DENSO ROBOT

Horizontal articulated

HM-G SERIES

INSTALLATION & MAINTENANCE GUIDE

Preface

Thank you for purchasing this high-speed, high-accuracy assembly robot.

Before operating your robot, read this manual carefully to safely get the maximum benefit from your robot in your assembling operations.

Robot series and/or models covered by this manual

Series	Model (**Note** 1)		Overall arm length
	Floor-mount	Overhead-mount	
HM-G (Medium-sized, horizontal articulated)	HM-4*60*G HM-4*70*G HM-4*85*G HM-4*A0*G (**Note** 2)	— HMS-4*70*G HMS-4*85*G — (**Note** 2)	600 mm 700 mm 850 mm 1000 mm

NOTE 1: Model names listed above apply to the models of robot systems. The model names of robot units are followed by M. If the robot system model is HM-4****G, for example, the robot unit model is HM-4****E/GM.

NOTE 2: For hanging, 700 mm or 850 mm only

Important

To ensure operator safety, be sure to read the precautions and instructions in "SAFETY PRECAUTIONS."

NOTE:

Robots and controllers that will be exported to South Korea after March 1st 2013 need to have KCs mark for each equipment.

How this book is organized

This book is just one part of the robot documentation set. This book consists of SAFETY PRECAUTIONS, chapters one through three.

Chapter 1 Installing Robot Components
Provides information about physical site planning, installation procedures, and engineering-design notes for hands.

Chapter 2 Customizing Your Robot
Describes how to customize your robot--defining the software motion space and restricted space, CALSETing, and setting control set of motion optimization.

Chapter 3 Maintenance and Inspection
Describes the regular maintenance and inspections necessary for maintaining the performance and functions of your robot.

Contents

Chapter 1 Installing Robot Components

1.1 Preparing a Proper Environment for Installation

Before installing the robot unit and robot controller, confirm that the operating environment is in conformity with each item of "SAFETY PRECAUTIONS, Installation Precautions". Also, take proper measures to protect the components from vibration.

In an inappropriate environment, the robot will not operate to its full capacity or performance, components may not last long, and unexpected failure may result.

1.1.1 Ambient Temperature and Humidity

Keep the ambient temperature between 0°C and 40°C during operation.

Keep the ambient humidity at 90% or below to prevent dew condensation.

1.1.2 Vibration

Do not install the robot in an environment where it will be exposed to excessive vibration or impact.

1.1.3 Connecting the Robot Unit and Robot Controller

Before delivery, the robot unit and the robot controller are adjusted to each other as a set. When two or more robots are to be used, use the robots and robot controllers that have been adjusted to each other as a set.

Caution: The robot unit and robot controller in a set are given the same serial number.

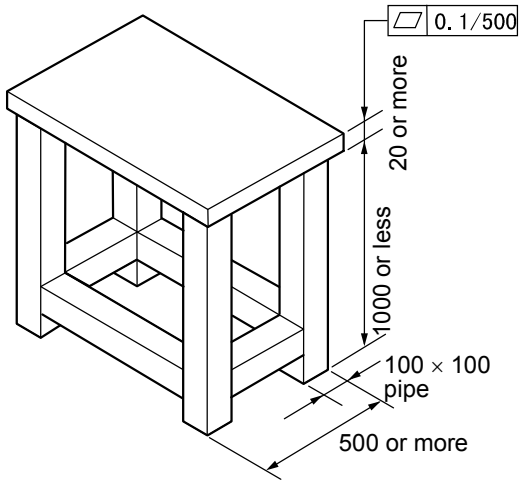
1.1.4 Installation Environment of the Robot Unit

The table on the next page lists the installation requirements for the robot unit. Prepare a highly rigid mount as shown on page 4.

> ⚠**Caution:** **Do not electric-weld the equipment including the robot. A large current may flow through the motor encoder or robot controller resulting in a failure. If electric welding is required, remove the robot unit and the robot controller from the equipment beforehand.**

Installation Requirements for the Robot Unit

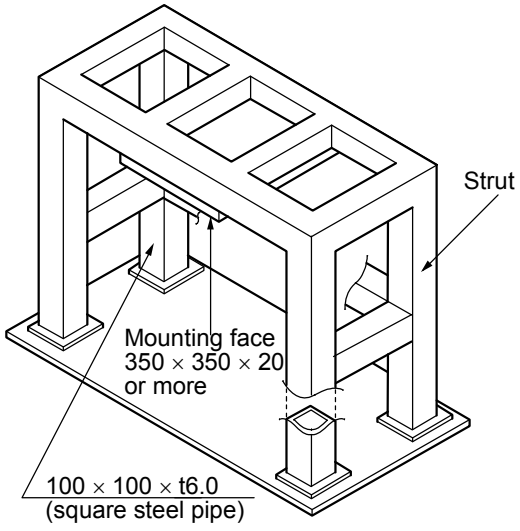
Item	Environments and Conditions
Flatness of the mount	0.1/500 mm (See the next page.)
Rigidity of the mount	Use steel materials. (See the next page.)
Installation type	Floor-mount or overhead-mount (Only for HMS-G)
Ambient temperature	During operation: 0 to 40ºC During storage and transportation: -10 to 60ºC
Humidity	During operation: 90% or less (No dew condensation allowed.) During storage and transportation: 75% or less (No dew condensation allowed.)
Vibration	During operation: 4.9 m/s^2 (0.5G) or less During storage and transportation: 29.4 m/s^2 (3G) or less
Altitude	During operation: 1,000 m or less
Safe installation environment	Refer to the SAFETY PRECAUTIONS, **3.1 "Insuring the proper installation environment"**
Working space, etc.	• Sufficient service space must be available for inspection and disassembly. • Keep wiring space (at least 190 mm for Standard type, at least 230 mm for Dust- & splash-proof type) behind the robot, and fasten the wiring to the mounting face or beam so that the weight of the cables will not be directly applied to the connectors.
Grounding conditions	Functional ground See the figure on page 11.



⚠Caution (1) When the robot operates at high speed, the robot mount undergoes large reaction forces. The mount must be rigid enough so that it will not vibrate or be displaced due to reaction forces. It is also advisable to mechanically join the robot mount with heavy equipment.

(2) Some mounts may produce a resonance sound (howling). If this sound is loud, increase the rigidity of the mount or slightly modify the robot speed.

Robot Mount Sample for Floor-mount Type



⚠Caution (1) When the robot operates at high speed, the top plate structure undergoes large reaction forces. The robot mount must be vibration-proof so that the top plate will not vibrate due to reaction forces. Also it must be designed to be separated from other top plate structures in the equipment.

(2) Some mounts may produce a resonance sound (howling). If this sound is loud, increase the rigidity of the mount or slightly modify the robot speed.

Robot Mount Sample for Overhead-mount Type

1.2 Mounting the Robot Unit

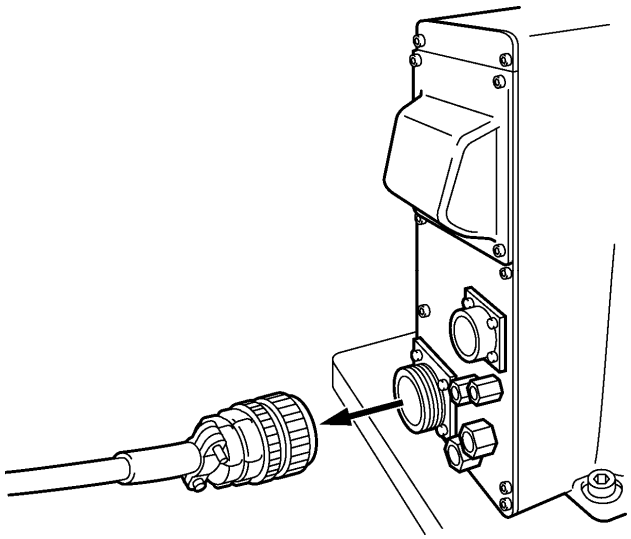
⚠Caution	(1)	**Before handling or installing the robot unit, be sure to read "SAFETY PRECAUTIONS, Installation Precautions."**
	(2)	**The grease is applied to the shaft and rack of the Z-axis for lubrication and rust-proof. Do no touch or wipe the shaft and rack so as to keep rust-proof.**
	(3)	**For UL-Listed robot units, do not move the 1st arm by holding its cover.**

1.2.1 Transporting the Floor-Mount Type

This section gives the typical installation procedure assuming that you have set up the robot mount bed and prepared robot mounting bolt holes in it. If you have not done it yet, first read Section 1.2.3 "Securing the Robot Unit."

⚠Caution	(1)	**The installation jobs should be handled by at least two persons.** **Robot unit weight: Approx. 56 kg (124 lbs)**
	(2)	**Be sure to put on a helmet, safety shoes, and gloves.**

Step 1 Disconnect the motor cable, encoder cable, air pipes, hand, and tools from the robot unit, if mounted.

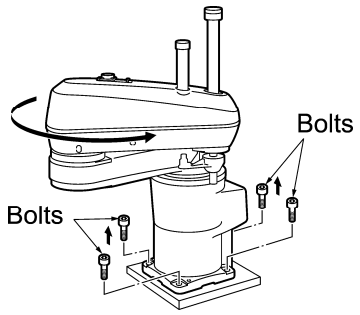


(HS-G illustration tentatively used)

Disconnect the motor cable, encoder cable, and others.

Step 2 Turn the 2nd axis until it comes into contact with the mechanical end in order to keep the safe position. Then remove the four bolts and release the robot unit from the pallet.

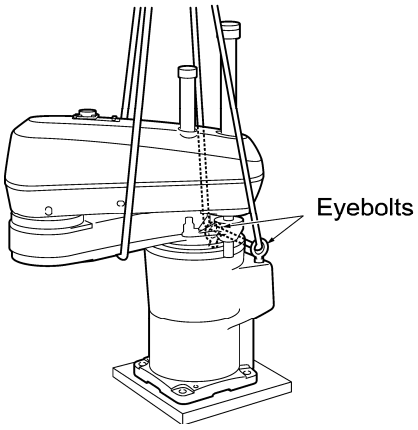
> ⚠**Caution: When worker A is removing those bolts, worker B should support the 1st-axis arm to prevent the robot unit from overturning.**



(HM-G)

Step 3 Transport the robot unit to the mounting position using the crane and eyebolts.

> ⚠**Caution (1) Since the robot unit weighs approx. 56 kg (124 lbs), prepare a crane and forklift with a hoisting load of 0.2 ton or more.**
>
> **(2) The mounting job must be handled by at least two persons including a qualified operator for sling, crane and forklift operation.**
>
> **(3) Be sure to put on a helmet, safety shoes, and gloves.**
>
> **(4) After the mounting job, remove the eyebolts from the robot unit and store them.**



(HM-G)

Step 3 Put the robot unit on the mount bed and secure it with four bolts temporarily.

Step 4 Fix the robot unit, referring to Section 1.2.3 "Securing the Robot Unit."

Tightening torque: 128 ±20 Nm (For HM-G series)

1.2.2 Transporting the Overhead-Mount Type (HMS-G series)

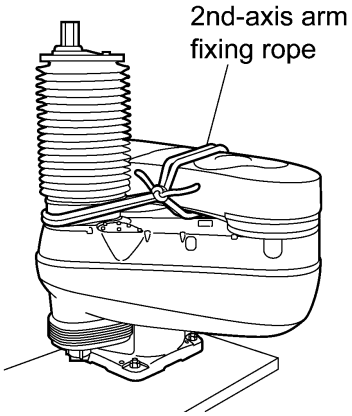
This section gives the typical installation procedure of the robot unit.

> **⚠Caution**
> **(1) Since the robot unit weighs approx. 56 kg (124 lbs), prepare a crane and forklift with a hoisting load of 0.2 ton or more.**
> **(2) The overhead mounting job must be handled by at least two persons including a qualified operator for sling, crane and forklift operation.**
> **(3) Be sure to put on a helmet, safety shoes, and gloves.**

Step 1

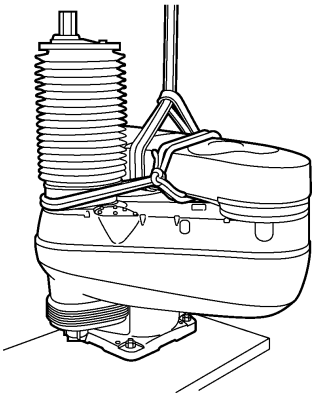
When unpacked, the overhead-mount robot unit is fastened with rope as shown below. Make sure that the robot's 2nd-axis arm cannot rotate.

> **⚠Caution: NEVER remove the 2nd-axis arm fixing rope until the installation of the robot unit is completed.**
> **This is to prevent the robot arm from rotating unexpectedly due to gravity.**



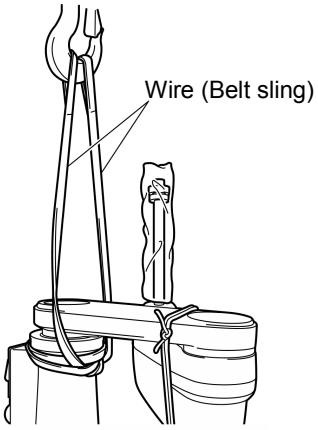
<HMS-G>

Step 2 As illustrated below, wind the belt sling around the 1st arm one turn.



<HMS-G>

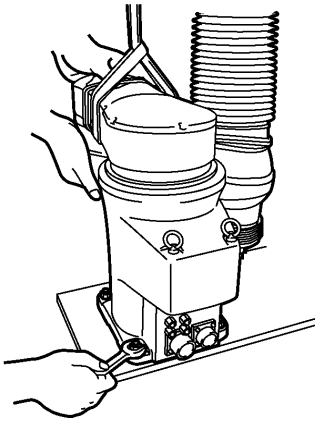
Step 3 Load the eyes of the belt sling on the hook of the crane.



(HS-G illustration tentatively used)

Step 4 Remove the four bolts and release the robot unit from the pallet.

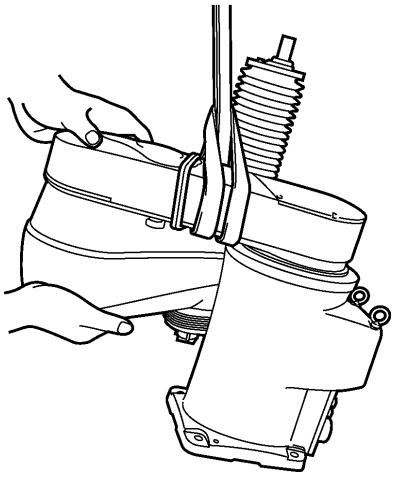
> ⚠**Caution: When worker A is removing those bolts, worker B should support the robot unit as shown below to prevent it from overturning.**



<HMS-G>

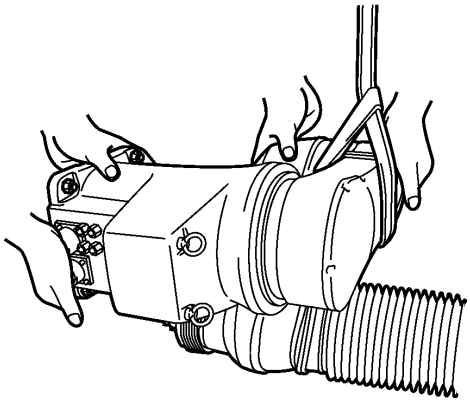
Step 5 While keeping the robot posture, slowly hoist the robot unit with the crane.

> ⚠**Caution: Before starting this job, make the work floor clear of obstacles.**



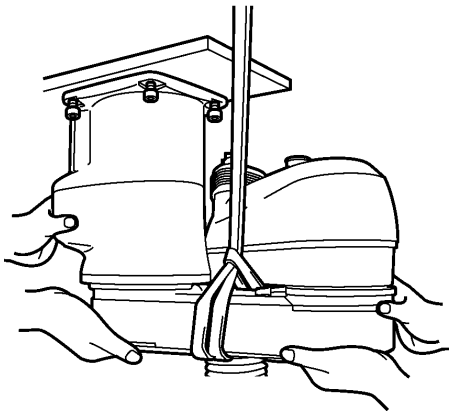
<HMS-G>

Step 6 Hoist the robot unit with the crane up to the height where the robot unit can be turned upside down, stop the crane, and have two workers turn the robot unit upside down as shown below.



<HMS-G>

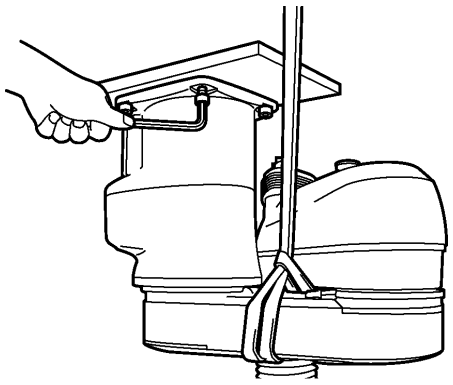
Step 7 While having two workers keep the robot unit in the upside-down position, slowly hoist the robot unit with the crane so that the robot base comes into contact with the robot installation face of the overhead-mount frame. Secure the robot unit with four mounting bolts temporarily.



<HMS-G>

Step 8 Firmly secure the robot unit, referring to Section 1.2.3, "Securing the Robot Unit."

Tightening torque: 128 ±20 Nm



<HMS-G>

Step 9 After completing bolting, unhook the belt sling from the crane and then remove the 2nd-axis arm fixing rope.

> ⚠**Caution: Store the 2nd-axis arm fixing rope for future removal of the robot unit. When removing the robot unit, secure the 2nd arm with the rope to prevent the 2nd arm from rotating.**

1.2.3 Securing the Robot Unit

(1) According to the dimensions specified in the figure below, drill four robot fixing holes and two dowel pin holes in the robot mount where the robot unit is to be anchored.

Drilling in the robot mount

Drilling in the robot mount		For HM/HMS-G series
Four robot fixing holes		M12 bolt holes a minimum of 20 mm deep
Two holes for dowel pins	For diamond-shaped pin	6H7 dia. hole a minimum of 12 mm deep
	For internally-threaded positioning pin	8H7 dia. hole a minimum of 12 mm deep

(2) Drive a diamond-shaped pin into the hole (HM/HMS-G: 6H7 dia.) so that the pin becomes oriented as shown below.

(3) Drive an internally-threaded positioning pin into the hole (HM/HMS-G: 8H7 dia.).

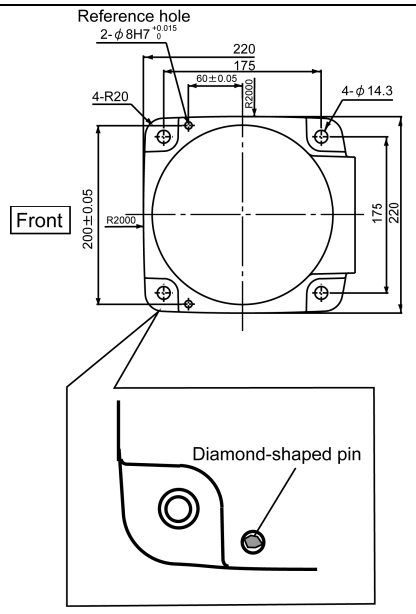
> ⚠**Caution: Never skip this step. These dowel pins may reduce chance of drop off of the robot unit during maintenance and misalignment due to vibration.**

(4) Put the robot unit on the robot mount, following the transport instructions given in Section 1.2.1 "Transporting the Floor-Mount Type" or Section 1.2.2 "Transporting the Overhead-Mount Type."

(5) Secure the robot unit with four bolts and plain washers.

