Reactor-Ready Flex Lab Reactor

Including Reactor-Ready Filter Lab Reactor

Instructions

radleys
accelerating chemistry

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Contents

1 Introduction

Thank you for purchasing Reactor-Ready Flex.
Please read this instruction manual thoroughly before operating the unit.

Reactor-Ready Flex is a flexible benchtop reaction system with a purpose-built framework that can be used with a wide range of dedicated glass Reaction and Filter Vessels and accessories. It can also be attached to a thermoregulator to allow a full comprehensive range of heating and cooling operations to be performed.

Key features

- Choose between the Reactor-Ready Pro and the Reactor-Ready Starter framework to suit your budget and application.
- Reactor-Ready Pro: Feature rich for maximum flexibility and rapid vessel exchange.
- Reactor-Ready Starter: Core functionality for those with limited budgets.
- Rapid Vessel exchange, with tool-free Vessel clamps and hose couplings.
- Dedicated process glass Reaction Vessels, single or vacuum jacketed, ranging in size from 100 ml to 5 L.
- Dedicated 1 L and 2 L single jacketed Filter Vessels.
- Triple support stand, with heavy-duty stainless steel Support Rods for maximum strength and stability.
- Accepts all leading brands of overhead stirrer, allowing easy, tool-free adjustment.
- Self-aligning stirrer coupling that engages without the need for tools.
- Optional hose manifolds that allow easy thermofluid drain-down.
- Temperature range: -70 °C to +230 °C for Reaction Vessels (subject to thermoregulator).
- Temperature range: -30 °C to +180 °C for Filter Vessels (subject to thermoregulator).
- Wide range of glassware accessories, including condensers, dropping funnels, etc.
- Log and control stirrers, circulators, balances, pumps, temperature sensors and other third-party devices with AVA Lab Control Software.

2 Warranty

Reactor-Ready Flex includes a one-year full parts and labour warranty from the date of the original purchase.

Warranty will only be valid if a Warranty form is completed and returned within one month of the date of purchase (see Warranty form at the back of this manual).

In the event of product failure, please contact your local distributor. Please do not return any goods without prior agreement.

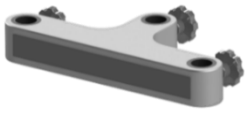
3 Safety guide

Please read this safety guide completely before using Reactor-Ready Flex.

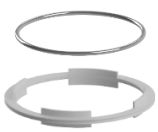
- Reactor-Ready Flex should only be operated by trained and competent personnel. As with all chemistries, a full risk assessment should be performed prior to starting, and care should be taken to monitor reactions at all stages.
- It is the responsibility of the user to ensure correct set up and continued maintenance of the framework and clamps.
- Always ensure that the unit is located on a level surface.
- Operate only in a fumehood with protective safety sash.
- Always ensure the Reaction or Filter Vessel is clamped and supported correctly, using the purpose-built framework and clamps. The unit should never be operated without this framework.
- Always read the complete instructions for any third-party equipment, such as overhead stirrers and thermoregulators, to ensure you are not contravening any safety recommendations or the manufacturer's warranty when used in conjunction with Reactor-Ready Flex.
- The maximum operating stirring speed for the unit is 500 rpm for continuous operation and 800 rpm for short periods.
- There is a risk of burns from hot or extreme cold temperatures during and after heating/cooling, so take care not to touch the unit or any auxiliary equipment.
- Reactor-Ready Flex will remain hot for a considerable time after the heat source has been turned off. A Temperature Probe or temperature sensitive label can be used to indicate when components are too hot to touch.
- Before starting your operation, ensure all fittings to the thermoregulator are fully tightened with no leaks, and that the Manifold drain and vent valves are closed.
- Reactor-Ready Flex metal components are resistant to the majority of solvents and are splash-resistant to dilute acids and alkalis at room temperature.
- Wipe away chemical spills immediately and avoid exposure to strong vapours such as HCl, as continued exposure to chemical vapours or liquids will cause corrosion to metal and/or plastic components.
- Reactor-Ready Flex can be used with Reaction Vessels with a recirculating fluid at temperatures between -70 °C and +230 °C, or with Filter Vessels with a recirculating fluid at temperatures between -30 °C and +180 °C, without damage to the unit. Careful inspection of all fluid connections to the unit should be regularly performed when operating at these temperatures.
- Ensure all wires and cables connecting auxiliary equipment are secured such that they cannot come into contact with the unit surfaces or moving parts.
- Flowing liquids can create a build-up of static, leading to risk of sparks and explosion. Care must be taken to properly bond and ground components of Reactor-Ready Flex to meet local safety requirements.
- During operation, do not leave the unit unattended unless in a supervised area.

4 Component guide

U-Shaped Base Plate	Drip Tray	Draindown Manifolds
		 
RR121010	RR121015	Upper Return Manifold Lower Supply Manifold Included in RR121129 (Draindown Manifold Kit)

T-Beam Support Brace	Stirrer Support		Vessel Support with Integrated Clamp
			
RR121035	Stirrer Support I-Beam RR210016	Stirrer Support Boss RR121112	RR121045

Vessel Support	PTFE Vessel Clamp	Filter Plate Support
		
RR121205	RR121215	RR171002

Vessel Support Collar	O-Ring Seal + Support Collar	Lid		Drop-in Stirrer Guide Assembly
				
RR121055	RR121090 + RR121095	Glass Lid RR136000	PTFE Lids Various	RR121069

Safety Stop Collars	Vessel Support Collar Alignment Tool	Rodaviss Hose Sealing Caps
 RR121050	 RR121051	

PEEK Vessel Sidearm Connector	Hose Tidy	Hose Supports
 Various options	 Included in RR121129 (Draindown Manifold Kit)	 RR121210

Support Rods with bosses + Locking Rod*	Quick-Release Insulated Hoses
 RR121029 (Reactor-Ready Flex)	 Included in RR121129 (Draindown Manifold Kit)

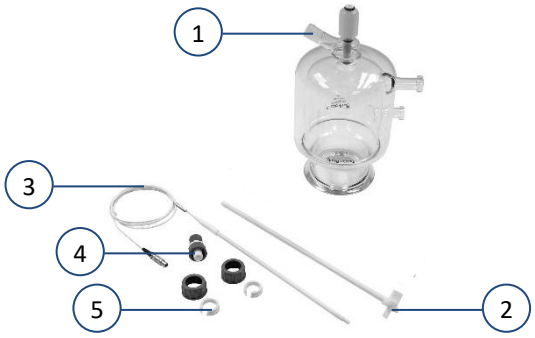
**Standard Support Rods for the Reactor-Ready Flex core system are 1080 mm long.*
Filter Vessels require Extended Support Rods, which are 1180 mm long.

5 Reaction and Filter Vessel guide

For use with the Reactor-Ready Flex core system

Process Vessel Kits

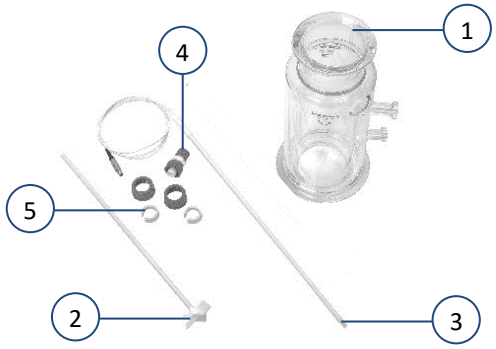
1 Glass Process Reaction Vessel with PTFE Stopcock
2 PTFE Turbine Stirrer
3 Pt100 PTFE Temperature Probe
4 PTFE Temperature Probe Adapter
5 Sidearm Couplings (connecting cap + connecting clip)



For use with the Reactor-Ready Flex Filter core system

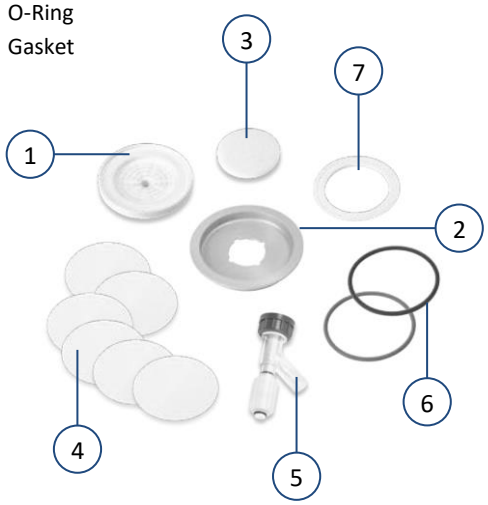
Filter Vessel Kits

1 Glass Filter Vessel
2 PTFE Turbine Stirrer
3 Pt100 PTFE Temperature Probe
4 PTFE Temperature Probe Adapter
5 Sidearm Couplings (connecting cap + connecting clip)



Filter Plate Assembly

1 Filter Plate (PTFE or PEEK available)
2 Aluminium Filter Plate Support Cup
3 Sintered Glass Membrane Support
4 Filter Membrane Evaluation Kit (see page 46)
5 BOV Glass Body and Piston
6 O-Ring
7 Gasket



6 Set-up and operation

6.1 Setting up Reactor-Ready Flex

6.1.1 Requirements

- Access to two mains power sockets – one for the thermoregulator and one for the overhead stirrer.
- Access to additional mains power sockets if pumps or vacuum pumps are required.
- A clear unobstructed site on a level surface within your fumehood.
- Cooling water supply for the reflux condenser.
- Inert gas and vacuum supply for operating under an inert atmosphere.
- An adjustable wrench for tightening the Quick-Release Insulated Hoses and thermofluid hoses.

6.1.2 Assembling the framework

Important information

→ Before beginning assembly, ensure that the framework is placed in its final position, as once fully assembled the unit should not be moved.

→ Make sure there is room for connections to the thermoregulator, and that all thermofluid hoses can be positioned and supported safely.

Step 1

Position the U-Shaped Base Plate on a flat work surface within the fumehood, ensuring that it is level and stable.

U-Shaped Base

All five of the adjustable feet should be in contact with the work surface.

Locate the Drip Tray into the base.

Step 2

Screw the three Support Rods into the base. The shortest rod should be positioned in the centre, and the two longer rods on either side.

If using the T-Beam Support Brace*
Do not tighten the Support Rod bosses (locking knobs) at this stage.

If not using the T-Beam Support Brace
Tighten the Support Rod bosses (locking knobs) using the Locking Rod (supplied).

U-Shaped Base with Drip Tray

Important information

→ Filter Vessels require Extended Support Rods, so ensure you are using the correct Support Rods for your application.
→ Once the Support Rods have been connected to the Base, wipe them with the lubricating cloth supplied to aid further assembly and operation of components.

If the T-Beam Support Brace is not being used, go to 6.1.3 – Assembling the Filter Support Plate

**The T-Beam Support Brace is mandatory if the Vessel Support with Integrated Clamp is being used.*

Step 3

Lower the T-Beam Support Brace onto the Support Rods, and slide it down until it is resting on the Support Rod bosses.

Now fully tighten the Support Rod bosses using the Locking Rod (supplied).

Remove the T-Beam Support Brace from the framework and place it to one side (it will be needed again later to stabilise the framework).

Useful notes

- At this stage, the T-Beam Support Brace ensures that the Support Rods are correctly screwed into position, and that they are straight and parallel. It will be needed again later to stabilise the framework.
- The Support Brace should slide freely up and down the Support Rods. To enable this, apply gentle pressure to the centre of the Brace when raising or lowering it. This will help to keep the Brace level and prevent it from twisting (which may cause it to stick).
- The T-Beam Support Brace is mandatory if the Vessel Support with Integrated Clamp is being used, but with the Vessel Support and standalone PTFE Clamp, it is optional.

6.1.3 Assembling the Filter Support Plate

If a Filter Vessel is not being used, go to 6.1.4 – Assembling the Draindown Manifolds

If using a Filter Vessel, the Filter Support Plate must be connected to the framework at this point.

Step 1

To connect the Filter Support Plate to the framework, first place a Safety Stop Collar onto the right-hand Support Rod and slide it down until it almost reaches the bottom of the Support Rod.

Hand-tighten the locking knob to secure.

Step 2

With the ridged side uppermost, lower the Filter Support Plate onto the right-hand Support Rod and slide it down until it rests on top of the safety stop collar.

Hand-tighten the two outer locking knobs to secure the Support Plate in place.

Note: If necessary, the positions of the Support Plate and Safety Stop Collar can be adjusted later, when all the components are in place.

Useful notes

- The Filter Support Plate is positioned towards the lower end of the Support Rod to allow enough space above it for additional components, such as the Filter Plate, Filter Vessel and overhead stirrer. It can be located on either of the side Support Rods, but it is recommended that the right-hand rod is used, as this allows the most ergonomic alignment of hoses, vessels and other system components.
- The Safety Stop Collar limits the downward movement of the Filter Support Plate.

