Aerospace/Military Thermal Management Systems Selection Guide
Aerospace and defense electronic systems are driving significant increases in power densities, resulting in thermal management challenges across a wide range of applications. Parker’s thermal management systems (TMS) team delivers complete end-to-end liquid-cooling solutions with significant advantages in size, weight, and power (SWaP) for mission-critical applications. From ships at sea to high-altitude unmanned aircraft, Parker TMS solutions enable electronics survivability in the harshest environments.

Single- and Two-Phase Cooling Solutions

Complete Thermal Management Systems Solutions

From liquid-cooled conduction and SprayCool® enclosures using flow-through or direct-spray technology to heat exchangers, controllers, pumps, and cold plate assemblies, Parker TMS offers end-to-end, system-level solutions to meet the unique thermal management challenges required by today’s military electronics.
Liquid Cooled Conduction Enclosures

The advanced liquid-cooled enclosures enable high-power density embedded electronics in ruggedized military, aerospace, industrial, and commercial applications.

Top-loaded enclosure uses a conduction-cooled card cage. Liquid-cooled chassis side walls enable cards in excess of 200 watts. This rugged enclosure is adaptable for different applications, with VPX, OpenVPX, VXS, VME64x, Compact PCI, or hybrid type backplanes.

Utilizing Parker’s proprietary Macrospray™ technology, these enclosures provide three times the watt/area capacity of traditional designs, or the same watt/area with 1/3 the flow rate.

Product Highlights

- All VITA 58 sizes available and easily configured for any application
- Embedded coldplates in adjacent walls are available for direct cooling of high-heat components (e.g. power supply)
- Compatible with most dielectric (e.g. PAO/fluorocarbon) or non-dielectric (e.g. EGW/PGW) cooling fluids
- Accommodates two-level field maintenance
- Options available to enable use of liquid flow through modules which can be attached to cards

Modular Solutions

SprayCool™ Modular Solutions deliver localized cooling of hot spots with low development costs by using standard components specifically designed and tested for harsh military environments. SprayCool modular components are readily configured in retrofit applications where electronics technology has outgrown existing cooling solutions. Modular Solutions are well suited for Radar, Power Electronics and High Performance Computing applications where local heat loads range up to 1.5kW and system loads reach 135kW. With superior localized cooling, customers can remove bulky, heavy, expensive and inefficient air cooling and air handling systems.

SprayCool Modular Solutions perform three primary functions in cooling: Acquire heat from source, transport the heat away from source and reject the heat.

Heat acquisition is accomplished by spraying a fine mist of non-conductive and noncorrosive coolant indirectly...
onto electronic packages. The coolant vaporizes carrying heat away from the packages. Transport occurs when the coolant vapor exits and is carried by manifolds and tubing to a heat exchanger. SprayCool components are connected by drip-less “quick disconnect” fluid connectors for ease of maintenance or reconfiguration.

Heat rejection is accomplished via a heat exchanger that rejects the thermal load to ambient air or platform fluid. Fluid options range from PAO, fuel, EGW, and engine bleed air. Air-to-air heat exchangers are also available.

With optimized standard components performing the essential functions of cooling SprayCool Modular Solutions achieve reductions in lifecycle costs, size and weight.

### Capabilities
- Reduces size and weight of electronics package and associated
- Decreases ownership costs by increasing reliability and enabling COTS operation in elevated temperature environments
- Modular SprayCool components are tailor made for retrofit of existing cooling systems resulting in low non-recurring engineering costs
- All components designed for harsh military applications on land, sea and air
- Improved EMI shielding
- Enables remote heat rejection options away from electronics

### Applications

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### System Building Blocks

#### SprayModules and Line Replaceable Modules (LRMs)
- SprayModules typically have the ability to cool components in the range of 100 to 200W
- LRM typically have the ability to cool assemblies in the range of 600 to 700W

#### Fluid Routing Components
- Rigid and flexible tubing
- Fluid manifolds
- Quick disconnects
- Clamps, fittings, heaters and filters

#### Thermal Management Units
- Pump, Reservoir and Heat Exchanger components and assemblies
- Heat Rejection capacities ranging from 1-2kW, 10+KW and 100+KW
- Ability to reject heat to air or liquid (i.e. PAO, Ethylene, Glycol, Water, EGW, Fuel, etc.)
The SprayCool MPE series of enclosures are available in 3U and 6U models. The series offers a new standard of scalable thermal performance, environmental isolation, and flexible design that simplifies integration while meeting today’s and tomorrow’s customer needs in harsh environments.

The SprayCool MPE series features small, lightweight, rugged, high-performance, direct-spray enclosures. Designed to provide unparalleled flexibility, the MPE can enable survivability for both commercial grade and rugged electronics in harsh military environment applications. Both are capable of protecting commercial grade or rugged electronics.

