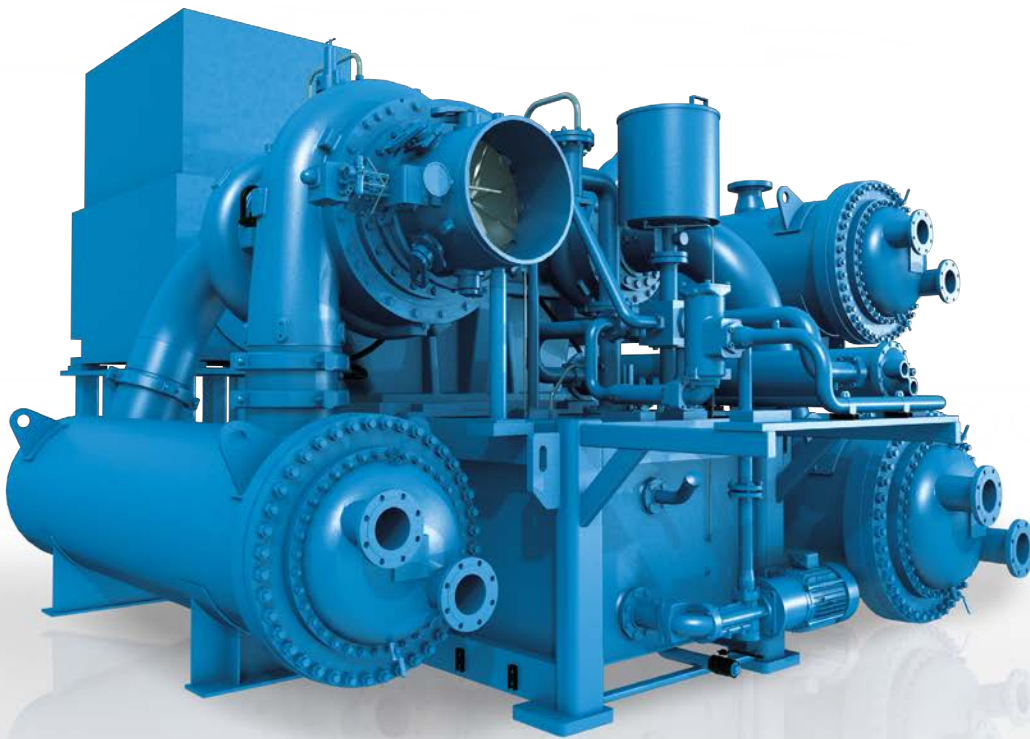




PAP PLUS

ENGINEERED AIR COMPRESSORS

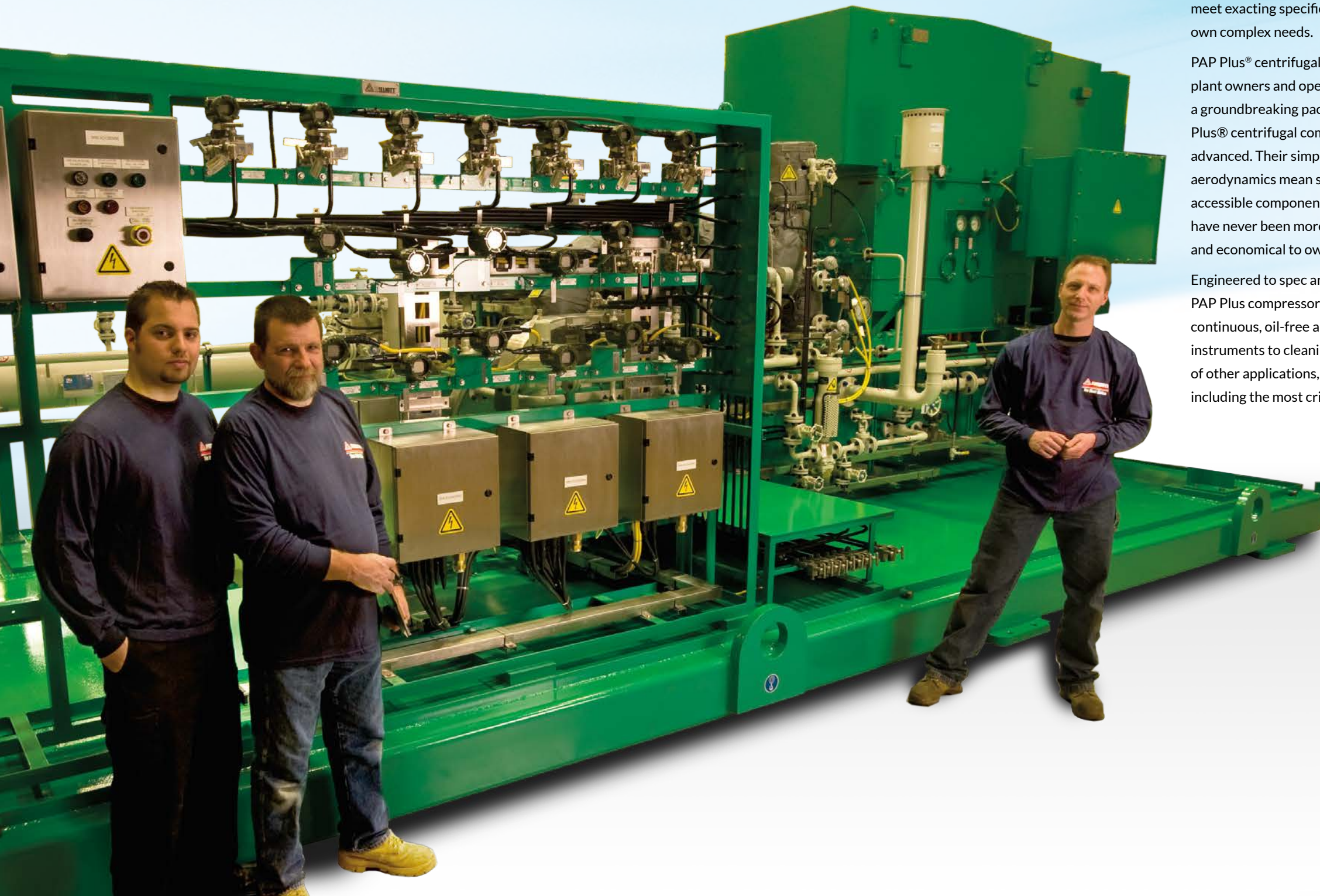


Meeting Critical Needs

Air compression plays a vital role for processes across a range of industries and is particularly critical in oil and gas, refining, and chemical/petrochemical applications. Compressor designs must meet exacting specifications—from API 672 standards to end users' own complex needs.

