Metering pumps
AX series

IWAKI
The highest reliability system metering

Iwaki metering pumps AX series are compact hydraulic diaphragm pumps designed to meet the exacting requirements of modern advanced chemical processes.

The light, compact body incorporates a highly reliable driving unit and unique hydraulic system to assure high, stable performance over long-term continuous operation.

In addition, the new-type servo system with built-in positioner and numerous accessories, are standardized to meet the most stringent service demands of chemical liquid feeding processes, making the AX series suitable for wide application not only in the chemical industry but in many other fields such as paper, food, and waste-water treatment.

**High precision and reliability**

Iwaki AX series are highly precise and reliable metering pumps for chemical processes which achieve metering accuracy within ±1% (see Note 1), linearity within ±2% (see Note 3) and feature a driving unit specially designed for long-term continuous operation.

**Improved cost performance**

The mechanical efficiency of the reduction gear as well as that of the entire pump is improved. In addition, the employment of a large-capacity pump head and the standardization of high-speed types have further improved the cost efficiency of the pump.
Compact and lightweight
An integrated SL crank and worm reduction gear incorporated in the compact driving unit, reducing the pump installation area to a half or less as well as the overall weight to 2/3 or less.

New integrated servo system with built-in positioner
An integrated servo unit with built-in positioner is employed, which directly controls the pump via mADC signal. This new type servo system has simplified both instrumentation work and also field adjustment.

Note 1: Metering accuracy (repeatability) expresses flow deviation from average rated capacity under steady state operating conditions, when the capacity is repeatedly measured.
Note 2: Linearity indicates the deviation of stroke/capacity ratio from the ideal straight line. Note that the linearity is not guaranteed.
Note 3: Reproducibility describes the ability to reproduce a specific pump flow rate under a given set of conditions when capacity setting is varied. Note that the reproducibility is not guaranteed.
Highly reliable advanced mechanism

**SL crank**  
(Screwed L crank patented in Japan and other countries)

The SL crank features a simple structure but is capable of generating a high piston driving force and features a highly reliable stroke adjustment mechanism for reciprocating pumps.

High-strength, simplified structure  
Compared with conventional cranks, e.g., split cam and connecting rod, the SL crank features a solid cam and connecting rod, leading to considerably increased strength.

No stroke length error  
The cam is coupled to the crank via 10 or more screw threads. Owing to the wide area supporting the piston load, it is free from problems such as play and biting due to crank wear during long-term continuous operation.

Compact and lightweight  
A compact, lightweight driving unit has resulted from the reduced crank unit size.

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**Hydraulic diaphragm**  
**Plunger**  
**Mechanically-driven diaphragm**

- **SUS**  
- **PVC**
### Material of wet end parts

<table>
<thead>
<tr>
<th>Type of pump</th>
<th>Hydraulic diaphragm</th>
<th>Plunger</th>
<th>Mechanically-driven diaphragm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUS</td>
<td>PVC</td>
<td>SUS</td>
</tr>
<tr>
<td><strong>Pump head</strong></td>
<td>SUS316/SCS314</td>
<td>PVC</td>
<td>SUS316</td>
</tr>
<tr>
<td><strong>Ball valve</strong></td>
<td>HC/SUS316</td>
<td>HC/SUS316/CE</td>
<td>HC/SUS440C</td>
</tr>
<tr>
<td><strong>Valve seat</strong></td>
<td>SUS316</td>
<td>PVC</td>
<td>SUS316/SCS316/STL</td>
</tr>
<tr>
<td><strong>Gasket</strong></td>
<td>PTFE</td>
<td>–</td>
<td>PTFE</td>
</tr>
<tr>
<td><strong>O-ring</strong></td>
<td>–</td>
<td>EPDM/FKM</td>
<td>–</td>
</tr>
<tr>
<td><strong>Diaphragm</strong></td>
<td>PTFE</td>
<td>PTFE</td>
<td>–</td>
</tr>
<tr>
<td><strong>Plunger</strong></td>
<td>–</td>
<td>–</td>
<td>SUS316+HCr/CE</td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td>Cylinder head (not wet end)</td>
<td>1. Low pressure type: Cast iron</td>
<td>2. Medium pressure type: SCPH-2</td>
</tr>
</tbody>
</table>

**Symbols**

- **SCS13**: Stainless steel (equivalent to SUS304)
- **SCS14**: Stainless steel (equivalent to SUS316)
- **HC**: Hastelloy C-276
- **440C**: Stainless steel 440C
- **STL**: Stellite alloy
- **HCr**: Hard chrome plating
- **PVC**: Non plasticized-polyvinyl chloride
- **PTFE**: Polytetrafluoroethylene (Teflon etc.)
- **EPDM**: Ethylene-propylene rubber
- **FKM**: Fluororubber
- **CE**: Ceramic

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**Driving unit gear oil / hydraulic oil**

Lubricating oil and hydraulic oil circuits are interconnected, and common oil is used. An air breather is mounted on the suction port to keep out rain water.

