

Aftermarket Heater Technology

Continuous innovation in regenerative heat exchangers



Rotary heater upgrade or enhancement is usually the most cost effective way to improve existing boiler performance.



Howden's programme of continuous product development enables us to improve the performance not only of our own equipment but also that of other manufacturers. Our upgrade and retrofit proposals draw on state-of-the-art technology to bring your existing equipment up to the performance level of a new unit.

Revolving Around You™



Upgrading air preheaters to the latest technology standards brings a wide range of benefits:

- Leakage reduction reduces the power demands of the fans and reduces the onward flow rate to the gas cleaning equipment increasing its performance.
- Optimising the heat transfer element profile and height can improve overall performance significantly.
- Enamelled elements offer both excellent corrosion protection and cleanability.
- Highly efficient cleaning devices minimise pressure drop drift and maximise availability.

It is common for plant operating conditions to change over the years. Changes such as the type and composition of the fuel or additional emissions reduction equipment can have a significant effect on optimum heater operation.

Common issues for regenerative heaters include:

- Fouling
- Corrosion
- Increasing leakage over time (leakage drift)
- Efficiency
- Fire risk.

Rotary heater upgrade or enhancement is usually the most cost effective way to improve existing boiler performance. Howden's program of continuous product development enables us to improve the performance not only of our own equipment but also that of other manufacturers. Our upgrade and retrofit proposals draw on state-of-the-art technology to bring your existing equipment up to the performance level of a new unit. With the widespread focus on environmental

impact and equipment efficiency, Howden is the right partner to support the operators from specification to project management and execution of upgrade and life extension projects.

Engineering solutions

Air preheaters play an integral part in the efficient operation of power plants. Dramatic results can be achieved by either increasing thermal performance or reducing or controlling both the heater fouling and leakage.

Our customized engineering software allows us to model either rotating or stationary matrix designs of rotary regenerative heat exchangers. We can accurately predict the behaviour of the equipment and offer solutions that lower your operational costs with an improved reliability. To recommend an optimum performance it is fundamental to understand the exact behaviour of the equipment.

Our engineering capabilities enable us to recommend the best retrofit, upgrade, refurbishment or enhancement which is the proven route to:

- Improved efficiency
- Greater reliability
- Higher availability
- Reduced operational costs
- Optimised performance.

Testing capabilities

Since the 1920's Howden Research & Development have always pioneered and refined the key part of the heat exchanger, the heat transfer elements. Testing of element developments, has and still is, carried out on our heat transfer test rig to establish their heat transfer and pressure drop characteristics.

More recently Howden have established an element fatigue test facility to establish effects of steam sootblowing on element life. The test rig has been sited at a power station for availability of sufficient quantity of high pressure steam.

The leading manufacturer of heating elements

Howden manufactures all types of heating elements for rotary regenerative air and gas heaters irrespective of the original manufacturer. From research and development, through tender preparation, manufacture, installation and commissioning, we enforce rigorous quality standards. Our focus is on product performance and reliability.

A reputation for quality and service

We are accredited to ISO 9001, ISO 14001 and OHSAS 18001 and are regularly audited by major customers and internationally recognised assessment organisations. Howden have manufactured heat transfer elements for over 90 years. During this long period we have built a reputation for quality, service and innovation. Over the past decade, internationally Howden has won more than 2000 contracts to supply replacement elements for air preheaters and FGD gas reheaters manufactured by more than 40 original equipment manufacturers.

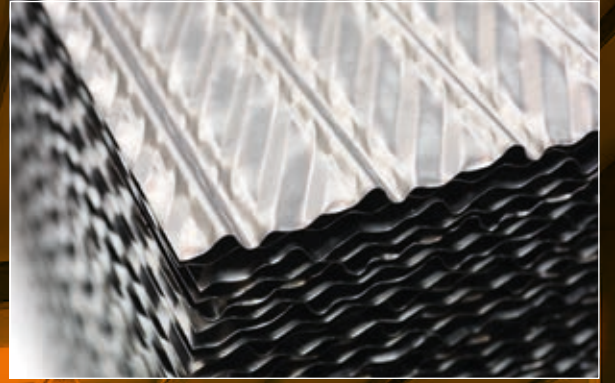
Repair maintenance and enhancement

In support of Howden products, we undertake repair, maintenance and enhancement of rotary air and gas heat exchangers, fans, and other similar equipment, on power stations and industrial plant.

