

Reactor-Ready Mini Jacketed Lab Reactor

Instructions



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1 Introduction

Thank you for purchasing Reactor-Ready Mini.

Please read this instruction manual thoroughly before operating the unit.

Reactor-Ready Mini is a compact and flexible benchtop reaction system with a purpose-built framework that can be used with a wide range of dedicated glass reaction 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

- Dedicated process glass reaction vessels, single or vacuum jacketed, ranging in size from 50 to 500 mL.
- Choose between the Reactor-Ready Mini Pro and the Reactor-Ready Mini Starter framework to suit your budget and application.
- Reactor-Ready Mini Pro: for rapid and mess-free vessel exchange.
- Reactor-Ready Mini Starter: without the Draindown Manifold kit, for those with limited budgets.
- Rapid Vessel exchange, with tool-free vessel clamps and hose couplings.
- Triple support stand, with heavy-duty stainless steel Support Rods for maximum strength and stability.
- Accepts a range of compact overhead stirrers, allowing easy, tool-free adjustment.
- Self-aligning stirrer coupling that engages without the need for tools.
- Optional hose manifolds (included in Pro) that allow easy thermofluid draindown.
- Temperature range: -70 °C to +230 °C jacket temperature (subject to thermoregulator).
- Wide range of glassware accessories, including condensers, dropping funnels, etc.
- Log and control stirrers, circulators, pumps, temperature sensors and other third-party devices with AVA Software.

2 Warranty

Reactor-Ready Mini 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 end 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 Mini.

- Reactor-Ready Mini 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 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 Mini.
- 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 Mini 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 Mini 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 Mini can be used with Reaction Vessels with a recirculating fluid at temperatures between -70 °C and +230 °C. 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 Mini 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	
 <p data-bbox="236 622 424 651">RR121532</p>	 <p data-bbox="555 622 743 651">RR121527</p>	 <p data-bbox="839 573 1070 602">Upper Return Manifold</p>	 <p data-bbox="1153 573 1385 602">Lower Supply Manifold</p>
Included in RR121510 (Draindown Manifold Kit)			

Stirrer Support	
 <p data-bbox="196 992 403 1021">Stirrer Support Boss</p> <p data-bbox="204 1032 395 1061">RR121520</p>	 <p data-bbox="595 992 770 1021">Safety Stop Collar</p> <p data-bbox="579 1032 770 1061">RR121524</p>



Vessel Support Plate Assembly	PTFE Vessel to Lid Clamp	Stirrer Guide Assembly	Drop-in Coupling
 <p data-bbox="276 1447 467 1476">RR121537</p>	 <p data-bbox="675 1447 863 1476">RR121518</p>	 <p data-bbox="978 1447 1126 1476">RR121521</p>	 <p data-bbox="1169 1447 1326 1476">RR121074</p>

Vessel Support Collar	O-Ring Seal + Support Collar	Lids	
 <p data-bbox="220 1933 411 1962">RR121519</p>	 <p data-bbox="539 1888 703 1962">RR121526 + RR121525</p>	 <p data-bbox="839 1888 935 1917">Glass Lid</p> <p data-bbox="802 1933 991 1962">RR136050</p>	 <p data-bbox="1058 1888 1158 1917">PTFE Lids</p> <p data-bbox="1026 1933 1214 1962">Various</p>

