

Kelvion



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Product Line: Engine Air & Gas Cooler

BOOST EFFICIENCY & LOWER EMISSIONS





EXPERTS IN HEAT EXCHANGE – SINCE 1920

Welcome to Kelvion! Where Heat Exchange is our Business. We are one of the leading global manufacturers of heat exchangers and have been providing solutions for almost every industrial application imaginable since the 1920s, specializing in customized solutions suitable for extreme environmental conditions - as of 2015 under the name of Kelvion.

With one of the most extensive selections of heat exchangers in the world, we are a well-known partner in many industries, including transportation, energy, oil and gas, the heavy industry, chemical and marine as well as sugar, food and beverage and the HVAC and refrigeration technology sector. Our products include Compact Fin Heat Exchangers, Plate Heat Exchangers, Single Tube Heat Exchangers, Transformer Cooling Systems, Cooling Towers and Shell & Tube Heat Exchangers.

Our many years of experience and in-depth expertise have made us specialists in this field. Our heat exchangers are designed specifically to meet the needs of the respective machine or equipment system, ensuring outstanding energy efficiency and reliability in any market segment. This gives our customers a cutting-edge over their competitors while also reducing operating costs over the long term.

As your heat exchange partner, we understand that outstanding and reliable after-sales services are critical for you, our customer, and we work alongside with you in close partnership supporting you throughout the full life cycle of your plant and equipment to ensure lasting business success.

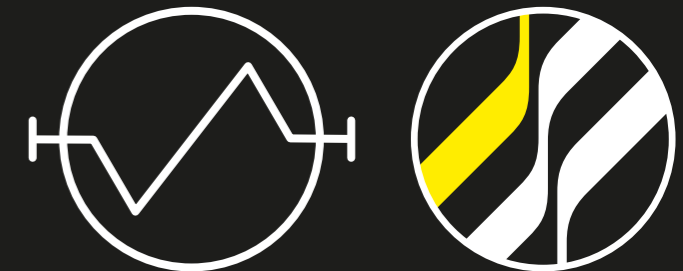
Kelvion – Experts in Heat Exchange.

KELVION – A TRIBUTE TO LORD KELVIN (1824 - 1907)

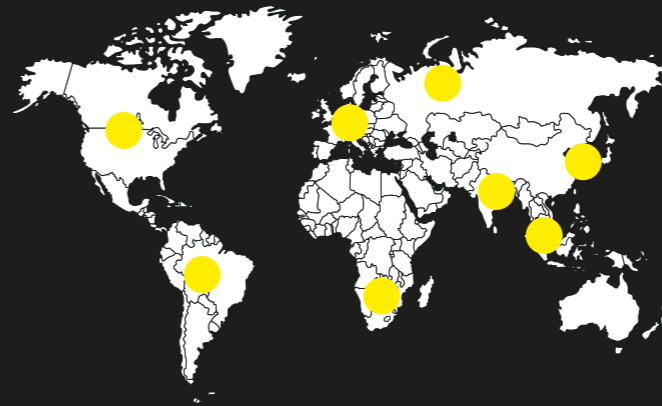


Lord Kelvin formulated the laws of thermodynamics and absolute units of temperature are stated in kelvin, in his honor.

OUR LOGO – INSPIRED FROM THE SCHEMATIC FOR HEAT EXCHANGER



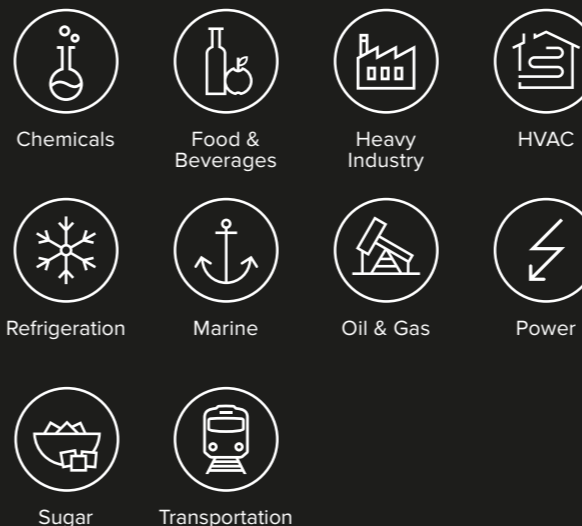
67 BRANCHES AND SALES PARTNERS WORLDWIDE



4,500 EMPLOYEES WORLDWIDE



YOUR MARKETS ARE OUR MARKETS

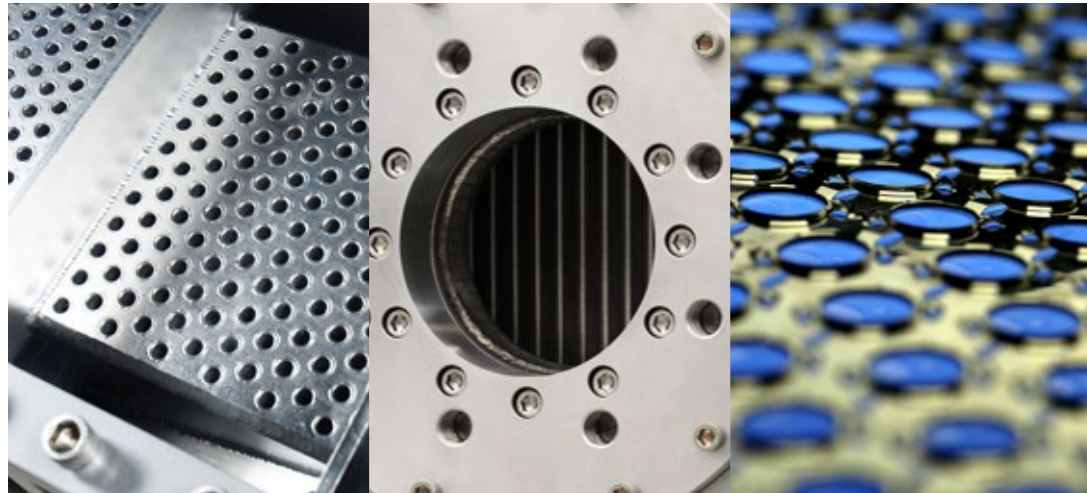


KELVION HAS A LONG HISTORY



We invest in quality and sustainability

CUSTOMIZED ENGINE COOLING SOLUTIONS



Kelvion's decades of experience in providing customized engine cooling technology have made us the partner of choice for many of the world's leading engine manufacturers.

We have supplied charge air coolers for almost all four-stroke and two-stroke marine diesel engines. Next to fuel, charge air is the most important component for effective combustion. Our coolers improve the efficiency of the entire engine, which means that less fuel is required for the same performance. By developing a dedicated and customer-oriented approach, we can optimize an engine's complete charge air modules.

Our exhaust gas recirculation coolers have a proven track record in reducing NOx emissions, while operating under extreme and challenging conditions, including temperatures up to 700 °C and soiling from soot particles. Developed in close collaboration with our customers, this technology satisfies the demands of international regulations on pollution from the world's shipping.



KEY BENEFITS AT A GLANCE

- ▶ Fully tailored engineering services
- ▶ Customized for individual engine designs
- ▶ Maximum efficiency and the highest safety standards
- ▶ Reliable performance and lower emissions

END-TO-END QUALITY



In addition to high performance levels and a lower environmental footprint, the Kelvion portfolio offers many advantages. Our coolers are economical to run and require minimum space. They are less susceptible to corrosion and fouling and easy to service and maintain. We can customize to suit individual engine designs, mounting criteria and operational conditions. This includes a choice of materials and configurations.

