Cold Plates: Single-Phase and Two-Phase Liquid Cooling

Developed by Parker Aerospace Gas Turbine Division, the unique macrolaminate construction employs a diffusion-bonding manufacturing process. This process allows multiple layers of extremely thin material to be bonded together, resulting in a finished product that has a material strength greater than 90 percent of the base material. Each layer may contain complex liquid paths that transport the coolant to specific areas of concentrated heat flux. This multilayer approach results in the ability to create parallel “low temperature” flow paths for the coolant prior to reaching multiple locations of the specific heat sources.

The unique manufacturing process includes the capacity to produce fluid channel passages with extremely high aspect ratios. A “slot” style fluid channel provides the most efficient method of thermal transfer (maximum contact area versus volume) from the cold plate wall to the coolant.

Thin cold plates and low-fluid volumes result in reduced sizes for any associated pumps or reservoir/accumulators in the overall system, contributing towards size, weight, and power (SWAP) benefits.

Very large format cold plates may be constructed with fluid passages of greater size and may therefore utilize vacuum brazing as a construction technique.

Single-phase and two-phase cooling can be achieved with a variety of fluids or refrigerants. Two-phase cooling may require the cold plate to operate with the coolant under considerable pressure. Parker has many years of experience manufacturing and testing complex fluid management systems and components that need to operate under extreme pressures in harsh environments.

Application
The unique Parker macrolaminate construction of cold plates are currently deployed in a number of applications within harsh environments.

• Cooling sensor packages on missile systems
• Cooling TX/RX modules on a large antenna array
• Cooling TX modules on a radar jammer
• Cooling laser diode packages for a directed energy program
• Cooling system for commercial aviation primary electronics

Features
• Macrolaminate (diffusion bonding) manufacturing process
• Multilayer fluid passage design
• High aspect ratio fluid channels — fabricated using proprietary manufacturing methods
• Very small channels allow low fluid volumes reducing overall system weight
• Thin lightweight construction
• Single-phase and two-phase cooling
• Rugged construction for harsh environments

Optional Features
• Wide range of pumps, reservoirs/accumulators, and heat exchangers available
• Single and two phase cooling
• Wide range of sizes; cold plates are available in sizes from 2x3” to 20x40”
• Accommodates a wide range of dielectric (e.g. PAO/fluorocarbon) and non-dielectric (e.g. EGW/PGW) fluids

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