YASKAWA

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

Have the following information available when contacting the YASKAWA Representative:

- System
- Primary Application
- Software Version *(Located on Programming Pendant by selecting: {Main Menu} - {System Info} - {Version})*
- Warranty ID *(Located on Robot Controller)*
- Robot Serial Number *(Located on Manipulator data plate)*
- Robot Sales Order Number *(Located on Robot controller data plate)*

Part Number: 191148-1CD
Revision: 0

MANUAL NO.
HW1486562

DANGER

- This manual explains the Error recovery function in sealing application of the YRC1000 system. 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”.

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.

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.

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 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.

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

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 result in personal injury caused by unintended manipulator movement.

Fig. : Release of Emergency Stop

- Observe the following precautions when performing a teaching operation within the P-point maximum envelope of the manipulator:
  - 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 result in personal injury caused by improper or unintended manipulator movement.

- Confirm that no person is present in the P-point maximum envelope of the manipulator 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

Injury may result if any person should enter the P-point maximum envelope of the manipulator 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, 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 supply cables.

In this manual, the equipment is designated as follows.

Equipment	Manual Designation
YRC1000 controller	YRC1000
YRC1000 programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator cable

Descriptions of the programming pendant keys, buttons, and displays are shown as follows:

Equipment		Manual Designation
Programming Pendant	Character Keys /Symbol Keys	The keys which have characters or symbols printed on them are denoted with [ ]. e.g. [ENTER]
	Axis Keys /Numeric Keys	[Axis Key] and [Numeric Key] 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, e.g. [SHIFT]+[COORD].
	Mode Switch	Mode Switch can select three kinds of modes that are denoted as follows: REMOTE, PLAY or TEACH. (The switch names are denoted as symbols)
	Button	The three buttons on the upper side of the programming pendant are denoted as follows: START, HOLD, or EMERGENCY STOP. (The button names are denoted as symbols)
	Displays	The menu displayed in the programming pendant is denoted with { }. e.g. {JOB}

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

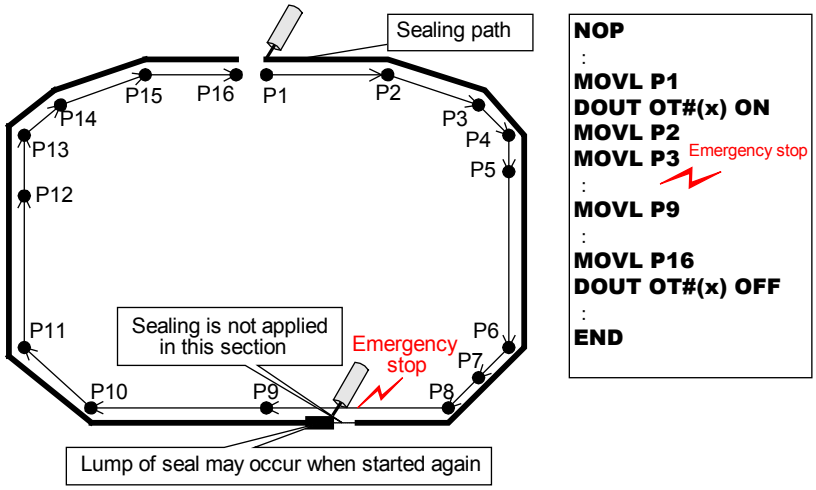
In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or bland names for each company or corporation. The indications of (R) and TM are omitted.

Contents

1 Functional overview

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[1)] occur while a specific general output signal[2)], 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

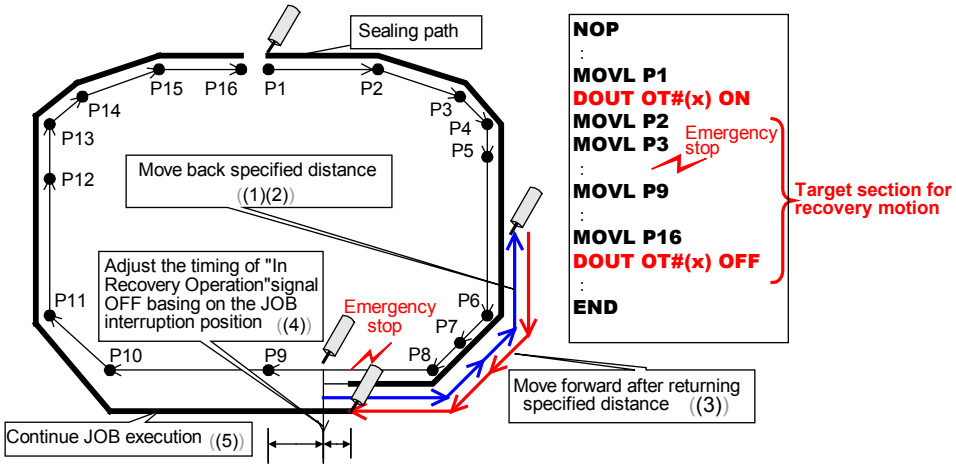
(1) When restarted, the specified general output signal [3)](In Recovery Operation signal) becomes ON.