At Kelvion we take pride in providing comprehensive, end-to-end quality management, supported by our global service network.

CERTIFICATIONS

- ▶ ISO 9001:2000
- ▶ Det Norske Veritas
- ▶ Bureau Veritas
- ▶ ASME
- ▶ Russian Maritime Register of Shipping
- ▶ Inspection Certificate 3.1 and EN 10203
- ▶ Lloyds Register

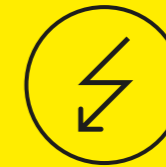
ENGINE GAS & AIR COOLERS GENERAL APPLICATIONS



MARINE



TRANSPORTATION

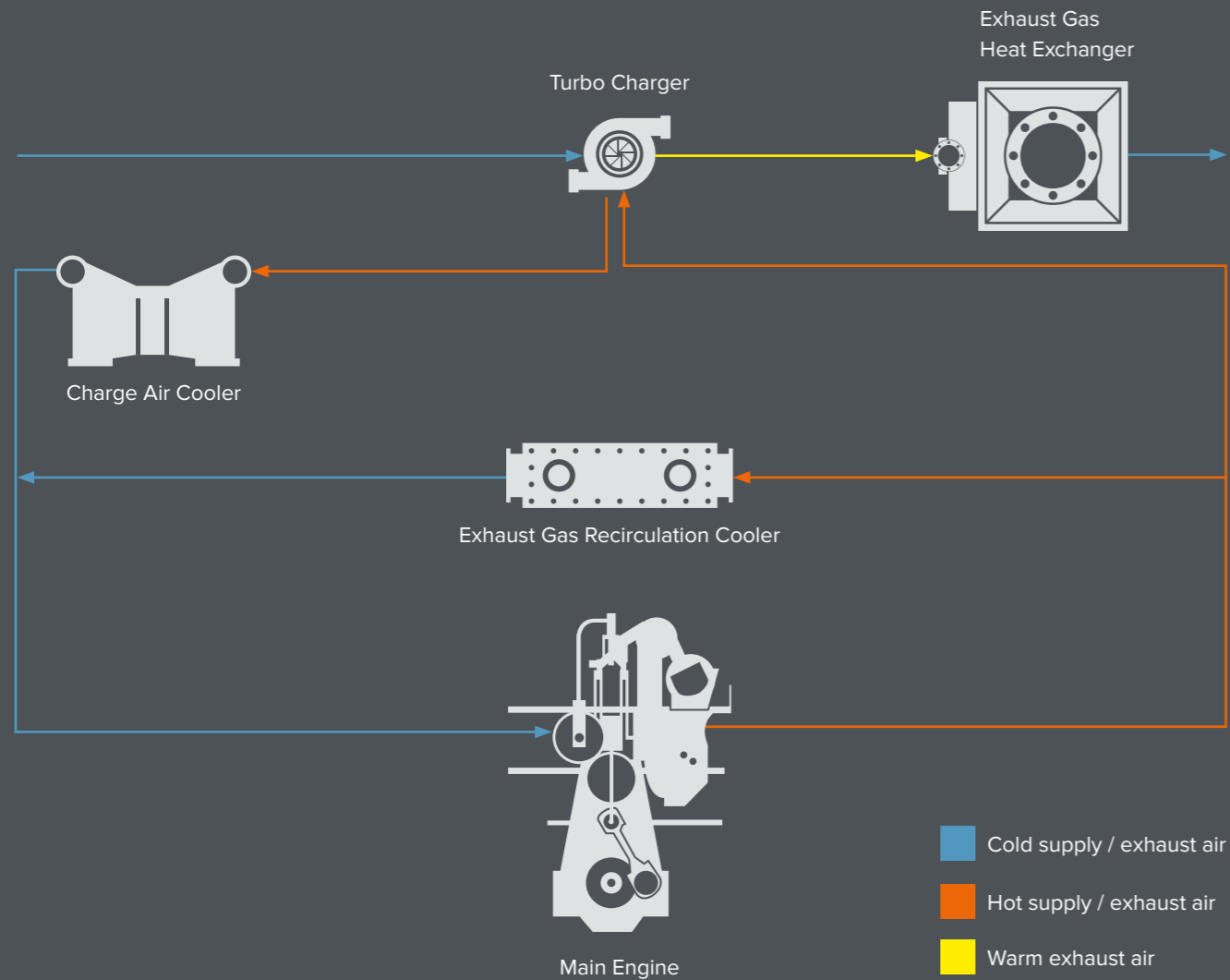


POWER

Optimum and clean performance

ENERGY EFFICIENCY AND EMISSION CONTROL

ENGINE GAS & AIR COOLER SYSTEM



Diesel and heavy oil engines in the marine and transportation industries rely on effective cooling systems to keep them running efficiently. The challenge for engine manufacturers is to boost performance, while saving energy and improving their green credentials.

Kelvion charge air coolers and exhaust gas recirculation coolers are helping customers around the world to achieve these aims. For many years we have worked collaboratively with engine manufacturers and plant suppliers to provide the first-class cooling solutions you need.

In addition we developed an Exhaust Gas Heat Exchanger to make use of the energy inside the exhaust gas stream of a combustion engines with a positive effect on the CO₂ balance.

Durability in all conditions

Because our engine oil and gas coolers are customized to suit your application, you can be sure of the right solution to suit your needs. Our coolers are subject to rigorous testing in our laboratory and using the latest in computer simulation. Designed and manufactured to the highest standards of precision engineering, our products offer a long life and durability, however harsh the environment.

Charge air cooler – CAC

The lower the temperature of engine intake air, the better the fuel consumption which, in turn, reduces emissions. For more than 50 years, Kelvion has led the way in developing and manufacturing charge air coolers. Specially designed for diesel and gas engines, they have a worldwide reputation for excellent performance and reliability.

Our charge air coolers are fitted in thousands of combustion engines around the globe, operating reliably on board ships, rail locomotives and mining trucks, as well as stationary installations, including power stations and cogeneration plants.

Through the use of special materials, advanced coating technology and new fin tube systems, Kelvion charge air coolers are also effective in engines that run with difficult fuels like biogas.



Exhaust gas recirculation cooler – EGR

To combat air pollution from shipping, the International Maritime Organization (IMO), Tier (the US exhaust gas standard), EURO and other regulatory bodies have imposed limits on emissions of nitrogen oxide (NOx) from marine diesel engines. Our exhaust gas recirculation cooler is setting new standards in this area, with an effective solution that can fulfill the requirement to reduce NOx emissions in low-speed, two-stroke, engines by up to 80%. We also have models for four-stroke engines.

Manufactured from temperature and corrosion-resistant stainless steel, this patented technology has the capability to handle exhaust gas temperatures as high as 700 °C. Its finned tube system ensures effective heat transfer over the entire surface and minimizes the collection of dirt and debris.

Our compact, service-friendly, recirculation coolers transfer heat extremely effectively to cooling water and are customized for each diesel engine manufacturer.



Exhaust gas heat exchanger – EGHE

We have expanded our product portfolio with the launch of the Kelvion exhaust gas heat exchanger. This new kid on the block is specially designed to capture waste heat from exhaust gas in combined heat and power units with combustion engines. The hot exhaust gas can be used in central heating, preheating, drying and generating electricity.



EFFICIENCY BOOST FOR ENGINES



The charge air cooler is positioned between the turbocharger compressor side outlet and the engine inlet. Hot compressed air is directed through the cooler's finned tube system and cooled down by water. As the temperature falls, the air density of the charge air increases, enabling a greater air mass to be compressed inside the engine. This means that more fuel can be burned in the combustion chamber.

