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Chapter 1
Introduction

1.1 About This Document

This manual provides information for the IA20 manipulator and contains the following sections:

**CHAPTER 1 - INTRODUCTION**
Provides general information about the structure of this manual, a list of reference documents, and customer service information.

**CHAPTER 2 - SAFETY**
This section provides information regarding the safe use and operation of Motoman products.

**CHAPTER 3 - IA20 INSTRUCTIONS**
Provides detailed information for the IA20 manipulator.

1.2 Reference to Other Documentation

For additional information refer to the following:

- NX100 Controller Manual (P/N 149201-1)
- Concurrent I/O Manual (P/N 149230-1)
- Operator's Manual for your application
- Vendor manuals for system components not manufactured by Motoman

1.3 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type (IA20)
- Application Type (welding, handling, etc.)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on back of controller)
Chapter 2
Safety

2.1 Introduction

It is the purchaser’s responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06-1999. The address is as follows:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338
INTERNET: www.roboticsonline.com

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. The robot must not be operated by personnel who have not been trained!

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.
This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming, Operation, and Maintenance Safety (Section 2.6)

2.2 Standard Conventions

This manual includes the following alerts – in descending order of severity – that are essential to the safety of personnel and equipment. As you read this manual, pay close attention to these alerts to insure safety when installing, operating, programming, and maintaining this equipment.

**DANGER!**
Information appearing in a DANGER concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

**WARNING!**
Information appearing in a WARNING concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

**CAUTION!**
Information appearing in a CAUTION concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

*Note: Information appearing in a Note provides additional information which is helpful in understanding the item being explained.*
2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-1999, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-1999 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

- Safety fences and barriers
- Light curtains and/or safety mats
- Door interlocks
- Emergency stop palm buttons located on operator station, robot controller, and programming pendant

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06-1999 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming, Operation, and Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to program, operate, and maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.
- Check the E-STOP button on the programming pendant for proper operation before programming. The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
• Any modifications to PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!

• Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.

• The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.

• Check and test any new or modified program at low speed for at least one full cycle.

• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

• Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.

• Use proper replacement parts.

• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS
MOTOMAN-IA20 INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 OPERATOR’S MANUAL
NX100 MAINTENACE MANUAL

The NX100 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.
This instruction manual explains operating instructions and maintenance procedures primarily for MOTOMAN-IA20.

General items related to safety are listed in Section 1: Safety of the NX100 Instructions. To ensure correct and safe operation, carefully read the NX100 instructions before reading this manual.

Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the NX100.

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

- **WARNING**: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

- **CAUTION**: Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

- **MANDATORY**: Always be sure to follow explicitly the items listed under this heading.

- **PROHIBITED**: Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

**NOTE**
To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING”.

---

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

Always be sure to follow explicitly the items listed under this heading.

Must never be performed.

---

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING”.
• Before operating the manipulator, check that servo power is turned OFF when the emergency stop buttons on the front door of the NX100 and programming pendant are pressed. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

• Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn ON the servo power.

Injury may result from unintentional or unexpected manipulator motion.

• Observe the following precautions when performing teaching operations within the working envelope of the manipulator:
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

• Confirm that no persons are present in the manipulator's work envelope and that you are in a safe location before:
  - Turning ON the NX100 power.
  - Moving the manipulator with the programming pendant.
  - Running check operations.
  - Performing automatic operations.

Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem. The emergency stop button is located on the right of the front door of the NX100 and the programming pendant.
Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product. The manipulator usually consists of the controller, the programming pendant, and manipulator cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX100 controller</td>
<td>NX100</td>
</tr>
<tr>
<td>NX100 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>
**Explanation of Warning Labels**

The following warning labels are attached to the manipulator.
Always follow the warnings on the labels.
Also, an identification label with important information is placed on the body of the manipulator. Prior to operating the manipulator, confirm the contents.

### Warning Label A:

- **WARNING**
- Moving parts may cause injury

### Warning Label B:

- **WARNING**
- Do not enter robot work area.

### Nameplate:

- MOTOMAN
- [Additional information not legible]
1 Product Confirmation
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   1.2 Order Number Confirmation ................................. 1-2
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1 Product Confirmation

1.1 Contents Confirmation

Confirm the contents of the delivery when the product arrives. Standard delivery includes the following four items (Information for the content of optional goods is given separately):

- Manipulator
- NX100
- Programming Pendant
- Manipulator Cables (Three cables; between manipulator and NX100)

CAUTION

- Confirm that the manipulator and the NX100 have the same order number. Special care must be taken when more than one manipulator is to be installed.

If the numbers do not match, manipulators may not perform as expected and cause injury or damage.
1.2 Order Number Confirmation

Check that the order number of the manipulator corresponds to the NX100. The order number is located on a label as shown below.

**Fig. 1 Location of Order Number Labels**

---

**THE MANIPULATOR AND THE CONTROLLER SHOULD HAVE SAME ORDER NUMBER.**

**ORDER No.**

---

**Fig. 1 Location of Order Number Labels**
1.3 Notes on Receiving and Storing the Product

The manipulator and NX100 have built-in batteries to store home position of each manipulator axis. The life of batteries (high capacity) in the NX100 is approximately two and a half years*1, and the life of batteries (low capacity) in the manipulator is approximately four to five months. If manipulator cables between the manipulator and the NX100 have not been connected for over four to five months, the home position data may be lost due to drained batteries in the manipulator.

**NOTE** To avoid losing the home position data, connect the manipulator cables between manipulator and NX100 right after the arrival of products.

If the data should be lost, replace the old batteries and perform home position calibration.