Modern manufacturing technology

At custom built production facilities located worldwide Howden has a capacity of to manufacture over 54,000 tonnes of elements per year. We have invested heavily in the latest modern manufacturing technology and our production facilities are staffed by experienced engineers and fully qualified operators. This enables us to address the needs of each major market and to respond quickly and effectively to customers' demands.





Element design and technology

We currently 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.

Our software allows us to model either rotating or stationary matrix design heat exchangers with equal ease, and includes element performance data derived from comprehensive wind-tunnel testing. 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.

The choice of heating element is vital to ensure that the optimum heat transfer and minimum pressure drop are achieved.

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

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:

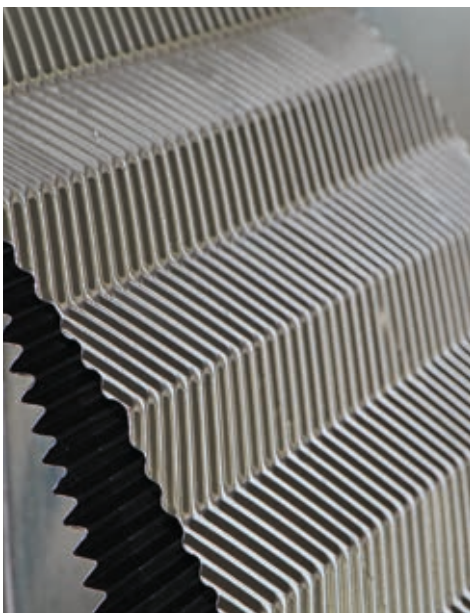
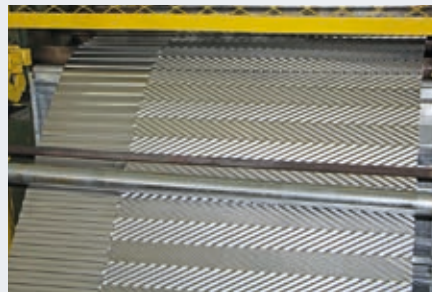
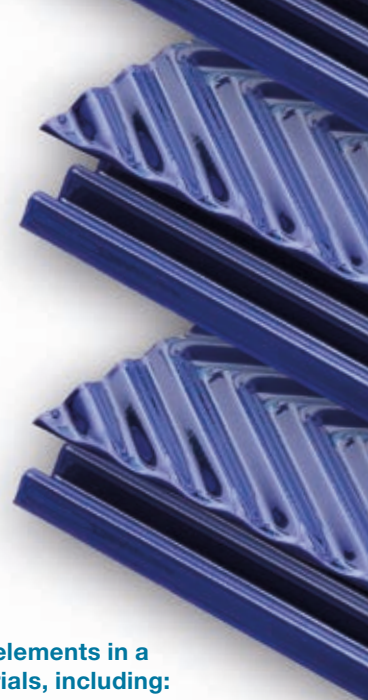
Carbon steel

Low alloy corrosion resistant steel (LACR)

Decarburised steel enamelled

Carbon steel enamelled

LACR enamelled.



Air preheater baskets

Elements can be supplied in a variety of baskets including our own designs, 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 supplied, resulting in improved ease of installation and longer life.

