Torishima’s Mechanical Seals

Mechanical seals — the shaft seals used in rotating machinery such as pumps, hydraulic turbines, agitators and centrifuges — play an important role in maintaining the safety and economic efficiency of machinery. As a comprehensive manufacturer of pumps, Torishima has never lost sight of the importance of mechanical seals. We are the fastest in the country at moving products from the research and development phase to manufacturing and commercialization.

Today, we provide a wide range of mechanical seals for applications requiring high levels of safety and quality, such as mechanical seals for sealing high-temperature and high-pressure fluids in power plant pumps (including boiler feed pumps and boiler circulating pumps). We also manufacture mechanical seals for pumps used in sewage plants, chemical plants, and desalination plants handling slurry-rich liquid, special highly corrosive liquids, and seawater. Moreover, we have utilized our years of experience in pump manufacturing to provide eco-friendly non-flushing seals, easy-maintenance cartridge seals, and a variety of other optimal mechanical seals for a diverse range of applications.

### Mechanical Seal Applications

<table>
<thead>
<tr>
<th>Field and Application</th>
<th>Power Generation</th>
<th>Seawater Desalination</th>
<th>Water Works &amp; Sewage</th>
<th>Agro Food &amp; Biochemicals</th>
<th>Chemical &amp; Petrochemical</th>
<th>General Industry, etc.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model of Mechanical Seal</td>
<td>Rubber backseals</td>
<td>Rotating single-spring seals</td>
<td>Rotating multi-spring seals</td>
<td>Stationary multi-spring seals</td>
<td>Cartridge seals</td>
<td>Special-purpose seals</td>
<td>toaster toasting machine</td>
</tr>
<tr>
<td>LV1000 Series</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>P15</td>
</tr>
<tr>
<td>CB7000 Series</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>P16</td>
</tr>
<tr>
<td>HU000 Series</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>P17</td>
</tr>
<tr>
<td>HB2000 Series</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>P18</td>
</tr>
<tr>
<td>MB2700CN</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>P19</td>
</tr>
<tr>
<td>MB400CN</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>P20</td>
</tr>
<tr>
<td>MB4110</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>P21</td>
</tr>
</tbody>
</table>

---

### Configuration Codes for Torishima Mechanical Seals

A number and a code indicate the configuration and materials used in each Torishima mechanical seal.

The seals are classified as H, M or L according to load, with H and M indicating heavy load and L indicating light load. H and L types are typically single-spring seals, while the M types are multi-spring units.

#### Sample configuration code

- **Model**: MB2704CB1AHL090
- **Stopper knock**: Cartridge
- **Design No./Application**: Process pump
- **Load and configuration**: Heavy load, multi-spring, balanced single seal

### Basic Structure of Mechanical Seal

Mechanical seals incorporate a seal (stationary ring) and washer (rotating ring) that prevents leakage of the sealed fluid by rotating relative to the seal face. The washer is held in close contact with seal by spring pressure and the pressure exerted by the sealed fluid. As the seal face wears, the washer advances toward the seal to maintain close contact with the seal face.

The cushion ring prevents leakage between the seal and seal cover, while the packing prevents leakage between the washer and shaft. Both also absorb vibration and restrict transmission of vibration to the seal face. Between the washer and shaft there is only negligible relative movement.

The only vibration that occurs is between the washer and shaft. The washer advances toward the seat only very slightly as the seal face wears. Therefore, the packing remains mostly free from wear.
### Pumps for Power Plants

#### Boiler feed pump
- **High-pressure multi-stage ring-section turbine pump**
- **Barrel-type high-pressure multi-stage turbine pump**

#### Condensate pumps
- **Vertical multi-stage high-pressure turbine pumps**

#### Circulating water/cooling water pumps
- **[Vertical mixed-flow pumps](#)**

#### Boiler circulating pumps
- **[Hot water circulating pumps](#)**
Pumps for Seawater Desalination Plants

High-pressure pumps for RO systems

- [Horizontal twin-suction axially split multi-stage volute pumps]
- [Horizontal axially split multi-stage volute pumps]

MSF system brine recirculation pumps

- [Vertical double-suction barrel pumps]
- [MSF system brine recirculation pumps]

Seawater intake pumps

- [Vertical mixed-flow pumps]

Product water pumps

- [Double-suction volute pumps]

