

Extractor King

Closed Loop Extraction Equipment & Accessories · Langley, BC, Canada

BASIC OPERATION GUIDE

Science King Jacketed Glass Reactors

Set-up, safe operating limits, daily operation, cleaning, maintenance and troubleshooting for Science King jacketed glass reactors with an inner heating/cooling jacket and an outer vacuum jacket.

Covers: Science King 50L Glass Reactor (GR-50L) and 100L Glass Reactor.

Read this whole guide before first use and keep it with the reactor. Where this guide and the reactor's nameplate or the documents supplied with it differ, follow the nameplate and those documents. Questions: 1.888.609.KING (5464) · admin@extractorking.com · extractorking.com

Contents

- | | |
|-------------------------------------|-----------------------------|
| 1. Safety first | 10. Heating and cooling |
| 2. Know your reactor | 11. Reflux and distillation |
| 3. Operating limits | 12. Draining |
| 4. Unpacking and inspection | 13. Shutdown |
| 5. Assembly | 14. Cleaning |
| 6. Leak and vacuum test | 15. Maintenance |
| 7. Connecting the chiller or heater | 16. Troubleshooting |
| 8. Charging the reactor | 17. Storage |
| 9. Stirring | |

1 Safety first

The four rules that prevent most glass reactor accidents

1. **Never pressurise the glass vessel.** It is built for vacuum to atmospheric pressure only.
2. **Never heat a closed system.** Always keep a vent path open through the condenser, a bubbler or the vacuum line.
3. **Never exceed the jacket pressure limit** (section 3). The circulator pump can easily exceed it.
4. **Never use cracked, chipped or star-cracked glass.** Damaged glass can implode under vacuum or break from temperature change.

- **Personal protection:** safety glasses or a face shield, a lab coat or chemical apron, and chemical-resistant gloves. Add insulated gloves for hot or very cold work. Work behind a shield where possible.
- **Flammable solvents (ethanol, isopropanol, hexane, acetone and others):** run in a well-ventilated area with no ignition sources. Ground the frame to prevent static. A standard motor and controller are **not** explosion-proof: if the area may contain flammable vapour, use an explosion-proof or air-driven motor and controls rated for that area, installed to your local code.
- **Electrical:** connect only to a grounded supply of the voltage on the nameplate (standard units are 220 V single phase; 3 phase on request). Keep the motor, speed controller and cords dry. Unplug before moving, cleaning or servicing. After switching off, wait at least 5 minutes before opening a variable-speed controller.
- **Moving parts:** keep hair, loose clothing, sleeves and jewellery away from the stirrer shaft and coupling.
- **Air-sensitive materials:** under vacuum, a leak pulls air in. Materials that react with air can react violently.
- **Never leave a running reactor unattended.** Keep a spill tray under the reactor and know how you will cool the batch in an emergency.

2 Know your reactor

Science King reactors have **three glass walls**:

- **Inner vessel:** holds the batch.

- **Heating/cooling jacket:** the circulating fluid from your chiller or heater flows here and sets the batch temperature.
- **Outer vacuum jacket:** an evacuated insulating layer. It keeps heat in, keeps cold in, and stops frost and condensation forming on the outside of the glass.

The reactor is supplied with a stirring motor and condenser on a stainless steel frame with casters. Typical parts:

Part	What it does
Lid with ports	Centre port for the stirrer shaft; side ports for the condenser, thermometer or probe, addition funnel, solids feed and vacuum/vent.
Stirrer motor, speed controller and shaft	Mixes the batch. The shaft passes through a PTFE seal in the lid that keeps vacuum.
Condenser and receiving flask	Condenses vapour for reflux or collection.
Bottom discharge valve	Drains the vessel. PTFE plug with an O-ring seal.
Jacket inlet and outlet	Connect to the chiller or heater.
Vacuum jacket port	Used to evacuate the outer insulating jacket.

Fittings differ by build. Check the packing list supplied with your reactor.

3 Operating limits

These are safe working limits for borosilicate jacketed glass reactors of this size. **If your reactor's nameplate or supplied documents give a different figure, use the lower one.**

Limit	Value
Pressure inside the vessel	Full vacuum to atmospheric only. Never pressurise.
Heating/cooling jacket pressure	0.03 MPa (0.3 bar, 4.4 psi) maximum. Fit a pressure relief or bypass on the circulator line.
Temperature difference between jacket fluid and batch	50 °C maximum.
Rate of temperature change	About 1 to 2 °C per minute. Ramp; never step.
Working temperature	Within the range on the nameplate. The seals, not the glass, usually set the limit. A typical range with PTFE seals is -60 to +200 °C.
Maximum fill	80% of nominal volume (about 40 L in a 50 L reactor, 80 L in a 100 L reactor).
Stirrer	Start at the lowest speed. Never run at high speed with an empty vessel.

