

Solutions for the oil and gas and chemical industries

Enabling efficient performance
and reliable operations across the
hydrocarbon production chain



In the oil and gas market where equipment availability and performance are essential, our customized solutions are the clear choice for air and gas handling.

For more than a century Howden, a Chart Industries company, has supplied air and gas handling equipment to every major oil and gas company in the world. From frozen sites in Siberia and the hottest nations of Africa, to offshore sites and remote desert fields, we work with customers wherever they are to deliver customized solutions.

Howden has an extensive portfolio of technologies available from simple equipment integrated by OEMs to the most elaborate engineered turnkey solutions. We work alongside our customers in selecting the most accurate solutions in order to make their oil and gas projects become real.



Future focus/ present service

As a technology enabler for the oil and gas industry we continually develop our products in line with the needs of process designers and operators. We work with them to design products, which enable efficient performance for duty conditions.

Our large installed base of products are supported to ensure they fulfil operational demands whether constant or evolving.



Efficiency

Our cutting-edge technology is engineered to provide the highest performance relative to energy required.

This supports our customers in cost-effective long-term operations.



Reliability

Our products are known for their durability, often operating in applications requiring continuous service.

This is backed up by a global network of engineers to support a lifetime of highly reliable performance.

Chart in numbers

\$8bn
market cap
(NYSE:GTLS)

\$4bn+
sales

1500+
engineers

50+
service
centers

64
manufacturing
sites

Serving applications for air and gas across hydrocarbon processes



Gas Compression

Our solutions and experience

Screw Compressors

API 619 and standard

Our world leading oil-injected and oil-free screw compressors are renowned for reliable performance in the most demanding application environments such as on-and-offshore oil and gas production, downstream processing and petrochemical production.

We supply both standardized and customized API 619 packaged solutions for high-end utilization, with minimal deviations. Our extensive pre-contract support ensures the best compressor selection for each application.

With thousands of installations worldwide, our compressors provide high integrity and low maintenance solutions for liquid chilling, process cooling and gas compression applications.

Why choose Howden?

- An extensive range with incremental frame sizes to meet every duty requirement
- Our VI technology optimizes performance efficiency for varying application conditions (including adjustable VI options)
- Flexible options for casing materials, bearing and sealing allow for a wide range of gases and applications to be efficiently compressed
- Double wall casing ensuring rigidity and reliability, reduced noise and thermal transfer
- Oil-free design for complex conditions involving gases with liquids, particulate, polymer forming, and varying molecular weight
- Long-term reliable and efficient performance due to surge free, low vibration operation and optimized rotor designs leading to life spans in excess of 50 years

Typical applications

- Process and PSA tail gas/
Process cooling
- Off gas/Flash gas/Vent gas/
Vapour recovery/Flare gas
- Booster (Gas turbine feed, gas
gathering, make-up and
recycle)
- Refrigeration and heat pumps

