

Competence Centre Frankenthal

Howden, Frankenthal —
European Flagship



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Unique Selling Point – Workshops & Functions at a Glance

- (A) Machining
- (B) Logistics
- (C) Assembly
- (D) Compressor Testing
- (E) Steam Generator
- (F) Sales & Aftermarket Engineering Purchasing
- (G) Repair & Logistic Center
- (H) Turbine Testing



Local Capabilities



Business Areas

- Aftermarket
- Steam Turbine (ST)
- Industrial Compression (IC)
- Turbo Fans (TF)
- Environmental Compression (EC)



Key-Components for Turbo Machinery

- Turbine Wheels & Compressor Impellers
- Journal Bearings
- Control Valves
- Shafts / Rotors
- Gearboxes



Specific Know-How

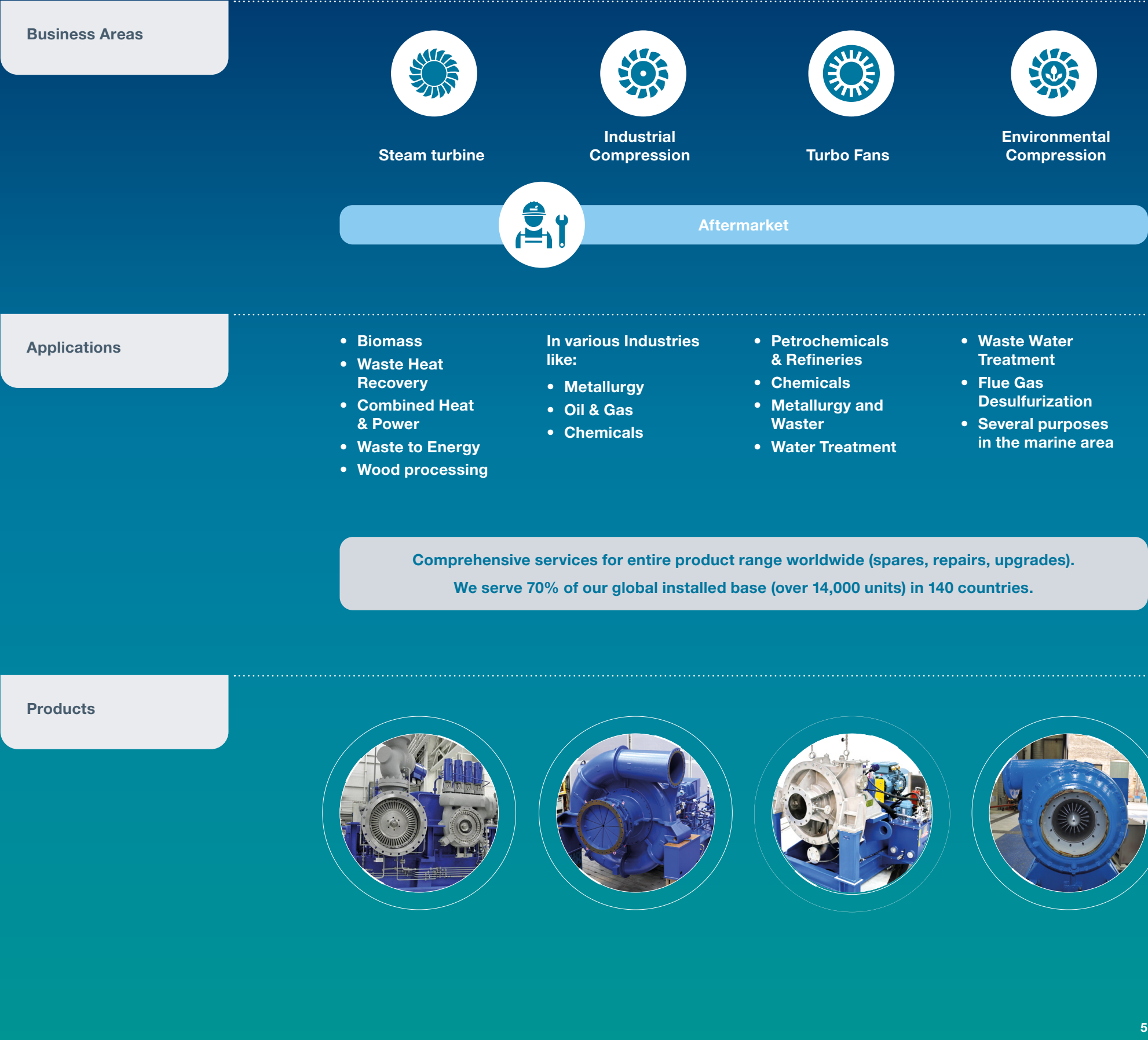
- Impeller & Wheel Design
- Gear Technology
- Bearing Technology
- Surface Technology
- Engineering
- R&D
- Trainee Concept



