YRC1000
MATERIAL HANDLING, PRESS TENDING, CUTTING, AND OTHER APPLICATIONS
OPERATOR’S MANUAL

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

MOTOMAN INSTRUCTIONS
YRC1000 INSTRUCTIONS
YRC1000 OPERATOR’S MANUAL (GENERAL) (SUBJECT SPECIFIC)
YRC1000 MAINTENANCE MANUAL
YRC1000 ALARM CODES (MAJOR ALARMS) (MINOR ALARMS)

The YRC1000 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.
The YRC1000 operator’s manual above consists of “GENERAL” and “SUBJECT SPECIFIC”.
The YRC1000 alarm codes above consists of “MAJOR ALARMS” and “MINOR ALARMS”.

Please have the following information available when contacting Yaskawa Customer Support:
• System
• Primary Application
• Software Version (Located on Programming Pendant by selecting: (Main Menu) - {System Info} - {Version})
• Robot Serial Number (Located on robot data plate)
• Robot Sales Order Number (Located on controller data plate)

Part Number: 178647-1CD
Revision: 1
DANGER

• This manual describes the various components of the YRC1000 system and general operations. Read this manual carefully and be sure to understand its contents before handling the YRC1000. Any matter, including operation, usage, measures, and an item to use, not described in this manual must be regarded as “prohibited” or “improper”.

• General information related to safety are described in “Chapter 1. Safety” of the YRC1000 INSTRUCTIONS. To ensure correct and safe operation, carefully read “Chapter 1. Safety” of the YRC1000 INSTRUCTIONS.

CAUTION

• In some drawings in this manual, protective covers or shields are removed to show details. Make sure that all the covers or shields are installed in place before operating this product.

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids the product warranty.

NOTICE

• 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.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the YRC1000.

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

**DANGER**
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Safety Signs identified by the signal word DANGER should be used sparingly and only for those situations presenting the most serious hazards.

**WARNING**
Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury. Hazards identified by the signal word WARNING present a lesser degree of risk of injury or death than those identified by the signal word DANGER.

**CAUTION**
Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury. It may also be used without the safety alert symbol as an alternative to “NOTICE”.

**NOTICE**
NOTICE is the preferred signal word to address practices not related to personal injury. The safety alert symbol should not be used with this signal word. As an alternative to “NOTICE”, the word “CAUTION” without the safety alert symbol may be used to indicate a message not related to personal injury.

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 “DANGER”, “WARNING” and “CAUTION”.

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## DANGER

- Before operating the manipulator, make sure the servo power is turned OFF by performing the following operations. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.
  - Press the emergency stop buttons on the front door of the YRC1000, on the programming pendant, on the external control device, etc.
  - Disconnect the safety plug of the safety fence.
    (when in the play mode or in the remote mode)

If operation of the manipulator cannot be stopped in an emergency, personal injury and/or equipment damage may result.

*Fig. : Emergency Stop Button*

- Before releasing the emergency stop, make sure to remove the obstacle or error caused the emergency stop, if any, and then turn the servo power ON.

Failure to observe this instruction may cause unintended movement of the manipulator, which may result in personal injury.

*Fig. : Release of Emergency Stop*

- Observe the following precautions when performing a teaching operation within the manipulator's operating range:
  - Be sure to perform lockout by putting a lockout device on the safety fence when going into the area enclosed by the safety fence. In addition, the operator of the teaching operation must display the sign that the operation is being performed so that no other person closes the safety fence.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always keep in mind emergency response measures against the manipulator's unexpected movement toward a person.
  - Ensure a safe place to retreat in case of emergency.

Failure to observe this instruction may cause improper or unintended movement of the manipulator, which may result in personal injury.

- Confirm that no person is present in the manipulator's operating range and that the operator is in a safe location before:
  - Turning ON the YRC1000 power
  - Moving the manipulator by using the programming pendant
  - Running the system in the check mode
  - Performing automatic operations

Personal injury may result if a person enters the manipulator's operating range during operation. Immediately press an emergency stop button whenever there is a problem. The emergency stop buttons are located on the front panel of the YRC1000 and on the right of the programming pendant.

- Read and understand the Explanation of the Warning Labels before operating the manipulator.
Warning

- Perform the following inspection procedures prior to conducting manipulator teaching. If there is any problem, immediately take necessary steps to solve it, such as maintenance and repair.
  - Check for a problem in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the YRC1000 cabinet after use.

If the programming pendant is left unattended on the manipulator, on a fixture, or on the floor, etc., the Enable Switch may be activated due to surface irregularities of where it is left, and the servo power may be turned ON. In addition, in case the operation of the manipulator starts, the manipulator or the tool may hit the programming pendant left unattended, which may result in personal injury and/or equipment damage.

Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and manipulator cables.

In this manual, the equipment is designated as follows.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>YRC1000 controller</td>
<td>YRC1000</td>
</tr>
<tr>
<td>YRC1000 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>
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 [SELECT] is pressed, or that the item is directly selected by touching the screen.

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and TM are omitted.
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1 Material Handling, Press Tending, Cutting, and Other Applications

1.1 Simplified Teaching and Playback

1.1.1 Teaching

1.1.1.1 Preparation for Teaching

Perform the following tasks before starting to teach.

- Set the operation mode to teach mode.
- Enter the job name.

1. Confirm that the mode switch on the programming pendant is set to “TEACH”. If not, set the switch to “TEACH”.

2. Press [SERVO ON READY]. The SERVO ON lamp will blink. If [SERVO ON READY] is not pressed, the servo power supply cannot be turned ON using the Enable switch.

3. Select {JOB} under the main menu, and select {CREATE NEW JOB} in the sub menu.

4. After the NEW JOB CREATE window appears, press [SELECT].
5. After the following window appears, input the job name. The word "TEST" is used in this example job name.

6. Move the active window to software keypad by pressing the [AREA]. Move the cursor to "T" and press [SELECT]. Enter "E," "S," and "T" in the same manner. The characters can also be entered by directly touching each character on the screen.

7. Press [ENTER] to register.
8. Move the cursor to "EXECUTE" and press [SELECT]. The job "TEST" is registered and the job is displayed. The NOP and END instructions are automatically registered.

Characters which can be Used for Job Names

Job names can be created from numbers and the alphabetical letters. The input display can be switched between upper-case characters, lower-case characters, and symbols by pressing [PAGE] during the operation 5. Up to 32 characters can be used.
1.1.2 Teaching Procedure

To playback the manipulator, the instruction to move the manipulator must be written in a job. This instruction is called a move instruction. The destination position, the interpolation method, the play speed, etc. are registered in the move instruction.