*1 Based on assumption that the NX100 is used under the ambient temperature of 20°C and annual backup time of 6800 hours (8 hrs x 245 days). The battery life varies according to service condition.
2.1 Transporting Method

2 Transporting

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sling applications and crane or forklift operations must be performed by authorized personnel only.</td>
</tr>
<tr>
<td>Failure to observe this caution may result in injury or damage.</td>
</tr>
<tr>
<td>• Avoid excessive vibration or shock during transporting.</td>
</tr>
<tr>
<td>Failure to observe this caution may adversely affect the performance as the system consists of precision components.</td>
</tr>
</tbody>
</table>

2.1 Transporting Method

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Before transporting the manipulator, check if the eyebolts are firmly fixed to the manipulator.</td>
</tr>
<tr>
<td>• The weight of the manipulator is approximately 120 kg including the eyebolts. Use a wire rope strong enough to withstand the weight.</td>
</tr>
<tr>
<td>• The eyebolts are designed to transport the manipulator: do not use them for anything other than transporting the manipulator.</td>
</tr>
<tr>
<td>• With any transportation equipment, make sure to avoid external force on the arm or motor unit when transporting the manipulator.</td>
</tr>
</tbody>
</table>

2.1.1 Using a Crane

As a rule, when removing the manipulator from the package and moving it, a crane should be used. The manipulator should be lifted using wire rope threaded through the eyebolts. Check if the eyebolts are firmly fixed with the manipulator before the transportation, and lift the manipulator in the posture as shown in "Fig. 2 Posture for Transportation".
2.1 Transporting Method

2.1.2 Using a Forklift

When using a forklift, the manipulator should be fixed on a pallet with shipping bolts as shown in "Fig. 3 Using a Forklift". Insert claws under the pallet and lift it. The pallet must be strong enough to support the manipulator. Transport the manipulator slowly with due caution in order to avoid overturning or slippage.
3 Installation

**WARNING**

- **Install the safeguarding.**
  
  Failure to observe this warning may result in injury or damage.

- **Install the manipulator in a location where the manipulator’s tool or the workpiece held by the manipulator will not reach the wall, safeguarding, or NX100 when the arm is fully extended.**
  
  Failure to observe this warning may result in injury or damage.

- **Do not start the manipulator or even turn ON the power before it is firmly anchored.**
  
  The manipulator may overturn and cause injury or damage.

- **When installing the wall/ceiling-mounted type, firmly fix the manipulator to the wall or ceiling with adequate strength and rigidity, and take preventive measures against falling to the manipulator base as a precaution.**
  
  Failure to observe this warning may result in injury or damage.

**CAUTION**

- **Do not install or operate the manipulator which is damaged or lacks parts.**
  
  Failure to observe this caution may cause injury or damage.
### 3.1 Installation of the Safeguarding

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

**Responsibility for Safeguarding (ISO 10218)**

The user of a manipulator or robot system shall ensure that safeguarding is provided and used in accordance with Sections 6, 7, and 8 of this standard. The means and degree of safeguarding, including any redundancies, shall correspond directly to the type and level of hazard presented by the robot system consistent with the robot application. Safeguarding may include but not be limited to safeguarding devices, barriers, interlock barriers, perimeter guarding, awareness barriers, and awareness signals.

### 3.2 Mounting Procedures for Manipulator Base

The manipulator should be firmly mounted on a baseplate or a foundation which is strong enough to support the manipulator and withstands repulsion forces during acceleration and deceleration.

Refer to "Table 1 Maximum Repulsion Forces of the Manipulator in an Emergency Stop" and "Table 2 Endurance Torque in Operation" to construct a solid foundation with the appropriate thickness to withstand maximum repulsion forces of the manipulator.

The baseplate flatness must be kept at 0.5 mm or less: insufficient flatness of installation surface may deform the manipulator shape and affect its functional abilities. Mount the manipulator base as described in "3.2.1 Mounting Example".

<table>
<thead>
<tr>
<th>Table 1 Maximum Repulsion Forces of the Manipulator in an Emergency Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum torque in horizontal rotation (S-axis moving direction)</td>
</tr>
<tr>
<td>Maximum torque in vertical rotation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2 Endurance Torque in Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endurance torque in horizontal operation (S-axis moving direction)</td>
</tr>
<tr>
<td>Endurance torque in vertical operation</td>
</tr>
</tbody>
</table>
3.2 Mounting Procedures for Manipulator Base

3.2.1 Mounting Example

Fix the baseplate firmly to the floor. The baseplate should be durable enough to prevent shifting of the manipulator and mounting fixture. It is recommended to prepare a baseplate of 32 mm or more in thickness, and the anchor bolts of size M16 or more for the baseplate fixation.

There are four mounting holes on the manipulator base. Securely fix the manipulator to the baseplate with hexagon socket head cap screws M12 (40 mm long is recommended). Tighten the hexagon socket head cap screws and anchor bolts firmly so that they will not be loosened during the operation. See "Fig. 4 Mounting the Manipulator on Baseplate ".

Fig. 4 Mounting the Manipulator on Baseplate
3.3 Installation Method

The manipulator can be mounted in three different ways: floor-mounted (standard), wall-mounted, and ceiling-mounted types are available. For wall- and ceiling-mounted types, the following points are different from the floor-mounted types.

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

There is no difference in the specification including the P-point maximum envelope among these manipulators with different installation methods.

3.3.1 Fixing the Manipulator Base

For the wall- or ceiling-mounted types, be sure to use four hexagon socket head cap screws M12 (tensile strength: 1200 N/mm² or more) to fix the manipulator base. Use a torque of 84 N·m in tightening the screws.

3.3.2 Precautions to Prevent the Manipulator from Falling

For the wall- or ceiling-mounted types, take appropriate measures to avoid the falling of the manipulator as a precaution. Refer to "Fig. 5 Fall Prevention Measure" for details.

In case of using the wall-ceiling-mounted type, inform Yaskawa of the matter when placing an order. Be sure to contact Yaskawa representative (listed on the back cover of this instruction manual) to execute a wall/ceiling installation on site.
When the manipulator is installed, it is necessary to satisfy the undermentioned environmental conditions:

- Ambient temperature: 0 to 40°C
- Humidity: 20 to 80%RH at constant temperature
- Free from exposure to water, oil, or dust
- Free from corrosive gas or liquid, or explosive gas
- Free from excessive shock or vibration (vibration acceleration: 4.9 m/s² (0.5 G) or less)
- Free from large electrical noise (plasma)
- Flatness for installation is 0.5 mm or less
4  Wiring

**WARNING**

- **Ground resistance must be 100 Ω or less.**
  Failure to observe this warning may result in fire or electric shock.

