# TH650A–IP/TS2100

## Industrial Robot

# INSTRUCTION MANUAL

## DUST-PROOF & DRIP-PROOF TYPE INDUSTRIAL ROBOT SPECIFICATIONS

**Notice**

1. Make sure that this instruction manual is delivered to the final user of Toshiba Machine's industrial robot.
2. Before operating the industrial robot, read through and completely understand this manual.
3. After reading through this manual, keep it nearby for future reference.

November, 2008

**TOSHIBA MACHINE CO., LTD.**

NUMAZU, JAPAN

The information contained in this manual is subject to change without prior notice to effect improvements.

## Preface

This manual describes the specifications of the TH–A series dust-proof and drip-proof type industrial robot.
This manual is essential to keep the robot performance for a long time, to prevent failures and to assure safety. Be sure to look through this manual and set up a maintenance program before actually starting the robot.

## Precautions on Safety

Important information on the robot and controller is noted in the instruction manual to prevent injury to the user and persons nearby, prevent damage to assets and to ensure correct use.
Make sure that the following details (indications and symbols) are well understood before reading this manual. Always observe the information that is noted.

[Explanation of indications]

| Indication | Meaning of indication |
|---|---|
| ! **DANGER** | This means that "incorrect handling will imminently lead to fatalities or major injuries". |
| ! **WARNING** | This means that "incorrect handling may lead to fatalities or serious injuries." |
| ! **CAUTION** | This means that "incorrect handling may lead to personal injuries *1) or physical damage *2)". |

*1) Injuries refer to injuries, burns and electric shocks, etc., which do not require hospitalization or long term treatment.

*2) Physical damage refers to major fires due to destruction of assets or resources.

[Explanation of symbols]

| Symbol | Meaning of symbol |
|---|---|
|  | This means that the action is prohibited (must not be done).<br>Details of the actions actually prohibited are indicated with pictures or words in or near the symbol. |
|  | This means that the action is mandatory (must be done).<br>Details of the actions that must be done are indicated with pictures or words in or near the symbol. |
|  | This means danger and caution.<br>Details of the actual danger and caution are indicated with pictures or words in or near the symbol. |

[Maintenance and inspection]

Be sure to observe the following items to use this product safely.

|  **DANGER** | |
|---|---|
|  <br>Prohibited | • DO NOT incinerate, disassemble or charge the batteries. Otherwise, they may rupture. |
|  <br>Mandatory | • Be sure to turn off the main power switch of the controller before starting inspection or maintenance.<br>• Batteries should be disposed of according to the user's in-house regulations. |

| ! CAUTION | |
|---|---|
|  Disassembly prohibited | • The user must NEVER replace or modify parts other than those described in the instruction manual. Otherwise, the performance may deteriorate or faults or accidents will be caused. |
|  Mandatory | • Always use the Toshiba Machine's designated spare parts when replacing the parts.<br>• Maintenance and inspection should be performed regularly. Otherwise, the system may malfunction or accidents will be caused. |

This manual is comprised of the following seven (7) sections:

Section 1 Specifications
This section describes the basic specifications and names of respective parts for the dust-proof and drip-proof type industrial robot.

Section 2 Transportation
This section describes how to remove the dust-proof and drip-proof type robot from its box and how to transport it to the installation site. This section also deals with the precautions to be taken when the robot is to be stored temporarily after unpacked.

Section 3 Installation
This section discusses the dust-proof and drip-proof type robot installation environment, space requirements, and how to install the robot.

Section 4 Tool Interface
This section discusses how to connect the cables and pipelines for the tool of the dust-proof and drip-proof type robot.

Section 5 Maintenance
This section describes the structure of the dust-proof and drip-proof type robot and all items required for the maintenance and inspection of the same robot.

Section 6 Cleaning of Robot Body
This section describes the precautions to be taken when the robot body is to be cleaned and washed.

Section 7 Maintenance and Replacement Parts
This section explains the maintenance and replacement parts.

# Table of Contents

Page

# 1. Specifications

## 1.1 Name of Each Part

The names of respective parts of the dust-proof and drip-proof type robot are shown in Fig. 1.1 below.

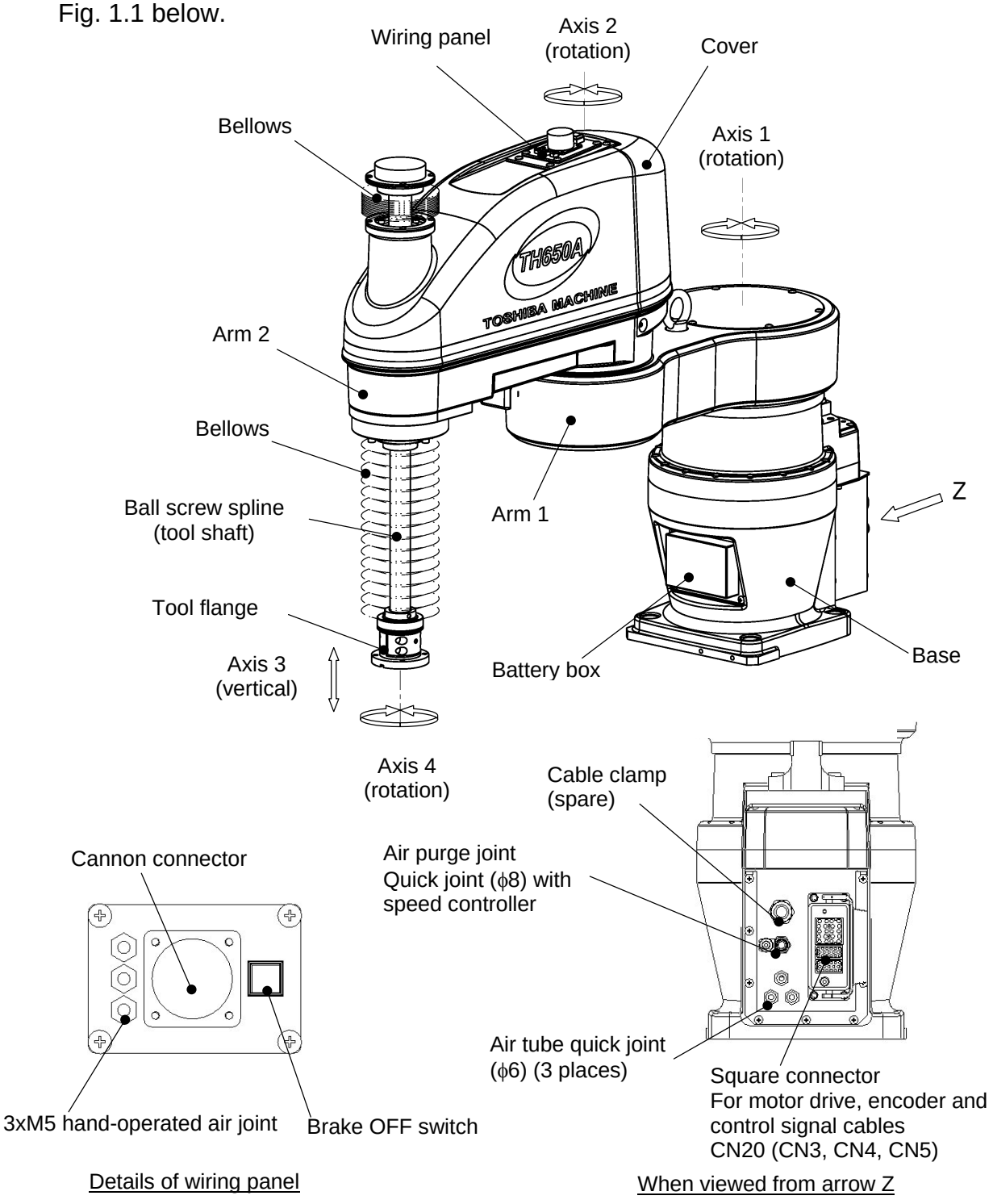



Fig. 1.1 Name of each part

## 1.2 Outer Dimensions

Fig. 1.2 and Fig. 1.3 show the outer dimensions and operating range of the robot.