6.1.4 Assembling the Draindown Manifolds

If the Draindown Manifolds are not being used, go to 6.1.5 – Assembling the Vessel Support

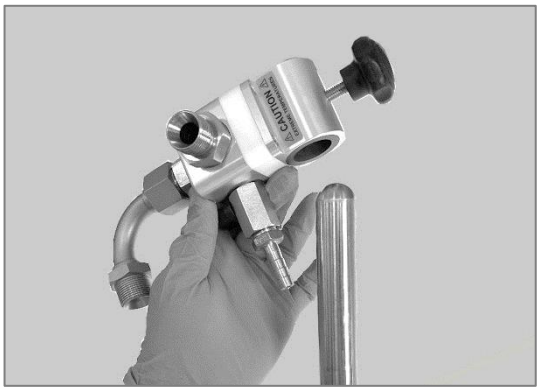
Useful notes

- Reactor-Ready Flex features independent Supply and Return Draindown Manifolds to simplify the connection between the thermoregulator and Reaction or Filter Vessel.
- The Draindown Manifolds are attached to the Support Rods and feature precision bore slide bearings. These allow for smooth and independent vertical and horizontal adjustment, providing the flexibility to accommodate different vessel sizes.
- The Draindown Manifolds can be located on either of the side Support Rods, but it is recommended that the left-hand rod is used, as this allows the most ergonomic alignment of hoses, vessels and other system components.

Step 1

With the drain valve pointing downwards, slide the Lower Supply Manifold onto the left-hand Support Rod. Ensure there is enough space below the Manifold to allow the thermoregulator hose to be attached.

When the Manifold is in the correct position, hand-tighten the locking knob.



Step 2

With the vent valve pointing upwards, slide the Upper Return Manifold onto the left-hand Support Rod, above the Lower Supply Manifold. Ensure there is enough space below the Manifold to allow the thermoregulator hose to be attached.

When the Manifold is in the correct position, hand-tighten the locking knob.

Important information

→ The drain valve on the Lower Supply Manifold must be pointing downwards to allow complete drainage of the Vessel.

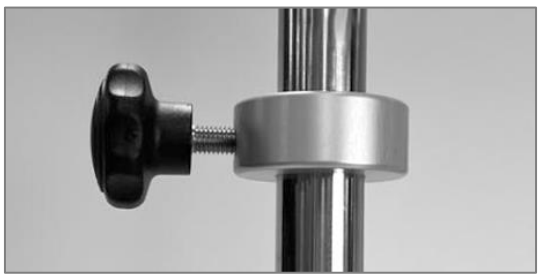
→ The vent valve on the Upper Return Manifold must be pointing upwards to avoid leakage of thermofluid during drainage of the Vessel.

6.1.5 Assembling the Vessel Support

Step 1

If using Safety Stop Collars, slide one onto each of the outer Support Rods. If Draindown Manifolds have been added to the framework, the Safety Stop Collars should be positioned just above them.

When the Safety Stop Collars are in approximately the correct position, hand-tighten the locking knobs.



Useful notes

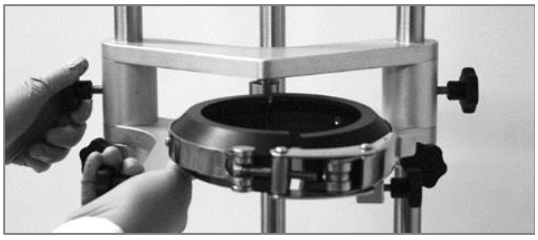
- The Safety Stop Collars are optional. They limit the downward movement of the Vessel Support.
- In some circumstances, it may be preferable to locate the Vessel Support between the Lower Supply and Upper Return Manifolds, rather than above them, to give optimal spatial alignment of system components.

Step 2

Lower the Vessel Support with Integrated Clamp **OR** the Vessel Support (without integrated clamp) onto the outer Support Rods and slide it down until it is in approximately the correct position. Secure it in place by hand-tightening the two locking knobs.

If using the Vessel Support (without integrated clamp), a spirit level can be used to ensure it is aligned correctly.

If Safety Stop Collars have been added to the framework (see Step 1), adjust them so they are located directly under the Vessel Support and retighten the locking knobs.



Vessel Support with Integrated Clamp

Vessel Support (without integrated clamp)

6.1.6 Adding the T-Beam Support Brace

If the T-Beam Support Brace is not being used, go to 6.1.7 – Adding the Stirrer Support

Step 1

Lower the T-Beam Support Brace onto all **three** Support Rods. The rounded top of the central Support Rod should be just visible above the central hole in the Brace.

Hand-tighten the three locking knobs.

Useful notes

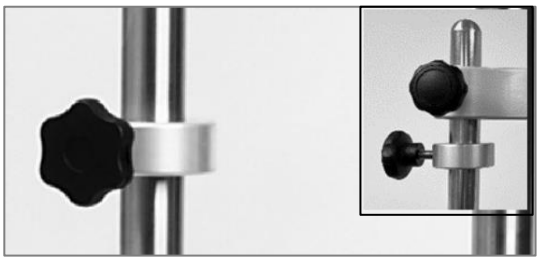
- The T-Beam Support Brace's sole function is to add stability to and maintain alignment of the framework.

6.1.7 Adding the Stirrer Support

Step 1

If using the Stirrer Support I-Beam

Slide a Safety Stop Collar onto each of the outer Support Rods. These will support the Stirrer Support I-Beam. When they are in approximately the correct position, hand-tighten both locking knobs.



If using the Stirrer Support Boss

Only one Safety Stop Collar is required and it is optional.

Step 2

If using the Stirrer Support I-Beam

Slide the Stirrer Support I-Beam onto the outer Support Rods, ensuring the two knobs on the central sliding boss are pointing upwards and to the front. Once it is in the correct position, secure it by hand-tightening the two outer locking knobs.

Adjust the Safety Stop Collars so that they are located directly under the I-Beam. Retighten the locking knobs.

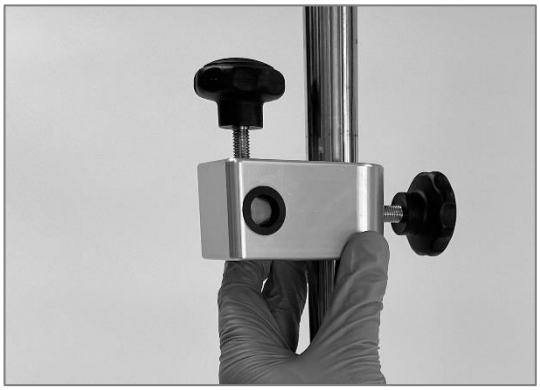
Useful notes

- The Stirrer Support I-Beam is designed to support an overhead stirrer, and features precision bore slide bearings enabling smooth height adjustment, offering maximum user flexibility in configuring the system.

If using the Stirrer Support Boss

Slide the overhead stirrer Support Boss onto one of the outer Support Rods. Once it is in the correct position, secure it by hand-tightening the outer locking knob.

If a Safety Stop Collar has been added to the framework (see Step 1), adjust it so it is located directly under the Stirrer Support Boss, and retighten the locking knob.



6.1.8 Reactor-Ready Flex core system – assembled framework

Pro	Starter
	

6.1.9 Locating the Vessel into the framework

Warning!

- Only Radleys vessels should be used with Reactor-Ready Flex as they have been specifically engineered to ensure a safe fit and leak-tight seal. **Never** use vessels from other manufacturers. For further information about Radleys vessels, see Section 7 – Jacketed glass Reaction and Filter Vessels.

A Vessel Support Collar must be attached to your Vessel before locating it into the Vessel Support Clamp on the framework.

Step 1

Select the appropriate Vessel for the chemistry you are performing. Invert the Vessel and place it on a flat surface, ensuring the sidearms are pointing to the right.

Undo the bolt on the Vessel Support Collar and place the collar around the neck of the Vessel.

Note: The opening of the Vessel Support Collar should be facing to the front and central (it should be at 90° to the Vessel sidearms). Partially tighten the bolt so that the Collar is closed but still free to move up and down the Vessel neck.

Step 2

If using the Vessel Support + Integrated PTFE Clamp, adjust the position of the Vessel Support Collar so that the distance from the bottom of the Vessel neck (with Vessel inverted) to the top of the protruding lugs on the Vessel Support Collar is between 40–41 mm.
Use the Vessel Support Collar Alignment Tool (supplied with Reactor-Ready Pro), or a ruler if the Alignment Tool is not available, to ensure the Collar is correctly positioned.

Once in the correct position, fully tighten the fastening bolt on the Vessel Support Collar.

If using the Vessel Support and standalone PTFE Clamp, position the Vessel Collar right up to the vessel flange 'angle' (i.e. top of the straight sided section, pushed up to the point where glass angles out to the actual flange).

Vessel Support with Integrated Clamp

Step 3

Turn the Vessel the correct way up and slightly tilt it away from you. Slot the lug on the back of the Vessel Support Collar into the central recess on the Vessel Support.

Straighten the Vessel, locating the lugs on each side of the Vessel Support Collar into the rectangular recesses on each side of the Vessel Support. The Vessel is now fully supported.

Note: When the Vessel is located in the Vessel Support, some movement of the Vessel is still possible until it is clamped.


Vessel Support (without integrated clamp)

Important information

→ The Vessel Support Collar **must** be positioned correctly to ensure smooth operation of the Vessel Support Clamp (see Section 6.1.11 – Clamping the Vessel Lid and Stirrer Assembly to the Vessel). If the Vessel is not vertically aligned after locating it into the Vessel Support, it may be possible to loosen the fastening bolt on the Vessel Support Collar and realign the Vessel whilst it is located in the Vessel Support. Once correctly aligned, the fastening bolt on the Collar must be retightened.

→ Alternatively, remove the Vessel and refit the Vessel Collar (as described earlier), ensuring the distance from the bottom of the Vessel neck to the top of the protruding lugs on the Collar is between 40–41 mm. (Use the Vessel Support Collar Alignment Tool or a ruler to ensure this.)

Step 4

If using the Vessel Support and standalone PTFE clamp OR the Vessel Support with Integrated Clamp manufactured before mid-2010

The Vessel Support features two extra locking knobs on either side at the front.

To further secure the Vessel, hand-tighten these locking knobs until they lightly grip the side lugs on the Vessel Support Collar.

Note: The locking knobs must be loosened before the final clamping operation is performed, as the Vessel must be free to move as it is being clamped.

Vessel Support (without integrated clamp)


Vessel Support with Integrated Clamp pre mid-2010

Important information

→ It is advisable to make any adjustments to the height of the Vessel on the framework at this stage by loosening the locking knobs on the Vessel Support and sliding it up or down. Subsequent adjustments to the height of the Draindown Manifolds and Stirrer Support may also be necessary.

→ If using a Filter Vessel, ensure there is enough space below the Vessel to allow the BOV Piston to be fully opened, and the Filter Plate assembly to be lowered sufficiently to enable the Filter Cake to be fully withdrawn from the Filter Vessel body.

6.1.10 Assembling the Vessel Lid, Stirrer Guide and Stirrer

Step 1

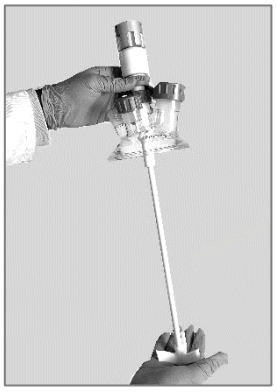
Before attaching the Glass or PTFE Lid to the Vessel, insert the PTFE Stirrer Guide into the central B24 port on the Lid.

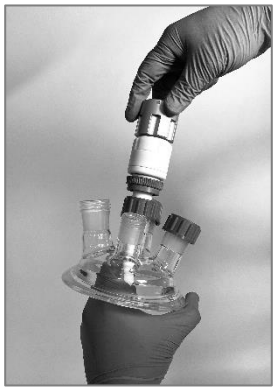
Hand-tighten the red Rodaviss screw cap to secure the Stirrer Guide in place.

Step 2

Loosen the metal locking cap on top of the Stirrer Guide (but do not unscrew fully). Feed the shaft of the Stirrer up through the underside of the Vessel Lid and into the Stirrer Guide. Continue to slide the shaft up until it just protrudes above the metal locking cap.

Hand-tighten the metal locking cap to secure the Stirrer shaft in place.





