

**RAAL**<sup>®</sup>  
complete cooling solutions



**CONDENSERS AND EVAPORATORS**



RAAL manufactures a wide range of high performing aluminium parallel flow condensers and evaporators for off-road equipment, automotive, commercial vehicles, railway and industrial equipment.

**▪ HVAC-R**

- Heating, ventilation, and air conditioning systems
- Refrigeration systems

**▪ RAILWAY EQUIPMENT**

- Railcars, subway trains, trams

**▪ AGRICULTURAL AND FORESTRY EQUIPMENT**

- Tractors
- Harvesters, sprayers
- Loaders, telehandlers
- Forestry equipment

**▪ INDUSTRIAL EQUIPMENT**

- Compressed air dryers, chillers

**▪ AUTOMOTIVE AND COMERCIAL VEHICLES**

- Buses, coaches, utility vehicles
- Cars, trucks

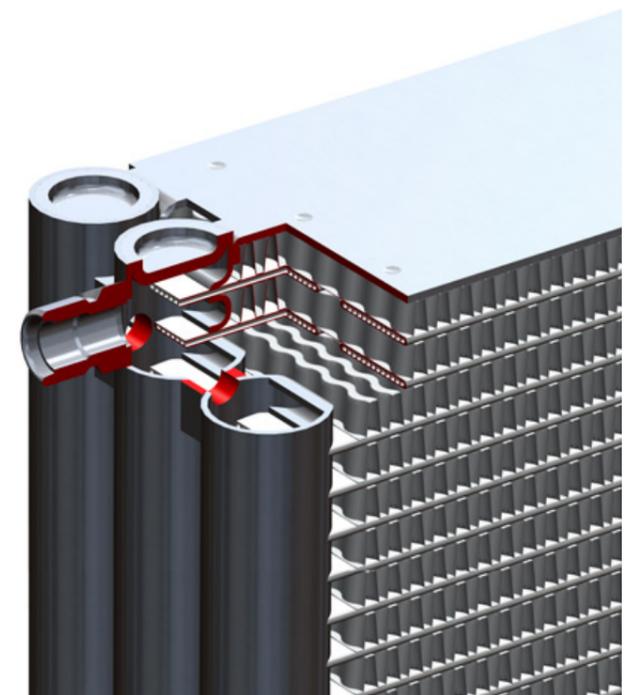
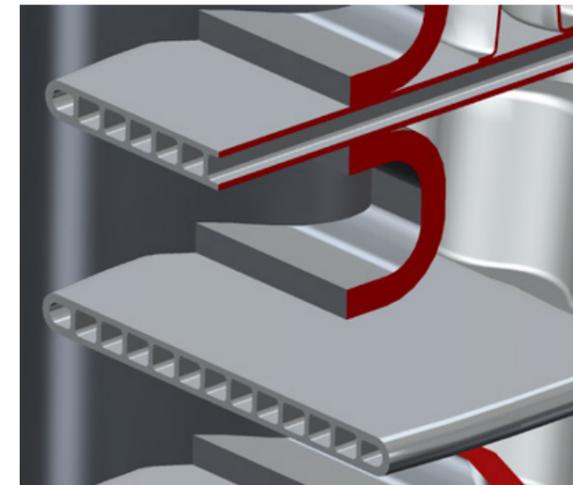
**▪ CONSTRUCTION AND MINING EQUIPMWENT**

- Excavators, bulldozers
- Loaders, telehandlers
- Articulated and rigid dump trucks
- Compactors
- Mining Equipment

**RAAL CONDENSERS and EVAPORATORS with extruded tubes and manifolds**

**Tubes & manifolds**

- different types of extruded tubes (multi channel)
- 1, 2, 3 or more rows of tubes mounted in parallel
- Core thicknesses (mm): 16, 18, 25.4, 43, 58, 68...
- Manifolds diameters (mm): ø20, 22, 30



**Technology**

- Brazing in controlled atmosphere with nitrogen, using Nocolok technology
- Continuous tunnel type furnaces
- Painting with epoxy-polyester powders in electrostatic field

**Materials**

- Aluminium alloys material
- Conventional aluminium alloys: Zn Arc Sprayed (ZAS) MPE tubes and fins with Zn content
- Long-life materials provide high mechanical resistance and corrosion protection

