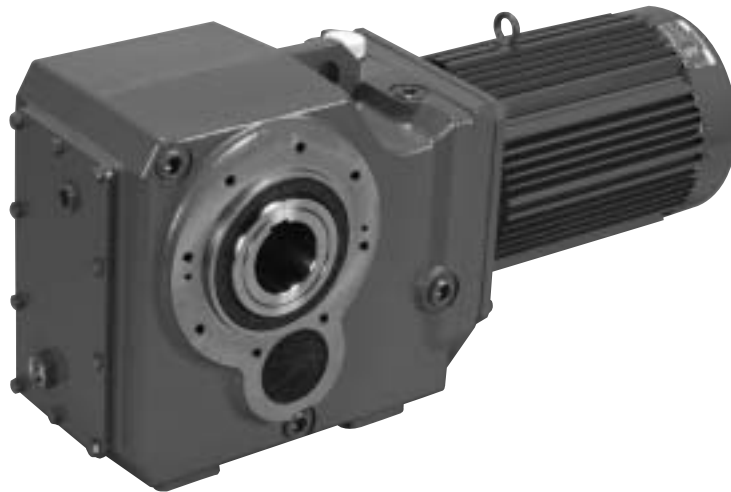


RHYTAX DRIVE



- Carefully read through the maintenance manual before use.
Only trained technicians should handle, install, and maintain gearmotor and reducer units.
- Actual user must keep a copy of this maintenance manual.
- Actual user must retain this maintenance manual for future reference.

Safety and Other Precautions


- Carefully read this maintenance manual and all accompanying documents before use (installation, operation, maintenance, inspection, etc.). Thoroughly understand the machine, information about safety, and all precautions for correct operation.
- Retain this manual for future reference.
- Pay close attention to the "DANGER" and "CAUTION" warnings regarding safety and proper use.



: Improper handling may result in physical damage, serious personal injury and/or death.



: Improper handling may result in physical damage and/or personal injury.

Matters described in  CAUTION may lead to serious danger depending on the situation. Be sure to observe important matters described in the manual.

DANGER

- Transport, installation, plumbing, wiring, operation, maintenance, and inspections should be performed by trained technicians; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- When using the equipment in conjunction with **an explosion proof motor**, a technician with electrical expertise should supervise the transport, installation, plumbing, wiring, operation, maintenance and inspection of the equipment to avoid a potentially hazardous, situation that may result in electrical shock, fire, explosion, personal injury and/or damage to the equipment.
- When the unit is to be used in a system for human transport, a secondary safety device should be installed to minimize chances of accidents resulting in personal injury, death, or damage to the equipment.
- When the unit is to be used for an elevator, install a safety device on the elevator side to prevent it from falling; otherwise, personal injury, death, or damage to the equipment may result.



How to Use This Maintenance Manual

- This maintenance manual is applicable commonly to the "gearmotor" and "speed reducer." Marks in the table below are shown at the upper right of respective pages according to the classification. Read the related pages.


On the **COMMON** pages, sentences related to special specifications are marked.

HOLLOW applies only to the hollow shaft type.

- For the handling of the brake of **gearmotor with a brake**, refer to the Brake Maintenance Manual (Catalog No. MM0202).

Specifications	Common specifications	Gearmotor	Speed reducer
Mark	COMMON		

———— Table of Contents ————

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1. Inspection when Delivered

⚠ CAUTION

- Make sure that the unit is positioned right-side-up before unpacking. Otherwise, injury may result.
- Make sure that the unit received is relevant with your order. When a different product is installed, injury or damage to the system may result.
- Do not remove the nameplate.

Check the following: when the gearmotor or speed reducer is delivered.

- (1) Descriptions on the nameplate conform to your order.
- (2) There were no damaged parts during transport.
- (3) A11 bolts and nuts are firmly tightened.

If there is any questions or defect found, consult your nearest agent, distributor, or sales office.

1-1) How to Check the Nameplate

- Let us know the (1) nomenclature of your gearmotor or reducer, (2) reduction ratio, and (3) serial number when calling us.

Gearmotor

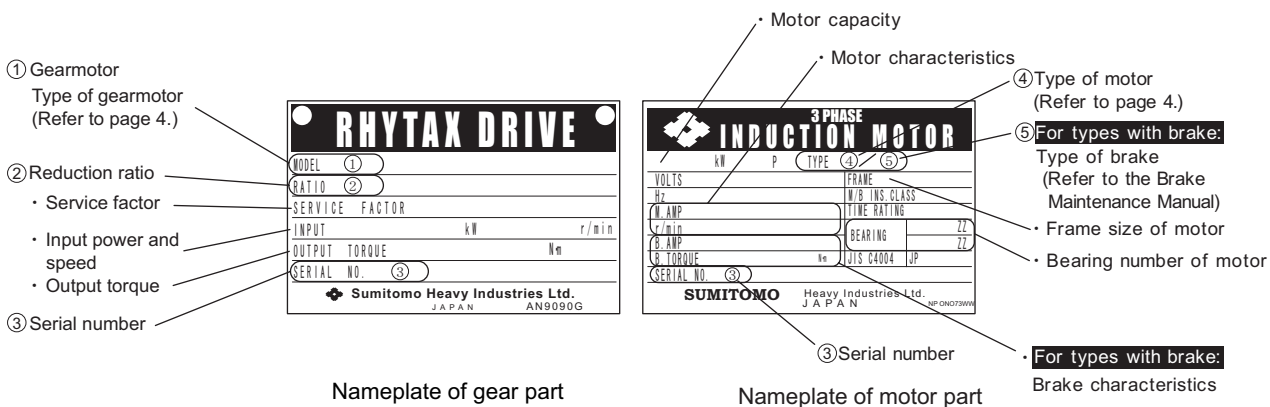


Fig. 1 Rating plates of gearmotor

Speed reducer

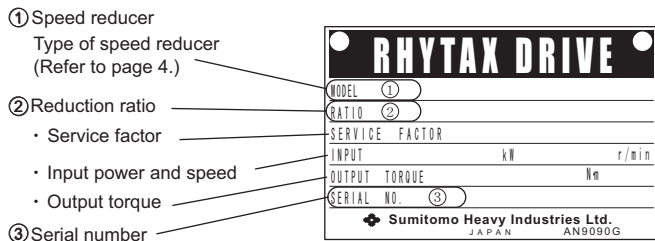


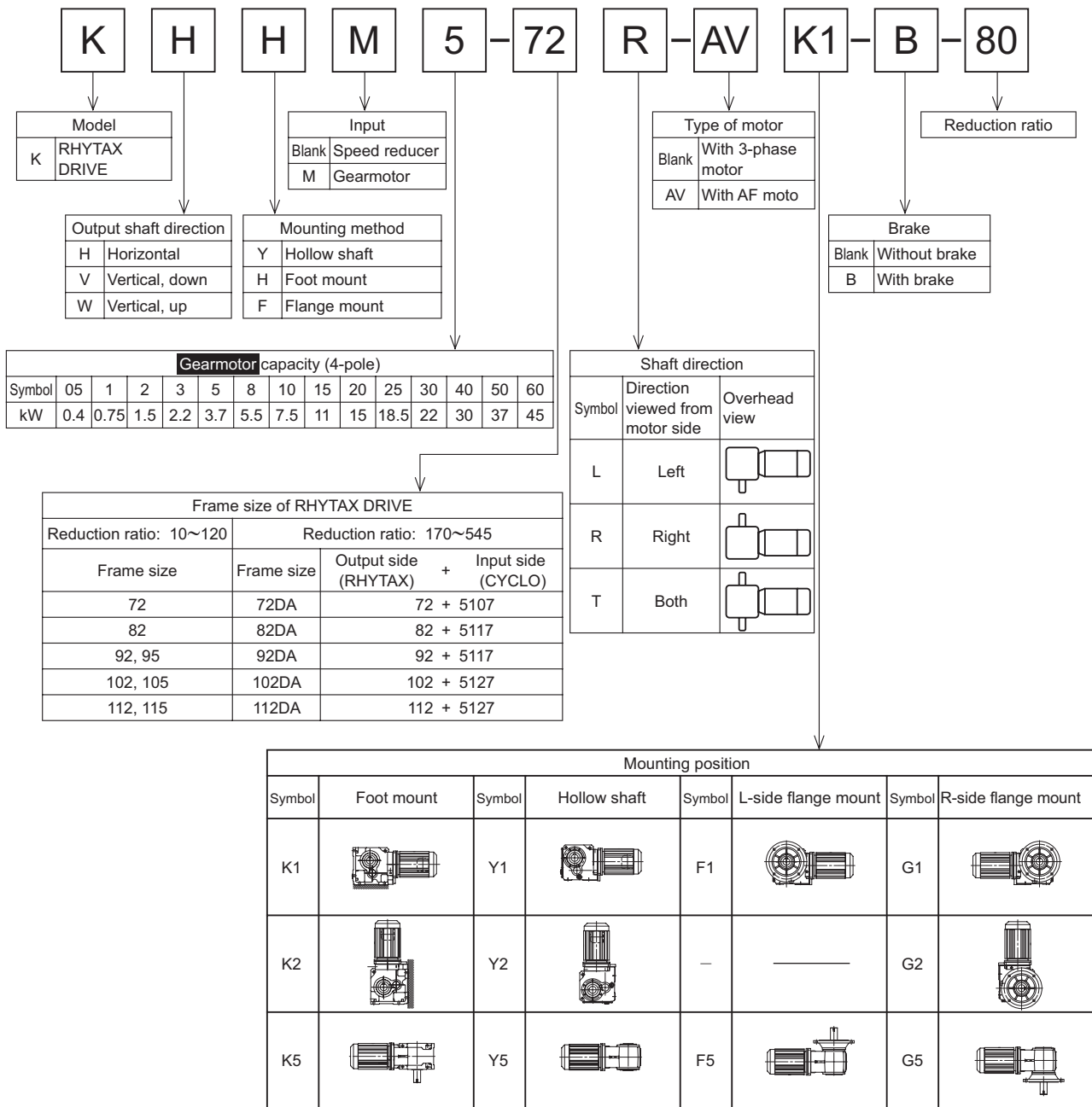
Fig. 2 Nameplate of speed reducer

1 - 2) Lubrication Method COMMON

- The oil bath lubrication method is applied to all models of RHYTAX DRIVE.
- Supply recommended oil before use. Oil has been removed from RHYTAX DRIVE before shipment from our factory. (See "8-3 Oil Supply and Change for Oil Lubrication Parts" on pages 18 and 19.)