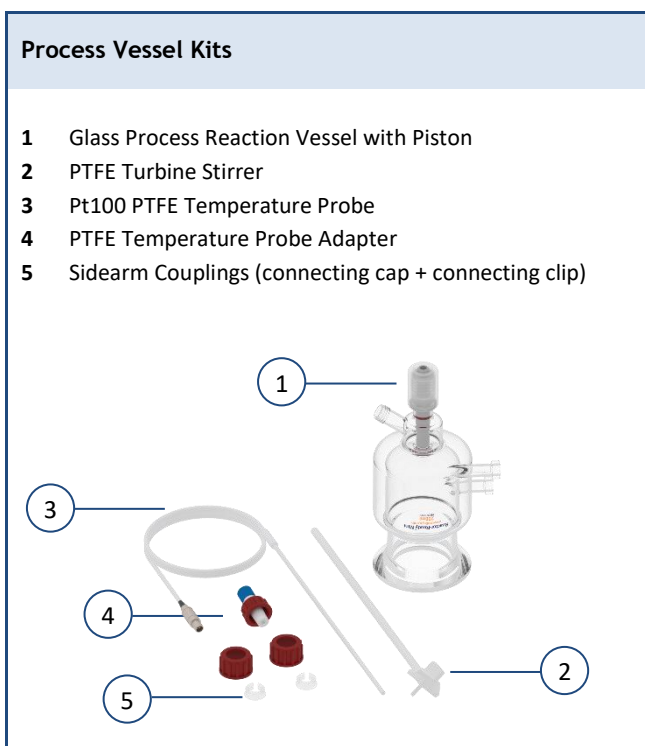
Hose Sealing Caps	Rodaviss Sealing Caps	M10 x 35 Socket Button Head screws (3 off)	M10 x 30 Socket Countersunk screws (2 off)
			

PEEK Vessel Sidearm Connectors	Hose Tidy	Hose Support Kit
 <p data-bbox="284 734 475 768">RR121543 (M16)</p>	 <p data-bbox="611 701 1064 768">RR121516 Included in RR121510 (Draindown Manifold Kit)</p>	 <p data-bbox="1193 734 1377 768">RR121547</p>

Mini Lower Rods	Quick-Release Insulated Hose
 <p data-bbox="379 1216 611 1249">RR121533 x 3</p>	 <p data-bbox="866 1227 1465 1261">RR121513 - Included in RR121510 (Draindown Manifold Kit)</p>

Mini Upper Rod	Mini Auxiliary Rod
 <p data-bbox="387 1709 627 1742">RR121534</p>	 <p data-bbox="1034 1709 1281 1742">RR121535</p>

5 Reaction Vessel guide



6 Set-up and operation

6.1 Setting up Reactor-Ready Mini

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 other devices 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

Place the vessel support plate upside down on a flat, stable work surface to ensure it is level. This stability is important for securely attaching the lower support rods.



Base Plate



Vessel Support Plate

Step 2

Hand-tighten the three lower support rods into the vessel support plate.



Use the provided Combination Wrench to firmly twist and tighten them at the base for optimal stability.



Step 3

Keep the vessel support plate and the poles in the same position. Align the base plate with the three lower support poles.



Insert the M10 x 35 Socket Button Head screws into the holes at the bottom of the base plate and tighten them securely using the supplied 6 mm Allen key.



Step 4

Rotate the framework 180 degrees so that the base plate and feet are firmly on a flat surface.



Step 5

Position the upper support pole and auxiliary pole on either side of the vessel support plate according to your preference. *Please note that the upper support pole will hold the overhead stirrer in place.*