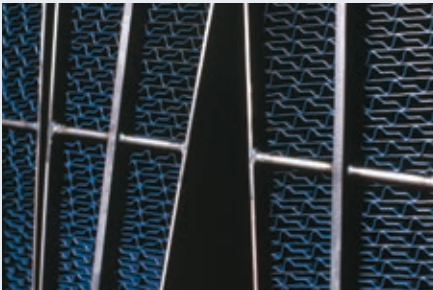
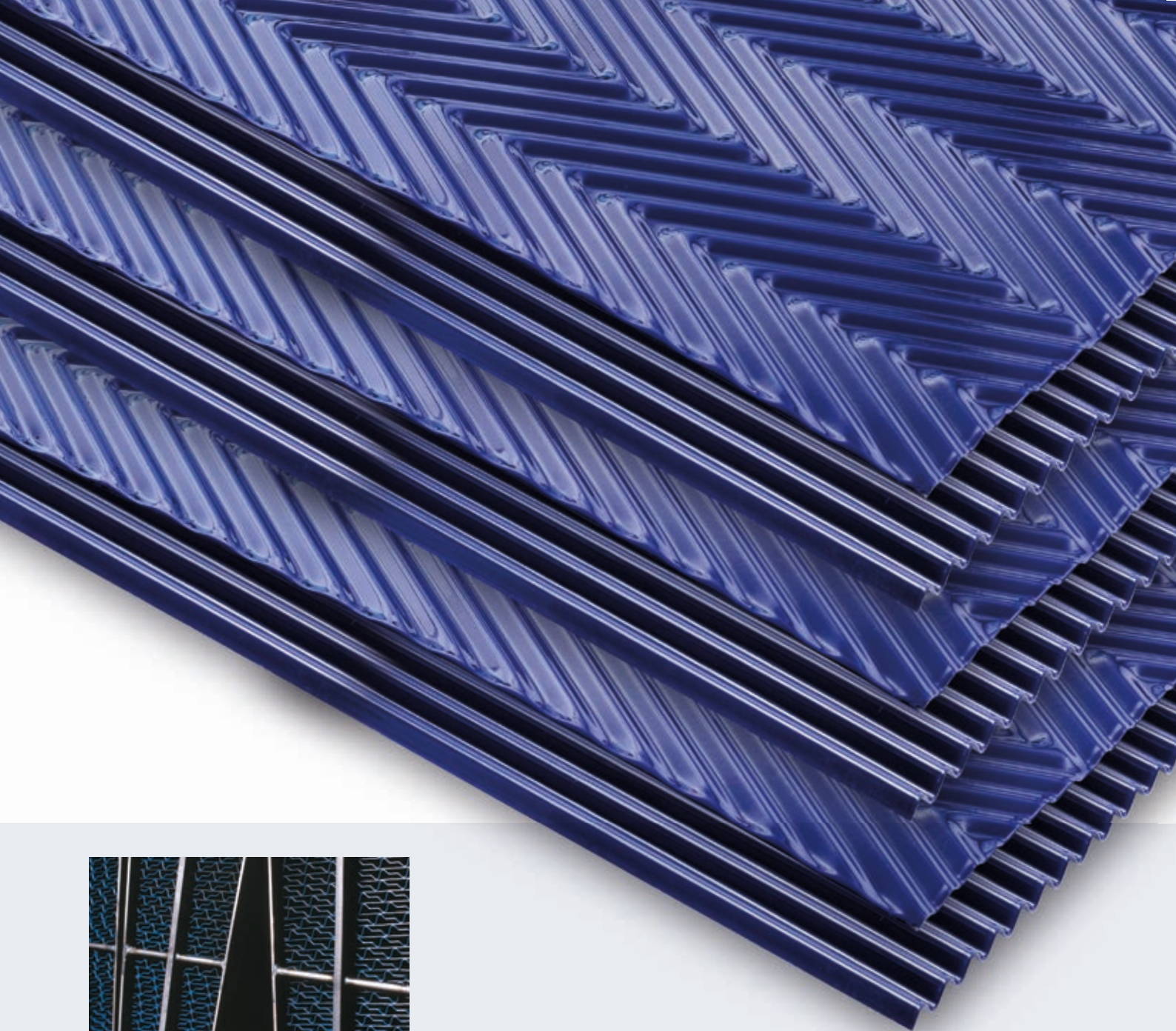
Each basket is protected for shipment by being plastic wrapped and palletised for loading into standard shipping containers.

The right profile at the right time

We can offer unrivalled advice in profile selection, particularly where operating conditions have changed since the original elements were supplied. We can recommend alternatives to assist in optimising plant operation.

Corrosion

Corrosion can be minimised by the use of a cold end layer of low alloy corrosion resistant steel or enamel coating. We have our own software to calculate and optimise the cold end temperature for each case, thus ensuring the most economic choice and depth of this more expensive material.



Hot end fouling

Hot end elements can be prone to fouling as a result of large particles of fused 'popcorn' ash becoming lodged in the element passages and smaller particles compacting behind them.

These large particles generally arise as a result of combustion problems, however it can be overcome through the use of an element profile that is less prone to fouling and easier to clean and/or the installation of hot end sootblowers.

Cold end fouling

This is generally caused through insufficient ash being present in the flue gas to absorb the condensing sulphuric acid arising from the combustion and oxidation of sulphur in the fuel. With excessively low cold end element temperatures, this condensation can produce problems with cold end fouling.

