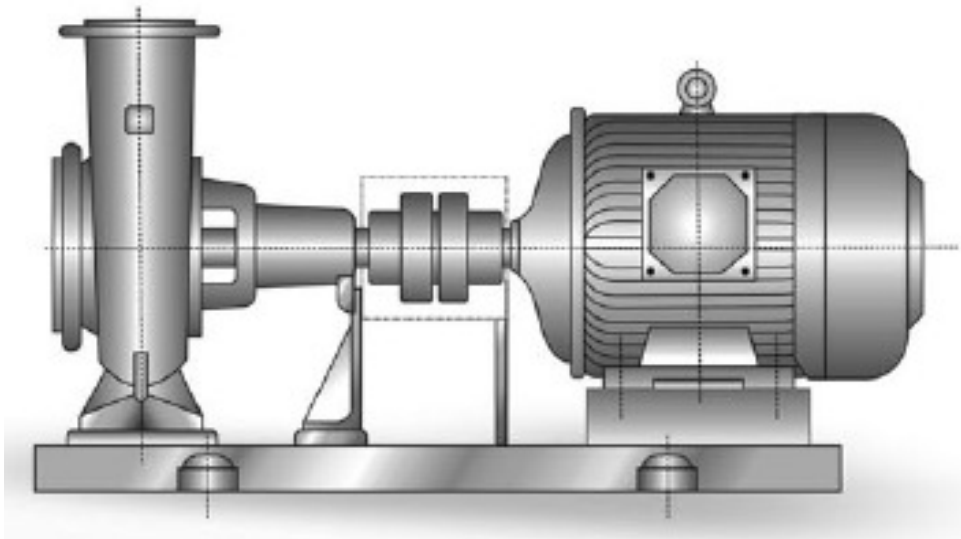


# CAL

END SUCTION



# SAFETY PRECAUTIONS

- Before using this machine, be sure to read this “SAFTY PRECAUTIONS” and the appended “INSTRUCTION MANUAL” carefully for proper operation.
- After reading through this paper, be sure to keep it in the place exposed to view at all time for operators.

Concerning the safety precautions, this paper describes the contents of WARNING by the use of the following symbols and signs.



Indicating the contents where a possibility of leading to serious results such as danger of injuries which persons may undergo in cases of mishandling due to neglect of this display is conceivable.

Besides the above, the following WARNING label is affixed to the safety cover (coupling guard) of body coupling unit or its vicinity.



The contents given below should always be following since any of them covers important note on safety.



## WARNING

### 1. General

- 1) Never allow any persons other than service engineers to engage in disassembly or repair, or remodeling work.
- 2) Never work alone and be sure to put on helmet, safety goggles, ear plugs, safety shoes, etc. in conformity with the Labor Safety and Health Law, etc.
- 3) Prior to carrying out any sparking work such as welding, etc., make sure that there are no dangers of fire and explosion hazards.
- 4) Check the place where emission of toxic gas and deficiency of oxygen are conceivable, such as pit, manhole, etc. before starting on works and make sure of safety.
- 5) When carrying out the work for centering check, disassembly, etc., be sure to turn OFF the motor switch and affix a tag indicating “NO POWER ON” or the like to the switch so that the switch will not be turned ON by mistake.
- 6) Before starting on work, be sure to conduct checking of singing outfits such as crane, wire-rope. etc. unflinching.
- 7) Install safety fences around the working area and secure an emergency passageway.
- 8) Since any splits oil on the floor, passageway, etc. may lead to a cause of slippage etc., wipe it off forthwith.



## WARNING

- 9) Shaft seal parts will not function to stop the pumped liquid completely. When handling such a liquid which may cause serious troubles to the human body, therefore, do not touch the splashing liquid from shaft seal parts.
- 10) Keep away from the casing of the pump that is handling such a hot liquid as may lead to a danger of scalds if coming in contact with the human body.
- 11) Do not gain access to rotating parts recklessly since there is possibility of scattering caused by breakage of rotating parts.
- 12) If you lean against, or step on the guard, it causes damage to the pump, and may result in scattering.
- 13) Do not open the terminal cover of electric equipment (motor, etc.) in live status. Otherwise, you may get electric shock.

### **2. Handling**

- 1) Where both pump and motor are assembled on the common bed, never hang a wire-rope on the eyebolt of the motor. Furthermore, do not gain access to the underside of the suspended pump.

### **3. Direct-coupling**

- 1) Fasten the coupling guard securely at the specified position with mounting bolts.

### **4. Maintenance**

- 1) When carrying out the work for replacement of gland packing or mechanical seal, be sure to turn OFF the motor switch and affix a tag indicating "NO POWER ON" or the like to the switch so that the switch will not be turned ON by mistake.

### **5. Disassembly and Reassembly**

- 1) Before carrying out the disassembly work, be sure to turn OFF the motor switch and affix a tag indicating "NO POWER ON" or the like to the switch so that the switch will not be turned ON by mistake.
- 2) To drain liquid from inside of the pump, close the suction valve and the discharge valve completely. If the liquid is at a high temperature, drain the liquid through the drain valve after the liquid cools down almost to a room temperature.
- 3) When the pumped liquid is a chemical solution, it may cause injury (inflammation, etc.) if it touches the human body. To prevent this, make sure that the liquid in the casing is completely drained.
- 4) When removing parts and partly-assembled components, hang wire-ropes to the positions as shown in the Instruction Manual and use a chain block, etc.
- 5) When handling hot components such ball bearing, coupling, etc., be sure to put on protective gloves.

# Instruction Manual

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## 0. General

Carefully read this Manual before operating the CAL pump.

Also, keep this Manual at an easily accessible place.

All the pump components are manufactured under the strict quality control system to assure of their specific performance. However, our compensation shall be out of application to trouble or damage caused by the following.

- (1) Operation of the pump under liquid quality, density and temperature, and running conditions which are deviated from those specified in the pump specifications.
- (2) Pump damage which is caused by improper handling and operation, incorrect installation, use of improper materials, improper piping, etc. -- that is -- by noncompliance with the descriptive instruction given in this Manual
- (3) Pump damages caused by natural disaster.

The long-term satisfactory running of any pump will be ensured by proper installation, handling and operation.

When repair is required, it is recommended to repair the pump by our skilled serviceman as far as possible or to return it to our factory.

In this Manual, each part name is followed with parenthesized part number, when deemed as necessary, to easily identify the components and parts.

### 0.1. Quality Control Plan

All inspection and test for material, dimension, performance, etc. are performed in the manufacturing process in accordance with quality control plan (QCP) submitted to the purchaser when the pump was ordered. Only pumps that have fully satisfied the specified performance values upon inspection and test are allowed for shipment.

### 0.2. Nameplate

Each pump is provided with nameplate.

When ordering spare parts or replacement parts, let us have the following information stamped on the nameplate.

- (1) Pump type & size, Product No.(expressed with AP\*\*\*\*\*, etc.), date of production, etc.
- (2) Parts name, material and quantity included in the Sectional Drawing and Spare Parts List.

### 0.3. Transportation

When transporting the pump directly coupled to a motor, apply a wire rope to the pump and motor, as illustrated in Fig 0.3-1. (Do not apply absolutely a rope to the eye-bolt of the motor.)

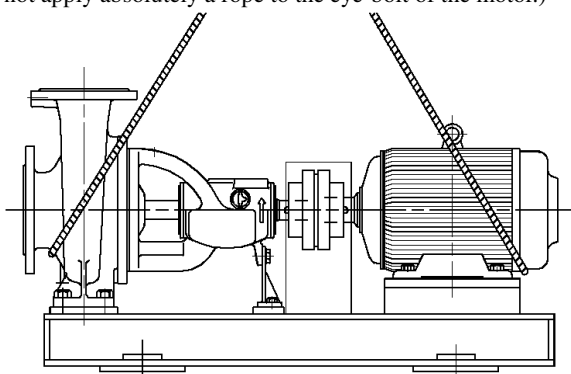


Fig 0.3-1

### 0.4. Construction

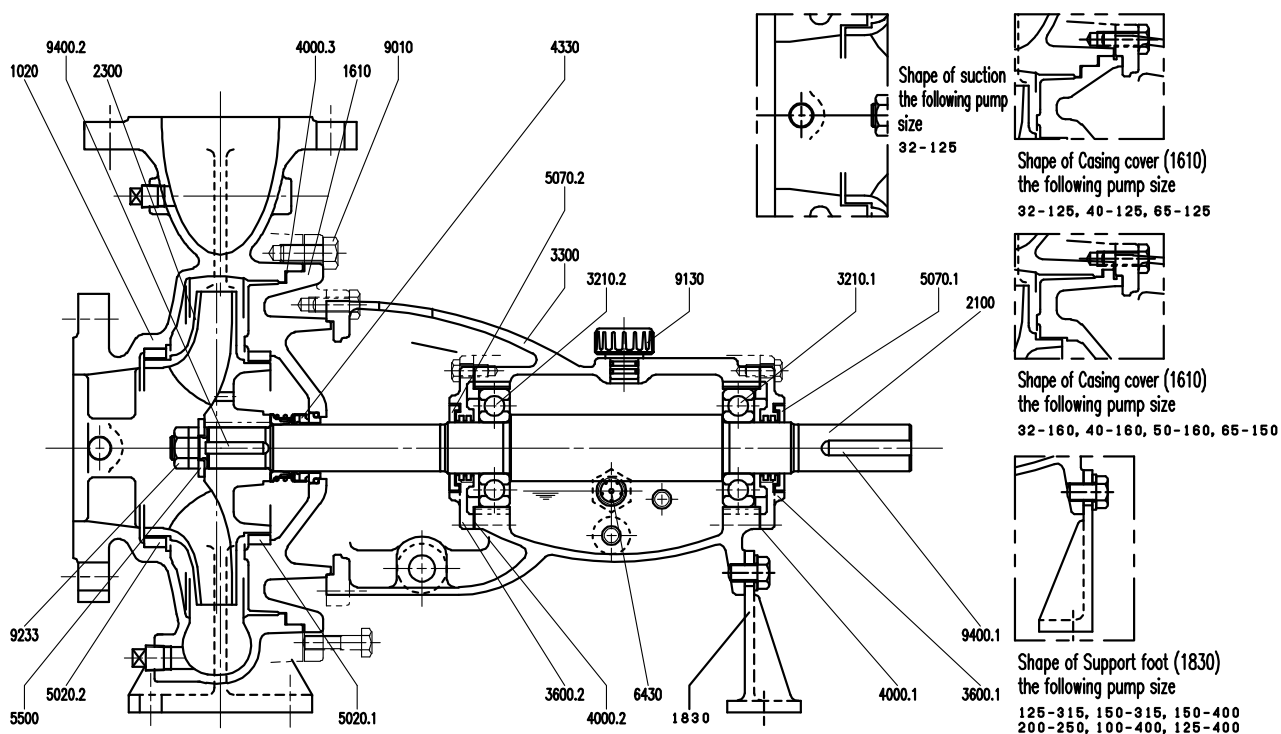
The CAL pumps provide single-stage, axial single-suction structure for vertical (upward) discharge. The pump casing is of back pull-out type with integral-casted axial suction nozzle and top discharge nozzle and support foot. The pump can be disassembled and internally inspected without removing the casing (1020) from

the piping.

