Hydraulic Pump (General)

<table>
<thead>
<tr>
<th>Products included in this catalog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gear pump (for high and medium pressure applications)</td>
</tr>
<tr>
<td>Vane pump, screw pump, etc. (for low pressure applications)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KYB products not included in this catalog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load sensing pump for mixer truck</td>
</tr>
<tr>
<td>Axial piston pump in bent axis design</td>
</tr>
</tbody>
</table>

Not included in KYB product lineup

- Internal gear pump
- Screw pump

Pump: Gear pump

[General Description]
High reliability is the primary policy for developing KYB pumps and is based on long experience in various applications, advanced technology and excellent production technology. The KFP series pumps having cast-iron bodies are those of high performance, light in weight, compact in design, and durable.

[Construction and Mechanism]
1. The shaft connected to the gear is driven by an engine or an electric motor.
2. While the gears are rotating, the oil filling the gear tooth grooves is moved from the suction port to the delivery port.
3. The shaft is designed to be rotated in one direction to realize high performance.
4. When placing an order, please specify the direction of shaft rotation: C rotation (clockwise viewing from the shaft end) or A rotation (anti-clockwise viewing from the shaft end).

Note: Rotating the pump in the direction opposite to the design will damage the inside of the pump and render it unusable.

Basic characteristics

- Volumetric efficiency (actual flow / theoretical flow)
  Operation at a low speed and high pressure increases internal leakage causing low performance.
- Input power (theoretical shaft power / mechanical efficiency)
  Operation at a high speed and high pressure increases shaft power.
- The actual flow and actual input power are related to the speed and pressure. Please contact KYB if the properties of each model need to be clarified.

Displacement of each Model

<table>
<thead>
<tr>
<th>Displacement (cm³/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>KP05</td>
</tr>
<tr>
<td>KFP23</td>
</tr>
<tr>
<td>KFS23</td>
</tr>
<tr>
<td>KFP32</td>
</tr>
<tr>
<td>KFS32</td>
</tr>
<tr>
<td>KFP51</td>
</tr>
</tbody>
</table>

※ Please consult KYB when selecting an appropriate gear pump model under the same displacement.

KFP, KFP, and KFS Series (Single)

- Low pulsation gear pump (KFS series)
  KFS23 series and KFS32 series are low pressure pulsation version of KFP23 series and KFP32 series. Noise in hydraulic systems is generally caused by the pressure pulsation created by the pump and dual flank engagement gear technology is utilized for these gear pump series to reduce the pressure pulsation.

KFP Series (Tandem)

- Each series is available with a variety of tandem models.
  - Dual:
    - KFP23
    - KFP32
    - KFP51
  - Triple:
    - KFP23
    - KFP32
    - KFP51
Hydraulic Pump (General)

<table>
<thead>
<tr>
<th>Products included in this catalog.</th>
<th>Gear pump (for medium and low pressure applications)</th>
<th>Vane pump, screw pump, etc. (for low pressure applications)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial piston pump in swash plate design</td>
<td>External gear pump</td>
<td>Internal gear pump</td>
</tr>
<tr>
<td>For closed circuit</td>
<td>For open circuit</td>
<td>Screw pump</td>
</tr>
</tbody>
</table>

KYB products not included in this catalog: (Contact KYB)

Load sensing pump for mixer truck
Axial piston pump in bent axis design

Not included in KYB product lineup

Pump: Gear pump

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The shaft is designed to be rotated in one direction to realize high performance. When placing an order, please specify the direction of shaft rotation: C rotation (clockwise viewing from the shaft end) or A rotation (anti-clockwise viewing from the shaft end).

Note: Rotating the pump in the direction opposite to the design will damage the inside of the pump and render it unusable.

Basic characteristics

- Volumetric efficiency (actual flow / theoretical flow)
- Operation at a low speed and high pressure increases internal leakage causing low performance.
- Input power (theoretical shaft power / mechanical efficiency)
- Operation at a high speed and high pressure increases shaft power.
- The actual flow and actual input power are related to the speed and pressure. Please contact KYB if the properties of each model need to be clarified.

