

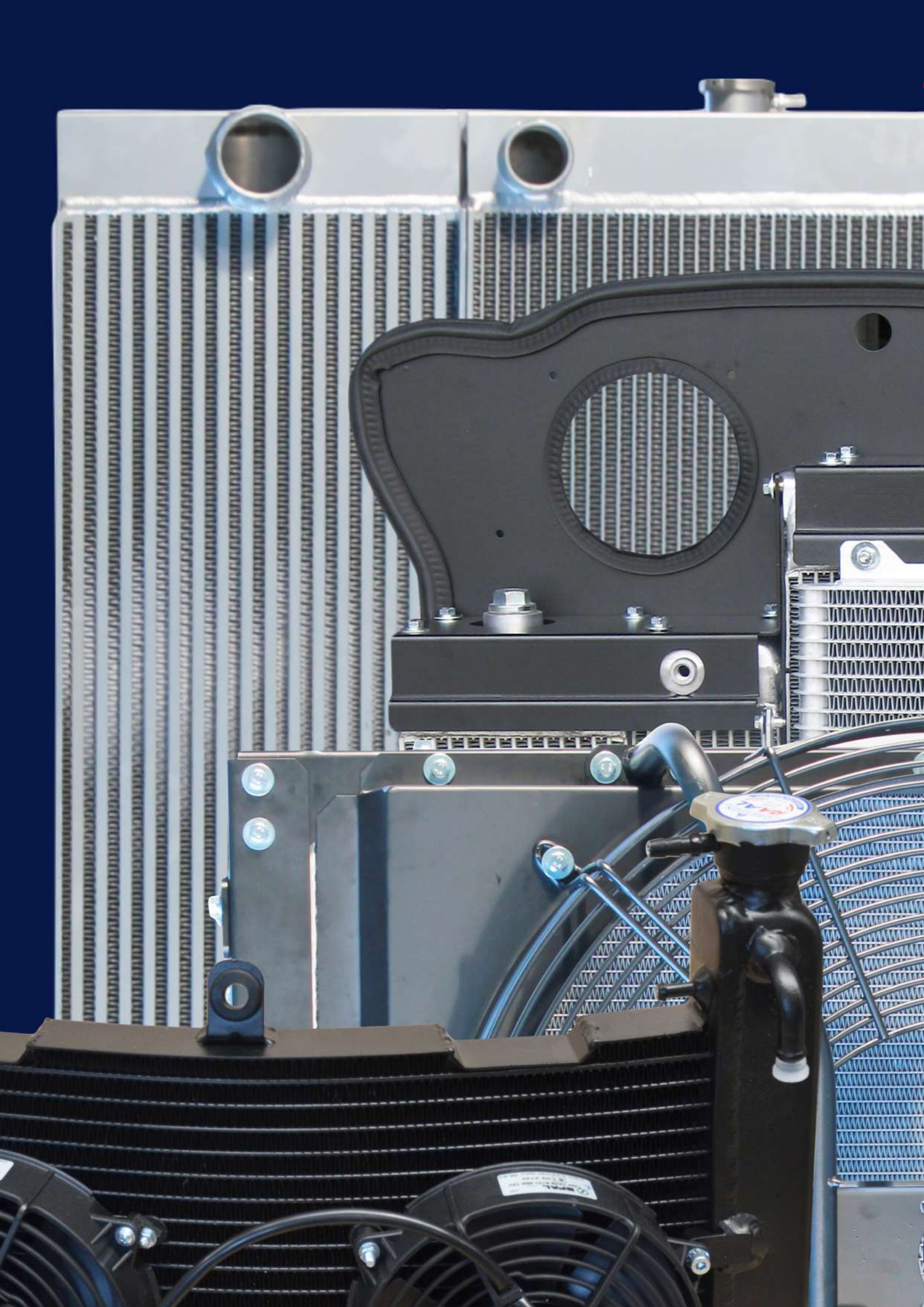


**RAAL**<sup>®</sup>  
complete *cooling* solutions



**COMPLETE  
COOLING  
SOLUTIONS**





**RAAL** is a manufacturer of complete cooling systems and heat exchangers, made of aluminium alloys and stainless steel, in brazed construction: radiators, oil coolers, air coolers, condensers and combined coolers, designed for agricultural, construction, industrial equipment and automotive applications.

#### AGRICULTURE AND FORESTRY



tractors · harvesters · sprayers · loaders · telehandlers  
garden machinery · forestry equipment

#### CONSTRUCTION AND MINING



loaders · excavators · bulldozers · drilling equipment · forklifts  
cranes · telehandlers · dump trucks · compactors · crushers  
asphalt & concrete pavers · motor graders · mining equipment

#### AUTOMOTIVE, COMMERCIAL VEHICLES AND RAILWAYS



buses · coaches · cars · motorcycles · utility vehicles · trucks  
ATVs · karts · snowmobiles · water scooters · locomotives  
railway equipment · traction transformers

