

Instruction Manual and Maintenance Inspection Procedures

Automatic Tool Changer for YASKAWA MOTOMAN MH12, MH24, GP12, and GP25

NITTAOMEGA type S-OY

NOTICE

For use of this document:

Please keep this document always readily available to those who use the product. If you need an additional copy, please download the document from our website:

<http://www.nitta.co.jp/>

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Preface

Thank you for selecting Nitta Automatic Tool Changer (hereafter referred to as "ATC").

This instruction manual provides precautions for handling, detailed descriptions of the specifications and mandate inspection and maintenance items for secure applications and appropriate maintenance and inspection of the system, focusing on mechanical sections of ATC. Therefore, those in charge of introduction line planning, maintenance and inspection, unpacking or actual operations of the product must read this document and fully understand the ATC before use.

Please keep this document always readily available to those who use the product.

- All rights reserved.
- External appearance and specifications described in this document are subject to change for improvement.
- Be sure to read this document carefully before working on the product.
- Be sure to confirm whether workers are required to be sufficiently trained for applicable expertise.
- Take note that we assume no responsibility regarding any damage or accident that occurs in works performed by customers.

Notice

This document is only intended for customers of Nitta Corporation (hereinafter referred to as "the company"). Technical information and drawings presented in this document are the proprietary of the company and it is prohibited to publish them to any third party without prior written consent of the company. The contents of this document are subject to change without any prior notice. The delivered product may not be the same as figures and photos contained herein due to any later change in specifications.

Product Warranty

- Warranty period

1 year from the delivery date of this product or 3,000 hours of operation, whichever comes first.

- Warranty subject

Any genuine part of the product exhibiting defect in material or manufacturing will be fixed or serviced without charge within the warranty period.

- Exclusion

Items listed below are excluded from warranty:

- (1) Any failure and accident arising out of user's negligence
- (2) Consumables
- (3) Any failure caused by natural disaster, accident, fire, theft or unauthorized use, etc.
- (4) Any failure or accident arising out of non-conformity to maintenance and inspection instructions set forth in this document and the maintenance and inspection procedures
- (5) Any failure or accident arising out of repair, adjustment, or alteration performed by other than Nitta engineers
- (6) 6. Any failure or accident arising out of any use of a used part

Please note that any indirect damage such as line stoppage due to system failure and any damage arising out of such damage are not warrantable.

Unpacking and Check

Although we exercise thorough care to eliminate wrong delivery before shipment, please check the following items when you unpack the product for confirmation. Should there be any defect or missing item, please contact our office indicated in the cover page of this document.

1. Please check that mounting bolts are included. (See the relevant delivery specifications.)
2. Please check the spare parts. (To be determined in separate meetings.)
3. For details of special options, please feel free to contact us.






Safety Precautions

For Safe Use of the Product

a) Hazard, warning and cautions indications in this document

This section describes safety precautions for proper use of the Nitta product and prevention of injuries and property damages. These precautions are classified into three levels according to severity of potential hazards and damages that may be caused by non-conformity thereto.

Indications in this document

 DANGER	Indicates a potential hazard which may lead to a situation where improper handling of the product can lead to death or any serious injury, but limited to a situation in which a warning is required highly urgently once the hazard is materialized.
 WARNING	Indicates a potential hazard which may lead to a situation where improper handling of the product can lead to death or any serious injury.
 CAUTION	Indicates a potential hazard which may lead to a situation where improper handling of the product can lead to any minor injury or property damage only.
 Referenc	This indicates use examples, etc.
 MEMO	This indicates special instructions less important than cautions.


Please note that even a potential hazard indicated with CAUTION may lead to a serious accident depending on conditions. Be aware that all indications are important and must be observed.

Disclaimer


- (1) We assume no responsibilities for any damage arising out of any accident caused by customer's intention or negligence, any failure occurring out of our product (including any software malfunction), or any natural disaster.
- (2) We assume no responsibilities for any damage arising out of usage not in conformity to instructions provided in this document or other instruction manuals.
- (3) We assume no responsibilities for any failure alleged to be warrantable by customers if there is no clear evidence of our responsibility.
- (4) We assume no responsibilities for incidental damages arising out of any usage of or inability to use our product (including loss of business profit and suspension of business, etc.).


b) Introduction


ATC does not work alone and is only usable when being equipped on a robot and a compatible unit. For increased safety of the entire system, it is necessary to consider not only the single ATC but also the robot system and compatible unit system as a whole.

-  **DANGER** For use of ATC, be sure to observe safety instructions concerning core robots and compatible units. For any work within the robot safety fence, consider preparing a safety system design to shut down power over 50V once any person gets into the fenced area.

c) General Precautions

 **CAUTION** Personnel engaged in installation, programming and maintenance works inside the robot safety fence for the ATC must have expertise in robot operations (having completed expert training). In addition, those engaged in disassembly or assembly works of the ATC, whether in or out of the safety fences, shall read this document and installation guide.

 **WARNING** In addition, for works in the safety fence area, be sure to wear appropriate clothing for the work with personal protective equipment such as a hard hat, safety boots, etc. For internal disassembly works for the ATC, use protective glasses for protection against pop-out parts.


 **WARNING** Do not use this product in any of the environments listed below. Otherwise, operators may be injured.


- Any combustible environment (environment with highly volatile and flammable substances)
- Any explosive environment (e.g. combustible gas or spattering of chemicals, etc.)
- Environment exposed to water/water drops or highly humid environment
- Any corrosive environment
- Any environment with high degree of radiation


When the product is used under any of the above environments, we assume no responsibility for any failure or damage.

Please also note that operational failure may occur in any environment subject to spattering of dust, chips, and cutting oil, etc.











d) Precautions for Installation


 **WARNING** For installation of the ATC, remove the pertinent product and place it out of the robot safety fence as long as possible so that installation can be performed securely.

 **DANGER** If installation work is performed inside the safety fence, securely shut off the power over 50V from the ATC and ensure that the robot is securely stopped before entering into the fence area.


 **DANGER** Be sure to check the following items before starting the installation procedure:

- (a) Welding power source, control power source and driving power source are all shut off before work.
- (b) All hydraulic and pneumatic pressure sources are off before work.
- (c) All residual hydraulic and pneumatic pressure is released before work.
- (d) Note that some connectors and cables may be hot depending on their specifications.

 DANGER	Turning the power supply or hydraulic/pneumatic pressure source ON during the installation work without notifying the operator(s) may create an extremely dangerous situation. Establish a procedure to always prevent such events for safety in work areas.
 CAUTION	Be sure to install specified parts. In addition, when you replace parts, install parts to their original positions and be sure to perform inspections in accordance with certain procedures.
 WARNING	Ensure that the rated load (moment torque) does not exceed product's rated value. Otherwise, not only the product functionality and life may be adversely affected but also unexpected accident may occur.
 WARNING	Ensure that the electric load applied to the signal pin and electrode does not exceed the rated voltage and allowable current. Otherwise, not only the product functionality and life may be adversely affected but also unexpected accident may occur.
 WARNING	Supply water and air to ATC hydraulic/pneumatic and chuck/unchuck ports so as to maintain pressure within the rated range. Otherwise, not only the product functionality and life may be adversely affected but also unexpected accident may occur.
 MEMO	<ul style="list-style-type: none">- To install a robot adaptor, set the robot mounting surface facing up, rather than horizontal. Then robot adaptor installation becomes relatively safer.- When installing a tool adaptor, set tools on the tool stand. Then tool adaptor installation becomes relatively safer.
 WARNING	Switch air supply to an chuck/unchuck port in the detached state to check that the coupling cam motions are correct. Operating without doing this may cause tool falling, product damage, or unexpected accident.
 DANGER	When manually switching air supply of the chuck/unchuck port, set tools on the tool stand. Otherwise, improper motions or piping may cause tool falling, product damage, or unexpected accident.
 CAUTION	Arrange cables and tubes without causing catching during robot motions. Otherwise, the ATC or modules may be damaged.
e) Precautions for teaching	
 WARNING	With the tool detached, check that the interlock signals output from the ATC are correct. Operating without doing this may cause tool falling, product damage, or unexpected accident.

-  **WARNING** For chucking/unchucking, switch chuck/unchuck air supply with the connecting surfaces of robot and tool adaptors are horizontally coherent on the stand. Otherwise, an unexpected accident may occur due to tool falling, in addition to damage to the ATC and its functional modules due to prying.
-

f) Precautions for Long-Term Shutdown or Transportation

-  **DANGER** The failsafe mechanism serves to prevent falling. Do not continue using the product when the air pressure is decreased. Otherwise, the gap between contact surfaces of robot and tool adaptor is increased and unexpected accident may occur.

When the tool is left coupled by the failsafe mechanism only for a prolonged period of time, the gap between contact surfaces of robot and tool adaptor is increased by vibration, etc. and unexpected accident such as falling may occur.

If it is absolutely necessary to stop the air supply for a long time with the tool coupled, be sure to take measures against falling, e.g. fixing it by rope, etc.

1. Overview of the Automatic Tool Changer (ATC)

A pneumatic-driven system is employed for the Nitta ATC. Basically, the ATC consists of 2 components: a robot adaptor and a tool adaptor. The robot adaptor has counter bores for mounting of P.C.D.56 (M4 x 8), making it possible to directly mount the adaptor to a robot flange on YASKAWA MH12, MH24, GP12, and GP25. The tool adaptor has P.C.D.56 (M4, x 8) taps for direct attachment of a tool. In addition, the ATC and its functional modules are equipped with transmission mechanisms such as a signal pin to transmit signals and power source to the tool, and pneumatic port.

[Transmission Mechanism]

The ATC has an electric signal pin to transmit/receive signals between the robot and tool. (For the number of pins, refer to the drawing.) Also, there are four M5 air ports.

1-1. Robot Adaptor

The robot adaptor is a basic component of the ATC.

[Chuck/unchuck Mechanism]

The cam mechanism to connect a robot adaptor and tool adaptor together is of a special structure, which is designed to automatically compensate for misalignment at the time of jointing and wear allowance to be generated over time. These cams are operated by an air cylinder and designed not to come off under temporary loading above the rated load.

Under such load, the contact surfaces of the robot adaptor and the tool adaptor will be slightly separated, but the adaptors will never be completely separated. Also, these cams are driven by a spring-return pneumatic cylinder, as a fail-safe mechanism to prevent falling of the tool adaptor even in the event of sharp reduction of the air pressure.

DANGER

The failsafe mechanism serves to prevent falling. Do not continue using the product when the air pressure is decreased. Otherwise, the gap between contact surfaces of robot and tool adaptor is increased and unexpected accident may occur.

When the tool is left coupled by the failsafe mechanism only for a prolonged period of time, the gap between contact surfaces of robot and tool adaptor is increased by vibration, etc. and unexpected accident such as falling may occur. If it is absolutely necessary to stop the air supply for a long time with the tool coupled, be sure to take measures against falling, e.g. fixing it by rope, etc.

1-2. Tool Adaptor

A tool adaptor is another fundamental component of the ATC, to which a tool is attached. A tool adaptor is equipped with lock rings to be engaged with robot adaptor's locking cams.

2. Configuration

This system is composed of the ATC and signal pin ASSY assembled thereto.
The signal pin ASSY is a spring-type electric contact.