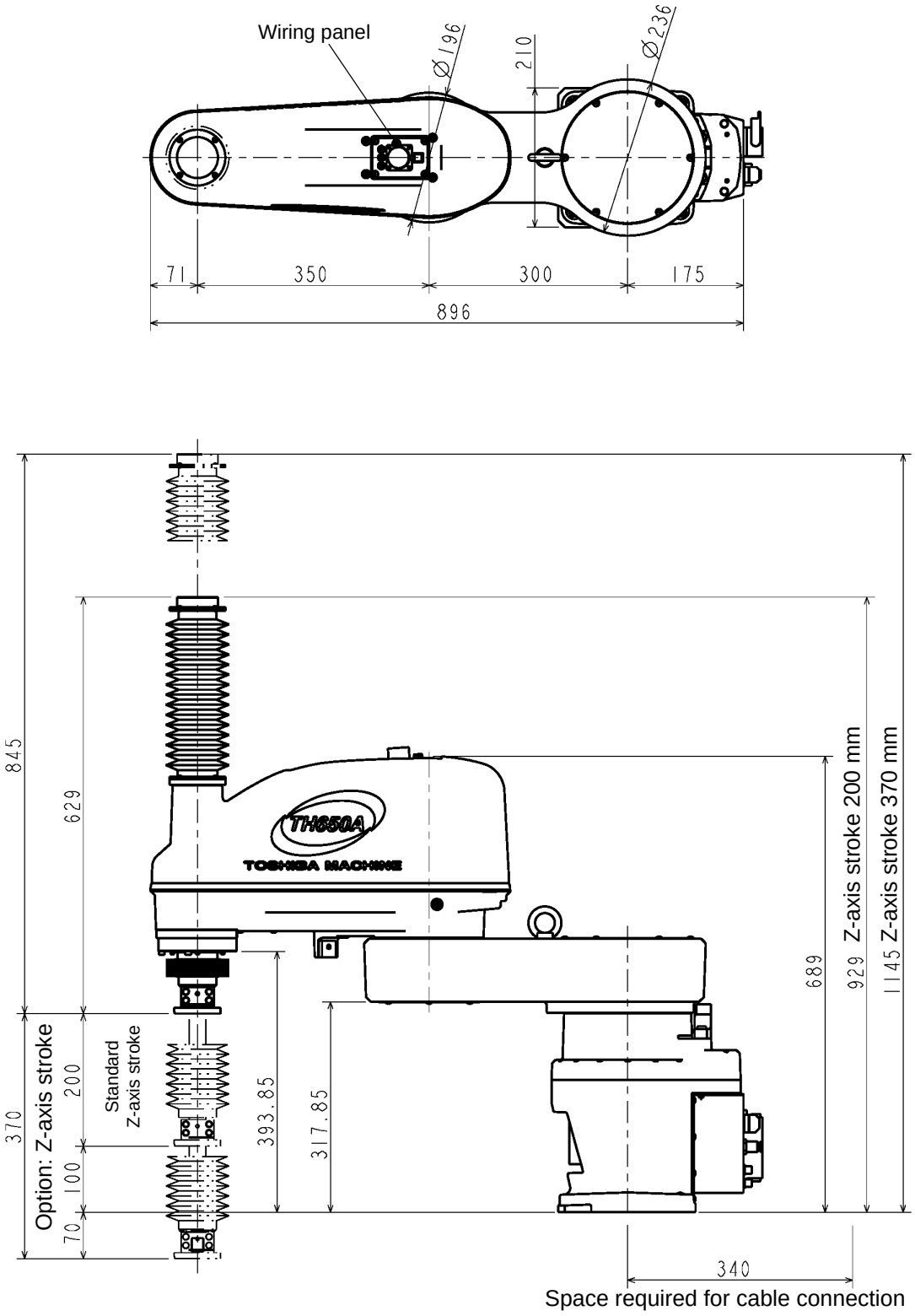



Fig. 1.2 Outer dimensions of the robot

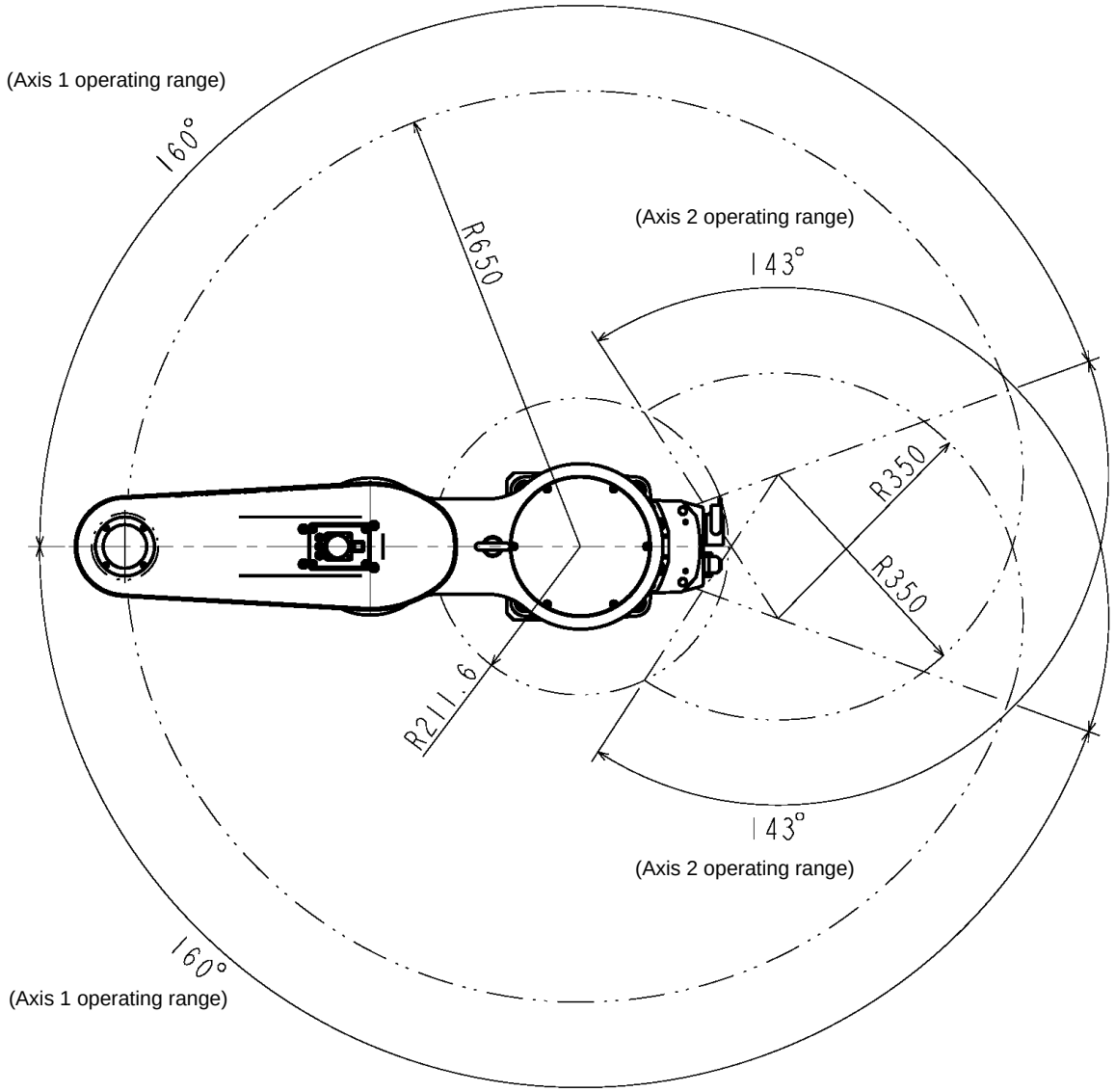



Fig. 1.3 Operating range of the robot

## 1.3 Specifications Table

| Item | | Specifications |
|---|---|---|
| Structure | | Horizontal articulated type SCARA robot |
| Model | | TH650A–IP |
| Ingress protection (IP) class of dust- and drip-proof structure | | IP65 (*1) |
| Applicable controller | | TS2100 (*2) |
| Mass of robot body | | 53 kg |
| No. of controlled axes | | Four (4) |
| Arm length | | 650 mm (300+350) |
| Motor capacity | Axis 1 | 1,000 (W) |
| | Axis 2 | 600 (W) |
| | Axis 3 | 400 (W) |
| | Axis 4 | 400 (W) |
| Operating range | Axis 1 | ±160 (deg) |
| | Axis 2 | ±143 (deg) |
| | Axis 3 | 200 (mm) [Option: 400 (mm)] |
| | Axis 4 | ±360 (deg) |
| Maximum speed (*3) | Axis 1 | 340 (deg/s) |
| | Axis 2 | 600 (deg/s) |
| | Axis 3 | 2,050 (mm/s) |
| | Axis 4 | 1,700 (deg/s) |
| | Composite speed of axes 1 and 2 | 7.52 (m/s) |
| Rated payload mass | | 2 (kg) |
| Maximum payload mass | | 10 (kg) |
| Permissible load inertia (*3) | | 0.1 (kg·m$^2$) |
| Repeatability (*4) | X, Y | ±0.01 (mm) |
| | Z | ±0.01 (mm) |
| | C | ±0.004 (deg) |
| Cycle time (*5) (When payload mass is 2 kg) | | 0.32 (sec) |
| Drive system | | By means of AC servo motors |
| Position detection method | | Absolute |

*1: For details of the ingress protection class, see Paragraph 3.2 (page 9).

*2: The robot controller is not constructed to provide dust-proof and drip-proof protection.

*3: When the mass of load exceeds 2 kg, or when the gravity center position of load is away from the axis 4 center position, both the speed and acceleration should be reduced, using the PAYLOAD command.

*4: The ambient temperature is predetermined at 20°C.

*5: Shuttle time for rough positioning in horizontal direction of 300 mm and vertical direction of 25 mm.

## 2. Transportation

### 2.1 Unpacking

The robot and controller are shipped separately in wooden crates or corrugated cardboards.
Open the packages in a location easily accessible, where the equipment is to be installed. Take careful precautions not to damage the robot and controller.
After opening the packages, make sure that all the accessories are present and that no part has been damaged during transport.
The package posture and contents are the same as in the standard robot. Refer to the TH650A Installation and Transportation Manual provided separately.
For the dust-proof and drip-proof type robot, strictly observe the following cautions.


**CAUTION**

- The main robot is factory-packed in a vinyl bag for shipment. Carefully remove the bag after the shipment has reached your office. If the vinyl bag is pulled by force, the cap or cover may be damaged.

### 2.2 Transportation

Move the robot and controller very carefully. Make sure that no excessive impact or vibration is exerted on the equipment. If the equipment is to be subject to vibration over a long period, be sure to tighten all of the clamp and base attaching bolts completely and put the equipment back into the wooden crates or corrugated cardboards.

### 2.2.1 Mass and Outer Dimensions

The mass and outer dimensions of the robot are shown in Fig. 2.1.

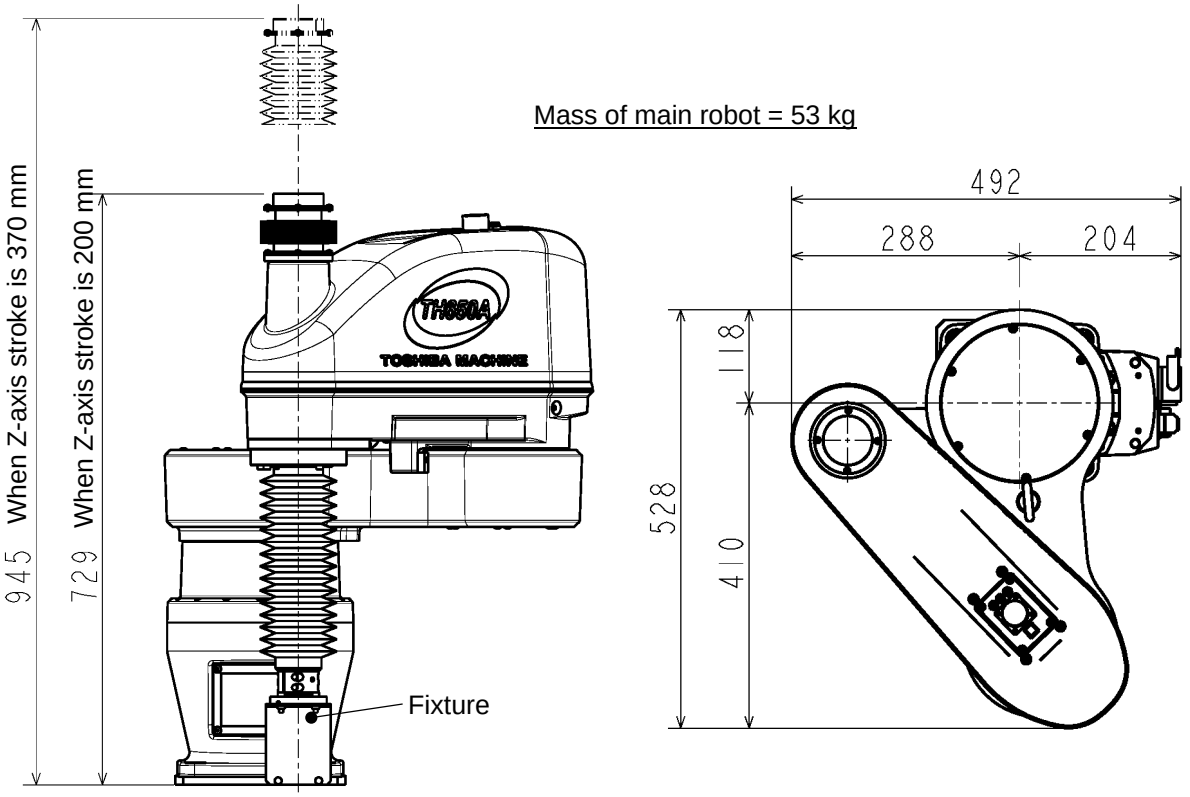



Fig. 2.1 Outer dimensions during transport

### 2.2.2 Transporting the Robot

The dust-proof and drip-proof specification robot has dust-proof and drip-proof parts such as bellows, etc. added to the standard robots. The instructions during transport of the robot are listed below. The instructions other than those listed below are the same as those for the standard robots. Refer to the TH650A Installation and Transportation Manual provided separately.

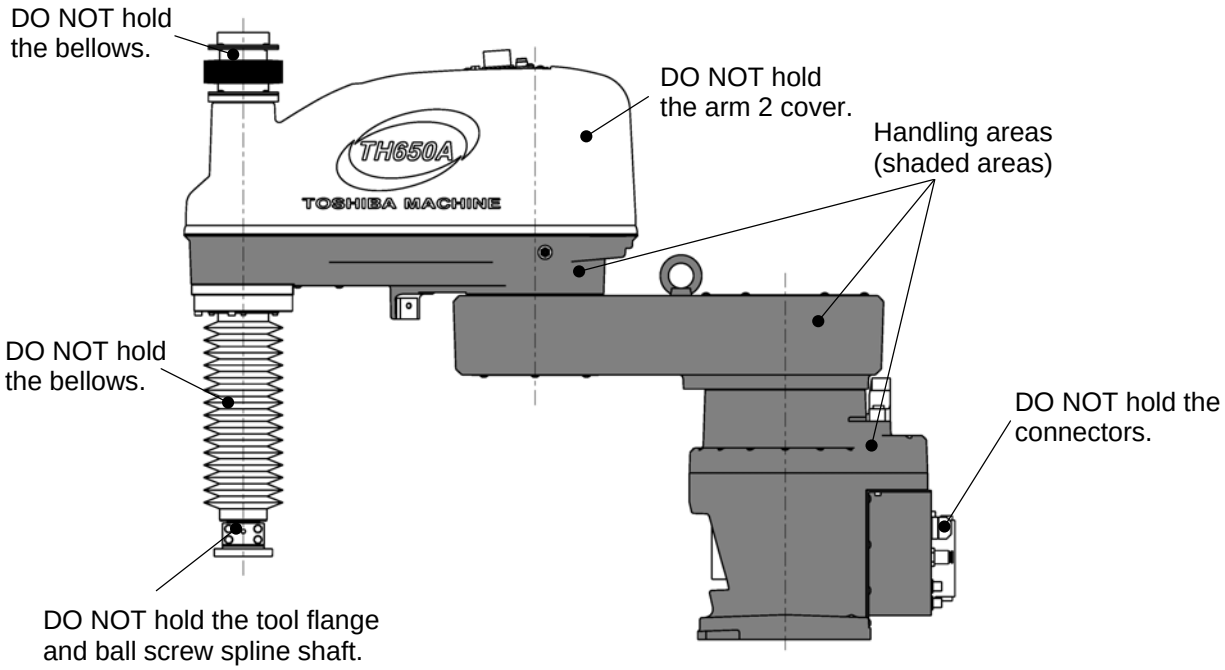



Fig. 2.2 Robot handling prohibited areas

After the installation, remove the clamp and eyebolt used for transport.