(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.

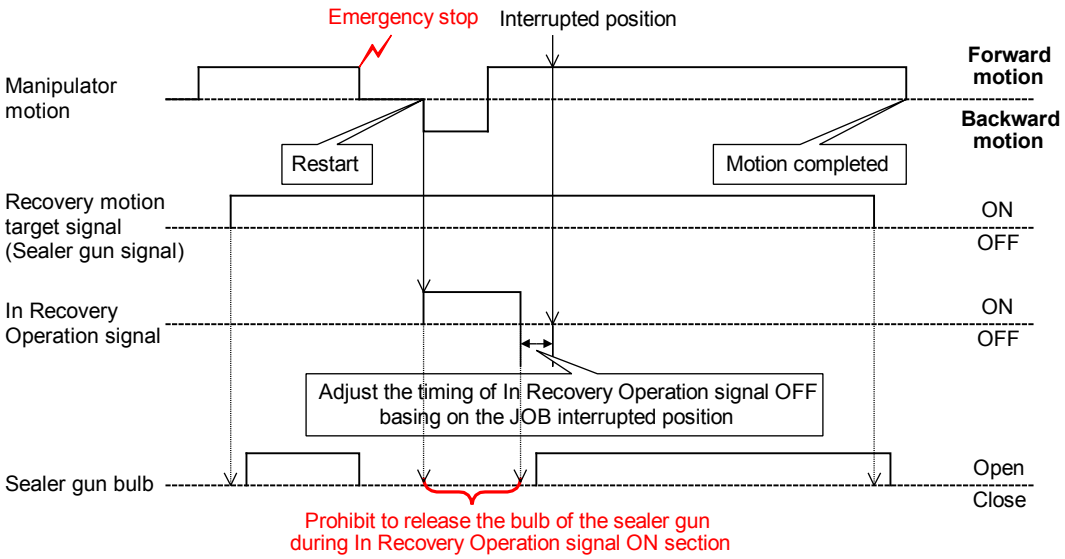
(5) Continue job execution.



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.

2 Error Recovery Sequence

Signal status during error recovery motion is as follows.



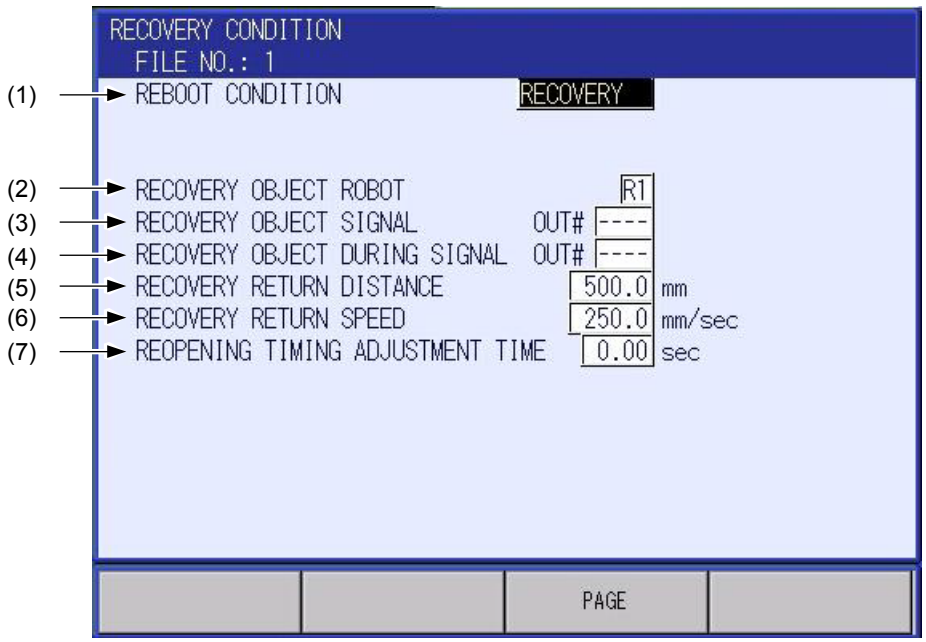
NOTE

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.