- **Before wiring, make sure to turn OFF the primary power supply, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)**
  Failure to observe this warning may result in fire or electric shock.

**CAUTION**

- **Wiring must be performed by authorized or certified personnel.**
  Failure to observe this caution may result in fire or electric shock.
4.1 Grounding

Follow the local regulations and electrical installation standards for grounding. The recommended grounding wire size is 5.5 mm² at minimum.

For grounding, connect the ground wire directly to the manipulator as shown in "Fig. 6 Grounding Method".

- Never use this line sharing with other ground lines or grounding electrodes for other electric power, motor power, welding devices, etc.

- Where metal ducts, metallic conduits, or distributing racks are used for cable laying, grounding should be performed in accordance with Electric Equipment Technical Standards.

Fig. 6 Grounding Method
4.2 Manipulator Cable Connection

Three manipulator cables are provided: one encoder cable (1BC) and two power cables (2BC and 3BC). (Refer to "Fig. 7 Manipulator Cables"). Connect these cables to the connectors on the manipulator connector base and the NX100 by referring to "Fig. 8 (a) Manipulator Cable Connections to the Manipulator" and "Fig. 8 (b) Manipulator Cable Connections to the NX100".

4.2.1 Connection to the Manipulator

Before connecting the manipulator cables to the manipulator, confirm the numbers on both the manipulator cables and the connectors on the manipulator connector base. Then, connect the cables in the order of 3BC, 2BC, 1BC. Insert the connectors adjusting the cable connector positions to the main key positions of the manipulator, and then set the lever until it clicks.

4.2.2 Connection to the NX100

Before connecting the manipulator cables to the NX100, confirm the numbers on both the manipulator cables and the NX100 board connectors. Then, connect the cables in order of X22, X21, X11. Insert the connectors adjusting the cable connector positions to the main key positions of the NX100, and set the lever until it clicks.

Fig. 7 Manipulator Cables
4.2 Manipulator Cable Connection

![Diagram of manipulator cable connections to the manipulator and NX100]

**Fig. 8 (a)** Manipulator Cable Connections to the Manipulator

**Fig. 8 (b)** Manipulator Cable Connections to the NX100
## 5 Basic Specifications

### 5.1 Basic Specifications

| Table 3 | Basic Specifications
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
<td><strong>Model</strong> MOTOMAN-IA20</td>
</tr>
<tr>
<td><strong>Configuration</strong></td>
<td>Vertically Articulated</td>
</tr>
<tr>
<td><strong>Degree of Freedom</strong></td>
<td>7 axes</td>
</tr>
<tr>
<td><strong>Payload</strong></td>
<td>20 kg</td>
</tr>
<tr>
<td><strong>Repetitive Positioning Accuracy</strong></td>
<td>±0.1 mm</td>
</tr>
<tr>
<td><strong>Range of Motion</strong></td>
<td></td>
</tr>
<tr>
<td>s-axis</td>
<td>±180°</td>
</tr>
<tr>
<td>L-axis</td>
<td>±125°</td>
</tr>
<tr>
<td>7th-axis</td>
<td>±180°</td>
</tr>
<tr>
<td>U-axis</td>
<td>±125°</td>
</tr>
<tr>
<td>R-axis</td>
<td>±180°</td>
</tr>
<tr>
<td>B-axis</td>
<td>±120°</td>
</tr>
<tr>
<td>T-axis</td>
<td>±180°</td>
</tr>
<tr>
<td><strong>Maximum Speed</strong></td>
<td></td>
</tr>
<tr>
<td>s-axis</td>
<td>2.27 rad/s (130°/s)</td>
</tr>
<tr>
<td>L-axis</td>
<td>2.27 rad/s (130°/s)</td>
</tr>
<tr>
<td>7th-axis</td>
<td>2.97 rad/s (170°/s)</td>
</tr>
<tr>
<td>U-axis</td>
<td>2.97 rad/s (170°/s)</td>
</tr>
<tr>
<td>R-axis</td>
<td>5.24 rad/s (300°/s)</td>
</tr>
<tr>
<td>B-axis</td>
<td>5.24 rad/s (300°/s)</td>
</tr>
<tr>
<td>T-axis</td>
<td>10.1 rad/s (580°/s)</td>
</tr>
<tr>
<td><strong>Allowable Moment</strong></td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>58.8 N·m (6 kgf·m)</td>
</tr>
<tr>
<td>B-axis</td>
<td>58.8 N·m (6 kgf·m)</td>
</tr>
<tr>
<td>T-axis</td>
<td>29.4 N·m (3 kgf·m)</td>
</tr>
<tr>
<td><strong>Allowable Inertia (GD²/4)</strong></td>
<td></td>
</tr>
<tr>
<td>R-axis</td>
<td>4 kgf·m²</td>
</tr>
<tr>
<td>B-axis</td>
<td>4 kgf·m²</td>
</tr>
<tr>
<td>T-axis</td>
<td>2 kgf·m²</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>120 kg</td>
</tr>
<tr>
<td><strong>Ambient Conditions</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>0 to 40°C</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td>20 to 80% RH at constant temperature</td>
</tr>
<tr>
<td><strong>Vibration acceleration</strong></td>
<td>4.9 m/s² (0.5 G) or less</td>
</tr>
</tbody>
</table>
| **Others** | • Free from corrosive gas or liquid, or explosive gas  
• Free from exposure to water, oil, or dust  
• Free from excessive electrical noise (plasma) |
| **Power Capacity** | 3.4 kVA |

---

*SI units are used in this table. However, gravitational unit is used in ( ).
*2 Conformed to ISO9283
*3 Refer to "5.1 Allowable Wrist Load" for details on the permissible moment of inertia.
5.2 Part Names and Working Axes

Fig. 9 Part Names and Working Axes
5.3 Manipulator Base Dimensions

Fig. 10 Manipulator Base Dimensions

Units: mm
5.4 Dimensions and P-Point Maximum Envelope

Fig. 11 Dimensions and P-Point Maximum Envelope

Units: mm
5.5 Operating Characteristics and Operating Method of the 7-Axis Manipulator

The 7-axis manipulator operates differently from the 6-axis manipulator, and requires the different operating method. The following sections explains how to operate the 7-axis manipulator based on the operation patterns (the joint coordinate system, Cartesian coordinate system, etc.).

