Instruction Manual and Maintenance & Inspection Procedures

Automatic Tool Changer NITTAOMEGA type S-C

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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Contents

Preface

Thank you for choosing 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.

- 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 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	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

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.
We assume no responsibilities for any damage caused by any use not described or prescribed in our catalogs (including the instruction manual).
We assume no responsibilities for any failure alleged to be warrantable by customers if there is no clear evidence of our responsibility.
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

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.
- 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.

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

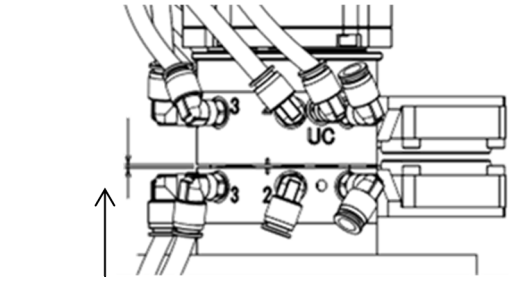
Be sure to check the following items before starting the installation procedure:
(a) Welding power source, control power source and driving power source are all shut off before work.
(b) All hydraulic and pneumatic pressure sources are off before work.
(c) All residual hydraulic and pneumatic pressure 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 hydraulic/pneumatic 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.
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

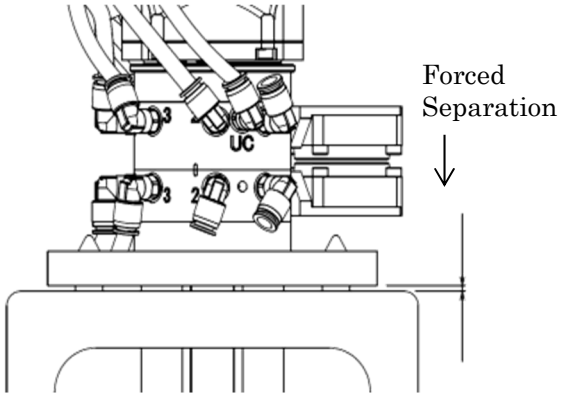
⚠WARNING With the tool detached, check that the interlock signals output from the ATC are correct. Operating without doing this may cause tool falling, product damage, or unexpected accident.

⚠WARNING For chuck/unchuck, switch chuck/unchuck air supply with the connecting surfaces of robot and tool adaptors kept horizontally coherent on the tool stand **with an about 1mm gap between them**.
Otherwise, unexpected accident may occur due to tool falling, in addition to damage of each interface and the ATC due to prying.



Raise the tool with 1mm clearance between jointing surfaces

Chuck (coupled)



Unchuck (separated)

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. Configuration

This system consists of the ATC unit accompanied by a remote sensor ASSY or an electric block ASSY.
Remote sensor spec: a remote sensor ASSY (contactless communication)
Signal pin spec: an electric block ASSY (spring-type electric contact)

