STERN TUBE SEAL

STERN KEEPER C-TYPE

MANUAL
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CHAPTER 1 DESCRIPTION OF SAFETY

1 LIST OF WARNING

The WARNING items in this manual are shown in TABLE 1-1.
The “WARNING” means the operation or the maintenance which would cause an accident resulting injury or death in case they are not kept.

<table>
<thead>
<tr>
<th>WARNING STATEMENT</th>
<th>OUTLINE OF WORK AND OPERATION</th>
<th>MEANING OF WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAGE NO</td>
<td>ITEM</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>2.1 Operation during run</td>
<td>Check temperature by hand touch outside of SEAL RING②.</td>
</tr>
<tr>
<td>10</td>
<td>2.2 Note during run</td>
<td>Check temperature of SEAL RING② to be normal.</td>
</tr>
<tr>
<td>11</td>
<td>1 Maintenance List</td>
<td>Check temperature by hand touch outside of SEAL RING②. Once a week.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check ANTICORROSI NG PLUG② every 3 months after operate CONTRACTIBLE SEAL⑤ and close water supply valve.</td>
</tr>
<tr>
<td>12</td>
<td>1 Maintenance List</td>
<td>Check ball valve, pressure gauge on VALVE UNIT⑦ once a year.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Re-grind SEAL RING② once a year, replace ROTATING SEAL RING①, BAND ⑨ and O–RING⑥ in case of large water leakage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Re-grind SEAL RING②, replace ROTATING SEAL RING①, BAND ⑨ and O–RING⑥ every 2 or 3 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean VACUUM EJECTOR ① of VALVE UNIT⑦ every 2 or 3 years.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the SEAL DEVICE including bolts, nuts etc at periodical inspection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace CONTRACTIBLE SEAL⑤, and O–RING② at periodic inspection.</td>
</tr>
</tbody>
</table>
TABLE 1-1 LIST OF WARNING (Continued)

<table>
<thead>
<tr>
<th>PAGE</th>
<th>NO</th>
<th>ITEM</th>
<th>OUTLINE OF WORK AND OPERATION</th>
<th>MEANING OF WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>1</td>
<td>Maintenance List</td>
<td>On removing the SHAFT, peel off old paint and apply ANTICORROSING PAINT.</td>
<td>To perform the work during shaft-run stop and dry dock stay.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When the SLEEVE is re-grinded on the SHAFT removing, replace ROTATING SEAL① and BAND⑨ as well.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When dismantling the SEAL DEVICE SHEET PACKING⑦ is replaced as well.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>3</td>
<td>Dismantle, assemble, inspection and adjustment</td>
<td>Replace ROTATING SEAL RING①. To stop shaft-rotation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remove SEAL RING②. Not to drop Split SEAL RING② when removing it.</td>
<td></td>
</tr>
</tbody>
</table>

2. LIST OF CAUTION

The CAUTION items in this manual are shown in TABLE 1-2.

The “CAUTION” means the operation or the maintenance which would cause an accident resulting device damage in case they are not kept.

TABLE 1-2 LIST OF CAUTION

<table>
<thead>
<tr>
<th>PAGE</th>
<th>NO</th>
<th>ITEM</th>
<th>OUTLINE OF WORK AND OPERATION</th>
<th>MEANING OF WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>1</td>
<td>Preparation before run</td>
<td>Check BALL VALVE① for air release on VALVE UNIT㉗ is opened fully and PRESSURE GAUGE shows 0 MPa.</td>
<td>Not to operate CONTRACTIBLE SEAL⑤ during shaft run.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.1</td>
<td>Operation during run</td>
<td>Check that CONTRACTIBLE SEAL⑤ is not working.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2.2</td>
<td>Note during run</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Check that pressure gauge of VALVE UNIT㉗ is 0 MPa.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>3</td>
<td>Dismantle, assemble, inspection and adjustment</td>
<td>After dismantle, assembly, inspection and adjustment in the sea, cancel CONTRACTIBLE SEAL⑤ operation.</td>
<td>Heat would be generated on SEAL RING①,②.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>After dismantle, assembly, inspection &amp; adjustment in the sea, release PLUG③ and discharge air in the SEAL DEVICE.</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 2 OUTLINE

1. INTRODUCTION

This SEAL DEVICE (STERN KEEPER TYPE SKC) is a kind of END FACE SEAL DEVICE lubricated with sea water.