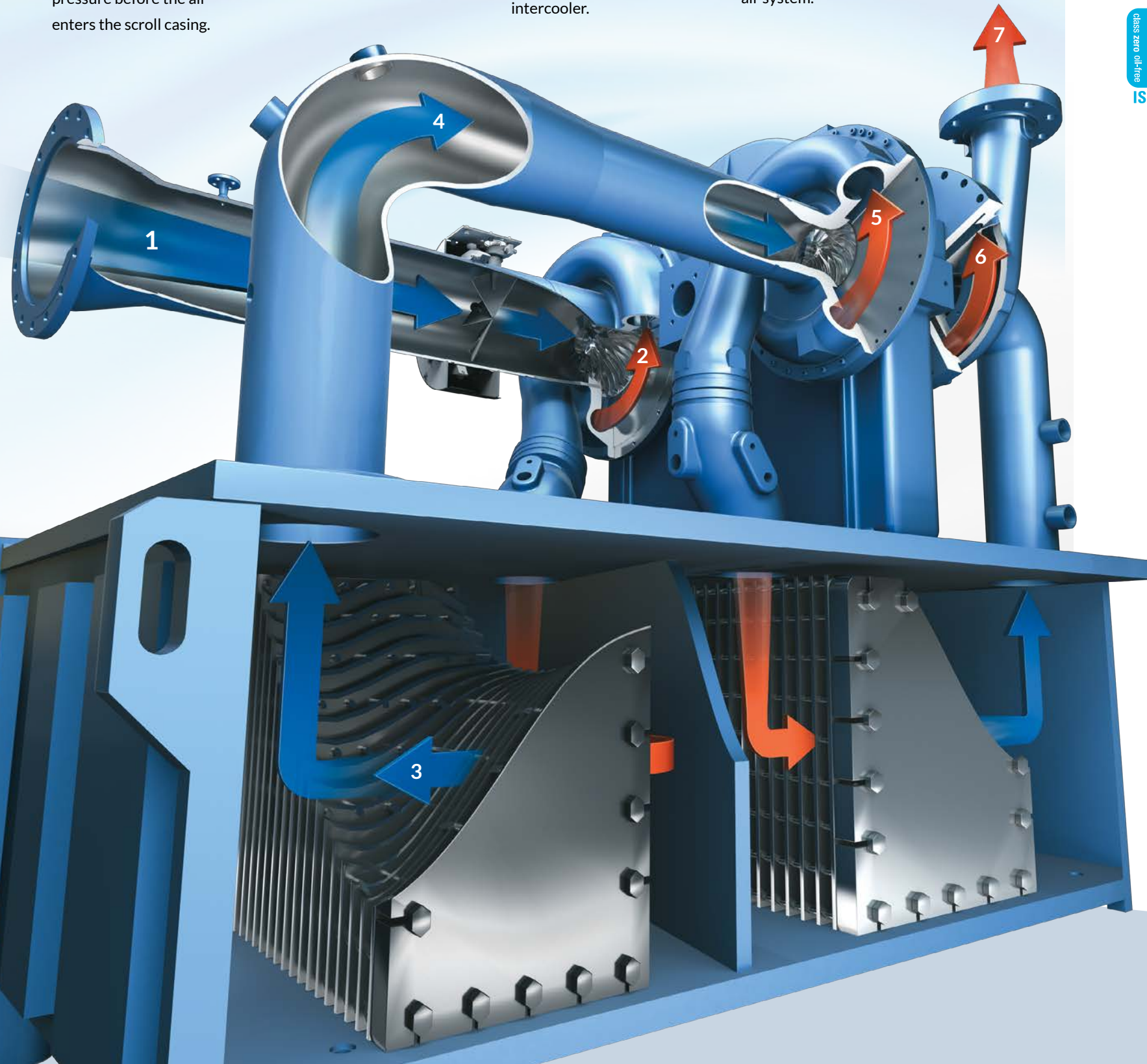
PAP Plus® centrifugal compressors have been the first choice of plant owners and operators for more than 50 years. Building on a groundbreaking package design (the first in the industry), PAP Plus® centrifugal compressors are both ruggedly simple and highly advanced. Their simplicity means exceptional reliability. Advanced aerodynamics mean stellar performance. And their uniquely accessible components mean inspection, maintenance, and service have never been more efficient or less disruptive, making them easy and economical to own.

Engineered to spec and built to last, thousands of custom-designed PAP Plus compressors are on the job worldwide providing continuous, oil-free air. From providing process air and powering instruments to cleaning pipes to driving pneumatic tools to dozens of other applications, you can count on them to meet critical needs, including the most critical of all—yours.



Compression Flow Process

- 1** Ambient air enters the first stage through the inlet control device.
- 2** The first-stage impeller accelerates the air. A radial diffuser converts the air's velocity into pressure before the air enters the scroll casing.
- 3** The air is conducted through interstage piping into the first intercooler.
- 4** The cooled air then flows into the second-stage inlet piping.
- 5** The compression process is repeated as the air passes through the second stage impeller, diffuser, and scroll casing and then into the second intercooler.
- 6** Air from the second intercooler moves through a third impeller, diffuser, and scroll casing.
- 7** Air is discharged into the aftercooler and air system.



