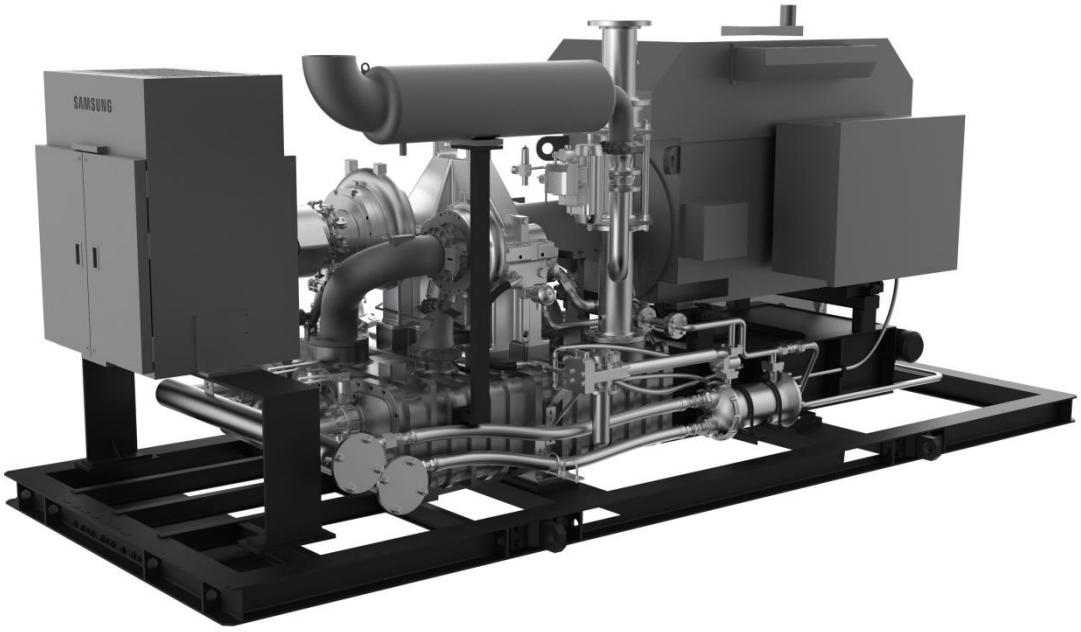
Hanwha Techwin

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

SM100



AIR COMPRESSOR (SM3100/SM4100/SM5100/SM6100)

Ed.11

2016-07-29

Normal

SM100 Manual

Air Compressor (SM3100/SM4100/SM5100/SM6100)

Thank you very much for purchasing equipment from Hanwha Techwin.

This document includes the guidelines for safety, installation, operation and repair and maintenance that will enable you to maintain consistent equipment performance at the max level, as well as the list of necessary replacement parts.

Hanwha Techwin guarantees that equipment delivered to you will have no problems in terms of design, material, manufacturing and performance. However, if you cause a problem by moving or changing the equipment without Hanwha Techwin's approval, or cause a defect due to your negligence, Hanwha Techwin will have no liability.

In addition, if you re-sell your equipment, the free warranty period will automatically expire.

If a problem occurs while you are using a Hanwha Techwin product, if you experience difficulties in achieving normal operation or if you want to purchase accessories, contact your agent or the service center of Hanwha Techwin.

Plant #2, Hanwha Techwin Co. Ltd. 1204 Changwon-daero, Seongsan-gu,
Changwon-si, Gyeongsangnam-do, Republic of Korea
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Thank you.

Hanwha Techwin

LIST

1. Preface

LIST

1.1 Purpose

This document contains the descriptions on the compressor manufactured by Hanwha Techwin and its operation and maintenance methods to ensure the best performance. The document describes the overall structures and functions of equipment, and how to install, operate and maintenance.

1.2 Audience

This document is for any personnel in charge of operating, servicing or installing the compressor.

1.3 Scope

This document describes the operation and maintenance procedures for a device manufactured by Hanwha Techwin. Regarding issues not discussed in this document, please consult Hanwha Techwin service agent. Certain basic turbo-machinery skills are prerequisite and so will not be covered in detail herein. Classes in Service and Operation of the compressor are available through Hanwha Techwin Support at:

http://www.hanwhatechwin.com/energy/customer/edu.asp

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1.4 Documentation History

The history of document is as below:

Ver.	Date	Revision
00	2015.04.30	First issued
10	2015.10.30	Equipment specification changed
11	2016.07.29	‘Expansion Joint’, ‘Refill and Replace of Oil’ updated

1.5 Warranty

Hanwha Techwin guarantees that delivered product is free of faults in terms of design, material, manufacturing and performance. After equipment is delivered to customer, during the warranty period, if a defect is observed in spite of the correct use of the equipment as stipulated in the manual provided, the manufacturer will provide repair or replacements.

However, even if the warranty period is not yet expired, if a fault occurs due to the purchaser's negligence in handling, storage or use, or arbitrary use not in accordance with the guidelines set forth in the manual, the manufacturer will not be responsible for any damage that occurs in such a situation. So, be careful. For more details, refer to 1.5.2 Warranty Exceptions.

The Fault warranty remains valid only for details notified in writing to Hanwha Techwin from the date of the confirmed quality control test completion to the expiration of the warranty.

1.5.1 Period

Hanwha Techwin provides warranties for the compressor during the following periods (whichever comes first).

- 18 months have passed since the delivery to customer.
- 12 months have passed since the installation.

If otherwise specified in the contract, however, the contract will take precedence over the aforementioned warranty periods.

1.5.2 Exceptions

In case of any of the followings, the warranty is not applied.

- In case equipment operates beyond the designed scope or gets damaged due to any work unrelated to the operation.
- The degradation of equipment with the passing of time or any abnormal condition caused by wear including natural discoloration of painting or plating, wear of consumables, etc.
- Any delicate and sensible phenomenon that does not affect quality and function (e.g. any sound generated from controller, sound of motor rotation, etc.)
- Any disorder caused by the operating environment (e.g. moisture and foreign matters, dust on a machine, oil mist, etc.)

If the cause of disorder is any of the followings, the warranty is not applied.

- Natural disasters including earthquake, typhoon, flood, lightening, etc. or accidents or fires
- Modifications unauthorized by Hanwha Techwin or agent
- In case the user uses unauthorized parts or lubricating oil
- Inadequate or faulty repairs and checks

1.6 Service Center

For the detailed information on the compressor, please contact the vendor from which you purchased your compressor, or contact Hanwha Techwin service center directly.

Address: Plant #2, Hanwha Techwin Co. Ltd. 1204, Changwon-daero, Seongsan-gu, Changwon-si, Gyeongsangnam-do, Republic of Korea

Tel: +82-55-260-2571

2. Safety Precautions

LIST

Before Installation and operation of the product, read this document in order to use the product safely and correctly.

Notice performed in accordance with procedures described in the body of this article, where the product is applied across the installation and operation are described safety precautions.

2.1 Special Warning

Operate the system in conformity with electrical specifications.

Using any voltage against the specifications or changing input voltage incorrectly may cause a fire, or an electric shock which can result in death.

While driving on a rotating part is not accessible or demolition.

Any access to the rotating drive or dismantlement is not allowed during operation for the purpose of repair or replacement. If access to such rotating part or coupling, fingers or clothes retracted may cause serious casualties.

Be sure to wear protective equipment during work around compressor.

Wear protective equipment to operate or control the unit. Failure to observe may serious injury or death of personnel when exposed to high pressure and/or high temperature gas.

Around the compressor used in the radio can cause a malfunction.

Radio or cell phone while driving the compressor using electronic devices such as control of the compressor may affect device. This is causing a malfunction in the compressor can cause damage.

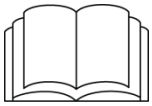
Do not touch the compressor while or immediately after operation.

Touching while or immediately after operating the compressor may cause burns.

2.2 Special Caution

Be sure to wear protective equipment during work.

Exposure to compressor operating environment may cause personnel injury including damage to hearing, burn, etc. Be sure to wear protective equipment to protect human body during work.



Read and understand manual before installation, operation or maintenance.

Unless manual is read and understood before installation, operation or maintenance, malfunction or wrong maintenance may cause serious damage to the compressor.

2.3 General Warning

If you don't follow the following instructions closely, you may be severely injured or even die. Workers must follow the instructions.

When you lift this equipment, do it in a designated area.

If you lift it in a non-designated area, accidental dropping of the equipment can cause it severe damage.

Operate the system in conformity with electrical specifications.

Using any voltage against the specifications or changing input voltage incorrectly may cause a fire, or an electric shock which can result in death. Be sure to operate the system in conformity with electrical specifications mentioned in this document.

Before operating the compressor, you must install the coupling cover.

The coupling rotates at a very high speed. So, if a contaminant enters it, it will be shot out of the machine and cause danger to the equipment itself or humans nearby.

Do not perform any repair work while the machine is in use.

During operation, do not approach the equipment for repairs or replacements or disassemble the equipment. Compression gas and high temperatures can cause damage to humans.

Operate equipment under the safe environment.

Do not operate the system in any places with inflammable material or seriously contaminated places. If you operate equipment in unsafe places, an explosion or fire may cause serious damages to equipment.

Turn off all power before repairing the equipment.

Before repairing the equipment, to prevent electrical shocks, you must turn off all power. After shutting down the machine, some parts may still contain electricity, so you need to wait for 10 minutes before you can perform repair and maintenance.

2.4 General Caution

If you do not follow these instructions, accidents can occur or you can suffer from physical damage. You must always follow these instructions.

Access the power source more than 10 minutes after the system stops.

Power may exist in the power source even after equipment completely stops. Never disconnect 3-phase power or access the power source immediately.

Before connecting the coupling, you must check the correct direction of rotation.

If the motor rotates in the wrong direction, it can cause damage to the equipment or humans.

Check the supply of lubricant before operating the equipment.

If you operate the equipment without supplying a sufficient amount of lubrication, the pump/motor can get overheated and/or malfunction or it can cause adhesions of the bearing.

Do not open the lubrication system while the equipment is in use.

During operation, the oil temperature and pressure will increase. During use, if you open parts of the lubrication system, hot and high pressured oil can cause injuries.

There is no additional wiring required inside control panel.

If a user operates equipment as user wants, an accident may be caused. In this case, the user shall be liable for the accident.

Install check valve, aligning with the direction indicated on the surface.

Installing check valve against the designated direction on pipe may cause serious damage to compressor.

Pay attention to the high pressure condensed water when discharging it.

In some cases, condensed water can be discharged with high pressure. So, when you discharge it, you need to open the valve gradually to minimize the effect of high pressure. In addition, if high pressure generates noise, you need to wear ear plugs.

3. Compressor Package

LIST

3.1 Definition of Equipment

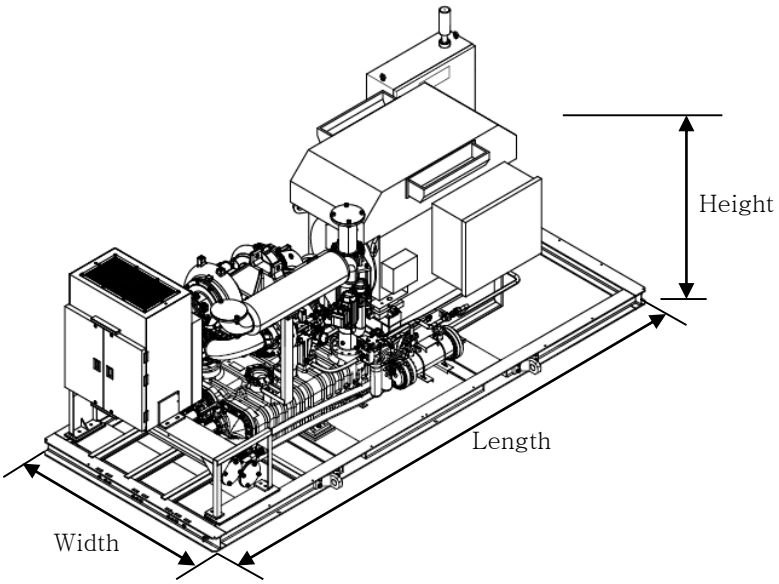
The compressor is driven by main motor and connected with bull gear set using coupling. When the bull gear set and pinion increase rotation speed, inhale gas and produce high pressure gas.

The open impeller and air foil diffuser of the compressor provide high efficiency over the entire operating range. Endurance test and performance test also offer high reliability in safe environment.

Control logic with Auto-dual (modulating, option) is used to maintain optimum operating conditions.

Dimensions of equipment

Dimensions of equipment are as follows.



		SM3100	SM4100	SM5100	SM6100
Dimension	mm	5,220x2,090x2,060	5,510x2,150x2,150	6,450x2,200x2,390	6,910x2,200x3,050
	Inch	217x82x81	217x84x84	254x87x94	272x87x120
Weight	kg	8,900	11,100	13,600	16,000

※This number may change depending on the details of the model.

Scope of supply

Scope of supply of SM100 series is as below. If you want to add option items, please contact Hanwha Techwin service center.

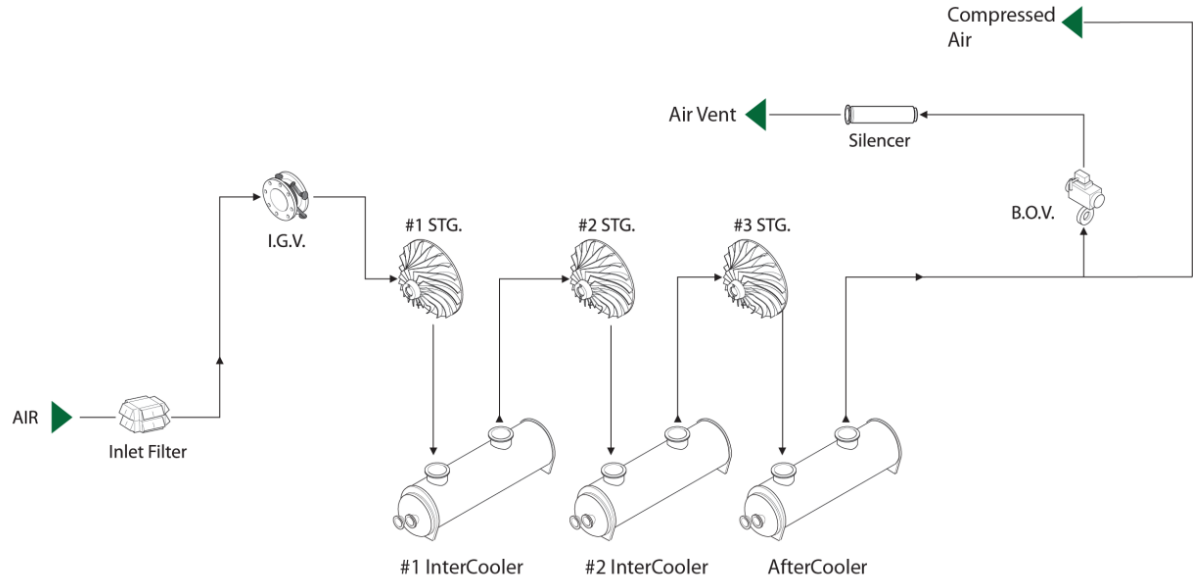
Standard	Option
Air Inlet Filter – Package Type	Air Inlet Filter – External Installation Type
Inlet guide vane	Air inlet filter differential pressure gauge
Blow off valve and Silencer	Dual oil filter
Check valve and expansion joint	Block valve
Complete lubrication system	Companion flange
After cooler	Auto trap for drain
Drain valve on all coolers	MODBUS / PROFIBUS interface
Main motor	Motor winding / bearing protection
PLC control system	
Base frame	
Cooling water manifold	
Sound enclosure	

3.2 Principle of System Operation

When starting the system, the impeller is rotated by the main motor/steam turbine, inducting the process gas through inlet filter and compressing the gas. The compressed gas is cooled by intercooler, installed between each stage, and dehumidified by auto trap to generate the refined compressed gas.

The compressed gas generated is cooled by the after cooler at the rear and supplied to users via the discharge check valve. In order to maintain the pressure at certain level, part of compressed gas is discharged through BOV (Blow-Off Valve).

Before or during operation of the compressor, the lubricant must be supplied to the gear and the bearings at all times. The lubricant must be supplied at a reasonable temperature and pressure, therefore a Main Oil Pump (MOP) or an Auxiliary Oil Pump (AOP) runs for a certain period of time.



Please see Below for System performance.

		SM3100	SM4100	SM5100	SM6100
Flow Rate	m3/hr	3,300~5,500	5,500~9,000	9,000~15,000	15,000~24,500
	CFM	2,000~3,250	3,250~5,300	5,300~8,800	8,800~15,000
Power	kW	200~580	300~930	500~1,500	800~2,500
	HP	270~780	400~1,200	670~2,010	1,070~3,350
Discharge Pressure	barA	3.5 ~ 13			
	PsiA	50~188			

※This number may change depending on the details of the model.

3.3 Inlet Filter

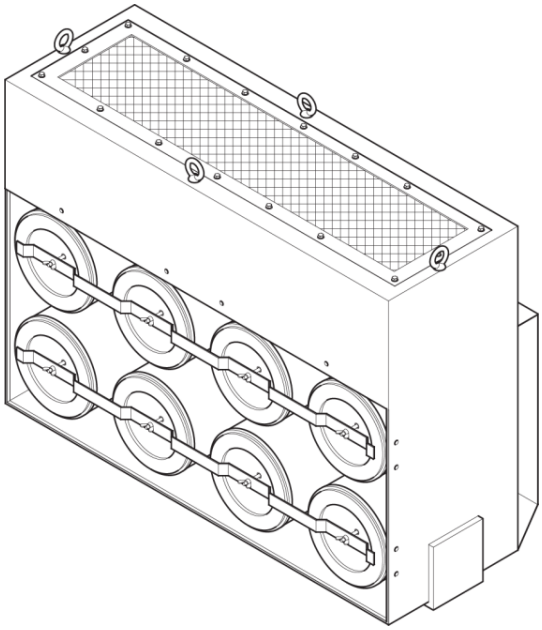
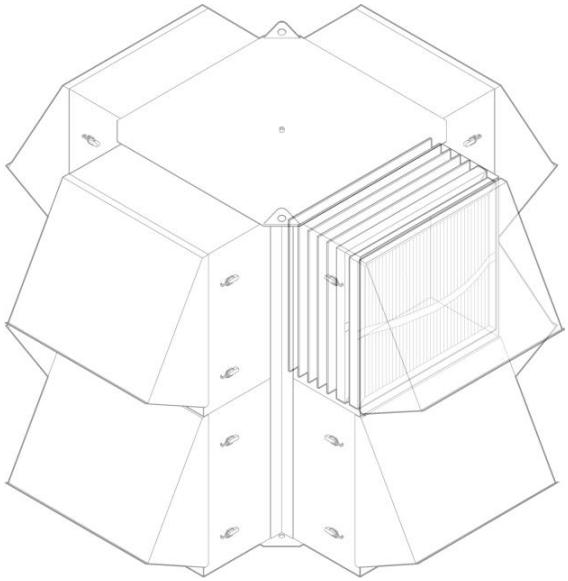
For compressor, it is important to manage intake of gas. Foreign material can be easily accumulated in the compressor because of its structure. Accumulated contaminants can cause corrosion as they produce other chemicals in the compression process and cause negative effects such as reducing the lifespan of parts. The inlet filter can purify the gas inhaled into the compressor to prevent the entry of contaminants into the equipment.

Use an authorized inlet filter only.

If you use an unauthorized filter, particularly one of inferior quality, it will not properly filter out contaminants in the suction air, which can lead to damage to the core or performance degradations. Management of the suction air quality can greatly affect the compressor performance or lifespan, so you must use an authorized filter only.

Depending on the equipment specs or the installation environment, you can use different types of filters. The repair and maintenance method depends on the filter type.

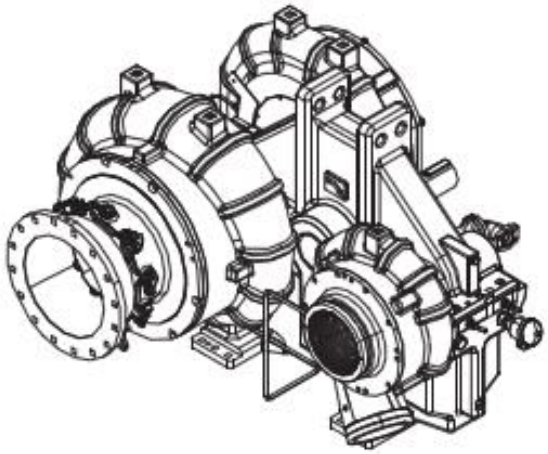
Please refer to the manufacturer's document or 'Maintenance' in this manual for details

Package Type	External Installation Type *Option
	

※This equipment may differ from the image.

3.4 Core

The core assembly is a key module in the compressor and its role is to produce high pressure gas. The core assembly is connected to the main motor and operated by the rotating motor. The core is composed of driving parts such as the bull gear, the pinion gear and the bearing; and aerodynamic parts such as the impeller, the diffuser and the scroll.



IGV (Inlet Guide Vane)

The IGV is located at the front of the first stage of the compressor. And it adjusts intake of fluid. It receives electrical signals of 4 to 20mA and adjusts the opening of the valve by 0 to 100%. The IGV creates a pre-swirl when process gas is inhaled, in order to minimize loss of the process gas.

IGV is divided into two types, electric and pneumatic type, depending on the actuator. Basically SM100 is operated with electric actuator. Pneumatic actuator also may be used on the request of customer.

Impeller

The impeller inhales and compresses the process gas. It is connected to the pinion shaft and located in each stage of the core assembly. The impeller receives mechanical energy from the main motor to create the rotation. In the process of discharging in the radial direction, centrifugal force is used to increase the gas pressure. The impeller applies an open type to implement high efficiency and a wide range of operation. It is made of corrosion resistant materials.

The impeller is precisely balanced to guarantee the stable operation at high speed.

Diffuser

The process gas from the impeller passes through the diffuser for effective pressure increase before it enters the scroll case. The kinetic pressure of process gas increased at the impeller increases the static pressure as the gas speed decreases after passing through the impeller. The air foil diffuser is used for this compressor for high efficient and wide operation range.

Scroll Case

The scroll case changes the radial direction of process gas discharge via the impeller and the diffuser to the axial direction, so that the process gas may be transported onto the next step. In addition, in this step, it works in tandem with the diffuser to increase the pressure of the process gas.

Bearing

The bearing supports the weight applied to the pinion shaft and helps the shaft to maintain the same location while rotating reliably. The bearing is assembled on the sides of the bull gear and the pinion gear.

The compressor has radial bearing and thrust collar on the pinion. Sleeve journal bearing and taper landed thrust bearing are used on bull gear by considering oil whip status at high speed.

Use only specified bearing.

The only specified right/left bearing must be used due to rotating direction even through bearing type and location on shaft are same.

Sealing System

The compressor seal is used to prevent leakage of gas and oil. While the compressor is in operation, the core process line is filled with high-pressure gas. Without the seal, the high-pressure gas leaks into the oil line and the oil leaks into the process line, exerting an adverse influence on the performance and safety of the compressor as well as the quality of the gas.

A labyrinth seal was applied to the compressor to minimize leakages of gas and oil. The seal keeps the gap in the process line and oil line to a minimum, and discharges the gas leaking from the narrow gap to the outside through the vent line.

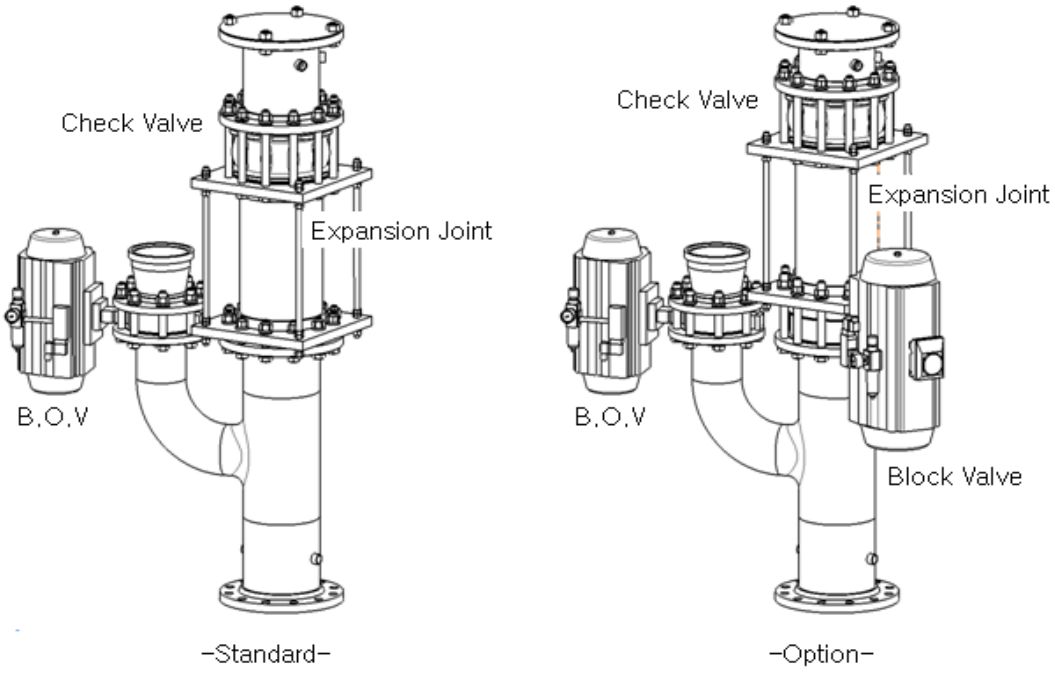
Gear Set

A gear set is a device used to change the rotational speed of the motor to that of the impeller. The gear set is composed of the bull gear and the pinion gear. When the bull gear is rotated by the main motor, the pinion gear will accelerate and as a result, the impeller assembled in the pinion shaft will rotate at high speed.

The gears used in the compressor are manufactured in compliance with the quality requirements of the American Gear Manufacturers Association (AGMA). Since not only materials but also machining process is managed, the gears are manufactured to precise AGMA grade 12(Bull gear)/13(Pinion gear) for high speed and stable speed operation. In accordance with AGMA safety standard, sufficient life is applied for superior durability and strength.

3.5 Compressed Air Discharge System

The compressed air discharge system delivers the compressed air produced in the compressor to users and prevents the compressed air from flowing back to the inner area of the compressor while the compressor is operating or is stopped.



Discharge Check Valve

The check valve prevents the high pressure air outside the compressor from flowing back into the compressor, and minimizes the flow impacts generated while the compressed gas flows. For normal operation of the check valve, the direction of valve operation should match the direction of the process gas flow. The parts front and rear the check valve should have straightness with a certain length.

For more details, refer to 'Installation' in the manual.

Expansion Joint

The compressed gas has high temperature and pressure, so the pipe where gas passes through will repeatedly expand and contract depending on the temperature changes. The expansion joint is installed between the pipes to minimize the impacts of contraction and expansion of the pipe caused by the compressed air.

BOV (Blow–off Valve)

When the compressed gas pressure exceeds setting level, the BOV discharges part of gas to the outside to adjust the pressure and to prevent surges of the compressor.

Silencer *Option

The silencer is connected to the rear of the BOV, it minimizes the noises generated during surges or compressor shutdown.

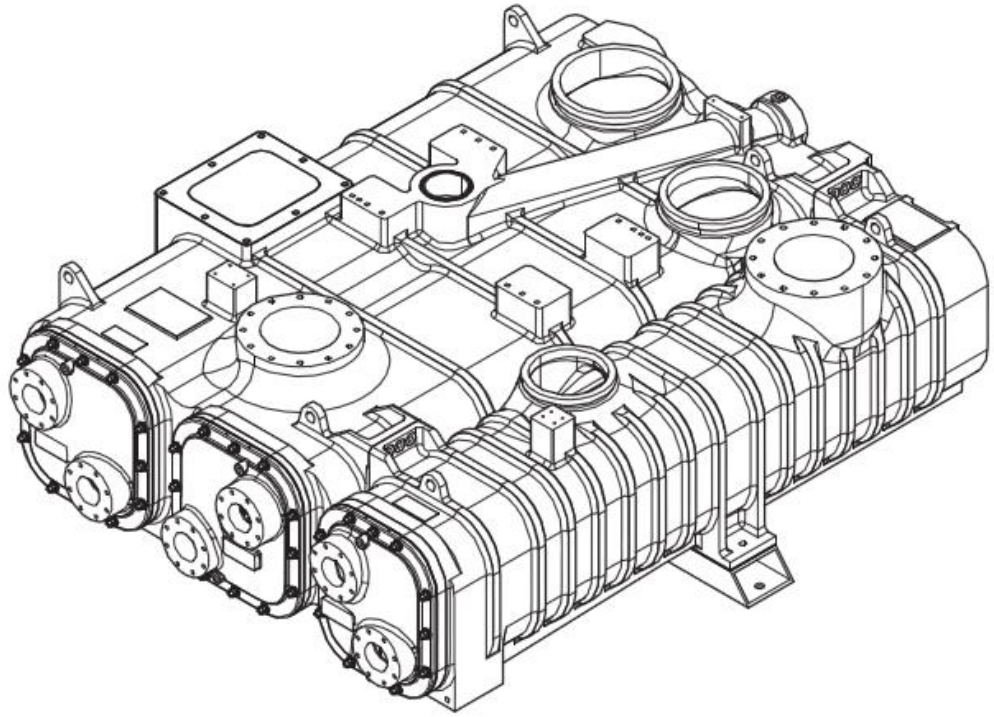
Block Valve *Option

Just like the check valve, the block valve prevents the high pressure air outside the compressor from flowing back into the equipment.

3.6 Cooling System

Cooler decreases the process gas temperature increased through compression at the rear of each stage, and increases the compression efficiency at the next stage. Heat exchanger for compressor can be selected among various types depending on the design condition.

The finned-tube type cooler is applied to the compressor to improve heat transfer rate and also to use the space more efficiently.



Condensate water can build up in compressor due to water in the gas condensing during operation. Condensate water causes performance degradation and freezing and bursting at temperature below zero. Therefore, user should discharge condensate inside through regular inspection.

Auto Trap *Option

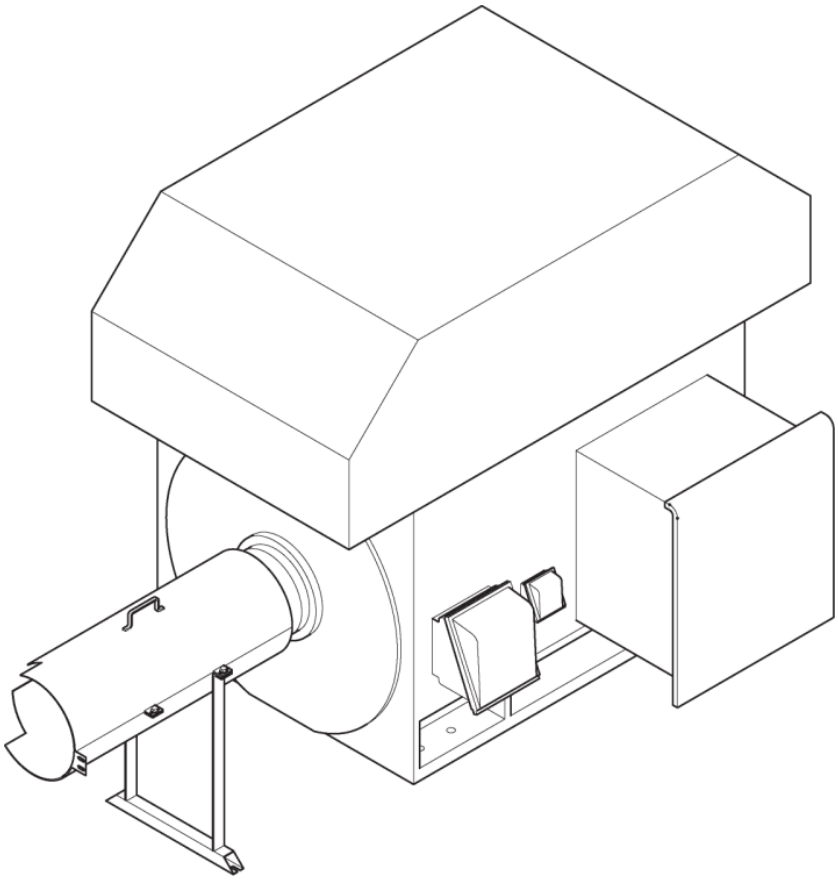
When the amount of condensate exceeds setting level, an auto trap is opened the auto drain valve and discharged the condensate out of compressor. The auto trap also prevents the movement caused by adverse pressures generated during discharge of the condensate.

3.7 Main Driver

Main Motor

The main motor, a power source of compressor, is connected to the gearbox through a flexible coupling. The main motor converts electrical energy into mechanical energy. The type and size of the motor depend on voltage, frequency, cooling type, prevention grade, bearing lubricating method, etc. When installing the main motor, care must be taken that the motor and compressor are not damaged by checking the rotation direction after turning on the power prior to connecting the coupling. Backlash may cause damage to the motor and compressor. Also it can cause electric shock, so care must be taken for installation and check.

Please refer to the manufacturer's document for details of the motor.



Coupling

The coupling transfer torque from the main motor to the core to operate the compressor. In addition, when compressor is in overload condition, it can protect the core and absorb effects of misalignment of the motor/core to improve the lifespan of the compressor.

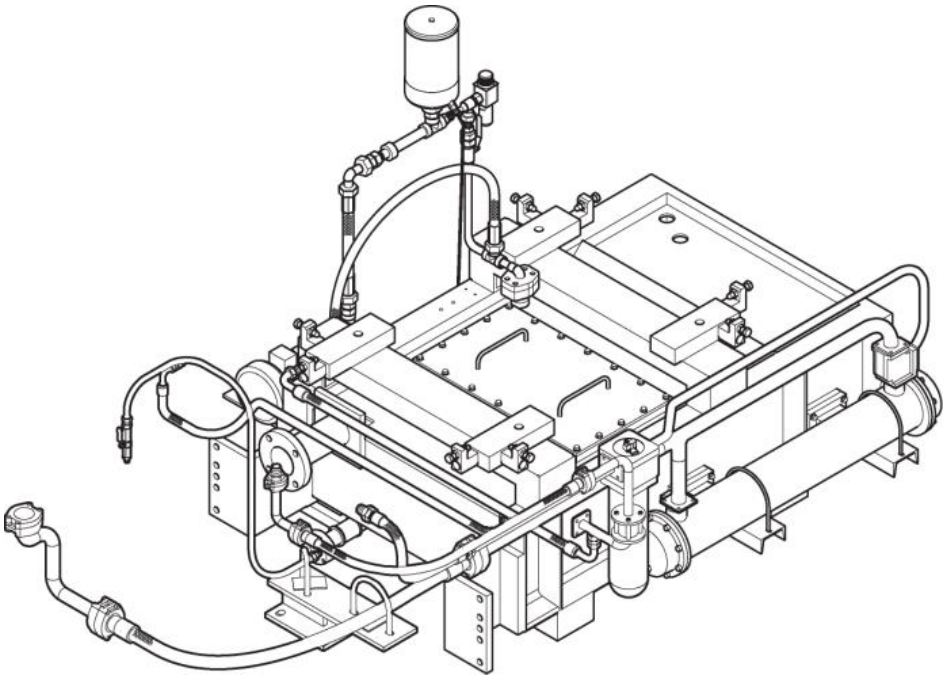
The coupling types of each model are as follows:

- Geared Type: SM3100, SM4100
- Disc Type: SM5100, SM6100

Please refer to the manufacturer's document for details of the coupling.

3.8 Lubrication System

When the compressor operates, each lubricating area generates friction heat. The accumulated heat may cause bearing to be stuck. Lubrication system supplies oil to each lubricating area of motor and inside gear box to prevent friction and abrasion and cool down the friction area.



Oil Reservoir

The oil reservoir is an oil-storage for operating the equipment. The tank is equipped with an oil demister, an oil heater, an oil level gauge, and etc.

MOP (Main Oil Pump)

The MOP is a device used to create proper pressure and convey adequate supplies of oil to the rotary parts of the compressor. It is connected to the main motor and the bull gear. They rotate together to supply oil when the motor is in operation.

AOP (Auxiliary Oil Pump)

AOP is used to increase the oil pressure and convey oil. Mainly, in the early phase of compressor operation, until the MOP can operate normally, the AOP is used to supply oil to each part of the compressor. In addition, if a sufficient amount of oil is not supplied due to a malfunctioning MOP, it operates to prevent damage to the compressor parts.

Oil Cooler

The oil cooler is installed at the rear of the oil pump and it cools the overheated oil off. During compressor operation, after moving through the rotary parts, the oil temperature gets very high. In this case, the lubrication ability and quality are suddenly degraded, so cooling of the oil is required.

Oil Strainer

The strainer performs as primary filter to prevent contaminants in the oil reservoir from entering the oil system including the oil pipe and the compressor's rotary parts.

Oil Filter

The oil filter is installed at the front of the lubricant unit to filter out contaminants from the oil. The compressor's oil repeatedly passes through the rotary unit, so it is likely to get mixed with fine metallic dusts and external contaminants. If oil with pollutants is supplied to the rotary parts, the parts may get damaged or the lifespan of the equipment can be reduced. So, it is necessary to manage contaminants carefully.

If elements are clogged with contaminants that were filtered out while using the oil filter, the differential pressure meter can send alarms. When you check alarms from the differential pressure meter, replace the element immediately to prevent possible problems with oil flows.

Oil Demister

This device is used to maintain the vacuum of the gear box and the oil reservoir. While discharging the air from the oil reservoir, its other role is to filter out oil mists.

Oil Heater

This increases the compressor oil temperature to aid normal operation of the gear and the bearing. But if the oil temperature is too high, then the lubrication ability will be degraded and the replacement period can be reduced. Therefore, it is designed to only operate within a certain temperature range.

If the oil heater is switched on while the oil is not circulating, the oil near the heater can be heated and hardened in the end. In order to prevent this problem, the system is designed to operate the AOP automatically if the oil heater is switched on.

PCV (Pressure Control Valve)

This device is used to maintain consistent oil pressure supplied to the compressor. If the pressure threshold is exceeded, it forces some oil to flow into the oil reservoir, so that pressure is reduced.

TCV (Temperature Control Valve)

The TCV is used to maintain the same temperature of oil supplied to the compressor. If the temperature threshold is exceeded, it allows oil to flow into the oil cooler, so that the temperature is reduced.

3.9 Enclosure

The enclosure is used to prevent and reduce noise of the compressor being sent outside. In addition, it protects the equipment against external impacts such as alien substances, direct sunlight or sand winds.

3.10 Control Panel

In the control panel, a lot of components are connected to operate, control and inspect the compressor. The main part is PLC, touch screen, relay, MC, Fuse, MCCB, Transformer, Transmitter, and SMPS. During operation of the compressor, it is programmed to receive feedback signals such as temperature, pressure and motor currents for controls. Depending on the compressor condition, it controls the system to maintain the same pressure and temperature levels.

3.11 Instrumentation

Each module of equipment has sensors to monitor and diagnose the equipment status. The measurement instruments are connected to the upper controller. The controller receives signals detected by the measurement instruments and it inspects and diagnoses the current condition and based on the result, it generates an alarm or tells the compressor to stop operating.

Pressure Sensor Tap

This device is used to detect pressure changes in the process gas. The measurement range of pressure sensor tap is determined by the compressor's operating pressure (operating pressure is 30 to 70% of the measurement range). In addition, if you want to measure high temperature fluid pressure, you need to install a pressure sensor tap in the control panel or gauge board and connect it to the measurement unit by using a tube.

Resistance Temperature Detector (RTD)

It senses the temperature changes and attached to the place required to measure the compressor temperature.

For temperature measurements, PT100Ω RTD is usually used. Estimations are based on the operating pressure/temperature, fluid speed, and the installation unit's pipe size. To protect the sensor and to perform easy repair and maintenance, a thermowell is also installed. Strength calculation will prevent damage to the protection pipe caused by vibration/fatigue.

Vibration Sensor

It senses any minute movement of the object and installed in compressor gearbox, bull gear and pinion gear to detect the compressor vibration. The sensing scope of the sensor depends on sensor type, cable length and transmitter. Care must be taken for replacement. The vibration sensor operates at the distance of 1mm. Therefore, failure to follow the installation procedure of the sensor may cause wrong value indication.

Differential Pressure Sensor *Option

This measures the differential pressure between process gas and transforms it to electrical signals. It is used for the same fluid or different fluids, and when you install it you need to pay attention to the high pressure/low pressure joints. Usually, three way manifolds are mounted and when you use different types of fluids together, special caution is required on manifolds. (If you open the equalization valve, gas gets mixed.)

4. Installation

LIST

Workers need to fully review the foundation diagram as well as the plot plan and the installation manual submitted prior to installation, so that they can clearly understand the compressor structure and installation procedures. The quality of the installation can directly affect the performance and lifespan of the compressor in the future, so you should perform the installation according to the proper method in the presence of qualified supervisors.

This document describes the installation procedures and precautionary items for the compressor, but, since the content of this document is concerned with general procedures, workers need to establish a detailed plan based on the manual by considering the actual site conditions.

Until test running, the inside and outside of the compressor should be protected against external impacts.

During construction, dust and welding debris can be generated, so the inlet/ outlet of the equipment should be covered with plastic affixed with strong adhesive tape to prevent these substances from entering. In addition, the exterior of the equipment should be protected against external damage from conditions such as dust, direct sunlight and rain.

4.1 Checking Delivery Items

To prevent corrosion, damage and contamination that can occur during transportation, the components including the compressor will be packaged according to internal standards. However, since a problem can occur during transportation, after receiving the product, you should inspect the product and each box to compare the contents with the packing list. You should perform an exterior inspection to check the packing condition. If you find any contaminations, corrosion or damage in the parts (or packing) or you determine that there are discrepancies with the packing list, you should notify the manufacturer.

Until installation, the equipment should remain in the package and be stored properly, so that it won't be affected by direct sunlight, humidity, strong winds dust or rains. In particular, if the packing is damaged, contaminants can corrode the surface or cause damage to the parts in the future.

4.2 Preparation prior to Installation

The following items shall be prepared prior to the installation work.

Material

Flushing Oil, Anchor bolt, Touch up paint

Tools

Spanner, Hammer, Magnetic base, Dial gauge, Level gauge, Torque wrench, etc.

Referenced Document

- General arrangement drawing
- Foundation drawing
- P&I Diagram
- Packing list
- Spare part list
- Special Tool list

Prior to installing the equipment, you need to install the safety tape.

While there is ongoing work, the safety tape should be displayed around the work area to indicate that it is a construction area. Since an accident can occur in a construction area due to material being dropped or other dangerous situations, members of the general public and non-workers should not be allowed to enter it.

4.3 Considerations prior to Installation

4.3.1 Compressor Configuration

The costs for installation and operation can be reduced depending on how the equipment is configured in the initial stages. The followings should be considered for optimal configuration.

- Allow sufficient free floor space around the compressor to place compressor rotational section and other parts removed to perform periodic inspection or repairs. Enough space is required to repair and maintain especially cooler bundles.
- Depending on the purpose of use, it can be installed indoors or outdoors. In case of outdoor installation, you need to make sure the motor and the controller are protected against rain or direct sunlight. For more on protective measures, contact the manufacturer.
- Condensate water of compressor may include moisture or foreign material containing oil. Therefore, if you directly discharge it, it may cause environmental pollution. In order to prevent this kind of problem, condensate water purification equipment, such a de-oiler, should be installed.
- If the external temperature drops below zero degree Celsius, the gas pipe can get clogged by condensed water. In order to prevent it, hot wire and thermal unit should be installed on the air pipe.
- If the 'Instrument Air' has moisture in it, and if the external temperature drops below freezing, the pipe can become blocked due to condensation of moisture. To prevent this problem, you need to make sure the air supply is passed through a dryer before being supplied to the compressor.
- When installing the compressor in a narrow space, installation of chain block or hoist on the upper structure can provide convenient material handling capability in order to reduce the time required for preparation and maintenance.

4.3.2 Consideration the Environment

For reliable operation of the compressor, the following environmental conditions need to be considered. Prior to compressor installation, the environmental conditions need to be checked and if there is a possibility of problems, you need to discuss this with the manufacturer.

Temperature

The installation temperature for the compressor should be within the range of 5 to 40 degrees Celsius whether indoors or outdoors. If the temperature is not within this range or there is huge temperature difference, you need to discuss this with the manufacturer.

Humidity

To protect mechanical and electrical devices and prevent condensation of water, the compressor needs to be installed in an environment with a humidity below 90%. If the humidity is not within this range, then you need to discuss this with the manufacturer.

Altitude

Considering the performance of compressor, up to 1000m altitude is the standard. If the altitude is not within this range, then you need to discuss with the manufacturer.

Vibration

Excessive vibration or impacts can cause negative effects on the reliable operation of the compressor. Keep adequate distance from a device or environment that generates vibrations, and if unavoidable, take proper measures to prevent vibration reaching the compressor. This is especially important in the piping and in the foundations.

Air Pollution

The conditions (sand, soil, iron dust, paint powder, pollen, dust, sulfur/chlorine compound, salt, etc) causing severe pollution around inlet filter shall contaminate and corrode compressor oil passage, core parts and cooler bundle. To prevent reduction of the lifespan of the equipment or damage by pollution, remove all the sources of possible pollution. If the environment contains too much pollution, then install an additional external filter.

Quality of Cooling Water

The following table shows the standard of the cooling water quality. When the standard is not satisfied, consult with manufacturer in advance.

Test item	Nomenclature	Unit	KS I 3003	Recommended	Remark (If not met)
PH	-	PH	6.5~8.0	6.5~8.5	Corrosion(Low) or scale(High)
Electric Conductivity	-	μs/cm	Below 800	Below 800	Scale
Hardness	-	mg/L as $CaCO_3$	Below 150	Below 100	Scale
Ca^{2+}	Calcium	mg/L	-	Below 100	Scale
Mg^{2+}	Magnesium	mg/L	-	Below 100	Scale
Na^{+}	Sodium	mg/L	-	Below 150	Scale
Fe^{2+}	Ferrous	mg/L	Below 1.0	Below 1.0	Scale
HCO_{3-}	Bicarbonate	mg/L	-	Below 100	Corrosion
Cl-	Chloride	mg/L	Below 200	Below 200	Corrosion
SO_4^{2-}	Sulfate	mg/L	Below 200	Below 200	Corrosion
SiO_2	Silica	mg/L	Below 50	Below 50	Scale
LSI	-	-	-	0.05~1.0	Corrosion(Low) or scale(High)
Suspended Solid	-	μm	-	Below 50	Scale or clogged pipe
Test item	Nomenclature	Unit	KS I 3003	Recommended	Remark (If not met)

4.4 Unpacking & Transportation

4.4.1 Unpacking

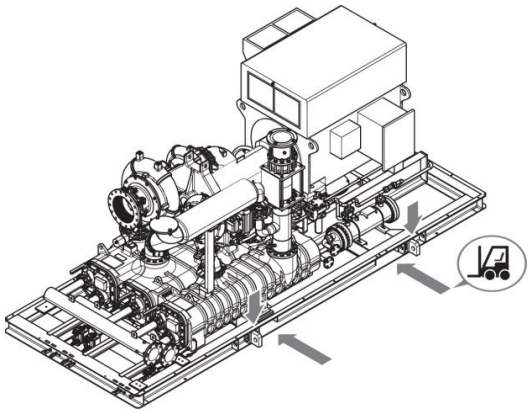
Care must be taken not to damage the equipment during unpacking. If tools such as hammers or pry-bars or knives are used, special care must be taken in order to avoid damaging the component parts of the compressor and package such as the instrumentation or the paint.

