DENAIR

RECIPROCATING PISTON GAS COMPRESSOR

Denair Company Introduction

Denair Energy Saving Technology (Shanghai) Co., Ltd. is a large-scale high-tech enterprise integrating R&D, manufacturing, direct sales and service. It was listed on the market in 2016 with stock code 870640. Adhering to the service orientation of high-end, energy-saving and direct sales, Denair is committed to providing comprehensive industrial gas solutions for global group users.

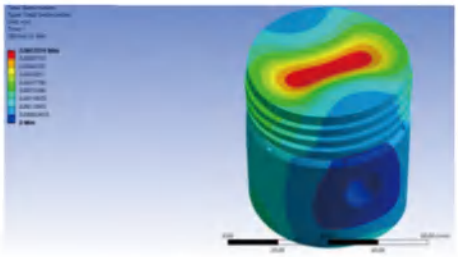
Relying on the science and technology, R&D center in Shanghai, China, Denair has always maintained a technical leading position in the global industrial gas field and continued to provide more energy-efficient industrial productivity for high-end industrial users around the world. The products cover five major industrial gas application fields, including centrifugal compressors, screw compressors, gas reciprocating piston compressors, diesel portable compressors, and air source heat pumps.

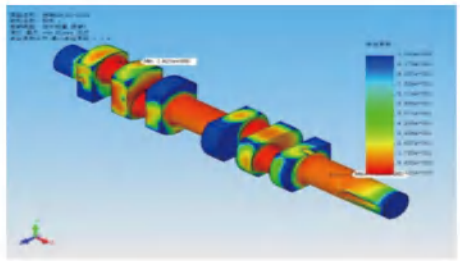
The company has successively passed ISO-9001/ISO4001, EU CE certification, German Rheinland certification, and National Energy-Saving certification. In 2015, the company was approved and established an Energy Efficiency Laboratory, and has successively obtained, Only controlled, related patents and software copyrights 141 items, and recognized as "National High-tech Enterprise", "Enterprise Technology Center", "Specialized New Enterprise", etc.

The factory located in in Zhangjiang Delta Science and Technology City, covers an area of 35,000 square meters. According to European standards, 20 lean production lines and automatic testing systems are designed, so that Denair has an annual production capacity of 15,000 compressors.

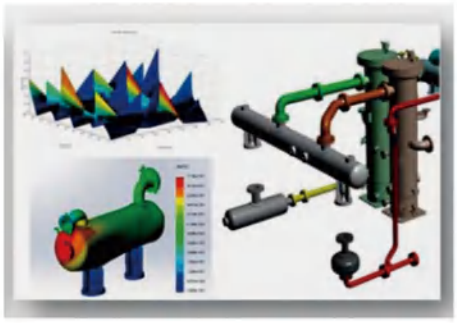
R&D Capability

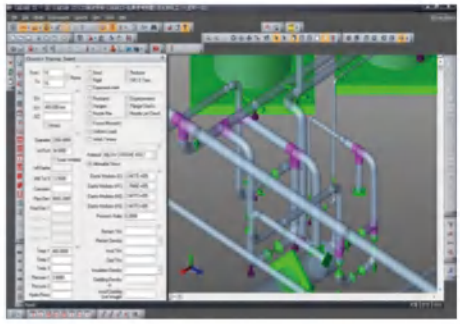
- DENAIR has professional compressor and complete system test platform.
- DENAIR has 12 invention patents, more than 200 new patents and published more than 50 professional papers.
- DENAIR adopts "three-dimensional design and assembly and motion simulation" and finite element method for mechanical analysis in the research and development process.