4 Unpacking and inspection

1. Check every item against the packing list. Keep the crate and packing in case anything needs to be returned.
2. Inspect all glass, inside and out, under good light for chips, cracks, scratches and star cracks. **Do not use damaged glass.** If anything is damaged, take photos and contact us right away.
3. Retighten all frame bolts and screws; they loosen in transit.
4. Wash all glass and wetted parts before first use (section 14).

5 Assembly

Two people are needed to handle the vessel and lid of a 50 L or 100 L reactor.

1. Place the frame on a firm, level floor in a ventilated area. Lock the casters.
2. Fit the bottom discharge valve with the PTFE plug **open**, so it cannot press on and crack the glass seat while you tighten it. Tighten it evenly by hand, then **close it**.
3. Seat the vessel in its support ring and tighten the clamp evenly.
4. Make sure the lid gasket or O-ring sits fully in its groove. Lightly grease ground-glass joints with vacuum grease if your reactor uses greased joints.
5. Lower the stirrer shaft and impeller into the vessel, pass the shaft up through the centre port of the lid, and fit the PTFE shaft seal.
6. Place the lid and tighten the lid clamp evenly, working around it in a cross pattern. **Do not over-tighten glass.** Snug and even is enough.
7. Mount the motor and couple the shaft. Turn the shaft by hand: it must turn freely, run true (no wobble) and not touch the glass, the temperature probe or anything else. Keep the impeller at least 30 mm above the vessel bottom.
8. Fit the condenser, receiving flask, thermometer or probe, and addition funnel. Close unused ports with glass stoppers, not soft caps, for vacuum work.
9. Turn the speed control fully down before switching the controller on.

6 Leak and vacuum test

Do this before the first run and after any reassembly, with the vessel empty and at room temperature.

1. Close the bottom valve and all ports.
2. Pull vacuum through the vacuum port, then close the valve between the reactor and the pump.
3. Watch the gauge for 5 to 10 minutes. A rising reading means a leak.
4. If it will not hold, check in this order: lid gasket and clamp, shaft seal, stoppers on unused ports, bottom valve, hose connections. To check the pump itself, connect the gauge straight to the pump.

Test with vacuum only. Never test a glass vessel with positive pressure.

7 Connecting the chiller or heater

1. Use hoses and fittings rated for the full temperature range you will run. Insulate them for cold work.
2. Connect the circulator **supply to the lower jacket port and the return to the upper port**, so the jacket fills completely and air escapes from the top. If your jacket ports are labelled differently, follow the labels.
3. Support the hoses so their weight does not hang on the glass jacket nozzles.
4. Protect the jacket from over-pressure. Set the circulator pump to a low pressure or flow setting, and fit a bypass or relief valve on the supply line. **Never close a valve on the jacket return while the pump is running.** Never isolate a full jacket and then let it warm up, because the fluid expands.
5. Choose a fluid for your temperature range: water or a water/glycol mix for moderate temperatures, a low-temperature heat transfer fluid for deep cold, a silicone heat transfer fluid for high temperatures. **Do not use steam** in a glass jacket.
6. Start circulation at room temperature and check every joint for leaks before you change temperature.

Outer vacuum jacket. The insulating outer jacket works only while it holds vacuum. If frost or condensation starts forming on the outside glass during cold work, the vacuum in that jacket has been lost. Call us for the procedure to re-evacuate it for your model.

8 Charging the reactor

1. Confirm the bottom valve is closed.
2. Bring the jacket to near the temperature of what you are adding. Pre-cool or pre-heat liquids so a large temperature difference never hits the glass.
3. Add liquids through the addition funnel and solids through the solids port. Powder pours create static, so keep the reactor grounded.
4. Do not fill above 80% of the nominal volume. Leave room for expansion, foaming and the stirring vortex.

9 Stirring

- Start from zero or the lowest setting and raise the speed slowly (start around 50 to 100 rpm), watching for wobble, knocking or a deep vortex.
- If the frame or glass vibrates at one speed, move to a different speed.
- Thick batches need lower speeds. If the motor labours or slows, reduce speed or load.
- Check the shaft seal for vapour or liquid leaks while running.

10 Heating and cooling

1. Start stirring and circulation first.
2. Change the circulator set-point gradually, about 1 to 2 °C per minute, and keep the jacket within 50 °C of the batch. Use the circulator's ramp or temperature-difference limit if it has one.
3. Watch both the jacket temperature and the batch temperature. Log them on important runs.

