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

Important notes and statements for safe operation, preventing physical injury, and property damage, are included on the body of the product and in the attached instruction manual.

Always Observe These Safety Instructions!

Safety Instruction to Prevent Personal Injuries

In this manual, the following symbols and signs are used to clearly indicate safety instructions.

 **Warning**	Ignoring this message can lead to improper handling resulting in death or serious injury to the operator.
 **Caution**	Ignoring this message can lead to improper handling resulting in injury to the operator or damage to the product.

⚠ 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.

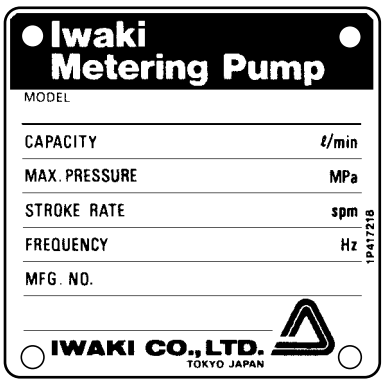
⚠ Caution

(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.***

OUTLINE OF PRODUCT

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.

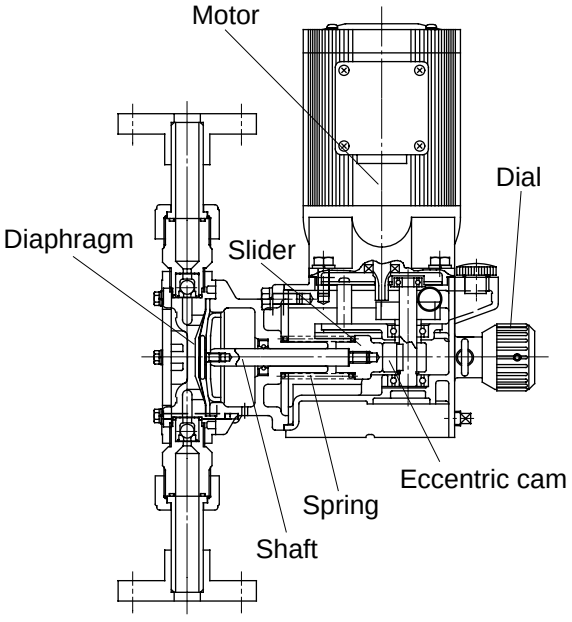
Standard accessory

Accessory \ Pump type	Hose connection type (VH,VC,VS)			Flange connection type	
	PVC		PE	VH VC VS,TC	S6
	Φ4×Φ9 Φ8×Φ13.5 Φ12×Φ18	Φ8×Φ14 Φ13×Φ20	Φ4×Φ6 Φ9×Φ12 Φ12×Φ16		
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 ① ②③④ ⑤ ⑥ ⑦	
① Series	SK Series
② Motor type	S: IWAKI original motor E: IEC motor
③ Pump head size	Four heads of 1, 2, 3, & 4
④ Speed-reducing gear ratio	1:1/27 2:1/15
⑤ Pump head material symbol	Refer to the material table
⑥ Motor symbol	Refer to the motor table
⑦ Special 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	Pole	Insulation class	Phase	Voltage/Frequency	Code No.
Totally enclosed fan cooled outdoor type	65W	4P	B	3φ	200/200/220V, 50/60/60Hz	32
					380/380/415V, 50/60/50Hz	33
					400/400/440V, 50/60/60Hz	34
Totally enclosed fan cooled indoor type	65W	4P		1φ	100/100/110V, 50/60/60Hz	11
					220/220/230V, 50/60/50Hz	12