In-house processes & Manufacturing Competences

- Welding & Heat Treatment
- Electronic Instrumentation & Control
- Machining (CNC)
- Assembly
- Performance Testing
- Digital Microscopy
- Quality Assurance
- Balancing
- Thermal Spraying (HVOF)
- Painting
- Dry-Ice Cleaning
- Centrifugal Casting (Babbiting)

Business Segments and Portfolio



Key Components for Turbo Machinery

Turbine Wheels

- Turbine wheel diameter between 160 and 1000 mm
- Application of modern creep resistance steels
- Live steam temperatures up to 550° C
- Impulse- and Reaction-Type blade design
- Typical Turbine Applications:
 - Power Generation
 - Mechanical Drives
 - Customer Specific Applications

Compressor Impellers

- Compressor impeller diameter between 220 and 1800 mm (in process: up to 2200 mm)
- Huge range of material applications according to specific requirements:
 - Un- and low-alloyed steels
 - High-alloyed/stainless steels
 - Aluminum alloys
 - Titanium alloys
 - Nickel-base-alloys
- Typical Compressor Applications:
 - Sulphuric Acid production
 - Metallurgy
 - Waste Water Treatment
 - Vapor Recuperation

Journal Bearings

- Inner bearings diameter up to 250 mm
- Babbitt-Type (Tin-base) as well as Brass-Type (Copper-base), depending on required application
- Different Bearing designs:
 - Integral
 - Tilting pads
- Typical Bearing Applications:
 - Gear Boxes
 - Turbines
 - Compressors
 - Turbo Fans

Control Valves

- Different drive concepts:
 - Oil-Hydraulic
 - Electro-mechanically (Oil-Free)
- Different sizes for each drive concept available (Depending on requirements)
- Application of modern creep resistant steels and steel castings
- Live steam temperatures up to 550° C, life steam pressures up to 120 bar
- Typical flange dimensions up to DN 350
- Typical application as:
 - Regulation valves
 - Safety valves
 - Combination valves (regulation/safety)
 - Inverse valves

Shafts & Rotors

- Length up to 3000 mm
- With integrated gear toothing, if required
- With internal thrust collar design
- Specific wheel/impeller joints:
 - Hirth-gearing
 - Oil-press fit
 - Heat-shrunk
- Different materials range:
 - Un- and low-alloyed steels
 - High-alloyed/stainless steels

Gearboxes

- Gear Box for turbo machinery applications with single stage design and helical & herringbone gearing
- A total of 11 different gear box sizes
- Centerline distances between 225 and 760 mm
- Gear ratio up to $i=17$, speed up to 30 000 rpm
- Power range:
 - Stand alone gear box up to 5,5 MW
 - Integrated gear box up to 12 MW
- Meets requirements according to DIN3990; DIN3960; AGMA 2101-C95 possible
- Typical gear box applications:
 - Compressors (stand alone and integral type)
 - Turbines (integral type)

Specific Know-How

Impeller & Wheel Design

- More than 50 years of impeller & wheel design experience
- Use of internally developed calculating tools based on decades of experience
- Continuous optimisation of existing impeller & wheel designs
- World lead manufacturer of huge welded impellers up to 2200 mm in diameter (open design)
- State of the art turbine wheels in blisk design (aviation approach)
- Machining of compressor wheels up to 900 mm out of a monoblock
- Established and proven process chain starting from raw material selection, welding, NDT to machining, balancing and final assembly.