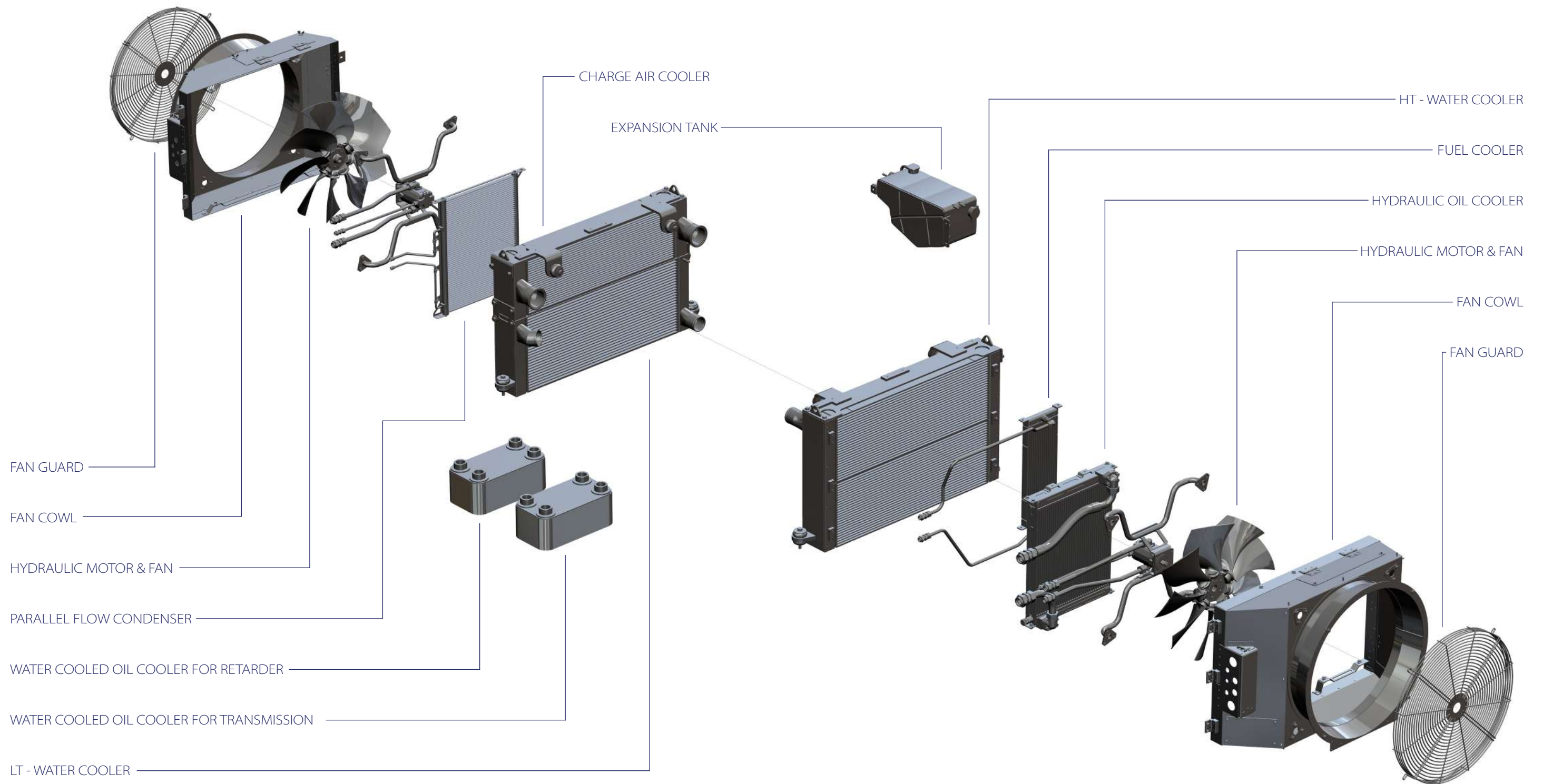
#### INDUSTRIAL EQUIPMENT



compressors · compressed air dryers · chillers · HVAC-R  
power generation equipment · gensets · windmills  
heat recovery systems · engines · hydraulic equipment



## COOLING SYSTEM





## COOLING SYSTEMS



**RAAL** manufactures **COMPLETE COOLING SYSTEMS**, composed of brazed aluminium heat exchangers:

- RADIATORS (HT, LT)
- CHARGE AIR COOLERS
- FUEL COOLERS
- Metallic structures: fan cowls, fan guards, frames, expansion tanks.
- The cooling systems are also equipped with fans, motors, etc.
- OIL COOLERS (engine, hydraulic, transmission, etc.)
- COMPRESSED AIR COOLERS
- CONDENSERS, EVAPORATORS

### EQUIPMENT and APPLICATIONS

- Agricultural and forestry equipment
- Automotive and commercial vehicles
- Industrial equipment
- Hydraulic equipment
- Power generation
- Construction and mining equipment
- Railway equipment
- Compressors
- Engines
- Military equipment

## COOLING SYSTEMS



### CONSTRUCTIVE SOLUTIONS

- Plate&Bar
- Tube&Fin
- Shell
- Brazed plates
- Extruded tubes

### FEATURES

- High cooling performance
- Compact construction
- Modular solution using various designs and configurations
- "Drop-in-place" concept for integration into the equipment

**RAAL bears the full responsibility for the complete cooling system**

**RAAL also manufactures HEAT SINKS, COLD PLATES, BATTERY COOLERS for hybrid and electric cars.**



## OIL COOLERS



### TYPES

- Hydraulic Oil Coolers
- Transmission Oil Coolers
- Engine Oil Coolers
- Retarder Oil Coolers
- Gearbox Oil Coolers
- Steering Oil Coolers
- Brake Oil Coolers
- Clutch Oil Coolers
- Hydrostatic Oil Coolers
- Fuel Coolers

### EQUIPMENT and APPLICATIONS

- Agricultural and forestry equipment
- Construction and mining equipment
- Commercial vehicles
- Automotive
- Military equipment
- Railway equipment
- Compressors
- Hydraulic equipment
- Power generation
- Industrial equipment

### CONSTRUCTIVE SOLUTIONS

- Plate&Bar (oil-air, oil-water)
- Shell (oil-air)
- Brazed plates (oil-water)
- Tube&Fin (oil-air)
- In-tank plate type (oil-water)

## OIL COOLERS

### PLATE&BAR OIL COOLERS (oil-air, oil-water)



### FEATURES

- Flexible design and robust construction
- Special-design turbulators, spacers and extruded tanks for up to 40 bar working pressure
- Wide variety of wavy fins for soiling prevention
- Special-design spacers and side plate expansion cuts for thermal stress management
- Internal / external bypass valves for cold start
- Suitable for hard working conditions: vibrations, shocks etc.

### SHELL OIL COOLERS (oil-air)



### FEATURES

- Light long-lasting construction
- Modular construction
- Suitable for hard working conditions: vibrations, shocks etc.
- High heat transfer
- Low air side pressure drops
- Suitable for low and medium working pressures
- Attractive design



## OIL COOLERS

### TUBE&FIN OIL COOLERS (oil-air)

#### FEATURES

- Lightweight
- Attractive design
- Good heat transfer performance
- Low air side pressure drops
- Suitable for low and medium working pressure
- Suitable for medium and large series



### BRAZED PLATES OIL COOLERS (oil-water)



#### FEATURES

- Compact, robust and modular construction
- High mechanical resistance
- Suitable for low and medium working pressure
- Very good weight/heat transfer ratio
- Suitable for medium and large series

### IN-TANK PLATE OIL COOLERS (oil-water)

#### FEATURES

- Very compact and efficient
- High working pressures up to 30 bar
- Good weight/heat transfer ratio
- Suitable for medium and large series



## RADIATORS

### PLATE&BAR RADIATORS (water-air)



#### EQUIPMENT and APPLICATIONS

- Agricultural and forestry equipment
- Construction and mining equipment
- Commercial vehicles and railway equipment
- Industrial equipment
- Military equipment

#### FEATURES

- Robust and compact construction
- Flexibility in choosing the right geometry of elements, to optimize performance
- A very large dimensional range
- High resistance to mechanical and thermal loads

### TUBE&FIN RADIATORS (water-air)



#### EQUIPMENT and APPLICATIONS

- Automotive
- Commercial vehicles
- Genset and industrial equipment
- Agricultural and forestry equipment

#### FEATURES

- Reduced weight and costs
- Good heat transfer performances
- Attractive design
- Suitable for medium and large series

RAAL also manufactures SHELL type RADIATORS (water-air).