Important information

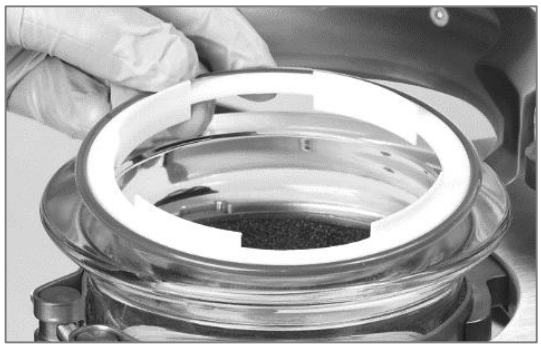
→ The Stirrer Assembly (Stirrer Guide + Stirrer) **must** be securely connected to the Vessel Lid before the Lid is placed on the Vessel.

6.1.11 Clamping the Vessel Lid and Stirrer Assembly to the Vessel

Step 1

Assemble the Vessel O-Ring Seal and PTFE O-Ring Support Collar.

Place the assembly onto the flange of the Vessel neck ensuring that the retaining lip of the O-Ring assembly is located in the neck of the Vessel.



Step 2

Take the Lid and Stirrer Assembly and guide the Stirrer shaft through the neck of the Vessel.

Then lower the Lid onto the Vessel O-Ring, ensuring that the Lid flange, O-Ring and Vessel flange are all aligned and sitting flush, and that the ports are in the correct position.

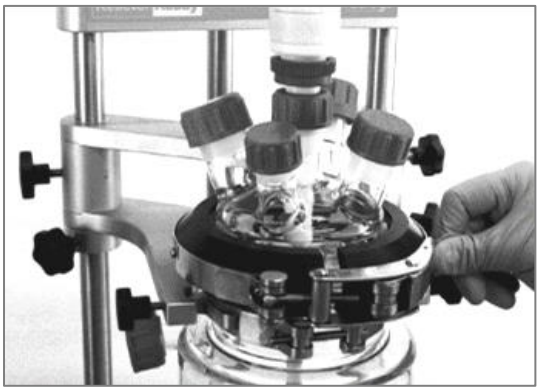
Useful notes

- ❖ Once you have placed the Lid and Stirrer Assembly on the Vessel flange, check that the Stirrer shaft is in the optimal position for your application.
- ❖ To reposition it, you will need to remove the Lid and Stirrer Assembly, loosen the locking cap on the Stirrer Guide and slide the Stirrer shaft up or down as required. Once in the correct position, retighten the locking cap on the Stirrer Guide.

Step 3

You will now need to clamp the Lid and Vessel together using the Vessel Support Clamp.

If using the Vessel Support with Integrated PTFE Clamp
Gently close the jaws of the Clamp around the join where the Vessel Lid flange and the Vessel flange meet.



Lock the Clamp in place with the fastening clip.
This is done by hooking the bolt of the fastening clip into the retaining recess of the Clamp and then snapping the clip shut.

Visual inspection of the O-Ring through the opening at the front of the Clamp should indicate a witness line where it seals against the Lid flange.

If using the Vessel Support and standalone PTFE Clamp
Place the Clamp over the Vessel Lid assembly, ensuring that it fits around the join where the Vessel Lid flange and the Vessel flange meet. When the Clamp is properly aligned, gently close the jaws. Lock the Clamp in place with the fastening clip. This is done by hooking the bolt of the fastening clip into the retaining recess of the Clamp and then snapping the clip shut.

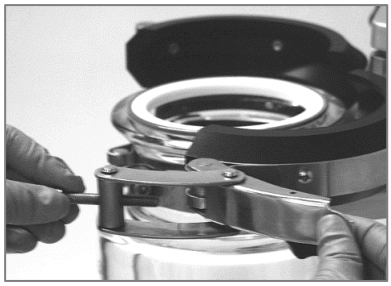
Visual inspection of the O-Ring through the opening at the front of the Clamp should indicate a witness line where it seals against the Lid flange.

Important information

→ There should be minimal movement of the Vessel and Lid when clamping them together. If significant movement is observed (either sideways or vertically), it is likely that the Vessel Support Collar is incorrectly positioned on the Vessel neck. You will need to open or remove the Vessel Support Clamp, remove the Vessel from the Vessel Support, and reposition the Vessel Support Collar.
(See Section 6.1.9 on page 15 – Locating the Vessel into the framework – for reference.)

Useful notes

- The Vessel Support Clamp can be adjusted by screwing the bolt on the fastening clip in or out to tighten or loosen the grip. This is best done when the Clamp is open.



Warning!

- **Never** use too much force when locking the Vessel Support Clamp as this may damage the Vessel. If the Clamp will not close, it may be necessary to readjust the Vessel Collar, or the Vessel Support Clamp if using a standalone Clamp.
- With the standalone Clamp, extra care must be taken to ensure the Clamp is correctly aligned to avoid damaging the Vessel.

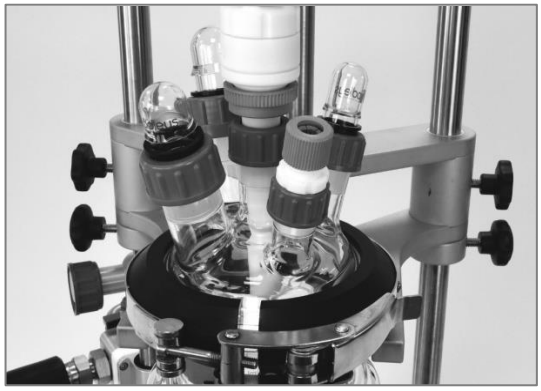
6.1.12 Attaching the Temperature Probe to the Vessel

Step 1

Insert the PTFE Temperature Probe Adapter into the B19 port on the Lid.

Hand-tighten the red Rodaviss screw cap to secure the Adapter in place.

Partially unscrew the blue locking cap on the top of the Probe Adapter.



Step 2

Feed the Pt100 Temperature Probe through the top of the blue locking cap on the Probe Adapter until it exits the other end.

Keep feeding the Probe through until it is the desired length. The Temperature Probe can be gently bent to ensure that it does not obstruct the Stirrer shaft inside the Vessel.

Hand-tighten the blue locking cap to secure the Temperature Probe in place.

Useful notes

- A Pt100 Temperature Probe and Probe Adapter are supplied with Vessel Kits or can be purchased as a separate items.

Step 3

Attach any additional components required (e.g. dropping funnels, solids addition funnels, etc.) to the remaining ports on the Lid, and secure by hand-tightening the red Rodaviss screw caps.

Note: Any ports on the Lid that are not in use should be sealed off with a red Rodaviss Sealing Cap (supplied x4). These Sealing Caps have PTFE faced liners for an inert seal.

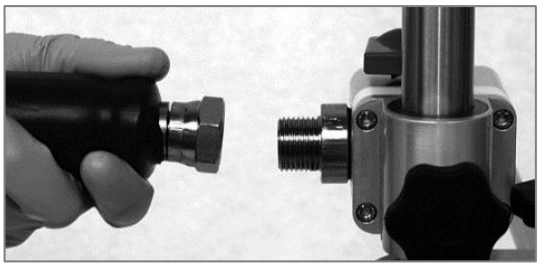
6.1.13 Attaching hoses to the Vessel

If using Quick-Release Insulated Hoses with the Draindown Manifolds

Step 1

Screw one of the Quick-Release Insulated Hoses onto the Lower Supply Manifold, and the other Hose onto the Upper Return Manifold.

Fully tighten both Hoses with a wrench to ensure there is no leakage.



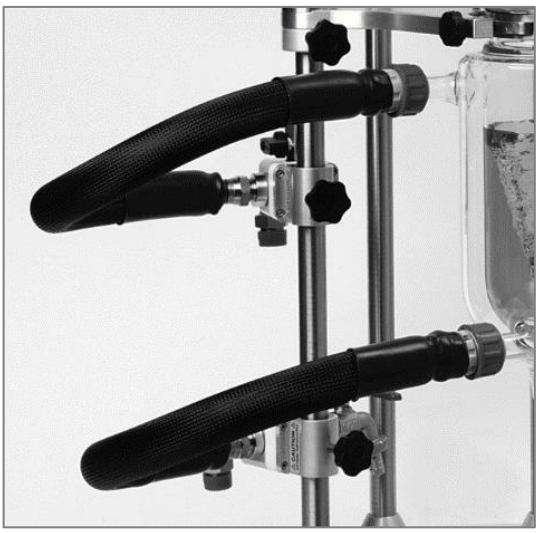
Step 2

Attach the other end of the lower Hose to the lower sidearm of the Vessel by pushing the PEEK Quick Coupling Connector onto the sidearm.
A slight twisting motion may aid this process.

Once the Connector is fully engaged on the sidearm, screw the red Rodaviss screw cap (located on the sidearm) onto the Hose connector.

Repeat for the upper Hose.

Note: Before attaching the Connectors to the sidearms, check that the two Viton O-Rings are properly located in the grooves of each coupling.



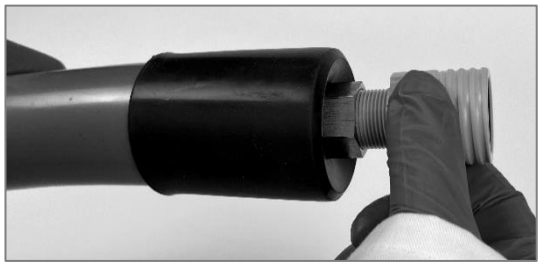
Important information

→ Once the Quick-Release Insulated Hoses are attached to the Vessel, only minor adjustments can be made to the height of the Draindown Manifolds.

If not using Quick-Release Insulated Hoses

Step 1

If using an M16 or M24 circulator hose, screw a PEEK Vessel Sidearm Connector onto the circulator hose.



Note: Before attaching the Connector to the hose, check that the Viton O-Ring is properly located in the grooves of the Connector.

If using an NW12 hose, push the hose onto the NW12 PEEK connector hose barb.

Step 2

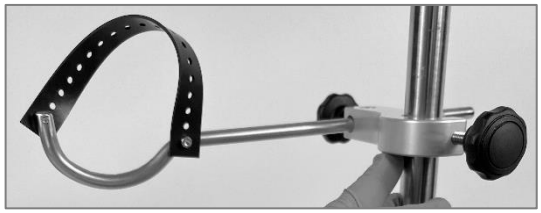
Attach the hose to the Vessel by pushing the PEEK Connector onto the sidearms. A slight twisting motion may aid this process.

Once the Connector is fully engaged on the sidearm screw the red Rodaviss screw cap (located on the sidearm) onto the hose Connector.

Step 3

If using Hose Supports

Attach the Hose Support boss heads to the framework and secure in position by tightening the locking knobs.



Support the hose on the curved section of the Hose Support rod, and then secure in place using the black Viton strap.

Adjust the black strap according to the thickness of the hose, and then tighten it to secure the hose in position.

Useful notes

- The optional Hose Supports reduce pressure on the Vessel sidearms and can be adjusted to accommodate various diameters of hose.

6.1.14 Assembling the overhead stirrer

Important information

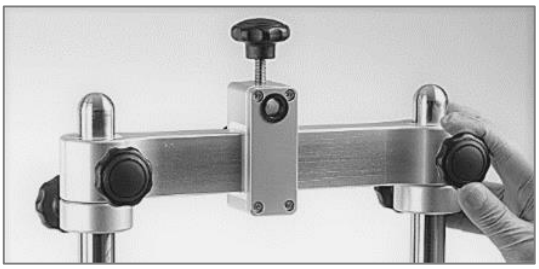
→ Always refer to the manufacturer's instructions for your chosen overhead stirrer before using it with Reactor-Ready Flex to be sure of any limitations or safety restrictions.

Step 1

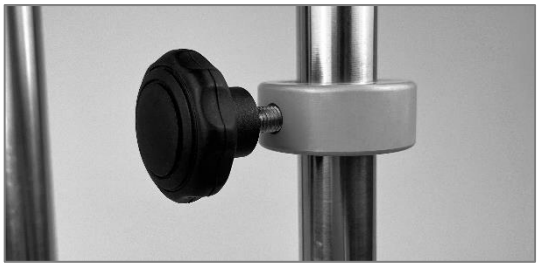
Ensure that the Stirrer Support (the Stirrer Support I-Beam or the Stirrer Support Boss) is positioned at a height that allows sufficient clearance between the Vessel and the overhead stirrer.

To do this, loosen the locking knob(s) on the Stirrer Support and slide it/them up or down.

Retighten the locking knob(s) to secure in position.



