Hydraulic Motor (General)

<table>
<thead>
<tr>
<th>Motor unit</th>
<th>Motor with reduction gear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston Motor</td>
<td>Gear motor, vane motor, etc.</td>
</tr>
</tbody>
</table>

**Basic Construction**

**Motor unit**

**[Construction and Mechanism]**
1. When high-pressure oil supplied from the pump flows into the cylinder block through the valve plate, the swash plate is pushed by the force of the piston assembly.
2. The piston assembly receives reaction force against it and produces reaction force in the rotating direction.
3. The oil delivered from the outlet port returns to the reservoir through the valve plate.
4. The inlet and outlet sides can be switched by an external valve operation to rotate the motor in the reverse direction.

**Swing motor (with reduction gear)**

- Shockless relief valve
- Motor portion
- Reduction gear portion
- Hydraulic circuit

**Traveling motor (with reduction gear)**

- Two-speed switching valve
- Parking brake
- Shockless relief valve
- Hydraulic circuit

- Output torque calculation formula:
  \[ T = \frac{P \times D}{2 \times \pi \times n} \]
  - D: Motor displacement [cm³/rev]
  - T: Output torque [N·m]
  - P: Effective pressure [MPa]
  - ηv: Mechanical (torque) efficiency

- Output speed calculation formula:
  \[ N = \frac{Q \times 10^3}{D} \times \eta_v \]
  - Q: Flow rate [L/min.]
  - ηv: Volumetric efficiency

- The speed can be decided by motor capacity, flow rate, and volumetric efficiency.
- Volumetric efficiency is affected by leakage inside the motor (from the high pressure side to the low pressure side), and decreases at a slower speed and higher pressure.

**Main Components of the Travel Motor (MAG)**

- Reduction gear
- Motor (standard component)
- Counterbalance valve (standard component for all models): Prevents the motor from overrunning on a down slope. The valve is effective to prevent cavitation.
- Two speed mechanism (standard component for all models): Two step speed change can be done under the same flow, which allows a wider range of speed control. (See Page 24)

**Main Components of the Swing Motor (MSG)**

- Reduction gear
- Shaft rotation type planetary reduction gear is adopted.
- Motor lubricant circulation system: Hydraulic fluid is also used as a reduction gear lubricant. No maintenance is required.
- Motor (standard component for all models)
- Shockless relief valve: Reduces shocks at the stop and prevents cavitation.
- Parking brake: Multiple-plate disk brake is adopted. (Output torque ratio over 100%)
- Make-up valve: Prevents cavitation.

- (Optional Components for All Models)
  - Parking brake delaying valve: Delays the response time of the parking brake
  - Anti-reaction valve: Reduces the reaction at the time the motor stops.

**Characteristics of the Shockless Relief Valve**

- Output torque can be obtained from motor displacement, pressure, and mechanical efficiency.
- The torque efficiency is affected by mechanical friction and other factors, and drops at a higher speed and lower pressure.
- The speed can be decided by motor capacity, flow rate, and volumetric efficiency.
- Volumetric efficiency is affected by leakage inside the motor (from the high pressure side to the low pressure side), and decreases at a slower speed and higher pressure.
Hydraulic Motor (General)

Motor: Piston Motor (Swash plate type)

Basic Construction

Motor unit
[Construction and Mechanism]
1. When high-pressure oil supplied from the pump flows into the cylinder block through the valve plate, the swash plate is pushed by the force of the piston assembly.
2. The piston assembly receives reaction force against it and produces reaction force in the rotating direction.
3. The oil delivered from the outlet port returns to the reservoir through the valve plate.
4. The inlet and outlet sides can be switched by an external valve operation to rotate the motor in the reverse direction.

Traveling motor (with reduction gear)

Swing motor (with reduction gear)

Motor (standard component)
- Counterbalance valve (standard component for all models): Prevents the motor from overrunning. The valve is effective to prevent cavitation.
- Two speed mechanism (standard component for all models): Two step speed change can be done under the same flow, which allows a wider range of speed control. (See Page 24)
- Shockless relief valve (standard component for MAG-50 through 230): Reduces shocks at the stop and prevents cavitation.
- Anti-cavitation valve (with no relief mechanism) (standard component for MAG-18 through 33): This valve has stopping performance similar to the shockless version and can prevent cavitation.
- Parking brake (standard component for MAG-50 through 230 and optional for MAG-12 through 33): A multiple-plate wet disk brake system is adopted.

(Optional Component)
- Automatic two-speed system (except for MAG-12): Speed is automatically switched from Low to High or vice versa according to travel load pressure.

Basic Characteristics

The motor's general characteristics (performance) are as follows.

Output torque calculation formula:
\[ T = \frac{P \times D}{2 \times \pi} \times \eta_m \]

\( T \): Output torque [N-m]
\( P \): Effective pressure [MPa]
\( \eta_m \): Mechanical (torque) efficiency

Output speed calculation formula:
\[ N = \frac{Q \times 10^3}{D} \times \eta_v \]

\( N \): Speed [rpm]
\( Q \): Flow rate [L/min.]
\( \eta_v \): Volumetric efficiency

The speed can be decided by motor capacity, flow rate, and volumetric efficiency.