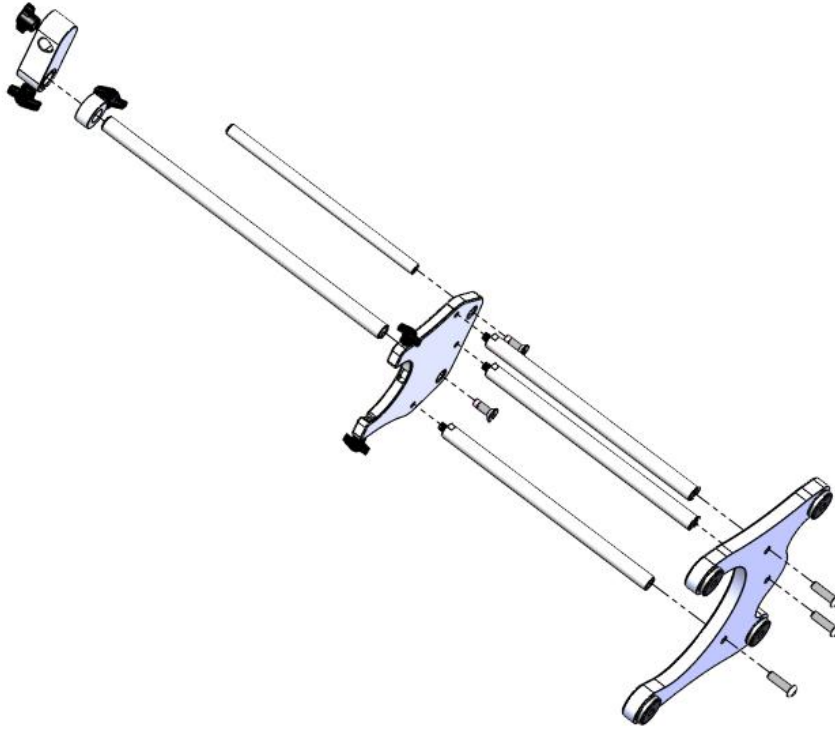


Insert the M10 x 30 Socket Countersunk screws into the holes at the bottom of the vessel support plate and tighten them securely using the supplied 6 mm Allen key.



Step 6

All four of the feet should be in contact with the work surface. Locate the Drip Tray into the base.



6.1.3 Adding the Stirrer Support

Step 1

Slide the Safety Stop Collar onto the longest upper Support Rod.

When the Safety Stop Collar is in approximately the correct position, hand-tighten the locking knob.



Step 2

Slide the Stirrer Support Boss onto the longest upper Support Rod. 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 adjust it so it is located directly under the Stirrer Support Boss and retighten the locking knob.



6.1.4 Reactor-Ready Mini System - assembled framework

Pro



Starter



6.1.5 Locating the Vessel into the framework

Warning!

- ◆ Only Radleys vessels should be used with Reactor-Ready Mini 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 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 thumbscrew on the Vessel Support Collar 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).



Step 2

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 the glass angles out to the actual flange) and tighten the thumbscrew.



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.



Important information

→ The Vessel Support Collar must be positioned correctly to ensure smooth operation of the Vessel Support Clamp (see Section 6.1.7 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 thumbscrew on the Vessel Support Collar and realign the vessel whilst it is located in the Vessel Support. Once correctly aligned, the thumbscrew on the collar must be retightened.

Step 4

The Vessel Support features 2 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.



6.1.6 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 B19 port on the lid.

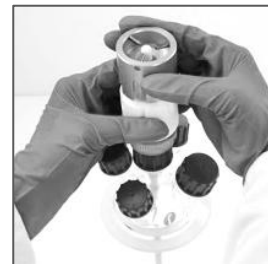
Hand-tighten the red Rodaviss screw cap to secure the Stirrer Guide in place.



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 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 shaft) must be securely connected to the vessel lid before the lid is placed on the vessel.

6.1.7 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 lid ports are in the desired 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.

Place the clamp over the vessel Lid assembly, ensuring that it fits around the join where the 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 6.1.5 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.

6.1.8 Attaching the Temperature Probe to the Vessel

Step 1

Insert the PTFE Temperature Probe Adapter into the compound angled B14 port of the lid.

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



Step 2

Partially unscrew the blue locking cap on the top of the probe adapter and 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 in the desired position. 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 a probe adapter are supplied with vessel kits or can be purchased as 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.



6.1.9 Attaching the Piston to the Vessel

Useful notes

- ❖ The Reactor-Ready Mini piston includes a retaining clip that serves as a safety mechanism to prevent the piston from falling out as a result of over-opening the bottom outlet valve (BOV). The piston will seal correctly even without the use of the retaining clip, so you may skip to step 3 if you prefer.

Warning!

- ◆ If the retaining clip is being used, the piston cannot be removed from the BOV. **Do not force the piston out**, as there is a risk of glass breakage. Refer to the section 'Removing the Piston with the Retaining Clip' below before continuing. Note: vessels are supplied with a retaining clip in the piston.

Step 1

Place the retaining clip above the BOV thread at the bottom of the vessel, ensuring the thicker side is facing up.



Step 2

Insert the piston into the Bottom Outlet Valve (BOV) and start screwing the piston in. When the bottom of the piston cap reaches past the groove, push the retaining clip into the cap (start at one of the open ends of the clip and keep pushing, following the clip to the other end). Ensure the piston is screwed in enough for the retaining clip to connect properly.



You will hear a click when it is secured.