Refer to **Table 0-1** for a representative Pump Sectional Drawing.

Table 0-1 Pump structure

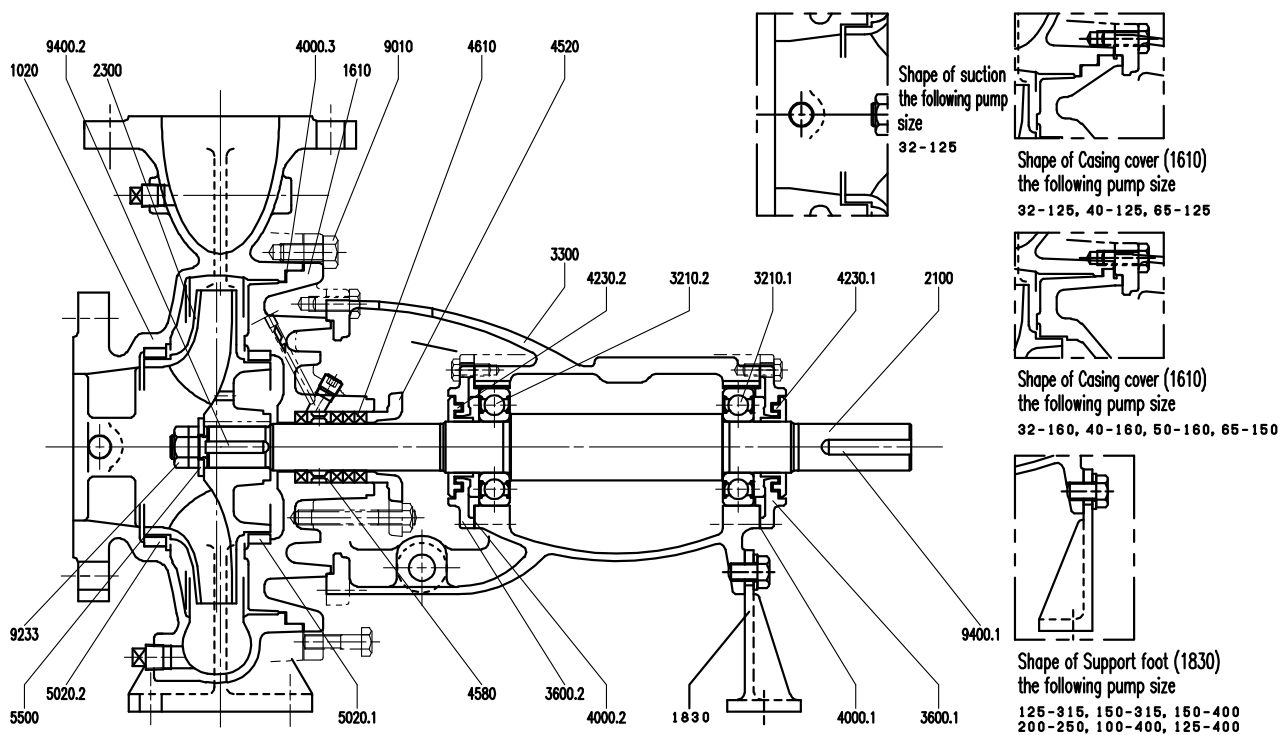
Pump structure	Reference figure
Mechanical seal (type of CA) Oil lubrication (round oil gauge)	Fig 0.4-1
Gland packing Grease lubrication	Fig 0.4-2
Mechanical seal Oil lubrication (constant level oiler)	Fig 0.4-3



Note1. The above figure is one structural example.

Note2. In the case of a mechanical seal of the option type, refer to Fig 0.4-3.

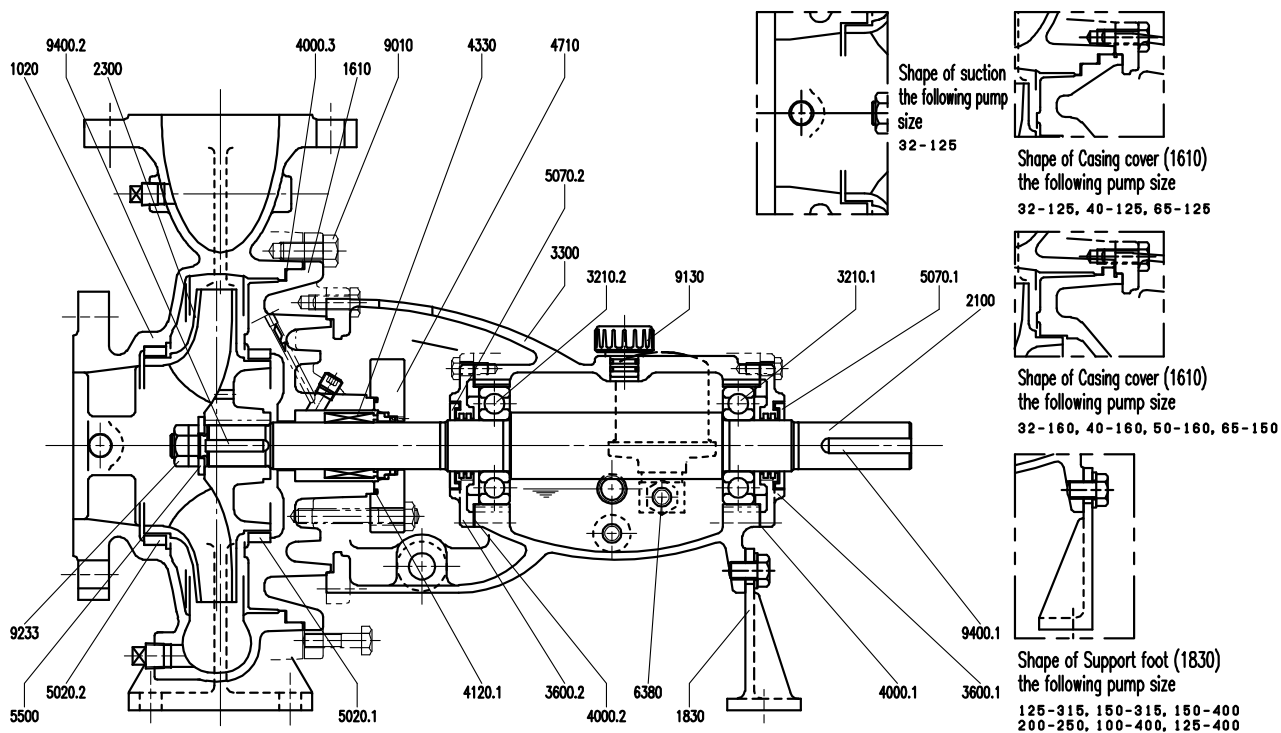
Fig 0.4-1 Sectional Drawing (mechanical seal type is "CA", oil lubrication with round oil gauge)



Note 1. The above figure is one structural example.

Note 2. The structure of gland packing is different depending on use conditions, refer to Section 6 (P.21).

Fig 0.4-2 Sectional Drawing (gland packing, grease lubrication)



Note 1. The above figure is one structural example.

Note 2. The structure of mechanical seal is different depending on use conditions, refer to Section 5.2 (P.13)

Fig 0.4-3 Sectional Drawing (mechanical seal, oil lubrication with constant level oiler)

### 0.4.1. Volute casing

Back pull out type volute casing (1020) is fixed with the casing cover (1610) and bearing housing (3300) at the driver side by means of bolts. The flat gasket (4000.3) is inserted between the mating surface of the volute casing (1020) and the casing cover (1610) to seal the pumped liquid.

The following models provide double volute casing structure to reduce radial thrust.

125-400, 200-250, 150-315, 150-400

### 0.4.2. Impeller

The impeller (2300) is installed with balance hole to balance the greater part of axial thrust. Sliding clearance between the casing wearing ring (5020) and the impeller is held to the minimum so that pumped liquid at discharge side will not return to suction side.

The impeller is inserted through the shaft (2100), and fixed to shaft (2100) with Hard Lock Nut® (9233). These Hard Lock Nut® consist of two pieces of bottom nut (convex type) and upper nut (concave type), special nuts having looseness preventive function.

### 0.4.3. Shaft seal

Casing cover (1610) as a part of the shaft seal is jointed, together with bearing housing (3300), to volute casing (1020).

The shaft seal is available in two types; the mechanical seal type and the gland packing type.

- (1) In the case of mechanical seal type.  
For the shaft seal construction, refer to Section 5 (P.13).
- (2) In the case of gland packing type.  
For the shaft seal construction, refer to Section 6 (P.21).

### 0.4.4. Bearing

The pump shaft (2100) is supported with two ball bearings (3210). The ball bearings are fit on the shaft, which are placed in the bearing housing (3300).

### 0.4.5. Shaft

The shaft components of each pump type are interchangeable with those of other pump. As shown in Table 0-2, the shaft is available in six sizes, which cover all models of the CAL pumps.

**Table 0-2 Combination of pump size and shaft size**  
[The case of 4 pole motor drive]

Shaft size	Pump size			
25-360	32-125	40-125	65-125	
	32-160	40-160	50-160	65-150
	32-200	40-200	50-200	65-190
35-470	80-150			
	80-190	80-200	100-190	
	32-250	40-250	50-250	65-240
	80-240	100-245	80-250	
	65-310	80-310	100-310	
45-470	50-315			
45-470A	150-200			
	125-250			
	80-400			
55-530	200-250			
	125-315			
	100-400	125-400		
65-530	150-315			
	150-400			

[The case of 2 pole motor drive]

Shaft size	Pump size			
25-360	32-125	40-125	65-125	
	32-160	40-160	50-160	
	32-200	40-200	50-200	
35-470	80-160			
45-470	80-200			
	32-250	40-250	50-250	80-250

## 1. Installation

### 1.1. Installation of base plate

Perform installation and centering of the pump by skilled workers. Incorrect installation and centering will cause various troubles while the pump is in running.

When the pump and the motor are directly coupled on a common base plate, the pump has been correctly centered before shipment. However, when installing the base plate at a local site, follow the sequence below and, after installation, check that it is leveled as specified.

- (1) Prepare packers and several kinds of 1mm to 0.1mm thick shims for leveling adjustment use, prior to installing.
- (2) After complete setting of the foundation concrete, position each packer at both sides from each foundation bolt and at the portions equivalent to both side from each of the pump and motor support feet. After positioning, place a mortar onto the foundation floor (under the base plate) in each packer position and the place each packer on the motor. In

this case, keeps each packer horizontal using a level. At this step, each packer requires no height adjustment, because it is adjusted in installing the base plate.

