

Mine Cooling Systems

Custom-designed solutions that are optimally engineered, energy-saving, and increase production



Howden's Mine Cooling Systems are the key to unlocking opportunities for the profitable recovery of valuable yet difficult-to-access resources in deep-level mines.

For more than a century, Howden, a Chart Industries Company, has supplied ventilation equipment to every major mining company in the world, from frozen sites in the Arctic and the hottest nations in Africa to some of the deepest mines on the planet.

Howden has partnered with resources companies to develop deeper underground operations as surface ore bodies deplete. Our mine cooling solutions kept pace with these challenges, and we commercialized pioneering technologies relied upon by our customers in the hottest, harshest work environments.

Now, as environmental responsibility and energy efficiency join productivity, safety, and health as industry priorities, Howden's engineers are as ready as ever to listen. We offer world-leading experience and personalized service and know-how in proven, bespoke mine cooling solutions for today's resources companies, wherever they operate.



By reducing blast clearing downtime, Howden can improve production rates by up to 70%

Combining world-class expertise and the latest technology, mine cooling systems and Ventsim™ CONTROL brings together impressive production efficiencies in your mine operation.

Ventsim™ CONTROL is fully integrated with the Ventsim™ DESIGN model. It utilizes intelligent software connected to hardware devices to monitor remotely, control, and automate airflow, heating, and cooling. In that way, it delivers safer, more productive, and lower-cost ventilation for your mine.

Cooling on Demand

Our on-demand update to Ventsim CONTROL aligns with the mining industry trends toward deeper mines which require cooled air to achieve higher standards of health and safety for workers. Users can monitor temperatures at deeper levels and push back cooled air more efficiently. These new controls ensure the cool air goes where it is required, saving operating and energy costs.

The improved efficiency supports the move to more sustainable operations, and the health and safety benefit allows mines to adopt higher standards in advance of incoming regulations.

-  Energy savings
-  Health and safety operation
-  Increase production

TMVS integration

Mine Cooling systems align with Howden's Total Mine Ventilation Solutions (TMVS) offerings by complementing our product suite for mine ventilation applications.

TMVS is a fully customizable, integrated suite of expertise, products and services. Providing efficiency and safety across operations globally.



Overview of mine cooling

At Howden, we play a vital role in creating Mine Cooling Systems to ensure the best solutions for the mine site.

With unmatched experience and reference installations, Howden's experts are capable of delivering the most optimal design solution.

Howden's know-how ranges from how to engineer mine cooling solutions to deal with the poor water quality at deep gold mines, to how to make solutions as energy efficient as possible to circumvent grid issues—catering to some of the strictest air quality, temperature, and occupational hygiene regulations across the globe.

Global footprint

Howden has expert project execution capabilities on all continents and major mining hubs. The decentralization of engineering capabilities was achieved by an intensive multiyear training program, reprioritization of key resources, and close collaboration of global business units.

Howden's mine cooling engineering expertise is not just isolated to equipment but also consists of front-end-engineering and design in support of our internal ventilation teams and external ventilation consultants.

Equipment

Howden provides complete turnkey mine cooling solutions for surface and underground systems, incorporating in-house technology and equipment from industry-leading partners. Howden is, therefore, technically neutral in our customer offerings.

A broad and quality portfolio is available, from Surface Bulk Air Coolers to Hard Ice Plants, ensuring business continuity and the mine site's productivity.





Surface bulk air cooling

Howden's stand-alone surface bulk air systems are well suited to shallower mines with shorter distances between the downcast shaft bottom and the mining zone. The primary system components are a refrigeration plant, bulk air cooler, and cooling tower.

Advantages:

- Less complex with no underground or shaft infrastructure
- Highest overall efficiency and lowest capital cost (approx. \$700 000 to \$1 million per MWR)
- Ease of installation
- Removes moisture from the ventilation air stream before mine entry



Surface chilled water systems

Typically used to supplement bulk air-cooling systems. Surface air chillers are used in mines where the surface air temperature has little bearing on underground temperatures and:

- There are long distances between the mining zones and the downcast shaft bottom
- High heat loads in the supply airways exist
- High VRTs or substantial fissure water loads are factors

Plants offer high refrigeration COPs; piping cooling to underground air coolers through a reticulation system designed to manage the pressure energy resulting from the elevation change (≈100 Bar per 1 000m).