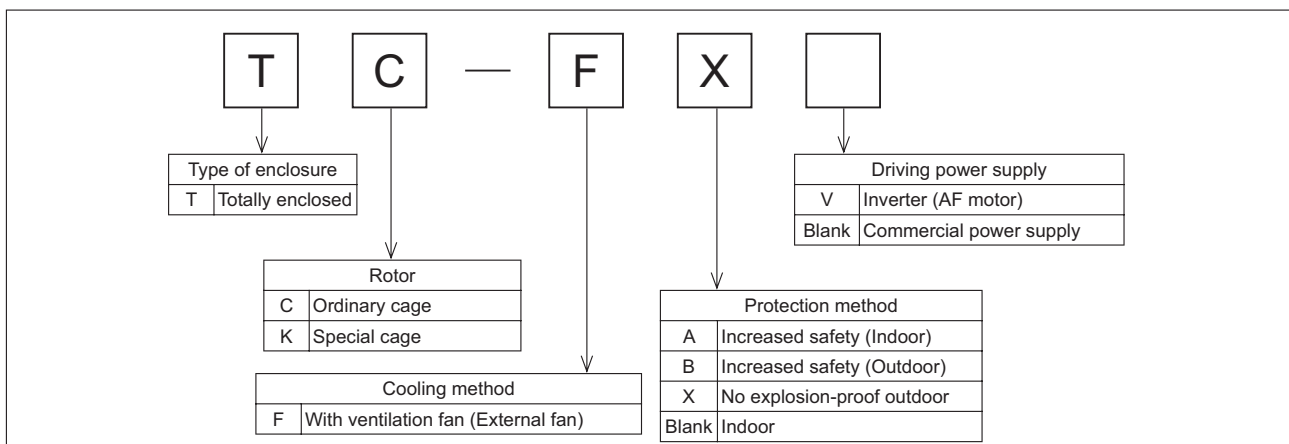
1 - 3) Nomenclature of Gearmotor and Speed Reducer

Symbols show the following. Make sure that the type of gearmotor or speed reducer conforms to your order.



1-4) Nomenclature of Motors

Symbols show the following: Make sure that the type of motor conforms to your order.



2. Storage

Note the following when storing the gearmotor or speed reducer before use.

2-1) Storage Location

Store the unit in a clean dry place indoor.

- Avoid storage outdoors on in places with humidity, dust, sudden temperature changes, or corrosive gas.

2-2) Storage Period

- (1) The storage period should be less than 6 months.
- (2) Special rust prevention is necessary, when the storage period exceed 6 months. Contact us for details.
- (3) Special rust prevention is necessary, when exporting products. Contact us for details.

2-3) Use After Storage

- (1) Check the oil seals, filler plug, and other non-metal parts before operation after long-term storage. Oil seals deteriorate when exposed to high temperatures and UV rays. Replace the oil seas and other parts if there is any sign of deterioration.
- (2) Make sure that there is no abnormal sound, vibration, or heat rise after starting operation. Make sure that the brake functions properly for motors with brake. Consult the nearest agent, distributor, or sales office if any abnormality is found.

3. Transportation

⚠ DANGER

- Do not stand directly under a unit suspended by a crane or other lifting mechanism; otherwise, personal injury or death may result.

⚠ CAUTION

- Be careful not to drop the gearmotor or speed reducer during transport. When a hanging bolt or hole is provided, make sure to use it. After mounting the gearmotor or speed reducer on a system, however, do not hoist the entire system using the hanging bolt or hole; otherwise, the system may be damaged by the falling unit or broken brackets.
- Before hoisting, check the weight with the nameplate, crate, outline drawing, catalog, etc. Never hoist the gearmotor or speed reducer that exceeds the rating of the crane or other mechanism being used to lift it; otherwise, injury or damage to the equipment and/or lifting device may occur.

4. Installation

DANGER

- Do not use the unit in an explosive atmosphere. Use an explosion-proof motor in that case; otherwise, explosion, ignition, an electric shock, injury, a fire, or damage to the equipment may occur.
- Use an appropriate explosion-proof type motor in a danger zone (which is likely to be filled with explosive gas or steam); otherwise, explosion, ignition, an electric shock, injury, a fire, or damage to the equipment may occur.

CAUTION

- Use the gearmotor or speed reducer conforming to the specifications shown on the nameplate or manufacturer's specifications; otherwise, an electric shock, injury, or damage to the equipment may occur.
- Do not place inflammables around the gearmotor; otherwise, a fire may occur.
- Do not place any objects that hinder ventilation around the gearmotor or speed reducer; otherwise, cooling effects may be reduced, leading to a fire hazard due to excessive heating.
- Do not step on or hang from the gearmotor or speed reducer; otherwise, injury may result.
- Do not touch the key ways, which are at the shaft end or on the inside of the gearmotor or speed reducer, or the edge of the motor cooling fin; otherwise, injury may result.
- When RHYTAX is used in food processing applications vulnerable to oil contamination, install an oil pan or other such device to cope with oil leakage due to failure or limited service life; otherwise, oil leakage may damage products.

4-1) Location of Installation

Ambient temperature: -10 ~ +40°C

Ambient humidity: 85% max.

Altitude: 1000m max.

Ambient atmosphere: There should be no corrosive gas, explosive gas, or steam. The location should be well ventilated and free from dust.

Location of installation: Indoor (free from dust or water splash)

- Special specifications are necessary when installation conditions are other than the above. Contact the nearest agent, dealer, or service office.
- RHYTAX units made for special specifications for outdoor use, increased safety, etc., can be safely operated under specified conditions no problem.
- Install RHYTAX units where inspection, maintenance, and other jobs can be carried out easily.
- Install RHYTAX units on a sufficiently rigid base.

4-2) Installation Angle

Install RHYTAX on a horizontal bed. (Contact us for inclined installation.)

When RHYTAX is manufactured for specific inclined installation, use the unit with specified angle.

(The axial direction of the outdoor type gearmotor is generally horizontal. Contact us for other axial directions.)

- Do not remove the eyebolt from the motor. If it is removed for some reason, insert a bolt, etc., into the threaded hole to prevent water from entering the motor.

4-3) Severe Load Conditions

We recommend using mounting bolts of strength at least class 8.8 (as indicated in JISB-1051), for conditions with strong vibrations or frequent start-stop.

5. Coupling with Other Machines

⚠ CAUTION

- Check the rotation direction before coupling with its driven machine. Difference in the direction of rotation may cause injury or damage to the equipment .
- Remove the key temporarily attached to the output shaft of the gearmotor or speed reducer, when the shaft is free rotating (i.e.: not loaded); otherwise, injury may result.
- Install appropriate protective device around rotating parts; otherwise, injury may result.
- When coupling the gearmotor or speed reducer with a load, pay attention to the alignment, belt tension, and parallelism of pulleys. Pay attention to the direct coupling accuracy when the unit is directly coupled with another machine. When a belt is used for coupling, adjust the belt tension correctly. Correctly fasten tightening bolts on the pulley and coupling before operation; otherwise, injury or damage to the equipment may result due to scattering fragments.

5-1) Confirming Rotation Direction

Gearmotor 

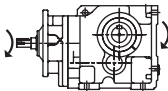
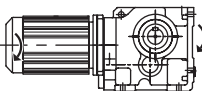
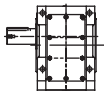
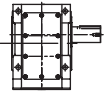
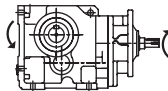
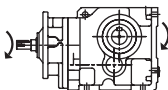
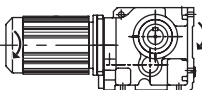
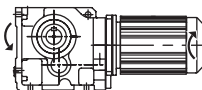
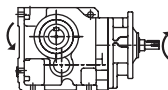





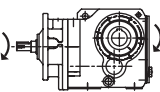
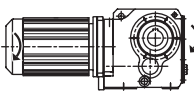

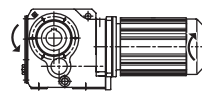
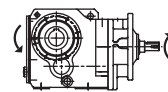
Directions of output shaft rotation with wiring is as shown in Fig. 23 on page 15, is shown in Fig. 3.

- When using wiring in Fig. 23, the motor shaft will rotate clockwise when viewed from the side opposite to the load. The direction of output shaft rotation is indicated by the arrow shown in Fig. 3.
- Switch the connection of R and T shown in Fig. 23 to reverse the rotation direction.

Speed reducer 

The relationship of rotation direction between input shaft and output shaft is shown by the arrows in Fig. 3.

Fig. 3 Rotation Direction of Slow Shaft Rotation

KHHM KHH Series	Export code R		Export code L		
	 KHH	 KHHM		 KHHM	 KHH
	 KHH	 KHHM	Export code T	 KHHM	 KHH
KHFM KHF Series	Export code R		Export code L		
	 KHF	 KHFM		 KHFM	 KHF
KHYM KHY Series	 KHY	 KHYM		 KHYM	 KHY

5-2) Coupling Installation

- Do not apply shock on excessive axial load to the shaft when installing the coupling. Otherwise, the bearing may be damaged or collar may come off.
- Thermal shrinking method is recommended for installation.

(1) When Using a Coupling

The accuracy of the dimensions (A, B, and X) shown in Fig. 4 should be within the tolerance shown in Table 1.

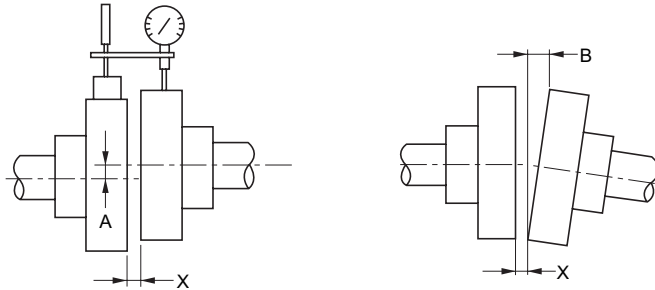


Fig. 4

Table 1 Centering Accuracy of Flexible Coupling

Dimension A Tolerance	0.1mm or manufacturer's specification
Dimension B Tolerance	0.1mm or manufacturer's specification
X dimension	Manufacturer's specification

(2) When Using a Chain Sprocket and Gear

- Make the chain tension angle perpendicular to the shaft.
- Refer to the chain catalog for the chain tension.
- Select sprockets and gears whose pitch diameter are three times the shaft diameter or greater.
- Install sprocket and gears so that their point of load application will be closer to the gearmotor or reducer side with respect to the length of the shaft. (Fig. 5)

(3) When Using a V-belt

- Excessive V-belt tension will damage the shaft and bearing. Refer to the V-belt catalog for proper tension.
- The parallelism and eccentricity (β) between two pulleys should be within 20 minutes. (Fig. 6)
- Use a matched set with the same circumferential length when more than one belt is to be installed.

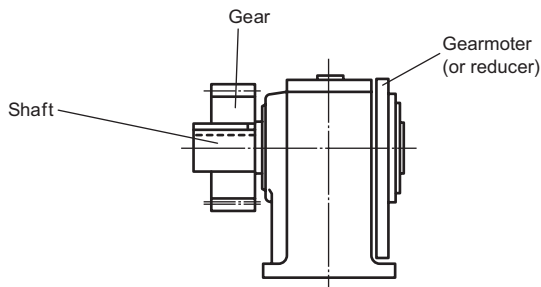


Fig. 5

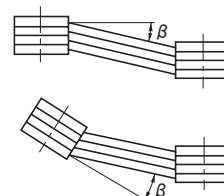


Fig. 6

5-3) Attaching and Removing Hollow Shaft and Driven Machine

- There are roughly two methods to attach with hollow shaft.....**torque arm mounting** and **flange mounting**. Each method need different precautions. Read the applicable section carefully.

- (1) Apply molybdenum disulfide grease to the surface of the driven shaft and the inside of the hollow shaft. Then insert the gearmotor or speed reducer on the driven shaft.
Pound the edge of the hollow shaft with a mallet when the engagement is tight. Do not pound hammer the casing and oil seal. When the engagement is very tight, make and use a jig shown in Fig. 7 for smoother insertion.

