



# Instruction Manual

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## ■ Maintenance Tools and Fixtures

# OCX-22

This instruction manual includes very important warnings, cautions and operating procedure in order to operate this pump safely and efficiently.  
Be sure to read this instruction manual thoroughly and fully understand before operation.  
After reading it, store it in a convenient place for immediate and future reading.



# Important information

This is the instruction manual of exclusive tools (OCX-22) which are used when you maintain and inspect oil-free scroll vacuum pumps ISP-1000. Be sure to read this instruction manual as well as instruction manual for the related scroll vacuum pumps in order to correctly understand its operation, functions and maintenance. The operator shall be fully conversant with the requirements stated within this instruction manual including important warnings, cautions and operation. Wrong operation (mishandling) can cause serious bodily injury, death, fire or explosion.




## ◆ Regarding safety

Warnings and cautions are especially important for safe operation. Symbols and marks have the following meanings.

### Examples of marks

 <b>WARNING</b>	Indicates a potentially hazardous situation which, if not avoided, may result in serious injury or loss of life.
 <b>CAUTION</b>	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damage.

### Examples of symbols

	Indicates [Beware]. We will explain briefly in or near the symbol. (The example on the left is [Beware of electric shock]).
	Indicates [Prohibited action]. We will explain briefly in or near the symbol. (The example on the left is [Do not touch]).
	Indicates [Required action]. We will explain briefly in or near the symbol. (The example on the left is [Be sure to ground]).

\* We shall not be responsible for any injury or damage caused by disregard of warnings, cautions or instructions.

### Supplementary notes

<b>Important</b>	Indicates notes which we ask you to observe. They are helpful to achieve full performance and functionality of the equipment.
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# 1. For safe operation


As the points below are very important for safe operation, be sure to fully read and understand before inspection and maintenance, and operate correctly.


⚠	WARNING
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 <p><b>Never evacuate hazardous gas</b></p>	<p><b>Danger of body injury, explosion and ignition</b></p> <p>Do not evacuate gas which is hazardous to humans or explosive, flammable, or corrosive. Do not evacuate with substances containing chemicals, solvents, and powders. If done, it can cause failure or bodily injury by gas, explosion or ignition.</p>
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 <p><b>Turn off electric source</b></p>	<p><b>Danger of electric shock and entanglement</b></p> <p>Be sure to turn off electric source on building site before wiring. If not, it can cause electric shock or bodily injury due to turning objects.</p>
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 <p><b>Be careful about high temperature</b></p>	<p><b>Danger of burns</b></p> <p>Conduct maintenance and inspection only after vacuum pump becomes cool enough. Maintenance and inspection soon after vacuum pump stops can cause burn injury.</p>
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 <p><b>Install short circuit protective device</b></p>	<p><b>Danger of fire and electric shock</b></p> <p>Install short circuit protective device. If not, it can cause bodily injury due to fire or electric shock.</p>
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 <p><b>Be sure to ground</b></p>	<p><b>Danger of electric shock</b></p> <p>Connect ground cable to ground terminal in motor terminal box. If not, it can cause bodily injury from electric shock.</p>
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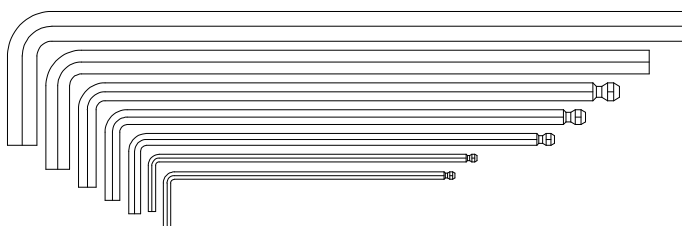
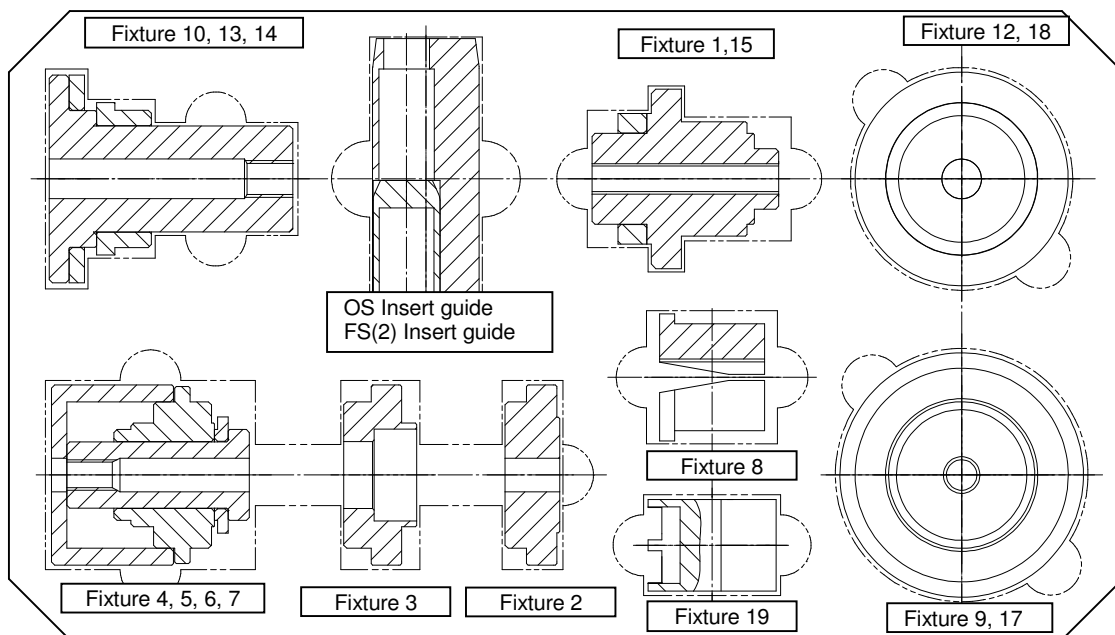
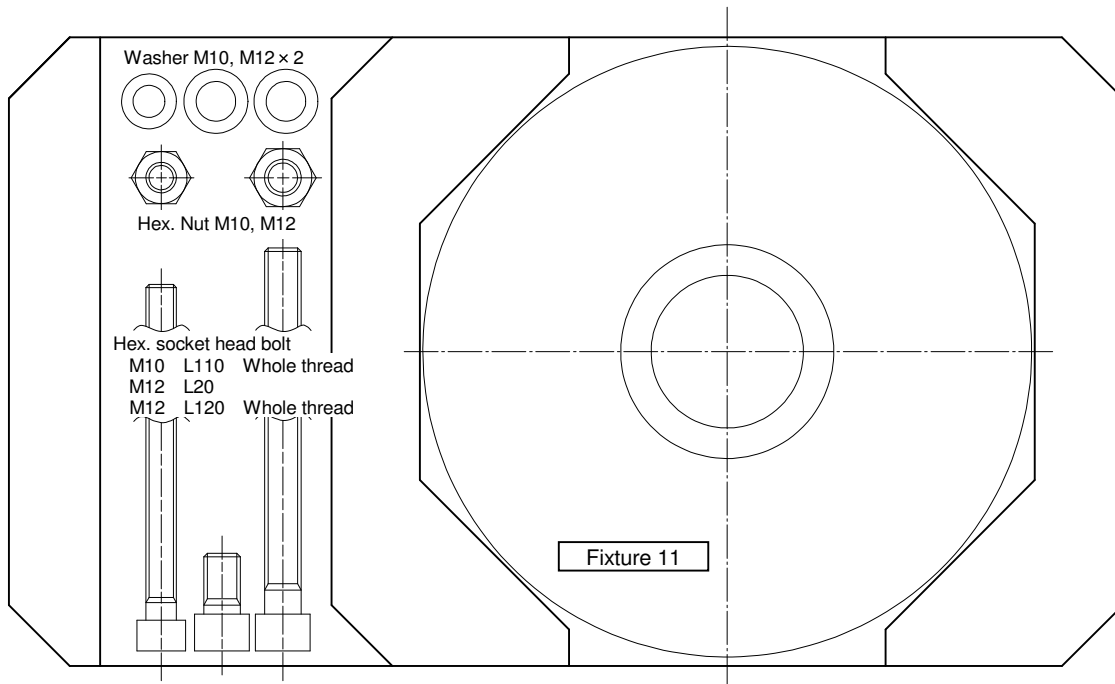
⚠	CAUTION
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 <p><b>Use ISP exclusive grease</b></p>	<p><b>Danger of shorter operating lifetime and Bearing failure</b></p> <p>Be sure to use <b>ISP exclusive grease</b> for Bearings. ✖Mixing with other oil can shorten grease lifetime and damage bearings.</p>
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 <p><b>Conduct periodical maintenance and inspection</b></p>	<p><b>Danger of failure and bodily injury</b></p> <p>Conduct periodical maintenance and inspection. If not, it can cause insufficient performance, failure of vacuum pump, and bodily injury.</p>
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 <p><b>Never use solvent</b></p>	<p><b>Danger of shorter operating lifetime and failure</b></p> <p>Never use solvent when cleaning inside the pump and Tip seal. ✖If done, it can shorten lifetime.</p>
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## 2. Names of Fixtures and Tools (OCX-22)



- |                  |     |                        |
|------------------|-----|------------------------|
| Hex. bar spanner |     |                        |
| Wrench flat      | 10  | Long type              |
| Wrench flat      | 8   | Long type              |
| Wrench flat      | 6   | Ball at tip, long type |
| Wrench flat      | 5   | Ball at tip, long type |
| Wrench flat      | 4   | Ball at tip, long type |
| Wrench flat      | 3   | Ball at tip, long type |
| Wrench flat      | 2.5 | Ball at tip, long type |

### 3. Preparation

#### 3.1 Check the product (OCX-22)





- ① Check that model name is as you ordered (Model name is attached to side of package).
- ② Check that there is no shortage or damage. If so, contact the distributor who sold it to you.
- ③ Check that accessory (instruction manual) is attached.



#### 3.2 Install Pump

Refer to an instruction manual of the pumps.

### 4. How to use

These are exclusive tools for doing the maintenance and inspection of Oil-Free Scroll Vacuum Pumps, ISP-1000.

 <b>WARNING</b>	
<p><b>Danger of body injury, explosion and ignition</b>  <b>Do not evacuate gas which is hazardous to humans or explosive, flammable, or corrosive. Do not evacuate with substances containing chemicals, solvents, and powders.</b>                      If done, it can cause failure or bodily injury by gas, explosion or ignition.</p>	 <b>Never evacuate hazardous gas</b>
<p><b>Danger of burns</b>  <b>Conduct maintenance and inspection only after vacuum pump becomes cool enough.</b>                      Maintenance and inspection soon after vacuum pump stops can cause burn injury.</p>	 <b>Be careful about high temperature</b>
<p><b>Danger of electric shock and entanglement</b>  <b>Be sure to turn off electric source on building site before wiring.</b> If not, it can cause electric shock or bodily injury due to turning objects.</p>	 <b>Turn off electric source</b>

 <b>CAUTION</b>	
<p><b>Danger of failure and bodily injury</b>  <b>Conduct periodical maintenance and inspection.</b>                      If not, it can cause insufficient performance, failure of vacuum pump, and bodily injury.</p>	 <b>Conduct periodical maintenance and inspection</b>

#### 4.1 Maintenance standards

Do the maintenance according to maintenance standards which are shown in time and period, whichever comes first. Maintenance items at each point include all items up to the time before. Do the maintenance carefully without missing any points.

Parts No.	Where to inspect	Maintenance standards			Remarks
		Annually or Every 8000hr	Every 2 years or Every 16000hr	Vapor pumping Every 400 times	
18	Needle bearing [FS(2)]	Grease/△	○	△	Supply with Bearing kit
21	Needle bearing [OS]	Grease/△	○	△	
31	Ball bearing [FS(1)]	△	○	△	
37	O-ring [Pin crank]	△	○	△	
38	Miniature ball bearing [Pin crank]	Grease/△	○	△	
53	Spider	△	○	△	
17	G-seal [FS(2)]	○	○	△	Supply with Seal set
19	Shaft seal(2) [FS(2)]	○	○	△	
20	G-seal [OS]	○	○	△	
28-1	Shaft seal(1) [FS(1)]	○	○	△	
28-2	G-seal [FS(1)]	○	○	△	
107	Exhaust valve set	○	○	△	Supply with Exhaust valve set
23	O-ring [FS(2)]	○	○	△	Supply with O-ring set
25	O-ring [Inlet, Outlet flange]	○	○	△	
90	O-ring [Cap]	○	○	△	
211	O-ring [Plug (1)]	○	○	△	
214	O-ring [FS(1)]	○	○	△	
215	O-ring [Plug (2)]	○	○	△	
224	O-ring [FS(1)]	○	○	△	
101	Tip seal set(1)	○	○	△	Supply with Bearing kit
103	Tip seal set(2)	○	○	△	
227	Tip seal	○	○	△	
104	Pin crank set	△	△	△	Supply with Pin crank kit
223	Stopper set	△	○	△	Supply with Stopper set
306	Air flush set	○	○	△	Supply with Air flush kit

○ · · Replace

△ · · Replace if something goes wrong



## CAUTION

### Danger of shorter operating lifetime and Bearing failure

Be sure to use ISP exclusive grease for bearings.