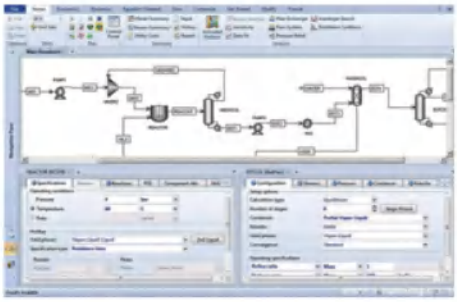


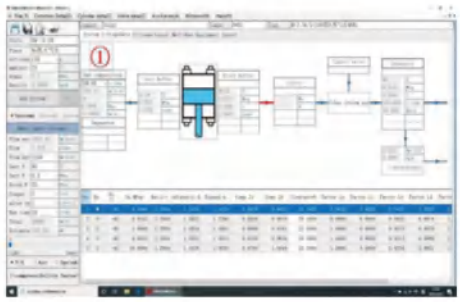
- DENAIR adopts American bentley auto pipe, bentley PULS 3 to analyze the stress and pulsation of the process compressor.



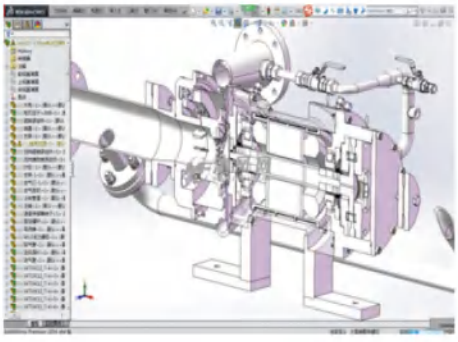


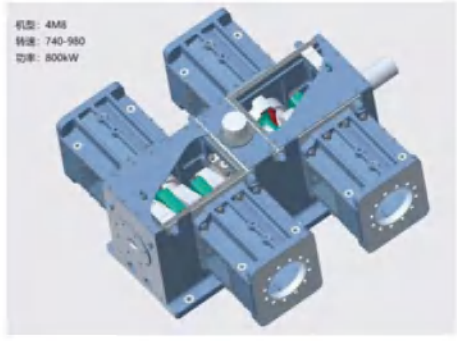
- ASPEN, an international large-scale process simulation software, is used to simulate the operation of various chemical units, and the dynamic state is calculated on the basis of steady-state process calculation.





- Solidwork 3D mechanical design software is used to realize detailed design, assembly and solid modeling.





Manufacturing Ability

CCF has integrity capability of manufacturing, inspection and testing, includes numerical machining workshop, rivet welding workshop, assembly workshop and quality inspection center, which owns large-size numerical-controlled planer type milling machine, CNC double column boring and milling machine, NC lathe, Five-axes coordinated numerical controlling machine center, automatic welding machine and plasma cutting machine etc., total over 200 set first-class machining equipment. CCF have set up digital workshop production lines and advanced information manufacturing management. The assembly plant equips with large and middle size compressor testing platform, which can be used for compressor mechanical and load running test before delivery.

Partial Production Equipment List

Euipment Name	Model & Specification	Equipment Name	Model & Specification
Italy NC milling and boring machine	Pama 2200	Glass-steel cooling tower	DBNL3-12
Toshiba fixed beam five side machining center	MPE2650	Well type tempering furnace	RJ2-75-6
CNC floor boring and milling machining center	TH6913	Well type carburize furnace	RQ3-90-9D
Five side bridge type machining center	Correa FP50/50	Box-type resistance furnace	RJX-30-9
Full function CNC lathe	CK7515/1500	Bogie-hearth resistance furnace	RJJ-90-10
CNC double column boring and milling machine	XK2425C*80-T6	Compressor testing platform	CCF
Horizontal machining center	800×800	Motor-driven pressure test pump	4DSY-15/80MPa
Precision threading lathe	J1—001	Spectrograph	Imported
Pendulum impact tester	JB-30B	Infrared carbon and sulfur analyzer	TL-851
Hydraulic universal material testing machine	DLY-30	High pressure testing pump	DSY25/60
CO2 Gas shielded welding machine	500GM3	Three coordinate measuring system from Germany Zeiss	Imported
Arc welding machine	YE-300WP	Fluorescent magnetic particle flaw detector	RGS-300
Carbon dioxide inverter welder	CO2/MAG	Magnetic particle flaw detector	CJW-9000
Gas shielded longitudinal seam automatic welding machine	500A，with operation unit	Ultrasonic flaw-detecting machine	CTS-22
High frequency induction heating equipment	GP100-C2	X-ray flaw detector	TF3125C