**! CAUTION**

- When lifting up the robot by workers, hold the shaded locations by hands, as shown in Fig. 2.2. If the ball screw spline shaft is held by hands, an unusually large force is exerted, resulting in a malfunction.
- If the bellows is held or gripped by hands, it may be broken due to friction with the parts inside.
- When carrying the robot by workers, take careful precautions to prevent their hand or leg from being caught in the robot.
- The work should always be performed by two (2) or more workers.

# 3. Installation

## 3.1 Installation Environment

Table 3.1 shows the environmental specifications for the robot and controller.

Table 3.1 Environmental specifications

| Item | Specifications |
|---|---|
| Temperature | In operation : 0 to 40°C<br>In storage : –10 to 50°C |
| Humidity | 20 to 90 % (Non-condensing) |
| Altitude | 1000 m or less |
| Vibration | In operation : 0.98 $m/s^2$ or less |
| Dust | No inductive dust should exist. |
| Gas | No corrosive or combustible gas should exist. |
| Sunlight | The robot and controller should not be exposed to direct sunlight. |
| Power noise | A heavy noise source should not exist nearby. |
| Magnetic field | A heavy magnetic field source should not exist nearby. |
| Dust-proof and drip-proof | Any place where the equipment sinks in liquid shall not exist.<br>Small chips involved in turning or cutting operation shall not be contained.<br>Mist of cutting fluid or coolant oil shall not be contained. |

**DANGER**

- Do not place the robot or controller near combustible. If it is not be done completely, an ignition may occur due to a fault causing a fire.

## 3.2 Ingress Protection (IP) Class of Dust-Proof and Drip-Proof Specifications

The Model TH650A robot (dust-proof and drip-proof specifications) has IP65 or equivalent ingress protect against water and dust.
Be sure to perform air purge. Ingress of water and dust cannot be prevented according to some operating environments.

I P 6 5

- 5: Indicates a degree of protection against ingress of water.
  Water jetted at any angle does not have harmful effects on the robot.
  Jetting water pressure: 30 kPa (30 kN/$m^2$ ≒ 0.3 kgf/$cm^2$)
  Flowrate: 12.5 L/min
  Distance from nozzle: 2.5 ~ 3 m
  Duration: Three (3) minutes
- 6: Indicates a degree of protection against solid foreign substances.
  Dust does not enter into the interior of the robot.
- IP: Is a symbol to indicate protection characteristics.

**! WARNING**

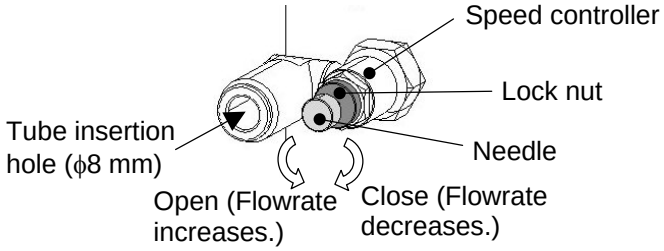
- DO NOT use the entire robot or part of the robot sinking in water. Otherwise, the water will enter the robot interior.
- DO NOT use the robot in an environment exceeding the specified IP class against water and dust. Otherwise, the water or dust may enter the robot interior, resulting in shortening of the robot life, deterioration of operating accuracy or mis-operation of the robot.
- The robot controller is not compliant with the dust-proof and drip-proof specifications.
- For drip-proofness of objects other than water, contact us.
- The bellows may discolor according to the operating environments, but there is no problem with dust-proof performance.
- Be sure to perform air purge. Otherwise, the dust-proof and drip-proof performance will drop.
- The dust-proof and drip-proof specification robots are not explosion-proof type robots.

### 3.3 Air Purge

The dust-proof and drip-proof type robot is provided with an air supply port for air purge in its base connector unit. See Fig. 1.1. (Quick-joint with speed controller)
Ingress of dust into the interior of the robot can be prevented by supplying air to the air supply port.
The air supply unit (reducer or pressure reducing valve, air filter, etc.) and air tube (8 mm-dia.) should be provided by the user.

- Air specifications
  Maximum operating pressure: 0.58 MPa (6 kgf/cm$^2$)
  Tube size: Outer dia. 8 mm × Inner dia. 5 mm
  Fluid used: Fresh dry air not containing compressor oil, etc.
  Degree of the air filtration 10 μm or less

- How to regulate flowrate
  Fully close the speed controller attached to the robot base connector unit.
  Set the pressure to 0.3 MPa ~ 0.58 MPa (maximum pressure), using a regulator (or pressure reducing valve: to be provided by the user), then connect the air tube.
  Turn the speed controller needle valve counterclockwise from the fully closed position to increase the air flow rate. Regulate the flowrate while observing the bellows condition and tighten the lock nut on the speed controller.
  When feeding excessive amount of air, the bellows are expanded. Therefore the feeding operation of air should be stopped immediately before the bellows starts to expand.




**! CAUTION**

- Be sure to use fresh dry air. If you neglect the instruction, condensation will occur in the interior of the robot, and water will accumulate within the interior of the robot, thus causing earth leakage or malfunction.
- DO NOT increase a pressure exceeding the specified maximum pressure. If you do not follow the instruction, seals attached at each joint will be damaged, and the dust-proof and drip-proof performance will be impaired.

## 3.4 Coordinate System

The robot's joint angle origin (0° or 0 mm position) is factory-calibrated according to the base reference planes. Fig. 3.1 shows the base coordinate system (XB, YB, ZB) and origin of each axis joint angle.

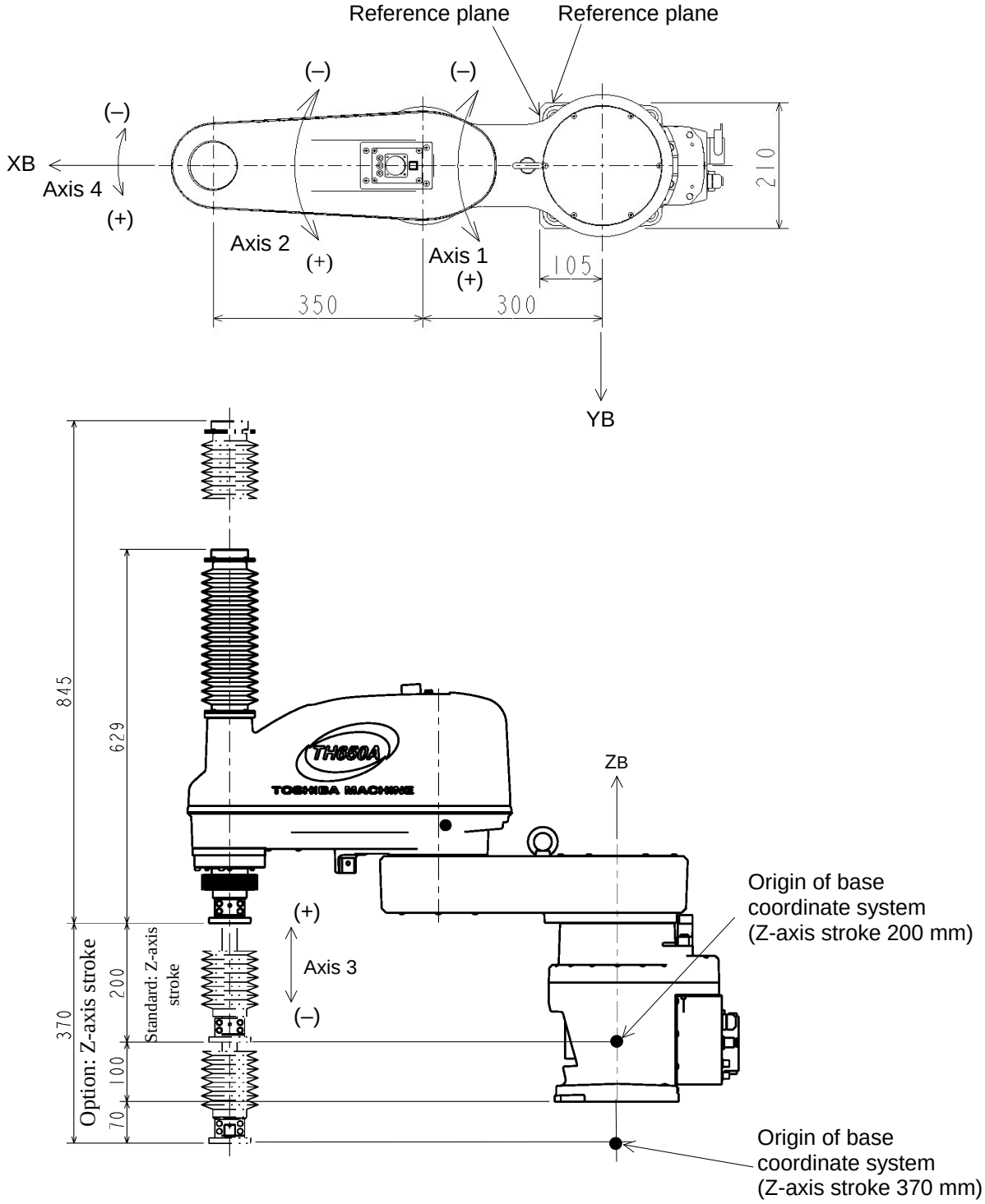



Fig. 3.1 Base coordinate system and joint angle origin

## 3.5 Installing the Robot

The robot is secured in the attachment holes (four places) on the base with M16 hexagonal socket head bolts.
The robot installation method is shown in Fig. 3.2. The reference planes are provided on the base section.
If you wish to adjust the robot position in the base coordinate system, or when you need to change the robot, you should prepare a reference plane to secure the robot to the reference plane on the base.

**! CAUTION**

- The robot will suddenly accelerate and decelerate during operation. When installing it on a frame, make sure that the frame has sufficient strength and rigidity.
  If the robot is installed on a frame that does not have sufficient rigidity, vibration will occur while the robot is operating, causing a fault.
  When the robot is installed on the floor, secure it firmly with anchor bolts, etc.
- Install the robot on a flat surface. If it is not be done, this will cause a decline in performance and a fault.

