



Rolls-Royce

Centrifugal compressors

Pipeline and barrel compressors for the energy industry



Pipeline and Barrel Compressors

Efficiency and reliability
from the leader in natural gas
compression equipment

The RFA36 and RFA24 are the most efficient pipeline compressors available today, demonstrating the performance that is the hallmark of Rolls-Royce compressors, derived in part from our rich Cooper-Bessemer® heritage. Our API 617 compliant pipeline and multi-stage barrel compressors apply advanced technology to continue to deliver cost-effective production.

Pipeline Compressors

The RFA36 is the first in a more efficient generation of industry leading centrifugal compressors. With field-proven efficiencies of up to 91 percent, the RFA can save hundreds of thousands of dollars annually in energy costs compared to conventional pipeline compressors of similar capacity.

This outstanding performance is achieved through design improvements based on the most recent advances in fluid dynamics.

Rolls-Royce also offers more conventional beam-style centrifugal pipeline compressors that achieve efficiencies of up to 89.5 percent. Engineered for peak aerodynamic efficiency, Rolls-Royce pipeline compressors are installed on most major natural gas pipeline systems throughout the world. They perform reliably in a variety of compression applications in all kinds of climates.

For over 65 years, more than 980 pipeline compressors have been installed in countries across the globe.

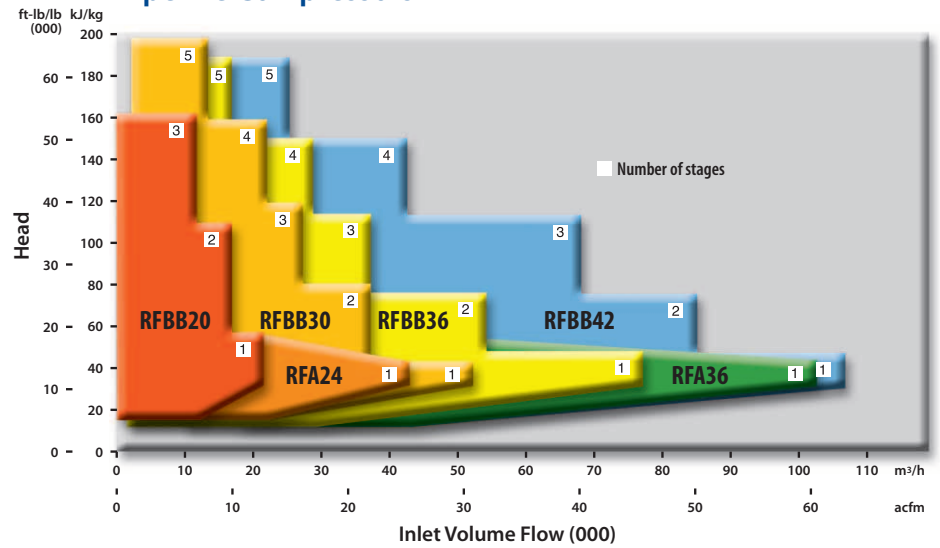
Barrel Compressors

Rolls-Royce multi-stage, vertically split centrifugal barrel compressors are used in natural gas gathering, storage, gas lift and reinjection service worldwide.

Aerodynamic efficiency, performance flexibility and high reliability are characteristic of Rolls-Royce barrel compressors. Sized to meet a wide range of flow and pressure requirements in continuous, full-load operation, they offer high dependability, even when handling natural gases containing large amounts of hydrogen sulfide, carbon dioxide and water.



