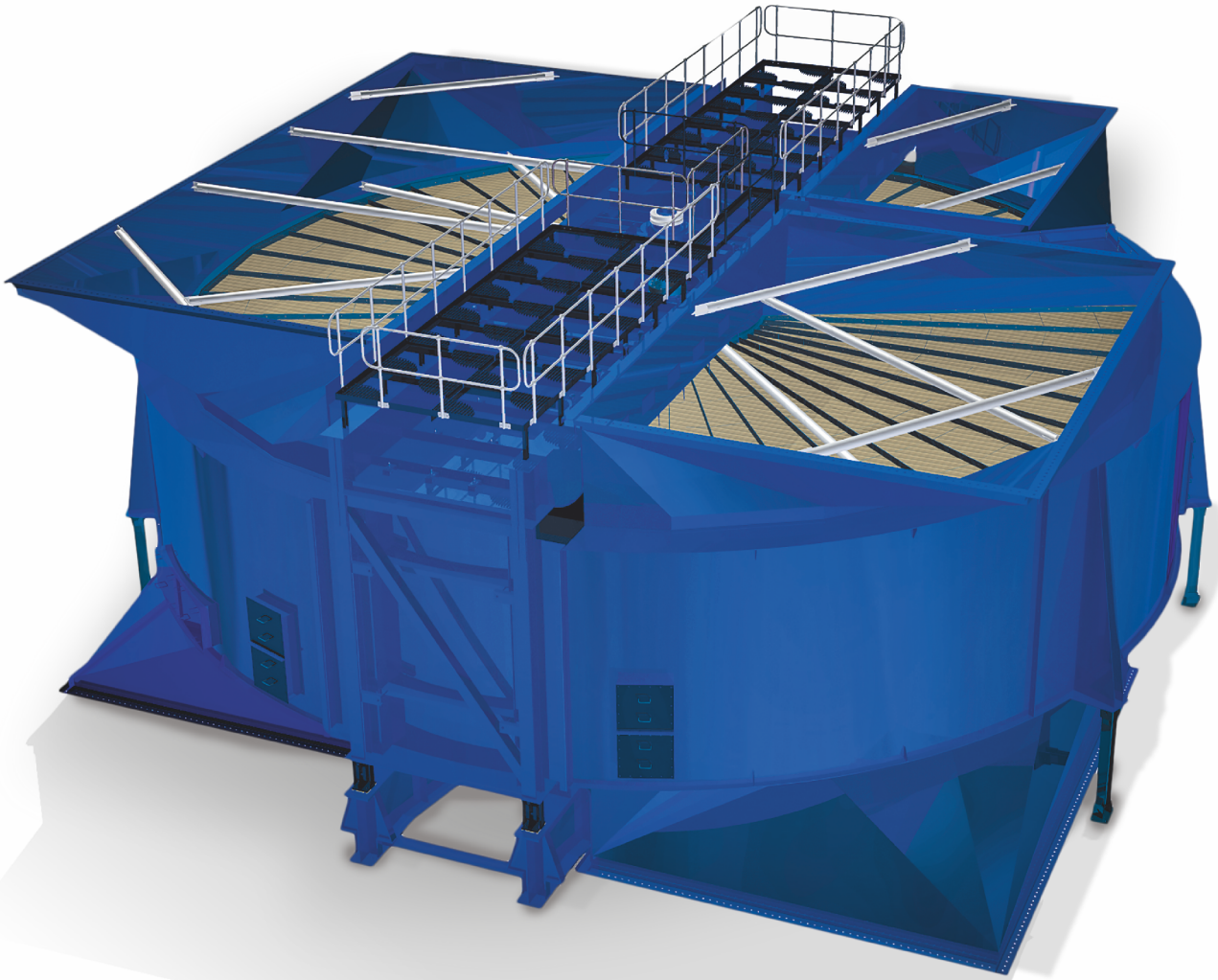
L&T Howden

Rotary Heater Technology

Continuous innovation in regenerative heat exchangers



Optimising performance in the power generation industry

L&T Howden Private Limited (LTH) is a joint venture between India's leading engineering and construction company Larsen & Toubro Limited and Howden, UK, which is one of the leading manufacturers of engineering products for thermal power industry worldwide.

Since forming the joint venture company to meet the requirements of rotary air preheaters and variable pitch axial fans (Variax®) in coal-based thermal power plants, LTH has emerged as a prominent player in the market.

Howden is a recognised world leader in rotary air heater technology with more than 90 years of experience. It was the first licensee of Fredrik Ljungstrom and commercialised the rotary air preheater in 1923.

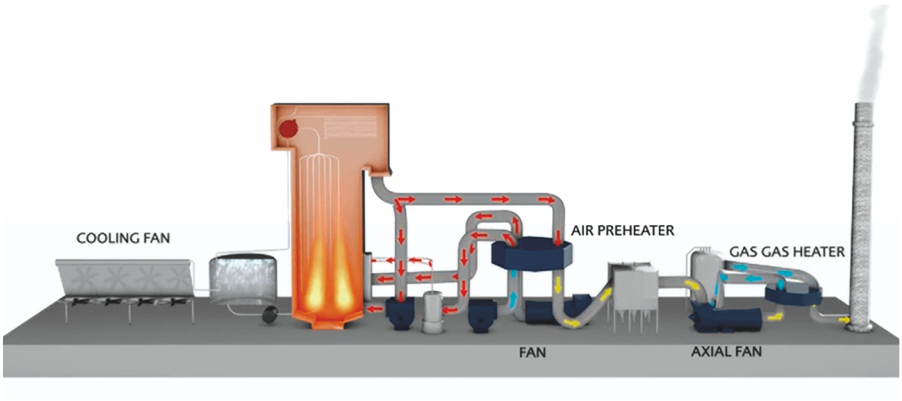
LTH has been a supplier of rotary air heaters to some of the prestigious supercritical technology-based power projects of NTPC, Mahagenco, RRVUNL, MPPGCL, Nabha Power and others.