- (3) After complete cure of the mortar at each packer, preinstall the common base plate (which pump and motor) onto the packers and then confirm the center height of the pump. After that, adjust the axial and crosswise horizontality of the pump by inserting leveling shims while reading a level, which shall be held on the discharge flange surface of the pump.
- (4) After complete positioning and leveling of the pump, perform pre-centering of the pump to the motor by use of specific centering tool (See Subsection 1.2). At this time, it is recommended to record the numerical centering data because they can be usefully referred to in checking the centering accuracy in directly coupling the pump to the motor.
- (5) After completion cure of the pre-centering work, fill up each anchor hole (foundation bolt hole) with concrete.
- (6) After completion cure of the grouted concrete, tightly tighten each foundation bolt with nut. In this case, adjust and check the direct coupling accuracy between the pump and motor, based on the recorded pre-centering data.
- (7) Grout mortar under the common bed until it reaches perfectly all the corners of the base plate, so as not to permit a cavity to be formed under the base plate.
- (8) After completion of all the above works, connect the discharge pipe and suction pipe to the corresponding connection flanges of the pump.

### 1.2. Direct coupling

The pump shaft and the motor shaft must be kept in line with one another. So, follow the procedure below in centering and leveling the coupling set.

- (1) Be sure check the rotational direction of the motor prior to direct coupling.  
The correct rotational direction is indicated with an arrow mark on the bearing housing (3300), clockwise (CW) toward the pump as viewed from the motor side.
- (2) To check the rotational direction of the motor with the pump that uses a flanged flexible shaft joint, remove the coupling bolts. With the pump that uses a rubber shaft joint, slide the couplings to the pump side and the motor side each, and tighten the set bolt on the motor side. You must check the rotational direction when the motor is not in direct connection with the pump.  
Checking the rotational direction of the motor in direct connection with the pump causes a fault of the mechanical seal.

- (3) After checking the rotational direction, directly connect the motor and pump couplings.
- (4) For centering work, put a straight-edge on the periphery of both couplings, put a wedged-edge on both surfaces of the couplings, and use calipers, etc., as shown Fig 1.2-1. To conduct the centering work more easily and accurately, you should use a dial gauge.
- (5) In this step, verify coaxiality and parallelism at four points at 90° angles, to verify that the measured values do not exceed those listed in Table 1-1.

Table 1-1

Shaft joint	Coaxiality A (mm)	Parallelism B1 – B2(mm)
Flanged flexible shaft joint	0.05	0.05
Rubber shaft joint	0.5	0.5

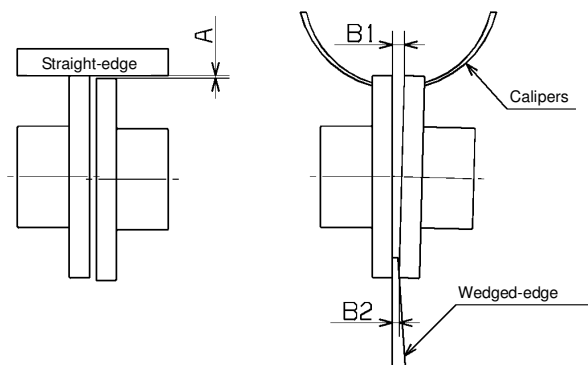


Fig 1.2-1

- (6) Be sure to tighten the set bolt completely.
- (7) If the pumped liquid is not at a room temperature, re-check the centering condition after the pumped liquid is stabilized at the specified temperature.

### 1.3. Piping

For piping work, follow the instructions given below.

- (1) During connections of the suction pipe and the discharge pipe, be careful not to apply force from the pump to each pipe. If force is applied from the piping to the pump, the pump may abnormally vibrate, causing a failure of the pump.
- (2) In piping design, minimize various piping losses in the suction line. For the purpose, avoid acute change of pipe section and acute bending of pipe and select such a pipe size as can ensure flow velocity of 3m/s max.
- (3) To prevent an air pocket in the suction pipe, kept it in upward slope toward the pump, in the case of pumping up.
- (4) If a suction pipe diameter is different from the pump suction port diameter, connect an eccentric taper tube as



shown in (Fig 1.3-1), so that an air pocket is not present.

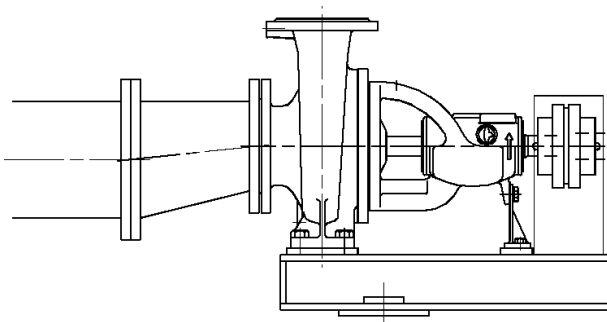


Fig 1.3-1

- (5) When connecting a valve to the discharge line, locate it as close as possible to the discharge nozzle of the pump. To provide a check valve, connect it between the pump discharge port and the discharge valve.
- (6) Where no flushing is applied to pipeline, foreign matter existing in the pipeline flows into the pump while the pump is in initial running. Therefore, the pump inlet must be provided a strainer no shut out inflow of such a foreign matter. A strainer used must have the effective area as large as 3 to 4 times the sectional area of the suction. If the strainer is clogged during pump running, the indicated value on the suction line pressure gauge will fluctuate. In such a case, the strainer must be disconnected for removal of clogged matter. The strainer can be removed when it can be confirmed that no foreign object remains in the piping.
- (7) Small piping such as flushing, etc. are designed and manufactured in alignment with the application and shape, so that they can be easily connected to the pump. In this case, too be careful no to apply abnormal piping load to the pump components, similarly to the main piping. Furthermore, prior to connecting, check internally each small pipe for existence of residual foreign matter and, if necessary, clean it for complete removal of residual foreign matter.
- (8) High temperature or temperature fluctuation of lifting liquid, if any, will result in expansion or shrinkage of the pipeline. When such a phenomenon is forecast, add a flexible pipe, etc. to the midway of the pipeline to protect the pump from thermal expansion load.
- (9) After completion of all the piping connection, recheck the pump to motor direct-coupled condition to confirm that it is free from center-deviation caused by abnormal piping load.

## 2. Operation

### 2.1. Starting

When putting the pump in initial operation after the installation, be sure to check the following items for normality, prior to starting. If abnormality de found upon checking, take corrective actions in accordance with the Troubleshooting Instructions given in this Manual.

- (1) The rotational direction of the motor... Is the correct? The correct direction is clockwise (CW) in face to the pump at the motor side. With the pump using the flanged flexible shaft joint, remove the coupling bolt when you check the rotational direction. With the pump using the rubber shaft joint, make sure that inside of the pump is completely filled with pumped liquid before turning ON the motor switch. Immediately after turning ON the motor switch, turn it OFF, and check the rotational direction of the motor.
- (2) Verify that the pump shaft and the motor shaft are directly connected in the specified centering condition. Verify that the coupling bolt is mounted (when the flanged flexible shaft joint is used), and that the set bolt is securely tightened.
- (3) Are small pipes connected perfectly? Is the flushing liquid injected and drained as specified?
- (4) In the case when a strainer is connected to the suction line, is not it clogged with foreign matter?
- (5) Is the suction line valve fully opened? Is the discharge line valve fully closed?
- (6) Are suction line and the pump internally full with pumped liquid? Is air purged out of them? (No-load running of the pump prohibited)
- (7) Check for leakage or other abnormal condition when the suction pipe and inside of the pump are filled with pumped liquid.
- (8) No leakage from the mechanical seal?
- (9) Can the coupling set be smoothly turned by hand? When you turn the coupling manually, be sure to turn OFF the motor switch, and affix a tag indicating "DO NOT TURN ON" or the like to the switch so that the switch will not be turned ON by mistake.

After checking the above items and making sure that there is nothing abnormal, turn on the motor start switch and turn it off immediately. Confirm that the pump runs smoothly and stops quietly.

If nothing abnormal be found, turn on the motor start switch and slowly open the discharge valve until the discharge flow reaches

the specified rate.



When it comes off from the rated flow remarkably and it drives, it causes the following accidents, and do the flowing quantity adjustment surely.

When flowing quantity is too small:

abnormal vibration, abnormal noise, pumped liquid temperature abnormal rise

When flowing quantity is too large:

abnormal vibration, abnormal noise, overloaded motor

Even when restarting after long-term shut-down of the pump, be sure to check each of the above items for normality.

## 2.2. Stopping

For stopping the pump, follow the instructions given below.

- (1) Fully close the discharge valve. Generally the pumps with check valve do not need this operation. However, if water hammer may occur when the pump suddenly stops, the discharge valve must be fully closed.
- (2) Switch off the motor. In this step, make sure that the pump smoothly slows down to stop.
- (3) If the pumped liquid may freeze up, completely drain the pumped liquid from inside of the pump and the water-cooled jacket.

## 2.3. Start/stop frequency

If start/stop operations are frequently repeated, it causes a fault of the pump and the motor. Do not repeat start/stop operations more than the specified frequency.

If start/stop operations may exceed the specified frequency, consult us.

- (1) 2P type: Up to once in 5 hours
- (2) 4P type: Up to twice in one hour

# 3. Maintenance Control

## 3.1. General

While the pump is running, check the following items and, if anything abnormal be found, stop the pump immediately, and check the following items:

- (1) Is the pump running free from abnormal noise and vibration?
- (2) Does the suction pressure meet the NPSH required for the pump? (Read the suction line pressure gauge for checking.)
- (3) Is the discharge pressure kept as specified?
- (4) Is the motor free from overload?

- (5) Is the pump casing full with lifted liquid during the pump running? And is the discharge valve kept closed?
- (6) Is each bearing free from abnormal temperature rise?

## 3.2. Shaft seal

### 3.2.1. In the case of mechanical seal type

It is one outstanding feature of mechanical seal that requires almost no maintenance while the pump is in running. However, the sliding surface of seat (4750) and washer (4720) may eventually wear after long-term running. Of course, the degree of this wear depends on various factors such as running conditions, lubricity of pumped liquid, existence of impurities in pumped liquid, etc. It is impossible to define a replacement interval for wearable parts (seat, washer). Therefore, it is recommended to store the running data, which can be utilized to know the approximate replacement interval of such wearable parts. Furthermore, it is recommended to always stock spare parts for the mechanical seal and to replace all when replacement is required.

In the case of the pump with mechanical seal, do not operate it in dry condition and be sure to carry out priming before starting and start the pump, with the stuffing box filled up with liquid. For further take note, occasionally liquid may leak a little from the mechanical seal, after started, until the seal becomes stable. This is not abnormal.

Refer to Section 5 (P.13) for the detail of the mechanical seal.

### 3.2.2. In the case of gland packing type

The surface of gland packing (4610) and that of the shaft that slides over it must be smooth at all times. If the shaft is scratched on the surface, or gland (4520) is tightened unevenly or over-tightened, it will cause the shaft seal to overheat or cause the gland packing to wear quickly. When replacing gland packing, use a new one in a material that will withstand the type of pumping liquid, and insert it into casing cover (1610) so that its mating faces are shifted by 90 degrees to each other. For the gland packing, ring-shaped molded packing is recommended.

If string-shaped gland packing is to be cut, use a tool such as the one shown in Fig 3.2-1 when cutting.

