MOTOMAN-MH50-20
INSTRUCTIONS

TYPE: YR-MH00050-A10 (STANDARD SPECIFICATION)
YR-MH00050-A11 (WITH LIMIT SWITCHES FOR SLU-AXES)

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS

MOTOMAN-MH50-20 INSTRUCTIONS
DX100 INSTRUCTIONS
DX100 OPERATOR'S MANUAL
DX100 MAINTENANCE MANUAL

The DX100 Operator's manual above corresponds to specific usage.
Be sure to use the appropriate manual.

Part Number: 156229-1CD
Revision: 3

MANDATORY

- This instruction manual is intended to explain mainly on the mechanical part of the MOTOMAN-MH50-20 for the application to the actual operation and for proper maintenance and inspection. It describes on safety and handling, details on specifications, necessary items on maintenance and inspection, to explain operating instructions and maintenance procedures. Be sure to read and understand this instruction manual thoroughly before installing and operating the manipulator.
- General items related to safety are listed in Chapter 1: Safety of the DX100 Instructions. To ensure correct and safe operation, carefully read the DX100 instructions before reading this manual.

CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.
- The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.
- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.
- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.
- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the MOTOMAN-MH50-20.

In this manual, the Notes for Safe Operation are classified as “DANGER”, “WARNING”, “CAUTION”, “MANDATORY”, or “PROHIBITED”.

DANGER	Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.
MANDATORY	Always be sure to follow explicitly the items listed under this heading.
PROHIBITED	Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

NOTE To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “DANGER”, “WARNING” and “CAUTION”.

DANGER

- Maintenance and inspection must be performed by specified personnel.

Failure to observe this caution may result in electric shock or injury.

- For disassembly or repair, contact your Yaskawa representative.
- Do not remove the motor, and do not release the brake.

Failure to observe these safety precautions may result in death or serious injury from unexpected turning of the manipulator's arm.

WARNING

- Before operating the manipulator, check that servo power is turned OFF pressing the emergency stop buttons on the front door of the DX100 and the programming pendant.
  When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

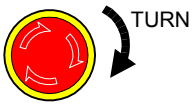
Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Figure 1: Emergency Stop Button

- Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Figure 2: Release of Emergency Stop



- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Keep in mind the emergency response measures against the manipulator's unexpected motion toward you.
  - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

- Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning ON the power for the DX100.
  - Moving the manipulator with the programming pendant.
  - Running the system in the check mode.
  - Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem.

The emergency stop buttons are located on the right of front door of the DX100 and the programming pendant.

CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  -Check for problems in manipulator movement.
  -Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the DX100 cabinet after use.

The programming pendant can be damaged if it is left in the P-point maximum envelope of the manipulator, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the DX100 instructions before operating the manipulator.

Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the controller, the programming pendant and supply cables.

In this manual, the equipment is designated as follows:

Equipment	Manual Designation
DX100 controller	DX100
DX100 programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator cable

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and TM are omitted.

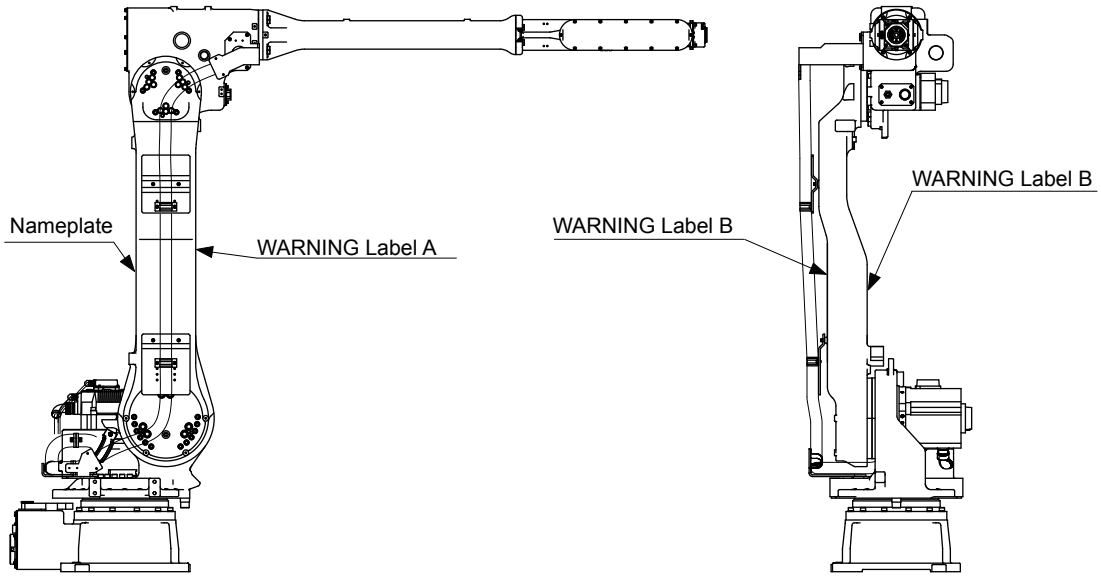
Explanation of Warning Labels

The following warning labels are attached to the manipulator.

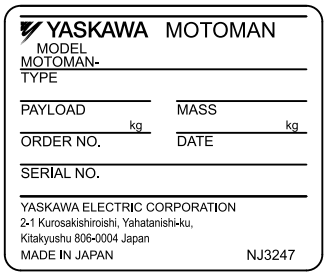
Always follow the warnings on the labels.

Also, an identification label with important information is placed on the body of the manipulator. Prior to operating the manipulator, confirm the contents.

Figure 3: Warning Label Locations



Nameplate



Warning Label A

Warning Label B

Table of Contents

1 Product Confirmation

CAUTION

- Confirm that the manipulator and the DX100 have the same order number. Special care must be taken when more than one manipulator is to be installed.

If the numbers do not match, manipulators may not perform as expected and cause injury or damage.

1.1 Contents Confirmation

Confirm the contents of the delivery when the product arrives.

Standard delivery includes the following four items (Information for the content of optional goods is given separately):

- Manipulator
- DX100
- Programming Pendant
- Manipulator cables (between the DX100 and the manipulator)

1.2 Order Number Confirmation

Check that the order number of the manipulator corresponds to the DX100. The order number is indicated on a label as shown below.

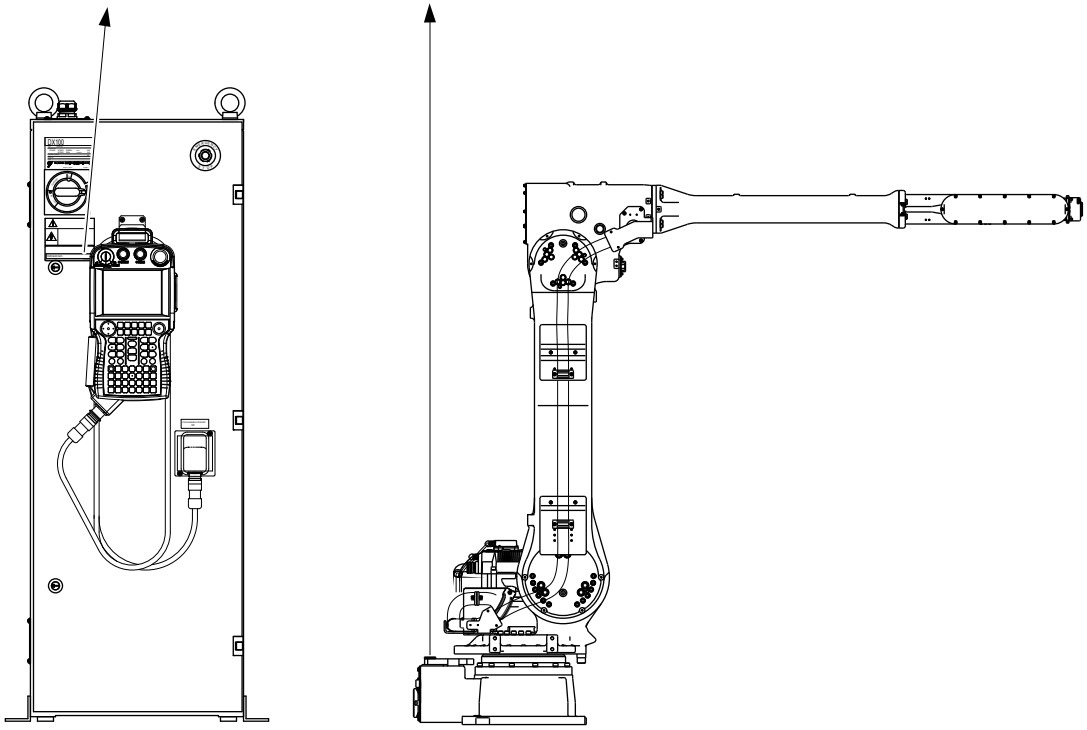
Fig. 1-1: Location of Order Number Labels

Label (Enlarged View)

THE MANIPULATOR AND THE CONTROLLER SHOULD HAVE SAME ORDER NUMBER.

ORDER. No.

Check that the manipulator and the DX100 have the same order number.



(a)DX100(Front View) (b)Manipulator (Side View)

2 Transport

CAUTION

- Sling and crane or forklift operations must be performed by authorized personnel only.

Failure to observe this caution may result in injury or damage.

- Avoid excessive vibration or shock during transport.

The system consists of precision components. Failure to observe this caution may adversely affect performance.

2.1 Transport Method

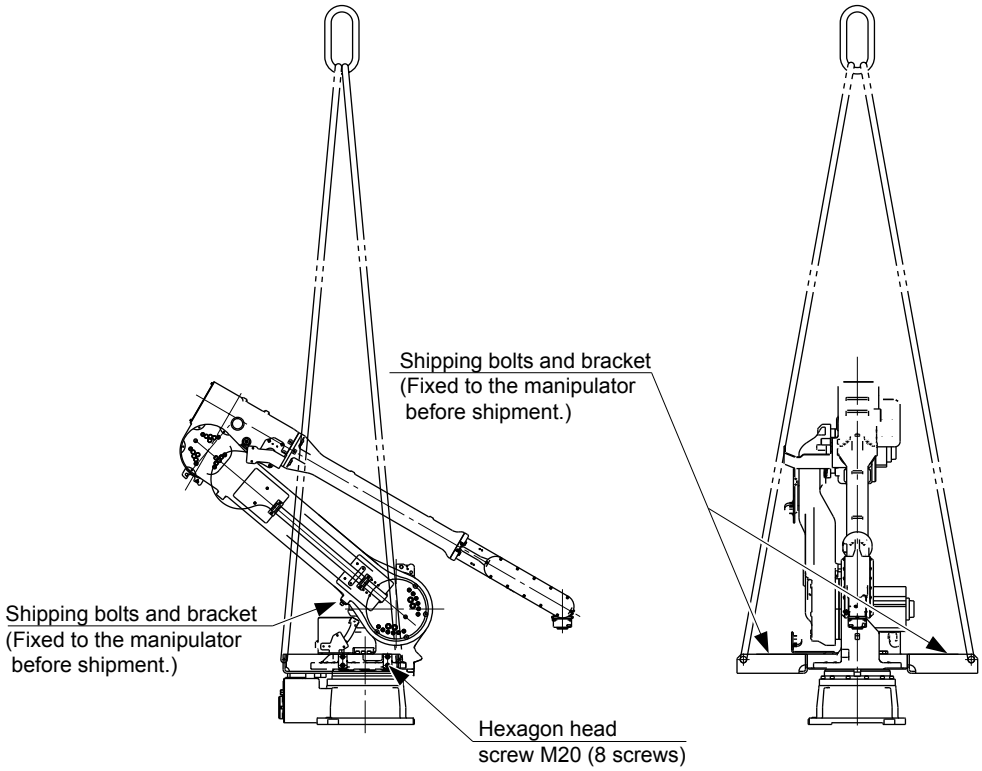
NOTE

- The weight of the manipulator is approximately 520 kg including the shipping bolts and brackets. Use a wire rope strong enough to withstand the weight.
- The attached eyebolts are designed to support the manipulator mass. Never use them for anything other than transporting the manipulator.
- Mount the shipping bolts and brackets before transporting the manipulator.
- Avoid putting external force on the arm of motor unit when transporting by a crane, forklift, or other equipment. Failure to observe this instruction may result in injury.

2.1.1 Using a Crane

As a rule, the manipulator should be lifted by a crane with a four-leg bridle sling using the shipping bolts and brackets when removing it from the package and moving it. Be sure that the manipulator is fixed with the shipping bolts and brackets before transport, and lift it in the posture as shown in *Fig. 2-1 “Transport Using a Crane”*.

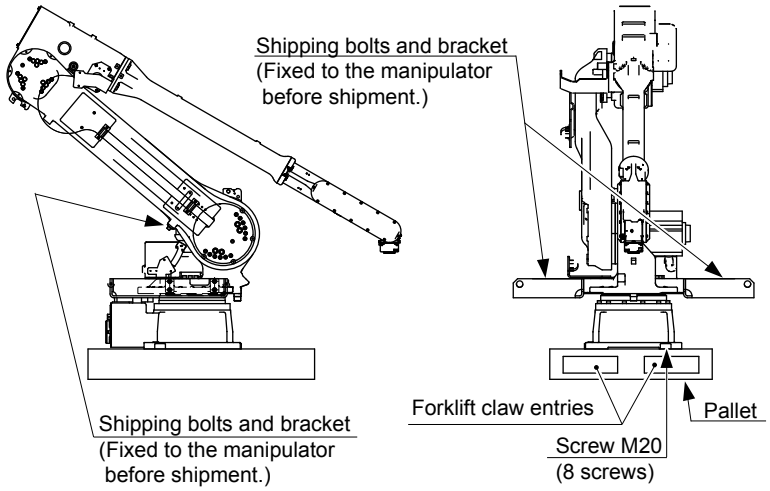
Fig. 2-1: Transport Using a Crane



2.1.2 Using a Forklift

When using a forklift, the manipulator should be fixed on a pallet with shipping bolts and brackets as shown in *Fig. 2-2 "Transport Using a Forklift"*. Insert claws under the pallet and lift it. The pallet must be strong enough to support the manipulator. Transport the manipulator slowly with due caution in order to avoid overturning or slippage.

Fig. 2-2: Transport Using a Forklift



2.2 Shipping Bolts and Brackets

The manipulator is provided with shipping bolts and brackets. (See *Fig. 2-1 “Transport Using a Crane” on page 2-2*)

The shipping bolts and brackets are painted yellow

NOTE

Before turning ON the power, check to be sure that the shipping bolts and brackets are removed. The shipping bolts and brackets then must be stored for future use, in the event that the manipulator must be moved again.

3 Installation

WARNING

- Install the safeguarding.

Failure to observe this warning may result in injury or damage.

- Install the manipulator in a location where the tool or the workpiece held by its fully extended arm will not reach the wall, safeguarding, or controller.

Failure to observe this warning may result in injury or damage.

- Do not start the manipulator or even turn ON the power before it is firmly anchored.

The manipulator may overturn and cause injury or damage.

CAUTION

- Do not install or operate a manipulator that is damaged or lacks parts.

Failure to observe this caution may cause injury or damage.

- Before turning ON the power, check to be sure that the shipping bolts and brackets explained in *section 2.2 “Shipping Bolts and Brackets” on page 2-4* are removed.

Failure to observe this caution may result in damage to the driving parts.

3.1 Installation of Safeguarding

To insure safety, be sure to install the safeguarding. They prevent unforeseen accidents with personnel and damage to equipment. The following is quoted for your information and guidance.

Responsibility for Safeguarding (ISO 10218)

The user of a manipulator or robot system shall ensure that safeguarding is provided and used in accordance with Sections 6, 7, and 8 of this standard. The means and degree of safeguarding, including any redundancies, shall correspond directly to the type and level of hazard presented by the robot system consistent with the robot application. Safeguarding may include but not be limited to safeguarding devices, barriers, interlock barriers, perimeter guarding, awareness barriers, and awareness signals.

3.2 Mounting Procedures for Manipulator Base

The manipulator should be firmly mounted on a baseplate or foundation strong enough to support the manipulator and withstand repulsion forces during acceleration and deceleration.

Construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator refer ring to *Table 3-1 "Maximum Repulsion Force of the Manipulator at Emergency Stop"* and *Table ""*.)

A baseplate flatness must be kept at 0.5 mm or less: insufficient flatness of installation surface may deform the manipulator shape and affect its functional abilities. Mount the manipulator bases as instructed in *section 3.2.1 “Mounting the Manipulator on the Baseplate”* or *section 3.2.2 “Mounting the Manipulator on the Floor” on page 3-4*.

Table 3-1: Maximum Repulsion Force of the Manipulator at Emergency Stop

Maximum torque in horizontal rotation (S-axis moving direction)	24500 N·m (2500 kgf·m)
Maximum torque in vertical rotation (LU-axis moving direction)	45080 N·m (4600 kgf·m)

Table 3-2: Endurance Torque in Operation

Endurance torque in horizontal operation (S-axis moving direction)	6125N·m (625 kgf·m)
Endurance torque in vertical operation (L-,U--axes moving direction)	11270 N·m (1150 kgf·m)

3.2.1 Mounting the Manipulator on the Baseplate

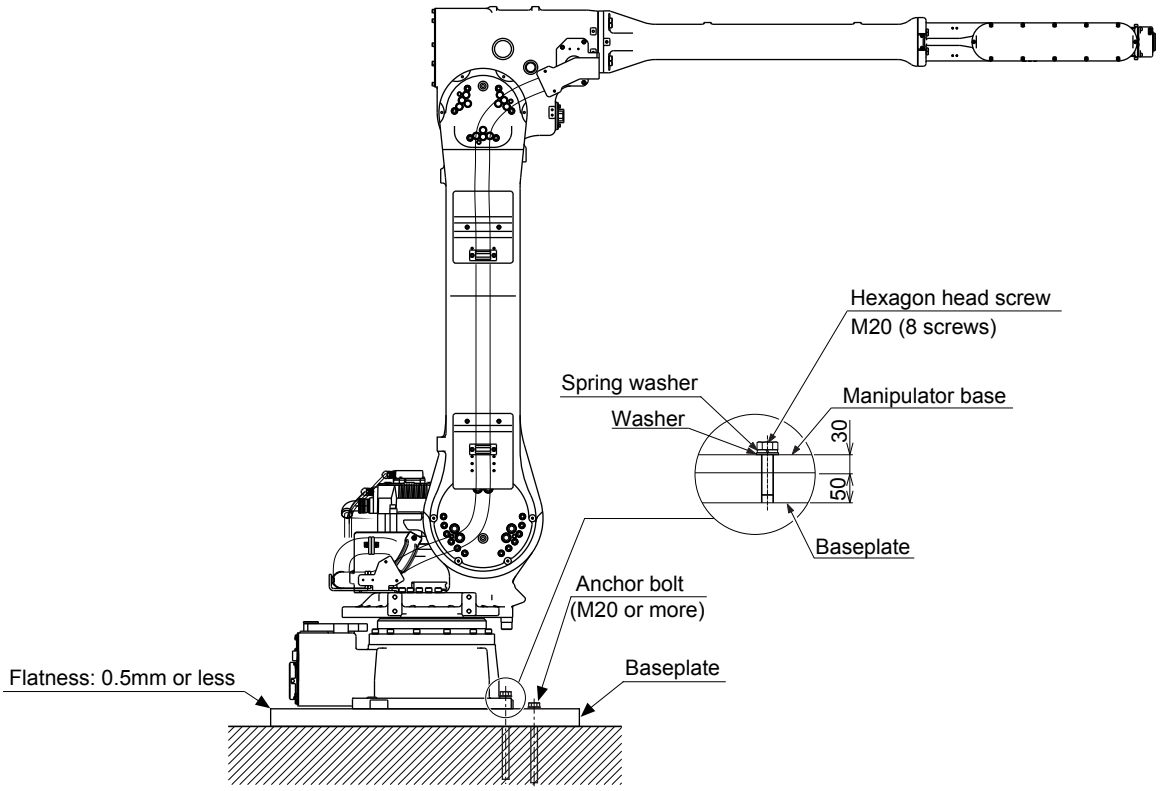
For the first process, anchor the baseplate firmly to the ground. The baseplate should be rugged and durable to prevent shifting of the baseplate of 50 mm or more thick, and anchor bolts of M20 or larger size.

