



ELECTRIC / HYBRID VEHICLE

Battery and Electric Thermal Management
Heat Exchange Plates for Battery Packs and Electronics



www.seniorflexonicsUSA.com



Senior Flexonics designs, engineers, validates, and manufactures thermal management components and systems for electric and hybrid vehicles, power and energy markets.

Senior Flexonics offers unparalleled product design, development, testing and manufacturing capabilities. Bartlett is the primary North American design and development center for thermal management, fluid conveyance, heat exchangers and flexible connectors. Housed in a dedicated sales, research, development and prototyping site Senior Flexonics' program of continuous improvement and innovation has enabled the delivery of cost effective, high performance products for the rapidly developing marketplace.



BATTERY AND ELECTRIC THERMAL MANAGEMENT

Our thermal management solutions maintain battery and electrical component temperatures to ensure optimum levels of safety, performance, and battery life. Our "Omega Fin" channel design minimizes pressure drop and limits the temperature differential to as low as 1%. Choice of materials is determined by customers specific performance requirements, boundary conditions, manufacturability, and cost effectiveness. We have extensive experience with Stainless Steel, Copper, Aluminum, and Glass Filled Nylon.

Heat Exchange Plates

Senior Flexonics has a wealth of experience in designing and manufacturing liquid cooled heat exchangers for the land vehicle and energy market. We have developed a number of systems to ensure precise temperature control of battery modules. Senior Flexonics takes advantage of various designs to meet its customers requirements, including:

Two-Ply Assembly



Three-Ply Assembly



Heatsinks



Extrusions

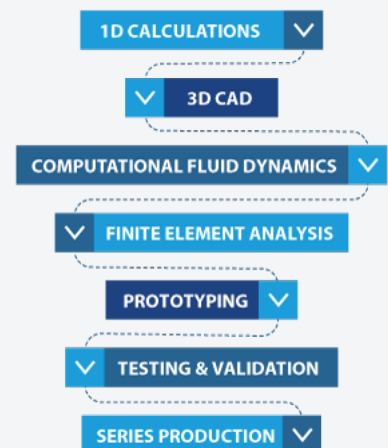


OUR CAPABILITIES

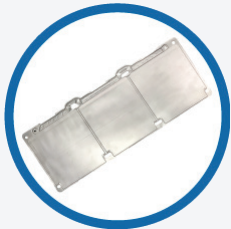
We pride ourselves on our innovative approach to solving technical problems, which we have used to develop trusted partnerships with customers and suppliers around the world.

Product Validation Capabilities:

- » CFD for performance and boiling
- » FEA for vibration NRFs
- » Rig performance measurement
- » Gas side and coolant side pressure pulsation
- » Thermal shock
- » Shaker vibration durability
- » Acceleration data acquisition on vehicle

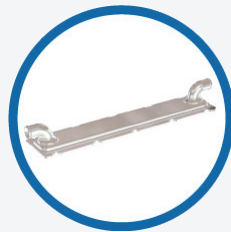


Whether it's combustion, hybrid or electric drive-trains, battery cooling or fuel cell applications, we use our knowledge and expertise to meet our customers requirements.



Battery Thermal Management

Manufactured in a range of materials including stainless steel, aluminum, copper, and plastics, our systems are designed to maximize power density, while minimizing package space, weight, coolant pressure drop, and cost.



Electronics Cooling Plates

The main component inside the inverter is the IGBT (Insulated Gate Bipolar Transistor), and it generates heat. An effective method of cooling the IGBT is through a liquid cooled heat sink.



EGR Cooler

Senior Flexonics provides a wide range of EGR Heat Exchangers, including Shell & Tube, Plate & Fin and our patented Co-axial Cooler. Our heat exchangers are used in HEV engine systems and have up to 95% efficiency, are highly resistant to fouling and are scalable to match performance requirements.



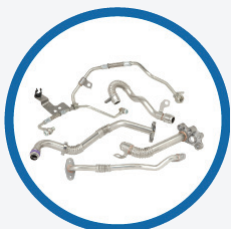
Flexible Connectors

We are an industry leading supplier of flexible connectors. We design, engineer and manufacture both long/soft and shorter self-supporting flex design options to meet customers unique platform requirements.



Hydrogen Thermal Management

Senior has developed high-efficiency condensers, recuperators, and cathode air pre-heaters capable of operating at extreme temperatures for prolonged periods of time.



Fluid Conveyance

Senior Flexonics has a long history of manufacturing tubing for a variety of fluid transfer applications. Used in isolation such as for an oil drain or fuel lines, or combined with our heat exchange plates, we offer expertly balanced and optimized systems to ensure customer needs are met.



KEY BENEFITS

- » Full service supplier.
- » Full collaboration with customers to provide products.
- » A fully engineered solution, from design concept through to high volume manufacture.
- » Global production facilities, 30 operations in 13 countries.
- » Extensive range of thermal management solutions.
- » Programs managed using APQP framework.
- » Comprehensive fleet of FEA and CFD software.
- » Fully equipped test lab for validation testing.
- » Performance and durability test equipment.
- » ISO 9001 / 14001 and IATF 16949 certification.



LOCATIONS

- » **Bartlett USA:** Sales, Engineering & Manufacturing
- » **Cape Town SA:** Manufacturing
- » **Crumlin UK:** Sales, Engineering & Manufacturing
- » **Kassel GERMANY:** Sales, Engineering & Manufacturing
- » **New Delhi INDIA:** Sales, Engineering & Manufacturing
- » **Olomouc CZE:** Sales & Manufacturing
- » **Saltillo MEXICO:** Manufacturing
- » **Tokyo JAPAN:** Sales
- » **Wuhan & Tianjin CHINA:** Sales & Manufacturing

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