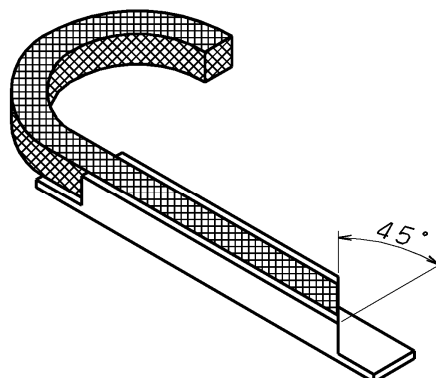


Fig 3.2-1

The gland should be slightly recessed from the casing cover. The gland packing should be lightly tightened at the beginning. Then, re-tighten it after running the pump for a certain period. Adjust the gland packing so that liquid leakage from the gland is approx. 10 to 20 cc/min.

The dimension of the shaft seal and gland packing are shown in Fig 3.2-2 and Table 3-1.

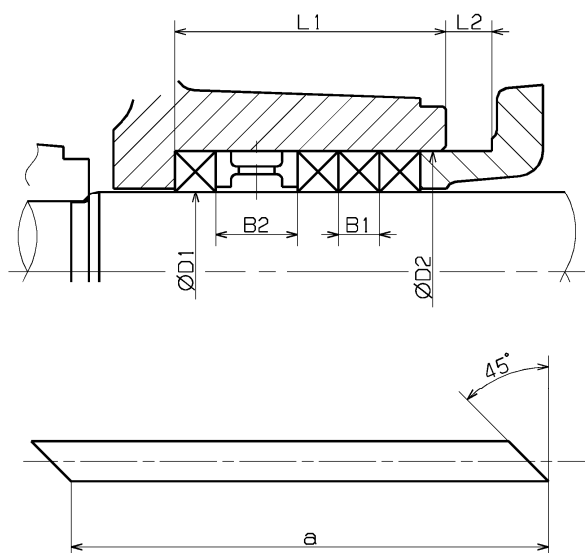


Fig 3.2-2

Table 3-1 the dimension of the shaft seal and gland packing

Unit: mm

Shaft size	Shaft seal dimensions				Quantity of gland packing		Gland packing dimensions			Lantern ring dimensions
					Lantern ring		Molded part	String-shaped part		
	D1	D2	D3	D4	Provided	None	D1×D2×B1	Thickness	Overall length (a)	B2
25-360	24	40	53	9	4	6	24×40× 8	8	100.5	16
35-470 45-470	32	48	53	9	4	6	32×48× 8	8	125.7	16
45-470A 55-530	45	65	65	12	4	6	45×65×10	10	172.8	20
65-530	55	75	65	12	4	6	55×75×10	10	204.2	20

Use molded ring-shaped gland packing as much as possible.

### 3.3. Meters and gauge

It is recommended that a pressure gauge or compound pressure gauge should be mounted to the pump body or the suction piping in proximity to the pump, and that a pressure gauge should be mounted to the discharge piping. These pressure gauges must be provided with gradations capable of covering about 150% of maximum operating pressure. Also connect a gauge cock to each gauge. When pumping a corrosive liquid, use an anti-corrosion gauge cock. When pumping liquid contains free matter or solid matter, use a proper strainer with the gauge cock. For the long life of each gauge, keep the gauge cock closed all the times, expect when it is opened to read the operating pressure.

### 3.4. Bearings

Maintenance and inspection of the pump bearings are very

important. Maintenance and control of bearings of each lubrication type are described below.

#### 3.4.1. In the case of grease lubricated bearings

Inspection and control of the bearing temperature and replacement of the ball bearings (3210) are required at an appropriate timing.



Heat-resistant grease is sealed in the bearing. The maximum permissible temperature thereof is **90 degrees C max** on the bearing housing (3300) surface or ambient **temperature plus 55 degrees C max**.

The bearing replacement intervals vary depending on operating conditions. During continuous operation, the bearings must be replaced at an interval of approx. 9000 hours, as standard. In the case of short-time operation, it is recommended that the bearings should be replaced every two years. Further, it is recommended to

replace the bearing together with shaft (2100) as shaft set (2101), for easy replacement. Ball bearing type used is “Non-contact double rubber seal type deep groove ball bearing (Clearance C3) as shown in Table 3-2.

Table 3-2

Shaft size	Ball bearing (JIS B1521 Designation No.)
25-360	6305 UUC3
35-470	6307 UUC3
45-470 45-470A	6309 UUC3
55-530	6311 UUC3
65-530	6313 UUC3

(Note)

1. Sealing grease shall be heat resisting grease.
2. Do not use the JIS designation Nos. given in Table 3-2 for arrangements.

### 3.4.2. In the case of oil lubricated bearings

Inspection and control of bearing temperature and lubricating oils as well as timely ball bearings (3210) replacement are necessary.



The maximum permissible temperature of each bearing is **75 degrees C max** on the bearing housing (3300) surface or ambient temperature plus **40 degrees C max**.

Before starting the pump operation, be sure to check the lubricating oil level with the oil gauge (6430). To use the constant level oiler (6380), check if lubricating oil is filled in the constant level oiler up to one third or higher level.

When resuming the operation of the pump that has been stopped for an extended period of time, clean the bearings and the inside of bearing housing with cleaning oil. At this time, cleaning while turning shaft (2100) by hand will remove dirt well.

When a new bearing is used, replace all amount of lubricating oil after operation for the initial 300 hours. After that, the replacement interval should be 3,000 hours of operation. The type of oil and quantity are shown in Table 3-3.

The bearing replacement intervals vary depending on operating conditions. During continuous operation, the bearings must be replaced at an interval of approx. 9000 hours, as standard. In the case of short-time operation, it is recommended that the bearings should be replaced every two years. The ball bearing type used is “Open type deep groove ball bearing (Clearance C3)”. The bearing type codes in use are listed in Table 3-3.

Table 3-3 Oil lubricated bearings, and lubricating oil

Shaft size	Bearing JIS B1521	Lub. Oil quantity (liter)	Lub. Oil name	
			Below 1800min <sup>-1</sup>	1800min <sup>-1</sup> or more
25-360	6305C3	0.25	VG46 Turbine oil	VG32 Turbine oil
35-470	6307C3	0.56		
45-470 45-470A	6309C3	0.65		
55-530	6311C3	1.08		
65-530	6313C3	1.30		

[In the case a round oil gauge is provided]

Check if the oil level is within the circle marked on the glass surface of the round oil level gauge.

[In the case a constant level oiler is provided]

To replenish lubricating oil, remove the oiler cover (6386) together with the Replenish (6382), and fill lubricating oil into the bearing housing (3300) until it reaches the mounting (6383). Then, fill the oiler with lubricating oil, and fit the oiler in mounting. Keep the oil level in the constant level oiler at one third or higher level.

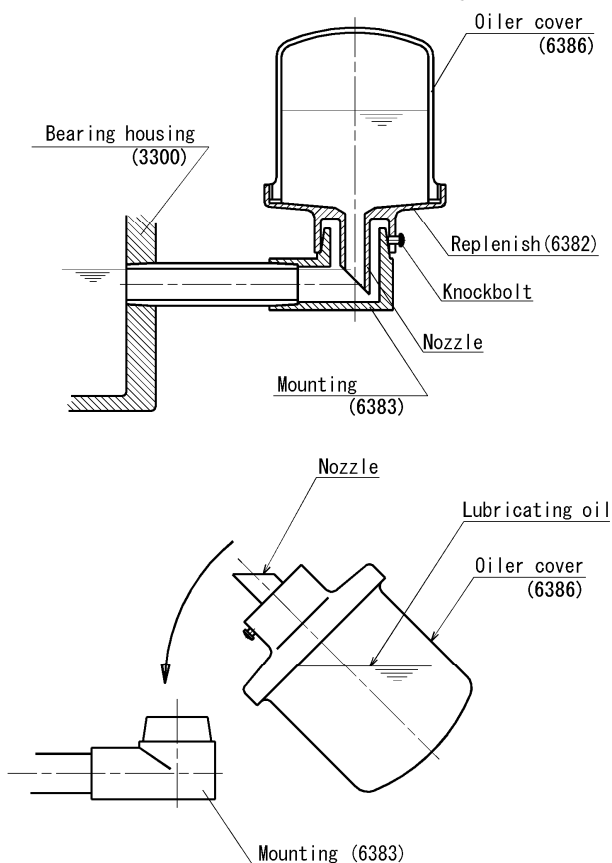


Fig 3.4-1

### 3.5. Sliding Clearance

Regarding the clearance between the case wearing ring and the impeller sliding surface, the design value for the impeller whose material is FC is  $\phi 0.4$  mm, and the tolerance value is  $\phi 1.0$  mm. The design value for the impeller whose material is SCS is  $\phi 0.6$  mm, and the tolerance value is  $\phi 1.2$  mm.

If the tolerance value is exceeded, replace the case wearing ring.

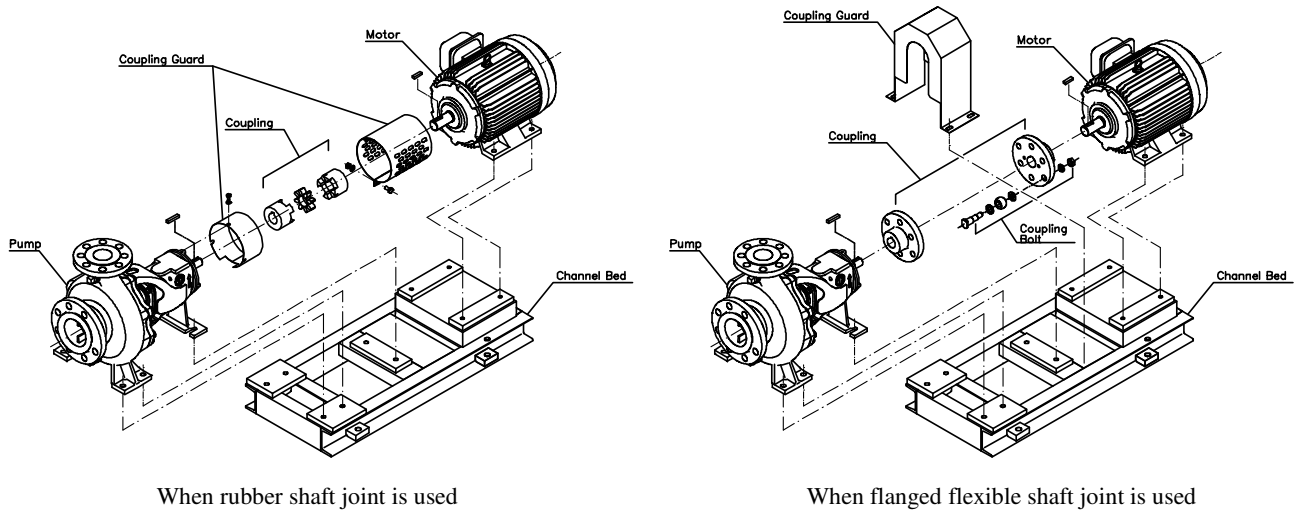
### 3.6. When the pump is left unused for a long period

When the pump is left unused for a long period, execute break-in operation for approx. 10 minutes once or twice a month. If break-in operation cannot be performed, turn the shaft (2100) manually.