※Mixing with other oil can shorten grease lifetime and damage Bearings.



Use ISP exclusive grease

## Important

### Causes of failure

Shorten maintenance interval if conditions of installation place or operation is inappropriate.

Especially ambient temperature has great influence on failure.

Maintenance interval is based on 10~40°C ambient temperature and 25°C average yearly ambient temperature.

Shorten maintenance interval if temperature is over it. If not, it can cause failure.

Maintenance interval is not a guarantee interval.

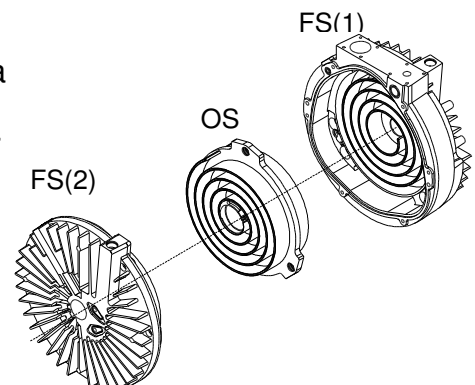
## 4.2 Necessary items for maintenance

Prepare the following items before maintenance.

1. Block (large) 2pcs.  
(70mm×70mm×length 350mm wood which does not damage pump)
2. Block (small) 1pc.  
(20mm×10mm×length 250mm wood which does not damage pump)
3. Clean cloth
4. Spanners (·17mm wrench flat ·19mm wrench flat ·24mm wrench flat ·30mm wrench flat)
5. Torque wrench for bolt with Hex. socket head
  - for 4mm wrench flat which can measure 3.0N·m (30kgf·cm) torque
  - for 6mm wrench flat which can measure 15N·m (150kgf·cm) torque
  - for 10mm wrench flat which can measure 20N·m (200kgf·cm) torque
6. Torque wrench for fixture 19. socket head
  - for 30mm wrench flat which can measure 20N·m (200kgf·cm) torque
7. Socket wrench (·19mm wrench flat)
8. Rubber mat which can prevent sliding
9. Straight edge screwdriver
10. Cross head screwdriver
  - M4 (tip shape No.2)
  - M5 (tip shape No.2)
11. Cutter (Sharp knife)
12. LOCTITE 242 or 542 (medium strength)
13. Tweezers (more than 150 mm)
14. Bamboo spatula, Brass brush
15. ISP exclusive grease
16. Stop ring supplier
17. Vernier caliper
18. Ampere meter (Clamp meter)
19. Air compressor etc.
20. Pirani vacuum gauge
21. Leak detector

## 4.3 Pump structure




This Pump is a scroll type vacuum pump. An orbiting scroll (OS) rotates between a fixed scroll FS(1) and a fixed scroll FS(2) and the set of scrolls compresses air. FS(1) is on Motor side and FS(2) is on Fan cover side.





# 5. Annually or every 8000 hours maintenance and inspection

## 5.1 Disassembly

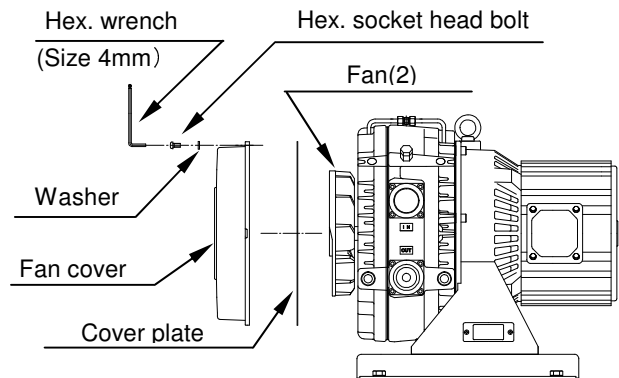
 <b>WARNING</b>	
<b>Danger of body injury, explosion and ignition</b> Do not evacuate gas which is hazardous to humans or explosive, flammable, or corrosive. Do not evacuate with substances containing chemicals, solvents, and powders. If done, it can cause failure or bodily injury by gas, explosion or ignition.	 <b>Never evacuate hazardous gas</b>
<b>Danger of electric shock and entanglement</b> Be sure to turn off electric source on building site before wiring. If not, it can cause electric shock or bodily injury due to turning objects.	 <b>Turn off electric source</b>

**Important**

Before disassembly, open Inlet to atmospheric pressure, repeat close-open operation for a couple of times in order to clean inside the pump, and cut off electric source.

### 5.1.1 Remove Fan cover

- Remove 4 Hex. socket head bolts which tighten Fan cover, and remove Fan cover and Cover plate.

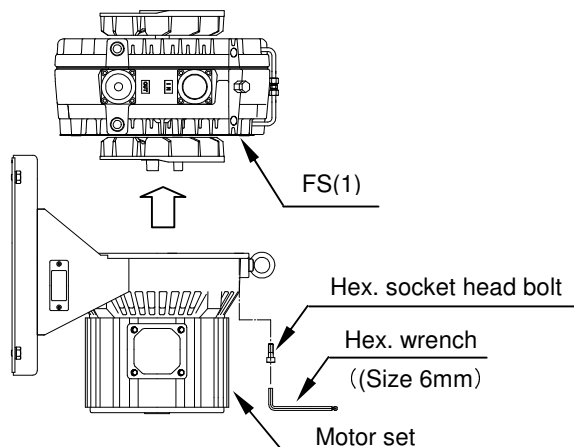


**Important**

Rotate Fan by hand and check smooth rotation, and remember the feeling of rotating resistance. When reassembling, check the slightly heavier rotating resistance. If rotation is not smooth, something will go wrong inside the pump. Check each Bearing and replace it if something goes wrong.

### 5.1.2 Remove Body set

- Place the pump vertically with Motor downwards.
- Remove Hex. socket head bolts which hold Motor set and FS(1), lift Body set and separate it from Motor set.



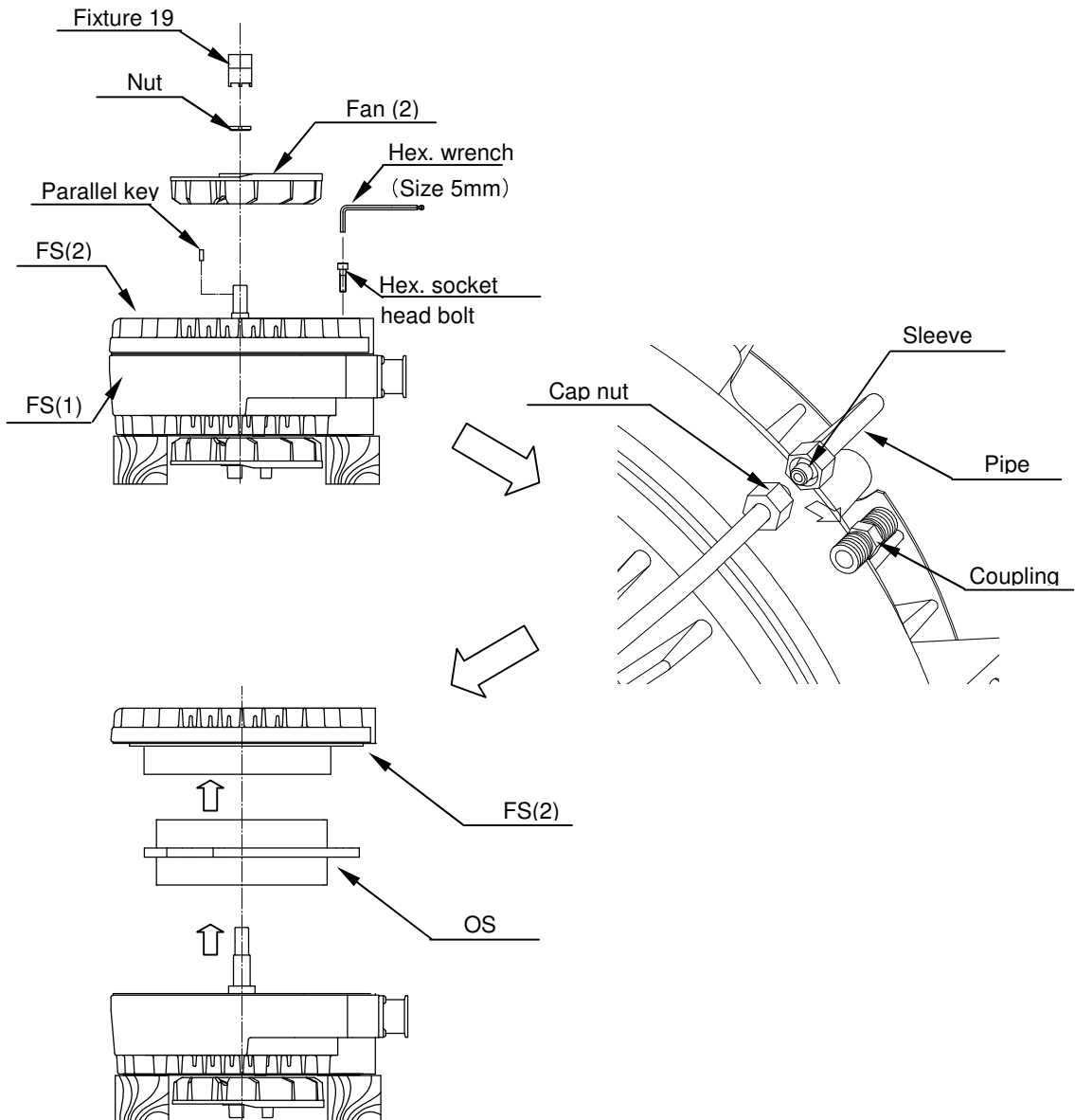
## Important

**Rotate Motor shaft by hand and check the smooth rotation.**

If rotation is not smooth with some resistance, check Motor bearings and Motor, and replace it if something goes wrong.

### 5.1.3 Disassembly of Body set

- ① Place Body set with FS(1) downwards on 2 blocks (wood which height is over 70mm).
- ② Remove Nut which fixes Fan(2) on FS(2) side, and remove Fan(2) and Parallel key.
- ③ Loosen Hex. socket head bolts diagonally by turns which fix FS(2), and remove them.
- ④ Remove Cap nut of pipe using spanner and disassemble FS(2) and remove coupling as drawing.
  - Pull FS(2) towards axis and remove it.
  - Pull OS towards axis and remove it.

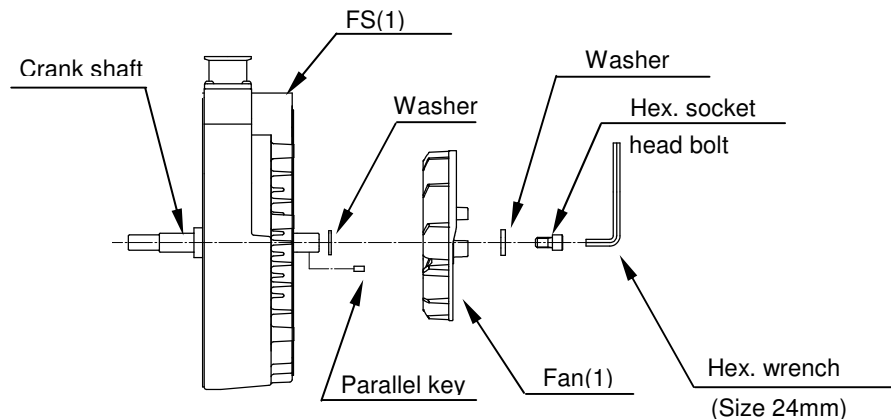


## Important

- When pulling FS(2) and OS, pay attention not to damage Needle bearing or Shaft seal with angle of Key groove of Crank shaft.
- When you cannot pull OS due to damaged OS Needle bearing, first do ⑤ item , pull Crank shaft and OS at the same time, and separate OS and Crank shaft from FS(2) side .

⑤ Remove Hex. socket head bolts which holds Fan(1) on FS(1) side, and remove a Washer and Fan(1).

- Remove Parallel key and pull Crank shaft.



## 5.2 Replace O-ring

When replacing O-rings, clean up the ditch for O-rings by clean cloths and put new O-rings.

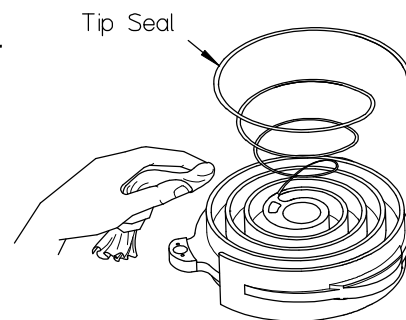
Refer to 4.1 Maintenance standards for maintenance intervals and 9. Extended Drawing for the positions of O-rings.

## Important

- Pay attention not to damage O-ring groove and sealed O-ring surface.
- Pay attention not to leave any thread of cloth in O-ring surface and O-ring groove.