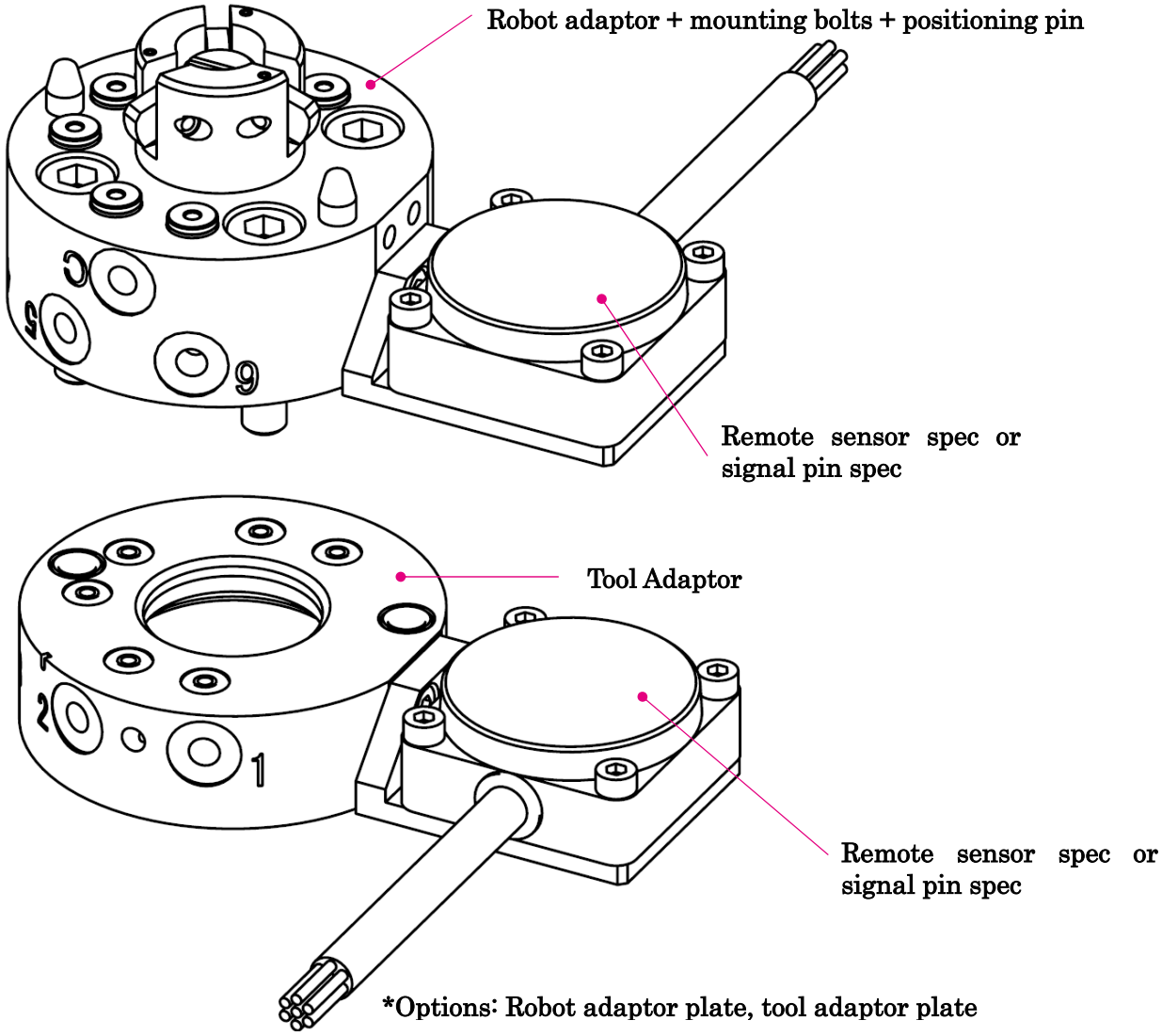


Fig. 1. Configuration diagram

2.Standard Specifications

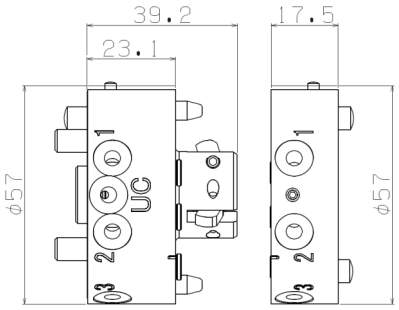
2-1. Specifications (Environment)

○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. Specifications (Adaptor)

2-2-1. ATC Specifications

Model		Robot Adaptor		SCR04-6JN00 (remote sensor NPN spec)
		Tool Adaptor		SCR04-6JC00 (common to PNP and NPN)
Tare weight		Payload		5-10kg or below
		Allowable moment		40.6Nm
		Allowable torque		34.3Nm
		Working pressure		0.39-0.85MPa
Position reproducibility				±0.010mm
Interface	Electricity	Remote sensor	Number of output signals	4+1 points (in-zone)
			Sensors	3-line DC sensors (up to 4 points)
		Signal pins	Number of contacts	15- or 25-core
			Capacitance	2.5A
			Rated frequency	50 or 60HZ
	Air	Number of ports		M5: 6 ports (with check)
		Allowable pressure		0.85MPa
		Effective sectional area		2.26mm^2/port
Weight		Robot Adaptor		151g
		Tool Adaptor		88g
Machine dimensions		Robot Adaptor		See the figure below
		Tool Adaptor		See the figure below



Robot Adaptor Tool Adaptor

(See the drawing for details.)

