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HONG SHEN

Product model：ZF-0.16/(30～200)-250

Product name：Natural gas compressor unit

**Operation Instructions**

**Z—SM**

**ANHUI HONGSHEN ENERGY EQUIPMENT CO., LTD.**

File name: Operation Instructions

Product mode: ZF－0.16/(30～200)－250

Product name: Natural gas compressor unit

Writer

Reviser

Standardization

Auditor

Approver

Date

Compressor main interface and protection value parameter table

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Name | | Parameter Value |
| 1 | Gas inlet port | | Butt welding joint φ27×3 1Cr18Ni9Ti |
| 2 | Gas supply pipe port | | Butt welding joint φ20×3 1Cr18Ni9Ti |
| 3 | Total sewage outlet port | | Butt welding joint φ20×3 1Cr18Ni9Ti |
| 4 | Safety valve main discharge port | | Butt welding joint φ32×4 (vented) 1Cr18Ni9Ti |
| 5 | Filling gas outlet port | | Butt welding joint φ12×3 1Cr18Ni9Ti |
| 7 | Control gas source inlet port | | Quick connector φ12×3 1Cr18Ni9Ti |
| 8 | Lubricating oil filter replacement cycle | | 300-500h (or as per filter body instructions) |
| 9 | Main motor cable port | | VV (3×25+1× 10 ) 380V/50Hz (for reference only) |
| 10 | Auxiliary motor cable port | | KVVR 12 × 1.5 AC380V/50Hz (for reference only) |
| 11 | Control cable port | | KVVR 12 × 1.0 AC220V/50Hz (for reference only) |
| 12 | Indicator light cable port | | KVVR 7 × 1.0 AC220V/50Hz (for reference only) |
| 13 | Temperature signal cable port | | KVVP2 16 × 0.75 DC24V (for reference only) |
| 14 | Pressure signal cable port | | KVVP2 24 × 0.75 DC24V (for reference only) |
| 15 | Inlet pressure | | >20.5MPa Automatically shut down or prohibit starting |
| 16 | Discharge pressure | | >22.5MPa Alarm and shutdown |
| 17 | Lubricating oil pressure | | <0.15MPa Alarm and shutdown |
| 18 | Discharge temperature at each stage | | >180℃ Alarm and shutdown |
| 19 | Lubricating oil | Grade/Code | Double grease synthetic compressor oil 4513-N100 |
| Oil amount | 20L |
| Replacement cycle | 3000h \* |
| 20 | Safety valve opening pressure | | 26.0～27.0MPa |

\* Note: When a new machine is used for the first time, replace the lubricating oil after 200 hours .

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# I. Overview

## **1. Introduction**

Welcome to use Hongshen CNG compressor.

This operation instructions will provide the technical details of the compressor unit, the operating procedures that should be followed, and the maintenance methods that must be performed to ensure the normal operation of the compressor unit.

**To ensure the reliable operation of the compressor, the operator must be familiar with this instruction manual and comply with the operating procedures in the instruction manual before operating the compressor.**

Before leaving the factory, the compressor has been subjected to simulated operation tests using nitrogen as the compression medium.

Only if the user follows the operating procedures in this manual, the manufacturer will guarantee the quality requirements listed in the product delivery terms. In the following cases, the guarantee will be invalid:

- The compressor is overloaded;

- The compressed medium is a gas other than that specified in the instructions;

——The operating temperature is not within the range specified in the operating procedures;

In addition, damage caused by incorrect operation, improper use of lubricants, and pipes not installed by our company are not covered by our warranty.

This compressor will perform satisfactorily if properly installed, maintained and used.

If any problem or unknown fault occurs, please contact our company as soon as possible.

## 2. Safety precautions

In order to protect the life safety of operators and maintenance personnel and ensure the reliable operation of the compressor, the following instructions are specially written.

* Introduction

**High-pressure gas has great energy and is very dangerous! Therefore, the gas in the high-pressure system must be safely vented before maintenance work can be carried out.**

Installation, operation and maintenance work can only be performed in accordance with the operating procedures or under the guidance of professionals.

Rotating parts are prone to accidents and are very dangerous, so try not to remove protective devices during operation.

Do not place flammable objects near the compressor.

Fireworks are strictly prohibited near the system.

Gas distribution pipelines and other accessories not provided by our company must be able to withstand the corresponding working pressure. If necessary, pressure tests must be carried out, and unloading devices should be provided during the tests.

The cables must be insulated and must not be exposed, entangled, or touch rotating parts.

Do not damage the wire protection layer.

The power control box can only be opened by professionals. Even if the main switch is powered off, the two poles of the main switch and the power cable of the terminal block are still energized. Therefore, do not touch the components in the power control box or perform maintenance without cutting off the power supply line. Before starting work, you must check whether the entire system is still energized.

* **Operation Notes:**

The compressor unit must be inspected regularly and kept in good working condition.

When the compressor unit is powered on and on standby, its care must be taken that no one is performing maintenance work on the machine, because the machine can run automatically.

The compressor should be operated within the range specified by the technical specifications.

Note that people are not allowed to touch the piping system when the compressor is running, especially the discharge pipe or high-temperature parts in operation.

When an oil leak is discovered, not only should the leaking fluid be cleaned up, but the leak should also be repaired.

When the compressor unit is running, the operator will check and compare the machine operating parameters at any time to see if they are normal.

* Maintenance work precautions

Maintenance work can only be carried out on a compressor that is stopped (no self-start possible) and completely emptied. First, the main switch of the power control box should be turned off. In order to prevent the unit from being started by mistake, the main switch should be locked or a corresponding instruction label should be attached.

**Before starting work, the air in the unit should be replaced cleanly.**

On compressor units, only original spare parts and recommended components may be used for repairs.

Do not perform high temperature work such as electric welding near the lubricating oil system.

During maintenance, the machine must be kept clean. The removed parts should be placed in a clean place and different parts should be covered with cloth, paper or tape to prevent dust.

After maintenance, a check must be made to ensure that no tools, parts or rags have been left on or in the compressor unit.

Never use flammable solvents to clean parts before the compressor unit has cooled down completely. After cleaning the parts with solvents, blow them clean with compressed air.

When blowing out equipment with compressed air, be extremely careful and wear goggles.

* Responsibility Statement:

The company does not assume any responsibility for damage to the compressor and all its consequences caused by failure to comply with safety regulations or neglect of conventional regulations for installation, use, operation and maintenance.

# Ⅱ. Main technical parameters of compressor

**Table 3-1 Compressor performance parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | Air/gas supply | | 600 Nm3 / h​​ |
| 2 | Suction pressure (gauge pressure) | | 3.0～20 MPa |
| 3 | Rated exhaust pressure (gauge pressure) | | 25.0 MPa |
| 4 | Suction temperature | | ≤40℃ |
| 5 | Compressed media | | natural gas |
| 6 | Noise | | ≤75 dB(A) |
| 7 | Lubricating oil temperature | | ≤80℃ |
| 8 | Total lubricating oil consumption | | ≤55g/h |
| 9 | Cylinder diameter | Stage 1 | φ58mm |
| Stage 2 | φ30mm |
| 10 | Piston stroke | | 95mm |
| 11 | Compressor speed | | 970 r/min |
| 12 | Shaft power | | ≤22.5kW |
| 13 | Discharge pressure (gauge pressure) | Stage 1 | 9.0～20MPa |
| Stage 2 | 25MPa |
| 14 | Lubrication method | | Crankshaft, connecting rod, crosshead pressure lubrication, cylinder, packing micro-oil lubrication |
| 15 | Cooling method | | Full air cooling |
| 16 | Equipped power | Compressor main motor | YB-250M-6 explosion-proof motor, 37kW, 970r/min  380V/50Hz IP54, dⅡBT4, B3 F grade |
| Oil pump motor | YB2-100L1-4 1.1kW B3 1420r/min dⅡBT4 |
| 17 | Vibration severity | | ≤28 |
| 18 | Compressor dimensions ( length x width x height) | | 3800×2200×2250mm |
| 19 | Compressor unit weight | | ~3500kg |

ZF-0.16/(30～200)-250 CNG substation natural gas compressor is a basic component of the product manufactured by our company with the technology introduced from the German MANNESMANN DEMAG company and the production license obtained from the company. In order to prevent welding slag and rust in the pipeline, the entire machine pipeline is made of stainless steel pipes, and an oil removal filter is installed at the air supply port . The machine has the characteristics of low energy consumption, low noise, low vibration, all-weather high reliability, high degree of automation, and easy operation and maintenance.

