DX200 OPTIONS
INSTRUCTIONS
FOR ERROR RECOVERY FUNCTION IN SEALING APPLICATION

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

MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS
DX200 INSTRUCTIONS
DX200 OPERATOR’S MANUAL (for each purpose)
DX200 MAINTENANCE MANUAL

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: 189386-1CD
Revision: 0
MANDATORY

• This manual explains the Error recovery function in sealing application of the DX200 system. Read this manual carefully and be sure to understand its contents before handling the DX200.

• General items related to safety are listed in Chapter 1: Safety of the DX200 Instructions. To ensure correct and safe operation, carefully read the DX200 Instructions.

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 DX200.

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

DANGER
Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.

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 “DANGER”, “WARNING” and “CAUTION”.
WARNING

- Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning ON the DX200 power
  - Moving the manipulator with the programming pendant
  - Running the system in the check mode
  - Performing automatic operations

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems. The emergency stop buttons are located on the right of the front door of the DX200 and the programming pendant.

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  - 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.

- Before operating the manipulator, check that servo power is turned OFF when the emergency stop buttons on the front door of the DX200 and programming pendant are pressed. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

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

Fig. : 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.

Fig. : Release of Emergency Stop
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>DX200 Controller</td>
<td>DX200</td>
</tr>
<tr>
<td>DX200 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>
Descriptions of the programming pendant 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>Character Keys /Symbol Keys: The keys which have characters or symbols printed on them are denoted with [ ]. e.g. [ENTER]</td>
</tr>
<tr>
<td>Axis Keys/Numeric Keys</td>
<td>[Axis Key] and [Numeric Key] are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Keys pressed simultaneously</td>
<td>When two keys are to be pressed simultaneously, the keys are shown with a &quot;+&quot; sign between them, e.g. [SHIFT]+[COORD].</td>
</tr>
<tr>
<td>Mode Switch</td>
<td>Mode Switch can select three kinds of modes that are denoted as follows: REMOTE, PLAY or TEACH.</td>
</tr>
<tr>
<td>Button</td>
<td>The three buttons on the upper side of the programming pendant are denoted as follows: START, HOLD, or EMERGENCY STOP.</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }. e.g. {JOB}</td>
</tr>
</tbody>
</table>

![Programming Pendant Diagram](image-url)

- Mode switch
- Start button
- Hold button
- Emergency stop button
- Page key
- Coordinate key
- Axis keys
- Shift key
- Enter key
- Numeric keys
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 bland names for each company or corporation. The indications of (R) and TM are omitted.
Contents

1 Functional overview ........................................................................................................................1-1
2 Error Recovery Sequence .............................................................................................................. 2-1
3 Recovery Condition File .............................................................................................................. 3-1
4 Editing Recovery Condition file .................................................................................................. 4-1
5 Recovery motion execution condition ......................................................................................... 5-1
6 Restrictions .................................................................................................................................. 6-1
1 Functional overview

If the job execution is interrupted due to the detection of the errors during sealing operation in the system which controls the sealer gun by general output signal, the following quality problems may occur when it is restarted.

- Sealing cannot be applied in certain section after restarted.
- When restarted, sealing compound will be applied before the manipulator speed reaches the taught speed, which generates a lump of seal.

The Error Recovery Function in sealing application prevents the above mentioned problems.

If this function is activated when restarting after job interruption, the In Recovery Operation signal is to be output according to the conditions set in the "RECOVERY CONDITION" file.

Then the manipulator starts backward motion to reach the step that satisfies the set conditions, and starts moving in the forward direction. Afterwards, when the manipulator reaches the position where the job is interrupted, the In Recovery Operation signal becomes OFF to continue the motion.

The above mentioned In Recovery Operation signal is built in the concurrent ladder program, which enables to start applying the sealing compound at the position where the job is interrupted, solving the sealing error problem. In addition, since the manipulator restarts the forward motion after returning to the position where it can reach enough teaching speed, a lump of seal can be prevented.
2 Error Recovery Sequence

If any of the following job interruptions occur while a specific general output signal, which controls the device (Sealer gun), is ON, the error recovery motion will be performed in the sequence indicated below.

### <Job interruption conditions>

- HOLD stop
- Servo OFF due to the following reasons:
  1. Emergency stop by PP
  2. Emergency stop by P panel
  3. External emergency stop
  4. Safety fence input signal
  5. Emergency stop by specific input
  6. Deceleration to an emergency stop by specific input signal
  7. Servo OFF due to overrun
  8. Servo OFF due to ON_EN
- Mode switching (PLAY to TEACH)
- Stopped by Alarm

### Recovery Motion sequence

1. When restarted, the specified general output signal \((\text{In Recovery Operation signal})\) becomes ON.
2. Manipulator starts back motion to the step exceeding the specified return distance \(^3\) at the specified return speed.
3. After reaching the return step, execute the job in a forward direction.
4. "In recovery operation" signal becomes OFF when the manipulator arrives at the position shifted the volume specified in Restart timing adjustment \(^3\) from the interrupted position.
5. Continue job execution.