The manipulator base is tapped for eight mounting holes; securely fix the manipulator base to the baseplate with eight hexagon head screws M20 (70 mm long is recommended).

Next, fix the manipulator base to the baseplate. Tighten the hexagon head bolts and anchor bolts firmly so that they will not work loose during the operation.

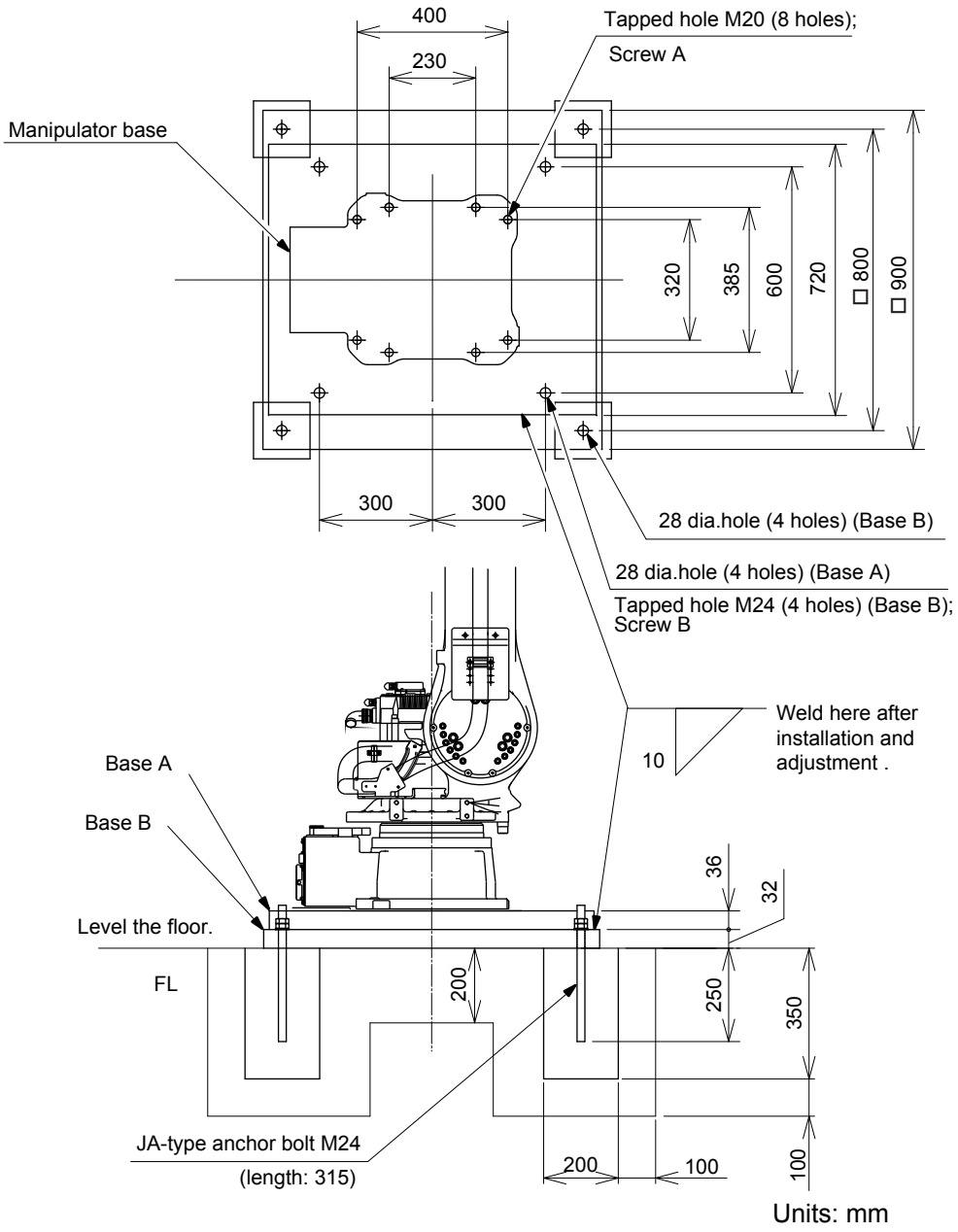
Refer to *Fig. 3-1 "Mounting the Manipulator on the Baseplate"*.

Fig. 3-1: Mounting the Manipulator on the Baseplate



3.2.2 Mounting the Manipulator on the Floor

The floor should be strong enough to support the manipulator. Construct a solid foundation with the appropriate thickness to withstand maximum repulsion force of the manipulator shown in *Table 3-1 "Maximum Repulsion Force of the Manipulator at Emergency Stop"* As a rough standard, if there is a concrete thickness (floor) of 200 mm or more, the manipulator base can be fixed directly to the floor with anchor bolts M20. Before mounting the manipulator, however, check that the floor is level and that all cracks, etc. are repaired. Any thickness less than 200 mm is insufficient for mounting, even if the floor is concrete.



Screw A: Screw M20 (length: 70) (8 screws); spring washer, flat washer
Screw B: Screw M24 (length: 70) (4 screws); spring washer
The fixing screws and bases are to be prepared by customer.

3.3 Types of Mounting

The manipulator can be mounted in three different ways: floor-mounted (standard), and wall-mounted, and ceiling-mounted types are available. For wall-mounted and ceiling-mounted types, the three points listed below are different from the floor-mounted type.

- S-Axis Operating Range
- Processes in Fixing the Manipulator Base
- Precautions to Prevent the Manipulator from Falling

3.3.1 S-Axis Operating Range

In case of installing wall-mounted type, the S-axis operating range must be ±30°. (Set before shipment.)

3.3.2 Processes in Fixing the Manipulator Base

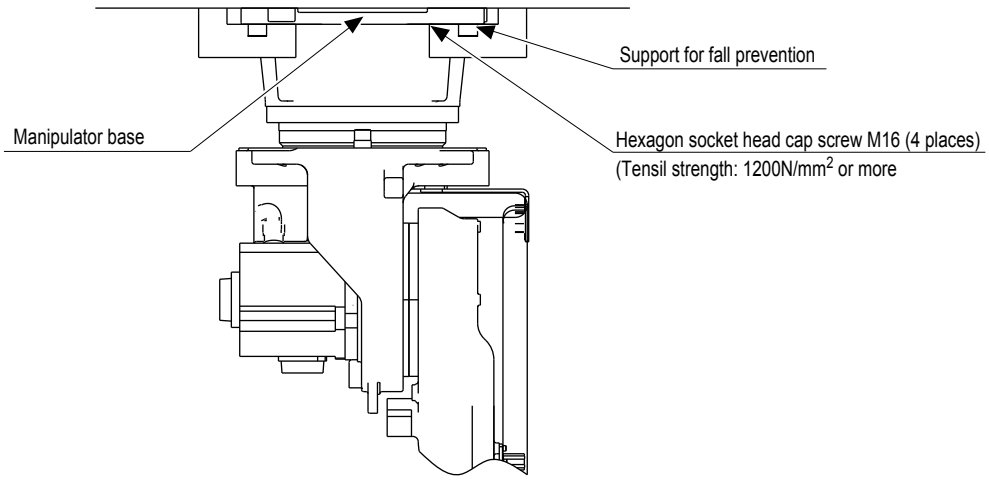
In case of installing wall/ceiling-mounted types, be sure to use eight hexagon socket head cap screws M20. Use a torque of 402 N·m (41 kgf·m) when tightening the screws.

3.3.3 Precautions to Prevent the Manipulator from Falling

In case of installing wall/ceiling-mounted types, for safety purposes, take measures to keep the manipulator from falling.

Refer to *Fig.3-2 "Precautions to Prevent the Manipulator from Falling"* for details.

Fig. 3-2: Precautions to Prevent the Manipulator from Falling



NOTE In case of using the wall/ceiling-mounted types, inform Yaskawa of the matter in an order placement. Be sure to contact your Yaskawa representative to execute wall/ceiling installations on site.

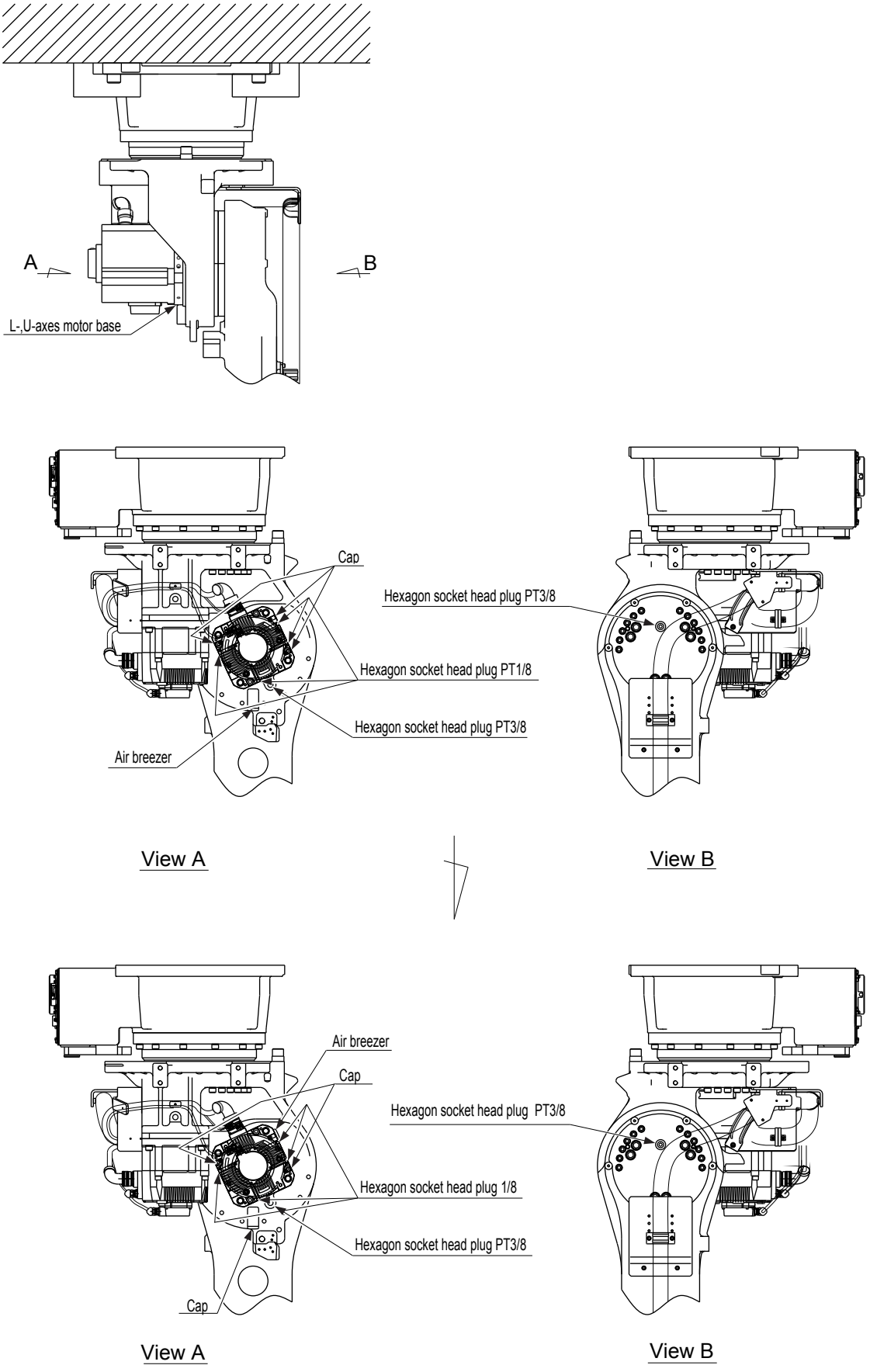
3.4 Notes on Mounting the Manipulators on the Ceiling

In the case if the manipulator shipped is the floor-mounted type, yet is to be mounted on the ceiling, mounting positions of each part on the view A in the figure below should be changed after installing the manipulator on the ceiling, to prevent a grease leakage from an air breather. Change the mounting positions of the parts as shown in the figure below.

After installing the manipulator on the ceiling, replace the positions of the parts installed in the LU-axes motor base, by switching the positions of the union and the hexagon socket head plug PT 1/8, and the positions of the grease cap and the air breather.

Replace the positions of the grease cap and the air breezer promptly, to prevent the grease leakage from a hole where a grease cap is to be installed.

Fig. 3-3: Parts Positions for Ceiling Mounted Manipulator



3.5 IP (International Protection)

For the standard type, environmental resistance for main part of the manipulator conforms to IP54; the wrist part conforms to IP67.

3.6 Location

When installing a manipulator, it is necessary to satisfy the following environmental conditions.

- Ambient temperature: 0° to 45°C
- Humidity: 20 to 80%RH (no-condensing)
- Free from exposure to dust, soot, oil, or water.
- Free from corrosive gas or liquid, or explosive gas or liquid
- Free from excessive vibration (Vibration acceleration: 4.9 m/s^2 [0.5 G] or less)
- Free from large electrical noise (plasma)
- Flatness for installation is 0.5 mm or less

4 Wiring

WARNING

- Ground resistance must be 100 Ω or less.

Failure to observe this warning may result in fire or electric shock.

- Before wiring, make sure to turn OFF the primary power supply, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)

Failure to observe this warning may result in fire or electric shock.

CAUTION

- Wiring must be performed by authorized or certified personnel.

Failure to observe this caution may result in fire or electric shock.

4.1 Grounding

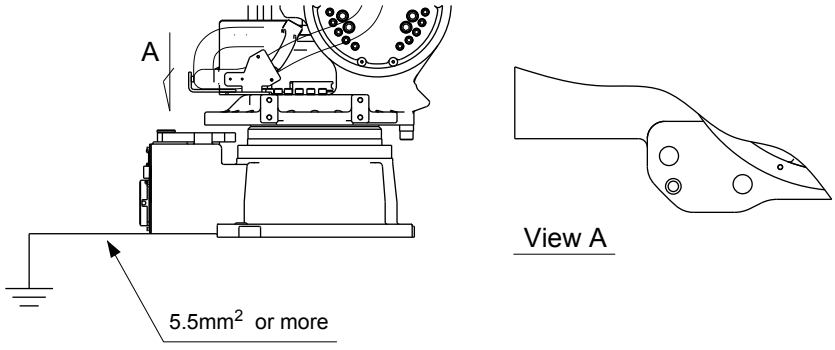
Follow electrical installation standards and wiring regulations for grounding. A ground wire of 5.5 mm^2 or more is recommended.

Refer to *Fig. 4-1 "Grounding Method" on page 4-1*to connect the ground line directly to the manipulator.

NOTE

- Do not use this wire sharing with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc.
- Where metal ducts, metallic conduits, or distributing racks are used for cable laying, ground in accordance with electrical installation standards.

Fig. 4-1: Grounding Method



4.2 Cable Connection

Two manipulator cables are delivered with the manipulator: an encoder cable (1BC) and a power cable (2BC). (Refer to *Fig. 4-2 “Manipulator Cables” on page 4-3*.)

Connect these cables to the connectors on the manipulator connector base and the DX100 board connectors. Refer to *Fig. 4-3(a) "Manipulator Cable Connection (Manipulator Side)" on page 4-4* and *Fig. 4-3(b) "Manipulator Cable Connection (DX100 Side)" on page 4-4*.

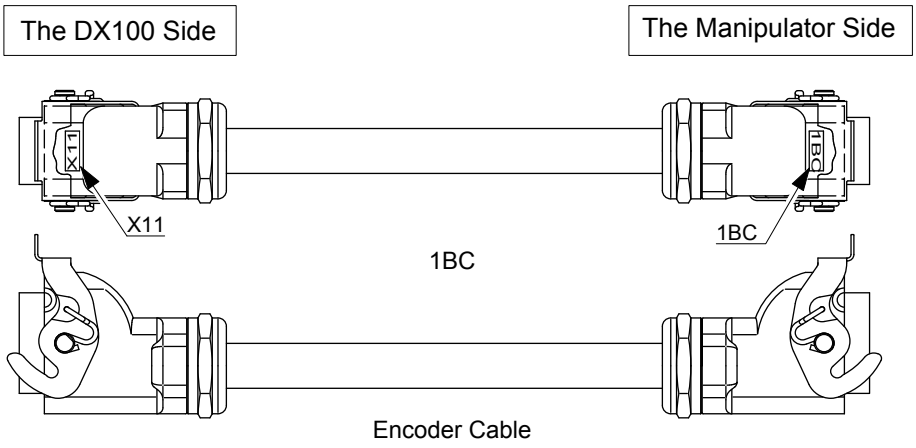
4.2.1 Connection to the Manipulator

Before connecting two cables to the manipulator, verify the numbers on both manipulator cables and the connectors on the connector base of the manipulator. When connecting, adjust the cable connector positions to the main key positions of the manipulator, and insert cables in the order of 2BC, then 1BC. After inserting the cables, depress the lever until it clicks.

4.2.2 Connection to the DX100

Before connecting cables to the DX100, verify the numbers on both manipulator cables and the connectors on the DX100. When connecting, insert the cables in the order of X21, then X11, and depress each lever low until it clicks.

