IWAKI PUMPS

# IWAKI Metering Pump

# SK Series

# Instruction Manual

⚠Read this manual before use of product

Thank you for selecting the Iwaki diaphragm metering pump SK series. This instruction manual has been prepared to ensure correct and safe handling of the pump. Please read this manual carefully and thoroughly prior to operating the pump.
Pay special attention to the "Safety Instruction" messages included in this manual.
This instruction manual should be kept by each user and within reach of the actual operator, for quick reference when needed.

# Contents


**IMPORTANT INSTRUCTIONS ····· 1**
Safety Instructions to Prevent Personal Injuries

**OUTLINE OF PRODUCT ····· 4**
1. Before Using Pump ····· 5
2. Operating Principle ····· 5
3. Identification Codes ····· 6
4. Specifications and Outer Dimensions ····· 8
5. Names of Parts ····· 10

**INSTALLATION ····· 14**
1. Before Use ····· 15
2. Installation/Piping/Wiring ····· 16
3. Operation ····· 18

**MAINTENANCE ····· 21**
1. Causes of Trouble and Troubleshooting ····· 22
2. Maintenance and Inspection ····· 24
3. Consumable Parts ····· 25
4. Disassembly and Assembly ····· 25

# *Important Instruction*

## *For the Safe and Correct Handling of the Pump*

- "Safety Instruction" section deals with important details about handling of the product. Before use, read this section carefully for the prevention of personal injury or property damage.
- Observe the instructions accompanied with "WARNING" or "CAUTION" in this manual. These instructions are very important for protecting users from dangerous situations.
- The symbols on this instruction manual have the following meanings:

| | |
|---|---|
| ⚠**Warning** | **Nonobservance or misapplication of "Warning" sections could lead to a serious accident which may result in death.** |
| ⚠**Caution** | **Nonobservance or misapplication of "Caution" sections could lead to personal injury or property damage.** |

## *Types of Symbols*

⚠ Indicates that "Warning" or "Caution" must be exercised. Inside this triangle, a concrete and practical image provided as a warning or caution message is depicted.

⃠ Indicates a prohibited action or procedure. Inside or near this circle, a concrete and practical image of the activity to be avoided is depicted.

❗ Indicates an important action or procedure which must be performed or carried out without fail. Failure to follow the instructions herein can lead to malfunction or damage to the pump.

### ⚠Export Restrictions

Technical information contained in this instruction manual might be treated as controlled technology in your countries, due to agreements in international regime for export control. Please be reminded that export license/permission could be required when this manual is provided, due to export control regulations of your country.

## ⚠ *Warning*

**(Always read and observe the following instructions to prevent personal injuries.)**

- ***Damaged or deteriorated tools are very dangerous.*** Use qualified and suitable tools only.

- ***Use of protectors:*** When disassembling, assembling, and conducting maintenance or when handling a dangerous type of liquid or a liquid of unknown property, be sure to wear safety gloves, a helmet, and protective shoes. In addition, when handling wet-end parts, always wear protective goggles, masks, etc.

- ***Always turn off the power supply prior to servicing the pump.*** Make special provisions so that no other operator mistakenly turns on the power supply while someone is working on the pump. In a noisy or poor visibility environment, display a sign near the power supply switch to notify others that someone is "WORKING" on the pump. Power supply mistakenly turned on during maintenance may lead to personal injury. Each operator must be especially careful of power supply operation.

- ***To ensure greater safety, check and make sure that there is no one near the pump when switching on the power supply.*** The pump is not equipped with an ON/OFF switch. Connecting the power cable or power plug supplies the power to the pump and starts the operation.

- ***Run the pump at the specified power supply voltage on the nameplate only.***
  Otherwise, fire or electric shock may result.

- ***If the pump operation is stopped due to a power failure or closure of discharge wire,*** turn off the power switch at once. After normal conditions return, turn the switch on again.

- ***Do not use the pump for anything that it is not designed to do.*** User's failure to observe this instruction exempts Iwaki from any responsibility for personal injury or damage to the equipment or facility caused by the pump's misuse.

- ***When handling a toxic or odorant liquid,*** ventilate the working area well. In addition, the operator must wear protector gear (such as a safety mask, safety goggles, and protective gloves).

- ***Do not allow toxic substances such as lubricants, solvents, or similar substances to flow into the local sewage system or river systems.*** Do not drain hazardous liquids such as chemical solutions discharged out of the pump directly onto the ground. Instead, drain such liquids into some kind of container. Observe the laws and regulations related to the application, handling, and processing of hazardous substances.

## ⚠ *Caution*

**(Always read and observe the following instructions to prevent personal injuries.)**

- ***The pump is not designed to be used under water. Operate the pump on in-line mode only.***

- ***Provide a safety valve on the discharge line.***

- ***Do not close any discharge or suction valve while in operation.***

- ***Use a proven chemically-resistant tube***

  The 4m PVC braided tube attached, for example, may be chemically attacked especially with sodium hypochlorite. Use a proven chemical resistant tube if an aggressive chemical is used.

# *OUTLINE OF PRODUCT*

*1. Before Using Pump ..... 5*

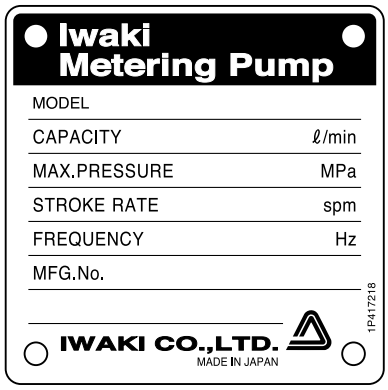
*2. Operating Principle ..... 5*

*3. Identification Codes ..... 6*

*4. Specifications and Outer Dimensions ..... 8*

*5. Names of Parts ..... 10*

# 1. Before Using Pump




After unpacking, check the following points to confirm that the delivered product and its accompanying parts and elements are exactly what you ordered.

[1] Do the model and specifications indicated on the nameplate conform to your order?

[2] Has the pump unit or any part of it not been damaged or bolts and nuts not been loosened during transportation?

[3] Is any accessory not missed?

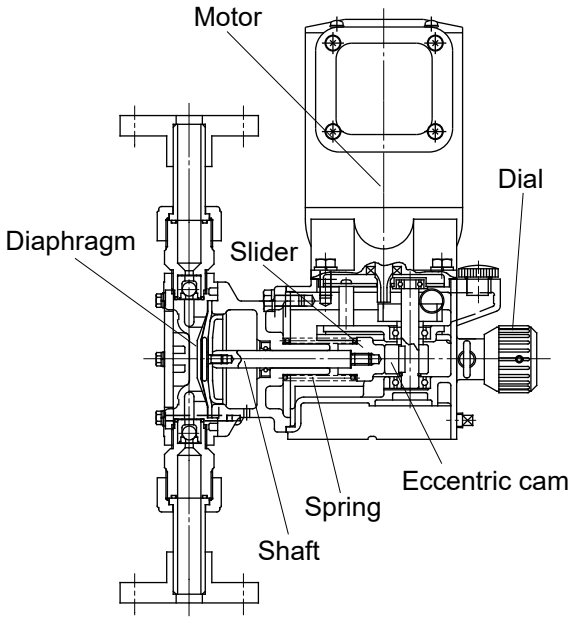
If you find anything wrong, please refer to the dealer you placed your order with.

Standard accessory

| Accessory \ Pump type | Hose connection type (VH,VC,VS) | | | Flange connection type | |
|---|---|---|---|---|---|
| | PVC | | PE | VH VC VS,TC | S6 |
| | ø4 × ø9 ø8 × ø13.5 ø12 × ø18 | ø8 × ø14 ø13 × ø20 | ø4 × ø6 ø9 × ø12 ø12 × ø16 | | |
| Mounting bolt (M8x25) (4 pcs) | ○ | ○ | ○ | ○ | ○ |
| Back press./check valve (1 pc) | ○ | Option | ○ | — | — |
| Hose (4 m) | ○ | — | — | — | — |
| Strainer (1 pc) | ○ | Option | ○ | — | — |
| Pump base | Option | | | | |

Note 1. Mark "○" attached. Mark "—" not attached.
2. When the pump is shipped, the flange unit and hose joint of pump types marked ▭ are detached from pump body and packed in the same box.