At the time of shipping, the compressor is packed properly to prevent entry of contaminants. If after the transportation phase, the package is found to be damaged, inspect the contents and evaluate whether they are damaged as well. If they are, contact the manufacturer. If the contents are not damaged, repair or replace the packing material to prevent damage.

Do not remove the cover or plug on the inlet/outlet connections until the commissioning phase for pipe connection work.

4.4.2 Transportation

The accessories and the compressor are large and heavy, so you must pay particular attention to possible accidental dropping of them when you move them. Before you move the accessories, check the size, the center of gravity, the weight and the lifting point in order to move them safely. In order to move the equipment, use a fork-lift or crane as required and appropriate. When you use a crane, use only the designated lifting point and lifting tool to prevent damage by contact with the slings or chains.



Use the specified lifting point to lift equipment.

Some lifting hooks are for certain part only. If you lift equipment using any locations other than the specified lifting point, the equipment may fall and cause injury, death and/or damage to the equipment.

When you use a forklift, do not let the equipment become unbalanced and fall over.

When you move equipment using a forklift, you must consider the center of gravity and the lifting points. If you don't, the devices installed in the base frame may fall over. In some cases, it can cause damage to the equipment and/or injury or death.

To prevent this, the operator must ensure that the forks are long enough to protrude from the opposite side of the package being lifted. This is also necessary to distribute the load correctly and prevent damage to the underside of the package or frame.

The equipment should be installed in a safe place.

Avoid installation in and environment with pollution or flammable material. If a safe environment is not present, installation or operation can cause danger such as explosion or fire.

4.5 Foundation Work

The compressor is heavy and may cause vibration, if not installed and held down correctly. This can cause damage to the foundation support structure where the equipment is set and to the compressor itself. To prevent this, you must follow the guidelines below before proceeding with the foundation work.

- It should have enough strength and size, and all conditions around the bottom should be equal.
- The foundation should be designed for the weight of the equipment and the direction of the load. The transient load applied to the equipment by the pipe, and the vibration load applied to the foundation by the equipment.
- Foundation work must be performed on an overall even and hard surface.
- The foundation support structure must provide a level surface on which to place the equipment with correctly located anchoring points per the requirements of the foundation and loading plan.
- When installing the equipment outdoors, the foundation may be deformed due to direct sunlight or temperature. First, take proper measures before proceeding with work.
- When using a concrete structure for foundation work, at least 28 days of hardening is required following completion of work. Installing and operating the equipment without having allowed for adequate hardening time can result in cracking and damage of the foundation.
- Take proper measures to prevent vibration generated by the neighboring environment from reaching the compressor. If required in order to isolate the vibration source from the support structure, install anti-vibration materials for vibration reduction.
- You can combine reinforced steel, concrete and steel structures properly to make the foundation. If the ground is firm, you can use a concrete structure but when mixing concrete, make sure it has adequate strength.
- Use proper chocking material for permanent machinery support for the compressor.

The foundation support structure design of the compressor is the responsibility of the purchaser.

The contents and data above are provided for the successful installation of the compressor. The manufacturer is not responsible for defects in the foundation support structure design or construction.

Foundation Inspection

Please be confirmed the following items for foundation quality prior to compressor installation.

- Center lines and Level
- Foundation strength
- Anchor location
- Foundation surface chipping condition

The foundation support structure must be kept free of contamination.

Before installation of compressor, the foundation support structure must be kept free of contamination by oil, dirt, water, etc. that could degrade the foundation support structure material. Protective sheeting (such as sheets of clean polyethylene) shall be used to cover the prepared surfaces when work is not in progress.

4.6 Setting and Adjusting the Height

When you set the compressor, if it is not maintained level, problems such as vibration may occur during installation or operation. Refer to the below procedures for the correct leveling procedure.

Leveling Procedures

Step 1 Clean bottom of base frame, anchor bolts, shim plate and others before seating the compressor on foundation.

Step 2 Install the shim plate/vibration proof pad in the designated locations per the Foundation and Loading plan.

Step 3 Install the anchor bolts in the base frame of compressor.

Step 4 Set the compressor to match the equipment and central anchor hole of base.

Step 5 Install the level gauge on the compressor mounting surface to check that it is level in both the X and Y directions (horizontal plane).

Step 6 Use the shim plates/vibration proof pad to adjust the level. Check the level on all the compressor and motor mounting surfaces.

Step 7 Adjust the level of the compressor within 0.5mm/M in X- and Y-horizontal directions through the final check.

Before installing the Shim plates, please check the surface conditions.

Check that the Shim plates used for leveling are clean, and foreign materials are not found on the surface. Such foreign materials on the shim plates can result in errors in level measurement and insufficient support stiffness for the compressor package, potentially leading to vibration problems.

4.7 Grouting

Grouting is a procedure to fill the void between bottom of equipment and the mating foundation. This filler material provides uniform support and a load-transfer link between the equipment and its foundation. During grouting, if there is moisture, oil or contaminant on the surface, the adhesive force to the foundation plane can be degraded. So keep the foundation plane as clean and dry as possible.

During grouting, the whole surface of the lower shim plate shall be contacted. Non-shrink concrete or epoxy cement shall be used for grouting. To enhance the contact strength, the base surface shall be smoothed. When the grout dries, remove the mold and do the final finishing work.

4.8 Storage

If the compressor is stored for prolonged period after installation or stopped for an extended period of time between operational periods, appropriate action shall be taken to prevent damage by foreign material and corrosion. If stored outside, contaminants such as rain and dust can cause corrosion and severe damage. Therefore, you must store the compressor and the main components in the designated place. In addition, you need to store them in a place free of extreme temperatures, that is level and well-supported so that no twisting can occur.

In any of the following cases, pay special attention to storage of the compressor.

- Please wait after arriving at the installation site.
- After completing installation, standby for more two weeks until the construction is completed.
- The operation is stopped for more than 30 days.
- The production of the factory is interrupted.

Equipment Storage Caution

Hanwha Techwin is not liable for any breakage and/or damage caused by improper storage of the equipment. If the equipment is to be temporarily stored outside, the customer shall take appropriate actions to prevent foreign objects from entering, damaging or contaminating the machinery.

Equipment Shutdown for long time during Operation

- When the compressor stopped for a long time during an interruption of operation, do not disconnect electrical power from control panel and keep the compressor in automatic mode, to permit operation of the auxiliary pump, allowing oil to be supplied to bearings.
- Use an auto trap or bypass pipe to fully discharge the condensed water from the inside of the cooler and close the bypass valve.
- If the temperature falls down below zero Celsius degree (or the freezing point) during storage period, it can cause damage to the equipment from freezing and bursting. So cooling water shall be removed from the cooling system including the gas cooler or cooling water pump shall be operated to prevent freezing cooling water.

Classification	Measures	Remark
After compressor is stopped	Operate AOP manually for 30 minutes and supply cooling water.	
During the period when the compressor is stopped	Power for control panel shall be supplied. · Motor space heater ‘ON’ · Oil heater ‘Auto’ · AOP ‘Auto’(Oil reservoir vacuum: Min 100mmH2O)	
	For supplying oil in the gear box and motor bearing, operate the AOP in manual mode for more than 20 minutes in a month.	
	Check an operation test of IGV, BOV, Block valve(if applied) for at least once in 2 weeks.	
Before restart of a stored compressor	Check the grease status and apply it if necessary.	If Ball-bearing type motor applied
	Remove the gas (air) in lube pipe through valve in MOP after AOP operation.	

Classification	Measures	Remark
	Check filters for abnormality.	
	Check oil quantity in oil reservoir.	
	Check for supply condition of instrument air.	

If you store or do not operate the compressor for a long time, all of the metallic parts such as the bearing and the journals can become rusty. Therefore, additional rust proofing is necessary before storage. After anticorrosion treatment, store those parts at a place without direct sunlight, humidity, strong wind, or rain, and make sure that the anticorrosion treatment is not damaged.

Observe the following precautions for the safety of the anticorrosion treatment workers.

- Remove all flammable materials from the work site.
- The site must be protected against direct rain.
- Some anticorrosion additives generate strong fumes. Be sure to have a 10-min break every 30 minutes of work.
- Be sure to wear safety goggles, dust mask, protective gloves, and safety clothes during work.

4.9 Shaft Alignment

4.9.1 Rough Alignment

Before performing precise alignment work, it is desirable to adjust the axial distance and perform rough axial alignment. When the alignment work really begins, since a tester with a fine unit is used, time can be saved and the quality of the final alignment can be ensured by carrying out the preliminary axial alignment.

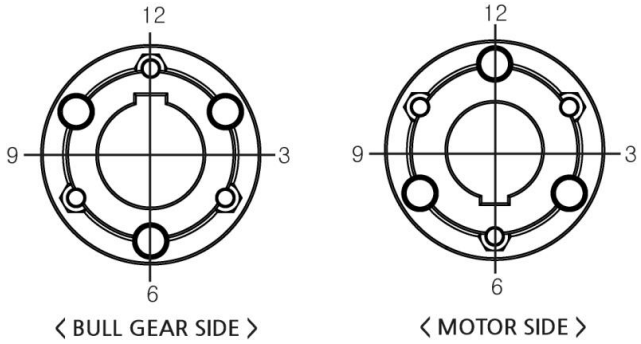
After dividing the plane of the coupling hub flange assembled in each shaft end into four sectors of 90 degrees, measure the distance between flange faces of each sector with an inner micrometer.

4.9.2 Alignment

Since the compressor rotates at high speed, it requires precise alignment. If alignment is not properly performed, the performance of the compressor might deteriorate due to vibration or even suffer damage. Therefore, an experienced person should be employed to perform the alignment work.

NOTE

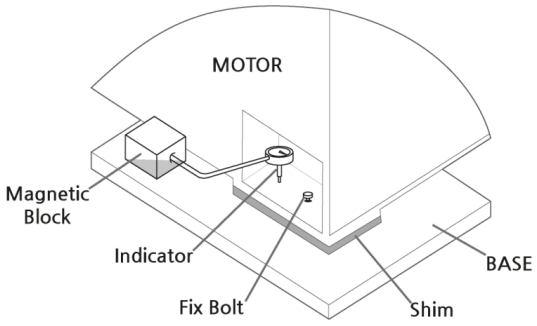
Prior to alignment and coupling assembly, the key of coupling flange should be aligned with the direction in Figure for balance.



4.9.2.1 Inspection & Calibration Soft Foot

Soft foot refers to a condition where one or more feet are on an unlevel footing. If you do not correct soft foot in the early phase of alignment work, it is hard to proceed to the next step. So, before you start, you must correct soft foot.

Calibration Procedures



Step 1 To check the condition of the surface contacted by the motor and motor mount, separate the fixing bolt and the shim.

Step 2 If there is a contaminant on the contact, remove it and mount the devices again.

Step 3 Mount magnetic base on the motor mount and set the dial gauge to zero to align with motor base.

Step 4 While fastening the fixing bolts on the measurement location, check whether the indicator reading is out of range (reference: 0.1mm).

Step 5 If it is out of range, use the shim plate to make adjustments.

Step 6 Until the allowable values of soft foot at 4 places are allowable, repeat the above procedure.

Step 7 Finally, when soft foot adjustments are completed, proceed to the next step.

4.9.2.2 Adjustment of the Alignment

When turning the motor or bull gear by hand, the shafts should rotate easily without any interference. If significant resistance to turning the shaft is found, find and fix the cause before performing any further alignment work.

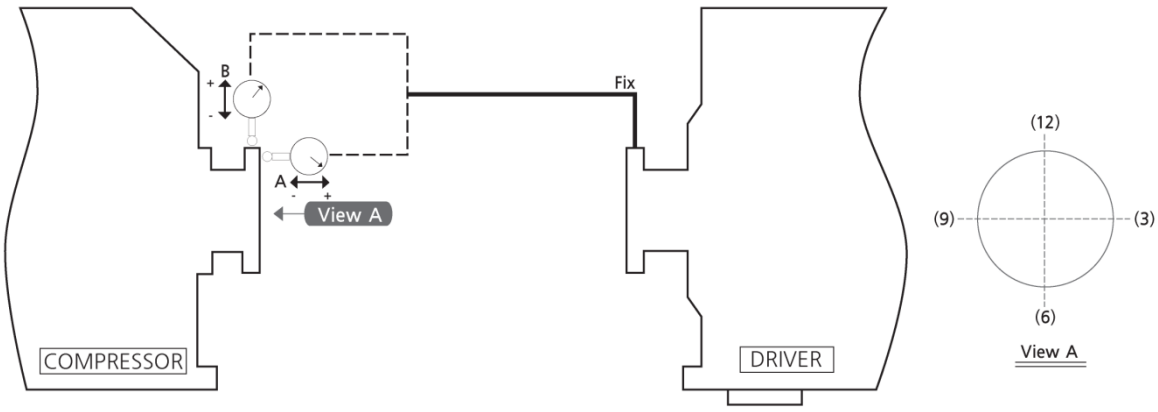
NOTE

Cold & Hot Alignment Classification

Cold condition: The oil that is not heated before operating the compressor.

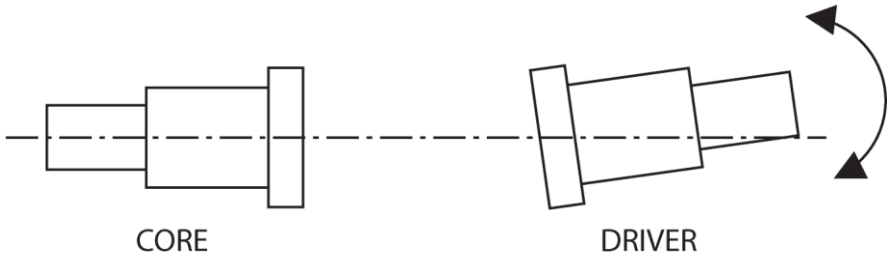
Hot condition: The condition of oil after operating the compressor with 100% Load for one hour. (after test operation)

For ease of identification, mark on the bull gear's coupling hub face with a marking pen in the direction of the following figure 'View A'



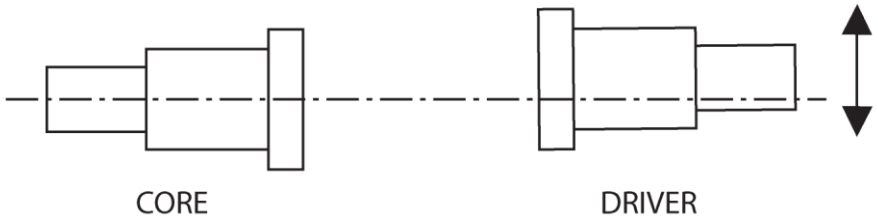
For more on how to perform alignment with the measurement values, refer to the guidelines below.

Face plane discrepancy (Angular Misalignment) correction ('A' gauge)



- Alignment Tolerance: Within 0.05 mm TIR
- Alignment Method:
  - 3-9 Direction: Use jacking bolts for adjusting on the motor mount
  - 12-6 Direction: Insert motor shims with the same thickness into 2 places(front or rear) of base

Rim plane discrepancy (Offset Misalignment) correction ('B" gauge)



- Alignment Tolerance
  - Within 0.05 mm TIR
  - For geared coupling, it is within 0.35+/-0.05 mm TIR.
- Alignment Method:
  - Motor shaft shall be higher than bull gear shaft.
  - 3-9 Direction: Move jacking bolts for adjusting of motor to the right or left direction.
  - 12-6 Direction: Insert shims with the same thickness into 4 places of base.

NOTE

During Rim alignment, observe the followings:

When you insert the shim plate, check gauge B and use the shim with 1/2 the thickness of the height. At this time, consider the value of loose motor.

4.9.2.3 Final Check

Check Procedures

Step 1 Adjust the measured value within the limit through repetition.

Step 2 When all measured values come within the limit, fix the motor.

Step 3 Fix the jacking bolt for adjusting motor.

Step 4 Inspect that the values of alignment and shafts interval are maintained without any changes, confirming shaft interval in the following table once again.

4.10 Installation of the Inlet Filter

The inlet filter is the main passage connecting the compressor to the outside. Prior to installation, you must consider the surrounding environment carefully in order to choose a proper location. If the location is not good, or the environment close to the filter is polluted, then it can have negative effects on the compressor's performance and function, as well as the inlet filter.

When you install an external installation type of inlet filter, select a good filter location by referring to the instructions and figures below.

- To prevent resistance when the filter sucks in the air, install it at least 3 meters above the ground (2 meters if installed on the roof.)
- You are recommended to have a length of straight pipe at least five times the pipe diameter, before the suction air is let into the compressor.
- When you install a pipe that connects the inlet filter and the compressor inlet, install a proper support to prevent the stress from being delivered to the compressor.

For proper quality management of the suction air, you will need to periodically check and replace the element at the inlet filter. To do this, you must include the space to install a working board near the filter. For more on the repair and maintenance procedures for the inlet filter, refer to [Maintenance] chapter in the manual.

If you want to install the inlet filter inside the factory, select a proper location with good air ventilation.

When the compressor starts operating, it will keep sucking in the external air. If you install the equipment in a place without a smooth air flow to the outside, it can cause a degradation in performance.

Filter Installation

For installing the inlet filter, follow the steps below

1 Open the filter hood.

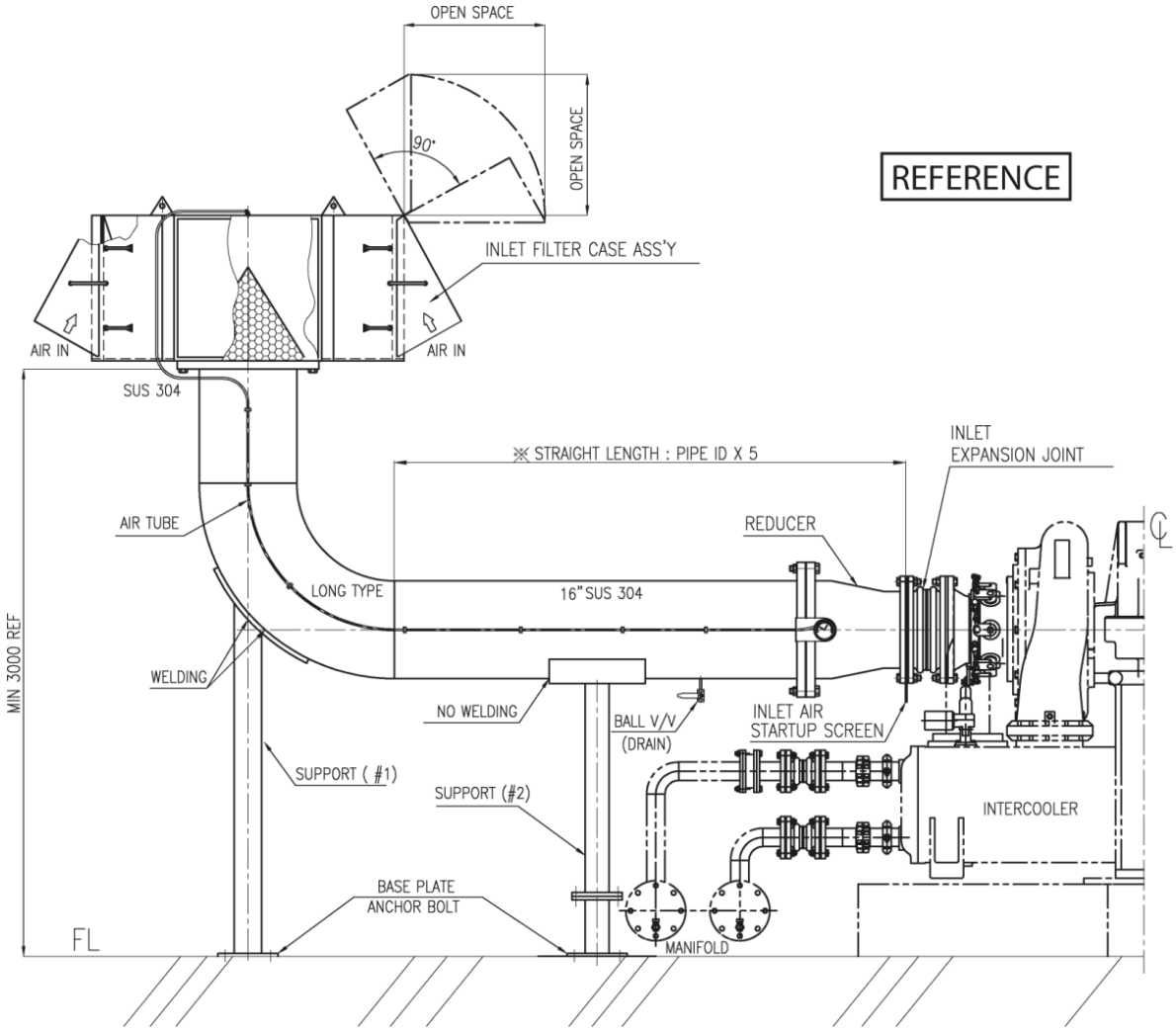
2 Using the bolts and nuts, connect the filter to the pipe. For smooth assembly, make sure that the bolt head is directed toward the inner area of the filter.

3 When the pipe and the filter are connected, assemble the second filter element. When the second filter element touches the case jaw, fix it with the clamp on the top/bottom of the case.

4 Assemble the 1st filter element. Press it inside so that it touches the second filter element assembled.

5 Fix the 1st filter element. Close the hood and fix it with the clamp in the middle.

For the overall filter configuration and installation diagram, refer to the figure below. The filter configuration can be changed based on the customer's request or the equipment's capacity.


OPEN SPACE
OPEN SPACE
90°
REFERENCE
INLET FILTER CASE ASS'Y
AIR IN
AIR IN
SUS 304
※ STRAIGHT LENGTH : PIPE ID X 5
INLET
EXPANSION JOINT
AIR TUBE
REDUCER
LONG TYPE
16"SUS 304
MIN 3000 REF
WELDING
NO WELDING
BALL V/V
(DRAIN)
INLET AIR
STARTUP SCREEN
SUPPORT (#1)
SUPPORT (#2)
INTERCOOLER
BASE PLATE
ANCHOR BOLT
MANIFOLD
FL

4.11 Piping

As contaminants enter, damage or performance deterioration of the compressor may result. To prevent this, before performing any piping work, cover the flange of the inlet/outlet connections with a blind cover. If welding work is to be performed at the site, perform grinding work away from the machinery or protect the machinery thoroughly in order to prevent corrosion. This is required even for painted or stainless steel surfaces.

For detail information on pipe connection, refer to the P&ID, Drawing of the compressor.

The layout and installation of pipes are the purchaser's responsibility.

- The information and advice are for satisfactory installation. The supplier shall not take any responsibility for design and installation of piping not in the manufacturer's scope of supply.
- The installation of pipes for the compressor should be carried out so as not to allow any transfer load or internal stress to the compressor.
- After the installation of pipes, any contamination should be removed by flushing without passing the fluid through the machinery.

The manufacturer is not responsible for any damage that occurs due to the arbitrary remodeling of the pipes.

If the customer needs to modify the pipe design for some reasons, they have to make sure that the process gas does not flow back and there is no condensate water accumulated. If the compressor is damaged or performance is degraded due to arbitrary modifications, Hanwha Techwin will not be responsible for it.

4.11.1 Process Pipe

Prior to pipe installation use compressed air to remove contaminants from the pipe. If they are not fully removed, contaminants can enter the core compressor or cooler and cause corrosion or damage to the parts.

When you assemble the process pipe, you have to first install enough support to prevent weight or twisting of the pipe from reaching the joint flange. If excessive force is delivered, the rotary units within the core can be damaged.

Prior to installation, the process pipe should be leak and pressure tested to verify its integrity and prevent leakages of gas in service. During installation, use appropriate gaskets and other sealing methods to prevent gas leakages during operation.

When each pipe is assembled, you need to manually rotate the shaft to check any changes in the alignment of core-motor.

The strainer and the check valve will be installed in the process pipe. Each part is a loose shipped part delivered to site. When these are installed, please refer to the following:

Inlet Start-up Strainer *Option *Included if the inlet filter is an external installation type

User should be installing the strainer temporarily to manage the quality of inlet gas especially in the initial operation phase. A temporary strainer should be removed within 20 hours of initiating operation. If it is left installed longer than this, damage to the strainer can cause severe damage to the rotary part of the compressor.

Use the inlet start-up strainer for the safety equipment.

If the compressor starts up after installation and the strainer is not installed, the rotational part can be damaged by substances in pipe.

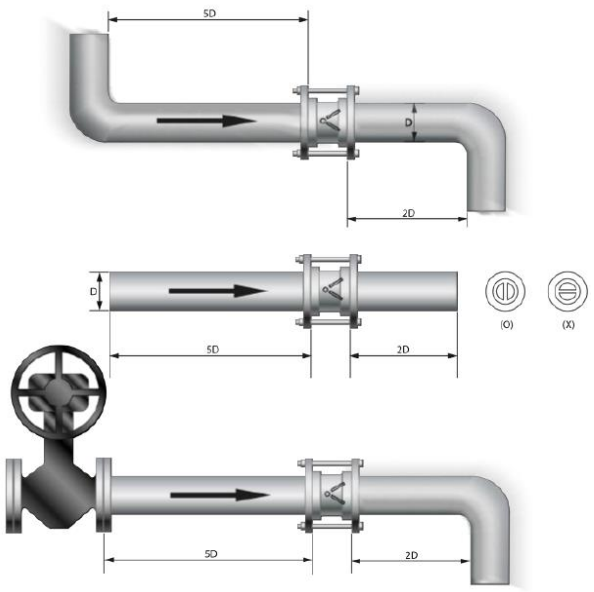
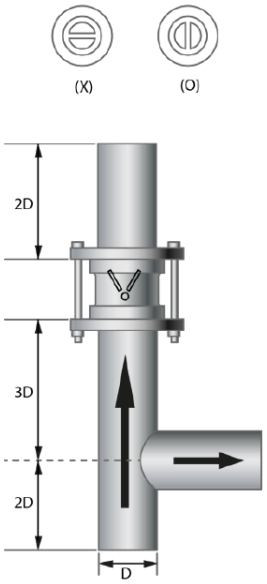
Installation Discharge Check Valve *If supplied as ship loose

If Discharge check valve is not installed properly, problems can be occur due to vibration or flow backward of comp. gas. Please caution the below item during installation.

- Ensure there is a minimum of 5 straight pipe diameters at the inlet and 2 straight pipe diameters at the outlet of the check valve.
  Even if Expansion joint is installed in the entrance of the Valve must comply with the 5D
  (D: Diameter of pipe)
- Install the nearest compressor outlet. (Recommend 5M inner of pipe length)
- Recommend Horizontal Installation and install the plate bilateral symmetry when Horizontal Installation.
- When vertical Installation, flow of fluid direction is upward absolutely and install the plate coincidence the direction of Upstream.

Install check valve, aligning with the direction indicated on the surface.

Installing check valve against the designated direction on pipe may cause serious damage to compressor.

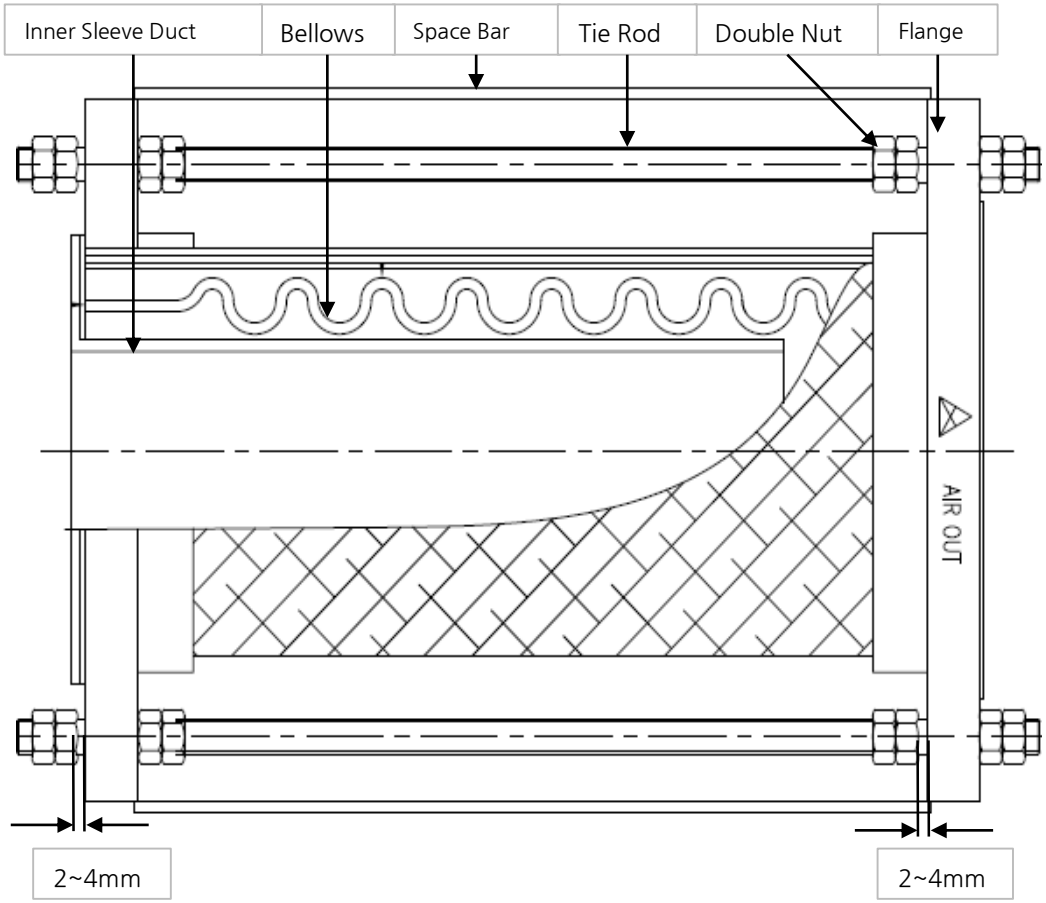
Horizontal Installation	Vertical Installation
	

Installation Expansion Joint *If supplied as ship loose

Please caution the below item during installation.

- Do not drop or shock the expansion joint.
- It must be installed in the same direction of flows as marked.
- Install the expansion joint without compression / tension / twisting due to incorrect alignment.
- Assemble double-nut tightly, if necessary apply with Loctite to the nut. .
- If user have installed Inner sleeve duct, make sure not to missed
- Do not force the expansion joint to match the bolt holes.
- Assemble double-nut of tie rod with flanges 2~4mm gap.

Expansion Joint



CAUTION

Transportation/Installation Expansion Joint must comply with the specified method.

- Use designated lifting Lug.
- Do not use chains or lifting devices directly to the bellows and bellows cover.
- If it has a space bar, then remove the installation is completely finished.
- If user do the test before installation, do not use the space bar for the purpose of supporting the thrust.

4.11.2 Cooling Water Pipe

The material of the pipe used to convey the cooling water should be SUS(stainless steel) in consideration of its long term use. At the inlet of the supply pipe, a strainer must be installed to prevent build-up of deposits in the cooler bundle. A flushing procedure must be performed to remove contaminants using clean water or dry compressed air.

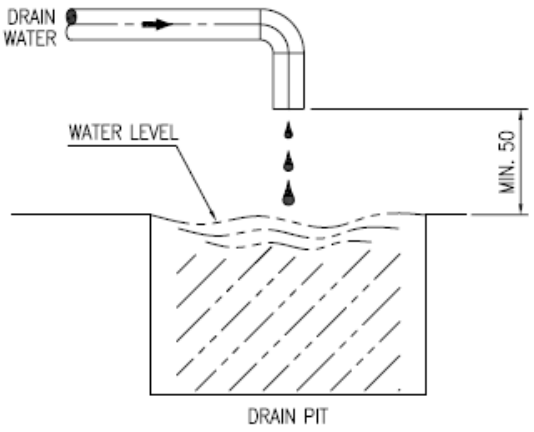
4.11.3 Oil Pipe

Connect the oil pipes to the supply and return oil connection on the core compressor and the motor. After installing the pipe, a flushing procedure must be performed in order to remove contaminants inside. During the flushing procedure, the motor and the core's oil inlet and outlet should be closed with a blind flange and a flushing bypass line should be installed to prevent dirt from the pipes from entering and damaging the bearings. When flushing is completed, the bypass line should be removed and pipe components and sensors should be installed in accordance with the P&ID.

4.11.4 Condensate Drain Pipe

Shut the bypass valve completely when auto trap is in use. Open the discharge valve when the compressor is under operation. But, in case condensate is discharged using the bypass valve, it should be appropriately adjusted depending on the outer environment.

Each condensate piping has to be separate from each other so that the discharge of condensate from each pipe is independent. The drain outlet should be higher than the surface of the discharged water (the surface of the condensate pit) by at least 50mm so that the condensate cannot flow back to the main body.



4.11.5 Instrument Air Pipe

For instrument control air pipe, SUS(stainless steel) pipes shall be used downstream of the drier to supply clean and dry air. In case of intermittent operating conditions, a filter shall be installed on the supply side for separating oil/moisture.

4.12 Coupling Assembly

Before assembling the coupling, check the rotational direction of the motor.

Before assembling the coupling, check the rotational direction of the motor. If the motor rotates in the reverse direction due to an incorrect power connection while the coupling is connected, it can damage the rotary units of the core.

Check motor alignment before installing the coupling.

Please check motor alignment before installing the coupling. Pipework and/or installing auxiliary parts may affect the motor alignment.

Geared coupling assembly (SM3100, SM4100)

Procedures for installing the coupling

Step 1 Check the serial number on coupling flange and coupling spacer.

Step 2 Disassemble bolts, nuts from coupling.

Step 3 Remove the substances on faces of assembled side.

Step 4 Locate the disk coupling for assembling.

Step 5 Match up the mark on flange with the mark on flange and then assemble parts with bolt by hands.

At this time, check the number on bolts and flange holes. It should be same.

Step 6 Fasten the bolt. Refer to the following table for torque.

	Torque (N-m)		Torque (lb-ft)	
	Min	**Max**	**Min**	**Max**
M10	31	57	23	42
M12	53	98	40	72
M14	86	159	64	117
M18	184	341	136	251

AS PER EA-TURBO-032_002

Step 7 Bolt should be fastened alternately each side (core side-motor side). If you fasten all bolts on one side first, the other side may not be available to assemble.

Disc coupling assembly (SM5100, SM6100)

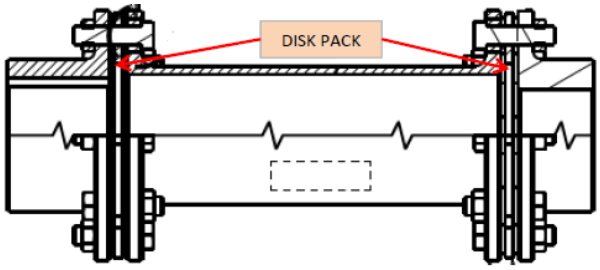
Procedures for installing the coupling

Step 1 Check the serial number on coupling flange and coupling spacer.

Step 2 Disassemble bolts, nuts and a disc pack from coupling.

Step 3 Remove the substances on faces of assembled side.

Step 4 Locate the disk coupling and disk pack for assembling.



Step 5 Match up the mark on flange with the mark on flange and then assemble parts with bolt by hands.

At this time, check the number on bolts and flange holes. It should be same.

Step 6 Fasten the bolt. Refer to the following table for torque.

	Torque (N-m)		Torque (lb-ft)	
	Min	**Max**	**Min**	**Max**
M10	31	57	23	42
M12	53	98	40	72
M14	86	159	64	117
M18	184	341	136	251

AS PER EA-TURBO-032_002

Step 7 Bolt should be fastened alternately each side (core side-motor side). If you fasten all bolts on one side first, the other side may not be available to assemble.

After assembling the coupling, check the rotational direction of the motor.

If the coupling is not separated after assembling it with the motor, check the rotational direction by instantaneous start up. This task should be done be approved service technicians.

Power off the motor before connecting the coupling.

Before the coupling installation or connection works are completed, the power to the motor and equipment shall be locked off. If the motor runs during the installation, the high speed rotations can cause physical injury or death.

4.13 Power Connection

Below is a description of electrical wiring performed at the site when you install the equipment. For more details on wiring methods, refer to the submitted diagrams.

Main power of the control panel

Standard input voltage is 3 phase/220V (or 440V/380V) with the frequency of 60 or 50 Hz. If you want to use non-standard power, then this should be discussed with the manufacturer.

Main power of the main motor

The power cable provided by the customer should be connected to the three phase terminal of the main terminal box of the main motor. Make sure the R/S/T (U/V/W) connection is correct.

Before powering on, check whether the motor insulation is completed properly and connect the grounding wire to the ground terminal of the outer box for the motor. For more details, refer to the diagrams and the relevant specifications.

Optional Switches

If there are additional devices such as pressure, temperature, fluid, trap and so on to be installed, then they should be wired properly according to the electrical diagram.

4.14 Check List

After the compressor installation, check the followings and record and keep them.

Classify	Items to be checked	Inspection criteria	Results	Remarks
Equipment foundation	1. Is the equipment foundation level according to the submitted diagram?	5 mm or less		X/Y direction
	2. Is the equipment foundation concrete work cured 100%?	Visual inspection		
	3. Are all the anchor bolts tightened to the required torque level?	Visual inspection		
	4. When you installed the anchor bolts, did you check the mounting conditions, and the contact surfaces between the shim plate and the main body's base plate?	Visual inspection		
	5. If necessary, did a user/contractor perform a test on all structures/mechanical aspects (certificate) and acquire all approvals necessary for equipment operation?	Approval		
Air pipes	1. Did you install and support all the air pipes according to the approved diagram?(suction, discharge, silencer(*Option))	Approved diagram		
	2. Are the internal surfaces of the suction pipe and the air suction filter case clean? (inner pipe welding sludge/dirt removal and check)	Visual inspection		
	3. Length of suction pipe should be more than 5 times of pipe diameter.	Visual inspection		on site installation
	4. Are the installation locations of inlet filter case's 1st and 2nd filters in accordance with the diagram?	Visual inspection		on site installation
	5. Is the discharge check valve installed in the correct direction of flows as marked?	Visual inspection		on site installation
	6. Is the discharge expansion joint(*Option) installed in the correct direction of flows as marked?	Visual inspection		on site installation
	7. Is the discharge expansion joint(*Option) installed without distortion?	Approved diagram (P&ID/GA)		on site installation
	8. Are the tie rod / double-nut of the discharge expansion joint(*Option) fixed at an appropriate interval(2~4mm)?	Interval: 2~4mm		on site installation
	9. Is the space bar removed after the discharge expansion joint(*Option) installation?	Visual inspection		on site installation
	10. Is the front/rear pipe straight of discharge check valve are adequate?	Visual inspection		
	11. Are the after cooler, the silencer(*Option) and the valve installed properly according to the approved diagram?	Visual inspection		on site installation
Cooling system	1. Is there sufficient space for the structures/ device/cooling water pipe near the compressor to facilitate easy disassembly of the cooler bundle?	Approved diagram		

Classify	Items to be checked	Inspection criteria	Results	Remarks
	2. Are all the cooling water pipes installed and flushed properly?	Visual inspection		
	3. Is the cooling water supply/circulation for all the cooling water pipes normal?	Visual inspection		
	4. Did you check for leaks in the cooling water system? Did you check the valve location/direction and the pump capacity/ system capacity?	Visual inspection		
	5. Is the cooling facility (cooling tower, cooler, utility, storage) operating normally, and is the capacity normal?	Visual inspection		
	6. Do the inter cooler and the after cooler have proper piping to facilitate the natural discharge of condensed water?	Visual inspection		
	7. Is the check valve installed in the drainpipe for the 1st/2nd stage condensed water drainpipe?	Visual inspection		
Pipe supports	1. Are all the pipes and devices installed and supported according to the installation diagram?	Visual inspection		
	2. After completing installation of all the pipes and supports, is the compressor pipe joint installed properly? (bolt torqueing, slope, gaps and mismatches to be checked)	Visual inspection		
Sub air pipe	1. Is the instrument air clean and dry and maintained at a minimal of 5kg/cm2	Minimum 5kg/cm^2		
	2. Is the instrument air system flushed to prevent impurities?	Visual inspection		
	3. Is the instrument air supply pipe connected to the BOV /oil demister according to the installation diagram?	Visual inspection		
	4. Is the system pressure sensor line properly installed according to the P&ID diagram?	Visual inspection		
Electricity	1. Is the start panel(*Option) connected to the high voltage power supply?	Visual inspection		
	2. Is the main motor connected to the high voltage power supply?	Visual inspection		
	3. Is the wiring interface between the start panel(*Option) and the compressor control panel complete?	Visual inspection		
	4. Is the control panel installed properly and is the wiring interface with the compressor complete?	Visual inspection		C/panel separation type
	5. Are the ship loose parts wiring completed for the inlet filter differential voltage sensor(*Option)/auto trap(*Option)/BOV?	Visual inspection		on site installation
	6. Did a user/contractor test all the electrical devices? Did they get necessary approvals for electrical works to operate the compressor?	Visual inspection		
Common	1. Are all the joints to the compressor and the neighboring systems properly tightened? Are the gasket installation and leakage conditions normal?	Visual inspection		

Classify	Items to be checked	Inspection criteria	Results	Remarks
	2. Is there an authorized lubricant available where the compressor is to be installed?	Visual inspection		
	3. Were the quantity and conditions of ship loose parts verified before placing them in the installation location?	Visual inspection		

5. Operation

LIST

The Hanwha compressor has sensors installed in it to check the operational status of the main parts. Using the information received from the sensors, the controller logic is applied to maintain the optimal operational status. Using the touch screen of the control panel installed in the compressor, the user can check the status of the compressor in real time, and if necessary, can directly control each sub device.

In this section, we will explain the control method and type for the compressor and the operational procedures.

CAUTION

Prior to operating the compressor, you should be fully familiar with the contents in this manual.

For safe and reliable operation, the user should fully read the manual and the relevant documents, and understand the compressor control system prior to operating the compressor.

5.1 Compressor Control

Hanwha compressor's control system is designed to maintain the same level of final discharge pressure for users regardless of the changes in the amount of consumption of the process gas. In addition, if you expect overloads or surges in the motor in the control process, the control system adjusts related devices to support the reliable operation of the compressor.

Depending on the ASV (BOV) type applied to the compressor, control method may vary. Samsung compressors have an auto dual type of BOV applied to them, but depending on requests from customers, a modulating type of ASV can be applied.

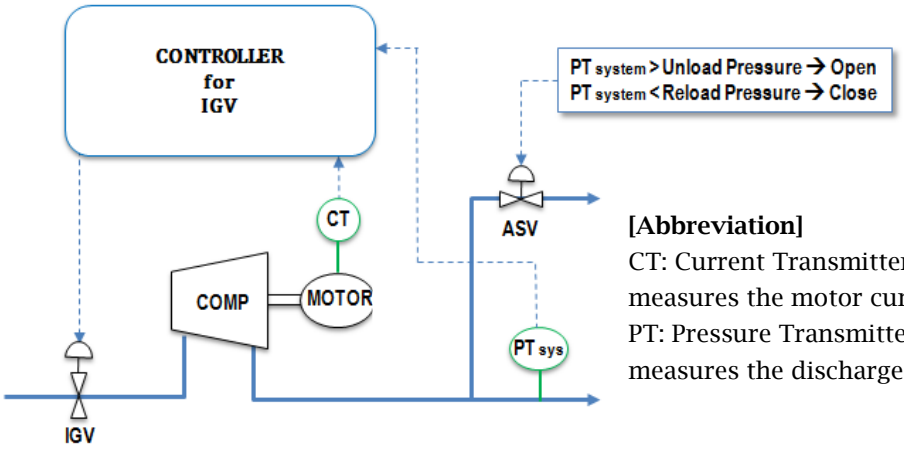
NOTE

ASV and BOV

This is the valve that is installed in the gas discharge unit of a compressor and is opened or closed to prevent surges. ASV stands for anti surge valve and is a more comprehensive term than BOV. BOV stands for blow off valve and is a kind of valve that discharges some gas pressure into the air when the pressure becomes too high.

5.1.1 Auto Dual Control *Standard

The below figure illustrates a simple structure of controllers for the compressor.



[Abbreviation]
CT: Current Transmitter,
measures the motor current.
PT: Pressure Transmitter,
measures the discharge pressure.

When the amount of compression gas consumption is increased and the system pressure is lowered, the control system gradually opens the IGV to maintain the system pressure at a certain level. However, if the amount of consumption keeps increasing and the IGV is opened too much, overloads can occur to the motor. Thus, to protect the motor, opening of the IGV is limited.

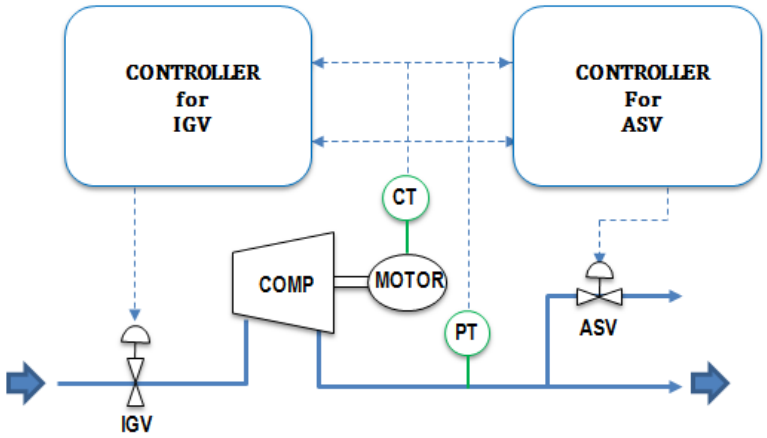
In contrast, when the amount of compression gas consumption is decreased and the system pressure is increased, the control system gradually closes the IGV to maintain the system pressure at a certain level. In this case, if the amount of consumption is suddenly dropped and the system pressure exceeds the unload pressure limit, the compressor opens the ASV and switches to unload conditions.

If the amount of process gas consumption keeps decreasing and the system pressure rises above a certain limit, then a surge effect can be noticed. When a surge occurs, along with performance deterioration, vibration and noise occur simultaneously and in extreme cases, the equipment may be damaged. To prevent this problem, the IGV opening is maintained and after that when the pressure rises again, the compressor is switched to unload conditions.

Once switched to unload conditions, the compressor will close the ASV and switch back to load conditions if the system pressure drops below the reload pressure.

5.1.2 Modulating Control *Option

The below figure illustrates a simple structure of controllers for the compressor.



[Abbreviation]

CT: Current Transmitter,
measures the motor current.

PT: Pressure Transmitter,
measures the discharge pressure.

When the amount of compression gas consumption is increased and the final discharge pressure is lowered, the control system gradually opens the IGV to maintain the system pressure at a certain level. However, if the amount of consumption keeps increasing and the IGV is opened too much, overloads can occur to the motor. Thus, to protect the motor, if the motor current reaches the max level, the IGV will stop opening further.

In contrast, when the amount of compression gas consumption is decreased and the final discharge pressure is increased, the control system gradually closes the IGV to maintain the system pressure at a certain level. In this case, if the amount of consumption is suddenly dropped, the final discharge pressure suddenly will be increased to generate surges. The ASV is gradually opened to reduce the final discharge pressure.