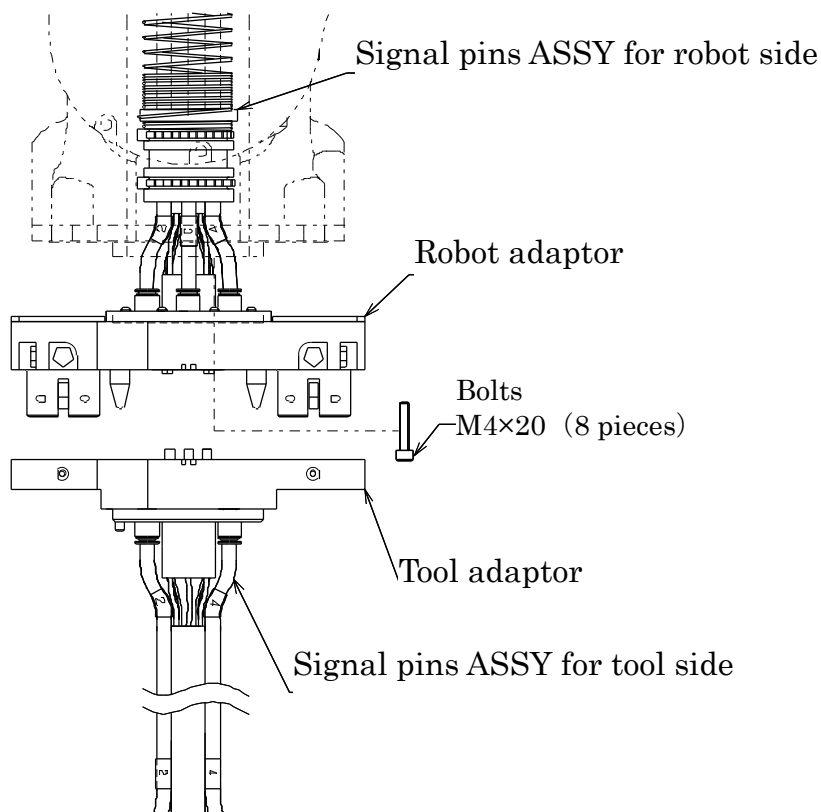


Fig. 1. System Diagram

3. Standard Specifications

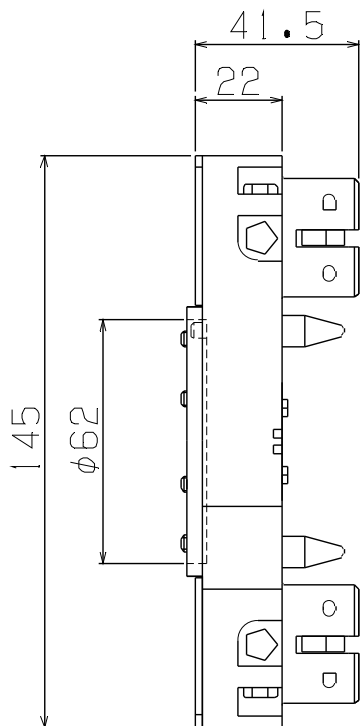
3-1. Specifications (Environment)

○Use conditions	
Ambient temperature	0-60°C (no condensation)
Ambient humidity	95%RH or below (no condensation)
Ambient atmosphere	Free of corrosive gas
Altitude	1,000m or less
Vibration resistance	10-500 (Hz) Acceleration: 50 (m/s ²) for 110 minutes (compliant with IEC60068-2-6)
○Transport conditions	
Ambient temperature	-25-60°C (maximum instantaneous temperature: 70°C)
Ambient humidity	95%RH or below (no condensation)

3-2. Specifications (Adaptor)

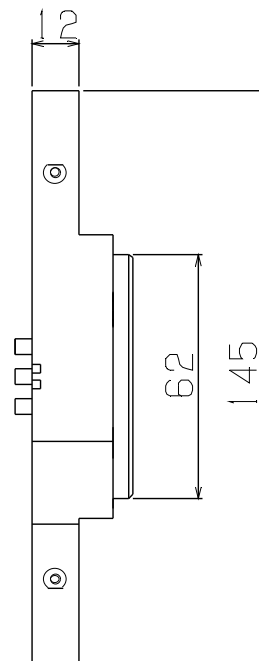
3-2-1. ATC Specifications

Model	Robot adaptor		Reference drawing: SOR16-4JNY□S
	Tool adaptor		Reference drawing: SOT16-4JCY□S
Tare weight	Payload		24kg or less
	Allowable moment torque		88Nm
	Max. allowable moment torque		147Nm
	Working pressure		0.39-0.85 MPa
Position reproducibility			±0.025mm
Interface	Electricity	Number of electric contacts	0-16
		Capacitance	6.6A: 4 5.1A: 2 2.5A: 10
		Rated frequency	50 or 60 HZ
		Overtoltage category	Overtoltage category III
	Air	Number of ports	M5: 4
		Allowable pressure	0.85 MPa
		Effective sectional area	4mm ²
Allowable pollution level			Pollution level 3
Weight	Robot adaptor		0.55kg
	Tool adaptor		0.35kg
Machine dimensions	Robot adaptor		See the figure below
	Tool adaptor		See the figure below



Robot adaptor

(Refer to the delivery specifications and drawing for details.)



Tool adaptor

(Refer to the delivery specifications and drawing for details.)

Note: Refer to the delivery specifications and drawing.

3-2-2. Signal Pin ASSY: Cable Specifications

Name		ETFE insulated PVC sheath shielded cable			
Model		RMFEV-ESB (2517)			
Nominal sectional area		(AWG17 x 2 cores + AWG19 x 1 core) x 2 + (AWG25 x 5 pairs)			
Dimensions		AWG	17	19	25
Conductor	Material	—	Tinned annealed copper wire		
	Configuration:	wires/mm	7/33/0.08	7/20/0.08	40/0.08
	Outer diameter	mm (approx.)	1.50	1.24	0.58
Insulation material	Material	—	ETFE		
	Thickness	mm (approx.)	0.30	0.25	0.20
	Outer diameter	mm (approx.)	2.10	1.74	0.98
Sheath	Material	—	Flame-retardant and oil-resistant PVC (black)		
	Thickness	mm (approx.)	1.3		
Final OD		mm (approx.)	13.9		
Conductor resistance (at 20°C)		mm (approx.)	18.6 or less	30.7 or less	107.3 or less
Withstand voltage		V/min.	AC 2000		
Insulation resistance (at 20°C)		MΩ·km	100 or above		

3-2-3. Signal Pin ASSY: Tube Specifications

Type	OD x ID (mm)	Max. working pressure (MPa at 20°C)	Min. bending radius (mm)	Applicable working temperature range (air)
FS-4-6x4	6x4	1.0	15	-40°C - +100°C

3-3. Precautions for Allowable Load and Installation

⚠ WARNING Rated load, rated moment, and rated torque of the ATC are dynamic specifications for the unit being mounted on a robot. Ensure that the maximum load never exceeds these values during normal operations taking into account the acceleration factor and inertia during acceleration/deceleration by the robot. Figure 2 shows the meanings of rated load, rated moment and rated torque.

Payload $W = 235\text{N}$ (24kg)
 Eccentric distance $L = \sqrt{(lm^2 + lt^2)}$
 Allowable bending moment $M = L \times W \times G_R^{(*)} = 0.24 \times 235 \times 1.5 \leq 88\text{N}\cdot\text{m}$ {864Kgf·cm}
 Allowable twisting torque $T = l_t \times W \times G_R^{(*)} = 0.25 \times 235 \times 1.5 \leq 88\text{N}\cdot\text{m}$ {864Kgf·cm}

Note: $G_R^{(*)}$ is the acceleration factor of constant acceleration/deceleration in automatic robot operations. For specific values of robot performance, please contact the robot manufacturer for further consideration. (Use 1.5-2.0G as a rough reference value.)

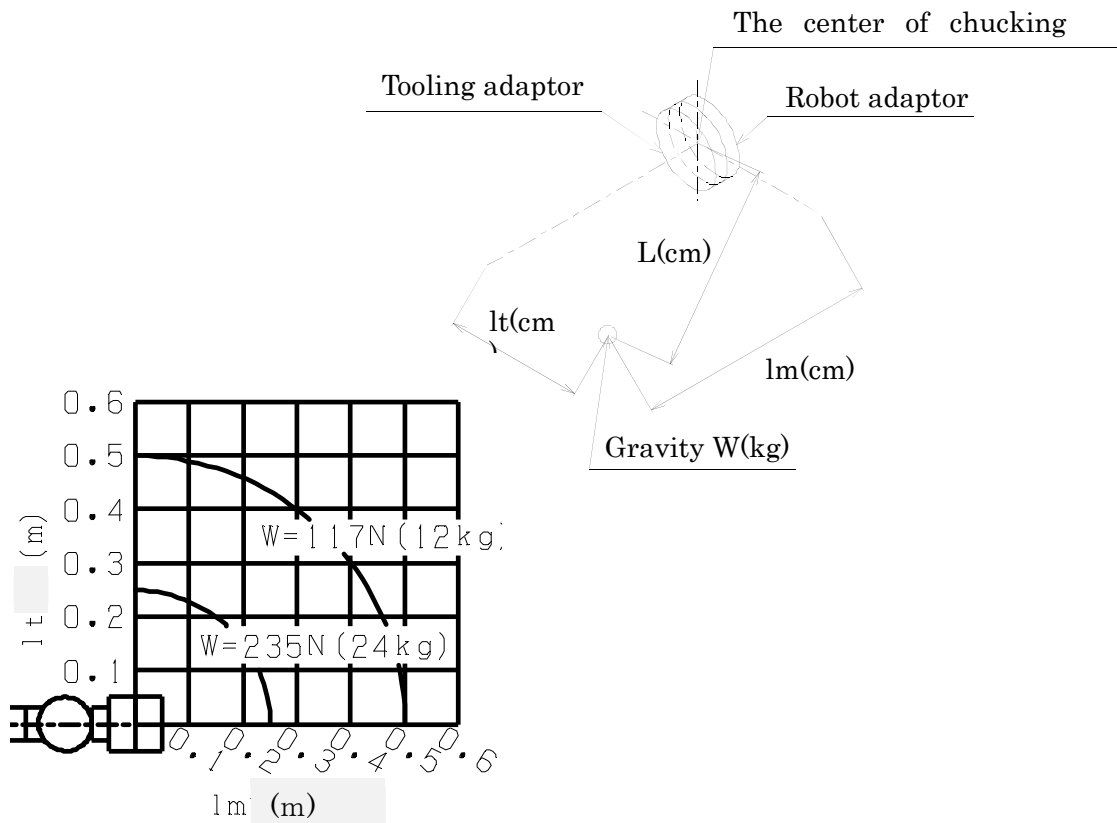


Fig. 2. An example of rated load definition ($G_R = 1.5$)

3-4. Allowable Power Load

⚠ CAUTION The ATC can support signal pin ASSY:
 6.6A: 4
 5.1A: 2
 2.5A: 10

4. Part Names

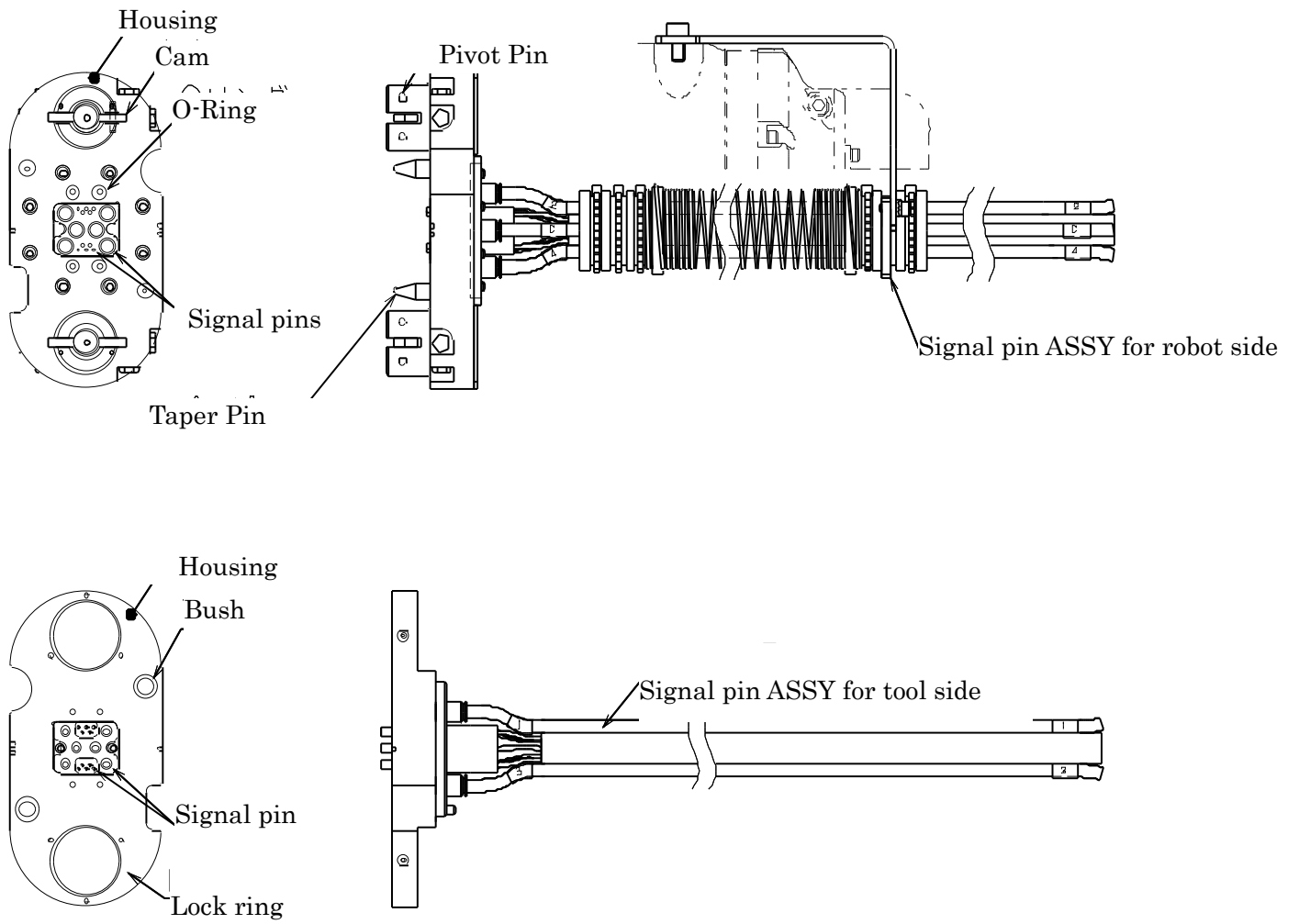


Fig. 3. Part Names

5. Procedures of Installation to Robot/Tool

⚠ DANGER

For use of ATC, be sure to observe safety instructions concerning core robots and compatible units. For any work within the robot safety fence, consider preparing a safety system design to shut down power over 50V once any person gets into the fenced area.

