Chill Out

Water Chillers Explained

by Stephen Keen with Pat King

What is a chiller and why would I want one?

Let's start with chiller basics - what is a water chiller and why would a person want one?

A water chiller does just what its name implies - it cools water. Chillers are used in indoor gardening for a wide range of applications including nutrient cooling and water-cooled equipment such as CO_2 generators, dehumidifiers, air conditioning and even lighting. Basically anything that creates heat can be cooled by water one way or another.

Given the efficiency of a chiller versus the efficiency of other common cooling methods, and the added control over garden temperatures (and therefore happier plants) that water-cooling affords, using water to cool makes more financial sense in the long run. It does, however, cost a little more up front and it is a little more difficult to set up than traditional cooling methods. I compare it to installing radiant barrier on attic roofs or buying Energy Star appliances for your home - in most cases, well worth the investment.

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How does a chiller work?

The cooling function of a chiller is very similar to that of an air conditioner. The energy savings comes in the form of the superior efficiency of the heat exchange of water versus air. Most chillers use electricity to power a thermostat-controlled compressor that forces refrigerant inside through a cycle. The refrigerant starts as a hot compressed gas being pumped to the condenser from the compressor.

In the condenser the compressed gas begins to condense to liquid as the heat is removed by a fan. Most of the heat being absorbed by the refrigerant is removed at this point and blown out of the chillers. The cooled liquid leaves the condenser and enters either an expansion valve or capillaries to control the amount of refrigerant entering the evaporator. As the refrigerant enters the evaporator it starts to absorb heat and boils off, becoming a vapor. Water is pumped through or across the evaporator and the heat is absorbed from the water by the refrigerant. The refrigerant is again sucked in to the compressor, compressed into a hot gas and sent to the condenser to start the cycle over. Some chillers also come with an option to run the cycle backwards. This results in the water being warmed instead of chilled and cool air instead of warm blowing out the back of the chiller.

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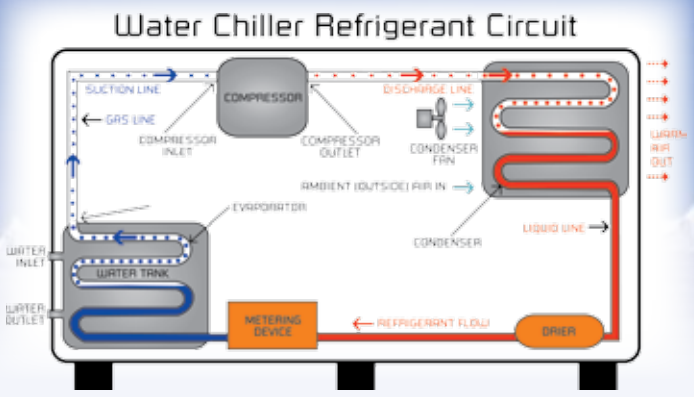

Why is a chiller more efficient than an air conditioner?

The primary reason for the superior efficiency of a chiller over an air conditioner despite their use of the same internal components is that the thermal conductivity of water is 23 times greater than that of air. What that means is a chiller will exchange the heat in a given space much more quickly than an air conditioner, allowing it to run less to get the same results. This is where you save electricity.

With an air conditioner, air is passed over the evaporator instead of water. Since the air is less conductive, the evaporator can't draw out as much heat as it can with water. The chiller evaporator is significantly smaller than an air evaporator because of the increased thermal load of water. In nearly all cases the evaporator in a chiller will be significantly more efficient than that of an air conditioner, again allowing it to run less to get the same amount of cooling.

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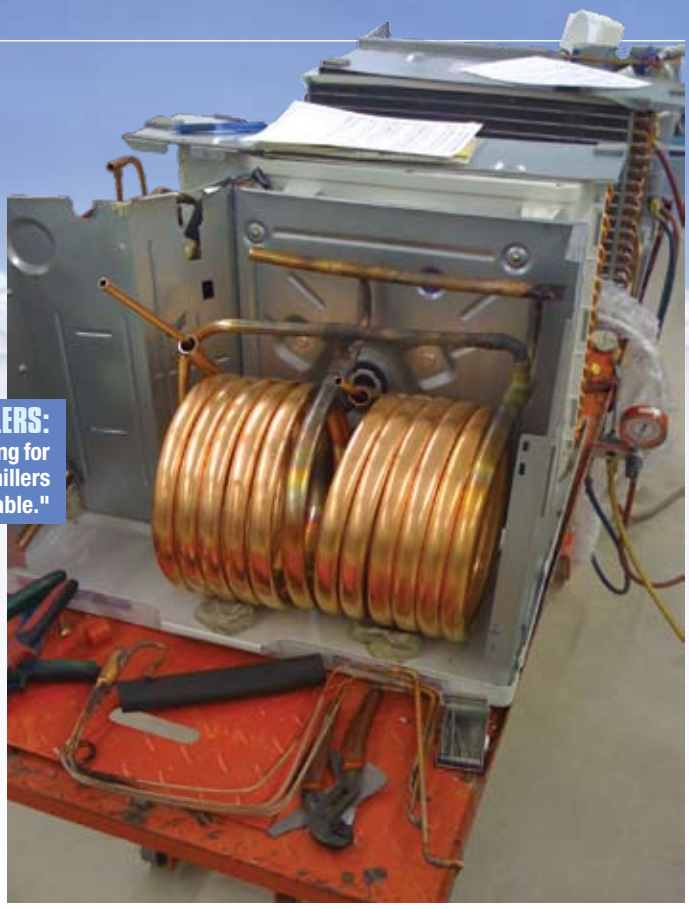
Outdoor chillers used in conjunction with indoor water-cooled air handlers can supply traditional style air conditioning - the difference is that there is water passed between them instead of refrigerant. This type of set-up can be installed by anyone as no refrigeration license would need to be installed. Water lines can run hundreds of feet to a water-cooled evaporator. A/C ducting cannot run for significant lengths as the airflow decreases dramatically with distance. Water is currently used in most large public buildings for heating and cooling, both due to its superior efficiency and because it affords the ability to use one cooling unit for a very large area, whereas several air conditioning units would be required due to the distance constraints involved with ducting.