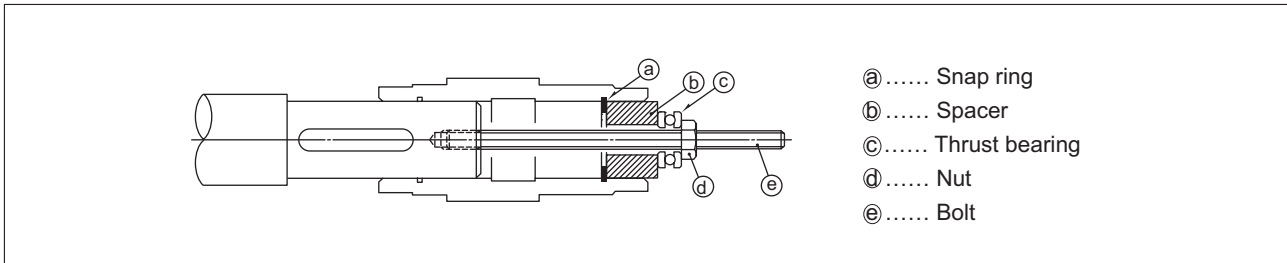


Fig. 7 Mounting Jig

Hollow shafts conform to the tolerance of JIS H8. When impact is expected or when the radial load is large during operation, firmly engage the hollow shaft with the driven shaft. (Recommended tolerance of the driven shaft is JIS js6 or k6.)

(2) Removal from driven shaft

Take care not to apply excessive force to the section between the casing and the hollow shaft. The jig shown in Fig. 8 will help smooth removal.

Users should prepare jigs for mounting, securing, and removing.

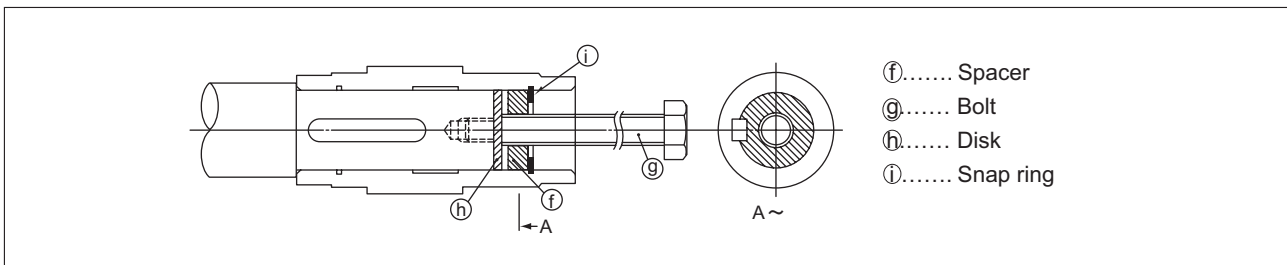


Fig. 8 Removal Jig

6) Example of Attachment and Recommended Design for Clamp Collar Method (Optional)

(1) Design of Driven Shaft

Design the driven shaft following the dimensions in Table 2.

(2) Attachment of Clamp Collar

- Clamp collar attached on the reducer unit is shipped with grease applied on the surface to tighten boss. It can be assembled right away.
- Shock absorber placed between the both plates during shipment can be removed by loosening all bolts.
- When reusing clamp collar after removing disassemble and cleanse the parts.
- Then apply molybdenum disulfide on sliding cone, tightening bolt, and the surface, which comes in contact with the bolt head.

(i) Degrease all of the boss hole and the shaft which comes in contact.

(ii) Slide the clamp collar on the hollow shaft. Do not tighten the mounting bolt at this point.

(iii) Slide the driven shaft or reducer to place the driven shaft in the hollow shaft.

(iv) Tighten mounting bolt to some extent. Make sure to place the surface of both plates in parallel when tightening bolts. A wrench with short handle is suitable for this purpose.

(v) Make sure that the clamp collar is set correctly. Tighten bolts gradually using a wrench with suitable length (to apply necessary torque).

Tighten each bolt evenly while maintaining both plates parallel. Tighten bolts little-by-little in the clockwise order, not diametrically opposite to each other. We recommend turning each bolt 30° each time.

(vi) Make sure to check the clamp collar with a torque wrench after tightening torque collar. Specified torque is shown on the nameplate of the clamp collar.

(vi) Make shore that both plates are parallel.

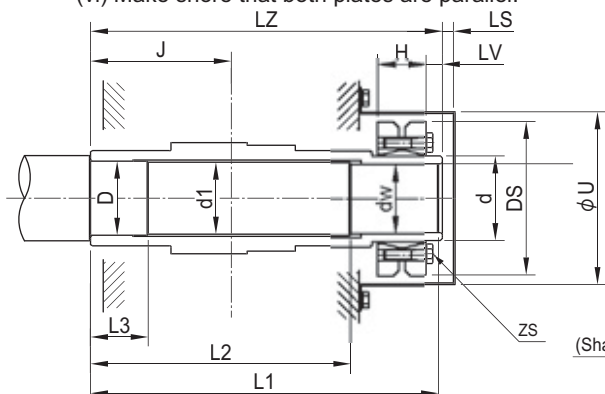


Fig. 9 Clamp Collar Type
Hollow shaft dimensions

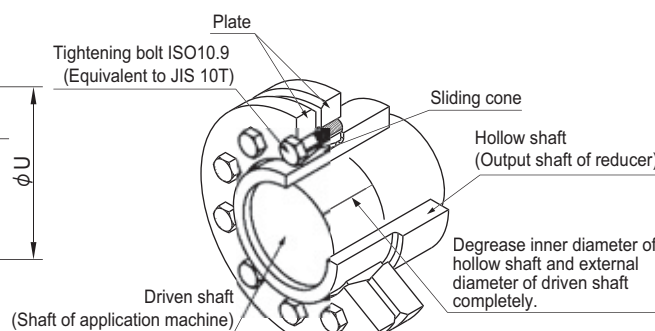


Fig. 10 Clamp Collar Structure

Table 2 Reference Dimension for Designing Clamp Collar

Frame size	Clamp collar			Mounting bolt		Hollow shaft					Driven shaft (Recommended designing dimension.)						
	Nomenclature	d	DS	H	ZS	TA [Nm]	J	LZ	LV	LS	U	dw	d1	D	L1	L2	L3
72	S-60X75	75	138	32	M8	30	116	274	5	26	155	60h6	60.5	61h7	271	217	47
82	H-65X80	80	145	46	M10	59	133	322	5	12	163	65h6	65.5	66h7	319	251	47
92	H-70X70	70	155	50	M10	59	141.5	343	5	16	183	70h6	70.5	71h7	340	268	54
102	H-80X110	110	185	60	M10	59	160	400	15	21	203	80h6	81	82h7	397	305	75
112	S-90X125	125	215	54	M10	59	181	438	17	31	233	90h6	81	92h7	435	347	81

Table 3 Specified Tightening Torque of Mounting Bolt

Bolt (ISO 10.9 JIS 10T)	M5	M6	M8	M10	M12	M16	M20	M24	M27
Tightening torque [Nm]	6.9	11.8	29.4	57.8	98	245	480	823	1225

7) Removal of Clamp Collar

- Conduct removal of clamp collar in the opposite steps of attachment method.
- Tighten bolt in order while not letting both plates tilt on the sliding cone.
- Never remove bolt when both plates are not parallel to each other. Both plates may pop out from the sliding cone suddenly, causing injury.

Instead, first tighten all bolts lightly, and insert a wedge between two plates to make them parallel.

(2) Mounting on to Driven Machine

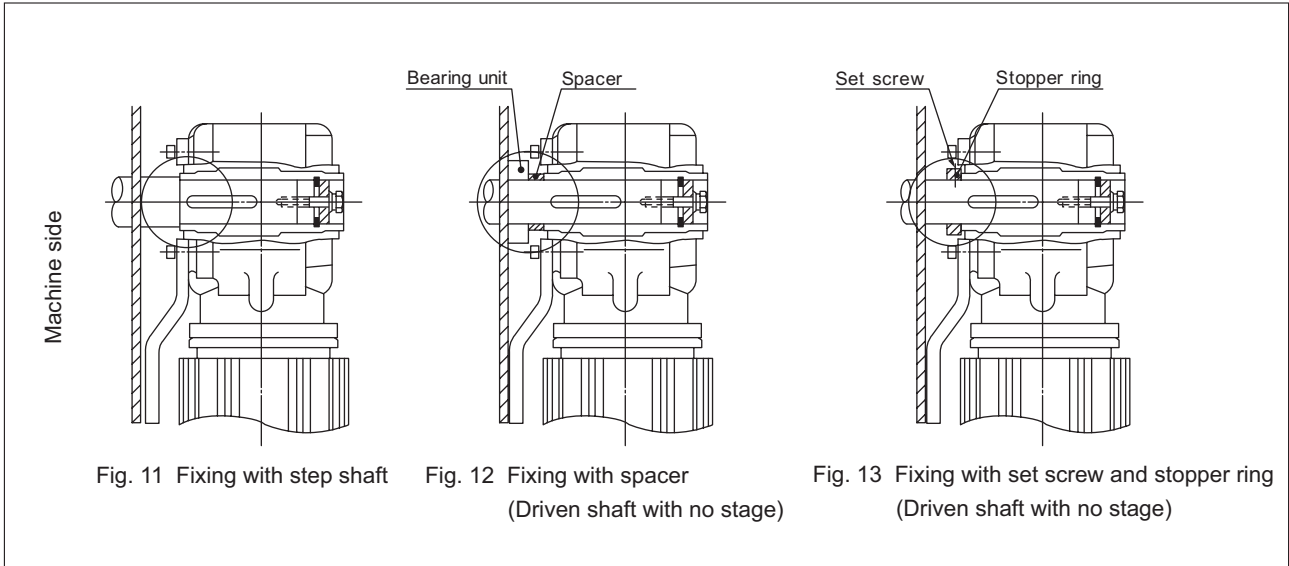
- Take care when coupling the driven shaft with the hollow shaft. The case of the gearmotor or speed reducer should not be gouged generating excessive force.

