www.howden.com

HOWDEN COMPRESSORS

HIGH POWER, HEAVY-DUTY RECIPROCATING COMPRESSORS

PASSION FOR COMPRESSION

Mr Geurt Thomassen began a lifelong involvement with the science and technology of gas compression in 1896. After securing a dealership for gas engines, he recognised the potential for improvement and started manufacturing engines to his own enhanced design. Building on success, in 1921 he designed his first reciprocating compressor and initiated a process of continuous development and improvement that made Thomassen Compression Systems BV one of the world's leading engineering companies.
Today, we are a key part of the compressor division of Howden Global, a company that shares our dedication to achieving the best, most efficient and most reliable compressor technology possible. Our commitment to our customers, and to the future of compressor technology, is as strong as ever.

THOMASSEN
COMPRESSION
SYSTEMS

HOWDEN THOMASSEN COMPRESSORS MARKETS INCLUDE:

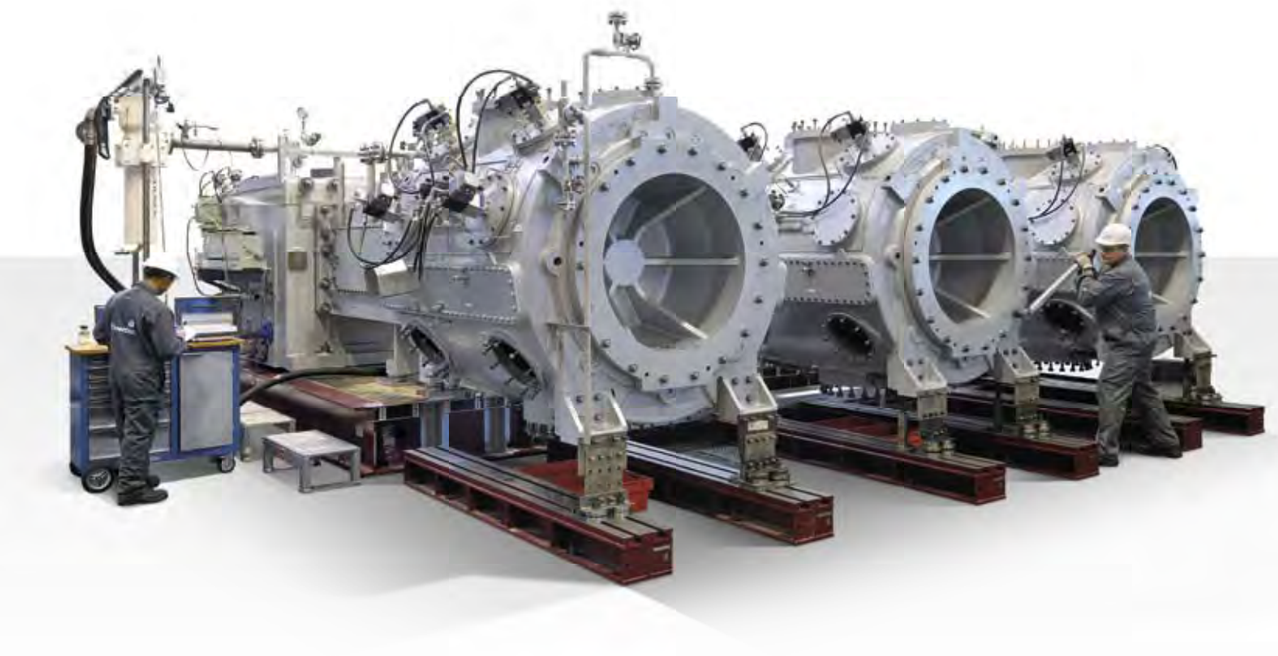

REFINERIES


PETROCHEMICALS


OIL AND GAS


OFFSHORE

HIGH-POWER THOMASSEN C-SERIES
RECIPROCATING COMPRESSORS
RANGE FROM 1 TO 24.8MW.



THE HOWDEN THOMASSEN COMPRESSORS C-SERIES

OUR HIGH-POWER C-SERIES RECIPROCATING COMPRESSORS, COVERING THE RANGE FROM ONE TO 24.8MW, ARE DESIGNED NOT ONLY TO MEET THE MOST EXACTING DEMANDS OF PROCESS-CRITICAL APPLICATIONS IN THE OIL, GAS, CHEMICAL AND REFINING INDUSTRIES, BUT TO OFFER SIGNIFICANT ADVANTAGES IN OPERATING COSTS AND RELIABILITY.