## AIR COOLERS

### PLATE&BAR AIR COOLERS

#### TYPES

- Charge Air Coolers
- Compressed Air Coolers
- Air Coolers for Dryers



#### EQUIPMENT and APPLICATIONS

- Agricultural and forestry equipment
- Construction and mining equipment
- Commercial vehicles
- Railway equipment
- Military equipment
- Compressors
- Air dryers
- Industrial equipment

#### FEATURES

- Robust and compact construction
- Long lasting
- Very large dimensional range
- High resistance to mechanical and thermal loads
- Suitable for low and medium series

## AIR COOLERS

### TUBE&FIN AIR COOLERS

#### TYPES

- Charge Air Coolers



#### EQUIPMENT and APPLICATIONS

- Automotive
- Commercial vehicles
- Industrial equipment

#### FEATURES

- Reduced weight and costs
- Good heat transfer performances
- Attractive design
- Suitable for medium and large series

### SHELL AIR COOLERS

#### TYPES

- Charge Air Coolers
- Compressed Air Coolers



#### EQUIPMENT and APPLICATIONS

- Agricultural and forestry equipment
- Construction and mining equipment
- Compressors
- Industrial equipment

#### FEATURES

- Reduced weight and costs
- Good heat transfer performances
- Attractive design
- High resistance to thermal loads
- Suitable for medium and large series



## CONDENSERS AND EVAPORATORS



### TYPES

- Parallel Flow Condensers
- Evaporators

### EQUIPMENT and APPLICATIONS

- HVAC-R
- Agricultural and forestry equipment
- Construction and mining equipment
- Automotive and commercial vehicles
- Railway equipment
- Air dryers and chillers
- Industrial equipment

### CONSTRUCTIVE SOLUTIONS

- Extruded tubes

### FEATURES

- Compact and lightweight
- High thermal performance
- High working pressure
- Low air pressure drop
- Suitable for different refrigerants
- Less refrigerant needed
- A wide range of sizes
- Reduced noise



## BATTERY COOLERS

### TYPES

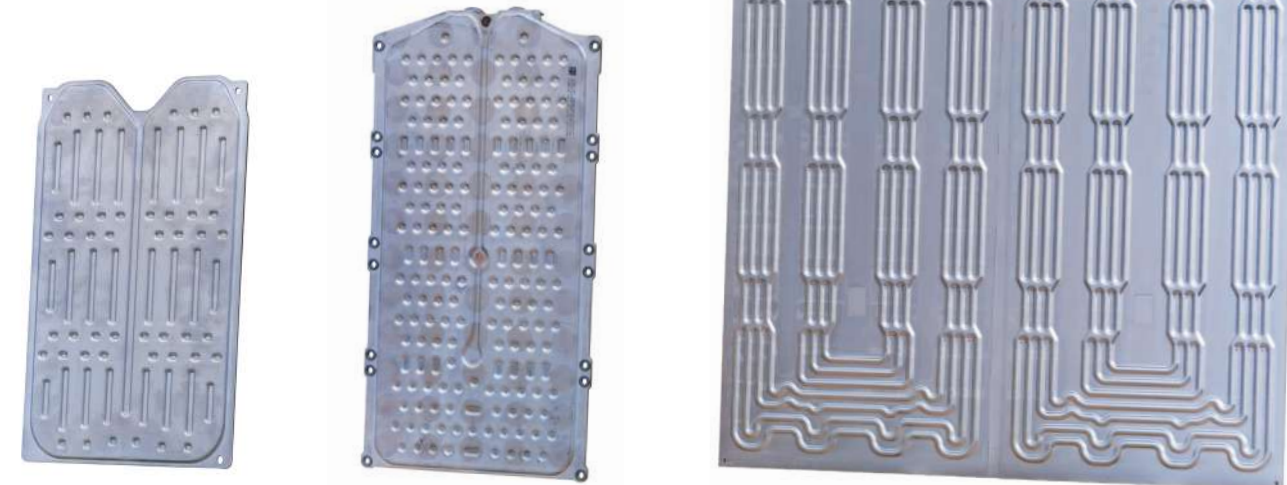
- Battery cooler

### EQUIPMENT and APPLICATIONS

- Cooling battery cells for hybrid and electric vehicles

### CONSTRUCTIVE SOLUTIONS

- Brazed plates



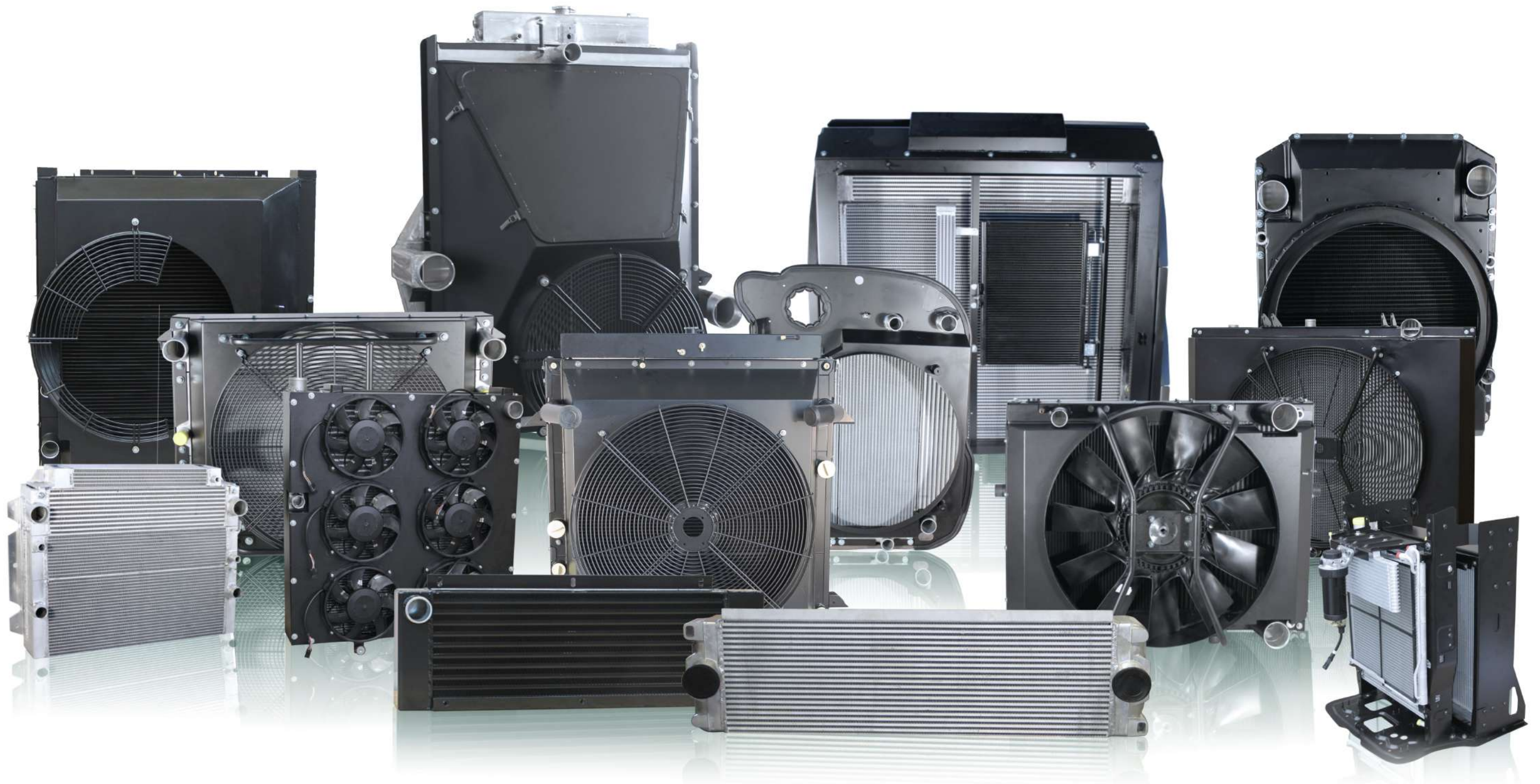
## STAINLESS STEEL HEAT EXCHANGERS



### FEATURES

- Suitable for high pressures, high temperatures, and corrosive environments





## COMPLETE COOLING SOLUTIONS



## CONSTRUCTIVE SOLUTIONS

RAAL offers a wide range of aluminium brazed heat exchangers, in different constructive solutions:

- **PLATE&BAR**
- **PLATES (IN-TANK)**
- **TUBE&FIN**
- **BRAZED PLATES**
- **SHELL**
- **EXTRUDED TUBES**

The design engineers will choose the best constructive solution for each application, in order to fully comply to customer requirements.