The system comprises surface heat rejection, surface refrigeration, a cooling water circuit, energy recovery/pressure reducing stations, water reservoirs, pre-cooling towers, and the chilled water reticulation system.

Advantages:

- Minimal thermal losses
- Low maintenance



Centralized underground refrigeration systems

Howden's centralized underground refrigeration systems offer the same positional efficiency as surface chilled water systems, yet the refrigeration plant, heat rejection, and air cooler are located underground.

Primarily they supplement either primary bulk air coolers or chilled surface chilled water systems where existing chilled water reticulation is at capacity or are used where an existing shaft infrastructure cannot accommodate additional reticulation.

The systems are typically used as stand-alone units where surface bulk air coolers have little effect, or the Capex expense of a surface chilled water reticulation system is unjustified. The essential system components include refrigeration machines, a heat rejection system, underground air coolers, and chilled water reticulation systems.

Advantages:

- Excellent positional efficiency
- Less expensive infrastructure
- Lower Capex commitment



Spot coolers

Spot cooling systems are small underground refrigeration systems for localized cooling at isolated workplaces and development ends, with cooling duties between 200kWR and 1 300kWR.

The equipment is compact and mounted on the skids to facilitate easy transportation to the site and relocation underground.

Systems components include a refrigeration skid with compressor and heat exchangers, pumping skid, electrical panels, an air handling unit, and a heat rejection system.

Advantages:

- Flexibility
- Cost efficiency



Hard ice systems

Our hard ice systems are suitable for hot mines typically ranging in depth between 1 500m and 2 000m (depending on conditions), where the reduction in the cost of returning water to the surface is a priority. Ice is produced on the surface and conveyed to an underground ice dam from where chilled water is circulated through the different zones of the mine.

The cooling energy of ice is a function of phase change from ice to water and the sensible temperature change of the ice melt. Components include plate ice makers, ammonia refrigeration, cooling towers, ice transport, cooling towers, and EC&I.

Advantages:

- Reduced costs
- Energy efficiency



Ammonia refrigeration

Howden pioneered Ammonia refrigeration systems in Mines during the 1970s.

Ammonia Refrigeration System is installed inline to cool the water down from 7°C to 1°C. This adds additional cooling capacity without infrastructure upgrades.

The system consumes no water, using the ambient air as the cooling medium reason due to is considered a green refrigerant.

Advantages:

- Mine cooling system offers a sustainability solution with no harmful CO₂ or HFCs emissions

Customised sustainable solutions to deal with challenging operating environments



Hard ice systems

A cooling solution to further expand mining to even deeper levels and an energy efficient system that reduces the return water pumping costs by using hard ice cooling technology.



Plate ice makers



Cooling towers



Ice transport systems



Structural/civil construction



Thermal ice storage



EC&I control systems

Hard ice technology delivers cost savings

Case Study | Mponeng Hard Ice System

Howden installed a 30 kg/sec 10 MW(R) hard ice plant, using plate ice makers and ammonia refrigeration screw compressor sets, at Mponeng. Howden was invited to investigate and design an energy-efficient cooling system that reduced the return water pumping costs by using hard ice cooling technology.

Challenge

Mponeng is one of South Africa's deepest mines, with virgin rock temperatures reaching up to 54.5°C at 3.5 km below the surface. For miners to work at acceptable temperatures, the ambient air has to be cooled down to 28°C wet bulb temperature.

Solution

After a full investigation, Howden established that hard ice technology would bring colossal power and cost savings on the return water pumping.

Hard ice advantages and energy efficiency making ice on the surface in ice-making machines, sending it down the mine into a dam, then circulating the cold meltwater through air coolers is more energy efficient than a conventional chilled water refrigeration system because the latent heat capacity of a kilogram of ice means it can take up far more heat than a kilogram of cold water.

This accounts for significant savings in operational costs. Once the ice melts, the water still has to be pumped back up to the surface, but the quantities are much smaller, and pumping costs are reduced to less than a quarter of the costs of a chilled water refrigeration system. In general, the mass flow rate ratio for hard ice compared to water would be 1:5.