## 5.3 Remove Tip seal

- Gradually remove old Tip seal from the end of outer periphery edge.



## CAUTION

**Danger of shorter operating lifetime and failure.**  
**Never use solvent when cleaning inside the pump and Tip seal.**  
✘ If done, it can shorten lifetime.



**Never use  
solvent**

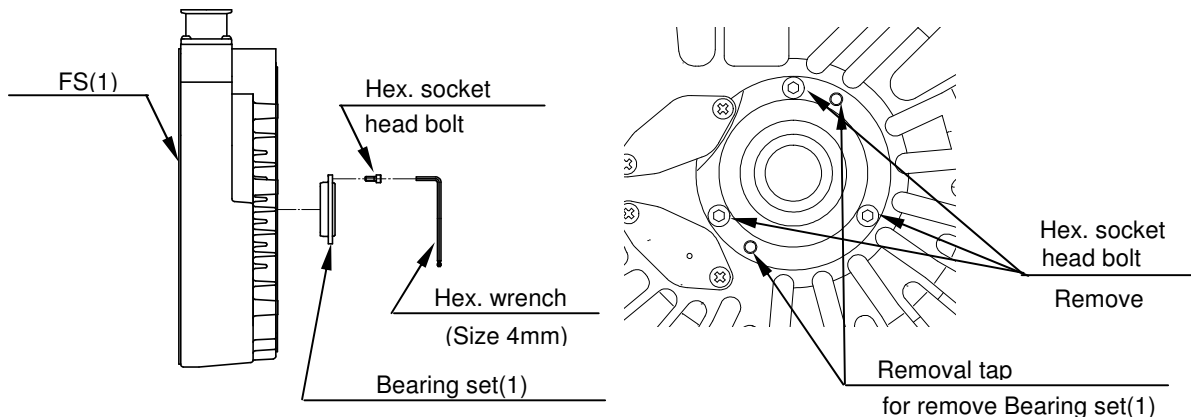
## Important

- If you feel resistance when removing Tip seal, dust will attach to side and groove of Tip seal. Wipe out dust from the groove and Tip seal by using clean cloth and bamboo spatula.

### 5.4 Maintenance of FS(1)

#### 5.4.1 Remove Bearing set(1)

- ① Remove Hex. socket head bolts which hold Bearing set(1).
- ② Screw up Hex. socket head bolt which attached Bearing set(1) into the removal tap which are on the Bearing set(1) and remove Bearing set(1).

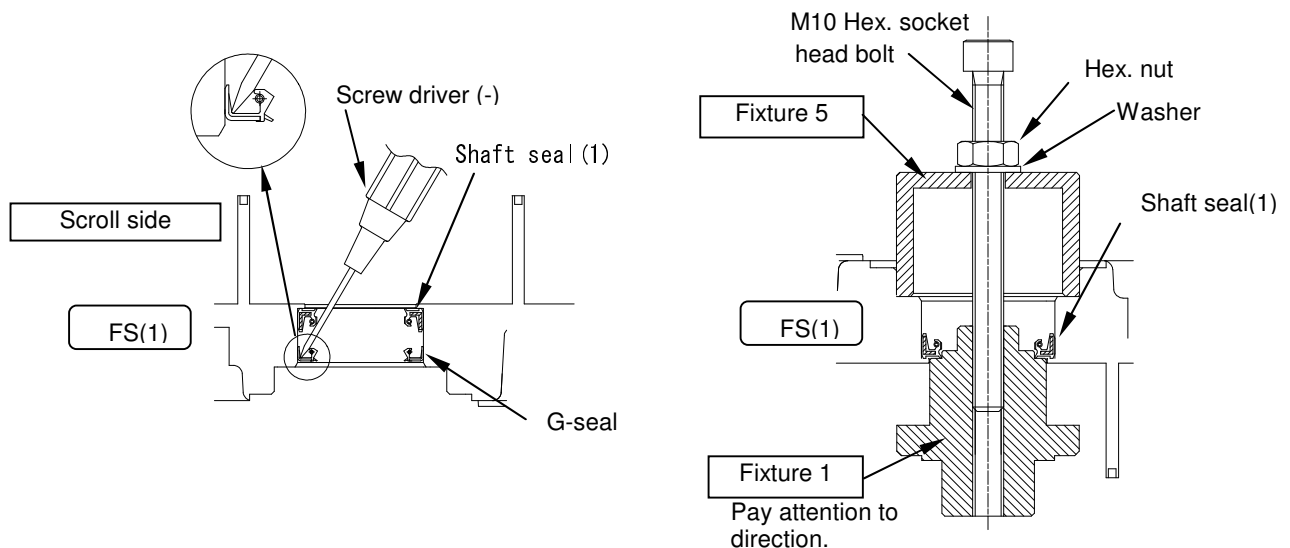


#### 5.4.2 Remove G-seal and Shaft seal(1)

## Important

- **Check direction of Shaft seal(1).**  
Side of Shaft seal(1) where you can see spring faces G-seal.
- **Pay attention to direction of Fixture 1.**  
Check direction of **Fixture 1** in the drawing above.
- **Remove Shaft seal(1) toward the Fin side (opposite side of scroll).**

- Insert straight edge screwdriver to G-seal from the scroll side, hit the screwdriver and remove it.
- Insert **Fixture 1** to Shaft seal(1) from scroll side, fit **Fixture 5** to FS(1) from the opposite side, and screw **M10** Hex. socket head bolt with Washer, and Hex. nut .
- Turn Hex. nut and remove Shaft seal(1).



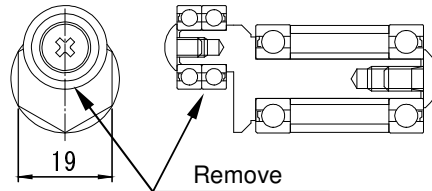
### 5.4.3 Clean FS(1)

- ① Wipe out dust on the place where Bearing of FS(1) and Shaft seal(1) enter.
  - Wipe out dust on wall and bottom of scroll wrap, inside the Inlet Flange and Inlet Filter with clean cloth.
  - Wipe out dust on side and bottom of Tip seal groove by using clean cloth and bamboo spatula.
  - Wipe out dust which remains at Pin crank and inner wall of FS(1).
  - Blow out the whole unit with air.

#### Important

- If you feel some resistance to remove Tip seal , be sure to wipe out dust.
  - Be sure to clean Tip seal groove with soft bamboo spatula since groove is fragile.
  - Always use clean cloth.
- Mixing with other grease can greatly deteriorate its performance.
- Pay attention not to leave the waste thread in the Bearings.

- ② Remove two screws located aside of Pin crank set on FS(1) with cross head screw driver and remove Pin crank set.
  - Hold side of Pin crank wide 19mm by spanner and remove screw which fixes Miniature ball bearings, and remove Miniature ball bearings.



#### Important

- No damage Miniature ball bearings by spanner when remove the screw.

- ③ Turn Miniature ball bearings by hand and check if it turns smoothly. If you feel rumble when it is turning by hand, replace Miniature ball bearings.
- ④ Blast off old grease by using air blow from removed Miniature ball bearings.
- ⑤ Wipe out dust Pin crank.
  - Holding big size Miniature ball bearings and turn Pin crank by hand and check if it turns lightly and smoothly.
  - If you feel rumble when it is turning by hand, replace all Pin crank set with new one.
  - When Pin crank set is replaced, remove two screws located aside of Pin crank set -and remove Pin crank set.
  - Wipe out adhesive and dust around screws.
  - Fit Pin crank set and tighten by screw with slight amount of LOCTITE 242 or 542.

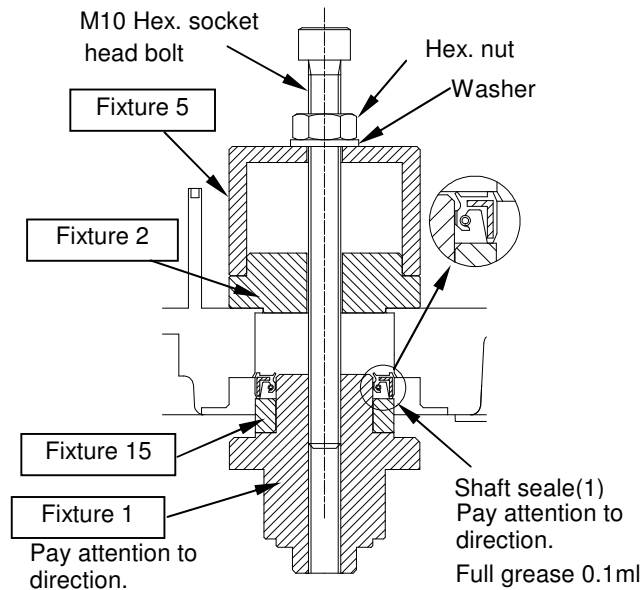
#### Important

- Use LOCTITE 242 or 542 (medium strength).
- Apply slight amount of LOCTITE to thread section.
- Wipe out extruded LOCTITE with clean cloth.

### 5.4.4 Fit Shaft seal(1)

- ① Apply slight amount of LOCTITE 242 or 542 to outer periphery of new Shaft seal(1).
- ② Insert **Fixture 15** and Shaft seal(1) to **Fixture 1** and fit it to FS(1) from the fin side .Fit **Fixtures 2 and 5** in this order to FS(1) from scroll side, and screw **M10** Hex. socket head bolt along with Hex. nut and Washer.

- ③ Turn Hex. nut and fit Shaft seal(1) .
- ④ Wipe out extruded LOCTITE with clean cloth.

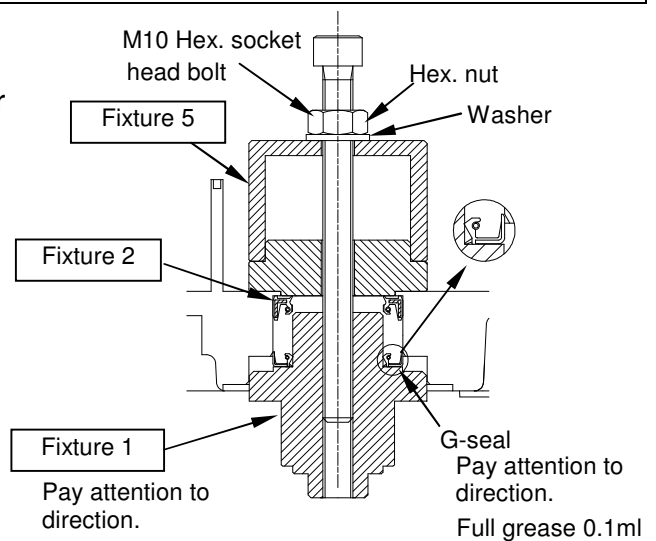


### Important

- Pay attention to direction of Fixtures and Shaft Seal(1).  
Side of Shaft Seal (1) where you can see spring faces Fixture.
- Wipe out extruded LOCTITE with clean cloth.

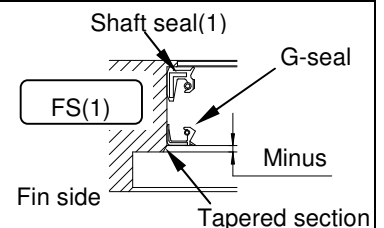
#### 5.4.5 Fit G-seal

- ① Apply slight amount of LOCTITE 242 or 542 to outer periphery of new G-seal.
- ② Insert G-seal to **Fixture 1** and fit it to FS(1) from the fin side. Fit **Fixtures 2 and 5** in this order to FS(1) from scroll side, and screw **M10** Hex. socket head bolt along with Hex. nut and Washer.
- ③ Turn Hex. nut and fit G-seal.

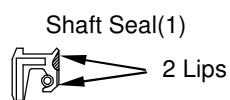


### Important

- Pay attention to directions of Fixture and G-seal.  
Side of G-seal where you can see spring faces Shaft seal (1).
- Check that the top of G-seal is lower than bottom of tapered section of FS(1).
- If not, tighten further with Fixture again in the same direction
- Wipe out extruded LOCTITE with clean cloth.



- ④ Fill **ISP exclusive grease [0.1ml(0.2g)]** between 2 lips of Shaft seal(1) and G-seal with syringe evenly around whole periphery.





## CAUTION

### Danger of shorter operating lifetime and Bearing failure

Be sure to use **ISP exclusive grease for Bearings.**

※Mixing with other oil can shorten grease lifetime and damage Bearings.



Use **ISP exclusive grease**

### 5.4.6 Fit Bearing set(1)

- Wipe out dust and grease attached to Bearing set(1).
- Turn Inner ring by hand and check that it turns lightly and smoothly.
- If you feel some rumble, replace the Bearing according to 6.4.
- Fit 3 holes of Bearing set(1) to screw holes on FS(1) side, and tighten by Hex. socket head bolt with slight amount of LOCTITE 242 or 542.

<b>Tightening torque</b> 2.94±0.3 N·m (30±3kgf·cm)
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## Important

- Use LOCTITE 242 or 542 (medium strength).
- Apply slight amount of LOCTITE to the thread section.
- Wipe out extruded LOCTITE with clean cloth.