4. Specifications and Outer Dimensions

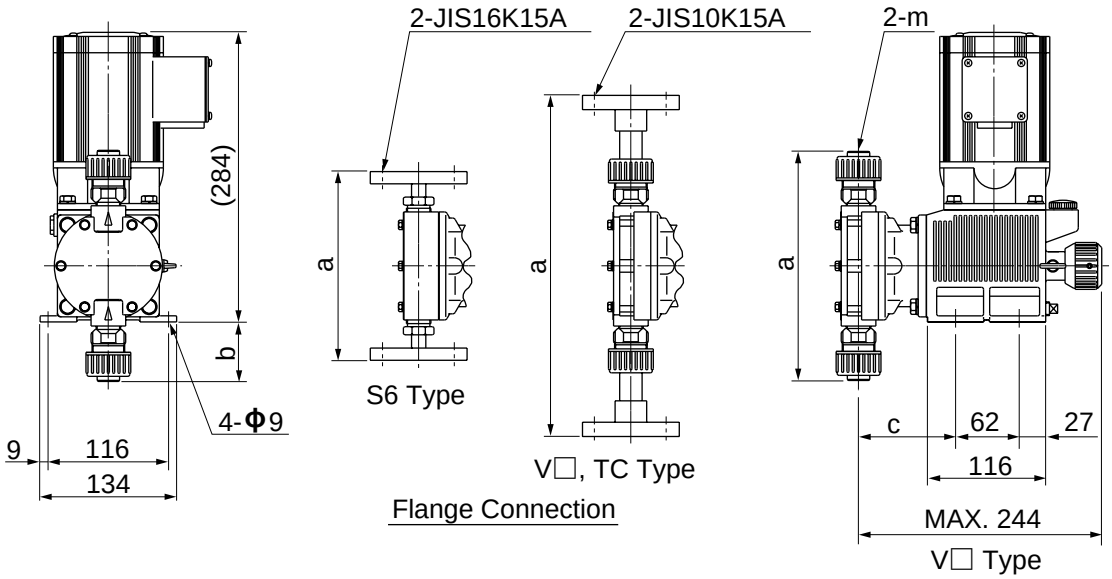
■ Specifications

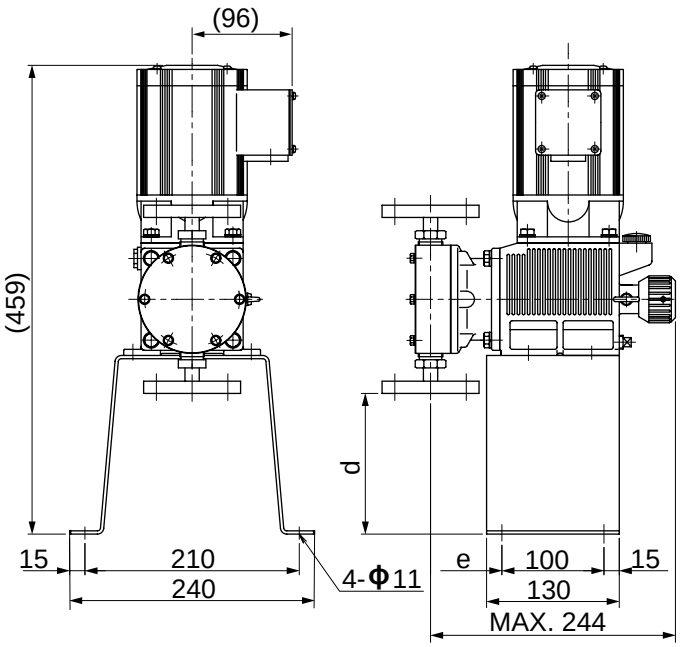
<table>
<tr><th rowspan="3">Model</th><th colspan="2">Max. disch. capacity L/min.</th><th colspan="2">Max. disch. pressure MPa</th><th colspan="2">Stroke speed spm</th><th rowspan="3">Diaphragm effective dia. mm</th><th rowspan="3">Max. stroke length mm</th><th colspan="3">Connection</th></tr>
<tr><th rowspan="2">50Hz</th><th rowspan="2">60Hz</th><th rowspan="2">PVC PVDF</th><th rowspan="2">SUS</th><th rowspan="2">50Hz</th><th rowspan="2">60Hz</th><th rowspan="2">Flange</th><th colspan="2">Hose</th></tr>
<tr><th>PVC</th><th>PE</th></tr>
<tr><td>SK-11</td><td>0.022</td><td>0.026</td><td rowspan="3">1</td><td rowspan="3">1.5</td><td rowspan="2">53</td><td rowspan="2">64</td><td>22</td><td>1.5</td><td rowspan="6">JIS 10K (JIS 16K for SUS Type)</td><td rowspan="3">φ4×φ9</td><td rowspan="3">φ4×φ6</td></tr>
<tr><td>SK-21</td><td>0.055</td><td>0.066</td><td rowspan="2">30</td><td rowspan="2">2.0</td></tr>
<tr><td>SK-22</td><td>0.1</td><td>0.12</td><td>96</td><td>116</td></tr>
<tr><td>SK-31</td><td>0.26</td><td>0.31</td><td rowspan="2">0.4</td><td>1.0</td><td>53</td><td>64</td><td rowspan="2">46</td><td rowspan="2">4.0</td><td rowspan="2">φ8×φ13.5</td><td rowspan="2">φ9×φ12</td></tr>
<tr><td>SK-32</td><td>0.46</td><td>0.55</td><td>0.7</td><td>96</td><td>116</td></tr>
<tr><td>SK-41</td><td>0.61</td><td>0.73</td><td>0.5</td><td>0.5</td><td>53</td><td>64</td><td rowspan="2">61</td><td rowspan="2">5.0</td><td rowspan="2">φ12×φ18</td><td rowspan="2">φ12×φ16</td></tr>
<tr><td>SK-42</td><td>1.10</td><td>1.32</td><td>0.3</td><td>0.3</td><td>96</td><td>116</td></tr>
</table>