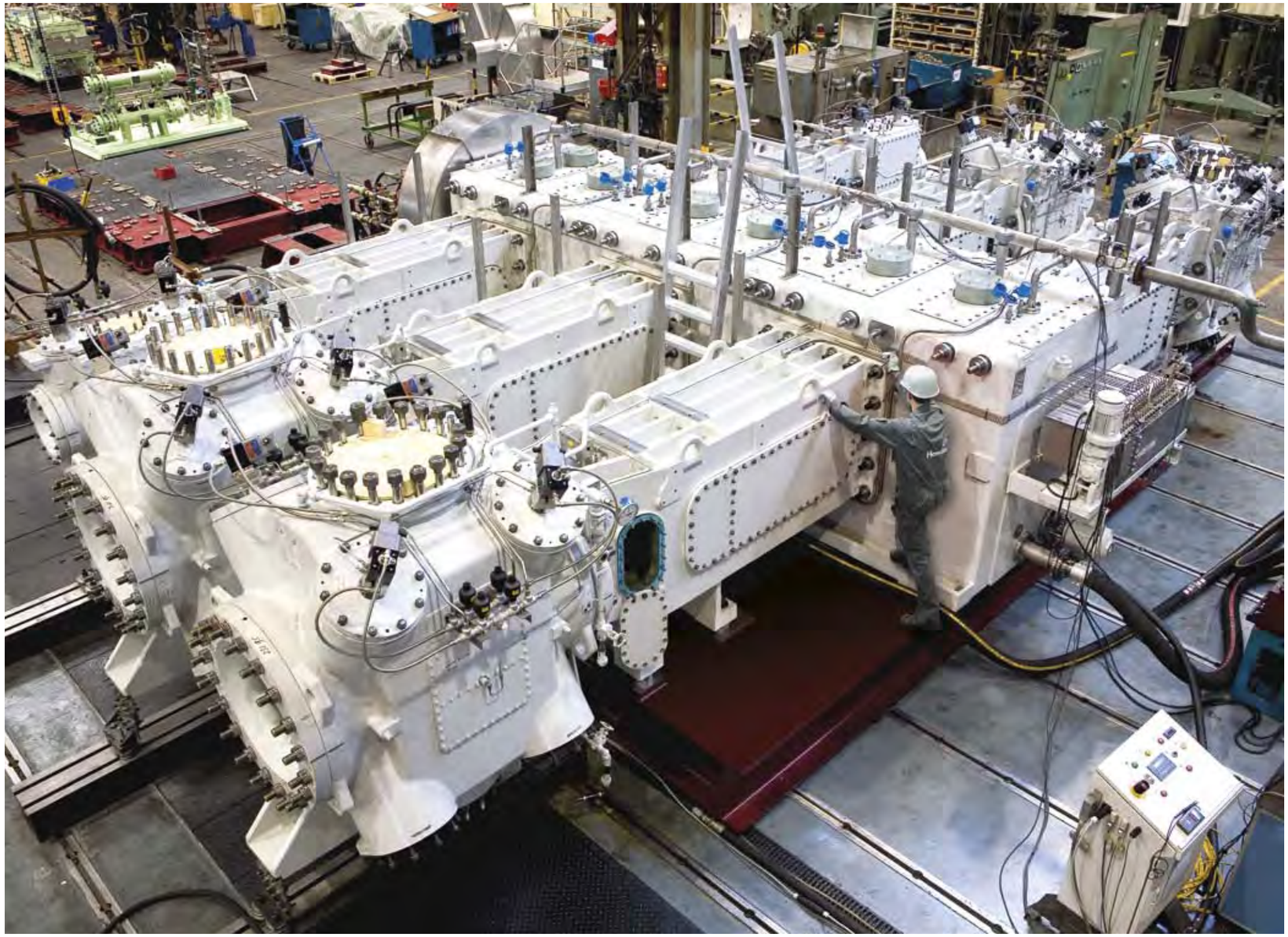
Without exception, our products meet all of the relevant API 618 and ISO specifications and have an impressive track record of continuous trouble-free performance in the most challenging environments.