Performance

Oil-injected

Pressure: up to 75 bar

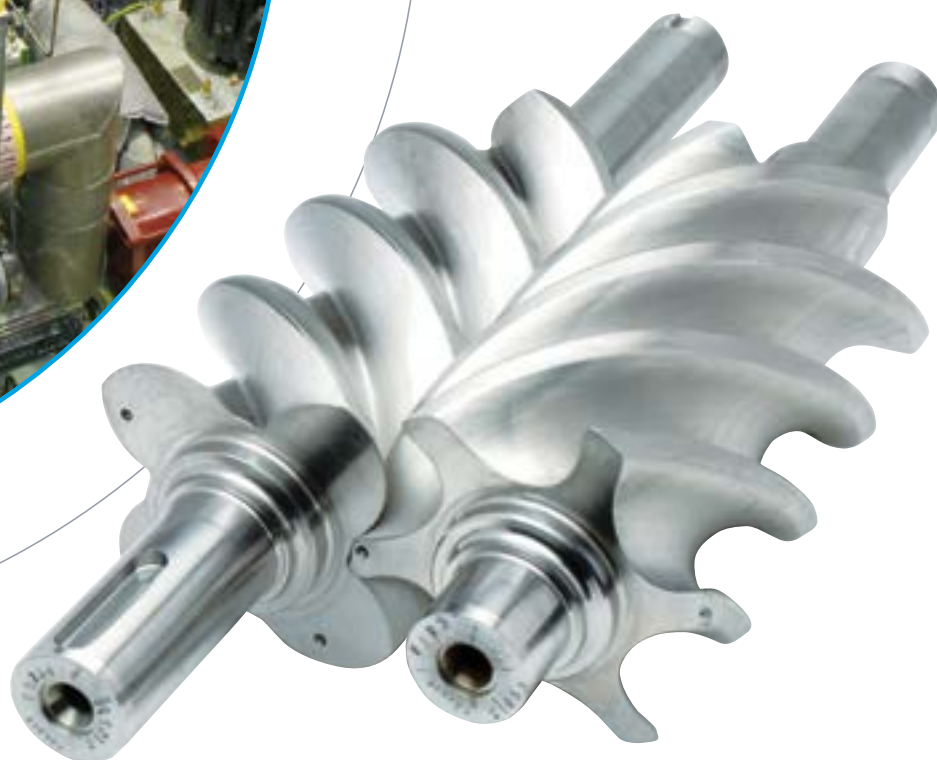
Flow: up to 29,000 m³/hr

Oil-free

Pressure: up to 45 bar

Flow: up to 92,000 m³/hr





Project example: FPSO, North Sea oilfield, UK

The FPSO was one of three serving the field with a production capacity of 60,000 bopd and a storage capacity of 650,000 bbl. The FPSO required gas compression capacity of 156 MSCFD to handle a mixture of Export, Flash, Permeate and Booster gas compositions with multiple case and flow requirements for each.

Due to the harsh and remote offshore production environment, the FPSO operation requires robust, extended maintenance intervals and reliable gas compression systems to ensure optimized operational performance. Limited space also means maximizing footprint is a critical design requirement alongside maintaining the high quality of operation, reliability and availability.

Five Howden oil-injected screw compressors were selected as an ideal match for the Permeate Gas and Flash Gas compressor systems. They are proven as very reliable and compact units able to handle a combined flow capacity of approximately 10 MMSCFD, while operating with differing flow requirements.

With an integrated capacity control feature the compressor is able to meet the flow capacity turndown requirements over multiple cases reducing costs by removing the need for VFDs. Also, Howden was able to meet the demands of the heavy hydrocarbon gas compound by ensuring the oil supply was designed specifically for the gas compound being compressed. The compressor system design provided the lowest possible oil carry over volume.

With an experienced design team, Howden addressed the added challenge of DNV, API and ATEX specifications to ensure quality, specification and safety requirements were met. Due to the harsh operating environment, enhanced materials including Duplex SS, 316SS and CS were incorporated into the designs.

Operating efficiently for over eight years, the compressors are further enhanced by Howden Uptime, our monitoring platform linked to a digital twin. This provides intelligent monitoring, enabling maintenance decisions to be made proactively, keeping performance optimized and avoiding unscheduled downtime.

Reciprocating compressors

API 618

Our reciprocating piston compressors are based on the designs for the Thomassen and Burton Corblin brands. They provide a comprehensive range of volumes and pressures to satisfy the demands of hydrogen and process gas compression within refining, chemical and petrochemical processes, as well as renewable energy and environmental applications.

The Thomassen 'C' series is one of the largest compressors in the world, offering heavy duty and high power units. Howden has more than 2 dozen references of operating reciprocating API618 compressors with more than 13MW of power.

The Burton Corblin 'P' series is for processes involving lower capacities. The fully integrated package we supply can incorporate control systems, regulation equipment and any other additional modules and utility packages required by the circumstances. The 'P' series is delivered ready for installation and start-up.

With an extensive history of design and supply to the oil and gas industry, our compressors are proven across over 3000 installations for H₂ and process gas.