⚠ WARNING

In addition, for works in the safety fence area, be sure to wear appropriate clothing for the work with personal protective equipment such as a hard hat, safety boots, etc.

⚠ CAUTION

Personnel engaged in installation, programming and maintenance works inside the robot safety fence for the ATC must have expertise in robot operations (having completed expert training). In addition, those engaged in disassembly or assembly works of the ATC, whether in or out of the safety fences, shall read this document and installation guide.

5-1. Robot Adaptor

This product can be directly attached to a robot flange of YASKAWA MH12, MH24, GP12, and GP25. (Refer to Fig. 1. System drawing.)

Mounting bolt: M4x20 x 8 pcs [Torque: 5Nm]

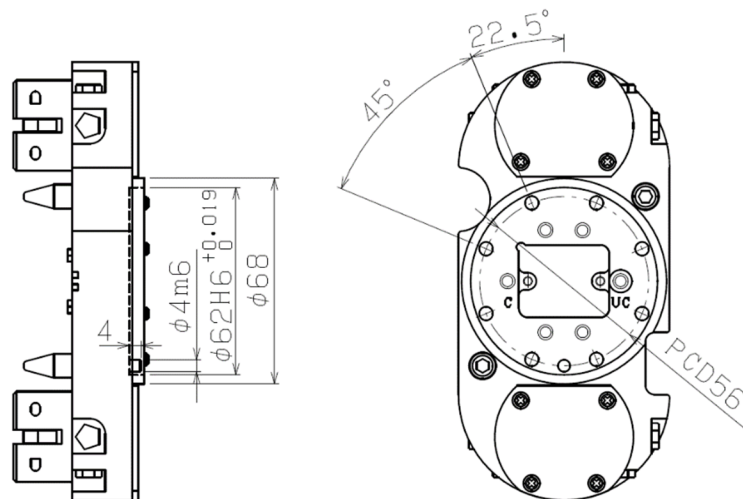


Fig. 4. Attachment to robot flange

⚠ CAUTION

If you manufacture (process) a robot/tool adaptor plate on your own, be sure to ensure sufficient depth of counterbore so that the head of any mounting screw will not protrude from the mounting surface of each adaptor plate.

When using male screws from the tool side to attach a tool to a tool adaptor, adjust the bolt length so that the tip of any male screw will not protrude from the tool adaptor plate surface.

⚠ CAUTION

Check that a parallel pin ($\phi 4 \times 1$) is inserted to the mounting surface of the robot and tool adaptor before attachment. Refer to 5-1., Fig. 4, 5-2., and Fig. 6.

For details, please refer to the delivery specifications (robot and tool adaptor drawings).

⚠ CAUTION

Be sure to use MEC-processed bolts or locking agent (low strength) for mounting bolts when tightening them.

⚠ CAUTION

Tightening bolts with torque above the specified torque level may damage the **ATC and threads**. Further, tightening bolts with torque below the specified torque level or failure to use the locking agent may cause bolts to be loosened, **leading to an accident and damage associated with ATC fall-off**.

Tighten bolts in the order of the numbers in steps so that equal force is applied to each bolt.
E.g. Tightening screws in a criss-cross pattern starting with (1), (2), (3) and so on.

For the installation work, set the robot flange surface facing upward at the height of your breast to prevent ATC from falling.

⚠ CAUTION

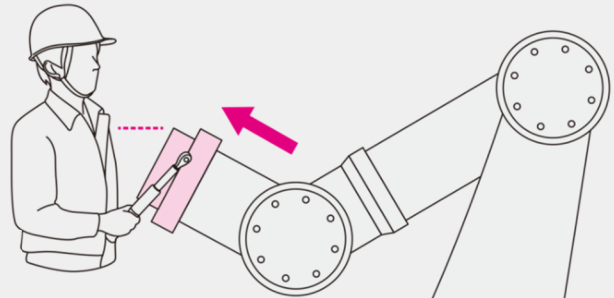
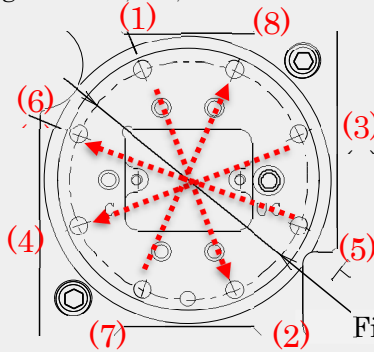


Fig. 5. Bolt tightening sequence and precaution

5-2. Tool Adaptor

This product is of the same mounting pattern as the robot flange of YASKAWA MH12, MH24, GP12, and GP25. (Refer to Fig. 1. System drawing.) No mounting bolt is included.

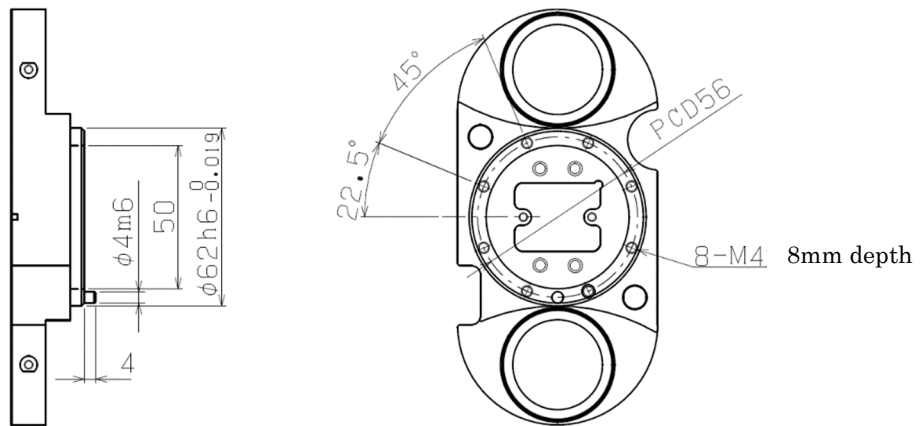


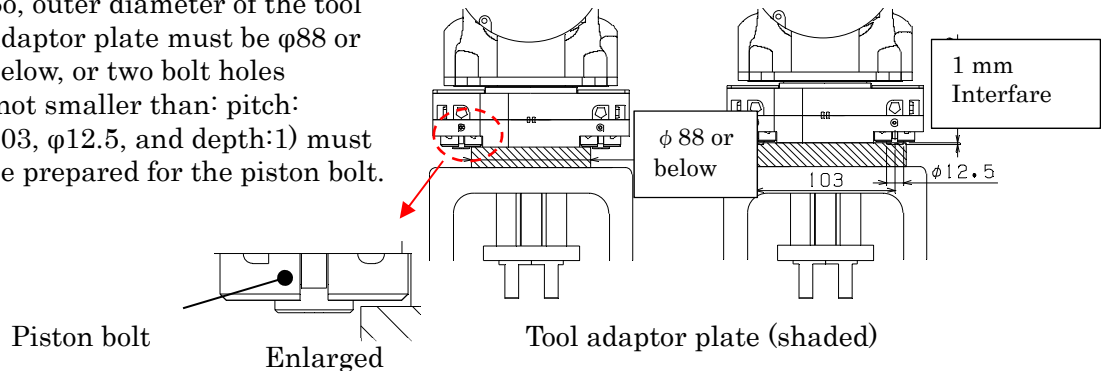
Fig. 6. Attachment to a tool bracket

⚠ CAUTION

If you manufacture (process) a tool adaptor plate on your own, check the following items. Otherwise, the ATC may be damaged.

The robot side piston bolt will protrude by 1mm toward the tool adaptor plate during the chuck/unchuck work.

So, outer diameter of the tool adaptor plate must be $\phi 88$ or below, or two bolt holes (not smaller than: pitch: 103, $\phi 12.5$, and depth:1) must be prepared for the piston bolt.



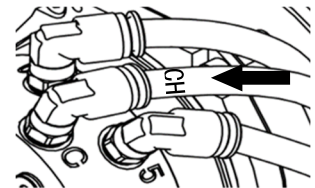
5-3. Connecting to Chuck/Unchuck Port

Connect piping from the solenoid valve to the "CHUCK" port and "UNCHUCK" port of the chuck/unchuck mechanism. The constant pressure line (with the valve not energized) must always be connected with the "CHUCK" port to maintain coupling of the chuck/unchuck port in the event of power failure.

⚠ WARNING

Be sure to shut off the power supply, air, water and hydraulic power before starting the work.

- Be sure to connect chuck (CH) and unchuck (UN) tubes properly. Otherwise the tool may fall off.
- Mark the chuck (CH) and unchuck (UN) tubes accordingly.
- Securely insert the tubes to the end to prevent disconnection.
- Do not manually switch the air supply without an absolute need to do so.



⚠ WARNING

Leave the "UNCHUCK" port opened without plugging even when chuck/unchuck is not to be performed (in a coupled state only). Also, be sure to pressurize the "CHUCK" port when using it. Otherwise, it may fall off.

⚠ WARNING

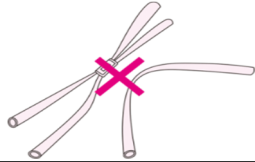
About air piping for ATC driving:

ATC has a fail-safe mechanism to prevent the tool side from falling even when the chuck-side air pressure is unexpectedly decreased. However, the air piping for ATC driving requires proper selection and arrangement of solenoid valve to prevent air from flowing into the "unchuck" side even when the valve is electrically turned OFF.

- Do not use any three-position, closed-center type solenoid valve. The chucked state cannot be maintained with the power supply turned OFF, which may result in falling.
- Do not share an exhaust port with other equipment. Otherwise, the chucked state cannot be maintained due to wrap-around back pressure, which may result in falling.
- Do not branch the air supply to the "CHUCK" port to other equipment. Otherwise, the chucked state cannot be maintained due to reduced pressure, which may result in falling.

⚠ WARNING

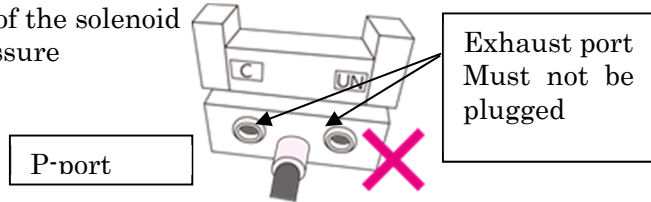
Perform installation carefully not to bend the tube connected with the chuck/unchuck port during robot motions. Otherwise, it may fall off.



- Tube bending
- Tube twisting
- Excessive tightening of tube with banding band

⚠ WARNING

Do not cap the exhaust port of the solenoid valve used for switching pressure on the chuck/unchuck port. Otherwise, it may fall off.



⚠ CAUTION

As a solenoid valve used for switching pressure on the chuck/unchuck port, select a double-solenoid type valve. Then effects of any noise malfunction are mitigated.

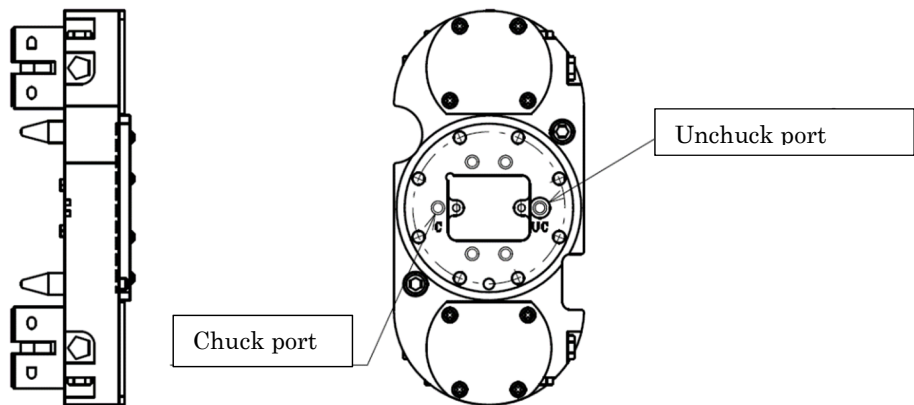


Fig. 7. Chuck and unchuck port piping

5-4. Electric Wiring and Air Piping

With reference to the internal wiring chart, connect the input and output wires to robot adaptor terminals. For air piping, perform the piping work according to the port numbers with reference to a relevant adaptor drawing.