SUPPLE-MENT

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.

(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#4096, 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

(4) **OUTPUT SIGNAL DURING RECOVERY**
(OUT#1 to OUT#4096, 0 : "- (Invalid)")
Specifies the general output number that indicates the error recovery operation status.

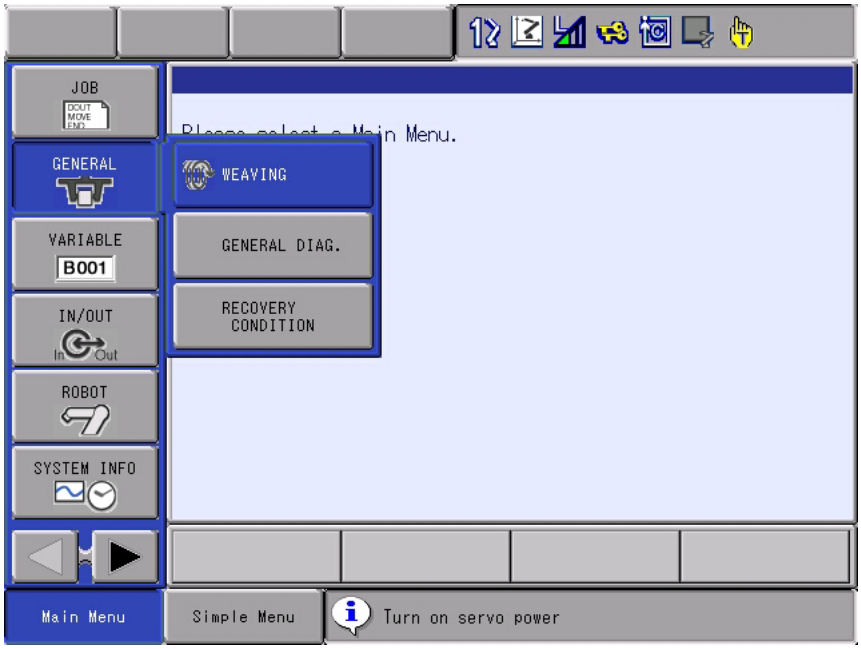
(5) **MINIMUM RECOVERY RETURN DISTANCE**
(100.0mm to 1000.0mm)
Specifies the minimum distance to return when performing recovery return motion.

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

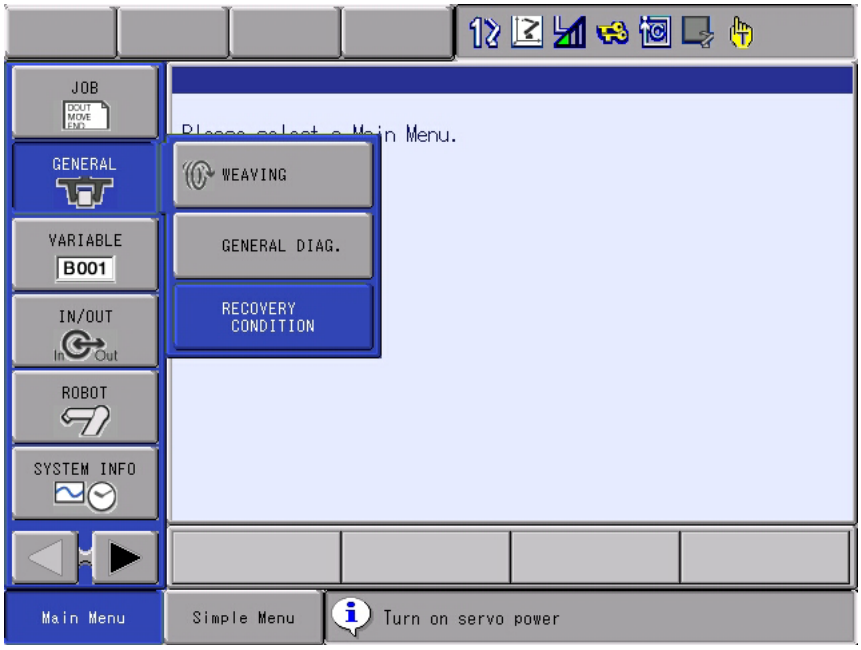
(7) **RESTART TIMING ADJUSTMENT TIME**
Specifies the time to adjust the timing of the In Recovery Operation signal to become OFF when the manipulator reaches the position where the job is interrupted.