**Corrosion Performance**

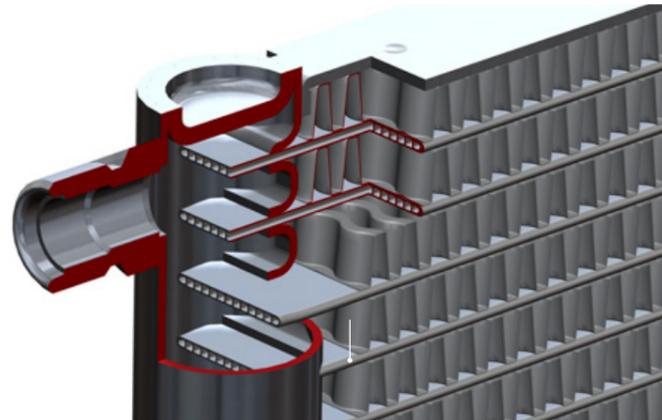
- Anti corrosion design
- Corrosion resistance tests according to ASTM B117/ ASTM G85 standards
- No leakage after more than 1000 h of salt spray exposure

**Refrigerant**

Different cooling refrigerants: R134a, R404a, R407c, CO<sub>2</sub>, etc.

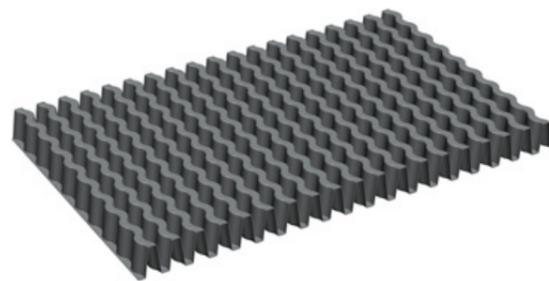


**EXTRUDED TUBES** construction solution for RAAL parallel flow condensers and evaporators

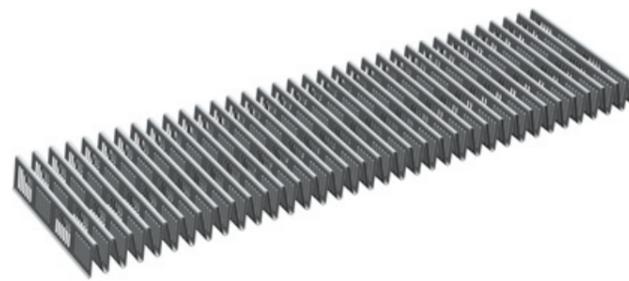


**RAAL Fins**

Condensers can be built with wavy fins and louvered fins



**Wavy fin** for off-road and heavy-duty equipment



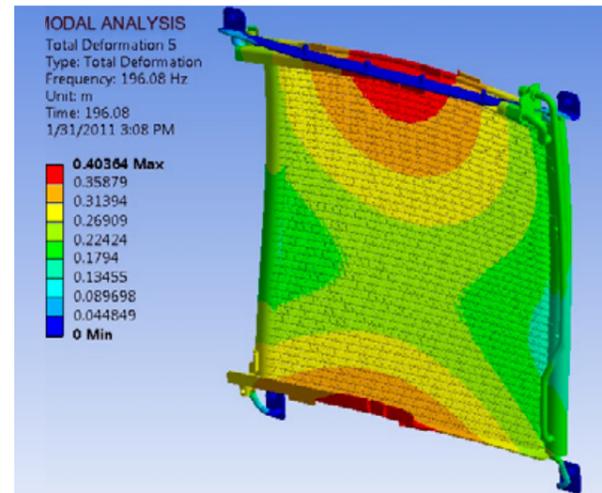
**Louvered fin** for automotive, commercial vehicles and stationary equipment

**Software**

- RAAL uses its own sizing software for calculation, modal analysis, KULLI, etc.
- 3D design (SolidWorks software)

**Testing**

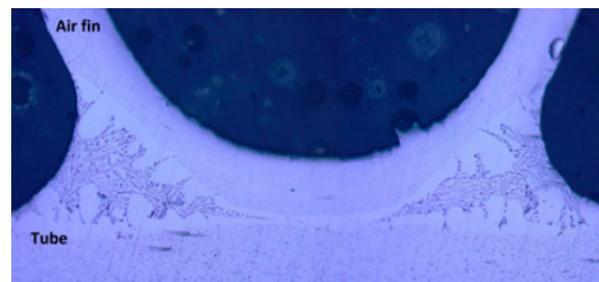
- Thermodynamic performance tests
- Burst pressure resistance tests
- Vibration tests