4. Watch for reactions that give off heat. Know in advance how you will cool or stop the batch.
5. If the bottom valve freezes during cold work, let it thaw before opening it. Never force it.

11 Reflux and distillation

- Start coolant through the condenser before you heat.
- Keep the system open to a vent, a bubbler, or the vacuum line through a cold trap. It must never be sealed while heating.
- For vacuum distillation, pull vacuum first, then heat. When finished, cool first, then let air or inert gas back in slowly before opening anything.

12 Draining

1. Slow or stop the stirrer.
2. Return the vessel to atmospheric pressure so the outflow does not pull air back up through the valve.
3. Place a container rated for the product and its temperature under the valve, then open the bottom valve slowly.
4. After draining slurries or solids, clean the valve plug and seat.

13 Shutdown

1. Bring the jacket back toward room temperature, staying inside the 50 °C difference and the ramp rate.
2. Turn the stirrer down to zero, then switch it off.
3. Isolate the vacuum pump and let air or inert gas back in slowly.
4. Drain the product.
5. Stop the circulator. If you disconnect it, drain the jacket. If it stays connected, make sure the jacket is not shut in.
6. Switch off and unplug. Wait at least 5 minutes before opening the speed controller.
7. Clean the reactor straight away.

14 Cleaning

1. Rinse with a solvent that dissolves the residue (ethanol or acetone for most extracts).
 2. Wash with warm water and a lab detergent, using a soft, non-metal brush.
 3. Rinse several times with clean water. Finish with an ethanol or acetone rinse if you need the vessel to dry quickly.
- **Never** use abrasive pads or cleaners, metal brushes, hydrofluoric acid or strong hot alkali on the glass. Remove rings and watches when cleaning glass.
 - Make sure cleaning chemicals are safe for borosilicate glass, PTFE and your O-rings. Some O-ring materials are attacked by solvents such as dichloromethane and THF.
 - Flush the heating/cooling jacket about once a year to remove sludge from the circulating fluid.

15 Maintenance

When	What to do
Before every run	Inspect the glass for cracks, chips, scratches and star cracks. Check the hoses and clamps.
Weekly in regular use	Check the shaft seal for leaks, the O-rings and gaskets, stirrer alignment, and frame and clamp tightness.
When vacuum gets worse or vapour escapes	Replace the PTFE shaft seal.
When hard, flattened or cracked	Replace the O-rings and gaskets. High and low temperatures shorten their life.
About every 12 months	Replace the lid gasket set. Flush the jacket. Have a noisy motor checked.

Keep a spare lid gasket set, shaft seal, bottom-valve O-rings and vacuum grease on hand. Parts are available at extractorking.com, or call us.

16 Troubleshooting

Problem	Likely cause	What to do
Vacuum won't hold or is slow	Worn gasket or O-ring, loose lid clamp, soft caps on ports, valve open, worn shaft seal, wet system, weak pump	Re-seat or replace gaskets, re-tighten evenly, use glass stoppers, close valves, replace the shaft seal, dry the system, test the pump on its own
Bottom valve leaks	Worn or wrong O-ring, damaged plug, solids on the seat	Clean the plug and seat; replace the O-ring or plug
Jacket fluid leaks at a nozzle	Loose coupling, heavy hoses, too much pressure	Re-tighten, support the hoses, lower the circulator pressure, add a bypass
Motor stalls or slows	Batch too thick, impeller fouled or touching, shaft misaligned	Lower the speed or load, clear the impeller, re-align and check clearances
Vibration or noise	Shaft not running true, loose coupling, resonance, worn bearing	Turn by hand and re-align, tighten the coupling, change speed, replace the bearing
Frost or condensation on the outside glass	The outer vacuum jacket has lost its vacuum	Call us to re-evacuate the outer jacket
Slow heating or cooling	Low flow, air in the jacket, circulator too small, sludge in the jacket	Check the hoses for kinks, purge air, flush the jacket, check the circulator size

17 Storage

- Store the reactor clean and dry, with the jacket drained.
- Leave PTFE valves slightly open so the plugs do not stick in their seats.

- Cover the glass against dust, lock the casters and unplug the unit.

Need help? Live chat at extractorking.com, call 1.888.609.KING (5464) or email admin@extractorking.com. Have your model and serial number ready. You can save your serial number in My account → My machines.

This guide gives general operating practice for jacketed glass reactors and does not replace your own risk assessment, your local electrical and fire codes, or the safety data sheets for the materials you process. Extractor King Industries Inc. · Langley, BC, Canada · Guide version 1.0, October 2026.