Installation, Operation and Maintenance Manual

MODEL SMKP
Horizontal Centrifugal Pump (API pump type "OH2")
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Safety Page

1 Safety Precautions

- Be sure to completely read this Manual and other accompanying documents before installation, operation, maintenance or inspection of this pump and to use this pump properly. Read all about the knowledge, safety information and precautions concerning the equipment prior to using it.
- In this Manual, precautions have been classified into "DANGER", "WARNING", "CAUTION", and "NOTICE".

<table>
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<td><strong>DANGER</strong></td>
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<tr>
<td><strong>WARNING</strong></td>
<td>This indicates a dangerous situation that may result in a serious injury or loss of life unless it is avoided.</td>
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<tr>
<td><strong>CAUTION</strong></td>
<td>This indicates a dangerous situation that may result in a slight injury or an injury of intermediate degree unless it is avoided.</td>
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<tr>
<td><strong>NOTICE</strong></td>
<td>This indicates a message related to the safety of persons or the protection of equipments (loss of property)</td>
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- Even a item indicated by "CAUTION" has the possibility of causing a serious result depending on the situation. You have to strictly observe the precautionary messages since they all explain important matters.
- General safety precautions for this product will be explained after the next paragraph and should be observed, together with the above.

2 Exemption Clauses

We are unable to take the responsibility for any accidents created due to inobservance of the items described in this Manual.
3 General Precautions on Safety

1. Make the following checks for the sake of safety before starting the pump.

1) Check all bolts and nuts are fastened correctly.  
2) Make an alignment check for the pump and the motor.  
3) Check the oil and grease of the rotary section.  
4) Check each valve is opened or closed correctly.  
5) Check that the rotary section protective guards (shaft coupling guard, etc.) are securely installed.  
6) Check that each alarm device can work securely in the set condition.  

2. Checking during operation

1) When making checks in the operating condition, be careful about the rotary shaft.  
2) In both operating condition and stop condition, don't insert hands or materials in the shaft coupling guard in any case. Avoid touching the rotary shaft.  
3) When checking the pump in the stop condition, observe the following items for the sake of safety.  
   Before removing the shaft coupling guard, make sure that the motor power supply is already shut off.  
   Make an indication securely so that the power supply may not be turned on by mistake.  

3. When modifying the pump main body or changing the set conditions of accessory equipment, be sure to make contact with us to obtain our permission beforehand.  
4. If you have any unclear matter, please ask us for information on it.
4 Important Warnings

**DANGER**
- Never carry out the maintenance when the motor power supply does not shut off.
- Strict safety procedure must be carried out when the pump is handling toxic and/or hazardous liquids.

**WARNING**
- Do not operate the pump in any case while the shaft coupling guard is removed. If any portion of the body is caught during the operation, this will result in a serious injury. (Start, stop/ pump start)
- When removing the shaft coupling guard, be sure to shut off the motor power supply beforehand. If the power supply is not shut off, there is a possibility that the pump may be suddenly started, thereby inviting great danger. (Control during operation/ periodic inspection)

**CAUTION**
- Before operating the pump, read the instruction manual and other attached documents thoroughly to operate it correctly.
- When the heavy parts above 20~25 kg are lifting, using the suitable crane and/ or in accordance with the site regulations should be carried out.
- When the pump is handling the high temperature liquid, avoid touching the pump.

**NOTICE**
- In case of the bearings lubricated by the oil, the lubricating oil is drained at delivery from the factory. At installation, be sure to put the regular lubricating oil. Operation without lubricating oil will cause severe damages to the bearings and the pump. (Start, stop/ pump start)
- Before starting the pump, check the records of the pump installation condition, alignment equipment, setting conditions, and bearing oil and grease. (Start/ stop/ pump start)
Chapter 1 Introduction

1) This manual is intended to give a good understanding of how to correctly operate the SMKP type horizontal centrifugal pump.

2) This pump passed completely the process of strict product inspections at our factory such as a component inspection, a hydrostatic test and a trial run with the result that its operating condition and performance were proved to satisfy the various requirements provided specification and conform to the standard.

3) It is necessary to operate the pump correctly to obtain its full performance. Incorrect will cause failures, shortening of service life and lack of performances. Keep the operation within each limit value specified in this manual and carry out the correct periodical inspection and maintenance to prevent accidents from occurring.

4) In case such a failure as makes the operation impossible occurs, contact and providethe following information.
a) Contents of pump nameplate (SERIAL No., SIZE, TYPE, SPEED, HEAD, CAPACITY, BUILT) (Refer to Fig. 1-1).

![Fig. 1-1 Nameplate](image)

b) Abnormal condition (Inform us of its greatest possible details including the conditions before and after occurrence of an abnormality.)

You can find "Where to contact" on the last page of this manual.
Chapter 2 Receiving the Pump and Storage

2.1 Receipt inspection

When the unit is received, inspect it carefully for visual damage and missing item against the Packing List. If you find any fault, please ask our staff in charge for information.

1) Check the contents on the pump nameplate (SERIAL No., SIZE, TYPE, SPEED, HEAD, CAPACITY, BUILT) are in compliance with the specification of the ordered product (Refer to Fig. 2-1).

![Fig. 2-1 Nameplate](image)

2) Check if any damage has not been caused during transportation.