Main move instructions begin with "MOV" in the INFORM III language used by the DX200.

<Example>

MOVJ VJ=50.00

MOVJ VJ=50.00

MOVL V=1122 PL=1

<Example>

Refer to the following JOB CONTENT window. When executing playback, the manipulator moves to the position of Step 1 with the interpolation type and play speed registered in Step 1’s move instruction. Then, the manipulator moves between Steps 1 and 2 with the interpolation type and play speed registered in Step 2’s move instruction. Then, the manipulator moves between Steps 2 and 3 with the interpolation type and play speed registered in Step 3’s move instruction. After the manipulator reaches the position of Step 3, the manipulator then executes the TIMER instruction followed by the DOUT instruction, and then continues on to Step 4.
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 III.

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.

Fig. 1-1: Teaching a Job

![Diagram showing the teaching process]

**CAUTION**

Make sure that the teach lock is set.
Make sure to keep a safe distance between the operator and the manipulator.

Actual work is not performed here.
1. Material Handling, Press Tending, Cutting, and Other Applications
1.1 Simplified Teaching and Playback

**Step 1 -- Standby Position**
Always be sure the manipulator is in a safe work area before operation.

1. Grip the Enable switch and the servo power will turn ON. The manipulator can then be operated.
2. Move the manipulator to the standby position using [Axis Keys]. Be sure the position is safe and that the work area is appropriate for the job to be programmed.
3. Select joint interpolation by pressing [MOTION TYPE]. Joint instruction "MOVJ..." will be displayed in the input buffer line.

```
MOVJ J0=0.75
```
4. Move the cursor to the line number 0000 and press [SELECT].

```
0000 NOP
0001 END
```
5. The input buffer line appears. 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 to 50%.

```
MOVJ VJ=0.5
```
6. Press [ENTER]. Step1 (Line 0001) is registered.
### Step 2 -- Near the Work Start Position

Define the manipulator’s working posture.

1. Move the manipulator to the working position using [Axis Keys].
2. Press [ENTER]. Step 2 (Line 0002) is registered.

<table>
<thead>
<tr>
<th>Frame</th>
<th>DOF</th>
<th>U</th>
<th>s=50.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>0</td>
<td>0</td>
<td>50.00</td>
</tr>
<tr>
<td>0100</td>
<td>0</td>
<td>0</td>
<td>50.00</td>
</tr>
<tr>
<td>0000</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0000</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

---

1-7
1 Material Handling, Press Tending, Cutting, and Other Applications
1.1 Simplified Teaching and Playback

**Step 3 -- Work Start Position**
Move the manipulator to the work start position with the pose as shown in Step 2.

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

2. Do not release the pose in Step 2. Press [COORD] to select the Cartesian coordinates. Move the manipulator to the welding start position using [Axis Keys].

3. With the cursor located on the line number 0002, press [SELECT].

4. The input buffer line appears. 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 to 12.50%.

5. Press [ENTER]. Step 3 (Line 0003) is registered.
1. Move the manipulator to the work end position with [Axis 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.


3. With the cursor located on the line number 0003, press [SELECT].

4. The input buffer line appears. Move the cursor to the right to V= 100.0, 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 200.0 cm/min.

5. Press [ENTER]. Step 4 (Line 0004) is registered.
1. Change the speed to high speed by pressing [FAST].

**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 [Axis Keys] to a position where it will not strike the fixture.

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

4. With the cursor located on line number 0004, press [SELECT].

5. The input buffer line appears. Move the cursor to the right to VJ=12.50, 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%.

6. Press [ENTER]. Step 5 (Line 0005) is registered.
1. Material Handling, Press Tending, Cutting, and Other Applications
2. Simplified Teaching and Playback

- **Step 6 -- Near the Standby Position**
  Move the manipulator near the standby position.

1. Move the manipulator near the standby position with [Axis Keys].
2. Press [ENTER]. Step 6 (Line 0006) is registered.

```
0070: MDV J=-50.00
0070: MDV J=-12.50
0070: MDV J=000.00
0070: MDV J=-50.00
0070: END
```
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 job end position of Step 5 to Step 1, so the manipulator can begin the next job quickly and efficiently.

The following operation will make Step 6 (end position) and Step 1 (standby position) identical.

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

   | 0002: NOP |
   | 0004: MOV Y,J=12.50 |
   | 0005: MOV Y,J=50.00 |
   | 0007: END |

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

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

   | 0002: MOV Y,J=50.00 |
   | 0004: MOV Y,J=12.50 |
   | 0005: MOV Y,J=200.0 |
   | 0006: MOV Y,J=50.0 |
   | 0007: END |

4. Press [MODIFY].

5. Press [ENTER]. This will change the position of Step 6 to be the same as Step 1.
1.1.3 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).

2. Change to medium speed by pressing [FAST] or [SLOW].

3. Press [FWD] to confirm each step executed by the manipulator. Each time [FWD] is pressed, the manipulator moves one step.

4. When you finish step confirmation, move the cursor to the beginning of the job.

5. Run all the steps continuously. Hold down [INTERLOCK] and press [TEST START]. The manipulator plays back all the steps continuously and stops when one cycle is finished.

Proceed to the next section to change the position and speed of the job steps.
1.1.1.4 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.

**NOTICE**

- After the job is corrected, be sure to confirm the path.

### Before Correcting a Job

1. Select (JOB) under the main menu and (JOB) under the sub menu to display the JOB CONTENT window.
1. Material Handling, Press Tending, Cutting, and Other Applications

1.1 Simplified Teaching and Playback

1.1.1.5 Changing the Position Data

Change the position registered in Step 2.

1. Move the manipulator to Step 2 (Line 0002) by pressing [FWD].
2. Move the manipulator to the modified position with [Axis Keys].
3. Press [MODIFY].
4. Press [ENTER]. The step’s position data is changed.
Adding a Step
Add a new step between Step 5 and Step 6.

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 [Axis Keys].

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.
Deleting 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. When a step is deleted, the numbering of step is automatically adjusted corresponding to the deletion.

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 with either of the following two procedures:

• Press [CANCEL] and press [FWD] to move the manipulator to the position of the step.

• Press [MODIFY] and press [ENTER] to change the position data of the step, then press [DELETE] and press [ENTER].