This machine is mainly used as a natural gas compressor for gas filling stations. The gas entering the compressor must meet the following requirements:

* **It should contain no free water;**
* **The hydrogen sulfide content should be less than 20mg/m3 ;**
* **The lower calorific value is not less than 34MJ/m3 ;**
* **The dust content is not more than 5mg/m3 , and the particle diameter is less than 10μm;**
* **The total sulfur content (calculated as sulfur) is less than 200 mg/m3 ;**
* **The carbon dioxide content is less than 3.0% (V/V).**

In this instruction manual, we have introduced in detail the operation, use, maintenance and care of the compressor, and have also made necessary explanations on the structure of the compressor and other aspects. The installation, operation and maintenance of the compressor should strictly comply with the provisions of the instruction manual. Our company does not assume any responsibility for damage to the machine and all its consequences caused by improper operation, maintenance or failure to use original accessories, etc., which violate the provisions of the instruction manual.

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# Ⅲ. Configuration of compressor unit

The unit ( see Figure 4-1 ) is mainly composed of a compressor chassis (skid), a compressor host, an electric motor, a separator, a lubricating oil system, an air pipeline system, a cooler system, an instrument control system, an auxiliary and an automatic control system, etc.



**Figure 4-1 Overall outline**

1. Compressor chassis 2. Compressor air/gas cooler 3. Explosion-proof fan 4. Explosion-proof cabinet 5. Compressor host 6. Lubrication station

7. Motor 8. Separator 9 Sequential plate 10. Recovery tank

# Ⅳ. Introduction of the compressor host

The structure of this machine is a Z-type single-row differential piston compressor, with two-stage compression, Ⅰ-Ⅱ in the same row, Ⅰ-stage cylinder is distributed in the lower part of the single row (crankshaft side), Ⅱ-stage cylinder is distributed in the upper part of the single row (cylinder head side), and a balance chamber is provided in the middle of the row to balance the piston force during the compression process. The structure of this machine is shown in Figure 5-1, and the structure of its main components is described as follows:



**Figure 5-1 Host structure diagram**

1. Crankcase Part A 2.Oil pump parts 3. Crankshaft parts 4. Slideway parts 5.Crosshead component 6. Distance piece component 7. Packing component 8. Connector component 9. First-stage cylinder component 10 Second-stage cylinder component 11 Piston rod component

## 1. Crankcase components

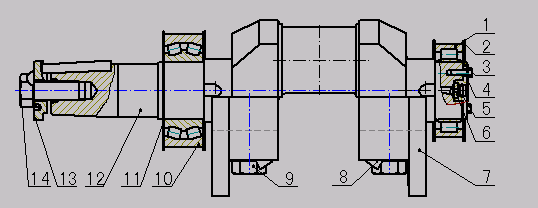
The crankcase (see Figure 5-2) is made of gray cast iron, with a machined surface and holes for installing the crosshead slideway; the oil pan at the bottom of the crankcase can store lubricating oil for use by the compressor, and is equipped with a coarse oil filter component for filtering the lubricating oil. There are hand hole covers on both sides of the crankcase, and one of the covers is equipped with an oil dipstick and an oil filling port. The other two end faces of the crankcase are provided with holes for installing bearings, bearing seats and oil pump end covers. A skeleton rubber oil seal is installed in the bearing seat to seal the lubricating oil in the crankcase to prevent it from leaking out.



**Figure 5-2 Crankcase components**

## 2. Crankshaft parts

The crankshaft (see Figure 5-3) is forged with 45# steel, and the crank pin is surface hardened to improve the wear resistance of the crankshaft; rolling bearings are installed on the two main journals of the crankshaft. Oil holes are drilled on the crankshaft to supply oil to the moving parts; balance irons are installed on the crank arms of the crankshaft to balance the unbalanced mass of the rotating part and the first-order reciprocating inertia force of the reciprocating parts.



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**Figure 5-3 Crankshaft components**

1. Bearing 2. Retaining ring 3. Keyboard 4. Locking washer 5. O-ring 6. Key 7. Counterweight 8. Counterweight lock plate 9. Bolt 10. Bearing 11. Retaining ring 12. Crankshaft 13. Press ring 14. Bolt

## 3. Connecting rod parts

The connecting rod (see Figure 5-4) is the connecting part between the crosshead and the crankshaft, and plays the role of converting the rotational motion of the crankshaft into the reciprocating motion of the crosshead. The connecting rod of this machine is forged with 45# steel, and its big end hole is inlaid with thin-walled bearings, on which wear-resistant babbitt alloy is cast, and the small end hole is lined with an integral bronze sleeve; the connecting rod body is an "I"-shaped section, and oil holes are drilled along the connecting rod axis between the big end bearing and the small end copper sleeve to supply oil to the small end bushing to lubricate the small end bushing and the crosshead slideway. The connecting rod bolts and nuts connecting the split are installed at the big end of the connecting rod, and the tightening torque is 280N·m .



**Figure 5-4 Connecting rod components**

1. Connecting rod small end bushing 2. Connecting rod 3. Connecting rod big end bearing 4. Connecting rod screw 5. Washer 6. Connecting rod nut

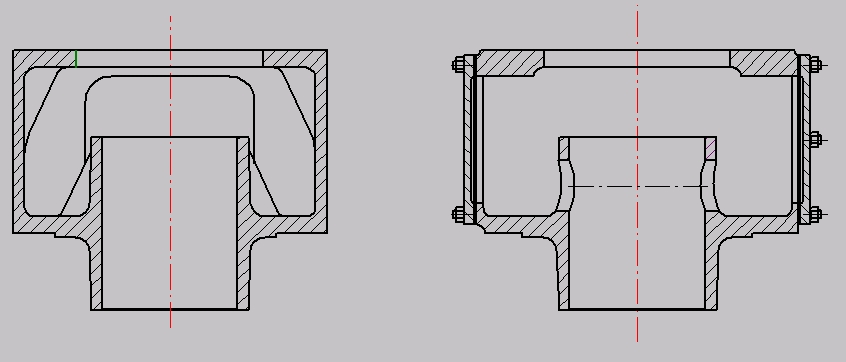
## 4. Crosshead parts

The crosshead (see Figure 5-5) is a component that connects the connecting rod and the reciprocating piston rod. It has a guiding function and bears the lateral force of the compressor. The crosshead of this machine is cast from ductile iron and has threads for connecting the piston rod and a crosshead pin for connecting the connecting rod.



**Figure 5-5 Crosshead components**

1. Crosshead body 2. Crosshead pin 3. Screw plug 4. Shaft retaining ring 5. Sliding shoe



**Figure 5-6　Crosshead slide**

The crosshead slideway is responsible for guiding and bearing the lateral force and the weight of the crosshead. The crosshead slideway of this machine (as shown in Figure 5-6) is made of HT250 casting.

## **5. Piston parts**

The Ⅰ-Ⅱ stage pistons are of differential type (see Figure 5-7), which are composed of the Ⅰ-stage piston, the Ⅱ-stage piston and the piston rod. The connection between the two pistons adopts a radial plane floating structure, and the axial clearance is 0.14~0.26 mm .