Adapting to Indian coal conditions

The presence of high ash content in domestic coal, going up to maximum of 40 to 42%, poses a major challenge to design in terms of leakage, cleanability, higher pressure drop and faster wear and tear. LTH is able to understand these problems better and offer the most suitable solution.

Introduction of pollution control measures like selective catalytic reduction (SCR) system in operating power plants will necessitate modification of the existing air preheaters. LTH is geared up to offer solutions which will address higher differential pressure (DP), ABS formation and requirement of better cleanability.

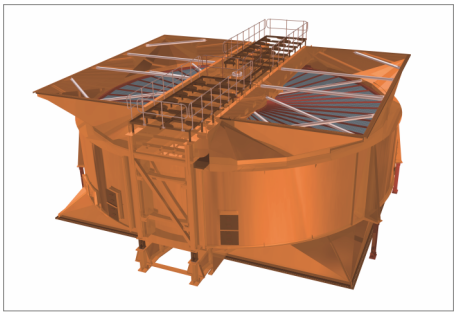
LTH has set up a state-of-the-art manufacturing facility at Hazira in Gujarat for producing air heater elements. The unit has a capacity to manufacture 20,000 APH baskets per year. A dedicated team of field engineers, backed by our design team, are always ready to help customers ensure maximum availability of APH.



APH & related offerings

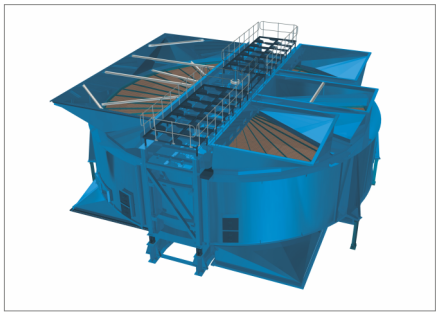
- Design, supply of new APH
- Retrofits
- SCR related improvements
- APH performance test, analysis, improvements
- New generation APH elements
- Field services

Our rotary heat exchangers are optimised for performance and reliability; they are custom designed to suit the arrangement, application, fuel and system design. They provide a very compact and cost effective solution for heat recovery in power plant, contributing up to 15% of the boiler heat transfer process for only around 2% of boiler unit investment.



Bisector heater

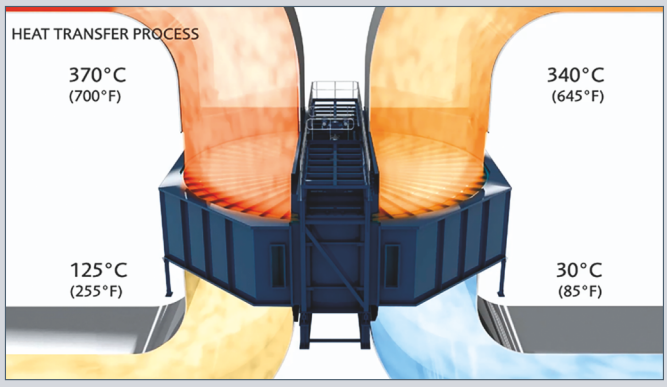
Trisector heater



Quad-sector heater

Our JV partner Howden has gained an extensive knowledge not only of our products but also their various applications which include pulverised coal, oil or biomass-fired boilers and both bubbling and circulating fluidised bed boilers and also emission control systems such as selective catalytic denitrification (DeNOx) and flue gas desulphurisation (FGD) processes.

Bisector air preheaters are supplied for combustion air preheating on heavy fuel oil, gas and coal-fired power plant. For coal firing, separate mill air preheaters and composite trisector and quad-sector preheaters have been supplied to suit the boiler arrangement.