5.5.1 Operation in the Joint Coordinate System

Note the following point in operating the manipulator in the joint coordinate system:

• When operating the 7th-axis, hold the "SHIFT" key and press the "S+" or "S-" key.

Fig. 12 7th-Axis Operation
5.5.2 Operation in the Cartesian Coordinate System, Tool Coordinate System, and User Coordinate System

Setting the wrist position and angle of the 6-axis manipulator accordingly determines the manipulator posture. However, the IA20 with 7 axes enables any manipulator posture, allowing users to freely modify the "elbow angle" (the manipulator arm angle) keeping its wrist at the same position and angle.

To modify the elbow angle without changing its current wrist position and angle, select the cartesian coordinate system, tool coordinate system, or user coordinate system, then hold the "SHIFT" key and press the "S+" or "S-" key. (Refer to "Fig. 12 7th-Axis Operation")

Enables the different postures keeping its wrist at the same position and angle.
5.6 Wrist Flange of Drip-Proof Specification IA20-A01

The wrist flange of drip-proof specification IA20-A01 has a cable through hole as well as the standard specification. (See Fig. A.) When mounting equipment such as an attachment, perform drip-proof treatment on the flange face. As an option, waterproof flange (HW0272404-A) is available. (See Fig. B.) The connectors for internal user I/O wiring harness are not drip-proof type; if the manipulator is installed at a location where some water is splashed on the manipulator, apply drip-proof treatment on those connectors when connection is completed. (Example: use of silicon tape, or connection within a connection box.)

Fig. A  Wrist Flange (Structure Common to Standard/Waterproof Specifications)

Fig. B  Mounted Image of Waterproof Flange
6.1 Allowable Wrist Load

6 Allowable Load for Wrist Axis and Wrist Flange

6.1 Allowable Wrist Load

The allowable wrist load is 20 kg; however, consider the limitations shown in Table 4 Allowable Moment and Total Inertia of the Wrist Axis to fulfill this condition. If force is applied to the wrist instead of the load, the forces on R-, B-, and T-Axes should be within the values shown in Table 4.

When the volume load is small, refer to the moment arm rating shown in Fig. 13 Moment Arm Rating. The allowable total inertia is calculated when the moment is at the maximum. Contact your Yaskawa representative when only inertia moment, or load moment is small while inertia moment is large. Also contact your Yaskawa representative in advance in a case where the load mass is combined with an external force.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Moment Nm (kgf·m)</th>
<th>GD²/4 Inertia kg·m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-axis</td>
<td>58.8 (6)</td>
<td>4</td>
</tr>
<tr>
<td>B-axis</td>
<td>58.8 (6)</td>
<td>4</td>
</tr>
<tr>
<td>T-axis</td>
<td>29.4 (3)</td>
<td>2</td>
</tr>
</tbody>
</table>

*: Gravitational unit

Fig. 13 Moment Arm Rating
6.2 Wrist Flange

The wrist flange dimensions are shown in "Fig. 14  Wrist Flange ". In order to see the alignment mark, it is recommended that the attachment be mounted inside the fitting. The depths of inside and outside fittings must be respectively 11 mm or less and 6 mm or less.

**NOTE**

- Wash off anti-corrosive paint (Yellow) on the wrist flange surface with thinner or light oil before mounting the tools.
- When mounting an attachment, use a screw which will not go beyond 10 mm of the tapped hole to avoid any possible adverse affect on the manipulator performance.
7.1 Internal User I/O Wiring Harness and Air Line

An internal user I/O wiring harness (0.1 mm² x 12 wires) and six air lines are incorporated in the manipulator for drives of the peripheral devices mounted on the arms as shown in "Fig. 15 Internal User I/O Wiring Harness and Air Lines".

The connector pins and the terminals are assigned as shown in "Fig. 16 Connectors for Internal User I/O Wiring Harness and Air Lines (Pin Details)". Wiring must be performed by user.

- The allowable current for wires: 2.5 A or less for each wire
- The maximum pressure for the air line is 490 kPa (5 kgf/cm²) or less

(The air line inside diameter: 2.5 mm.)
7.1 Internal User I/O Wiring Harness and Air Line

Fig. 16 Connectors for Internal User I/O Wiring Harness (Pin Details)

**NOTE**
For wirings, refer to the Internal Connection Diagram in the following chapter.
8 Electrical Equipment Specification

8.1 Internal Connections
9 Maintenance and Inspection

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Before maintenance or inspection, be sure to turn OFF the main power supply, and put up a warning sign. (ex. DO NOT TURN THE POWER ON.)</td>
</tr>
<tr>
<td>Failure to observe this warning may result in electric shock or injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Maintenance and inspection must be performed by specified personnel.</td>
</tr>
<tr>
<td>Failure to observe this caution may result in electric shock or injury.</td>
</tr>
<tr>
<td>• For disassembly or repair, contact your Yaskawa representative.</td>
</tr>
<tr>
<td>• Do not remove the motor, and do not release the brake.</td>
</tr>
<tr>
<td>Failure to observe this caution may result in injury from unexpected turning of the manipulator's arm.</td>
</tr>
<tr>
<td>• The battery pack must be connected before removing encoder connector when maintenance and inspection.</td>
</tr>
<tr>
<td>Failure to observe this caution may result in the loss of home position data.</td>
</tr>
</tbody>
</table>

9.1 Inspection Schedule

Proper inspections are essential not only to assure that the mechanism will be able to function for a long period, but also to prevent malfunctions and assure safe operation. Inspection intervals are classified into six levels as shown in "Table 5 Inspection Items". Conduct periodical inspections according to the inspection schedule in Table 5.

