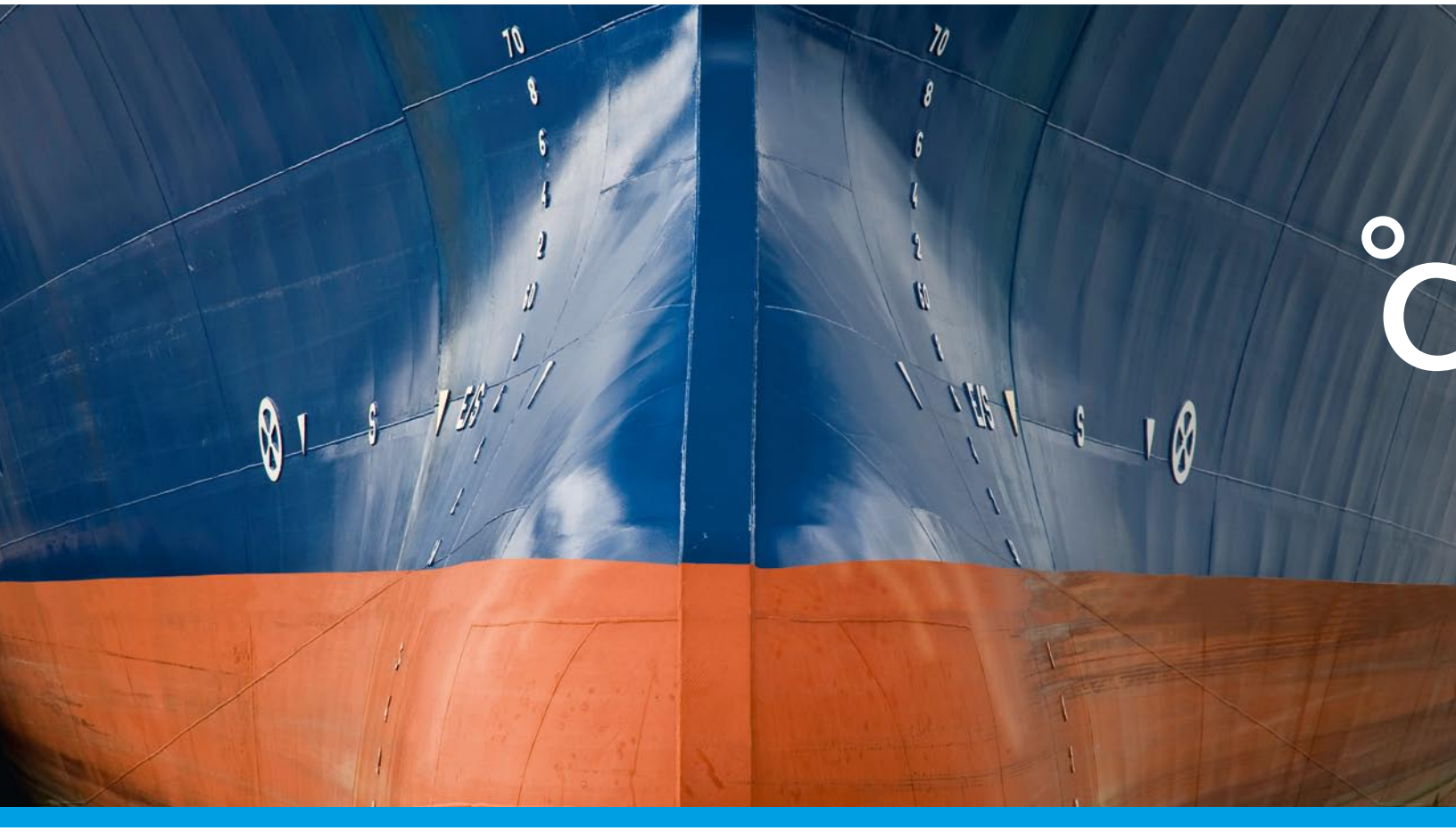
In Touch



Refrigeration technology for marine systems

In touch – efficient solutions for the maritime industry

GEA Refrigeration Technologies

When people travel over the high seas – or when perishable goods such as fish and juice must be shipped: rivers and oceans are still highly attractive as routes of transport. With our refrigeration and cooling technologies, we make every effort to ensure that passengers are comfortable and that cargo arrives in good condition. And we are specialists in delivering refrigeration technology for compact transport of energy: for example, for cost-efficient transport of liquefied natural gas from distant storage facilities to consumption centers.