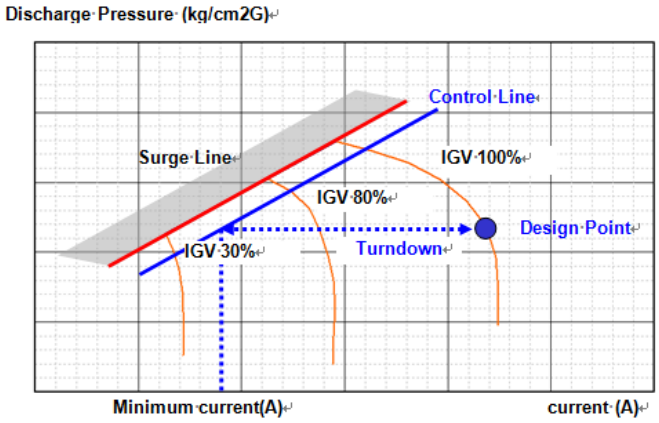
When the IGV maintains a consistent level of final discharge pressure, if the amount of gas is reduced consistently, the final discharge pressure will rise to cause surges. When a surge occurs, along with performance deterioration, vibration and noise occur simultaneously and in extreme cases, the equipment may be damaged. To prevent this problem, run the ASV to make sure that the amount of flux passing the compressor does not cause surges.

5.1.3 Surge Control

Surge control of the compressor is mandatory for its reliable operation. As mentioned above, a surge can occur depending on the changes in the amount of discharge gas consumption during operation of the compressor, but when the compressor starts operating; or stops; or when there is a sudden change in the amount of fluid during operation, a surge can also occur. For reliable operation throughout the entire system, you need to determine the surge control area by considering the compressor inlet conditions, the gas cooler's temperature changes, the factory conditions and the control signals' delivery speed.

If an operation point of the compressor reaches a surge area, the control system will adjust the valve to revert back to a safe condition, but when a surge signal goes into default once, the ASV is opened (default 20%) to remove a surge. In addition, if surge signals are accumulated five or more times, a signal is generated and the compressor is stopped to determine faults of the compressor.

The method for determining the surge control area depends on how a surge is determined.



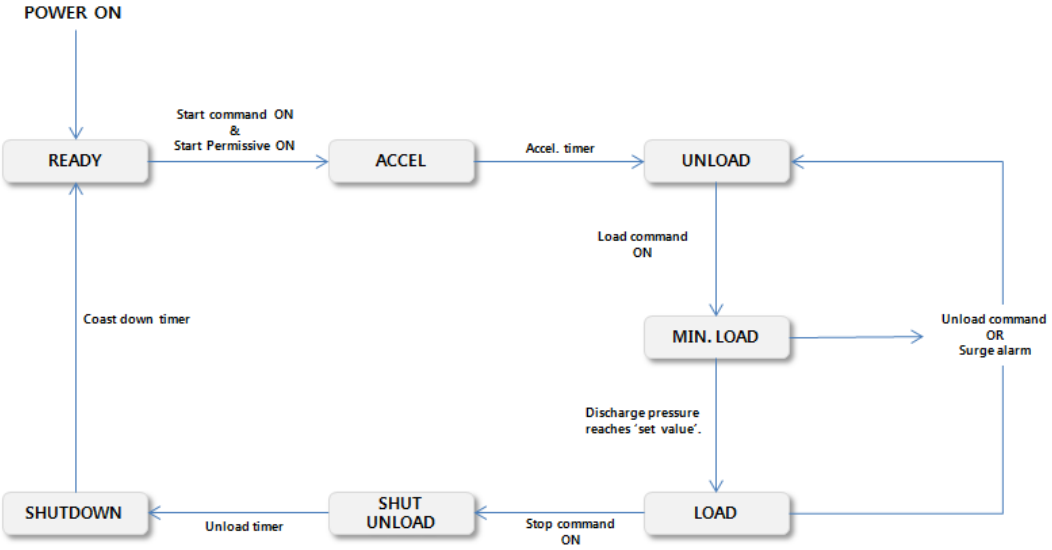
The above figure shows the changes in the discharge pressure depending on the motor current. The Surge Line was determined through the performance test of the manufacturer, the Control Line was determined in consideration of the external condition to protect the compressor. It may vary depending on the external conditions, but in general, the surge control line has a 7% margin from the surge line base on the rated current.

An intersection between the surge control line and the pressure setting is called the minimum current. During compressor operation, the IGV is closed to adjust the discharge pressure to the pressure setting. In this case, the compressor's operation point will approach the surge control line. Then, an operation point will reach the minimum current and the ASV is gradually opened to prevent the operation point from reaching the surge line.

5.1.4 Compressor Operational Status

The operational status of the compressor is defined with the following seven types, which can occur simultaneously. Refer to the figure below for information regarding the transition from one to another.

- Ready state: The compressor is completely stopped.
- Acceleration state: The compressor starts and the motor accelerates.
- Unload state: Unload condition, the motor rotates but discharge pressure or flow rate is not created.
- Min load state: A transition from unload to load condition.
- Load state: At the request of the user, the discharge pressure and gas is created.
- Shut unload state: Prior to stopping of the compressor, unload is maintained. Same as unload.
- Shutdown state: The motor and the compressor are stopped.



5.2 Alarm and Warning

The compressor control system is designed to monitor main sections or parts and issue an alarm or display a warning message to the operator for any abnormality. If an alarm is issued, the relevant message is displayed on the status screen and the alarm lamp flickers. The operator shall take the appropriate action according to the alarm message. Then, click the [Reset] button to cancel the alarm.

If the preset threshold is exceeded, the control system shuts down the compressor. The operator shall read the trip message, take the appropriate action, and restart the compressor. Prior to the restart, be sure to click the [Reset] button to cancel the trip status.

The control system monitors the following items.

- Vibration at each stage (Option: bull gear, main motor vibration)
- Motor bearing (Option: bull gear bearing, gear box bearing)
- The pressure and temperature of the process gas
- The pressure and temperature of the oil
- The motor current
- The oil level of the oil reservoir

For more on detailed alarms and warning list, refer to 'Alarm and Danger Screen' in5.3.2.

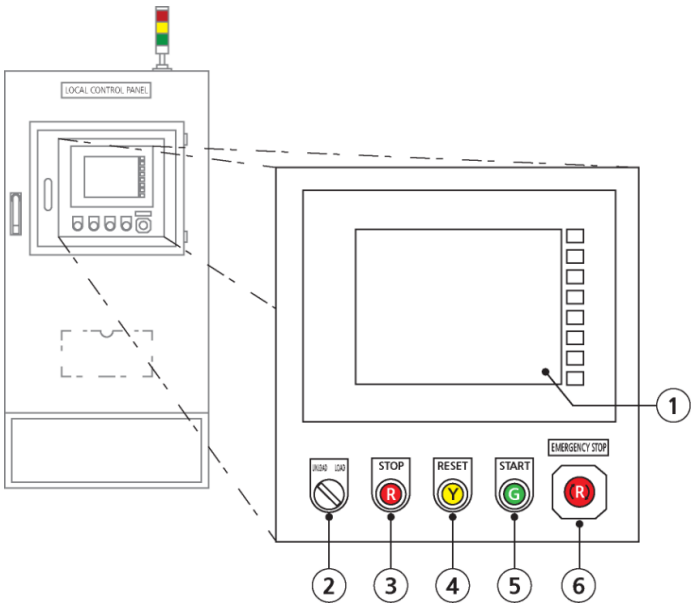
5.3 Controller Operation

For the reliable operation of the compressor, you need to check the equipment status and properly control the auxiliary devices such as the oil pump and the oil heater. The auxiliary devices automatically stop and operate by the control logic, but in some cases, an operator can directly control them.

5.3.1 Control Panel

The compressor control system consists of the control panel retaining the PLC, and various types of device, valves, motors and sub devices. The PLC is one of the most critical components of the control system. It sends control signals to analyze the status of each device and maintain reliable operation of it.

In the control panel, user friendly buttons, lamps, and touch screens are installed. The following types of buttons and lamps with their functions are installed in the panel.



The above control panel may vary in its shape due to the compressor specifications or customers' requirements.

Index	Name	Type	Status	Description	Remark
①	Touch screen	-	-	Check the compressor condition and control each instruments.	
②	Auto load/Unload	Switch	Unload	IGV & BOV are adjusted to turn the compressor into un load conditions.	
			Auto load	When the compressor is ready for operation, a load will be automatically applied.	
③	Stop	Button	Pushed	Compressor stop	
④	Reset	Button	Pushed	Alarm/Trip reset	
⑤	Start	Button	Pushed	Compressor start	
⑥	Emergency Stop	Button	Pressed	Compressor emergency stop	
-	Common Alarm	Lamp	ON	One of the alarm conditions occurred.	Option
-	Common Shutdown	Lamp	ON	One of the shutdown (trip) condition occurred	Option

5.3.2 Touch Screen

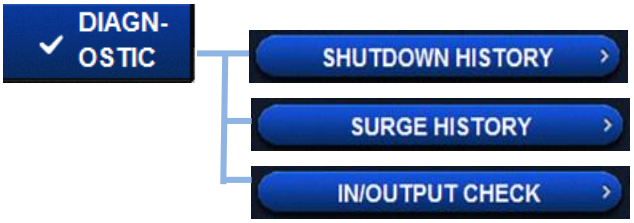
Operator can check the equipment status using information displayed on the touch screen in real time and control major equipments when required.

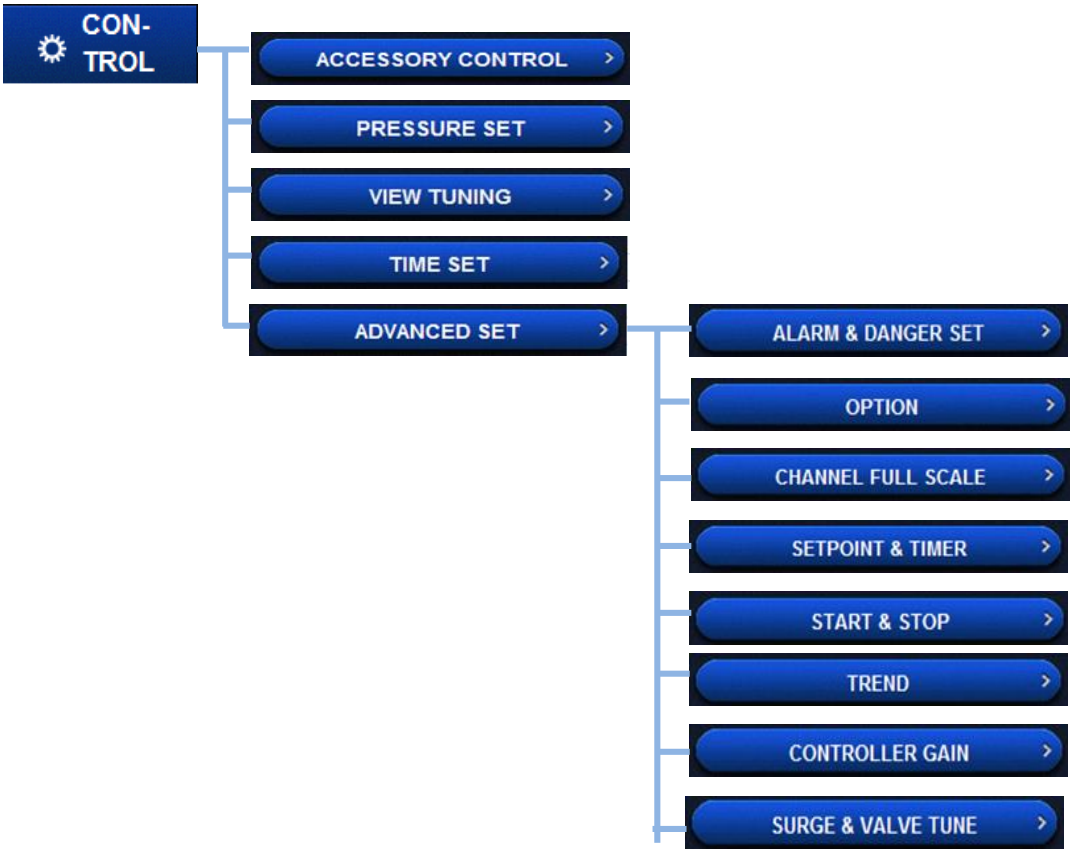
The screen is organized as follows. (The Advanced Setting screen can be accessed if you deactivate the lock function.)

MAIN SCREEN, READYSCREEN, ALARM&SHUTDOWN SCREEN can be moved

AIR SYSTEM, LUBRICATION SYSTEM, MACHINE-BULL GEAR SYSTEM

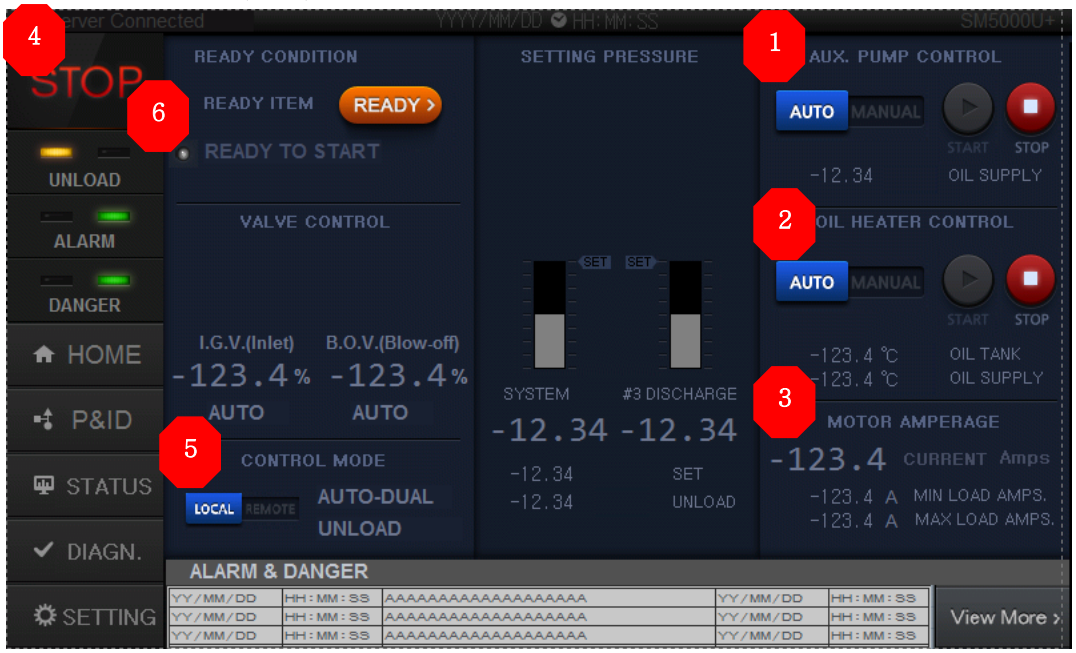
STATUS1, STATUS2





Main Screen

Operators can check compressor for overall conditions, control auxiliary pump and oil heater.
Refer to the manual (5.3.3) for the details of AOP and oil filter.



(1) AUX. PUMP CONTROL

The auxiliary oil pump can be manually or automatically operated. However, during compressor operation, it should be set to automatic at all times.

(2) OIL HEATER CONTROL

The oil heater can be set to manual or automatic operation.

(3) MOTOR AMPERAGE

You can check the main motor's present current, initial current and rated current.

(4) COMPRESSOR STATUS

The operational condition of the compressor can be checked visually through the lamp colors.

(5) CONTROL MODE

You can check the control type of the compressor.

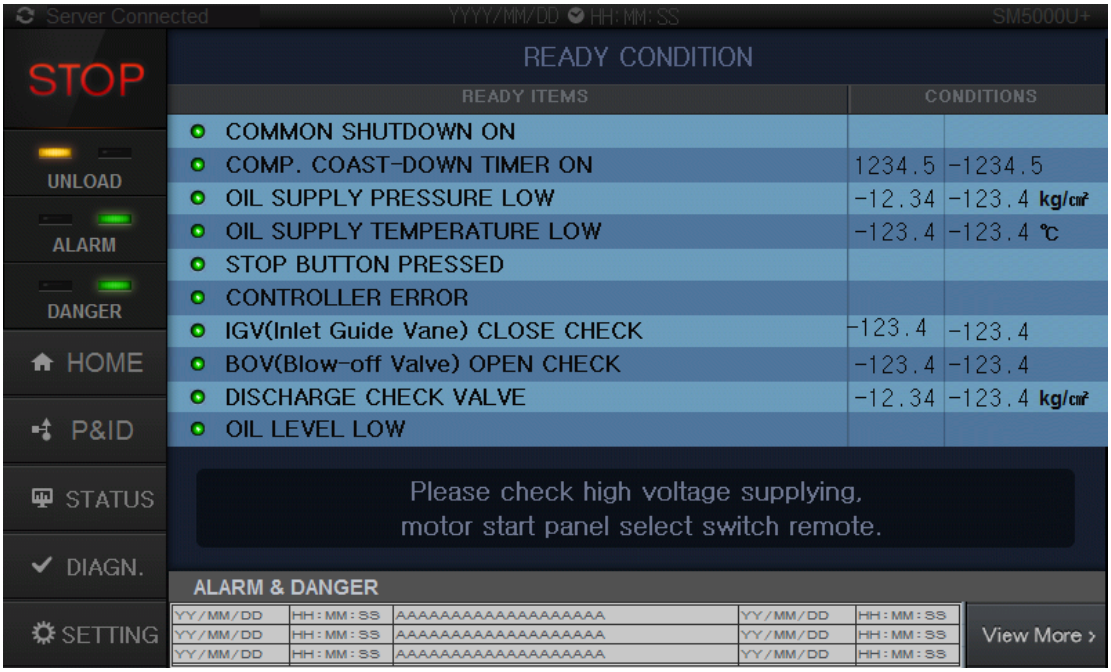
(6) READY CONDITION

Users can check initial condition required for the compressor operation on the Ready condition check screen. When the operation condition is satisfied, 'Ready' button turns green. User can check unsatisfied items in 'ready condition check screen' by pushing the 'Ready' button in red.

Ready Condition Screen

Ready condition check screen displays required initial condition for compressor operation. Yellow lamp indicates that the operation condition is not satisfied. Green lamp indicates that the condition is satisfied.

The remedy actions for each error message are following:



COMMON SHUTDOWN

If there is a danger signal present for the compressor, it cannot operate. Press the 'View More' button in the bottom right to go to the alarm and shutdown list screen and check the message displayed in the danger alarms and take the necessary actions. When the danger signal is not present, the lamp automatically changes to green. Press the reset button to remove the danger signal.

COMP. COAST-DOWN TIMER ON

The coast down timer (4 minutes typically) starts right after the main motor is cut off from the electricity. While the timer is running, the compressor cannot start again. Because of its inertia, the compressor should rotate freely for about two or three minutes. The coast down timer set value can be changed during commissioning.

OIL SUPPLY PRESSURE LOW

The oil supply pressure of compressor should be more than 0.26kg/cm^2 and AOP is operated to start compressor. The Condition window displays the current oil supply pressure. Operate AOP to adjust to the operation possible condition in case of low pressure. Press [Start] button at AOP setting window of main screen to operate AOP.

OIL SUPPLY TEMPERATURE LOW

When the oil supply temperature of compressor should be more than 30℃, the compressor can operate.

The' CONDITION' window displays the current oil supply temperature. In case of low temperature, move to the 'MAIN' screen and operate the oil heater to satisfy the ready condition. Press [Start] button at oil heater setting window of main screen to operate oil heater.

STOP BUTTON PRESSED

'Stop' button is pressed. Release this button.

CONTROLLER ERROR

The PLC controller is malfunctioning. Go to 'Diagnostic' -> 'Controller Check' and check the status of the controller.

CHECK IGV OPEN

IGV is not on default position (Full Close). Check the valve is in Auto mode.

CHECK BOV CLOSED

BOV is not on default position (Full Open). Check the valve is in Auto mode.

INSPECT DISCHARGE CHECK VALVE

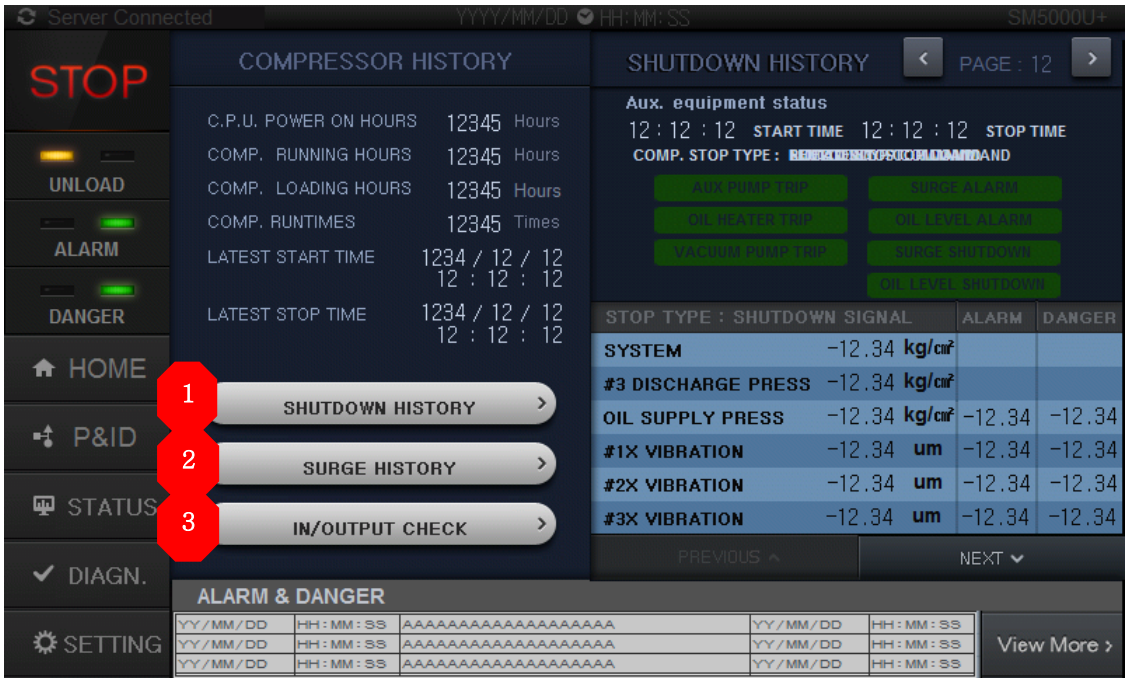
The compressor discharge pressure must be less than the compressor inlet pressure plus 0.5 kg/cm^2 (typically). If it is above this value, then check whether the discharge check valve functions properly.

OIL LEVEL

When the oil level sensor is installed, the system can create the upper limit, the low limit and the shutdown low limit signals. When such alarms are issued, the compressor will not run.

Diagnostic Screen

Operation, shutdown and surge history, I/O check and time setting are possible.



(1) SHUTDOWN HISTORY

When the equipment is stopped during operation, you can check the equipment condition. A maximum of 20 stopped status values are stored in chronological order. The three most recent stops will have the status values recorded 16 seconds ago. (Standard sensors only)

(2) SURGE HISTORY

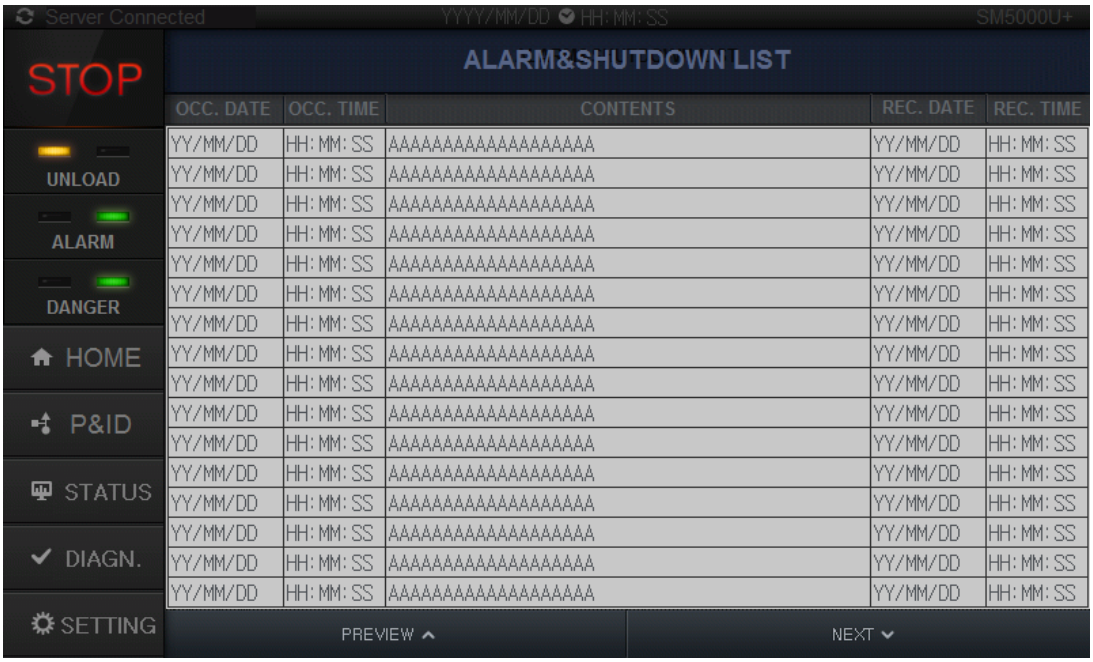
You can check the surge time, the final outlet pressure, and the motor current when a surge occurs. A maximum of 24 sets of surge data is saved.

(3) IN/OUTPUT CHECK

User can check digital I/O signals and analogue I/O signals, RTD input value, etc.

Alarm & Danger Screen

Detailed alarm and danger messages are displayed with the occurrence time.



If there is an analog or RTD fault in the list of occurring alarms, press the Next button to check the details. The table below shows the list of alarms and danger messages set for the compressor. *Asterisk indicates that it is optional.

Alarm Message	Danger Message
[ALARM]SURGE ALARM	[DANGER]SURGE DANGER
[ALARM]CONTROLLER ERROR	[DANGER]OIL LEVEL LOW LOW
[ALARM]OIL LEVEL LOW	*[DANGER]MOTOR BRG "DE"VIB.HH
*[ALARM]CHECK COOLING WATER FLOW	*[DANGER]MOTOR BRG"NDE"VIB.HH
*[ALARM]INLET FILTER DP ALARM	[DANGER]OIL SUPPLY PRESS LL
*[ALARM]OIL FILTER DP ALARM	[DANGER]#1X VIB HH
[ALARM]AUX OIL TRIP	[DANGER]#2X VIB HH
*[ALARM]VACUUM PUMP TRIP	[DANGER]#3X VIB HH
[ALARM]OIL SUPPLY PRESS L	*[DANGER]MOTOR CURRENT HH
[ALARM]#1X VIB. H	[DANGER]OIL SUPPLY TE. HH
[ALARM]#2X VIB. H	[DANGER]FINAL STAGE INLET TE. HH
[ALARM]#3X VIB. H	*[DANGER]MOTOR COIL "R" TE.HH
*[ALARM]MOTOR BRG "DE/NDE" VIB. H	*[DANGER]MOTOR COIL "S" TE.HH
[ALARM]MOTOR CURRENT H	*[DANGER]MOTOR COIL "T" TE.HH
[ALARM]OIL SUPPLY TE. H	*[DANGER]#2 INLET TE.HH
[ALARM]FINAL STAGE INLET TE. H	[DANGER]MOTOR BRG "DE" TE.HH
[ALARM]OIL RESERVOIR TE. L	[DANGER]MOTOR BRG "NDE" TE.HH
[ALARM]MOTOR COIL "R" TE. H	[DANGER]MOTOR START PANEL NO RESPONSE
*[ALARM]MOTOR COIL "S" TE. H	
*[ALARM]MOTOR COIL "T" TE. H	
*[ALARM]#2 INLET TE. H	
*[ALARM]SYSTEM TE. H	
[ALARM]MOTOR BRG "DE" TE. H	
[ALARM]MOTOR BRG "NDE" TE.H	

Alarm Message	Danger Message
*[ALARM]C/W SUPPLY TE. H	
*[ALARM]C/W RETURN TE. H	
*[ALARM]ENCLOSURE FAN TRIP	
[ALARM]CHECK "CHECK VALVE"	
[ALARM]PRE-SURGE	
[ALARM]OIL HEATER TRIP	※ Items with * : Option
[ALARM]CHECK RTD SIG(NEXT SCREEN)	
[ALARM]CHECK ANALOG SIG(NEXT SCREEN)	

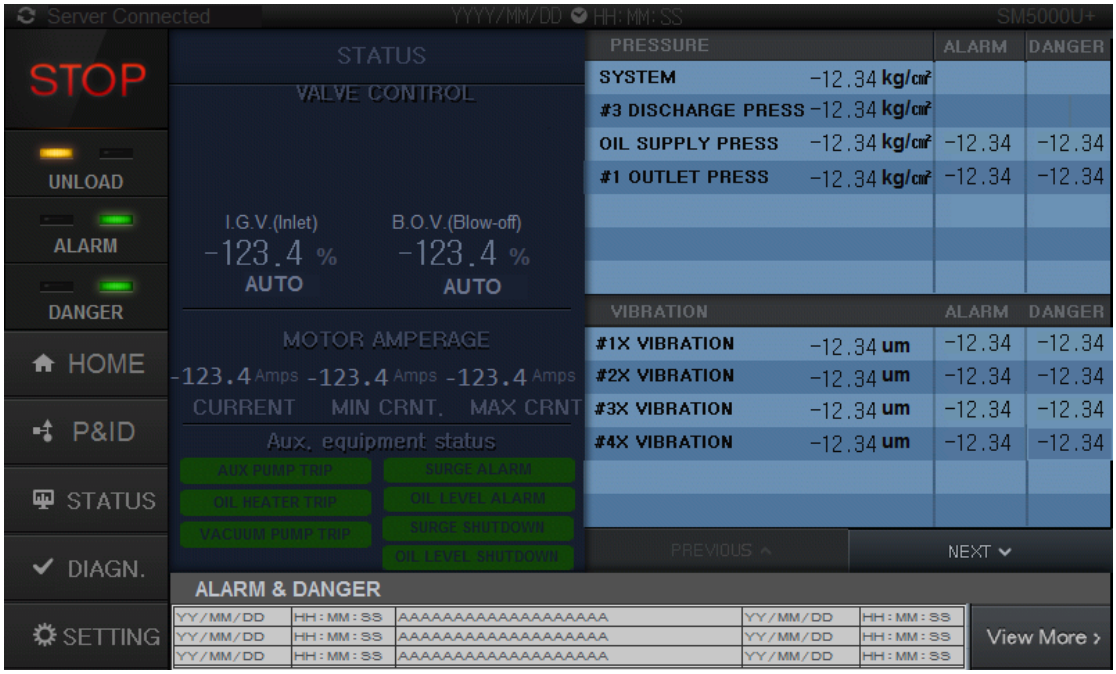
NOTE

Remote Monitoring System

If a danger signal or alarm is issued while operating the remote monitoring system, a message will be sent to the mobile phone linked with the system. For more on troubleshooting, refer to the Troubleshooting chapter of this manual.

Status Screen

The values of all sensors attached to equipment and the current status of auxiliary equipment are shown on one screen. If any alarm and danger signal occurs for pressure, temperature and vibration, the applicable lamp will illuminate. Operator can foresee the alarm or danger signal.



Setting Screen

All the sub devices should be set to automatic mode when operating the compressor.

(1) ACCESSORY CONTROL

It is recommended to set all the sub devices to automatic mode during compressor operation.

- MOTOR SPACE HEATER *<standard spec>*
  - ON: If the compressor stops, for a period of 30 minutes, the motor space heater will remain operating continuously.
  - OFF: Without additional signals, it will remain stopped.
- ENCLOSURE LIGHT <only for customers who used enclosures>
  - ON: Lights turn on when you open the enclosure.
  - OFF: Without additional signals, the enclosure light will remain off.
- ENCLOSURE FAN <only for customers who use enclosures >
  - Auto: When the compressor starts operating, the fan will also begin operating. After the compressor stops, the fan will keep operating for a period of 30 minutes.
  - Manual: Press the On button to operate it. Press the Off button to stop.
- BLOCK VALVE <only for customers who use block valves>
  - Auto: When the compressor starts operating, the valve will also open. When the compressor stops, the fan will close.
  - Manual: Press the On button to operate it. Press the Off button to stop.
- VACUUM BLOWER <only for customers who used ejectors and vacuum blowers as dual>
  - Auto: The vacuum differential pressure is detected by the switch or transmitter to operate the vacuum blower.
  - Manual: Press the On button to operate it. Press the Off button to stop.

(2) PRESSURE SET

The set pressure, unload pressure, reload pressure, etc. can be selected on this screen.

- Pressure setting: based on customer requirements.
- Unload pressure: pressure setting + 0.3kg/cm^2
- Reload pressure: pressure setting – 0.3kg/cm^2

(3) VIEW TUNING

The overall tuning values can be checked. The settings are subject to change depending on the installation environment or compressor condition.

PIC252 (Set Pressure Control): Discharge pressure controller tuning setting variables.

Setting items	Contents	Setting value (TBD)
Deadband	Dead band, pressure sensitivity	0.01
Error_High_Limit	Upper limits error	0.5
Error_Low_Limit	Lower limits error	-0.5
KP	Proportional control constant	3.0
Ti	Integral control constant	0.5
KD	Derivative control constant	0.0
DIRECT / REVERSE	PID controller's control direction	DIRECT

IIC150 (Max Current Control): max motor current controller tuning variable

Setting items	Contents	Setting value (TBD)
Deadband	Dead band, pressure sensitivity	1.0
Error_High_Limit	Upper limits error	3.0
Error_Low_Limit	Lower limits error	-3.0
KP	Proportional control constant	1.0
Ti	Integral control constant	2.0
KD	Derivative control constant	0.0
DIRECT / REVERSE	PID controller's control direction	DIRECT

PIC252A (Unload Pressure Control): unload pressure controller tuning variable

Setting items	Contents	Setting value (TBD)
Deadband	Dead band, pressure sensitivity	0.01
Error_High_Limit	Upper limits error	0.5
Error_Low_Limit	Lower limits error	-0.5
KP	Proportional control constant	1.2
Ti	Integral control constant	0.8
KD	Derivative control constant	0.0
DIRECT / REVERSE	PID controller's control direction	DIRECT

ASC150A (Current Control): current surge controller tuning variable

Setting items	Contents	Setting value (TBD)
Deadband	Dead band, pressure sensitivity	5.0
Error_High_Limit	Upper limits error	15
Error_Low_Limit	Lower limits error	-15
KP	Proportional control constant	0.2
Ti	Integral control constant	3.0
KD	Derivative control constant	0.0
DIRECT / REVERSE	PID controller's control direction	DIRECT

(4) TIME SET

You can set the controller time. Click the Set button and set the current time in the order of year, month, date, hour, minute, and second. After that, click the update button to apply changes. If you want to cancel, press 'ESC' or 'CANCEL'.

(5) ADVANCED SET

The 'Advanced Set' screen can be accessed if you enter the password.

The 'Advanced Set' screen's surge and valve tune menu can be used to manually operate the IGV and the BOV. If you need to inspect valve operation, go to manual mode and enter the desired degree of opening for inspection. However, valve operation test can be performed only if the compressor is stopped. After finishing checking the valve, switch to auto mode and allow the compressor to operate normally.

5.3.3 Control Auxiliary Device

Auxiliary Oil Pump (AOP)

In general, two units of oil pumps are installed in the compressor. The MOP is connected to the bull gear, and when the motor rotates, it rotates together. The AOP is connected to an additional motor for operation. The oil pump can facilitate lubrication and cooling of the parts as oil with adequate pressure is delivered to the rotary parts.

AOP can be controlled under auto-mode or manual mode. However it is not possible to turn off AOP manually when it is required to run. Also do not operate AOP manually when MOP is running since system can be damaged by overloaded AOP.

When the compressor is stopped, the following conditions turn on AOP. If the AOP is overloaded or oil level is low or the oil temperature is under 16℃, the AOP will not operate even the following conditions are meet.

Oil heater is running

If the oil heater runs without oil circulation, the oil near the heater can be hardened. Run the AOP to circulate oil.

Plant's sudden blackout detection (only for the AOP power consisting of UPS)

The AOP runs for 30 minutes. In case of power failure, the compressor is stopped, and the MOP is disabled. In this case, starts the AOP to protect bearings.

The final discharge pressure is greater than 0.5 kg/cm^2

If the discharge pressure is greater than inlet pressure above 0.5 kg/cm^2 when the compressor is stopped, it means that the flow is reversed. For this reason, the compressor can rotate in the reverse direction. To prevent damages to the bearings, the AOP is operated and oil is supplied.

The oil supply temperature is lower than 30℃

The AOP will start operating. During operation, if the supplied temperature reaches 34℃, it will be automatically stopped. However, if the oil reservoir temperature has dropped to below 36℃, the oil heater is operating. And AOP is operated during 10 minutes in oil heater running 30 minutes for the oil circulating.

Even **if the compressor is still operating**, as long as the conditions below are met, the AOP will automatically operate.

The oil supply pressure is lower than 1.63 kg/cm^2

The oil supply pressure is lower than 1.63 kg/cm^2, the AOP runs until the pressure reaches to 2.0 kg/cm^2.

Oil Heater

The oil heater warms up lube oil before the compressor being rotating. Once compressor starts, the oil heater does not need to be on. The operator can select the operation mode of the oil heater regardless of the operation status of the compressor.

Regardless of the operational status of the compressor, the user can select any operational mode for the oil heater. However, if the oil reservoir's level is below a certain level or the oil temperature rises above 45℃, the operator cannot control the oil heater manually. Besides, if the oil temperature rises above 45℃, the oil heater is stopped automatically even in the Manual mode.

When the oil heater operates to prevent damage, the AOP will be operated even if the compressor is stopped.

If the oil heater is set to the Automatic mode, it works as followings

Case	Operation
The oil temperature in the oil reservoir is below 36℃.	The oil heater runs.
The oil temperature in the oil reservoir is above 38℃.	The oil heater stops.

5.4 Initial Start Up / Commissioning

These procedures are applied when restarting the compressor after first commissioning, modification and maintenance. Checks and initial trial run shall be performed under the supervision of manufacturer's engineers and authorized managers.

The equipment shall be operated by trained engineers only.

Operator shall read the manual and understand it clearly. Failure to do this may cause severe personal injury or equipment damage. Be sure to read safety precautions prior to operation.

5.4.1 Oil Supply

Prior to the operation of the compressor, you must ensure that a sufficient amount of oil is supplied. The spec and amount of use of oils should be referred to in Chapter 6 'Lubrication System Spec.' After supplying oil, flushing should be performed to remove any contaminants from the inside. The oil inlet/outlet at the core and the motor should be closed by the blind flange. P&ID should be used to check whether the pipe, the parts and the sensors are properly located.

5.4.2 Pre Inspection

Prior to test operation, check the following items.

Mechanical check point

Item	Check points
General	Check the compressor level is in allowable range (0.5mm/M).
	Confirm that all the parts are clean.
	Confirm that inside of pipes are clean. If there are any contaminants or ice, it must be cleaned before operation.
Pipe	Check all tie-in points are connected to customer lines. Tie-in point information is specified in general arrangement drawing.
	Check the connection of pipes (air, water, oil). If loose, fix it securely
Instrument air	Check the instrument gas connection that is connected as shown in P&ID.
	Check pressure and flow rate of instrument gas. Required range is specified in P&ID and Utility consumption list.
IGV	Check for contaminants inside.
	Operate the IGV to check if it is between minimum and maximum of the scale.
Shaft	When shaft rotates manually, check each unit for any abnormal noise or vibrations.
RCV	Operate the valve to check if it is between minimum and maximum of the scale.
Oil heater	Check specifications on nameplate and confirm that the equipment is appropriate.
Oil tank	Check oil level in oil tank. When injecting oil, make sure the oil gauge indicates 80% between 'H' and 'L' mark.
AOP	Check specifications on nameplate and confirm that the equipment is appropriate.
Main motor	Open terminal box and connect each power cable.

Item	Check points
	Connect the ground cable to the motor ground.
	Check specifications on nameplate and confirm that the equipment is appropriate.
	Check the location of the magnetic sensors.
Coupling	Check the rotation direction of the main motor and gearbox.
	Check the mounting condition of the coupling.
Ship loose part	Check the all ship loose parts are installed according to P&ID.

Electric check point

Item	Check points
Wiring	Check the all electrical wiring are conducted according to P&ID (and/or wiring diagram, if available) and tested accordingly.
Power	Check the connections for power supply are conducted according to P&ID · Main motor · Oil heater · AOP motor · The others (if necessary)
Control panel	Check the installation condition and operation condition.
Junction box	Check the installation condition and operation condition.

Final check point

Item	Check points
Alarm/Trip warning	Check touch screen on control panel or in control room if there are any warnings. If it is, check the causes.
MOP	Remove the MOP air bubble. Open the air removal valve and operate the AOP to keep oil circulating until there are no air bubbles.
Valves	All instrument valve positions are set according to P&ID (open or close)
Cooling water	Check cooling water is supplied.
Main Motor	Perform an inching test. · When all the pre-inspection works are done, press the start button of the control panel to operate the compressor and maintain the condition for about 2seconds. · After 2 seconds, press the stop button to stop the compressor. After the compressor is stopped, the coast down time will be maintained for 4 minutes. · When the compressor is stopped, check the motor rotational direction, the equipment vibrations and operational characteristics.

5.4.3 Operating Procedure

When the pre inspection works are done and it is found that there is no problem in the operation of the equipment, then refer to the procedures below for test operation. During operation, check the main parts, temperature and pressure and check each part for abnormal noises or vibration and any leakage of oil, gas or cooling water.

1 Check the level and temperature of oil reservoir.
2 Supply the control power.
3 When temperature is 36℃ or below, operate the oil heater.
4 Supply the I/A. Check settings.
5 Supply cooling water to oil cooler.
6 Operate AOP.
7 Check pipes for leakage.
8 Check oil temperature. If the temperature regulator is not working automatically, stop operation.
9 Check oil pressure. Adjust settings when necessary.
10 Check that IGV, ASV actuators are at open position.
11 Operate the compressor.
12 Monitor current of the main motor until it becomes stable after reaching the start peak.
13 Supply process gas to compressor in stages and continue to operate until it is normal. Record the measurement values for all measuring points.
14 When the operation is continued with all the temperature values stable, stop the compressor.
15 Stop the compressor

5.5 Normal Operation

All systems including compressor must be warmed up prior to real operation.

5.5.1 Utility Warming up

1 Power supply of Local Control Panel and auxiliary equipment
2 Supply of Instrument Air(I/A)
3 Operation of safety device
4 Valve location installed in Suction/Discharge Side
5 Drain Valve location and Interlock operation
6 Existence of condensate water in the oil reservoir.
7 AOP condition

5.5.2 Compressor Warming up

1 Apply process gas to the system including compressor.
2 Operate the compressor until pressure is applied within it with ASV fully opened (100%)
3 Vent the residual gas from the inside to the outside. Open the drain valve to drain all the internal condensate water.
4 If there is no more condensate water to be drained, close the drain valve.

5.5.3 Operation Condition Check

The following conditions should be satisfied in order to operate the compressor. The conditions can be checked through the 'Ready condition' screen of the touch screen.

- The compressor shutdown signal is not generated.
- Compressor is in ready. (240 seconds after stopping the compressor)
- Oil supply temperature is more than 30℃.
- The IGV should be fully closed.
- The ASV should be fully opened.
- The discharge check valve has no problem.
- Do not press the general stop, emergency stop and the remote stop buttons.

Compressor timer

When the compressor stop or emergency stop signal is detected, the compressor timer will start operating. At the time of factory shipping, the compressor timer is set to 4minutes (240 sec, coast down time) and after a site acceptance test, the timer setting can be changed depending on the actual motor stopping time. You cannot operate the compressor before the timer has come to a stop.

5.5.4 Start-up

If a start command (LCP START button, remote start command from a hardwired terminal, or remote start command by serial link) is inputted without all of the start permissive satisfied, only the AOP starts. A start command can start the compressor start sequence only after all of start permissive conditions are satisfied. If the AOP is not running, then the AOP runs first to prepare the oil supply pressure to start the compressor. Once the oil supply pressure reaches 0.26kgf/cm^2 (typically), the compressor start command is transmitted to the MCC or motor start panel. If there is something wrong with the compressor start sequence, then an alarm is issued that indicates the startup fault. If there are no problems during the start sequence and the AUTOLOAD/UNLOAD switch is set to AUTOLOAD, then the compressor starts to generate compressed air. During the start sequence, the maximum values for vibration measurements are saved and can be monitored on the HMI screen.

When the compressor starts, each valve is operated as follows;

Condition	IGV (% Open)	ASV (% Close)	Status
Start ~ Unload condition	0	0	Unload condition (With ASV opened 100%)
Unload -> Load switched	Open(until MINLOAD)	Close(until MINLOAD)	Discharge pressure is increased.
Load condition	Min ~ Max	Min ~ Max	Inlet pressure/Anti-Surge control

When the compressor starts operating, you need to check for any warning or danger signal and any abnormal noise or vibration.

The compressor will be unloaded if any of the following conditions are met;

- Loading failure
  - Oil supply temperature and pressure, motor current or inlet temperature of final stage is failure.
  - Surge is detected during the loading process.
- Over pressure detected
  - (When an autodual BOV is applied) the control target pressure becomes higher than the UNLOAD PRESSURE.
  - This condition resets when the system pressure falls below the RELOAD PRESSURE.
- Control target unavailable
- Surge alarm

5.5.5 Stop

The compressor can be stopped if you press the normal/emergency stop button or remotely send the stop signal. In addition, if a shutdown signal is issued due to malfunction during operation, it will be stopped accordingly.

Depending on how a stop signal is generated, a different procedure for stopping is used. For more details, refer to the following table.

Stop type	Stop method	
Normal stop Remote stop	Unload condition	When the stop button is pressed, 100msec passes and it will immediately stop.
	Load condition	When the stop button is pressed, 100msec passes. Then switch to unload conditions and the equipment stops after 30 seconds.
Emergency stop	Regardless of load conditions, when the emergency stop button is pressed, if 100 msec is passed, the equipment stops immediately.	
Shutdown	Regardless of load, the equipment stops as soon as shutdown is detected.	

5.5.6 Emergency Stop

If the user presses the emergency stop button, the compressor stops rotating or if the trip condition is fulfilled during the operation, the compressor will not rotate. For the sequence of emergency shutdown, see the below.

1 Emergency stop or shutdown signal is detected.
2 When the compressor stop is recognized, ASV is open quickly.
3 Main Motor stops.
4 If Main Motor Run Status signal is OFF or emergency stop signal is generated during normal operation, following steps are performed.
   A Coast Down Timer (4min) is started.
   B Re-Lubricating Timer (30min) is started.
   C AOP starts in auto and continues for re-lubricating time.
   D Oil Heater shall be changed to Control Mode.

If the compressor is tripped due to an emergency stop signal, the emergency stop alarm is issued. To restart the compressor, click ‘Reset’ to cancel the emergency stop alarm.

6. Maintenance

LIST

6.1 Lubrication Guide

When the compressor begins to operate, the friction of parts will generate heat and as this heat accumulates, the rotary units can get stuck. To prevent damage to the parts and maintain reliable operation, the user must to use the lubricant with specifications recommended by the manufacturer and properly supply the lubrication to the rotary units of the gear box and the motor.

6.1.1 Lubrication System Specification

	SM3100	SM4100	SM5100	SM6100
The initial charge level	187	220	311	355

6.1.2 Supplier and Specification of Oil

The company recommends the user to use oil as follows:

Product	SCL-32
ISO	VG 32
Advantages	· API group Ⅲ base oil with high viscosity index used · Various technologies applied to ensure the good performance of lubricant · Energy saving type compressor oil with good wear-resistance and extreme pressure properties · Low temperature property enhanced · The replacement cycle of lubricant improved with enhanced oxidative stability

SCL-32 is genuine lubricant for compressor developed by Hanwha Techwin. The SCL-32 extends the replacement cycle, improves wear resistance and extreme pressure properties. And the SCL-32 reduces the coefficient of friction to prevent damage to equipment.