Displacement of each Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Displacement (cm³/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KP05</td>
<td>0 20 40 60 80 100 120</td>
</tr>
<tr>
<td>KFP23</td>
<td>20 40 60 80 100 120</td>
</tr>
<tr>
<td>KFP32</td>
<td>50 70 90 110 130 150</td>
</tr>
<tr>
<td>KFP51</td>
<td>100 120 140 160 180 200</td>
</tr>
</tbody>
</table>

※ Please consult KYB when selecting an appropriate gear pump model under the same displacement.

KP, KFP, and KFS Series (Single)

[Model code] <Single series>

<table>
<thead>
<tr>
<th>Example</th>
<th>Model</th>
<th>Displacement (cm³/rev)</th>
<th>Speed (rpm)</th>
<th>Mass flow rate (l/min)</th>
<th>Mass flow rate (l/min)</th>
<th>Weight (kg)</th>
<th>Oil model compatible with displacement value</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPO5</td>
<td>3.0-13.2</td>
<td>10600-30000</td>
<td>39</td>
<td>1.5-1.7</td>
<td>O</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>KFP23</td>
<td>7.9-33.3</td>
<td>10600-30000</td>
<td>100</td>
<td>2.4-4.3</td>
<td>KP04</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>KFP23</td>
<td>12.5-45.8</td>
<td>10600-30000</td>
<td>100</td>
<td>2.4-4.3</td>
<td>DP04</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>KFP32</td>
<td>20.0-60.0</td>
<td>10600-30000</td>
<td>125</td>
<td>3.8-5.6</td>
<td>DP2000</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>KFSA4</td>
<td>20.7-51.6</td>
<td>10600-30000</td>
<td>125</td>
<td>3.8-5.6</td>
<td>KP00</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>KFS23</td>
<td>30.0-135.0</td>
<td>10600-25000</td>
<td>250</td>
<td>30.5-25.7</td>
<td>KP00</td>
<td>○</td>
<td></td>
</tr>
</tbody>
</table>

※ KFS is a low pulsation type
● Compatible
○ Compatible except for the port

Low pulsation gear pump (KFS series)

KFS23 series and KFS32 series are low pressure pulsation version of KFP23 series and KFP32 series. Noise in hydraulic systems is generally caused by the pressure pulsation created by the pump and dual flank engagement gear technology is utilized for these gear pump series to reduce the pressure pulsation.

KFP Series (Tandem)

[Model code] <Tandem series> (Dual and triple models)

<table>
<thead>
<tr>
<th>Example</th>
<th>Model</th>
<th>10-12</th>
<th>14-16</th>
<th>18-20</th>
<th>22-24</th>
<th>26-28</th>
</tr>
</thead>
<tbody>
<tr>
<td>KFP23</td>
<td>KFP23</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>KFP51</td>
<td>KFP23</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Each series is available with a variety of tandem models

- Dual
- Triple
- Tandem combination with different models

※ The front pump represents the model name of the tandem combination with different models.
※ The displacement of the front pump needs to be greater than that of the rear pump or the same.
[Caution to specify a tandem pump (Dual or Triple)]

- Two or three pumps are driven with a single shaft.
- Specifications of each pump are the same as the single pump.
- Supply hydraulic fluid from the single reservoir, even if the front, center (in the triple model), and rear pumps have separate suction ports.
- Set the displacement volume as follows: Front pump ≥ Center pump ≥ Rear pump
- When only the front pump is operated, the maximum operating pressure may be applied. When multiple pumps are loaded simultaneously, however, the torque value (T value) in the following Q x P formula should not be exceeded.

\[ Q \times P \text{ expression (T value)} \]

\[ (QF \times PF) + (QR \times PR) \leq TT \]
\[ (QC \times PC) + (QR \times PR) \leq TC \]
\[ QR \times PR \leq TR \]

\[ TT, TC, \text{ and } TR \text{ values} \]