3.Procedures of Installation to Robot/Tool

3-1. Preparation

<Packed components>

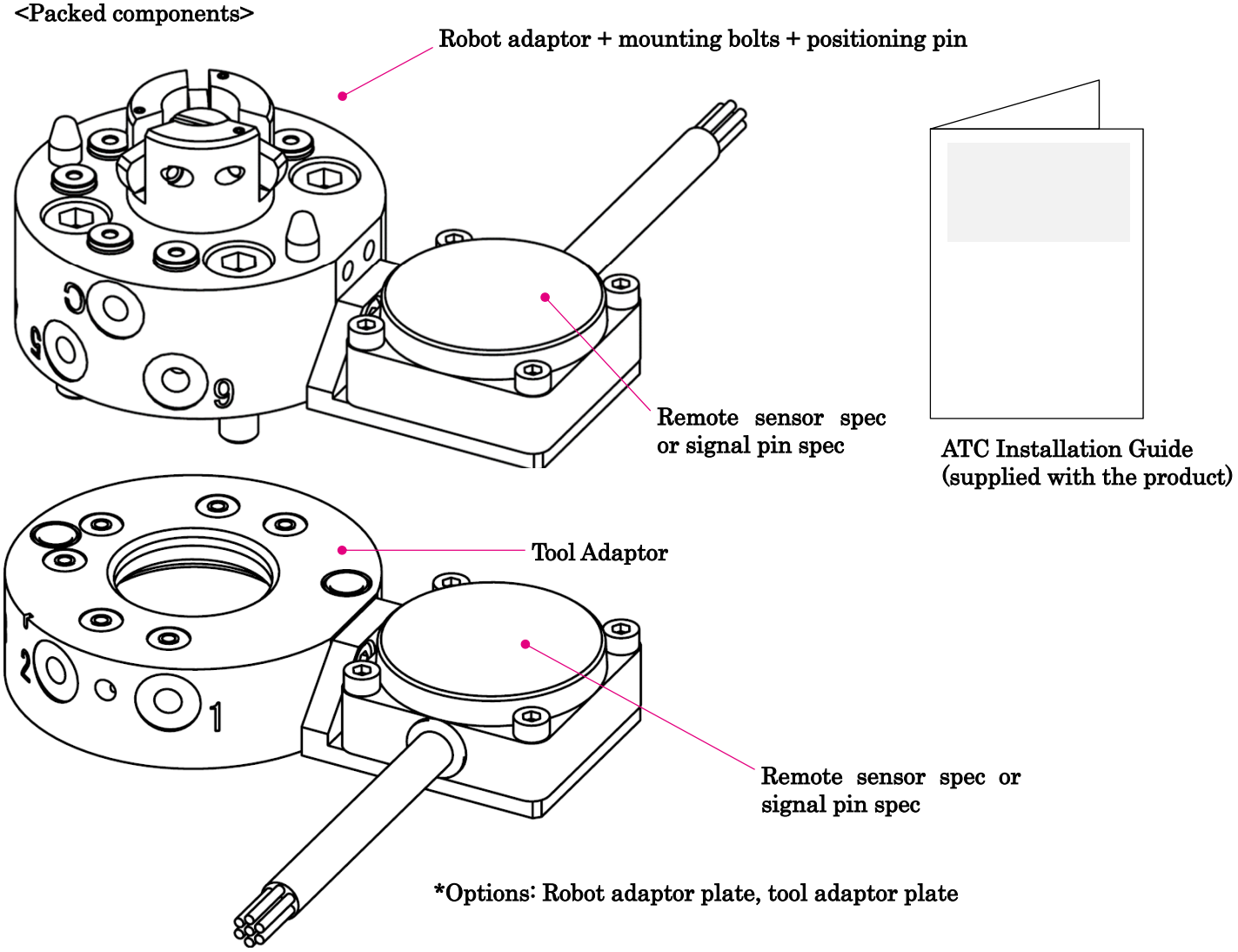
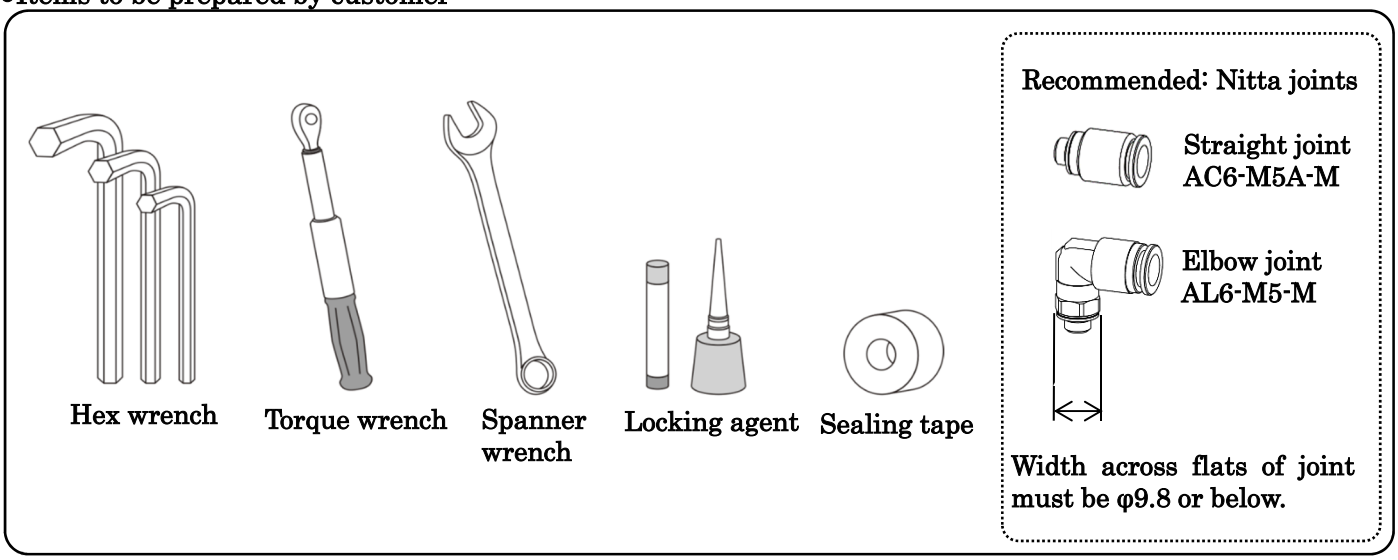


Fig. 2. Packed components

●Items to be prepared by customer



⚠ 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.

3-2. Installation of Robot Adaptor and Tool Adaptor

3-2-1. Overview of Installation

(1) Install the robot adaptor plate to the robot flange. Mounting bolts shall be supplied by the customer. Robot adaptor plate varies in shape depending on a robot to be used. Adaptor plates compatible with various robots are listed in Chart 1.
(2) Install a robot adaptor to the robot adaptor plate with 4 supplied M6x25 bolts (recommended torque level: 8N·m).
(3) Fit a joint to each of the chuck port (C), unchuck port (U), and other ports used. Joints available from Nitta are listed in Chart 2.
(4) Install the tool adaptor plate to the tool. Mounting bolts shall be supplied by the customer. Tool adaptor plate varies in shape depending on a tool to be used.
(5) Install the tool adaptor to the tool adaptor plate.
(6) Mounting bolts vary depending on tool to be used.
Use 6 M4 bolts (recommended torque level: 2.5N·m) or 4 M6 bolts (recommended torque level: 8N·m). Mounting bolts shall be supplied by the customer. Adaptor plates compatible with various robots are listed in Chart 1.
*If a customer-supplied adaptor plate is to be used, be sure not to make a hole at the center of the tool adaptor plate. Press out the central part of the tool with a piston bolt, to separate the tool adaptor. For teaching, supply air to the unchuck port at a position about 1mm away from the tool stand.
(Refer to 4-2. Check Points in Teaching.)
(7) Fit joints to relevant ports on the tool side as with the robot side.