Toshiba fixed beam five side machining center

Italy NC milling and boring machine

Spanish five side machining

Compressor testing platform

Russian CNC cylindrical grinder

HBM-5T4500×2600×1350 CNC machining center

Quality Guarantee Ability

Our products are inspected in accordance with military standard quality systems, the company has complete testing method, normative inspection procedures with advanced inspection equipment of universal testing machine, direct-reading spectrometer, infrared carbon and sulfur analyzer, X-ray flaw detector, and three coordinate measuring systems. With stress library, non-destructive detection room, physical and chemical laboratory to ensure fabrication quality and accuracy.

Detection room

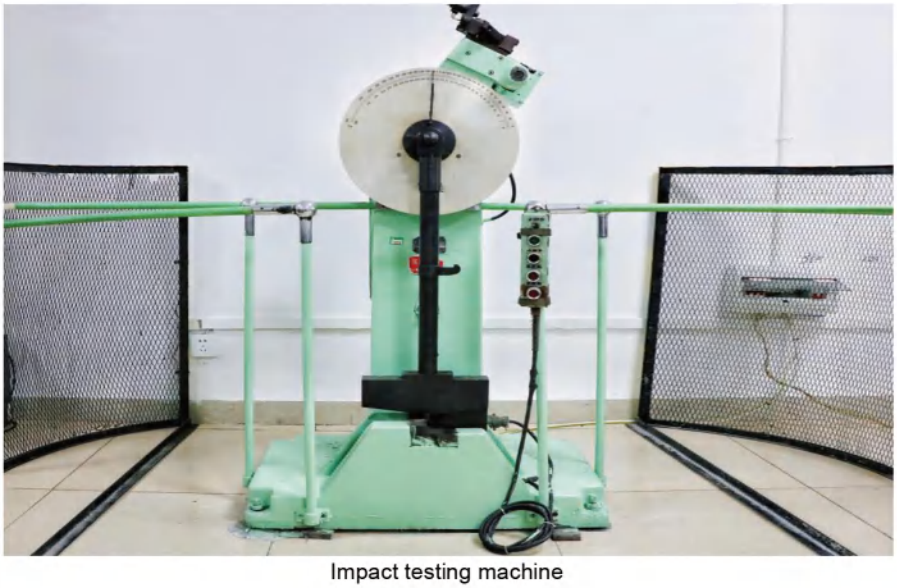
Metallographic

PC controlled hydraulic universal testing machine

Dew point meter SAHP-PL

Infrared carbon and sulfur analyzer

HS310 Slience stress generator



Impact testing machine

Pressure testing machine

Spark direct reading spectrometer

Product Introduction

Product Features

- High power and high balance

  The design of each row connecting a single crankshaft has divided the included angle of the crankshaft on the circumference. The included angle of the center line of each row of cylinders is 180 degrees, and the moment of inertia is small or even zero, which reduces the wear of the main journal and the main shaft, not only increases the service life, but also enables the compressor to run for a long time under low vibration and high stability.

- Low energy consumption

  The structural characteristics of the compressor, the application of special bearing technology, valve technology and special material technology help minimize transmission efficiency and friction loss. The airflow resistance loss has been greatly improved, and the power consumption of the compressor has been significantly reduced.

- Complete programmatic design

  The component design is based on a complete design software development. Comprehensive and accurate design, the whole process from product parameters to part drawing output, computerized design technology ensures product performance.