The structure is simple with applying rubber elasticity and meets complex vibration from shaft system completely.

The synthetic rubber (NBR) and stainless steel (SUS316) or bronze (CAC403) are applied to the sealing face (contacting face of ROTATING SEAL RING① and SEAL RING②).

The characteristic of the SEAL DEVICE is as follows.

(1) The shaft abrasion, which is caused in case of conventional grand packing, is not happened as there is not the sealing face on the SLEEVE.

(2) The ROTATING SEAL RING① is made of elastic rubber and thrust pad on both front and rear of ROTATING SEAL RING① and has a good performance of followability to axial and radial deflection.

(3) The installation work is easy.

(4) The corrosion-proof countermeasures are introduced in the SEAL DEVICE.

(5) As the CONTRACTIBLE SEAL⑤ for emergency is installed, it is available to stop water leakage and replace ROTATING SEAL RING① by supplying air in the sea.

(6) As both end faces of SEAL RING② are available to use, the action is easy to take in case of emergency. Furthermore it is available to re-use SEAL RING② by re-grinding the sealing face.

2. SPECIFICATION

2.1 SEAL TYPE END FACE SEAL DEVICE BY SEA WATER LUBRICATION

2.2 PLANNED CONDITION

(1) Cooling water : Sea water

(2) Sleeve material : CAC402+0.5%Ni

(3) Cooling water pressure (normal): draught pressure + 0.01~0.04 MPa

(4) Cooling water pressure (Max) : Max. 0.15 MPa

(5) Water volume of cooling water : Min. 10L/min

In case of water supply to RUBBER BEARING.

\[ \text{Water volume} = \frac{1000 \text{m}^3/\text{h}}{5.9} \times \text{SLEEVE Dia. (cm)}^2 \]

Please contact specified bearing supplier when not rubber bearing.

(6) Air pressure to work CONTRACTIBLE SEAL⑤ : 0.2~1.0 MPa
3. PERFORMANCE

The performance of the SEAL DEVICE is shown in TABLE 2-1.

**TABLE 2-1 PERFORMANCE LIST**

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak water volume</td>
<td>0~50L/day</td>
</tr>
<tr>
<td>Shaft surface speed limit</td>
<td>Max. 8m/s</td>
</tr>
<tr>
<td>Pressure of cooling water</td>
<td>Min. 0.035MPa</td>
</tr>
<tr>
<td>Temperature of cooling water</td>
<td>0~35℃</td>
</tr>
<tr>
<td>Temperature of SEAL RING</td>
<td>0~40℃</td>
</tr>
<tr>
<td>Pressure of CONTRACTIBLE SEAL</td>
<td>0.2~1.0 MPa</td>
</tr>
</tbody>
</table>

*: During shaft-run, it is not available to use.

4. ASSEMBLY SPECIFICATION

The clearance tolerance between CASING③ and the SLEEVE is shown in TABLE 2-2.

The squareness tolerance between the seal installation face and the SLEEVE is shown TABLE 2-3.