## 4. Disassembling and Reassembling

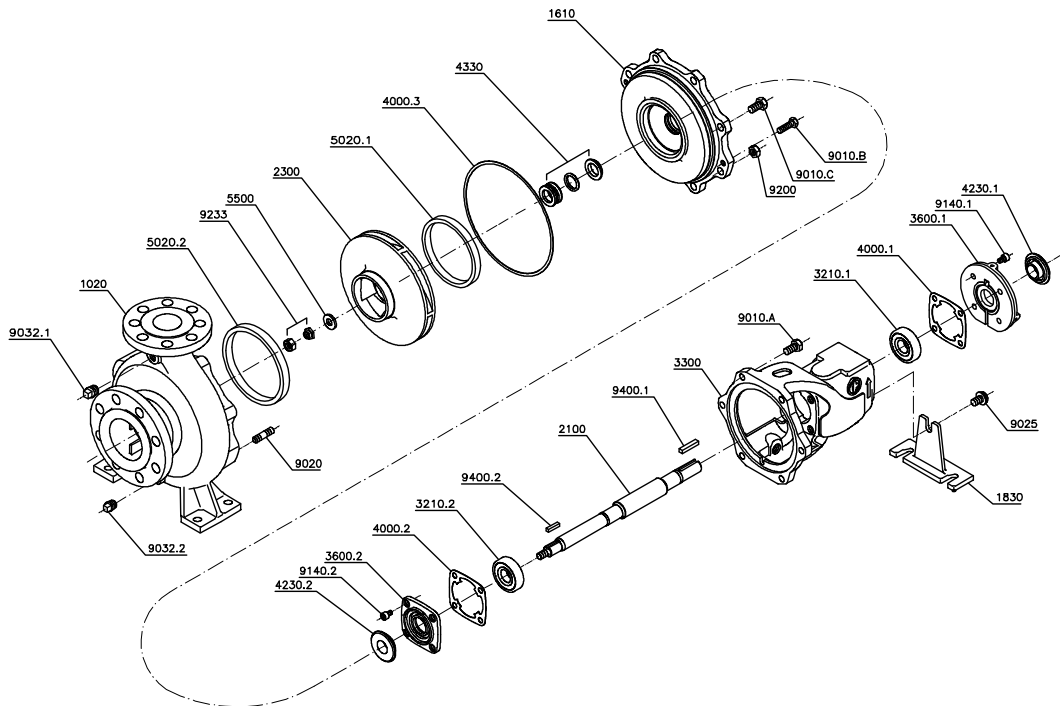
### 4.1. General

As its advantageous point, the CAL pump can be disassembled without demounting the volute casing (1020) from the base plate and the pipelines. In disassembling, be careful not to impact and damages the Pump. Refer to the Pump Sectional Drawing submitted at the time of order in disassembling and reassembling.



The above figure shows an example of pump and motor configuration. The type of configuration varies depending on the pump model and the motor being used.

Fig 4.1-1 Layout of Pump and Prime mover



The above figure shows an example of pump and motor configuration. The type of configuration varies depending on the pump model and the motor being used.

See the Pump Sectional Drawing submitted at the time of order.

Fig 4.1-2 Illustrated parts breakdown of pump

## 4.2. Disassembling

Follow the sequence below in disassembling

- (1) Remove the coupling guard. When the flanged flexible shaft joint is used, remove the coupling bolt.
- (2) Remove the motor, and relocate it.
- (3) Open the drain plug or drain valve located on the bottom of volute casing (1020) to drain the pumped liquid out of the casing, so that inside of the volute casing is open to the atmosphere. For prevention of danger, be sure to check that the liquid in the volute casing is completely cooled down, prior to draining.
- (4) Disconnect the small pipes from the pump.
- (5) Remove the bolts (9010.C) for mounting the volute casing and the casing cover (1610), nut (9200) for the stud bolt (9020), and the bolts for fastening the support foot (1830) to the bed.
- (6) Remove bearing housing (3300) and casing cover together with the rotor from volute casing by jack bolt (9010.B).
- (7) For the oil lubricated type, remove the oil drain plug to drain lubricating oil from the bearing housing.
- (8) Unscrew the Hard Lock Nut® (9233) and remove the impeller (2300), washer (5500) and the key (9400.2). As for the Hard Lock Nut®, first unscrew upper nut (concave type), and after removed it unscrew bottom nut (convex type). Do not screw upper and bottom nut simultaneously.
- (9) Disassembling the shaft seal.  
For the mechanical seal type, refer to Section 5 (P.13).  
For the gland type, remove the gland (4520) and remove the lantern ring (4580) and the gland packing (4610).
- (10) Separate the casing cover (1610) from the bearing housing (3300). (It is convenient for reassembling to put a match mark on both of the casing cover and the bearing housing.)
- (11) For the grease lubricated type, remove the labyrinth (4230) from the shaft. For the oil lubricated type, remove the drip (5070) from the shaft.
- (12) Unscrew the set bolt of the coupling and separate the pump side coupling from the shaft with the coupling remover. Check for wear and other damage of the element. If an abnormal condition is found, replace the element with a new one.
- (13) Remove the both bearing covers (3600) from the bearing housing.
- (14) Slowly pull the shaft out of bearing housing, with the ball bearings (3210) left in the bearing housing.
- (15) When replacements of the ball bearings are required, remove the rubber seal and heat up the ball bearings only by acetylene gas, etc. And remove them from the shaft.

Caution: Do not heat the shaft.

- (16) In principle, replace the flat gasket (4000) and O-ring (4120) used for each seal surface with new ones when disassembling the pump.

## 4.3. Reassembling

In reassembling, follow the reverse sequence of the disassembly, with careful attention to the items given below.

- (1) Wash each component / parts. Particularly do not permit dust, etc. to adhere to the joint and contact portions.
- (2) When ball bearings (3210) of the grease lubrication type are used, press-fit the bearings on the shaft (2100). For the oil lubricated type, heat up the ball bearings with oil at 110 to 120°C, and shrink-fit them on the shaft.

In this case, insert the bearings securely until they touch the stepped parts of the shaft.

- (3) Use caution not to damage the sealing surfaces and contact surfaces of the flat gasket (4000), and other parts.
- (4) As for the Hard Lock Nut® (9233), first fasten bottom nut (convex type) fully, and then fasten upper nut (concave type).
- (5) After completion of the reassembling work, recheck the direct-coupled condition pursuant to Subsection 1.2 (P.5) and start the pump pursuant to Subsection 2.1 (P.6). When a mechanical seal is used, slight leakage from the shaft seal part may occur at the beginning of operation. However, the leakage will be gradually eliminated. If leakage occurs even after a considerable term of running, again disassemble the pump for inspection.

## 4.4. Spare parts

### 4.4.1. Ordering spare parts

Send the following information, without fail, when ordering spare parts.

- Pump size and pump type code
- Production No.
- Year of production

These are stamped on the nameplate affixed to the bearing housing (3300).

#### 4.4.2. Recommended spare parts

As shown in Table 4-1.

Table 4-1 Recommended Spare Parts and Replacement Cycle

Item No.	Parts No.	Parts name	Replacement cycle (year)
1	2100	Shaft <sup>*1</sup>	6 (9,000 hours or 2)
2	3210	Ball bearing <sup>*1</sup>	9,000 hours or 2
3	4000	Flat gasket	2 <sup>*3</sup>
4	4120	O-ring	2 <sup>*3</sup>
5	4330	Mechanical seal	2 <sup>*3</sup>
6	4610	Gland packing	1 <sup>*3</sup>
7	5020	Casing wearing ring	6
8	5500	Washer (for Hard lock nut)	2 <sup>*3</sup>
9	9233	Hard lock nut	2 <sup>*3</sup>

\*1 It is recommended to replace the bearings together with the shaft for reduction of working manhour and improvement of replacement work quality at customer side.

\*2 Figure in parenthesis shows the replacement cycle in the case of replacing the bearings together.

\*3 When disassembling, replace them with new parts.

## 5. Mechanical seal

### 5.1. General

- (1) The life of mechanical seal is remarkably shortened by inclusion of foreign matter therein.  
In reassembling the pump, clean the mechanical seal and other internal components. In addition, be careful not to permit such foreign matters to intrude in the pipeline during running.
- (2) Absolutely avoid dry running of the pump. (Including the running under the seal box pressure below the atmospheric

bar.) Dry running will result in seizure trouble of the mechanical seal, eventually causing not only the mechanical seal but also the pump itself to be damaged.

- (3) The sliding surfaces of the mechanical seal are fine finished by lapping. Be careful to protect it from flawing and chipping in handling.
- (4) In principle, the sliding surface of the mechanical seal after overhaul must be replaced with a new one, or must be re-finished by lapping.

### 5.2. Outline of Construction Parts

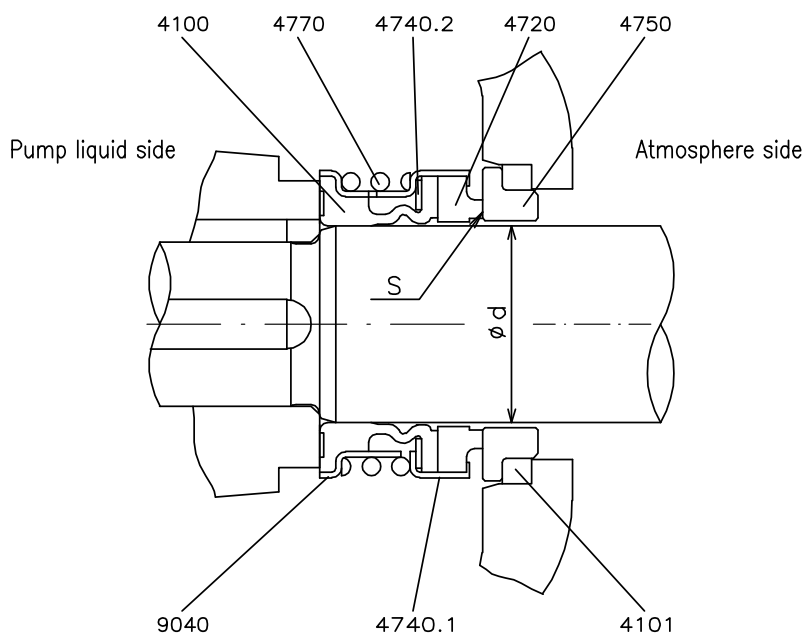
For the mechanical seal sectional drawings, refer to Table 5-1. The material of mechanical seal is different depending on use conditions. Refer to the sectional drawing of pump.

Table 5-1 Mechanical Seal Type

Mechanical seal type	Remark	Sectional drawing
CA φd SS	Rubber bellows type single mono-coil seal (simple type)	Fig 5.2-1
LCA φd F LCA φd E	Rubber bellows type single mono-coil seal (clutch type)	Fig 5.2-2
LTW φd F LTW φd E	Rubber bellows type double mono-coil seal (clutch type)	Fig 5.2-3
LA200-RFφd LA200-REφd LA200-RKφd	Multi-spring type single seal (SiC × carbon)	Fig 5.2-4
L9SA-SEφd L9SA-SKφd	Multi-spring type single seal (SiC × SiC)	Fig 5.2-5
MBS100-RFφd	Metal bellows type single seal	Fig 5.2-6

MBS100-RFφD is balanced seal. Other models are unbalanced seal.