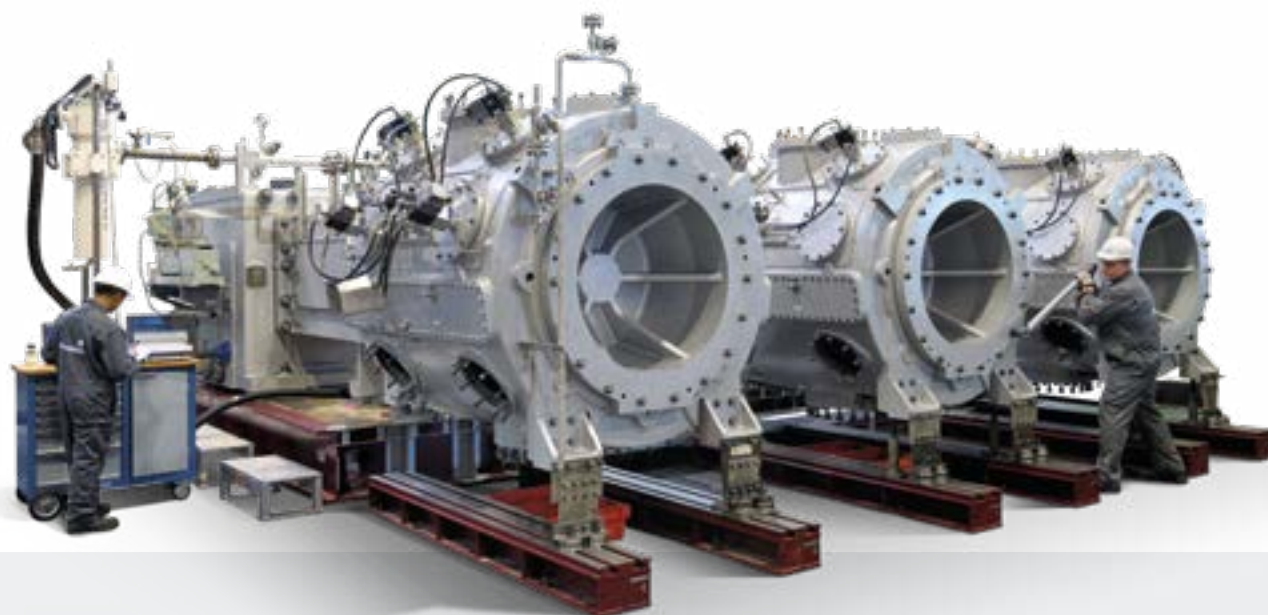
Why choose Howden?

- Unique Free Floating Piston (FFP) reduces ring wear and greatly extends intervals between maintenance
- Rod load up to 1,800 kN ensuring the most compact solution
- API 618 low rotation speed offering robust reliable and lasting equipment
- Power up to 33MW to limit connections to one equipment set
- Dry and lubricated compressors packages for easy installation

Typical applications

- H₂ process gas make up, recycle, storage
- N₂ booster for blanketing
- Off gas, vapour and vent gas recovery
- Process gas boost





Project example: KNPC Refinery - H₂ compression for clean fuels processes

With the Clean Fuels Project, KNPC created an integrated refining system to replace the Shuaiba Refinery with a complex capable of full conversion, the highest light ends product yield and nil fuel oil production.

High-pressure hydrogen supply for secondary units is critical and reliability is an absolute prerequisite for a project where system downtime can cost millions of dollars.

The compressors receive hydrogen from the world's largest hydrogen production facility as well as recovered hydrogen from the production units.

For the modernized refinery complex Howden Thomassen Compressors were selected by the engineering firm Fluor to build the largest API reciprocating compressors ever constructed for the oil, gas, refining and petrochemical industries. The final decision to proceed with six compressors, with eight cylinders, was based on striving to achieve the highest efficiency and greatest flexibility in regulating capacity. For these compressors, specific attention was placed on the preliminary phase, investigating aspects such as torsional vibrations and pulsations. This enabled Howden, in collaboration with Fluor, to identify the critical issues early on and come up with concrete solutions, guaranteeing the reliability of the compression system.