Simply Superior



Machinery doesn't have to be complex to be effective. PAP Plus compressors are built on a simple, centrifugal design that delivers superior reliability and performance. The only moving parts are the bull gear and the rotors. With no lubricated parts in the air passages, the airstream is oil-free.

Intercoolers Minimize Power Loss

Effective intercoolers are a key to compressor operating performance and energy efficiency. All FS-Elliott packaged air compressors feature compact, highly efficient heat exchangers that provide minimum pressure loss, high heat-transfer efficiency, and fast and simple cleaning of the straight-through tube bundles. Phenolic (fluoropolymer) coatings are also available for extreme duty applications.

For a detailed animation of this compressor, visit us online:

WWW.FS-ELLIOTT.COM

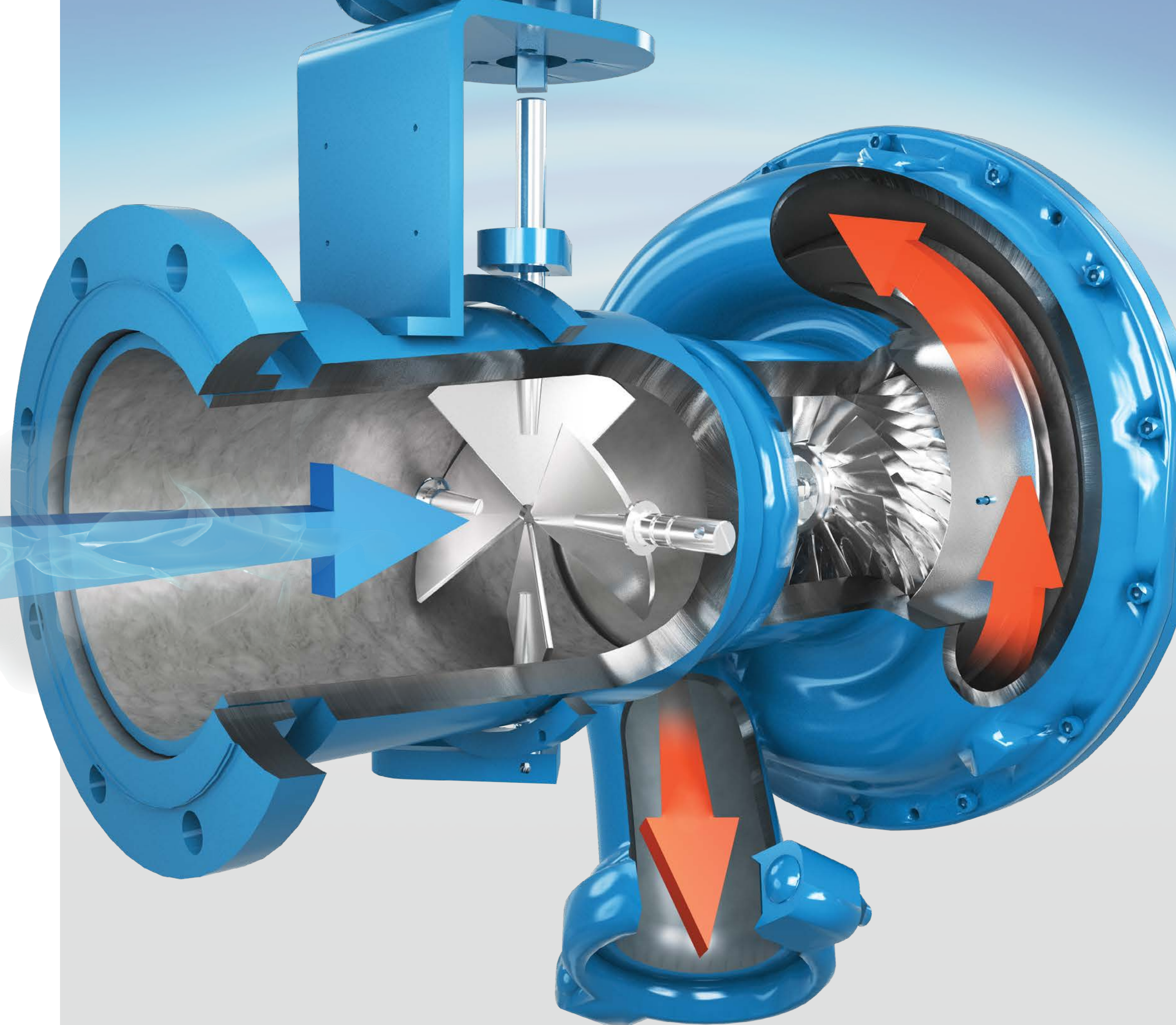
Design

Impeller, diffuser, and scroll designs are uniquely sized to meet your specific needs in order to provide peak efficiency and large operating ranges. Superior impeller designs feature optimum blade loading and shroud profiling for your required performance level, which minimizes skin friction, incidence, recirculation, and other loss mechanisms inherent in impeller performance.

FS-Elliott engineers use the latest engineering design software to improve aerodynamic performance and enhance product design. Computational Fluid Dynamics (CFD) is used to perform complex flow analysis of aerodynamic components to increase stage efficiencies and optimize compressor performance.