If the cursor in the window is blinking, the manipulator is not in the taught position.
1. Material Handling, Press Tending, Cutting, and Other Applications
1.1 Simplified Teaching and Playback

### 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.

```
0000 NOP
0010 MOV X=50.00
0020 MOV X=50.00
0030 MOV X=12.50
0040 MOV Y=200.0
0050 MOV Y=50.00
0060 MOV Y=50.00
0070 END
```

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

```
0000 NOP
0010 MOV X=50.00
0020 MOV X=50.00
0030 MOV X=12.50
0040 MOV Y=200.0
0050 MOV Y=50.00
0060 MOV Y=50.00
0070 END
```

3. The input buffer line appears. Move the cursor to the right to “V= 200.0,” 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 93.0 cm/min.

```
0000 NOP
0010 MOV X=50.00
0020 MOV X=50.00
0030 MOV X=12.50
0040 MOV Y=93.0
0050 MOV Y=50.00
0060 MOV Y=50.00
0070 END
```

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

```
0000 NOP
0010 MOV X=50.00
0020 MOV X=50.00
0030 MOV X=12.50
0040 MOV Y=93.0
0050 MOV Y=50.00
0060 MOV Y=50.00
0070 END
```

The unit for speed can be verified and modified by “SPEED DATA INPUT FORM” from {SETUP} → {OPERATE COND}.
1.1.2 Playback

1.1.2.1 Preparation before Playback

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 [Axis Keys].

When playback is started, the manipulator begins to move from the Step 1.

1.1.2.2 Playback Procedure

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

1. Switch the mode switch on the programming pendant to "PLAY."
2. Press [SERVO ON READY] to turn ON the servo power.
3. Press [START]. The manipulator will perform one complete taught cycle and then stop.
1.1.3 Example for General Purpose Application

1.1.3.1 Example Job

The figure below shows an example of cutting. The job creation 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>Moves manipulator to the standby position. (Step 1)</td>
</tr>
<tr>
<td>0002</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator near the cutting start position. (Step 2)</td>
</tr>
<tr>
<td>0003</td>
<td>MOVJ VJ=12.50</td>
<td>Moves manipulator to the cutting start position. (Step 3)</td>
</tr>
<tr>
<td>0004</td>
<td>TOOLON</td>
<td>Starts cutting.</td>
</tr>
<tr>
<td>0005</td>
<td>MOVL V=50.0</td>
<td>Moves manipulator to the cutting end position. (Step 4)</td>
</tr>
<tr>
<td>0006</td>
<td>TOOLOF</td>
<td>Ends cutting.</td>
</tr>
<tr>
<td>0007</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator to the position where the tools and workpieces do not interfere. (Step 5)</td>
</tr>
<tr>
<td>0008</td>
<td>MOVJ VJ=25.00</td>
<td>Moves manipulator to the standby position. (Step 6)</td>
</tr>
<tr>
<td>0009</td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
1.1.3.2 Teaching Procedure

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

• Teach Step 1, which is the standby position, to a safe position where the manipulator will not collide with the workpiece and the tool.

• Confirm the cutting path with [FWD] and [BWD] after teaching.

■ Step 2 -- Near cutting position

Define the cutting pose.

1. Specify the correct posture with [Axis Keys] for the manipulator to start cutting.

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

| 0100 | MD |
| 0101 | W0 | U=-25.00 |
| 0102 | W0 | U=-25.00 |
| 0103 | EN |
Step 3 -- Cutting Start Position
Move to the cutting start position with the pose as shown in Step 2, and register the TOOLON instruction.

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

2. Move the manipulator to the cutting start position with [Axis Keys]. At this time, do not release the pose input in Step 2.

3. With the cursor located on the line number, press [SELECT].

4. The input buffer line appears. 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%.

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

6. Press [2/TOOL ON]. “TOOLON” is displayed in the input buffer line.

7. Press [ENTER]. The TOOLON instruction is registered.
1 Material Handling, Press Tending, Cutting, and Other Applications
1.1 Simplified Teaching and Playback

- **Step 4 -- Cutting End Position**

  Define the cutting end position.

  1. Move the manipulator to the cutting end position with [Axis 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 interpolation (MOVL) by pressing [MOTION TYPE].

  3. With the cursor located on the line number, press [SELECT].

  4. The input buffer line appears. 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 50.0mm/s with [Numeric Keys] and press [ENTER].

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

  6. Press [./TOOL OF]. “TOOLOF” is displayed in the input buffer line.

  7. Press [ENTER]. The TOOLOF instruction is registered.
1.1.3.3 Confirmation of Cutting Operation (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 (250 mm/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. Switch the mode switch on the programming pendant to “PLAY.”
2. Select {UTILITY} and {SETUP SPECIAL RUN}. The SPECIAL PLAY window appears.

![SPECIAL PLAY window](image)

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 window with speed limit enabled](image)

- **Cutting Execution**
  Once the path has been determined, cutting is finally executed at actual speed. If the job is played back with the speed limitation drive disabled, cutting is executed at taught speed.
1.2 Operation for Tool Control

1.2.1 Function Keys

Each function used for tool control is allocated on the [Numeric Keys] of the programming pendant.

- **2** TOOLON: Registers the TOOLON instruction. If [INTERLOCK] is pressed simultaneously, the TOOLON operation is executed.
- **3** TOOLON JOB: Registers the CALL instruction for the reserved job TOOLONxx.
- **-** TOOLOFF: Registers the TOOLOFF instruction. If [INTERLOCK] is pressed simultaneously, the TOOLOFF operation is executed.
- **-** TOOLOFF JOB: Registers the CALL instruction for the reserved job TOOLOFFxx.
1.2.2 Tool Control Settings

The following setting can be performed on the GENERAL DIAGNOSIS window.

1. Select (GENERAL) under the main menu.
2. Select (GENERAL DIAGNOSIS).
   - The GENERAL DIAGNOSIS window appears.

   - Each time [SELECT] is pressed, “CONTINUE” and “STOP” is alternately displayed. The displayed state is the current setting.

   - Select “CONTINUE” to continue the work operation when the manipulator is restarted after it abort for any reason during the work operation. Select “STOP” to abort the work operation if the manipulator stops. When the manipulator is restarted, it moves without doing any work. Use the work start command to restart the work instruction.

3. Select the setting data of “WORKING ABORT PROCESS”.
   - Each time [SELECT] is pressed, “CONTINUE” and “STOP” is alternately displayed. The displayed state is the current setting.
1.2.3 Work Instructions

1.2.3.1 TOOLON/TOOLOF Instructions

These instructions are to perform TOOLON/TOOLOFF. The function keys are [TOOLON] and [TOOLOF].

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [TOOLON] or [TOOLOF].
   – The TOOLON or TOOLOF instruction is displayed in the input buffer line. Or press [INFORM LIST] to display the instruction box and select the TOOLON/TOOLOF instruction.

