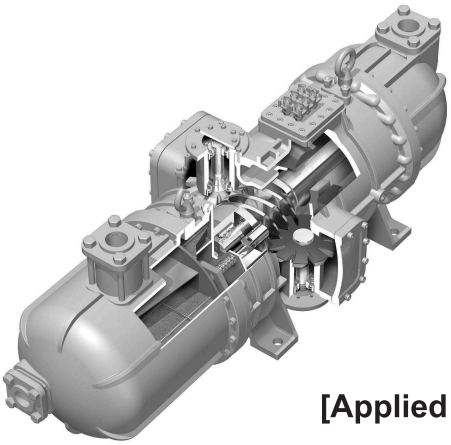
DAIKIN

Si50-402A

Service Manual

For Overhaul and Inspection

Semi-Hermetic Single Screw Compressor Version IV



[Applied Models]

ZH(C)3LSF	ZH(C)3LTG	ZH(C)3LTGU	ZH(C)3LTGV
ZH(C)5MLF	ZH(C)3WLG	ZH(C)3WLGU	ZH(C)3WLGV
ZH(C), (A)5LLF	ZH(C), (A)5LMG	ZH(C), (A)5LMGU	ZH(C), (A)5LMGV
ZH(C), (A)7SLF	ZH(C), (A)5WLG	ZH(C), (A)5WLGU	ZH(C), (A)5WLGV
ZH(C)7LLF	ZH(C)7LSG	ZHA7MSGU	ZHA7MSGV
ZH(C), (A)9SLF	ZH(C), (A)7WSG	ZH(C)7LSGU	ZH(C)7LSGV
ZH(C), (A)9LLF	ZH(C), (A)9LSG	ZH(C), (A)7WSGU	ZH(C), (A)7WSGV
ZH3LMF	ZH(C), (A)9WSG	ZH(C), (A)9LSGU	ZH(C), (A)9LSGV
ZH5SLF		ZH(C), (A)9WSGU	ZH(C), (A)9WSGV
ZH5LMF			
ZHA7MLF			

Semi-Hermetic Single Screw Compressor Version IV

[Applicable Models]

ZH3LSF	ZH3LMF	ZHC3LSF		ZH3LTG	ZHC3LTG	
ZH5MLF	ZH5SLF	ZHC5MLF		ZH3WLG	ZHC3WLG	
ZH5LLF	ZH5LMF	ZHC5LLF	ZHA5LLF	ZH5LMG	ZHC5LMG	ZHA5LMG
ZH7SLF		ZHC7SLF	ZHA7SLF	ZH5WLG	ZHC5WLG	ZHA5WLG
ZH7LLF		ZHC7LLF	ZHA7MLF	ZH7LSG	ZHC7LSG	ZHA7MSG
ZH9SLF		ZHC9SLF	ZHA9SLF	ZH7WSG	ZHC7WSG	ZHA7WSG
ZH9LLF		ZHC9LLF	ZHA9LLF	ZH9LSG	ZHC9LSG	ZHA9LSG
				ZH9WSG	ZHC9WSG	ZHA9WSG

ZH3LTGU	ZHC3LTGU			ZH3LTGV	ZHC3LTGV	
ZH3WLGU	ZHC3WLGU			ZH3WLGV	ZHC3WLGV	
ZH5LMGU	ZHC5LMGU	ZHA5LMGU		ZH5LMGV	ZHC5LMGV	ZHA5LMGV
ZH5WLGU	ZHC5WLGU	ZHA5WLGU		ZH5WLGV	ZHC5WLGV	ZHA5WLGV
ZH7LSGU	ZHC7LSGU	ZHA7MSGU		ZH7LSGV	ZHC7LSGV	ZHA7MSGV
ZH7WSGU	ZHC7WSGU	ZHA7WSGU		ZH7WSGV	ZHC7WSGV	ZHA7WSGV
ZH9LSGU	ZHC9LSGU	ZHA9LSGU		ZH9LSGV	ZHC9LSGV	ZHA9LSGV
ZH9WSGU	ZHC9WSGU	ZHA9WSGU		ZH9WSGV	ZHC9WSGV	ZHA9WSGV

1. Scope of Application

This booklet applies to semi-hermetic single screw compressor for use in Model F type (ZH_F), G type (ZH_G). Replacement intervals specified in the booklet are empirically worked out based on the design service life expected of the compressors operated under the design conditions, and are intended to provide a general guide by which to formulate a maintenance plan.

∗Revised point (in August, 2004)

1. Disassemble of control motor (manufactured from September, 2004)
   Refer to page 21 and 22.
2. Installation of control motor (manufactured from September, 2004)
   Refer to page 34 to 36.

2. Overhaul

Generally, maintenance and inspection of equipment are important in preventing their failure and damage to them. Equipment, even without defective structure or components, gradually age and wear over long years of operation. For example, screw compressors, despite their apparent good operating condition, may face such problems as decreasing insulation resistance of the motor, oil deterioration, and worn and fatigued bearings during long periods of operation. Most of such changes with time are invisible from the outside in many cases, and it is only after an accident that they are noticed. For this reason, in the case of equipment required to be highly reliable, it is most important to grasp their wear condition precisely and take necessary measures against accidents if they are to maintain proper operating conditions for expanding service life.

Overhaul interval: 40,000 hours or 7 years, whichever comes first.

3. Periodic Inspection

"Periodical Inspection" means to inspect, adjust and clean various parts of devices and equipment at the scheduled interval.

3.1 Periodic Inspection Items and Intervals

Table 3-1 shows periodic inspection items and intervals. Conduct inspections at the earliest indicated inspection intervals.

Table 3-1 Periodic inspection items and intervals

No.	Item	Inspection
1	Measurement of motor insulation resistance	1 year
2	Changing of refrigeration oil	7,500 hrs or 4 years
3	Inspection of gate rotor	20,000 hrs or 4 years
4	Inspection of suction filter	20,000 hrs or 4 years

3.2 Periodic Inspection Instructions

1. Insulation Resistance of The Motor

■ Insulation Resistance Testing

A megger is used to apply voltage directly to an insulated object, measure leakage current through the insulated object, and find the insulation resistance values. Its scale is voltage / leakage graduated with such insulation resistance values.

The following equation holds:
Insulation resistance = applied voltage / leakage current

Note:

1. A megger indicates an increasing resistance value with time, because absorption current flows through the insulated object at an early stage, lowering the resistance value correspondingly.
2. Prohibit anyone from measuring insulation resistance in a vacuum.
   It must be measured at atmospheric pressure or after the filling of refrigerant. The reason is that in a vacuum, the insulation ability of gas lowers, and thus electric discharge is apt to occur.

(Measuring Procedure)

(1) Turn off the main power and operating power.
(2) Remove the terminal cover.
(3) Before measurement, disconnect the cables connected to the compressor or control panel.
(4) Disconnect the CTP protector lead wire.
(5) Conduct measurement.

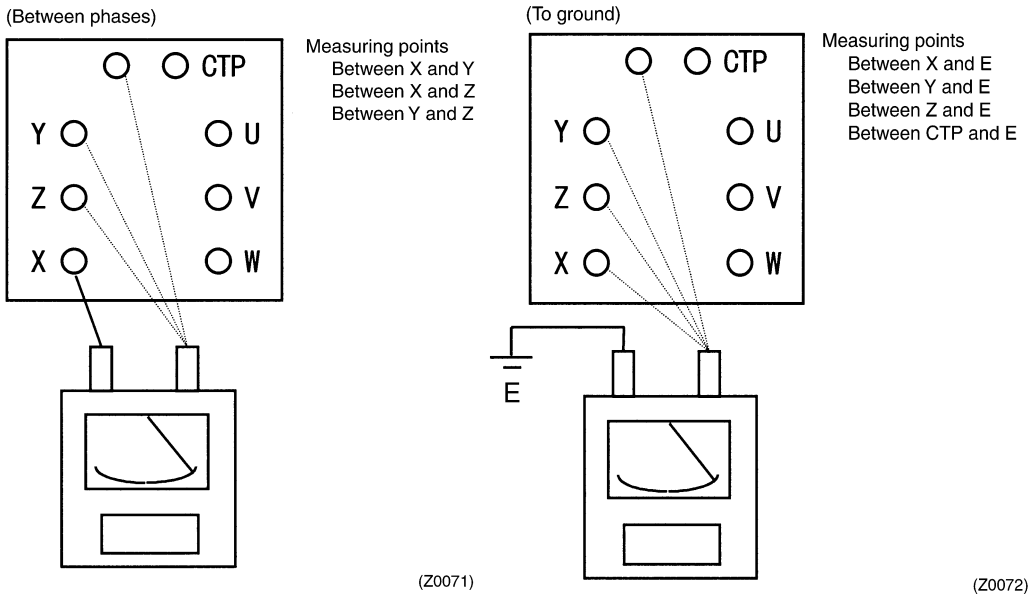


Fig. 3-1 Motor insulation resistance measurement method

(Measurement Standard)

Using a 500-V megger. The measured value shall be 3 MΩ or higher.

2. Changing Refrigerating Oil

Oil degrades after many hours of operation and due to aging. Replace oil regularly after 7,500 hours of operation or four years, whichever comes first.

(Changing Procedure)

(1) Perform a pump down operation to reduce pressure inside the compressor.

(2) Release the internal pressure of the compressor.
Loosen the flare nut at the service port (with check valve) of the compressor (see Fig. 3-2). Remove the partition lid, then tighten the flare nut to collect refrigerant from the compressor. To loosen and tighten the flare nut, use two wrenches to turn the flare nut and keep the other nut stationary.

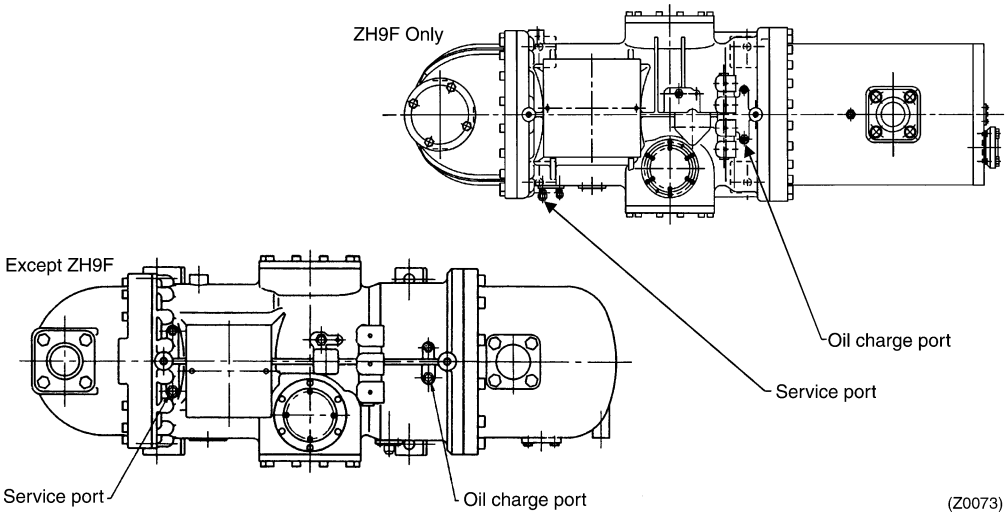


Fig. 3-2 Service port and oil charge port locations

(3) After confirming that refrigerant is completely collected, drain oil from the two drain ports located on the lower section of the casing.
The compressor rotates in the reverse direction when it stops operating. This causes oil to remain in the suction side. Therefore, be sure to drain oil from the two drain ports.

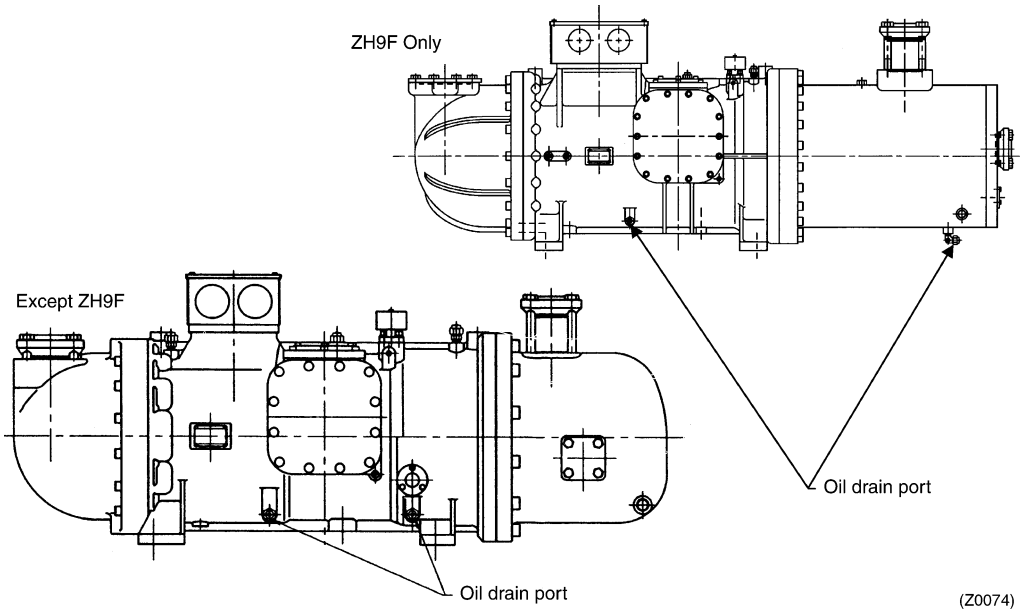


Fig. 3-3 Drain port locations

(4) Charging oil

Connect a vacuum pump to the suction service port (1/4" DCut) on the casing. While evacuating the compressor, add oil from the discharge service port (3/8" DCut).

① Use IDEMITSU DAPHNE FVC68D refrigeration oil (or equal such as CASTROL ICEMATIC SW68) for refrigerant R407C, R134a, or R404A.

Caution

Even though the CASTROL ICEMATIC SW68 is similar to the IDEMITSU DAPHNE FVC68D in the property under the standards, it is not recommended due to a high level of hydrolyte. In order to use the CASTROL ICEMATIC SW68 due to the reason that the IDEMITSU DAPHNE FVC68D is hard to be got outside Japan, observe the following points.

- To refill or replace refrigeration oil, make it a rule not to mix different types of oil.
- To refill different types of oil, follow the procedure shown below.

a) Check to be sure on the oil level gauge that oil returns, following the procedure shown in Section 3-2.2), and then discharge the oil.
b) Fill replacement oil (new oil). (Do not expose the new oil to air until just before filling.)
c) Evacuate the compressor for a minimum period of one hour, and then charge the refrigerant.
d) While operating the refrigeration machine for a period of approximately an hour, clean the inside of the system.
e) Discharge the oil in the same manner as that shown in a) above.
f) Following b) above, fill the replacement oil (new oil) again. (Do not expose the new oil to air until just before refilling.)
g) Evacuate the compressor for a minimum period of 12 hours, and then charge the refrigerant.
h) Check to be sure that moisture content in the system is 75 PPM or less. (If this condition is not satisfied, use a drier to operate the system.)

For the refrigerant R22, use SUNISO 4GSD (or equal such as SUNISO 4GS, COSMO SUPER FREEZE 56, BP ENERGOL LPT-F46, or POLAROL SUPER 56).

Caution

Use the equal oil only if the SUNISO 4GSD is hard to be got outside Japan, provided that the following points shall be observed.

- To refill or replace refrigeration oil, make it a rule not to mix different types of oil.
- To refill different types of oil, follow the procedure a) through f) shown below.

② Add the same amount of new oil as drained because some remains in the refrigerant and on various parts inside. Drained oil contains refrigerant and appears to be more in volume than actual oil amount. Stir the oil to evaporate the dissolved refrigerant before measuring. Do not add more oil than necessary, since an excessive amount of oil reduces oil separation efficiency and causes system problems. (Oil surface should be visible on the oil level gauge during equipment operation.)

③ Take care not to let in air, or dust and other foreign particles remaining on the bottom of the oil container.

④ Since oil is apt to absorb moisture, be sure to use new oil.

3. Inspecting The Gate Rotor

This inspection is done to check that no abnormal condition is present due to dust and other foreign particles inside or harsh operating conditions of liquid compression, etc.

(1) Perform a pump down operation to reduce pressure inside the compressor.
(2) Release the internal pressure of the compressor.
Loosen the flare nut of the service port (with check valve) of the compressor (Same as Section 3-2.2). Remove the partition lid, then tighten the flare nut to collect refrigerant from the compressor.
(3) Remove the side caps from both sides of the compressor. (Fig. 3-4)
Since a small amount of oil is still in the compressor, place drain pans under the side caps to receive oil before opening the side caps.

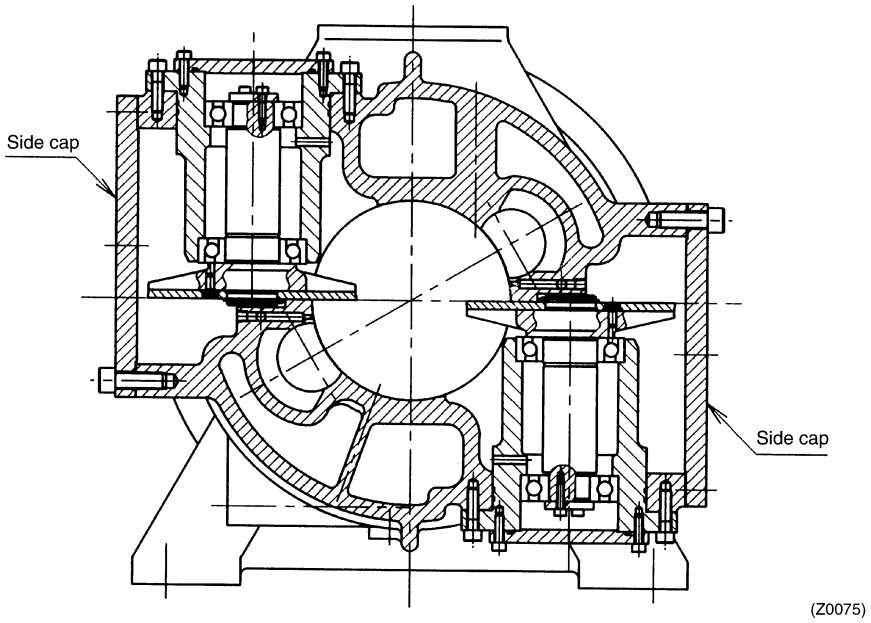


Fig. 3-4 Side cap locations

(4) Inspection of the gate rotor
Visually check the gate rotor surface for scar, chipping, cracking, etc. Check all gate rotor teeth.

Table 3-1 Gate rotor inspection standards

Item	Standard	Remedy
Cracking	No cracking	Replace
Chipping	No chipping 3 mm or more long in long side	
Scar	No scar 1 mm or more deep	
Surface yellowing*	No yellowing	

* When the yellowing is observed on the gate rotor blade, remove gate rotor and check the damage on outside of the screw rotor.
If the damage on screw rotor is found, conduct one of the following counter measures.
- Repair (deburr, etc.) the damaged part of the screw rotor.
- Replace the screw rotor.

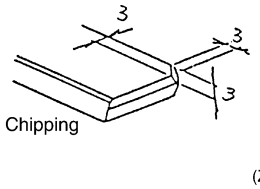


Fig. 3-5 Inspection of gate rotor chipping

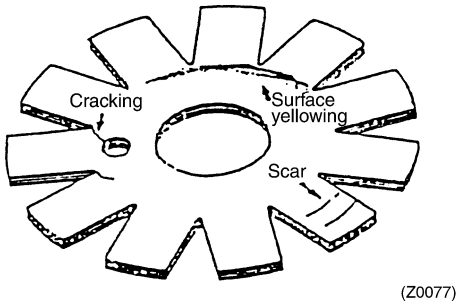


Fig. 3-6 Inspection of gate rotor surface

(5) Measuring the slit clearance
The slit clearance is a gap between the gate rotor and casing, and it affects the compressor performance and reliability to a great extent. Therefore, the slit clearance must be set properly (60 to 90 μm).
While pressing the periphery of the gate rotor shaft with fingers, insert a thickness gauge into the slit clearance to measure the gaps on both suction and discharge sides. Be careful not to insert the thickness gauge too deep. If the thickness gauge is inserted to deep, it can be caught between the screw rotor and gate rotor and break.
(See Fig. 3-7 and 3-8.)