MB8500CN
- Pressure: 0 to 5 MPaG
- Circumferential speed: Up to 60 m/s
- Shaft diameter: 50 to 300 mm

MB2901
- Pressure: 0 to 1 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 50 to 300 mm

MB2704CN
- Pressure: 0 to 2 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 50 to 300 mm

MT4100
- Pressure: 0 to 1 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 50 to 200 mm

MB2704CN
- Pressure: 0 to 1 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 50 to 200 mm

P19

P21

P18

0 to 5 MPaG
Up to 60 m/s
50 to 300 mm

0 to 1 MPaG
Up to 20 m/s
50 to 300 mm

0 to 2 MPaG
Up to 20 m/s
50 to 200 mm

0 to 1 MPaG
Up to 20 m/s
50 to 200 mm
Pumps for Water Works & Sewerage Plants

Water transmission & distribution pumps

[Double-suction volute pumps]

[Multi-stage turbine pumps]

Stormwater drainage pumps

[Vertical mixed-flow pumps]

Effluent pumps

[Vertical mixed-flow volute pumps]

Sludge transfer pumps

[Non-clogging volute pumps]

- **MB2704CN**
  - Pressure: 0 to 2 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 20 to 200 mm

- **HB2000 Series (HB2700)**
  - Pressure: 0 to 3 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 25 to 50 mm

- **MU2922**
  - Pressure: 0.1 to 0.5 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 50 to 300 mm

- **MT4100**
  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 50 to 300 mm

- **MB2901**
  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 50 to 300 mm

- **LU1000 and LD1000 Series (LU1107/LD1107)**
  - Pressure: 0 to 0.5 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 30 to 60 mm

- **P16**
  - Pressure: 0.1 to 0.5 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 14 to 80 mm

- **P18**
  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 50 to 300 mm

- **P19**
  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 50 to 300 mm
Pumps for Rivers, Agricultural Pumping & Drainage, and Irrigation

**River drainage pumps**

- **Vertical mixed-flow pumps**
- **Vertical axial-flow pumps**

**Agricultural drainage pumps**

- **Horizontal mixed-flow pumps**

**Irrigation pumps**

- **Double-suction volute pumps**

**Agricultural pumps**

- **Horizontal axially split multi-stage volute pumps**

- **MB2901** 0 to 1 MPaG  Up to 20 m/s  Shaft diameter: ø50 to 300 mm

- **MT4100** 0 to 1 MPaG  Up to 20 m/s  Shaft diameter: ø50 to 300 mm

- **MT9200**
  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: ø50 to 300 mm

- **MB8500CN/MB2400CN**
  - Pressure: 0 to 5 MPaG
  - Circumferential speed: Up to 60 m/s
  - Shaft diameter: ø50 to 300 mm

- **MT4100**
  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: ø50 to 300 mm

- **HU2000 and HB2000 Series (HU2700/HB2700)**
  - Pressure: 0 to 3 MPaG
  - Circumferential speed: Up to 60 m/s
  - Shaft diameter: ø20 to 90 mm

- **MB8500CN**
  - Pressure: 0 to 5 MPaG
  - Circumferential speed: Up to 60 m/s
  - Shaft diameter: ø50 to 300 mm

- **MB2400CN**
  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: ø50 to 300 mm

**Pressure:**
- 0 to 1 MPaG
- 0 to 3 MPaG
- 0 to 5 MPaG
- 0 to 1 MPaG

**Circumferential speed:**
- Up to 20 m/s
- Up to 60 m/s
- Up to 20 m/s

**Shaft diameter:**
- ø50 to 300 mm
- ø20 to 90 mm
- ø50 to 300 mm
- ø50 to 300 mm
- ø20 to 300 mm
Pumps for Chemical & Petrochemical Plants

### Process pumps for chemical plants

- **LU1000 Series (LU1107)**
  - Pressure: 0 to 0.5 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: Ø20 to 60 mm

  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: Ø20 to 200 mm

### Cooling water pumps for petrochemical plants

- **MB2000 Series (MB2000)/MB2704CN**
  - Pressure: 0 to 2 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: Ø40 to 200 mm

### Boiler feed pumps for petrochemical plants

- **MB2500/MB8500CZ**
  - Pressure: 0 to 5 MPaG
  - Circumferential speed: Up to 60 m/s
  - Shaft diameter: Ø60 to 200 mm