### 5.4.7 Fit Tip seal

- Fit new Tip seal in the same way as 5.7.

### 5.4.8 Grease Miniature ball bearing of Pin crank

- Fill **ISP exclusive grease** to ball section of Miniature ball bearing (Pin crank) which was removed from FS.
- Apply **ISP exclusive grease** between ball and inner ring while turning inner ring .

<b>Grease volume</b> [ / 1 pc.]	<b>ISP-1000</b>
	<b>0.1ml(0.2g)</b>



## CAUTION

### Danger of shorter operating lifetime and Bearing failure

Be sure to use **ISP exclusive grease for Bearings.**

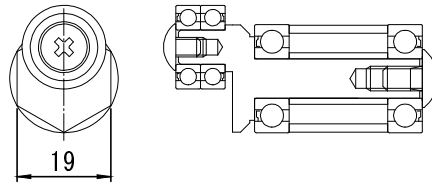
※Mixing with other oil can shorten grease lifetime and damage Bearings.



Use **ISP exclusive grease**

### 5.4.9 Fit Miniature ball bearings of Pin crank

- Insert Miniature ball bearings into Pin crank as shield side becomes exterior. Hold side of Pin crank wide 19mm by spanner and tighten by screw with slight amount of LOCTITE 242 or 542.
- Fit Pin crank set and tighten by screw with slight amount of LOCTITE 242 or 542.



### Important

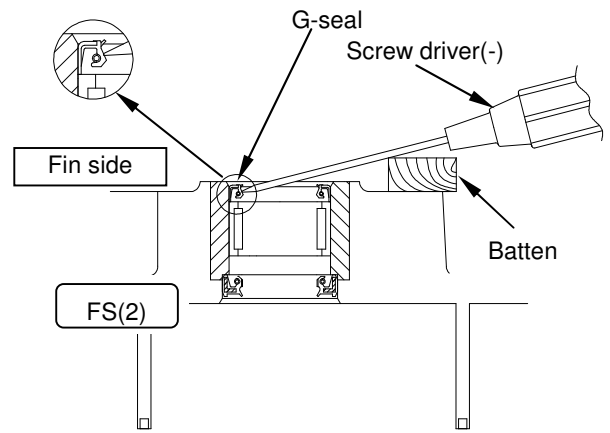
- Use LOCTITE 242 or 542 (medium strength).
- Apply slight amount of LOCTITE to thread section.
- Wipe out extruded LOCTITE with clean cloth.

## 5.5 Maintenance of FS(2)

### 5.5.1 Remove G-seal

Remove the G-seal as follows and replace it with new one.

- Insert straight edge screwdriver to G-seal from the Fin side of FS(2) and remove it.



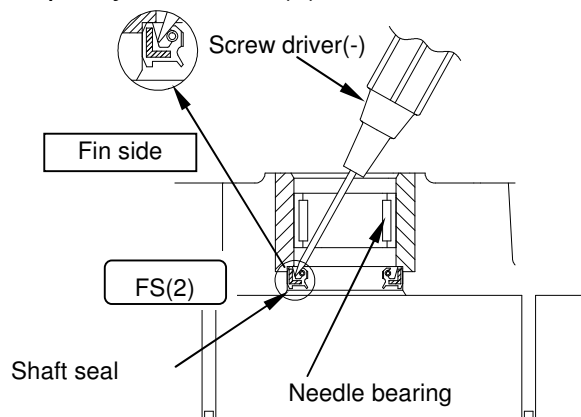
### Important

- Pay attention not to damage Flange surface of FS(2), scroll section, and Needle bearing section .

### 5.5.2 Remove Shaft seal(2)

Remove the Shaft seal (2) as follows and replace it with new one.

- Insert straight edge screwdriver from the fin side of FS (2) to Shaft seal(2), lightly tap handle of screwdriver and remove Shaft seal(2) while moving the screwdriver around the whole periphery Shaft seal(2).



### Important

- Pay attention not to damage Flange surface of FS(2), scroll section and Needle bearing section.



### 5.5.3 Clean FS(2)

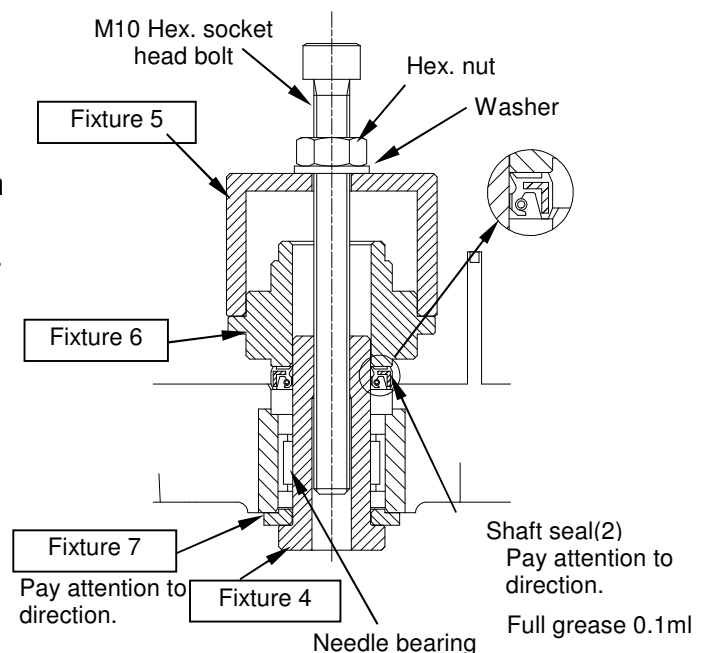
- ① Wipe out dust on the place where Shaft seal(2) of FS(2) and G-seal enter, with clean cloth.
  - Wipe out dust on wall and bottom of scroll wrap with clean cloth.
  - Wipe out dust attached to side and bottom of Tip seal groove by using bamboo spatula covered with clean cloth so as not to damage the groove.
  - Blow out the whole unit with air.
- ② Fully wipe out old grease attached to Needle bearing in the center of FS(2) with clean cloth while turning roller until no more comes out.

### Important

- If you feel some resistance to remove Tip seal , be sure to wipe out dust.
  - Be sure to clean Tip seal groove with soft bamboo spatula since groove is fragile.
  - Always use clean cloth.
- Mixing with other grease can greatly deteriorate its performance.
- Pay attention not to leave the waste thread in the Bearings.

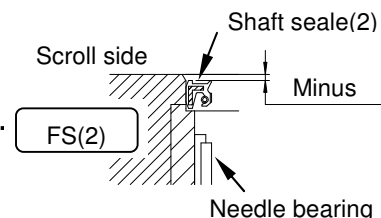
### 5.5.4 Fit Shaft seal (2)

- ① Apply slight amount of **LOCTITE 242 or 542** around outer periphery of new Shaft seal (2).
- ② Insert **Fixture 7** to **Fixture 4** and insert them to FS(2) from the fin side.
- ③ Horizontally insert Shaft seal(2) to **Fixture 4**.
  - Fit **Fixtures 6 and 5** in this order to Shaft seal(2) from the scroll side. Screw **M10 Hex. socket head bolt** along with **Hex. nut** and **Washer** from the scroll side.
- ④ Turn Hex. nut and fit Shaft seal(2).



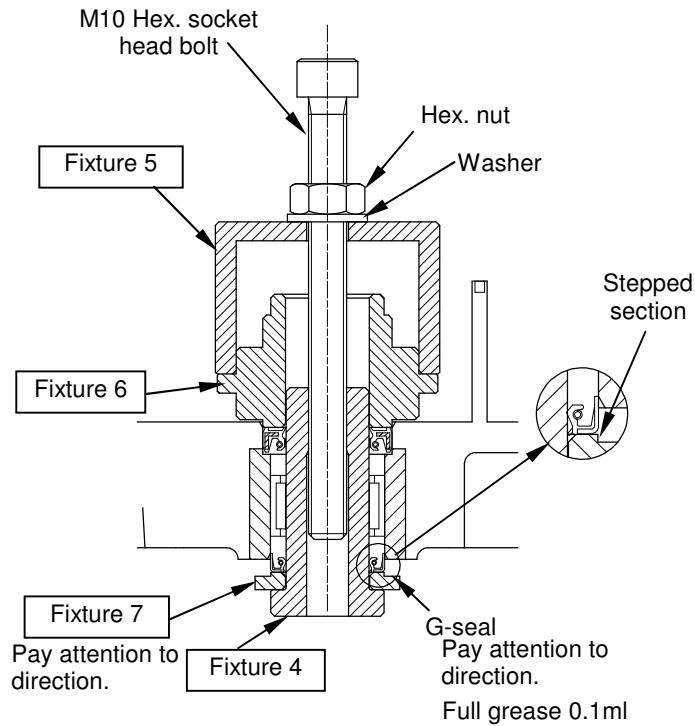
### Important

- Pay attention to directions of Fixture and Shaft seal(2). Side of Shaft seal(2) where you can see spring faces Needle bearing.
- Horizontally place Shaft seal(2) on the Fixture.
- Check that Shaft seal(2) is lower than the surface of FS(2) scroll side. If not, tightly further again with Fixture in the same direction. Otherwise, Shaft seal(2) can contact OS



### 5.5.5 Fit G-seal

- ① Insert **Fixture 7** and new G-seal to **Fixture 4**.
- ② Insert **Fixture 6** and **Fixture 5** in this order to FS(2) from scroll side.
- ③ Insert G-seal and **Fixture 4** with **Fixture 7** to FS(2) from the fin side, and screw **M10 Hex. socket head bolt** along with **Hex. nut** and **Washer** from the opposite side.
- ④ Turn Hex. nut and fit G-seal.



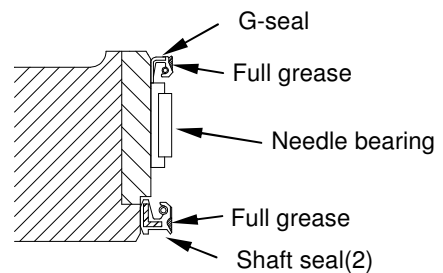
### Important

- **Pay attention to directions of Fixtures and G-seal.**  
Side of G-seal where you can see spring faces Bearing.
- **Check that G-seal is lower than FS(2) Fin side and that is parallel to fin surface (not curved).**  
If not, tighten further again with Fixture in the same direction.

### 5.5.6 Grease Needle bearing and Shaft seal, G-seal

- Fill **ISP exclusive grease** to roller section of Needle bearing.
- Apply **ISP exclusive grease** between roller and cage while turning roller.

Grease volume [ / 1 pc.]	ISP-1000
	1.2ml(2.2g)



- Evenly fill **ISP exclusive grease [0.1ml (0.2g)]** between 2 lips of Shaft seal (2), and also between 2 lips of G-seal.



### CAUTION

#### Danger of shorter operating lifetime and Bearing failure

Be sure to use **ISP exclusive grease for Bearings.**

※Mixing with other oil can shorten grease lifetime and damage Bearings.



Use **ISP exclusive grease**

## Important

- Be sure to use clean rubber gloves when applying grease to Needle bearing.
- Apply grease a bit more to both roller and cages which are somewhat worn, different from new Bearing.

### 5.5.7 Fit Tip seal

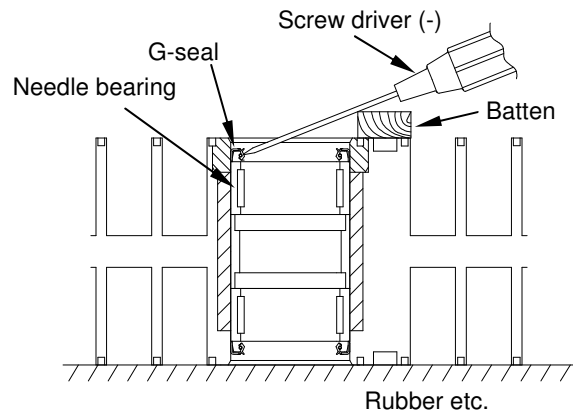
- Fit new Tip seal in the same way as 5.7.

## 5.6 Maintenance of OS

### 5.6.1 Remove G-seal

Remove G-seal as follows and replace it with new one.

- Place OS on horizontal stand with rubber.
- Place batten on OS and remove G-seal with straight edge screwdriver.
- Remove G-seal on the opposite side in the same way.