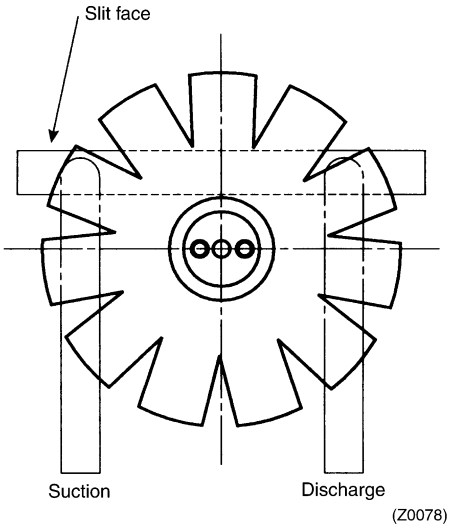


Fig. 3-7 Slit clearance measuring location

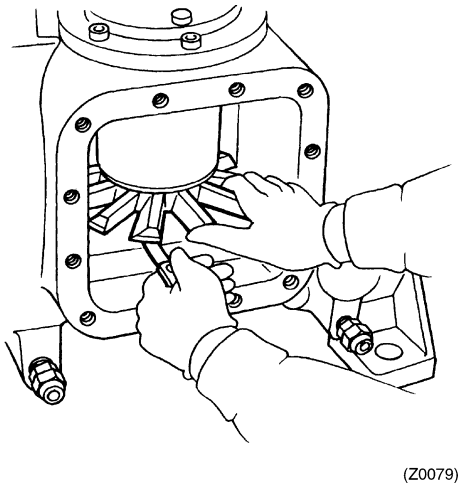


Fig. 3-8 Measuring slit clearance on suction side

4. Cleaning The Suction Filter

(1) Perform a pump down operation to reduce pressure inside the compressor.
(2) Release the internal pressure of the compressor.
Loosen the flare nut of the service port (with check valve) of the compressor (see Fig.3-2). Remove the partition lid, then tighten the flare nut to collect refrigerant from the compressor. (Same as Section 3.2.2)
(3) Disconnect the suction pipe, and remove the suction filter.
(4) Remove dust and foreign particles from the inside of the filter by using compressed air and cleaning solution. Check the filter thoroughly for tears and damage. (Replace the filter if there is a tear.) Dry the filter thoroughly before installation to remove cleaning solution and moisture.

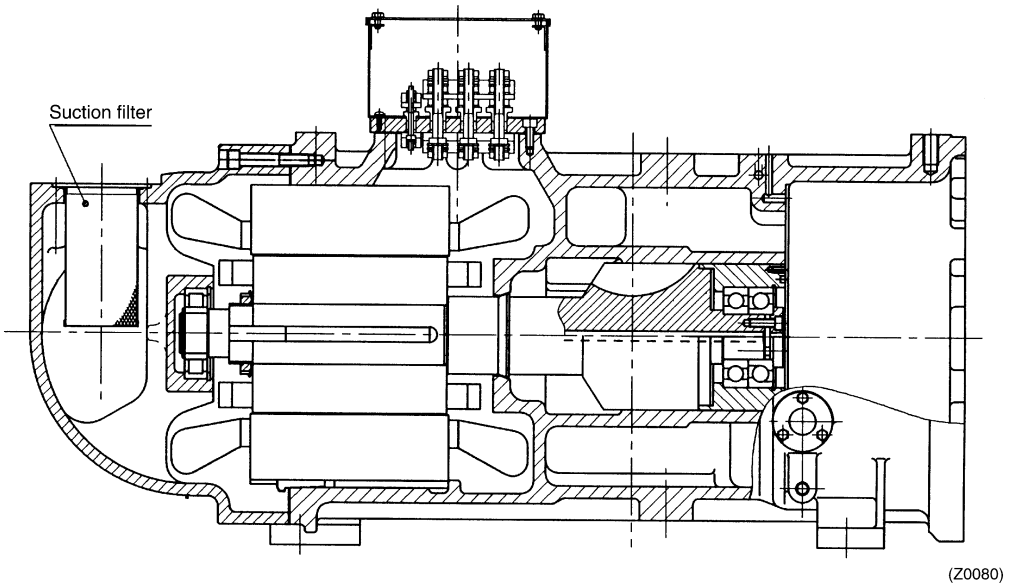


Fig. 3-9 Suction filter location (Cross sectional diagram of casing)

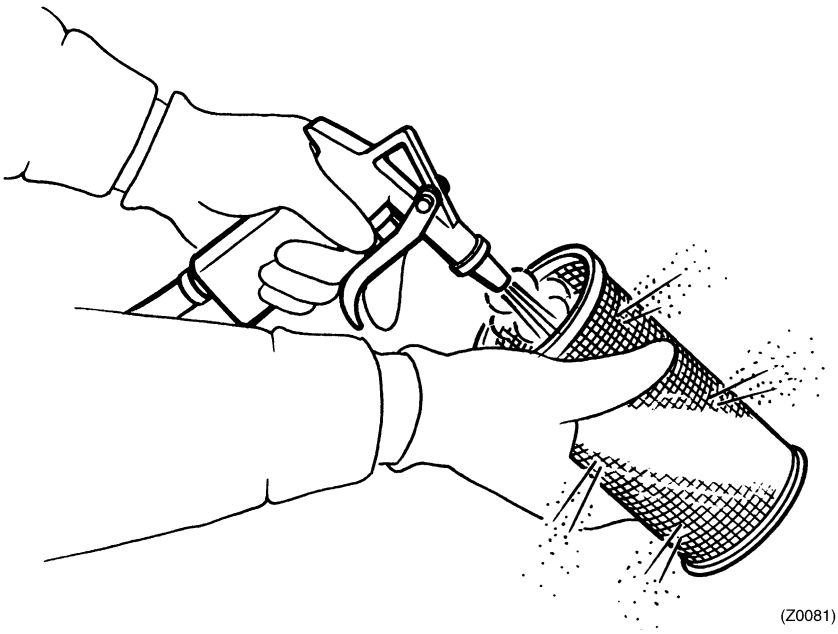


Fig. 3-10 Cleaning suction filter

4. Overhaul Instructions

The driving and friction parts in the compressor wear for prolonged over time. To prevent accidents caused by worn parts, it is necessary to inspect those parts regularly and overhaul the compressor as needed.

4.1 Disassembly and Inspection

1. Draining Oil

Drain oil by referring to Section 3.2.2 "Changing refrigerating oil."

2. Remove The Side Caps (One on Each Side) and The Discharge End Cover. (in case of ZH9F, oil collector)

- Receive remaining oil with a drain pan.
- Be sure to mount guide bolts when removing the discharge end cover. Furthermore, since continuous capacity control units have a pilot valve (as shown in Fig. 4-2-2) inside, remove the discharge end cover with care paid not to bend this valve.
- Be careful not to damage the oil filter with the discharge end cover.
- Locate the first demister between the discharge end cover and cylinder cover, and remove it. (Except ZH9F)

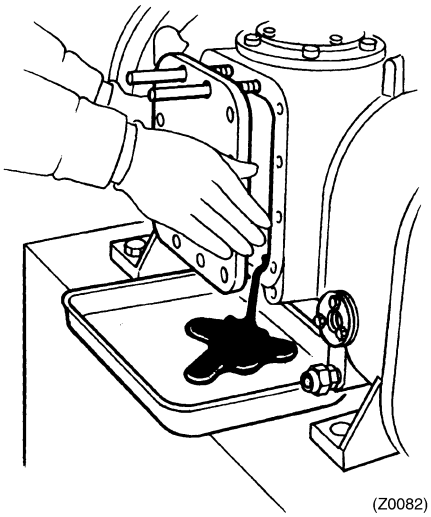


Fig. 4-1 Removing side cap

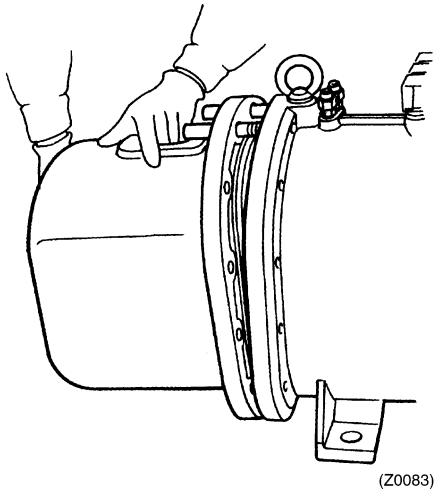


Fig. 4-2 Removing discharge end cover

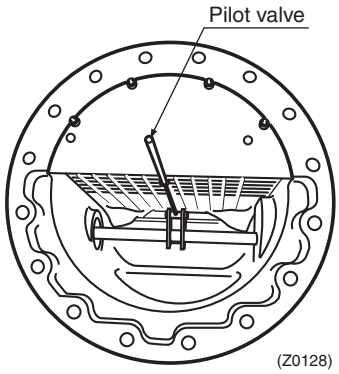


Fig. 4-2-2 Pilot valve

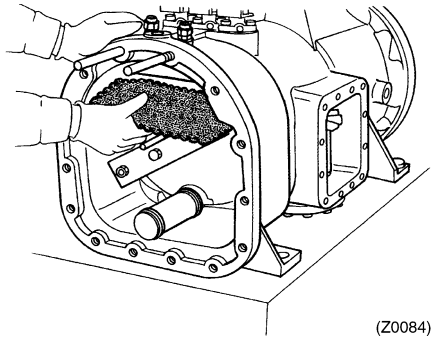
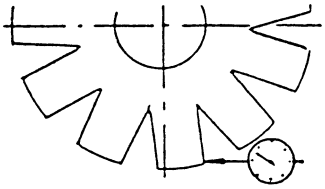


Fig. 4-3 Removing first demister

3. Inspection of The Gate Rotor and Surrounding Parts

(1) Checking the slit clearance
Measure the slit clearance by referring to Section 3.2.3) "Inspecting The Gate Rotor."
(2) Measuring the backlash
Measure the backlash of the gate rotor and screw rotor. If the measured value exceed the standard value, replace the gate rotor.
[Standard value] 0.15 mm or less for all teeth (ZH3, 5) and 0.20mm or less for all teeth (ZH7, 9)

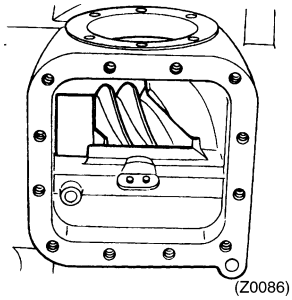


(Z0085)

Fig. 4-4 Measurement of gate rotor backlash

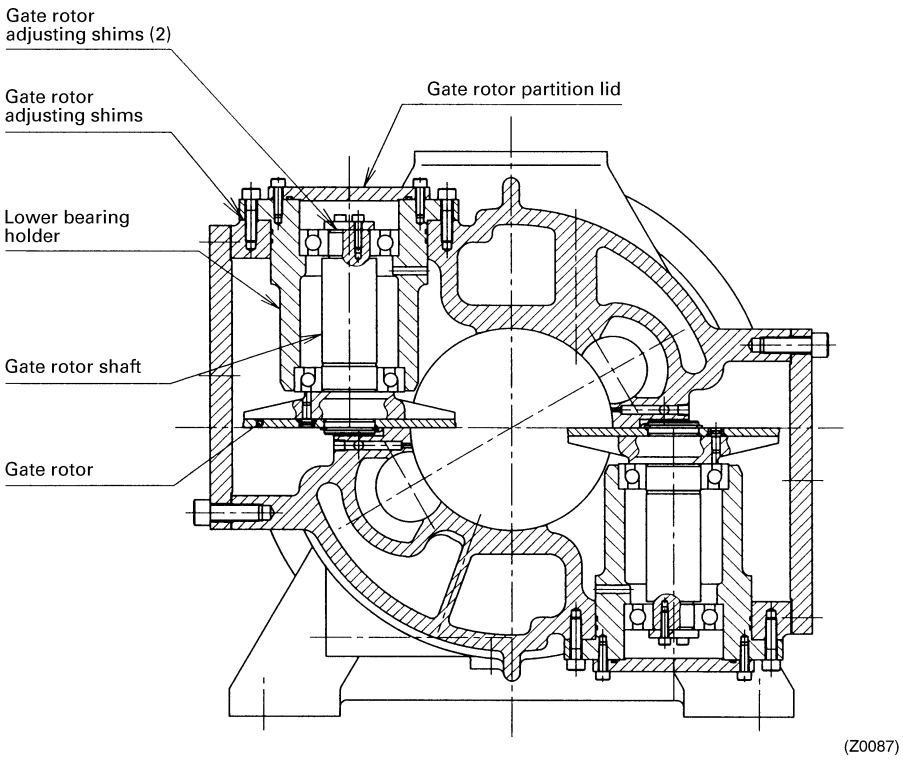
4. Disassembling The Gate Rotor and Surrounding Parts

(1) Positioning the screw rotor
Position the screw rotor so that the gate rotor can be removed without damage.
(2) Removing the gate rotor partition lid
In the ZH3F, the gate rotor partition lid is mounted together with the lower bearing holder.



(Z0086)

Fig. 4-5 Screw rotor position



(Z0087)

Fig. 4-6 Cross sectional diagram of gate rotor

(3) Removing the gate rotor bearing retainer plate
While holding the gate rotor with hand, loosen the bolts. Be careful not to lose gate rotor adjusting shims (1) mounted between the gate rotor shaft and retainer plate.
Be sure to use the original combination of gate rotor, lower bearing holder, gate rotor adjusting shims and gate rotor adjusting shims (2). (Do not exchange parts between the upper and lower sets).

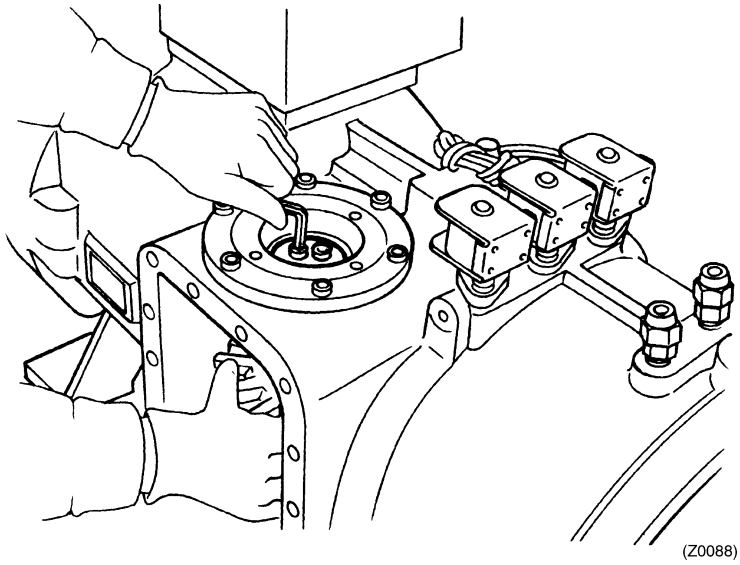


Fig. 4-7 Removing gate rotor bearing retainer plate

(4) Removing the lower bearing holder (upward and downward units)
① In the guide bolt hole, thread the bolt that was used for the lower bearing holder mounting and lift the lower bearing holder from the casing.
② Remove the shims inserted between the lower bearing holder and casing. (Do not lose the shims.)
③ The lower bearing holder and the casing are sealed with an O-ring. Therefore, the lower bearing holder is hard to be removed from the casing. To separate the lower bearing holder from the casing, insert two flat-blade screwdrivers or the like under the flanged part symmetrically as shown in Fig. 4-8 and then slowly twist the screwdrivers, or tighten the burst bolt with pad metal put to the burst bolt.

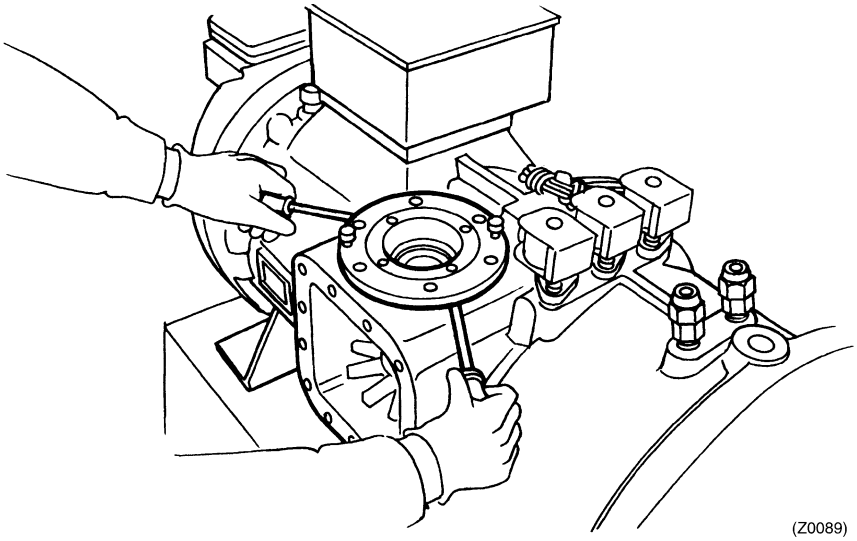


Fig. 4-8 Removing lower bearing holder

④ In the upward gate rotor, the lower bearing holder falls off when the O-ring is separated. Therefore, mount long bolts in the casing bolt holes and place a hand below the gate rotor to support it during removal operation.

(5) Turn the gate rotor shaft to remove it from the screw rotor. Be careful not to damage the gate rotor.

5. Removing and Installation of Gate Rotor

(1) Remove C type retaining ring.
(2) Remove the gate rotor from the shaft.
(3) Apply red check to the gate rotor, and check that the rotor is free of cracks.
If the rotor is found cracked, replace it with a new one.
(4) Install the gate rotor on the shaft, and mount the C-type retaining ring.
The gate rotor has front and back sides. Position the gate rotor so that the manufacturing number is visible.

6. Removing The Suction End Cover

(1) Remove all the mounting bolts.
(2) Mount guide bolts in two bolt holes on the upper section.
(Be sure to mount guide bolts, since the suction end cover is heavy.)
(3) In the guide bolt holes, thread the bolts that were removed previously, then remove the suction cover from the casing.
Locate positioning pins at two locations, and screw them.

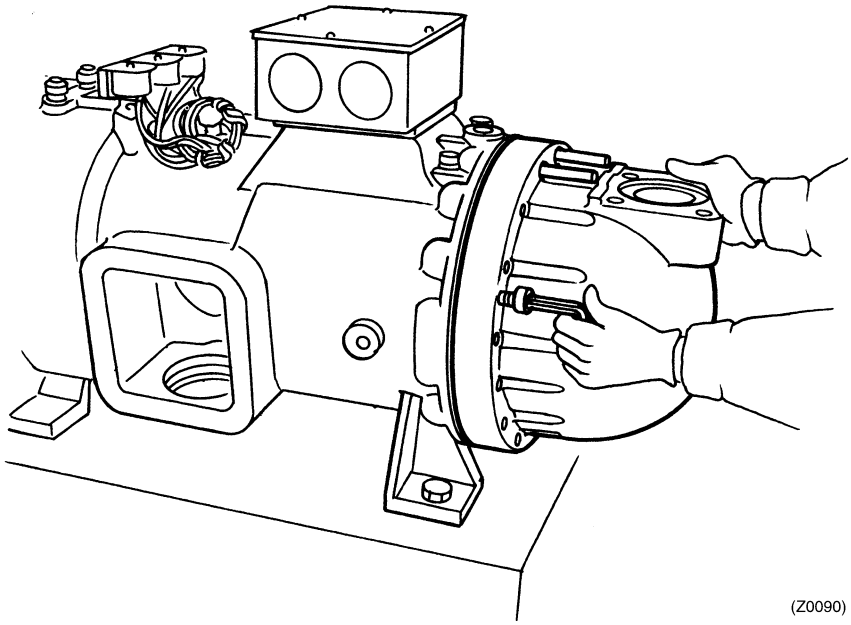


Fig. 4-9 Removing suction end cover

7. Removing The Motor Rotor

(1) Remove the rotor locking plate using a standard screwdriver.
(2) Loosen the lock nut. (Use the special tool or jig (1).)
(3) As shown in Fig. 4-11 grip rotor fins with pliers, and remove the rotor. Securely support the rotor so as not to drop the rotor. At removal, be careful not to damage the stator coil end.
(4) Remove the motor rotor key from the screw shaft.

