Motoman XRC Controller

Arm Interference Instructions Manual

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MOTOMAN

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NOTES

SECTION 1 INTRODUCTION

1.1 About this Document

This manual provides instructions for the XRC arm interference function and contains the following sections:

SECTION 1 – INTRODUCTION

General information about this manual, a list of reference documents, and customer service information.

SECTION 2 - SAFETY

Provides information for the safe use and operation of Motoman products.

SECTION 3 – ARM INTERFERENCE INSTRUCTIONS

Provides detailed instructions for the arm interference function.

1.2 *Reference to Other Documentation*

For additional information refer to the following:

- Concurrent I/O Parameters Manual (P/N 142102-1)
- Operator's Manual for General Purpose (P/N 142099-1)
- Operator's Manual for Handling (P/N 142100-1)
- Operator's Manual for Spot Welding (P/N 142101-1)
- Operator's Manual for Arc Welding (P/N 142098-1)
- Motoman UP6, XRC Manipulator Manual (P/N 142104-1)
- Motoman UP20, XRC Manipulator Manual (P/N 144342-1)
- Motoman UP50, XRC Manipulator Manual (P/N 144343-1)
- Motoman UP130, XRC Manipulator Manual (P/N 142107-1)

1.3 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type (UP6, SK16X, etc.)
- Application Type (welding, handling, etc.)
- Robot Serial Number (located on the back side of the robot arm)
- Robot Sales Order Number (located on back side of XRC controller)

NOTES

SECTION 2 SAFETY

2.1 Introduction

It is the purchaser's responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06. The address is as follows:

Robotic Industries Association

900 Victors Way P.O. Box 3724 Ann Arbor, Michigan 48106 TEL: (734) 994-6088 FAX: (734) 994-3338

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. The robot must not be operated by personnel who have not been trained!

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.

This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming Safety (Section 2.6)
- Operation Safety (Section 2.7)
- Maintenance Safety (Section 2.8)

2.2 Standard Conventions

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

- DANGER
- WARNING
- CAUTION
- NOTE

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



DANGER!

Information appearing under the DANGER caption concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.



WARNING!

Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.



NOTE:

CAUTION!

Information appearing under the CAUTION caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

Information appearing in a NOTE caption provides additional information which is helpful in understanding the item being explained.

Arm Interference Instruction Manual

2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06, section 6.13.4 and 6.13.5, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety measures are available:

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

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Programming tips are as follows:

- Any modifications of the controller PLC can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the PLC. Making any changes without the written permission of Motoman will **VOID YOUR WARRANTY!**
- Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.
- Back up all programs and jobs onto a floppy disk whenever program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- The concurrent I/O (Input and Output) function allows the customer to modify the internal ladder inputs and outputs for maximum robot performance. Great care must be taken when making these modifications. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations that may damage the robot or other parts of the system.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.

- Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place.
- Check the E-STOP button on the teach pendant for proper operation before programming.
- Carry the teach pendant with you when you enter the workcell.
- Be sure that only the person holding the teach pendant enters the workcell.
- Test any new or modified program at low speed for at least one full cycle.

2.7 Operation Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Operation tips are as follows:

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

2.8 Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. Maintenance tips are as follows:

- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Check all safety equipment for proper operation. Repair or replace any nonfunctioning safety equipment immediately.
- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to operate the system.
- Back up all your programs and jobs onto a floppy disk whenever program changes are made. A backup must always be made before any servicing or changes are made to options, accessories, or equipment to avoid loss of information, programs, or jobs.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the cell.
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- Be sure all safeguards are in place.
- Use proper replacement parts.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller, external servo box, and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot. This includes controller parameters, ladder, and I/O (Input and Output) modifications. Check and test all changes at slow speed.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).

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YASNAC XRC OPTIONS

FOR ARM INTERFERENCE CHECK FUNCTION

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

MOTOMAN INSTRUCTIONS

MOTOMAN SETUP MANUAL MOTOMAN-DDD INSTRUCTIONS YASNAC XRC INSTRUCTIONS YASNAC XRC OPERATOR'S MANUAL YASNAC XRC OPERATOR'S MANUAL for BEGINNERS

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





- This manual explains the arm interference check function of the YAS-NAC XRC system and general operations. Read this manual carefully and be sure to understand its contents before handling the YASNAC XRC.
- General items related to safety are listed in Section 1: Safety of the Setup Manual. To ensure correct and safe operation, carefully read the Setup Manual before reading this manual.



- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.
- The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.
- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.
- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.
- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.

NOTES FOR SAFE OPERATION

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

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



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 "CAUTION" and "WARNING".





Definition of Terms Used Often in This Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product.

The manipulator usually consists of the controller, the playback panel, the programming pendant, and supply cables.

The MOTOMAN manipulator is the YASKAWA industrial robot product.

In this manual, the equipment is designated as follows.

Equipment	Manual Designation
YASNAC XRC Controller	XRC
YASNAC XRC Playback Panel	Playback Panel
YASNAC XRC Programming Pendant	Programming Pendant

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

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

Description of the Operation Procedure

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

Outline

2	Settings for Arm Interference Check			
	2.1 TOOL INTERFERE File			
	2.2 Enable or Disable Arm Interference Check			
	2.3 Calibration Between Manipulators			
3	Example Settings for the TOOL INTERFERE File			
4	Alarms and Errors			
-				
	4.1 During Axis Operation			
	4.2 During Playback, Forward, Backward, or Test			
	Operation			

5 Notes on the Arm Interference Check Function

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1 Outline

In a system with one controller and multiple manipulators, the arm interference check function can be used to detect possible interference to avoid collision during operation. The following three patterns can be checked:

- Arm against arm
- Arm against tool
- Tool against tool

Interference is checked by using a cylinder that is slightly larger than the arm or tool. A sphere is placed on both ends of the cylinder. If the cylinder and spheres of one manipulator have any contact with those of the other while moving, the manipulators stop because interference was detected.



