

MOTOMAN-MPL160 II INSTRUCTIONS

TYPE:**YR-MPL0160-J00 (DX200 STANDARD SPECIFICATION)**

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

MOTOMAN INSTRUCTIONS

MOTOMAN-MPL160 II INSTRUCTIONS
DX200 INSTRUCTIONS
DX200 OPERATOR'S MANUAL (for each purpose)
DX200 MAINTENANCE MANUAL

The DX200 operator's manual above corresponds to specific usage.
Be sure to use the appropriate manual.

Part Number: 172536-1CD
Revision: 0

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MANDATORY

- This instruction manual is intended to explain mainly on the mechanical part of the MOTOMAN-MPL160 II 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 DX200 Instructions. To ensure correct and safe operation, carefully read the DX200 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.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338
www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. **NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!**

We recommend approved Yaskawa training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the MOTOMAN-MPL160 II.

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.



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 DX200 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 DX200.
 - 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 DX200 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 cabinet of the DX200 after use.

The programming pendant can be damaged if it is left in the manipulator's work area, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the DX200 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
DX200 controller	DX200
DX200 programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator cable

Explanation of Warning Labels

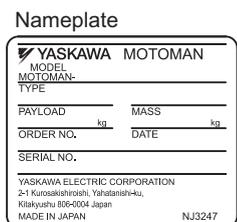
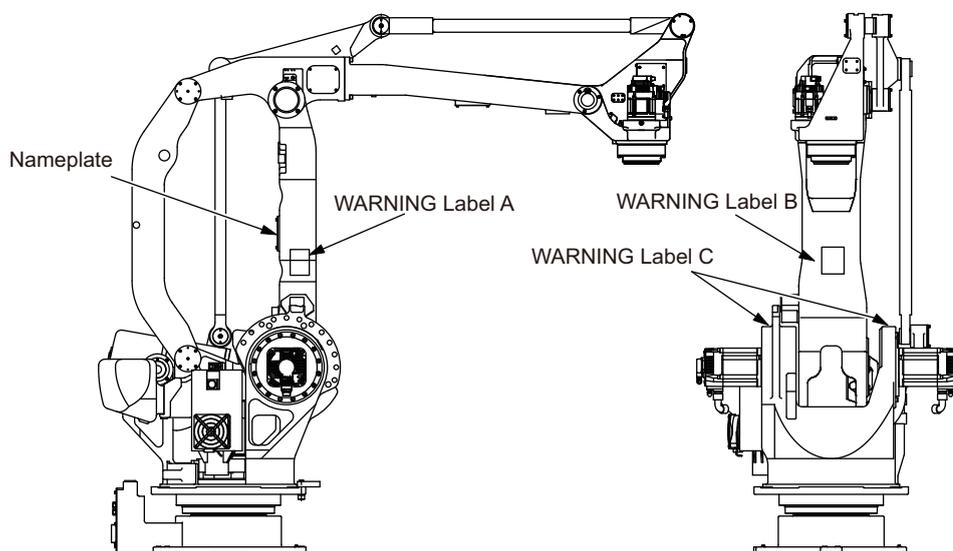
The following warning labels are attached to the manipulator.

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.

Note: Taking the maintenance-relevant trainings offered by Yaskawa is indispensable for replacing the L-axis of the balancer-equipped manipulator.

Figure 3: Warning Label Locations



Signal Output for Motor Protection

A cooling fan is equipped in order to protect the motor of S-axis of the manipulator from overheating. If the cooling fan is out of order, warning message [COOLING FAN2 ERROR] will appear on the programming pendant.

If operation is continued while this warning message remains displayed, the component parts of the DX200 and robot components are liable to become damaged, leading to a major breakdown.

During high speed continuous operation, the temperature may rise abruptly depending upon the ambient temperature and the operation pattern, so it is necessary to promptly detect a warning.

A warning message is output as a dedicated output signal, so it is recommended that you monitor it on the system side as a warning signal for the sake of safety.

Refer to “DX200 Concurrent I/O” (165294-1CD) for details on the signal output.

Table 1: Dedicated output signal

80290
SOUT#0575
COOLING FAN2 ERROR

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1 Product Confirmation



CAUTION

- Confirm that the manipulator and the DX200 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.

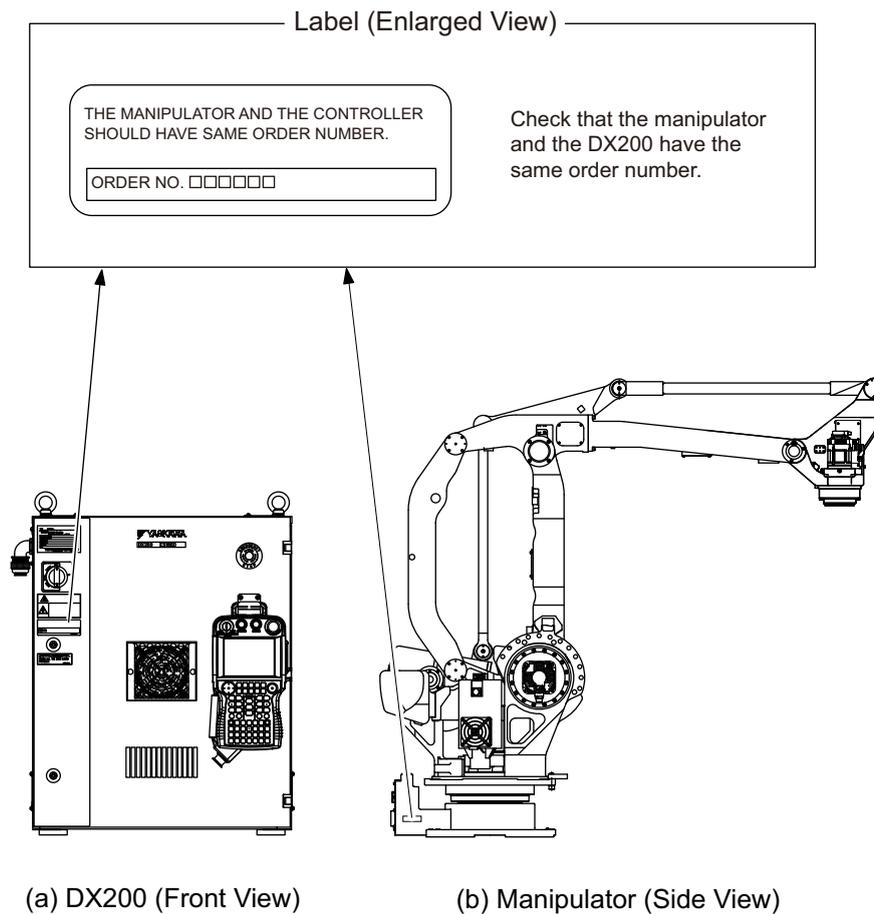
Standard delivery includes the following four items (information for the content of optional goods are given separately):

- Manipulator
- DX200
- Programming pendant
- Manipulator cables (between the DX200 and the Manipulator)

1.2 Order Number Confirmation

Check that the order number of the manipulator corresponds to the DX200. The order number is located on a label as shown below.

Fig. 1-1: Location of Order Number Labels



2 Transport



CAUTION

- Sling applications 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

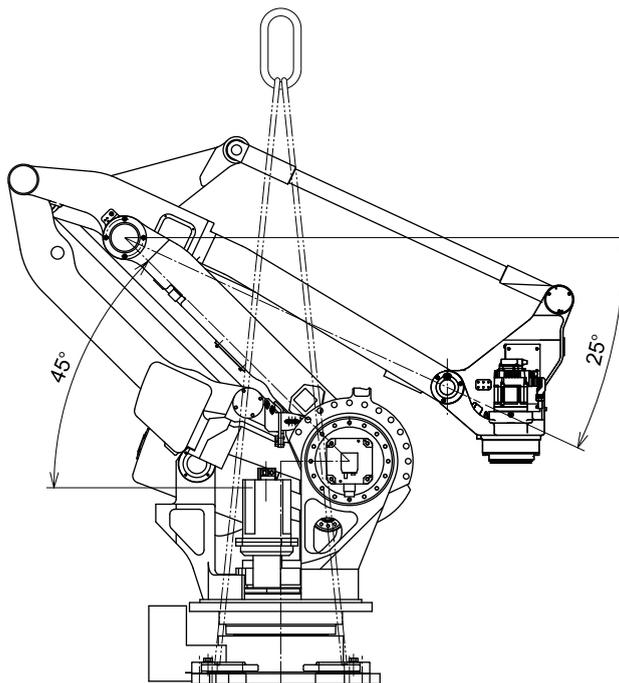


- The weight of the manipulator is approximately 1750 kg including the shipping bolts and brackets. Use a wire rope strong enough to withstand the weight.
- Shipping bolts and brackets are designed to support the manipulator weight. Do not use them for anything other than transporting the manipulator.
- Mount the shipping bolts and brackets for transporting the manipulator.
- Avoid putting external force on the arm or motor unit when transporting by a crane 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 four wire ropes 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 "Transporting Position".

Fig. 2-1: Transporting Position



Factory setting for angle and pulse of each axis

Axis	S	L	U	T
Angle	0°	-45°	-25°	0°
Pulse	0	-87552	-48640	0

2.2 Shipping Bolts and Brackets

The manipulator is provided with shipping bolts and brackets at positions A, B, and C. (See Fig. 2-1 “Transporting Position”.)

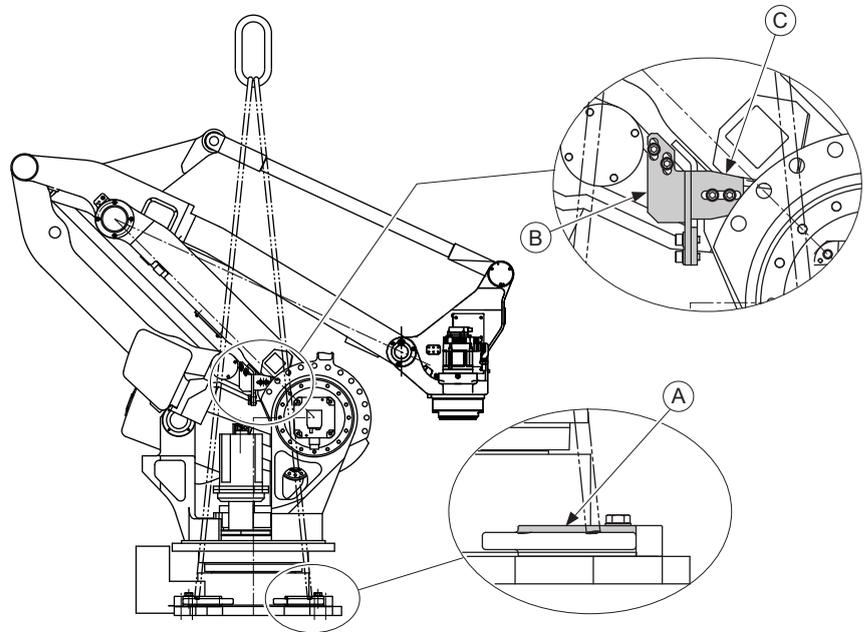
- The shipping bolts and brackets are painted yellow.

Position	Screw Type	Pcs
A	Hexagon socket head cap screw M20	4
B and C	Hexagon socket head cap screw M10	4



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.

Fig. 2-2: Shipping Bolts and Brackets



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 the 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 *Fig. 2-2 "Shipping Bolts and Brackets"* 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 the information and guidance.

Responsibility for Safeguarding (ISO 10218)

Responsibility for Safeguarding (ISO 10218)

The user of a manipulator or robot system shall ensure that the safeguarding is provided and used in accordance with Chapter 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.

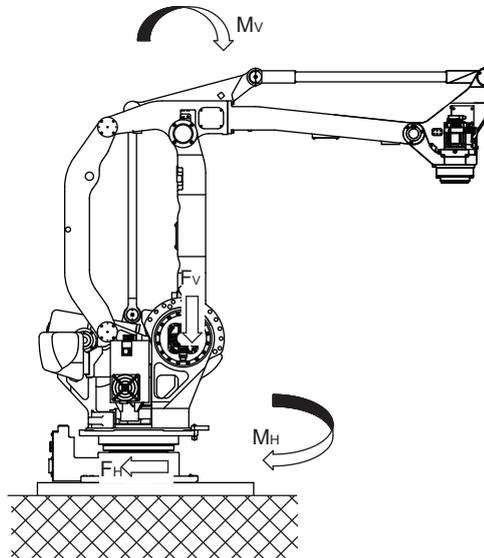
Construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator as shown in *Table 3-1 "Manipulator Repulsion Force and Torque"*.

During installation, if the flatness is not right, the manipulator shape may be deformed and its functional ability may be compromised. The flatness for baseplate must be kept at 0.5 mm or less. Fix the manipulator base as described in section 3.2.1 "Mounting the Manipulator and Fixture on the Baseplate".

Table 3-1: Manipulator Repulsion Force and Torque

	Horizontal rotation		Vertical rotation	
	Repulsion force F_H	Torque M_H	Repulsion force F_V	Torque M_V
Emergency stop	20580 N•m (2100 kgf•m)	39200 N•m (4000 kgf•m)	49980 N•m (5100 kgf•m)	62720 N•m (6400 kgf•m)
Acceleration/deceleration	6370 N•m (650 kgf•m)	11760 N•m (1200 kgf•m)	21560 N•m (2200 kgf•m)	15680 N•m (1600 kgf•m)

Fig. 3-1: Manipulator Repulsion Force and Torque

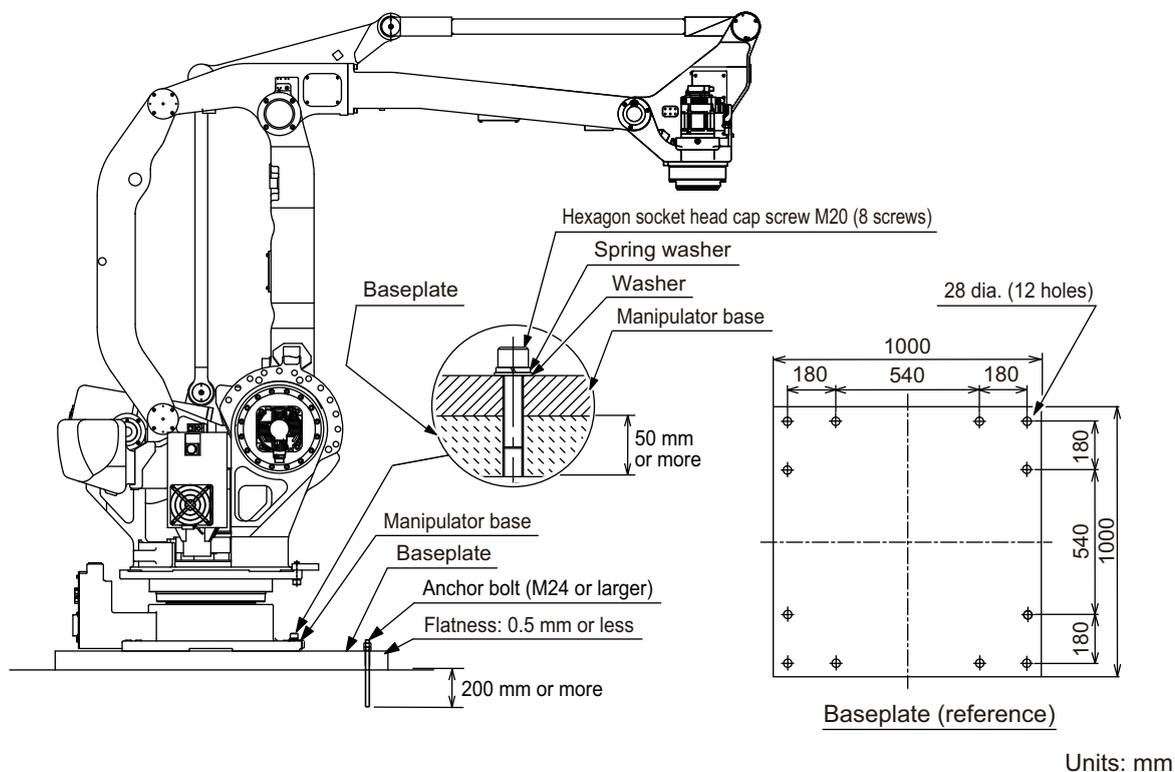


3.2.1 Mounting the Manipulator and Fixture on the Baseplate

For the first process, anchor the baseplate firmly on the floor. The baseplate should have enough rigidity, which is 50 mm or more in thickness. The size of the anchor bolt recommended for the baseplate fixation is M24 or more.

Next, fix the manipulator base to the baseplate. There are eight mounting holes on the manipulator base: securely fix the manipulator to the baseplate using eight hexagon head screws M20 (Tensile strength: 1200 N/mm^2 or more) (80 mm long is recommended). Tighten the bolts with a tightening torque of $402 \text{ N}\cdot\text{m}$ ($41 \text{ kgf}\cdot\text{m}$). Tighten the hexagon head screws and anchor bolts firmly so that they will not be loosened during the operation.

Fig. 3-2: Mounting the Manipulator on Baseplate



3.3 Protection Class

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

3.4 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 (non-condensing)
- Free from dust, soot, or water
- Free from corrosive gas or liquid, or explosive gas or liquid
- Free from excessive vibration
(Vibration acceleration: 4.9 m/s² [0.5G] or less)
- Free from large electrical noise (plasma)
- Flatness for installation: 0.5 mm or less

4 Wiring



WARNING

- Ground resistance must be 100Ω or less.

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

- Before wiring, make sure to turn the primary power supply off, 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.

- DO NOT cover the cable with heat insulating material, and avoid multiple cabling when laying manipulator cables from the manipulator to the DX200.

Failure to observe this caution may result in burn caused by cable heat emission failure.

4.1 Grounding

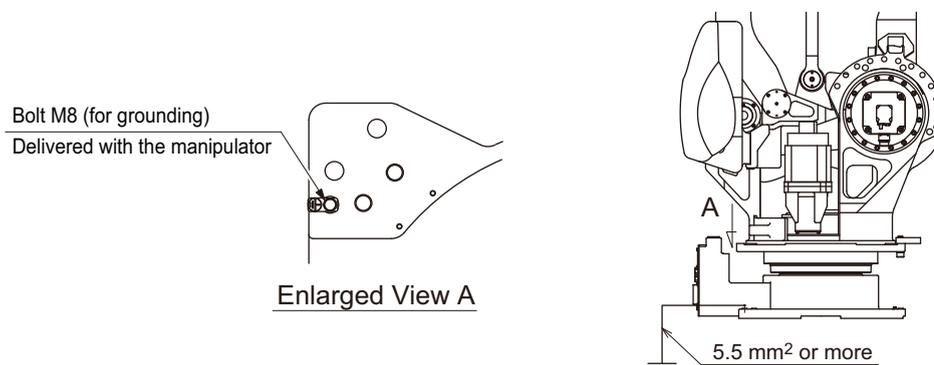
Follow electrical installation standards and wiring regulations for grounding. A ground wire of 5.5 mm^2 or more is recommended.

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



- Never 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

Three manipulator cables are delivered with the manipulator: an encoder cable (1BC) and an power cable (2BC). (Refer to Fig. 4-2 "Manipulator Cables".)

Connect these cables to the manipulator base connectors and to the DX200. Refer to Fig. 4-3(a) "Manipulator Cable Connectors (Manipulator Side)".

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.



DO NOT cover the cable with heat insulating material, and avoid multiple cabling.

4.2.2 Connection to the DX200

Before connecting cables to the DX200, verify the numbers on both manipulator cables and the connectors on the DX200. When connecting, insert the cables in the order of X21 then X11, and depress each lever until it clicks.

Fig. 4-2: Manipulator Cables

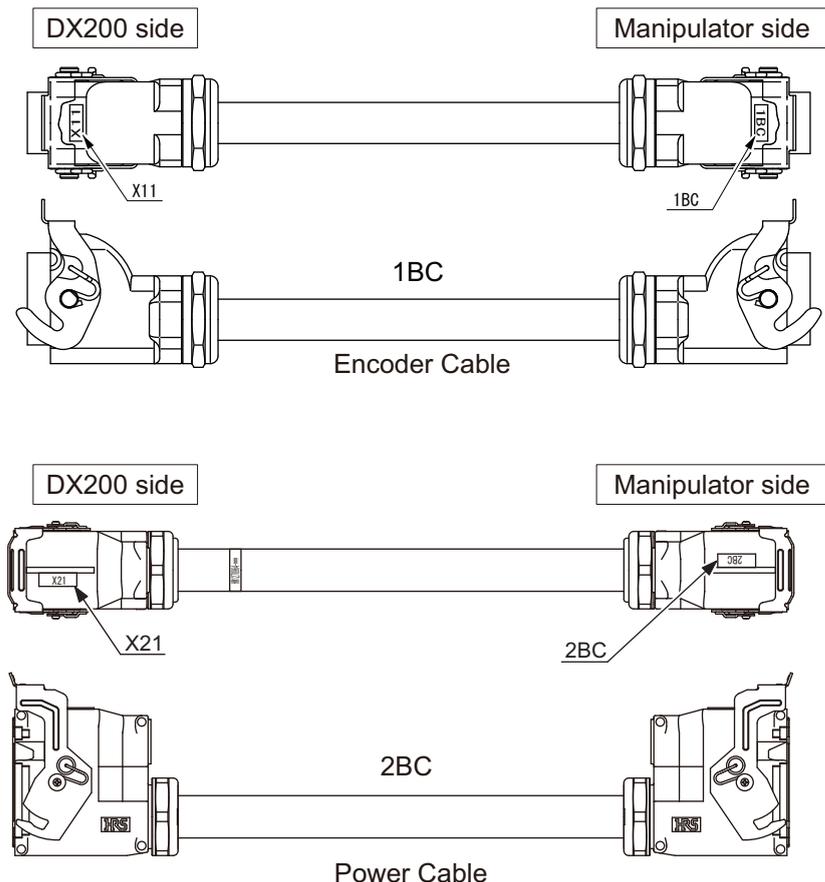


Fig. 4-3(a): Manipulator Cable Connectors (Manipulator Side)

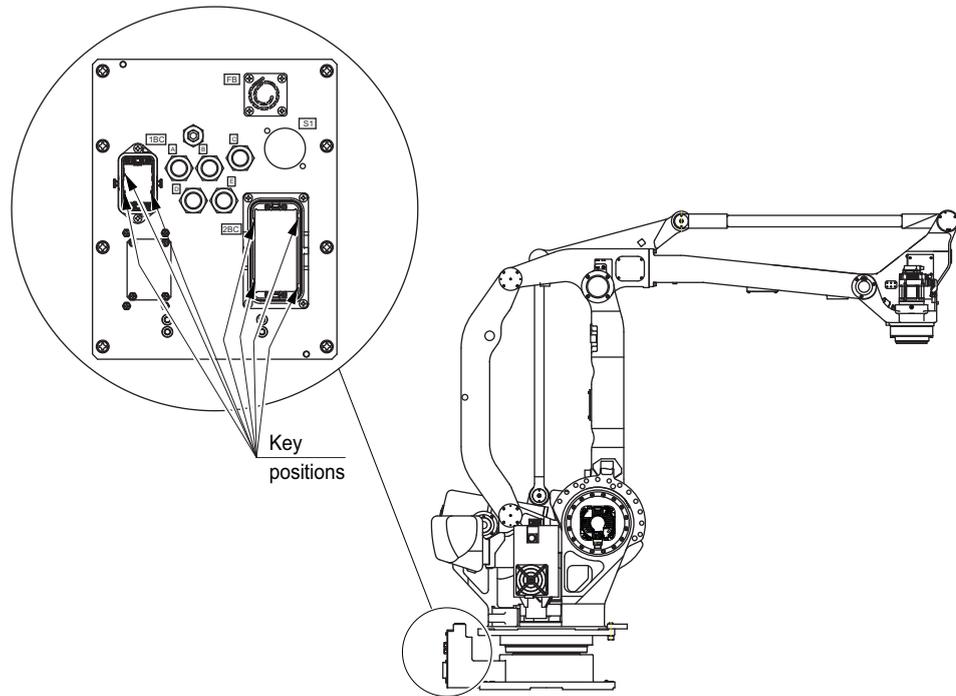
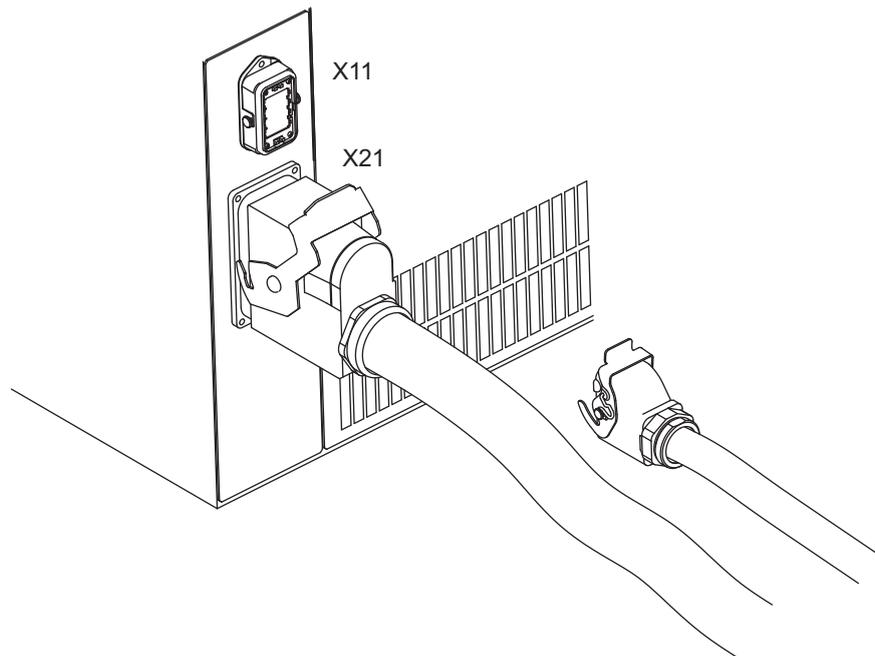


Fig. 4-3(b): Manipulator Cable Connection (DX200 Side)



5 Basic Specifications

5.1 Basic Specifications

Table 5-1: Basic Specifications¹⁾

Item	Type	MOTOMAN-MPL160II YR-MPL0160-J00
Structure		Vertically Articulated
Degree of Freedom		4
Payload		160 kg
Repeatability ²⁾		±0.5 mm
Range of Motion	S-Axis (turning)	-180° – +180°
	L-Axis (lower arm)	-45° – +90°
	U-Axis (upper arm)	-120° – +15.5°
	T-Axis (wrist twist)	-360° – +360°
Maximum Speed	S-Axis	2.44 rad/s, 140° /s
	L-Axis	2.44 rad/s, 140° /s
	U-Axis	2.44 rad/s, 140° /s
	T-Axis	5.32 rad/s, 305° /s
T-Axis Allowable Inertia ($GD^2/4$) ³⁾		80 kg·m ²
Approx. Mass		1700 kg
Protective Structure		Main part of the manipulator: IP54 or equivalent Wrist axis only: IP67 or equivalent
Ambient Conditions	Temperature	0 to 45°C
	Humidity	20 to 80% RH (non-condensing)
	Vibration	4.9 m/s ² (0.5G) or less
	Others	Free from corrosive gas or liquid, or explosive gas or liquid Free from exposure to dust, soot, or oil Free from excessive electrical noise (plasma)
Power Requirements		9.5 kVA
Noise ⁴⁾		73dB

1 SI units are used in this table. However, gravitational unit is used in ().

2 Conformed to ISO9283

3 Refer to *section 6.1 "Allowable Wrist Load"* for details on the permissible moment of inertia.

4 Conformed to ISO6926

1, Measurement is carried out when the maximum load is mounted to the manipulator and operated in the maximum speed.

