YASKAWA

MOTOMAN-HC10
INSTRUCTIONS

TYPE:
YR-1-06VXHC10-A00

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

MOTOMAN INSTRUCTIONS

MOTOMAN-HC10 INSTRUCTIONS
YRC1000 INSTRUCTIONS
YRC1000 OPERATOR'S MANUAL (GENERAL) (SUBJECT SPECIFIC)
YRC1000 MAINTENANCE MANUAL
YRC1000 ALARM CODES (MAJOR ALARMS) (MINOR ALARMS)
YRC1000 OPTIONS INSTRUCTIONS OPERATOR'S MANUAL Collaborative Operation

The YRC1000 operator's manual above corresponds to specific usage. Be sure to use the appropriate manual.
The YRC1000 operator's manual above consists of "GENERAL" and "SUBJECT SPECIFIC".
The YRC1000 alarm codes above consists of "MAJOR ALARMS" and "MINOR ALARMS".

Please have the following information available when contacting Yaskawa Customer Support:
- System
- Primary Application
- Software Version *(Located on Programming Pendant by selecting: {Main Menu} - {System Info} - {Version})*
  Robot Serial Number *(Located on robot data plate)*
  Robot Sales Order Number *(Located on controller data plate)*

Part Number: 180571-1CD
Revision: 0

MANUAL NO.
HW1483896

DANGER

- This instruction manual is intended to explain mainly on the mechanical part of the MOTOMAN-HC10 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. Any matter not described in this manual must be regarded as “prohibited” or “improper”.
- General information related to safety are described in “Chapter 1. Safety” of the YRC1000 INSTRUCTIONS. To ensure correct and safe operation, carefully read “Chapter 1. Safety” of the YRC1000 INSTRUCTIONS.

CAUTION

- In some drawings in this manual, protective covers or shields are removed to show details. Make sure that all the covers or shields are installed in place 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 is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids the product warranty.

NOTICE

- 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.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the MOTOMAN-GP8/AR700, -GP7/AR900.

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

	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Safety Signs identified by the signal word DANGER should be used sparingly and only for those situations presenting the most serious hazards.
	Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury. Hazards identified by the signal word WARNING present a lesser degree of risk of injury or death than those identified by the signal word DANGER.
	Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury. It may also be used without the safety alert symbol as an alternative to “NOTICE”.
	NOTICE is the preferred signal word to address practices not related to personal injury. The safety alert symbol should not be used with this signal word. As an alternative to “NOTICE”, the word “CAUTION” without the safety alert symbol may be used to indicate a message not related to personal injury.

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

- 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

- 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.

DANGER

- Before operating the manipulator, make sure the servo power is turned OFF by performing the following operations. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.
  - Press the emergency stop buttons on the front door of the YRC1000, on the programming pendant, on the external control device, etc.
  - Disconnect the safety plug of the safety fence. (when in the play mode or in the remote mode)

If operation of the manipulator cannot be stopped in an emergency, personal injury and/or equipment damage may result.

Fig. : Emergency Stop Button

- Before releasing the emergency stop, make sure to remove the obstacle or error caused the emergency stop, if any, and then turn the servo power ON.

Failure to observe this instruction may cause unintended movement of the manipulator, which may result in personal injury.

Fig. : Release of Emergency Stop

- Observe the following precautions when performing a teaching operation within the manipulator's operating range:
  - Be sure to perform lockout by putting a lockout device on the safety fence when going into the area enclosed by the safety fence. In addition, the operator of the teaching operation must display the sign that the operation is being performed so that no other person closes the safety fence.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always keep in mind emergency response measures against the manipulator’s unexpected movement toward a person.
  - Ensure a safe place to retreat in case of emergency.

Failure to observe this instruction may cause improper or unintended movement of the manipulator, which may result in personal injury.

- Confirm that no person is present in the manipulator's operating range and that the operator is in a safe location before:
  - Turning ON the YRC1000 power
  - Moving the manipulator by using the programming pendant
  - Running the system in the check mode
  - Performing automatic operations

Personal injury may result if a person enters the manipulator's operating range during operation. Immediately press an emergency stop button whenever there is a problem. The emergency stop buttons are located on the front panel of the YRC1000 and on the right of the programming pendant.

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

WARNING

- Perform the following inspection procedures prior to conducting manipulator teaching. If there is any problem, immediately take necessary steps to solve it, such as maintenance and repair.
  - Check for a problem in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the YRC1000 cabinet after use.

If the programming pendant is left unattended on the manipulator, on a fixture, or on the floor, etc., the Enable Switch may be activated due to surface irregularities of where it is left, and the servo power may be turned ON. In addition, in case the operation of the manipulator starts, the manipulator or the tool may hit the programming pendant left unattended, which may result in personal injury and/or equipment damage.

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
YRC1000 controller	YRC1000
YRC1000 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.

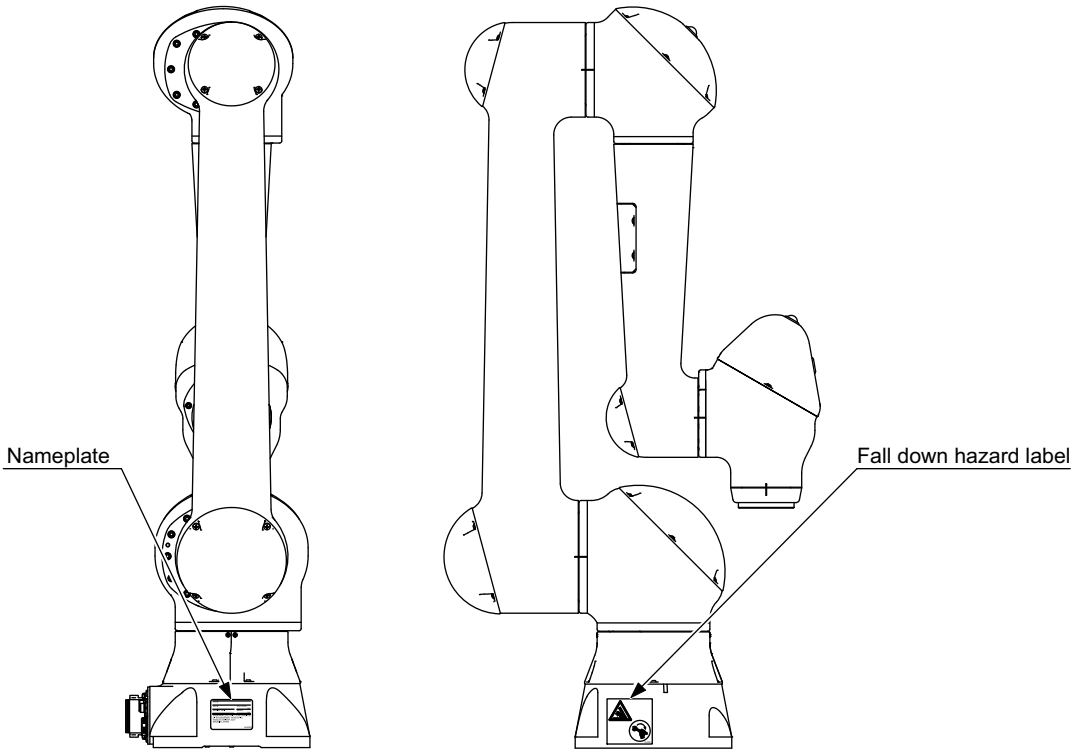
Explanation of Warning Labels

The following warning labels are attached to the manipulator.

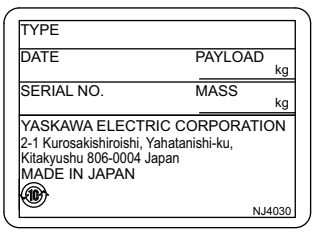
Always follow the warnings on the labels.

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

Fig. : Warning Label Locations



Nameplate



Fall down hazard label

Contents

1 Product Confirmation

CAUTION

- Confirm that the manipulator and the YRC1000 have the same order number. Pay special attention when installing two or more manipulators.

Failure to observe this instruction may cause improper movement of the manipulator, which may result in personal injury and/or equipment damage.

1.1 Contents Confirmation

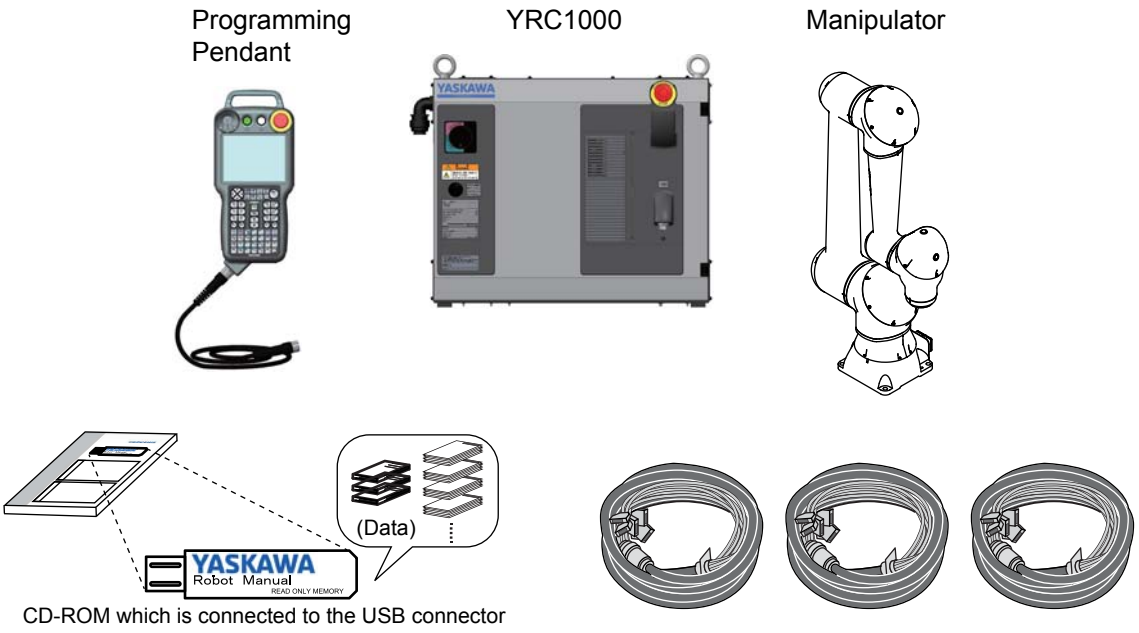
Confirm the contents of the delivery when the product arrives.

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

YRC1000 Packing contents

- Manipulator (accessories included)
- YRC1000 (spare parts included)
- Programing Pendant
- Three types of manipulator cables (between the YRC1000 and the manipulator)
- Manual

Fig. 1-1: Five Items for Standard Specifications

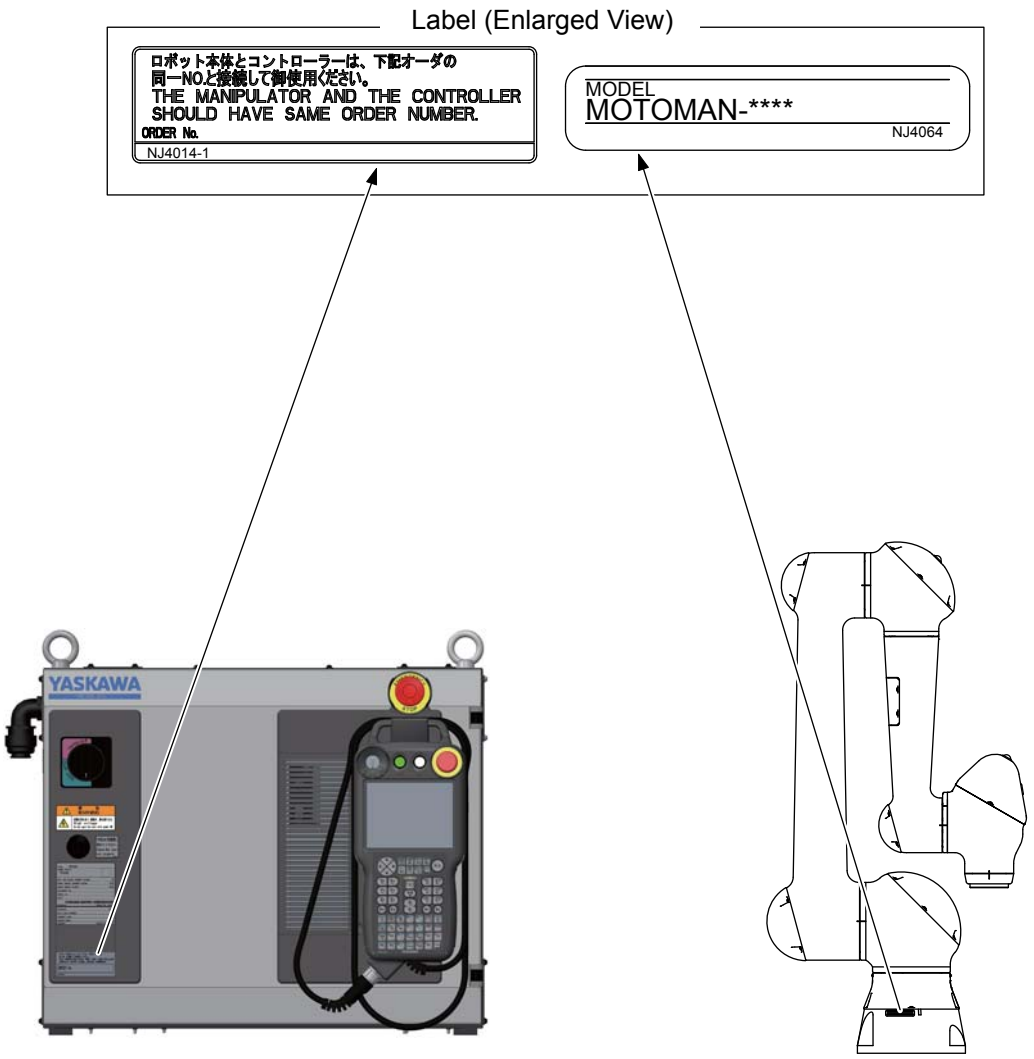


Accessories of Manipulator	Pcs	Application
Hexagon socket head cap screw M12 (length:45 mm)	4	For mounting (manipulator)
Conical spring washer M12	4	
Washer M12	4	
Eyebolt M8	2	For lifting (manipulator)
Grease zerk A-PT1/8	6	For the grease replenishment (gear part)
Joint KQ2F06-01-X2	6	
Pin HW1407797-5-85	1	For the home position calibrating (S-axis)

1.2 Order Number Confirmation

Confirm the order number of the manipulator corresponds to the YRC1000. The order number is located on a label as shown below.

Fig. 1-2: Location of Order Number Labels



(a) YRC1000 (Front View)

(b) Manipulator (Back View)

2 Transporting

WARNING

- Operation of the crane, sling, or forklift must be performed only by authorized personnel.

Failure to observe this instruction may result in personal injury and/or equipment damage.

NOTICE

- Avoid excessive vibration or shock while transporting or moving the YRC1000.

Failure to observe this instruction may adversely affect the performance of the YRC1000 because it consists of precision components.

2.1 Transporting Method

NOTE

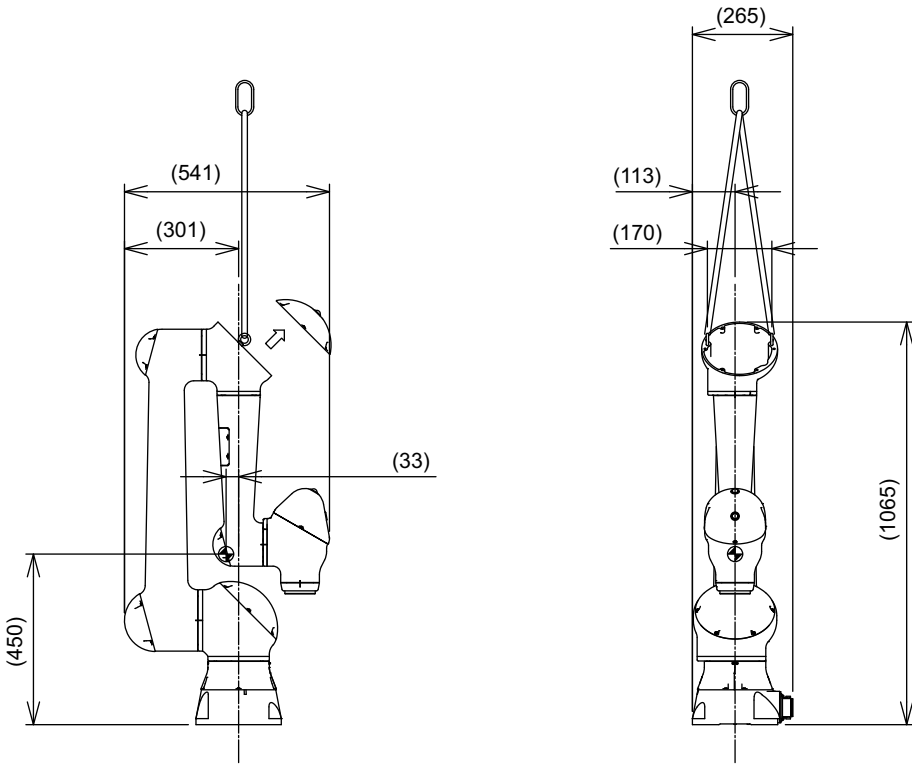
- Check that the eyebolts are securely fastened.
- The weight of the manipulator is approximately 47 kg (including the shipping bolts and brackets). Use a wire rope strong enough to withstand the weight.
- Attached eyebolts are designed to support the manipulator' mass. Do not use them for anything other than transporting the manipulator.
- Avoid applying external force on the arm or 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 two wire ropes when removing it from the package and moving it.