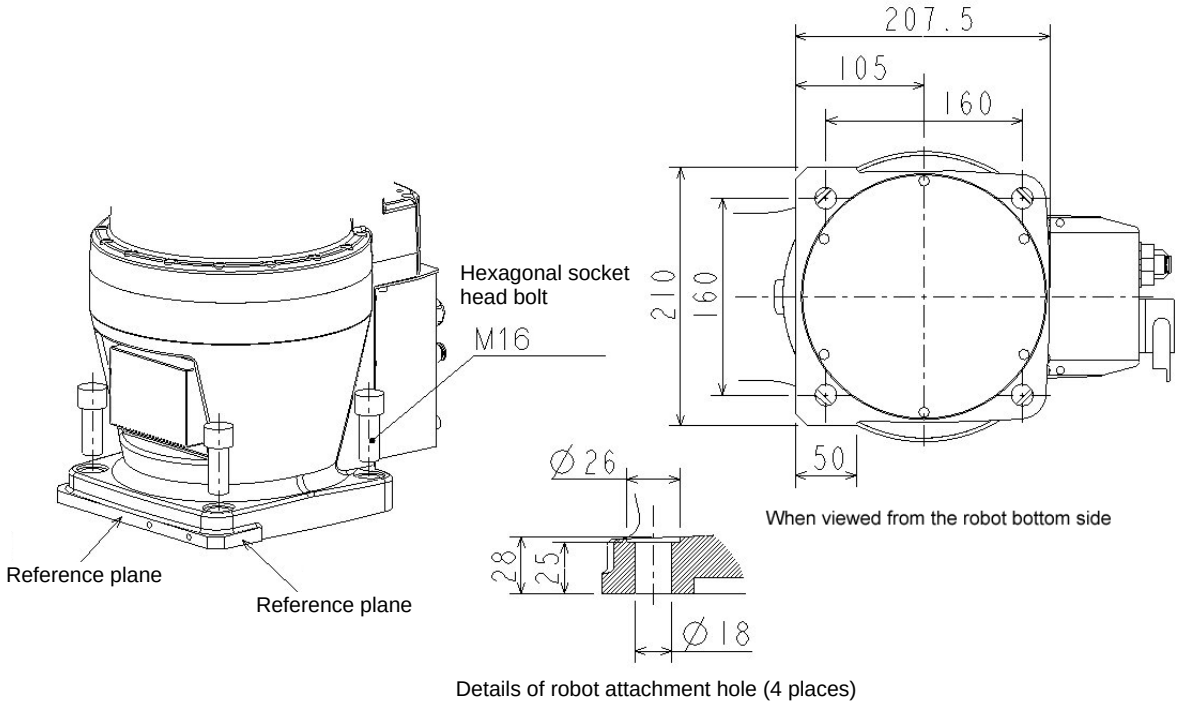



Fig. 3.2 Installation method

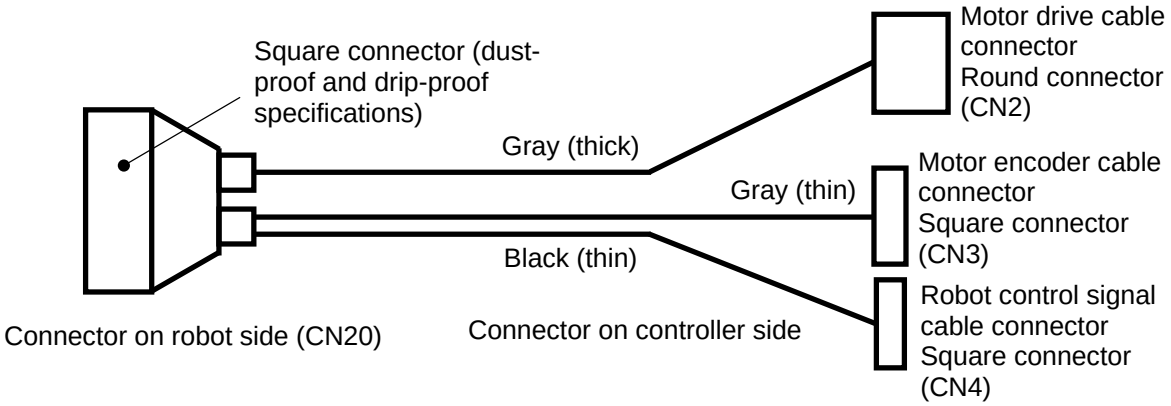
## 3.6 Cable Connection

The connector layout on the controller side and the connection method are the same as those for the standard robots. Refer to the TH650A Installation and Transportation Manual provided separately.

For the dust-proof and drip-proof type robot, the connector on the robot side differs from that of the standard robots.

This paragraph describes the cable connection on the robot side.

### 3.6.1 Cables between Robot and Controller




**! CAUTION**

- The robot controller and connector on the robot controller side are not dust-proof and drip-proof construction.

### 3.6.2 Connecting and Disconnecting Connectors

**! CAUTION**

- Before connecting or disconnecting the cable to or from the controller, turn off the main power (POWER) switch.
- When disconnecting a cable, be sure to hold the connector body by hand to pull it out. If you pull out the cable, the cable may be broken.

To connect the connector, make sure of the top and bottom sides of the connector, insert the connector attached to the cable completely into the connector on the robot side, then lock the lever of the connector on the robot side. If the lock is loose, fault is caused by poor contact in the connector. To avoid this, make sure that the lever is locked completely.

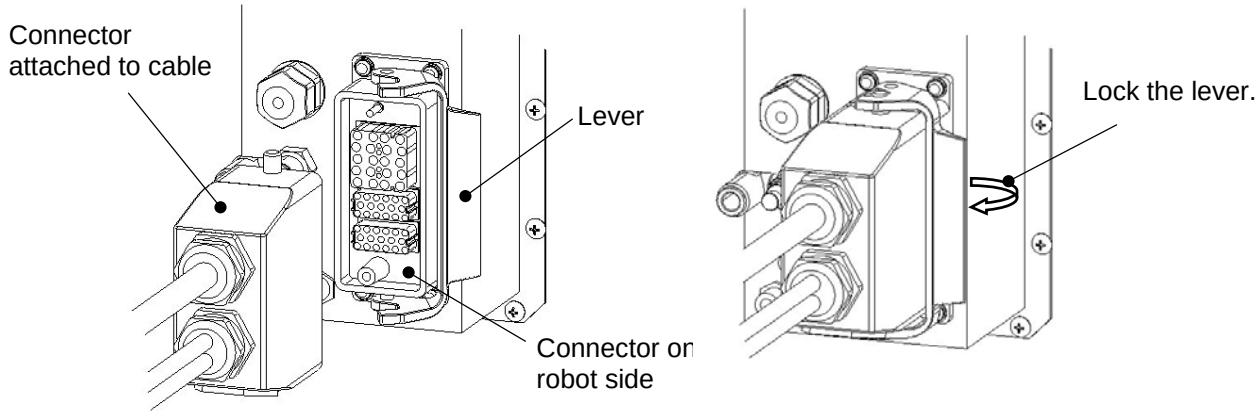
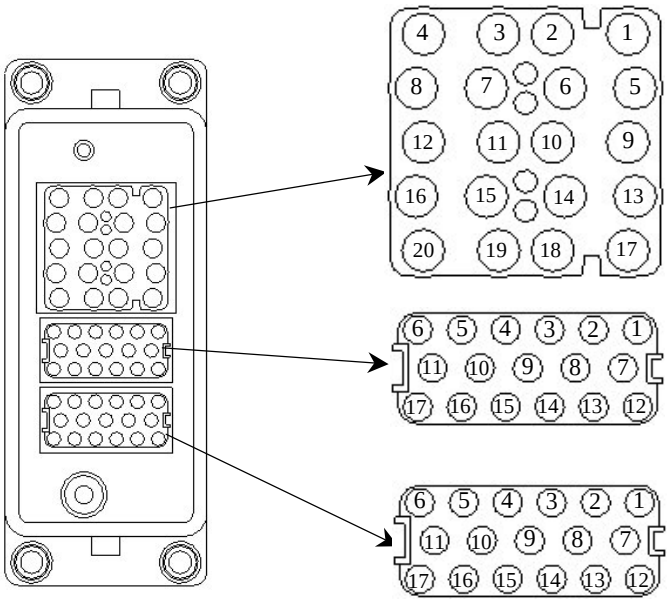



Fig. 3.3 Connecting and disconnecting connectors

### 3.6.3 Connector Terminal Layout

Square connector on the robot side: CN20
Type: 09300160307 (Body) 09140160313 (Frame)
Maker: HARTING




Motor drive cable connector (CN2)
Type: 09140203101
Maker: HARTING

Motor encoder cable connector (CN3)
Type: 09140173101
Maker: HARTING

Robot control signal cable connector (CN4)
Type: 09140173101
Maker: HARTING

## 4. Tool Interface

A tool mounting method and tool signals are the same as for the standard robots. For details, refer to the TH650A Installation and Transportation Manual provided separately.

### 4.1 Wiring between Tools of the Robot

The Model TH650A robot comes with wiring cables for five (5) input signals for sensors, etc. four (4) control signals for solenoid valves, etc., and with 24 VDC power supply cables. They are connected to the controller. The cables are connected to the connectors on the upper side of the arm 2. The user shall prepare the following connectors and connect the cables.

Cannon connector (dust-proof and drip-proof type):

Type: JA06A–20–29S–J1 (Maker: JAE)

Coupling (dust-proof and drip-proof type):

Type: E2KD1220 (Maker: SANKEI)

Adaptive cable: Conductive cross section area 0.2 $mm^2$ ~ 0.5 $mm^2$

The connectors are soldered to the cables.

**! DANGER**

- Be sure to use the designated cables. Otherwise, fires or faults may be caused.
- Be careful not to connect the cable to the wrong terminal in the connector.
- After making cable connection, confirm the correct connection with a tester or the like.

When controlling the robot from the sequencer (i.e., programmable ladder controller: PLC), etc. installed separately, remove the motor cover from the base section, remove connectors JOES and JOFS on the rear side, then connect the cables running from the PLC, etc. through the cable clamp provided on the motor cover. (See Fig. 4.1.) The user shall prepare the following plug connectors and connect the cable for the portion preceding JOES and JOFS to them. The current should be 1 A or less per cable.

Type of connector: JOES SMP–07V–BC (Maker: J.S.T. Mfg.)
JOFS SMP–06V–BC (Maker: J.S.T. Mfg.)

Type of contact: BHF–001T–0.8SS (Maker: J.S.T. Mfg.)
Adaptive cable: Conductive cross section area 0.2 $mm^2$ ~ 0.3 $mm^2$

Opposite connector type

Type of connector: JOEP SMR–07V–B (Maker: J.S.T. Mfg.)
JOFP SMR–06V–B (Maker: J.S.T. Mfg.)
Type of contact: BYM–001T–0.6 (Maker: J.S.T. Mfg.)

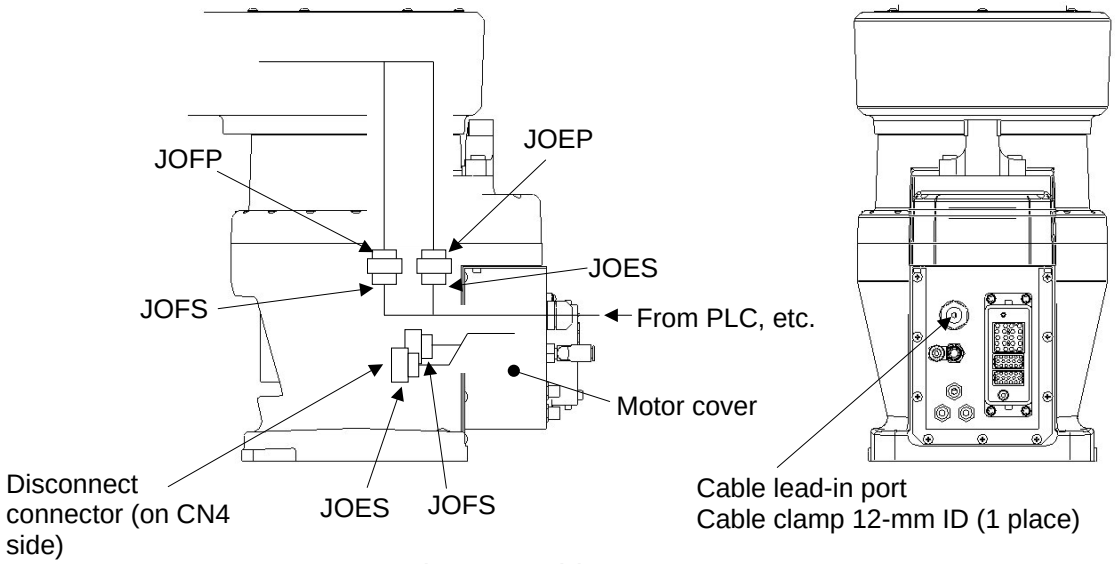



Fig. 4.1 Wiring to PLC, etc.

### 4.1.1 How to Connect Connectors

The motor cover of the dust-proof and drip-proof type robot is equipped with a cable clamp (dust-proof and drip-proof construction). To connect the cables from the separate PLC, etc., use this cable clamp to connect them with the connectors in the robot.
When routing the connection cable through a cable clamp, use a shielded cable clamp of 6.0~12.0-mm OD.

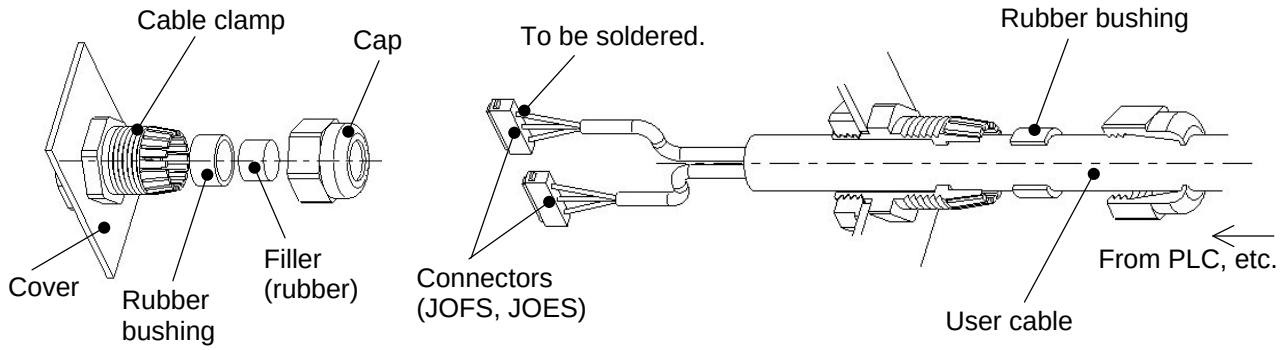



Fig. 4.2 How to connect cable to connector

[1] Remove the motor cover of the base. Liquid gasket is applied to the motor cover attachment surface to protect the robot against dust and drip. For the dismantling procedures, see Section 5.

[2] Remove the cap of the cable clamp, then the rubber bushing and filler. This filler is unnecessary and is not used any more.