Fixing bolts: M12 x 35 mm, JIS strength class: 12.9 (For HM/HMS-G series)

Tightening torque: 128 ±20 Nm (For HM/HMS-G series)



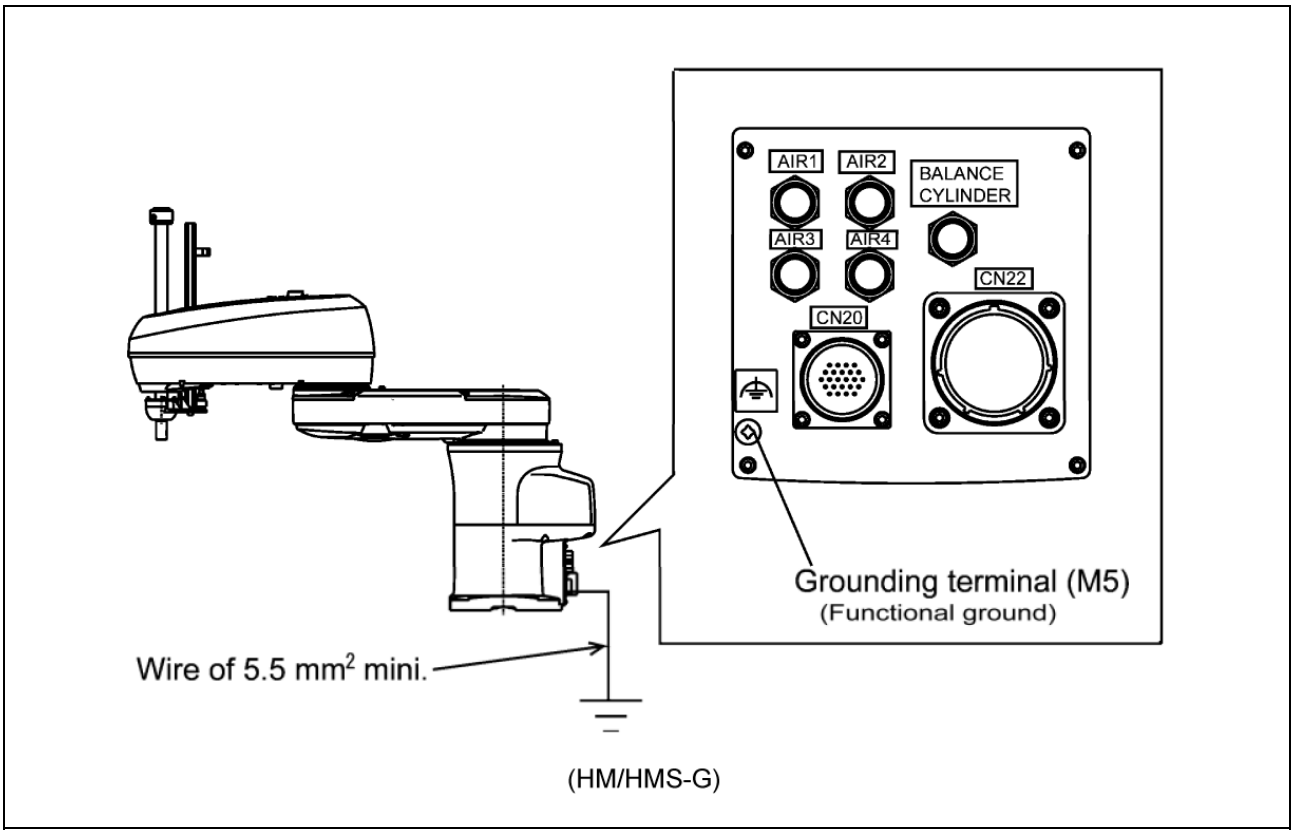
(For HM/HMS-G series)

Bolt Positions for Securing the Robot Unit

1.2.4 Grounding the Robot Unit

Ground the grounding terminal of the robot unit using a wire of 5.5 mm^2 or more.

> ⚠**Caution: Use a dedicated grounding wire and grounding electrode. Do not share them with other power facilities or welding machines.**



Grounding the Robot Unit

1.3 Installing the Robot Controller

For the installing procedures of the robot controller, refer to the RC7M CONTROLLER MANUAL, Section 6.2 "Installing the Robot Controller."

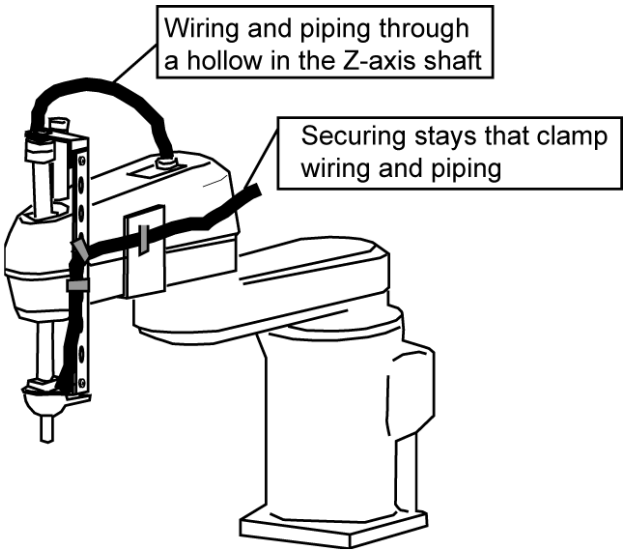
1.4 Electrical Wiring and Air Piping of the Robot Unit

Make electrical wiring and air piping for the hand or tool to be attached to the arm end, referring to the either of examples (1) and (2) below.

(1) Using a hollow provided in the Z-axis shaft

Robot model	HM/HMS-40***G series (10 kg payload type)	HM/HMS-4A***G series (20 kg payload type)
Hollow diameter in the Z-axis shaft	ϕ17	ϕ19

(2) Securing stays to the robot unit for clamping wiring and piping



Wiring and Piping Image (HM-G series)

Note (1) Mounting stays may cause those stays, wiring and piping to interfere with the robot unit. If it happens, modify the software limit to decrease the motion range. (Refer to Section 2.2.)

(2) The UL-Listed robot units have a tall 1st arm cover, so take care not to cause that arm cover to interfere with the stays.

1.4.1 Notes for Wiring and Piping Through a Hollow in the Z-axis Shaft

The Z-axis shaft has a hollow through which you may make wiring and piping from the hand control signal connector (CN21) or air piping joints on the top of the 2nd arm.

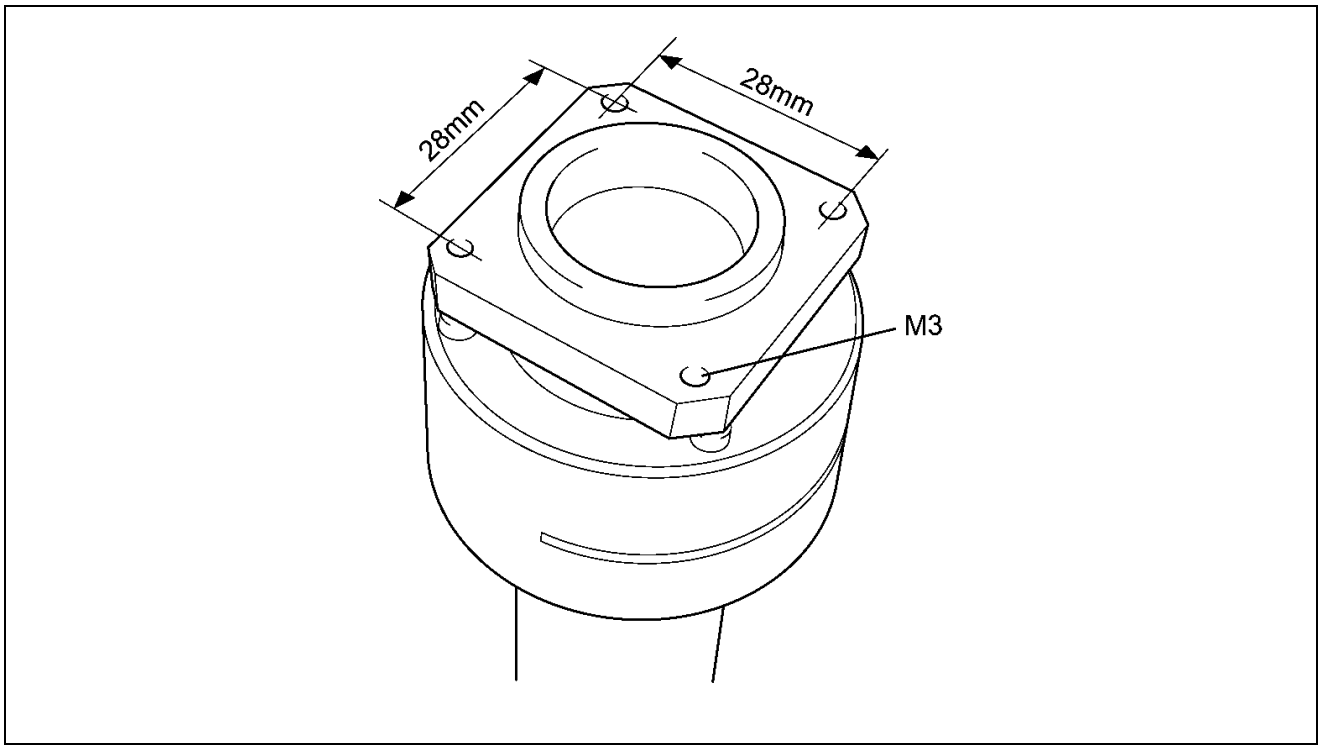
In this wiring and piping, check that:

(1) When the robot is in motion, the wiring and piping do not become taut or interfere with other sections.

(2) During up- or down-movement of the Z-axis, the wiring and piping inside the hollow do not become taut or interfere with other sections.

(3) For the HM/HMS-G series, when securing stays that clamp wiring and piping to the Z-axis upper end, use the internal threads (M3) provided in the upper end of the Z-axis shaft.

(4) Making the wiring and piping able to be pulled out through the hollow makes maintenance easy.



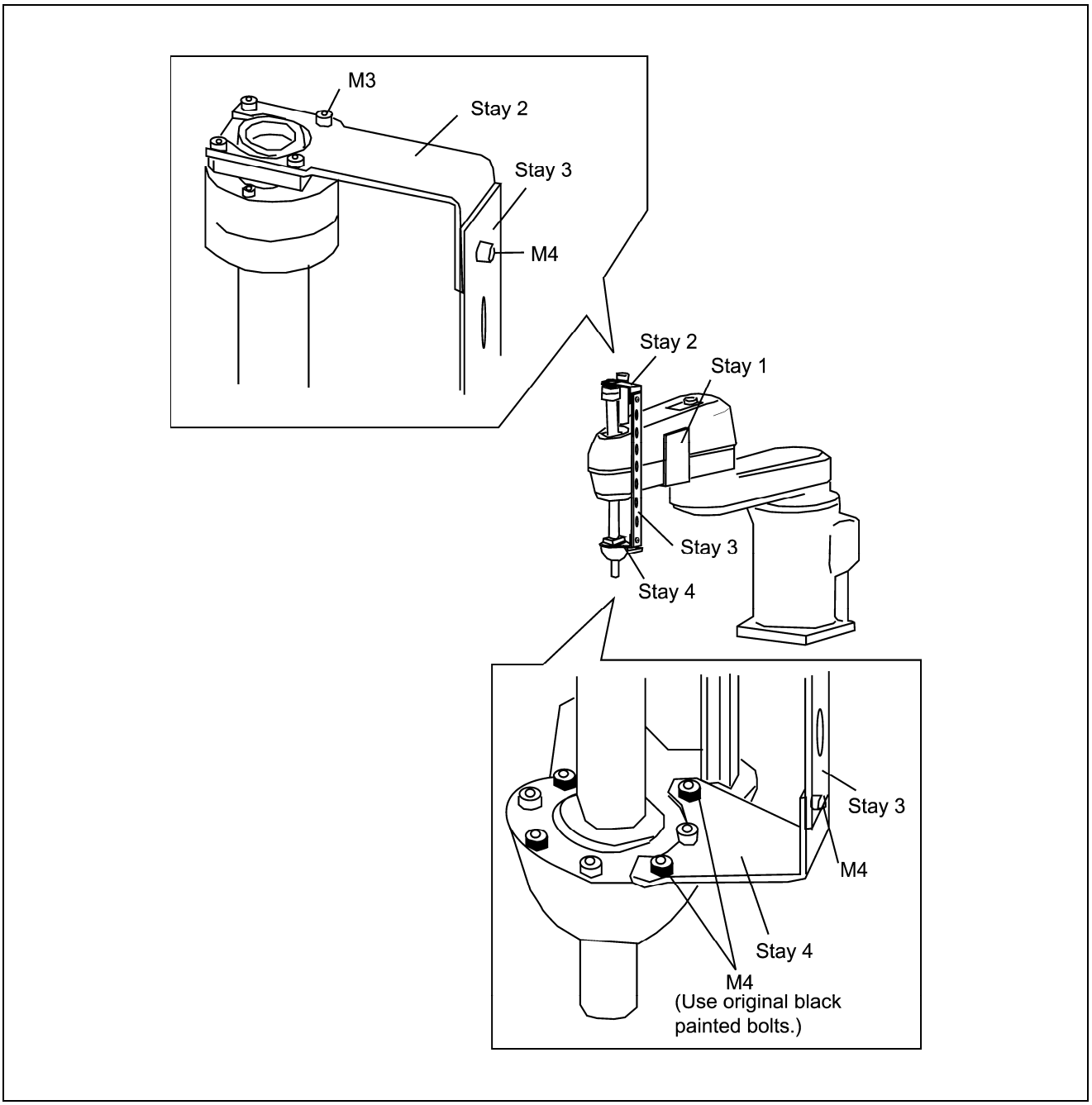
Internal threads provided in the upper end of the Z-axis shaft (HM/HMS-G series)

1.4.2 Reference Drawings for Stays that Clamp Wiring and Piping

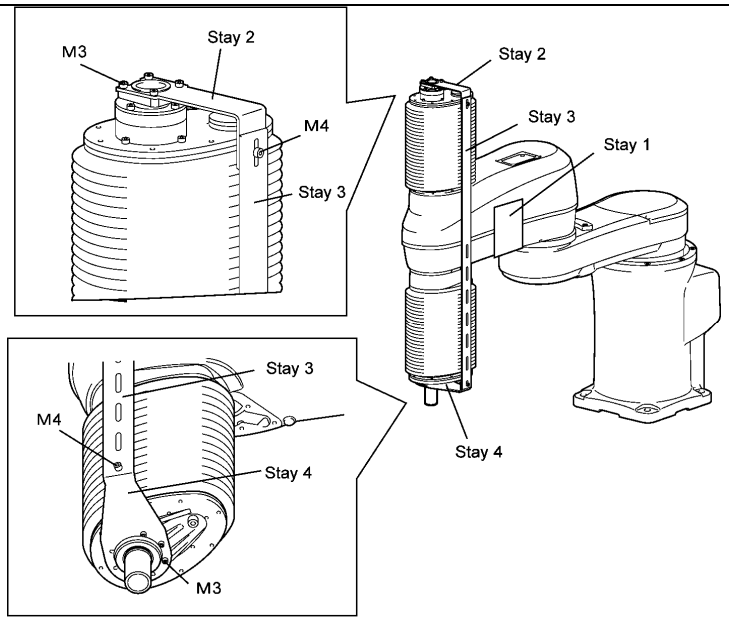
Note : Maintenance and inspection of the robot unit sometimes requires removing and installing the covers. Mount the stays for wiring and piping so that they will not interfere with removal/installation of the covers.

When preparing stays for clamping wiring and piping to the robot unit, refer to Stay 1 through Stay 4 shown below.

(1) Mounting stays



Mounting stays (HM/HMS-G; Standard type)

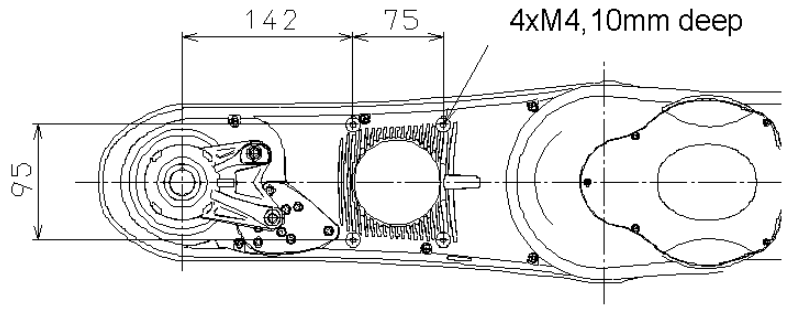


Mounting stays (HM/HMS-G; Dust- & splash-proof type)

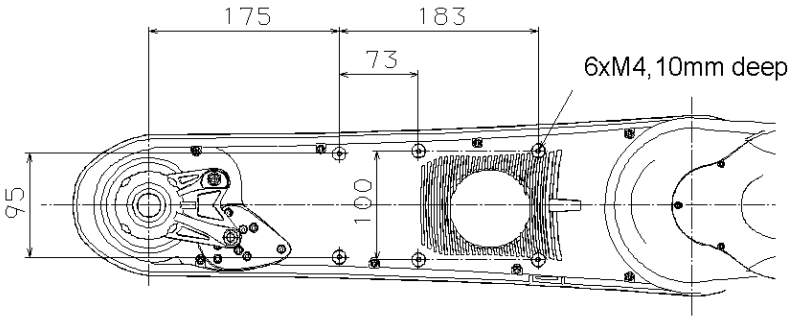
(2) Internal threads in the lower end of the second arm (HM/HMS-G series)

The figures below show internal threads provided in the lower end of the second arm. These threads are used for securing stays that clamp wiring and piping to the robot unit.

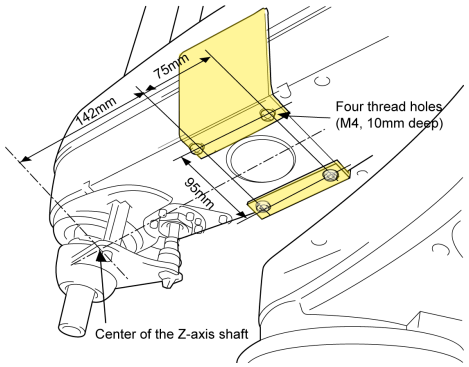
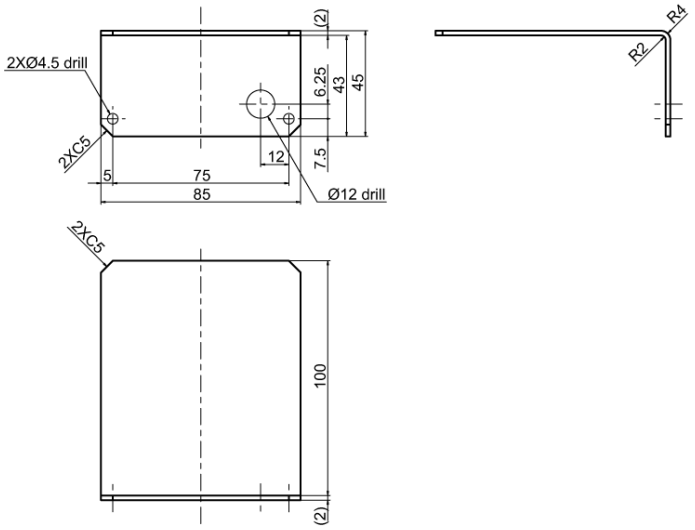
HM-4*60*G(-W)
HM/HMS-4*70*G (-W)



HM/HMS-4*85*G (-W)
HM-4*A0*G (-W)

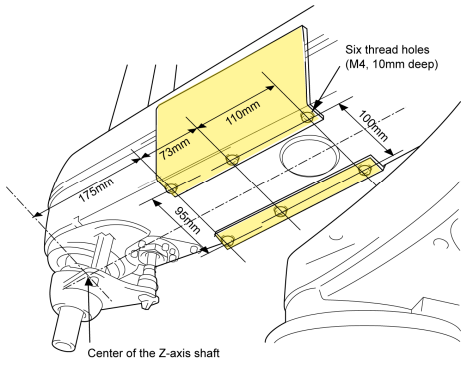
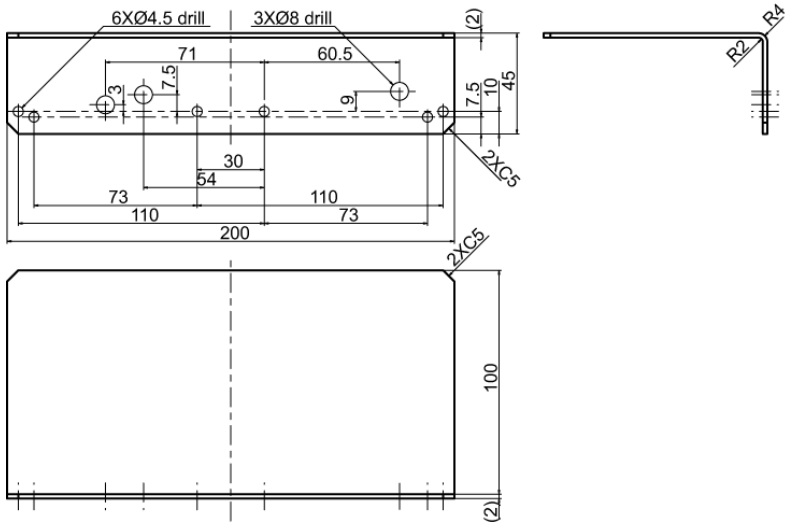