Intermediate tier fouling

In addition to cold end fouling, recent applications of denitrification processes such as Selective Catalytic Reduction (SCR), with the partial slip of excess ammonia through the catalyst promotes the formation and subsequent condensation of ammonium bisulphate (ABS) that tends to condense and form sticky deposits further up the heater elements in the intermediate tier of elements.

Element fouling solutions

The use of a 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, our latest HCP Element™ further minimise cold end fouling and increase their cleanability even further allowing successful operation at even lower gas outlet temperatures and increased efficiency.

SurePack Elements™

As heat transfer elements are regularly subjected to high energy excitation forces from the sootblowers used to clean the elements, it is essential that these elements are sufficiently tightly packed in their containers to minimise the element vibration and consequent fatigue damage.

Whenever enamelled elements are used, it is equally important that the element packs are not over compressed as this can cause localised damage to the enamel coating that can lead to subsequent pack loosening during heater operation. As part of our commitment to the ongoing development of our element manufacturing methods, Howden have re-engineered the element packing presses and packing procedures. This involved:

A major upgrade of the hydraulic circuitry, controls and load distribution system to produce a even and controlled distribution of pressure across the whole plate area

The installation of dedicated, computer-monitored control panels that both prevent either under or over compression and provide an automatic packing record for each element basket

As a result of the application of these latest processes, we can ensure the customer will receive consistent, high-quality element baskets that will be best suited to withstand the rigours of through life operation. Such attention to detail inevitably results both in improved first quality and extended element life.

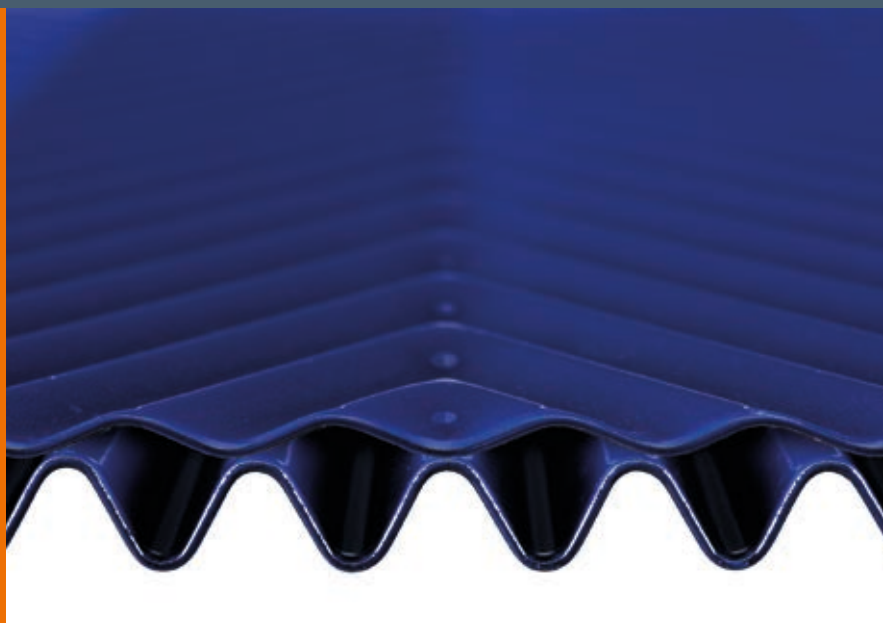


Full sector baskets

Whenever required, SurePack Elements™ can be assembled and welded to create full sector baskets as adopted for speed of installation in many horizontal shaft air preheaters. This much improved manufacturing technique for full-sector baskets matches the thermal performance obtained by more traditional manufacturing processes, but with extended element life as a result of the improved packing process. The result is consistent superior quality packing, giving reduction in element vibration as a result of steam sootblowing, and reduction of element movement in horizontal heaters.



Enamel coating produces an element with the combination of both corrosion protection and good cleanliness when used in the rigorous environments experienced in the low temperature, cold end layers of air heaters, and the even more aggressive regimes associated with FGD gas heaters and air heaters located after SCR DeNOx installations.



In a continuous and ongoing development programme, Howden have optimised the appropriate parameters of enamelling processes, quality, cost and service life and, consequently, can offer our customers a highly competitive product for all air and gas heaters, to a quality specification, which meets or exceeds that of the existing elements installed. All enamel coated elements are packed in specially designed baskets to ensure adequate protection of the enamelling during transportation and installation.