Fig. 4-2: Manipulator Cables



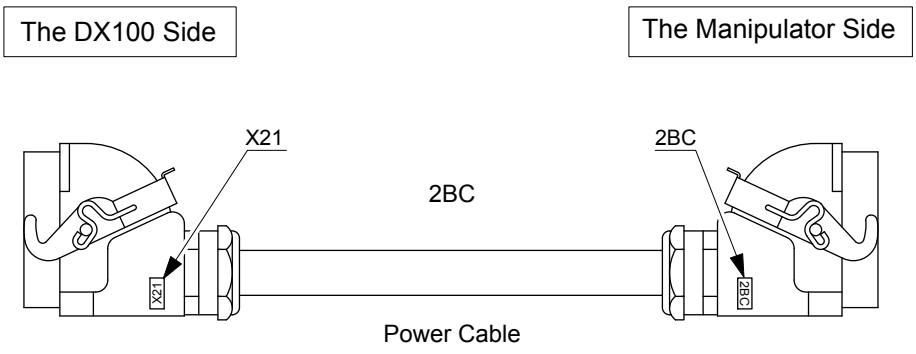


Fig. 4-3(a): Manipulator Cable Connection (Manipulator Side)

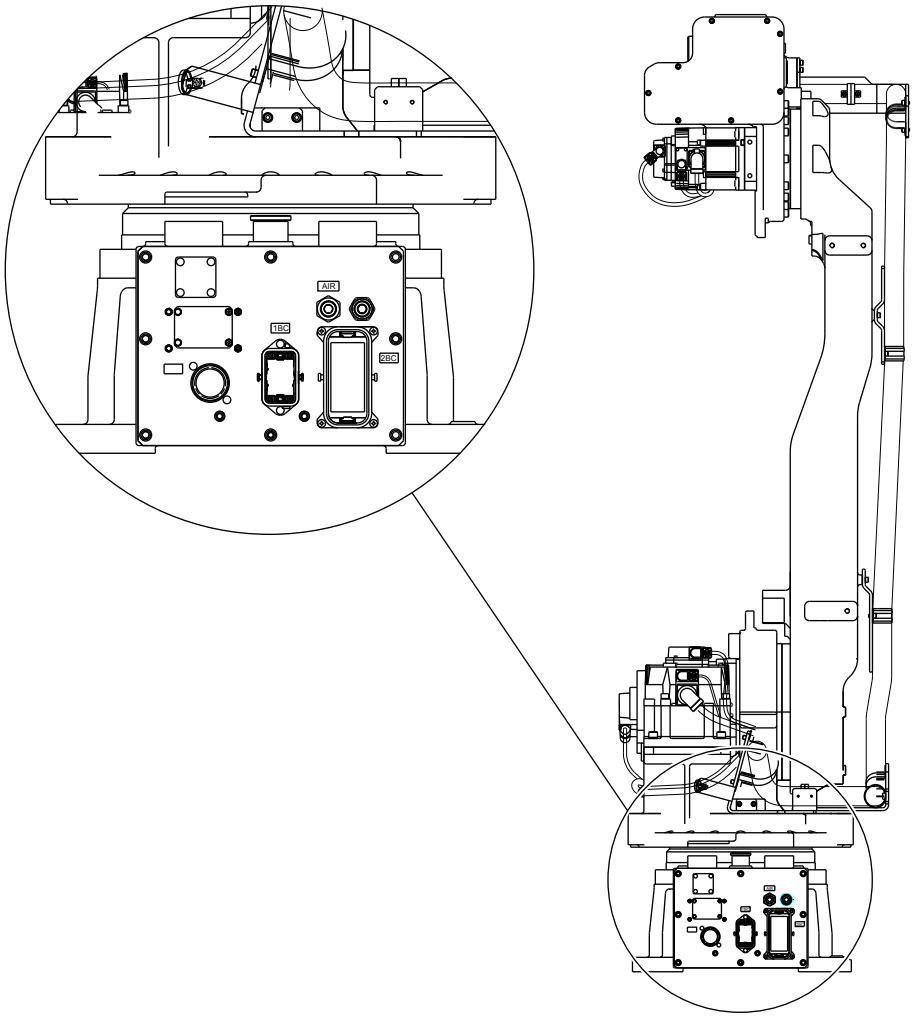
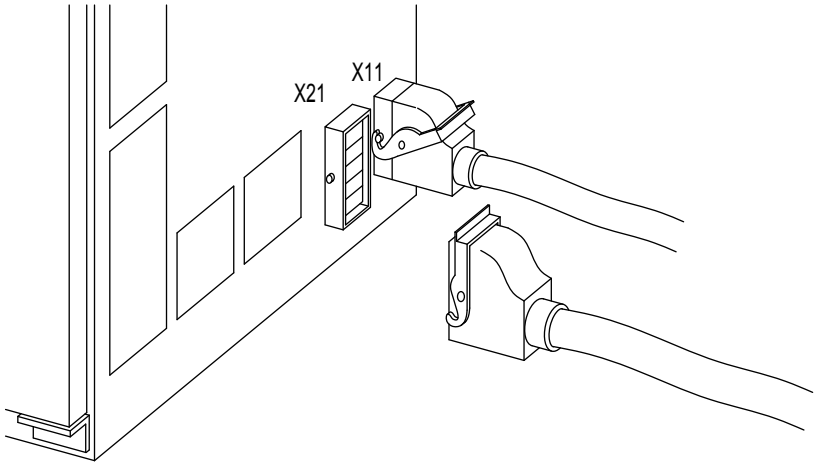


Fig. 4-3(b): Manipulator Cable Connection (DX100 Side)



5 Basic Specifications

5.1 Basic Specifications

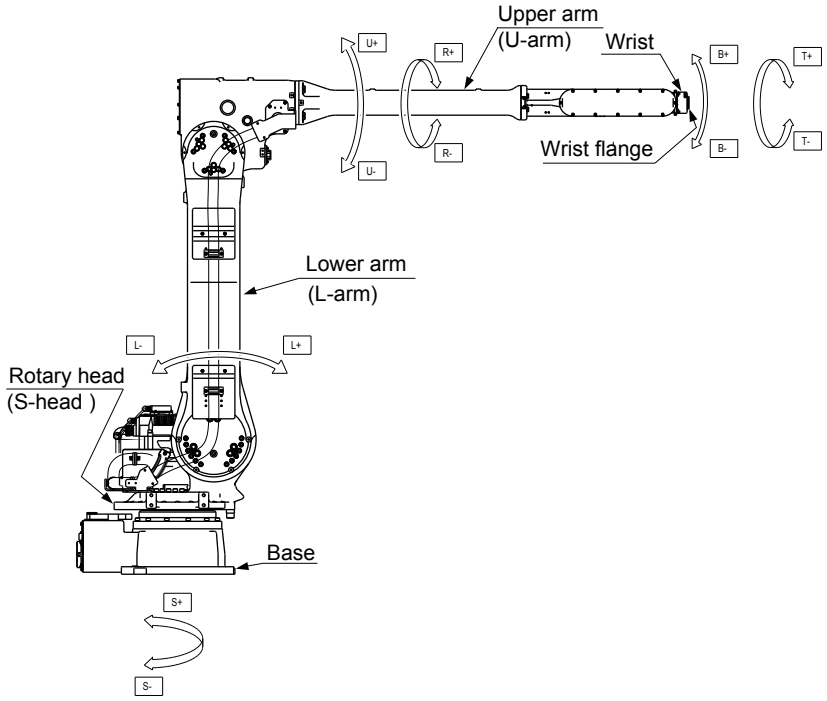
Table 5-1: Basic Specifications[1)]

ITem \ Model		MOTOMAN-MH50-20
Structure		Vertically Articulated
Degree of Freedom		6
Payload		20 kg
Repeatability[2)]		±0.15 mm
Range of Motion[3)]	S-Axis (turning)	±180°
	L-Axis (lower arm)	+135°, -90°
	U-Axis (upper arm)	+251°, -160°
	R-Axis (wrist roll)	±190°
	B-Axis (wrist pitch/yaw)	+230° to -50°
	T- Axis (wrist twist)	±360°
Maximum Speed	S-Axis	3.14 rad/s, 180°/s
	L-Axis	3.11 rad/s, 178°/s
	U-Axis	3.11 rad/s, 178°/s
	R-Axis	6.98 rad/s, 400°/s
	B-Axis	6.98 rad/s, 400°/s
	T-Axis	10.47 rad/s, 600°/s
Allowable Moment[4)]	R-Axis	39.2 N•m (4.0 kgf•m)
	B-Axis	39.2 N•m (4.0 kgf•m)
	T-Axis	19.6 N•m (2.0 kgf•m)
Approx. Mass		495 kg
Ambient Conditions	Temperature	0°C to 45°C
	Humidity	20 to 80% RH at constant temperature
	Vibration Acceleration	Less than 4.9 m/s^2 (0.5G)
	Others	Free from corrosive gas or liquid, or explosive gas. Free from water, oil, or dust. Free from excessive electrical noise (plasma).
Power Requirements		3.5 kVA

1 SI units are used in this table. However, gravitational unit is used in ( ).
2 Conformed to ISO09283
3 For the limit switch specification (type: MH00050-A11), the range of motion is limited with switch before shipment.
4 Refer to *section 6.1 "Allowable Wrist Load" on page 6-1* for details on the permissible moment of inertia.

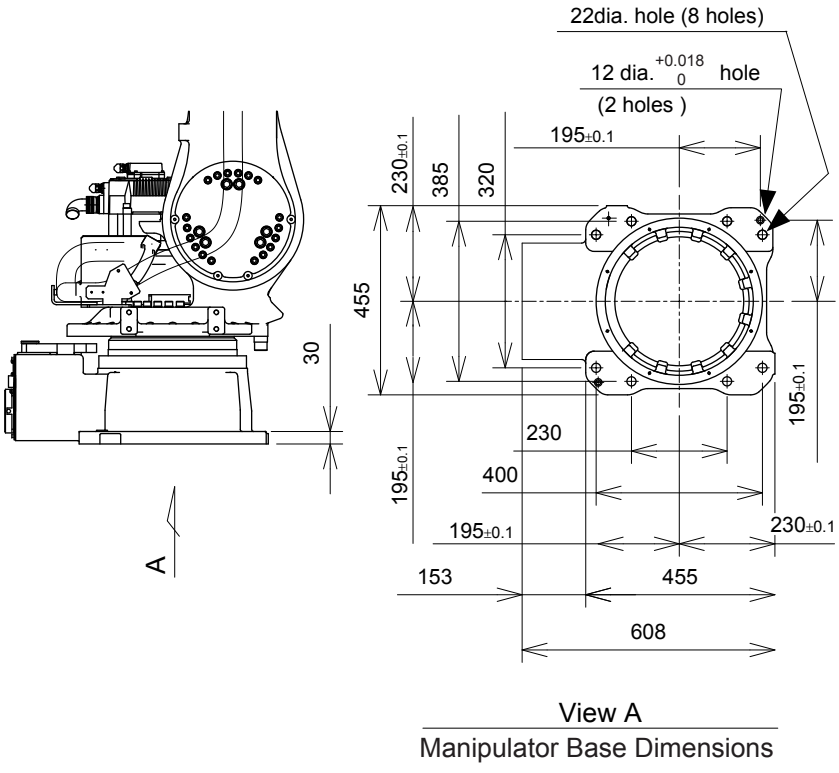
5.2 Part Names and Working Axes

Fig. 5-1: Part Names and Working Axes



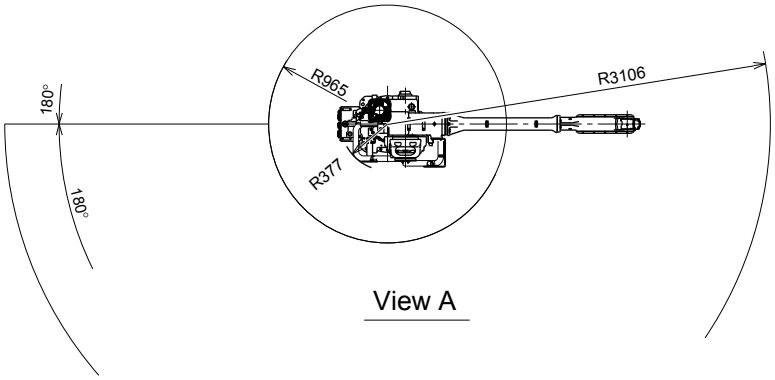
5.3 Manipulator Base Dimensions

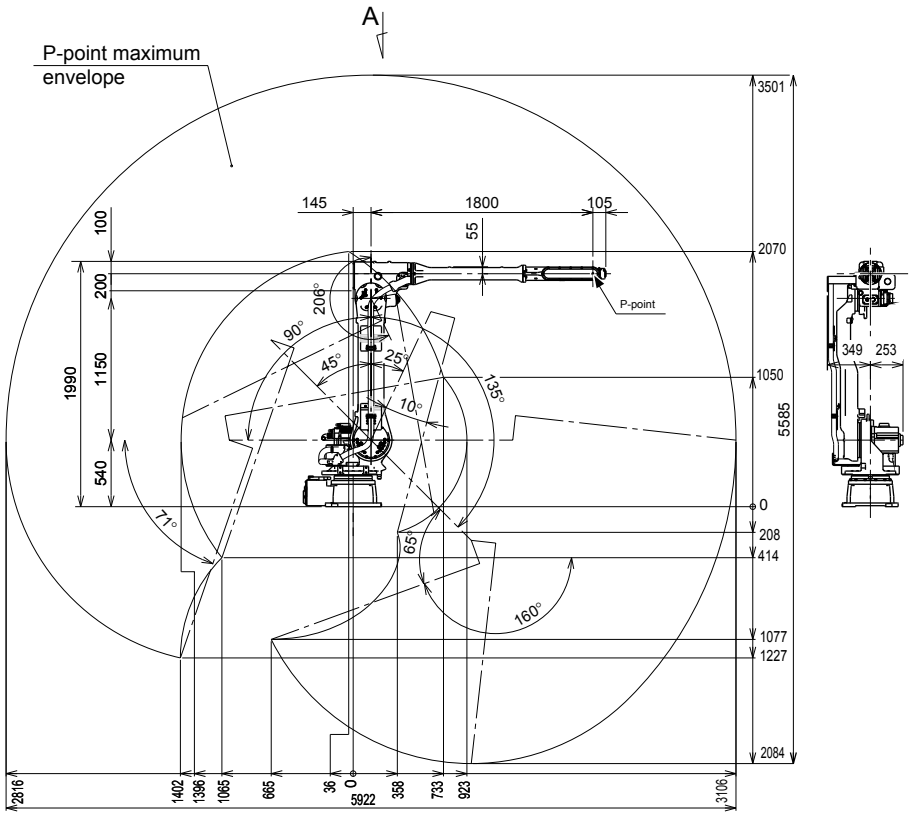
Fig. 5-2: Manipulator Base Dimensions



5.4 Dimensions and P-Point Maximum Envelope

Fig. 5-3: Dimensions and P-Point Maximum Envelope





5.5 Alterable Operating Range

The operating range of the S-axis can be altered in accordance with the operating conditions as shown in *Fig. 5-2 "S-Axis Operating Range"*. If alteration is necessary, contact your Yaskawa representative in advance.

Table 5-2: S-Axis Operating Range

Item	Specifications
S-Axis Operating Range	±180°(standard) ±165° ±150° ±135° ±120° ±105° ±90° ±75° ±60° ±45° ±30° ±15°

6 Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

The allowable wrist load is 20 kg maximum. If force is applied to the wrist instead of the load, force on R-, B-, and T-axes should be within the value shown in *Table 6-1 "Allowable Wrist Load"*. Contact your Yaskawa representative for further information or assistance.

Table 6-1: Allowable Wrist Load

Axis	Moment N•m (kgf•m)[1)]	$GD^2/4$ Total Moment of Inertia kg•m^2
R-Axis	39.2 (4)	1.05
B-Axis	39.2 (4)	1.05

1 ( ): Gravitational unit

The allowable moments of inertia for R-axis and B-axis are calculated when the moment is at the maximum. The allowable moment of inertia for T-axis varies depending on the moment, as shown in *Fig. 6-1(a) "T-Axis Allowable Moment of Inertia Diagram (Measured Value from the Rotation Center of the T-Axis Flange Surface)"*. Use the manipulator to meet those conditions.
For example, with MOTOMAN-MH50-20, the allowable moment of inertia for the T-axis is 0.25 kg•m^2 when the moment is 19.6 N•m, and 0.75 kg•m^2 when 0 N•m.

When the volume load is small, refer to the moment arm rating shown in *Fig. 6-1(b) "Moment of Arm Rating" on page 6-2*.

Fig. 6-1(a): T-Axis Allowable Moment of Inertia Diagram (Measured Value from the Rotation Center of the T-Axis Flange Surface)

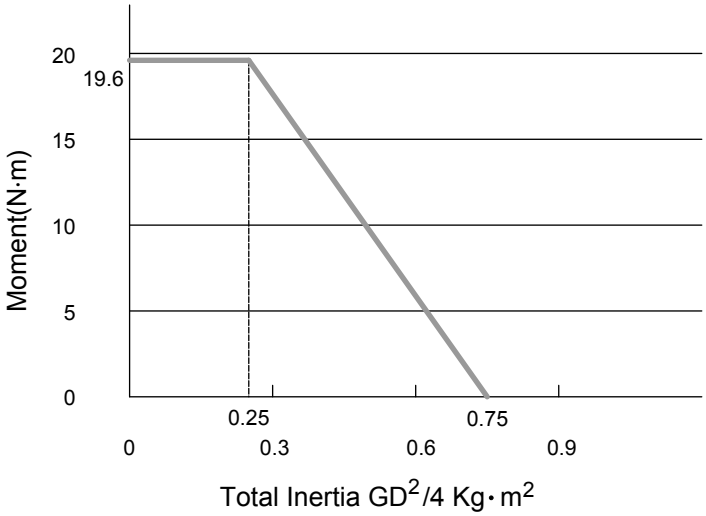
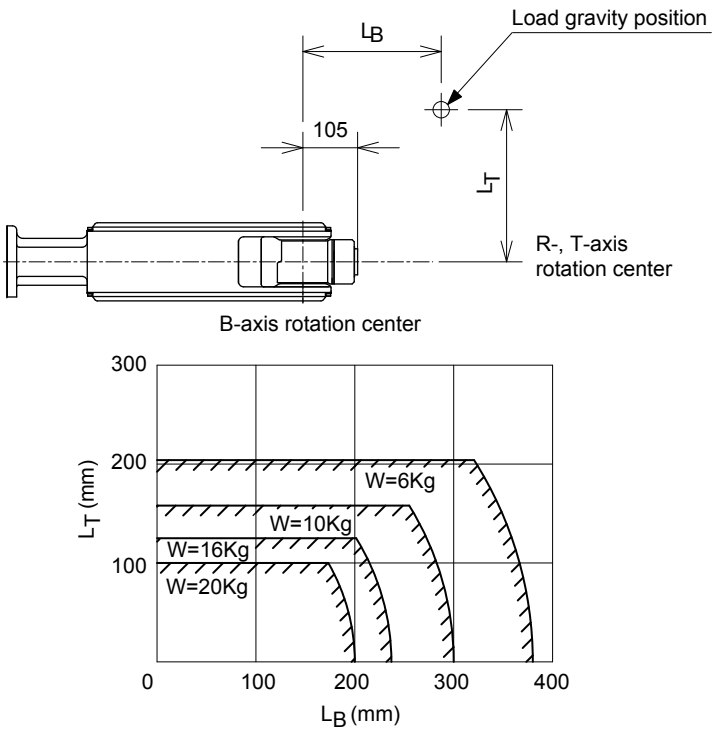


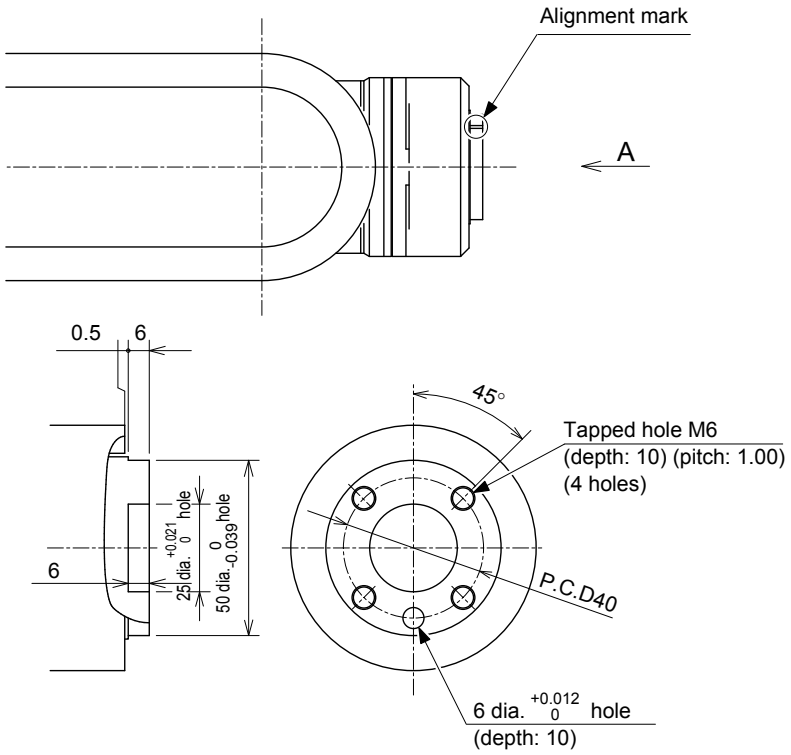
Fig. 6-1(b): Moment of Arm Rating



6.2 Wrist Flange

The wrist flange dimensions are shown in *Fig. 6-2 "Wrist Flange" on page 6-3*. To make the alignment mark visible and to enable an easy grease exchange for the B- and T-axis gears, mount the attachment inside the fitting. Fitting depth of inside and outside fittings must be 5 mm or less.

