

EcoTrim ET-1024 SYSTEM MANUAL

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

MOTOMAN INSTRUCTIONS

MH24 MANIPULATOR INSTRUCTIONS
MSR-355 AND MSR-655 POSITIONER MANUAL
EcoTrim ET-1024 SYSTEM MANUAL
DX200 INSTRUCTIONS
DX200 OPERATOR'S MANUAL
DX200 MAINTENANCE MANUAL

The DX200 operator's manual above corresponds to specific usage.
Be sure to use the appropriate manual.

Part Number: 175932-1CD
Revision: 0



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MANDATORY

- This system manual provides an overview of the Motoman EcoTrim ET-1024 System. It gives general information about the system, a description of its major components, and the procedures for installation, system operation, and preventive and repair maintenance. Be sure to read and understand this manual thoroughly before installing and operating the EcoTrim ET-1024 System.
- General items related to safety are listed in Section 1 of the DX200 Controller Manual. To ensure correct and safe operation, carefully read the DX200 Controller Manual before reading this manual.



CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure that 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 a modification is made, the revision 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.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338
www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. **NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!**

We recommend approved Yaskawa training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the Motoman EcoTrim ET-1024 System.

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.



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



WARNING

- Before operating the manipulator, check that servo power is turned OFF by pressing the EMERGENCY STOP buttons on the front door of the DX200 controller and on the Programming Pendant (refer to *Fig. 1*). When 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.

Figure 1: EMERGENCY STOP Button



- Release the EMERGENCY STOP button (refer to *Fig. 2*). Once this button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Figure 2: Release of EMERGENCY STOP Button



- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
 - View the manipulator from the front whenever possible.
 - Always follow the predetermined operating procedure.
 - Ensure that you have a safe place to retreat to in case of emergency.

Improper or unintended manipulator operation may result in injury.

- 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 power for the DX200 controller.
 - 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 immediately if there is a problem. The EMERGENCY STOP buttons are located on the front of the front door of the DX200 controller and on the Programming Pendant.

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**CAUTION**

This Robot Cell has Collaborative Motion functionality:

Collaboration is a special type of operation between a person and robot sharing a common workspace. The following are the guidelines for collaborative operation.

1. Used for pre-determined tasks.
2. Possible when all protective measures are active.
3. For robots with features specifically designed for collaborative operation.

The integrator shall include in the information for use the safeguards and mode selection required for collaborative operation.

**CAUTION**

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately and be sure that all other necessary processing has been performed.
 - Check for problems in manipulator movement.
 - Check for damage to insulation and sheathing of external wires.
- Always return the Programming Pendant to the hook on the cabinet of the DX200 controller after use.

The Programming Pendant can be damaged if it is left in the manipulator's work area, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the DX200 Controller Manual before operating the EcoTrim ET-1024 System.

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 Programming Pendant, and supply cables.

In this manual, the equipment is designated as follows:

Equipment	Manual Designation
DX200 controller	DX200
DX200 Programming Pendant	Programming Pendant
Cable between the manipulator and the controller	Manipulator cable

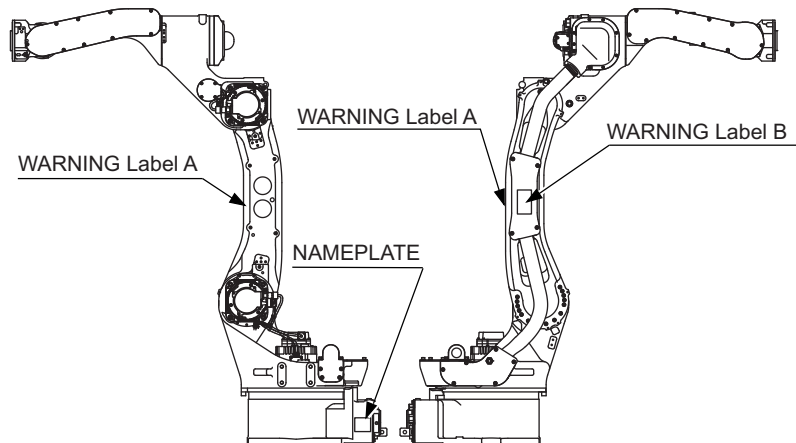
Explanation of Warning Labels

The following warning labels are attached to the manipulator (refer to *Fig. 3*).

Always follow the warnings on the labels.

Also, an identification label with important information is placed on the body of the manipulator. Prior to operating the manipulator, confirm the contents.

Figure 3: Warning Labels Location



Nameplate:

YASKAWA MOTOMAN	
MODEL MOTOMAN- TYPE	
PAYLOAD	MASS
ORDER NO.	DATE
SERIAL NO.	
YASKAWA ELECTRIC CORPORATION 2-1 Kurosakishiroishi, Yahatanishi-ku, Kitakyushu 806-0004 Japan MADE IN JAPAN	
NJ3247	

WARNING Label A:



WARNING Label B:



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1 Introduction

1.1 About This Document

This manual is intended to provide a “first look” and overview of the complete Motoman EcoTrim-1024 system. You should read and understand this system manual before moving on to the more detailed documentation that is included with your EcoTrim-1024 system. Although basic in content, this manual is intended for personnel who have received operator training from Motoman and are familiar with the operation of this particular Motoman system. For more detailed information on any specific component or peripheral, please review the full documentation package that is included with the EcoTrim-1024 system (refer to *section 1.3*).

This system manual contains the following sections:

chapter 1 "Introduction"

This chapter provides general information about the EcoTrim-1024 System and its components, a list of reference documents, and customer service contact information.

chapter 2 "Equipment Description"

This chapter provides a description of the major components of the EcoTrim-1024 System.

chapter 3 "Installation"

This chapter provides installation procedures for the EcoTrim-1024 System.

chapter 4 "Operation"

This chapter provides an overview of EcoTrim-1024 System operation, including start-up, loading, normal operations, fault recovery, and system shutdown.

chapter 5 "Maintenance"

This chapter provides a listing of preventive maintenance requirements for certain components of the EcoTrim-1024 System.

chapter 6 "Anchor Requirements"

This chapter gives recommended anchoring hardware specifications and foundation requirements for all the equipment that is part of the EcoTrim-1024 System.

Appendix A

Appendix A provides a check sheet on what is included with the documentation.

Appendix B

Appendix B provides pneumatic schematics for the EcoTrim ET-1024 System.

Appendix C

Appendix C provides optional and replacement parts for the EcoTrim ET-1024 System.