(3) Reference drawing for Stay 1 (For HM-4*60*G (-W) and HM/HMS-4*70*G (-W))

Mounting Stay 1	Drawing of Stay 1
HM-4*60*G (-W) HM/HMS-4*70*G (-W)  	 No burr permitted Recommended material: SPCC (t2.0) Surface treatment: Galvanizing

Stay 1 for HM-4*60*G (-W) and HM/HMS-4*70*G (-W)

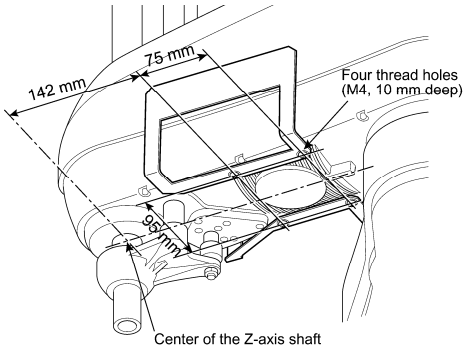
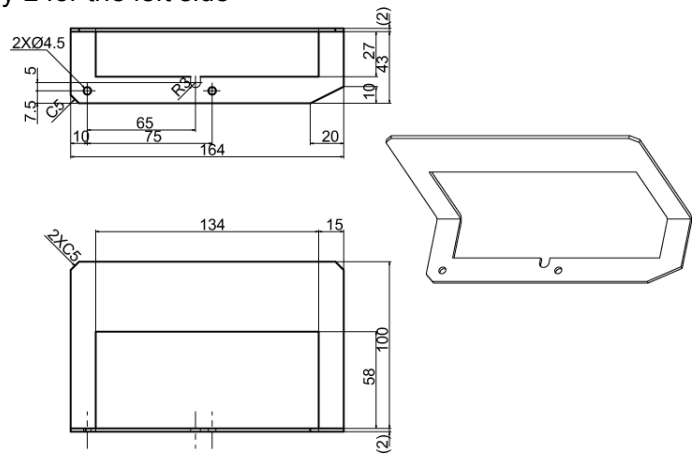
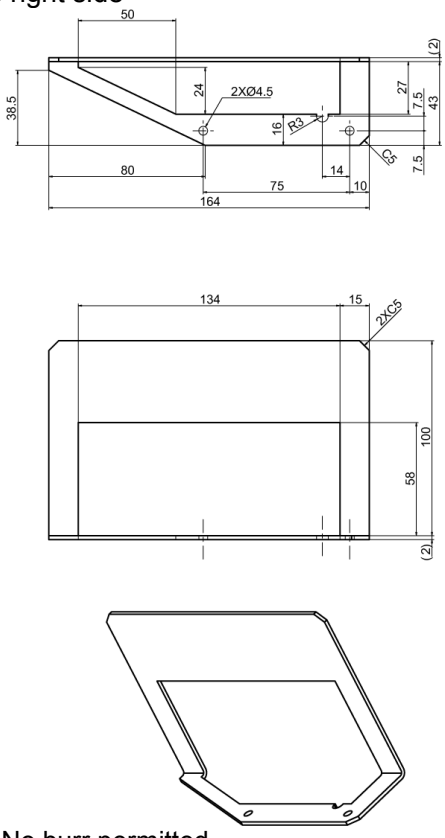
(4) Reference drawing for Stay 1 (For HM/HMS-4*85*G (-W) and HM-4*A0*G (-W))

Mounting Stay 1	Drawing of Stay 1
HM/HMS-4*85*G (-W) HM-4*A0*G (-W)  	 No burr permitted Recommended material: SPCC (t2.0) Surface treatment: Galvanizing

Stay 1 for HM/HMS-4*85*G (-W) and HM-4*A0*G (-W)

(5) Reference drawing for Stay 1 (For HM-4∗60∗G-UL)

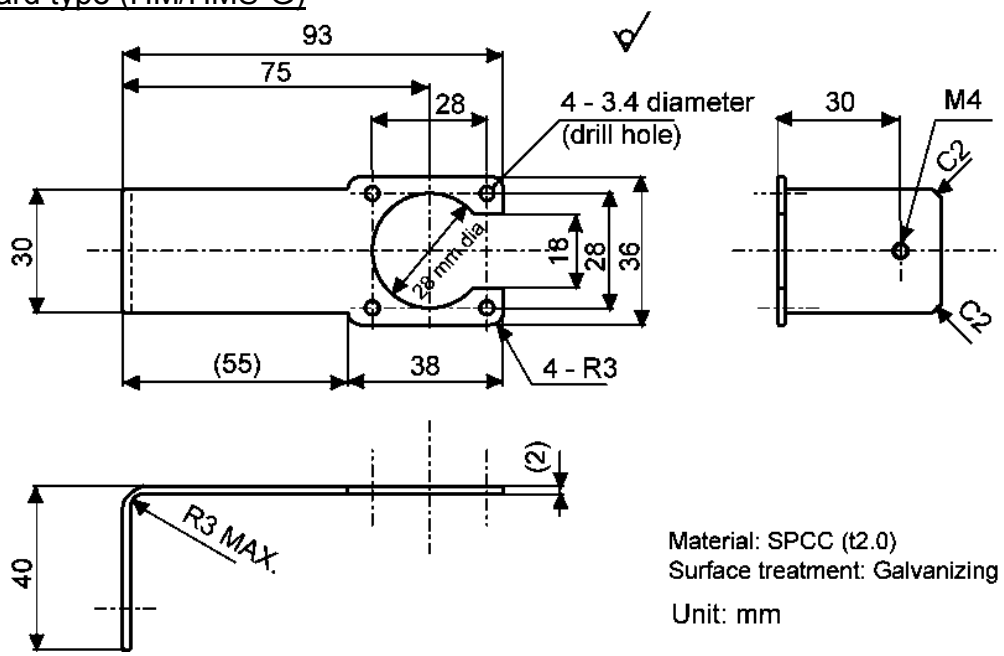
For the UL-listed robot unit with 600 mm stroke (HM-4∗60∗G-UL), prepare stays L and R exclusively designed for the left and right sides, following the drawings shown below. This is because mounting the stay shown in (3) above on this robot unit may cause the first arm cover to interfere with the stay when the robot arm moves near the factory default software motion limit position.

Mounting Stay 1	Drawing of Stay 1
HM-4∗60∗G-UL  	Stay L for the left side  No burr permitted Recommended material: SPCC (t2.0) Surface treatment: Galvanizing
	Stay R for the right side  No burr permitted Recommended material: SPCC (t2.0) Surface treatment: Galvanizing

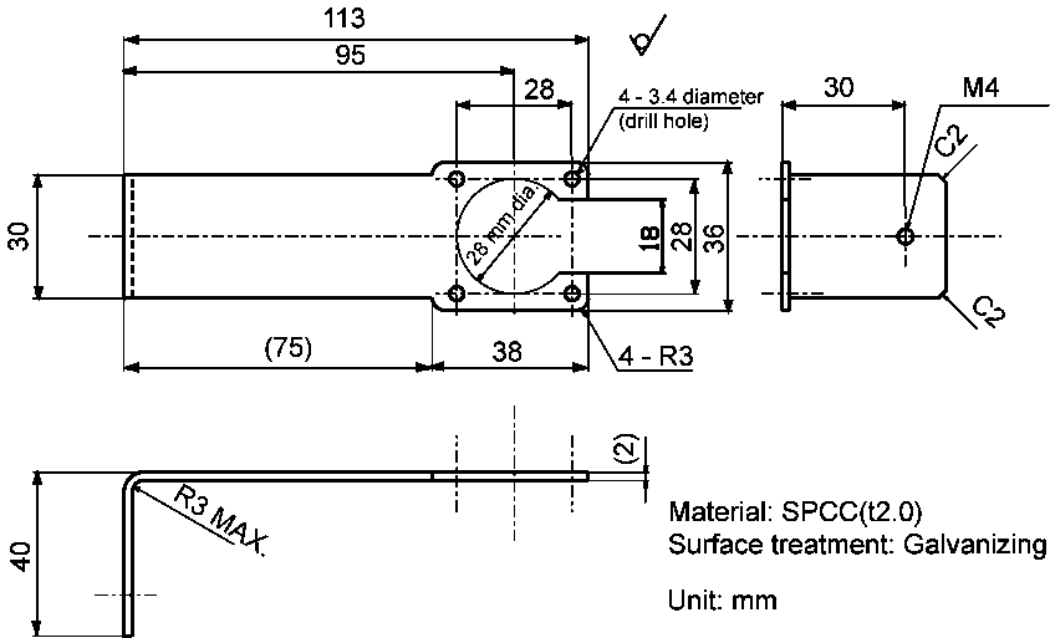
Stay 1 for HM-4∗60∗G-UL

(6) Reference drawing for Stay 2

For standard type (HM/HMS-G)

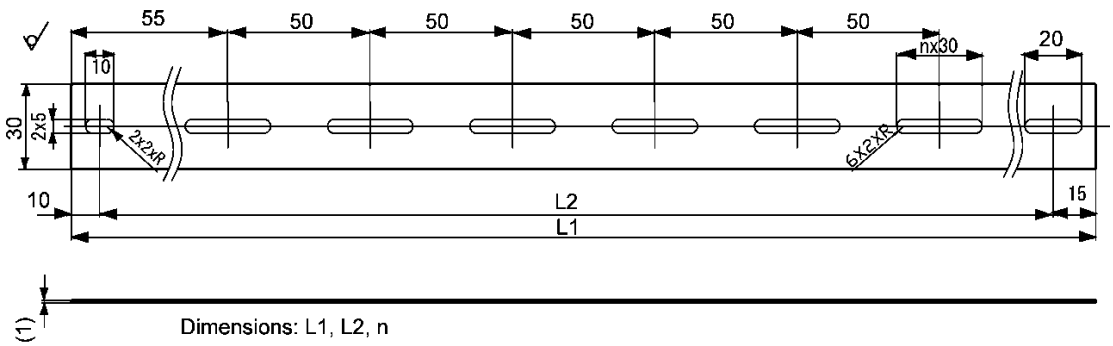


For dust- & splash-proof type (HM/HMS-G-W)



Reference drawing for Stay 2

(7) Reference drawing for Stay 3



Dimensions: L1, L2, n

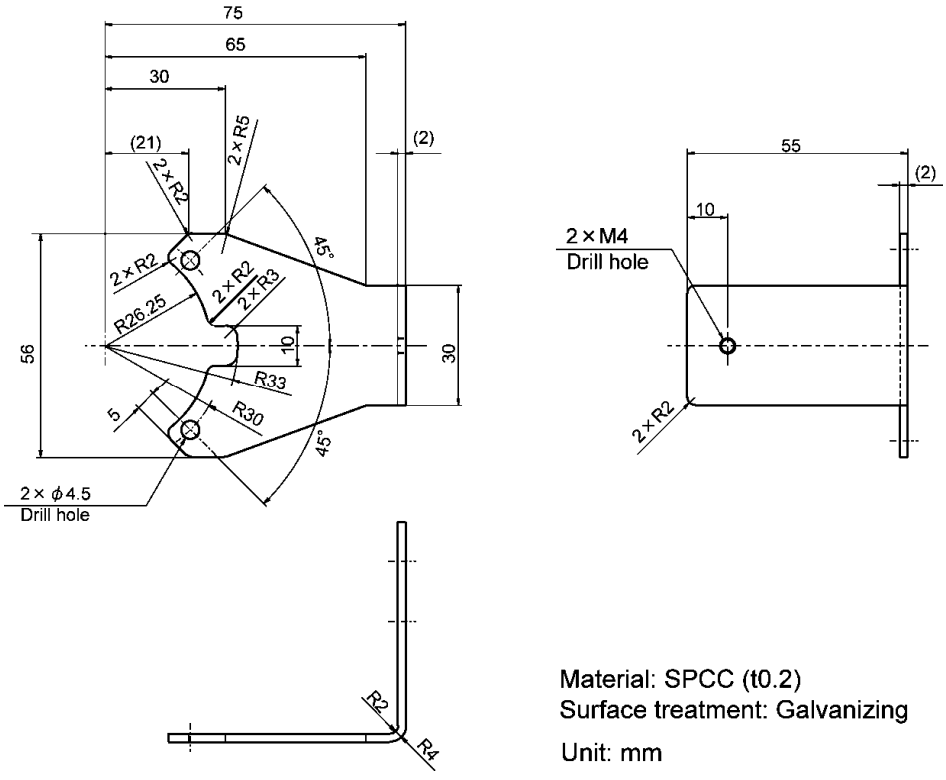
Model	Z-axis stroke	L1	L2	n
HM/HMS-E/-E2 series	200mm	375mm	350mm	6
	300mm	475mm	450mm	8
	400mm	575mm	550mm	10
HM/HMS-E/-E2-W series	200mm	545mm	520mm	9
	300mm	645mm	620mm	11
	400mm	745mm	720mm	13

Material: SPCC-SD (t1.0)
Surface treatment: Galvanizing
Unit: mm

Reference drawing for Stay 3

(8) Reference drawing for Stay 4

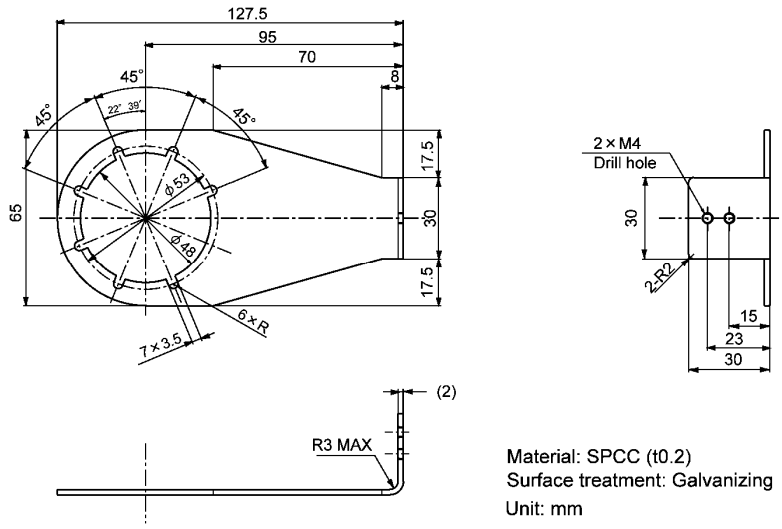
Standard type (HM/HMS-G series)



Material: SPCC (t0.2)
Surface treatment: Galvanizing
Unit: mm

Reference drawing for Stay 4 (1)

Dust- & splash-proof type (HM/HMS-G-W series)

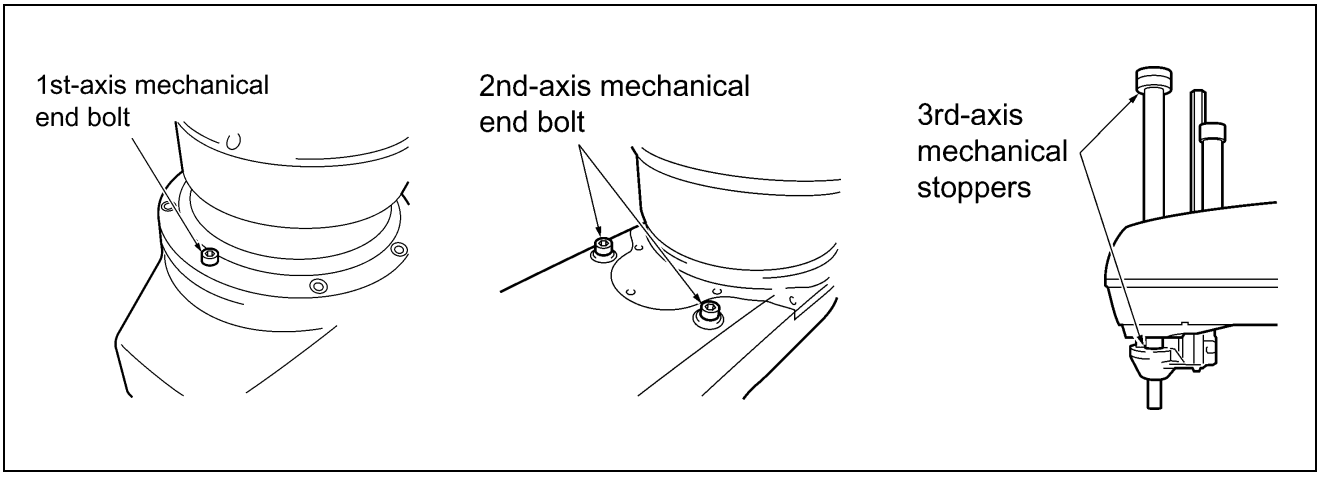


Reference drawing for Stay 4 (2)

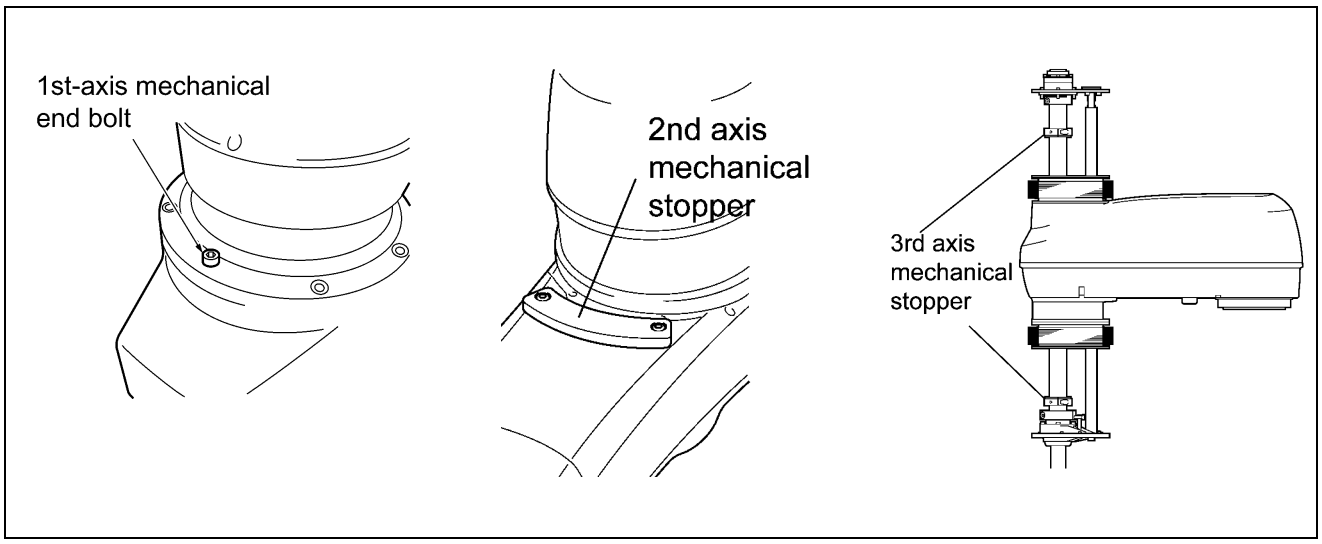
1.4.3 Prohibition Against Use of Mechanical End Bolts and Mechanical Stoppers for Wiring or Piping

Never remove the 1st- or 2nd-axis mechanical end bolts or 3rd-axis mechanical stoppers shown below or use them for securing stays that clamp wiring or piping.