Our C-series compressors utilise a proven, rigid construction frame design incorporating between one and eight compression cylinders. Every component, from the bearings to the casings, has been designed or selected for maximum performance and robust reliability. The arrangement has been optimised for easy access to facilitate maintenance and minimise downtime. In addition the cylinders are horizontally opposed and balanced to ensure long-term vibration-free running.

Many of the features that make our compressors the right choice for demanding situations can be added to existing compressors from virtually any manufacturer. This means that a relatively minor retrofit project can present an exceptionally cost effective route to enhanced performance and return its investment in reduced energy costs and downtime in a surprisingly short time.

THE PATH TO
EXCEPTIONAL PERFORMANCE

THE HOWDEN THOMASSEN COMPRESSORS C-SERIES IS THE RESULT OF DECADES OF EVOLUTION, COMBINING PRACTICAL EXPERIENCE WITH METICULOUS RESEARCH, PROTOTYPING AND TESTING.



AT THE DESIGN STAGE, EVERY UNIT IS SUBJECTED TO AN INDIVIDUAL PROCESS OF FINITE ELEMENT ANALYSIS AND MODELLING. THIS ALLOWS US TO REDUCE WEIGHT AND LIMIT FREE FORCES WHEREVER POSSIBLE WHILE MAINTAINING THE NECESSARY MARGINS OF STRENGTH, RIGIDITY AND RELIABILITY. THEORETICAL DATA FROM SIMULATION PROGRAMMES IS CHECKED AND CONFIRMED AGAINST EXPERIMENTAL ANALYSIS USING OUR PURPOSE-BUILT HEAVY DUTY COMPRESSOR AS A TEST BED.

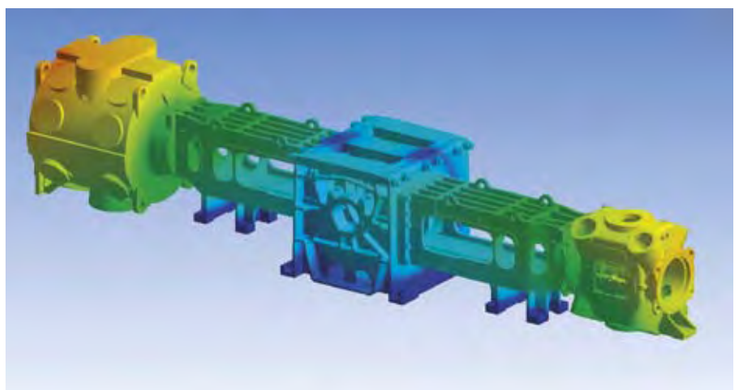
We have developed software that precisely simulates the oscillating torque in the system and its effect on various components by taking account of the complex variable forces that change with the angle of the crank.

- We investigate the behaviour of dynamically loaded bearings under a range of operating conditions.
- We predict the ways in which factors such as inertia from the process gas and the oscillating components, loadings, load reversals, oil temperature and viscosity, running speed and bearing clearance will affect performance.

PASSION FOR COMPRESSION

FINITE ELEMENT ANALYSIS

At Howden Thomassen Compressors we have our own in-house Finite Element Modelling (FEM) facilities. FEM analysis is a very important part of the design process for heavy duty compressor components, because it enables us to provide the properties and characteristics we need, such as rigidity and resistance to fatigue, while reducing weight as far as possible and so improving overall efficiency.



INNOVATIVE THINKING, PROVEN RESULTS

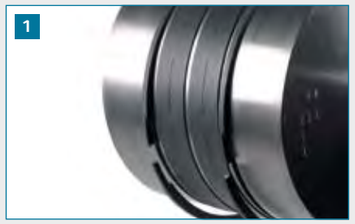
THE EFFICIENCY AND RELIABILITY OF THE C-SERIES IS THE RESULT OF COMBINING STRINGENT ATTENTION TO DETAIL, SUCH AS THE EXCLUSIVE USE OF ROLLED THREADS FOR GREATER FATIGUE RESISTANCE ON ALL HIGH TENSILE BOLTS, WITH SOME MAJOR ADVANCES IN COMPRESSOR TECHNOLOGY.