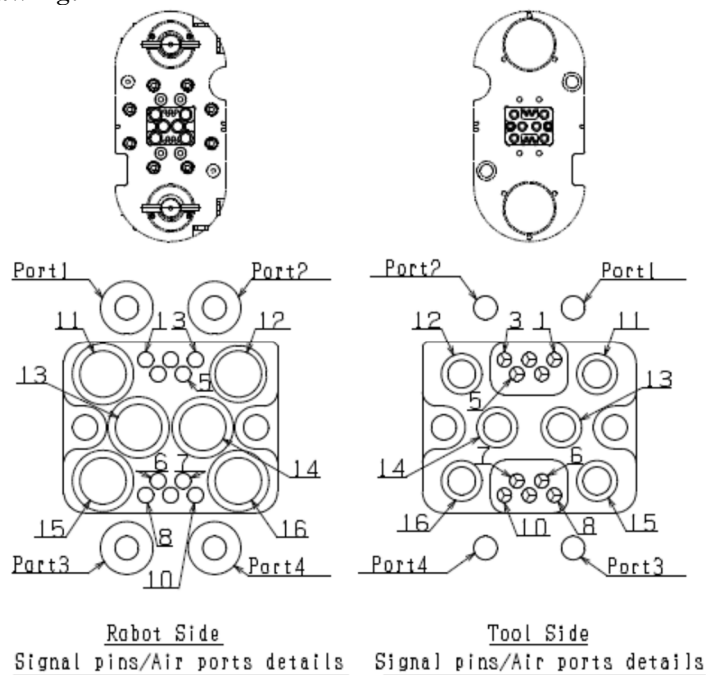


Fig. 8. Wiring and piping

-
- ⚠ WARNING** Perform wiring as per the delivery specifications. Improper wiring may cause failure or electric leakage, etc.
-
- ⚠ WARNING** Securely apply Class III grounding for earth and shield lines. Otherwise, electric shock and noise may occur, leading any malfunctions.
-
- ⚠ CAUTION** Ensure no chips of sealing tape on the relay, etc. get into the module. Otherwise, it gets into the O-ring sealing section inside and causes leakage.
-
- ⚠ CAUTION** Use SUMIPLEX BN NO.1 (manufactured by Sumico Lubricant) or equivalent grease on the ATC port surface. Without lubrication, early breakage and leakage may occur.
-

5-5. How to Fix Robot Side Signal Pin ASSY

Attach the robot side signal pin ASSY to the U-axis of the robot by using the cable clamp fixing plate. At this point, attach the T- and R-axes of the robot at their zero points (0°) without twisting of the signal pin ASSY.

Mounting bolt: M6x12 x 2 pcs [Torque: 15Nm]

Also, use the cable clamp plate 2 to fix the clamp.

Mounting bolt: M4x12, Nord lock washer x 2 pcs [Torque: 4.5Nm]

-
- ⚠ CAUTION** Any excessive force applied to the robot side signal pin ASSY may cause cable disconnection or damage the piping tubes. Be sure to use a cable clamp fixing plate.
-
- ⚠ CAUTION** Do not remove a banding band to change the cable clamp position. Any change in fixing position length may cause excessive cable tension or involvement with peripheral equipment, resulting in cable, tube and joint damage.
-

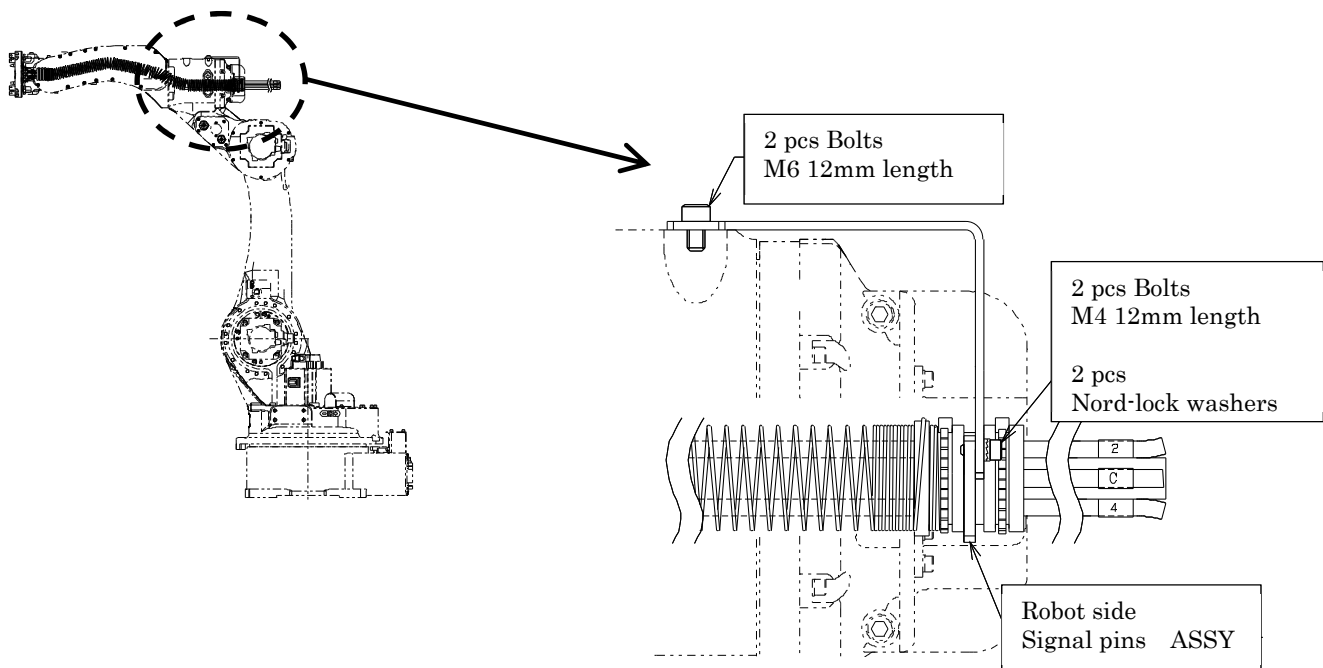


Fig. 9. Fixing robot side signal pin ASSY - attachment to robot's U-axis

 **CAUTION**

Be sure to use MEC-processed bolts or locking agent (low strength) for mounting bolts when tightening them.

 **CAUTION**

Tightening bolts with torque above the specified torque level may damage the **ATC and threads**. Further, tightening bolts with torque below the specified torque level or failure to use the locking agent may cause bolts to be loosened, **leading to an accident and damage associated with ATC fall-off**.

6. Operations and Programming

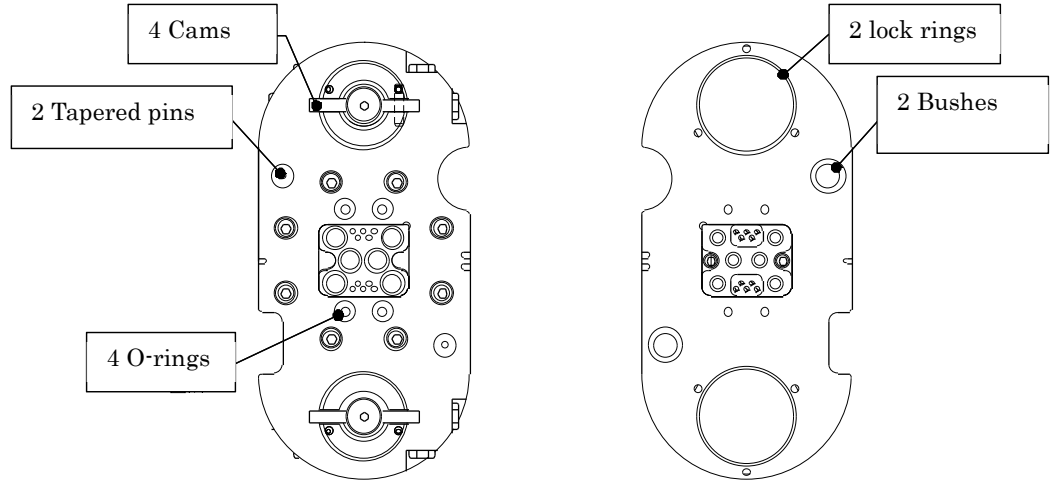
6-1. Checking before Teaching (Robot Operations)

⚠ CAUTION

Ensure that cables and tubes (hereinafter cables, etc.) are routed and fixed to the bracket without breaking. Also, ensure that the cables, etc. are fixed so that they do not interfere with peripheral components and work pieces during robot operations.

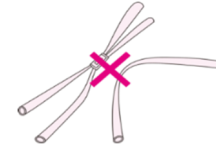
⚠ CAUTION

Check that the points indicated in the figure below are greased up.



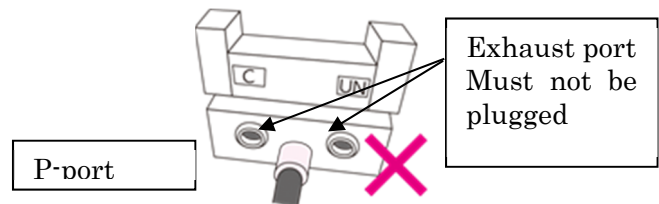
⚠ WARNING

1) Ensure that air supply is not shut off by bending/twisting of the unchuck tube and excessive tightening of the banding bands. When the air supply is inhibited, the cam may not work properly resulting in tool side module falling.



- Tube bending
- Tube twisting
- Excessive tightening of tube with banding band

2) Check that the unchuck port air is discharged before coupling (no residual pressure). Any residual pressure may prevent normal cam operations and cause the tool side modules fall off.



⚠ WARNING

When operating a robot with a tool coupled, be sure to supply air to the chuck port.

6-2. Operations and Programming

This section describes a simple example of external interlock signals of the ATC.

The ATC requires synchronization with a robot and peripheral devices and exchange of operation check signals to ensure reliability and safety.

WARNING

Without setting of external interlock signals, safety of the ATC may not be ensured in the event of operator errors or malfunction, posing a risk of tool falling. Please be sure to configure interlock settings including tool presence signal (*1) and air pressure check signal (*2), etc. Check that interlock signals are input to the superior control devices, such as PLC.

*1 Tool presence signal: A signal that indicates presence of each tool on the tool stand. Unchucking is allowed only when all tools are present on the tool stand.

*2 Air pressure check signal: A signal that indicates normal source air pressure
Working pressure: 0.39-0.85MPa

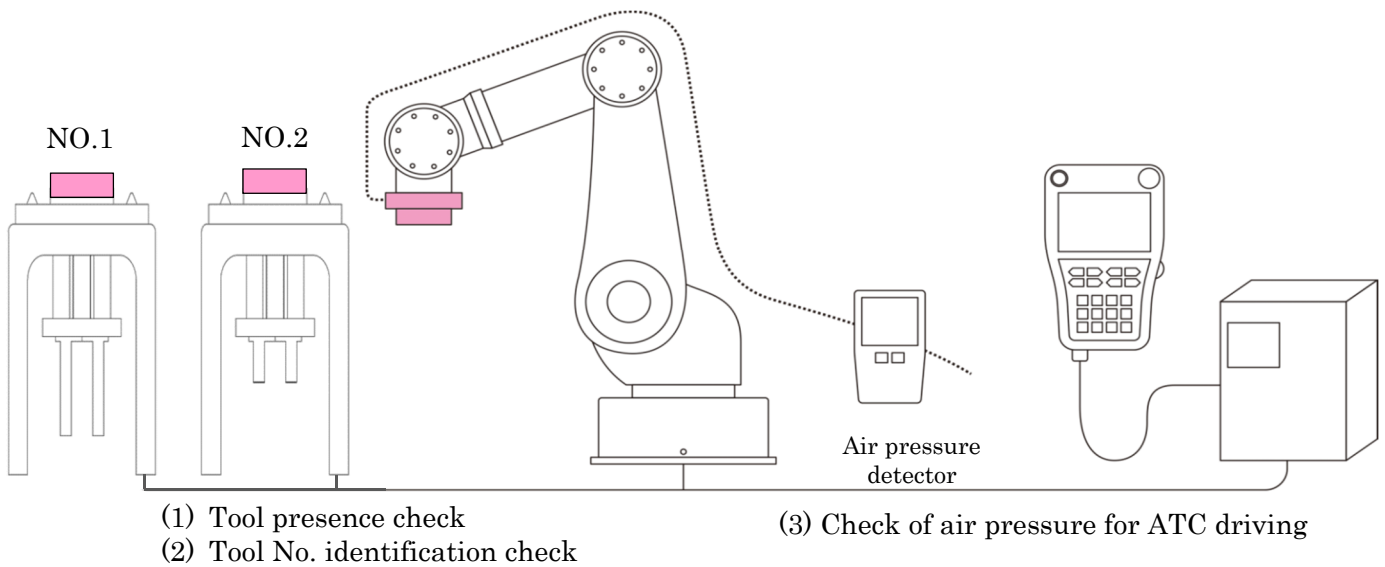


Fig. 10. An example of interlock setting

- The illustration above shows an example interlocking scheme for your reference. Please design safe interlocking scheme appropriate for your facilities.

