Mechanical Seal

Ebara DSC4 pumps employ **cartridge type, duplex mechanical seals in tandem arrangement**.

Cartridge type mechanical seal provide:
- Easy maintenance because it is handled as one unit
- High reliability due to assembly and adjustment separate from the bowl unit

Duplex mechanical seals in tandem arrangement provide:
- High reliability because of dual seals construction
- Long life operation with oil lubrication

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Part Name</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STATIONARY RING (UPPER)</td>
<td>CARBON</td>
</tr>
<tr>
<td>2</td>
<td>SEAL RING (UPPER)</td>
<td>CERAMIC+STAINLESS STEEL</td>
</tr>
<tr>
<td>3</td>
<td>STATIONARY RING(LOWER)</td>
<td>SILICON CARBIDE</td>
</tr>
<tr>
<td>4</td>
<td>SEAL RING (LOWER)</td>
<td>SILICON CARBIDE</td>
</tr>
</tbody>
</table>
**Cable – Sectional View**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Part Name</th>
<th>Material</th>
<th>No. for 1 Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>278</td>
<td>Sealing Compound</td>
<td>Epoxy Resin</td>
<td>–</td>
</tr>
<tr>
<td>811-01</td>
<td>Line Cord</td>
<td>Type W</td>
<td>1</td>
</tr>
<tr>
<td>811-02</td>
<td>Control Cord</td>
<td>Type SOOW</td>
<td>1</td>
</tr>
<tr>
<td>814</td>
<td>Frame</td>
<td>Cast Iron</td>
<td>1</td>
</tr>
<tr>
<td>817</td>
<td>Opposite Side Bracket</td>
<td>Cast Iron</td>
<td>1</td>
</tr>
<tr>
<td>826-01</td>
<td>Gland</td>
<td>Cast Iron</td>
<td>1</td>
</tr>
<tr>
<td>830</td>
<td>Shaft</td>
<td>420 Stainless Steel</td>
<td>1</td>
</tr>
<tr>
<td>842</td>
<td>Motor Cover</td>
<td>Cast Iron</td>
<td>1</td>
</tr>
<tr>
<td>849-02</td>
<td>Ball Bearing</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>857-03</td>
<td>Earth Terminal</td>
<td>Copper</td>
<td>–</td>
</tr>
<tr>
<td>915</td>
<td>Terminal Board Assy.</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>924-01</td>
<td>Packing</td>
<td>NBR</td>
<td>1</td>
</tr>
</tbody>
</table>
2. THERMAL DETECTOR FOR MOTOR WINDING
The motor shall be equipped with a Miniature Thermal Protector (MTP). This MTP is embedded in the windings and will act to protect the motor from over-heating. If the motor winding temperature reaches the MTP acting point it will activate and open the circuit.

**Switch Rating**
- CONTACT RATING: AC115V 18A / AC230V 13A
- CONTACT TYPE: B – CONTACT (NORMALLY CLOSED)
- OPEN TEMP.: 140±5°C (284 ± 9°F)

**Fig.6-2 THERMAL DETECTOR FOR MOTOR WINDING**

**CHARACTERISTICS**
The circuit is normally closed.
The disc is operated both by the current passing through it and by heat received from the windings.
When the temperature of the disc reaches a predetermined point corresponding to the maximum allowable temperature of winding, the disc snaps open to interrupt the circuit.
When the winding temperature returns to the safe operation range, the circuit is restored automatically.
3. LEAKAGE DETECTOR
A built-in float type leakage detector is fitted to sense leaking of pumping water and/or seal oil into the motor as a result of failure of the mechanical seal.