For detailed information about how to order or use SCL-32, please contact the Hanwha Techwin, Aftermarket group (comp.am@hanwha.com)

The above oil is not available; the following oil can be substituted.

Supplier	Oil Name	ISO	Remark
SHELL	TURBO T-32	VG32	Turbine Oil
SK	TUBINE OIL #32	VG32	
MOBIL	MOBIL LIGHT #32	VG32	

Caution for selection oil

If low grade oil, or one not recommended by manufacturer is used, it may cause the se rious damage to the rotating parts of compressor.

6.1.3 Refill and Replace of Oil

The compressor's oil keeps getting filtered and refilled as it circulates in the system, but to maintain the clean condition, you need to periodically replace the oil.

※ Recommend replacement cycle is below:

- SCL-32: Earlier time between below conditions.
  - Operating 16,000 hours
  - 2 years after oil changing
- Substitution Oil: Earlier time between below conditions.
  - Operating 8,000 hours
  - 1 year after oil changing

Do not mix oils with different specifications.

Mixing oils from different manufacturers can lead to lowered performance and serious damage to the machinery. When oil in reservoir is replaced, drain out the existing oil, clean the inside of the reservoir and then fill with new oil.

The oil level should be between L and H of the level gauge.

If the oil level drops below L, the compressor may fail to operate due to an insufficient amount of oil or the rotary parts, such as the bearing, can be damaged if operator forcefully operates the machine. Furthermore, if the oil level is above H, then there could be a problem with recovering oil or operation of the vacuum gauge. Thus, when you check the oil level, you have to make sure that the oil level is between L and H at all times (80%: Manufacturer's recommendation)

Oil replacement cycle

The replacement cycle depends on the operating environment of compressor. It is recommended to check oil at least every six months. The oil sample (approximately 0.1 liter) shall be taken from the downstream of oil filter in lubrication system and should be taken in warm condition.

6.1.4 Greasing

Some rotary parts (such as main motor, AOP, Motor of Vacuum pump, etc) on the compressor require periodic greasing. Depending on the type of equipment, lubricant specifications/ refill amount and period will vary. For more details, refer to the document provided by the manufacturer or the name plate.

6.1.4.1 Main Motor

Depending on the type of bearings, lubricant specifications/ refill amount and period will vary. Refer to the motor maker manual and the name plate on the part.

6.1.4.2 Coupling (Geared Type)

NOTE

Following Grease refill and replacement procedure is only applicable to the gear type coupling.

Grease refill and replacement procedure in this paragraph is only applicable to the gear type coupling. If you use a disk or diaphragm type coupling, it is not applicable, so skip this.

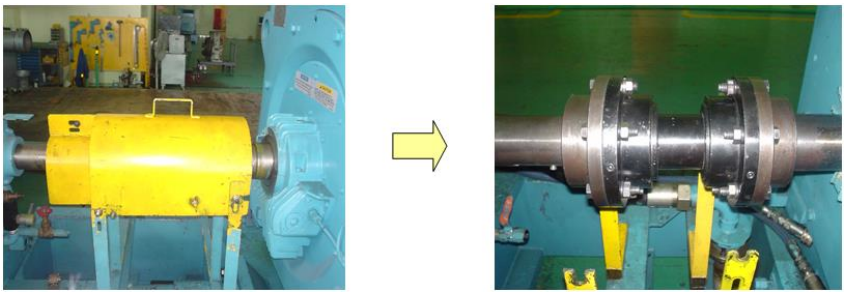
The grease specifications applied to the coupling are shown as follows.

Supplier	Oil Name	Refill & Replace
GULF	GULFCROWN Grease EP#1	Check the grease condition frequently and if necessary, refill or replace the grease. After 4,000 hours of operation, grease shall be replaced. However if you use LTG (long term grease) you should replace it after 16,000 hours of use. For more details on LTG, please contact the service center.
SHELL	ALVANIA Grease EP#2	
TEXACO	MULTIFAK EP-1	
MOBIL	MOBILUX EP-1	

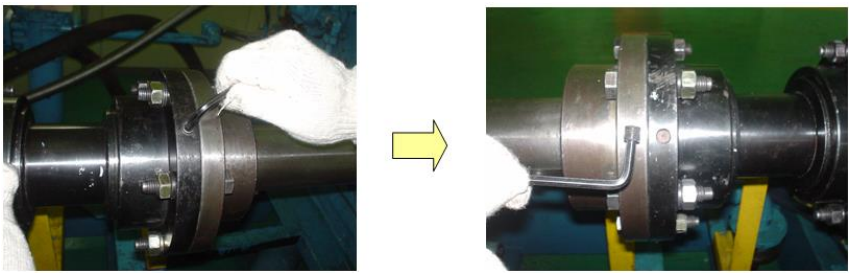
For more on how to refill and replace grease, refer to the following procedures.

Grease refill procedures

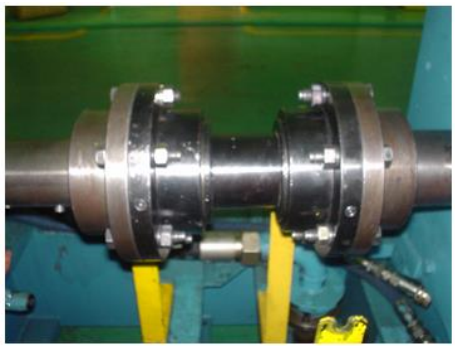
Step 1 Disassemble the coupling cover.

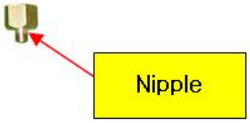


Step 2 Using an L wrench (5mm), loosen the grease injection hole for the coupling at both side (up, down)



Step 3 Mount a grease nipple on the grease injection hole and inject grease using a gun. Check if grease came out from the injection hole on the opposite side.





How to replace grease

Step 1 Disassemble the coupling cover.

Step 2 Dismount the coupling.

Step 3 Stand the coupling up and push down the outer ring.

Step 4 Using a thinner, remove grease completely, refill with new grease and execute the above steps in the reverse order.

6.2 Maintenance Schedule

Regular maintenance prevents accidents caused during the equipment operation in advance and is an essential procedure for prolonging the product life cycle. Especially the maintenance quality may decisively affect the product quality. Therefore, the schedule and procedure, suggested by the manufacturer, must be observed. Also the equipment status should be checked regularly during operation. Checking of minor symptoms during the equipment operation may prevent fatal accident.

But, the equipment wearing conditions differ depending on operation load or work environment. Also part status in the same compressor can vary. Therefore, the check list, supplied by Hanwha Techwin, should be used until a user prepares a self-check schedule of equipment installed in the field. If a user can perform a self-evaluation, make an evaluation sheet and perform regular check.

If any repair other than specified in this manual is required, contact the service center of Hanwha Techwin.

Only engineers who qualified by Hanwha Techwin shall perform the maintenance operations.

Except for simple inspection or general consumable replacements, you need to contact Hanwha Techwin service center and make the certified engineer to perform periodic inspection or overhaul work. (Certified engineer: Persons who have received repair training after certification in each level)

If any other persons perform overhaul, disassembly or repair, Hanwha Techwin will not be held responsible for any damage or injuries that may occur.

You are recommended to use authentic parts provided by Hanwha Techwin only.

For repair and maintenance works, you are recommended to use authentic parts provided by our company only. If a problem occurs due to the use of unauthorized parts, Hanwha Techwin will not be held responsible, and the warranty will be considered invalid.

Prior to beginning work, install the safety rope around you.

When there is ongoing work, you need to show the safety rope near the working area so that those nearby know it is a construction area. In a construction area, dropping or falling accidents can occur, so members of the general public except for workers should not be allowed to enter.

6.2.1 Classification of Inspection Periods

To interpret the inspection results, refer to the reference parameter for the Running status provided with a report submitted when the equipment is delivered.

Periods		Maintenance codes	By
Preventive inspection	Daily/weekly inspection	-	Customer/approved repair person
	Monthly inspection (600 hours)	-	
Periodic maintenance	Semi-annual inspection (4000 hours)	S1	
	Annual inspection (8000 hours)	S2	Approved repair person
	3 year inspection (24000 hours)	S3	
	5 year inspection (40000 hours)	S4	
OCD (On Condition)	When a problem occurs	S5	

Ex) Repair sequence for equipment operation period

Classification	1 Year		2 Year		3 Year		4 Year		5 Year	
	Jun	Dec	Jun	Dec	Jun	Dec	Jun	Dec	Jun	Dec
Maintenance codes	S1	S2	S1	S2	S1	S3	S1	S2	S1	S4

But the above maintenance sequence may vary depending on the operating environment or customer's requests.

6.2.2 Daily Check

WORK	ITEM	REMARK
Check and record	Alarm/Warning message	
	Inlet filter D/P gauge	If D/P gauge(option) is installed
	Cooling tower, cooling pump, drier operation status	
	Cooling water supply pressure	
	Cooling water supply temperature	
	Leakage of cooling water	
	Condensate water drain condition	
	Oil filter D/P gauge	
	Oil demister D/P gauge	
	Oil supply pressure	
	Oil leakage	Max. 2drops/hr
	Excessive vibration, noise and temperature on system	
	Cleanness of the motor housing inlet filter	

6.2.3 Monthly Check

WORK	ITEM	REMARK
Check and record	Oil level	Re-fill if necessary
	IGV operating condition	Valve open/close condition as signal change
	BOV operating condition	
	Block valve operating condition	Manually open/close status check
	Coupling grease condition	In case of applying a geared type, Refill or replace in case of malfunction.
Refill	Motor bearing grease	1,440 hours (two months) interval

6.2.4 Semi-annually (Maintenance Code S1, Operating time: 4000 hr or 0.5 yr)

* Option: items requiring additional contracts. Customer: can be done by customers.

WORK	ITEM	REMARK
Check	Monthly inspection Performed	
	Cooling water tower, cooling water pump, and drier operation status	
	Loose mounting sensors	
	Condition of each valve	
	Joint of control panel slot	
	MOP coupling condition	
	AOP coupling condition	
	Motor oil level	
Replace	Inlet filter element	
	Coupling grease	In case of applying a geared type. However, if you use LTG (long term grease), replace it after 16,000 hours.
	Motor bearing (Sleeve bearing) oil	Self-lubricating

The following parts and tools are used for S1 repair works. You can purchase them at our agent or company if necessary.

NO	Service Interval (hr)	Part Description	Total Q'ty
1	4,000	Inlet Filter 1st element	1 Set
2	4,000	Inlet Filter 2nd element	1 Set
3	4,000	Grease / Oil	

6.2.5 Annually (Maintenance Code S2, Operating time: 8000hr or 1yr)

Customer: can be done by customers;
Consumable: can be purchased.

WORK	ITEM	REMARK
S1	S1 inspections performed	
Check	Loose BOV assembly	
	IGV ball joint condition	
	IGV calibration	
	Motor alignment	
	Pressure transmitter	
	MOP coupling's tooth	
	Temperature sensor	
	Loose mounting vibration probes	
Cleaning	BOV positioner	
	Chemical/Mechanical cleaning of Inter coolers	
	Chemical cleaning of oil cooler	
	Inside the oil reservoir	
Replace	Oil filter elements	CONSUMABLE
	Oil mist elements	CONSUMABLE
	Oil	For SCL-32, Replace oil after 16,000 hours
	Regulator elements	CONSUMABLE
	Air filter elements (Vacuum blower type)	CONSUMABLE

In addition to the items shown in the above table, the following tools and parts are used for S2 repairs works. If necessary, you can purchase them from our agent or company.

NO	Service Interval (hr)	Part Description	Total Q'ty
1	8,000	Inter Cooler Repair KIT	1 Set
2	8,000	Oil Cooler Repair KIT	1 Set

Operation Of Foundation Plan

In case of crack or deformation found during yearly maintenance, re-work for Foundation Plan.

6.2.6 Triennially (Maintenance Code S3, operational hours: 24000 hr, or 3 yr)

Customer: can be done by customers;
Consumable: can be purchased.

WORK	ITEM	REMARK
S2	S2 inspection performed	
Disassemble and check	Gear box disassembly inspections	
	Check impeller	
	#1, #2, #3, Blind, Bull bearing	
	Vibration of core	
	Tooth of the bull gear/pinion gear	
	Vibration of motor	
	Discharge/outlet and all expansion joints	
	AOP check valve	
	MOP check valve	
	PCV (Pressure Control Valve)	
	Start panel burning	
	TCV (Temperature Control Valve)	If necessary, wash or replace it.(*CONSUMABLE*)
Check	Control panel	
	Start panel	
Replace	MOP coupling rubber	CONSUMABLE
	Each regulator	
	Gasket types	CONSUMABLE
	O-rings types	CONSUMABLE
	IGV Condensor	CONSUMABLE
	PLC battery	CONSUMABLE
	V-JOINT rubber set	

In addition to the items shown in the above table, the following tools and parts are used for S3 repairs works. If necessary, you can purchase them from our agent or company.

NO	Service Interval (hr)	Part Description	Total Q'ty
1	24,000	V-Joint Rubber Set	1Set

6.2.7 5 Year Inspection(Maintenance Code S4, operational hours: 40000 hr or 5 yr)

Customer: can be done by customers;
Consumable: can be purchased.

WORK	ITEM	REMARK
S3	S3 inspection performed	
Repair	IGV assembly set (kit)	CONSUMABLE
	Rotor balancing	
Replace	AOP coupling	
	IGV&BOV positioner	CONSUMABLE (SW-1000R)
	Discharge check valve	CONSUMABLE
	IGV actuator	CONSUMABLE
	Inter cooler bundle	CONSUMABLE
	After cooler bundle	CONSUMABLE
	Bearing set	CONSUMABLE
	Seal set	CONSUMABLE
	MOP repair set (Kit)	CONSUMABLE
	MOP coupling	CONSUMABLE
	Main motor coupling	CONSUMABLE
	Touch screen	CONSUMABLE

6.2.8 Non Periodic Inspection (Maintenance Code S5)

The following inspection items are applicable to S5 code.

- After cooler replacement
- Oil cooler replacement
- Standard parts replacement
- Accessory replacement
- Electrical devices replacement
- Repair and maintenance works not included in S1/2/3/4

6.3 Disassembly and Check

6.3.1 Inlet Filter

For centrifugal compressor, it is important to manage quality of inlet air. Therefore maintenance schedule should be determined by regular checking the differential pressure of manometer installed on inlet pipe at operating site.

If the differential pressure gauge of the inlet filter is not installed, replace the element in the semi-annual inspection period.

If the differential pressure gauge (option) is not installed, the inlet filter should be replaced in half inspection period(Service Code: S1, 4000Hr).

Depending on the inlet filter specification, different repair periods and methods are used.

Depending on the inlet filter specification (package or external installation), repair and maintenance methods vary. Check the inlet filter specification first before proceeding.

6.3.1.1 Package Type Filter

Classification	Filter Replace DP	Remark
Filter Element	450 mmH_2O	Cleaning not allowed. Replace the element after stopping the compressor.

6.3.1.2 External installation type Filter

If differential pressure of filter reaches to 200mmH_2O;

- Clean the 1st element with compressed air or detergent and reassemble to filter case.

If differential pressure of filter reaches to 250mmH_2O after cleaning the 1st element;

1 Alarm message is display on the touch screen.
2 Stop the compressor.
3 Replace the 1st and 2nd element.

How to assemble or disassemble the 1st element

1 Open the clamps on top/bottom of the filter hood and open the hood to the top.
2 Pull the handle to the 1st element to disassemble the element.
3 Wash or replace the element.
4 Push it until it touches the 2nd element assembled in the filter.
5 Fix the 1st element. Close the hood and fix it with the clamps on top/bottom.

How to assemble or disassemble the 2nd element

1 While disassembling the element, do not allow any contaminant to enter the compressor.
2 Refer to the above steps when you disassemble the 1st element.
3 Pull the edge of the 2nd element to disassemble the element.
4 Replace the element.
5 Mount the new element in the case. Push it until it reaches the case jaw and then fix it with the clamp.
6 Mount the 1st element.

How to clean the element

- Cleaning with Compressed Air
  - Based on the assembled position of 1st element, inject compressed air of 30 psig from the inside (clean side) toward the outside (side with foreign materials).
- Cleaning with Cleanser
  - Clean 1st element with warm water of 65~75℃ or non-volatile neutral detergent, and dry in the shade at least for 12 hours.

6.3.2 Core Assembly

Only engineers who qualified by Hanwha shall perform the disassembling and reassembling of core work.

Prior to shipping, the core assembly goes through a precise assembly procedure. So, if you disassemble or repair it on your own without our engineer supervising you, our company will not be responsible for any problems that may occur.

Observe the followings to disassemble Core Assembly

- If wear of inside gear, damages of bearings and seals, etc. are found visually, stop the operation immediately and check the part.
- When internal check and repair of gear box, care should be taken to protect gear box from foreign materials. While the work is not carried out, cover gearbox with vinyl or equivalent to prevent foreign materials from mixing.
- Since rotor assembly is balanced at the factory, never disassemble the impeller of each stage separately.
- Do not disassemble bearing supporting the rotor of each stage without Hanwha's permission.

6.3.2.1 IGV (Inlet Guide Vane)

The actuator rotates the control arm and the IGV vane performs switching. So, if there is a contaminant in the joint/assembly then a malfunction can occur.

Refer to the table below for inspections.

Check Item	Check Contents	Remedy in Failure
Ball Joint Fix Nut	Any interferences and looseness in rotation	Interferences: confirm link assembly configuration Looseness: re-assemble using a tool
IGV Assembly	Cleaning status	clean using compressed air or soft cloth
Control ring Contact Side	Operating status	In case of not operating smoothly, apply grease after cleaning
Snap Ring	Assembled status	Clean/replace after checking worn status and disassembling

6.3.2.2 Gear Box

Prerequisites

- Disassembly of core assembly must be done in the presence of engineers of manufacturer.
- Rainy or dusty conditions must be avoided when disassembling core unit and gearbox.

Preparation

1 Disconnect power from the equipment.
2 Disassemble pipes connected to core assembly.
3 Remove vibration sensors from the compressor body. Wrap the removed sensor with dry cloth and store in safe location.

Disassembly Procedures (Core Unit – Gear Box)

Step 1 Release bolt from coupling cover and remove coupling cover.
Step 2 Remove bolt to disconnect coupling connecting motor and bull gear
Step 3 Disassemble bull gear oil seal, MOP prior to the upper/lower plates of gear box.
Step 4 Remove bolts on the upper/lower plates of gear box and separate them at regular intervals using 4 holes of jacking bolts.
Step 5 Connect 4 holes positioned at the upper corner of the gear box to an overhead hoist, and lift the gear box upper plate vertically.
Step 6 Place the upper plate of gear box on wooden pallet or block.
Step 7 When reassemble the gear box, must be assembled by bolts to the specified torque and sequence. (For more information, please contact the local service provider.

Check List

Part	Check item	Remedies for failure
Shaft	Wear, corrosions and cracks	Report to manufacturer
	Probe Area scratches and dents	Report to manufacturer (Scratches or dents may affect measurement of vibration)
Gear	Damage, wear and cracks of gear teeth	Report to manufacturer
Bearing	Abnormal wear, cracks and discoloration.	
Seal	Transformation and wear of rotating contact side	
O-ring	Cuts, cracks, damage and elasticity	Replacement

6.3.3 Compressed Gas Discharge System

The compressed air discharge system is designed to prevent back flows of the discharged air and the compressed air discharge pipe. The discharge system is consists of check valve, expansion joint, BOV (or ASV) and silencer.

Prerequisites

- Disassembly of equipment must be done in the presence of engineers of manufacturer.
- Rainy or dusty conditions must be avoided when disassembling or checking the part.

Preparation

- Disconnect power from the equipment.

Access the power source more than 10 minutes after the system stops.

Power may exist in the power source even after equipment completely stops. Never disconnect 3-phase power or access the power source immediately.

Necessary tools

Wrench set, pin with a diameter of 0.2mm, spanner set

Disassembly procedures

Step 1 Lock the BOV and remove the BOV pipes.

Step 2 Loosen the three (3) set screws that securely fasten the check valve case and guide and separate the guides, the spring and the disk.

Step 3 Press the check valve disk to see if it operates properly.

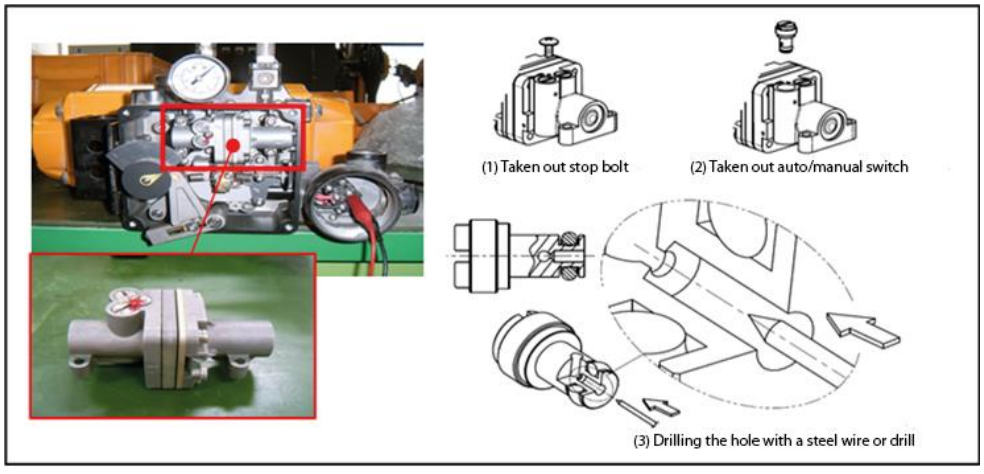
Step 4 If a disc in check valve does not operate smoothly, check the reason and take proper actions such as cleaning or replacing.

Step 5 Check operability and calibration of the BOV and cleanness of the operation unit.

Step 6 Check consistent air supplies to the BOV and separate the pilot valve.

Step 7 Apply air pressure to the hole on the opposite side of the manual/auto switch to remove residue.

Step 8 If clogging remains after step 7, as shown in the figure below, use a drill or steel wire with a 0.2 mm diameter.



After disassembling the check valve, inspect and clean each functional unit.

If the disc in check valve does not operate smoothly due to contaminants or corrosion or the spring is not resilient, disassemble them completely to remove contaminants and perform cleaning.

Do not use cleaners that contain chlorine when cleaning expansion joint.

Check abrasion or material deformation on the functional area that contacts the valve.

If you see some gaps when the disc and guide are contacting (close condition), the check valve needs to be replaced. Excessive pressing or abrasion on contact area of disc and guide can cause the gap.

Check the sliding contact between the disc piston and the guide pocket.

Even if the gap between the disc piston and the guide pocket is normal condition (less than 0.8mm), frequent switching or excessive shaking of valve indicates that the check valve is failed and it can cause secondary damage to the compressor. In this case, the check valve needs to be replaced. And the disc piston's outer diameter and the guide pocket's inner diameter are separated too much, it also indicates that the check valve needs to be replaced.

6.3.4 Main Motor

The main motor should be repaired and inspected by a qualified technician.

When maintain the main motor, sufficient care must be taken to avoid severe personal injury and property damage resulted from electric shock and burn due to high voltage. It is strongly recommended the personnel disassemble and check the motor only when necessary. The disassembly and check operation shall be performed with the support of manufacturer or by experienced person.

For more information, please refer to the manufacturer's manual.

Prerequisites

- Disassembly of motor must be done in the presence of engineers of manufacturer.
- Rainy or dusty conditions must be avoided when disassembling and checking the equipment.

Preparation

- Disconnect power from the equipment.

Access the power source more than 10 minutes after the system stops.

Power may exist in the power source even after equipment completely stops. Never disconnect 3-phase power or access the power source immediately.

Disassembly Procedures

Step 1	Loosen bolts on terminal box and disconnect the cable.
Step 2	Reassemble bolts and close terminal box cover.
Step 3	Loosen coupling cover and remove coupling spacer.
Step 4	Secure coupling flange to hold the shaft using shaft fixing bolt.
Step 5	Loosen bolts securing the motor.
Step 6	Remove the main motor.
Step 7	Perform assembly in the reverse order of disassembly. Position the motor in place on the base plate according to Shaft Alignment Procedure.(Refer to 'installation')

6.3.4.1 Coupling

Coupling is a part to connect between a motor shaft and bull gear shaft, which transfers the torque between the shafts by correcting the misalignments of two shafts' parallel tolerance, angle tolerance, shaft floating tolerance, etc. Any excessive misalignment between the two shafts may cause life cycle reduction and damage to coupling and compressor parts. Therefore, check the alignment status of motor shaft and bull gear shaft during regular maintenance of the compressor, and if necessary, realign it.

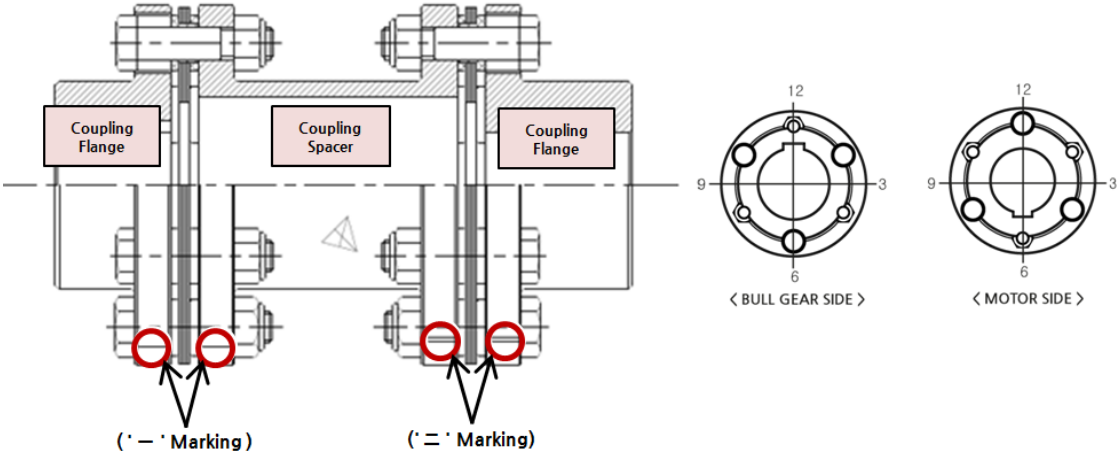
Prerequisites

- Disassembly of coupling must be done in the presence of engineers of manufacturer.
- Rainy or dusty conditions must be avoided when disassembling and checking the part.

Preparation

- Disconnect power from the equipment.

Disassembly Procedures (Disc Coupling)

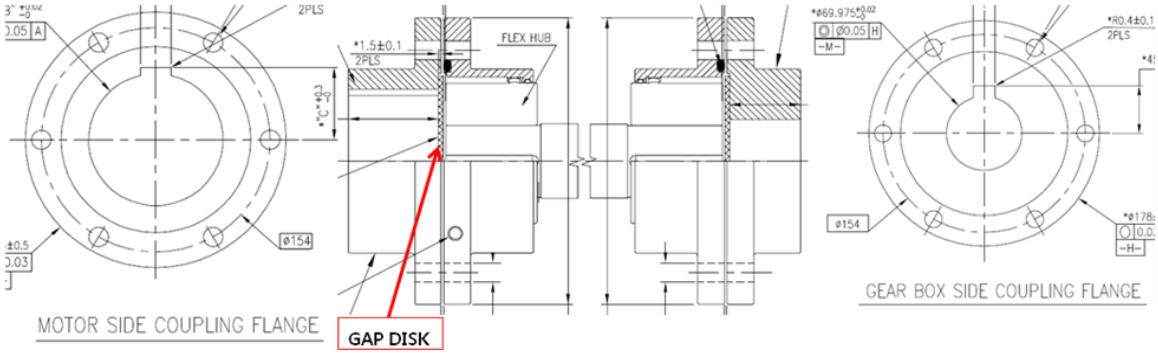


Step 1 Verify the assembled location (I-marking) of coupling spacer and disc pack.

Step 2 Loosen bolts secured on both ends of the coupling and disassemble coupling spacer and disc pack.

Step 3 Verify the assembled marking location and perform assembly in the reverse order of disassembly

Disassembly Procedures (Geared Coupling)



Step 1 Disassemble coupling and joint of flange.

Step 2 Disassemble geared coupling spacer and coupling.

Step 3 When assembling it, apply grease to the gear tooth and the geared coupling and pay attention to the assembly plane when you fasten it.

6.3.5 Cooling System

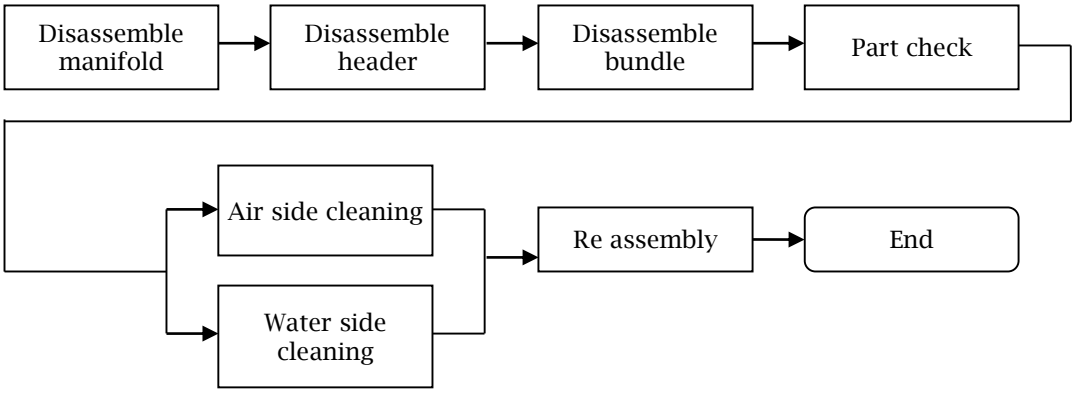
Caution

Cleaning of cooling system shall be performed by worker who is approved by Hanwha Techwin service training or in qualified agency.

While cooler operates, contaminants attached to the tube inner/outer and fin of tube and it causes pressure loss, corrosion, thermal resistance, etc. They may cause surge or shutdown due to the temperature rise of compressed gas.

If the temperature of cooler discharge gas raises at least 8℃ than the temperature specified in the specifications, cooler needs to be cleaned. If the temperature rises continuously, the amount of compressed gas is reduced, the discharge pressure is lowered and the power required for unit flow rate is increased.

Air side and Water side cleaning shall be performed separately. Cleaning method is determined in accordance with the cleaning part. Please refer to the following instruction.



Observe the followings for chemical cleaning.

- In case of the chemical cleaning, use a cleaning agent that doesn't corrode the copper pipe, zinc plate or the aluminum cooling fins. The fluid flow speed should not exceed 0.5m/sec.
- After chemical cleaning, remove the residual cleaning agents within the cooler using a counter agent and clean it with cooling water.
- Avoid reusing of used O-ring, and check for leakage by a hydraulic test after reassembled.

6.3.5.1 Disassemble the Manifold

Before separating the manifold, block off cooling water supplies and remove the remaining cooling water inside the pipe. If you need to implement the discharge line, you need to consider possible damage and corrosion to the neighboring parts as well as possible human injury.

When you store the separated manifold, cover its inlet/outlet to prevent entry of contaminants.

6.3.5.2 Disassemble the Header

Assemble the stud bolt to the header top and fix it with a lifting tool. After that, remove the other bolts. When you separate the header from the cooler case, fasten the jacking bolts to the holes on both sides of the header, because it will make the job a lot easier. After separating the header, use a flat tool to separate the gasket. At the time of re-assembly, it is recommended to replace the gasket with a new one.

6.3.5.3 Disassemble the Bundle

Remove the cooler bundle for cooler cleaning according to below instruction.

Disassemble procedures

Step 1	Remove a manifold connected with cooler inlet/outlet flange.
Step 2	Apply jacking bolt to hole and fasten it slowly to disassemble the head.
Step 3	Remove o-ring. (It is recommended to replace it with new one when it re-assembly.)
Step 4	Assemble eye bolt on the bundle case and then connect rope. Taking out bundle slightly by pull the rope. Care must be taken not to shake the bundle. Use support or additional rope if required.
Step 5	Store the disassembled bundle in safe area.

6.3.5.4 Air side Cleaning

This procedure is for cleaning the attached contaminants on plate fin. Take proper method between mechanical cleaning and chemical cleaning.

Mechanical cleaning

Eject compressed air or steam of $4N/m^2$ or less in the perpendicular direction of tube.

For cleaning and assembly, verify the direction of fin is arranged uniformly. When the fin is folded, unfold it to prevent damage to parts.

Chemical cleaning

Drip the bundle in the tank filled with cleaning agent and clean-up it until the cooling fin is gray.

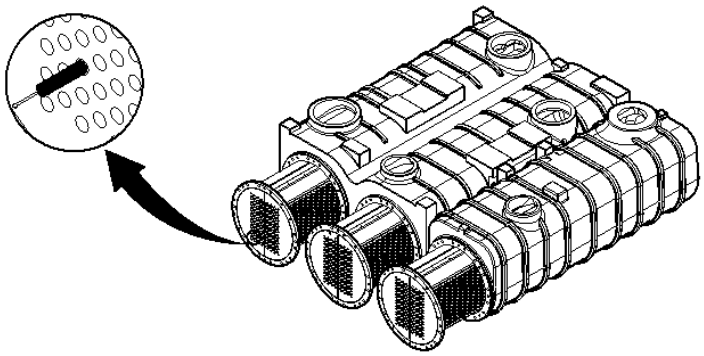
After chemical cleaning, completely remove the residual cleaning agent using final neutral agent for assembly.

6.3.5.5 Water side Cleaning

The cooling water flown toward tube-side may be contaminated by the external dust or foreign materials through cooling tower. So it should be cleaned frequently.

Mechanical Cleaning

Clean the inside of each tube-side using brush with wire in its long rod after disassembling bundle.



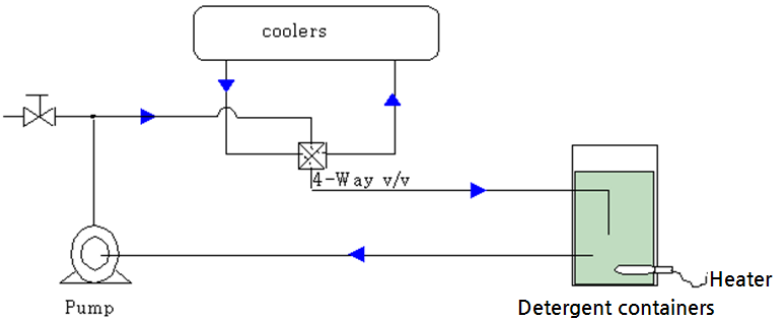
CAUTION

Wire brush may be stuck in the tube during mechanical cleaning

The wire brush may be stuck into the tube in case of not securing rod and wire brush t ightly. Make sure to check the inside of tube and brush status during cleaning.

Chemical Cleaning

Dip the disassembled bundle in the tank filled with cleaning agent, clean it until the fin is gray, and then blow out it with compressed air. For cleaning of the assembled bundle, refer to following procedure.



[Notes]

Cleaner: Non-toxic, Noncorrosive, Nonflammable, Innocent, Organic solvents

Using Temperature: 40~60℃

Purifying Time: 1.5~2.0 Hr

Step 1 Prepare basket with cleaning agent.

Step 2 Heat the agent temperature to 40~60℃ and then connect pipe for cleaning. Circulate cleaning agent for 1.5~2 hours.

Step 3 After circulating agent, completely remove the residual cleaning agent using final neutral agent.

6.3.5.6 Items to check when you disassemble the cooler

When you disassemble the cooler, check the following guidelines. If you see any sign of defects after inspection, take proper actions according to the instructions below, and if you cannot take necessary action at the site, contact an agent or our service center.

Parts	Items to check	Troubleshooting methods
Utility	Water quality	Impurities in the cooling water in the water tank of the cooling tower (Such as seaweed, sand etc.) should be periodically removed.
	Amount of cooling water	Inspect the cooling water pressure meter supplied from the cooling tower. Periodically inspect and clean the strainer installed at the inlet.
	Cooling water supply condition	· Temperature: below 35 ℃. · Pressure: 2.5 ~ 5.0 kg/cm^2.
	Winter pump/cooling water freezing	After repairing the pump in the winter, while compressor is in operation, check the cooling water and the pump.
Cooler	O-Ring status	After disassembly, replace when you assemble again. (Recommended)
	Fin/tube abrasion/corrosion /damage/clogging	Cooler should be inspected annually.
	Tube corrosion	· If there are less than five pipes damaged, use a copper rod to block its inlet/outlet. · If there are more than five pipes damaged, contact agency or service center.

6.3.6 Lubrication System

6.3.6.1 Oil Filter Element (Cartridge)

The oil filter is used to remove contaminants created during the operation. Enough filtering and maintenance of lubricant to prevent foreign material entering into the lubrication system is required: otherwise it may cause severe damage to equipment. When foreign materials accumulated in filter increases differential pressure, filter replacement signal is sensed from control panel. At the time, filter shall be replaced. Also replace the filter when proper oil supply pressure is not formed in gear box.

Depending on the oil specification, repair and maintenance methods may vary.

Depending on the oil filter specification (single or dual), different repair and maintenance procedures are used. Check the filter specifications first before proceeding further.

Prerequisites

- These procedures shall be performed by appropriate personnel qualified to disassemble, assemble and setup the equipment.
- Rainy or dusty conditions must be avoided when disassembling and checking the part.

Preparation

- (Single) Disconnect power from the compressor.
- (Single) Drain oil in the oil supply pipe. In the case of oil drains, high pressure can cause injuries.
- (Dual, option) Turn the lever of oil filter to the opposite side of the filter to be replaced to change the oil flow direction.

Replacement Procedures

Step 1 Prepare a proper container for collecting the drained.

Step 2 Open the drain port and remove oil in the filter.

Step 3 Loosen the fixed bolts on the filter slightly and remove the upper cap.

Step 4 Disconnect element. Clean the remaining parts with clean cloth.

Step 5 Close the drain port.

Step 6 Lubricate O-ring assembled part of the element to be replaced and insert it into the assembled part.

Step 7 Clean the housing under the filter and assemble it to the body.

Care must be taken to prevent from foreign material entering into the equipment during assembly.

Entering foreign material by wearing gloves, etc. may cause malfunction of filter eleme nt. If foreign material enters into the equipment, it may cause severe damage to equip ment.

6.3.6.2 Air Regulator for Oil Demister

The oil demister is equipped with air regulator to maintain the Instrument air (I/A) supply pressure. Water can build up in regulator due to water in the I/A during operation, it can be causing damage to regulator.

To avoid it, check the condensate gauge of regulator frequently and maintain it below 'Main Drain Level'. The element of regulator should be replaced at earlier time of 2 year or 0.1 Mpa differential pressure occur. For the procedure of replacement, refer to following.

Prerequisites

- These procedures shall be performed by appropriate personnel qualified to disassemble, assemble and setup the equipment.
- Rainy or dusty conditions must be avoided when disassembling and checking the part.

Preparation

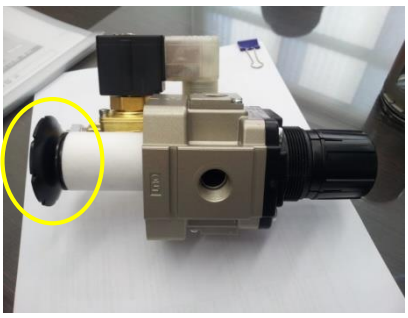
1 Disconnect power from the compressor.

2 Cut off the supply of instrument air.

Replacement Procedures

Step 1 Pull down the locker in regulator case and rotate it counterclockwise then remove the case.

Step 2 Rotate and pull up the black lever in case module to disassemble element part.



Step 3 Disassemble the element and replace with a new unit.

Step 4 Assemble in reverse order of the disassembly procedure.

6.3.6.3 Oil Demister Element

Oil demister element maintains the needed level of vacuum inside of oil reservoir. When differential pressure of demister element is 0.07bar(710mmH_2O) in the daily check, the element should be replaced.

Prerequisites

- These procedures shall be performed by appropriate personnel qualified to disassemble, assemble and setup the equipment.
- Rainy or dusty conditions must be avoided when disassembling and checking the equipment.

Preparation

- Disconnect power from the compressor.

Replacement Procedures

Step 1 Loosen wing nut that secures housing in demister.
Step 2 Remove loosen clamp with housing cover.
Step 3 Remove bolt securing filter.
Step 4 Remove filter in housing by pulling out vertically, and then replace with new one.
Step 5 Assemble the components in adverse order.

Observe the followings.

- Be careful not to miss o-ring during the disassembly or assembly procedure
- At the initial run after startup, maintain the vacuum degree of oil reservoir over at least 100mmH_2O
- In case of continuous operation, maintain the vacuum degree of oil reservoir over at least 80mmH_2O

6.3.6.4 Oil Demister (Vacuum blower Type) Air Filter *Option

To remove contaminants in the air supplied to the oil demister, you can use the air filter mounted in the system. If a certain amount of contaminants are accumulated in the filter, air supply will be interrupted and the performance of the demister can be degraded so periodic inspection and replacement of the filter element are required.

The filter should be replaced generally once a year (or after 8,000 hours of operation.) However, depending on the installation environment, the amount of contaminants can vary. For example, if the machine is installed in a desert or a severely polluted environment, the filter will need to be replaced more frequently.

Prerequisites

- These procedures shall be performed by appropriate personnel qualified to disassemble, assemble and setup the equipment.
- Rainy or dusty conditions must be avoided when disassembling and checking the equipment.

Preparation

- Disconnect power from the compressor.
- Blower motor power off.

Replacement Procedures

Step 1 Unfasten the wing nuts that fix the filter housing.
Step 2 Remove loosen clamp with housing cover.
Step 3 Remove bolt securing filter.
Step 4 Remove filter in housing by pulling out vertically, and then replace with new one.
Step 5 Assemble the components in adverse order.

6.3.6.5 Oil Strainer

The oil strainer is the auxiliary part for preventing equipment from contaminants in oil. When replacing oil, or when opening the top cover of the oil reservoir, the user need to separate and clean the oil strainer (if necessary, replace it) and then mount it again. Replacement and disassembly of the oil strainer should be done when cleaning the inner area of the oil reservoir.

Prerequisites

- These procedures shall be performed by appropriate personnel qualified to disassemble, assemble and setup the equipment.
- Rainy or dusty conditions must be avoided when disassembling and checking the equipment.

Preparation

1 Disconnect power from the compressor.
2 Drain oil in the oil reservoir.

Cleaning Procedures

Step 1 Disassemble the cover on the oil reservoir.
Step 2 Remove oil strainer in the oil reservoir.
Step 3 Clean using cleaning agent or replace with new one if necessary.

6.3.6.6 Oil Cooler

Oil cooler has the structure to flow oil in shell side and cooling water in tube side. If the oil supply temperature rises over 60℃, the oil cooler should be cleaned.

Prerequisites

- These procedures shall be performed by appropriate personnel qualified to disassemble, assemble and setup the equipment.
- Rainy or dusty conditions must be avoided when replacing the equipment.
- (For chemical cleaning) Use a cleaning agent that doesn't corrode the copper pipe.

Preparation

1 Disconnect power from the compressor.
2 Close the cooling water supply pipe.
3 Drain residual oil completely in oil pipe and shell.
4 Drain residual cooling water in tube.
5 Remove water manifold.
6 (For mechanical cleaning) Disassemble the bundle. When the bundle does not get removed easily, slightly tap the edge of float side tube sheet using a rubbery hammer not to damage the tube.

Chemical Cleaning

Step 1	Connect pipe for cleaning to inlet and outlet port and then circulate cleaning agent using small pump.
Step 2	After circulating agent, completely remove the residual cleaning agent using final neutral agent.

6.3.7 Instrumentation

The compressor is equipped with different types of sensors, including temperature sensors, pressure sensors and vibration sensors, etc. Such sensors are selected by considering noise, size and attachment positions. It is recommended to use manufacturer supplied items to ensure the best performance of the equipment.

Prerequisites

- These procedures shall be performed by appropriate personnel qualified to disassemble, assemble and setup the equipment.
- Rainy or dusty conditions must be avoided when disassembling and checking the part.

Preparation

- Disconnect power from the compressor.

Replacement Procedures (RTD)

Step 1	To facilitate reassembly, attach RTD tags on attachment positions.
Step 2	Loosen RTD head and disconnect signal cables.
Step 3	Turn and loosen the lock nut located on top of fitting to remove RTD only. (With Thermowell attached to the pipe).
Step 4	Replace the RTD with a new one.
Step 5	Assemble in reverse order of the disassembly procedure.

Replacement Procedures (Pressure Transmitter)

Step 1	Close transmitter valve to stop the fluid flow.
Step 2	Disconnect the air tubing connection.
Step 3	Disconnect signal cables.
Step 4	Replace the pressure transmitter with a new one.
Step 5	Assemble in reverse order of the disassembly procedure.

Replacement Procedures (Vibration Sensor)

Step 1	In case of damaged cables, a common replacement method is available. In case of damaged probes, do the following steps.
Step 2	Disconnect vibration sensor cables from probe.
Step 3	Remove probe from the scroll.
Step 4	Replace the probe with a new one and assemble in reverse order of the disassembly procedure.

Calibration

All electronic equipment such as sensor or gauge, etc. should be periodically calibrated at earlier time of once a year or 8,000 operating hours.

Precautions

- When replacing the element, take care of direction of the element. Make sure the side with a center blocked is facing downwards.
- Replace the element with clean, bare hands. No gloves are allowed.
- When disassembling and reassembling entire filters, make sure the arrow on upper cover aligns with direction of gas passage.

6.4 Sensor/Valve Calibration Procedures

The IGV/BOV and the sensors shown below are very critical in adjusting the loads and achieving the desired compressor performance. Manage them according to the periodic inspection schedule so that they can operate in the optimal condition.

6.4.1 IGV, BOV

Perform correction and calibrations on the IGV and the BOV twice a year.

Calibration procedures

Step 1 Inject instrument air(pneumatic) or input signals(electrical).

Step 2 Using a zero adjuster, calibrate it as follows.

1. Adjust the initial input signal to 4mA
2. Turn the zero adjuster to adjust the rotational angle of the actuator to the valve's initial position.
3. At this time, confirm that the pressure gauge indicating the air pressure supplied to the actuator shows zero.

Step 3 Adjust the span according to the following procedure.

1. Adjust the input signal to 20mA.
2. When the valve is fully closed, check whether the span reading is equal to 100%.
3. Using a span control screw, adjust the angle.
4. If you adjust the span, the zero is changed. So repeat step 2 again.

Step 4 Repeat steps 2/3 to make sure you have 4mA = 0%(0°), 20mA = 100%(90°).

Step 5 Repeat the above steps three times. Ensure that you get consistent results. Once you do, finish the calibration works.

Step 6 If the positioner type is YT-1000R, fasten the fixing screws.

6.4.2 Sensor

The calibration method varies depending on the sensor type. Before working on the sensor, check the following.

6.4.2.1 Calibration of the Pressure Sensor

Calibrate the sensor as follows.

Calibration procedures

Step 1 Adjust the zero as follows.

1. When no pressure is applied, check if the screen pressure reading is 0.
2. If not, adjust it with the zero control screws until you get a zero reading.

Step 2 Span screw controls

1. Check if the screen pressure reading is the same as the pressure applied to the sensor.
2. If not, then using the span screws, adjust the reading.

6.4.2.2 Calibration of the Temperature Sensor

The temperature sensor used in our equipment is calibrated and tested before shipping. For this reason, there is no need to calibrate it at the site of installation. But if there is a problem with temperature measurement, check the wiring, and if you conclude that the sensor is problematic, replace it immediately.