1.2 System Overview

The EcoTrim-1024 System provides a complete trimming solution in a standardized configuration. There are two available tables that can be selected for the EcoTrim-1024 System cell assemblies, the MSR-355 (standard) and the MSR-655 (optional). The payloads are 355 and 655 kg per side of the table. The EcoTrim-1024 system is designed around a single Motoman MH24 robot, a DX200 controller, and the Ultrasonic trimming process.

The EcoTrim-1024 System uses the servo driven rotary positioner. The rotary positioner allows an operator to prepare and set up parts on one side of the positioner while the robot trims on the other side.

The EcoTrim-1024 System features a total safety environment that meets or exceeds the requirements of the ANSI/RIA R15.06-2012 standard and is designed to safeguard both personnel and equipment. Heavy-gauge, wire-mesh safety fencing prevents unintended entry of personnel into the work cell while it is in operation.

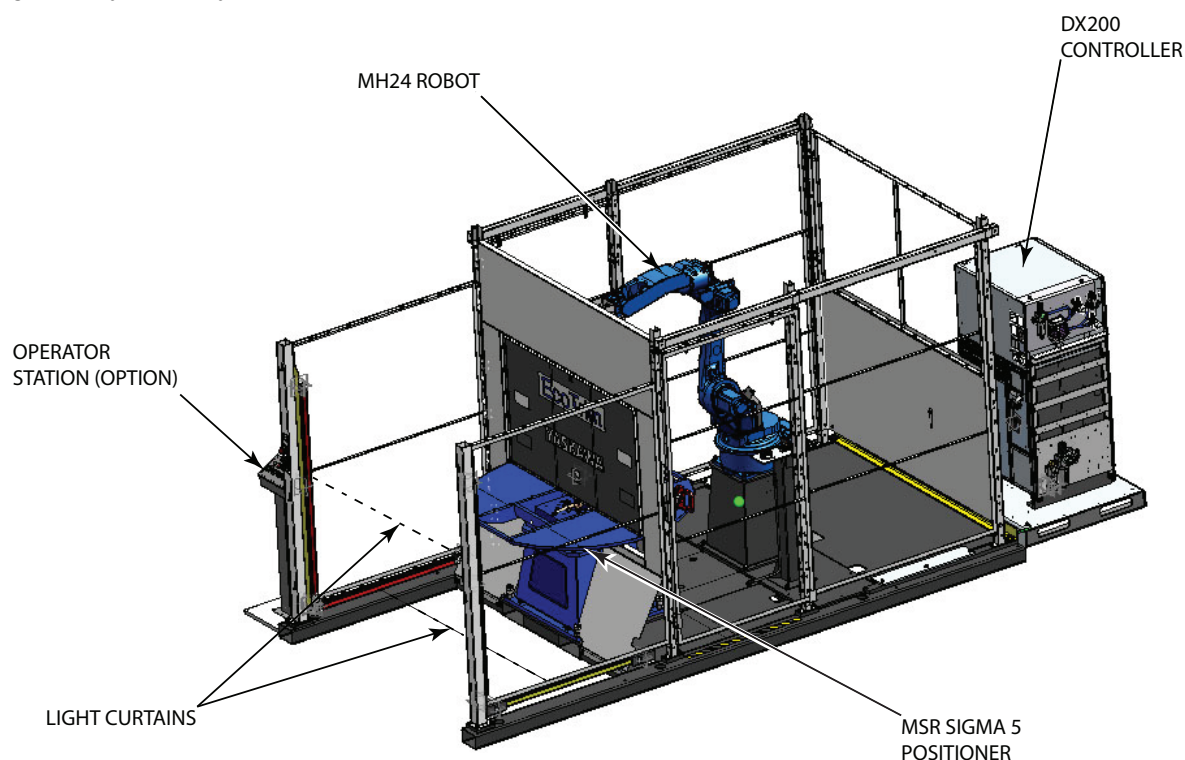
Dual-interlocked access doors on each side of the work cell provide convenient access to equipment while providing a safety interlock to disable all equipment should these doors be opened while the robot is active.

A dual-channel safety light curtain system provides a “sensing field” in front of the rotary positioner through use of an infrared light beam. Rotary positioner motion is prevented whenever an operator is in a position to disrupt the sensing field of the light system. In addition, maximum robot travel is physically limited by an S-axis “hard stop” at the base of each robot. *Fig. 1-1* illustrates the layout and component locations for the EcoTrim-1024 System.

Safeguards for the system complement the system operation while protecting the people that will program, operate, and/or provide maintenance to the system. Possible pinch points and other hazards from the risk assessment process determined needed safeguards and interlocks. While the system design safeguards the support and operation staff, it does not protect against misuse of the system. Misuse of the system includes, but is not limited to, climbing over/under barriers, climbing over/under interlocked doors, or disabling/bypassing of system interlocks.

During the install and commissioning process the end user must ensure tooling, ancillary equipment, etc. have not introduced additional hazards into the design. This evaluation ensures that the system will provide safe and reliable operation. The Risk Assessment document should be reviewed for installation of the system and prior to operation. Any changes and additions to the system require full review of the Risk Assessment document.

Fig. 1-1: System Layout — EcoTrim-1024 Shown



1.2.1 System Layout

The MH24 manipulator (robot), an MSR positioner, and heavy-gauge, wire-mesh safety fencing all share a common steel base for ease of installation and assurance of proper alignment between the robot and rotary positioner. The wire-mesh safety fencing completely surrounds the EcoTrim-1024 work cell.

The equipment platform is located outside and to the rear of the work cell. This arrangement allows most of the component wiring interconnects to be pre-wired at the factory, thus reducing the amount of point-to-point wiring required by the customer. All operator controls, including those on the Programming Pendant, DX200 controller, Ultrasonic trimming tool, and Operator Station pedestal, are accessible from outside the EcoTrim-1024 System work cell.

1.2.2 Major Components

The EcoTrim-1024 System includes the following major components:

- Motoman MH24 manipulator (robot)
- DX200 controller
- One MSR series rotary positioner
- One Programming Pendant (located on the DX200 controller)
- Operator Station
- Ultrasonic Trimming (Standard) or Hybrid (Optional) tool
- Safety equipment:
 - Heavy gauge, wire-mesh safety fencing
 - Dual-channel, interlocked safety light curtain system
 - Dual-channel, interlocked work-cell entry doors
 - Steel screen on the MSR rotary positioner

1.2.3 Theory of Operation and Safe Guarding

The DX200 EcoTrim-1024 cell is designed to accommodate a single MH24 robot.

- EcoTrim-1024 - Single MH24 robot with MSR-355 positioner or optional MSR-655.

The robot controller and Ultrasonic/Hybrid tool controls are located behind the cell. Two sliding doors with safety interlocks allow access from either side. The MH24 sits on a 610 mm raiser.