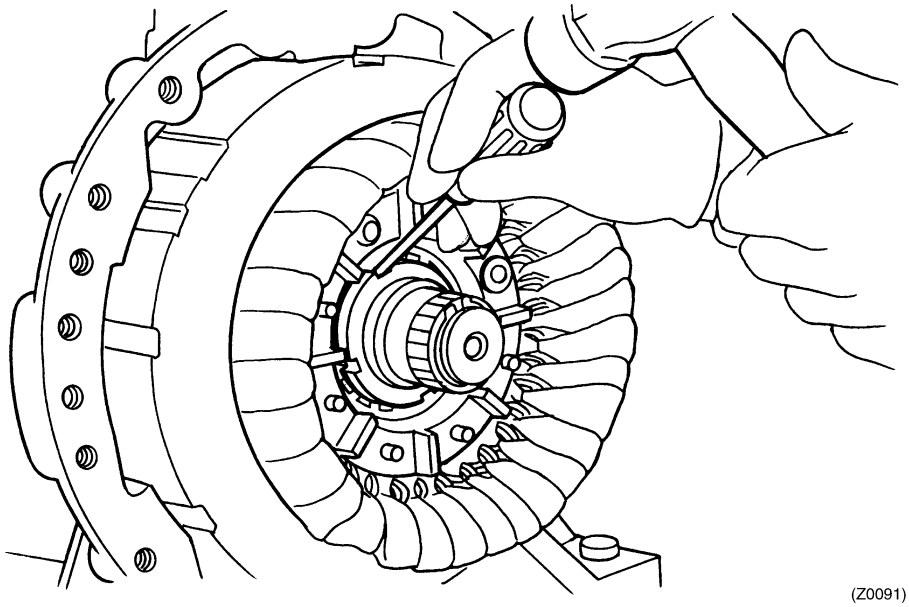


Fig. 4-10 Removing rotor locking plate

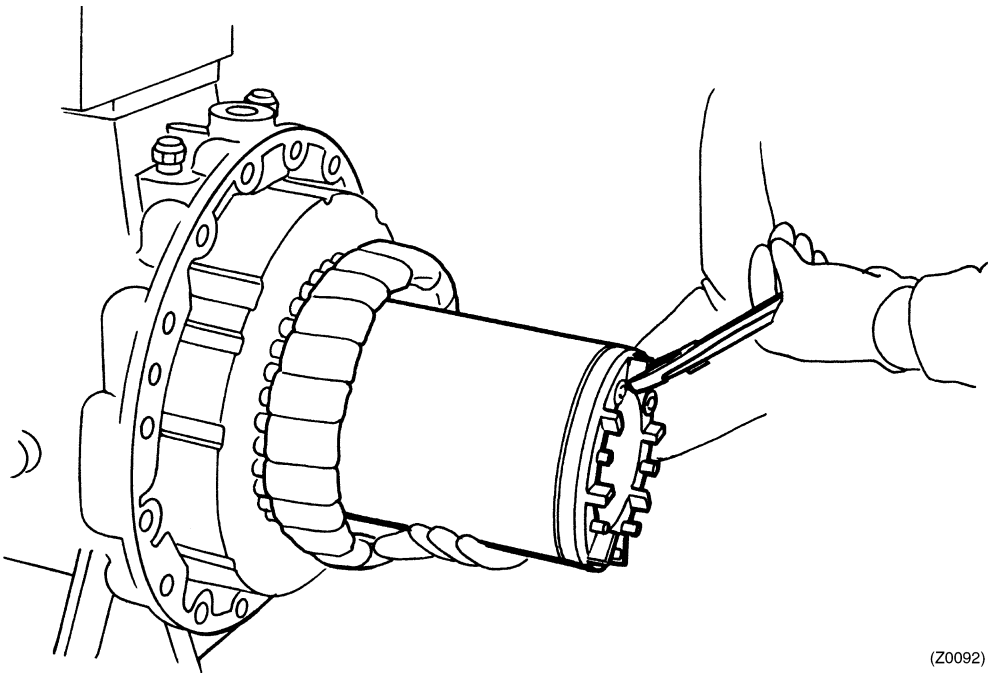


Fig. 4-11 Removing motor rotor

8. Disassembly of The Controller

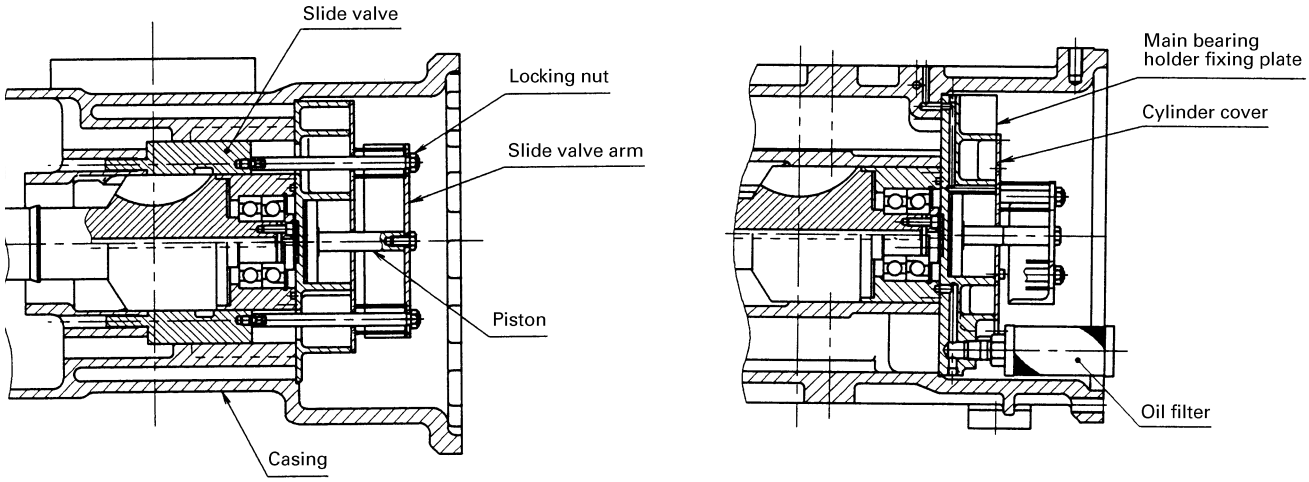


Fig. 4-12 Cross sectional diagram of controller

(1) Remove the slide valve arm.
Remove the two locking nuts of the slide valve shaft and the hexagon head bolt (or locking nut in the case of continuous capacity control unit) at the center of the arm. Since the hexagon head bolt is applied with thread lock compound, use an impact wrench or the like to loosen this bolt.

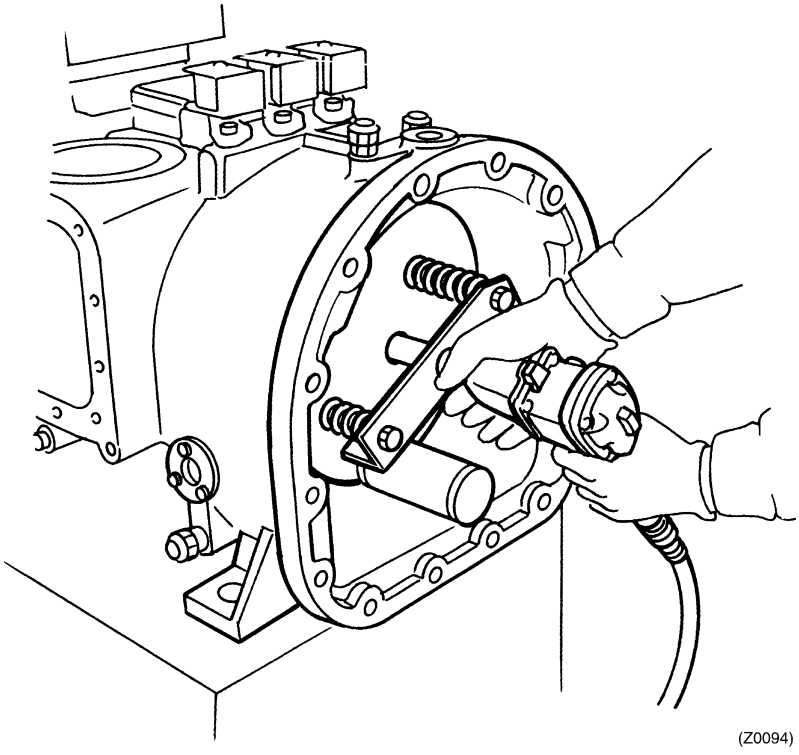


Fig. 4-13 Removing slide valve arm

(2) Remove the oil filter using the special tool, and clean. (ZH3F only)
After cleaning, dry thoroughly.
If the filter is damaged or torn, replace.

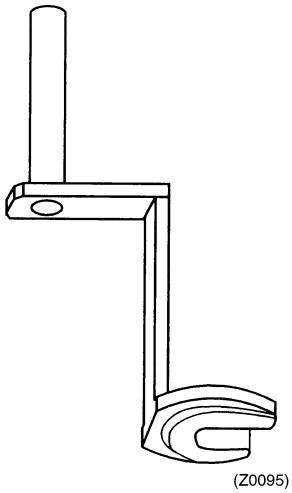


Fig. 4-14 Oil filter removing tool

(3) Remove the mounting bolts, and remove the cylinder cover.
(4) Pull out the piston.
(5) Remove the mounting bolts, and remove the main bearing holder fixing plate.
Use guide bolts when removing the fixing plate, since it is heavy.
Do not lose screw adjusting shims (1) located inside.
(6) Remove the oil filter from the fixing plate, and clean. (except for ZH3F)
After cleaning, dry thoroughly.
If the filter is damaged or torn, replace.
(7) Remove the slide valve from the casing.

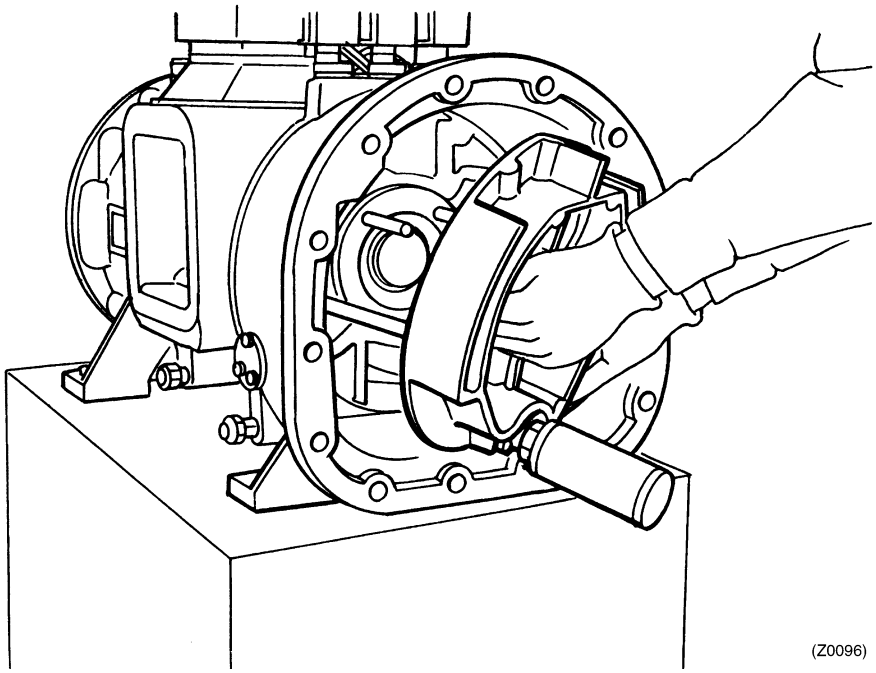


Fig. 4-15 Removing main bearing holder fixing plate

9. Removing and Disassembling The Screw Assembly Pulley

(1) Place alignment marks on the casing and main bearing holder.

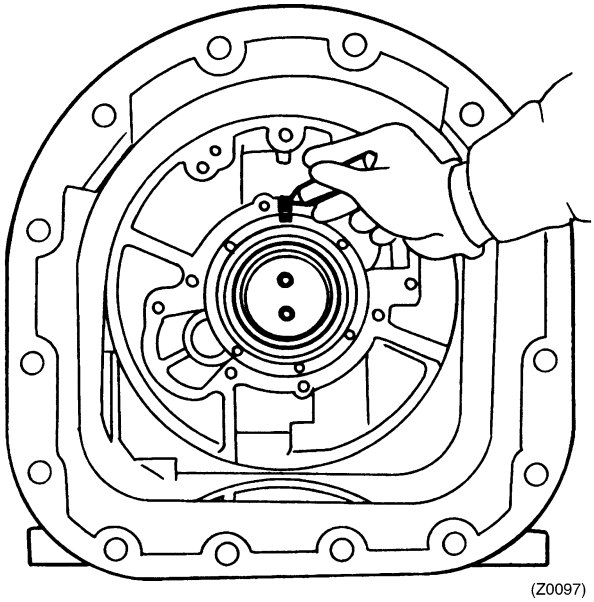


Fig. 4-16 Placing alignment marks on casing and main bearing holder

(2) Removing the screw shaft

Push the screw shaft from the suction side until the bearing holder completely extends from the discharge side. Then pull out the shaft from the discharge side. Insert one hand through the side cap hole and support the shaft to prevent the screw shaft from damaging the casing when the screw rotor section comes out of the casing. Use leather gloves during removal to prevent injuries by the screw and stator.

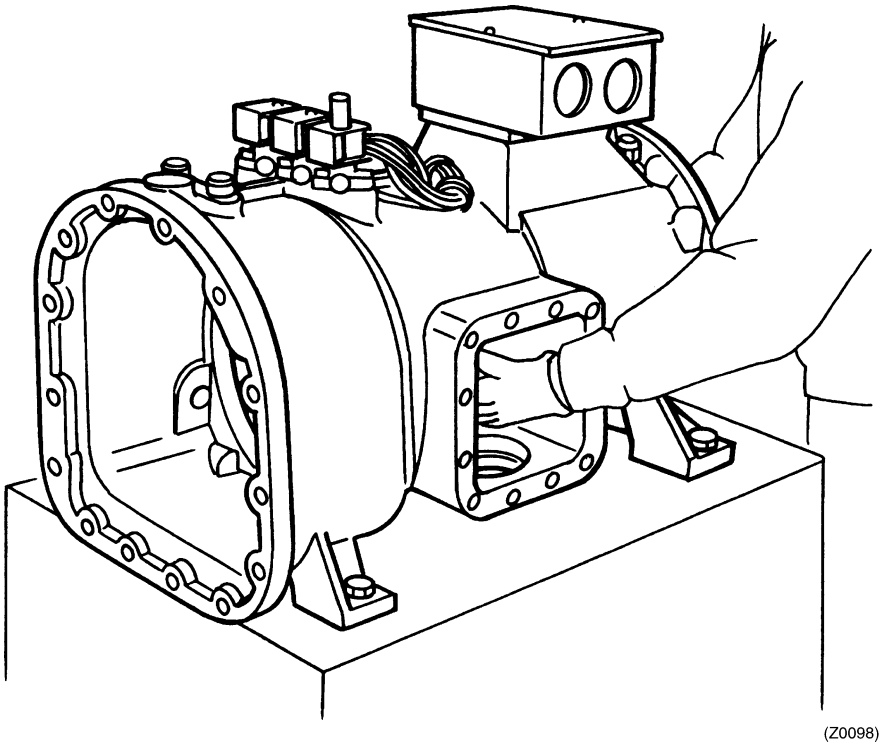


Fig. 4-17 Removing screw shaft (1)

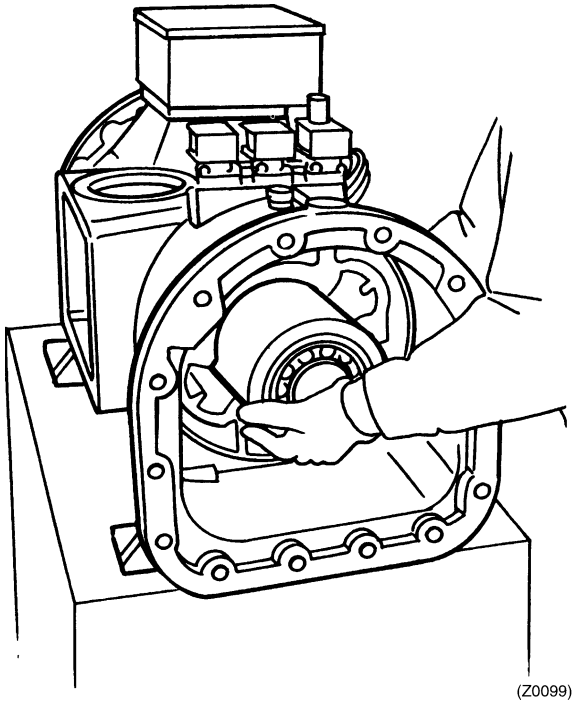


Fig. 4-18 Removing screw shaft (2)

(3) Disassembling the screw assembly
Remove the bolts, and remove the screw bearing retainer plate.
Remove the main bearing holder from the screw shaft. Do not lose screw rotor adjusting shims (2).

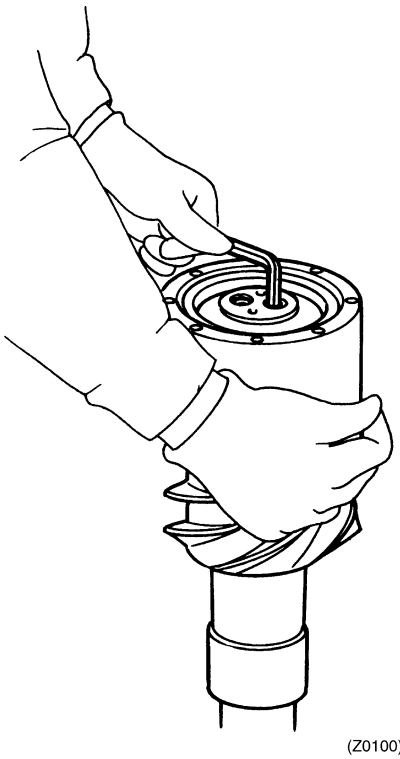


Fig. 4-19 Disassembling screw assembly

4.2 (Continuous Capacity Control Unit) Disassembly of Control Motor (Manufactured from September, 2004)

1. Check the position of the control motor

Check that the control motor is in its 100% position. (If this motor is not in the 100% position, it cannot be disassembled.) The following section shows the checking method.

The position of the control motor can be checked on the opening degree indication plate or according to the position of brass block provided on the side of the motor.

Type of compressor	Representative type of control motor	Position of brass block at 100%
ZH3G, 5G	VM30A	Around the upper limit
ZH7G, 9G	VM30AZ	Around the lower limit

■ Should the control motor not be in its 100% position, charge a rated voltage of the control motor through each pin, as shown in Table below. (Reference: It takes approximately two minutes for the motor to move from 0% to 100%. The motor stops at 0% or 100% via a micro switch.)

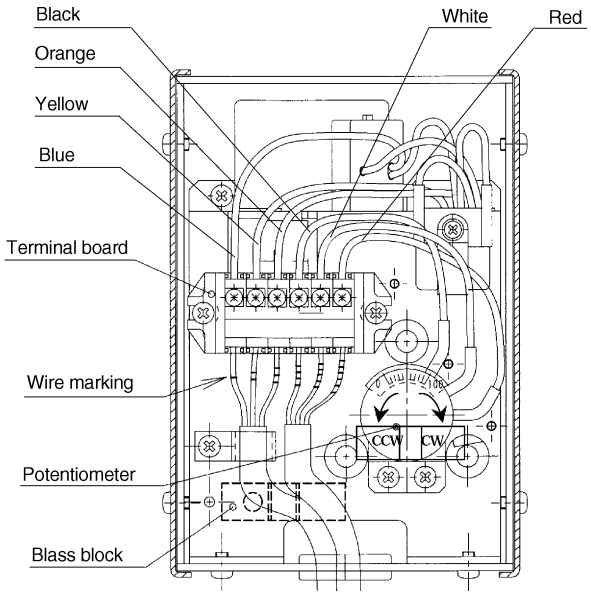
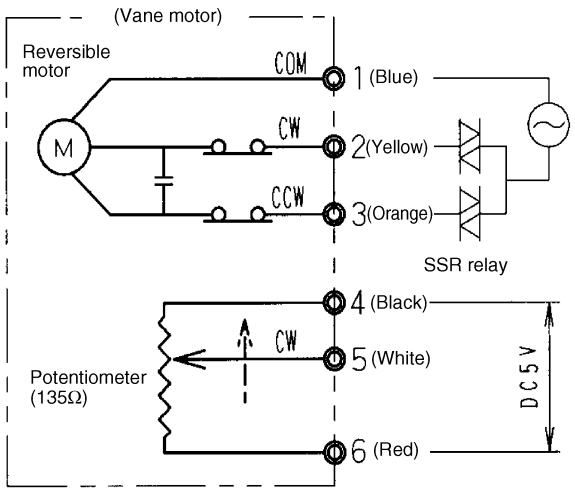


Fig. 4-20 Top view of control motor (with potentiometer)

Type of compressor	Representative type of control motor	Apply 200V to terminals shown below
ZH3G, 5G	VM30A(P)	Blue to yellow
ZH7G, 9G	VM30A(P)Z	Blue to orange

Note: In order to disconnect wires from the control board, be sure to provide marking on the wire.