Both the first and second level pistons are made of 45# forged steel. The first level piston is equipped with eight piston rings and one support ring, while the second level piston is equipped with nine piston rings and one support ring. When assembling, the piston rings are installed in the piston ring grooves, and their openings should be staggered 180 degrees from each other. °.

Before assembly, the external threads of No. 8 and the connecting end of the piston rod and piston and the internal threads of No. 7 should be cleaned with Loctite 755 cleaning agent, and then evenly coated with Loctite 272 glue and tightened. The curing time of the glue is 8 to 10 hours . When disassembling, just heat the nut and remove it; in addition, before assembly, the fitting surfaces of No. 3, 4, and 7 should be cleaned, and then evenly coated with Loctite 510 flat sealant.

Tightening torque: cross head nut is 700N·m; piston nut is 600N·m.

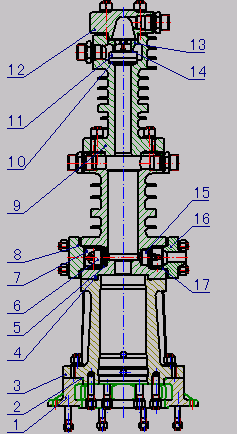
**Figure 5-7 Piston components**

1. Stage 2 piston ring 2. Stage 2 support ring 3. Stage 2 piston 4. Screw 7 Stage 1 bearing ring 8. Stage 1 piston ring 9. Stage 1 piston

## 6. Cylinder parts

The first and second stage cylinder components (see Figure 5-8) are assembled together, and it consists of a connector, a first stage cylinder, a first stage intake and exhaust valve, a second stage cylinder, a second stage combination valve, a second stage cylinder cover, etc.; the first stage cylinder and the second stage cylinder are made of 40Cr forged steel, the connector is made of HT250 forged steel, and the second stage cylinder cover is made of 45 forged steel; the first stage cylinder is symmetrically arranged with an intake valve hole and an exhaust valve hole, each of which is equipped with an intake valve and an exhaust valve, and is fixed with a valve ring and a pressure cover; the connector is mainly used to install packing components; a second stage combination valve is arranged on the upper part of the second stage cylinder, and is fixed with a valve ring and a pressure cover.

Heat sinks are arranged on the first-stage cylinder and the second-stage cylinder body to cool the cylinder, and an oil filling hole is processed on the upper side of the cylinder for oil supply and lubrication of the cylinder; in addition, the inner surface of the first-stage cylinder and the second-stage cylinder is nitrided to improve the wear resistance of the cylinder.



**Figure 5-8 Cylinder components**

1. Connector 2. Connecting tube 3. O-ring 4. First-stage cylinder 5. Valve gasket

6. Exhaust valve 7. First-stage exhaust pressure valve ring 8. Gland 9. Second-stage cylinder 10. Concentric valve gasket

11. Concentric valve 12. Second-stage cylinder head 13. Second-stage pressure valve ring 14. Concentric valve upper gasket 15. Intake valve 16. Intake flange 17. First-stage intake pressure valve ring

7. Packing parts

The packing (see Figure 5-9) is a component that prevents the gas in the cylinder from leaking from the piston rod and the cylinder. It is mainly composed of a packing tube, a packing box, a spring, a sealing ring, a flow control ring, etc. The packing of this machine is equipped with a leakage sealing ring. The trace amount of oil-containing gas leaking from the main packing sealing ring is blocked by the leakage sealing ring and cannot enter the crankcase. Then it must be led to a safe outdoor location through the exhaust hole through a pipeline for waste oil collection and gas release.

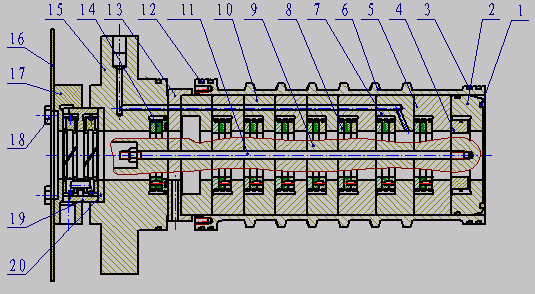


Figure 5-9 Packing components

1. Gasket 2. Pressure relief ring stuffing box 3. O-ring 4. Pressure relief ring 5. Main stuffing box

6. Second-stage cooling jacket 7. Oil filling stuffing box 8. Main sealing ring 9. Main stuffing box 10. Low pressure stuffing box 11. Tie rod 12. O-ring 13. Air extraction gasket 14. Leakage seal 15. Packing flange

16. Oil baffle plate 17. Oil scraper gland 18. Bolt 19. Oil scraper ring component 20. Baffle

**Ⅴ. Introduction to the compressor system**

This compressor has seven main systems: gas system, cooling system, sewage system, lubrication system, instrument control system, control pipeline system and electrical equipment system. They are described below:

**1. Gas system**

The function of the gas system is mainly to guide the natural gas to the compressor, and after being compressed, cooled and separated at various levels of the compressor, it is guided to the place of use.

The natural gas enters the air intake separator, the first cylinder, the first cooler, the first separator, the second cylinder, the second cooler, the second separator, the pre-filter, the oil removal filter, the check valve in turn, and finally the compressed natural gas is delivered to the gas vending machine and the gas cylinder group through the priority control panel. The pipes and other equipment connected to the above components constitute the main gas pipeline of the compressor, and the safety valve outlet pipeline, the sewage pipeline for removing oil and water, and the pipeline connected to the pressure gauge constitute the auxiliary pipeline.

**1). Safety valve**

The safety valve is a protective device. When the pressure in the system exceeds the working pressure, it will automatically open to discharge the excess gas to reduce the system to the normal working pressure. The safety valve of this machine is installed on the exhaust system. The opening pressure of each level of safety valve is as follows (gauge pressure):

Safety valve opening pressure: 26.0～27.0MPa

The safety valves of this machine are all installed on the oil-water separation gas at all levels, and are all spring-closed safety valves. It is mainly composed of valve body, valve disc, spring seat, spring, adjusting nut, etc. If you need to adjust the opening pressure, just screw in or out the adjusting nut on the top of the safety valve to adjust to the required opening pressure.

Since this compressor compresses natural gas, the natural gas released after the safety valve is opened must be drained to a safe location using a steel pipe.

**Note: The safety valve should be calibrated once a year according to relevant regulations;**

**2).**  **Water separator**

In order to separate the oil and water in the natural gas, the machine is equipped with oil-water separators at the first-stage air intake, first-stage exhaust and second-stage exhaust.

The oil-water separator (see Figure 6-2) is mainly composed of a main body, a separator rod group, etc.

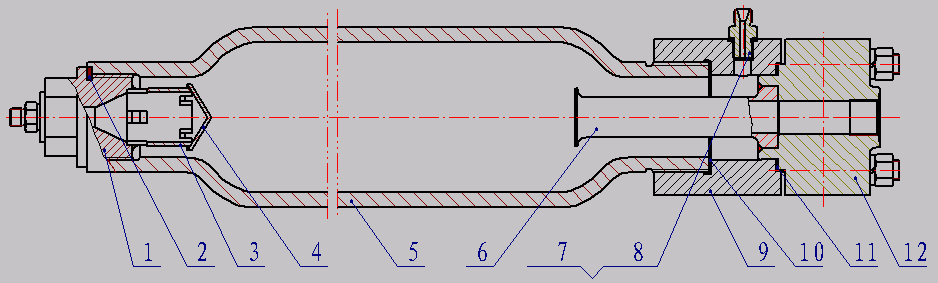
In order to regularly discharge the accumulated oil and water, the oil-water separator is provided with a drain port at the bottom to regularly discharge the oil and water.

