INSTRUCTION MANUAL

Automatic Tool Changer

NITTAOMEGA type M165-K

NOTICE
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https://www.nitta.co.jp/en

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Preface

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

This document 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.

Ensure that this document is securely delivered to end users of this 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) Any failure caused by any use of used parts

  Any secondary damage such as line stoppage due to a system failure or damage arising out thereof is also out of the warranty coverage.

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.

- Please check that mounting bolts are included. (See the relevant delivery specifications.)
- Please check the spare parts. (To be determined in separate meetings.)
- For details of options, e.g. special modules, 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	Improper use disregarding this indication may lead to a hazardous situation which may result in death or serious injury and requires urgent alerting when such hazard is materialized.
⚠ WARNING	Improper use disregarding this indication may lead to a hazardous situation which may result in death or serious injury.
⚠ CAUTION	Improper use disregarding this indication may lead to a hazardous situation which may result in minor injury or property damage.
Referenc	This indicates use examples, etc.
MEMO	This indicates special instructions less important than cautions.

Please note that a severe accident may occur depending on situations even when instructions in the indications are observed. Please strictly observe the instructions.

Disclaimer

(1) We assume no responsibilities for any damage arising out of any failure caused by intention or negligence of customer (including software malfunction), or any reason not attributable to Nitta, such as an accident or natural disaster.
(2) We assume no responsibilities for any damage caused by any use not described or prescribed in our catalogs (including the instruction manual).
(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 any incidental damage arising out of use of or inability to use our product (including but not limited to loss of business profit and business interruption).

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, installation guide, and maintenance procedures.

⚠ WARNING

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.
- Flammable environment (containing highly volatile and flammable substances)
- Environment with explosive atmosphere (e.g. combustible gas and chemical spattering)
- Environment exposed to water/water drops or highly humid environment
- Environment with corrosive atmosphere
- Environment with high degree of radiation

When the product is used under any of the above environment, we assume no responsibility for any failure or damage.
Also, malfunction may occur in an environment with spattering dust, chip and cutting oil, etc.

⚠ WARNING

Do not disassemble or reassemble any parts other than those mentioned in this manual. A serious accident such as a fall may occur.

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 pneumatic, and water pressure sources are off before work.

（c） All residual hydraulic, pneumatic and water 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.

⚠ WARNING

Use positioning pins when you put the ATC on robots and tools.
If it is installed without using the positioning pin, the position may move to wrong position during use, the ATC cannot be connected and separated reliably, and a serious accident such as dropping may occur.
If the positioning pins are unavoidable, the customer should take measures to prevent the tool from falling due to abnormal chucking or unchucking.

Referenc

Example of countermeasures when the positioning pin cannot be used

- Perform daily inspections (checking misalignment, scratches or abnormalities on each part such as taper pin, bush, cam, lock parts, grease application)
- Slow down the chucking / unchucking operation as much as possible
- Reliably capture the interlock signal.
  Especially for the presence sensor of the stand, move to the next step after confirming that the presence sensor of the tool is in the ON.

⚠ 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 air to pneumatic, fall prevention system, and ATC 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.

⚠WARNING	Make sure there is no chips of sealing tape or other dusts getting into the air supply, fall prevention system, and ATC chuck/unchuck port. Otherwise, not only the product function and life may be adversely affected but also unexpected accident may occur.

MEMO	- 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 a 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 and its functional 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 chuck/unchuck, switch air supply for chuck/unchuck with the coupling planes of robot side and tool side adaptors are horizontally coherent on the tool 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.

⚠ DANGER	When the welding power is on, there is a risk of electricity leakage. Do not touch any component connected with the ATC.

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.

g) Precautions for disposal

When disposing of this product, please comply with laws and regulations.

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 ATC is compatible with all the robot tools with respective adaptor plates (optional). 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.

1-1. Configuration

This system is composed of the ATC (Robot Adaptor and Tool Adaptor) and additional functional modules assembled thereto.

The signal pin ASSY is a spring-type electric contact.