6.4.2.3 Calibration of the Vibration Sensor

In general, the vibration sensor used in our equipment is calibrated and tested before shipping. This means that there usually is no need to calibrate it at the site of installation. But if it is damaged, replace it by referring to 6.3.7 in this manual.

7. Troubleshooting

LIST

7.1 General

The worker should always observe the compressor status (temperature, vibration, pressure, noise, smell, etc). If the user quickly recognize even minor failure and take a measure, it may prevent serious breakdown or danger.

This chapter provides a troubleshooting procedure suggested by Hanwha Techwin. To prevent severe failures caused by minor faults, the user must quickly find the causes of any failure and take proper corrective actions. When the user decides any corrective actions cannot be taken for the identified problems in the field, notify problems to Hanwha Techwin CS Center.

Visual Inspection

Prior to troubleshooting, check the followings.

- Check the wirings of instrument are connected correctly.
- Check sensors for proper conditions. Disconnect sensors from each part for inspection. When any damage is found, replace the sensor.
- Check damaged parts for leakage.

Managers for troubleshooting

Managers for troubleshooting are as follows.

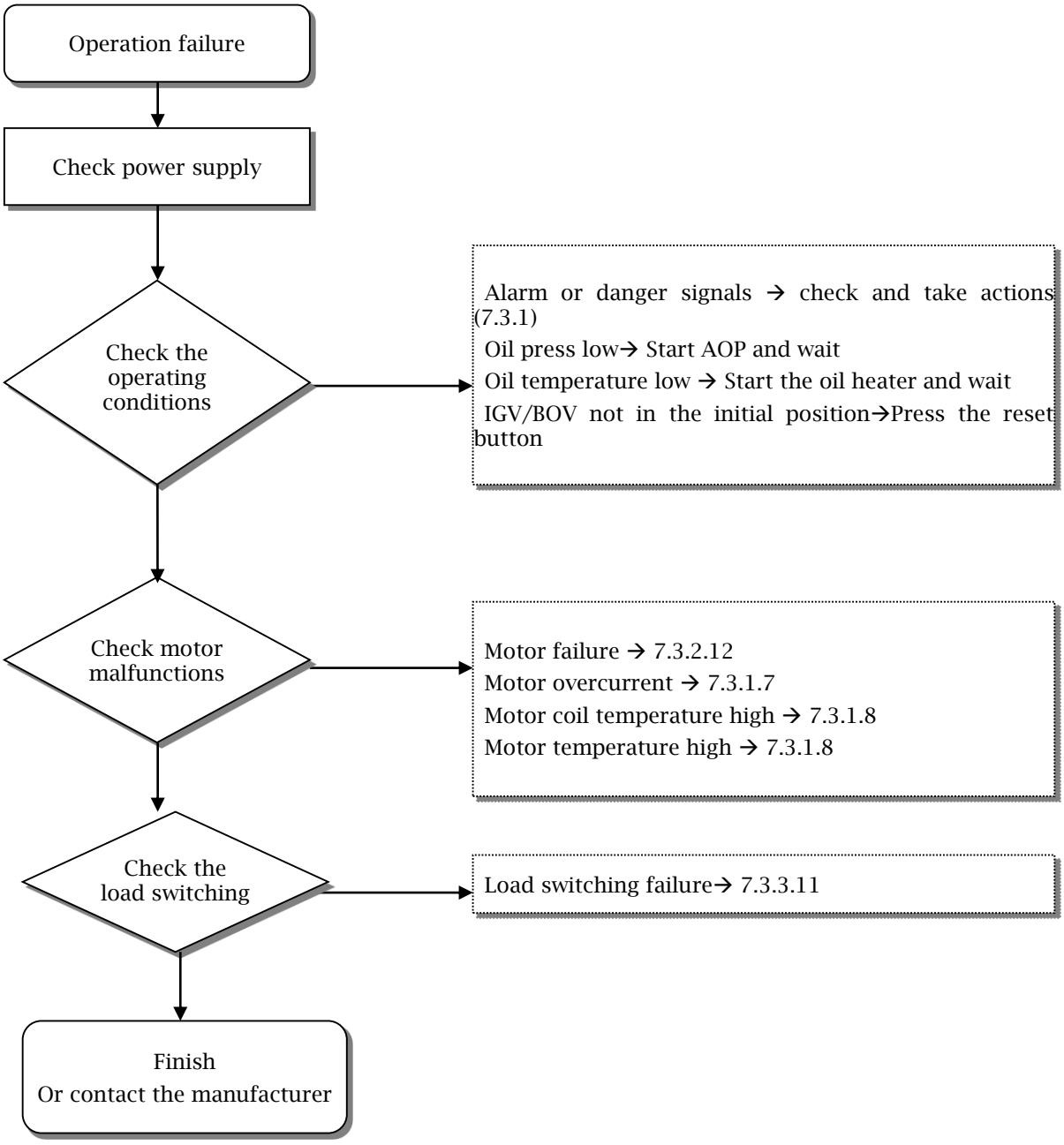
- O (Operation Manager): performs works related to PLC error and compressor operation(control setting).
- M (Maintenance Manager): performs disassembly and repair related to the maintenance carried out at site or regular maintenance.
- T (Hanwha Techwin): performs works requiring compressor (core) disassembly, and removal and repair affecting the compressor performance.

7.2 Troubleshooting Each Type of Malfunction

The following chart shows items and procedures for each type of malfunction. If you encounter any issues other than those described in the manual, contact your agent or Hanwha Techwin service center.

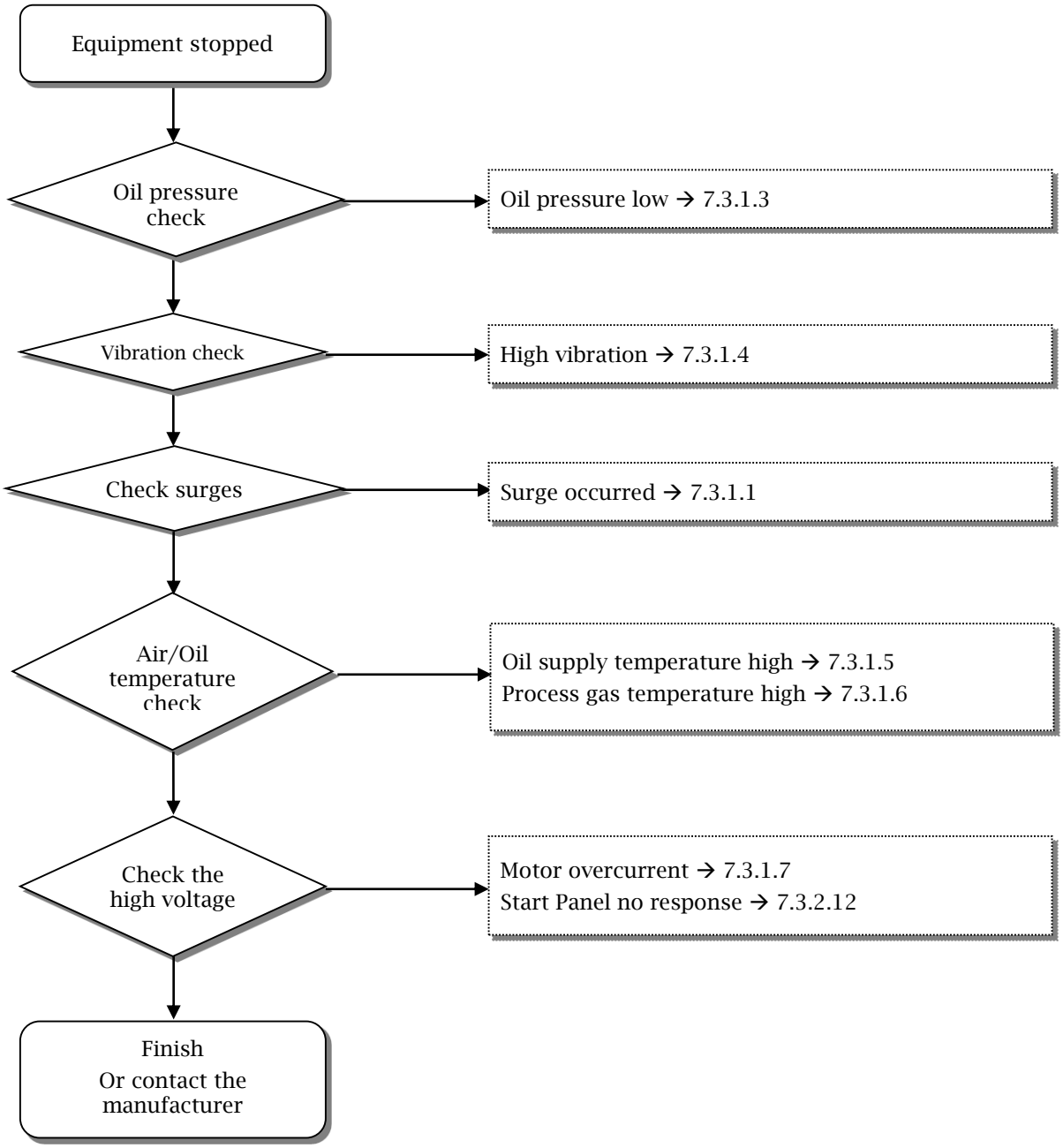
7.2.1 Compressor Operation Failures

If the compressor does not operate properly, take necessary actions according to the following procedures. If it does not fully recover after you have taken the necessary actions, then contact the agent or Hanwha Techwin service center.



7.2.2 Stopped Compressor

If the compressor is stopped during operation, then check the following items. If it does not fully recover after you have taken the necessary actions, then contact the agent or Hanwha Techwin service center.



7.2.3 Malfunctions of the Sub Devices for the Compressor

The following table shows how to troubleshoot malfunctions of the sub devices installed in the compressor.

System	Malfunctions	Remedy
Process system	Differential pressure of inlet filter is high	check 7.3.2.1
	Unstable Movement of IGV	check 7.3.2.2
	Bearing and rotor temperature rising	check 7.3.2.3
	Main motor temperature is abnormal	check 7.3.1.8
	Main motor vibrations	check 7.3.2.4
	Main motor noises	check 7.3.2.5
	BOV movement is unstable	check 7.3.2.6
Oil system	Oil filter's differential pressure is negative	check 7.3.2.7
	MOP with abnormal noises	check 7.3.2.8
	Oil cooler temperature rising	check 7.3.2.9
Control system	Control panel malfunctions	check 7.3.2.10
	PLC part failed	check 7.3.2.11
	Soft starter errors	check 7.3.2.12

7.2.4 Main Malfunction Status

The following table shows how to troubleshoot the main cases of malfunctions during operation.

Malfunctions	Remedy
Process gas temperature too high	check 7.3.1.6
Process gas temperature too low	check 7.3.3.1
Process gas pressure too high	check 7.3.3.2
Process gas pressure too low	check 7.3.3.3
System pressure control failed	check 7.3.3.4
Oil in the process gas	check 7.3.3.5
Oil pressure too low	check 7.3.1.3
Oil temperature too high	check 7.3.1.5
Oil heating failed (slowly rising temperature)	check 7.3.3.7
Oil discolored	check 7.3.3.8
Compressor vibration excessive	check 7.3.3.9
Excessive current usage	check 7.3.3.10
Unload switching (unload to load)	check 7.3.3.11

7.2.5 Remote Monitoring System Alarm *option

Target of application

The below shows how to troubleshoot an error indicated by an alarm message sent to the remote monitoring system users.

When equipment fails, an alarm message will be sent to the mobile phone liked with the remote monitoring system. In this section, we will explain how to troubleshoot an error indicated by abbreviations or tag ID.

Tag ID	Explanation	Measures
PT130	Oil Supply Pressure (L, LL)	7.3.1.3Low Oil Supply Pressure
VT131X	Vibration Stage 1X (H, HH)	7.3.1.4Abnormal Vibrations
VT131Y	Vibration Stage 1Y (H, HH)	7.3.1.4Abnormal Vibrations
VT132X	Vibration Stage 2X (H, HH)	7.3.1.4Abnormal Vibrations
VT132Y	Vibration Stage 2Y (H, HH)	7.3.1.4Abnormal Vibrations
VT133X	Vibration Stage 3X (H, HH)	7.3.1.4Abnormal Vibrations
VT133Y	Vibration Stage 3Y (H, HH)	7.3.1.4Abnormal Vibrations
VT134X	Vibration Stage 4X (H, HH)	7.3.1.4Abnormal Vibrations
VT134Y	Vibration Stage 4Y (H, HH)	7.3.1.4Abnormal Vibrations
PDIT120	Oil Filter DP Transmitter (H)	Replace filter element
CT150	Motor Current (H)	7.3.1.7 Overcurrent Motor
PDIT200	Inlet Filter DP Transmitter (L)	Replace filter element
PDIT103	Vacuum Transmitter (H)	Check the vacuum system/demister
VT151Y	Motor DE Vibration Y (H, HH)	7.3.1.4Abnormal Vibrations
VT152Y	Motor N-DE Vibration Y (H, HH)	7.3.1.4Abnormal Vibrations
LT101	Oil Level Transmitter (H, L, LL)	7.3.1.2 Low Oil Level
VT151X	Motor DE Vibration X (H, HH)	7.3.1.4Abnormal Vibrations
VT152X	Motor N-DE Vibration X (H, HH)	7.3.1.4Abnormal Vibrations
VT136X	Vibration Bull Gear InBoard X (H, HH)	7.3.1.4Abnormal Vibrations
VT136Y	Vibration Bull Gear InBoard Y (H, HH)	7.3.1.4Abnormal Vibrations
VT135X	Vibration Bull Gear OutBoard X (H, HH)	7.3.1.4Abnormal Vibrations
VT135Y	Vibration Bull Gear OutBoard Y (H, HH)	7.3.1.4Abnormal Vibrations
TE130	Oil Supply Temperature (H, HH)	7.3.1.5High Oil Supply Temperature
TE241	Final Stage Inlet Air Temperature (H, HH)	7.3.1.6 High Compressed Gas Temperature
TE101	Oil Reservoir Temperature(L)	7.3.3.7Oil Heating Failed (temperature rising slowly)
TE150R	Motor Winding R Temperature (H, HH)	7.3.1.8 Motor Temperature Rising (Winding, Bearing)
TE150S	Motor Winding S Temperature (H, HH)	7.3.1.8 Motor Temperature Rising (Winding, Bearing)

Tag ID	Explanation	Measures
TE150T	Motor Winding T Temperature (H, HH)	7.3.1.8 Motor Temperature Rising (Winding, Bearing)
TE151	Motor Bearing DE Temperature (H, HH)	7.3.1.8 Motor Temperature Rising (Winding, Bearing)
TE152	Motor Bearing NDE Temperature (H, HH)	7.3.1.8 Motor Temperature Rising (Winding, Bearing)
TE302	Cooling Water Return Temperature (H)	7.3.2.13 Gas Cooler Temperature Rising
TE010	Control Panel Temperature (H)	7.3.2.10 Control Panel Error
TE135	Bull Gear Outboard Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE136	Bull Gear Inboard Journal BRG Temperature (H. H)	7.3.2.3 Bearing and Rotor Temperature Rising
TE301	Cooling Water Supply Temperature (H)	7.3.2.13 Gas Cooler Temperature Rising
TE155	Motor Inlet Air Temperature (H)	7.3.1.8 Motor Temperature Rising (Winding, Bearing)
TE131	#1 Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE141	#1 Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE132	#2 Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE142	#2 Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE133	#3 Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE143	#3 Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE134	#4 Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE144	#4 Journal BRG Temperature (H, HH)	7.3.2.3 Bearing and Rotor Temperature Rising
TE146	Bull Gear Outboard Thrust BRG Temperature	7.3.2.3 Bearing and Rotor Temperature Rising
TE145	Bull Gear Outboard Thrust BRG Temperature	7.3.2.3 Bearing and Rotor Temperature Rising

7.3 Troubleshooting Procedures

7.3.1 Alarm, Danger Signals

If a danger signal or alarm is issued during the compressor's operation, you need to check the cause in the control screen and take necessary actions. The following table shows the cause of main alarms/danger signals and how to troubleshoot them. If the unit does not fully recover after you have taken the prescribed actions, then contact the agent or Hanwha Techwin service center.

7.3.1.1 Surge

Cause	Remedy	Manager
IGV/BOV operation failure	Instrument air pressure shortage (4.0 barG) Or higher	M
	Check pilot valve condition after disassembling	M
Process gas temperature high	Refer to 7.3.1.6	M
Process gas passage blocked	Check inlet filter for foreign material and filter status	M
	Check the check valve for operation	M
Surge recognition error	Check sensor for operation	M
	Check tube status after disassembling sensor	M
	Check external signal incoming	M
Incorrect tuning	Adjust IGV and BOV operating speed	T
	Adjust considering atmosphere temperature	T
Fluctuating load	Check BOV operation condition. Analyze load state	T

7.3.1.2 Low Oil Level

Cause	Remedy	Manager
Quantity of oil low	Refill the oil	O
Leakage in oil pipe	Repair or replace pipe after check	M
Level switch error	Repair or replace after check	M

7.3.1.3 Low Oil Supply Pressure

Cause	Remedy	Manager
AOP failed	AOP operated	O
Oil pipe leakage	Repair or replace after check	M
Oil supply amount shortage	Check MOP/AOP and replace	M
	Check and replace AOP check valve	M
	Bleed air in pipe	M
Blocked oil passage of oil supply system	Clean or replace oil strainer after checking	M
	Check oil filter and clean/replace	M
	Check PCV and TCV for operation.	M

Cause	Remedy	Manager
Indication system failure	Repair or replace pressure gauge	M
	Oil level S/W malfunctions	M

7.3.1.4 Abnormal Vibrations

Cause	Remedy	Manager
Low oil temperature	Operate after preheating oil	M
Condensate water entered	Check auto trap for failure	M
	Check condensate water outlet and adjust	M
Main motor misalignment	Check shaft alignment	M
Damaged by external material(FOD)	Clean and replace oil and air filter	M
Compressor installation standard not observed	Check base frame and foundation for contact	M
	Check base frame for damage	M
	Check grouting and anchor bolt for damage	M
Coupling damaged	Repair or replace after checking status	T

7.3.1.5 High Oil Supply Temperature

Cause	Remedy	Manager
Oil supply amount shortage	Check MOP/AOP and replace if require	M
	Check and replace AOP check valve	M
	Bleed air in pipe	M
Cooling water supply shortage	Check cooling water supply pressure and adjust	M
High cooling water supply temperature	Check cooling water supply temperature and adjust	M
Blocked oil passage of oil supply system	Clean or replace oil strainer after checking	M
	Check oil filter and clean/replace	M
	Check PCV and TCV for operation	M
Bearing abnormal wear	Analyze oil ingredient	M
	Check oil replacement cycle	M
	Check oil filter and clean/replace	M
Indication system failure	Check RTD for connection	M
	Check and replace RTD	M

7.3.1.6 High Compressed Gas Temperature

Cause	Remedy	Manager
Flowing backward of high temperature gas	Check final discharge check valve / replace	M
	Check for any chattering	M
Surge	Check 7.3.1.1	M
Defective RTD sensor	Check RTD for connection and repair or replace	M
	Check RTD sensor and repair or replace	M

7.3.1.7 Overcurrent Motor

Cause	Remedy	Manager
Motor start current limited (insufficient torque)	Check the motor current	T
Power shutting off unit trip (MMS/EOCR/CP/MCCP)	Replace the unit allow for starting current and safety ratio	T
	Readjust to setting value which is actual starting current reflected	T
	Check for power consumption between design and actual	T
Power shutting off unit damage	Check for damaged unit and replace	T

7.3.1.8 Motor Temperature Rising (Winding, Bearing)

Cause	Remedy	Manager
Motor wire temperature rising	Check air ventilation configuration of motor	M
	Check compressor surrounding atmosphere temperature	M
Motor bearing temperature rising	Check RTD for disconnection and replace	M
	Check RTD sensor and replace	M
	Check lubricant quantity for shortage	M
	Check distance between coupling shafts	M
	Check external noise such as compressor surrounding weld	M
	Check motor bearing for damage	T

7.3.2 Major Part Failure

The following describes how to troubleshoot malfunctions of the main parts in the compressor.

7.3.2.1 Inlet Filter's Differential Pressure Too High

Cause	Remedy	Manager
Filter element failure	Check and replace filter element.	M
Foreign material entered	Clean filter element and replace if necessary	M

7.3.2.2 Unstable Movement of IGV

Cause	Remedy	Manager
Control Ring foreign material	Remove foreign material after stop.	M
Foreign material in linkage	Remove foreign material	M
Looseness actuator /control ring fastening bolt	Check tightening condition and re-tightening	T

7.3.2.3 Bearing and Rotor Temperature Rising

Cause	Remedy	Manager
High oil temperature	Refer to troubleshooting 7.3.1.5	M
Oil supply amount shortage	Bleed air in pipe	M
	Check MOP/AOP and replace if require.	M
	Check and replace AOP check valve.	M

7.3.2.4 Abnormal vibration on Main Motor

Cause	Remedy	Manager
Motor case vibration	Check oil reservoir and core for tightening and retighten.	M
	Check motor case for crack.	M
	Check oil reservoir mounting for strength and install side stiffener.	M
	Check shim thickness by motor foot location.	M
	Recheck and correct soft foot	M
	Recheck and correct motor alignment	M

7.3.2.5 Abnormal Noise on Main Motor

Cause	Remedy	Manager
Air gap imbalance	Repair motor	T
Abnormal contact between rotary part and fixed part	Check and repair	T
Crack on rotary part and end ring	Repair motor	T

Cause	Remedy	Manager
Motor bearing damage	Analyze cause of damage and repair	T
Single phasing (open phase)	Check power system and repair	T
Poor soft foot	Check soft foot and alignment	T
Motor supports (oil reservoir, etc.) and resonance	Check oscillation frequency of support structure	T
	Reinforce structure	T
Lack of motor strength	Reinforce structure or replace motor	T
Motor inner structure defect	Check motor and repair	T
Contact with other parts	Separate with the parts	T
Motor case vibration	Check motor case for crack	T
	Check oil reservoir mounting for strength and install stiffener on the side.	T
	Check shim thickness on motor foot	T

7.3.2.6 Unstable Movement of BOV

Cause	Remedy	Manager
Instrument air is not supplied	Check I/A supply valve for blocking	O
	Check I/A supply pressure	O
Positioner failure	Check instrument air for foreign material	O
	Calibration according to operation scope change	O
Pneumatic actuator failed	Check instrument air for foreign material (Air flow blocked)	M
	Check and replace actuator spring	T

7.3.2.7 Oil Filter D/P Detected '-' value

Cause	Remedy	Manager
D/P transmitter failure	Replace transmitter	T

7.3.2.8 Abnormal Noise on MOP

Cause	Remedy	Manager
Check the rotational direction of the MOP	Check the rotational direction of the MOP and take proper actions	O
Foreign material in MOP	Check and clean	M
	Replace MOP (if required)	M
Air entered into MOP	Check for leakage and repair	M
	Replace MOP (if required)	M
MOP Shaft transform or damage	Replace MOP	M

7.3.2.9 Oil Cooler Temperature Rising

Cause	Remedy	Manager
Cooling water pipe stuck	Remove contamination or replace pipe	M
Lack of cooling water pressure	Check pressure pump and replace	M
Oil pipe stuck	Remove contamination or replace pipe	M
Lack of oil pressure	Check MOP/AOP or replace	M
Auxiliaries in lube system fault	Clean or replace TCV/PCV/oil filter/oil strainer	M
RTD sensor defect	Check temperature sensor or replace	M
	Check PLC RTD module connection	M
Cooler failure	Check and remedy or replace	T

7.3.2.10 Control Panel Error

Cause	Remedy	Manager
Touch panel operation error	Check touch HMI program and modify	T
Touch panel screen dark	Adjust brightness / replace	T
Control switch error	Check for contact connection. Replace if it is poor.	T
Cooling fan error (noise, stop)	Replace fan	T
Relay error	Check for wiring connection or replace	T

7.3.2.11 PLC Part Failure

Cause	Remedy	Manager
Card error (Relay malfunctions, card malfunctions)	Replace the card	T
Card insert error	Check card specification and replace	T
PLC is not operated	Check program and power	T
Communication error	Check communication protocol, connection of wiring	T
Time display error	Replace mercury battery	T
Program delete	Replace back-up battery	T

7.3.2.12 Motor Start Failures

Cause	Remedy	Manager
Error is not removed from motor starter.	Press the reset button	O
Run signal is not transmitted to motor starter.	Verify the operation of relay and ready condition.	O
Motor starter is set to local mode.	Return it to remote mode.	O
Motor starter failure.	Check magnetic contact for burning out.	M
Motor does not start.	Check motor rotational shaft for seizing.	M
Soft starter control is error.	Check if the in/out control value is greater than 10KΩ	M
Soft starter is overheated.	Check and replace cooling pan.	M
Incorrect soft start setting value.	Change voltage control to current control	M

7.3.2.13 Gas Cooler Temperature Rising

Cause	Remedy	Manager
Cooling water pipe stuck	Remove contamination or replace pipe	M
Lack of cooling water pressure	Check pressure pump and replace	M
RTD sensor defect	Check temperature sensor or replace	M
	Check PLC RTD module connection	M
Cooler failure	Check and remedy or replace	T

7.3.3 Main Malfunctions

The following table shows how to troubleshoot the main types of compressor malfunctions.

7.3.3.1 Low Process Gas temperature

Cause	Remedy	Manager
Inlet temperature low	Check and adjust inlet temperature	O
Discharge pressure low	Check discharge pressure and pressure control	O

7.3.3.2 High Process Gas Pressure

Cause	Remedy	Manager
Flowing backward of latter stage gas	Check valve on the latter stage inlet side.	M
Error set pressure value	Check and readjust set pressure	M

7.3.3.3 Low Process Gas Pressure

Cause	Remedy	Manager
Leak on pipe	Check pipe and repair or replace.	M
Damaged pressure gauge	Repair or replace after check	M
Inlet filter clogged	Clean or replace after check	M

7.3.3.4 System Pressure Control Failure

Cause	Remedy	Manager
Pressure transmitter failure	Replace pressure transmitter	M
Motor set point too small	Obtain margin for enough set-point setting	M
IGV is not operated	Press reset button	M
Improper pressure set-point	Press reset button	M

7.3.3.5 Oil Included in Process Gas

Cause	Remedy	Manager
Oil demister failed	Check the vacuum system and the demister	M
Seal damages	Check and replace the seal	T

7.3.3.6 High Oil Supply Pressure

Cause	Remedy	Manager
Improper oil pressure setting	Check oil pressure and reset	O
Oil viscosity increased	Check oil supply temperature	M
	Check oil heater for disconnection and operation status	M
	Check TCV status	M
Supplied oil status	Analysis and replace	M
Foreign material entered in oil pipe	Clean or replace pipe	M
Oil pressure gauge damaged	Repair or replace after check	M

7.3.3.7 Oil Heating Failed (temperature rising slowly)

Cause	Remedy	Manager
Power is not supplied to oil heater	Verify that power is supplied normally	M
Damage of oil heater	Replace oil heater	M

7.3.3.8 Oil Discoloration

Cause	Remedy	Manager
Oil status changed	Replace the oil	M
Nonstandard oil used	Replace with standard oil	M
Foreign material entered in oil	Replace oil after analyzing ingredient	M
Moisture entered	Replace oil	M

7.3.3.9 Compressor with Excessive Vibration

Cause	Remedy	Manager
Condensate water entered	Check auto trap for failure	M
	Check condensate water outlet and adjust	M
Damaged by external material(FOD)	Clean and replace oil and air filter	M
Low oil temperature	Operate after preheating oil.	M
Main motor imbalance	Check shaft alignment	M
Compressor installation standard not observed	Check base frame and foundation for contact	M
	Check base frame for damage	M
	Check grouting and anchor bolt for damage	M
Coupling damaged	Repair or replace after checking status	T

7.3.3.10 High Power Consumption

Cause	Remedy	Manager
Low voltage supplied to motor	Check power supply condition	O
Excessive load operation	Control operation load	O
Low motor efficiency	Consult with motor manufacturer	M

7.3.3.11 Unload – Load Switching Failure (Unload – Load)

Cause	Remedy	Manager
Low air supply to IGV	Adjust minimum operation pressure to 4.0 barG or more.	M
Adjust IGV operation scope	Calibration	M
IGV operation failure	Refer to troubleshooting 7.3.2.2	M
IGV initial position setting error	Press reset button	M
Low air supply pressure to BOV	Adjust minimum operation pressure to 4.0 barG or more.	M
Adjust BOV operation scope	Calibration	M
BOV operation failure	Refer to troubleshooting 7.3.2.6	M
BOV initial position setting is error	Press reset button	M
Poor contact of switch	Check auto/manual mode.	M
Disconnection or poor contact of signal line	Reconnect or replace the signal line	M
Pressure setting error	Readjust to the designed pressure after check.	M
Poor operation of touch screen	Check frame and screen for damage and replace	T

8. IPB

LIST

8.1 Terminology

Location

A number represents the position and details of parts used from Publisher to identify the item number.

For more information, please contact our service center.

Index No.

Index No. refers to Location number with the identification number of the parts. It is required number for the purchase of parts. For more information, please check the 'Order for Compressor Part' at the end of this document.

Part Name

Part name indicates the name, application and location of the part corresponding to an index number.

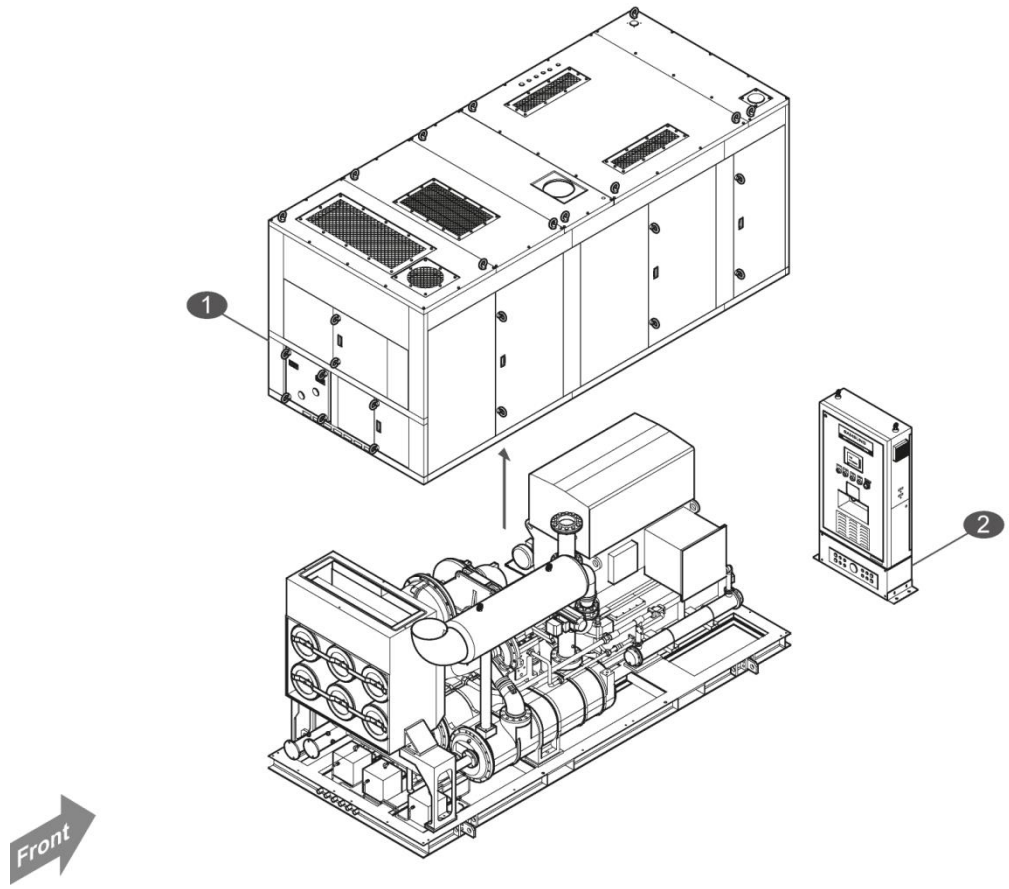
Q'ty(Quantity)

Q`ty indicates the quantity of the item on the drawing for assembly.

Remark

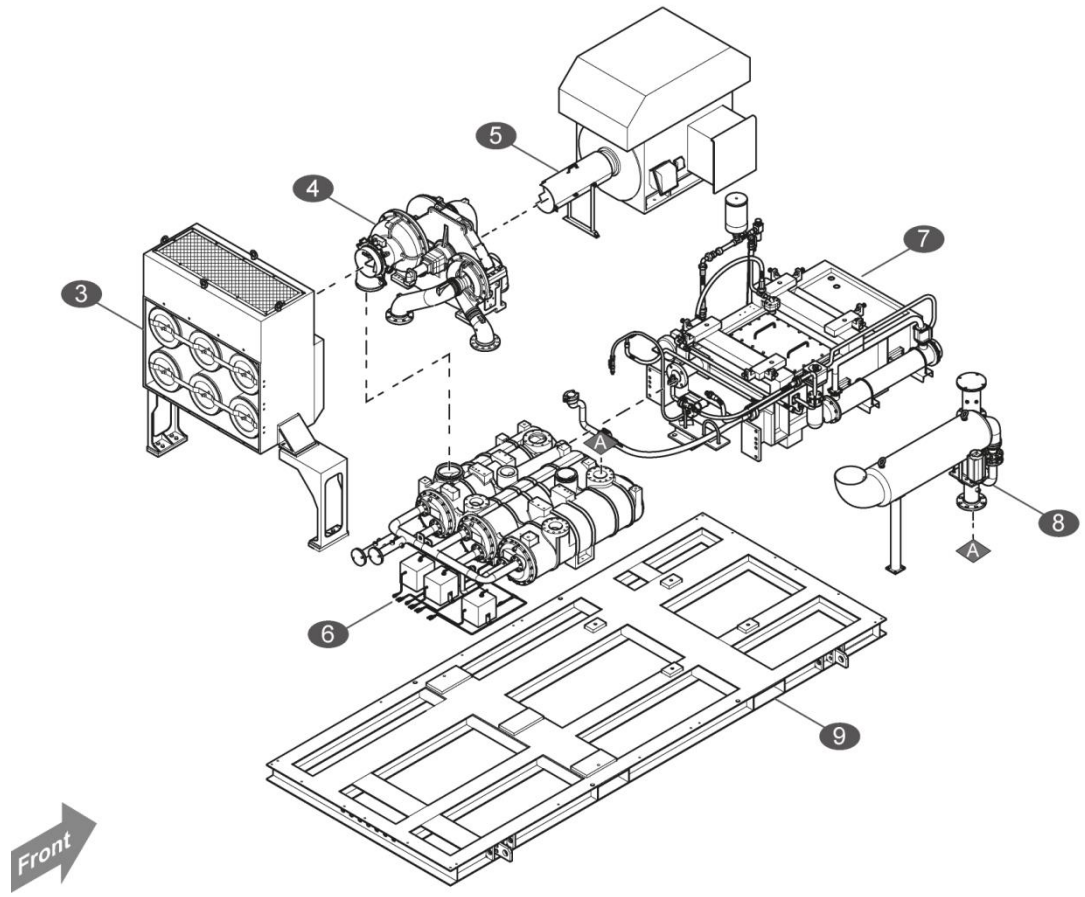
You can check to know about special information by using a mark.

8.2 Compressor



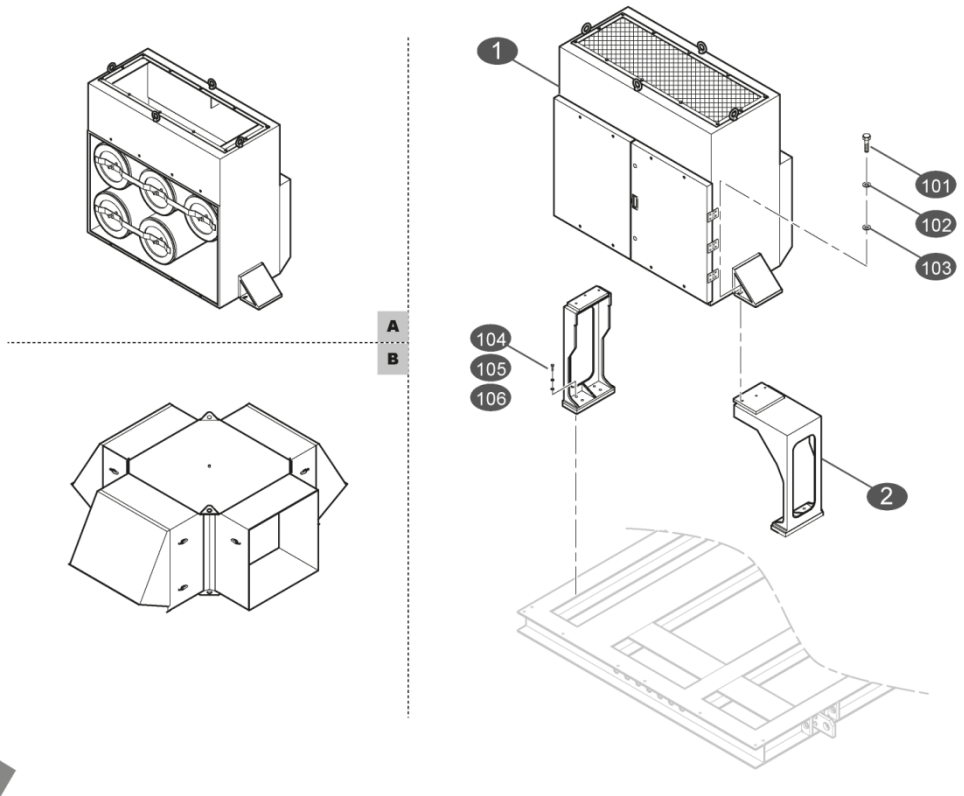
NO	PART NAME	Q'TY	REMARK
EPN01	COMPRESSOR	1	
1	ENCLOSURE	1	EPN1101
2	CONTROL PANEL	1	SEE PARA 8.10

(CONT)



NO	PART NAME	Q'TY	REMARK
3	INLET FILTER	1	SEE PARA 8.3
4	AIR PIPE	1	SEE PARA 8.4
5	CORE MODULE	1	SEE PARA 8.5
6	MAIN DRIVER	1	SEE PARA 8.6
7	COOLING SYSTEM	1	SEE PARA 8.7
8	LUBRICATION MODULE	1	SEE PARA 8.8
9	BASEFRAME	1	EPN18

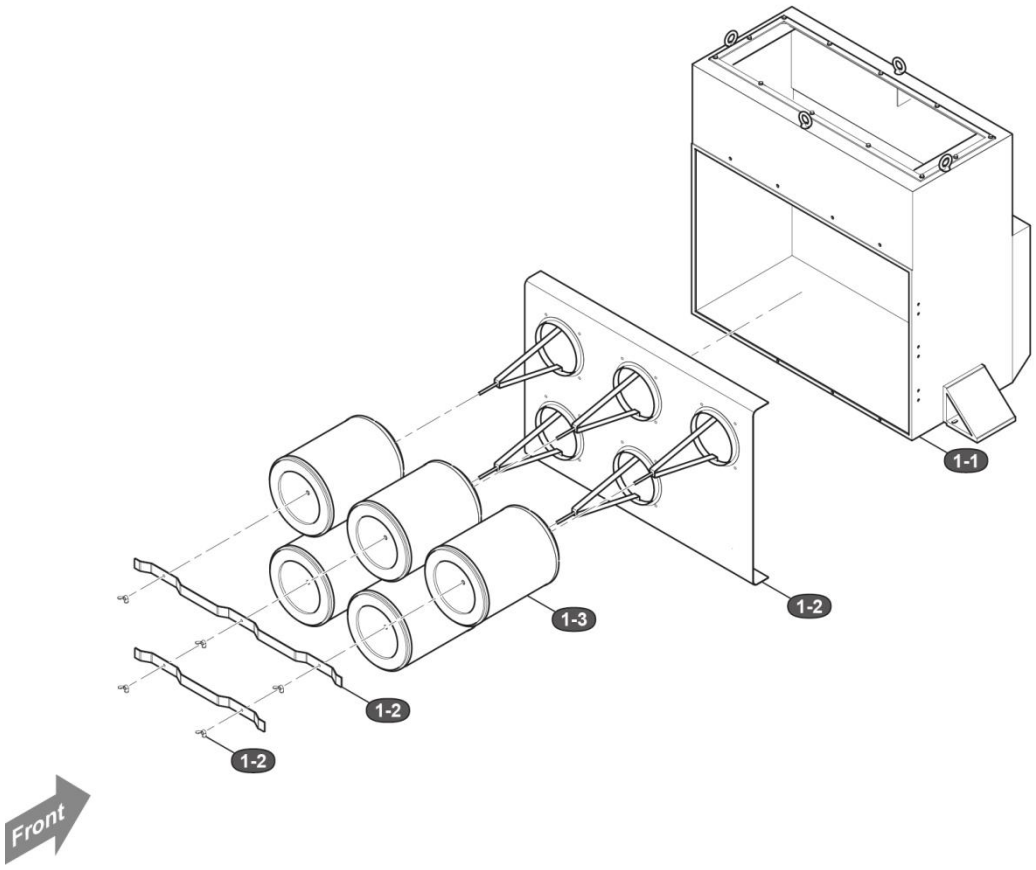
8.3 Inlet Filter



[A] _ with Enclosure **[B]** _ External Installation Type (see paragraph 1.1.2)

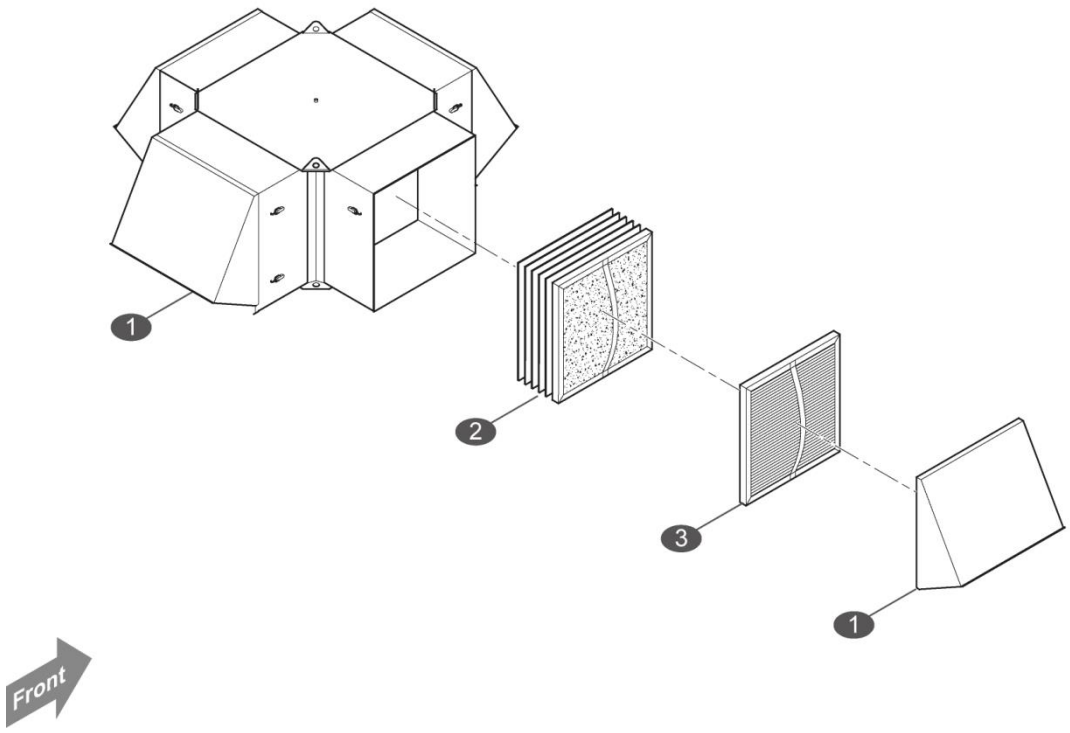
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN1301	1	INLET FILTER ASSY (PACKAGE)	1	
EPN3003	1	INLET FILTER ASSY (EXTERNAL)		
EPN1201	2	INLET FILTER SUPPORT ASSY	1	
EPN01	101	HEX BOLT	6	
EPN01	102	SPRING WASHER	6	
EPN01	103	FLAT WASHER	6	
EPN01	104	HEX BOLT	14	
EPN01	105	SPRING WASHER	14	
EPN01	106	FLAT WASHER	14	

8.3.1 Inlet filter _ Packaged type



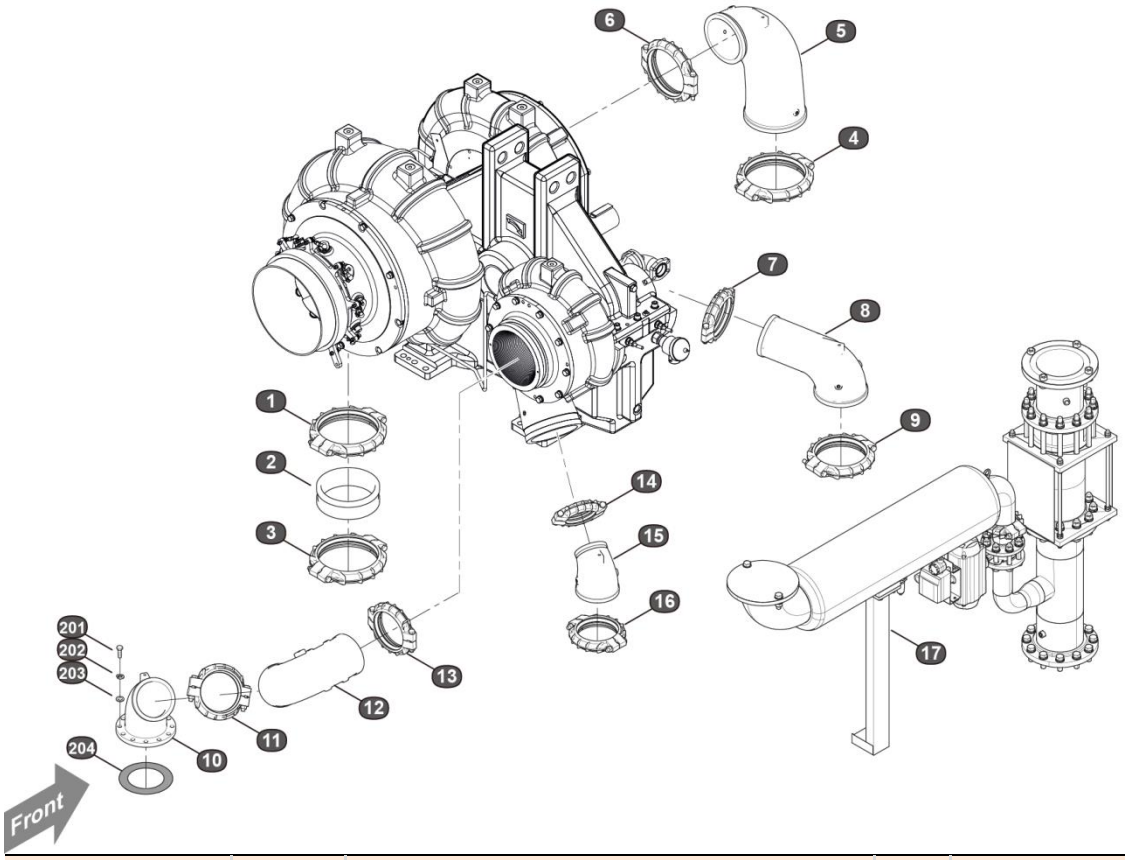
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN1301	1-1	FILTER HOUSING ASSY	1	
EPN1301	1-2	FILTER CARTRIDGE SUPPORT ASSY	1	
EPN1301	1-3	FILTER CARTRIDGE	3-5	