Dimensions (unit: mm)

<table>
<thead>
<tr>
<th>Model</th>
<th>Shaft Specification</th>
<th>T T</th>
<th>C T</th>
<th>T R</th>
</tr>
</thead>
<tbody>
<tr>
<td>KFP23</td>
<td>DP16/32: 10T spline</td>
<td>543.3</td>
<td>63.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DP16/32: 11T spline</td>
<td>1479</td>
<td>1030</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DP16/32: 14T spline</td>
<td>3957</td>
<td>2368</td>
<td></td>
</tr>
</tbody>
</table>

< Q x P expression (T value) >  ※ T values (TT, TR, and TC): Simple expression to obtain allowable shaft torsional torque

For dual model:
\[ (QF \times PF) + (QR \times PR) \leq TT \]
\[ PF : \text{Front pump pressure (MPa)} \]
\[ QF: \text{Front pump displacement (cm}^3/\text{rev}) \]
\[ QR: \text{Rear pump displacement (cm}^3/\text{rev}) \]
\[ PR: \text{Rear pump pressure (MPa)} \]

For triple model:
\[ (QF \times PF) + (QC \times PC) + (QR \times PR) \leq TT \]
\[ PC: \text{Center pump pressure (MPa)} \]
\[ QC: \text{Center pump displacement (cm}^3/\text{rev}) \]

Coupling hole unit: mm

- **Spline: L**
- **Straight: M**
【Caution to specify a tandem pump (Dual or Triple)】

- Two or three pumps are driven with a single shaft.
- Specifications of each pump are the same as the single pump.
- Supply hydraulic fluid from the single reservoir, even if the front, center, and rear pumps have separate suction ports.
- Set the displacement volume as follows: Front pump ≥ Center pump ≥ Rear pump
- When only the front pump is operated, the maximum operating pressure may be applied. When multiple pumps are loaded simultaneously, however, the torque value (T value) in the following Q x P formula should not be exceeded.

<Q x P expression (T value)> ※ T values (TT, TR, and TC): Simple expression to obtain allowable shaft torsional torque

For dual model: \(QF \times PF + QR \times PR \leq TT\)
\(PF\): Front pump pressure (MPa)
\(PR\): Rear pump pressure (MPa)

For triple model: \(QF \times PF + QC \times PC + QR \times PR \leq TT\)
\(PC\): Center pump pressure (MPa)

TT, TC, and TR values

Dimensions (unit: mm)

### Coupling hole unit: mm

#### Spline: L

<table>
<thead>
<tr>
<th>Model</th>
<th>D.P</th>
<th>T o.r.i.</th>
<th>P.C.D</th>
<th>d</th>
<th>Direct drive without flexible coupling</th>
<th>Drive with flexible coupling</th>
</tr>
</thead>
<tbody>
<tr>
<td>KP05</td>
<td>D16</td>
<td>100.00 - 120.00</td>
<td>2.000</td>
<td>10.027 - 11.013</td>
<td>11.040 - 11.125</td>
<td></td>
</tr>
<tr>
<td>KFP23</td>
<td>D16</td>
<td>100.00 - 120.00</td>
<td>2.000</td>
<td>11.420 - 11.475</td>
<td>11.495 - 11.550</td>
<td></td>
</tr>
<tr>
<td>KFP32</td>
<td>D16</td>
<td>100.00 - 120.00</td>
<td>2.000</td>
<td>11.945 - 11.995</td>
<td>12.000 - 12.050</td>
<td></td>
</tr>
<tr>
<td>KF51</td>
<td>D16</td>
<td>100.00 - 120.00</td>
<td>2.000</td>
<td>12.470 - 12.550</td>
<td>12.565 - 12.620</td>
<td></td>
</tr>
</tbody>
</table>