Pipeline Compressors

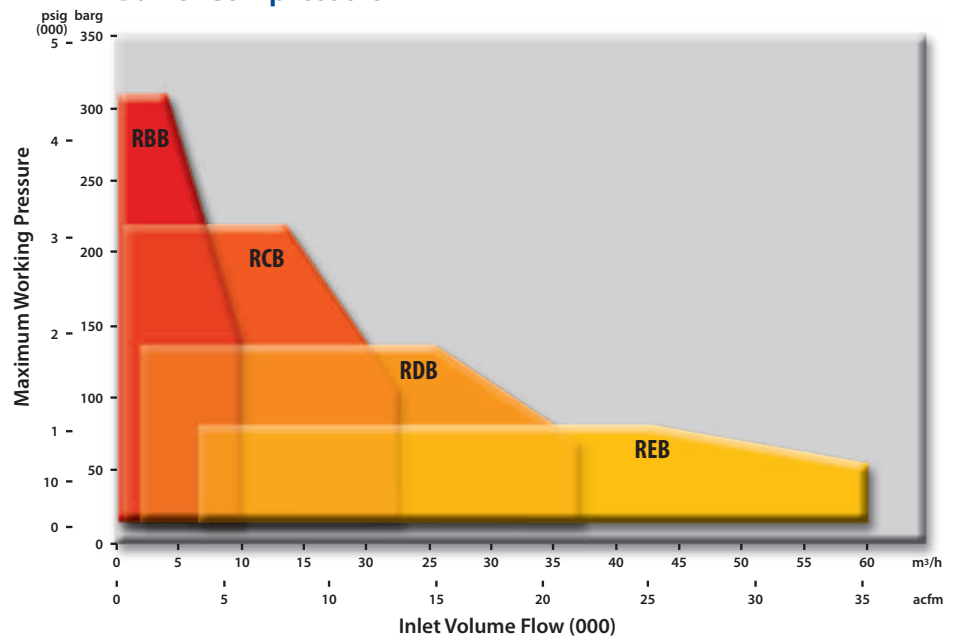


Over 740 Rolls-Royce barrel compressors have been built, with more than 500 units installed in natural gas handling applications, including over 60 units designed for sour gas service. In high-pressure reinjection, there are standard Rolls-Royce designs up to 4,500 psig (310 barg) maximum working pressure.

Compressor Packages

Rolls-Royce is an experienced packager of complete compression systems, including modules for offshore compression. Custom-designed units are available for harsh arctic, offshore and desert environments.

Barrel Compressors



Pipeline compressors

Rolls-Royce design advancements have resulted in our conventional pipeline compressors delivering up to 89.5 percent efficiencies, while the RFA achieves up to 91 percent. All Rolls-Royce compressors are designed to API 617 for the widest customer acceptance. State-of-the-art aerodynamic engineering of the entire gas path provides peak efficiencies while providing a wide operating map.

Rolls-Royce conventional pipeline centrifugal compressors can accommodate up to five compression stages for higher head applications.

- Six standard frames have flange sizes from 20 to 42 inches (510 to 1,070 mm).
- Design inlet flows range from 1,000 to 62,800 acfm (1,700 to 106,500 m³/h).
- Pressure capabilities up to 3,220 psig (222 barg).
- Power ratings up to 75,000 hp (56,000 kW) at design speeds from 3,600 to 13,800 rpm.