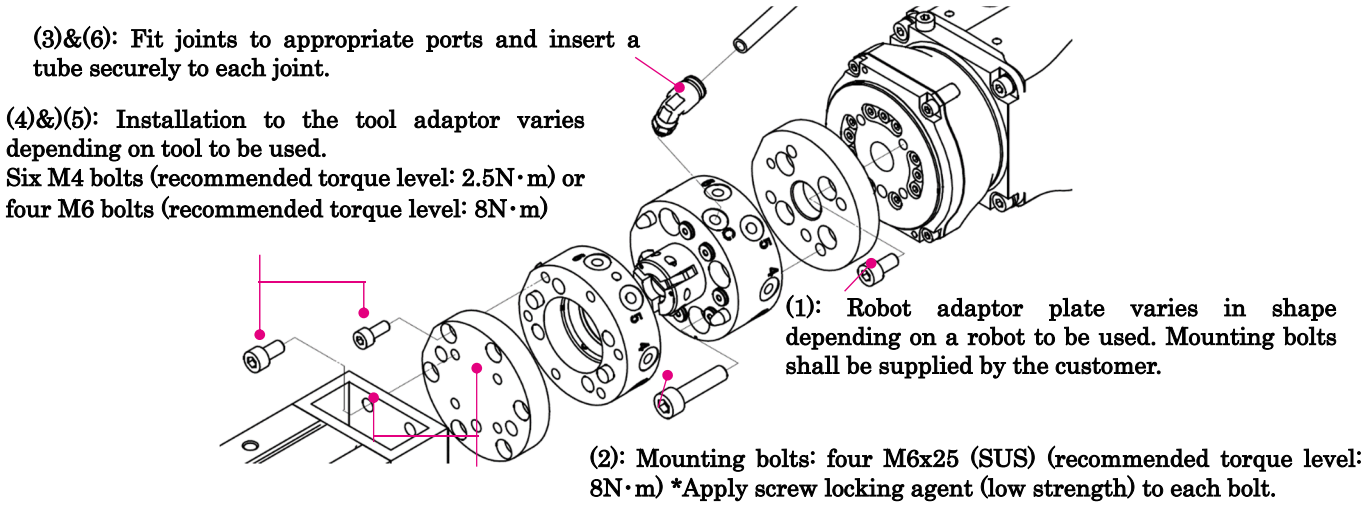


Fig. 3. Robot adaptor and tool adaptor installation

Chart 1. Robot adaptor plates compatible with various robots

Please contact us if a robot you are using is not listed above.

No.		Compatible robots
Robot Side	SCPR10-A01	Kawasaki Heavy Industries, Ltd.: RC005L Denso Corporation: VS-068 Fanuc Ltd.: CR-7i, LRMate200iD Mitsubishi Electric Corporation: RV-7FR
Tool Side	SCPT10-A01	
Robot Side	SCPR10-A02	Kawasaki Heavy Industries, Ltd.: RS010L
Tool Side	SCPT10-A02	
Robot Side	FAX-00D-00	Nachi-Fujikoshi Corporation: MZ07
Tool Side	SCPT16-A00	
Robot Side	SCPR10-A04	Yasukawa Electric Corporation: MOTOMAN-GP7, MOTOMAN-GP8
Tool Side	SCPT10-A04	

*For RS006L (Kawasaki Heavy Industries), no adaptor plate but a spigot adjustment ring is required.

⚠ 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

- Select parallel pins for the robot adaptor depending on mounting flange specifications. (φ6x10 and φ6/φ4x10, staged, are supplied with the product.)
- Tool adaptor parallel pins (φ6x10) are already fitted before delivery.

⚠ 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 bolt 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

⚠ CAUTION

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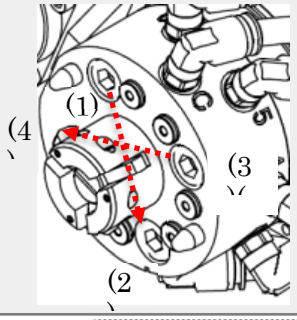


For the installation work, set the robot flange surface facing upward at the height of your breast to prevent ATC from falling.

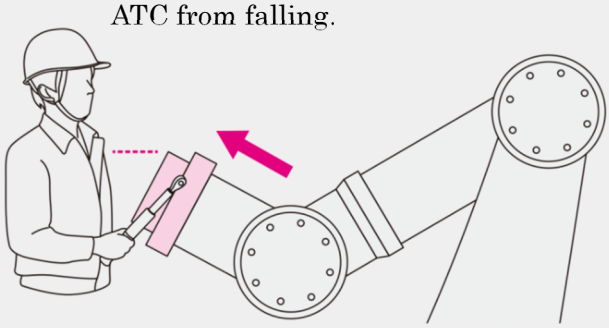
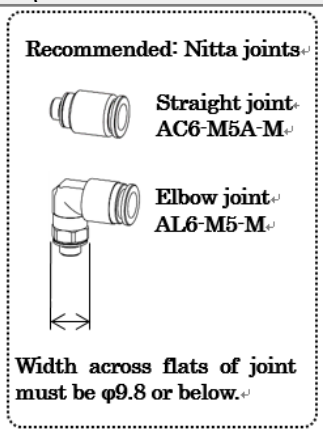


Fig. 4. Bolt tightening sequence and precaution



Recommended Nitta fittings.

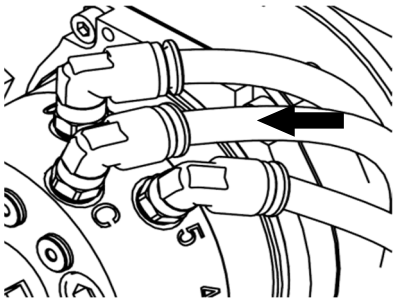
3-3. Connecting to Fitting/Removal Port

Connect piping from the solenoid valve to the "CHUCK" port and "UNCHUCK" port of the fitting/removal mechanism. The constant pressure line (with electromagnetic valve not energized) must always be connected with the "CHUCK" port to ensure jointing of the fitting/removal 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.

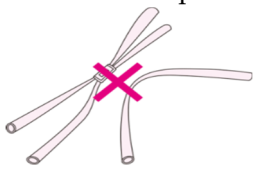
⚠ DANGER

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

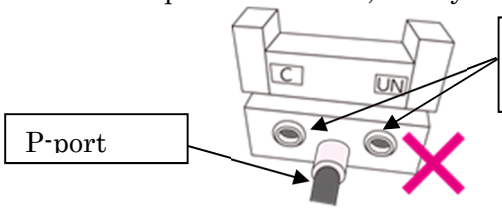
Perform installation carefully not to bend the tube connected with the chuck/unchuck port during robot motions. Otherwise, it may fall off.



- 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.

3-4. Fixing Cables and Tubes, etc.