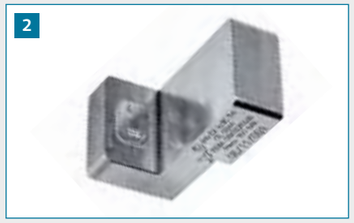
1 THE FREE FLOATING PISTON

3 HYDROFIT COUPLINGS

2 Rsens™

Please note that these features are optional and are not all found in every Howden Thomassen Compressors product. The illustration simply indicates their position when installed.





ELIMINATING RIDER RING WEAR: THE FREE FLOATING PISTON

The Free Floating Piston, a patented innovation, is a radical rethink of piston operation. Rider ring wear is, inevitably, one of the major causes of compressor maintenance shutdowns. Oil lubrication systems can greatly extend the life of the rider rings, piston rings and the cylinder wall itself, but oil lubrication is not always an option. Where continual running times of several years are increasingly demanded by operators, it becomes more and more beneficial to extend the gaps between maintenance breaks. To address this, we developed the FFP™ system.

Instead of being supported by the rider rings, the piston is supported on a film of the process gas itself. The gas film is produced by flooding the interior of the piston with gas during the compression phase and allowing a small quantity of the gas to flow out of the bottom of the piston to support its weight. This means that, except for a very brief period during the start-up of the compressor, there is no contact at all between the rider ring and the cylinder so that rider ring wear is virtually eliminated. The ultra-thin film of gas, around 10–50 microns deep, represents less than one per cent of compressor capacity and is allowed for at the design stage so that there is no reduction in output.

The first Free Floating Piston compressor we installed in an industrial application has now been running for over ten years without any replacement of the rider rings. Today, there are more than one hundred Free Floating Piston compressors in use within the oil and gas, refinery and petrochemical industries. Even where oil lubrication would be viable option, the Free Floating Piston has proved to be a simpler and more cost effective route to improved reliability and availability (see **www.thomassen.com/ffp** 'How it works').

OPTIMISING MAINTENANCE INTERVALS: Rsens™

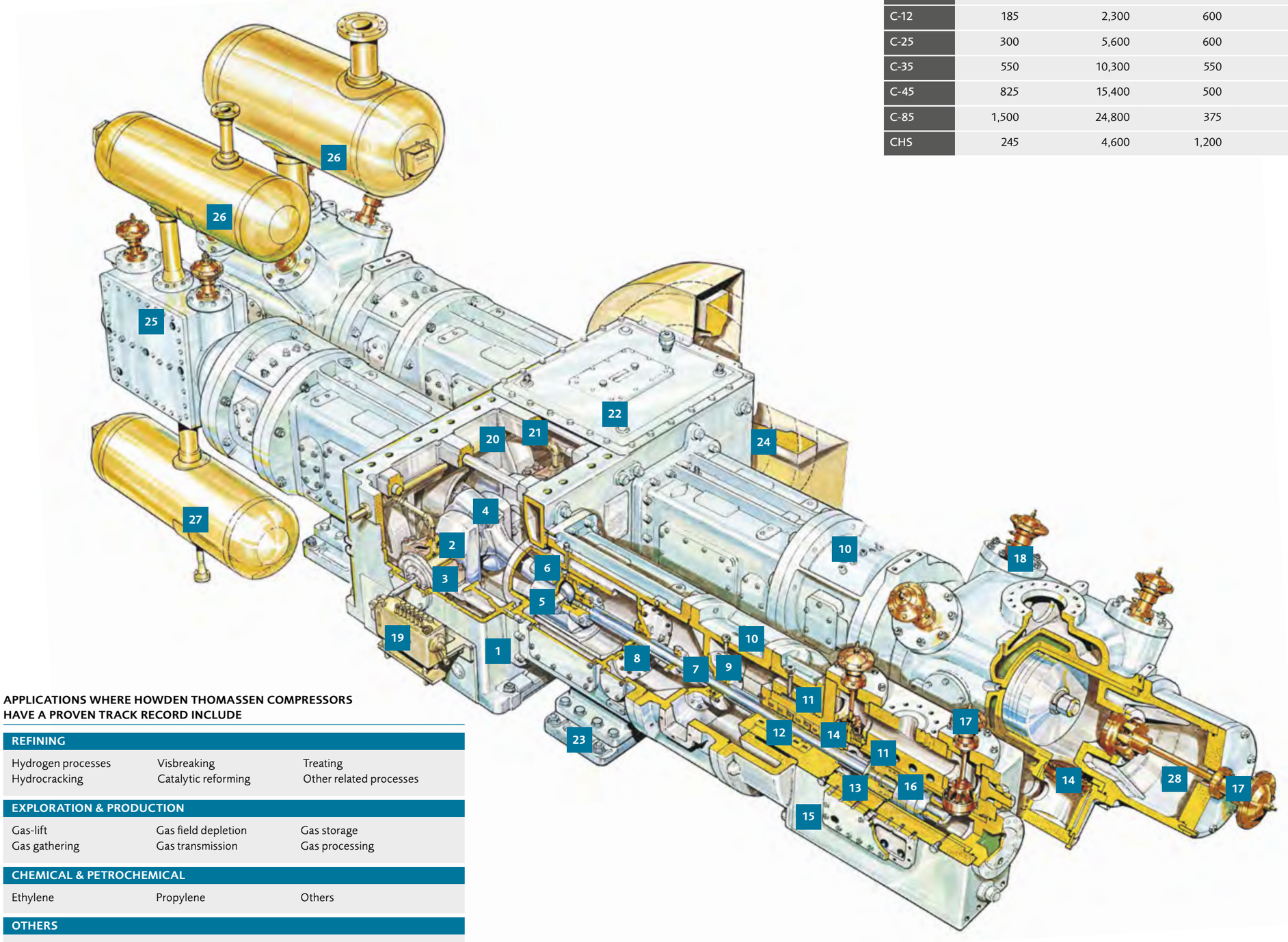
The Rsens™ rider ring monitoring system is designed for situations where FFP™ are not installed and where planned downtime will be required for rider ring replacement. The timing of the shutdown is crucial: intervene too early and you will be replacing viable rider rings, leave it too late and there may be very expensive knock-on damage to the piston and cylinder lining. Accurate information about rider ring condition is therefore invaluable. Most of the available sensors, however, measure the drop in the level of the piston rod. This can be affected by a number of variables which confuse the data. Our unique Rsens™ system places a sensor inside the piston head cover itself, from where it can provide precise and reliable feedback of rider ring condition.