The standard servo driven MSR positioner provides either a 60 inch (1500 mm) or optional 72 inch (1829 mm) H-Frame tabletop. The table comes programmed for two reciprocating positions (Side A/Side B). Based on the selected table, options are available for additional load positions, rotary brushes, slip-rings and hard-stops.

The functional safety unit (FSU) is included in the controller for monitoring the rotary table. Two FSU "Axis Range Limit" files monitor the table's position (within 1 degree) to determine if the table is at "Side A" or "Side B". The status of these two "Axis Range Limit" files generate outputs FSUOUT#1 ("Side A @ Robot") and FSBOUT#2 ("Side B @ Robot"). The controller outputs connect to the coils of two force-guided relays. The contacts of these relays (At Side A and Side B), or with the light curtain's "Clear" status to generate an element in the E-stop chain.

Fig. 1-2(a): FSU Generated “At Side A/B” Signals

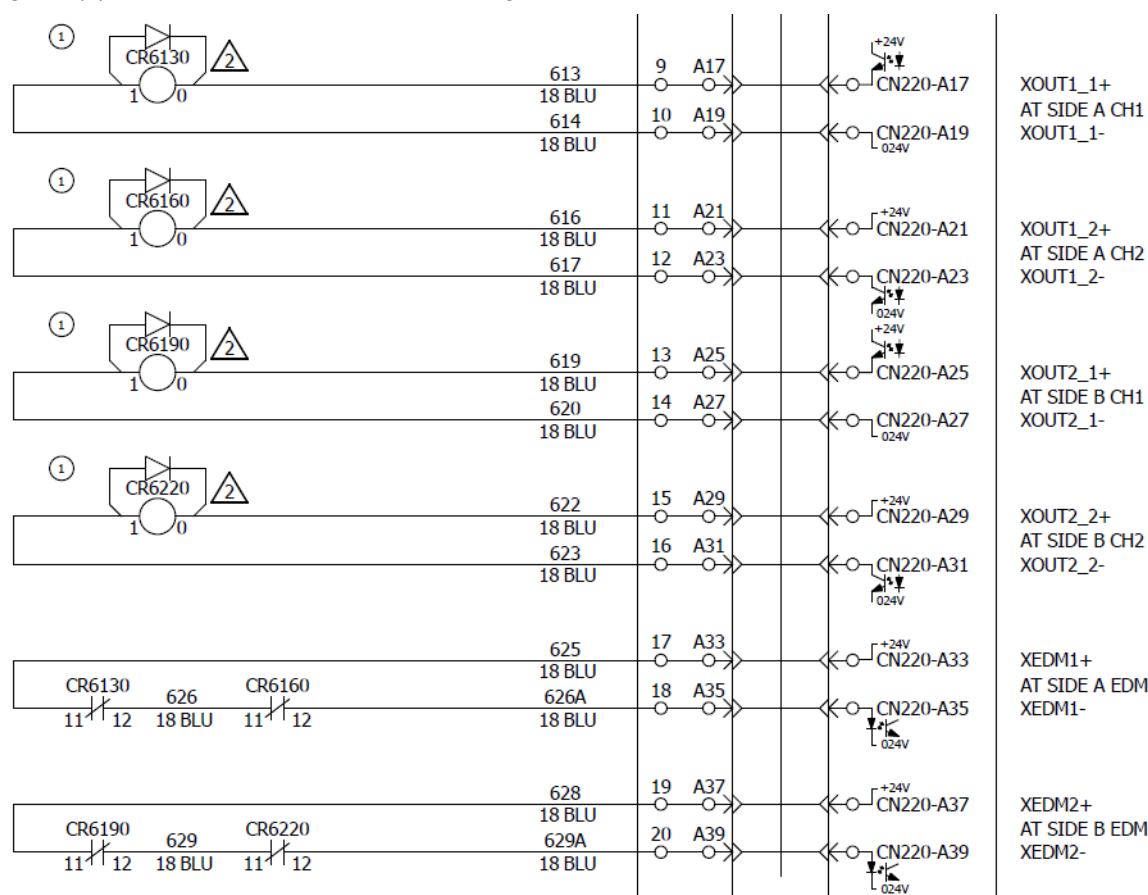
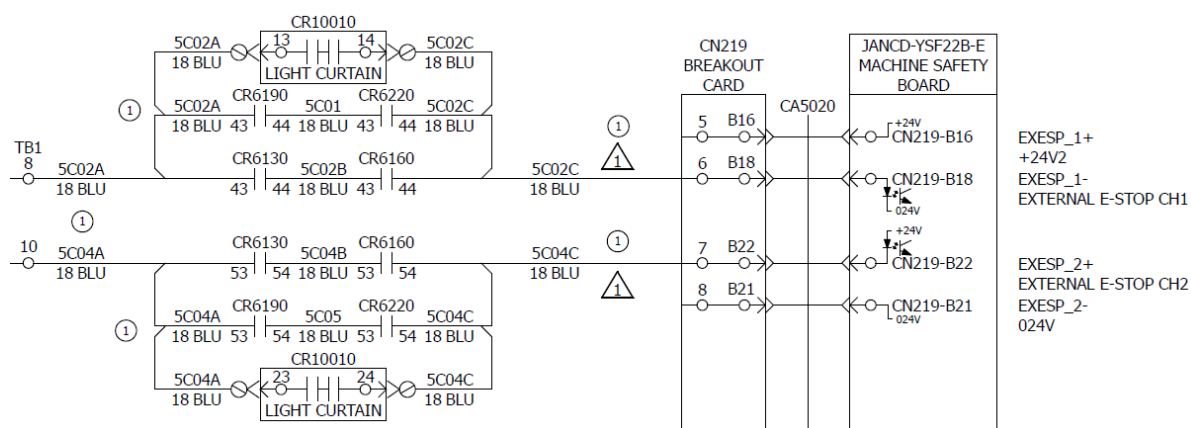