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2 Settings for Arm Interference Check

2.1 TOOL INTERFERE File

To use the arm interference check function, settings for the cylinders and spheres of the manipulator's arms and tools are required. For the arms, the settings have already been preset at the factory so there is no need to make these settings. For the tools, the settings must be made by the user in the TOOL INTERFERE file, because the tool's form varies depending on the application.

Select "ROBOT" from the top menu, and then select "TOOL INTERFERE." The following display appears.

DATA	EDIT	DISPLA	Y UTILITY			
TOOL INTERFERE						
TOOL NO.: 0						
1 POINT1 X	0mm	POINT2 X:	140mm			
Y	: 0mm	Y:	0mm			
Z	: 0mm	Z:	100mm			
RADIUS	: 70mm					
2 POINT1 X	140mm	POINT2 X:	140mm			
Y	: 0mm	Y:	0mm			
Z	: -50mm	Z:	240mm			
RADIUS	: 30mm					

• Twenty-four files can be set.

A file is selected according to the tool number specified for the operation.

- The cylinders and spheres can be set for five positions. Scroll down to view the settings for the other positions.
- For POINT 1 and POINT 2, enter the positions of the two ends of the cylinder. In the same manner as the tool dimension settings, enter the value measured from the center of the T-axis flange (the tool coordinate origin X=0, Y=0, Z=0).
- Enter the radius of the cylinder and the sphere. For the sphere, settings must be made for both POINT 1 and POINT 2.

2.2 Enable or Disable Arm Interference Check

Enable or disable the arm interference check in the LIMIT RELEASE display. Select "ROBOT" from the top menu, and then select "LIMIT RELEASE." The following display appears.



Move the cursor to the setting for "ARM INTERFERENCE RELEASE," and press [SELECT]. The setting switches between "VALI" and "INVA."

- When "INVA" is selected ARM INTERFERENCE RELEASE is invalid, so the arm interference check is enabled.
- When "VALI" is selected ARM INTERFERENCE RELEASE is valid, so the arm interference check is disabled.

2.3 Calibration Between Manipulators

Calibration between manipulators is necessary prior to use of the arm interference check function. Refer to "3.5 System Setup" of the "YASNAC XRC OPTIONS INSTRUCTION FOR INDEPENDENT/COODINATED FUNCTION (RE-CKI-A426)" for details on how to calibrate between manipulators.

3 Example Settings for the TOOL INTERFERE File

The following diagram is an example of settings for the TOOL INTERFERE file.



Note: This example has no offset in the Y-direction.

TOOL INTERFERE 0					
1 POINT1 X=	0mm	POINT2 X=	140mm		
Y=	0mm	Y=	0mm		
Z=	0mm	Z=	85mm		
RADIUS	70mm				
2 POINT1 X=	140mm	POINT2 X=	140mm		
Y=	0mm	Y=	0mm		
Z=	-50mm	Z=	250mm		
RADIUS	30mm				
3 POINT1 X=	140mm	POINT2 X=	0mm		
Y=	0mm	Y=	0mm		
Z=	240mm	Z=	400mm		
RADIUS	20mm				
4 POINT1 X=	0mm	POINT2 X=	0mm		
Y=	0mm	Y=	0mm		
Z=	0mm	Z=	0mm		
RADIUS	0mm				
5 POINT1 X=	0mm	POINT2 X=	0mm		
Y=	0mm	Y=	0mm		
Z=	0mm	Z=	0mm		
RADIUS	0mm				

4 Alarms and Errors

4.1 During Axis Operation

If the arm or tool interference occurs during axis operation, "ARM (TOOL) INTERFERENCE" is displayed in the message line on the programming pendant, and the manipulators stop. If so, move the axis in the direction where the arms do not interfere. If the axis cannot be moved in such a direction, temporarily disable the arm interference check by validating "ARM INTERFERENCE RELEASE" as explained in "2.2 Enable or Disable Arm Interference Check."

4.2 During Playback, Forward, Backward, or Test Operation

If arm or tool interference occurs during playback, forward, backward, or test operation, "Alarm 4620 ARM (TOOL) INTERFERENCE" will occur, and the manipulators will stop. If so, move the axis to a position where the arms do not interfere with each other. If interference occurs during playback operation, recheck the job.

5 Notes on the Arm Interference Check Function

Take note of the following precautions when using the arm interference check function.

<Accuracy of arm (tool) interference check>

The accuracy of the arm interference check depends on the accuracy of the calibration between manipulators and any delay of the operating servo system. Therefore, allow enough margin for the radius in the TOOL INTERFERE file.

<Settings in the TOOL INTERFERE file>

Determine the settings in the TOOL INTERFERE file according to the dimensions in the drawing.

<Applicable manipulator models>

The arm interference check function is not applicable for some manipulator models. Contact your Yaskawa representative for more information.

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YASNAC XRC OPTIONS INSTRUCTIONS

FOR ARM INTERFERENCE CHECK FUNCTION

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

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