We specialize in offering a wide range of design concepts for optimizing heat transfer according to specific applications. Our charge air coolers can be configured as insert coolers, block coolers, coolers with housing and also special models. This technology is ideally suited to diesel and gas engines above 200 kW. However, through the use of special materials, advanced coatings and innovative finned-tubes, our charge air coolers are suitable for biogas and other special gas engines.

Charge air coolers for special gas engines

Conventional charge air coolers that are based on copper or aluminum are unable to withstand the rigors of conventional engines that operate with contaminated gases, such as biogas. We have developed cooler versions using corrosion-resistant stainless steel and applying specialist surface treatments. Together with our compact finned-tube system, we are able to meet the tough operational requirements of special gas engines. Our solutions optimally and significantly guarantee system resistance and long service life even under extreme conditions.

PRODUCT TYPES



Insert Charge Air Cooler

This model is used on combustion engines with an installed or integrated gas side casing. During servicing, it can be pulled out without dismantling the air duct, saving time and costs.



Charge Air Cooler with housing

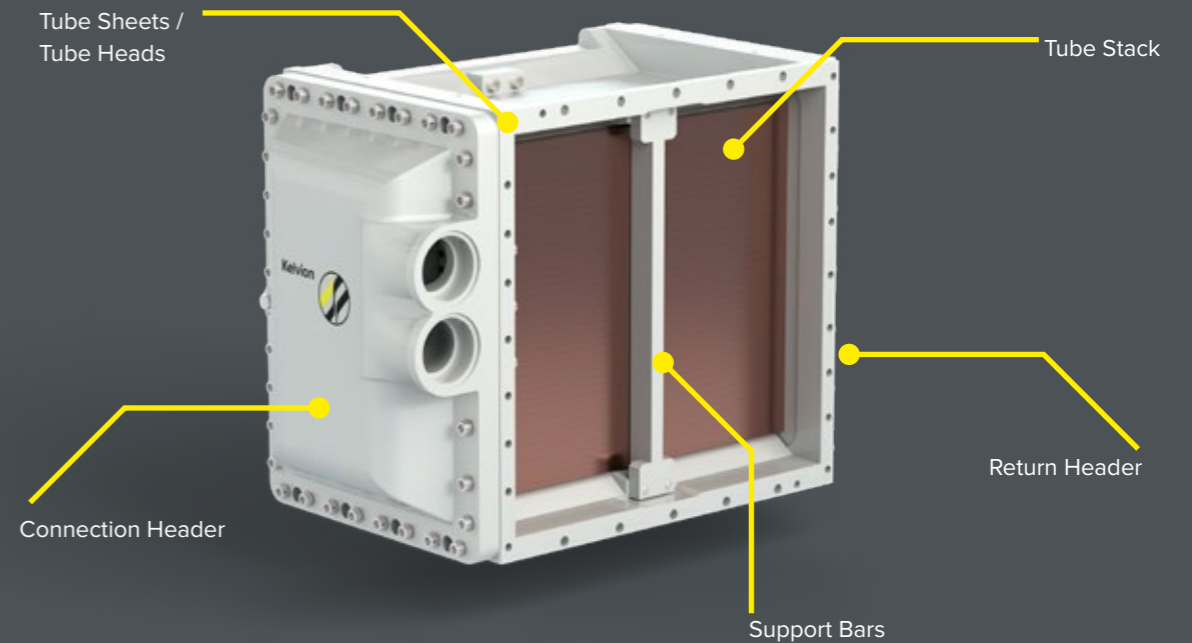
This cooler comes with gas side casing. The cooler core is inserted into a special housing, which includes all air side connections. It is an ideal plug and play solution for engine manufacturers. Like the insert version, this cooler can be serviced without dismantling the air duct



Block Charge Air Cooler

The gas side housing is formed by cooler components, such as the side wall or tube sheet. This configuration is a cost-efficient solution for small cooler units.

CHARGE AIR COOLER STRUCTURE



Exhaust Gas Recirculation Cooler – EGR

RESISTANT EMISSION REDUCER



EGR for four-stroke Engines

Exhaust gas recirculation (EGR) cooler

This technology, developed in close collaboration with our customers, ensures that – with large-size diesel engines – the recirculated exhaust gas is mixed at the lowest possible temperature with the combustion air. The result is effective reduction of NOx pollution, fulfilling the emission guidelines set by the IMO, Tier and EURO.

Our EGR coolers effectively transfer the heat to cooling water. Finned-tubes help to minimize fouling and clogging on the gas-side cooling surface. Structures embossed on the rib surfaces produce the turbulence that enables the cooled gas to flow through all areas of the heat exchanger for enhanced heat transfer.

Kelvion EGR coolers are manufactured from durable stainless steel that is resistant to the effects of temperature and corrosion. Two cooler solutions are available for four-stroke engines.

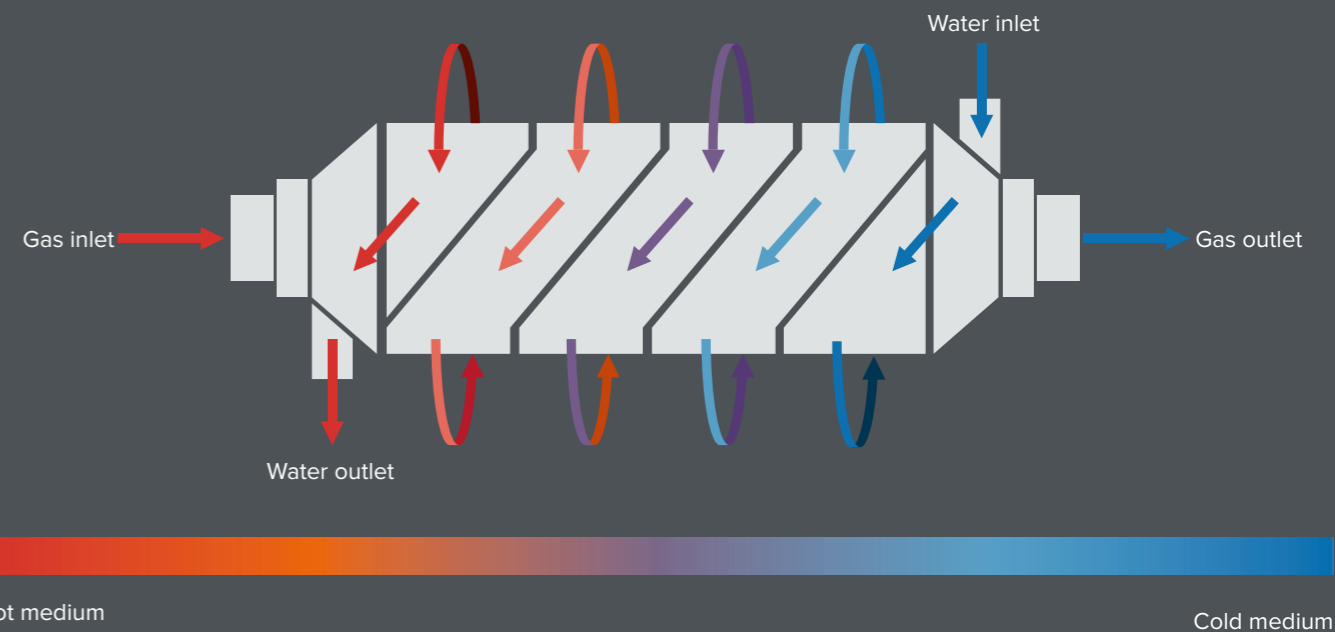
The high-temperature model is designed for exhaust gas temperatures up to 700 °C, and the low-temperature version, with downstream condensate drain, is designed for gas intake at a maximum of 200 °C.