8.3.2 Inlet filter _ External install type



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN3004	1	INLET FILTER ELEMENT,1ST	AR	
EPN3006	2	INLET FILTER ELEMENT, 2ND	AR	

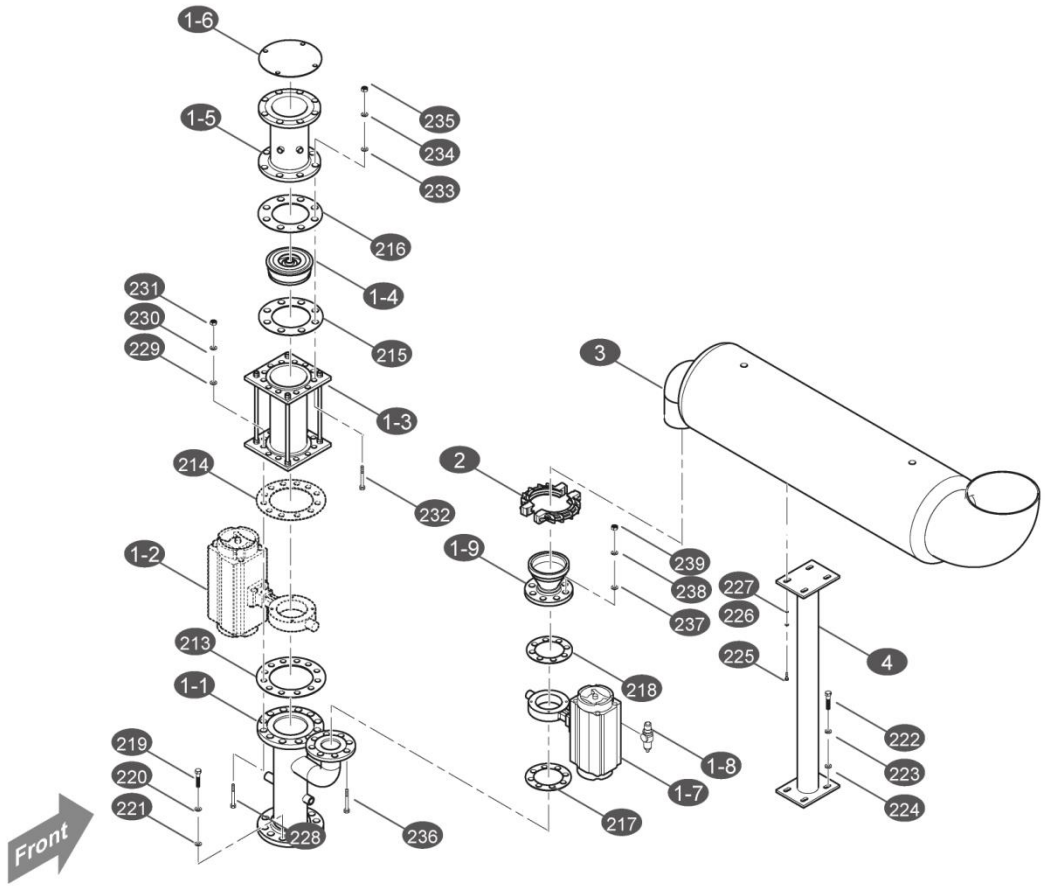
8.4 Air Pipe



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0123	1	V-JOINT, #1 OUTLET	1	
EPN0123	1-1	V-JOINT RUBBER	1	
EPN0112	2	#1 AIR PIPE	1	
EPN0175	3	V-JOINT, #1 COOLER IN	1	
EPN0175	3-1	V-JOINT RUBBER	1	
EPN0176	4	V-JOINT, #1 COOLER OUT	1	
EPN0176	4-1	V-JOINT RUBBER	1	
EPN0113	5	#2 INLET AIR PIPE	1	
EPN0124	6	V-JOINT, #2 INLET	1	
EPN0124	6-1	V-JOINT RUBBER	1	
EPN0125	7	V-JOINT, #2 OUTLET	1	
EPN0125	7-1	V-JOINT RUBBER	1	
EPN0114	8	#2 OUTLET AIR PIPE	1	
EPN0126	9	V-JOINT, #2 COOLER IN	1	
EPN0126	9-1	V-JOINT RUBBER	1	
EPN0115	10	#3 INLET AIR PIPE	1	

LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0127	11	V-JOINT, #3 INTLET	1	
EPN0127	11-1	V-JOINT RUBBER	1	
EPN0174	12	#3 INLET AIR PIPE_B	1	
EPN0177	13	V-JOINT, #3 INTLET_2	1	
EPN0177	13-1	V-JOINT RUBBER	1	
EPN0128	14	V-JOINT, #3 OUTLET	1	
EPN0128	14-1	V-JOINT RUBBER	1	
EPN0116	15	#3 OUTLET AIR PIPE	1	
EPN0129	16	V-JOINT, #3 COOLER IN	1	
EPN0129	16-1	V-JOINT RUBBER	1	
EPN0801	17	AIR DISCHARGE SYSTEM	1	SEE PARA 8.4.1
EPN01	201	HEXAGON BOLT	8	
EPN01	202	SPRING WASHER	8	
EPN01	203	FLAT WASHER	8	
EPN01	204	GASKET	1	

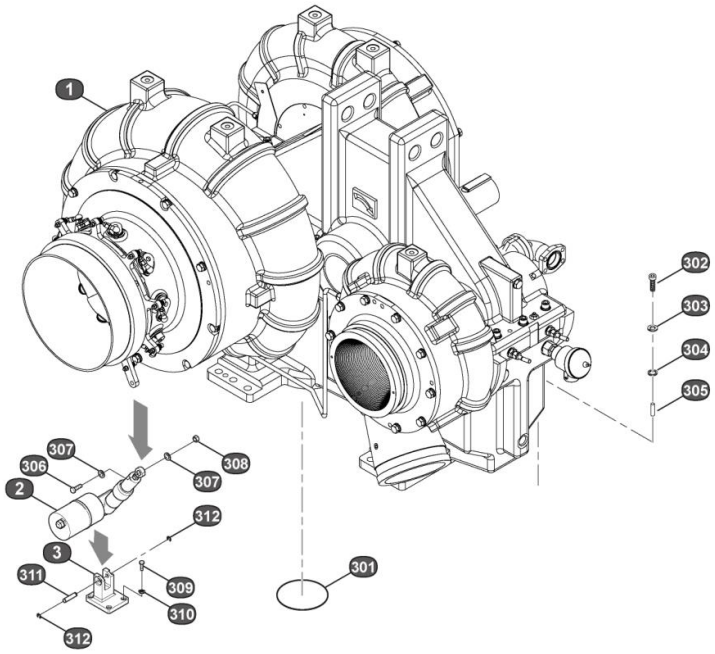
8.4.1 Air discharge system



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0801	1	AC DISCHARGE PIPE ASSY	1	
EPN0801	1-1	AC OUTLET AIR PIPE	1	
EPN25	1-2	BLOCK VALVE	1	OPTION
EPN22	1-3	DISCHARGE EXPANSION JOINT	1	
EPN23	1-4	DISCHARGE CHECK VALVE	1	
EPN28	1-5	DISCHARGE CONNECTOR	1	
EPN0801	1-6	AC PIPE COVER	1	
EPN24	1-7	BOV ASSY	1	
EPN24	1-7-1	POSITIONER	1	
EPN24	1-7-2	PNUMATIC ACTUATOR	1	
EPN24	1-7-3	AIR REGULATOR	1	
EPN24	1-7-4	VALVE ASSY	1	
EPN26	1-8	WATER SEPERATOR	1	
EPN3040	1-9	SILENCER CONNECTOR	1	EPN3040
EPN0131	2	V-JOINT, SILENCER	1	
EPN1501	3	SILENCER	1	

LOCATION	NO	PART NAME	Q'TY	REMARK
EPN3008	3	SILENCER	1	SHIPLOOSE
EPN1401	4	SILENCER SUPPORT ASSY	1	
EPN0801	213	RING GASKET	1	
EPN0801	214	RING GASKET	1	
EPN0801	215	RING GASKET	1	
EPN0801	216	RING GASKET	1	
EPN0801	217	RING GASKET	1	
EPN0801	218	RING GASKET	1	
EPN01	219	HEXAGON BOLT	8	
EPN01	220	SPRING WASHER	8	
EPN01	221	FLAT WASHER	8	
EPN01	222	HEXAGON BOLT	8	
EPN01	223	SPRING WASHER	8	
EPN01	224	FLAT WASHER	8	
EPN01	225	HEXAGON BOLT	4	
EPN01	226	SPRING WASHER	4	
EPN01	227	FLAT WASHER	4	
EPN0801	228	HEXAGON BOLT	12	
EPN0801	229	SPRING WASHER	12	
EPN0801	230	FLAT WASHER	12	
EPN0801	231	HEXAGON NUT	12	
EPN0801	232	HEXAGON BOLT	12	
EPN0801	233	SPRING WASHER	12	
EPN0801	234	FLAT WASHER	12	
EPN0801	235	HEXAGON NUT	12	
EPN0801	236	HEXAGON BOLT	8	
EPN0801	237	SPRING WASHER	8	
EPN0801	238	FLAT WASHER	8	
EPN0801	239	HEXAGON NUT	8	

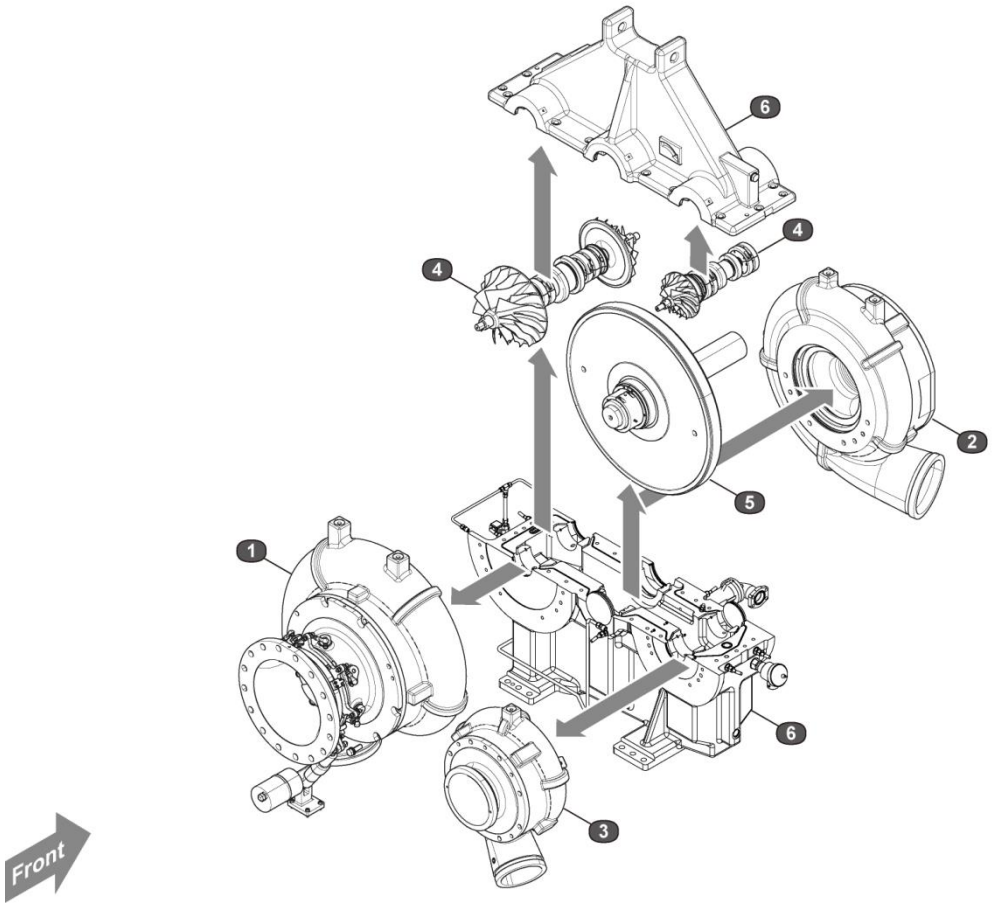
8.5 Core module



ONLY ENGINEERS WHO QUALIFIED BY HANWHA SHALL PERFORM THE DISASSEMBLING AND REASSEMBLING OF CORE WORK

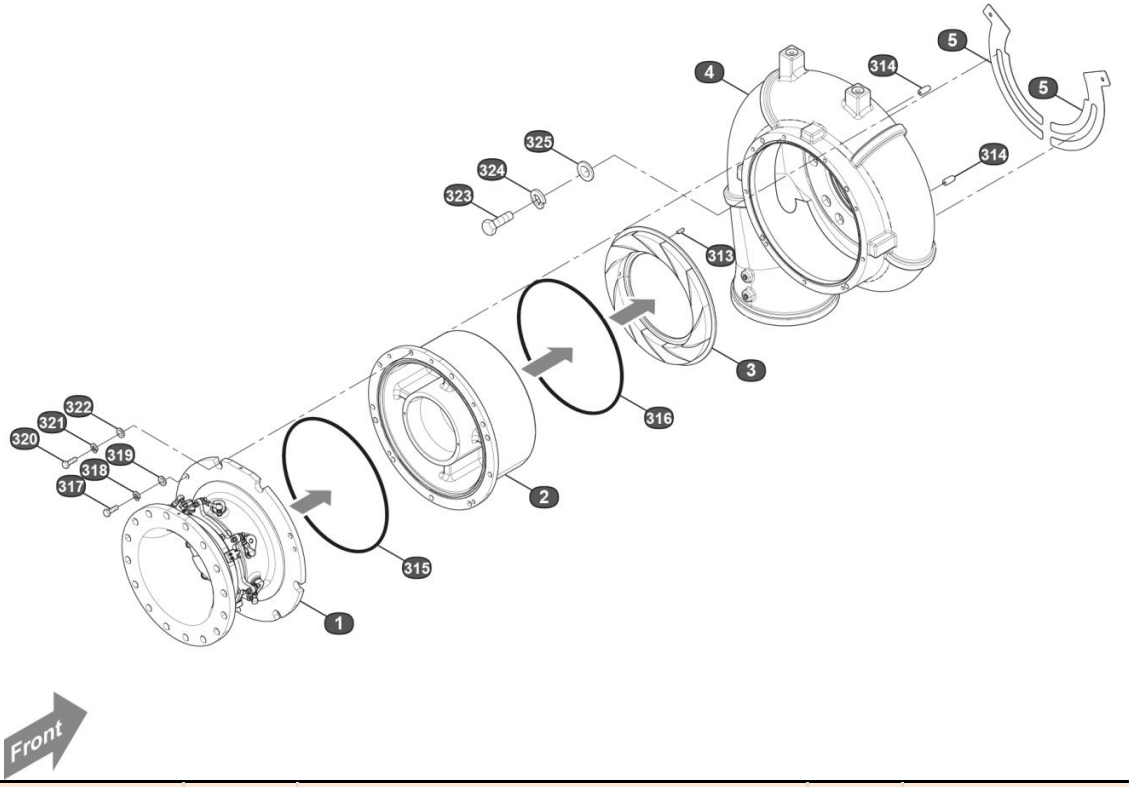
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0101	1	CORE ASSY	1	SEE PARA 8.5.1
EPN0132	2	I.G.V. ACTUATOR ASS'Y	1	
EPN010150	3	BRACKET, LINEAR MOTOR	1	
EPN01	301	O-RING	1	
EPN01	302	HEX BOLT	12	
EPN01	303	SPRING WASHER	12	
EPN01	304	FLAT WASHER	12	
EPN01	305	PIN	2	
EPN01	306	HEX BOLT	1	
EPN01	307	FLAT WASHER	2	
EPN01	308	HEX NUT	2	
EPN01	309	HEX BOLT	4	
EPN01	310	SPRING WASHER	8	
EPN01	311	PIN	1	
EPN01	312	E-RING	2	

8.5.1 Core Assembly



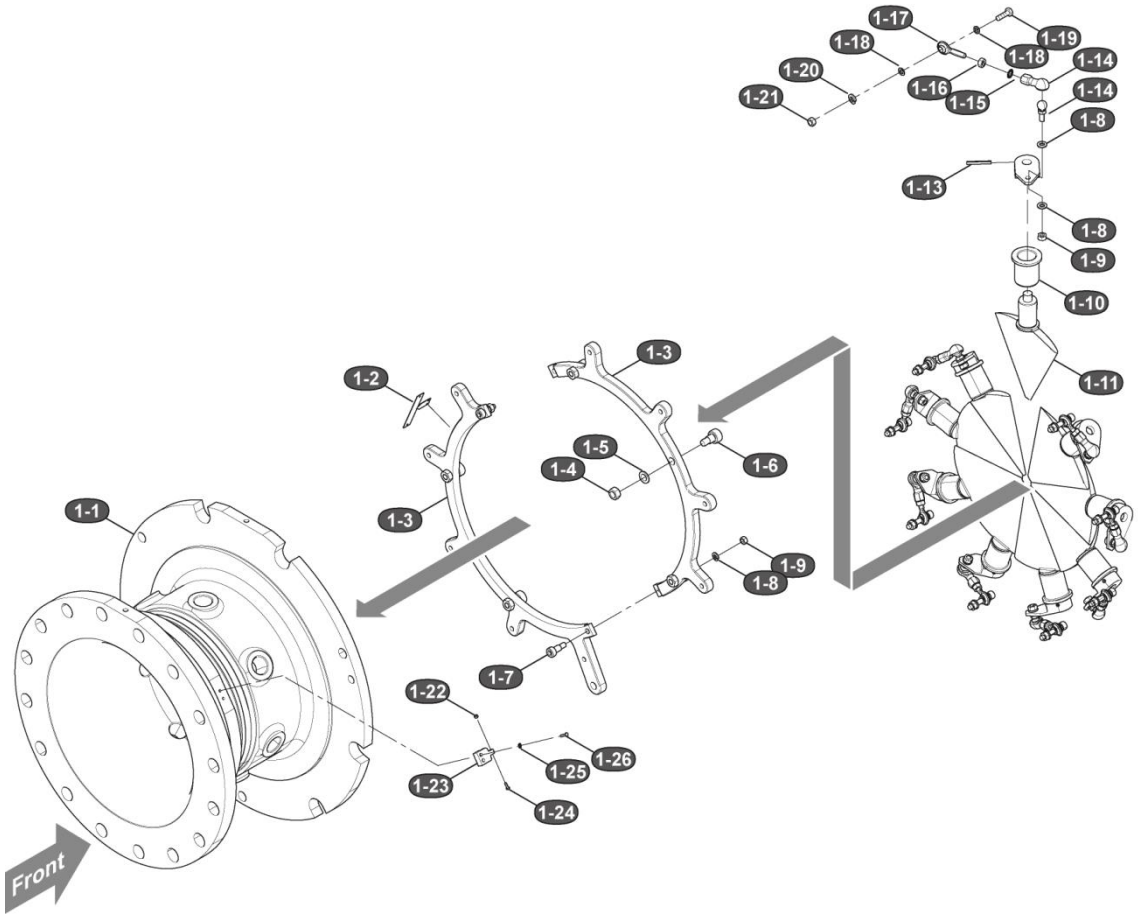
NO	PART NAME	Q'TY	REMARK
1	IGV & #1 STAGE		
2	#2 STAGE		
3	#3 STAGE		
4	ROTOR SET		
5	BULL GESR SET		
6	GEAR BOX		

8.5.1.1 IGV & #1 STAGE



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010121	1	IGV ASSY		SEE PARA 8.5.1.1.
EPN010125	2	#1 SHROUD		
EPN010122	3	#1 DIFFUSER		
EPN01012001	4	#1 SCROLL CASE		
EPN0101	313	DIFFUSER PIN	1	
EPN0101	314	SCROLL LOCATING PIN	2	
EPN010191	315	O-RING, IGV	1	
EPN010123	316	O-RING, #1 SCROLL	1	
EPN0101	317	HEX BOLT	3	
EPN0101	318	SPRING WASHER	3	
EPN0101	319	FLAT WASHER	3	
EPN0101	320	HEX BOLT	8	
EPN0101	321	SPRING WASHER	8	
EPN0101	322	FLAT WASHER	8	
EPN0101	323	HEX BOLT	6	
EPN0101	324	SPRING WASHER	6	
EPN0101	325	FLAT WASHER	6	

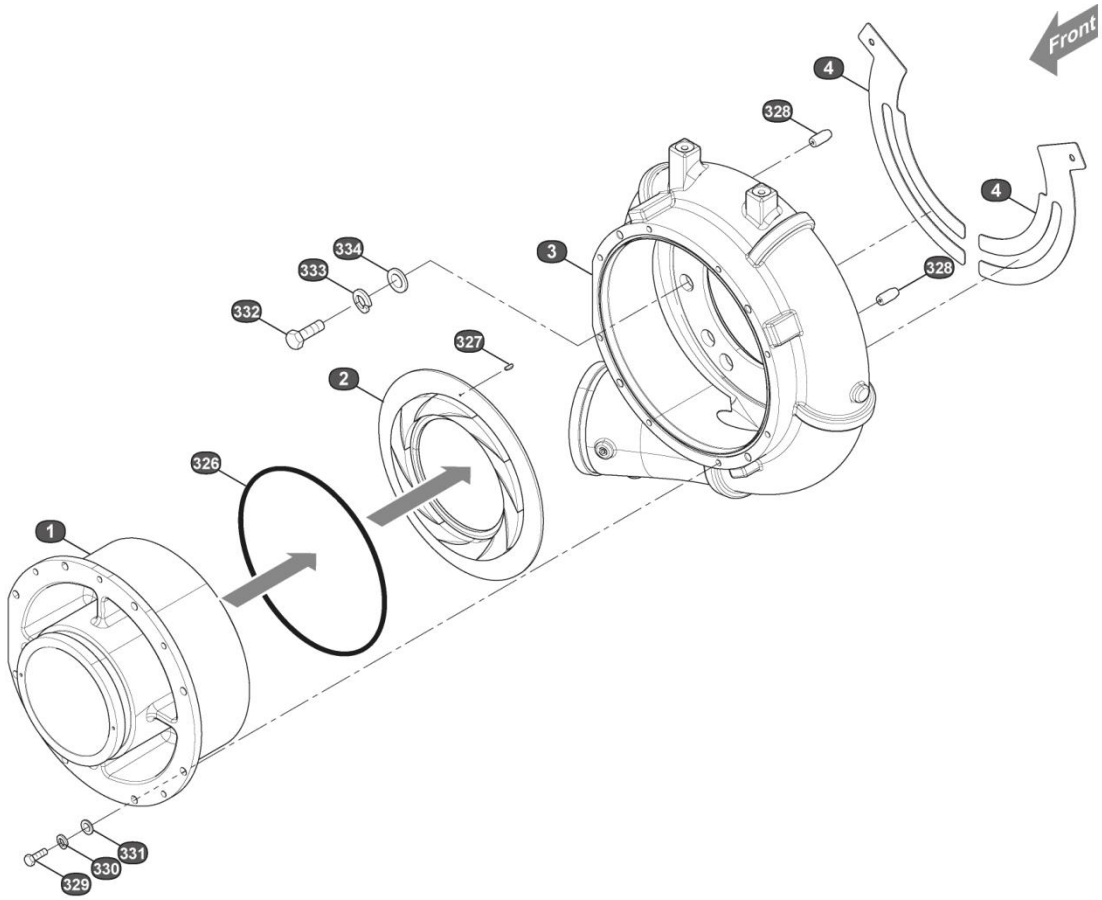
A. IGV & #1 SCROLL ASS'Y



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010121	1-1	IGV CASE	1	
EPN010121	1-2	IGV SCALE	1	
EPN010121	1-3	CONTROL RING	1	
EPN010121	1-4	HEX NUT	5	
EPN010121	1-5	TOOTHED LOCK WASHER	5	
EPN010121	1-6	STUD TYPE TRACK ROLLER	5	
EPN010121	1-7	STRIPPER BOLT	2	
EPN010121	1-8	SPRING WASHER	2	
EPN010121	1-9	HEX NUT	2	
EPN010121	1-10	INLET GUIDE VANE-VANE	7	
EPN010121	1-11	BEARING	7	
EPN010121	1-12	CONTROL LINK ARM	7	
EPN010121	1-13	SPRING PIN	7	
EPN010121	1-14	BALL JOINT	7	
EPN010121	1-15	TOOTHED LOCK WASHER	7	
EPN010121	1-16	NUT-HEX	7	

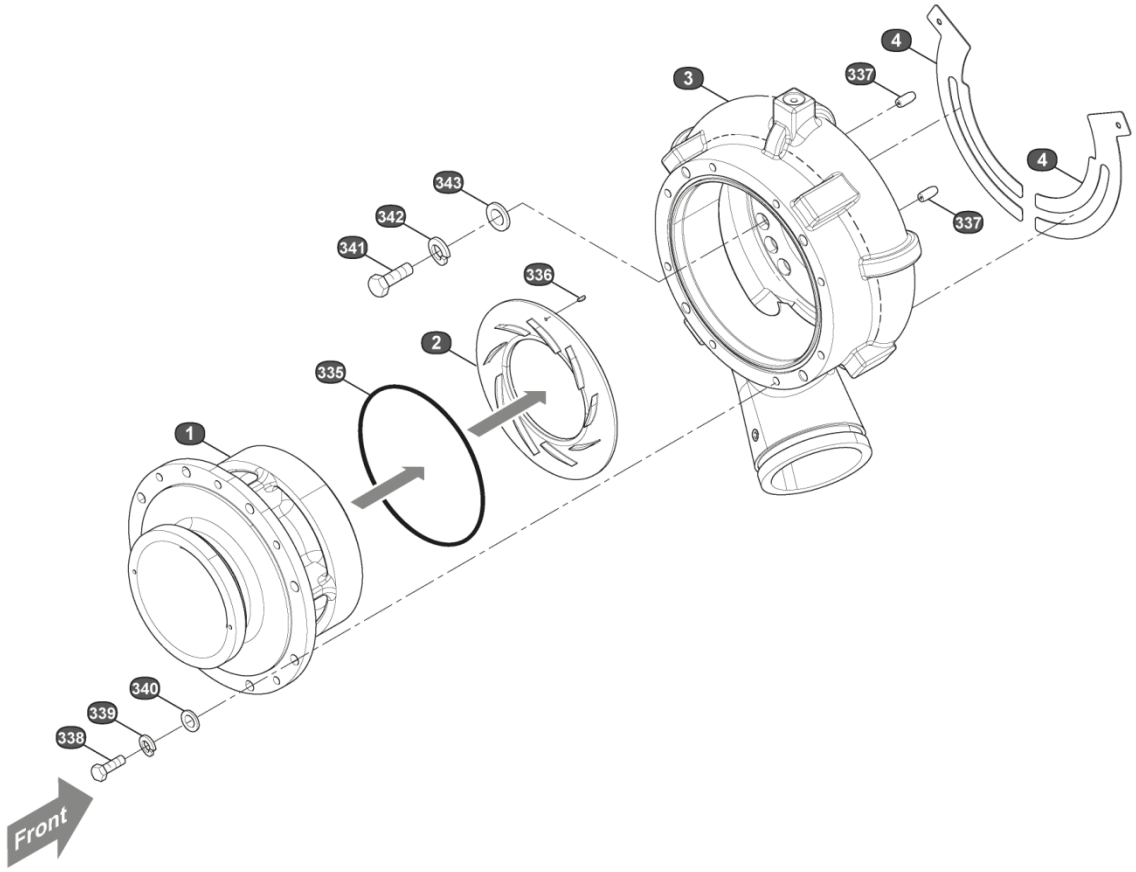
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010121	1-17	ROD END	7	
EPN010121	1-18	WASHER	14	
EPN010121	1-19	WRENCH BOLT	7	
EPN010121	1-20	SPRING WASHER	7	
EPN010121	1-21	NYLON LOCK NUT	7	
EPN010121	1-22	HEX NUT	1	
EPN010121	1-23	STOPPER PLATE	1	
EPN010121	1-24	HEX BOLT	1	
EPN010121	1-25	SPRING WASHER	2	
EPN010121	1-26	HEX BOLT	2	

8.5.1.2 #2 STAGE



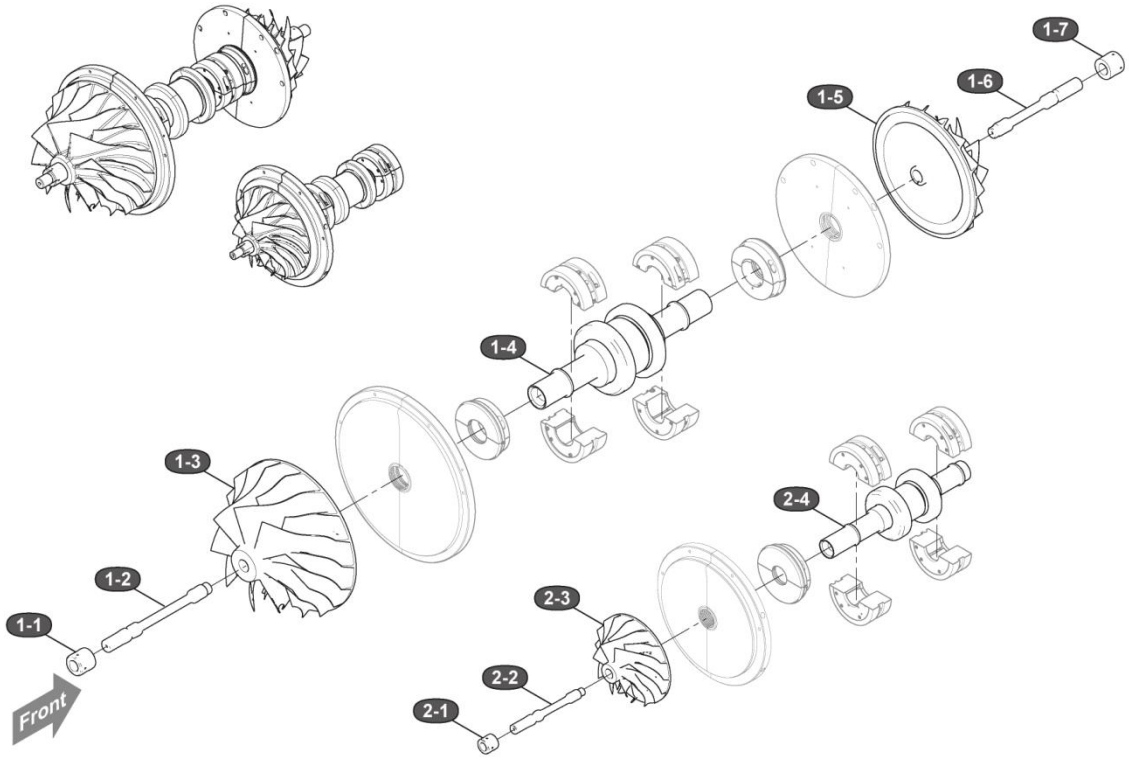
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010130	1	#2 SHROUD	1	
EPN010127	2	#2 DIFFUSER	1	
EPN010126	3	#2 SCROLL CASE	1	
EPN010185	4	#2 SCROLL SHIM PLATE	1	
EPN010128	326	O-RING, #2 SCROLL	1	
EPN0101	327	DIFFUSER PIN	1	
EPN0101	328	SCROLL LOCATING PIN	2	
EPN0101	329	HEX BOLT	6	
EPN0101	330	SPRING WASHER	6	
EPN0101	331	FLAT WASHER	6	
EPN0101	332	HEX BOLT	6	
EPN0101	333	SPRING WASHER	6	
EPN0101	334	FLAT WASHER	6	

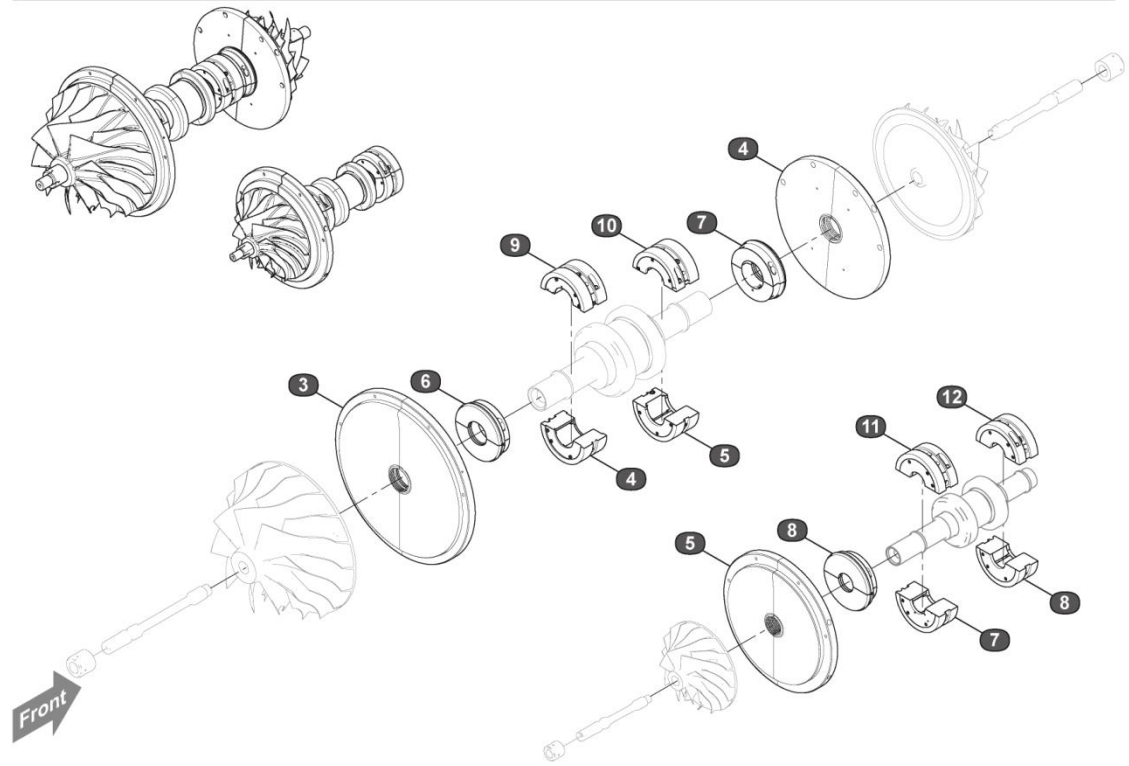
8.5.1.3 #3 STAGE



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010135	1	#3 SHROUD	1	
EPN010132	2	#3 DIFFUSER	1	
EPN010131	3	#3 SCROLL CASE	1	
EPN010186	4	#3 SCROLL SHIM PLATE	1	
EPN010133	335	O-RING, STAGE #3	1	
EPN0101	336	DIFFUSER PIN	1	
EPN0101	337	SCROLL LOCATING PIN	2	
EPN0101	338	HEX BOLT	6	
EPN0101	339	SPRING WASHER	6	
EPN0101	340	FLAT WASHER	6	
EPN0101	341	HEX BOLT	6	
EPN0101	342	SPRING WASHER	6	
EPN0101	343	FLAT WASHER	6	

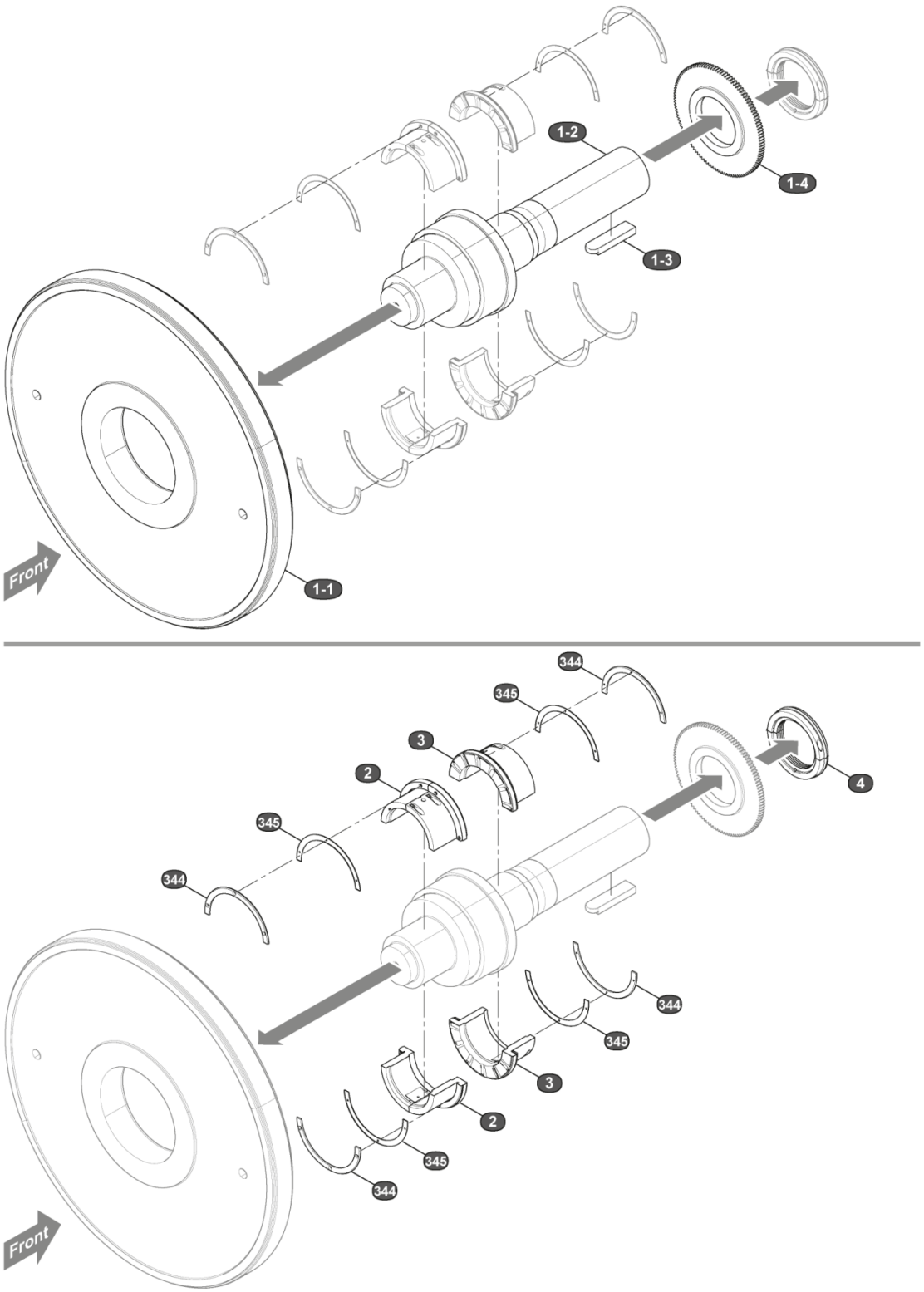
8.5.1.4 Rotor set





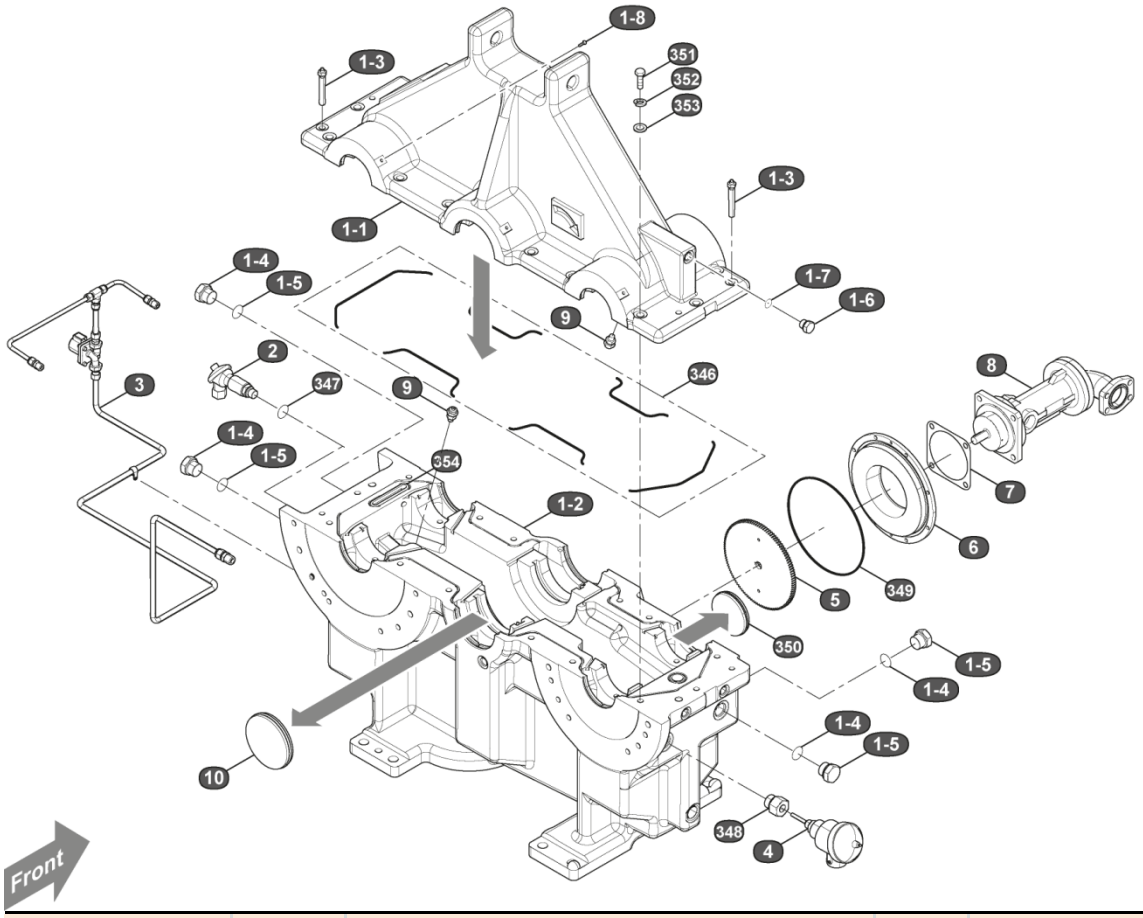
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010143	1	#1 ROTOR ASSY	1	
EPN010143	1-1	#1 NUT CAP	1	
EPN010143	1-2	#1 TIE SHAFT	1	
EPN010143	1-3	#1 IMPELLER	1	
EPN010143	1-4	#1 PINION ASSY	1	
EPN010143	1-5	#2 IMPELLER	1	
EPN010143	1-6	#2 TIE SHAFT	1	
EPN010143	1-7	#2 NUT CAP	1	
EPN010144	2	#2 ROTOR ASSY	1	
EPN010144	2-1	#3 NUT CAP	1	
EPN010144	2-2	#3 TIE SHAFT	1	
EPN010144	2-3	#3 IMPELLER	1	
EPN010144	2-4	#2 PINION ASSY	1	
EPN010108	3	#1 CARBON SEAL ASSY OR AIR SEAL	1	
EPN010109	4	#2 CARBON SEAL ASSY OR AIR SEAL	1	
EPN010110	5	#3 CARBON SEAL ASSY OR AIR SEAL	1	
EPN010112	6	#1 OIL SEAL	1	
EPN010113	7	#2 OIL SEAL	1	
EPN010114	8	#3 OIL SEAL	1	
EPN010102	9	#1 BEARING	1	
EPN010103	10	#2 BEARING	1	
EPN010104	11	#3 BEARING	1	
EPN010105	12	#4 BEARING	1	

8.5.1.5 Bull Gear Set



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010101	1	BULL GEAR ASSY	1	
EPN010101	1-1	BULL GEAR	1	
EPN010101	1-2	MAIN SHAFT	1	
EPN010101	1-3	KEY PIN (PUMP)	1	
EPN010101	1-4	KEY PIN	1	
EPN010101	1-5	INNER RACE, CLUTCH	1	
EPN010106	2	BULL GEAR BEARING	1	
EPN010107	3	BULL GEAR BLIND BEARING	1	
EPN010115	4	RUBBER SEAL, BULL GEAR	1	
EPN010115	5	OIL SEAL, BULL GEAR, MOTOR SIDE	1	
EPN0101	344	BEARING SHIM PLATE	2	
EPN0101	345	BEARING SHIM PLATE	2	

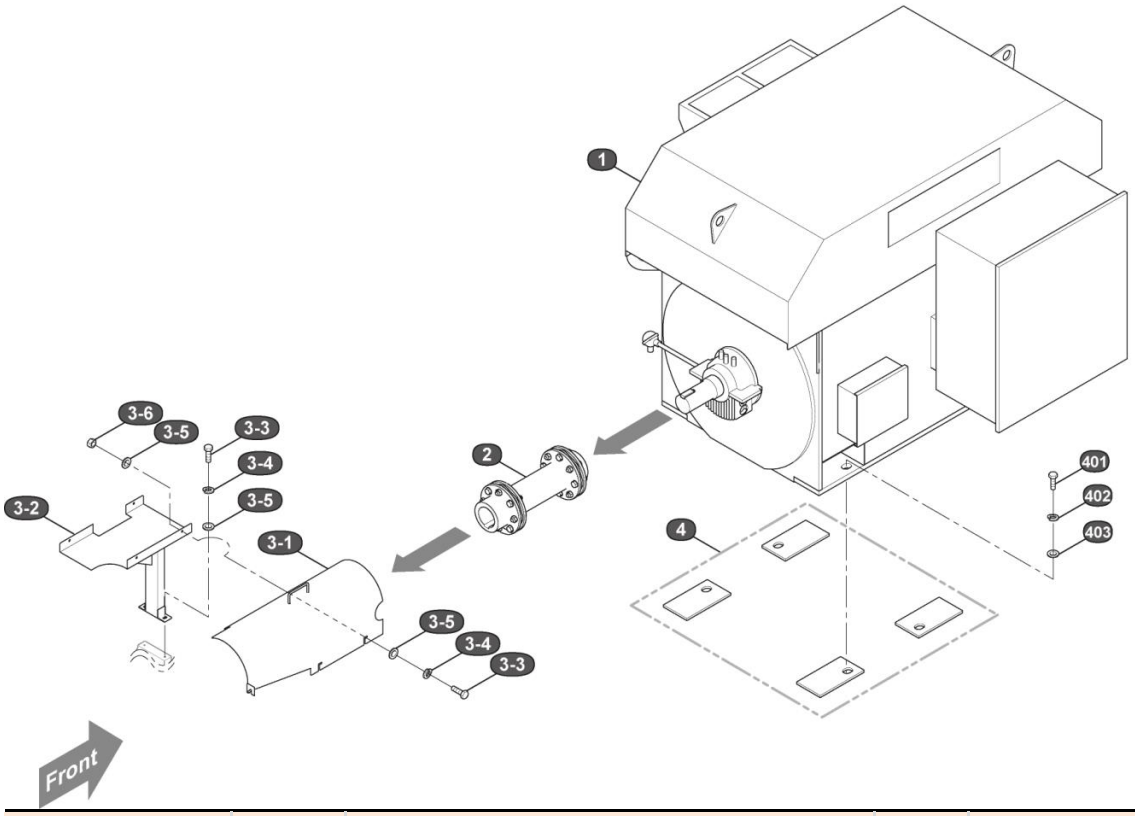
8.5.1.6 Gearbox Module



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010117	1	GEARBOX ASSY	1	
EPN010117	1-1	UPPER GEARBOX	1	
EPN010117	1-2	LOWER GEARBOX	1	
EPN010117	1-3	KNOCK PIN	2	
EPN010117	1-4	PLUG	4	
EPN010117	1-5	O-RING	4	
EPN010117	1-6	HEXAGON BOLT	12	
EPN010117	1-7	O-RING	1	
EPN010117	1-8	PLUG	1	
EPN010149	2	PRESSURE TRANSMITTER	1	
EPN010118	3	BUFFER PIPING ASSY	1	
EPN010118	3-1	AIR BREATHER FILTER	1	
EPN010118	3-2	AIR BREATHER FILTER ELEMENT	1	
EPN010148	4	RTD SENSOR	1	
EPN010183	5	MOP IDLE GEAR	1	
EPN010182	6	FLANGE-MOP	1	
EPN010192	7	GASKET,MOP	1	