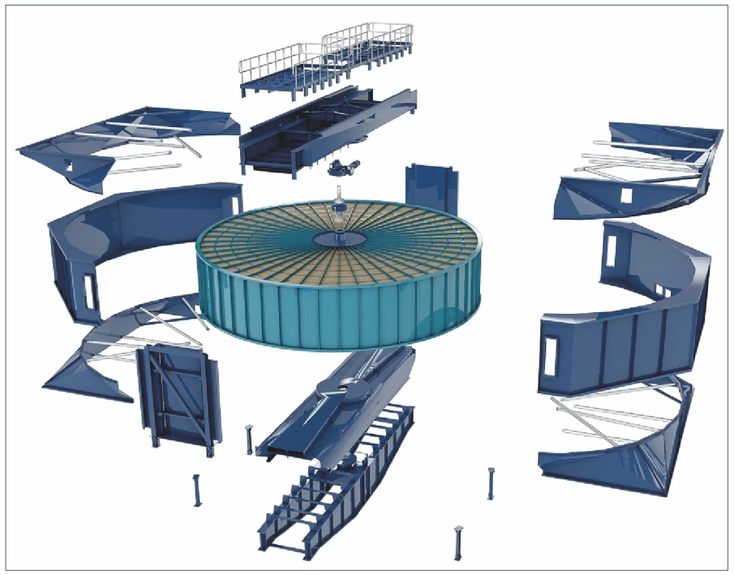


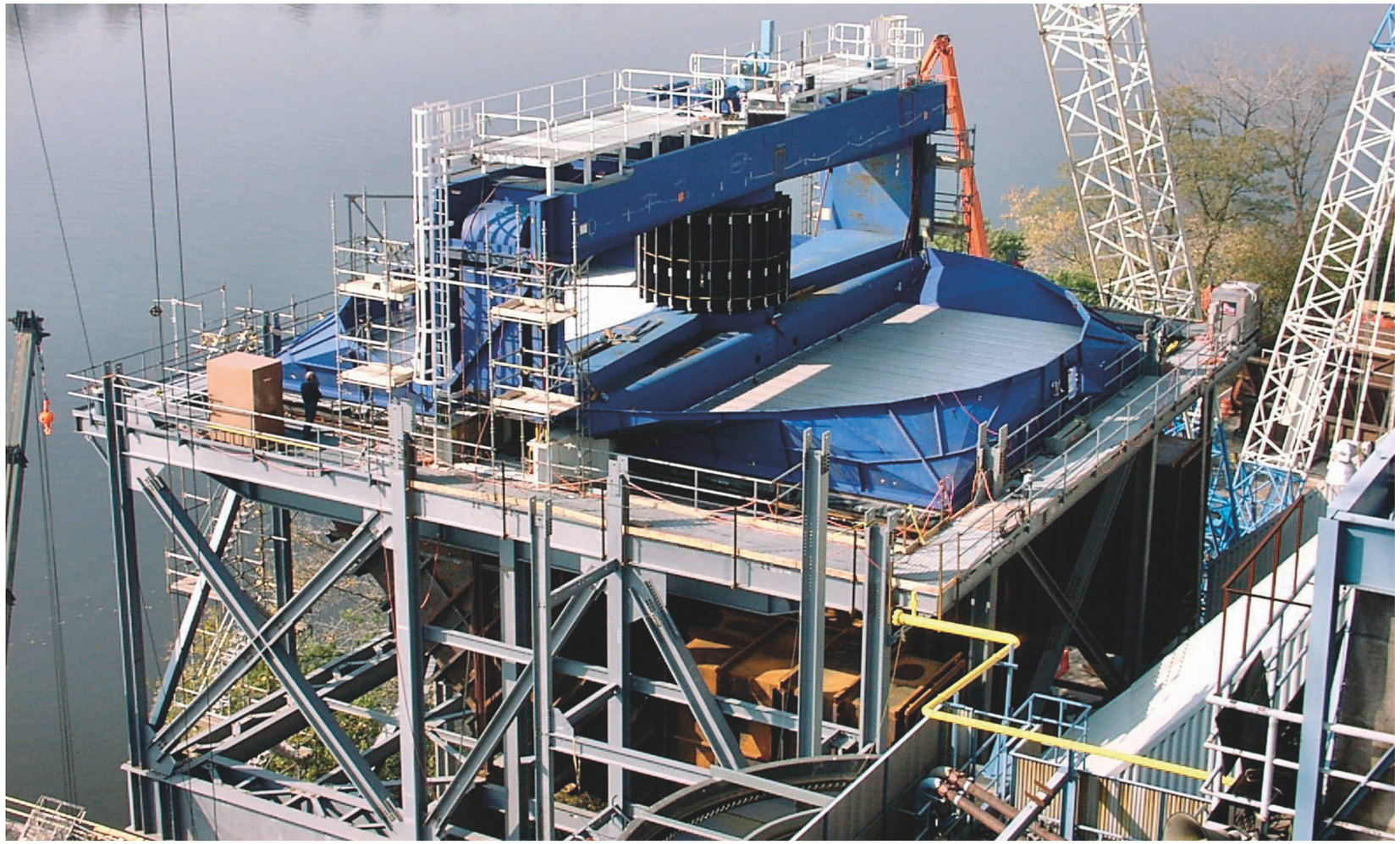
Heat Transfer Process

The heater absorbs waste heat from the flue gas as it leaves the economiser at typical temperatures around (370°C) and transfers this energy to the rotating steel heat transfer element plates. The hot elements then rotate into the inlet air used to provide the oxygen to fire the fuel in the boiler furnace. This heats the air from around 30 to 340°C, improving the efficiency of the boiler plant as energy is transferred back to the furnace, thus saving fuel. A further benefit is that hot air promotes stable combustion conditions. In the case of a mill heater the heated Primary Air is used to dry and transport the fuel to the furnace.

Air Preheaters

Rotary regenerative air preheaters have a much reduced size and cost relative to recuperative tubular or plate heat exchangers.





Features

The Howden air preheaters are designed around external insulation. The housing and ducts are structurally independent of the rotor. Finite element analysis has been used in the generic design of the rotor which is free to expand in all directions such that thermally induced stresses are kept to a minimum during all modes of operation.

Centre column or bottom girder support

Custom designed and optimised to suit arrangement and client preference.

Sealing system

The sealing system has evolved to have static sealing surfaces set to achieve minimal gaps with the moving seals at operating conditions combined with labyrinth multiple seals.

The Howden VN sealing concept maintains low design leakage between outages.

Where the application requires Hot End actuated sector plates, advanced systems are available.

Centre drive system with inverter speed control

The shaft mounted centre drive employs a high ratio gearbox with the option of multiple electric motors and an air motor. The drive system is completely removed from inside the air preheater and doesn't require the time consuming installation and outage replacement of pin racks.

