**Radiator**

- Capability of cooling engine and secondary loop systems
- Full face or bed type layout
- Folded tubes or welded tubes layout
- Designs applicable for low and high temperature applications, as well as fuel cell systems
- I Flow, U Flow, and cross counterflow designs available
- Delivers excellent performance and low pressure drop with superior packaging
- Highly diversified portfolio with core depths that can satisfy all engine cooling requirements
- Deep knowledge of vehicle cooling systems to prevent system failures
- Proven product designs meet the most stringent durability requirements
- Capability and willingness to tailor designs for unique requirements

**Features**
- Capability of cooling engine and secondary loop systems
- Full face or bed type layout
- Folded tubes or welded tubes layout
- Designs applicable for low and high temperature applications, as well as fuel cell systems
- I Flow, U Flow, and cross counterflow designs available

**Customer Benefits**
- Portfolio covers broad cooling needs for all applications from Internal Combustion Engine, Hybrid and full electric vehicles
- High efficiency radiators enable fan and water pump power reduction
- Compact constructions allow styling flexibility and fuel efficiency
- Tube designs to avoid protective grids

**ESTRA Advantage**
- Broad line-up with high heat transfer and low charge air pressure drop
- Variety of center and turbulator geometries enable optimal system sizing
- Extensive manifold and turbulator design experience that best optimize charge air heat transfer and pressure drop
- New mono tube portfolio designed to comply with latest legal emission requirements
- Proven high temperature and high strength materials for all vehicle applications
- High structural and fluid dynamic expertise to customize product

**Charge Air Cooler**

- Provides optimal charge air temperatures in all vehicle conditions
- Optimizes charge air pressure drop to ensure smooth engine efficiency and reduce turbo lag
- Full face or bed type layout

**Features**
- Provides optimal charge air temperatures in all vehicle conditions
- Optimizes charge air pressure drop to ensure smooth engine efficiency and reduce turbo lag
- Full face or bed type layout

**Customer Benefits**
- Charge air cooler portfolio covers all customer applications
- Variety of packaging options for any performance condition
- Improved heat transfer efficiency
- Reduces vehicle emissions and turbo Lag
Be the most preferred partner for each of our customers
- we do this by continuously developing ourselves individually and as one family
Heat Exchangers

- Powertrain Cooling Module
- Condenser
- Radiator
- Charge Air Cooler
- Motor, Fan & Shroud
- Liquid Cooled Chiller
- Liquid Cooled Condenser
- Battery Cooling Plate
- Inner Heat Exchanger
- Evaporator & Heater Core
### Powertrain Cooling Module

**Features**
- Provide adequate airflow and sealing to cool all components in module
- Reduced vibrational loads
- Reduced airborne and transmission noise

**ESTRA Advantage**
- Modules customized to deliver superior packaging, performance and mass attributes.
- Strong system development capability to optimize all cooling configurations
- Innovative solutions for mounting and serviceability
- Technical know-how to manage noise and vibration attributes
- Proven solutions to protect against debris impact without the need for grids

**Customer Benefits**
- Compact designs deliver high performance, low mass and require less fan power
- Fastener-less designs and proven assembly concepts enable ease of serviceability
- Customized sealing improves module airflow and reduce fan power

### Condenser

**Features**
- Delivers excellent performance and low pressure drop with superior corrosion resistance
- Variety of tube geometries designed to fulfill all vehicle systems and compressor requirements
- Customized air center geometries focused on optimizing heat transfer and pressure drop to fit vehicle airflow
- Innovative design and manufacturing solutions for vehicle integration
- Core bending technology available to enhance compactness
- Folded or extruded tube designs provide impact resistance to road debris without the need for grids

**ESTRA Advantage**
- Integrated receiver dehydrator provides refrigerant sub-cooling for evaporator and removes moisture from system
- Internal flow paths allows proper oil circulation
- Variable design solutions for sub-cooling placement
- Dual filters at receiver dehydration and outlet connection deliver high level technical cleanliness

**Customer Benefits**
- Heat exchangers that deliver high performance with low mass
- Reliable material system that provides long life durability
- Flexible design solutions can offset poor vehicle air distribution
- Fastener-less and unique mounting solutions improve the serviceability
<table>
<thead>
<tr>
<th>Liquid Cooled Condenser</th>
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<tbody>
<tr>
<td><strong>Features</strong></td>
</tr>
<tr>
<td>- Provides sub-cooled liquid to the evaporator</td>
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<tr>
<td>- Removes moisture and allows oil circulation in the refrigerant system</td>
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<tr>
<td>- Provides heat source for battery thermal management</td>
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<tr>
<td>- Integrated filters at receiver dehydration and outlet connection deliver high level technical cleanliness</td>
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<tr>
<td><strong>Customer Benefits</strong></td>
</tr>
<tr>
<td>- Lightweight compact designs provide more stable performance</td>
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<tr>
<td>- Enables thinner powertrain cooling module requiring fan power</td>
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<td>- Heat source for electric vehicle and hybrid vehicles</td>
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<tr>
<th>Motor, Fan &amp; Shroud</th>
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<tr>
<td><strong>Features</strong></td>
</tr>
<tr>
<td>- Low profile fan and shroud designs available for improved compactness</td>
</tr>
<tr>
<td>- Fan geometries include acoustic rings and other noise dampening design features</td>
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<tr>
<td>- Blade geometry customized for system air flow and Low level acoustics</td>
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<tr>
<td><strong>Customer Benefits</strong></td>
</tr>
<tr>
<td>- Optimized fan and shroud design delivers perfect airflow and acoustics level</td>
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<tr>
<td>- Lower power levels as fan and system pressures are equalized</td>
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<tr>
<td>- Low acoustics as system level approach minimizes in vehicle noise levels</td>
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<th>Estra Advantage</th>
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<tbody>
<tr>
<td><strong>Liquid Cooled Condenser</strong></td>
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<tr>
<td>- Deliver excellent performance and low pressure drop in a customizable compact package</td>
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<tr>
<td>- Extensive knowledge in fabrication and brazing technologies</td>
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<tr>
<td>- Comprehensive understanding of material system requirements</td>
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<tr>
<td>- Diverse portfolio of heat transfer surfaces</td>
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<tr>
<td>- Wealth of experience in system integration</td>
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<tbody>
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<td><strong>Motor, Fan &amp; Shroud</strong></td>
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<tr>
<td>- High level of expertise in development of efficient blades with low noise characteristics</td>
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<tr>
<td>- Strong system integration capability with excellent experience in airflow management for all vehicle architectures</td>
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<tr>
<td>- Highly diverse portfolio of blade geometries to meet all cooling airflow requirements</td>
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<tr>
<td>- Low level of acoustics that extend through entire RPM range</td>
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</table>
**Battery Cooling Plate**