Figure 6-2 Oil-water separat**or**

1. Connector 2. Washer 3. Small cover 4. Bracket 5. Separator body 6. Separation rod 7. Pipe joint 8. Washer 9. Separator head 10. Washer 11. Washer 12. Separator head

**3). Check valve**

The function of the one-way valve is to prevent the gas in the pipeline from flowing back after the one-way valve. It is mainly composed of valve body, valve cover, sealing ring, spring, pipe joint, etc. A filter is installed in front of each one-way valve to protect the reliability of the one-way valve.

## 2. Cooling system

This compressor adopts natural cooling of cylinder and gas circulating air cooling;

The air cooler is mainly used to cool the high-temperature natural gas at each level and the lubricating oil in the oil pan, ensuring that the compressor has a perfect thermal cycle, so that the high-temperature parts can be cooled, the lubricating oil temperature will not be too high to reduce the lubrication performance, etc. The system is mainly composed of primary and secondary coolers, oil coolers, etc.

## 3. Sewage system

The sewage discharge system of the compressor adopts centralized sewage discharge, and all sewage discharge valves are also concentrated on the instrument control cabinet. The sewage discharge valves include the high-efficiency oil removal filter purge valve, the pre-filter purge valve, the first, second, third, and fourth-stage oil-water separator purge valve, the intake separator purge valve, the first and second-stage cylinder exhaust purge valve, and the first and second-stage cylinder intake purge valve. All sewage outlets are concentrated in the sewage tank and then discharged from the main sewage outlet.

blowdown valve should be opened regularly for blowing and draining every 2-3 hours of operation of the compressor or according to the gas quality. The blowing time should not exceed 30 seconds. **The blowdown valves should be opened one by one and not at the same time.** After each blowdown valve is opened for blowing, it should be closed immediately before opening another blowdown valve for blowing, and so on. **Note: The main blowdown valve must be fully opened when discharging .**

## 4. Lubrication system

The compressor has two independent lubrication systems: a circulating lubrication system and a cylinder and packing oil injection lubrication system.

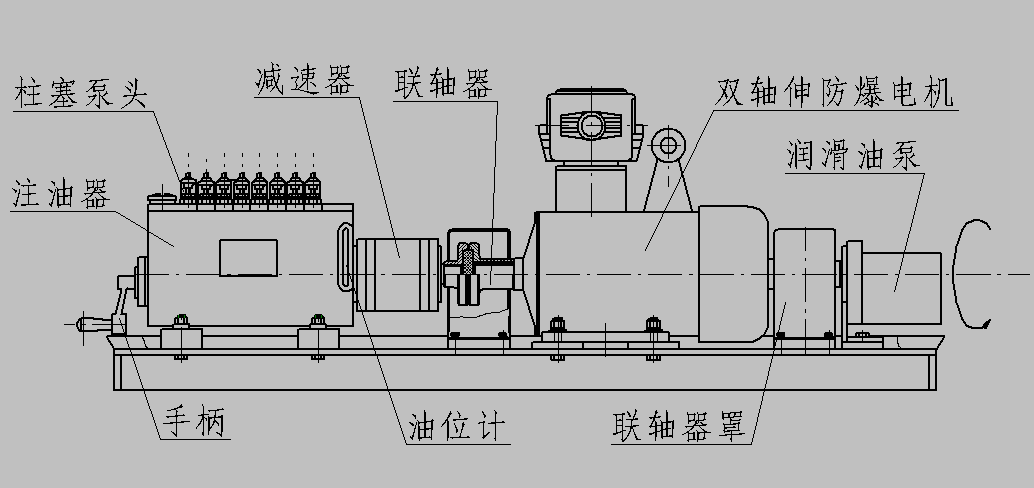
* **Compressor circulation lubrication system**

The circulating lubrication system provides pressurized lubricating oil through an oil pump fixed on the chassis, which is driven by a motor. There is an oil pan at the bottom of the crankcase. In this lubrication system, the oil passes through the coarse oil filter installed at the bottom of the crankcase, enters the oil pump for pressurization, and then passes through the oil cooler to the fine oil filter component. Part of the oil returns to the oil pump inlet through the overflow valve. After passing through the fine oil filter component, the lubricating oil is divided into two paths: one part passes through the small hole on the crankshaft to the big end bearing of the connecting rod, and then enters the oil hole on the connecting rod body to the small end bushing and the crosshead guide rail, so that the lubricating oil can reach each lubrication point; the other part goes to two sets of packing cylinders for packing cooling.

The rolling bearings of the crankshaft are lubricated by splash oil.

* **Cylinder and packing lubrication**

Two-shaft extension explosion-proof motor



Coupling shell

Oil level gauge

Handle

Oiler

Lube pump

Coupling

Reducer

Plunger pump head

**Figure 6-3 Oiler (Oil injector)**

The lubrication of the compressor cylinder and packing is driven by the oiler at the rear shaft of the explosion-proof motor, which lubricates the first and second cylinders and the second row of packing. The oiler (as shown in Figure 6-3) consists of a plunger pump, an oil tank, a base, an oil pan, a reducer and an explosion-proof motor. The plunger pump is the main component of the oiler, which is fixed to the top surface of the oil tank by screws and driven by the explosion-proof motor to lubricate the compressor cylinder and packing with pressure oil. The maximum oil injection pressure reaches 32MPa, which greatly improves the reliability of the compressor operation and extends the service life of the piston ring and packing. For specific instructions, please refer to the factory documents of the supporting manufacturer.

The diaphragm check valve (as shown in Figure 6-4) is manufactured by our company with Austrian technology. It is used in pressure lubrication systems to prevent oil from flowing in reverse and to keep a certain back pressure in the oil return line . There is an inspection hole at the inlet of this valve, which can be used to check whether there is oil in the oil pipe or whether there is gas backflow.

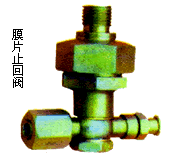


Figure 6-4 Diaphragm check valve

* **Lubricating oil** .

The amount of oil in the compressor crankcase is about 25L, and the amount of oil should be between the two scales of the oil dipstick. It must be checked with an oil dipstick before each start. It should not be too much or too little. It can also be appropriate to make sure that the lubricating oil level does not exceed the rotation space of the crankshaft balance iron. The recommended lubricating oil is 4513-N100 synthetic compressor oil produced by Chongqing Yiping Advanced Lubricating Oil Company. This lubricating oil has excellent chemical stability at high temperatures, is not easy to form carbon deposits and colloids, has no reaction to sealing materials and compressed gases, is water-soluble, has low solubility in hydrocarbon gases, can prevent dilution by compressed gases during operation, maintain appropriate operating viscosity, extend service time and equipment life, and this type of lubricating oil is biodegradable and does not require recycling, which is beneficial to environmental protection.

The oil of a new unit should be changed every 200 hours of use. After 200 hours of operation, the oil of a unit can be changed every 3000 hours. You can also take samples and analyze them regularly to determine the oil change cycle, or seek advice from lubricant manufacturers. Chongqing Yiping Lubricant Technical Service Hotline: (023) 68799368.

