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SECTION 1
INTRODUCTION

1.1 About this Document

The XRC Operator’s Manual for Painting provides information about painting applications for Motoman robots using the XRC controller, including job teaching, playback, and editing. Also included is information about the robot instruction set, user variables, alarm/error messages and special robot settings (e.g., tool constant, user coordinates, etc.).

This manual is intended to teach basic controller and robot operation and programming to operators, programmers, engineers, and maintenance personnel who design, install, use, and maintain a Motoman robotic system. Power users performing advanced programming and operation of the controller may need the XRC Inform II manual (P/N 142971-1). Please contact your salesman directly, or the Motoman service staff at (937) 847-3200, to order the XRC Inform II manual.

This manual is organized as follows:

SECTION 1 – INTRODUCTION
General information about this manual, a list of reference documents, and customer service information.

SECTION 2 – SAFETY
Provides information for the safe use and operation of Motoman products.

SECTION 3 – OPERATOR’S MANUAL FOR BEGINNERS
Provides an introduction to the XRC controller and programming pendant including basic operating instructions in teaching, playback, and editing modes. The arc welding section provides job examples and gives basic instructions for setting condition files and operation methods.

SECTION 4 – OPERATOR’S MANUAL FOR BEGINNERS SUPPLEMENT
Provides detailed instructions for teaching procedures, operation methods, and painting conditions. Example job and painting test are included.

SECTION 5—OPERATOR’S MANUAL SUPPLEMENT FOR PAINTING
Provides detailed information about the XRC controller and programming pendant; introduces the manipulator coordinates; and provides instructions in teaching, playback, editing modes. The painting section discusses instructions and functions, settings and condition files.

1.2 Reference to Other Documentation

For additional information refer to the following:

- Concurrent I/O Parameters Manual for PX-Series Robots (P/N 147466-1)
- Motoman PX2900, XRC Manipulator Manual (P/N 147464-1)
- Motoman PX2850/2750, XRC Manipulator Manual (P/N 147472-1)
- Motoman PX800, XRC Manipulator Manual (P/N 147463-1)
- Motoman PX1850/2050, XRC Manipulator Manual (P/N 147471-1)
### 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 (PX2900, etc.)
- Application Type (painting, etc.)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of XRC controller)
SECTION 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. 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

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 Safety (Section 2.6)
- Operation Safety (Section 2.7)
- Maintenance Safety (Section 2.8)
2.2 **Standard Conventions**

This manual includes information essential to the safety of personnel and equipment. As you read through this manual, be alert to the four signal words:

- **DANGER**
- **WARNING**
- **CAUTION**
- **NOTE**

Pay particular attention to the information provided under these headings which are defined below (in descending order of severity).

**DANGER!**

*Information appearing under the DANGER caption 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 under the WARNING caption 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 under the CAUTION caption 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 caption 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, section 6.13.4 and 6.13.5, 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 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 measures are available:

- Safety fences and barriers
- Light curtains
- Door interlocks
- Safety mats
- Floor markings
- Warning lights

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 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 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. All personnel involved with the operation of the equipment must understand potential dangers of operation. Programming tips are as follows:

- Any modifications of the controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the PLC. 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.
- Back up all programs and jobs onto a floppy disk whenever 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.
- The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.
- 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 operate the system.
• 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 the E-STOP button on the teach pendant for proper operation before programming.
• Carry the teach pendant with you when you enter the workcell.
• Be sure that only the person holding the teach pendant enters the workcell.
• Test any new or modified program at low speed for at least one full cycle.

2.7 Operation 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. All personnel involved with the operation of the equipment must understand potential dangers of operation. Operation tips are as follows:

• Be sure that only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories are permitted to operate this robot system.
• Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
• Inspect the robot and work envelope to ensure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
• Ensure that all safeguards are in place.
• 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 operate the system.
• Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
• The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
• 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. This includes controller parameters, ladder, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
2.8 **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. All personnel involved with the operation of the equipment must understand potential dangers of operation. Maintenance tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- 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 operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Be sure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- 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. This includes controller parameters, ladder, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- 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.

The YASNAC XRC operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
MANDATORY

• This manual explains the various components of the YASNAC XRC system and general operations. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.

• General items related to safety are listed in the Setup Manual Section 1: Safety. To ensure correct and safe operation, carefully read the Setup Manual before reading this manual.

CAUTION

• 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 YASNAC XRC.
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”.

iii
• Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed. When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are 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.

Emergency Stop Button

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

Injury may result from unintentional or unexpected manipulator motion.

Release of Emergency Stop

• Always set the Teach Lock before entering the robot work envelope to teach a job.

Operator injury can occur if the Teach Lock is not set and the manipulator is started from the playback panel.

• 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 YASNAC XRC 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 are problems. The emergency stop button is located on the right side of both the YASNAC XRC playback panel and 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 playback panel, the programming pendant, and supply cables. In this manual, the equipment is designated as follows.

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<th>Manual Designation</th>
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<tbody>
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<td>XRC</td>
</tr>
<tr>
<td>YASNAC XRC Playback Panel</td>
<td>Playback Panel</td>
</tr>
<tr>
<td>YASNAC XRC Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
</tbody>
</table>
Descriptions of the programming pendant and playback panel keys, buttons, and displays are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td></td>
</tr>
<tr>
<td>Character Keys</td>
<td>The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
</tbody>
</table>
| Symbol Keys                | The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key [P]
|                            | The cursor key is an exception, and a picture is not shown.                       |
| Axis Keys                  | "Axis Keys" and "Number Keys" are generic names for the keys for axis operation and number input. |
| Number Keys                |                                                                                     |
| Keys pressed simultaneously| When two keys are to be pressed simultaneously, the keys are shown with a "+" sign between them, ex. [SHIFT]+[COORD] |
| Displays                   | The menu displayed in the programming pendant is denoted with { }. ex. {JOB}          |
| Playback Panel             | Playback panel buttons are enclosed in brackets. ex. [TEACH] on the playback panel |

**Description of the Operation Procedure**

In the explanation of the operation procedure, the expression "Select • • • " means that the cursor is moved to the object item and the SELECT key is pressed.
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1 INTRODUCTION

1.1 XRC Overview

The main power switch and the door lock are located on the front of the XRC controller. The programming pendant hangs from a hook located on the top right front face of the controller. The playback panel can be found mounted on the cabinet door of the controller. Find information for setup, installation, and connection of the XRC system by referring to the “MOTOMAN Setup Manual”.

Playback Panel Front View

- **SERVO ON READY**
  Turns on the servo power.

- **PLAY and TEACH**
  Switches back and forth between play and teach mode.

- **EDIT LOCK**
  Switches editing enable/disable.

- **REMOTE Button**
  Switches to remote mode.

- **ALARM Lamp**
  Lights on at error/alarm occurrence.

- **EMERGENCY STOP Button**
  Starts playback.

- **START Button**
  Stops playback.

- **HOLD Button**
  Stops playback.
1.2 Button Descriptions

Playback panel buttons are enclosed in brackets throughout this manual.

[TEACH] on the playback panel
1.3 Programming Pendant

1.3 Programming Pendant

Menu Area

General Purpose Display Area

Cursor Key

Deadman Switch

Located on the back of the programming pendant. When you squeeze it, the power comes on.

Status Area

Page Key

Select Key

Area Key

Manual Speed Key

Axis Key

Enter Key

Motion Type Key

Number Key / Specific Key

Press to input numbers. These keys also function as specific keys to input instructions. When the keys can be used as specific keys, the keys' function is automatically switched.

Programming Pendant
1.4 Key Descriptions

- **Named Keys**

The keys which have a name on them are denoted with [ ]. ENTER is shown as [ENTER] and TEACH LOCK is shown as [TEACH LOCK].

The number keys have additional functions along with their number values. Dual function keys are used in the context of the operation being performed. For example: TIMER may be described in text as [1] or [TIMER].

- **Symbol Keys**

The keys which have a symbol on them are not denoted with [ ] but depicted with a small picture excepted the cursor key. It is denoted as “Cursor”.

- **Axis Keys and Number Keys**

The axis key and number key are denoted with “Axis Operation Keys” and “Number Keys” when all of the keys are shown at one time.

- **Simultaneously Pressed Keys**

When two keys are pressed simultaneously, these keys are denoted through combining with “+” such as [SHIFT]+[COORD].
1.5 Screen Descriptions

Menu items shown in the programming pendant display are denoted with { }. 

In the case of the above menu, each item is shown as {JOB}, {EDIT}, {DISPLAY}, and {UTILITY}. The items of the pull down menu are shown in the same manner, e.g. {Rename Job}.

Four screen views are used in this manual to illustrate the programming pendant displays.

- **Full Screen View**
- **Upper Screen View**
- **Middle Screen View**
- **Lower Screen View**
The following basic sequence is used to operate the manipulator.

1. Turn on the XRC controller.
2. Teach a job on the robot.
3. Replay the job on the manipulator. (called “playback”)
4. When finished, turn off the power. Be sure to follow the proper shutdown sequence as described in Section 6.
2.1 Turning On the Main Power

When turning on the power, always turn on the main power supply first and then the servo power supply. Ensure that the area around the manipulator is safe before turning on the power.

2.1.1 Startup Diagnostics

The startup diagnostics are performed when the XRC main power is turned on, and the startup display is shown on the programming pendant screen.

2.1.2 When Startup Diagnostics are Complete

When the power is turned off, the XRC saves all condition data, including:

- Mode of operation
- Cycle
- Called job (active job if the XRC is in the play mode; edit job if the XRC is in the teach mode) and the cursor position in the job.
2.2 Turning on the Servo Power

2.2.1 During Play Mode

1. When the safety guard is closed, press [SERVO ON READY] on the playback panel to turn on the servo power supply. This button lights.

**NOTE** When the safety guard is open, the servo power supply cannot be turned on.

2.2.2 During Teach Mode

1. Press [SERVO ON READY] on the playback panel to turn on the servo power supply. The button will light when the servo power is turned on.

2. Press [TEACH LOCK] to enter the teach mode.

3. The servo power is turned on and [SERVO ON READY] on the playback panel lights when the operator grips the deadman switch.

**Servo Power ON/OFF --- Deadman Switch**

When the operator squeezes the deadman switch, the servo power turns ON. However, if the operator squeezes the switch until a “click” is heard, the servo power will turn OFF.
2.2 Turning on the Servo Power

NOTE When using the playback panel, programming pendant, or external signal to perform emergency stop, the servo power on operation from the deadman switch is cancelled. When turning the power back on, follow the previously listed instructions.
The robot is generally operated using two types of coordinates: joint coordinates and rectangular coordinates. Press the axis operation keys on the programming pendant to move each axis of the manipulator.

### 3.1.1 Joint Coordinates

![Axis Keys](image-url)
3.1 Manipulator Motion

- **S** Rotates main body
  - X-S-  X+S+

- **L** Moves lower arm forward/backward
  - Y-L-  Y+L+

- **U** Moves upper arm up/down
  - Z-U-  Z+U+

- **R** Rotates upper arm
  - X-R-  X+R+

- **B** Moves wrist up/down
  - Y-B-  Y+B+

- **T** Rotates wrist
  - Z-T-  Z+T+
3.1.2 Rectangular Coordinates

(Z-Axis)

(X-Axis)

(Y-Axis)

This figure shows direction only (not position) of rectangular coordinates.)

<table>
<thead>
<tr>
<th>X</th>
<th>Moves in parallel with X- Axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>Moves in parallel with Z-Axis</td>
</tr>
</tbody>
</table>

| Y | Moves in parallel with Y- Axis |

<table>
<thead>
<tr>
<th>TX</th>
<th>Rotates around X- axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>TY</td>
<td>Rotates around Y- axis</td>
</tr>
<tr>
<td>TZ</td>
<td>Rotates around Z -axis</td>
</tr>
</tbody>
</table>

3-3
### 3.1.3 Move Instructions and Steps

The manipulator uses job instructions to move and execute playback. This is called a move instruction. The destination position, the interpolation method, the play speed, etc. are registered in the move instruction.

The reason it is called a move instruction is that the main instruction begins with "MOV" in the INFORM II language used by the XRC.

**<Example>**

MOVJ  VJ=50.00
MOVL  V=1122   PL=1

From one move instruction to the next move instruction is one step. Step 1 is 001 and step 2 is 002. The next step is 003, and so on.

“Position of Step1” corresponds to the position registered in the move instruction of Step number 001 (S:001).

**<Example>**

Refer to the job content display in the following. When executing playback, the manipulator moves between Step 1 and Step 2, and the play speed is registered in Step 2’s move instruction. After the manipulator reaches Step 2, the manipulator then executes the TIMER instruction followed by the DOUT instruction, and then continues on to Step 3.

```plaintext
J:JOB-A    S:002        R1            TOOL:00
0005 MOVJ VJ=50.00
0006 MOVL V=1234
0007 TIMER T=5.00
0008 DOUT OT#(1) ON
0009 MOVJ VJ=50.00
```

<table>
<thead>
<tr>
<th>Step Number</th>
<th>Line Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>0005</td>
</tr>
<tr>
<td>Step 2</td>
<td>0006</td>
</tr>
<tr>
<td>Step 3</td>
<td>0009</td>
</tr>
</tbody>
</table>

**STEP 2**

MOVL  V=1122

**STEP 1**

MOVJ  VJ=50.00
3.2 Teaching

3.2.1 Preparation Before Teaching

Perform the following tasks before starting to teach.

- Enable the operation of the playback panel.
- Set the operation mode to teach mode.
- Set the teach lock.
- Enter the job name.

1. Confirm that [REMOTE] on the playback panel is not lit. If the lamp is lit, press [REMOTE] to turn it off so that the playback panel will be ready to operate.

2. Enter the teach mode by pressing [TEACH] on the playback panel.

3. Press [TEACH LOCK]. [TEACH LOCK] will light indicating the Teach Lock is turned on. The operation mode and cycle cannot be changed using the playback panel or an external input device. Playback cannot be performed. Also, if [TEACH LOCK] is not lit, the servo power supply cannot be turned on using the deadman switch.

4. Select {JOB} under the top menu, and select {CREATE NEW JOB} in the sub menu. The input line is displayed.
5. After the new job display is shown, press [SELECT].

![Job Display](image1)

6. After the following display is shown, input the job name. The word “TEST” is used in this example job name.

![Alphabet](image2)

7. Move the cursor to “T” and press [SELECT]. Do the same to enter “E”, “S”, and “T”.

![Alphabet](image3)


![Job Display](image4)
9. Move the cursor to “EXEC” and press [SELECT]. The job “TEST” is registered in the XRC memory and the job is displayed. The NOP and END instructions are automatically registered.