In Table 5, the inspection items are categorized by three types of operations: operations which can be performed by personnel authorized by the user, operations which can be performed by personnel being trained, and operations which can be performed by service company personnel. Only the specified personnel are to do the inspection work.
• The inspection interval depends on the total servo operation time.
• The following inspection schedule is based on the case that each axis is used under normal conditions. For axes which are used very frequently (in handling applications, etc.), it is recommended that inspections be conducted at shorter intervals. For the details, contact your Yaskawa representative.

### Table 5 Inspection Items

<table>
<thead>
<tr>
<th>Items</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>1000 H</td>
<td>6000 H</td>
<td>12000 H</td>
</tr>
<tr>
<td>① Alignment mark</td>
<td>○</td>
<td>Visual</td>
<td>Check alignment mark accordance and damage at the home position.</td>
<td>○</td>
</tr>
<tr>
<td>② Working area and whole exterior of manipulator</td>
<td>○</td>
<td>Visual</td>
<td>Check the work area if dust or spatter is present. Check for damage and outside cracks.</td>
<td>○</td>
</tr>
<tr>
<td>③ Actuator</td>
<td>○</td>
<td>Visual</td>
<td>Check for grease leakage.</td>
<td>○</td>
</tr>
<tr>
<td>④ Baseplate mounting bolts</td>
<td>○</td>
<td>Spanner, Wrench</td>
<td>Tighten loose bolts. Replace if necessary.</td>
<td>○</td>
</tr>
<tr>
<td>⑤ Cover mounting screws</td>
<td>○</td>
<td>Screwdriver, Wrench</td>
<td>Tighten loose screws. Replace if necessary.</td>
<td>○</td>
</tr>
<tr>
<td>⑥ Connector cable</td>
<td>○</td>
<td>Manual</td>
<td>Check for loose connectors and tighten if necessary.</td>
<td>○</td>
</tr>
<tr>
<td>⑦ Wire harness in manipulator</td>
<td>○</td>
<td>Visual</td>
<td>Check for damages.</td>
<td>○</td>
</tr>
<tr>
<td>⑧ Wire harness in manipulator (Lead wires for BT-axes)</td>
<td>○</td>
<td>Visual</td>
<td>Check for damages.</td>
<td>○</td>
</tr>
<tr>
<td>⑨ Battery pack in manipulator</td>
<td>○</td>
<td>Visual</td>
<td>Replace <strong>4</strong></td>
<td>○</td>
</tr>
<tr>
<td>⑩ Batteries in NX100 (Alkaline batteries)</td>
<td>To be replaced every 2 years</td>
<td>Replace the batteries when the battery alarm occurs or in the 2-year cycle.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
### Table 5 Inspection Items

<table>
<thead>
<tr>
<th>Items</th>
<th>Schedule</th>
<th>Method</th>
<th>Operation</th>
<th>Inspection Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>8000 H Cycle</td>
<td>12000 H Cycle</td>
<td>24000 H</td>
</tr>
<tr>
<td>Overhaul</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 Wire harness in manipulator (for the S-, L-, 7th-, U-, R-, B-, T-axes) is to be replaced at 24000 H inspection.
*2 For the grease, refer to "Table 6 Inspection Parts and Grease Used".
*3 When a grease leakage is found, promptly contact your Yaskawa representative.

### Table 6 Inspection Parts and Grease Used

<table>
<thead>
<tr>
<th>No.</th>
<th>Grease Used</th>
<th>Inspected Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Harmonic Grease SK-1A</td>
<td>Actuator</td>
</tr>
</tbody>
</table>

Inspection numbers correspond to the numbers in "Table 5 Inspection Items".

---

Note: The manipulator is in the home position.

---

Fig. 18 Inspection Parts and Inspection Numbers
9.2 Notes on Maintenance Procedures

9.2.1 Battery Pack Replacement

The battery packs are attached in the two positions indicated in "Fig. 19 Battery Location".

If a battery alarm occurs in the NX100, replace the battery in accordance with the following procedure:

1. Turn OFF the NX100 main power supply.
2. Unscrew four plate fixing screws to remove the cover plate with a battery pack holder, and pull out the battery pack for replacement attached to the battery pack holder.
3. Remove the battery pack from the battery pack holder. (Do not remove the connectors at this point.)

**NOTE** Make sure to remove the old battery pack after connecting the new one so that the encoder absolute data does not disappear.
4. Remove the refresh circuit connector from the board.

5. Connect the new battery pack to the unoccupied connectors on the board.

6. Remove the connectors of the old battery pack from the board.

7. Connect the refresh circuit connector to the unoccupied connector on the board.

8. Mount the new battery pack on the battery pack holder.

9. Push the battery pack holder into place, and fix its plate section with four plate mounting screws.

**NOTE** Make sure not to pinch the cable when putting the cover plate back into place.
9.2 Notes on Maintenance Procedures

9.2.2 Batteries in NX100

The NX100 is equipped with a battery unit (9 alkaline batteries; size D) for encoder backup to secure the home position data.

It is recommended to replace the batteries every two years, however, note that the battery life depends on the operation condition. When the batteries are about to be worn out, the programming pendant displays a notification message to replace the batteries.

To replace the batteries, remove the battery unit cover fixing screws (4 screws) to open the unit cover. It is recommended that the NX100 power is turned ON while replacing the batteries.

For the location of the battery unit, refer to the figure below.

![Battery Unit in NX100](image)
Grease Replenishment for the S-, L-, U-, 7th-, R-, B-, T-Axis Actuators

The manipulator is in the home position.