Adjustable Inlet Guide Vane

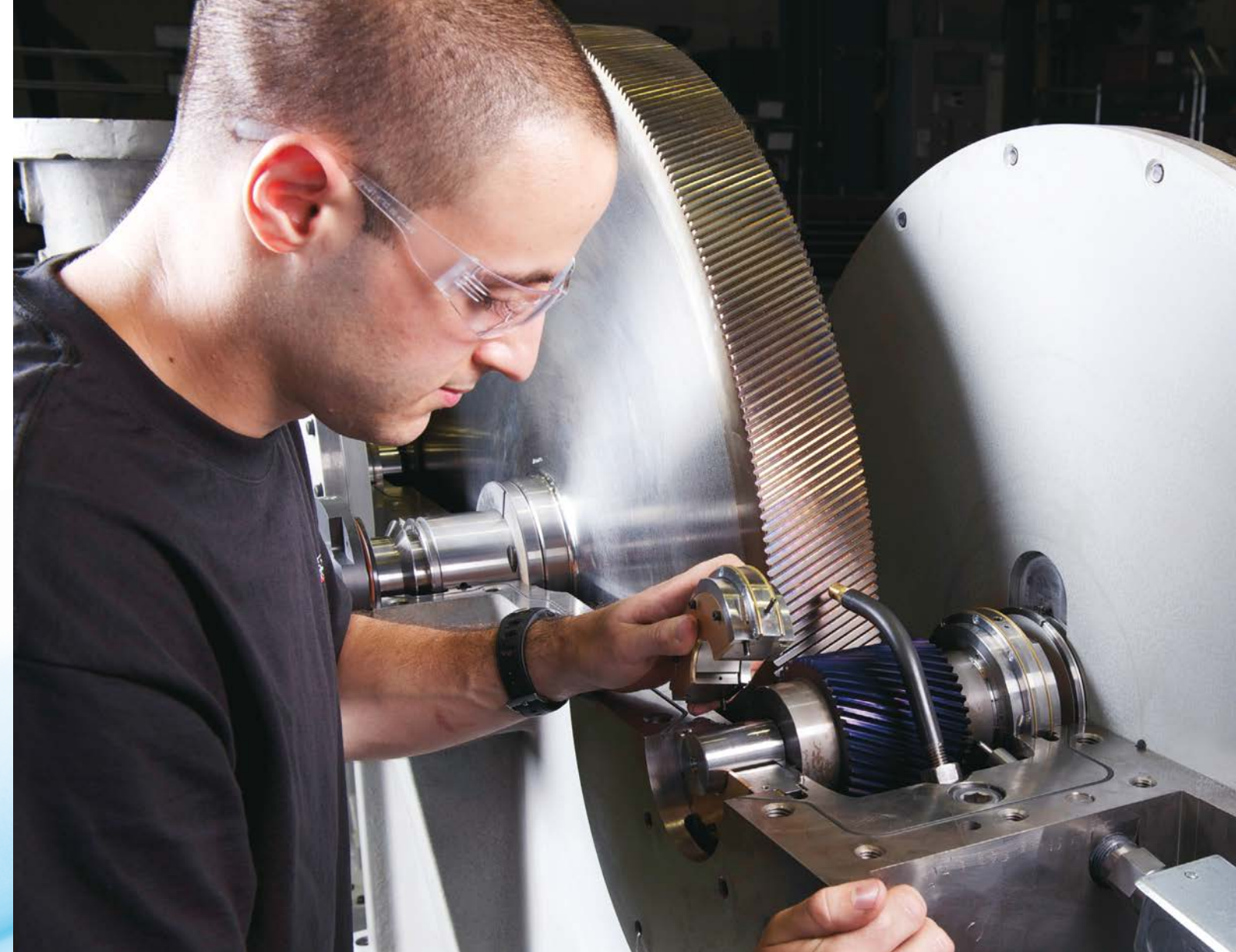
Adjustable inlet guide vanes control inlet flow to save energy. The guide vanes are automatically positioned in response to ambient air and system demand changes. They reduce the flow through the compressor by imparting a pre-swirl to the incoming airstream. This pre-swirl controls the work of the first stage impeller, adjusting the power and throughput to match system demand. By controlling the amount of air being compressed (and consequently the power consumed), the inlet guide vane efficiently adjusts to plant conditions and load variations to conserve energy.



Accessibility & Maintenance

The gearing, intercoolers, aerodynamic parts, lubrication system, and control system are all independently accessible. Maintenance of any one of these items does not require disassembling other components or exchanging large assemblies. Unlike other compressors, the unique PAP Plus horizontally split design was meticulously designed to provide quick and easy local maintenance. Components do not need to be sent back to the factory. Compare this time-efficient procedure with other compressor designs that require days to perform the same tasks.

In fact, a complete maintenance operation, including removing the gearcase cover, inspecting gears, bearings, and seals, and reassembly, can be accomplished within 3 to 8 hours, depending on the specific site situation. This procedure can be done without disturbing impellers, diffusers, air or water piping, or other components. Simply lift the cover to expose these components.



Bolts are easily accessible to remove the gearcase cover. The cover lifts off easily, exposing gears, bearings and seals without removing any other components. The top half of the bearing comes off by removing two screws.



The bottom half can be rolled out and removed from the casing for inspection. The two-piece seal assembly can be removed by sliding it into the bearing cavity area, allowing the bearing to be removed following the above procedure.



Seal and Bearing Inspection Time Comparison

Overall, PAP Plus owners spend significantly less time and effort on maintenance.

Inspection Procedure	Horizontally Split Centrifugal Compressor		Vertically Split Centrifugal Compressor	Screw Compressor
	PAP Plus	Brand "X"		
Remove Inlet Piping, Valve & Filter	Not Required	¾ hour	1 hour	Not Permitted Voids Warranty
Remove Interstage Piping	Not Required	½ hour	Not Required	
Remove Oil Piping to Bearings	Not Required	¾ hour	Not Required	
Remove Main Oil Pump	Not Required	¾ hour	Not Required	
Disconnect Main Drive Coupling	Not Required	¾ hour	Not Required	
Open Intercooler Casing	Not Required	Not Required	3 hours	
Remove Intercooler Bundles	Not Required	Not Required	4 hours	
Remove Impellers	Not Required	Not Possible	4 hours	
Remove Gearcase Cover	½ hour	½ hour	Not Required	
Pull Bullgear	Not Required	½ hour	Not Required	
Remove Bearing Assemblies	½ hour	Not Possible	2 hours	
Remove Shaft Seal Assemblies	½ hour	Not Possible	1 hour	
Remove Casing & Diffusers	Not Required	1½ hours	Not Required	
Remove Complete Rotor Assemblies with Bearing Attached	Not Required	1 hour, Return Rotor Assemblies with Bearings Attached to OEM to Maintain Warranty	Not Required	
Reverse Above Operations	1½ hours	5½ hours	15 hours	
Total	3 hours	11 hours + Weeks for OEM to Return Rotor Assemblies and New Bearings	30 hours	

Customization Expertise

FS-Elliott's engineering staff has the depth and know-how to meet any requirement—from the simplest to the most complex. Our base designs have the reputation as the most rugged, reliable packages for API 672 applications. These packages can be customized to

accommodate rigid customer specifications and special operating parameters. Here are a few examples of the custom work we're known for around the world.