Low maintenance

Conceptual and detailed design targets the achievement of simplicity and minimal maintenance. Fixed sealing surfaces and centre drive greatly reduce maintenance by removing actuators and pin racks.

Standard spherical roller bearings with oil bath lubrication

Standard proprietary rolling element bearings with bath lubrication using extremely high viscosity oil have been used by Howden in this application for over fifty years. Water cooling systems are employed at the hot end bearing.

High availability

The major cause of reduced availability in air preheaters is due to element fouling. Careful element selection to suit the application, cold end temperature control and the use of the correct cleaning system maintains very high availability.

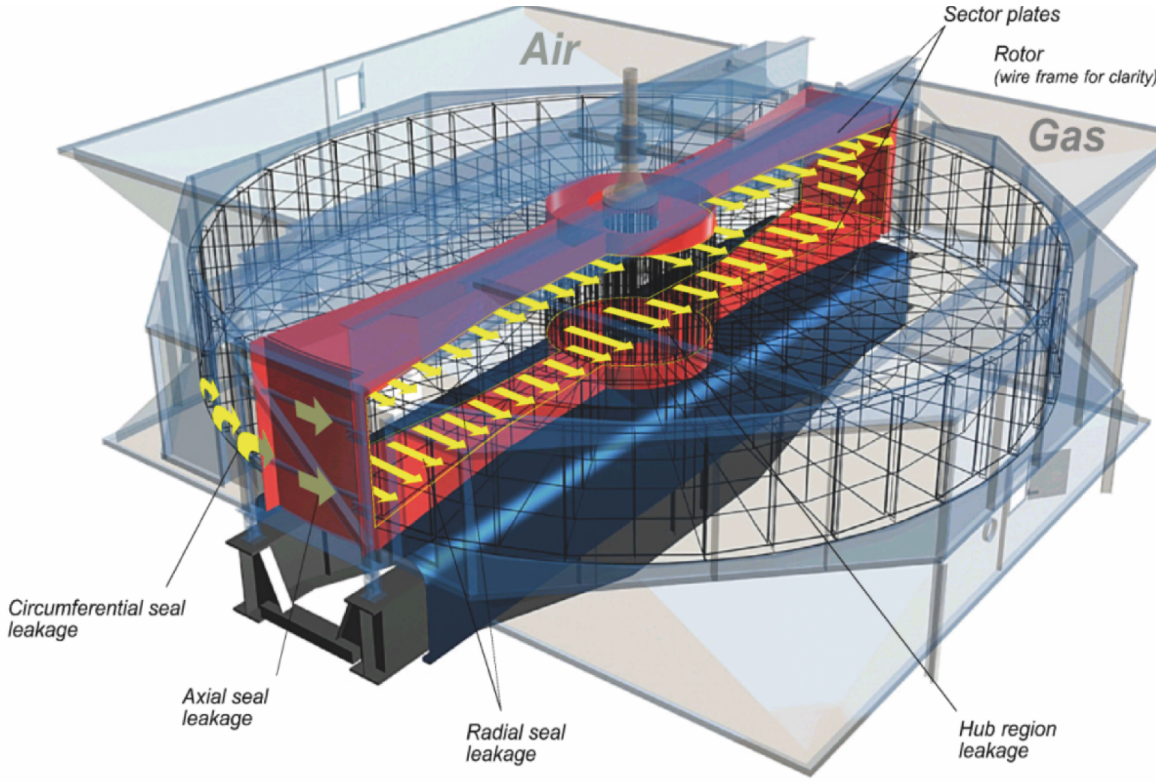
Cleaning systems

Unlike tubular or plate recuperative heat exchangers, fouling does not cause deterioration in heat transfer in a rotary regenerative heat exchanger. Fouling increases pressure differentials and consequently fan power and leakage.

Several proven cleaning systems are available to suit the degree of fouling and space restrictions, including:

- Semi retractable steam sootblowers
- Fully retractable multi-fluid (air/steam and LP & HP water) sootblowers
- Semi retractable HP water washing

Air Preheater technology and experience



Features

Leakage sealing systems

Over the many years of our ongoing heater applications experience, Howden have investigated and developed a large number of different leakage sealing system designs to both minimise leakage level and eliminate the 'leakage drift' that inevitably occurs in actuated systems with time.

In that respect, the sealing arrangement for which Howden is most renowned is our advanced VN sealing system which keeps leakage consistently low for extended periods. The original VN sealing system was developed as a result of Howden's experience which showed that moving sector plates are consistently the prime cause of increasing leakage due to wear on the rotor seals and deterioration of seals between the adjustable sector plates and the casing.

The solution developed over thirty years ago was to use fixed sector sealing plates and to compensate for the increased gaps between rotor and sector plate by doubling the number of seals on the rotor. In addition the sealing strips on the rotor were changed to a single leaf design that had been proven to be an improvement over the previous channel design. Since then, many hundreds of air heaters throughout the world have had the system retrofitted. In the last few years, well over 500 new air preheaters and FGD gas reheaters have been supplied with VN sealing.

A further benefit is that annual maintenance hours are reduced by more than 50% over the more traditional designs.

While VN sealing was originally conceived, developed and demonstrated with double sealing many years ago, and continues to be successful today, the further development of VN sealing systems has never stopped. Indeed, Howden have continued to develop VN sealing to achieve progressively lower leakage levels by integrating designs with triple, quadruple and even sextuple seals over the sealing plates at any time – thereby maximizing the benefits of no-contact labyrinth sealing.