Fig. 6-2: Wrist Flange



View A

NOTE

- Wash off anti-corrosive paint (yellow) on the wrist flange surface with thinner or light oil before mounting the tools.
- Mount the attachment with the mounting bolts (length: 10 mm or less).
  Failure to observe this instruction may affect the manipulator performance.

7 System Application

7.1 Peripheral Equipment Mounts

The peripheral equipment mounts are provided on the U-axis (upper arm) as shown in *Fig. 7-1 “Installing Peripheral Equipment”* for easier installation of the users’ system applications. The following conditions (*Table 7-1 "Constraint for Attaching" on page 7-2* shall be observed to attach or install peripheral equipment.

Fig. 7-1: Installing Peripheral Equipment

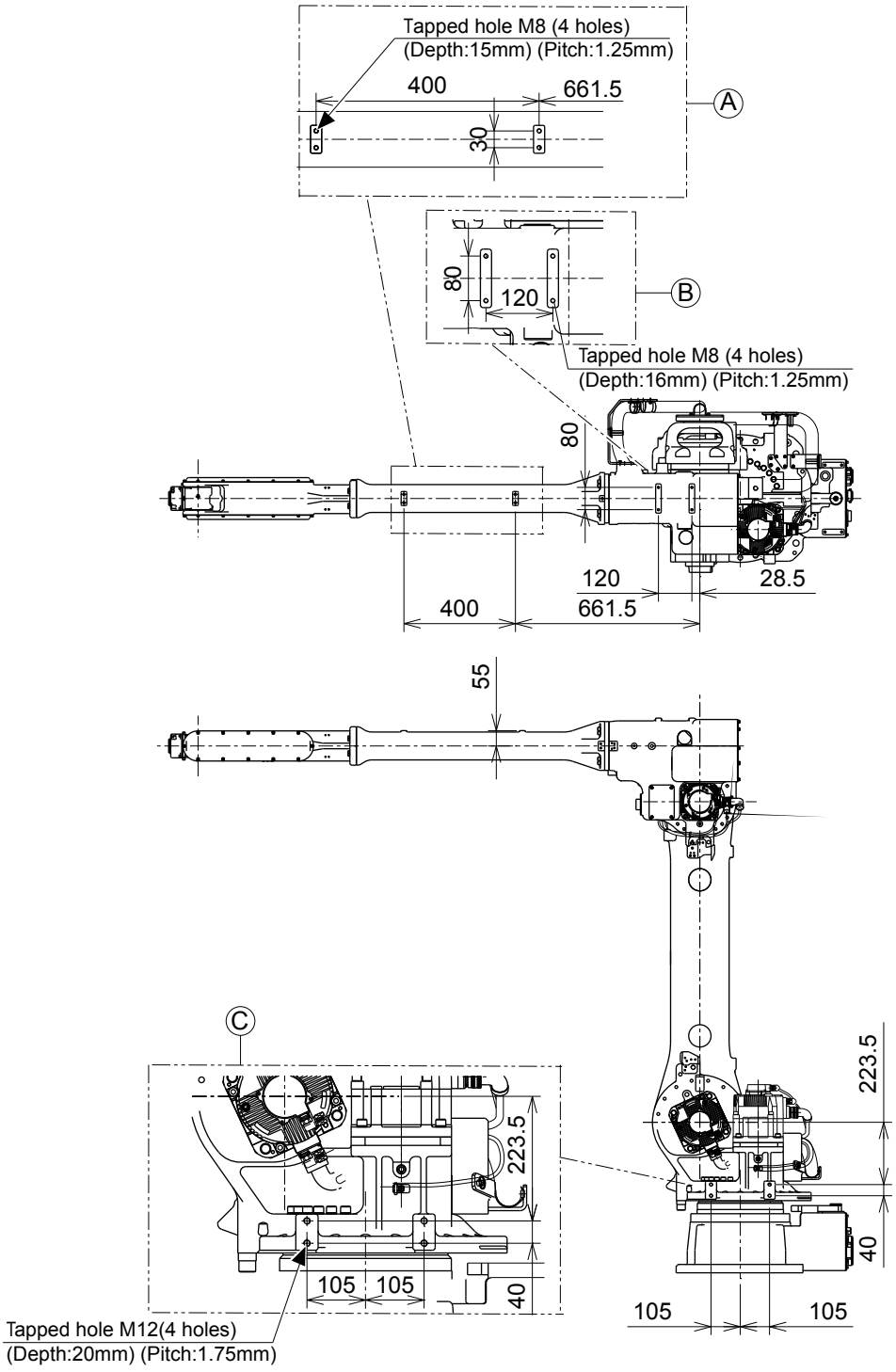


Table 7-1: Constraint for Attaching

Section	Application	Note
A	Cable processing	Up to 20 kg for attaching load mass including wrist load.
B	Cable processing and valve load	Up to 10 kg. 49 N•m (5 kgf•m) max. for increased moment amount of upper arm (Floor-, ceiling-mounted type only)
C	Transfer, etc. load	Up to 30 kg (Floor-, ceiling-mounted type only)

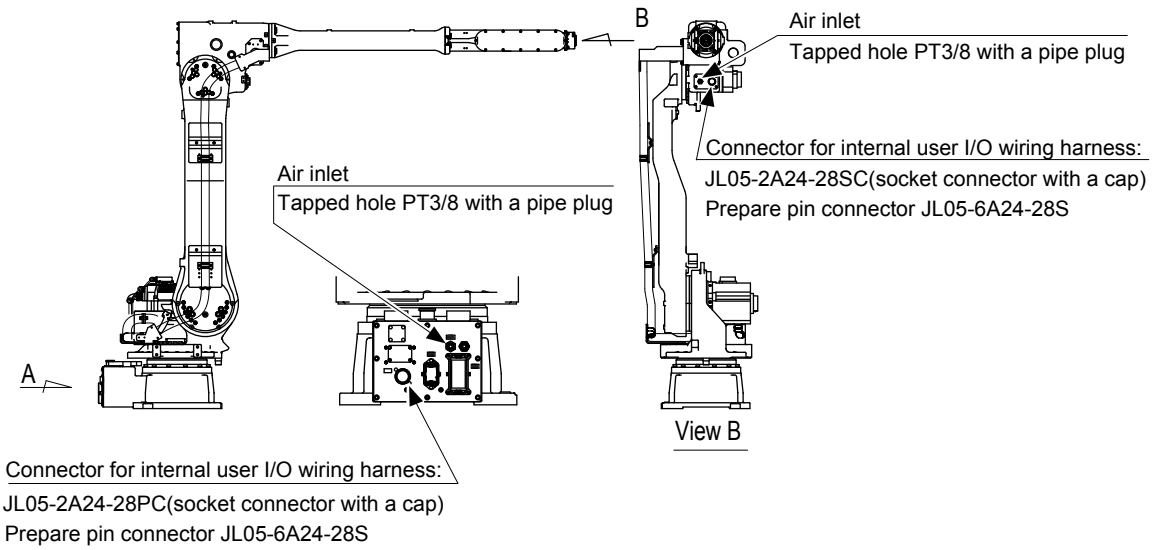
7.2 Internal User I/O Wiring Harness and Air Lines

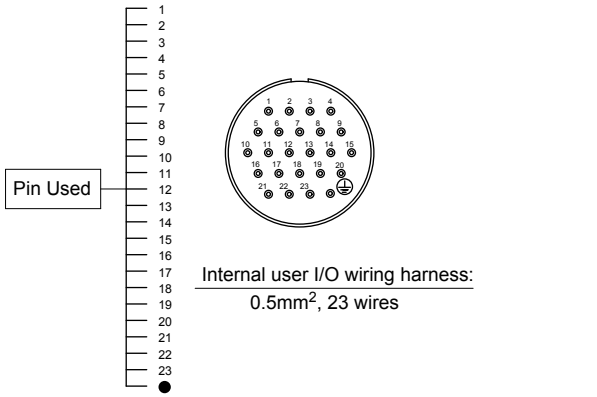
Internal user I/O wiring harness (0.5 mm^2 x 23 wires) and an air line are incorporated in the manipulator for the drive of peripheral devices mounted on the upper arm as shown in *Fig. 7-2 "Connectors for Internal User I/O Wiring Harness and Air Lines"*

The *Fig. 7-2 "Connectors for Internal User I/O Wiring Harness and Air Lines"* also shows the connector pin (1 to 23) assignment. Perform wiring referring to the figure and the conditions below.

Items	Conditions
The allowable current for internal user I/O wiring harness	5.1A or less per a wire. The total current value for pins 1 to 23 must be 34.5A or less.
The maximum pressure for the air line	490 kPa (5 kgf/cm^2) or less (The air line inside diameter: 8 mm.)

Fig. 7-2: Connectors for Internal User I/O Wiring Harness and Air Lines





Pin Details for Internal User I/O Wiring Harness

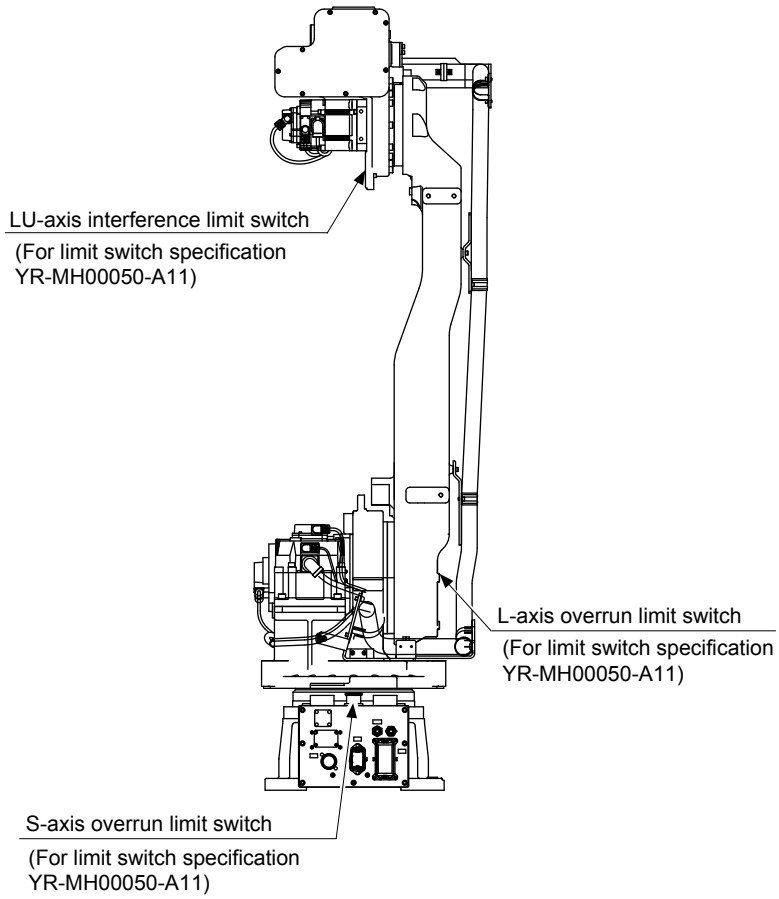
The same numbered pins (1 to 23) on the two connectors are connected with a single lead wire of 0.5 mm^2.

8 Electrical Equipment Specification

8.1 Position of Limit Switch

The limit switches are optional. See *Fig. 8-1 "location of Limit Switches"*. The manipulator with S- and L-axis overrun limit switches, and L-, U-axes interference limit switches are the type YR-MH00050-A11 only.

Fig. 8-1: location of Limit Switches



8.2 Internal Connections

Highly reliable connectors are equipped on each connection part of the manipulator to enable easy removal and installation for maintenance and inspection.

For the numbers, types, and locations of connectors, see *Fig. 8-2 "Location and Numbers of Connectors"* and *Table 8-1 "List of Connector Types"*.

Fig. 8-2: Location and Numbers of Connectors

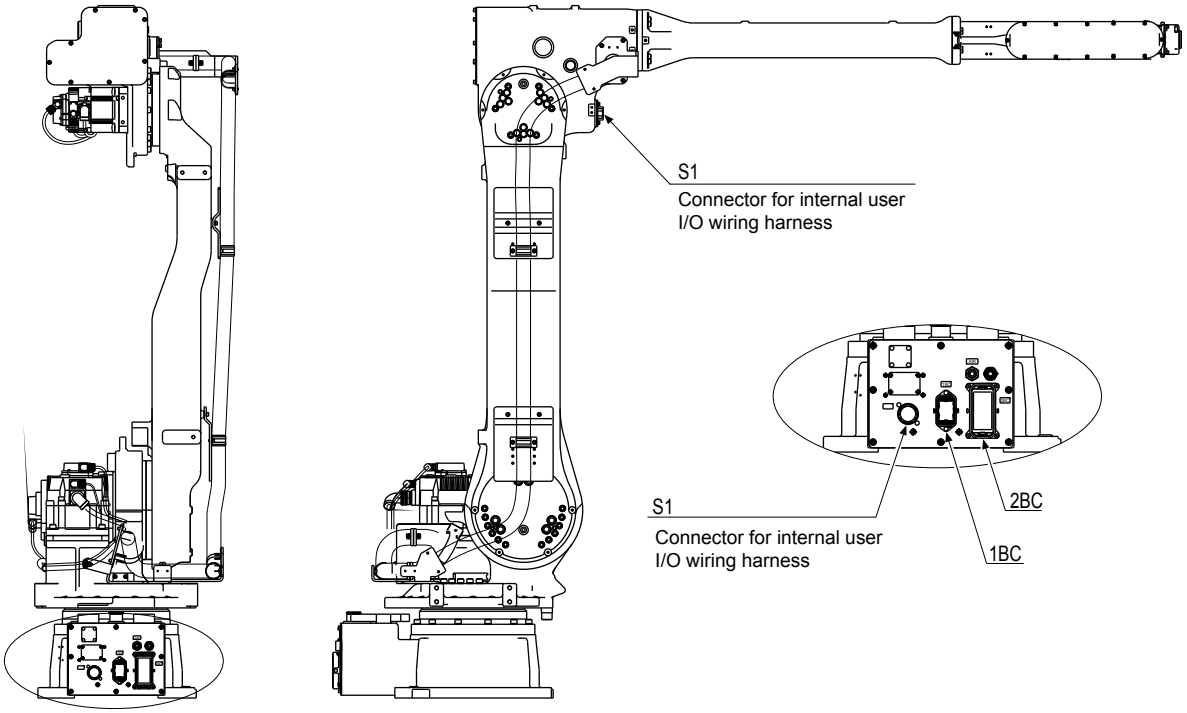


Table 8-1: List of Connector Types

Name	Type of Connector
Connector for the internal user I/O wiring harness on the connector base	JL05-2A24-28PC (JL05-6A24-28S:Optional)
Connector for the internal user I/O wiring harness on U-arm	JL05-2A24-28SC (JL05-6A24-28P:Optional)

Fig. 8-3(a): Internal Connection Diagram

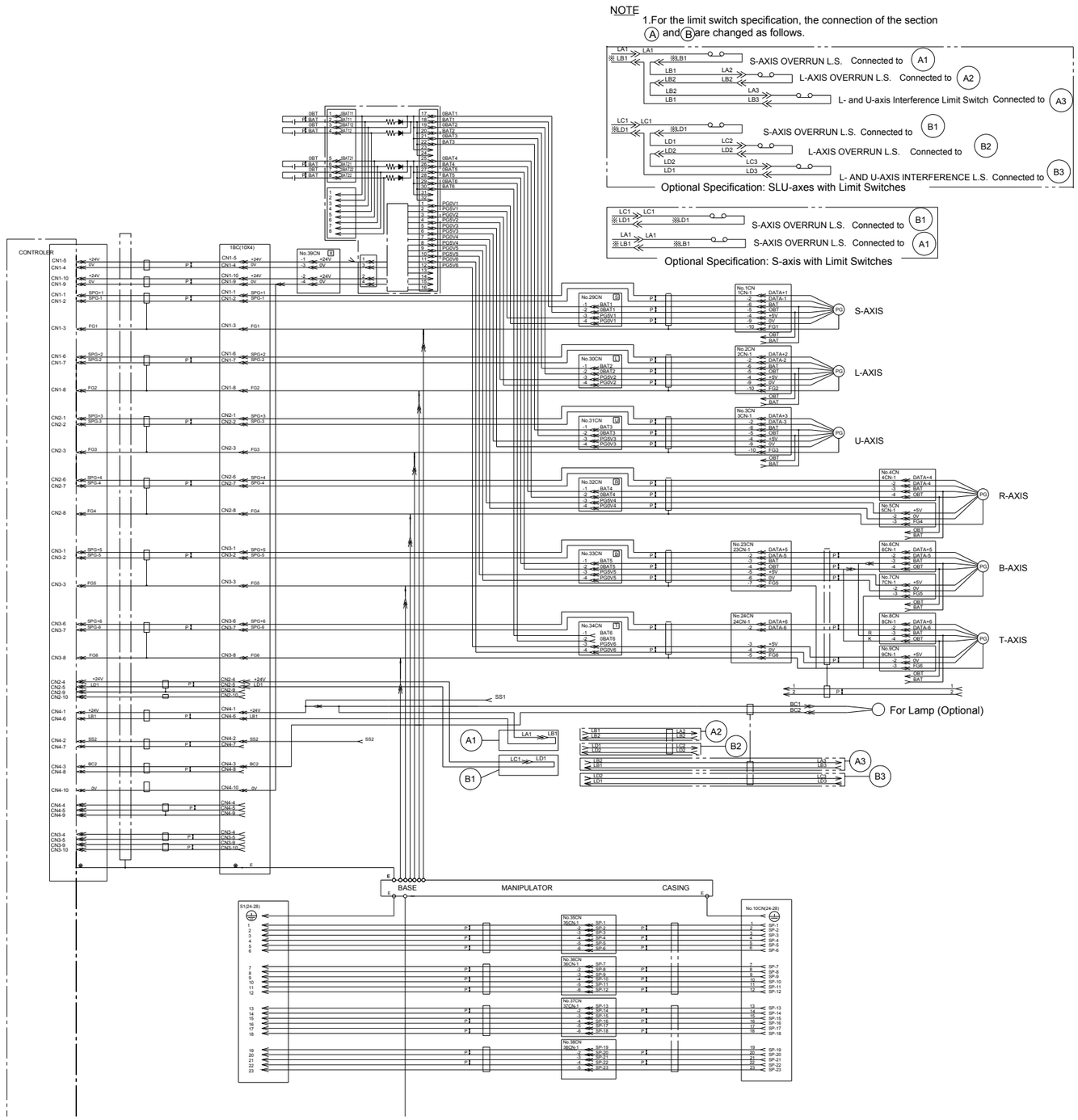
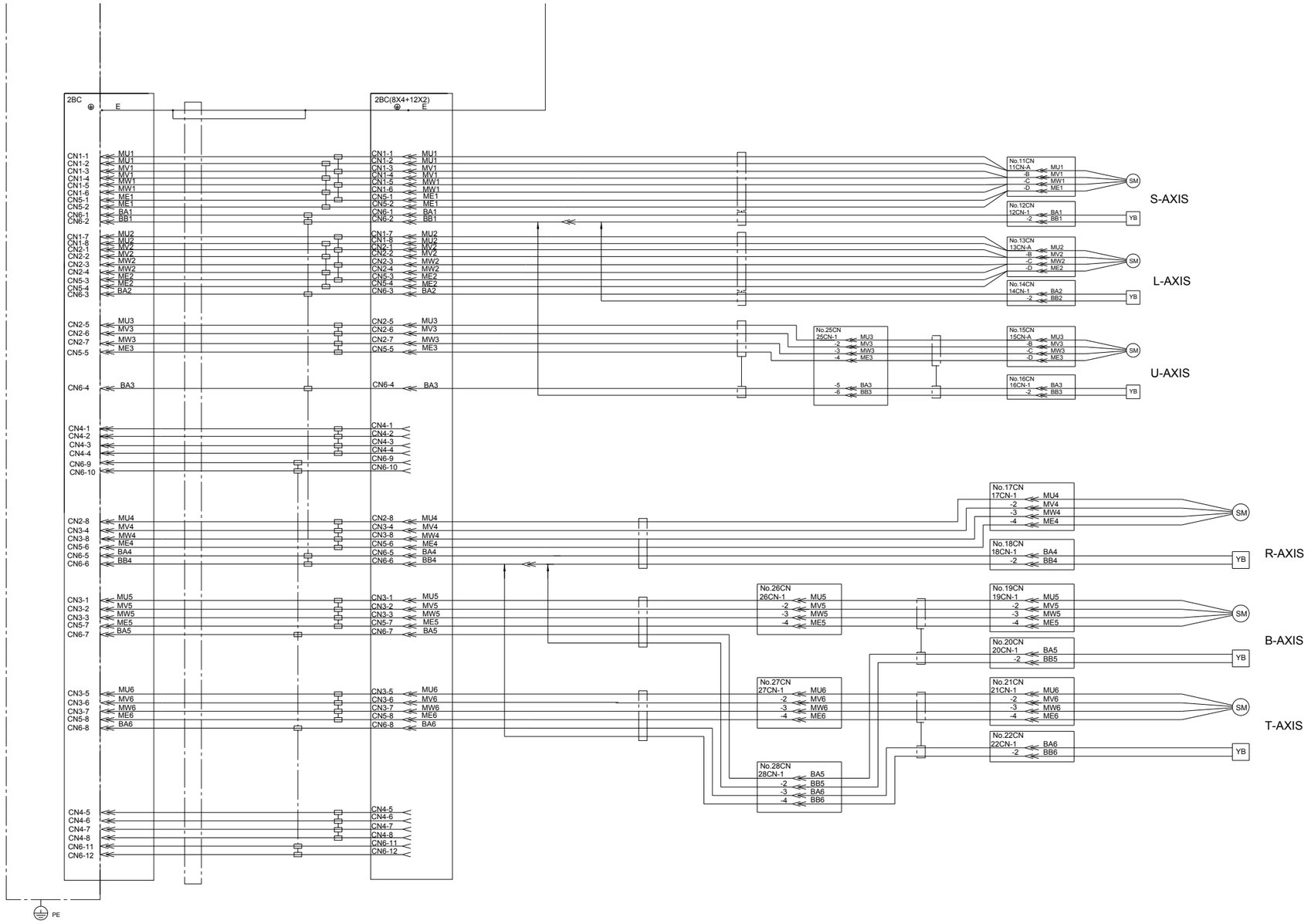