Installed in an Asian oil refinery, this engineered air system is used in the production of clean fuels. The compressor package inlet air flow is 2,585 cfm (4,390 m³/hr). The end product for this refinery upgrade project is unleaded gasoline.

This special package design features interstage cooling and packaged aftercooler provided in accordance with TEMA C design requirements, and is engineered with special materials to allow for an aggressive seawater cooling medium. This compressor system provides air flow at 5,000 cfm (8,495 m³/hr) for two separate critical applications at an oil refinery in the Middle East.



This engineered air, 2,670 cfm (4,540 m³/hr) system was designed for a Middle East oil refinery. This air package design was based on API 672 plus comprehensive EPC and end user specifications. This compression unit is applied for the production of unleaded/low-sulfur gasoline.

Exceptional Reliability

PAP Plus compressors combine more than 50 years of operational and design experience in an extremely rugged and reliable package. These quality-built packages are routinely required to operate uninterrupted for up to three years while maximizing efficiencies and minimizing unplanned downtime.



1 Carbon Ring Shaft Seal

- Technology the result of years of operational experience. The horizontally split design assures ease of maintenance and oil-free operation.

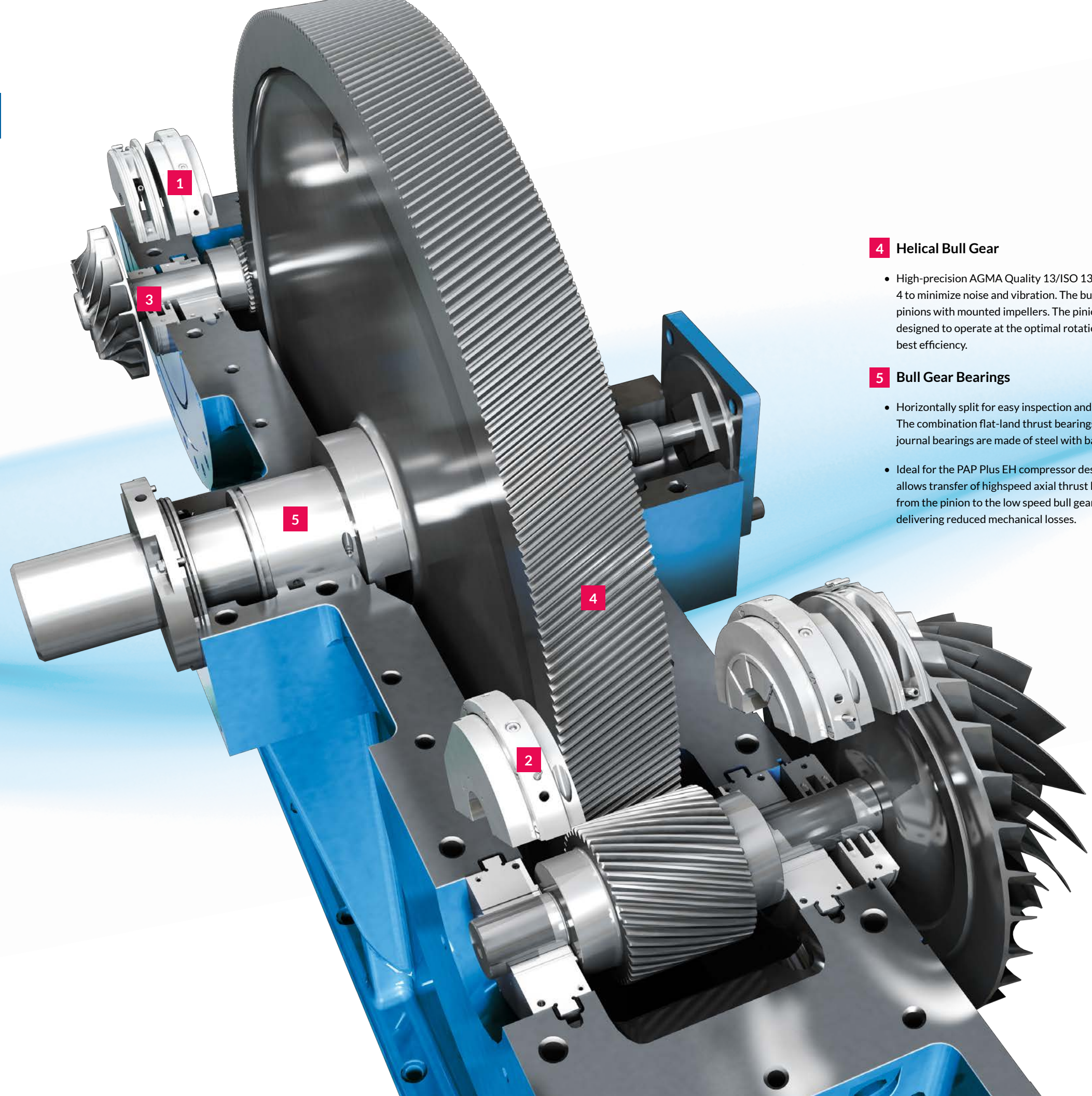


2 Self-Centering, Horizontally Split Tilt or Flex Pad Journal Bearings

- Support rotors for the best stability through the entire operating range of loads and temperatures. Optional instrumented bearings are available.

3 Pinion and Impeller Assemblies

- Composed of a rotor supported by two self-centering tilt or flex pad journal bearings. A shaft seal located at each impeller seals oil in the gearbox and out of the compression chamber. The rotor's extremely short shaft lengths mean that centrifugal forces are not amplified through a long lever arm.