Step 3

Tighten the piston until it is finger-tight within the BOV.



Removing the Piston with the Retaining Clip

Start by partially unscrewing the piston. Use your thumb* to grip the retaining clip between the thick and thin layers from the front. One side will pop out; gently lift the other side.



**If needed, use a thin tool such as a spatula or ruler to lift the retaining clip at one end.*



Once the retaining clip is fully lifted out of the piston, unscrew the piston until it fully comes out.



Important information

→ For instructions on replacing the O-rings and routine maintenance, see Section 8 Piston and O-rings Routine Maintenance.

6.1.10 Assembling the Draindown Manifolds

If the Draindown Manifolds are not being used, go to 6.1.11 Attaching hoses to the Vessel.

Useful notes

- ❖ Reactor-Ready Mini features independent Supply and Return Draindown Manifolds to simplify the connection between the thermoregulator and reaction vessel.
- ❖ The Draindown Manifolds can be located on any side of the Mini Lower 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, place the Lower Supply Manifold onto the left-hand Lower Rod. Ensure there is enough space below the manifold to allow a draining 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, place the Upper Return Manifold onto the left-hand Lower Rod, above the Lower Supply Manifold.

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 the drainage of the vessel.



6.1.11 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

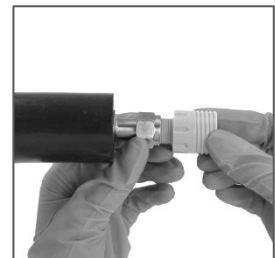
→ Once the Quick-Release Insulated Hoses are attached to the Vessel, only minor adjustments can be made to the height of the Draindown Manifolds.

If not using Quick-Release Insulated Hoses

Step 1

If using an M16 circulator hose, screw a M16 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 (pressureless) 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.



Important information

→ When attaching circulator hoses to the vessel side arms rather than using the draindown manifold kit, it is strongly recommended to use hose supports to reduce the weight of the hoses applied onto the sidearms of the vessel

6.1.12 Assembling the overhead stirrer

Important information

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

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

- ❖ Support rods of up to 16.5 mm diameter can be accommodated in the Stirrer Support Boss.

Step 3

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



Step 4

Loosen the locking knob on the Stirrer Boss and slide it down until the coupling pins on the Stirrer Drive Drop-in 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 Drop-in Coupling is not in contact with the pins of the Stirrer Guide.

Retighten the locking knobs on the Stirrer Support Boss.



Important information

- Reactor-Ready Mini 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 Drop-in Coupling are perfectly aligned with the Stirrer Guide you may need to adjust the position of the overhead stirrer. The sliding boss 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

Reposition the safety stop collar so that it is located directly below the 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 Mini is 500 rpm for continuous operation and 800 rpm for short periods.

6.2 Operating Reactor-Ready Mini

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

Important information

- Reactor-Ready Mini 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 Mini should not be left unattended unless in a supervised area.

6.2.1 Optimizing 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 Mini system.

6.2.2 Operating temperature range

Reactor-Ready Mini 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.

Warning!

- ◆ The Reactor-Ready Mini 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.

6.2.3 Choosing a thermoregulator (circulator)

There are many thermoregulators available that are suitable for use with Reactor-Ready Mini. 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.



6.2.4 Choosing a thermofluid

There is also a wide range of thermofluids available which are suitable for use with Reactor-Ready Mini. 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 Mini 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.

6.2.5 Choosing an overhead stirrer

Radleys recommends the use of the Radleys RS20 Control Mini Overhead Stirrer Motor with Reactor-Ready Mini. The RS20 Stirrer is very compact and lightweight, and ideal for smaller volumes and lower viscosities. However, whichever overhead stirrer is chosen, always refer to the manufacturer's instructions before using it with Reactor-Ready Mini to be sure of any limitations or safety restrictions.

6.2.6 Connecting a thermoregulator to Reactor-Ready Mini

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 M16 fittings as standard. If the thermofluid hoses you are using do not have M16 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 Mini 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 Mini 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 Mini, please refer to the Warning section above.

6.2.7 Charging Reactor-Ready Mini 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

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.