° In touch with your processes and requirements

Marine: GEA ensures the right temperature on board

Our goal is to create solutions for you that are not only long-term as well as cost-effective, but at the same time are energy-saving and environmentally protective.

The cooling of processes and products and the temperature control of cargo underway are the specialties of GEA Refrigeration Technologies. Merchant-marine businesses also handsomely profit from this experience, and the fishing industry is a prime example. Seafood, of course, is increasingly growing in popularity. The number of health-consciousness customers is growing who appreciate the beneficial properties of seafood. The fishing industry moreover creates and maintains jobs, particularly in some of the poorest countries.

Centuries ago, salt enabled the preservation of fish and thereby helped to maintain human life: which is what made salt so precious. Today it is modern cooling and freezing technology that is absolutely essential for the operation of trawlers and fishing ships. As a result, our units and systems are widely used on board large and small fishing and seafood factory ships. We install the technology that you need to immediately freeze fish on the high seas. Compact, advanced, and energy-efficient systems cool or freeze the ready cargo, or help in pre-cooling and intermediate storage. Small fishing trawlers and cutters need cooling beds of ice for their fresh catches, so that they can land fish with the same high quality as their larger competitors.

And when vitamins go on long voyages – e.g., in the form of orange juice – we are at your service with the required refrigeration technology. Juice-carrier ships require effective cooling to ensure the preservation of vitamins during juice transport. Reliable cooling during ocean transport is essential for cost-effective processing of juice or concentrate onsite, where the fruit is actually harvested. This saves room, since juice is considerably more compact and cheaper to transport than the amount of fruit required for its production. Despite all the space that can be saved, we are still talking about huge volumes: stainless steel tanks on ships can contain up to 4 million liters of juice.

Compactness is also in demand for an entirely different application: natural gas. If distances or infrastructure does not allow transport by pipeline, ship transport is often the best alternative. But the same laws apply here on board: space is money. GEA liquefying systems reduce space requirements by liquefying gas down to below -160 °C, and our cryotechnology enables great economy in the transport of energy media. Such liquefying shrinks the space needed for such gas to around 1/600th of the requirements for uncompressed gas.

But last, and not least, people themselves are importantly involved. Intercontinental flights have replaced most transoceanic passenger-ship travel, but passenger business still plays a major role. Cruises are becoming increasingly popular. During such cruises, the quality of time spent on board is at least as important as sightseeing on land. And systems by GEA are also on board for such cruises: in ensuring the freshness of food storage, and for comfort provided by on-board HVAC systems.

What counts is the greatest possible benefit under cost-efficient conditions, with a maximum of environmental and climate protection. With GEA Refrigeration Technologies, you are on the right course.

Regardless of which of maritime sector you are involved in, our engineers work up the ideal refrigeration and HVAC solutions with great enthusiasm for detail.

In flake ice made from freshwater or seawater, the fish on board will retain its freshness.

° Refrigeration technology for top product quality

GEA Refrigeration Technologies catches freshness on the high seas

The fishing sector not only supplies consumers with seafood – one of the most important of food types – but also assures the economic existence of countless people. Flawless cooling is critical for small fishing ships and cutters. Both the chefs of harbor restaurants as well as wholesale customers of fishermen depend, after all, on absolutely fresh fish at competitive prices.

To ensure a long life for business relationships as well, GEA Refrigeration Technologies offers effective cooling or freezing technology for every fisherman. The daily routine of fishing work varies considerably. Some fishing boats leave port in early morning and return to harbor on the same day. Others are underway for days on end. To maintain freshness quality in any case, the catch should be immediately cooled to around 0 °C. There are two solutions possible here: the ice is either loaded on board when the ship leaves the harbor, or the ice is produced on the ship as needed.

This all sounds easy enough, but it demands considerable expertise. Ice machines dedicated to this purpose cool water in a vertical cylinder until it freezes on the inner wall. The ice is scraped off and falls into an ice container located below. The flake ice gained in this way is ideal for use on the high seas, especially since it is "fish-friendly". Despite the name "flake ice", the small curved pieces of ice have no sharp corners – which protect the thin, delicate skin of a fish. Flake ice is particularly gentler on fish skin when it has been made from seawater: the salt content makes the ice even "softer". In addition, this ice is dry, and the fish does not swell. The cool mass has just the right consistency – not too hard and not too liquid – and can be easily handled on a ship, since it can be heaped up.