Stirrer Support I-Beam



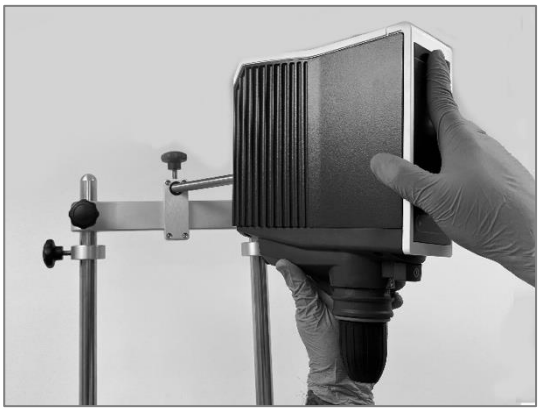
Stirrer Support Boss

Step 2

If using the Stirrer Support I-Beam

Locate the rod on the back of the overhead stirrer into the hole in the sliding boss on the Stirrer Support I-Beam.

Adjust the position of the sliding boss and the overhead stirrer so that the chuck of the overhead stirrer is aligned with the Stirrer Guide below. Once positioned correctly, hand-tighten the locking knobs on both the top and front of the sliding boss.



If using the Stirrer Support Boss

Locate the rod on the back of the overhead stirrer into the hole in the Stirrer Support Boss. Hand-tighten the locking knob on the top of the Stirrer Support Boss to secure the overhead stirrer.

Adjust the position of the overhead stirrer so that the chuck is aligned with the Stirrer Guide below. Do this by sliding the Stirrer Support Boss up or down, and to the left or right, then hand-tighten the locking knob on the side of the boss.

Useful notes

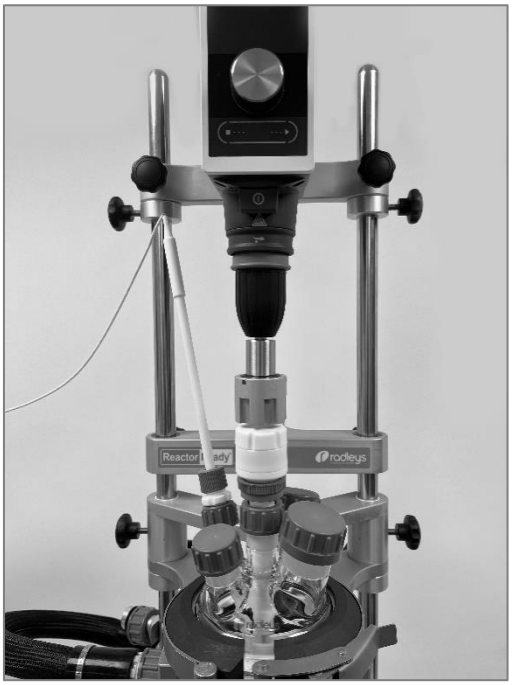
- The Stirrer Support Boss and the sliding boss on the Stirrer Support I-Beam can accommodate different sizes of overhead stirrer rods, with the use of removable adapters.
- With the adapter in place, stirrer rods of up to 13.5 mm diameter can be accommodated. Removal of the adapter (by gently prising from the hole with a suitable implement) allows stirrer rods of up to 16.5 mm to be used.

Step 3

Insert the spindle of the Stirrer Drive Coupling into the chuck on the overhead stirrer, and fully tighten the chuck.

Step 4

Loosen the locking knobs on the Stirrer Support I-Beam and slide it down until the coupling pins on the Stirrer Drive Coupling engage with the coupling pins on the metal cap of the Stirrer Guide below.



Note: Only the pins of the two components should be in contact with each other. Ensure that the body of the Stirrer Drive Coupling is not in contact with the pins of the Stirrer Guide.

Retighten the locking knobs on the I-beam.

Important information

→ Reactor-Ready Flex features a unique patented rapid stirrer coupling which allows quick and easy alignment of the overhead stirrer with the Stirrer Guide. However, care should still be taken to ensure alignment is correct. Although some degree of misalignment can be tolerated, correct alignment will enable smooth operation of the Stirrer, and reduce wear on the coupling pins.

→ To ensure the pins on the Stirrer Drive Coupling are perfectly aligned with the Stirrer Guide you may need to adjust the position of the overhead stirrer. The sliding boss on the Stirrer Support I-Beam allows the overhead stirrer to be moved forwards, backwards, upwards, downwards, left or right. Whenever adjusting the position of the sliding boss, you should manually support the weight of the overhead stirrer to allow free movement of the sliding boss.

Step 5

If Safety Stop Collars were added when the framework was assembled (see Section 6.1.7 on page 14 – Adding the Stirrer Support), reposition them so that they are located directly below the I-beam or Stirrer Support Boss.

Hand-tighten the locking knobs to secure.

Useful notes

- It is recommended that the overhead stirrer is given a test run before use. To do this, switch on the power to the overhead stirrer and start the stirrer motor as slowly as possible. If it does not operate smoothly, the position of the overhead stirrer will need to be adjusted.
- The maximum stirring speed for Reactor-Ready Flex is 500 rpm for continuous operation and 800 rpm for short periods.

6.2 Set-up instructions for Filter Vessels only

6.2.1 Assembling the Filter Plate

Important information

→ Before starting assembly, ensure the Filter Plate is clean, and that the recess is free of any residues or solid materials.

Useful notes

❖ Both PEEK and PTFE Filter Plates are available for different applications. See page 46 for more details.

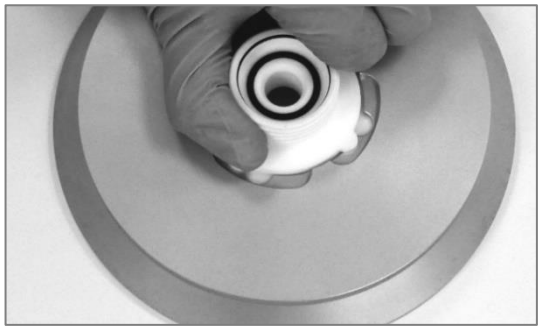
Step 1

Slot the Filter Plate into the aluminium Filter Plate Support Cup, ensuring that the lugs on the Filter Plate are aligned with the recesses on the Filter Cup.

Invert the assembly and place on a flat surface.

Step 2

Now, carefully gripping the threaded section, gently twist the Filter Plate to lock the components together.



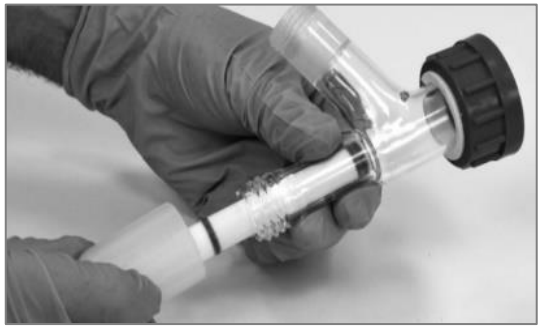
Warning!

♦ When locking together the Filter Plate and Filter Plate Support Cup, take care not to damage the thread on the Filter Plate.

Step 3

Insert the Filter Vessel Piston into the open end of the BOV glass body.

Screw the Piston cap onto the thread of the BOV glass body.



Important information

→ Filter Vessel Pistons are designed specifically for use with Filter Vessels and are not interchangeable with Reaction Vessel Pistons. Always check you are using the correct Piston for your application.

Step 4

With the assembly still inverted, check that both pre-fitted O-Rings are fully seated inside the thread of the Filter Plate.

Carefully insert the flanged end of the BOV glass body into the threaded section of the Filter Plate until it fully engages with both O-Rings. Hand-tighten the red Rodaviss screw cap.

Screw the Piston cap further until the O-Ring Seal at the top of the Piston engages with the Filter Plate. Continue tightening until you feel resistance, indicating that the valve is in the closed position.

Warning!

♦ **Do not** overtighten the Piston as this could damage the glass thread of the BOV glass body.

Step 5

Turn the Filter Plate and BOV Piston assembly the correct way up and place it on the Filter Support Plate.

Use the inner curved ridge on the Support Plate as a guide as to where the Filter Plate assembly should sit.

Step 6

Slot the Sintered Glass Membrane Support into the Filter Plate, ensuring that it is lying flat.

Note: The Membrane Support should be placed with the smooth side up.

Step 7

Lay your chosen Filter Membrane on top of the Membrane Support.

Ensure that it is correctly aligned with the Filter Plate, and that it is lying flat with no creases.

Important information

→ Radleys supplies Filter Membranes suitable for this application (see page 46 for more details). However, if you are using your own filter membrane, ensure it is the correct size and that it fits the Filter Plate exactly.

Step 8

Assemble the O-Ring and Gasket.

With the O-Ring facing downwards, gently press the O-Ring/Gasket assembly into the recess of the Filter Plate to secure the Filter Membrane in place.

Ensure it is fully seated on top of the Filter Membrane, and that the Filter Membrane is lying flat with no creases.

Warning!

♦ When pressing the O-Ring/Gasket assembly into the Filter Plate, ensure the Filter Support Plate is fully supported to avoid any unexpected movement of the Plate.

6.2.2 Attaching the Filter Plate Clamp

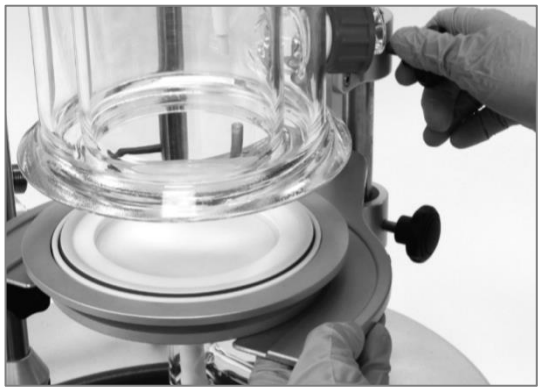
Step 1

Screw the pin for the Filter Plate Clamp into the inner hole at the rear of the Filter Support Plate.

Step 2

Loosen the locking knobs on the Filter Support Plate and gently pivot it until the Filter Plate is aligned under the Filter Vessel.

Now raise the Support Plate until the flange on the Filter Vessel neck and the flange on the Filter Plate meet and are flush (some lateral adjustment may be required to fully align the flanges). This is best achieved by supporting the front of the Support Plate whilst applying upward pressure to the support leg.



Step 3

Once in position, hand-tighten the two locking knobs on the Support Plate. Then move the Safety Stop Collar directly under the Support Plate and hand-tighten the locking knob.

Step 4

You will now need to attach the Filter Plate Clamp.

The Filter Plate Clamp comes in two parts.
Attach the first part of the Clamp to the Filter Support Plate by hooking it over the raised pin at the rear of the Support Plate.

Step 5

Do the same with the second part of the Clamp, so that it sits on top of the first part.

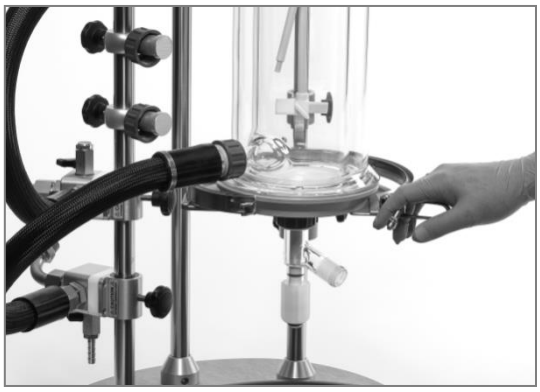
Note: The first part of the Clamp must always go on the left-hand side of the Support Plate.

Useful notes

❖ Each of the two parts of the Filter Vessel Support Clamp can be positioned on either the left or the right (depending on whether you are left- or right-handed), but whichever part you attach first must always go on the left-hand side of the Support Plate.

Step 6

To clamp the Filter Vessel and Filter Plate together, gently close the jaws of the Vessel Support Clamp around the join where the Vessel neck flange and the Filter Plate flange meet.



Lock the Clamp in place with the fastening clip.
This is done by hooking the bolt of the fastening clip into the retaining recess of the Clamp and then snapping the clip shut.

Note: Before locking the Clamp, ensure that the flanges on the Filter Plate and Filter Vessel are engaged with the grooves in the Clamp, and that the BOV Piston assembly is facing the right way. (For reference, see Section 6.2.3 on page 33 – Attaching a collection vessel.)

Important information

→ It is important to obtain a good seal between the Filter Plate and the Filter Vessel for maximum filtration performance and to avoid leakages. To achieve the correct tension, adjust the bolt on the Clamp fastening by screwing it in or out to increase or decrease the compression force on the seal. However, take care not to overtighten the bolt as this may damage the Vessel or Gasket.

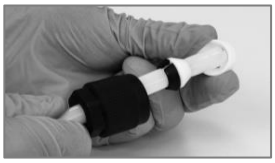
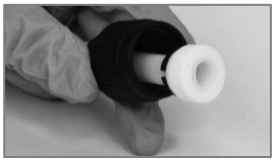
Useful notes

❖ The design of the Vessel Support Clamp allows for slight variations in the size of the Vessel flange.

