MOTOMAN Cockpit
INSTRUCTIONS
FOR PREVENTIVE MAINTENANCE FUNCTION

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

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: 180155-1CD
Revision: 0
DANGER

• This manual describes details on the preventive maintenance function of MOTOMAN Cockpit including settings for the controller to use the function. Read this manual carefully and be sure to understand its contents before handling the controller. 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/DX200 INSTRUCTIONS. To ensure correct and safe operation, carefully read “Chapter 1. Safety” of the YRC1000/DX200 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.

• Software described in this manual is supplied against licensee only, with permission to use or copy under the conditions stated in the license. No part of this manual may be copied or reproduced in any form without written consent of YASKAWA.

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/DX200.

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”. 
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</td>
</tr>
<tr>
<td></td>
<td>The keys which have characters or symbols printed on them are denoted with [ ]. ex. [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, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }. ex. {JOB}</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 ™ are omitted.
Contents

1  Functional Overview ....................................................................................................................... 1-1
   1.1 Description of the MOTOMAN Cockpit Preventive Maintenance Function.................... 1-1
   1.2 Setup ........................................................................................................................................ 1-1

2  Window Structure and Display Method........................................................................................ 2-1
   2.1 How to Display the Maintenance Window .............................................................. 2-1
   2.2 Line Window ...................................................................................................................... 2-3
   2.3 Maintenance Window Structure ..................................................................................... 2-5
   2.4 How to Display the Maintenance Settings Window .................................................. 2-6
   2.5 Maintenance Settings Window Structure ....................................................................... 2-7

3  Preventive Maintenance Function for Speed Reducer ............................................................... 3-1
   3.1 Diagnosis by Life Calculation ......................................................................................... 3-1
   3.2 Diagnosis by Torque Average Value ............................................................................ 3-3

4  Inspection Notification Function .................................................................................................. 4-1

5  Record of Inspection/Replacement Date ..................................................................................... 5-1
   5.1 Inspection History ............................................................................................................. 5-1
   5.2 Maintenance Journal ....................................................................................................... 5-4

6  Preventive Maintenance Function for Hardware ......................................................................... 6-1
   6.1 Diagnosed Components ................................................................................................. 6-1
   6.2 Replacement Timing Indication .................................................................................... 6-1
   6.3 Window Structure ............................................................................................................ 6-2

7  Timing of Updating the Information on the Window ................................................................. 7-1
1 Functional Overview

1.1 Description of the MOTOMAN Cockpit Preventive Maintenance Function

The MOTOMAN Cockpit preventive maintenance function (hereinafter referred to as the MC preventive maintenance function) includes the function to provide information for life assessment of the speed reducer, the function to indicate the timing of inspection of the manipulator, and the function to provide information on the timing of replacement of the controller’s components, which are all useful for preventive maintenance of the robot. The MC preventive maintenance function is an optional add-on application to expand the function of the MOTOMAN Cockpit Platform (hereinafter referred to as MCP), and the maintenance window and the maintenance settings window are added. The image of the MC preventive maintenance function is shown in fig. 1-1 “Window of the MC Preventive Maintenance Function”. The following functions are available:

- Preventive maintenance function for speed reducer
- Inspection notification function
- Preventive maintenance function for hardware
- Maintenance journal (log) function

*NOTE*

Some functions are not supported by the DX100, FS100, and NX100.

Fig. 1-1: Window of the MC Preventive Maintenance Function

1.2 Setup

To use the MC preventive maintenance function, the license file of the MOTOMAN Cockpit preventive maintenance function must be loaded into MCP. For details on the license file, contact your YASKAWA representative.
2  Window Structure and Display Method

The MC preventive maintenance function has the Maintenance window and the Maintenance settings window. The status relating to preventive maintenance is also shown in the controller list.

2.1 How to Display the Maintenance Window

1. Log in to the MCP.

2. The Line Group window appears. Select the line to display.
Window Structure and Display Method

2.1 How to Display the Maintenance Window

3. Select the controller to display.

4. Select the “Maintenance” tab.
2.2 Line Window

The status of each controller registered on the selected line is shown. In addition to the model, version, and application, the status relating to preventive maintenance is shown.

- **Speed Reducer**
  The status of the manipulator’s speed reducers is shown.