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



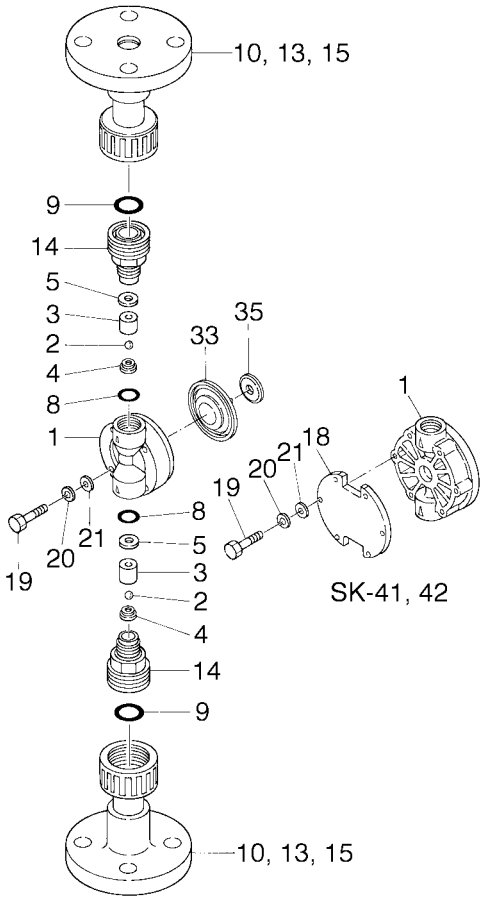


Model	Hose connection type						Flange connection type									
	PVC						PVC, PVDF					SUS				
	a	b	c	d	e	m	a	b	c	d	e	a	b	c	d	e
SK-1	146	18	92	157	66	Note	256	73	92	102	66	186	38	89	137	63
SK-2	164	27	93	148	67		273	82	93	94	67	151	21	90	155	64
SK-3	199	44	96	131	70		309	99	96	76	70	168	29	96	146	70
SK-4	225	57	96	118	70		335	112	96	63	70	184	37	96	138	70

Note: Refer to Connection of Specifications on page 8.

5. Names of Parts

■ SK-□11, 21, 22, 31, 32, 41, 42, VC, VH, VS, TC (Flange Connection)

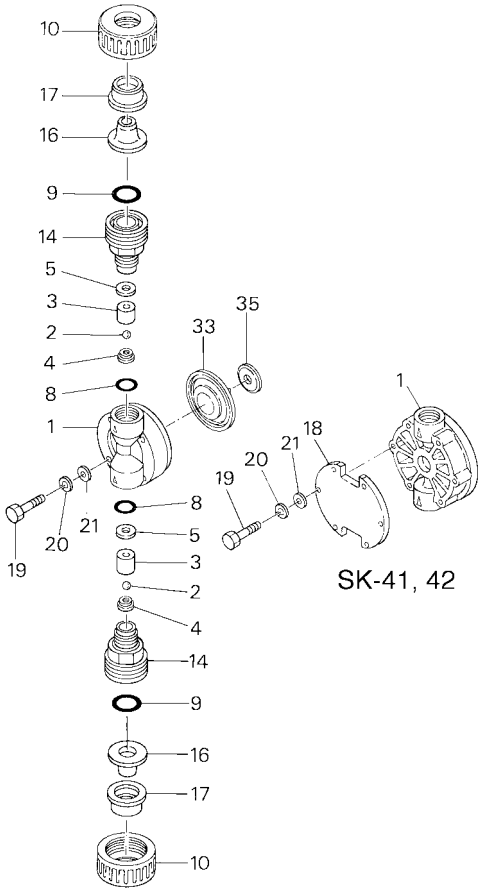


No.	Parts name	Q'ty	Material			
			VC	VH	VS	TC
1	Pump head	1	PVC	PVC	PVC	PVDF
2	Valve (ball check)	2	ALMLNA CERAMIC	HASTELLOY C	HASTELLOY C	ALMLNA CERAMIC
3	Valve guide	2	PVC	PVC	PVC	PVDF
4	Valve seat	2	FKM	EPDM	SUS316	FKM
5	Valve gasket	2	PTFE	PTFE	PTFE	PTFE
8	O-ring	2	FKM	EPDM	EPDM	FKM
9	O-ring	2	FKM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