Character Which Can Be Used for Job Names

Job names can be created from numbers, letters from the alphabet, or registered characters. The input display for each character is displayed when the page key is pressed during the operation 6. Up to eight alphanumeric characters can be used.
### 3.2 Teaching

#### 3.2.2 Teaching

**Teaching a Job**

A job is a work program that describes the tasks that the manipulator will execute. Jobs are created using a robot programming language called INFORM II.

The following example will instruct you how to teach the manipulator all of the steps from Point A to Point B of the following workpiece. This job can be completed in 6 steps.

**Safety Check**

- Ensure the teach lock is set.
- Ensure that there is a safe distance between you and the manipulator.

**TEACHING**

Register each step.

Overlapping the first step and last step.

**Step Confirmation**

Actual work is not performed here.
### Step 1 -- Start Position

Always be sure the manipulator is in a safe work area before operation.

1. Grip the deadman switch and the servo power will turn on. The manipulator can then be operated.

2. Move the manipulator to the desired position using the axis operation keys. Be sure the position is safe and that the work area is appropriate for the job to be programmed.

3. Select joint motion by pressing [MOTION TYPE]. Joint instruction "MOVJ..." will be displayed in the input buffer line.

4. Move the cursor to the line number 0000 and press [SELECT].

5. The input buffer line is displayed. Move the cursor to the right to VJ=**,**, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified.

6. Press [ENTER]. Step1 (Line 0001) is registered.
3.2 Teaching

### Step 2 -- Near the Work Start Location

Define the manipulator work pose.

1. Move the manipulator to the working position using the axis operation keys.

2. Press [ENTER]. Step 2 (Line 0002) is registered.

---

### Step 3 -- Work Start Location

Move the manipulator to the work start location as in Step 2 pose.

1. Change to medium speed by pressing [FST] or [SLW] until $\mathbf{\_}$ is displayed in the status area.

2. Do not release the pose in Step 2. Press [COORD] to select the rectangular coordinates. Move the manipulator to the welding start location using the axis operation keys.

3. Move the cursor to the line number 0002 and press [SELECT].
4. The input buffer line is displayed. Move the cursor to the right to \( VJ=*.** \), which shows the speed. While pressing [SHIFT] simultaneously, move the cursor \( \uparrow \) up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed 12.50%.

\[
\Rightarrow MOVJ \ VJ=12.50
\]

5. Press [ENTER]. Step 3 (Line 0003) is registered.

![Input Buffer Line]

- **Step 4 -- Work End Position**

Specify the work end position.

1. Move the manipulator to the work end position with the axis operation keys. While the manipulator is moving, keep a wide enough distance to ensure it will not strike the workpiece. There is no need to follow the work line too closely.


\[
\Rightarrow MOVL \ V=66
\]

3. Move the cursor to the line number 0003 and press [SELECT].

\[
\Rightarrow MOVL \ V=66
\]

4. The input buffer line is displayed. Move the cursor to the right to \( V=*.** \), which shows the speed. While pressing [SHIFT] simultaneously, move the cursor \( \uparrow \) up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 138 cm/min.

\[
\Rightarrow MOVL \ V=138
\]
3.2  Teaching

5. Press [ENTER]. Step 4 (Line 0004) is registered.

```
0000 NOP
0001 MOVJ VJ=50.00
0002 MOVJ VJ=50.00
0003 MOVJ VJ=12.50
0004 MOVL V=138
0005 END
```

■ Step 5 -- Position Away From Workpiece and Fixture

Move the manipulator to a position where it will not strike the workpiece or fixture.

1. Change the speed to high speed by pressing [FST] or [SLW].

```
FST
MAN SPEED
```

**NOTE** This button only affects teaching speed. When the job is played, the job will execute at the speed defined in Step 4.

2. Move the manipulator with the axis operation keys to a position where it will not strike the fixture.

3. Press [MOTION TYPE] to set to the joint motion type (MOVJ).

```
⇒ MOVJ VJ=12.50
```

4. Move the cursor to line number 0004 and press [SELECT].

```
⇒ MOVJ VJ=12.50
```

3-12
5. The input buffer line is displayed. Move the cursor to the right to V=*.**, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 50%.

![MOVJ VJ=50.00](image)

6. Press [ENTER]. Step5 (Line 0005) is registered.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Move the manipulator near the start position with the axis operation keys.</td>
</tr>
<tr>
<td>2</td>
<td>Press [ENTER]. Step6 (Line 0006) is registered.</td>
</tr>
</tbody>
</table>

![Step 6 -- Near the Start Position](image)
### Ensuring the First and Last Step are Identical

The manipulator has stopped at Step 6, which should be very close to Step 1. It is possible to move directly from the welding end position of Step 5 to Step 1, so the manipulator can begin the next welding job quickly and efficiently. The following operation will make Step 6 (end position) and Step 1 (start position) identical.

1. Move the cursor to Step 1 (Line 0001).

2. Press [FWD]. The manipulator will move to Step 1.

3. Move the cursor to Step 6 (Line 0006).

4. Press [MODIFY].

5. Press [ENTER]. This will change the position of Step 6 to be the same as Step 1.

### 3.2.3 Path Confirmation

The job is now complete. Try to check each step separately to ensure there are no problems.

1. Move the cursor to Step 1 (Line 0001).
3.2 Teaching

Did the manipulator move exactly as you expected? Proceed to the next section to change the position and speed of the job steps.

3.2.4 Correcting a Job

**CAUTION**

• After the job is corrected, confirm the path.

Before Correcting a Job

Confirm the manipulator’s motion in each step. If any position modification or adding or deleting of steps is necessary, display the job content first with the following procedure.

1. Select {JOB} under the top menu and {JOB} under the sub menu.

Confirm that the teach lock is on.
3.2 Teaching

- **Change the Position Data**
  Change the position registered in Step 2.

  ![Diagram](image)

  1. Move the manipulator to Step 2 (Line 0002) by pressing [FWD].
  2. Move the manipulator to the modified position with the axis operation keys.
  3. Press [MODIFY].
  4. Press [ENTER]. The step's position data is changed.

- **Add a Step**
  Add a new step between Step 5 and Step 6.

  ![Diagram](image)

  1. Move the manipulator to Step 5 (Line 0005) by pressing [FWD].
  2. Move the manipulator to the position at which you wish to add a step using the axis operation keys.

  ```
  0004 MOV L V=138
  0005 MOV J VJ=50.00
  0006 MOV J VJ=50.00
  0007 END
  ```
3. Press [INSERT].

4. Press [ENTER]. The step is added. When a step is added, the numbering is automatically adjusted to count the new step.

Delete a Step
Delete the step you just added.

1. Move the manipulator to Step 6 (Line 0006) by pressing [FWD].

2. Make sure the cursor is on the step you wish to delete, and press [DELETE].

3. Press [ENTER]. The step is deleted.
### Changing the Speed Between Steps

Change the manipulator speed. Slow the speed between Step 3 and Step 4.

1. Move the cursor to Step 4.

2. Move the cursor to the instruction and press [SELECT].

3. The input buffer line is displayed. Move the cursor to the right to "V=138", which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed to 66cm/min.

4. Press [ENTER]. The speed is changed.

---

**When “Error 2070: Set Robot Exactly to Taught Position” Occurs**

When the operator presses [ENTER] during the previous operation, an error can occur in some cases. The error occurs because the manipulator has not been moved exactly to the taught position. Cancel the error by pressing [CANCEL] and press [FWD] to move the manipulator. If the cursor in the display is blinking, the robot is not in the taught position.
4 PLAYBACK

4.1 Preparation Prior to Playback

Before executing manipulator playback, release the teach lock.


   TO RUN THE PROGRAM FROM THE BEGINNING OF THE JOB, PERFORM THE FOLLOWING OPERATION.
   • Move the cursor to the beginning of the job.
   • Move the manipulator close to Step 1 with the axis operation keys.
     When playback is ready to begin, the manipulator begins to move from the Step 1.

4.2 Playback

Begin operation only after ensuring there is no one in the working envelope of the manipulator.

1. Press [PLAY] on the playback panel.

2. Press [START] on the playback panel. The manipulator will perform one complete taught cycle and then stop.

How did it go? Did the manipulator perform exactly as you expected?
5 ARC WELDING

5.1 Example Job

The figure below shows an example of welding a workpiece with an explanation of each step.

<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator to waiting position. (Step 1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator near welding start position. (Step 2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=12.50</td>
<td>Moves manipulator to welding start position. (Step 3)</td>
</tr>
<tr>
<td>0004</td>
<td>ARCON</td>
<td>Specifies manipulator arc start.</td>
</tr>
<tr>
<td>0005</td>
<td>MOVL V=50</td>
<td>Moves manipulator to welding end position. (Step 4)</td>
</tr>
<tr>
<td>0006</td>
<td>ARCOF</td>
<td>Specifies manipulator arc end.</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator to position a safe distance away from equipment. (Step 5)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator to waiting position. (Step 6)</td>
</tr>
<tr>
<td>0009</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

5.2 Teaching Procedure

5.2.1 Teaching Procedure Items

The teaching procedure is explained in Step 2 (welding pose definition) and the welding procedure is explained in Step 3 (welding start) and Step 4 (welding end).
5.2 Teaching Procedure

5.2.2 Operation Method

■ Step 2 -- Near Welding Start Location

Define the pose of the welding torch.

1. Using the axis operation keys, specify the correct posture for the manipulator to begin welding.

2. Press [ENTER]. Step 2 is registered.

\[
\begin{align*}
0000 & \text{ NOP} \\
0001 & \text{ MOVJ VJ=25.00} \\
0002 & \text{ MOVJ VJ=25.00} \\
0003 & \text{ END}
\end{align*}
\]

■ Step 3 -- Welding Start Position

Move the welding torch to the welding start location with the pose as shown in Step 2, and register the ARCON instruction.

1. Change to medium speed by pressing [FST] or [SLW] until $\Rightarrow$ is displayed in the status area.

2. Move the manipulator to the welding start position with the axis operation keys. At this time, do not release the pose input in Step 2.

3. Move the cursor to the line number and press [SELECT].
5.2 Teaching Procedure

4. The input buffer line is displayed. Move the cursor to the right to VJ=",", which shows the speed. While pressing [SHIFT] simultaneously, move the cursor  up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed 12.50%.

5. Press [ENTER]. Step 3 is registered.

6. Press [ARCON]. ARCON is displayed in the input buffer line.

Step 4 -- Welding End Condition

Specify the welding end position.

1. Move the manipulator to the welding end position with the axis operation keys. While the manipulator is moving, keep a wide enough distance to ensure it will not strike the workpiece. There is no need to follow the work line too closely.

2. Set the motion type to linear motion type (MOVL) by pressing [MOTION TYPE].

3. Move the cursor to the line number and press [SELECT].

4. The input buffer line is displayed. Move the cursor to the right to V=66, which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 50 cm/min with the number keys and press [ENTER].
5.3 Setting Welding Conditions

5.3.1 Registration of Welding Condition

There are two ways to register the welding condition, the one way is using the arc start condition file and the other way is using the additional items of the ARCON instruction. The latter way is described here.

See "OPERATOR'S MANUAL FOR ARC WELDING" for the arc start condition file.

1. Move the cursor to the ARCON instruction and press [SELECT]. The ARCON instruction is displayed in the input buffer line. Press [SELECT]. The detail edit display is shown.

2. Press [SELECT] if the “MENU” setting is “UNUSED” or “ASF# ( )” in the detail edit display. Select “AC=” in the selection dialog. The detail edit display is shown as follows.

<table>
<thead>
<tr>
<th>JOB</th>
<th>EDIT</th>
<th>DISPLAY</th>
<th>UTILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETAIL EDIT</td>
<td>R1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARCON</td>
<td>WELDING CURR</td>
<td>AC=200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WELDING VOLT</td>
<td>AVP=100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TIMER</td>
<td>T=0.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPEED</td>
<td>UNUSED</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RETRY</td>
<td>UNUSED</td>
<td></td>
</tr>
</tbody>
</table>

<!> ARCON AC=200 AVP=100 T=0.30

5. Press [ENTER]. Step 4 is registered.

6. Press [ARCOF]. ARCOF is displayed in the input buffer line.

Press [ENTER]. The ARCOF instruction is registered.
5.3 Setting Welding Conditions

5.3.2 Setting Other Parameters

Shielding Gas Flow Rate

The shielding gas flow must be adjusted depending on nozzle shape, welded joint shape, length of the wire protruding from the nozzle, and the welding speed.

<table>
<thead>
<tr>
<th>Wire Length (mm)</th>
<th>CO₂ Gas Flow Rate (1/min.)</th>
<th>MAG Gas Flow Rate (1/min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-15</td>
<td>10-20</td>
<td>15-25</td>
</tr>
<tr>
<td>12-20</td>
<td>15-25</td>
<td>20-30</td>
</tr>
<tr>
<td>15-25</td>
<td>20-30</td>
<td>25-30</td>
</tr>
</tbody>
</table>

The table above is for a nozzle diameter of 20mm. If the nozzle diameter is smaller, lower the gas flow rate.
5.4 Welding Test

5.4.1 Check Run

Perform the check run in order to confirm that the teaching procedure was done correctly. The check run can be performed without performing actual work. This is possible because the work output instruction of the ARCON instruction is not executed.

1. Press [PLAY] on the playback panel to turn on the play mode.

2. Select {UTILITY} and {SPECIAL RUN}. The special play display is shown.

   DATA   EDIT   DISPLAY   UTILITY
   SPECIAL PLAY   R1   S   C   L
   LOW SPEED START   INVALID
   SPEED LIMIT   INVALID
   DRY-RUN SPEED   INVALID
   MACHINE LOCK   INVALID
   CHECK-RUN   INVALID
   WEAV PROHIBIT IN CHK-RUN   INVALID

   COMPLETE

3. Move the cursor to the “CHECK-RUN” setting and press [SELECT]. The condition becomes "VALID" and the check run is turned on.

   DATA   EDIT   DISPLAY   UTILITY
   SPECIAL PLAY   R1   S   C   L
   LOW SPEED START   INVALID
   SPEED LIMIT   INVALID
   DRY-RUN SPEED   INVALID
   MACHINE LOCK   INVALID
   CHECK-RUN   VALID
   WEAV PROHIBIT IN CHK-RUN   INVALID

   COMPLETE
5.4.2 Welding Execution

Once the path has been determined, the welding is finally executed. If the check run is turned off, the ARCON and the ARCOF instructions are executed.