⚠ 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.

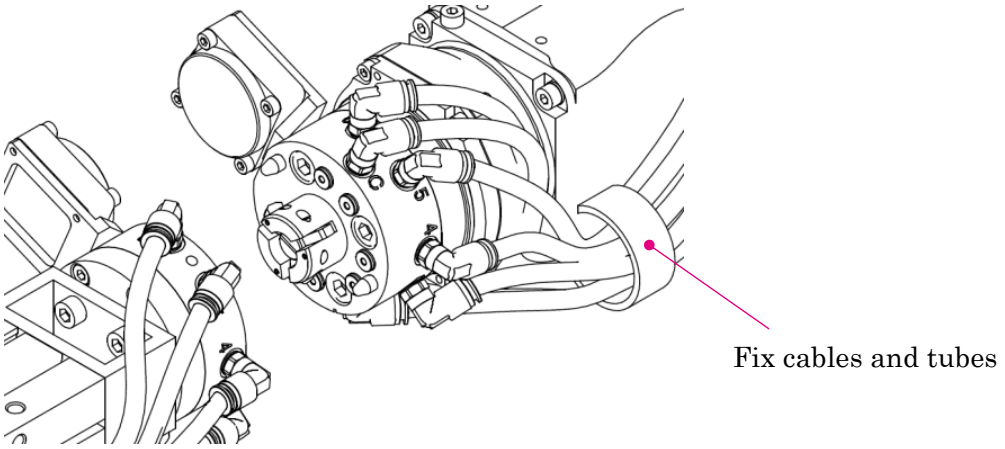


Fig. 5. Fixing of cables and tubes, etc.

4.Operations

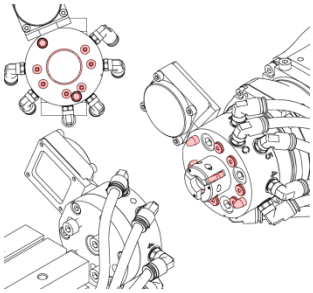
4-1. Checking before Teaching (Robot Operations)

⚠ 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.* See Fig. 5.

⚠ CAUTION

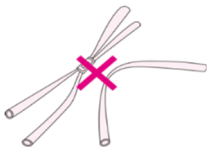
Ensure that grease is applied to the shaded portions.



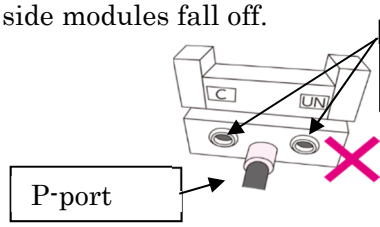
⚠WARNING

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.

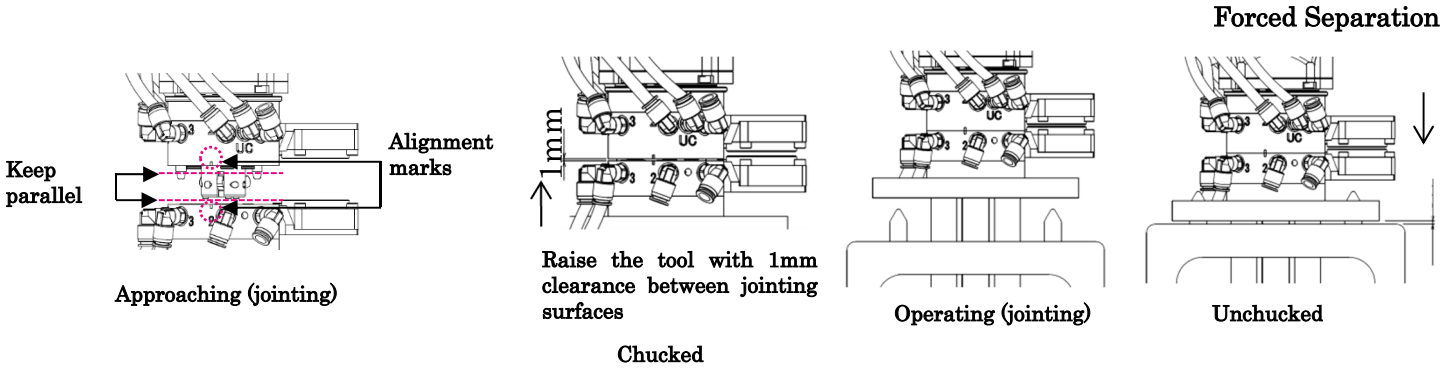


⚠WARNING

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

4-2. Check Points in Teaching

The coupling surfaces of the robot adaptor and tool adaptor must be in parallel during the ATC chuck/unchuck operation. Otherwise, proper jointing and smooth separation may be prevented. Moreover, the electric contacts and pneumatic ports may be spoiled earlier. For chucking, keep joint surfaces in parallel with about 1mm clearance in between and supply air to the chuck port for jointing.



⚠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.

5.For Safe Use

5-1. Precautions for Allowable Load and Installation

⚠WARNING	Allowable load, allowable moment and allowable torque specified for the ATC are dynamic specifications of the unit 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. Fig. 6 shows the meanings of rated load, rated moment and rated torque.

Payload W = 98.1N (10kg)

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

Allowable bending moment M = L x W x G_R(*) = 0.275 x 98.1 x 1.5 ≦ 40.6N·m {414Kgf·cm}

Allowable twisting torque $T = L_t$ x W x G_R(*) = 0.233 x 98.1 x 1.5 ≦ 34.3N·m {350Kgf·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.)