- Low operation noise

  The unit adopts a large number of synthetic materials, and the design takes into account the high-balanced dynamic performance and low-speed configuration, which greatly reduces the operating noise of the compressor.

- Modular development, design speed guaranteed

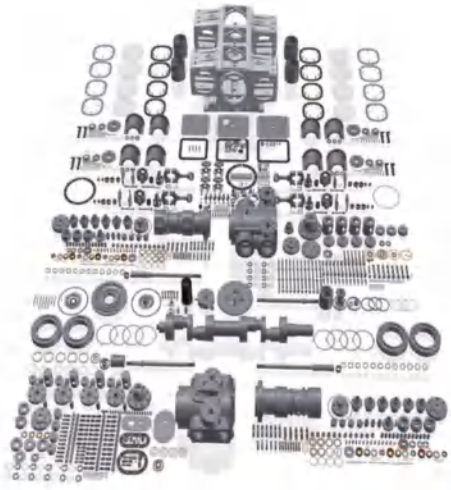
  Complete enterprise standardization and rich basic parts library make product customization more convenient and faster.

- Fewer consumable parts, long service life

  The application of high-performance materials and the structural design of the parts improve the performance of the wearing part, and make the wearing parts more adaptable to the actual working conditions.

- High technical precision, easy operation and maintenance

  From design, manufacturing to installation, all procedures are equipped with strict technical standards, regulations and quality assurance systems. The core components such as the compressor bare block are processed by high-precision CNC machine, which fully guarantees the reliability of the unit. The complete package of the unit provides the operator with more convenient operation.

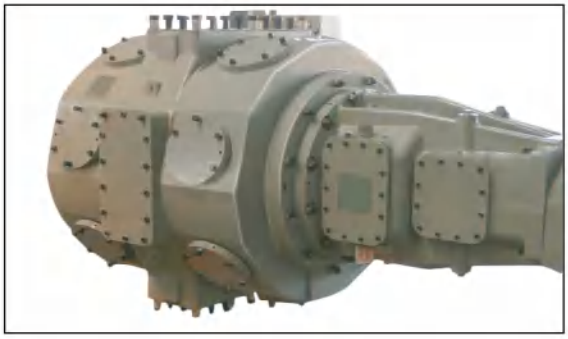


Compressor structure-compressor head components overview

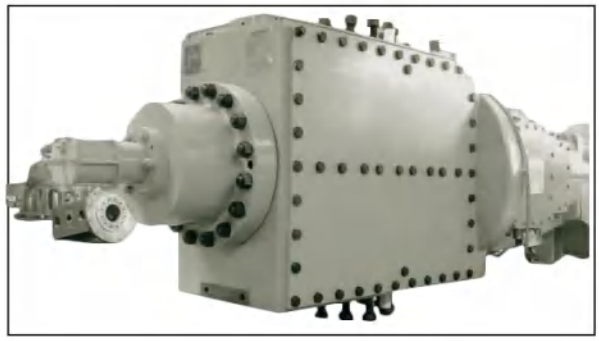
Cylinder

With the changes of compressor gas flow rate, pressure, temperature and working conditions, a variety of cylinder series have been developed, bringing together decades of compressor cylinder design experience, suitable for various harsh working conditions. The material of the cylinder can be cast iron, ductile iron, cast steel, combined carbon steel, stainless steel, forged steel, etc. In order to meet the specific requirements, the number and type of cylinders can be customized, which will greatly improve reliability and save usage and operating costs.

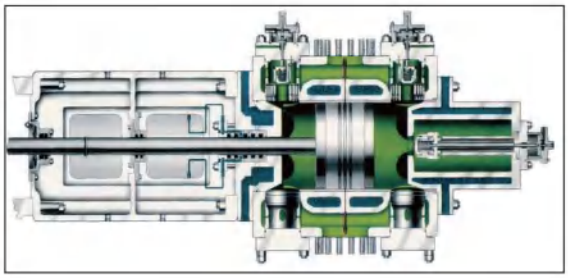
The cylinder block is basically designed as a "through-cylinder" structure, which not only simplifies the process of the cylinder, but also greatly enhances the versatility of the cylinder in different series.