### Cooling water pumps for oil refineries

- **MB2901**
  - Pressure: 0 to 1 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: Ø40 to 200 mm
Pumps for General & Specialized Industrial Plants

**Cooling water pumps for paper mills**

[Double-suction volute pumps]

- **MB2704CN**
  - Pressure: 0 to 2 MPaG
  - Circumferential speed: Up to 30 m/s
  - Shaft diameter: 20 to 300 mm

**Boiler feed pumps for utility plants**

[High-pressure multi-stage ring-section turbine pumps]

- **MB8500CZ**
  - Pressure: 0 to 5 MPaG
  - Circumferential speed: Up to 60 m/s
  - Shaft diameter: 50 to 300 mm

**Hot water pumps for buildings**

[Multi-stage turbine pumps]

- **HB2000 Series (HB2700)**
  - Pressure: 0 to 3 MPaG
  - Circumferential speed: Up to 20 m/s
  - Shaft diameter: 20 to 300 mm

**Process pumps for food processing plants**

[Singly-suction volute pumps]

- **LU1000 Series (LU1107)**

 pressures:

- 0 to 0.5 MPaG
- 0 to 1 MPaG
- 0 to 2 MPaG

 circumferential speeds:

- Up to 15 m/s
- Up to 30 m/s
- Up to 60 m/s

 shaft diameters:

- 20 to 80 mm
- 20 to 200 mm
- 50 to 300 mm
**Rubber Bellows Mechanical Seals**

### LU1000 Series

**Features**
- The rubber bellows expands to compensate for face wear and shaft movement; because the packing does not slide, the shaft does not wear. It accommodates slurry deposition, thereby avoiding problems.
- Because the rubber packing floats the stationary ring and the rotating ring is supported by the rubber bellows, it has excellent shock-absorbing characteristics. The clutch-type rotating transmission can be used regardless of the direction of rotation.

**Application**
- LD1000 Series (Double seal)
- LD1000 Series (for submersible pumps)

**Material**
- LD1000 Series (Double seal) - silicone, silicone/carbon
- LD1000 Series (for submersible pumps) - NBR, FKM

### HU2000 Series

#### HU2000 Series (Balanced type)

**Application**
- Pressure: 0 to 1 MPa
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 20 to 90 mm
- Target fluids: water, warm water, oil, and acidic and alkaline liquids

**Material**
- Seal face: tungsten carbide/tungsten carbide
- Packing: NBR, FKM, PTFE

### HB2000 Series

#### HB2000 Series (Balanced type)

**Application**
- Pressure: 0 to 3 MPa
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 20 to 90 mm
- Target fluids: water, warm water, oil, and acidic and alkaline liquids

**Material**
- Seal face: tungsten carbide/tungsten carbide
- Packing: NBR, FKM, PTFE

---

**Rotating Mechanical Seals**

### LU1000 Series

**Application**
- LU1107

**Material**
- LU1000 Series - silicone, silicone/carbon
- LU1107 - NBR, FKM

### HU2000 Series (Unbalanced type)

**Application**
- HU2700

**Material**
- HU2000 Series (Unbalanced type) - silicone, silicone/carbon
- HU2700 - NBR, FKM

---

**LD1000 Series (Double seal)**

**Features**
- This is a slurry-resistant rubber bellows type mechanical seal. It incorporates high-performance sealing material for long life and excellent resistance to corrosive fluids. The short mounting dimension makes it suitable for retrofitting into pumps with small housings.

**Application**
- LD107

**Material**
- LD1000 Series (Double seal) - silicone, silicone/carbon
- LD1107 - NBR, FKM

### LD1000 Series (for submersible pumps)

**Application**
- LD1107 (for submersible pumps)

**Material**
- LD1000 Series (for submersible pumps) - silicone, silicone/carbon
- LD1107 (for submersible pumps) - NBR, FKM
Rotating Mechanical Seals

MU2000 Series (Unbalanced type)/MB2000 Series (Balanced type)

Features
- This is a rotating balanced-type cartridge mechanical seal. This cartridge-type seal has a simple structure that makes it easy to install.

Application
- Pressure: 0 to 1 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 20 to 200 mm
- Target fluids: Water, warm water, oil, acidic and alkaline liquids, chemical fluids

Material
- Seal face: Carbon/SiC, SiC/SiC, carbon/tungsten carbide
- Packing: NBR, FKM

MT2700 (Balanced type)

Features
- This is the optimal mechanical seal for high-load applications involving high pressure and high temperature. The multi-spring type rotating seal costs the mechanical seal through circulation in the pumping ring.