The SprayCool MPE enclosures are truly versatile, in small, light, and cost-effective formats. Using patented direct-spray evaporative technology, electronics are protected in the MPE’s sealed, closed-loop environment, ensuring electronics survivability in extreme operating environments, encompassing both temperature and vibration. Architected to reduce non-recurring engineering expenses for custom products, the MPE can be delivered in any payload configuration without mission-specific development.

The MPE series was developed to meet the requirements of ground and airborne platforms. Further, the SprayCool MPE assures broad flexibility in that it can be scaled to customer’s exact specifications at an affordable cost. Designed to provide from four to 21 user slots, these rugged enclosures can accommodate a range of proprietary, commercial, and rugged electronics.

The MPE series is designed to operate in a harsh environment over extended temperature of -55°C to 71°C (-65°C optional) and altitude ranges of up to 55,000 feet (75,000 feet optional). To accomplish this, electronics are housed in an evaporative, cooled, sealed enclosure creating a safe environment for the electronics within.

Leveraging open industry standards and common commercial-grade electronics, the MPE enclosure can allow customers to quickly field common applications without redesign or requalification across a broad range of vehicle types and applications.

Product Highlights
- Meets demanding environmental requirements of MIL-STD-810F
- EMI per MIL-STD-461,462
- Sealed construction prevents moisture and dust contamination
- Open system architecture for 3U and 6U VPX, VXS, cPCI/CPCle, and VME/VME-64X
- Configurable I/O, backplane, and power supply
- Supports MIL-STD-704, 1275B power input
- No air filters or other frequent maintenance items
- Flexible heat exchanger up to 2kW
- Scalable from seven to 11 3U slots, four to 21 6U slots
- Supports self-diagnostics and BIT
- Optional mounting features including shock isolation
- Compatible with ½ ATR short-mounting MPE

Platforms
- Ground vehicles
- Unmanned aerial vehicles
- Rotor-wing aircraft
- Airborne platforms

Applications
- Sensor processing
- Electronic warfare
- Mission computing
- Command and control
### Capabilities

- Ability to mix commercial cards and custom/rugged electronics, significantly reducing integration risk, time, and costs
- Lowest system cost compared to conduction or other liquid alternatives
- Enables highest electronics density available at extreme environments
- Enables highest electronics reliability available today
- Capable of operating in tactical environments
- Sealed to provide maximum protection against contamination
- Does not require additional ECS capacity
- Scalable: meets various electronics payload requirements
- Minimize size, weight, and power consumption
- Altitudes up to 55,000 ft. (75,000 ft. optional)

### Specifications

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<th>MPE-3U</th>
<th>MPE-6U</th>
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<tr>
<td><strong>Configurations</strong></td>
<td>Up to 11 user slots</td>
<td>4 to 21 user slots, 6U x 160mm x 0.8”</td>
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<tr>
<td><strong>Dimensions:</strong></td>
<td>12.62”L x 6.38”W x 10.625”H</td>
<td>12.45”L x 12”W x 12”H (8 user slot unit)</td>
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<tr>
<td><strong>Cooling capacity:</strong></td>
<td>up to 2kW (with heat exchanger)</td>
<td>up to 2kW (with heat exchanger)</td>
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<tr>
<td><strong>Storage temperature:</strong></td>
<td>-65° to 85°C</td>
<td>-65° to 85°C</td>
</tr>
<tr>
<td><strong>Operating temperature:</strong></td>
<td>-55° to 71°C (optional: -65°C)</td>
<td>-55° to 71°C (optional: -65°C)</td>
</tr>
<tr>
<td><strong>Reliability:</strong></td>
<td>14,000 hours MTBF</td>
<td>14,000 hours MTBF</td>
</tr>
<tr>
<td><strong>Power consumption:</strong></td>
<td>80W maximum (for cooling system)</td>
<td>80W maximum (for cooling system)</td>
</tr>
<tr>
<td><strong>MIL-STD:</strong></td>
<td>MIL-STD-704 and 1275B</td>
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<tr>
<td><strong>Weight:</strong></td>
<td>150 lbs.</td>
<td>28 lbs.</td>
</tr>
<tr>
<td><strong>Backplanes:</strong></td>
<td>VPX, cPCI/cPCIe, VME/VME-64X</td>
<td>VME/VME-64X, cPCI/cPCIe, VPX, VXS</td>
</tr>
<tr>
<td><strong>Environmental:</strong></td>
<td>Exceeds humidity, salt fog, fungus, thermal shock, sand, and dust requirements of VITA 47</td>
<td>Exceeds humidity, salt fog, fungus, thermal shock, sand, and dust requirements of VITA 47</td>
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### Optional Accessories