Fig. 8-3(b): Internal Connection Diagram



9 Maintenance and Inspection

DANGER

- Maintenance and inspection must be performed by specified personnel.

Failure to observe this caution may result in electric shock or injury.

- For disassembly or repair, contact your Yaskawa representative.
- Do not remove the motor, and do not release the brake.

Failure to observe these safety precautions may result in death or serious injury from unexpected turning of the manipulator's arm.

WARNING

- Before maintenance or inspection, be sure to turn the main power supply OFF, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)

Failure to observe this warning may result in electric shock or injury.

CAUTION

- The battery pack must be connected before removing detection connector when maintenance and inspection.

Failure to observe this caution may result in the loss of home position data.

9.1 Inspection Schedule

Proper inspections are essential not only to assure that the mechanism will be able to function for a long period, but also to prevent malfunctions and assure safe operation. Inspection intervals are classified into six levels as shown in *Table 9-1 "Inspection Items" on page 9-2*".

In *Table 9-1 "Inspection Items" on page 9-2*, the inspection items are categorized by three types of operations: operations which can be performed by personnel authorized by the user, operations to be performed by trained personnel, and operations to be performed by service company personnel. Only specified personnel shall perform the inspection work.

NOTE

- The inspection interval depends on the total servo operation time.
- If axes are used very frequently (in handling applications, etc.), inspections may be required at shorter intervals. Contact your Yaskawa representative.

Table 9-1: Inspection Items (Sheet 1 of 2)

Items[1)]		Schedule						Method	Operation	Inspection Charge		
		Daily	1000HCycle	6000HCycle	12000HCycle	24000H	36000H			Specified Personnel	Licensee	Service Company
1	Alignment mark	●						Visual	Check alignment mark accordance at the home position. Check for damage.	●	●	●
2	External lead	●						Visual	Check for damage and deterioration of leads.	●	●	●
3	Working area and manipulator	●						Visual	Clean the work area if dust or spatter is present. Check for damage and outside cracks.	●	●	●
4	SLU-axes motor	●						Visual	Check for grease leakage.[2)]	●	●	●
5	Baseplate mounting bolts		●					Spanner	Tighten loose bolts. Replace if necessary.	●	●	●
6	Cover mounting screws		●					Screwdriver, Wrench	Tighten loose bolts. Replace if necessary.	●	●	●
7	SLU-axes motor connector		●					Manual	Check for loose connectors and tighten if necessary.	●	●	●
8	Connector Base		●					Manual	Check for loose connectors.	●	●	●
9	RBT-axes timing belts				●			Manual	Check for belt tension and wear.		●	●
10	Wire harness in manipulator (For SLU-axes) (For RBT-axes)				●			Visual Multimeter	Check for conduction between the main connector of base and intermediate connector with manually shaking the wire. Check for wear of protective spring.[3)]		●	●
						●			Replace in every 24000H.			●
11	Wire harness in manipulator (For BT-axes)				●			Visual Multimeter	Check for conduction between the connectors. Check for wear of protective spring			●
						●			Replace in every 24000H.			●
12	SLU-axes limit switch,dog			●				Screwdriver, Wrench, Multimeter	Check for stain, damage, and looseness. Tighten and check the dog movement.		●	●
13	Battery pack in manipulator						●		Replace the battery pack when the battery alarm occurs or the manipulator drove for every 36000H.		●	●

Table 9-1: Inspection Items (Sheet 2 of 2)

Items[1)]		Schedule						Method	Operation	Inspection Charge		
		Daily	1000HCycle	6000HCycle	12000HCycle	24000H	36000H			Specified Personnel	Licensee	Service Company
14	S-axis speed reducer			●	●			Grease Gun	Check for malfunction[4)]. (Replace if necessary.) Supply grease [5)]. (6000H cycle). Replace grease[5)]. (12000H cycle).See *section 9.3.1*		●	●
15	LU-axes speed reducers			●	●			Grease Gun	Check for malfunction[4)]. (Replace if necessary.) Supply grease[5)]. (6000H cycle). Replace grease[5)] (12000H cycle). See *section 9.3.2* and *section 9.3.3*		●	●
16	RBT-axis speed reducers			●	●			Grease Gun	Check for malfunction[4)]. (Replace if necessary.) Supply grease[5)]. (6000H cycle). Replace grease[5)]. (12000H cycle). See *section 9.3.4*		●	●
17	T-axis gears			●				Grease Gun	Check for malfunction[4)]. (Replace if necessary.) Supply grease[5)]. (6000H cycle). Replace grease[5)]. (12000H cycle). See *section 9.3.5*		●	●
18	R-axis tapered roller bearing			●				Grease Gun	Check for malfunction[4)]. (Replace if necessary.) Supply grease[5)]. (6000H cycle). See*section 9.3.7*		●	●
19	Overhaul						●					●

1 Inspection No. correspond to the numbers in *Fig. 9-1 "Inspection Parts and Inspection Numbers" on page 9-4*
2 The occurrence of a grease leakage indicates the possibility that grease has seeped into the motor. This can cause a motor breakdown. Contact your Yaskawa representative.
3 When checking for conduction with multimeter, connect the battery to “BAT” and “OBT” of connectors on the motor side for each axis, and then remove connectors on detector side for each axis from the motor. Otherwise, the home position may be lost. (Refer to *section 9.3.8 “Notes for Maintenance” on page 9-20*.)
4 The application that requires highly frequent operation such as handling may cause grease leakage of air breather or the internal pressure rise of speed reducer. Contact your Yaskawa representative.
5 For the grease, refer to *Table 9-2 "Inspection Parts and Grease Used'"*.

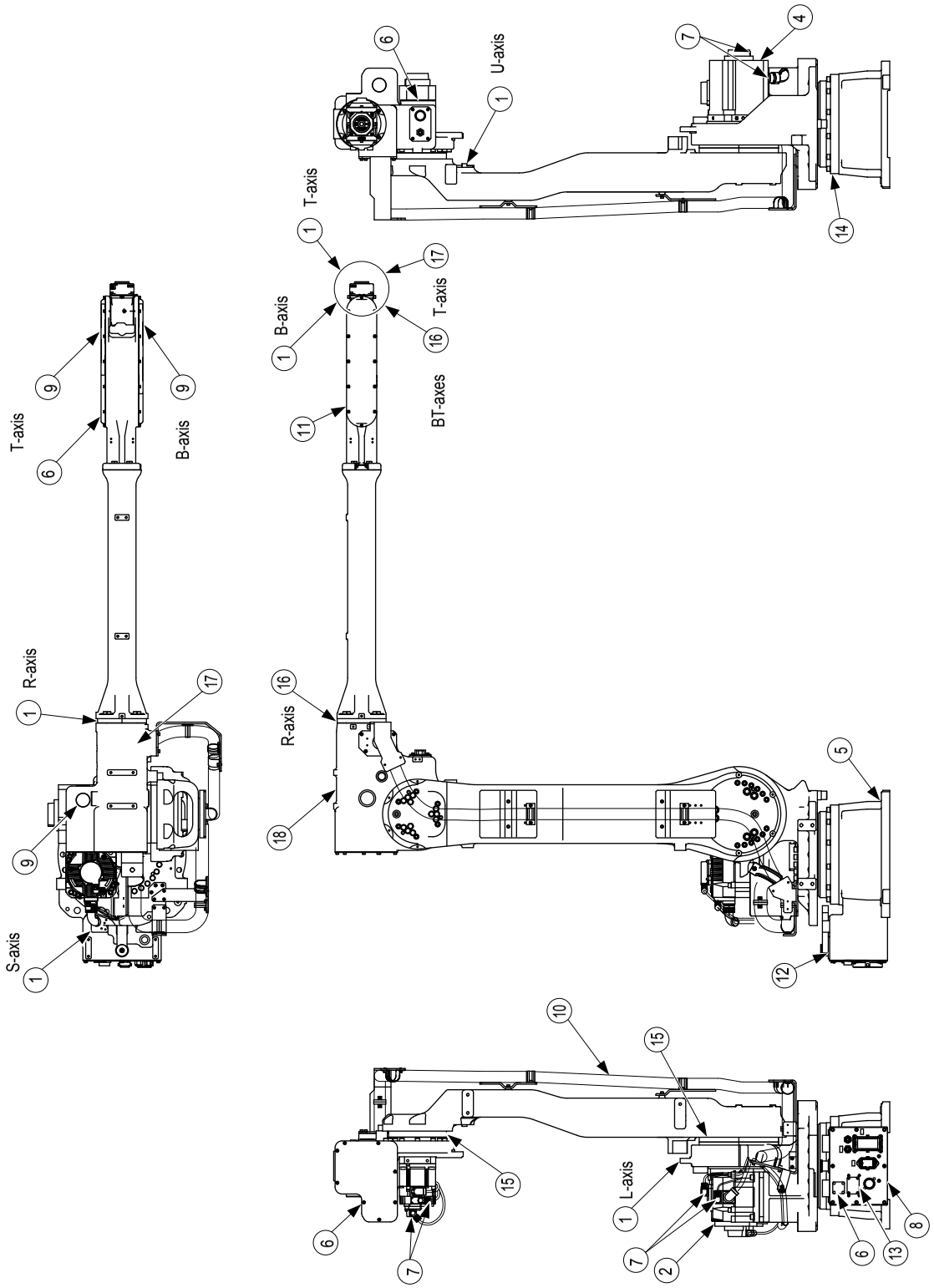


Fig. 9-1: Inspection Parts and Inspection Numbers

Table 9-2: Inspection Parts and Grease Used

No.	Grease Used	Inspected Parts
14,15	Molywhite RE No.00	Speed reducers for S-,L-,U-axes
16,17	Harmonic Grease SK-1A	Speed reducers for R-,B-,T-axes
18	Alvania EP Grease	R-axis Tapered roller bearing

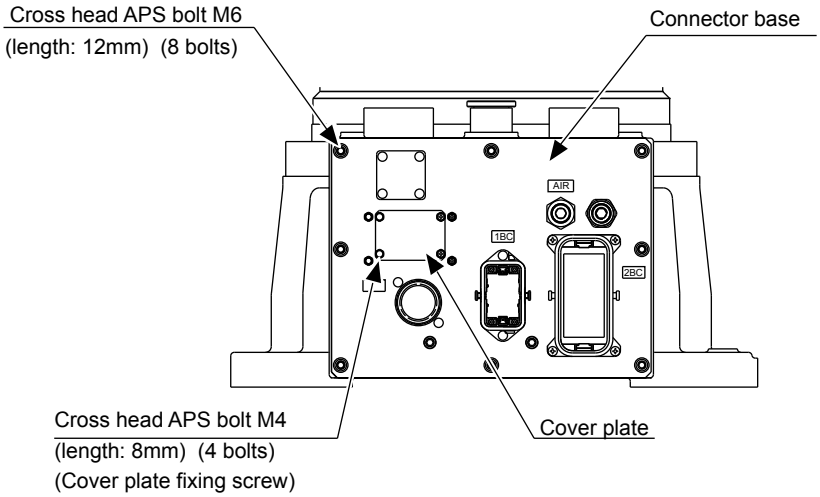
Numbers in the above table correspond to the numbers in the *Table 9-1 "Inspection Items"*.

9.2 Notes on Maintenance Procedures

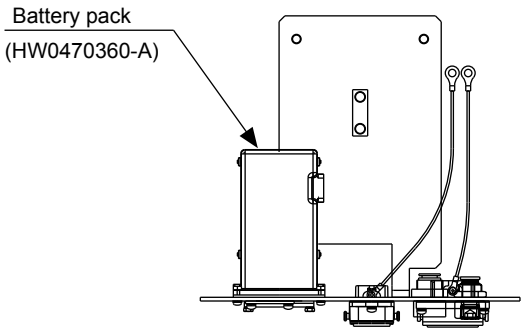
9.2.1 Battery Pack Replacement

The battery packs (type: HW0470360-A) are installed in the positions shown in *Fig. "Battery Location"*. If the battery alarm occurs in the DX100, replace the battery in accordance with the following procedures:

Battery Location

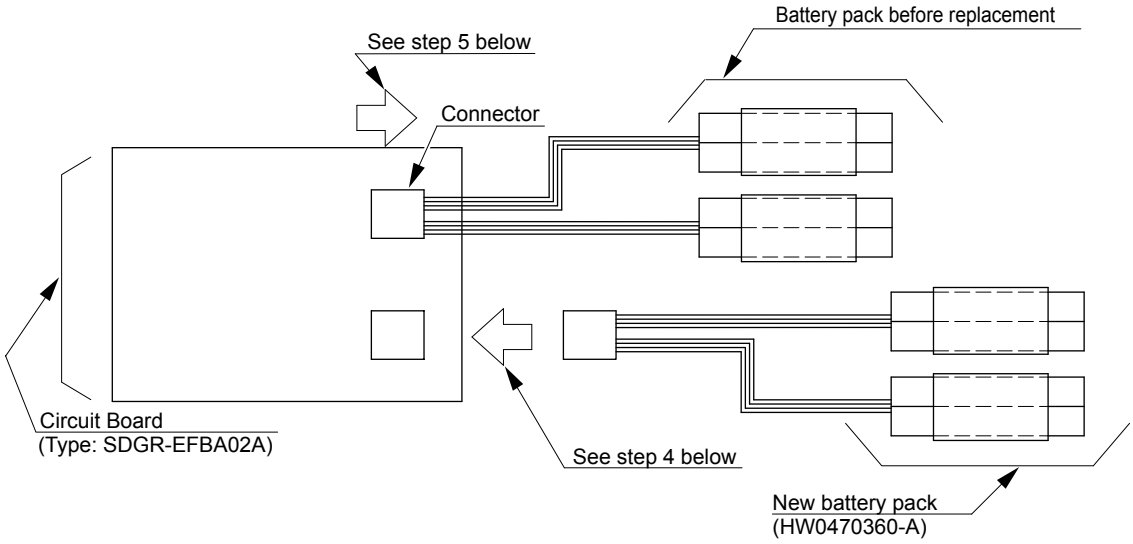


(a) Back View



(b) Top View

Fig. 9-2: Battery Connection



1. Turn OFF the DX100 main power supply.
2. Remove the plate fixing screws and the plate on the connector base, then pull the battery pack out to replace it with the new one.
3. Remove the old battery pack from the battery holder.
4. Connect the new battery pack to the unoccupied connector on the circuit board.
5. Remove the old battery pack from the circuit board.

NOTE Remove the old battery pack after connecting the new one so that the encoder absolute data does not disappear.

6. Mount the new battery pack to the holder.
7. Reinstall the plate.

NOTE Do not allow plate to pinch the cables when reinstalling the plate.

9.3 Notes on Grease Replenishment/Exchange Procedures

Make sure to follow the instructions listed below at grease replenishment/ exchange. Failure to observe the following notes may result in damage to motor and speed reducer.

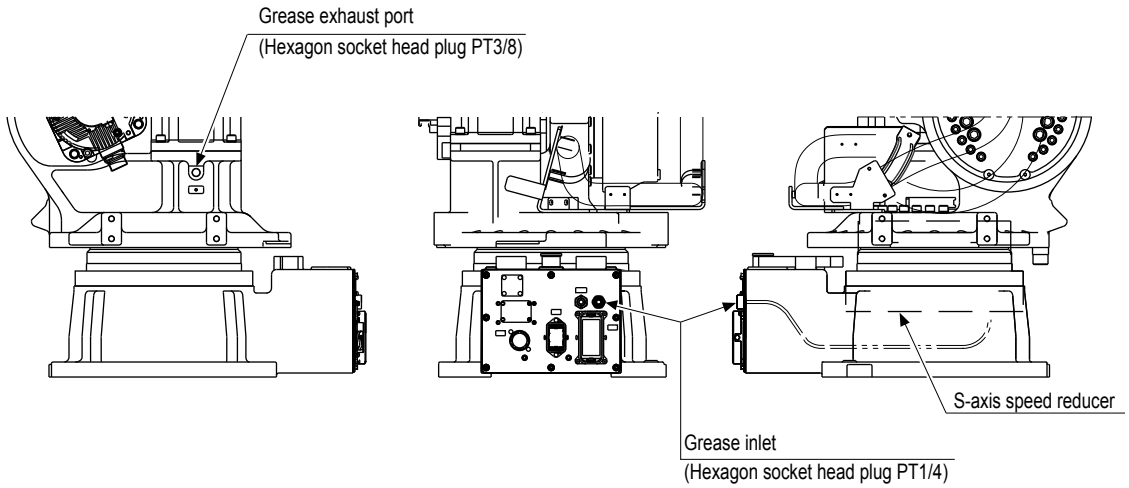
NOTE

- If grease is added without removing the plug/screw from the grease exhaust port, the grease will leak inside a motor or an oil seal of a speed reducer will come off, which may result in damage to the motor. Make sure to remove the plug/screw.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.
- Make sure to use a grease pump to inject grease. Set air supply pressure to the grease pump at 0.3 MPa or less, and the grease injection rate at 8 g/s or less.
- Make sure to fill hoses, which are joined to the grease inlet, with grease beforehand to prevent air from intruding into the speed reducer.