6-3. Basic ATC Flow

Ensure the robot interlock with reference to the flow indicated in Chart 1.



Chart 1. Basic ATC Flow

Robot operation		Robot output signal			External input	
		Control solenoid valve		User air port solenoid valve	Fixture LS	Driving air pressure
		Chuck	Unchuck		Tool side presence	
Coupling	Robot SB pos.	OFF	ON	OFF	ON	ON
	↓	↓	↓	↓	↓	↓
	Robot movement	↓	↓	↓	↓	↓
	↓	↓	↓	↓	↓	↓
	Cplg pos. proximity	↓	↓	↓	↓	↓
	↓	↓	↓	↓	↓	↓
	Robot movement	↓	↓	↓	↓	↓
	↓	↓	↓	↓	↓	↓
	Coupling position	↓	↓	↓	↓	↓
	↓	↓	↓	↓	↓	↓
Chuck	ON	OFF	↓	↓	↓	
↓	↓	↓	ON	↓	↓	
Cplg completed	↓	↓	↓	OFF	↓	
↓	↓	↓	↓	↓	↓	
Robot movement	↓	↓	↓	↓	↓	
↓	↓	↓	↓	↓	↓	
Robot work	↓	↓	↓	↓	↓	
Separation	Robot work	ON	OFF	ON	OFF	ON
	↓	↓	↓	↓	↓	↓
	Robot movement	↓	↓	↓	↓	↓
	↓	↓	↓	↓	↓	↓
	Separation point	↓	↓	OFF	ON	↓
	↓	↓	↓	↓	↓	↓
	Unchuck	OFF	ON	↓	↓	↓
	↓	↓	↓	↓	↓	↓
	Robot movement	↓	↓	↓	↓	↓
↓	↓	↓	↓	↓	↓	
Sep. pos. proximity	↓	↓	↓	↓	↓	
↓	↓	↓	↓	↓	↓	
Robot movement	↓	↓	↓	↓	↓	
↓	↓	↓	↓	↓	↓	
Robot SB pos.	↓	↓	↓	↓	↓	

(represents process stepping conditions.)

⚠ WARNING

Continuous signaling is recommended for solenoid valves for chuck/unchuck. Please do not use one-shot signaling because it may not maintain the chuck status due to malfunction caused by any noise resulting in module falling.

⚠ CAUTION

When the user pneumatic port is used under negative pressure, be sure to break the negative pressure when attaching/detaching the ATC.

6-4. Interlocking around ATC

For safe and smooth operations of ATC, it is recommended to configure the following signals.

- 1) Signal of detection of decreased air pressure for ATC driving
This signal notifies a robot of reduction of ATC driving air pressure for any reason, and robot operations will be halted when this signal is turned OFF.
- 2) Tool side presence signal
This signal detects the tool side unit of ATC (material handling equipment, etc.) is on the tool stand. This is an interlock signal to provide unchucking valve ON output, check that the ATC is securely located on the tool stand, and proceed with next robot step while checking that the entire tool side unit of the ATC is on the tool stand. This prevents the tool from falling in any unexpected situation.

⚠ WARNING

The tool presence signal is a very important interlock signal to tell the ATC can be detached safely.

Failure to use the tool presence signal as an interlock signal may cause the tool fall off during manual operations, leading to an unexpected accident.

- 3) Tool Number confirmation signal.
This signal is used by the ATC to check consistency between a coupled tool and running program No. when, for example, multiple robots are coupled with a tool from the same tool stand.
- 4) ATC operation check signal indicators
It is recommended to install indicators that shows ON/OFF states of user signals (e.g. material handling clamp end work present) through the ATC. This allows to readily comprehend any signal-related trouble and interlock waiting status.

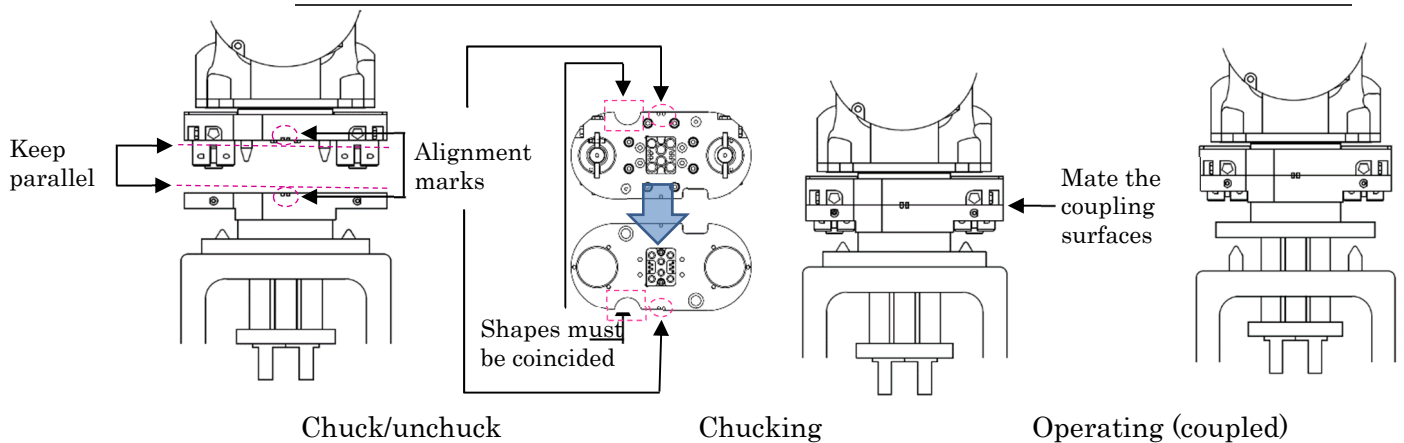
6-5. Precautions for Operations

⚠ CAUTION

Basically, the coupling surfaces of the robot adaptor and tool adaptor must be in parallel during the ATC chuck/unchuck operation. Otherwise, proper coupling and smooth detachment may be prevented. Moreover, the electric contacts and pneumatic ports may be spoiled earlier.

If it is not possible to maintain parallelism with the robot and the tool stand, the tool stand must have an alignment function. On a tool stand with an alignment function, mate the flat planes by pressing the robot adaptor against the tool adaptor for proper teaching. (The alignment function must be designed to compensate for robot thrust, tool weight, flatness, and center deviation.)

Also, in the detachment process, the tool adaptor may lean and cause prying due to reaction force of ATC's electric contact and pneumatic port, preventing detachment. In such cases, the robot adaptor must be pressed against the tool adaptor as in the coupling process to prevent the tool adaptor from moving (deviating and leaning) right after detachment. At this point, the tool must remain on the tool stand. Then, perform teaching so that the built-in sensors can detect detachment and ensure smooth evacuation without prying.



◆ MEMO

For the above, it is recommended to place ATC's tool stand on the level. However, if it needs to be upright due to a space constraint, please consider the following.

- 1) There must be no backlash of the tool adaptor's tool stand (besides the alignment function).
- 2) It must not move due to tool's offset load during detachment or coupling of the tool adaptor. (As far as possible, it should be supported near the tool adaptor.)
- 3) It must be pressed with sufficient pressure for coupling with the tool adaptor and have sufficient rigidity to prevent deflection of the tool stand. Also, the anchor bolts must not be loosened or come off.
- 4) Tool side supports and tool side supported positioning sections of the tool stand must be abrasion resistant. It is desirable that parts can be replaced.

⚠ WARNING

Do not separate the robot adaptor carelessly when the tool adaptor is not in its home position on the tool stand.
Separating the tool adaptor while not in its home position may damage ATC or peripheral equipment and/or hurt operators.

⚠ WARNING

Continuous signaling is recommended for solenoid valves for chuck/unchuck. Please do not use one-shot signaling because it may not maintain the chuck status due to malfunction caused by any noise resulting in module falling.

If the ATC is applied for demurring or other machining, position the tool stand so that no cutting chips and cutting oil are adhered to the tool adaptor.

If the stand position is exposed to adverse environment with spatters, water drops and dust particles, install an automatic cover (Nitta Change Cover) or the like to protect the tool adaptor. Further, in oily atmosphere, ensure good conduction by, for example, air blow on the signal pin section.

⚠ CAUTION Be sure to attach/detach the ATC without pneumatic pressure applied to the user pneumatic port. Otherwise, user pneumatic O-ring may be damaged or come off.

6-6. Emergency Response Actions

6-6-1. Response Actions to Interference or Crash

⚠ CAUTION In the event of interference or crash with a robot or a jig attached to the robot (e.g. gun and a tool, etc.), be sure to take the inspection and response actions described in Chart 2. A significant force is applied to ATC upon interference or crash, which may create any factor that shorten the product service life. Therefore, the inspection interval may need to be shortened as necessary.

Chart 2. Response Actions to Interference or Crash

	Check item	Check method	Response action to abnormality
1	Presence/absence of cracking	Visual	ATC replacement
2	Housing deformation	Visual	ATC replacement
3	Loose bolts	Check by using a hex wrench	Mounting bolt replacement
4	Cam coupling/detachment operations and signal system check	Turn the valve ON/OFF manually and check operations and signal ON/OFF.	ATC replacement
5	Presence/absence of gap of coupling planes	Visual: Cam surface damage; lock ring damage; pivot pin breakage; and mating surface dent	ATC replacement
6	Presence/absence of rattle in the rotation direction	Visual: Tapered pin breakage; bush damage; and check for loose bolts by using a hex wrench	ATC or mounting bolt replacement
7	Check for damage in the electric signal pin and cables, etc.	Visual, and I/O panel signal check	ATC or signal pin ASSY replacement

6-6-2. Response Action to Water Exposure

⚠ CAUTION If the equipment is exposed with water, immediately stop using it and check if water enters into the product. Using the equipment with water presenting in internal electric component may cause signal output failure due to short-circuit. Moreover, when grease is washed out by water, sliding parts will be subject to higher friction, which can result in poor coupling or sealing. In the event of exposure to water, be sure to conduct the inspection and actions specified in Chart 3.

Chart 3. Response Action to Water Exposure

	Check item	Check method	Action
1	Electric contact	Check for short-circuit on the I/O unit side. Visually check for accumulation of water.	If any, wipe off with a dry cloth. (*Do not attempt to blow water off with an air gun or the like as doing so may let water get further into the equipment.)
2	Cam, lock ring and tapered pins	Visual check	Apply grease
3	O-ring	Visual check	Apply grease
4	Other section exposed with water	Check all sections for water accumulation and wipe off if any.	Apply grease to uncoated metal parts.

6-7. Points to Check during Line Downtime (or Line Uptime)

⚠ WARNING

- Recommended usage

During the robot downtime, e.g. nighttime or holidays, keep the tool side module detached. During uptime, check that the cam is closed at the time of approaching for coupling of the tool side unit. Coupling with the cam left opened may cause crash between the cam and lock ring.

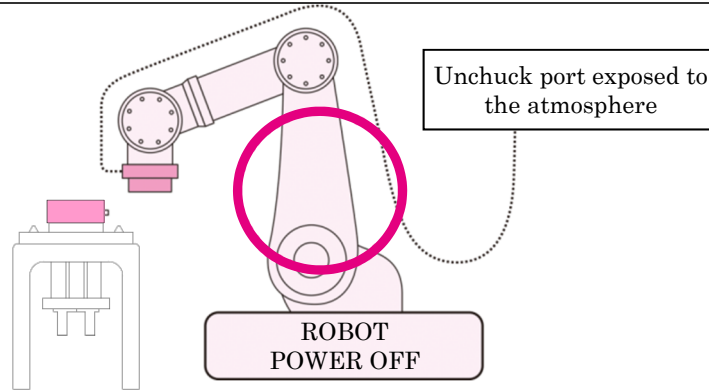


Fig. 11. Precautions for Line Downtime

⚠ DANGER

- Usage not recommended (only allowed if there is an absolute necessity)

If the tool side adaptor cannot be kept detached during downtime due to any reasons related to the facilities, take due care of the following.