The preliminary studies and collaboration with Fluor meant we could make robust choices concerning the design in order to create a flexible, but easily adjustable capacity for each of the different compressors.

The first Thomassen C-85 reciprocating compressor with eight cylinders and a capacity of 16.6MW was delivered within the challenging one-year deadline. The building of these compressors is a key milestone representing a new generation of compressors that not only comply, but exceed the current API 618 specifications and Shell DEPs.

Performance

Power: up to 33 MW

Pressure: up to 600 bar

Rod load: up to 1800 kN



Diaphragm compressors

Howden has been at the leading edge of diaphragm compressor innovation for almost a century through the Burton Corblin brand, and continues to advance in areas of safety and performance.

Our diaphragm compressors are selected for processes requiring full gas confinement, high pressures (reaching up to 3000 bar), and high quality gas preservation.

Diaphragm technology is the first choice in any situation where complete hermetic separation is required. Examples of this include the handling of rare, toxic, flammable and explosive gases and pure H_2 . As such they are common within refining and petrochemical processes.

With low to very high discharge pressures they address a wide array of processes and are relied upon for specialist applications. Howden has over 4,500 compressors operating in oil and gas and chemical industries.



Why choose Howden?

- Highly reliable and safe with fail-safe stop procedure and containment of process gas
- High compression ratio (of up to 20:1) reduces stages resulting in a reduced footprint and compact unit with lower energy and maintenance costs
- Skid mounted turnkey package eases installation with no foundations required
- Insulated compression chamber with static sealing prevents gas contamination and maintains safe operating environment
- HIDS system provides real-time monitoring of head integrity

Typical applications

- H_2 make up and recycle
- N_2 booster for blanketing
- Off gas/leak gas/vent gas recovery
- Complex process gas compression
- Clean gas processes

Project example: High purity compression for PTA

Purified Terephthalic Acid (PTA) production requires H_2 gas containment and purity preservation for final product quality and to ensure the prevention of any toxic or hazardous leaks.

Major PTA production sites integrate diaphragm compression technology for the hydrogenation reactor feed with pure H_2 at high pressure around 10 to 20 Mpa. The full insulation of the compression chamber, ensured by static sealing, preserves hydrogen gas purity.

End users and engineering companies select Howden for equipping a large quantity of PTA sites around the world and the diaphragm compressors operate continuously in hazardous areas.

Howden also provide other PTA compressor applications such as nitrogen compressors, centrifugal compressors and packing seal compressors. Other chemical and industrial gas companies widely use our diaphragm technology.

Periflow® compressors

API

Periflow® compressors are perfectly suited to applications such as process gas recycling, pressure boosting, gas extraction and gas drying. These are often seen in offshore production and downstream processing.

Their exceptional flow control and suitability for wet and particulate-laden gases makes them immensely versatile. With pressures up to 350 bar and flow ranging from 10 to 20,000 m³/hr, Periflow® compressors are suitable for a very wide range of process gases, including those containing liquids or particles.

Fully compliant with API, area protection requirements and site specifications, Periflow® has consistently demonstrated its worth in critical applications throughout the world.

The system is as simple in operation as it is in concept. This is because it requires no anti-surge systems, damping bottles, heat exchangers, vibration or stress monitoring, lubrication oil consoles or complex instrumentation, making it significantly smaller and lighter than comparable units.

Typical applications

- Process gas recycle
- Gas booster
- Gas with particles handling
- Gas transfer and extraction



Why choose Howden?

- Light weight, small footprint and low vibration allowing easy installation without resonances and related fatigue of connections - ideal for offshore
- Wet and dry seal options run from basic to high containment designs with simple installation
- Roller bearing lubricated by a compact oil mist system meaning no lubrication oil monitoring console
- Efficient operation by controlling process flow via variable speed drive
- No complex instrumentation, anti-surge system or monitoring needed
- Minimal maintenance requirements due to low speed operation

Project example: FPSO gas drying compression systems

Regeneration compressors operate in FPSO ships gas drying units. The fleet covers the offshore fields located more than 200km from coasts.