For two-stroke diesel engines with medium and high performance ratings, we provide extra corrosion protection to offset the risk from the upstream pre-scrubber in the gas flow. With exhaust gas recirculation, NOx emissions from these engines are reduced by up to 80%.

High pressure EGR cooler

In this high pressure system, exhaust gas is discharged into the upstream part of the turbocharger turbine. After it has been cooled by a high-temperature EGR cooler and a low-temperature EGR cooler (optional), it is recirculated into the combustion air at the downstream part of the turbocharger compressor.

EGR OPERATION



Patent protected design for optimized water flow facilitate minimized stress at critical parts with regard to thermal expansion.

EGR FOR TWO-STROKE ENGINES

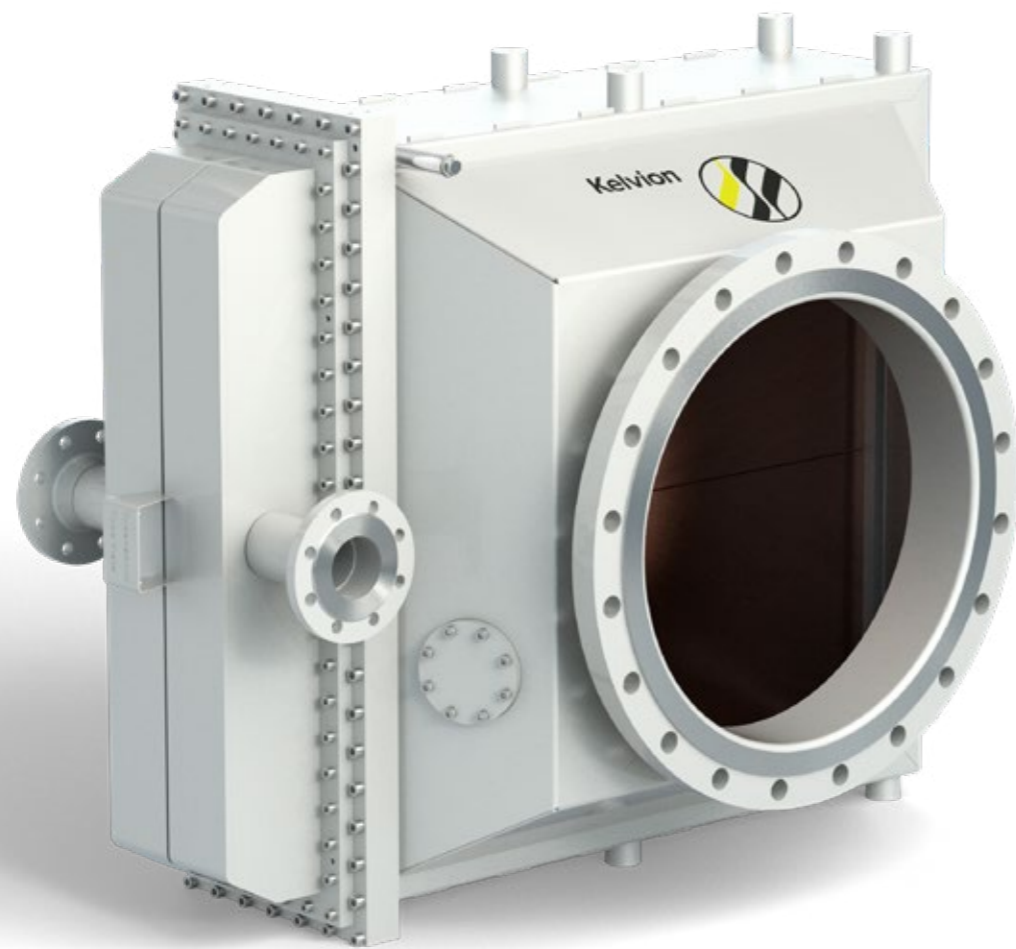


MATERIALS

- ▶ Fins: 316L
- ▶ Tubes: 316L or 904L (seawater resistant)
- ▶ Tube sheets: 316L or ASTM A182-F51 (seawater resistant)
- ▶ Headers: Carbon steel or ASTM A182-F51 (seawater resistant)
- ▶ Sidewalls: 316L
- ▶ Support plate: 316L
- ▶ Bolts: 316L
- ▶ Gasket: Graphit / 316L

Exhaust Gas Heat Exchanger – EGHE

TAKING ADVANTAGE OF RESIDUAL HEAT



This new addition to our product line is a compact heat exchanger made from high-alloyed stainless steel and can handle temperatures up to 550°C. Its compact and modular design makes it extremely versatile and easy to service. Our exhaust gas heat exchanger is designed to recover heat from exhaust gas produced by combustion engines in combined heat and power plants.

The heat exchanger transfers the heat from the exhaust gas to a liquid (water or water-glycol solutions). When heated up, this liquid can be used in central heating systems; for preheating air in the combustion chambers of furnaces and turbines; to dry coal, pulp, wood and other materials and for generating electricity in waste heat to power plants.

EGHE STANDARD DESIGN

Standard	TYP 32	TYP 48	TYP 64	TYP 80	TYP 96
L / mm	800	1000	1000	1000	1000
D / mm	618	777	937	1094	1120
H / mm	475	635	795	955	1254
Flange, Gas side	DN200 PN10	DN250 PN10	DN350 PN10	DN450 PN10	DN600 PN10
Weight 8RR / kg (incl. water)	225	320	420	557	711
Weight 16RR / kg (incl. water)	239	353	478	646	839
Performance range* / kW	82 - 251	182 - 577	328 - 1030	506 - 1587	736 - 2304

(* Fixed parameters: T_{Gas,max,in} = 550 °C T_{Gas,out} = 150 °C, T_{W,in} = 80 °C

BENEFITS

- ▶ Standard series
- ▶ Extended performance range
- ▶ Modular design enables high versatility
- ▶ Performance and fouling characteristics approved in real operation
- ▶ Minimal space required
- ▶ Replaceable slot