If the line has to be stopped with the tool side module coupled, be sure to release the unchuck port regardless of air supply pressure presence. (No residual pressure allowed.)

If the unchuck port is not released, the cam may be operated due to air wraparound resulting in tool side module falling. Position the tool appropriately to prevent falling and turn the power and air supply OFF before stopping the equipment.

There may be residual air pressure when:

- air supply is shut off by bending/twisting of the unchuck tube or excessive tightening of the banding bands (see 6-1 in page 13): or
- the exhaust ports of the manifold and solenoid valve are plugged.

(See 6-1 in page 13)

Points to check before restarting the line:

- Ensure there is no gap between the coupling planes.

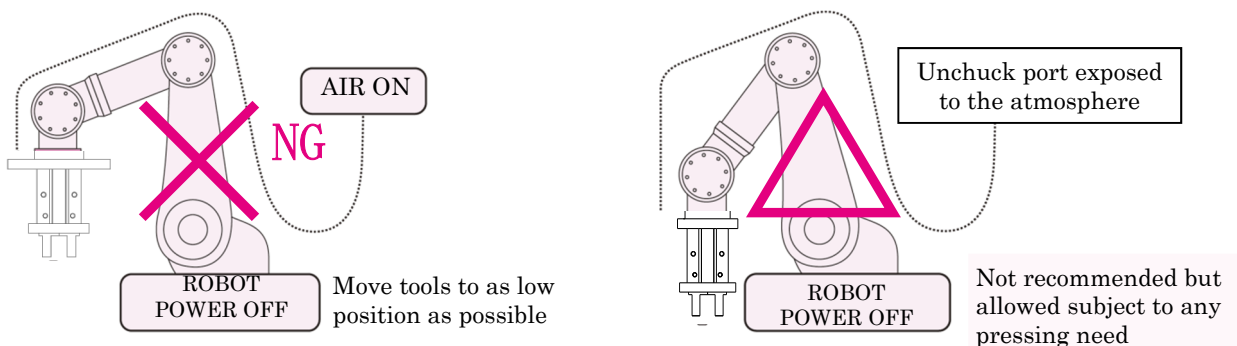


Fig. 12. Positions that should be avoided during line downtime

6-8. Precautions for Transportation

⚠ WARNING

To move the system with the modules coupled together without air supply, use rope or the like to bind them and prevent tool side module from falling.

7. Maintenance and Inspection

7-1. Inspection Schedule

Basically, there are monthly, quarterly, yearly, and 4-year (renewal consideration) inspections; additional inspection items are to be performed in inspections of longer intervals.

For inspection items for different intervals, refer to Chart 5.

Appropriate works and inspection not only improve the life of the mechanism but also are necessary to prevent failures and ensure safety, so please be sure to perform the regular inspection exactly according to the inspection schedule.

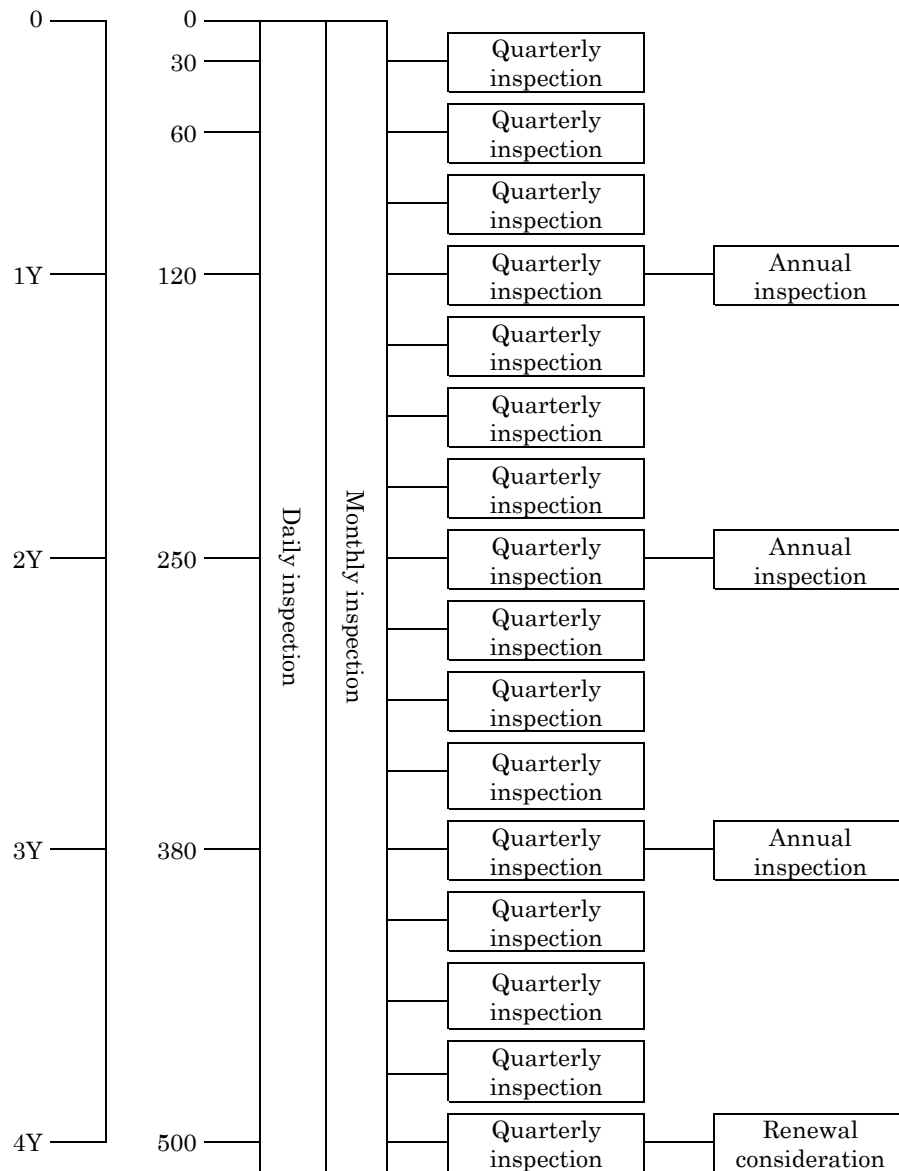
7-2. Inspection Intervals

Inspection intervals are determined based on chuck/unchuck frequency calculated based on standard shift time.

Standard chuck/unchuck frequency:
 $Once/min. \times 60 \text{ min.} \times 8 \text{ hrs./day} \times 22 \text{ days/month} = 10,560 \text{ times}$

Calculate the chuck/unchuck frequency from cycle time and up time of a robot to be used, and perform regular inspections when either chuck/unchuck count or use period reaches calculated intervals. For example, in a two-shift system the monthly inspection must be performed twice in a month (every 10,000 cycles).

Chart 4. Inspection schedule



8. Maintenance and Inspection Points

Inspection items are basically classified into daily inspection, monthly inspection, quarterly inspection, biannual inspection, annual inspection, and 4-year inspection (renewal consideration) as indicated in the following chart. For working procedure of each inspection item, refer to the maintenance and inspection procedures described later.

Chart 5. List of robot/tool adaptor inspection items

Interval	Item	Check method	Response action to abnormality
Daily inspection	There shall be no foreign materials on the signal pin. Ensure that the pin height is consistent.	Visual	Signal pin replacement See 9-3-1.
	There shall be no foreign materials, electric corrosion, and/or discoloration on the electrode.	Visual	Signal pin replacement See 9-3-1.
	There shall be no wearing on signal pin ASSY cables and tubes.	Visual	Signal pin ASSY replacement See 9-3-3.
	Check that there is no air leakage when the units are coupled	Tactile	O-ring replacement See 9-3-2.
	Check that there is no gap between mating surfaces when the units are coupled (Check for any rattle)	Visual	ATC replacement
	Check that no foreign matter adheres to the mating surfaces of adaptors of the robot and tool.	Visual	ATC replacement
Monthly inspection	Grease the cams, lock pins, tapered pins and bushing	Visual	See 9-2-1.
	There shall be no loose fixing bolts.	Tactile	See 9-2-2.
	There shall be no loose mounting bolts for the cable clamp fixing plate of the signal pin ASSY.	Tactile	See 9-2-3.
	Cams shall move smoothly.	Visual	ATC replacement
Quarterly inspection	There shall be no rattling in the pivot pins, lock rings and the housing.	Tactile	Hex socket head screw Re-tightening, or ATC replacement
Annual inspection	Signal pin ASSY replacement (robot side)	—	See 9-3-3.
	Pneumatic port O-ring replacement	—	See 9-3-2.
4-year inspection	Renewal is recommended	—	Please contact us.

9. Maintenance Procedures

9-1. Recommended Spare Parts

Components that should be prepared as spare parts are listed according to the ranks specified in the Chart 8. To purchase these parts, check the product model and serial No. and then contact us.

Rank A: Consumables and items whose expected replacement interval is relatively short

Rank B: Mechanical parts that work frequently

Rank C: Important mechanical parts that require particular expertise for replacement

⚠ CAUTION

Replacement of important mechanism parts requires special skills, so the device warranty becomes void if our customers replace any of such parts by themselves. Be sure to ask us for replacement.

Chart 6. Recommended spare parts

Rank	Name
A	Signal pin (tool side)
A	O-ring (robot side)
C	Signal pin ASSY

For detailed parts information, refer to the delivery specifications and parts placement diagram.

⚠ CAUTION

If you find any damage to the housing, etc. when replacing with spare parts, please contact us.

9-2. Inspection of Parts

9-2-1. ATC Grease Up

Pressure-, heat-, and water-resistant mineral lithium composite grease or lithium grease should be applied thinly and evenly to external sliding faces. Application points are indicated in Fig. 13.

For new products, please check that grease has been already applied in plant.

(Recommended grease: SUMIPLEX BN NO. 1 (manufactured by Sumico Lubricant))

⚠ CAUTION

Do not use molybdenum grease.

As Nitta uses mineral lithium composite grease, be sure to use the same type of grease. Recommended NLGI No. (JIS consistency number) is No.1 and No.2.

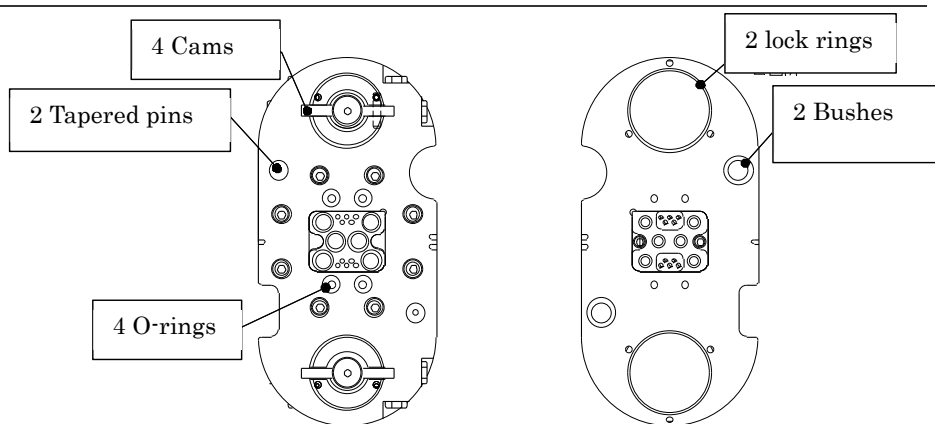


Fig. 13. ATC Grease-Up Points

⚠ CAUTION

Without greasing, prying and early wear will be generated on each part.

9-2-2. Inspection for Loose Mounting Bolt

Ensure that there is no loose robot/tool adaptor mounting bolt.

For bolt locations, refer to Fig. 14. In addition, the torque level of each bolt is specified below.