- Maintain a uniform surface temperature to prolong battery life
- Dissipate high heat loads to enable fast charging
- Maintain low pressure drop system for reduced power consumption
- Vast manufacturing knowledge in sampling, forming and brazing/welding
- Cooling plates capable of maintaining uniform surface temperature < 1 K across entire plate surface
- Systems design that can deliver < 3 K temperature spread over entire system
- High corrosion resistance and low conductive material suitable for battery cooling applications
- Flexible designs solutions for low pressure drop in all packaging

**Features**

- Delivers excellent performance and coolant pressure drop with superior corrosion resistance
- Extensive knowledge in fabrication and brazing technologies
- Comprehensive understanding of material system requirements
- Diverse portfolio of heat transfer surfaces
- Strong system integration experience

**ESTRA Advantage**

- Uniform temperature at battery contact surface
- Customized plate designs to accommodate any stack configuration
- Integrated refrigerant controls for efficient thermal management

**Customer Benefits**

- Lightweight compact designs provide more stable performance
- Enables thinner powertrain cooling module requiring lower fan power
- Integrated refrigerant controls for efficient thermal management

**Liquid Cooled Chiller**

- Provides heating and cooling source for both battery cooling and heat pump systems
- Chiller portfolio includes both plate-plate and plate and fin technologies.
- Various refrigeration controls and connections available such as eTXV, EXV, etc.
- 3 way valve and/or reversing valves available

**Features**

- Liquid Cooled Chiller
- Chiller portfolio includes both plate-plate and plate and fin technologies.
- Various refrigeration controls and connections available such as eTXV, EXV, etc.
- 3 way valve and/or reversing valves available

**Customer Benefits**

- Uniform temperature at battery contact surface
- Customized plate designs to accommodate any stack configuration
- Wide range of mounting and connecting solutions
Inner Heat Exchanger

**ESTRA Advantage**
- Design uses tube and center technology for applications in heat pump systems
- Robust designs capable of operating in low and high pressure systems
- Balanced material system provides superior corrosion protection
- Technical know how to develop water shedding and drainage features into the designs to enhance evaporator performance
- Proven folded tube technology offers high performance and greater durability eliminating the need for coatings
- Optimized designs maintain a uniform temperature in all environments and under all load conditions

**Features**
- Superior performance and temperature uniformity
- Reduced odor and emissions

**Customer Benefits**
- Acts as cabin condenser for heating and as evaporator for cooling
- Delivers more heating capacity than traditional cabin condenser
- Packaging is interchangeable in existing HVAC modules
### Evaporator

- Delivers conditioned air with good stratification
- Reduced odor
- Plate type or tube & center design
- Enhanced hydrophilic coating available for superior corrosion and anti-microbial protection

### Heater Core

- Delivers conditioned air with superior performance and good temperature uniformity
- U flow, cross counter or single-pass layouts

### Estra Advantage Evaporator
- Delivers better performance and lower mass with less packaging space required as compared to plate type evaporators
- Unique material system provides superior corrosion protection
- Technical know-how to develop water shedding and drainage features into the designs to enhance evaporator performance
- Proven folded tube technology offers high performance and greater durability without the need for coatings
- Effective solutions for managing temperature stratification

### Estra Advantage Heater Core
- Provides excellent performance and lower mass with packaging solutions for all HVAC module architectures
- Variety of tube geometries designed to fit all vehicle systems and heating requirements
- Customized tank geometries enable flexible module designs
- Multi-pass heater design ensures uniform temperature distribution for all module architectures

### Features

#### Evaporator
- Delivers conditioned air with good stratification
- Reduced odor
- Plate type or tube & center design
- Enhanced hydrophilic coating available for superior corrosion and anti-microbial protection

#### Heater Core
- Delivers conditioned air with superior performance and good temperature uniformity
- U flow, cross counter or single-pass layouts

### Customer Benefits

#### Evaporator
- Compact designs deliver high performance and high efficiency with low mass
- Scalable designs offer flexible packaging to meet various architecture requirements
- Maintains uniform temperature distribution at all load conditions and with all vehicle architectures

#### Heater Core
- Compact designs deliver high performance and low pressure with low mass
- Scalable designs offer flexible packaging to meet various customer architectures
- Maintains uniform temperature distribution at all load conditions and with all vehicle architectures