DESIGN FEATURES

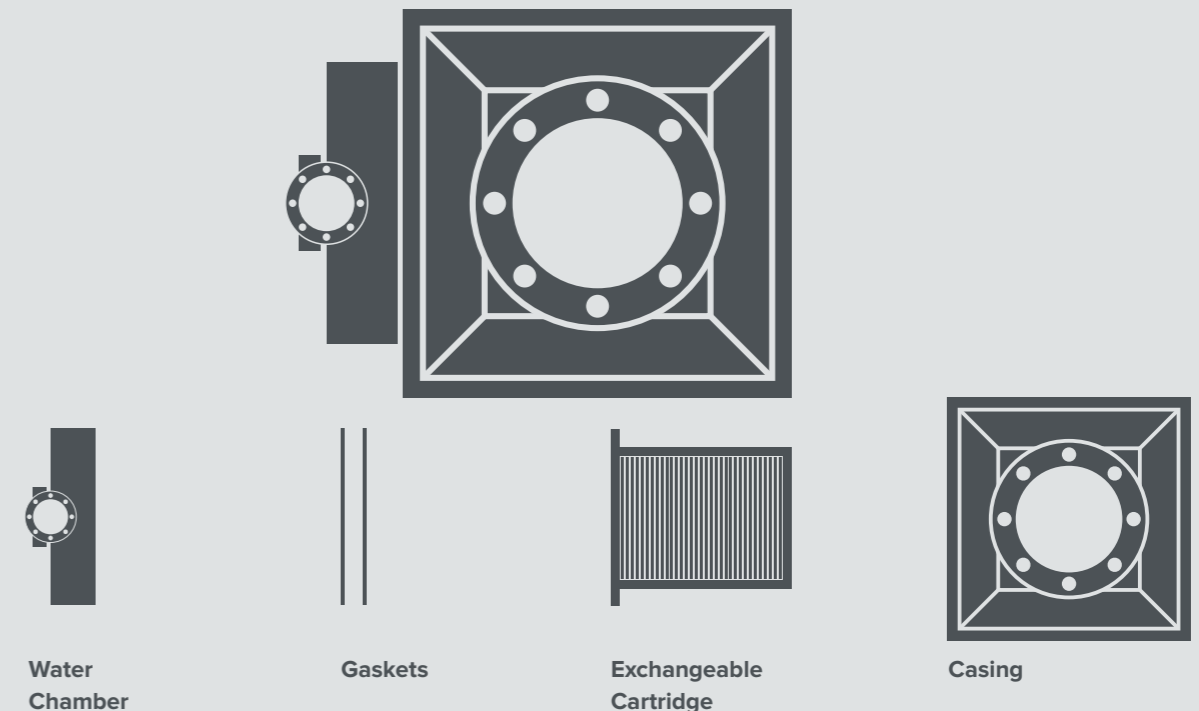
Stainless Steel

- ▶ Standard series temperature-resistant until 550°C
- ▶ Corrosion resistant

Easy Service

- ▶ Easy cleaning & exchange of the heat exchange bundle

MODULAR DESIGN



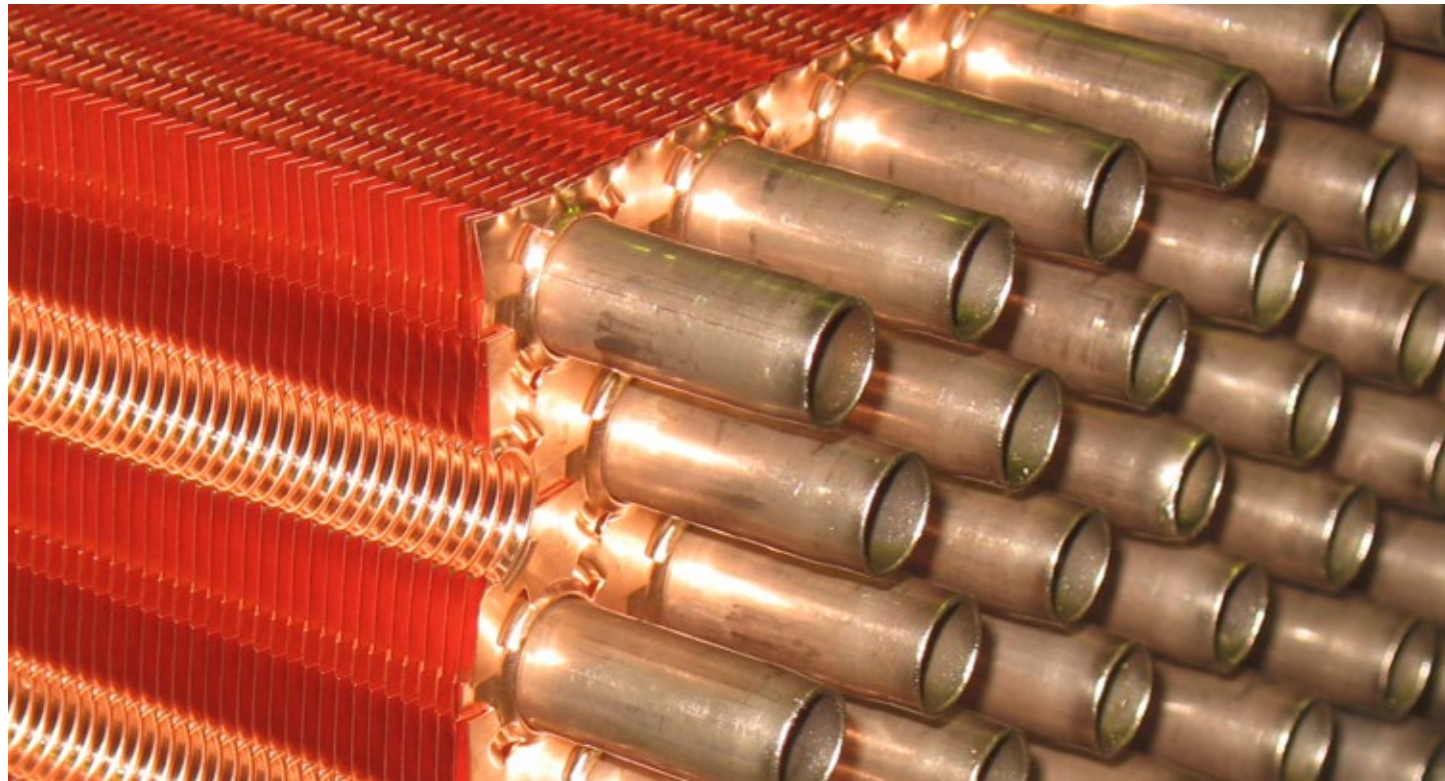
Water Chamber

Gaskets

Exchangeable Cartridge

Casing

COMPACT FIN TUBE SYSTEM



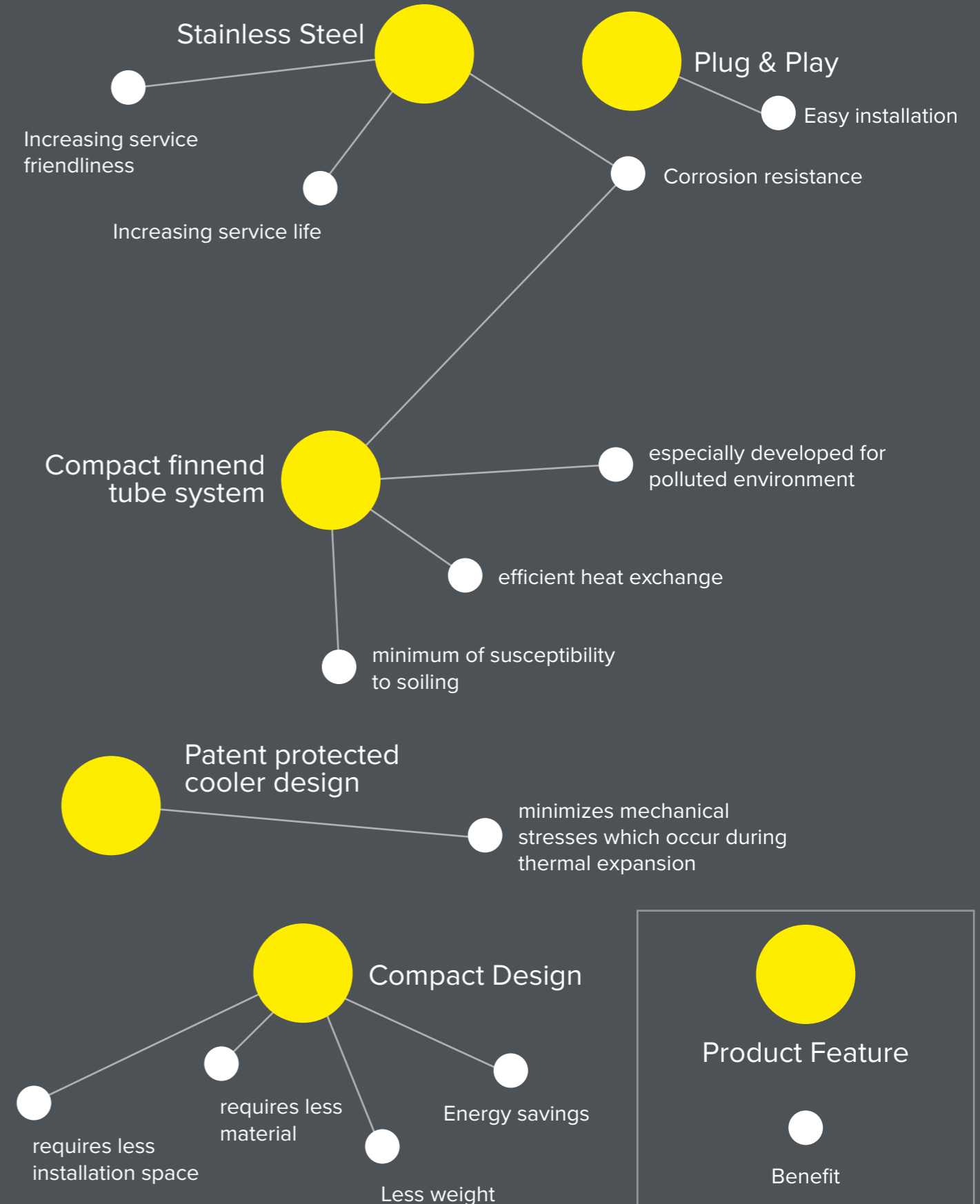
TUBES

- ▶ **Copper and nickel alloy: CuNi10**
Good seawater resistance;
Excellent heat exchange
- ▶ **Copper and nickel alloy: CuNi30**
Excellent seawater resistant;
Excellent heat exchange
- ▶ **Copper: Cu**
Excellent heat exchange;
Good resistance against tap water
- ▶ **Stainless steel 316L (1.4404):**
Average heat exchange;
High corrosion resistance except sea water;
High material strength

FINS

- ▶ **Copper: Cu**
Excellent heat exchange;
Average resistance against condensation;
Lower material strength
- ▶ **Aluminum: Al**
Excellent heat exchange;
Low weight
- ▶ **Stainless Steel 409L (1.4512)**
Good to excellent corrosion resistance;
Good heat exchange;
High material strength
- ▶ **Stainless Steel 316L (1.4404)**
Excellent corrosion resistance;
Average heat exchange;