Application
- Pressure: 0 to 3 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 20 to 200 mm
- Target fluids: Boiler feedwater, boiler circulating water, high-pressure feedwater

Material
- Seal face: SiC/tungsten, tungsten carbide/carbon

Cartridge Mechanical Seals

MB2704CN (Inside rotating type)/MB2704CZ (Inside rotating type, with pumping ring)

Features
- This is a rotating balanced-type cartridge mechanical seal. This cartridge-type seal has a simple structure that makes it easy to install.

Application
- Pressure: 0 to 8 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 20 to 200 mm
- Target fluids: Boiler feedwater, boiler circulating water, high-pressure feedwater

Material
- Seal face: SiC/SiC, SiC/carbon, tungsten carbide/carbon

Application
- Pressure: 0 to 3 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: 20 to 200 mm
- Target fluids: Water, warm water, oil, acidic and alkaline liquids

Material
- Seal face: SiC/tungsten, tungsten carbide/carbon

Material
- Seal face: SiC/SiC, SiC/carbon, tungsten carbide/carbon
### MB8500CN (Stationary inside type)/MB8500CZ (Stationary inside type, with pumping ring)

**Features**
Stationary balanced cartridge-type mechanical seals are suitable for high-speed, high-pressure, and high-temperature fluids. Not affected by machinery distortion, these seals provide excellent sealing.

**Application**
- Pressure: 0 to 5 MPaG
- Circumferential speed: Up to 60 m/s
- Shaft diameter: Φ50 to 300 mm
- Target fluids: Boiler feedwater, boiler circulating water, high-pressure feedwater

**Material**
- Seal face: SiC/SiC, SiC/carbon, tungsten carbide/carbon

### MB2400CN (Outside rotating type)

**Features**
This is a compact outside rotating type seal. The outer dimension of the stuffing box is narrow enough to be mounted without modification.

**Application**
- Pressure: 0 to 1 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: Φ50 to 300 mm
- Target fluids: Water, warm water, oil, and acidic and alkaline liquids

**Material**
- Seal face: SiC/SiC, SiC/carbon, tungsten carbide/carbon

### MB2901 (Stationary balanced type, non-flushing)

**Features**
This split mechanical seal can be replaced without disassembling equipment. This type can be used on positive-pressure equipment.

**Application**
- Pressure: 0 to 1 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: Φ50 to 300 mm
- Target fluids: Water, wastewater, seawater, etc.

**Material**
- Seal face: SiC/SiC, SiC/carbon, SIC composite/SIC composite

### MU2922 (Stationary balanced type, dry running application)

**Features**
This split mechanical seal is capable of negative-pressure operation and can be used for both positive-pressure and negative-pressure applications.

**Application**
- Pressure: -0.1 to 0.1 MPaG
- Circumferential speed: Up to 20 m/s
- Shaft diameter: Φ50 to 300 mm
- Target fluids: River water, etc.

**Material**
- Seal face: Carbide coating/carbon, carbide coating/resin

### MT9200 (Stationary balanced type, dry running application)

**Features**
This split mechanical seal is capable of negative-pressure operation. It can be operated while biodegradable grease is fed to the seal face.

**Application**
- Negative pressure
- Circumferential speed: Up to 20 m/s
- Shaft diameter: Φ50 to 300 mm
- Target fluids: River water, etc.

**Material**
- Seal face: Carbide coating/copper alloy
Stationary Mechanical Seals

MB2500 (Balanced type)

Features
Stationary balanced seals are used for heavy loads under high speed, high pressure, and high temperature. These seals remain unaffected by the centrifugal forces caused by rotation. In addition, they demonstrate enhanced seal performance, as they remain square to the seal face and are unaffected by deterioration of equipment and heat distortion. These mechanical seals are cooled by circulation through a pumping ring.

Application
- Pressure: up to 8 MPaG
- Circumferential speed: up to 60 m/s
- Shaft diameter: 50 to 300 mm
- Target fluids: boiler feedwater, boiler circulating water, high-pressure feedwater

Material
- Seal face: SiC/carbon, tungsten carbide/carbon

MT4100 (Balanced type)

Features
These stationary seals incorporate highly wear-resistant materials such as tungsten carbide and SiC as seal face materials. These seals are also suitable for pumping fluid containing slurry.