[3] Pass the cables running from the PLC, etc. through the cap, rubber bushing and cable clamp in this order, then solder the connectors.

[4] Check the designated poles and cables for continuity with a tester or the like.

[5] Push the rubber bushing into the cable clamp, and tighten the cap securely.

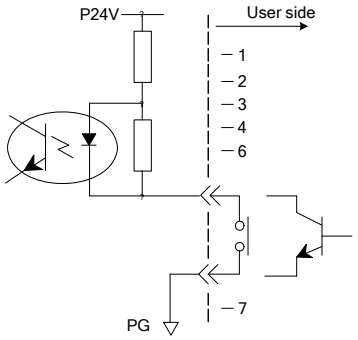
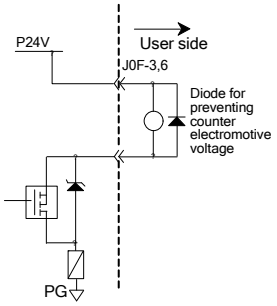
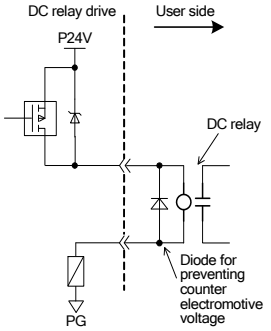
[6] Connect the cable to the connectors (JOFP, JOEP) on the robot side.

[7] Replace the motor cover into its original position. For installation procedures, see Section 5 "Maintenance".

**! DANGER**

- Before connecting or disconnecting the cables, be sure to turn off the main power (“POWER”) switch. If you neglect the instruction, malfunction may occur in the robot, which can be dangerous.
- Be sure to use the cable within the specifications. If it is not be done completely, it is possible to create the danger of fire or earth leakage due to cable heating.
- Be careful not to forget to attach a rubber bushing when connecting the connectors. If rubber bushings are provided, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.
- If the user does not making connection, DO NOT remove the filter plug. The dust-proof and drip-proof performance will be impaired, resulting in ingress of water and dust.

Input/output signal connector CN0

<table>
<tr><th>Pin</th><th colspan="2">Signal name</th><th>Signal no.</th><th colspan="2">Input/output circuit and example of connections</th></tr>
<tr><td>A</td><td>Not used</td><td></td><td></td><td colspan="2" rowspan="8"> 
</td></tr>
<tr><td>B</td><td>Not used</td><td></td><td></td></tr>
<tr><td>C</td><td>Not used</td><td></td><td></td></tr>
<tr><td>D</td><td>GRP1 OPN</td><td>Grip 1 open</td><td>201</td></tr>
<tr><td>E</td><td>GRP1 CLS</td><td>Grip 1 close</td><td>202</td></tr>
<tr><td>F</td><td>GRP2 OPN</td><td>Grip 2 open</td><td>203</td></tr>
<tr><td>G</td><td>GRP2 CLS</td><td>Grip 2 close</td><td>204</td></tr>
<tr><td>H</td><td>WORK</td><td>Workpiece</td><td>205</td></tr>
<tr><td>J</td><td>PG</td><td>0 V</td><td></td><td>Minus common (X8HN)<br> 
</td><td>Plus common (X8HI)<br> 
</td></tr>
<tr><td>K</td><td>Not used</td><td></td><td></td></tr>
<tr><td>L</td><td>GRP1</td><td>Grip 1</td><td>201</td></tr>
<tr><td>M</td><td>$\overline{\text{GRP1}}$</td><td>– Grip 1</td><td>202</td></tr>
<tr><td>N</td><td>P24V</td><td>24 V DC power supply</td><td></td></tr>
<tr><td>P</td><td>GRP2</td><td>Grip 2</td><td>203</td></tr>
<tr><td>R</td><td>$\overline{\text{GRP2}}$</td><td>– Grip 2</td><td>204</td></tr>
<tr><td>S</td><td>P24V</td><td>24 V DC power supply</td><td></td></tr>
<tr><td>T</td><td>Shield</td><td></td><td></td></tr>
</table>

The Model TH650A robot shall use signals for non-voltage contact input or transistor open-collector input.

No-voltage contact specifications:

Contact rating: 24 V DC, 10 mA or over (circuit current: approx. 7 mA)

Minimum contact current: 24 V DC, 1 mA

Contact impedance: 100 Ω or less

Transistor specifications:

Withhold voltage between collector and emitter: 30 V or over

Current between collector and emitter: 10 mA or over (circuit current: approx. 7 mA)

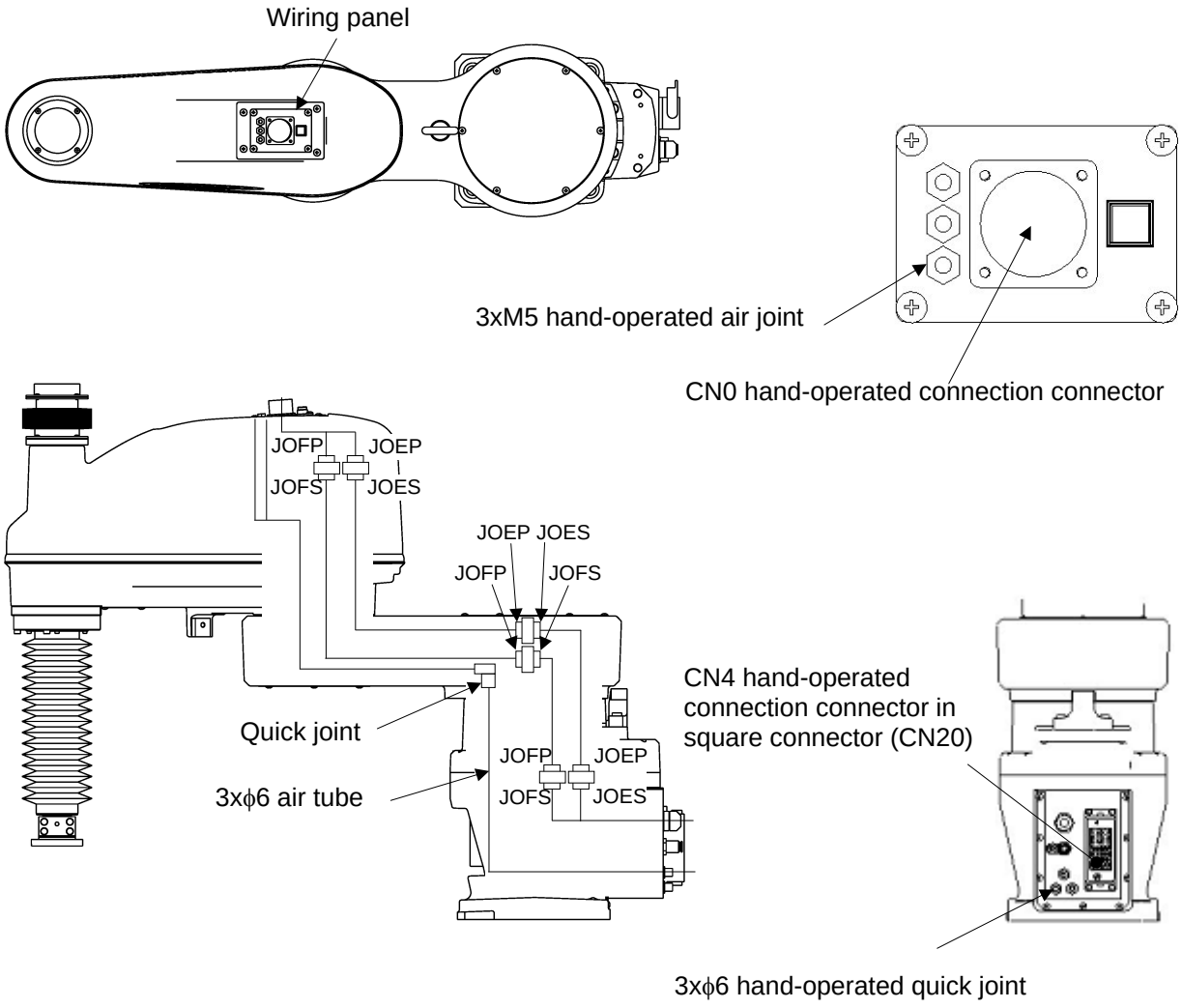
Leak current between collector and emitter: 100 μA or less

By using the 24 V DC power supply of the controller, a relay, solenoid valve, etc., can be driven. When using an external power supply, use common GND between the external power supply and the robot controller.

Output specifications:

| | | |
|---|---|---|
| Rated voltage | : | 24 V DC (max. 30 V DC) |
| Rated current | : | 1 A |
| Leak current | : | 100 μA or less |

- The robot controller shall supply up to a total 2 amperes at 24 VDC.
- Even if using an external power supply, total current value shall be within 2 amperes.
- When a relay, solenoid valve, etc., are connected, it is necessary to use a surge killer or diode to absorb the surge voltage.



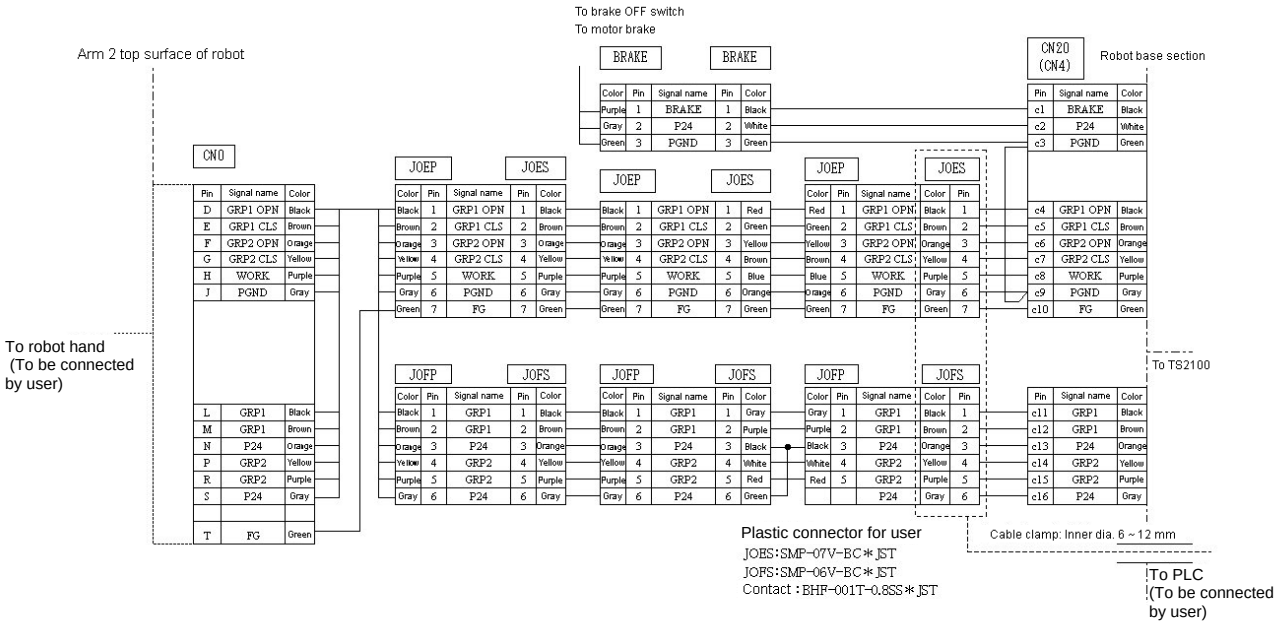
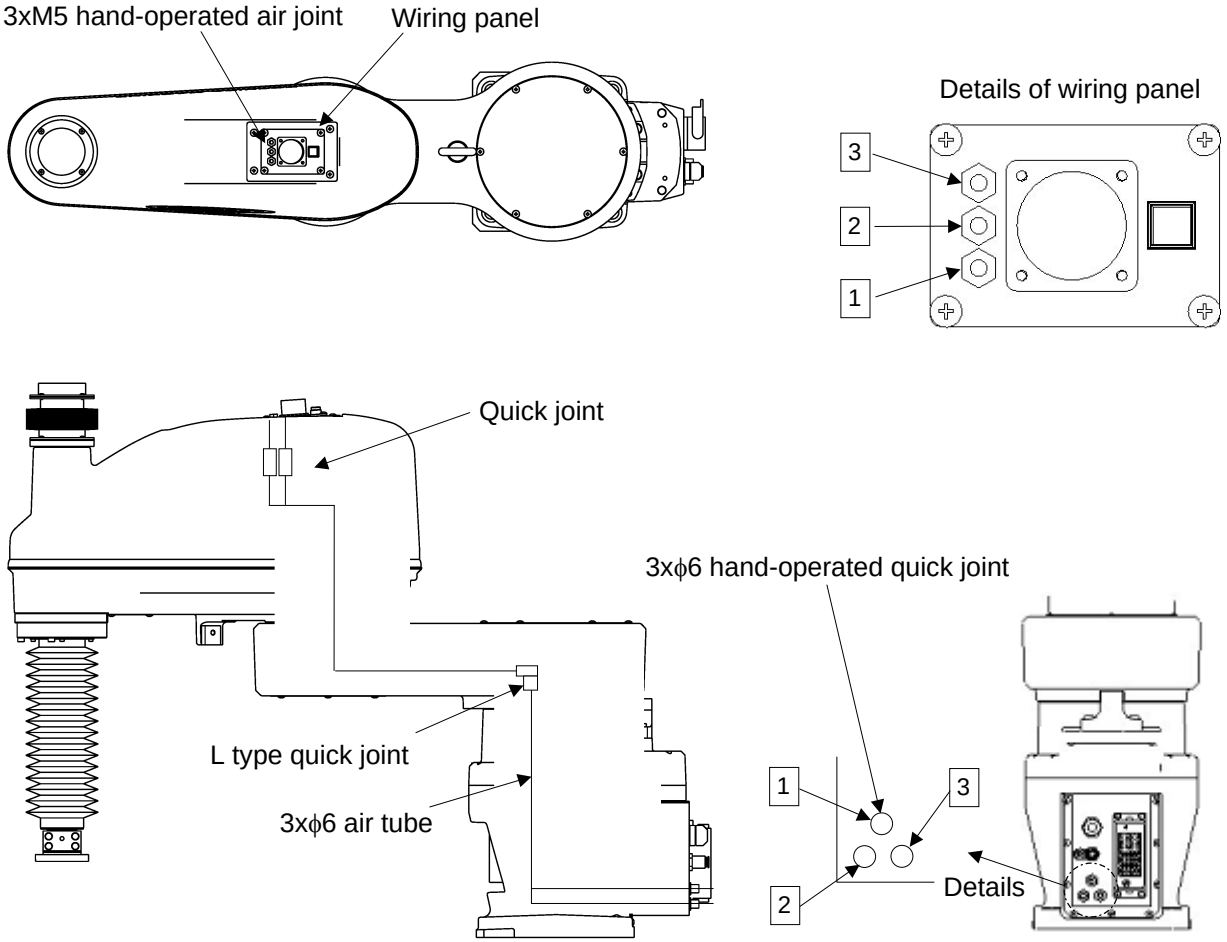