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-□11, 21, 22, 31, 32, 41, 42, VC, VH, VS (Hose Connection)

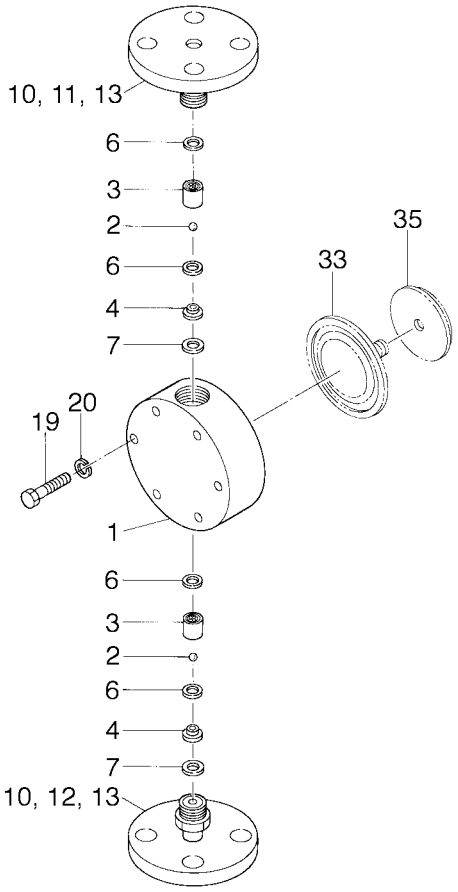


No.	Parts name	Q'ty	Material		
			VC	VH	VS
1	Pump head	1	PVC	PVC	PVC
2	Valve (ball check)	2	ALMLNA CERAMIC	HASTELLOY C	HASTELLOY C
3	Valve guide	2	PVC	PVC	PVC
4	Valve seat	2	FKM	EPDM	SUS316
5	Valve gasket	2	PTFE	PTFE	PTFE
8	O-ring	2	FKM	EPDM	EPDM
9	O-ring	2	FKM	EPDM	EPDM
10	Nut	2	PVC	PVC	PVC
14	Adapter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

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-□11, 21, 22, 31, 32, 41, 42 S6

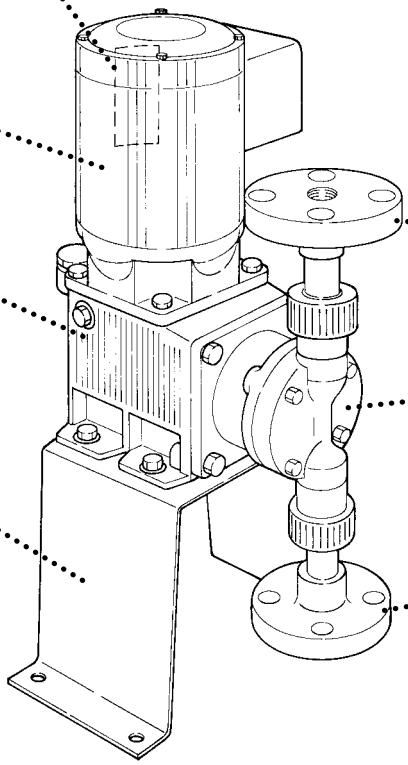


No.	Parts name	Q'ty	Material
1	Pump head	1	SUS316
2	Valve (ball check)	2	HASTELLOY C276
3	Valve guide	2	SUS316
4	Valve seat	2	SUS316
6	Valve gasket A	4	PTFE
7	Valve gasket B	2	PTFE