   – TOOLON
     Turns ON the work instruction.
     Turns ON the work start command (system output relay #51530) and waits for the work start response (system input relay #41130). The next instruction is executed when the work response turns ON. The work start response relay turns ON immediately after the work start command is output.

   – TOOLOF
     Turns OFF the work instruction.
     Turns ON the work end command (system output relay #51531) and waits for the work end response (system input relay #41131). The next instruction is executed when the work end response turns ON.
     The work end response relay turns ON immediately after the work end command is output. The work instruction is programmed to hold after the work start command turns ON and to turn OFF when the work end command turns ON.
     When the manipulator stops during the work operation, the work instruction turns OFF.
     When restarting, turn ON the work instruction when “WORKING ABORT PROCESS” is set to “CONTINUE”. Do not turn OFF the work instruction when “STOP” is set.

4. Press [INSERT].
5. Press [ENTER].
1.2.3.2 CALL Instruction

This instruction calls a reserved job TOOLONxx or TOOLOFxx. The function keys for registration are [TOOLON JOB] and [TOOLOF JOB].

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [TOOLON JOB] or [TOOLOF JOB].
   – The CALL instruction is displayed in the input buffer line.

   ![CALL Instruction Display]

4. Select the job name.
   – The JOB LIST window appears.
5. Press [PAGE].
   – The window for character input appears.
   The job name can now be changed.

   ![Job Name Input Window]

   – Modify the job name and press [ENTER].

6. Press [INSERT].
7. Press [ENTER].
1.2.3.3 WVON Instruction

This instruction starts the weaving motion. Specify conditions in the weaving condition file when registering the WVON instruction.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [INFORM LIST].
4. Select the WVON instruction.
   - The WVON instruction is displayed in the input buffer line.

   ![WVON Instruction Display]

   - To register the instruction displayed in the input buffer line without editing, press [INSERT] and then press [ENTER].
5. Select the file number and edit.
   - The input line is displayed.

   ![Input Line Display]

   - Input weaving file number using [Numeric Keys] and press [ENTER]. (In the following example, 2 is entered.)

6. Press [INSERT].
7. Press [ENTER].

1.2.3.4 WVOF Instruction

This instruction ends the weaving motion.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [INFORM LIST].
4. Select the WVOF instruction.
   - The WVOF instruction is displayed in the input buffer line.

   ![WVOF Instruction Display]

5. Press [INSERT].
6. Press [ENTER].
1.3 Weaving Operation

1.3.1 Weaving Basic Coordinate System

Weaving is performed based on the following coordinate system. This coordinate system is automatically generated when weaving is executed.

- **Wall Direction**: Z-direction of the robot axis
- **Horizontal Direction**: The direction to the approach point from the wall
- **Direction of Travel**: The direction in which the manipulator moves from the weaving start point to the end point

The approach point is a point indicated by a step immediately before the step where weaving starts.

Depending on the mounting status and shape of the workpiece, a definition of the above coordinate system may not be sufficient to generate a weaving pattern. In this case, register the reference point REFP 1, REFP 2, or REFP 3 (MODE: ELLIPSE).

If the “MODE” is set to “ELLIPSE”, the reference point REFP 1 will not be referred to.

For details, see chapter 1.3.4.2 “Editing the Condition Data”.
1.3.1.1 Cases that Require the Registration of Reference Points

The registration of the reference point REFP 1, REFP 2, or REFP 3 is not usually required. They are required only with a special workpiece condition, etc.

The REFP 1, that defines the wall direction, is a point on the wall surface or its expansion plane. The REFP 2, which defines the horizontal direction, is a point at the right or left side of the wall.

If the "MODE" is set to "ELLIPSE", REFP 3 is the reference point which defines the direction of travel.

< Example 1 >
REFP 1 is registered because the wall direction is not parallel to the Z-axis of the robot coordinates.
**Example 2**

REFP 2 is registered because the approach point is at another side of the wall.

If the weaving start step (immediately before WVON) and the previous step (approach point) are same, the weaving start point and the approach point become same, and the horizontal direction become undefined.

In this case, register the reference point REFP 2.
1.3.2 WVON

1.3.2.1 Function

This is the weaving start operation.

1.3.2.2 Syntax

The tag to be used varies according to the control group of job.

Table 1-1: Job Type and Control Group

<table>
<thead>
<tr>
<th>Type</th>
<th>Control Group of Job</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent</td>
<td>Job with one manipulator (Standard)</td>
<td></td>
</tr>
<tr>
<td>Coordinated</td>
<td>Job with two manipulators</td>
<td>Option</td>
</tr>
</tbody>
</table>

Table 1-2: Tag Usage Limitation

<table>
<thead>
<tr>
<th>Tag</th>
<th>Control Group of Job</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>RB1</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB2</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB3</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB4</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB5</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB6</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB7</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB8</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>WEV#</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>AMP=</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>FREQ=</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>ANGL=</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>DIR=</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

O: Available  
X: Not available
1.3.2.3 Explanation

- **RBn [1]**
  Be sure to choose one of the following tags.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBn</td>
<td>Specifies the weaving motion of robot 1 to 8.</td>
<td></td>
</tr>
</tbody>
</table>

- **WEV# (Weaving condition file number)/AMP [2] = Weaving half-amplitude [3]**
  Be sure to choose one of the following tags.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
</table>
| WEV# (Weaving condition file number) | Specifies the weaving condition file number. Conditions for the weaving motion are registered in the weaving condition file. | No. 1 to 16
No. 1 to 16
The number can be specified by B/I/D/LB/LI/LD variable. |
| AMP = Weaving half-amplitude  | Specifies the half-amplitude of weaving.                                    | Half-amplitude: 0.1 to 99.9 mm
Half-amplitude can be specified by B/I/D/LB/LI/LD/LB/I/LI/LD/LI/D/LD variable. (Unit: 0.1 mm) |

- **FREQ = Weaving frequency [4]**
  Only when "AMP = Weaving half-amplitude" is selected in the above "WEV# (Weaving condition file number)/AMP [2] = Weaving half-amplitude [3]", be sure to add the following tag.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
</table>
| FREQ = Weaving frequency | Specifies the weaving frequency. | Frequency: 0.1 to 5.0 Hz
The frequency can be specified by B/I/D/I/LB/LI/LD/LB/I/LI/LD/LI/D/LD variable. (Unit: 0.1 Hz) |

- **ANGL = Weaving angle [5]**
  Only when "AMP = Weaving half-amplitude" is selected in the above "WEV# (Weaving condition file number)/AMP [2] = Weaving half-amplitude [3]", this tag is added or omitted after "FREQ = Weaving frequency [4]"

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
</table>
| ANGL = Weaving angle | Specifies the weaving angle. | Angle: 0.0 to 180.0 degree
The degree can be specified by B/I/D/I/LB/LI/LD/LB/I/LI/LD/LI/D/LD variable. (Unit: 0.1) |
**1.3 Weaving Operation**

- **DIR = Starting direction of weaving [6]**
  This tag can be added or omitted.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
</table>
| DIR = Starting direction of weaving | Specifies the starting direction of weaving. | Direction: 0 to 1  
0: Forward  
1: Backward  
The direction can be specified by B/I/D/B/[I]/I/[D]/[I]/LB/LD/LB/[I]/LD/[I] variable. |
### Setting conditions for weaving

- **Weaving half-amplitude**
  Specify the amplitude size of weaving motion.