4 Helical Bull Gear

- High-precision AGMA Quality 13/ISO 1328.2 Grade 4 to minimize noise and vibration. The bull gear drives pinions with mounted impellers. The pinion shafts are designed to operate at the optimal rotational speed for best efficiency.

5 Bull Gear Bearings

- Horizontally split for easy inspection and maintenance. The combination flat-land thrust bearings and sleeve journal bearings are made of steel with babbitt lining.
- Ideal for the PAP Plus EH compressor design and allows transfer of highspeed axial thrust loads from the pinion to the low speed bull gear bearings, delivering reduced mechanical losses.

Basic Packages

AIR SYSTEM

1 Inlet Guide Vane

- Variable inlet guide vanes redirect air flow to maximize aerodynamic efficiencies and lower power consumption
- Available SMART positioners quickly and accurately position vanes for precise control

2 Airend

- Horizontally split gearcase allows quick access to rotor assemblies and internal gearing without distributing air piping
- Split bearings and seals allow field replacement without removing and re-balancing rotor assemblies
- Available embedded bearing RTD's provide accurate and reliable temperature monitoring of compressor bearings
- Additional vibration monitoring sensors enable critical feedback for long-term machinery protection and diagnostic intervention

3 Intercooler/Aftercooler

- Internally mounted intercooler bundles for effective interstage air-cooling and heat transfer and compact installation footprint
- Available material upgrades to mitigate the most aggressive jobsite environments
- Available package mounted aftercooler allows for reduced installation costs

LUBRICATION SYSTEM

4 Oil Filters

- Dual stainless steel body oil filters
- Integral transfer valve allows for seamless filter changeover during normal operation

- Valved vents and drains prevent contamination during draining of off-line oil filter housing

5 Oil Pumps (MOP/AOP)

- Both main and auxiliary oil pumps meet 100% capacity requirements
- Ensures sufficient oil supply in the case of main pump failure

6 Oil Cooler

- Shell & Tube type heat exchanger with 3/8" admiralty tubes and naval rolled brass tube sheets
- Allows for efficient cooling of highly aggressive water types

7 POWER GENERATION

Main Driver (Motor or Turbine)

- Electric main driver motor (IEC or NEMA) specified API 541 or API 547
- Available API 611 or 612 steam turbine

8 Main Drive Coupling

- Flexible disc type coupling excellent for high-speed/high-torque loads
- High reliability and maintenance free

9 CONTROL PANEL

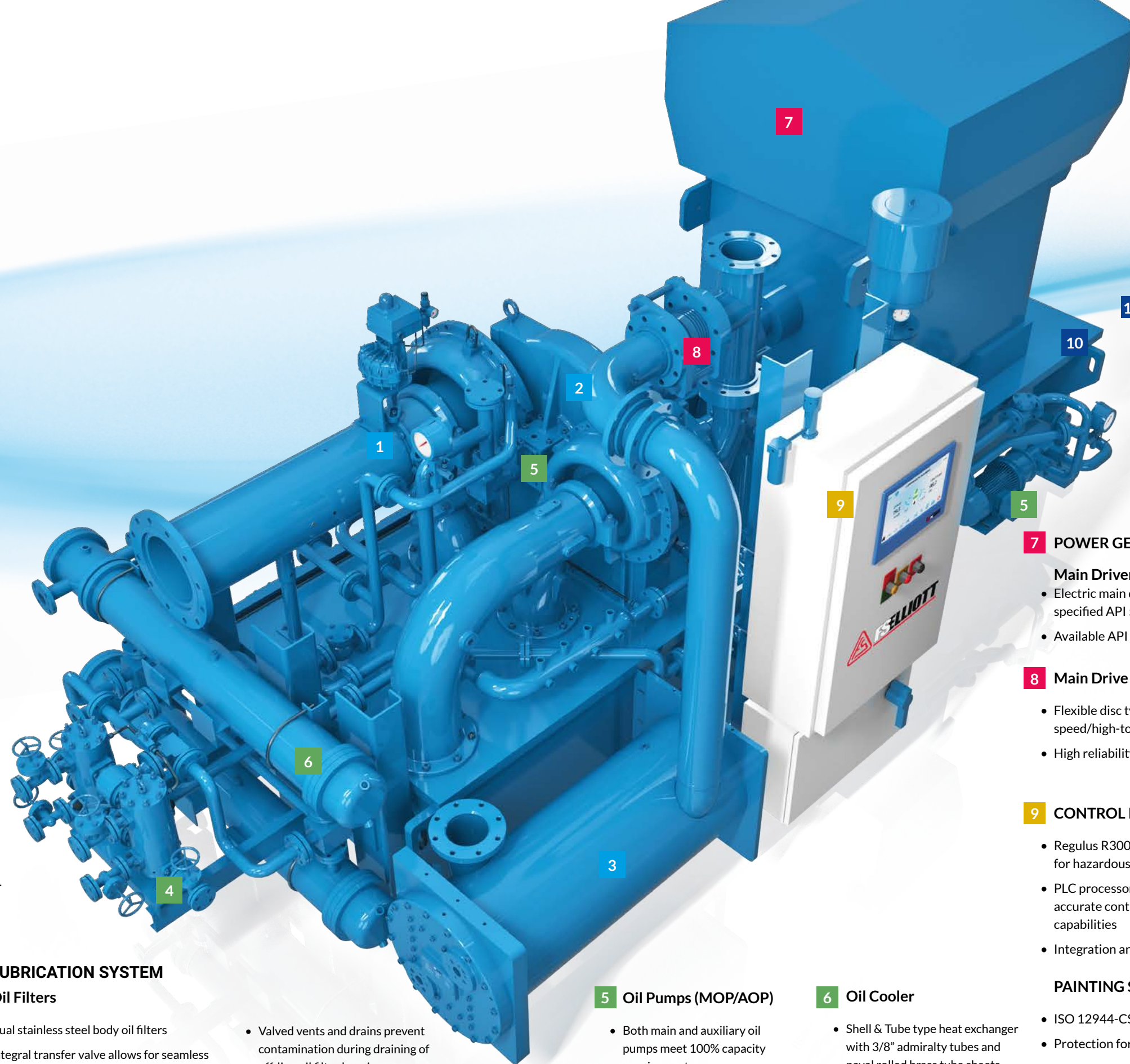
- Regulus R300 control panel meets requirements for hazardous locations
- PLC processor based R300 allows for more accurate control and advanced diagnostic capabilities
- Integration and communication with plant DCS