4 Editing Recovery Condition file

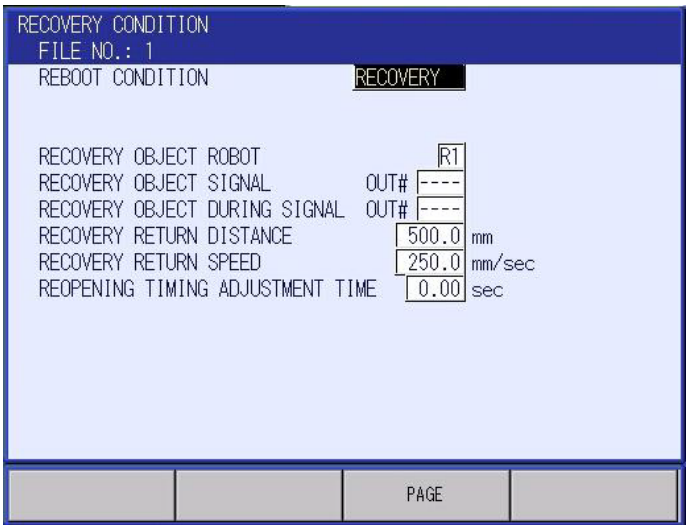
1. Select main menu [GENERAL]



2. Select sub menu [RECOVERY CONDITION]



– ERROR RECOVERY file is shown



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.

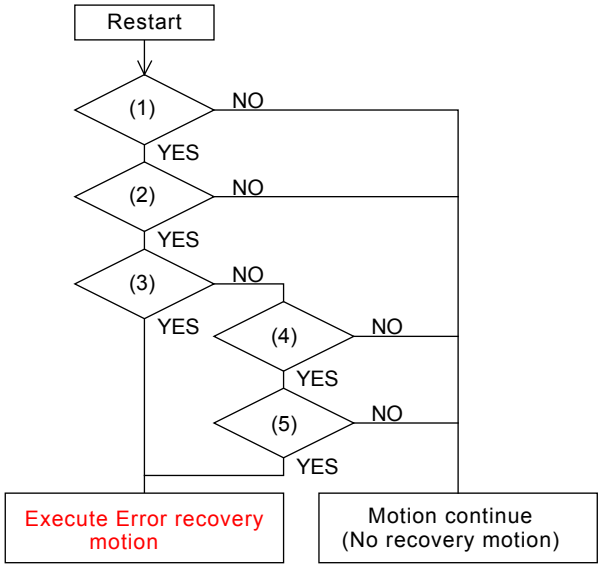
(1) RECOVERY OBJECT SIGNAL is set in RECOVERY CONDITION file

(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. ***1)***

(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.***2)***



NOTE

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 programing pendant to inform the operator that the manipulator is in the recovery operation.

6 Restrictions

■ **Operations that disable the recovery function**

Recovery motion will not be started up if any of following operations is performed before restart.