<table>
<thead>
<tr>
<th>Color</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Warning (high)</td>
<td>The torque fluctuation value or the life of the speed reducer(s) of one or more axes exceeds the upper threshold.</td>
</tr>
<tr>
<td>Yellow</td>
<td>Warning (mid)</td>
<td>The torque fluctuation value or the life of the speed reducer(s) of one or more axes is between the lower threshold and the upper threshold.</td>
</tr>
<tr>
<td>Blue</td>
<td>Normal</td>
<td>The torque fluctuation values and the lives of the speed reducers of all axes are below the lower threshold.</td>
</tr>
</tbody>
</table>

Note 1: The upper threshold and the lower threshold are specified in chapter 2.5 “Maintenance Settings Window Structure” as the threshold values for the speed reducers.

Note 2: For the FS100 and NX100, this item “Speed Reducer” is not supported.

Note 3: For the DX100, only the torque fluctuation value is evaluated if the high-speed Ethernet server function and the speed reducer life diagnosis function (the controller’s optional functions) are both activated.

- **Periodic Inspection**
  The period of time until the next inspection is shown.

<table>
<thead>
<tr>
<th>Color</th>
<th>Period</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Past Inspection Period</td>
<td>The time of inspection has been exceeded.</td>
</tr>
<tr>
<td>Yellow</td>
<td>&lt; 500 Hours remaining</td>
<td>Less than 500 hours remain until the next periodic inspection.</td>
</tr>
<tr>
<td>Blue</td>
<td>&gt; 500 Hours Remaining</td>
<td>More than 500 hours remain until the next periodic inspection.</td>
</tr>
</tbody>
</table>

Note: The above-mentioned period of time is specified in chapter 2.5 as the threshold of the periodic inspection.
2 Window Structure and Display Method

2.2 Line Window

- Hardware Life
  For reference, the life of the controller’s components are classified into 4 levels.

<table>
<thead>
<tr>
<th>Color</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Replacement required.</td>
<td>Time to replace the components (for reference).</td>
</tr>
<tr>
<td>Yellow</td>
<td>Replacement Required Soon.</td>
<td>The components have been used for more than half of their lives and the time to replace them is approaching (for reference).</td>
</tr>
<tr>
<td>Green</td>
<td>Normal (&gt; 30%)</td>
<td>The components have been used for about half of their lives.</td>
</tr>
<tr>
<td>Blue</td>
<td>Normal (&gt; 50%)</td>
<td>The components are new or used for less than half of their lives.</td>
</tr>
</tbody>
</table>

*Note: For the DX100, FS100 and NX100, this item "Hardware Life" is not supported.*
2.3 Maintenance Window Structure

The Maintenance window is shown in fig. 2-1 “Maintenance Window” and described below.

Fig. 2-1: Maintenance Window

① Speed reducer preventive maintenance window
The graphs of the speed reducer’s life and the torque indicating the speed reducer’s status are shown. For details, refer to chapter 3 “Preventive Maintenance Function for Speed Reducer”.

② Maintenance History/Journal window
The inspection history and the maintenance journal (log) can be kept. For details, refer to chapter 5 “Record of Inspection/Replacement Date”.

③ Periodic Inspection window
The bar graph of remaining time for each inspection item is shown. For details, refer to chapter 4 “Inspection Notification Function”.

④ Hardware preventive maintenance window
The lives of the controller’s components are indicated by color. For details, refer to chapter 6 “Preventive Maintenance Function for Hardware”.

2.4 How to Display the Maintenance Settings Window

1. Log in to MCP.

2. The Line Group window appears. Select “SETTINGS”.

3. Select “Display Settings”.

4. Select “Maintenance”.
2.5 Maintenance Settings Window Structure

①Speed Reducer Fluctuation
Specify the allowable rate of the torque fluctuation value of the speed reducer. If the measured value (the latest value minus the average value) is equal to or less than the value specified here, it is judged OK. If the measured value is greater than the value specified here, it is judged NG. Two levels, “Upper” and “Lower”, can be specified for the torque fluctuation. The “Upper Threshold” must be greater than the “Lower Threshold”. The default settings are shown below. For details, refer to chapter 3.1 “Diagnosis by Life Calculation”.