3) Check all painted surface if any scraped damage has not been caused. If necessary, touch up on the areas.

4) Check if any nuts and bolts have not become loose. Tighten if required.

5) Check that all the accessories are included.
Chapter 3 General Description

The type “SMKP” centrifugal pump is a centerline-mounted single-stage overhung unit designed to provide an extremely compact, high efficiency pump incorporation the latest hydraulic and mechanical improvements. Its construction makes it particularly suitable for applications requiring extreme ruggedness and almost completes freedom from maintenance for long periods. Some of the outstanding features of this pump are its construction features, exceptional versatility and interchangeability.

3.1 Construction Features

3.1.1 Rotating Element
The rotor is balanced in accordance with the requirement of API 610 (ISO 13709). It is designed for stability and high-efficiency by state-of-the-art technologies.

1) Impeller
The impeller is single-piece casting, single suction, and fully enclosed type, finished all over and balanced. Replaceable impeller wear rings are furnished and they are held in position by headless setscrews after being installed with an interference fit.
They are mounted on the pump shaft by an impeller nut and key-driven.

2) Pump Shaft
The heavy-duty pump shaft is designed for sufficient stiffness and minimal shaft deflection.

3.1.2 Casing
The casing is designed double (standard) or single volute. The double volute design assures radial balance of the pump rotor at all capacities.
The back pullout design of this pump allows the complete rotating assembly to be removed without disturbing the suction and discharge piping or the driver.
The spiral wound gasket is furnished between the casing and casing cover. Replaceable case wear rings are furnished.

3.1.3 Casing cover (Stuffing Boxes)
Cartridge type mechanical seal that meets latest API 682 (ISO 21049) dimensions is utilized (standard).
To arrange the soft packing is available (optional).

3.1.4 Bearings and Bearing Housings
The radial thrust loads are carried by rolling-element (single-row deep-groove ball) bearings mounted on the inboard side.
The axial thrust load is carried by the paired single-row, angular contact type ball bearing mounted on the outboard side.
The lubrication for bearings is oil bath and disc-oiled system.
Chapter 4 Installation

4.1 Foundation and Anchor Bolts

NOTICE

- The foundation should have sufficient rigidity. A low-rigidity foundation will shift the pump installing position or cause vibrations. Accordingly, the foundation must be rigid enough.

4.1.1 Pump foundation

The pump foundation is usually prepared with concrete. The pump is fixed with anchor bolts embedded in this foundation. In many cases, such a simple shape as shown in Fig. 4-1 is adopted for the foundation.

Determine the natural frequency of the foundation so that it may not be equal to the rotation speed of the pump. Generally, the foundation weight is considered to be 3 to 5 times as large as the total machine weight. If the ground is soft, hammer piles in the ground for the sake of reinforcement. Start the pump installation work after the foundation concrete is laid and becomes hard. (Usually, it takes 10 to 14 days after the foundation concrete is laid.)

4.1.2 Anchor bolts

As the anchor bolts to fix the foundation and the pump (Pump base), the type shown in Fig. 4-2 is often used. Two anchor bolt fixing methods are available, namely, a box extraction embedding method and a template (gauge plate) using method in width anchor bolts are embedded concurrently with the foundation concrete.

☆ In the box extraction embedding method, box (extraction holes are made for anchor bolts when the foundation concrete is laid and then the anchor bolts are fixed after the pump is carried in. (Fig. 4-2, (a) and (b).)

☆ In the template using method, anchor bolt positioning is performed by the template(*) before the pump is carried in with the object of reducing the installation work period and the anchor bolts are fixed when the foundation concrete is laid. (Fig. 4-2, (c) and (d).)

(*) The template will be supplied if you order it.
Chapter 4 Installation

4.2 Preparations for installation

**WARNING**
- The lifting lugs of the pump are used to lift only the pump. Don't lift whole system (pump + motor + base, etc.) by this tackle in any case.
- The motor lifting apparatus is used to lift the motor itself. Don't lift the whole system in any case.
- Check the equipment weight and the lining angle before lifting and use proper wire ropes.
- Check that the crane lifting capacity is enough before lifting.

**NOTICE**
- The foundation should have sufficient rigidity. A low-rigidity foundation will shift the pump installing position or cause vibrations. Accordingly, the foundation must be rigid enough.
- The steel liner is used to adjust the horizontal level of the pump and receive the empty weight and operating load of the pump.

If installation, operation, maintenance and inspection are appropriate, the pump can be stably operated for a long time. Perform installation work according to the following procedure.

4.2.1 General installation procedure

The following flowchart shows the general installation procedure.

Marking of base point line ⎯⎯⎯⎯ Installation drawing, foundation drawing

Chipping work ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯ Foundation surface and others of pump and auxiliaries

Foundation work ⎯⎯⎯⎯⎯⎯⎯⎯⎯ Iron rod, flask, and concrete laying

Equipment carrying-in work ⎯⎯ Lifting

Installation work ⎯⎯⎯⎯⎯⎯⎯ Arrangement, assembly, and alignment

Small piping work ⎯⎯⎯⎯⎯ Support

Painting work

Trail run ⎯⎯⎯⎯⎯ Operation check

The above procedure varies depending on the site condition.