Be sure to lift the manipulator in the posture as shown in *fig. 2-1 "Transporting Position (factory setting)"* . The length of the wire rope must be 155 mm or longer. (⊕ indicates the position of the center of gravity).

Fig. 2-1: Transporting Position (factory setting)



Factory setting for angle and pulse of each axis

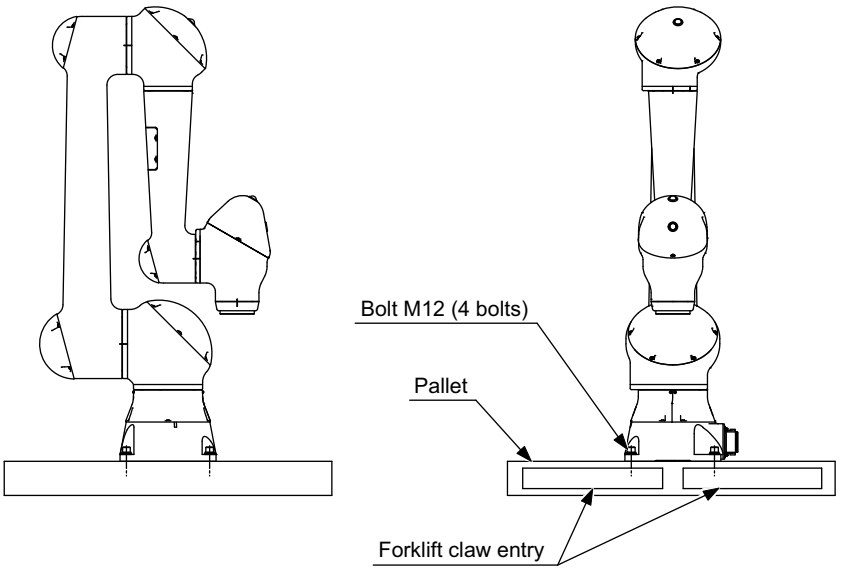
Axis	S	L	U	R	B	T
Angle	0°	0°	0°	0°	0°	0°
Pulse	0	0	0	0	0	0

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 "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: Using a Forklift



3 Installation

DANGER

- Perform the risk assessment.

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

WARNING

- Install the manipulator in a location where the tool or the workpiece held by its fully extended arm will not reach the wall, the safety fence, or the YRC1000, etc.

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

- Make sure to firmly anchor the manipulator before turning ON the power and operating the manipulator.

Failure to observe this instruction may cause overturning of the manipulator, which may result in personal injury and/or equipment damage.

- When mounting the manipulator on the wall, the wall must have sufficient strength and rigidity to support the weight of the manipulator. In addition, take precautionary measures on the manipulator base to prevent the manipulator from falling.

Failure to observe this instruction may result in personal injury and/or equipment damage.

- Do not install or operate a damaged manipulator or a manipulator any of whose components is missing.

Failure to observe this instruction may cause improper movement, etc. of the manipulator, which may result in personal injury and/or equipment damage.

NOTICE

- After completing the installation of the manipulator, make sure to remove the shipping bolts and brackets before turning ON the power.

Failure to observe this instruction may result in damage to the main drive unit.

3.1 Installation of the Safety fence

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

Responsibility for Safeguarding (ISO10218)

When designing a robot system in which an operator and a robot collaborate in the environment of no safeguarding, sufficient risk assessment should be carried out to avoid damages to the equipment or unexpected injury to the operator or people around the system during the operation.

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 reaction forces during acceleration and deceleration.

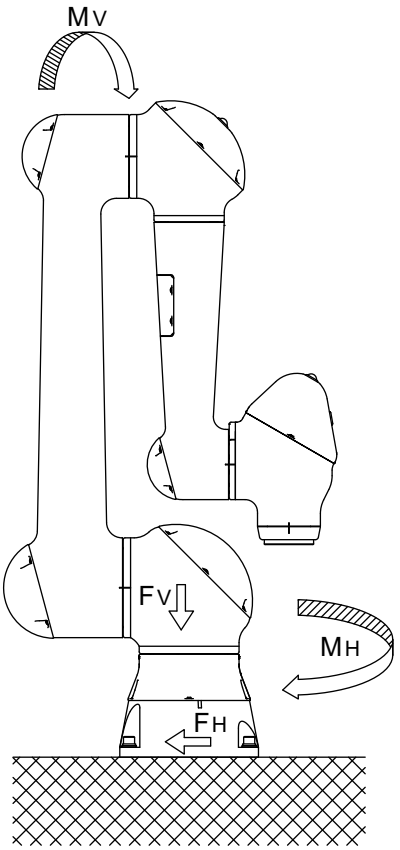
Construct a solid foundation with the appropriate thickness to withstand maximum reaction forces of the manipulator referring to *table 3-1 “Manipulator Reaction Force and Torque”* .

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 base as instructed in *chapter 3.2.1 “Mounting Example”* .

Table 3-1: Manipulator Reaction Force and Torque

	Horizontal rotation		**Vertical rotation**	
	Reaction force F_H	**Torque M_H**	**Reaction force F_V**	**Torque M_V**
Emergency stop	2548 N (260 kgf)	1842 N•m (188 kgf•m)	2254 N (230 kgf)	1842 N•m (188 kgf•m)
Acceleration/deceleration	784 N (80 kgf)	559 N•m (57 kgf•m)	784 N (80 kgf)	696 N•m (71 kgf•m)

Fig. 3-1: Manipulator Reaction Force and Torque



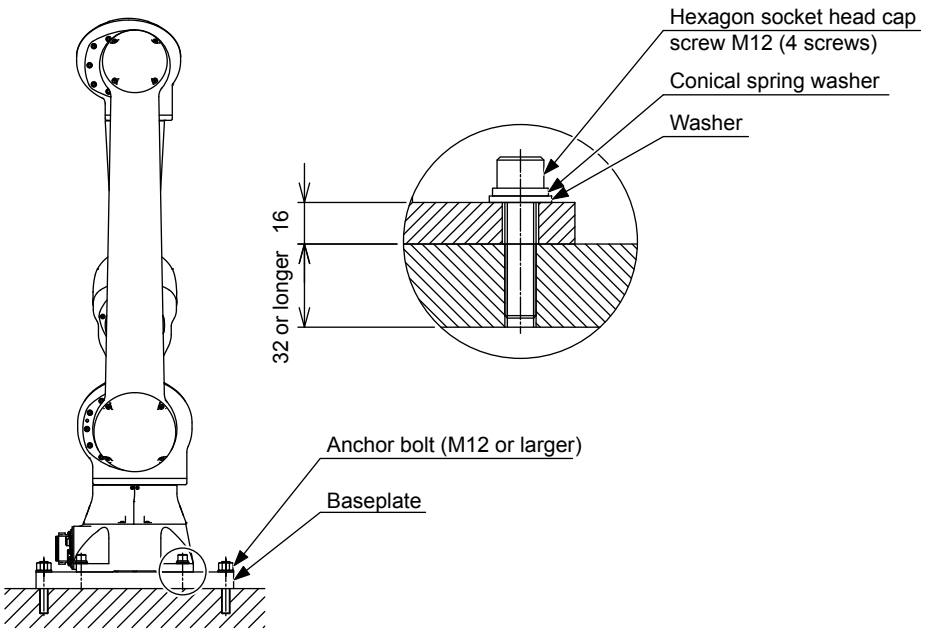
3.2.1 Mounting Example

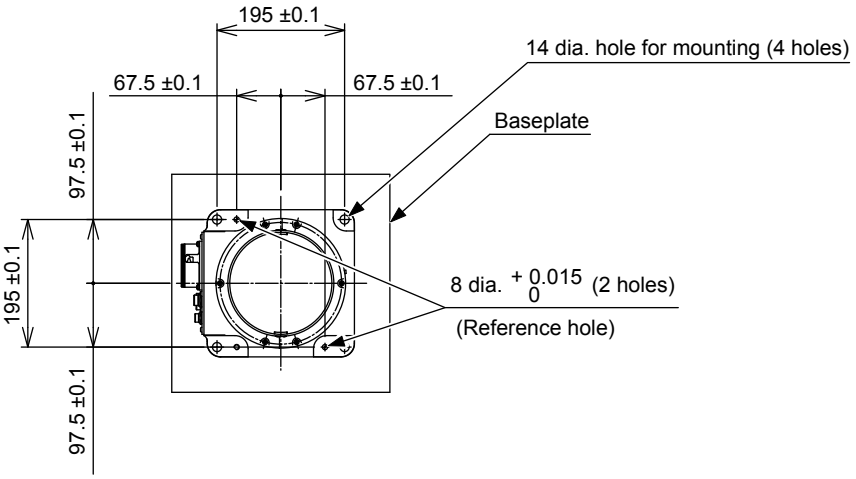
For the first process, anchor the base plate firmly to the ground. The baseplate should be rugged and durable to prevent shifting of the manipulator or the mounting fixture.
It is recommended to prepare a baseplate of 32 mm or more thickness, and anchor bolts of M12 or larger size.

The manipulator base is tapped for four mounting holes.
Fix the manipulator base to the baseplate with the four hexagon socket head cap screws M12 (Tensile strength: 1200 N/mm^2 or more, recommended length: 45 mm) by using the tightening torque 84 N·m.

The hexagon socket head cap screws and the anchor bolts must be tightened firmly so that they will not work loose during the operation.
Refer to *fig. 3-2 "Mounting Manipulator on Baseplate"* .

Fig. 3-2: Mounting Manipulator on Baseplate





3.3 Mounting Method

The MOTOMAN-HC10 are available in four ways: floor-mounted, wall-mounted, tilt-mounted and ceiling-mounted way.
For wall-mounted, tilt-mounted and ceiling-mounted ways, the following points listed below are different from the floor-mounted way.

- Fixing of the Manipulator Base
- Precautions to Prevent the Manipulator from Falling

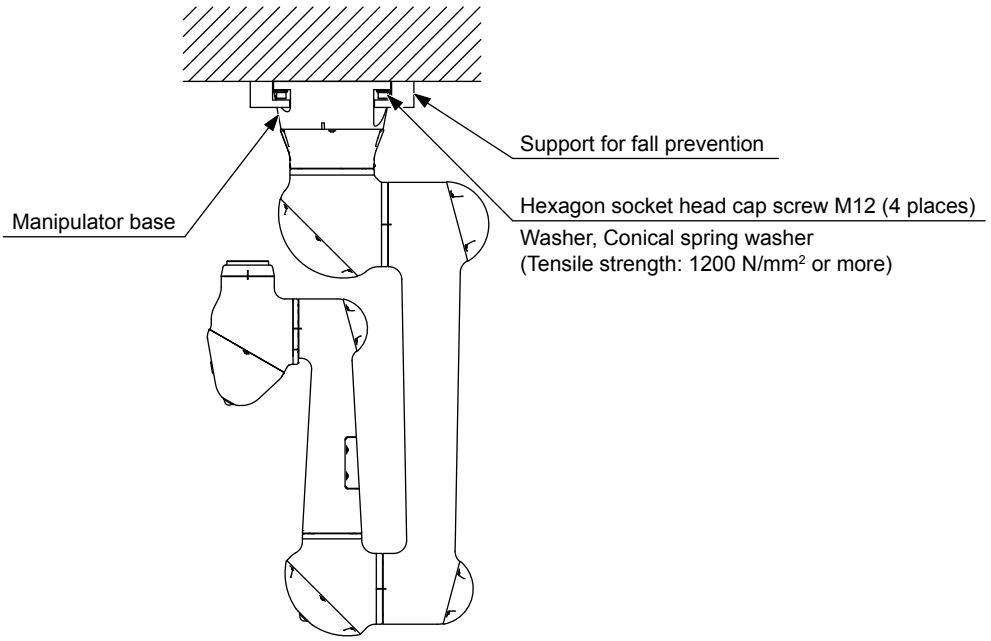
3.3.1 Fixing the Manipulator Base

For the wall- and ceiling-mounted ways, be sure to use four hexagon socket head cap screws M12 (tensile strength: 1200 N/mm^2 or more) when fixing the manipulator base. Use a torque of 84 N·m when tightening the screws.

3.3.2 Precautions to Prevent the Manipulator from Falling

For the wall- or ceiling-mounted ways, take appropriate measures to avoid the falling of the manipulator in case of emergency. Refer to *fig. 3-3 "Precaution Against Falling"* for details.

Fig. 3-3: Precaution Against Falling



NOTE

In case of using the wall-/ceiling-/tilt-mounted way, inform YASKAWA of the matter when placing an order. Be sure to contact YASKAWA representative (listed on the back cover of this instruction manual) to execute a wall/ceiling installation on site.

3.4 Location

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

- Ambient Temperature: 0° to +40°C[1)]
- Humidity: 20 to 80%RH (non-condensing)
- Free from water, explosive gas or liquid, or corrosive gas or liquid.
- Free from excessive vibration
  (Vibration acceleration: 4.9 m/s^2 [0.5G] or less)
- Free from large electrical noise (plasma)
- Flatness for installation: 0.5 mm or less
- Free from the strong magnetic field
- Altitude: 1000 m or less

When the operation is started after the manipulator has been out of operation and left in the low temperature (almost 0°C) for a long period, the alarm may occur since the resistance of the drive unit is large.
If the alarm occurs, perform the break-in for few minutes.

1 0 to +35°C when the soft cover for covering the manipulator (optional) is mounted for reducing the contact/collision impact.

4 Wiring

WARNING

- Ground resistance must be 100 Ω or less.

Failure to observe this warning may result in fire and/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.)

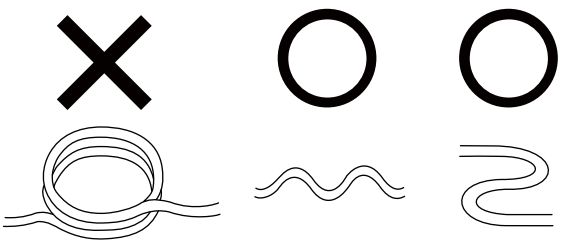
Failure to observe this warning may result in electric shock and/or personal injury.

- Wiring must be performed by authorized or certified personnel.

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

- When laying the cables from the manipulator to the YRC1000, DO NOT cover the cable with heat insulating material and avoid multiple cabling.

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



4.1 Grounding

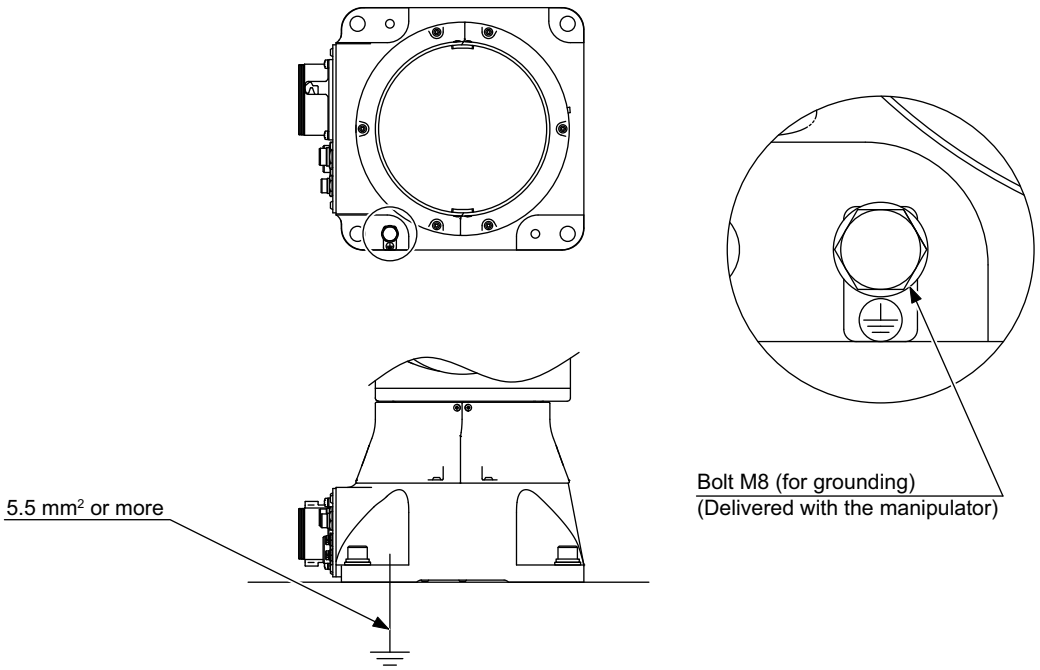
Follow the electrical installation standards and wiring regulations for grounding. A ground wire of 5.5 mm^2 or more is recommended.