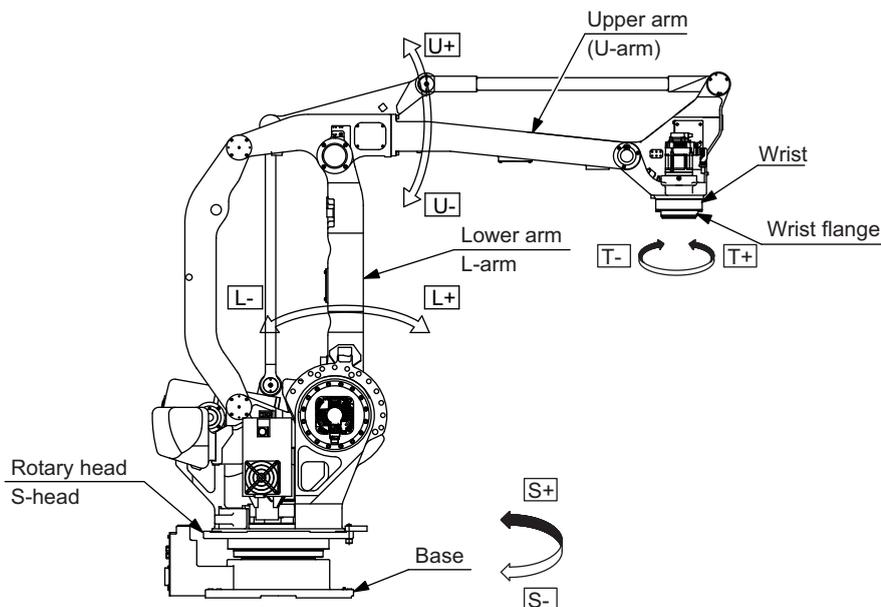
2, Measurement is carried out:

-between 1.2m and 1.5m above the ground.

-400mm away from the P-point maximum envelope.

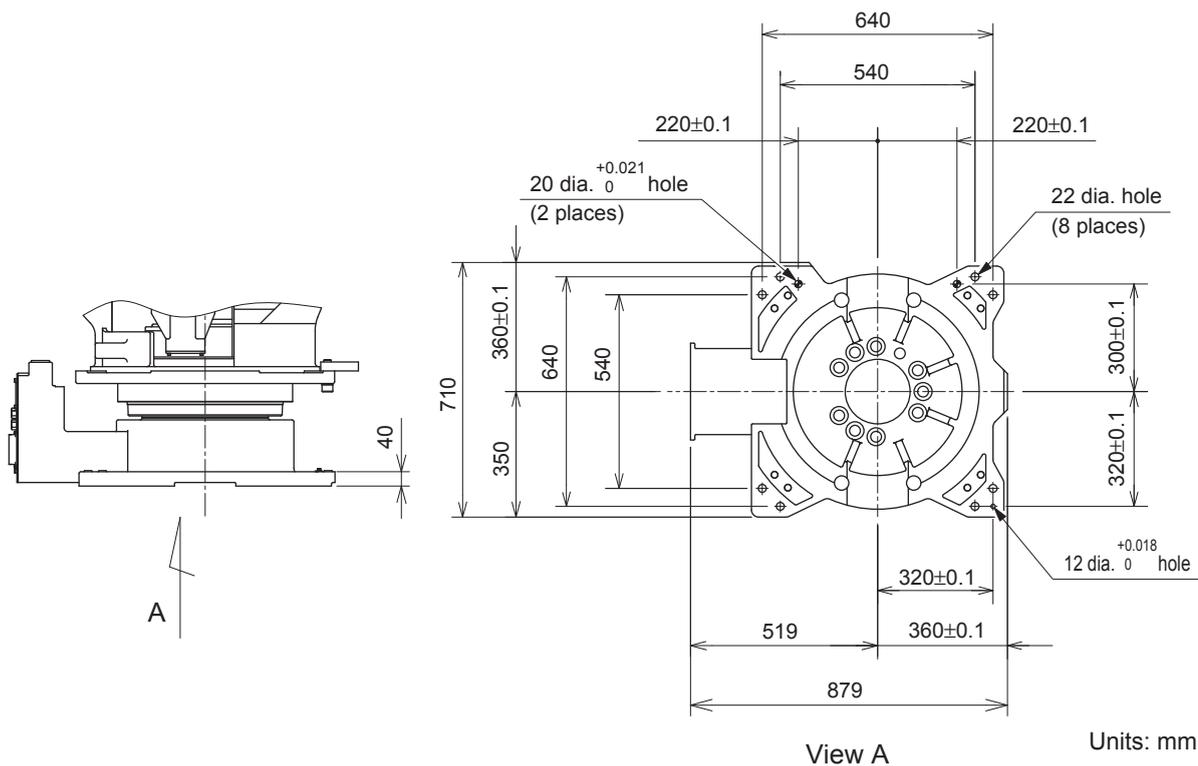
5.2 Part Names and Working Axes

Fig. 5-1: Part Names and Working Axes



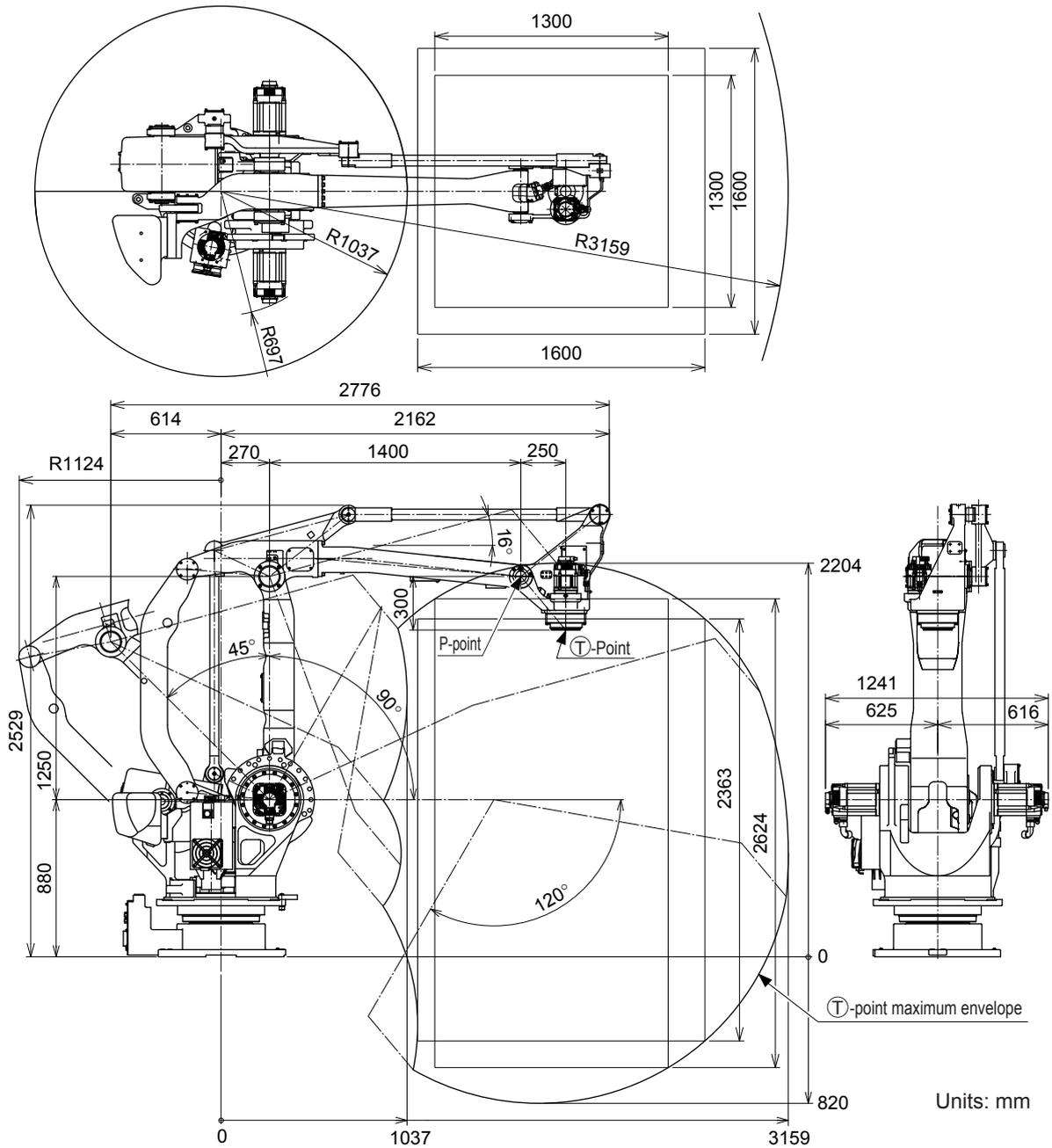
5.3 Manipulator Base Dimensions

Fig. 5-2: Manipulator Base Dimensions



5.4 Dimensions and T-Point Maximum Envelope

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



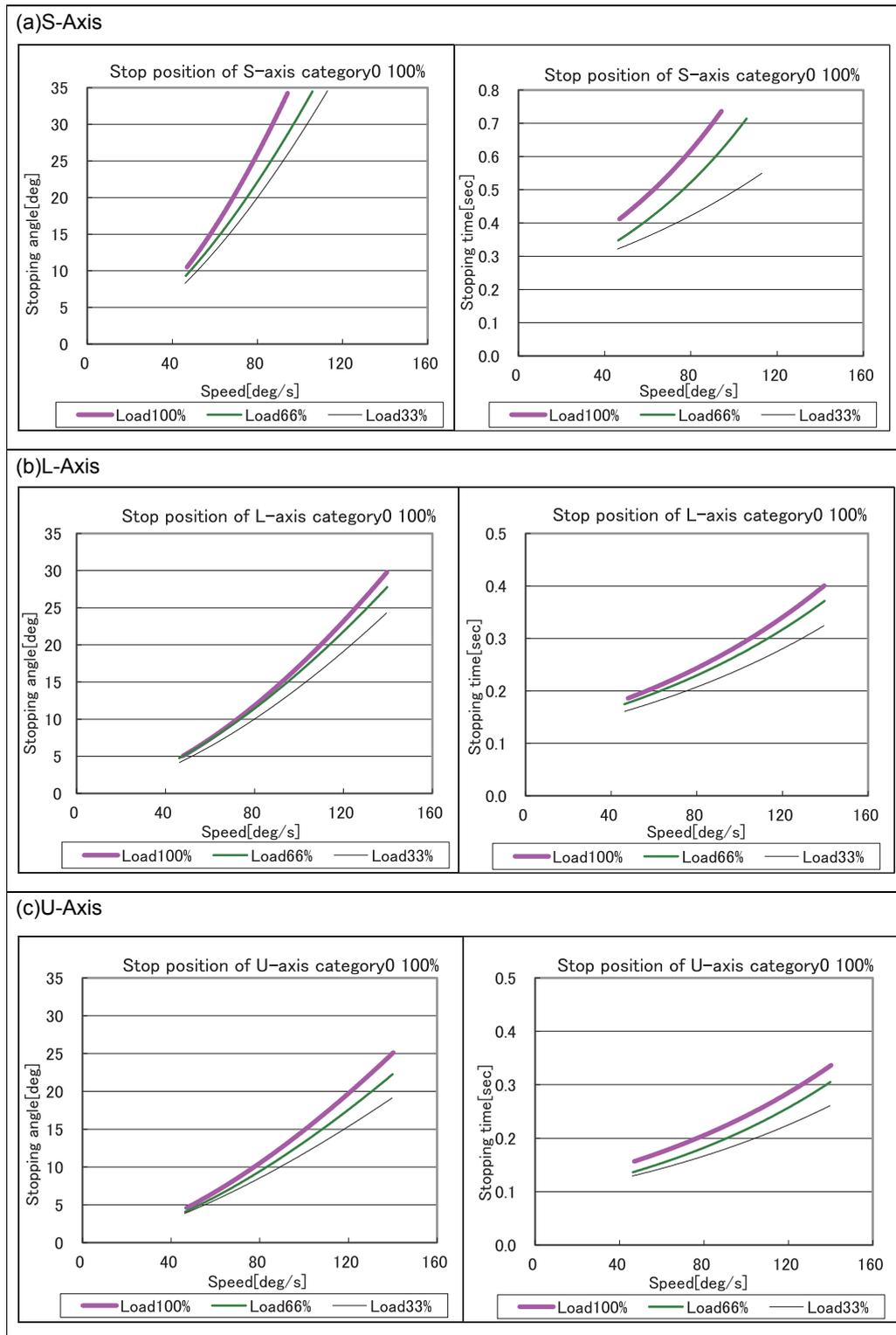
5.5 Stopping Angle and Time at the Emergency Stop

Following data on stopping angle and time at the emergency stop are measured under the standard of ISO10218.

5.5.1 Stop Category 0: Emergency Stop

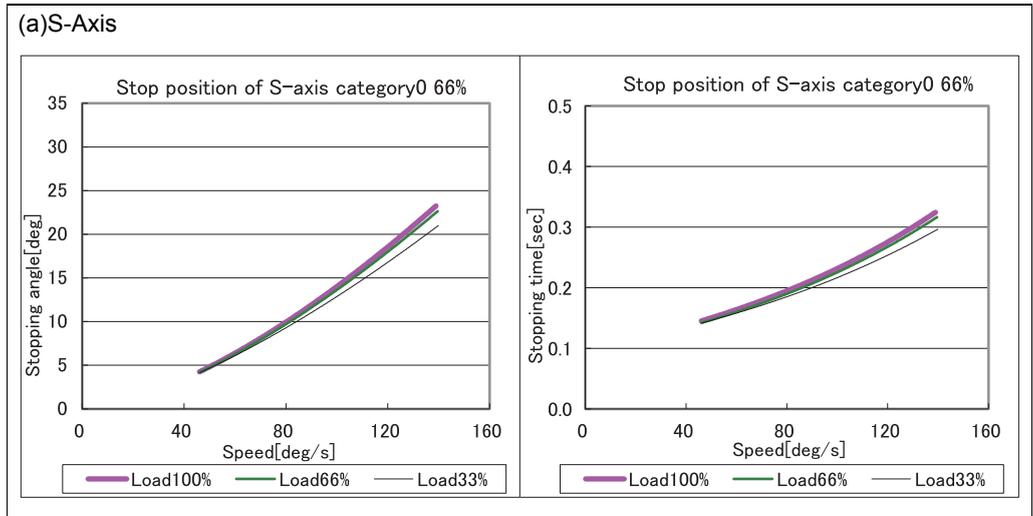
5.5.1.1 Position 100%

Fig. 5-4: Category 0, Position 100% : Stopping Angle and Time for each Axis at the Emergency Stop



5.5.1.2 Position 66%

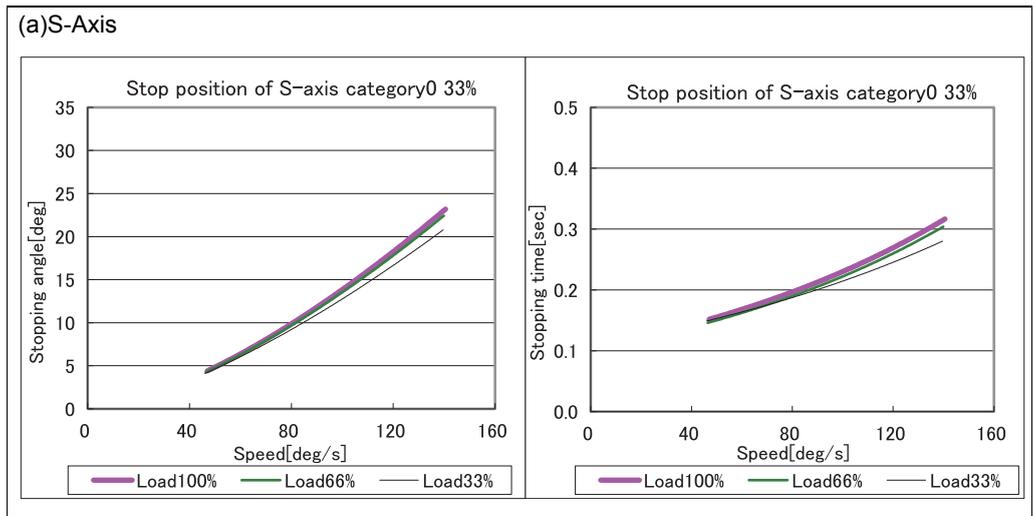
Fig. 5-5: Category 0, Position 66% : Stopping Angle and Time for each Axis at the Emergency Stop



Note: L- and U-axis takes one pose only for this structure.

5.5.1.3 Position 33%

Fig. 5-6: Category 0, Position 33% : Stopping Angle and Time for each Axis at the Emergency Stop



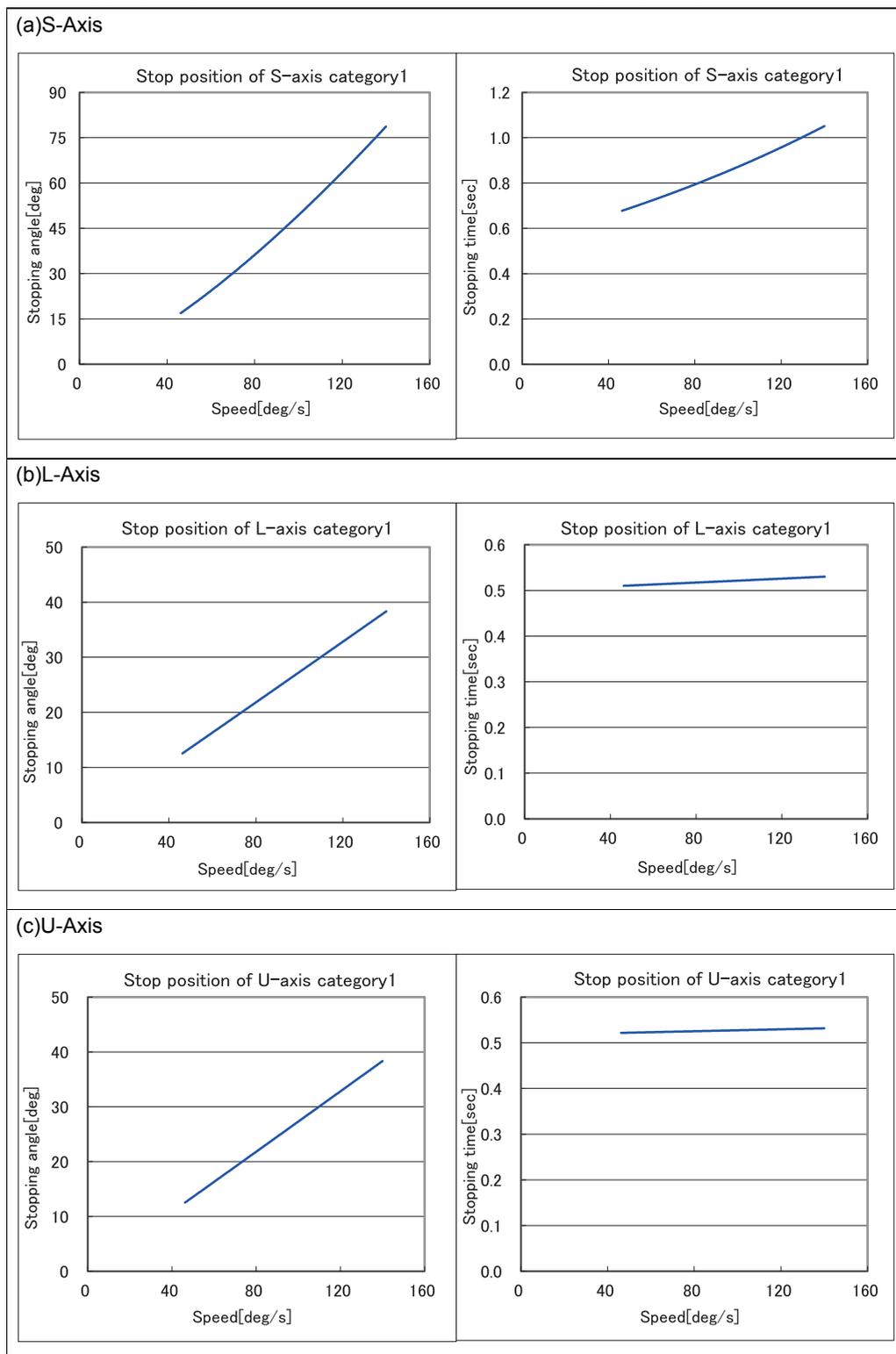
Note: L-, U- axis takes one pose only for this structure.

5.5.2 Stop Category 1: Emergency Stop

The stopping angle and time at the emergency stop in category 1 are not subjected to the manipulator position and the load.

Stop of category1 doesn't depend on the robot position and the load.

Fig. 5-7: Category 1: Stopping Angle and Time for each Axis at the Emergency Stop



5.6 Alterable Operating Range

The operating range of the S-axis can be altered in accordance with the operating conditions as shown in *Table 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	$\pm 180^\circ$ (standard) *($\pm 165^\circ$) $\pm 150^\circ$ $\pm 135^\circ$ $\pm 120^\circ$ $\pm 105^\circ$ $\pm 90^\circ$ $\pm 75^\circ$ $\pm 60^\circ$ $\pm 45^\circ$ $\pm 30^\circ$ *($\pm 15^\circ$)

* The interval between stoppers must be 60° or more.



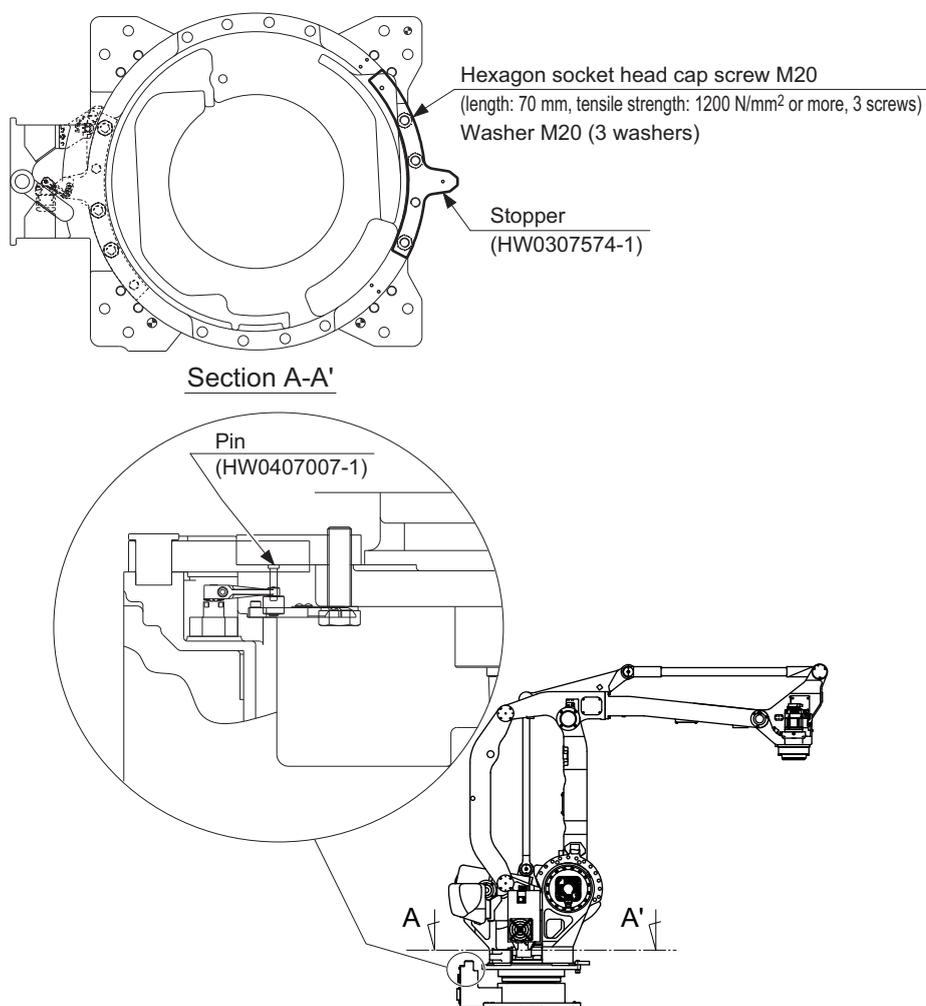
When altering the operating range to $\pm 15^\circ$ or $\pm 165^\circ$, please contact your Yaskawa representative.

5.6.1 Components for Altering Operating Range

When modifying the operating range of the S-axis, prepare the components shown in Fig. 5-8 "Components of S-Axis Stopper" referring to the following list.

- (1) Pin (drawing No. HW0407007-1, 1 pin)
- (2) Stopper (drawing No. HW0307574-1, 1 stopper)
- (3) Hexagon socket head cap screw M20
(length: 70 mm, tensile strength: 1200 N/mm² or more, 3 screws)
- (4) Flat washer M20 (3 flat washers)

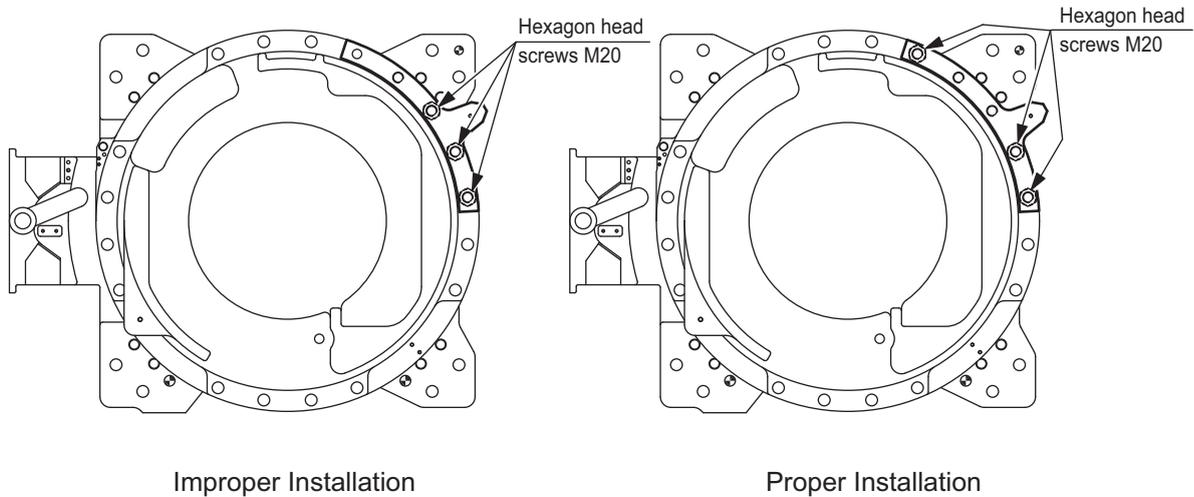
Fig. 5-8: Components of S-Axis Stopper



5.6.2 Notes on the Mechanical Stopper Installation

- Apply the Loctite 242 to the thread part of the pin HW0407007-1, and install the pin bottom up into the S-axis mechanical stopper HW0307574-1 as shown in Fig. 5-8 "Components of S-Axis Stopper". Mount the stopper to the S-head with three hexagon head screws M20 (length: 70 mm) and tighten the screws to the tightening torque of 402 N·m (tensile strength: 1200 N/mm² or more). The stopper is installed as shown in Fig. 5-8 when the operating range is $\pm 180^\circ$.
- The S-axis mechanical stopper can be installed at a pitch of 15 degrees. However, to avoid the mechanical troubles caused by interference between stoppers (e.g. $\pm 15^\circ$, $\pm 165^\circ$), install the stopper referring to Table 5-3 "Settable Angle for S-Axis Stopper".
- To ensure the stopper strength, make sure to fix both sides of the protrusion with screws. DO NOT fix only one side of the protrusion. (See Fig. 5-9 "Properly-Mounted Image".)
- As in the figures: Fig. 5-10(a) "Properly-Mounted Models for S-Axis Stopper" to Fig. 5-10(m) "Properly-Mounted Models for S-Axis Stopper", the S-axis mechanical stopper is reversible that either side of the stopper can be used and installed except for the installation at the angles: $\pm 30^\circ$, $\pm 60^\circ$, $\pm 120^\circ$, $\pm 150^\circ$ degrees. If the stopper cannot be installed in the range shown in Table 5-3, flip the stopper and retry installing the stopper.