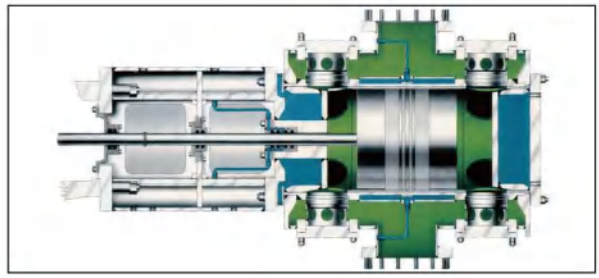
Cast iron cylinder with dual chamber adapter and midbody



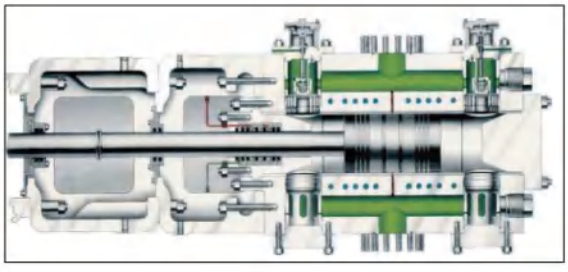
Forged steel cylinder with dual chamber adapter and midbody



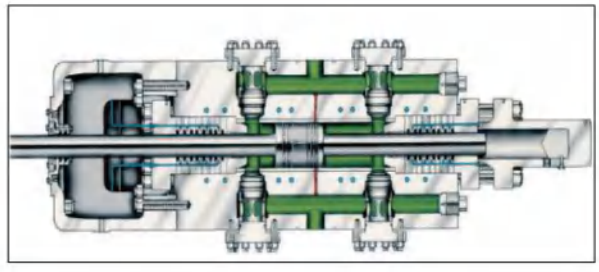
Cast iron or ductile iron cylinder, working pressure 1500psi



Special purpose carbon steel or stainless steel cylinders



Forged steel cylinder, working pressure 7500psi



Tandem cylinders with extended tail rod

Compressor Head Structure

Body

- Body material is made of high hardness cast iron HT250 or QT600
- Adopt resin sand precision manufacturing process
- CNC machining to ensure the concentricity of the main shaft and the verticality of the slideway
- Frame type multi-support structure
- Optional high-strength cylinder liner or corrosion-resistant stainless steel, hartz alloy cylinder liner

Bearing bush

- Integrally cast aluminum inlaid alloy bearing bush
- High strength, low friction coefficient and long life
- The pressure bearing capacity is 5 times of the babbitt bearing bush, and the service life is 3 times higher, providing reliable operation guarantee for the crankshaft

Connecting rod

- Made of high-strength die-forged alloy steel
- The large head tile is an upper and lower two-lobe structure, which can be adjusted by adding a gasket
- There is a spiral oil groove in the small head tile, which is easy to build an oil film
- Improve the anti-fatigue performance of the pulse movement of the unit

Crankshaft

- High-strength alloy steel torsion forging, single-turn single-row and short-stroke structure
- Flexible matching, high load capacity, significantly reduced torque at high speed
- Counterweight can be equipped at the bottom of the crankshaft to achieve better balance performance

Cross-head

- Removable and adjustable shoe structure
- The sliding shoe is made of aluminum inlaid alloy material
- High-performance nut and hydraulic tightening coupling make piston rod removal easy and convenient
- Centering adjustment pads allow fine-tuning of centering without disassembling the piston
- High load range ensures the safety of the drive