## Important

Pay attention not to damage scroll top, bottom and side surfaces of OS

### 5.6.2 Clean OS

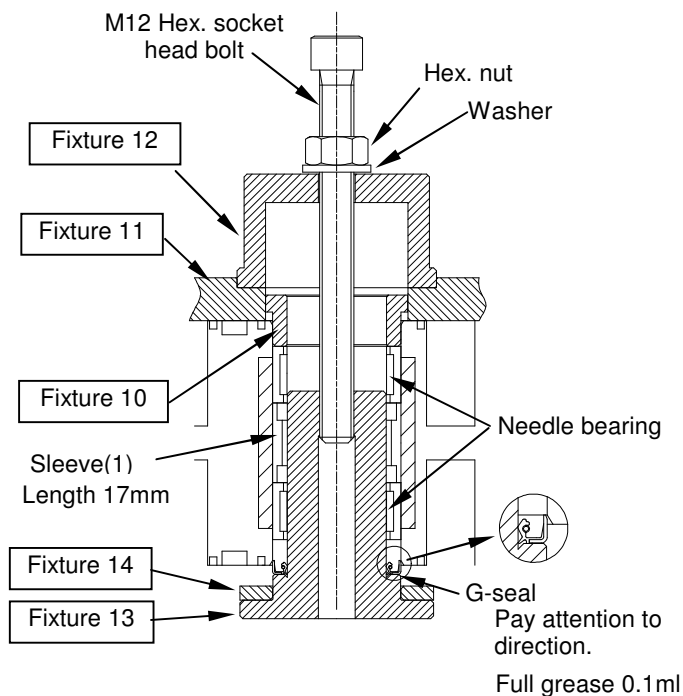
- ① Wipe out dust in the place where G-seals enter OS with clean cloth.
  - Wipe out dust on wall and bottom of scroll wrap with clean cloth.
  - Wipe out dust attached to side and bottom of Tip seal groove by using bamboo spatula covered with clean cloth so as not to damage the groove.
  - Blow out the whole unit with air.
- ② Fully wipe out old grease attached to Needle bearings and Sleeve in the center of OS with clean cloth while turning roller until no more comes out.

## Important

- If you feel some resistance to remove Tip seal, be sure to wipe out dust.
  - Be sure to clean Tip seal groove with soft bamboo spatula since groove is fragile.
  - Always use clean cloth.
- Mixing with other grease can greatly deteriorate its performance.
- Pay attention not to leave the waste thread in the Bearings.

### 5.6.3 Fit G-seal

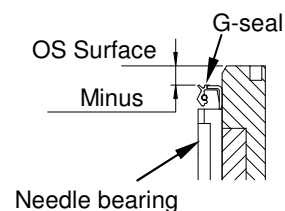
- ① Insert **Fixture 14** and new G-seal to **Fixture 13**, and then to OS. Insert **Fixture 10** from the opposite side.
- ② Insert **Fixtures 11 and 12** in this order to **Fixture 10**, screw **M12** Hex. socket head bolt along with Hex. nut and Washer, and turn Hex. nut and fit G-seal.
- ③ Fit G-seal on the opposite side in the same way.



## Important

▪ **Pay attention to directions of Fixtures and G-seals.**

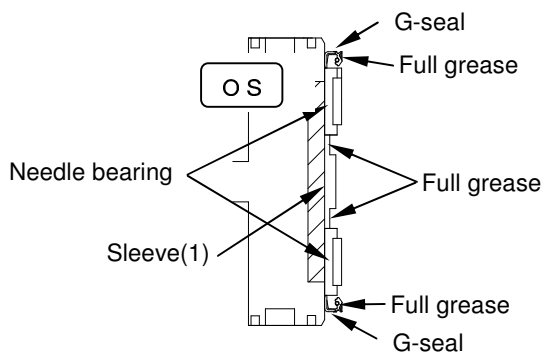
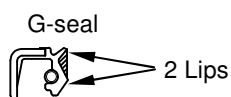
- Side of G-seal where you can see spring faces Bearing.
  - Check that G-seal is lower than OS surface.
- If not, tighten further again with fixture in the same direction.



### 5.6.4 Grease Needle bearing of Pin crank

- ① Fill **ISP exclusive grease** to roller section of Needle bearing (Pin crank) which was removed from OS.
  - Apply **ISP exclusive grease** between roller and cage while turning roller.
- ② Evenly fill **ISP exclusive grease [1ml(2g) / 1section]** in 2 grooves of Sleeve(1) between Needle bearings.
- ③ Every fill **ISP exclusive grease [0.1ml(0.2g)]** between 2 lips of G-seal.

Grease volume [ / 1 pc.]	ISP-1000
	2.6ml(5.0g)





## CAUTION

### Danger of shorter operating lifetime and Bearing failure

Be sure to use ISP exclusive grease for Bearings.

✘Mixing with other oil can shorten grease lifetime and damage Bearings.



Use ISP exclusive  
grease

## Important

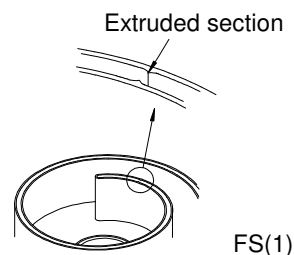
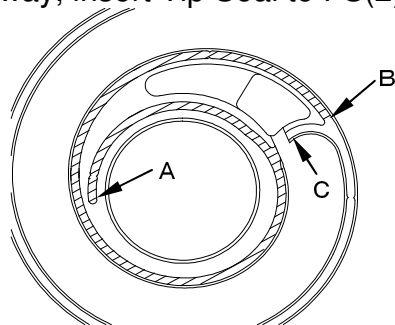
- Be sure to use clean rubber gloves when applying grease to Needle bearing.
- Apply grease a bit more to both roller and cages which are somewhat worn, different from new Bearing.

### 5.6.7 Fit Tip seal

- Fit new Tip seal in the same way as 5.7.

## 5.7 Replace Tip seal

- ① First insert short black Tip seal from center on FS(2) side of OS section A to B of the following drawing. Cut run off part by cutter (shape knife).
- ② Insert Tip seal attaché white soft back-up from section C gradually further towards out side. Place white part facing downwards and black hard sliding material facing up wards. Out of black hard sliding materials from the surface of the fence is the minimal.
- ③ Cut Tip Seal at 2~3mm before the end of Tip Seal groove by cutter (sharp knife).
- ④ Insert remaining Tip Seal at the center of the groove from FS(1) side and cut at 2~3mm before the end of the groove by cutter (sharp knife).
- ⑤ Internally extruded section at the wrap functions as a stopper to hold Tip Seal. Completely push sliding material by hand into the groove.
- ⑥ In the same way, insert Tip Seal to FS(2) side and FS(1) side of OS.

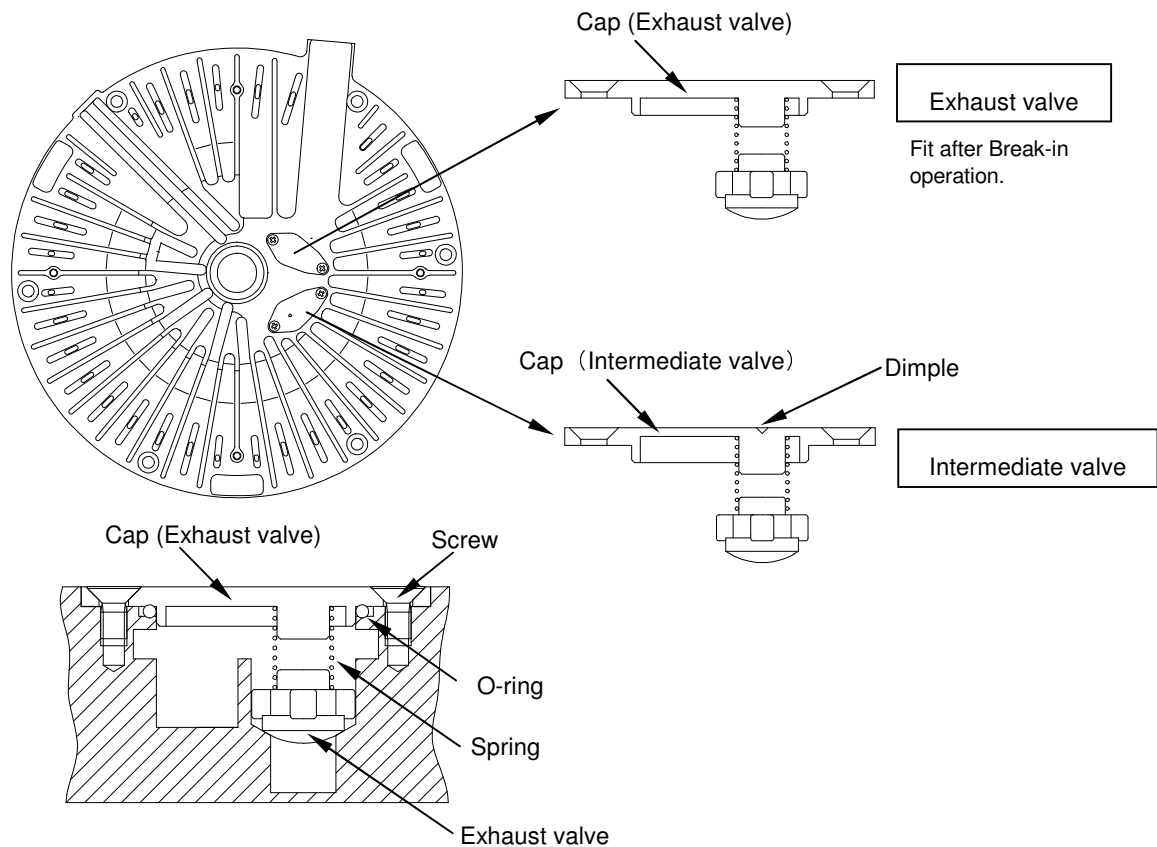


## 5.8 Replace Exhaust valve and Intermediate valve

- ① Remove screws of Cap with cross head screwdriver and remove Cap, Spring and Exhaust valve.
- ② Clean sealing surface where Outlet hole and Exhaust valve contact by using clean cloth and brass brush so as not to damage, and blow out with air.
- ③ Fit new Exhaust valve and Spring to FS without gradient against seal surface.  
**Exhaust valve should be fit after process of 6.12 Break-in operation.**
- ④ Fit Cap to FS and tighten the screw.

In the same way, replace Intermediate valve.

**Intermediate valve should be fit before process of 6.12 Break-in operation.**



## Important

- Fit Exhaust valve and Spring to FS without gradient against seal surface.
- Be careful not to mistake Intermediate valve for Exhaust valve.
- The one where there is a dimple on the surface is Intermediate valve .

### 5.9 Maintenance of Inlet flange

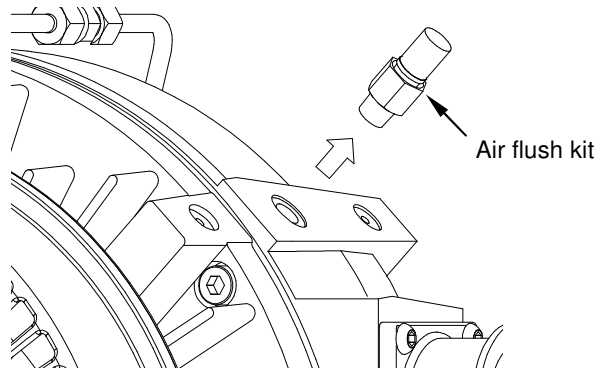
- ① Remove Hex.socket head bolts of Inlet flange.
- ② Clean inside the Inlet flange and Inlet filter with clean cloth ,and blow out dusts.
- ③ Put a new O-ring in the groove of Inlet flange. Put the Inlet flange on the FS(1) and tighten by Hex. socket head bolts with slight amount of LOCTITE 242 or 542.

### 5.10 Maintenance of Outlet flange

- ① Remove Hex.socket head bolts of Outlet flange.
- ② Clean inside the Outlet flange and muffler with clean cloth ,and blow out dusts.
- ③ Put a new O-ring in the groove of Outlet flange. Put the Outlet flange on the FS(1) and tighten by Hex. socket head bolts with slight amount of LOCTITE 242 or 542.

### 5.11 Maintenance of Air flush port

- ① Remove Air flush kit from pump.
- ② Put slight amount of LOCTITE 242 or 542 and tighten Air flush kit to pump.

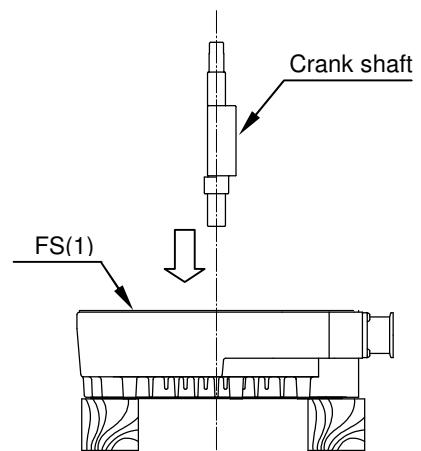


## 5.12 Assembly

Assemble in reverse order of disassembly.