Parts table of a mechanical seal set

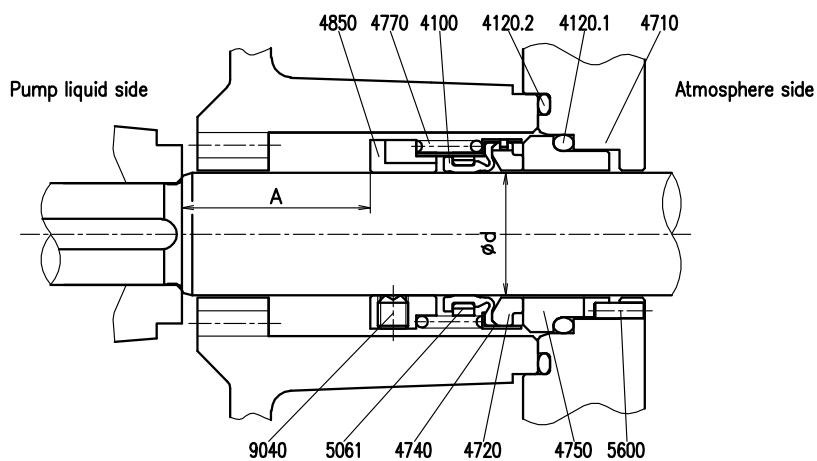
Mechanical seal type: CA φd SS	
Parts No.	Parts Name
4100	Packing
4101	Cushion ring
4720	Sealing washer
4740.1,2	Follower ring
4750	Seat
4770	Spring
4850	Stopper

Unit: mm

Shaft size	d
25-360	24
35-470	32
45-470	
45-470A	45
55-530	
65-530	55

Note: For order of additional spare parts, designate the type of the mechanical seal as a set, in order to ensure preferable seal effect.

Fig 5.2-1 Construction of mechanical seal "CA"



Parts table of a mechanical seal set

Mechanical seal type: LCA φd F/E	
Parts No.	Parts Name
4100	Packing
4120.1	O-ring
4720	Sealing washer
4740	Follower ring
4750	Seat
4770	Spring
4850	Stopper
5061	Spline ring
9040	Set screw

Parts table of a pump

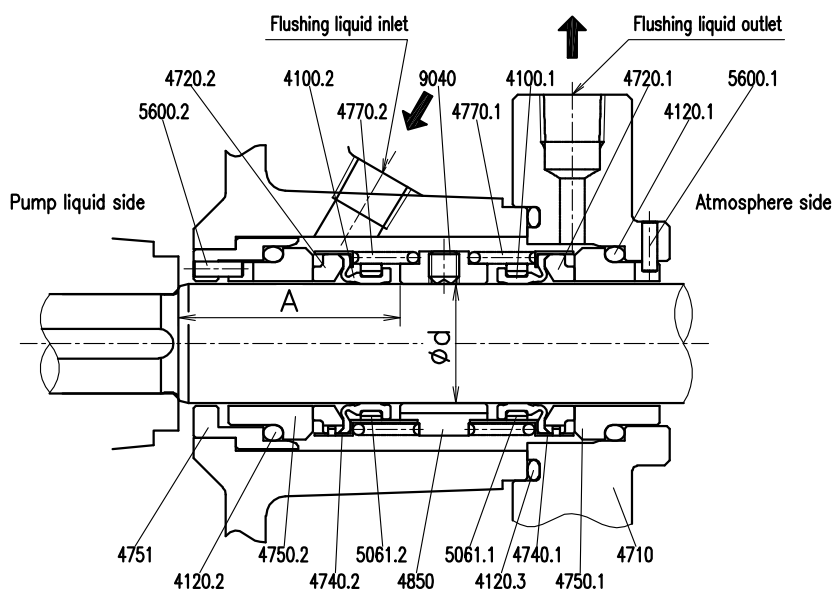
Parts No.	Parts Name
5600	Pin
4120	O-ring
4710	Seal cover

Unit: mm

Shaft size	d	A
25-360	24	37
35-470	32	32
45-470		
45-470A	45	36.5
55-530		
65-530	55	35

Note: For order of additional spare parts, designate the type of the mechanical seal as a set, in order to ensure preferable seal effect.

Fig 5.2-2 Construction of mechanical seal "LCA"



Note 1: 4120.2 of additional spare parts, designate the type of the mechanical seal as a set, in order to ensure preferable seal effect.

Note 2: Quantity of flushing liquid and pressure of it are different depending on use conditions, refer to pump-datasheet.

Parts table of a mechanical seal set

Mechanical seal type: LTW $\phi d$ F/E	
Parts No.	Parts Name
4100.1,2	Packing
4120.1,2	O-ring
4720.1,2	Sealing washer
4740.1,2	Follower ring
4750.1,2	Seat
4770.1,2	Spring
4850	Stopper
5061.1,2	Spline ring
9040	Set screw

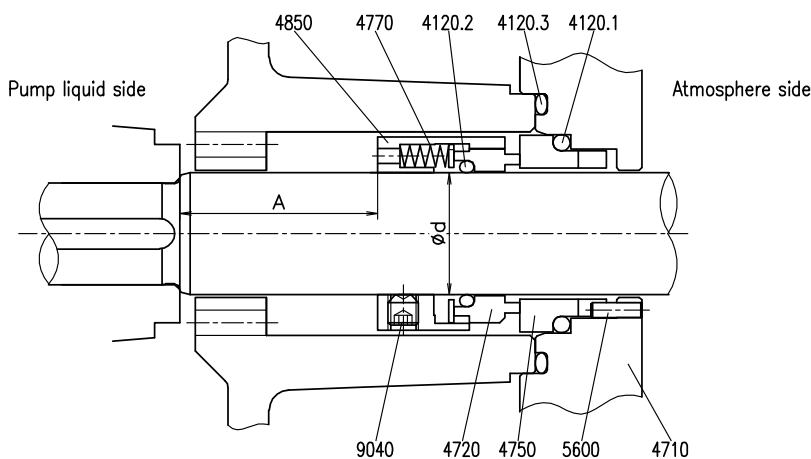
Parts table of a pump

Parts No.	Parts Name
5600.1,2	Pin
4120	O-ring
4710	Seal cover
4751	Seat holder

Unit: mm

Shaft size	d	A
25-360	24	44.5
35-470	32	53
45-470		
45-470A	45	49.5
55-530		
65-530	55	52.5

Fig 5.2-3 Construction of mechanical seal "LTW"



Conforming to DIN 24960 standard (Except for mechanical seal overall length)

Note: For order of additional spare parts, designate the type of the mechanical seal as a set, in order to ensure preferable seal effect.

Parts table of a mechanical seal set

Mechanical seal typ: LA200-RF/RE/RK $\phi d$	
Parts No.	Parts Name
4120.1,2	O-ring
4720	Sealing washer
4750	Seat
4770	Spring
4850	Stopper
9040	Set screw

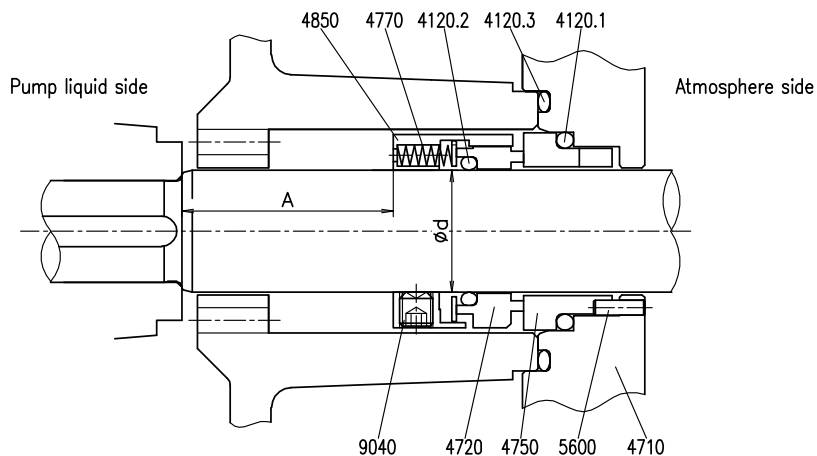
Parts table of a pump

Parts No.	Parts Name
5600	Pin
4120.3	O-ring
4710	Seal cover

Unit: mm

Shaft size	d	A
25-360	24	39
35-470	32	41
45-470		
45-470A	45	43
55-530		
65-530	55	41.5

Fig 5.2-4 Construction of mechanical seal "LA200" (SiC  $\times$  carbon)



Conforming to DIN 24960 standard (Except for mechanical seal overall length)

Note: For order of additional spare parts, designate the type of the mechanical seal as a set, in order to ensure preferable seal effect.

Parts table of a mechanical seal set

Mechanical seal type: L9SA-SE/SK $\phi d$	
Parts No.	Parts Name
4120.1,2	O-ring
4720	Sealing washer
4750	Seat
4770	Spring
4850	Stopper
9040	Set screw

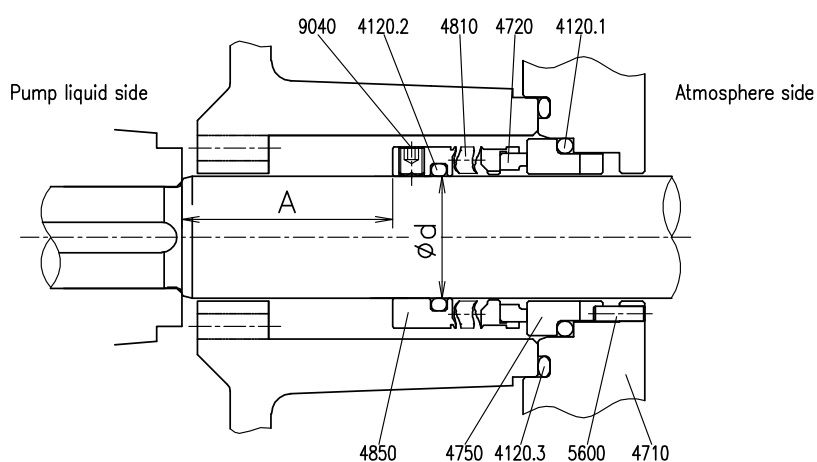
Parts table of a pump

Parts No.	Parts Name
5600	Pin
4120	O ring
4710	Seal cover

Unit: mm

Shaft size	d	A
25-360	24	37
35-470	32	39
45-470		
45-470A	45	40
55-530		
65-530	55	39.5

Fig 5.2-5 Construction of mechanical seal "L9SA" (SiC x SiC)



Conforming to DIN 24960 standard

Note: For order of additional spare parts, designate the type of the mechanical seal as a set, in order to ensure preferable seal effect.