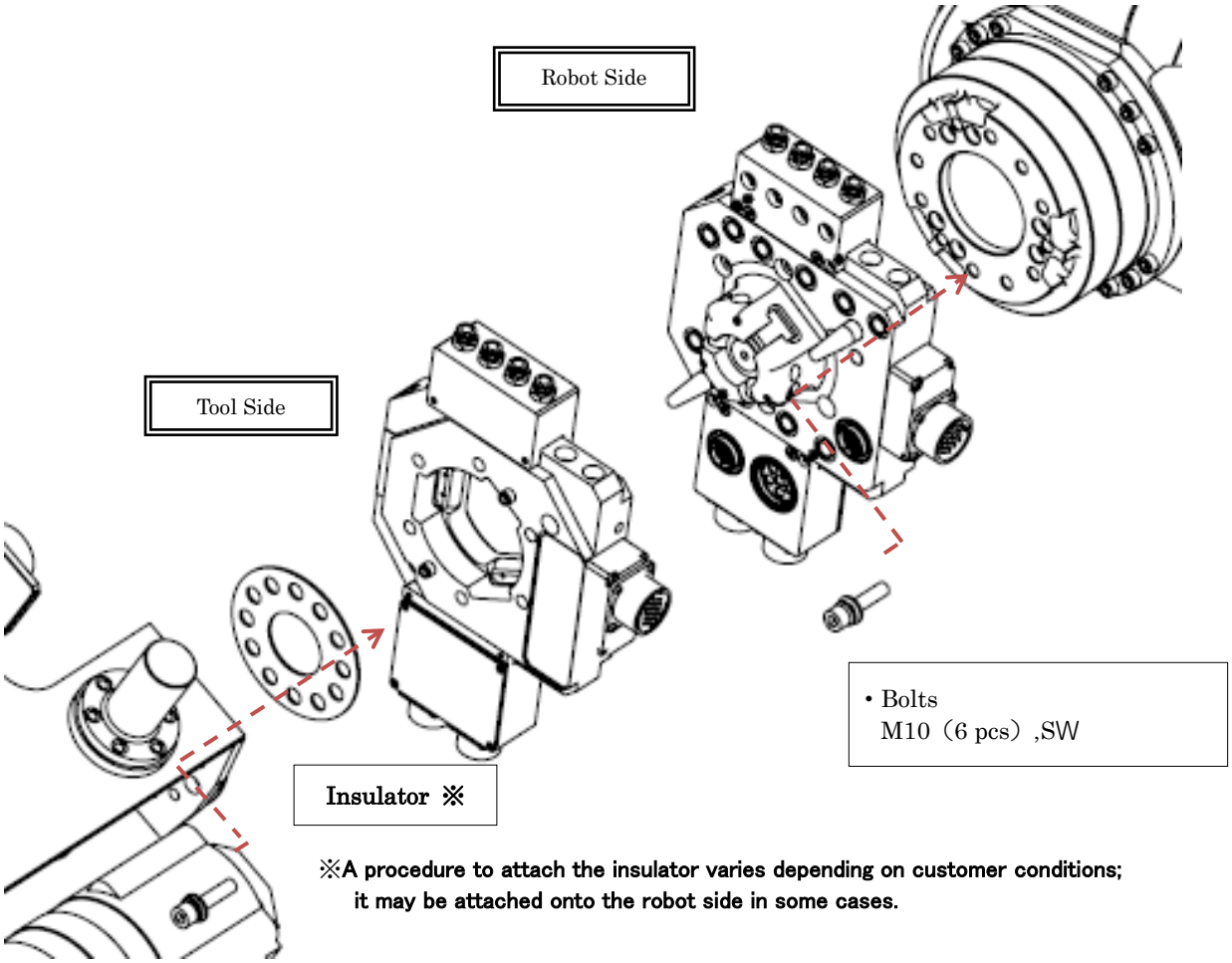


Fig. 1. System diagram

1-2. Parts Names

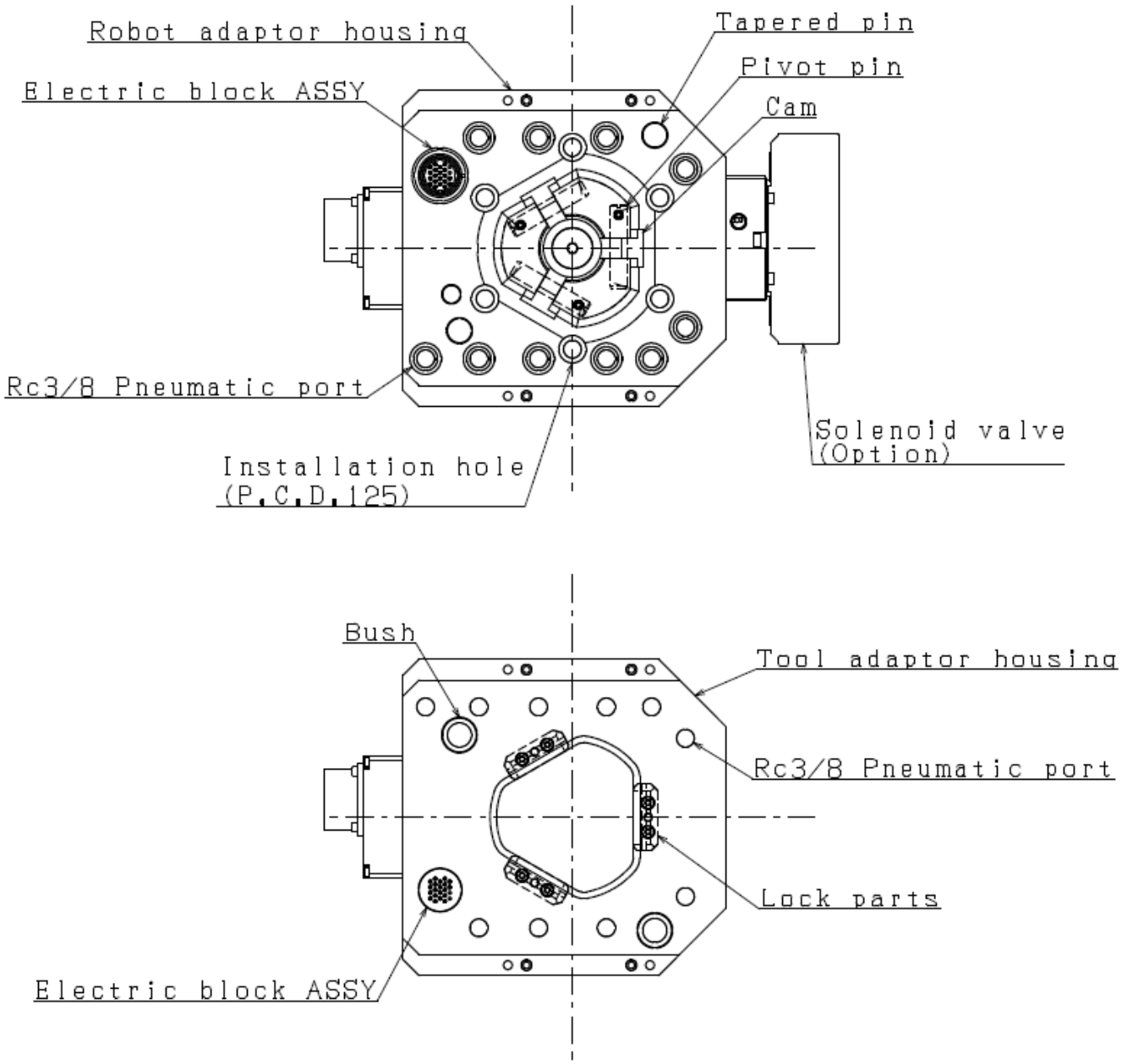


Fig. 2. Parts names

1-3. Robot Side

1-3-1. Robot Adaptor

The robot adaptor is a basic component of the ATC. Each robot adaptor is equipped with sensors that transmit signals (chuck end signal, unchuck end signal and coupling check end signal) to communicate its attachment conditions.

[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.

⚠WARNING

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.

[Chuck/Unchuck Sensor Signals]

- Chuck end signal (coupling end)

Signal that indicates the cam is not fully engaged. When this signal and a coupling check signal are both active, the robot can pick the tool adaptor from the tool stand.

- Unchuck end signal (detachment end)

This signal indicates that a cam to lock (couple) the robot adaptor and tool adaptor is drawn into the robot adaptor. While this signal is active, the robot adaptor may approach the tool adaptor freely and leave the tool adaptor after completion of tool replacement on the tool stand safely.

- Coupling check end signal (face end)

This signal indicates that jointing planes of both the robot adaptor and tool adaptor are in contact.
When coupling the adaptors, make the coupling planes of the adaptors parallel and check that the coupling planes are sufficiently close to each other. Then operate the cam for coupling.

1-3-2. Selection of Input Device

⚠ CAUTION Check specifications of the input device. Signals representing the robot adaptor attachment condition may not be present.

The chuck/unchuck sensor of ATC consists of a proximity sensor. (Refer to 2-2-3. 2-2-4.)
Select an input device with which ON determination is possible.

1-3-3. Robot adaptor plate (optional)

Conforming to the ISO flange (P.C.D.125 (M10 x6pcs)) pattern, the adaptor is mountable to a robot flange.

They can also be mounted to various robots not compatible with the P.C.D.125 (M10x6) pattern with a robot adaptor plate.

No drilling and threading for mounting to a robot are performed on the standard robot adaptor plate.

(We may perform such processing upon your request. You may also prepare a robot adaptor place on your own. When attaching the adaptor plate to the robot adaptor, see " 3 .Procedures of Installation to Robot/Tool".)

1-4. Tool Side

1-4-1. 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 parts to be engaged with robot adaptor's locking cams.

1-4-2. Tool Adaptor Plate (Optional)

Conforming to the ISO flange (P.C.D.125 (M10 x6pcs)) pattern, the adaptor is mountable to a robot flange.

They can also be mounted to various tools not compatible with the P.C.D.125 (M10x6) pattern with a tool adaptor plate.

No drilling and threading for mounting to a tool are performed on the standard tool adaptor plate.

(As with the robot adaptor plate, we can offer a mounting hole drilling service following your instructions. You may also prepare an adaptor plate on your own. For precautions for installation of an adaptor plate onto the tool adaptor unit, please contact us.)

1-5. Option

For details of options, e.g. non-standard signal pin modules, spot welding modules, and pneumatic modules, please feel free to contact us

2. Standard Specifications

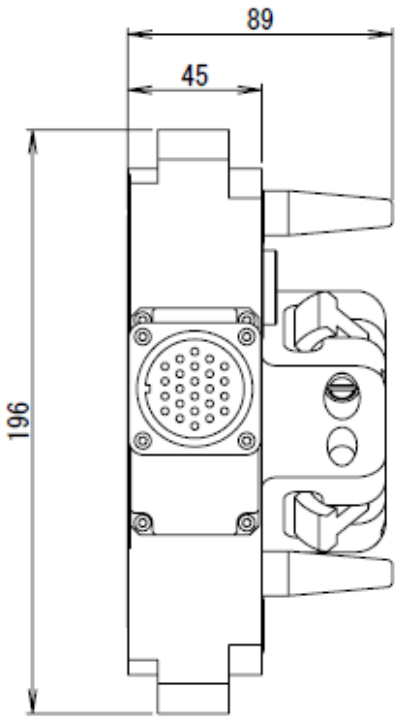
2-1. Common Specifications

○Use conditions	
Ambient temperature	0-60℃ (no condensation)
Ambient humidity	95%RH or below (no condensation)
Ambient atmosphere	Free of corrosive gas
Altitude	1000m 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)

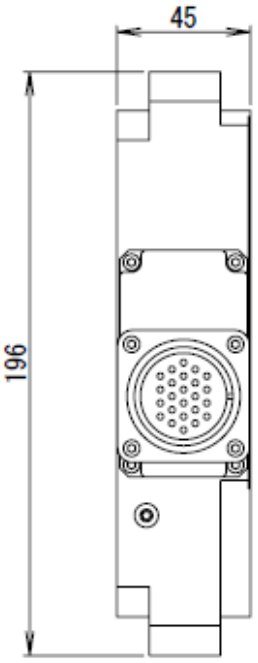
2-2. ATC

2-2-1. ATC Specifications

Model	Robot Adaptor		See the drawing
	Tool Adaptor		See the drawing
Payload			100-165kg
Allowable moment			1372Nm
Allowable torque			1372Nm
Working pressure			0.39-0.85MPa
Position reproducibility			±0.025mm
Interface	Electricity	Number of electric contacts	See the drawing
		Rated voltage	50VDC or below
		Max. allowed current	3A
		Overvoltage category	Overvoltage category III
		Allowable pollution level	Pollution level 3
	Air	Number of ports	10
		Allowable pressure	0．85MPa{8.66kg/cm^2}
		Effective sectional area（CV value）	17.07mm^2（0.93）/ポート（Rc3/8）
Machine weight	Robot Adaptor		4.7kg
	Tool Adaptor		3.9kg
Body material			Aluminum alloy
Dimensions	Robot Adaptor		See below
	Tool Adaptor		See below



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



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

Note: Refer to the delivery specifications and drawing.

2-2-2. Internal Power Wire for ATC

Name		Polyester flex-resistant power wire
Model		DKHV
Nominal sectional area		0.5mm^2
Conductor	Material	Annealed copper wire for electricity
	Configuration: No. of wires/wire dia.	6/18/0.08 wires/mm
	Outer diameter	1.1mm
Insulation material	Material	Heat-resistant vinyl
Withstand voltage	Under water	2000V/5 min

Name		Polyester flex-resistant power wire
Model		DKXV
Conductor	Material	Annealed copper wire for electricity
	Configuration: No. of wires/wire dia.	6/11/0.08 wires/mm
	Outer diameter	0.9mm
Insulation material	Material	Flame-retardant polyester
Withstand voltage	Under water	1000V/min
	Sparking	5000V/0.15 sec.

2-2-3. Coupling Check End Sensor

Name	Azbil anti-spatter proximity switch
Model	FL7M-3J6HW-903
Type	DC 2-wire shield type
Detection method	High-frequency oscillation
Rated power supply voltage	12/24VDC (common)
Operating voltage range	10-30VDC
Leak current	0.55mA or below
Operation mode	Normal open *1
Output mode	DC 2-wire; transistor output
Control output	Switching current: 3-100mA　Residual voltage: 3.0V or below（load current） Output withstand voltage: 30VDC
Response frequency	1500Hz or above

*1: In proximity of detection object; load "operating"

2-2-4. Chuck and Unchuck Sensor

Name	Omron proximity switch
Model	NPN： E2E-S05S12-WC-C1-R2M or PNP： E2E-S05S12-WC-B1-R2M
Type	DC 3-wire type
Power supply voltage	DC10～30V ripple（p-p）10%included
Operating voltage range	10-30VDC
Leak current	10mA or below
Operation mode	Normally open *1
Output mode	NPN open collector or PNP open collector
Control output	Switching current: 100mA or below、Residual voltage: 2V or below （Load current：100mA、Cable length：2m）
Response frequency	4kHz or above

*1: In proximity of detection object; load "operating"

2-2-5. Precautions for Allowable Load and Installation

⚠WARNING Rated load, rated moment, and rated torque in the ATC specifications 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 during acceleration/deceleration by the robot. The **Fig. 3** shows the meanings of rated load, rated moment and rated torque.