# 2. Operating Principle




The rotation of the motor is reduced by means of the reduction gear unit. The rotary motion is changed to a reciprocating motion by the spring-back mechanism (including the eccentric cam, slider, spring, etc.). The reciprocating motion is transmitted to the diaphragm directly connected with the shaft, changing the volume inside the pump chamber. Thus, variation of the volume inside the pump chamber and the functioning of the valves in the pump head produce pump operation.
The adjustment of flow rate is done by rotating a dial to change the stroke length.

# 3. Identification Codes

**Example:**

| SK - S 3 2 VC - 33 S<br>① ② ③ ④ ⑤ ⑥ ⑦ | |
|---|---|
| ①Series | SK Series |
| ②Motor type | S: IWAKI original motor |
| ③Pump head size | Four heads of 1, 2, 3, & 4 |
| ④Speed-reducing gear ratio | 1:1/27 2:1/15 |
| ⑤Pump head material symbol | Refer to the material table |
| ⑥Motor symbol | Refer to the motor table |
| ⑦Special symbol | S: Special specification other than standard version. |

## ■ Standard Material

| Material symbol | | VC | VH | VS | S6 | TC |
|---|---|---|---|---|---|---|
| Part | Pump head | PVC | PVC | PVC | SUS316 | PVDF |
| | Valve (ball check) | CE | HC | HC | HC | CE |
| | Valve seat | FKM | EPDM | SUS316 | SUS316 | FKM |
| | O ring | FKM | EPDM | EPDM | — | FKM |
| | Valve gasket | PTFE | | | | |
| | Diaphragm | PTFE+EPDM (EPDM does not contact liquid.) | | | | |

CE :Alumina ceramic
HC :Hastelloy C276
PVC :Hard polyvinylchloride
PVDF :Polyvinylidenefluoride
FKM :Fluoro rubber
PTFE :Polytetra-fluoroethylrne

## ■ Specification of Motor (IWAKI original Motor)

| Motor type | Output, Phase, Pole, Insulation | Voltage, Frequency, Speed, Rated amperage | Code |
|---|---|---|---|
| Totally enclosed, outdoor type | 65W, 3-phase, 4-pole, B class | 200/200/220V, 50/60/60Hz, 1390/1670/1690min$^{-1}$, 0.63/0.54/0.55A | 32 |
| | | 380/380/415V, 50/60/50Hz, 1370/1630/1390min$^{-1}$, 0.32/0.29/0.35A | 33 |
| | | 400/400/440V, 50/60/60Hz, 1380/1650/1680min$^{-1}$, 0.34/0.29/0.30A | 34 |
| Totally enclosed indoor type | 65W, 1-phase, 4-pole, B class | 100/100/110V, 50/60/60Hz, 1370/1670/1690min$^{-1}$, 1.25/1.15/1.15A | 11 |
| | | 220/220/230V, 50/60/50Hz, 1370/1670/1380min$^{-1}$, 0.58/0.58/0.58A | 12 |

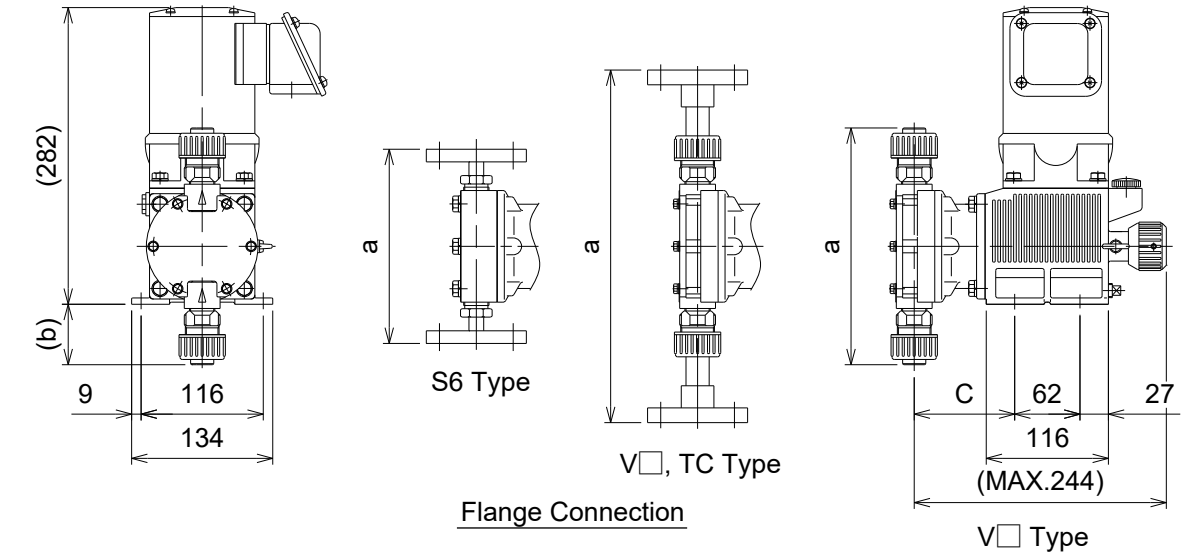
# 4. Specifications and Outer Dimensions

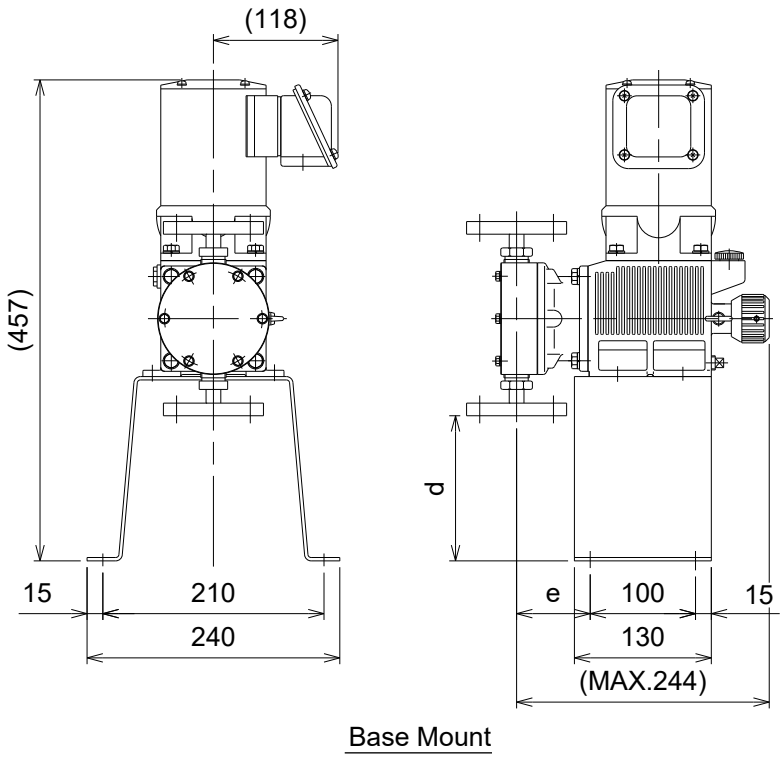
## ■ Specifications

| Model | Max. disch. capacity L/min. | | Max. disch. pressure MPa | | Stroke speed spm | | Diaphragm effective dia. mm | Max. stroke length mm | Connection | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50Hz | 60Hz | PVC PVDF | SUS | 50Hz | 60Hz | | | Flange | Hose | |
| | | | | | | | | | | PVC | PE |
| SK-11 | 0.022 | 0.026 | 1.0 | 1.5 | 53 | 64 | 22 | 1.5 | JIS 10K 15A (JIS 16K 15A for SUS Type) | $\phi$4 × $\phi$9 | $\phi$4 × $\phi$6 |
| SK-21 | 0.055 | 0.066 | | | | | 30 | 2.0 | | | |
| SK-22 | 0.10 | 0.12 | | | 96 | 116 | | | | | |
| SK-31 | 0.26 | 0.31 | 0.4 | 1.0 | 53 | 64 | 46 | 4.0 | | $\phi$8 × $\phi$13.5 | $\phi$9 × $\phi$12 |
| SK-32 | 0.46 | 0.55 | | 0.7 | 96 | 116 | | | | | |
| SK-41 | 0.61 | 0.73 | 0.5 | 0.5 | 53 | 64 | 61 | 5.0 | | $\phi$12 × $\phi$18 | $\phi$12 × $\phi$16 |
| SK-42 | 1.10 | 1.32 | 0.3 | 0.3 | 96 | 116 | | | | | |