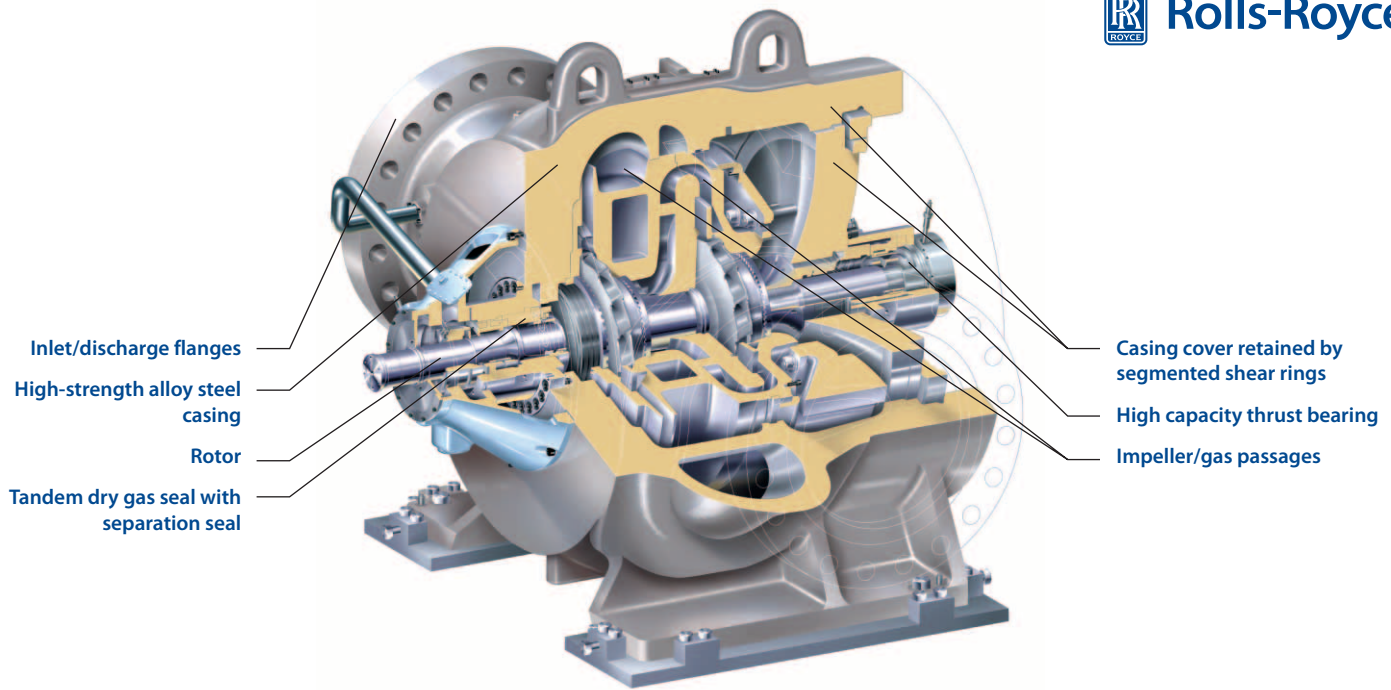
Applications

Many units are adapted to perform efficiently in a variety of unique duties not limited to pipeline applications, including:

- Major oil and gas customer operates a 40 MW synchronous motor-driven RF3BB42 compressor with variable inlet guide vanes at the output end of their gas plant in Alberta, Canada to boost pressure up to pipeline levels.
- Series/parallel gas storage units for a Canadian gas transmission company, each with tandem or triple pipeline compressors driven by an RB211 gas turbine.
- 4, 10, 18, and 30 MW pipeline compressors in North American transmission service, driven by variable speed, synchronous motors.

RFA36 and RFA24

The RFAs are the most efficient, proven pipeline compressors in service to date, featuring axial inlet, tangential discharge and a single-stage, spherically shaped cast casing.



They are compact, rugged units that weigh only two-thirds as much as a conventional compressor. The casing is typically cast from high-strength alloy steel. To minimize downtime, the aerodynamic and bearing/seal assemblies are removed toward the coupling end leaving the main piping undisturbed.

Journal and thrust bearings are of the tilting-pad type. For highest capacity, the bearings use individually lubricated pads to reduce bearing temperature and increase reserve capacity.

Conventional designs

Rolls-Royce conventional beam-style pipeline compressors are available with either overhung- or beam-style rotors. The single-stage, overhung design has high aerodynamic efficiency and wide speed and flow capabilities. Its construction provides easy access for maintenance and eliminates balance seal leakage. The beam style design offers high head capability through the use of multiple impellers and minimizes parasitic losses and starting torque requirements.

Impellers are designed for maximum aerodynamic efficiency and constructed of high-strength, forged alloy steel. Blades are milled out of the heavy hub forging and all impellers are fully shrouded and welded. Impellers are followed by a vaned or vaneless diffuser and a carefully-matched cast volute. On most frame sizes, movable inlet guide vanes are available for increased flexibility with fixed- or variable-speed drivers. Special materials are available for corrosive applications.

Standard casings are cast to offer generous flow passages and a near-spherical shape for compactness, high strength and top performance. Main flanges are horizontally opposed to neutralize pipe forces and movements. Shear ring segments or bolts retain the main cover. Magnetic bearings are available as an option.

Impellers are tested to 115 percent of maximum design speed, while casings are hydrostatically tested to 150 percent of design working pressure.

Model	RFBB20	RFA24	RFBB30	RFBB36	RFA36	RFBB42
Maximum working pressure, psig (barg)	2,000 (140)	2,000 (140)	3,220 (222)	2,250 (155)	1,800 (125)	1,500 (105)
Max flange size, inches (mm)	20 (510)	24 (610)	30 (760)	36 (910)	36 (910)	42 (1,070)
Number of stages	1-4	1	1-5	1-5	1	1-5
Maximum power, BHP (kW)	20,000 (14,900)	20,000 (14,900)	75,000 (56,000)	75,000 (56,000)	50,000 (37,300)	75,000 (56,000)
Design speed range, rpm	9,000-13,800	9,000-13,800	3,600-8,000	3,600-6,666	3,600-9,500	3,600-6,666
Impeller diameter, inches (mm)	10-26 (250-660)	12-26 (305-660)	20-35 (508-889)	24-51 (610-1,295)	24-51 (610-1,295)	24-51 (610-1,295)
Max design inlet flow, acfm (m ³ /h)	12,720 (21,600)	25,300 (43,000)	30,800 (52,300)	45,400 (77,100)	60,500 (102,800)	62,800 (106,500)

NOTE: Specifications given in this brochure are subject to change without notice.