[Wiring diagram] (Example: Equipped with potentiometer)



[Output characteristics (on VM30AP)]

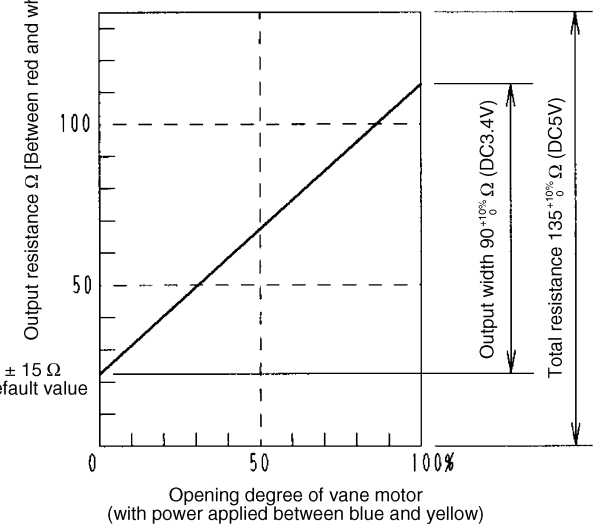


Fig. 4-21 Wiring diagram of control motor

2. Separating control motor from drive shaft

As shown in figure left, loosen the hexagon socket head setscrews (in two places) on the side of the control motor. Since the thread lock compound "Loctite" is applied to the threaded part, screw tightening force becomes stronger. Therefore, use POWER BIT to loosen the setscrews.

3. Disassembling control motor and insulation material

Remove the fixing bolts from the main unit of the control motor, and then pull out the main unit and insulation material.

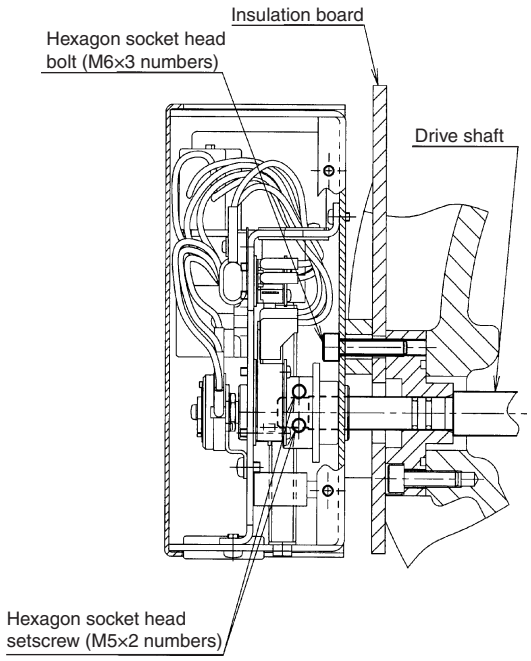


Fig. 4-22 Section view of control motor

4. Provide match marks on the drive shaft.

Provide match marks on the brass bushing and the drive shaft respectively, so that the position of the drive shaft (100% position) is identified.

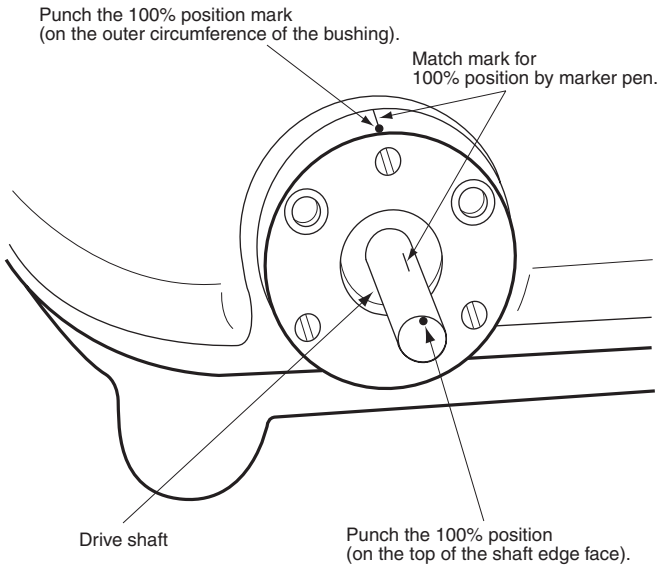


Fig. 4-23 Match marks on drive shaft

4.3 Replacing The Bearing

Unlike slide bearings, roller bearings have limited service life. They must be replaced regularly. To prevent accidents caused by worn roller bearings, replace all roller bearings during an overhaul.

4.3.1 Removing Bearings

1. Main Shaft Bearing

(1) Suction end cover (outer ring of cylindrical roller bearing)
① Remove the C-type retaining ring.
② Remove the outer ring of the bearing.
Use an ordinary bearing remover or special jig (2) to remove the outer ring.

(2) Screw shaft (inner ring of cylindrical roller bearing)
① Remove the C-type retaining ring.
② Remove the inner ring of the bearing by using a chisel.
Be careful not to scratch the screw shaft. If the screw shaft is accidentally scratched, remove burrs by grinding the irregular surface.

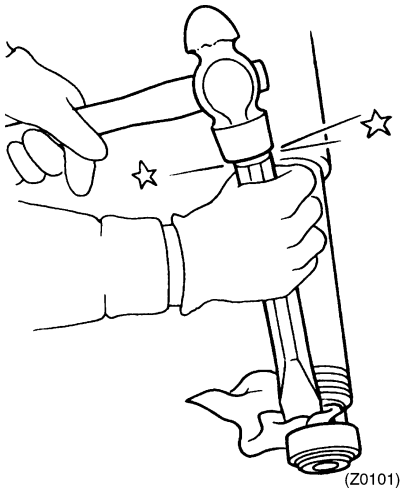


Fig. 4-24 Removing inner ring of screw shaft bearing

(3) Main bearing holder (angular-contact ball bearing, deep groove ball bearing)
① Removing the beveled C-type retainer ring
The beveled C-type retainer is securely installed in the groove to keep the bearing in place. For easy removal, first pry the end section of the C-type retainer ring toward inside using snap-ring pliers.

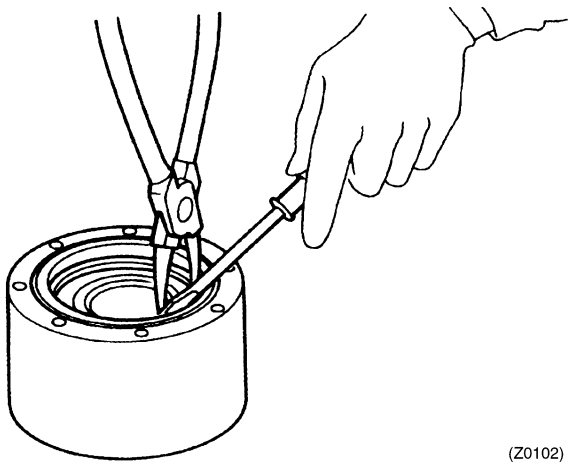


Fig. 4-25 Removing C-type retainer ring

② Removing the bearing
From the opposite side of the end with the C-type retainer ring, remove the outer ring of the bearing by placing a bronze rod and hammering it. Since the outer ring is not pressed in deeply, it can be removed easily.

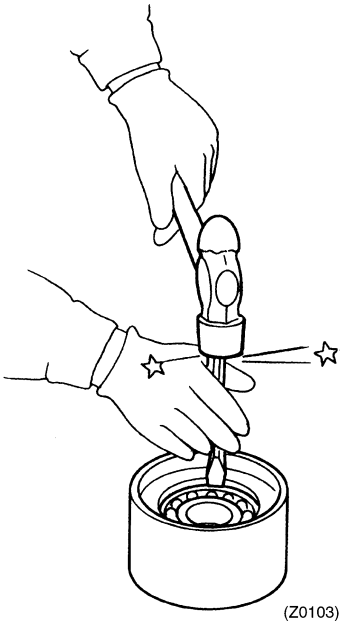


Fig. 4-26 Removing main bearing holder bearing

2. Gate Rotor Bearings (Angular-Contact Ball Bearing, Deep Groove Ball Bearing)
Remove the angular-contact ball bearing and deep groove ball bearing from the lower bearing holder by using a bronze rod and hammer.

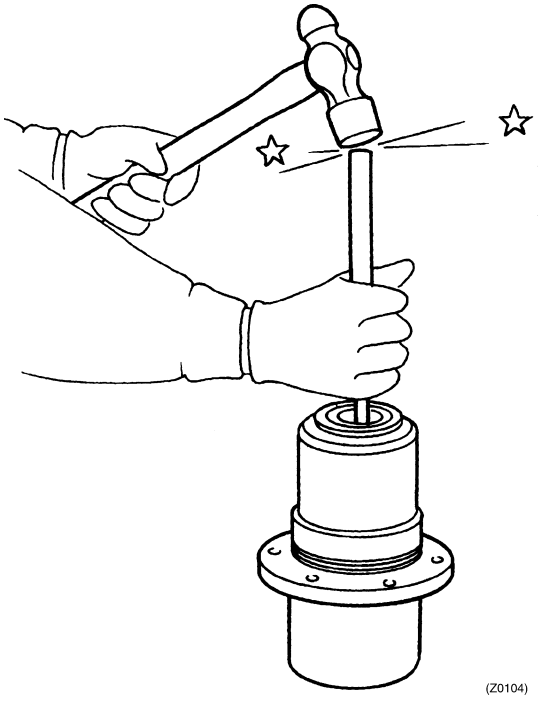


Fig. 4-27 Removing lower bearing holder bearing

4.3.2 Installation of Bearings

Before installing the bearings, clean the bearing holder and suction end cover.

Caution It can be presumed that condensate is produced around the bearing after it is cooled down to -50°C or less with dry ice or the like. Therefore, after inserting the bearing in the housing, heat it up with a drier to remove the moisture.

1. Main Shaft Bearing

(1) Suction end cover (outer ring of cylindrical roller bearing)
Cool the outer ring of the cylindrical roller bearing down to -50°C or less with dry ice or the like. Be sure to insert the bearing to the contact surface. After the bearing is inserted, fix it with a C-type retainer ring.

(2) Screw shaft (inner ring of cylindrical roller bearing)
Heat the inner ring of the bearing (120°C max.), and insert the tip of the screw shaft. After the shaft is inserted, place a plate and hammer the shaft all the way. Then, mount the C-type retainer ring.

(3) Main bearing holder (angular-contact ball bearing, deep groove ball bearing)
Insert the bearings into the main bearing holder. Since fitting is tight, cool the bearings to a temperature of -50°C or lower using dry ice. After inserting the bearings, mount the beveled C-type retainer ring.

- Be sure to install the bearings in the correct direction.
- The beveled C-type retainer is tapered. After installation, hammer it into the groove.

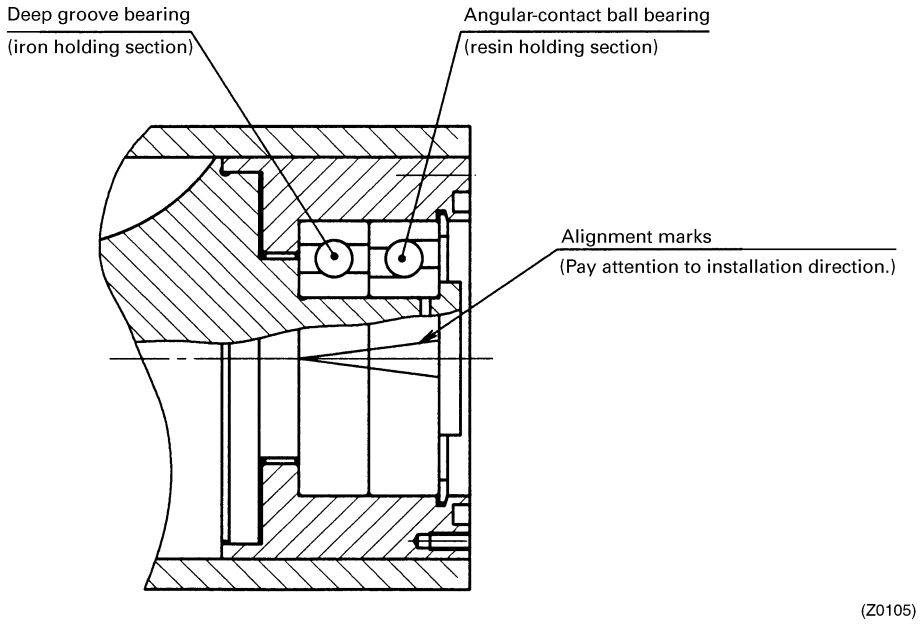


Fig. 4-28 Direction of bearings

2. Installing and Adjusting The Gate Rotor Bearings

(1) Installing the bearings
Cool the angular-contact ball bearing and the deep groove ball bearing down to -50°C or less with dry ice or the like. Be sure to insert the bearing to the contact surface. Furthermore, be sure to install the angular-contact bearing in the correct direction.

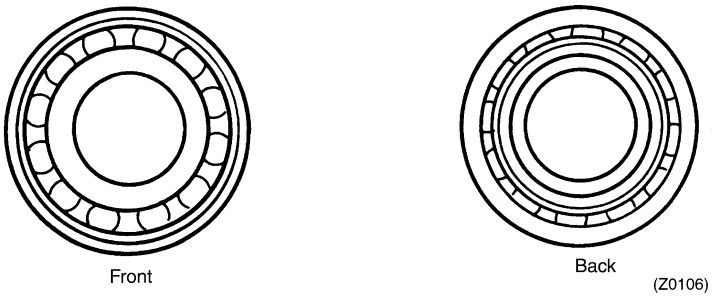


Fig. 4-29 Front and back sides of angular-contact ball bearing

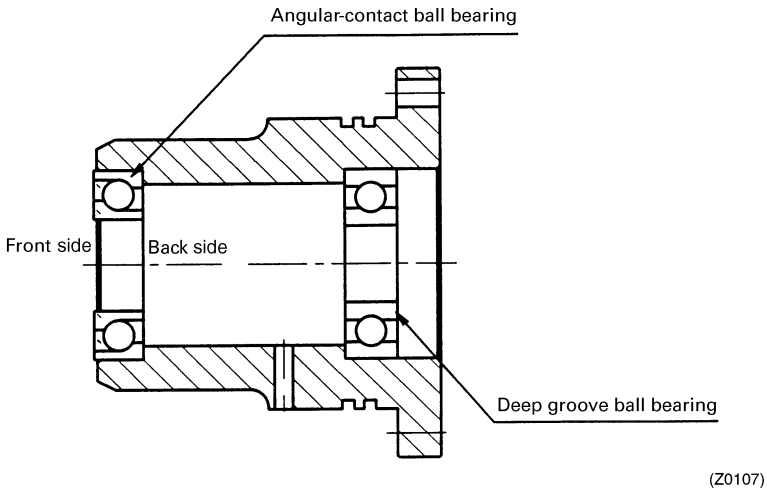


Fig. 4-30 Direction of bearings

(2) Adjusting the preload (temporary assembly)
Install the gate rotor shaft in the lower bearing holders mounted with the bearings, and check the preload of the bearings.

① Insert the gate rotor shaft into the bearings.
② Install gate rotor shims (2) and the gate rotor bearing retainer plate, and tighten the bolts to the specified torque.
③ Turn the gate rotor with full force by hand. At this time, it is desirable that the gate rotor stops after it makes one or two rotation. If the gate rotor does not rotate smoothly or the bearing produces a rolling sound, make adjustment of the shims in the following manner.
   a) When rolling sound is produced
      Reduce the thickness of the gate rotor adjusting shims, and check again.
   b) When gate rotor does not rotate smoothly
      Increase the thickness of the gate rotor adjusting shims, and check again.
④ After adjustment, disassembly.
   During disassembly, separate the shims, lower bearings and gate rotor shafts according to their installation locations (upward and downward units) so that they can be reinstalled in the original positions.

4.4 Replacement of O-ring of Drive Shaft Bushing (Continuous Capacity Control Unit)

1. Disassembling bushing

Remove the fixing bolt from the bushing and slightly pull out the bushing as it is mounted onto the drive shaft. Then, remove the bushing as shown in Fig. 4-31 below.

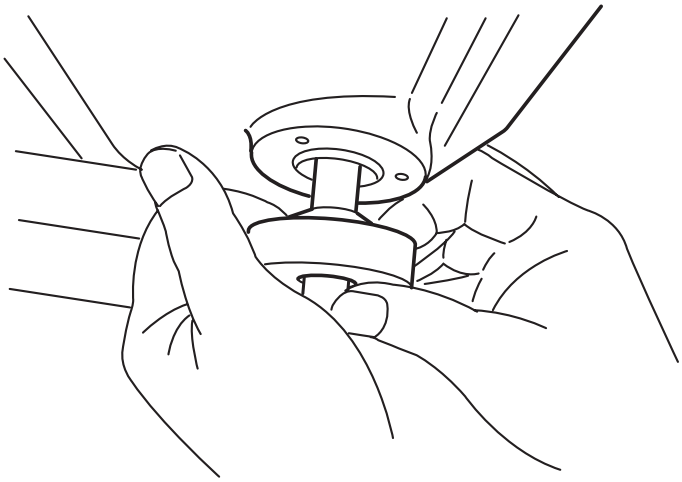


Fig. 4-31 Removing bushing

2. Replacing O-ring and reassembling bushing

Replace the O-ring of the drive shaft bushing and then apply grease (Shell Alvania Grease S(RL) No. 2) to the O-ring and also to the inside of the bushing as shown in Fig. 4-32 below. After that, put the drive shaft in the discharge end cover, and finally reassemble the bushing. Furthermore, if the bushing has any flaw or abnormal wear inside (grease applied part), replace the bushing.

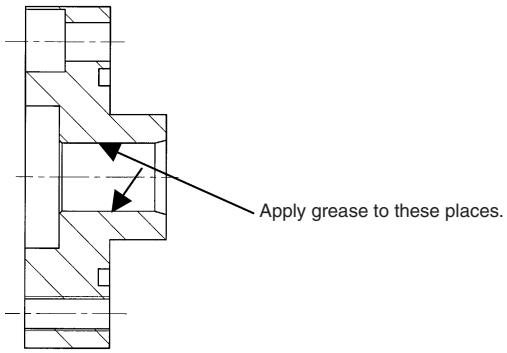


Fig. 4-32 Sectional view of bushing

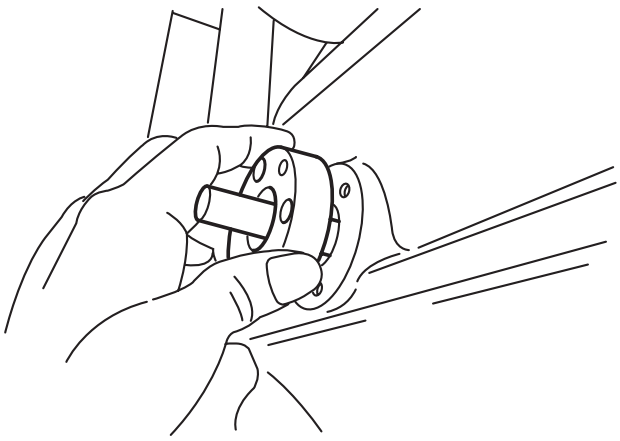


Fig. 4-33 Reassembling of bushing

4.5 Final Assembly

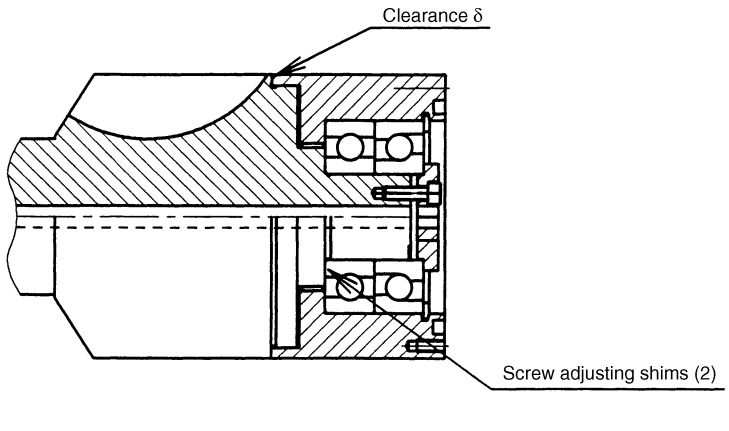
Caution

- Clean the casing and all other parts, and dry them thoroughly.
- Use new packings and O-rings.

1. Assembling The Screw Shaft and Main Bearing Holder

Install screw adjusting shims (2) and the main bearing holder on the screw shaft, and install the screw bearing retainer plate. Tighten the two bearing retainer plate mounting bolts evenly.