Securing Hollow Shaft to Torque Arm

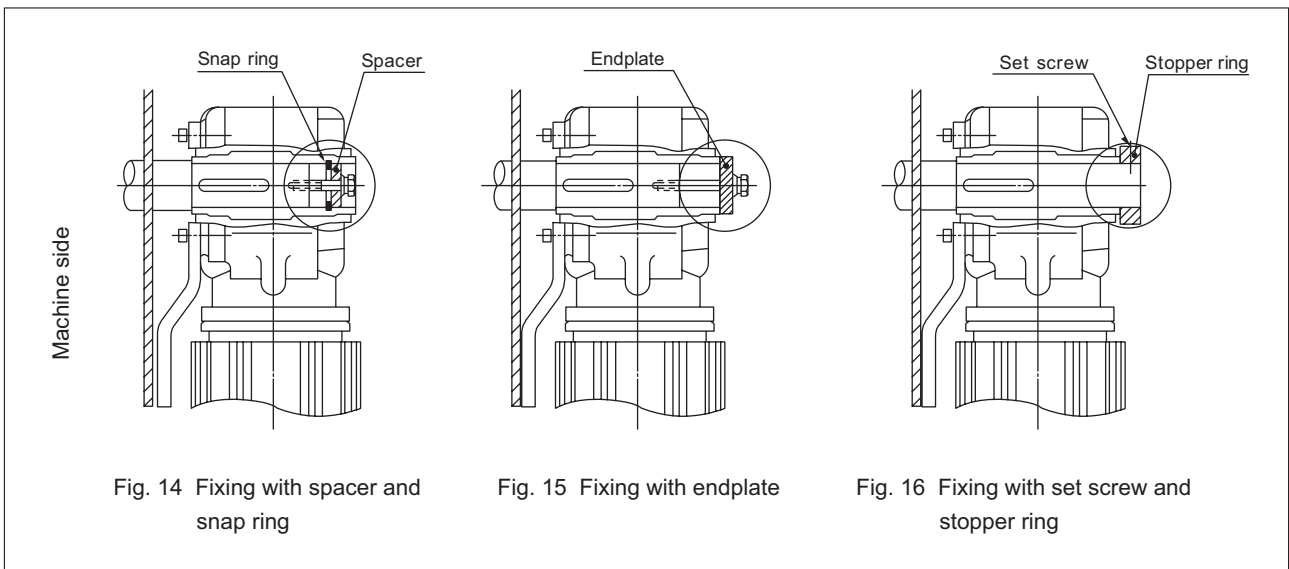
(a) Fixing on to driven shaft

Be sure to secure the gearmotor on the driven shaft.

Example of fixing gearmotor to prevent moving to the machine side (Overhead KHYM-72-Y1)



Example of Fixing gearmotor to prevent moving opposite side of the machine side (KHYM- 72-Y1 viewed from above)



(b) Locking by Torque Arm

Allow some degree of freedom when attaching locking part. No excess force should be exerted between gearmotor and driven shaft.

Never secure the torque arm with locking bolts.

Torque arm may be used only when the drive is operated in one direction, continuously or when starting frequency is low.

Use rubber bush to reduce shock between torque arm and mounting bolt (or spacer) when startup frequency and when starting-stop frequency is frequent.

(i) Attachment of "Attachment-Type Torque Arm"

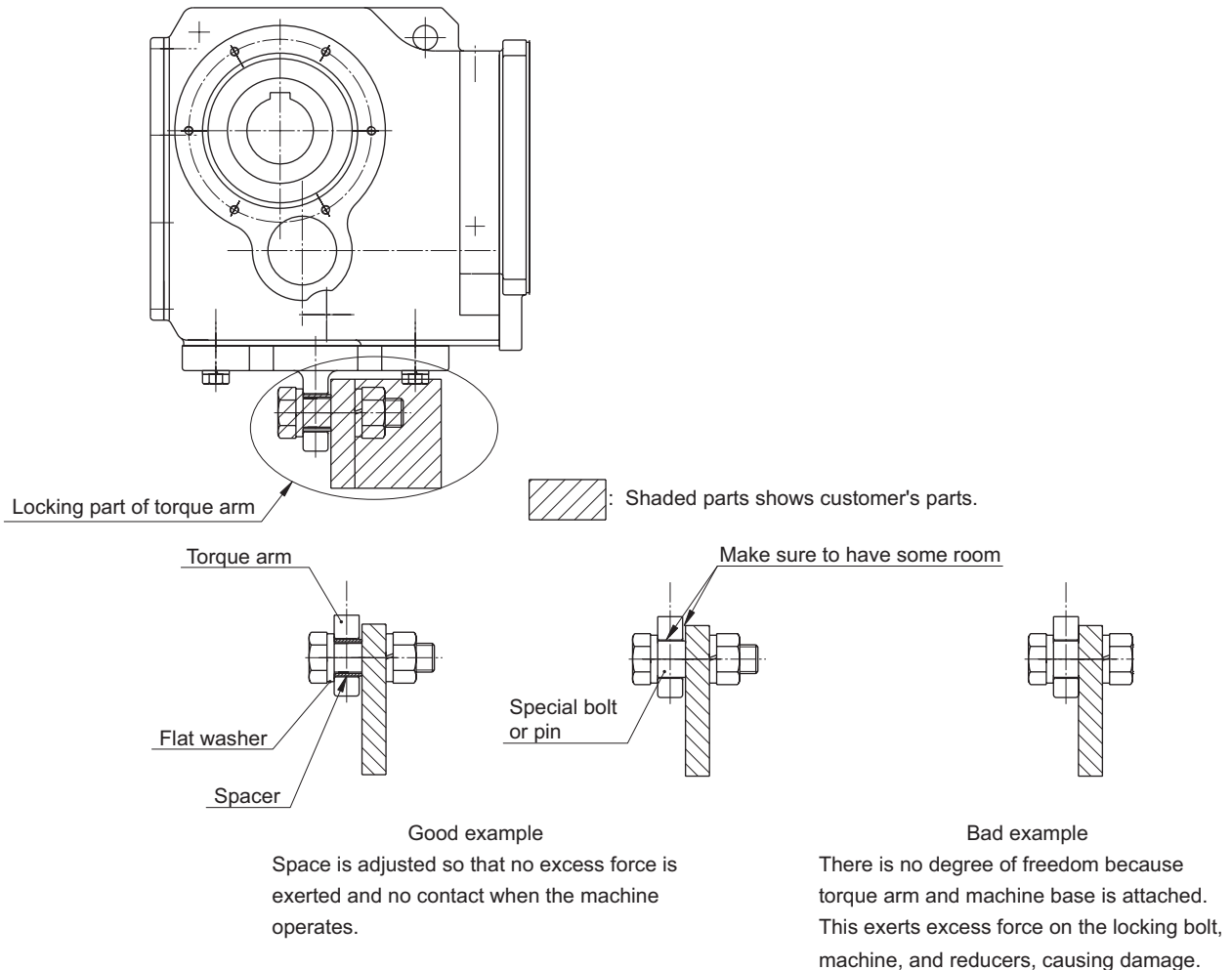


Fig. 17 Attachment Example of Torque Arm Locking

(ii) Attachment of "Plate-Type Torque Arm"

Attach torque arm to the driven machine side of the gearmotor casing.

Use hexagon socket head bolt for attachment (Refer to Table 4 for sizes).

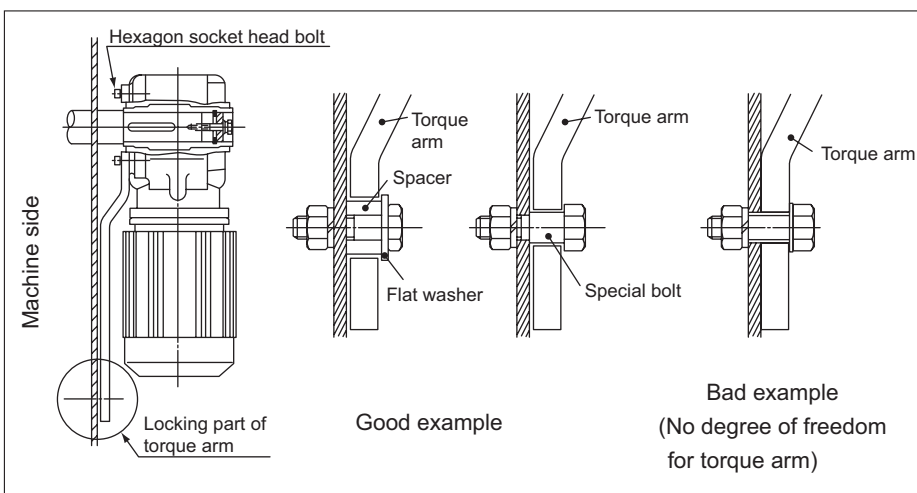


Table 4 Size of Hexagon Socket Head Bolt

Frame Size	Bolt
72, 72DA	M12
82, 82DA	M12
92, 95, 92DA	M16
102, 105, 102DA	M16
112, 115, 112DA	M20

This table is applicable for previous frame sizes. (For example, previous frame size of 72 is 70 and 71.)

Fig. 18 Attachment Example of Plate Type Torque Arm (Overhead view of KHYM-72-Y1)

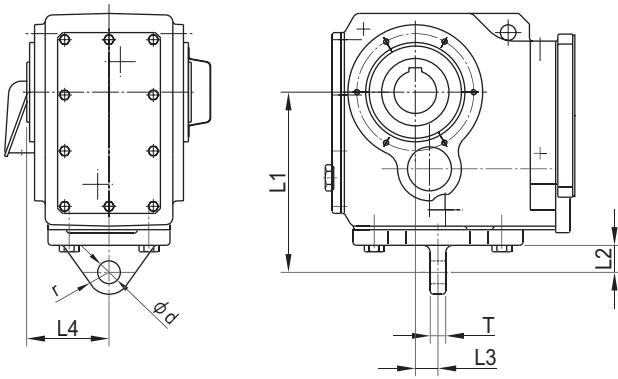


Table 5

Frame size	L1	L2	L3	L4	T	r	φd
72	254	38	32	116	22	31	32
82	288	44	35	133	26	40	40
92, 95	320	47	35	142	28	40	40
102, 105	370	58	47.5	160	32	45	50
112, 115	387	59	47.5	181	36	50	50

Fig. 19 Torque Arm Dimension of Attachment Type (Optional)

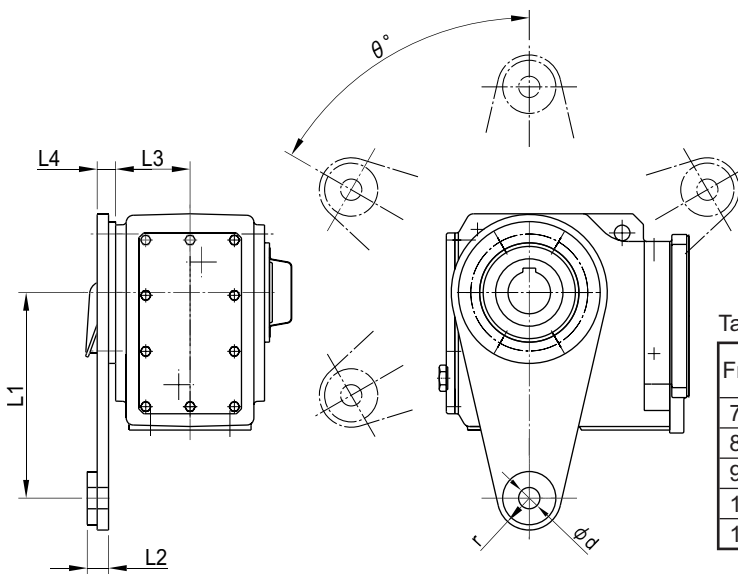


Table 6

Frame size	L1	L2	L3	θ	T	r	φd H9
72	290	105	26	60	30	45	30
82	310	121	28	45	30	45	30
92, 95	360	128	31	60	35	55	35
102, 105	400	146	35	60	35	55	35
112, 115	460	164	38	60	40	60	42

Fig. 20 Torque Arm Dimension of Plate Type (Optional)

Attachment of Hollow Shaft Type Flange (Optional)