The Rsens™ system uses a solid state sensor that is unimpaired by the most hazardous environment, including corrosive and acid gases, extreme temperatures and pressures and even explosions. The placing of the electronic components outside the cylinder makes them easy to access even while the compressor is running normally.

PROTECTING AGAINST PISTON ROD FAILURE: HYDROFIT COUPLINGS

The piston rods in C-series compressors are fitted with Hydrofit hydraulic couplings at both the piston and the crosshead ends to offset against fatigue failure at the most critical points, where the rod is coupled to other components. Easily assembled and adjusted, pre-loaded couplings substantially reduces cyclic stresses and offer a simple route to extending piston rod life.

C-SERIES RECIPROCATING COMPRESSORS
COMPONENTS AND RANGE



APPLICATIONS WHERE HOWDEN THOMASSEN COMPRESSORS HAVE A PROVEN TRACK RECORD INCLUDE

REFINING		
Hydrogen processes	Visbreaking	Treating
Hydrocracking	Catalytic reforming	Other related processes
EXPLORATION & PRODUCTION		
Gas-lift	Gas field depletion	Gas storage
Gas gathering	Gas transmission	Gas processing
CHEMICAL & PETROCHEMICAL		
Ethylene	Propylene	Others
OTHERS		
Gas to liquids	LNG	LDPE
Coal to liquids	Polysilicone	

FRAME SIZE AND RATINGS API 618 RECIPROCATING COMPRESSORS

Model	Rating kN	Rated Power kW	Rated Speed	No. of Cranks
C-7	130	800	600	1-2
C-12	185	2,300	600	1-4
C-25	300	5,600	600	1-6
C-35	550	10,300	550	1-6
C-45	825	15,400	500	2-6
C-85	1,500	24,800	375	2-8
CHS	245	4,600	1,200	1-6