Note 1. Figures of max. discharge capacity are based on pumping clear water at temperature of 20°C at max.discharge pressure.
2. Max. discharge pressure of SK-41 hose connection type is 0.3MPa.
3. Flow rate accuracy: ±2%FS
4. Self-priming ability at full stroke length: 1m for SK-1 & SK-2, 2m for SK-3 & SK-4
5. Handled liquid temperature: 0 - 50°C for PVC & PVDF material types, 0 - 80°C for SUS material type
6. Ambient temperature: 0 - 40°C
7. Ambient humidity: 35 - 85%RH
8. Max. discharge capacity of VS type of SK-3&4 is reduced by 15% than the figures shown above.
9. Standard painting color: RAL5002 (Ultra marine blue)

## ■ Outer dimensions



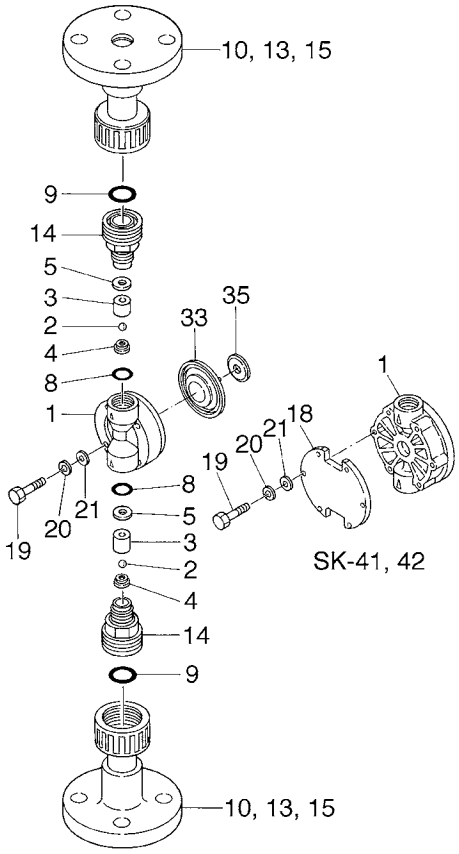




| Model | Hose connection type | | | | | | Flange connection type | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PVC | | | | | | PVC, PVDF | | | | | SUS | | | | |
| | a | b | c | d | e | m | a | b | c | d | e | a | b | c | d | e |
| SK-1 | 146 | 18 | 90 | 157 | 64 | Note | 256 | 73 | 90 | 102 | 64 | 186 | 38 | 88 | 137 | 62 |
| SK-2 | 164 | 27 | 92 | 148 | 66 | | 273 | 82 | 92 | 94 | 66 | 151 | 21 | 90 | 155 | 64 |
| SK-3 | 199 | 44 | 96 | 131 | 70 | | 309 | 99 | 96 | 76 | 70 | 168 | 29 | 96 | 146 | 70 |
| SK-4 | 225 | 57 | 95 | 118 | 69 | | 335 | 112 | 95 | 63 | 69 | 184 | 37 | 96 | 138 | 70 |

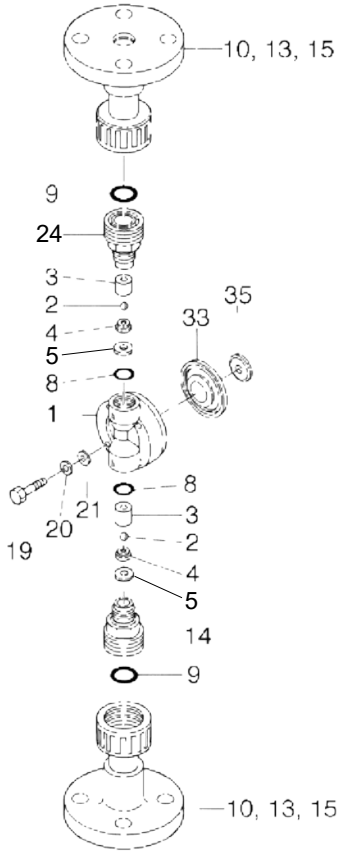
Note: Refer to Connection of Specifications on page 8.

# 5. Names of Parts

■ SK-□VC/VH/VS/TC (Flange Connection)




■ SK-11/-21/-22 VS



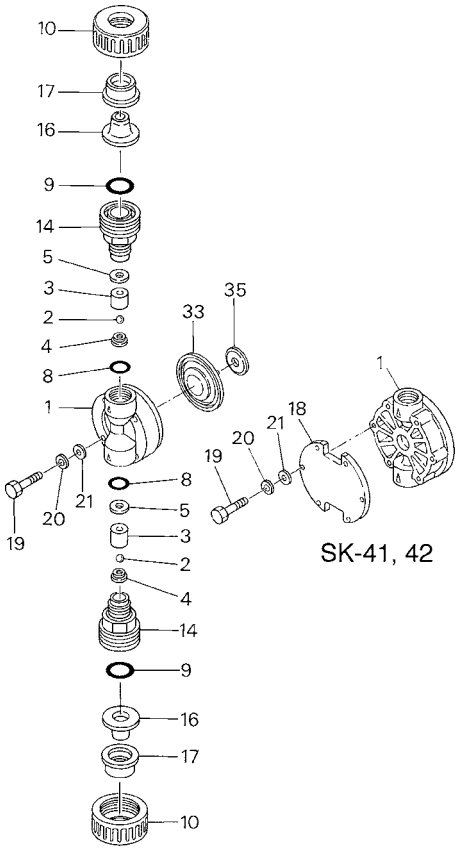

| No. | Parts name | Q'ty | Material | | | |
|---|---|---|---|---|---|---|
| | | | VC | VH | VS | TC |
| 1 | Pump head | 1 | PVC | PVC | PVC | PVDF |
| 2 | Valve (ball check) | 2 | ALMLNA CERAMIC | HASTELLOY C | HASTELLOY C | ALMLNA CERAMIC |
| 3 | Valve guide | 2 | PVC | PVC | PVC | PVDF |
| 4 | Valve seat | 2 | FKM | EPDM | SUS316 | FKM |
| 5 | Valve gasket | 2 | PTFE | PTFE | PTFE | PTFE |
| 8 | O-ring | 2 | FKM | EPDM | EPDM | FKM |
| 9 | O-ring | 2 | FKM | EPDM | EPDM | FKM |
| 10,13,15 | Flange unit | 2 | PVC | PVC | PVC | PVDF |
| 14 | Adapter | 2(1)* | PVC | PVC | PVC | PVDF |
| 24 | Out adapter | 1* | - | - | PVC | - |

*One adapter (#14) and one out adapter (#24) are used for the SK-11/-21/-22 VS.

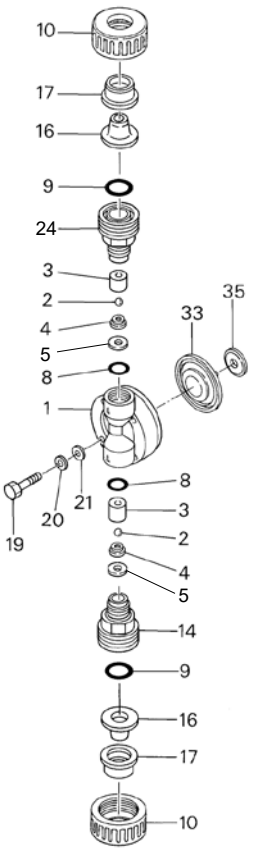
| No. | Parts name | Q'ty | Material | Remarks | | | |
|---|---|---|---|---|---|---|---|
| | | | | SK-11 | SK-21, 22 | SK-31, 32 | SK-41, 42 |
| 18 | Reinforcing plate | — | SS400 | — | — | — | 1 Q'TY |
| 19 | Hex head bolt (*) | — | STNLS STL | M4 × 30 (4 pcs) | M5 × 30 (4 pcs) | M5 × 30 (4 pcs) | M5 × 45 (6 pcs) |
| 20 | Spring washer | — | STNLS STL | M4 (4 pcs) | M5 (4 pcs) | M5 (4 pcs) | M5 (6 pcs) |
| 21 | Plate washer | — | STNLS STL | M4 (4 pcs) | M5 (4 pcs) | M5 (4 pcs) | M5 (6 pcs) |
| 33 | Diaphragm | 1 | PTFE+EPDM | | | | |
| 35 | Retainer | 1 | SUS304 | | | | |

(*) Hex. socket head bolt for SK-11.