Fig. 1-2(b): “Light Curtain Clear” or “At Side A/B” into E-Stop

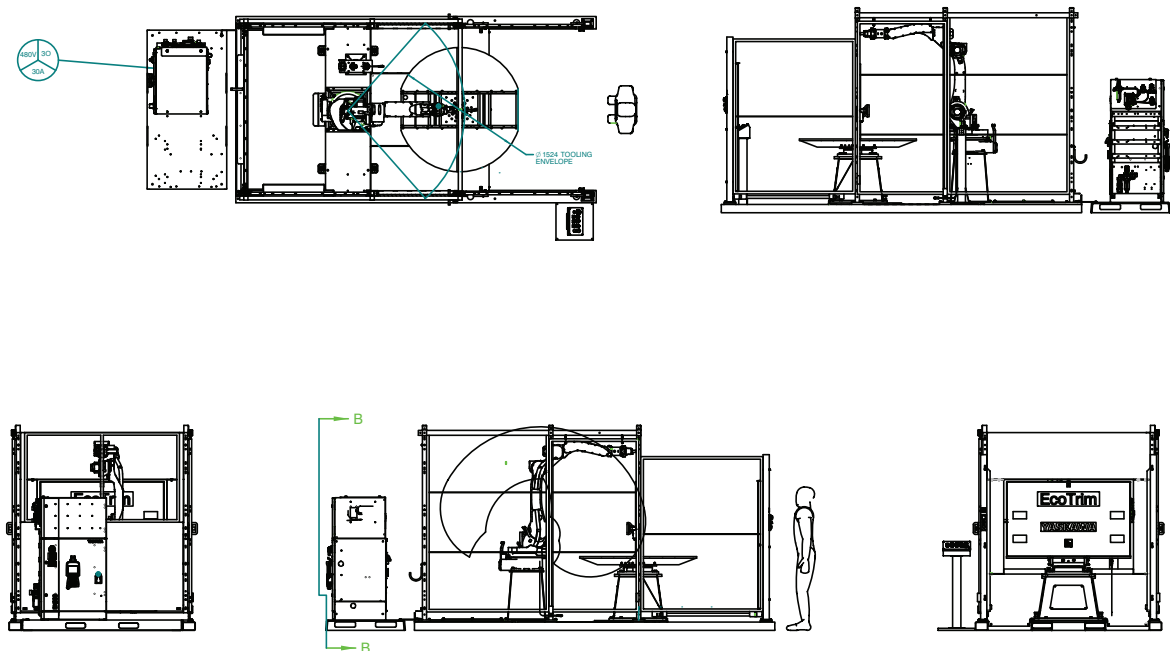


This logic ensures that the table is located at “Side A” or “Side B” when the light curtain is broken. If the curtain is broken when the table is out of position (stopped or moving) the “External E-Stop” signal will open resulting in a category#1 stop in either “Play” or “Teach” Mode.

The integrator or end-user may implement additional safety and zone monitoring though the standard system which does not include FSU functionality.

A three button operator station is located on the front right fence post. It provides a [Cycle Start] push button, [Auto/Manual] push button, and [E-Stop] button.

Fig. 1-3(a): ET-1024 Cell



1.2.3.1 System Teaching:

Programming of the system is intended to take place from within the cell. In order to program the robot, the controller needs to be in “Teach Mode” from the selector switch on the front of the pendant. This “Teach Mode” selection will limit all robot speeds to 250 mm/min. While in “Teach Mode”, the two gates may be in the open position allowing the programmer to work inside the cell. In order for the robot servo motors to be turned on, the “deadman” switch on the teach pendant needs to be maintained at its midway point. Once servo power is on, the operator is able to manipulate and program the part as desired. While in “Teach Mode” the MSR table can be rotated from side A to B or B to A via the teach pendant’s external axis keys on the pendant or by selecting the “Sweep” job and test starting through the job logic. If the operator or another person enters the light curtain while teaching the cell, the external E-Stop logic (explained earlier) will E-Stop the system as soon as the table leaves the “Side A” or “Side B” position.

1.2.3.2 System Operation:

Once path and logic programming is complete, the system can begin operation once meeting the following conditions:

1. Teach pendant must be in “Play Mode”.
2. Close both sliding gates.
3. Apply servo power to the teach pendant.
4. The [Start] button on the pendant needs to be pressed to begin execution of the INFORM job. Normal cell production can now begin.

Normal cell production begins with the assumption that the rotary table is at either “Side A” or “Side B” as reported by the FSU’s “Axis Range Limit” function. When the light curtain on the front of the cell is clear, the rotary table will begin its movement as directed by the “INFORM” job. If an operator

approaches the cell to load a part and breaks the light curtain, the rotary table will need to be at (and remain at) the “Side A” or “Side B” position. Once the part has been loaded, the operator steps out of the light curtain, the “Light Curtain Clear” relay will actuate and bypass the “Side A/B” requirement. The operator can then press the [Cycle-Start] button on the operator station which will either latch (if the robot is actively processing a part on the other side of the table) or will initiate table movement from the executing “INFORM” job to sweep the table 180 degrees to allow the operator to unload the processed part while presenting the robot with the unprocessed part. Once the table has swept into position, the operator can safely enter the light curtain to remove the processed part and begin installation of a new part into the fixture. Assuming there are no faults or issues during the production of the part, once completed, the robot will return to a safe position. After the next part has been loaded and the [Cycle Start] button pressed/latched the “INFORM” job will sweep the table from side-to-side so the operator can unload the processed part. When a new part has been loaded, the process begins again.

1.2.3.3 Key Safety Devices

- DX200 controller with MH24 robot and MSR rotary table:
 - Dual channel pendant E-Stop
 - Dual channel pendant “deadman” switch
 - Play/Teach mode switch
 - Functional Safety Unit (FSU)
- Safety Gate Interlocks (qty 2):
 - Dual channel dry contact outputs
- Cascaded L-Shaped light curtain:
 - 30 mm object sensitivity
 - 29 ms response time
 - Dual channel output
- Pilz PNOZ-S4 Safety Relay:
 - Monitors outputs from light curtains & generates dry-contact connections for use in the external E-Stop logic

- Three button operator station:
 - Dual channel “Cycle Start” button
 - Dual channel “E-Stop”
 - Single channel “Auto/Manual” switch
- Functional Safety Unit (FSU):
 - Responsible for monitoring the MSR rotary table to ensure no external motion occurs (via “Standstill monitor” function while the light curtain is broken.
- Omron G7SA Force Guided Relays:
 - Monitors FSU “At Side A” and “At Side B” outputs to generate dry contact connections for use in the external E-Stop logic.