Types of chillers:

All chillers are not the same! Just like air conditioners, there are several different chiller designs and types available and your

needs should be carefully considered before a purchase is made. If your application calls for a heavy duty chiller, you will not get the results you need from a chiller intended only for nutrient cooling. Further, actual cooling output varies from brand to brand even on chillers with the same size compressor, so do your research before you buy. In our market, there are a lot to choose from, but we've broken them down into three main categories:



AQUARIUM/RESERVOIR CHILLERS:
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Aquarium/Reservoir chillers:

These chillers are very affordable, extremely common and are made to hold a body of water at a specific temperature against the ambient temperatures only. They are not made to carry a load. These chillers are only to be used for light duty cooling and can only be used indoors, so they are designed to run quietly as well. They cannot handle a direct or significant heat load. I compare them to refrigerators, as long as the door is closed and there is no heat being introduced, the refrigerator does exactly what you require of it, but you can't put a constant heat source inside and expect it to stay cold. This goes for the aquarium/reservoir chillers as well. Mostly this is a result of smaller condensers and fans, necessary to suppress noise and maintain a small cabinet size. When used

under the light loading for which they're intended, these chillers are affordable and readily available with several different brands to choose from.

Equipment chillers:

These are usually more expensive than the variety mentioned above but are more rugged and are made to directly counteract a heat source. These chillers can handle constant loads and most can be placed outside if desired. These chillers are usually more energy efficient and will last longer under harsh conditions.

Some of these are better than others, and they can range from 80 to 100 per cent load capacity. This means that with a 12,000 BTU compressor for example, some will give you 12,000 BTU of cooling and some will only get you 9600 BTU. The higher output chillers are usually a bit more expensive, but since they are more energy efficient, they will run less often, cost less to operate and last longer than the chillers with lower output, as you get more cooling out of the same power consumption.

Commercial chillers:

These chillers are the most expensive available, but are also the highest quality and longest lasting chillers you can buy. Some units come with built-in pumps and reservoirs so you simply attach your plumbing to the water outlets, add water, turn them on and set your water temperature. The commercial size chillers can only be placed outdoors (they are too large and remove too much heat to be placed indoors) and most can be roof-mounted if needed.

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How to properly size a chiller:

Properly sizing your chiller is vital! Heating and cooling are both measured in BTU and if the BTU loading is higher than the BTU output of the chiller, the chiller will run constantly and will never or rarely get your body of water to your desired temperature. You will need to closely estimate how much heat is being produced by the equipment that you're trying to cool to know how much cooling you need. You must also consider ambient temperatures, how well the room is insulated, if there is any venting to the outside and the cubic footage of the area that you're cooling.

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In general, 1000 watt bulbs produce 3500 BTU and 1000 watt digital ballasts produce 2500 BTU of heat. (Every light and ballast is different so these are generalizations). So if you were looking to cool a room with 4000 watts and with the ballasts in the garden, you would need a chiller with at least 24,000 BTU to counteract the heat generated by the lights and ballasts alone. You'd need to add BTUs to the chiller if you wanted to add water-cooled air conditioning or if you wanted to use any other water-cooled equipment such as CO_2 generators. If I can offer one piece of advice that you'll thank me for later, it would be to always size your chiller 20 per cent larger than

you think you need. A properly sized larger chiller will use less power than a smaller chiller because it runs less often and requires less effort from the compressor. A larger chiller will last longer and offers you the ability to expand your set-up later. I've found that many people add lights to their garden after they switch to water-cooling because they have freed up some electricity and have more control over their garden temperatures.

Where should I put it?

For a chiller to operate at maximum efficiency, it must have a constant supply of fresh air. It is a mechanical heat exchanger and cannot exchange heat efficiently if it is in a closed room or in a hot attic. To take maximum advantage of its energy efficiency, the chiller should be placed outdoors if possible, even if it is hot outdoors. If you leave it in the house, even in a different room, your home air conditioner is cooling the heat from the back of the chiller, which is really just the heat from your garden, so it isn't providing nearly as much energy-savings as it does if you put it outside.

In short, water cooling has been used for decades, mainly in commercial and industrial applications. It's already been proven in these other applications that water chillers can be extremely energy friendly additions to the indoor garden! The energy savings that can be afforded by using water to cool your equipment and environment often allows gardeners to add more lights to their space because they have more control over their temperatures and smaller electric bills. This results in larger yields with little or no increase in power consumption, and happier plants in a more consistent environment. When the correct chiller, for the correct application, properly sized, is used in the indoor garden, the benefits of more control and less energy use will nearly always offset the upfront expense. MY

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