



# Air Cooled Heat Exchangers

Robust and reliable for all loads and applications



## What it is

Air cooled heat exchangers are commonly used in industrial applications where a reliable source of water is not available as a cooling medium. Even if water is available, in some cases, air cooled exchangers are favored for economic or operational reasons – because dedicated cooling water circuits, pumps, water cooling systems and water conditioning systems add complexity and capital requirements, as well as operating and maintenance costs.

Air cooled heat exchangers are used throughout the entire oil and gas industry from upstream production to refineries and petrochemical plants, under conditions including high pressure and temperature, as well as corrosive fluids and environments. Common applications include gas re-injection, gas lift and pipeline applications, cooling and condensing of hydrocarbon gases, and cooling of machinery oil and heavy hydrocarbons. Air cooled steam condensers are a special type of heat exchanger employed to condense steam at the exhaust end of steam turbines for both power generation and mechanical drive applications.

## How it works

The hot process fluid to be cooled flows through a tube while the cooling air flows across the outer surface to remove heat. The cooling air is propelled by fans in either a forced draft or induced draft configuration. Specially designed fins are attached to the outer surface of the tube to create a large surface area for more effective cooling. The heat transfer rate is a function of the fins' surface area and the velocity of the air flow.

The mechanical design of the exchanger must accommodate the process conditions including pressure and temperature and, possibly, corrosivity, fouling and condensation. GE produces various configurations to meet all these conditions.

The key to quality and long service life is the proper selection of materials and fabrication technology, not the least of which is advanced welding capabilities. Large exchangers can include thousands of tubes so it is crucial to maintain dimensional stability and weld integrity.

## Worldwide presence

GE's Oil & Gas business has more than 100 years of industry experience and 5,500 employees worldwide. Our Air Cooled Heat Exchanger team is centered in Vibo Valentia, Italy, and is an integral part of the larger Oil & Gas organization headquartered in Florence. Together, we provide complete solutions to all industry segments – with a broad and expanding portfolio of advanced technologies, plant equipment and services.

We are a global company with a local touch. Our highly experienced personnel offer comprehensive customer support, backed by immediate access to all of GE's broad resources. Our people understand the local customs and regulations, and can help you identify and track growth opportunities.

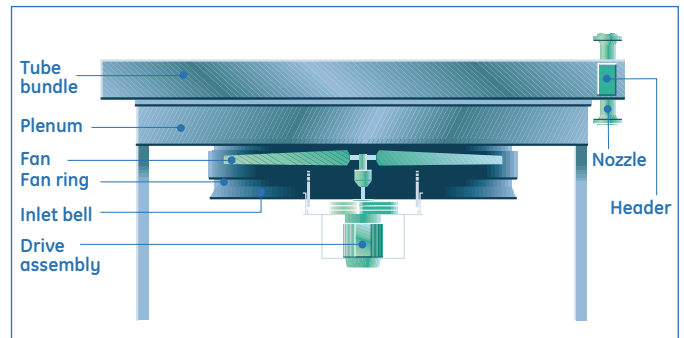
Our Air Cooled Heat Exchanger team offers extensive experience in both new units and after-sales services. We draw on the broad resources and facilities of GE's Oil & Gas business to effectively serve all possible customer needs – from providing simple information about air cooling capabilities to formal responses to your Requests for Quotation.

## Experience makes the difference

We have been a global leader in the fabrication of air cooled heat exchangers and steam condensers since the late 1960s. We have supplied more than 10,000 bundles for applications throughout the industry from upstream applications to hydrocarbon processing.

The quality of our exchangers is a result of advanced design techniques employing the latest software, world-class fabrication facilities and capabilities, Six-Sigma quality methodology and extensive experience both in manufacturing and in-field service.

### Air Cooled Heat Exchanger Sketch



## The right technology for every application

Different applications have unique process conditions that the heat exchanger must be designed to match, including various combinations of:

- Pressure
- Corrosion
- Temperature
- Fouling

GE's air cooled heat exchanger designs offer the flexibility needed to deliver optimum performance for all applications.

**High pressure applications** – upstream and midstream processes such as gas re-injection, gas lift, LNG and gas transportation pipelines

**Process plant applications** – cooling and condensing of hydrocarbons and gases

**Low pressure, dirty fluids** – cooling of heavy hydrocarbons and machinery oil



## A complete range of products

Air cooled heat exchanger types are usually defined by the configuration of the header.

### Pipe and bend configuration

This equipment uses a header made of forged pipe and is designed to withstand very high pressures.



It is recommended for use with clean fluids since no inspection openings are provided. Its fully welded design is especially suitable for critical and hazardous applications. Designs can handle extremely demanding pressure – over 650 bar (9,427 psi) – temperature and material conditions.

### Plug box configuration

These exchangers are suitable for a wide range of applications and services involving cooling and condensing of hydrocarbons and gases over a broad range of process conditions in any size plant.



The distributor (header) of this model is a completely welded box with holes in front of each finned tube to allow cleaning and inspection. The design effectively meets competing needs such as low cost and high versatility. This configuration can cover most

common applications with operating conditions typically up to 220 bar (3,192 psi).

### Cover plate configuration

These exchangers are generally used for dirty fluids with low operating pressures, in applications such as cooling of machinery oil and heavy hydrocarbons in refineries.



Cover plate heat exchangers are designed for ease of maintenance. A flanged removable cover allows complete access to the inside of the header for cleaning – since this feature substantially limits the design pressure, this type of heat exchanger is not recommended

for critical service applications. Operating conditions are typically up to 35 bar (507 psi) and processed fluids can be very viscous.

