COUNTERFLOW WORT CHILLER

Counterflow Wort Chiller

Story and photos by **Reg Pope**

Homebrewers all want to cool wort quickly after the boil. Wort needs to be cooled to a temperature at which the yeast can be safely pitched. Quick cooling also helps with cold break formation and - when some very light base malts are used — helps minimize the production of dimethyl sulfide (DMS). In addition, moving the wort quickly through the 160–120 °F (71–49 °C) range ensures that contaminating organisms have a smaller chance to gain a foothold at these temperatures that are favorable to their growth.

A clean and simple method is to use an immersion chiller. These devices are popular with homebrewers, but their capacity is a bit limited. The key consideration is volume.

Using the algebraic formula (πr2h) for the volume of a cylinder — which is what a tube is, a long thin cylinder — a ⅜-inch (95 mm) x 25 foot (7.6 m) immersion coil has 32 cubic inches (537 cubic centimeters) of volume, equivalent to a little over a pint of liquid. That's the amount of wort the chiller displaces and the volume of cooling medium available to do work (move heat out of the wort) during chilling. So, the wort next to this "pint of coldness" is what's being chilled.

You can stir the wort, to get it flowing past the coils, but this takes hands-on effort during wort cooling. Also, opening the brew kettle to stir it with the chiller can allow airborne microorganisms to settle in your wort when it is in a temperature range favorable to their growth. And, if you are worried about aerating your wort while it's hot, you may shy away from swirling your immersion chiller.

What if you could take the volume of wort in contact with the chiller and turn it over at a constant rate? And what if you could take the water and replace it with fresh, cool water at a constant rate as well? This is the theory behind the counterflow chiller. The word "counterflow"

describes the flow pattern of the water and wort relative to each other. The wort entry point is at the water exit and the water entry point is at the wort exit, so the two liquids move past each other in opposite directions. The warmest wort encounters the warmest water at the beginning of its residence in the chiller, and meets the coldest water at its lowest temperature as it exits. The hot wort encounters progressively cooler conditions and it travels through the chiller and continually transfers heat to the cooling water. The cooling water is common tap water and the water and wort never come in direct contact with each other. The wort touches only copper and remains enclosed inside a tube so there is no risk of the aeration or contamination.

Parts and Tools

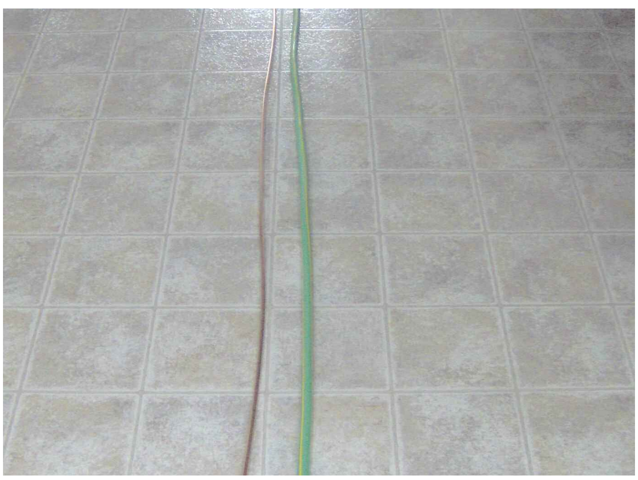
- (2) ½-inch copper tee
- (2) ½-inch threaded x ⅜-inch compression fitting (6 inches or 15 cm)
- ½-inch rigid copper tubing
- (25 feet) ⅜-inch OD copper tubing
- (25 feet) ⅝-inch garden hose
- (4) ½-inch hose clamps
- Tubing cutter
- JB Weld
- Utility knife
- Screwdriver
- Drill and ⅜-inch drill bit

1: CONSTRUCTING THE COPPER TEES

The chiller is a basic "tube within a tube" design. The key to its function is the fitting that allows connection of the input and output hoses and tubes, and connects and seals all of the components of the wort reservoir and cooling jacket. Construction begins with the copper tees, the threaded/compression fittings and a small length of ½-inch (1.3-cm) rigid copper tubing to connect them.