<table>
<thead>
<tr>
<th>Initial value (default)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Threshold</td>
<td>30.0</td>
</tr>
<tr>
<td>Lower Threshold</td>
<td>20.0</td>
</tr>
</tbody>
</table>
2.5 Maintenance Settings Window Structure

- **Speed Reducer Life**
  Specify the thresholds of speed reducer life and the scale on the x-axis. Before the "time until replacement" which is calculated by the speed reducer's life calculation becomes "0", the replacement notice is indicated at the time specified here. If the "time until replacement" is greater than the threshold specified here, it is judged OK. If the life is shorter than the threshold specified here, it is judged NG. Two levels, "Upper" and "Lower", can be specified for the speed reducer life. The "Lower Threshold" must be greater than the "Upper Threshold". For details, refer to chapter 3.1 "Diagnosis by Life Calculation".

<table>
<thead>
<tr>
<th></th>
<th>Initial value (default)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Threshold</td>
<td>0.0</td>
<td>Hrs</td>
</tr>
<tr>
<td>Lower Threshold</td>
<td>1000.0</td>
<td>Hrs</td>
</tr>
<tr>
<td>Disp. Time MIN</td>
<td>0.0</td>
<td>Hrs</td>
</tr>
<tr>
<td>Disp. Time MAX</td>
<td>36000.0</td>
<td>Hrs</td>
</tr>
</tbody>
</table>

- **Scheduled Inspections**
  Specify the inspection schedule (interval) and the threshold of each inspection item. The threshold must be less than the inspection interval. The initial values (default settings) are shown below.

<table>
<thead>
<tr>
<th></th>
<th>Schedule (unit: Hrs)</th>
<th>Threshold (unit: Hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection</td>
<td>1000.0</td>
<td>500.0</td>
</tr>
<tr>
<td>Grease Supply</td>
<td>6000.0</td>
<td>1000.0</td>
</tr>
<tr>
<td>Grease Exchange</td>
<td>12000.0</td>
<td>1000.0</td>
</tr>
<tr>
<td>Cover/Connector/Lead</td>
<td>12000.0</td>
<td>1000.0</td>
</tr>
<tr>
<td>Lead Wire Exchange</td>
<td>24000.0</td>
<td>1000.0</td>
</tr>
<tr>
<td>Overhaul</td>
<td>36000.0</td>
<td>1000.0</td>
</tr>
<tr>
<td>Battery Exchange</td>
<td>36000.0</td>
<td>1000.0</td>
</tr>
</tbody>
</table>

- **"Restore"**
  Restores the settings to the initial values.

- **"Apply"**
  Applies the modified settings.

- **"Cancel"**
  Cancels the modification and restores the settings to the previous values.
3 Preventive Maintenance Function for Speed Reducer

3.1 Diagnosis by Life Calculation

With this function, the life of the speed reducer is estimated by using two methods, the life calculation and the torque average value. The life estimation is performed by executing the job in the play mode. It is not necessary to prepare a specific job for this estimation.

- The accuracy of the life estimation is not guaranteed. Use this function as one of the methods to estimate the life of the speed reducer.
- If periodic grease replenishment/exchange is not performed or excessive force such as mechanical interference is applied, failure of the speed reducer may occur before reaching the estimated life.
- The life estimation is performed by executing the job in the play mode. When operating the manipulator in the teach mode (operation by [Axis Key], FWD operation, or test operation), the life estimation is not performed.

- For the FS100 and NX100, this function is not supported.
- For the DX100, only the estimation by using the torque average value is supported if the high-speed Ethernet server function and the speed reducer life diagnosis function (the controller’s optional functions) are both activated.

With this function, only the diagnosis for the manipulator axes can be performed. The diagnosis for the external axes cannot be performed.
Graph

The life calculation can be confirmed by the graph “Speed Reducer Life”. Use this graph as one of the methods to estimate the life of the speed reducer.

The vertical axis of the graph indicates the remaining time until replacement, and the horizontal axis indicates the operating time.

To modify the scale on the horizontal axis, modify the “Disp. Time MIN” and the “Disp. Time MAX” in chapter 2.5 “Maintenance Settings Window Structure”. To modify the threshold, modify the “Upper Threshold” or “Lower Threshold” in chapter 2.5.
3.2 Diagnosis by Torque Average Value

**Diagnosis Element**

The torque waveform during the job operation is monitored, and the waveform attributed to the speed reducer is extracted from the torque waveform, and the average value of the vibration amplitude is calculated. This data is called the torque average value, and this serves as the basic data to estimate the life of the speed reducer. The life curve graph of the operating time versus the torque average value is shown below.