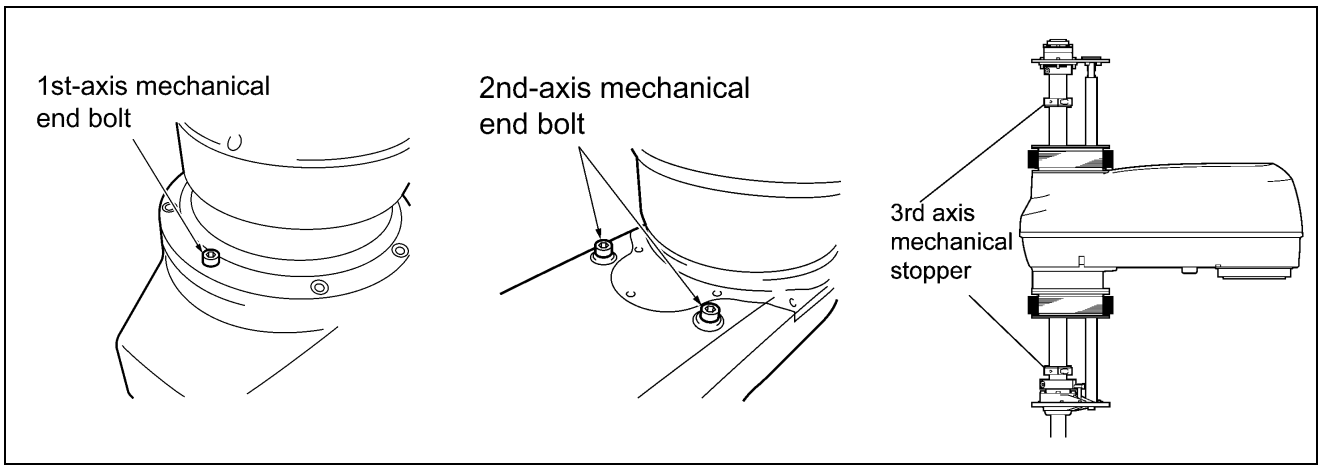
Doing so may result in the following problems: The CALSET initial position will be deviated when CALSET is performed; software limits will become invalid; the robot arm will fail to run as programmed; the robot arm will interfere with its peripheral devices; and so on.



HM-G; Standard type



HM-4*60*G-W and HM-4*70*G-W; Dust- & splash-proof type



HM-4*85*G-W and HM-4*A0*G-W; Dust- & splash-proof type

1.4.4 Piping of Source Air

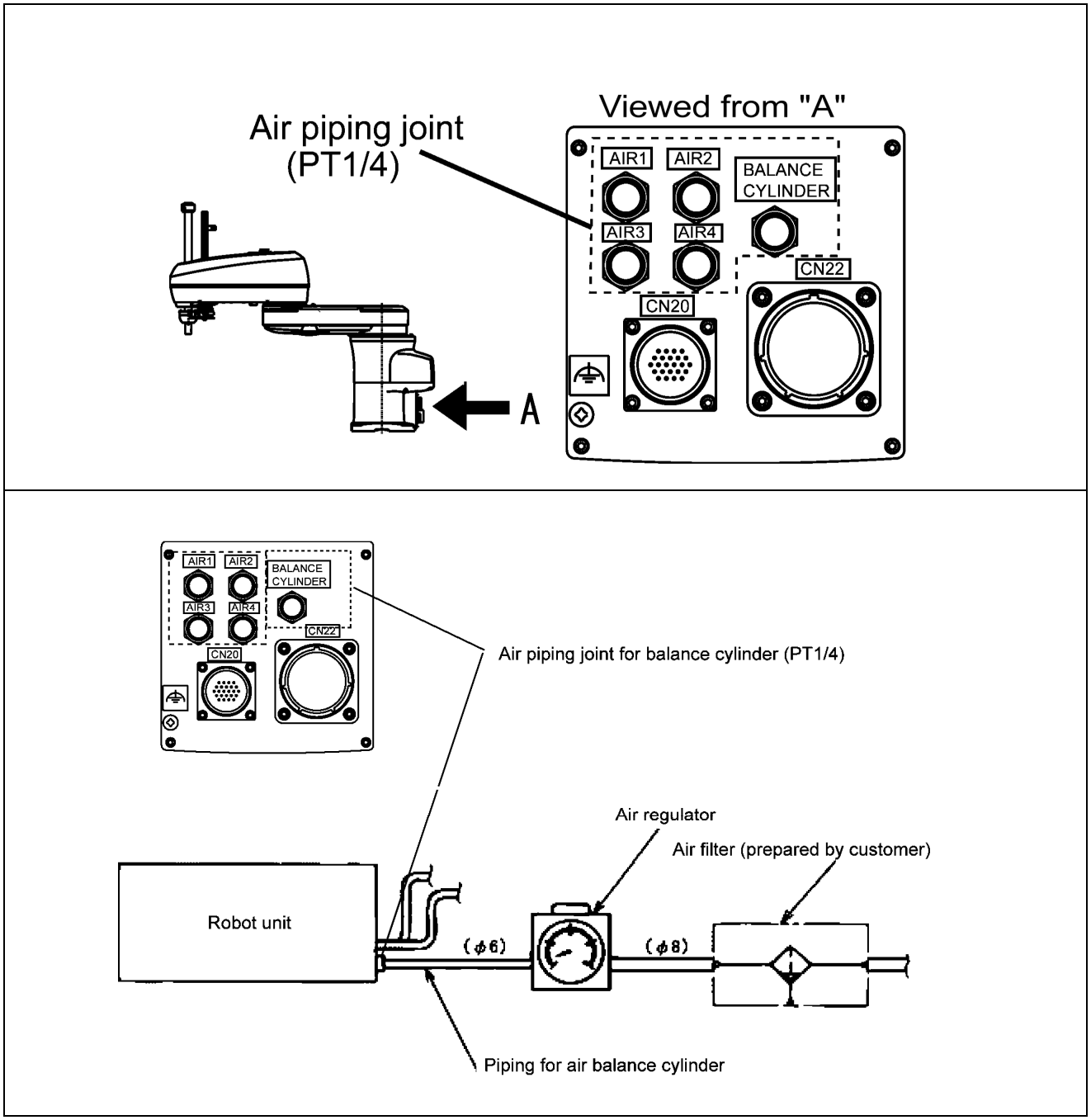
The robot unit is equipped with four air piping systems (6 mm in diameter a pipe) for controlling hands. Supply air that matches the hand in use, keeping the air pressure below the withstanding pressure of the pipe (0.59 MPa).

In addition to the four piping systems, the robot unit except the dust- & splash-proof type is equipped with another air piping system for the air balance cylinder (6 mm diameter). Air to be supplied to the cylinder should satisfy the following specifications.

- Air pressure: See "Adjusting the air balance cylinder".
- Air flowrate: 70 Nl/min (to be assured)
- Filtering: Dry air filtered through an air filter (Recommended filtration rating: 5 μm or below)

Also, observe the details below regarding the environment and conditions to install the air regulator.

- Avoid use in locations subjected to vibration and shock.
- Avoid use in locations subjected to ambient temperatures of 40℃ or higher.
- When there is a heat source in the surroundings, avoid use in locations subjected to radiant heat.
- Avoid use in atmospheres abundant in grit and dust, or atmospheres where corrosive gases or spatter are present.
- Avoid use in locations subjected to direct sunlight, the wind and rain, or water.
- Avoid repetition of drastic rise and fall in pressure or pressure pulsation, which can decrease the operating life of the pressure meter.
- Install as close to the robot as possible.



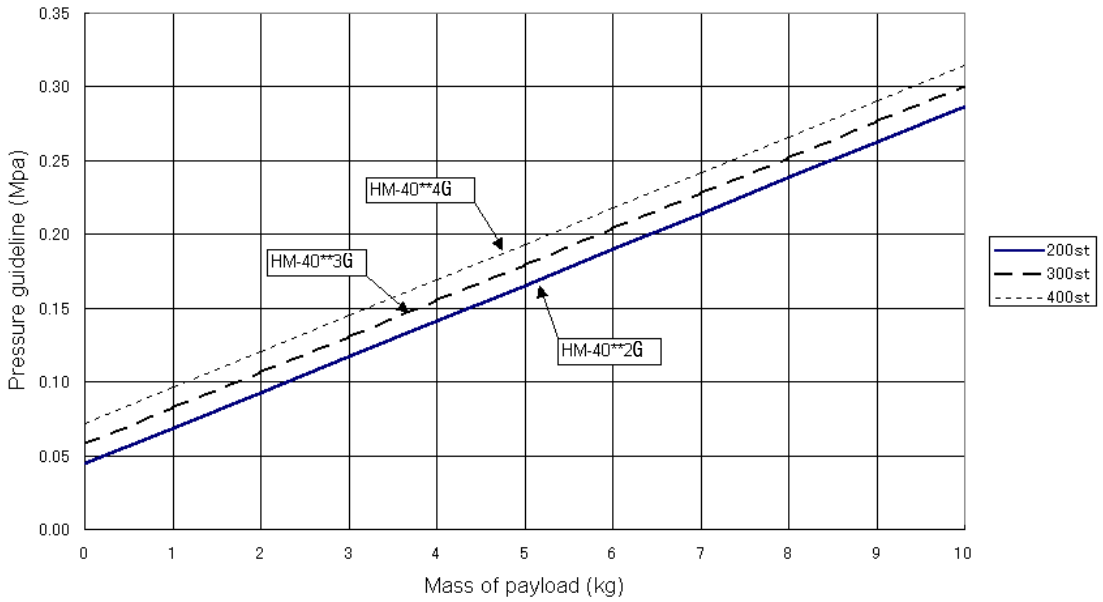
Air Piping of the Robot Unit (HM/HMS-G)

Adjusting the air balance cylinder

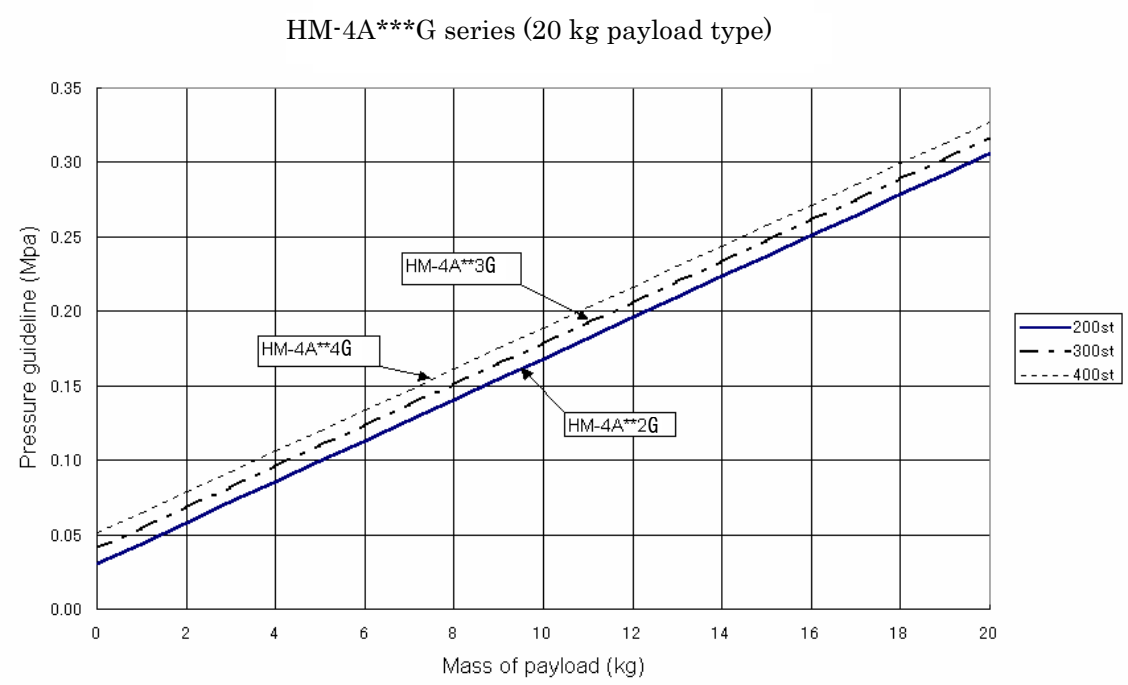
Adjust the air pressure by using the air regulator so that the end-effector plus payload chucked by the end-effector will balance with gravity.

For details, refer to the graphs below and the SETTING-UP MANUAL, Section 5.3, "Adjusting the air pressure balance of the Z-axis, [F1 Arm]—[F12 Maint.]—[F4 Adj.Z.Bal]."

HM-40***G series (10 kg payload type)



HM-4A***G series (20 kg payload type)



Note: This graph shows only a guideline.

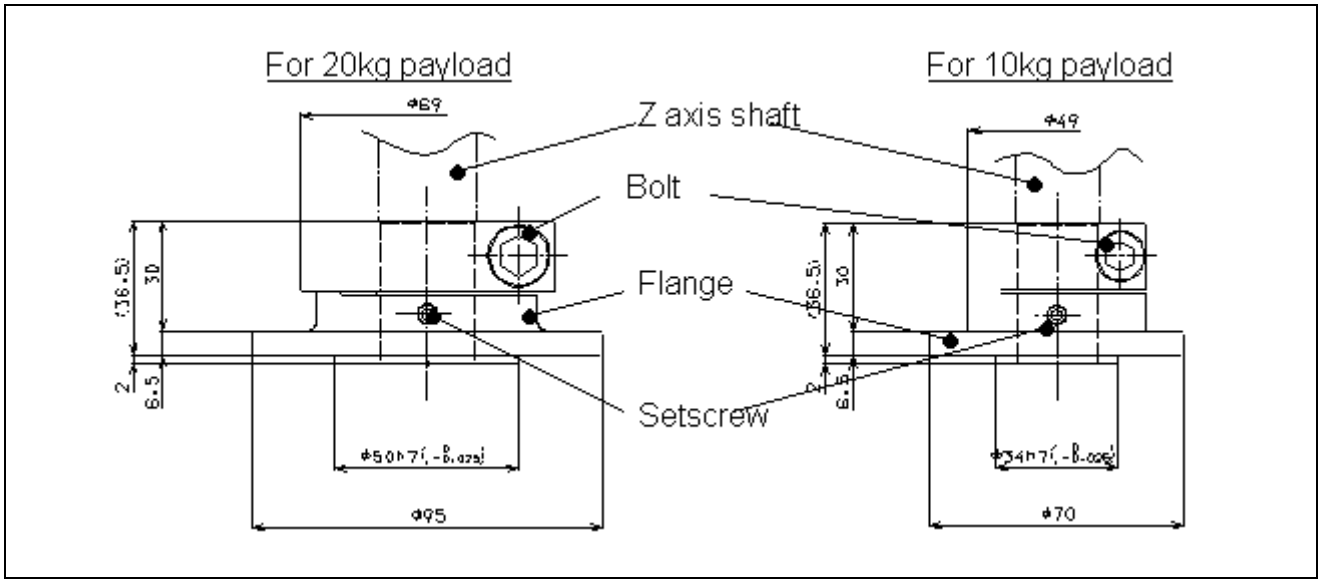
Air Pressure Guideline

1.5 Installing the Flange Kit (Option)

The flange kit consists of a flange, fixing bolt, and setscrew. Install the flange to the T-axis shaft.

Robot model	Bolt & screw	Fixing torque
For 10 kg payload	Fixing bolt (M8)	35±6 Nm
	Setscrew (M5)	1.5±0.15 Nm
For 20 kg payload	Fixing bolt (M10)	70±13 Nm
	Setscrew (M5)	1.5±0.15 Nm

Caution: (1) After moving the Z-axis shaft to the upper end, install the flange.
(2) The setscrew is only for positioning. Never use it for hand fixing.



Installing the Flange Kit (HM/HMS-G)

1.6 Engineering-design Notes for Robot Hands

Refer to the GENERAL INFORMATION ABOUT ROBOT for HM-G SERIES, Chapter 3, Section 3.6 "Engineering-design Notes for Robot Hands"

1.7 Moving Each Axis with Motor Power OFF in Emergency Stop

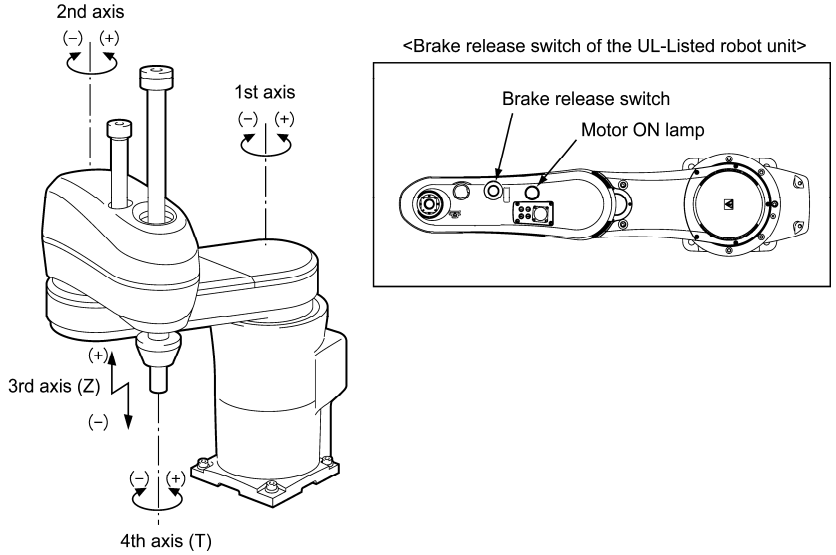
The table below shows which axes have a brake in the HM-G series of robot units and how to release the brake.

> ⚠**Warning:(1) Performing the brake release operation unexpectedly drops or raises the Z-axis. Make sure beforehand that the release operation will not cause bodily injuries or equipment damages.**
>
> **(2) When moving the 3rd axis (Z-axis), be careful not to let your fingers get caught in the geared part of the rack.**

Robot unit type	Axes with brake	How to release brake
Except UL-Listed ones	3rd axis (Z)	With the teach pendant or mini-pendant Access: [F2 Arm]—[F12 Maint.]—[F3 Brake.] on the teach pendant **Note: For details, refer to the SETTING-UP MANUAL, Chapter 5 "Commands Assigned to Function Keys of the Teach Pendant" and Chapter 6 "Using the Mini-Pendant."**
UL-Listed	1st axis (J1) 2nd axis (J2) 3rd axis (Z)	When the controller power is ON, holding down the brake release switch releases the brakes of all axes. **Note: On UL-Listed robot units, the teach pendant or mini-pendant cannot release the brakes.**

The table below shows how to move each axis with the motor power being OFF when the robot is in an emergency stop.

Moving the axes in an emergency stop

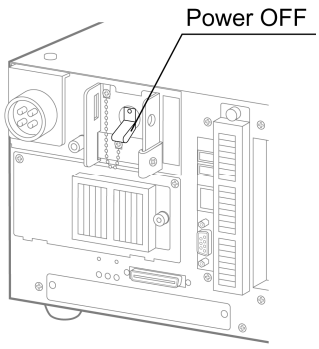
<table>
<tr><th>Axis</th><th>Robot units except UL-Listed ones</th><th>UL-Listed robot unit</th></tr>
<tr><td>1st axis (J1)</td><td rowspan="2">Move the robot arm by hand.</td><td rowspan="3">Move the target axis by hand while holding down the brake release switch.</td></tr>
<tr><td>2nd axis (J2)</td></tr>
<tr><td>3rd axis (Z)</td><td>(1) Reset the emergency stop state as follows.
If the emergency stop has been triggered by the teach pendant or mini-pendant, turn the Emergency stop button on the pendant clockwise; if it has been triggered by the equipment, restore the emergency stop switch to the short-circuited state.
(2) Release the brakes with the teach pendant or mini-pendant and then move the target axis by hand.</td></tr>
<tr><td>4th axis (T)</td><td>Turn the axis by hand.</td><td>Turn the axis by hand.</td></tr>
<tr><td colspan="3"> 
</td></tr>
</table>

Caution: When moving the robot by hand, hold by a part other than the plastic cover.

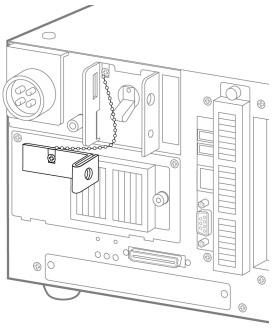
1.8 Locking Out the Power Switch

Lock out the power switch during maintenance and inspection jobs using a commercially available padlock, according to the following procedure.