PAINTING SYSTEM

- ISO 12944-CSM
- Protection for harsh environments

10 OIL RESERVOIR

- Standard five-minute retention time
- Sufficient oil volume to keep running in case of failure, preventing damage
- Stainless steel material upgrade available



Control Systems

At the heart of every PAP Plus compressor is the Regulus® Control System. A touch of the screen lets you control and manage the performance of one or multiple compressors, at the unit or remotely, to meet air demands while maximizing energy savings. An extensive array of optional features is available to accommodate any site

Regulus Control Systems

Superior pressure control capability and the flexibility to meet even the most complex system requirements set Regulus Control Systems apart. By eliminating excessive air blow-offs to the atmosphere while efficiently responding to the facility's changing air demands, Regulus empowers operators to master one of their plant's highest operating expenses—energy costs. And because the Regulus product line and customization options are the broadest in the centrifugal compressor marketplace, FS-Elliott engineers can assist you in designing a solution tailor-made for your needs.



R200 Control System

The R200 model includes an enhanced PLC and is packaged with control and monitoring features that are considered optional on comparable systems. Its larger memory provides for advanced trending and diagnostics while still maintaining the cost benefits of a standardized design.



R300 Control System

The R300 model is packaged with many standard features and available options that make it easily adaptable to a wide variety of applications. It is ideal for situations that call for increased analog and digital input and output requirements.



R400 Control System

The R400 model is the control system of choice for those applications requiring the highest level of customization. Tailor the enclosure, hardware, control mode, communication package, and indication, alarm and trip functions to fit your needs. Redundancy is available for the central processing unit, power supply, and input/output modules to allow continuous operation at all times.

Energy Savings

- Multiple compressor unit energy management capabilities
- Precise air system pressure control maximizes turndown capability and energy savings
- Advanced adaptive controller saves energy by permitting protected operation closer to actual surge
- Innovative adjustable inlet guide vane design maximizes efficiency at off-design operations
- Suction Throttle and Auto-Dual control modes add operational flexibility and efficiency

Operating Simplicity

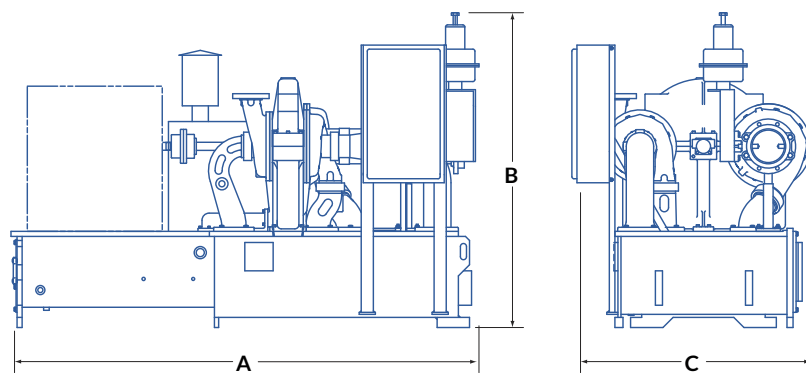
- All control set points are accessible from one interface
- Numerous language display capabilities
- Multiple choices of communication protocols with interfacing systems
- Supervisory capabilities include monitoring the entire air system from one location
- One-touch, instantaneous data storage and historical trend viewing enables detailed operating analysis and the ability to identify and avert potential problems
- Compressor can run virtually unattended at optimum efficiency through various plant air demand conditions

Weights, Dimensions & Ranges

PAP Plus compressors combine more than 50 years of operational and design experience in a highly robust, uniquely easy-to-maintain package. Our customers enjoy lower cost of ownership and absolute reliability from PAP Plus models ranging from 25 to 695 m³/min (900 to 24,500 cfm) and 185 to 4,475 kW (250 to 6,000 HP).

PAP Plus Compressor Frame	Overall Dimensions						Approximate Weight*	
	A*		B*		C*		lb.	kg
	in.	mm	in.	mm	in.	mm		
S1	124	3150	61	1549	81	2057	9500	4309
A1	124	3150	61	1549	81	2057	14000	6350
BH	174	4420	75	1905	96	2438	27000	12245
CH	195	4953	152	3861	120	3048	38000	17235
DH	252	6401	134	3404	153	3886	70000	31750
EH	280	7112	192	4877	242	6147	120000	54431

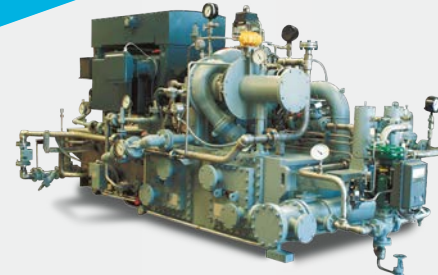
* Value may vary with motor rating and type



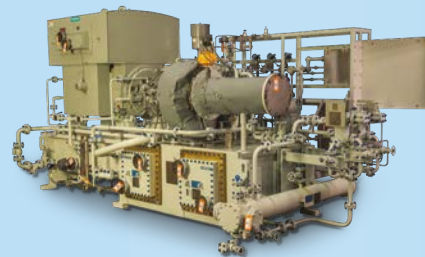
Discharge Pressure:
40 to 450 psig/2.75 to 31 barg
 Performance may vary based on actual site conditions. Consult your authorized FS-Elliott distributor for more information.