5.4.3 Adjustments for Welding Defects

To adjust welding conditions after welding, look at the appearance of the welding bead.

<table>
<thead>
<tr>
<th>Welding Defect</th>
<th>Reason for Occurrence</th>
<th>Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pore: Generic name of defect caused by the influence of H2, N2, CO2, and Ar. Pits and blowholes, etc. may exist.</td>
<td>• Shortage of shield gas flow rate • Spatter adheres to nozzle • Influence of wind • Adhesion of rust and oil to surface • Paint adhesion • Welding current, voltage, and welding speed are incorrect • Torch angle and wire length are incorrect</td>
<td>• With no influence from the wind, and when the torch angle and wire length are correct, 15-301/min is assumed to be the suitable shield gas rate. • Change the gas flow rate according to the workpiece construction condition. • Remove the spatter frequently and thoroughly. • Choose the best welding condition and spatter will be prevented from occurring frequently. • Adjusting the torch angle and nozzle height will also reduce the amount of spatter. • Close the shutter, door, and window. • Avoid using a fan during welding. • Use a screen. • Remove rust and oil with thinner, brush, and grinder, etc. • Remove paint using thinner. • Define the proper voltage range. • Adjust the voltage in accordance with the arc length. • Make the torch angle smaller. • Set the wire length in accordance with the welding condition.</td>
</tr>
<tr>
<td>Welding Defect</td>
<td>Reason for Occurrence</td>
<td>Correction Method</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Undercut:</strong></td>
<td>• Excessive welding current</td>
<td>• Lower the welding current and speed. Adjust the voltage.</td>
</tr>
<tr>
<td>Defect name for when the groove is not completely filled along the toe of the weld.</td>
<td>• Incorrect welding voltage</td>
<td>• Adjust the torch angle and aim position.</td>
</tr>
<tr>
<td></td>
<td>• Excessive welding speed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Unsuitable torch angle and aim position</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Incomplete fusion:</strong> State in which the welding surfaces do not melt together well enough.</td>
<td>• Adjust the torch welding current, welding speed, wire aim position, angle, etc.</td>
</tr>
<tr>
<td></td>
<td>• Unsuitable welding work-piece condition</td>
<td>• Remove rust and oil.</td>
</tr>
<tr>
<td></td>
<td>• Dirt on welding surface</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Incomplete penetration:</strong> State where there is insufficient distance between the surface of the metal and the bottom of the welded area.</td>
<td>• Adjust the torch welding current, welding speed, wire aim position, angle, etc.</td>
</tr>
<tr>
<td></td>
<td>• Unsuitable welding work-piece condition (It is easy for the welding current or the voltage corresponding to the current to be too low.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Overlap:</strong> State where the toe of weld is not fused with the base metal. (Occurs often in T joint welding).</td>
<td>• Move the wire aim position forward by several millimeters during T joint welding or adjust the voltage.</td>
</tr>
<tr>
<td></td>
<td>• Excessive welding current</td>
<td>• Move the wire aim position forward by 1-1.5mm during thin plate welding.</td>
</tr>
<tr>
<td></td>
<td>• Unsuitable aim position</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Inappropriate torch angle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Welding speed is too slow</td>
<td></td>
</tr>
</tbody>
</table>
# 5.4 Welding Test

## Welding Defects

<table>
<thead>
<tr>
<th>Welding Defect</th>
<th>Reason for Occurrence</th>
<th>Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Convex bead:</strong></td>
<td>• Welding current is too high&lt;br&gt;• Arc voltage is too low&lt;br&gt;• Welding speed is too slow or too fast</td>
<td>• Lower the welding speed.&lt;br&gt;• Adjust the voltage.</td>
</tr>
<tr>
<td>Part of the fillet weld has a swelled bead surface. It can be seen in an upward weld at vertical position and an incline position.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Concave bead:</strong></td>
<td>• Welding current is too high&lt;br&gt;• Arc voltage is too high&lt;br&gt;• Welding speed is too slow</td>
<td>• Lower the welding speed.&lt;br&gt;• Adjust the voltage appropriately.</td>
</tr>
<tr>
<td>Part of the fillet weld has a dented bead surface. It can be seen in a downward weld at a vertical position or incline position</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Meandering of beads:</strong></td>
<td>• The welding wire is bent and twisted.&lt;br&gt;• The welding chip's hole diameter is growing larger.&lt;br&gt;• Magnetic blow influences welding.</td>
<td>• Shorten the wire length.&lt;br&gt;• Use a pail.&lt;br&gt;• Exchange old tips for new tips.&lt;br&gt;• Change earthing condition.&lt;br&gt;• Change welding direction.</td>
</tr>
<tr>
<td>State in which welding bead is shaped like a snake.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6 HANDLING

6.1 Example Job

The figure below shows an example of handling a workpiece. The job creating procedure is then explained.

```
<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=25.00</td>
<td>Move to waiting position (Step1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Move near gripping position (before gripping) (Step2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVL V=100.0</td>
<td>Move to the gripping position (Step3)</td>
</tr>
<tr>
<td>0004</td>
<td>HAND 1 ON</td>
<td>Gripping the workpiece</td>
</tr>
<tr>
<td>0005</td>
<td>TIMER T=0.50</td>
<td>Waiting for gripping the workpiece to be completed</td>
</tr>
<tr>
<td>0006</td>
<td>MOVL V=100.0</td>
<td>Move to near gripping position (after gripping) (Step4)</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Move to waiting position (Step5)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVJ VJ=25.00</td>
<td>Move near release position (before releasing) (Step6)</td>
</tr>
<tr>
<td>0009</td>
<td>MOVL V=100.0</td>
<td>Move to release assistance position (Step7)</td>
</tr>
<tr>
<td>0010</td>
<td>MOVL V=50.0</td>
<td>Move to release position (Step8)</td>
</tr>
<tr>
<td>0011</td>
<td>HAND 1 OFF</td>
<td>Releasing the workpiece</td>
</tr>
<tr>
<td>0012</td>
<td>TIMER T=0.50</td>
<td>Waiting for releasing the workpiece to be completed</td>
</tr>
<tr>
<td>0013</td>
<td>MOVL V=100.0</td>
<td>Move to near release position (after releasing) (Step9)</td>
</tr>
<tr>
<td>0014</td>
<td>MOVL VJ=25.00</td>
<td>Move to waiting position (Step10)</td>
</tr>
<tr>
<td>0015</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
```
6.2 Usage of HAND Instruction

6.2.1 Function

These instructions open and close the each of the hands mounted to the manipulator. They correspond to single-, double-, and triple solenoids. Up to four hands can be controlled by a single manipulator.

The following solenoid signal controls are available according to the valve selected.

- **SP (single-solenoid)**

  The HAND instruction turns the tool valve (x-1) ON/OFF. The inverse signal is output to the tool valve (x-2). Connect it to the either one when used as a single-solenoid.

- **2P (double-solenoid)**

  The HAND instruction turns the tool valve (x-1) ON/OFF. The inverse signal is output to the tool valve (x-2).

- **3P (triple solenoid)**

  Adding “ALL” to the HAND instruction allows both tool valve (x-1) and tool valve (x-2) to be turned ON/OFF simultaneously. Functions as a double-solenoid if ALL is not added to the HAND instruction.

<table>
<thead>
<tr>
<th>Instruction (x: TOOL NO)</th>
<th>SP (Valve x-1/x-2)</th>
<th>2P (Valve x-1/x-2)</th>
<th>3P (Valve x-1/x-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAND x ON</td>
<td>ON/(-/OFF)</td>
<td>ON/OFF</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>HAND x OFF</td>
<td>OFF/(-/OFF)</td>
<td>OFF/ON</td>
<td>OFF/ON</td>
</tr>
<tr>
<td>HAND x ON ALL</td>
<td>-</td>
<td>-</td>
<td>ON/ON</td>
</tr>
<tr>
<td>HAND x OFF ALL</td>
<td>-</td>
<td>-</td>
<td>OFF/OFF</td>
</tr>
</tbody>
</table>

6.2.2 Instruction and Additional Items

<table>
<thead>
<tr>
<th>HAND</th>
<th>#1</th>
<th>1</th>
<th>OFF</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>①</td>
<td>②</td>
<td>③</td>
<td>④</td>
</tr>
</tbody>
</table>

**Device Number (#1 or #2)**
Set when two manipulators are used for handling.
6.3 Teaching Procedure

6.3.1 Teaching Points

The teaching procedure is explained in Step 2, 3, and 4 concerning gripping movement and Step 6, 7, 8, and 9 concerning release movement.

- Step 1, which is the waiting position, is adjusted to a safe position where the robot does not collide with the workpiece and jig, etc.
- Confirm the welding path by using [FWD] and [BWD].

6.3.2 Operation Procedure

Step 2 -- Near Gripping Position (before gripping)

Define the pose of the gripping torch.

1. Specify the correct posture with the axis operation keys for the manipulator to begin gripping the workpiece. It is necessary to choose a direction in which the tools and the workpiece do not interfere when the manipulator approaches the workpiece, and teach that position. (It is usually located right above the grip position usually.)

2. Press [ENTER]. Step 2 is registered.
6.3 Teaching Procedure

### Step 3 -- Gripping Position

Move the torch to the gripping position as in Step 2, and register the HAND instruction.

1. Change to medium speed by pressing [FST] or [SLW].
   
   Medium speed:  is displayed in the status area.

2. Move the manipulator to the gripping position with the axis operation keys. At this time, do not release the pose input in Step 2.

3. Set the linear motion "MOV" by pressing [MOTION TYPE].

4. Move the cursor to the line number and press [SELECT].

5. The input buffer line is displayed. Move the cursor to the right to "V=11.0", which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 100 mm/s with the number keys and press [ENTER].

6. Press [ENTER]. Step 3 is registered.

7. Press [TOOL1 ON/OFF]. “HAND 1 ON” is displayed in the input buffer line.

8. Press [INFORM LIST]. The inform list is displayed. Move the cursor to “CONTROL” and press [SELECT]. Then, move the cursor to “TIMER” and press [SELECT].
9. The input buffer line is displayed. Move the cursor to the right to “T=1.00”, which shows the time. Press [SELECT] to enable the input of numbers. Then, input the desired value of 0.5s with the number keys and press [ENTER].

\[
\text{⇒ TIMER T=0.50}
\]

Press [ENTER]. The TIMER instruction is registered.

Press [INFORM LIST] again. And turn off the LED of the INFORM LIST key.

Step 4 -- Near Gripping Position (after gripping)
Define the waiting position after gripping.

1. Move the manipulator near the gripping position with the axis operation keys. It is necessary to choose a direction in which the treatment device and the tools do not interfere when the manipulator moves, and teach that position. (It is usually located right above the grip position. The same position as the steps is also available.)

2. Move the cursor to the line number and press [SELECT].

\[
\text{⇒ MOVL V=11.0}
\]

3. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 100.0 mm/s with the number keys and press [ENTER].

4. Press [ENTER]. Step 4 is registered.

<table>
<thead>
<tr>
<th>0000</th>
<th>NOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>MOVL V=100.0</td>
</tr>
<tr>
<td>0002</td>
<td>MOVL V=100.0</td>
</tr>
<tr>
<td>0003</td>
<td>HAND 1 ON</td>
</tr>
<tr>
<td>0005</td>
<td>TIMER T=0.50</td>
</tr>
<tr>
<td>0007</td>
<td>END</td>
</tr>
</tbody>
</table>
6.3 Teaching Procedure

- **Step 6 -- Near Release Position (before releasing)**

Define the pose of the release torch.

1. Specify the correct position with the axis operation keys for the manipulator to begin releasing the workpiece. It is necessary to choose a place in which the holding workpiece and the piling up workpiece do not interfere when the manipulator approaches the palette, and teach that position. (It is usually located right above of the release assistance position.)

2. Set the joint motion (MOVJ) by pressing [MOTION TYPE].

   `=> MOVJ VJ=0.78`

3. Move the cursor to the line number and press [SELECT].

   `=> MOVJ VJ=0.78`

4. The input buffer line is displayed. Move the cursor to the right to “VJ=0.78”, which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified. Set the speed 25.00%.

   `=> MOVJ VJ=25.00`

5. Press [ENTER]. Step 6 is registered.

   ```
   0000 NOP
   0001 MOVJ VJ=25.00
   0002 MOVJ VJ=25.00
   0003 MOVL V=100.0
   0004 HAND 1 ON
   0005 TIMER T=0.50
   0006 MOVL V=100.0
   0007 MOVJ VJ=25.00
   0008 MOVJ VJ=25.00
   0009 END
   ```

- **Step 7 -- Release Assistance Position**

Define the assistance position for releasing.

1. When moving directly from the position in Step 6 to the release position, the workpiece which has already been piled up and the holding workpiece interfere occasionally. The release assistance position to conduct a detour operation is taught at this time. The pose is set the same as Step 6.

2. Set linear motion (MOVL) by pressing [MOTION TYPE].

   `=> MOVL V=11.0`
3. Move the cursor to the line number and press [SELECT].

   \[
   \text{MOVJ \ V=11.0}
   \]

4. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 100.0 mm/s with the number keys and press [ENTER].

5. Press [ENTER]. Step 7 is registered.

```
0000 NOP
0001 MOVJ VJ=25.00
0002 MOVJ VJ=25.00
0003 MOVJ V=100.0
0004 HAND 1 ON
0005 TIMER T=0.50
0006 MOVJ V=100.0
0007 MOVJ VJ=25.00
0008 MOVJ VJ=25.00
0009 MOVJ V=100.0
0010 END
```

---

**Step 8 -- Release Position**

Move the torch to the release position as in Step 7, and register the HAND instruction.

1. Change to medium speed by pressing [FST] or [SLW].
   Medium speed:  is displayed in the status area.

```
MJOB  EDIT  DISPLAY  UTILITY
JOB CONTENT  R1  9 19  
```

2. Move the manipulator to the release position with the axis operation keys. At this time, do not release the pose input in Step 7.

3. Move the cursor to the line number and press [SELECT].

   \[
   \text{MOVJ \ V=11.0}
   \]

4. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 50.0 mm/s with the number keys and press [ENTER].
5. Press [ENTER]. Step 8 is registered.

6. Press [TOOL1 ON/OFF]. “HAND 1 ON” is displayed in the input buffer line.

7. The input buffer line is displayed. Move the cursor to the right to “ON”, which shows the tool status. While pressing [SHIFT] simultaneously, move the cursor up and down until “OFF” is specified.