4.2.2 Preparations before installation

Examine the work plan and drawings thoroughly before starting the installation. If you have any unclear point or doubt in the drawings, consult with the constructor or our staff at once.
Chapter 4 Installation

4.2.3 Precautions on installation
1) When lifting the equipment, set wires carefully so as not to give damage to the equipment. Take the wire set positions and the wire length into consideration so that the load may not lose its balance.
2) When lifting divided equipment and easy-to-transform materials, don't remove reinforcing materials until assembly.
3) It may be divided into the pump, motor, and base. Then, each of them may be carried in. (To prevent the base from being deformed.) After setting the base temporarily, install the pump and the motor.

4.2.4 Liner for installation
It is necessary to place the steel liner to be used between the bottom surface of the base (or the bottom surface of the base plate) and the foundation surface as near to the anchor bolts as possible. (Refer to Fig. 4-3.)

4.2.5 Installation reference surface setting
1) Installation reference line setting
Check the reference line (flat surface, height) of the pump machine place and perform marking-off for the axial centerline, flange centerline, and flange surface position from the foundation drawing for installation. Installation height setting
2) Check that the bottom surface of the base can be installed by the mortar allowance height (Check the drawing dimensions) from the foundation floor surface.

4.2.6 Foundation surface rough leveling
After rough leveling of the foundation, arrange a set of one temporary parallel liner and 2 taper liners on the foundation on both sides of the anchor bolts of the pump as shown in Fig. 4-4. At this time, remove laitance (weak concrete embossed and settled on the concrete surface) completely, and also remove the oil existing on the foundation concrete surface completely.
Chapter 4 Installation

4.3 Pump Installation

**CAUTION**
- At installation, perform alignment for the pump and motor for each process.
- After stuffing concrete, be careful not to freeze it. Frozen concrete becomes low in strength.
- Don't apply the piping load to the pump. If the load is applied to the pump, this will result in equipment damage, vibrations or noise.
- Before pipe connections, clean the inside of each pipe. If any foreign material stays there, the pump will be damaged. The steel liner is used to adjust the horizontal level of the pump and receive the empty weight and operating load of the pump.

Alignment is already performed correctly at the factory. For reasons of handling it during transportation and a difference in foundation surface between the factory and the site, the common base may be deflected if the pump is installed as it is, and this may cause axial offset between the pump and the motor, thereby making normal operation impossible. Perform installation and alignment according to the following procedure.

4.3.1 Pump installation
1) Put the pump, motor and common base on the temporary liner and also set the anchor bolts in the anchor bolt holes. Make a clearance of 30 to 50 mm to cause mortar to flow between the bottom surface of the base and the foundation floor. (Refer to Fig. 4-5.)

![Fig. 4-5](image)

2) Determine the position and height of the pump discharge port. Make the axial center between the pump and the motor level with a level gauge by using the work surface of the flange.

4.3.2 Anchor bolt fixing
In the condition where the anchor bolts are set on the common base, cause concrete to flow into the anchor bolt holes to fix the anchor bolts.
Chapter 4 Installation

4.3.3 Pad Creation and real liner installation

The pad is a basis for fixing the real liner and created by mixing common cement, sand and water at the rate of 1:1:small quantity, and a proper quantity of non-shrinking agent recommended by the maker.

1) Spray water to provide a damped condition 24 hours before pad creation. After completion of compaction to the goal height, put the parallel liner as shown in Fig. 4-6.

2) Arrange the real liner so that the anchor bolt may be in the center of the real liner as shown in Fig. 4-6, and so that the real liner may be as near to the bolt as possible on both sides. If the distance between anchor bolts exceeds 0.8 m, put another liner at an easy-to-deflect position between them.

3) Adjust the parallel liner position to the setting height from the reference level surface with the level gauge and obtain the horizontality in the direction of the liner with the level gauge.

4) The pad will be hardened properly in about 2 days when the temperature is about 20°C, though it depends on the temperature, humidity and composition.

5) After the concrete is hardened and the setting at the installation is completed, tighten the nuts of the anchor bolts.

Fig. 4-6
Chapter 5 Piping

5.1 General

**NOTICE**

- Never force piping into place at suction and discharge flanges.

1) All piping must be supported independently of the pump. The piping must always line-up with pump flange.

2) Friction in piping means wasted energy…piping should be of ample size, with a minimum of bend and fittings.

3) Compensation should be made for pipe expansion on elevated temperature installations.

4) Piping should not be connected to the pump until the base plate has been thoroughly welded, driver and pump hold-down bolts have been tightened.

5) Flush all piping thoroughly to remove all foreign matters before connecting it to the pump.

5.1.1 Suction piping

**NOTICE**

- Never throttle the pump with the suction valve.

1) The suction line should be as direct and short as possible.

2) Keep suction lines tight and avoid air pockets.

3) The suction pipe should be as large or larger than the pump suction flange size.

4) Increasers, if used, should be eccentric and installed with sloping side down and at least five pipe diameters from suction flange.

5) Suction strainers, when used, should have a net-free area of at least three times the suction pipe area.

6) When working under suction head or flooded suction, install a gate valve in the suction line, to permit closing the line for pump inspection and maintenance.

