Adding a Liquid Trap to Your Vacuum Lumber Drying System

How to keep water out of your vacuum pump with a catch tank, drain and condenser - a DIY build guide

Why you need a trap

When you dry wood under vacuum, the water in the wood boils off at a low temperature. Some of it leaves as liquid (sap and free water that drips or gets sucked out of the stack), and most leaves as water vapor. Both head straight for your pump. Liquid in a pump is bad news: piston and rotary-vane pumps can be damaged by a slug of water, oil-sealed pumps turn their oil into milky sludge, and water left inside a cylinder rusts it overnight.

The fix is to put a **knockout trap** (a sealed, vacuum-rated catch tank) in the hose line **between the chamber and the pump**. Air and vapor slow down inside the tank, the liquid falls to the bottom, and drier air continues on to the pump. Add a drain valve, a way to see the water level, and (best of all) a simple condenser in front of the trap, and your pump stays dry.

> **How much water are we talking about?** A lot more than most people expect. Drying green oak to furniture dryness removes roughly **1 liter of water per board foot** (about 1 quart). A 100 board foot load can give up around 25 gallons (100 L) over the full drying run. Not all of it will land in your trap, but plan your tank size and drain schedule with numbers like these in mind.

The complete layout

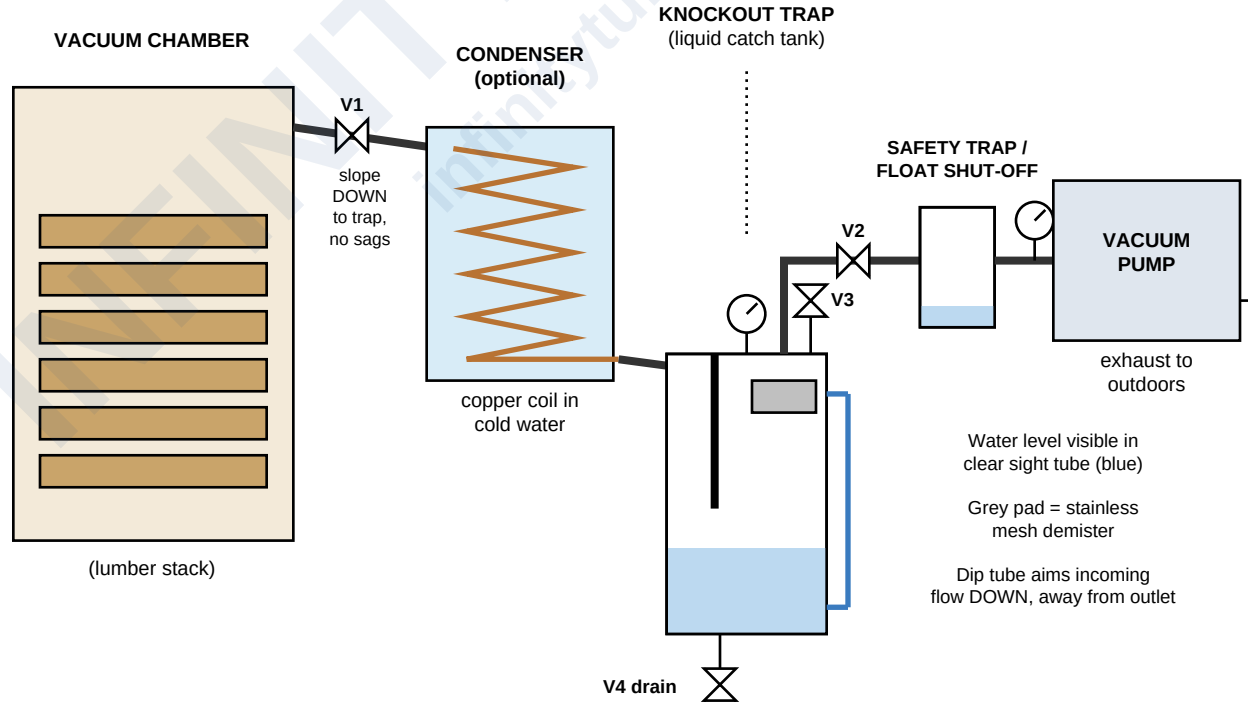


Figure 1. Recommended order of parts, from chamber to pump. V1-V4 are ball valves.