9.3.1 Grease Replenishment/Exchange for S-Axis Speed Reducer

NOTE For the ceiling-mounted manipulator, the grease exhaust port and the grease inlet are inverted.

Fig. 9-3: S-Axis Speed Reducer Diagram



9.3.1.1 Grease Replenishment

(Refer to *Fig. 9-3 "S-Axis Speed Reducer Diagram" on page 9-8*.)

1. Remove the hexagon socket head plug PT3/8 from the grease exhaust port.

NOTE

- If grease is injected with the plug on, the grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.

2. Remove the hexagon socket head plug PT1/4 from the grease inlet and install the grease zerk PT1/4. (The grease zerk is delivered with the manipulator.)
3. Inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: 520 cc (1040 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. Move the S-axis for a few minutes to discharge excess grease.
5. Wipe the discharged grease with a cloth and reinstall the plug PT3/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
6. Remove the grease zerk from the grease inlet and reinstall the plug PT1/4. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 12 N·m (1.2 kgf·m).

9.3.1.2 Grease Exchange

(Refer to *Fig. 9-3 "S-Axis Speed Reducer Diagram" on page 9-8*.)

1. Remove the hexagon socket head plug PT3/8 from the grease exhaust port.

NOTE

- If grease is injected with the plug on, the grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.

2. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/4. (The grease zerk is delivered with the manipulator.)

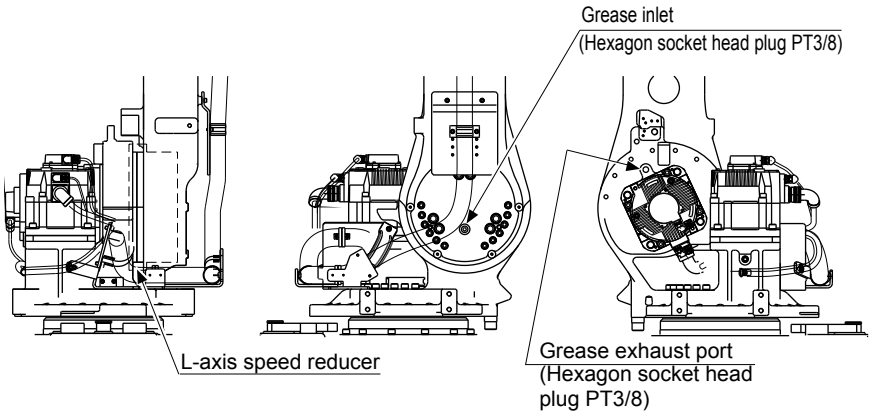
3. Inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: 2600 cc
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
4. The grease exchange is completed when new grease appears in the grease exhaust port.
   The new grease can be distinguished from the old grease by color.
5. Move the S-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth and reinstall the plug PT3/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

If the plug is installed while the grease is being exhausted, the grease will leak inside the motor and may cause a damage. Ensure that the grease has been completely exhausted before installing the plug.

7. Remove the grease zerk from the grease inlet and reinstall the plug PT1/4. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 12 N·m (1.2 kgf·m).

9.3.2 Grease Replenishment/Exchange for L-Axis Speed Reducer

Fig. 9-4: L-Axis Speed Reducer



9.3.2.1 Grease Replenishment

(Refer to *Fig. 9-4 "L-Axis Speed Reducer"*.)

1. Tilt the L-arm vertical to the ground.
2. Remove the hexagon socket head plug PT3/8 from the grease exhaust port.

NOTE

- If grease is injected with the plug on, the grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.

3. Remove the hexagon socket head plug PT3/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
4. Inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: 250 cc (500 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
5. Move the L-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth and reinstall the plug PT3/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
7. Remove the grease zerk from the grease inlet and reinstall the plug PT3/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

9.3.2.2 Grease Exchange

(Refer to *Fig. 9-4 "L-Axis Speed Reducer" on page 9-11*.)

1. Tilt the L-arm vertical to the ground.
2. Remove the hexagon socket head plug PT3/8 from the grease exhaust port..

NOTE

- If grease is injected with the plug on, the grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.

3. Remove the hexagon socket head plug PT3/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
4. Inject grease through the grease inlets using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: 1650 cc
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
5. The grease exchange is completed when new grease appears in the exhaust port. The new grease can be distinguished from the old grease by color.
6. Move the L-axis for a few minutes to discharge excess grease.
7. Wipe the discharged grease with a cloth and reinstall the plug PT3/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

NOTE

If the plug is installed while the grease is being exhausted, the grease will leak inside the motor and may cause a damage. Ensure that the grease has been completely exhausted before installing the plug.

8. Remove the grease zerk from the grease inlet and reinstall the plug PT3/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

9.3.3 Grease Replenishment/Exchange for U-Axis Speed Reducer

Fig. 9-5: U-Arm Posture in Grease Replenishment/Exchange for U-Axis Speed Reducer

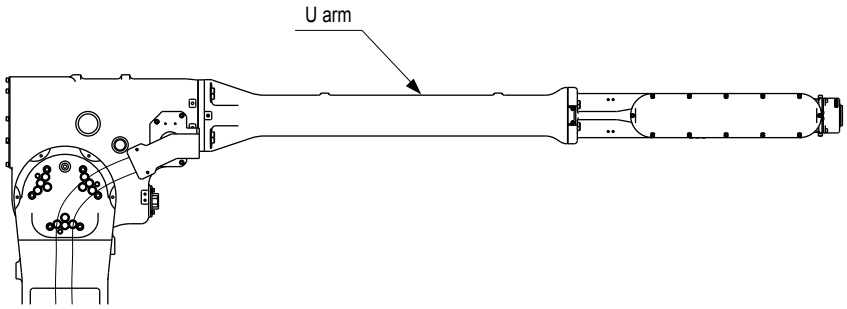
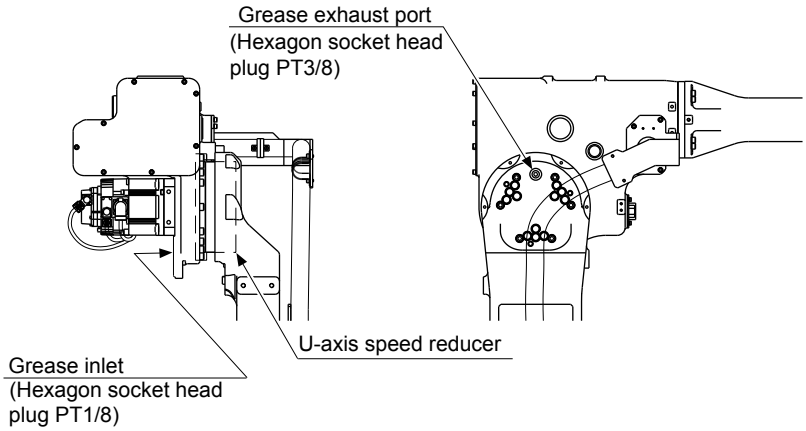


Fig. 9-6: U-Axis Speed Reducer



9.3.3.1 Grease Replenishment

(Refer to *Fig. 9-6 "U-Axis Speed Reducer"*.)

1. Tilt the U-arm horizontal to the ground. (Refer to *Fig. 9-5 "U-Arm Posture in Grease Replenishment/Exchange for U-Axis Speed Reducer"*.)
2. Remove the hexagon socket head plug PT3/8 from the grease exhaust port.

NOTE

- If grease is injected with the plug on, the grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.

3. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)

4. Inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: 140 cc (280 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
5. Move the U-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth and reinstall the plug PT3/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).
7. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

9.3.3.2 Grease Exchange

(Refer to *Fig. 9-6 "U-Axis Speed Reducer" on page 9-13*.)

1. Tilt the U-arm horizontal to the ground. (Refer to *Fig. 9-5 "U-Arm Posture in Grease Replenishment/Exchange for U-Axis Speed Reducer" on page 9-13*.)
2. Remove the hexagon socket head plug PT3/8 from the grease exhaust port.

NOTE

- If grease is injected with the plug on, the grease will leak inside the motor and may cause a damage. Make sure to remove the plug before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.

3. Remove the hexagon socket head plug PT1/8 from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)
4. Inject grease through the grease inlet using a grease gun.
   - Grease type: Molywhite RE No.00
   - Amount of grease: 700 cc
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less
5. The grease exchange is completed when new grease appears in the grease exhaust port. The new grease can be distinguished from the old grease by color.
6. Move the U-axis for a few minutes to discharge excess grease.

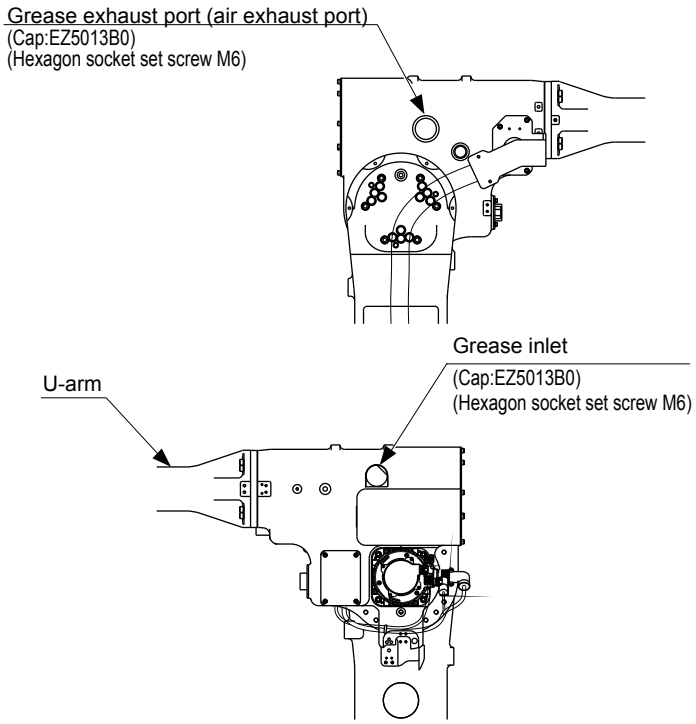
7. Wipe the discharged grease with a cloth and reinstall the plug PT3/8 on the grease exhaust port. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

NOTE If the plug is installed while the grease is being exhausted, the grease will leak inside the motor and may cause a damage. Ensure that the grease has been completely exhausted before installing the plug.

8. Remove the grease zerk from the grease inlet and reinstall the plug PT1/8. Apply Three Bond 1206C to the thread part of the plug, and tighten the plug with a tightening torque of 4.9 N·m (0.5 kgf·m).

9.3.4 Grease Replenishment/Exchange for R-Axis Speed Reducer

Fig. 9-7: R-Axis Speed Reducer



9.3.4.1 Grease Replenishment

(Refer to *Fig. 9-7 "R-Axis Speed Reducer"*.)

1. Remove the hexagon socket set screw M6 and its cap from the grease exhaust port.

NOTE
- If grease is injected with the screw on, the grease will leak inside the motor and may cause a damage. Make sure to remove the screw before the grease injection.
- Do not install a joint, a hose, etc. to the grease exhaust port. Failure to observe this instruction may result in damage to the motor due to coming off of an oil seal.

2. Remove the hexagon socket set screw M6 and its cap from the grease inlet and install the grease zerk PT1/8. (The grease zerk is delivered with the manipulator.)

3. Inject grease through the grease inlet using a grease gun.
   - Grease type: Harmonic Grease SK-1A
   - Amount of grease: 8 cc (16 cc for 1st supply)
   - Air supply pressure of grease pump: 0.3 MPa or less
   - Grease injection rate: 8 g/s or less

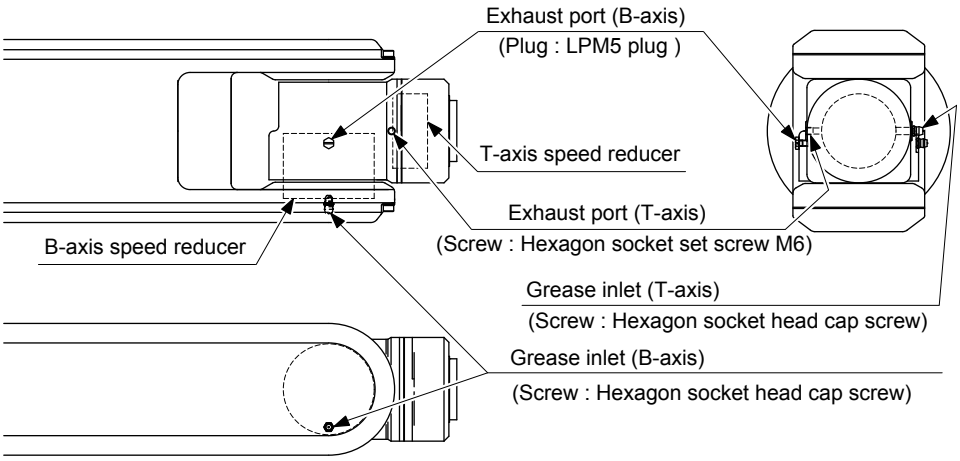
The exhaust port is used for air exhaust, and the grease is not exhausted from the exhaust port. Do not inject excessive grease through the grease inlet.

4. Move the R-axis for a few minutes to discharge excess grease.
5. Wipe the discharged grease with a cloth and reinstall the screw M6 and its cap on the grease exhaust port. Apply Three Bond 1206C to the thread part of the screw, and tighten the screw with a tightening torque of 4.9 N·m (0.5 kgf·m).
6. Remove the grease zerk from the grease inlet and reinstall the screw M6 and its cap. Apply Three Bond 1206C to the thread part of the screw, and tighten the screw with a tightening torque of 4.9 N·m (0.5 kgf·m).

9.3.5 Grease Replenishment for B-, T-Axes Speed Reducer

9.3.5.1 Grease replenishment

Fig. 9-8: B-, T-Axes Speed Reducers Diagram



1. Remove the LPM5 plug and the hexagon socket head set screw M6 from the exhaust ports.

NOTE Remove the cover for the B-axis speed reducer. (Refer to *section 9.3.8 "Notes for Maintenance" on page 9-20*.)

2. Remove the hexagon socket head cap screws M6 from the grease inlets. (Refer to *Fig. 9-8 "B-, T-Axes Speed Reducers Diagram"*.)
3. Install a grease zerk A-MT6 x 1 to the grease inlet. (The grease zerk is delivered with the manipulator.)
4. Inject grease through the grease inlet using a grease gun. (Refer to *Fig. 9-8 "B-, T-Axes Speed Reducers Diagram"*.)
   - Grease type: Harmonic grease SK-1A
   - Amount of grease: For B-axis: 10 cc (20 cc for the first supply)
     For T-axis: 5 cc (10 cc for the first supply)

NOTE The exhaust port is used for air exhaust, and the grease is not exhausted from the exhaust port. Do not inject excessive grease through the grease inlet.

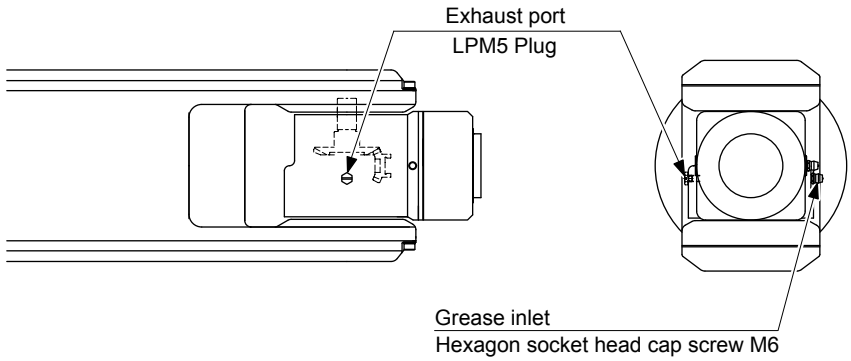
5. Reinstall the plug/screw to the exhaust ports. Before installing the plug/screw, apply Three Bond 1206C on the thread part of the plug/screw, then tighten the plug/screw with a tightening torque of 5 N•m (0.51 kgf•m).
6. Remove the grease zerk from the grease inlets, and reinstall the screws. Before installing the screws, apply Three Bond 1206C on the thread part of the screws, then tighten the screws with a tightening torque of 5 N•m (0.51 kgf•m).

NOTE Mount the cover for the B-axis speed reducer. (Refer to *section 9.3.8 "Notes for Maintenance" on page 9-20*)

9.3.6 Grease Replenishment for T-Axis Gear

9.3.6.1 Grease Replenishment

Fig. 9-9: T-Aaxis Gear Diagram



1. Remove the LPM5 plug from the exhaust port.
2. Remove the hexagon socket head cap screw M6 from the grease inlet.
3. Install a grease zerk A-MT6 x 1 to the grease inlet. (The grease zerk is delivered with the manipulator.) (Refer to *Fig. 9-9 "T-Aaxis Gear Diagram"*.)
4. Inject grease through the gear grease inlet using a grease gun. (Refer to *Fig. 9-9 "T-Aaxis Gear Diagram"*.)
   - Grease type: Harmonic grease SK-1A
   - Amount of grease: 5 cc (10 cc for the first supply)

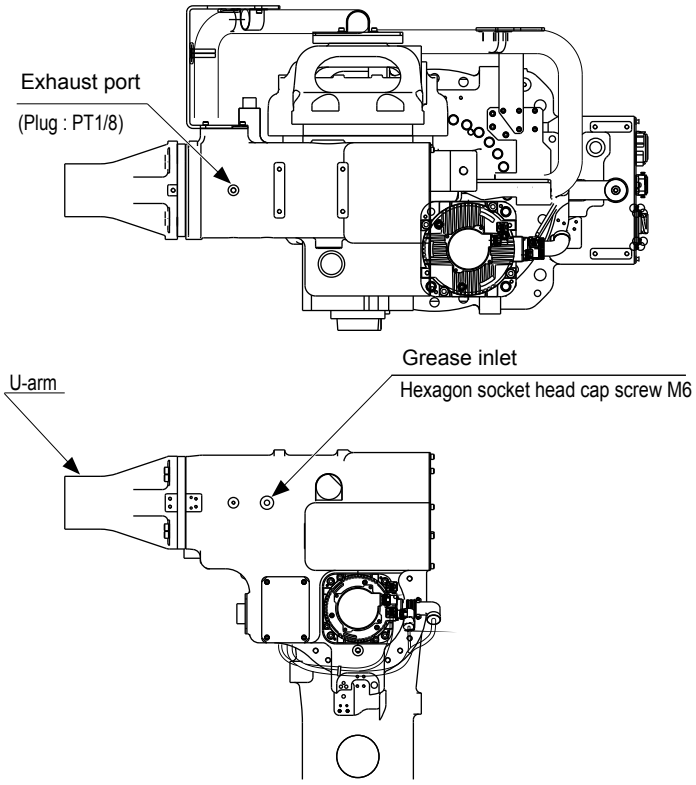
NOTE The exhaust port is used for air exhaust, and the grease is not exhausted from the exhaust port. Do not inject excessive grease through the grease inlet.