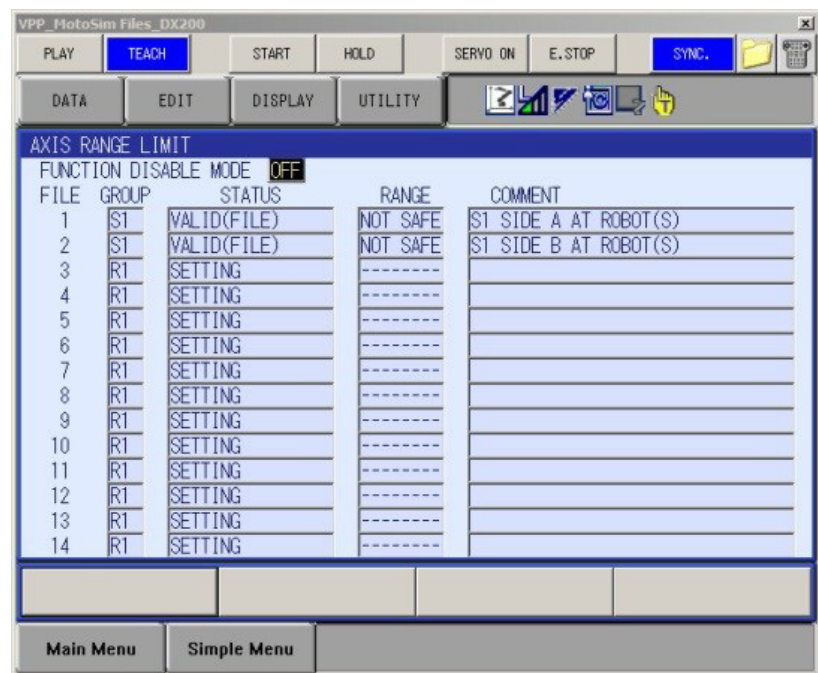
1.2.3.4 Safety Logic Implementation:

1. In “Play Mode” and “Teach Mode”, FSU-based “Axis Range Limit” functions generate “At Side A/B” outputs which prevent the MSR positioner from moving out of “At Side A” or “At Side B” anytime the light curtain is broken.
2. In “Play Mode” the DX200 monitors the “Safety Gates,” closed ensuring someone is not accessing the work cell while in “Play Mode”.
3. The FSU is not for preventing robot collisions with either the safety fence or the MSR positioner.

1.2.3.5 Functional Safety Setup

The following FSU files are utilized as standard in the EcoTrim-1024 cells:

Fig. 1-4(a): “Axis Range Limit” Files Used



1 Introduction

1.2 System Overview

Fig. 1-4(b): "S1 Side A at Robot" Details:

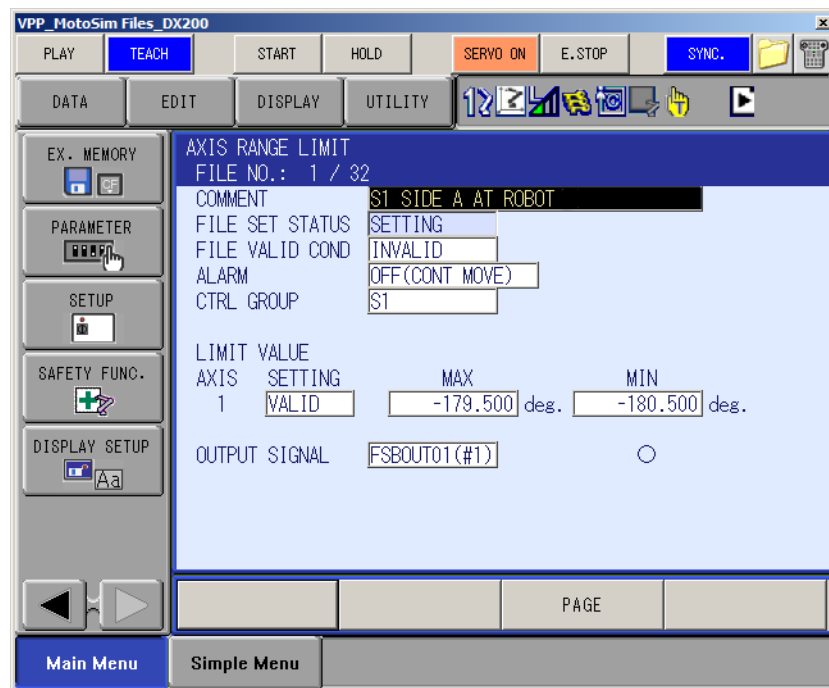
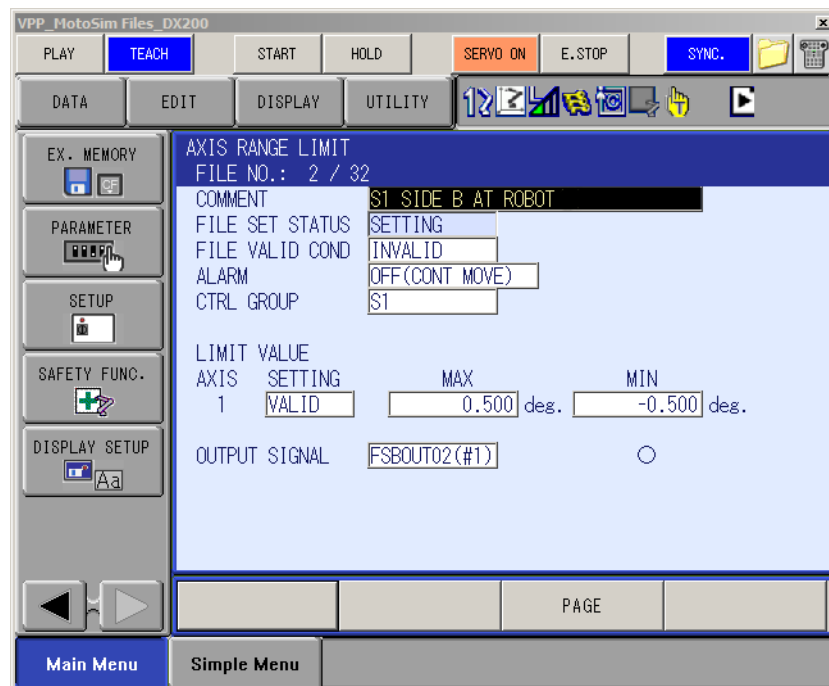


Fig. 1-4(c): "S1 Side B at Robot" Details



1.3 Reference Documentation

For additional information on individual components of the EcoTrim-1024 System, refer to the following documentation that is included with your delivered system:

- Motoman *MH24 Manipulator Manual* (P/N 171483-1CD)
- Motoman *DX200 Controller Manual* (P/N 165292-1CD)
- Motoman *Maintenance Manual for DX200* (P/N 165293-1CD)
- Motoman *DX200 Concurrent I/O Manual* (P/N 165294-1CD)
- Motoman *MSR-355 and MSR-655 Positioner Manual* (P/N 169856-1CD)
- Motoman *DX200 For Cutting Device Manual* (P/N 165266-1CD)
- Motoman *DX200 Form Cutting Function Manual* (P/N 165468-1CD)
- Motoman *DX200 Material Handling, Press Tending, Cutting, and Other Applications, Operators* (P/N 165300-1CD)
- Motoman *DX200 Independent/Coordinated Control Function Manual*
- Motoman *INFORM User's Manual* (P/N 165301-1CD)
- Vendor manuals for system components not manufactured by YASKAWA

1.3.1 Location of Operations in Reference Documentation

The table below provides the location(s) for various operations within the included reference manuals.