Payload W = 980-1617N (100-165kg)

Eccentric distance $L = \sqrt{(lm^2 + lt^2)}$

Ex: Allowable bending moment $M = L \times W \times G_R^{(*)} = 0.56 \times 1617 \times 1.5 \leqq 1372Nm\{13443Kgf \cdot cm\}$

Allowable twisting torque $T = L_t \times W \times G_R^{(*)} = 0.56 \times 1617 \times 1.5 \leqq 1372Nm\{13443Kgf \cdot cm\}$

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 standard.)

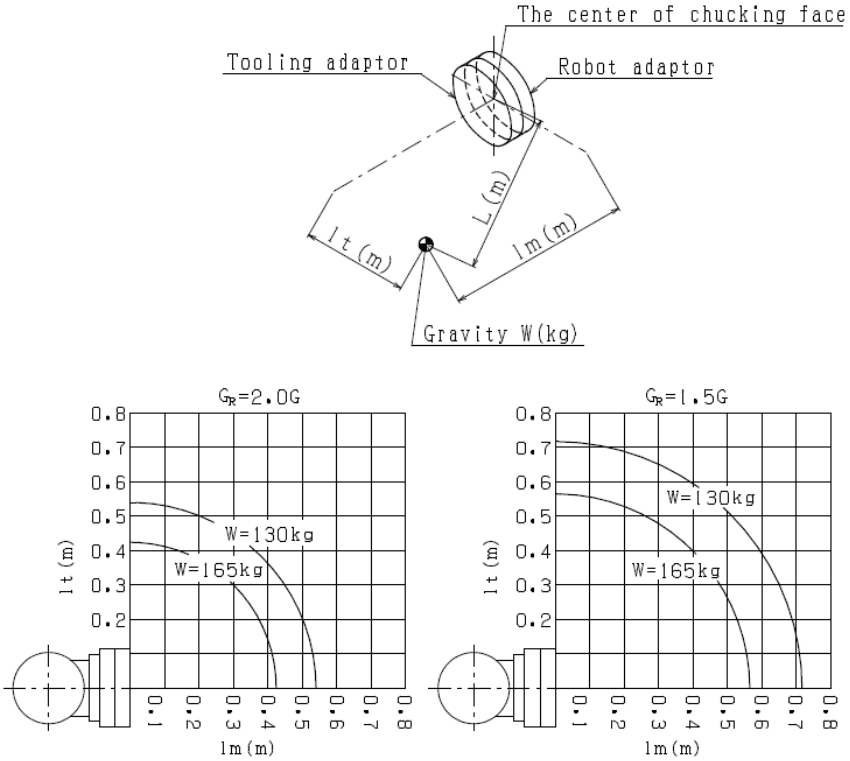


Fig. 3. An example of rated load definition (G_R=1.5/2.0)

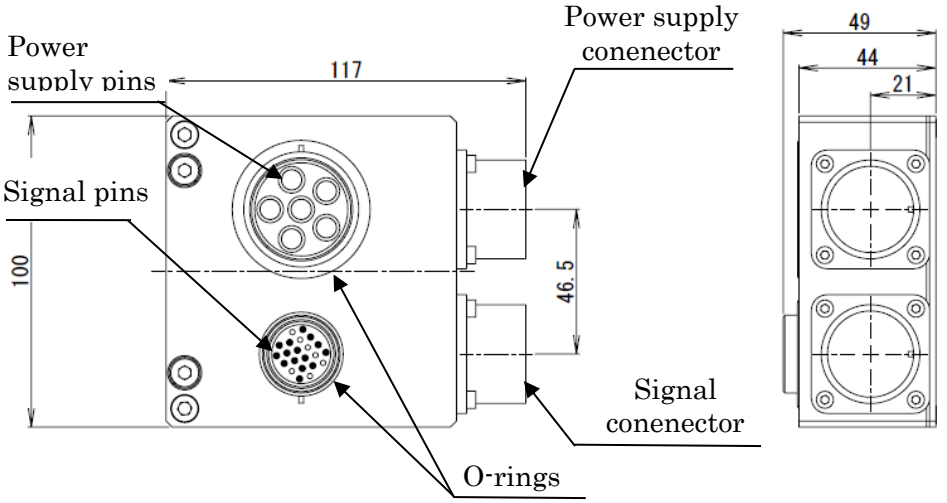
2-2-6. Alloable Electric Lord

⚠ CAUTION The ATC with the standard signal pin ASSY (20-pin), as an entire contact ASSY, is capable of carrying up to 13A current. Also, each of the pins is capable of carrying 3A current. However, when multiple signal pins are to used, do not let 3A current applied to any adjacent pin as it will cause insufficient insulation, leading to short circuit.

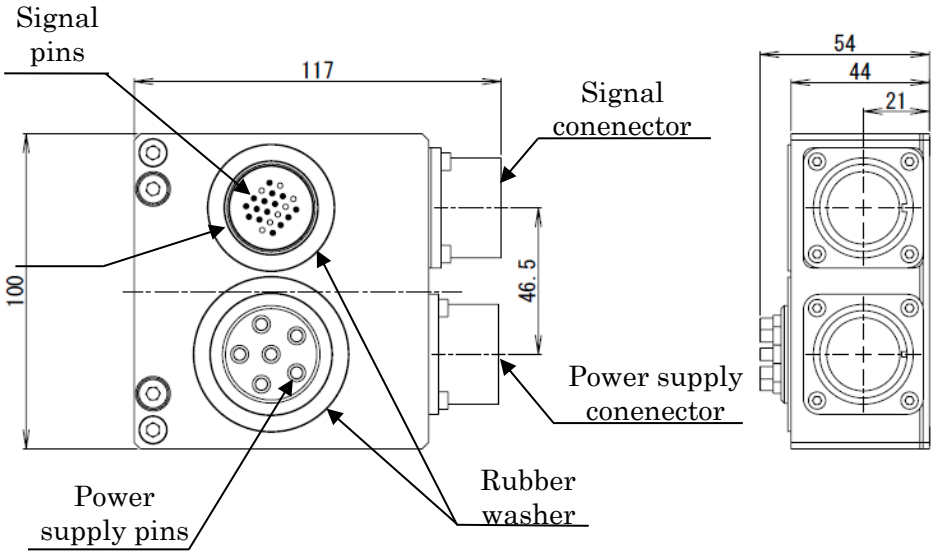
2-3. Servo Motor Module

2-3-1. Servo Motor Module Specifications

Model	Robot Side	See the drawing
	Tool Side	See the drawing
Weight	Robot Side	0.54kg
	Tool Side	0.60kg
Body material		Aluminum alloy
Number of electrodes	Motor power	6 electrodes
	Signal	22 electrodes
Rated voltage	Motor power	600VAC
	Signal	50VDC or below
Max. allowed current	Motor power	20A
	Signal	3A
Overvoltage category		Overvoltage category III
Allowable pollution level		Pollution level 3



R side
Servo motor module
(Refer to the delivery specifications and drawing for details.)



T side
Servo motor module
(Refer to the delivery specifications and drawing for details.)

2-3-2. Internal Power Wire for Servo Motor Module

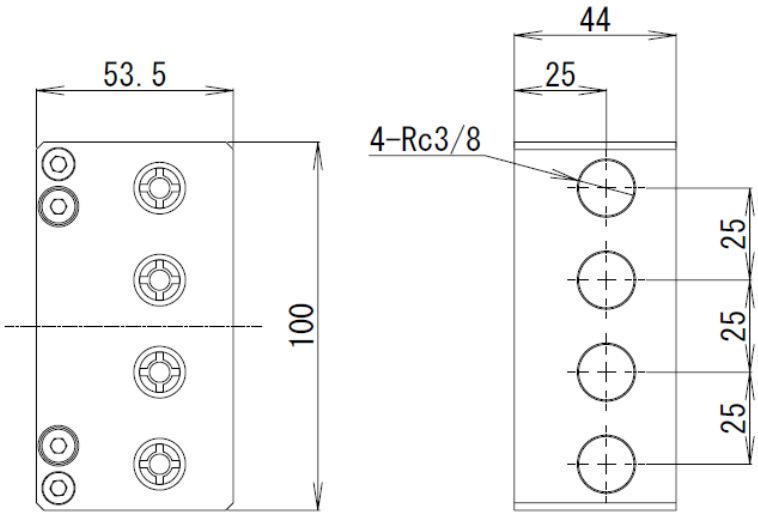
Motor power			
Application		Brake	Power
Name		Polyvinyl chloride wire for electric appliances	
Model		KIV	
Nominal sectional area		0.75mm²	3.5mm²
Conductor	Material	Tinned annealed copper wire	
	Configuration: no. of wires/wire dia.	30/0.18 wires/mm	45/0.32 wires/mm

Signal		
Name		Large-diameter multipair cable
Model		UL2464-SB
Nominal sectional area		24AWG
Conductor	Material	Tinned soft-copper stranded wire
	Configuration: no. of wires/wire dia.	7/0.203 wires/mm
Insulation material	Material	Lead-free heat-resistant PVC
Final diameter		About 7.5mm
Withstand voltage		2000VAC/5 min

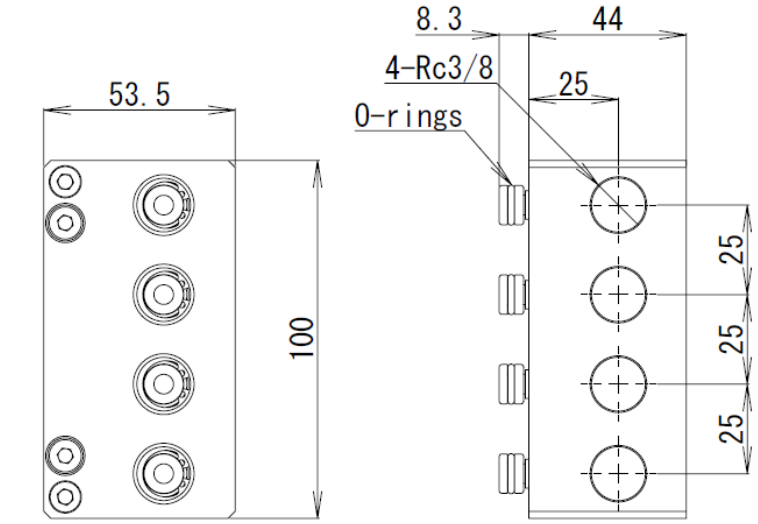
2-4. Pneumatic Module

4 Ports type specifications

Model	Robot Side	See the drawing
	Tool Side	See the drawing
Weight	Robot Side	0.51(kg)
	Tool Side	0.55(kg)
Body material		Aluminum alloy
Number of ports		4
Fluid used		Air
Fluid temperature		0-80℃ (no condensation)
Ambient temperature		0-60°C
Ambient humidity		95%RH or less
Normal pressure		0.86MPa
Effective sectional area		13.78mm²/PORT
Cv value		0.75/PORT
Connecting screw size		Rc1/4



R side Pneumatic module
(Refer to the delivery specifications and drawing for details.)