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

NOTE

- 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, 1BC, TQ, and SW are delivered. (Refer to *fig. 4-3 "Manipulator Cable for YRC1000"* .)
Connect the both edge of the manipulator cable to the manipulator base connectors and to the YRC1000. Before connecting the cable to the manipulator, verify the numbers on the connector as shown in *fig. 4-3 "Manipulator Cable for YRC1000"* .
For the connecting position, refer to *fig. 4-4 "Manipulator Cable Connection (Manipulator Side)"* and *fig. 4-5 "Manipulator Cable Connection (YRC1000 Side)"* .

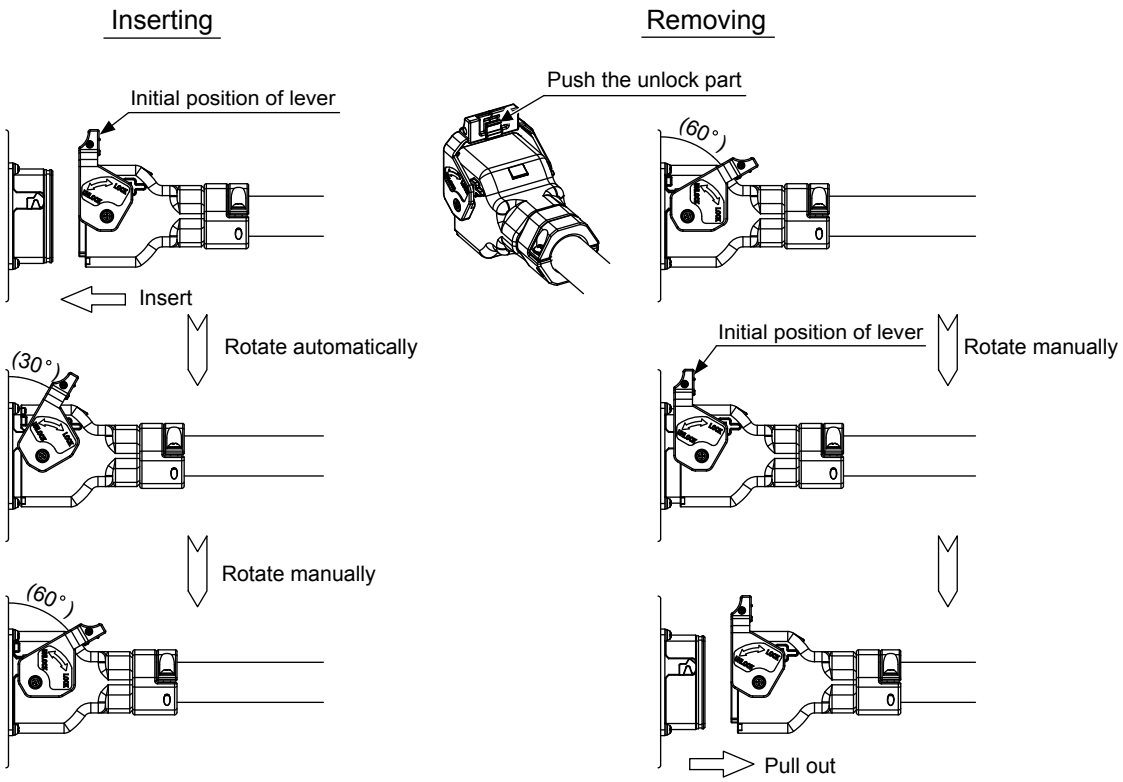
■ **Procedures for inserting the connector (1BC)**

1. Confirm the connector lever of the manipulator cable is at the initial position. Insert the cable straight into the connector on the back side of the YRC1000. Insert the manipulator cable to a fixed depth then the lever rotates about 30 degree forward automatically.
2. Push the lever with hand and turn it (about 30 degree) until the lock is clicked.

■ **Procedures for removing the connector**

1. Release the lock by pushing the unlock part of the lever to unlock. Turn the lever about 60 degree to return to the initial position.
2. Pull out the connector straight.

Fig. 4-2(a): Connection of Manipulator Cable (1BC)



■ **Procedures for inserting the manipulator cable (For TQ and SW)**

1. Confirm that the direction of the arrow on the manipulator cable is upward, and insert the cable straight into the manipulator and the connector of the YRC1000.
2. Turn the knob with the arrow mark to the direction of the arrow.

■ **Procedures for removing the manipulator cable (For TQ and SW)**

1. Turn the knob with the arrow mark to the opposite direction of the arrow.
2. Pull out the connector straight.

Fig. 4-2(b): Connection of Manipulator Cable (TQ, SW)

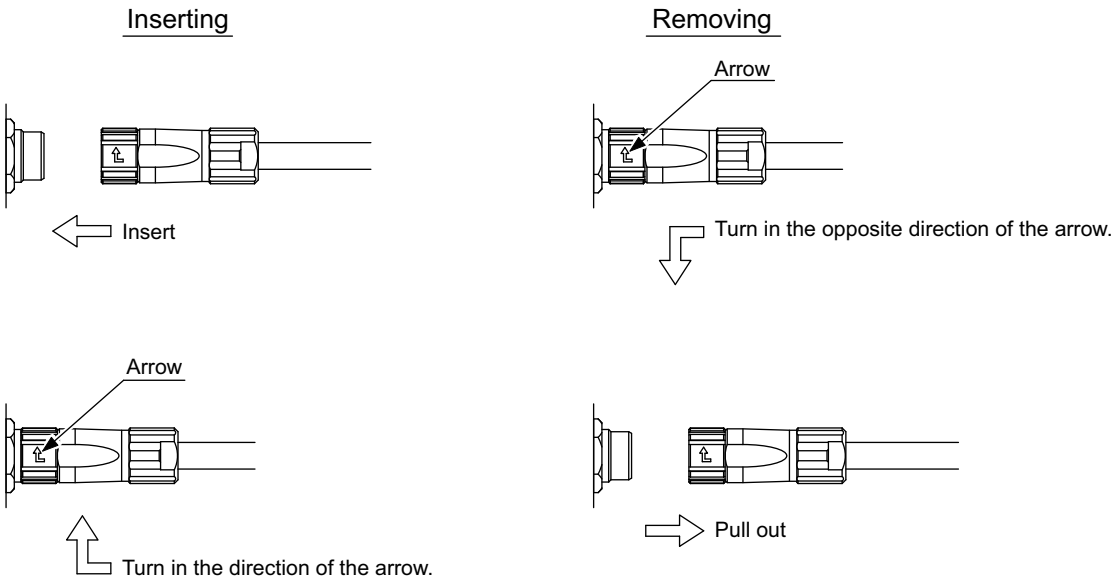


Fig. 4-3: Manipulator Cable for YRC1000

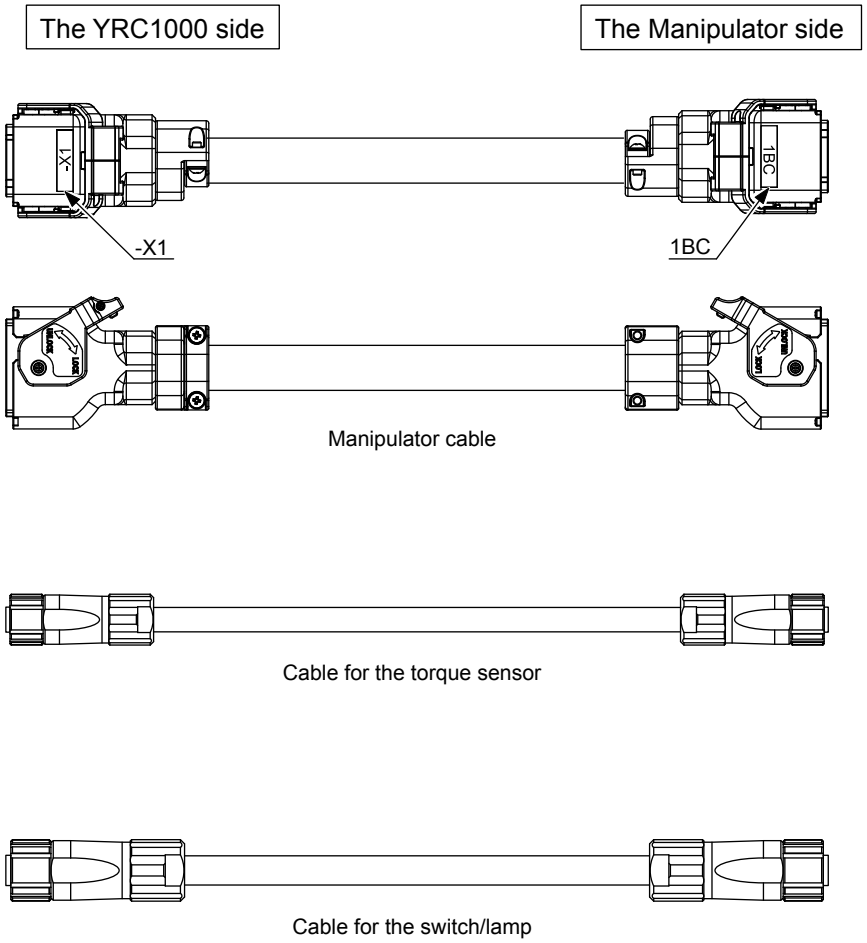


Fig. 4-4: Manipulator Cable Connection (Manipulator Side)

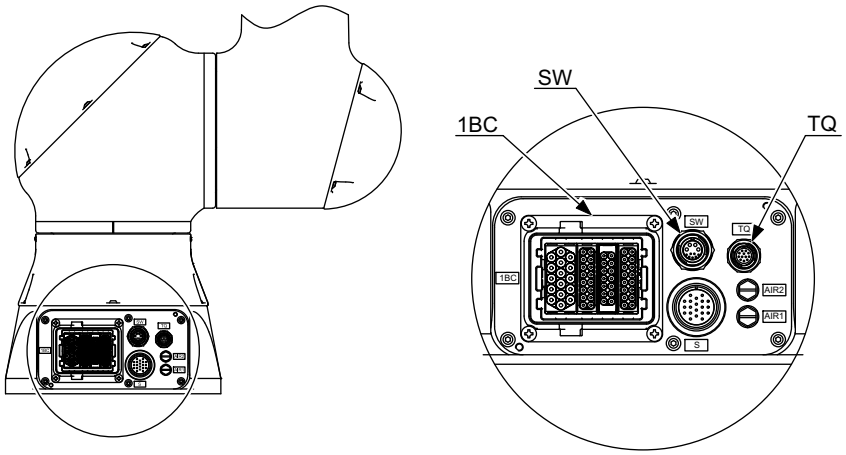
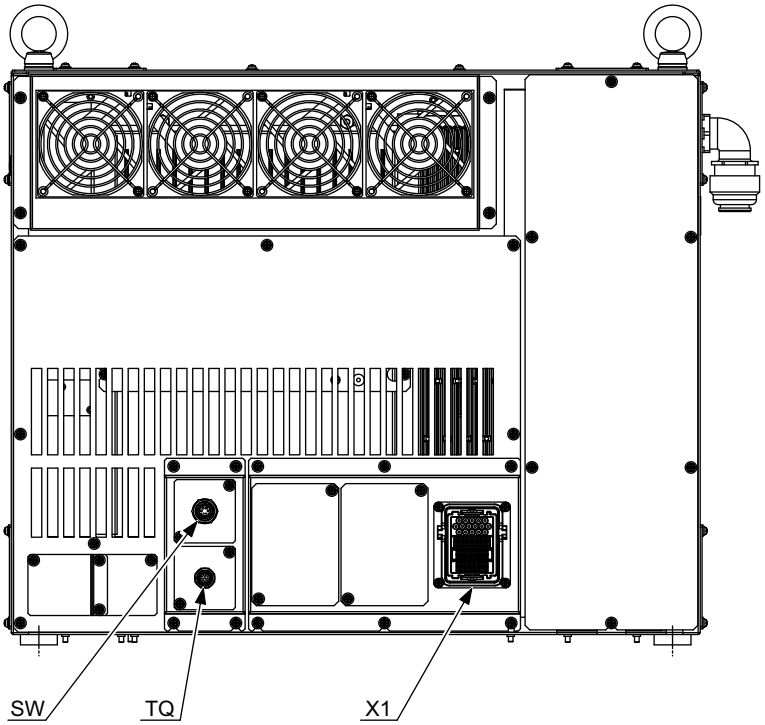


Fig. 4-5: Manipulator Cable Connection (YRC1000 Side)



5 Basic Specifications

5.1 Basic Specifications

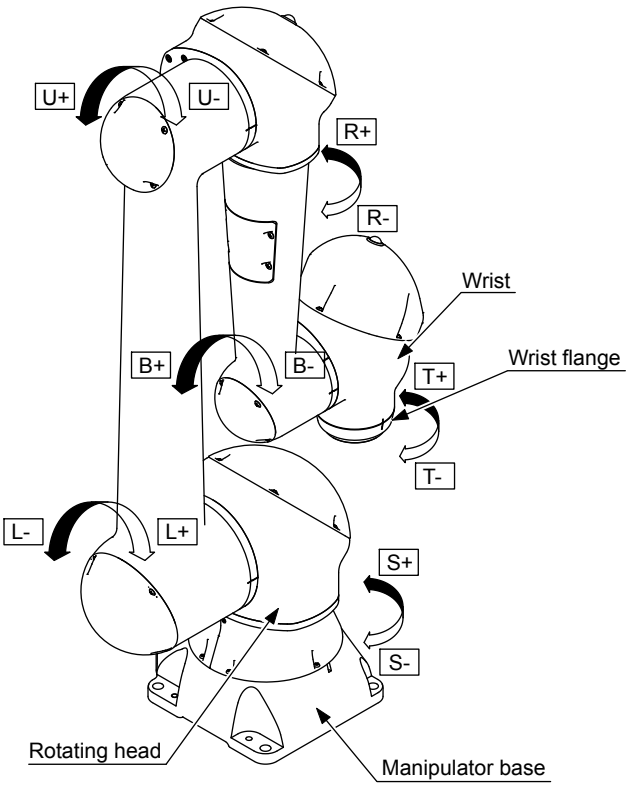
Table 5-1: Basic Specifications[1)]

Item \ Model		MOTOMAN-HC10
Application		For collaborative operation
Structure		Vertically Articulated
Degree of freedom		6
Payload		10 kg
Repeatability[2)]		±0.1 mm
Range of Motion	S-Axis (turning)	-180° - +180°
	L-Axis (lower arm)	-180° - +180°
	U-Axis (upper arm)	-5° - +355°
	R-Axis (wrist roll)	-180° - +180°
	B-Axis (wrist pitch/yaw)	-180° - +180°
	T-Axis (wrist twist)	-180° - +180°
Maximum Speed	S-Axis	2.27 rad/s, 130°/s
	L-Axis	2.27 rad/s, 130°/s
	U-Axis	3.14 rad/s, 180°/s
	R-Axis	3.14 rad/s, 180°/s
	B-Axis	4.36 rad/s, 250°/s
	T-Axis	4.36 rad/s, 250°/s
Allowable Moment[3)]	R-Axis	27.4 N•m (2.8 kgf•m)
	B-Axis	27.4 N•m (2.8 kgf•m)
	T-Axis	9.8 N•m (1.0 kgf•m)
Allowable Inertia ($GD^2/4$)	R-Axis	0.78 kg•m^2
	B-Axis	0.78 kg•m^2
	T-Axis	0.10 kg•m^2
Approx. Mass		47 kg
Protective enclosure		IP20
Mounting method		Floor-, wall-, tilt-, ceiling-mounted,
Ambient Conditions	Temperature	0 to 40°C[4)]
	Humidity	20 to 80% RH (non-condensing)
	Vibration	4.9 m/s^2 (0.5G) or less
	Altitude	1000 m or less
	Others	Free from corrosive gas or liquid, or explosive gas Free from dust, soot, or water Free from excessive electrical noise (plasma) Free from strong magnetic field
Power Capacity		1 kVA
Applicable controller		YRC1000
Noise[5)]		70 dB or less

1 SI units are used in this table. However, gravitational unit is used in ( )
2 Conformed to ISO9283
3 Refer to *fig. 6-1 "Moment Arm Rating"* for details on the allowable inertia.
4 0 to +35°C when the soft cover for covering the manipulator (optional) is mounted for reducing the contact/collision impact.
5 Conformed to equivalent continuous A-weighted sound pressure level measured in accordance with ISO11201(EN31201)
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 1.2 m and 1.5 m above the ground.
-400 mm away from the P-point maximum envelope.