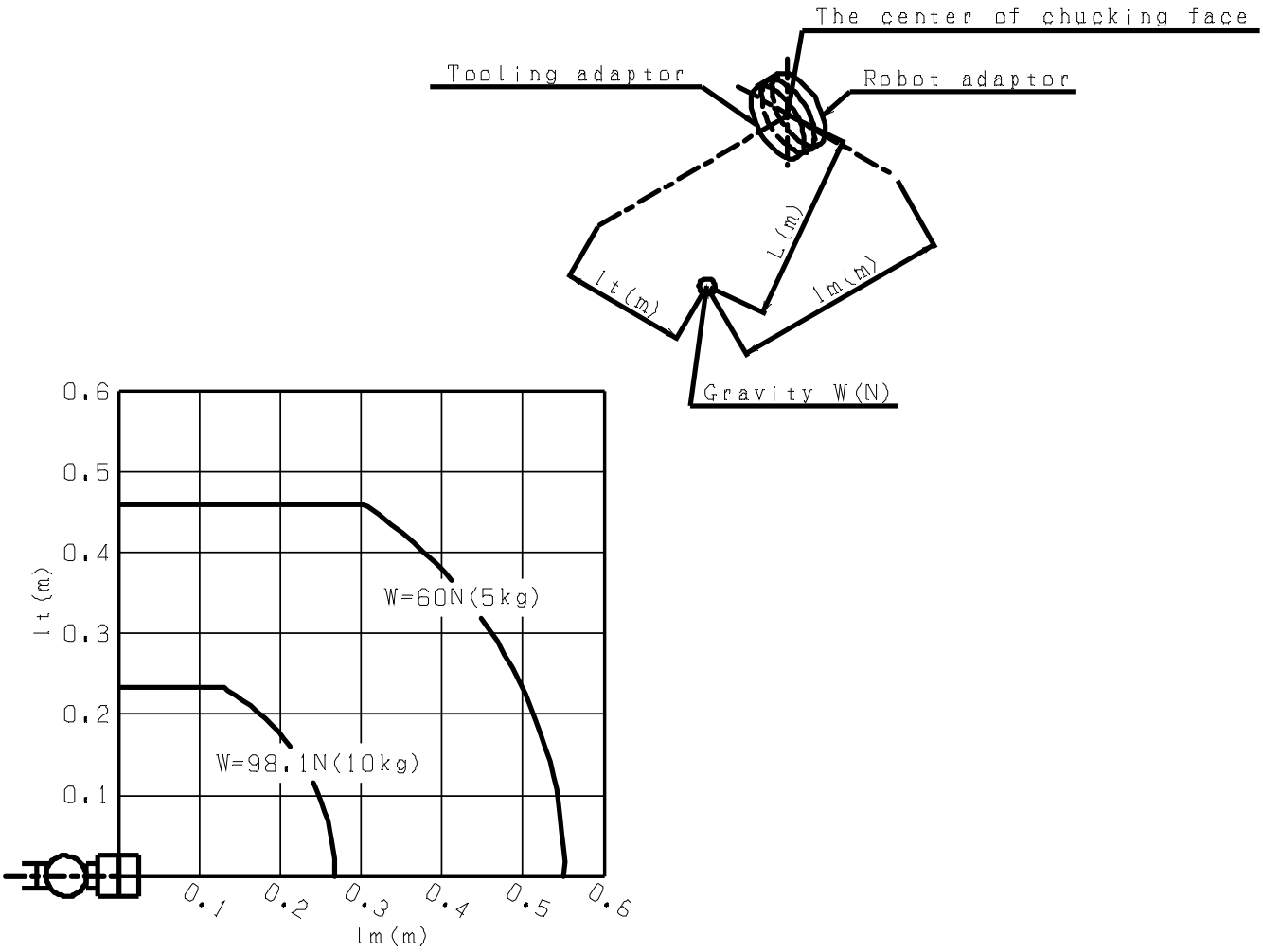


Fig. 6. An example of rated load definition (GR = 1.5)

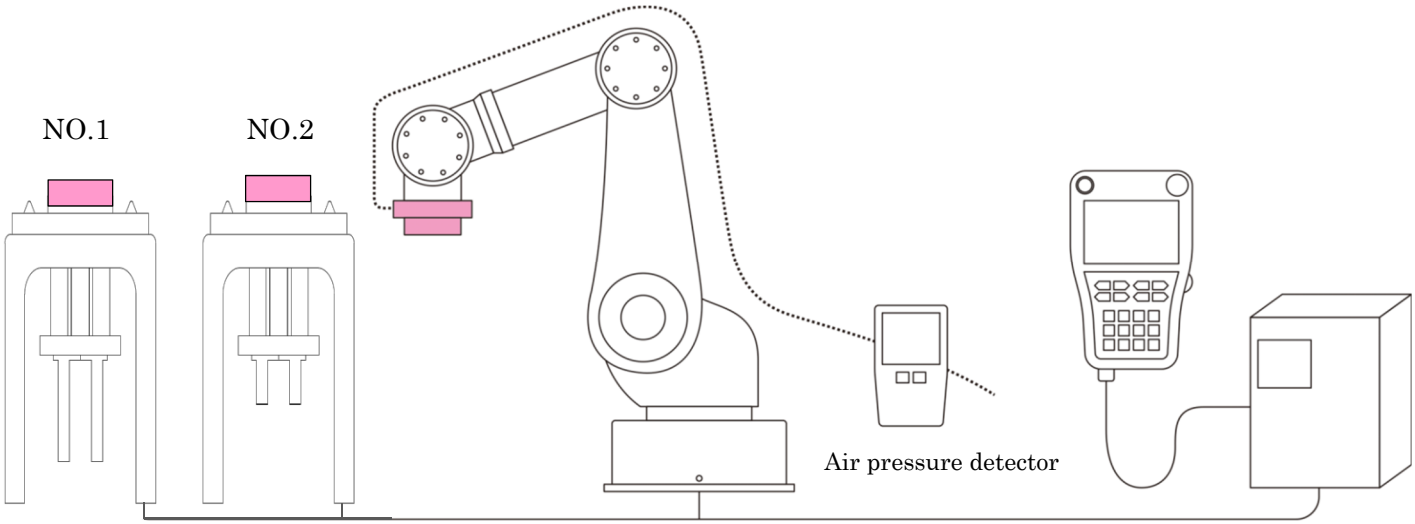
5-2. Operations and Programming

5-2-1. External Interlock Signal Setting

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

⚠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



(1) Tool presence check
(2) Tool No. identification check
(3) Check of air pressure for ATC driving

Fig. 7. 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.