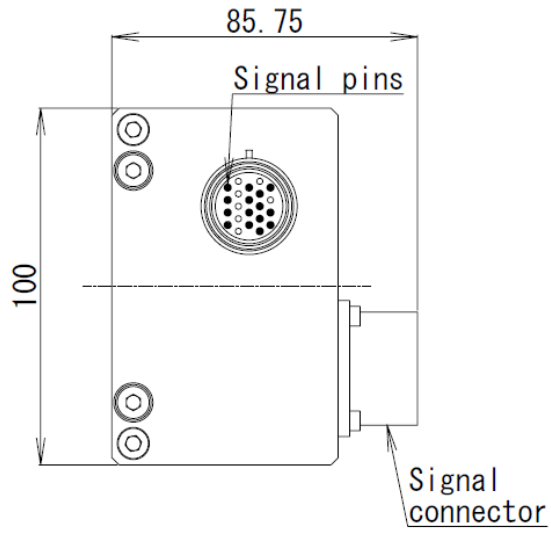


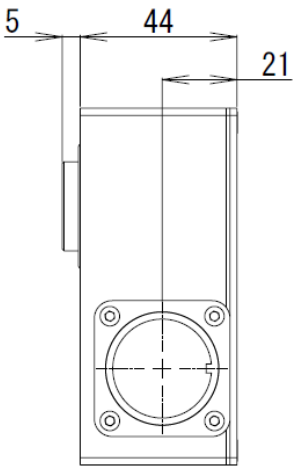
T side Pneumatic module
(Refer to the delivery specifications and drawing for details.)

2-5. Signal module

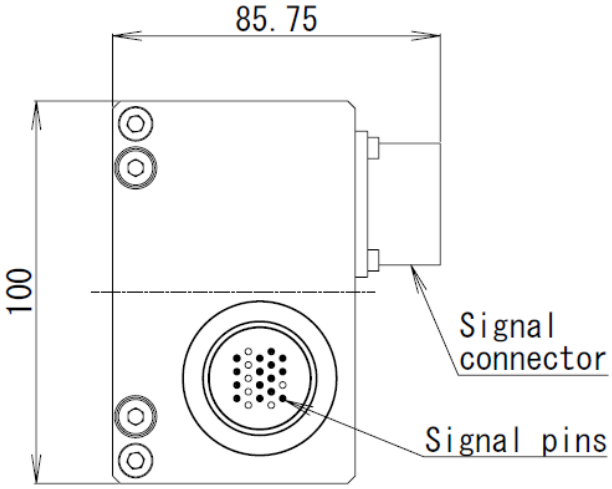
Specifications

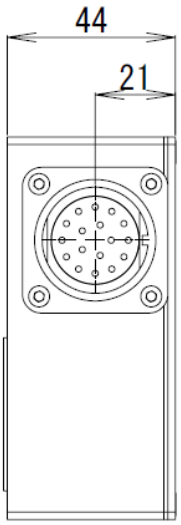
Model	Robot Side	See the drawing
	Tool Side	See the drawing
Weight	Robot Side	0.35(kg)
	Tool Side	0.40(kg)
Body material		Voltage-proof resin
Number of electrodes		22
Rated voltage		50VDC or below
Max. allowed current		3A
Overvoltage category		Overvoltage category III
Allowable pollution level		Pollution level 3





R side Signal module
(Refer to the delivery specifications and drawing for details.)



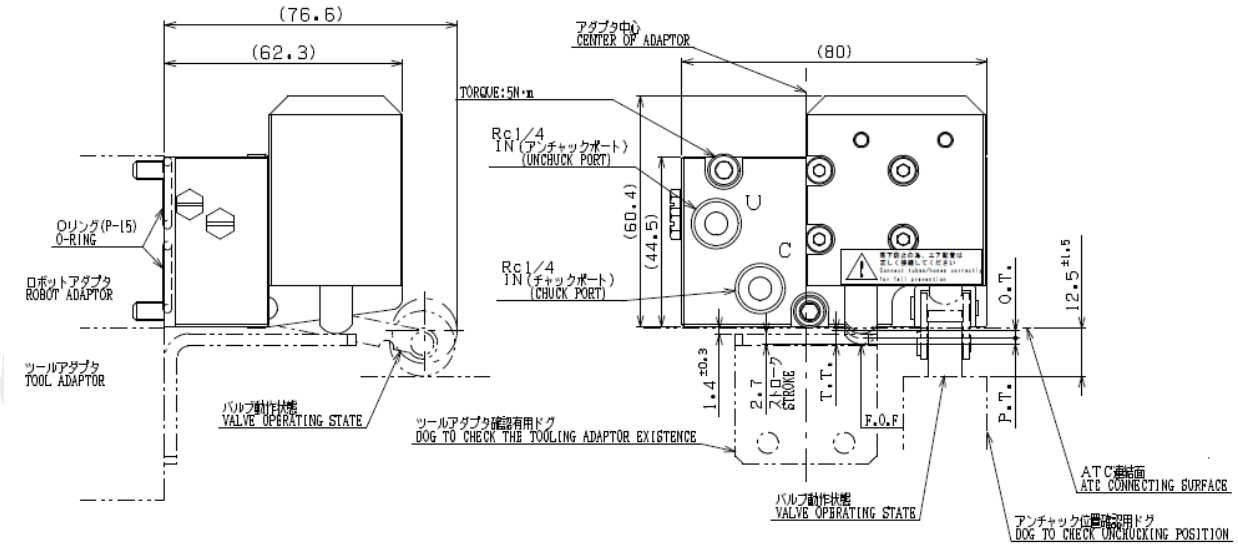


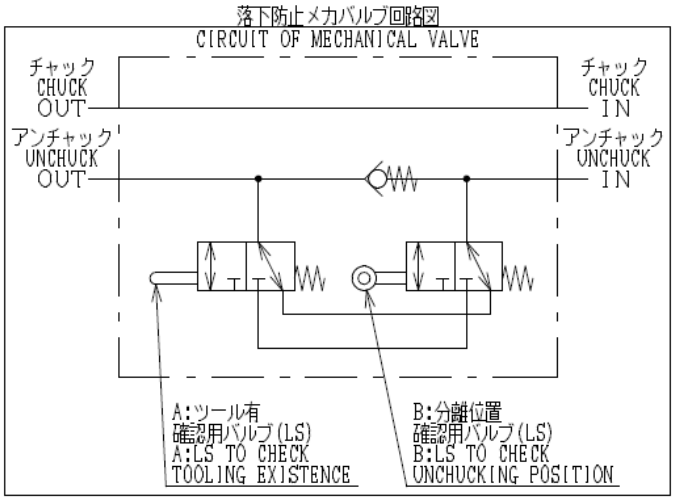
T side Signal module
(Refer to the delivery specifications and drawing for details.)

2-6. Fall Prevention System

Specifications

Product No.		CAR-006-M*
External dimensions (height x width x thickness)		60.4 x 80 x 62.3mm
Main unit material		Aluminum alloy
Weight		0.5kg
Flow characteristics	C [dm3(s·bar)]	0.6
	b	0.15
Fluid used		Air
Working pressure		0～1.0MPa
Ambient temperature and working air temperature		0～-60°C(no freezing)
Joint diameter (nominal)		Rc1/4
Grease up		Not required