- **Weaving angle**
  Specify the angle of weaving motion.

- **Starting direction of weaving**
  Specify the starting direction of weaving motion.

#### MODE: TRIANGLE, L-TYPE

- **SINGLE**
- **TRIANGLE**
- **L-TYPE**
- **ELLIPSE**
1.3.2.4 Registering the WVON Instruction

This is the instruction to start the weaving operation.

1. Move the cursor to the address area.
2. Press [INFORM LIST].
   – The instruction list dialog box appears.
3. Select “DEVICE”.
4. Select the WVON instruction.
   – The “WVON” instruction appears in the input buffer line.
5. Press [SELECT], and set the file number in the DETAIL EDIT window.
   – Select the file number (1 to 255).
   (1) Move the cursor to the file number and press [SELECT].
   (2) Input the file number using [Numeric Key] and press [ENTER].

6. Press [ENTER].
   – The set contents are displayed in the input buffer line.
   – The set contents are registered in the job.

   – When the set contents are not to be registered, press [CANCEL] to return to the JOB CONTENT window.
1.3.3 WVOF Instruction

1.3.3.1 Function

This is the weaving end instruction.

1.3.3.2 Syntax

The control group of job limits the tag usage.

![Diagram of WVOF and END]

Table 1-3: Job Type and Control Group

<table>
<thead>
<tr>
<th>Type</th>
<th>Control Group of Job</th>
<th>Note</th>
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</thead>
<tbody>
<tr>
<td>Independent</td>
<td>Job with one manipulator (Standard)</td>
<td></td>
</tr>
<tr>
<td>Coordinated</td>
<td>Job with two manipulators</td>
<td>Option</td>
</tr>
</tbody>
</table>

Table 1-4: Tag Usage Limitation

<table>
<thead>
<tr>
<th>Tag</th>
<th>Control Group of Job</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>RB1</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB2</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB3</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB4</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB5</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB6</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB7</td>
<td>X</td>
<td>O</td>
</tr>
<tr>
<td>RB8</td>
<td>X</td>
<td>O</td>
</tr>
</tbody>
</table>

O: Available
X: Not available
1. Material Handling, Press Tending, Cutting, and Other Applications
1.3 Weaving Operation

1.3.3.3 Explanation

**RB1/RB2/RB3/RB4/RB5/RB6/RB7/RB8 [1]**

Be sure to choose one of the following tags.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Explanation</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBn</td>
<td>Specifies the weaving motion of robot 1 to 8.</td>
<td></td>
</tr>
</tbody>
</table>

<Example>

```
NOP
MOVJ VJ=50.00      · · ·  Step 1
MOVL V=220         · · ·  Step 2
MOVL V=200         · · ·  Step 3
WVON WEV#(2)       · · ·  Weaving start
ARCON AC=220 AVP=100 T=0.50 · · ·  Welding start
MOVL V=138         · · ·  Step 4
ARCOF AC=160 AVP=90 T=0.50 · · ·  Welding end
WVOF               · · ·  Weaving end
MOVL V=200         · · ·  Step 5
MOVJ VJ=50.00      · · ·  Step 6
END                 · · ·          
```
1.3.3.4 Registering the WVOF Instruction

This is the instruction to end the weaving operation.

1. Move the cursor to the address area.

2. Press [INFORM LIST].
   – The instruction list dialog box appears.

3. Select “DEVICE”.

4. Select the “WVOF” instruction.

5. Press [ENTER].
   – The set contents are registered in the job.
1.3.4 WEAVER CONDITION Window

A. COND NO. (1 to 255)

The weaving condition file number between 1 and 255 is shown.

B. MODE, C. SMOOTH

Set the weaving mode to SINGLE, TRIANGLE, L-TYPE, or ELLIPSE.

For the SINGLE, TRIANGLE, or L-TYPE mode, ON/OFF of SMOOTH can be set.

D. SPEED TYPE (FREQUENCY, MOVING TIME)

Specify the setting type of the weaving motion speed.

Two types are available: setting by frequency and setting by the moving time in each weaving section.
1 Material Handling, Press Tending, Cutting, and Other Applications
1.3 Weaving Operation

E. FREQUENCY
Specify the weaving frequency if “SPEED TYPE” is set to “FREQUENCY”. Note that when the mode is set to “SINGLE” and the speed type is set to “FREQUENCY”, the maximum frequency is determined by the amplitude as illustrated in the graph below. Specify a frequency within the allowable range.

F. AMPLITUDE TYPE (SAME, EACH)
Specify the amplitude type of weaving, SAME or EACH. When the amplitude type is set to EACH, the right-left amplitude for SINGLE or the lateral-longitudinal amplitude for ELLIPSE (V: semi-minor axis, H: semi-major axis) can be specified.

When set to SAME in the SINGLE, TRIANGLE, or L-TYPE mode

When set to EACH in the SINGLE, TRIANGLE, or L-TYPE mode

The definitions of “right” and “left” differ depending on the wall direction, and the wall side is defined as “left”.

![Graph showing Maximum Frequencies for Different Amplitudes](image-url)
When set to SAME in the ELLIPSE mode

- **MODE**: ELLIPSE
- **SMOOTH**: ON
- **FREQUENCY**: 3.5 Hz
- **AMPLITUDE TYPE**: SAME
- **AMPLITUDE**: V: 2.000 mm, H: 10.000 mm

When set to EACH in the ELLIPSE mode

- **MODE**: ELLIPSE
- **SMOOTH**: ON
- **FREQUENCY**: 3.5 Hz
- **AMPLITUDE TYPE**: EACH
- **AMPLITUDE**: V: 2.000 mm, H: 0.000 mm

**G. PATTERN**

- **AMPLITUDE**
  Specify the amplitude size at weaving when MODE is set to SINGLE or ELLIPSE.