6.2.3 Attaching a collection vessel

Step 1

Attach a length of PTFE tubing to the BOV connector (supplied). To do this, remove the black cap and compression fittings on the BOV connector.


Push the PTFE tubing through the cap and slide the compression fittings onto the tubing in the correct order and orientation.

Position the fittings so that they are flush with the end of the tubing.

Screw the black cap back onto the BOV connector.

Important information

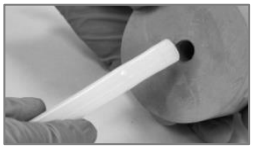
→ To minimise the dead volume in this fitting, the PTFE tubing should be flush with the inner fittings of the cap on the BOV connector, and not protrude beyond them. To check this, remove the cap once the tubing has been installed, visually inspect, and adjust the tubing if necessary. Then refit the cap.

Step 2

Insert the tapered joint of the BOV connector into the outlet on the BOV glass body and hand-tighten the red Rodaviss screw cap.

Step 3

Place a collection flask on a flat surface. Push a length of PTFE tubing through the central hole in the rubber bung of the collection flask.




Attach the right-angled connector to the tubing at the top end of the bung. Push the bung into the top of the collection flask.

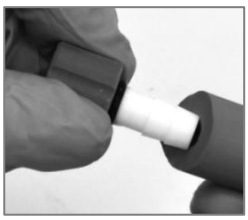
Feed the end of the PTFE tubing from the BOV connector into the right-angled connector in the bung.


Important information

→ To minimise splashing, the PTFE tubing extending from the bottom of the bung should be long enough for the end to sit below the level of the sidearm of the collection flask.

Step 4

Remove the hose barb connector from the collection flask, fit a length of vacuum tubing onto the hose barb, and secure with a hose tie.



Refit the hose barb connector to the flask. Attach the other end of the vacuum tubing to your vacuum pump.

Step 5

If required, a cold trap or cold finger can be inserted between the collection flask and vacuum pump.

A cold finger will require immersion into a dewar with a suitable coolant.

A cold trap will need filling with a coolant such as dry ice and acetone.

Useful notes

❖ Addition of a cold trap or cold finger will significantly improve the performance of your pump and the filtration process. For more information on how to install a cold trap, see page 46.

6.3 Converting Reactor-Ready Flex core to Filter core

An existing Reactor-Ready Flex core system that uses Reaction Vessels can be converted to a filter core system capable of accommodating the full range of Reactor-Ready Flex Reaction and Filter Vessels. To make the conversion, you will first need to fully dismantle your existing Reactor-Ready Flex core system.

6.3.1 Dismantling the Reactor-Ready Flex core system

Step 1
Drain any thermofluid from the Reaction Vessel that is currently fitted. (See Section 6.4.8 on page 40 – Draining fluid from Reactor-Ready Flex – for instructions on how to do this.)

Step 2
Remove the overhead stirrer and Lid from the Reaction Vessel.

Step 3
Disconnect the insulated hoses from the Draindown Manifolds or Vessel sidearms and remove the Reaction Vessel from the framework.

Step 4
Remove the Stirrer Support; the T-Beam Support Brace (if applicable); the Vessel Support with Integrated Clamp / Vessel Support + standalone Clamp; the Draindown Manifolds (if applicable); and all the Safety Stop Collars (if applicable).

Step 5
Loosen the three Support Rod bosses at the base of the Support Rods, using the Locking Tool provided. Now unscrew each of the Support Rods from the base. Once they are fully detached, remove the Support Rod bosses from the Support Rods. The filter core system can now be assembled.

6.3.2 Assembling the Reactor-Ready Flex Filter core system

Assembling the filter core system requires all the dismantled components from the Reactor-Ready Flex core system, as well as the following Reactor-Ready Flex upgrade components:

1180 mm Extended Support Rod Kit
RR170015

Filter Plate Clamp DN150
RR171004

Filter Plate Support
RR171002

Begin by screwing the three Support Rod bosses onto each of the Extended Support Rods, as far as they will go. Now assemble the framework as described in Section 6.1 – Setting Up Reactor-Ready Flex – using the Reactor-Ready Flex upgrade components in conjunction with the original Reactor-Ready Flex core components.

6.4 Operating Reactor-Ready Flex

Before operating Reactor-Ready Flex, ensure you have read the safety guide on page 4 of this manual.

Important information

→ Reactor-Ready Flex should only be operated by trained and competent personnel.
→ As with all chemistries, a full risk assessment should be performed prior to starting, and care should be taken to monitor reactions at all stages.
→ During operation Reactor-Ready Flex should not be left unattended unless in a supervised area.

6.4.1 Optimising thermal performance

The thermal performance, whether heating or cooling, will be affected by:

- Ambient temperature and atmospheric conditions,
- Reactor contents load to be heated/cooled,
- Heating and cooling power of the thermoregulator,
- The nature of the thermofluid,
- The size of the Reaction Vessel.

Please take care to consider and optimise these parameters if you wish to maximise the performance of your Reactor-Ready Flex system.

6.4.2 Operating temperature range

With Reaction Vessels, Reactor-Ready Flex can tolerate a thermofluid temperature between -70 °C and +230 °C without damage to the unit. The working reaction temperature range will vary depending on your thermoregulator, vessel size, contents volume, etc. as stated above.

With Filter Vessels, the temperature range is reduced due to the nature and composition of the Filter Plate materials as follows:

- PEEK Filter Plate temperature range: -30 °C to +180 °C
- PTFE Filter Plate temperature range: -30 °C to +120 °C
- Silicone O-Ring temperature range: -30 °C to +180 °C
- Viton O-Ring temperature range: -20 °C to +180 °C

Warning!

♦ The Reactor-Ready Flex unit will remain hot or cold for some considerable time after the heating/cooling source has been switched off. This means there is a risk to the user of burns from hot or cold parts. A temperature probe or temperature sensitive label can be used to indicate when components are too hot or cold to touch. Always wear suitable protective equipment such as gloves, face protection, and aprons to avoid injury.

6.4.3 Choosing a thermoregulator (circulator)

There are many thermoregulators available that are suitable for use with Reactor-Ready Flex. Choice is determined by factors such as heating and cooling power over the required operating temperature range, and the workspace available. Careful consideration needs to be given to the performance required – fast heating and/or cooling or working at extreme temperatures will not be possible with a low-powered thermoregulator.

As a result of in-house testing, Radleys recommends Huber thermoregulators. However, other leading brands such as Lauda, Julabo, Polyscience and Haake are also suitable.

6.4.4 Choosing a thermofluid

There is also a wide range of thermofluids available which are suitable for use with Reactor-Ready Flex. Again, choice is determined by the operating temperature that is required, and careful consideration needs to be given to maximum and minimum temperatures in consultation with manufacturers' specifications and safety data.

Important information

→ Always refer to the manufacturer's specifications and operating instructions for your thermoregulator and thermofluid before using them with Reactor-Ready Flex to be sure of any limitations or safety restrictions.

For technical assistance on selecting a thermoregulator, thermofluid and accessories for your application, please email **sales@radleys.com.**

6.4.5 Choosing an overhead stirrer

Radleys recommends the use of the Heidolph Hei-TORQUE range of overhead stirrers with Reactor-Ready Flex. The Hei-TORQUE Core is ideal for smaller volumes and lower viscosities, whereas the Hei-TORQUE 200 and 400 (Expert or Ultimate) are best for a wide range of volumes and viscosities. However, whichever overhead stirrer is chosen, always refer to the manufacturer's instructions before using it with Reactor-Ready Flex to be sure of any limitations or safety restrictions.

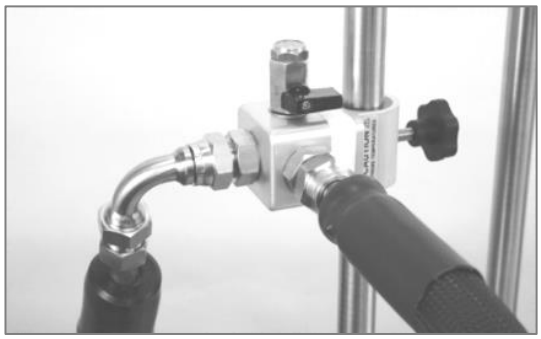
Useful notes

❖ Please note that the Heidolph Hei-TORQUE 100 (Expert & Ultimate) stirrer motor models can create a minor low-level vibration at speeds between 115 and 200 rpm, which can result in the Reactor-Ready Flex drop-in coupling making a knocking noise.

6.4.6 Connecting a thermoregulator to Reactor-Ready Flex

If using Quick-Release Insulated Hoses and Draindown Manifolds

Screw the thermofluid hoses directly onto the right-angled connectors on the Lower Supply and Upper Return Manifolds, ensuring they are fully tightened with a wrench.



Useful notes

- ❖ The Draindown Manifolds feature a right-angled connector for attaching the thermofluid hoses. In normal use, these connectors point downwards to minimise strain on the hoses and couplings. However, in some circumstances you may wish to realign this connector to accommodate thermoregulator hoses in a different configuration.
- ❖ To achieve this, slightly loosen the female swivel coupling which attaches the right-angled connector to the Manifold and twist the right-angled connector to the required position. Retighten the female swivel coupling.

Important information

→ The Draindown Manifolds are supplied with M24 fittings as standard. If the thermofluid hoses you are using do not have M24 fittings, then an adapter will be required.

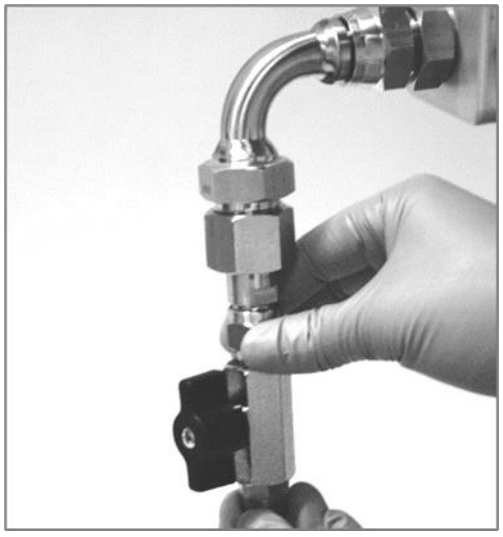
If not using Quick-Release Insulated Hoses and Draindown Manifolds

Connect your insulated hoses to the thermoregulator. Once everything is secure and tightened you can switch on the thermoregulator.

If using isolating valves

To attach isolating valves, screw the appropriate adapters (if required) onto the right-angled connectors on the Draindown Manifolds, and check that they are fully tightened. Then screw the appropriate isolating valves onto the adapters (if required) and ensure they are fully tightened.

Now screw the thermofluid hoses onto the valves and tighten with a wrench. Ensure that all hoses and connectors remain fully tightened.



Warning!

- Care must be taken to avoid pressurising the Vessel jacket.
- **Never** run the thermoregulator with the isolating valves closed. This would expose the Vessel jacket to full pump pressure, which could result in glassware failure/breakage.
- **Never** leave the Vessel with both isolating valves closed when the jacket contains heat transfer fluid. Expansion of the fluid caused by temperature change could result in glassware failure/breakage.

Important information

→ We do not recommend the use of isolating valves with Reactor-Ready Flex due to the possibility of over-pressurising the vessel jacket if they are accidentally closed off during operation or sealing the vessel in the jacket. However, you may wish to use isolating valves if connecting one thermoregulator to multiple Reactor-Ready Flex systems.

→ If using isolating valves, they should only be placed on the supply hose (from the thermoregulator to the vessel) and never on the return (from the vessel to the thermoregulator).

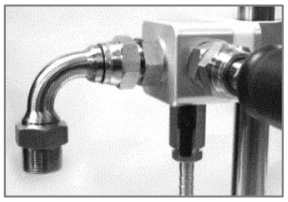
→ If you plan to use isolating valves with Reactor-Ready Flex, please refer to the Warning section above.

6.4.7 Charging Reactor-Ready Flex with thermofluid

If Quick-Release Insulated Hoses and Draindown Manifolds are not being used, go to Step 3.

Step 1

Ensure the drain valve on the Lower Supply Manifold is closed.



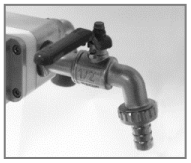
Open

Closed

Useful notes

❖ The Lower Supply Manifold has been upgraded and now features a more compact drain tap.
For units purchased pre-February 2019, see opposite.