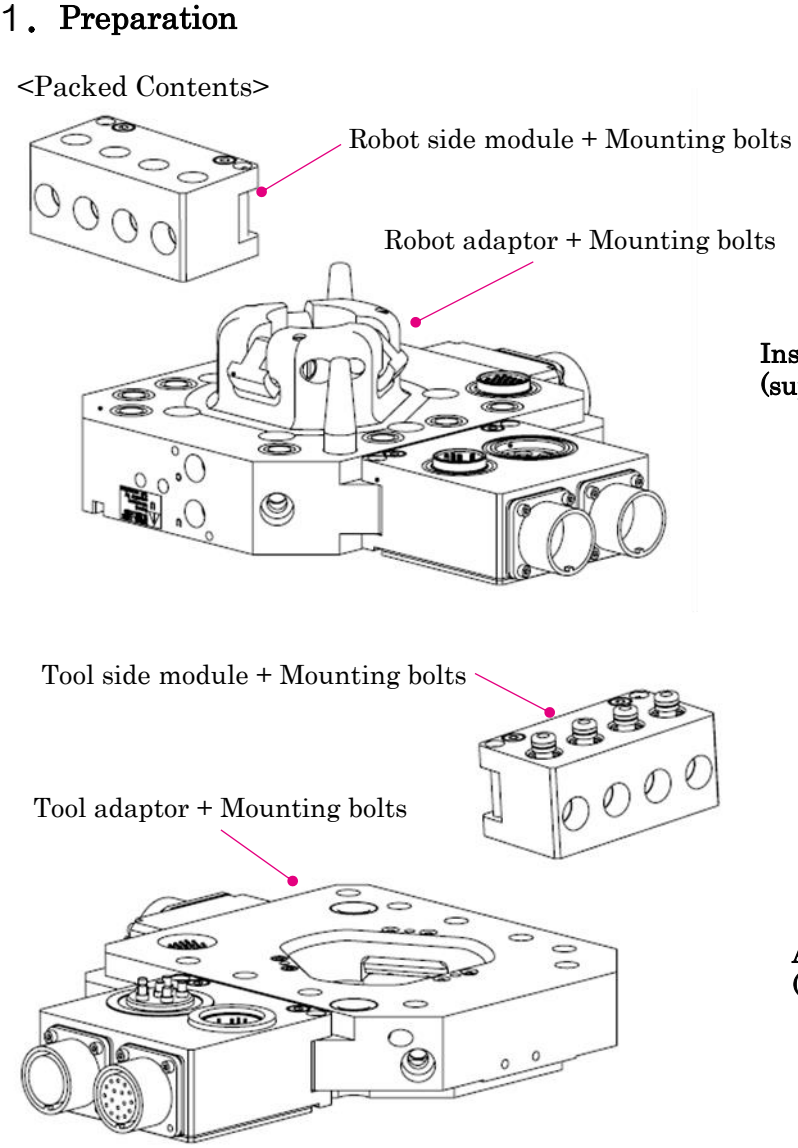
(Refer to the delivery specifications for details.)

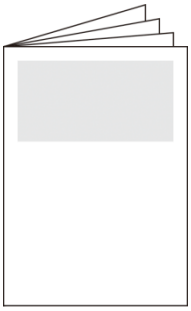
3. Procedures of Installation to Robot/Tool

Contents of this section are also described in the installation guide (supplied with the product).

3-1. Preparation

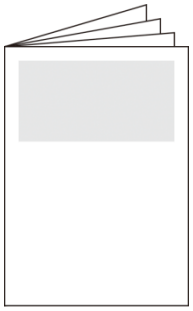
<Packed Contents>





Instruction Manual (this document)
(supplied with the product)

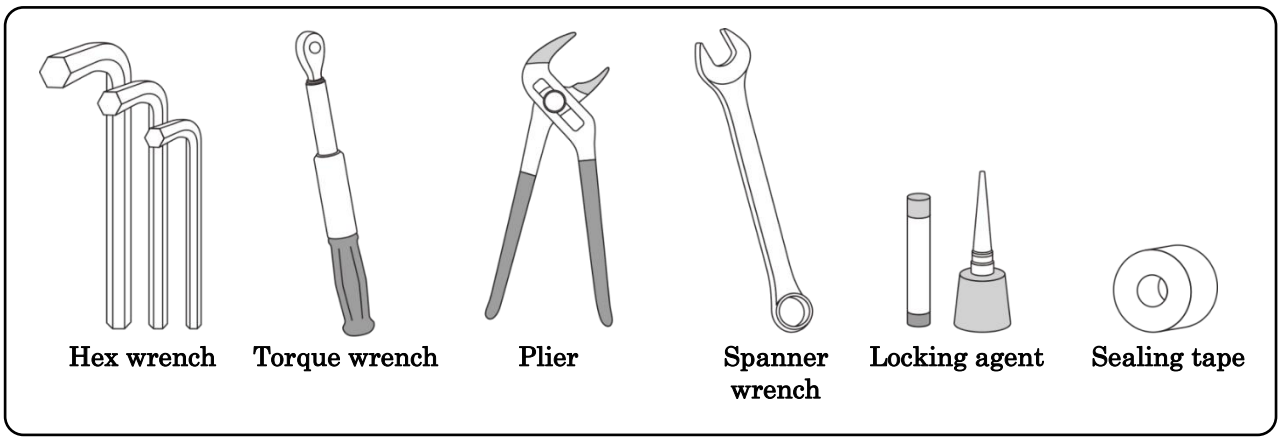
***For details of this product, please refer to the instruction manual.**



ATC Installation Guide
(supplied with the product)

Fig. 4. Packed Components

●Items to be prepared by customer



*The above is the standard configuration for your reference. The robot adaptor plate, tool adaptor plate, insulation materials, fittings, and cables, etc. may need to be prepared by customer depending on specifications. For details of your configuration, please refer to respective delivery specifications.

⚠ 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. For internal disassembly works for the ATC, use protective glasses for protection against pop-out parts.

⚠ 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 the maintenance procedures.

3-2. Robot and Tool Adaptor Installation

3-2-1. Overview of Installation

The each adaptor can be mounted to the robot and tool directly compatible with the ISO flange pattern. (P.C.D.125 (M10 x6pcs)) (Refer to the Fig.below)

Before adaptor installation, two knock pins must be inserted into each robot/tool adaptor mounting surface. (Refer to below for details)

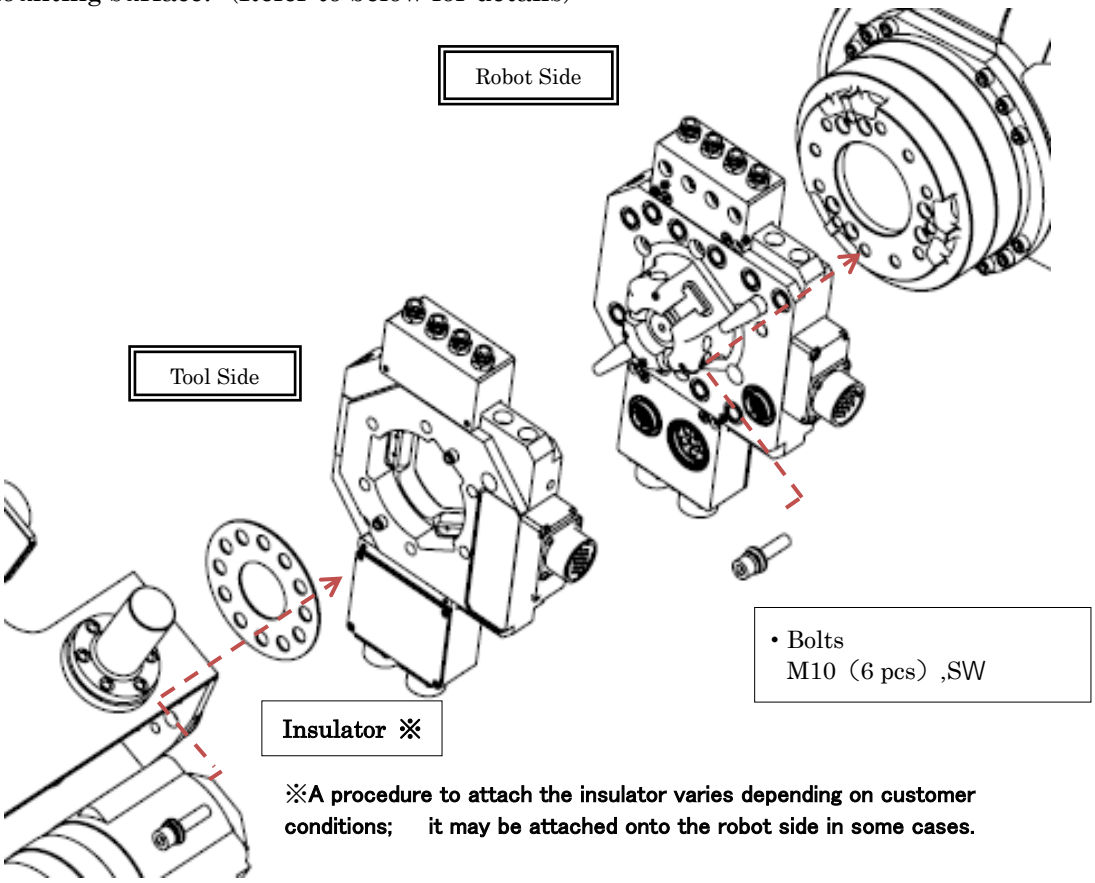


Fig. 5. Robot/tool assembly drawing

To use the robot and tool adaptor plate (optional), drill the plate to make appropriate mounting holes (or threads) for the robot and tool.

Mount the robot and tool adaptor plate to the robot and tool first and then mount the robot adaptor on it.

The robot and tool adaptor can be mounted to the robot and tool adaptor plate compatible with the ISO flange pattern. (P.C.D.125 (M10 x6pcs))

⚠WARNING Use positioning pins when you put the ATC on robots and tools.
If it is installed without using the positioning pin, the position may move to wrong position during use, the ATC cannot be connected and separated reliably, and a serious accident such as dropping may occur.
If the positioning pins are unavoidable, the customer should take measures to prevent the tool from falling due to abnormal chucking or unchucking.

Reference

Example of countermeasures when the positioning pin cannot be used
- Perform daily inspections (checking misalignment, scratches or abnormalities on each part such as taper pin, bush, cam, lock parts, grease application)
- Slow down the chucking / unchucking operation as much as possible
- Reliably capture the interlock signal.

Especially for the presence sensor of the stand, move to the next step after confirming that the presence sensor of the tool is in the ON.