**ADVANTAGES OVER THE CLASSIC FIN AND TUBE**

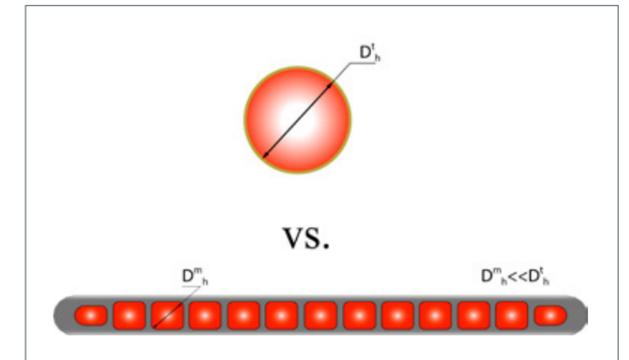
**Increase Heat Transfer**

The brazing process forms a single aluminium block consisting of the micro channel and the fin, increasing the conductivity between fins and micro channels.



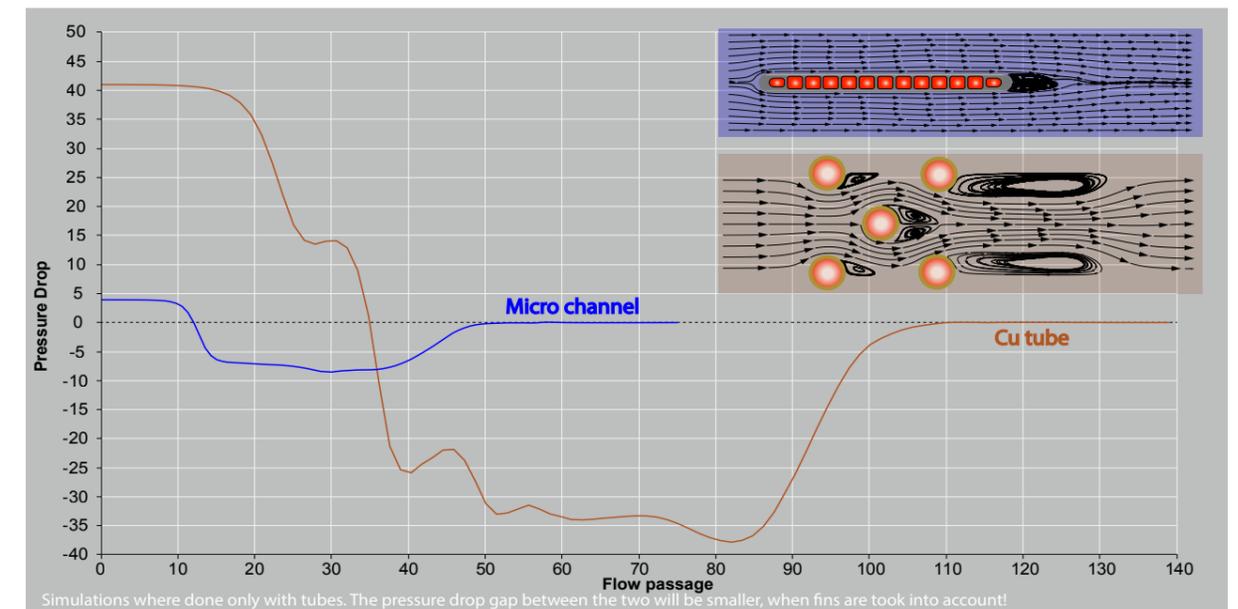
Brazed joint tube-air fin

The smaller hydraulic diameter can increase the internal heat transfer coefficient up to 6 times than Cu tubes version.



**Pressure drop**

Shorter passages on air side and a parallel flow will result in lower pressure drops over the micro channel condenser. As a consequence of the lower pressure drop the energy consumption for the refrigerant cooling is lower, through the use of a lower power consumption fans, consequently reducing the noise.



Simulations were done only with tubes. The pressure drop gap between the two will be smaller, when fins are taken into account!