■ **SK-□VC/VH/VS (Hose Connection)**




■ **SK-11/-21/-22 VS**



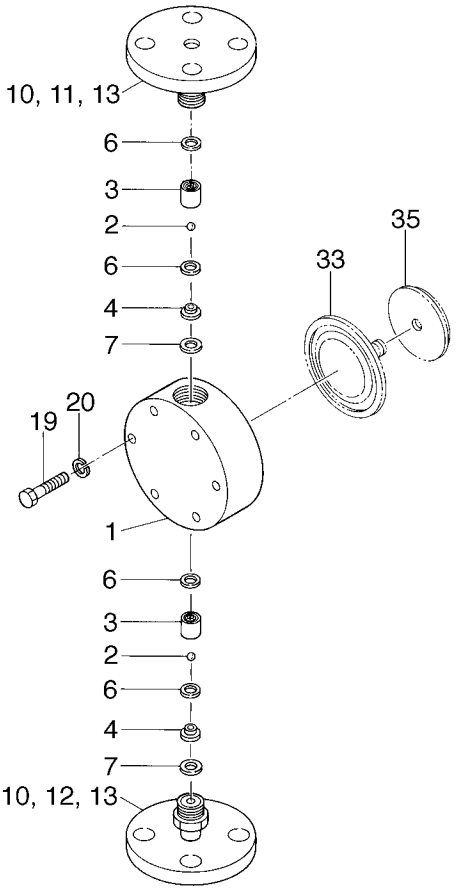

| No. | Parts name | Q'ty | Material | | |
|---|---|---|---|---|---|
| | | | VC | VH | VS |
| 1 | Pump head | 1 | PVC | PVC | PVC |
| 2 | Valve (ball check) | 2 | ALMLNA CERAMIC | HASTELLOY C | HASTELLOY C |
| 3 | Valve guide | 2 | PVC | PVC | PVC |
| 4 | Valve seat | 2 | FKM | EPDM | SUS316 |
| 5 | Valve gasket | 2 | PTFE | PTFE | PTFE |
| 8 | O-ring | 2 | FKM | EPDM | EPDM |
| 9 | O-ring | 2 | FKM | EPDM | EPDM |
| 10 | Nut | 2 | PVC | PVC | PVC |
| 14 | Adapter | 2(1)* | PVC | PVC | PVC |
| 16 | Hose insert | 2 | PVC | PVC | PVC |
| 17 | Ferrule | 2 | SS400 | SS400 | SS400 |
| 24 | Out adapter | 1* | - | - | PVC |

*One adapter (#14) and one out adapter (#24) are used for the SK-11/-21/-22 VS.

| No. | Parts name | Q'ty | Material | Remarks | | | |
|---|---|---|---|---|---|---|---|
| | | | | SK-11 | SK-21, 22 | SK-31, 32 | SK-41, 42 |
| 18 | Reinforcing plate | — | SS400 | — | — | — | 1 Q'TY |
| 19 | Hex head bolt (*) | — | STNLS STL | M4 × 30 (4 pcs) | M5 × 30 (4 pcs) | M5 × 30 (4 pcs) | M5 × 45 (6 pcs) |
| 20 | Spring washer | — | STNLS STL | M4 (4 pcs) | M5 (4 pcs) | M5 (4 pcs) | M5 (6 pcs) |
| 21 | Plate washer | — | STNLS STL | M4 (4 pcs) | M5 (4 pcs) | M5 (4 pcs) | M5 (6 pcs) |
| 33 | Diaphragm | 1 | PTFE+EPDM | | | | |
| 35 | Retainer | 1 | SUS304 | | | | |

(*) Hex. socket head bolt for SK-11.

## ■ SK-□S6



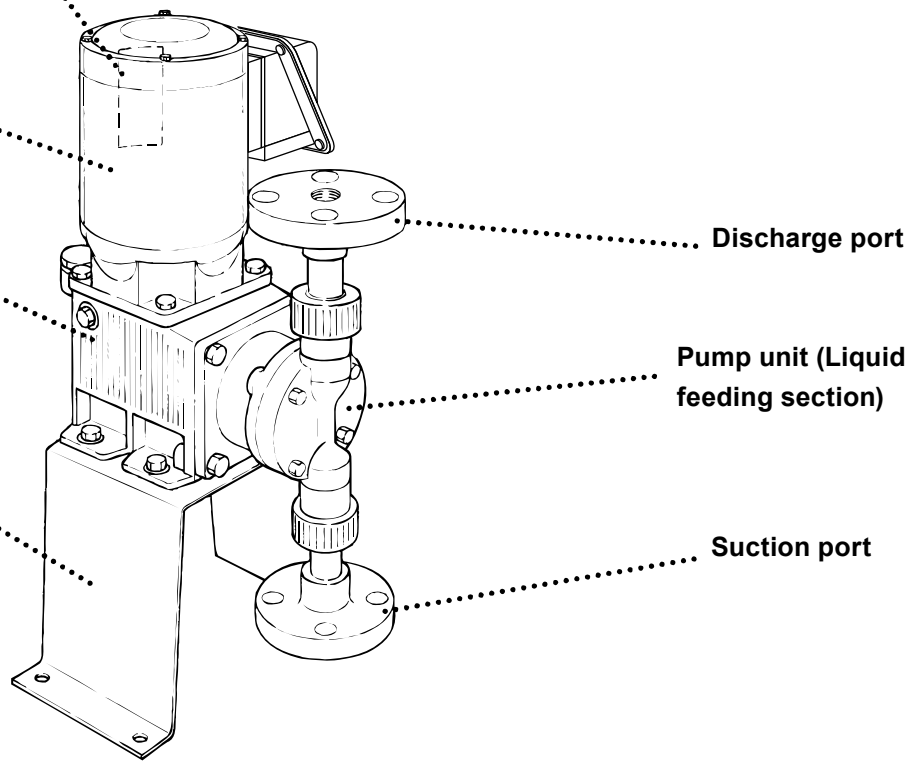

| No. | Parts name | Q'ty | Material |
|---|---|---|---|
| 1 | Pump head | 1 | SUS316 |
| 2 | Valve (ball check) | 2 | HASTELLOY C276 |
| 3 | Valve guide | 2 | SUS316 |
| 4 | Valve seat | 2 | SUS316 |
| 6 | Valve gasket A | 4 | PTFE |
| 7 | Valve gasket B | 2 | PTFE |

| No. | Parts name | Q'ty | Material | Remarks | | | |
|---|---|---|---|---|---|---|---|
| | | | | SK-11 | SK-21, 22 | SK-31, 32 | SK-41, 42 |
| 19 | Hex head bolt | — | STNLS STL | M4 × 35 (4 pcs) | M5 × 35 (4 pcs) | M5 × 45 (4 pcs) | M5 × 45 (6 pcs) |
| 20 | Spring washer | — | STNLS STL | M4 (4 pcs) | M5 (4 pcs) | M5 (4 pcs) | M5 (6 pcs) |
| 33 | Diaphragm | 1 | PTFE+EPDM | | | | |
| 35 | Retainer plate | 1 | SUS304 | | | | |
| 10, 11, 13 | Flange unit | 1 | SUS316 | Discharge port | | | |
| 10, 12, 13 | Flange unit | 1 | SUS316 | Suction port | | | |

## ■ Description on Main Unit and Label

**Motor Specification label**

Use only the power voltage specified on this label.

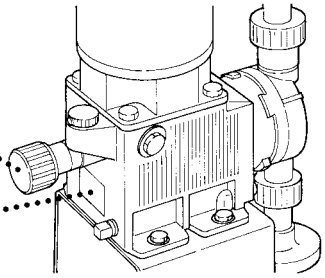



**Direction of rotation label for stroke length adjustment**

The stroke length can be adjusted through a range of 100% to 0% by rotating the dial.

**Pump nameplate**

Operate the pump by strictly observing the pump specifications indicated on this nameplate.



**⚠CAUTION**

Do not use any solvent when wiping the nameplate, labels, or the pump main unit.