5.1.2 Discharge piping

1) A check valve and a gate valve should be installed in discharge line. The check valve is placed as close the pump as possible to protect the pump from excessive pressure and prevent liquid from running back through the pump in case power failure. The gate valve is used in starting, stopping and controlling capacity of the pump.

2) Increasers, when used, should be placed to the nearest point of the pump.
Chapter 5 Piping

5.1.3 Water Hammer

1) Water hammer is an increase in pressure due to changes in the velocity of a liquid flowing through a pipeline. This dynamic pressure change is the result of the transformation of the kinetic energy of the moving mass of liquid into pressure energy. When the velocity is changed by closing a valve or by some other means, the pressure produced is frequently much greater than the static pressure on the line, and may cause rupture or damage to the pump, piping or fittings.

2) Starting at the closed valve, a wave of increased pressure is transmitted back through the pipe with constant velocity and intensity. When the pressure wave has traveled upstream to the end of the pipe where there is a reservoir of large main, the elasticity of the compressed liquid and of the expanded pipe reverse the flow and a wave of normal pressure travels downstream, the flow being progressively reversed at the liquid expands.

3) If the liquid were incompressible and the pipe inelastic, the instantaneous closure of the valve would create an infinite pressure. Since it is impossible to close a valve instantaneously, it is apparent that a series of pressure waves is created, thus causing an increased pressure at the valve. If the valve is completely closed before the first pressure wave has time to return to the valve as a wave of low pressure, the pressure increase continuously up to the time of complete closure, and the resulting pressure is the same as if the valve had been closed instantaneously. The velocity of the pressure wave depends upon the ratio of the wall thickness to the inside pipe diameter, on the modulus of elasticity of the pipe material, and on the modulus of elasticity of the liquid.

4) The head due to water hammer in excess of normal static head is a function of the destroyed velocity, the time of closure and the velocity of pressure wave along the pipe. The value of water hammer can be calculated with a fair degree of providing all of the factors influencing water hammer are known.

5) Water hammer may be controlled by regulating valve closure time, relief valves, surge chambers and other means.

6) It is recommended that competent engineering services be engaged for such calculations since few pump users or pump manufacturers have the knowledge and experience necessary for this work.
Chapter 5 Piping

5.1.4 Noise in centrifugal pumping machinery installations

1) Sound is energy and may be produced by movement within machinery. This is also true for centrifugal pump.
   Sound is produced by liquid flowing in the pump casing, the bearings within the pumping units, the coupling and
   the unit drivers.
   Not all sound is objectionable. Sound, which is objectionable is defined as noise.
   Sound may be transmitted in three manners:

   a) Air-borne within the machinery room.
   b) Liquid-borne by the liquid being pumped.
   c) Structure-borne through the attached piping and support system.

2) Since sound is much more readily transmitted through incompressible structures, structure-borne sounds are
   generally most objectionable. Two of the most important factors in minimizing sound in a pump installation are
   the selection of the pumping unit for the operating conditions and the pump installation. To insure minimum
   sound, the pump should be chosen for operation near the point of best efficiency, and proper suction conditions
   should be provided.

3) The prevention of noise is greatly dependent upon the pump installation. Proper alignment of the pump and
   driver is essential, as well as the support of the suction and discharge piping.
   The manner in which the pump is installed and in which the piping is supported may contribute to objectionable
   harmonics. A greater degree of noise prevention may be obtained when the pumping unit is supported free of
   building structures by the use of vibration isolators and flexible piping connectors. Noise emanating from
   motions of high velocity liquids within the piping system should not mistakenly be attributed to the pumping unit.
Chapter 6 Operation

6.1 Precaution on pump operation

It is desirable to operate the pump at best efficiency point. In some cases, however, the pump must be inevitably operated at a smaller flow rate or larger flow rate for the reason of service. In these cases, it is necessary to use the pump with a good understanding of its characteristics.

6.1.1 Operation at reduced flow rate

If the pump is operated at an extremely small flow rate or shut-off point for a long time, vibration and noise will be increased. And liquid temperature will rise.

If this occurs, the pump will be damaged.

The followings are several countermeasures to protect the pump from such possible damage:

1) Liquid temperature relays which shut down the pump unit if the liquid temperature exceeds a predetermined maximum.

2) Constant open by-pass between pumps discharge and first valve piped back to suction source.

3) Low suction pressure control that will shut off the pump unit should the suction pressure drop below an established minimum.

6.1.2 Operation at reducing head (extremely large flow rate)

In case of operation at an extremely large flow rate, you must pay attention to an increase of vibrations, noise and cavitation due to low suction performance of pump. And the motor should be watched carefully because brake horsepower increase. The discharge valve should be throttled to a safe point.
Chapter 6 Operation

6.2 Pump start

**WARNING**

- Be sure to install the motor terminal box cover. If not, an electric shock may be caused.

6. 2.1 Preparations before starting the pump

1) Check that pump alignment is already completed.

2) Check the direction of rotation
   - To check the direction of rotation after completion of motor wiring, operate the motor without load. At that time, check whether the direction of rotation is equal to that indication of rotation arrow provided on the pump.

3) Set the shaft coupling bolts and tightens the nut completely.

4) Perform priming work by the suction-side valve, priming funnel or start the vacuum pump to fill the inside of the pump with liquid up to the maximum level. Check whether the shaft sealing liquid (mechanical seal flushing) piping valve can open and close normally. Pass liquid to check the condition as required. In the case of bearing cooling, check this condition.

