



The Clear Solution for Data Center Cooling™

Extreme cooling performance with low-cost dielectric fluid submersion cooling



[Left] 42U rack filled with servers, [Right] Two evaporative cooling towers outside of a GRC installation

Free Cooling in the CarnotJet™ System: When is it available?

ABSTRACT: A major limitation of using traditional air cooling is that the ability to use “free cooling,” also called air-side economization, may only be used during periods of mild outside air temperature and humidity. At Newark Airport in New Jersey, for instance, temperature data from thegreengrid.org indicates that air-side economization can only be utilized 30% of the time. This study will explain the difference between dry-bulb and wet-bulb temperatures and will show how Green Revolution Cooling’s CarnotJet™ system can leverage highly efficient evaporative cooling all year long.

W*et bulb* is the temperature that results from water evaporating. Sometimes called “free cooling” in the data center world, in evaporative cooling a cooling tower rejects heat to the air by evaporating water, thereby transferring heat from water to air and cooling the water at nearly no power.

In the CarnotJet™ system, water is used to reduce the temperature of heated coolant from 105° F (40° C) as it exits the rack to 95° F (35° C) as it reenters. In order to maintain effectiveness, the system rejects heat directly into warm outside water approaching 90°F. If the water was warmer than 90° F, the system would “de-rate” (e.g. lose some cooling capacity at peak server load), but still function.

In contrast, air-cooled data centers typically use air up to 81° F (27° C), a process that first requires chilling

water to 45° - 50° F and is extremely energy intensive.

Because “wet bulb” temperature is an indicator of what temperature will result when water evaporates.. GRC sizes its system to accept a wet-bulb temperature of 85°F. In locales ranging from Texas to New York City, wet bulb temperatures rarely reach beyond the low 80s F.

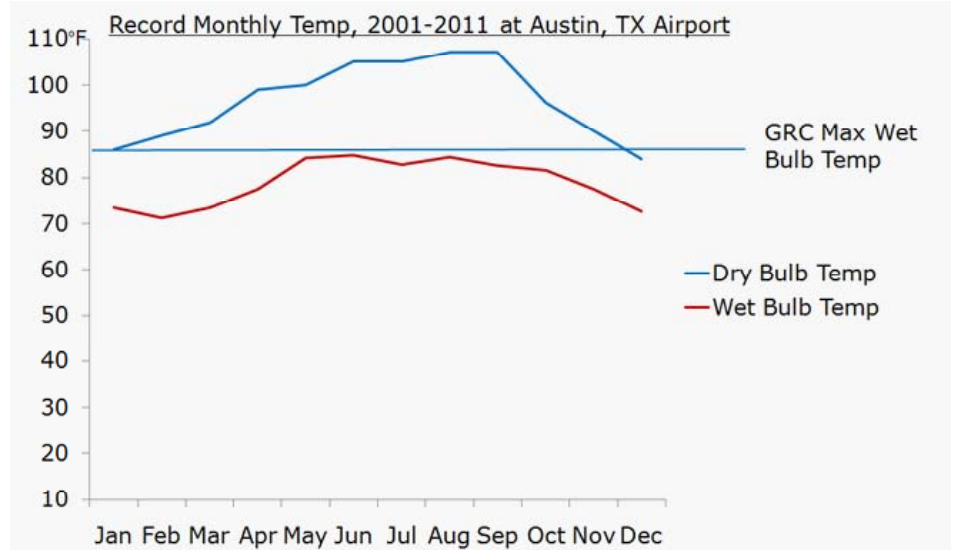


Figure 1: Austin, Texas: Record wet bulb temperatures well within safe range for GRC Temperature Sources: Weather-Source (certified NCDC data)

Following are some examples from Austin, TX and Newark, NJ that illustrate the reliability of evaporative cooling in the CarnotJet™ system.

Figure 1 shows the record temperature for each month over a ten-year period. Although the dry-bulb temperature is routinely over 105°F, the wet-bulb never reaches or surpasses 85°F.