Fig. 5-9: Properly-Mounted Image



NOTE

1. Apply the specified components when mounting the S-Axis mechanical stopper.
2. TURN OFF the electric power supply before mounting.

5.6.3 Adjustment of the Soft Limit of the S-Axis Pulse

Apply the Instruction for “DX200 Instructions chapter 8.17 Changing the Parameter Setting (165292-1CD)” as part of reference materials for adjusting the programming pendant when modifying the range of motion of S-Axis.

Pulse limit (positive (+) direction of the S-axis): S1CxG400

Pulse limit (negative (-) direction of the S-axis): S1CxG408

	MPL160 II
Degree	Number of Pulse
0°	0
±15° ¹⁾	± 29089
± 30°	± 58179
± 45°	± 87268
± 60°	± 116357
± 75°	± 145446
± 90°	± 174536
± 105°	± 203625
± 120°	± 232714
± 135°	± 261804
± 150°	± 290893
±165° ¹⁾	± 319982
± 180°	± 349071

1 Refer to section 5.6 “Alterable Operating Range”.



Adjust both of the pulse limit and the angle of the S-axis mechanical stopper when modifying the range of motion of the manipulator.

Fig. 5-10(a): Properly-Mounted Models for S-Axis Stopper

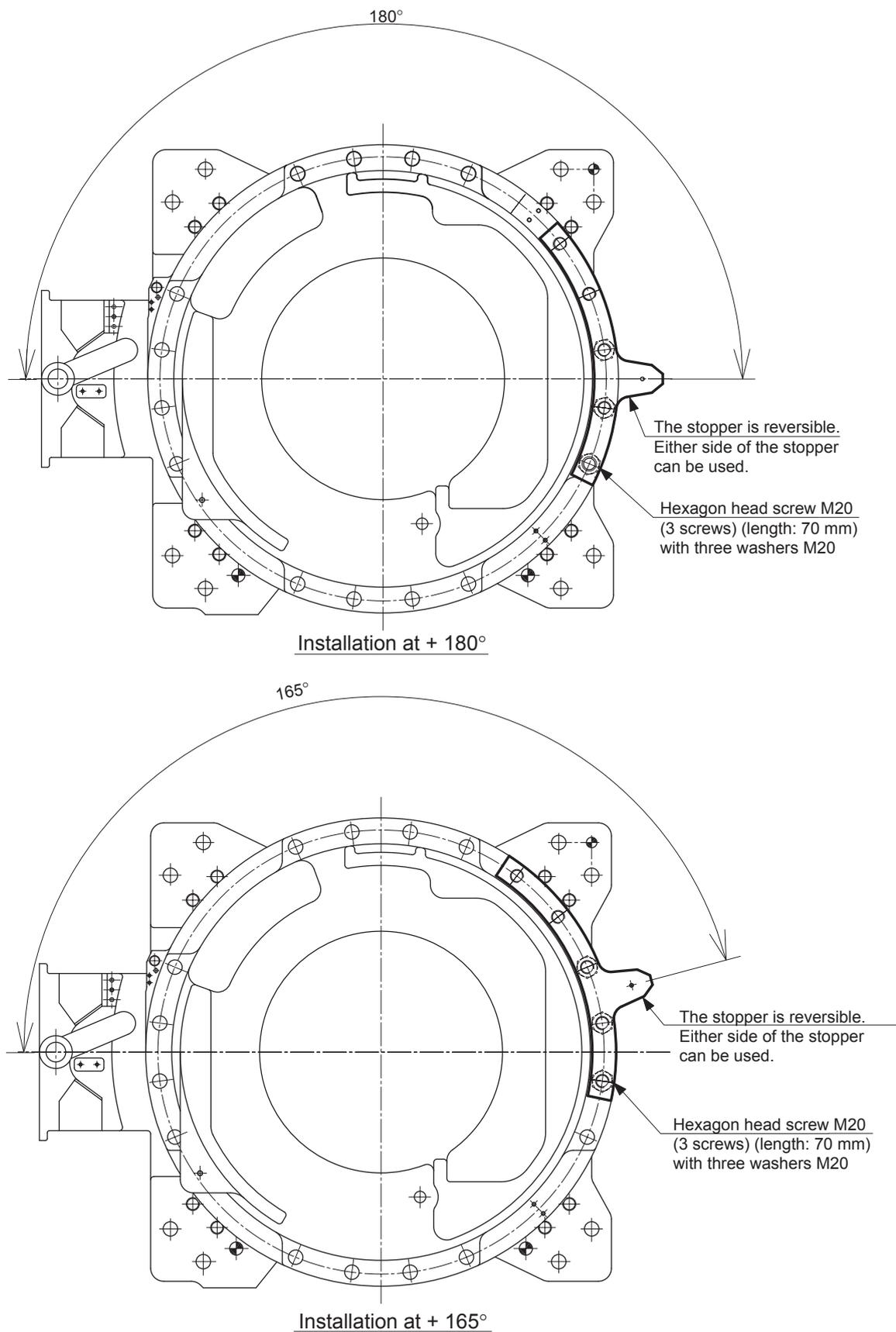


Fig. 5-10(b): Properly-Mounted Models for S-Axis Stopper

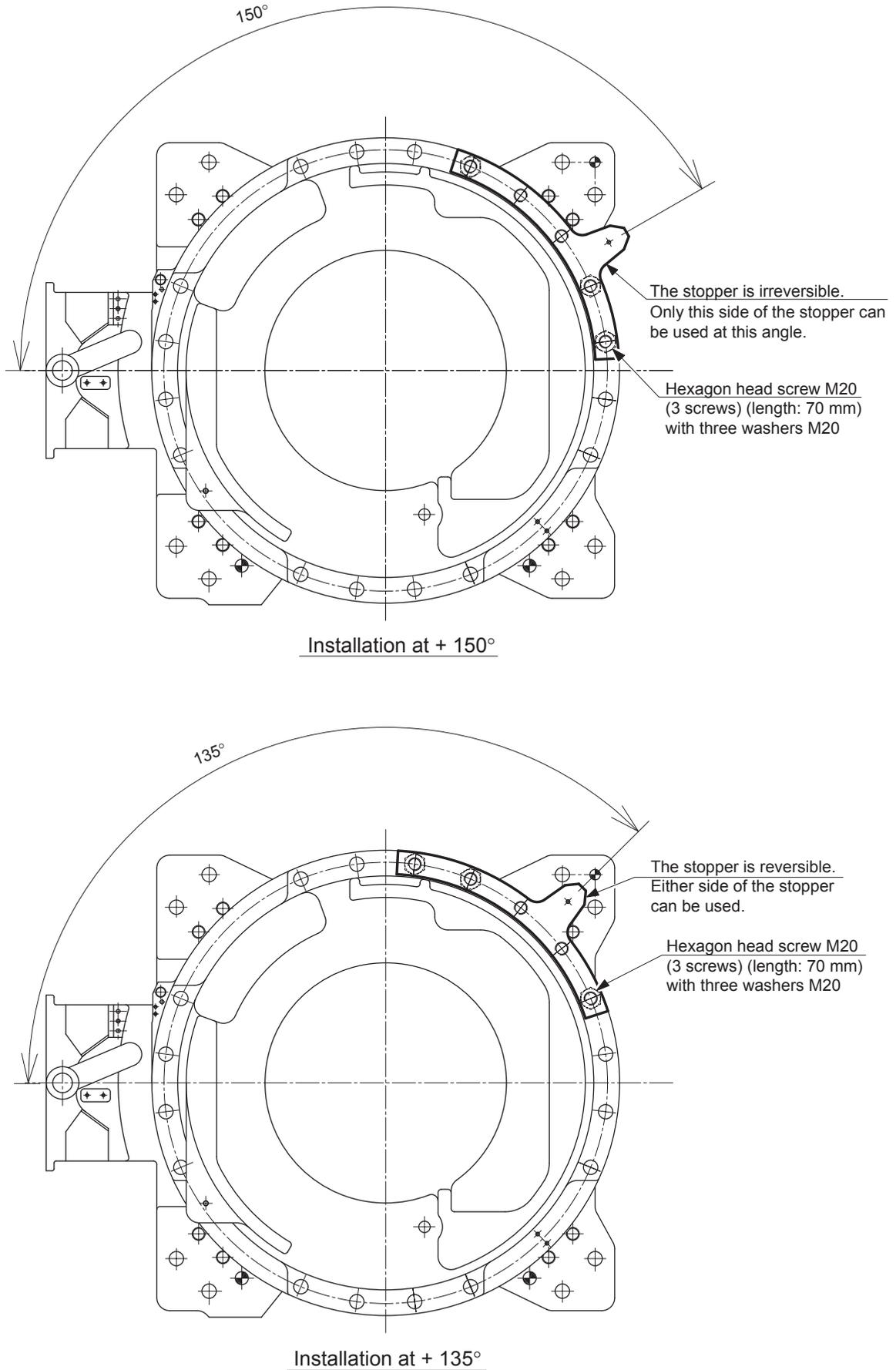


Fig. 5-10(c): Properly-Mounted Models for S-Axis Stopper

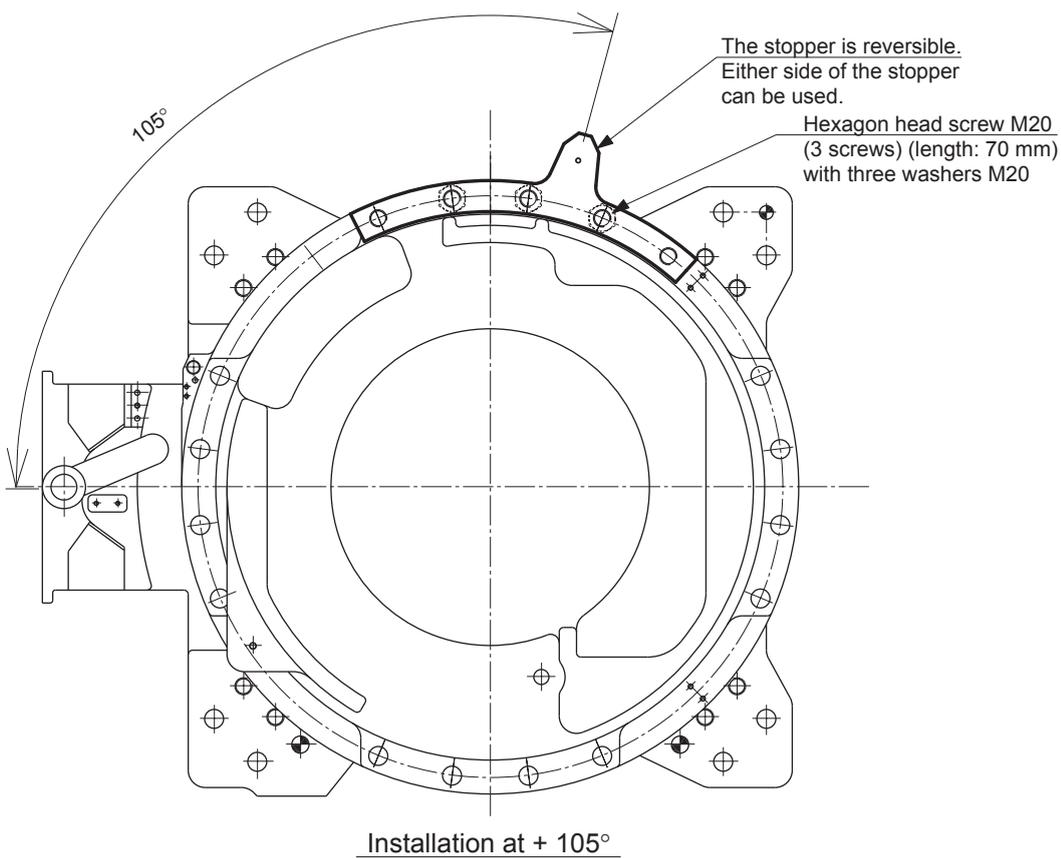
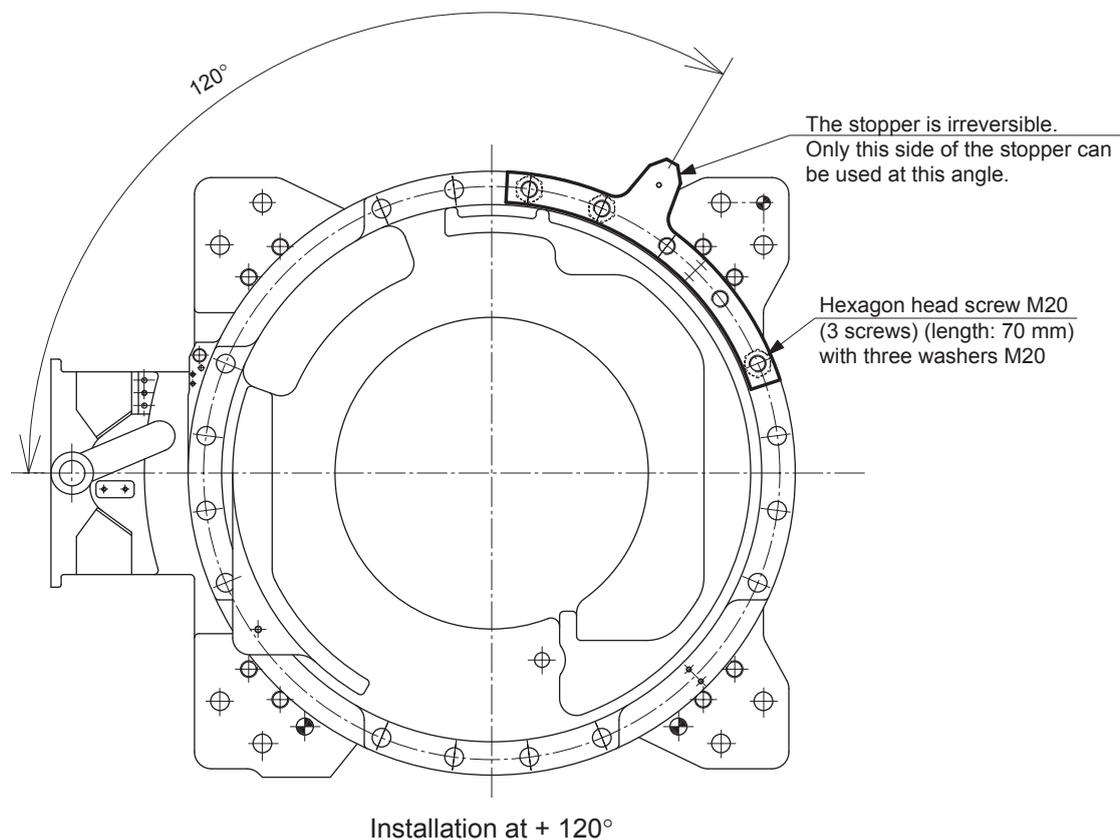


Fig. 5-10(d): Properly-Mounted Models for S-Axis Stopper

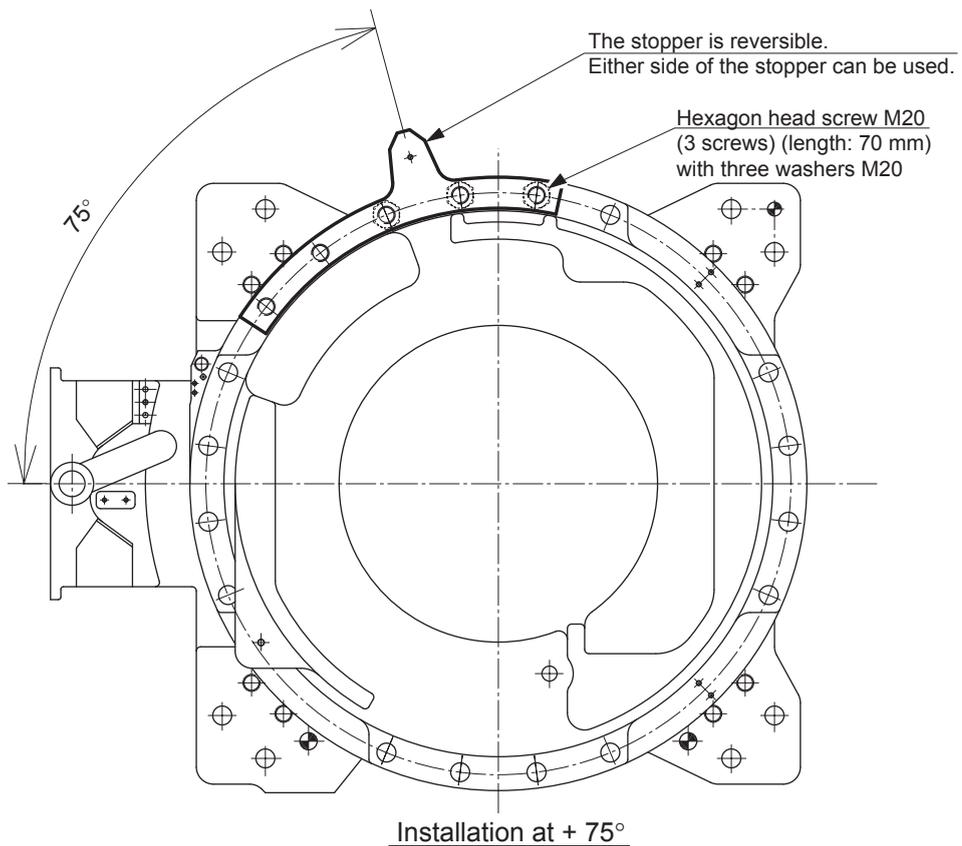
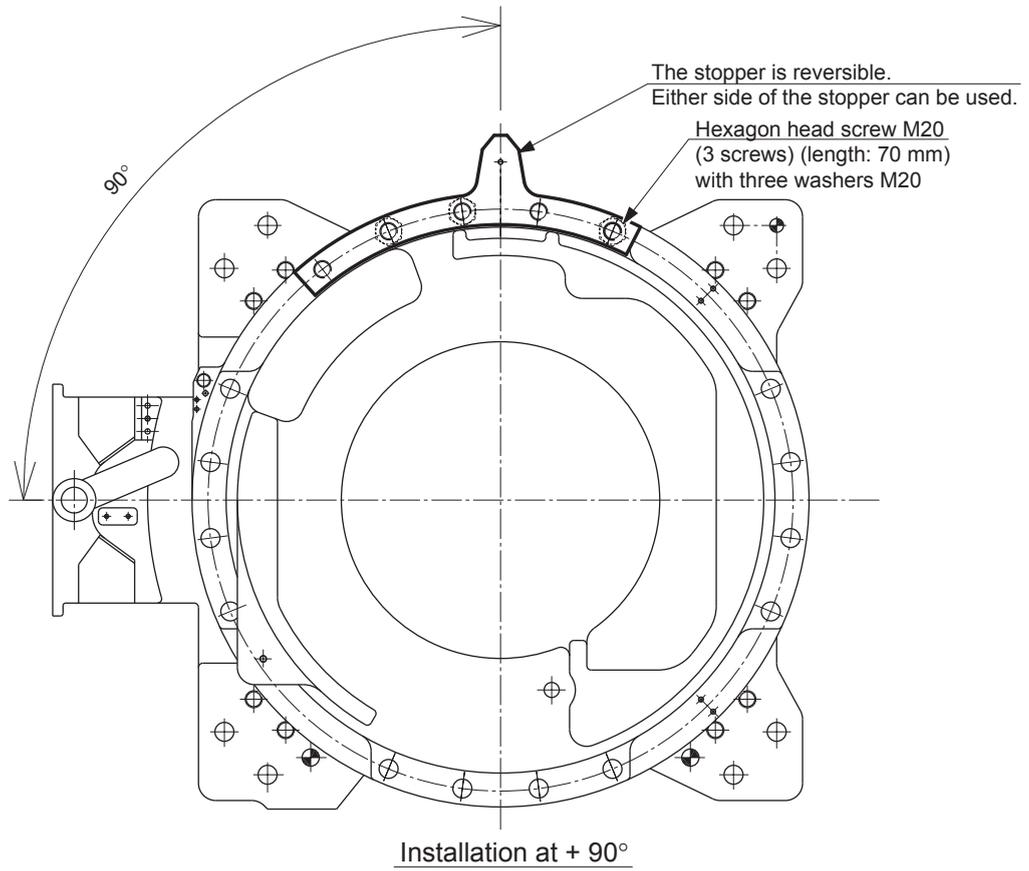
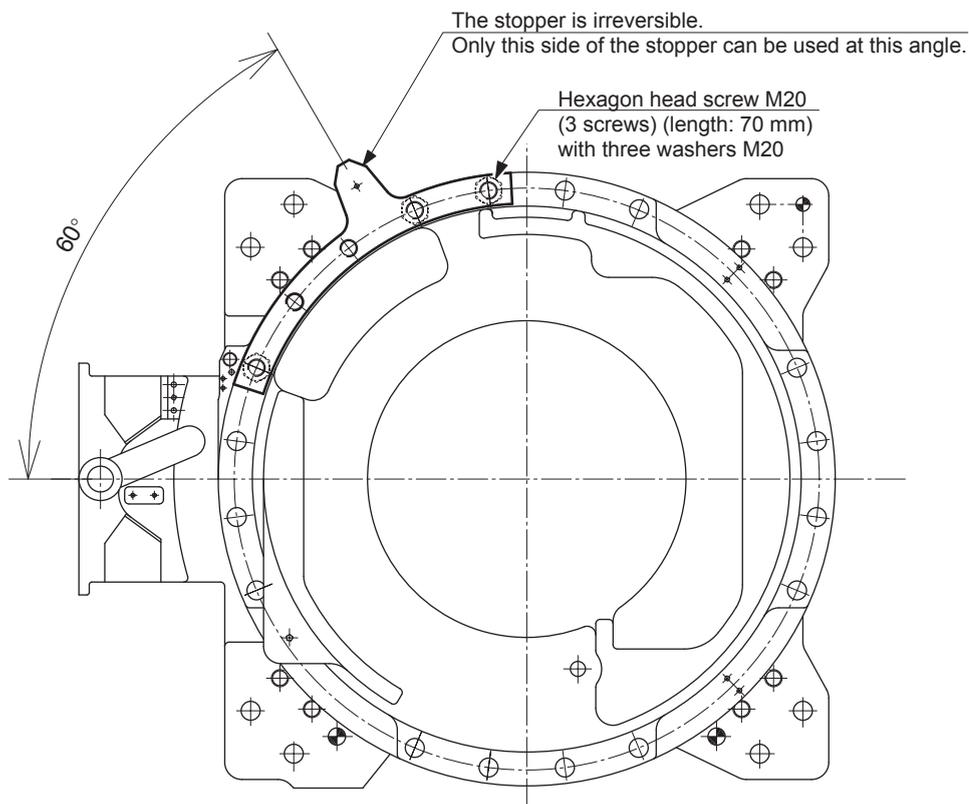
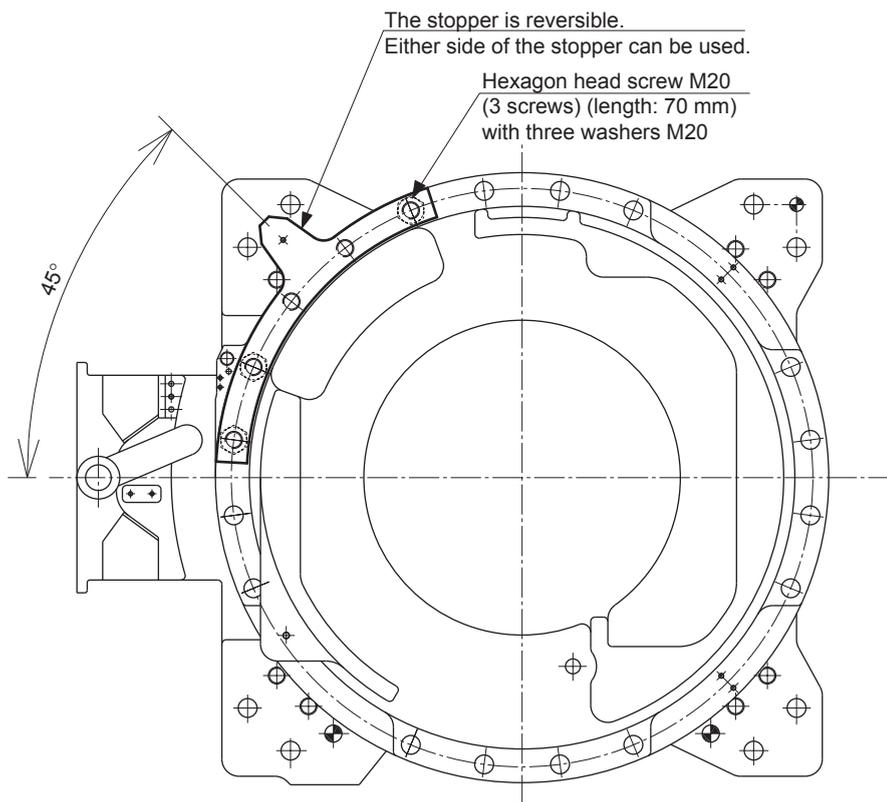