5) Check the bearing lubricating oil. Be sure to supply oil up to the center of oil gauge level before starting the pump. Oil level shall be maintained within 2mm of center level for bearing housing (Refer to Fig. 6-2).

![Fig. 6-2](image)
6.3 Precaution on pump operation

Pump trouble tends to occur in the early stage of operation. Perform operations with special care at a trial run. If any trouble occurs, stop the pump at once.

1) Turn on the start switch and continue to operate the pump for 4 or 5 seconds, then turn off the switch. Repeat these start and stop operations 2 or 3 times to check the following points:
   a) Check if the shaft rotation is smooth.
   b) Check if the bearing section is normal.
   c) Check if any abnormal smell is not given out.
   d) Check if any abnormal noise or vibration does not occur.
      After that, increase the rotation speed to the specified speed level.

2) Pay attention to the temperature changes of the bearing. In particular, check that any sudden temperature rise does not occur for 30 minutes after starting.

3) At this time, observe the suction/discharge pressure value, current value, vibration value, noise value, etc.
   Note that a large variation or sudden change appears as an evidence of abnormal symptom.

6.4 Pump operation and stop

6.4.1 Operation
1) Perform priming work by the suction-side valve to fill the inside of the pump with liquid up to the maximum level.

2) Check if the shaft sealing liquid (mechanical seal flushing or gland liquid injection) piping valve can open and close normally. Pass liquid to check the condition as required. In the case of bearing cooling, check this condition.

3) Turn on the start switch to operate the pump.

4) After the rotation speed reaches the specified speed level, open the discharge valve to start liquid feeding.

5) At this time, observe the suction and discharge pressure value, current value, vibration value, noise value, etc.

6) Pay attention to the temperature of the bearing.
Chapter 6 Operation

6.4.2 Stop  
1) Close the discharge valve completely, then turn off the switch to stop the operation.  
2) After the pump is stopped, stop the liquid feed from the outside. In particular, continue liquid feed to the shaft sealing section until the pump is completely stopped.

6.4.3 Emergency stop  
If the pump is stopped because of a power failure, be sure to turn off the power switch. After that, close the discharge valve. In the power "ON" condition, the pump may be suddenly started when a power recovery is made from the failure. This is very dangerous.

6.5 Precautions on long-time stop  
1) Drain the liquid in the pump completely.  
2) Rotate the rotary body by hand once a week to change the contact portion of the bearing.  
3) During the stop period, perform disassembly and inspection. Check each section and make a schedule for part replacement or spare part procurement as required.  
4) When operating the pump after a long-time stop, start with the check items before starting.
CHAPTER 7 MAINTENANCE AND INSPECTION

7.1 Daily check

7.1.1 Operation log

We recommend you to check the daily operation condition and record it in an "Operation log" after starting date of pump operation.

1) Inspection items

- Starting time
- Shut-down time
- Operation time
- Total operation time
- Checking hour
- Suction pressure
- Discharge pressure
- Shaft sealing condition
- Shaft sleeve (If equipped)
- Bearing temperature
- Electrical current and voltage value of power supply
- Lubricating oil
- Vibration
- Noise
- Etc.

2) When a large transition is found in the record of pressure and current values, this may augur badly for a failure. At that time, it is important to investigate the reason in order to perform troubleshooting in an early stage.

8.1.2 Precaution on daily check

1) Keep gauge cock close. Open it when reading. If the cock is always kept open, the life of gauge cock will be shortened.
2) Pay attention to the bearing temperature and oil level.

7.2 Periodical inspection

7.2.1 Inspection items and intervals

<table>
<thead>
<tr>
<th>Every 3 months</th>
<th>a. Inspection of bearing lubricating oil condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every 6 months</td>
<td>a. Inspection of gland packing and Shaft Sleeve (If equipped)</td>
</tr>
<tr>
<td></td>
<td>b. Inspection of alignment between Pump and Driver</td>
</tr>
<tr>
<td>Every 1 year</td>
<td>a. Replacement of gland packing (If equipped)</td>
</tr>
<tr>
<td></td>
<td>b. Dismantling check</td>
</tr>
<tr>
<td></td>
<td>c. Replacement of bearing lubricating oil</td>
</tr>
<tr>
<td></td>
<td>d. Arrange spare parts</td>
</tr>
</tbody>
</table>

WARNING * Be sure to turn off the motor power supply before starting the inspection. In particular, in case of automatic operation, the motor may be suddenly started. You make sure of this point.

WARNING * Be careful not to be caught by the rotary section. It will result in a serious injury.
Chapter 7 Maintenance and Inspection

7.3 Bearing maintenance

The pump bearings are oil lubricated.
Refer to Lubricant List.

7.3.1 Lubrication of bearing
Great care should be exercised to keep the housing clean and only clean oil lubricants should be used. Foreign solids or liquids within the bearing housing can completely ruin the bearings in a short time.

When changing the oil, flush the inside of the housing with solvent to remove accumulated dirt.

7.3.2 Constant level oiler
The constant level oiler is installed in the bearing housing. (In some case, it may be dismantled and packed separately. please check the crate box.)