The substitute oil must meet the working condition requirements of the high-pressure reciprocating natural gas compressor, and the oil temperature must be able to meet normal operation at 80°C, and the oil flowability must be good at a low temperature of -20°C; the main performance indicators of the 4513-N100 synthetic compressor oil selected for this machine are as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Quality Index | | | |
| No. 68 | No. 100 | No. 150 | No. 220 |
| Density (20℃), g/cm3 | 1.00～1.10 | | | |
| Kinematic viscosity, (40℃) mm2/S | 61.2～74.8 | 90～110 | 135～165 | 198～242 |
| Viscosity index not less than | 180 | 190 | 200 | 210 |
| Flash point (open), ℃ not less than | 220 | | | |
| Pour point, ℃ not higher than | -40 | | | |
| Neutralization value, mgKOH/g not more than | 0.2 | | | |
| Mechanical impurities, ﹪ (m/m) not more than | 0.01 | | | |
| Moisture content, ﹪ (m/m) not more than | 0.2 | | | |

Yiping brand 4513-N100 synthetic compressor oil is equivalent to foreign oil brands:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| YP BRAND | SUMMIT | SHELL | AGIP | CIP |
| No. 4513 | PGS-100 | MODRELA GS | DICREA S150 | CP-1508-100  CP-1507-100 |

## 6. Compressor electrical equipment system

See electrical manual for details.

# Ⅵ. Installation and use of compressor

## 1. Installation of compressor

Due to the complex structure of piston compressors, the nature of reciprocating motion and pulsation impact, the quality of the machine assembly is crucial to whether the compressor can safely achieve the function of the machine during operation. Therefore, this compressor has been installed in strict accordance with technical requirements and installation processes before leaving the factory, and has undergone running-in and load testing. All major performance indicators meet the design requirements. Users do not need to disassemble and reassemble or adjust the original parts before use. If the specified storage date is exceeded, it must be disassembled and inspected, and reassembled according to the gap size provided in the quality certificate. If it is not used for a long time, an oil seal should be used.

The foundation of the compressor must be constructed according to the foundation drawing provided, and ensure that the compressor is at an appropriate distance from the building and other equipment to allow for maintenance and sufficient operating space. In addition, the foundation surface must be very flat to avoid deformation of the compressor body due to uneven foundation, which may cause unnecessary vibration.

If the ambient temperature is too low, the lubricating oil viscosity will be high, the oil pipeline resistance will be large, and the oil pressure will be low, which will make it difficult to start; if the ambient temperature is too high, the exhaust temperature will be high, which will reduce the performance of moving parts and seals, thus affecting their life. The ambient temperature of the compressor should be -10 to +40℃ when it is working. When it is lower or higher than this temperature range, heating or ventilation measures should be taken.

When the installation conditions are ripe, the whole machine can be installed:

* Lifting:

The main unit of this compressor is skid mounted. It must be lifted by professionals using wire ropes to lift the lifting points on the skid. Other reasonable lifting methods can also be used to lift the whole unit according to the actual situation, but safety and reliability must be guaranteed. Pre-lifting check whether there is any contact between the wire rope and the unit. If there is, it should be protected; after three trial lifts, it should be officially lifted slowly without any unbalanced weight; when it is in place, inclined iron pads must be placed around the skid for automatic leveling. **After the installation and connection, the compressor unit needs to be replaced with gas before formal operation to exhaust the air in the compressor and its pipelines** .

## 2. Before the compressor is put into normal operation, the following conditions should be noted and checked:

* Check the tightness of each connection part, especially the tightness between the gas connection parts.
* Check whether the quality and quantity of lubricating oil meet the specified requirements. The oil level in the crankcase should be between the two scales of the oil dipstick. If the amount is insufficient, add oil in time; shake the oiler by hand and check the oil supply from each diaphragm check valve.
* Manually crank the car to check the flexibility and reliability of moving parts.
* Check whether the indications of each testing instrument are correct and whether there are calibration certificates.
* Check the integrity of the motor and cables. There should be no looseness or other obvious defects on the electrical components.
* Turn on the power supply to make the electrical system ready for starting, and check whether all control and safety devices are sensitive.

reliable.

* If all the above is normal, you can start the compressor, otherwise make corresponding inspections.

## 3. After the compressor starts to operate normally, you should always pay attention to and check the following situations:

* The compressor should run smoothly and all moving parts should make normal sounds.
* The connecting flange parts, shaft seals, inlet and exhaust valves, cylinder heads and pipelines must not leak air or oil.
* The inlet and exhaust valves should work normally, and there should be no abnormalities in the safety valve.
* The exhaust temperature at each level should meet the specified requirements.
* Check the sewage discharge device regularly to ensure timely discharge and observe whether the sewage valve is blocked.
* The lubricating oil pressure should be within the range of 0.15-0.4MPa and should not be lower than 0.15MPa under any circumstances.
* For automatic control of compressors, please refer to Compressor Electrical Equipment System

## 4. Compressor shutdown

There are four types of compressor shutdowns: automatic shutdown, manual shutdown, emergency shutdown, and fault shutdown. Automatic shutdown is a normal phenomenon. At this time, the compressor is in standby mode and may start at any time. No maintenance work should be performed on the compressor to prevent accidents. Manual shutdown is caused by the alarm of the compressor unit automatic control system or other external factors. At this time, solve the alarm cause or wait for a while before manually starting it. Emergency shutdown is an emergency measure taken when an unexpected situation occurs that may affect the normal operation of the compressor. At this time, there is a large amount of high-pressure gas in the compressor. It is recommended to manually vent

# Ⅶ. Repair and maintenance of compressor

Compressors are usually assembled into assemblies first, and then the final assembly is done. The assembly of a repaired compressor is somewhat different from that of a newly manufactured compressor. In order to utilize the original parts, the assembly dimensions and clearances are not as strict as those of newly manufactured parts, and are often allowed to be slightly larger or smaller than when they were manufactured. During assembly, the repairman must eliminate the errors of the parts during machining and the accumulated errors in the fit, so as to ensure the geometric accuracy and fit requirements of the assembly. In addition, defects such as scratches, abrasions and cracks must be repaired, and the geometric dimensions of the assembly must be measured and inspected.

## 1. Preparation before compressor installation and disassembly

* The relevant technical data and maintenance process sheets of the compressor must be available. The repair personnel must digest and master these technical data.
* Before assembly, the construction site must be prepared with tools, clamps, measuring tools, materials and auxiliary supplies for assembly.
* The cleaned parts should be classified and placed in designated locations.
* The assembly and disassembly site must be clean, well-ventilated and well-lit.

## 2. Assembly and disassembly of the compressor

When disassembling the cylinder, measures should be taken to prevent the cylinder from falling.

Generally, according to the maintenance requirements and workload, it can be divided into three types: **minor maintenance, medium maintenance and major maintenance** . Minor maintenance is irregular and mainly for inspection. Medium maintenance is generally carried out after 3000-6000 hours of operation, and major maintenance is generally carried out after 10000 hours of operation.

**Precautions:**

* Installation and disassembly work must be done carefully and meticulously. Repair personnel must be sober and calm, have a clear purpose, and fully understand the contents of the manual and relevant regulations.
* When installing and disassembling a compressor, several people usually work together. They should be under unified command and action and abide by safety operating procedures. Do not disassemble the machine without understanding its structure, principle, performance or purpose of repair. Try not to disassemble parts without faults.
* The repairer should understand the structure of the machine and the function of each component to prevent forgetting to install, installing incorrectly, and leaving residues in the machine.

Forgot to install, mainly forget to install washers, pins, spacers or fillers, etc. Special attention should be paid when assembling small parts.

Common mis-assembly phenomena include incorrect assembly procedures or wrong coupling parts, so special attention should be paid to the matching of assembly parts.

Excess objects left in the machine include iron filings, yarn ends, rags, nuts, bolts and tools, etc. They should be removed immediately upon discovery.