# *INSTALLATION*

*1. Before Use ..... 15*

*2. Installation/Piping/Wiring ..... 16*

*3. Operation ..... 18*

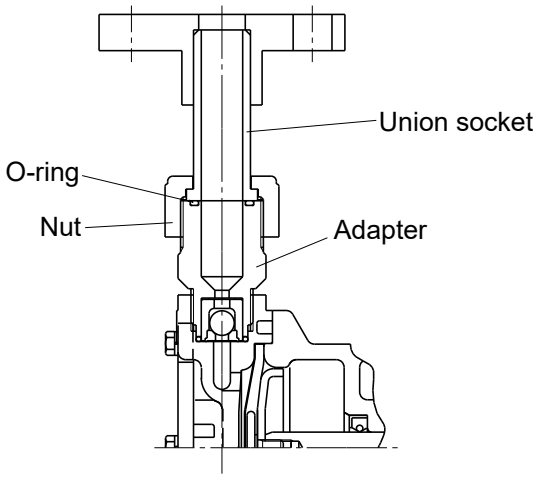
# 1. Before Use

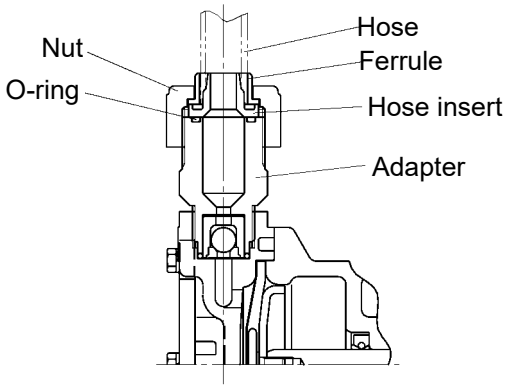
## 1. Before using pump

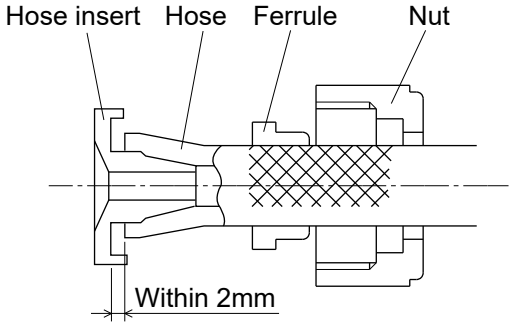
The pump is shipped with the flange unit, tube insert, ferrule, O-ring and nut which are removed from the pump body to be packed in the same box. When the pump is used, mount them to the pump body according to the following procedure.

**⚠ CAUTION**

- **When the flange unit or tube insert is fixed to the pump body, pay attention so that O-ring can not be dislocated from the groove. Special attention must be taken for the suction side O-ring.**




**In case of flange connection**

[1] Mount O-ring securely on the adaptor.

[2] Securely tighten by hand the nut with flange unit to the adapter.

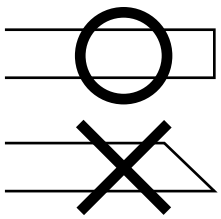
**⚠ Caution**

When tighten the nut, hold the adapter with wrench.

**In case of hose connection**

[1] Cut the hose end flat. Otherwise, it may happen the liquid leakage.

Side view of hose



[2] Put the nut and ferrule on the hose and then insert the hose insert into the hose.

**⚠ Caution**

As shown on illustration on left, push hose enough onto hose insert so that the hose end should be within 2 mm from the hose insert.

[3] Securely tighten the nut by hand to the adapter.

**⚠ Caution**

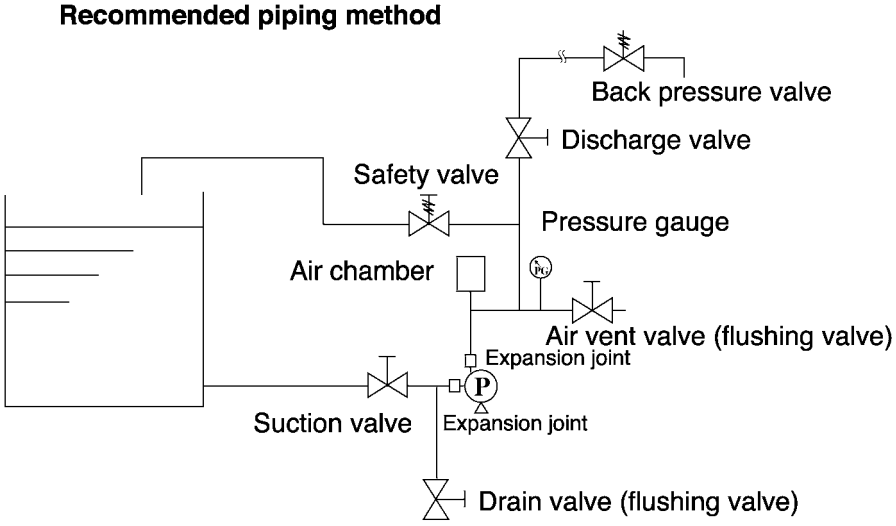
Do not tighten the nut excessively because it is the plastic material. Note that some liquids shorten the life time of attached PVC hose or do not allow it to be used.

# 2. Installation/Piping/Wiring

## 1. Installation/Piping/Wiring

### ■ Recommended plumbing

**Recommended piping method**




Plumbing should be done to satisfy pump suction and discharge conditions. Special care must be taken when slurry containing liquid is handled.

## 2.1 Installation

[1] Install the pump as close to the suction tank as possible and below the liquid level of suction tank. Short discharge piping is also recommended.

[2] Keep enough space around the pump for the future maintenance works. Also consider the safety of motor and distribution panel against the disaster such as flood.

[3] Install the pump at the flat place which is not influenced by the vibration caused by nearby machines.

[4] Install the pump horizontally on the concrete foundation or on the place which can support the pump. Apply the level on the pump flange surface to check the horizontal.

## 2.2 Plumbing

[1] The best piping arrangement for minimum loss is the straight runs with as few bends and fittings as possible, and no projected part where the air stays.

[2] The pipes should be supported independently so that unnecessary weight and vibration are not transmitted directly to the pump. Special care must be taken for the PVC material pump head.

[3] When the precipitating slurry containing liquid is handled, do not arrange “U” shaped part on the way. Arrange a drain plug at the bottom of piping.

[4] In case the pump is used to transfer the viscous, toxic and/or adhesive liquids, it is recommended to install the flushing purpose plumbing at the time of maintenance works.

[5] In case the high or low temperature liquid is handled, install the expansion joint in a pipe line to allow the stress caused by thermal expansion and contraction.

[6] Use reliable pipe which can resist the corrosion by liquid and the pressure applied to the pipe.

[7] If PVC pipes are employed, pay attention so that the adhesive agent can not get into the pump.

[8] Inside of pipes should be washed and cleaned before being connected to the pump suction and discharge ports.

[9] The safety valve is necessary to protect the pump and piping. Install it near to the pump discharge port in the discharge piping.

### 2.2.1 Suction piping

[1] Flooded suction is always recommended. The diameter of the suction pipe should never be smaller than the pump inlet port size.

[2] Air sucked-in through the joints may cause pumping failure or flow instability. Securely mount the joints for the air not to be sucked in.

### 2.2.2 Discharge piping

[1] Install a safety valve near the pump in the discharge piping. Install the discharge side valve behind the safety valve.

[2] Use the discharge pipe which can resist to the pressure more than that of set pressure of safety valve.

**⚠ Caution**

When the pump is operated for the first time, check if the liquid does not leak from flange unit or from hose jointed part.

## 2.3 Wiring

The electrical wiring must be done by the authorized electrician in accordance with local regulations and observing the followings.

[1] Use the electromagnetic switch which conforms to the used motor specifications (voltage and capacity etc.)

[2] If the pump is used outdoor, the wiring should be done so that the rainwater can not get into the switch part.

[3] Do not install the electromagnetic switch or push button switch directly on the pump or base.

[4] Install the ammeter to check the pump operating condition.

[5] Connect the wires to motor as follows.

| Motor | | Power source |
|---|---|---|
| (Red) U | ———————— | R |
| (White) V | ———————— | S |
| (Black) W | ———————— | T |

Motor be rotates anticlockwise seen from top. (The pump allows any direction of motor rotation.)

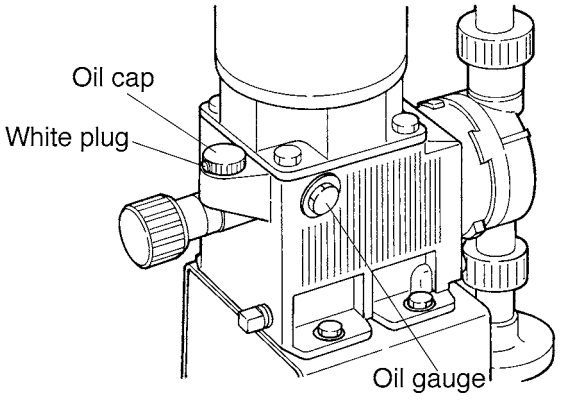
**⚠ Caution**

Do not fail to connect the ground wire to the mark “E” of motor terminal box.