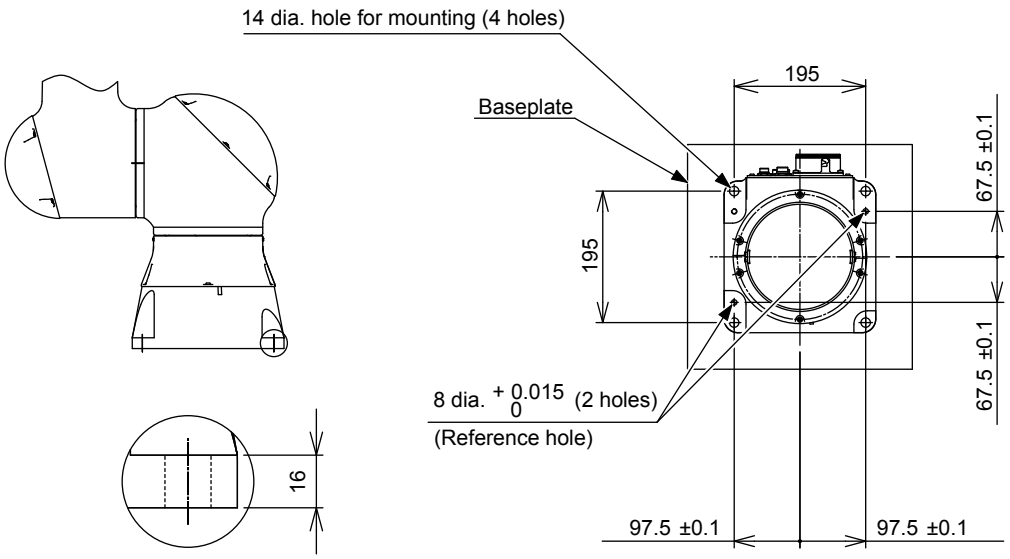
5.2 Part Names and Working Axes

Fig. 5-1: Part Names and Working Axes



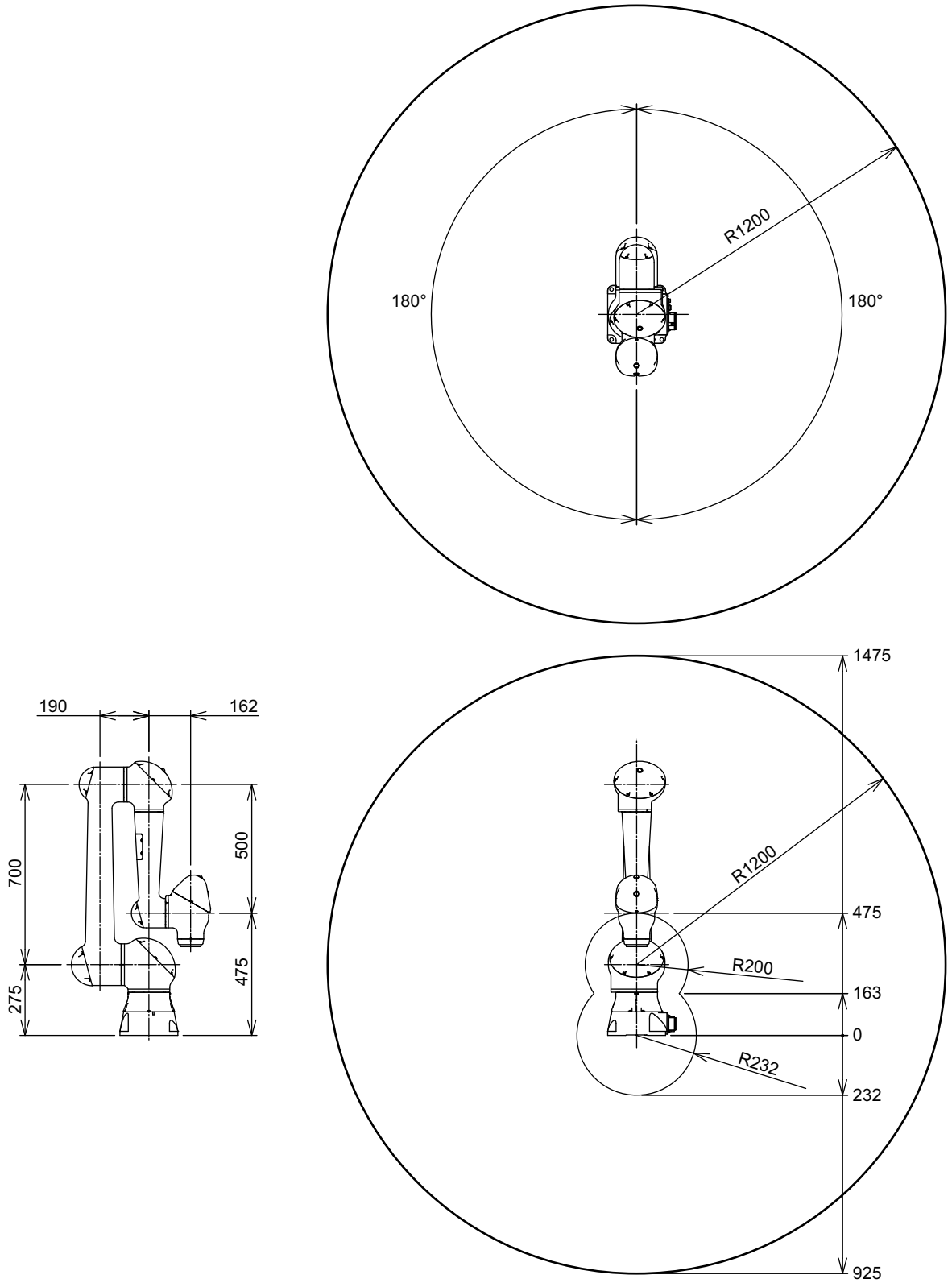
5.3 Baseplate Dimensions

Fig. 5-2: Manipulator Base Dimensions



5.4 Dimensions and P-Point Maximum Envelope

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



5.5 Stopping Distance and Time for S-, L-, and U-Axes

5.5.1 General Information

- The stopping distance is an angle traveled by the manipulator from the moment when the stop signal is activated until the manipulator comes to a complete standstill.
- The stopping time is a time elapsed from the moment that the stop signal is activated until the manipulator comes to a complete standstill.
- The data that are given for the main axes S, L and U are the maximum displacement.
- Superposed axes motions may result in longer stopping distance.
- Stopping distance and stopping time are measured in accordance with ISO 10218-1, Annex B
- Stop categories: According to IEC60204-1
  - Stop category 0
  - Stop category 1
- The values specified for Stop category 0 are the reference values that are determined by tests and simulations. The actual stopping distance and stopping time may differ.

5.5.2 Definition of Use

Load : Rated load weight and load on an arm

Speed : Operating speed of the manipulator

Extension : Distance between the rotation center and the P-point of each axis

5.5.3 Stopping Distance and Time for Stop Category 0: S-, L- and U-Axes

Measurement Conditions

- Load: Maximum load
- Speed: Maximum speed
- Posture: Maximum inertia generation posture

Axis	Stopping distance (deg)	Stopping Time (sec)
S-axis	6.4	0.082
L-axis	10.2	0.144
U-axis	16.6	0.140

5.5.4 Stopping Distance and Time for Stop Category 1: S-, L- and U-Axes

5.5.4.1 Extension

Refer to *fig. 5-4 "S-Axis Extension"* ,*fig. 5-5 "L-Axis Extension"* and *fig. 5-6 "U-Axis Extension"* for each axis arm extension.

Fig. 5-4: S-Axis Extension

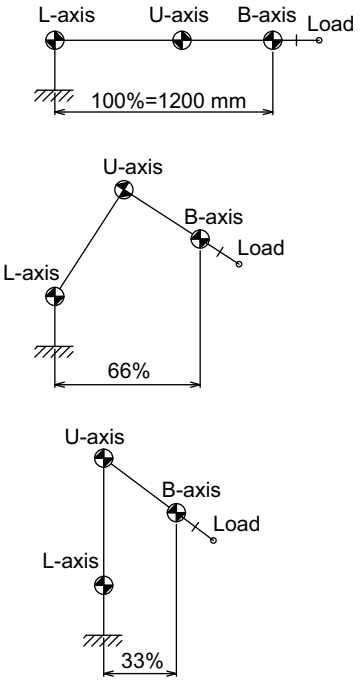


Fig. 5-5: L-Axis Extension

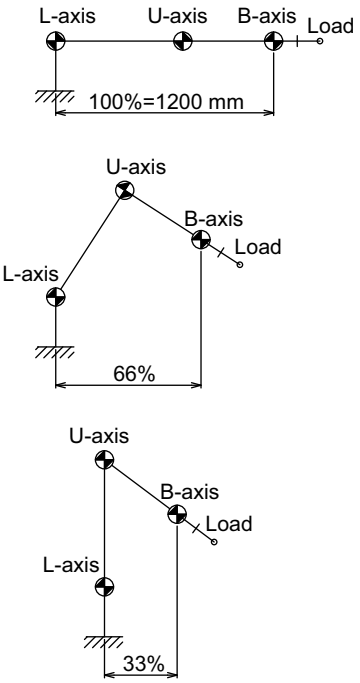
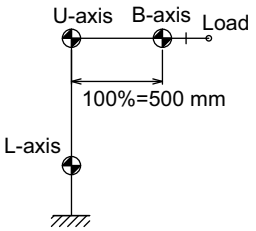
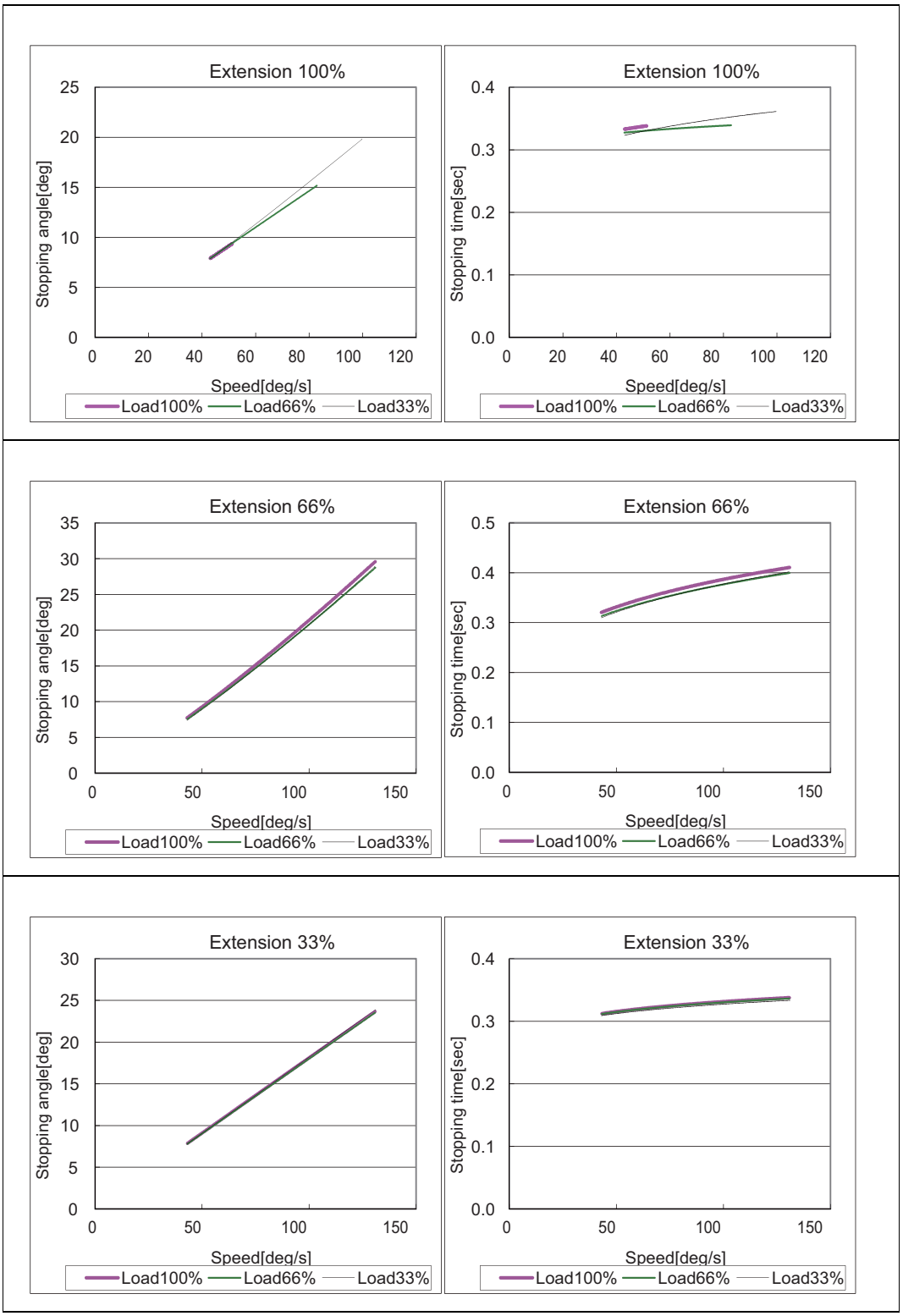


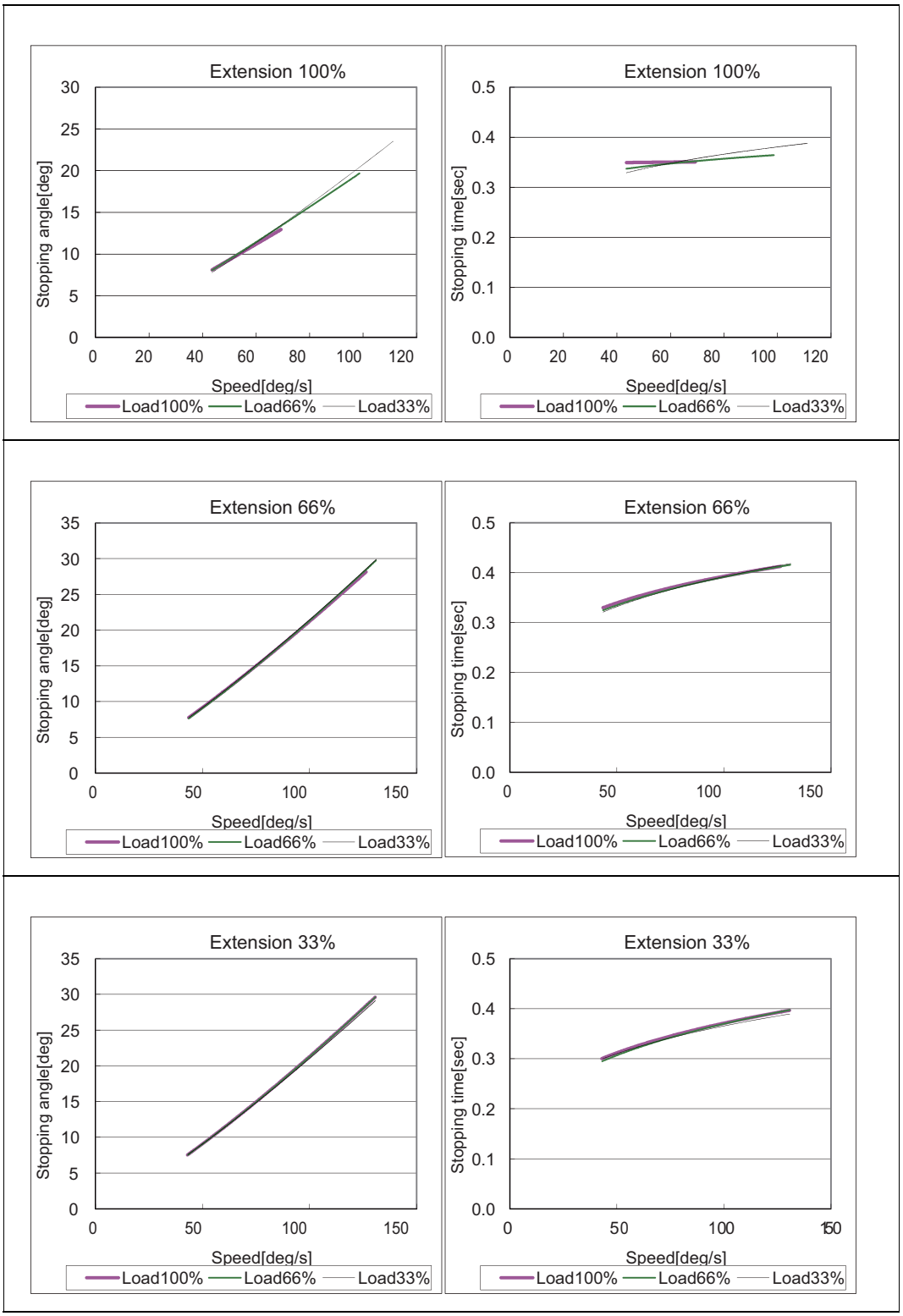
Fig. 5-6: U-Axis Extension



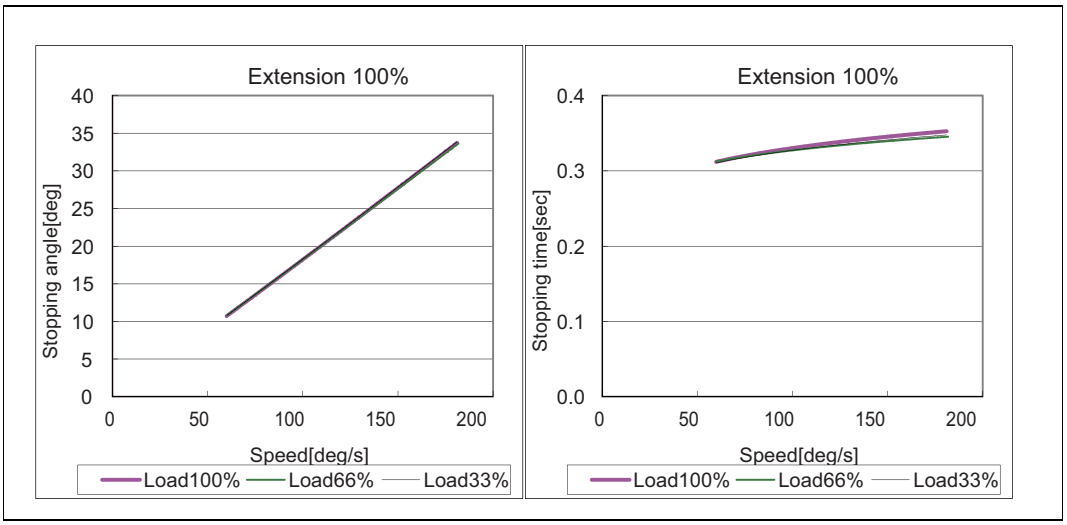
5.5.4.2 Stopping Distance and Time for Stop Category 1: S-Axis