Pistons, piston rods, piston rings, support rings

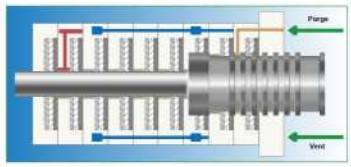
- Piston rod is mostly made of 42CrMo, 38CrMoAl 7-4PH, etc., with high wearing resistance, long life and high fatigue ultimate strength
- Piston is basically designed with no oil lubrication
- The material of the piston ring is self-lubricating materials such as "PTFE" and "PEEK", and the split piston ring solves the problem of installation elasticity
- The radial pressure guiding groove of the support ring enables the ring to rotate while the piston reciprocates, reducing wear and increasing the service life by more than 3 times

Pressure padding

- The self-compensation of the tangential opening of the double sealing ring increases the life of the ring
- The structure design of the closed water channel box can better improve the working environment of the padding ring
- Rings can be exchanged without removing the piston rod

Magnetic particle test

- According to the standard inspection regulations, all piston rods need to be carefully tested by ultraviolet (black light) wet fluorescent magnetic particle
- This strict inspection guarantees the purity of the piston rod material



Controller

- Siemens PLC, higher precision
- 7-inch color screen with intuitive interface
- Remote operation and maintenance, intelligent control, online collaboration, unattended, energy saving and efficiency enhancement, cloud communication
- Humanized menu structure design, normal display of operating parameters and status
- Modbus RTU, USS, PROF old US-DP, free port communication available

Variable frequency technology application

- Eliminate or reduce compressor operating time at unloading state. Accurately tracking the gas demand can meet the requirements of different production capacity and reduce energy consumption by about 35%

Design Features

High rigidity skid

The smaller the vibration of the reciprocating process compressor, the more stable the operation and the smaller the vibration, so the failure rate is lower and the power saving is relatively low. The skid structure designed by the international advanced 3D simulation analysis software is all made of reinforced short section steel, supplemented by steel plate or reinforcement welding. The overall stiffness of the skid-mounted unit is favorable, which provides a good foundation for smooth operation and saving power consumption.

Air valve cushion technology

The air cushion valve is manufactured with proprietary technology and its valve spring is a pagoda-type special stainless steel wire spring. The excellent dynamic characteristics supplemented by the air cushion effect make the impact force small and the operation stable, and can also be selected for the non-standard customization with well-known valve brands according to user requirements.

Surface hardening technology

The surface for the piston rod in the high-pressure compression stage of the reciprocating process compressor adopts a super-hardened coating. Its surface hardness reaches HRC75-80, and the friction coefficient is reduced by 15-20% to ensure the service life of the piston rod and its packing seals, long cycle reliable operation.

Advanced connection

The crankshaft end of the compressor and the flywheel are connected by a keyless expansion sleeve, which completely eliminates the weakening of the crankshaft strength by the keyway and the fatigue damage of the crankshaft caused by the stress concentration caused by the keyway so that the safety factor is further improved. Easy installation, good neutrality and more reliable connection. All the above provides a good foundation for saving power consumption for smooth operation.

Compound packing and sealing technology

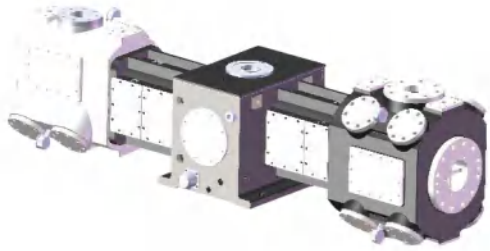
The reliability and long service life of the high-pressure packing and sealing components are the core key technologies of the compressor. On the basis of the traditional three-six-lobe packing seal, the back-pressure-free and load-equalizing throttling technology is combined to form a composite packing, which is especially suitable for oil-free or less oil lubrication. At the same time, increasing the cooling water flow and shortening the packing cooling water flow to improve the heat exchange efficiency is an effective improvement of the equipment operation efficiency.