Enamelling process

Rotary heat exchanger elements are frequently exposed to very severe fouling and corrosive conditions. High quality acid-resistant vitreous enamelling provides effective resistance to these hazards and Howden works closely with specialist suppliers to offer coatings of the highest quality.

The quality and life of the enamel coating depends on a number of critical factors including:

Base material

Enamel constituents

Enamel thickness

Enamelling technique.

Howden's vitreous enamel is produced from natural, inorganic raw materials and has a minimum amount of additives in order to ensure maximum adherence to the steel boundary and to minimise the production of pores during the drying process. Porosity levels have fallen over the last decade as a result of better base material and enamel selection.

Dry Electrostatic Enamelling Process

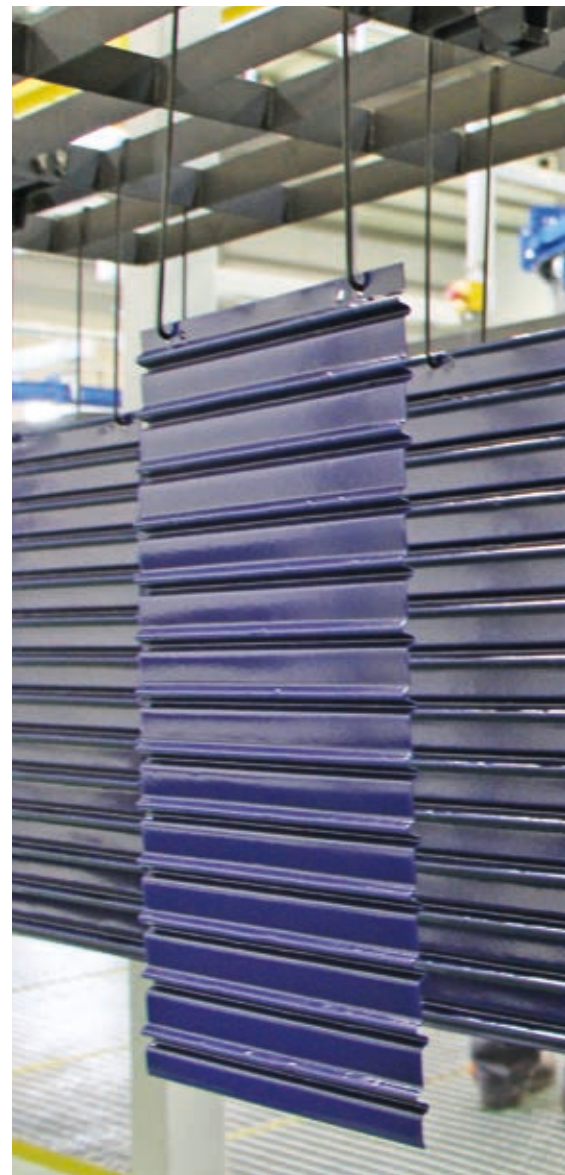
Enamel coatings are applied to decarburised enamelling steels (DC04ED), mild steel and LACR. Prior to their acceptance the coils are sampled and checked for their suitability for enamelling. The base steel coil is rolled to the correct element profile geometry and plate size in our fully automated rolling lines before being sent for enamelling.

Enamel can be applied either by a wet or dry process. While wet dipping has been the traditional and most common method used, the Electrostatic Dry Powder Method is a more modern process and uses electrostatically charged powder. In order to ensure the maximum element durability, Howden uses the latest dry powder process for enamelling heating elements.

The frit is electrostatically charged in a robotically controlled spray gun, and then applied in a special cabin that creates a controlled 'powder-fog' inside, letting all pieces pass across this fog.

The next step is to fuse the enamel in a quality controlled environment at a temperature of around 850°C creating a mechanical and chemically bonded vitreous enamel coating. As a result we produce a high quality product suited to withstand severe operational conditions.

Finally the heating enamelled elements are packed with a system called SurePack Elements™ in specially designed basket to ensure the quality and the durability of the product.