### PLATE&BAR

**RAAL plate&bar heat exchangers** are available in a wide range of types and sizes, due to the exceptional flexibility in building the core structure.

**Working fluids:** water, oil, air, refrigerant, etc.

### TYPES

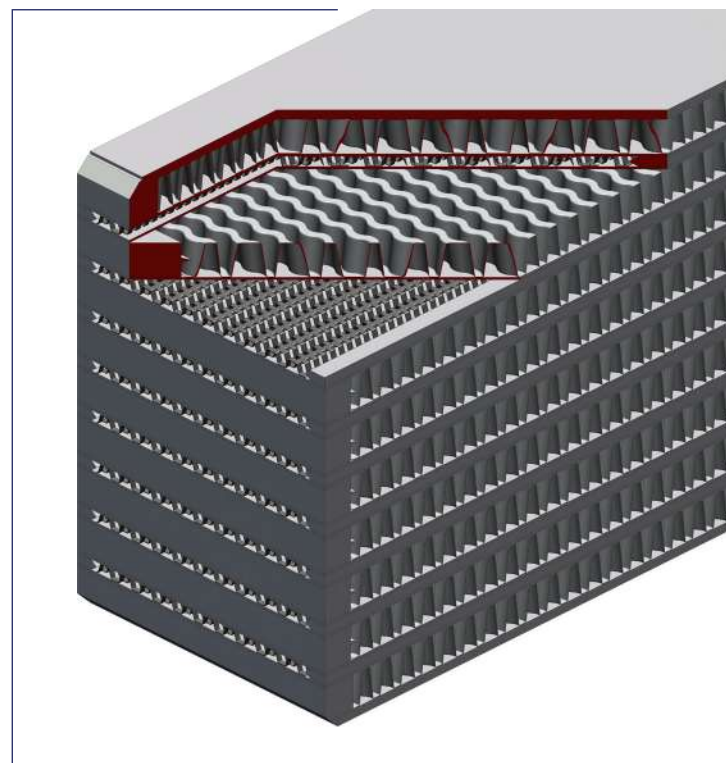
- Radiators (water-air)
- Oil Coolers (oil-air, oil-water)
- Charge Air Coolers (air-air, air-water)
- Compressed Air Coolers
- Fuel Coolers
- Air Dryers Coolers

### EQUIPMENT and APPLICATIONS

- Agricultural and forestry equipment
- Construction and mining equipment
- Commercial vehicles
- Military equipment
- Railway equipment
- Compressors
- Air dryers
- Hydraulic equipment
- Power generation
- Industrial equipment

### FEATURES

- Solid construction, long lasting and safe functioning
- Big sizes available by modular solutions
- High resistance at mechanical and thermal loads (vibrations, pressure cycle, thermal cycle).
- Suitable for high temperatures and pressures
- Suitable for low and medium series



## CONSTRUCTIVE SOLUTIONS

### TUBE&FIN

**RAAL Tube&Fin heat exchangers** feature high performance for automotive, commercial vehicles and industrial applications, where high mechanical and thermal stresses occur.

**Working fluids:** water, oil, air etc.

### TYPES

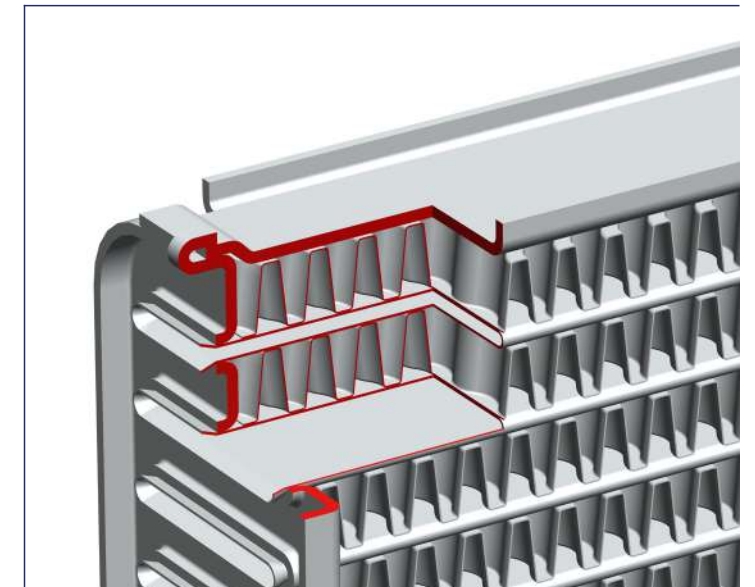
- Radiators (water-air)
- Oil Coolers (oil-air)
- Charge Air Coolers (air-air)
- Compressed Air Coolers
- Heater Cores

### EQUIPMENT and APPLICATIONS

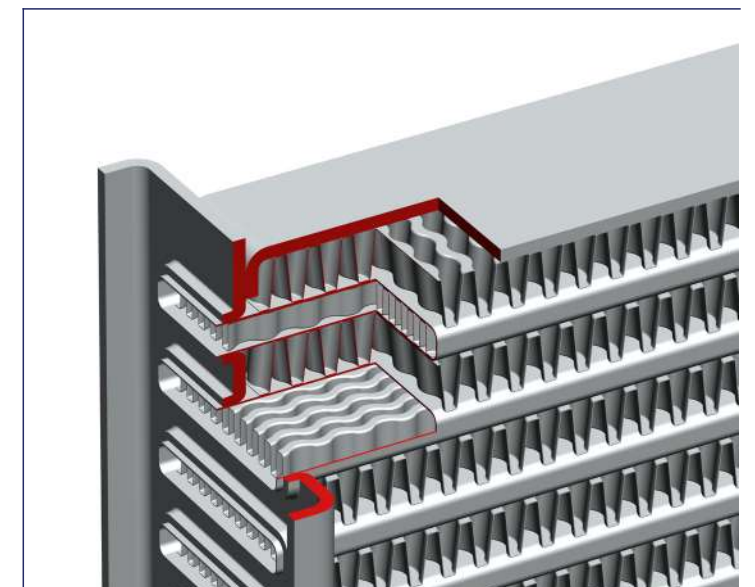
- Automotive
- Commercial vehicles
- Industrial equipment
- Agricultural and forestry equipment
- Power generation
- Construction and mining equipment

### FEATURES

- Light weight
- Attractive design
- Good heat transfer performance
- Suitable for low and medium pressures
- Suitable for medium and large series



radiator (water-air)



charge air cooler (air-air)



## CONSTRUCTIVE SOLUTIONS

### SHELL

**RAAL shell type heat exchangers** were designed considering the increase of thermal performances simultaneously with the reduction of the pressure drops, using a compact, robust and very light construction.