8. Press [INFORM LIST]. The inform list is displayed. Move the cursor to “CONTROL” and press [SELECT]. Then, move the cursor to “TIMER” and press [SELECT].

9. The input buffer line is displayed. Move the cursor to the right to “T=1.00”, which shows the time. Press [SELECT] to enable the input of numbers. Then, input the desired value of 0.5s with the number keys and press [ENTER].

Press [ENTER]. The TIMER instruction is registered.

Press [INFORM LIST] again and turn off the LED of the INFORM LIST key.
■ Step 9 -- Near Release Position (after release)

Define the waiting position.

1. Move the manipulator near the release position with the axis operation keys. It is necessary to choose a direction in which the tools and workpiece do not interfere, and teach that position. (It is usually located right above the release position.)

2. Move the cursor to the line number and press [SELECT].

3. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 100.0 mm/s with the number keys and press [ENTER].

4. Press [ENTER]. Step 9 is registered.

---

6.4 Handling Test

6.4.1 Speed Limitation Drive

To confirm the taught path, the speed limitation drive is executed. All the operations operate below the limitation speed in the teach mode (250mm/s usually) during speed limitation drive. If the taught speed is below the limitation speed, the operation is executed at the same speed as teaching.

1. Press [PLAY] on the playback panel to turn on the play mode.
6.4 Handling Test

2. Select {UTILITY} and {SPECIAL RUN}. The special play display is shown.

![Special Play Display]

3. Move the cursor to the “SPEED LIMIT” setting and press [SELECT]. The condition becomes “VALID” and the speed limit is turned on.

![Special Play Display with VALID SPEED LIMIT]

6.4.2 Handling Execution

Once the path has been determined, the handling is finally executed at actual speed. If the speed limitation drive is turned off, the handling is executed at taught speed.
# 7 GENERAL PURPOSE

## 7.1 Example Job

The figure below shows an example of cutting. The job creation procedure is then explained.

![Diagram of example job](image)

<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=25.00</td>
<td>Move to the waiting position. (Step1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Move near the cutting position. (Step2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=12.50</td>
<td>Move to the cutting start position. (Step3)</td>
</tr>
<tr>
<td>0004</td>
<td>TOOLON</td>
<td>Start cutting.</td>
</tr>
<tr>
<td>0005</td>
<td>MOVL V=50.00</td>
<td>Move to the cutting end position. (Step4)</td>
</tr>
<tr>
<td>0006</td>
<td>TOOLOF</td>
<td>End cutting.</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Move to the position which does not interfere with the tools or workpieces. (Step5)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVJ VJ=25.00</td>
<td>Move to the waiting position. (Step6)</td>
</tr>
<tr>
<td>0009</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

## 7.2 Teaching Procedure

### 7.2.1 Teaching Points

The teaching procedure of Step 2 which specifies the cutting pose and Step 3 and 4 (cutting section) are explained.
7.2 Teaching Procedure

7.2.2 Operation Procedure

- **Step 2 -- Near cutting position**

  Define the cutting pose.

  1. Specify the correct posture with the axis operation keys for the manipulator to start cutting.

  2. Press [ENTER]. Step 2 is registered.

  ```
  0000 NOP
  0001 MOVJ VJ=25.00
  0002 MOVJ VJ=25.00
  0003 END
  ```

- **Step 3 -- Cutting Start Position**

  Move to the cutting start position as in Step 2, and register the TOOLON instruction.

  1. Change to medium speed by pressing [FST] or [SLW].
     Medium speed: is displayed in the status area.

  2. Move the manipulator to the cutting start position with the axis operation keys. At this time, do not release the pose input in Step2.

  3. Move the cursor on the line number and press [SELECT].

  4. The input buffer line is displayed. Move the cursor to the right to "VJ=25.00", which shows the speed. While pressing [SHIFT] simultaneously, move the cursor up and down (to higher and lower play speeds) until the desired speed is specified.
     Set the speed to 12.50%.

"Step 1, which is the waiting position, is adjusted to a safe position where the robot will not collide with the workpiece and the tool.
Confirm the cutting path with [FWD] and [BWD] after teaching."
7.2 Teaching Procedure

5. Press [ENTER]. Step 3 is registered.

```
0000 NOP
0001 MOVJ VJ=25.00
0002 MOVJ VJ=25.00
0003 MOVJ VJ=12.50
0004 TOOLON
0005 MOVL V=50.0
0006 END
```

6. Press [f.3]. “TOOLON” is displayed in the input buffer line.

![Enter](image)

Press [ENTER]. The TOOLON instruction is registered.

---

### Step 4 -- Cutting End Position

Define the cutting end position.

1. Move the manipulator near the gripping position with the axis operation keys. It is necessary to choose a direction in which the treatment device and the tools do not interfere when the manipulator moves, and teach that position.

2. Set linear motion (MOVL) by pressing [MOTION TYPE].

![Enter](image)

3. Move the cursor to the line number and press [SELECT].

![Enter](image)

4. The input buffer line is displayed. Move the cursor to the right to “V=11.0”, which shows the speed. Press [SELECT] to enable the input of numbers. Then, input the desired value of 50.0 mm/s with the number keys and press [ENTER].

5. Press [ENTER]. Step 4 is registered.

```
0000 NOP
0001 MOVJ VJ=25.00
0002 MOVJ VJ=25.00
0003 MOVJ VJ=12.50
0004 TOOLON
0005 MOVL V=50.0
0006 END
```
7.3 Cutting Test

7.3.1 Speed Limitation Drive

The speed limitation drive is executed to confirm the taught path. All the operations operate below the limitation speed during teach mode (250mm/s usually) in the speed limitation drive. If the taught speed is below the limitation speed, the operation is executed at the same speed as the teaching procedure.

1. Press [PLAY] on the playback panel to turn on the play mode.

2. Select {UTILITY} and {SPECIAL RUN}. The special play display is shown.

3. Move the cursor to the “SPEED LIMIT” setting and press [SELECT]. The condition becomes “VALID” and the speed limit is turned on.

6. Press [f.1]. “TOOLOF” is displayed in the input buffer line.

Press [ENTER]. The TOOLOF instruction is registered.
7.3.2 Cutting Execution

Once the path has been determined, cutting is finally executed at actual speed. If the speed limitation drive is turned off, cutting is executed at the same speed as during teaching.
8.1 Example Job

The figure below shows an example of the spot welding of a workpiece. The job content procedure is then explained.

<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Move to waiting position. (Step 1)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=25.00</td>
<td>Move near welding start position. (Step 2)</td>
</tr>
<tr>
<td>0004</td>
<td>MOVJ VJ=25.00</td>
<td>Move to welding start position (Step 3)</td>
</tr>
<tr>
<td>0005</td>
<td>SPOT GUN#1 MODE=0 WTM=1</td>
<td>Welding starts. Specifies spot welding gun no.1. Specifies single gun. Specifies welding condition 1.</td>
</tr>
<tr>
<td>0006</td>
<td>MOVJ VJ=25.00</td>
<td>Moves to position a safe distance away from equipment. (Step 4)</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Moves to waiting position. (Step 5)</td>
</tr>
<tr>
<td>0008</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
8.2 Setting Welding Conditions

8.2.1 Setting Spot Welding Gun Condition Files

The following items are specified in the spot welding gun condition files.

- GUN NO. (Initial:1)
- GUN TYPE (Initial:SINGLE GUN)
- WELDER NO. (Initial:1)
- OPEN MONITOR (Initial:OFF)
- GUN OPEN/CLOSE SET AT STOP (Initial:ON)

If your setting contents are different from the system, change the file content.

**Operation**

Select (SPOT WELDING) under the top menu ➔ Select {GUN CONDITION}† ➔
Move the cursor to the item to be set ➔ Press [SELECT]

**Explanation**

† The gun condition display is shown.

![Gun condition display]

8.2.2 Setting Welding Condition for the Welder

It is necessary to set the welding power supply and the welding time for the welder during spot welding.

For the setting method, refer to the manual of the welder being used.

Specify the Welding Condition No. that you set in the SPOT instruction line 0005. (Example.WTM=1)

For the welding power supply and the welding time, refer to the following table:
8.3 Teaching Procedure

8.3.1 Teaching Procedure Items

The teaching procedure is explained in Step2 (welding pose definition) and the welding procedure is explained in Step3 (welding start) and Step4 (welding end).

- Step1, which is waiting position, is adjusted to a safe position where the robot does not collide with the workpiece and jig, etc.
- Set the gun to the opening condition during teaching.
- Confirm the welding path by using [FWD] and [BWD] after teaching is completed.

8.3.2 Operation Procedure

Step 2 -- Near Welding Start Position

Define the pose of the welding torch.

1. Use the axis operation keys to specify the correct posture for the manipulator to begin welding.

2. Press [ENTER] to register Step 2.

<table>
<thead>
<tr>
<th>Board Thickness (mm)</th>
<th>Large Current - Short Time</th>
<th>Small Current - Long Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time (cycle)</td>
<td>Pressurizing Power (kgf)</td>
</tr>
<tr>
<td>1.0</td>
<td>10</td>
<td>225</td>
</tr>
<tr>
<td>2.0</td>
<td>20</td>
<td>470</td>
</tr>
<tr>
<td>3.2</td>
<td>32</td>
<td>820</td>
</tr>
</tbody>
</table>

(1 cycle = 16.7 msec)
8.3 Teaching Procedure

- **Step 3 -- Welding Start Position**

Move the torch to the welding start location and register the SPOT instruction.

1. Change the speed to medium by pressing [HIGH] + [SLW].
   - is displayed in status area.

2. Press the axis operation keys to move the manipulator to the welding start position.

3. Press [ENTER] to register Step 3.

4. Press [, /SPOT]. “SPOT GUN#(1) MODE=0 WTM=1” is displayed in the input buffer line.
   - Press [ENTER]. The SPOT instruction is registered.
8.4 Welding Test

8.4.1 Check Run

Execute the check run in order to confirm that the teaching procedure is done correctly. The check run can be conducted without actually performing work. This is because the work output instruction of the SPOT instruction is not executed.

1. Press [PLAY] on the playback panel to turn on the play mode.

2. Select {UTILITY} and {SETUP SPECIAL RUN}. The special play display is shown.

3. Move the cursor to the “CHECK-RUN” setting and press [SELECT]. The condition becomes “VALID” and the check run is turned on.

8.4.2 Welding Execution

Once the path has been determined, the welding is finally executed. If the check run is turned off, the SPOT instruction is executed.
9 TURNING THE POWER OFF

9.1 Turning the Servo Power Off (Emergency Stop)

When the emergency stop button is pressed, the servo power supply is turned off and the manipulator cannot be operated. The emergency stop button is on both the programming pendant and the playback panel. The brake operates once the servo power supply is turned off, and the manipulator can no longer operate. The emergency stop mode can be operated at any time.

9.2 Turning the Main Power Off

After turning off the servo power, then turn off the main power. When the main power switch on the front of the XRC is turned off, the main power is cut.
YASNAC XRC
OPERATOR’S MANUAL
FOR BEGINNERS

HEAD OFFICE
2-1 Kurosaki-Shiroishi, Yahatanishi-ku, Kitakyusyu-shi, 806-0004, Japan
Phone 81-93-645-7745 Fax 81-93-645-7746

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YASKAWA ELECTRIC CORPORATION

Specifications are subject to change without notice for ongoing product modifications and improvements.
Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS

- MOTOMAN SETUP MANUAL
- MOTOMAN-□□□ INSTRUCTIONS
- YASNAC XRC INSTRUCTIONS
- YASNAC XRC OPERATOR’S MANUAL
- YASNAC XRC OPERATOR’S MANUAL FOR BEGINNERS

The YASNAC XRC operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
This manual explains the various components of the YASNAC XRC system and general operations. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.

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

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NOTES FOR SAFE OPERATION

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Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed. When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are 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 the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Always set the Teach Lock before entering the robot work envelope to teach a job.

Operator injury can occur if the Teach Lock is not set and the manipulator is started from the playback panel.

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 YASNAC XRC 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 are problems. The emergency stop button is located on the right side of both the YASNAC XRC playback panel and programming pendant.
CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  - Check for problems in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.

- Always return the programming pendant to the hook on the XRC cabinet after use.

  The programming pendant can be damaged if it is left in the manipulator's work area, on the floor, or near fixtures.

- Read and understand the Explanation of the Alarm Display in the Setup Manual before operating the manipulator.

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 playback panel, the programming pendant, and supply cables. In this manual, the equipment is designated as follows.

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<td>Playback Panel</td>
</tr>
<tr>
<td>YASNAC XRC Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
</tbody>
</table>
Descriptions of the programming pendant and playback panel keys, buttons, and displays are shown as follows:

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<th>Manual Designation</th>
</tr>
</thead>
<tbody>
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<td>Programming Pendant</td>
<td><strong>Character Keys</strong> The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td></td>
<td><strong>Symbol Keys</strong> The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key</td>
</tr>
<tr>
<td></td>
<td>The cursor key is an exception, and a picture is not shown.</td>
</tr>
<tr>
<td></td>
<td><strong>Axis Keys</strong> and <strong>Number Keys</strong> are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td></td>
<td><strong>Keys pressed simultaneously</strong> When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td></td>
<td><strong>Displays</strong> The menu displayed in the programming pendant is denoted with { }. ex. {JOB}</td>
</tr>
<tr>
<td>Playback Panel</td>
<td><strong>Buttons</strong> Playback panel buttons are enclosed in brackets. ex. [TEACH] on the playback panel</td>
</tr>
</tbody>
</table>

**Description of the Operation Procedure**

In the explanation of the operation procedure, the expression "Select • • • " means that the cursor is moved to the object item and the SELECT key is pressed.
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4 Painting Test
   4.1 Speed Limitation Drive .......................................... 4-1
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1 Example Job

The figure below shows an example of painting job with an explanation of each step.