Table 1-1: Reference Table

Description	Manual/Chapter	Handling	Installation & Commissioning	Start-up	System Information	Use of System	Maintenance	Decommissioning	Emergency Situations	Robot Specific Information
Environmental Information	Manipulator & Controller Chap 3, Positioner Chap 2	✓	✓	✓		✓	✓			
Dimensions	EcoTrim Chap 3	✓			✓		✓			
Mass Value(s)	EcoTrim Chap 3	✓			✓		✓			✓
Center of Gravity, Lifting	Positioner & Manipulator Chap 2	✓					✓	✓		✓
Anchoring	EcoTrim Chap 3	✓	✓	✓			✓			
Vibration Dampening	Positioner Chap 2 Manipulator Chap 3		✓		✓		✓			
Assembly & Mounting Condition	Positioner Chap 2 Manipulator Chap 3		✓				✓	✓		
Space Needed for Maintenance	EcoTrim Chap 3		✓		✓	✓	✓			
Connecting Power	EcoTrim Chap 3		✓	✓	✓		✓	✓	✓	
Waste Removal	Controller Chap 1		✓				✓	✓		
Protective Measures by Users	Throughout Manuals		✓		✓		✓			
Initial Checks	EcoTrim Chap 3 & 4		✓	✓		✓	✓			
Description of system, fittings, and protective devices	EcoTrim Chap 3		✓	✓	✓	✓	✓			✓
Range of Applications	EcoTrim Chap 1				✓		✓			✓
Safety Function Perform Correctly	EcoTrim Chap 3 & 4		✓	✓		✓	✓			
Controller Functions, Operator Panels, Teach Pendants and Enabling Devices	EcoTrim Chap 2 & 3		✓		✓	✓	✓			
Drawings and Diagrams	Throughout Manuals and Included Outside Manuals	✓	✓		✓		✓			
Hazards and Measuring Methods	Throughout Manuals	✓	✓	✓	✓		✓	✓	✓	
Technical Documents concerning Electrical Equipment	Included Outside Manuals		✓	✓	✓		✓			
Documents of Complying with Mandatory Requirements	Included Outside Manuals				✓					✓
Modifications Made to Protective Equipment	Drawings				✓		✓			
Load Analysis	Documents Included				✓					✓
Energy Loss, Human Interventions	EcoTrim Chap 3				✓		✓		✓	

Description	Manual/Chapter	Handling	Installation & Commissioning	Start-up	System Information	Use of System	Maintenance	Decommissioning	Emergency Situations	Robot Specific Information
Maintenance and Intended Life	EcoTrim Chap 5				✓		✓			
Interface Requirements	EcoTrim Chap 3				✓		✓			
Dynamic Limiting Zones	EcoTrim Chap 2 & 4				✓		✓			✓
Risks that Can Not be Eliminated	Throughout Manuals	✓	✓	✓	✓	✓	✓	✓	✓	✓
Risks with Certain Applications	Throughout Manuals					✓				✓
Foreseeable Misuse	Throughout Manuals					✓				
Material Flow	Manipulator Chap 4 Positioner Chap 5					✓	✓			
Intended Use	EcoTrim Chap 2					✓				
Residual Risk for Various Tasks	Throughout Manuals					✓	✓			
Span of Control	EcoTrim Chap 2					✓	✓		✓	✓
Description of Manual Controls	EcoTrim Chap 2					✓				
Settings and Adjustments	EcoTrim Chap 4					✓	✓			✓
Modes and Means for Stopping	EcoTrim Chap 2 & 4					✓	✓		✓	
Fault ID, Repair, and Restarting	EcoTrim Chap 4					✓	✓			
Personal Protective Equipment	Throughout Manuals	✓	✓	✓	✓	✓	✓	✓	✓	✓
Test and Examination After Changing Components	EcoTrim Chap 3 & 4					✓	✓			
Instructions for Disconnecting Pendants	Controller Chap 4					✓	✓			
Instructions for Fault and Emergency Recovery	EcoTrim Chap 4					✓	✓			
Training Requirements	EcoTrim Chap 1					✓	✓			✓
Drawings and Diagrams allowing Maintenance Carry Out Task	Throughout Manuals						✓			
Information to Replace Safety Devices	EcoTrim Chap 3						✓			✓
Contact Information	EcoTrim Chap 1						✓			
Safe Working Practices for Manual Suspension of Safeguards	Controller Chap 14						✓			
Dismantling	Manipulator Chap 3 Positioner Chap 2						✓	✓		
Emergency Situations	EcoTrim Chap 4						✓		✓	
Raising and Lowering Speed Using Pendant	Controller Chap 8						✓			✓
Information on Limiting Device	EcoTrim Chap 2 & 3						✓			✓
Information on Operating and Enabling Devices	EcoTrim Chap 3					✓	✓			✓

Description	Manual/Chapter	Handling	Installation & Commissioning	Start-up	System Information	Use of System	Maintenance	Decommissioning	Emergency Situations	Robot Specific Information
Stopping Time and Distance	Drawings; Positioner Chap 4									✓
Specifications for Fluids	Manipulator Chap 9 Positioner Chap 6						✓			✓
Limits for Range of Motion	EcoTrim Chap 2									✓
Relevant Standards	Included Outside Manuals									✓
Instruction on Synchronized Motion	EcoTrim Chap 2									✓
Programmed Limits	Controller Chap 11									✓
Robot Suitable for Integration	Documents Included									✓

1.4 Customer Support Information

If you need technical assistance with any aspect of your EcoTrim-1024 System, please contact Motoman Customer Support at the following 24-hour support telephone number:

(937) 847-3200

Please have the following information ready before you call:

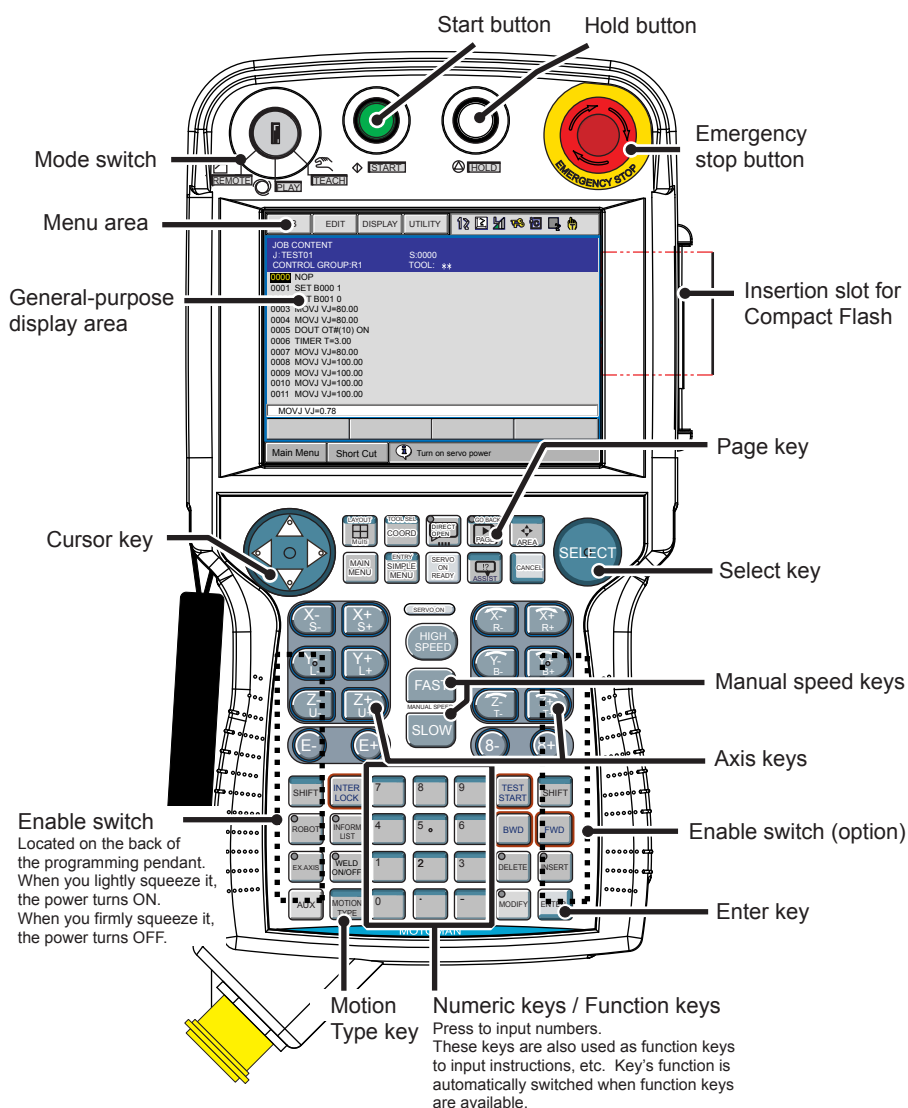
- | | |
|----------------------------|--|
| • System | EcoTrim-1024 System, DX-Series |
| • Robot | MH24 |
| • Positioner | MSR-355 and MSR-655 |
| • Primary Application | Trimming |
| • Controller | DX200 |
| • Software Version | Access this information on the Programming Pendant display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION} |
| • Robot Serial Number | Located on a data plate on the rear of each robot |
| • Robot Sales Order Number | Located on a data plate on the front door of the DX200 controller |

2.3 Programming Pendant

The Programming Pendant (see *Fig. 2-6*) provides the primary means of programmer/operator interaction with the EcoTrim ET-1024 System. The pendant features the Windows® CE operating system and displays information on a 6½ -inch, color LCD, touch-screen display (640 X 480 VGA). The pendant also incorporates a Compact Flash card and USB port for program backups.

The pendant provides icon-driven system programming. It also features a menu-driven interface to simplify operator interaction with the robot. Most operator controls are located on the Programming Pendant. This allows the DX200 controller cabinet to be mounted remotely. By using the pendant, the operator can teach the robot motion; perform programming, editing, maintenance, and diagnostic functions, and transfer control of the EcoTrim ET-1024 System to or from the Operator Station. For detailed information on the pendant programming keys, programming functions, and display functions, please refer to the DX200 *Operator's Manual* that is included with your EcoTrim ET-1024 System (see *section 1.3*).

Fig. 2-6: DX200 Programming Pendant



2 Equipment Description

2.4 Operator Station

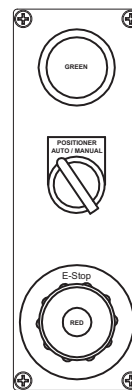


- The Programming Pendant's LCD display goes dark after a few minutes of inactivity. Press any key to restore the screen.
- Operator Station “enable” or “disable” is accomplished with the Programming Pendant's Mode Select Switch. To transfer control of the EcoTrim ET-1024 System to the Operator Station, set the Programming Pendant's Mode Select Switch to REMOTE. The Operator Station enable/disable function cannot be selected at the Operator Station.

2.4 Operator Station

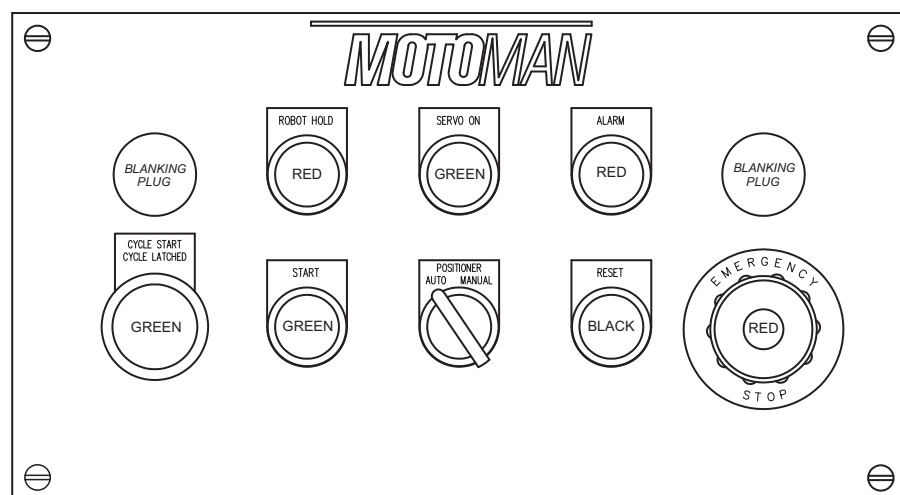
The standard Operator Station includes a NEMA enclosure and is mounted on the EcoTrim system fence post. The standard Operator Station includes the Positioner Auto/Manual, Cycle Start, and E-Stop buttons.

Fig. 2-7: Operator Station



The optional Pedestal Operator Station (see Fig. 2-8) includes a NEMA enclosure on a stand-alone pedestal.

Fig. 2-8: Optional Pedestal Operator Station



2.4.1 Cycle Start/Cycle Latched

The operation of the Cycle Start/Cycle Latched button depends upon the structure of the Control Master job.