S1



A1



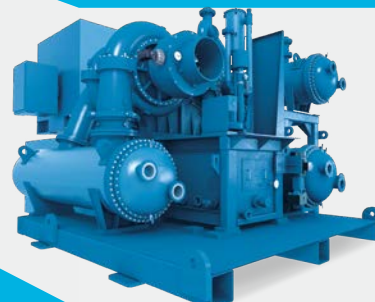
BH



CH



DH



EH

25 m³/min / 900 CFM
 185 kW / 250 HP

60 m³/min / 2200 CFM
 335 kW / 450 HP

45 m³/min / 1500 CFM
 260 kW / 350 HP

100 m³/min / 3400 CFM
 520 kW / 700 HP

100 m³/min / 3500 CFM
 595 kW / 800 HP

195 m³/min / 6900 CFM
 930 kW / 1250 HP

155 m³/min / 5500 CFM
 745 kW / 1000 HP

310 m³/min / 11000 CFM
 1490 kW / 2000 HP

285 m³/min / 10000 CFM
 1490 kW / 2000 HP

525 m³/min / 18500 CFM
 4100 kW / 5500 HP

425 m³/min / 15000 CFM
 1190 kW / 1600 HP

695 m³/min / 24500 CFM
 4475 kW / 6000 HP



Quality Commitment

Quality Systems

We take nothing for granted at our manufacturing facility and headquarters located in Export, PA. Every PAP Plus compressor is carefully crafted under our stringent quality program and accompanying standards. By the time your compressor arrives at your site for installation, it has undergone a rigorous execution process encompassing marketing, sales, engineering, manufacturing, inspection, and testing. The entire process is governed by our ISO 9001 Certified Quality Management System. This quality process also assures that our suppliers are qualified and continuously monitored to the same high standards we demand of ourselves.

Testing

To ensure our compressors stand up to your requirements, we make sure they stand up to ours. Every FS-Elliott compressor is rigorously tested in our ultra-modern test facility equipped with the most progressive test equipment, instrumentation, and control systems available. This 16,000 ft²/1,490 m² facility allows us to test three complete compressor units at once, using variable speed drives that provide 50 and 60 hertz capabilities up to 6,000 HP/4,475 kW and 6,600 volts. Wide-ranging resources allow us to accommodate project-specific testing requirements as well as mechanical testing in compliance with API 672 standards and performance testing in accordance with the ASME Power Test Code.

Technical Manual

Every FS-Elliott technical manual meticulously describes the installation, operation, and maintenance of our air compressor system. The information is the culmination of years of design and operational experience. Following the recommended procedures and guidelines will result in years of reliable operation. The manual includes:

- Technical drawings specific to each equipment package
- Drawings and literature of the major accessories
- Normal maintenance parts listings and spare parts interchangeability records
- Instructions for ordering replacement parts and obtaining service assistance and training for operators and maintenance personnel

Global Coverage, Local Support

FS-Elliott compressors are designed with field maintenance and service in mind, allowing your plant personnel to perform regular inspection and maintenance or choose to work with a local factory trained and certified distributor service team. Backed by over 50 years of centrifugal compressor expertise, our global network of personnel and facilities are ready to address your service needs quickly and professionally. From initial design and installation to timely upgrades in step with your evolving needs, we are committed to keeping your vital operations productive, optimized and reliable.



Efficient Installation and Start-Up

Working with our distributors, we tailor installation and start-up services to meet your needs. From providing quality assistance to your commissioning team to delivering total turnkey installation, we will help get your machine up and running quickly and efficiently.



Remote Technical Service

FS-Elliott and our global distribution network provide the first line of support with experienced engineers and technicians who are equipped to offer troubleshooting and operation/maintenance advice remotely.



Timely Accurate Repairs

Our compressors are designed for complete field servicing. FS-Elliott's factory authorized distributor service network is available to perform a variety of repairs at your facility from a simple oil change to a complete overhaul.



Essential Preventive Maintenance Made Easier

PAP Plus compressors include key features that ensure reliable operation over extended periods with minimal maintenance:

- Inherently low vibration
- No rubbing or direct wearing parts
- Optimum clearances between rotating and stationary parts
- No oscillating load
- Integrated package to simplify installation and ongoing use

Even with a reliable design, preventive maintenance is key to avoiding unexpected shutdowns and production interruptions. FS-Elliott and our distribution network will act as your preventive maintenance partners throughout the life of your machine.



Auxiliary Upgrades

FS-Elliott offers a range of control system upgrades and associated equipment upgrades, such as inlet guide vanes, to ensure the most efficient compressed air supply regardless of your system's age.



OEM Equipment Overhaul

The airend overhaul program will provide you with a completely revamped compressor core, refurbished back to OEM specifications.



Training

We offer a wide range of operator and maintenance training programs, including standard, self-contained packages and customized sessions to fit your needs. Training can be delivered at your facility or one of ours.



24/7/365 Parts and Service Availability

Our global service network offers round-the-clock emergency service 365-days a year. We also maintain an extensive inventory to give you immediate access to quality OEM service parts.



Extended Value Through Machinery Modernization (Upgrades/Rerates)

Rerating an existing compressor is an efficient option to meet the changing demands of your compressed air system. By implementing design innovations and upgrades to match current needs, you can improve reliability and reduce life-cycle costs.



Headquarters—Export, Pennsylvania, USA

Basingstoke, United Kingdom
Houston, Texas, USA
Jubail, Kingdom of Saudi Arabia
Kӧngen, Germany
Kuala Lumpur, Malaysia
Los Angeles, California, USA
Pune, India
Shanghai, China
Taipei, Taiwan
Tangerang, Indonesia

Building on a 50-year tradition of excellence in compressor design and manufacturing, FS-Elliott brings our customers the resources of a global industry leader along with the convenience and responsiveness of local sales and service. Thousands of reliable, hard-working FS-Elliott compressors are installed worldwide.

FS-Elliott Co., LLC

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Represented by:



ISO 9001- certified for the design and manufacture of centrifugal compressors.

FS-Elliott Co., LLC reserves the right to modify the design or construction of the equipment described in this brochure and to furnish it, as altered, without further reference to the illustrations or information contained herein.