High material strength
- ▶ **Stainless Steel 904L (1.4539)**
Excellent corrosion resistance also against chlorides;
Average heat exchange;
High material strength

PRODUCT FEATURES & BENEFITS



Application: Marine

ON THE RIGHT COURSE

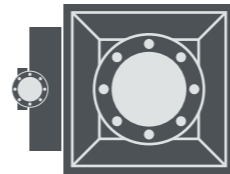
Charge Air Cooler



Exhaust Gas Recirculation Cooler



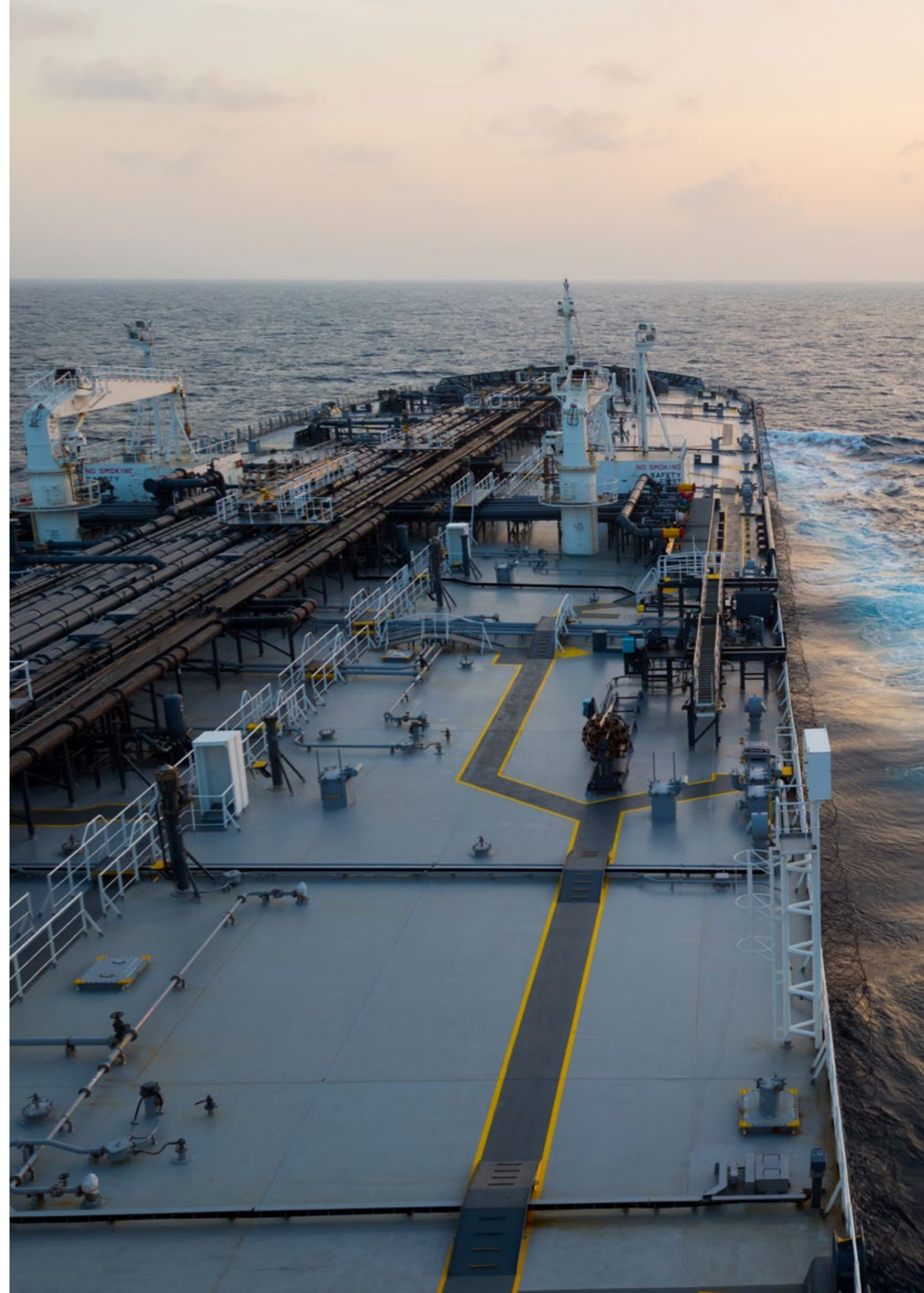
Exhaust Gas Heat Exchanger



Ships are often subject to extreme conditions at sea and diesel engine manufacturers are continually striving to make engines greener and more efficient. Our use of optimized materials and proven production processes, backed by decades of know-how, mean we can deliver the technology that our customers need.

Cooling the charge air is widely regarded as an innovative solution to improving an engine's performance. Our charge air coolers for four-stroke marine engines have clearly demonstrated their ability to fulfill the most demanding of expectations. This applies not only to efficient cooler performance, but also to the dimensions of our coolers. Thanks to their compact design, they have led the way in our sector in regard to installation space, weight and use of materials.