Parts table of a mechanical seal set

Mechanical seal type: MBS100-RF $\phi d$	
Parts No.	Parts Name
4120.1, 2	O-ring
4720	Sealing washer
4750	Seat
4810	Bellows
4850	Stopper
9040	Set screw

Parts table of a pump

Parts No.	Parts Name
5600	Pin
4120	O-ring
4710	Seal cover

Unit: mm

Shaft size	d	A
25-360	24	37
35-470	32	36.5
45-470		
45-470A	45	40
55-530		
65-530	55	38

Fig 5.2-6 Construction of mechanical seal "MBS100"

### 5.2.1. Quench

For the carbon bush type quench structure, refer to Fig 5.2-7. For the oil carbon bush type quench structure, refer to Fig 5.2-8.

- Quench flow rate: 1.0 liter/min or less
- Quench pressure: 0.03 MPaG or less

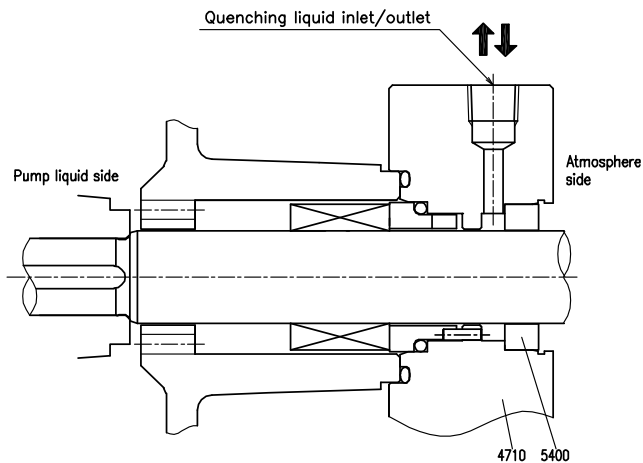


Fig 5.2-7 Quench (Carbon bush type)

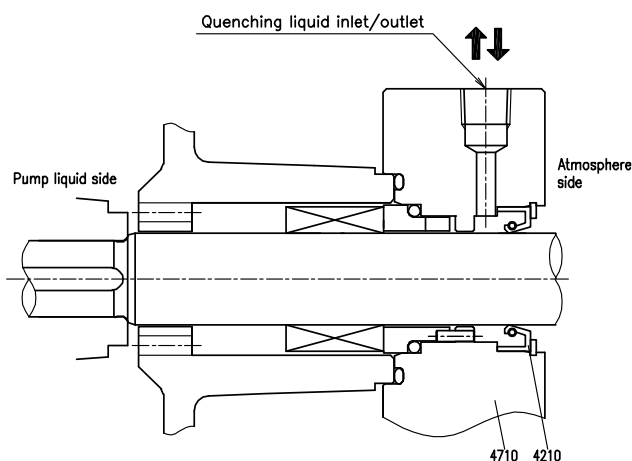


Fig 5.2-8 Quench (Oil seal type)

To execute quenching with the carbon bush type by using water, the water flow rate and pressure should be as shown below. If it is expected to exceed the following flow rate and pressure, use the oil seal type.

- Quench water flow rate: 1.0 L/min or less
- Quench pressure: 0.03 MPaG or less

To execute quenching by using air, the quench pressure should be the same as that for water quenching. The flow rate should be appropriately determined.

The oil seal type should be used to execute quenching by using a liquid with high lubrication property. The quench pressure should be the same as that for the carbon bush type. The flow rate should be appropriately determined.

- Quench pressure: 0.03 MPaG or less

### 5.2.2. Jacket water cooling

In case a jacket water cooling type, refer to Fig 5.2-9.

Do not use the liquid with a strong causticity for cooling water because the material of the jacket cover (1650) is a cast iron. The temperature and the pressure of cooling water should be assumed to be the next.

- Temperature of cooling water: 30°C or less  
(At inlet of cooling water)
- Pressure of cooling water: 0.3MPaG or less

The cooling water flow rate is different depending on use conditions. Refer to the pump data sheet.

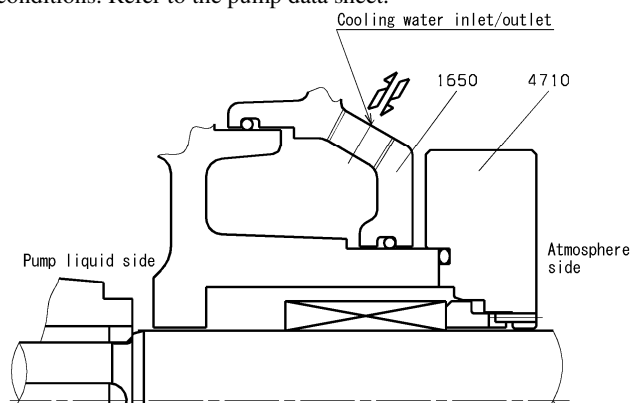


Fig 5.2-9 Jacket water cooling

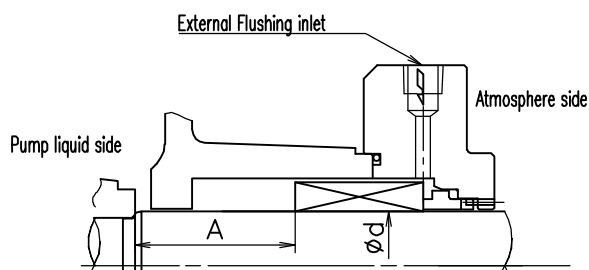
### 5.2.3. External flushing

For the external flushing type, refer to Fig 5.2-10. To inject external flushing liquid, the following two methods are available: The self flushing method to flush pumped liquid over the seal cover from the seat near the discharge flange, and the external flushing method to flush liquid over the seal cover (4710) from an external source. The models of mechanical seal that enable self/external flushing or external flushing are LCA, LA200 and L9SA.

To flush liquid from an external source, the flushing flow rate should be as follows:

- Flushing flow rate: 4 to 5 L/min.

The pressure of flushing flow is different depending on use conditions. Refer to the pump data sheet.

Unit: mm  
Unit: mm

Mechanical seal type		LCA $\phi$ d F/E	LA200-RF $\phi$ d LA200-RE $\phi$ d LA200-RK $\phi$ d	L9SA-RE $\phi$ d L9SA-RK $\phi$ d
Shaft size	d	A	A	A
25-360	24	49.5	51.5	49.5
35-470	32	47	56	54
45-470				
45-470A	45	56.5	63	60
55-530				
65-530	55	49.5	56.5	54.5

Fig 5.2-10 External flushing

### 5.3. Causes leakage from mechanical seal

- (1) When the life period expires.
- (2) When the construction materials of mechanical seal are abnormally eroded.  
The construction materials are carefully selected pursuant to the specifications which were submitted in ordering. When placing an order, therefore, submit the information on the precise properties of intended pumped liquid and other data. In addition, let us have the changed content of the specifications, if any.
- (3) In case of leakage caused by slurry, dust and scale:  
Inclusion of dust and scale in pumped liquid will accelerate wear of the sliding surface and interfere with follow ability of washer (4720) by adhesion of dust and scale to packing (4100) or spring (4770). Finally such a phenomenon will cause leak trouble. In such a case, adequately clean the internal components and each pipeline.
- (4) Imperfect installation, centering and piping connection.  
Improper installation, centering and piping of the pump cause abnormal vibration of the pump, and contact between the rotor and the stator, resulting in leakage from the mechanical seal, damage to the bearing and other troubles. Fully considering the above, perform installation, centering and leveling, piping connection, etc. in strict compliance with this Manual.
- (5) Occasionally incorrect handling and operation, if any, will cause leakage from the mechanical seal.  
For correct pump handling and operation, refer to Section 2 (P.6).

### 5.4. Disassembling

Refer to Subsection 4.2 (P.12) for the pump disassembling

sequence.

#### 5.4.1. Disassembling procedure and precautions

Refer to the disassembling procedure for the type of the mechanical seal being used.

##### [A] Single mechanical seal (Type: CA)

- (1) After completion of the disassembling steps 4.2(1)~4.2(8) (P.12), pull the rotating side mechanical seal set {washer (4720), packing (4100), follower (4740), spring (4770), stopper (4850)} out of shaft (2100).
- (2) After removing the casing cover (1610), remove the seat (4750) and the cushion ring (4101) from the casing cover. When removing the casing cover, use caution so as not to break the seat (4750), and not to damage the internal surface of the seat by hitting it against the shaft (2100). Seat is only fitted in casing cover through cushion ring. So, it can be pulled out by the both hands.

##### [B] Single mechanical seal (Type: LCA, LA200, L9SA, MBS100)

- (1) After completion of the disassembling steps (P.12) of 4.2 (1) through 4.2 (8), loosen the seal cover mounting nut, and slide the seal cover toward the bearing housing (3300). In this step, use caution so as not to break the seat (4750), and not to damage the internal surface of the seat by hitting it against the shaft (2100).
- (2) Remove the casing cover (1610).
- (3) Remove the set bolt (9040) from the stopper (4850), and pull out the mechanical seal on the rotary side from the shaft (2100).
- (4) The seat has been simply inserted in the seal cover with the O-ring (4120.1). It can be removed by pulling it out forcedly with both hands.

##### [C] Double mechanical seal (LTW type)

- (1) After the 4.2 (1) to 4.2 (8) disassembling steps (P.12) are completed, loosen the seal cover (4710) mounting nut, and slide the seal cover (4710) to the bearing housing (3300) side. In this step, use caution so as not to break the seat (4750.1), and not to damage the internal surface of the seat by hitting it against the shaft (2100).
- (2) Remove the casing cover (1610).  
When removing the casing cover, use caution so as not to break the seat (4750.2), and not to damage the internal surface of the seat by hitting it against the shaft.
- (3) Remove the set bolt (9040) from the stopper (4850), and pull out the mechanical seal on the rotary side from the shaft (2100).

- (4) The seats (4750.1 and 4750.2) have been simply inserted in the seal cover and the casing cover with the O-rings (4120.1 and 4120.2) respectively. They can be removed by pulling them out forcibly with both hands.

### 5.5. Inspection and maintenance of disassembled parts

- (1) Check the casing cover (1610) for adhesion of internal scale, and remove rust and scale.
- (2) Check the O-ring (4120) or the cushion ring (4101) insertion part of the casing cover and the seal cover (4710). If a flaw is found, remove it by filing the relevant part with sand paper.
- (3) Check the sliding surfaces for wear. Measure the amount of wear, and check for surface roughness caused by a foreign object caught in the mechanical seal.
- (4) In principle, the mechanical seal must be replaced with a new one once it is overhauled, or the seat (4750) and the washer (4720) must undergo re-lapping, regardless of an amount of wear.
- (5) After the above inspection is completed, thoroughly wash the disassembled parts with wash oil, etc.

### 5.6. Reassembling

#### 5.6.1. Re-assembling procedure and precautions

Refer to the reassembling procedure for the type of the mechanical seal being used.

Before reassembling the mechanical seal, be sure to clean the disassembled parts. Check each part for damage, and check for a missing part before reassembling the mechanical seal.