6.2.8 Draining Thermofluid from Reactor-Ready Mini

If the reaction vessel needs to be removed from the Reactor-Ready Mini 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 Mini assembly. If this is not possible, 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 (or using a hose) 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.

6.2.9 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 6.2.10 Connecting the Hose Tidies) 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.

6.2.10 Connecting the Hose Tidies

If the Quick-Release Insulated Hoses and Draindown Manifolds are not being used, skip and go to 6.2.11 Static

Reactor-Ready Mini is supplied with two Hose Tidies which attach to the side 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 side of the framework as the Draindown Manifolds.



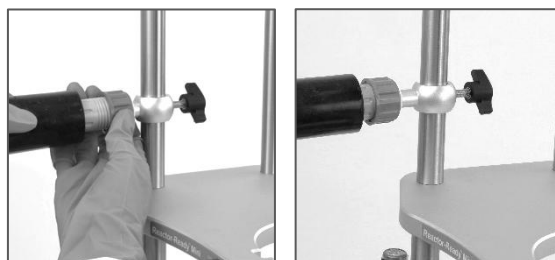
Important information

→ To minimise the risk of thermofluid leakage from the hose whilst using the Hose Tidy, each Hose Tidy should be positioned higher on the framework than 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.

6.2.11 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.

7 Jacketed Glass Reaction Vessels

Radleys supplies a range of reaction vessels specifically for use with Reactor-Ready Mini.

Reaction vessels are available as single or vacuum jacketed, and range in size from 50 to 500 mL.

Important information

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

Construction materials

The wetted components of Reactor-Ready Mini Reaction Vessels are type 3.3 borosilicate glass, PTFE and FEP.

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.

We recommend against the use of valves and flow restriction on heat transfer fluid return lines to avoid the possibility of stopping the flow or increasing the pressure in the vessel jacket.



A reaction 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.

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

Radleys vessels with the zero dead space stopcock (see page 34) are suitable for use from -70 °C to +230 °C.

Important information

→ At temperatures below -60 °C, there may be some weeping from the stopcock. Please see **Minimising weeping at low temperatures** on page 35 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 Mini 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 vacuum jacketed reaction vessel

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.

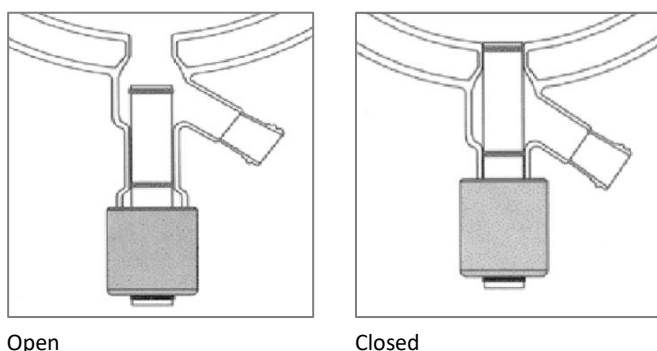
Minimum and maximum fill volumes

Minimum and maximum fill volumes for Reactor-Ready Mini reaction vessels will vary from application to application depending on the stirrer shaft used, the viscosity of the contents, the speed of stirring, contents temperature etc. You can find some guidelines at the end of this document:

- **11 Appendix A: Vessel Fill Volumes**
- **12 Appendix B: Vessel Volumes with pH Probe**

Zero dead space stopcock (ZDS)

All Reactor-Ready Mini vessels feature a zero dead volume stopcock. This stopcock is designed to minimise 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.



- 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 15 mm bore minimises sample hold-up and is ideal for slurries.
- 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 Mini ZDS 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 Reactor Ready Mini ZDS, 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.

8 Piston and O-rings Routine Maintenance

Minimising weeping at low temperatures

Care must be taken with the piston seals, particularly when operating at extremely low temperatures, as below -60 °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 -60 °C) it is recommended that:

- Piston O-ring seals are replaced between **every** run.
- A secondary stopcock, attached to the GL18 outlet, is used to catch any fluid that may weep through the stopcock (RR139170).