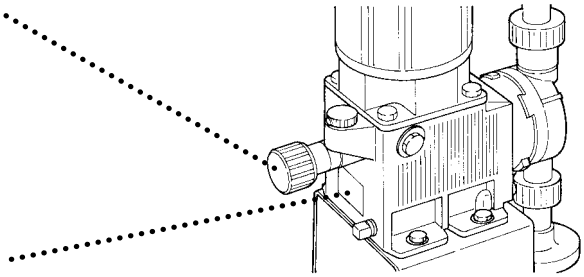
No.	Parts name	Q'ty	Material	Remarks			
				SK-11	SK-21, 22	SK-31, 32	SK-41, 42
19	Hex head bolt	—	STNLS STL	M4×35 (4 pcs)	M5×35 (4 pcs)	M5×45 (4 pcs)	M5×45 (6 pcs)
20	Spring washer	—	STNLS STL	M4 (4 pcs)	M5 (4 pcs)	M5 (4 pcs)	M5 (6 pcs)
33	Diaphragm	1	PTFE+EPDM				
35	Retainer plate	1	SUS304				
10,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

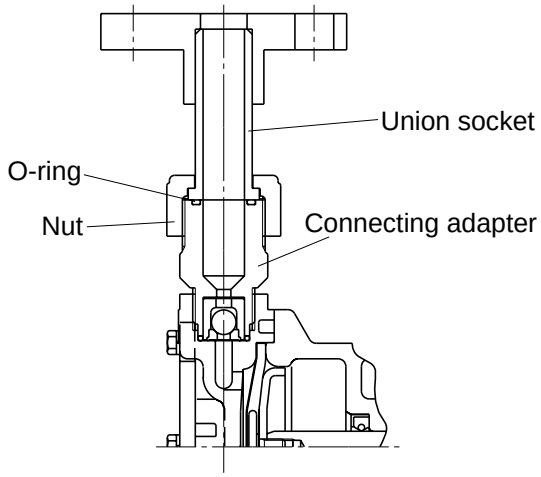
1. Before Use

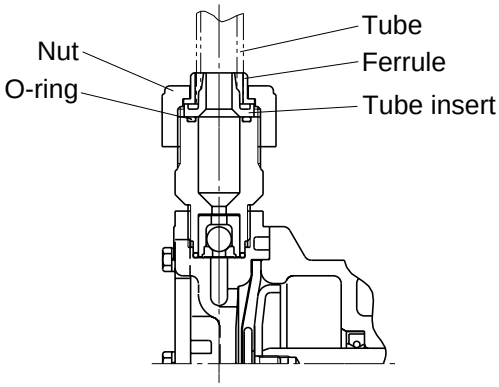
1. Before using pump

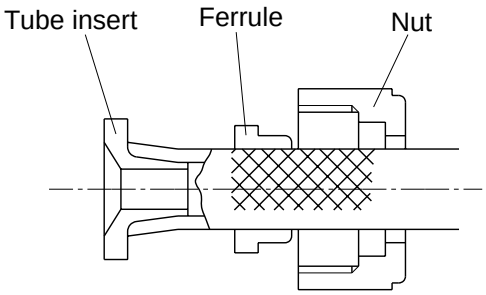
The pump is shipped with the flange unit, tube insert, ferrule, O-ring and nut which are removed from the pump body to be packed in the same box. When the pump is used, mount them to the pump body according to the following procedure.

⚠ 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.**







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

In case of flange connection

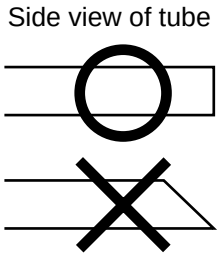
[2] Securely tighten by hand the nut with flange unit to the adapter.

⚠ Caution

When tighten the nut, hold the adapter with wrench.

In case of hose connection

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



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

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

⚠ Caution

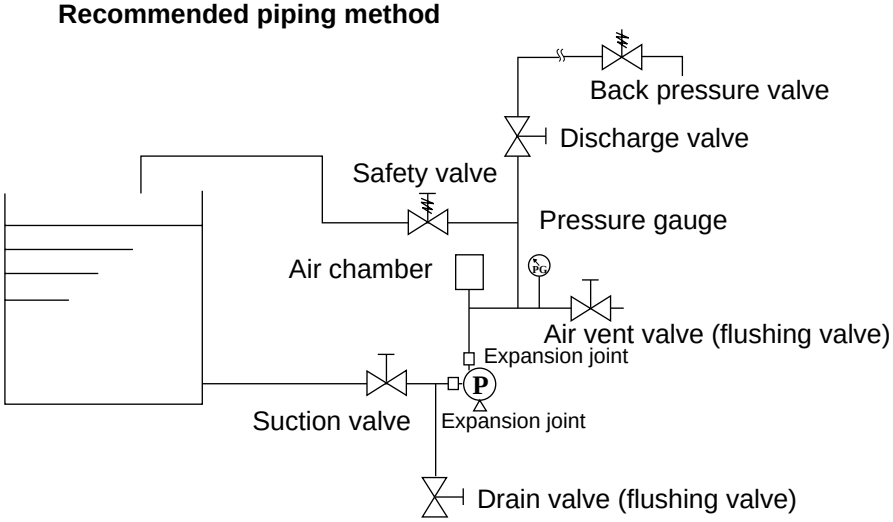
Do not tighten the nut excessively because it is the plastic material.