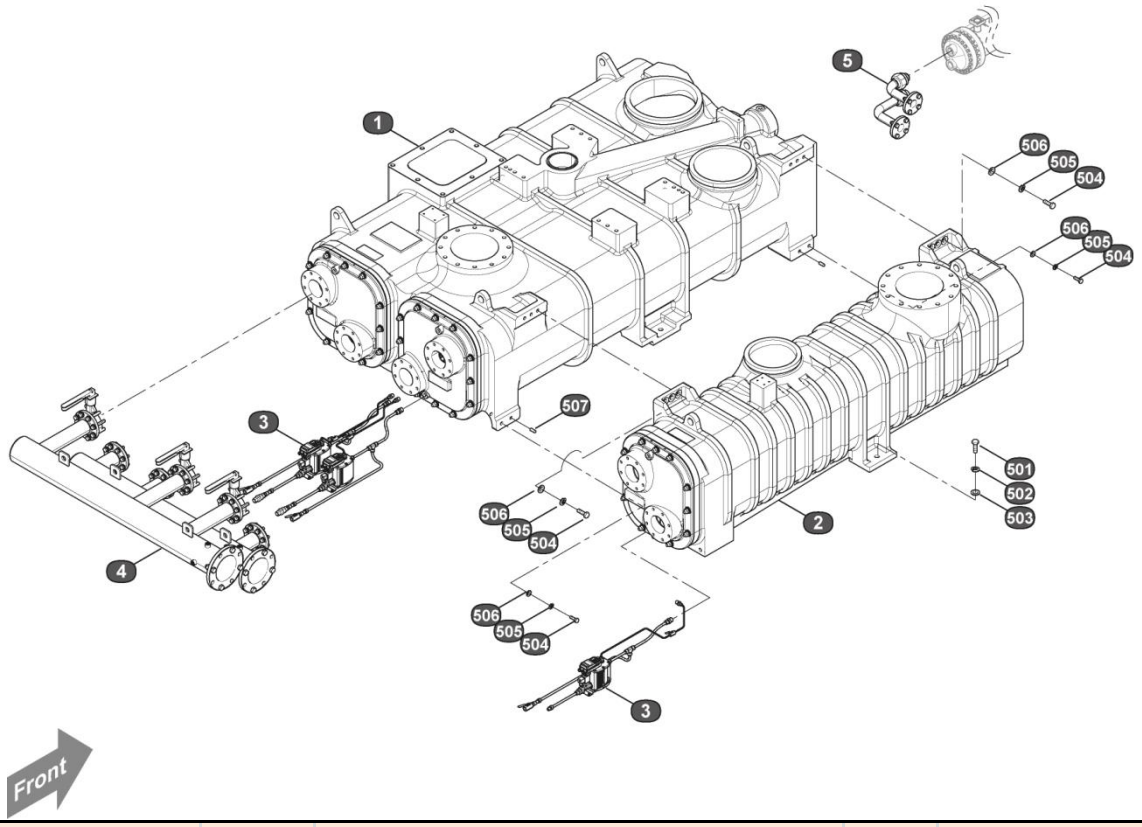
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010145	8	MAIN OIL PUMP	1	
EPN010145	8-1	COUPLING RUBBER	1	
EPN010141	9	OIL NOZZLE	2	
EPN010119	10	COVER-BLIND,BULL	1	
EPN0101	346	O RING, GEARBOX	1	
EPN0101	347	O RING, PT	1	
EPN0101	348	ADAPTER	1	
EPN0101	349	O RING, MOP	1	
EPN0101	350	SIDE COVER, #4	1	
EPN0101	351	WRENCH BOLT	14	
EPN0101	352	SPRING WASHER	14	
EPN0101	353	FLAT WASHER	14	
EPN0101	354	O RING	1	

8.6 Main driver



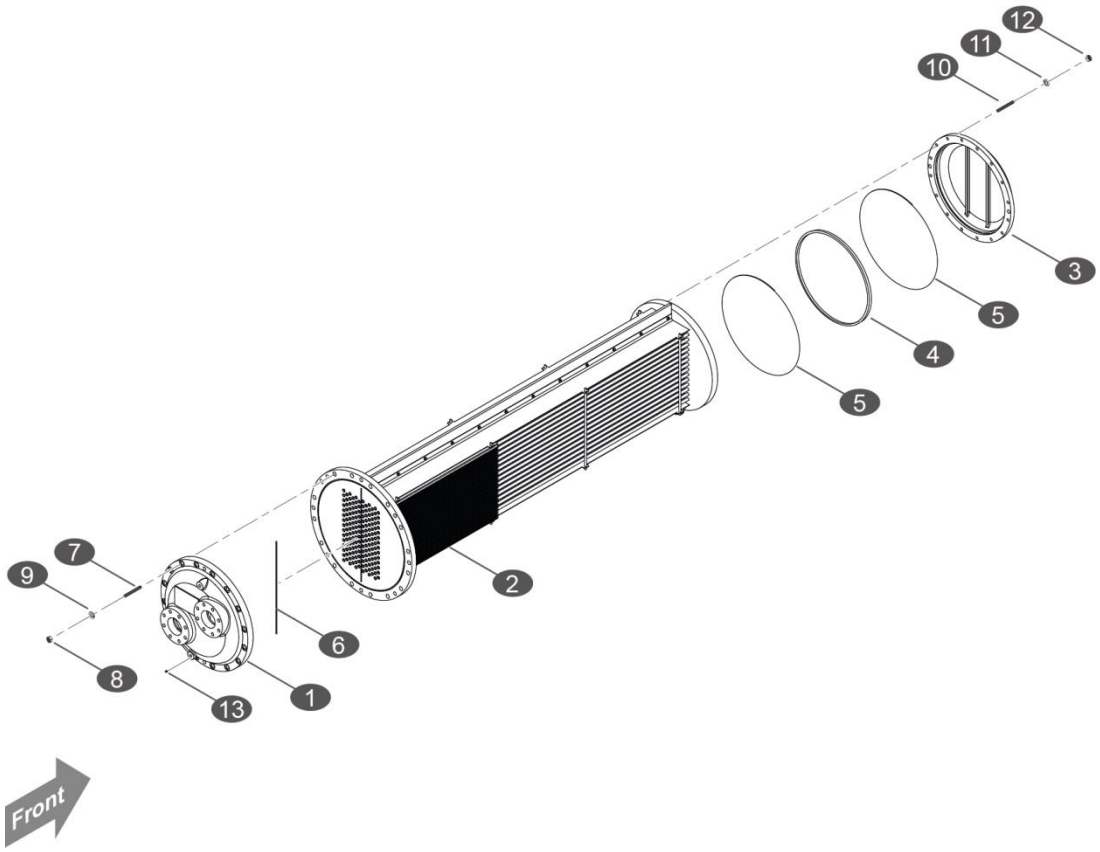
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0201	1	MOTOR	1	
EPN0201	1-1	BEARING DE	1	IF APPLIED
EPN0201	1-2	BEARING NDE	1	IF APPLIED
EPN0201	1-3	BEARING OIL SEAL	1	IF APPLIED
EPN03	2	DISC COUPLING ASS'Y	1	
EPN03	2-1	COUPLING BOLT	16	
EPN03	2-2	COUPLING GAP DISK	1	IF APPLIED
EPN03	2-3	COUPLING O-RING	2	
EPN04	3	COUPLING COVER-ASSY	1	
EPN04	3-1	UPPER COVER	1	
EPN04	3-2	LOWER SUPPORT COVER	1	
EPN04	3-3	WRENCH BOLT	7	
EPN04	3-4	SPRING WASHER	7	
EPN04	3-5	FLAT WASHER	7	
EPN04	3-6	HEX NUT	4	
EPN3012	4	MOTOR SHIM	1	
EPN01	401	HEX BOLT	4	
EPN01	402	SPRING WASHER	4	
EPN01	403	FLAT WASHER	4	

8.7 Cooling system



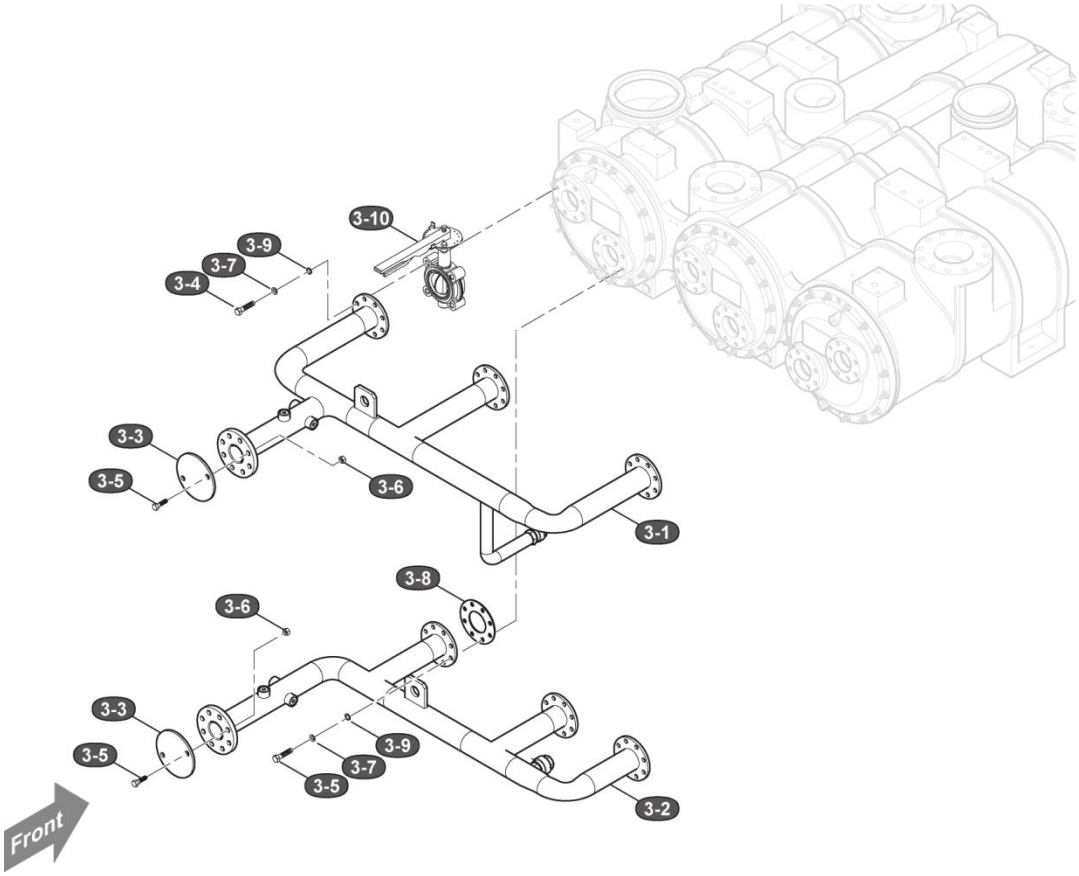
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0102	1	COOLER CASE	1	
EPN0103	1-1	#1 INTERCOOLER ASSY	1	SEE PARA 8.7.1
EPN0104	1-2	#2 INTERCOOLER ASSY	1	SEE PARA 8.7.1
EPN0106	2	AFTERCOOLER CASE	1	SM6100
EPN0105	2-1	#3 INTERCOOLER ASSY	1	SEE PARA 8.7.1
EPN0901	3	CW MANIFOLD ASSY	1	SEE PARA 8.7.2
EPN1701	4	CONDENSATE DRAIN PIPING ASSY	1	SEE PARA 8.7.3
EPN0923	5	ADAPTER FOR OIL COOLER	1	
EPN01	501	HEX BOLT	2	
EPN01	502	SPRING WASHER	2	
EPN01	503	FLAT WASHER	2	
EPN01	504	HEX BOLT	16	SM6100
EPN01	505	SPRING WASHER	16	SM6100
EPN01	506	FLAT WASHER	16	SM6100
EPN01	507	PIN	2	SM6100

8.7.1 Cooler bundle



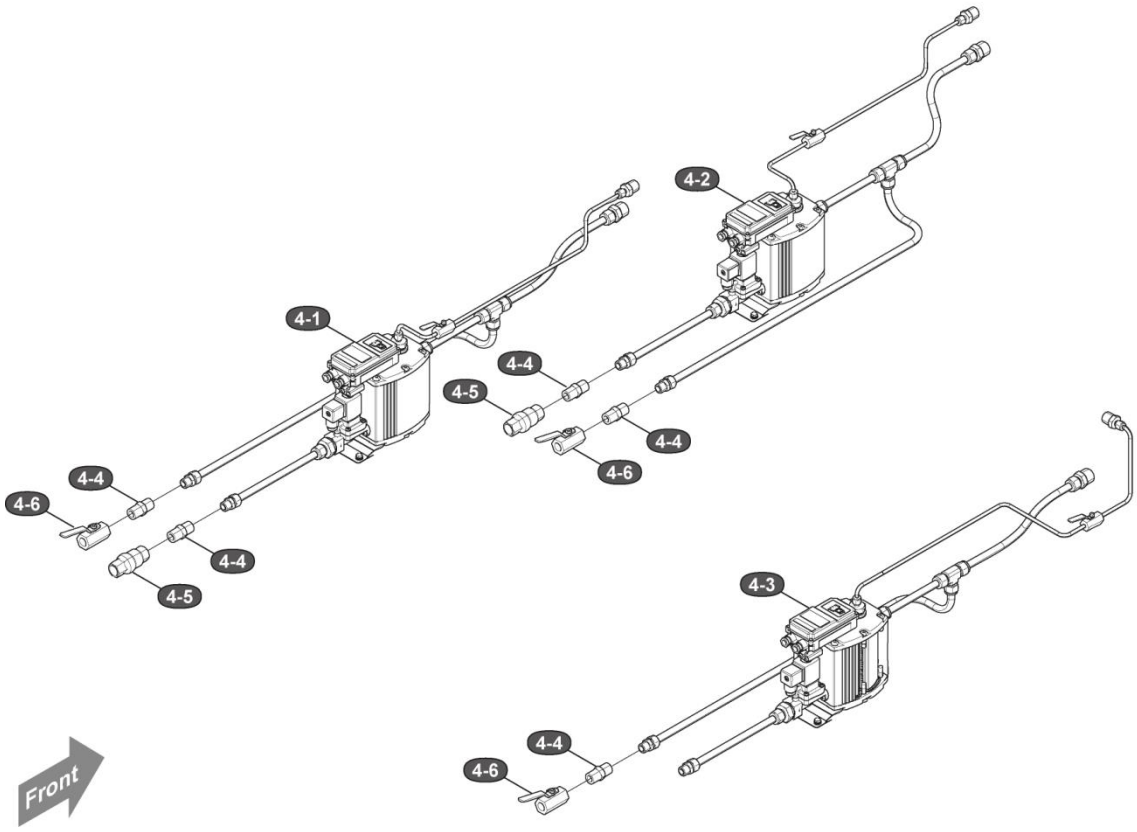
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0103 (#1 IC) EPN0104 (#2 IC) EPN0107 (#3 IC) EPN0109 (AC)	1	FIXED SIDE HEADER, COOLER	1	
	2	BUNDLE ASSY	1	
	3	HEADER, FLOATING SIDE	1	
	4	HOUSING, FLOAT SIDE TUBE SHEET	1	
	5	O-RING, FLOAT SIDE TUBE SHEET	2	
	6	O-RING, FIXED SIDE, DIVIDER	1	
	7	STUD BOLT, FIXED SIDE	16	
	8	HEXAGON NUT	16	
	9	SPRING WASHER	16	
	10	STUD BOLT, FLOAT SIDE	16	
	11	HEXAGON NUT	16	
	12	SPRING WASHER	16	
	13	HEXAGON PLUG, FIXED SIDE	2	

8.7.2 CW manifold assembly



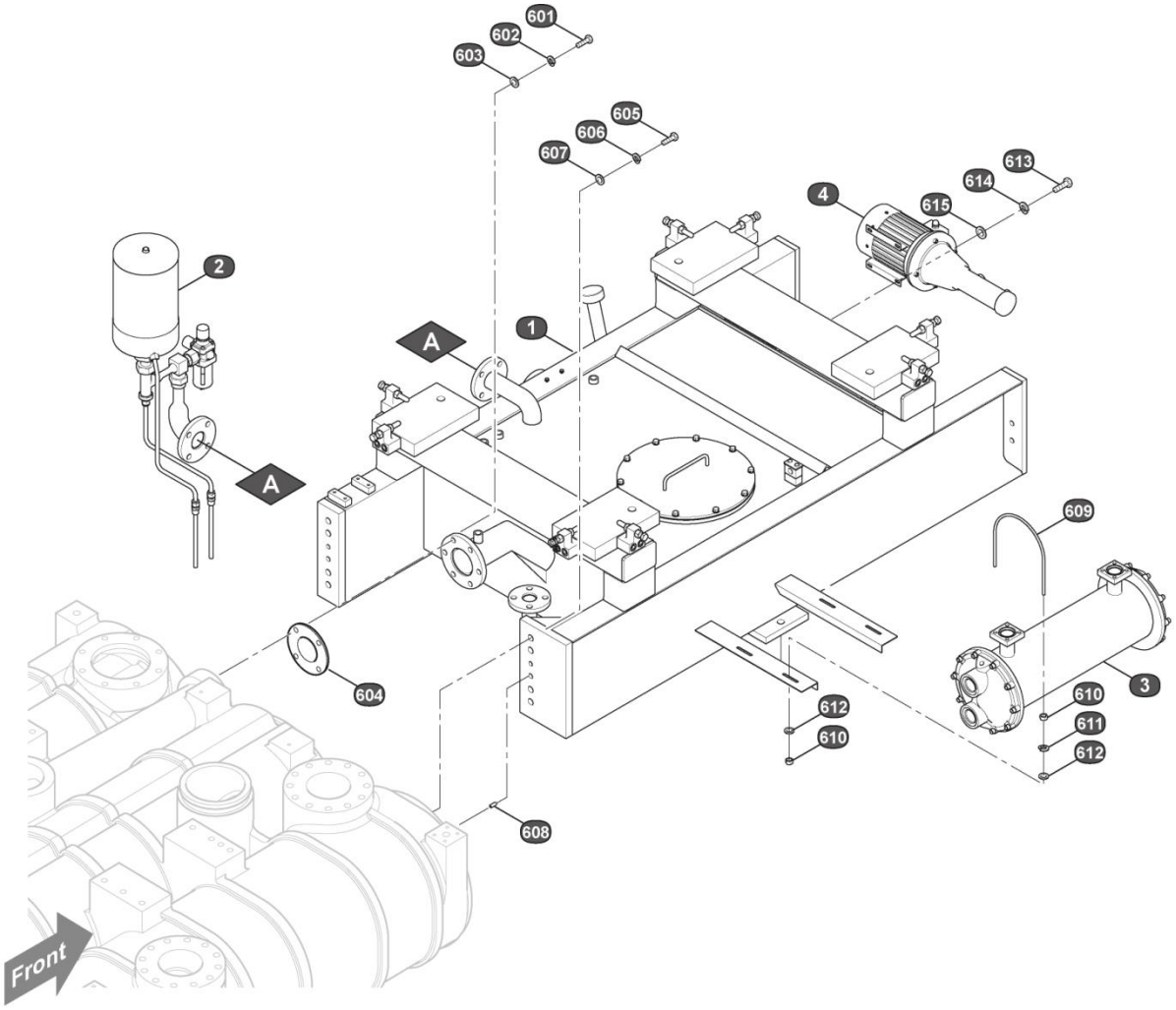
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0901	3-1	C/W SUPPLY MANIFOLD	1	
EPN0901	3-2	C/W RETURN MANIFOLD	1	
EPN0901	3-3	COVER	2	
EPN0901	3-4	HEX BOLT	12	
EPN0901	3-5	HEX BOLT	28	
EPN0901	3-6	HEX NUT	4	
EPN0901	3-7	SPRING WASHER	48	
EPN0901	3-8	GASKET	3	
EPN0901	3-9	FLAT WASHER	48	
EPN0901	3-10	BUTTERFLY VALVE	3	

8.7.3 Condensate drain piping



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN1701	4-1	PIPING-DRAIN PIPE ASSY, STG1	1	AUTOTRAP: OPTION
EPN1701	4-2	PIPING-DRAIN PIPE ASSY, STG2	1	AUTOTRAP: OPTION
EPN1701	4-3	PIPING-DRAIN PIPE ASSY, STG3	1	AUTOTRAP: OPTION
EPN1701	4-4	HEX NIPPLE	3	
EPN1701	4-5	CHECK VALVE	1	
EPN1701	4-6	BALL VALVE	1	

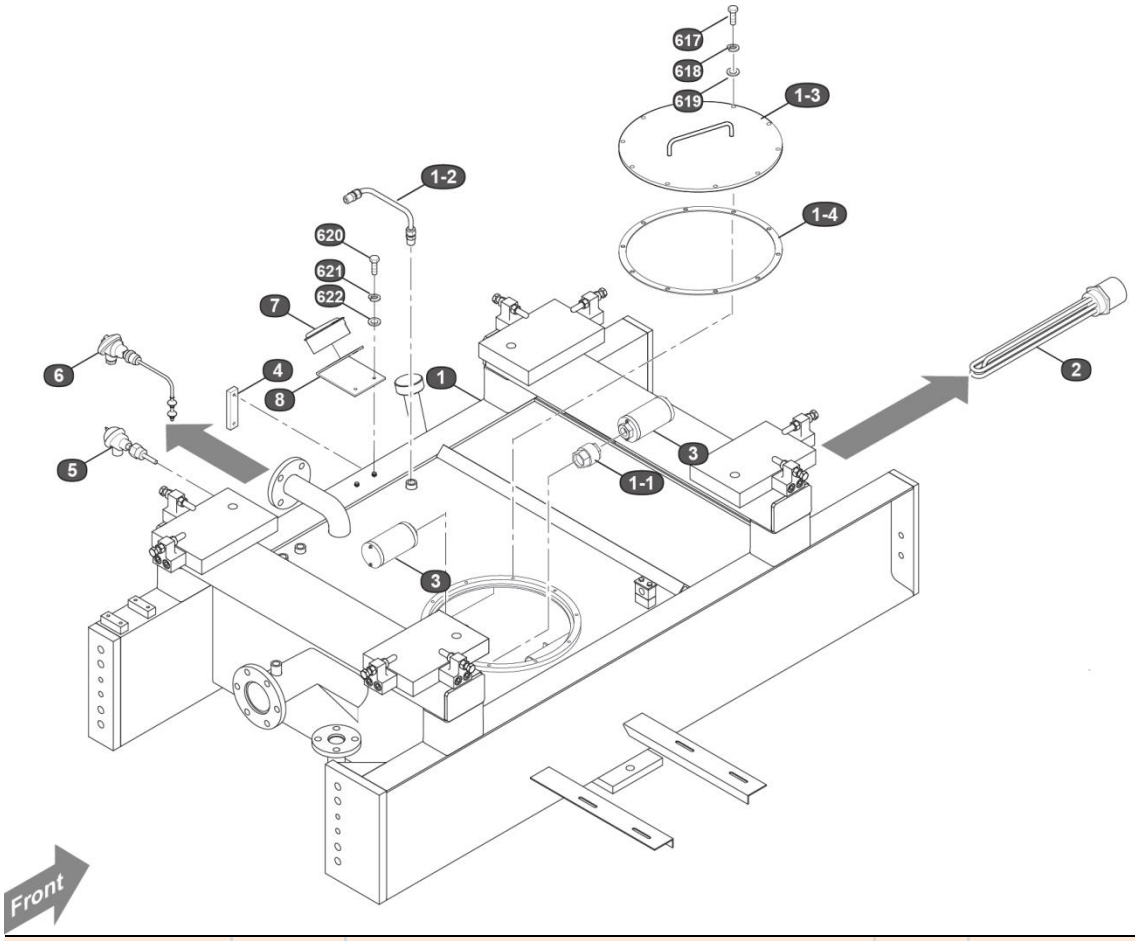
8.8 Lubrication module



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0501	1	OIL TANK ASSY	1	SEE PARA 8.8.1
EPN0701	2	OIL DEMIST ASSY	1	SEE PARA 8.8.2
EPN0602	3	OIL COOLER ASSY	1	
EPN0602	3-1	OIL COOLER REAR SIDE COVER	1	
EPN0602	3-2	OIL COOLER FLOAT SIDE COVER	1	
EPN0602	3-3	OIL COOLER GASKET	2	
EPN0602	3-4	OIL COOLER O-RING	1	
EPN0602	3-5	OIL COOLER BOLT	48	
EPN0602	3-6	OIL COOLER SPRING WASHER	48	
EPN0602	3-7	OIL COOLER FLAT WASHER	96	
EPN0602	3-8	OIL COOLER NUT	48	
EPN0604	4	AUXILIARY OIL PUMP	1	
EPN0604	4-1	AUXILIARY OIL PUMP COUPLING	1	
EPN0604	4-1-1	AUXILIARY OIL PUMP COUPLING RUBBER	1	CONSUMABLE
EPN01	601	HEX BOLT	6	CONSUMABLE

LOCATION	NO	PART NAME	Q'TY	REMARK
EPN01	602	SPRING WASHER	6	
EPN01	603	FLAT WASHER	6	
EPN01	604	GASKET	1	
EPN01	605	WRENCH BOLT	8	
EPN01	606	SPRING WASHER	8	
EPN01	607	FLAT WASHER	8	
EPN01	608	PIN	2	
EPN0501	609	U-BOLT	1	
EPN0501	610	HEX NUT	8	
EPN0501	611	SPRING WASHER	4	
EPN0501	612	FLAT WASHER	8	
EPN0501	613	HEX NUT	2	
EPN0501	614	SPRING WASHER	2	
EPN0501	615	FLAT WASHER	2	

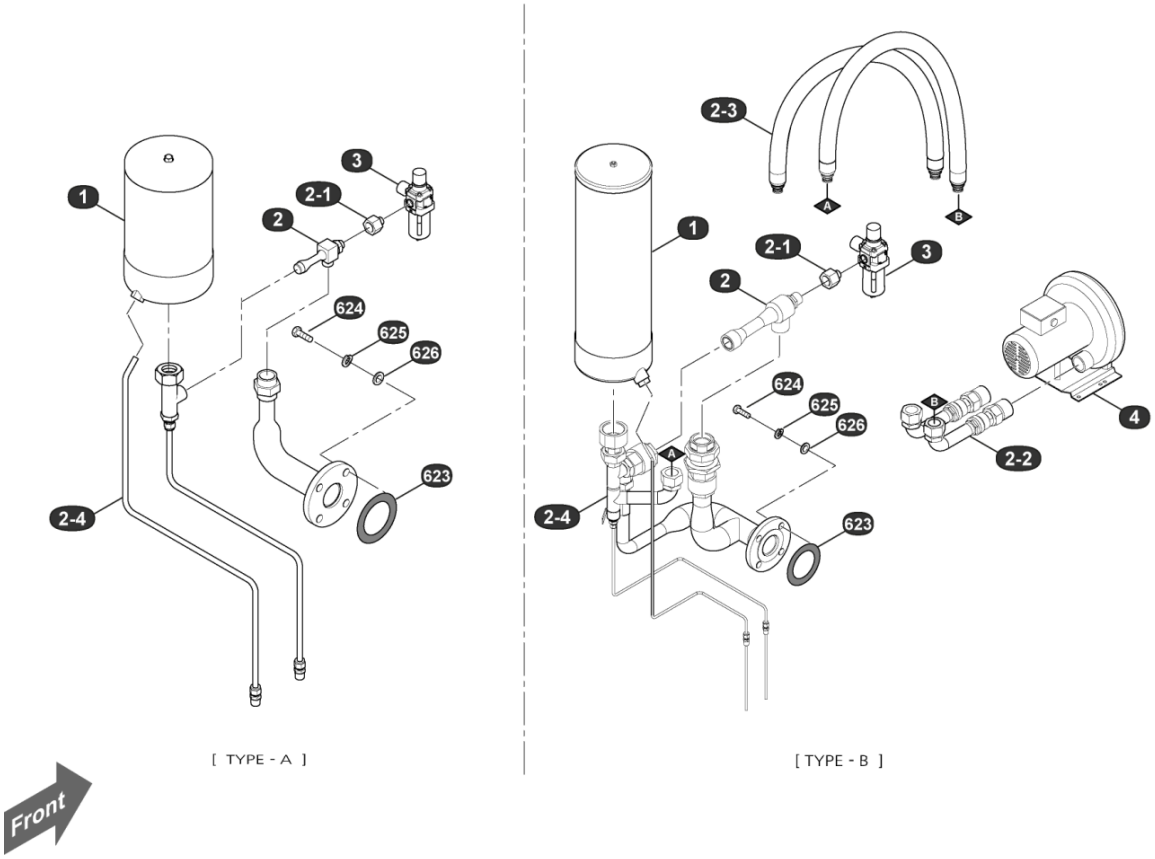
8.8.1 Oil Tank



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN050101	1	OIL TANK	1	
EPN050103	2	OIL HEATER	1	
EPN050105	3	STRAINER, OIL FILTER	2	
EPN050106	4	OIL LEVEL SIGHT	1	
EPN050107	5	OIL TEMP SENSOR	1	
EPN050108	6	OIL LEVEL SWITCH	1	
EPN050109	7	OIL DIFFERENTIAL PRESSURE GAUGE	1	
EPN050110	8	OIL DP GAUGE BRACKET	1	
EPN0501	1-1	CHECK VALVE, MOP SUCTION	1	
EPN0501	1-2	OIL DP GAUGE TUBE	1	
EPN0501	1-3	OIL TANK MANHOLE COVER	1	
EPN0501	1-4	OIL TANK MANHOLE GASKET	1	
EPN0501	617	HEX BOLT	10	
EPN0501	618	SPRING WASHER	10	
EPN0501	619	FLAT WASHER	10	
EPN0501	620	HEX BOLT	2	

LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0501	621	SPRING WASHER	2	
EPN0501	622	FLAT WASHER	2	

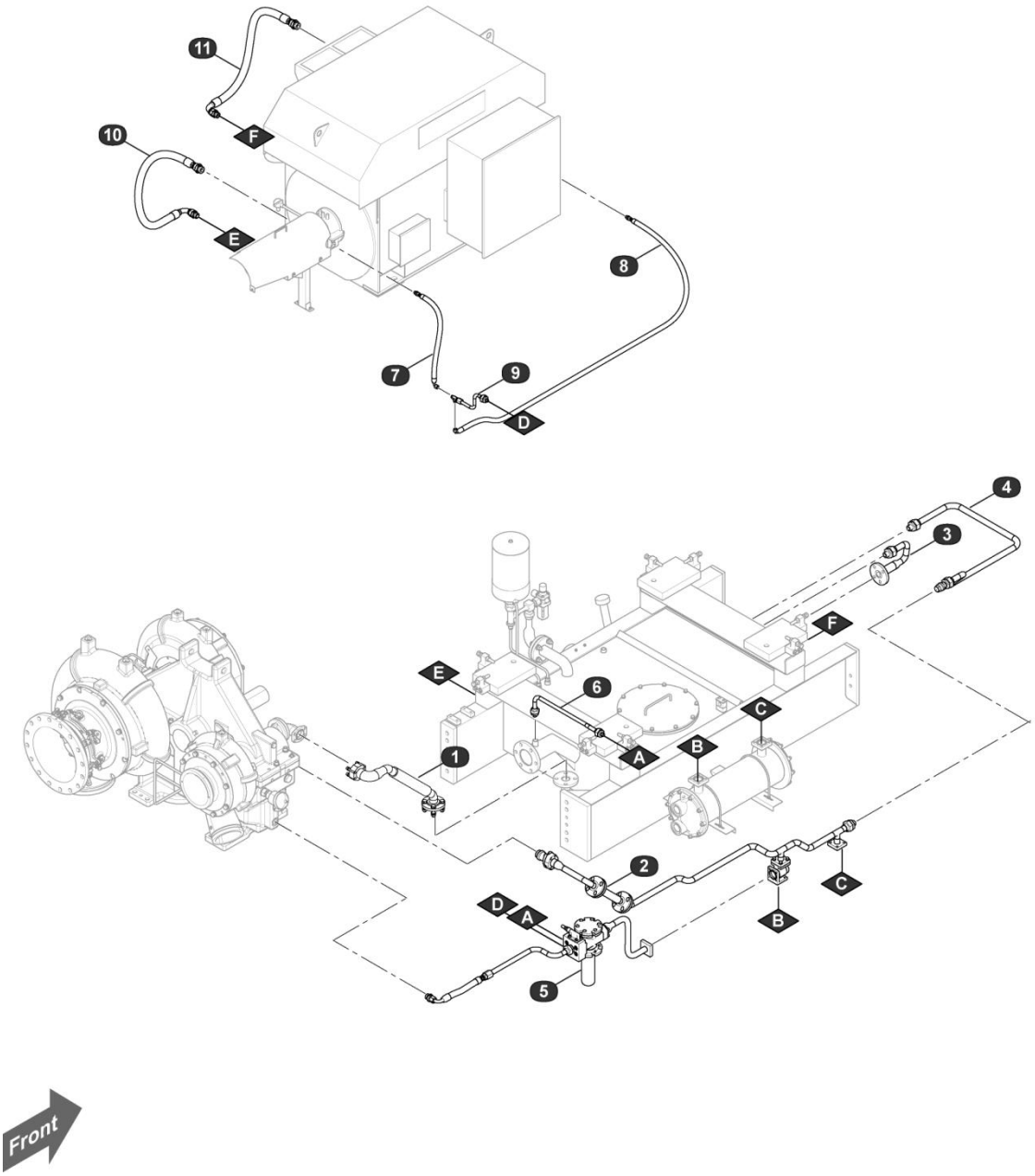
8.8.2 Oil Demister Assembly



TYPE A: JEP PUMP TYPE (STANDARD) , TYPE B : BLOWER TYPE (OPTION)

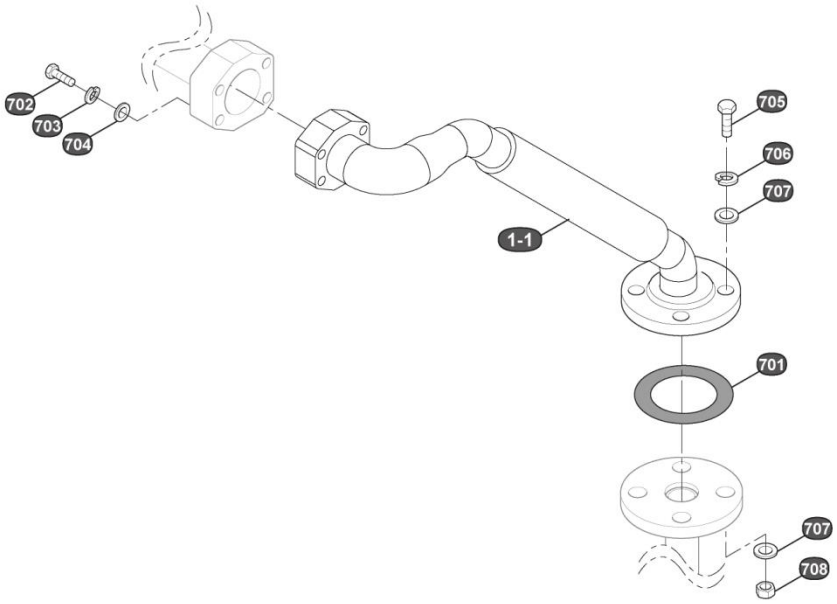
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN070101	1	EXHAUST CLEANER	1	
EPN070103	2	JET PUMP	1	
EPN070102	3	AIR REGULATOR	1	
EPN070104	4	RING BLOWER	1	OPTION
EPN0701	2-1	ADAPTER	1	
EPN0701	2-2	OIL DEMISTER ASSY-PIPE	1	OPTION
EPN0701	2-3	OIL DEMISTER ASSY-HOSE	1	OPTION
EPN0701	2-4	OIL DEMISTER ASSY-TUBE	1	
EPN0701	623	GASKET	1	
EPN0701	624	HEX BOLT	4	
EPN0701	625	SPRING WASHER	4	
EPN0701	626	FLAT WASHER	4	

8.9 Oil Piping



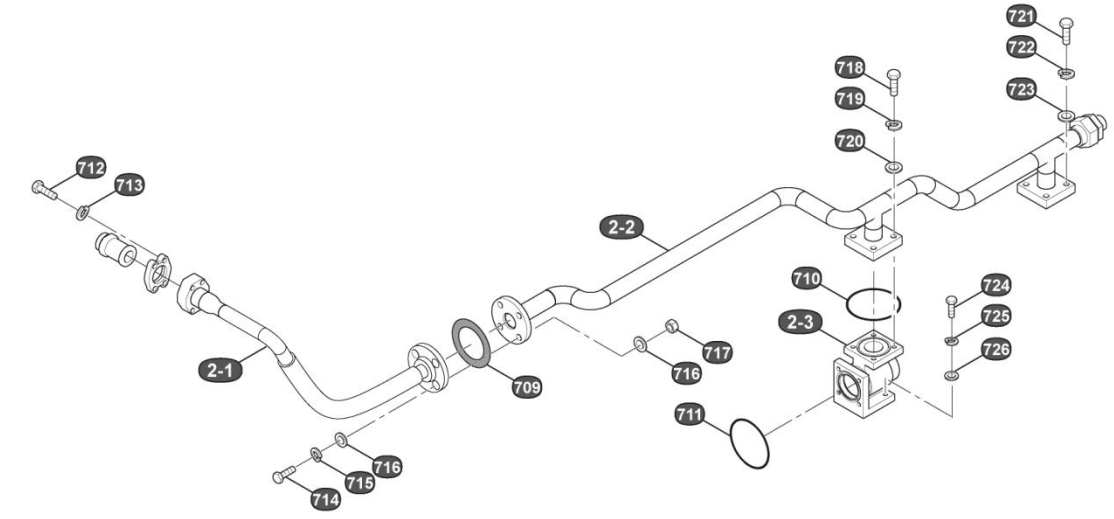
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN0601		OIL PIPING ASSY	1	
EPN060101	1	MOP SUCTION PIPING	1	SEE PARA 8.9.1
EPN060102	2	MOP DISCHARGE PIPING	1	SEE PARA 8.9.2
EPN060103	3	AOP SUCTION PIPING	1	SEE PARA 8.9.3
EPN060104	4	AOP DISCHARGE PIPING	1	SEE PARA 8.9.4
EPN060117	5	GEAR BOX SUPPLY PIPING	1	SEE PARA 8.9.5
EPN0601	6	PCV DRAIN PIPING	1	
EPN0601	7	MOTOR INLET PIPING, DE	1	
EPN0601	8	MOTOR INLET PIPING, NDE	1	
EPN0601	9	MOTOR INLET HOSE	1	
EPN0601	10	MOTOR OUTLET PIPING, DE	1	
EPN0601	11	MOTOR OUTLET PIPING, NDE	1	

8.9.1 MOP Suction Piping Assembly



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN060101	1-1	MOP SUCTION PIPE	1	
EPN060101	701	GASKET	1	
EPN060101	702	HEX BOLT	4	
EPN060101	703	SPRING WASHER	4	
EPN060101	704	FLAT WASHER	4	
EPN060101	705	HEX BOLT	4	
EPN060101	706	SPRING WASHER	4	
EPN060101	707	FLAT WASHER	8	
EPN060101	708	HEX NUT	4	

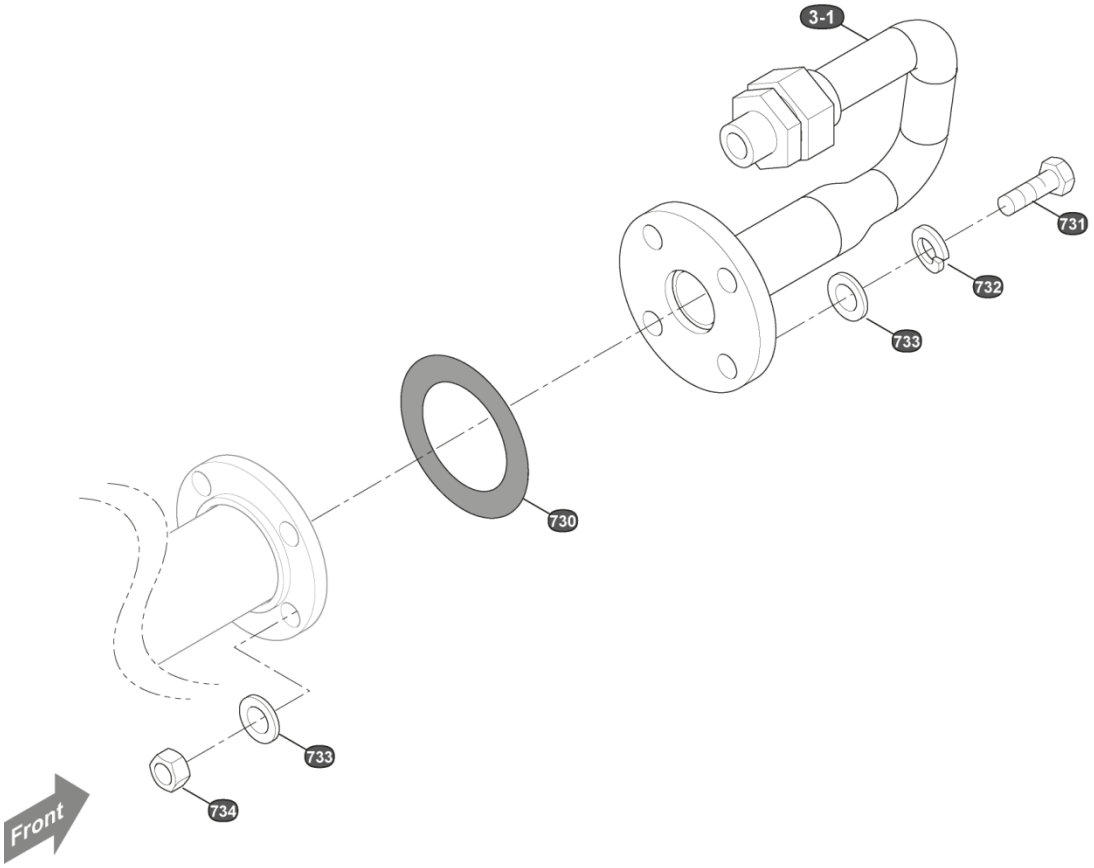
8.9.2 MOP Discharge Piping Assembly



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN060102	2-1	MOP DISCHARGE PIPE-1	1	
EPN060102	2-2	MOP DISCHARGE PIPE-2	1	
EPN060102	2-3	TEMPERATURE CONTROL VALVE	1	
EPN060102	709	GASKET	1	
EPN060102	710	O-RING	1	
EPN060102	711	O-RING	1	
EPN060102	712	HEX BOLT	4	
EPN060102	713	SPRING WASHER	4	
EPN060102	714	HEX BOLT	4	
EPN060102	715	SPRING WASHER	4	
EPN060102	716	FLAT WASHER	8	
EPN060102	717	HEX NUT	4	
EPN060102	718	HEX BOLT	4	
EPN060102	719	SPRING WASHER	4	
EPN060102	720	FLAT WASHER	4	
EPN060102	721	HEX BOLT	4	

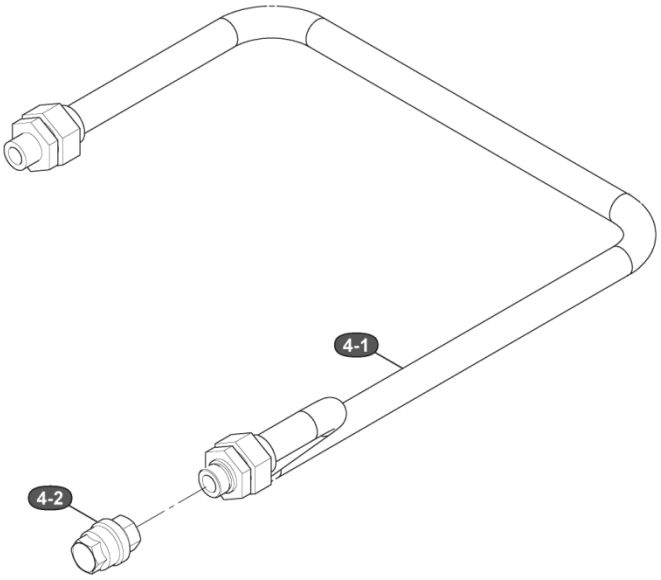
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN060102	722	SPRING WASHER	4	
EPN060102	723	FLAT WASHER	4	
EPN060102	724	HEX BOLT	4	
EPN060102	725	SPRING WASHER	4	
EPN060102	726	FLAT WASHER	4	

8.9.3 AOP Suction Piping Assembly



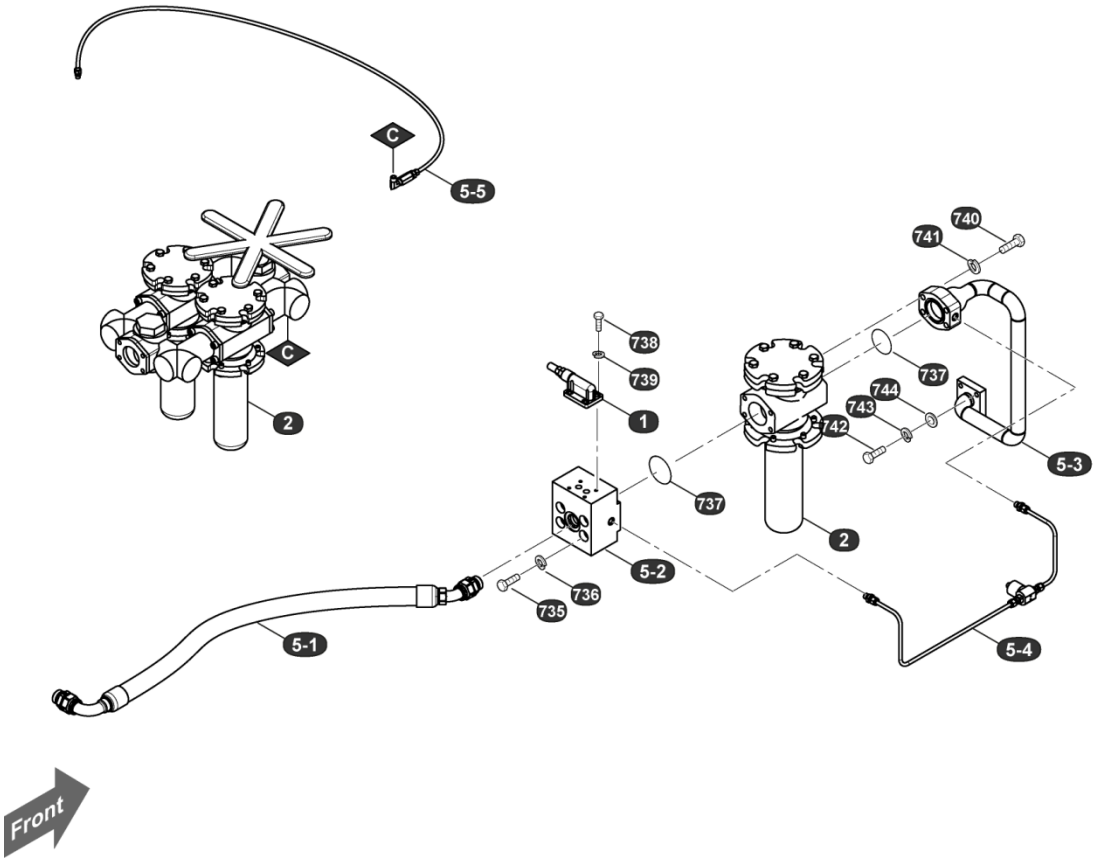
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN060103	3-1	AOP SUCTION PIPE	1	
EPN060103	730	GASKET	1	
EPN060103	731	HEX BOLT	4	
EPN060103	732	SPRING WASHER	4	
EPN060103	733	FLAT WASHER	8	
EPN060103	734	HEX NUT	4	