3-2-2. Installation Procedures

① Robot adaptor plate installation (when using an adaptor plate)

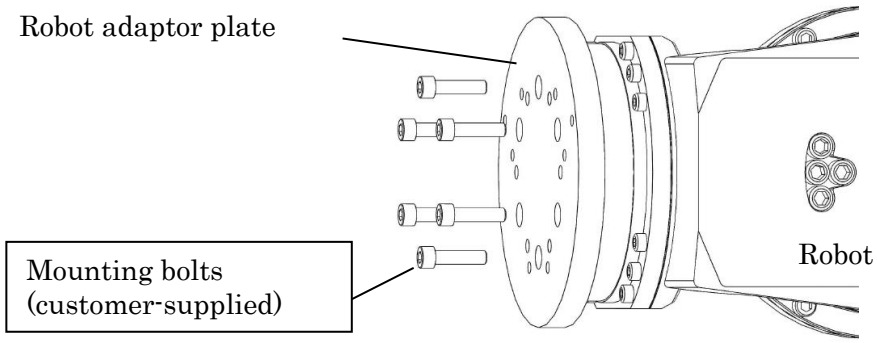


Fig. 6. Robot adaptor plate installation

⚠WARNING

When manufacturing (processing) a robot adaptor plate at your company,do not drill holes over ϕ85mm in the center of the robot adaptor plate for the purpose of light weight etc.
Otherwise, the robot adaptor may be damaged and the chuck/unchuck operation may not be possible.

⚠ CAUTION

1) If you manufacture (process) a robot 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.
2) Be sure to use locking agent (low strength) for mounting bolts when tightening them.

②Robot adaptor installation

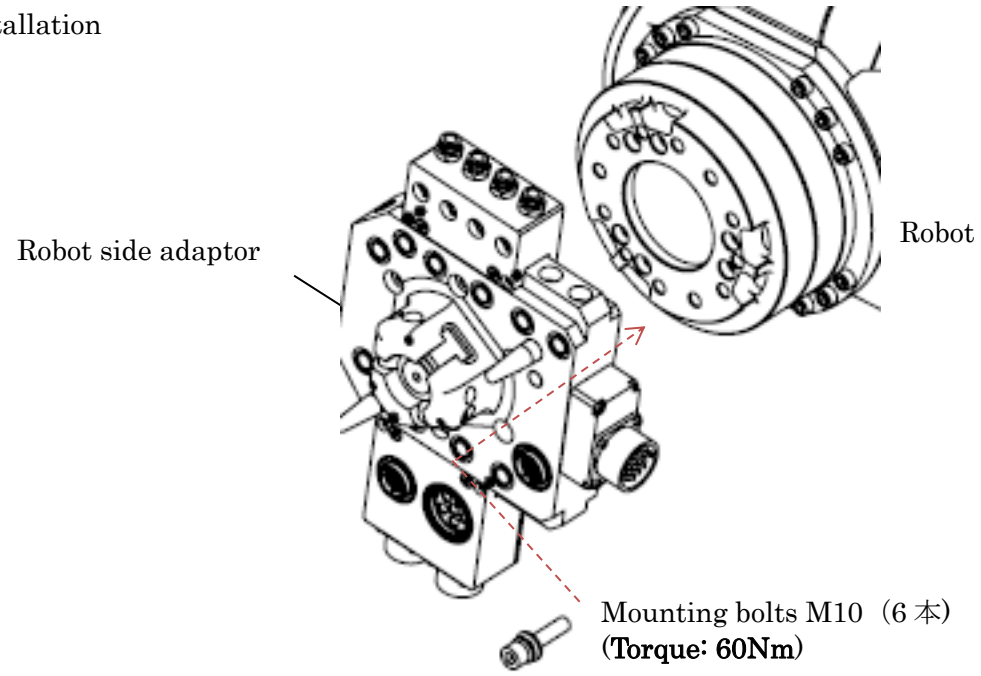


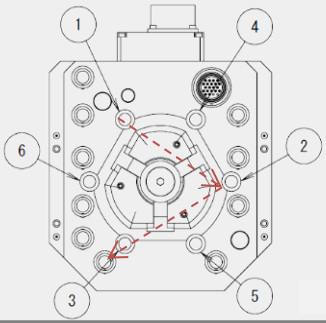
Fig. 7. Robot adaptor installation

⚠ CAUTION

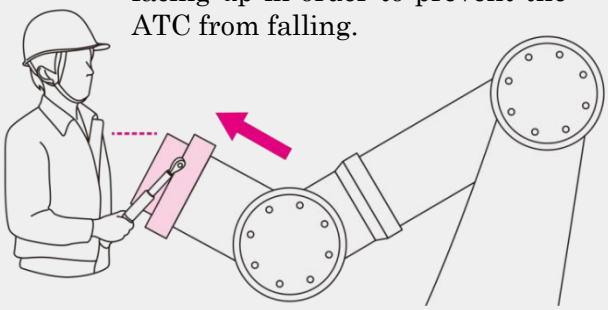
1) Before installation, check that two knock pins are inserted into the robot adaptor mounting surface.
2) Be sure to use locking agent (low strength) for mounting bolts when tightening them.

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

⚠ CAUTION



The installation tasks should be performed at the height of chest with the robot flange surface facing up in order to prevent the ATC from falling.



Bolt tightening sequence and precaution

⚠ CAUTION

Tightening bolts with torque above the specified torque level may damage screw threads on the robot side or tool side and ATC itself.
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 ATC fall off.

③Tool adaptor plate and tool adaptor installation

The tool adaptor can be mounted same as on the robot side. (Refer to Fig.5)
ISO flange pattern. (P.C.D.125 (M10 x6pcs))

Mounting bolts： M10（6 本） **(Torque: 60Nm)**

⚠ CAUTION	If you manufacture (process) a 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	Before installation, check that two knock pins are inserted into the tool adaptor mounting surface.

⚠ CAUTION	Be sure to use locking agent (low strength) for mounting bolts when tightening them.

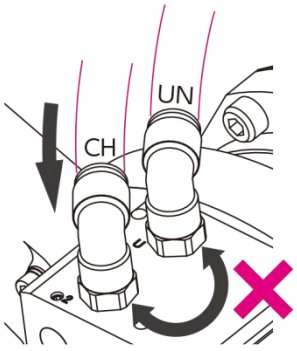
3-3. Connecting to Fitting/Removal Port

Connect piping from the solenoid valve to the "CHUCK" port and "UNCHUCK" port of the fitting/removal 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.

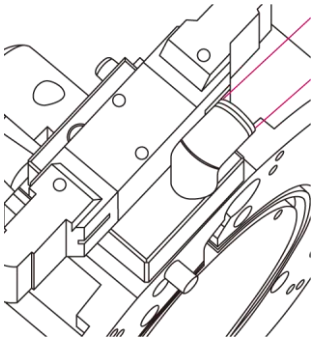
⚠WARNING

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

- Be careful to ensure tubes are connected to right ports (chuck port (CH) and unchuck (UN) port). Otherwise the tool may fall off.
- Clearly mark the chuck (CH) and unchuck (UN) tubes accordingly.
- Securely insert the tubes to the end to prevent accidental disconnection.
- There are two types of chuck/unchuck air piping: standard spec and solenoid valve spec (a robot adaptor with solenoid valve).
- For the solenoid valve spec, there are one air supply port.
- Do not manually switch the air supply without an absolute need to do so.



Standard



Solenoid valve spec

Single tube connection for solenoid valve spec

⚠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.

⚠DANGER

About air piping for ATC driving:

ATC has a fail-safe mechanism to prevent the tool side from falling even when 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.

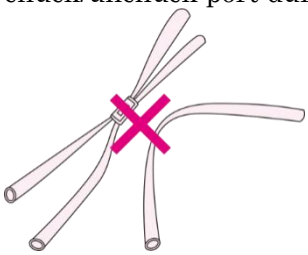
- **Do not use any three-position, closed-center type solenoid valve. The chucked state cannot be maintained with the power supply turned OFF, which may result in falling.**
- **Do not share an exhaust port with other equipment. Otherwise, the chucked state cannot be maintained due to wrap-around back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

⚠ CAUTION

Do not perform chuck / unchuck operation before installing it to the robot.
Make sure robot adaptor must be fixed with bolts to the robot when it will be chucked / unchucked.
Otherwise, the blank plate on the mounting surface may be damaged and inoperable.

⚠ WARNING

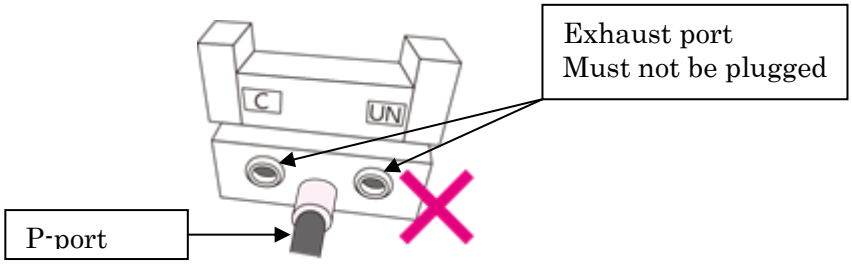
Perform installation carefully not to bend the tube connected with the chuck/unchuck port during robot motions. Otherwise, it may fall off.



- 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.

⚠ WARNING

Make sure there is no chips of sealing tape or other dusts getting into the ATC chuck/unchuck port. Otherwise, not only the product functionality and life may be adversely affected but also unexpected accident may occur.

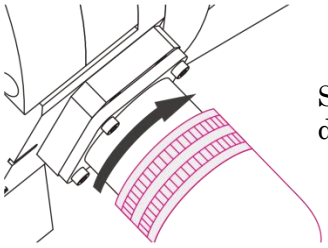
3-4. Electric Wiring

With reference to the internal wiring chart, connect the input and output wires to robot adaptor terminals (connectors). Connect the built-in sensors to a robot (line, etc.) control system.

Signals from these sensors will be taken through the aforementioned terminals. In case of the connector spec, be sure to securely insert the connectors.

⚠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.



Securely and fully tighten to prevent connector disconnection during robot operations.