**TABLE 2-2 CLEARANCE TOLERANCE**

<table>
<thead>
<tr>
<th>SHAFT DIAMETER</th>
<th>DIMENSION A</th>
</tr>
</thead>
<tbody>
<tr>
<td>φ 70~φ149</td>
<td>3±0.5</td>
</tr>
<tr>
<td>φ150~φ209</td>
<td>4±1</td>
</tr>
<tr>
<td>φ210~φ699</td>
<td>6±1</td>
</tr>
</tbody>
</table>

**TABLE 2-3 SQUARENESS TOLERANCE**

<table>
<thead>
<tr>
<th>SHAFT DIAMETER</th>
<th>SQUARENESS (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>φ 70~φ149</td>
<td>0.2</td>
</tr>
<tr>
<td>φ150~φ209</td>
<td>0.3</td>
</tr>
<tr>
<td>φ210~φ399</td>
<td>0.5</td>
</tr>
<tr>
<td>φ400~</td>
<td>0.8</td>
</tr>
</tbody>
</table>


CHAPTER 3 STRUCTURE AND OPERATION

1. FUNDAMENTAL STRUCTURE (DRAWING 3-1, 3-2)

The SEAL DEVICE consists of dynamic components which is installed on the SLEEVE and static components which is installed on the end face of the STERN TUBE.

Both the impact resilience of seal lip and the water pressure applied to the back face of ROTATING SEAL RING① provides with sealing pressure.

Some grooves are prepared on the thrust pad on lip side of ROTATING SEAL RING① and can replace cooling water to seal lip.

The CONTRACTIBLE SEAL⑤ is U-shaped, rubber made ring. The air is applied to the inside of it and shrink it to prevent the water leakage.

![DRAWING 3-1](image1)

![DRAWING 3-2](image2)

2. DETAILED STRUCTURE

2.1 CASING

The CASING③ with CONTRACTIBLE SEAL⑤ is installed on the face of the STERN TUBE and the SEAL RING② is fixed on the bow side of CASING③.

To prevent corrosion between the SHAFT and CASING③, the end face of the STERN TUBE is insulated with SHEET PACKING⑦ and BUSH⑧. To prevent corrosion, between hull and compressed air system of CONTRACTIBLE SEAL⑤ is insulated with TUBE⑹.

The piping system for cooling water is insulated with RUBBER HOSE⑱.
2.2 ROTATING SEAL RING
The ROTATING SEAL RING① is installed between CASING③ and SEAL RING② and then fixed with BAND⑨.

It is made of synthetic rubber(NBR) with excellent performance of waterproof, abrasion-proof and sealing. The spare ROTATING SEAL RING① is set on bow side and the replacement of it is very easy in the sea.

The ROTATING SEAL RING① plays important role to seal the water with SEAL RING②.

2.3 SEAL RING
The SEAL RING②, which is fixed on CASING③, is made of stainless steel(SUS316) or bronze(CAC403).

It is split into two pieces.

Both end faces of it are available to use as the sealing faces and one of them is prepared as another sealing face.

The sealing face must be kept not give any flaw.

The sealing face, where is contacting with ROTATING SEAL RING①, is the most important portion.

After it is finished finely with a lathe machine, it is polished with sand paper(No.240) neatly.

When the sealing face is re-grinded with a lathe machine, chuck the outside of the SEAL RING② not to open the split of it.

2.4 CONTRACTIBLE SEAL
The CONTRACTIBLE SEAL⑤ is made of rubber(NBR) and put into CASING③ and held with STOP RING④.

The CONTRACTIBLE SEAL⑤ is used when the SEAL RING② or ANTICORROSION-PLUG㉘ is replaced in the sea.

By supplying air (0.2~1.0 MPa), the CONTRACTIBLE SEAL⑤ is shrink inside and tighten the SHAFT and stop water leakage.

Accordingly, it is not used except the above case.

When the CONTRACTIBLE SEAL⑤ is operated for a long time, not to enclose a compressed air for a long time from BALL VALVE of VALVE UNIT㉗ but always keep to supply compressed air.

As the CONTRACTIBLE SEAL⑤ is not use during shaft running, discharge air after it is used.
CHAPTER 4  HANDLING PROCEDURE

1  PREPARATION BEFORE RUN

1.1  NORMAL RUN
(1) To confirm that the BALL VALVE① for air release on VALVE UNIT⑦ is opened fully and the pressure gauge shows 0 MPa.