#### Straight: M

<table>
<thead>
<tr>
<th>Model</th>
<th>D</th>
<th>L</th>
<th>H</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>KP05</td>
<td>12.5</td>
<td>14.2</td>
<td>4</td>
<td>0.3</td>
</tr>
<tr>
<td>KFP23</td>
<td>19.02</td>
<td>23.27</td>
<td>5</td>
<td>0.03</td>
</tr>
<tr>
<td>KFP32</td>
<td>22.0</td>
<td>24.9</td>
<td>6</td>
<td>0.03</td>
</tr>
<tr>
<td>KFP31</td>
<td>30.0</td>
<td>30.0</td>
<td>8</td>
<td>0.03</td>
</tr>
</tbody>
</table>

For clockwise rotation (C): ※ The mirror image applies to the anticlockwise rotation (A)

With a triple-pump model, the pump nearest the shaft is the front pump, followed by the center pump, and finally the rear pump.
Dimensions (unit: mm)

- **KFP32/KFS32**

  - For clockwise rotation (C). The mirror image applies to anticlockwise rotation (A). The rear port type is also available.
  - KFP32 tandem (dual) pump is available.
  - When the max. flow rate is less than 190 l/min., the common suction port on the front unit can be used.

  ※ Formula to calculate A, B, and C (See Table 1.)

  \[YF = \text{Front pump Y length}, \quad YR = \text{Rear pump Y length} \]

  1. If KFP2319 or a smaller pump is used as a front pump
     \[A = 141.1 + YF + YR \]
     \[B = 63.8 + YF \]
     \[C = 52.0 + YR \]
  2. If KFP2323 or a larger pump is used as a front pump
     \[A = 149.1 + YF + YR \]
     \[B = 67.8 + YF \]
     \[C = 56.0 + YR \]

  ※ For anticlockwise rotation (A)

  ◇ KFP23 tandem (dual and triple) are available.
  ◇ When the max. flow rate is less than 100 l/min, the common suction port on the front unit can be used.
  ◇ Tandem (dual) model and tandem combination with the KFP23 series is possible.

- **KFP51**

  - For anticlockwise rotation (A)
  - The mirror image applies to the clockwise rotation (C).

  ※ KFP51 tandem (dual and triple) are available.
  ※ When the max. flow rate is less than 190 l/min, the common suction port on the front unit can be used.

  ◇ Tandem models and tandem combination with KFP23 and KP05 series are possible.
### KFP23 Tandem

- **For anticlockwise rotation (C):** The mirror image applies to the clockwise rotation (A).

#### Formula to calculate A, B and C (See Table 1.)

- **YF:** Front pump Y length, **YR:** Rear pump Y length.

1. **If KFP2319 or a smaller pump is used as a front pump**
   - \(A = 141.1 + YF + YR\)
   - \(B = 63.8 + YF\)
   - \(C = 52.0 + YR\)

2. **If KFP2323 or a larger pump is used as a front pump**
   - \(A = 149.1 + YF + YR\)
   - \(B = 67.8 + YF\)
   - \(C = 56.0 + YR\)

#### Table 1. KFP23 tandem displacement, specifications, and dimensions (details)

- **KFP23 tandem (dual and triple) are available.**
- When the max flow rate is less than 100 l/min, the common suction port on the front unit can be used.

\[\text{Table 1. KFP23 tandem displacement, specifications, and dimensions (details)}\]

<table>
<thead>
<tr>
<th>Model</th>
<th>Displacement (ml)</th>
<th>Max. Capacity (l/min)</th>
<th>Max. Pressure (bar)</th>
<th>Max. Flow (l/min)</th>
<th>YF</th>
<th>YR</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>KFP2319/22</td>
<td>191.5</td>
<td>600-1500</td>
<td>70</td>
<td>300</td>
<td>191.5</td>
<td>12.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Performance Curve (Hydraulic fluid: ISO VG32, oil temperature: 50°C)

※ The typical displacements of models of each series are illustrated. Please consult us for models of other displacements.
Performance Curve (Hydraulic fluid: ISO VG32, oil temperature: 50°C)