1. CRANKCASE/OILSUMP
2. CRANKSHAFT WITH INTEGRAL FORGED DRIVE FLANGE
3. MAIN BEARING
4. CONNECTING ROD
5. CROSSHEAD
6. ADJUSTABLE, REPLACEABLE CROSSHEAD SHOES
7. PISTON ROD WITH HYDRAULIC CONNECTIONS
8. PARTITION COVER WITH OIL AND GAS SEAL
9. DOUBLE COMPARTMENT PARTITION COVER WITH GAS SEAL
10. CROSSHEAD GUIDE/DISTANCE PIECE
11. COOLING WATER JACKET
12. STUFFINGBOX
13. REPLACEABLE DRY TYPE CYLINDER LINER
14. VALVES
15. FORGED STEEL CYLINDER
16. PISTON WITH PTFE RIDER- AND PISTON RINGS
17. PNEUMATIC VALVE ACTUATOR
18. MULTI-VALVE TYPE CAST CYLINDER
19. CYLINDER AND STUFFINGBOX LUBRICATOR
20. LUBE OIL HEADER
21. SPACER BLOCK AND TIE RODS
22. FRAME COVER
23. CROSSHEAD GUIDE SUPPORT
24. FLYWHEEL
25. SINGLE VALVE TYPE CAST CYLINDER
26. SUCTION PULSATION VESSEL
27. DISCHARGE PULSATION VESSEL
28. CLEARANCE POCKET

GLOBAL AFTERMARKET
SERVICE AND SUPPORT

EVERY HOWDEN THOMASSEN COMPRESSORS PRODUCT IS SUPPORTED BY AN ABSOLUTE COMMITMENT TO WORLDWIDE SUPPORT AND SPARE PARTS.

Our commitment not only ensures that your machinery is kept in optimal condition, it also means that we can offer advice on fully costed upgrade projects designed to give you the benefits of state-of-the-art technological developments that may substantially reduce maintenance and energy costs and repay their investment in a surprisingly short time.

Over the years, we have found that the best route to optimising performance is to work in partnership with your in-house engineers. By understanding your processes, constraints and future planning, we can provide advice and upgrades that exactly match your requirements.

UPGRADES AND RE-RATING SERVICES FOR VIRTUALLY ANY COMPRESSOR EQUIPMENT

We can carry out upgrades, overhauls and re-rating exercises that will bring new levels of performance to your existing equipment irrespective of its location, manufacturer or application, enabling it to cope with changes in demand, processes, operating conditions and environmental constraints. State-of-the-art innovations, such as Hydrofit couplings, Free Floating Piston technology and Rsens™ monitoring, can be incorporated into existing compressors.

Operating through a global network of strategically situated centres, our service engineers respond quickly and efficiently to the needs of customers and provide the most cost effective route to meeting present and future demands. Our services include:

- inspection, overhaul and repair.
- customer-focused maintenance contracts.
- specialist engineering.
- a full spare parts programme.
- re-rating and upgrading.
- customer training.


Before


After

SERVICE AND SUPPORT

INSPECTION, OVERHAUL AND REPAIR

Because we can expertly handle all of your compressor maintenance requirements, from routine inspection to troubleshooting and emergency repairs, you can be assured that your compressors will be maintained at optimum efficiency and that help is on hand quickly when you need it. We aim for preventative maintenance wherever possible.

We also investigate technological developments that might raise performance. In the hands of our highly experienced engineers, a routine repair can present an opportunity for introducing improved specifications or capabilities.

Howden Thomassen Compressors service engineers have outstanding experience in all types of compressors and applications and are fully trained and experienced in procedures such as:

- dis-assembly, inspection and overhaul of virtually any type of reciprocating compressor.
- installation and commissioning.
- emergency callout.
- repair or replacement of worn and damaged components.
- re-blading of steam turbine rotors.
- low and high speed compressor balancing.
- laser alignment.

Whether they are working in our factories and workshops or on site in our customers premises, our engineers work as a team to deliver the most reliable and robust outcome for each individual situation.

Our experience covers reciprocating, centrifugal and screw compressors, steam turbines, pumps and auxiliary systems. Extensive in-house facilities enable us to design and manufacture parts on a short time scale and all of our repairs are carried out in full accordance with API guidelines.

IN-HOUSE INSPECTION AND TEST FACILITIES

Our facilities in the Netherlands are comprehensively equipped with modern test, inspection and repair equipment custom designed for working with heavy duty compressor plant. Our services include:

- certified NDO inspections.
- eddy current inspections.
- mechanical machining.
- heat treatment.
- grinding of hard and abradable coatings.
- over-speed testing of rotating parts.
- emergency parts supply.
- stacking and de-stacking of rotors.
- lead labyrinth repairs.
- high precision welding.
- dynamic balancing.
- specialist engineering.