Cold: yes. Too cold: no. There is a temperature below which fish cannot be stored. Otherwise, dreaded freezer burn will take place and will rob seafood of its taste and its attractive color. The purpose of the ice, however, is not only to keep the fish at a particular temperature. As the ice slowly melts, this automatically washes the fish – and the natural mucous layer and the moisture of the skin will remain.

Whether for fresh water or sea water – we at GEA know what it's all about. Our 40 models of Geneglace ice machines offer the perfect solution for virtually any application. Daily ice capacity of these machines is between 200 kg and 50 metric tons, depending on the equipment type. Ice machines that directly produce the ice on board are equipped with ice generators especially designed for the rough conditions that prevail on the high seas. They chug along even despite heavy waves and are not sensitive to corrosion by the saline content of sea air. These ice generators are available alone or as compact ice machines with ice packs. Likewise available are accessories such as the following: ice towers for storage, conveyor belts, insulated transport boxes, and dosing systems.

GEA Refrigeration Technologies for fishing trawlers and cutters:

- Geneglace ice machines on board
- Conveyor systems
- Dosing systems
- Control systems

GEA is the first manufacturer of ice machines in Europe. Designed according to a simple principle, Geneglace ice generators benefit from over 50 years technical experience and a continuous policy of development – for economical and energy-efficient solutions to produce, store, and handle the ice.

To prevent bulky equipment systems from interfering from work on smaller trawlers, GEA offers automatic ice towers, installed on land, with solutions for simple dosing and for practical and hygienic ice handling. After all, ice is critical for cooling of such freight – and it can come from on board or on land.

° Flawless cooling for transport of fish

Ice towers by GEA: ice-cold freshness at the press of a button

GEA ice towers on land for trawlers and fishing cutters:

- Automatic ice production, storage, and dispensing
- Ice dispensing according to the FIFO principle (first-in, first-out)
- Hygienic ice storage in accordance with food and beverage requirements
- Dosing and weighing systems

If a fisherman doesn't want to invest in an ice maker on board, he doesn't have to wait long for ice. GEA supplies its maritime customers throughout the world with ice from on land, and has already equipped hundreds of fishing harbors with ice towers. Fishermen can pick up the individual amounts of ice that they need from these towers. In ideal cases, such ice silos are integrated into the port facilities such that a transport system directly fills the ships with ice, without tedious loading.

To be ideally prepared for peak demand, such facilities produce and store the ice in advance. GEA Refrigeration Technologies offers automatic towers for such requirements: systems that store the ice hygienically, in accordance with food and beverage requirements, and in perfect consistency. These systems dispense the ice by screw conveyors at the press of a button on the first-in, first-out principle (FIFO). As required, GEA can also supply such towers with weighing functions, coin payment, and indicators for ice filling levels.

For example, GEA has installed an ice tower at the French fishing harbor Port de pêche de la Turballe. This harbor, in vicinity of Saint-Nazaire, is the second main source of income for this region, after tourism. Earlier, this port was a major terminal for sardines, and now the fishing fleet does most of its business with sea bass, mackerel, and octopus. The harbor is populated by a colorful fishing fleet of netters, coastal fishing vessels, and deep-sea trawlers. With propulsion ratings of around 600 PS, lengths of over 22 meters, and a crew of six or seven, trawlers are among the largest fishing vessels in this French harbor – and they use a goodly amount of ice. To assure their customers of special fish quality, these trawler fisherman go out only briefly to sea – around 15 to 30 minutes – and quickly bring their catch on land in ice-cooled boxes.

In addition to flake ice, the fishing industry also makes extensive use of liquid ice, which is a water-ice suspension. On the basis of its liquid consistency, it can be easily pumped – which means that the ice production and the dispensing points can be relatively far apart. The extremely small ice crystals are gentle on the fish skin and cool the cargo especially fast and uniformly. The GEA product portfolio includes five land-based liquid-ice machines that cater for this trend. Their output ranges from 3,000 to 12,000 kg of ice per hour, depending on the model.

Modernized with GEA technology: today, the "Jupiter" carries 2,000 metric tons of freight. Its freezing capacity is 170 tons per day – 2.5 times its previous rating.