Table 7  Grease Type and Amount of Grease

<table>
<thead>
<tr>
<th>Axis</th>
<th>Amount of Grease</th>
<th>Grease Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-, L- axes</td>
<td>17 cc (18 cc for the 1st supply)</td>
<td>Harmonic Grease SK-1A</td>
</tr>
<tr>
<td>7th-, U-axes</td>
<td>6 cc (7 cc for the 1st supply)</td>
<td></td>
</tr>
<tr>
<td>R-, B-, T-axes</td>
<td>2 cc (3 cc for the 1st supply)</td>
<td></td>
</tr>
</tbody>
</table>

Exchange the grease as follows referring to "Fig. 21 Grease Inlets and Air Exhaust Ports for the S-, L-, U-, 7th-, R-, B-, T-Axis Actuators".

1. Remove the plug from the air exhaust port.

**NOTE**

Adding grease without removing the plug on the air exhaust port may cause a damage. Never fail to remove the plug before the grease injection.
2. Remove the hexagon socket head cap screw M6 from the grease inlet and install the grease zerk A-MT6X1. (The grease zerk is delivered with the manipulator.)

3. Inject grease into the grease inlet using a grease gun, referring to " Table 7  Grease Type and Amount of Grease ".

4. Move the grease-replenished axis for a few minutes.

5. Wipe the discharged grease with a cloth. Remove the grease zerk from the grease inlet and reinstall the screw. Tighten the screw to a tightening torque of 9.8 N·m (1.0 kgf·m). (Apply Three Bond 1206C to the thread part of the screw.)

6. Reinstall the plug on the exhaust port.

9.2.4 Actuator Replacement

As shown in the following table, when an actuator needs to be replaced due to a failure, etc., there are three methods (which are different by replacement parts) according to the time that may be consumed to recover the manipulator. Contact your Yaskawa representative when actuator replacement is necessary.

<table>
<thead>
<tr>
<th>Method</th>
<th>Time Required for Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Replacing only the actuator</td>
<td>Long</td>
</tr>
<tr>
<td>(b) Replacing the whole arm</td>
<td>Short</td>
</tr>
<tr>
<td>(c) Replacing a part of the arm</td>
<td>Medium</td>
</tr>
</tbody>
</table>

As an example, the following figure indicates the methods (a) to (c) to replace the B-axis actuator.

![Fig. 22 Methods for Actuator Replacement (Example of the B-axis Actuator)]
Actuator Replacement (Example of the B-Axis Replacement Procedure)

Refer to the "Table 8 Parts Checklist" and "Fig. 23 Disassembly / Reassembly for the B-Axis Actuator Replacement".

Disassembly to Remove the B-Axis Actuator

1. Move the manipulator to the home position.
2. Turn OFF the NX100 power supply.
3. Unscrew the hexagon socket head cap screws (nineteen screws), and remove the covers \( \text{\textcircled{a}} \) and \( \text{\textcircled{b}} \).
4. Cut off the cable ties (three places), and pull out the BT-axis internal wiring harness \( \text{\textcircled{c}} \) from the arm \( \text{\textcircled{d}} \) and the B-axis actuator \( \text{\textcircled{e}} \).
5. Unscrew the hexagon socket head cap screws \( \text{\textcircled{f}} \) (sixteen screws).

\begin{itemize}
  \item Make sure to support or lift the arm \( \text{\textcircled{f}} \) for fall prevention.
\end{itemize}

6. Remove the arm \( \text{\textcircled{f}} \) using the tapped through holes \( \text{\textcircled{g}} \) (size M5, two places; refer to the view A in Fig23).
7. Unscrew the hexagon socket head cap screws \( \text{\textcircled{h}} \) and \( \text{\textcircled{i}} \) (twelve screws in total).
8. Remove the B-axis actuator \( \text{\textcircled{e}} \) from the arm \( \text{\textcircled{d}} \); insert a flat tip screwdriver into the removal notches \( \text{\textcircled{j}} \) (two places), and slowly remove the actuator.

Reassembly to Install the B-Axis Actuator

1. Remove the old sealing bond remaining on the joint faces \( \text{\textcircled{a}} \) and \( \text{\textcircled{b}} \) of the arms \( \text{\textcircled{d}} \) and \( \text{\textcircled{e}} \).
2. Lightly apply the sealing bond Locktite 515 to the joint surface \( \text{\textcircled{c}} \) of the B-axis actuator \( \text{\textcircled{e}} \).
3. Check the connector directions of the B-axis actuator \( \text{\textcircled{e}} \) (refer to the view B in Fig23), and insert the actuator \( \text{\textcircled{e}} \) into the arm \( \text{\textcircled{d}} \).

\begin{itemize}
  \item Do not hit or cause a shock to the actuator when setting the B-axis actuator \( \text{\textcircled{e}} \) in the arm \( \text{\textcircled{d}} \).
\end{itemize}

4. Set the hexagon socket head cap screw \( \text{\textcircled{e}} \) (one screw) to the collar \( \text{\textcircled{f}} \), and place it to the position indicated in the view C in Fig23.

\begin{itemize}
  \item The screw \( \text{\textcircled{e}} \) is a stopper to stop the arm rotation, and is 5 mm longer than the screw \( \text{\textcircled{f}} \).
\end{itemize}

5. Fix the B-axis actuator \( \text{\textcircled{e}} \) to the arm \( \text{\textcircled{d}} \) with the hexagon socket head cap screws \( \text{\textcircled{g}} \) and \( \text{\textcircled{h}} \) (eleven screws and one screw, respectively). Tighten the screws to a tightening torque of 4.0 N·m (0.41 kgf·m).
6. Lightly apply the sealing bond Locktite 515 to the joint face \( \text{\textcircled{i}} \) of the B-axis actuator \( \text{\textcircled{e}} \).
7. Fix the arm \( \text{\textcircled{d}} \) to the B-axis actuator \( \text{\textcircled{e}} \) with the hexagon socket head cap screws \( \text{\textcircled{j}} \) (sixteen screws). Tighten the screws to a tightening torque of 4.0 N·m (0.41 kgf·m).
8. Run the BT-axis internal wiring harness \( \text{\textcircled{c}} \) through the B-axis actuator \( \text{\textcircled{e}} \) and the arm \( \text{\textcircled{d}} \).
9. Fix the harness with the cable ties 🌡.
10. If necessary, apply the sealing bond Three Bond 1206C to the cover joint face 🌡.
11. Install the covers 🌡 and 🌡 with the hexagon socket head cap screws 🌡 (nineteen screws). Tighten the screws to a tightening torque of 6.0 N·m (0.61 kgf·m).