---

1. In case of the job interruption due to controller power OFF, the recovery motion will not be performed when restarted.
2. The general output number for sealer gun control is set in the "RECOVERY CONDITION" file.
3. To be set in "RECOVERY CONDITION" file.
Signal status during error recovery motion is as follows.

This control method performs only Input/output control of the specified “In Recovery Operation” signal, without shifting the I/O status of the sealer gun signal (Recovery Object signal) that is controlled by a job. Therefore, in order to perform error recovery motion during sealing operation, concurrent ladder program also should be changed to control the external output signal, which controls the bulb of the sealer gun, so as not to be turned ON.
3 Recovery Condition File

Recovery Condition file contains the conditions to execute error recovery motion.

Eight Recovery Condition files are prepared and up to eight signals can be controlled as recovery targets.

(1) RESTART CONDITION (Continue / Recovery / Dialog)
   Specifies the restart method when executing error recovery motion
   • Continue: When restarted, continue the motion without activating error recovery (Function Invalid)
   • Recovery: When restarted, execute error recovery motion
   • Dialog: When restarted, indicate the dialog message so that the user can select the method; "Continue" or "Recovery"

   NOTE) Restart condition setting will be applied for all system, regardless of file number

(2) RECOVERY OBJECT ROBOT (R1 to R8)
   Specifies the target robot for which the error recovery will be implemented

(3) RECOVERY OBJECT SIGNAL
   (OUT#1 to OUT#2048, 0: "- (Invalid)"
   Specifies the general output number that indicates the section (Sealing operation section) where the error recovery function in sealing application is to be implemented

The settings in the Recovery condition file can be changed only in Management mode.

Only reference of the setting status is allowed in Operation mode and Edit mode.
(4) OUTPUT SIGNAL DURING RECOVERY
(OUT#1 to OUT#2048, 0 : "- (Invalid)"
  Specifies the general output number that indicates the error
  recovery operation status.

(5) MINIMUM RECOVERY RETURN DISTANCE
(100.0mm to 1000.0mm)
  Specifies the minimum distance to return when performing
  recovery return motion.

(6) RECOVERY RETURN SPEED
  Specifies the speed when performing return motion.

(7) RESTART TIMING ADJUSTMENT TIME
  Specifies the time to adjust the timing of the In Recovery
  Operation signal to become OFF when the manipulator reaches
  the position where the job is interrupted.
4 Editing Recovery Condition file

1. Select main menu [GENERAL]

2. Select sub menu [RECOVERY CONDITION]
3. Display the target file

   The following two methods can change the file number.

   • Press [PAGE] key to call the target file
     Pressing [PAGE] key to switch to the next file number
     Pressing [PAGE] key + [SHIFT] key to switch the screen to the previous file number

   • Specify the desired file number by inputting numeric value.
     Press [PAGE] button on the screen to input the desired file number and press [ENTER] key
5 Recovery motion execution condition

If the job is stopped by a “Job interruption conditions” described in chapter 2 “Error Recovery Sequence”, the error recovery motion will be executed under the following conditions.

(1) RECOVERY OBJECT SIGNAL is set in RECOVERY CONDITION file

(2) The mode switch is set to “PLAY” and the general output signal specified for RECOVERY OBJECT SIGNAL is ON by RECOVERY OBJECT ROBOT specified in RECOVERY CONDITION file.  

(3) “Recovery” is set for RESTART CONDITION in RECOVERY CONDITION file

(4) “Dialog” is set for RESTART CONDITION in RECOVERY CONDITION file

(5) “Recovery” is selected from the dialog selection box.

1) Only when the general output signal for “RECOVERY OBJECT SIGNAL” is controlled by "DOUT OT#(x) ON/OFF" instruction or "ANTOUT AT#(x) ON/OFF" instruction, the recovery motion will be applied.

If the general output signal is controlled by "DOUT OG#(x) / OGH#(x)" instruction and "ANTOUT AG#(x)" instruction, PULSE instruction or manually in TEACH mode, the recovery motion cannot be applied.

2) If "DIALOG" is set for the RESTART CONDITION in RECOVERY CONDITION file, the following selection dialog box is shown when restarted.

The operator presses START button after selecting "CONTINUE" or "RECOVERY" to execute the JOB.
5 Recovery motion execution condition

**NOTE**

- Recovery motion will be activated only by playback start in PLAY mode.
- While the manipulator is executing the recovery motion, the following message is to be indicated in the message area on the programming pendant to inform the operator that the manipulator is in the recovery operation.

