

# Recirculating Chiller Protection Options and Fluid Compatibility



Recirculating chillers are “off-the-shelf” liquid cooling systems that offer precise temperature control and/or cooling below ambient temperatures.

## **EXTENDING THE LIFETIME AND RELIABILITY OF YOUR SYSTEM**

Recirculating chillers are used to cool various types of equipment, including medical equipment, lasers, microscopes, analytical instrumentation, semiconductor processing equipment, power supplies, electronics, and many other applications. Chillers have a number of options to configure the system to your particular application. These chiller options include protection, convenience, special applications, and fluid compatibility options.

Protection and convenience options, featured below, include external flow valves, external pressure relief valves, anti-siphon systems, air filters, water filters, and remote start capabilities. Selecting the appropriate options can make operation and maintenance of your chiller easier, help to minimize the risk of premature system failure, and ensure optimal system performance.

## **OPTIONS FOR PROTECTING BOYD RECIRCULATING CHILLERS**

### **EXTERNAL FLOW VALVE**

A highly recommended option is the external flow valve. An external flow valve is a manually adjustable globe valve that is used to control the coolant flow rate to your application. As the valve is opened, more flow bypasses the application and is redirected back to the return line of the chiller.

The external flow valve is installed on the back of the chiller in parallel with the chiller coolant supply/return.

This option is useful in applications where the process pressure drop is unknown or a specific flow is required. It also provides maximum flexibility for the chiller to be used at different flow rates.

### **EXTERNAL PRESSURE RELIEF VALVE**

Another option is an external pressure relief valve. This valve allows the recirculating chiller to continue to run and maintain temperature and pressure if the flow to the application is temporarily interrupted. For example, this could be helpful if your application is cycling on and off. The external pressure relief valve can also be used to prevent the chiller supply from exceeding a predetermined pressure setting. The external pressure relief valve and the external flow valve options should not be selected together, as the interaction between them may be difficult to control.

The external pressure relief valve is a manually adjustable check valve that can be set to 50-100 psig. When flow is interrupted, the valve opens and bypasses flow to the chiller’s return. This valve is typically installed externally on the back of the chiller in parallel with the chiller coolant supply/return. When using a positive displacement pump in conjunction with an external pressure relief valve, the pump’s integral bypass valve setting is usually increased to 90 psi. This is to prevent the pump from bypassing flow and creating a low flow condition on the return line, causing the chiller to turn off. Minimal flow rates of 0.5 gpm for Boyd’s RC009 through RC022 chillers and 1.5 gpm for Boyd’s RC045 chillers are required to prevent this low flow condition.

### **ANTI-SIPHON SYSTEM**

A valve option that offers both protection and convenience is an anti-siphon system. This system allows a chiller to be installed at an elevation below that of the application. The chiller tank is vented, so when the chiller is shut off, coolant in the hoses between the chiller and the application will flow back to the tank if the application is at a higher elevation than the chiller. In this situation, the fluid can overflow the tank if there is no anti-siphon system installed. The anti-siphon system option is most beneficial when space is an issue, and the only location available for the chiller is below the application or in a clean room application.

This anti-siphon system consists of an internal check and solenoid valves that are installed on the supply and return lines respectively. The check valve allows coolant flow to the application, but it also prevents it from flowing back to the chiller. The solenoid valve is open to allow coolant flow when power is on and closed to prevent coolant from flowing back to the chiller's vented tank when power to the chiller is shut-off. Like valves, filters help to protect your chiller and your application.

## **AIR FILTER**

For dusty and/or dirty environments, an air filter is highly recommended. An air filter will help to prevent dust build-up that could lead to decreased chiller cooling capacity. It also reduces the need to clean the condensing coil and other internal refrigeration components. Mounted internally to the chiller behind the front grill, the air filter is easily accessible. Boyd recommends replacing the air filter periodically depending on the level of dust in the air. For example, in a clean environment, such as in an air-conditioned laboratory, the air filter may only need to be replaced every 6 months. However, in a very dusty or dirty environment, such as on a machine shop floor, the filters may need to be replaced as often as every month.

## **5-MICRON COOLANT FILTER**

Just as important as an air filter is a water or coolant filter. As the name implies, a 5-micron filter removes particles up to  $5\mu$  (0.197 mils) from the coolant supplied to your application, protecting equipment from blockage or damage due to particulate buildup. It is located on the supply line of the chiller. All of the coolant flow is directed through the filter. If a chiller has both a coolant filter and a pressure relief or flow valve, the filter will be installed after the valve. In this situation 100% of the coolant flow to the application will pass through the filter. Boyd recommends that the filter be inspected the day after initial set up and on a weekly basis after that. Failure to replace filter cartridges can lead to a decrease in flow and consequently a decrease in chiller cooling capacity or a system shutdown.

These filters can be used with turbine and positive displacement pumps. They are especially beneficial when using positive displacement pumps, which are sensitive to particles. Coolant filters are not recommended with centrifugal pumps because the pressure drop through the filter is too high.

The remote start option is considered a convenience option.

## **REMOTE START**

The remote start option allows an external circuit to control the chiller on/off function via dry contacts on the rear of the chiller. An auto-restart is included with the standard chiller controller package, however, a remote start is beneficial for those who would like to simultaneously start their equipment and the recirculating chiller from a computer or relay for ease of operation. The remote start can also prevent accidental operation of the applications without the chiller and vice versa, which could cause damage, unnecessary energy consumption, etc.

