



Liquid Cooling for Data Processing Environments

> Introduction

In the quickly advancing world of information technology, the cooling needs of data processing centers are requiring higher demands for performance than ever before. Energy densities are increasing in equipment, especially in high performance computing applications. As densities continue to rise, cooling systems must accommodate the changing heat loads. BAC is committed to providing products that are adaptable to these changing systems and laying ground work to be part of technologies that can better meet the evolving needs of the cooling industry.

> Solutions for Today

One of the ways to solve these challenges is through liquid cooling. Liquid cooled systems utilize a fluid to absorb heat, as opposed to traditional systems which utilize air as the heat transfer medium. Compared to air cooled methods, liquid based systems can operate in a smaller foot print and reject much higher heat loads. These systems often include a cooling tower to facilitate heat rejection from the fluid that is passed through the system. Use of a cooling tower further decreases the system's occupied space and allows for more effective cooling of the ever increasing heat densities. Products such as BAC's Series 3000 Cooling Tower can range from 220 to 1,350 nominal tons in a single cell; which when used with a water chiller, can provide an economic way to supply liquid cooled systems with fluid temperatures as low as 35°F(2°C).

> How Liquid Cooling Works

On a component level, liquid cooled applications handle high heat loads by delivering a chilled liquid, directly to the heat source. The liquid absorbs heat from the source and is easily removed by pumping the liquid out of the system. In data centers, liquid delivery is typically achieved through a coolant distribution unit (CDU) which supplies liquid to data racks. The liquid, which is usually contained in a pipe or water block, absorbs heat from inside the rack and is pumped back to the CDU where it relies on the building cooling system to chill it before recirculation. The method of chilling the liquid and the components of the cooling loop can all vary depending upon a given application. On the following page are three common arrangements of liquid cooling system components; in these diagrams the CDU and liquid loop are accounted for in the 'IT Equipment' block:

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Figure 3a. Class W1/W2/W3

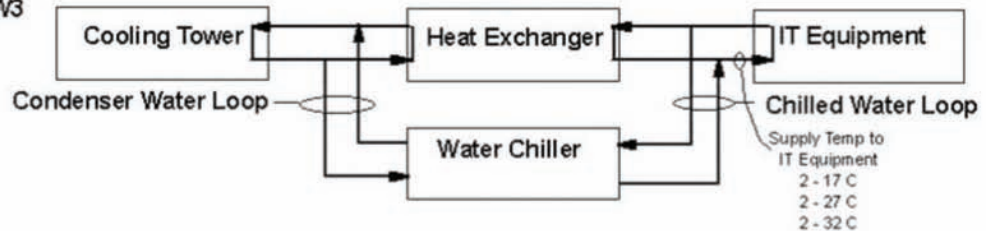
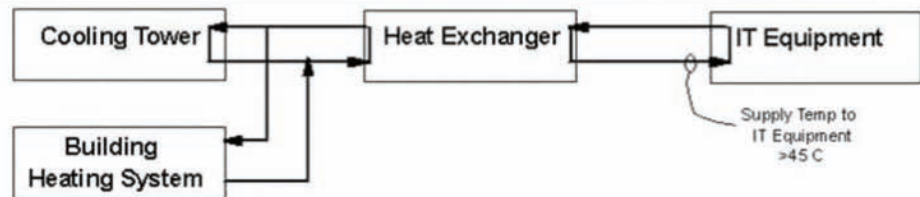


Figure 3b. Class W4



Figure 3c. Class W5



NOTE: Image courtesy of ASHRAE Technical Committee (TC) 9.9 Mission Critical Facilities, Technology Spaces and Electronic Equipment, *2011 Thermal Guidelines for Liquid Cooled Data Processing Environments*, © American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; www.ashrae.org.

> ASHRAE on Liquid Cooling

On a building level, the various requirements for cooling equipment correspond to the temperature of the liquid supplied to the IT equipment. Recently the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) published their “2011 Thermal Guidelines for Liquid Cooled Data Processing Environments”. This paper defines different facility classes based on the temperature requirements of the supply liquid. Broken into five separate categories, ASHRAE offers recommendations for what specific pieces of equipment best suit the cooling application and what guidelines should be followed when operating a liquid cooled installation. The entire paper can be found at: [http://tc99.ashraetcs.org/documents/ASHRAE 2011 Liquid Cooling Whitepaper.pdf](http://tc99.ashraetcs.org/documents/ASHRAE%202011%20Liquid%20Cooling%20Whitepaper.pdf).



> Applications for Cooling Towers

One reoccurring recommendation for additional heat rejection equipment is a cooling tower. Cooling towers can dissipate the excess heat that liquid collects while running through a system. Compared to air cooled systems or dry coolers, cooling towers can provide lower condenser water temperatures and are able to operate more efficiently in all environments by relying on the wet bulb temperature instead of the dry bulb temperature. Depending upon the needs of the data facility, cooling towers can be used in conjunction with a chiller, where condenser water temperature is directly related to chiller efficiency; or they can be used as part of a water-side economizer, where the leaving water temperature is directly related to the temperature of the liquid supplied to the facility. In either scenario, a cooling tower significantly influences the overall system performance.

Specific cooling tower selections will depend upon the application and a number of other design considerations. In a broad sense there are two options, either an open cooling tower or a closed circuit cooling tower. An open cooling tower can offer superior efficiency at a relatively low first cost. A closed circuit cooling tower has the unique benefit of being able to eliminate the need for a heat exchanger, thus simplifying the overall installation. BAC offers a complete line of both open and closed circuit cooling towers.

> BAC Products for Liquid Cooling

The Series 3000 Cooling Tower is the industry standard for factory assembled cooling towers. Available in a wide range of footprints and capacities, the Series 3000 has been installed in thousands of locations, including several liquid cooled data centers. With reliable year round operation, data centers can benefit from lower design condenser temperatures and greater control over their heat loads. The Series 3000 offers unsurpassed flexibility for inlet and outlet piping, including the optional EASY CONNECT® Piping Arrangement, allowing for easy installation into new or existing cooling systems.

Additionally, BAC offers the FXV Closed Circuit Cooling Tower which is well suited for liquid cooled data processing environments. Available as a dual air intake or single air intake, the FXV utilizes a closed circuit coil which limits outside containments from entering the system. The specific model and size of a cooling tower can be selected based on the application, while the overall guidelines for the system can be configured around the liquid cooling environmental classifications set forth by ASHRAE. BAC's broad offering of products provides the opportunity to optimize the configuration for any cooling system.

> Customizing Your Cooling System

There are a multitude of options when selecting and operating a cooling system for a data processing center. Liquid cooled systems offer a unique combination of performance and versatility. For more information on ASHRAE's liquid cooled thermal guidelines, visit: [http://tc99.ashraetcs.org/documents/ASHRAE 2011 Liquid Cooling Whitepaper.pdf](http://tc99.ashraetcs.org/documents/ASHRAE%202011%20Liquid%20Cooling%20Whitepaper.pdf). For evaporative cooling products that could benefit your facility and specific system recommendations, contact your local BAC Representative.