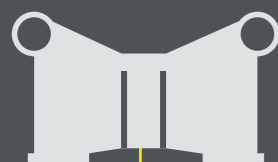
The great efficiency and the environmental compatibility of our charge air coolers and exhaust gas recirculation coolers are also being fully exploited for the benefit of two-stroke engines. We provide tailored solutions that fully conform to all individual requirements and international regulations. Our coolers don't just benefit new facilities: in retrofit situations they also make a key contribution to the systematic enhancement of performance and sustainability.



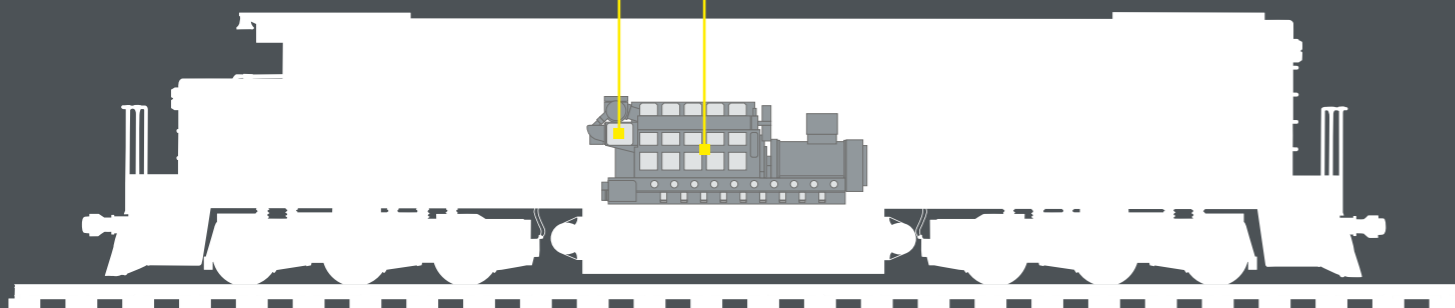
Application: Transportation

DRIVEN BY EXPERIENCE

Charge Air Cooler



Exhaust Gas Recirculation Cooler



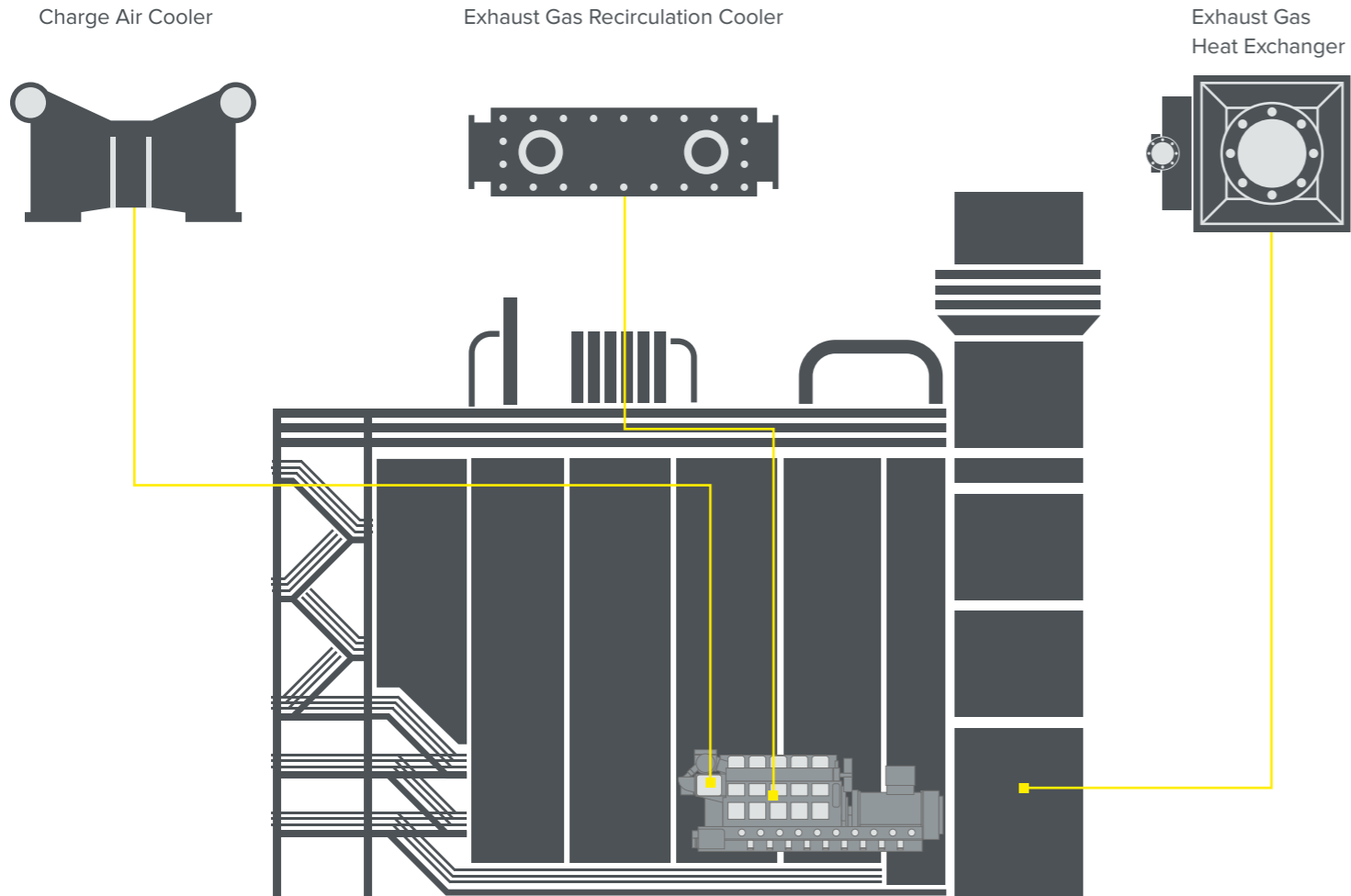
Thanks to the compact design of our coolers – achieved by their innovative fin geometry – our products are pioneers within the transport sector for installation space, weight, and use of materials. Mining trucks and other heavy-haulage vehicles profit as a result. Even under the most extreme operational conditions, our solutions support the maximum functionality and reliability of diesel engines.

Our charge air coolers can be found in thousands of passenger and freight trains. Systems developed by Kelvion cool diesel engines, efficiently and reliably, in a great variety of models and generations. The sustainability of our systems is clearly demonstrated in our success. Our expertise and experience are reflected in subcontractor status with world's largest railway companies, close collaboration with locomotive manufacturers and successfully passed endurance tests.



Application: Power

THE POWER OF EFFICIENCY



Diesel power stations and cogeneration plants

The performance capacity and the reliability of our charge air coolers have been proven time and time again in two and four-stroke diesel engines around the world to cool fresh intake air to between 40 and 60 °C after its compression and subsequent heating. By increasing the air volume supplied to the combustion process, it enhances the effective performance of the engine.

Kelvion Charge Air Coolers are the first choice for natural-gas plants. Developments of gas engines in the last few years have led to increasing demands placed on charge air coolers. They include stricter requirements with respect to corrosion, soiling, and service friendliness. Our compact fin tube system, made of corrosion-resistant stainless steel, offers an excellent option for significantly increasing the service life and the service friendliness of charge air coolers – without appreciable impairment of the power density of the components.