Superior quality enamel

Howden's enamelling process ensures a superior quality compared to other systems of enamelling. The benefits of Howden's dry enamel coating include:

Greater resistance to acid attack

Erosion resistance

High resistance to mechanical and thermal shock

Excellent bonding to metal substrate

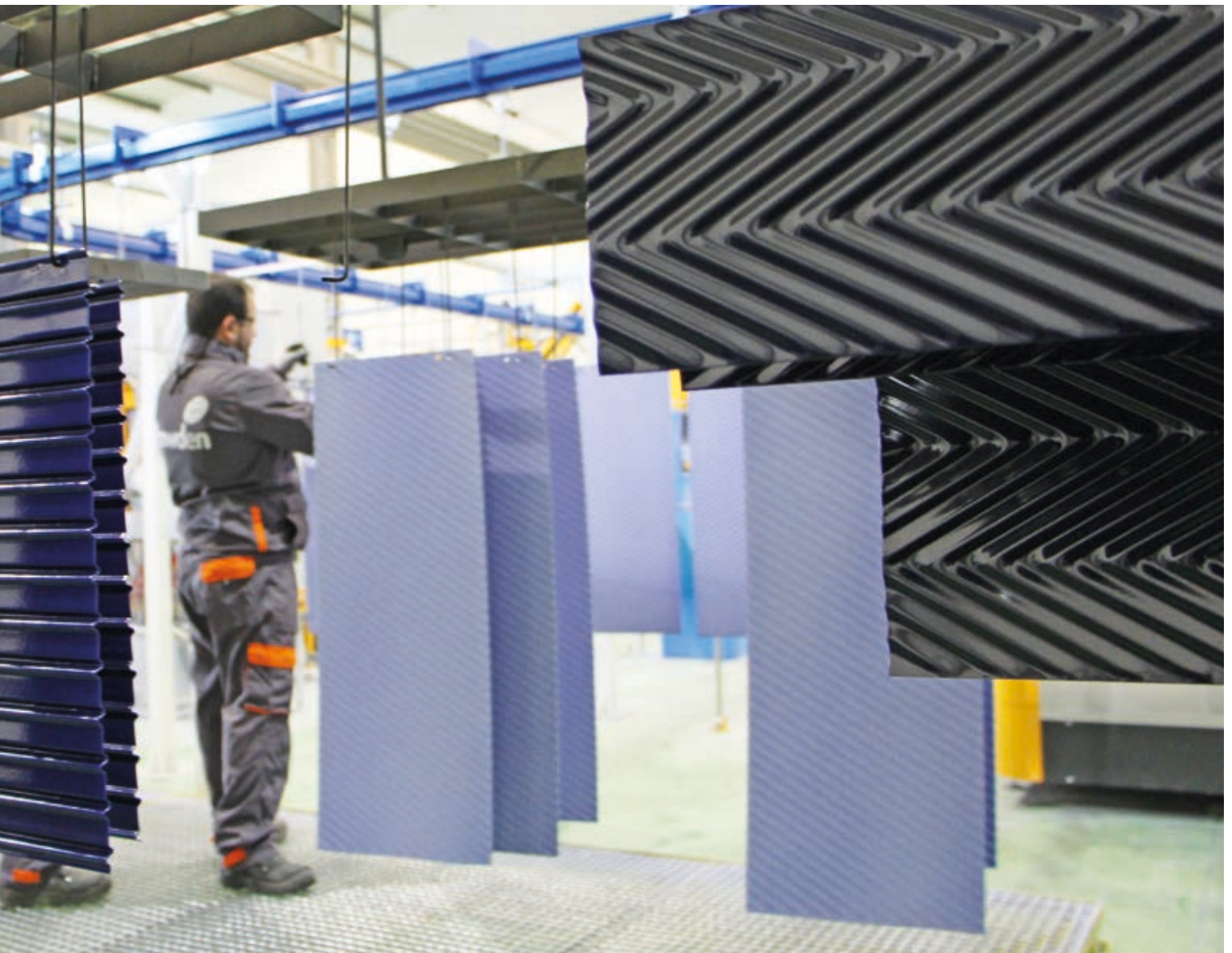
Homogeneity in the internal enamel structure

Much improved coating thickness tolerance (allowing for thinner coatings and higher element basket compression pressures)

Uniformity of enamel thickness, absence of excessive enamel accumulation (greater edge coverage produces increased corrosion resistance)

Surface finish (the smooth, vitreous surface reduces the adhesion of solids)

Production process is non-toxic and environmentally safe.



SureCoat™ Plus (enamelled mild steel) and SureCoat™ Premium (enamelled LACR steel)

In the past, it was not possible to manufacture high quality enamelled cold end elements for heaters using standard mild steel or Low Alloy Corrosion Resistant Steel (LACR). After carrying out extensive research, we have now developed the breakthrough technology that allows us to meet customer demands for these elements.