※ The typical displacements of models of each series are illustrated. Please consult us for models of other displacements.
**Pump: Swashplate type piston pump**

[General Description]
KYB’s piston pumps are used for construction equipment, agricultural machines, and other industrial equipment in a wide variety of market sectors. All series are high-performance, high-reliability piston pumps developed on an abundance of experience in numerous applications. They are manufactured by advanced production systems. This catalog provides only piston pumps for general purpose closed circuit applications and construction equipment open circuit applications. All rotary parts are manufactured by one of KYB’s affiliated companies, Takako Industries, Inc., which is the world-leading company in this technology.

**Basic Construction**

*This piston pump has the same basic structure with the piston motor, and is equipped with additional pump functions. The direction of rotation of the input shaft is fixed.*

[Construction and Mechanism]

1. The input shaft connected to the driving power source rotates. So does the connection between the cylinder block and the input shaft is made by the spline.
2. Then, the pistons reciprocate along the cylinder bores in a movement determined by the swash plate’s tilting angle.
3. When the pistons are pulled out from the cylinder block, oil is drawn from the reservoir. When the pistons are pushed in, oil is delivered to the valve and actuator side.
4. The suction port and delivery port are divided by the valve plate.

<Variable displacement pump>

1. The greater the tilting angle of the swash plate, the greater the reciprocation stroke (displacement) of the piston. When the angle is 0, the reciprocation of the piston stops, reducing the discharge volume to zero.
2. In the closed circuit, the delivery side and suction side are reversed as the swash plate’s tilting angle shifts from +α to −α even though the rotating direction of the input shaft remains unchanged.

**Main Functions**

[Variable Displacement]
The pump displacement can be changed by external control of the swash-plate tilting angle. (A two-way delivery flow in the closed circuit.)

- Manual type: The swash plate angle is controlled with a lever link.
- Regulator: The swash plate angle is controlled with a swash plate angle controller.

**Volumetric efficiency, input horsepower, and mechanical efficiency**

- Volumetric efficiency (actual flow rate / theoretical flow rate)
- Actual horsepower (theoretical horsepower / mechanical efficiency)
- Actual shaft power (theoretical shaft power / mechanical efficiency)

**Pressure and flow characteristics**

(horsepower control characteristics)

[Pressure and flow characteristics]

**LS Control characteristics**

- It is possible to control the flow rate almost proportional to the pump rotating speed.

**Closed Circuit and Open Circuit**

- Closed circuit
  1. The closed hydraulic circuit is constructed with an actuator (motor) and a pump.
  2. The speed and direction of the actuator can be decided by changing the pump tilt angle to +α or to −α as the delivery port and the pump flow change accordingly.
  3. The closed circuit features a smooth starting and stopping of the actuator.
  4. The pump and the motor can be put into one case and made into a compact size as integrated HST.

- Open circuit
  1. In the open circuit, oil is drawn by the pump from the reservoir, and the returning oil from the actuator is flown to the reservoir.
  2. With a fixed-displacement pump, the speed and direction of an actuator are controlled with the switching and spool opening of the control valve. With the variable displacement pump, the pump controls the flow rate and the swash-plate tilting angle can be changed only in the +α direction.
  3. In the open circuit, one single pump can connect to and control multiple actuators.
Pump: Swashplate type piston pump

[General Description]
KYB’s piston pumps are used for construction equipment, agricultural machines, and other industrial equipment in a wide variety of market sectors. All series are high-performance, high-reliability piston pumps developed on an abundance of experience in numerous applications. They are manufactured by advanced production systems. This catalog provides only piston pumps for general purpose closed circuit applications and construction equipment open circuit applications. All rotary parts are manufactured by one of KYB’s affiliated companies, Takako Industries, Inc., which is the world’s leading company in this technology.