5. Reinstall the plug to the exhaust port. Before installing the plug, apply Three Bond 1206C on the thread part of the plug, then tighten the screw with a tightening torque of 5 N•m (0.51 kgf•m).
6. Remove the grease zerk from the gear grease inlet, and reinstall the screw. Before installing the screw, apply Three Bond 1206C on the thread part of the screw, then tighten the screw with a tightening torque of 5 N•m (0.51 kgf•m).

9.3.7 Grease Replenishment for R-axis Cross Roller Bearing

9.3.7.1 Grease Replenishment

Fig. 9-10: R-axis Tapered Roller Bearing Diagram



1. Remove the plug PT 1/8 from the exhaust port.
2. Remove the hexagon socket head cap screw M6 from the grease inlet.
3. Install a grease zerk A-MT6 x 1 to the grease inlet. (The grease zerk is delivered with the manipulator.) (Refer to *Fig. 9-10 "R-axis Tapered Roller Bearing Diagram"*.)
4. Inject grease through the grease inlet using a grease gun. (Refer to *Fig. 9-10 "R-axis Tapered Roller Bearing Diagram"*.)
   - Grease type: Alvania EP grease 2
   - Amount of grease: 8 cc (16 cc for the first supply)

NOTE The exhaust port is used for air exhaust, and the grease is not exhausted from the exhaust port. Do not inject excessive grease through the grease inlet.

5. Reinstall the plug to the exhaust port. Before installing the plug, apply Three Bond 1206C on the thread part of the plug, then tighten the screw with a tightening torque of 5 N•m (0.51 kgf•m).
6. Remove the grease zerk from the grease inlet, and reinstall the screw. Before installing the screw, apply Three Bond 1206C on the thread part of the screw, then tighten the screw with a tightening torque of 5 N•m (0.51 kgf•m).

9.3.8 Notes for Maintenance

When performing maintenance such as replacement of a wire harness in the manipulator, the encoder connector may be necessary to be removed. In this case, be sure to connect the battery pack to the battery backup connector before removing the encoder connector.

Removing the encoder connector without connecting the battery pack leads to disappearance of the encoder absolute data.

For the battery pack connection, refer to *Fig.9-11 "Encoder Connector Diagram"*.

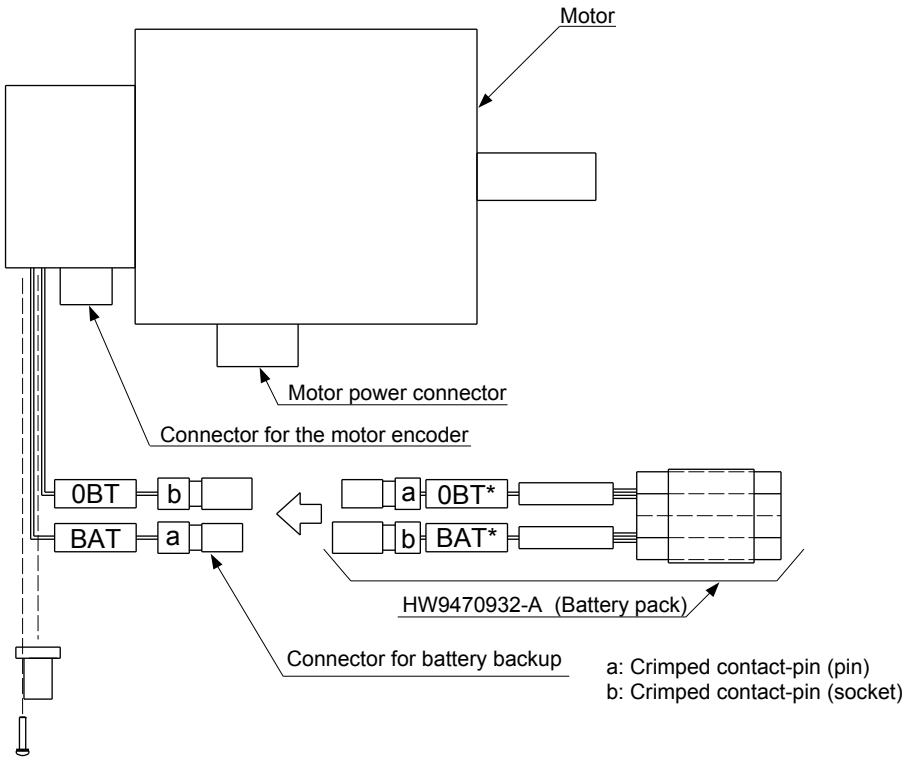
9.3.8.1 Battery Pack Connection

The connectors (crimped contact-pin) for battery backup are installed at the end point of each motor (marked as BAT and OBT). Connect the battery pack according to the following procedure.

1. Remove a cap attached to battery backup connectors of the motor.
2. Connect a battery pack (HW9470932-A) to the battery backup connectors (BAT and OBT are marked) located at the end point of an encoder cable. With the battery pack connected to the battery backup connectors, perform maintenance check.
3. After the maintenance check, confirm all connectors are connected and remove the battery pack. Reinstall the cap onto the battery backup connectors of the motor.

NOTE Do not remove battery pack in the connector base.

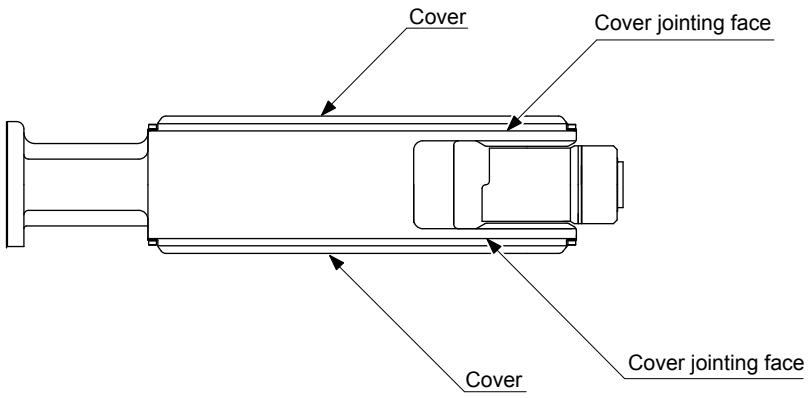
Fig. 9-11: Encoder Connector Diagram



9.3.8.2 Wrist Unit

The motor and encoder units are provided with the wrist unit. To prevent fumes from penetrating into the wrist unit, the matched parts are sealed with sealing bond. If the wrist cover is disassembled, make sure to reseal with sealing bond (Three Bond 1206C, refer to *Table 10-1 "Spare Parts for the MOTOMAN-MH50-20" on page 10-1*.)

Fig. 9-12: Sealing Part of Wrist Unit



10 Recommended Spare Parts

It is recommended to keep the parts and components in the following table in stock as spare parts for the MOTOMAN-MH50-20. Product performance can not be guaranteed when using spare parts from any company other than Yaskawa. The spare parts are ranked as follows:

- Rank A: Expendable and frequently replaced parts
- Rank B: Parts for which replacement may be necessary as a result of frequent operation
- Rank C: Drive Unit

NOTE For replacing parts in Rank B or Rank C, contact your Yaskawa representative.

Table 10-1: Spare Parts for the MOTOMAN-MH50-20 (Sheet 1 of 2)

Rank	Parts No.	Name	Type	Manufacturer	Qty	Qty per Unit	Remarks
A	1	Grease	Molywhite RE No.00	Yaskawa	16kg	-	For each axis speed reducer
A	2	Grease	Harmonic Grease SK-1A	Harmonic Drive System Co., Ltd.	2.5kg	-	
A	3	Grease	Alvania EP Grease 2	Showa Shell Sekiyu.k.k.	16kg	-	
A	4	Liquid Gasket	Three Bond	Three Bond Co., Ltd.	-	-	
B	5	Battery Pack	HW0470360-A	Yaskawa	1	1	
B	6	Battery Pack	HW9470932-A	Yaskawa	1	1	
B	7	R-axis Timing Belt	60S4.5M468	Mitsuboshi Belting Limited	1	1	
B	8	B-axis Timing Belt	80S4.5M653	Mitsuboshi Belting Limited	1	1	
B	9	T-axis Timing Belt	80S4.5M518	Mitsuboshi Belting Limited	1	1	
B	10	S-axis Speed Reducer	HW0387752-A	Yaskawa	1	1	
			HW1382898-A	Yaskawa	1	1	For the manipulator assembled after Apr.2 2014
B	11	S-axis Input Gear	HW0313741-1	Yaskawa	1	1	
B	12	L-axis Speed Reducer	HW9381465-B	Yaskawa	1	1	
B	13	L-axis Input Gear	HW9482771-A	Yaskawa	1	1	
C	14	U-axis Speed Reducer	HW0387753-A	Yaskawa	1	1	
C	15	U-axis Input Gear	HW0313740-1	Yaskawa	1	1	

Table 10-1: Spare Parts for the MOTOMAN-MH50-20 (Sheet 2 of 2)

Rank	Parts No.	Name	Type	Manufacturer	Qty	Qty per Unit	Remarks
C	16	R-axis Speed Reducer	HW9380623-A	Yaskawa	1	1	
C	17	B-axis Speed Reducer	HW9381633-A	Yaskawa	1	1	
C	18	T-axis Speed Reducer	HW0382140-A	Yaskawa	1	1	
C	19	AC Servomotor for S-axis	HW0388669-A SGMRV-30ANA-YR1*	Yaskawa	1	1	
C	20	AC Servomotor for L-axis	HW0388670-A SGMRV-37ANA-YR1*	Yaskawa	1	1	
C	21	AC Servomotor for U-axis	HW0388667-A SGMRV-13ANA-YR1*	Yaskawa	1	1	
C	22	AC Servomotor for R-, B- and T-axes	HW0389298-A SGMPH-02ANA-YR1*	Yaskawa	1	3	
C	23	Wire Harness in Manipulator	HW0175116-A	Yaskawa	1	1	
C	24	Wire Harness in Manipulator for B- and T-axes	HW0374330-A	Yaskawa	1	1	For BT-axes
C	25	Connector Base	HW0374034-B	Yaskawa	1	1	
C	26	Wrist Unit	HW0171278-F	Yaskawa	1	1	
C	27	Circuit Board	SGDR-EFBA02A	Yaskawa	1	1	

11 Parts List

11.1 S-Axis Unit

Fig. 11-1: S-Axis Unit

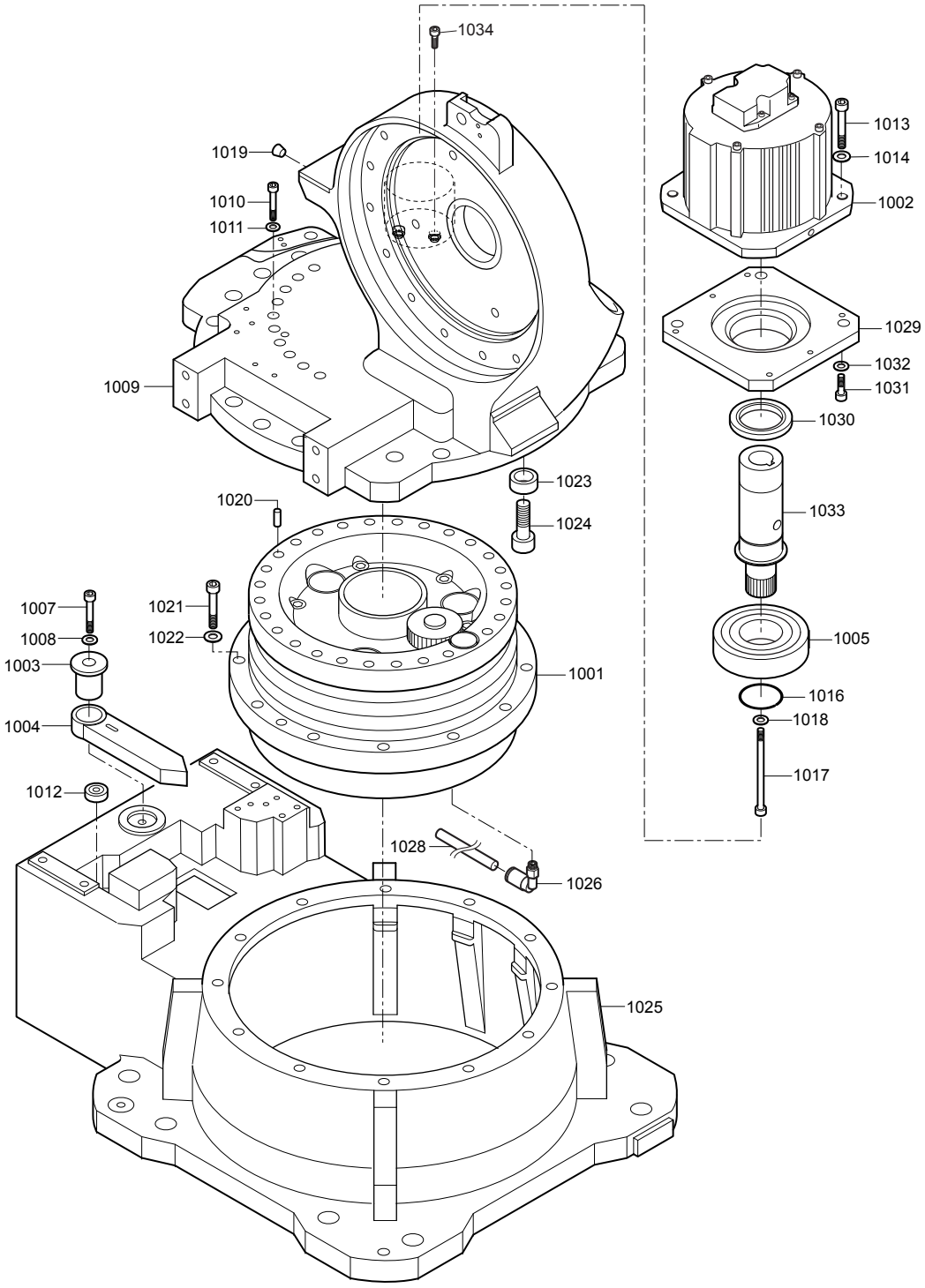


Table 11-1: S-Axis Unit

No.	DWG No.	Name	Pcs
1001	HW0387752-A	Speed reducer	1
	HW1382898-A (For the manipulator assembled after Apr.2 2014)	Speed reducer	1
1002	SGMRV-30ANA-YR1*	Motor	1
1003	HW9404486-1	Shaft	1
1004	HW0400405-1	Stopper	1
1005	6310	Bearing	1
1007	M8X45	Socket screw	1
1008	2H-8	Spring washer	1
1009	HW0102237-2	S head	1
1010	M12X45	Socket screw	15
	M12X45 (For the manipulator assembled after Apr.2 2014)	Socket screw	16
1011	2H-12	Spring washer	15
	2H-12 (For the manipulator assembled after Apr.2 2014)	Spring washer	16
1012	C-30-SG-22A	Grommet	1
1013	M12X55	Socket screw	3
1014	2H-12	Spring washer	3
1016	STW-50	Retaining Ring-C type	1
1017	M8X100	Socket screw	1
1018	2H-8	Spring washer	1
1019	PT3/8 (STAINLESS)	Plug	1
1020	MSTH10-25	Parallel pin	1
1021	M12X55	Socket screw	12
1022	2H-12	Spring washer	12
1023	HW9405875-1	Collar	1
1024	M20X40	Socket screw	1
1025	HW0102236-1	Base	1
1026	KQ2L10-01S	Elbow	1
1028	NB-1075-0.43	Tube	1
1029	HW0314010-1	M base	1
1030	Y507212.5	Oil seal	1
1031	M6X20	Socket screw	2
1032	2H-6	Spring washer	2
1033	HW0313741-1	Gear	1
1034	M12X35 (For the manipulator assembled after Apr.2 2014)	GT-SA bolt	2

11.2 L-Axis Unit

Fig. 11-2: L-Axis Unit

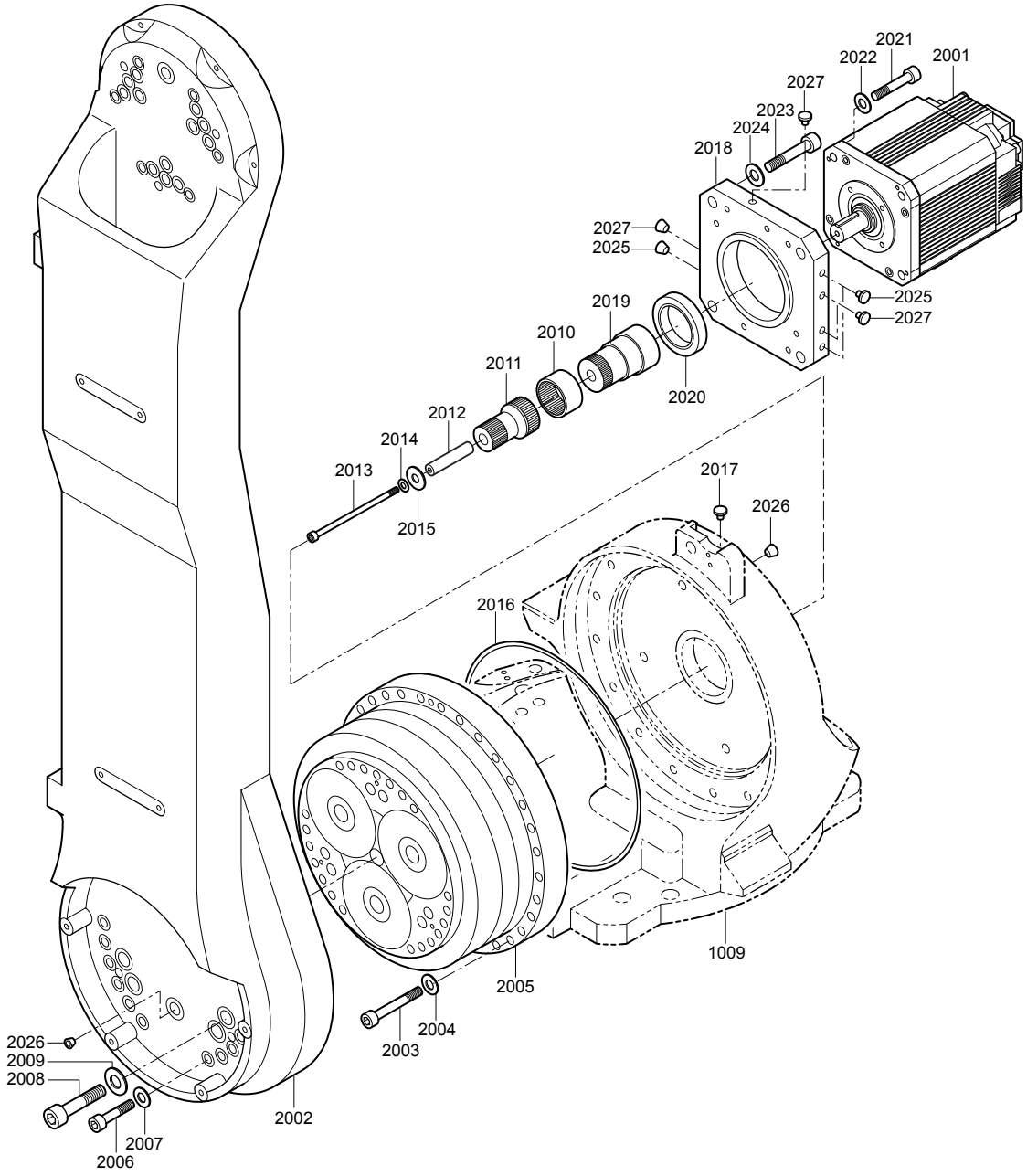


Table 11-2: L-Axis Unit

No.	DWG No.	Name	Pcs
2001	SGMRV-37ANA-YR1*	Motor	1
2002	HW0102644-1	L arm	1
2003	M12X55	Socket screw	16
2004	SW2H-12	Spring washer	16
2005	HW9381465-B	Speed reducer	1
2006	M10X40	Socket screw	18
2007	2H-10	Spring washer	18
2008	M16X45	Socket screw	6
2009	2H-16	Spring washer	6
2010	HW9481343-A	Shaft	1
2011	HW9482771-A	Gear	1
2012	HW9405902-1	Pipe	1
2013	M8X130	Socket screw	1
2014	2H-8	Spring washer	1
2015	M8	Washer	1
2016	G270	O ring	1
2017	EZ0094-A0	Air breather	1
2018	HW0314011-1	M base	1
2019	HW0312815-2	Gear	1
2020	Y507212.5	Oil seal	1
2021	M12X65	Socket screw	4
2022	2H-12	Spring washer	4
2023	M6X30	Socket screw	2
2024	2H-6	Spring washer	2
2025	EZ5002A0	Cap	3
2026	PT3/8 (STAINLESS)	Plug	2
2027	PT1/8 (STAINLESS)	Plug	4
1009	HW0102237-2	S head	1