The oiler is adjusted to maintain proper oil level before leaving our factory. Keep the oiler bottle with the correct grade of oil. Under normal conditions, the oiler will maintain proper oil level.

For details, follow the manufacturer's recommendations.

<table>
<thead>
<tr>
<th>No.</th>
<th>Parts Name</th>
<th>Material</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>RESERVOIR</td>
<td>GLASS</td>
<td>1</td>
</tr>
<tr>
<td>②</td>
<td>LOWER CASING</td>
<td>ZINC DIE CAST</td>
<td>1</td>
</tr>
<tr>
<td>③</td>
<td>CASING</td>
<td>ZINC DIE CAST</td>
<td>1</td>
</tr>
<tr>
<td>④</td>
<td>GLASS COVER</td>
<td>CS</td>
<td>1</td>
</tr>
<tr>
<td>⑤</td>
<td>ADJUSTER</td>
<td>CS</td>
<td>1</td>
</tr>
<tr>
<td>⑥</td>
<td>LOCK NUT</td>
<td>CS</td>
<td>1</td>
</tr>
<tr>
<td>⑦</td>
<td>SET SCREW</td>
<td>CS</td>
<td>1</td>
</tr>
<tr>
<td>⑧</td>
<td>PLUG</td>
<td>CS</td>
<td>1</td>
</tr>
<tr>
<td>⑨</td>
<td>PACKING</td>
<td>CS</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. 7-1 Constant Level Oilier

7.4 Shaft sealing

7.4.1 Inspection and maintenance of mechanical seal
Mechanical seals should be checked for leakage, particularly during the first hours of operation.

Minor leakage through the seal usually stops after a short time, but if it continues stop the pump and examine the seal.

Excessive leakage past a mechanical seal generally indicates worn or broken parts requiring replacement.

However, it should be pointed out that certain liquids, due to their characteristics, require more frequent seal inspection than other.

A chronic condition may indicate the wrong type of seal is being applied to do the job. Operating conditions such as this should be reported to your DMW agent.

For details, follow the manufacturer's recommendations.
**Chapter 8 Troubleshooting**

When a failure has occurred, perform the following trouble shootings to find its probable cause, and then take proper corrective measures. The following descriptions are general failures and typical countermeasures for them. In some cases, however, several causes may be combined. Please inquire the detail contents of us, if necessary.

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Emergency measures</th>
<th>Permanent measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>The start condition cannot be satisfied.</td>
<td>1. Check each condition. If this may be due to an apparatus failure, temporarily start the pump with short-circuit condition whenever necessary. 2. Check if the pump can be started independently.</td>
<td>1. Check each apparatus and circuit and clarify the unsatisfied condition. 2. Repair or replace if necessary.</td>
</tr>
<tr>
<td>The protective circuit is functioning.</td>
<td>1. Check each condition.</td>
<td>1. Check the protective circuit.</td>
</tr>
<tr>
<td>The motor fails</td>
<td>Check the conditions and repair or replace the defected causes.</td>
<td>Check the protective circuit for motor.</td>
</tr>
<tr>
<td>Foreign materials are stuffed in the rotary section, etc.</td>
<td>1. Remove the Coupling Spacer and check whether hand turning is possible or not. 2. If impossible, dismantle and clean the pump.</td>
<td></td>
</tr>
<tr>
<td>The bearing is seized.</td>
<td>Ditto If impossible, repair or replace the Bearing.</td>
<td></td>
</tr>
<tr>
<td>The impeller is clogged with foreign material.</td>
<td>Once stop the pump, try to restart it.</td>
<td>1. Dismantle and clean the Pump. 2. Check the Suction Strainer.</td>
</tr>
<tr>
<td>Suction lift is too high or NPSHA is insufficient.</td>
<td>Wait for a while until the suction liquid level rises.</td>
<td>1. Check the protective circuit of Suction Level. 2. Check the equipment and circuit of liquid feed system.</td>
</tr>
<tr>
<td>Actual head and loss of head are higher than anticipated.</td>
<td>1. Check the actual head and piping loss again. 2. It shall be avoided to operate at smaller than min. flow rate.</td>
<td></td>
</tr>
<tr>
<td>The mechanical fault (Worn wear ring or impeller damage, etc.)</td>
<td>1. Replace the Wear Ring. (Check the running clearance.) 2. Replace the Impeller (Check the wear of Impeller Blade.)</td>
<td></td>
</tr>
<tr>
<td>The pump is not primed. (Insufficient priming)</td>
<td>Perform the priming again. (Complete venting is necessary)</td>
<td>Resolve the air pockets or insufficient venting of pipeline.</td>
</tr>
<tr>
<td>Pump rotating speed is too low.</td>
<td>1. Measure the rotation speed. 2. Check the driver and its power supply.</td>
<td>1. Check the frequency and voltage of power supply. 2. Repair the motor if necessary.</td>
</tr>
</tbody>
</table>
## Chapter 8 Troubleshooting