Adjust clearance δ between 0.03 and 0.05 mm(except ZH9), 0.04~0.06mm(ZH9 only), as shown below. (Minimum clearance on periphery)



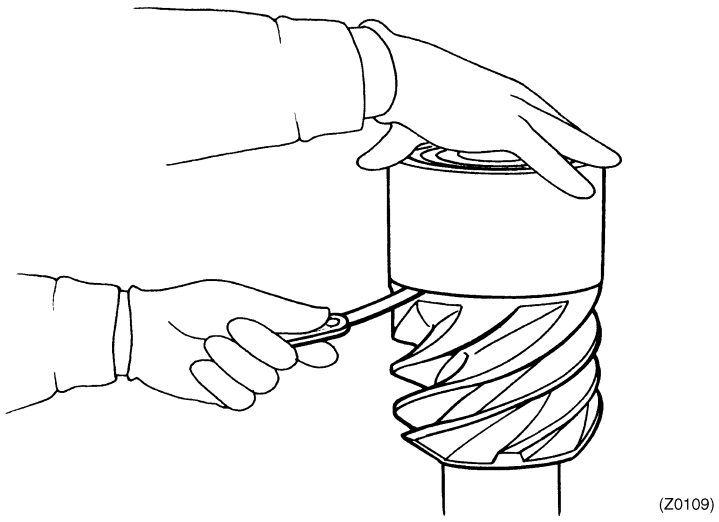


Fig. 4-34 Adjusting clearance between screw rotor and main bearing holder

2. Inserting The Screw Shaft

Insert the screw shaft into the casing until the end face of the main bearing holder makes approximately full contact with that of the casing (i.e., the mounting surface of fixing plate of the main bearing holder).
For this process, wear leather gloves to prevent hand injuries. (Do not use fabric work gloves.)
The screw shaft is heavy, and the main bearing holder rotates, making it difficult to hold it.
Be careful not to drop the screw shaft during installation.

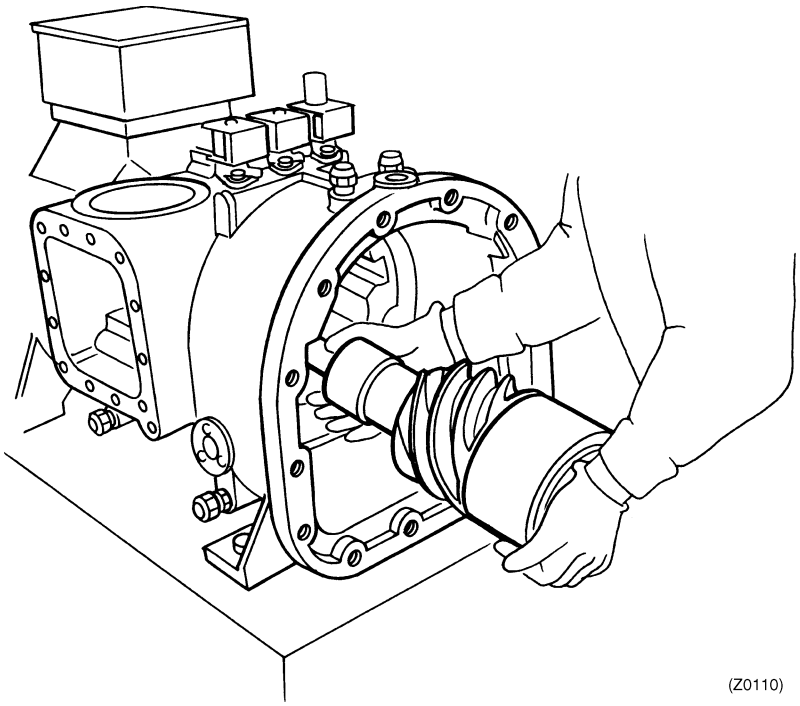


Fig. 4-35 Inserting screw shaft

3. Positioning screw rotor

Mount the jig (3) onto the main bearing holder and casing. In order to make adjustment of the direction and position of the screw rotor shaft, put the screw adjusting shims (1) between the jig and the main bearing holder, by the same height as that at the disassembly.

4. Installing The Motor Rotor

(1) Mount the jig (3) onto the main bearing holder and casing.
(2) Insert the motor rotor key into the screw shaft from the suction side, and insert the motor rotor.
Insert the motor rotor in the direction shown below.

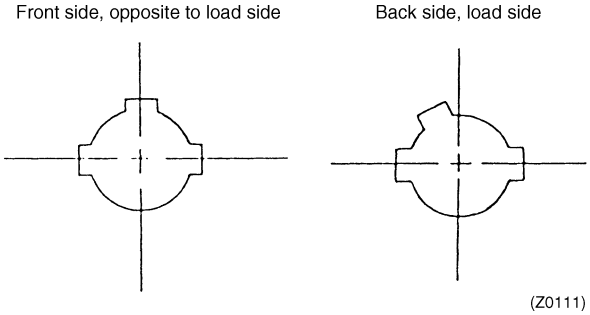


Fig. 4-36 Motor rotor inserting direction

(3) Tighten the lock nut, and bend the tab on the lock washer to prevent the lock nut from loosening.

5. Installing The Suction End Cover

(1) Install the suction end cover. In this step, use the two positioning pins to position the suction end cover. (Use guide bolts.)

(2) Insert the screw shaft into the bearing of the suction end cover.
The holding section of the cylindrical roller bearing is made of plastic. Since the retainer can easily break if a shock is given to it, be careful to insert it.

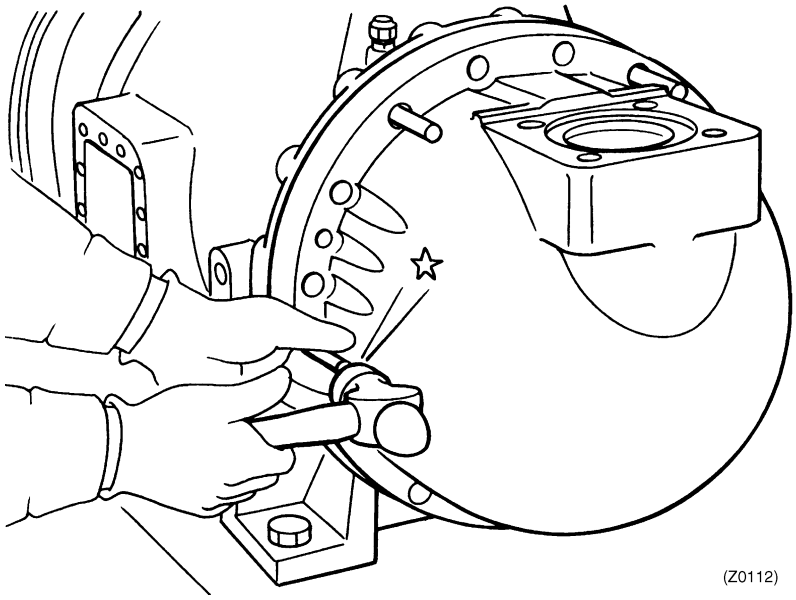


Fig. 4-37 Installing suction end cover

(3) Rotate the screw rotor to make sure it moves smoothly.

6. Installing The Gate Rotor and Adjusting The Slit Clearance

(1) Install the O-rings on the lower bearing holder. (ZH_F : two O-rings)
(ZH_G : three O-rings (two kinds)···Confirm the installing position on spare parts list.)
(2) Set the screw rotor in the position indicated in Fig. 4-5, and engage the screw rotor with the gate rotor.
(3) Apply oil on the O-rings of the lower bearing holder, and install the lower bearing holder in the casing.
① After the lower bearing holder is inserted to the O-ring section, use the mounting bolt holes to press the lower bearing holder into the casing.
(Use bolts longer by 5 to 20 mm than the mounting bolts. Using the mounting bolts may damage the threads since they are too short for this process.)
② Before the casing and the flange of the lower bearing holder contact, insert shims, and tighten securely.
(4) Install the gate rotor bearing retainer plate.
(To prevent the gate rotor from rotating, hold the gate rotor by hand while tightening.)
(5) Measure the slit clearance (gap between the gate rotor and casing) with a clearance gauge. With the clearance gauge hooked on the gate rotor, insert jig (4) into the screw bearing retainer plate. Rotate the screw rotor, and insert the gauge in the slit.
① Standard value: 0.06 to 0.09 mm
② If the measured clearance deviates from the standard value, adjust the thickness of the gate rotor adjusting shims.
(To increase the clearance, add shims.)
After making adjustment of the clearance, rotate the screw rotor with the jig (4) to make sure it rotates smoothly.
(6) Mount a O-ring (ZH_G: Packing) on the bottom cover of the lower bearing holder, and then install the bottom cover of the lower bearing holder.
(7) Following the steps (1) through (6), assemble the gate rotor on the opposite side as well.
(8) Install the side cap.

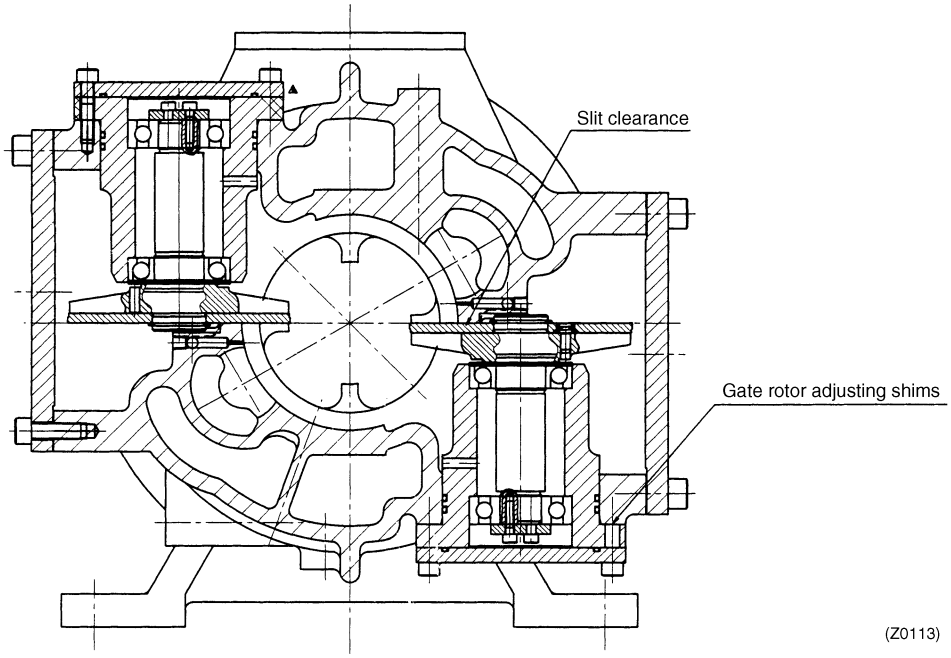


Fig. 4-38 Adjusting slit clearance

7. Installing The Main Bearing Holder Fixing Plate, Assembling The Controller, and Installing The Oil Filter

(1) Insert the slide valve into the casing.
- In the right hole, insert the slide valve with "2" stamped on the end surface.
- Make sure the slide valve operates smoothly.

(2) Mount the oil filter on the fixing plate. (except for ZH3F)

(3) Remove jig (2), then install the fixing plate. During this step, insert guide bolts in the main bearing holder, and place the screw adjusting shims between the main bearing holder and fixing plate.

(4) Insert the piston in the fixing plate

(In case of ZH_F)

(5) Place the cylinder cover. Extend the piston until it contacts the cylinder cover, then tighten the four bolts around the cylinder. (After tightening bolts, make sure the piston moves smoothly.)

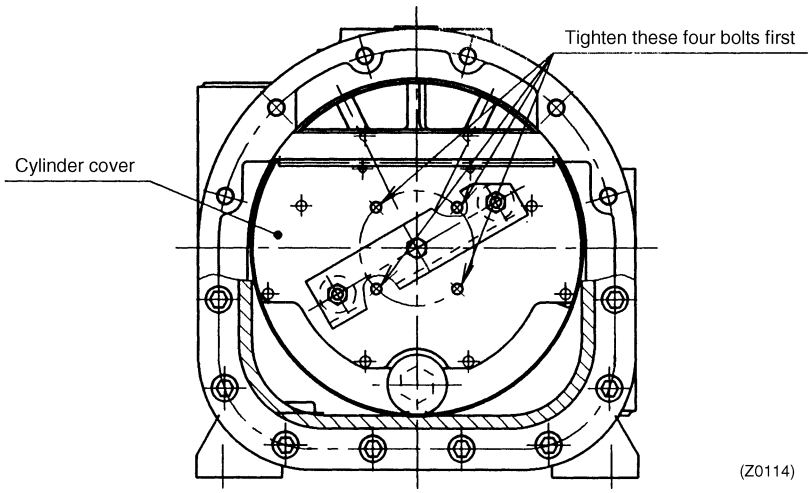


Fig. 4-39 Adjusting piston and installing cylinder cover

(6) Tighten the other mounting bolts of the cylinder cover.

(In case of ZH_G)

(5), (6) place the cylinder cover. Extend the piston until it contacts the cylinder cover, then tighten the bolts. (After tightening the bolts, make sure the piston moves smoothly.)

(7) Install the oil filter using jig (5). (for ZH3F only)

(8) Pull the slide valve forward, then hook the slide valve spring on the slide valve shaft. (upward and downward units)

(9) Install the slide valve arm with the locking nut (slide valve) and hexagon head bolt (or locking nut in the case of continuous capacity control unit) (piston). At this time, apply thread lock compound (e.g. Loctite No. 262) to the hexagon head bolt, and use a new locking nut.

8. Installing The Discharge End Cover (In case of ZH9F, Oil collector)

Since the discharge end cover is heavy, be sure to use guide bolts.

<Step capacity control unit>

Insert the first demister (except ZH9F) in the cylinder cover (main cylinder bearing holder fixing plate in the case of Type G), and install the discharge end cover.

<Continuous capacity control unit>

(1) Before installing the discharge end cover, check to be sure the joint (arm) of the drive shaft and the pilot valve is located above the drive shaft.

(2) Install the lever (dedicated jig (6)) to the end face of the drive shaft (outside of the discharge end cover) with a M8 hexagon head bolt, in the same direction as that of the arm. (See Fig. 4-41.)

(3) Insert the first demister in the fixing plate of the main bearing holder, and then, while inserting the pilot valve in the piston, install the discharge end cover. (If the arm is located below the drive shaft, the pilot valve will be damaged when conducting the next step 9). Therefore, pay attention to this point.)

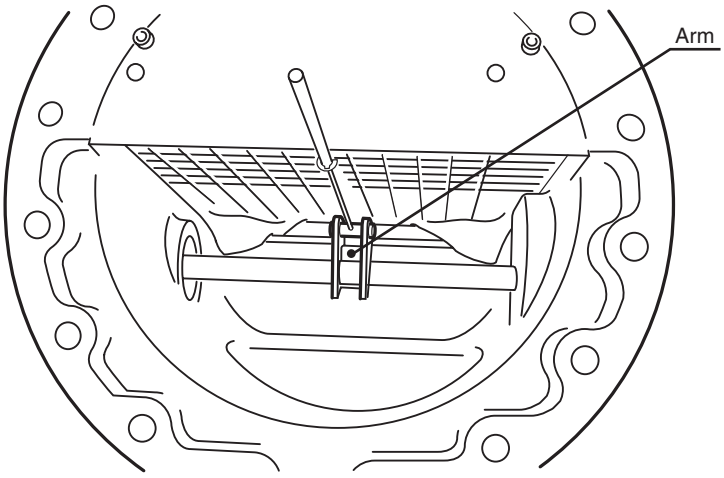


Fig. 4-40 Arm position

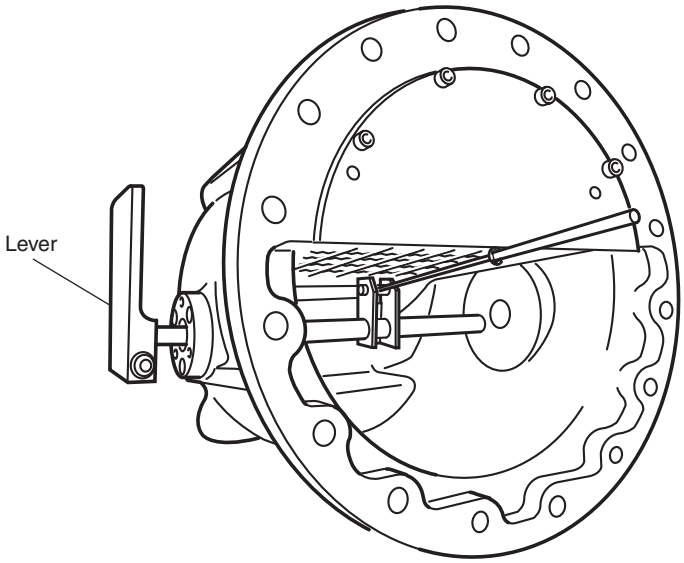


Fig. 4-41 Installing lever

9. <Continuous capacity control unit> Installation of control motor (Manufactured from September, 2004)

(1) Preparation

① Rotate the control motor in the direction shown in figure below (subject to models) until it lightly hits the end of rotation and then mark this hit point on the drive shaft and bushing. (Refer Fig. 4-23)
(This light hit point means a place where the Type E retainer ring of the pilot valve makes contact with the end face of the piston shaft. At this time, the slide valve, piston, etc., are located on the minimum load side.)

Caution

When the drive shaft makes contact with the end of rotation, do not rotate it further. Furthermore, do not rotate the drive shaft by 60 degrees or more in the counter-rotation direction.

② In order not to rotate the drive shaft, remove the lever.

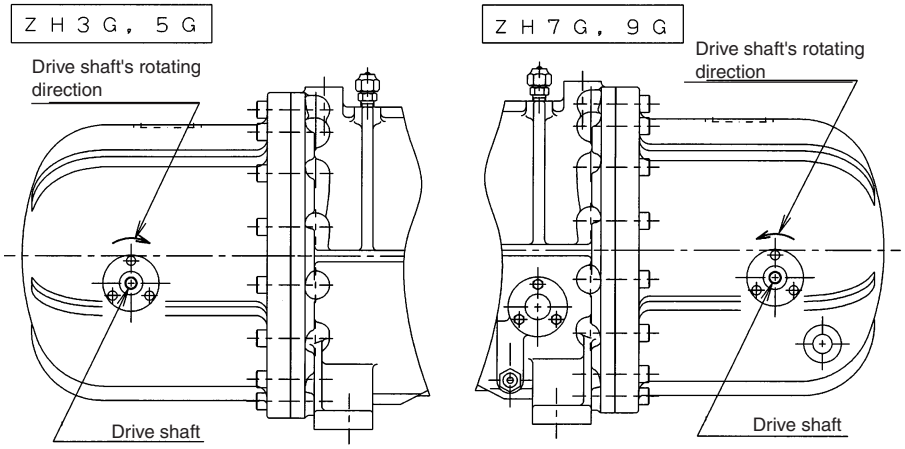


Fig. 4-42 Rotating direction

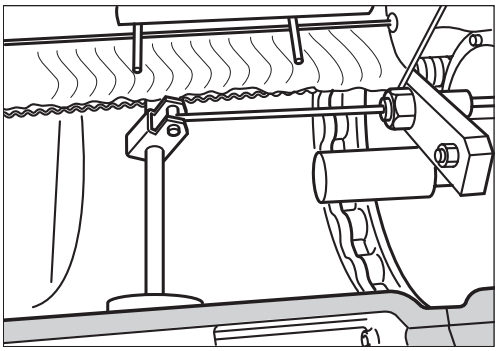
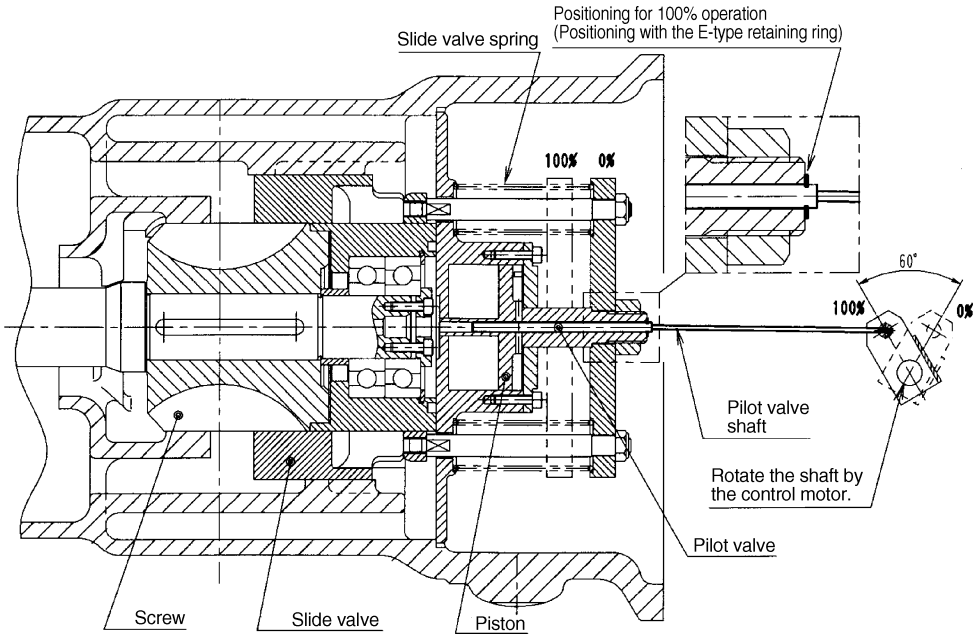


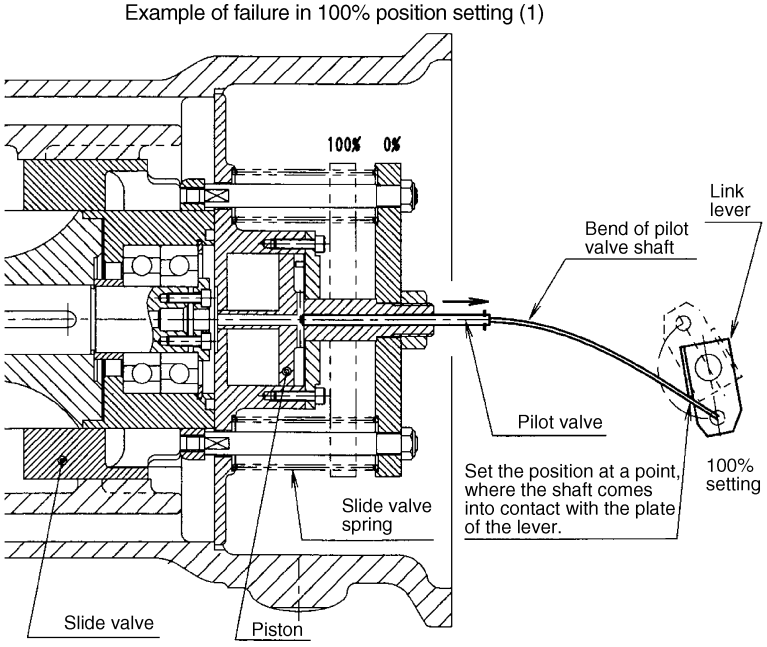
Fig. 4-43 State of ② above (on cut model)

Caution: Be noted that rotating the drive shaft too tightly makes the internal linkage shifted. This may cause damage to the parts or set off a malfunction alarm when operating.