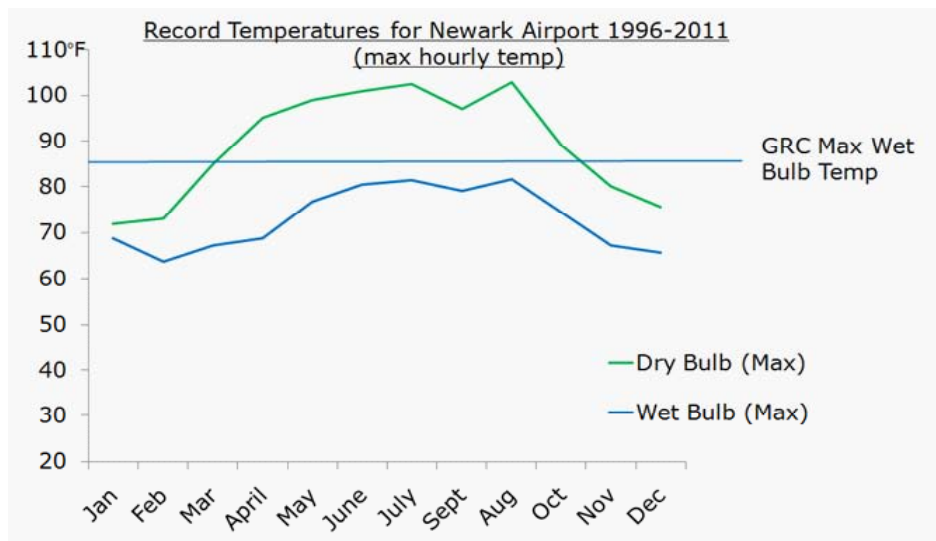


Figure 2: New York City: Another year-round locale for GRC Temperature Sources: Weather-Source (certified NCDC data)

Figure 2 shows the monthly record temperature for the last fifteen years at Newark Airport in New Jersey. The highest wet-bulb temperature recorded at Newark Airport was ~81° F, well below the 85°F that the CarnotJet™ system uses .

Figure 3 shows hourly temperatures for the hottest day at Newark Airport in the last 15 years (August 9, 2001). It shows that the wet-bulb temperature typically stays relatively constant during the day, even when



Figure 3: Intra-day temperatures

dry-bulb rises. This is because the amount of moisture in the air stays constant during the day; as the temperature rises, the air can hold more moisture, so relative humidity drops.

The ability to utilize low-power “free cooling” during the warmest time of day is instrumental in saving energy. As seen in Figure 4 below, Newark Airport can only use air-side economization for 30% of the time year-round while GRC’s system can use evaporative cooling 100% of the time.

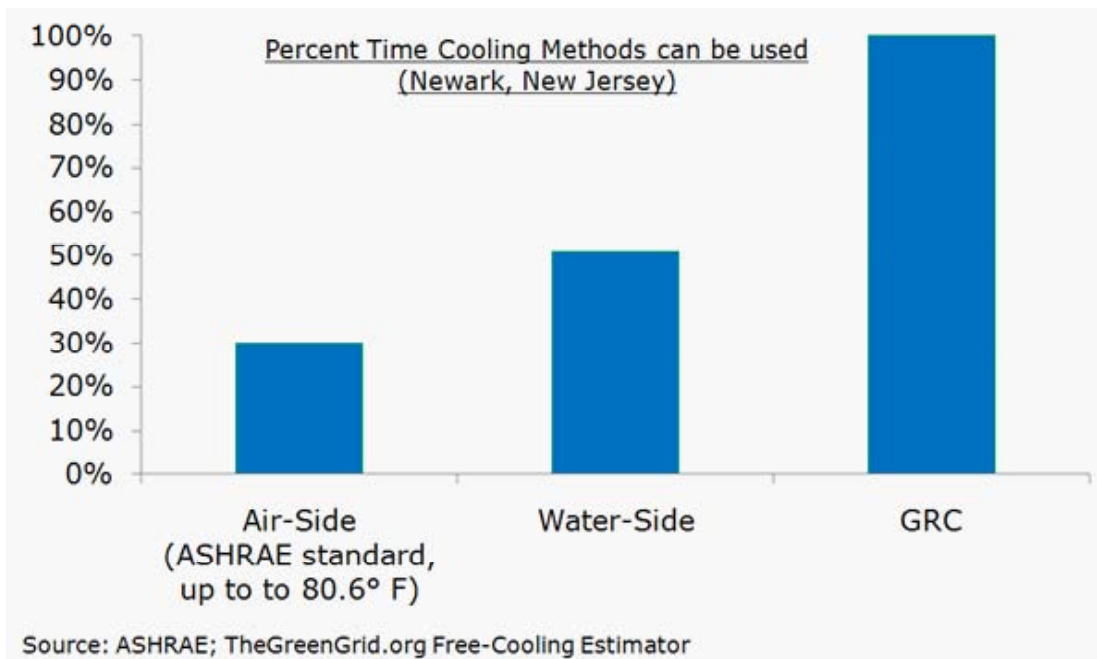


Figure 4: Hours Per Year of Free Cooling for GRC vs. Air-Side Economization

For more information about the CarnotJet™ system contact GRC at info@grcooling.com