![Message]

During error recovery movement [All]
6 Restrictions

- **Operations that disable the recovery function**
  Recovery motion will not be started up if any of following operations is performed before restart.
  - Turn the controller power OFF
  - Select a JOB including Master JOB call.
  - Switch the mode to TEACH to move the cursor in the JOB.
  - Switch the mode to TEACH to perform rest run and forward and backward operations.
  - Switch the mode to TEACH to perform JOG operation.
  - Switch the mode to TEACH to edit the RECOVERY CONDITION file

- **JOB interruption during recovery motion**
  If the job is interrupted by the job interruption conditions described in chapter 2 “Error Recovery Sequence” during recovery motion, the manipulator will perform backward motion to the specified return step to continue the recovery motion.

  However, if any of the following operations are performed after interruption, the recovery motion signal becomes OFF when restarted and later the recovery motion will not be performed.
  - Turn the controller power OFF
  - Select a JOB including Master JOB call.
  - Switch the mode to TEACH to move the cursor in the JOB.
  - Switch the mode to TEACH to perform rest run and forward and backward operations.
  - Switch the mode to TEACH to perform JOG operation.
Restrictions

- **Backward motion during recovery motion**
  When performing backward motion during recovery motion, only move instructions in the job are executed. Since “JUMP "LABEL"” instructions are not executed, the JOB execution path may be different from the normal path.
  Note that the instructions other than move instructions are not to be executed when performing backward motion. (Same as normal job execution)

**NOTE**
The cursor on the step blinks during recovery backward motion.
Recovery return position, recovery prohibit instruction

When moving back the specified distance during error recovery motion, the manipulator cannot move back exceeding NOP instruction. That is, the manipulator cannot perform the backward motion exceeding NOP instruction at the first line of the JOB target for recovery motion or the NOP instruction inserted in the JOB. In this case, the manipulator quits backward motion when it reaches the MOV instruction just before NOP instruction and then starts forward motion. If there is a possibility for the manipulator to interrupt with the peripheral device during the recovery motion, insert NOP in the JOB. To insert NOP instructions in the JOB, set the language setting level in the teaching condition to standard or higher level and then select it from the CONTROL.

```
<NOP at the head of the JOB>
NOP
DOUT OT#(x) ON
MOV
MOV
MOV
:
MOV
:
MOVLP16 NWAIT
DOUT OT#(x) OFF
:
END
```

```
<NOP inserted in the JOB>
NOP
DOUT OT#(x) ON
MOV
:
DOUT OT#(x) OFF
NOP
DOUT OT#(x) ON
MOV
:
DOUT OT#(x) OFF
END
```

- If there are no steps in the interrupted job, the job execution will be normally continued without performing recovery motion when restarted.

- Don’t insert NOP instruction between a series of three teaching points for such as circular interpolation and free curve interpolation. The interpolation cannot be performed when executing the recovery motion in the forward direction when restarted.

- If the recovery motion in the forward direction is interrupted again, the manipulator returns to the initial recovery position when it is restarted again. Therefore, even if the NOP instruction is executed when executing recovery motion in the forward direction, which occurs when a large plus number is set for the RESTART TIMING ADJUST TIME, the manipulator returns to the initial recovery position exceeding the NOP instruction when the operation is interrupted and restarted again. (A new recovery condition cannot be created before the first recovery motion is completed.)
NOTE

When the JOB is interrupted during recovery motion, the manipulator stop position may not coincide with the cursor position on the programming pendant with NOP instruction inserted between them due to the response lag of the motor control.

In this case, the manipulator performs forward motion when restarted since it is supposed to move to the step just after NOP instruction.

At that time, the sealer gun output becomes OFF. Therefore, don’t set NOP instruction to prohibit recovery in the sealing section. In such case, be sure to set NOP instruction in the approach section before work section.

<Cursor position and manipulator position when job interruption>

When the JOB is interrupted during recovery motion, the manipulator stop position may not coincide with the cursor position on the programming pendant with NOP instruction inserted between them due to the response lag of the motor control.

In this case, the manipulator performs forward motion when restarted since it is supposed to move to the step just after NOP instruction.

At that time, the sealer gun output becomes OFF. Therefore, don’t set NOP instruction to prohibit recovery in the sealing section. In such case, be sure to set NOP instruction in the approach section before work section.
6 Restrictions

- **If multiple recovery conditions are set**
  If multiple recovery condition files are set for one manipulator and the job is interrupted during multiple recovery object signals are all ON, the recovery motion will be performed according to the recovery condition file of low number.

  It is not capable of parallel execution of recovery motion for multiple recovery object signals.

- **Recovery motion for coordinated job of multiple robots**
  If the recovery files for multiple robots are valid in the coordinated job of multiple robots, the recovery motion will be performed according to the recovery condition file in which longer return distance is set.

  It is not capable of parallel execution of recovery motion for multiple recovery object signals.

**NOTE**
To perform parallel execution of the recovery motion for multiple robots, activate Independent control function.
For inquiries or after-sales service on this product, contact your local YASKAWA representative as shown below.