CAUTION
NOT TO OPERATE THE CONTRACTIBLE SEAL⑤ DURING RUN.

(2) To confirm that the pressure of cooling water is 0.035MPa<P<0.15 MPa with pressure gauge on pipe.
(3) To confirm that the cooling water is running with pressure gauge and touching cooled water pipe.
(4) To confirm that the water is not leaking anywhere except sealing face.

1.2  AFTER LONG STOPPAGE OR DISMANTLE MAINTENANCE
(1) After leave dock, to confirm that the air is discharged after PLUG③ on CASING③ is released and the water is supplied to the SEAL DEVICE.
(2) To confirm the note in accordance with previous item 1.1(NORMAL RUN)

2  OPERATION PROCEDURE

2.1  OPERATION DURING RUN
(1) To confirm that the cooling water is running with pressure gauge.
(2) To confirm that the water is not leaking and check the volume of it if any.
(3) To touch the outside of SEAL RING② and confirm the temperature of it.

WARNING
NOT TO TOUCH THE ROTATING SHAFT TO CHECK THE TEMPERATURE.

(4) To confirm that the pressure gauge on VALVE UNIT⑦ is 0MPa.

CAUTION
NOT TO OPERATE CONTRACTIBLE SEAL⑤ DURING RUN.
2.2 NOTE DURING RUN
(1) To confirm that the pressure of cooling water is normal.
(2) To confirm that the volume of leaked water is normal.
(3) To confirm that the temperature of SEAL RING② is normal.
(4) To confirm that the pressure gauge on VALVE UNIT㉗ is 0 MPa.

WARNING
NOT TO TOUCH THE ROTATING SHAFT

CAUTION
NOT TO OPERATE CONTRACTIBLE SEAL⑤ DURING RUN

3. ACTION AFTER RUN
3.1 NORMAL RUN
(1) To confirm the water leakage during shaft-stop.
(2) To stop the supply of cooling water to the BEARING.

3.2 LONG STOPPAGE
(1) In case of stop over one week, to supply the water to the SEAL DEVICE once a week.
(2) To confirm the note in accordance with previous item 3.1 (NORMAL RUN)

4. CONTRACTIBLE SEAL OPERATION PROCEDURE
4.1 PREPARATION
To open BALL VALVE○a2 of VALVE UNIT㉗ and discharge drain of VACUUM EJECTOR fgets.
To confirm that the air is discharged by putting hand on air discharge side of BALL VALVE○a1 of VALVE UNIT㉗. Clean VACUUM EJECTOR fgets if the air-discharge is too weak.

4.2 OPERATION
To close BALL VALVE○a1 for air release of VALVE UNIT㉗ and supply compressed air (0.2~1.0 MPa) to CONTRACTIBLE SEAL⑤ by opening BALL VALVE○a2.
Accordingly, the CONTRACTIBLE SEAL⑤ is shrunk to tighten the SLEEVE for sealing.
But the CONTRACTIBLE SEAL⑤ is not available to use during shaft-run.

4.3 CANCELLATION
To close BALL VALVE○a2 of VALVE UNIT㉗. Open BALL VALVE○a2 after opening BALL VALVE○a1, sucks out air enough through the copper pipe for 10 to 20 sec.
After that, close the BALL VALVE○a2.
 CHAPTER 5 MAINTENANCE

The MAITENANCE LIST of SEAL DEVICE is shown in TABLE 5-1.

As the maintenance frequency below is standard term, please implement it per actual condition.