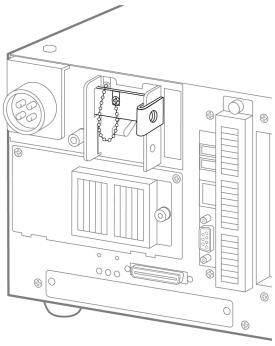
Step 1 **Check that the power switch of the robot controller is turned OFF.**



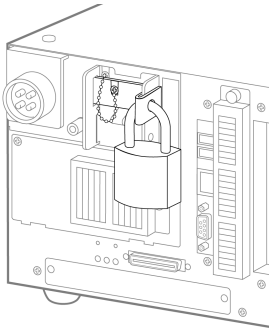
Step 2 **Remove the lockout bar provided on the robot controller.**



Step 3 **Put the lockout bar on the upper side of the power switch.**



Step 4 **Padlock the lockout bar.**



Chapter 2 Customizing Your Robot

2.1 What Is Customization?

You may customize your robot by modifying or setting the following:

- Software motion limits for defining the motion space
- Mechanical ends for defining the restricted space
- Control set of motion optimization
- Robot installation conditions

You are recommended to define new motion space and restricted space in order to prevent interference with other devices or entanglement of the hand's wiring and piping.

WARNING:

Always set the software motion limits and mechanical ends so that the motion space will be within the restricted space. Otherwise, the robot will bump the mechanical stops, causing serious accidents.

2.2 Modifying Software Motion Limits to Define New Motion Space

2.2.1 What Is a Software Motion Limit?

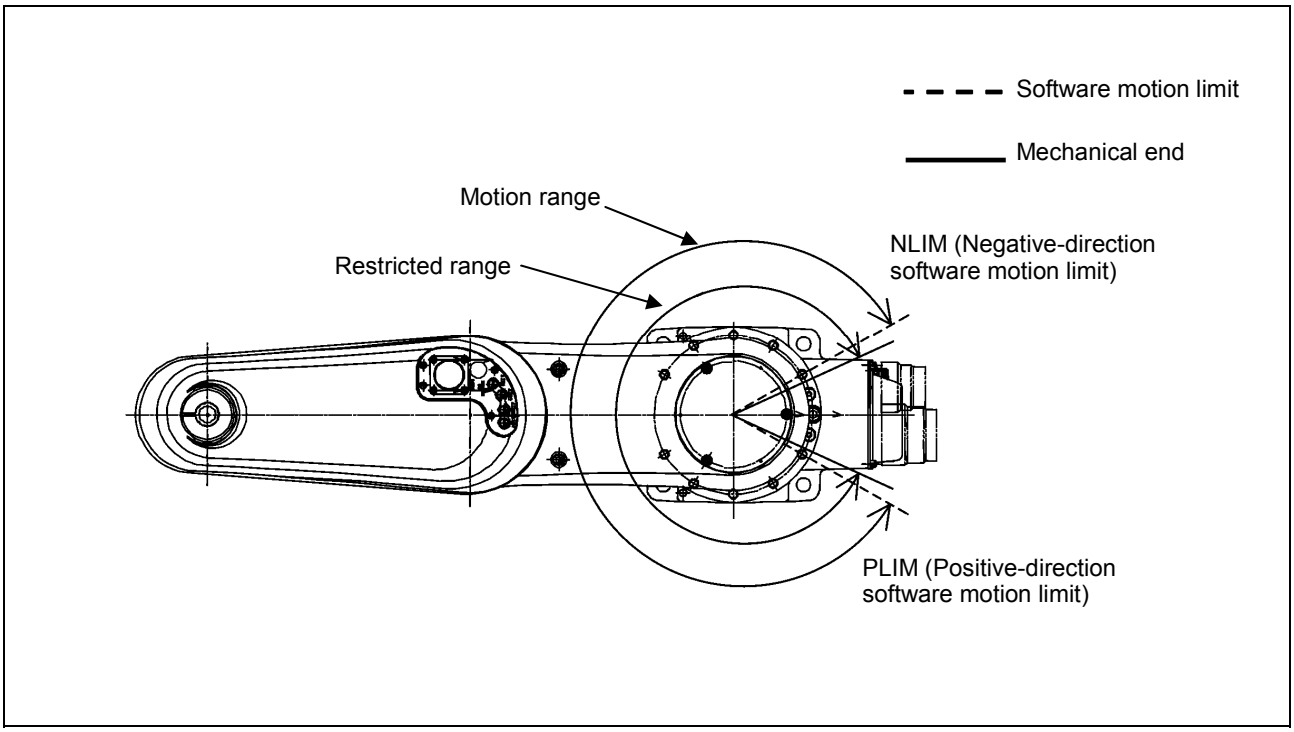
A limit to the operation range of the robot defined by software is called a software motion limit. Software motion limits become valid after CAL of the robot has been completed and the robot has entered the range set by the limits.

A mechanical motion limit is called a mechanical end and set by a mechanical stop. To prevent the robot from striking against a mechanical stop, each software motion limit is set slightly in front of the mechanical end as shown below.

If the robot reaches a software motion limit during manual or automatic operation, an error message will be displayed (error code starting from 607x where x represents the axis number) and the robot will come to a stop. The power to the motor will be also turned OFF if the robot is in automatic operation.

Each of all axes is assigned a software motion limit in both the positive and negative direction of the operation range. The software motion limit in the positive direction is called the positive-direction software motion limit and that in the negative direction is called the negative-direction software motion limit.

> ⚠**Note: Software motion limits are not functions in accordance with safety standards.**



Software Motion Limits and Mechanical Ends

2.2.2 Software Motion Limits (Factory defaults)

The table below lists the factory defaults of software motion limits.

(1) HM-G; Standard type

Robot type		Standard type		
		HM-4***2G HM-4***2G-UL	HM-4***3G HM-4***3G-UL	HM-4***4G HM-4***4G-UL
3rd-axis (Z-axis) stroke		200 mm	300 mm	400 mm
1st axis	Positive direction	165°		
	Negative direction	-165°		
2nd axis	Positive direction	147° (HM-4*60*E: 143°)		
	Negative direction	-147° (HM-4*60*E: -143°)		
3rd axis	Positive direction	350 mm	350 mm	350 mm
	Negative direction	150 mm	50 mm	-50 mm
4th axis	Positive direction	360°		
	Negative direction	-360°		

(2) HM-G-W; Dust- & splash-proof type

Robot type		Dust- & splash-proof type		
		HM-4***2G-W	HM-4***3G-W	HM-4***4G-W
3rd-axis (Z-axis) stroke		200 mm	300 mm	400 mm
1st axis	Positive direction	165°		
	Negative direction	-165°		
2nd axis	Positive direction	147° (HM-4*60*E-W: 140°, HM-4*70*E-W: 146°)		
	Negative direction	-147° (HM-4*60*E-W: -140°, HM-4*70*E-W: -146°)		
3rd axis	Positive direction	310 mm	310 mm	310 mm
	Negative direction	110 mm	10 mm	-90 mm
4th axis	Positive direction	360°		
	Negative direction	-360°		

(3) HMS-4*70*G; Overhead-mount type (Overall arm length 700 mm)

Robot type		Standard type			Dust- & splash-proof type		
		HMS-4*702G	HMS-4*703G	HMS-4*704G	HMS-4*702G-W	HMS-4*703G-W	HMS-4*704G-W
3rd-axis (Z-axis) stroke		200 mm	300 mm	400 mm	200 mm	300 mm	400 mm
1st axis	Positive direction	165°			165°		
	Negative direction	-165°			-165°		
2nd axis	Positive direction	145°			142°		
	Negative direction	-145°			-142°		
3rd axis	Positive direction	-436 mm	-456 mm	-456 mm	-496 mm	-496 mm	-496 mm
	Negative direction	-656 mm	-756 mm	-856 mm	-696 mm	-796 mm	-896 mm
4th axis	Positive direction	360°					
	Negative direction	-360°					

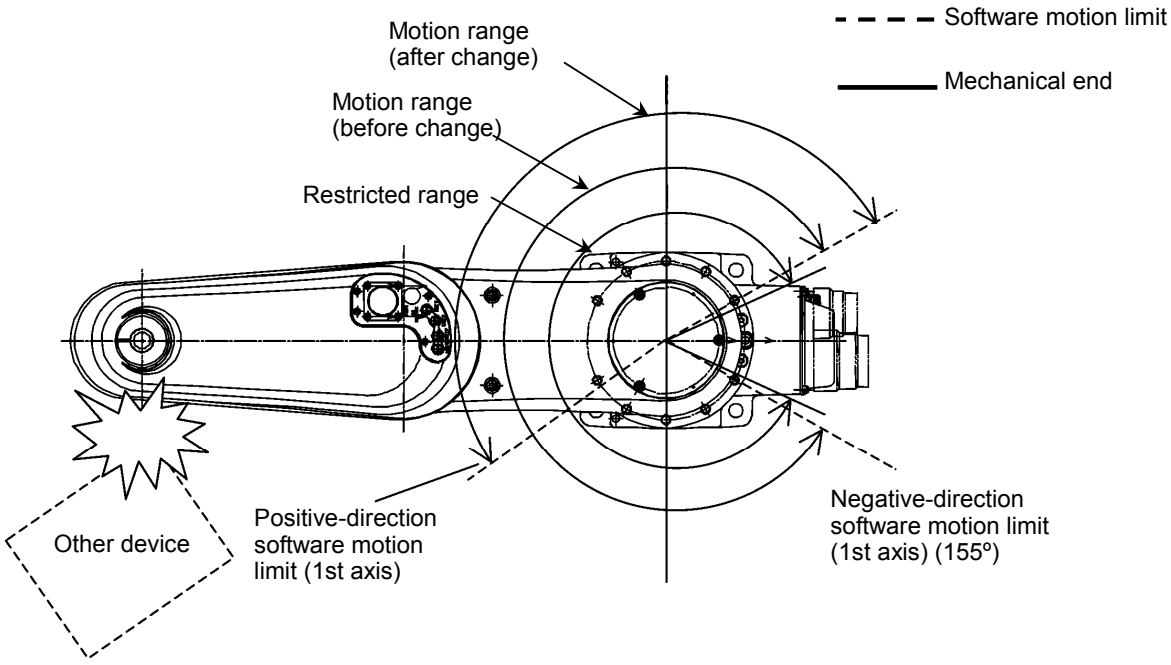
(4) HMS-4*85*G; Overhead-mount type (Overall arm length 850 mm)

Robot type		Standard type			Dust- & splash-proof type		
		HMS-4*852G	HMS-4*853G	HMS-4*854G	HMS-4*852G-W	HMS-4*853G-W	HMS-4*854G-W
3rd-axis (Z-axis) stroke		200 mm	300 mm	400 mm	200 mm	300 mm	400 mm
1st axis	Positive direction	165°			165°		
	Negative direction	-165°			-165°		
2nd axis	Positive direction	142°			142°		
	Negative direction	-142°			-142°		
3rd axis	Positive direction	-436 mm	-456 mm	-456 mm	-496 mm	-496 mm	-496 mm
	Negative direction	-656 mm	-756 mm	-856 mm	-696 mm	-796 mm	-896 mm
4th axis	Positive direction	360°					
	Negative direction	-360°					

2.2.3 Changing Software Motion Limits

If the robot interferes with other devices or the air piping and wiring of the hand become taut as the robot arm moves, then change the software motion limits to make the motion space smaller as shown below.

Caution: When changing software motion limits, always take into account that the robot arm will move within the range specified by the initial software motion limits.



Changing Software Motion Limits

2.2.4 Precautions When Changing the Software Motion Limits

(1) Confirm the motion space of the robot unit in the actual working environment.
(2) When setting the software motion limits, be careful with the units.
(3) Specifying too small motion space may cause the robot unit to seem immovable.

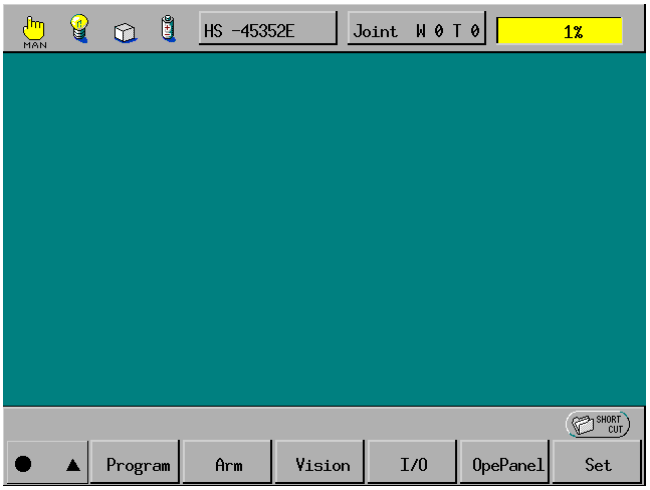
2.2.5 Procedure for Changing the Software Motion Limits

Described below is the procedure for changing the software motion limits.

Step 1 **Turn the power switch of the robot controller ON.**

Step 2 **Set the mode selector switch of the teach pendant to MANUAL.**

Step 3 **Press [F2 Arm] on the top screen of the teach pendant.**

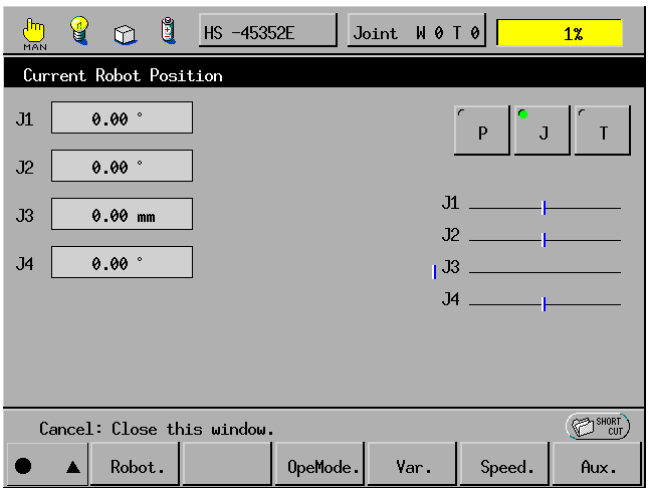


F2

The Current Robot Position window appears as shown in Step 4.

Step 4

Press the SHIFT key and then press [F12 Maint.].



F12

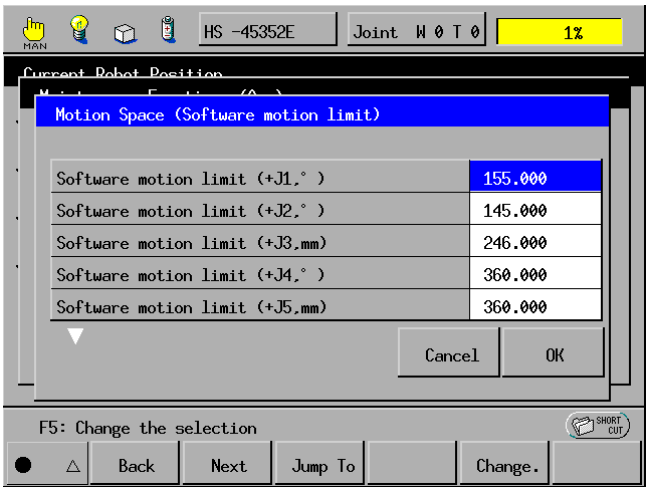
The Maintenance Functions (Arm) window will appear.

Step 5

In the Maintenance Functions (Arm) window, press [F1 M Space].

The Motion Space window will appear as shown below.

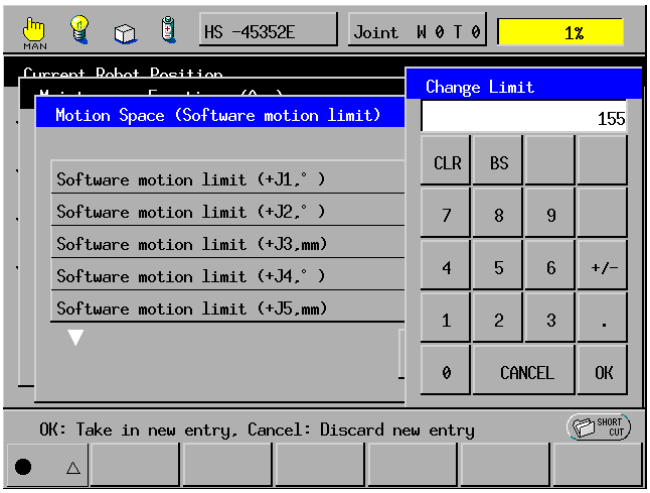
Select the item to be modified, then press [F5 Change].



F5

Step 6 The numeric keypad will appear as shown below.

Enter a desired value using the numeric keys, then press OK.



Step 7 The new value will be set on the line of the item selected in the Motion Space window.

If two or more items must be changed, repeat Steps 6 and 7.

Step 8 **Press OK in the Motion Space window.**

Step 9 **Turn the robot controller off.**

> **Caution:** Restarting the controller makes the new motion space settings (software motion limits) effective.

2.3 Changing Mechanical Ends to Define New Restricted Space

2.3.1 What is a Mechanical End Change?

In the case of the HM-G series, you may change mechanical ends on the 1st through 3rd (Z) axes.

When the robot leaves the factory, the mechanical ends are set at points 2° to 3° outside the default software motion limits. (Refer to Section 2.2.2 "Software Motion Limits (Factory defaults)."

Adding mechanical stops to change mechanical ends is called "Mechanical end change."

Regarding to the additional mechanical stopper installation, you may need to prepare and install the stopper on your own.

Please contact your DENSO representative for more details.

CAUTIONS IN CHANGING THE MECHANICAL ENDS

1. **When changing the mechanical ends, design the mechanical stoppers according to your usage and manufacture them.**
2. **After changing the mechanical end, the software motion limits (PLIMs, NLIMs) should be changed not to interfere the mechanical end at the robot operation.**
3. **When the robot has collided with a mechanical stopper, contact us for inspection and repairs before using the robot because the robot may be damaged.**
   Also because the mechanical stopper designed and made by the customer may be damaged, do not reuse the mechanical stopper, but replace it before using the robot.
4. **The reference drawings described on this manual cannot be covered on the customer's usage conditions sufficiently. Design, manufacture and install the mechanical stoppers according to your usage conditions.**
5. **The weight addition by the mechanical stoppers may affect the maximum payload.**
6. **The failures caused by the mechanical stoppers shall not be covered by the warranty even if the robot is under warranty.**

NOTE: This manual does not include reference diagram of mechanical stoppers. Please contact your DENSO representative for more details.

2.4 Performing CALSET

2.4.1 What Is CALSET?

Calibrating the relationship between position-related information recognized by the robot controller and the actual position of the robot unit is called CALSET.

CALSET must be performed when any motor is replaced or when any encoder backup battery goes dead so that the position-related data retained in the encoder is lost as a result.

After CALSET is completed, the calibrated data of the robot unit will be stored in the robot controller. This data is called CALSET data which differs on each robot.

Back up the CALSET data periodically, referring to "Backing Up Projects."

2.4.2 Preparation for CALSET

Press each of the 1st- to 4th-axes against the associated mechanical ends by hand to get the actual positions.

CALSET requires some space for bringing each axis into contact with the mechanical end.

Caution: (1) When CALSETing, move the axis to be CALSET in the vicinity of the mechanical end, release the brake, and bring the axis into contact with the mechanical end. When bringing the 3rd axis (Z-axis) into contact with the mechanical end, be careful not to let your fingers get caught in the geared part of the rack.

(2) After CALSET, confirm in the manual mode that each axis stops at the software motion limit before coming into contact with the mechanical end.

(3) In automatic operation, start to run the robot at low speed. Ensuring safety, gradually increase the speed. It makes adjustment easy.

(4) Position-related data in some programs made before CALSET may vary somewhat after CALSET.

NOTE: When CALSETing the 4th axis of the dust- & splash-proof type, you need to pull down the lower bellows for setting the CALSET bolt.