Fig. 23 Disassembly / Reassembly for the B-Axis Actuator Replacement
9.2 Notes on Maintenance Procedures

Home Position Recalibration (Example)

After replacing an actuator, recalibrate the manipulator home position as described in this section.

Before operation, prepare part(s) listed in the following table required for the operation.

Table 8  Parts Checklist

<table>
<thead>
<tr>
<th>No</th>
<th>Item</th>
<th>Qty</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>B-axis actuator SGAGS-451E-A7AC-YR11</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>②</td>
<td>Arm (wrist) HW0101257-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>③</td>
<td>Arm (wrist base) HW0101256-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>④</td>
<td>BT-axis internal wiring harness HW0271849-A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>⑤</td>
<td>-Hexagon socket head cap screw M4 (length: 40 mm) -Conical spring washer 2H-4</td>
<td>11 each</td>
<td></td>
</tr>
<tr>
<td>⑥</td>
<td>-Hexagon socket head cap screw M4 (length: 45 mm) -Conical spring washer 2H-4</td>
<td>1 each</td>
<td></td>
</tr>
<tr>
<td>⑦</td>
<td>Collar HW0405817-5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>⑧</td>
<td>-Hexagon socket head cap screw M4 (length: 35 mm) -Conical spring washer 2H-4</td>
<td>16 each</td>
<td></td>
</tr>
<tr>
<td>⑨</td>
<td>Cover HW0308210-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>⑩</td>
<td>Cover HW0308211-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>⑪</td>
<td>-Hexagon socket head cap screw M5 (length: 14 mm) -Conical spring washer 2H-5</td>
<td>19 each</td>
<td></td>
</tr>
<tr>
<td>⑫</td>
<td>Tapped through hole M5</td>
<td>2 places</td>
<td>For arm removal</td>
</tr>
<tr>
<td>⑬</td>
<td>Cable tie</td>
<td>3 places</td>
<td></td>
</tr>
<tr>
<td>⑭</td>
<td>Old sealing bond remaining part</td>
<td>1 place</td>
<td>Remove the old sealing bond remaining on these parts.</td>
</tr>
<tr>
<td>⑮</td>
<td>Old sealing bond remaining part</td>
<td>1 place</td>
<td></td>
</tr>
<tr>
<td>⑯</td>
<td>Sealing bond application part (Loctite 515)</td>
<td>1 place</td>
<td></td>
</tr>
<tr>
<td>⑰</td>
<td>Sealing bond application part (Loctite 515)</td>
<td>1 place</td>
<td></td>
</tr>
<tr>
<td>⑱</td>
<td>Sealing bond application part (Three Bond 1206C)</td>
<td>1 place</td>
<td></td>
</tr>
<tr>
<td>⑲</td>
<td>Notch</td>
<td>2 places</td>
<td>For actuator removal</td>
</tr>
</tbody>
</table>

Table 9  Parts List

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Qty</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positioning pin</td>
<td>HW0483865-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>Diameter: 5 mm (+0/-0.012) Length: 100 mm Material: SUS440C</td>
</tr>
</tbody>
</table>
9.2 Notes on Maintenance Procedures

Using the programming pendant, adjust each axis home position so that the positioning pin fits into the groove or corresponding pin hole as shown in “Fig. 24 Home Position Calibration”, then register each position to the NX100.

For details, refer to "Home Position Calibration” described in "NX100 INSTRUCTIONS (RE-CTO-A211)".

![Fig. 24 Home Position Calibration](image-url)

7th-axis

T-axis

B-axis

R-axis

S-axis

U-axis

L-axis
9.2 Notes on Maintenance Procedures

9.2.5 Interface Board

The interface boards are connected to their respective actuators, and the specific data of each actuator is stored in the respective interface boards. Therefore, when replacing an actuator, it is also required to replace its corresponding interface board.

**CAUTION**

- Do not connect the interface board to the other actuator.

Failure to observe this caution may cause a malfunction.

Contact your Yaskawa representative when the interface board replacement is necessary.

Fig. 25 Location of Interface Boards
9.2 Notes on Maintenance Procedures

9.2.6 Brake Driver Board

The brake driver boards JARCH-DKB01-2 are used for the MOTOMAN-IA20.

Fig. 26 Brake Driver Board

- Alarm Causes and Corrective Actions

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
</table>
| • Verify that the wiring has been performed properly.  
  Failure to observe this caution may cause damage or malfunction. |
| • When an alarm is indicated, check its content.  
  Failure to observe this caution may cause fire, damage, or malfunction. |

An alarm can be identified if it is a major or minor error, with the indications of the green and orange LEDs on the brake driver board as shown in the following table.