#### [A] Single mechanical seal (CA type)

- (1) Insert cushion ring (4101) in seat (4750) and push them together into casing cover (1610).  
When inserting the cushion ring into the seat, use caution about the direction of the cushion ring. (Refer to Fig 5.6-1)

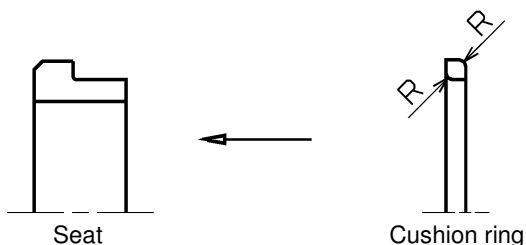


Fig 5.6-1 Cushion ring

- (2) With the seat and the cushion ring attached to the casing cover, mount the casing cover to the bearing housing

(3300).

When mounting the casing cover to the bearing case, use caution so as not to break the seat, and not to damage the internal surface of the seat by hitting it against the shaft (2100).

- (3) Apply a proper amount of oil to packing (4100) and shaft.
- (4) Insert the rotating side mechanical seal set {washer (4720), packing, follower (4740), spring (4770), stopper (4850)} through shaft. In this case, be sure to check whether dust, etc. adhere to the seat and the seal end face S (Fig 5.2-1 (P.14)).
- (5) Mount the key (9400.2) to the shaft, and fit the impeller (2300) on the shaft. Mount the washer (5500), and fully tighten the Hard Lock Nut® (9233). This completes the mechanical seal assembling procedure. For the pump assembling procedure, refer to the steps of 4.2 (1) through (8) (P.12). (Follow the disassembling procedure in reverse order.)

#### [B] Single mechanical seal (Type: LCA, LA200, L9SA, MBS100)

- (1) Put the O-ring (4120.1) in the seat (4750), and insert the seat into the seal cover (4710).
  - a) Use caution about the positions of the seat whirl-stop notch and pin (5600). (See Fig 5.6-2)
  - b) When inserting the seat into the seal cover, be careful not to damage the sliding surface of the seat.
  - c) After inserting the seat, re-check for misalignment of the pin with the notch, and for inclination of the seat.

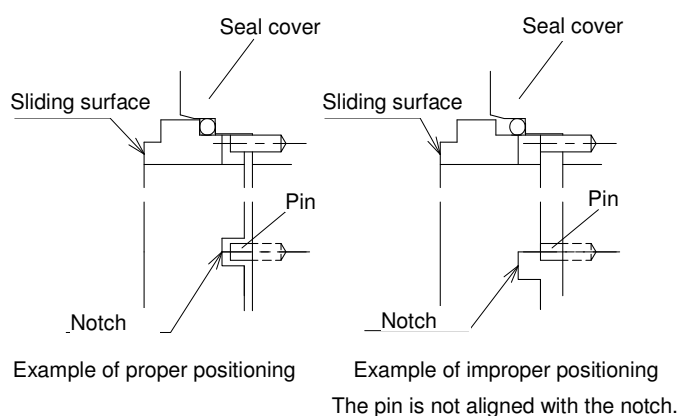


Fig 5.6-2 Relative positions of pin and notch

- (2) With the mechanical seal for the fixed side attached to the seal cover, put the corresponding O-ring (4120.3) in the seal cover. Fit the seal cover on the shaft (2100), and slide the seal cover toward the bearing housing (3300). When mounting the seal cover to the shaft, use thorough caution

so as not to break the seat, and not to damage the bore of the seat by hitting it against the shaft (2100).

- (3) Apply an appropriate amount of oil to the packing (4100) or the O-ring (4120.2), and the shaft. Then, fit the mechanical seal for the rotary side on the shaft, according to the dimension A (shown in Figs. Fig 5.2-2, 5.2-4, 5.2-5, 5.2-6, Fig 5.2-7, Fig 5.2-8 and 5.2-10) (P.14–P.18), and fasten the mechanical seal with the set bolt (9040) securely. Mechanical seal of LCA type:
  - a) Insert the follower (4740) and the spring (4770) in proper orientation.
  - b) When inserting the washer (4720) and the stopper (4850), align the engaging clutch properly.
- (4) After completion of the above mounting procedure, re-check if the set bolt is securely tightened, and make sure that the washer normally works.
- (5) Mount the casing cover (1610) to the bearing housing (3300).
- (6) Mount the seal cover to the casing cover. First, tighten the cover temporarily according to the procedure described in Section 4.3 (P.12). After mounting the impeller (2300), tighten the cover completely.

#### [C] Double mechanical seal (LTW type)

- (1) Put the O-rings (4120.1 and 4120.2) in the seats (4750.1 and 4750.2), and insert the seats into the casing cover (1610) and the seal cover (4710), respectively. For the mounting procedure, refer to Section 5.6.1 [B], (1) (P19).
- (2) With the mechanical seal for the fixed side mounted to the seal cover, put the O-ring (4120.3) in the seal cover. Fit the seal cover on the shaft (2100), and slide the seal cover toward the bearing housing (3300). When mounting the

seal cover to the shaft, use thorough caution so as not to break the seat (4750.1), and not to damage the internal surface of the seat by hitting it against the shaft (2100).

- (3) Apply an appropriate amount of oil to the packing (4100.1) and the shaft. Then, insert the set of washer {washer (4720.1), follower (4740.1), packing (4100.1) and spline ring (5061.1)}, spring (4770.1) and stopper (4850) in sequence. Fit the stopper on the shaft according to dimension A (shown in Fig 5.2-3 (P15)), and fasten the stopper with the set bolt (9040) securely.
- (4) Apply an appropriate amount of oil to the packing (4100.2) and the shaft. Then, insert the spring (4770.2), and the set of washer {washer (4720.2), follower (4740.2), packing (4100.2) and spline ring (5061.2)} for the liquid contact side in sequence.
- (5) With the mechanical seal for the fixed side mounted to the casing cover, mount the casing cover to the bearing housing. When mounting the casing cover to the bearing case, use caution so as not to break the seat (4750.2), and not damage the internal surface of the seat by hitting it against the shaft.
- (6) Mount the seal cover to the casing cover. In this step, make sure that the flushing outlet port is placed vertically upward. First, tighten the cover temporarily according to the procedure described in Section 4.3 (P.12). After mounting the impeller (2300), tighten the cover completely.

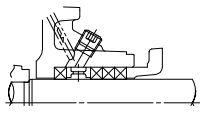
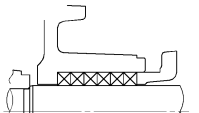
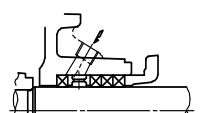
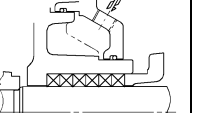
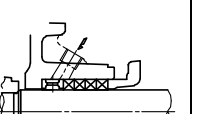
## 6. Gland packing

The following types of shaft seal structure is available depending on operating conditions (See Table 6-1)

For external flushing, flushing pressure, flushing flow rate and casing cover cooling water flow rate very depending on operating conditions.

For details, refer to the pump data sheet.

Table 6-1 Type of gland packing

Code		NA	NB	NC	HW <sup>(2)</sup>	VH
Liquid injection system		Self flushing	Without flushing	External flushing	Without flushing	Neck flushing by external flushing
Jacket water cooling		None	None	None	Provided	None
Sketch						
Application		Pumping of clean liquid, or $P_s^{(1)} \leq 0.05$ MPaG	$P_s^{(1)} \geq 0.05$ MPaG, or odorous liquid (In case where liquid leakage from shaft seal must be minimized)	Injection from vacuum tank (In case where external flushing is continued even while the pump is not in operation, in order to prevent air intake.)	Pumping of clean, high-temperature liquid at suction pressure higher than atmospheric pressure	Pumping of liquid with wearing ingredients. In case where gland packing must be protected from corrosion
Pumped liquid temperature	General liquid	Below 100°C	Below 100°C	Below 100°C	100 to 160°C	Below 100°C
	Heat medium	—	—	—	100 to 220°C	—

(1)  $P_s$ : Pump suction pressure

(2) For gland packing HW (with water cooled jacket):

Do not use the liquid with a strong causticity for cooling water because the material of the jacket cover (1650) is a cast iron. The temperature and the pressure of cooling water should be assumed to be the next.

- Temperature of cooling water: 30°C or less (At inlet of cooling water)
- Pressure of cooling water: 0.3 MPaG or less

The cooling water flow rate is different depending on use conditions. Refer to the pump data sheet.



## 7. Troubleshooting

Main possible troubles of the pump are as described hereunder. If a trouble occurs with the pump, stop the pump immediately, and take corrective actions depending on the cause and phenomenon of the trouble. If the trouble can not be fixed or the cause can not be identified in spite of having implemented the following measures, examine the content of the trouble in detail. After that, contact a nearest distributor or dealer authorized by Torishima.

### 7.1. Pump cannot be filled with liquid.

Probable Cause	Corrective Action
Air intake from discharge valve	Tighten the discharge valve. If the problem persists, check the seat surface, and re-adjust the full-close limit.
Fault of air bleeding solenoid valve	Provide a bypass, or open the valve manually, if a manual handle is provided. Check and repair the valve, as required.

### 7.2. Pump cannot start.

Probable Cause	Corrective Action
Starting conditions cannot be satisfied.	Check the starting conditions. If this problem is caused by a fault of equipment or circuit, repair the relevant part.
Protective circuit is activated.	Check if the pump has been reset after recovery from a fault.

### 7.3. Insufficient discharge or incapable of pumping

Probable Cause	Corrective Action
Insufficient priming of pump and piping, or insufficient air bleeding	Execute priming or air bleeding again. If the problem persists, repair the piping, and re-design the air bleeding valve and the air bleeding pipe.
Clogged suction valve or impeller	Clean piping or remove and clean impeller as necessary.
Excessive wear of pump parts	Disassemble pump and repair or replace faulty parts or adjust clearance between sliding parts as necessary.
Ingestion of air from stuffing box	Increase the sealing water pressure, and check if sealing water normally flows. Clean inside of the sealing water piping, if necessary. If the self flushing pressure is insufficient, change the flushing method to external flushing from an external high-pressure source.
Low rotation speed	Check the motor for overload or abnormal voltage to keep the motor load and voltage normal.
Reversing	Exchange connection of motor terminals.
Cavitation	Check for clogging of a foreign object in the suction valve, suction strainer and piping, and remove it, if any.
Excessive total head required	The actual pump head is higher than the planned level. Consult us for corrective action.

### 7.4. Motor overload

Probable Cause	Corrective Action
The motor load is remarkably deviated from the rating.	Narrow the discharge valve opening to adjust the flow rate appropriately.
Liquid of large weight per volume or high viscosity	If the specific gravity and viscosity given in the specifications cannot be maintained, reduce the discharge rate to an allowable lower level. If it is not effective, adjust the outer diameter of the impeller, or use a motor with larger capacity.
Check valve with automatic discharge valve does not work well.	Replace worn parts of valve.
Excessively high rotation speed	Restore the rotation speed to the specified value by adjusting the power supply voltage, or by using the governor. If the rotation speed cannot be restored, reduce the discharge rate to an allowable lower level. If it is not effective, adjust the outer diameter of the impeller, or use a motor with larger capacity.
Foreign object trapped in pump	Disassemble and remove foreign objects.
Freezing of pumped liquid	To leave the pump unused in cold weather, be sure to drain liquid from the pump so that no liquid remains in the pump.