Replacing the O-rings

If replacing both the top and middle O-ring

1. Undo bolt using provided Hex Key.
2. Unscrew the end from the housing (Note: this has a left-hand thread) and take the O-ring off, then go to step 3.

If replacing just the top O-rings

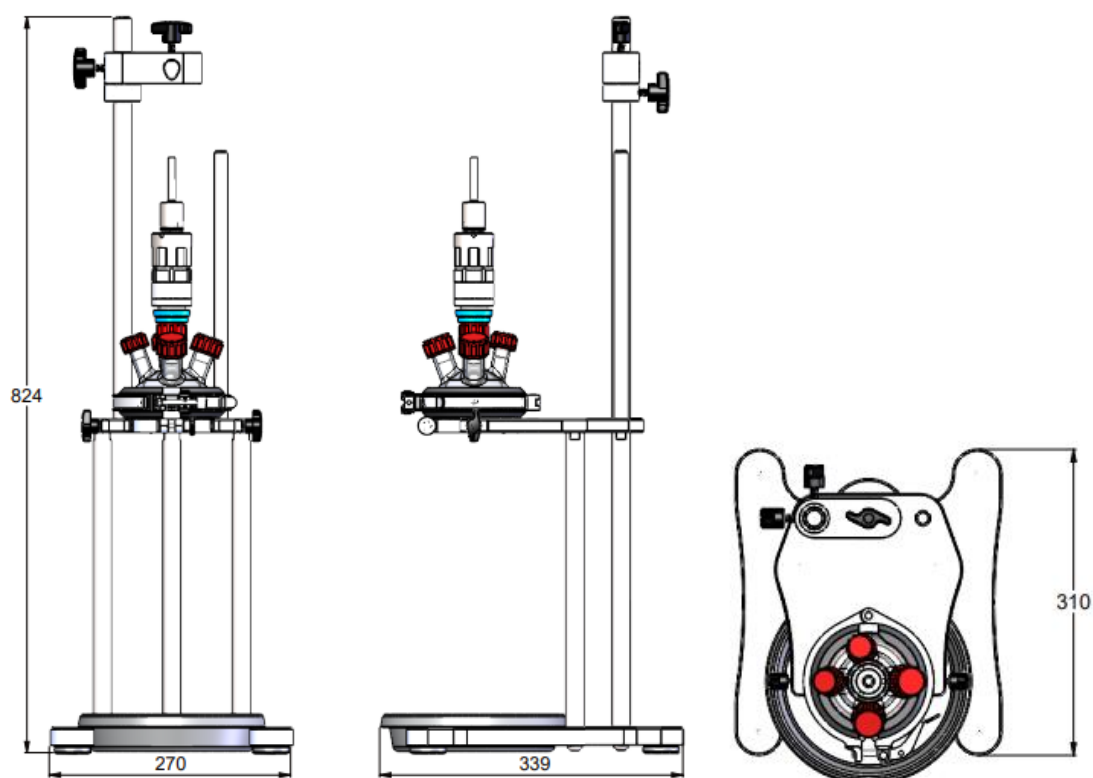
3. Using a scalpel, carefully cut through the top O-ring(s), making sure not to cut or score the PTFE, as this will cause the piston not to seal properly.
4. Once you have made an incision, you can usually pull the O-ring away by hand.
5. Place boiling water into a beaker or cup and drop the new O-ring(s) in; this is to help them stretch.
6. Take the O-ring(s) out carefully (using tweezers or similar). If possible, pre-stretch the O-ring over a taper if available (a PTFE stopcock is ideal for this). Push the O-ring(s) into place. If this is hard to do, place them back into the boiling water and leave for a few minutes, then try again.
7. Once the O-ring(s) have been fitted, wet the piston end and push carefully back into your vessel.