Equally, in this pursuit of ever lower leakage levels while listening to the Voice of the Customer (VOC), we have continued to work and develop our approach towards actuated sealing systems that are designed to minimise the seal gaps at all times and loads. In doing so, we have redesigned our moving sector plates, seals, actuators and gap sensors to optimise their performance while maintaining excellent long term operation and minimised leakage drift.

Indeed, whenever the need occurs (as it had done on GGH applications), we have taken further steps towards a Zero Leakage Heater by designing and implementing dynamic sealing variants, where small supplementary low leakage fans are used to modify the pressure pattern between the seals to further reduce (or even eliminate or reverse) the direction of direct leakage from the high pressure air side of the heater to the much lower pressure gas side of the heater.

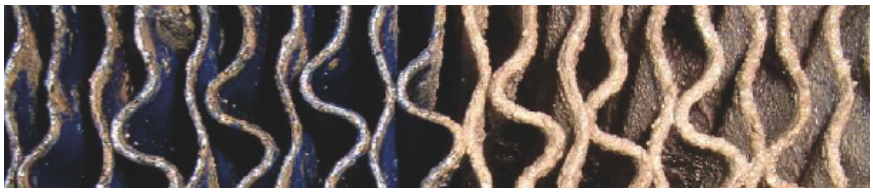
Enerjet™ cleaning system

The Howden Enerjet™ cleaning system is a method of on-line high pressure water washing of air preheaters designed to provide effective and efficient cleaning of severely fouled heat exchanger elements while the air preheater is in normal use. It is has been designed to be used as an alternative system when normal sootblowing practices prove inadequate to keep the heat transfer elements clean. By eliminating the problems of lost availability that arise due to excessive fouling, the Enerjet™ system can repay its initial investment in well under a year, depending on the speed of the fouling.

Fouling and plugging lead to an increase in pressure drop, which places an additional burden on the fans. Stopping production for cleaning is costly. In extreme cases the build up of contaminants can lead to unplanned outages, with even more serious financial consequences. All of these unwanted and expensive situations and risks can now be avoided by on-line Enerjet™ cleaning.

The Enerjet™ system uses carefully designed nozzle jets and carrier lances that come in a number of different embodiments. By adjusting and testing the volumes and pressures used, we have eliminated all of the problems traditionally associated with water-based cleaning systems, and moved the technology on to include moving lance systems that allow Enerjet™ cleaning to be used during everyday operation. This system has successfully operated in a growing number of air preheaters for more than 12 years and has been shown to recover from excessive fouling while producing no detectable damage to the rotor structure or detrimental effects on the downstream gas cleaning equipment.

While the Enerjet™ system can be used with any type of air preheater from any manufacturer, and works well with most kinds of element profile, it is at its most effective when used in conjunction with Howden's enamelled HC Elements™ or HCP Elements™. Each of these designs offer radically improved flow and cleanability.



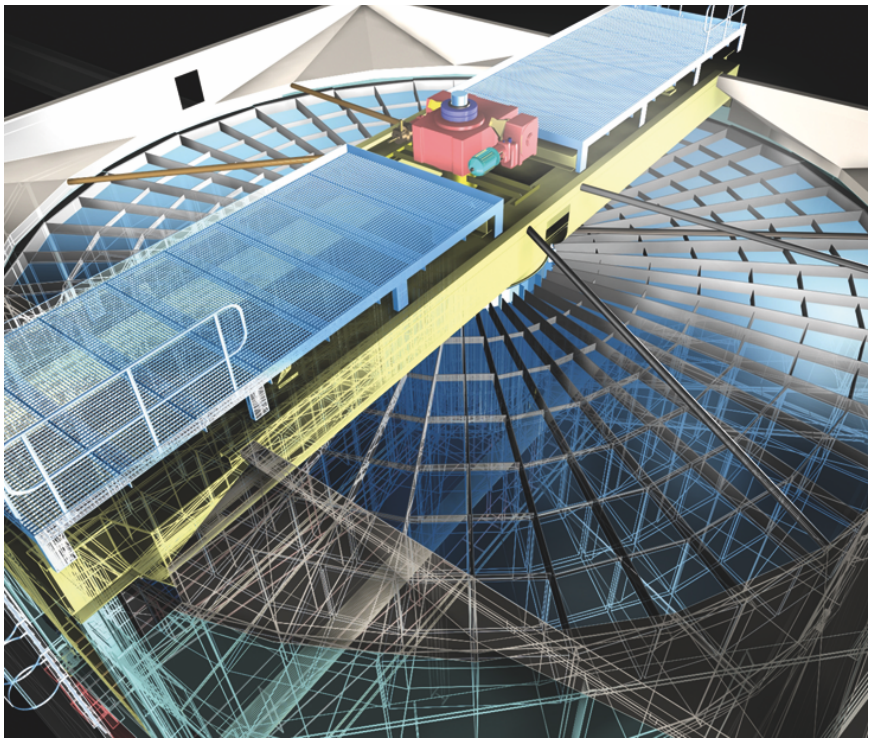
After HP washing

After normal sootblowing

Fire detection and fire fighting systems

Air preheaters can be susceptible to fires when operated under adverse conditions. Such problems are generally caused by periods firing heavy fuel oil with poor combustion when soot and oil residue can be deposited on the heater elements. The risk of fire is further increased in coal fired units during subsequent transient operating conditions, when the coal mills are brought on line.