Robot adaptor: M4x20 x 8 pcs [Torque = 5Nm]

Tool adaptor: M4 x 8 pcs (customer-supplied)

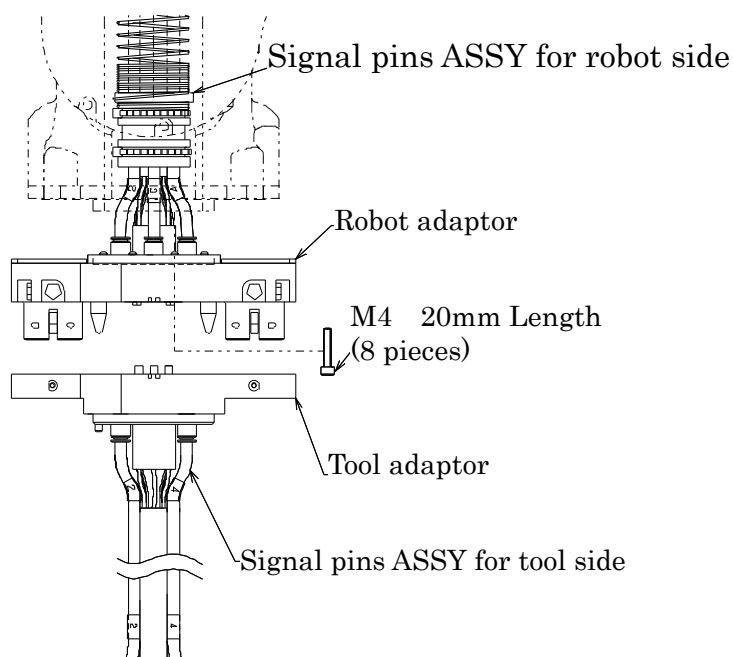


Fig. 14. Adaptor mounting bolt position

9-2-3. Inspection for Loose Mounting Bolt for Signal Pin ASSY

Ensure that there is no loose fixing bolt for the robot side signal pin ASSY.

For bolt locations, refer to Fig. 15. In addition, the torque level of each bolt is specified below.

Mounting bolt: M6x12 x 2 pcs [Torque: 15Nm]

Mounting bolt: M4x12, Nord lock washer x 2 pcs [Torque: 4.5Nm]

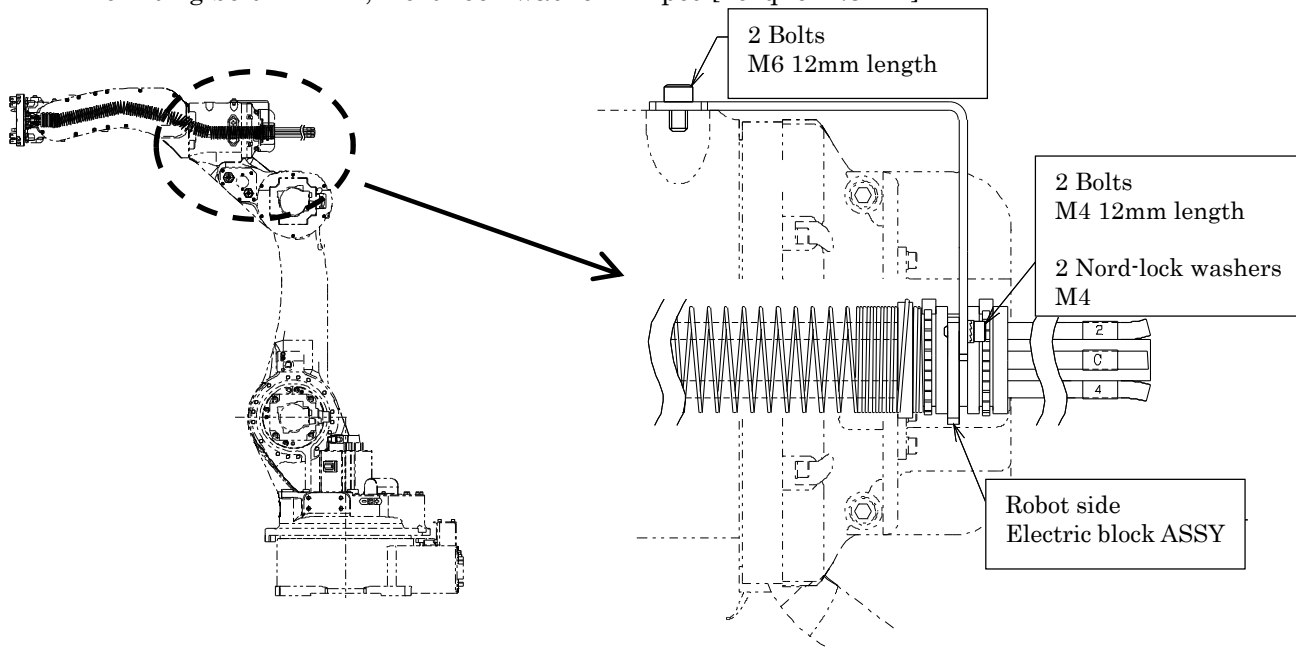


Fig. 15. Locations of mounting bolts for cable fixing plate

9-3. Replacement of Parts

9-3-1. Standard of Replacement and Cleaning of Tool Side Electric Contact Pins and Procedures

1) Preparation

Separate the ATC from the robot and fix its tool side securely to the tool stand before starting the work. During the work, be sure to keep the robot disconnected from the power source for safety's sake.

⚠ WARNING **Ensure that the unit is not energized before starting the replacement work.**

2) Tool side signal pin and electrode replacement and cleaning standards

If poor conductivity or operational failure is observed in the tool side signal pin and electrode, or any dirt, spatter, dust, or wear is seen on the pin side surface, clean or replace the electric signal pin and electrode by following instructions given in this document.

3) Tool side signal pin and electrode cleaning

3-1) If any dirt, spatter or dust, etc. adhering to the signal pin or electrode is observed, use a maintenance brush (hog-bristle or nylon) to remove the foreign materials. At this point, be careful not to scratch the pin surface.

3-2) Use the Quick Dry Cleaner (Kure) or volatile cleaning agent such as alcohol on the contact parts only for cleaning.

4) Tool side signal pin replacement

4-1) Signal pin removal procedure

Pull out the pin tip upward as illustrated in Fig. 16 and then the external brass cylinder will come out together with the tip part. This task can be easily done by using longnose pliers.

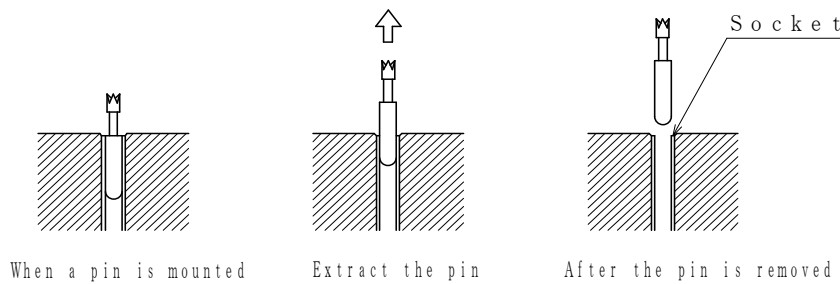


Fig. 16. Tool side spring pin replacement

⚠ CAUTION **Be sure to identify any removed pin to prevent reuse and install a new signal pin.**

- If the pin is found to be broken in the replacement procedure

Use a sharp file (second-cut) of $\phi 2-3\text{mm}$ as illustrated in Fig. 17 to pull out the pin.

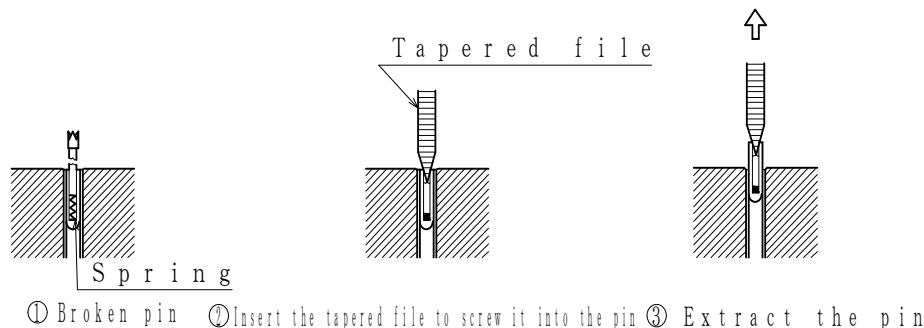


Fig. 17. Pulling out a broken pin

4-2) Signal pin installation procedure

To install a signal pin, press in a new pin straight until the brass section of its external cylinder gets into the module. Forcibly pressing the pin tip against the module may deform the tip, so use a moderate force to press it in by hand. At this point, be careful not to allow dust and spatters, etc. enter into the socket.

5) Tool side electrode replacement

5-1) Electrode removal procedure

As illustrated in Fig. 18, pull out the pin tip part straight upward. Then the tip part and external brass cylinder embracing it will be removed. This task can be easily done by using longnose pliers.

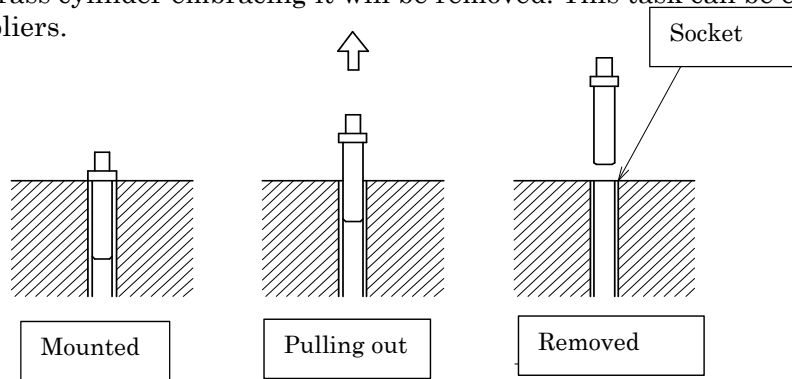


Fig. 18. Removing a tool side electrode

⚠ CAUTION

Be sure to identify any removed pin to prevent reuse and install a new signal pin.

5-2) Electrode installation

To install an electrode, press in a new pin straight until the brass section of its external cylinder gets into the module. Forcibly pressing the pin tip against the module may deform the tip and socket, so exercise care when inserting it.

At this point, be careful not to allow dust and spatters, etc. enter into the socket.

9-3-2. O-Ring Replacement Procedure

1) O-ring removal

If any O-ring is damaged, use a race knife or the like to remove it from the fitting groove.

⚠ CAUTION

When removing the O-ring, be careful not to scratch the fitting groove, etc.

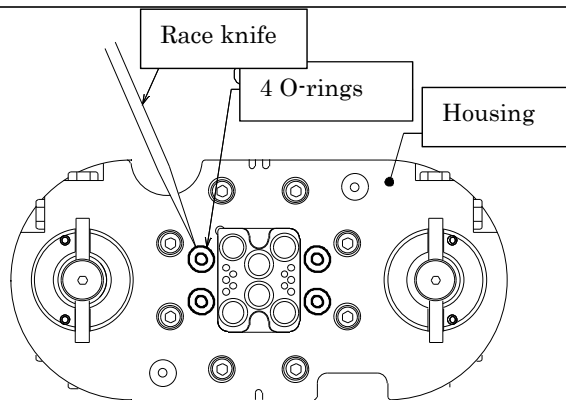


Fig. 19. O-rings to be replaced

2) O-ring fitting

O-ring can be easily fitted into the fitting groove by hand.

⚠ CAUTION

Do not reuse O-ring.

3) Grease up

Apply grease on the O-ring surface.

Use SUMIPLEX BN NO.1 (manufactured by Sumico Lubricant) or equivalent grease.

9-3-3. Robot Side Signal Pin ASSY Replacement

1) Robot side signal pin ASSY removal procedure

- (1) Perform teaching of the T- and R-axes to locate and stop them at their zero points (0°).
- (2) Remove two M4x12 hex bolts that fix the cable clamp fixing plate 2.
- (3) Also remove two M6x12 hex bolts from the U-axis of the robot.
- (4) Remove eight M4x20 hex bolts that fix the adaptor and remove the signal pin ASSY from the robot.
- (5) Disconnect all piping tubes. (User port: 4 tubes Chuck/unchuck port: 2 tubes)
- (6) Remove six air fittings from the adaptor.
- (7) Remove two M3x10 hex bolts that fix the cable ASSY to the adaptor.