Each FPSO has a production capacity of 150,000 barrels and can compress up to 6 million cubic meters of natural gas per day. Gas collected from the fields is treated and dried before liquefaction, transportation or reinjection takes place. Operations are conducted in order to avoid corrosion and hydrates formation in process pipes and equipment. Periflow® compressors are used in dehydration units for the regeneration of reactor molecular sieves and the compressors' variable speed delivers constant gas flow and pressure for a regeneration process preserving desiccant.

FPSOs require reliable, compact equipment with a small footprint, simple integration, low to no vibration, and can run for long periods without needing maintenance. Due to operating in different fields with different gas compositions and flows, the equipment used must be able to adjust to these fields and be compatible with the identified running conditions.

Centrifugal compressors

API 617/672 or standard

Multiple chemical production processes require the movement and compression of gases. Often these gases are corrosive, erosive and sticky in nature and necessitate highly engineered compressors that are suitable for reliable operation in such harsh environments.

Howden's turbo blowers and compressors, based on our legacy brands such as Kühnle, Kopp & Kausch (KK&K), CKD and Turblex, set the benchmark for safety and reliability, at the lowest lifecycle costs.

With a large portfolio of products, we serve diverse applications within refineries and petrochemical production plants, for example polyethylene, polypropylene, methyl methacrylate and maleic anhydride.

With more than 4,000 references worldwide we deliver solutions that bring high efficiency to processes and reduce operation cost.

Why choose Howden?

- Modular design approach allowing flexibility to process and site demands
- Single stage or multistage units with either an integrated or separate gearbox to suit the application
- Can be supplied with an integral Howden steam drive for reduced footprint and cost

Typical applications

- Process gas and gas recycle
- Combustion air for SRU
- SO₂ blowers for SAR
- Mechanical vapor recompression (MVR)
- Air blowers for process and conveyors

Performance

Flow: up to 600,000 m³/h

Pressure ratio: up to 3.5

Project example: Caprolactam plant

A world leading producer of Caprolactam approached Howden for the replacement of a 40 years old turbo compressor in their production process.

The project needed to be carried out during a scheduled overhaul to minimize downtime. This required precise preparations for a smooth installation with connection into existing pipework and extremely limited space for lifting the compressor onto the concrete base.

Howden's design engineers were able to minimize the footprint of the new compressor, while still maintaining API requirements, and enable dismantling of several parts, which greatly aided the installation.

Expert project coordination from technical preparation with the customer, pre-contract support and contract management resulted in the replacement with minimal site downtime.



Turbo fans

API 673, PIP, PED, ATEX

Howden's ExVel® turbo fans are a unique centrifugal fan and blower technology, which provides substantially higher compression for air and process gas compared to a traditional centrifugal fan.

With a compression ratio from a single stage up to 1 bar (14.5 psi), ExVel® turbo fans can provide as much as 4 times that of a traditional centrifugal fan with a wide potential flow range. This allows for greater process production with both less and more efficient equipment, costing as much as half the cost of a centrifugal compressor.

ExVel® turbo fans are gas tight designs as standard and are fabricated from a variety of steels and alloys in order for them to be optimized for challenging petrochemical, chemical, oil and gas applications which may present wet, corrosive, and even hazardous gas compositions.