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Emergency measures</th>
<th>Permanent measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air pocket or leak in suction pipeline</td>
<td>Perform the priming again. (Complete venting is necessary)</td>
<td>Modify the pipeline.</td>
</tr>
<tr>
<td>Air is inhaled from the gland.</td>
<td>Tighten the gland packing further.</td>
<td>Replace the gland packing.</td>
</tr>
<tr>
<td>Excessive rotation speed.</td>
<td>1. Measure the rotation speed 2. Check the power supply.</td>
<td>1. Check and adjust the power supply especially frequency.</td>
</tr>
<tr>
<td>Operation at over capacity range.</td>
<td>Adjust the discharge valve opening so that operating point becomes within 120% of rated point.</td>
<td>1. Review the rated point and exchange the motor capacity if necessary. 2. Clean the pipeline. Take a preventive measures against foreign substances if any.</td>
</tr>
<tr>
<td>Misalignment of coupling</td>
<td>Perform the realignment.</td>
<td>Perform the realignment.</td>
</tr>
<tr>
<td>Defect of the bearings</td>
<td>Check the conditions and repair or replace the defected causes.</td>
<td>1. Check the conditions and causes of defect. 2. Replace the bearings. 3. Pay attention to contamination of lube oil.</td>
</tr>
<tr>
<td>Severe contact of rotor and stator.</td>
<td>1. Disassemble the pump and check the conditions. 2. Repair or replace the defected causes.</td>
<td>1. Check the operating condition before stopping. (Vibration, Temperature, Current, etc.) 2. Replace the damaged parts. 3. Check the dynamic balance and bending of rotor shaft.</td>
</tr>
<tr>
<td>Excessive tightening of gland packing.</td>
<td>Loosen the gland packing.</td>
<td></td>
</tr>
<tr>
<td>The selection of mechanical seal is not proper.</td>
<td>Check the operation conditions. (Suction Pressure, Temperature, Viscosity, etc.)</td>
<td>1. Select the Mechanical Seal with actual specifications. 2. Modify and change the type of seal.</td>
</tr>
<tr>
<td>Fault of mechanical seal installation.</td>
<td>Disassemble the Mechanical Seal and reinstall correctly.</td>
<td>1. Check any damages in Mechanical Seal. 2. Reinstall the Mechanical Seal and change the defected parts if necessary.</td>
</tr>
<tr>
<td>Excessive compression at mating face</td>
<td></td>
<td>Check the axial position of Cartridge Sleeve.</td>
</tr>
<tr>
<td>The packing is excessively tightened.</td>
<td>Loosen the packing gland, then tighten it gradually.</td>
<td>Tighten packing gland carefully and equally.</td>
</tr>
<tr>
<td>Packing insertion is faulty.</td>
<td></td>
<td>Change the packing model.</td>
</tr>
<tr>
<td>Packing selection is not proper.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The sleeve is worn away.</td>
<td>Reset the packing.</td>
<td></td>
</tr>
<tr>
<td>The lantern ring position is not proper.</td>
<td>Adjust the position.</td>
<td></td>
</tr>
<tr>
<td>The cooling water volume is not proper.</td>
<td>Adjust it by the cooling water valve.</td>
<td>Adjust the cooling water volume to the specified value.</td>
</tr>
</tbody>
</table>
## Chapter 8 Troubleshooting

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Emergency measures</th>
<th>Permanent measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient quantity of lube oil. (Lack or excessive)</td>
<td>Adjust the quantity of lube oil.</td>
<td></td>
</tr>
<tr>
<td>Degradation of lube oil. Inclusion of foreign material.</td>
<td>Clean the inside of bearing housing and replace the lube oil.</td>
<td></td>
</tr>
<tr>
<td>Bearing defect</td>
<td>Check the conditions and repair or replace the defected causes.</td>
<td>1. Check the conditions and causes of defect. 2. Replace the bearings. 3. Pay attention to contamination of lube oil.</td>
</tr>
<tr>
<td>Misalignment of coupling</td>
<td>Perform the realignment.</td>
<td>Perform the realignment.</td>
</tr>
<tr>
<td>Insufficient type or grade of lubricating oil</td>
<td>Replace the lubricating oil with proper one.</td>
<td></td>
</tr>
<tr>
<td>The cooling water volume is not proper.</td>
<td>Adjust it by the cooling water valve.</td>
<td>Adjust the cooling water volume to the specified value.</td>
</tr>
<tr>
<td>The temperature of the liquid handled is too high.</td>
<td>1. Contact us regarding actual specifications of liquid handled. 2. Several parts may be exchanged for suitability.</td>
<td></td>
</tr>
<tr>
<td>Insufficient minimum flow operation for a long period</td>
<td>Control the operating point.</td>
<td>70% to 120% of best efficiency flowrate is preferable as operating region.</td>
</tr>
<tr>
<td>Shut-off operation</td>
<td>Open the discharge valve.</td>
<td>Don’t operate the pump at shut-off point.</td>
</tr>
<tr>
<td>Severe contact of rotor and stator.</td>
<td>Dismantle the pump and restore it.</td>
<td>Replace the damaged parts.</td>
</tr>
<tr>
<td>Insufficient bolt tightening</td>
<td>Stop the pump and re-tighten the each bolt equally more further.</td>
<td></td>
</tr>
<tr>
<td>Mechanical seal defect</td>
<td>Check where does the leakage come from.</td>
<td>Replace the mechanical seal.</td>
</tr>
<tr>
<td>O-ring or gasket defect</td>
<td>Replace the O-ring and/or gaskets.</td>
<td></td>
</tr>
<tr>
<td>Oil leakage from labyrinth ring (Bearing housing)</td>
<td>Check the oil level and correct by constant level oiler.</td>
<td></td>
</tr>
</tbody>
</table>
## Chapter 8 Troubleshooting