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.)

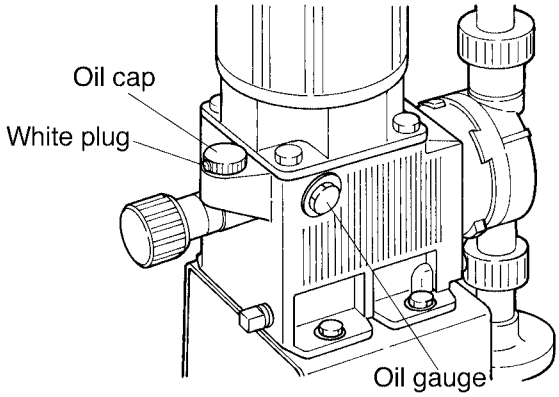
⚠ Caution

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

3. Operation

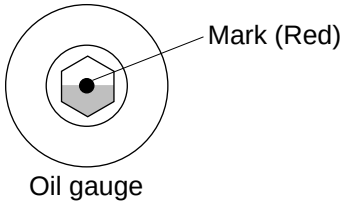
1. Preparation for start-up

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. • Set the discharge capacity of pump by making the calibration curve which shows the relation between the stroke length vs discharge capacity at actual conditions.	• Repeat the measurements and if no dispersion is found, the pump operates normal. • 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. • 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

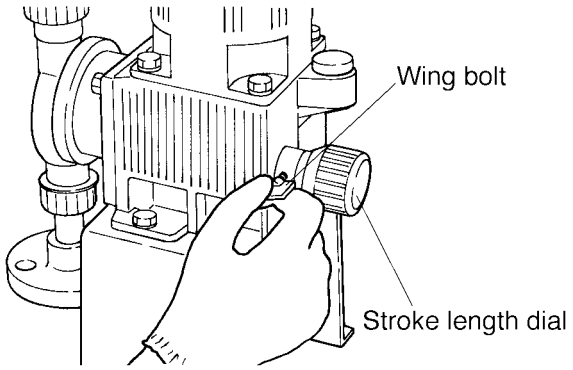
It may possible that motor and gear box will be hot. Do not touch them by bare hand or do not put the goods on it which is apt to be deformed by heat.

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.

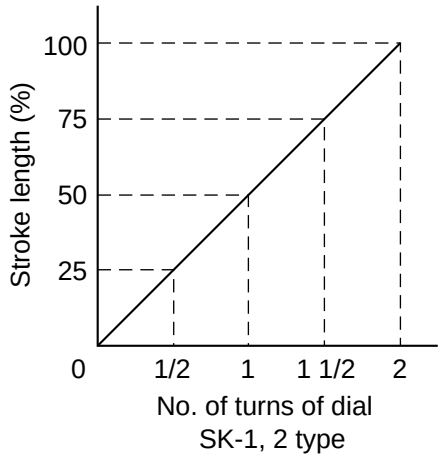


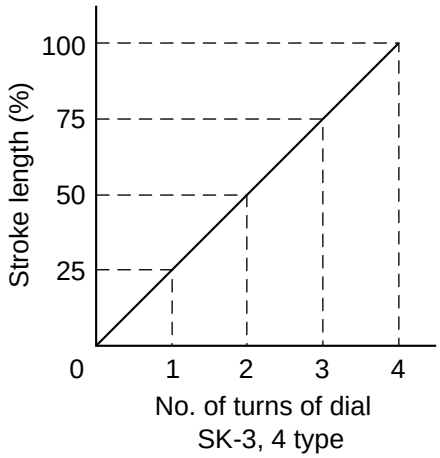
[1] Loosen the wing bolt of adjusting dial.

[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

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
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.

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.