# 3. Operation

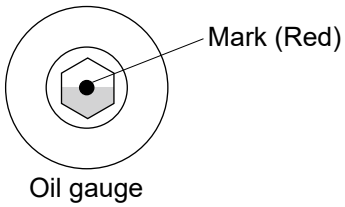
## 1. Preparation for start-up

Check the following items before the initial start-up.




[1] Check every part of the pump for damage, loosened bolts or oil leakage etc.

[2] Check the oil gauge if the oil is filled to correct level (red point mark of oil gauge).




[3] Before start-up of the pump, remove the plug from the oil cap. If the plug is not removed, it may happen the oil may leaks.

## 2. Operation

Follow the procedure mentioned below when the pump is operated for the first time.

| No | Operation | Remarks |
|---|---|---|
| 1 | • Open the valves of discharge and suction sides. | |
| 2 | • Turn on the power switch of motor to start the pump. | |
| 3 | • Set the stroke length to 0%. | • See the following item “Stroke length adjustment” |
| 4 | • Run in for about 5 minutes at 0% stroke length and check there is no abnormality in the pump. | • When the ambient temperature is very low, it may happen the motor is over-loaded ( more than rated amperage) for a while after start-up. This happens because of low temperature of oil. In this case, continue the operation at no load till oil temperature rises. |
| 5 | • Release the air inside the pump. | • Operate the pump with the air-vent valve opened or operate the pump increasing the stroke length gradually at no pressure at the discharge piping. |

| No | Operation | Remarks |
|---|---|---|
| 6 | • Set the stroke length at 100% and run in for 30 to 60 minutes. | • Check to see if the motor current value is within rated one and there is no abnormality on the pump. |
| 7 | • Set the stroke length at 100% and run in for 30 to 60 minutes. | |
| 8 | • Measure the discharge capacity under the actual operating condition using instrument such as measuring cylinder.<br>• Set the discharge capacity of pump by making the calibration curve which shows the relation between the stroke length and discharge capacity at actual conditions. | • Repeat the measurements and if no dispersion is found, the pump operates normal.<br>• The pump test data which is submitted on request when ordered is based on pumping clear water at ambient temperature but not based on the data of actual piping and liquid in the field. |
| 9 | • Supply air periodically to the air chamber.<br>• For the details, refer to the operating manual of the air chamber. | • Air and liquid touch directly in the air chamber so the compressed air dissolves a small bit in the liquid. If the air is not supplied, its volume in the chamber decreases as time passes and the air chamber loses its performance. |

**⚠ Caution**

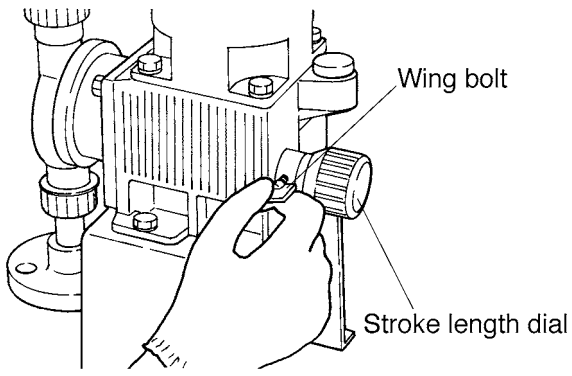
It may possible that motor and gear box will be hot. Do not touch them by bare hand or do not put the goods on it which is apt to be deformed by heat.

## 3. Stroke length adjustment

Stroke length is adjusted by changing the return length of pump shaft by rotating adjusting dial.

**⚠ Caution**

Do not turn the stroke length adjusting dial when the pump stops.

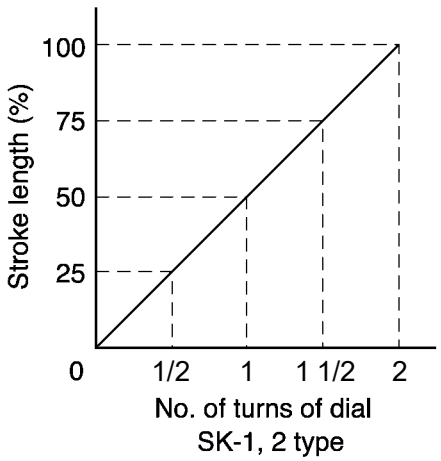


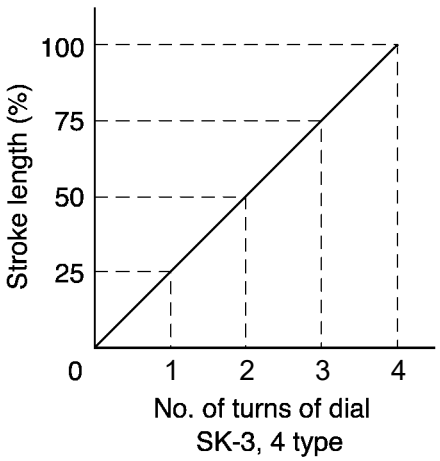

[1] Loosen the wing bolt of adjusting dial.

[2] Select necessary stroke length referring the pump performance curve.
The scale of stroke length on dial is shown by %.

[3] Adjust the dial to necessary stroke length.
See the graphs below for the number of turns of dial to stroke length of 0 to 100%.

[4] Tighten the wing bolt after the stroke length is adjusted.




## 4. Notice when pump is stopped and started again

[1] If the pump is put out of operation in cold weather (even briefly), open the drain valve on the suction side and run the pump without load to remove the liquid in the pipe and pump chamber. (This is to protect the pump from the damage to be caused by frozen liquid.) If the liquid can not be drained, the pump should be kept warm by the heater to prevent the liquid from freezing.

[2] When the pump stops over half a year, the diaphragm must be stopped at the bottom dead end in order to avoid the deformation of diaphragm.
To stop the diaphragm at the bottom dead end;
1) First of all, adjust the stroke length adjusting dial at 100%.
2) Then, switch on the motor for a few seconds and switch off.
3) Turn the dial by hand and see if it turns freely in the range of gauge 0 – 8 (SK-1 & 2) and gauge 0 – 6 (SK-3 & 4). (The dial gets hard to turn beyond the range.) If the dial turns freely in this range, then, the diaphragm is at the bottom dead end.
4) If this can not be obtained for the first try, repeat the above procedure 2) until you will get the dial to turn freely in the above mentioned range.

[3] When the pump is stopped for a short period of time (within a week), it can be started with desired stroke length and discharge pressure.

[4] When the pump has been out of use for a long period (within three months ), the pump should be started with stroke length of 0% and at no load for several minutes, and then get into the duty operation after the drive unit got lubricated enough. When the pump has been stopped three months or more, it may possible that the pump can not get the required flow capacity. This is caused by provisional deformation of diaphragm. The required flow capacity is recovered if the pump is operated few hours at 100% full stroke length.

# *MAINTENANCE*

*1. Causes of Trouble and Troubleshooting ..... 22*

*2. Maintenance and Inspection ..... 24*

*3. Consumable Parts ..... 25*

*4. Disassembly and Assembly ..... 25*

# 1. Causes of Trouble and Troubleshooting

Refer to "1. Causes of Trouble and Troubleshooting". Consult supplier for more information.
If you find any troubles, turn off the power supply immediately.

| Item | Problems | Ref. No. for cause/countermeasures |
|---|---|---|
| A | Discharge capacity is short. | 1, 2, 4, 5, 6, 7, 8, 9, 11, 12 |
| B | Discharge capacity is excessive. | 3, 7, 9 |
| C | Discharge capacity is unstable. | 1, 2, 3, 4, 5, 7, 8, 11, 12 |
| D | No liquid is discharged. | 1, 2, 4, 7, 8, 11, 12 |
| E | Discharge pressure does not rise. | 1, 2, 4, 8, 10, 11, 12 |
| F | Liquid is not being sucked. | 1, 2, 4, 5, 6, 7, 8, 12 |
| G | Liquid leaks. | 5, 6, 20, 21 |
| H | Motor does not run. | 15, 16, 17, 18, 19 |
| I | Excessive amperage is applied to motor. | 13, 15, 16, 17, 19 |
| J | Excessive vibration and loud noise. | 8, 12, 13, 15, 19 |
| K | Oil leaks. | 14 |
| L | Gear box is excessively heated. | 7, 13, 19 |