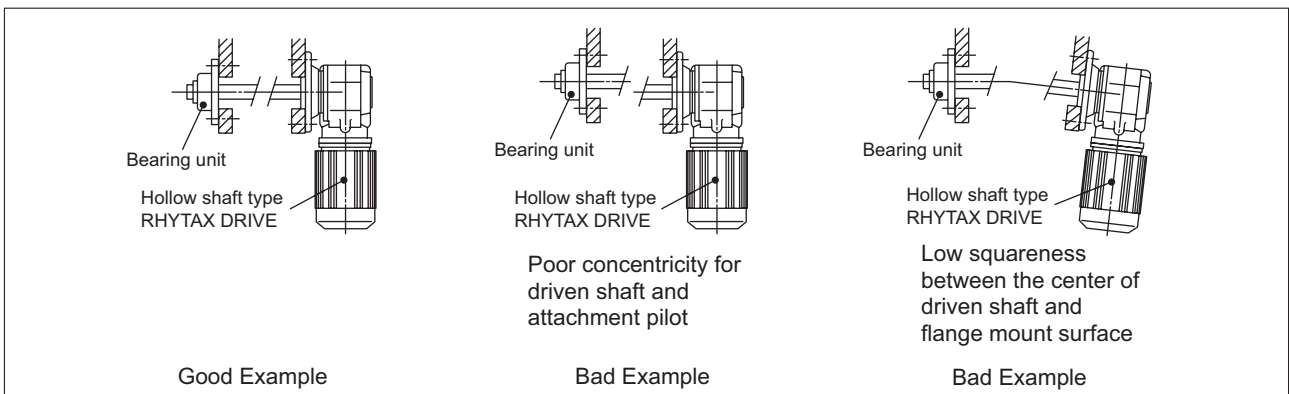


Fig. 21 Attachment Example of Flange Mount (Overhead view of KHYM-72-K1)



6. Wiring

- Following explanation is for standard **Sumitomo three-phase motor**. Follow related motor maintenance manual when using motor with **brake or motor manufactured by other companies**.

⚠ DANGER

- Do not handle the unit when cables are live. Be sure to turn off the power; otherwise, electric shock may result.
- Connect a power cable to the unit according to the diagram shown inside the terminal box or in the maintenance manual; otherwise, electric shock or fire may result.
- Do not forcibly curve, pull, or clamp the power cable and lead wires; otherwise, electric shock or fire may result.
- Correctly ground the grounding bolt; otherwise, electric shock may result.
- The lead-in condition of an **explosion-proof type motor** shall conform to the facility's electrical codes, extension regulations and explosion-proofing guide, as well as the maintenance manual; otherwise, electric shock, personal injury, explosion, fire or damage to the equipment may result.

⚠ CAUTION

- When wiring, follow the facility's electrical codes and extension regulations; otherwise, burning, electric shock, injury, or fire may result.
- The motor is not equipped with a protective device. However, it is compulsory to install an overload protector according to facility electrical codes. It is recommended to install other protective devices (earth leakage breaker, etc.), in addition to an overload protector, in order to prevent burning, electric shock, injury, and fire.
- Do not touch the terminals when measuring insulation resistance; otherwise, electric shock may result.
- **When using a star-delta starter**, select one with an electromagnetic switch on the primary side (3-contact type); otherwise, fire may result.
- When using a **400V-class inverter** to drive the motor, mount a suppresser filter or reactor on the inverter side, or provide reinforced insulation on the motor side; otherwise, dielectric breakdown may cause fire or damage to the equipment.
- **When driving an explosion-proof type motor with an inverter**, use one inverter for one motor. Use the approved inverter for the motor.
- When measuring the insulation resistance of an **explosion-proof type motor**, confirm that there is no gas, steam, or other explosive substance in the vicinity, in order to prevent possible explosion or ignition.

- Voltage drop becomes large when the wiring is long. Select wire diameter to make voltage drop less than 2%.
- Attach terminal box cover securely for **outdoor motor and explosion-proof motor**. Make sure that mounting bolts are secure for attaching terminal box after wiring.

6-1) Attaching and Removing Terminal Box Cover (**0.4kW Three-Phase Motor**)

(1) Removal Method

Pull off the side of terminal box as shown in Fig. 22.

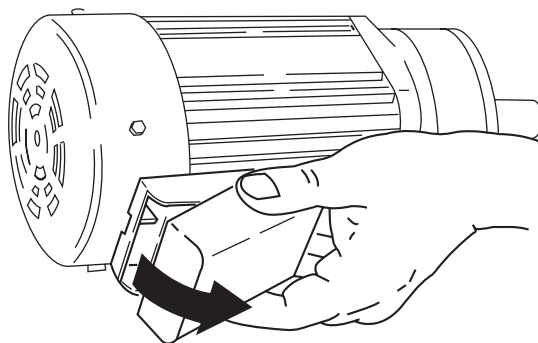


Fig. 22

(2) Attachment Method

Press the terminal box cover on to the terminal box case until it clicks into place.



6-2) Measure Insulation Resistance

- Measure the individual motor. Always disconnect motor from the control panel before measurement.

Measure the insulation resistance before wiring. Insulation (R) changes by motor output, voltage, type of insulation, temperature of coil, level of fouling, operating period, and the time with voltage applied during test. In general, insulation resistance must be greater than the value shown in Table 7.

Table 7 Value of Insulation Resistance

Mega voltage	Insulation Resistance (R)
500V	1MΩ or larger

Reference: The following inequalities are shown in JEC-2100.

$$R \geq \frac{\text{Rated voltage [V]}}{\text{Rated output [kW]} + 1000} \quad [\text{M}\Omega]$$

$$R \geq \frac{\text{Rated voltage [V]} + (\text{Number of revolutions per minute}/3)}{\text{Rated output [kW]} + 2000} + 0.5 \quad [\text{M}\Omega]$$

Do not turn the power on when insulation resistance is low. Contact the nearest agent, distributor, or sales office. Defective insulation may cause drop in insulation resistance.

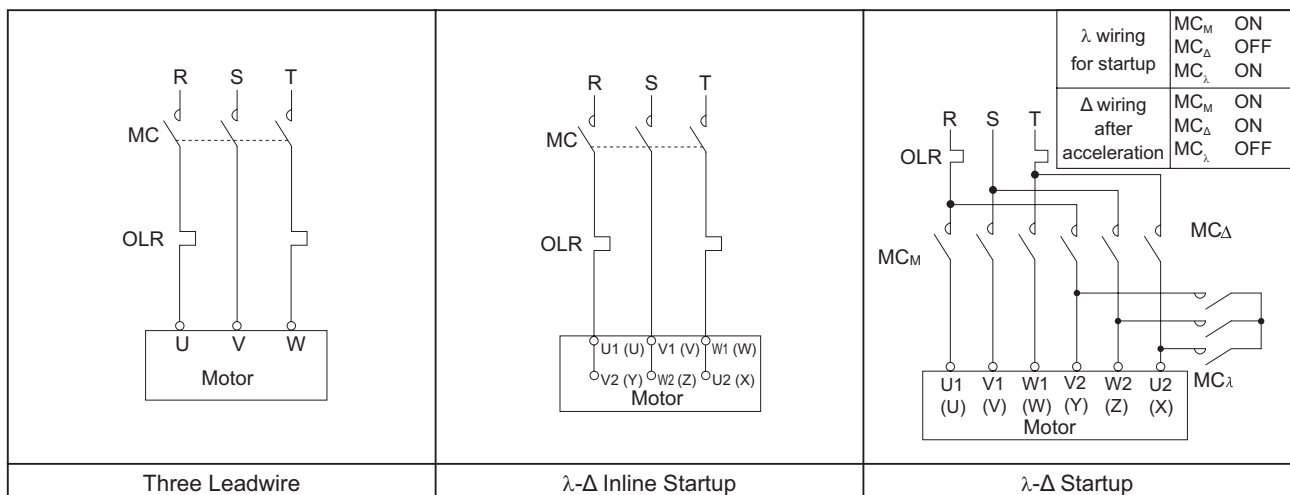
6-3) Coordination of Protection System

- (1) Use a circuit breaker to protect against short-circuiting
- (2) Use an overload protector to protect from current exceeding the rated current shown in the nameplate.
- (3) **For increased safety explosion-proof motor:** Use an overload protector to protect within the allowable locking time with locked rotor current shown on the nameplate.

6-4) Motor Wiring

Fig. 23 shows the standard specification of motor wiring and terminal code.

Fig. 23 Motor Wiring and Terminal Code



Note: () shows Previous motor terminal code.

MC: Electromagnetic switch
 OLR: Overload protector
 — To be provided by the customer

7. Operation

⚠ DANGER

- Do not approach or touch rotating parts (output shaft, etc.) during operation; loose clothing may become caught in these rotating parts and cause serious injury or death.
- Make sure to turn off the power switch when the power supply is interrupted. Unexpected resumption of power may cause electric shock, personal injury, or damage to the equipment.
- Do not operate the unit with the terminal box cover removed. Return the terminal box cover to the original position after maintenance, in order to prevent electric shock.
- Do not open the terminal box cover when power is supplied to an **explosion-proof type motor**; otherwise, explosion, ignition, electric shock, personal injury, fire, or damage to the equipment may result.

⚠ CAUTION

- Do not put fingers or foreign objects into the opening of the gearmotor or reducer; otherwise electric shock, personal injury, fire, or damage to the equipment may result.
- Do not touch the gearmotor or reducer unit during operation. The unit becomes very hot and may cause burns.
- Do not loosen the oil filler plug during operation; otherwise, hot, splashing lubricant may cause burns.
- Stop the operation immediately if any abnormality occurs during operation; otherwise, electric shock, personal injury, or fire may result.
- Do not exceed rated load; otherwise, it may cause personal injury, or damage to the equipment.

- Supply the RHYTAX DRIVE unit with recommended oil before operation. Oil is drained from the unit before shipping.

Install, supply oil, and wire the unit. Then make sure of the following before operation.

- (1) Wiring is correct.
- (2) Coupling with the driven machine is correct.
- (3) Mounting bolts are tightened firmly.
- (4) The unit rotates in the expected direction.
- (5) Oil level settles at the center of the oil gauge when the unit is at stop.

After the check, start a trial run with no load and apply load gradually.

Make sure of the following list is "true" for trial run.

Table 8 Checklist for Trial Run

There is no abnormal noise or vibration	<ol style="list-style-type: none"> (1) The housing is not distorted due to uneven installation surface. (2) Installation base is not generating excessive noise because on insufficient rigidity. (3) Shaft center of the unit and driven machine is aligned. (4) The vibration of the driven machine is not conducted to the gearmotor or reducer.
Surface temperature of the gearmotor or reducer is not abnormally hot	<ol style="list-style-type: none"> (1) Voltage rise and drop is not large. (2) Ambient temperature of the operation location is not high. (3) For gearmotors: Operating current does not exceed rated current shown on the nameplate.

When any abnormality is found, stop operation and contact our nearest agent, distributor, or sales office.

8. Daily Inspection and Maintenance

⚠ DANGER

- Do not handle the unit when cables are live. Be sure to turn off the power; otherwise, electric shock may occur.
- Do not approach or touch any rotating parts (output shaft, etc.) during maintenance or inspection of the unit; loose clothing may become caught in these rotating parts and cause serious injury or death.
- Do not disassemble or modify **explosion-proof type motors**; otherwise, explosion, ignition, electric shock, or damage to the equipment may occur.
- Conform to the facilities' electrical codes, extension regulations, and explosion-proofing guide, as well as the maintenance manual **explosion-proof type motor**; otherwise, explosion, ignition, electric shock, or damage to the equipment may occur.