### Finning

Together with header features, finning of the tubes is key to air cooled heat exchanger performance. GE produces three types of finning:



**Extruded** – high efficiency fins for higher temperature applications (typically up to 300°C). These fins provide the base tube with complete and permanent corrosion protection against atmospheric contaminants.

**Embedded or grooved** – high efficiency finning for high operating temperatures (even up to 400°C)

**L-footed** – standard fin for low temperature applications (typically up to 170°C) where some degree of tube wall protection is required.

	Gas Re-injection	Gas Compression and Gathering Gas Lift	Liquefied Natural Gas	Gas Pipelines and Storage	Gas-to-Liquids	Refineries & Petrochemicals	Machinery Lube Oil Cooling
<b>Header Configuration</b>							
Pipe & Bend	●			●			
Plug Box		●	●	●	●	●	●
Cover Plate						●	●
<b>Finning Type</b>							
Extruded/Embedded	●	●	●	●	●	●	●
L-Footed		●		●		●	●

## Advanced technology in gas cooling

GE's Oil & Gas business has always been at the leading edge of technology – meeting current customer needs and even anticipating future requirements. There are two key factors to consider when choosing the best technologies for air cooled heat exchangers: the gas type and the pressure of the gas to be cooled.

**Gas type** – Non-corrosive gases such as natural gas are typically the easiest to handle where the possibility of water condensation is the major complexity. If, however, the gas is sour (containing substantial levels of  $H_2S$  and  $CO_2$ ) the corrosive effect of these components, coupled with water, is a serious consideration.

**Gas pressure** – Very high gas pressure requires special considerations with respect to design, material type and thickness, and manufacturing – particularly welding.

In the extreme case of sour gas at very high pressure, the gas is highly corrosive and the heat exchanger technology must be carefully adapted to the specific characteristics of the gas.

### Materials

To prevent equipment corrosion under these conditions, special thicker material is required – not only for the air cooled heat exchanger, but for the whole plant. We use advanced corrosion-resistant alloys, such as Incoloy 825, which however require specialized welding techniques to ensure high-quality construction of the heat exchangers.

### Welding

Welding of complex parts of different shape and thickness results in severe heating and the possibility of non-uniform cooling that can cause stresses to develop. Extra care must therefore be taken to assure proper cooling and the control of stresses. Stress levels are analyzed and relieved with local heat treatment (tube-to-header welds) and in our specialized furnace (headers and flanges).

All these technologies are continuously evolving. The first high-tech pipe and bend air cooled heat exchanger we supplied in the early 1970s was for sweet gas with pressure slightly over 300 bar. Our latest applications are for more than 650 bar with  $H_2S$  content as high as 18%. And our investment in technology continues in an effort to meet even more extreme conditions.

## Quality starts with the design

In addition to our advanced design tools and capabilities, all our mechanical design work is carried out in strict compliance with international codes and engineering standards. We are also quite experienced in meeting special design requests from our customers.

Great care has been taken in standardizing supporting structures in order to reduce the fabrication cycle time and simplify installation.

### Extensive manufacturing proficiency

After four decades of fabricating air cooled heat exchangers for the global industry, our products are well established and our manufacturing techniques are continually updated.

Our header boxes are made with high-quality materials and very advanced welding and machining techniques. We can produce fin tubes with diameters of 1", 1.25", 1.5" and 2" with up to 11 fins/inch and lengths up to 18 meters.

Our facilities are equipped with multiple finning machines and automatic welding stations, a 20 x 4 m stress relieving furnace and all other specialized equipment needed for the high-quality industrial production of air cooled heat exchangers. Our plant is located in Vibo Valentia, Italy, and has a capacity in excess of 1,000 bundles per year.

### Focused on quality

All our manufacturing processes are implemented in strict accordance with GE's world class Six-Sigma quality system which conforms to all major international quality assurance standards including ISO9001, BS 5750 and UNI EN 29001. Compliance of the QA system with these standards is certified by LLRR. Our plant is certified with ASME R, U, U2 stamps and is staffed with level 3 NDT personnel. We are equipped with all the facilities necessary to perform chemical and physical material properties testing as well as for the execution of NDF testing and thermal bond testing for finned tubes.

## Air cooled steam condensers

Air cooled condensers are preferred to water cooled condensers in special environmental or water shortage conditions.

The steam condenser is a vacuum-tight air cooled heat exchanger, usually with bundles sloped at approximately 30° to reduce footprint, and 100% fully welded connections.

Our system is provided as a full package consisting of exhaust steam duct, finned tube bundles, vacuum system, hot well, pumps, piping and accessories.

Our condensers generally include both one-pass pre-condenser bundles and multi-pass post-condenser bundles of proprietary design. This arrangement prevents back-flow and freezing, and has been conceived with operational flexibility in mind regardless of severe weather conditions.

Effectiveness has been well proven at successful installations in diverse climates – from Siberia to the Sahara Desert.



## Providing service to the industry

GE's Oil & Gas business offers a multitude of after-sales services to keep heat exchanger and condenser equipment operating at peak performance for many years, or to upgrade them to meet more stringent regulations or new customer operational requirements. Beyond parts and bundle replacements, our services include:

### Performance assessment

The performance of air coolers is checked and diagnosed by collecting data on air flow, tube flow, fan power, overall status of equipment and processing it directly in the field. We provide a detailed action plan to optimize air cooler performance.

### Upgrading

Where there is a need to increase air cooler capacity, our performance assessment will provide information on what upgrades are feasible for your current equipment. We can also supply the detailed fabrication drawings needed to perform modification work.

### Modification

Our people are fully qualified to perform any kind of work on any kind of air cooler including re-qualification to provide performance guarantees.



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