* Disassembly should create conditions for assembly. When disassembling, check the markings first, and if they are missing, add them immediately. The markings should be clear and the symbols should be approved.
* The dimensions and relative positions before and after assembly should be recorded in original form for inspection.
* When replacing or repairing parts to be installed, each part must be inspected and tested, and can only be assembled after it meets the technical requirements. Important parts should also be tested and inspected before formal assembly.
* All nuts should be tightened. Choose the right tools to make the tightening force uniform and appropriate. To avoid damaging the small nuts and oil pipe joints, tighten them gently.
* Each safety pin must be installed. Forgetting to install the nuts and other parts of the safety pin will cause accidents due to looseness. The pin should be aligned with the center. The adjusted machine can be tightened according to regulations, and then the pin hole can be drilled and assembled. It is absolutely not allowed to loosen the nut to align the pin hole.
* Bolts working under vibration conditions must be equipped with anti-loosening safety devices.
* When assembling oil and gas pipelines, prevent leakage.
* All processed surfaces of parts should be oiled. They should also be oiled immediately after cleaning to prevent rust.
* After the nut is removed, it should be screwed onto the corresponding bolt that was removed immediately. All removed nuts, washers, keys and pins should be placed in the small parts box.
* Be careful when installing and removing parts to prevent damage and scratches. For this purpose, you must use appropriate tools and adopt correct operating methods.
* After disassembly, the parts should be placed in order on the ground with wooden boards. The piston and piston rod should be hung vertically. The bearing shell should be reversed with the back of the shell facing up. The parts should not be placed against each other, but should be placed separately and firmly. The bearing gasket set should be wrapped in paper and marked. The open holes on the parts should be wrapped or covered with cloth.
* All parts to be inspected must be cleaned and burrs removed before measurement.
* During the assembly and disassembly process, try to avoid knocking, and use special tools to assemble and disassemble without damaging any parts.
* Each time the cotter pin and spring washer are removed, they cannot be used anymore and must be replaced with new ones.
* When cleaning, pay special attention to the joint surface and positioning surface. Remove burrs, oil stains and scratches on the above parts. The indexing line straight mouth and fitting surface should be flat and clean.
* Assemblers should not carry items that are not related to the work. If several tasks need to be performed at the same time, they should be performed one by one in order to avoid mistakes caused by rushing. If nuts, washers, pins, etc. are found to be missing, they must be searched for with all efforts. If alloy pieces, plugs of parts, fragments, etc. are found during disassembly, the cause must be found out.
* For abnormal wear and damage, the cause must be identified before it can be eliminated.
* The performance evaluation of assemblies must be carried out after the individual parts have been evaluated and assembled.
* Oil stains on the working surface cannot be removed with emery cloth or scraper, but should be cleaned with solution.
* When installing or disassembling parts that are fixed by several bolts, they should be loosened or tightened evenly; it is prohibited to loosen or tighten the bolts with a wrench or a wrench with a pad.

## 3. Disassembly and assembly methods of the main components of the compressor

* Piston and cylinder
* Disassembly:

┄┄Disassemble the cylinder head and each row of high-pressure cylinders.

┄┄Turn the flywheel to rotate the piston to the outer dead center.

┄┄Use the cross head wrench opening to fix the cross head and loosen the cross head nut.

┄┄Fix the crosshead nut and unscrew the piston - piston rod from the crosshead.

┄┄In order to avoid damage to the piston rod thread and damage to the stuffing box when the piston rod passes through the stuffing, a special thread protection sleeve (provided with the package) must be installed on the threaded end of the piston rod for protection (see Figure 8-1).

┄┄If the resistance of the piston rod is too great when removing it, do not operate it roughly. Push the piston rod back into the cylinder, check the cause, and then remove it after solving it.

┄┄Take out the piston - piston rod, arrange the piston ring and supporting ring in order, and make a record.

┄┄Disassemble the cylinder.

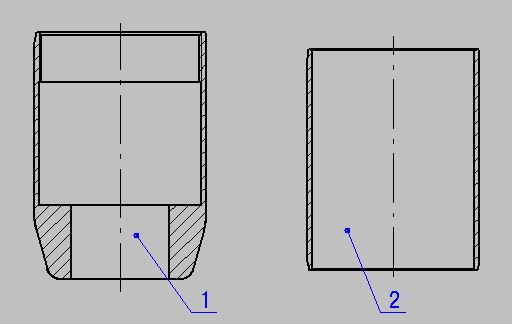
* Assembly:

┄┄During assembly, we recommend using new O-rings between the cylinders, the material should be fluoro-rubber.

┄┄Add a threaded protective sleeve to the threaded end of the piston rod (as shown in Figure 8-1).

┄┄Install the piston and piston rod into the cylinder, and install the piston ring and support ring in the reverse order of removal.

┄┄Remove the threaded protective sleeve after the piston rod passes through the packing.



**Figure 8-1 Threaded protective sleeve**

1. Protective cover A 2. Protective cover B

┄┄Screw the cross nut onto the piston rod.

┄┄Screw the piston rod into the crosshead and install the high-pressure cylinder. Turn the piston rod to adjust the inner and outer dead center clearances so that the clearances between the piston and the cylinder cover and cylinder seat meet the requirements of the quality certificate. The clearance value is measured by imprinting with lead wire.

┄┄Fix the cross head and tighten the cross head nut according to the tightening torque specified in Table 8-1.

* Air valve
* Disassembly:

┄┄Remove the intake and exhaust valve glands or cylinder heads.

┄┄Remove the pressure valve ring.

┄┄Use the pull hammer in the special tool to pull out the air valve and the air valve gasket.

* Load:

┄┄Carefully wipe the valve hole on the cylinder.

┄┄Insert new air valve gasket.

┄┄Install the air valve into the valve hole.

┄┄Install the valve ring. At the same time, pay attention to the correct placement of the support point of the valve ring on the air valve.

┄┄Insert the triangular washer or O-ring.

┄┄Press the gland evenly.

**Table 8-1 Tightening torque**

|  |  |  |
| --- | --- | --- |
| Nuts | Piston | 600 Nm |
| Crosshead | 7 00 Nm |
| Crankshaft balance weight bolt | | 280 Nm |
| Connecting rod bolt | | 150 Nm |

* Packing and oil scraper ring

The packing and oil scraper ring generally do not require maintenance. They only need to be inspected or replaced when a major overhaul or leakage is found.

* Disassembly:

┄┄After disassembling the first-stage cylinder or the second-stage cylinder, turn the cylinder upside down, first remove the uppermost oil scraper ring and then remove the connecting flange on the cylinder, take out the vacuum stuffing box, and then take out the stuffing box, low-pressure oil injection stuffing box, front stuffing box and pressure relief stuffing box in turn.

┄┄Take out the sealing ring from the stuffing box. Pay attention to the placement order of the rings when taking out the sealing ring. Also, note that the leakage sealing ring, main sealing ring and pressure relief ring are matched with the corresponding stuffing box, and they cannot be interchanged.

* Load:

┄┄When assembling the packing, it should be installed in the reverse order of disassembly.

* Connecting rod
* Disassembly:

┄┄Place the piston at the outer dead center and wedge it with a wedge.

┄┄Remove the shaft retaining ring of the cross pin.

┄┄Use a copper rod to knock out the cross pin.

┄┄Rotate the crankshaft to the appropriate position and remove the connecting rod from the opening in the crankcase opposite to the crosshead guide.

* Load

┄┄During assembly, tighten the connecting rod nut with a torque wrench to the torque specified in Table 8-1 and use a new lock washer.