Multi-stage barrel compressors

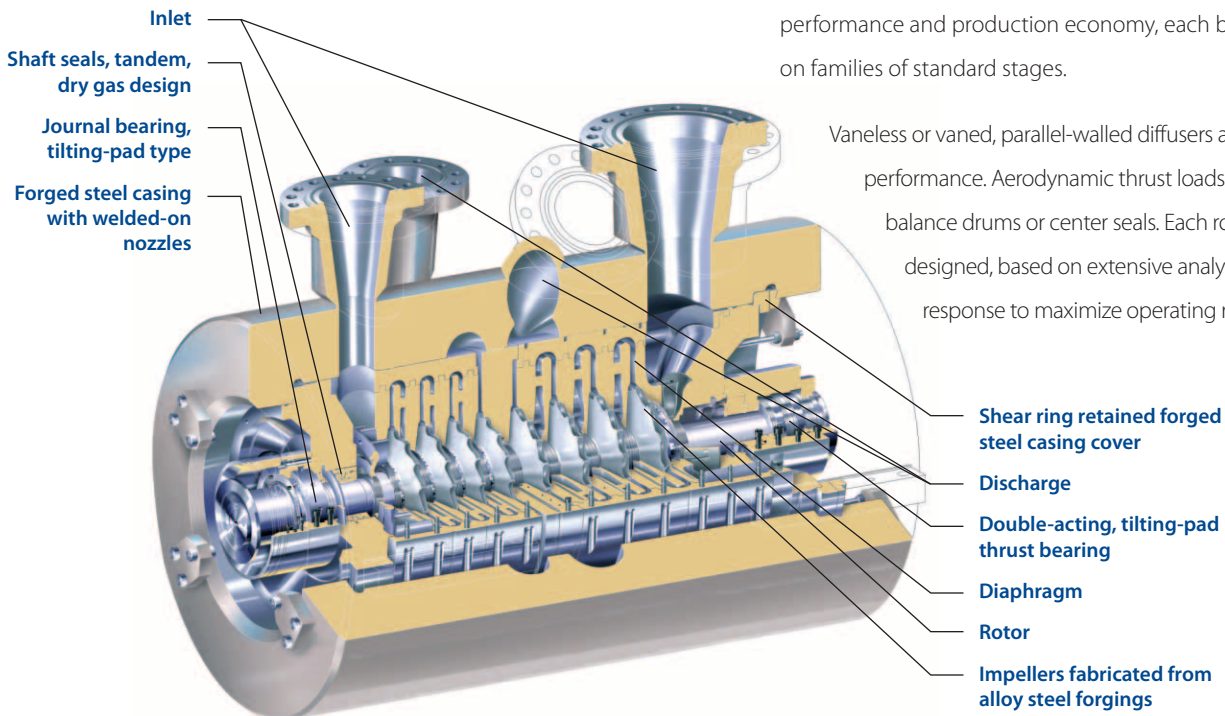
Rolls-Royce barrel compressors are available in four frame sizes with up to nine compression stages. Standard configurations are available up to 4,500 psig (310 barg) maximum working pressures and up to 35,000 acfm (60,300 m³/h) flows. Power ratings up to 75,000 hp (56,000 kW) at design speeds from 3,500 to 13,800 rpm.

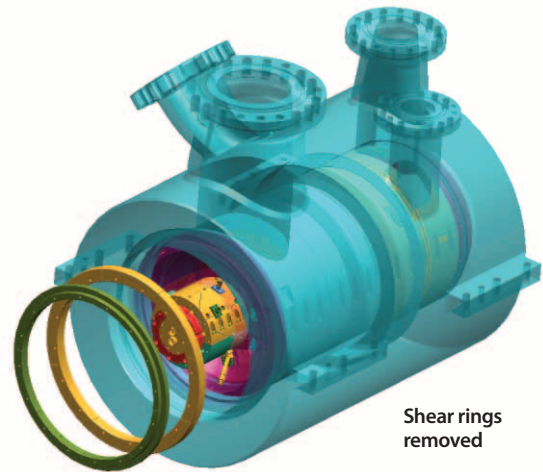
Applications

Rolls-Royce centrifugal barrel compressors are found in a variety of natural gas compression applications. Installations range from single units to multiple-unit trains, driven by gas turbines or electric motors. Complete systems for onshore or offshore service are designed, manufactured, tested, installed and supported by Rolls-Royce.