## **CHILLER OPTIONS FOR ADVANCED REQUIREMENTS AND SPECIALIZED APPLICATIONS**

Recirculating chillers are liquid cooling systems that offer precise temperature control and/or cooling below ambient temperatures (See Figure 1). Chillers have many options so that they can be easily integrated into a wide variety of applications. These recirculating chiller options include special application options, fluid compatibility options, protection options, and convenience options.

Special applications and fluid compatibility chiller options, featured below, include a heater, internal insulation package, low temperature operation, water-cooled condenser, and 0.1°C set point.

## HEATER

When the ambient temperature is below your required chiller set point temperature, a heater may be needed. This option is especially helpful when equipment is turned off nightly or turned on and off in a cold environment. The heater option is a submerged 2000 W, 230V electric resistance heater that allows a set point temperature to be reached faster during cold start-ups or during frequent coolant set point cycling. It has a built-in over temperature (non-adjustable) shut-off. When the coolant is within 3°C of the set temperature, the heater shuts off and the refrigeration cycle takes over until the set temperature is reached. This option is available on Boyd's RC011 to RC045 models. It does not extend the coolant temperature range.

## INTERNAL INSULATION PACKAGE

An internal insulation package greatly reduces the formation of condensation on the tank, pump head, and coolant lines when the chiller coolant set temperature is below the ambient dew point. It helps prevent corrosion within the chiller as well as damage to electronics from drips. An internal insulation package is recommended for applications where the set temperature is 10°C or less as well as when the ambient temperature is above 25°C.

## LOW TEMPERATURE OPERATION

For low temperature set points (-5°C to 25°C), the low temperature operation option maximizes performance and provides more low temperature cooling capacity than a standard chiller. An internal insulation package is required when selecting this option. Low temperature operation is used in lasers, x-ray cooling, analytical instrumentation, and more.

## WATER-COOLED CONDENSER

Another option is a water-cooled condenser. This option allows for rejecting heat to an external liquid coolant source via a brazed plate liquid-to-liquid condenser instead of rejecting it to ambient air with a liquid-to-air condenser. This option prevents room warming and possible air conditioning overload. Also, water-cooled chillers are quieter because there is no condenser fan. The liquid coolant source is typically facility water, but it can also be another chiller located in a different room. The chiller cooling capacity is based on a facility water temperature of 75°F (24°C) at a pressure less than 100 psi. Table 1 shows the recommended facility water flow rates for each Boyd recirculating chiller. Contact Boyd's applications engineering for required facility flow rates at different temperatures.

## 0.1°C SET POINT

With a standard chiller, the user can set the temperature to the nearest degree. With the 0.1°C set point option, temperature can be set to the nearest tenth of a degree, allowing for more precise control of the coolant delivery temperature. It is only available in Celsius. This feature is recommended when temperature stability is critical. Laser cooling and analytical instrumentation cooling are two applications for which this option might be selected.

Fluid compatibility options include a deionization (DI) water cartridge, high purity plumbing, and PAO compatibility.

## DEIONIZATION WATER CARTRIDGE

A DI water cartridge removes ions from the coolant, maintaining a fluid resistivity level between 1- 3 Megaohm/cm by partial flow through the resin bed. The filter cartridge is externally mounted

Model	Flow Rate (min)
RC011	1.4 gpm
RC022	1.4 gpm
RC045	3.4 gpm

Table 1: Recommended Facility Water Flow Rates for Boyd Recirculating Chillers

on the return to the chiller. High purity plumbing should be selected with this option due to the corrosivity of deionized water. The filter should be replaced every 3-6 months with normal operation. Resistivity can be tested to determine if the cartridge should be replaced sooner. (This option does not include a resistivity indicator light and is not available with centrifugal pumps.)

## HIGH PURITY PLUMBING

With the high purity plumbing option, all wetted components are fully compatible with DI water. High purity components include a nickel-brazed evaporator, a stainless steel positive displacement pump, and nickel-plated or nylon fittings. The high purity plumbing option is strongly recommended when selecting a DI water cartridge.

## PAO COMPATIBILITY

Standard chillers typically use filtered water and inhibited ethylene glycol and propylene glycol water solutions. However, polyalphaolefin can be used as a coolant as well. Polyalphaolefin (PAO) is a heat transfer fluid used frequently in military and aerospace industries for its dielectric properties and wide range of operating temperatures. When using this fluid, the appropriate wetted materials must be selected. The PAO compatibility option includes a ½ HP centrifugal pump, brass fittings, push lock hose, 5-micron oil filter, anti-siphon system, and internal insulation package. The PAO compatibility option is available only on the RC011, RC022, and RC045 recirculating chillers.

There are many options available with recirculating chillers. Coolant compatibility and temperature control options are just a few of them. Understanding the options available on a chiller is important in determining how a chiller will meet your application's specific liquid cooling needs.

## CONCLUSION

There are many options available with recirculating chillers. Valves, filters, and remote start are just a few of the options available on standard cooling systems. Selecting the right options can help make your system operation and maintenance easy as well as keep your costs down. Modified cooling systems can also be designed to meet other additional requirements. For example, custom recirculating chillers can be designed for reduced acoustic levels, for additional cooling capacity or wattage, for various shapes and sizes, with or without "skins", and more.

# BOYD

Boyd is the trusted global innovator of sustainable solutions that make our customers' products better, safer, faster, and more reliable. Our innovative engineered materials and thermal solutions advance our customers' technology to maximize performance in 5G infrastructure and the world's most advanced data centers; enhance reliability and extend range for electric and autonomous vehicles; advance the accuracy of cutting-edge personal healthcare and diagnostic systems; enable performance-critical A&D technologies; and accelerate innovation in next-generation electronics and human-machine-interface.

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