11.3 U-Axis Unit

Fig. 11-3: U-Axis Unit

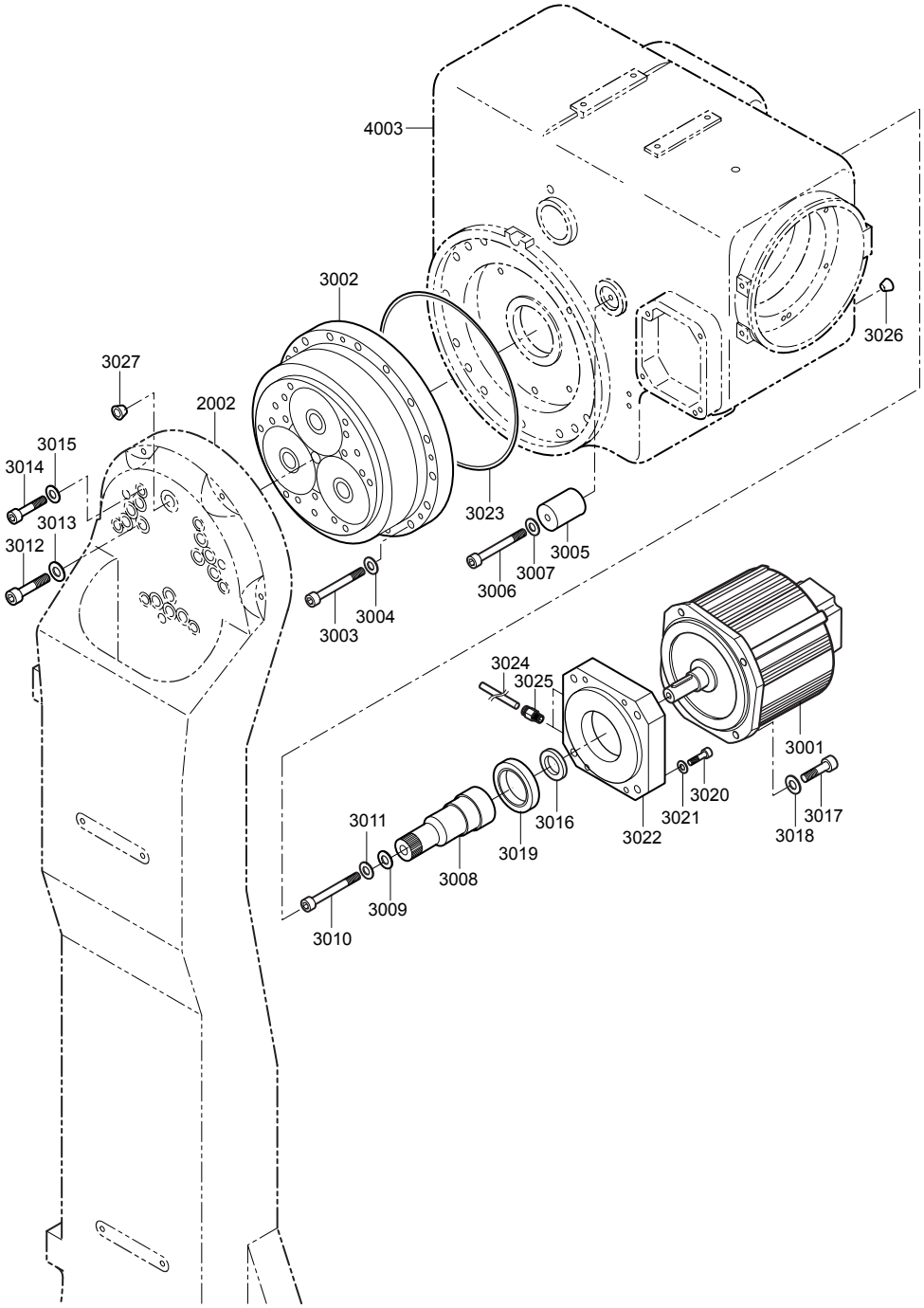


Table 11-3: U-Axis Unit

No.	DWG No.	Name	Pcs
3001	SGMRV-13ANA-YR1*	Motor	1
3002	HW0387753-A	Speed reducer	1
3003	M10X40	Socket screw	16
3004	2H-10	Spring washer	16
3005	HW0413914-1	Stopper	1
3006	M6X60	Socket screw	1
3007	2H-6	Spring washer	1
3008	HW0313740-1	Gear	1
3009	HW8411125-3	Washer	1
3010	M6X115	Socket screw	1
3011	2H-6	Spring washer	1
3012	M12X30	Socket screw	12
3013	2H-12	Spring washer	12
3014	M10X30	Socket screw	6
3015	2H-10	Spring washer	6
3016	HW9405257-1	Collar	1
3017	M8X55	Socket screw	4
3018	2H-8	Spring washer	4
3019	Y426012.5	Oil seal	1
3020	M6X30	Socket screw	2
3021	2H-6	Spring washer	2
3022	HW0314012-1	M base	1
3023	G195	O ring	1
3024	TSH6-01M	Union	2
3025	UB-0640-0.1C	Tube	2
3026	PT1/8 (STAINLESS)	Plug	1
3027	PT3/8 (STAINLESS)	Plug	1
2002	HW0102644-1	L arm	1
4003	HW0102645-1	Casing	1

11.4 R-Axis Unit

Fig. 11-4: R-Axis Unit

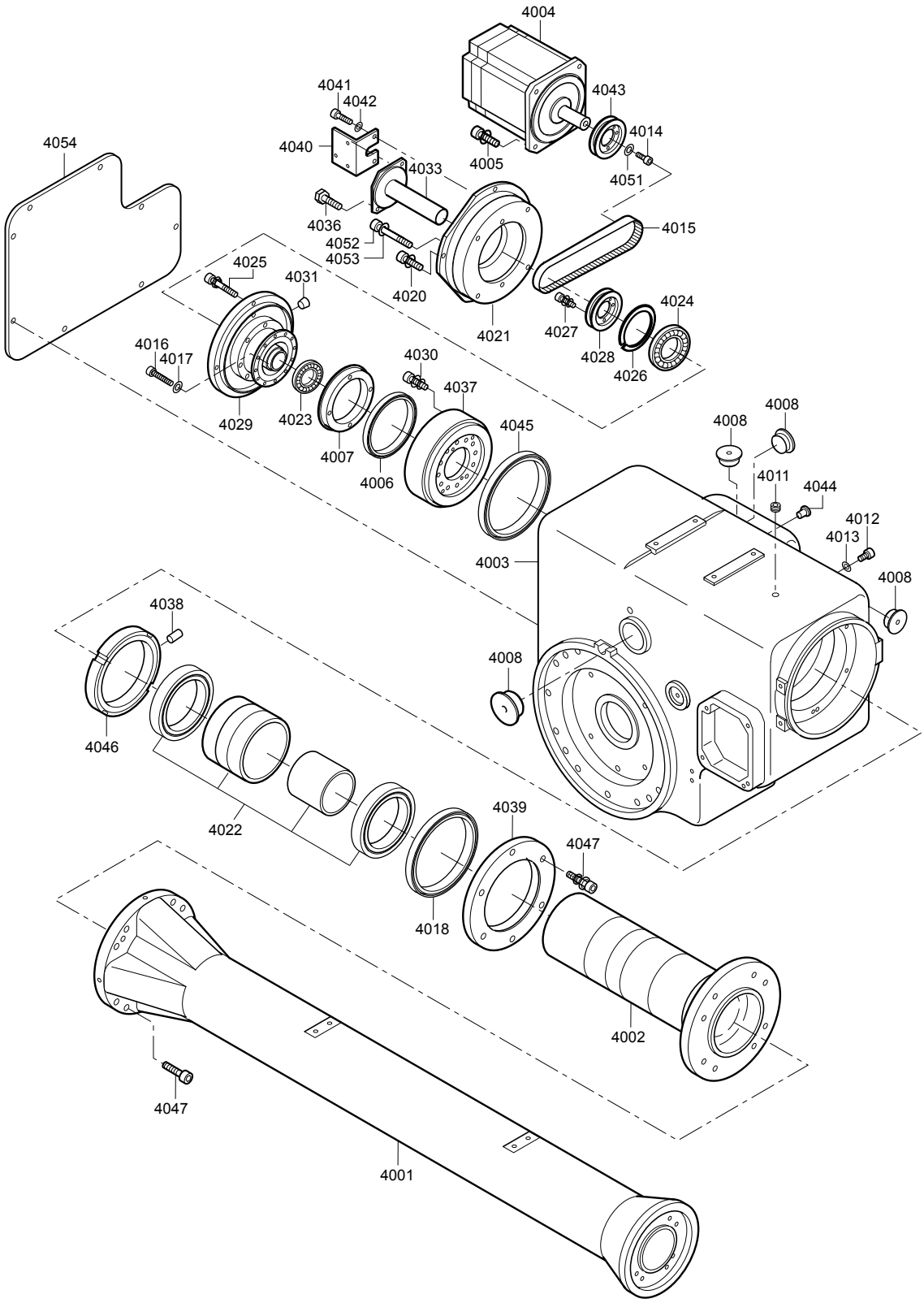


Table 11-4: R-Axis Unit (Sheet 1 of 2)

No.	DWG No.	Name	Pcs
4001	HW0102646-1	U arm B	1
4002	HW0201294-1	Shaft	1
4003	HW0102645-1	Casing	1
4004	SGMPH-02ANA-YR1*	Motor	1
4005	M5X20	GT-SA bolt	3
4006	VC901056	Oil seal	1
4007	HW9404736-1	Shaft	1
4008	EZ5013B0	Cap	4
4011	PT1/8 (STAINLESS)	Plug	1
4012	M6X6	Socket screw	1
4013	2H-6	Spring washer	1
4014	M4X12	Socket screw	1
4015	60S4.5M468	Belt	1
4016	M4X20	Socket screw	12
4017	2H-4	Spring washer	12
4018	VC1051258	Oil seal	1
4020	M6X20	GT-SA bolt	5
4021	HW0201296-1	Housing	1
4022	32919XUDB+57/G20	Bearing	1
4023	6806ZZ	Bearing	1
4024	6809ZZ	Bearing	1
4025	M6X45	GT-SA bolt	4
4026	IRTW-58	Retaining rings	1
4027	M4X10	GT-SA bolt	4
4028	HW9481267-A	Pulley	1
4029	HW9380623-A	Speed reducer	1
4030	M4X10	GT-SA bolt	2
4031	M6X8	H set screw	2
4033	HW9301491-A	Support	1
4036	M5X16	APS bolt	2
4037	HW9303180-1	Shaft	1
4038	M5X8	Magic screw	2
4039	HW9301880-1	B cover	1
4040	HW9404738-1	Support	1
4041	M5X10	Socket screw	2
4042	2H-5	Spring washer	2
4043	HW9481280-A	Pulley	1
4044	EZ5002A0	Cap	1
4045	V-120A	V ring	1
4046	HW9404713-1	B nut	1
4047	M8X30	GT-SA bolt	14
4051	2H-4	Spring washer	1

Table 11-4: R-Axis Unit (Sheet 2 of 2)

No.	DWG No.	Name	Pcs
4052	M6X50	Socket screw	6
4053	2H-6	Spring washer	6
4054	HW0414652-1	Cover	1

11.5 Wrist Unit

Fig. 11-5: Wrist Unit

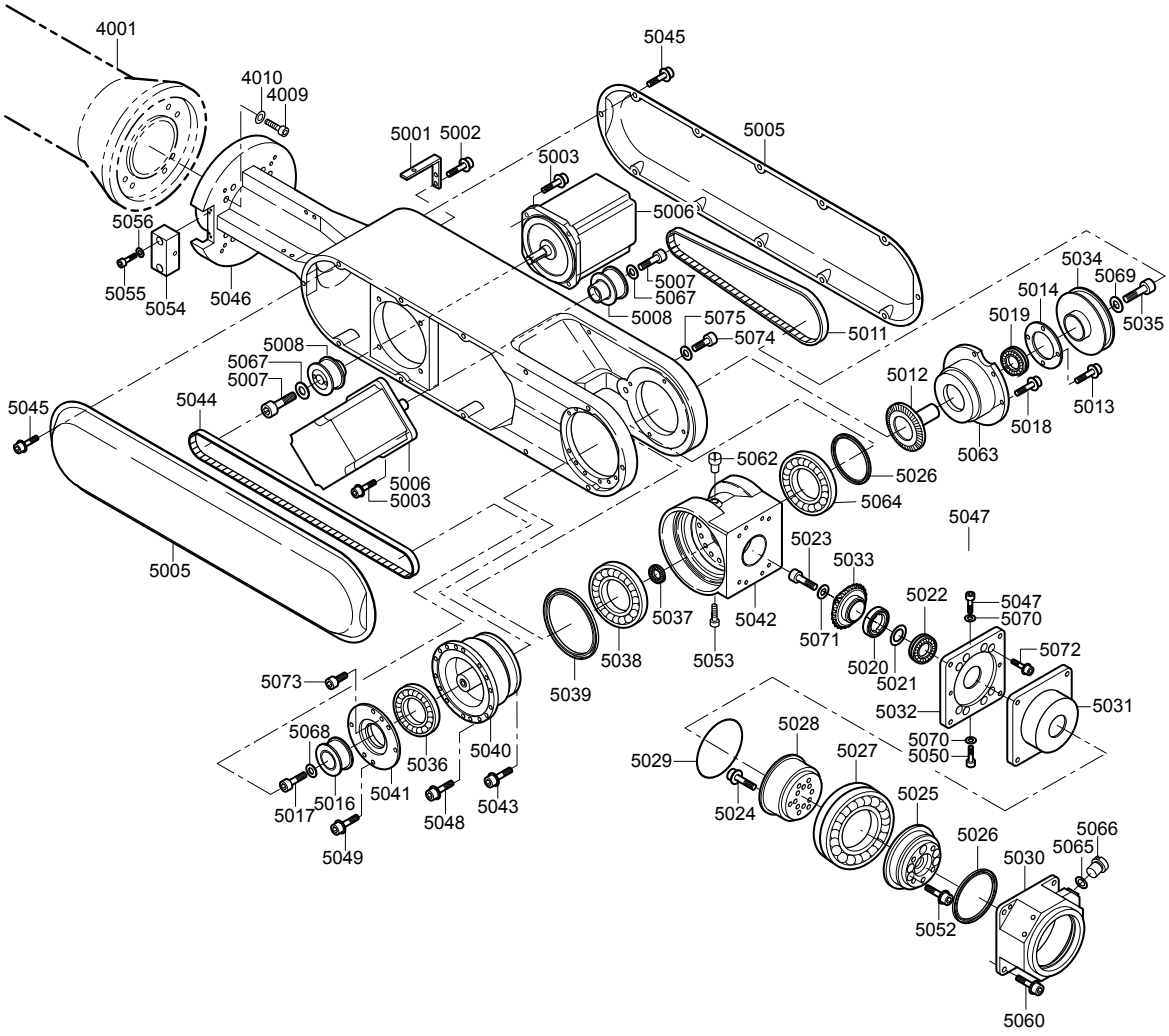


Table 11-5: Wrist Unit (Sheet 1 of 2)

No.	DWG No.	Name	Pcs
5001	HW9406556-1	Support	1
5002	M4X12	GT-SA bolt	2
5003	M5X20	GT-SA bolt	4
5005	HW9200798-1	Cover	2
5006	SGMPH-02ANA-YR11	Motor	2
5007	M4X16	Socket screw	2
5008	HW9482727-A	Pulley	2
5011	80S4.5M518	Belt	1
5012	HW9381658-A	Gear	1
5013	M4X12	GT-SA bolt	4
5014	HW9405452-1	B cover	1
5016	HW9482725-A	Pulley	1
5017	M5X16	Socket screw	1
5018	M4X16	GT-SA bolt	4
5019	HW9482218-A	Bearing	1
5020	HW9405199-1	B nut	1
5021	SP-0120**	Shim	1
5022	HW9481180-A	Bearing	1
5023	M5X16	Socket screw	1
5024	M5X12	GT-SA bolt	8
5025	HW0304232-1	Shaft	1
5026	TC60747	Oil seal	2
5027	HW9481187-A	Bearing	1
5028	HW0304233-1	Shaft	1
5029	S75	O ring	1
5030	HW0304087-1	Housing	1
5031	HW0382140-A	Speed reducer	1
5032	HW0304086-1	Housing	1
5033	HW9381659-A	Gear	1
5034	HW9482726-A	Pulley	1
5035	M5X20	Socket screw	1
5036	6002ZZ	Bearing	1
5037	6901ZZ	Bearing	1
5038	6814ZZ	Bearing	1
5039	HW9482668-A	Oil seal	1
5040	HW9381633-A	Speed reducer	1
5041	HW9405792-1	Housing	1
5042	HW0200451-1	Wrist base	1
5043	M5X16	GT-SA bolt	11
5044	80S4.5M653	Belt	1
5045	M5X12	GT-SA bolt	24
5046	HW0100623-1	U arm	1
5047	M6X6	Socket screw	1
5048	M4X16	GT-SA bolt	12

Table 11-5: Wrist Unit (Sheet 2 of 2)

No.	DWG No.	Name	Pcs
5049	M4X12	GT-SA bolt	4
5050	M6X6	Socket screw	1
5052	M5X16	GT-SA bolt	5
5053	M6X6	Socket screw	1
5054	HW0405201-2	Block	1
5055	M4X20	Socket screw	2
5056	2H-4	Spring washer	2
5057	M6	L Washer	1
5060	M5X16	GT-SA bolt	4
5062	LP-M5	Plug	1
5063	HW9405791-3	Housing	1
5064	6811LLU	Bearing	1
5065	HW0404606-1	Cover	1
5066	HW0404605-1	Plug	1
5067	2H-4	Spring washer	2
5068	2H-5	Spring washer	1
5069	2H-5	Spring washer	1
5070	M6	Washer	2
5071	2H-5	Spring washer	1
5072	M4X12	GT-SA bolt	8
5073	M6X6	Socket screw	1
5074	M6X14	Socket screw	1
5075	M6	Washer	1
4001	HW0102646-1	U arm B	1
4009	M6X50	Socket screw	8
4010	2H-6	Spring washer	8

MOTOMAN-MH50-20
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