When the condition of the speed reducer changes from “normal operation” to “deterioration”, the torque component arising from the speed reducer deterioration changes from “normal” to “increase”. Thus, if the torque component is increasing, the speed reducer is presumed to be in the deterioration period.

With this function, the torque component arising from the speed reducer deterioration is recorded in the database on a daily basis, and the life of the speed reducer is estimated by monitoring the change of the torque component.
By operating a job in the play mode, the data (the torque component arising from the speed reducer deterioration) for each axis is automatically recorded in the database on a daily basis, and the data is accumulated. If the gap between the latest value (the average value of the measured results of 5 days including today (default)) and the average value (the average value of the measured results of 30 days (default) from 90 days prior to today (default) to 60 days prior to today (default)) becomes greater than the threshold value, it is diagnosed that the speed reducer will fail shortly, and the color of the label beside the graph is changed. The average value is measured in percentage, and 100% is the rated torque.

Graph

The measured value (Measurement) and the variation value (Variation) can be confirmed by the graph “Speed Reducer”. This graph is automatically updated every 24 hours. Use this graph as one of the methods to estimate the life of the speed reducer.
3 Preventive Maintenance Function for Speed Reducer
3.2 Diagnosis by Torque Average Value

① Label of the diagnosis result of the speed reducer
The status of the speed reducer is shown by color. The color of this label is the same as the color of the “Speed Reducer” in the “Line” window. Refer to chapter 2.2 “Line Window”.

② Option buttons of “Measurement” and “Variation”
• When “Variation” is selected

The variation (the latest value minus the average value) is shown on the graph.
The horizontal lines of “Upper Threshold” and “Lower Threshold” are shown.

The “Upper Threshold” and “Lower Threshold” of the “Speed Reducer Fluctuation” in chapter 2.5 “Maintenance Settings Window Structure” correspond respectively to the “Upper Threshold” and “Lower Threshold” here.

In the graph above, the “Variation” of the L-axis is greater than the “Upper Threshold”, thus the label of the diagnosis result of the speed reducer is red.
• When “Measurement” is selected

The measured value is shown on the graph.

Pull-down menu
The desired group can be selected and displayed.
4 Inspection Notification Function

With this function, the color of the inspection notification label is changed when it is time for inspection of the manipulator.

If the inspection notification label turns red, contact your YASKAWA representative for inspection by a qualified personnel.

![Periodic Inspection Graph]

1. **Periodic inspection label**
   The necessity of the periodic inspection is indicated by color. If the remaining time until the next periodic inspection for one of the items falls below the threshold, the label turns red.

2. **Inspection items**
   The inspection items are shown. For details on the inspection, refer to the instruction manual for the manipulator.

3. **Remaining, Threshold, Consume**
   The remaining time until the next periodic inspection for each item is shown. The threshold is indicated by the red line. “Consume” means the time elapsed from the previous inspection. The Schedule and Threshold specified in the Periodic Inspection window described in chapter 2.3 “Maintenance Window Structure” are reflected in this graph. The remaining time is calculated every hour based on the servo operating time of the controller.
5 Record of Inspection/Replacement Date

5.1 Inspection History

The dates of inspection and replacement can be recorded and confirmed as follows:

1. Select “History” in the Maintenance window.
   - The history of inspection appears below.
5 Record of Inspection/Replacement Date

5.1 Inspection History

2. Select a date of inspection to see the comment recorded then in the “Details” field below.

3. After performing an inspection or replacement, click “Add”.

![Inspection History Table]

![Add Button]
4. An entry window appears.

By clicking “Add”, “Consume” of the inspection item specified in the window is reset to 0, and the remaining time until the next inspection becomes the same as the Schedule.
5.2 Maintenance Journal

The maintenance journal (log) can be created as follows:

   - The record of maintenance appears below.

   ![Maintenance Journal Interface]

2. An entry window appears.

   ![Maintenance Journal Entry Window]
6 Preventive Maintenance Function for Hardware

6.1 Diagnosed Components

With this function, the life of each component of the controller is estimated by calculating the wearing of the component based on the usage environment and the load on the component, and the diagnosis for the component is indicated as a reference for the timing of replacement.