Performance

Flow: up to 200 m³/s

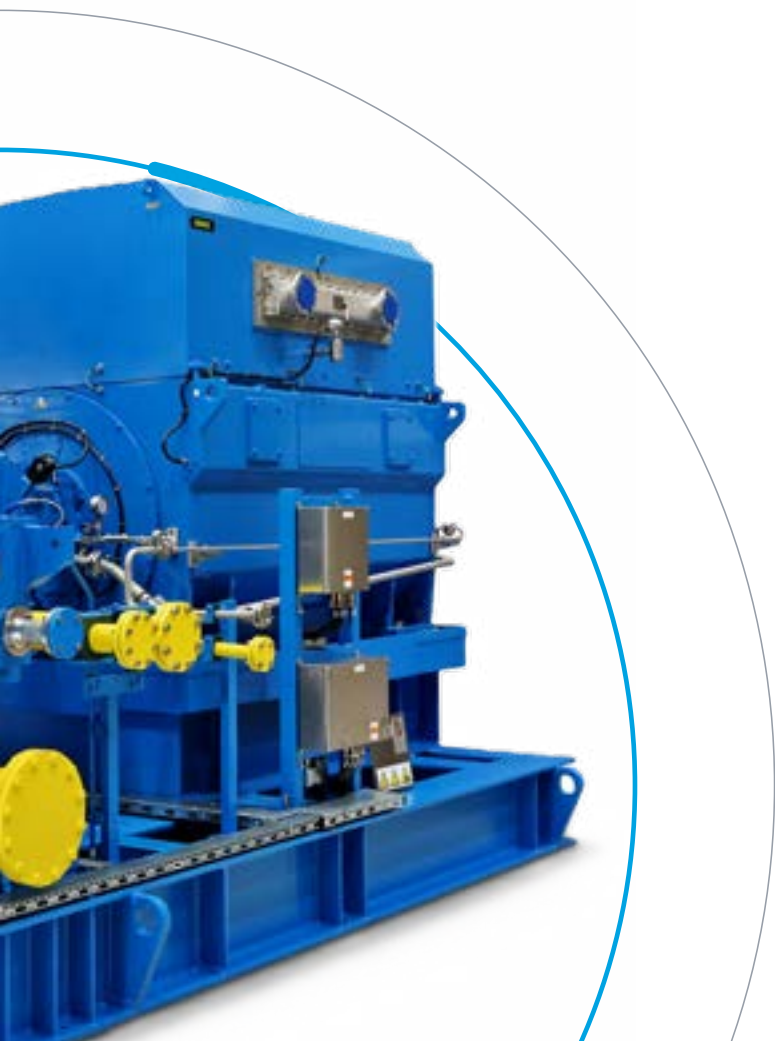
Design pressure: from full vacuum to 20 bar

Why choose Howden?

- High compression ratio at high flows and efficiencies resulting in significantly lower CAPEX, smaller/less equipment, low OPEX
- Exceptional performance and value compared to other fan/compressor options
- Materials of construction options to meet challenging process gases & environments
- Extensive installation and application experience

Typical applications

- Mechanical Vapor Recompression (MVR)
- Zero liquid discharge (ZLD)
- Steam Assisted Gravity Drainage (SAGD)
- Air and process gas boosting



Energy

Our solutions and experience

Steam turbines

API 611/612 and ATEX

Steam turbines are designed to turn energy from fluid onto the rotor, and our products are considered the most economical and flexible turbines available.

Howden turbines operate as mechanical drives running process pumps and compressors, as well as being part of a genset, generating both power (up to 40MW) and heat for your internal and external use.

With both applications we are able to improve the overall efficiency of your processes.

Our turbines are based on long-standing designs from Kühnle, Kopp & Kausch (KK&K) and Peter Brotherhood with more than 20,000 installed worldwide supporting industrial processes on-and-offshore.

Why choose Howden?

- Back pressure or condensing type covering water-steam cycle operation modes
- Quick start without pre-heating for fast ramp-up to full load
- Highly customizable package designs to meet specifications
- Oil unit integrated in base frames enabling compact footprint and easy site installation
- Nozzle group control valves available allowing higher efficiency in partial load operation
- Perfectly suitable for packing companies/EPC who complete the unit for their customers

Typical applications

- Compressor and pump mechanical drive
- Steam turbine for power generation
- Waste heat recovery
- Gas expansion
- ORC (Organic Rankine Cycle)

Performance

Heat and power generation: 75kW to 40MW

Mechanical drive: 10kW to 40MW





Rotary heat exchangers

API 560

Fired heaters can be used for multiple processes within downstream oil and gas processing facilities such as hydrocrackers, distillation units, reformers and superheaters and increased efficiency of 10-15% can be gained by preheating combustion air.

Howden's regenerative air preheaters extract waste heat from the exhaust gas, as it leaves the furnace or boiler, transferring this energy to the inlet air used to provide the oxygen to fire the fuel. As the preheater slowly rotates at around 1-2 rpm, thin metal heat transfer elements absorb heat from the hot gas stream and transfer it to the incoming cold air stream.