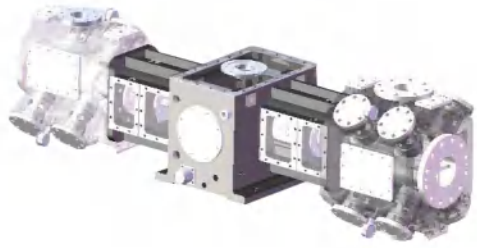
Floating head tube water-cooled cooler

The cooling water and air of the reciprocating compressor are in reverse convection, and the heat exchange area is left with a 50% margin on the basis of the design area. The design of the reasonable structure ensures excellent cooling effect and further improves the reliability of the unit process. The tube core is detachable, which is convenient for cleaning and descaling, and improves the economy of operation. According to different user needs, air-cooled, water-cooled and mixed-cooled coolers can be provided. The heat exchangers are all high-efficiency finned tubes, and the heat exchange area is increased by 30%.

Denair Compressor Series

D series - horizontal two-row symmetrical balanced reciprocating piston compressor



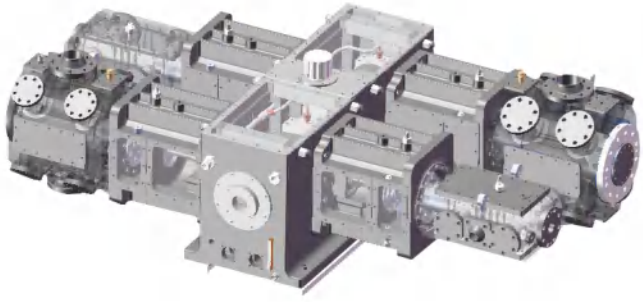


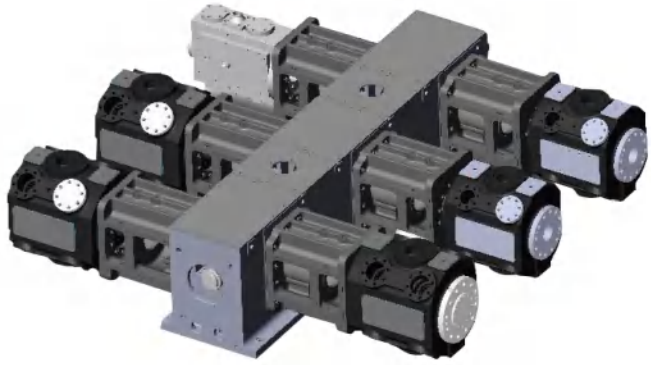
Product Features

- Good movement balance: The unit is a two-row symmetrical balance type, and the angle between the crank angle and the axis line of the two rows of cylinders is 180 degrees. The inertial force is completely balanced, and the inertial moment is small or even zero. And the center of gravity is low, the contact area with the bottom skid is large, and it can run smoothly with minimal vibration.
- Long service life: The two rows of pistons act in opposite directions, and the pistons move in a horizontal direction, which can cancel each other, because the stress of the main journal is improved, the wear of the main journal and the main bearing is reduced, and the service life is prolonged.
- The overall rigidity of the fuselage is good: The overall fuselage is designed by the finite element software to simulate the motion load of the compressor, and the fuselage and the middle body adopt an integrated structure.
- Lubricating oil level design: It can be equipped with clamp thermal resistance and electric heater to detect oil temperature and oil level, and interlock with the operation of the unit.
- Convenient inspection and maintenance: The body is equipped with a window that can be disassembled and installed to check the operation of the crosshead.
- Pre-lubricating oil pump: Forced lubrication of moving parts ensures reliable operation.