5.5.4.3 Stopping Distance and Time for Stop Category 1: L-Axis



5.5.4.4 Stopping Distance and Time for Stop Category 1: U-Axis



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	-180° - +180° (standard) -165° - +165° -150° - +150° -135° - +135° -120° - +120° -105° - +105° -90° - +90° -75° - +75° -60° - +60° -45° - +45° -30° - +30° -15° - +15° -0° - +0°

5.6.1 Components for Altering Operating Range

Prepare the components listed in *fig. 5-7 "The Components of the S-Axis Stopper and Stopper Mounting Position."* , when modifying the angle of S-axis.

(1) Ring (HW1306534-1): 2 rings

(2) Stopper (HW1306535-1): 1 stopper

(3) Stopper (HW1306535-2): 1 stopper

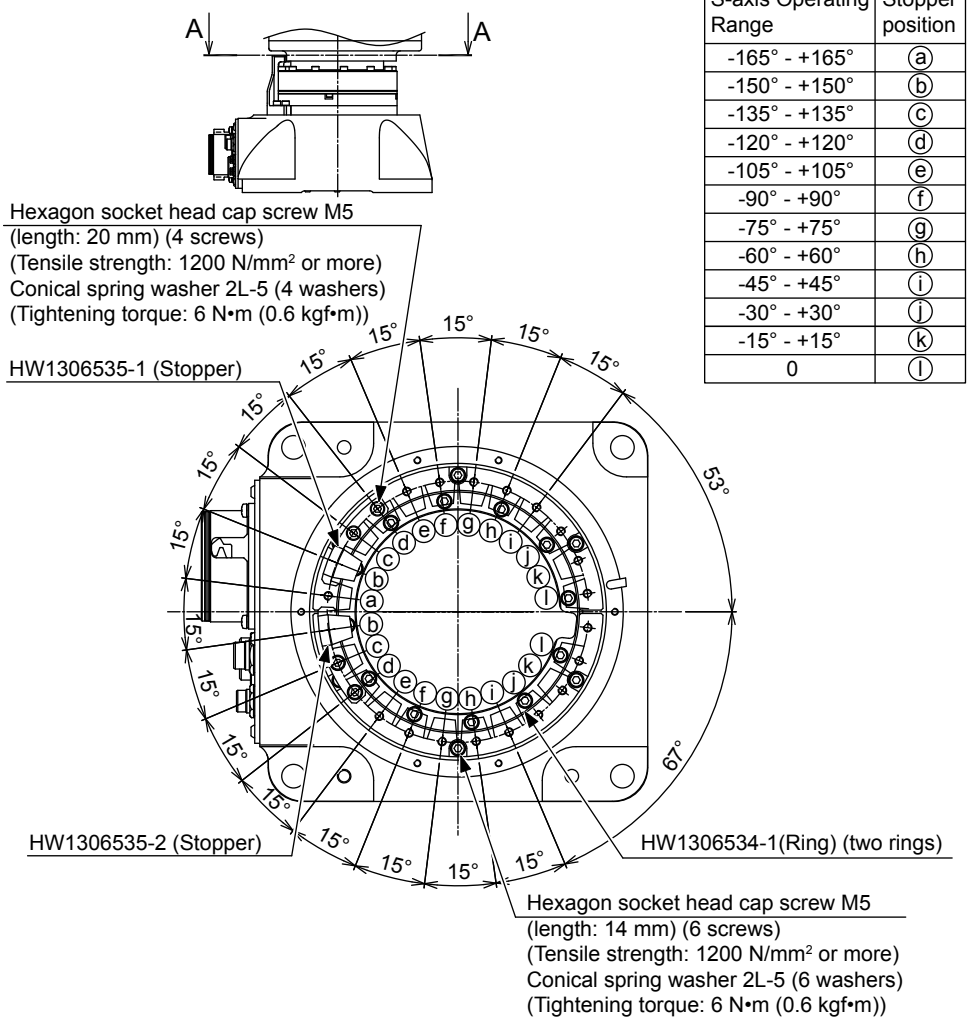
(4) Hexagon socket head cap screw M5 (length: 20 mm): 4 screws
(Tensile strength: 1200 N/mm^2 or more)

(5) Hexagon socket head cap screw M5 (length: 14 mm): 6 screws
(Tensile strength: 1200 N/mm^2 or more)

(6) Conical spring washer M5: 10 washers

Fig. 5-7: The Components of the S-Axis Stopper and Stopper Mounting Position.

S-axis Operating Range	Stopper position
-165° - +165°	ⓐ
-150° - +150°	ⓑ
-135° - +135°	ⓒ
-120° - +120°	ⓓ
-105° - +105°	ⓔ
-90° - +90°	ⓕ
-75° - +75°	ⓖ
-60° - +60°	ⓗ
-45° - +45°	ⓘ
-30° - +30°	ⓙ
-15° - +15°	ⓚ
0	ⓛ



Section A-A Stopper Mouting Position

5.6.2 Notes on the Mechanical Stopper Installation

When mounting the S-axis mechanical stopper, as shown in *fig. 5-7 "The Components of the S-Axis Stopper and Stopper Mounting Position."* , mount the HW136534-1 (two rings) with six hexagon socket head cap screws M5 (length: 14 mm) (two screws) (three places) with using the tightening torque 6 N･m (tensile strength: 1200 N/mm^2 or more), mount the HW1306535-1 and HW1306535-2 (two stoppers) with four hexagon socket head cap screws M5 (length: 20 mm) (two screws) (two places) with using the tightening torque 6 N･m (tensile strength: 1200 N/mm^2 or more) to the base.

When the motion range is ±180° (standard), mounting the stopper is not required.
S-axis mechanical stopper can be set at 15° pitch intervals from ± 0° to 165° range.
For the settable angles, refer to *table 5-3 "The Settable Angle for S-Axis Stopper"* .

NOTE

1. Use the specified bolts when mounting the S-Axis mechanical stopper.
2. Turn OFF the electric power supply before mounting.

5.6.3 Adjustment to the Pulse Limitation of S-Axis

Apply the Instruction for "Chap.8.17 Changing the Parameter Setting" in "YRC1000 INSTRUCTIONS (RE-CTO-A221)" as part of reference materials for adjusting the programming pendant when modifying the range of motion of S-Axis.

The limitation to the pulse (Pulse Soft Limit + 1st Axis) : SICxG800

The limitation to the pulse (Pulse Soft Limit - 1st Axis) : SICxG810

Degree	±0°	±15°	±30°	±45°	±60°	±75°	±90°
Number of Pulse	±0	±40070	±80139	±120209	±160279	±200348	±240418

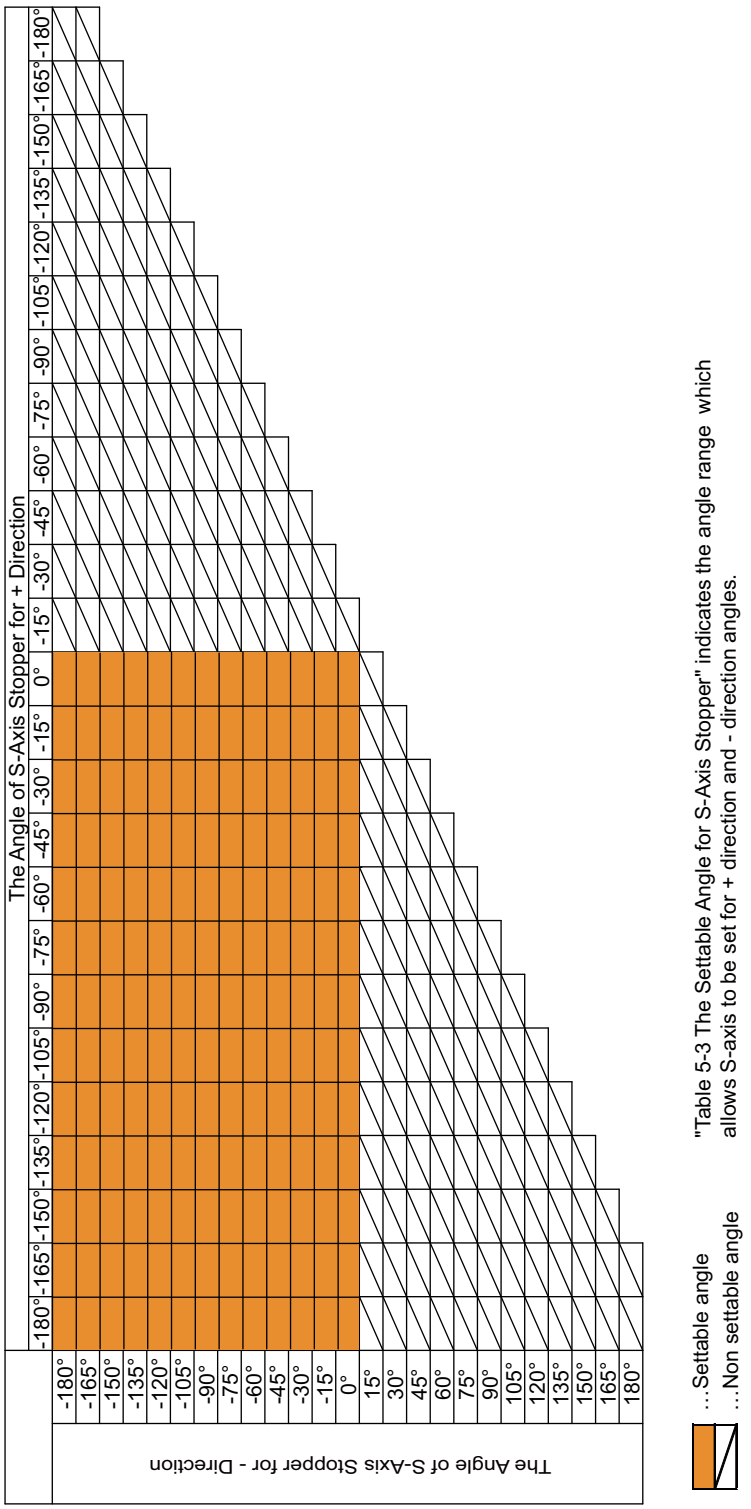
Degree	±105°	±120°	±135°	±150°	±165°	±180°
Number of Pulse	±280487	±320557	±360627	±400696	±440766	±480835

NOTE

When modifying the range of motion for machinery, adjust both of the pulse limitation and the angle of S-Axis mechanical stopper.

The settable angles for S-axis stopper are shown in *table 5-3 "The Settable Angle for S-Axis Stopper"* .

Table 5-3: The Settable Angle for S-Axis Stopper



6 Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

The allowable payload of the wrist axis is 10 kg. However, the requirements listed in *table 6-1 "Allowable Wrist Load"* must be satisfied regarding the moment and the inertia.

Even if the load is not applied as mass but applied as force, the values in *table 6-1* must not be exceeded.

Table 6-1: Allowable Wrist Load

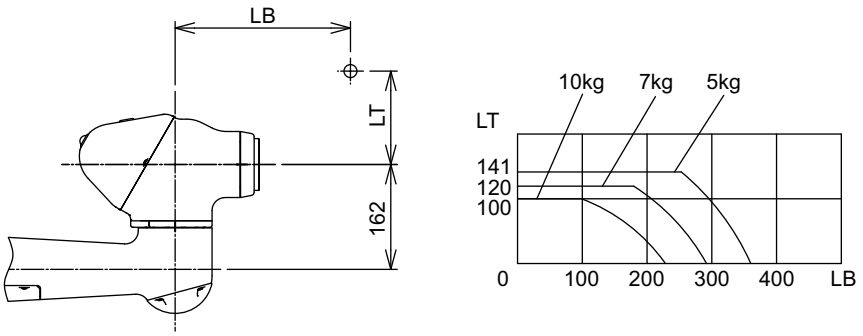
Axis	Allowable moment N•m (kgf•m)[1)]	Allowable inertia ($GD^2/4$) kg•m^2
R-Axis	27.4 (2.8)	0.78
B-Axis	27.4 (2.8)	0.78
T-Axis	9.8 (1.0)	0.1

1 ( ): Gravitational unit

When the volume of the load is relatively small, refer to the moment arm rating (L_B, L_T) shown in *fig. 6-1 "Moment Arm Rating"* .

Each value of the allowable inertia above is calculated assuming that the moment load is at the maximum. Thus, in the case when only the inertia load is applied, when the moment load is small while the inertia load is large, or when the load is not applied as mass but applied as force, etc., contact your YASKAWA representative in advance.

Fig. 6-1: Moment Arm Rating

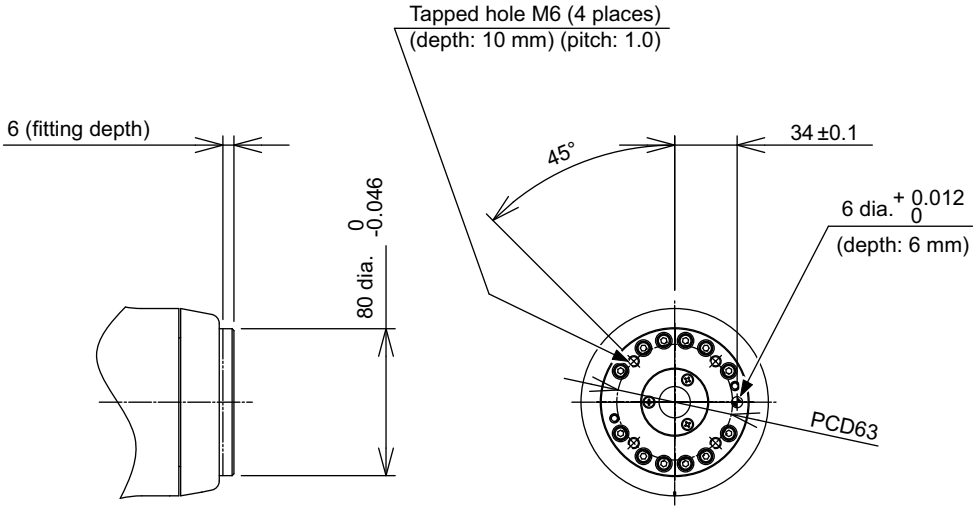


6.2 Wrist Flange

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 6 mm or less.

Fig. 6-2: Wrist Flange



7 System Application

7.1 Internal User I/O Wiring Harness and Air Lines

Internal user I/O wiring harness (8 wires :0.2 mm^2, 8 wires :0.3 mm^2) and two air lines are incorporated in the manipulator for the drive of the peripheral devices mounted on the upper arm as shown in *fig. 7-1 "Connectors for Internal User I/O Wiring Harness and Air Line (Standard specifications)"* .