Compared with other industrial areas, the use of special gases in power plants is relatively new. One of the challenges is that these

fuels have not been fully researched and are therefore difficult to regulate. Also they place extreme chemical and physical stresses on the materials they come into contact with. We have adapted our charge air coolers to withstand these harsh special gases. Surface treatments in the form of Delta Seal, KTL, or tin plating are available for enhancement of the corrosion resistance of the material. The choice of stainless steel as the base material for the fin tube system significantly enhances corrosion resistance over any other material previously used. Our compact fin tube system is primarily characterized by the configuration and the geometry of the fins, as developed by computational fluid dynamics (CFD). This design supports optimum heat exchange with a minimum susceptibility to soiling.

Exhaust gas

With the exhaust gas heat exchanger, heat no longer needs to be wasted in power plants. Before going up through the chimney, the exhaust gas pass through the heat exchanger and the waste heat used to heat up water for various heating systems and processes.



OUR SERVICE IN THREE WORDS: PEACE OF MIND



START-UP SERVICES

We ensure that our products are delivered safely and are fully validated to give a robust and reliable performance over as long a life cycle as possible.

- ▶ Assistance to assembly and disassembly, shipping and transport



SPARE PARTS AND SPARE PARTS SOLUTIONS

Even the best equipment shows signs of wear over time. We use only the highest quality spare parts, designed to match the excellence of the originals. This ensures that the optimum interaction between components is maintained. By safeguarding the original design we offer maximum security of your investment.

- ▶ Delivery and assembly of spare parts



REPAIRS AND OVERHAULS

We understand that unscheduled downtime can be disastrous. That is why our trained engineers are ready to respond quickly in an emergency. We will review and repair components while keeping any disruption to a minimum. Any overhaul work is carried out in our service centers and conforms to the highest quality standards.

- ▶ Complete overhaul, repair or new production
- ▶ Renewal of corrosion protection and exterior painting



INSPECTIONS AND MAINTENANCE

Through regular inspections and maintenance, we help you to reduce costs, extend the lifetime of all your Kelvion products and to achieve a reliable performance. This also helps you with budget planning.

- ▶ Internal cleaning (tube side: at factory or on site, shell side: at factory)
- ▶ Cleaning and flushing of cooler core including documentation of results
- ▶ Brush cleaning tube side including documentation of results (if screwed headers)



TESTING AND MONITORING

Having an understanding of the condition of the equipment allows you to secure reliable production, improve safety and energy efficiency and increase equipment lifetime. It can also help you to prevent breakdowns and prepare for the future.

- ▶ Tightness test and refurbishment / repair



UPGRADES AND REPLACEMENTS

We replace components to keep our heat exchangers running smoothly and to prevent downtime. Where parts have become obsolete, we will suggest an upgrade.

- ▶ Analysis and assessment of performance bottle-necks

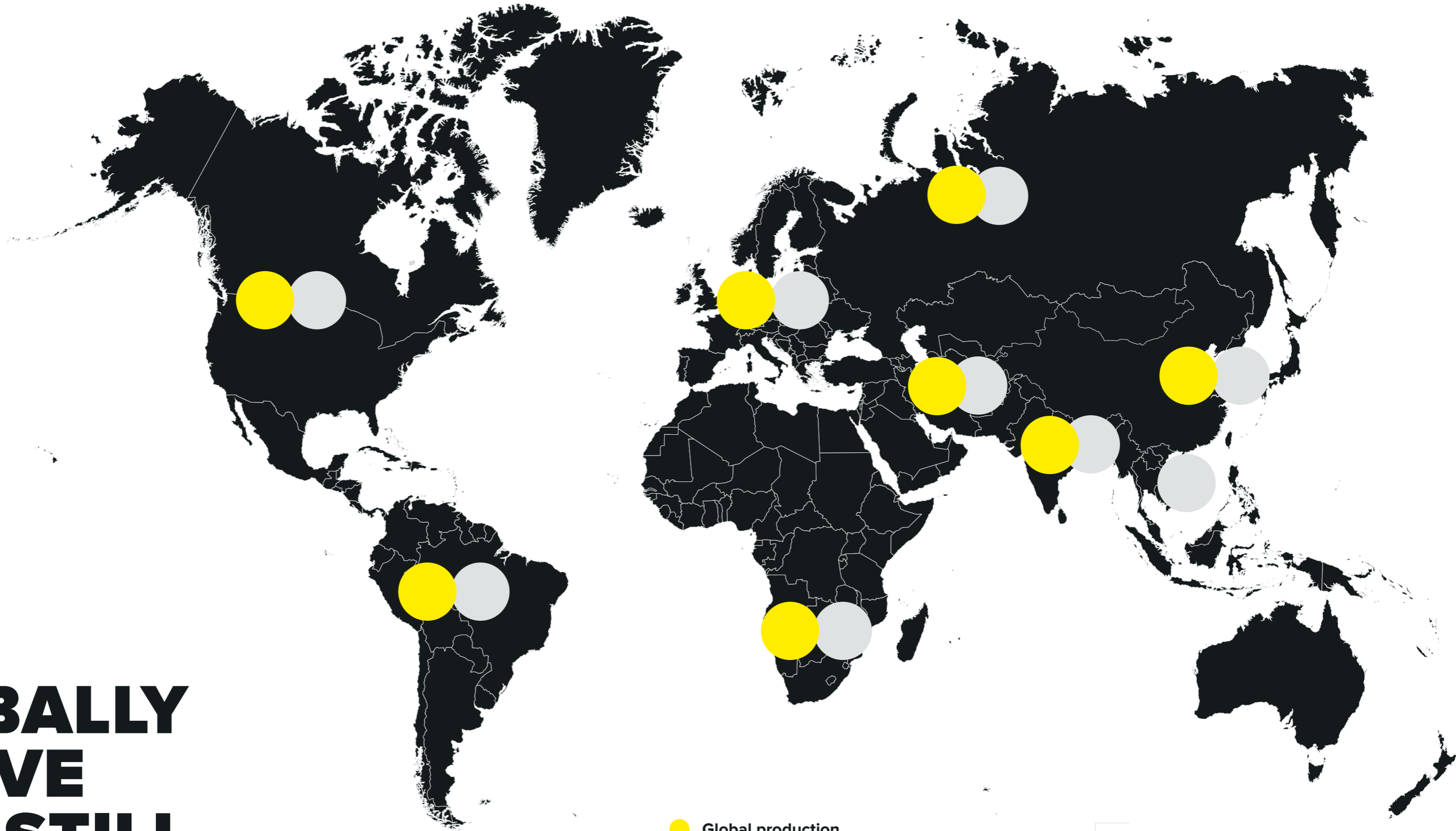


CONSULTING AND TRAINING

Would you like a consultancy service that takes into account the special features of your process and where you feel that finding the right solutions are more important than closing the deal quickly? Then you will feel right at home with Kelvion. We will work closely with you to develop the exact solution that is best tailored to your needs.

- ▶ Examination and assessment of operating conditions
 - ▶ Endoscopic examination of tube side regarding pollution, corrosion and erosion
 - ▶ Examination of fin side regarding pollution, corrosion and erosion
 - ▶ Analysis of water and other product samples
 - ▶ Investigation of corrosion problems (destructive testing and sample analysis with specialists)
 - ▶ Assessment of deposits or corrosion products which may possibly occur on the tube side
 - ▶ General visual inspection and documentation of results
 - ▶ Pressure test (tube and gas side)
 - ▶ Repeating pressure tests acc. to PED / DVGW (category I+II)
 - ▶ Repeating pressure tests acc. to PED / DVGW (category III+IV, Kelvion together with 3rd party)

GLOBALLY ACTIVE AND STILL CLOSE BY



- Global production footprint
- Global sales and service