Gear Technology

- Howden Turbo has more than 30 years of experience in gear technology and manufacturing being one of the biggest gear manufacturers for single-stage gears in Europe
- Use of commercial calculation software & tools as well as internally developed ones based on decades of experience
- In-house manufacturing of toothing (helical and herringbone types as well as hirth tooths) by appropriate grinding machines
- Service and repair/revamp of gear sets from own product portfolio as well as from other existing gear manufacturers
- Established and proven process chain starting from raw material selection (forgings and castings) to assembly and testing of gear boxes

Bearing Technology

- Many decades of experience in design, calculation, manufacturing and testing of journal bearings
- In-house manufacturing of complete journal bearings including centrifugal casting and quality assurance
- In-depth technical collaboration with universities regarding further development of calculation and simulation tools
- Unique journal bearing test rig for evaluation of numerical results and testing of next generation bearing set ups
- Use of advanced industry calculation standards for turbo machinery
- Participation in different national committees such as AG Turbo/FVV

Surface Technology

- Huge expertise in surface technology such as thermal spayed coating, dry-ice cleaning and painting
- Complete in-house HVOF Coating process chain from development of coating parameters to final finishing and grinding ("turnkey" components)
- Development of dry-ice cleaning concepts for specific components being sensitive to alternative clean-blasting techniques
- Entire in-house process for conventional painting of small and large parts



Specific Know-How

Engineering	R&D	Trainee Concept
<ul style="list-style-type: none">• Huge experience in different engineering areas:<ul style="list-style-type: none">- Materials engineering (material selection and substitution)- Tailored solutions particularly on older turbomachines (revamps, modifications, thermodynamically recalculations etc.)• Development repair concepts especially for “valuable” turbomachinery components• Assessment of existing and development of new electronic instrumentation and control systems even on existing machines	<ul style="list-style-type: none">• Use of state of the art simulation tools:<ul style="list-style-type: none">- Finite-Element-Method (FEM) for stress and modal analysis- Computational Fluid Dynamics (CFD) for fluid simulations- Numerical rotordynamics• Experimental modal analysis• Development of Industry 4.0 Tools for machine monitoring directly from Frankenthal (DDA, Digital Twin)• Development of electrical hardware architecture for turbomachinery	<ul style="list-style-type: none">• Howden highly values its employees and places great emphasis on their training and development:<ul style="list-style-type: none">- Dual Study Program (B.A. degree)- Different study courses such as Mechanical and Electrical Engineering as well as Business Administration- Theory at Cooperative State University, practise in various departments at site• Apprenticeships:<ul style="list-style-type: none">- Various disciplines- Dual system, duration up to 3.5 years• Internal Talent Board Program• Graduate Program



Examples of In-House Processes & Manufacturing Competences

Welding & Heat Treatment	Electronic Instrumentation & Control	Machining
<ul style="list-style-type: none">• Welding processes, e.g. TIG, MAG & MMA• 3 Supporting turn-tables:<ul style="list-style-type: none">- Up to 30 to diameter of component up to 4000 mm• 12 certified welding experts with broad welding experience• More than 50 years of welding expertise of large compressor impellers up to 2200 mm in diameter• Temperatures up to 980° C• Component size diameter up to 5600 mm• Hot working for large compressors blades• Typical applications:<ul style="list-style-type: none">- Stress relief heat treatment- Heat treatment according to NACE requirements	<ul style="list-style-type: none">• Full skid electronics and controls planning and assembly capabilities• Full live time service support capabilities – updates/additional functionalities /controls replacements• According to international design norms and regulations• Full simulation and test capabilities in local test center• In total 12 hardware engineers, software engineers, project engineers, project manager dedicated only for electronic instrumentation & control• In total 7 electronic technicians in assembly and testing workshop	<ul style="list-style-type: none">• Unique range of modern machine park:<ul style="list-style-type: none">- 5-axis /milling /lathe CNC machining centres- Grinding machines- Gear grinding machines (incl. Hirth-joints)- Centrifugal casting (Babbitting)- Balancing machines- Thermal spraying (HVOF)• Typical component examples:<ul style="list-style-type: none">- Impeller & Wheels- Casings out of steel castings & cast iron- Valves- Journal bearings- Shafts/Rotors
Assembly	Performance Testing	Digital Microscopy
<ul style="list-style-type: none">• Assembly of compressors and turbines• A total of 16 experienced specialists with broad expertise in turbo machinery• Separate piping workshop• Pressure and leak test procedures for piping & casings• Typical applications:<ul style="list-style-type: none">- Assembly of entire compressors & turbofans- Assembly of steam turbines- Assembly of regulation and safety valves	<ul style="list-style-type: none">• Thermodynamic performance measurement of compressors and turbines prior to delivery• Internal steam generator for steam turbine testing• Mechanical diagnostics with conventional sensors and optical devices• Hydraulic and electromechanical testing of regulation and safety valves• Advanced testing of journal bearings• Trim balancing• Modifiable data acquisition system• Cross qualification between technologies• Steam power: max. 800 kW, pressure 40 bara, max. temperature 380° C, flow rate 8t/h ... 10t/h	<ul style="list-style-type: none">• Mobile/transportable device for fact findings• 2D and 3D measuring of surface imperfections and surface profiles• Magnification of imperfections / findings up to 200 (e.g. pitting)• Statement about possible repair measures (instead replacing by a new part)• Typical applications:<ul style="list-style-type: none">- Condition assessment of parts and components- Examination and assessment of functional surfaces- Determination of surface quality