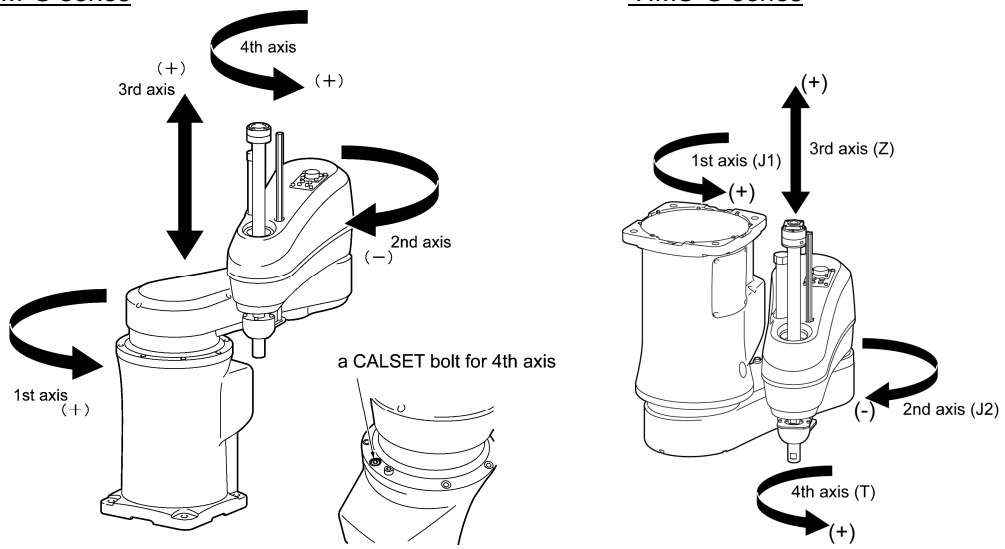
What is a CALSET position?

The limit position of an axis to be CALSET is called a CALSET position. Each axis has a mechanical end in each of the positive and negative directions. The CALSET to be carried out before shipment uses mechanical ends shown below as CALSET positions.

(2) CALSET position (HM/HMS-G series)

Mounting CALSET bolts on the 4th axis: To CALSET the 4th axis, you need to mount a CALSET bolt on the axis. As illustrated below, the CALSET bolt is built in the robot unit, so remove it and set it up into the specified position. After completion of CALSET, put it back into place.

Location	1st axis	Turning end in the positive direction (counterclockwise end when viewed from the top)
	2nd axis	Turning end in the negative direction (clockwise end when viewed from the top)
	3rd axis	Upper end (in the positive direction)
	4th axis	Turning end in the positive direction (counterclockwise end when viewed from the top)
External appearance		HM-G series / HMS-G series



Notes for 4th axis CALSET

(1) Remove the CALSET bolt from the robot and set it as shown in right figures.

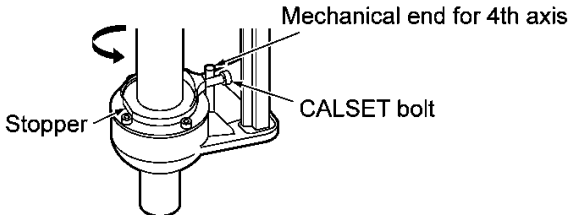
(2) Rotate the 4th axis shaft to the CALSET position by moving the stopper with hand.

Caution: Never push with too large torque.

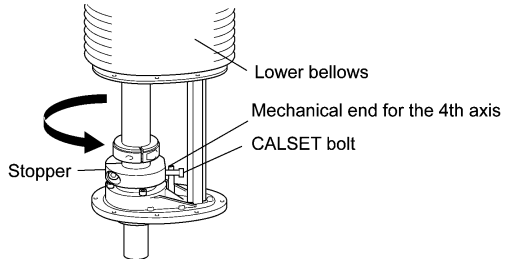
Pushing torque: 0.5Nm or less

(3) In case of the dust- & splash-proof type, perform 4th-axis CALSET after removing the lower bellows.

For HM-G series



For HM-G-W series



CALSET Positions at Shipment (HM/HMS-G series)

2.4.3 Performing CALSET

[1] CALSET of a Single Axis

CALSETing a specified single axis only is called single-axis CALSET.

Perform single-axis CALSET if the motor of an axis is replaced so that the axis must be CALSET, or if some axes cannot be moved to the CALSET positions (mechanical stop positions) at any given time because of interference between the robot unit and its surrounding facilities.

Described below is the procedure to perform single-axis CALSET.

For the UL-Listed robot units, brake releasing is required in CALSETing the 1st, 2nd, and 3rd axes each; for other models, it is required only in CALSETing the 3rd axis.

Caution: When moving the robot by hand, hold by a part other than the plastic cover.

Step 1 **Move the axis to be CALSET to the mechanical end position.**

■ **Brake releasing on UL-Listed robot units**

On the UL-Listed robot units, when the brake release switch is being pressed, the brakes of all axes are released.

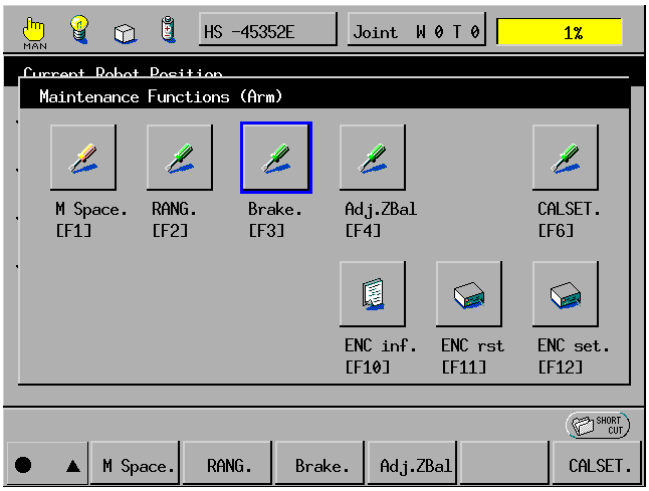
With the brake release switch being pressed, move the axis to be CALSET by hand to bring it into contact with the mechanical end in the CALSET position.

At that time, be careful not to let your fingers get caught in the geared part of the rack. After that, skip to Step 10.

Step 2 **On the top screen of the teach pendant, press [F2 Arm].**

Step 3 **Press the SHIFT key and [F12 Maint.].**

The Maintenance Functions (Arm) window appears as shown below.



F3

Press [F3 Brake.].

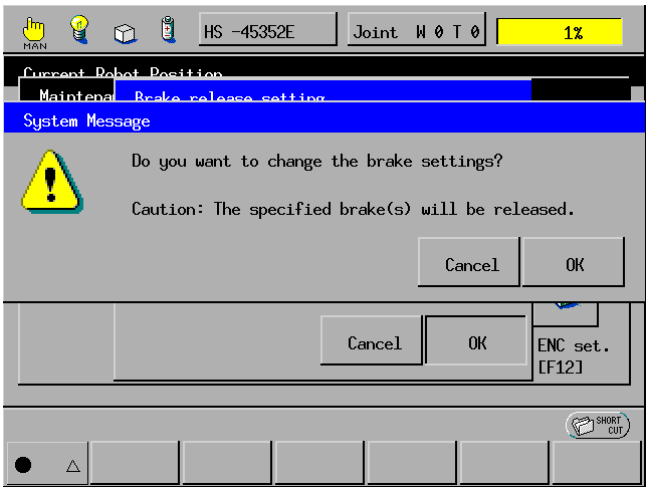
Step 4 The Brake release setting window appears as shown below.

Step 5 **Select "Brake released."**

Step 6 **Confirm that there is no danger even if the arm falls as a result of the brake being released.**

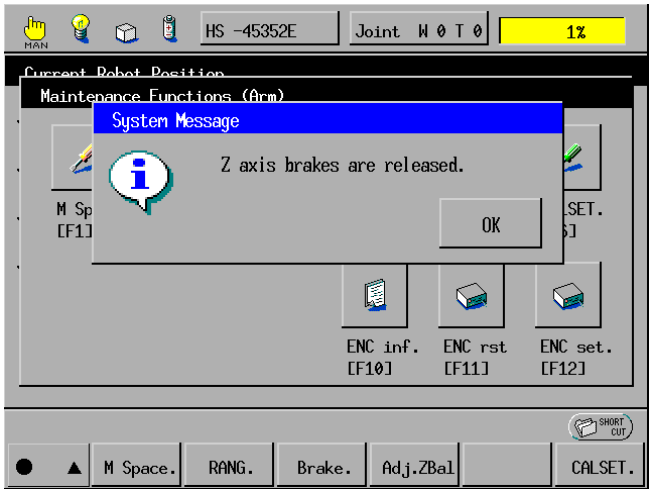
Then press OK.

Step 7 The system message appears asking you whether you want to change the brake settings.



Press OK.

Step 8 The system message appears informing that the brake is released.



Press OK.

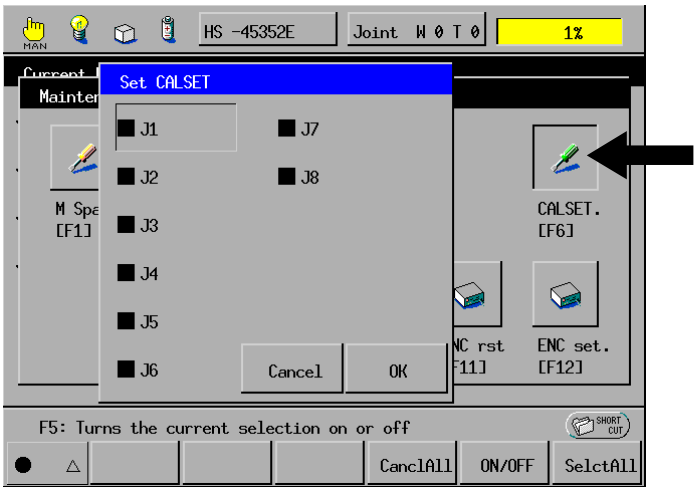
Step 9 **Press the axis to be CALSET against the mechanical end in the CALSET position by hand.**

Caution: When bringing the 3rd axis (Z-axis) into contact with the mechanical end, be careful not to let your fingers get caught in the geared part of the rack.

Step 10

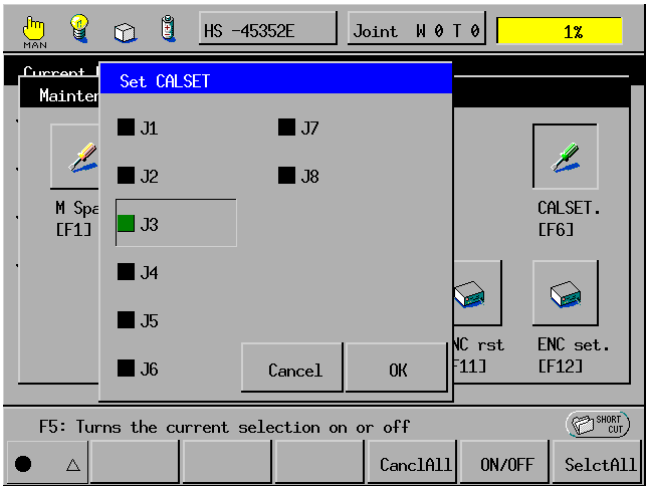
Press [F6 CALSET.].

The Set CALSET window appears as shown below.



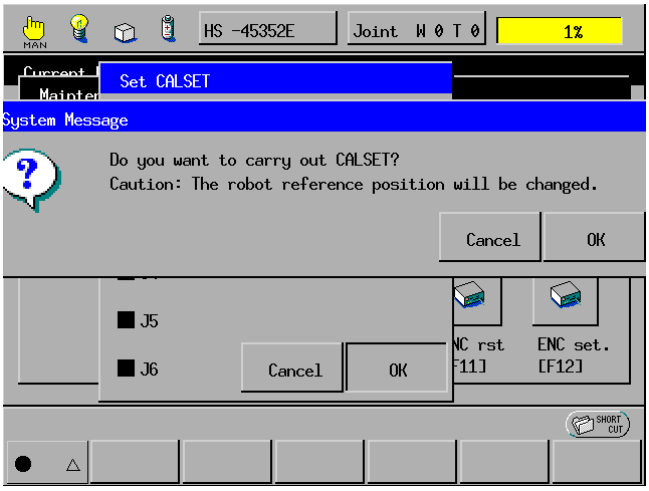
Step 11

Press the axis number to be CALSET to turn it on (green). For other axes that are not to be CALSET, turn it off (black).



Press OK.

Step 12 The system message appears asking whether you want to carry out CALSET.



Press OK.

Step 13 The system message appears informing that CALSET is successfully completed.

Press OK.

Step 14 **Press the ROBOT STOP button.**

The robot brake becomes activated.

Step 15 **Turn the ROBOT STOP button to cancel robot stop.**

Step 16 **Press the MOTOR key to turn the motor ON.**

> **Caution:** A "motor lock overload" error may occur just after the power to the motor is turned ON. In this case, try to turn ON the power to the motor several times, or release the brake, move the axis a little in the opposite direction of the mechanical end, and turn ON the power to the motor again.

Step 17 **Move the CALSET axis in the opposite direction from the mechanical end by manual operation from the teach pendant.**

The single-axis CALSET of the specified axis is completed.

[2] CALSET of All Axes

The CALSET of all axes is called all-axis CALSET.

The procedure is the same as that for single-axis CALSET except that you should select all axes in Step 11. For detailed procedure, see “[1] CALSET of a Single Axis.”

2.5 Setting Control Set of Motion Optimization

The optimum speed or acceleration will vary depending upon the payload and center of gravity of the hand and/or workpiece that are to be set at the end of the robot flange. Set the payload and center of gravity position of the hand or workpiece and the control set of motion optimization according to the payload and the robot posture.

The mass of payload is a total mass of a hand and workpiece, expressed in gram.

For further information, see the PROGRAMMER'S MANUAL (I), Section 4.7, "Setting the Master Control Parameters in User Preferences." For the setting procedure, refer to the SETTING-UP MANUAL, Section 2.8 "Setting the Master Control Parameters of the Payload, Center of Gravity, and Control Set of Motion Optimization."

2.6 Setting Robot Installation Conditions

Depending on whether the robot is floor-mounted or overhead-mounted, the optimum operating conditions differ.

However, as for horizontal articulated type; the HM-G series (floor-mount type) and HMS-G series (overhead-mount type), the installation conditions are preset at the factory. You do not need to change the factory default of the installation settings.

Chapter 3 Maintenance and Inspection

3.1 Maintenance & Inspection Intervals and Purposes

The table below lists the intervals and purposes of maintenance & inspection required for your robot.

Maintenance & Inspection Intervals and Purposes

No.	Intervals	What to do:	Needed:
1	Daily before starting operations	Inspection jobs specified in Section 3.2.	To use your robot safely.
2	Quarterly	Inspection jobs specified in Section 3.3.	To maintain the precision of the robot and to prevent failures caused by overheat of the robot controller.
3	Semiyearly	Inspection jobs specified in Section 3.4.	To check the rotary sections and slideways of the robot and its controller for wear, preventing seizure, breakage, and other serious failures that could result from wear.
4	Biennial	Replacement of backup batteries specified in Section 3.5.	To retain the position data stored in the electronic absolute encoders built in the robot unit and the robot-specific data (programs, parameters, etc.) stored in the internal memory of the robot controller. To maintain the precision of the robot motion.

⚠ Caution: Maintenance and inspection must be carried out by a trained worker who possesses the ability to perform these tasks safely. Before performing maintenance and inspection jobs, read the SAFETY PRECAUTIONS, "4. Precautions while Robot is Running" and "5. Daily and Periodical Inspections."

3.2 Daily Inspections

3.2.1 Check Items

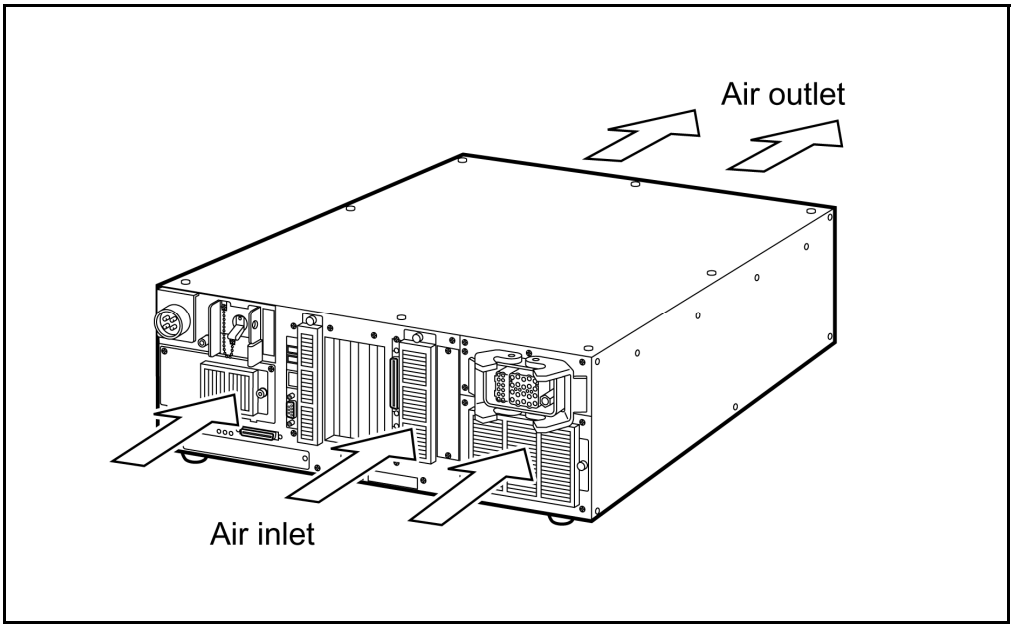
Before starting operations, check the items listed below every day.

Daily Inspections Table

No.	Check:	Controller Power	How to check:	Criterion	What to do: (Note 1)
1	Connectors (CN1 to CN10 on the robot controller) and their mating parts	OFF	Visually	No looseness, disengagement or dirt.	Engage the parts properly and clean them.
2	Cables (connected to CN1 to CN10 on the robot controller) and robot's external cables	OFF	Visually	Free of damage or gouges.	Repair or replace.
3	LCD on the teach pendant	ON	Visually	Properly displayed	Repair or replace.
4	Pilot lamps on the robot controller	ON	Visually	Should light.	Repair or replace.
5	Cooling fan in the robot controller	ON	Visually **(Note 2)**	Should work properly.	Repair or replace.
6	EMERGENCY STOP button on the teach pendant or the mini pendant	ON	Press the EMERGENCY STOP button.	The robot should come to an emergency stop.	Repair or replace.
7	Safety door	ON	Operate the safety door switch and open the switch-wiring door.	The robot should come to an emergency stop.	Inspect and repair.
8	Brake release switch on the UL-Listed robot units	OFF	Check for looseness.	No looseness.	Tighten up.
9	Bellows (on the Z-axis of dust- & splash-proof type)	OFF	Visually	No breakage.	Inspect and repair.
10	Motor ON lamp on the UL-Listed robot units	ON	Visually	It should light when the motor is ON.	Inspect and repair.
11	Robot unit (Except lubrication points)	OFF	Visually	No grease leak	Wipe off grease

Note 1 Some repair and replacement operations shown in "What to do:" column may involve special jobs. Contact our Robot Service Section.

Note 2 The normal operation of the cooling fan is as shown on the next page.



Normal Operation of Cooling Fan

3.3 Quarterly Inspections

3.3.1 Check Items and Lubrication

Check the items listed below every three months.

Quarterly Inspections Table

No.	Check:	Controller Power	How to check:	Criterion	What to do:
1	Robot base mounting bolts	OFF	Measure the tightening torque with a torque wrench.	No looseness. Specified torque: 128 ±20 Nm	Tighten the bolts to the specified torque.
2	Cooling fan filters in the robot controller	OFF	Visually	No dust or dirt.	Clean the cooling fan filters. (Refer to Section 3.3.2.)

3.3.2 Cleaning the Cooling Fan Filters in the Robot Controller

For the cleaning procedures of the air intake filter, refer to the RC7M CONTROLLER MANUAL, Section 6.4 "Cleaning the Air Intake Filter."