8.9.4 AOP Discharge Piping Assembly



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN060104	4-1	AOP DISCHARGE PIPE	1	
EPN060104	4-2	CHECK VALVE, AOP	1	

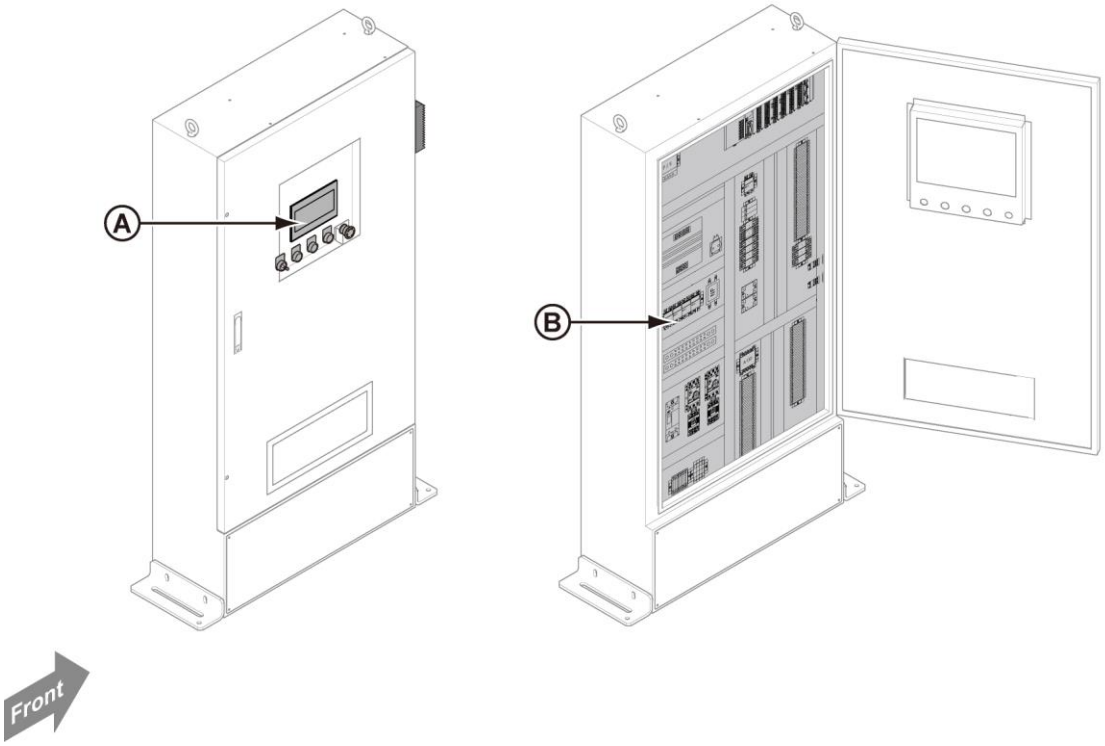
8.9.5 Gearbox Supply Piping Assembly



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN010147	1	PRESSURE CONTROL VALVE	1	
EPN060112	2	SINGLE OIL FILTER	1	
EPN060112	2-1	OIL FILTER ELEMENT	2	
EPN060112	2	DUAL OIL FILTER	1	OPTION
EPN060112	2-1	OIL FILTER ELEMENT	2	
EPN060117	5-1	GB SUPPLY PIPE-1	1	
EPN060117	5-2	PCV BOX	1	
EPN060117	5-3	GB SUPPLY PIPE-2	1	
EPN060117	5-4	PDIT TUBE	1	OPTION
EPN060117	5-5	OIL FILTER DRAIN HOSE	1	OPTION
EPN060117	735	WREHCN BOLT	4	
EPN060117	736	SPRING WASHER	4	
EPN060117	737	O-RING	2	
EPN060117	738	WRENCH BOLT	4	
EPN060117	739	SPRING WASHER	4	
EPN060117	740	WRENCH BOLT	4	

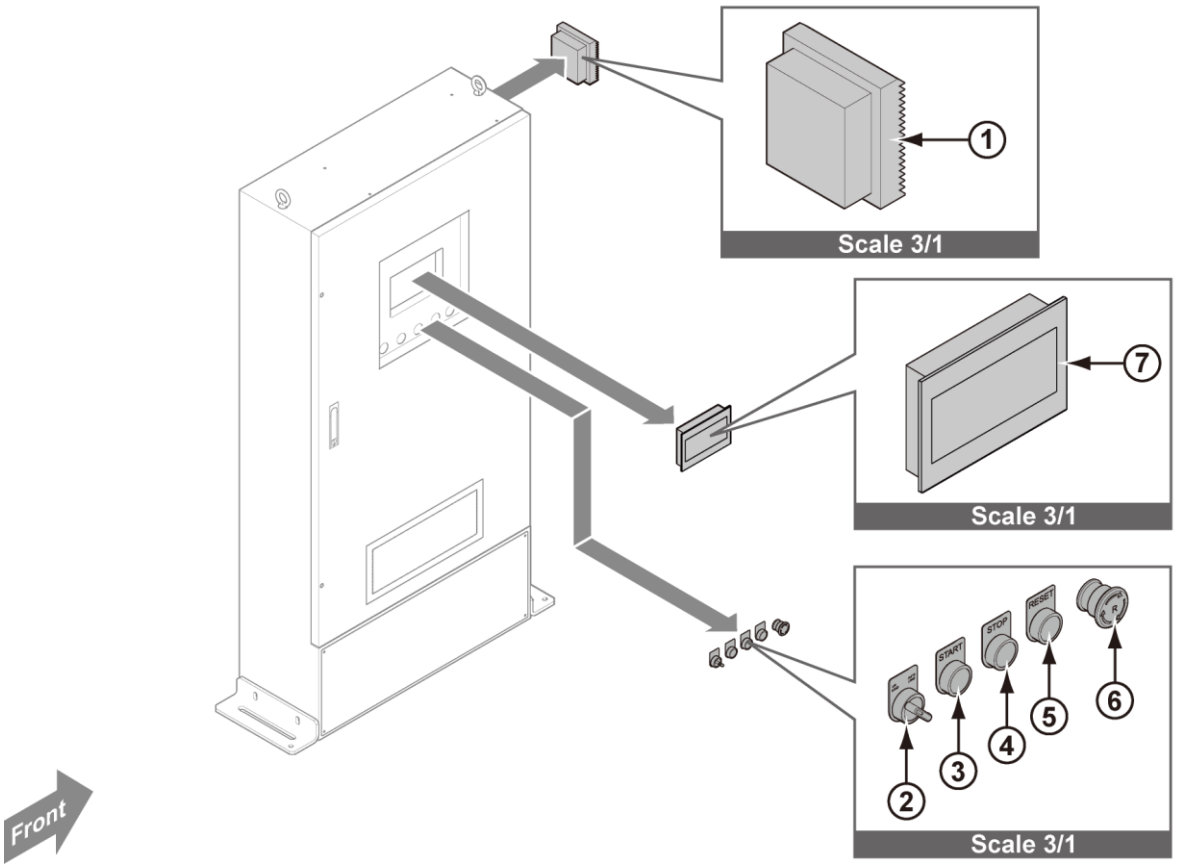
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN060117	741	SPRING WASHER	4	
EPN060117	742	HEX BOLT	4	
EPN060117	743	SPRING WASHER	4	
EPN060117	744	FLAT WASHER	4	

8.10 Control Panel



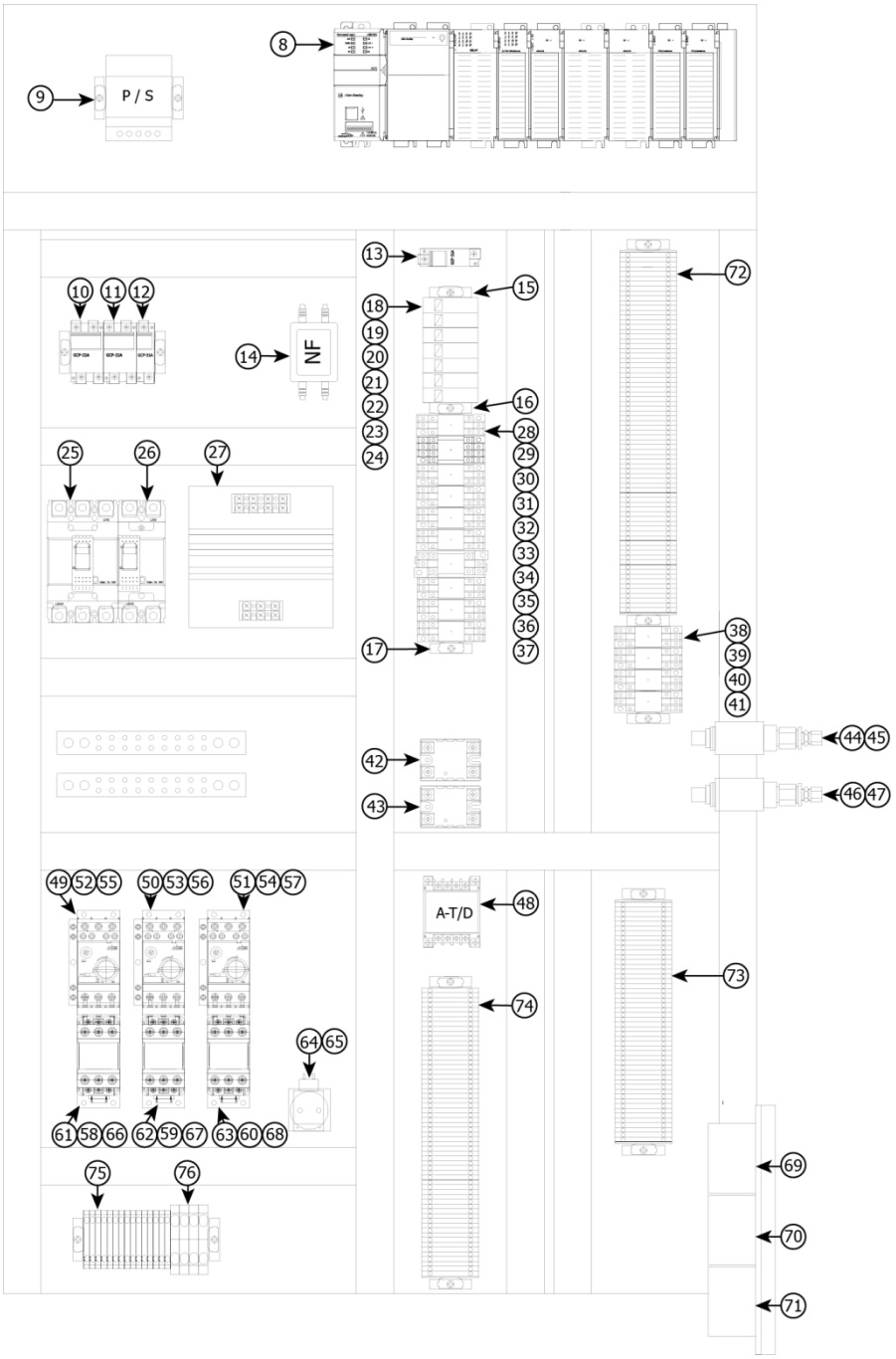
LOCATION	NO	PART NAME	Q'TY	REMARK
EPN1001	A	PANEL COVER PARTS	1	
EPN1001	B	PANEL INNER PARTS	1	

8.10.1 Panel Cover Parts



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN1001	1	COOLING FAN	1	EP03403400-003
EPN1001	2	PUSH BUTTON	1	EP00501700-002
EPN1001	3	PUSH BUTTON	1	EP07-000846
EPN1001	4	PUSH BUTTON	1	EP00501700-003
EPN1001	5	SELECT SWITCH	1	EP20-000141
EPN1001	6	EMERGENCY PUSH BUTTON	1	EP07-000509
EPN1001	7	TOUCH SCREEN	1	EPN10010201

8.10.2 PLC Inner Parts



LOCATION	NO	PART NAME	Q'TY	REMARK
EPN1001	8	AB PLC ASS'Y	1	
EPN1001	9	POWER SUPPLY	1	5945S1000020-03
EPN1001	10	CIRCUIT PROTECTOR	1	EP07-001030
EPN1001	11	CIRCUIT PROTECTOR	1	EP07-001030
EPN1001	12	CIRCUIT PROTECTOR	1	EP07-001032
EPN1001	13	CIRCUIT PROTECTOR	1	EP07-001033
EPN1001	14	NOISE FILTER	1	EP03103400-001
EPN1001	15	FUSE HOLDER	1	EP04201800-001
EPN1001	16	FUSE HOLDER	1	EP10-001860
EPN1001	17	FUSE HOLDER	1	EP10-001860
EPN1001	18	FUSE	1	EP10-002270
EPN1001	19	FUSE	1	EP10-002271
EPN1001	20	FUSE	1	EP04101800-001
EPN1001	21	FUSE	1	EP04101800-001
EPN1001	22	FUSE	1	EP04101800-001
EPN1001	23	FUSE	1	EP04101800-001
EPN1001	24	FUSE	1	EP04101800-001
EPN1001	25	MOLD CASE CIRCUIT BREAKER	1	EP07-000890
EPN1001	26	MOLD CASE CIRCUIT BREAKER	1	EP07-000400
EPN1001	27	TRANSFORMER	1	EP23-0000944
EPN1001	28	RELAY	1	EP18-000115
EPN1001	29	RELAY	1	EP18-000116
EPN1001	30	RELAY	1	EP18-000115
EPN1001	31	RELAY	1	EP18-000115
EPN1001	32	RELAY	1	EP18-000115
EPN1001	33	RELAY	1	EP18-000115
EPN1001	34	RELAY	1	EP18-000117
EPN1001	35	RELAY	1	EP18-000115
EPN1001	36	RELAY	1	EP18-000115
EPN1001	37	RELAY	1	EP18-000115
EPN1001	38	RELAY	1	EP01001100-004
EPN1001	39	RELAY	1	EP01001100-004
EPN1001	40	RELAY	1	EP01001100-004
EPN1001	41	RELAY	1	EP01001100-004
EPN1001	42	SOLID STATE RELAY	1	EP01301200-001
EPN1001	43	SOLID STATE RELAY	1	EP01301200-001
EPN1001	44	PRESSURE TRANSMITTER	1	TE33-000496

LOCATION	NO	PART NAME	Q'TY	REMARK
EPN1001	45	PRESSURE TRANSMITTER	1	TE33-000494
EPN1001	46	PRESSURE TRANSMITTER	1	TE33-000496
EPN1001	47	PRESSURE TRANSMITTER	1	TE33-000495
EPN1001	48	AC CURRENT TRANSDUCER	1	EP00101500-001
EPN1001	49	MMS (MANUAL MOTOR STARTER)	1	EP07-000388
EPN1001	50	MMS (MANUAL MOTOR STARTER)	1	EP07-000389
EPN1001	51	MMS (MANUAL MOTOR STARTER)	1	EP08-000176
EPN1001	52	MMS MOUNTING UNIT	1	EP10-000953
EPN1001	53	MMS MOUNTING UNIT	1	EP10-000953
EPN1001	54	MMS MOUNTING UNIT	1	EP10-000953
EPN1001	55	MMS ALARM CONTACT	1	EP20-000120
EPN1001	56	MMS ALARM CONTACT	1	EP20-000120
EPN1001	57	MMS ALARM CONTACT	1	EP20-000120
EPN1001	58	MMS DIRECT ADAPTER	1	EP10-000951
EPN1001	59	MMS DIRECT ADAPTER	1	EP10-000951
EPN1001	60	MMS DIRECT ADAPTER	1	EP10-000951
EPN1001	61	SPARK KILLER	1	EP01601900-002
EPN1001	62	SPARK KILLER	1	EP01601900-002
EPN1001	63	SPARK KILLER	1	EP01601900-002
EPN1001	64	RECEPTACLE	1	EP00902600-002
EPN1001	65	CAPACITOR (FOR IGV ACTUATOR)	1	5945S1000043
EPN1001	66	MAGNETIC CONTACTOR	1	EP07-000399
EPN1001	67	MAGNETIC CONTACTOR	1	EP07-000399
EPN1001	68	MAGNETIC CONTACTOR	1	EP07-000399
EPN1001	69	VIBRATION TRANSMITTER	1	CST51301-G03
EPN1001	70	VIBRATION TRANSMITTER	1	CST51301-G03
EPN1001	71	VIBRATION TRANSMITTER	1	CST51301-G03
EPN1001	72	TERMINAL BLOCK	1	EP01700500-001
EPN1001	73	TERMINAL BLOCK	1	EP01700500-001
EPN1001	74	TERMINAL BLOCK	1	EP01700500-001
EPN1001	75	TERMINAL BLOCK	1	EP01700500-004
EPN1001	76	TERMINAL BLOCK	1	EP21-000087

8.11 Part List

PART NUMBER	INDEX	LOCATION	TITLE	
COMPRESSOR	1	EPN01	8.2	Compressor
CORE ASSY	1	EPN0101	8.5	Core module
BULL GEAR ASSY	1	EPN010101	8.5.1.5	Bull Gear Set
BULL GEAR	1-1	EPN010101	8.5.1.5	Bull Gear Set
MAIN SHAFT	1-2	EPN010101	8.5.1.5	Bull Gear Set
KEY PIN (PUMP)	1-3	EPN010101	8.5.1.5	Bull Gear Set
KEY PIN	1-4	EPN010101	8.5.1.5	Bull Gear Set
INNER RACE, CLUTCH	1-5	EPN010101	8.5.1.5	Bull Gear Set
#1 BEARING	9	EPN010102	8.5.1.4	Rotor set
#2 BEARING	10	EPN010103	8.5.1.4	Rotor set
#3 BEARING	11	EPN010104	8.5.1.4	Rotor set
#4 BEARING	12	EPN010105	8.5.1.4	Rotor set
BULL GEAR BEARING	2	EPN010106	8.5.1.5	Bull Gear Set
BULL GEAR BLIND BEARING	3	EPN010107	8.5.1.5	Bull Gear Set
#1 CARBON SEAL ASSY OR AIR SEAL	3	EPN010108	8.5.1.4	Rotor set
#2 CARBON SEAL ASSY OR AIR SEAL	4	EPN010109	8.5.1.4	Rotor set
#3 CARBON SEAL ASSY OR AIR SEAL	5	EPN010110	8.5.1.4	Rotor set
#1 OIL SEAL	6	EPN010112	8.5.1.4	Rotor set
#2 OIL SEAL	7	EPN010113	8.5.1.4	Rotor set
#3 OIL SEAL	8	EPN010114	8.5.1.4	Rotor set
RUBBER SEAL, BULL GEAR	4	EPN010115	8.5.1.5	Bull Gear Set
OIL SEAL, BULL GEAR, MOTOR SIDE	5	EPN010115	8.5.1.5	Bull Gear Set
GEARBOX ASSY	1	EPN010117	8.5.1.6	Gearbox Module
UPPER GEARBOX	1-1	EPN010117	8.5.1.6	Gearbox Module
LOWER GEARBOX	1-2	EPN010117	8.5.1.6	Gearbox Module
KNOCK PIN	1-3	EPN010117	8.5.1.6	Gearbox Module
PLUG	1-4	EPN010117	8.5.1.6	Gearbox Module
O-RING	1-5	EPN010117	8.5.1.6	Gearbox Module
HEXAGON BOLT	1-6	EPN010117	8.5.1.6	Gearbox Module
O-RING	1-7	EPN010117	8.5.1.6	Gearbox Module
PLUG	1-8	EPN010117	8.5.1.6	Gearbox Module
BUFFER PIPING ASSY	3	EPN010118	8.5.1.6	Gearbox Module

PART NUMBER	INDEX	LOCATION	TITLE	
AIR BREATHER FILTER	3-1	EPN010118	8.5.1.6	Gearbox Module
AIR BREATHER FILTER ELEMENT	3-2	EPN010118	8.5.1.6	Gearbox Module
COVER-BLIND,BULL	10	EPN010119	8.5.1.6	Gearbox Module
#1 SCROLL CASE	4	EPN01012001	8.5.1.1	IGV & #1 STAGE
IGV ASSY	1	EPN010121	8.5.1.1	IGV & #1 STAGE
IGV CASE	1-1	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
IGV SCALE	1-2	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
CONTROL RING	1-3	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
HEX NUT	1-4	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
TOOTHED LOCK WASHER	1-5	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
STUD TYPE TRACK ROLLER	1-6	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
STRIPPER BOLT	1-7	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
SPRING WASHER	1-8	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
HEX NUT	1-9	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
INLET GUIDE VANE-VANE	1-10	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
BEARING	1-11	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
CONTROL LINK ARM	1-12	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
SPRING PIN	1-13	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
BALL JOINT	1-14	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
TOOTHED LOCK WASHER	1-15	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
NUT-HEX	1-16	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
ROD END	1-17	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
WASHER	1-18	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
WRENCH BOLT	1-19	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
SPRING WASHER	1-20	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y

PART NUMBER	INDEX	LOCATION	TITLE	
NYLON LOCK NUT	1-21	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
HEX NUT	1-22	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
STOPPER PLATE	1-23	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
HEX BOLT	1-24	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
SPRING WASHER	1-25	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
HEX BOLT	1-26	EPN010121	8.5.1.1.A	IGV & #1 SCROLL ASS'Y
#1 DIFFUSER	3	EPN010122	8.5.1.1	IGV & #1 STAGE
#1 SHROUD	2	EPN010125	8.5.1.1	IGV & #1 STAGE
#2 SCROLL CASE	3	EPN010126	8.5.1.2	#2 STAGE
#2 DIFFUSER	2	EPN010127	8.5.1.2	#2 STAGE
#2 SHROUD	1	EPN010130	8.5.1.2	#2 STAGE
#3 SCROLL CASE	3	EPN010131	8.5.1.3	#3 STAGE
#3 DIFFUSER	2	EPN010132	8.5.1.3	#3 STAGE
#3 SHROUD	1	EPN010135	8.5.1.3	#3 STAGE
OIL NOZZLE	9	EPN010141	8.5.1.6	Gearbox Module
#1 ROTOR ASSY	1	EPN010143	8.5.1.4	Rotor set
#1 NUT CAP	1-1	EPN010143	8.5.1.4	Rotor set
#1 TIE SHAFT	1-2	EPN010143	8.5.1.4	Rotor set
#1 IMPELLER	1-3	EPN010143	8.5.1.4	Rotor set
#1 PINION ASSY	1-4	EPN010143	8.5.1.4	Rotor set
#2 IMPELLER	1-5	EPN010143	8.5.1.4	Rotor set
#2 TIE SHAFT	1-6	EPN010143	8.5.1.4	Rotor set
#2 NUT CAP	1-7	EPN010143	8.5.1.4	Rotor set
#2 ROTOR ASSY	2	EPN010144	8.5.1.4	Rotor set
#3 NUT CAP	2-1	EPN010144	8.5.1.4	Rotor set
#3 TIE SHAFT	2-2	EPN010144	8.5.1.4	Rotor set
#3 IMPELLER	2-3	EPN010144	8.5.1.4	Rotor set
#2 PINION ASSY	2-4	EPN010144	8.5.1.4	Rotor set
MAIN OIL PUMP	8	EPN010145	8.5.1.6	Gearbox Module
COUPLING RUBBER	8-1	EPN010145	8.5.1.6	Gearbox Module
PRESSURE CONTROL VALVE	1	EPN010147	8.9.5	Gearbox Supply Piping Assembly
RTD SENSOR	4	EPN010148	8.5.1.6	Gearbox Module
PRESSURE TRANSMITTER	2	EPN010149	8.5.1.6	Gearbox Module

PART NUMBER	INDEX	LOCATION	TITLE	
BRACKET, LINEAR MOTOR	3	EPN010150	8.5	Core module
FLANGE-MOP	6	EPN010182	8.5.1.6	Gearbox Module
MOP IDLE GEAR	5	EPN010183	8.5.1.6	Gearbox Module
#2 SCROLL SHIM PLATE	4	EPN010185	8.5.1.2	#2 STAGE
#3 SCROLL SHIM PLATE	4	EPN010186	8.5.1.3	#3 STAGE
GASKET,MOP	7	EPN010192	8.5.1.6	Gearbox Module
COOLER CASE	1	EPN0102	8.7	Cooling system
#1 INTERCOOLER ASSY	1-1	EPN0103	8.7	Cooling system
FIXED SIDE HEADER, COOLER	1	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
BUNDLE ASSY	2	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
HEADER, FLOATING SIDE	3	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
HOUSING, FLOAT SIDE TUBE SHEET	4	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
O-RING, FLOAT SIDE TUBE SHEET	5	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
O-RING, FIXED SIDE, DIVIDER	6	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
STUD BOLT, FIXED SIDE	7	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
HEXAGON NUT	8	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
SPRING WASHER	9	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
STUD BOLT, FLOAT SIDE	10	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
HEXAGON NUT	11	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
SPRING WASHER	12	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
HEXAGON PLUG, FIXED SIDE	13	EPN0103/0104/0107/0109	8.7.1	Cooler bundle
#2 INTERCOOLER ASSY	1-2	EPN0104	8.7	Cooling system
#3 INTERCOOLER ASSY	2-1	EPN0105	8.7	Cooling system
AFTERCOOLER CASE	2	EPN0106	8.7	Cooling system
#1 AIR PIPE	2	EPN0112	8.4	Air Pipe
#2 INLET AIR PIPE	5	EPN0113	8.4	Air Pipe
#2 OUTLET AIR PIPE	8	EPN0114	8.4	Air Pipe
#3 INLET AIR PIPE	10	EPN0115	8.4	Air Pipe
#3 OUTLET AIR PIPE	15	EPN0116	8.4	Air Pipe

PART NUMBER	INDEX	LOCATION	TITLE	
V-JOINT, #1 OUTLET	1	EPN0123	8.4	Air Pipe
V-JOINT RUBBER	1-1	EPN0123	8.4	Air Pipe
V-JOINT, #2 INLET	6	EPN0124	8.4	Air Pipe
V-JOINT RUBBER	6-1	EPN0124	8.4	Air Pipe
V-JOINT, #2 OUTLET	7	EPN0125	8.4	Air Pipe
V-JOINT RUBBER	7-1	EPN0125	8.4	Air Pipe
V-JOINT, #2 COOLER IN	9	EPN0126	8.4	Air Pipe
V-JOINT RUBBER	9-1	EPN0126	8.4	Air Pipe
V-JOINT, #3 INTLET	11	EPN0127	8.4	Air Pipe
V-JOINT RUBBER	11-1	EPN0127	8.4	Air Pipe
V-JOINT, #3 OUTLET	14	EPN0128	8.4	Air Pipe
V-JOINT RUBBER	14-1	EPN0128	8.4	Air Pipe
V-JOINT, #3 COOLER IN	16	EPN0129	8.4	Air Pipe
V-JOINT RUBBER	16-1	EPN0129	8.4	Air Pipe
V-JOINT, SILENCER	2	EPN0131	8.4.1	Air discharge system
I.G.V. ACTUATOR ASS'Y	2	EPN0132	8.5	Core module
#3 INLET AIR PIPE_B	12	EPN0174	8.4	Air Pipe
V-JOINT, #1 COOLER IN	3	EPN0175	8.4	Air Pipe
V-JOINT RUBBER	3-1	EPN0175	8.4	Air Pipe
V-JOINT, #1 COOLER OUT	4	EPN0176	8.4	Air Pipe
V-JOINT RUBBER	4-1	EPN0176	8.4	Air Pipe
V-JOINT, #3 INTLET_2	13	EPN0177	8.4	Air Pipe
V-JOINT RUBBER	13-1	EPN0177	8.4	Air Pipe
MOTOR	1	EPN0201	8.6	Main driver
BEARING DE	1-1	EPN0201	8.6	Main driver
BEARING NDE	1-2	EPN0201	8.6	Main driver
BEARING OIL SEAL	1-3	EPN0201	8.6	Main driver
DISC COUPLING ASS'Y	2	EPN03	8.6	Main driver
COUPLING BOLT	2-1	EPN03	8.6	Main driver
COUPLING GAP DISK	2-2	EPN03	8.6	Main driver
COUPLING O-RING	2-3	EPN03	8.6	Main driver
COUPLING COVER-ASSY	3	EPN04	8.6	Main driver
UPPER COVER	3-1	EPN04	8.6	Main driver
LOWER SUPPORT COVER	3-2	EPN04	8.6	Main driver
WRENCH BOLT	3-3	EPN04	8.6	Main driver
SPRING WASHER	3-4	EPN04	8.6	Main driver
FLAT WASHER	3-5	EPN04	8.6	Main driver

PART NUMBER	INDEX	LOCATION	TITLE	
HEX NUT	3-6	EPN04	8.6	Main driver
OIL TANK ASSY	1	EPN0501	8.8	Lubrication module
CHECK VALVE, MOP SUCTION	1-1	EPN0501	8.8.1	Oil Tank
OIL DP GAUGE TUBE	1-2	EPN0501	8.8.1	Oil Tank
OIL TANK MANHOLE COVER	1-3	EPN0501	8.8.1	Oil Tank
OIL TANK MANHOLE GASKET	1-4	EPN0501	8.8.1	Oil Tank
OIL TANK	1	EPN050101	8.8.1	Oil Tank
OIL HEATER	2	EPN050103	8.8.1	Oil Tank
STRAINER, OIL FILTER	3	EPN050105	8.8.1	Oil Tank
OIL LEVEL SIGHT	4	EPN050106	8.8.1	Oil Tank
OIL TEMP SENSOR	5	EPN050107	8.8.1	Oil Tank
OIL LEVEL SWITCH	6	EPN050108	8.8.1	Oil Tank
OIL DIFFERENTIAL PRESSURE GAUGE	7	EPN050109	8.8.1	Oil Tank
OIL DP GAUGE BRACKET	8	EPN050110	8.8.1	Oil Tank
OIL PIPING ASSY	0	EPN0601	8.9	Oil Piping
PCV DRAIN PIPING	6	EPN0601	8.9	Oil Piping
MOTOR INLET PIPING, DE	7	EPN0601	8.9	Oil Piping
MOTOR INLET PIPING, NDE	8	EPN0601	8.9	Oil Piping
MOTOR INLET HOSE	9	EPN0601	8.9	Oil Piping
MOTOR OUTLET PIPING, DE	10	EPN0601	8.9	Oil Piping
MOTOR OUTLET PIPING, NDE	11	EPN0601	8.9	Oil Piping
MOP SUCTION PIPING	1	EPN060101	8.9	Oil Piping
MOP SUCTION PIPE	1-1	EPN060101	8.9.1	MOP Suction Piping Assembly
MOP DISCHARGE PIPING	2	EPN060102	8.9	Oil Piping
MOP DISCHARGE PIPE-1	2-1	EPN060102	8.9.2	MOP Discharge Piping Assembly
MOP DISCHARGE PIPE-2	2-2	EPN060102	8.9.2	MOP Discharge Piping Assembly
TEMPERATURE CONTROL VALVE	2-3	EPN060102	8.9.2	MOP Discharge Piping Assembly
AOP SUCTION PIPING	3	EPN060103	8.9	Oil Piping
AOP SUCTION PIPE	3-1	EPN060103	8.9.3	AOP Suction Piping Assembly
AOP DISCHARGE PIPING	4	EPN060104	8.9	Oil Piping

PART NUMBER	INDEX	LOCATION	TITLE	
AOP DISCHARGE PIPE	4-1	EPN060104	8.9.4	AOP Discharge Piping Assembly
CHECK VALVE, AOP	4-2	EPN060104	8.9.4	AOP Discharge Piping Assembly
SINGLE OIL FILTER	2	EPN060112	8.9.5	Gearbox Supply Piping Assembly
OIL FILTER ELEMENT	2-1	EPN060112	8.9.5	Gearbox Supply Piping Assembly
DUAL OIL FILTER	2	EPN060112	8.9.5	Gearbox Supply Piping Assembly
OIL FILTER ELEMENT	2-1	EPN060112	8.9.5	Gearbox Supply Piping Assembly
GEAR BOX SUPPLY PIPING	5	EPN060117	8.9	Oil Piping
GB SUPPLY PIPE-1	5-1	EPN060117	8.9.5	Gearbox Supply Piping Assembly
PCV BOX	5-2	EPN060117	8.9.5	Gearbox Supply Piping Assembly
GB SUPPLY PIPE-2	5-3	EPN060117	8.9.5	Gearbox Supply Piping Assembly
PDIT TUBE	5-4	EPN060117	8.9.5	Gearbox Supply Piping Assembly
OIL FILTER DRAIN HOSE	5-5	EPN060117	8.9.5	Gearbox Supply Piping Assembly
OIL COOLER ASSY	3	EPN0602	8.8	Lubrication module
OIL COOLER REAR SIDE COVER	3-1	EPN0602	8.8	Lubrication module
OIL COOLER FLOAT SIDE COVER	3-2	EPN0602	8.8	Lubrication module
OIL COOLER GASKET	3-3	EPN0602	8.8	Lubrication module
OIL COOLER O-RING	3-4	EPN0602	8.8	Lubrication module
OIL COOLER BOLT	3-5	EPN0602	8.8	Lubrication module
OIL COOLER SPRING WASHER	3-6	EPN0602	8.8	Lubrication module
OIL COOLER FLAT WASHER	3-7	EPN0602	8.8	Lubrication module
OIL COOLER NUT	3-8	EPN0602	8.8	Lubrication module
AUXILIARY OIL PUMP	4	EPN0604	8.8	Lubrication module
AUXILIARY OIL PUMP COUPLING	4-1	EPN0604	8.8	Lubrication module
AUXILIARY OIL PUMP COUPLING RUBBER	4-1-1	EPN0604	8.8	Lubrication module
OIL DEMIST ASSY	2	EPN0701	8.8	Lubrication module
ADAPTER	2-1	EPN0701	8.8.2	Oil Demister Assembly
OIL DEMISTER ASSY-PIPE	2-2	EPN0701	8.8.2	Oil Demister Assembly

PART NUMBER	INDEX	LOCATION	TITLE	
OIL DEMISTER ASSY-HOSE	2-3	EPN0701	8.8.2	Oil Demister Assembly
OIL DEMISTER ASSY-TUBE	2-4	EPN0701	8.8.2	Oil Demister Assembly
EXHAUST CLEANER	1	EPN070101	8.8.2	Oil Demister Assembly
AIR REGULATOR	3	EPN070102	8.8.2	Oil Demister Assembly
JET PUMP	2	EPN070103	8.8.2	Oil Demister Assembly
RING BLOWER	4	EPN070104	8.8.2	Oil Demister Assembly
AIR DISCHARGE SYSTEM	17	EPN0801	8.4	Air Pipe
AC DISCHARGE PIPE ASSY	1	EPN0801	8.4.1	Air discharge system
AC OUTLET AIR PIPE	1-1	EPN0801	8.4.1	Air discharge system
AC PIPE COVER	1-6	EPN0801	8.4.1	Air discharge system
CW MANIFOLD ASSY	3	EPN0901	8.7	Cooling system
C/W SUPPLY MANIFOLD	3-1	EPN0901	8.7.2	CW manifold assembly
C/W RETURN MANIFOLD	3-2	EPN0901	8.7.2	CW manifold assembly
COVER	3-3	EPN0901	8.7.2	CW manifold assembly
HEX BOLT	3-4	EPN0901	8.7.2	CW manifold assembly
HEX BOLT	3-5	EPN0901	8.7.2	CW manifold assembly
HEX NUT	3-6	EPN0901	8.7.2	CW manifold assembly
SPRING WASHER	3-7	EPN0901	8.7.2	CW manifold assembly
GASKET	3-8	EPN0901	8.7.2	CW manifold assembly
FLAT WASHER	3-9	EPN0901	8.7.2	CW manifold assembly
BUTTERFLY VALVE	3-10	EPN0901	8.7.2	CW manifold assembly
ADAPTER FOR OIL COOLER	5	EPN0923	8.7	Cooling system
PANEL COVER ASSEMBLY	A	EPN1001	8.10	Control Panel
PLC MODULE	B	EPN1001	8.10	Control Panel
COOLING FAN	1	EPN1001	8.10.1	Panel Cover Assembly
PUSH BUTTON	2	EPN1001	8.10.1	Panel Cover Assembly
PUSH BUTTON	3	EPN1001	8.10.1	Panel Cover Assembly
PUSH BUTTON	4	EPN1001	8.10.1	Panel Cover Assembly
SELECT SWITCH	5	EPN1001	8.10.1	Panel Cover Assembly
EMERGENCY PUSH BUTTON	6	EPN1001	8.10.1	Panel Cover Assembly
TOUCH SCREEN	7	EPN1001	8.10.1	Panel Cover Assembly
AB PLC ASS'Y	8	EPN1001	8.10.2	PLC Module Inside
POWER SUPPLY	9	EPN1001	8.10.2	PLC Module Inside
CIRCUIT PROTECTOR	10	EPN1001	8.10.2	PLC Module Inside
CIRCUIT PROTECTOR	11	EPN1001	8.10.2	PLC Module Inside

PART NUMBER	INDEX	LOCATION	TITLE	
CIRCUIT PROTECTOR	12	EPN1001	8.10.2	PLC Module Inside
CIRCUIT PROTECTOR	13	EPN1001	8.10.2	PLC Module Inside
NOISE FILTER	14	EPN1001	8.10.2	PLC Module Inside
FUSE HOLDER	15	EPN1001	8.10.2	PLC Module Inside
FUSE HOLDER	16	EPN1001	8.10.2	PLC Module Inside
FUSE HOLDER	17	EPN1001	8.10.2	PLC Module Inside
FUSE	18	EPN1001	8.10.2	PLC Module Inside
FUSE	19	EPN1001	8.10.2	PLC Module Inside
FUSE	20	EPN1001	8.10.2	PLC Module Inside
FUSE	21	EPN1001	8.10.2	PLC Module Inside
FUSE	22	EPN1001	8.10.2	PLC Module Inside
FUSE	23	EPN1001	8.10.2	PLC Module Inside
FUSE	24	EPN1001	8.10.2	PLC Module Inside
MOLD CASE CIRCUIT BREAKER	25	EPN1001	8.10.2	PLC Module Inside
MOLD CASE CIRCUIT BREAKER	26	EPN1001	8.10.2	PLC Module Inside
TRANSFORMER	27	EPN1001	8.10.2	PLC Module Inside
RELAY	28	EPN1001	8.10.2	PLC Module Inside
RELAY	29	EPN1001	8.10.2	PLC Module Inside
RELAY	30	EPN1001	8.10.2	PLC Module Inside
RELAY	31	EPN1001	8.10.2	PLC Module Inside
RELAY	32	EPN1001	8.10.2	PLC Module Inside
RELAY	33	EPN1001	8.10.2	PLC Module Inside
RELAY	34	EPN1001	8.10.2	PLC Module Inside
RELAY	35	EPN1001	8.10.2	PLC Module Inside
RELAY	36	EPN1001	8.10.2	PLC Module Inside
RELAY	37	EPN1001	8.10.2	PLC Module Inside
RELAY	38	EPN1001	8.10.2	PLC Module Inside
RELAY	39	EPN1001	8.10.2	PLC Module Inside
RELAY	40	EPN1001	8.10.2	PLC Module Inside
RELAY	41	EPN1001	8.10.2	PLC Module Inside
SOLID STATE RELAY	42	EPN1001	8.10.2	PLC Module Inside
SOLID STATE RELAY	43	EPN1001	8.10.2	PLC Module Inside
PRESSURE TRANSMITTER	44	EPN1001	8.10.2	PLC Module Inside
PRESSURE TRANSMITTER	45	EPN1001	8.10.2	PLC Module Inside
PRESSURE TRANSMITTER	46	EPN1001	8.10.2	PLC Module Inside
PRESSURE TRANSMITTER	47	EPN1001	8.10.2	PLC Module Inside

PART NUMBER	INDEX	LOCATION	TITLE	
AC CURRENT TRANSDUCER	48	EPN1001	8.10.2	PLC Module Inside
MMS (MANUAL MOTOR STARTER)	49	EPN1001	8.10.2	PLC Module Inside
MMS (MANUAL MOTOR STARTER)	50	EPN1001	8.10.2	PLC Module Inside
MMS (MANUAL MOTOR STARTER)	51	EPN1001	8.10.2	PLC Module Inside
MMS MOUNTING UNIT	52	EPN1001	8.10.2	PLC Module Inside
MMS MOUNTING UNIT	53	EPN1001	8.10.2	PLC Module Inside
MMS MOUNTING UNIT	54	EPN1001	8.10.2	PLC Module Inside
MMS ALARM CONTACT	55	EPN1001	8.10.2	PLC Module Inside
MMS ALARM CONTACT	56	EPN1001	8.10.2	PLC Module Inside
MMS ALARM CONTACT	57	EPN1001	8.10.2	PLC Module Inside
MMS DIRECT ADAPTER	58	EPN1001	8.10.2	PLC Module Inside
MMS DIRECT ADAPTER	59	EPN1001	8.10.2	PLC Module Inside
MMS DIRECT ADAPTER	60	EPN1001	8.10.2	PLC Module Inside
SPARK KILLER	61	EPN1001	8.10.2	PLC Module Inside
SPARK KILLER	62	EPN1001	8.10.2	PLC Module Inside
SPARK KILLER	63	EPN1001	8.10.2	PLC Module Inside
RECEPTACLE	64	EPN1001	8.10.2	PLC Module Inside
CAPACITOR (FOR IGV ACTUATOR)	65	EPN1001	8.10.2	PLC Module Inside
MAGNETIC CONTACTOR	66	EPN1001	8.10.2	PLC Module Inside
MAGNETIC CONTACTOR	67	EPN1001	8.10.2	PLC Module Inside
MAGNETIC CONTACTOR	68	EPN1001	8.10.2	PLC Module Inside
VIBRATION TRANSMITTER	69	EPN1001	8.10.2	PLC Module Inside
VIBRATION TRANSMITTER	70	EPN1001	8.10.2	PLC Module Inside
VIBRATION TRANSMITTER	71	EPN1001	8.10.2	PLC Module Inside
TERMINAL BLOCK	72	EPN1001	8.10.2	PLC Module Inside
TERMINAL BLOCK	73	EPN1001	8.10.2	PLC Module Inside
TERMINAL BLOCK	74	EPN1001	8.10.2	PLC Module Inside
TERMINAL BLOCK	75	EPN1001	8.10.2	PLC Module Inside
TERMINAL BLOCK	76	EPN1001	8.10.2	PLC Module Inside
ENCLOSURE	1	EPN1101	8.2	Compressor
INLET FILTER SUPPORT ASSY	2	EPN1201	8.3	Inlet Filter
INLET FILTER ASSY	1	EPN1301	8.3	Inlet Filter

PART NUMBER	INDEX	LOCATION	TITLE	
(PACKAGE)				
FILTER HOUSING ASSY	1-1	EPN1301	8.3.1	Inlet filter _ Packaged type
FILTER CARTRIDGE SUPPORT ASSY	1-2	EPN1301	8.3.1	Inlet filter _ Packaged type
FILTER CARTRIDGE	1-3	EPN1301	8.3.1	Inlet filter _ Packaged type
SILENCER SUPPORT ASSY	4	EPN1401	8.4.1	Air discharge system
SILENCER	3	EPN1501	8.4.1	Air discharge system
CONDENSATE DRAIN PIPING ASSY	4	EPN1701	8.7	Cooling system
PIPING-DRAIN PIPE ASSY, STG1	4-1	EPN1701	8.7.3	Condensate drain piping
PIPING-DRAIN PIPE ASSY, STG2	4-2	EPN1701	8.7.3	Condensate drain piping
PIPING-DRAIN PIPE ASSY, STG3	4-3	EPN1701	8.7.3	Condensate drain piping
HEX NIPPLE	4-4	EPN1701	8.7.3	Condensate drain piping
CHECK VALVE	4-5	EPN1701	8.7.3	Condensate drain piping
BALL VALVE	4-6	EPN1701	8.7.3	Condensate drain piping
BASEFRAME	9	EPN18	8.2	Compressor
DISCHARGE EXPANSION JOINT	1-3	EPN22	8.4.1	Air discharge system
DISCHARGE CHECK VALVE	1-4	EPN23	8.4.1	Air discharge system
BOV ASSY	1-7	EPN24	8.4.1	Air discharge system
POSITIONER	1-7-1	EPN24	8.4.1	Air discharge system
PNUMATIC ACTUATOR	1-7-2	EPN24	8.4.1	Air discharge system
AIR REGULATOR	1-7-3	EPN24	8.4.1	Air discharge system
VALVE ASSY	1-7-4	EPN24	8.4.1	Air discharge system
BLOCK VALVE	1-2	EPN25	8.4.1	Air discharge system
WATER SEPERATOR	1-8	EPN26	8.4.1	Air discharge system
DISCHARGE CONNECTOR	1-5	EPN28	8.4.1	Air discharge system
INLET FILTER ASSY (EXTERNAL)	1	EPN3003	8.3	Inlet Filter
INLET FILTER ELEMENT,1ST	1	EPN3004	8.3.2	Inlet filter _ External install type
INLET FILTER ELEMENT, 2ND	2	EPN3006	8.3.2	Inlet filter _ External install type
SILENCER	3	EPN3008	8.4.1	Air discharge system

PART NUMBER	INDEX	LOCATION	TITLE	
MOTOR SHIM	4	EPN3012	8.6	Main driver
SILENCER CONNECTOR	1-9	EPN3040	8.4.1	Air discharge system

ORDER FOR COMPRESSOR PART

이 문서는 부품의 구매를 돕기 위해 제작되었습니다. 사용자(고객)는 각 부품의 위치와 정보를 본 문서의 일러스트와 파트리스트를 통해 확인할 수 있습니다. 구매를 원하는 경우 아래 표에 장비와 부품의 정보를 기록하여 당사의 서비스 센터로 보내주시기 바랍니다.
This document has been prepared to assist customer for ordering parts. Customer can identify the location and information of the part wanted to order through illustrations and part-lists. If you want to order the part, please fill out the below table and send to Service Center.

고객 명 / Customer: _____ 장비 번호 / Serial No.: _____

Location	No	Part Name	Quantity	Remark
EPN3006	2	*INLET FILTER ELEMENT, 2ND*	*6*	

[CAUTION] 당사가 공급한 순정 부품의 사용을 권장합니다. 비 순정품 사용으로 발생하는 일체의 문제에 대해서는 무상 보증기간과 관계없이 당사가 책임지지 않습니다. / For repair and maintenance work, you are recommended to use authentic parts provided by Hanwha Techwin only. If a problem occurs due to the use of unauthorized parts, Hanwha Techwin will not be held responsibility.

[NOTE] 부품을 구매하기 위해서는 당사와 추가 협의가 필요할 수 있습니다. / For some parts, you may need to discuss this with Hanwha Techwin.

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