<table>
<thead>
<tr>
<th>LINE</th>
<th>INSTRUCTION</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ V=25.00</td>
<td>Moves manipulator to waiting position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVL V=50</td>
<td>Moves manipulator near painting start position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVL V=50 NWAIT</td>
<td>Moves manipulator to Path 1 start position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 3)</td>
</tr>
<tr>
<td>0004</td>
<td>PAINTSET PCF# (1)</td>
<td>Set painting condition number 1.</td>
</tr>
<tr>
<td>0005</td>
<td>SPYON ANT=1.00</td>
<td>Spray on.</td>
</tr>
<tr>
<td>0006</td>
<td>MOVL V=100</td>
<td>Moves manipulator to Path 1 end position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 4)</td>
</tr>
<tr>
<td>0007</td>
<td>MOVL V=100</td>
<td>Moves manipulator to Path 2 start position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 5)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVL V=100</td>
<td>Moves manipulator to Path 2 end position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 6)</td>
</tr>
<tr>
<td>0009</td>
<td>MOVL V=100</td>
<td>Moves manipulator to Path 3 start position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 7)</td>
</tr>
<tr>
<td>0010</td>
<td>MOVL V=100</td>
<td>Moves manipulator to Path 3 end position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 8)</td>
</tr>
<tr>
<td>0011</td>
<td>MOVL V=100</td>
<td>Moves manipulator to Path 4 start position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 9)</td>
</tr>
<tr>
<td>0012</td>
<td>MOVL V=100 NWAIT</td>
<td>Moves manipulator to Path 4 end position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 10)</td>
</tr>
<tr>
<td>0013</td>
<td>SPYOF ANT=-1.00</td>
<td>Spray off.</td>
</tr>
<tr>
<td>0014</td>
<td>PAINTEND</td>
<td>Painting end</td>
</tr>
<tr>
<td>0015</td>
<td>MOVL V=50</td>
<td>Moves manipulator to waiting position.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Step 11)</td>
</tr>
</tbody>
</table>
2 Teaching Procedure

2.1 Teaching Procedure Items

The teaching procedure is explained in Step 2 (painting pose definition), Step 3 (painting start position) and Step 10 (painting end position).

**NOTE**
- Step 1 and 11, which are both the waiting position, are adjusted to a safe position where the robot does not collide with the workpiece and the fixture, etc.
- After teaching is completed, confirm the painting path with [FWD] and [BWD].

2.2 Operation Method

- **Step 2 -- Near Painting Start Position**
  Define the pose of the painting start position.

  1. Using the axis operation keys, specify the correct pose for the manipulator to begin painting.

  2. Press [ENTER]. Step 2 is registered.

- **Step 3 -- Painting Start Position**
  Move to the painting start position with the pose as shown in Step 2, and register the PAINT-SET instruction and the SPYON instruction.

  1. Change to medium speed by pressing [FST] or [SLW] until " is displayed in the status area.

  2. Move the manipulator to the painting start position with the axis operation keys. At this time, do not release the pose input in Step 2.
3. Press [INFORM LIST] to display the INFORM command list. Select “PAINTSET”. The input buffer line is displayed.

   => PAINTSET PCF#(1)

4. Move the cursor to PAINT#(0), which shows the painting condition number. Set the number 1 with the number key. Press [ENTER] to register the PAINTSET instruction.

   => PAINTSET PCF#(1)

5. Select “SPYON” in the INFORM command list.

   => SPYON ANT=0.00

6. Move the cursor to the ANT=0.00. Input “1.00” with the number key. Press [ENTER] to register the SPYON instruction.

   => SPYON ANT=1.00

7. Move the cursor to the line number and press [SELECT]

   => MOVJ VJ=50.00

8. Set the motion type to linear motion type (MOVL) by pressing [MOTION TYPE]

   => MOVL V=66

9. Move the cursor to the right to V=66, which shows the speed. Set to 100 cm/min with the number keys.

   => MOVL V=100

10. Press [ENTER]. Step 3 is registered
Step 10 -- Painting End Position

Move to the painting end position and register the SPYOF instruction.

1. Change to medium speed by pressing [FST] or [SLW] until is displayed in the status area.

2. Move the manipulator to the painting end position with the axis operation keys.

3. Press [INFORM LIST] to display the INFORM command list. Select “PAINTSET”. The input buffer line is displayed.

4. Move the cursor to the ANT=0.00. Input “-1.00” with the number key. Press [ENTER] to register the SPYOF instruction.

5. Move the cursor to the line number and press [SELECT]

6. Set the motion type to linear motion type (MOVL) by pressing [MOTION TYPE]

7. Move the cursor to the right to V=66, which shows the speed. Set to 100 cm/min with the number keys.

8. Press [ENTER]. Step 10 is registered.
2.2 Operation Method
3.1 Operation Method

1. Select {PAINT} under the top menu.
   Select {PAINT CONDITION} under the sub menu.
   The painting condition setting display is shown as follow.

2. Move the cursor to “PAINT VOLUME”, “PAINT SPEED”, “BELL
   ROTATION”, “SHAPING AIR”, “HIGH VOLTAGE” and specify
   the value each with the number keys.
   The display of the next condition number is shown by pressing
   the page key.  The display of the desired condition number can be searched
   by input the condition number. Move the cursor to the condition
   number, press [SELECT], input the desired number by number
   input keys and press [ENTER].
3.1 Operation Method
4 Painting Test

4.1 Speed Limitation Drive

The speed limitation drive is executed to confirm the taught path. All the operations operate below the limitation speed during teach mode (250mm/s usually) in the speed limitation drive. If the taught speed is below the limitation speed, the operation is executed at the same speed as the teaching procedure.

1. Press [PLAY] on the playback panel to turn on the play mode.

2. Select {UTILITY} and {SPECIAL RUN}. The special play display is shown.

3. Move the cursor to the “SPEED LIMIT” setting and press [SELECT]. The condition becomes “VALID” and the speed limit is turned on.
Once the path has been determined, painting is finally executed at actual speed. If the speed limitation drive is turned off, painting is executed at the specified speed during teaching.
Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

The YASNAC XRC operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
MANDATORY

• This supplementary instruction manual explains the operations of the painting application of the YASNAC XRC system for the teaching, playback, editing of jobs and files, and management of each operation. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.

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

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

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Must never be performed.

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Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed. When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are turned off.

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Operator injury can occur if the Teach Lock is not set and the manipulator is started from the playback panel.

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- 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 YASNAC XRC power
- Moving the manipulator with the programming pendant
- Running check operations
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**Symbol Keys** The keys which have a symbol printed on them are not denoted with \[\] but depicted with a small picture.  
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The cursor key is an exception, and a picture is not shown.  
**Axis Keys Number Keys** “Axis Keys” and “Number Keys” are generic names for the keys for axis operation and number input.  
**Keys pressed simultaneously** When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them,  
ex. [SHIFT]+[COORD]  
**Displays** The menu displayed in the programming pendant is denoted with \{\}.  
ex. \{JOB\}  
**Playback Panel Buttons** Playback panel buttons are enclosed in brackets.  
ex. [TEACH] on the playback panel |

**Description of the Operation Procedure**

In the explanation of the operation procedure, the expression “Select • • •” means that the cursor is moved to the object item and the SELECT key is pressed.
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Work Instruction List
1 Outline

This supplementary instruction describes the operations of the painting application of the YASNAC XRC system for the teaching, playback, editing of jobs and files, and management of each operation.
2  Assigned Keys

Keys for the painting application are assigned to the number keys as follows.

![Assigned Keys Diagram]

1. **TIMER**
   - Used to register a timer instruction, “TIMER,” in a job.

2. **REF PNT**
   - Used to register a reference point, “REEP,” in a job or to change an already-registered reference point. Press [REF PNT] + [FWD] to move the manipulator to the registered reference point.

3. **SPRAY ON**
   - Used to register an instruction to start the spray, “SPYON,” in a job.

4. **SPRAY OFF**
   - Used to register an instruction to end the spray, “SPYOF,” in a job.

5. **PAINT ON/OFF**
   - **<Teach Mode>** Used to output a permission signal to prohibit painting of a spray signal. To turn OFF the permission signal, press this key again.
   - **<Play Mode>** Used to stop outputting a spray signal while the spray signal is being output by the SPYON instruction. To start outputting the spray signal, press this key again.
The output destinations of the spray signal and the atomization pressure signal are written in the concurrent I/O ladder program. If the connection of the destinations of the general-purpose signal is changed in the painting system's configuration, also change the destinations in the concurrent I/O ladder program. Unless the destinations are set correctly, a spray signal or an atomization pressure signal cannot be output correctly.

NOTE

In a system configuration where more than two sprays are connected, the operation of all sprays is controlled by the “PAINT ON/OFF” key.
3.1 Example of a Painting System Configuration

The following diagram shows an example of a system configuration where the paint control panel controls the painting devices.
### 3.1.1 Settings for Painting System When Using a Spray Gun

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Settings</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Gun Type</td>
<td>Sets the type of gun to be used.</td>
<td>“SPRAY”</td>
<td></td>
</tr>
<tr>
<td>2 Supply Type</td>
<td>Sets the paint supplying device.</td>
<td>“UNUSED”</td>
<td></td>
</tr>
<tr>
<td>3 Number of Connected CCVs</td>
<td>Sets the number of CCVs to be connected.</td>
<td>0</td>
<td>Not necessary to set.</td>
</tr>
<tr>
<td>4 Atomized Air Output</td>
<td>Sets the output method of the atomized air.</td>
<td>“I/O OUTPUT” or “LEVEL”</td>
<td></td>
</tr>
<tr>
<td>5 Pattern Output</td>
<td>Sets the output method for atomizing pattern.</td>
<td>“I/O OUTPUT” or “LEVEL”</td>
<td></td>
</tr>
</tbody>
</table>

### 3.1.2 Settings for Painting System When Using a Bell Gun

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Settings</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Gun Type</td>
<td>Sets the type of gun to be used.</td>
<td>“BELL”</td>
<td></td>
</tr>
<tr>
<td>2 Supply type</td>
<td>Sets the paint supplying device.</td>
<td>“UNUSED”</td>
<td></td>
</tr>
<tr>
<td>3 Number of Connected CCVs</td>
<td>Sets the number of CCVs to be connected.</td>
<td>0</td>
<td>Not necessary to set.</td>
</tr>
<tr>
<td>4 Turbine Output</td>
<td>Sets the method to control the number of bell rotations by turbine.</td>
<td>“I/O OUTPUT” or “LEVEL”</td>
<td></td>
</tr>
<tr>
<td>5 Shaping Output</td>
<td>Sets the method to control the shaping air pressure.</td>
<td>“I/O OUTPUT” or “LEVEL”</td>
<td></td>
</tr>
</tbody>
</table>
# 3.2 Teaching for Painting Operations

Taking an example where a workpiece, such as the one shown in the following diagram, is to be painted, the following flowchart outlines the operational procedure and the robot program for the reference job that are necessary to use the manipulator for painting operations.

## Operational Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Create a job. Teach manipulator’s motions (reference job) to perform painting.</td>
</tr>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>2</td>
<td>Set instructions to start and stop the spray. (Register the work instructions.)</td>
</tr>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>3</td>
<td>Confirm the motion. (Test run)</td>
</tr>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>4</td>
<td>Fine-tune a job. Reset the painting conditions.</td>
</tr>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>5</td>
<td>Start the actual production. (Automatic operation)</td>
</tr>
</tbody>
</table>

Face to be painted

- **Step 1**
- **Step 2**
- **Step 3**
- **Step 4**
- **Step 5**
- **Step 6**
- **Step 7**
- **Step 8**
- **Step 9**
- **Step 10**
- **Step 11**

Path 1
Path 2
Path 3
Path 4

Teaching point (Step)

- **Create a job.** Teach manipulator’s motions (reference job) to perform painting.
- **Set instructions to start and stop the spray.** Set a start instruction and an end instruction for the spray to be used for the workpiece to be painted.
- **Confirm the motion.** (Test run)
- **Fine-tune a job.** Reset the painting conditions.
- **Start the actual production.** (Automatic operation) Teaching has been successfully completed. Start the actual production with the manipulator.
## 3.2 Teaching for Painting Operations

### Reference Job

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>MOVJ VJ=25.00</td>
<td>Move to the standby position (Step 1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVL V=50</td>
<td>Move to a position near the start position for painting (Step 2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVL V=50 NWAIT</td>
<td>Move to the start position for painting (the start point of path 1) (Step 3)</td>
</tr>
<tr>
<td>0004</td>
<td>SPYON</td>
<td>Spray ON</td>
</tr>
<tr>
<td>0005</td>
<td>MOVL V=100</td>
<td>Move to the end point of path 1 (Step 4)</td>
</tr>
<tr>
<td>0006</td>
<td>MOVL V=100</td>
<td>Move to the start point of path 2 (Step 5)</td>
</tr>
<tr>
<td>0007</td>
<td>MOVL V=100</td>
<td>Move to the end point of path 2 (Step 6)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVL V=100</td>
<td>Move to the start point of path 3 (Step 7)</td>
</tr>
<tr>
<td>0009</td>
<td>MOVL V=100</td>
<td>Move to the end point of path 3 (Step 8)</td>
</tr>
<tr>
<td>0010</td>
<td>MOVL V=100</td>
<td>Move to the start point of path 4 (Step 9)</td>
</tr>
<tr>
<td>0011</td>
<td>MOVL V=100 NWAIT</td>
<td>Move to the end point of path 4 (Step 10)</td>
</tr>
<tr>
<td>0012</td>
<td>SPYOF</td>
<td>Spray OFF</td>
</tr>
<tr>
<td>0013</td>
<td>MOVL V=50</td>
<td>Move to the standby position (Step 11)</td>
</tr>
<tr>
<td>0014</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
3.3 Confirming a Step

3.3.1 FWD and BWD Operations

Use [FWD] and [BWD] on the programming pendant to confirm whether the teaching point of the step is correct or not. To move the manipulator step by step, press [FWD] or [BWD].

[FWD]: Moves the manipulator in ascending order through the step numbers. Press only [FWD] to execute a move instruction. Press [INTERLOCK] + [FWD] to carry out all of the instructions.

[BWD]: Moves the manipulator in descending order through the step numbers. Only move instructions are executed.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move the cursor to the step to be checked ➔ Press [FWD] or [BWD]††</td>
<td></td>
</tr>
</tbody>
</table>

*1 <When [FWD] is held down>
The manipulator reaches the next step and stops there.

If any instruction other than a move instruction is registered, the manipulator will not move to any further job, even if [FWD] is pressed. Move the manipulator ahead by either of the following operations.

• If any instruction other than a move instruction is to be carried out
  Press [INTERLOCK] + [FWD].
• If no instruction is to be carried out
  Press the cursor key to move the cursor to the next move instruction and then press [FWD].

<When [BWD] is held down>
The manipulator reaches the previous step and stops there.

<To skip steps>
Change the cursor’s position using the cursor keys. Then, press [FWD] or [BWD] to directly move the manipulator to the step at the cursor’s position.