Fig. 4.3 Wiring between tools of the robot

## 4.2 Air Pipes Used for Tools of the Robot

The Model TH650A robot comes with three (3) air line pipes necessary for tools.
The outer diameter of the air pipes is 6 mm. Fig. 4.4 shows the air pipe.
The user shall prepare solenoid valves and air control unit.




The air tube is identified by the number and color. Make piping in the correct manner with reference to the following figure.

1 : Red 2 : White 3 : Blue

Air joint pitches of the panel

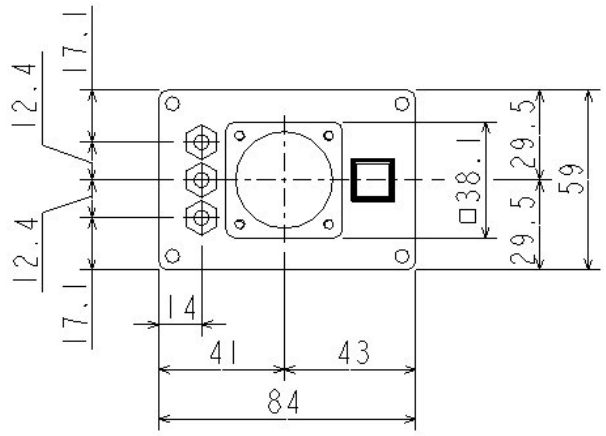



Fig. 4.4 Air pipe used for tools

## 5. Maintenance

The basic structure of the dust-proof and drip-proof type robot is the same as that of the standard robots. For the contents of inspection, etc., refer to the TH650A Maintenance Manual provided separately.
This section describes the layout of the mechanical components and the procedures for mounting and dismounting the covers and for replacing the upper and lower bellows.

### 5.1 Layout of Mechanical Components

The layout of the mechanical components is shown in Fig. 5.1.

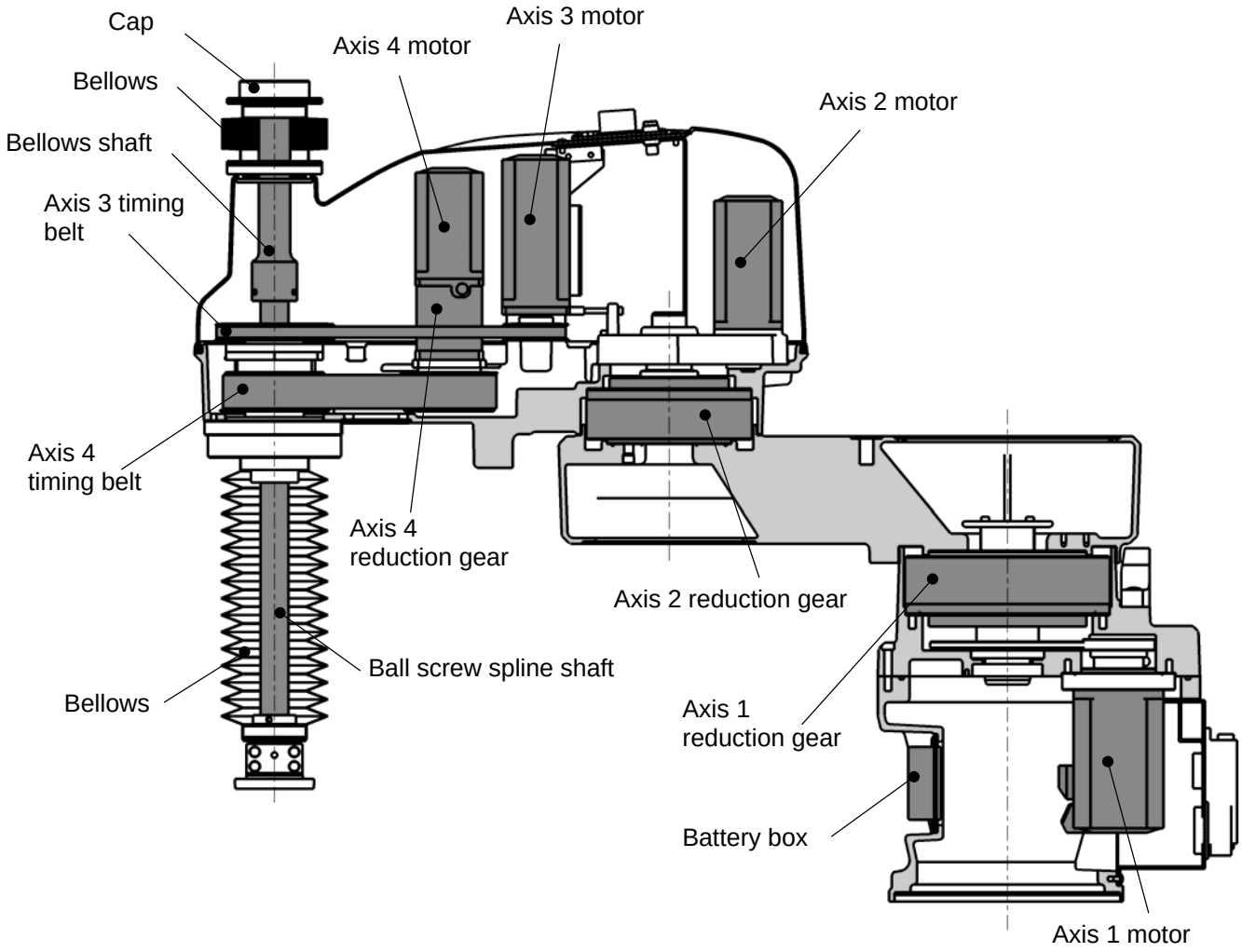



Fig. 5.1 Layout of the mechanical components

## 5.2 Maintenance Tools and Preparatory Parts

We recommend for the user to prepare tools necessary for maintenance operation and parts that follow.

- Screwdrivers (for plus and minus screws)
- Hexagonal spanner set M3~M16
- Cutter knife
- Liquid gasket (Recommended type: 1211 made by ThreeBond)
- Loctite (242 middle strength)

## 5.3 Replacement Procedures of Bellows

Our servicemen shall do the bellow replacement job. We do not guarantee a fault or accident caused by bellows replacement conducted by the user.

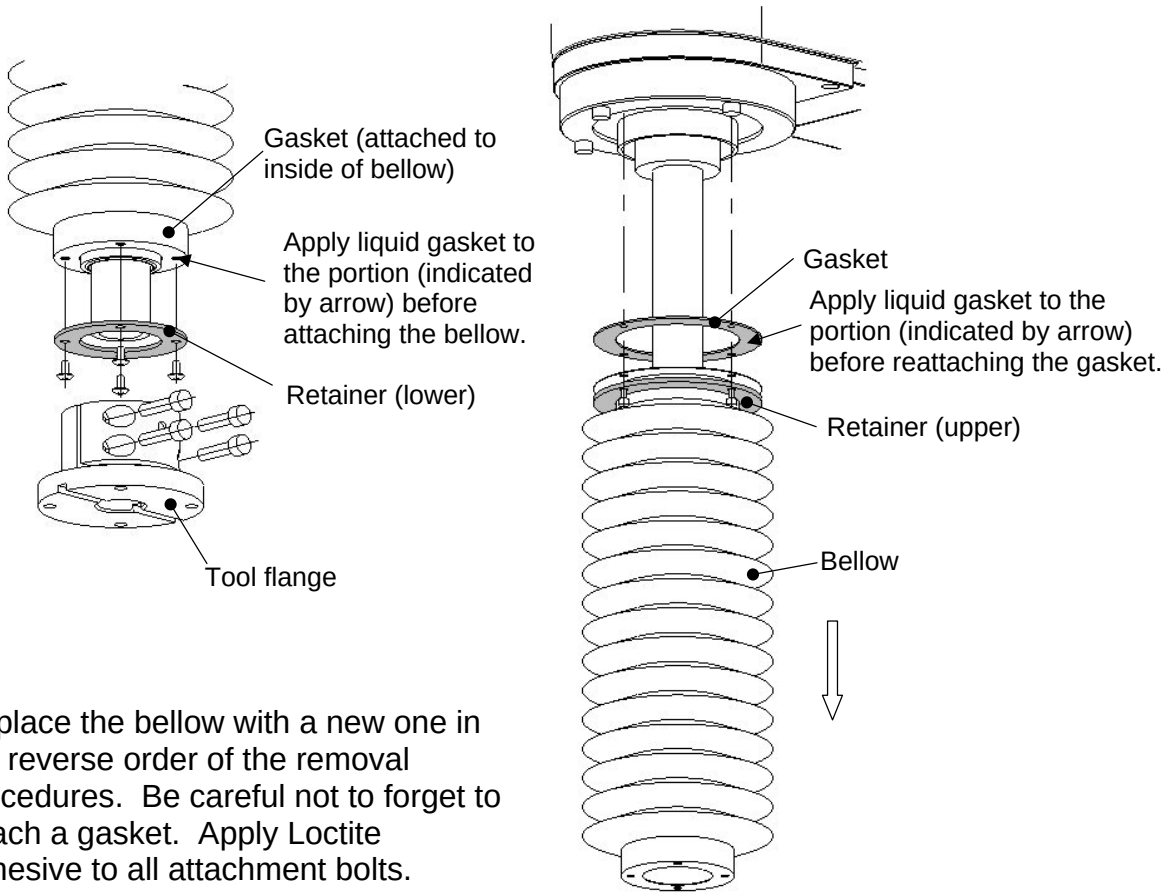
**! DANGER**

- Be sure to turn off the controller power supply and to pull out the power plug before replacement work.

### 5.3.1 Replacement Procedures of Lower Bellow

1) Remove the tool flange, then detach the retainer under the bellow.

2) Detach the retainer above the bellow to pull out the bellow downward.




3) Replace the bellow with a new one in the reverse order of the removal procedures. Be careful not to forget to attach a gasket. Apply Loctite adhesive to all attachment bolts.

Fig. 5.2 Lower bellow

**! CAUTION**

- DO NOT pull the bellow by force when removing it. If it is not be done completely, the bellows may be broken.
- Be sure to apply Loctite adhesive to the attachment bolts. If you neglect the instruction, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.
- Be careful not to forget to attach gaskets. If it is not be done, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.