Fig. 5-10(e): Properly-Mounted Models for S-Axis Stopper



Installation at + 60°



Installation at + 45°

Fig. 5-10(f): Properly-Mounted Models for S-Axis Stopper

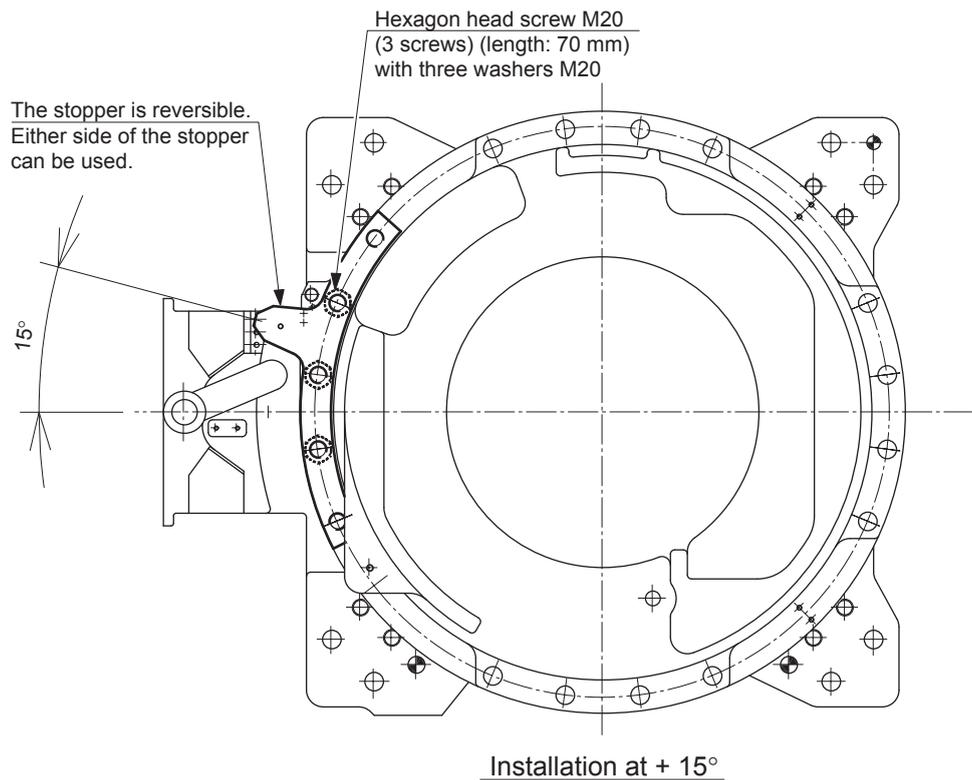
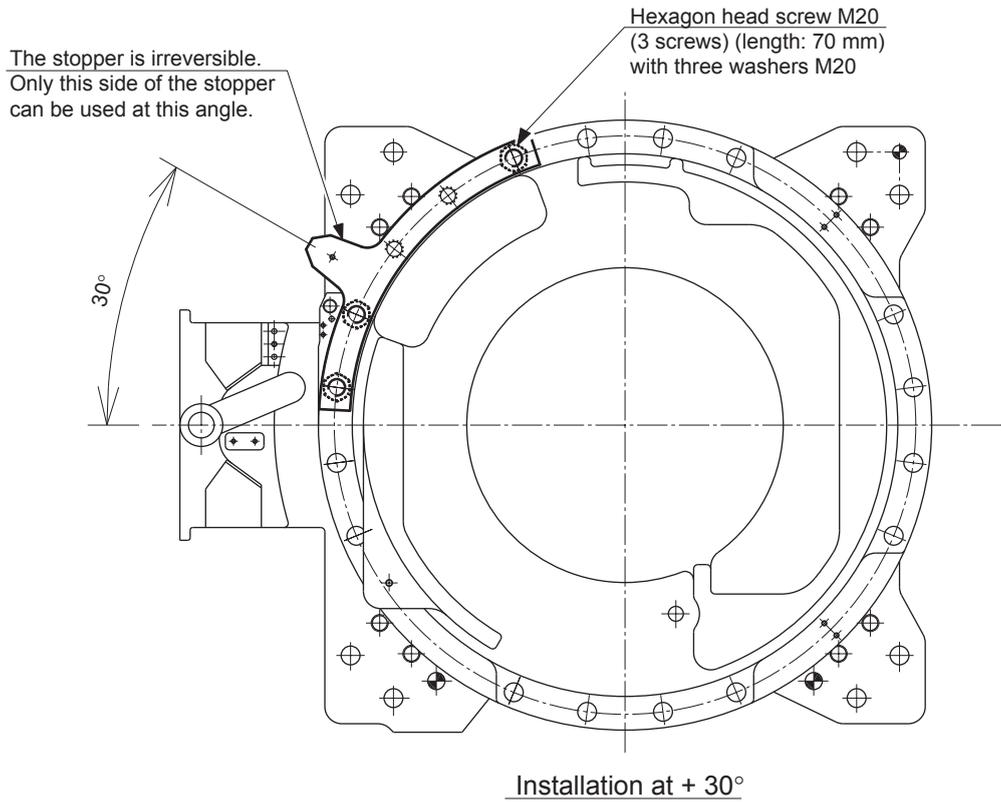


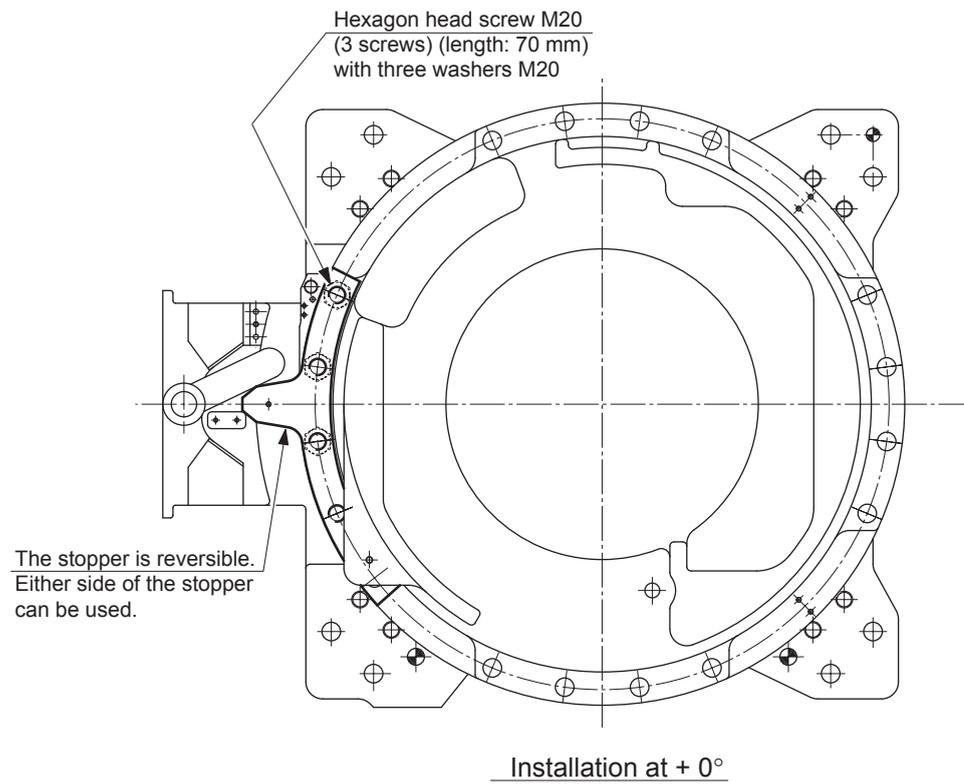
Fig. 5-10(g): Properly-Mounted Models for S-Axis Stopper

Fig. 5-10(h): Properly-Mounted Models for S-Axis Stopper

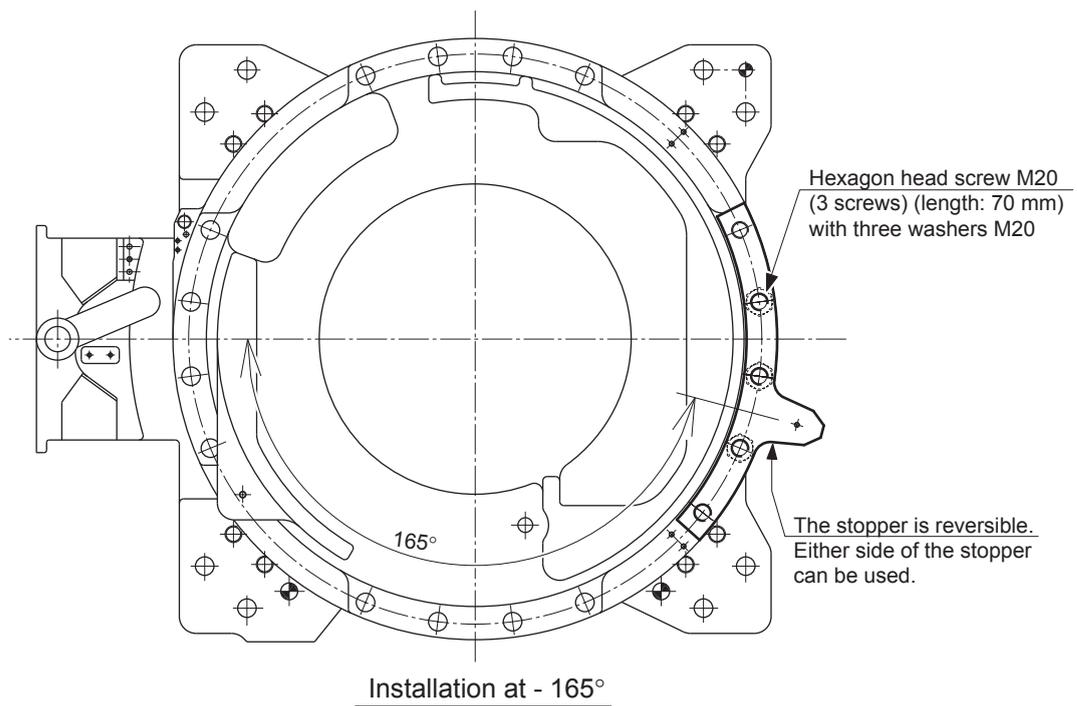
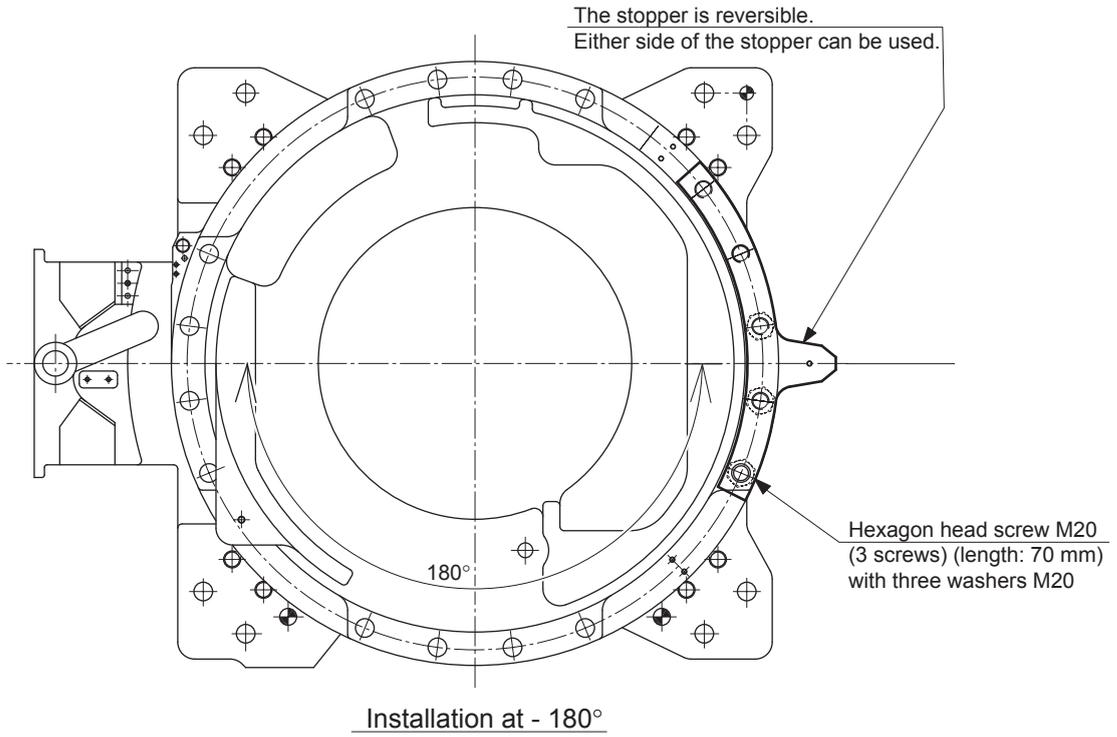


Fig. 5-10(i): Properly-Mounted Models for S-Axis Stopper

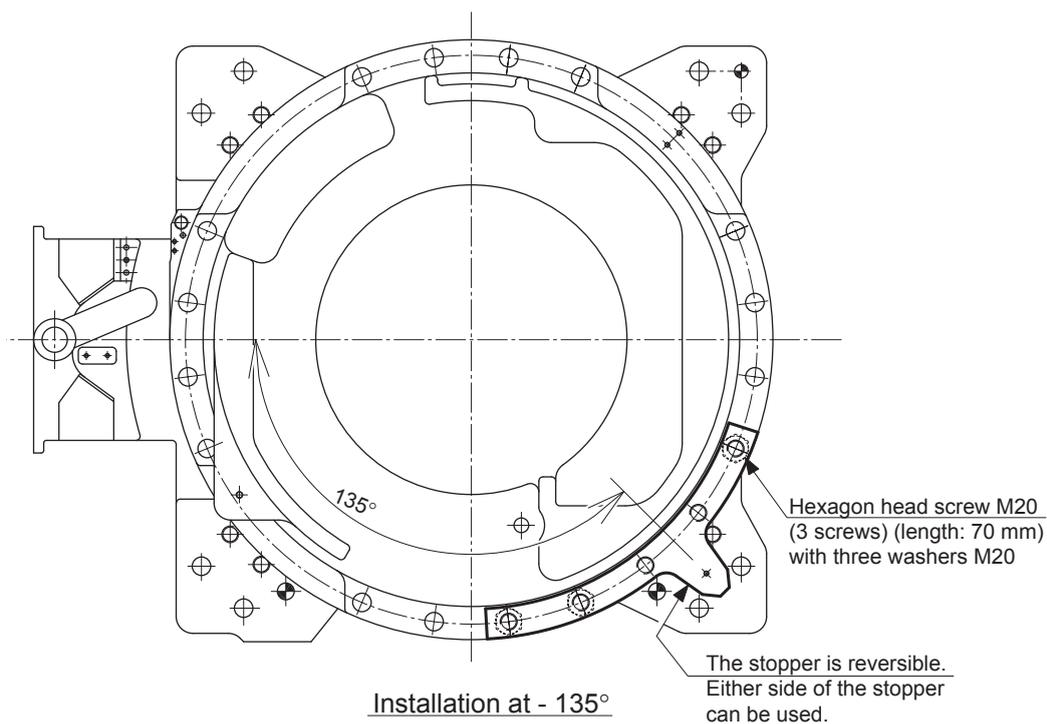
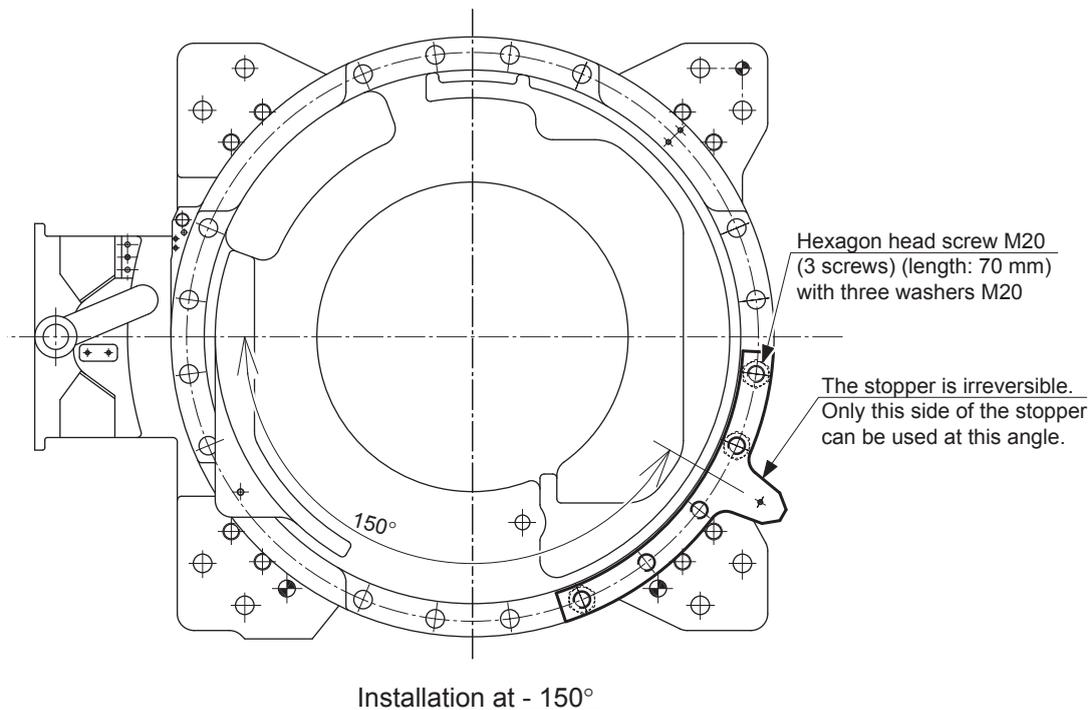


Fig. 5-10(j): Properly-Mounted Models for S-Axis Stopper

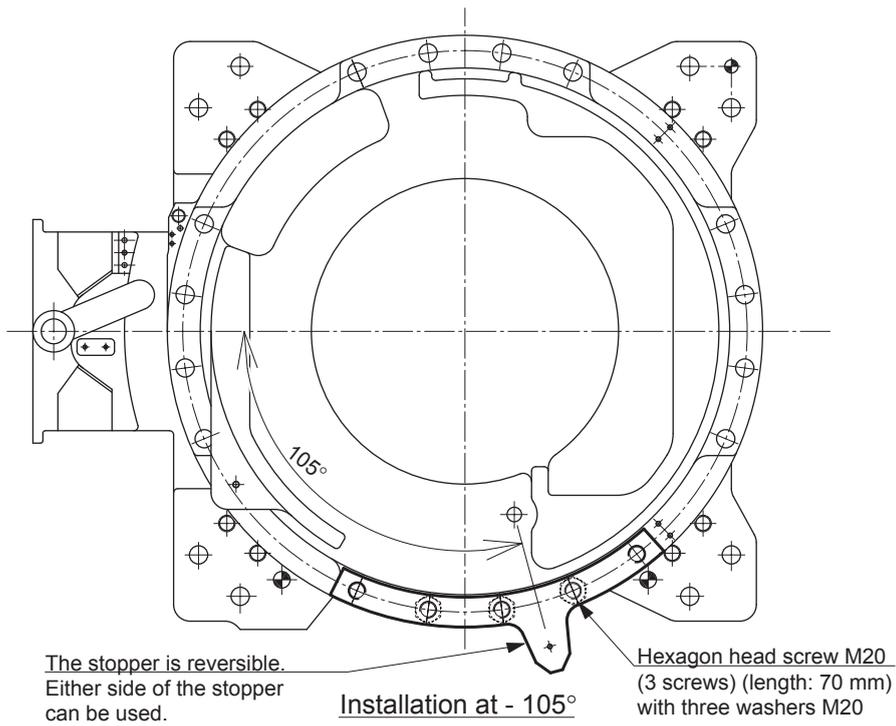
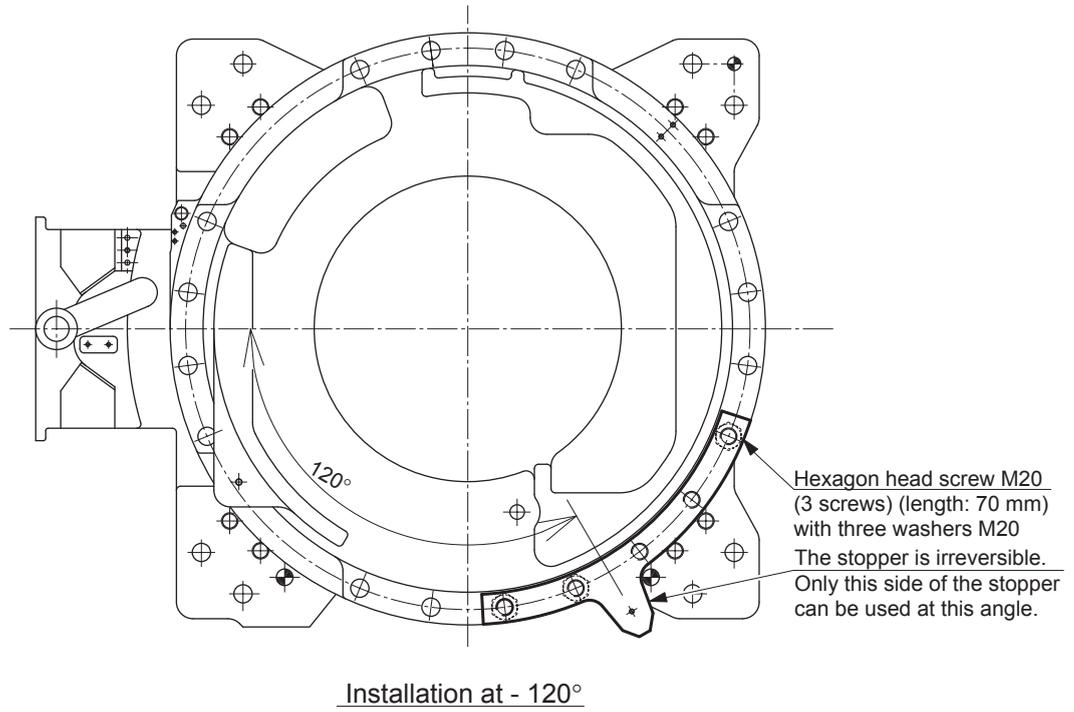


Fig. 5-10(k): Properly-Mounted Models for S-Axis Stopper

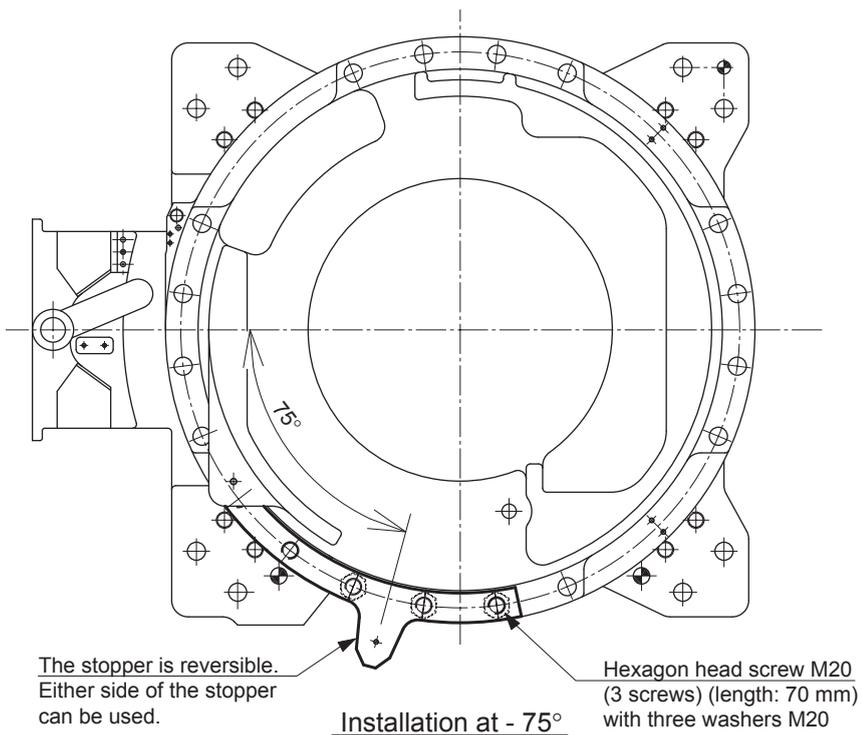
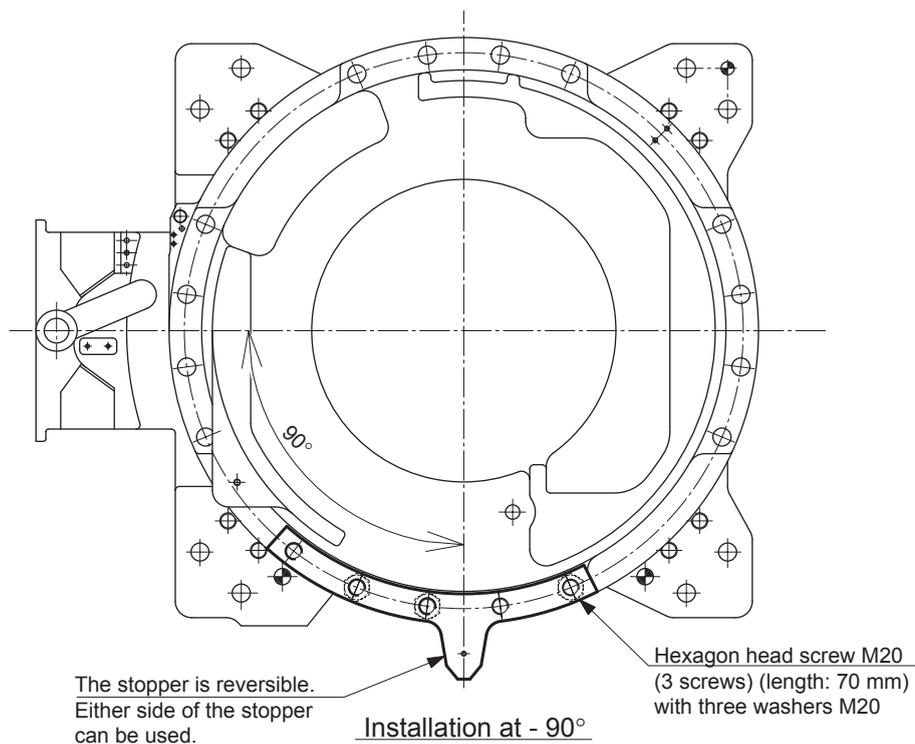