### 5.12.1 Assemble Body set

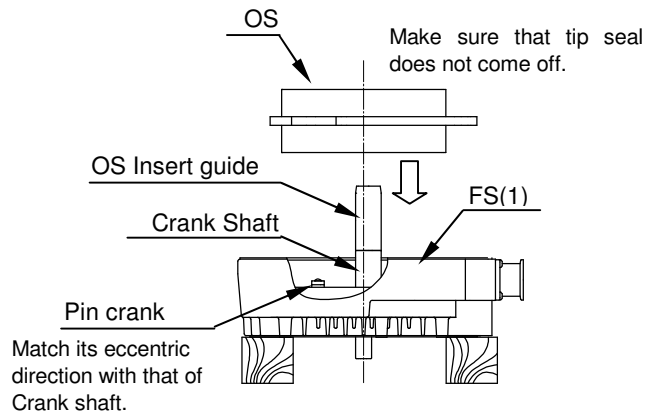
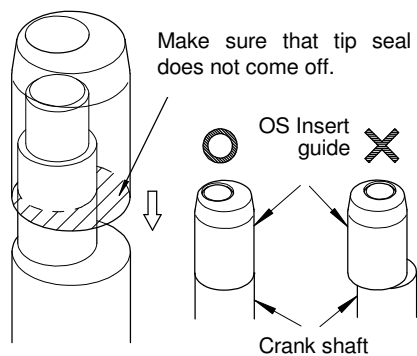
- ① Place 2 blocks (wood which height is over 55mm) on horizontal workbench and FS(1) on the top of them.
  - Fit Crank shaft vertically to FS(1).



### Important

When fitting Crank shaft to FS(1), pay attention not to damage Bearing and Shaft seal with the angle of Key groove of Crank shaft.

- ② Turn eccentric section of both Crank shaft and Pin crank in the same direction. Put the **OS Insert guide** on the Crank shaft as shown in the drawing. Fit OS to FS(1).

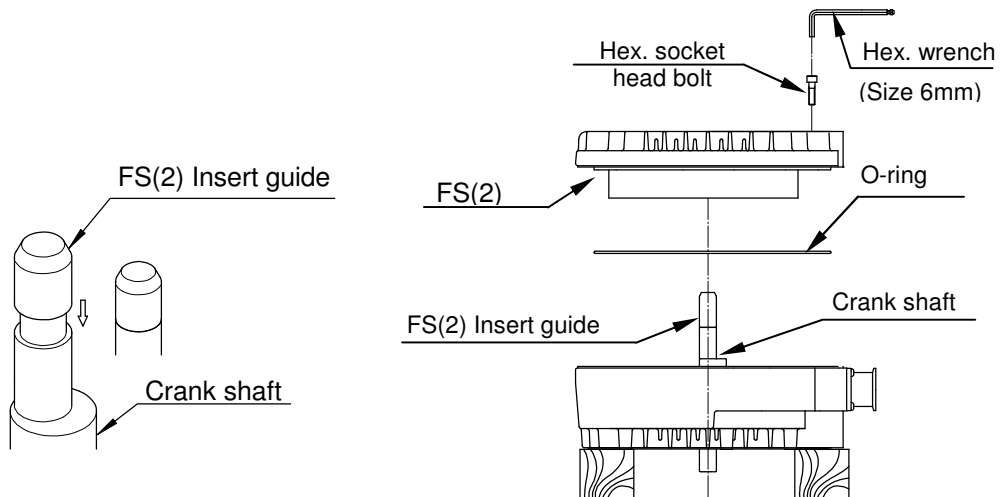


### Important

Pay attention that Tip seal does not come off when fitting OS.

- ③ Put the **FS(2) Insert guide** on the Crank shaft. Fit new O-ring to FS(2), fit it to FS(1) and tighten the Hex. socket head bolts.

**Tightening torque 14.7±0.7 N·m (150±7kgf·cm)**

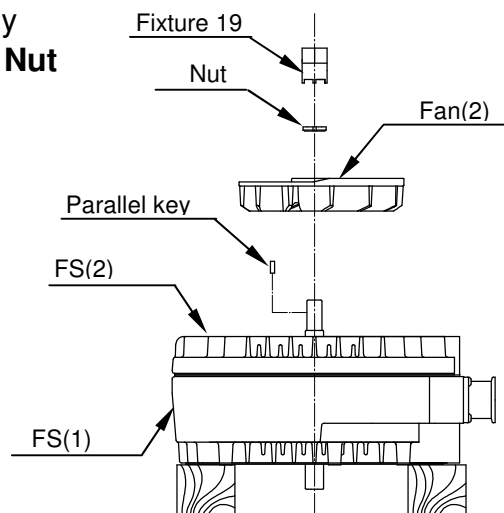


### Important

- Check that there is no dust or damage on the surface of O-ring for FS(1), FS(2) and O-ring surface.
- Check that O-ring does not come off from mating side and Tip seal does not come off from the groove.
- Diagonally tighten Hex. socket head bolts fixing FS(2) by turns in order to tighten evenly.

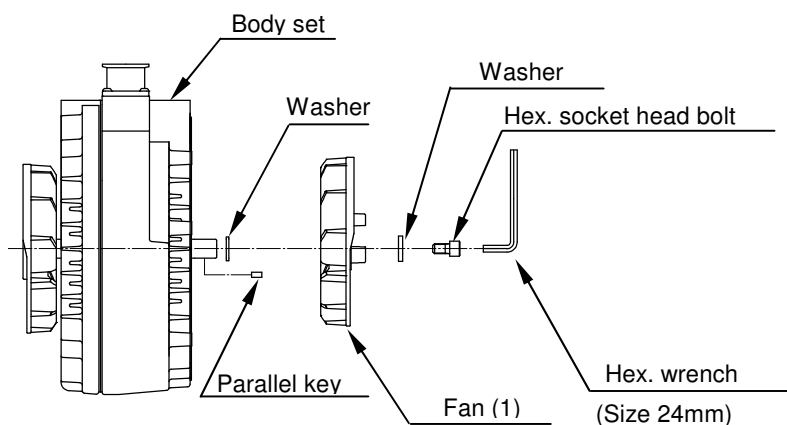
- ④ Fit Parallel key and Fan(2) to FS(2), apply slight amount of **LOCTITE 242 or 542 to Nut** and fully tighten.

**Tightening torque  
19.6±0.7 N·m  
(200±7kgf·cm)**



- ⑤ Stand Body set vertically, fit Washer, Parallel key and Fan(1). Apply slight amount of **LOCTITE 242 or 542 to Hex. socket head bolts** and fully tighten along with Washer.





**Tightening torque 19.6N·m (200±7kgf·cm)**

## Important

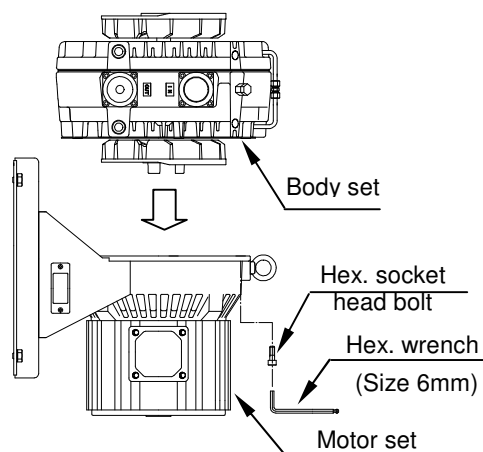
Turn Fan(2) by hand and check that it turns smoothly (a little bit heavier than rotating resistance checked in Disassembly 5.1.1) If rotation is heavy, disassemble again and check that Tip seal does not come off.

- Use **LOCTITE 242 or 542 (medium strength)**.
- Apply slight amount of **LOCTITE** to only thread section.
- Wipe out extruded **LOCTITE** with clean cloth.

### 5.12.2 Fit Body set

- ① Stand Motor set and Body set vertically and fit new Spider to Coupling.
  - ② Match nail of Fan with nail of Spider, Parallel pin with hole position, and fit Body to Motor set.
- Check that Fan(2) turns smoothly and tighten Hex. socket head bolts.

**Tightening torque  
14.7±0.7 N·m  
(150±7kgf·cm)**



## Important

Fit pump to Motor set so that Inlet can face the same direction as before maintenance.

### **5.12.3 Fit Fan cover**

- Apply slight amount of LOCTITE 242 or 542 to the thread section of Hex. socket head bolts.
- Tighten Fan cover and Cover plate(2) together with the bolts.

### **5.13 Break-in operation**

Be sure to do **break-in operation** (refer to 6.12).

## 6. Every two years or every 16000 hours maintenance and inspection

### 6.1 Disassembly

Disassemble in the same way as 5.1.

### 6.2 Replace O-ring

Replace O-ring in the same way as 5.2.

### 6.3 Remove Tip seal

Remove Tip seal in the same way as 5.3.

### 6.4 Maintenance of FS (1)

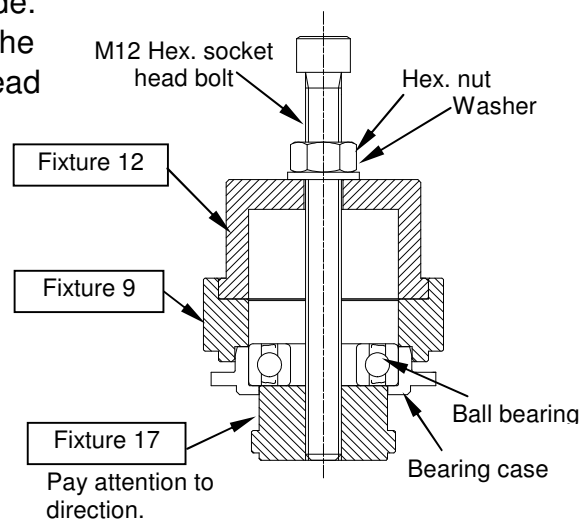
Regarding G-seal and Shaft seal do in the same way as 5.4.2~5.4.5.

#### 6.4.1 Remove Bearing set (1)

Remove Bearing set (1) in the same way as 5.4.1.

#### 6.4.2 Remove Ball bearing

- ① Fit **Fixture 17** (pay attention to direction) to Bearing from Flange side of Bearing case side.
- ② Fit **Fixtures 9 and 12** to Bearing case from the opposite side and screw **M12 Hex. socket head bolts** along with **Hex. nut** and **Washer**.
- ③ Turn **Hex. nut** and remove **Ball bearing**.

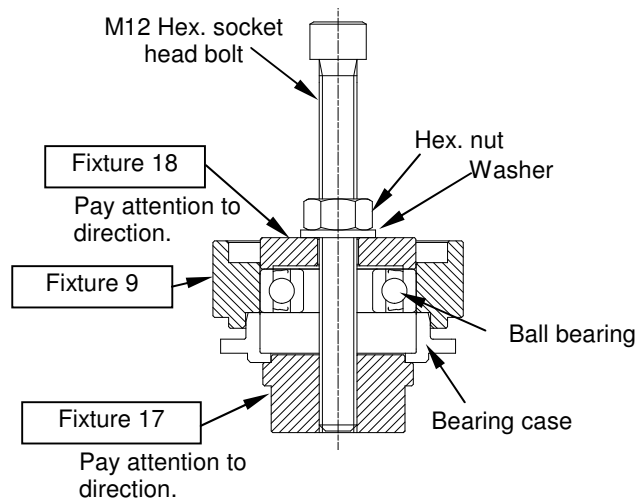


#### 6.4.3 Clean FS(1)

Clean FS(1) in the same way as 5.4.3.

#### 6.4.4 Fit Ball bearing

- ① Fit **Fixture 17** to Bearing case from Flange side (pay attention to direction) .
- ② Fit **Fixture 9** to Bearing case from the opposite side and insert new Bearing horizontally.
- ③ Fit **Fixture 18** (pay attention to direction) to Bearing and screw **M12 Hex. socket head bolt** along with **Hex. nut** and **Washer** from **Fixture 18** side.
- ④ Turn **Hex. nut** and fit Bearing.



### 6.4.5 Fit Bearing set (1)

Fit Bearing set(1) in the same way as 5.2.

### 6.4.6 Fit Tip seal

Fit new Tip seal in the same way as 5.7.

### 6.4.7 Replace Miniature ball bearing of Pin crank set.

- Remove Miniature ball bearing in the same way as 5.4.3.
- Insert new Miniature ball bearings into Pin crank as shield side becomes exterior. Hold side of Pin crank wide 19mm by spanner and tighten by screw with slight amount of LOCTITE 242 or 542.
- Fit Pin crank set and tighten by screw with slight amount of LOCTITE 242 or 542.

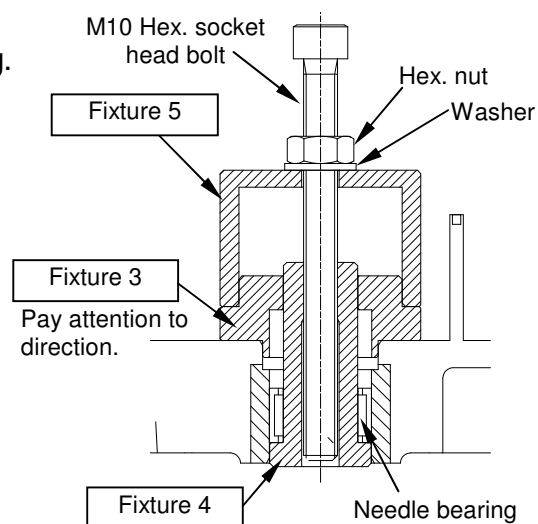
## 6.5 Maintenance of FS (2)

### 6.5.1 Remove G-seal and Shaft seal (2)

Remove G-seal and Shaft seal (2) in the same way as 5.5.1 and 5.5.2.

