THE TOP TWO QUESTIONS ABOUT OUR NEUCOOL™ TECHNOLOGY

What is the science of two-phase, and why does it remove more heat?

In direct-to-chip liquid cooling, a coolant—whether it be water, oil, or refrigerant—is pumped through cold plates attached to the chips to remove the generated heat.

In single-phase cooling, heat is transferred from the fins of the cold plates into the liquid molecules, which then carry the heat away. This process energizes the liquid molecules and subsequently raises their temperature, a phenomenon known as sensible heating.

In two-phase cooling, liquid reaches its boiling temperature and starts evaporating. In addition to the same heat transfer mechanisms active in single-phase cooling, the generation of bubbles on the cold plate surface further enhances the heat transfer by providing improved mixing and increased convective heat transfer.

This enhancement in the heat transfer mechanism means that more heat can be extracted at the same temperature difference, so you can get more power out of your chips if you use two-phase cooling.

Additionally, boiling takes place at a constant temperature and a large amount of energy can be stored. As a quick comparison, the amount of energy that can be stored by boiling our refrigerant R1233zd corresponds to a 42°C rise in single-phase water cooling at the same flow rate. Therefore, two-phase cooling requires lower flow rates to extract a target heat load, and the chips will have uniform temperatures.

What dielectric do we use, and why did we choose it?

We are using R1233zd in our system. In choosing our working fluid, we were concerned with thermal performance, safety, and sustainability. There is a large selection of high-performance refrigerants that provide good heat transfer performance, and these are also dielectric, meaning that there won't be any damage to IT equipment in the event of a leak. Therefore, the main driving factor in our selection has been sustainability.

Most two-phase cooling solutions use refrigerants that fall under the category of polyfluroalkyl substances, otherwise known as PFAS. PFAS refrigerants are different from each other when it comes to their properties. The GWP, or Global Warming Potential, is one such property that varies wildly from refrigerant to refrigerant; it is a commonly used scale for measuring the climate effects of different gases.

In the event of a leak, PFAS refrigerants vaporize and eventually make their way into the upper atmosphere. With a high GWP, PFAS would remain in the upper atmosphere, where it has a high potential to warm the globe. However, with a low GWP, the PFAS substance breaks down in a matter of days into triflouroacetic acid, which is a naturally occurring compound. Numerous independent studies conducted over the past two decades have concluded that TFA from manmade sources does not pose a risk to the environment or human health. Our refrigerant of choice R1233zd has a GWP of 1. So, on top of having good thermal performance, it is also environmentally friendly.

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