Volumetric efficiency is affected by mechanical friction and other factors, and drops at a higher speed and lower pressure.

[Characteristics of the Shockless Relief Valve]
Motor: Piston Motor Unit

Motors

[Swash Plate Piston Motor]
The MSF series is a compact, light, swashplate type piston motor, which has been used for construction and agricultural machines. All rotary parts are manufactured by one of KYB-affiliated companies, Takako Industries, Inc., which is the world’s leading company in this technology.

**MSF Series (motor unit)**

- **MSF-23**

<General purpose>

<table>
<thead>
<tr>
<th>Model</th>
<th>Diameter (mm)</th>
<th>Max. working pressure (MPa)</th>
<th>Max. speed (rpm)</th>
<th>Max. flow rate (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSF-18</td>
<td>16.4 ~ 18.4</td>
<td>24.5</td>
<td>3000</td>
<td>50</td>
</tr>
<tr>
<td>MSF-23</td>
<td>22.6</td>
<td>24.5</td>
<td>3000</td>
<td></td>
</tr>
</tbody>
</table>

Models for fan and mixer drum driving applications are also available. Please contact us for details.

Motor: Piston motor (with reduction gear)

The MAG series offers high-torque motors for medium- or high-speed traveling crawler vehicles. It consists of a case rotation planetary reduction gear and a swash plate piston motor, and is equipped with a two-speed change unit and a parking brake unit.

The two-speed change mechanism supports the automatic speed change according to the load. The MSG series motors incorporating a shaft-rotation type simple planetary reduction gear and the swash plate motor are ideal solutions for the swing system of excavators and mini-excavators. The motor is equipped with a parking brake in our standard version.

**MAG Series (with reduction gear)**

(For excavator and mini-excavator travel)

<table>
<thead>
<tr>
<th>Model</th>
<th>Max. output torque (kN·m)</th>
<th>Max. working pressure (MPa)</th>
<th>Max. speed (rpm)</th>
<th>Max. flow rate (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAG-33V</td>
<td>1.18</td>
<td>20</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>MAG-170VP</td>
<td>2.26</td>
<td>24.5</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>MAG-18VP-180E</td>
<td>3.19</td>
<td>27.5</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>MAG-20VP-20E</td>
<td>4.27</td>
<td>27.5</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>MAG-50VP-60D</td>
<td>7.84</td>
<td>29.4</td>
<td>55</td>
<td>80</td>
</tr>
<tr>
<td>MAG-65VP-180E</td>
<td>17.7</td>
<td>34.3</td>
<td>55</td>
<td>150</td>
</tr>
<tr>
<td>MAG-80VP-180E</td>
<td>19.3</td>
<td>34.3</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>MAG-170VP-200D</td>
<td>37.3</td>
<td>34.3</td>
<td>50</td>
<td>270</td>
</tr>
<tr>
<td>MAG-230VP-200D</td>
<td>58.8</td>
<td>34.3</td>
<td>50</td>
<td>320</td>
</tr>
</tbody>
</table>

Models for winches and skid-steer loaders are also available. Please contact us for details.

**MSG Series (with reduction gear)**

(For excavator and mini-excavator swing)

<table>
<thead>
<tr>
<th>Model</th>
<th>Max. output torque (kN·m)</th>
<th>Max. working pressure (MPa)</th>
<th>Max. speed (rpm)</th>
<th>Max. flow rate (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSO-37P-10E</td>
<td>0.83</td>
<td>20.6</td>
<td>70</td>
<td>85</td>
</tr>
<tr>
<td>MSO-27P-3EE</td>
<td>1.27</td>
<td>20.6</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>MSO-27P-4EE</td>
<td>2.04</td>
<td>20.6</td>
<td>70</td>
<td>77</td>
</tr>
<tr>
<td>MSO-52P-21</td>
<td>3.48</td>
<td>24</td>
<td>85</td>
<td>85</td>
</tr>
</tbody>
</table>

Models for all types of excavators are also available. Please contact us for details.

**Two-speed Change Mechanism** (MAG series for travel systems)

The swashplate has three surface sections, a, b, and c, and can be tilted by external pilot pressure with two steel balls at the rear of the swashplate working as fulcrums.

1st Speed: Low speed (high torque)

Low speed = Large displacement

When the control valve position is switched to 1st speed, the variable valve connects the swash plate control piston chamber behind the swash plate with the reservoir and the section “a” of the swash plate is pressed against the fixed face by the driving force of the motor on the piston and the spring on the cylinder block side. As a result, the swash plate tilts at a maximum angle $\alpha$ to output a larger displacement (1st speed).

2nd Speed: High speed (low torque)

High speed = Small displacement

Switching the variable valve position to 2nd speed with the control valve leads the motor driving pressure to the swash plate control piston. As the force of the piston overcomes the driving force of the motor and the force of the spring, the face “b” of swash plate is pressed to the fixed face, making the swash plate tilt at a minimum angle $\beta$ to generate a smaller displacement (2nd speed).