### 6.5.2 Remove FS (2) Needle Bearing

- ① Insert **Fixture 4** to FS(2) from. Fin side.
- ② Fit **Fixtures 3 and 5** to FS(2) from scroll side, and screw **M10** Hex. socket head bolts along with Hex. nut and Washer.
- ③ Turn Hex. nut and remove Needle bearing.

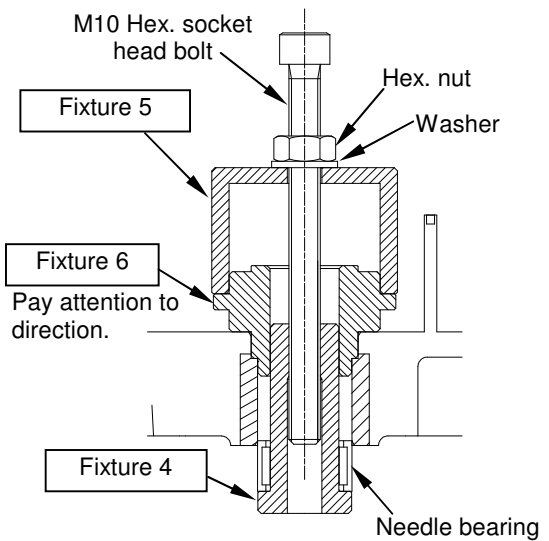


### 6.5.3 Clean FS(2)

- Clean FS(2) in the same way as 5.5.3 ①.

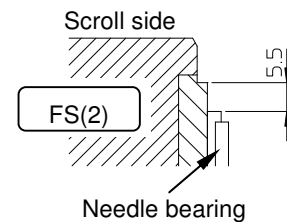
### 6.5.4 Fit FS(2) Needle bearing

- ① Insert new Needle bearing to **Fixture 4**.
- ② Insert **Fixture 6** to **Fixture 5** and fit them to FS(2) from scroll side .
- ③ Insert **Fixture 4** with Needle bearing to FS(2) from fin side and screw **M10** Hex. socket head bolt along with Hex. nut and Washer.
- ④ Turn Hex. nut and fit Needle bearing.



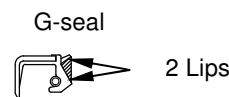
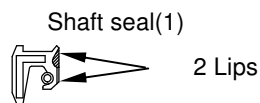
### Important

- Pay attention to Fixture direction.
- Check that 5.5mm between edge surface (scroll side) of Needle bearing and stepped section on FS (2) side.  
If not, fully tighten with Fixture in the same direction.
- Wipe out dust on Fixture with clean cloth.



### 6.5.5 Fit G-seal and Shaft seal

- ① Do in the same way as 5.5.4 and 5.5.5.
- ② Evenly fill **ISP exclusive grease [0.1ml(0.2g)]** between 2 lips of Shaft seal and between 2 lips of G-seal around the whole periphery with syringe.



## CAUTION

#### Danger of shorter operating lifetime and Bearing failure

Be sure to use **ISP exclusive grease for Bearings.**

※Mixing with other oil can shorten grease lifetime and damage Bearings.



**Use ISP  
exclusive grease**

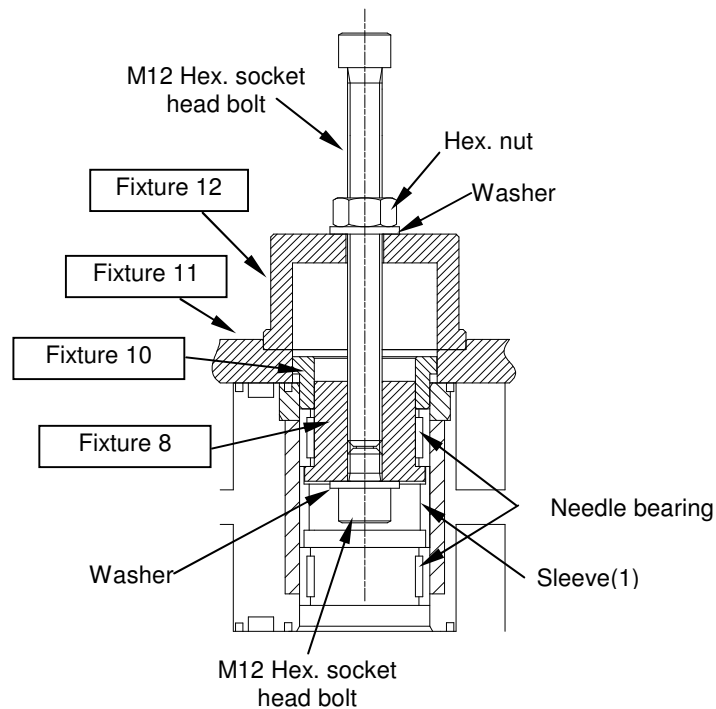
## 6.5.6 Fit Tip seal

Fit new Tip seal in the same way as 5.7.

## 6.6 Maintenance of OS

### 6.6.1 Remove G-seal and Needle bearing

- ① Remove G-seal in the same way as 5.6.1.
- ② Insert 2 pcs. of **Fixture 8** to Needle bearing of OS. Fit short **M12** Hex. socket head bolts with Washer into **Fixture 8** from the opposite side.
- ③ Insert **Fixture 10** to **Fixture 8** from opposite side, fit **Fixtures 11 and 12** in this order and screw **M12** Hex. socket head bolts along with Hex. nut and Washer.
- ④ Turn Hex. nut, remove Needle bearing and Sleeve(1).
- ⑤ Also remove Needle bearing on the opposite side.



### Important

- Pay attention to Fixture direction.
- Pay attention not to damage top, bottom and side of scroll of OS.

### 6.6.2 Clean OS

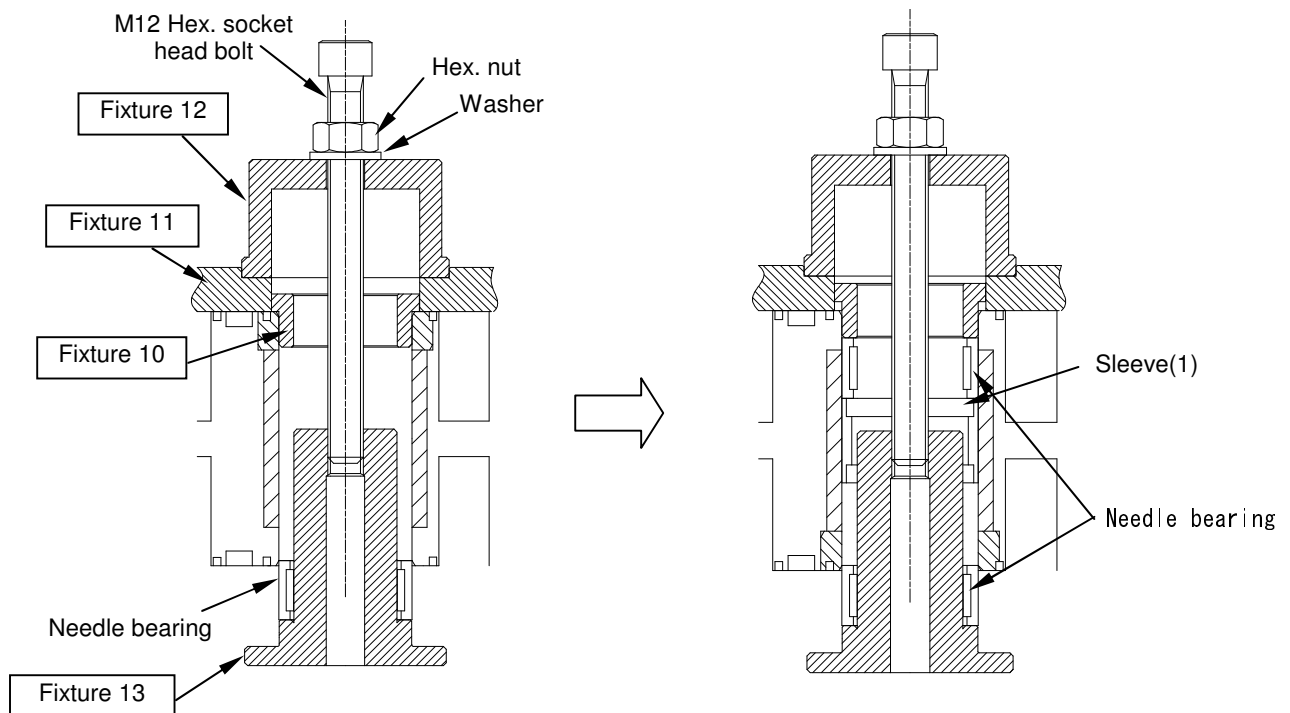
Clean OS in the same way as 5.6.2.

### Important

- If you feel some resistance when removing Tip seal, be sure to wipe out dust.
- Be sure to clean Tip seal groove by soft bamboo spatula since it is fragile.
- Always use clean cloth.  
Mixing with other grease can greatly deteriorate the performance.
- Pay attention not to leave the waste thread in Bearings.

### 6.6.3 Fit Needle bearing

- ① Insert new Needle bearing to **Fixture 13** and fit to one side of OS. Fit **Fixture 10** from the opposite side.
- ② Insert **Fixtures 11 and 12** in this order to **Fixture 10** and screw **M12 Hex. socket head bolts** with **Hex. nut** and **Washer**.
- ③ Turn **Hex. nut** and fit **Needle bearing**. Insert **Sleeve(1)** from the opposite side.
- ④ Insert **Fixture 10** to **Needle bearing** side already pressed, insert the other new **Needle bearing** to **Fixture 13**, and fit it to OS from the opposite side .
- ⑤ Fit **Fixtures 11 and 12** and screw **M12 Hex. socket head bolt** along with **Hex. nut** and **Washer**.
- ⑥ Turn **Hex. nut** and fit **Needle bearing**. Check that **Sleeve (1)** does not turn. If it turns, tighten further again in the same direction.



### Important

- Pay attention to direction of Fixtures.
- Needle bearing consists of 2 pcs. Do not combine with other set of Bearing.
- Pay attention not to damage top, bottom and side of scroll of OS.
- Wipe out dust on Fixtures with clean cloth.

### 6.6.4 Fit G-seal

- Fit G-seal in the same way as 5.6.3.
- Evenly fill **ISP exclusive grease [0.2ml(0.4g)]** between 2 lips of G-seal around periphery with syringe.
- Evenly fill **ISP exclusive grease [1ml(2g)/1section]** in 2 grooves of **Sleeve(1)** between **Needle bearings**.



## CAUTION

### Danger of shorter operating lifetime and Bearing failure

Be sure to use ISP exclusive grease for Bearings.

※Mixing with other oil can shorten grease lifetime and damage Bearings.



Use ISP  
exclusive grease

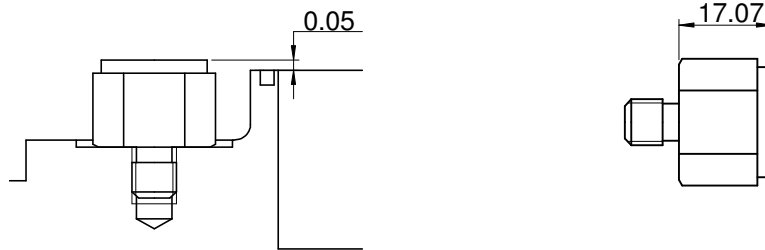
### 6.6.6 Fit Tip seal

Fit new Tip seal in the same way as 5.7.

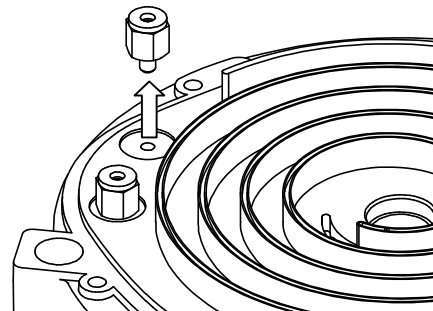
## 6.7 Replace Stopper set

### 重要

- For replacing Stopper set, replace either one side which is more wearred.
  - Check height of the Stopper set.
  - Check that surface of Stopper set comes out from the wrap surface over 0.05mm. If it was below 0.05mm (height lower than 17.07mm) both FS(1) and FS(2) side, replace to new Stopper set.
- If it is not replaced, tip of scroll wrap contacts surface (bottom) and damages it, resulting in failure.



- Loosen hex metal part of the Stopper set by socket of size 19mm.
- Fit new Stopper set to FS.



## 6.8 Replace Exhaust valve and Intermediate valve

- Do in the same way as 5.8.

## 6.9 Maintenance of Inlet flange

- Do in the same way as 5.9.

## 6.10 Maintenance of Outlet flange

- Do in the same way as 5.10.

## 6.11 Maintenance of Air flush port

- Do in the same way as 5.11.







## Important

- Use LOCTITE 242 or 542 ( medium strength ).
- Apply slight amount of LOCTITE to thread section.
- Wipe out extruded LOCTITE with clean cloth.

### 6.12 Assembly

- Do in the same way as 5.12.