Examples of In-House Processes & Manufacturing Competences

Quality Assurance

- Extensive range of Non Destructive Testing (NDT) procedures:
 - Visual testing (VT)
 - Penetration testing (PT)
 - Magnetic Particle testing (MPT)
 - X-Ray radiation
- Climatized measuring equipment room
- Tactile measuring instrument for large components
- Typical applications:
 - Dimension control
 - Welding quality
 - Incoming goods inspection

Balancing

- A total of 5 low speed balancing machines, suitable for smaller and bigger rotating parts Balancing of large rotors, length up to 3000 mm, diameter up to 1800/2200 mm
- Balancing quality $G=2,5$ as standard for turbo machines, $G=1$ also possible
- Meets requirements according to DIN EN 21940
- Typical applications:
 - Rotors
 - Shafts for turbines & Compressors and fans
 - Gear sets

Thermal Spraying

- High-Velocity-Oxygen-Fuel-Process (HVOF)
- Application specific range of different Carbide-based hard facing coatings with harnesses up to 2300 HV
- Size of the components:
 - Length max. 2000 mm
 - Diameter max. 800 mm
- Subsequent grinding possible, surface quality up to $Rz=1,6$
- Typical applications:
 - Sealing areas
 - Valve spindles
 - Shaft restoration
 - Local repair of components

Painting

- Typical standard painting:
 - Painting up to 140°C 2K-Epoxy Priming coat with 2K-Poly Urethane top-coat in C3-C5 Hold time 5–15 years
 - Painting across 140°C 2K- Epoxy Priming coat with 1K-Si/AK Priming coat in C3-C5 hold time 5–15 years
 - Atex painting 2K-Epoxy Priming coat with 2K-PUR Priming coat. Electrostatically conductive in C3-C5 hold time 5–15 years.
 - Preliminary work by blasting according to SA 2½ (Corundum, glass beads and steel shot)
- Typical applications:
 - Casings
 - Pedestals
 - Piping
 - etc.

Dry-Ice Cleaning

- Cleaning of parts with blasting of solid carbon dioxide pellets (-78,4° C)
- Environmentally friendly
- No chemical additives in use
- No water usage
- Only little dry waste
- High cleaning rate
- Extreme gentle handling of surfaces – no abrasive impact
- Process increase lifetime cycle of parts
- Typical applications:
 - Cleaning of Exhaust Gas Recirculation impellers
- All medium carrying parts:
 - Inner prerotation driver
 - Impeller
 - Inner diffuser drive

Centrifugal Casting

- Centrifugal casting of tilting pads as well as integral bearings
- Bearing casting diameter up to 300 mm
- Minimal lead times due to optimized series production
- High performance, Tin-based Babbitt application with excellent emergency running characteristics
- Quantity of bearings & tilting pads p.a.: 3500
- Quality assurance by ultrasonic testing
- Typical applications:
 - Industrial compressors
 - Turbo Fans
 - Gear Boxes
 - Spare Parts (Aftermarket)

Sustainability goals 2022



Following goals / objectives in 2022

- Implement new Howden Standards
- Improve Howden Environmental Standards to 75% at Frankenthal and to 65% at satellite sites (UK to 50%)
- Integrate satellite sites into Scorecard
- Reduce electricity consumption by replacing fluorescent tubes with LEDs (where possible, sometimes depending on landlord)
- Water reduction: 1%
- Waste reduction: 4%
- Install a program for the reduction of waste to landfill at Frankenthal
- Install charging stations for fleet and employees cars at Frankenthal



Long term goals / objectives

- Green energy supply for satellite sites at the next contract renewal (done at Frankenthal since 2021)
- Reduce CO₂-Footprint by 50% by 2030 and become carbon net zero by 2035
- Waste to landfill to zero by 2030
- Plan and install a ~2 MW photovoltaic system at Frankenthal site



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