**Automatic air vent valve**

This valve automatically discharges the gas contained in the hydraulic oil to prevent gas lock and maintain metering accuracy. The simple structure assuring correct operation, ensures the discharge of the gas contained in the hydraulic oil together with a small amount of oil at each stroke.

**Diaphragm**

(Spherical diaphragm)

The spherical diaphragm developed by Iwaki operates under a unique principle, utilizing the change in material shape. No tensile stress acts on the diaphragm, assuring high durability under long-term continuous operation.

**Oil compensator valve**

This is the valve to keep the oil volume of hydraulic cylinder at the optimum level. The mechanically-operated valve always opens at the bottom dead position of diaphragm to avoid excess replenishment of oil and diaphragm damage.
Operating principle
When piston 1 advances, it moves diaphragm 3 through hydraulic oil 2 and pushes out the liquid in pumping chamber 4, which in turn opens discharge valve 5 and is discharged through the valve (discharge stroke). Conversely, when the piston retracts, the diaphragm is sucked back, and liquid opens suction valve 6 to enter the pump chamber (suction stroke). As a result, the diaphragm serves only as a membrane to separate hydraulic oil from liquid and suffers no stress concentration. Additionally, the diaphragm is protected by backup plate 7.

Automatic air vent valve
Automatic air vent valve 9, a ball check valve with valve seat on both upper and lower sides, automatically discharges the gas generated and contained in the hydraulic oil. While the valve moves from the lower to the upper valve seat in the early stage of the suction stroke, air together with a small amount of oil is discharged within a short time period. The automatic air vent valve and hydraulic cylinder from an integrated unit to facilitate handling and maintenance.

* Set spring pressure of the check valve (ball valve): 0.2 to 0.3 kgf/cm².

Oil compensator valve
Oil compensator valve 8 automatically compensates for the shortage in hydraulic oil 2 to maintain the oil at the specified. Should oil shortage occur, the max. retract point (bottom dead center) of the diaphragm is shifted backward from the optimum position, causing the diaphragm to depress the oil compensator valve, open the valve port, and introduce oil into the oil cylinder. The oil compensator valve detects diaphragm position and replenish hydraulic oil thus making it possible to avoid excess oil replenishment and therefore optimum operation.

Relief valve
Built-in oil relief valve 10 protects the pump from abnormally high pressure on the process side and from misoperation of the discharge side valve.
Wide variety of pump components

Series configuration

- Servo unit
  - Pneumatic servo system
  - Electric servo system

- Motor unit
  - General purpose flange motor
  - Inverter motor
  - VS motor

- Driving unit
  - AXJ
  - AXK
  - AXA
  - AXB

- Hydraulic system and pump unit

- Hydraulic diaphragm, low pressure type (L)
  - SUS
  - PVC
  - PTFE

- Hydraulic diaphragm, medium pressure type (M)
  - SUS

- Plunger (P)
  - SUS
  - Hastelloy C
  - Titanium

- Mechanically-driven diaphragm (K/KE)
  - SUS
  - PVC

- Motor unit
  - Pulse generator

- Wide variety of pump components

- AX-L
- AX-K
- AX-P
- AX-M
# Major standard specifications (Dimensions in mm)

## AX-L

**Hydraulic diaphragm, Low pressure type**

### AXJ

- **Stroke length**: 0 to 15mm
- **Standard motor**: 0.2kW

### AXK

- **Stroke length**: 0 to 24mm
- **Standard motor**: 0.40/0.2kW

### AXA

- **Stroke length**: 0 to 30mm
- **Standard motor**: 0.75/0.4kW

### AXB

- **Stroke length**: 0 to 40mm
- **Standard motor**: 1.5/0.75kW

## AX-M

**Hydraulic diaphragm, Medium pressure type**

### AXJ

- **Stroke length**: 0 to 15mm
- **Standard motor**: 0.2kW

### AXK

- **Stroke length**: 0 to 24mm
- **Standard motor**: 0.40/0.2kW

### AXA

- **Stroke length**: 0 to 30mm
- **Standard motor**: 0.75/0.4kW

### AXB

- **Stroke length**: 0 to 40mm
- **Standard motor**: 1.5/0.75kW

### AX-M Specifications

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>AXJ</th>
<th>AXK</th>
<th>AXA</th>
<th>AXB</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.918</td>
<td>0.717</td>
<td>0.37</td>
<td>0.09</td>
</tr>
<tr>
<td>20</td>
<td>1.935</td>
<td>1.43</td>
<td>0.74</td>
<td>0.22</td>
</tr>
<tr>
<td>30</td>
<td>2.954</td>
<td>2.14</td>
<td>1.17</td>
<td>0.36</td>
</tr>
<tr>
<td>40</td>
<td>3.972</td>
<td>2.84</td>
<td>1.58</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Note: The maximum discharge pressure in the table applies to stainless steel type. That for PVC type is 0.7MPa.
### AX-P