### Switch Rating
- **CONTACT RATING**: Breaking capacity: AC50VA/DC50W
- Max. breaking current: AC0.5A/DC0.5A
- Max. operating voltage: AC300V/DC300V
- **CONTACT TYPE**: B-CONTACT (NORMALLY CLOSED)

### Part List

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Part Name</th>
<th>Material</th>
<th>Qty/Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LEAD WIRE</td>
<td>Heatproof Polyvinyl Chloride Wire (0.3mm)</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>HOUSING</td>
<td>316 Stainless Steel</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>FLOAT</td>
<td>316 Stainless Steel</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>STOPPER</td>
<td>316 Stainless Steel</td>
<td>1</td>
</tr>
</tbody>
</table>

UNIT: mm
4. THERMAL DETECTOR FOR THRUST BEARING (OPTION)

**ASSEMBLY OF BEARING TEMP. DETECTOR**

**Fig. 6-4 THERMAL DETECTOR FOR THRUST BEARING**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Part Name</th>
<th>Material</th>
<th>Qty</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Resistance Bulb</td>
<td>–</td>
<td>1</td>
<td>Pt100Ω at 0°C 3W 5mA</td>
</tr>
<tr>
<td>2</td>
<td>Cap</td>
<td>Stainless Steel</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Lead Wire</td>
<td>–</td>
<td>1</td>
<td>7/Ø 0.16 Teflon-Teflon</td>
</tr>
<tr>
<td>4</td>
<td>Spring</td>
<td>Stainless Steel</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Self Lock Retaining Ring</td>
<td>Spring Steel</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
7. LUBRICATION

<table>
<thead>
<tr>
<th>Lubricant</th>
<th>Lower Bearing</th>
<th>Upper Bearing</th>
<th>Shaft Seal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Grease</td>
<td>Turbine Oil</td>
<td></td>
</tr>
<tr>
<td>EXXON</td>
<td>UNIREX N3</td>
<td>—</td>
<td>TERESSO 32</td>
</tr>
<tr>
<td>MOBIL</td>
<td>POLYREX EM</td>
<td>DTE OIL, OIL LIGHT</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* Other lubricants may be used when the oil is not allowed.

8. SHOP PAINTING

<table>
<thead>
<tr>
<th>Coating Spec. No.</th>
<th>I</th>
<th>II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>SSPC - SP - 10</td>
<td>SSPC - SP - 3</td>
</tr>
<tr>
<td>Materials &amp; coating nos.</td>
<td>Zinc rich primer x 1</td>
<td>Zinc rich primer x 1</td>
</tr>
<tr>
<td>Color</td>
<td>Black</td>
<td>Green</td>
</tr>
<tr>
<td>Total dry film thickness (µm)</td>
<td>140</td>
<td>10</td>
</tr>
</tbody>
</table>

Spec. No. I : surfaces contacting pumping liquid
Spec. No. II : internal surface of motor

*Note:* Non-ferrous material and stainless steel are not painted.
1. PUMP RATED CAPACITY AND TOTAL HEAD

Pumping requirements in the system are stated as **Rated Capacity** and **Rated Total Head**. Rated capacity is the flow rate determined by the total design capacity of the pumping station and the number of operating pumps.

\[
\text{Rated Capacity} = \frac{\text{Total design capacity of pumping station}}{\text{Number of operating pumps}}
\]

**Rated Total Head** = System head at the rated capacity.

The pump is operated at the cross point of the pump Q-H (capacity-head) curve and the **System Head Curve** as shown in Fig. 1-1. The head at the cross point is defined as the rated total head of pump.

![Fig. 1-1 PUMP OPERATION POINT]
2. SYSTEM HEAD

System head of the system is the sum of the Static Head and the Dynamic Head, and its curve is a quadratic curve of the flow rate as shown in Fig. 1-2.

**System Head** = Static head (Ha) + Dynamic Head (Hd)

![Fig. 1-2 SYSTEM HEAD CURVE](image-url)
Static Head (Ha)
Static head arises from the difference between the pump suction pit water level and the discharge water level.