5-2-2. Basic Flow of ATC

Ensure the robot interlock with reference to the flow indicated in Table 3.

参 考

Chart 3. Basic flow of ATC

	Robot operation	Robot output signal		External input	
		Control solenoid valve		Fixture LS	Driving air pressure
		Chuck	Unchuck	Tool side presence	
Coupling	Robot SB pos.	OFF	ON	ON	[ON]
	↓ Robot movement	↓	↓	↓	[↓]
	↓ Cplg pos. proximity	↓	↓	[↓]	[↓]
	↓ Robot movement	↓	↓	[↓]	[↓]
	↓ Coupling position	↓	↓	[↓]	[↓]
	↓ Chuck	ON	OFF	[↓]	[↓]
	↓ Cplg completed	↓	↓	[↓]	[↓]
	↓ Robot movement	↓	↓	OFF	[↓]
	↓ Robot work	↓	↓	↓	[↓]
Separation	Robot work	ON	OFF	OFF	[ON]
	↓ Robot movement	↓	↓	[↓]	[↓]
	↓ Separation point	↓	↓	[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 valve for chuck/unchuck. Please do not use one-shot signaling because it may not maintain the coupled state 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.

5-2-3. 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 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.

5-3. Maintenance and Inspection

For sale use and longer service life of the product, it is recommended to perform routine inspection works. Appropriate working inspection not only improve the life of the mechanism but also are necessary to prevent failures and ensure safety, so it is recommended to perform inspection routinely before start of each service time.

5-3-1. Daily Inspection Items

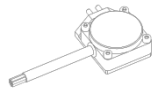
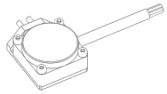
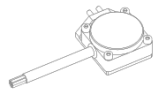
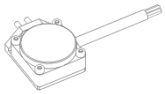
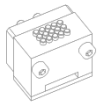
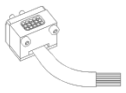
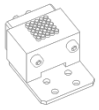
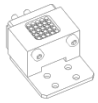
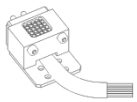
Daily inspection items and response actions against abnormality are listed in Table 4.

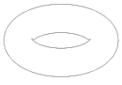
Chart 4. List of daily robot/tool adaptor inspection items

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	Electric block ASSY replacement (See Chart 5)
	Check that there is no air leakage when the units are coupled	Tactile	O-ring replacement (See Chart 5)
	Check that the remote sensor ASSY or electric block ASSY cables are free of wear	Visual	Remote sensor ASSY or electric block ASSY replacement (See Chart 5)
	Check that tubes are free of bending and wear	Visual	Tube replacement
	Check that there is no gap between mating surfaces when the units are jointed (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
	There shall be no loose fixing bolts on the ATC.	Tactile	Retightening or replacement of bolts

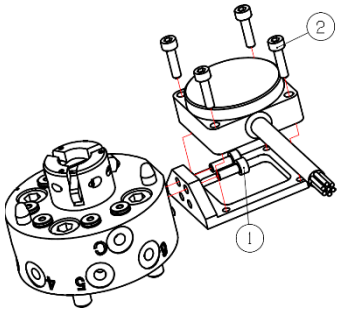
5-3-2. Maintenance and Replacement Parts (available for sale)

Chart 5. Maintenance and replacement parts

Appearance	No.	Name
	SCAR-00R-00	Remote sensor ASSY (NPN spec)
	SCAT-00R-00 (common to PNP and NPN)	
	SCAR-00R-01	Remote sensor ASSY (PNP spec)
	SCAT-00R-00 (common to PNP and NPN)	
	SCAR-015-00	Electric block ASSY (signal pin spec) 15-core solder terminal
	SCAT-015-00	
	SCAR-015-01	Electric block ASSY (signal pin spec) 15-core cable supplied (1m)
	SCAT-015-01	
	SCAR-025-00	Electric block ASSY (signal pin spec) 25-core solder terminal
	SCAT-025-00	
	SCAR-025-01	Electric block ASSY (signal pin spec) 25-core cable supplied (1m)
	SCAT-025-01	

Appearance	No.	Name
	GORI004-50	O-ring (P4: NBR, hardness: 50)

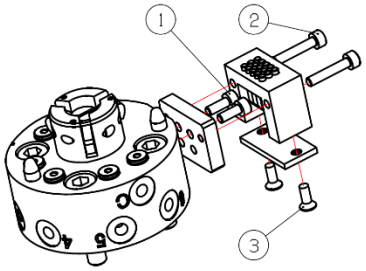
Remote sensor ASSY installation (robot side example)



(1) GSSH03008S: hex bolts; M3x8; SUS
Locking agent (low strength)
Torque level: 1N・m

(2) GSSH03012S: hex bolts; M3x12; SUS
Locking agent (low strength)
Torque level: 0.6N・m

Electric block ASSY (signal pin spec)



(1) GSSH03008S: hex bolts; M3x8; SUS
Locking agent (low strength)
Torque level: 1N・m

(2) GSSH03012S: hex bolts; M3x12; SUS
Locking agent (low strength)
Torque level: 0.6N・m

(3) GSPG03008S: cross-recessed head small screw; M3x8; SUS
Locking agent (low strength)
Torque level: 0.08N・m

*For details please download and see relevant drawings from our website.