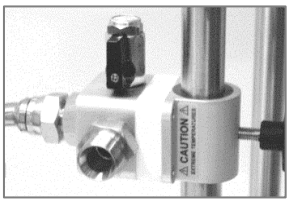
Open



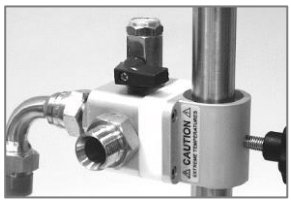
Closed

Step 2

Ensure the vent valve on the Upper Return Manifold is closed.



Open



Closed

Step 3

Start flow and run the purge cycle on your thermoregulator for approximately 10 minutes at ambient temperature to purge all air from the system.

During the purge cycle, keep a careful watch on all fluid connections to ensure there are no leaks. If leaks are detected, switch off the thermoregulator and retighten the appropriate fittings.

Important information

→ The exact timing for the purge cycle, and the indication that all air has been removed, will be dependent on the thermoregulator being used. Please refer to the manufacturer's thermoregulator instruction manual for further information.

→ Always run the purge cycle at ambient temperature to remove any trapped air and to check for thermofluid leaks before applying any heating or cooling. If any leaks are detected, fittings should be retightened. Once this has been done, the thermoregulator should be set to run at the proposed upper and lower operating temperatures to again check for leaks. If further leaks are detected, the fittings should be retightened.

→ It is strongly recommended that all manifold fittings are inspected and, if necessary, re-tightened after the first few runs above ambient temperature.

6.4.8 Draining thermofluid from Reactor-Ready Flex

If the Reaction or Filter Vessel needs to be removed from the Reactor-Ready Flex framework for cleaning, or to replace it with another Vessel, the thermofluid in the jacket must first be drained.

Step 1

Ensure the thermoregulator is switched off and allow the thermofluid to cool to a safe temperature.

Warning!

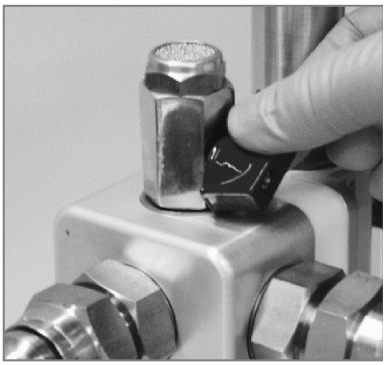
♦ You **must** allow the thermofluid to warm or cool to a safe ambient temperature before draining the system or venting to atmosphere.

Step 2

If using the Quick-Release Insulated Hoses and Draindown Manifolds

If the thermofluid is to be drained back into the thermoregulator's internal reservoir, open the vent valve on the Upper Return Manifold. This will vent the system to atmosphere and allow the thermofluid to drain, via gravity, from the Vessel jacket.

Close the vent valve once the jacket is empty.



Important information

→ Ensure that the thermoregulator has sufficient capacity to collect the full volume of thermofluid.

→ To achieve full drainage of the Vessel, the thermoregulator needs to be at a lower height than the lower sidearm of the Reaction Vessel. Ideally the thermoregulator should be positioned below the Reactor-Ready Flex assembly. If this is not possible, it may be necessary to raise the Vessel Support on the frame until the Vessel is higher than the thermoregulator. Alternatively, the Vessel can be drained to an external reservoir.

To drain the thermofluid to an external reservoir, place a suitable container (with sufficient capacity to collect the full volume of thermofluid) directly under the drain valve on the Lower Supply Manifold.

Open the drain valve on the Lower Supply Manifold. Then open the vent valve on the Upper Return Manifold. Allow the thermofluid to drain from the Vessel jacket.

Close the drain valve and vent valve once the jacket is empty.

Useful notes

❖ The speed at which the thermofluid will drain is dependent on the height of the Draindown Manifolds relative to the Vessel, and the exact positioning of the thermoregulator and hoses. Best results will be achieved with the Manifolds as high as possible and the thermoregulator as low as possible.

If not using the Quick-Release Insulated Hoses and Draindown Manifolds

Locate the valve on the thermoregulator and place a sufficiently sized container underneath it. Now carefully open the valve to drain the fluid.

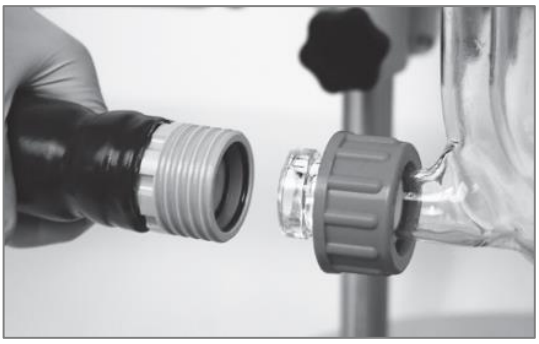
6.4.9 Disconnecting the thermoregulator

If using the Quick-Release Insulated Hoses and Drain down Manifolds

Step 1

Once the thermofluid has been drained from the Vessel, the Quick-Release Insulated Hoses can be detached from the Vessel sidearms.

To do this, first unscrew the red Rodaviss screw caps, and then gently ease the hose connectors from the Vessel sidearms.



Step 2

The hose connectors should now be sealed with the red Rodaviss Sealing Caps (supplied with the Quick-Release Insulated Hoses) or attached to the Hose Tidies (see Section 6.4.10) to prevent dripping of any thermofluid residues.

If not using the Quick-Release Insulated Hoses and Draindown Manifolds

Once the thermofluid has been drained from the Vessel, the insulated hoses can be detached from the Vessel sidearms. To do this, first unscrew the red Rodaviss screw cap, and then gently ease the hose connectors from the Vessel sidearms.

Useful notes

- Due to the nature of the glass Vessel design, it is likely that some residual thermofluid will remain at the bottom of the jacket, below the level of the lower sidearm. This can be removed once the Vessel has been removed from the Clamp.

6.4.10 Connecting the Hose Tidies

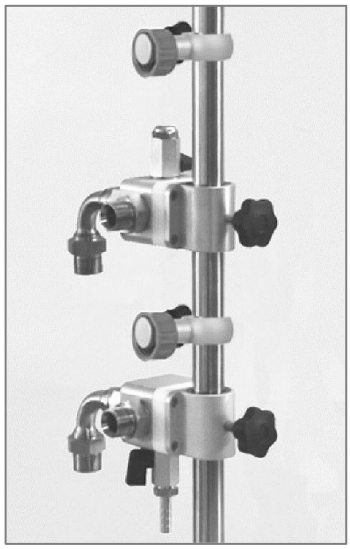
If the Quick-Release Insulated Hoses and Draindown Manifolds are not being used, go to 6.4.11 – Static

Reactor-Ready Flex is supplied with two Hose Tidies which attach to the side Support Rods of the framework and allow the Quick-Release Insulated Hoses to be conveniently sealed and secured when not in use, preventing them interfering with further work.

The Hose Tidies can be conveniently added or removed from the framework at any time without disturbing the rest of the system.

Step 1

To attach the Hose Tidies to the framework, place the bracketed end of each Hose Tidy around the side Support Rod and hand-tighten the locking knob to secure.



Note: The two Hose Tidies should be added to the same Support Rod as the Draindown Manifolds.

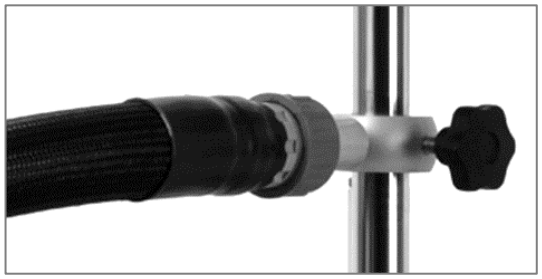
Important information

→ To minimise the risk of thermofluid leakage from the hose whilst using the Hose Tidy, each Hose Tidy should be positioned above its corresponding Manifold.

Step 2

To connect the Quick-Release Insulated Hoses to the Hose Tidies, push the PEEK coupling on the Hose onto the protruding lug of the Hose Tidy. A slight twisting motion while pushing the fitting may aid this process.

Once the coupling is fully engaged on the lug, screw the red Rodaviss screw cap located onto the Hose connector and hand-tighten.



Warning!

- **Never** operate the system with a thermoregulator running whilst hoses are attached to the Hose Tidies. Hose Tidies are a convenient storage device for hoses not connected to a Vessel (for example, when changing or cleaning the Vessel). They are not intended to provide a leakproof seal for a system fully charged with thermofluid.

6.4.11 Static

Static can be generated in any circulating fluid system. This is not a fault with the equipment, but an unfortunate and accepted occasional side effect of the methodology. The following is provided for your information only and is not intended to be a definitive guide as to what action to take in the case of static build up.

Possible causes of static

Generally, oil-based thermofluids (heat-transfer fluids) are not good conductors of electricity and can therefore produce static charge. This is because, whilst in use, they are creating constant friction with the tubing, Reaction Vessel jacket and the inside of the thermoregulator. This is similar to what happens when rubbing a balloon on a nylon jumper to make it stick to a wall. Some thermofluids are better than others, and not all will create static.

In some cases, the friction generated from the Stirrer shaft turning in the reactor contents can also cause static, though this clearly depends on the makeup of the contents. It is also possible that site and environmental factors can have an effect on static. However, there are numerous reaction systems in the field that are pumping oil around a reactor, and only a small percentage have static issues.

Possible solutions

There are two popular methods for reducing or eliminating the risk of static build up in a system, and in most cases it would be prudent to adopt both:

1. The use of earthing lines to connect all of the system components (reactor, framework, thermoregulator, etc.) to an earth line. This is often the accepted practice in process and plant installations.

2. Adding an anti-static additive/oil to the thermofluid, which helps make the thermofluid a better electrical conductor. It is important to ensure that the additive is compatible with the thermofluid in use and that its concentration is maintained (even after thermofluid changes).

Warning!

- It is the responsibility of the user of the equipment to ensure that safe engineering practices are used to deal with static. If you do experience any signs of static build up in your system, it is strongly recommended that this is discussed and reviewed with your on-site process safety advisors.

6.4.12 Filtration

If using a Filter Vessel in your Reactor-Ready Flex system, the following points should be noted:

- Filter Vessels are designed for optimum use in filtration operations to separate a solid from a liquid. The temperature-controlled jacket allows this process to be done under either hot or cold conditions.

  In normal use, the biphasic mixture may be added to the Vessel from an external source, where it may be temperature controlled during the filtration operation. In temperature-critical applications, it may be best to pre-heat or cool the reactor jacket and reaction mixture before adding it to the Filter Vessel, to avoid unwanted side effects during any temperature equilibration time.

  It is advisable to add the mixture to the Vessel with the bottom outlet valve closed initially. This allows for the mixture to fully equilibrate in the Reaction Vessel before filtration begins. Once this has been achieved, vacuum may be applied and the bottom outlet opened, to allow filtration to begin.

  Note: Even though the bottom outlet valve is closed, it may be possible for a small amount of liquid to pass through the Filter Membrane into the cavity below. This cavity is small, and liquid loss is minimal.

- The thermal control available on the Filter Vessel allows the possibility of using it as a Reaction Vessel as well. In this way, reaction and filtration processes can be conveniently combined to streamline operations. It should be noted that during any extended reaction time, even with the bottom outlet valve closed, it may be possible for a small amount of liquid to pass through the Filter Membrane into the cavity below. This cavity is small, and liquid loss is minimal.

- In some circumstances, vacuum may need to be applied to the Filter Vessel from above the filter base (via a port in the Filter Vessel Lid) during your process. When doing this, small air bubbles in the reactor contents may be observed, either around the Filter Plate seal, or through the Filter Membrane. This is not uncommon and does not indicate that the Filter Vessel is leaking.

- Reactor-Ready Flex Filter Vessels feature a full-length thermal jacket to maximise heat transfer and ensure uniform temperatures within the Vessel. However, the Filter Plate, outlet valve, and connecting tubing are not temperature controlled. Particular care should be taken when filtration is performed whilst the Filter Vessel is being heated, as precipitation or crystallisation may occur when hot liquid contacts components at ambient temperature below the Filter Membrane. This may result in clogging or blockage of the filtration path.

Choice of Filter Plate material

Reactor-Ready Flex Filter Plates and accompanying Gaskets are available in both PTFE and PEEK.
PTFE offers the highest level of chemical compatibility, however, its reduced mechanical stability lowers its operating temperature range.

- PEEK Filter Plate temperature range: -30 °C to +180 °C
- PTFE Filter Plate temperature range: -30 °C to +120 °C

For processes requiring maximum chemical compatibility, the PTFE Filter Plate and Gasket should be used.
For processes requiring an operating temperature above +120 °C, the PEEK Filter Plate and Gasket should be used.
Note: It is important that the Gasket and Plate material are matched.