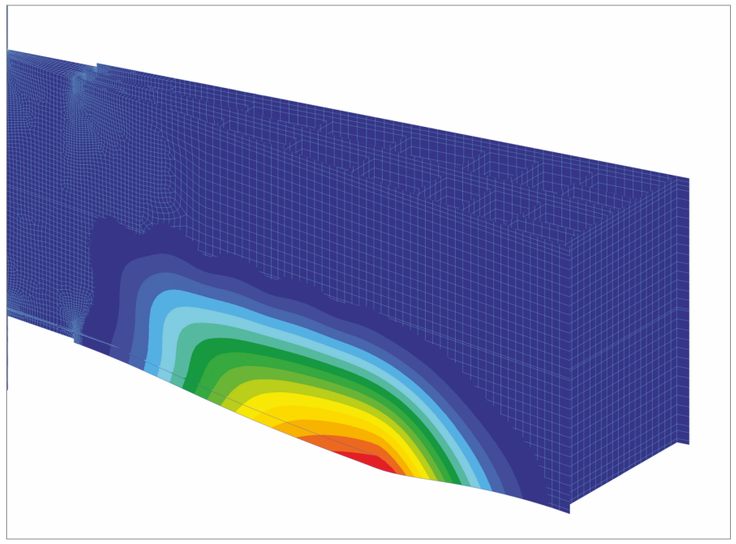
Howden's experienced engineers have developed fire detection systems, which use fast-response fire detection probes and an associated fire detection panel to continuously monitor the rotor for a higher temperature hot spots and also a high rate of change of temperature. The fire fighting system is manually activated once the operator has confirmed that there is a fire and that it is spreading.



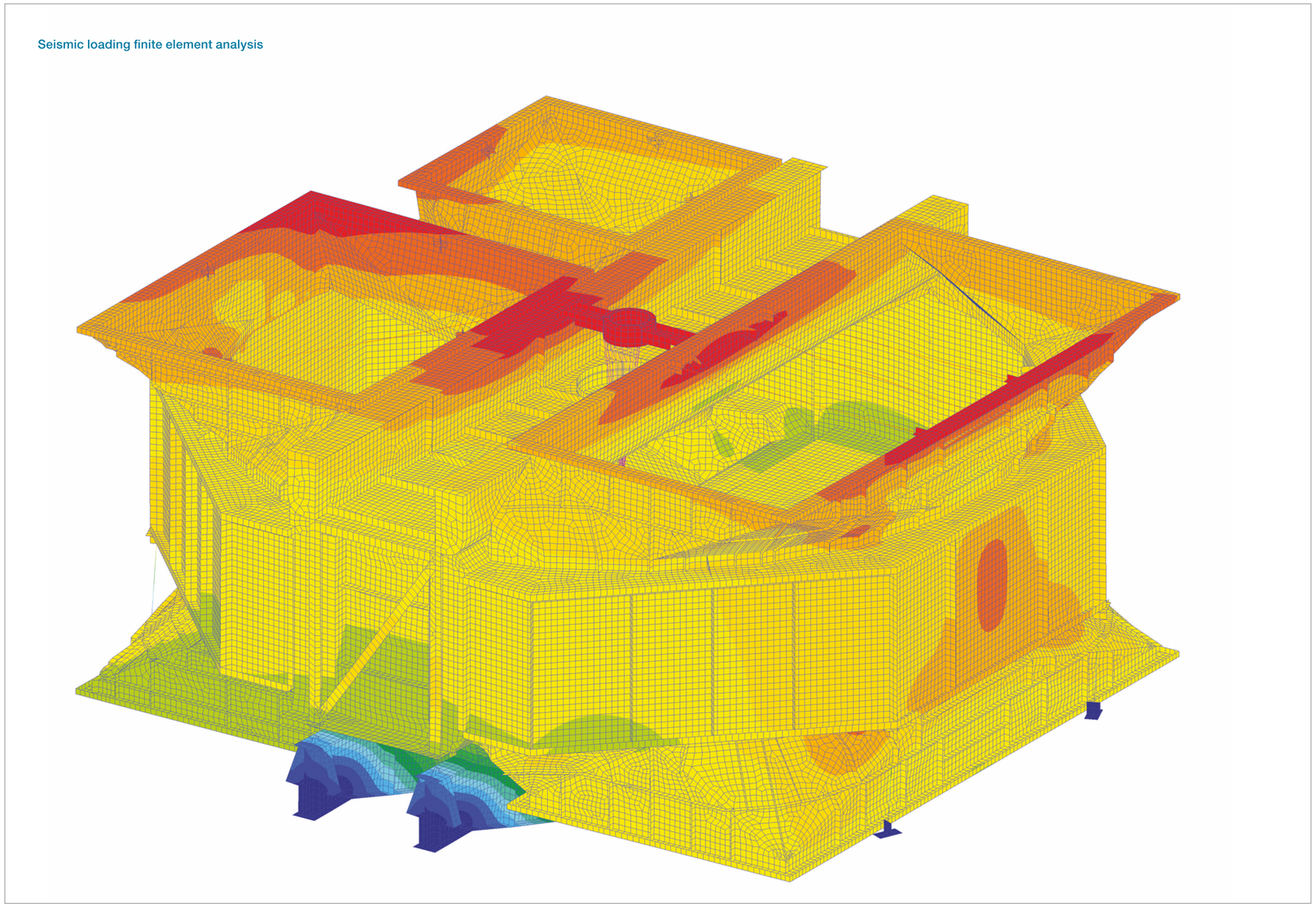
Heater Design, Development and Analysis

Our JV partner Howden carries out continual research, development and analysis of both new and aftermarket heaters to optimise product performance and reliability.