The connector pins 1 to 16 are assigned as shown in *fig. 7-2 "Details of the Connector Pin Numbers (Standard Specifications)"* . Wiring must be performed by users. conditions below:

The allowable current for internal user I/O wiring harness	2.5 A or less for each wire (The total current value for pins 1 to 16 must be 40 A or less.)
The maximum pressure for the air line	490 kPa (5 kgf/cm^2) or less (The air hose inside diameter: 2.5 mm)

Fig. 7-1: Connectors for Internal User I/O Wiring Harness and Air Line (Standard specifications)

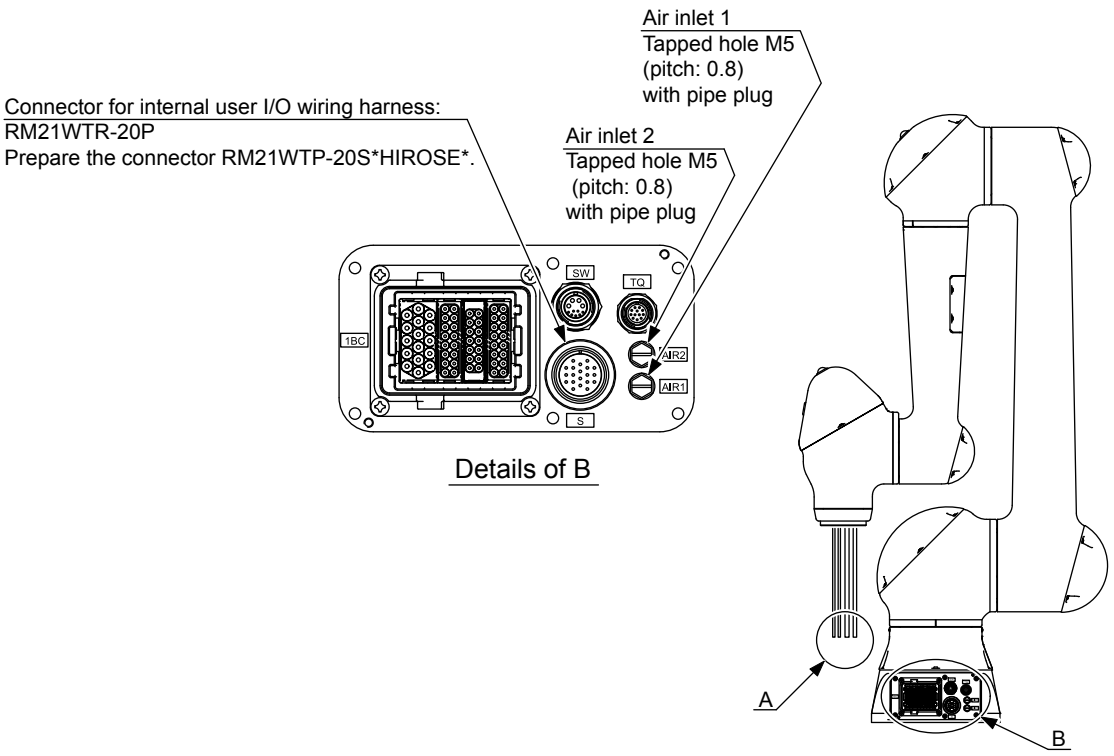


Fig. 7-2: Details of the Connector Pin Numbers (Standard Specifications)

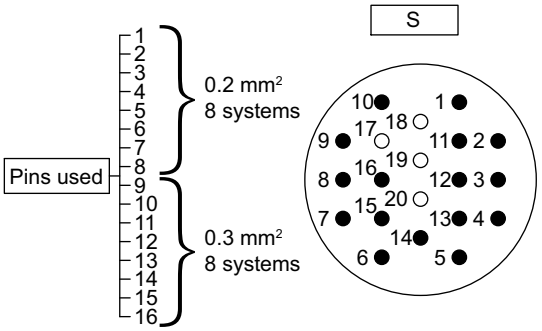


Fig. 7-3: Connectors for Internal User I/O Wiring Harness and Air Line (When From the Bottom of the Manipulator Base)

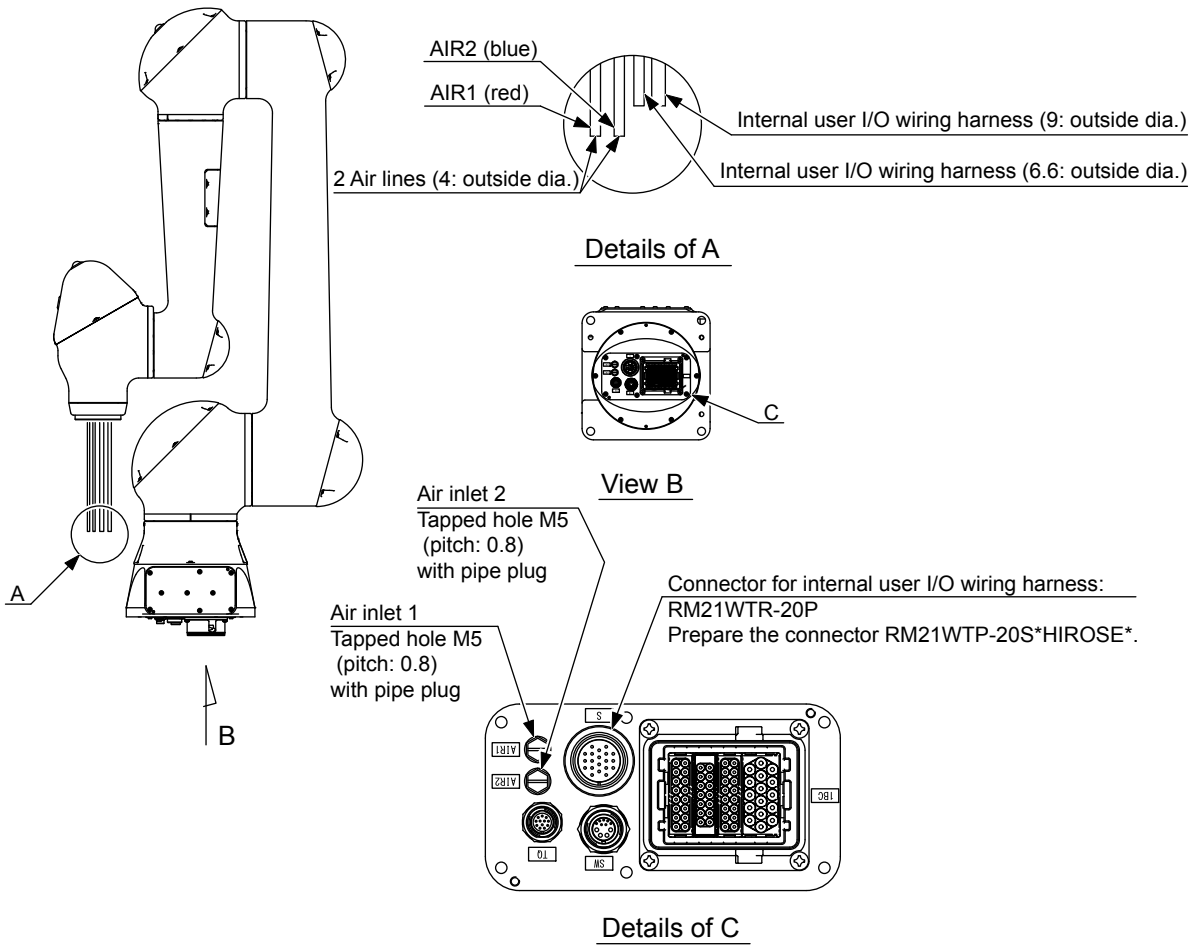
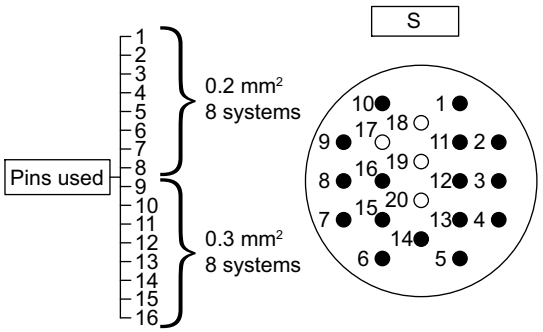


Fig. 7-4: Details of the Connector Pin Numbers (When From the Bottom of the Manipulator Base)



7.2 Soft Cover for Covering the Manipulator (Optional)

The soft cover for covering the manipulator is optional.

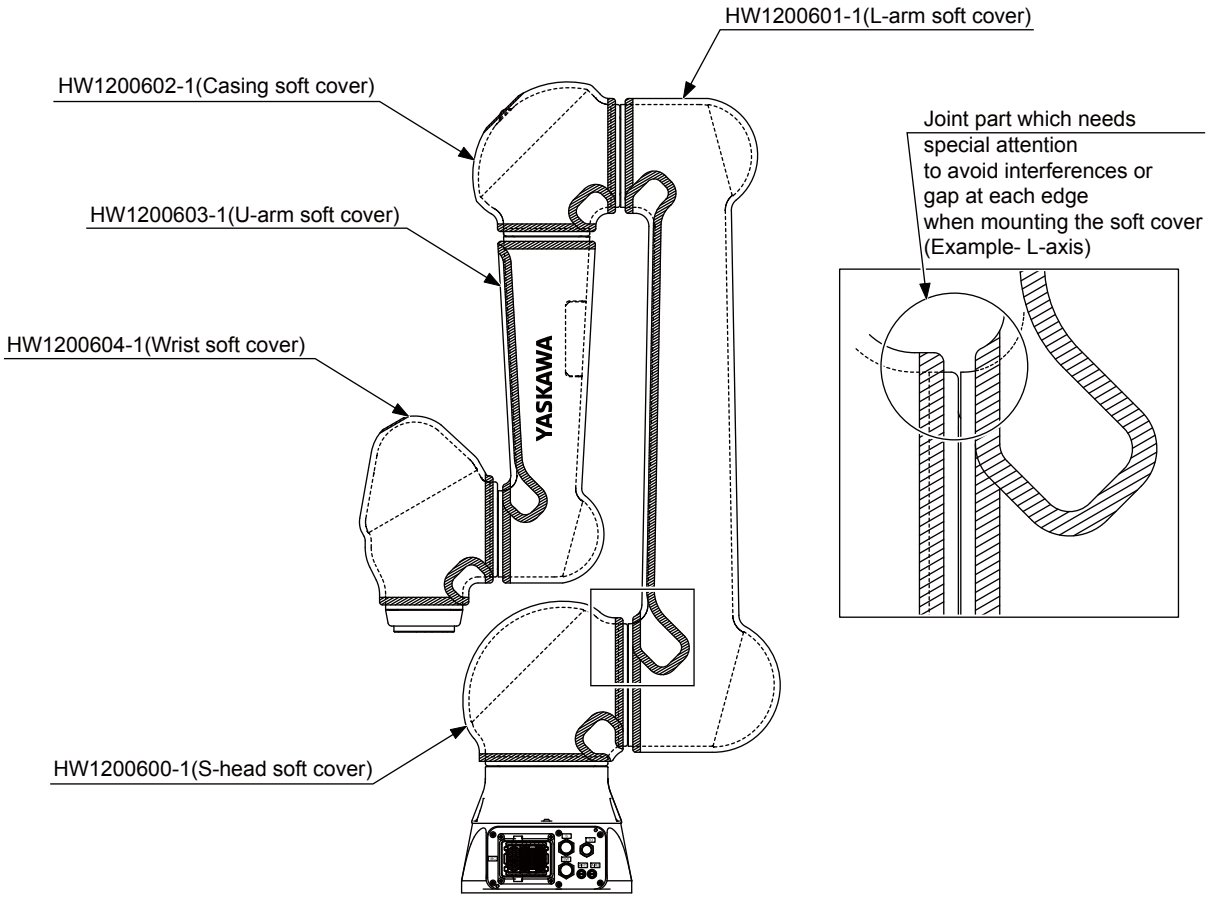
For the mounting position of the soft cover, refer to *fig. 7-5 "Mounting Position of the Soft Cover"* .

■ **Notes when mounting the soft cover**

Mount the soft cover properly by following the notes below to avoid it from being damaged (wear) or coming off.

- Mount the soft cover correctly so that the corner deviation may not occur.
- The soft cover is made of elastic material. Be careful not to strain excessively.
- Do not cover the entire joint part for preventing interference.

Fig. 7-5: Mounting Position of the Soft Cover



■ **Notes when using a soft cover**

When the soft cover is mounted, the temperature of the manipulator's components rises easily. Therefore, the limitation of the ambient temperature for installation is set below the standard temperature for the purpose of protecting the manipulator.

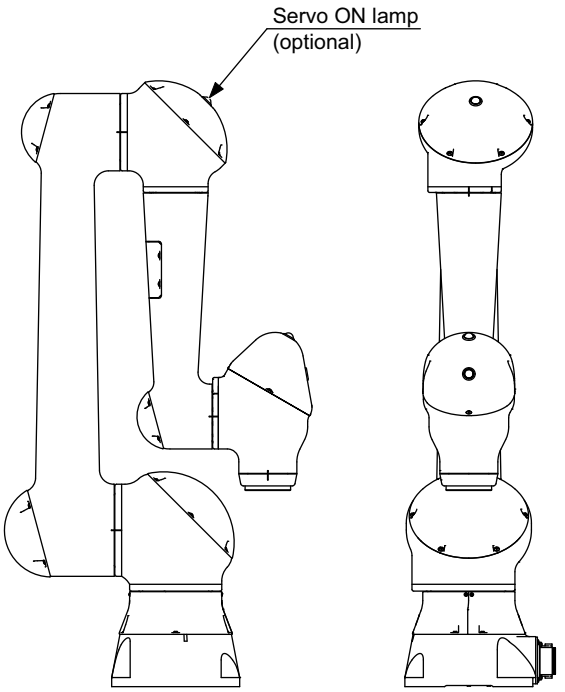
Standard	0 - 40°C
When mounting the soft cover	0 - 35°C

8 Electrical Equipment Specification

8.1 Position of Servo ON Lamp

Servo ON lamp is an optional. For its location, refer to *fig. 8-1 "Servo ON Lamp"* .

Fig. 8-1: Servo ON Lamp



8.2 Internal Connections

High reliability connectors are equipped on each connection part of the manipulator to enable easy removal and installation for maintenance and inspection. For the number and location of connectors, see *fig. 8-2 “Locations and Numbers of Connectors”* .

Diagrams for internal connections of the manipulator and the YRC1000 are shown in *fig. 8-3(a) “Internal Connection Diagram for YRC1000”* , *fig. 8-3(b) “Internal Connection Diagram for YRC1000”* .