The main advantage of the **RAAL** shell heat exchangers consists of the modular construction and the flexibility in choosing the air fin height and type as well as the turbulator type.

**Working fluids:** water, oil, air, etc.

### TYPES

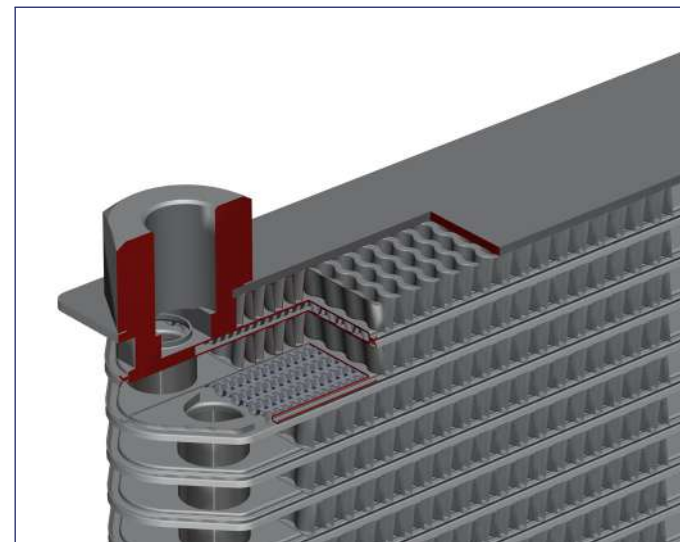
- Oil Coolers (oil-air)
- Charge Air Coolers (air-air, air-water)
- Radiators (water-air)
- Evaporators
- Fuel Coolers

### EQUIPMENT and APPLICATIONS

- Agricultural and forestry equipment
- Construction and mining equipment
- Compressors
- Industrial equipment
- Automotive
- Hydraulic equipment

### FEATURES

- Compact and efficient
- Long-lasting, light construction
- Attractive design
- Suitable for medium and large series



### PLATES (IN-TANK)

**RAAL plate (in-tank) heat exchangers** are used mainly to cool down the engine oil or transmission oil for automotive and off-road applications.

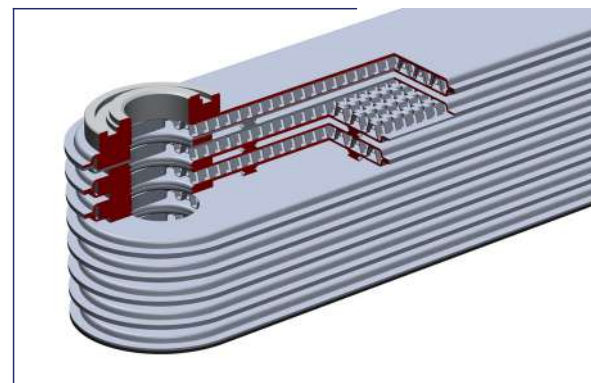
The Plates (in-tank) design can be used for oil coolers (oil-water).

### EQUIPMENT and APPLICATIONS

- Automotive and commercial vehicles
- Agricultural and forestry equipment
- Construction and mining equipment

### FEATURES

- Very compact and efficient
- Suitable for medium and large series
- High working pressures and good resistance at static and dynamic loads



## CONSTRUCTIVE SOLUTIONS

### BRAZED PLATES

**RAAL brazed plates heat exchangers** have been designed to increase the thermal performances in the fluid-to-fluid cooling applications.

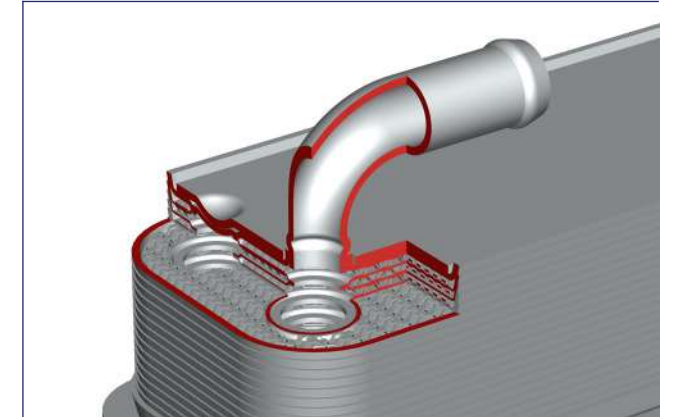
**Working fluids:** water, oil, air, etc.

### TYPES

- Water Cooled Oil Coolers (WCOC)
- Water Cooled Charge Air Coolers (WCAC)
- Evaporators

### EQUIPMENT and APPLICATIONS

- Agricultural and forestry equipment
- Construction and mining equipment
- Automotive
- Commercial vehicles
- Air dryers
- Heat recovery systems
- Heat pumps
- Industrial equipment



### FEATURES

- Compact, robust, modular construction
- High efficiency/weight ratio
- High mechanical resistance (high burst pressures)
- Suitable for medium and large series

### EXTRUDED TUBES

**RAAL extruded tubes heat exchangers** are available in a wide range of sizes, with different types of extruded tubes (multi-channel) and configurations (1, 2, 3 or more rows of tubes and manifolds mounted in parallel).

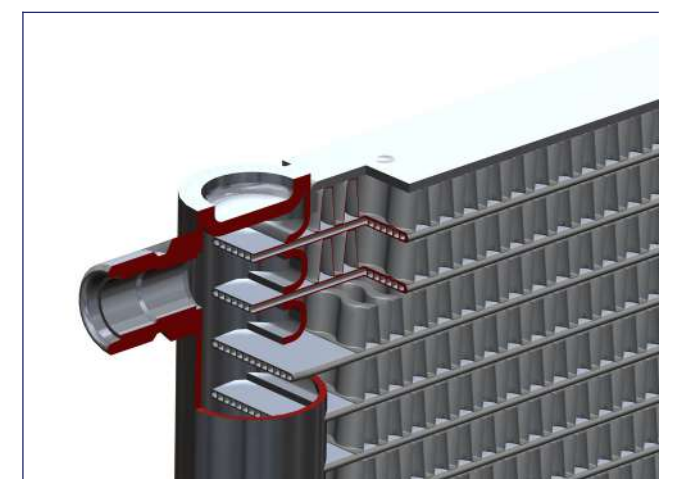
**Working fluids:** refrigerant

### TYPES

- Condensers
- Evaporators
- Fuel Coolers

### EQUIPMENT and APPLICATIONS

- HVAC-R
- Agricultural and forestry equipment
- Construction and mining equipment
- Automotive
- Commercial vehicles
- Railway equipment
- Air dryers
- Industrial equipment
- Heat pumps