Each compression project is analyzed to select the most aerodynamically flexible and efficient frame and rotor combination. For optimum performance and production economy, each barrel frame size is based on families of standard stages.

Vaneless or vaned, parallel-walled diffusers are used for maximum performance. Aerodynamic thrust loads are compensated by balance drums or center seals. Each rotor system is custom-designed, based on extensive analyses of lateral and torsional response to maximize operating reliability.





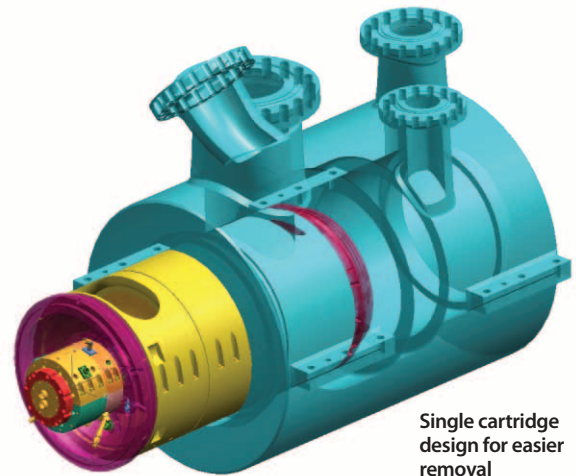
Shear rings removed

Casings are forged with welded-on nozzles. For ease of maintenance, the new configuration joins the end covers, aerodynamic and rotor assemblies, as well as the bearings and seals into a single cartridge that can be installed and withdrawn as one piece. The cartridge is retained in the casing using segmented shear rings to avoid the need for hydraulic torquing equipment. It is estimated that a full cartridge change-out can be accomplished in less than 24 hours.

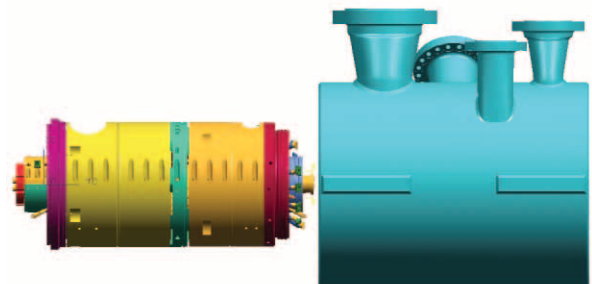
Shaft seals are available as tandem dry gas type or wet film bushing seals. The dry gas seal designs include buffered barrier seals to prevent their contamination by lube oil.

Journal and thrust bearings, with horizontally split housings to improve maintainability, are of a tilting-pad type with renewable pads and collars. All thrust bearings accept equal thrust loading in either direction and are self-leveling.

Impellers are tested to 115 percent of maximum design speed, while casings are hydrostatically tested to 150 percent of design working pressure.



Single cartridge design for easier removal



Cartridge removed

Model	RBB	RCB	RDB	REB
Maximum working pressure, psig (barg)	4,500 (310)	3,220 (222)	2,000 (140)	1,200 (85)
Max inlet flange size, inches (mm)	16 (405)	20 (508)	24 (610)	30 (762)
Max discharge flange size, inches (mm)	12 (305)	16 (406)	20 (508)	20 (508)
Number of stages	1-9	1-9	1-9	1-9
Maximum power, BHP (kW)	35,000 (26,100)	50,000 (37,300)	60,000 (44,700)	75,000 (56,000)
Design speed range, rpm	8,000-13,800	5,000-11,500	4,500-8,500	3,500-6,500
Impeller diameter, inches (mm)	12-17 (305-432)	18-22 (458-560)	24-28(610-711)	28-34 (711-863)
Max design inlet flow, acfm (m ³ /h)	6,000 (10,200)	13,500 (23,000)	22,000 (37,000)	35,500 (60,300)

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Package equipment

Centrifugal compressors engineered to suit gas and steam turbines, and fixed- or variable-speed electric motors

Rolls-Royce works with our customers from project planning and manufacturing to installation and service. Our comprehensive compressor systems include drivers, package components, baseplates, speed increasers and oil consoles.