When AMPLITUDE TYPE is set to EACH in the above step F, specify the amplitude size individually for the right-left amplitude for SINGLE or the lateral-longitudinal amplitude for ELLIPSE (V: semi-minor axis, H: semi-major axis).
1.3 Weaving Operation

- VERTICAL, HORIZONTAL
  If MODE is set to TRIANGLE or L-TYPE, the data for the triangle must be set to define the weaving pattern.

- ANGLE
  Specifies the angle of weaving motion.
• **TRAVEL ANGLE**  
  Specifies the travel angle of weaving motion.

**MODE: ELLIPSE**
H. TIMER (MODE)

As shown below, a single weaving cycle is divided into three or four sections. The timer mode can be specified for each section.

**Wall direction**

- **Horizontal direction**

<table>
<thead>
<tr>
<th>Single</th>
<th>Triangle</th>
<th>L-type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Set one of the following timer modes:

- **WEAV STOP**: Weaving stops but manipulator moves.
- **ROBOT STOP**: Manipulator stops.

**NOTE**

If the corner radius (CR) is specified in the move instruction, weaving operations cannot be performed.

**NOTE**

When MODE is set to ELLIPSE, weaving operations can be performed only in MOVL, MOVC, SMOVL, SMOVC, or IMOV.

ELLIPESE cannot be used when the teaching such as the following is performed in the two-manipulator coordinated system.

- The travel distance of the master-side manipulator is longer than that of the slave-side manipulator.
1.3 Weaving Operation

K. HOVER WEAVING COND. (option)

- **SET (ON/OFF)**
  Specifies whether hover weaving is used or not.

- **TIMER**
  Finishes hover weaving when the time specified here ends.

- **INPUT SIGNAL**
  Finishes hover weaving when the input signal specified here is input.

<table>
<thead>
<tr>
<th>Reference Job</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOP</td>
</tr>
<tr>
<td>MOVJ VJ=10.00</td>
</tr>
<tr>
<td>MOVJ VJ=25.00</td>
</tr>
<tr>
<td>REFP 3</td>
</tr>
<tr>
<td>ARCON ASF#(1)</td>
</tr>
<tr>
<td>WVON WEV#(1)</td>
</tr>
<tr>
<td>MOVL V=60</td>
</tr>
<tr>
<td>WVOF</td>
</tr>
<tr>
<td>ARCOF</td>
</tr>
<tr>
<td>MOVJ VJ=25.00</td>
</tr>
<tr>
<td>MOVJ VJ=25.00</td>
</tr>
<tr>
<td>END</td>
</tr>
</tbody>
</table>

Welding start point.
Reference point for defining the direction of travel.

*Teaching by interpolation instruction, not by joint interpolation.
The same point with the welding start point.

**NOTE**

In hover weaving, the start and end points are the same. Therefore, the weaving direction cannot be determined. For this reason, the user needs to register a reference point (REFP 3) to define the direction of travel.

Wall Direction: Robot axis Z+ direction
Horizontal Direction: Direction from the wall to approach point
Direction of Travel: Direction from weaving start point to REFP 3

**NOTE**

In hover weaving, the start and end points are the same. Therefore, the arc retry function and arc restart function are not available.
1.3.1 Displaying the Weaving File

1. Select **(ARC WELDING)** under the main menu.

2. Select **(WEAVING)**.

3. Display the desired file number.
   (1) The desired file can be called up by using [PAGE].
   (2) Press [PAGE] to call the next file.
   (3) Press [SHIFT]+[PAGE] to call the previous file.
1.3.4.2 Editing the Condition Data

1. Select the item to be edited.

2. Input the value using [Numeric Key].
1.3.5 Prohibiting Weaving

If the weaving instruction is registered during the "CHECK" operation in the play mode or "TEST RUN" or [FWD] operation in the teach mode, weaving is performed as well as other move instructions.

However, in the cases when weaving should not be performed because the manipulator collides with a workpiece, etc., follow the procedure below to prohibit weaving.

1.3.5.1 Method to Prohibit Weaving during a "CHECK" Operation

2. Select (UTILITY).
3. Select (SETUP SPECIAL RUN).
   - The SPECIAL PLAY window appears.
4. Select "WEAV PROHIBIT IN CHK-RUN".
   - Each time [SELECT] is pressed, "VALID" and "INVALID" alternate.
1.3.5.2 Method to Prohibit Weaving during a “TEST RUN” or FWD Operation

1. Press [AREA] on the JOB CONTENT window in the TEACH mode.
2. Select {UTILITY}.
3. Select {SETUP SPECIAL RUN}.
   - The SPECIAL TEACH window appears.
4. Select "WEAV PROHIBIT IN TEST RUN/NEXT".

1.3.5.3 Method to Prohibit Weaving by Means of a System Input Signal

The system input signal 40047 is used.
### 1.4 Table of Work Instructions

- `< >` indicates alpha-numerical data.
- If multiple items are shown in one additional item section, select one.

#### Table 1-5: Instructions for Material Handling, Press Tending, Cutting, and Other Applications

<table>
<thead>
<tr>
<th>TOOLON Function</th>
<th>Function</th>
<th>Turns ON work tools (work instructions).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>UNIT 1 to UNIT 4</td>
<td>Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>TOOLON</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOOLEF Function</th>
<th>Function</th>
<th>Turns OFF work tools (work instructions).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>UNIT 1 to UNIT 4</td>
<td>Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>TOOLEF</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WVON Function</th>
<th>Function</th>
<th>Starts weaving.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>RB 1 to RB 8</td>
<td>Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>WEV#(&lt;weaving condition file number&gt;)</td>
<td>1 to 255</td>
<td></td>
</tr>
<tr>
<td>DIR=&lt;starting direction of weaving&gt;</td>
<td>0: Forward  1: Backward</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>WVON  WEV#(1)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WVOF Function</th>
<th>Function</th>
<th>Ends weaving.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Item</td>
<td>RB 1 to RB 8</td>
<td>Displayed only when using multiple manipulators.</td>
</tr>
<tr>
<td>Example</td>
<td>WVOF</td>
<td></td>
</tr>
</tbody>
</table>
2 Handling Application

2.1 Outlines

2.1.1 Function Keys

Each function used for handling is allocated on the [Numeric Keys] of the programming pendant.