NOTE
For safety reasons, set the speed of a manual operation to “Medium” or “Slow.”
3.3.2 Notes on FWD and BWD Operations

■ FWD Operation

- Moves the manipulator in ascending order through the step numbers.
  Press [FWD] to carry out a move instruction.
  Press [INTERLOCK] + [FWD] to carry out all of the instructions.

- The manipulator’s motion is completed in one cycle.
  After the END instruction has been completed, the manipulator will not move even if [FWD] is pressed. However, if the job is the called job, the manipulator moves to the next instruction after the CALL instruction.

■ BWD Operation

- Moves the manipulator in descending order through the step numbers. Only move instructions are carried out.
- After Step 1 has been completed, the manipulator will not move even if [BWD] is pressed. However, if the job is the called job, the manipulator returns to the move instruction immediately before the CALL instruction.
### 3.3.3 Selecting Manual Speed

When pressing the axis keys in the teach mode, the manipulator or each axis of the station moves to the desired position. Each axis moves at the selected manual speed. When using [FWD] or [BWD] to operate the manipulator, it moves at the selected manual speed. The selected manual speed can be confirmed with the speed that is displayed in the status area of the programming pendant.

The symbols for the manual speed selection are:

- ![Symbol](image)
  - Moves a small distance by inching.
- ![Symbol](image)
  - Moves a medium distance by inching.
- ![Symbol](image)
  - Moves a large distance by inching.
- ![Symbol](image)
  - Moves continuously at low speed.
- ![Symbol](image)
  - Moves continuously at medium speed.
- ![Symbol](image)
  - Moves continuously at high speed.

To set the manual speed, use [HIGH] or [LOW]. Refer to the following guidelines to select the manual speed.

- Every time [HIGH] is pressed, the manual speed setting changes in this order: “INCHING SMALL,” “INCHING MEDIUM,” “INCHING LARGE,” “CONTINUOUSLY LOW,” “CONTINUOUSLY MEDIUM,” and “CONTINUOUSLY HIGH.”

- Every time [LOW] is pressed, the manual speed setting changes in this order: “CONTINUOUSLY HIGH,” “CONTINUOUSLY MEDIUM,” “CONTINUOUSLY LOW,” “INCHING LARGE,” “INCHING MEDIUM,” and “INCHING SMALL.”
• When using [FWD] or [BWD] to operate the manipulator, it moves at a “CONTINUOUSLY LOW” speed even if the manual speed is set to “INCHING.”
• [HIGH SPEED] can only be used for operations with [FWD]; it cannot be used for operations with [BWD].
3.3.4 Modifying Steps

The following flowchart outlines how to modify a move instruction. The procedure to change the position data differs depending on the parameters. For information on the regular procedure of how to modify the position, refer to “3.4 Modifying Steps” of the YASNAC XRC OPERATOR’S MANUAL FOR GENERAL PURPOSE.

* For the detailed procedure, refer to the following "Simplified Position Modification" in this section.
3.4 Test Run for Painting

### Simplified Position Modification

This section describes the simplified procedure for position modification.

#### Operation

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move the cursor to the move instruction to be changed&lt;sup&gt;1&lt;/sup&gt; ➞ Move the manipulator using the axis keys&lt;sup&gt;2&lt;/sup&gt; ➞ Press [ENTER]&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

#### Explanation

- **1** Call up the JOB CONTENT display and move the cursor to the move instruction whose position data is to be changed.
- **2** Turn ON the servo power supply and move the manipulator to the changed position using the axis keys. When the manipulator is moved using the axis keys, a light appears in the top corner of the [MODIFY] key. Press [MODIFY] to turn the light OFF.
- **3** The position data is changed into the current position of the manipulator.

### 3.4 Test Run for Painting

#### 3.4.1 Test Run

In a test run, the pseudo-playback in the teach mode can be performed. The test run is a convenient way to confirm continuous paths or the motions of each instruction. This section shows the differences between the pseudo playback in a test run and the playback in the play mode.

- **NOTE**
  - In a test run, any motion speed that has been set to a speed exceeding the maximum teaching speed is limited to the maximum teaching speed.
  - Among the special operations that are available at playback in the play mode, only the machine lock is enabled in a test run.

To perform a test run, press [INTERLOCK] + [TEST START]. For safety reasons, the manipulator only moves while these keys are pressed.
3.4 Test Run for Painting

**Operation**

Select (JOB) under the top menu ➔ Select (JOB CONTENTS)*1 ➔ Press [INTERLOCK] + [TEST START]*2

**Explanation**

*1 The JOB CONTENT display of the job for which the test run is carried out appears.

*2 The manipulator starts moving according to the operation cycle. After the manipulator starts its motion, it continues to move even if [INTERLOCK] is released. However, the manipulator stops its motion if [TEST START] is released.

**NOTE**

- In a manual full-speed function, the manipulator operates the test run, the forward and the backward motions with a speed that has been set by the job in the teaching mode.
- Make sure that nobody enters the working envelope of the manipulator during the operation. Injury may result if anyone enters the working envelope of the manipulator.

3.4.2 Test Run with Actual Painting

In a regular test run, a spray signal is not output during the execution of a SPYON or SPYOF instruction. To output a spray signal in a test run, the following operation is required.

**Operation**

Select (JOB) under the top menu ➔ Select (JOB CONTENTS)*1 ➔ Press [PAINT ON/OFF]*2 ➔ Press [INTERLOCK] + [TEST START]*3

**Explanation**

*1 The JOB CONTENT display of the job for which a test run is carried out appears.

*2 Press [PAINT ON/OFF]

*3 After pressing [PAINT ON/OFF], the following message appears in the message line indicating that a spray signal can be output.

When a test run is carried out under these conditions, a spray signal is output when a SPYON instruction is carried out. The output of the spray signal turns OFF when a SYPOF instruction is carried out.

*3 The manipulator starts moving according to the operation cycle. After the manipulator starts its motion, it continues to move even if [INTERLOCK] is released. However, the manipulator stops its motion if [TEST START] is released.

**NOTE**

- In a manual full-speed function, the manipulator operates the test run, the forward and the backward motions with a speed that has been set by the job in the teaching mode.
- Make sure that nobody enters the working envelope of the manipulator during the operation. Injury may result if anyone enters the working envelope of the manipulator.
3.4 Test Run for Painting

3.4.3 Manual Full-Speed Function

In a manual full-speed function, the operation speed of the manipulator at the test run, the forward and the backward are operated with a speed which is set by the job.

**Operation**

Select (JOB) under the top menu ➔ Select (JOB CONTENTS)*1 ➔ Select [UTILITY]
➔ Select [FULL SPEED]*2

**Explanation**

*1 The JOB CONTENT display of the job for which a test run is carried out appears.
*2 The message of [Full-speed test mode] appears when a full-speed test run is carried out.

![Full-speed test mode.](image)

- In a manual full-speed function, the manipulator operates the test run, the forward and the backward motions with a speed that has been set by the job in the teaching mode.
- Make sure that nobody enters the working envelope of the manipulator during the operation. Injury may result if anyone enters the working envelope of the manipulator.

- The manual full-speed function is available when the manual speed is set as “High”. And also this function is available during the re-selection of [Full-speed] from the [UTILITY].
3.5 Play Mode

If the play mode is entered while the JOB CONTENT display is displayed, the PLAYBACK display appears.

① JOB CONTENT
The cursor moves as it follows the actual playback operation, and the job contents are automatically scrolled.

② SETTING SPEED OVERRIDES
Displayed when the speed override has been selected and a setting made.

③ CYCLE TIME
The measured result of the manipulator’s operation time is displayed. The time for the previous cycle is reset at the start of each operation, and new measurements are taken. The user can specify whether to display the cycle time or not. For details, refer to the following "3.5.1 Setting Display/No-display of Cycle Time ".

④ MEASURE START JOB
The starting step for taking measurements. Measurement starts at the same time as when the top corner of the [START] key’s light appears on the playback panel and the playback operation starts.

⑤ MOVING TIME
The total time that the manipulator moved during playback (⑥) is displayed.

⑥ PLAYBACK TIME
The time from when measurement starts until it finishes is displayed. Measurement is complete when the manipulator stops for any reason and the top corner of the [START] key’s light appears on the playback panel.
3.5 Play Mode

### 3.5.1 Setting Display/No-display of Cycle Time

Whether the cycle time is displayed in the PLAYBACK display can be set using the following operation.

**Operation**

Select {DISPLAY} under the top menu in the PLAYBACK display ➔ Select {CYCLE TIME} \(^1\)

**Explanation**

\(^1\) The cycle time is displayed. If the steps are repeated, the cycle time will not be displayed.

### 3.5.2 Playback

A playback operation is an operation to carry out taught jobs. To play back jobs using the playback panel, perform the following operation.

**Operation**

Press [REMOTE] on the playback panel to turn OFF the [REMOTE] key’s light \(^1\) ➔ Press [PLAY] on the playback panel \(^2\) ➔ Press [START] on the playback panel \(^3\)

**Explanation**

\(^1\) To start up the jobs, use the playback panel.

\(^2\) The play mode is entered.

\(^3\) [START] on the playback panel lights up, and the manipulator starts moving.

■ Stop Spraying during the Playback

While carrying out a paint operation job in play mode, the user can stop only the spray signal without stopping the manipulator.

**Operation**

Press [PAINT ON/OFF] during playback \(^1\)

**Explanation**

\(^1\) If [PAINT ON/OFF] is pressed, the following message appears, in the message line, and the output of the spray signal turns OFF.

![Paint inhibit signal is ON.]

If [PAINT ON/OFF] is pressed again, the message disappears, and the spray signal is output again.
3.6 Anticipation Output Function

The anticipation output function is a function to quicken or slow the execution timing of painting start/end instructions. Using this function, a paint start or end instruction can be carried out before or after the step is reached.

“ANT=” is used when anticipation output is performed.
“ANT=” can be added to the following two instructions:

- SPYON (spray start)
- SPYOF (spray stop)

To carry out anticipation output, set the time “ANT=**second,” add it to the SPYON or SPYOF instruction, and set “NWAIT” to the move instruction of the step.

Setting the time to a negative value (-) advances the signal output.
Setting the time to a positive value (+) delays the signal output.

3.6.1 Example

Advanced Signal Output

While the manipulator moves towards step n, painting starts 0.5 seconds before step n is reached; and stops 0.5 seconds before step n+1 is reached while the manipulator moves towards step n+1.

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>n-2</td>
<td>MOVL</td>
</tr>
<tr>
<td>n-1</td>
<td>MOVL NWAIT</td>
</tr>
<tr>
<td></td>
<td>SPYON ANT=-0.5</td>
</tr>
<tr>
<td>n</td>
<td>MOVL NWAIT</td>
</tr>
<tr>
<td></td>
<td>SPYOF ANT=-0.5</td>
</tr>
<tr>
<td>n+1</td>
<td>MOVL</td>
</tr>
<tr>
<td>:</td>
<td>:</td>
</tr>
</tbody>
</table>

Delayed Signal Output

While the manipulator moves towards step n+1, painting starts 0.5 seconds after step n is reached; and stops 0.5 seconds after step n+1 is reached while the manipulator moves towards the next step.

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>n-2</td>
<td>MOVL</td>
</tr>
<tr>
<td>n-1</td>
<td>MOVL NWAIT</td>
</tr>
<tr>
<td></td>
<td>SPYON ANT=0.5</td>
</tr>
<tr>
<td>n</td>
<td>MOVL NWAIT</td>
</tr>
<tr>
<td></td>
<td>SPYOF ANT=0.5</td>
</tr>
<tr>
<td>n+1</td>
<td>MOVL</td>
</tr>
<tr>
<td>:</td>
<td>:</td>
</tr>
</tbody>
</table>
3.6.2 Notes on Anticipation Output Function

- If the time required by the manipulator to reach step n from step n-1 by a SPYON instruction is shorter than the time set at “ANT=XX,” painting starts when the cursor moves to the SPYON instruction.

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>n-2</td>
<td>MOVL</td>
</tr>
<tr>
<td>n-1</td>
<td>MOVL NWAIT</td>
</tr>
<tr>
<td></td>
<td>SPYON ANT=2.0</td>
</tr>
<tr>
<td>n</td>
<td>MOVL</td>
</tr>
<tr>
<td>n+1</td>
<td>MOVL</td>
</tr>
</tbody>
</table>

If the time required by the manipulator to reach n+1 from n is shorter than the time set at “ANT=XX,” painting starts when the manipulator reaches step n+1.

- If NWAIT is not added to step n, painting starts immediately after the manipulator reaches step n.

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>n-2</td>
<td>MOVL</td>
</tr>
<tr>
<td>n-1</td>
<td>MOVL NWAIT</td>
</tr>
<tr>
<td></td>
<td>SPYON ANT=2.0</td>
</tr>
<tr>
<td>n</td>
<td>MOVL</td>
</tr>
</tbody>
</table>

- If a CALL or JUMP instruction is added before the SPYON instruction, the NWAIT operation is interrupted and the setting of “ANT=XX” is disregarded. Painting starts when the cursor moves to the SPYON instruction.

- The NWAIT operation is not performed in a FWD/BWD operation or during playback in one step. Therefore, the same operations as those done when NWAIT is not set are performed.

- Because the NWAIT operation is not continued when the manipulator is restarted after an emergency stop, the path differs from the continuous operation path.
4 Work Instructions

4.1 SPYON

The SPYON instruction is used to start painting. As a work start instruction, the instruction turns ON the Specific Output Signals corresponding to the specified gun number. The instruction also sets the advance time for turning ON the splay and the delay time for turning ON the atomizing in the register. These times were set in the setting file of the painting system characteristics.

Additional items for the SPYON instruction are as follows.

1. **Gun No. (Setting range: 1 to 4)**
   - Controls the work start signal of the Specific Output Signals corresponding to the specified gun number.
   - If setting is omitted, 1 is applied for the gun number.

2. **Execution timing (Setting range: -327.68 to 327.67)**
   - Sets the anticipation time (advance time, delay time) in units of seconds.
   - If setting is omitted, 0 is applied for the anticipation time.

4.1.1 Registering the SPYON Instruction

To easily register the SPYON instruction, refer to " Registering the SPYOF Instruction in a One-touch Operation “ in this section.

**Operation**

Move the cursor to the address area ➔ Press the [INFORM LIST] ➔ Select (DEVICE) ➔ Select (SPYON) ➔ Press [SELECT] and set each item in the DETAIL EDIT display ➔ Press [ENTER]

**Explanation**

*1 The instruction list appears.
4.1 SPYON

*2 “SPYON” appears in the input buffer line.