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>MAINTENANCE ITEM</th>
<th>ACTION FOR SAFETY</th>
<th>IMPLEMENT PROCEDURE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every day</td>
<td>Check cooling Water supply to</td>
<td>1. Check pressure gauge 1. Check cooled pipe with hand touch.</td>
<td>In case of larger volume, Refer to 5-2. (Trouble and Action)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the BEARING</td>
<td>2. Check cooled pipe with hand touch.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check leaked water volume</td>
<td>3. Clean filter of cooling water system. (Draught pressure + 0.01~0.04 MPa)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once a week</td>
<td>Check temperature of the SEAL</td>
<td>WARNING Not to touch the SHAFT</td>
<td>Below 50℃ is normal. In case the shaft temperature is too high to touch, refer To 5-2. (Trouble and Action)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long stoppage in</td>
<td>Cooling water Supply to the</td>
<td>In case of long stoppage in the sea, supply water to the STERN TUBE and replace water in the STERN TUBE once a week.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the sea. (Over a</td>
<td>BEARING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>week)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once every three</td>
<td>ANTICORROSI NG PLUG check</td>
<td>WARNING To check during shaft-stop</td>
<td>In case dimension (t) is below 1 mm, replace it. (dimension(t) of new one:10mm) Note) In case of shaft-diameter below Φ99, the dimension (t) is 5 mm.</td>
<td>Operate CONTRACTIBLE SEAL and close water supply valve and start to work.</td>
</tr>
<tr>
<td>months</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![DRAWING 5-1](image)

Dimension (t) of ANTICORROSOING PLUG
<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>MAINTENANCE ITEM</th>
<th>ACTION FOR SAFETY</th>
<th>IMPLEMENT PROCEDURE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a year</td>
<td>Check ball valve and pressure gauge of VALVE UNIT㉗</td>
<td>WARNING To implement during shaft-stop</td>
<td>In case trouble or damage is found, replace it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement of ROTATING SEAL RING①</td>
<td></td>
<td>Only when the leaked water is over 100L/day, replace it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement of BAND⑨</td>
<td></td>
<td>Only when the ROTATING SEAL RING① is replaced, the BAND⑨ is replaced as well.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Re-grind of SEAL RING②</td>
<td></td>
<td>Only when the leaked water is over 100L/day, re-grind it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement of O−RING⑥</td>
<td></td>
<td>Only when the SEAL RING② is replaced, the O−RING is replaced as well.</td>
<td></td>
</tr>
<tr>
<td>Once every two or three years</td>
<td>Replacement of ROTATING SEAL RING①</td>
<td>WARNING To implement during shaft-stop</td>
<td>Replace to new one. (Spare ROTATING SEAL RING① is set on the SHAFT and then bonded.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement of BAND⑨</td>
<td></td>
<td>It is replaced with ROTATING SEAL RING① replacement.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Re-grinding of SEAL RING②</td>
<td></td>
<td>Re-grind it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement of O−RING⑥</td>
<td></td>
<td>Replace to new one and passed over 3 months, replace to new one again.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cleaning of VACUUM EJECTOR①</td>
<td></td>
<td>Remove it from VALVE UNIT㉗ and clean it.</td>
<td></td>
</tr>
<tr>
<td>Periodic inspection</td>
<td>Check the SEAL DEVICE, bolt, nut etc</td>
<td>WARNING To implement during dry-dock stay and shaft-stop</td>
<td>Remove from hull and clean each components.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement of CONTRACTIBLE SEAL⑤</td>
<td></td>
<td>If corrosion, damage and degrading are found, replace to new one or repair it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement of O−RING㉙</td>
<td></td>
<td>Replacement to new one.</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 5-1 MAINTENANCE LIST (Continued)

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>MAINTENANCE ITEM</th>
<th>ACTION FOR SAFETY</th>
<th>IMPLEMENT PROCEDURE</th>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodic inspection</td>
<td>Application of ANTICORROSONG PAINT</td>
<td>WARNING</td>
<td>Peel off old paint on the SLEEVE and apply ANTICORROSONG PAINT. Refer to assembly drawing for paint area.</td>
<td>In case a rough surface is found, make it smooth with sand paper.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To implement during shaft-stop</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Each dismantle work</td>
<td>Replacement of SHEET PACKING⑦</td>
<td>WARNING</td>
<td>Replacement to new one. when it is removed at dismantle work.</td>
<td>Apply a liquid packing to set.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To implement during shaft-stop</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 2 TROUBLE AND ACTION