Lube and Seal Oil/Seal Gas Systems

Rolls-Royce generally provides lube and seal gas systems on all units. Seal oil instead of dry gas seal systems are also available. The systems include pumps, motors, coolers, filters and instrumentation selected to provide and monitor the required oil flow pressures. The lube oil and gas seal systems are in general compliance to API 614.

Controls

Complete microprocessor-based control systems are provided for individual units, multiple units and station control.

Our quality standards are exemplified by our ISO 9001 certification. Factory testing includes a full closed-loop system simulation that tests the operation of the hardware and the software for functionality and dynamic response.

Control systems include:

- Integrated control of gas turbine or motor driven compressor packages
- Complete unit sequencing of the driver, accessories and compressor
- Complete unit monitoring and protection
- Equipment Health Management
- Compressor surge protection
- Compressor load sharing
- Compressor suction or discharge control
- Data communication
- Interface with DCS systems
- Installation supervision, commissioning and training

Training programs are available that instruct users on the operation of their control systems and provide insight into how the controls interact with the mechanical equipment and process. Control systems are supported by a global Technical Support and Field Service organization.

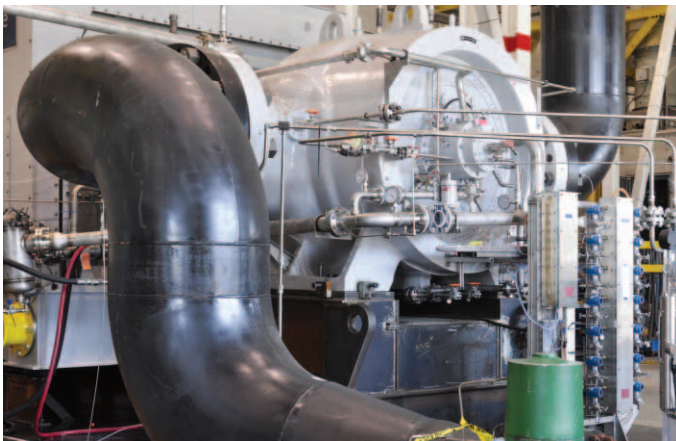


Controls are designed specifically for the demanding requirements of energy producers

Worldwide manufacturing, testing and sourcing

Centrifugal compressors manufactured by Rolls-Royce are tested and packaged at its Mount Vernon, Ohio facility.

Impellers undergo fabrication and heat treatment to provide high durability and strength. A milled, two-piece construction is used on all impeller designs.



String test performed on RFBB36

All critical components and the assembled unit receive thorough testing during and after manufacture. Impellers are balanced, then over-speed tested at 115 percent of maximum operating speed. Casings are tested for leaks, strength and design integrity in compliance to API 617.

Aerodynamic performance is proven through open- or closed-loop testing to confirm achievement of the contract efficiency, head and flow of the compressor at specified design and operating points. Full-load and full-pressure Type 1 and Type 2 testing to ASME PTC 10 standards is also available.

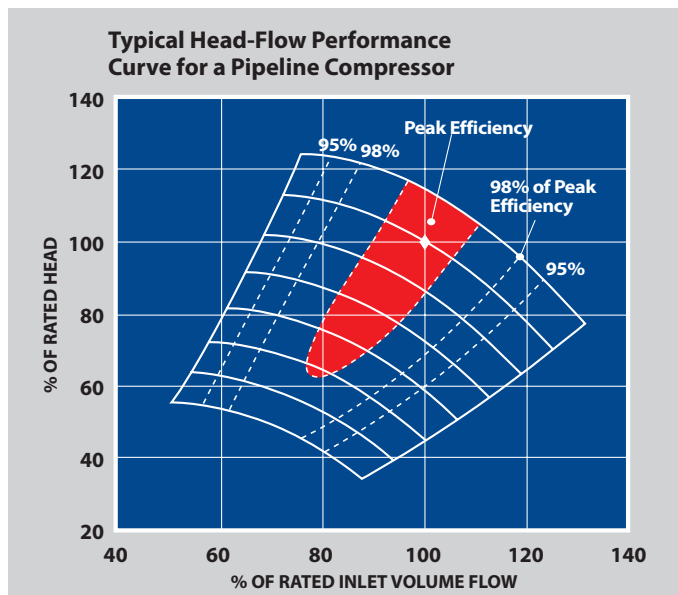
The finished unit receives a final mechanical running test that includes a check of oil flows and vibration levels throughout the specified speed range. A static gas seal test confirms that all components will satisfactorily contain gas at the system's rated pressure.