Ⅷ. Failure and troubleshooting of compressor units

**Table 9-1 Compressor unit failures and troubleshooting**

|  |  |  |
| --- | --- | --- |
| Faults | Possible reason | Methods of troubleshooting |
| No enough gas | 1. There are leaks at various connection points in the gas process pipeline. 2. The piston ring or air valve is leaking. 3. The resistance loss of the air valve is too large. 4. The connecting nuts between the cylinders or between the cylinders and the cylinder heads are loose or the safety valves are not sealed tightly, causing gas leakage. 5. The first stage1111 clearance volume is too large. 6. There is air leakage from the packing seal. 7. The motor speed decreases. | 1. Check each connection with soapy water under pressure to find out the leak and eliminate it, and replace it if necessary. 2. Check the piston ring or valve and replace if necessary 3. Check or replace the air valve. 4. Tighten the nut and inspect the ground sealing surface. 5. Adjust the clearance volume. 6. Check the packing and replace related parts if necessary. 7. Check motor or grid voltage. |
| Each stage  pressure  does not  comply with regulations | 1. The pressure gauge is faulty. 2. The air valve is not working properly and is leaking. 3. There is a leak in the gas pipeline. 4. Packing leaks. 5. The valve plate is damaged, the spring is broken or loses its elasticity. 6. The cooling effect of the cooler is poor. | 1. Check pressure gauge or replace. 2. Check or replace. 3. Check the compressed gas process, identify the cause and eliminate it. 4. Check the packing and replace related parts if necessary. 5. Replace the gas valve. 6. Clean the cooler dirt. |
| Exhaust  Temperature is  too high | 1. There is too much dirt in the cooling pipe, which affects the cooling effect. 2. The air valve is leaking.   3. The piston ring is damaged or not sealed tightly, causing air to flow between the two ends of the cylinder. | 1. Remove dirt. 2. Replace the gas valve. 3. Overhaul or replace the piston ring. |
| Lower oil  pressure | 1. There is not enough lubricating oil in the crankcase. 2. The primary oil filter is contaminated or clogged. 3. The spin-on oil filter is clogged. 4. Oil pressure gauge malfunctioning. 5. The oil pump pipeline is blocked or damaged. 6. The oil pump has failed. 7. The lubricating oil quality does not meet the requirements and the viscosity is too low. 8. The clearance of lubrication parts is too large. | 1. Add lubricating oil. 2. Cleaning. 3. Replace. 4. Replace the oil pressure gauge. 5. Repair or replace the oil pump pipeline. 6. Check the sealing condition of the oil pump inlet and outlet ports. 7. Replace lubricating oil with one of specified quality. 8. Adjust the clearance of the lubricating oil part. |
| Abnormal sound from the compressor | 1. Metal blocks (such as valve plates, springs, etc.) fall between the cylinder head and the cylinder, causing a collision sound. 2. The roughness of the piston and cylinder mirror surfaces is damaged and they stick to each other. 3. The air valve is loose. 4. The connecting nut between the step pistons is loose. 5. The nut of the connecting rod bolt is loose. 6. The cross pin is stuck or displaced. 7. The wear of the connecting rod big end bearing causes the clearance to be too large. 8. The bearing cap is loose. | 1. Stop the unit in time and remove the metal block. 2. Remove for inspection. 3. Check and tighten the air valve. 4. Fasten the screw nuts. 5. Check nuts and tighten as specified. 6. Check the cross pin and the connecting rod small end copper bushing and replace if necessary. 7. Replace the big head bearing. 8. Tighten the nuts on the bearing caps. |
| The compressor lubricating oil temperature rises abnormally | 1. Poor lubricant quality or dirt. 2. The assembly clearance of the motion mechanism is too small or there are hard metal particles in the middle. 3. The combined clearance of the moving parts is poor. 4. The viscosity of the oil is not suitable for lubrication of this machine. | 1. Replace the lubricating oil that meets the requirements. 2. Readjust the gap and clean off the metal particles. 3. Adjust the gap to meet the specified value. 4. Replace with appropriate lubricant. |
| The motor does not rotate when the start button is pressed or stops rotating very quickly after starting. | 1 The external grid voltage is too low.  2 The wire connection is poor or broken.   1. There is a fault inside the starter. 2. The buttons and contactor contacts are dirty or damaged. 3. The motor itself is faulty. | 1 Check the grid voltage and eliminate the fault.  2 Check the cable connection parts and repair the damaged parts  3 Check the launcher.  4 Remove dirt and repair damage.  5 Check and repair the motor according to the motor manual. |

# Ⅸ. Parts Catalog

This parts catalog is for users to inquire and order spare parts for reference. The specific specifications should be based on the manufacturer's latest technical drawings.

## 1. Compressor mainframe parts catalog

**Table 10-1 Host components**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | HZ01.87 | Cylinder parts | 1 |
| 2 | HZ01.83 | Piston parts | 2 |
| 3 | HZ01.51 | Packing parts | 2 |
| 4 | ZP100.5 | Middle body parts | 2 |
| 5 | ZP100.3 | Connecting rod parts | 2 |
| 6 | HZ01.1 | Crankcase components | 1 |
| 7 | HZ01.2 | Crankshaft parts | 1 |
| 8 | ZP100.4 | Crosshead body parts | 2 |
| 9 | HZ01.88 | Cylinder parts | 1 |
| 10 | GB/T5780 | Bolt M10×25 | 2 |
| 11 | GB/T93 | Washer 10 | 2 |
| 12 | GB/T95 | Washer 10 | 2 |
| 13 | D-40/7\*1-0-5 | Pad | 1 |
| 14 | HZ01.2-3 | Hollow shaft | 1 |
| 15 | HZ01.0-1 | Tube | 1 |
| 16 | HZ01.0-2 | Connectors | 1 |
| 17 | JB/ZQ4454-86 | Sealing pad 20×24 | 1 |
| 18 | Q11F-16P | Ball valve 20 | 1 |

## 2. Connecting rod parts catalog

**Table 10-2 Connecting rod parts**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | ZP100TE\*93129820 | Connecting rod nut | 2 |
| 2 | ZP100.3-1 | Gasket | 2 |
| 3 | ZP100.3-2 | Connecting rod | 1 |
| 4 | ZP100TE\*03372877 | Connecting rod screw | 2 |
| 5 | ZP100TE\*25112456 | Connecting rod bearing | 1 |
| 6 | ZP100TE\*25112086 | Connecting rod bushing | 1 |

## 3. Crosshead body parts catalog

**Table 10-3 Crosshead body parts**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | GB/T894.1 | Retaining Ring | 1 |
| 2 | ZP100TE\*03876877 | Cross pin | 1 |
| 3 | ZP100.4-1 | Crosshead | 1 |
| 4 | ZP100TE\*93126477 | Screw plug | 1 |
| 5 | GB/T70.1 | Screws | 1 |

## 4. Parts catalogue of middle body components

**Table 10-4 Middle body parts**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | GB/T898 | Double-screw bolt | 12 |
| 2 | GB/T6170 | Nuts | 12 |
| 3 | HZ01.5-1 | Middle body | 1 |
| 4 | ZP100TE\*05797474 | Gasket | 1 |
| 5 | ZP100TE\*05792374 | Gasket | 2 |
| 6 | ZP100TE\*03002077 | Hand hole cover | 2 |

## 5. Crankcase parts catalog

**Table 10-5 Crankcase components**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | GB/T898 | Double-screw bolt | 12 |
| 2 | GB/T6170 | Nuts | 12 |
| 3 | ZP100TE\*10744074 | Bearing seat components | 1 |
| 4 | ZP100TE\*21311303 | Bearing cover | 1 |
| 5 | HG4-692-76 | Skeleton type rubber oil seal | 1 |
| 6 | ZP100TE\*21399046 | Gasket | 1 |
| 7 | GB/T898 | Double-screw bolt | 18 |
| 8 | GB/T6170 | Nuts | 44 |
| 9 | ZP180TE\*25199136 | Gasket | 1 |
| 10 | HZ01.1-1 | Crankcase | 1 |
| 11 | GB/T6175 | Nuts | 16 |
| 12 | GB/T898 | Double-screw bolt | 16 |
| 13 | ZP100TE\*05797474 | Gasket | 2 |
| 14 | ZP100TE\*05796274 | Gasket | 1 |
| 15 | GB/T898 | Double-screw bolt | 8 |
| 16 | HZ01.1-2 | End caps | 1 |
| 17 | ZP100TE\*05792374 | Gasket | 2 |
| 18 | ZP100TE\*03002077 | Hand hole cover B | 1 |
| 19 | HZ01.1-3 | Gasket | 1 |
| 20 | GB/T93 | Washer | 18 |
| 21 | GB/T897 | Double-screw bolt | 18 |
| 22 | HZ01.1.1 | Oil pan parts | 1 |
| 23 | HZ01.1.2 | Coarse oil filter parts | 1 |
| 24 | ZP100TE\*05830074 | Oil dipstick parts | 1 |
| 25 | ZP100TE\*03862677 | Hexagonal plug | 1 |
| 26 | JB/T1002-77 | Washer | 1 |
| 27 | ZP100TE\*05805274 | Oil rod casing | 1 |
| 28 | ZP100TE\*03002177 | Hand hole cover | 1 |