When I purchased my supplies, the rigid tubing was available in a minimum length of 24 inches (61 cm), however only three inches is needed, two lengths of 1½-inch (3.8 cm). These were cut to length using the tubing cutter.

Dry fit the pieces in case any burrs or rough cuts prevent them from going together easily, and file them if necessary. Mix the JB Weld according to the manufacturer's directions. Assemble the fitting, using a generous amount of JB Weld to secure the parts. Once assembled, allow these fittings to dry and set overnight at a minimum.



2: THE TUBE WITHIN THE TUBE

The next step is to insert the copper tubing into the garden hose. Cut off the ends of the hose, taking the last six or eight inches of the hose and the fittings, and save them.

Lay out the hose in as straight a line as possible. Uncoil the ⅜-inch tubing and straighten it as much as possible as well. These items want to hold a curl and it will be impossible to get them completely straight. However, the straighter you can make them, the easier the next step will be (see photo at left).

3: INSERT THE TUBING

You will probably need some kind of lubricant to insert the copper tube into the hose, and dishwashing detergent works well. Squirt an ounce or so of dishwashing liquid into one end of the garden hose. (If the soap is really thick, add a little water as well.) Insert the end of the ⅜-inch copper tubing into the lubricated end of the garden hose and continue feeding it in until it extends out either end of the hose a few inches.

4: COILING YOUR CHILLER

The next step is to shape the cooler. I recommend taking the time to do it neatly. Commercial chillers are arranged in a nice, neat, stacked coil for a reason. First of all, it looks nicer. Second, it ensures a trouble free gravity drain. A sloppy coil will result in some parts of the tube being higher than others as the fluid travels around the loop. This will cause fluid to be trapped in the coil when the resistance of its weight exceeds the weight of the fluid behind it. In other words, it will stop draining before it's empty. It may be a small amount of fluid, but it is still a waste. In addition, there is the potential for contamination associated with poor drainage of wort and water when cleaning the unit.

An empty Cornelius keg is the perfect size to use as the form. Place it near one end of the hose and begin wrapping it around the keg in a spooling fashion. The curve of the keg is not so severe that it will readily cause kinking of the copper tubing, and the hose will act as a sort of protective sleeve during this step, but proceed with care just in case. Hold on to the end of the copper tube to keep it from sliding into the hose and out of reach. When finished, simply slide the keg out of the middle of the coil. There will inevitably be some movement of the tubing inside the hose during coiling, trim the hose and/or tubing so that there is 5 or 6 inches (13 or 15 cm) of tubing protruding from each end of the hose.

5: REAMING THE FITTING

The end fitting fabricated earlier is made up partially from a fitting that is designed to rest at the end of a length of ⅜-inch copper tubing and has a small lip of material that facilitates that by providing a "butting" surface. We need this fitting to "float" over our tubing, so that lip must be removed. This is accomplished by simply reaming out the fitting with a drill and ⅜-inch bit.

6: AFFIXING THE FITTINGS

Once this is done, the fittings can slide into place over the ends of the copper tubing and into the ends of the hose. Remove the end nut and the sealing bushing from the compression fitting — and don't forget to place the hose clamps on the hose before attaching the fitting.

A bit of liquid soap and some elbow grease will be required to get the end of the fitting (tee side) into the end of the hose. Once this is done, position and tighten the clamp (see photo).

Attach the reserved hose ends in the same manner and apply clamps to complete the assembly. Up until now there was no top or bottom to the unit. Be mindful of your flow pattern now as you attach the hose ends. The wort will flow via gravity from the top copper tubing access to the bottom one. The water must flow in the opposite direction. Thus the female hose fitting must be at the bottom and the male fitting at the top.

The assembly is now complete. The coil will hold its shape on its own but Zip ties can be used for this as well. BYO