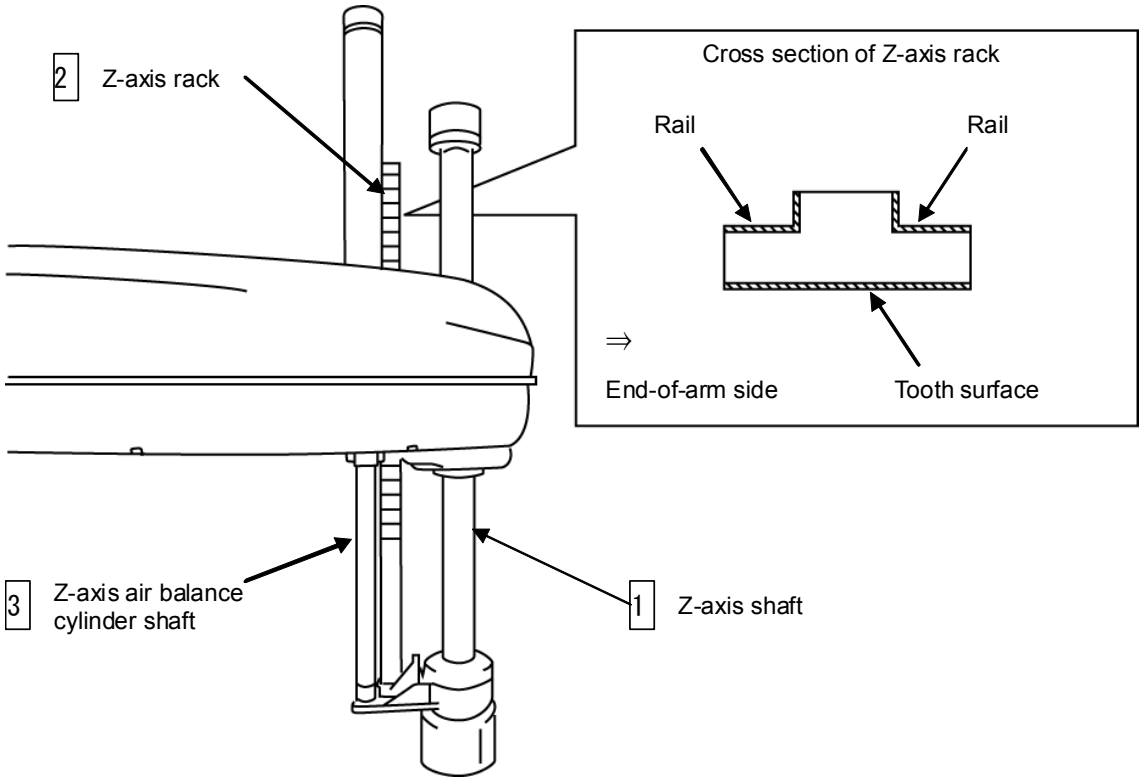
3.4 Semiyearly Inspections

3.4.1 Lubrication

Apply the specified grease to the whole Z-axis shaft as shown below every six months.

Lubrication Points and Lubricants (HM/HMS-G series)

No.	Lubrication points	Lubricant type	Lubricant amount	Remarks
1	Z-axis shaft	Epinoc AP1	2 to 3 cc	Apply the grease to the whole Z-axis shaft.
2	Z-axis rack	Epinoc AP1	2 to 3 cc	Apply the grease to the rack and gear of the Z-axis shaft.
3	Z-axis air balance cylinder shaft	Epinoc AP1	2 to 3 cc	Apply the grease to the whole cylinder shaft.



<Example of HM-G>

NOTE: When applying grease to the dust- & splash-proof type, you need to pull down the upper bellow on the Z-axis shaft.

3.5 Biennial Inspections

3.5.1 Battery Replacement and Belt Inspection

Replace the two types of backup batteries listed below and inspect the timing belts every two years.

Please contact your DENSO representative to inspect timing belts and to adjust them.

> **⚠Caution: (1) The battery used in this device may present a risk of fire or chemical burn if mistreated. Do not recharge, disassemble, heat above 100°C (212°F), or incinerate.**
>
> **(2) Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.**

Types of Backup Batteries

	Battery type	Used to:	Located:	Refer to:
1	Encoder backup battery	Back up the position data of the servomotor encoder.	In the robot unit	Section 3.5.2
2	Memory backup battery	Back up programs, parameters, and CAL data.	In the robot controller	Section 3.5.3

The position data of the encoder contained in the servomotor is stored in the internal memory of the encoder.

Programs, parameters, CAL data, etc. are stored in the internal memory of the robot controller.

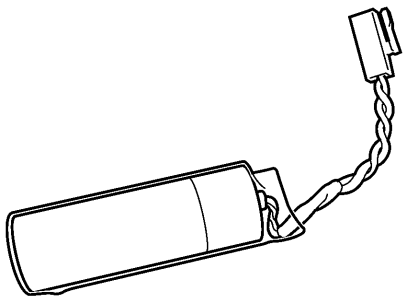
The backup battery for each memory retains the above data, while the power to the robot controller is turned OFF. However, these batteries have a limited lifetime and must, therefore, be replaced regularly.

> **⚠Caution: Without replacing the backup batteries, important robot-specific data stored in each memory will be lost.**

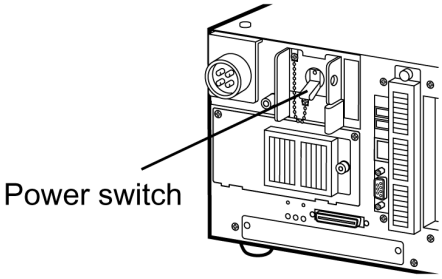
3.5.2 Replacing the Encoder Backup Battery

Replace the encoder backup battery according to the procedure given below.

STEP 1 **Prepare two new backup batteries for replacement.**

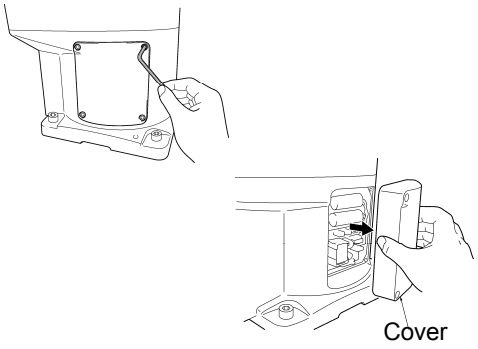


STEP 2 **Turn the controller power OFF.**



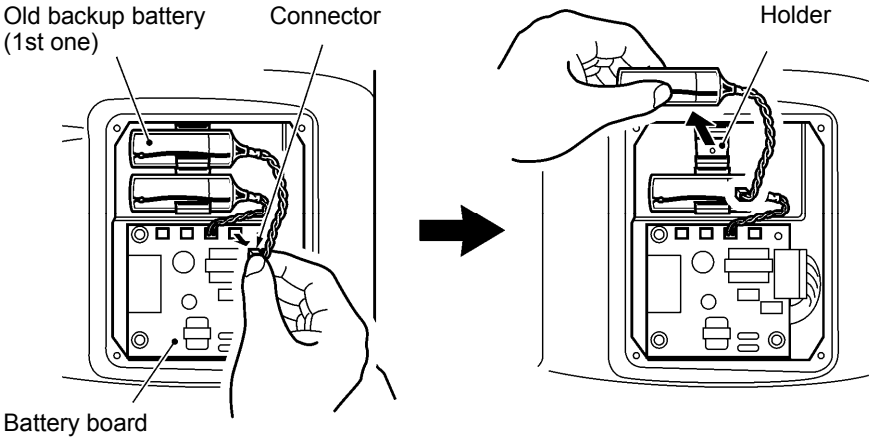
STEP 3 **Remove the cover from the robot unit.**

Four hex. socket-head bolts (M3x8)

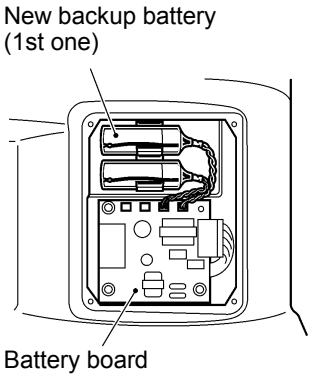


NOTE: On the dust- & splash-proof type, the cover has a packing for sealing. Take care not to lose it.

STEP 4 **Disconnect the old battery (1st one) from the battery board and then remove it from the holder.**

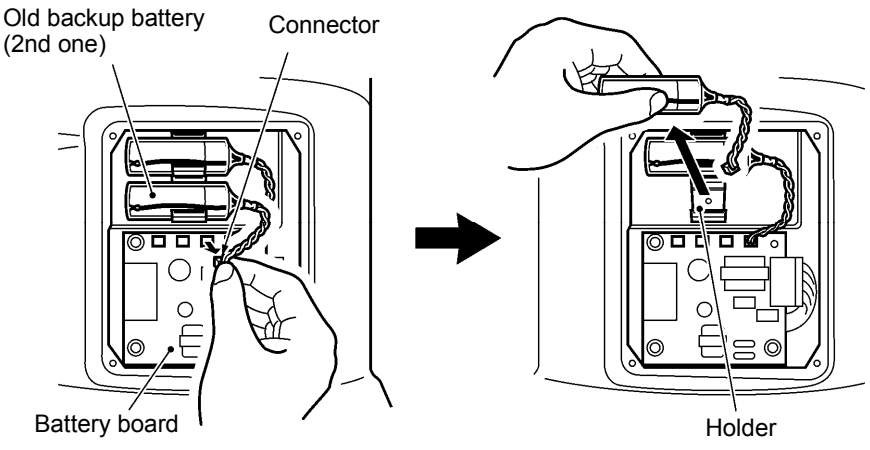


STEP 5 **Connect a new battery (1st one) to the battery board from which you have disconnected the old one in Step 4, and then load it into the holder.**



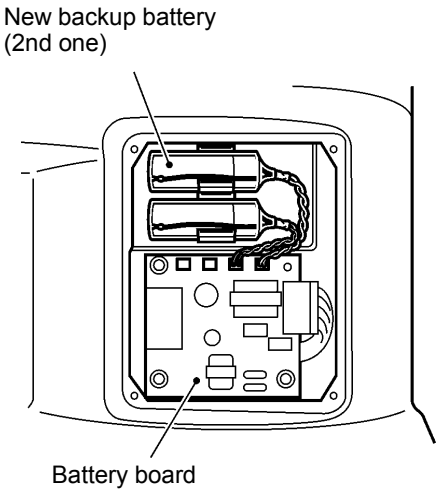
NOTE: Do not disconnect both of the current batteries at the same time. Doing so will lose the encoder positional data.

STEP 6 **Disconnect the remaining old battery (2nd one) from the battery board and then remove it from the holder.**



STEP 7

Connect a new battery (2nd one) to the battery board from which you have disconnected the old one in Step 6, and then load it into the holder.



NOTE: Be sure to replace both of two batteries with new ones at one time. Otherwise, the battery service life will become short.

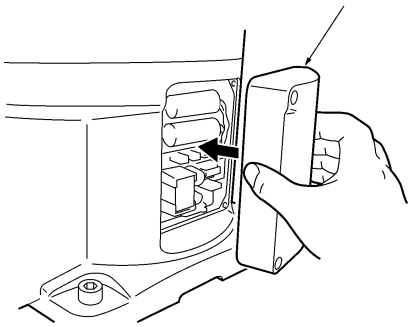
STEP 8

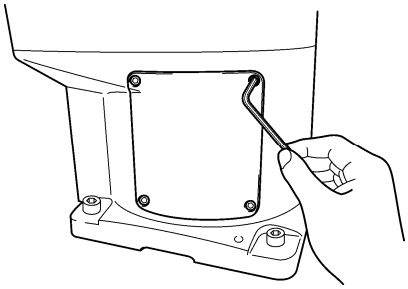
Install the cover to the robot unit.

NOTE: On the dust- & splash-proof type, the cover has a packing for sealing. Take care not to lose or pinch it.

Tightening toque

Hex. socket-head bolt (M3x8): 1.6±0.3 N•m





3.5.3 Replacing the Memory Backup Battery

For the replacing procedures of the memory backup battery, refer to the RC7M CONTROLLER MANUAL, Section 6.5 "Replacing the Memory Backup battery."

3.5.4 Setting the Next Battery Replacement Date

After replacing the memory backup battery, set the next battery replacement date from the teach pendant, according to the following procedure.

Check that the system clock of the robot controller shows the correct date beforehand. If it is incorrect, the next replacement date will also become incorrect.

STEP 1

On the top screen of the teach pendant, press [F6 Set].
The Settings (Main) window appears.

STEP 2

Press [F6 Maint.] in the Settings (Main) window.
The Maintenance menu appears.

STEP 3

Press [F4 Battery] in the Maintenance menu.
The Next Battery Replacement Date window appears.
In the top of the window, the current setting is displayed.
The date entry areas show the default replacement date that is two years later the current data at which you open this window, assuming that the battery service life is two years.

STEP 4

Press OK.
NOTE: If you do not want to change the replacement date, press Cancel.
The message "Are you sure you want to set the next battery replacement date?" appears.

STEP 5

Press OK.
The screen returns to the Settings (Main) window.

3.6 Supplies for Maintenance

The table below lists the supplies for maintenance.

Supplies for Maintenance

No	Name	Part No.	Remarks	
1	Grease	410971-0040	2.5 kg can	Epinoc Ap-l
2	Grease	410971-0050	16 kg can	
3	Encoder backup battery set	410679-0010	A set of two batteries (HS-E17500)	
4	Air filter set	410053-0100	For standard type of controllers (FS-1705W)	
		410053-0110	For global type of controllers (FS-1705)	
5	Memory backup battery	410076-0261	For RC7M controller	
6	Fuse (1.3A)	410054-0230	For LM13 for controller I/O	
7	Fuse (3.2A)	410054-0270	For LM32 for controller I/O	
8	IC for output (NPN)	410077-0010	IC (M54522P) for controller output	
9	IC for output (PNP)	410077-0020	IC (M54564P) for controller output	

3.7 Replacing Fuses and Output ICs

For the replacing procedures of the fuses and output ICs, refer to the RC7M CONTROLLER MANUAL, Section 6.6 "Replacing Fuses and Output ICs."

3.8 Checking the Odometer and Trip Meter

You may check the odometer and trip meter which count traversed distance of each axis in the Odometer window of the teach pendant.

The access to the Odometer window is [F6 Set]—[F6 Maint.]—[F5 Odometer].

The Odometer window shows the following items:

[Odometer]	Shows the total distance of each axis traversed after the robot leaves the factory. You cannot reset the odometer.
[Trip meter]	Shows the distance of each axis traversed after you reset the trip meter to zero. You can reset the trip meter by pressing [F6 Reset] in the Odometer window and following the guidance shown on the screen.

3.8.1 Displaying the Odometer and Trip Meter

STEP 1

Turn the robot controller ON.

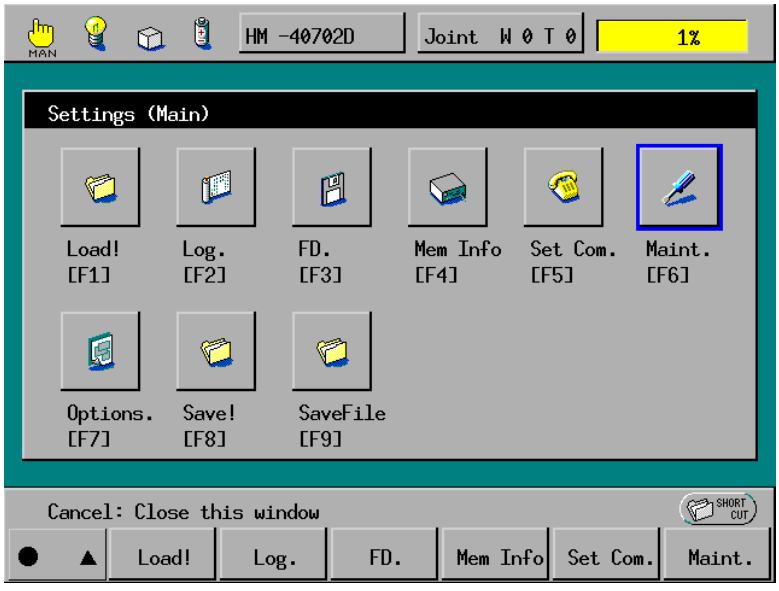
STEP 2

On the teach pendant, set the mode switch to the MANUAL position.

STEP 3

On the top screen, press [F6 Set].

The Settings (Main) window appears as shown below.

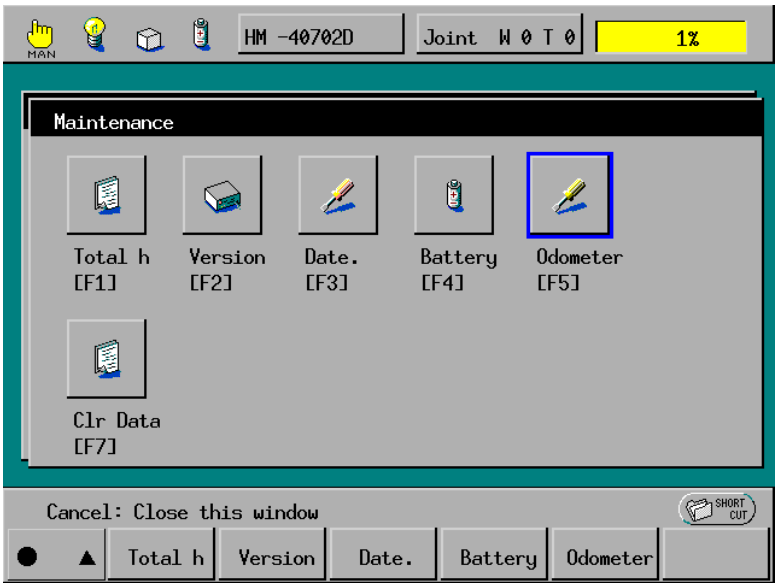


F6

Press [F6 Maint.].

STEP 4

The Maintenance menu appears as shown below.

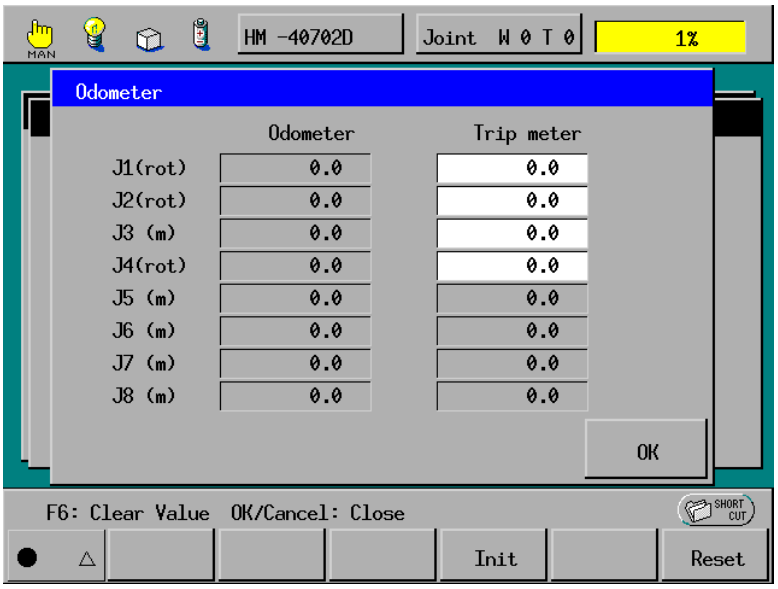


F5

Press [F5 Odometer].

STEP 5

The Odometer window appears as shown below.