° In touch with *Jupiter*: something new from something old

Big yields from advanced cooling and freezing technology

The new refrigeration systems for the *Jupiter*:

- 10 vertical plate freezers
- 2 air coolers
- Valves and control units
- Refrigerated seawater system (RSW)
- 2 saltwater pumps

In many countries, fish represent the most important source of protein – for example, on the west coast of Africa. To assure such staples of diet for the population there, the trawler *Jupiter* is on duty in the ocean off Namibia. Equipped with trawls and extensive GEA refrigeration systems, the ship is on the hunt for horse mackerel – with good success. It was launched in 1990 by the shipbuilders Volkswerft, in Stralsund, Germany. Since decades on the high seas had taken their toll, the ship was recently renovated. As contracted by the owners Namsov Fishing Enterprises (Pty) Ltd, GEA Refrigeration Technologies in 2006 brought its refrigeration systems up to the state of the art – with GEA responsible from planning to implementation. Today, the *Jupiter* has a cargo capacity of 2,000 metric tons. Freezing capacity has risen by around 250 %: from originally 65 to now an average of 170 tons per day. For *Jupiter* this was a major milestone – but almost routine for the experienced GEA team, which has for decades been intimately familiar with this ship type (Atlantik 488).

GEA Refrigeration Technologies also feels at home on other ship types: it has by now modernized over 40 trawlers. GEA experience and good consulting pay off handsomely for the fishing business, since GEA emphasizes keeping as much old equipment as possible and effectively adding new systems only as necessary.

GEA Refrigeration Technologies assures flawless cooling in all climate zones.

The way is the goal. For vacationers who book a cruise, the ship experience itself has increasingly become the actual destination. Cruise ships are becoming ever larger, and passengers expect an extensive offering of entertainment, sports, wellness – and, naturally, luxury.

Cooling and refrigeration for passenger ships:

- Chillers for comfort climate control
- Refrigeration technology for storage of food and beverages
- Heat exchangers
- Air-handling units

° Cooling and refrigeration for feeling good

To ensure that demanding passengers arrive relaxed

All of this of course includes comfortable room climate – already enough of a challenge in normal hotels. On cruise ships, though, it represents truly difficult terrain: which GEA Refrigeration Technologies gladly moves through for you. We have, for example, equipped passenger ships of Carnival Cruise Lines Inc. and of P&O Cruises with HVAC systems that create comfy coolness during hot nights on board.

The general trend for wellness and good health has also extensively entered the world of cruise cuisine. In fact, cruise passengers expect delicious but healthy food on board. The cooks of the countless restaurants on board cruise ships therefore expect that their fresh ingredients are stored under perfect conditions. In order to ensure sophisticated cooling in storage rooms for foods and beverages, GEA refrigeration systems are hard at work for the two reference cruise lines mentioned above. Those in charge of such restaurants take it absolutely for granted that the quality and reliability of such systems are flawless. The great challenger for GEA here, however, is in the efficient organization of the installation work. During construction and outfitting of a cruise ship, installation specialists from GEA Refrigeration Technologies must work from the bottom of the ship upward, from level to level, in extremely cramped space.

It serves as a morning wake-up, an invigorating vitamin kick at the office, and as a constituent for many mixed drinks: orange juice. This beverage enjoys great popularity throughout the entire world. As direct juice, or as juice concentrate, it is available virtually everywhere – thanks to advanced and precise refrigeration technology by GEA Refrigeration Technologies.

° One degree precision cooling for juice carriers

Making sure it tastes good: direct or frozen juice from across the ocean

We usually don't think about where our orange juice comes from – we simply drink it. But it has often been underway for weeks – usually from Brazil – which demands flawless cooling. A challenge for GEA Refrigeration Technologies: GEA has equipped many juice carriers with refrigeration systems. These freighters transport direct only juice or concentrate. In addition, GEA has modernized and retrofitted older ships.

Direct juice is pasteurized and filled immediately after pressing. It is designated on its labels as "not from concentrate" (NFC). Today, however, the greatest share of orange juice is shipped in the form of concentrate, from which water and aroma have been removed. The process of concentration reduces its volume to around one-sixth of the pressed juice. It is designated as "frozen concentrated orange juice" (FCOJ) and is transported at a frosty -10 °C. At its destination, water and aroma are returned to the concentrate. This variation of juice is accordingly cheaper at retail dealers. As part of growing quality consciousness and the higher standard of living of many consumers, however, the demand for direct juice is growing.