⚠ CAUTION


- Do not put fingers or foreign objects into the opening of the gearmotor or reducer; otherwise electric shock, personal injury, fire, or damage to the equipment may result.
- The gearmotor or reducer becomes very hot during operation. Touching the unit may result in burns.
- Do not touch the terminal when measuring insulation resistance; otherwise, electric shock may occur.
- Do not operate the unit without a safety cover in place to shield rotating parts; otherwise loose clothing may become caught in the unit and cause serious injury.
- Promptly identify and correct any abnormalities observed during operation following the instructions in this maintenance manual. Do not operate until abnormality is corrected.
- Change lubricant following the maintenance manual instructions. Be sure to use our recommended lubricant.
- Drain lubrication oil before mounting, moving, or transporting the unit.
Moving the unit with oil may cause leak of oil from the labyrinth seal (of input side of reducer) to the inside of motor.
- Do not change lubricant during operation or immediately after stopping; otherwise, burns may occur.
- Supply/discharge grease to/from the motor bearing following the maintenance manual instructions. Avoid contact with rotating parts; otherwise, injury may occur.
- Do not operate damaged gearmotors or reducers; otherwise, injury, fire, or damage to the equipment may occur.
- We do not assume any responsibility for damage or injury resulting from an unauthorized modification by a customer.
- Dispose of the gearmotor or reducer lubricant as general industrial waste.
- Make sure that there is no gas, steam, or other explosive substance around the unit when measuring the insulation resistance of an **explosion-proof type motor** to prevent explosion or ignition.

- Overhaul every 20,000 hours or 3~5 years of operation is recommended for RHYTAX DRIVE. Although it may vary on the operation condition, regular overhaul allows longer lifetime.
- Do not overhaul the unit by yourself. Overhaul of gearmotor and reducer requires experience. Have it conducted at our specialized factory.

8-1) Daily Inspection

Conduct daily inspection following Table 9. Insufficient inspection may cause trouble.

Table 9 Daily Inspection

Inspection item		Details of inspection
Electric current		The current is lower than the rated current shown on the nameplate.
Noise		There is no abnormal noise. There is no sudden change in sound.
Vibration		There is no excessive vibration. Vibration does not change suddenly.
Surface temperature		Surface temperature is not abnormally high. Surface temperature dose not rise suddenly. The temperature rise during operation differs according to the models. When the difference between the temperature of the gear surface and the ambient temperature is approximate 60°C there will be no problem if there is no fluctuation.
Oil level (Oil-lubricated model)	At rest	Oil level is at the middle of oil gauge at rest. • Add lubrication oil to the upper red line when oil level is between two red lines. Do not add oil during operation.
	In operation	There is no significant change of oil level compared to the usual oil level. • Use the lower red line to help your oil level check. Oil level may become lower than this line during operation according to the rotational speed and direction.
Lubrication oil degradation		Lubrication oil is clean. • Check lubrication oil by sampling oil at stop or by observing oil gauge. Change oil gauge soon when it starts to become dirty.
Oil or grease leakage		Grease does not leak from the gear section.
Foundation bolt		Foundation bolts are tight.
Chain and V-belt		Chain and V-belt are tight.

When any abnormality is found, take corrective measures listed in "10. Troubleshooting (pages 20 and 21)." Contact our nearest agent, distributor or sales office if the abnormality can not be corrected.

8-2) Lubrication Method

- Make sure to supply and replace lubricants as specified. Insufficient care may cause trouble.

- All models utilize oil bath for lubrication system.
- Bearing part of output shaft and input side gear (CYCLO) part of reduction ratio 170~545 can be used right away. They are lubricated by grease at the time of shipping.

8-3) Oil Supply and Change for **Oil Lubrication Parts**

(1) Oil Change Timing

Table 10 Oil Change Interval

Oil supply	Change time		Duration of operation
	At the time of purchase		
Oil change	First time	After 500 hours	—————
		Once/6 months	Up to 10 hours operation/day
	Second time and after	Once/2,500 hours	10-24 hours operation/day
		Once/1-3 months	Under special environment, such as high temperature, high humidity, and active gas

*Take sufficient measure following "10. Troubleshooting" on page 20 when the oil gauge is found to be dirty in the daily inspection, regardless of the above timing.

(2) Recommended Oil

Make sure to use the recommended oil shown in Table 11.

Table 11 Recommended Lubricants (Equivalent to SP type industrial high-pressure gear oil or JIS K2219)

Ambient temperature [°C]	Cosmo Oil	Nippon Oil	Idemitsu Kosan	Shell Oil	Exxon Mobil		Japan Energy	Gulf Oil	Caltex Oil	BP Oil
-10~+25	Cosmo Gear SE150	Bonnock M150	Daphne Super Gear Oil 150S	Omala Oil 150	Spartan EP150	Mobil Gear 629 (ISO VG 150)	JOMO Reductus 150	EP Lubricant HD150		Energol GR-XP 150
+10~+40	Cosmo Gear SE220	Bonnock M220	Daphne Super Gear Oil 220S	Omala Oil 220	Spartan EP220	Mobil Gear 630 (ISO VG 220)	JOMO Reductus 220	EP Lubricant HD220	Meropa 220	Energol GR-XP 220
+30~+50	Cosmo Gear SE320	Bonnock M320	Daphne Super Gear Oil 320S	Omala Oil 320	Spartan EP320	Mobil Gear 632 (ISO VG 320)	JOMO Reductus 320	EP Lubricant HD320	Meropa 320	Energol GR-XP 320

(3) Amount of Oil

Table 12-1~12-3 shows approximate quantity of necessary oil. Make sure of the oil level through the oil gauge.

Table 12-1 Oil Supply quantity for Hollow Shaft Type

[Unit: ℓ]

Mounting position	Y1	Y2	Y3	Y4	Y5	Y6
	F1	F2	F3	F4	F5	F6
Frame size	G1	G2	G3	G4	G5	G6
72, 72DA	2.2	8.8	5.7	8.8	3.2	5.7
82, 82DA	3.3	12.8	8.5	12.8	5.0	8.5
92, 95, 92DA	4.4	16.5	11.1	16.5	6.7	11.1
102, 105, 102DA	6.6	24.2	16.4	24.2	10.1	16.4
112, 115, 112DA	8.7	31.6	21.5	31.6	13.3	21.5

Table 12-2 Oil Supply Quantity for Solid Shaft Type (1)

[Unit: ℓ]

Mounting position	F1	F2	F3	F4	F5	F6
	G1	G2	G3	G4	G5	G6
Frame size	G1	G2	G3	G4	G5	G6
72, 72DA	2.2	8.8	5.7	8.8	3.2	5.7
82, 82DA	3.3	12.8	8.5	12.8	5.0	8.5
92, 95, 92DA	4.4	16.5	11.1	16.5	6.7	11.1
102, 105, 102DA	6.6	24.2	16.4	24.2	10.1	16.4
112, 115, 112DA	8.7	31.6	21.5	31.6	13.3	21.5

Table 12-3 Oil Supply Quantity for Solid Shaft Type (2)

[Unit: ℓ]

Mounting position Frame size	K1	K2	K3	K4	K5	K6
	V2					
72, 72DA	2.1	8.5	5.5	8.5	3.1	5.5
82, 82DA	2.9	11.3	7.5	11.3	4.4	7.5
92, 95, 92DA	3.8	14.5	9.7	14.5	5.8	9.7
102, 105, 102DA	6.3	23.4	15.8	23.4	9.7	15.8
112, 115, 112DA	7.7	28.0	19.0	28.0	11.8	19.0

(4) Oil Supply

- Make sure that the unit is at stop when filling oil.
- Be careful not to overfill. It may take some time for the oil to settle when the oil viscosity is high.
- No additional oil is necessary when the oil level lowers during operation. Make sure that the oil level is sufficient when the unit is at stop.

- (1) Remove the oil filler plug.
- (2) Fill the oil through oil filler port while checking the oil level through the oil gauge.
- (3) Fill the oil to the upper line of the oil gauge.
- (4) Replace the oil filler plug.

(5) Oil Discharge

Remove the drain plug and discharge oil.

8-4) Grease Replacement for **Grease Lubricated Part**

- The part may be used for a long time safely without replacing grease, because the unit contains long-lifetime grease. However, grease replacement along with the overhaul every 20,000 hours or 3~5 years of operation is recommended for RHYTAX DRIVE. Although it may vary on the operation condition, regular overhaul allows longer lifetime.
- Do not overhaul the unit by yourself. Overhaul of gearmotor and reducer requires experience. Have it done at or specialized factory.

9. Disassembly and Assembly

⚠ DANGER

- Do not disassemble or modify **explosion-proof time motors**; otherwise, explosion, ignition, electric shock, or damage to the equipment may occur.

⚠ CAUTION

- Always conduct disassembly and assembly at our specialized factory. Contact position and clearance of bearing must be adjusted with high precision to exert sufficient performance.

10. Troubleshooting

Refer to Table 13-1 and 13-2 and take corrective action as soon as possible if any problem occurs to gearmotor or reducer. If the problem can not be eliminated, contact out nearest agent, dealer, or sales office.

Table 13-1 Troubleshooting





Problem		Possible cause	Correction
 <p>The motor does not operate under no load.</p>		Power failure	Contact the electric power company.
		Defective electric circuit	Check the circuit.
		Blown fuse	Replace the fuse.
		Protective device is engaged	Fix the problem and recover.
		Load locking	Check the load and safety device.
		Poor switch contact	Adjust the contact area.
		Disconnection of motor stator coil	Return the unit to factory for servicing.
		Bearing is broken	Replace the bearing.
	3-phase is functioning as single-phase	Check the power supply with a voltmeter. Check the motor, coil in the transformer, contact, fuse, etc. and repair or replace them.	
The motor runs without a load, but the output shaft does not rotate.		Damage due to overloading of gears	Return the unit to factory for servicing.
<p>The output shaft turns without a load</p> <p>When a load is applied</p>	The switch is heated.	Insufficient capacity of switch	Replace with specified switch.
		Overload	Decrease the load to the specified value.
	Fuse trips.	Insufficient capacity of fuse	Replace with specified fuse.
		Overload	Decrease the load to the specified value.
	The speed will not increase and the motor is overheating.	Voltage drop	Contact the electric power company.
		Overload	Decrease the load to the specified value.
		Short-circuited motor stator coil	Return the unit to factory for servicing.
	The motor stops.	The key is missing	Install a key.
		The bearing is burned	Replace the bearing.
		Poor adjustment of protective device	Adjust the protective device.
	The motor runs in the reverse direction.	Connection error	Change the connection.
	Fuse trips.	The outlet wire is short-circuited	Return the unit to factory for servicing.
	Poor contact between motor and starter	Complete the connection.	
Temperature rise excessively.		Overload	Decrease the load to the specified value.
	Voltage drop or rise	Contact the electric power company.	
	The ambient temperature is high	Improve the ventilation method.	
	Damaged bearing	Replace the bearing.	
	Abnormal wear of cycloid disk due to overloading	Replace the cycloid disk.	
Oil leakage	Oil/grease leaks from high speed/slow speed shaft section.	Damaged oil seal	Replace the oil seal.
	Oil/grease leaks from the contact surfaces of frame and outside cover.	Loose bolts	Tighten bolts correctly.
	Oil/grease leaks into motor.	Damaged oil seal	Return the unit to factory for servicing.
		Excessive oil/grease supply	Remove excess oil/grease.
Abnormal noise is generated. Abnormal vibration is generated.		Entry of dust and foreign matter into bearings or damaged bearings	Replace the bearing.
	Entry of foreign matter into cycloid disk	Remove the foreign matter and check the damage.	
	Distortion of housing because the installation surface is not flat	Make the installation base flat or make adjustment using shims.	
	Resonance due to insufficient rigidity of installation base	Reinforce the installation base to increase rigidity.	
	Nonalignment of shaft with driven machine	Align the shaft centers.	
	Transmission of vibration from the driven machine	Individually operate the gearmotor or reducer to check the source of the sound.	
Abnormal noise comes from motor.		Entry of foreign matter	Remove the foreign matter.
		Damaged bearings	Replace the bearing.
Oil gauge is dirty.		Soiling of lubrication oil	Replace lubrication oil and clean or replace oil gauge.
		Damaged gear	Repair at specified factory.