### FEATURES

- Light weight
- Attractive design
- Suitable for medium and large series



## CONSTRUCTIVE SOLUTIONS



PLATE&BAR



PLATE&BAR



TUBE&FIN



EXTRUDED TUBES



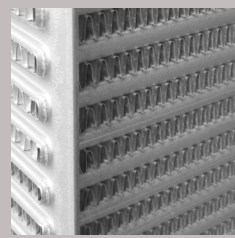
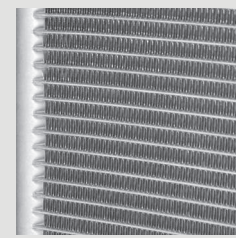
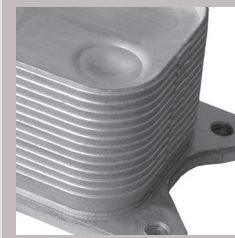


SHELL



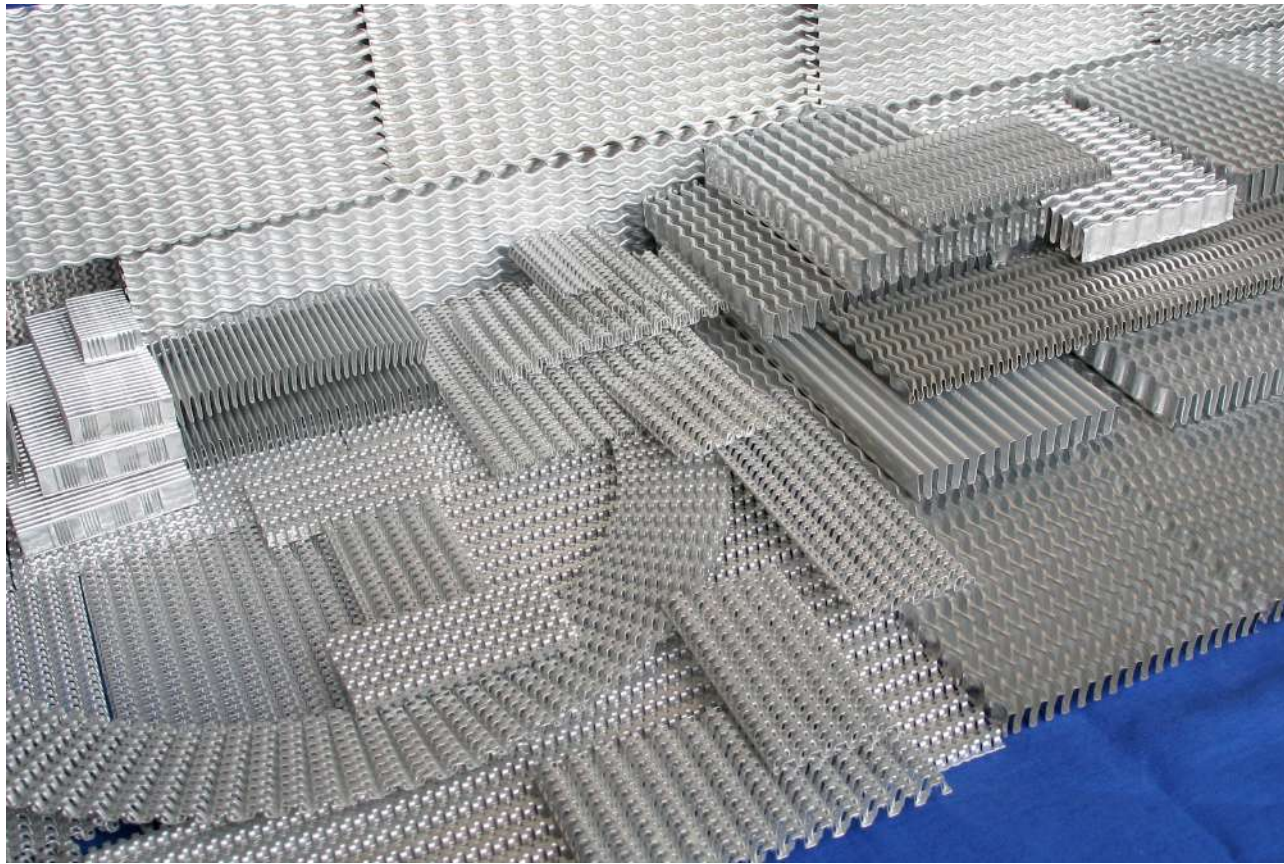
BRAZED PLATES

## CONSTRUCTIVE SOLUTIONS

 <b>PLATE&amp;BAR</b>	 <b>SHELL</b>	 <b>TUBE&amp;FIN</b>	 <b>EXTRUDED TUBES</b>	 <b>BRAZED PLATES</b>
<b>RADIATORS</b> (water-air)	<b>RADIATORS</b> (water-air)	<b>RADIATORS</b> (water-air)		
<b>OIL COOLERS</b> (oil-air) (oil-water)	<b>OIL COOLERS</b> (oil-air)	<b>OIL COOLERS</b> (oil-air)		<b>OIL COOLERS</b> (oil-air)
<b>AIR COOLERS</b> (air-air) (air-water)	<b>AIR COOLERS</b> (air-air) (air-water)	<b>AIR COOLERS</b> (air-air)	<b>PARALLEL FLOW CONDENSERS</b>	<b>AIR COOLERS</b> (air-air) (air-water)
<b>FUEL COOLERS</b>	<b>FUEL COOLERS</b>	<b>FUEL COOLERS</b>	<b>FUEL COOLERS</b>	
	<b>EVAPORATORS</b>		<b>EVAPORATORS</b>	<b>EVAPORATORS</b>



## RAAL FINS AND TURBULATORS



The unique **RAAL** fin forming technology allows the development of a wide range of fins and turbulators, according to the application requirements.

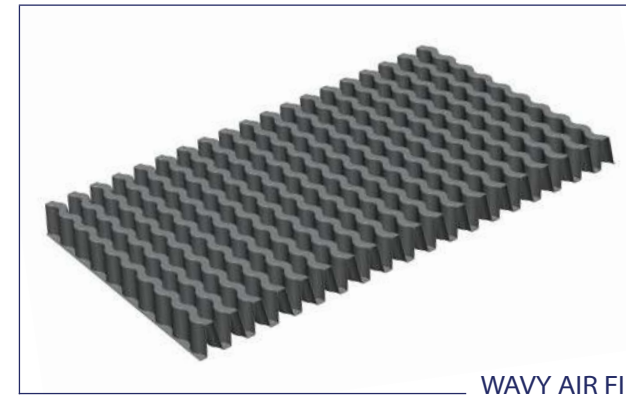
**RAAL** fins have the optimum geometry suited for each fluid involved in the thermal transfer process.

**RAAL** patented fin forming machines can achieve, with simple adjustments, the required geometries (pitch, height, etc.).