A typical juice carrier transports approximately 32,000 m^3 of juice per trip. This is equivalent to 32 million one-liter cartons. The juice – whether in fresh or concentrated form – is stored in stainless steel tanks on board. The juice is pre-cooled before being stored on board, after which systems of GEA go into action. These systems must ensure a temperature of -10 °C for the concentrated juice. Direct juice is stored just above the freezing point: a process in which precision is critical, since the juice must not by any means be allowed to freeze. Normally, a double, indirect system provides the refrigeration: ice packs cool a brine solution, which is pumped to the insulated cargo holds. There, air coolers cool the air around the tanks. In new ships, GEA prefers the refrigerant ammonia, owing to its environmentally friendliness. It is easy to implement the legal regulations that must be observed with this gas: for example, a separate and gas-tight compressor room. It is very difficult, or impossible, to observe such regulations in converted ships; as a result, other refrigerants (e.g., R404A) are applied in such cases.

Whichever type of juice is planned for transport, GEA is your highly competent contact partner. This applies not only when advanced technology must be integrated in new ships, but also when things are a bit tricky: for example, conversion under time pressure of an old freighter for the transport of juice.

Know-how for refrigeration processes on juice carriers:

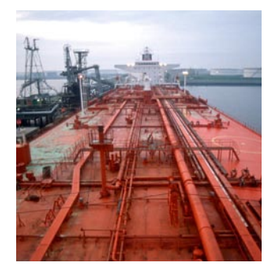
- Implementation of new systems
- Conversion and retrofitting of old ships
- Chillers
- Air coolers
- Environmentally friendly refrigerants

A total of 600 m³ of natural gas at ambient pressure can be reduced to 1 m³ – with the aid of frosty temperatures. This enables simple, safe, and economical transport of gas across the oceans.

Sometimes refrigeration simply enables making large things smaller: for example, for more economical transport. On LNG tankers, liquefied natural gas is shipped in insulated pressurized tanks at temperatures below -160 °C. A goodly number of such tankers crisscross the world's oceans, and their number is rapidly increasing. A field in which the know-how of GEA Refrigeration Technologies is in demand.

° Refrigeration technology for energy media

Extra space means extra money: gas safely and economically underway



GEA Refrigeration Technologies offers cryotechnology for gas liquefaction systems, refrigeration technology for gas storage in ship tanks, and temperature monitoring for regasification. We also deliver the required valves and fittings.

The import of liquefied natural gas (LNG), delivered by ship, is on the increase. One reason is that the gas reserves of some countries are dwindling. Another is that countries would like to free themselves from dependence on single importers of gas. Depending on the route, gas transport by ship can even be more economical than via pipeline – and the required infrastructure has grown accordingly. More and more facilities, for example, are now required for regasification – and the demand for refrigeration technology placed on GEA has accordingly grown as well.

When gas is cooled to -163 °C, it liquefies and shrinks to 1/600th of its uncompressed volume. Transport of the energy-laden liquid takes place in LNG tankers in special, insulated pressurized tanks (today, frequently preferred in the form of membrane tanks). In contrast to traditional spherical tanks, membrane tanks have the advantage that they fit more completely into the ship structure and optimally utilize the available cargo space. They consist of Invar®, a nickel-steel alloy that is especially tolerant to temperature fluctuations. Membrane tanks are not subject to deformation, even if below-zero temperatures prevail inside and tropical heat, outside.

The sophisticated insulation of membrane tanks, however, cannot entirely prevent their contents from slowly warming, with part of the cargo evaporating. It is necessary to vent the evaporated gas to prevent the pressure in the tank from exceeding a safe level. As a rule, this vented gas is used as fuel for the ship. For this reason, many LNG tankers are turbine ships that can use natural gas as fuel. At the present time, it is not yet economical to re-cool this gas: i.e., to return the evaporated gas to a liquid state. Natural-gas prices, however, are rising, and experts assume that motor-driven ships with gas re-liquefaction systems will in the near future replace the present turbine ships. A number of advanced LNG tankers have already been designed for installation of gas re-liquefaction facilities, with the result that it will be possible to retrofit these ships at relatively little expense.