### 6.13 Break-in operation

 <span style="font-size: 24px; font-weight: bold; margin-left: 10px;">WARNING</span>	
<p><b>Danger of explosion and ignition</b>  <b>Do not evacuate gas which is hazardous to humans or explosive, flammable, or corrosive.</b> Do not evacuate with substances containing chemicals, solvents, and powders. If done, it can cause failure or bodily injury by gas, explosion or ignition.</p>	 <b>Never evacuate hazardous gas</b>
<p><b>Danger of fire and electric shock</b>  <b>Install short circuit protective device.</b>                      If not, it can cause bodily injury due to fire or electric shock.</p>	 <b>Install short circuit protective device</b>
<p><b>Danger of electric shock</b>  <b>Connect ground cable to ground terminal in motor terminal box.</b>                      If not, it can cause bodily injury from electric shock.</p>	 <b>Be sure to ground</b>

## Important

- When you have replaced Tip seal, do break-in operation so as to smooth Tip seal surface.
- Be sure to take off Exhaust valve during break-in operation.
- During break-in, open Inlet valve 2~3 times hourly so as to emit worn powder.
- This pump is common for 50Hz/60Hz. Do break-in for both 50Hz and 60Hz.

When electric source is either 50Hz or 60Hz, do break-in at the same electric source as pump installation site.

- ① Do break-in of Tip seal in the following way while removing Exhaust valve.
- ② Close Inlet valve and operate at 50Hz.
- ③ Loosen Hex. socket head bolts which fix FS(1) and FS(2), and tighten with hand till it stops.
- ④ If current during pump operation is within + 10% from rated figure (refer to [rated current chart ] on next page), continue operation as it is. If it exceeds + 10% from rated figure, open Inlet to atmosphere and operate for a while, then close Inlet again and check current. Repeat this procedure till current is less than 10% from rated figure.
- ⑤ If current is less than the rated figure, tighten Hex. Socket head bolts and do 24 hours continuous operation.



<b>Tightening torque    14.7±0.7N·m(150±7kgf·cm)</b>
--

- ⑥ Change electric source to 60Hz and do ②~⑤.
- ⑦ Stop pump and turn off electric source.

- ⑧ After break-in running, clean up inside the pump. Follow the procedure in 5.1.1~5.1.3. Clean up inside the pump and blow out.
- ⑨ Wipe out dust at Exhaust valve hole with clean cloth in the same way as 5.8, blow out with air and fit Exhaust valve.
- ⑩ Apply **ISP exclusive grease** to roller at OS Needle bearings and FS(2) Needle bearings.
- Apply **ISP exclusive grease** between roller and cage while turning roller.

Grease volume [ /bearing]	Where to apply		ISP-1000
		OS Needle bearing	0.4ml(0.8g)
		FS(2) Needle bearing	0.2ml(0.4g)

- ⑪ Evenly fill **ISP exclusive grease [0.1ml(0.2g)]** between OS G-seal and Needle bearings; FS(2) G-seal and Needle bearings; and between 2 lips of FS(2) Shaft seal(2) and G-seals of OS around the whole periphery with syringe.
- ⑫ Assemble in reverse order of disassembling.

 <b>CAUTION</b>	
<p><b>Danger of shorter operating lifetime and Bearing failure</b></p> <p>Be sure to use <b>ISP exclusive grease for Bearings.</b></p> <p>※ Mixing with other oil can shorten grease lifetime and damage Bearings.</p>	 <b>Use ISP exclusive grease</b>

## 6.14 Inspect pump performance

- ① Operate pump and measure currents.

Model	Specification	current after break-in (when Inlet is closed)
ISP-1000	3-phase 200V	4.0~4.3A

- ② Check that there is no abnormal noise and vibration.
- ③ Inspect the ultimate pressure and leak tightness.

Ultimate pressure:  $\leq 1.0\text{Pa}$

Leak tightness:  $\leq 1.0 \times 10^{-2} \text{ Pa} \cdot \text{L/s}$

## 6.15 Rated current chart

**ISP-1000** Three-phase

Voltage	V	200	208	230	380	400	415	460
Hertz	Hz	50   60	60	60	50	50	50	60
Rated current	A	5.5   5.8	5.8	5.7	3.3	3.6	3.8	3.5
Rated current +10%	A	6.1   6.4	6.4	6.3	3.6	4.0	4.2	3.9

# 7. Fixture combination chart

Fixture No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	17	18	19	
FS(1)	1. Remove Shaft seal	○				○														
	2. Fit Shaft seal	○	○			○										○				
	3. Fit G-seal	○	○			○														
FS(2)	4. Fit Shaft seal				○	○	○	○												
	5. Fit G-seal				○	○	○	○												
OS	6. Fit G-seal										○	○	○	○	○					
FS(1)	7. Remove Ball bearing									○			○					○		
	8. Fit Ball bearing									○								○	○	
FS(2)	9. Remove Needle bearing			○	○	○														
	10. Fit Needle bearing				○	○	○													
OS	11. Remove Needle bearing								○		○	○	○							
	12. Fit Needle bearing									○	○	○	○							
Fan(2)	13. Remove Fan(2)																			○
	14. Fit Fan(2)																			

# 8. Parts list

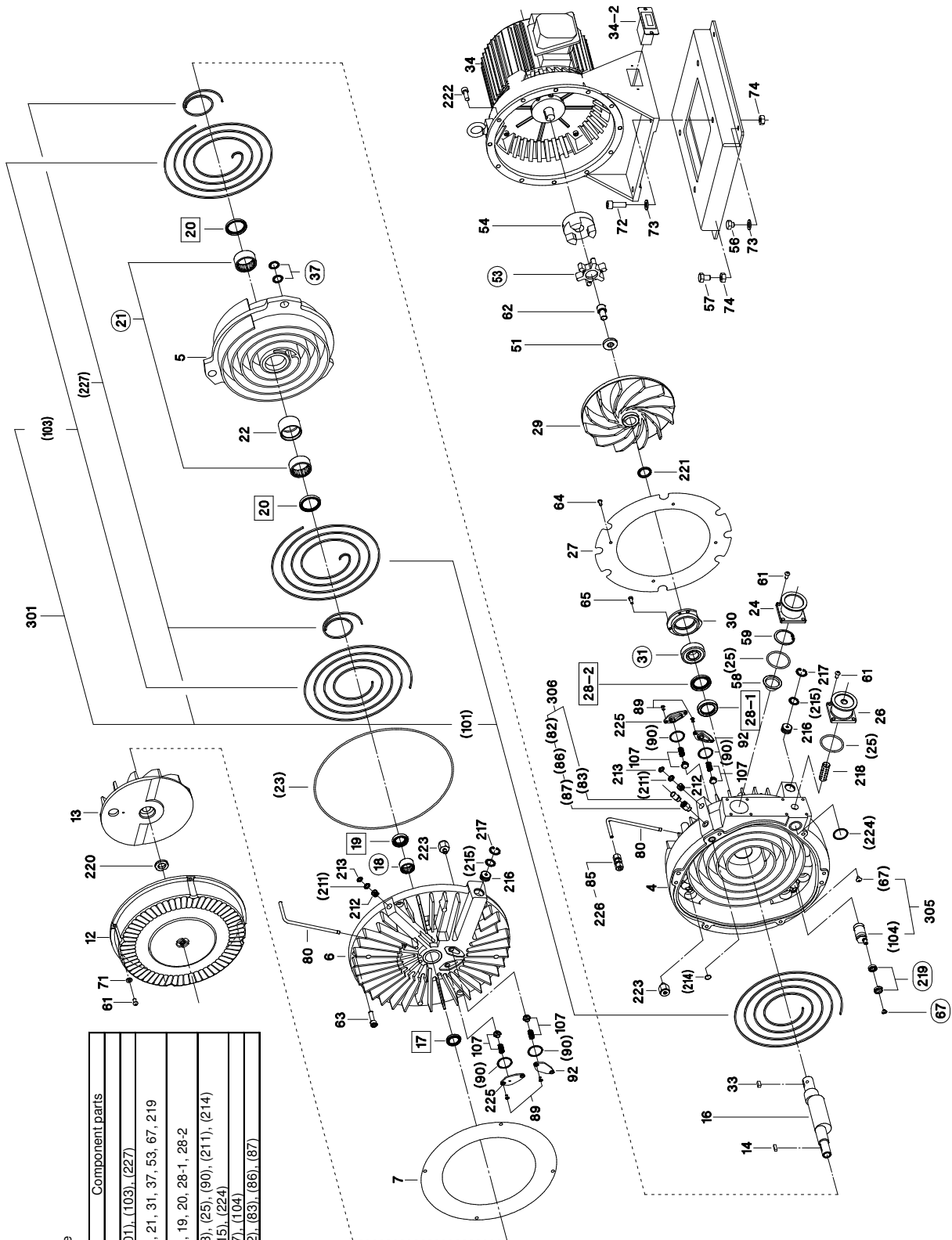
No.	Parts Name	Quantity	No.	Parts Name	Quantity
4	FS(1)	1	65	Bolt	3
5	OS	1	69	Plug	2
6	FS(2)	1	71	Washer	4
7	Cover plate(2)	1	72	Bolt	4
12	Fan cover	1	73	Washer	7
13	Fan(2)	1	74	Nut	5
14	Parallel key	1	80	Pipe	2
16	Crank shaft	1	89	Screw	8
22	Sleeve(1)	1	92	Cap	2
24	Inlet flange	1	107	Exhaust valve set	1
26	Outlet flange	1	212	Plug (1)	2
27	Cover plate(1)	1	213	Snap ring	2
29	Fan(1)	1	216	Plug (2)	2
30	Bearing case	1	217	Snap ring	2
33	Parallel key	1	218	Muffler	1
34	Motor set	1	220	Nut	1
34-2	Hour counter	1	221	Washer	1
51	Washer	1	222	Bolt	6
54	Coupling	1	225	Cap (2)	2
56	Bolt(1)	3	226	Coupling	1
57	Bolt(2)	3	301	Tip seal set	1
58	Inlet filter	1	302	Bearing kit	1
59	Snap ring	1	303	Seal kit	1
61	Bolt	12	304	O-ring set	1
62	Bolt	1	305	Pin crank kit	1
63	Bolt	6	306	Air flush kit	1
64	Screw	4			

(Consumables)

No.	Parts Name	Quantity	Remarks
(17)	G-seal [ FS(2) ]	1	No.303 supplied by Seal set
(18)	Needle bearing [ FS(2) ]	1	No.302 supplied by Bearing kit
(19)	Shaft seal(2) [ FS(2) ]	1	No.303 supplied by Seal set
(20)	G-seal [ OS ]	2	No.303 supplied by Seal set
(21)	Needle bearing [ OS ]	1 set	No.302 supplied by Bearing kit
(23)	O-ring [ FS(2) ]	1	No.304 supplied by O-ring set
(25)	O-ring [ Inlet, Outlet flange ]	2	No.304 supplied by O-ring set
(28-1)	Shaft seal(1) [ FS(1) ]	1	No.303 supplied by Seal set
(28-2)	G-seal [ FS(1) ]	1	No.303 supplied by Seal set

(31)	Ball bearing [ FS(1) ]	1	No.302 supplied by Bearing kit
(37)	O-ring [ Pin crank ]	6	No.302 supplied by Bearing kit
(53)	Spider	1	No.302 supplied by Bearing kit
(67)	Screw	3	No.302 supplied by Bearing kit
(67)	Screw	6	No.305 supplied by Pin crank kit
(82)	Housing	1	No.306 supplied by Air flush kit
(83)	Air-muffler	1	No.306 supplied by Air flush kit
(85)	Sleeve	2	No.306 supplied by Air flush kit
(86)	Ball	1	No.306 supplied by Air flush kit
(87)	Snap ring	1	No.306 supplied by Air flush kit
(90)	O-ring [ Cap ]	4	No.304 supplied by O-ring set
(101)	Tip Seal set(1)	1	No.301 supplied by Tip seal set
(103)	Tip Seal set(2)	1	No.301 supplied by Tip seal set
(104)	Pin crank set	3	No.305 supplied by Pin crank kit
(211)	O-ring [ Plug(1) ]	2	No.304 supplied by O-ring set
(214)	O-ring	1	No.304 supplied by O-ring set
(215)	O-ring [ Plug(2) ]	2	No.304 supplied by O-ring set
(219)	Miniature ball bearing [ Pin crank ]	6	No.302 supplied by Bearing kit
(223)	Stopper set	12	No.307 supplied by Stopper set
(224)	O-ring	1	No.304 supplied by O-ring set
(227)	Tip seal	2	No.301 supplied by Tip seal set

# 9. Extended Drawing



The parts remarked by ( ), O, □ are supplied with Set or Kit.

No.	Parts name	Component parts
107	Exhaust valve set	
301	Lip seal set	(101), (103), (227)
302	Bearing kit	18, 21, 31, 37, 53, 67, 219
	[remarked by O]	
303	Seal set	17, 19, 20, 28-1, 28-2
	[remarked by □]	
304	O-ring set	(23), (25), (90), (211), (214)
	[remarked by O]	
305	Pin crank kit	(67), (104)
306	Air flush kit	(82), (83), (86), (87)



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