Fig.8. Connection of cable connector

3-5. Cable Fixing

⚠CAUTION	Robot side cables must be securely tied together with other cables and tubes and fixed around the robot adaptor's connector part by using a spiral tube or banding band, etc. Also ensure that cables and tubes are free of any excessive force while the robot's wrist axis is rotating. Excessive force applied onto cables and tubes may break a connector of the joint part or cause open-circuit.

3-6. 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 the Fig.beiow. 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.

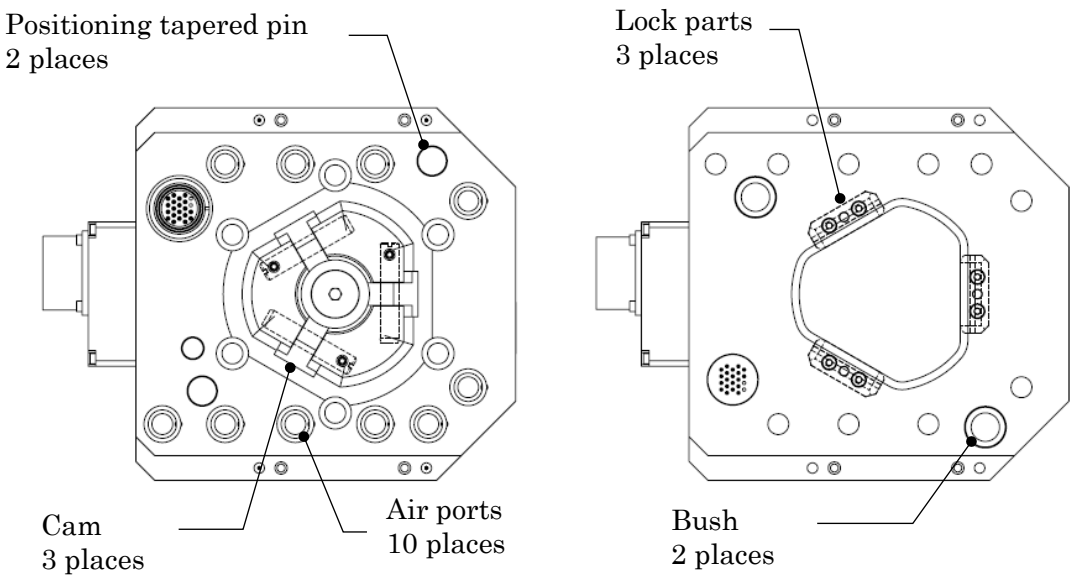


Fig. 9. ATC greasing points

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

3-7. Precautions for Installing ATC to a Tool

3-7-1. ATC Orientation

MEMO In order to minimize the gap between mating surfaces, it is recommended to install ATC so that the maximum possible load is oriented as illustrated in the figure below.

Referenc

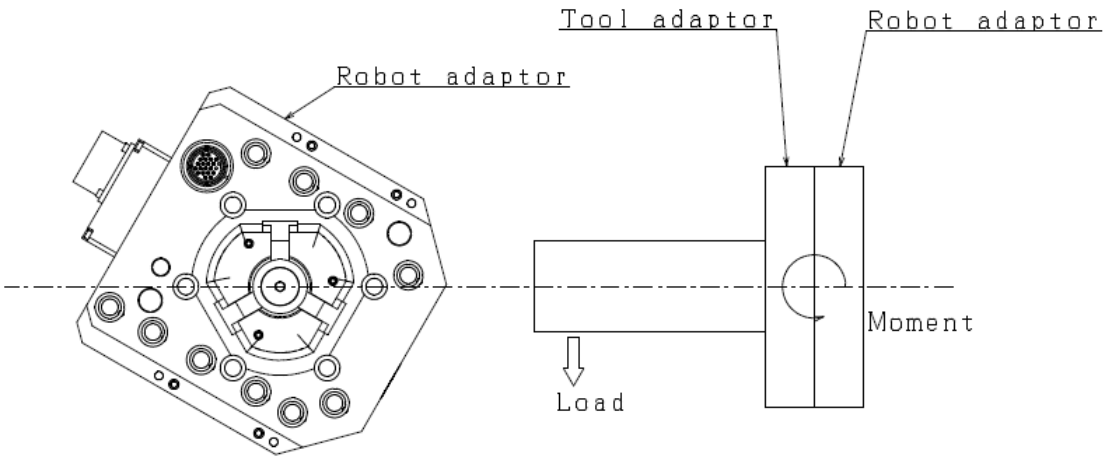


Fig. 10. ATC orientation

3-7-2. Precautions for using a servo motor for a tool

MEMO If you use a tool with a servo motor (servo gun/servo material handling equipment, etc.), install a battery for memory storage on the tool side or use an encoder with no need for powered memory storage in preparation for power failure to the encoder for separation.
In addition, functionality to electrically disconnect/connect the servo motor is necessary on the robot.

3-8. Procedure for Installing Module to ATC

3-8-1. Module Mounting Bolts

Chart 1. Module assembly bolts and torque level *1

Servo Motor Pneumatic Signal	R/T	R・T (common)	
	Screw shape	M5×35＋M5 shoulder bolts	
	Nitta model No.	GSSH05035M+ GSHL65-10（2 each）	
	Torque	5Nm	
Fall Prevention System And Tool Dog	R/T	R side	T side
	Screw shape	M5×30 SUS	M5×10 SCM
	Nitta model No.	GSSH05030S	GSSH05010M
	Torque	5Nm	5Nm

*1 Apply screw locking agent (low strength) to each bolt.

⚠ CAUTION Tightening bolts with torque above the specified torque level may damage threads on the ATC side and modules.
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 module fall off.

3-8-2. When a Servo Motor Module is used:

⚠ WARNING Perform wiring as per the delivery specification drawings. 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.

3-8-3. When a pneumatic module is used:

⚠ CAUTION Ensure no chips of sealing tape, etc. get into the module. Otherwise, it gets into the O-ring sealing section inside and causes leakage.

⚠ CAUTION Mineral oil grease (Sumiplex BN No.1 Sumiko Lubricant Co., Ltd.) is applied to the O-ring of the module.
When greased, use the same type of grease.
If non-compliant grease is used or if it is not lubricated, early breakage and leakage may occur.

3-8-4. When a Signal Module is used:

⚠ WARNING Perform wiring as per the delivery specification drawings. 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.

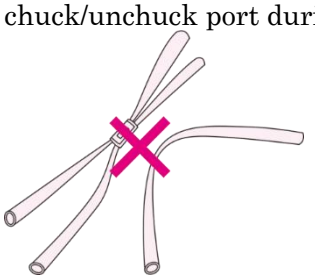
3-8-5. When a Fall Prevention System Is Used:

⚠ CAUTION

- Ensure that there is no problem with piping.
- Ensure that the lever and DOG positions are as per the delivery specifications.

⚠ 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

Make sure there is no chips of sealing tape or other dusts getting into the fall prevention system chuck/unchuck port. Otherwise, not only the product functionality and life may be adversely affected but also unexpected accident may occur.

⚠ WARNING

The fall prevention function may deteriorate due to the seal or other dusts entering the fall prevention mechanical valve or the deterioration of the internal seal, which may cause an unexpected accident.
Please check the valve function regularly.

4.Operations and Programming

4-1. 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

Ensure that grease is applied to the ATC–
※See 3-6.ATC Grease up

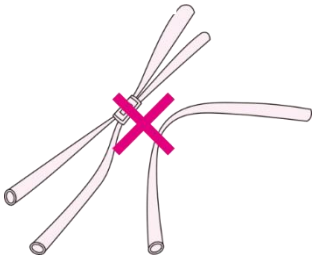
⚠ CAUTION

Ensure that grease is applied to the pneumatic ports.
※See 3-6.ATC Grease up

⚠ WARNING

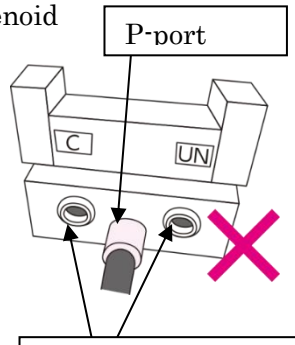
1) Ensure that air supply is not shut off by bending/twisting of the unchuck tube and excessive tightening of the banding bands. When the air supply is inhibited, the cam may not work properly resulting in tool side module falling.
2) Check that the unchuck port air is discharged before coupling (no residual pressure). Any residual pressure may prevent normal cam operations and cause the tool side modules fall off.

1) Tube



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

2) Solenoid



Exhaust port
Must not be plugged

⚠ WARNING

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

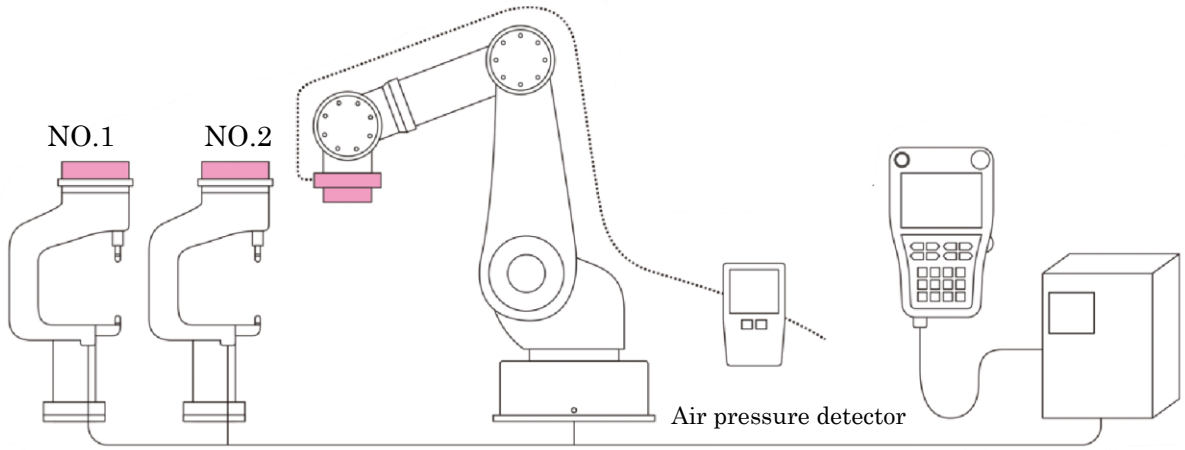
4-2. Operations and Programming

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.