For liquefaction on land, for the cryotechnology and re-liquefaction on board, and for regasification: GEA Refrigeration Technologies works in effective support of the complete liquefied-gas refrigeration chain.

Our products are not merely products. They are solutions for your requirements. This means that we provide you with an extensive selection of pre-defined as well as individually configurable solutions. This allows you to find the configuration for your application that harmonizes planning and installation expense, functionality, investment, and operating costs.

° GEA refrigeration technology for the maritime sector

Our products for your products

Valves and fittings

They are inconspicuous at first glance, but immensely important at second: the most suitable valves and fittings. They are matched to their particular application – not only with regard to maximum permissible pressures. The response behavior of the AWP valves, the resistance of the components to the media used and to external influences, and much more mean that these small components make a major contribution to the service life and the safety of your systems.

Chillers

On such diverse applications as cruise ships and animal transporters: GEA chillers assure just the required climate. After all, outside temperatures in equatorial regions can often result in heavy perspiration, even at full speed ahead. A comfort air conditioning system – fed from the cool circuits of our chillers – creates a pleasant ambience. The basis of these systems is onshore units that day in and day out prove their functional reliability. But they also fully stand up to the demands encountered on the high seas – after all, their operation has proven that neither steep pitching of a ship, nor other effects heavy seas can impede GEA chillers in their production of cold water.

Freezers

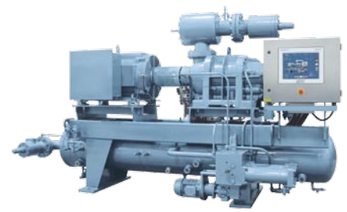
Floating fish factories spend days or weeks at sea – during which time no freshness should be lost. For this reason, the catch is frozen immediately on board: for fish that has been unprocessed, filleted, or portioned and otherwise prepared for the convenience of consumers. And if large catches exceed the freezer capacity of the ship, refrigeration technology by GEA has provided intermediate storage to ensure that fresh fish always lives up to its name.

Ice machines

Refrigeration at the press of a button – possible with Geneglace ice machines. As the leading European manufacturer of ice machines, GEA can resort to decades of experience for offering more than 40 models in various sizes. The machines deliver various ice qualities, including slurry ice and flake ice – used extensively, for example, in the fishing industry.

Ice towers

Rush hours occur not only in urban traffic: there are also rush hours in fishing harbors and in supermarkets. Fishermen rush to stock up on ice before they head out to sea, and sales staff in supermarkets need plenty of ice before they can display their goods at the fresh-fish counter. This means that fishermen and supermarkets benefit from stocking up in advance on ice. That's why GEA offers an extensive portfolio of solutions – plus the required ice-transport systems – including Geneglace ice-storage facilities inside supermarkets and Geneglace ice towers for filling ships.



Packages and skids

Perfectly inter-coordinated compressors, including their complete periphery, on stable, low-vibration frames – these are the GEA packages and skids. With our package solutions for refrigeration, you can rest assured that everything has been well thought out for you at our factory. And you can also be satisfied over low installation costs, since the units are completely delivered on a package or skid – ready to be hooked up and plugged in.

Piston and screw compressors

With its extensive offerings of Bock piston compressors as well as Grasso piston and screw compressors, GEA Refrigeration Technologies covers all normally encountered requirements placed on the supply of refrigeration. These machines have especially proven their reliability at sea. After all: when the nearest service support point is hundreds or thousands of sea miles away, the ruggedness of the machines is doubly important. This is why GEA has optimized its valves and fittings to match the adverse conditions of maritime service under continuous operation.

Control systems

Similarly to valves and fittings, control systems often remain unnoticed, since their performance cannot be measured in impressive kilowatt ratings or volumetric flow. But it can be expressed in intelligence – which helps to find the optimal operating point, to save energy, to determine machine operating times and capacity utilization, and to thus enable maintenance based on the operating state. Whether for individual units or complete refrigeration systems – we deliver the control systems that assure you maximum benefits.

The products named here represent only a small selection from our comprehensive portfolio. But this selection should make it clear that refrigeration technology has many facets for GEA. This enables us to assemble those products for you – from the correct standpoint and from the great options in our portfolio – that will optimally satisfy your requirements. In this process you will profit from tried and proven system components that are assembled to provide a harmonious overall solution, and to offer you what you are looking for: moderate investments, minimal operating costs, and maximum benefits.