MAINTENANCE CONTRACTS

Our maintenance philosophy is based firmly on the principle of reducing the total lifetime cost of your equipment by maximising availability and reliability. We do this by monitoring the condition of critical elements to prevent failure and, if failure does occur, by taking steps to prevent its recurrence. Building on feedback from customers, field engineers and R&D specialists, we have developed a flexible Maintenance Management System designed to give plant operators total security and peace of mind.

Our modular package includes the following optional units.

Proactive Performance Maintenance Optimiser (PPMO)

By carrying out thorough checks at fixed intervals, scheduled to suit your requirements, we can record component wear and tear, identify trends and carry out preventative maintenance at the optimum time.

Supplier Stock Agreement

It is vitally important to have spare parts available when you need them. We can list the parts we undertake to keep in stock and set out the delivery deadlines that we will meet.

Scheduled and Emergency Call-outs

We know that a compressor breakdown can have severe consequences. We are on call 24 hours a day, and pride ourselves on responding with maximum effectiveness in minimum time, using highly qualified service engineers.

Specialist Engineering Backup

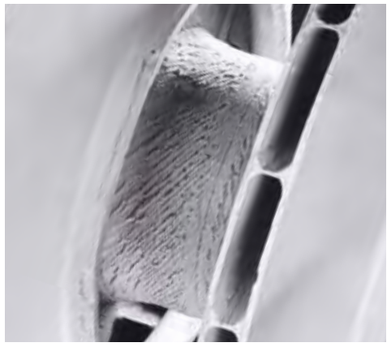
Our specialist engineers can advise on and carry out modifications and enhancements to help customers raise the efficiency and reliability of their equipment and get the best from their maintenance programmes.

Repair Services

Because it makes economic and logistical sense for customers to deal with a single service partner, our repair shop can provide a guarantee that capacity will be available when it is needed.

Other Engineering Services

Our in-house facilities are impressively comprehensive. They include failure analysis and Root Cause Analysis, performance metrics and feasibility studies, stress calculations, pulsation investigations, design studies using FEM techniques, rotor dynamic analysis, vibration analysis, full system analysis and reverse engineering.



SERVICE AND SUPPORT

SPARE PARTS

We supply a comprehensive range of spare parts for both our own and third-party compressors. Through continued improvements in the durability and operating efficiency of components, every replacement becomes an opportunity to raise performance. Replacing a standard piston with our Free Floating Piston technology, for example, can reduce downtime and running costs by entirely eliminating the need to replace rider rings.

With service centres around the world including the Far East, Middle East, India and South America and a global network of sales offices and representatives, we are always ready to provide a fast response to requests for spare parts.

Supporting older equipment

In addition to standard components, Howden Thomassen Compressors is frequently able to supply parts for compressors that are no longer supported by the original manufacturer.

CENTRIFUGAL COMPRESSOR AFTERMARKET SERVICES

We bring more than 40 years experience, state-of-the-art design capabilities and high quality engineering to the enhancement of centrifugal compressors, irrespective of the original manufacturer.

- We can fit new compressor rotors within an existing casing, modifying the design to meet new demands if necessary.
- We can adjust spherical tilting pad bearings to improve rotor stability.
- We can install customised mechanical wet seals or dry gas seals to reduce oil leakage.
- We can replace geared couplings with dry flexible disc or diaphragm couplings, reducing maintenance costs.
- We can fit abradable seals with tighter clearances to reduce recirculation losses and buffer gas consumption.
- We can reverse engineer and usually improve any component.

TRAINING

To keep your compressor running at peak performance and identify potential problems, it is vital to understand the equipment and the principles behind its workings. Our training courses, delivered either on your own premises or at our training facilities in the Netherlands, provide a practical knowledge of compressors.

Our instructors ensure that your staff have all the information, background and skills they need to keep your compressors running safely and efficiently and carry out all of the necessary routine maintenance. Each course is tailored to the needs of the delegates attending and the equipment and process they will be involved with.

FOR FURTHER INFORMATION ABOUT NEW EQUIPMENT, UPGRADES OR MAINTENANCE SERVICES, OR TO ARRANGE A VISIT FROM ONE OF OUR SERVICE ENGINEERS, PLEASE CONTACT: **info@thomassen.com**

PASSION FOR COMPRESSION

Howden, A Chart Company