Replacement Pistons and O-Rings

Replacement pistons and O-Rings for Reaction Vessels
Mini Piston 15mm Single & Vacuum Jacketed Vessel RR166060
Replacement 15mm piston top O-Ring RR166100
Replacement 15 mm piston middle O-Ring RR166102

9 General specifications

Front, side, and top view Reactor-Ready Mini dimensions



Specifications	
Weight (framework only)	10 kg (with draindown manifold kit); 8.2 kg without
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	M16

Materials of construction	
Base Plate	Aluminium 6082 HE30, Stainless steel 316 1.4401, ABS (Acrylonitrile Butadiene Styrene)
Support Rods	Stainless steel 316 1.4401
Drip Tray	Talc filled Polypropylene
Vessel Support Plate	Aluminium 6082-HE30, Stainless steel 316 1.4401, Nylon (Polyamide), PET (Polyethylene Terephthalate)
PTFE Vessel Clamp DN60	Aluminium 6082 HE30, Stainless steel 316 1.4401, Carbon-filled PTFE, PET (Polyethylene Terephthalate)
Safety Stop Collar	Aluminium 6082-HE30, Stainless steel 316 1.4401, Nylon (Polyamide)
Vessel Support Collar	Aluminium 6082-HE30, Stainless steel 316 1.4401, Viton
Reactor-Ready Mini 5 Neck Lid DN60 - 3xB19, 2xB14	Borosilicate glass 3.3
DN60 PTFE 5 Neck Lid Assembly - 3xB19, 1xB14, 1x12mm	PTFE, Glass-filled polypropylene
PTFE Support Collar for FEP O-Ring – DN60	PTFE
FEP Encapsulated Silicone Vessel O-Ring – DN60	FEP encapsulated silicone
Stirrer Support Boss	Aluminium 6082-HE30, Stainless steel 316 1.4401, Nylon (Polyamide), IGUS iglidur® G
Stirrer Guide	PTFE, PEEK, Viton, Aluminium 6082 HE30, Stainless steel 440C, Glass bearings, Glass-filled polypropylene
Stirrer Drive Drop-in Coupling	Stainless steel 316 1.4401, Stainless steel 440C
Lower Supply and Upper Return Manifolds	Aluminium 6082 HE30, Stainless steel 316 1.4401, PTFE, Nylon (Polyamide)
Quick-Release Insulated Hoses	PTFE, PEEK, Viton, Stainless steel 316 1.4401
Hose Tidy	Aluminium 6082-HE30, PTFE, Stainless steel 316 1.4401, Nylon (Polyamide)
M16 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
Reaction Vessel Piston	15 % glass-filled PTFE, PTFE, FEP encapsulated silicone, Stainless steel 316 1.4401
Stirrer Shaft	PTFE
Temperature Probe	PTFE

10 General Routine maintenance

- To maintain your Reactor-Ready Mini 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 Mini 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.

11 Appendix A: Vessel Fill Volumes

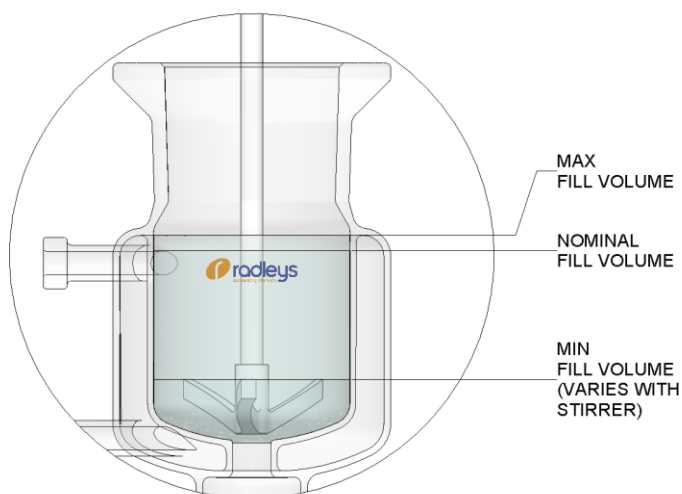
We have created some guidelines to help end-users understand the approximate minimum and maximum fill volumes for the Reactor-Ready Mini reaction vessels. Please see the table below:

Catalogue Number	Description of Vessels	Nominal Volume (ml)	Maximum Fill Volume (ml) ¹	Minimum Fill Volume (ml) ^{2,3}	
				Stirrer Shaft	Volume (ml)
RR130005	50ml Single Jacketed	50	70	Retreat Curve	15
				Turbine	10
				U-Shape	30
RR130006	50ml Vacuum Jacketed	50	75	Retreat Curve	20
				Turbine	15
				U-Shape	35
RR130010	100ml Single Jacketed	100	110	Retreat Curve	20
				Turbine	20
				U-Shape	70
RR130011	100ml Vacuum Jacketed	100	125	Retreat Curve	20
				Turbine	25
				U-Shape	65
RR130025	250ml Single Jacketed	250	270	Retreat Curve	55
				Turbine	30
				U-Shape	175
RR130026	250ml Vacuum Jacketed	250	280	Retreat Curve	55
				Turbine	65
				U-Shape	180
RR130050	500ml Single Jacketed	500	575	Retreat Curve	75
				Turbine	55
				U-Shape	365
RR130051	500ml Vacuum Jacketed	500	575	Retreat Curve	60
				Turbine	70
				U-Shape	365

Important Notes:

These volumes are guidelines only.

1. The Maximum Fill volume is the volume of fluid required to fill the vessel to the top of the vessel jacket, when there is no stirring vortex & contents are at ambient temperature.
2. The Minimum fill volume is defined here as the volume required to cover the stirrer shaft rotor blade when there is no stirring vortex & contents are at ambient temperature. The actual minimum fill volume required will vary from application to application, depending on the final position of the stirrer shaft, any probes being used, the viscosity of the contents, the speed of stirring required, contents temperature etc.



The stirrer shaft rotor blade does not necessarily need to be fully covered for stirring to occur (e.g. U Shape stirrer shafts).

3. The Minimum fill volume is achieved here with the stirrer shaft set as low as possible inside the vessel (while safely gripped by the stirrer guide). This is not necessarily the optimal position for a given stirrer shaft (e.g. turbine).

12 Appendix B: Vessel Volumes with pH Probe

We have created some guidelines to help end-users understand the approximate minimum volume required for the Reactor-Ready Mini reaction vessels when using a pH probe. Please see the table below:

Catalogue Number	Description of Vessels	Nominal Volume (ml)	Minimum Volume with pH probe (ml) ^{1,2,3}
RR130005	50ml Single Jacketed	50	30
RR130006	50ml Vacuum Jacketed	50	35
RR130010	100ml Single Jacketed	100	50
RR130011	100ml Vacuum Jacketed	100	50
RR130025	250ml Single Jacketed	250	100
RR130026	250ml Vacuum Jacketed	250	105
RR130050	500ml Single Jacketed	500	155
RR130051	500ml Vacuum Jacketed	500	155

Important Notes:

These volumes are guidelines only.

1. The Minimum Volume with pH probe is measured with the appropriate Retreat Curve stirrer shaft (set as low as possible inside the vessel), which gives the most clearance possible.
2. The pH probe used in the testing is RR20432 Combination pH Probe 325 mm x 12 mm – which is the probe recommended for use with Reactor-Ready Mini.
3. The Minimum Volume with pH probe is defined here as the volume required to cover the reference junction (diaphragm) of the pH probe, when there is no stirring vortex & contents are at ambient temperature. The actual minimum volume required will vary from application to application, depending on the final position of the stirrer shaft, any other probes being used, the viscosity of the contents, the speed of stirring required, contents temperature etc.

Warranty – Email Back

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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	<input type="checkbox"/>	Lab Equipment Dealer/Manufacturer
Animal/Marine/Vetinary	<input type="checkbox"/>	Medical/Clinical/Diagnostic/Device
Automation/Engineering/Electronics/Instrumentation	<input type="checkbox"/>	Metals/Mining
Chemical/Agrochem	<input type="checkbox"/>	Natural Products/Tobacco
Consumer/Cosmetics/Textile	<input type="checkbox"/>	Petrochem/BioFuels
CRO/CMO/CDMO	<input type="checkbox"/>	Speciality Chemicals/Materials
Defence	<input type="checkbox"/>	Testing Services
Energy	<input type="checkbox"/>	Waste/Water/Recycling/Environmental
Engineering Contracts/Facility Mgmt/ Instrumentation Service	<input type="checkbox"/>	Other _____
Food/Flavourings/Farming/Beverages	<input type="checkbox"/>	

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

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