Application
- Pressure: up to 1 MPaG
- Circumferential speed: up to 20 m/s
- Shaft diameter: 50 to 500 mm
- Target fluids: river water, etc.

Material
- Seal face: tungsten carbide/tungsten carbide, SiC/SiC

Selecting Auxiliary Equipment for Torishima Mechanical Seals

Auxiliary Equipment for Mechanical Seals

The full performance and benefits of mechanical seals can be achieved with the proper combination of auxiliary equipment. Thus, care is required in the selection of auxiliary equipment and mechanical seals. Auxiliary equipment for mechanical seals is broadly categorized for cooling (or warming), flushing, or quenching; this equipment can be employed alone or in combination. Cooling (warming) through a cooling jacket may have to be performed when stopped depending to the fluid temperature and the nature of the fluid.

1. Cooling (Warming)

This equipment is used for cooling high-temperature sealed fluid and for maintaining the warmth of fluids that can freeze. Cooling (warming) can be achieved by either of two methods: cooling/warming the periphery of the seal face; or installing a jacket on the sealed box or seal cover. A design for cooling should incorporate temperature adjustment of the sealed fluid within the heat tolerance and cold tolerance of the packing and should have sufficient capacity to absorb the heat generated at the seal face. Be careful that the fluid temperature does not fall excessively, as some fluids can become polymerized. When the purpose is cooling, design to reduce the saturation temperature of the sealed fluid at ambient atmospheric pressure by 20°C to 30°C. In the case of normal water, cooling is used when the temperature inside the sealed box exceeds 80°C. Because some heat is conducted by the body of the equipment, the cooling capacity must be designed to incorporate the above conditions.

Example of Cooling (Warming)

Air or gas trapped inside the sealed box reduces thermal conductivity and significantly reduces the cooling (warming) effect. This contributes to abnormal heating and premature wear of the seal face. The sealed box must be completely purged of all air and gas.

Completely purge all air inside the sealed box.

Air or gas trapped inside the sealed box reduces thermal conductivity and significantly reduces the cooling (warming) effect. This contributes to abnormal heating and premature wear of the seal face. The sealed box must be completely purged of all air and gas.
2. Flushing
Flushing is intended to cool the seal face by causing the sealed fluid to flow, thus preventing the stagnation of foreign matter and intrusion to the seal face. Use a clear solution for the flushing fluid and inject it as close to the seal face as possible. If the injection velocity is too fast, the outer circumference will wear if the seal face material is a carbon type. The velocity should be 1–3 m/s. It is possible to use the self-flushing method (using its own fluid as an injection fluid for flushing) or to use the external flushing method (using a separate fluid). In addition, it is possible to perform cooling, heating, and slurry removal by installing auxiliary equipment such as coolers, heaters, filters, and cyclone separators at a point along the flushing piping.

When flushing in order to cool the seal face, use the following figure as a guideline because the flow of the flushing liquid differs according to the temperature inside the sealed box and the temperature of the flushing fluid. Injection pressure should be 0.098–0.2 MPa higher than the pressure in the sealed box.

Separating Solids from the Flushing Fluid
For fluids containing slurry, external flushing is the preferable method; however, if no other suitable source of fluid is available, the self-flushing method may be employed. In this case, the following methods may be used to separate solids from the flushing fluid:

A) The filter method (30 to 100 mesh)
B) The magnetic filter method
Both A) and B) require monitoring to deal with mesh clogging; a safe approach is to switch between two filters positioned in parallel and to use a pressure gauge and thermometer. But these methods might not remove some of the slurry that is most harmful to the mechanical seal.
C) The cyclone separator method
This method is used to remove any slurry with a specific gravity higher than that of the sealed fluid.

3. Quenching
Quenching is used to wash out deicers; toxic or explosive fluids; volatile fluids such as LPG; and leaked fluids that precipitate and harden when exposed to outside air. Normally, the injection fluid is clear water, but care is required because a fluid high in ion content can cause failure of the washer as minerals adhere to the seal face of the packing. It is essential that the injection fluid not react with the leaked fluid; if there is no suitable fluid, nitrogen gas or argon gas may be used.