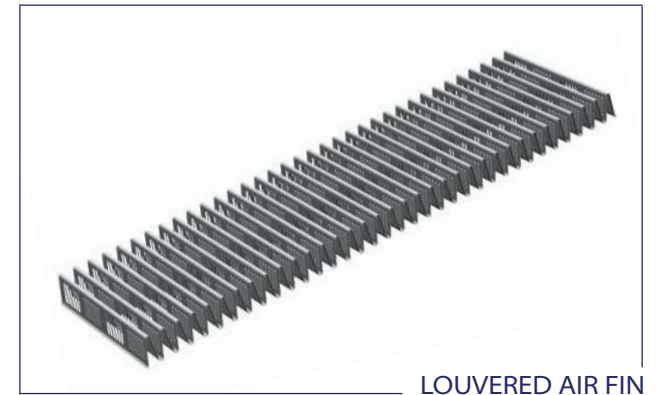


## RAAL FINS AND TURBULATORS

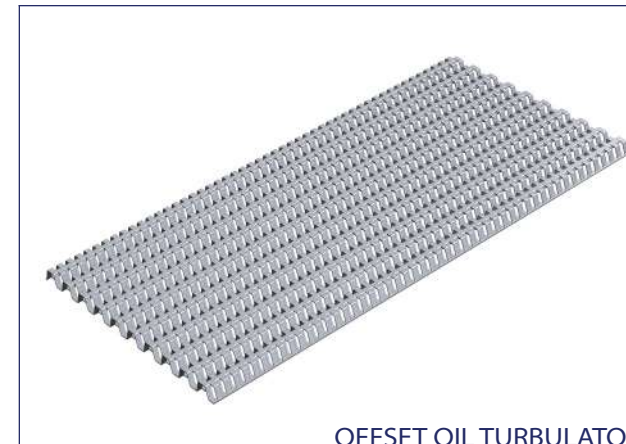
### STANDARD RAAL FINS AND TURBULATORS



WAVY AIR FIN



LOUVERED AIR FIN



OFFSET OIL TURBULATOR



OFFSET AIR TURBULATOR



OFFSET "X" OIL TURBULATOR



OFFSET WATER TURBULATOR

**RAAL** uses the newest aluminium and aluminium alloys, purchased from the most important suppliers of the European market.

The fins, turbulators, as well as the other heat exchangers components (tubes, sheets, manifolds, etc.) are manufactured using "long-life" materials. These materials derive from the standard alloy, by modifying the main alloying elements, in order to obtain higher mechanical and corrosion resistance.

The outstanding features of **RAAL** heat exchanger components ensure long lasting products in different operating conditions.



## CAPABILITY

**RAAL** is an integrated company, all activities (manufacturing, design, testing, etc.) being carried out "in house". This competitive advantage provides both a very short development and assimilation cycle in production of new products as well as short term manufacturing and supply of series production.

### MANUFACTURING

- aluminium alloys heat exchangers and complete cooling systems, with 9 brazing lines, using the Nocolok technology
- stainless steel heat exchangers with a vacuum furnace for stainless steel brazing
- steel structures, as parts of the **RAAL** cooling systems in two manufacturing sites in Romania: Bistrita on 12500 m<sup>2</sup> and Prundu Birgaului on 32000 m<sup>2</sup>.



## CAPABILITY

### ENGINEERING

**RAAL** R&D department, experienced and highly qualified, provides a very short development and assimilation cycle in production.

- DESIGN AND SIMULATION
- PRODUCT DESIGN
- TESTING CENTER
- PROTOTYPE WORKSHOP
- TOOLS AND EQUIPMENT

### LOGISTICS

**RAAL** is able to provide customized logistics services (transport, storage, distribution) according to customers' needs and requests.

**RAAL** has subsidiaries and warehouses in Italy, Holland, Germany, Russia and USA.

**FLEXIBILITY, EXPERIENCE** and **INNOVATION**, as reflected in **RAAL** products, satisfy the highest demands.



## ENGINEERING

### Design, calculation and simulation

**RAAL** uses its own dimensioning software for heat exchangers, software developed in-house based on theoretical studies and thousands of tests performed.

**RAAL** uses FEA (Finite Element Analysis) to simulate the structural, flow and vibration stress conditions.

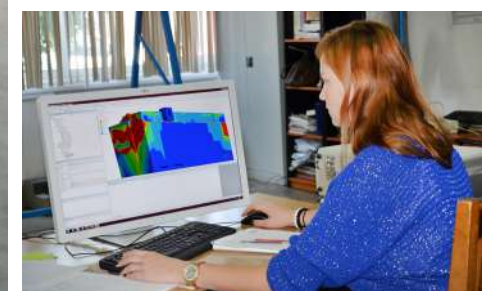
### Product design

**RAAL** has vast experience in designing heat exchangers and cooling systems. Starting from the specifications, dimensions or CAD data of the application, **RAAL** designers are able to find the best solutions for the most efficient use of the available space.

**RAAL** designers have the ability to continuously optimize the products, so as to fully meet the requirements of the application.

### Testing and validation

**RAAL Testing Center** is the facility where the validation of new products is performed. Based on technical specifications or on the parameters obtained by means of DAQ performed on customer equipment, the heat exchangers are tested for performance and strength.



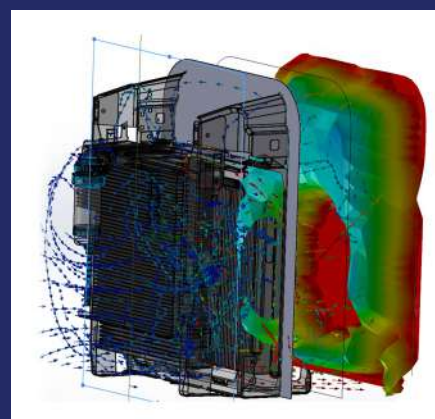
## ENGINEERING

### RAAL Testing Center capabilities:

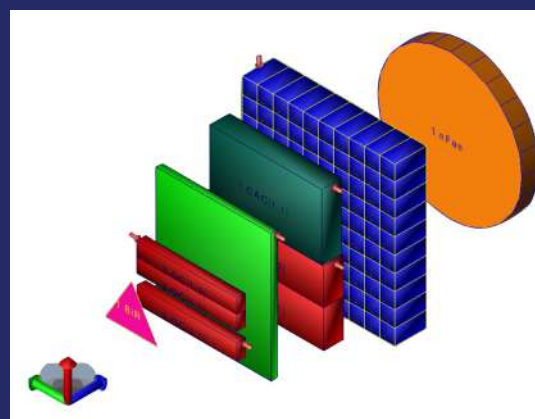
- thermal and fluid-dynamic performance tests on the wind tunnel
- durability tests: thermal cycle, pressure cycle, burst pressure, performed at ambient or at high temperatures in the climate chamber
- durability tests: shock and vibration
- internal cleanliness tests
- chemical and accelerated corrosion tests
- metallographic studies