Fig. 8-2: Locations and Numbers of Connectors

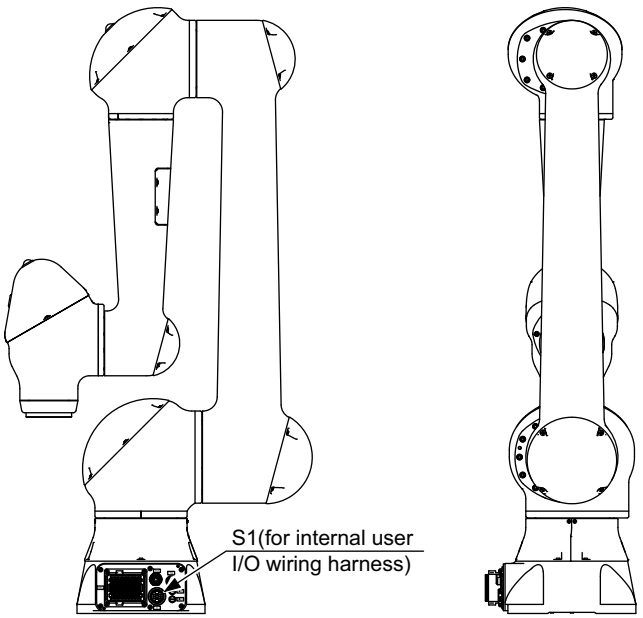


Table 8-1: List of Connector Types

Name	Type of Connector
Connector for Internal User I/O Wiring Harness on the connector base	RM21WTR-20P (RM21WTP-20S*HIROSE*: Optional)

Fig. 8-3(a): Internal Connection Diagram for YRC1000

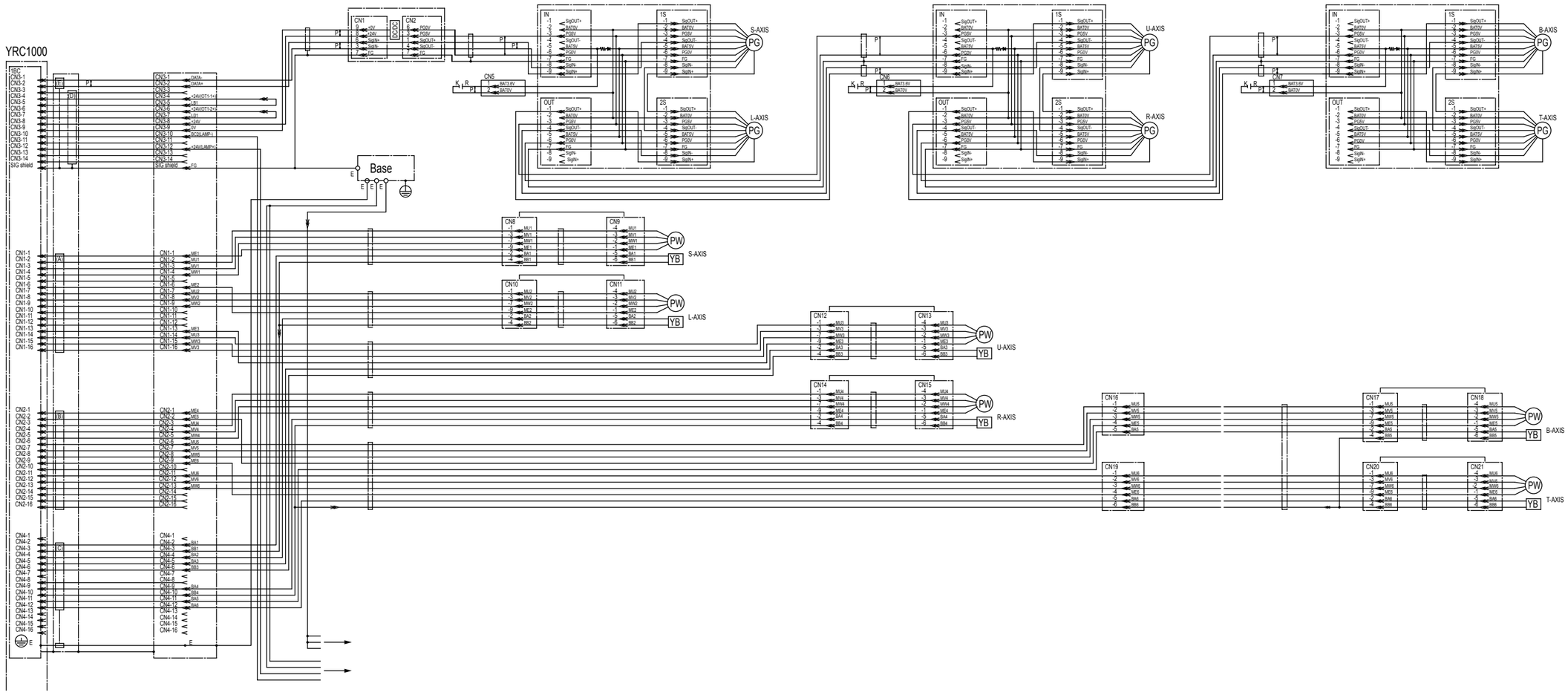
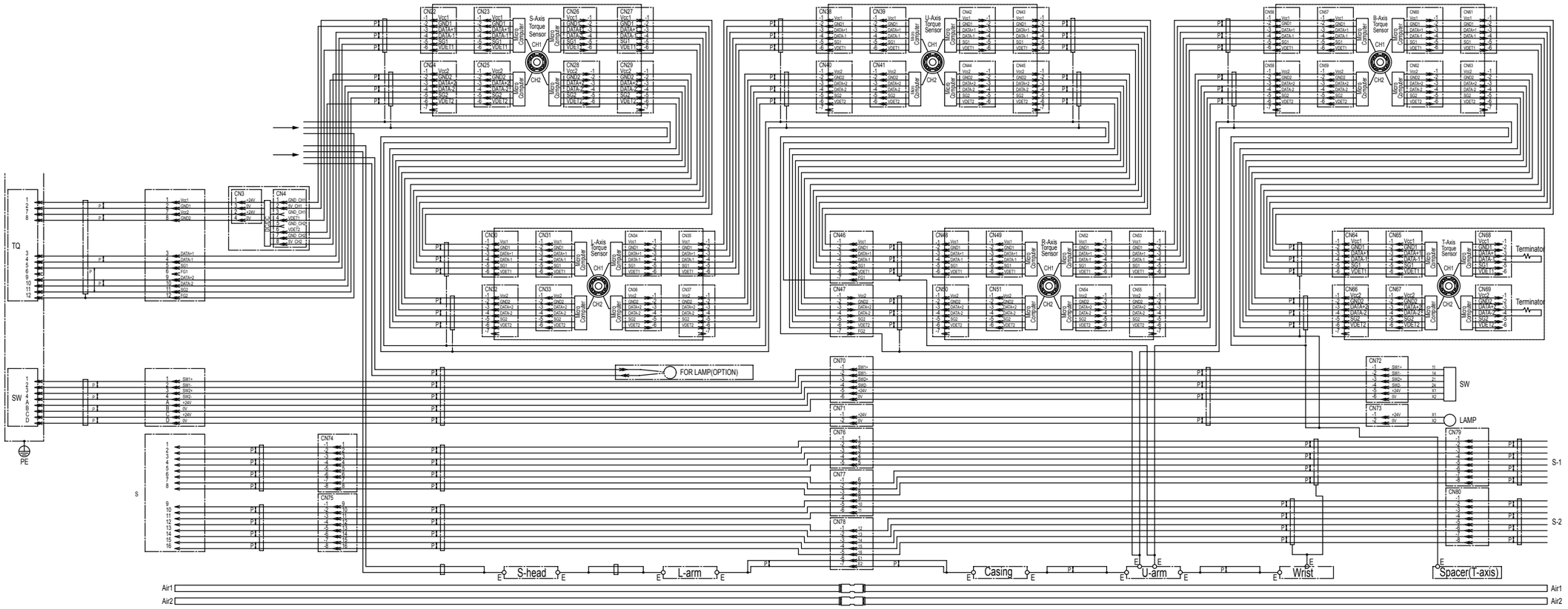


Fig. 8-3(b): Internal Connection Diagram for YRC1000



9 Maintenance and Inspection

DANGER

- Do not remove the motor, and do not release the brake.

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

WARNING

- 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.
- 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.

NOTICE

- 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"* .

In *table 9-1*, the inspection items are categorized by 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 must be based on the servo power supply on time.
- The following inspection schedule is based on the case where the manipulator is used for the cooperation with the working people. If the manipulator is used for other application or if it is used under special conditions, a case-by-case examination is required.
  The inspection may be conducted at shorter intervals if the manipulator is used very frequently for the application such as handling, in this case, contact your YASKAWA representative.

Table 9-1: Inspection Items

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. Or check the position deviation at the check point.	●	●	●
2	External lead wire	●						Visual	Check for damage and deterioration.	●	●	●
3	Working area and manipulator	●						Visual	Clean the work area if dust or spatter is present. Clean the seeped oil or etc.[2] Check for damage and outside cracks.	●	●	●
4	Baseplate mounting bolts		●					Spanner Wrench	Tighten loose bolts. Replace if necessary.	●	●	●
5	External cover mounting screws		●					Screwdriver, Wrench	Tighten loose bolts. Replace if necessary.	●	●	●
6	Connector of manipulator cable		●					Manual	Check for loose connectors.	●	●	●
7	Connector base unit (including the lead wire for the basic axis) (including the power board)				●			Manual Visual	Check for the communication error. (Check the cable by shaking the wire manually.) Check for the cable condition. (Replace the cable if abnormal abrasion occurs.)		●	●
						●			Replace[3]		●	●
8	Internal wiring harness (Lead wire for the wrist axis)				●			Visual	Check for the cable condition. (Replace the cable if abnormal abrasion occurs.)		●	●
						●			Replace[3]		●	●
9	Battery pack in manipulator					●			Replace the battery pack when the battery alarm occurs or the manipulator drove for 24000H.		●	●
10	S-, L-, U-, R-, B-, T-axes gears				●	●		Grease gun	Check for malfunction. (Replace if necessary.) Supply grease[4](12000H cycle).		●	●
11	Overhaul						●					●

1 Inspection No. correspond to the numbers in *fig. 9-1 "Inspection Items"*
2 Due to the operating conditions or the ambient environment, the oil may seep from the lip part of the oil seal and adhere to the outside of the lip part.
The seeped oil may accumulate and fall in drops depending on the operation. Before the operation, clean the oil in the lower side of the oil seal of sliding parts to prevent the seeped oil from accumulating. Frequent reverse motions or operations under a high-temperature environment may lead to a high temperature of the motor and the oil may seep due to a rise in the internal pressure of the grease bath.
In that case, release the grease inlet immediately after completing the operation to lower the internal pressure.
(When releasing the grease inlet, ensure that grease does not scatter.)
3 Wire harness in manipulator to be replaced at 24000H inspection.
4 For grease to be used for each part, refer to *table 9-2 "Inspection Parts and Grease Used"* .

Table 9-2: Inspection Parts and Grease Used

No.	Grease Used	Inspected Parts
8,9,10,11	Harmonic Grease SK-1A	S, L, U, R, B and T-axes speed reducers, S, L, U, R, B and T-axes gears

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

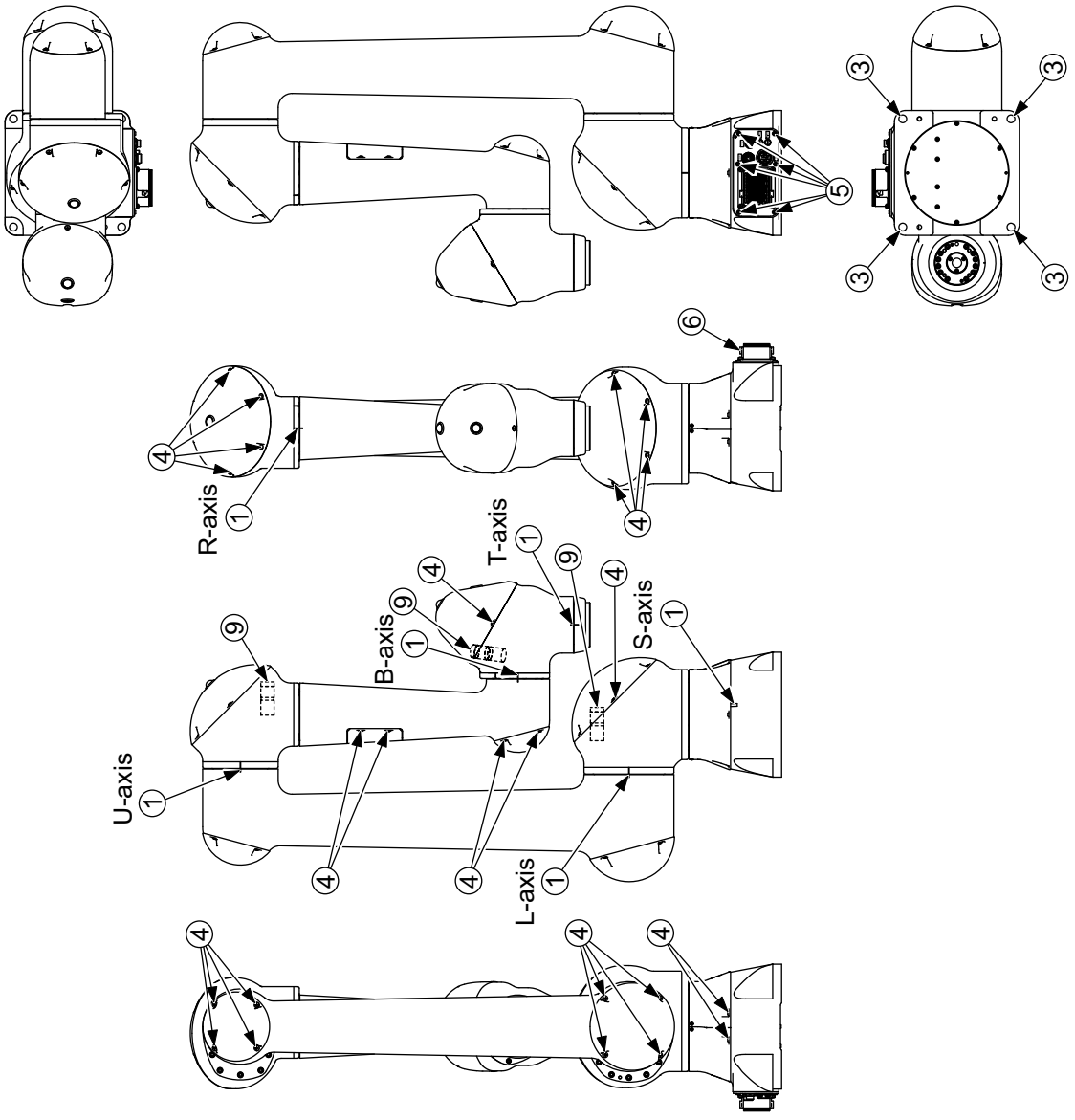


Fig. 9-1: Inspection Items

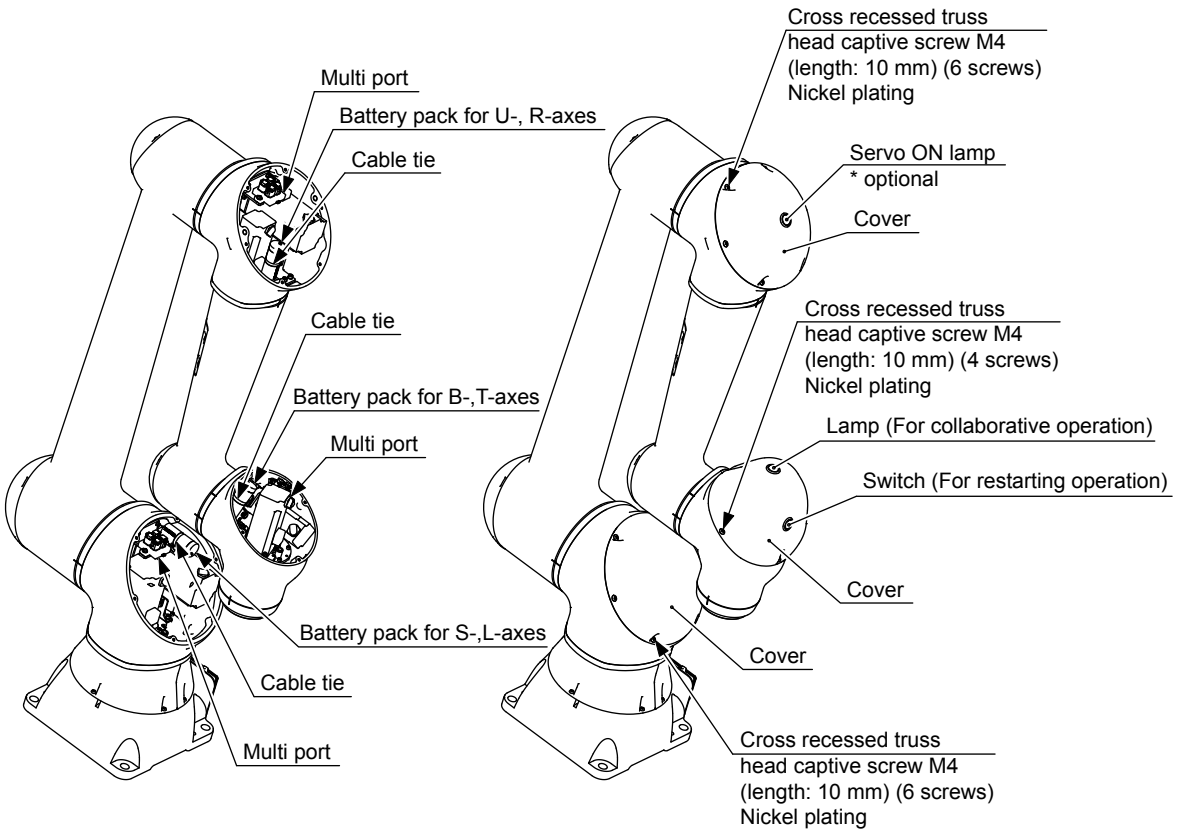
9.2 Notes on Maintenance Procedures

9.2.1 Battery Pack Replacement

Each of the three battery packs are located in the positions shown in *fig. 9-2 "Locations of the Battery and Multi-port Connector"* with the multi-port connector connectors.

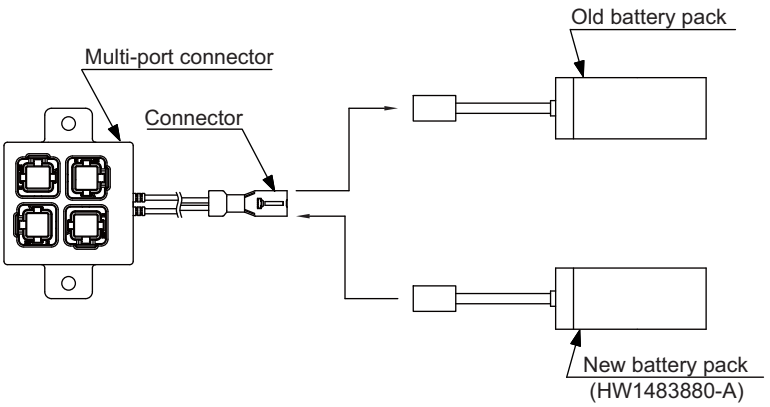
When the battery alarm message is shown on the programming pendant, replace the battery pack in accordance with the following two methods. Perform the replacement by referring to *chapter 9.4 "Notes for Maintenance"* .