| Ref. | Cause | Countermeasures |
|---|---|---|
| 1 | Foreign matter is clogging valve ball, valve seat and/or valve guide. | Disassemble and clean. |
| 2 | Valve seat and/or valve ball is worn. | Replace. |
| 3 | Differential pressure is inadequate. | Install a back-pressure valve in discharge line. (0.3 bar is required as min. differential pressure.) |
| 4 | Air leaks into suction line. | Inspect suction pipes and connections. Re-tighten. |
| 5 | Defect of valve gasket or O-ring | Replace. |
| 6 | Damage to diaphragm | Replace. Check discharge pressure and foreign matter or crystallization in pump chamber if its life is too short. |
| 7 | Pumping condition (liquid, temperature, pressure, piping, etc.) is altered. | Renew pump performance data regarding altered pumping condition after confirming that pump is suitable. |
| 8 | Suction pipe or strainer is clogged. | Disassemble and clean. |
| 9 | Stroke length dial is shifted. | Readjust and tighten lock bolt securely after confirming that no liquid is discharged at stroke length of 0%. |
| 10 | Dust is clogging mouth of pressure gauge or pressure gauge is defective. | Clean or replace. |
| 11 | Leak from safety valve | Readjust pressure setting or replace if it is defective. |

| Ref. | Cause | Countermeasures |
|---|---|---|
| 12 | Cavitation occurs due to insufficient NPSH required. | Examine suction condition. |
| 13 | Lubricating oil of drive unit is not proper. | Check that specified oil is used. Check oil quantity and stain. Replenish or replace if necessary. |
| 14 | Defect of oil seal or O-ring | Replace. |
| 15 | Defect of motor | Replace. |
| 16 | Wrong wiring or defect of contact | Check wiring. Replace switch, etc. if necessary. |
| 17 | Voltage drop | Inspect cause and take countermeasures accordingly. |
| 18 | Fuse is burnt. | Inspect cause and take countermeasures accordingly. |
| 19 | Overload (excessive discharge pressure) | Check discharge line and take countermeasures for lowering pressure. |
| 20 | Pump head bolts are not tightened enough. | Tighten bolts. |
| 21 | Suction and/or discharge port is not tightened enough. | Tighten. |

# 2. Maintenance and Inspection

## 2.1 Daily inspection

[1] Check to see if the pump runs smoothly without abnormal vibration and noise.

[2] Check to see if the discharge pressure, flow capacity and motor amperage during operation are the same as those shown on the nameplates of pump and motor. If great difference is seen, take measures referring to the item “Cause of trouble and troubleshooting”.

[3] Check for no leakage from the pump.

[4] Check to see if the drive unit is short of oil, no oil leakage.

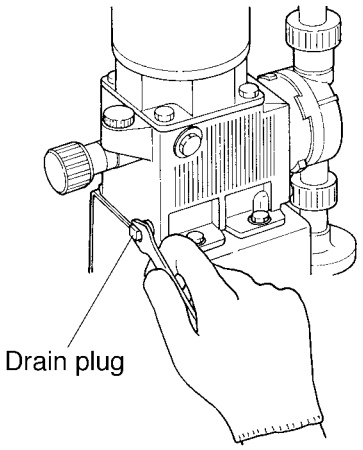
[5] If a stand-by pump is ready, operate it from time to time to keep it ready for use any time.

## 2.2 Periodic inspection

[1] Inspection of suction and discharge valves
Check them once six months or more and replace them if abnormal scratch or wear is found.

[2] Inspection of diaphragm
Check it once six months or more often.

[3] Replacement of oil in the drive unit
Replace the reduction gear oil at the following intervals to keep pump performance.
- Running-in period: after 500 hours
- Operation period: every 2000-3000 hours




Procedure:
Remove a drain plug and drain the oil from the drive unit. Then clean the inside of drive unit with flushing oil. Supply new oil up to the 550mL of oil gauge.

Recommended oil is:

| Oil company | Product name |
|---|---|
| Exxon Mobil Corporation | Mobilgear 600XP220 |

[4] Replacement of hose
Inspect hose once six months. Time to be replaced of hose depends on pumped liquid and its condition. Replace hose when you find the change of color due to ultra-violet and/or pumped chemical or the deformation due to high pressure.

# 3. Consumable Parts

Consumable parts shown on the table below must be replaced at the time of replacement time shown on the table below.

| Parts | Q'ty per pump head | Time to be replaced |
|---|---|---|
| Valve | 2 | One year |
| Valve guide | | |
| Valve seat | | |
| O-ring (VH,VC,VS,TC) | 4 | |
| Valve gasket (VH,VC,VS,TC) | 2 | |
| Valve gasket (S6) | 6 | |
| Diaphragm | 1 | 4,000 hours |

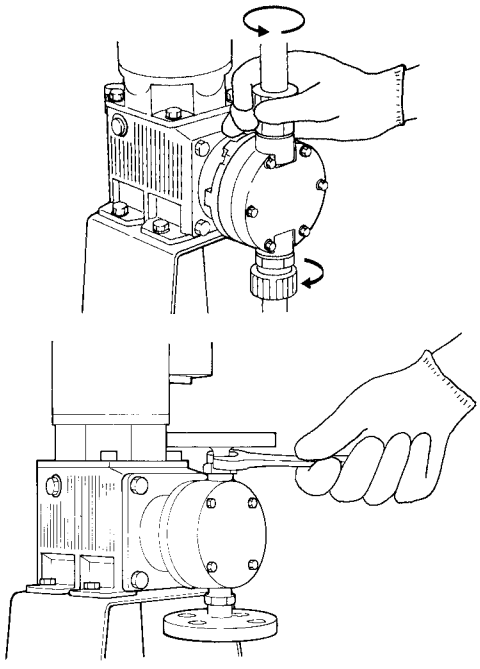
Note 1. Time to be replaced is based on pumping clear water at ambient temperature and it depends on characteristics, temperature and other conditions of pumped liquid.
2. O ring must be replaced every time when pump is disassembled regardless of the replacement time shown on the above table.

# 4. Disassembly and Assembly

## 4. Disassembly and Assembly

Refer to the item "Names of parts" on the section "Outline of Product".
Clean the pump chamber before disassemble the pump.

## 4.1 Disassembly and assembly of valve assembly



- **Disassembly**

[1] Remove the discharge and suction piping.

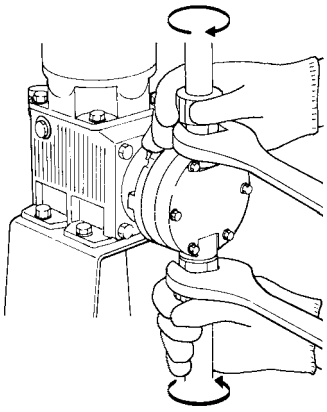
[2] Remove the suction and discharge flange units and remove valves.
If the scratch or wear on the valve and valve seat etc. are found, replace by new ones. Pay attention to the liquid which may flow out from the pump chamber or valves.

- **Assembly**

[1] Mount the valve assembly referring to the illustration on the item "Names of parts".

**⚠ Caution**

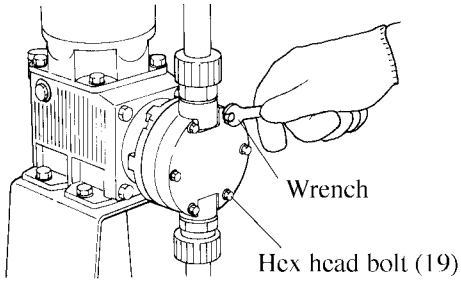
When the valves are assembled, pay attention to the position and direction of valves, valve guide and valve seat. If the pump is operated with wrongly mounted valve assembly, it will be in danger of motor burning or pump break down and liquid splash due to the excessive pressure in the pump chamber.

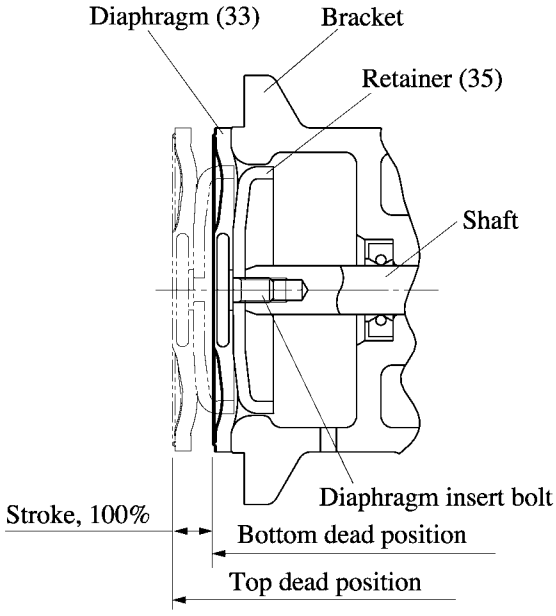


[2] Mount the connection joint parts of suction and discharge ports.