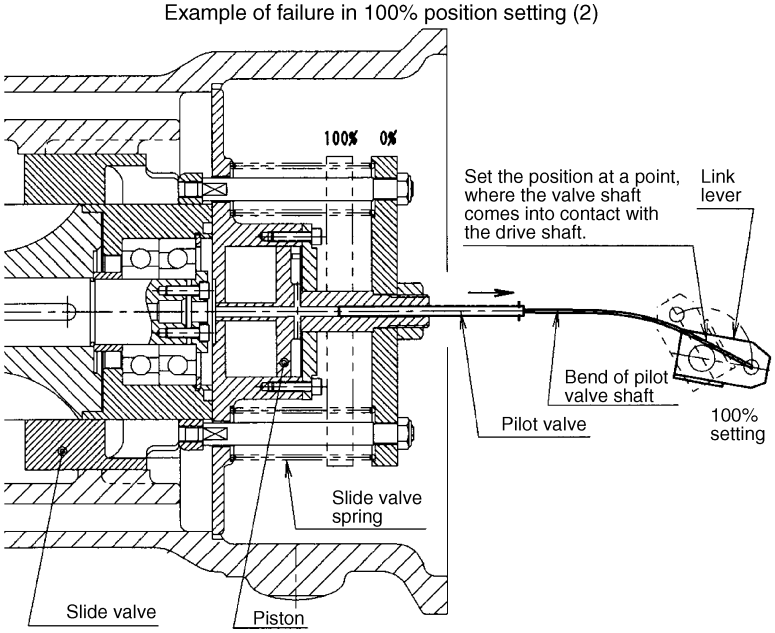
While the compressor is in stop mode (i.e. in 0% position), set the position of the shaft (to 100% position) at a point, where retaining ring of the pilot valve hits the end of the piston, and then mount the control motor (in 100% state).

Fig. 4-44 Procedure for setting of 100% position (in normal operation)



If the shaft is further rotated tightly beyond the 100% set position, the shaft of the pilot valve will sink in the lower part. If the opening degree of the control motor becomes 0% under these conditions, the pilot valve will reach the high load position, thus resulting in a malfunction or disabling the capacity control due to the high-load start up.

Example of failure in 100% position setting (2)



If the control motor is mounted in the counter rotation direction, the pilot valve will exceeds the 0% position further down to the low load side. Consequently, even if a signal is output to the high load side of the opening of the control motor, the pilot valve will not exceed the 0% position, thus resulting in faulty capacity control (faulty load-up) of the compressor.

Fig. 4-45 Examples for failure of 100% position setting (In malfunction)

(2) Installation

① Replace to a new control motor. (In accordance with information in Section 4-2.(1), check to be sure that the control motor is in its 100% position. If it is not in the 100% position, follow information in Section 4-2.(1), charging a voltage through the control motor.)

② Put insulation material in place first, and then insert the control motor in the drive shaft. After that, install it onto the discharge end cover via the insulation material. (See Fig. 4-22.)

③ Apply a thread lock compound (e.g. Loctite No. 222) to the locking screw and then tighten the screw onto the drive shaft. (See Fig. 4-22.)

5. Airtightness Test

Using dry air mixed with refrigerant, pressurize to 𝔸. Then, use a gas detector (or soap water) to check for leaks. Apply soap water on the side caps and other cover mounting sections to make sure no air bubbles are formed. If air bubbles are formed, release the pressure, then re-tighten the bolts. If the leak does not stop, check the packing seating surfaces and replace the packing.

refrigerant type	𝔸
R22	2.8MPa(28bar)
R134a	2.0MPa(20bar)
R407c	2.98MPa(29.8bar)

6. Charging Oil

Part of oil may remain in the refrigerating system. Therefore, charge the same amount of oil removed from the compressor during disassembly. When a new gate rotor is installed, pour about a half of the total oil capacity to the suction side to prevent excessive heating during initial operation.

7. Caution in Test Operation

1) Check to make sure all bolts are tightened.
2) Check the wiring for proper connection.
3) Conduct inching.
   ① Check the rotating direction using high and low pressure gauges.
   (If the rotating direction is correct, the low pressure gauge indicates decreasing and the high pressure gauge shows rising pressure.)
   ② Check that no abnormal noise is generated.
4) Since moisture enters at the time of overhaul, it is recommended to use a drier for test operation.

8. Required Tools

1. General Tools and Measuring Instruments

Table 8-1 List of general tools and measuring instruments

		Name	Specification (size)	Application
Tools	1	Hex-key wrenches	M5, M6, M8, M10, M12, M16	
	2	Torque wrench		Refer table 8-2
	3	POWER BIT	VESSEL A16 of 2.5-mm opposite side and 65-mm total length or equal (It is better to have an opposite side of shorter than 2.5 mm in length.)	For installation or disassembly of control motor
	4	Torque wrench		
	5	C-type retainer ring removing tools	For holes (large, small) and shafts	Gate rotor and bearing holders
	6	Guide bolts	M6, M8, M10, M12, M16	Fixing plate and cover installation
	7	Other general tools	Adjustable end wrench, spanners, pliers, screwdrivers, hammer, plastic hammer, T-shape wrenches, chisel	
Measuring instruments	8	Megger taster	500-V megger	
	9	Depth gauge	Dial type (minimum scale division: 0.01 mm)	Screw shims (1)
	10	Thickness gauges	0.03 to 0.10 mm	Clearance between main bearing holder and screw and slit clearance
	11	Dial gauge	Minimum scale division: 0.01 mm, stroke: 10 mm	For measuring Backlash
Others	12	Drier	Output: Approx. 1000 W	For removing moisture from bearing
	13	Wire and plug	Class 200 V, 40 mA	For rotating control motor
	14	Grease	Shell Alvania Grease S No. 2 … Inside Japan Shell Alvania Grease RL No. 2 … Outside Japan	For continuous capacity control unit

Table 8-2. List of tightening torque for bolts and nuts (N - m)

Nominal bolt/nut size	Terminal nut	Locking nut	5T	Class 12.9
M5	4.2	—	3.0	11.6
M6	—	—	5.2	14.0
M8	—	—	12.3	34.0
M10	16.7	25.2	25.2	68.0
M12	26.5	—	42.7	118
M16	—	—	103	293
M20	—	26	202	570
M24	—	—	348	—

Notes:

1. Indicate metric coarse threads and standard bolts (5T, 12.9).
2. Tolerances on tightening torque are ±15%.
   However, the tolerance on tightening torque at terminal block is ±5%.
3. When tightening hexagon socket head cap screws in the compressor, apply specifications for class 12.9.
4. The tightening torque of hexagon socket head screw used for control motor is to be 3.5N-m ±15%.

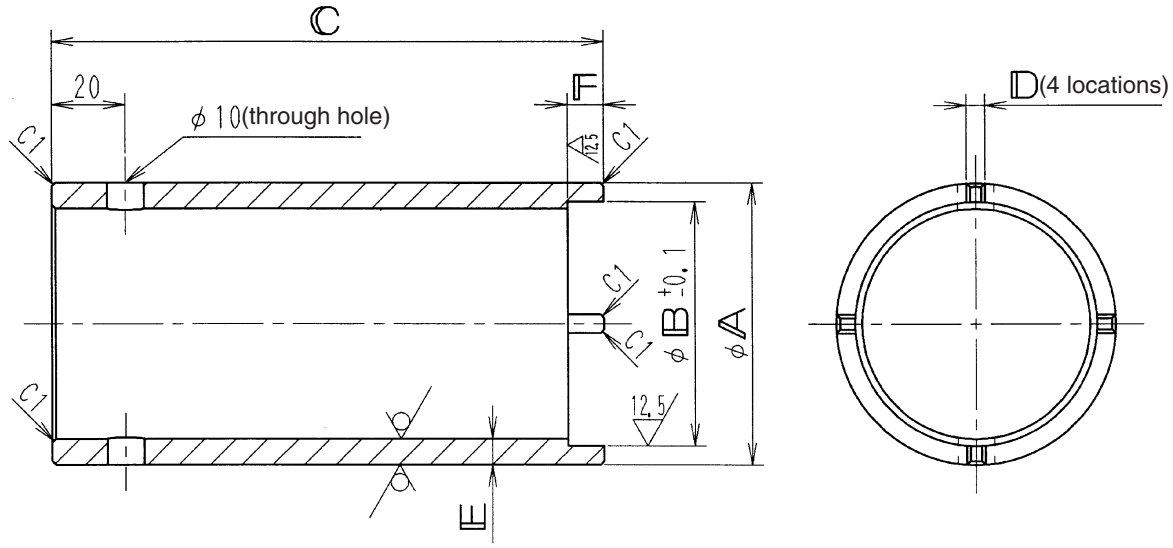
2. Special Tools

For an overhaul, be sure to prepare jigs listed in Table 8-3.

Table 8-3. List of special tools

Name used in manual	Tool name		Application	Applicable model
Jig(1)	Jig(1)	Lock nut tightening jig	Motor rotor mounting	ZH3~9F, G
Jig(2)	Jig(2)-1	Bearing removing jig	Removal of suction end cover	ZH3, 5F
	Jig(2)-2			ZH3~9F, G
Jig(3)	Jig(3)	Temporary bearing holder mounting plate	Centering of screw	ZH3~9F, G
Jig(4)	Jig(4)-1	Handle	Adjustment of slit	ZH3, 5F
	Jig(4)-2			ZH3~9F, G
Jig(5)	Jig(5)	Oil filter removing jig	Required only for ZH3F	ZH3F
Jig(6)	Jig(6)	Lever	Continuous capacity control unit	ZH-G

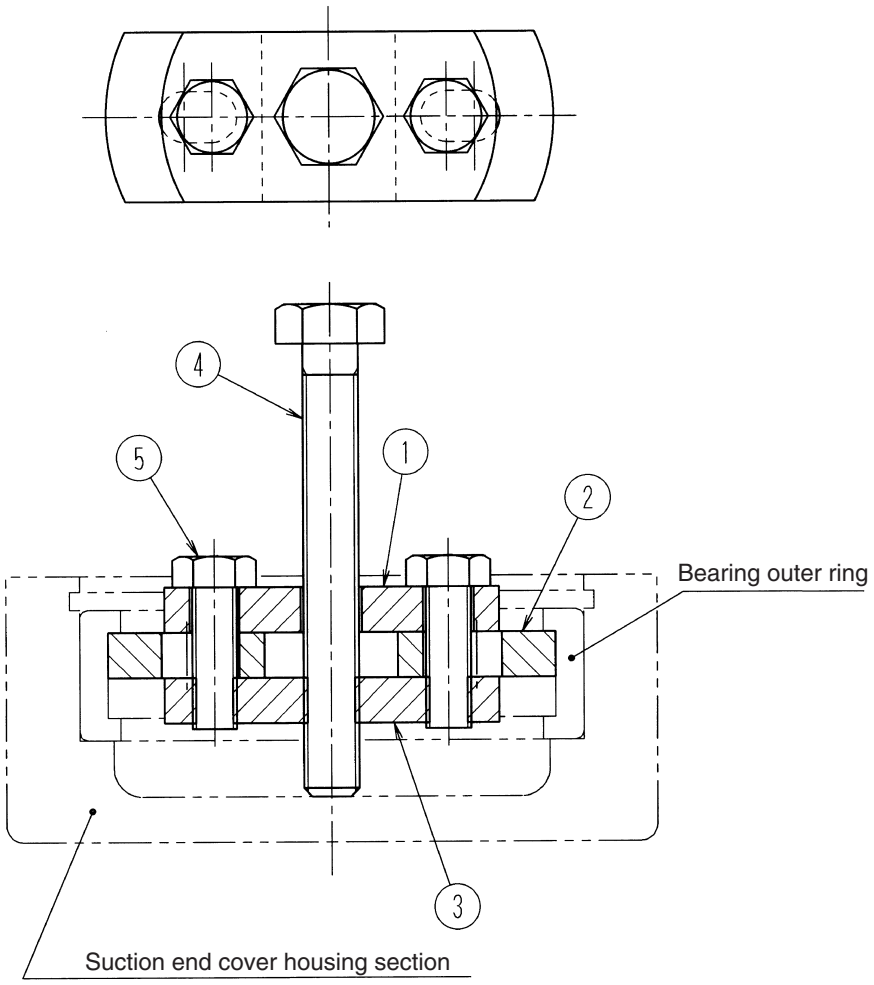
Jig (1) [Lock Nut Tightening Jig]



Applicable model	A	B	C	D	E	F	Material
ZH3_	76.3	66	150	5	7.0	10	STPG370E 65A, sch80
ZH5F, ZH7F	89.1	75	200	6	7.6	10	STPG370E 80A, sch80
ZH9F	101.6	92	250	7	8.1	12	STPG370E 90A, sch80
ZH5G	76.3	70	150	6	7.0	10	STPG370E 65A, sch80
ZH7G, ZH9G	101.6	86	200	7	8.1	11	STPG370E 90A, sch80

(Z0115)

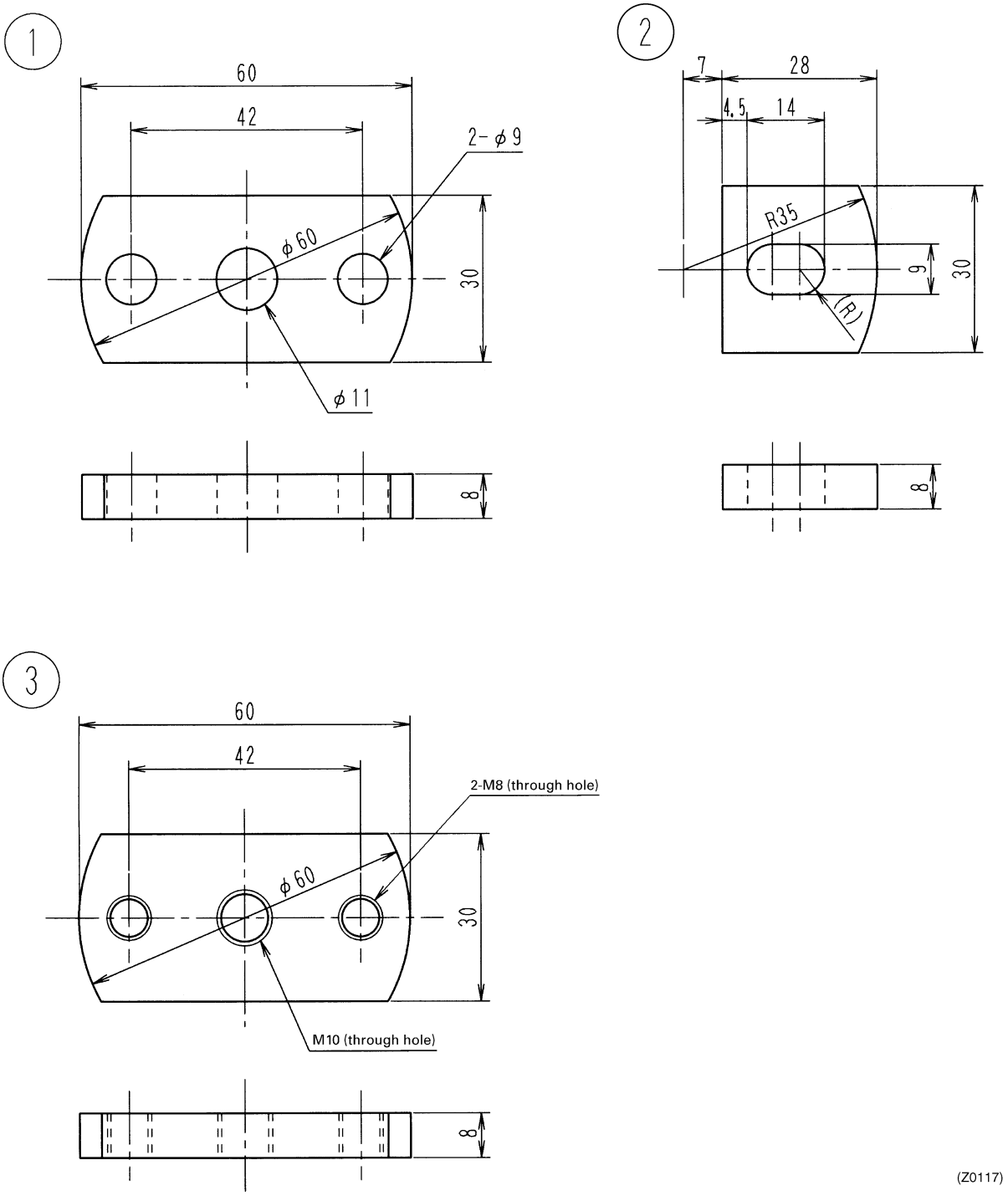
Jig (2)-1 [Bearing Removing Jig Set]



(Z0116)

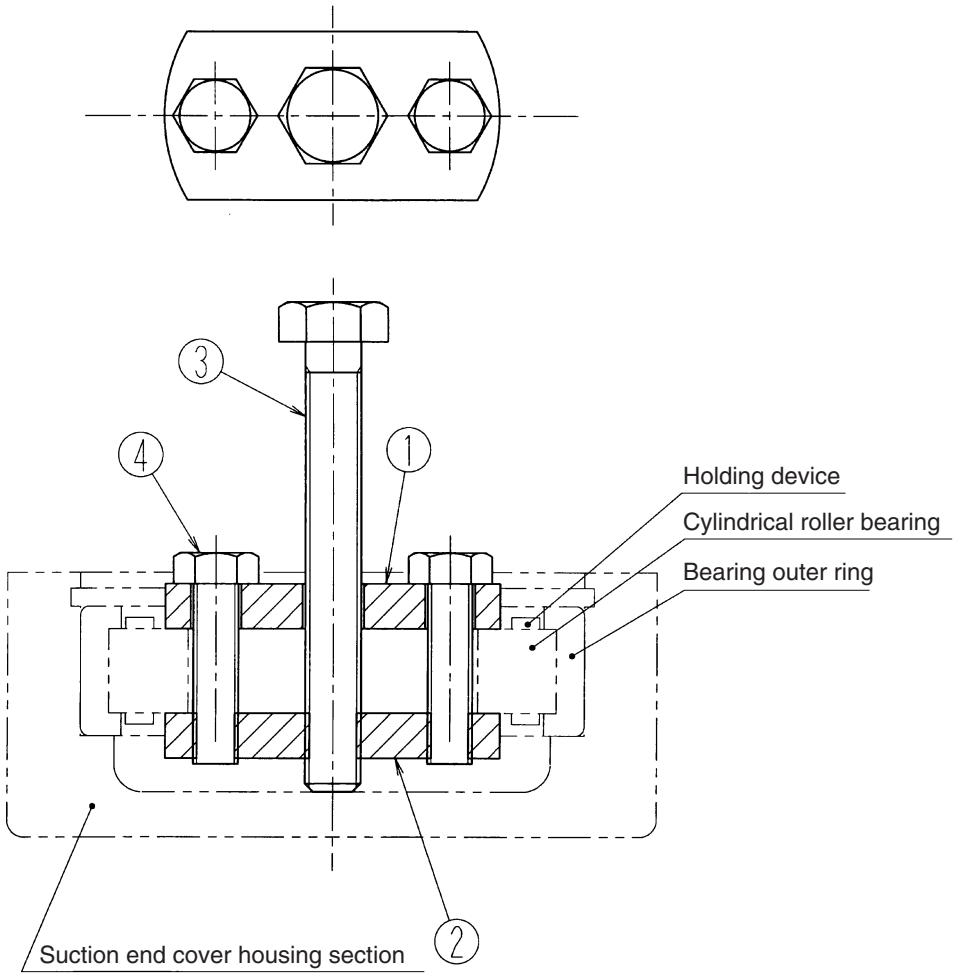
Parts No.	Name	Quantity	Material	Remarks
①	Guide plate	1	SS400 or SM400A	See next page.
②	Batten(1)	2	SS400 or SM400A	See next page.
③	Batten(2)	1	SS400 or SM400A	See next page.
④	Removing bolt	1	S45C	JIS B1180 fully threaded hexagon head bolt A M10x70-10.9, chamfered end
⑤	Hexagon bolt	2	S45C	JIS B1180 hexagon head bolt with nominal diameter body A M8x25-5.6