**Weight and Occupied space**

Having a smaller thickness the micro channel is lighter than the Cu tube condenser, making it suitable for mobile applications. Also, because it is thinner, the occupied space in the system is smaller leading to smaller condensing units

**Refrigerant charge in the system**

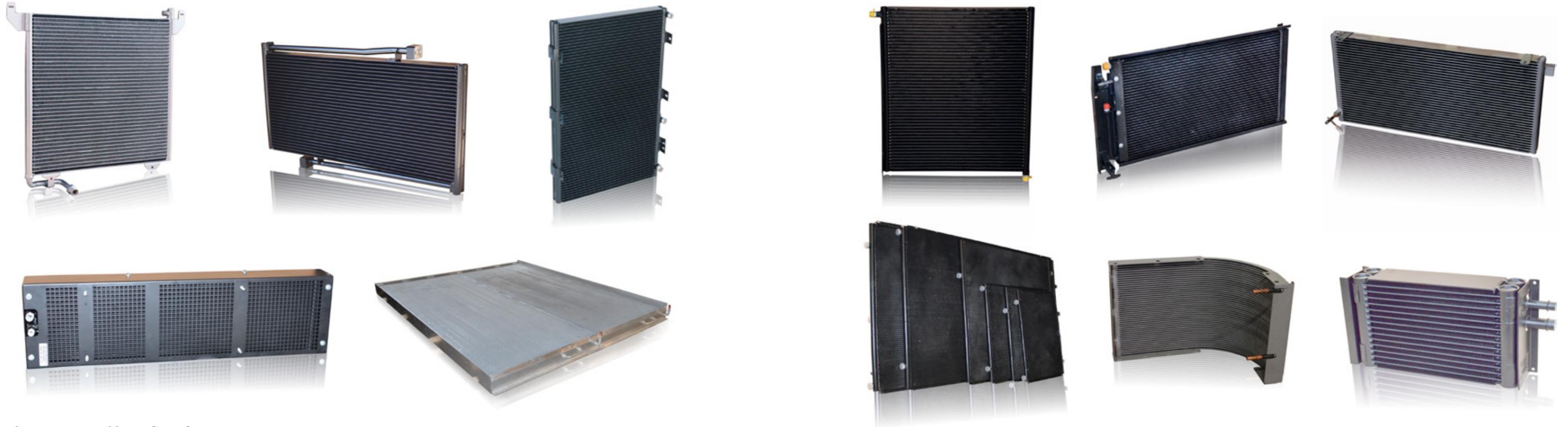
Smaller internal volume of the micro channels helps the environment by lowering the refrigerant charge needed for the system by 80%



**Aluminium – Copper brazed connections**

Aluminium condensers can be easily integrated in HVAC-R systems with copper tubes using torch brazed joint.

Cooper/aluminium joints are protected against galvanic corrosion by using shrink wrap materials or painting.



## Advantages and benefits of RAAL customers

### Flexibility and customized solutions

- thousands of different condensers and a wide range of sizes

### Experience and expertise

- 30 years of experience
- specialized teams (R&D, tool and die design, manufacturing, sales, logistics, marketing)

### Innovation, technology and performance

- 150 R&D engineers
- 30-50 days for a new product development
- a well-equipped test center, patents for fin forming machines and new design/technology solutions
- investment in the latest equipment and technologies

### Short terms, competitive prices

### Quality and reliability

- high quality management standards: ISO9001 and ISO/TS16949
- extended warranty terms (24 or 36 months), post-sale services

### Environment protection

- compact and lightweight products with minimal impact on the environment, 100% recyclable products
- Environmental Management System according to EN ISO 14001:2004

### Long-term partnership

- The mutual trust, openness towards the latest technical solutions and customer approach are the core values of **RAAL**, that guarantee a long-term business relationship



## Contact

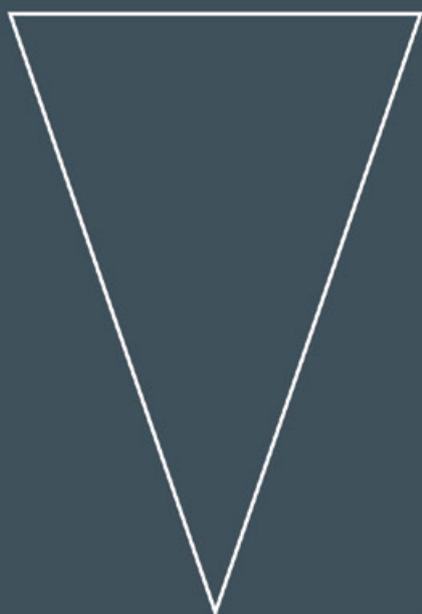
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