Switches the signal output of [f•1] and [f•2] ON and OFF when [INTERLOCK] is simultaneously pressed. “1” side gripper valve signals (HAND 1-1 to HAND 4-1) can be allocated to [f•1] and “2” side gripper valve signals (HAND 1-2 to HAND 4-2) can be allocated to [f•2]. Alternatively, user signals can be allocated to the keys. The key allocations can be changed from the HANDLING window or by changing the AP parameters directly.

Switches gripper 1 (HAND 1-1/HAND 1-2) output or the gripper 2 (HAND 2-1/HAND 2-2) output ON and OFF when [INTERLOCK] is simultaneously pressed. The output signal is a double-solenoid-type signal. Also, press these keys during editing on the JOB CONTENT window in the teach mode to register the HAND instructions.

Not used.
2.1.2 HAND Instruction

2.1.2.1 Function

The following instructions open and close the grippers mounted on the manipulator. They correspond to single-, double-, and triple-position solenoids. Up to four grippers can be controlled for each manipulator. The following sequences are available for solenoid signal control, according to the valve selected.

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

- **2P (double-solenoid)**
  The HAND instruction turns ON/OFF the gripper valve (x-1). The inverse signal is output to the gripper valve (x-2).

- **3P (triple-position solenoid)**
  Adding ALL to the HAND instruction allows both gripper valve (x-1) and gripper valve (x-2) to be turned ON/OFF simultaneously. Functions as a double-solenoid if ALL is not added to the HAND instruction.

\[
\begin{array}{|c|c|c|}
\hline
\text{Instruction (x: Gripper No.)} & \text{SP (Valve x-1/x-2)} & \text{2P (Valve x-1/x-2)} & \text{3P (Valve x-1/x-2)} \\
\hline
\text{HAND x ON} & \text{ON/- (-OFF)} & \text{ON/OFF} & \text{ON/OFF} \\
\text{HAND x OFF} & \text{OFF/- (-OFF)} & \text{OFF/ON} & \text{OFF/ON} \\
\text{HAND x ON ALL} & \text{-} & \text{-} & \text{ON/ON} \\
\text{HAND x OFF ALL} & \text{-} & \text{-} & \text{OFF/OFF} \\
\hline
\end{array}
\]

Table 2-1: Valve ON/OFF Condition of Each Solenoid
2 Handling Application
2.1 Outlines

2.1.2.2 Instruction and Additional Items

<table>
<thead>
<tr>
<th>HAND</th>
<th>1</th>
<th>OFF</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Gripper Number (1 to 4)
Required.

(2) Gripper Output Status (ON/OFF)
Required.
Select ON or OFF.

(3) Valve Simultaneous Control (ALL)
Adds to turn valves 1 and 2 ON or OFF simultaneously.
2.1.3 HSEN (Gripper Sensor) Instruction

2.1.3.1 Function

Confirm that the gripper sensor is in the specified status. If the gripper sensor is in the specified status, the result is $B014*$ and the next instruction is executed. If a timer is specified, the instruction waits for the specified time (including infinity) to be input.

2.1.3.2 Instruction and Additional Items

HSEN 1 ON T=10.00

(1) Sensor Number (1 to 8)
Required.

(2) Sensor Input Status (ON/OFF)
Required.
Select ON or OFF.

(3) Signal waiting time (T=0.01 to 655.35 sec)
FOREVER: Unlimited time
If omitted, T=0.

$B014$: Variable for execution result
Sets the execution result.
0: is set when the instruction is ended before the timer is over.
1: is set when the instruction is ended when the timer is over.
Handling Application

2.1 Outlines

2.1.3.3 Examples

Waits until sensor 1 turns ON (OFF).
At completion, the result (1: gripper sensor 1 is ON (OFF)) is set in $B014.

HSEN 1 ON FOREVER
OFF FOREVER

Checks whether sensor 1 is turned ON at completion of HSEN instruction.
The result (0: gripper sensor 1 is OFF, 1: gripper sensor 1 is ON) is set in $B014.

HSEN 1 ON

Waits 10 seconds for gripper sensor 1 to turn ON.
Sets the result 1 (gripper sensor 1 is ON) in $B014 if the sensor input
turns ON. Sets the result 0 (gripper sensor 1 is OFF) if the sensor does
not turn ON after 10 seconds.

HSEN 1 ON T=10.00

To observe the $B014 contents with an IF statement, use the GETS
instruction to read the contents to a B variable.
2.1.4 Handling Window

1. Select (ROBOT) under the main menu.
2. Select (HANDLING DIAG).
   – The HANDLING window appears.

3. Select “F1 KEY ALLOCATION” or “F2 KEY ALLOCATION,” and then edit.
   – The selection dialog box appears.
   – If a signal from “HAND1” to “HAND4” is selected, the key allocation to the corresponding gripper valve signal can be modified. (In the following example, “HAND3” is selected in the “F2 KEY ALLOCATION.”)

When “GENERAL OUT” is selected, the output number of user signal is asked.
2 Handling Application
2.1 Outlines

– Input desired number with [Numeric Keys] and press [ENTER] to change the allocation of user output signal.

An error message is displayed if the input number lies outside the designated range. Press [CANCEL] to cancel the modification of the key allocation.

– If [f•1] or [f•2] and [INTERLOCK] are pressed simultaneously, the output of the designated signal is switched ON and OFF.

4. Select “SHOCK SENSOR FUNC” or “SHOCK SENSOR INPUT,” and then edit.

– If “SHOCK SENSOR FUNC” is selected, “USED” and “NOT USED” are alternately displayed.
If “SHOCK SENSOR INPUT” is selected, “VALID” and “INVALID” are alternately displayed.
The displayed state is the current setting.

NOTE
The “-1” gripper valve signals can be allocated to [f•1] and the “-2” gripper valve signals can be allocated to [f•2].
2.1.5 Shock Sensor Function

If “SHOCK SENSOR FUNC” is “USED” in the HANDLING window, the shock sensor is enabled. When the shock sensor does not exist, set “NOT USED.”

2.1.6 Shock Sensor Input Signal

- **Function**
  When this signal turns OFF, “SHOCK SENSOR WORKING” is displayed on the programming pendant and the system enters HOLD status.

- **Signal Condition**
  The signal is normally an ON (NC) signal.

- **How to Use this Signal**
  Input the shock sensor output signal to #20026 (CN309-B2 of AIO board).

2.1.7 Shock Sensor Input Reset

- **Function**
  This function resets the HOLD status and enables the axis operation and [FWD]/[BWD] operations in order to allow the manipulator to be retracted after shock sensor operation.
  Set the function on the HANDLING window. If “SHOCK SENSOR FUNC” is “USED” and “SHOCK SENSOR INPUT” is “INVALID” in the teach mode, “SHOCK SENSOR INP. RELEASING” is displayed and the input is disabled. The input is enabled if “SHOCK SENSOR INPUT” is “VALID.”