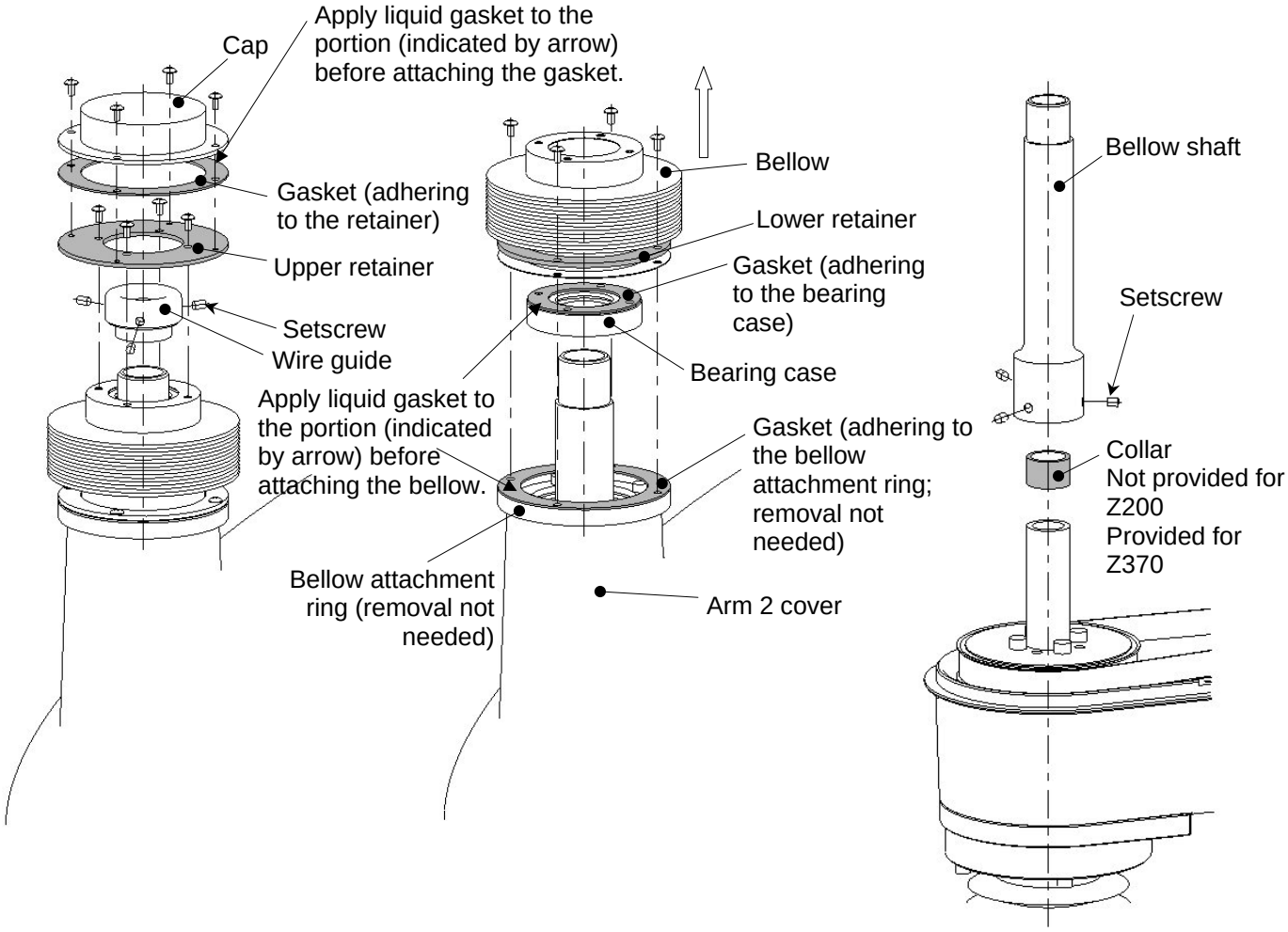
5.3.2 Replacement Procedures of Upper Bellow

1) Remove three (3) setscrews after having removed the cap and upper bellow, and then remove the wire guide.

2) Remove the lower retainer and pull out the bellow upward.

3) Pull out the bearing case upward to detach the arm 2 cover. For detaching the arm 2 cover, see Paragraph 5.3.2.

4) Remove three (3) setscrews securing the bellow shaft to replace the ball screw, and then pull out the bellow shaft. At this time, pull out the collar between the ball screw and the bellow shaft together.
This collar is provided for only the robot with 370-mm Z-axis stroke. The robot with 200-mm Z-axis stroke does not contain the collar.
For replacement of the ball screw, refer to the TH650A Maintenance Manual provided separately.




5) Replace the bellow with a new one in the reverse order of the removal procedures. Be careful not to forget to attach gaskets. Apply Loctite adhesive to all attachment bolts.

Fig. 5.3 Upper bellow

**! CAUTION**

- DO NOT pull the bellow by force when removing it. If it is not be done completely, the bellows may be broken.
- Be sure to apply Loctite adhesive to the attachment bolts. If you neglect the instruction, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.
- Be careful not to forget to attach gaskets. If it is not be done, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.

## 5.4 Mounting and Dismounting Covers

The dust-proof and drip-proof specification robots have a gasket (packing) attached to the attachment surfaces of each cover.
Since liquid gasket is applied to some portions, they differ in mounting and dismounting work from the standard robots. Please follow the work procedures stated in this paragraph during carrying out the work.

**! DANGER**

- Before mounting and dismounting each cover, be sure to turn off the main power (“POWER”) switch.
- When opening the cover, extreme care should be taken to prevent water and foreign substances from entering in the interior of the robot. If the power is supplied to the robot with water and foreign substances remaining inside the robot, this will cause an electric shock or fault, which can be dangerous.

### 5.4.1 Base Cover

Two type of base cover are available: One is used for connector panel as well; other for battery box as well.

1) The base cover used for the connector panel as well is secured to the base with nine (9) cross-recessed truss head screws (M4x6) and two (2) hexagonal socket head bolts (M4x10) in such a way to surround the gasket. The gasket attachment surface is coated with liquid gasket. Remove the cover while stripping off the liquid gasket using a minus screwdriver or the like. DO NOT pull the cover by force because it is connected to the connector and other components internally.

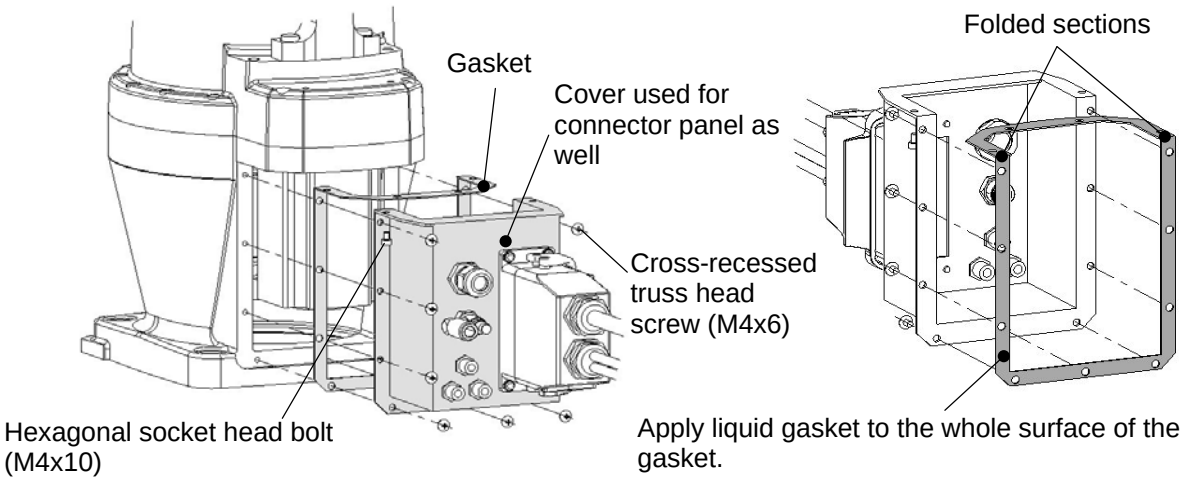



Fig. 5.4 Cover used for connector panel as well

When mounting the cover, apply liquid gasket to the area shown in Fig. 5.4 above. Especially, apply excessive amount of liquid gasket to the folded sections of the cover.

After assembly, apply liquid gasket to the whole area of the cover attachment surface to fill a gap between the gasket, cover, and base. Also, apply Loctite adhesives to all attaching bolts.

**! CAUTION**

- Be sure to attach the gasket and apply liquid gasket. Also, be sure to coat Loctite adhesives to all attaching bolts. If it is not be done completely, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.

2) The base cover used for the battery box as well is secured to the base with four (4) cross-recessed truss head screws (M4x6) in such a way to sandwich the gasket between the cover and the base. The gasket attachment surface is coated with liquid gasket. Remove the cover while stripping off the liquid gasket, using a minus screwdriver or the like. DO NOT pull the cover by force because it is connected to the connector and other components internally.

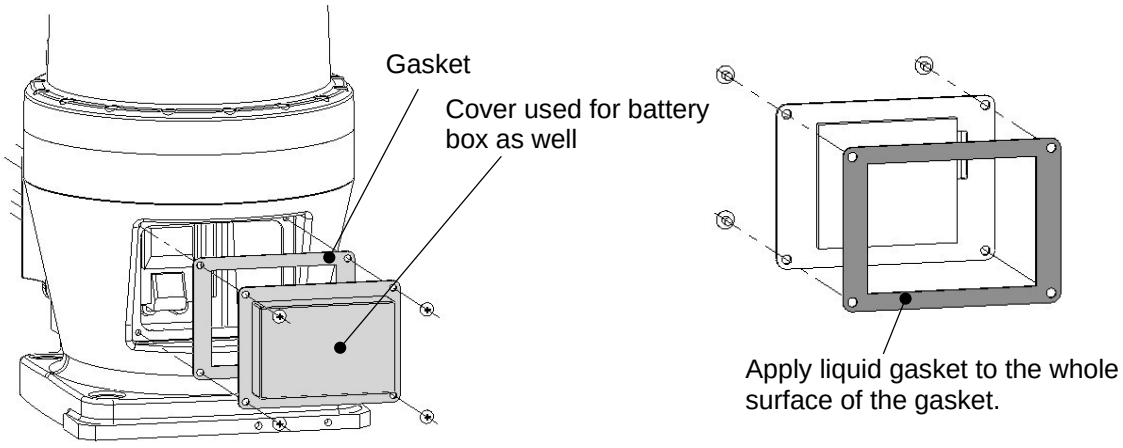



Fig. 5.5 Cover used for battery box as well

When mounting the cover, apply liquid gasket to the area shown in Fig. 5.5 above. Also, apply Loctite adhesives to all attaching bolts.

**! CAUTION**

- Be sure to attach the gasket and apply the liquid gasket. Also, be sure to coat Loctite adhesives to all attaching bolts. If it is not be done completely, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.

### 5.4.2 Arm 1 Cover

The arm 1 covers are installed above the axis 1 (arm 1 cover) and under the axis 2 (arm 2 cover). The covers are secured to the arm 1 with six (6) cross-recess truss head screws (M4x6) in such a way to sandwich the gasket between the arm and the cover. The gasket attachment surface is coated with liquid gasket. Detach the cover while stripping off the liquid gasket using a minus screwdriver or the like.