- Custom backplane can accommodate any configuration of power supply or system slots
- Attitude independent valves adhere to mobility requirements of platform (the need for inverted operation)
- Custom I/O panel
- Fluid fill and drain system
- Fluid handling tool
- System integration cart
- Fluid heaters (extreme cold operation)
- Operational redundancy (n+1) electronics

### SprayCool Technology

SprayCool is Parker’s patented two-phase “direct spray” liquid-cooling technology. It consists of deploying a fine mist of non-corrosive, non-toxic, non-conductive liquid (Fluorinert™ by 3M) sprayed in a thin layer, which evaporates and cools electronics. The process continuously cycles within a sealed, closed-loop system. In doing so, SprayCool-enabled products isolate the electronics from dirty, corrosive environments found in military and industrial applications, resulting in temperature-optimized, higher performance, and more durable electronic devices, often without the need of dedicated environmental control systems.
HRU-1000
Heat Rejection Unit

Improves electronics performance with a minimum 1000 watts of cooling power in a downsized package with Parker’s HRU-1000. This rugged, stand-alone 1/2 ATR short-sized unit is designed for the space-constrained environments where high-performance cooling is a must. Pump, motor, and an advanced motor-logic controller are combined with completely integrated dual high-performance fans and a high-performance heat exchanger to create a top cooling rate for its class and size.

Available for multiple cooling fluids, Parker’s HRU-1000 mates readily with components for wide-ranging versatility and comes standard with quick-disconnect hose assemblies. Works well in avionics, vetronics, telemetry, and navtonics applications where vibration, shock, acceleration, altitude, and environmental factors such as humidity, sand, salt, and dust can impact performance.

Product Highlights

- Meets demanding environmental applications for humidity, sand, salt, and dust
- Suitable for avionics, vetronics, telemetry, and navtonics applications
- Comes equipped with quick-disconnect assembly
- High-performance fans and heat exchanger create top cooling rate for its class and size

Specifications and Options

| Configuration: | 1/2 ATR short size with front “doghouse” per ARINC 404A |
| Dimensions: | 15.19”L x 4.88”W x 7.62”H |
| Working fluids: | Polyalphaolefin (PAO); Ethylene glycol/water (EGW) mixture; Propylene glycol/water (PGW) mixture; 3M Fluorinert™ fluids FC-77, FC-104, FC-75 |
| Storage temperature: | -55° to 105°C per MIL-STD-810F method 501.4, Procedure II and 502.4, Procedure II |
| Operating temperature: | -40° to 70°C per MIL-STD-810F method 501.4, Procedure II and 502.4, Procedure II |
| Electrical connector: | MIL-C-26482, Amphenol™ PT02E-16-99P |
| Input power: | 28VDC per MIL-STD-704E, 200W max. |
| Weight: | 23 lbs. (depending on configuration) |
| Water rating: | Per MIL-STD-810F-506.4 Procedure II |
| Hose (supplied): | Low permeation Tube: seamless, extruded, conductive Teflon™ Reinforcement: corrosion-resistant, steel wire braid Cover: integral silicone Low two-inch minimum bend radius Fire-proof per AS4897 and AS150 |
| EMI/EMC: | When fitted with standard MIL-C-38999 style connectors, meets MIL-STD-461E conducted and radiated emissions and susceptibility requirements CE102, CS101, CS114, CS115, CS116, RE102, RS103 |
| Quick disconnect (supplied): | Simple, one-hand push/pull operation; flush face, self-sealing valving; low attach/detach fluid volume loss (no drip); SAE AS1709 and MIL-C25427 qualified |
| Environmental: | Exceeds vibration, shock, altitude, acceleration, humidity, salt fog, fungus, thermal shock, sand, and dust requirements |
Optional

• Custom supply/return hose manifolding (e.g. one HRU-1000 connected to two ATR boxes)
• Custom hydraulic connectors
• Custom electrical connector (J1)
• Custom fan speed-control curve
• Custom pump speed-control surve
• Custom fluids
• Custom operating temperature
• Custom finishes
• Intermittent water submersion capability
• Fill and bleed kit
• ATR box quick-disconnect nipple kit (one nipple with pressure relief, one nipple without pressure relief)

Pumps, Reservoirs and Controllers

Parker can support the infrastructure required to reject the heat contained in fluid with complete system solutions and components such as pumps, motors, controllers, reservoirs, and filters.

Valves, Hoses and Quick Disconnects

Combining diverse fluid-handling experience and products enables Parker to provide highly engineered, integrated system solutions for the most challenging thermal management.

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