Customer service and aftermarket support

Capabilities

Our customer service organization is built on the long-term commitment of Rolls-Royce to the successful operation and maintenance of customer power and compression equipment. With experienced field representatives and service centers worldwide, Rolls-Royce provides the technical support for unit commissioning and operation, as well as repair services, including contract maintenance.



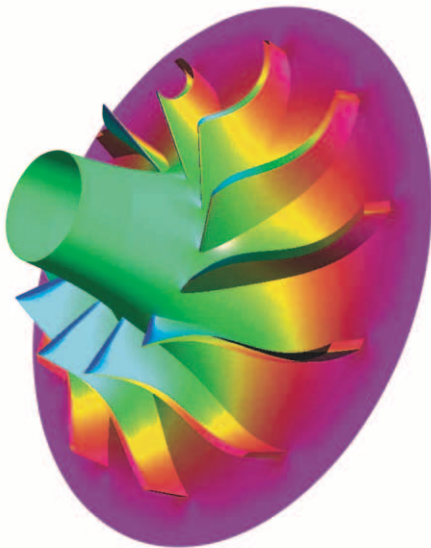
Our genuine OEM replacement parts inventory and special diagnostic equipment keep our centrifugal compressors operating at top performance regardless of the application. An example of the Rolls-Royce commitment to providing complete life-cycle solutions is compressor "re-aero" services.

Re-Aero Services

Rolls-Royce compressor components are custom selected/ designed to provide optimum performance at specific operating and site conditions. Often field conditions change over time. Even slight process condition changes may require an existing compressor to operate far enough from the original design point to warrant a new compressor aero design or upgraded components. For example, a small decrease in compressor efficiency can result in excessive fuel costs. Also, re-aero of an existing unit offers the opportunity to incorporate the latest aero design advancements for improved performance and efficiencies throughout the operating range. The Rolls-Royce Customer Service Support staff will expertly evaluate your current compressor operating conditions and help identify opportunities to enhance efficiency. With the expertise to rebuild or replace the compressor aero components to restore maximum efficiency levels, Rolls-Royce can extend the life of your equipment investment far into the future.

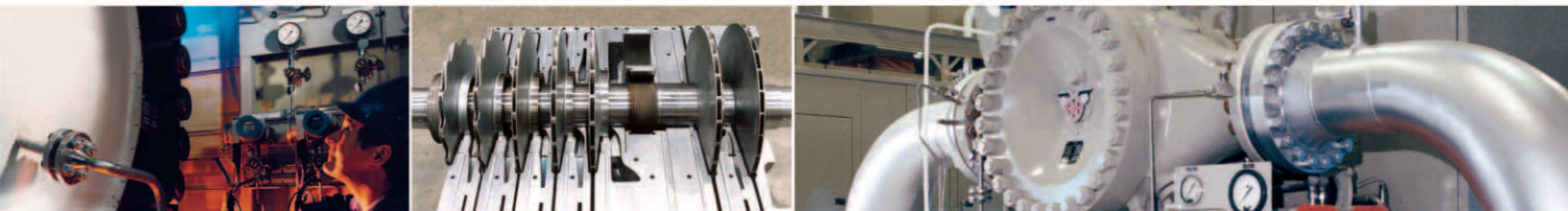
Experience combined with technology

The advancements of our centrifugal compressors come from more than 65 years of aerodynamic and mechanical design derived in part from our rich heritage of designing, manufacturing and servicing compressors under the Cooper-Bessemer® brand name. This legacy is now combined with the expertise behind the world's most respected name in engineering: Rolls-Royce.



State-of-the-art computer analysis continues to enhance efficiencies and long-term product integrity:

- Three-dimensional finite element analyses for stress optimization of casings, impellers, thrust balance drums and diaphragms.
- Lateral rotor dynamic programs, analyze rotor response and stability.
- Forced and unforced torsional programs analyze the complete driver and driven systems.
- Fluid dynamic programs accurately predict compressor performance under specified operating conditions and gas mixtures.
- Three-dimensional CAD/CAM systems and CFD analysis aid the optimization and refinement of compressor aerodynamic designs while reducing lead times.





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