⚠ 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.

5-3-3. 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. (Shaded sections: application points)

For new products, please check that grease has been already applied in plant. Application points are indicated in Fig. 8. (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.

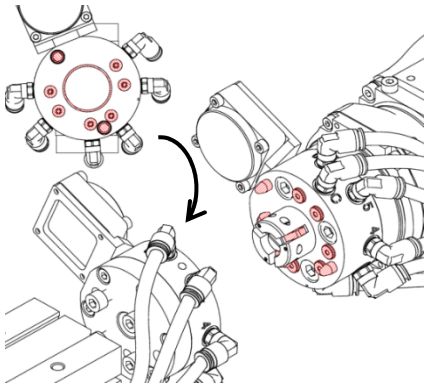


Fig. 8. Greasing points

⚠ CAUTION

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

5-4. E

mergency Response Actions

5-4-1. 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. a tool), be sure to take the inspection and response actions described in Table 6. 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 6. 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 chuck/unchuck	Turn each relevant valve ON/OFF manually and visually check the cam movement	ATC replacement
5	Presence/absence of gap of coupling planes	Visual: Cam surface damage; lock ring damage; pivot pin breakage; and mating surface deformation Check port damage	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 remote sensor, electric signal pins and cables, etc.	Visual, and I/O panel signal check	ASSY or ASSY replacement

5-4-2. 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 7.

Chart 7. **Response actions to water exposure**

	Check item	Check method	Action
1	Electric contact (signal pin spec)	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.

5-5. Precautions for Transportation

⚠ CAUTION	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.

6.Troubleshooting

[Installation]

Symptom	Probable cause	Action
Cannot install to a robot	Incompatible with mounting holes on the robot	Check the robot and refer to the instruction manual for plate model number.
Cam does not work	Coupling parts are damaged	Replace the ATC. For details, refer to "3-2. Robot adaptor and tool adaptor installation diagram" in the instruction manual.
	Chuck/unchuck air is not supplied	Check the air supply source. For details, refer to "3-3. Connecting to Fitting/Removal 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 "3-3. Connecting to Fitting/Removal Port" and "3-4. Fixing Cables and Tubes, etc." 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 "3-3. Connecting to Fitting/Removal Port" and "3-4. Fixing Cables and Tubes, etc." in the instruction manual.
	There is any foreign substance between coupling surfaces.	Eliminate any foreign substance.
	Distance between coupling surfaces is not appropriate (e.g. too far).	Correct teaching. For details, refer to 4-2. Check Points in Teaching.
Unable to separate	The forced separation function is not active.	Ensure that no hole is drilled at the center of the tool adaptor mounting surface. For details, refer to "3-2. Robot adaptor and tool adaptor installation diagram" in the instruction manual.
	Air is not supplied. (Decrease in air source pressure)	Check the air source pressure and for tube bending. For details, refer to "3-3. Connecting to Fitting/Removal Port" and "3-4. Fixing Cables and Tubes, etc." in the instruction manual.

[Teaching and Operations]

Symptom	Probable cause	Action
Unintentionally separated	Wrong piping, etc.	Refer to "3-3. Connecting to Fitting/Removal Port" and "3-4. Fixing Cables and Tubes, etc." in the instruction manual.
A signal error occurs	Cable is disconnected	Replace the electric block ASSY, remote sensor ASSY, or a pertinent cable. For details, refer to "5-3-2. Maintenance and Replacement Parts" in the instruction manual.
	The signal pin is damaged (electric block spec)	Replace the electric block ASSY. For details, refer to "5-3-2. Maintenance and Replacement Parts" in the instruction manual.
	Any foreign substance is attached on the signal pin (electric block spec)	Eliminate any foreign substance.
	ATC is exposed with water (electric block spec)	Wipe off any water on the electric contact with a dry cloth For details, refer to "5-4-2. Response Action to Water Exposure" in the instruction manual.
	There is a gap between coupling surfaces	Refer to "There is a gap between coupling surfaces" in the Chart.
	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.
	The remote sensor is damaged (remote sensor spec)	Replace the remote sensor ASSY. For details, refer to "5-3-2. Maintenance and Replacement Parts" in the instruction manual.
	NPN and PNP are opposite (in case of remote sensor)	Replace the remote sensor. For details, refer to the instruction manual for the remote sensor.
	Any foreign substance is attached to the sensor surface (remote sensor spec)	Eliminate any foreign substance.
The pneumatic port (with check) is not effective	The pneumatic port (with check) is damaged	Replace the ATC. For details, refer to "3-2. Robot adaptor and tool adaptor installation diagram" in the instruction manual.

[Teaching and Operations]

Symptom	Probable cause	Action
Insufficient air flow	O-ring is worn out or displaced	Fit a new O-ring. For details, refer to "5-3-2. Maintenance and Replacement Parts" and "5-3-3. ATC Grease Up" in the instruction manual.
Abnormal sound due to air leakage	Joint handle or tube is not sufficiently inserted	Check the joints and tubes. For details, refer to "3-3. Connecting to Fitting/Removal Port" in the instruction manual.
	A joint or tube is damaged	Check the joints and tubes. For details, refer to "3-3. Connecting to Fitting/Removal Port" and "3-4. Fixing Cables and Tubes, etc." in the instruction manual.
	O-ring is worn out or displaced	Fit a new O-ring. For details, refer to "5-3-2. Maintenance and Replacement Parts" and "5-3-3. ATC Grease Up" in the instruction manual.
	The ATC is damaged	Replace the ATC. For details, refer to "3-2. Robot adaptor and tool adaptor installation diagram" 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 "3-2. Robot adaptor and tool adaptor installation diagram" in the instruction manual.
	Used under load over the rating	Use with in the rated range. For details, refer to "5-1. Precautions for Allowable Load and Installation" 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.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