Jig (2)-1 [Bearing Removing Jig Parts]



(Z0117)

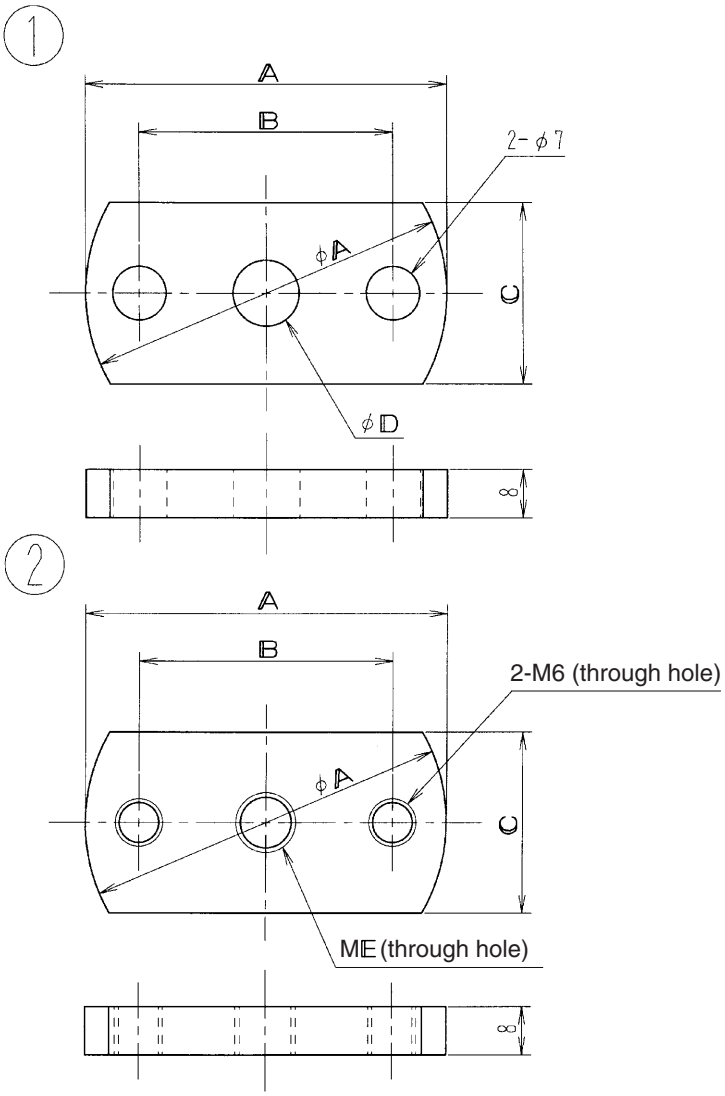
Jig (2)-2 [Bearing Removing Jig Set]



(Z0118)

Parts No.	Name	Quantity	Material	Remarks
①	Guide plate	1	SS400 or SM400A	See next page.
②	Batten	1	SS400 or SM400A	See next page.
③	Removing bolt	1	S45C	See next page.
④	Hexagon bolt	2	S45C	JIS B1180 hexagon head bolt with nominal diameter body A M6x30-5.6

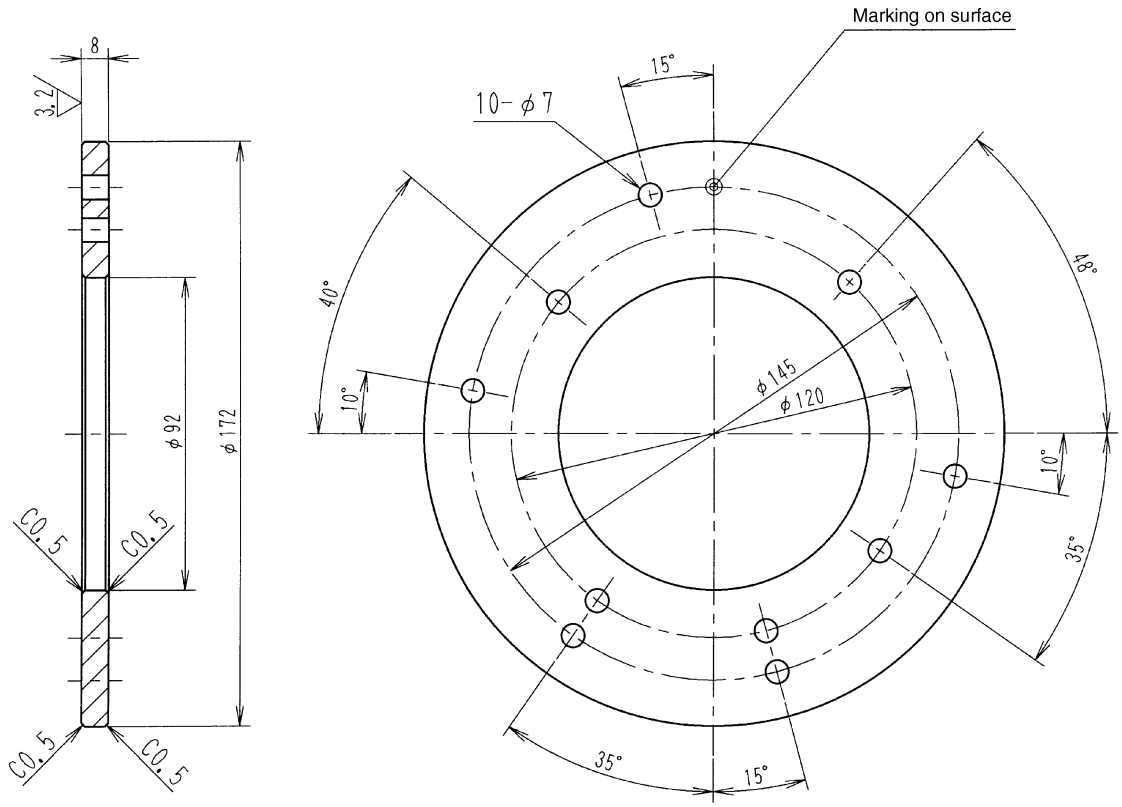
Jig (2)-2 [Bearing Removing Jig Parts]



Applicable model	A	B	C	D	E	Removing bolt
ZH3_	54	30	25	9	8	JIS B 1180 fully threaded hexagon head bolt A M8x70-10.9 chamfered end
ZH5F, ZH7_	62	40	35	13	12	JIS B 1180 fully threaded hexagon head bolt A M12x70-10.9 chamfered end
ZH5G	46	30	25	9	8	JIS B 1180 fully threaded hexagon head bolt A M8x70-10.9 chamfered end
ZH9_	67	50	35	13	12	JIS B 1180 fully threaded hexagon head bolt A M12x70-10.9 chamfered end

(Z0119)

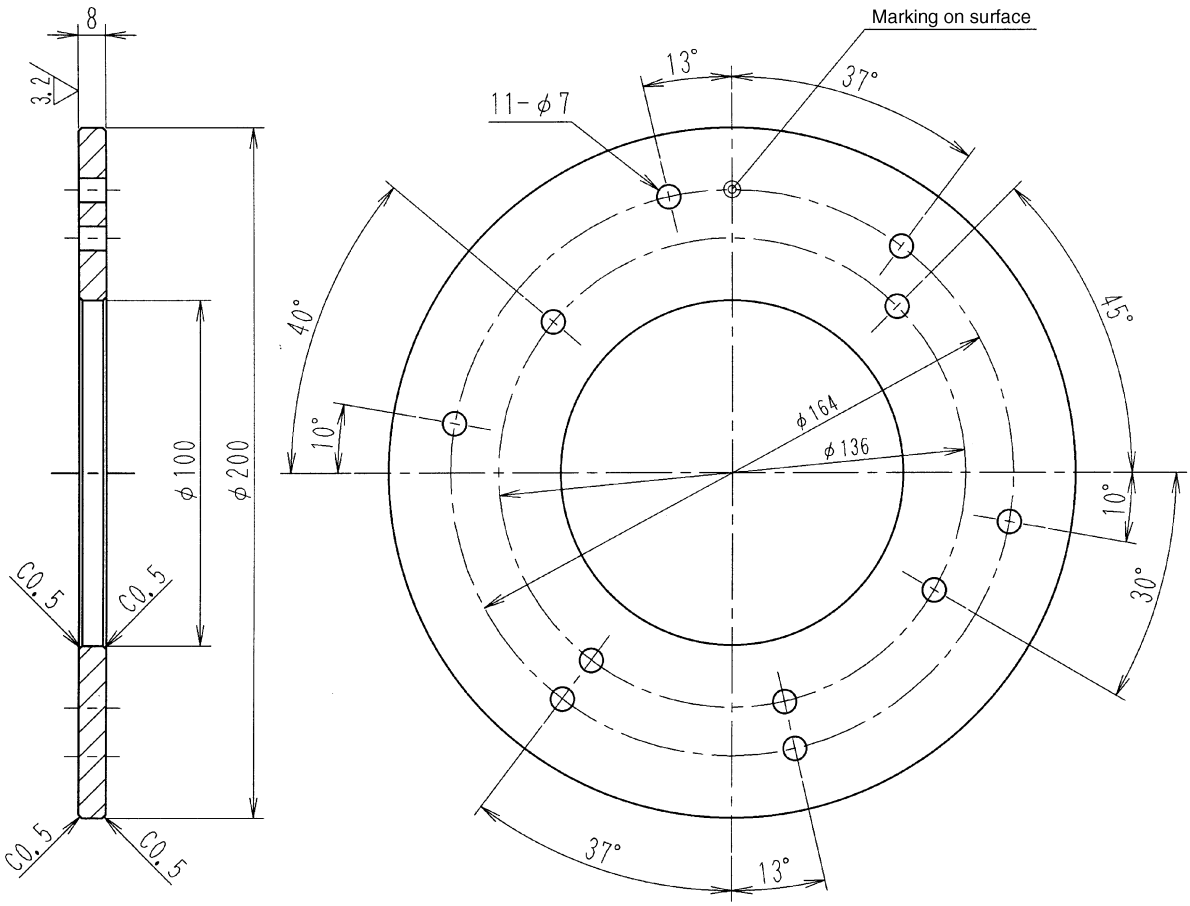
Jig (3) Temporary Bearing Holder Mounting Plate [jig]
[For ZH3_] Material: SS400



Mount the jig so that the marking appears on the front and top.

(Z0120)

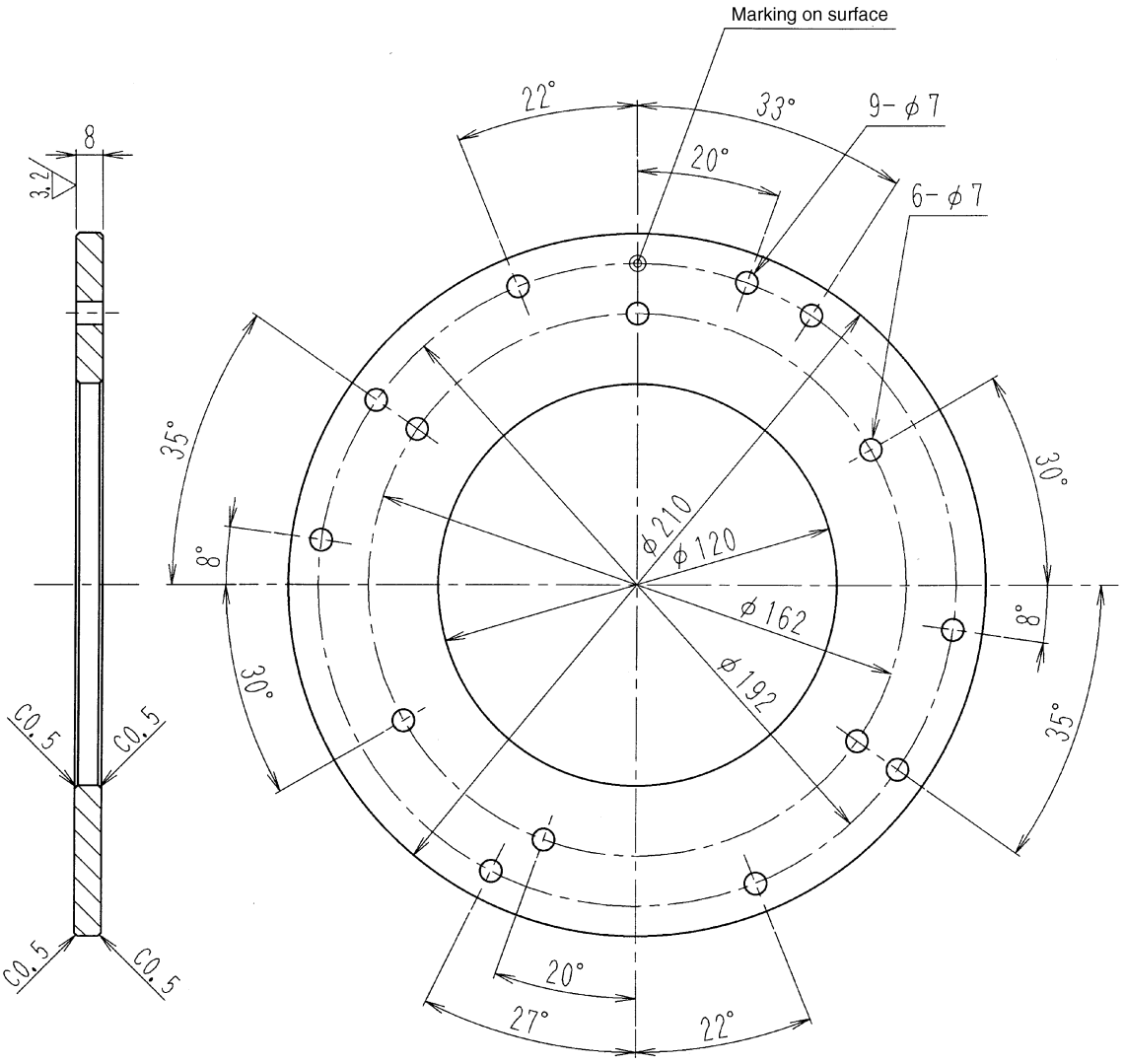
Jig (3) Temporary Bearing Holder Mounting Plate [jig]
[For ZH5_] Material: SS400



Mount the jig so that the marking appears on the front and top.

(Z0121)

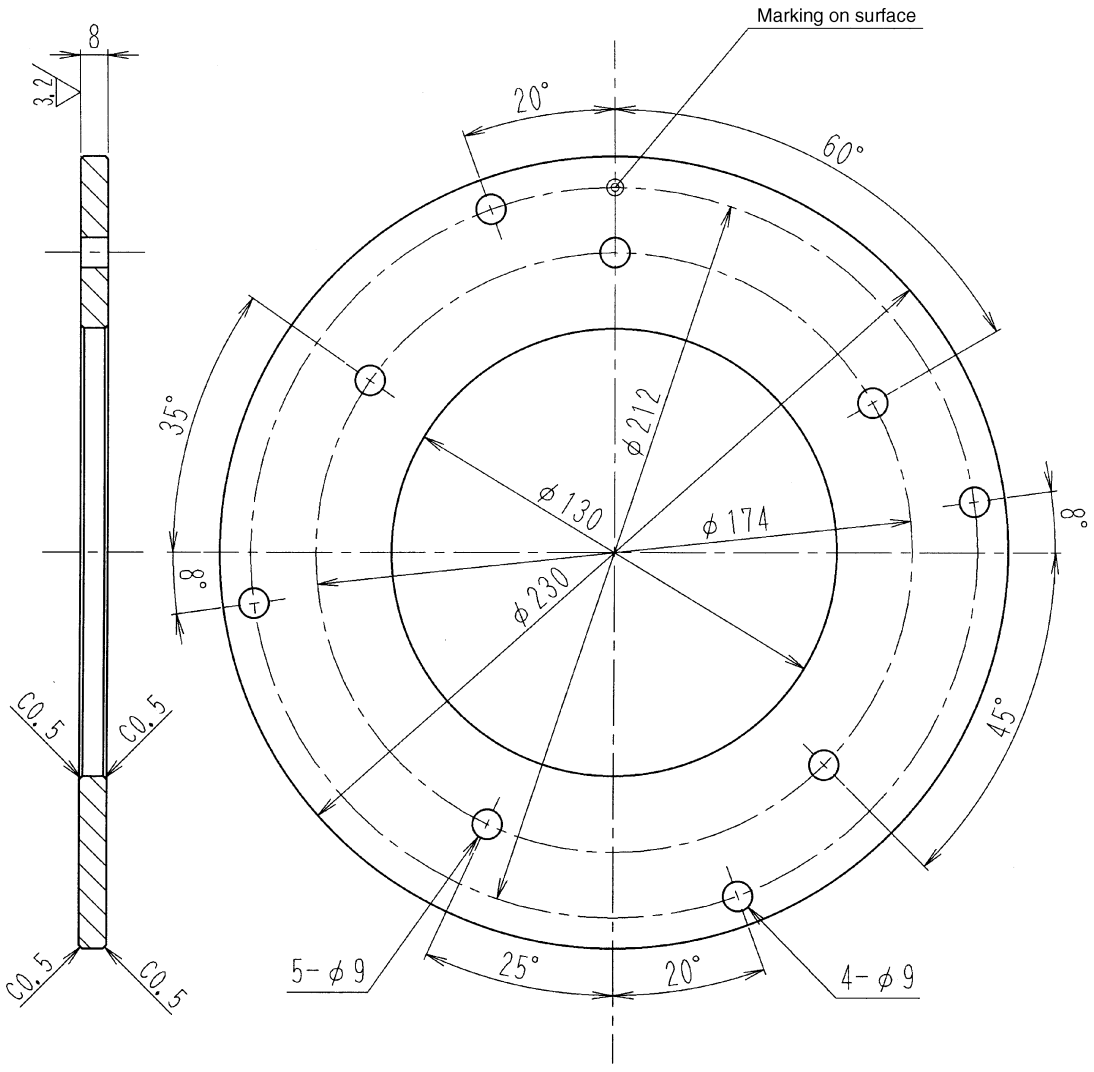
Jig (3) Temporary Bearing Holder Mounting Plate [jig]
[For ZH7_] Material: SS400



Mount the jig so that the marking appears on the front and top.