Table 13-2 Troubleshooting

	Problem	Possible cause	Correction
Inverter tripping	Shut-off due to overcurrent occurs.	Sudden acceleration/deceleration	Increase the acceleration/deceleration time.
		Sudden change in load	Decrease the load change.
	Grounding overcurrent occurs.	Grounding on the output side	Make correction to eliminate grounding.
	DC overcurrent occurs.	Short-circuiting on the output side	Make correction to eliminate short-circuiting. Check cables.
	Shut-off due to regenerative overvoltage occurs.	Sudden deceleration	Increase the deceleration time. Reduce the braking frequency.
	Thermal relay operates.	Overloading	Decrease the load to the specified value.

11. Construction Drawing

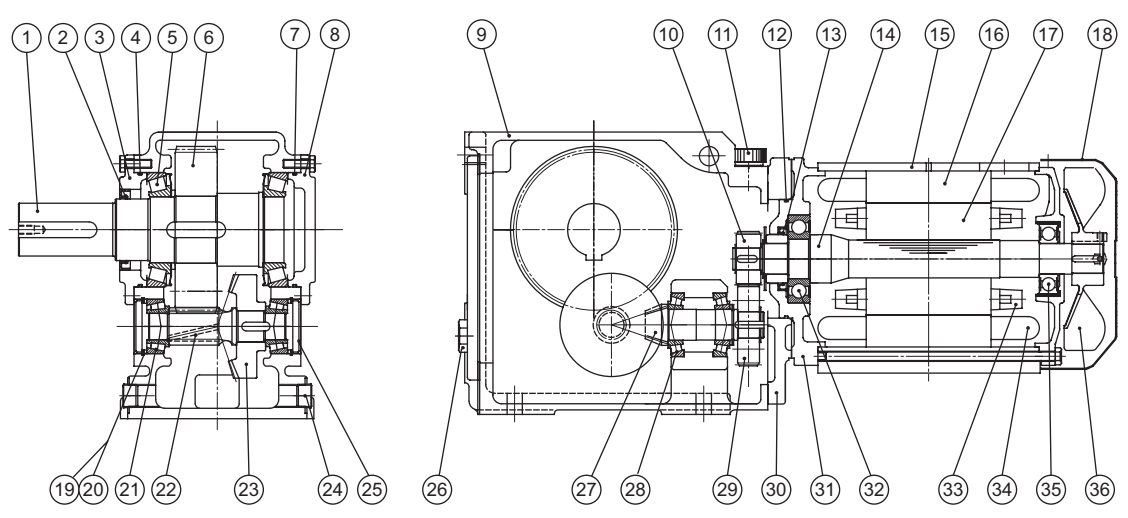


Fig. 24 Foot Mount Type Gearmotor (Example: KHHM-72R-K1)

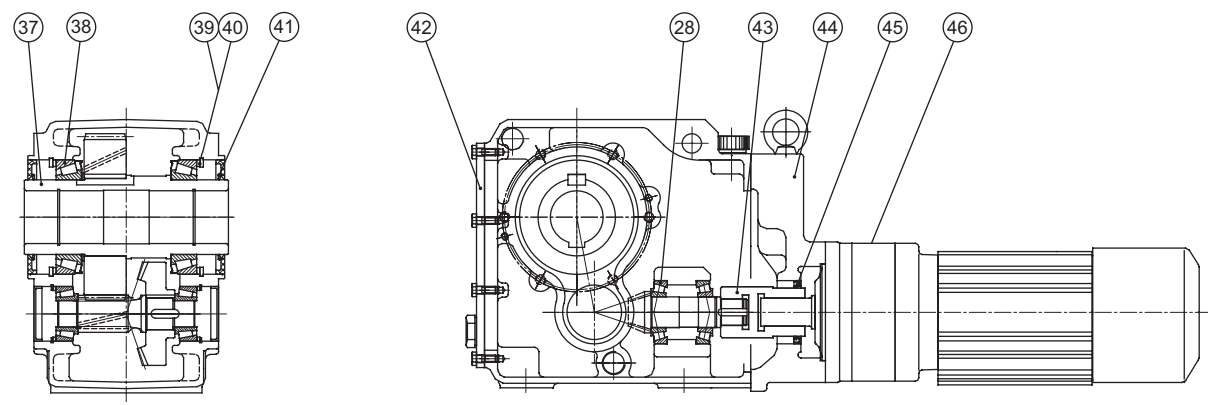


Fig. 25 Hollow Shaft Type Gearmotor (Example: KHYM-72DA-Y1)

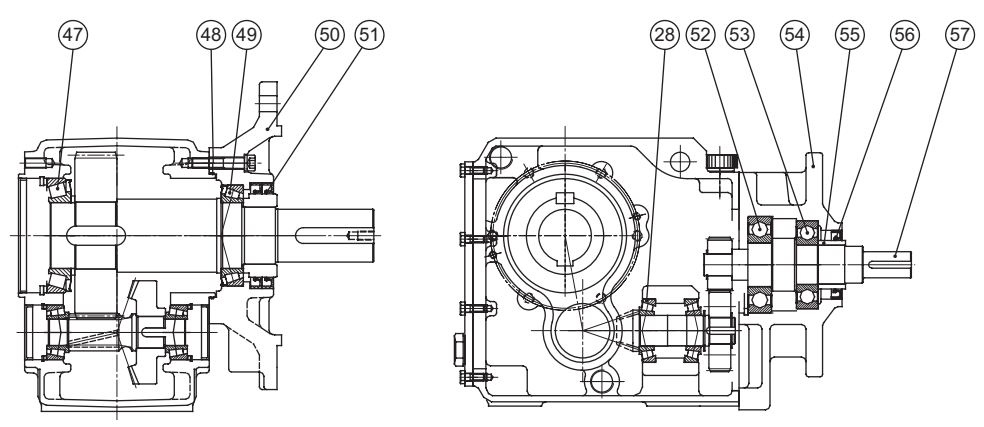


Fig. 26 Flange Mount Type Reducer (Example: KHF-72L-F1)

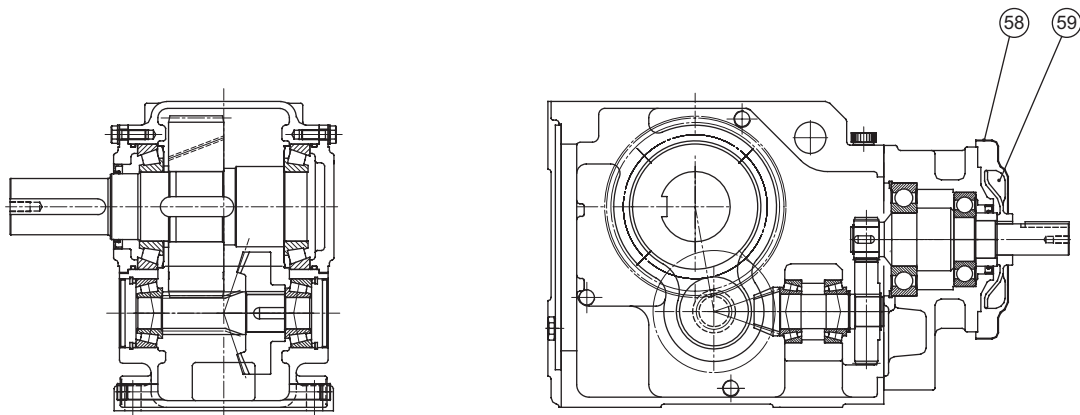


Fig. 27 Foot Mount Type Reducer (Example: KHH-115R-K1)

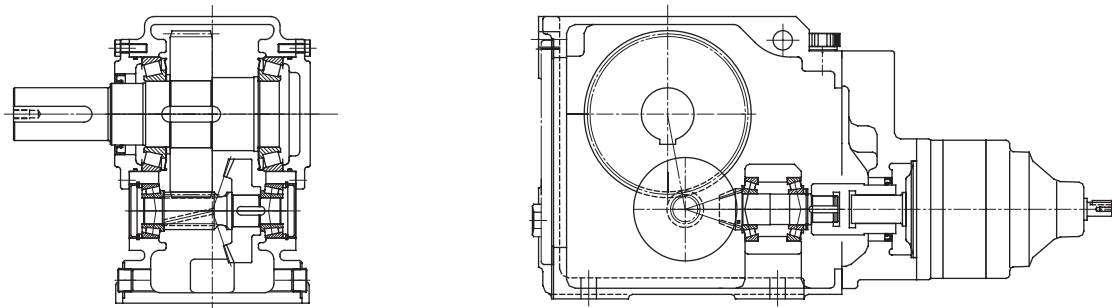


Fig. 28 Foot Mount Type Reducer (Example: KHH-72DAR-K1)

Table 14 Major Parts

Part No.	Part name	Part No.	Part name	Part No.	Part name	Part No.	Part name
1	Output shaft	16	Stator core	31	Motor joint cover	46	CYCLO DRIVE
2	Oil seal	17	Rotor core	32	Bearing	47	Bearing
3	Output side cover (1)	18	Fan cover	33	Rotor conductor	48	O-ring
4	O-ring	19	Snap ring for C-type hole	34	Rotor coil	49	Bearing
5	Bearing	20	Spacer	35	Bearing	50	Flange
6	Gear (third stage)	21	Bearing	36	Fan	51	Oil seal
7	O-ring	22	Pinion (third stage)	37	Hollow shaft	52	Bearing
8	Output side cover (2)	23	Bevel gear	38	Bearing	53	Bearing
9	Casing	24	Oil drain plug	39	Snap ring for C-type hole	54	Input shaft cover
10	Pinion (first stage)	25	Seal cap	40	Spacer	55	Collar
11	Oil filler plug	26	Oil gauge	41	Oil seal	56	Oil seal
12	O-ring	27	Bevel pinion	42	Casing cover	57	Input shaft
13	Oil seal	28	Bearing	43	Coupling bush	58	Fan cover
14	Motor shaft	29	Gear (first stage)	44	Coupling cover	59	Fan
15	Motor frame	30	Joint plate	45	Oil seal		

12. Bearing and Oil Seal

12-1) Bearing

Tables 15-18 show the types of bearings for each frame size. Numbers in the table (e.g. ⑤) shows the part no. in the construction drawings (Figs. 24~28).

