

Energy efficiency ▶

Innovation

Asia

Acquisitions

Cooling technologies



The efficiency of energy systems is now a major priority for sustainable development. It requires both an improvement in the performance of individual components and the optimization of complete systems. Coolers make a major contribution to this.

All electrical and electronic devices in operation experience energy losses resulting in the generation of heat. This heat needs to be dissipated to prevent components from overheating and avoid any premature deterioration in them. That is what coolers do.

They work via a series of heat exchanges with the component which they are in mechanical contact with. These exchanges employ the general principles of thermodynamics, that is principally:

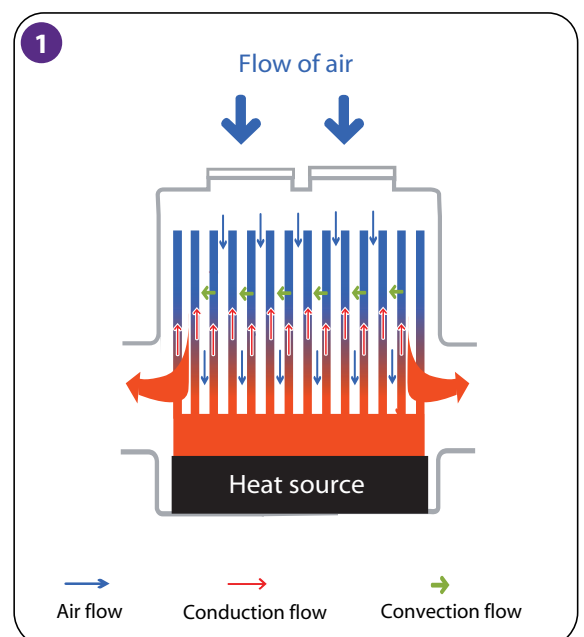
- conduction through the metallic elements of the dissipator,
- convection between the cooler and the fluid flowing through it (air, water, etc.).

The cooling systems—also known as thermal dissipators—are designed based on the principle that the efficiency of heat dissipation depends on the conductivity of materials used, the transfer surface between the heat transfer fluid and the dissipator, and the latter's heat transfer coefficient. The choice of design and dimensions of the dissipator also help to maximize the performance of a cooling system.

AIR, WATER AND PHASE-CHANGE COOLING—THREE TECHNOLOGIES MEETING ALL TYPES OF INDUSTRIAL NEEDS

- 1 Air cooling** : this is the most straightforward system to implement, using air from the atmosphere to dissipate heat. The addition of a ventilation system to the dissipator can enhance convection (and thus dissipation of heat) by accelerating the flow of air in the cooler. In this case, we talk about forced convection, rather than natural convection
- 2 Phase-change cooling (heat pipe)** : a heat pipe takes the form of a sealed container carrying a fluid (generally water or methanol). The lower end of the heat pipe located close to the item for cooling is known as the evaporator. When the electrical equipment starts up, the liquid present in the evaporator heats up and vaporizes, thereby storing the energy originating from the heat emitted by the element. The gas diffuses inside the sealed copper tubes and then flows towards the upper end of the heat pipe known as the condenser, in which aluminum fins are crimped into the copper tubes. In contact with the air blown by natural convection or forced convection via the fins, the gas present in the copper tubes cools down and condenses, thereby transferring its energy to the ambient air in the form of heat and liquefying again.

The liquid then goes back to the evaporator part of the heat pipe through the action of gravity.

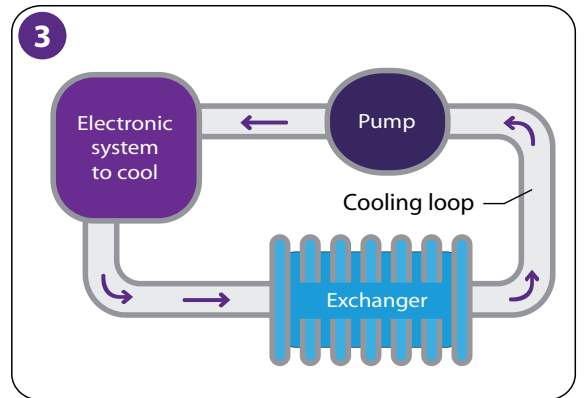
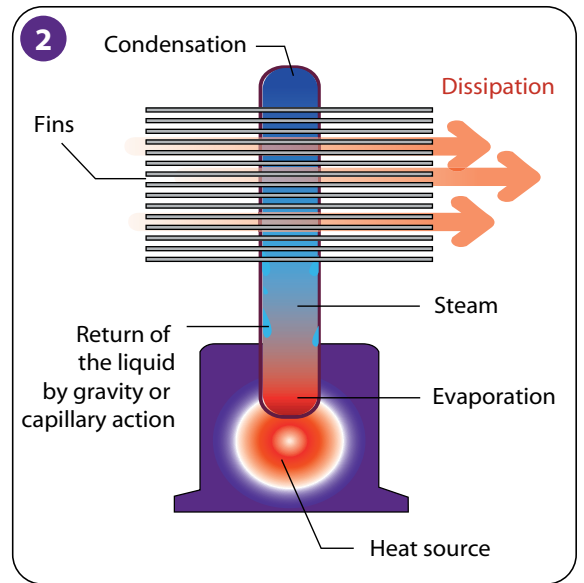


The heat pipe system provides superior cooling performance to air cooling and benefits, such as a greater transfer surface, improved compactness of full systems, as well as the possibility of separating the heat source created by the electronic components from the condensing section where heat is dissipated.

3 Water cooling : with this technology, the circulation of water throughout the cooling device (cold plates + related cooling loop) is what facilitates the heat transfer. The heat dissipated by the electronic system is carried towards an air/heat exchanger using a hydraulic pump built into the cooling loop.

The physical characteristics of the water ensure very high thermal performance compared with a direct air cooling system. This cooling technology is used to dissipate the heat of very high-power electronic equipment (hundreds of KW to several MW). It delivers the best performance, but requires flawless reliability (seal, robustness, corrosion resistance) owing to the proximity of the water and electricity.

The cooling solution chosen will depend on industrial issues (space saving, yield improvement, power supply quality, etc.) and, of course, the required cooling performance. Carbone Lorraine has all three technologies covered.



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> Thermal Management, a booming market