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What each part does

Part	Job	DIY notes
V1 isolation valve	Lets you shut off the chamber from the trap	Full-port ball valve, same size as your hose
Condenser (optional but strongly recommended)	Cools the vapor so it turns back into liquid before the pump	10-20 ft of 3/8" or 1/2" copper tubing coiled in a bucket of cold water; coil must run downhill to the trap
Knockout trap	Slows the flow so liquid drops out and collects	PVC pipe trap or steel tank - see build below
Dip tube	Points incoming flow downward, away from the outlet	Inlet pipe extends to about half the tank height
Demister pad	Catches fine droplets before they leave	Stainless steel pot scrubber pushed under the outlet port
Sight tube	Shows the water level without opening anything	Clear reinforced vinyl tube connected top and bottom
Vacuum gauge(s)	Tells you if the trap or hose is blocked or leaking	One on the trap, one at the pump inlet
V3 vent valve	Lets air into the trap so it can drain	Small 1/4" ball valve on the top cap
V4 drain valve	Empties the trap	1/2" to 3/4" ball valve at the lowest point
Safety trap / float shut-off	Last line of defense if the main trap overfills	Small second trap, or a float ball valve that seals the line when water rises
V2 isolation valve	Lets you shut off the pump side while draining	Full-port ball valve

Build: a simple PVC knockout trap

For small and medium DIY chambers, a trap made from Schedule 40 PVC pipe is cheap, easy to build and strong enough for full vacuum. A 6" pipe trap is a good starting size.

Trap size	Pipe length	Approx. capacity	Good for
4" Sch 40	18 in (45 cm)	1 gal (3.8 L)	Vacuum bags, very small chambers
6" Sch 40	24 in (60 cm)	3 gal (11 L)	Small lumber chambers, frequent draining
8" Sch 40	30 in (75 cm)	6.5 gal (25 L)	Larger loads, or less frequent draining
Steel tank (old air-compressor tank, cleaned)	-	10-30 gal	Big chambers

Materials

- One length of **solid-wall Schedule 40 PVC pressure pipe** (never foam-core / cellular-core DWV pipe - it can collapse).
- Two Schedule 40 end caps to match (pressure-rated, not thin drain caps).
- PVC primer and heavy-body cement.
- Threaded fittings: two hose-barb or NPT adapters for inlet and outlet (match your hose size), one 1/4" NPT for the vent and gauge, one 1/2" or 3/4" NPT for the drain.

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- A short piece of smaller PVC or copper pipe for the dip tube.
- Stainless steel pot scrubber (demister).
- Clear reinforced (braided) vinyl tubing and two small barbs for the sight tube.
- Ball valves (V1-V4), vacuum gauge, thread sealant (PTFE paste works better than tape for vacuum).
- Wire-reinforced vacuum-rated hose. Plain garden hose or thin vinyl tubing will flatten under vacuum.

Step by step

1. **Cut and clean.** Cut the pipe square and deburr it. Dry-fit both caps.
2. **Drill and tap the top cap** for three ports: inlet, outlet, and a 1/4" port for the vent valve and gauge (use a 1/4" tee to share one port). Space inlet and outlet as far apart as possible. Alternatively, solvent-weld threaded PVC adapters through the cap for stronger threads.
3. **Fit the dip tube** to the underside of the inlet port so it reaches about half way down the pipe. This sends the incoming air and water downward so liquid can't skip straight across to the outlet.
4. **Drill and tap the bottom cap** for the drain fitting, in the center.
5. **Add sight-tube ports** on the side of the pipe: one barb about 1" above the bottom cap, one about 3" below the top. Connect them with the clear tubing. Mark a **MAX** line on it well below the dip tube end.
6. **Cement the bottom cap** on. Push the stainless pot scrubber up under where the outlet will be, then **cement the top cap**. Let the cement cure 24 hours before pulling a vacuum.
7. **Install the valves and gauge** with PTFE paste. Mount the trap **upright**, lower than the chamber outlet and condenser, so everything drains downhill into it.
8. **Plumb the hose** chamber - V1 - condenser - trap inlet; trap outlet - V2 - safety trap - pump. Run every hose so it slopes toward the trap with no low sags (sags fill with water and send slugs to the trap).

Build: the condenser (biggest pump-saver)

Water vapor passes straight through a trap. To catch it, cool it first. The easy DIY way:

- Coil 10-20 ft (3-6 m) of 3/8" or 1/2" soft copper refrigeration tubing around a bucket or paint can, then slide it off.
- Set the coil in a bucket of cold water, inlet at the top, outlet at the bottom, so condensed water runs downhill out of the coil.
- Connect the bottom outlet to the trap inlet. Add ice or a slow trickle of tap water to keep it cold.
- The colder the coil, the more water you catch. Under deep vacuum water boils at room temperature, so anything warmer than about 70-80 °F (20-25 °C) will let a lot of vapor through.

Key rule: keep the trap and condenser COOL. Water sitting in a warm trap under vacuum will boil and get pulled into the pump as vapor anyway. Keep the trap out of the sun and away from the kiln heat, and drain it regularly so there's little water left in it to re-boil.

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How to drain the trap

You can't just open the drain valve while the system is under vacuum - air will rush in and nothing will come out. There are two practical ways to do it.