- **How to Use this Function**
  Refer to chapter 2.1.4 “Handling Window” for details about using this function.

2.1.8 Low Air Pressure Input Signal

- **Function**
  If the air pressure drops, this signal turns ON and triggers a user alarm (system section) in the play mode. In the teach mode, the message “AIR PRESSURE LOWERING” is displayed.

- **Signal Condition**
  The signal is normally an OFF (NO) signal.

- **How to Use this Signal**
  Input the low air pressure signal to #20027 (CN309-A2 of AIO01 board). The alarm can be reset by turning OFF the signal and reset the alarm.
  To perform axis operations while the air pressure is low, set to teach mode and reset the alarm. The above message is displayed, but manipulator operations are possible.
2 Handling Application
2.2 Registering Instructions

2.2 Registering Instructions

2.2.1 HAND Instruction

This instruction turns ON/OFF the gripper valve signal and controls the tool.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [TOOL 1 ON/OFF] or [TOOL 2 ON/OFF].
   – “HAND 1 ON” is displayed if [TOOL 1 ON/OFF] is pressed; “HAND 2 ON” is displayed if [TOOL 2 ON/OFF] is pressed in the input buffer line.
   If “HAND” is selected after pressing [INFORM LIST], “HAND 1 ON” is displayed.

4. Select the gripper number and edit.
   – The input line is displayed.
   – Input the gripper number with [Numeric Keys], and press [ENTER].
5. Select the gripper output status and edit.
   – If inserting a valve simultaneous control (to make the gripper valve 1 output same as the valve 2 output), select “HAND.”
   – If no settings are to be made for other additional items, press [INSERT] and then press [ENTER]. The HAND instruction is registered.
6. Edit the valve simultaneous control.
   – If inserting a valve simultaneous control (to make the gripper valve 1 output same as the valve 2 output), select “HAND.”
2 Handling Application
2.2 Registering Instructions

– Press [SELECT]. The DETAIL EDIT window appears. Select “VALVE SIM CTRL.”

– The selection dialog box appears.

– Select “ALL.” The data of “VALVE SIM CTRL” items change to the “ALL” and the “ALL” tag is added to the input buffer data.

– Press [ENTER] to display the JOB CONTENT window.

7. Press [INSERT].
8. Press [ENTER].
2 Handling Application
2.2 Registering Instructions

2.2.2 HSEN Instruction

This instruction monitors the various inputs used for handling and outputs the monitor result as a variable.

1. Select {JOB} under the main menu.
2. Select {JOB}.
3. Press [INFORM LIST].
4. Select the HSEN instruction.
   - The HSEN instruction is displayed in the input buffer line.
   - To register the instruction shown in input buffer line without editing, press [INSERT] and then press [ENTER].
5. Select the sensor number and edit.
   - The input line is displayed.
   - Input the sensor number with [Numeric Keys], and press [ENTER].
6. Select the sensor input status and edit.
   - If the UP or DOWN ARROW cursor is pressed together with [SHIFT], “ON” and “OFF” are alternately displayed.
   - If no settings are to be made for other additional items, press [INSERT] and then press [ENTER]. The HSEN instruction is registered.
7. Edit the signal waiting time.
   - If inserting a signal waiting time, select “HSEN.”

Press [SELECT]. The DETAIL EDIT window appears. Move the cursor to “WAIT TIME”.

Press [SELECT]. The DETAIL EDIT window appears. Move the cursor to “WAIT TIME”.
2 Handling Application

2.2 Registering Instructions

– Press [SELECT]. The selection dialog box appears. Move the cursor to “T=”.

– Press [SELECT]. “T=” is set for WAIT TIME, and a numerical value entry field appears on the right. Move the cursor to the field.

– Press [SELECT]. The input line appears. Input a desired waiting time by using [Numeric Keys].

– Press [ENTER]. The input value is shown in the input buffer line.

– To keep the waiting status for unlimited time, move the cursor to “FOREVER” in the above-mentioned selection dialog box, and press [SELECT].

– After editing the details, press [ENTER] to return to the JOB CONTENT window.

8. Press [INSERT].

9. Press [ENTER].
2 Handling Application
2.3 Table of Work Instructions

- <> indicates alpha-numerical data.
- If multiple items are shown in one additional item section, select one.

<table>
<thead>
<tr>
<th>Function</th>
<th>Handing Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAND</td>
<td></td>
</tr>
<tr>
<td>Additional Item</td>
<td>&lt;Gripper Number&gt; 1 to 4 Required.</td>
</tr>
<tr>
<td></td>
<td>&lt;Gripper Output Status&gt; ON or OFF Required.</td>
</tr>
<tr>
<td></td>
<td>ALL</td>
</tr>
<tr>
<td></td>
<td>Valve simultaneous control</td>
</tr>
<tr>
<td></td>
<td>Used to turn gripper valves 1 and 2</td>
</tr>
<tr>
<td></td>
<td>ON or OFF simultaneously if a 3P solenoid is used.</td>
</tr>
<tr>
<td>Example</td>
<td>HAND 1 ON</td>
</tr>
<tr>
<td></td>
<td>HAND 1 OFF ALL</td>
</tr>
<tr>
<td>HSEN</td>
<td></td>
</tr>
<tr>
<td>Additional Item</td>
<td>$B014 Result variable. Cannot be displayed on screen.</td>
</tr>
<tr>
<td></td>
<td>&lt;Gripper Sensor Number&gt; 1 to 8 Required.</td>
</tr>
<tr>
<td></td>
<td>&lt;Sensor Input Status&gt; ON or OFF Required.</td>
</tr>
<tr>
<td></td>
<td>T=&lt;signal waiting time&gt; or FOREVER</td>
</tr>
<tr>
<td></td>
<td>T:0.01 to 655.35 seconds FOREVER. Unlimited time</td>
</tr>
<tr>
<td></td>
<td>If omitted, T=0.</td>
</tr>
<tr>
<td>Example</td>
<td>HSEN 1 ON FOREVER</td>
</tr>
<tr>
<td></td>
<td>HSEN 1 OFF</td>
</tr>
<tr>
<td></td>
<td>HSEN 1 ON T=10.00</td>
</tr>
</tbody>
</table>

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YRC1000
MATERIAL HANDLING, PRESS TENDING, CUTTING, AND OTHER APPLICATIONS
OPERATOR’S MANUAL

Specifications are subject to change without notice for ongoing product modifications and improvements.