Fig. 5-10(l): Properly-Mounted Models for S-Axis Stopper

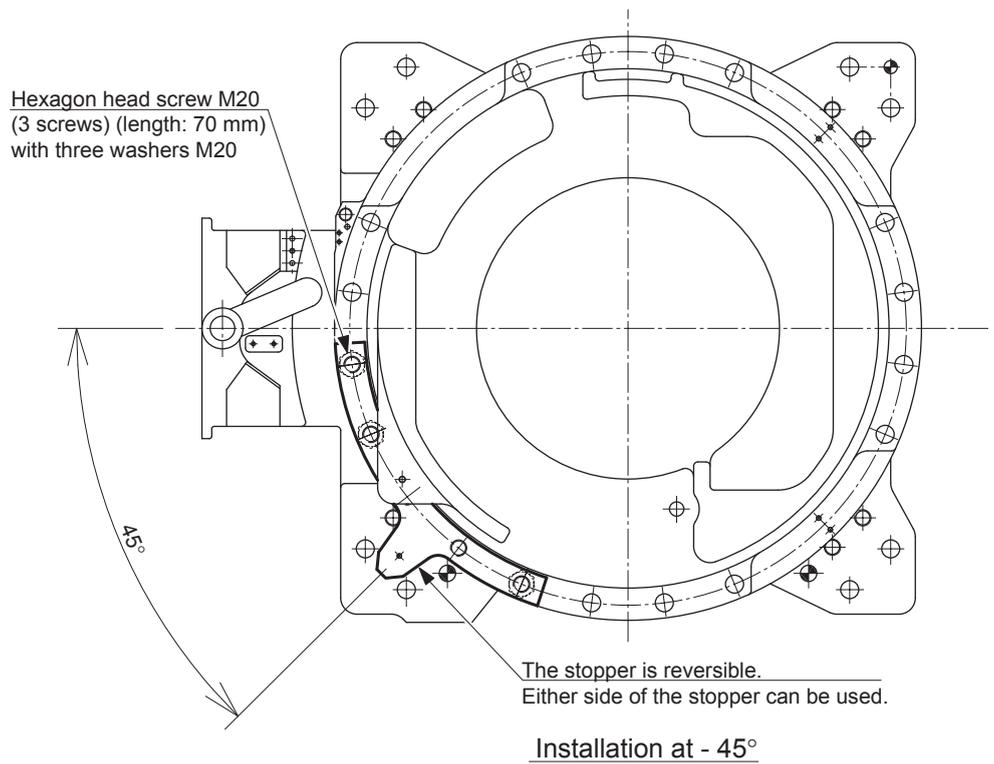
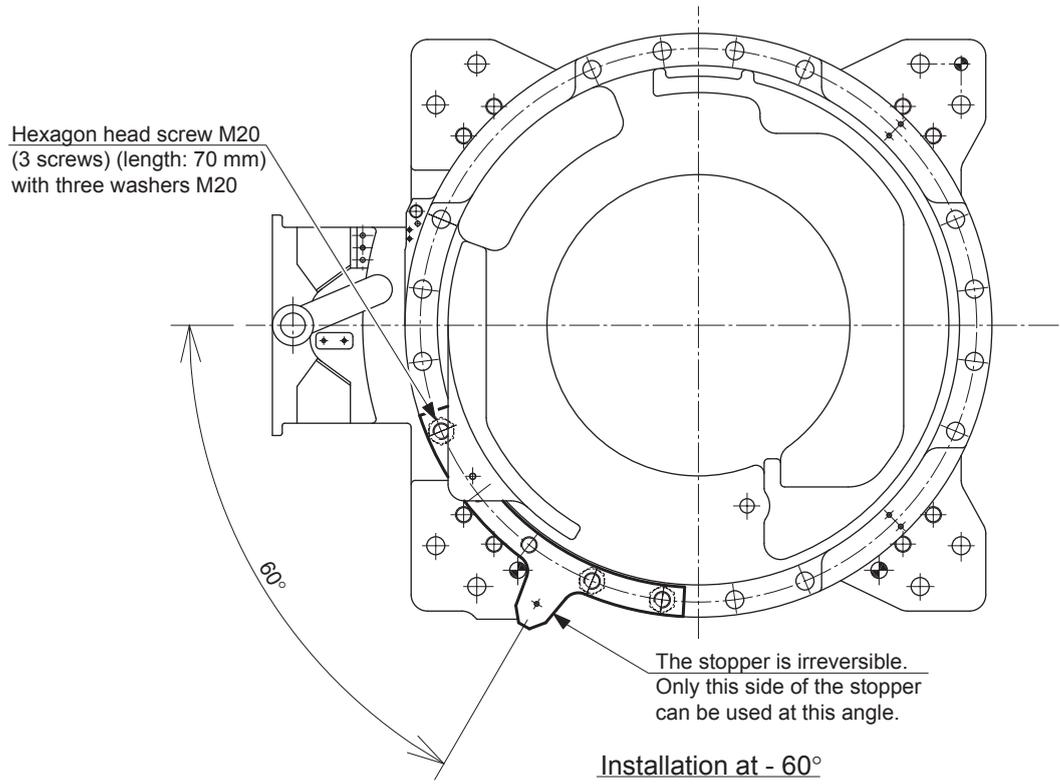
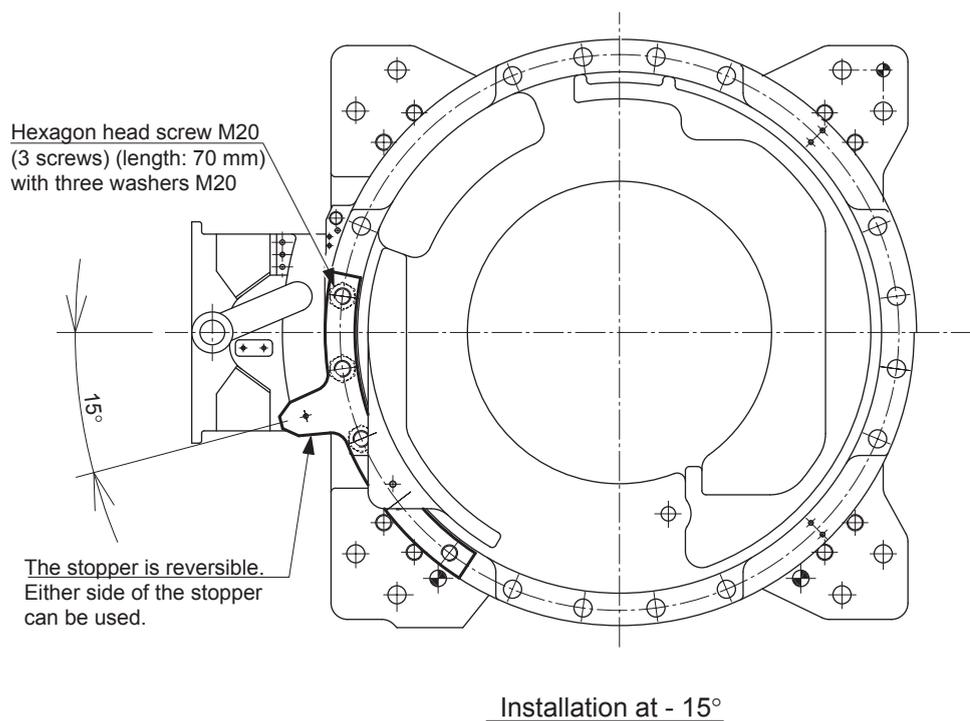
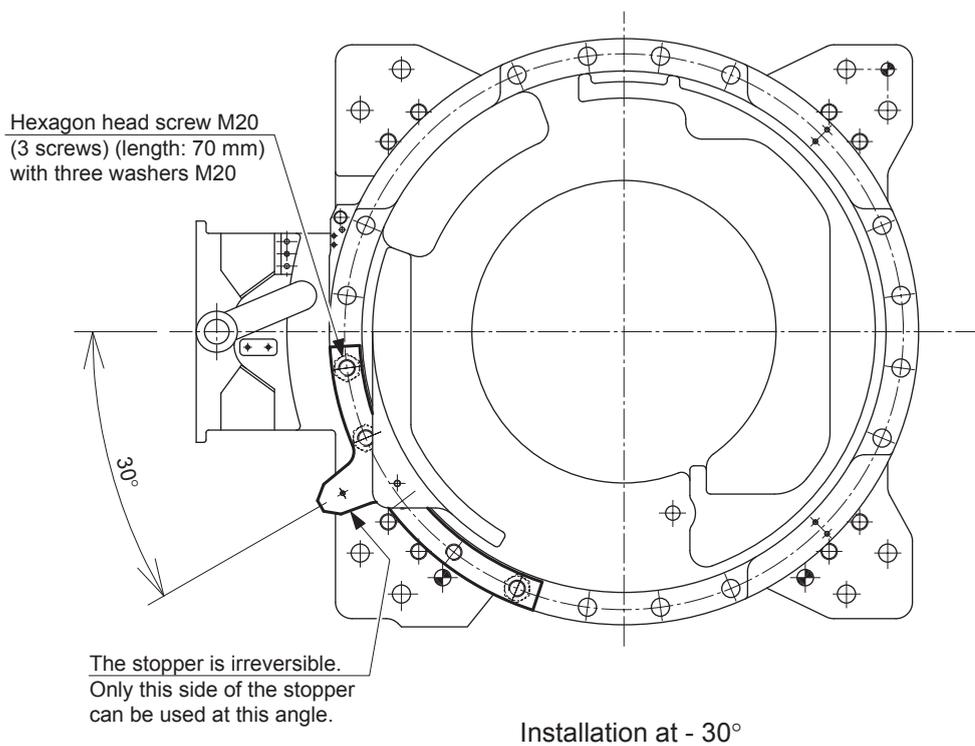


Fig. 5-10(m): Properly-Mounted Models for S-Axis Stopper



6 Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

The allowable wrist load including the weight of the mount/gripper is 160 kg maximum.

1. The total moment of inertia ($GD^2/4$) of T-axis should be within the value shown in *Table 6-1 "Allowable Total Inertia"*.

Table 6-1: Allowable Total Inertia

T- Axis Total Moment of Inertia ($GD^2/4$)
kg·m ²
80 kg·m ²

2. When the inertia of the volume load on the flange is small, the eccentricity of load center measured from T-axis flange rotation center is in the range shown in *Fig. 6-1 "Moment Arm Rating for MPL160 II"*. When the inertia of the volume load on the flange (J_i) is large, use the following formula to calculate the eccentricity L_T .

Formula:

$$J = J_i + WL_T^2$$

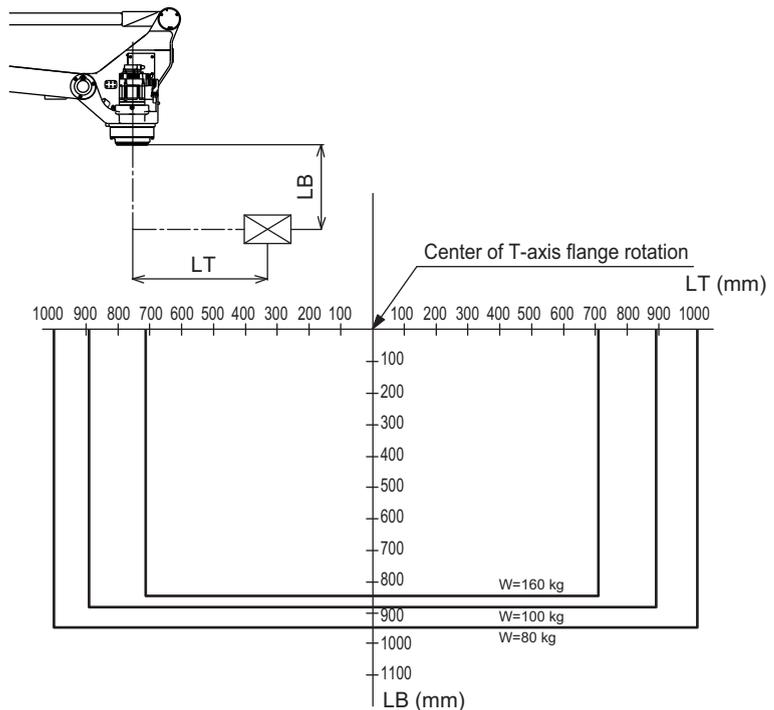
J : Total inertia ($GD^2/4$) of the T-axis (kg·m²)

J_i : Inertia of the volume load on the flange (kg·m²)

W : Payload (kg)

L_T : Eccentricity (mm)

Fig. 6-1: Moment Arm Rating for MPL160 II

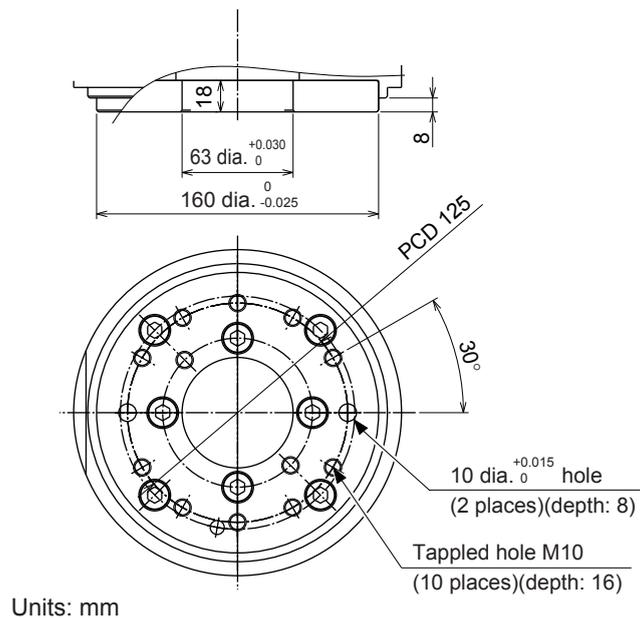


6.2 Wrist Flange

The wrist flange dimensions are shown in *Fig. 6-2 "Wrist Flange"*. It is recommended that the attachment be mounted inside the fitting in order to identify the alignment marks. Fitting depth shall be 8 mm or less.

When the outside fitting is used, the depth of outside fitting must be 8 mm or less.

Fig. 6-2: Wrist Flange



Wash off anti-corrosive paint (yellow) on the wrist flange surface with thinner or light oil before mounting the tools.

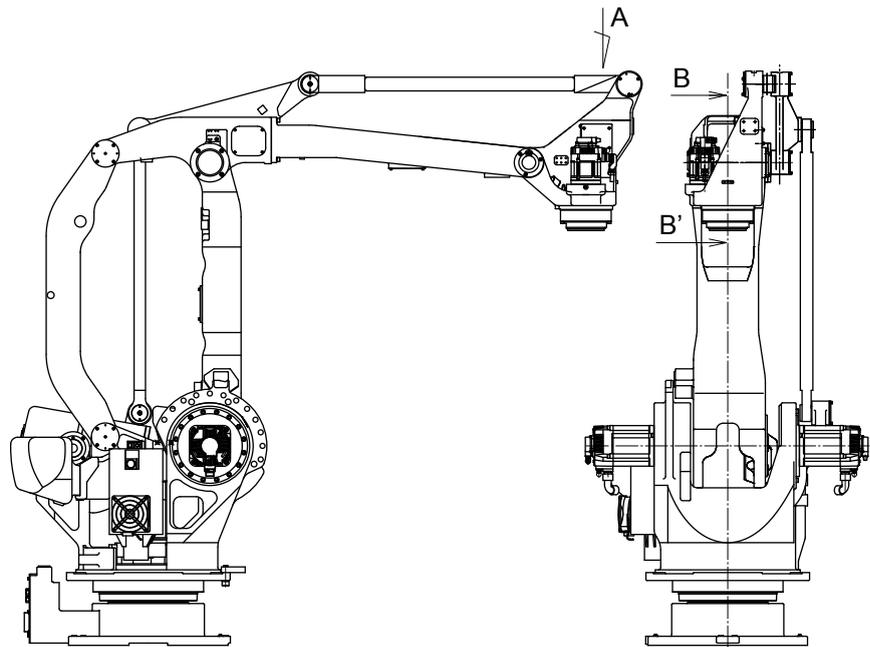
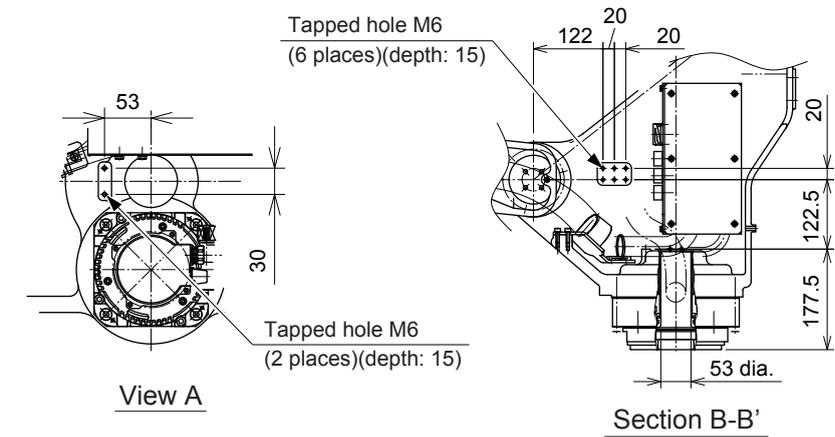
7 System Application

7.1 Peripheral Equipment Mounts

The peripheral equipment mounts and tapped holes are provided on the wrist unit as shown in Fig. 7-1 "Installing Peripheral Equipment" for easier installation of the users' system applications.

The following conditions shall be observed to attach or install peripheral equipment. (Refer to Table 7-1 "Conditions for Installation".)

Fig. 7-1: Installing Peripheral Equipment



Units: mm

Table 7-1: Conditions for Installation

Application	Note
Cable Processing and Valve Load	Up to 160 kg including the peripheral equipment mass attached to the wrist unit

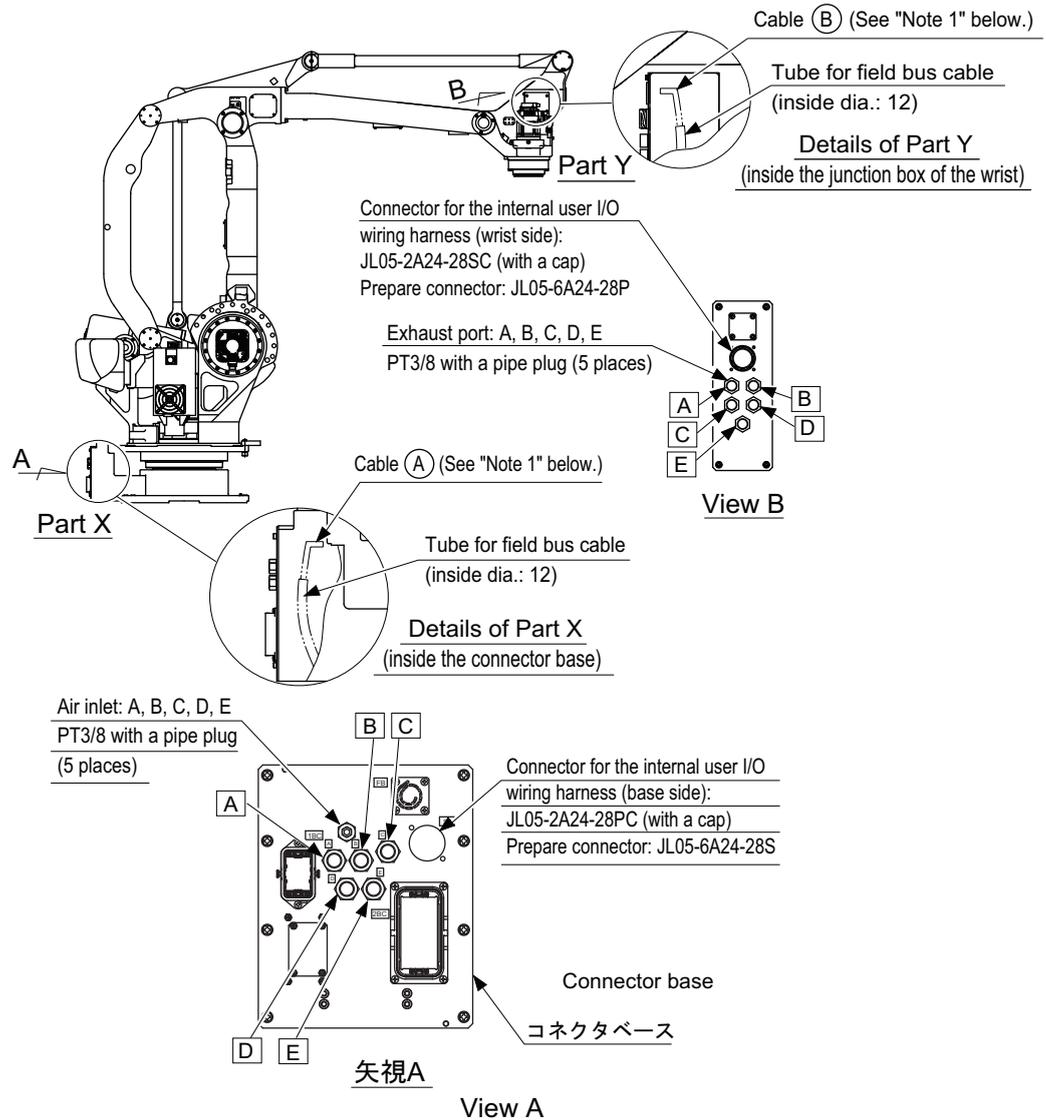
7.2 Internal User I/O Wiring Harness and Air Line

Internal user I/O wiring harness ($0.5 \text{ mm}^2 \times 23$ wires), and air lines (5 lines) are incorporated in the manipulator for the drive of peripheral devices mounted on the upper arm as shown in *Fig. 7-2(a) "Connectors for Internal User I/O Wiring Harness and Air Line"*.

The connector pins 1 to 23 are assigned as shown in *Fig. 7-2(c) "Details of the Connector Pin Numbers"*. Wiring must be performed by users.

The allowable current for internal user I/O wiring harness	2.0A or less for each wire (The total current value for pins 1 to 23 must be 44A or less.)
The maximum pressure for the air line	784 kPa (8 kgf/cm^2) or less (The air line inside diameter: 7.5 mm)

Fig. 7-2(a): Connectors for Internal User I/O Wiring Harness and Air Line

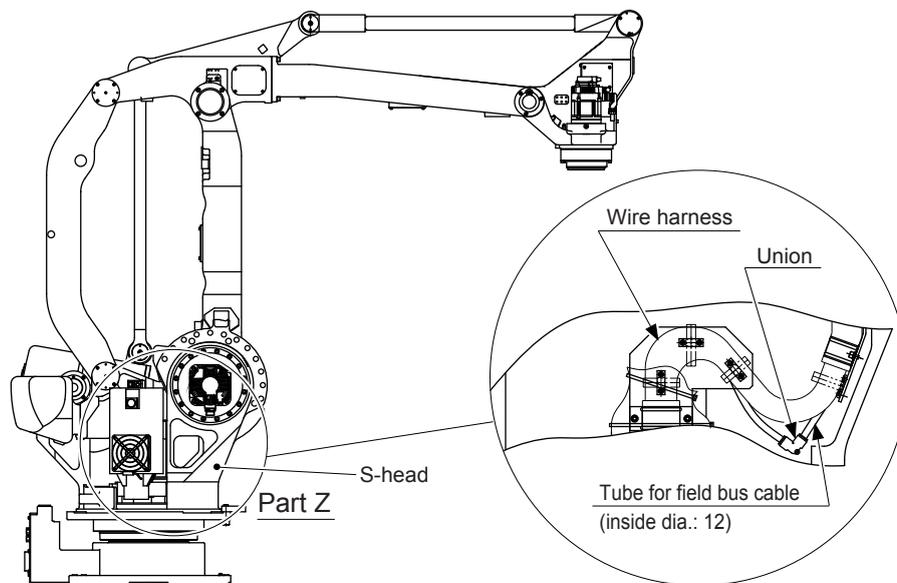


Note 1: This manipulator has a built-in tube for a field bus cable. A cable with a cross sectional area of 2 mm² is provided in the tube in advance. To run a field bus cable through the manipulator, remove the covers of the connector base and the junction box, fix the field bus cable with the cable ①, and pull the cable ② on the wrist.

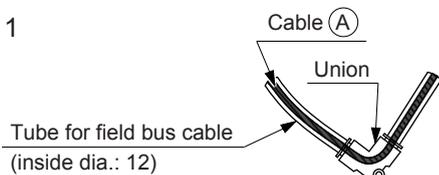
Note 2: As shown in Fig. 7-2(b) "Field Bus Cable Connection", the tube for a field bus cable (inside dia.: 12 mm) is connected by a union in the Z part of the S-head.

Run the field bus cable ③ by following the steps below.

Fig. 7-2(b): Field Bus Cable Connection

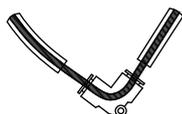


Step 1



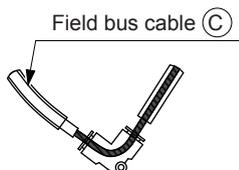
1. The tube for a field bus cable (inside dia.: 12 mm) is connected by a union, in which the cable A runs. (See the step 1 on the left.)

Step 2



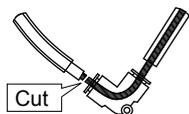
2. Remove the union from the tube for a field bus cable. (See the step 2 on the left.)

Step 3



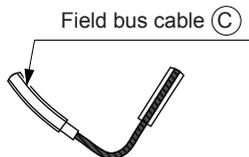
3. Pull the field bus cable C fixed to the cable A until it reaches the union. (See step 3 on the left.)

Step 4



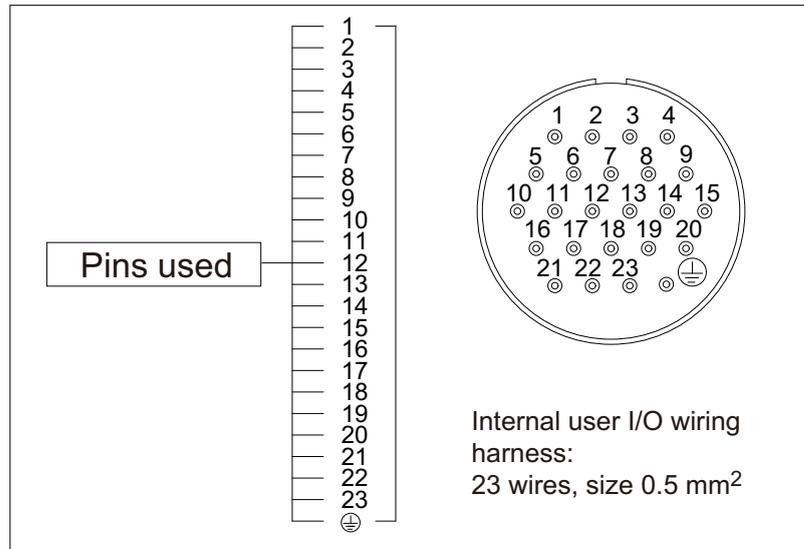
4. Cut the cable A from the field bus cable C. (See step 4 on the left.)

Step 5



5. Remove the union, fix the cable A to the field bus cable C, and run it through the manipulator. (See step 5 on the left.)

Fig. 7-2(c): Details of the Connector Pin Numbers



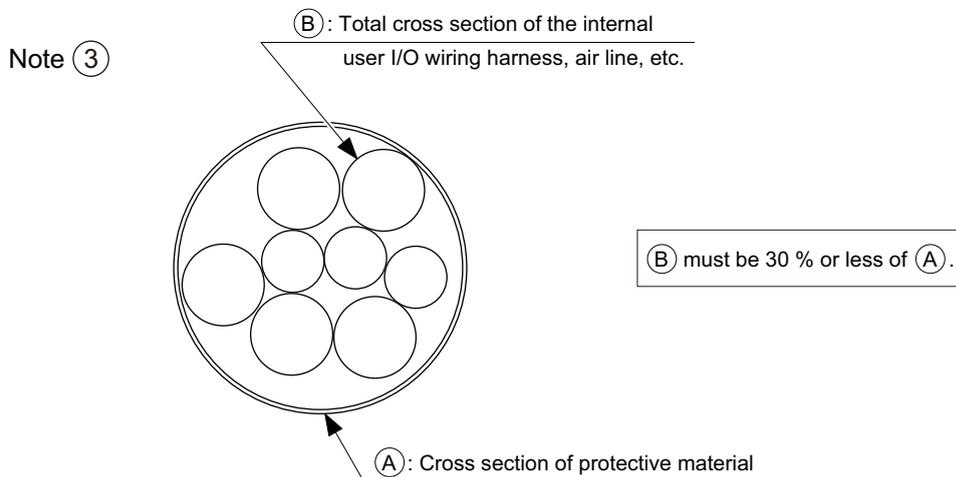
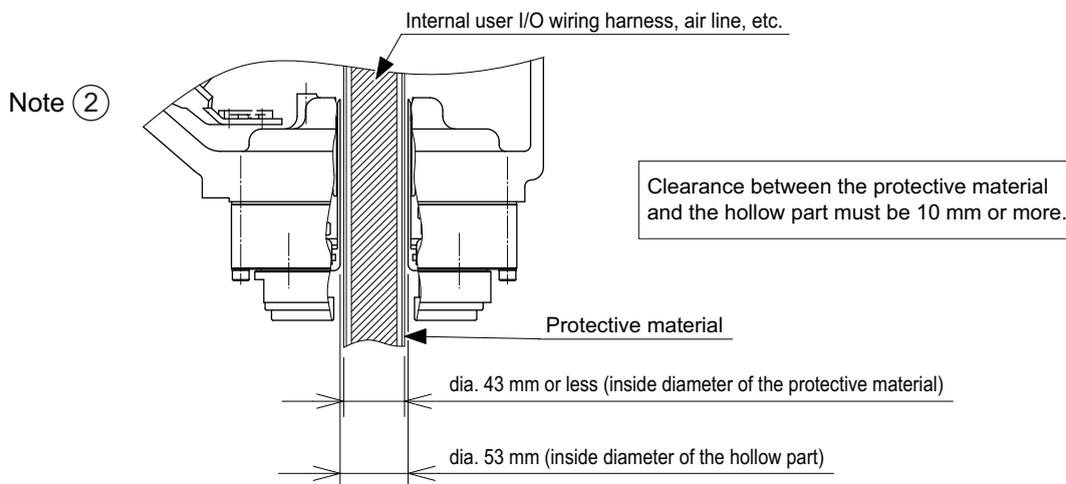
The same numbered pins (1 to 23) of the two connectors are connected with a single lead wire of 0.5 mm².