### Tools and equipment

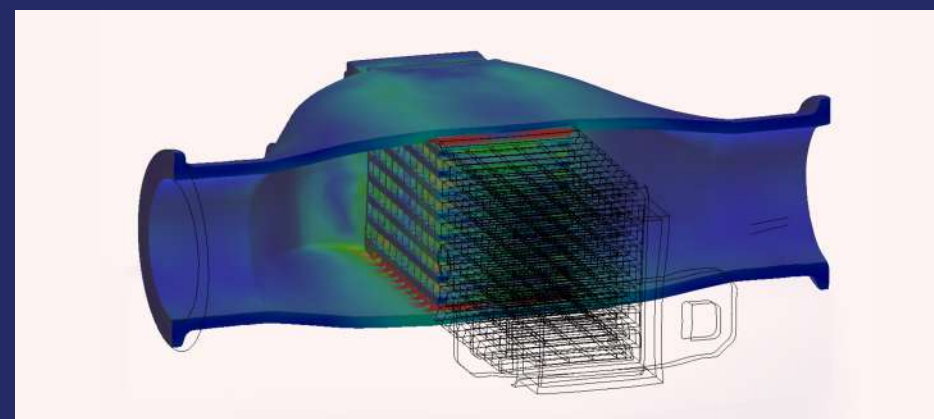
- **RAAL** engineers have a vast experience in tool and die design, and in designing the specific equipment necessary for the manufacturing process.
- **RAAL** places special importance on the design, manufacturing and optimization of the new generation of fin forming machines, which provide a wide range of fins and turbulators.



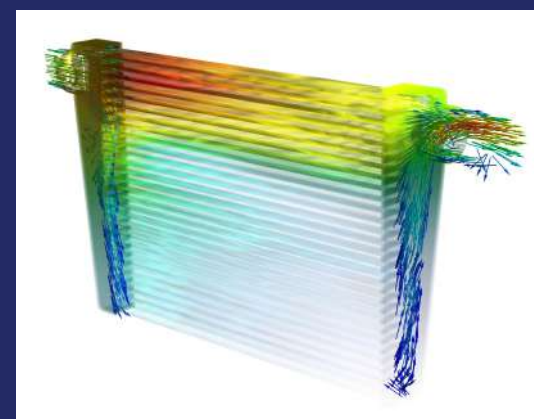
External Fluid Flow



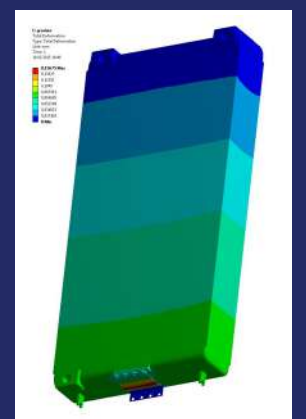
Heat Transfer Simulation



Structural Mechanics



Internal Fluid Flow



Modal Analysis



## QUALITY

All RAAL products are manufactured in compliance with the following standards:

**ISO 9001:2015 and IATF 16949:2016** - Quality Management System

**EN ISO 14001:2015** - Environmental Management System

**OHSAS 18001:2007** - Occupational Health and Safety Management System

RAAL also has the following accreditation:

EN ISO 3834-2

EN 14732

DIRECTIVE 2014/68/EU (PED 97/23/EC)

DIN EN 13585

EN ISO 15614-1, -2

EN ISO 9606-1, -2

DIN EN 13134

EN 15085-2 CL1

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ITALY



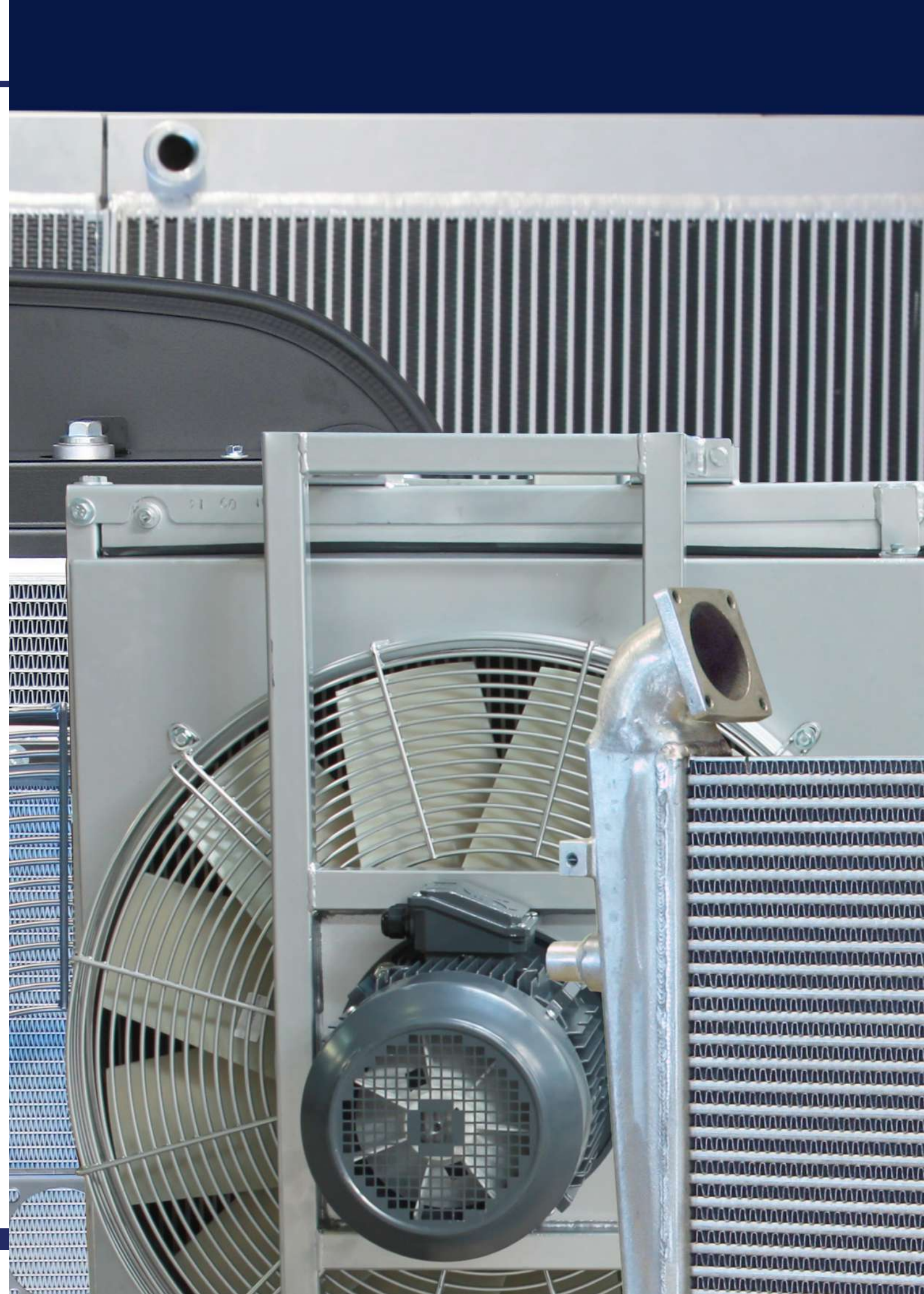
GERMANY



HOLLAND



USA





**www.raal.ro**