![Static Head Diagram](image)

**Fig. 1-3-1 STATIC HEAD**

Dynamic Head (Hd) – Wet Pit
Dynamic head for Fig. 1-3-1 is as follows:

\[ \text{Hd} = \text{Hf} + \frac{V^2}{2g} \]

Where,

- \( \text{Hf} \): Hydraulic loss from the discharge of the QDC to the system discharge end
- \( \frac{V^2}{2g} \): Velocity head at the system discharge end
Dynamic Head (Hd) – Dry Pit

Dynamic head for Fig. 1-3-2 is as follows:

\[ \text{Hd} = \text{Hf} + \frac{V^2}{2g} \]

Where, \( \text{Hf} \) : Hydraulic losses of piping  \( (\text{Hf} = \text{Hf1} + \text{Hf2}) \)

\( \frac{V^2}{2g} \) : Velocity head at the system discharge end

**Pump Total Head (Ht)**  The pump total head is a sum of the static head and the dynamic head. The pump total head may be obtained from the following equation:

**Pump Total Head (Ht)** = Static Head + Dynamic Head = (Ha + Hd)

Where,  
- Ha : Static Head
- Hd : Dynamic Head
3. PUMP OPERATION RANGE

As stated in paragraph 1, the pump is operated at the cross point of its Q-H curve and the system head curve. Therefore, so long as the system head curve is not changed, the pump is operated at a design point. In an actual pumping system, however, the static head varies depending on the suction and/or discharge water level. As a result, the system head curve shifts as shown in Fig. 1-4.

With this shift in the system head curve, the cross point with pump Q-H varies, and this variation is termed as the Pump Operation Range.
4. NPSH

Adequate suction pressure at the impeller inlet is necessary for the pump to perform as designed. This suction pressure (absolute) converted into water head is called NPSH req. and is shown on the pump performance curve as one of the pump characteristics.

On the other hand, actual suction pressure (absolute) converted into water head is called NPSH av. and is defined as shown in Fig. 1-5.

NPSH req. shall not exceed NPSH av. in the continuous operation range.

![Diagram of NPSH](image)

NPSH available (m)
NPSH av. = Is + Pa – Pv

Where,

- Is: Submergence of impeller (m)
- Pa: Atmospheric pressure (m)
  under 1 atm, Pa = 10.3m
- Pv: Vapour pressure (m)
  water at 20°C, Pv = 0.24 (m)
5. AIR-ENTRAINING VORTEX

Lack of enough submergence causes the generation of harmful air-entraining vortices as shown in Fig. 1-6. The submergence at which generation of vortices can be avoided is termed as the **Minimum Submergence** ($S$).

![Air-entraining vortex](image)

**Fig. 1-6 AIR-ENTRAINING VORTEX**

6. SUBSURFACE VORTEX

In cases where the clearance between pump and bottom of the pit is not adequate, harmful subsurface vortices generates as shown in Fig.1-7.

![Subsurface vortex](image)

**Fig. 1-7 SUBSURFACE VORTICES**
7. SUBMERSION AND CLEARANCE

![Graph showing submergence and clearance](image)

Fig. 1-8 SUBMERGENCE AND CLEARANCE
8. PUMP SELECTION

In this paragraph, a sample selection of the DSC4 pump is demonstrated by using a simple wet pit case.

Conditions | Rated capacity: 4500 GPM
---|---
Ha: | 70 ft
Hd: | 15 ft

Step 1: Selection of pump model

Assuming a sum of Ha and Hd as pump total head, select pump from **DSC4 FAMILY CURVES**. In this case, the assumed total head is 85 ft, and EO-66145 is selected from family curves.
Step 2: Check Items on the Selected Pump
Check the selected pump for the following items:

- **Pump continuous operation range**
  Confirm that the pump continuous operation range based on the system head variation is within the continuous operable range of the performance curve.

- **NPSH**
  NPSH req. shall not exceed NPSH av. in the continuous pump operation range.

- **Motor rating**
  Pump power input shall not exceed motor rating in the pump operation range.

- **Starting method and cable size**
  Check starting method and cable size with Part 5. ELECTRICAL DATA.