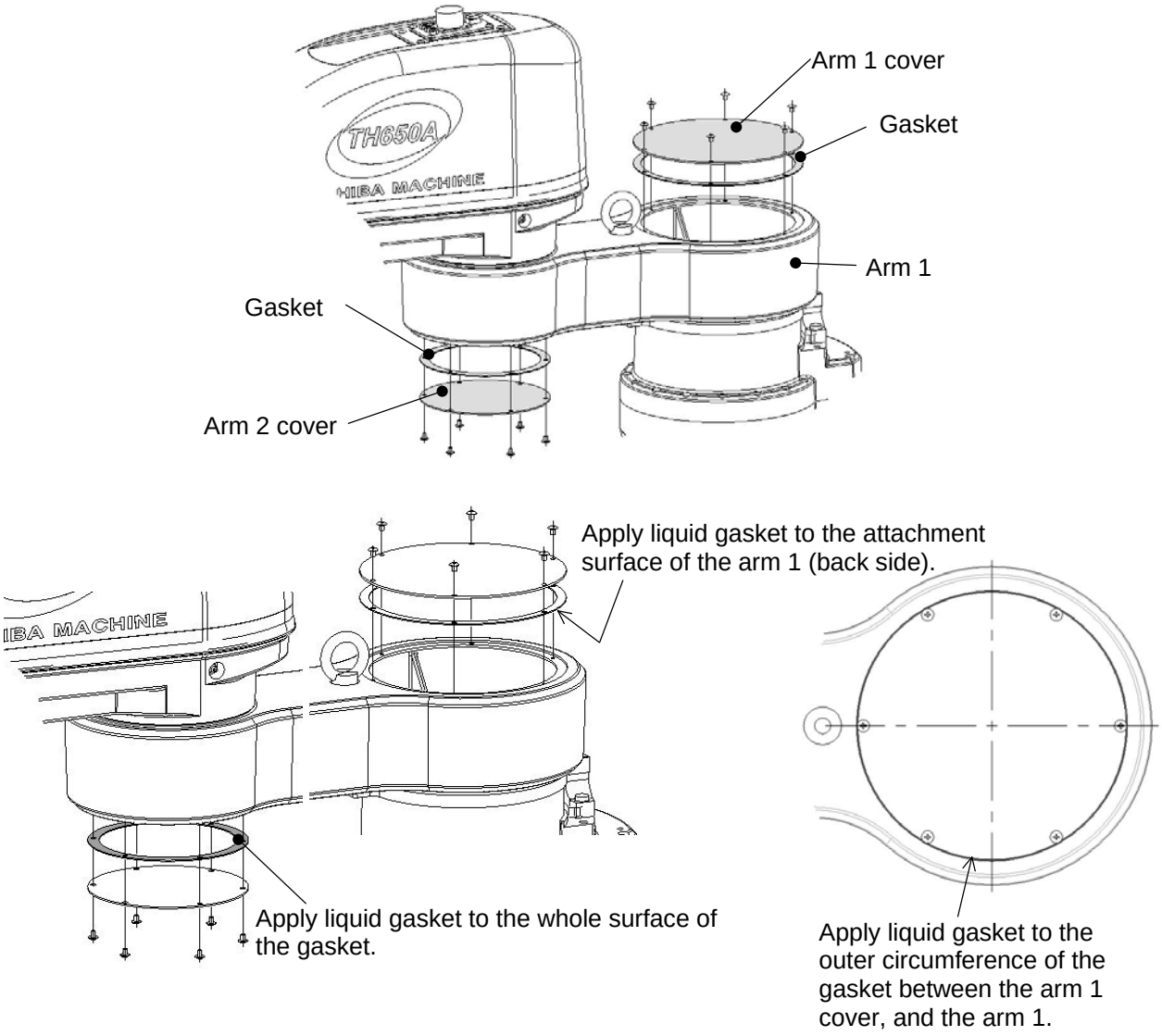



Fig. 5.6 Arm 1 cover

When mounting the cover, apply liquid gasket to the area shown in Fig. 5.6 above. After mounting the arm 1 cover, a gap between the arm 1 and the arm 1 cover should be applied with liquid gasket. Also, apply Loctite adhesives to all attaching bolts.

**! CAUTION**

- Be sure to attach the gasket and apply liquid gasket. Also, be sure to coat Loctite adhesives to all attaching bolts. If it is not be done completely, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.

5.4.3 Arm 2 Cover

1) Detach the arm 2 cover after having removed the bellow. For removal of the upper bellow, see Paragraph 5.2.2.
Firstly, remove the wiring panel attached to the panel. Though the gasket (packing) is provided between the panel and wiring panel, it is glued to the wiring panel and they can be disconnected all together. DO NOT pull the cover by force because it is connected to the connector and other components internally. After disconnecting the wiring panel, remove the connectors inside, then remove the four (4) truss head screws (M4 × 10) securing the panel. Similarly to the wiring panel, the gasket is glued to the periphery of the panel and is also glued to the cover with liquid gasket. Therefore the panel cannot be separated from the cover. Be careful not to strip away the panel by force.

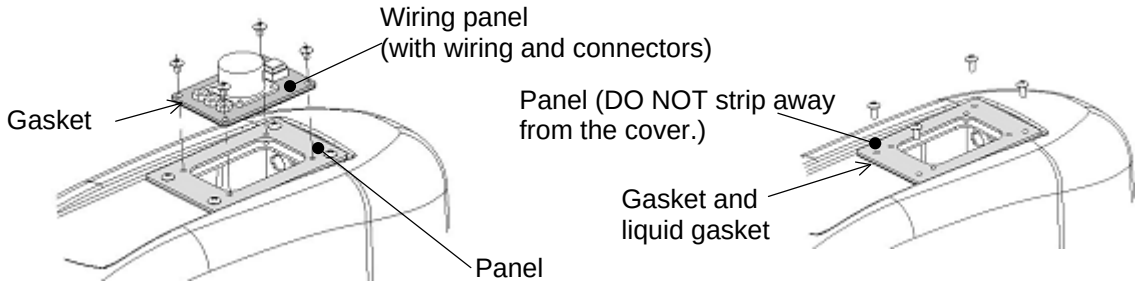



Fig. 5.7 Arm 2 cover (1)

2) Though the cover is embedded to the arm 2, liquid gasket is applied to the circumference of the packing under the cover to protect the robot against dust and drip. When detaching the cover, strip off the liquid gasket over the whole surface between the arm 2 and the packing using a cutter or the like. Then strip off the liquid gasket gradually with a minus screwdriver or the like before detaching the cover. DO NOT strip off the liquid gasket applied between the cover and the packing. Detach the cover together with the packing.

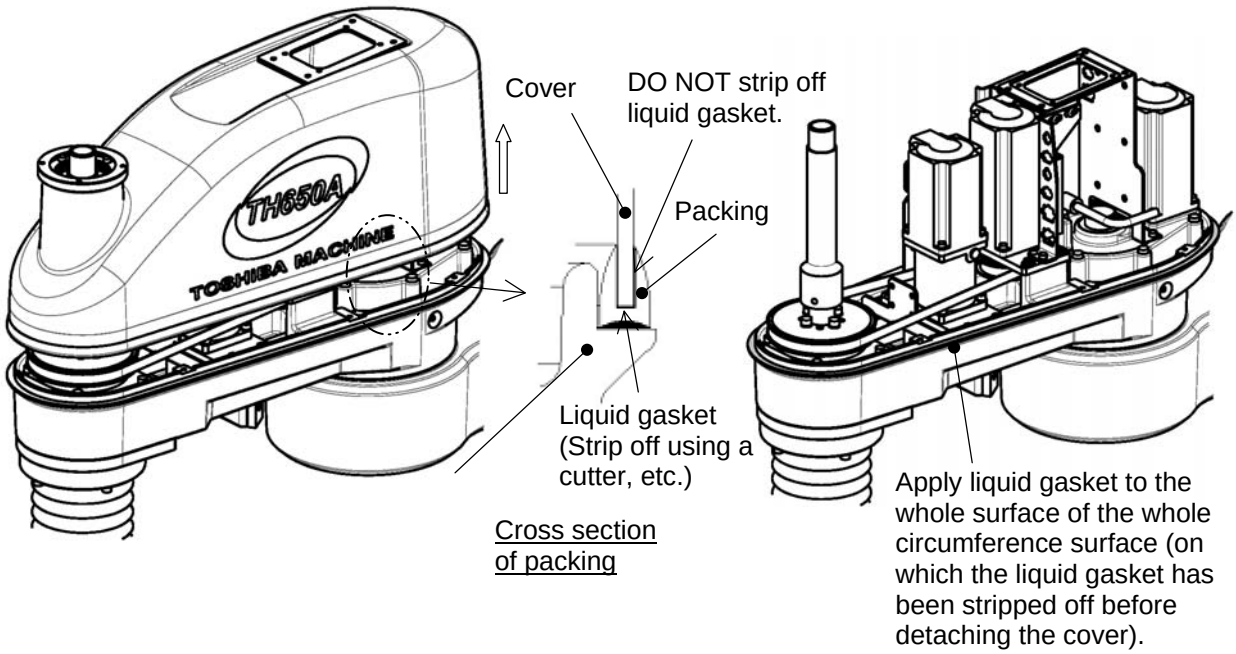



Fig. 5.8 Arm 2 cover (2)

When mounting the cover, apply liquid gasket to the area shown in Fig. 5.8 above. Also, apply Loctite adhesives to all attaching bolts.

**! CAUTION**

- When using a cutter, take careful precautions not to cut the packing body.
- DO NOT strip off the liquid gasket between the cover and packing. If it is not be done completely, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.
- The cover may separate from the packing according to circumstances. In order to avoid such a problem, apply liquid gasket to between the cover and the packing before attaching the cover.
- Be sure to attach the gasket and apply liquid gasket. Also, be sure to coat Loctite adhesives to all attaching bolts. If it is not be done completely, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.

### 5.4.4 Lid Used for Arm 2 Panel

The arm 2 has a lid attached hereinunder so as to mount a wiring panel.
Refer to the TH650A Installation and Transportation Manual provided separately.
The lid is secured to the arm 2 with four (4) cross-recessed truss head screws (M4x6) in such a way to sandwich a gasket between the arm 2 and the lid.
No liquid gasket is coated to the lid and gasket. Remove the four (4) cross-recessed truss head screws, and you can dismantle the lid. As the gasket is glued to the lid, they can be removed all together.
When mounting the lid, apply Loctite adhesives to all attaching bolts and mount the gasket together with the lid.

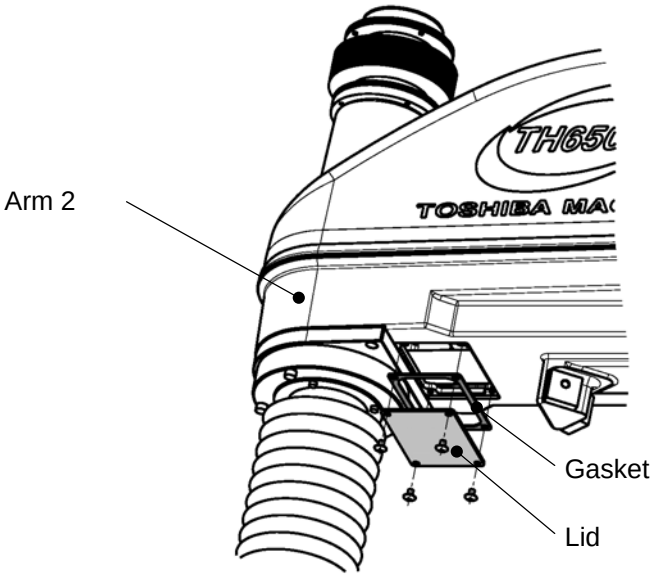



Fig. 5.9 Lid used for arm 2 panel

**! CAUTION**

- Be sure to attach the gasket . Also, be sure to coat Loctite adhesives to all attaching bolts. If it is not be done completely, the dust-proof and drip-proof performance will be impaired resulting in ingress of water and dust.

## 6. Cleaning Robot Body

To clean and wash the robot body, be sure to use a neutral detergent. Use a soft sponge and waste cloth, and take careful precautions not to cut or scratch the robot body.

Rinse the robot body in compliance with the specified values corresponding to the ingress protection class to protect the robot against water. Be sure to rinse the robot while purging air.

**! DANGER**

- Be sure to turn off the controller power supply and to pull out the power plug before cleaning work. If you do not follow the instruction, this will cause an electric shock or fault, which can be dangerous.
- After cleaning, completely wipe out the water.

**! CAUTION**

- Be sure to use a neutral detergent to clean and wash the robot body. If a detergent (such as chlorine detergent and acid detergent) other than the neutral detergent is used, the paint may deteriorate, or the cover or bellows may be damaged.
- Be sure to rinse the robot body while purging air. It is not be done completely, the dust-proof and drip-proof performance will be impaired resulting in ingress of water.

# 7. Maintenance and Replacement Parts

## 7.1 List of Maintenance and Replacement Parts

| No. | Part name | Type | Our dwg. No. | Unit code | Maker | Q'ty | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | Bellows | | S828912 | Y610A38Z0 | Toshiba Machine | 1 | When Z-axis stroke is 200 mm |
| 2 | Bellows | | S835831 | Y610A38Y0 | Toshiba Machine | 1 | When Z-axis stroke is 370 mm |

The replacement parts other than the above are the same as those of the TH650A robot. For details, see the TH650A Maintenance Manual provided separately.

- When you wish to purchase the maintenance and replacement parts, contact us after confirming the serial number of the robot body.

APPROVED BY: Y. Yamaguchi

CHECKED BY: K. Calen.

PREPARED BY: R. Amemiya