Model Type	2D3		2D8	
Number of throws	1	2	1	2
Rated power (kW)	55	110	160	315
Stroke (mm)	90		140	
Maximum (RPM)	985		740	
Piston speed (m/s)	2.94		3.45	
Total rod load (N)	30,000		80,000	
Rod diameter (mm)	35		60	
Crankshaft Centerline, from bottom (mm)	280		420	

M series -horizontal or six-row symmetrical balanced reciprocating piston compressor





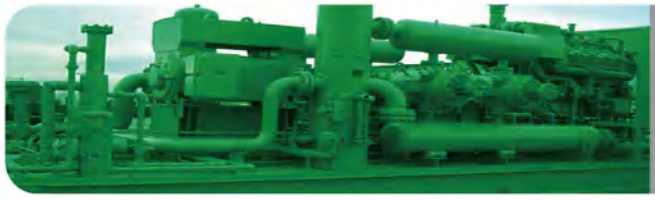
Product Features

- With D-type compressor, excellent mechanical design ensures the stable operation and long service life of the compressor.
- Easy to maintenance: Multi-columns, and each column has one stage, so the operation rigidity is good.
- Suitable for large displacement and multi-stage compression.
- Adopting positioning measures for the motor and air end: Make the motor and the air end have good coaxiality, and avoid the deterioration of the alignment between the motor and the crankshaft during operation, thus reducing the service life of moving parts.
- Up-down arrangement: The intake and exhaust ports of cylinders at all stages are designed downwards, which makes the pipeline connection and arrangement reasonable and easy to maintain.
- Fully automatic instrumentation, assisting users to complete automatic control and data monitoring.

Model Type	4M8	4M10	4M12	4M16	6M8
Number of throws	4	4	4	4	6
Rated power (kW)	600	900	1200	1330	1000
Stroke (mm)	120	120-140	140-180	320	120
Maximum (RPM)	740	740	590	375	740
Piston speed (m/s)	2.96	2.96-3.45	3.45	4	2.96
Total rod load (N)	80,000	100,000	120,000	160,000	80,000
Rod diameter (mm)	60	60	70	80	60
Crankshaft Centerline, from bottom (mm)	430	850	1050	1330	430

Industrial Applications

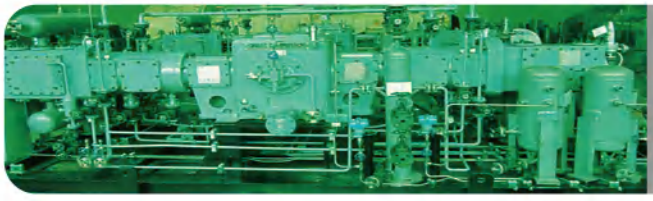
Compressed media: Hydrogen, nitrogen, carbon dioxide, hydrocarbons, natural gas, petroleum associated gas, air, etc.



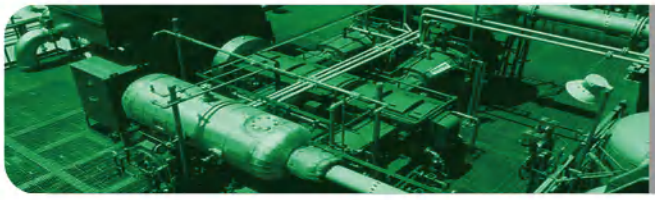
Reciprocating compressor units for petroleum and natural gas pipeline transportation

Large reciprocating compressor units for chemical industry

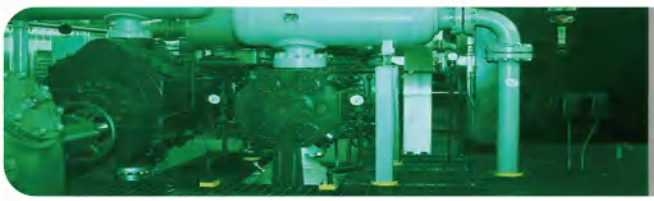
Medium and high pressure oil free compressor units for PET bottle blowing



Compressor units for large scale oil refinery



Associated gas recovery compressor unit for offshore drilling platform



LNG plant feed gas booster unit

Applicable Industries

Oil and gas processing

Chemical material production

LNG process

Oil and gas extraction, transportation and storage

Wind tunnel test

Gas power generation process

Fertilizer production process

Fracturing hydrogen production process

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