The TROUBLE AND ACTION is shown in the TABLE 5-2

### TABLE 5-2 TROUBLE AND ACTION

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large water leakage</td>
<td>• Abrasion of ROTATING SEAL RING①</td>
<td>Optimum volume of leaked water is about 0〜50L/day Even if the water is increased over 500L/day, adjustment is not necessary. As the water level is changed periodically, check it for four or five days. And in case the water level is not decreased, take the actions below.</td>
</tr>
<tr>
<td></td>
<td>• Abrasion of SEAL RING②</td>
<td>(1) Remove SEAL RING② and repair rough surface to make smooth with sand paper etc.</td>
</tr>
<tr>
<td></td>
<td>• Bite of dusts on sealing face</td>
<td>(2) In case the water level is not decreased after the action (1), replace ROTATING SEAL RING① to spare one and reverse SEAL RING②. In case the SEAL RING② is re-grinded, the ROTATING SEAL RING② must be replaced to new one.</td>
</tr>
<tr>
<td></td>
<td>• Step on sealing face of split portion</td>
<td>(3) The step on split portion is smoothed with sand paper.</td>
</tr>
<tr>
<td>Temperature of SEAL RING is very high.</td>
<td>The air is held in the SEAL DEVICE</td>
<td>Release PLUG㉓ of CASING③ and discharge air in the SEAL DEVICE and water supply system.</td>
</tr>
<tr>
<td></td>
<td>Cooling water is not supplied.</td>
<td>Check valve operation. Check pump and pipe system.</td>
</tr>
<tr>
<td></td>
<td>CONTRACTIBLE SEAL is working</td>
<td>Open BALL VALVE ○a₁ for air discharge of VALVE UNIT㉗ and close BALL VALVE ○a₂ and release CONTRACTIBLE SEAL⑤ operation.</td>
</tr>
<tr>
<td></td>
<td>Sealing face is not fitting.</td>
<td>In case the ROTATING SEAL RING① is replaced, the heat is generated until the sealing face is fitted. Release PLUG㉓ of CASING③ and discharge sea water to cool and wait the sealing face is fitting. (20〜30 hr) In case the temperature is increased, supply water to location (mark ↓) on DRAWING 5-2 and cool it.</td>
</tr>
<tr>
<td>Pressure of cooling water is too low.</td>
<td>Water supply is disturbed.</td>
<td>Check valve operation. Check pump, piping system and filter etc.</td>
</tr>
</tbody>
</table>

![DRAWING 5-2 SEAL RING](image)
3 DISMANTLE, ASSEMBLY, INSPECTION AND ADJUSTMENT

3.1 DISMANTLE, ASSEMBLY AND MAINTENANCE

3.1.1 REPLACEMENT OF ROTATING SEAL RING

Below is procedure to replace ROTATING SEAL RING① in the sea.

Refer to (6)〜(14) to replacement in dry dock.

WARNING    TO STOP SHAFT-ROTATION

(1) Stop water supply to the BEARING.
(2) Preparation before CONTRACTIBLE SEAL⑤ operation.
   (Note: To stop shaft-rotation. Refer to CHAPTER 4. HANDLING PROCEDURE)
(3) Close BALL VALVE① for air release of VALVE UNIT⑦ to supply the air to
   CONTRACTIBLE SEAL⑤.
(4) Open BALL VALVE⑦ of VALVE UNIT⑦ and increase air pressure slowly to
   reach 0.2〜1.0MPa.
(5) Release PULG㉓ to discharge the air and confirm that CONTRACTIBLE SEAL⑤
   is working.
(6) Remove NUT⑰ and BOLT⑫ and then remove SEAL RING②.
   As there are GUIDE PIN⑲ is in SEAL RING②, open it both side equally.
   In case GUIDE PIN⑲ is bent, it must be replaced.