Standard mild steel and LACR are more widely available.

The new materials enable effective washing or sootblowing.

Greater strength and corrosion resistance increases element life.

Reduced fouling and plugging increases intervals between downtime or outages.

The elements are designed specifically for cold end applications in air preheaters.

Reduced pressure drop over the heater due to fouling reduces demands on FD and ID fans.

When used in conjunction with new HCP Element™ and the Howden Enerjet™ cleaning system, the benefits of the new enamelling techniques for mild or LACR steel are even more dramatic. By taking a systematic view of the science of the contamination and cleaning cycle, we have evolved an integrated system that delivers far more than the sum of its parts.



Air preheater technology and experience



After HP washing

Normal soot blowing



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 system 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 the 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 this 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 further developed VN sealing to achieve and 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, 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 so doing, we have redesigned our moving sector plates, seals, actuators and gap sensors to optimise their performance while maintaining excellent long term operation and minimized 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 designed to be used as an emergency fallback alternative in the event that 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.

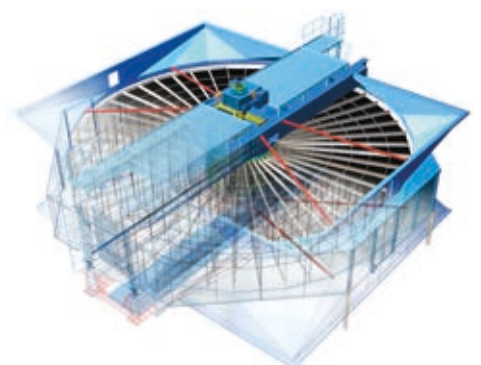
Fouling and plugging lead to an increase in pressure drop, which places an additional burden on the fans. Stopping production for cleaning is costly. In extreme cases the build up of contaminants can lead to unplanned outages, with even more serious financial consequences. All of these unwanted and expensive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

The Enerjet™ system uses a 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 the Enerjet™ to be used during everyday operation. This system has been successfully operated in a growing number of air preheaters for more than 10 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 Element™ or HCP Element™. Each of these designs offer radically improved flow and cleanability.

Intelligent heater monitoring

Developed over many years of research, innovation and comprehensive field testing, the Howden Intelligent Airheater Monitoring system enables operators to identify, localise and minimise many of the major causes of loss of availability in rotary air preheaters on boilers fired by fossil fuel. The system provides a simplified route to understanding the operation and condition of the heater, optimising the effectiveness of the cleaning procedures and improving the performance of the entire boiler draught plant.



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 whatever their needs, 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 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 actually reduce the size of the FGD plant, with obvious cost savings.

Also the use of Selective Catalytic Reactor (SCR) equipment 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 important savings in fan consumptions. Each retrofit project is based on a thorough analysis of the prevailing situation as well as a concise determination of the target performance.

Within the Howden organisation our testing capabilities include:

Fan performance testing

Dust burden emissions test

Heat exchanger leakage tests

Sound level survey and analysis

Vibration analysis with intrinsically safe equipment in hazard areas

Dynamic balancing of rotors in situ

Laser and optical alignment

Site strain gauging of high speed rotating equipment.

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 including fans and rotary heat exchangers and other rotating & static plant on power station sites & process plants using our mechanical, electrical and control & 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

In 1923 Howden and Fredrik Ljungström formed a joint venture to develop the recently invented rotary regenerative heat exchanger for use in the rapidly expanding electricity supply industry. Since those early pioneer days the company now 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

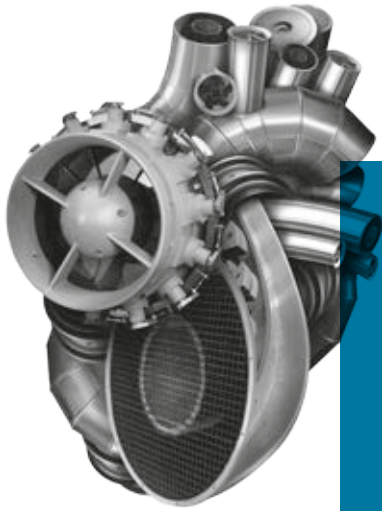
Site surveys, inspection and plant evaluation

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

Howden people live to improve our products and services and for over 160 years our world has revolved around our customers. This dedication means our air and gas handling equipment adds 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.



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Revolving Around You™