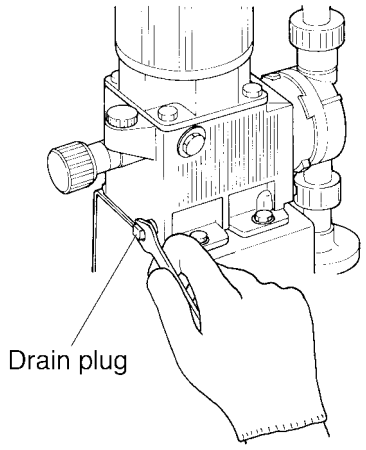
[5] If a stand-by pump is ready, operate it from time to time to keep it ready for use any time.

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 oil once six months or more often.
Time to be replaced: The first replacement is done at 500 hours running after the initial start up and then replace it once a year or more often. Replace it at any time however if emulsification or dirt is found.



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 specified level of oil gauge.

Oil volume to be replaced	Recommended oil
0.55 liters	Esso (EXXON) GP80W-90 Shell SPIRAX/EP80 Mobil PEGASUS GEAR OIL 80

3. Spare Parts

It is recommended that the following consumable parts are always kept in your hand.

Parts	Q'ty per pump head	Estimated service life
Valve	2	One year
Valve guide		
Valve seat		
O-ring (VH,VC,VS,TC)	4	
Valve gasket (S6)	2 (6)	
Diaphragm	1	4,000 hours

Note: Service life is estimation but not guarantee because it depends on the operating conditions.

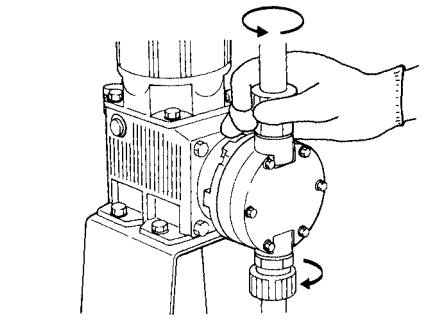
4. Disassembly and Assembly

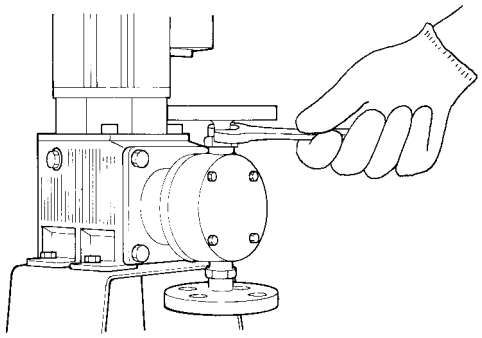
4. Disassembly and Assembly

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.

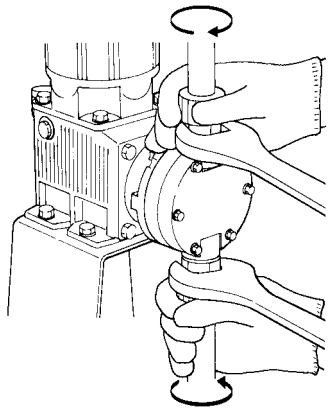
[2] Remove the suction and discharge flange units and remove valves.
If the scratch or wear on the valve and valve seat etc. are found, replace by new ones. Pay attention to the liquid which may flow out from the pump chamber or valves.

● Assembly

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

⚠ Caution

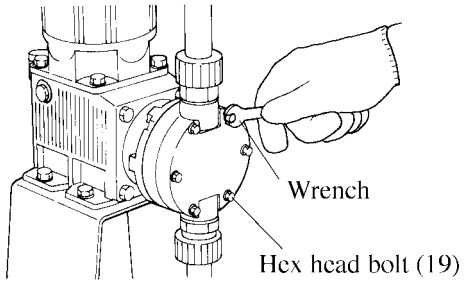
When the valves are assembled, pay attention to the position and direction of valves, valve guide and valve seat. If the pump is operated with wrongly mounted valve assembly, it will be in danger of motor burning or pump break down and liquid splash due to the excessive pressure in the pump chamber.