Table 15 Bearing for Output Shaft

Mounting method Frame size	⑤ Bearing for foot mount type (solid shaft)		③⑧ Bearing for hollow shaft type		Bearing for flange mount type (solid shaft)			
		Qty		Qty	④⑨ Shaft side	Qty	④⑦ Opposite of shaft side	Qty
72, 72DA	4T-30215	2	32017XU	2	30215XU	1	4T-30215	1
82, 82DA	30216U	2	32018XU	2	32016XU	1	30216U	1
92, 95, 92DA	30217U	2	32020XU	2	32018XU	1	30217U	1
102, 105, 102DA	30220U	2	32024XU	2	32020XU	1	30220U	1
112, 115, 112DA	30222U	2	32026XU	2	32022XU	1	30222U	1

This table is comparable to previous frame sizes (Replace 72 with 70 or 71).

Table 16 Bearing for Intermediate Shaft

Position Frame size	②① Bearing for 3rd-stage pinion shaft		②⑧ Bearing for 2nd-stage bevel pinion shaft			
		Qty	Bevel pinion side	Qty	1st-stage gear side	Qty
72, 72DA	4T-33206	2	4T-30207	1	4T-30207	1
82, 82DA	4T-33207	2	4T-32208	1	4T-30208	1
92, 95, 92DA	4T-33208	2	4T-32208	1	4T-30208	1
102, 105, 102DA	4T-32309	2	4T-33211	1	4T-33211	1
112, 115, 112DA	ET-32310	2	4T-33211	1	4T-33211	1

This table is comparable to previous frame sizes (Replace 72 with 70 or 71).

Table 17 Bearing for Motor Shaft

(Reduction Ratio: 10~120)



Frame size	Motor capacity	③② Bearing on load side of motor		③⑤ Bearing on anti-load side of motor	
			Qty		Qty
72 82	1.5	6207ZZ-CM	1	6204ZZ-CM	1
	2.2	6207ZZ-CM	1	6205ZZ-CM	1
92, 95	3.7, 5.5	6309ZZ-CM	1	6206ZZ-CM	1
102, 105	7.5, 11	6309ZZ-CM	1	6307ZZ-CM	1
112, 115	15	6309ZZ-CM	1	6307ZZ-CM	1
	18.5, 22, 30	6314ZZ-CM	1	6312ZZ-CM	1
	37, 45	6314ZZ-CM	1	6312ZZ-CM	1

This table is comparable to previous frame sizes (Replace 72 with 70 or 71).

Table 18 Bearing for Input Shaft

(Reduction Ratio: 10~120)



Position Frame size	⑤② Gear side		⑤③ Motor side	
		Qty		Qty
72	6310ZZ-CM	1	6309ZZ-CM	1
82	6311ZZ-CM	1	6309ZZ-CM	1
92, 95	6313ZZ-CM	1	6311ZZ-CM	1
102, 105	6317ZZ-CM	1	6314ZZ-CM	1
112, 115	6317ZZ-CM	1	6314ZZ-CM	1

This table is comparable to previous frame sizes (Replace 72 with 70 or 71).

- Consult your nearest agent, distributor, or sales office for overhaul and bearing replacement.
- Bearing number shown above is the nomenclature of products manufactured by NTN.

12-2) Oil Seal

Tables 19 ~ 23 show the types of oil seal for each frame size. Numbers in the table (e.g. ②) shows the part no. in the construction drawings (Figs. 24~28).

Table 19 Oil Seal for Output Shaft

Position Frame size	② Foot mount type (solid shaft)			④ Hollow shaft type Inner			⑤ Flange mount type (solid shaft) Inner		
	Inner Diameter × Outer Diameter × Width	Qty		Inner Diameter × Outer Diameter × Width	Qty	Inner Diameter × Outer Diameter × Width	Qty		
		L, R shaft	T shaft						
72, 72DA	D70 × 92 × 12	1	2	D85 × 130 × 10	2	D95 × 120 × 13	2		
82, 82DA	D75 × 100 × 13	1	2	D90 × 140 × 13	2	D95 × 120 × 13	2		
92, 95, 92DA	D80 × 105 × 13	1	2	D100 × 150 × 13	2	D110 × 140 × 14	2		
102, 105, 102DA	D95 × 120 × 13	1	2	D120 × 180 × 15	2	D110 × 140 × 14	2		
112, 115, 112DA	D105 × 135 × 14	1	2	D130 × 200 × 15	2	D130 × 160 × 14	2		

This table is not comparable to previous frame sizes. Consult us for previous frame sizes.

Table 20 Oil Seal for Motor Shaft (4P Standard Motor)



(Reduction ratio: 10~120)

Frame size	Motor capacity [kW]	⑬ Inner Diameter × Outer Diameter × Width	Qty
72, 82	1.5, 2.2	MHS 45 × 62 × 9	1
92, 95	3.7, 5.5, 7.5, 11, 15	MHS 55 × 72 × 9	1
102, 105			
112, 115	18.5, 22, 30, 37, 45	MHS 65 × 88 × 9	1

This table is comparable to previous frame sizes (Replace 72 with 70 or 71).

Table 21 Oil Seal for Input Shaft



(Reduction ratio: 10~120)

Position Frame size	⑥ Inner Diameter × Outer Diameter × Width	
	Qty	
72, 72DA	D 55 × 78 × 12	1
82, 82DA	D 55 × 78 × 12	1
92, 95, 92DA	D 65 × 88 × 12	1
102, 105, 102DA	D 85 × 110 × 13	1
112, 115, 112DA	D 85 × 110 × 13	1

The oil seal is made of acrylic rubber.

This table is comparable to previous frame sizes

(Replace 72 with 70 or 71).

Table 22 Oil Seal for Coupling Bushing

(Reduction ratio: 170 and larger)

Position Frame size	④ Inner Diameter × Outer Diameter × Width	
	Qty	
72DA	S 55 × 72 × 9	1
82DA	S 65 × 90 × 12	1
92DA	S 65 × 90 × 12	1
102DA	S 80 × 100 × 10	1
112DA	S 80 × 100 × 10	1

This table is comparable to previous frame sizes (Replace 72 with 70 or 71).

Table 23 Oil Seal for CYCLO (Reduction ratio: 170 and larger)

Frame size	Input size (CYCLO) frame size	Slow-speed shaft	Gearmotor	Speed reducer
			Motor shaft	High-speed shaft
72DA	5107	D 38 × 58 × 11	S20 × 35 × 7	S25 × 40 × 8
82DA, 92DA	5117	D 50 × 72 × 12	S32 × 52 × 11	S32 × 52 × 11
102DA, 112DA	5127	D 55 × 78 × 12	S32 × 52 × 11	S32 × 52 × 11

This table is comparable to previous frame sizes (Replace 72 with 70 or 71).

Table 24 Type and Shape of Oil Seal

Type	Specification	Construction	NOK LTD	Koyo Chicago Rawhide LTD
S	Circumferential rubber with spring (JIS S Type)		SC Type	MHS Type
D	Circumferential rubber with spring and dust lip (JIS D Type)		TC Type	MHSA Type

(JIS B2402-1976 oil seal)

12-3) O-Ring

Tables 25 and 26 show the types of O-rings for each frame size. Numbers in the table (e.g. ⑫) shows the part no. in the construction drawings (Figs. 24~28).

Table 25 O-Ring for Gear Section

Position Frame size	④ Casing (output side)		⑫ Casing (input side)		⑦ Bearing cover		④⑧ Flange	
	Nominal No.	Qty	Nominal No.	Qty	Nominal No.	Qty	Nominal No.	Qty
72, 72DA	1AG125	2	1AG190	1	-	1	1AS140	1
82, 82DA	1AG135	2	1AG210	1	-	1	1AG150	1
92, 95, 92DA	1AG145	2	1AG240	1	-	1	1A167	1
102, 105, 102DA	1AG170	2	1AG280	1	1AG150	1	1A169	1
112, 115, 112DA	1AG190	2	1AG280	1	1AG165	1	1A172	1

This table is not comparable to previous frame sizes. Consult us for previous frame sizes.

Table26 O-Ring for Motor (4P Standard Motor)
(Reduction ratio: 10~120)



Motor capacity [kW] Frame size	1.5-11		15-45	
	⑫ Nominal No.	Qty	⑫ Nominal No.	Qty
72	1AG130	1	-	-
82	1AG130	1	1AG130	1
92, 95	1AG130	1	1AG167	1
102, 105	1AG130	1	1AG169	1
112, 115	1AG130	1	1AG172	1

This table is comparable to previous frame sizes (Replace 72 with 70 or 71).

13. Warranty

The scope of our warranty for our products is limited to the range of our manufacture.

Warranty (period and contents)

Warranty Period	The warranty period for the Products shall be 18 months after the commencement of delivery or 18 months after the shipment of the Products from the seller's works or 12 months from the Products coming into operation, whichever comes first.
Warranty Condition	In the event that any problem or damage to the Product arises during the "Warranty Period" from defects in the Product whenever the Product is properly installed and combined with the Buyer's equipment or machines, maintained as specified in the maintenance manual, and properly operated under the conditions described in the catalog or as otherwise agree upon in writing between the Seller and the Buyer or its customers; the Seller will provide, at its sole discretion, appropriate repair or replacement of the Product, without charge, at a designated facility, except as stipulated in the "Warranty Exclusions" described below. However, if the Product is installed or integrated into the Buyer's equipment or machines, the Seller shall not reimburse the cost of: removal or re-installation of the Product or other incidental costs related thereto, any lost opportunity, any profit loss or other incidental or consequential losses or damages incurred by the Buyer or its customers.
Warranty Exclusions	Notwithstanding the above warranty, the warranty as set forth herein shall not apply to any problem or damage to the Product that is caused by: <ol style="list-style-type: none"> 1. Installation, connection, combination or integration of the Product in or to the other equipment or machine that is rendered by any person or entity other than the Seller; 2. Insufficient maintenance or improper operation by the Buyer or its customers, such that the Product is not maintained in accordance with the maintenance manual provided or designated by the Seller; 3. Improper use or operation of the Product by the Buyer or its customers that is not informed to the Seller, including, without limitation, the Buyer's or its customers' operation of the Product not in conformity with the specifications, or use of lubricating oil in the Product that is not recommended by the Seller; 4. Any problem or damage to any equipment or machine to which the Product is installed, connected or combined, or on any specifications particular to the Buyer or its customers; 5. Any changes, modifications, improvements or alterations to the Product or those functions that are rendered on the Product by any person or entity other than the Seller; 6. Any parts in the Product that are supplied or designated by the Buyer or its customers; 7. Earthquake, fire, flood, sea-breeze, gas, thunder, acts of God or any other reasons beyond the control of the Seller; 8. Normal wear and tear, or deterioration of the Product's parts, such as bearings, oil-seals; 9. Any other troubles, problems or damage to the Product that are not attributable to the Seller.

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