WARNING    NOT TO DROP SPLIT SEAL RING② WHEN REMOVING IT

(7) Clean spare sealing face of SEAL RING②.
(8) Take out ROTATING SEAL RING① with PULL-OUT JIG from notch as DRAWING 5-3.
   On this occasion, pull out ROTATING SEAL RING① as its circumference comes out evenly.

DRAWING 5-3 PULLING-OUT PROCEDURE OF SEAL RING
(9) Remove \textit{BAND} after release \textit{BOLT}. Cut \textit{ROTATING SEAL RING} with a knife and remove it from the \textit{SLEEVE}.

(10) Clean thrust pad of \textit{CASING} and surface of the \textit{SLEEVE} and apply grease on them and inside diameter area of \textit{ROTATING SEAL RING} as well.

(11) Clean and degrease split portion of \textit{SEAL RING}. And connect split portion with \textit{BOLT} after liquid packing is applied on it.

(The connection location is beyond \textit{ROTATING SEAL RING} of bow side) On this occasion, the step on sealing face is not acceptable. The step is finished to be smooth with sand paper.

(Refer to \textit{DRAWING5-4})

\textit{DRAWING5-4} LIQUID PACKING APPLICATION ON \textit{SEAL RING}.

(12) Clean the sealing face of \textit{ROTATING SEAL RING} and \textit{SEAL RING}. And apply grease on them.

(13) Pushing spare \textit{ROTATING SEAL RING} with \textit{SEAL RING}, move spare \textit{ROTATING SEAL RING} into \textit{CASING}.

\textbf{DRAWING 5-5} INSTALLATION PROCEDURE OF \textit{SEAL RING}
3.1.2 RE-GRINDING OF SEAL RING

After remove NUT and BOLT, take off SEAL RING from CASING. Then re-grind the sealing face till the abrasion is disappeared. The surface roughness of sealing surface must be below 1.5 μm Ry. The trace out of a lathe machine must be cleaned with sandpaper (No.120~240). The chuck of a lathe machine is tightened from outside. The split portion is opened if the chucking is done inside. In case the split portion is opened even if they are tightened with bolts, re-grind the split portion.

When thickness \([t]\) changes to low-limit, replace to new one (DRAWING 5-6)

![Spare sealing face](image)

**DRAWING 5-6 THICKNESS \([t]\) of SEAL RING**

3.1.3 STANDARD SIZE & REPLACEMENT BASE SIZE OF SEAL RING (mm)

<table>
<thead>
<tr>
<th>SEAL RING</th>
<th>SHAFT DIAMETER</th>
<th>ORIGINAL THICKNESS</th>
<th>LIMIT TOTAL THICKNESS TO RE-GRIND</th>
<th>LIMIT TOTAL THICKNESS TO RE-GRIND ONE SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\phi 70\sim \phi 99)</td>
<td>12</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>(\phi 100\sim \phi 149)</td>
<td>16</td>
<td>10</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>(\phi 150\sim \phi 209)</td>
<td>20</td>
<td>13</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>(\phi 210\sim \phi 399)</td>
<td>24</td>
<td>16</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(\phi 400\sim \phi 699)</td>
<td>26</td>
<td>18</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
3.1.4 SLEEVE RE-GRINDING LIMIT
The SLEEVE is re-grinded because of abrasion and corrosion. The applicable re-grinding dimension per SLEEVE SIZE is as follows.

<table>
<thead>
<tr>
<th>DIAMETER OF SLEEVE (mm)</th>
<th>MAX RE-GRINDING MARGIN (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ф 70 ~ Ф 149</td>
<td>2 IN DIAMETER</td>
</tr>
<tr>
<td>Ф 150 ~ Ф 209</td>
<td>3 IN DIAMETER</td>
</tr>
<tr>
<td>Ф 210 ~ Ф 399</td>
<td>5 IN DIAMETER</td>
</tr>
<tr>
<td>Ф 400 ~ Ф 699</td>
<td>7 IN DIAMETER</td>
</tr>
</tbody>
</table>

In case the SLEEVE is re-grinded over the dimension above, replace to new SEAL DEVICE with new dimension.