Basic Construction

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[Construction and Mechanism]
1. The input shaft connected to the driving power source rotates. So does the connection between the cylinder block and the input shaft is made by the spline.
2. Then, the pistons reciprocate along the cylinder bores in a movement determined by the swash plate tilting angle.
3. When the pistons are pulled out from the cylinder block, oil is drawn from the reservoir. When the pistons are pushed in, oil is delivered to the valve and actuator side.
4. The suction port and delivery port are divided by the valve plate.

<Variable displacement pump>
1. The greater the tilting angle of the swash plate, the greater the reciprocation stroke (displacement) of the piston. When the angle is 0, the reciprocation of the piston stops, reducing the discharge volume to zero.
2. In the closed circuit, the delivery side and suction side are reversed as the swashplate tilting angle shifts from +α to −α even though the rotating direction of the input shaft remains unchanged.

Basic characteristics
When selecting the pump, examine the following characteristics.

- Volumetric efficiency, input horsepower, and mechanical efficiency
- Pressure and flow characteristics (horsepower control characteristics)

Main Functions
[Variable Displacement]
The pump displacement can be changed by external control of the swash-plate tilting angle. (A two-way delivery flow in the closed circuit.)
- Manual type: The swash plate angle is controlled with a lever link.
- Regulator:
The regulator for the control of the swash plate angle of an open circuit pump has the following control devices.
- Horsepower control: The swash plate angle (and the pump displacement) changes depending on the pump delivery pressure in order not to exceed the engine horsepower consumption making constant the maximum input torque to the pump, and ultimately making constant the pump’s horsepower consumption. This control is effective in preventing the engine from stalling due to the pump power consumption exceeding the engine power, and in utilizing the engine horsepower efficiently. (PSVD)
- Load sensing control: This control aims to deliver the required flow that matches the ongoing operation. The pump delivers the required flow to the actuator at required pressure. The pumps swash plate angle (and pump displacement) fluctuates so that differential pressure between the upstream and downstream sides of the LS valve can remain constant. Then, no sufficient flow and less heat generation can be made, which generates energy-saving system.

[Tandem pumps (Dual, Triple)]
Two or three pumps are driven with a single input shaft. Flow rates in the first and second pumps can be set independently. The piston pump is used to drive travel motors. The third pump may be used as a change pump in the closed circuit as well. (PSV2)

[Single flow and split flow]
As described in the basic construction of the piston pump, a typical piston pump is a single flow type with one suction port and one delivery port. On the other hand, a split flow type pump has two independent delivery systems with alternately positioned ports on a single cylinder block. (PSVD)

Closed Circuit and Open Circuit

Closed circuit
1. The closed hydraulic circuit is constructed with an actuator (motor) and a pump.
2. The speed and direction of the actuator can be decided by changing the pump tilt angle to + α, or to − α as the delivery port and the pump flow change accordingly.
3. The closed circuit features a smooth starting and stopping of the actuator.
4. The pump and the motor can be put into one case and made into a compact size as integrated HST.

Open circuit
1. In the open circuit, oil is drawn by the pump from the reservoir, and the returning oil from the actuator is flown to the reservoir.
2. With a fixed-displacement pump, the speed and direction of an actuator are controlled with the switching and spool opening of the control valve. With the variable displacement pump, the pump controls the flow rate and the swash-plate tilting angle can be changed only in the + α direction.
3. In the open circuit, a single pump can connect to and control multiple actuators.
Typical piston pumps are variable and high-pressure types mainly used for construction equipment, etc., engaged in heavy-duty work. They are widely used in areas that require horsepower control, load-sensing, and other control functions.

### PSV Series (Closed circuit)

- **PSV2-16**

### PSVD Series (Open circuit)

- **PSVD2-21**

### PSVL Series (Open circuit and load sensing)

- **PSVL-42**

---

### Dimensions (unit: mm)

- PTO shaft (option) is shown in the pump unit outline drawing.