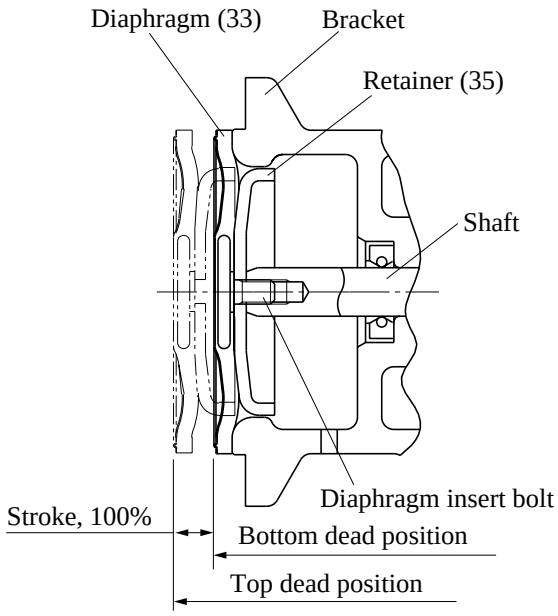


[2] Mount the connection joint parts of suction and discharge ports.

[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 counter-clockwise. 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.

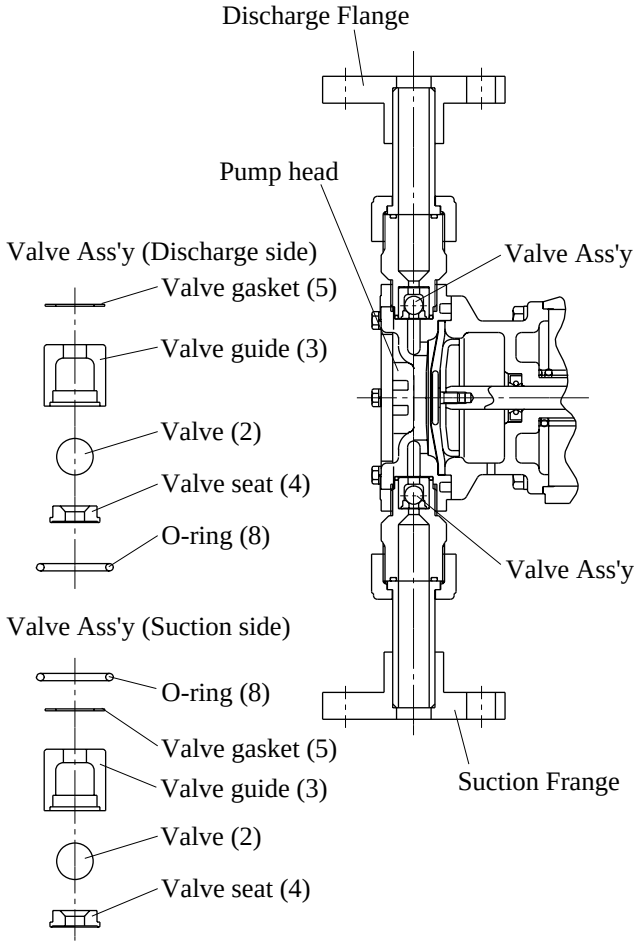
[2] Mount the retainer (35) on the diaphragm and turn it clockwise direction to mount it to the pump shaft. Confirm that the retainer securely touches the end of pump shaft.

[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.)

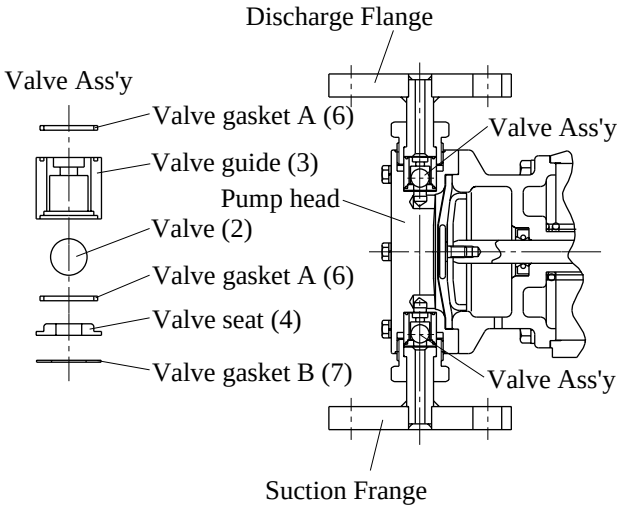
[4] The pump head should be mounted tightly to the bracket until no gap is seen between pump heas and bracket. Tighten the bolts diagonally.
The tightening torque of bolts are:
2.2 N•m for SK-1 and 2.9 N•m for all other models.

[5] In the reverse procedure to the disassembling, mount the joints at suction and discharge ports and mount the pipes.

SK-VH, VC, VS, TC Type



SK-S6 Type



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