Choice of Filter Membrane material

A range of Filter Membranes are available for use with your Reactor-Ready Flex Filter Vessel. Polyester membranes offer a cost-effective solution for general use and are available in a range of different porosities. For operations requiring maximum chemical compatibility, a PEEK membrane is recommended.

Polyester and PEEK Filter Membranes for DN150		
1 µm polyester (Pack of 3) RR171064	5 µm polyester (Pack of 3) RR171066	10 µm polyester (Pack of 3) RR171068
20 µm polyester (Pack of 3) RR171070	35 µm PEEK (Pack of 3) RR171074	40 µm polyester (Pack of 3) RR171072
Filter Membrane Evaluation Kit (Pack of 6): Includes one of each of the Filter Membranes above. RR170030		

If necessary, you can use your own filter membrane material, but it must be cut to the correct size to fit the Reactor-Ready Flex Filter Plate. This is best achieved by using the Filter Plate Gasket as a template.

Installing a cold trap

To protect your vacuum pump, and to enhance the performance of your filtration system, it is recommended that you install a cold trap between the collection vessel and your pump, using a Radleys Cold Trap Kit. This minimises the amount of vapour entering the pump, thereby protecting the internal components from chemical attack and reducing any residual vapour pressure which may reduce the vacuum achievable.

To install your cold trap, cut a piece of vacuum tubing to a suitable length and connect one end to the sidearm of the collection vessel. Attach the other end of the tubing to the inlet connector on the cold trap. Cut a second length of tubing and connect one end to the outlet on the cold trap and the other end to the connector on your vacuum pump.

Radleys Cold Trap Kits

High Vacuum 500ml Cold Trap Kit

RR170046

Requires the use of a suitable coolant, for example acetone and dry ice, in the chamber of the trap.

Two-piece B34 Cold Trap Kit

RR170048

Requires the use of a dewar flask (not provided) as well as a suitable coolant in the dewar.

6.4.13 Filter Vessel accessories and instructions

The following range of accessories are available for use with Reactor-Ready Flex Filter Vessels.

Spray Lance for Reactor-Ready Flex Vessels

Step 1

Remove the fully assembled Spray Lance from the box.

Check all components are firmly screwed together, and hand tighten if necessary.

Step 2

Connect one end of the silicon tubing (for non-abrasive chemicals) to the hose barb on the elbow component of the Spray Lance.

Make sure it is secured tightly to avoid any leakage.

Step 3

Insert the Spray Lance into the B34 port on the Vessel Lid. The B34 compression fitting will hold the Lance in place during operation.

Note: The height of the Lance as well as the angle of the nozzle can be adjusted by loosening the compression fitting cap.

Step 4

If using the Spray Lance with a peristaltic pump, insert the middle part of tubing into the peristaltic pump head and close the clamp. Adjust the rpm settings to your desired speed and the diameter settings of the tubing. A flow rate of 0.85 l/min is the minimum required to give a spray pattern to cover the sides of the Vessel.

Step 5

Place the other end of the tubing into your solvent container, making sure it is submerged sufficiently so that solvent can pass through the tubing.

Step 6

For filtering applications, the bottom outlet valve should be opened. For rinsing, it should be closed. Press start on the peristaltic pump to start the spray lance.

Filter Cake Catcher

Step 1

Ensure that the Filter Plate assembly is securely clamped to the Filter Vessel as described in Section 6.2.2.

The Filter Cake Catcher can now be added.

Step 2

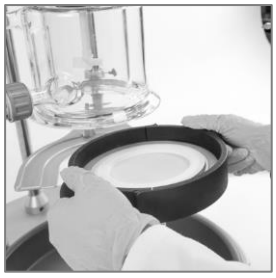
Place both halves of the Filter Cake Catcher around the Filter Plate, lining up the bottom flaps and the top clips.

Push them together until an audible click is heard. The Filter Cake Catcher is now secure.

Step 3

After filtration, the Filter Plate can be removed from the Vessel.

The Filter Cake Catcher will capture any solids from the filtration.



Step 4

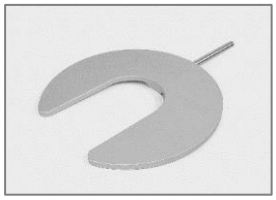
To detach the Filter Cake Catcher from the Filter Plate assembly, ensure that the Filter Plate assembly is secured and then press on the two tabs next to the top clips to release the two halves.

Filter Plate Benchtop Support

Step 1

The Filter Plate Benchtop Support comes assembled ready for use.

Ensure that the M6 screw on the bottom of the Benchtop Support is screwed tightly.



Step 2

Clamp the Filter Plate Benchtop Support to a suitable retort stand using the stainless-steel rod. Adjust the height and position of the Filter Plate Benchtop Support as required.

Step 3

Place the retort stand with the Filter Plate Benchtop Support on a flat and stable surface The Filter Plate Benchtop Support is now ready for use with the Filter Plate assembly.

7 Jacketed glass Reaction and Filter Vessels

Radleys supplies a range of Reaction Vessels and Filter Vessels specifically for use with Reactor-Ready Flex.

- Reaction Vessels are available as single or vacuum jacketed, and range in size from 100 ml to 5 L.
- Filter Vessels are single jacketed and are available in 1 L or 2 L sizes.

Important information

→ Only Radleys Vessels should be used with Reactor-Ready Flex as they have been specifically engineered to fit the Reactor-Ready Flex framework and ensure a safe and leak-tight seal. **Never** use Vessels from other manufacturers.

Construction materials

The wetted components of Reactor-Ready Flex Reaction Vessels are type 3.3 borosilicate glass and fluoropolymer.
The wetted components of Reactor-Ready Flex Filter Vessels are type 3.3 borosilicate glass and either PEEK or fluoropolymer, depending on which base is used.

A Reaction Vessel

Vacuum and pressure

Unless stated otherwise, Radleys Vessels are suitable for use under vacuum, typically down to 10 mbar, but not for use under positive pressure of contents. The maximum allowable differential jacket pressure between the flow and return is 0.5 barG. We recommend against the use of valves and flow restriction on HTF return lines to avoid the possibility of stopping the flow or increasing the pressure.

A Filter Vessel

Safe Delta-T (ΔT)

To limit the potential stress (and therefore Vessel breakage) caused by a big difference between the temperature of the contents and the jacket, the ΔT (Delta-T = the difference between the two temperatures in K) should be limited to our recommended 50 K.

With Huber Unistat thermoregulators, this can be done using the Delta-T limiter, found under 'Limits' in the Unistat menu (or as function 18 in older units). However, please note that this can only be achieved if the contents temperature is being monitored.

Important information

→ If the internal temperature is not being monitored (for instance, if the Vessel is empty) then great care should be taken to cool or heat the Vessel in a controlled way to prevent thermal shock. This may be achieved by either tempering in stages or by use of a ramp function.

Warning!

- When heating/cooling your jacketed Vessel, the difference between the temperature of the Vessel contents and the jacket temperature (ΔT), should not exceed 50 K to avoid the Vessel breaking.

Temperature range

Standard jacketed Vessels with the Radleys V4 zero dead space stopcock (see page 52) are suitable for use from -70 °C to +230 °C.

Important information

→ At temperatures below -50 °C, there may be some weeping from the stopcock. Please see **Minimising weeping at low temperatures** on page 53 for advice on techniques to minimise this.

Self-sealing couplings

The use of self-sealing couplings is **not** recommended on any connections or hoses. The internal shape of the sealing mechanism causes a restriction in the flow and therefore affects the performance of the thermoregulator.

The same is true of in-line valves, and care should be taken to prevent the possibility of pressurising the jacket in this way (for instance by using lockable valves).

Warning!

- The use of self-sealing couplings can also lead to Vessel breakage due to pressurising the jacket, either because the jacket becomes isolated from atmospheric pressure, or the Vessel outlet is shut whilst the circulator is running.

Vessel sidearms

Whilst Reactor-Ready Flex hoses are specifically designed to prevent stress being put on the Vessel sidearm, care should be taken to avoid stress caused by misaligning or twisting the hoses.

Vacuum jacketed Vessels

Vacuum jacketed Vessels are recommended for use with sub-ambient reactions.

The additional vacuum jacket surrounding these Vessels helps increase the performance of the system by minimising heat/cold loss from the Vessel. A double O-Ring seal at the top of the piston further improves the sealing of the Vessel stopcock, which is particularly useful at extremely low temperatures.

A vacuum jacketed Reaction Vessel

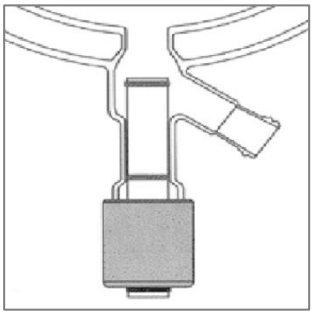
By positioning the sealing O-Rings in an environment surrounded by a vacuum, the design of these Vessels ensures maximum isolation of the piston seal and hot/cold thermal fluid, thereby minimising heat transfer.

Benefits of using vacuum jacketed Vessels

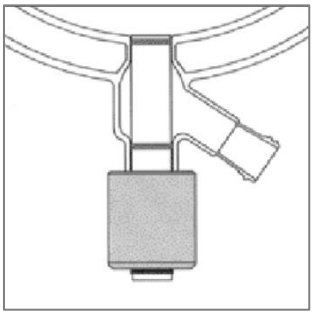
- Visibility – reduced icing and condensation means you can see inside when cooling.
- Energy efficiency – cooling power is optimised.
- Safety – the insulated outer surface means there is no touch hazard when hot or cold.

V4 zero dead space stopcock (V4 ZDS)

All Reactor-Ready Flex Vessels feature the V4 ZDS. This zero dead volume stopcock minimises the dead space at the bottom of the Reaction Vessel during reactions. The stopcock also minimises hold-up of reaction contents after draining the reactor.



Open



Closed

Features

- Proprietary design helps prevent over-tightening that can cause glass breakage.
- Piston design allows quick and safe removal, eliminating the cleaning and assembly problems associated with other stopcock styles.
- Glass-filled PTFE piston minimises the differential expansion between piston and Reaction Vessel and removes the danger of the piston fracturing the Vessel due to over-tightening followed by piston expansion. The piston also reduces the differential contraction between Vessel and piston when operating at temperatures down to -60 °C.
- Interchangeable between Vessels, with a full range of replacement parts and FEP O-Rings.
- The large 15 mm bore minimises sample hold-up and is ideal for slurries (25 mm available on request).
- Features a double O-Ring Seal at the top of the piston to further improve the sealing of the Vessel stopcock, which is particularly useful at extremely low temperatures.

Warning!

- The Reactor-Ready Flex V4 ZDS stopcock should only be operated by hand and **not** with the use of tools. If the piston cannot be inserted or removed easily, do not force it. If the piston becomes stuck, please contact your local distributor or email **sales@radleys.com** for technical advice.

When closing the V4 ZDS stopcock, the piston will reach the closed position whereupon you will feel resistance. The piston does not need to be tightly closed to provide a seal – in fact, this can lead to breakage of the glass thread and should therefore be avoided. Once the piston is fully closed, gently (with fingers only) unscrew the cap by a ¼ turn to prevent stressing the thread.

Important information

→ Reactor-Ready Flex Filter Vessels feature the same V4 ZDS stopcock design as Reaction Vessels, however, the piston assembly is longer to allow the Filter Vessel to accommodate the additional length of the outlet of the Filter Vessel base.

→ Pistons are **not** interchangeable between Reaction Vessels and Filter Vessels, so care should be taken to ensure the correct piston is being used for your application.

Minimising weeping at low temperatures

Care must be taken with the piston seals, particularly when operating at extreme low temperatures, as below -50 °C there may be some weeping from the stopcock. (Some minimal weeping at low temperatures is commonplace with most reaction systems with conventional-style stopcocks.)
The occurrence of weeping may vary from experiment to experiment and from vessel to vessel.

The performance of the piston and O-Rings, particularly when operating at low temperatures, will be reduced by the following factors:

- Low temperatures – will cause the FEP encapsulated O-Rings to harden and become brittle during use, which reduces the elasticity of the polymer and potentially the effectiveness of the seal.
- Drainage of Vessel contents containing solids (crystals, heterogeneous catalysts, etc.) from the stopcock – can cause small particles to be trapped between the stopcock and glass, causing etching of the glass, piston and O-Ring.
- Continued use under normal conditions – will cause wear and tear on the O-Ring.

Important information

→ O-Rings and pistons should be routinely checked and replaced to maintain the performance of the system. Periodic replacement of the whole piston assembly may also be required.

→ The FEP O-Rings may not suit all applications, therefore alternative O-Ring Seals are available. Please email **sales@radleys.com** for technical advice.