The ATC has three built-in sensors for detection of its own motions. For details, please refer to "Overview of the Automatic Tool Changer (ATC)."

⚠WARNING

Configure interlock settings for chuck (*1), unchuck(*2), face (*3) and tool presence signals, etc. of the ATC.
Check that the cams are opening/closing and the face sensor (1 place) is properly detected
Check that interlock signals are input to the superior control devices, such as PLC. Without setting of external interlock signals, safety may not be ensured in the event of operator errors or malfunction, posing a risk of tool falling.
*1. Chuck signal: Indicates that cam is opened
*2. Unchuck signal: Indicates that cam is closed
*3. Face signal: Indicates that coupling planes of the robot adaptor and tool adaptor are closely mated together



(1) Tool presence check
(2) Tool No. identification check
(3) ATC internal signal check (face, chuck, and unchuck)
(4) Check of detected decrease in air pressure for ATC driving

Fig. 11. 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.
- We offer specs with fall-protection mechanical valve or safety switch. (For details, please feel free to contact us.)
- If you do not choose to have our fall-protection mechanical valve or safety switch, be sure to introduce an appropriate safety system separately.

4-3. Basic Flow of ATC

Please check the flow outlined in Chart 4 below and ensure the robot interlocking.

Reference

Chart 2. Basic flow of ATC

	Robot motion	Input			Robot Output		External input
		Chucking Sensor			Controlling		Fixture Limit
		Face	Chuck	Unchuk	Chuk	Unchuck	Tool side
CHUCKING	Waiting position	OFF	OFF	ON	OFF	ON	ON
	↓ Moving	↓	↓	↓	↓	↓	↓
	↓ Near by chucking position	↓	↓	↓	↓	↓	↓
	↓ Approaching	↓	↓	↓	↓	↓	↓
	↓ Chucking position	ON	↓	↓	↓	↓	↓
	↓ Chuck	↓	ON	OFF	ON	OFF	↓
	↓ Chucking completion	↓	↓	↓	↓	↓	↓
	↓ Moving	↓	↓	↓	↓	↓	OFF
	↓ Working	↓	↓	↓	↓	↓	↓
UNCHUCKING	Working	ON	ON	OFF	ON	OFF	OFF
	↓ Moving	↓	↓	↓	↓	↓	↓
	↓ Unchuck position	↓	↓	↓	↓	↓	ON
	↓ Unchuck	↓	OFF	ON	OFF	ON	↓
	↓ Leaving	OFF	↓	↓	↓	↓	↓
	↓ Near by unchucking position	↓	↓	↓	↓	↓	↓
	↓ Moving	↓	↓	↓	↓	↓	↓
	↓ Waiting	↓	↓	↓	↓	↓	↓

□ represents process stepping conditions.

・"ATC coupling check end ON" should be active during robot operations (during production).

⚠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 Please shuts off the electric signals applied to the ATC signal pin before chucking and unchucking.
If the signal pins are connected or disconnected while the signal is on, the surface of the signal pins might be damaged due to electric shock, etc., and the signal pins may deteriorate faster.

4-4. 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 unchuck 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 No. check 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 constantly shows ON/OFF states of the aforementioned three signals (chuck end, unchuck end, and coupling check end signals) indicating the ATC operation status, and user signals used with the ATC (e.g. tool clamp end work presence).
This allows to readily comprehend any signal-related trouble and interlock waiting status.

4-5. Precautions for Operations

⚠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.

⚠ CAUTION Basically, the connection surfaces of the robot adaptor and tool adaptor must be in parallel during the ATC attaching/detaching operation.
Otherwise, proper chuck and smooth unchuck 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 unchuck process, the tool adaptor may lean and cause prying due to reaction force of ATC's electric contact and pneumatic port, preventing unchuck. 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 unchuck. At this point, the tool must remain on the tool stand. Then, perform teaching so that the built-in sensors can detect unchuck and ensure smooth evacuation without prying.

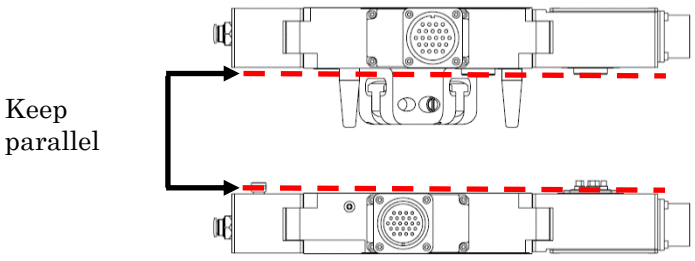


Fig. 12. Precautions when teaching

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 unchuck or chuck 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.

MEMO	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 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.

We offer standardized peripheral devices for the ATC such as fall-protection system. For details, please feel free to contact us.

4-6. 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 operations performed with cam left opened may cause crash between the cam and lock parts, resulting in component damage.

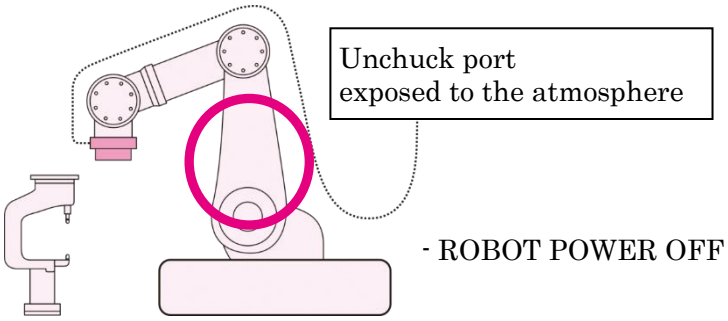


Fig. 13. Precautions for Line Downtime

⚠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: (see 4-1.)

●air supply is shut off by bending/twisting of the unchuck tube or excessive tightening of the banding bands : or

●the exhaust ports of the manifold and solenoid valve are plugged.

Points to check before restarting the line:

●Ensure there is no gap between the coupling planes.

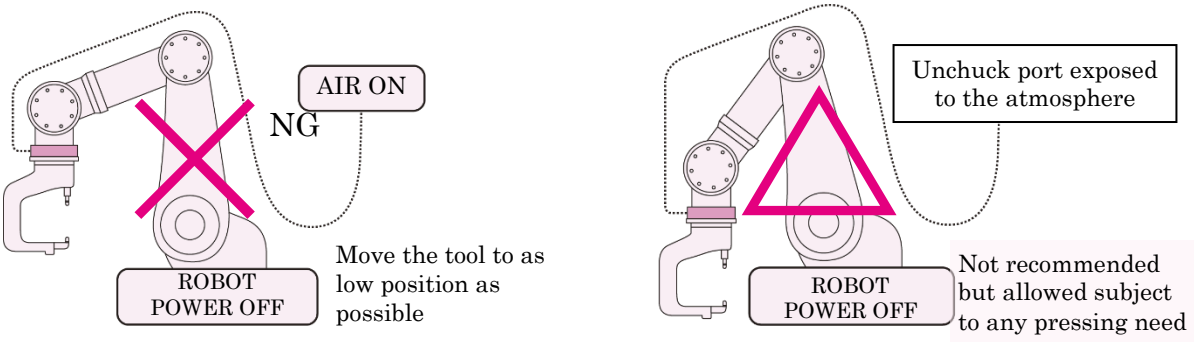


Fig. 14.Positions that should be avoided during line downtime

4-7. Emergency Response Actions

4-7-1. 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 transformer, etc.), be sure to take the inspection and response actions described in Chart 3. 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. For ATC replacement and damaged part replacement, please refer to relevant sections of this document and the "Maintenance Procedures."

Chart 3. 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	Mounting bolts	Re-tightening
4	Cam chuck/unchuck 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 parts and pivot pin breakage and damage; and mating surface dent	Replacement of damaged parts
6	Presence/absence of rattle in the rotation direction	Visual: Tapered pin breakage; bush damage; and loose bolts	Replacement of damaged parts
7	Check for damage in electric signal pins and connector cables, etc.	Visual, and I/O panel signal check	ATC replacement and replacement of damaged parts

4-7-2. 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 4.

Chart 4. Response actions to water exposure

	Check item	Check method	Action
1	Electric contact and proximity SW signal	Check for short-circuit on the I/O unit side. Visually check for malfunction of the chuck/unchuck sensor and LED ASSY, and ensure there is no water infiltration.	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 parts and tapered pin	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.

4-7-3. 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.

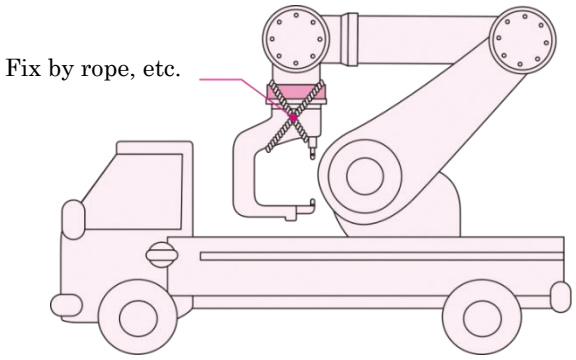


Fig.15. Precautions for transportation

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