<table>
<thead>
<tr>
<th>Probable cause</th>
<th>Emergency measures</th>
<th>Permanent measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>The shaft is bending.</td>
<td></td>
<td>Restore or replace the Shaft.</td>
</tr>
<tr>
<td>Shaft coupling defect</td>
<td></td>
<td>Replace the Coupling. (Including Spacer)</td>
</tr>
<tr>
<td>Misalignment of coupling</td>
<td></td>
<td>Realign the Coupling.</td>
</tr>
<tr>
<td>Bearing damage or defect</td>
<td>Check the conditions and repair or replace the defected causes.</td>
<td>1. Check the conditions and causes of defect.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replace the Bearings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Pay attention to contamination of lube oil.</td>
</tr>
<tr>
<td>The pipeline/pump is clogged with foreign materials.</td>
<td></td>
<td>1. Once stop the pump, clean the pipeline and remove foreign materials.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Check the strainer in pipeline.</td>
</tr>
<tr>
<td>Severe contact of rotor and stator.</td>
<td>1. Disassemble the pump and check the conditions.</td>
<td>1. Check the operating condition before stopping.</td>
</tr>
<tr>
<td></td>
<td>2. Repair or replace the defected causes.</td>
<td>(Vibration, Temperature, Current, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Replace the damaged parts.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Check the dynamic balance and bending of rotor shaft.</td>
</tr>
<tr>
<td>The pipeline vibrates.</td>
<td></td>
<td>Install a proper support.</td>
</tr>
<tr>
<td>The foundation is imperfect.</td>
<td></td>
<td>Increase the foundation strength.</td>
</tr>
</tbody>
</table>
Chapter 9 Inspection of Parts

9.1 Impeller

Replace if excessively worn or corroded. Original impeller was statically and dynamically balanced; it is always desirable to recheck impeller balance before reinstalling into pump.

9.2 Case and impeller wear rings

Case and impeller wear rings are provided for both front and back side of impeller. These wear rings allow a small clearance in accordance with API 610 to be maintained between the rotating impeller and the stationary casing. Consequently, the clearance will become large, resulting in low performance and/or vibration generation. For proper hydraulic performance, this clearance should be approximate value. Wear rings should be replaced when clearances have increased more than the following limit.

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Allowable clearance</th>
<th>Explanation</th>
</tr>
</thead>
</table>
| Impeller wear rings and case wear rings| Two times (2x) new clearances | Radial clearances C  
When the pump performance comes down, renewal of these parts will be recommended even if the clearances have not measure up to the clearances shown at left.  
If the clearance shown at left does not matter practically, these parts may be used. |
Chapter 9 Inspection of Parts

9.3 Ball bearings

The expected life of ball bearings will be for 25,000 hours of total operation time or 2 years after installed into the pump, whichever comes earlier.
Replace new ones if necessary when abnormal generation of heat and/or vibration occurs.
If dirty, clean with solvent, dry and coat with machine oil.

New bearing should be unwrapped until ready for use. Whenever in doubt about the condition of a bearing stocked, don't use it.

In critical services, replace bearings at each overhaul.

9.4 Recommended spare parts

Arrange spare parts beforehand so that pump may not be stopped for a long time if any defect is found at pump inspection.
Usually, the following parts are recommended as spares.

• Recommended spare parts:
  Usually, the following parts are recommended as spares.
  1) Case wear rings
  2) Impeller wear rings
  3) Mechanical seal
  4) Throat bushing
  5) O-rings and gaskets
  6) Bearings
  7) Labyrinth rings
Chapter 10 Warranty and Service

We warrant that the products are free from defects in material and/or workmanship and will have the capacities and ratings described in our proposal as accepted. If any failures are found in the products, stop the operation at once and investigate the condition. After that, immediately inform us of the failure condition in detail as much as possible with nameplate items especially our serial number and model, and promptly deliver the defective goods or parts to us for investigation, delivery pre-paid.

The accepted method of testing/inspection shall be carried out for determination of the existence of any such defect.

[1] Warranty term and period
The warranty term and period depend on the purchase condition at the contract.

[2] Warranty range
The warranty is effective only for the following case.
1) When you install, operate and maintain the products properly in accordance with the manual and yet the defect occurs.

2) It is distinct that material, manufacturing and/or workmanship executed by us cause such failure after investigation by the accepted method.

1) Failures attributable to improper handling, use, storage, etc. on user side.

2) Failures occurring after the expiration of the warranty period.

3) Failures attributable to repair or modification by others than our representative or service agent.

4) Failures attributable to use the parts other than those manufactured by or supplied from us.

5) Failures by a fire, disaster, natural calamity or other force majeure.

6) Failures attributable to use the products other than that contracted with us.

7) Consumables: Mechanical seal, wear ring, shaft sleeve, O-ring, gasket, Lubricating oil, etc.

[4] Responsible indemnity range
Our responsible indemnity range on this warranty condition shall be limited to repair, replacement and modification (if required) of defective goods or parts, excluding indemnity of any losses that may occur secondarily.