*3 The DETAIL EDIT display appears. Move the cursor to setting and press [SELECT]. Use the number keys to enter the setting and press [ENTER].

*4 The settings are displayed in the input buffer line. When [ENTER] is pressed, the settings are registered in the job. If the settings are not to be registered, press [CANCEL] to return to the job contents display.

Registering the SPYON Instruction in a One-touch Operation

**Operation**

Press [8 SPRAY ON]*1 ➔ Press [ENTER]*2

**Explanation**

*1 “SPYON” appears in the input buffer line.

*2 The SPYON instruction has been registered.
### 4.1.2 Notes on the SPYON Instruction

When a SPYON instruction is carried out, the Specific Output Signals corresponding to the specified gun number turns ON as a work start instruction. The instruction also sets the advance time for turning ON the spray and the delay time for turning ON the atomizing in the register. These times were set in the setting file of the painting system characteristics. The concurrent I/O ladder program controls the actual outputs of the spray signal and atomization signal according to the ON status of the work start instruction of the Specific Output Signals and the advance time for turning ON the spray and the delay time for turning ON the atomizing that are set in the register. The graph shows the timing of when the spray signal and the atomization pressure signal are turned ON.

When the system configuration or the output destination of the spray or atomization pressure signals is changed, be sure to make changes in the concurrent I/O ladder program.

### 4.2 SPYOF

The SPYOF instruction is used to complete painting. The instruction turns OFF the Specific Output Signals (a work start instruction) corresponding to the specified gun number. The instruction also sets the advance time for turning OFF the spray and the delay time for turning OFF the atomizing in the register. These times were set in the setting file of the painting system characteristics.

Additional items for the SPYOF instruction are as follows.

1. **Gun No. (Setting range: 1 to 4)**
   - Controls the work start signal of the Specific Output Signals corresponding to the gun number.
   - If setting is omitted, 1 is applied for the gun number.

2. **Execution timing (Setting range: -327.68 to 327.67)**
   - Sets the anticipation time (advance time, delay time) in units of seconds.
   - If setting is omitted, 0 is applied for the anticipation time.
4.2.1 Registering the SPYOF Instruction

To register the SPYOF instruction in a one-touch operation, refer to “Registering the SPYOF Instruction in a One-touch Operation” in this section.

**Operation**

Move the cursor to the address area ➔ Press [INFORM LIST] ➔ Select (DEVICE) ➔ Select {SPYOF} ➔ Press [SELECT] and set each item in the DETAIL EDIT display ➔ Press [ENTER]

**Explanation**

*1 The instruction list appears.

*2 “SPYOF” appears in the input buffer line.

*3 The DETAIL EDIT display appears. Move the cursor to setting and press [SELECT]. Use the number keys to enter each setting and press [ENTER].

*4 The settings are displayed in the input buffer line. When [ENTER] is pressed, the settings are registered in the job. If the settings are not to be registered, press [CANCEL] to return to the job contents display.
4.2 SPYOF

Registering the SPYOF Instruction in a One-touch Operation

**Operation**

Press [9 SPRAY OFF]*1 ➔ Press [ENTER]*2

**Explanation**

*1 “SPYOF” appears in the input buffer line.

*2 The SPYOF instruction has been registered.

### 4.2.2 Notes on the SPYOF Instruction

When a SPYOF instruction is carried out, the Specific Output Signals (a work start instruction) corresponding to the specified gun number turns OFF. The instruction also sets the advance time for turning OFF the spray and the delay time for turning OFF the atomizing in the register. These times were set in the setting file of the painting system characteristics.

The concurrent I/O ladder program controls the actual outputs of the spray signal and atomization signal according to the OFF status of the work start instruction of the Specific Output Signals and the advance time for turning OFF the spray and the delay time for turning OFF the atomizing that are set in the register. The graph shows the timing of when the spray signal and the atomization pressure signal are turned OFF.

When the system configuration or the output destination of the spray or atomization pressure signals is changed, be sure to make changes in the concurrent I/O ladder program.
The PAINTSET instruction is used to set the painting conditions for the painting machine controller.

Additional items for the PAINTSET instruction are as follows.

1. **Gun No. (Setting range: 1 to 3)**
   - Controls the spray signal of the painting system file corresponding to the gun number.
   - If setting is omitted, 1 is applied for the gun number.

2. **Painting condition file No. (Setting range: 1 to 128)**
   - Outputs the painting conditions for each setting in the painting condition file to the paint control panel.

3. **Amount of discharge (Setting range: 0 to 999 [cc/min])**
   - Outputs the setting for the amount of discharge to the paint control panel if the paint control panel is used to control the paint supplying device (when the paint supply that was set in the settings for the painting system is not connected).

4. **Level of the amount of discharge (Setting range: 1 to 128)**
   - Outputs the setting for the level of the amount of discharge to the paint control panel if the paint control panel is used to control the paint supplying device.

5. **Number of the bell rotations (Setting range: 1 to 999 [krpm])**
   - Outputs the data to the group of general-purpose output that has been set in the painting system file.

6. **Level of the number of bell rotations (Setting range: 1 to 128)**
   - If the output type of rotations in the painting system is set to “LEVEL”:
     - Outputs the data to the general-purpose output that has been set in the painting system file.
   - If the output type of rotations in the painting system is set to anything other than “LEVEL”:
     - Does not function even if a setting is made.

7. **Shaping air pressure (Setting range: 1 to 999 [kPa])**
   - Outputs the data to the group of general-purpose output that has been set in the painting system file.
4.3 PAINTSET

- **Level of the shaping air pressure (Setting range: 1 to 128)**
  - If the shape output type in the painting system is set to “LEVEL”:
    - Outputs the data to the general-purpose output that has been set in the painting system file
  - When the shape output type in the painting system is set to anything other than “LEVEL”:
    - Does not function even if a setting is made.

- **High-voltage level (Setting range: 1 to 3)**
  - Outputs the data to the group of general-purpose output that has been set in the painting system file.

- **Operation speed (Setting range: 0.1 to 1500.0 [mm/s])**
  - Sets the moving speed of the manipulator for a painting operation.
  - If the speed is not set in the move instruction in the PAINTSET section, the manipulator moves at the speed set here.

**NOTE**
If each item (amount of discharge, revolutions, shape, high-voltage, operation speed) is set after the painting condition file number has been set, the settings in the painting condition file are disregarded and the latter settings become valid.

### 4.3.1 Registering the PAINSET Instruction

**Operation**

Move the cursor to the address area ➔ Press [INFORM LIST] ➔ Select {DEVICE} ➔ Select {PAINSET} ➔ Press [SELECT] and set each item in the DETAIL EDIT display ➔ Press [ENTER]

**Explanation**

*1 The instruction list appears.

*2 “PAINTSET” appears in the input buffer line.
*3 The DETAIL EDIT display appears. Move the cursor to setting and press [SELECT]. Use the number keys to enter each setting and press [ENTER].

*4 The settings are displayed in the input buffer line. When [ENTER] is pressed, the settings are registered in the job. If the settings are not to be registered, press [CANCEL] to return to the job contents display.

4.4 CALL

The CALL instruction is used to call a specified job. This section describes an example where the job registration table is specified.

Additional items for the CALL instruction are as follows.

1. **Job registration table No. (Setting range: 1 to 3)**
   Sets the job registration table number.

2. **Job registration No. (Setting range: 1 to 1024)**
   Sets the registration number of the job that is registered in a specified job registration table.
Example of CALL Job

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>WAI  DIN OT#(1)=ON</td>
<td>Waits for a start signal to be input.</td>
</tr>
<tr>
<td>0002</td>
<td>DIN  B000  OG#(2)</td>
<td>Enter the job registration number.</td>
</tr>
<tr>
<td>0003</td>
<td>CALL  JET#(1) ENTRY=B000</td>
<td>Calls the job corresponding to the registration number that is entered in B000.</td>
</tr>
<tr>
<td>0004</td>
<td>PULSE  OT#(1)  T=1.00</td>
<td>Outputs the work end signal in pulses.</td>
</tr>
<tr>
<td>0005</td>
<td>END</td>
<td></td>
</tr>
<tr>
<td>0006</td>
<td>MOVL V=100</td>
<td></td>
</tr>
</tbody>
</table>

4.4.1 What Is a Job Registration Table?

In a job registration table, jobs that are read out by instructions such as the CALL instruction can be registered. Three files are available for the job registration table. Each job registration table can hold 1024 jobs. A job can be registered or edited in the job registration table even during play mode. The updated table becomes valid the next time when the job registration table is referred by instructions such as the CALL instruction.

How to Set the Job Registration Table

**Operation**

Select {JOB} under the top menu ➔ Select {JOB REGISTRATION} *1 ➔ Select the item and make the settings

**Explanation**

*1 The JOB REGISTRATION display appears.

* TABLE NUMBER (Setting range: 1 to 3)
The job registration table number.
② **NO**
   The job registration number.

③ **JOB NAME**
   Sets the job name.
   To call up the job list so that a job can be entered, press [SELECT].
   To delete the registered job, press [ENTER] without selecting a job.

④ **CTRL GROUP**
   Displays the control group of the selected job.

### 4.4.2 Registering the CALL Instruction

**Operation**

Move the cursor to the address area ➔ Press [INFORM LIST]**  ➔ Select {CONTROL}  
 ➔ Select {CALL} ➔ Press [ENTER]

**Explanation**

**1** The instruction list appears.
5 Painting Condition File

5.1 What Is a Painting Condition File?

A painting condition file is a file in which the painting conditions are registered. Use this file to make the setting and correction of the painting instructions easier.

The XRC’s internal memory can usually hold 128 painting condition files. One painting condition package can contain 128 painting condition files. By using an optional PC card, 1024 painting condition packages can be managed.

The PAINTSET instruction is used to make the settings for a painting condition file.
5.2 Managing a Painting Condition File

1. **CONDITION NO. (Setting range: 1 to 128)**
   Displays the painting condition number.

2. **COMMENT**
   Maximum eight characters.

3. **PAINT VOLUME**
   Sets the amount of paint to be discharged. The setting is made in units of cc/min or by levels, depending on the connected device that is registered in the settings for the painting system.\(^1\)

4. **PAINT SPEED**
   Sets the moving speed of the manipulator in a painting operation.

5. **BELL ROTATION**
   Sets the number of the bell rotations of the bell gun. The setting is made in units of krpm or by levels, depending on the connected device that is registered in the settings for the painting system.\(^2\)

6. **SHAPING AIR**
   Sets the shaping air pressure of the bell gun. The setting is made in units of kPa or by levels, depending on the connected device that is registered in the settings for the painting system.\(^3\)

7. **HIGH VOLTAGE**
   Sets the high voltage of the bell gun. The setting is made by levels.

\(^1\) The setting for the amount of discharge differs depending on the type of the supply section that was registered in the settings for the painting system.
   - When the supply section is set to “UNUSED”:
     The amount of discharge is set by levels.
   - When the supply section is set to “FGP”:
     The amount of discharge is set in units of cc/min.

\(^2\) The setting for the number of the bell rotations differs depending on the number of rotations to be output that was registered in the settings for the painting system.
   - When the number of rotations to be output is set to “I/O OUTPUT”:
     The number of bell rotations is set in units of krpm.
   - When the number of rotations to be output is set to “LEVEL”:
     The number of bell rotations is set by levels.
5.2 Managing a Painting Condition File

3 The setting for the shaping air pressure differs depending on the shape output that was registered in the settings for the painting system.
   • When the shape output is set to "I/O OUTPUT":
     The shaping air pressure is set in units of kpa.
   • When the shape output is set to "LEVEL":
     The shaping air pressure is set by levels.

5.2.1 Calling Up the List of Painting Condition Files

Operation

Move the cursor to {PAINT} under the top menu ➔ Press [SELECT] ➔ Move the cursor to {DATABASE LIST} ➔ Press [SELECT] to call up the DATABASE LIST display

5.2.2 Registering a Painting Condition File (Optional)

Register a specified painting condition file as follows.

Operation

Move the cursor to the address area ➔ Select {DATA} ➔ Select {REGISTER DATABASE} ➔ Use the number keys to type the model number of the car

NOTE

When a PC card is set as an option, a painting condition file cannot be changed without the PC card inserted. Be sure to insert the PC card before registering or changing a painting condition file.
5.3 Editing a Painting Condition File

5.2.3 Deleting a Painting Condition File

Delete a specified painting condition file as follows.

**Operation**

Move the cursor to the address area ➔ Select {DATA} ➔ Select {DELETE DATABASE}
 ➔ Use the number keys to type the model number of the car

5.3 Editing a Painting Condition File

**NOTE**

When a PC card is set as an option, a painting condition file cannot be changed without the PC card inserted. Be sure to insert the PC card before registering or changing a painting condition file.

5.3.1 Calling Up a Painting Condition File

**Operation**

Select {CONDITION NO.} ➔ Display the number of the desired condition file *1

**Explanation**

*1 Two methods are available to display the desired condition file number.

- Using the page key

  The next condition file number is displayed every time the page key is pressed.

  To display the previous condition file number, press [SHIFT] + the page key.

- Using the number keys

  Move the cursor to the condition file number and press [SELECT]. Use the number keys to type the desired condition file number and press [ENTER].
5.3 Editing a Painting Condition File

5.3.2 Editing a Painting Condition File

Follow these steps to edit {COMMENT}.

**Operation**

Select {COMMENT} ➔ Type the comment using alphanumeric characters

Follow these steps to edit {PAINT VOLUME}.

**Operation**

Select {PAINT VOLUME} ➔ Type the volume of paint using the number keys

Follow these steps to edit {PAINT SPEED}.

**Operation**

Select {PAINT SPEED} ➔ Type the speed using the number keys

Follow these steps to edit {BELL ROTATION}.

**Operation**

Select {BELL ROTATION} ➔ Type the number of rotations using the number keys

Follow these steps to edit {SHAPING AIR}.

**Operation**

Select {SHAPING AIR} ➔ Type the pressure using the number keys

Follow these steps to edit {HIGH VOLTAGE}.

**Operation**

Select {HIGH VOLTAGE} ➔ Type the voltage using the number keys
6 Painting System Setting File

**① GUN TYPE**
Sets the gun type.
“SPRAY” or “BELL” can be selected.

**② PAINT SUPPLY**
Sets the paint supplying device.
“UNUSED” or “FGP” can be selected, however, normally select “UNUSED.”
- When “UNUSED” is selected
  The paint supplying device is controlled by the paint control panel. Therefore, control of the amount of discharge from the XRC is controlled by the I/O output.
- When “FGP” is selected
  The paint supplying device, FGP, is controlled by the XRC. The amount of discharge is controlled by the servo.