Are you looking for a company that understands your sector? A company that realizes what requirements rough seas place on mechanical systems on board, what kind of reliability is demanded of each individual component, and what takes place at the shipyards? Then you have come to the right place with us. We solve your refrigeration problems – because we offer not only products, but also solutions – just as individual as your business and as customized as your ship. And we are not only just in the planning phase at your side: we also take care of project engineering, implementation, commissioning, and maintenance of your equipment.

° In touch with our customers

Customer proximity with top priority and a view to your success

Engineering

Ships are usually one of a kind. As a result, refrigeration solutions on board cannot be implemented with standard solutions. Virtually all large refrigeration systems are thought out on an individual basis, so that our investments remain low and your benefits come out high. Nevertheless on board, where every cubic meter is precious and a many trades compete for space in cramped quarters, there is still the possibility of combining standard components in customized manner, and to arrive at a tailored solution. A solution that is optimally matched to your requirements with respect to investment, functionality, space requirements, a minimum of maintenance, and long life cycles. And, on top of everything, our solutions are energy efficient, to ensure thrifty application of valuable resources.

In dialog with our experts, you will soon realize that you are speaking not only to refrigeration engineers. You will see that your contacts at GEA Refrigeration Technologies for development and engineering speak your language and understand your sector. That promotes dialog with you, simplifies formulation of problems, and finally leads to implementation of safe and reliable systems that have been harmonized with the transport or production functions required. And, since we deliver measurement, control, and instrumentation technology in addition to the hardware, interface problems simply do not exist. After signing of our contract, our team will by no means leave you alone. It will support the setup of your systems, as well as assembly and commissioning of your equipment. After all: we bear responsibility for the success of your business.

Engineering and redesign

It is a paradox, but one of which we are aware: there, out in the boundless high seas, room is scarce, at least on board ship. This is why we help you to find the optimal solution and to arrive at optimal integration of the required technology in new or used ships. In many cases, enhancement of your benefits will occur. This is because, for example, our systems require less space, increase the refrigerated cargo capacity or the possible throughput of goods, and because they simply save energy.

In turn, all of this makes itself positively felt in the operational range of your ships. After all, we are well aware that the criteria applicable on sea are different from those on land. Place your trust in the experience of our engineers. They create solutions with a long view, to assure that your investments bring in maximal returns.

Service

Weeks out at sea and then only a few days in port – routine for you. Preventive and restorative maintenance cannot therefore be concretely scheduled at prescribed intervals. Instead, it must be oriented to your work plans. No problem. We are there if and when you need us. And to ensure that time in port remains short, we would be glad to flexibly plan your human resources. This flexibility will also not fail owing to the mechanical engineering involved – which is why we place such value on low-maintenance, rugged equipment assemblies. And, if intervention should now and then become necessary to maintain the reliability of our equipment, we stand ready with advice for your staff and train them in the most important maintenance work "for in-between".

Spare parts

Whether as part of regular maintenance or owing to unplanned down time: even the longest-lived system now and then needs a spare part. And such parts must be available not only when you need them, but also where. This is why we have support points around the entire world that stock the normal wear, spare, and exchange parts for you. Our spare-parts warehouses contain not only GEA parts, but also the most common products of other manufacturer. This means, for example, that minor filter changes won't become a major problem.

To simplify logistics, we also pay attention as early as the machine-design phase that the same wear parts will be used in as many different modules as possible – which acts against unnecessary proliferation of part types. For us, this means simpler warehousing operations at the service support points – and for you this enhances the chances of spontaneous availability and fast assignment of our service team. A win-win situation that saves both of us time and money.

GEA Refrigeration Technologies works toward the following:

- Comprehensive consulting and responsible project support
- Great investment security
- Future-proof solutions
- A maximum of equipment operating time
- Long equipment life cycles
- Low energy consumption
- Minimal operating expense
- Highly competent service
- Fast spare parts delivery
- Climate- and environmentally friendly technologies

Would you like to learn more about us and our solutions?

On our Web site you will find contact details, our application and product brochures, and much more: www.gearefrigeration.com

Please don't hesitate to get in touch with us:
GEA Refrigeration Technologies and its companies are located worldwide. Our complete addresses are available on the Internet under www.gearefrigeration.com

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