To prevent leakage of the quenching fluid, a mechanical seal may be used in addition to an auxiliary bushing, oil seal, lip seal or gland packing. The pressure of the quenching injection fluid should be lower than that of the sealed box, typically 0.02–0.05 MPa. If the quenching flow is intended for cooling, about 70% of the flushing flow is required.

Typical Configurations of Double Mechanical Seals

<table>
<thead>
<tr>
<th>Typical Configuration</th>
<th>Typical Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back-to-back</td>
<td>Applied to liquid containing gas or solid matter, toxic or corrosive liquid.</td>
</tr>
<tr>
<td>Tandem</td>
<td>Applied to liquid containing gas and solid matter, toxic or corrosive liquid, and liquid of high pressure that cannot be sealed with a single seal.</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>Applied to super-high-pressure equipment that cannot be sealed with a single seal, and equipment with wide pressure fluctuations.</td>
</tr>
<tr>
<td></td>
<td>Applied to very high pressure equipment. 1st stage seal is for pressure drop and 2nd stage is for sealing.</td>
</tr>
<tr>
<td></td>
<td>Applied where low pressure fluid which cannot be sealed with a single seal and fitting length in axial direction is short and, in addition, leakage must be collected.</td>
</tr>
<tr>
<td></td>
<td>Applied where high pressure fluid which cannot be sealed with a single seal and fitting length in axial direction is short and, in addition, leakage must be collected.</td>
</tr>
</tbody>
</table>
**Piping Plans for Auxiliary Equipment (API 682)**

An appropriate match between piping and auxiliary equipment is required in order to maximize the performance of mechanical seals. In the piping examples shown in the diagrams below, all plans are numbered according to API standards (API 682-3rd).

### Flushing Plans for Single Seals

<table>
<thead>
<tr>
<th>API Plan</th>
<th>Schematic</th>
<th>API Plan</th>
<th>Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Self flushing (Internal flushing)</td>
<td>21</td>
<td>Self flushing (Cooler)</td>
</tr>
<tr>
<td>02</td>
<td>Dead ended</td>
<td>22</td>
<td>Self flushing (Cooler + Strainer)</td>
</tr>
<tr>
<td>11</td>
<td>Self flushing</td>
<td>23</td>
<td>Pumping ring circulation (Cooler)</td>
</tr>
<tr>
<td>12</td>
<td>Self flushing (Strainer)</td>
<td>31</td>
<td>Self flushing (Cyclone separator)</td>
</tr>
<tr>
<td>13</td>
<td>Reverse flushing</td>
<td>32</td>
<td>External flushing</td>
</tr>
<tr>
<td>14</td>
<td>Through flushing</td>
<td>41</td>
<td>Self flushing (Cyclone separator + Cooler)</td>
</tr>
</tbody>
</table>

### Piping Plans for Quenching/Draining Systems and Dual Seals

<table>
<thead>
<tr>
<th>API Plan</th>
<th>Schematic</th>
<th>API Plan</th>
<th>Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>Single seal (Quenching pot type)</td>
<td>54</td>
<td>Dual seal (External circulation type/pressurized/wet)</td>
</tr>
<tr>
<td>52</td>
<td>Dual seal (Reservoir type/non-pressurized/wet)</td>
<td>61</td>
<td>Single seal (with no quenching provided)</td>
</tr>
<tr>
<td>53A</td>
<td>Dual seal (Reservoir type/pressurized/wet)</td>
<td>62</td>
<td>Single seal (with quenching provided)</td>
</tr>
<tr>
<td>53B</td>
<td>Dual seal (Bladder accumulator/pressurized/wet)</td>
<td>65</td>
<td>Single seal (Drain/leak detection system)</td>
</tr>
<tr>
<td>53C</td>
<td>Dual seal (Piston type accumulator/pressurized/wet)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Piping diagram codes**

- Orifice
- Flow regulator
- Pressure gauge
- Lower level switch
- Strainer
- Relief valve
- Pressure switch
- Bladder accumulator
- Cooler
- Flowmeter
- Upper limit pressure switch
- Piston accumulator
- Stop valve
- Cyclone separator
- Lower limit pressure switch
- Drain pot
- Check valve
- Thermometer
- Upper level switch
- Reservoir

**Piping Plans for Quenching/Draining Systems and Dual Seals**

1. Through flushing
2. Reverse flushing
3. Self flushing (Strainer)
4. Self flushing (Cyclone separator + Cooler)