#### <Closed circuit>

<table>
<thead>
<tr>
<th>Model</th>
<th>Displacement (cm³/rev)</th>
<th>Max. working pressures (MPa)</th>
<th>Max. speed (rpm)</th>
<th>Control device</th>
<th>Control device</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSV-10</td>
<td>10.0</td>
<td>27.5</td>
<td>3,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSV-16</td>
<td>16.4</td>
<td>27.5</td>
<td>3,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSV2-10</td>
<td>10.8X2</td>
<td>27.5</td>
<td>3,200</td>
<td></td>
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<tr>
<td>PSV2-16</td>
<td>16.4X2</td>
<td>27.5</td>
<td>3,200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Only CW is available (clockwise when viewing from the input shaft side).

---

### Dimensions (unit: mm)

- PTO shaft (option) is shown in the pump unit outline drawing.
### Pump: Piston Pump

Typical piston pumps are variable and high-pressure types mainly used for construction equipment, etc., engaged in heavy-duty work. They are widely used in areas that require horsepower control, load-sensing, and other control functions.

#### PSV Series (Closed circuit)

![PSV-10 (single)](image1)

#### PSVD Series (Open circuit)

![PSVD-16 (single)](image2)

#### PSVL Series (Open circuit and load sensing)

![PSVL-16 (single)](image3)

### Dimensions (unit: mm)

※ PTO shaft (option) is shown in the pump unit outline drawing.

#### <Closed circuit>

**PSV-10 (single)**

![PSV-10 (single)](image4)

**PSV-16 (single)**

![PSV-16 (single)](image5)

**PSV2-10 (tandem)**

![PSV2-10 (tandem)](image6)

**PSV2-16 (tandem)**

![PSV2-16 (tandem)](image7)
Performance Curve  Operating oil: ISO VG46  Oil temperature: 50°C

<Open Circuit>

■ PSVD2-13, 17, 21 and 27 [Split flow (Single cylinder block with two flow systems)]

Hydraulic circuit

- Invalve spile 546° 1630-13°

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Measured dimensions</th>
<th>Part sizes</th>
</tr>
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<tbody>
<tr>
<td>PSVD2-13</td>
<td></td>
<td></td>
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<tr>
<td>PSVD2-17</td>
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<tr>
<td>PSVD2-21</td>
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<td></td>
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<tr>
<td>PSVD2-27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ PSVL-42 and 54 [Load sensing]  ※ To be used with an LS valve. (See Page 55.)

Hydraulic circuit

- Invalve spile 546° 1630-13°

<Open Circuit: Load sensing>

■ PSVL-42

<Load sensing system working mechanism> (multiple operations)

- The maximum load pressure PLS is selected by the shuttle valve, which controls the pump regulator and the pressure compensator valve.
- The pressure compensator valve adjusts the flow at Ac so that PC upper stream pressure equals (PLS + β)
- Differential pressure (Pp - Pc) between the uppersteam and downstream sides of A1 and A2, which control the flow to each actuator, remains constant, enabling multiple operations under different loading conditions.

<Closed circuit>

■ PSV-10

■ PSV-16

<Load sensing system working mechanism> (multiple operations)
**Performance Curve**  Operating oil: ISOVG46  Oil temperature: 50°C

**<Open Circuit>**

**PSVD2-13, 17, 21 and 27 [Split flow (Single cylinder block with two flow systems)]**

- Hydraulic circuit

**PSVL-42 and 54 [Load sensing]  To be used with an LS valve. (See Page 55.)**

- Hydraulic circuit

**<Closed circuit>**

**<Load sensing system working mechanism> (multiple operations)**

- The maximum load pressure $P_{ls}$ is selected by the shuttle valve, which controls the pump regulator and the pressure compensator valve.
- The pressure compensator valve adjusts the flow at $A_c$ so that pressure compensator valve PC1 upstream pressure equals $(P_{ls} + \beta)$
- Differential pressure $(P_{p} - P_{c})$ between the uppersteam and downstream sides of A1 and A2, which control the flow to each actuator, remains constant, enabling multiple operations under different loading conditions.