The wrist part of MOTOMAN-MPL160 II has a hollow structure for the internal user I/O wiring harness, air line, etc. To run the internal user I/O wiring harness, air line, etc. through the hollow part, follow the conditions below.

Table 7-2: Conditions to Run the Wiring Harness, Air Line, etc. through the Hollow Part

Item	Notes
① Inside diameter of the hollow part: 53 mm	
② Inside diameter of the protective material for the wiring harness: 43 mm or less	② Before running the wiring harness etc., protect it with protective springs etc. Also, clearance of 10 mm or more is needed between the hollow part and the protective material.
③ Ratio of the cross section of the wiring harness etc. to the protective material: 30 % or less	③ Since sufficient clearance is also needed between the protective material and the wiring harness etc., make sure that the ratio of the total cross section of the wiring harness etc. to the cross section of the protective material is 30% or less.

Fig. 7-3: Conditions to Run the Wiring Harness, Air Line, etc. through the Hollow Part

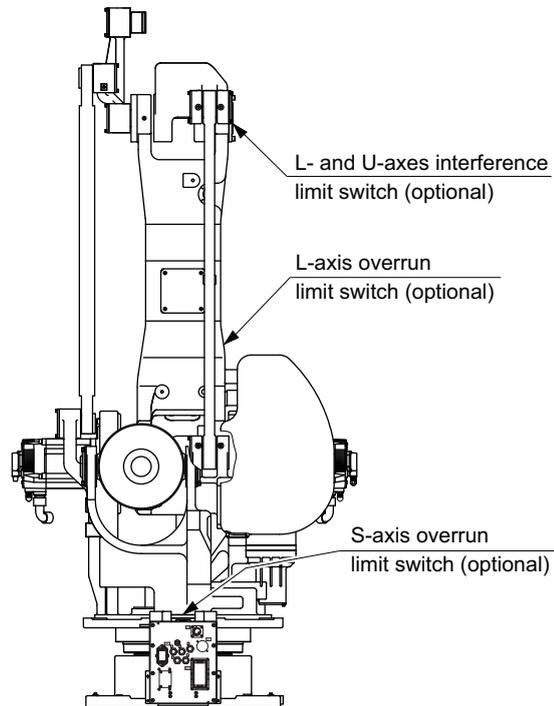


8 Electrical Equipment Specification

8.1 Position of Limit Switch

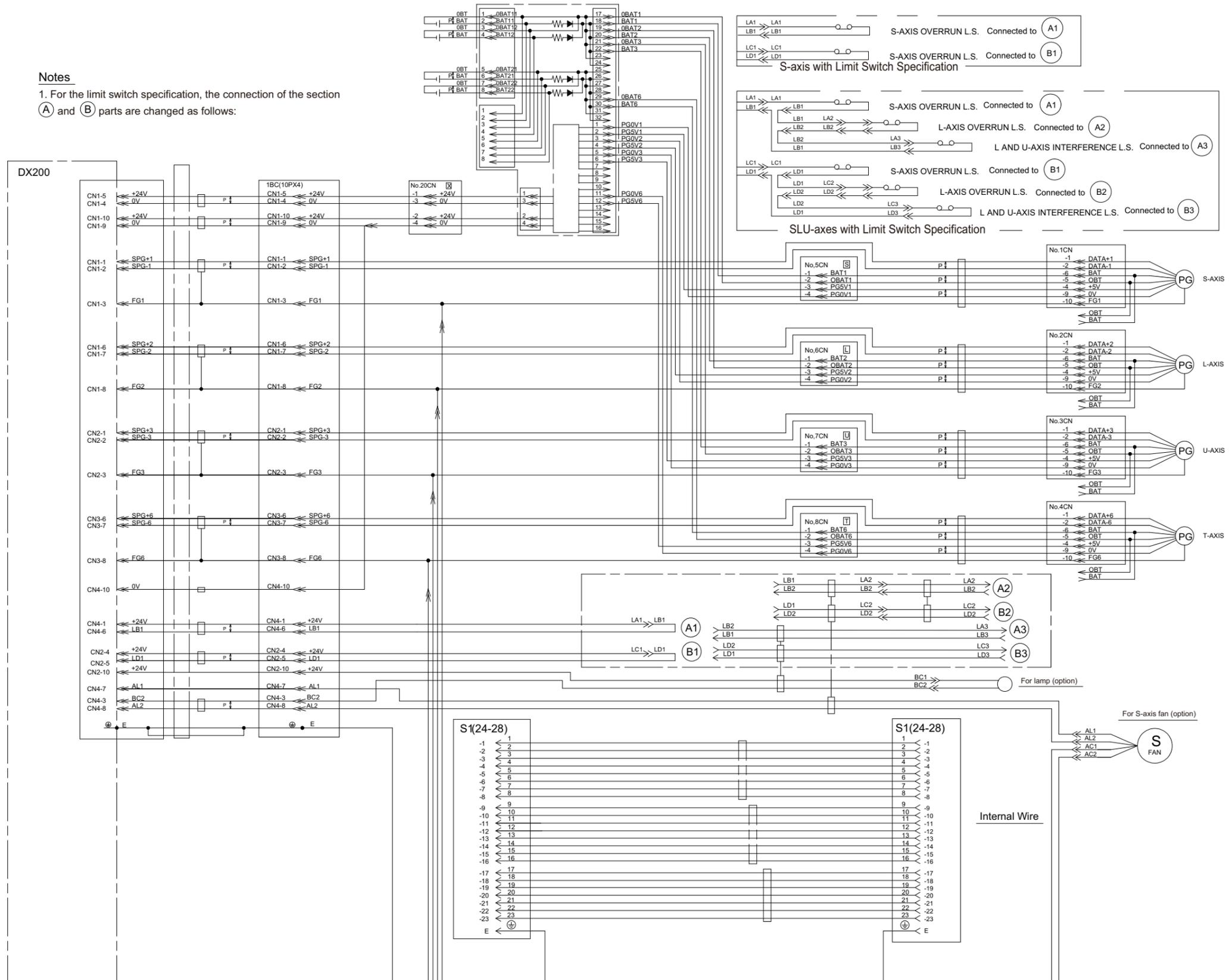
The limit switches are optional. For the S-, L-, and U-axes with limit switches specifications, the limit switches are located on the S-axis, L-axis, and U-axis respectively. For the location, refer to *Fig. 8-1 "Location of Limit Switches"*.

Fig. 8-1: Location of Limit Switches



8.2 Internal Connections

Fig. 8-2(a): Internal Connection Diagram



Notes

1. For the limit switch specification, the connection of the section (A) and (B) parts are changed as follows:

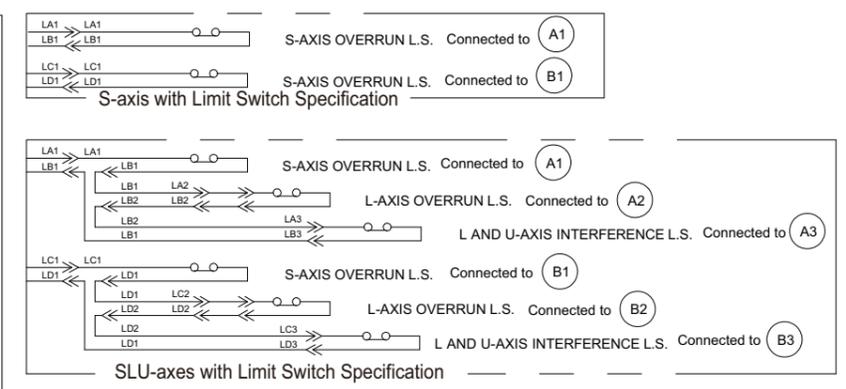
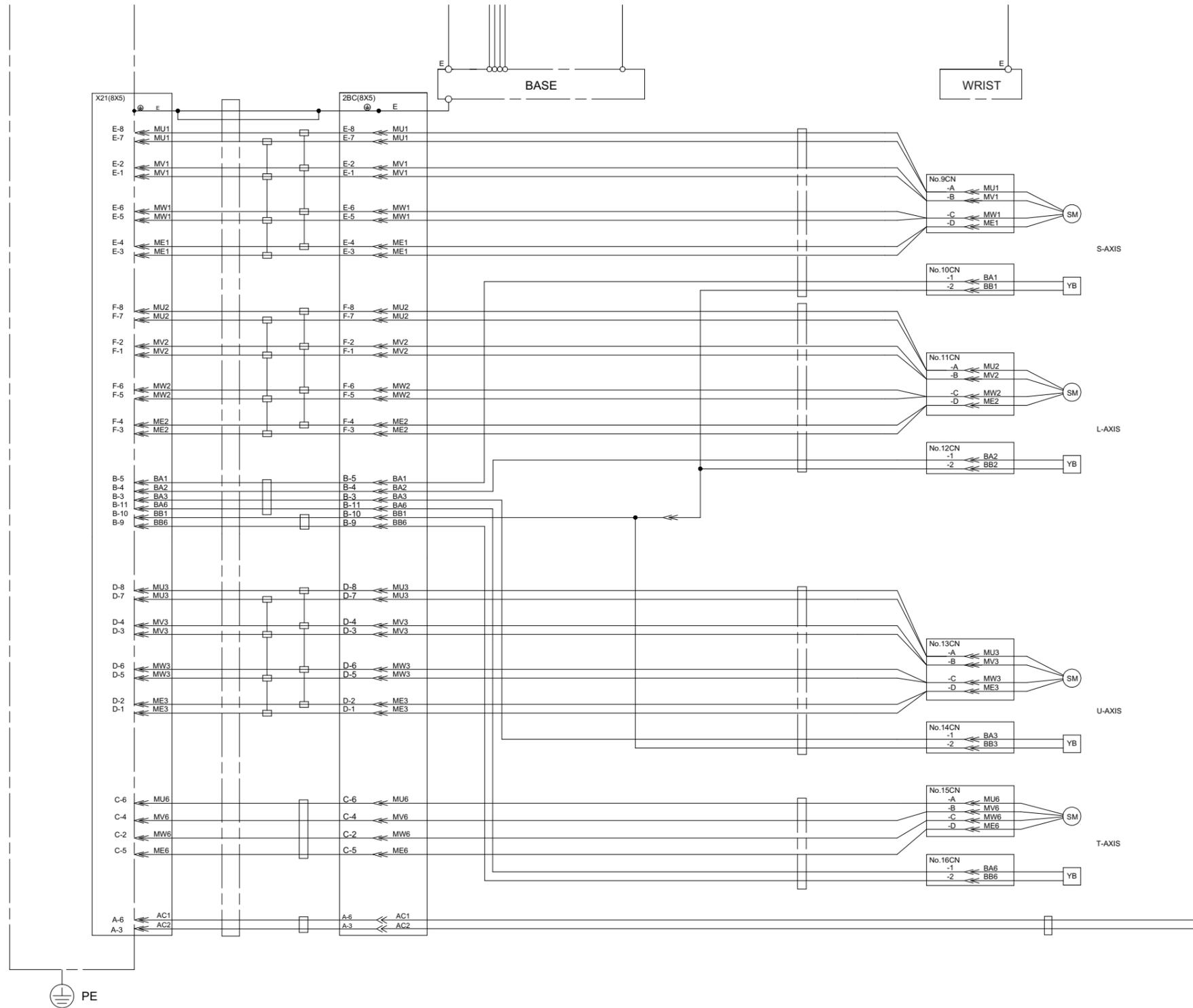


Fig. 8-2(b): Internal Connection Diagram



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 several levels as shown in *Table 9-1 "Inspection Items"*.

In *Table 9-1*, 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.
- The following inspection schedule is based on the case that each axis is used under normal conditions. For axes which are used very frequently (in handling applications, etc.), it is recommended that inspections be conducted at intervals of 1/2 of the schedule indicated in *Table 9-1 "Inspection Items"*.
- From the standpoint of the preventive maintenance, it is recommended that the following parts be replaced at the secondary inspection (18000 H).
 - Speed reducers for the S-, L-, U-, and T-axes
 - Cross roller bearing for the U-axis
 - Oil seal for the L-, U-, and T-axis motor units

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

Items ¹⁾		Schedule						Method	Operation	Inspection Charge		
		Daily	1000H Cycle	5000H Cycle	9000H Cycle	18000H	36000H			Specified Person	Licensee	Service Company
1	Alignment mark	●						Visual	Check alignment mark accordance and damage at the home position.	●	●	●
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	Motors for L- and U-axes	●						Visual	Check for grease leakage. ²⁾	●	●	●
5	Baseplate mounting bolts		●					Spanner Wrench	Tighten loose bolts. Replace if necessary.	●	●	●
6	Connector base		●					Manual	Check for loose connectors and tighten if necessary.	●	●	●
7	LU-axis connectors		●					Manual	Check for loose connectors and tighten if necessary.	●	●	●
8	Connectors in S-head			●				Manual	Check for loose connectors.	●	●	●
9	L-axis balancer			●				Grease Gun, Visual	Supply grease. Check for loose screw nuts and shafts, and tighten if necessary.		●	●
10	Wire harness in manipulator (Wires for S-, L-, and U-axes) (Wires for T-axis)				●			Multimeter, Visual	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 ⁴⁾			●
11	Links/Connections				●			Visual, Manual	Move the L- and U-axes back and forth, up and down to check any backlash. Replenish grease ⁵⁾ See <i>section 9.3.7</i> .		●	●
12	Battery pack in manipulator						●	Screwdriver, Wrench	Replace the battery pack when the battery alarm occurs or the manipulator drove for 36000H. See <i>section 9.2.1</i> .		●	●
13	S-axis speed reducer			●	●			Grease Gun	Check for malfunction. (Replace if necessary.) Replenish grease ⁵⁾ (5000H cycle). See <i>section 9.3.2</i> . Exchange grease ⁵⁾ (9000H cycle). See <i>section 9.3.2</i> .		●	●

9-2

HW1482999

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

Items ¹⁾	Schedule						Method	Operation	Inspection Charge			
	Daily	1000H Cycle	5000H Cycle	9000H Cycle	18000H	36000H			Specified Person	Licensee	Service Company	
14	Speed reducers for L- and U-axes			●	●			Grease Gun	Check for malfunction. (Replace if necessary.) Replenish grease ⁵⁾ (5000H cycle). See <i>section 9.3.3</i> and <i>section 9.3.4</i> . Exchange grease ⁵⁾ (9000H cycle). See <i>section 9.3.3</i> and <i>section 9.3.4</i> .		●	●
15	T-axis speed reducer			●	●			Grease Gun	Check for malfunction. (Replace if necessary.) Replenish grease ⁵⁾ (5000H cycle). See <i>section 9.3.5</i> . Exchange grease ⁵⁾ (9000H cycle). See <i>section 9.3.5</i> .		●	●
16	Bearing			●				Grease Gun	Replenish grease ^{5) 6)} Exchange grease ⁵⁾		●	●
17	Motor cooling fan			●				Visual	Check for damage and operation.		●	●
18	Overhaul											●

- 1 Inspection item numbers correspond to the numbers in Fig. 9-1 "Inspection Items".
- 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 9.3.7 "Grease Replenishment for Links"*.)
- 4 Wire harness in manipulator to be replaced at 18000H inspection.
- 5 For the grease, refer to *Table 9-2 "Inspection Parts and Grease Used"*.
- 6 Replenish grease to the U-axis cross-roller bearing at 5000 H or after a year, whichever comes first.

Table 9-2: Inspection Parts and Grease Used

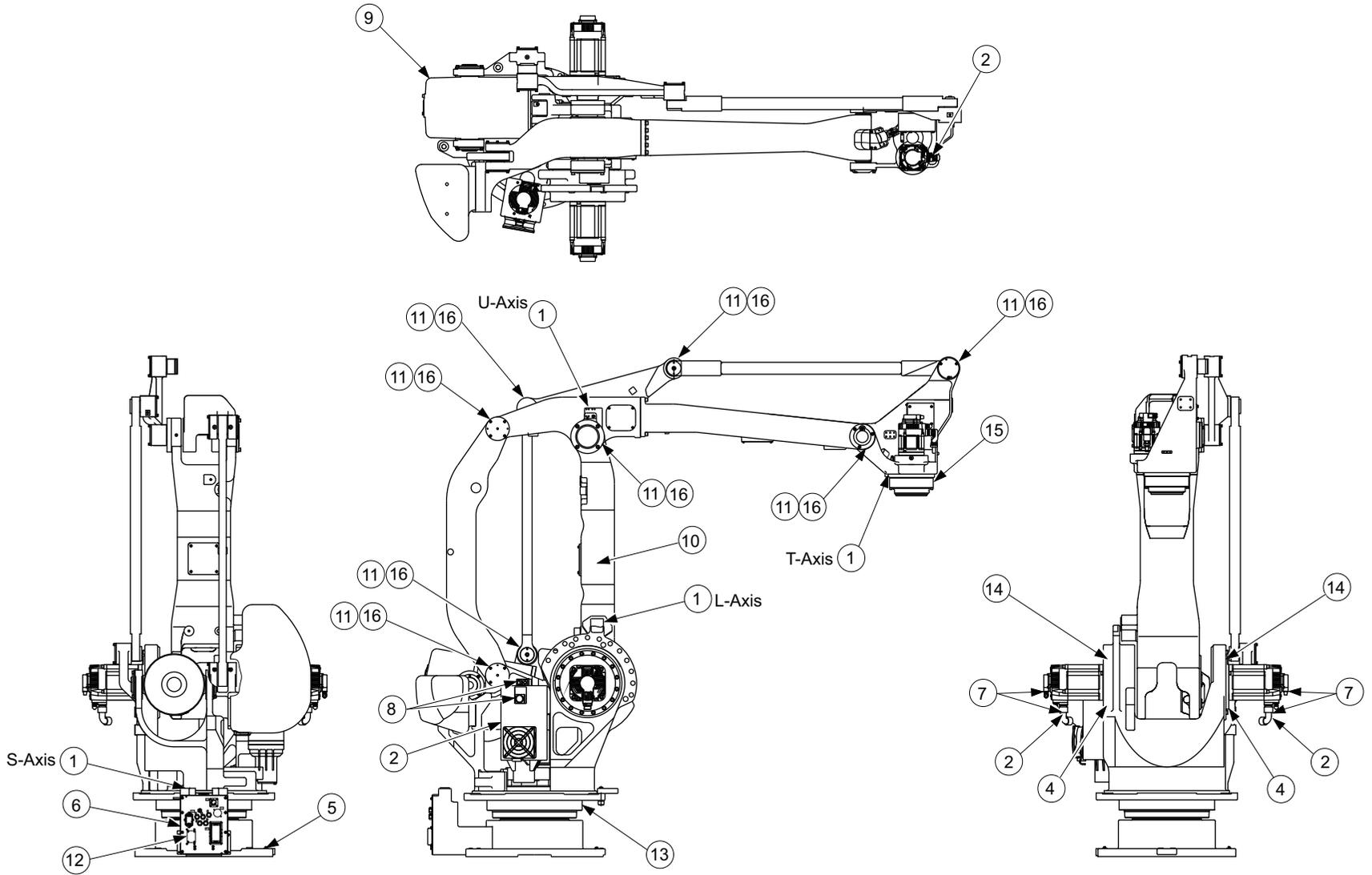
No.	Grease Used	Inspected Parts
13, 14, 15	Molywhite RE No.00	Speed reducers for S-, L-, U- and T-axes
9, 16	Alvania EP Grease 2	L-axis balancer, bearings

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

9-3

HW1482999

Fig. 9-1: Inspection Items



9-4

HW1482999

9.2 Notes on Maintenance Procedures

9.2.1 Battery Pack Replacement

The battery packs are installed in the position shown in *Fig. 9-2(a)* "Battery Location (Back View)" and *Fig. 9-2(b)* "Battery Location (Top View)". If the battery alarm occurs in the DX200, replace the battery in accordance with the following procedure:

Fig. 9-2(a): Battery Location (Back View)

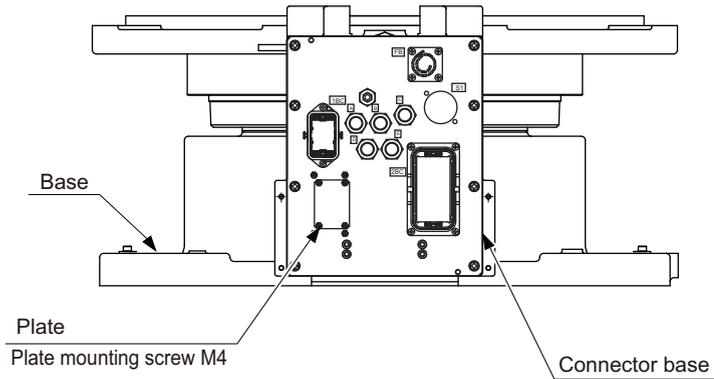


Fig. 9-2(b): Battery Location (Top View)

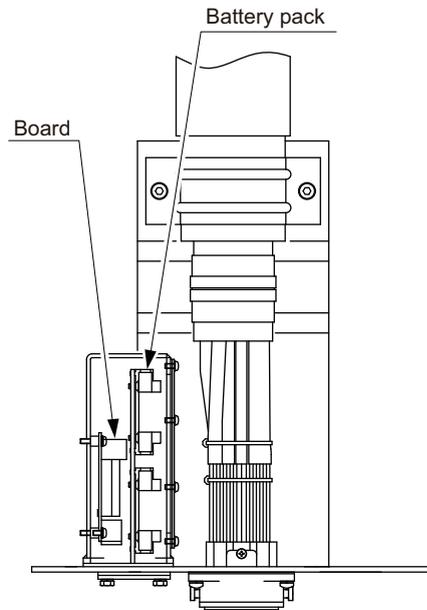
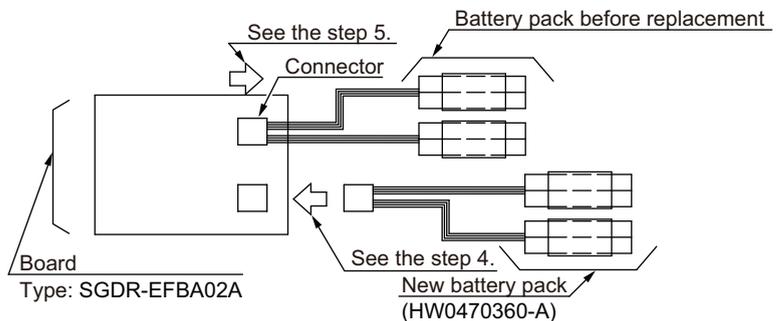


Fig. 9-3: Battery Connection



9 Maintenance and Inspection

9.2 Notes on Maintenance Procedures

1. Turn OFF the DX200 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 battery pack from the battery holder.
4. Connect the new battery pack to the unoccupied connector on the board.
5. Remove the old battery pack from the board.



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.



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

9.3 Grease Replenishment/Exchange

9.3.1 Notes on Grease Replenishment/Exchange Procedures

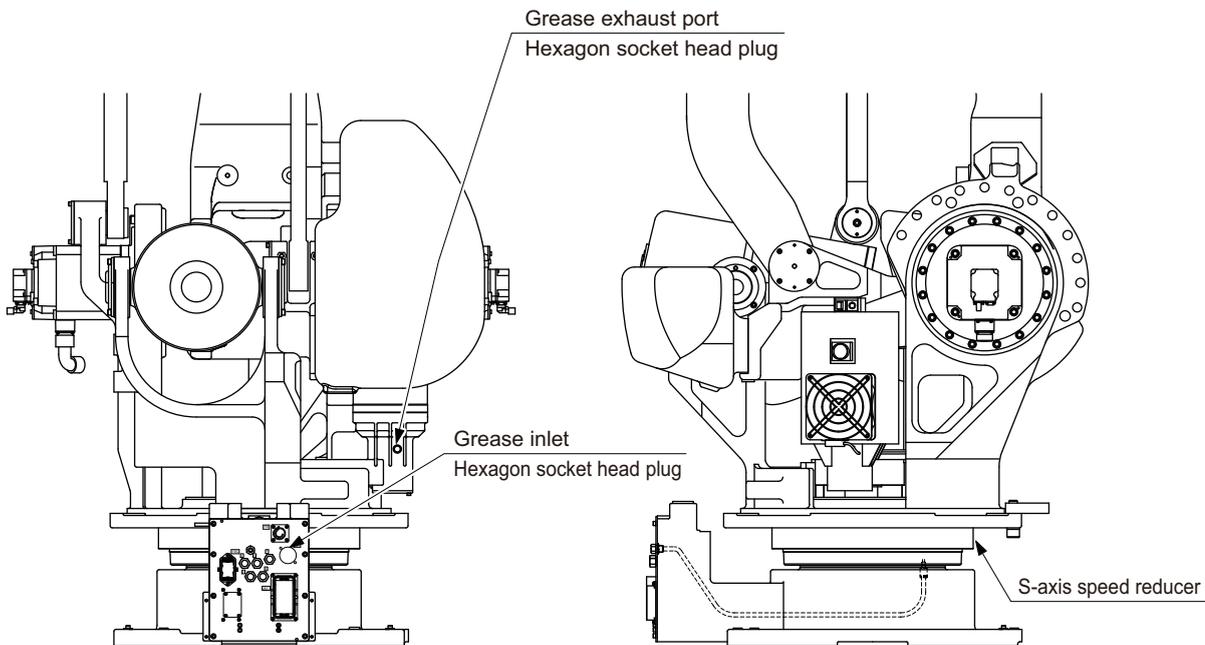
Make sure to follow the instructions listed below at grease replenishment/exchange. Failure to observe the following notes may result in damage to a motor and a speed reducer.



- If grease is added without removing the plug/screw from the grease exhaust port, 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.

9.3.2 Grease Replenishment/Exchange for S-Axis Speed Reducer and Gear

Fig. 9-4: S-Axis Speed Reducer and Gear Diagram



9.3.2.1 Grease Replenishment

(Refer to Fig. 9-4 "S-Axis Speed Reducer and Gear Diagram".)

1. Remove the hexagon socket head plugs from the grease inlet and grease exhaust port.

NOTE

- If grease is injected with the plug on, 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. Install a grease zerk A-PT1/4 to the grease inlet.
(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:	2100 cc (4200 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. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 24.5 N•m (2.5 kgf•m).
6. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then 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 "S-Axis Speed Reducer and Gear Diagram".)

1. Remove the hexagon socket head plugs from the grease inlet and grease exhaust port.



- If grease is injected with the plug on, 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. Install a grease zerk A-PT1/4 to the grease inlet. (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: approx. 10400 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. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 24.5 N•m (2.5 kgf•m).



If the plug is installed while grease is being exhausted, grease will leak inside the motor and may cause a damage. Make sure to install the plug when the grease exhaust is completed.

7. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).