**AXJ**

- **Stroke length**: 0 to 15mm
- **Standard motor**: 0.2kW

<table>
<thead>
<tr>
<th>Plunger diameter ø mm</th>
<th>Max. discharge flow L/min</th>
<th>Maximum discharge pressure MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of strokes (spm) at 50Hz</td>
<td>Number of strokes (spm) at 60Hz</td>
</tr>
<tr>
<td>05</td>
<td>0.012</td>
<td>0.019</td>
</tr>
<tr>
<td>08</td>
<td>0.032</td>
<td>0.048</td>
</tr>
<tr>
<td>11</td>
<td>0.062</td>
<td>0.093</td>
</tr>
<tr>
<td>16</td>
<td>0.137</td>
<td>0.206</td>
</tr>
<tr>
<td>22</td>
<td>0.260</td>
<td>0.390</td>
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<tr>
<td>32</td>
<td>0.550</td>
<td>0.825</td>
</tr>
<tr>
<td>44</td>
<td>1.01</td>
<td>1.52</td>
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</tbody>
</table>

### AX-K/KE

**AXJ**

- **Motor output**: 0.4kW

<table>
<thead>
<tr>
<th>Model</th>
<th>Max. discharge flow L/min</th>
<th>Maximum discharge pressure MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of strokes (spm) at 50Hz</td>
<td>Number of strokes (spm) at 60Hz</td>
</tr>
<tr>
<td>K90</td>
<td>1.4</td>
<td>2.1</td>
</tr>
<tr>
<td>K120</td>
<td>3.5</td>
<td>5.3</td>
</tr>
<tr>
<td>KE90</td>
<td>1.1</td>
<td>1.7</td>
</tr>
<tr>
<td>KE120</td>
<td>2.9</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Note: K is for standard. KE is for latex application.

If flow rate (which you need) exceeds value on above table, CX series is available. Please refer to CX series catalog.

**AXK**

- **Stroke length**: 0 to 24mm
- **Standard motor**: 0.4/0.2kW

<table>
<thead>
<tr>
<th>Plunger diameter ø mm</th>
<th>Max. discharge flow L/min</th>
<th>Maximum discharge pressure MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of strokes (spm) at 50Hz</td>
<td>Number of strokes (spm) at 60Hz</td>
</tr>
<tr>
<td>08</td>
<td>0.051</td>
<td>0.076</td>
</tr>
<tr>
<td>11</td>
<td>0.097</td>
<td>0.146</td>
</tr>
<tr>
<td>16</td>
<td>0.215</td>
<td>0.323</td>
</tr>
<tr>
<td>22</td>
<td>0.407</td>
<td>0.611</td>
</tr>
<tr>
<td>32</td>
<td>0.861</td>
<td>1.29</td>
</tr>
<tr>
<td>44</td>
<td>1.62</td>
<td>2.44</td>
</tr>
</tbody>
</table>

**AXK**

- **Stroke length**: 0 to 30mm
- **Standard motor**: 0.75/0.4kW

<table>
<thead>
<tr>
<th>Plunger diameter ø mm</th>
<th>Max. discharge flow L/min</th>
<th>Maximum discharge pressure MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of strokes (spm) at 50Hz</td>
<td>Number of strokes (spm) at 60Hz</td>
</tr>
<tr>
<td>08</td>
<td>0.063</td>
<td>0.095</td>
</tr>
<tr>
<td>11</td>
<td>0.120</td>
<td>0.180</td>
</tr>
<tr>
<td>16</td>
<td>0.265</td>
<td>0.391</td>
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<tr>
<td>22</td>
<td>0.498</td>
<td>0.747</td>
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<tr>
<td>32</td>
<td>1.07</td>
<td>1.61</td>
</tr>
<tr>
<td>44</td>
<td>2.03</td>
<td>3.05</td>
</tr>
<tr>
<td>58</td>
<td>3.53</td>
<td>5.30</td>
</tr>
<tr>
<td>68</td>
<td>4.86</td>
<td>7.29</td>
</tr>
</tbody>
</table>