Fig. 9-2: Locations of the Battery and Multi-port Connector



■ **Normal (The control power supply of the YRC1000 can be turned ON)**

Fig. 9-3: Battery connection (the control power supply of the YRC1000 can be turned ON)



1. Turn ON the power supply of the YRC1000 and turn OFF the servo power.

DANGER

- Make sure to perform the battery replacement with the emergency stop button being pressed.

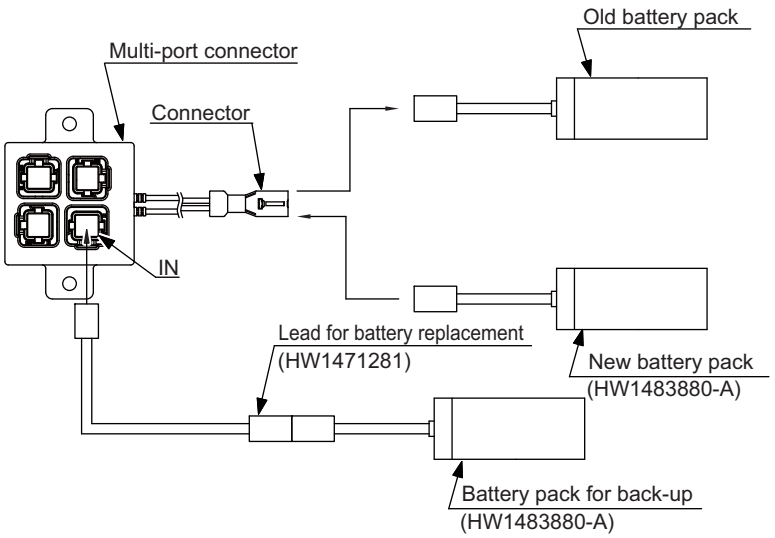
Failure to observe this instruction may cause improper movement of the manipulator which may result in personal injury and/or equipment damage.

2. Loosen the cover mounting bolt and remove the cover.
3. The old battery pack is fixed with the cable tie. Cut the cable tie to remove the old battery pack.
4. Remove the old battery pack from the multi-port connector and mount the new battery pack.
5. Fix the new battery pack with the cable tie T18L.
6. Tighten the cover mounting bolt by using the tightening torque shown in *fig. 9-2 "Locations of the Battery and Multi-port Connector"* to reinstall the cover.

NOTE When reinstalling the cover, be careful not to get caught the cable.

■ **When the control power supply of the YRC1000 cannot be turned ON**

Fig. 9-4: Battery connection (the control power supply of the YRC1000 cannot be turned ON)



1. Prepare the lead for battery replacement (HW1471281-A) and the battery pack for backup. (Apart from the new battery pack for replacement, prepare the battery pack for backup)
2. Loosen the cover mounting bolt and remove the cover.
3. Remove the connector from the “IN” port of the multi-port connector. Connect the lead for battery replacement to the “IN” port of the multi-port connector.
4. Connect the battery pack for backup to the lead for battery replacement.
5. The old battery pack is fixed with the cable tie. Cut the cable tie to remove the old battery pack.

NOTE Before removing the old battery pack, make sure to connect the battery pack for backup to prevent the encoder absolute data from disappearing.

6. Remove the old battery pack from the multi-port connector and mount the new battery pack.
7. Fix the new battery pack with the cable tie T18L.
8. Remove the lead for battery replacement and the battery pack for backup from the multi-port connector, connect the connector which has been removed in no.3 of this procedure to the “IN” connector again.
9. Tighten the cover mounting bolt by using the tightening torque shown in *fig. 9-2 “Locations of the Battery and Multi-port Connector”* to reinstall the cover.

NOTE When reinstalling the cover, be careful not to get caught the cable.

9.3 Notes on Grease Replenishment Procedures

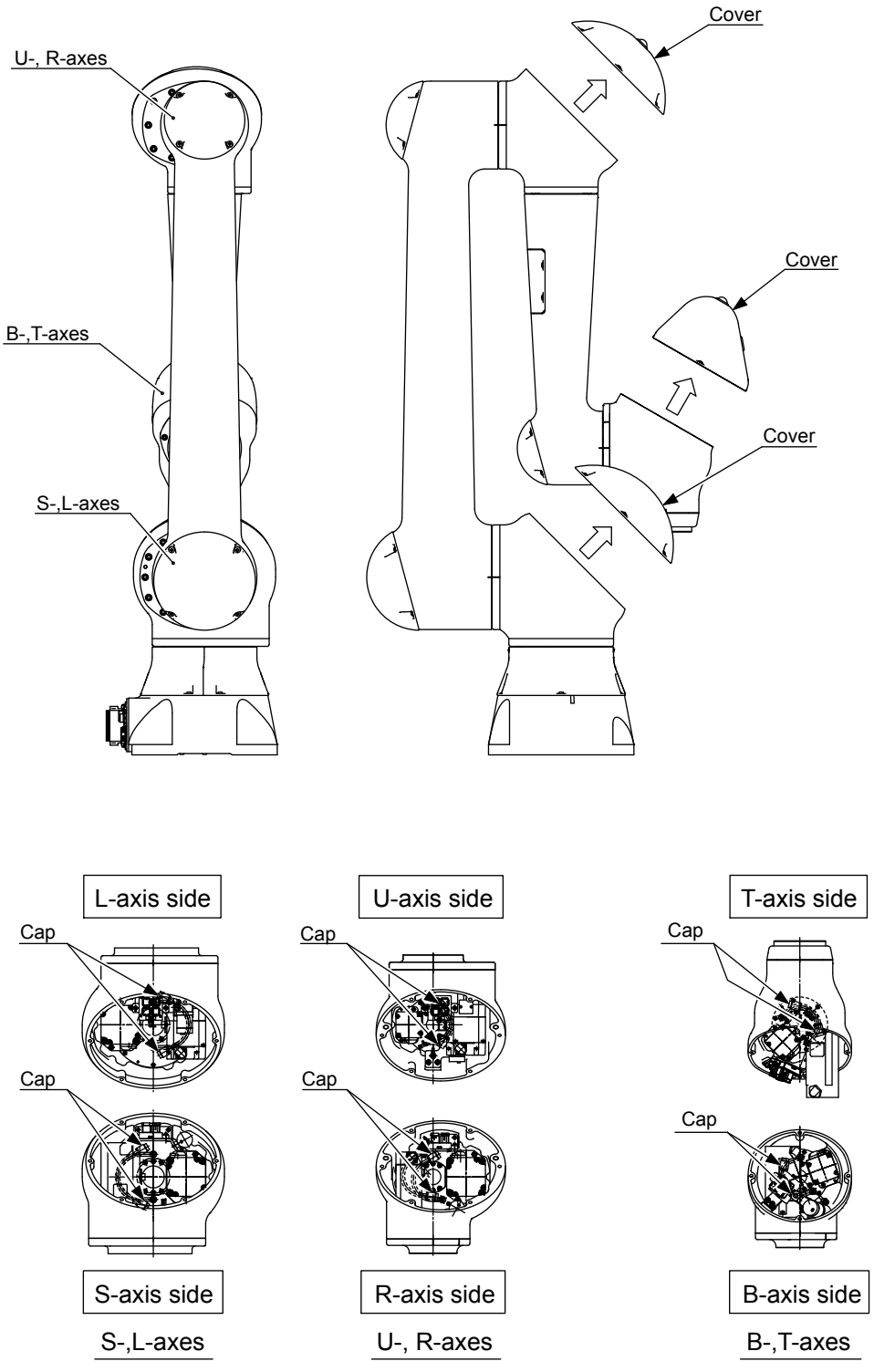
Make sure to follow the instructions listed below at grease replenishment. Failure to observe the following notes may result in damage to motor and speed reducer.

NOTE

- A injection syringe is one of recommended spare parts for grease replenishment. Do not replenish grease by using the grease pump.
- Soften the grease in a injection syringe by stirring or etc., and fill the necessary amount.
- If the replenishment is performed more than the specified numbers, the internal pressure may rise during the operation and the grease leakage may occur.
- When filling, grease may flow from the inlet.
  Make sure to prepare a cloth or etc. to wipe off grease and the container which receives grease.

9.3.1 Grease Replenishment for Each Axis Gear

Fig. 9-5: Each Axis Gear Diagram



9.3.1.1 Grease Replenishment

(Refer to *fig. 9-5 "Each Axis Gear Diagram"* .)

Replenish the grease in accordance with the following procedure:

1. Adjust the posture of the manipulator to perform grease replenishment smoothly.
2. Remove the two caps from the grease inlets.
3. Install the injection syringe for replenishment to the grease inlet. (The injection syringe is a recommended spare part.)
4. Inject the grease through the grease inlet.
   - Grease type: Harmonic Grease SK-1A
   - Amount of grease:
     S-, L-axes : 3 g
     U-axis : 2 g
     R-, B- and T-axes : 1 g
5. Remove the injection syringe for replenishment from the grease inlet. Install the two caps to the grease inlets.

9.4 Notes for Maintenance

9.4.1 Multi-Port Connector

Three multi-port connectors (refer to *fig. 9-6 "Multi-Port Connector"*) for the motor signals are mounted on each part of the manipulator. (For the locations, refer to *fig. 9-2 "Locations of the Battery and Multi-port Connector"*)

The multi-port connector has four ports: two for the motor and the other two for the wire harness.(Refer to *fig. 9-7 "Wiring of Multi-port Connector Part"*)

When disconnecting the connector of the multi-port connector during the battery replacement, be careful not to disconnect the connector between the motor and the multi-port connector. If the connector between the motor and the multi-port connector is disconnected, the encoder absolute data disappears.

Fig. 9-6: Multi-Port Connector

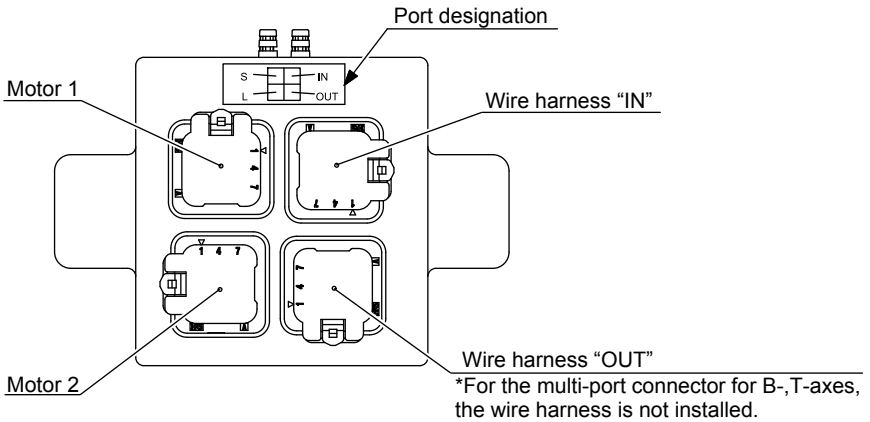
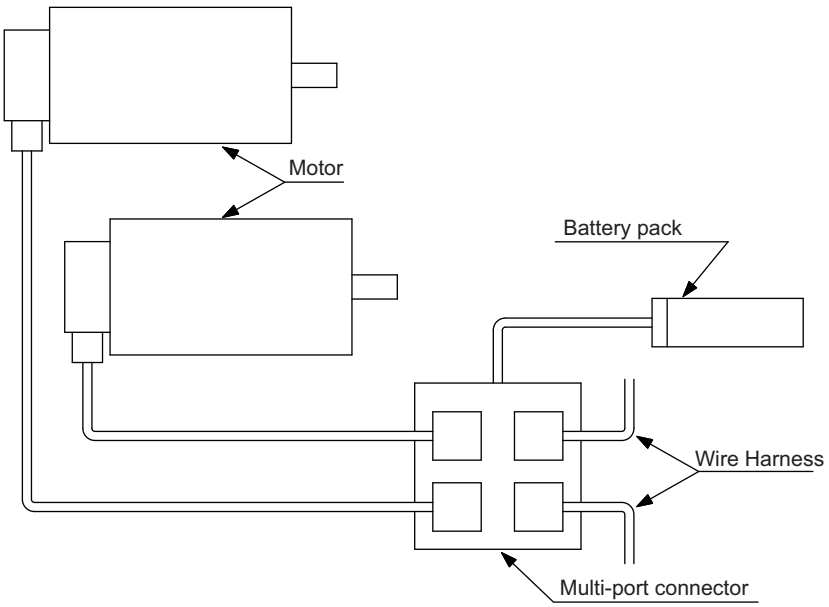


Fig. 9-7: Wiring of Multi-port Connector Part



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-GP8/AR700, -GP7/AR900.

To purchase lead wires of the wire harness or etc., check the order/ manufacture no. and contact YASKAWA representative.

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

NOTE For replacing parts in rank B or rank C, contact your YASKAWA representative.

Table 10-1: Spare Parts for the YR-1-06VXHC10-A00 (Sheet 1 of 2)

Rank	Parts No.	Name	Type	Manufacturer	Qty	Qty per Unit	Remarks
A	1	Grease	Harmonic Grease SK-1A	Harmonic Drive Systems Co., Ltd.	2.5 kg	-	
A	2	Adhesive	LOCTITE 518	Henkel Japan Ltd	-	-	
A	3	Lead Wire for Battery Replacement	HW1471281-A	YASKAWA Electric Corporation	1	-	
A	4	Battery Pack	HW1483880-A	YASKAWA Electric Corporation	1	3	
B	5	S- and L-axis unit	HW1172956-A	YASKAWA Electric Corporation	1	1	
B	6	U- and R-axis unit	HW1172957-A	YASKAWA Electric Corporation	1	1	
B	7	B- and T-axis unit	HW1172958-A	YASKAWA Electric Corporation	1	1	
B	8	Connector base unit	HW1372979-A	YASKAWA Electric Corporation	1	1	Including the internal wiring harness for the basic axis
B	9	Internal wiring harness for the wrist axis	HW1173202-A	YASKAWA Electric Corporation	1	1	
C	10	S-and L-Axes AC Servomotor	SGM7J-04APK-YR1*	YASKAWA Electric Corporation	1	2	
C	11	U-Axis AC Servomotor	SGM7J-02APK-YR1*	YASKAWA Electric Corporation	1	1	

Table 10-1: Spare Parts for the YR-1-06VXHC10-A00 (Sheet 2 of 2)

Rank	Parts No.	Name	Type	Manufacturer	Qty	Qty per Unit	Remarks
C	12	R-, B- and T-Axes AC Servomotor	SGM7J-01APK-YR1*	YASKAWA Electric Corporation	1	3	
C	13	Power Cable for S-, L- and U-Axes AC Servomotor	HW1372681-A	YASKAWA Electric Corporation	1	3	
C	14	Power Cable for R-, B- and T-Axes AC Servomotor	HW1372679-A	YASKAWA Electric Corporation	1	3	
C	15	S-axis torque sensor	HW1385471-A	YASKAWA Electric Corporation	1	1	
C	16	L-axis torque sensor	HW1385471-B	YASKAWA Electric Corporation	1	1	
C	17	U-axis torque sensor	HW1385472-A	YASKAWA Electric Corporation	1	1	
C	18	R-axis torque sensor	HW1385473-A	YASKAWA Electric Corporation	1	1	
C	19	B-axis torque sensor	HW1385474-A	YASKAWA Electric Corporation	1	1	
C	20	T-axis torque sensor	HW1385474-B	YASKAWA Electric Corporation	1	1	
C	21	Multi-Port Connector	HW1384619-A	YASKAWA Electric Corporation	1	3	
C	22	Power Supply Board	HW1384624-A	YASKAWA Electric Corporation	1	1	
C	23	Voltage conversion board for the torque sensor	HW1385477-A	YASKAWA Electric Corporation	1	1	
B	24	Replacement Kit for S-Axis Speed Reducer	Y005C-6VXHC10A00S	YASKAWA Electric Corporation	1	1	
B	25	Replacement Kit for L-Axis Speed Reducer	Y005C-6VXHC10A00L	YASKAWA Electric Corporation	1	1	
B	26	Replacement Kit for U-Axis Speed Reducer	Y005C-6VXHC10A00U	YASKAWA Electric Corporation	1	1	
B	27	Replacement Kit for R-Axis Speed Reducer	Y005C-6VXHC10A00R	YASKAWA Electric Corporation	1	1	
B	28	Replacement Kit for B-Axis Speed Reducer	Y005C-6VXHC10A00B	YASKAWA Electric Corporation	1	1	
B	29	Replacement Kit for T-Axis Speed Reducer	Y005C-6VXHC10A00T	YASKAWA Electric Corporation	1	1	

MOTOMAN-HC10
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