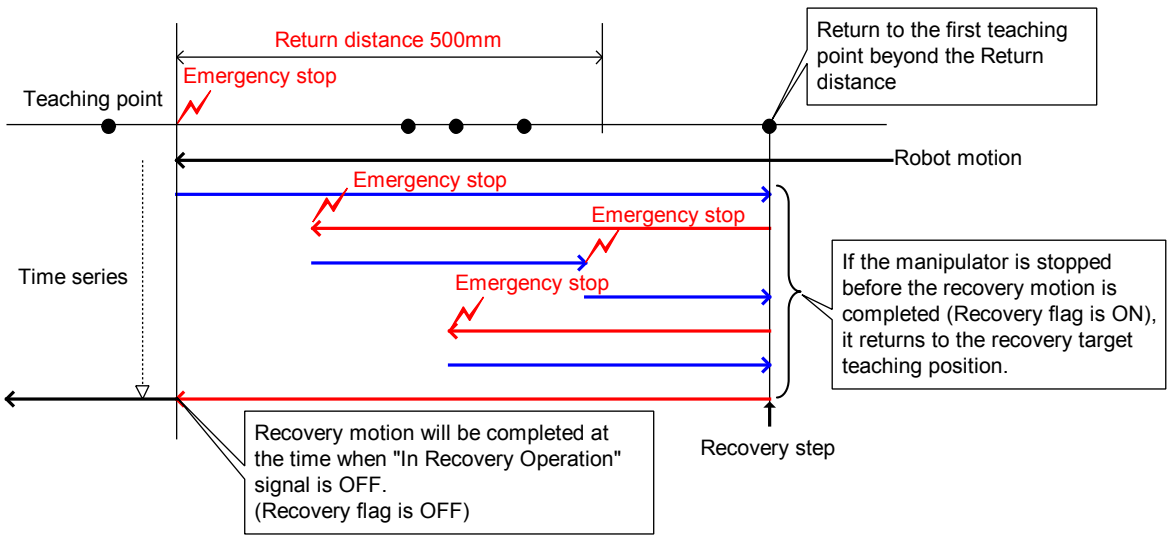
- Turn the controller power OFF
- Select a JOB including Master JOB call.
- Switch the mode to TEACH to move the cursor in the JOB.
- Switch the mode to TEACH to perform rest run and forward and backward operations.
- Switch the mode to TEACH to perform JOG operation.
- Switch the mode to TEACH to edit 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.



■ **Backward motion during recovery motion**

When perfuming 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.

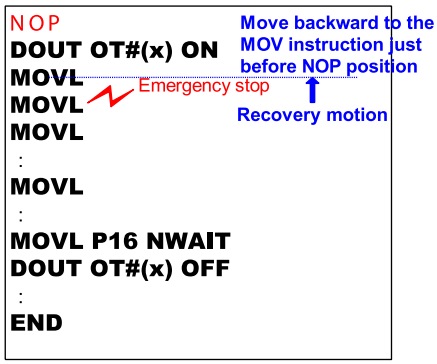
Note that the instructions other than move instructions are not to be executed when performing backward motion. (Same as normal job execution)

NOTE The cursor on the step blinks during recovery backward motion.

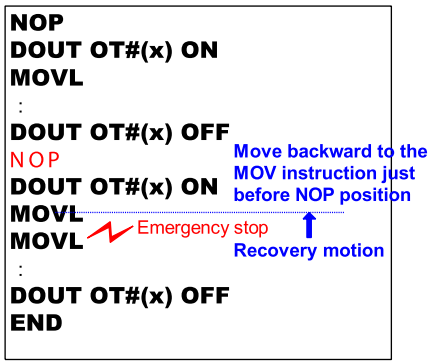
■ **Recovery return position, recovery prohibit instruction**

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 inserted in the JOB>



NOTE

- 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

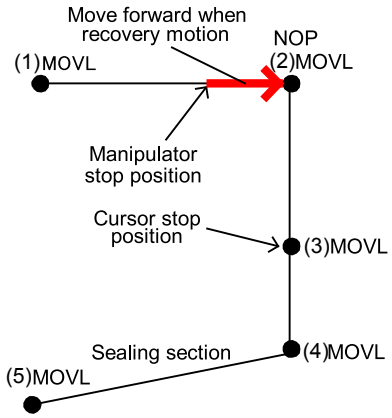
When the JOB is interrupted during recovery motion, the manipulator stop position may not coincide with the cursor position on the programming pendant with NOP instruction inserted between them due to the response lag of the motor control.

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>

```
NOP
 :
MOVL  (1)
NOP                    Perform recovery
MOVL  (2)              motion toward(2)
MOVL  (3)              Cursor stop position
MOVL  (4)
DOUT OT#(X) ON         Sealing start
MOVL  (5)
 :
END
```



- **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.

To perform parallel execution of the recovery motion for multiple robots, activate Independent control function.

YRC1000 OPTIONS
INSTRUCTIONS
FOR ERROR RECOVERY FUNCTION IN SEALING APPLICATION

YASKAWA

YASKAWA ELECTRIC CORPORATION

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