FEA rotor buckling



Seismic loading finite element analysis



Heater Development

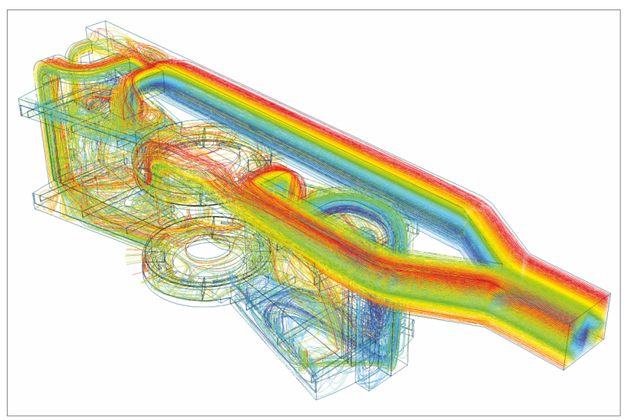
Howden Group, which was founded in 1854, is the world's largest and longest established fan manufacturer and was the first company to form a joint venture with Fredrik Ljungström in 1923 to commercialise the rotary heat exchanger. This combination of performance critical fan and heat exchangers provides Howden's customers with unrivalled experience in air and gas handling applications.

Although a very mature product, research and development is still constantly ongoing to refine and improve rotary heaters to suit changing customer requirements, fuel types, emissions legislation and efficiency improvements. This continual improvement of the product is reflected in our core value "innovation defines our future".

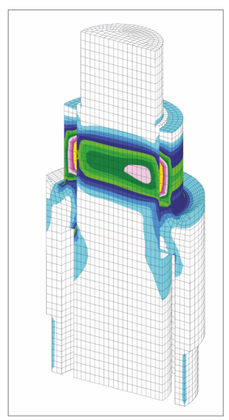
R&D is carried out by several international development teams working together in the location most appropriate to suit the work. To better quantify and eliminate the damage caused by excessive sootblowing, we have recently carried out extensive testing of element fatigue using a purpose designed steam sootblower test rig sited within a power station.

3D design modelling of heaters is also carried out throughout the Group. In house engineering analysis including Finite Element Analysis and Computational Fluid Dynamics capabilities are also applied by highly qualified and experienced professional engineers.

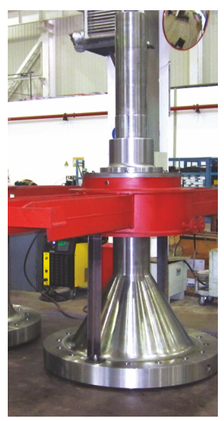
Element fatigue testing rig



Computational fluid dynamics of purge & scavenge system



FEA mounting bell stress



Top bearing, mounting bell and shaft

Element design and technology

We have a wide range of profiles available, enabling us to offer the right balance of thermodynamic performance, pressure drop and ease of cleaning for any situation.

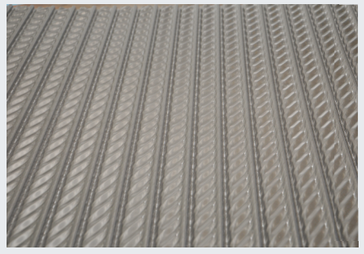
As the choice of element profile is obviously critical to the availability and efficiency of the entire plant, we are continually developing improved profiles for particular operating conditions.

All designs have been fully tested in our laboratories to establish the basis of our thermal and pressure drop predictions, and this performance has been verified at site in accordance with major national and international standards.

Additionally through life, aftermarket support and Howden expertise is available to recommend alternative profiles or arrangements that can improve the performance of the regenerative heat exchanger, particularly if the operating conditions have been changed since the original elements were specified.

We can supply elements in a variety of materials, including:

- Carbon steel grade IS 513 D/DD
- Corten Steel



Air preheater baskets

Elements can be supplied in a variety of baskets, which have been developed to maximise the rotor area and to reduce the amount of gas bypassing the elements.

The baskets are strongly constructed to ensure that the elements remain tightly packed to avoid damage during the operation of the air heater.

In many cases replacement element baskets can be supplied with significant design and operational improvement compared to those originally installed, resulting in improved ease of installation and longer life.

Each basket is protected for shipment by being plastic wrapped and palletised for loading into standard shipping containers.

Corrosion

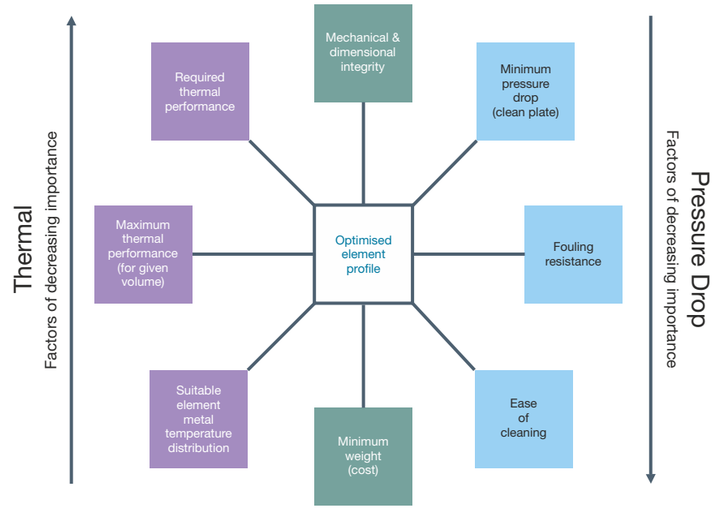
Corrosion can be minimised by the use of a cold end layer of low alloy corrosion resistant steel or enamel coating. Using in-house software we optimise the extent of the cold end elements to suit operational duties.