F6

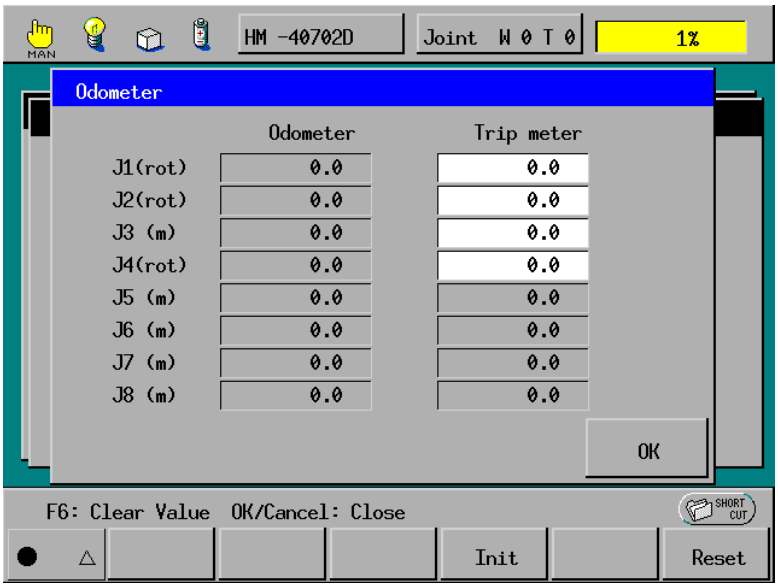
In the above Odometer window, the J1, J2 and J4 are expressed in number of revolutions and J3 in meter.

3.8.2 Resetting the Trip Meter to Zero

STEP 1

Display the Odometer window as shown below.

Access: [F6 Set]—[F6 Maint.]—[F5 Odometer] from the top screen.

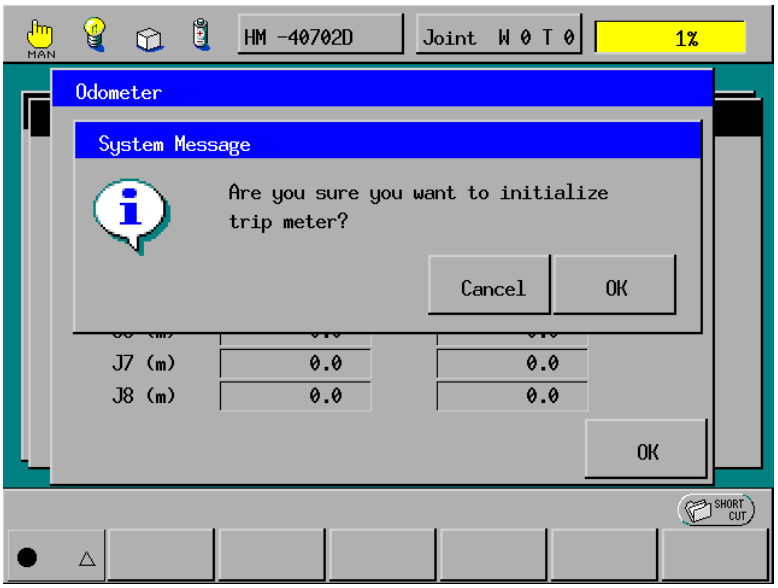


F6

Press [F6 Reset].

STEP 2

The following message appears.



Press the OK button.

The trip meter has been reset to zero.

3.9 Checking the Controller ON-Time and the Robot Running Time and Resetting Their User Counters

You may check the robot controller ON-time and the robot running time in the Total hours window of the teach pendant.

The Total hours window shows the following items:

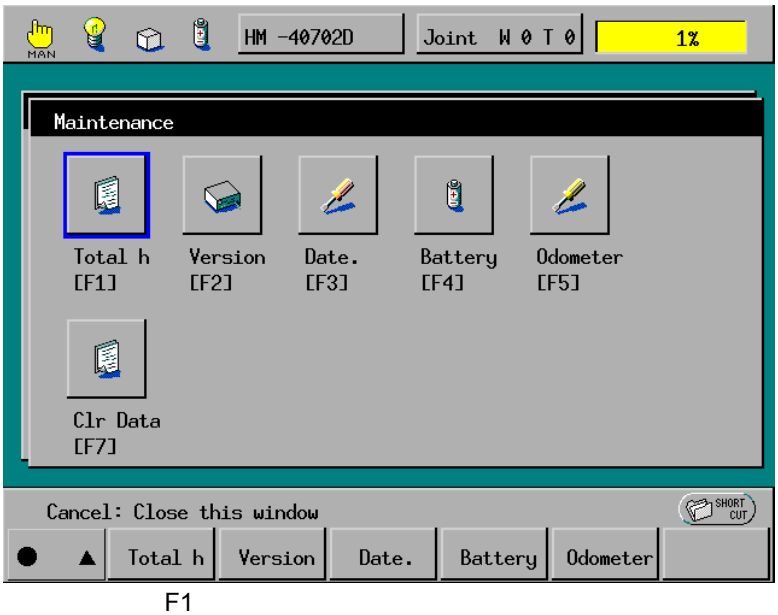
[Total operation]	Shows the grand total of the robot controller ON-time counted after the controller leaves the factory.
[Total running]	Shows the grand total of the robot running time counted after the robot leaves the factory.
[Cumu. operation]	Shows the total of the robot controller ON-time counted after you reset the user counter to zero.
[Cumu. running]	Shows the total of the robot running time counted after you reset the user counter to zero.
[Operation]	Shows the ON-time of the robot controller counted after it is turned ON this time.
[Running]	Shows the running time of the robot counted after the robot controller is turned ON this time.

3.9.1 Displaying the Controller ON-time and the Robot Running Time

STEP 1

Display the Maintenance window as shown below.

Access: [F6 Set]—[F6 Maint.] from the top screen

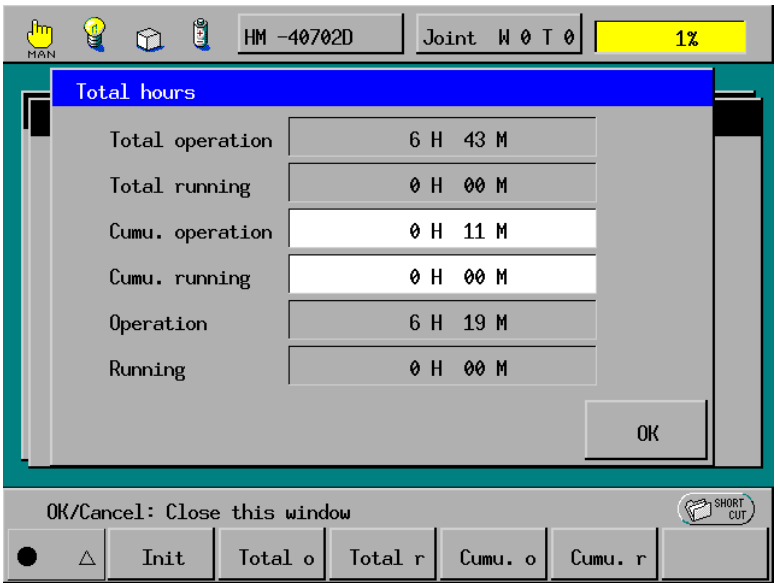


F1

Press [F1 Total h].

STEP 2

The Total hours window appears as shown below.



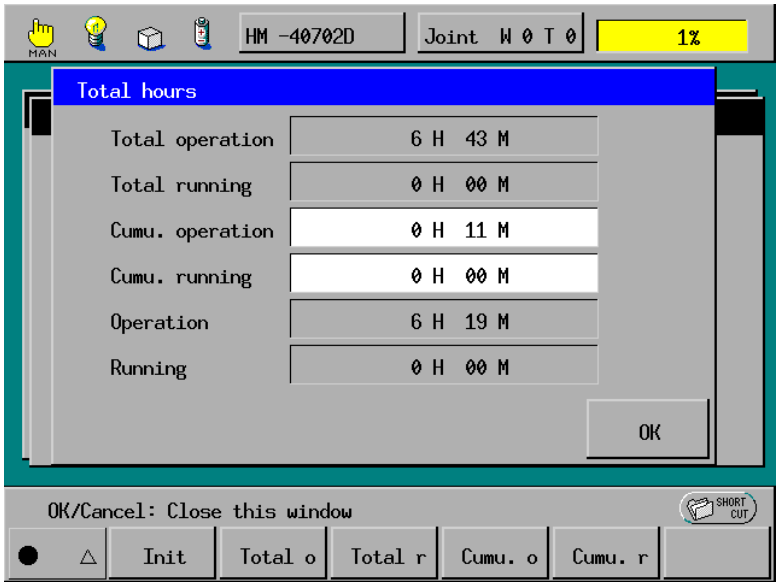
[Total operation]	Shows the grand total of the robot controller ON-time counted after the controller leaves the factory.
[Total running]	Shows the grand total of the robot running time counted after the robot leaves the factory.
[Cumu. operation]	Shows the total of the robot controller ON-time counted after you reset the user counter to zero.
[Cumu. running]	Shows the total of the robot running time counted after you reset the user counter to zero.
[Operation]	Shows the ON-time of the robot controller counted after it is turned ON this time.
[Running]	Shows the running time of the robot counted after the robot controller is turned ON this time.

3.9.2 Resetting the User Counters of the Controller ON-Time and the Robot Running Time

STEP 1

Display the Total hours window as shown below.

Access: [F6 Set]—[F6 Maint.]—[F1 Total h] from the top screen

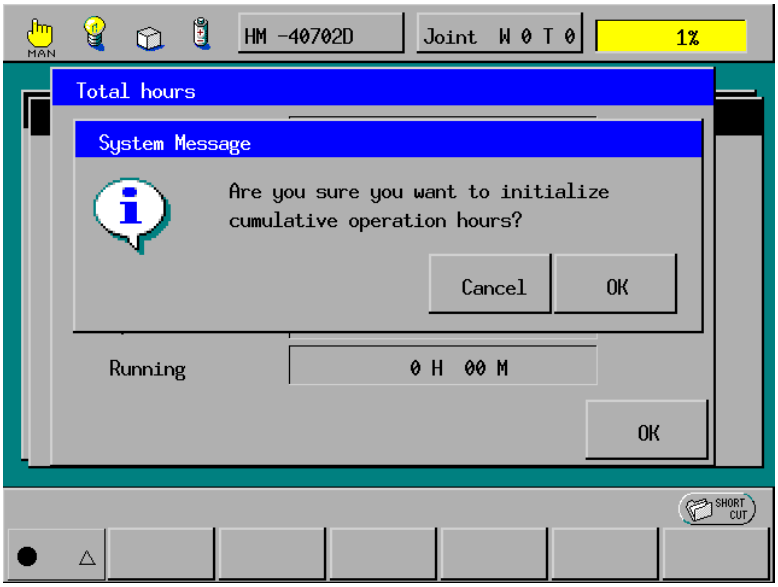


F4

To reset the user counter of the controller ON-time (Cumu.operation), for example, press [F4 Cumu. o].

STEP 2

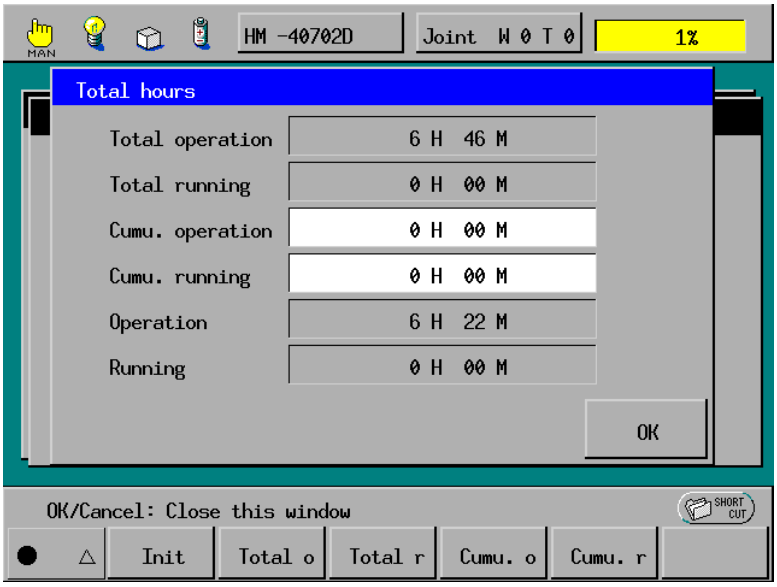
The following system message appears.



Press the OK button.

STEP 3

The user counter of the controller ON-time has been reset to zero as shown below.



3.10 Backing up Projects

You should back up project data periodically in WINCAPSIII in order to recover the robot controller smoothly after loss of project data due to unexpected accidents such as expired service life of memory backup batteries.

Be sure to back up project data and preserve it, in particular:

- at the time of purchase
- after performing CALSET
- after changing RANG values
- after replacement of a motor

DENSO preserves arm data configured at the time of shipment for 10 years. If your arm data is lost, contact your DENSO representative.

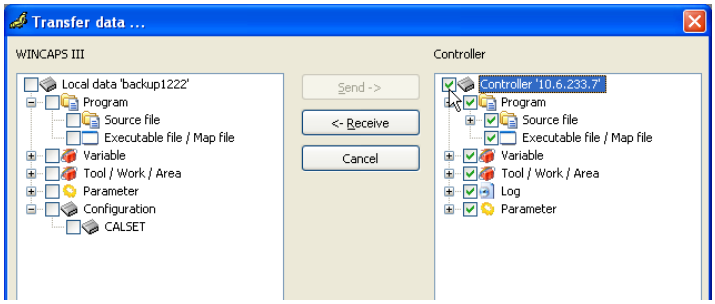
Note	Arm data refers to CALSET and RANG values in project data, which is unique to individual robots and determines the position of each joint.

3.10.1 Back up project data

Use WINCAPSIII to back up project data.

When a project has been created in WINCAPSIII

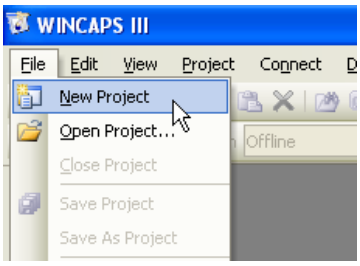
Receive all data from the controller and preserve it.



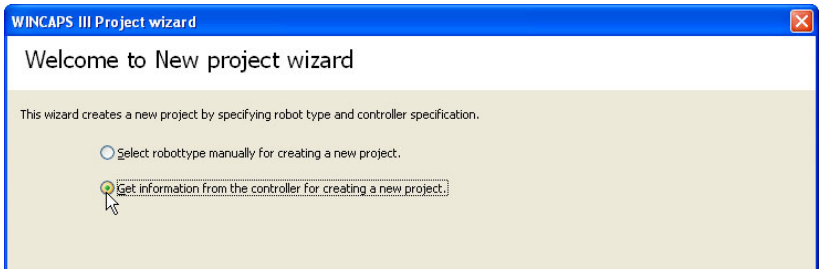
When creating a new project to preserve backup data

Follow the procedure given below.

STEP 1 Create a new project in WINCAPSIII.

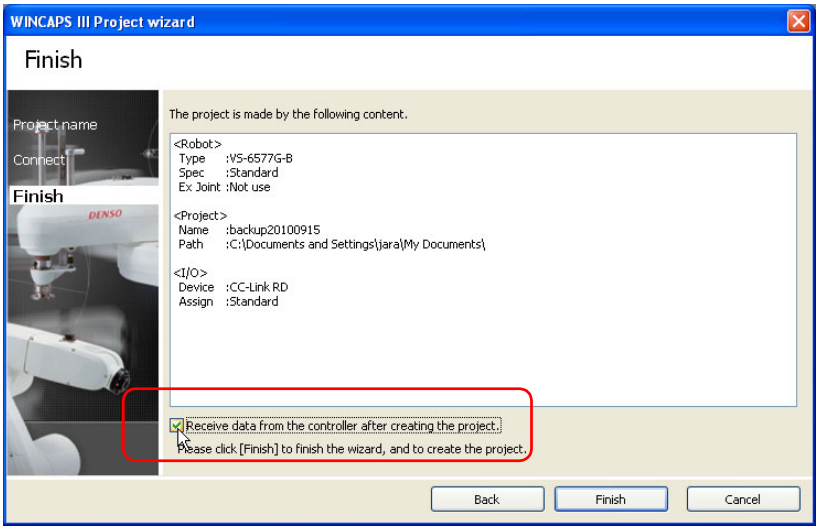


STEP 2 Choose "Get information from the controller for creating a new project."



STEP 3 Following the project wizard, enter the IP address and the desired backup file name.

STEP 4 Select "Receive data from the controller after creating the project."



STEP 5 Close the project.

3.10.2 Transfer arm data

When WINCAPSIII exchanges project data with the robot controller, arm data unique to individual robots can be transferred only from the robot controller to WINCAPSIII, but it cannot from WINCAPSIII to the robot controller. This is to protect arm data in the robot controller from being overwritten accidentally.

To transfer arm data from WINCAPSIII to the robot controller, use the following procedure.

STEP 1

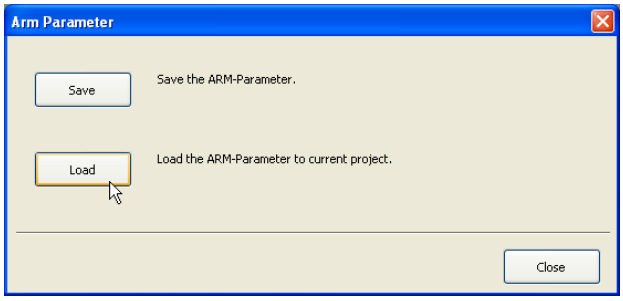
Loading the arm data (***.wam) into the WINCAPSIII project

This step is necessary when only arm data is supplied by DENSO. When project data has been backed up, open the project data in WINCAPSIII and proceed to STEP 2.

Start WINCAPSIII, log on as a Programmer, and create a project suitable for your robot model.

Choose Tool | Arm parameters to display the Arm Parameter window.

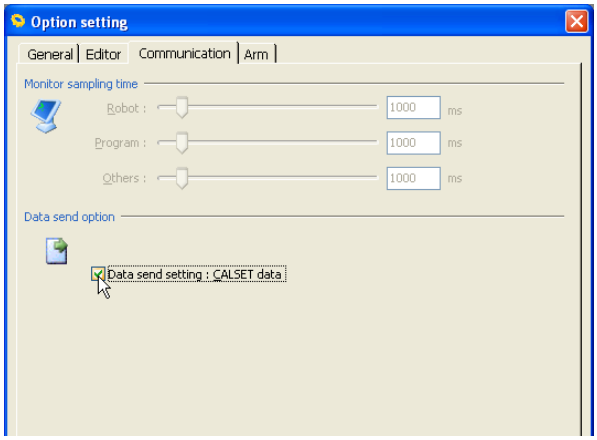
Press Load and select the arm data (***.wam) to load.



STEP 2

Configuring communication options for transfer of arm data from WINCAPSIII to the robot controller

Choose Tool | Option | Communication tab. Select "Data send setting: CALSET data" and press OK.



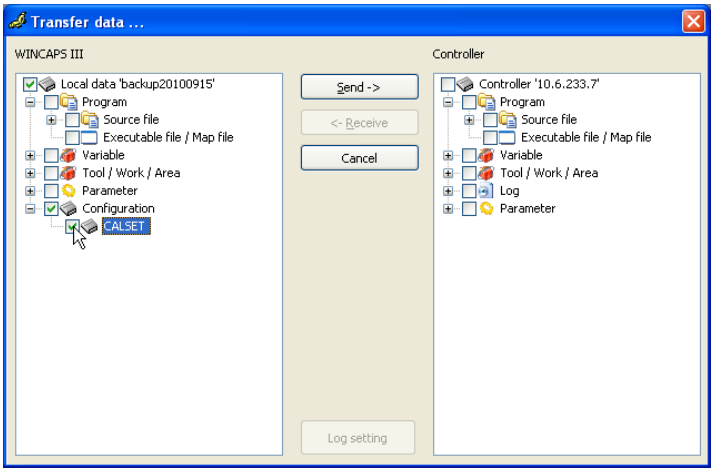
ATTENTION: During ordinary operations, the "Data send setting: CALSET data" should be deselected. If it is selected, creating a new project and transferring arm parameters overwrites the CALSET-related data in the robot controller with the transferred data, causing errors in teaching positions.

STEP 3

Transferring arm data to the robot controller

Choose Connect | Transfer data to display the Transfer data window.

Select Parameters | Arm parameters and Configuration | CALSET, then press Send.



Upon completion of transfer of the CALSET-related arm data, restart the robot controller.

Horizontal Articulated Robot
HM-G SERIES

INSTALLATION & MAINTENANCE GUIDE

First Edition July 2005
Tenth Edition October 2011
Eleventh Edition February 2013

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The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.