

How to Size a Chilled Water Buffer Tank Correctly

If you're looking for the **correct** way to size a chilled water buffer tank, you've probably had experience with chillers cycling because the buffer tank is too small.

Ever had the frustration of fluctuating temperatures as your load changes? The temperature of the room plummets suddenly as the load drops.

The system goes out on LT fault, which requires a service call to site to carry out the reset. And then there's the possibility of flood back and oil lift in the compressor, and all sorts of other problems.



Fiddling with the BMS and installing additional valves may help temporarily, but it doesn't solve the problem.

Or maybe your issue has been the opposite: going way over budget on a 10,000L buffer tank, when you only needed **half** that extra volume.

We've seen hundreds of cases like these in our 20 years of serving the HVAC industry.

Figuring out the buffer tank you need for your chilled water system might seem like a huge task, but getting the correct size is essential.

We've simplified what might seem like a difficult process with an [easy-to-use formula](#) for calculating your system's required buffer tank volume.

When You Need a Chilled Water Buffer Tank

A chiller requires a certain system volume to operate in a low-load situation without cycling.

Cycling can occur in low-load conditions, such as when all employees leave their office building toward the end of the day.

The building load reduces substantially, so the volume of the system needs to be increased to prevent cycling and therefore damage to the chiller.

We call this "total system volume" (TSV).

Chiller manufacturers vary in their system volume requests, but 4L per kW is considered the standard ratio.

4L/kW applies to air conditioning comfort control applications. The higher end of the range will be toward 11L/kW, which applies to Multifunction Chillers.

This is because the heating and cooling must be balanced and within certain limits, complicating the system and therefore requiring that extra volume.

Chiller manufacturers will also specify the volume of the chiller. The volume of water in your pipe system (loop volume) plus your chiller volume equals your TSV.

If your TSV is less than the required system capacity (as requested by the chiller manufacturer), you will need a buffer tank to make up the difference.

In this case, the function of the tank is to provide a **buffer** (add volume) to your system. A buffer tank can be used in other situations too, which you can read about [here](#).

The Formula

Chiller kW x 4L = Required System Capacity (L)

Required System Capacity (L) – Total System Volume (L) = Required Buffer Tank Volume (L)

Note: if your chiller is 4-pipe, it's best to go with 11L per kW for calculating your required system capacity.

Example 1:

A 1000kW chiller will require a 4000L system capacity. If the TSV is only 3500L, a 500L buffer tank will need to be installed.

In this instance, the buffer tank is providing a “buffer” to allow the chiller (or heat pump) to operate in a low-load situation without cycling excessively.

However, you may not need a buffer tank at all.

Example 2:

A 600kW chiller will require a 2400L system capacity. If the TSV is 2400L, no buffer tank is required.

An important note to consider is the location of the bypass valve. Its position determines whether the loop volume can/can't be considered in the calculation.

What's a bypass valve?

Water systems are always designed for the maximum amount of water you're going to need to provide sufficient air conditioning on the hottest day.

So in the middle of winter, when you won't need much cooling, there's going to be a lot of excess water not being used by the air conditioning system.

The excess water must continue being pumped to ensure the system is operating at full capacity, so it has to be redirected through other pipework to skip over the route to the air conditioning.

Redirection of this excess water is done using a bypass valve.

This allows a continuous flow through the system without unnecessary use by the air conditioning.

The positioning of the bypass valve is important – it can't be too close to the chiller.

If the chiller is producing 6-degree water, for example, and the bypass valve suddenly opens and 9L of cold water flows back into the chiller, damage can occur.

To prevent this, your bypass valve should be far enough away from the chiller so that the volume of water enclosed in that section of pipe meets the specification or minimum volume of water that the chiller requires to operate.

Your Total System Volume changes when you include a bypass valve.

Therefore, the TSV used in the buffer tank volume calculation should be adjusted based on the length of pipe used for the water to come out from the chiller and return through the bypass.

When the bypass valve is located too near to the chiller, the adjusted TSV must be disregarded, and a buffer tank must be sized according to the original TSV as if the bypass valve isn't there.

Example 3:

A chiller manufacturer has recommended 3.25L/kW for a 750kW chiller, so we calculate $750 \times 3.25 = 2,437.5\text{L}$ to find the required system capacity. In this case, the bypass valve is located too near to the chiller, meaning the adjusted TSV must be neglected.

Instead, we size a buffer tank for the original TSV, rounding up to a 2500L buffer tank.

Example 4:

A 2100kW 4-pipe chiller will require a 23,100L system capacity. If the TSV is only 10,000L, a 13,100L buffer tank will need to be installed.

What happens if you undersize a chilled water buffer tank?

If you undersize or fail to install a chilled water buffer tank, you may experience any of the following issues:

- The temperature of the room suddenly plummeting as the load drops.
- The system going out on LT fault, which requires a service call to site to carry out the reset.
- The possibility of flood back and oil lift in the compressor.

Adjustments to the BMS and installing additional valves may help temporarily, but they can't **solve** these problems.

This is why an easy-to-use formula is essential in figuring out the **correct** volume for your chilled water buffer tank from the beginning.

Now that you know the secret to correct buffer tank calculations...

Check out our [Aquazone Buffer Tanks](#), and send us your system brief! We'd love to chat and advise on any questions you might have.

Remember to include a schematic of your pipe layout with elevations so we can give you the best engineering advice possible.

You can email sales@masterflow.net.au or submit our form [here](#).