**③ CCV NUMBER (Setting range: 0 to 52)**
Sets the number of CCVs (the number of painting colors) to be connected. When a CCV is connected to the paint control panel, set the CCV number to zero.

**④ BELL ROTATION OUTPUT**
Sets the output method to control the number of bell rotations.
“I/O OUTPUT,” “LEVEL,” “CURRENT (4 - 20mA),” “VOLTAGE (0 - 5V),” or “VOLTAGE (0 - 10V)” can be selected.
- When “I/O OUTPUT” is selected
  The paint control panel controls the number of bell rotations. The set number of bell rotations (krpm) is output for the output bit specified in the painting device characteristics file.
- When “LEVEL” is selected
  The paint control panel controls the number of bell rotations. The level value that was set is output for the output bit specified in the painting device characteristics file.

**⑤ SHAPING OUTPUT**
Sets the output method to control shaping.
“I/O OUTPUT,” “LEVEL,” “CURRENT (4 - 20mA),” “VOLTAGE (0 - 5V),” or “VOLTAGE (0 - 10V)” can be selected.
- When “I/O OUTPUT” is selected
  The paint control panel controls shaping. The shaping air pressure (kPa) that was set is output for the output bit specified in the painting system characteristics file.
• When “LEVEL” is selected
  The paint control panel controls shaping. The level value that was set is output for the
  output bit specified in the painting system characteristics file.

6.1 Calling Up a Painting System Setting File

**Operation**

Select the number of the painting gun in {GUN NO} of the DETAIL EDIT display ➔ Call up
the desired painting system setting file using the page key ➔

**Explanation**

1. Press the page key ➔ to call up the next PAINT SYSTEM CONFIG. file.
2. Press the [SHIFT] + page key ➔ to call up the previous PAINT SYSTEM CONFIG.
   file.

6.2 Editing a Painting System Setting File

Follow these steps to edit {GUN TYPE}.

**Operation**

Select {GUN TYPE} ➔ Select the corresponding gun type ➔ Press [ENTER]

Follow these steps to edit {PAINT SUPPLY}.

**Operation**

Select {PAINT SUPPLY} ➔ Select the corresponding type for the paint supply ➔ Press
[ENTER]

Follow these steps to edit {CCV NUMBER}.

**Operation**

Select {CCV NUMBER} ➔ Use the number keys to type the number of CCVs
Follow these steps to edit {BELL ROTATION OUTPUT}.

**Operation**

Select {BELL ROTATION OUTPUT} ➤ Select the corresponding output of the number of rotations ➤ Press [ENTER]

Follow these steps to edit {SHAPING OUTPUT}.

**Operation**

Select {SHAPING OUTPUT} ➤ Select the corresponding shape output ➤ Press [ENTER]
7 Painting System Characteristics Setting File

1 **PAINT VOL-FGP**
   The setting differs depending on the gun type registered in the settings for the painting system.
   - When “UNUSED” is selected
     The setting does not affect the manipulator’s motion.
   - When “FGP” is selected
     The FGP capacity (the amount of discharge per rotation) is set in units of cc.

2 **MAX PAINT VOL**
   The setting differs depending on the gun type registered in the settings for the painting system.
   - When “UNUSED” is selected
     The setting does not affect the manipulator’s motion.
   - When “FGP” is selected
     The maximum allowable amount of discharge of FGP is set in units of cc.

3 **SPY ON ADVANCE TIME**
   Sets the shifting time of the advanced signal output for when the spray signal is turned ON. The advance time for outputting spray is set in the register corresponding to the gun number when the SPYON instruction is carried out.

4 **SPY OFF ADVANCE TIME**
   Sets the shifting time of the advanced signal output for when the spray signal is turned OFF. The advance time for outputting spray is set in the register corresponding to the gun number when the SPYOF instruction is carried out.

5 **ATOM ON DELAY TIME**
   Sets the timing of the advanced signal output for turning ON the atomization pressure signal for when the spray signal is turned ON, and the timing of the delayed signal output for turning OFF the atomization pressure signal for when the spray signal is turned OFF.
When the SPYON instruction is carried out, the delay time of the atomization pressure signal is set in the register corresponding to the number of the gun.

7. ATOM OFF DELAY TIME
Sets the timing of the advanced signal output for turning OFF the atomization pressure signal for when the spray signal is turned OFF, and the timing of the delayed signal output for turning ON the atomization pressure signal for when the spray signal is turned ON.

When the SPYOF instruction is carried out, the delay time of the atomization pressure signal is set in the register corresponding to the number of gun.

7. PAINT VOLUME
Sets the output destination of the amount of discharge and also the number of output bits.

8. PAINT CONDITION
Sets the output destination of the painting conditions and also the number of output bits.

9. TURBIN
Sets the output destination of the number of rotations (turbine) and also the number of output bits.

• When “I/O OUTPUT” is selected
  Sets the output destination of the number of bell rotations and also the number of output bits.

• When “LEVEL” is selected
  Sets the output destination of the level of the number of bell rotations and also the number of output bits.

10. SHAPING
Sets the output destination of the shape (pattern) and also the number of output bits.

• When “I/O OUTPUT” is selected
  Sets the output destination of the shaping and also the number of output bits.

• When “LEVEL” is selected
  Sets the destination of the shaping level and also the number of output bits.

11. HIGH VOLTAGE
Sets the output destination of high voltage and also the number of output bits.

7.1 Editing the Painting System Characteristics Setting File

Operation
Select an item to be edited ➔ Use the number keys to type the new settings
7.2 ON Timing of the Work Start Instruction for the SPYON Instruction

The graph shows the ON timing of the work start instruction of the Specific Output Signals when the SPYON instruction is carried out. The ON timing depends on the relationship between the anticipation time of the SPYON instruction, the advance time for turning ON the spray, and the delay time for turning ON the atomizing.

7.3 OFF Timing of the Work Start Instruction for the SPYOF Instruction

The graph shows the OFF timing of the work start instruction of the Specific Output Signals when the SPYOF instruction is carried out. The OFF timing depends on the relationship between the anticipation time of the SPYOF instruction, the advance time for turning OFF the spray, and the delay time for turning OFF the atomizing.
7.4 Notes on the ON/OFF Timing of the Work Start Instruction

When Executing the SPYON Instruction

- If the total of the anticipation time, the advance time for turning ON the spray, and the delay time for turning ON the atomizing of the SPYON instruction that has been set is longer than the time required by the manipulator to reach step n from step n-1, the timing of when the work start instruction turns ON can be explained by the following graph.

When Executing the SPYOF Instruction

- If the total of the anticipation time, the advance time for turning OFF the spray, and the delay time for turning OFF the atomizing of the SPYOF instruction that has been set is longer than the time required by the manipulator to reach step n+1 from step n, the timing of when the work start instruction turns OFF can be explained by the following graph.
If the total of the anticipation time, the advance time for turning OFF the spray, and the delay time for turning OFF the atomizing of the SPYOF instruction that has been set is longer than the time required by the manipulator to reach step \( n+1 \) from step \( n \), the timing of when the work start instruction turns OFF can be explained by the following graph.
8 File Management

8.1 Operation Flowchart

The following flowchart indicates the procedures needed for operations such as file transfer and file management performed with the programming pendant.
8.2 Savable Data and File Names

The FLOPPY DISK/PC CARD display shows the eight groups or classifications of data that can be saved.
The table on the next page lists the kind of data in the eight groups. The table shows examples of the file names that are automatically given after the data is saved.

The saved data can be reloaded into the XRC’s memory.
However, the data of the groups marked with a black square, "■,” have limitations when loading, because these groups contain information related to the system.

To load the data of the groups marked with a black square, “■,” refer to the “YASNAC XRC INSTRUCTIONS.”

The numbers ① through ⑤ in the above display correspond to the numbers 1 through 5 in the table on the next page.

- If the operator selects ⑤ “BATCH USER MEMORY,” all data belonging to groups ① and ② are saved as one file.
- When ⑤ “BATCH USER MEMORY,” ⑥ “BATCH CMOS,” or ⑦ “SYSTEM DATA” is selected, jobs are also saved, but the job headers of the saved jobs are not saved to an external memory unit. Saving of job headers is only completed if ① “JOB” is selected to save the data.
### Savable Data and File Names

<table>
<thead>
<tr>
<th>Savable Data</th>
<th>File Names</th>
<th>Save</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ SYSTEM DATA</td>
<td>ALLCMSxx.HEX</td>
<td>O</td>
<td>x</td>
</tr>
<tr>
<td>○ BATCH CMOS</td>
<td>CMOSxx.HEX</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>○ BATCH USER MEMORY</td>
<td>JOBxx.HEX</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>○ JOB</td>
<td>Job name.JBI</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Job name.JBR</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>○ FILE/GENERAL DATA</td>
<td>Tool data</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Weaving data</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>User coordinates</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Variables</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Arc start conditions</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Arc end conditions</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Welding conditions- auxiliary data</td>
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<td>O</td>
</tr>
<tr>
<td></td>
<td>Welder characteristics</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Collision detection level settings</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Servo-gun pressurized force</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Servo-gun dry spot pressurized force</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Spot-gun characteristics</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Spot-welder characteristics</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Short/full open position data</td>
<td>O</td>
<td>O</td>
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<tr>
<td></td>
<td>Painting color characteristics</td>
<td>O</td>
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<tr>
<td></td>
<td>Painting conditions</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Paint filling amount</td>
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<td>O</td>
</tr>
<tr>
<td></td>
<td>Job registration table</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>○ PARAMETER</td>
<td>Robot matching parameter</td>
<td>O</td>
<td>O</td>
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<tr>
<td></td>
<td>System definition parameter</td>
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<td>O</td>
</tr>
<tr>
<td></td>
<td>Coordinate origin parameter</td>
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<td>O</td>
</tr>
<tr>
<td></td>
<td>System matching parameter</td>
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<td>O</td>
</tr>
<tr>
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<td>CIO parameter</td>
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<td></td>
<td>Function definition parameter</td>
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<tr>
<td></td>
<td>Parameter for each application</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Communication (general-purpose) parameter</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Sensor parameter</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Servo parameter</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Servomotor parameter</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Motion control parameter</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Servo power block parameter</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

E: Edit mode, M: Management mode
O: Available, x: Not available
### 8.2 Savable Data and File Names

<table>
<thead>
<tr>
<th>Savable Data</th>
<th>File Names</th>
<th>Save</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARAMETER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion function parameter</td>
<td>MF.PRM</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Motion communication parameter</td>
<td>RSM.PRM</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>PC definition parameter</td>
<td>PCD.PRM</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I/O DATA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concurrent I/O program</td>
<td>CIOPRGLST</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>I/O name</td>
<td>IONAME.DAT</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>SYSTEM DATA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User word registration name</td>
<td>UWORD.DAT</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>SV monitor signal</td>
<td>SVMON.DAT</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Variable name</td>
<td>VARNAME.DAT</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Second home position</td>
<td>HOME2.DAT</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Alarm history</td>
<td>ALMHIST.DAT</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Home positioning data</td>
<td>ABSO.DAT</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>System information</td>
<td>SYSTEM.SYS</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Painting system settings</td>
<td>PAINTSYS.DAT</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Painting device characteristics</td>
<td>PAINTDEV.DAT</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

- E: Edit mode, M: Management mode
- O: Available, ×: Not available
# 9 Work Instruction List

The following table lists the instructions related to the painting application.
- The parentheses indicate data such as alphanumeric characters.
- For instructions which have more than one item in one frame, select only one.

<table>
<thead>
<tr>
<th>Painting Instruction</th>
<th>Function</th>
<th>Item</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPYON</strong> <em>(Spray ON)</em></td>
<td>Turns ON the work start instruction of the Specific Output Signals for the specified painting gun.</td>
<td>GUNNO = (Gun No.)</td>
<td>1 to 4</td>
<td>Applied when several guns are provided.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ANT = (Anticipation time)</td>
<td>-327.68 to 327.67 seconds</td>
<td></td>
</tr>
<tr>
<td>Example of Use</td>
<td>SPYON</td>
<td>GUNNO=2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPYON</td>
<td>ANT=1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPYON</td>
<td>GUN=1 ANT=-2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPYOF</strong> <em>(Spray OFF)</em></td>
<td>Turns OFF the work start instruction of the Specific Output Signals for the specified painting gun.</td>
<td>GUNNO = (Gun No.)</td>
<td>1 to 4</td>
<td>Applied when several guns are provided.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ANT = (Anticipation time)</td>
<td>-327.68 to 327.67 seconds</td>
<td></td>
</tr>
<tr>
<td>Example of Use</td>
<td>SPYOF</td>
<td>GUNNO=2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPYOF</td>
<td>ANT=1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPYOF</td>
<td>GUN=1 ANT=-2.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The table below illustrates the function of the PAINTSET (Paint Set) command, which is used to set the painting conditions for the paint control panel.

### Function Set

<table>
<thead>
<tr>
<th>Item</th>
<th>Function Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUNNO = (Gun No.)</td>
<td>1 to 4 Applied when several guns are provided.</td>
</tr>
<tr>
<td>PCF# ((Painting condition file No.))</td>
<td>1 to 128</td>
</tr>
<tr>
<td>PF = (Amount of discharge)</td>
<td>0 to 999 cc/min</td>
</tr>
<tr>
<td>PFL = (Level for the amount of discharge)</td>
<td>1 to 128</td>
</tr>
<tr>
<td>BR = (Number of bell rotations)</td>
<td>0 to 999 krpm</td>
</tr>
<tr>
<td>BRL = (Level of number of bell rotations)</td>
<td>1 to 128</td>
</tr>
<tr>
<td>SH = (Shaping air pressure)</td>
<td>0 to 999 kPa</td>
</tr>
<tr>
<td>SHL = (Level of shaping air pressure)</td>
<td>1 to 128</td>
</tr>
<tr>
<td>HVL = (Level of high voltage)</td>
<td>0 to 3</td>
</tr>
<tr>
<td>PV = (Painting operation speed)</td>
<td>0.1 to 1500.0 mm/s</td>
</tr>
</tbody>
</table>

### Example of Use

- `PAINTSET PCF#(1)`
- `PAINTSET PF=200 BR=500 SH=500`
- `PAINTSET PCF#(100) PV=1000`