9.3.3 Grease Replenishment/Exchange for L-Axis Speed Reducer

Fig. 9-5(a): L-Axis Speed Reducer Diagram

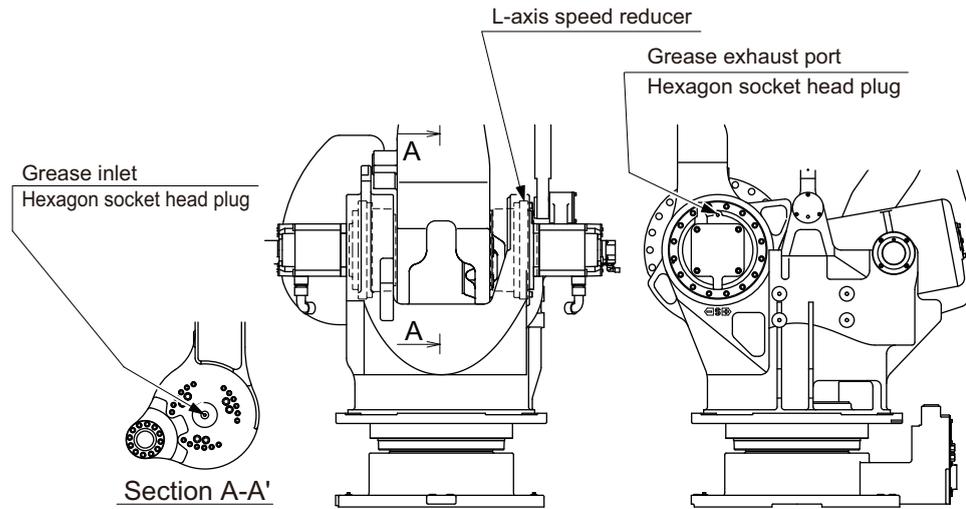
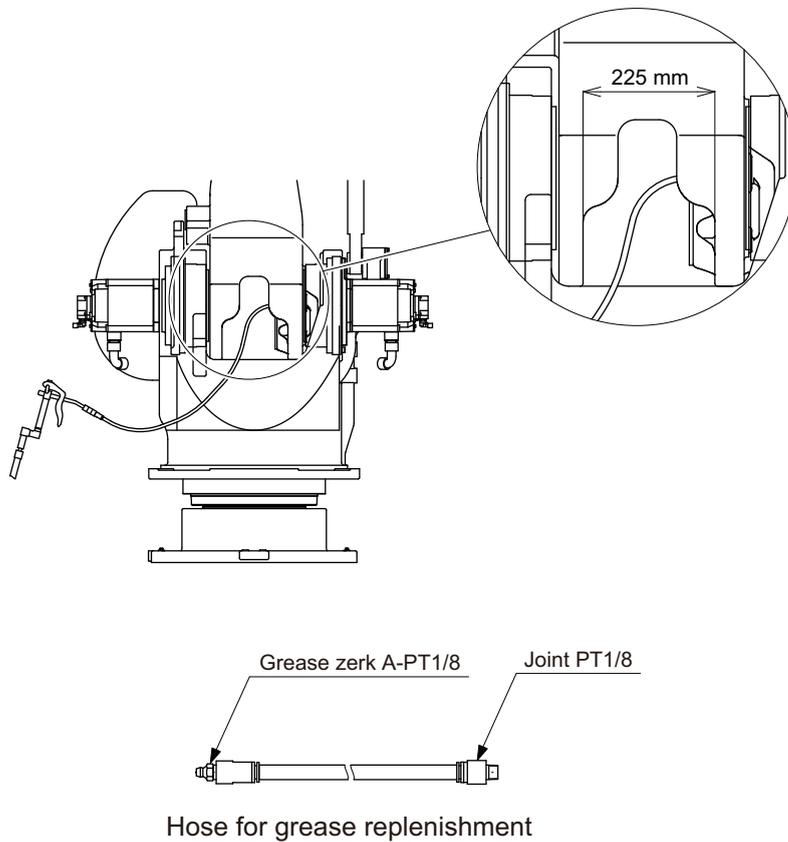


Fig. 9-5(b): L-Axis Grease Replenishment



9.3.3.1 Grease Replenishment

(Refer to Fig. 9-5(a) "L-Axis Speed Reducer Diagram" and Fig. 9-5(b) "L-Axis Grease Replenishment".)

1. Remove the hexagon socket head plugs from the grease inlet and grease exhaust port.



- If grease is injected with the plug on, 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.

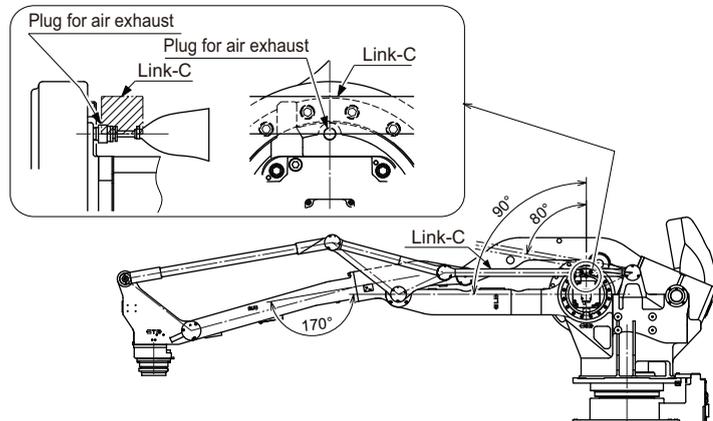
2. Install a grease zerk A-PT1/8 to the grease inlet.
(The grease zerk is delivered with the manipulator.)
3. Inject grease through the grease inlet using a grease gun
 - Grease type: Molywhite RE No.00
 - Amount of grease: 360 cc
(720 cc for 1st supply)
 - Air supply pressure of grease pump: 0.3 MPa or less
 - Grease injection rate: 8 g/s or less
4. If you cannot inject grease with your grease gun, prepare a grease hose as shown in Fig. 9-5(b) and inject grease.
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. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 24.5 N•m (2.5 kgf•m).
7. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).



CAUTION

- If the L-arm is tilted at 80 degrees or more, the link-C interferes with the plug for air exhaust.

Do not tilt the L-arm over 80 degrees when verifying the manipulator operation.



9.3.3.2 Grease Exchange

(Refer to Fig. 9-5(a) "L-Axis Speed Reducer Diagram".)

1. Remove the hexagon socket head plugs from the grease inlet and grease exhaust port.



- If grease is injected with the plug on, 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. Install a grease zerk A-PT1/8 to the grease inlet.
(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: approx. 1800 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 L-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 24.5 N•m (2.5 kgf•m).

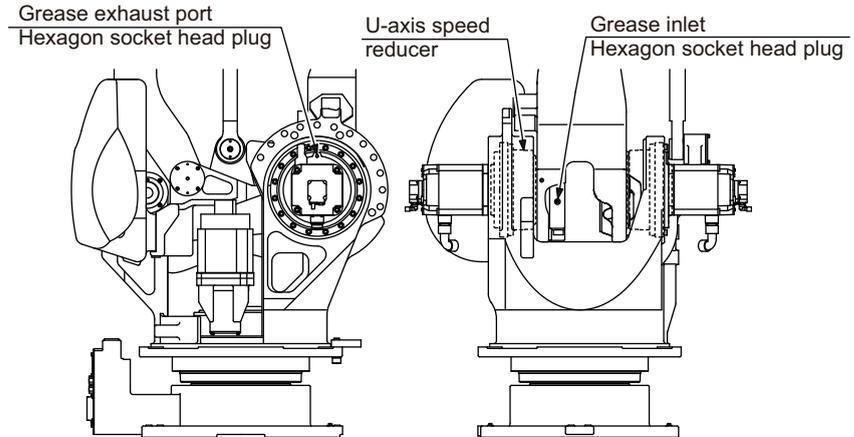


If the plug is installed while grease is being exhausted, grease will leak inside the motor and may cause a damage. Make sure to install the plug when the grease exhaust is completed.

7. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).

9.3.4 Grease Replenishment/Exchange for U-Axis Speed Reducer

Fig. 9-6: U-Axis Speed Reducer Diagram



9.3.4.1 Grease Replenishment

(Refer to Fig. 9-6 “U-Axis Speed Reducer Diagram”.)

1. Remove the hexagon socket head plugs from the grease inlet and grease exhaust port.

NOTE

- If grease is injected with the plug on, 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. Install a grease zerk A-PT1/8 to the grease inlet.
(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: 320 cc
(640 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 U-axis for a few minutes to discharge excess grease.
5. Wipe the discharged grease with a cloth, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 24.5 N•m (2.5 kgf•m).

NOTE

If the plug is installed while grease is being exhausted, grease will leak inside the motor and may cause a damage. Make sure to install the plug when the grease exhaust is completed.

6. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).

9.3.4.2 Grease Exchange

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

1. Remove the hexagon socket head plugs from the grease inlet and grease exhaust port.



- If grease is injected with the plug on, 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. Install a grease zerk A-PT1/8 to the grease inlet.
(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: approx. 1600 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 U-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 24.5 N•m (2.5 kgf•m).

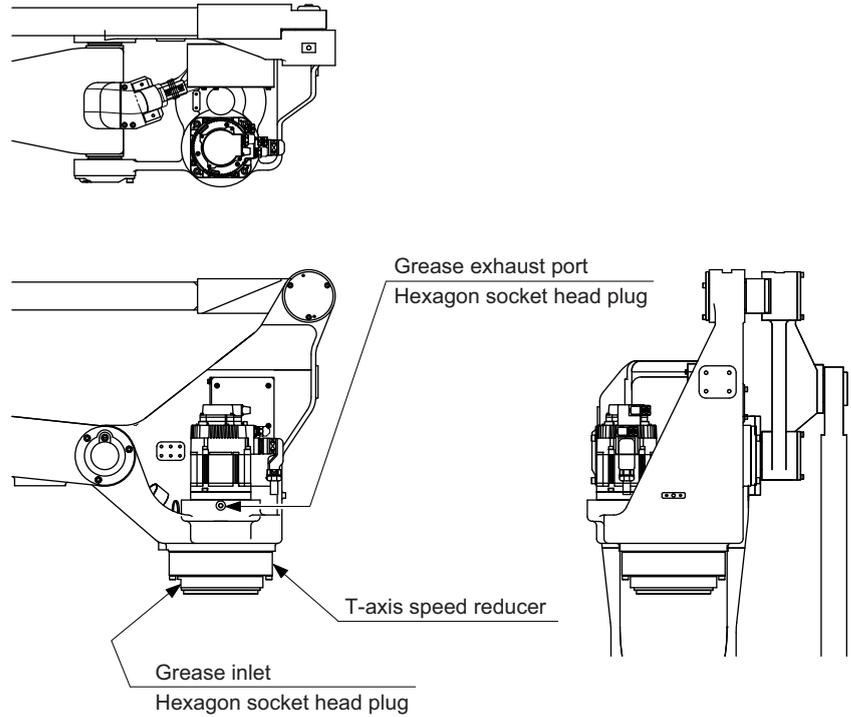


- If the plug is installed while grease is being exhausted, grease will leak inside the motor and may cause a damage. Make sure to install the plug when the grease exhaust is completed.

7. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).

9.3.5 Grease Replenishment/Exchange for T-Axis Speed Reducer

Fig. 9-7: T-Axis Speed Reducer Diagram



9.3.5.1 Grease Replenishment

(Refer to Fig. 9-7 “T-Axis Speed Reducer Diagram”.)

1. Remove the hexagon socket head plugs from the grease inlet and grease exhaust port.



- If grease is injected with the plug on, 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. Install a grease zerk A-PT1/8 to the grease inlet.
(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: 180 cc
(360 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 T-axis for a few minutes to discharge excess grease.
5. Wipe the discharged grease with a cloth, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).



If the plug is installed while grease is being exhausted, grease will leak inside the motor and may cause a damage. Make sure to install the plug when the grease exhaust is completed.

6. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).

9.3.5.2 Grease Exchange

(Refer to Fig. 9-7 “T-Axis Speed Reducer Diagram”.)

1. Remove the hexagon socket head plugs from the grease inlet and grease exhaust port.



- If grease is injected with the plug on, 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. Install a grease zerk A-PT1/8 to the grease inlet. (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: approx. 900 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 T-axis for a few minutes to discharge excess grease.
6. Wipe the discharged grease with a cloth, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).

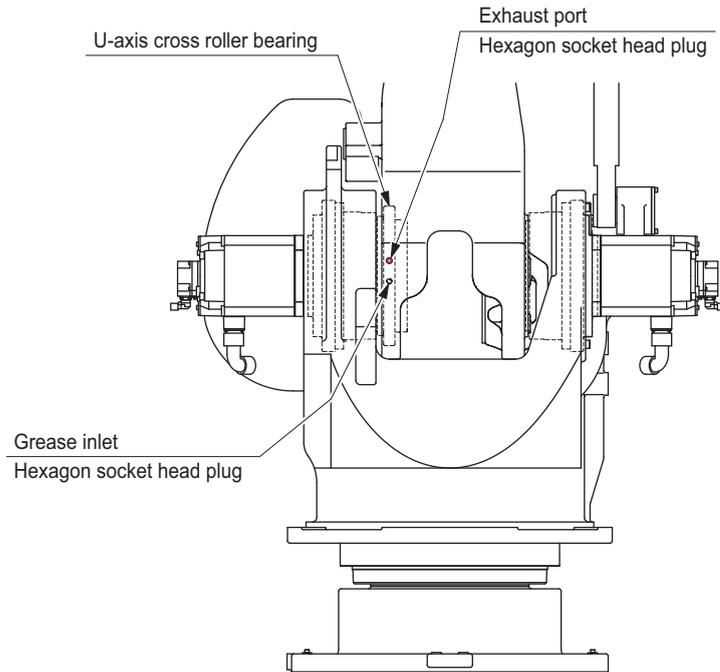


If the plug is installed while grease is being exhausted, grease will leak inside the motor and may cause a damage. Make sure to install the plug when the grease exhaust is completed.

7. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).

9.3.6 Grease Replenishment for U-axis Cross Roller Bearing

Fig. 9-8: U-Axis Cross Roller Bearing Diagram



1. Remove the hexagon socket head plug of the exhaust port. (Refer to Fig. 9-8 "U-Axis Cross Roller Bearing Diagram".)
2. Remove the hexagon socket head plug of the grease inlet and install the grease zerk A-PT1/8. Inject grease through the grease inlet using a grease gun. (The grease zerk is delivered with the manipulator.)
 - Grease type: Alvania EP Grease 2
 - Amount of grease: approx. 60 cc
 - Air supply pressure of grease pump: 0.3 MPa or less
 - Grease injection rate: 8 g/s or less
3. Reinstall the plug into the exhaust port. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).



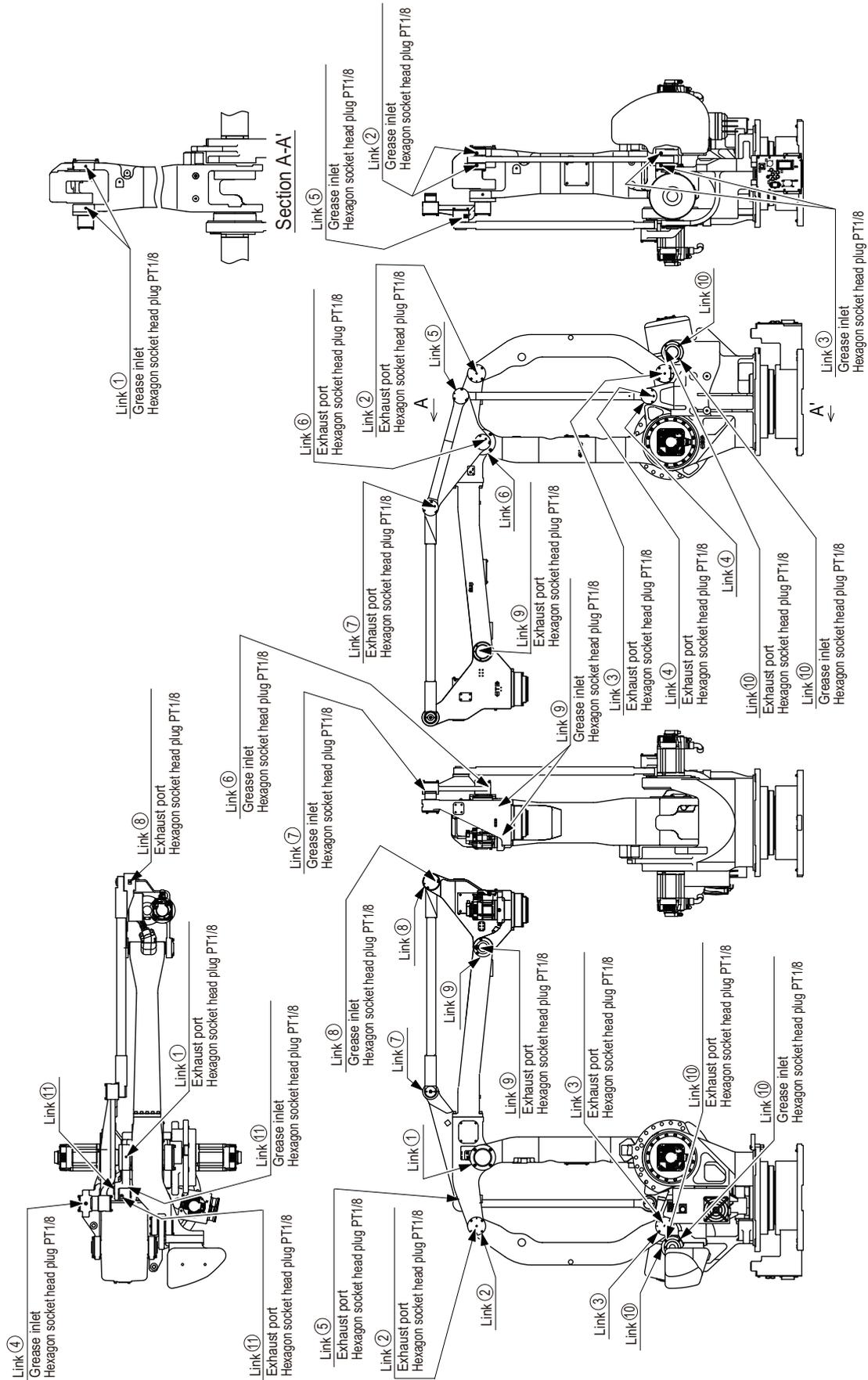
The exhaust port is for AIR flow: Grease is not exhausted from the exhaust port.

Do not inject excessive grease through the grease inlet.

4. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).

9.3.7 Grease Replenishment for Links

Fig. 9-9: Grease Replenishment for Links



9 Maintenance and Inspection

9.3 Grease Replenishment/Exchange

1. Remove the hexagon socket head plug PT1/8 from the exhaust port of each link. (Refer to Fig. 9-9 "Grease Replenishment for Links")
2. Remove the hexagon socket head plug PT1/8 from the grease inlet of each link and install the grease zerk A-PT1/8. Inject grease through the grease inlet using a grease gun. (The grease zerk is delivered with the manipulator.)

- Grease type: Alvania EP Grease 2
- Amount of grease for links 1, 2, 3, 6: 6 cc (12 cc for 1st supply)
- Amount of grease for links 4, 5, 9: 12 cc (24 cc for 1st supply)
- Amount of grease for links 7, 8: 3 cc (6 cc for 1st supply)
- Amount of grease for links 10, 11: 5 cc (10 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 for AIR flow: Grease is not exhausted from the exhaust port.



Do not inject excessive grease through the grease inlet.

3. Reinstall the plug into the exhaust port of each link. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 kgf•m).
4. Remove the grease zerk from the grease inlet, and reinstall the plug. Before installing the plug, apply Three Bond 1206C on the thread part of the plug. Then tighten the plug with a tightening torque of 4.9 N•m (0.5 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. 9-10 "Battery Pack Connection"*.

9.3.8.1 Battery Pack Connection

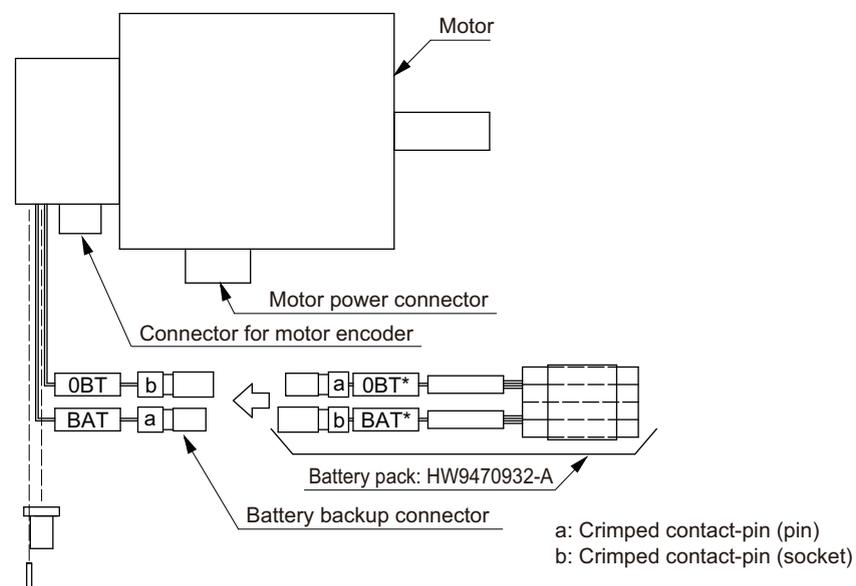
The connectors (crimped contact-pin) for the battery backup are installed at the end point of the motors (BAT and OBT are marked). Connect the battery packs according to the following procedure.

1. Remove the cap attached to the battery backup connector of the motors.
2. Connect the battery packs (HW9470932-A) with the battery backup connectors (BAT and OBT are marked) located at the end point of the cables for the encoder. (Under this condition, remove the encoder connector and carry out the maintenance checks.)
3. Confirm all connectors connected after the maintenance check, and remove the battery packs. Install the caps attached to the battery backup connectors of the motors.



Do not remove the battery pack in the connector base.

Fig. 9-10: Battery Pack Connection



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-MPL160 II. Product performance cannot 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.



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

Table 10-1: Spare Parts for the YR-MPL0160-J00

Rank	Parts No.	Name	Type	Manufacturer	Qty	Qty per Unit	Remarks
A	1	Grease	Molywhite RE No.00	Yaskawa	16kg	-	For speed reducers
A	2	Grease	Alvania EP Grease 2	Showa Shell Sekiyu K.K.	16kg	-	For links and bearings
A	3	Battery Pack	HW0470360-A	Yaskawa	1	1	
A	4	Battery Pack	HW9470932-A	Yaskawa	1	1	For replacement of wire harness in manipulator
A	5	Liquid Gasket	Three Bond 1206C	ThreeBond Co., Ltd.	1	1	
B	6	Replacement Kit for S-Axis Speed Reducer	Y005C-MPL0160J00S	Yaskawa	1	1	
B	7	Replacement Kit for L-Axis Speed Reducer	Y005C-MPL0160J00L	Yaskawa	1	1	
B	8	Replacement Kit for U-Axis Speed Reducer	Y005C-MPL0160J00U	Yaskawa	1	1	
B	9	Replacement Kit for T-Axis Speed Reducer	Y005C-MPL0160J00T	Yaskawa	1	1	
B	10	U-axis Cross Roller Bearing	HW9482144-A	Yaskawa	1	1	
C	11	AC Servomotor for S-, L-, and U-axes	SGMRV-44ANA-YR1* HW0389698-A	Yaskawa	1	3	
C	12	AC Servomotor for T-axis	SGMRV-13ANA-YR1* HW0388666-A	Yaskawa	1	1	
C	13	Wire Harness in Manipulator	HW1172025-A	Yaskawa	1	1	
C	14	Wire Harness in Manipulator	HW1372054-A	Yaskawa	1	1	
C	15	Board	SGDR-EFBA02A	Yaskawa	1	1	

11 Parts List

11.1 S-Axis Unit

Fig. 11-1: S-Axis Unit

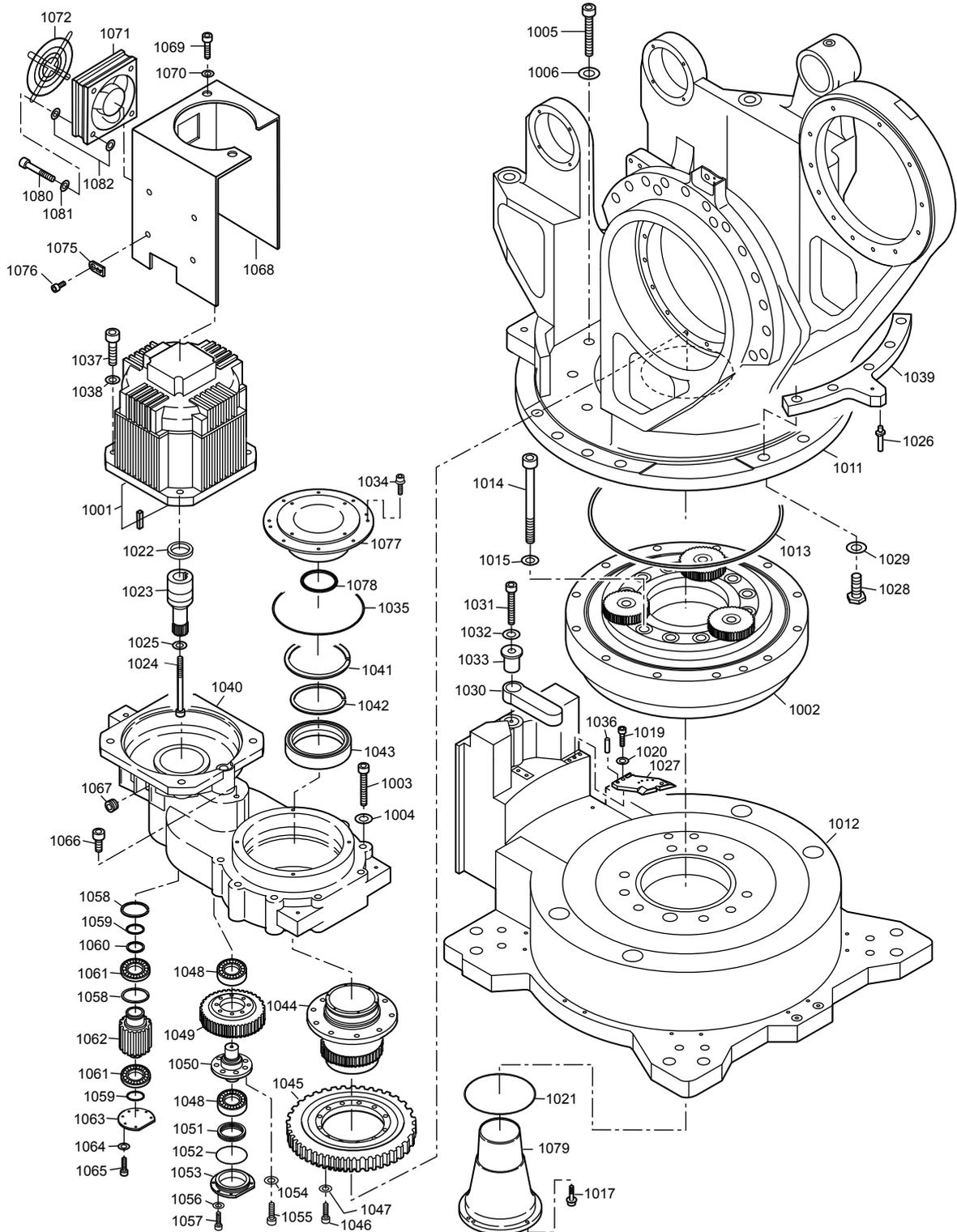


Table 11-1: S-Axis Unit (Sheet 1 of 2)