The functional overview is described in the following.

For the DX100, FS100, and NX100, this function is not supported.

6.1 Diagnosed Components

The wearing is calculated and the diagnosis as a reference for the timing of replacement is indicated for the following components:

- Cooling fan
- Capacitor
- Amplifier IGBT
- Contactor

Note that for the manipulator fan, regardless of whether the manipulator has a fan or not, the diagnosis is indicated. For details on whether the manipulator has a fan or not, refer to the instruction manual for the manipulator.

6.2 Replacement Timing Indication

For the components to be replaced, diagnosis is categorized into 4 levels and can be used as a reference for the timing of replacement.

<table>
<thead>
<tr>
<th>Indication (color)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>The component is new or used for less than half of its life.</td>
</tr>
<tr>
<td>Green</td>
<td>The component has been used for about half of its life.</td>
</tr>
<tr>
<td>Yellow</td>
<td>The component has been used for more than half of its life and the time to replace it is approaching (for reference).</td>
</tr>
<tr>
<td>Red</td>
<td>Time to replace the component (for reference).</td>
</tr>
</tbody>
</table>
6 Preventive Maintenance Function for Hardware
6.3 Window Structure

The window of the preventive maintenance function for the hardware is shown in fig. 6-1 “Window of the Preventive Maintenance Function for Hardware” and described below.

**Fig. 6-1: Window of the Preventive Maintenance Function for Hardware**

1. **Overall diagnosis of the preventive maintenance for the hardware**
   Among all the components subject to the preventive maintenance function for the hardware, the worst diagnosis result (closest to the replacement) is indicated.

2. **Unit tab**
   The component (unit) shown in the window can be switched by using these tabs. The color of the tab indicates the status of the subcomponent with the worst diagnosis result (closest to the replacement) in the unit. When two or more servo boards are used, all the subcomponents of the servo boards are subject to the preventive maintenance function for the hardware.

3. **Indication of diagnosis for each subcomponent**
   Diagnosis for each subcomponent of the selected unit is indicated. Indications for the selected servo board are shown.

4. **Servo Board**
   When two or more servo boards are inserted in the controller, the desired servo board can be selected.
6 Preventive Maintenance Function for Hardware

6.3 Window Structure

- Cooling Fan

- Capacitor
6 Preventive Maintenance Function for Hardware
6.3 Window Structure

- **Amplifier IGBT**

```
Hardware
Cooling Fan  Capacitor  Amplifier IGBT  Contactor
```

- **Contactor**

```
Hardware
Cooling Fan  Capacitor  Amplifier IGBT  Contactor
```

- Control Box Fan
- Manipulator Fan
- CPS Fan
- Regenerative Fan
- Servo Board #1
- Contactor (TU) 
  #1
- Servo Board #1
## 7 Timing of Updating the Information on the Window

The timing of updating the information viewed by MCP differs depending on the window. The following table lists the timing when information of each item related to the MC preventive maintenance function is updated. The updating process is executed at the timing marked with \( \bigcirc \) or described in the “Others” column.

<table>
<thead>
<tr>
<th>Window</th>
<th>Item</th>
<th>Timing of updating the information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1H(^{1)})</td>
</tr>
<tr>
<td>Line</td>
<td>Speed Reducer</td>
<td>△(^{3)})</td>
</tr>
<tr>
<td></td>
<td>Periodic Inspection</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Hardware Life</td>
<td>O</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Speed reducer label</td>
<td>△(^{3)})</td>
</tr>
<tr>
<td></td>
<td>Speed reducer graph (torque)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Speed reducer graph (variation)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Speed reducer graph (life)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Periodic inspection label</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Periodic inspection graph</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Hardware preventive maintenance</td>
<td>O</td>
</tr>
</tbody>
</table>

1 Updated every hour, at XX:00.
2 Updated every day, at the time specified in “MOTOMAN Cockpit Platform INSTRUCTIONS (HW1484338) chapter 4.2.1 “Basic Information” Settings”.
3 The data of the speed reducer is updated at “1D”, but the diagnosis result by using the threshold is updated at “1H”.
MOTOMAN Cockpit
INSTRUCTIONS
FOR PREVENTIVE MAINTENANCE FUNCTION

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