**Dimensions (unit: mm)**

- **MSF-18 (motor unit)**

- **MSF-23 (motor unit)**
**Motor: Piston Motor Unit**

**Swash Plate Piston Motor**

The MSF series is a compact, light, swashplate type piston motor, which has been used for construction and agricultural machines. All rotors are manufactured by one of KYB-affiliated companies, Takako Industries, Inc., which is the world’s leading company in this technology.

### MSF Series (motor unit)

- **MSF-23 (motor unit)**

<General purpose>

<table>
<thead>
<tr>
<th>Model</th>
<th>Displacement (cm³/rev)</th>
<th>Max. working pressure (MPa)</th>
<th>Max. speed (rpm)</th>
<th>Max. flow rate (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSF-18</td>
<td>16.4 – 18.4</td>
<td>24.5</td>
<td>3000</td>
<td>50</td>
</tr>
<tr>
<td>MSF-23</td>
<td>23.6</td>
<td>24.5</td>
<td>3000</td>
<td>50</td>
</tr>
</tbody>
</table>

Models for fan and mixer drum driving applications are also available. Please contact us for details.

### MAG Series (with reduction gear)

**Two-speed Change Mechanism**

(MAG series for travel systems)

- Low speed = Large displacement
  - When the control valve position is switched to 1st speed, the variable valve connects the swash plate control piston chamber behind the swash plate with the reservoir and the section "a" of the swash plate is pressed against the fixed face by the driving force of the motor on the piston and the spring on the cylinder block side. As a result, the swash plate tilts at a maximum angle α to output a larger displacement (1st speed).

- High speed = Small displacement
  - Switching the variable valve position to 2nd speed with the control valve leads the motor driving pressure to the swash plate control piston. As the force of the piston overcomes the driving force of the motor and the force of the spring, the face "b" of swash plate is pressed to the fixed face, making the swash plate tilt at a minimum angle β to generate a smaller displacement (2nd speed).

### MSG Series (with reduction gear)

**Two-speed Change Mechanism**

(MAG series for travel systems)

- Low speed = Large displacement
  - When the control valve position is switched to 1st speed, the variable valve connects the swash plate control piston chamber behind the swash plate with the reservoir and the section "a" of the swash plate is pressed against the fixed face by the driving force of the motor on the piston and the spring on the cylinder block side. As a result, the swash plate tilts at a maximum angle α to output a larger displacement (1st speed).

- High speed = Small displacement
  - Switching the variable valve position to 2nd speed with the control valve leads the motor driving pressure to the swash plate control piston. As the force of the piston overcomes the driving force of the motor and the force of the spring, the face "b" of swash plate is pressed to the fixed face, making the swash plate tilt at a minimum angle β to generate a smaller displacement (2nd speed).

**Dimensions (unit: mm)**

### MSF-18 (motor unit)

- For excavator and mini-excavator travel

### MSF-23 (motor unit)

- For excavator and mini-excavator swing

Models for winches and skid-steer loaders are also available. Please contact us for details.

Motor: Piston Motor Unit
Dimensions (unit: mm)

- **MAG-12V (for travel)**

- **MAG-170VP and 230VP (for travel)**

- **MAG-18V, 26V, 33V, and 50VP (for travel)**

- **MSG-27P-10E and 16E (for swing)**

- **MSG-27P-23E (for swing)**

- **MSG-50P-21 (for swing)**

**Precautions for handling MAG/MSG series**

- These series are designed for excavators and mini-excavators with open circuit, MAG models are also available for closed circuit travel motors and winch applications. Please contact us for details.
- We may recommend motor capacities and speed ratios suitable for the customer’s requirements. Please let us know what your application requirements are.
- MAG motor is to be installed with its output shaft horizontally positioned and the main port facing sideways or upward. When the main port is set facing sideways, use the upper one out of two drain ports. Do not install MSG motor with the output shaft facing downward. Also use the specific drain port. It should not be substituted with the vent port.
- Do not use the parking brake of MSG motor for dynamic braking. Configure the circuit so that the parking brake applies after the motor stops.
- Please read the “Precautionary on the Use of Hydraulic Equipment” on Page 4. Please contact us with any questions.
Motors

Performance Curve  Operating oil: ISO VG46  Oil temperature: 50℃

<Motor with reduction gear for travel>
- **MAG-12V**
- **MAG-18V**
- **MAG-26V**
- **MAG-33V**
- **MAG-50V**
- **MAG-85V**

<Motor with reduction gear for swing system>
- **MAG-170V**
- **MAG-230V**
- **MSG-27P-10E**
- **MSG-27P-16E**
- **MSG-27P-23E**
- **MSG-50P-21**
Motors

Performance Curve Operating oil: ISO VG 46 Oil temperature: 50℃

<Motor unit>
- MSF-18
- MSF-23

<Motor with reduction gear for travel>
- MAG-12V
- MAG-18V
- MAG-26V
- MAG-33V
- MAG-50V
- MAG-85V

<Motor with reduction gear for swing system>
- MSG-27P-10E
- MSG-27P-16E
- MSG-27P-23E
- MSG-50P-21