For more information, visit: [howden.cloud/ice-CS](https://www.howden.cloud/ice-CS)

Howden capabilities, service and solutions

Howden offers custom-engineered mine cooling solutions. We deliver turnkey engineering, procurement, and construction (EPC) on a turnkey basis in collaboration with our industry-leading technology partners.

Our offering includes:

- Equipment solutions
- Process and systems engineering
- Detail design
- Project execution
- Site installation and commissioning
- Aftermarket support

Mine cooling capability:

- Cooling cars
- Spot cooling chillers
- Screw chillers
- Centrifugal chillers
- Cooling towers
- Bulk air coolers

Engineering services:

- **FEED (Front-End Engineering and Design) studies:** Development of cooling strategies for new and existing mines
- **Detail design:** Civil, structural, process, mechanical, piping, electrical, control, and instrumentation
- **Feasibility studies:** Technology options evaluation and life-cycle cost comparisons
- **In-house engineering:** Including civil, structural, process, mechanical, electrical
- **Process simulations:** FEA, CFD, vibration analysis, 3D modeling
- **Design, selection, and specification of complete turnkey plant equipment:** Piping, valves, vessels, pumps, compressors, fans, heat exchangers, cooling towers, and conveyors
- **Basic and detailed engineering design (EPC/M)**

Howden processes are certified to ISO9001:2008, ISO14001:2004, and BS OHSAS 18001:2007.



Aftermarket services

Howden has a well-established global aftermarket network to maximize performance and longevity.

At Howden, we supply, repair, and replace OEM parts for utility fans, industrial fans, commercial fans, and ash handling systems. They were initially manufactured by more than 40 companies that Howden has acquired.

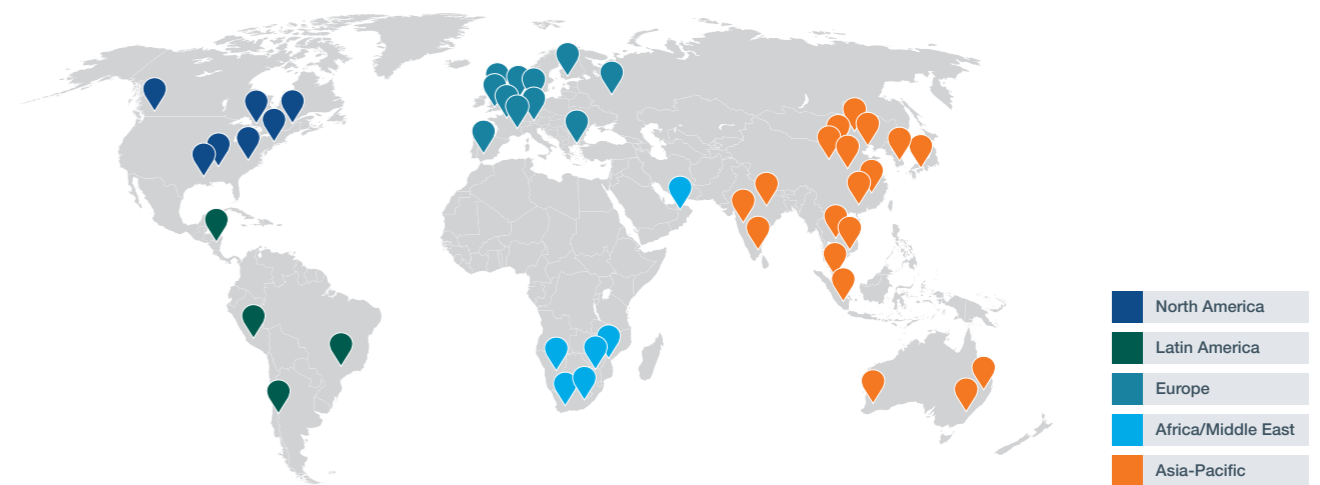
Authentic replacement parts and original specifications for most of these former fan manufacturers are only available from Howden. We also offer the technical expertise and responsive approach you depend on to put your system back in operation as quickly and efficiently as possible.

To support these efforts, we also offer:

- Performance testing
- Vibration analysis
- Field supervision
- Maintenance contracts
- Turnkey services

Moreover, 165 years of knowledge, innovations, and expertise in the mining, industrial, nuclear, naval, and power utility industries make up the collection of companies that comprise Howden aftermarket.

Global presence. Local support.



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