Why choose Howden?

- Engineered elements with high thermal efficiency to maximize recovered energy and cost savings with lower CO₂ emissions
- Compact footprint design relative to recuperative alternatives reducing installation requirements and meeting space constraints onsite
- Very low rotational speed resulting in low wear levels and minimal maintenance

Typical applications

- Air preheating within fired equipment

Project example: Sarnia complex, Canada

The Sarnia integrated refining and petro-chemical facility, had a critical gas cracker, whose air preheater required replacement. The operator was keen to minimize the impact on the rest of the plant and keep the downtime as short as possible, whilst taking advantage of any potential performance level improvements.

Howden responded with a specially-designed regenerative heater, modelled to fit the operating conditions in the refinery with precise element profiles for the thermal and pressure drop required.

The heater was pre-assembled in our factory allowing for easy onsite installation. Firstly, the baskets and rotor seals were installed in the air heater, then the complete unit was installed and coupled up to the existing foundations and ductwork.

Significant improvements in furnace operation and the performance of both the forced-draft and induced-draft fans have been reported.

Air and gas handling

Our solutions and experience

Cooling fans

The processing and refining of fossil fuels uses a range of high temperature processes from gas cracking and oil distillation to additional thermal methods to obtain final products.

In many cases, equipment used within the value chain also generate high levels of heat such as compression within liquefaction or boosting for transportation. All such activities necessitate cooling systems as a result.

These cooling systems typically circulate water in order to transfer heat away from the process and incorporate cooling towers, air cooled condensers (ACC) or air cooled heat exchangers (ACHE) acting as condensers.

Howden's fans are used to ensure adequate volumes of air are passed through the cooling tower, ACC or ACHE. The fans are axial type and designed to meet not only the required flow, but critically operate within the specified noise level permitted on each site, an increasing factor in environmental considerations.

Why choose Howden?

- Outstanding fan durability and efficiency based on Fiberglass Reinforced Plastic (FRP) blades
- Able to meet required performance levels with the lowest noise emissions with our innovative designs

Typical applications

- Process cooling air within cooling towers, ACHEs and ACCs

Project example: Golden Pass LNG plant

The plant operates 3 liquefaction trains to provide an annual output of 16 million metric tons of LNG. The liquefaction process requires substantial amounts of cooling along with the onsite power plant, requiring a large number of coolers and condensers.

As well as the required cooling output, noise emissions were to be kept within stringent limits. Howden was able to propose multiple variants and supported the Korean OEM with testing and technical data using our global team.

The resulting contract comprised more than 600 SX axial cooling fans, which provide the ultra-low noise critical to minimizing the impact of the LNG operation within the local environment.

Process fans

Howden has a wide range of specialized centrifugal and axial fans for a variety of industrial and high specification HVAC applications.

The fans are available in a variety of standard sizes in order to offer customers an optimal solution for their applications, and can be designed to operate at 500°F for 4 hours.

Why choose Howden?

- Best fit solutions for configured or engineered fans
- Multiple designs for integration to system and sites
- Reputed fan brands for industrial processes and utilities

Typical applications

- Air supply - primary air fans, overfire, drying
- Gas processing - flue and flare
- HVAC and cooling towers
- Material conveying



Stronger together – combining with Chart's product technology

As part of Chart Industries, our access to a broader technology portfolio brings increased advantages to our customers.

Chart has developed a leading position as a technology provider to the oil and gas industry. With expertise in cryogenic liquid gas management and heat exchange, Chart's products are seen across the process chain to the point of chemical or petrochemical production.

Chart capabilities

- Cryogenic storage and transportation of liquid gases
- LNG regasification
- Small scale LNG plants
- Bunkering & ship fueling systems
- Air-cooled, brazed aluminum, hairpin and specialty heat exchangers
- Turboexpanders
- Carbon capture technology
- Water treatment



Howden

Make an enquiry through our website.
www.chartindustries.com/howden