3.1.5 REPLACEMENT OF CONTRACTIBLE SEAL (per each shaft removal)
(1) Remove both SEAL RING② and ROTATING SEAL RING①.
(2) Remove CASING③ from the STERN TUBE.
(3) Take off BOLT⑭ and remove STOP RING④ from CASING③.
(4) Remove both CONTRACTIBLE SEAL⑤ and O-RING㉙.
(5) Re-assembly is implemented in accordance with 3.1.7 (ASSEMBLY AND INSTALLATION).

3.1.6 REPLACEMENT OF ANTICORROSING PLUG
In case the replacement in the sea is implemented, it is done after implementation of 3.1.1 (REPLACEMENT OF ROTAION SEAL RING (1)～(5)).

3.1.7 ASSEMBLY AND INSTALLATION (REFER TO DRAWING5-7～5-9)
(1) Clean CASING③ and STOP RING④ and check there is not any flaw on the contacting face with CONTRACTIBLE SEAL⑤. (In case there is any sludge etc. on the contacting face of CONTRACTIBLE SEAL⑤ with CASING③ and STOP RING④, clean it with a sandpaper etc. and finish it to become smoothly.)
(2) Apply water-proof grease thinly on the location marked ///// on CASING③.
(3) Apply water-proof grease thinly on one side (CASING③ side) of CONTRACTIBLE SEAL⑤ and push it into CASING③. As the outside diameter of CONTRACTIBLE SEAL⑤ is larger than the inside diameter of CASING③, push one part of it in first and the other part in order.
(4) Apply water-proof grease thinly on one side (STOP RING④ side) of CONTRACTIBLE SEAL⑤ which is set in CASING③.
(5) Install O-ring㉙ into the groove of CASING③.
(6) Apply water-proof grease thinly on the location marked ///// on STOP RING④ and fix it on CASING③ with BOLT⑭. (BOLT⑭ must be tightened in order diagonally.)
(7) Put SHEET PACKING⑦ on the back of CASING③ with rubber adhesive.

(8) Clean the end face of the STERN TUBE.

(9) Put CASING③ on the end face of the STERN TUBE with BOLT⑩.

(10) Check the arrangement of CASING③ with marking TOP. The clearance between top/bottom and right/left must be arranged equally. (Refer to P.6 TABLE 2-2)

(11) Before the SHAFT is installed in the STERN TUBE, apply ANTICORROSING PAINT on the location where the SEAL DEVICE is installed widely.

(Refer to attachment drawing-1)

(12) Installation onto the SHAFT

When the SHAFT is installed into the BEARING of the STERN TUBE from stern side, an watchman, who stays inboard, checks if the SHAFT is inserted correctly.
(13) Put BAND⑨ on the outside of ROTATING SEAL RING① and tighten it with BOLT⑮.

(14) Clean the sealing face of ROTATING SEAL RING① and SEAL RING②, the surface of thrust pad of CASING③ and the surface of the SLEEVE. Then apply a grease on them thinly.

(15) Pushing forward ROTATING SEAL RING① with SEAL RING②, move ROTATING SEAL RING① into CASING③.

(16) Fix SEAL RING② with NUT⑰.

(17) Put spare BAND⑨ on the band groove of spare ROTATING SEAL RING① and tighten with BOLT⑮.

On this occasion, not to make SEAL RING② touch.

(18) Install TUBE FITTING⑰ for piping to supply compressed air to CONTRACTIBLE SEAL⑤.

Then connect VALVE UNIT⑱ and the SEAL DEVICE side with Ф10mm COPPER PIPE⑳.

On this occasion, fix ISOLATION TUBE⑳ on COPPER PIPE⑳ with hull to prevent corrosion.