The brake driver board enables alarm identification by indicating the green and orange LEDs. The alarm has two modes as shown in the following table:

<table>
<thead>
<tr>
<th>Alarm Mode</th>
<th>Green LED</th>
<th>Orange LED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Error</td>
<td>OFF</td>
<td>Blinks</td>
<td>Alarm mode involving a system failure. To reset the alarm, restore power to the NX100.</td>
</tr>
<tr>
<td>Minor Error</td>
<td>ON</td>
<td>Blinks</td>
<td>Alarm mode slightly involving a system failure. To reset the alarm, repeat the release instruction.</td>
</tr>
</tbody>
</table>
**Major Errors**

The green LED turns OFF while the orange LED blinks. The blink patterns of the orange LED indicate error diagnostics as follows:

<table>
<thead>
<tr>
<th>Status</th>
<th>Reference voltage failure: detected when the reference voltage in the brake driver board is approx. 2.15 V or less, or 2.9 V or more.</th>
</tr>
</thead>
</table>
| Cause  | (a) Improper power supply: the 24 V power supply unit fails to supply the proper voltage (24 V) to the brake driver board.  
(b) Brake driver board failure. |
| Corrective Action | (a) Replace the 24 V power supply unit for the brake driver board.  
(b) Replace the brake driver board. |

**Green LED: OFF**
**Orange LED: single blink**

![Diagram of green LED OFF and orange LED single blink]

**Status**

Base block failure.

**Cause**

(a) When the NX100 is restarted immediately after turning OFF its power, the control power for the brake driver board is at the rising edge before the control power for the board completely drops to 0 V.  
(b) Brake driver board failure.

**Corrective Action**

(a) Turn OFF the NX100, and restart it after a brief interval.  
(b) Replace the brake driver board.
9.2 Notes on Maintenance Procedures

Green LED: OFF
Orange LED: continuous blink

Status
CPU failure.

Cause
• Brake driver board failure.

Corrective Action
• Replace the brake driver board.

Minor Errors
The green LED lights up while the orange LED blinks. The blink patterns of the orange LED indicate error diagnostics as follows:

Green LED: ON
Orange LED: double blink

Status
• Deviant current: detected when a difference occurs between the current for instruction and the current for detection.
• Overcurrent: detected when a current exceeding the deviant current flows.

Cause
(a) Improper combination of the brake driver board and the actuator.
(b) Brake driver board failure.

Corrective Action
(a) Correct the combination.
(b) Replace the brake driver board.
9.2 Notes on Maintenance Procedures

Green LED: ON
Orange LED: triple blink

Status
Electrical load failure.

Cause
(a) Disconnection between the brake driver board and the brake.
(b) Short circuit between the brake driver board and the brake.

Corrective Action
(a) Reconnect the connectors.
(b) Measure the resistance of the brake; if disconnection or short circuit is found, repair the actuator.
(c) If recovery is unachievable with the actions (a) and (b), replace the brake driver board.

Green LED: ON
Orange LED: continuous blink

Status
Power supply voltage failure.

Cause
• Improper power supply: the 24 V power supply unit fails to supply the proper voltage (24 V) to the brake driver board.

Corrective Action
• Replace the 24 V power supply unit for the brake driver board.
9.2 Notes on Maintenance Procedures

---

**When the Orange LED Does Not Light Up**

**Status**
Unable to power ON the brake driver board.

**Cause**
(a) Insufficient power supply voltage.
(b) Improper connection of the wires for power supply (CN2).
(c) Improper connection of the wires for power supply (CN2) to the 24 V power supply unit.
(d) Blown fuse.

**Corrective Action**
(a) Replace the 24 V power supply unit for the brake driver board.
(b) Reconnect the connectors of the wires for power supply (CN2).
(c) Correct the connection of the wires (CN2) to the 24 V power supply unit.
(d) Replace the brake driver board.

---

**Status**
Unable to release the brake even when the power of the brake driver board is ON.

**Cause**
(a) Improper connection of the wires for release instruction (CN3).
(b) Low input voltage to the wires for release instruction (CN3).
(c) Improper connection of the wires for release instruction (CN3) to the 24 V power supply unit.

**Corrective Action**
(a) Reconnect the connectors of the cables (CN3).
(b) Replace the 24 V power supply unit for the brake driver board.
(c) Correct the connection of the wires (CN3) to the 24 V power supply unit.
Recommended Spare Parts

It is recommended to keep the parts and components in the following table in stock as spare parts for the MOTOMAN-IA20 (see "Table 10 Spar Parts for IA20-A00/-A01"). Product performance may not be guaranteed when using spare parts recommended by companies other than Yaskawa. The spare parts are ranked as follows:

- Rank A: Expendable and frequently replaced parts
- Rank B: Parts for which replacement may be necessary as a result of frequent operation
- Rank C: Drive Unit

**NOTE** To replace parts in Rank B or Rank C, make sure to contact your Yaskawa representative.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Qty per Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>Grease</td>
<td>Harmonic Grease SK-1A</td>
<td>Showa Shell Sekiyu K.K.</td>
<td>2.5 kg</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>Liquid Gasket</td>
<td>Three Bond 1206C</td>
<td>ThreeBond Co., Ltd.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>Sealant</td>
<td>Loctite 515</td>
<td>Henkel Japan Ltd.</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A</td>
<td>4</td>
<td>Battery Pack</td>
<td>HW0470360-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>Wire Harness in Manipulator</td>
<td>HW0172391-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>Wire Harness in Manipulator for BT-Axes</td>
<td>HW0271849-A</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>S-Axis Actuator</td>
<td>SGAGS-362H-A7AC-YR11</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>L-Axis Actuator</td>
<td>SGAGS-362H-A7AC-YR11</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>9</td>
<td>7th-Axis Actuator</td>
<td>SGAGS-112F-A7AC-YR11</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>U-Axis Actuator</td>
<td>SGAGS-112F-A7AC-YR11</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 10  Spare Parts for IA20-A00/-A01

<table>
<thead>
<tr>
<th>Rank</th>
<th>Parts No.</th>
<th>Name</th>
<th>Type</th>
<th>Manufacturer</th>
<th>Qty</th>
<th>Qty per Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>11</td>
<td>R-Axis Actuator</td>
<td>SGAGS-451E-A7AC-YR11</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>12</td>
<td>B-Axis Actuator</td>
<td>SGAGS-451E-A7AC-YR11</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>13</td>
<td>T-Axis Actuator</td>
<td>SGAGS-221E-A7AC-YR11</td>
<td>Yaskawa Electric Corporation</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>