## 6. Crankshaft parts catalog

**Table 10-6 Crankshaft components**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | GB/T283-1987 | Bearings | 1 |
| 2 | GB/T893.1 | Retaining Ring | 4 |
| 3 | ZP100.2-1 | Keyboard | 1 |
| 4 | GB/T5783 | Bolt | 3 |
| 5 | ZP100TE\*03001977 | Stop washers | 1 |
| 6 | GB/T3452.1-1992 | O-Ring | 1 |
| 7 | ZP100TE\*03001877 | Key | 1 |
| 8 | ZP100.2-2 | Counterweight | 2 |
| 9 | ZP100.2-3 | Counterweight lock plate | 2 |
| 10 | ZP100.2-3 | Bolt | 4 |
| 11 | GB/T286-1964 | Bearings | 1 |
| 12 | GB/T894.1 | Retaining Ring | 1 |
| 13 | ZP100.2-2 | Crankshaft | 1 |
| 14 | GB/T1096-1979 | Key | 1 |
| 15 | ZP100.2-4 | Pressure ring | 1 |
| 16 | GB/T856 | Washer | 1 |
| 17 | GB/T5786 | Bolt | 1 |

## 7. Packing parts catalog

**Table 10-7 Packing components**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | HZ01 .51U-12 | Washer | 1 |
| 2 | HZ01 .51-1 | Pressure reducing ring stuffing box | 1 |
| 3 | GB/T1235-1976 | O-ring 110 × 3.1 | 2 |
| 4 | OR-90.00 × 3.00-FPM80 | O-ring | 1 |
| 5 |  | Pressure relief ring | 1 |
| 6 | HZ01 .51-2 | Main stuffing box | 1 |
| 7 | HZ01 .52-2 | Secondary cooling jacket | 1 |
| 8 | HZ01 .51-3 | Oil filling stuffing box | 1 |
| 9 |  | Main sealing ring | 7 |
| 10 | HZ01 .51-4 | Main stuffing box | 1 |
| 11 | HZ01 .51-5 | Low pressure stuffing box | 5 |
| 12 | GB/T6170 | Nut M6 | 2 |
| 13 | HZ01 .51-6 | Tie rod | 2 |
| 14 | GB/T1235-1976 | O-ring 120 × 3.1 | 3 |
| 15 | HZ01 .51-7 | Air pump ring | 1 |
| 16 |  | Leakage sealing ring | 1 |
| 17 | HZ01 .51-8 | Packing flange | 1 |
| 18 | HZ01 .51-9 | Oil baffle | 1 |
| 19 | ZP100TE \* 06066277 | Oil scraper gland | 1 |
| 20 | GB/T5781 | Bolt M8 × 50 | 4 |
| 21 | ZP100TE \* 25199036 | Oil scraper ring parts | 1 |
| 22 | HZ01 .51-10 | Baffle | 1 |

## 8. Cylinder parts catalog

**Table 10-8 Cylinder Parts A**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | HZ01 .87-1 | Connecting tube | 1 |
| 2 | HZ01 .87-2 | Connector | 1 |
| 3 | GB/T6170 | Nut M14 | 8 |
| 4 | GB/T898 | Double-screw bolt AGM14-M14×40 | 8 |
| 5 | GB/T898 | Double-screw bolt AGM16-M16 × 65 | 8 |
| 6 | GB/T6170 | Nut M14 | 36 |
| 7 | GB/T93 | Washer 16 | 36 |
| 8 | GB/T3452.1-1992 | O-ring 200×5.7 | 1 |
| 9 | GB/T898 | Double-screw bolt AGM16-M16×55 | 8 |
| 10 | GB/T95 | Washer 16 | 14 |
| 11 | OR-132.94 × 3.53-FPM80 | O-ring | 1 |
| 12 | HZ01 .87-4 | First stage cylinder | 1 |
| 13 | HZ01 .87-5 | Valve gasket Φ44/Φ49 × 1 | 2 |
| 14 |  | Exhaust valve 38DD | 1 |
| 15 | HZ01 .87-6 | First stage exhaust pressure valve ring | 1 |
| 16 | HZ01 .87-7 | Gland | 1 |
| 17 | GB/T898 | Double-screw bolt AGM16-M16 × 60 | 16 |
| 18 | HZ01 .87-8 | Sealing ring | 2 |
| 19 |  | Screw-in straight connector 25 | 5 |
| 20 | HZ01.191.10-9​ | Washer φ44/φ37×2 | 5 |
| 21 | OR-108 × 5-FPM80 | O-Ring | 1 |
| 22 | GB/T898 | Double-screw bolt AGM20-M20 × 65 | 6 |
| 23 | GB/T6170 | Nut M20 | 10 |
| 24 | GB/T93 | Washer 16 | 10 |
| 25 | HZ01 .87-11 | Second-stage cylinder | 1 |
| 26 | HZ01 .87-3 | Concentric valve gasket Φ70/Φ60.5 × 2 | 1 |
| 27 |  | Concentric valve 30R1/54C | 1 |
| 28 | HZ01 .87-13 | Stage 2 cylinder head | 1 |
| 29 | GB/T898 | Double-screw bolt AGM20-M20 × 80 | 4 |
| 30 | HZ01 .87-14 | Sealing ring | 1 |
| 31 | HZ01 .87-15 | Second-stage pressure valve ring | 1 |
| 32 | HZ01 .87-16 | Concentric valve upper gasket Φ40/Φ48 × 1 | 1 |
| 33 | GB/T827 | Rivets 2 × 6 | 4 |
| 34 |  | " No. one cylinder of second stage" label | 1 |
| 35 |  | " No. one cylinder of first stage" label | 1 |
| 36 |  | Intake valve 38DD | 1 |
| 37 | HZ01 .87-17 | Inlet flange | 1 |
| 38 | HZ01 .87-18 | First stage air intake valve ring | 1 |
| 39 |  | Screw-in straight connector 6 | 1 |
| 40 | HZ01 .87-1 | Washer φ20/φ14.5 × 2 | 1 |
| 41 | GB/T70 | Screw M16 × 50 | 8 |

## 9. Piston parts catalog

**Table 10-10 Piston parts**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Code | Name | Quantity |
| 1 | ZP100.21-9 | Lock washer | 1 |
| 2 | ZP100.21-8 | Cross head nut | 1 |
| 3 | HZ01.83-1 | Piston rod | 1 |
| 4 | HZ01.83-2 | First stage piston | 1 |
| 5 |  | First stage piston ring | 8 |
| 6 |  | First stage support ring | 1 |
| 7 | HZ01 | Piston nut | 1 |
| 8 | GB/T5783 | Bolt M6×20 | 6 |
| 9 | HZ01.83-4 | Contour washers | 6 |
| 10 | HZ01.83-5 | Ring | 1 |
| 11 | HZ01.83-6 | Second stage piston | 1 |
| 12 |  | Second stage support ring | 1 |
| 13 |  | Second stage piston ring | 9 |

**Drawing 1**