No.	DWG No.	Name	Pcs
1001	SGMRV-44ANA-YR1*	Motor	1
1002	HW0281280-A	Speed reducer	1
1003	M8X100	Socket screw	10
1004	2H-8	Spring washer	10
1005	M16X70	Socket screw	12
1006	2H-16	Spring washer	12
1011	HW0101143-1	S-head	1
1012	HW0101142-1	Base	1
1013	G415	O-ring	1
1014	M20X160	Socket screw	9
1015	2H-20	Spring washer	9
1017	M6X20	GT-SA Bolt	4
1019	M6X16	Socket screw	1
1020	2H-6	Spring washer	1
1021	G135	O-ring	1
1022	HW0414514-1	Shaft	1
1023	HW0307565-3	Shaft	1
1024	M8X115	Socket screw	1
1025	2H-8	Spring washer	1
1026	HW0407007-1	Pin	1
1027	HW0403903-1	Plate	1
1028	M20X70(12.9)	Bolt	3
1029	M20	Washer	3
1030	HW0402102-1	Stopper	1
1031	M8X40	Socket screw	1
1032	2H-8	Spring washer	1
1033	HW9404486-1	Shaft	1
1034	M5X16	GT-SA Bolt	8
1035	S180	O-ring	1
1036	MSTM6-20	Pin	2
1037	M12X40	Socket screw	4
1038	2H-12	Spring washer	4
1039	HW0307574-1	Stopper	1
1040	HW0101152-1	Gear case	1
1041	AR175	Ring	1
1042	WR140	Ring	1
1043	6828ZZ	Bearing	1
1044	HW0307564-1	Gear	1
1045	HW0307654-1	Gear	1
1046	M6X20	Socket screw	10
1047	2H-6	Spring washer	10
1048	HR33206J	Bearing	2
1049	HW0307655-1	Gear	1
1050	HW9405047-1	Shaft	1

11 Parts List
11.1 S-Axis Unit

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

No.	DWG No.	Name	Pcs
1051	HW9405304-*	Shim	*
1052	G85	O-ring	1
1053	HW9405048-1	Housing	1
1054	2H-8	Spring washer	8
1055	M8X25	Socket screw	8
1056	2H-5	Spring washer	7
1057	M5X16	Socket screw	7
1058	IRTW-72	Ring	2
1059	ISTW-35	Ring	2
1060	CIMR35-1	Shim	2
1061	6207ZZ	Bearing	2
1062	HW0307656-1	Gear	1
1063	HW9405051-1	Cover	1
1064	2H-5	Spring washer	7
1065	M5X16	Socket screw	7
1066	M12X20	Socket screw	1
1067	PT3/8 (STAINLESS)	Plug	1
1068	HW0314644-A	Cover	1
1069	M8X25(STAINLESS)	Socket screw	2
1070	2H-8(STAINLESS)	Spring washer	2
1071	HW0471083-A	Fan	1
1072	A-33C	Fan cover	1
1075	TA1-S10	Clamp	4
1076	M5X10	Round head screw	4
1077	HW0308464-1	Flange	1
1078	TC8511013	Oil seal	1
1079	HW0308465-1	Shaft	1
1080	HW0484457-A	Bolt	4
1081	M5	Washer	4
1082	CC-0613-10	Washer	8

11.2 L-Axis Unit

Fig. 11-2(a): L-Axis Unit

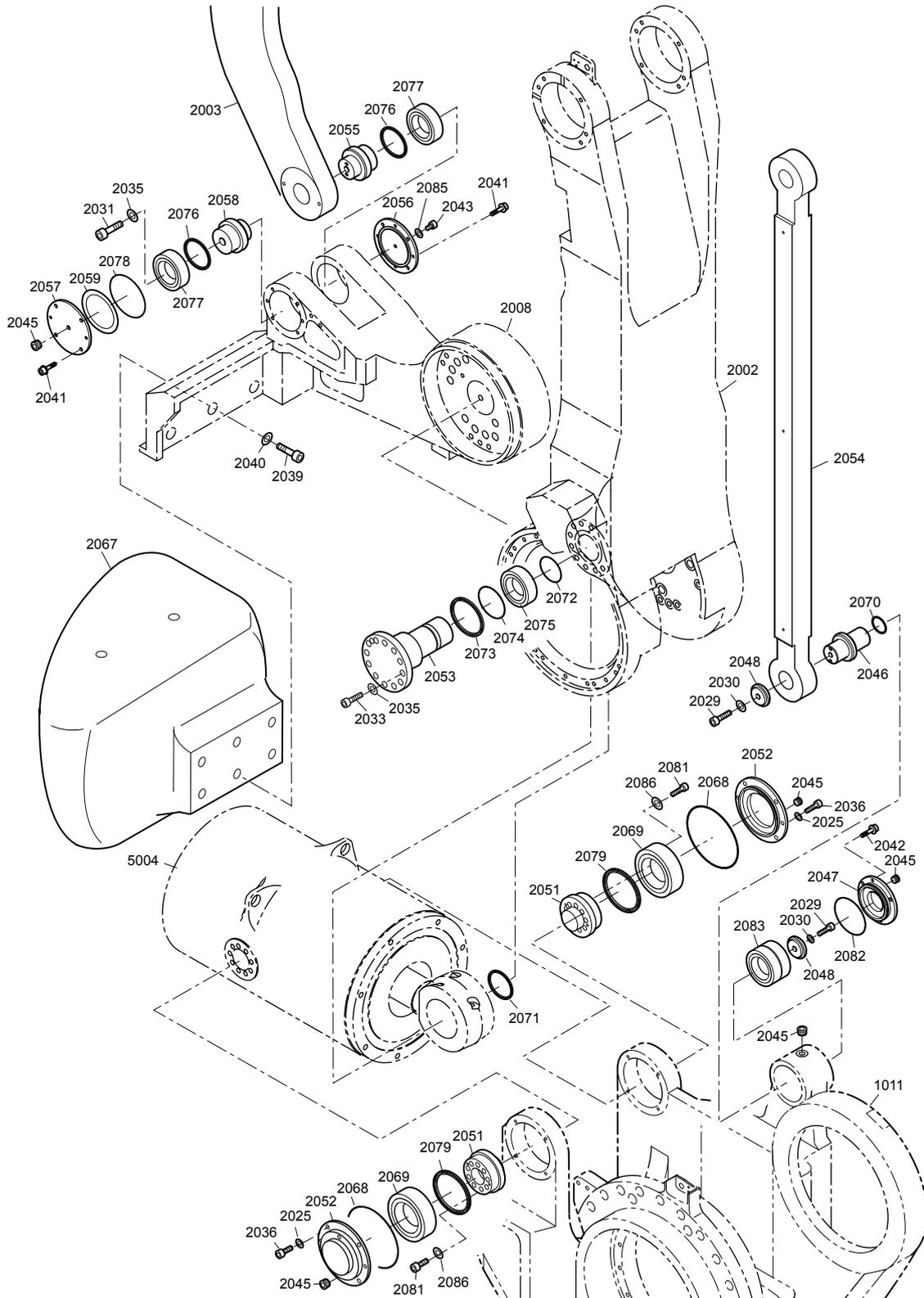


Fig. 11-2(b): L-Axis Unit

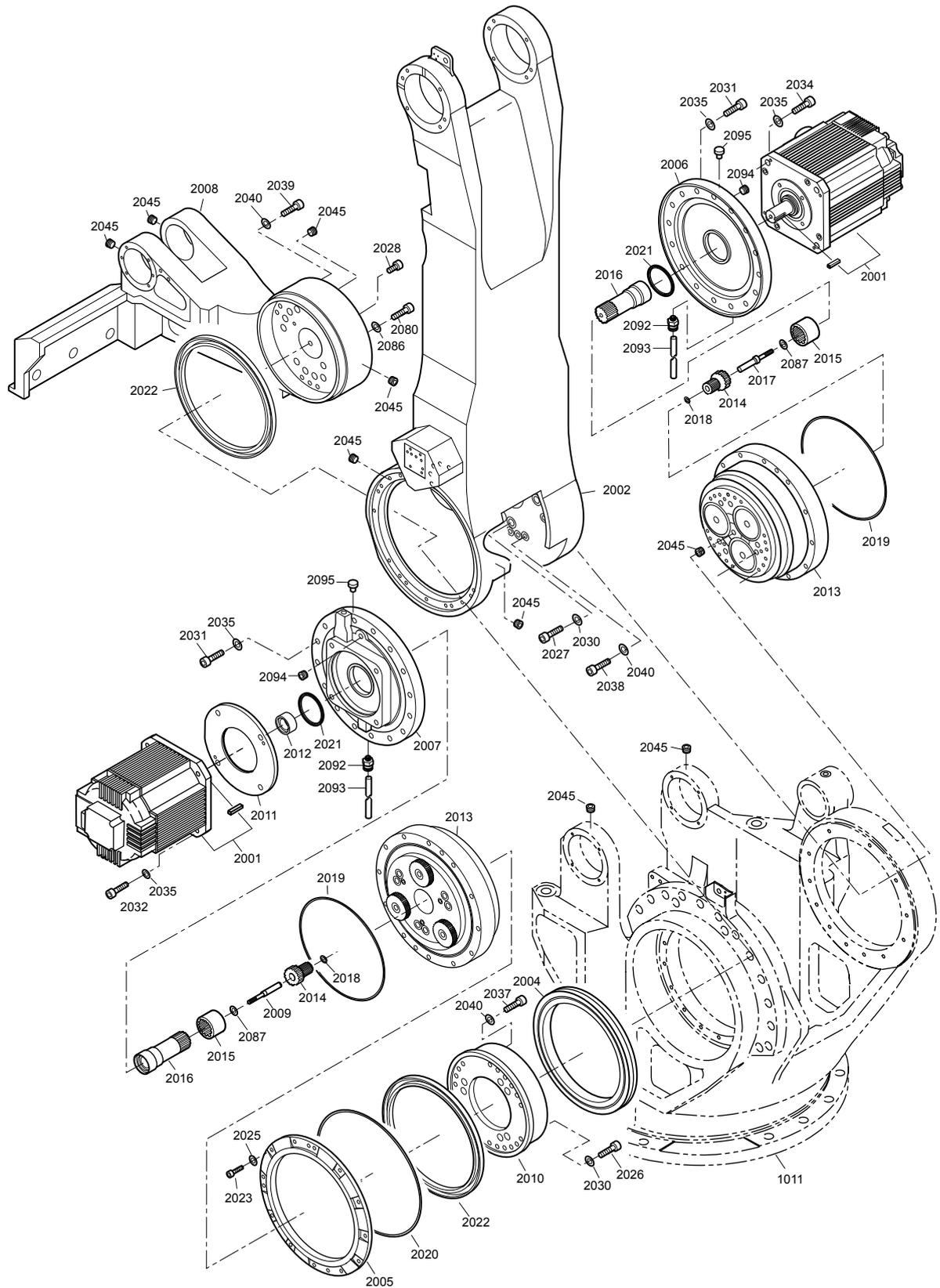


Table 11-2: L-Axis Unit (Sheet 1 of 2)

No.	DWG No.	Name	Pcs
2001	SGMRV-44ANA-YR1*	Motor	2
2002	HW0101144-1	L-arm	1
2003	HW0101146-1	Link A	1
2004	HW9482144-A	Cross roller bearing	1
2005	HW9301736-1	B-cover	1
2006	HW9200827-1	M-base	1
2007	HW0200685-1	M-base	1
2008	HW0101145-1	Link-B	1
2009	HW9481363-B	Bolt	1
2010	HW0307569-1	Shaft	1
2011	HW0308096-1	Spacer	1
2012	HW0414515-1	Shaft	1
2013	HW0388209-B	Speed reducer	2
2014	HW9481362-A	Gear	2
2015	HW9481343-A	Shaft	2
2016	HW9482306-F	Shaft	2
2017	HW9481363-A	Bolt	1
2018	ISTW-12	Stopper	2
2019	G270	O-ring	2
2020	GS310	O-ring	1
2021	Y507212.5	Oil seal	2
2022	VB 265 280 7	Oil seal	2
2023	M8X25	Socket screw	12
2025	2H-8	Spring washer	20
2026	M10X60	Socket screw	18
2027	M10X50	Socket screw	18
2028	M10X45	Socket screw	1
2029	M10X25	Socket screw	2
2030	2H-10	Spring washer	38
2031	M12X75	Socket screw	33
2032	M12X55	Socket screw	4
2033	M12X50	Socket screw	12
2034	M12X40	Socket screw	4
2035	2H-12	Spring washer	53
2036	M8X25	Socket screw	8
2037	M16X65	Socket screw	6
2038	M16X60	Socket screw	6
2039	M16X50	Socket screw	18
2040	2H-16	Spring washer	30
2041	M6X15	GT-SA bolt	8
2042	M6X20	GT-SA bolt	3
2043	M6X6	Socket screw	1
2045	PT1/8 (STAINLESS)	Plug	14

11 Parts List
11.2 L-Axis Unit

Table 11-2: L-Axis Unit (Sheet 2 of 2)

No.	DWG No.	Name	Pcs
2046	HW0307641-1	Shaft	1
2047	HW0406922-1	B-cover	1
2048	HW0406923-1	Pup washer	2
2051	HW9405055-1	Shaft	2
2052	HW9405699-1	B-cover	2
2053	HW9302054-1	Shaft	1
2054	HW0308094-1	Link-C	1
2055	HW0400016-1	Shaft	1
2056	HW0400008-1	B-cover	1
2057	HW0406931-1	B-cover	1
2058	HW0400015-1	Shaft	1
2059	HW0400012-*	Shim	*
2067	HW0200689-1	Counter wait	1
2068	S105	O-ring	2
2069	HR32916J	Bearing	2
2070	AG3217A4	Oil seal	1
2071	VB60787	Oil seal	1
2072	WR60	Clip	1
2073	VB75956	Oil seal	1
2074	AR-85	Clip	1
2075	NA6912	Needle bearing	1
2076	AG3512E1	Oil seal	2
2077	HR32011XJ	Bearing	2
2078	G85	O-ring	1
2079	KE901107	Oil seal	2
2080	M10X45	Socket screw	9
2081	M10X50	Socket screw	18
2082	G75	O-ring	1
2083	HW0484003-A	Bearing	1
2085	2H-6	Spring washer	1
2086	2H-10	Spring washer	27
2087	HW0408806-2	Washer	2
2092	TSH6-01M	Union	2
2093	UB-0640-0.1C	House	2
2094	PT3/8 (STAINLESS)	Plug	2
2095	EZ0094-A0	Air breather	2
5004	HW0100477-1	Case	1
1011	HW0101143-1	S-head	1

11.3 U-Axis Unit

Fig. 11-3: U-Axis Unit

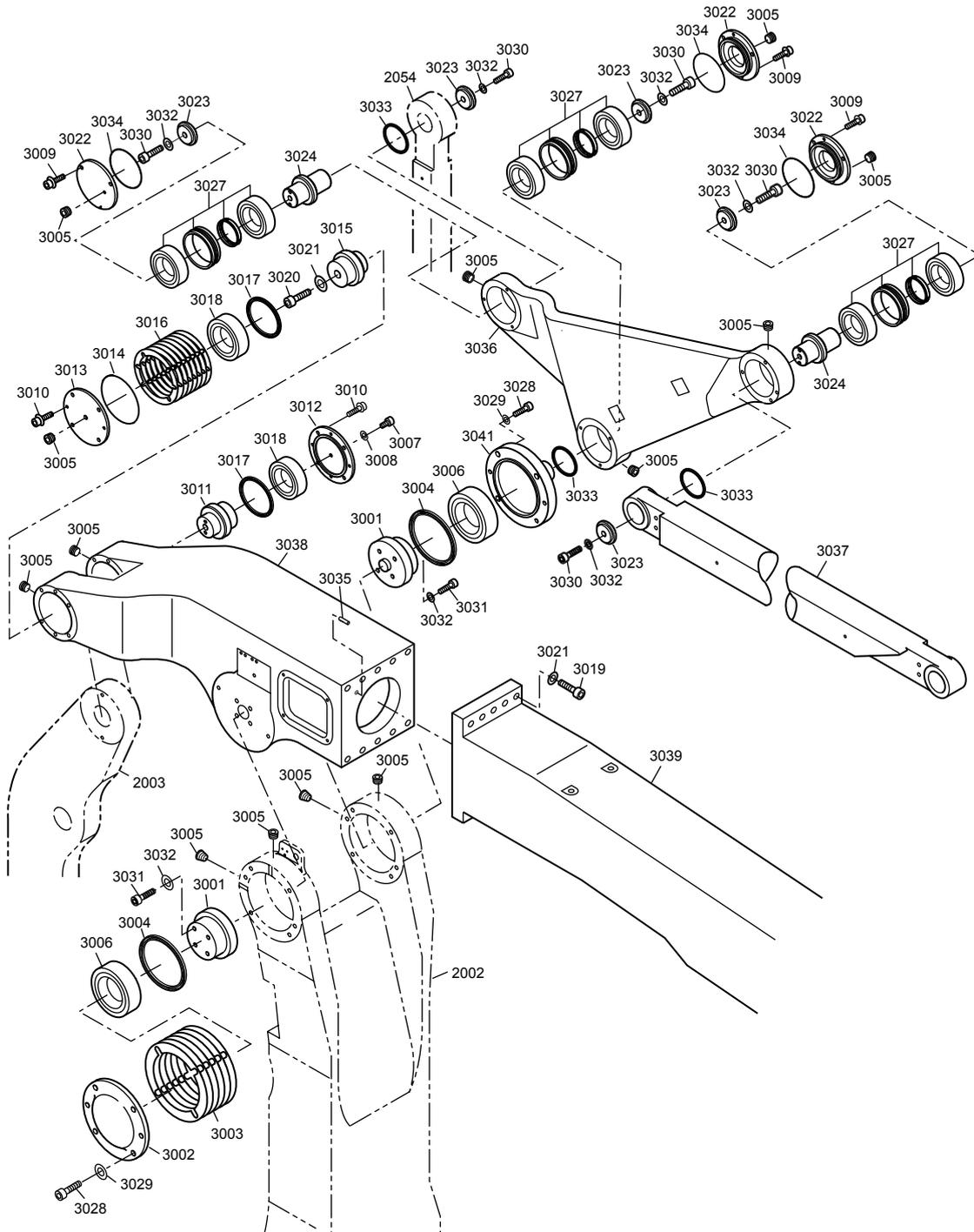


Table 11-3: U-Axis Unit

No.	DWG No.	Name	Pcs
3001	HW9403571-2	Shaft	2
3002	HW9301405-1	B-cover	1
3003	HW9403656-*	Shim	*
3004	AG4059E0	Oil seal	2
3005	PT1/8 (STAINLESS)	Plug	13
3006	HR32016XJ	Bearing	2
3007	M6X6	Socket screw	1
3008	2H-6	Spring washer	1
3009	M6X20	GT-SA Bolt	9
3010	M6X15	GT-SA Bolt	8
3011	HW0400016-1	Shaft	1
3012	HW0400008-1	B-cover	1
3013	HW0406931-1	B-cover	1
3014	G85	O-ring	1
3015	HW0400015-1	Shaft	1
3016	HW0400012-*	Shim	*
3017	AG3512E1	Oil seal	2
3018	HR32011XJ	Bearing	2
3019	M12X45	Socket screw	10
3020	M12X75	Socket screw	1
3021	2H-12	Spring washer	11
3022	HW0406922-1	B-cover	3
3023	HW0406923-1	Pup washer	5
3024	HW0307641-1	Shaft	2
3027	HW0484003-A	Bearing	3
3028	M10X30	Socket screw	8
3029	2H-10	Spring washer	8
3030	M10X25	Socket screw	5
3031	M10X50	Socket screw	8
3032	2H-10	Spring washer	13
3033	AG3217A4	Oil seal	3
3034	G75	O-ring	3
3035	MSTH6-10	Pin	2
3036	HW0200686-1	Link-D	1
3037	HW0308095-1	Link-E	1
3038	HW0101147-1	Casing	1
3039	HW0101148-1	U-arm	1
3041	HW0307566-1	Shaft	1
2002	HW0101144-1	L-arm	1
2003	HW0101146-1	Link A	1
2054	HW0308094-1	Link-C	1

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

No.	DWG No.	Name	Pcs
4001	SGMRV-13ANA-YR1*	Motor	1
4002	HW0381150-C	Speed reducer	1
4003	HW0102580-1	Wrist base	1
4004	HW0406923-1	Pup washer	2
4005	G75	O-ring	1
4006	HW0406922-1	B-cover	1
4007	HW0484003-A	Bearing	1
4008	HW0307641-1	Shaft	1
4009	AG3217A4	Oil seal	1
4010	S90	O-ring	1
4011	HW9404246-*	Shim	*
4012	HW0405915-1	B-cover	1
4013	AG3584A0	Oil seal	2
4014	HW9404245-1	Shaft	2
4015	HR32012XJ	Bearing	2
4016	HW9404383-1	B-cover	1
4017	M8X65	Socket screw	8
4018	2H-8	Spring washer	8
4019	M10X25	Socket screw	2
4020	2H-10	Spring washer	2
4021	M8X25	GT-SA Bolt	3
4022	M8X30	GT-SA Bolt	3
4023	M6X20	GT-SA Bolt	3
4024	PT1/8 (STAINLESS)	Plug	7
4025	LP-M5	Plug	1
4026	HW0314598-1	Guide	1
4027	HW0314599-1	Gear	1
4028	HW0314600-1	Gear	1
4029	HW0314601-1	M base	1
4030	HW0314602-1	Flange A	1
4031	HW0314603-1	Flange B	1
4032	HW0414320-1	B-nut	1
4033	HW0414321-1	Housing	1
4034	HW0412116-1	Shaft	1
4035	HW0403139-1	B-cover	1
4036	R10-27	Washer	1
4037	S105	O-ring	1
4038	HR32909J	Bearing	2
4039	ARP568-169	O-ring	1
4040	G60	O-ring	1
4041	6813	Bearing	1
4042	WR65	Circlip	1
4043	TC57676	Oil seal	1
4044	M6X8	H set screw	2

Table 11-4: Wrist Unit (Sheet 2 of 2)

No.	DWG No.	Name	Pcs
4045	M8X25	GT-SA Bolt	8
4046	M6X20	GT-SA Bolt	4
4047	M10X20	Socket screw	8
4048	2H-10	Spring washer	8
4049	M4X10	GT-SA Bolt	8
4050	M8X80	Socket screw	30
4051	2H-8	Spring washer	30
4052	M6X20	Socket screw	1
4053	2H-6	Spring washer	1
4054	M10X20	Socket screw	9
4055	2H-10	Spring washer	9
4056	MSTH8-20	Pin	1
3037	HW0308095-1	Link-E	1
3039	HW0101148-1	U-arm	1

11.5 Balancer Unit

Fig. 11-5: Balancer Unit

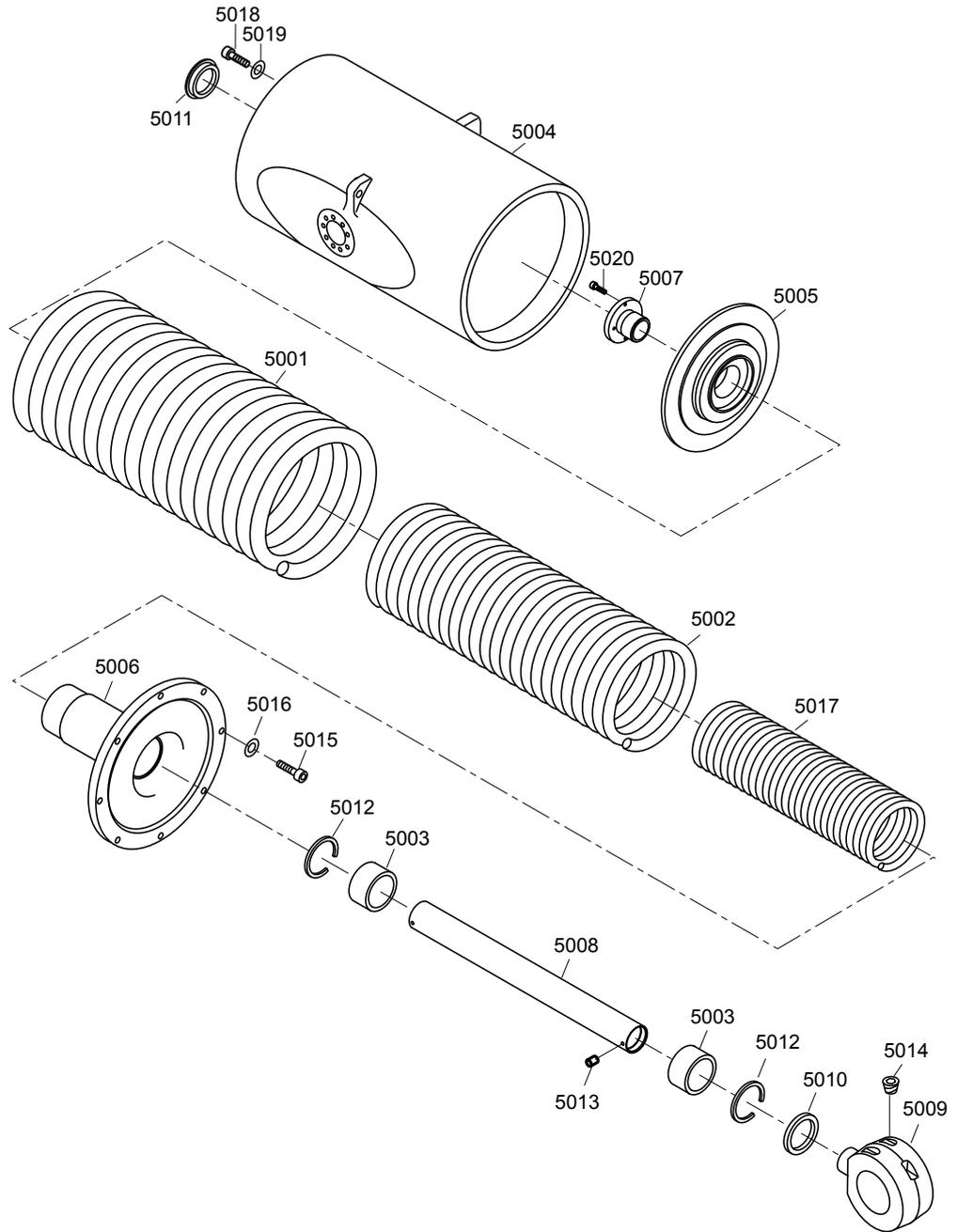


Table 11-5: Balancer Unit

No.	DWG No.	Name	Pcs
5001	HW0481740-A	Coil spring	1
5002	HW0481741-A	Coil spring	1
5003	SOB607440	OILES bearing	2
5004	HW0100477-1	Case	1
5005	HW0306033-1	Flange	1
5006	HW0200420-1	Flange	1
5007	HW0401112-1	Flange	1
5008	HW0303581-1	Rod	1
5009	HW9405057-1	Clevis	1
5010	FD3187A0	Dust seal	1
5011	EZ2228B0	Cap	1
5012	IRTW-75	Stopper	2
5013	M6X8	Magic screw (set screw)	2
5014	PT1/8 (STAINLESS)	Plug	3
5015	M10X40	Socket screw	8
5016	2H-10	Spring washer	8
5017	HW0481742-A	Coil spring	1
5018	M8X16	Socket screw	3
5019	2H-8	Spring washer	3
5020	M5X10	Socket screw	2

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