**AXB**

- **Stroke length**: 0 to 40mm
- **Standard motor**: 1.5/0.75kW

<table>
<thead>
<tr>
<th>Plunger diameter ø mm</th>
<th>Max. discharge flow L/min</th>
<th>Maximum discharge pressure MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of strokes (spm) at 50Hz</td>
<td>Number of strokes (spm) at 60Hz</td>
</tr>
<tr>
<td>11</td>
<td>0.16</td>
<td>0.241</td>
</tr>
<tr>
<td>16</td>
<td>0.347</td>
<td>0.521</td>
</tr>
<tr>
<td>22</td>
<td>0.664</td>
<td>0.996</td>
</tr>
<tr>
<td>32</td>
<td>1.43</td>
<td>2.15</td>
</tr>
<tr>
<td>44</td>
<td>2.71</td>
<td>4.07</td>
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<tr>
<td>58</td>
<td>4.71</td>
<td>7.07</td>
</tr>
<tr>
<td>68</td>
<td>6.48</td>
<td>9.72</td>
</tr>
<tr>
<td>88</td>
<td>10.8</td>
<td>16.2</td>
</tr>
</tbody>
</table>
Feature for process automation and FA

**Electric servo unit**
The servo unit for the AX series features a built-in positioner, which directly controls the pump stroke length by mA DC signal from the controller. In addition, a special stroke controller the "Iwaki Stroke Setter" with ratio relay, signal limiter, and other control functions has been designed to meet automatic control requirements in a variety of fields. This system with the simple structure facilitates both instrumentation work as well as adjustment.

**Direct control by mA DC signal**
This servo unit directly controls pump discharge within a range from 0 to 100% by 4 to 20mA signal from the automatic controller (refer to Fig. 2).

**Simplified electrical and instrumentation work**
This servo unit requires no wiring for the servo motor and feedback resistor which, on conventional servo systems, is indispensable. Only mA DC signal wiring is required, which not only improves ease of instrumentation work but also allows control which is highly resistant to the externally induced noise (refer to Fig. 3).

**Simplified system adjustment**
The pump side servo unit is adjustment prior to delivery. Unlike conventional systems, field adjustment between servo unit and positioner is unnecessary.

**Simplified structure**
The system can be constructed with a minimum number of control devices (refer to Fig. 4).

**Speed controller**
With the pump speed controller, the discharge flow of metering pumps AX series can be linearly controlled. Flow rate control by speed controller has the advantages of fast response and wide control range and has become more common with the widespread use of inverters. The pulse generator detects the gear speed through a high frequency pulse generating proximity switch and outputs a digital pulse. The gear is directly coupled with the motor via the worm shaft, not only making it possible to obtain a correct speed signal but also allowing adaption to any variable speed motor.

**Pneumatic servo unit**
The pneumatic servo unit for AX series employs a high torque pneumatic motor (piston type), and gives high reliability. Both pneumatic-pneumatic positioner, and also electric-pneumatic positioner which is operated by mA DC input signal are available.
Automatic control system

Fig. 1  Structural drawing of electric servo unit

Pump discharge can be directly controlled by output signal from the controller or ratio relay.

Fig. 2  Example of direct control

When the stroke setter is installed, ratio relay, signal limiter, zero shift, and other control functions as well as manual operation become available.

Fig. 3  Combination with stroke setter

An example of two-value separate control where speed is first controlled and then stroke length. Speed signal is output from the built-in pulse generator.

Fig. 4  Example of two-value control (stroke length and speed)

Controlling the accumulated number of pump strokes enables batch metering and charging.

Fig. 5  Speed feedback in inverter control

This type of control not only ensures accurate speed information but also features high response and a wide control range.

Fig. 6  Example application to batch metering and charging

Controlling the accumulated number of pump strokes enables batch metering and charging.

Fig. 7  Pneumatic servo "A" type (Pneumatic-pneumatic positioner)

Fig. 8  Pneumatic servo "D" type (Electro-pneumatic positioner)
Optional accessories

Relief valve, back pressure valve, air chamber, and other standard equipment necessary for the metering pump piping are optionally available. Optional accessories of various standard materials (SUS316, PVC, PVDF fluororesin) are available.

**Flow checker** (Flow detector)
- Capacity: 0.01–6L/min
- Working pressure: Max. 0.5MPa
- Material: PVC

**Diaphragm rupture detector**
Diaphragm breakage monitor for double diaphragm type pumps. In the case of damage to the diaphragm, the monitor detects the difference of conductivity between hydraulic oil and process liquid and outputs an alarm signal. Its application range includes not only acids and alkalis but also organic solvents with low conductivity.

**Relief valve**
- Capacity: 1–70L/min
- Working pressure: 0.15–1MPa  Note: High pressure types are also available.
- Material: SUS316, PVC, PVDF

**Air chamber**
- Capacity: 1–30 liters
- Working pressure: Max. 0.9MPa (SUS)
  : Max. 0.5MPa (PVC)
- Material: SUS316, PVC  Note: Accumulators (Bladder type) are also available.

**Back pressure valve**
- Capacity: 1–70L/min
- Working pressure: 0.05–0.8MPa
- Material: SUS316, PVC, PVDF

**PVC, 1 type**  **PVC, 2-25 type**  **PVC, A type**  **PVC, N type**  **SUS, 2-25 type**  **SUS, A type**