Unconventional Gas Firing

Where pulverised fuel fired boilers are being converted to fire unconventional gas, Howden have very high performance elements to maximise efficiency in this clean, non fouling application.

Element fouling solutions

Elements are required to cope with several types of fouling; hot end popcorn ash, cold end acid enhanced fouling and sticky ammonium bisulphate (ABS) fouling after an SCR.
The use of aerodynamically “closed” profile elements as embodied in our range of HC Element™ increases the effectiveness of the sootblowers for cleaning the elements throughout the depth of the heater. Moreover, Howden’s proven element profiles of “HS” series give better performance for high ash content flue gas conditions in Indian power plants.



Choosing appropriate element profile

Manufacturing

We enforce the same rigorous Howden and international quality standards.

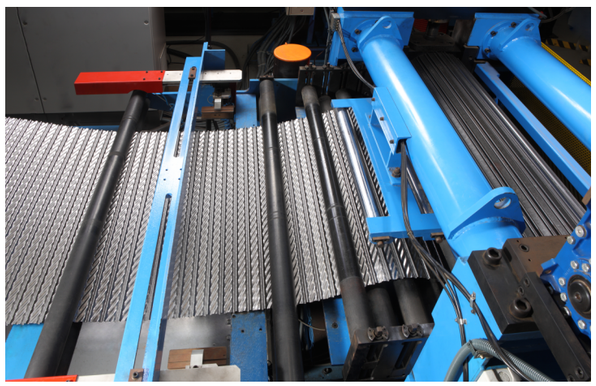
L&T Howden factory at Hazira, Gujarat

Modern manufacturing technology

LTH has set up a modern fully automated facility to manufacture APH element baskets. This ensures required dimensional accuracy and optimum packing pressures for the element baskets.

PLC controlled element packing process

As heat transfer elements are regularly subjected to high energy excitation forces from the sootblowers used to clean them, it is essential that these elements are sufficiently tightly packed in their containers to minimise the element vibration and consequent fatigue damage. Such attention to detail inevitably results both in improved quality and extended element life.



Installation, maintenance, refurbishment and enhancement

With products whose operating life can be anything up to 40 years and beyond, we believe in building lasting relationships with our customers. It's our duty to offer only the very highest standards of service, from initial installation of plant and equipment through routine maintenance to subsequent refurbishment and enhancements.

Plant enhancement

With the growing demand for enhanced performance and life extension of plant, Howden has the engineering expertise and experience to provide cost effective site solutions.

Our research and development coupled with long standing links with specialist suppliers, enables us to improve the performance of our own products as well as that of equipment supplied by other manufacturers.

Upgrading or enhancing an air preheater is usually one of the most cost-effective ways of improving boiler performance. Dramatic results can be achieved by either increasing thermal performance or reducing leakage. Before retrofitting FGD and/or plant downstream of the boiler, it is always worth investigating air preheater leakage, which can create unnecessary demands elsewhere in the system. Improving the air preheater sealing system can significantly reduce the size and cost of the FGD plant, with obvious cost savings.

The use of Selective Catalytic Reduction (SCR) equipment also makes special demands on rotary regenerative heaters that greatly benefit from specific adaptations to help them cope with the more arduous fouling environment.

In many cases, heat recovery can be increased by installing higher performance elements, or increasing their overall depth, or both.

Leakage reduction can make significant savings in fan power consumption. Each retrofit project is based on a thorough analysis of the prevailing situation as well as a concise determination of the target performance.

Routine maintenance and spare parts

We have the experience and expertise to plan and carry out routine maintenance, allowing our customers to focus on their core activities. Using the very latest computer based maintenance management systems we are able to schedule work load so as to minimise disruption. We have the capability to carry out inspections and servicing, designed to keep expensive equipment trouble free. From maintenance records, we can recommend critical interventions or suggest upgrades that will improve performance or economy.

We have extensive experience of routine maintenance of Howden products. This includes fans, rotary heat exchangers and other plant on power station sites, in addition to process plants using our mechanical, electrical control and instrumentation skills.

We regard the supply of parts as a core activity, and we treat it with the same attention that we bring to new installations. Enquiries and orders are handled by experienced staff, to ensure that the correct components are supplied in a timely manner. Where appropriate, we will advise on new technologies or developments that might raise the performance, longevity or economy of installed plant.

Efficiently meeting our customer requirements

We draw our experience from Howden, which has thousands of air and gas heaters installed in more than 70 countries around the world.

With a wide range of heater solutions we can efficiently meet our customer requirements with the security of proven performance. Wherever our customers are located, a Howden office is close at hand. With engineering and sales offices throughout the world, we understand and satisfy local market needs.

Our site service activities

- Refurbishment to original specification and upgrade of any regenerative rotary heat exchangers to latest technology
- Performance upgrades
- Turnkey supply of design, material, site management, site installation
- Site surveys, inspection and plant evaluation
- Preventive maintenance and maintenance advice
- Medium and long-term planned outage management and support for unplanned outages
- Performance and function tests and the relevant problem solution/implementation
- Custom-made replacement spares, upgrade spares for any air and gas movement equipment as well as air preheaters

At the heart of your operations

L&T Howden people live to improve our products and services and our world has revolved around our customers. This dedication means our air and gas handling equipment add maximum value to your operations. We have innovation in our hearts and every day we focus on providing you with the best solutions for your vital operations.

L&T Howden

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