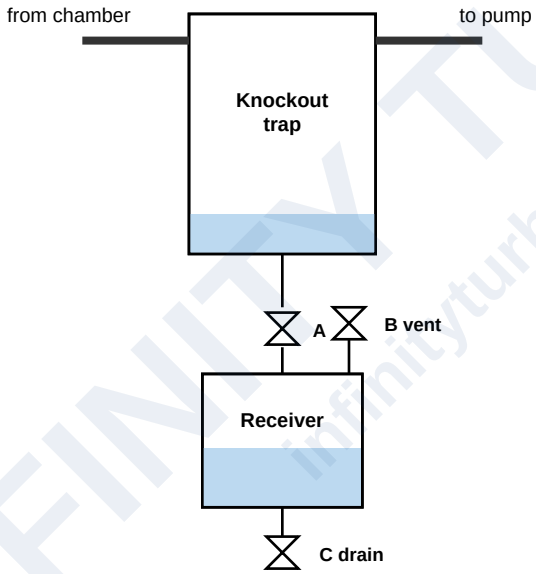
Option 1: Batch drain (simplest)

1. Close **V1** (chamber stays under vacuum) and **V2** (pump side). Switch the pump off or let it idle on its own valve.
2. Open **V3** to let air into the trap. Wait for the gauge to read zero.
3. Open **V4** and drain into a bucket. Close V4 and V3.
4. Open V2, let the pump pull the trap down to match the chamber, then slowly open V1.

Best when the trap is big enough to go several hours between drains.

Option 2: Two-valve airlock drain (drain while running)

Add a small receiver tank under the trap with a valve between them. You drain only the receiver, so the trap, chamber and pump keep running under vacuum the whole time.



Normal running: A open, B and C closed.

1. Close A (trap and chamber stay under vacuum).
2. Open B to let air into the receiver only.
3. Open C and drain the water into a bucket.
4. Close C, then close B.
5. Open A slowly. The gauge dips briefly while the pump re-evacuates the receiver.

Tip: make the receiver small (1/4 to 1/2 of the trap volume) so re-evacuation is quick.

Figure 2. Airlock drain. Build the receiver from a short piece of the same PVC pipe.

Other options you may see

- **Barometric drain leg:** a pipe running down into a bucket of water lets water drain out on its own, but it must be about 34 ft (10.3 m) tall for full vacuum. Only practical if you have a multi-storey drop.
- **Liquid pump-out:** a small peristaltic or diaphragm pump that can pull from vacuum can empty the trap automatically, controlled by a float switch. More cost and complexity, but hands-off.

Protecting the pump: the safety trap

If you forget to drain, the main trap fills and water goes over the top. A second line of defense is cheap:

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- **Second small trap:** a 2" or 3" PVC version of the main trap right before the pump. If you ever see water in it, drain the main trap more often.
- **Float shut-off:** a float ball valve (as used on maple-sap vacuum lines and in wet/dry vacuums) in the top of the trap. When water rises, the ball floats up and seals the outlet. The pump gauge will jump to full vacuum - your signal to drain.
- **Compressed-air water separator** with a clear bowl and **manual** drain also works as a small final catch (automatic drains don't work under vacuum).

Testing and running

1. **Leak test the trap alone:** close V1, run the pump to full vacuum, close V2, and switch off. The trap gauge should hold steady for 15+ minutes. A slow drop means a leaky thread or fitting - reseal with PTFE paste.
2. **Find leaks** by listening for a hiss, or by brushing a little water or alcohol on a joint while watching the gauge - the needle twitches when you cover the leak.
3. **During drying,** check the sight tube every hour or two at first until you learn how fast it fills.
4. **Compare gauges.** If the pump gauge reads much higher vacuum than the trap gauge, something between them is blocked (often a water slug or a closed float valve).
5. **After each run,** drain the trap and run the pump for a few minutes with its inlet open to clean, dry air to push out any moisture inside it. On piston pumps, this keeps cylinders from rusting.

Safety

- **Implosion hazard:** never use glass jugs, carboys, thin plastic buckets, water jugs or paint pails as a trap. Use Schedule 40 (or heavier) PVC, a steel pressure tank, or a purpose-made vacuum vessel.
- **Don't use old propane or fuel tanks** unless professionally cleaned and certified - residual gas is a fire/explosion risk.
- **Heat:** PVC softens above about 140 °F (60 °C). Keep the trap away from kiln heaters and hot surfaces.
- **Wood water is acidic** and full of tannins, especially from oak. It stains concrete and corrodes plain steel. Use PVC, stainless or brass where it touches water, and dispose of it responsibly.
- Vent pump exhaust outdoors and keep electrical parts away from the drain area.

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Troubleshooting

Symptom	Likely cause	Fix
Water still reaching the pump	Trap too small or too full; no demister; flow too fast	Drain more often, go up a pipe size, add a pot-scrubber demister, lengthen the dip tube
Pump oil milky / cylinders rusty	Water vapor passing through	Add or improve the condenser; use colder water or ice; dry the pump after each run
Trap gauge drops slowly when isolated	Leaky threads or cement joint	Reseal threads with PTFE paste; check for cracks around tapped ports
Sudden vacuum jump at pump, chamber vacuum falls	Float valve closed or water slug in hose	Drain trap; remove hose sags; re-slope hoses toward trap
Water boiling in sight tube	Trap too warm	Move trap to a cooler spot; drain more often; add condenser
Hose flattening	Hose not vacuum-rated	Replace with wire-reinforced vacuum/suction hose

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