When operating at extreme low temperatures (below -50 °C) it is recommended that:

- Piston O-Ring Seals are replaced between **every** run.
- Vacuum jacketed Reaction Vessels are used to minimise thermal strain on the piston and O-Rings. The pistons on these Reaction Vessels also feature double O-Rings for improved sealing performance.
- A secondary stopcock, attached to the B19 outlet, is used to catch any fluid that may weep through the stopcock (RR139098).

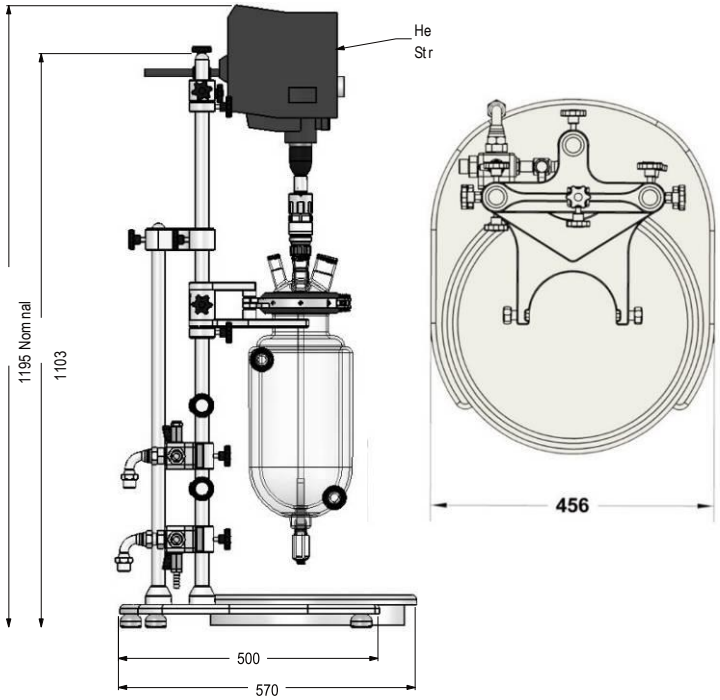
Replacement pistons and O-Rings

Replacement pistons and O-Rings for Reaction Vessels	
V4 15 mm piston for single jacketed Reaction Vessel RR161100	V4 25 mm piston for single jacketed Reaction Vessel RR166070
V4 15 mm piston for vacuum jacketed Reaction Vessel RR166055	V4 25 mm piston for vacuum jacketed Reaction Vessel RR166075
V4 Replacement 15 mm piston top O-Ring RR166100	V4 Replacement 25 mm piston top O-Ring RR166104
V4 Replacement 15 mm piston middle O-Ring RR166102	V4 Replacement 25 mm piston middle O-Ring RR166106

Replacement pistons and O-Rings for Filter Vessels	
15 mm piston for Filter Vessel RR171062	Filter Plate O-Ring – silicone (-30 °C to +180 °C) DN150 RR171048
Replacement 15 mm piston top O-Ring RR166100	Filter Plate O-Ring – Viton (-20 °C to +180 °C) DN150 RR171050
Replacement 15 mm piston middle O-Ring RR166102	Filter Plate Gasket – PTFE DN150 RR171040
23 mm Viton O-Rings for Quick-Release Insulated Hose Coupling RR121071/1	Filter Plate Gasket – PEEK DN150 RR171042
34 mm Viton O-Rings for Quick-Release Insulated Hose Coupling – NW20 RR210050/1	

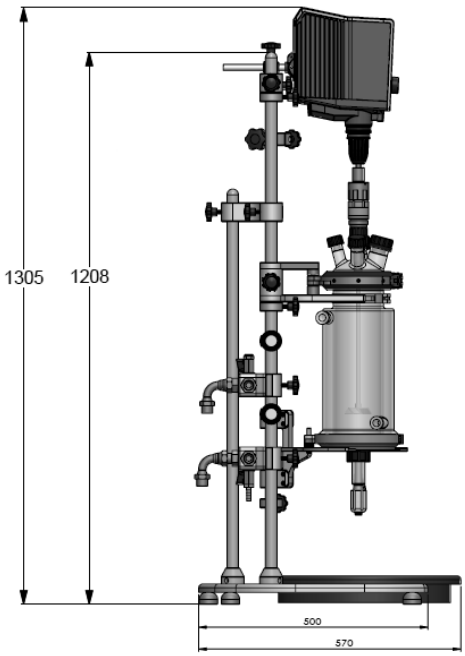
8 General specifications

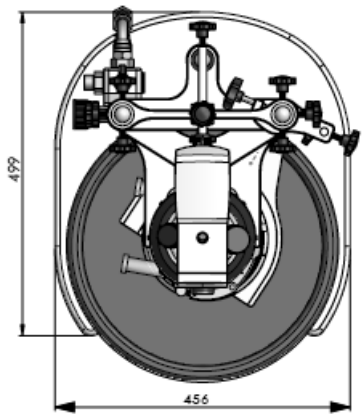
8.1 Reactor-Ready Flex core system



Specifications	
Weight (framework only – with U-Shaped Base Plate)	27 kg
Jacket temperature range	-70 °C to +230 °C
Vessel max Delta-T (temperature difference between Vessel jacket and Vessel contents)	50 K
Stirrer speed	500 rpm continuous 800 rpm for short periods
(If applicable) Draindown Manifold Kit - Thermoregulator hose connector fittings	M24

8.2 Reactor-Ready Flex Filter core system





Specifications	
Weight (framework only)	30.7 kg
Jacket temperature range	-30 °C to +180 °C
Vessel max Delta-T (temperature difference between vessel jacket and vessel contents)	50 K
Stirrer speed	500 rpm continuous 800 rpm for short periods
(If applicable) Draindown Manifold Kit - Thermoregulator hose connector fittings	M24

8.3 Materials of construction

U-Shaped Base Plate	Aluminium 6082 HE30, Stainless steel 316 1.4401, Nitrile
Support Rods	Stainless steel 316 1.4401
Drip Tray	Polypropylene
Vessel Support	Aluminium 6082-HE30, PTFE, Stainless steel 316 1.4401, Nylon
PTFE Vessel Clamp DN100	Stainless steel 316 1.4401, carbon-filled PTFE
Vessel Support + Integrated PTFE Clamp	Aluminium 6082 HE30, Stainless steel 316 1.4401, carbon-filled PTFE
T-Beam Support Brace	Aluminium 6082 HE30
Safety Stop Collar	Aluminium 6082-HE30, PTFE, Stainless steel 316 1.4401, Nylon
Vessel Support Collar	Stainless steel 316 1.4401, Viton
Reactor-Ready Flex 5 Neck Lid DN100 – 1xB19 2xB24 1xB29 1xB34	Borosilicate glass 3.3
DN100 PTFE 5 Neck Lid – 1xB19 2xB24 1xB29 1xB34 & 2 Blanked Ports	PTFE
DN100 PTFE 5 Neck Blaze Lid & 2 Blanked Ports – 1xB19 2xB24 1xB29 1xB34	PTFE
PTFE Support Collar for FEP O-Ring – DN100	PTFE
FEP Encapsulated Silicone Vessel O-Ring – DN100	FEP encapsulated silicone
Stirrer Support Boss	Aluminium 6082 HE30, PTFE
Stirrer Support I-Beam	Aluminium 6082 HE30, PTFE
Stirrer Guide	PTFE, PEEK, Viton, Aluminium 6082 HE30, Stainless steel 440C
Stirrer Drive Coupling	Stainless steel 316 1.4401, Stainless steel 440C

Lower Supply and Upper Return Manifolds	Aluminium 6082 HE30, Stainless steel 316 1.4401, PTFE
Quick-Release Insulated Hoses	PTFE, PEEK, Viton, Stainless steel 316 1.4401
Hose Tidy	Aluminium 6082-HE30, PTFE, Stainless steel 316 1.4401, Nylon
M16 Sidearm Connector	PEEK, Viton
M24 Sidearm Connector	PEEK, Viton
NW12 Sidearm Connector	PEEK, Viton
Hose Supports	Aluminium 6082-HE30, Stainless steel 316 1.4401, Nylon, Viton
Jacketed Reaction Vessel	Borosilicate glass 3.3
Jacketed Filter Vessel	Borosilicate glass 3.3
Reaction Vessel Piston	15 % glass-filled PTFE, PTFE, FEP encapsulated silicone
Stirrer Shaft	PTFE
Temperature Probe	PTFE
Filter Plate	PTFE or PEEK
Filter Plate Support Cup	Aluminium 6082 HE30
Filter Plate Benchtop Support	Aluminium 6082-HE30, Stainless steel 316 1.4401
Filter Cake Catcher	Nylon PA12
Spray Lance	PTFE
Spray Nozzle	Stainless steel 316

9 Routine maintenance

- To maintain your Reactor-Ready Flex system in prime condition, check all moving parts and seals regularly.
- Moving parts should be kept clean and free from any obstructions or surface contamination. Parts relying on sliding motion may benefit from regular application of a thin surface coating of lubricating oil.
- The three coupling pins on both the Stirrer Guide and the Stirrer Drive Coupling should be regularly inspected. These pins will wear over time and will require periodic replacement.
- The Quick-Release Insulated Hoses feature a double O-Ring sealing mechanism within the PEEK coupling. To ensure that this coupling provides a good seal, regular inspection of the O-Rings is recommended. O-Rings should be replaced if any sign of damage or wear is observed, or if any leakage occurs from this connection during operation.
- The FEP encapsulated silicone O-Ring Seal in the PTFE O-Ring support collar will also require periodic replacement.
- Reactor-Ready Flex metal components are resistant to the majority of solvents and are splash resistant to dilute acids and alkalis at room temperature. However, always wipe away any chemical spills immediately and avoid exposure to strong vapours such as HCl, etc., as continued exposure to even low levels of chemical vapours or liquids will cause corrosion to metal and/or plastic components. Elevated temperatures will also accelerate any potential corrosion/chemical attack.
- The manifold fittings should be checked to ensure they are still tight, particularly after temperature cycling.

Additional maintenance for Filter Vessels

- The filter base features a double O-Ring sealing mechanism within the coupling to the glass BOV. To ensure that this coupling provides a good seal, regular inspection of the O-Rings is recommended. O-Rings should be replaced if any sign of damage or wear is observed, or if any leakage occurs from this connection during operation.
- The filter base Gasket and sealing O-Ring should be regularly checked for any sign of damage or wear, particularly from expansion and contraction when exposed to high or low temperatures. Regular replacement of these components is required to maintain optimum filtration performance.
- The Sintered Glass Membrane Support should be regularly removed for cleaning and inspected for signs of blockage or damage. If necessary, the Membrane Support should be replaced. Reactor-Ready Flex Filter Vessel membranes are available in a range of materials and porosities to suit your application. These are intended for single use only and should be replaced for each new operation.

Warranty – Email Back

sales@radleys.com

To qualify for your warranty please complete, scan and email this form to Radleys

Product Name/Model	
Product Batch or Serial No. (If shown)	
Date of purchase	
Supplier's name and address	
Organisation name	
First name	
Last name	
Job Title	
Department	
Address	
Country	
Postal/Zip Code	
Email	
Phone	
Mobile	

Type of Organisation: *Tick all relevant boxes*			
Academic		Lab Equipment Dealer/Manufacturer	
Animal/Marine/Vetinary		Medical/Clinical/Diagnostic/Device	
Automation/Engineering/Electronics/Instrumentation		Metals/Mining	
Chemical/Agrochem		Natural Products/Tobacco	
Consumer/Cosmetics/Textile		Petrochem/BioFuels	
CRO/CMO/CDMO		Speciality Chemicals/Materials	
Defence		Testing Services	
Energy		Waste/Water/Recycling/Environmental	
Engineering Contracts/Facility Mgmnt/ Instrumentation Service		Other _____	
Food/Flavourings/Farming/Beverages			

Field of work: *Tick all relevant boxes*			
Analytical Chemistry		Liquid Handling & Micro Plates	
Automation/HTS		Material Sciences	
Biochemistry		Medical Devices	
Biological Sciences		Medicinal Chemistry	
Catalysis		Microbiology/Tissue Culture	
Chromatograohy		Molecular Biology	
Clinical/Medical/Pathology		Neurology	
Colloids		Organic Chemistry	
Construction		Parallel Chemistry/Combi-Chem	
Crystallisation		Polymers & Oils	
Drug Discovery		Process Dev/ Scale-Up	
Environmental Health		Process Safety/Calorimetry	
Estate & Facilities Management		Purchasing/Stores	
Food & Agriculture		QC/QA	
Formulation		Separation/SPE	
Geology		Support/Engineering	
Health & Safety		Temperature Control	
Inorganic Chemistry/Metallurgy		Veterinary	