[3] Put the pipe or tube on the suction and discharge flanges or ports.

## 4.2 Disassembly and assembly of diaphragm




**● Disassembly**

[1] Remove the suction and discharge pipes.

[2] Remove the pump head fixing bolts (19) by wrench.

[3] Remove the diaphragm (33) by turning it to counterclockwise.
It can be easily removed if the diaphragm is stopped at the top dead point by switching ON and OFF the motor power source.
If damage or scratch is seen on the diaphragm, replace it by new one.

**● Assembly**

[1] Position the pump shaft at the top dead end by switching ON and OFF the motor power source.

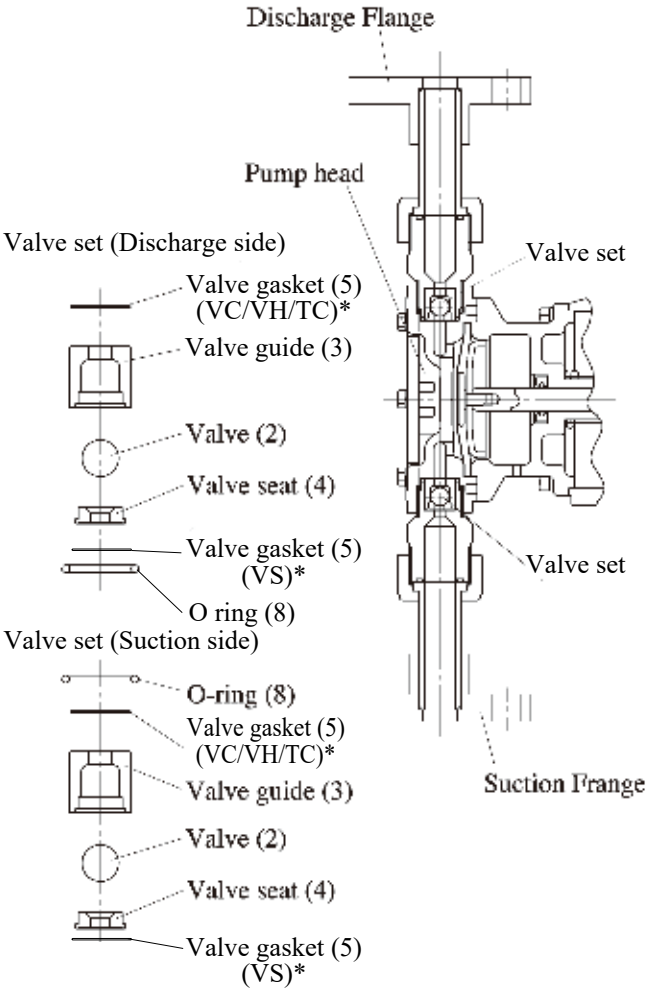
[2] Mount the retainer (35) on the diaphragm and turn it clockwise direction to mount it to the pump shaft.
Confirm that the retainer securely touches the end of pump shaft.

[3] Before the pump head is mounted, adjust the diaphragm at the bottom dead end of 100% stroke length. (Adjust the dial gauge to 100% and switch on and off the motor till the diaphragm comes to dead bottom end.)

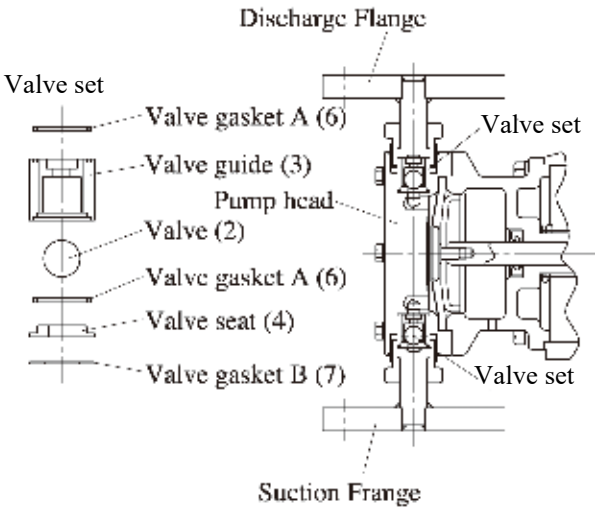
[4] The pump head should be mounted tightly to the bracket until no gap is seen between pump head and bracket. Tighten the bolts diagonally.
The tightening torque of bolts are:
SK-1 VC/VH/VS/TC: 2.2N·m
SK-2/-3/-4 VC/VH/VS/TC: 2.9N·m
SK-1 S6: 2.2N·m
SK-2 S6: 2.9N·m
SK-3/-4 S6: 4.9N·m

[5] In the reverse procedure to the disassembling, mount the joints at suction and discharge ports and mount the pipes.
*The mounting position of the valve gasket changes with the wet end type of the pump. See page 10, 11, and 12 for the proper mounting position as well.

**SK-VH, VC, VS, TC Type**




**SK-S6 Type**



https://www.iwakipumps.jp
IWAKI CO.,LTD. 6-6 Kanda-Sudacho 2-chome Chiyoda-ku Tokyo 101-8558 Japan
TEL: +81 3 3254 2935 FAX: +81 3 3252 8892

**European Headquarter** / IWAKI Europe GmbH
TEL: +49 2154 9254 0 FAX: +49 2154 9254 48
**Germany** / IWAKI Europe GmbH
TEL: +49 2154 9254 50 FAX: +49 2154 9254 55
**The Netherlands** / IWAKI Europe GmbH (Netherlands Branch)
TEL: +31 74 2420011 FAX: +49 2154 9254 48
**Italy** / IWAKI Europe GmbH (Italy Branch)
TEL: +39 0445 561219 FAX: +39 0445 569088
**Spain** / IWAKI Europe GmbH (Spain Branch)
TEL/FAX: +34 934 741 638
**Poland** / IWAKI Europe GmbH (East Europe Branch)
TEL: +48 12 347 0755 FAX: +48 12 347 0900
**Belgium** / IWAKI Belgium N.V.
TEL: +32 13 670200 FAX: +32 13 672030
**Denmark** / IWAKI Nordic A/S
TEL: +45 48 242345
**Finland** / IWAKI Suomi Oy
TEL: +358 10 201 0490

**France** / IWAKI France S.A.
TEL: +33 1 69 63 33 70 FAX: +33 1 64 49 92 73
**Norway** / IWAKI Norge AS
TEL: +47 23 38 49 00
**Sweden** / IWAKI Sverige AB
TEL: +46 8 511 72900
**U.S.A.** / IWAKI America Inc.
TEL: +1 508 429 1440 FAX: +1 508 429 1386
**Argentina** / IWAKI America Inc. (Argentina Branch)
TEL: +54 911 6477 4116
**Brazil** / IWAKI Do Brasil Comercio De Bombas Hidraulicas LTDA.
TEL/FAX: +55 19 3244 5900
**Singapore** / IWAKI Singapore Pte Ltd.
TEL: +65 6316 2028 FAX: +65 6316 3221
**Indonesia** / IWAKI Singapore (Indonesia Office)
TEL: +62 21 6906606 FAX: +62 21 6906612
**Malaysia** / IWAKIm SDN. BHD.
TEL: +60 3 7803 8807 FAX: +60 3 7803 4800

**Australia** / IWAKI Pumps Australia Pty Ltd.
TEL: +61 2 9899 2411 FAX: +61 2 9899 2421
**China** (Hong Kong) / IWAKI Pumps Co., Ltd.
TEL: +852 2607 1168 FAX: +852 2607 1000
**China** (Guangzhou) / GFTZ IWAKI Engineering & Trading Co., Ltd.
TEL: +86 20 84350603 FAX: +86 20 84359181
**China** (Shanghai) / IWAKI Pumps (Shanghai) Co., Ltd.
TEL: +86 21 6272 7502 FAX: +86 21 6272 6929
**Korea** / IWAKI Korea Co., Ltd.
TEL: +82 2 2630 4800 FAX: +82 2 2630 4801
**Taiwan** / IWAKI Pumps Taiwan Co., Ltd.
TEL: +886 2 8227 6900 FAX: +886 2 8227 6818
**Thailand** / IWAKI (Thailand) Co., Ltd.
TEL: +66 2 322 2471 FAX: +66 2 322 2477

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