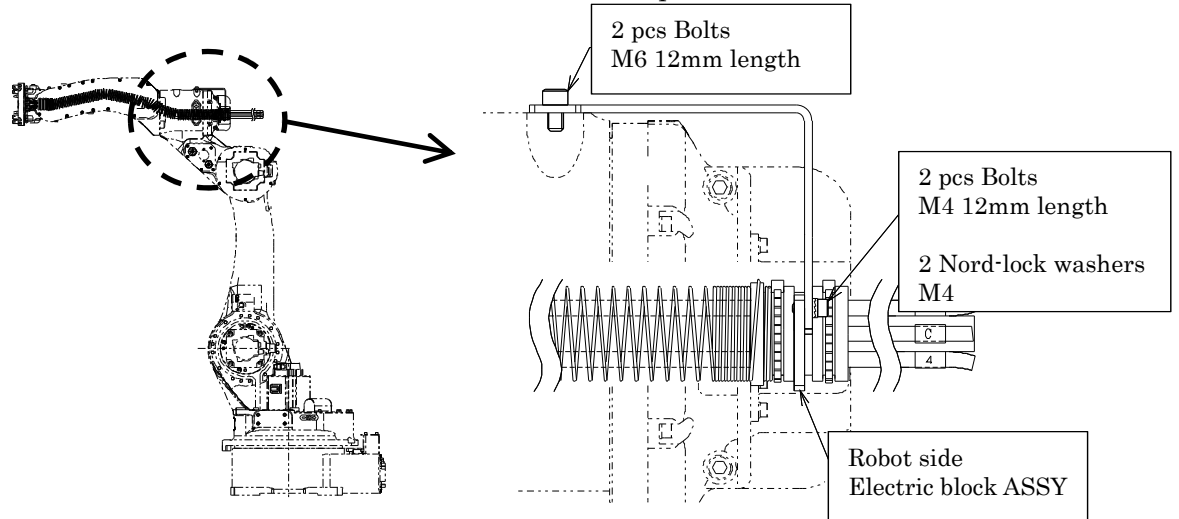


Fig. 20. Removing a cable clamp fixing plate

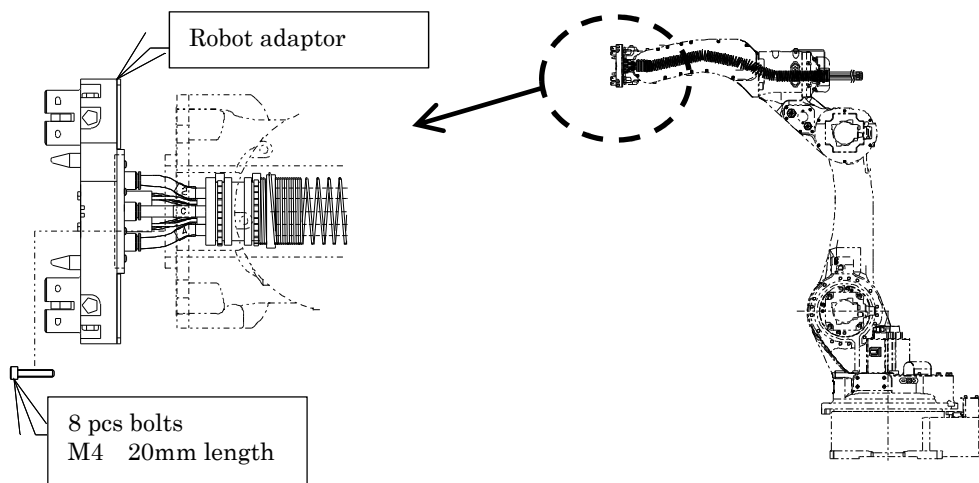


Fig. 21. Removing an adaptor

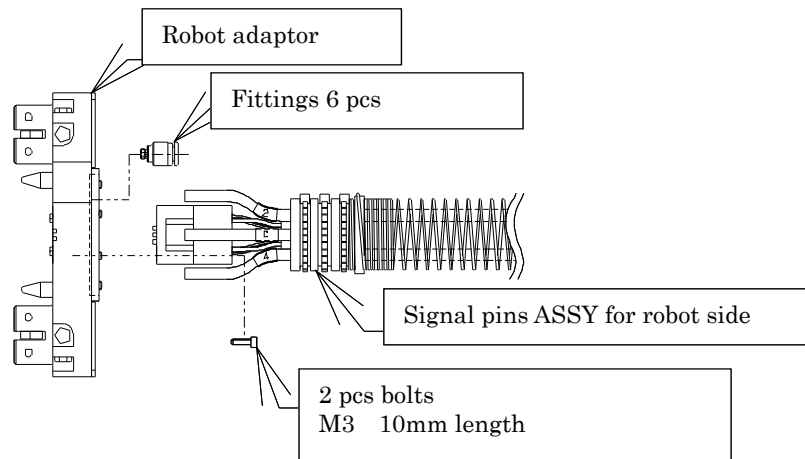


Fig. 22. Removing a signal pin ASSY

2) Installation of robot side signal pin ASSY

- (1) Install the signal pin ASSY to the adaptor with two M3x10 hex bolts.
- (2) Attach six air fittings (GFITTAC06M5M: AC6-M5A) to the adaptor.
- (3) Pipe each tube to the fittings. (User port: 4 tubes Chuck/unchuck port: 2 tubes)
- (4) Install the signal pin ASSY to the hollow hole on the robot and fix it with eight M4x20 hex bolts. At this point, check that the signal pin ASSY is free of twisting.
- (5) Attach the signal pin ASSY to the U-axis of the robot by using the cable clamp fixing plate by using two M6x12 hex bolts.
- (6) Fix the clamp using two M4x12 hex bolts with the cable clamp fixing plate 2. (Insert the Nord lock washers, too.)



CAUTION

Do not remove a banding band to change the cable clamp position. Any change in fixing position length may cause excessive cable tension or involvement with peripheral equipment, resulting in cable, tube and joint damage.



CAUTION

Tightening bolts with torque above the specified torque level may damage threads on the ATC side and maintenance and replacement parts. Further, tightening bolts with torque below the specified torque level or failure to use the locking agent may cause bolts to be loosened, leading to maintenance/replacement part fall off.

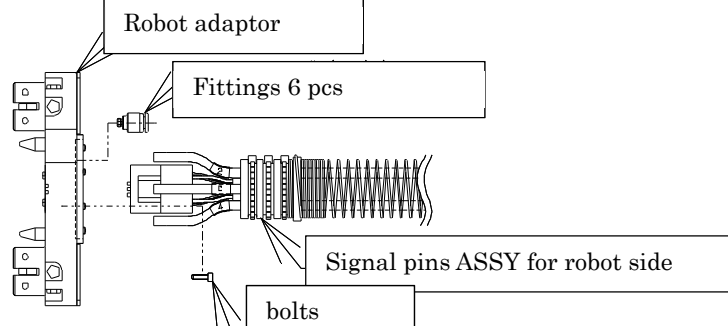


Fig. 23. Installing a signal pin ASSY

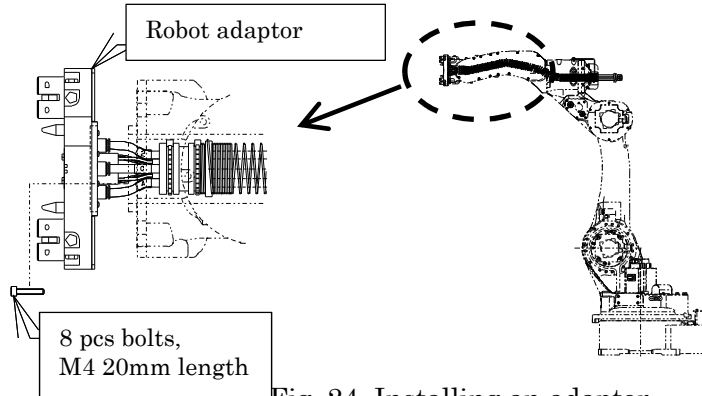


Fig. 24. Installing an adaptor

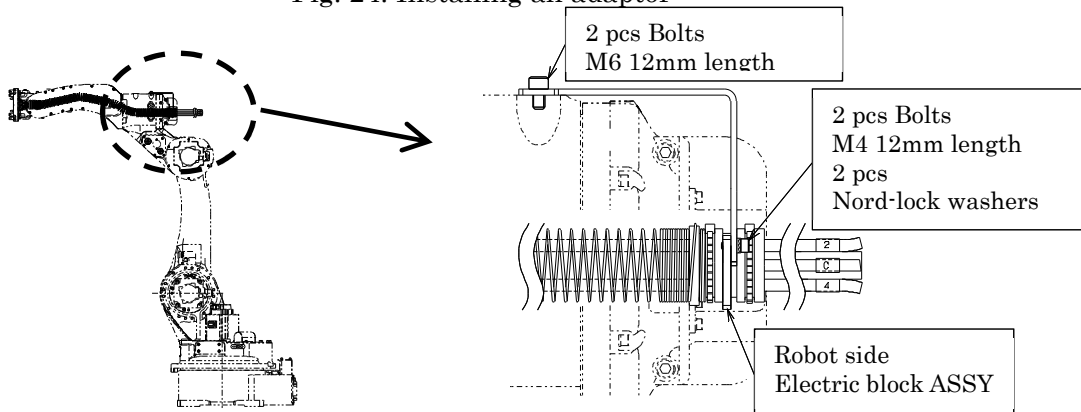


Fig. 25. Installing a cable clamp fixing plate

1 0. Troubleshooting

[Installation]

Symptom	Probable cause	Action
Cam does not work	Chucking parts are damaged	Replace the ATC. For details, refer to "5. Procedures of Installation to Robot/Tool" in the instruction manual.
	Chuck/unchuck air is not supplied	Check the air supply source. For details, refer to "5-3. Connecting to Chuck/Unchuck Port" in the instruction manual.
		Check the solenoid valve operation.
		Check the tube connection. (Disconnection, twisting, bending, or breaking) → Tube replacement For details, refer to "5-3. Connecting to Chuck/Unchuck Port" and "5-5. How to Fix Robot Side Signal Pin ASSY" in the instruction manual.

[Teaching and Operations]

Symptom	Probable cause	Action
There is a gap between coupling surfaces	Air is not supplied (Decrease in air source pressure)	Check the air source pressure and for tube bending. For details, refer to "5-3. Connecting to Chuck/Unchuck Port" and "5-5. How to Fix Robot Side Signal Pin ASSY" in the instruction manual.
	There is any foreign substance between coupling surfaces	Eliminate any foreign substance.
	Coupling is incomplete	Mate the coupling surfaces and then correct teaching so as to achieve appropriate coupling operations.
Unable to separate	Air is not supplied (decrease in air source pressure)	Check the air source pressure and for tube bending. For details, refer to "5-3. Connecting to Chuck/Unchuck Port" and "5-5. How to Fix Robot Side Signal Pin ASSY" in the instruction manual.
Unintentionally separated	Wrong piping, etc.	Refer to "5-4. Electric Wiring and Air Piping" in the instruction manual.
Insufficient air flow	O-ring is worn out or displaced	Fit a new O-ring. For details, refer to "9-3-2. O-Ring Replacement Procedure" and "9-2-1. ATC Grease Up" in the instruction manual.

[Teaching and Operations]

Symptom	Probable cause	Action
A signal error occurs	Cable is disconnected	Replace the signal pin ASSY or a pertinent cable. For details, refer to "9-3-3. Robot Side Signal Pin ASSY Replacement" in the instruction manual.
	The signal pin is damaged	Replace the signal pin. For details, refer to "9-3-1. Standard of Replacement and Cleaning of Tool Side Electric Contact Pins and Procedures" in the instruction manual.
	Any foreign substance is attached on the signal pin	Eliminate any foreign substance.
	ATC is exposed with water	Wipe off any water on the electric contact with a dry cloth For details, refer to "6-6-2. Response Action to Water Exposure" in the instruction manual.
	ATC positioning parts are worn out	Replace the ATC. For details, refer to "3-2. Robot adaptor and tool adaptor installation diagram" in the instruction manual.
	There is a gap between coupling surfaces	Refer to "There is a gap between coupling surfaces" in the Chart.
Abnormal sound due to air leakage	Joint handle or tube is not sufficiently inserted	Check the joints and tubes. For details, refer to "5-3. Connecting to Chuck/Unchuck Port" in the instruction manual.
	A joint or tube is damaged	Check the joints and tubes. For details, refer to "5-3. Connecting to Chuck/Unchuck Port" and "5-5. How to Fix Robot Side Signal Pin ASSY" in the instruction manual.
	O-ring is worn out or displaced.	Fit a new O-ring. For details, refer to "9-3-2. O-Ring Replacement Procedure" and "9-2-1. ATC Grease Up" in the instruction manual.
	Air is flowing out from the port, when ATC is unchucked.	Please control by solenoid valve.
	The ATC is damaged	Replace the ATC. For details, refer to "5. Procedures of Installation to Robot/Tool" in the instruction manual.

[Operations]

Symptom	Probable cause	Action
Displacement gets worse Rattling	Any mounting bolt is damaged or hole sagging occurs	Replace the ATC. This may be mitigated by tightening mounting bolts to the appropriate torque level. For details, refer to "5. Procedures of Installation to Robot/Tool" in the instruction manual.
	Used under load over the rating	Use with in the rated range. For details, refer to "3-3. Precautions for Allowable Load and Installation" in the instruction manual.
	ATC positioning Parts are worn out	Replace the ATC. For details, refer to "5. Procedures of Installation to Robot/Tool" in the instruction manual.