

APPLICATION NOTE AN-003

Chiller Options for 274 Applications

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The 274 is a water cooled mount that requires an external water circulation system to operate properly. Sizing the chiller to the load of the 274 is also important to avoid overloading the chiller system.

Three common water systems are:

1. House water -- a facility-supplied water service
2. Chiller – an actively-cooled recirculating water system
3. Radiator – a passively-cooled recirculating water system

House water, when available, is typically the best solution, as there is little additional cost, and water temperature is typically maintained within reasonable tolerances. A pressure regulator may be needed to control pressure and flow rate through the 274.

A chiller provides the best level of control, as it is typically co-located with the 274, and can be sized to meet the needs to the application. It is, however, the most costly solution, as chillers suitable for the 274 can cost several thousand dollars.

A radiator is a low-cost solution typically only suitable for lower power applications. Instead of actively cooling the water, a radiator, as the name implies, is simply a closed water loop with a water-to-air heat exchanger (a radiator) that is typically equipped with a fan to improve the performance of the radiator. Because the water temperature is not controlled, the maximum capacity of the 274 will be directly impacted by the rising water temperatures that will occur as the system is in operation. The amount of rise will be dependent on the thermal transfer efficiency of the radiator.

This application note focuses on the chiller option.

Selecting a Chiller

When selecting a chiller, it is important to understand the total thermal load you will be putting into the water. The thermal load is a combination of the load of your device plus the TEC power needed to maintain the desired plate temperature:

$$P_{Chiller} = P_{Load} + P_{TEC}$$

For example, let's assume you have a device that generates 140 watts of heat, you want to maintain the device at 25°C, and your chiller will be providing 20°C water. The 274 manual provides a curve of TEC power versus plate temperature at 20°C water temperature, and for a 140 watt load, the expected TEC power is 85 watts. Therefore, the total load into the water is 225 watts.

When sizing the chiller, you should always add some extra head room to allow for system variances. In this example above, a 250 watt to 275 watt chiller would be recommended.

When operating the 274 to its maximum rating of 180 watts device load, a total of 420 watts of power is going into the water, so a 475 to 500 watt chiller would be required.

To improve thermal capacity of the 274, the water temperature can be lowered. This can be especially important when operating at very cold plate temperatures. However, a chiller operating at 10°C water will have a lower thermal capacity than a chiller operating at 20°C. When operating in these more extreme conditions, it is best to consult with the factory so we can review your application and select an appropriate chiller.

Solid State Cooling Oasis Three

Because most applications will not be pushing the 274 to its maximum capacity, we typically recommend Solid State Cooling's Oasis Three, a 275 or 300 watt chiller, depending on the pump option. This will typically allow thermal loads to at least 140 watts, as shown in the example above. The Oasis Three is a highly efficient, quiet chiller that uses TEC technology for cooling rather than conventional compressor-based chillers.

The Oasis Three is available with two pump options, a 4.5 liter per minute (lpm) and a 3 lpm. The 4.5 lpm pump is actually the lower cost, lower rated system (275 watts). The 3 lpm pump is higher rated (300 watt) because it is more efficient.

There is also a stainless steel wetted materials option, but the standard chiller is most compatible with the wetted materials of the 274.

Oasis Three with 1C Pump

- Part Number: 10-12684-1CL
- 275 Watts of cooling capacity @ 20°C in 20°C ambient air
- Pump: ~4.5 lpm @ 10 psig centrifugal pump

Oasis Three with 1CL Pump

- Part Number: 10-12684-1C
- 300 Watts of cooling capacity @ 20°C in 20°C ambient air
- Pump: ~3 lpm @ 10 psig centrifugal pump

Both Oasis Three chillers have the following common features:

- Operating Range from 5°C to 50°C
- Fittings: 3/8" Female NPT
- Wetted materials: Copper, brass and polymers (AL and AT options are Aluminum, Stainless Steel and polymers)

- Power cord has separate part number, dependent on the destination country
- Features:
 - Variable speed fan for quiet operation
 - Backlit display (user selectable On or Off)
 - Automatic restart
 - USB communications standard
 - Universal power input
 - RoHS compliant

To receive a quote or purchase an Oasis Three, contact Solid State Cooling via their web site: www.sscooling.com. The *Contact Us* section has listings for both US domestic sales and international distributors.

Tubing Components

When using one of the Oasis Three chillers listed above, you will also need the following items to connect the chiller to the 274:

- Hose barbs (McMaster p/n 5346K19)
- Pipe clamps (McMaster p/n 5415K11)
- 3/8" I.D. Hose (McMaster p/n 5233K64)

This will provide you with a fixed chiller-to-274 connection.

Quick-Disconnect Solution

For a quick-disconnect system, you can replace the brass fittings on the 274 with a quick-disconnect fitting system, such as the PMC Series from Cole-Parmer. The PMC series uses a 1/8" I.D. tube, not the 3/8" ID of the standard barb fittings shown above.

- Cole-Parmer p/n 06359-70 – replaces the brass barb fitting
- Cole-Parmer p/n 06360-45 – 1/8" I.D. barb fitting for tubing
- Tubing: McMaster p/n 5233K52 – 1/8" I.D. PVC Clear Tubing

There is a complete series of fittings available on the Cole-Parmer site.

They also have a HFC Series with 3/8" I.D. tubing for reduced restriction on water flow. For longer tubing runs, these fittings

Other Chiller Options

Solid State Cooling offers chiller models that reach upwards of 1200 watts, but compressor-based solutions can offer higher cooling capacities and better cost performance when operating at very high thermal loads. At Arroyo Instruments, we use a NESLAB ThermoFlex 1500. It is oversized for most applications, but suits our needs for testing extreme conditions and flow rates. It is a workhorse chiller and has been around for many years, and would be a solid consideration for a larger chiller applications.