(Z0122)

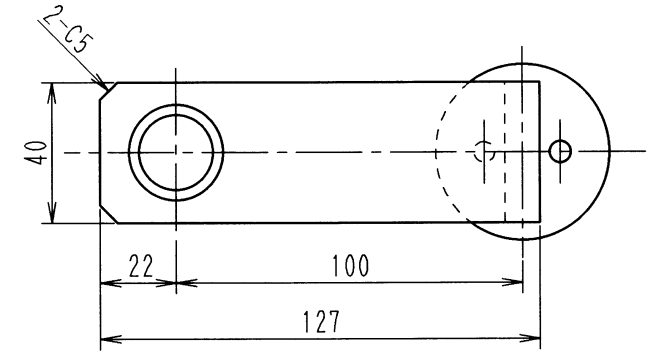
Jig (3) Temporary Bearing Holder Mounting Plate [jig]
[For ZH9_] Material: SS400



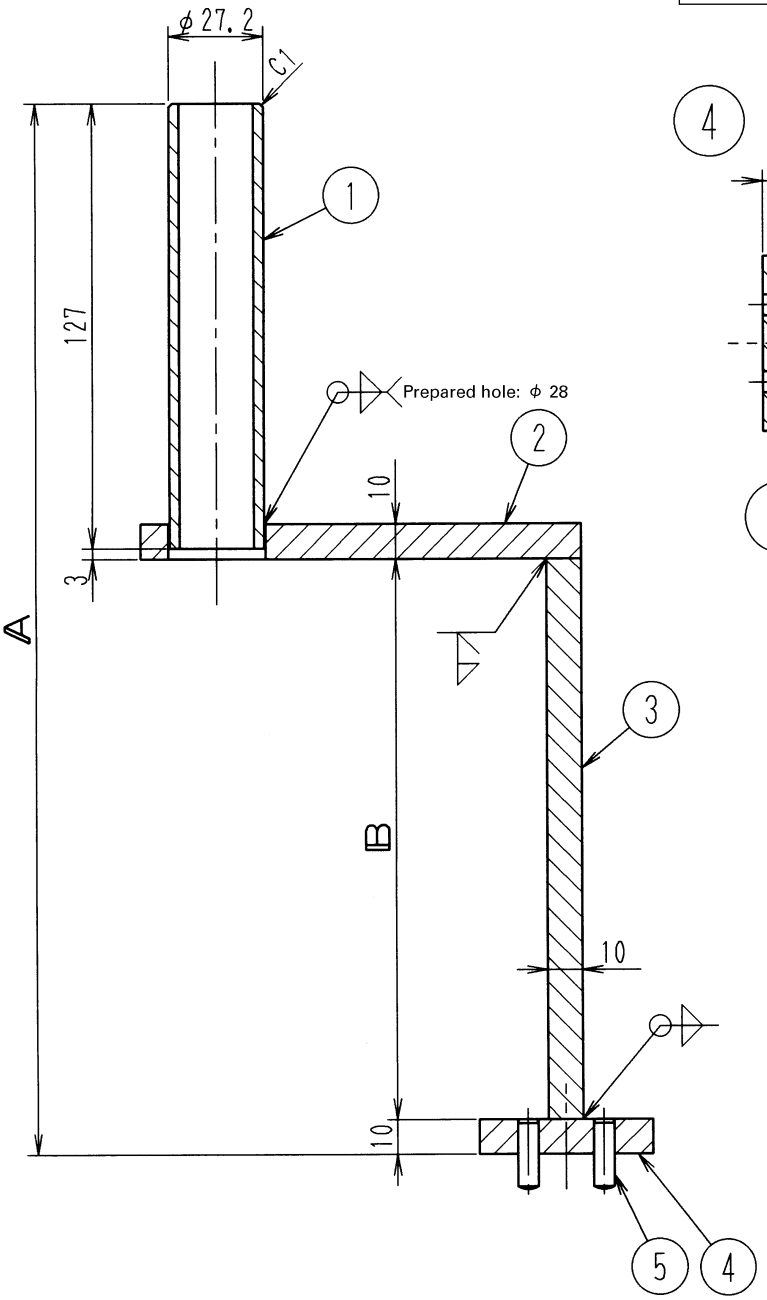
Mount the jig so that the marking appears on the front and top.

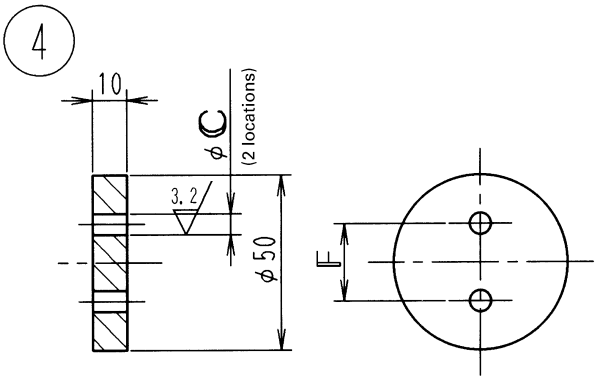
(Z0123)

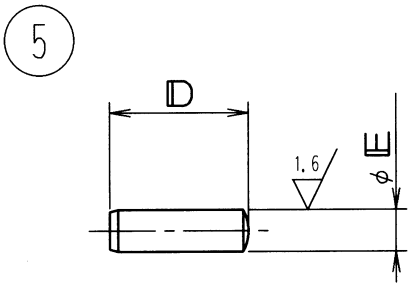
Jig (4)-1 [Handle Jig Set]



Parts No.	Name	Material	Remarks
①	Handle	STPG370E	20A, sch40 (t2. 9)
②	Stay (1)	SS400 or SM400A	
③	Stay (2)	SS400 or SM400A	
④	Disc	SS400 or SM400A	
⑤	Straight pin	S45C	JIS B1354 Class A or equivalent



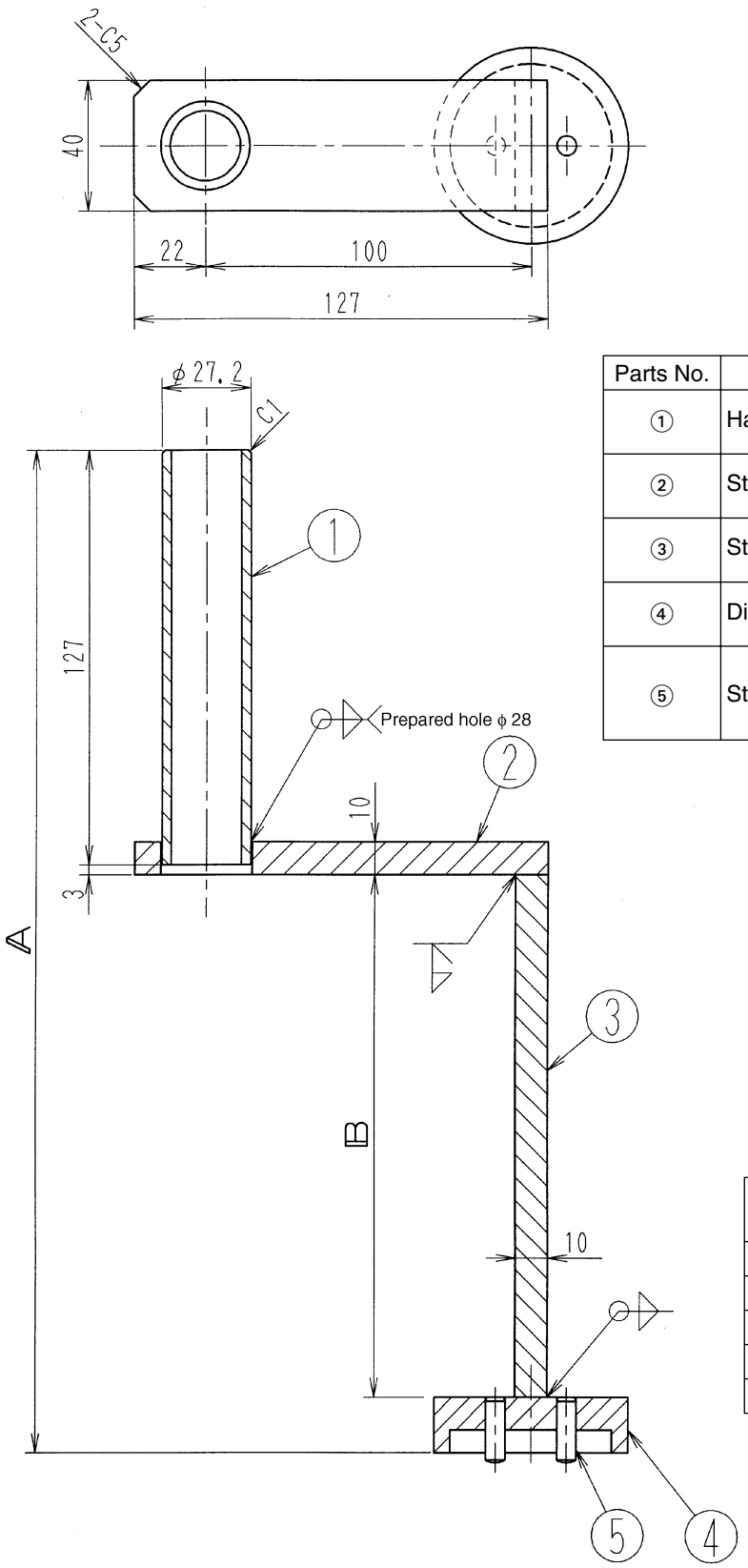




	ZH3_F	ZH5_F
A	300	325
B	160	185
C	$6^{+0.012}_{0}$	$8^{+0.015}_{0}$
D	20	24
E	$6^{+0.012}_{+0.004}$	$8^{+0.015}_{+0.006}$
F	22	28

(Z0124)

Jig (4)-2 [Handle Jig Set]

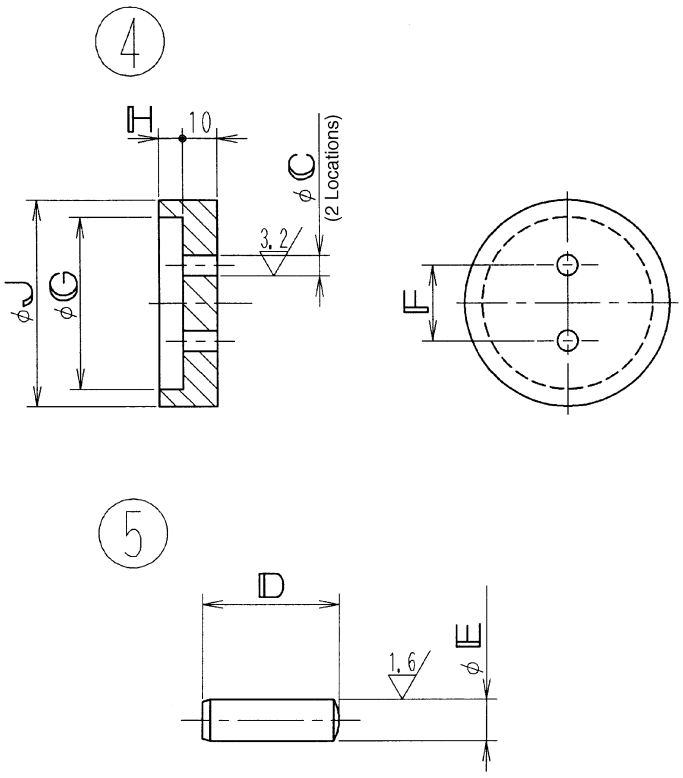


Parts No.	Name	Material	Remarks
①	Handle	STPG370E	20A, sch40 (t2. 9)
②	Stay (1)	SS400 or SM400A	
③	Stay (2)	SS400 or SM400A	
④	Disc	SS400 or SM400A	Refer next page
⑤	Straight pin	S45C	JIS B1354 Class A or equivalent Refer next page

Applicable model	A	B
ZH3_F	307	160
ZH3_G	287	140
ZH5_	333	185
ZH7_	321	170
ZH9_	371	220

(Z0125)

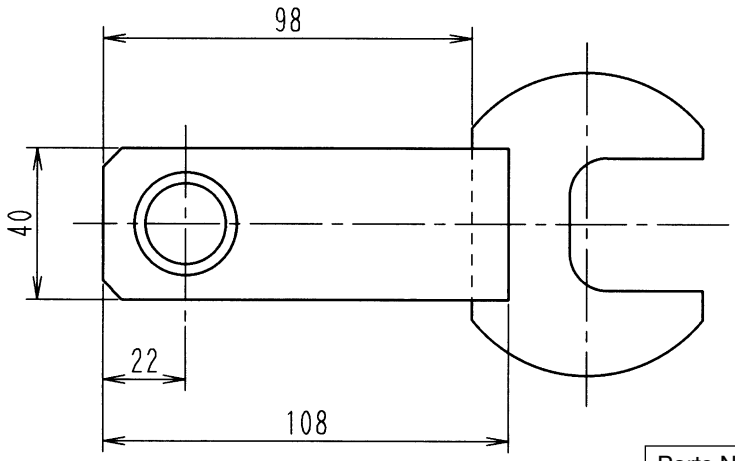
Jig (4)-2 [Handle Jig Parts]



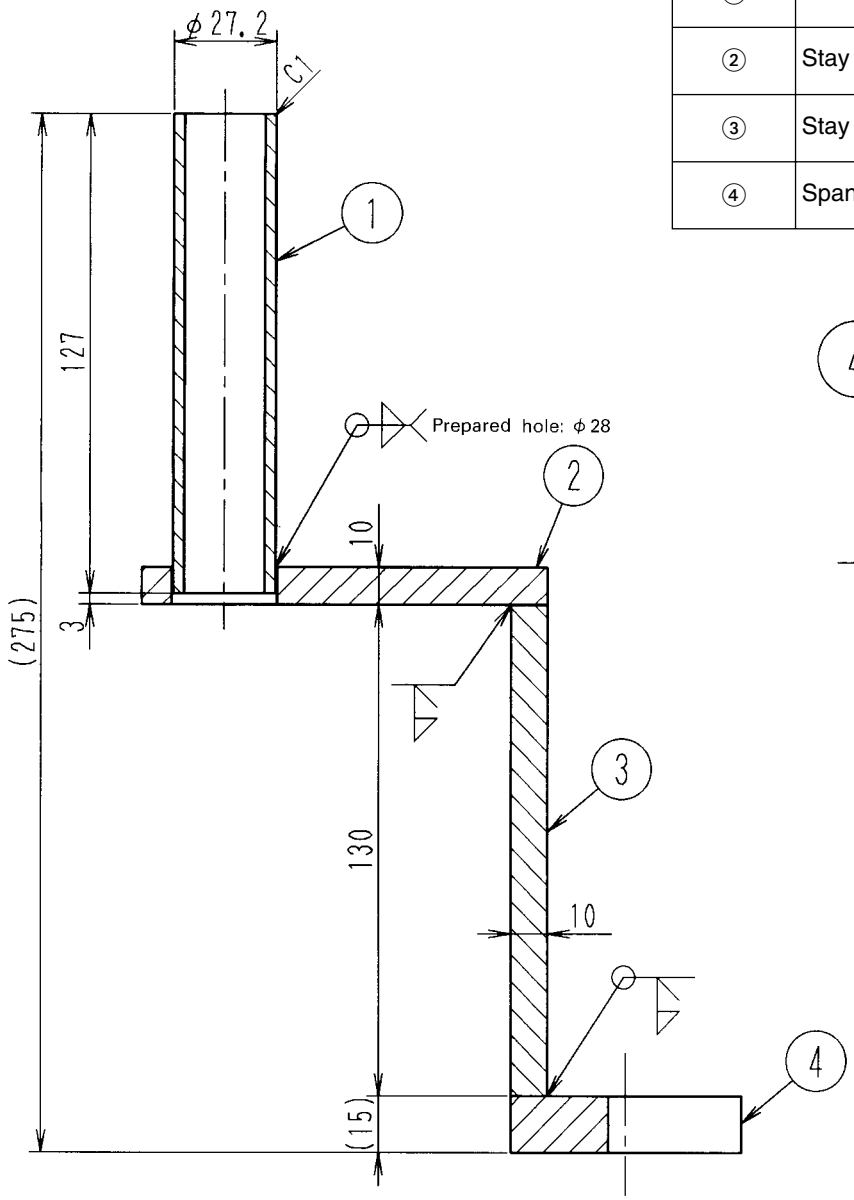
Applicable model	C	D	E	F	G	H	J
ZH3_F	$6^{+0.012}_{0}$	20	$6^{+0.012}_{+0.004}$	22	50.5	7	60
ZH3_G	$6^{+0.012}_{0}$	20	$6^{+0.012}_{+0.004}$	26	50.5	7	60
ZH5_	$8^{+0.015}_{0}$	24	$8^{+0.015}_{+0.006}$	28	60.5	8	70
ZH7_	$8^{+0.015}_{0}$	24	$8^{+0.015}_{+0.006}$	32	75.5	11	85
ZH9_	$8^{+0.015}_{0}$	24	$8^{+0.015}_{+0.006}$	36	80.5	11	90

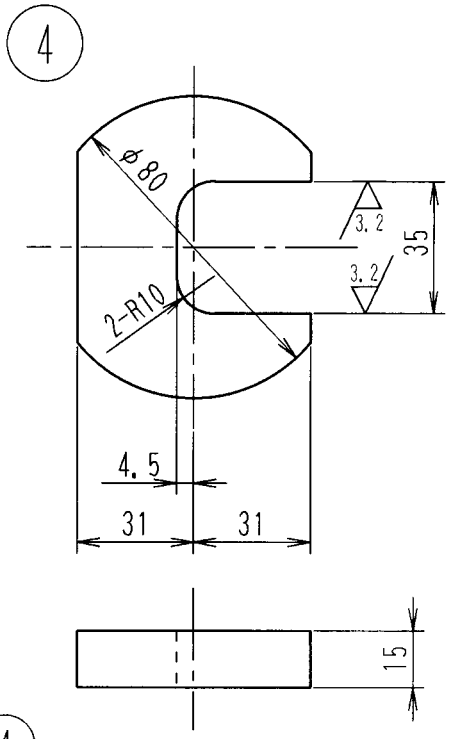
(Z0126)

Jig (5) [Oil Filter Removing Jig] [For ZH3_F]



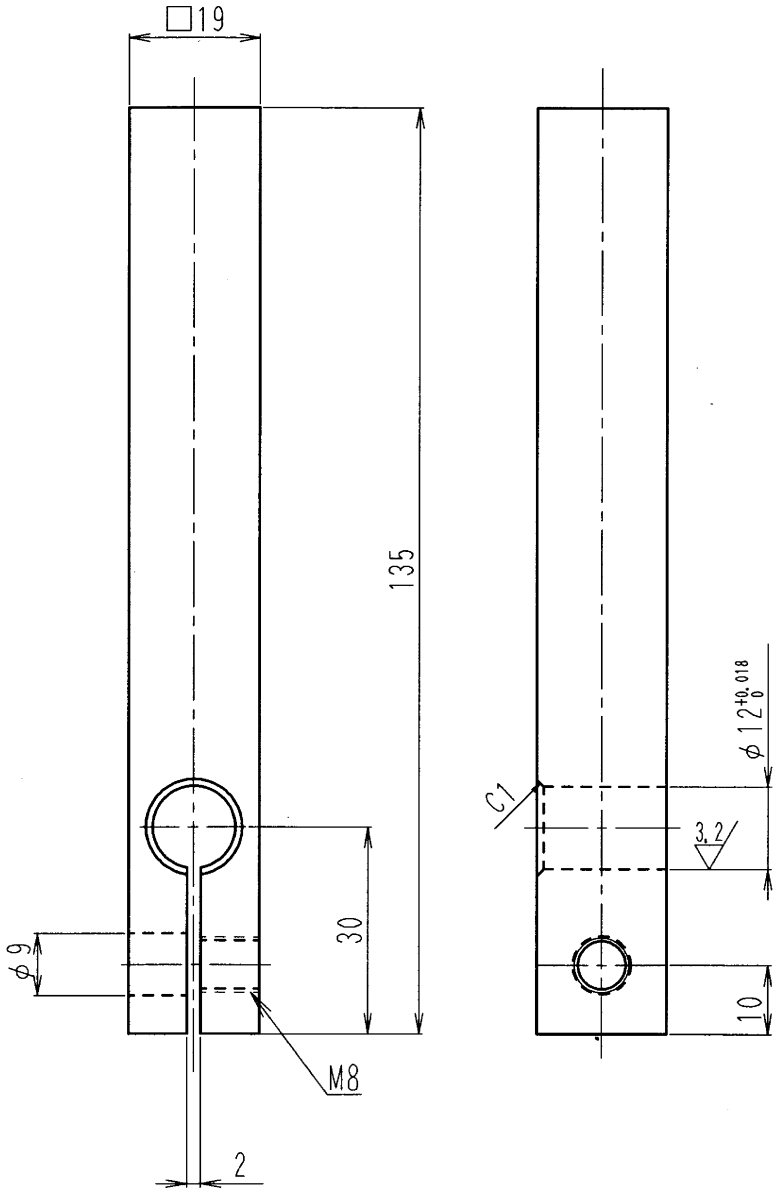
Parts No.	Name	Material	Remarks
①	Handle	STPG370E	20A, sch40 (t2. 9)
②	Stay (1)	SS400 or SM400A	
③	Stay (2)	SS400 or SM400A	
④	Spanner	SS400 or SM400A	





(Z0127)

Jig (6) [Lever]
[For continuous capacity control unit] Material: SS400



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Drawings & Flow Charts

The air conditioners manufactured by Daikin Industries have received **ISO 9000 series** certification for quality assurance.

Certificate Number.
(ISO9001) **JMI-0107** (ISO9002) **JQA-1452**
JQA-0495

All Daikin Industries locations and subsidiaries in Japan have received environmental management system standard **ISO 14001** certification.

Daikin Industries, Ltd.
Domestic Group
Certificate Number. EC99J2044

About ISO 14001

ISO 14001 is the standard defined by the International Organization for Standardization (ISO) relating to environmental management systems. Our group has been acknowledged by an internationally accredited compliance organisation as having an appropriate programme of environmental protection procedures and activities to meet the requirements of ISO 14001.

Dealer

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