The green Cycle Start/Cycle Latched button, located on the Operator Station, initiates a positioner sweep cycle if the robot is in the Home position. If the Cycle Start/Cycle Latched button is pressed while the robot is outside Home position, the Cycle Start command does not execute and the positioner does not sweep until the robot returns to Home position.

The green Cycle Latched lamp illuminates when the Cycle Start/Cycle Latched button is pressed during operation. When the lamp is illuminated, the positioner will sweep and the robot will begin trimming immediately after the current cycle is complete and the robot has returned to Home position. It is not necessary to wait for the robot to finish trimming and return to Home position before pressing the Cycle Start/Cycle Latched button. Pressing the Cycle Start/Cycle Latched button while the robot is still in motion latches the Cycle Start command into the controller. If a person or object enters the safety zone created by the light curtain system, the Cycle Start command will unlatch and the positioner will not sweep.

2.4.2 Emergency Stop (E-STOP)

Pressing the red Emergency Stop (E-STOP) button on the Operator Station stops all system operation and removes servo power. Brakes are applied to the robot, and all positioner motion is stopped.

2.4.3 Robot Hold

Pressing the red Robot Hold button stops robot operation and interrupts the job until the operator presses the green Start button to resume operation. Operation resumes at the point in the program where the Robot Hold state was initiated.

2.4.4 Alarm

A red Alarm lamp illuminates to indicate that the DX200 controller has encountered an alarm condition.

2.4.5 Positioner Auto/Manual

The Positioner Auto/Manual switch is used to select automatic or manual mode for the MSR rotary positioner. When the switch is set to the Auto position, the robot trims the parts immediately after the positioner sweeps. When the switch is set to the Manual position, the robot does not immediately start to trim after the positioner sweeps and remain in Home position.



The Positioner Auto/Manual signal depends upon the structure of the Control Master job.

2.4.6 Start

Pressing the green Start button starts the current, active job. The Operator Station must be enabled and servo power must be ON for the Start button to function.

EcoTrim ET-1024 System	2	Equipment Description
	2.4	Operator Station

2.4.7 Reset

The black Reset button is used to clear a minor alarm or error condition.

2.4.8 Servo On

The green Servo On push button turns servo power ON when the robot is in Play mode and the Operator Station is enabled.

2.5 MSR Family Positioner

The MSR Family positioner is part of the EcoTrim ET-1024 System. It is mounted on the same common equipment base as the MH24 robot and the wire-mesh safety fencing. The MSR family is a high-speed rotary positioner that features controlled rotary motion and a 355 kg (783 lb) and 655 kg (1444 lb) payload capacity per side. The standard configuration utilizes a brushless servo drive motor plus gear reducer, a 1524 mm (60-inch) circular table top, and a housing. A steel screen divides the table top, providing two semicircular work areas (Side A and Side B). The steel screen creates a barrier that safeguards the operator from the trimming operation. The MSR family uses a rotary motion to sweep each side of the circular turntable 180° from the operator's loading zone, into the robot's work zone and back to the operator again. The positioner can accept optional external axis control for coordinated motion between the positioner and the robot. See *Fig. 1-1* for a general view of the MSR positioner.



WARNING

Do not operate the MSR family positioner unless the screen is in place. Operation of the positioner without the screen in place can result in serious injury to the operator.

For detailed positioner information, including illustrated parts lists, load capabilities, and dimensions, refer to the *MSR 355 and 655 Positioner Manual* that is included with your EcoTrim ET-1024 System (see *section 1.3*).



- All tooling and fixtures for the MSR family rotary positioner are supplied by the customer.
- In high humidity areas, use surface protection to prevent corrosion of the tooling plates.

2.6 Trimming Equipment

In its standard configuration, the EcoTrim ET-1024 System includes a Ultrasonic blade sharpener, and blade sensor. Optional equipment may also be included with your EcoTrim ET-1024 System.

The Ultrasonic cutting tool is used for high-speed cutting, trimming deburring and chamfering applications. This method of cutting and trimming is ideal for a variety of non-metallic materials including plastics, film, fiberglass and non-woven fabrics. It can be used for automotive interior components such as carpet, headliners, door trim and instrument panels; also recreational vehicles such as boats, ATVs and snowmobiles. These tools can replace waterjet and laser cutting, hard tooling and manual routing.

The kits come complete with the cutting tool, cables, air lines and regulators, and all mounting hardware. Optional tools are available to maintain sharp blades.

2.6.1 Ultrasonic Cutting Tool (standard)

The ultrasonic cutting tool comes with built-in compliance to keep the cutting blade tight against part fixtures for precise and repeatable cuts. There are six different blades available, but it is recommended to try the standard blade first. The ultrasonic oscillator is cooled with compressed air (60 psi).

Ultrasonic Cutting Robot Kit includes:

- Ultrasonic cutting tool w/compliance, oscillator, control and power cables
- Air regulators, valve pack, air lines
- DX200 top mount cabinet and mounting hardware

Items to be purchased separately:

- Cutting blade (174862-1 standard blade is recommended)
- Blade fixing screw (174868-1)

2.6.2 Hybrid Tool (optional)

The hybrid tool combines the ultrasonic cutting tool (w/o compliance) and a high-speed router for heavier materials. The ultrasonic cutting tool features a retractable 'control ball' that extends over the blade when cutting thick, soft material. This feature allows the tool to compress the material for cleaner, smoother cuts. The router has a 'plunging' cylinder used for starting holes in heavier materials. The router motor (40 psi) and ultrasonic oscillator (60 psi) are both air-cooled.

Hybrid Tool Robot Kit includes:

- Ultrasonic cutting tool w/o compliance, oscillator, control and power cables
- High-speed end mill, motor controller, control and cables
- Air regulators, valve pack, air lines
- DX200 top mount cabinet and mounting hardware

2.7 Safety Features

The EcoTrim ET-1024 System includes a total safety environment. Complying with all safety standards ensures safe and reliable operation of the robot work cell.



Users are responsible for determining that the safeguards provided with the EcoTrim ET-1024 System are adequate for their plant conditions. Users must also ensure that all safeguards are maintained in working order.

2.7.1 Safety Fencing

The heavy-gauge, steel-mesh safety fencing that is provided with the EcoTrim ET-1024 System attaches to the common base and encloses the entire work cell. It forms a physical barrier that prevents personnel from entering the work cell during automatic operation.

2.7.2 Safety Light Curtains

The safety light curtain system consist of two units (a Send unit and a Receive unit) that emit and receive infrared light pulses to create an invisible protective field. The infrared light pulses, coded by the Send unit, are sent to the Receive unit, which evaluates them. If an object or person penetrates the protective field created by the infrared light, outputs of the safety light curtain system change state to stop all machine motion. The safety light curtain system incorporates a dual-channel safety feature. The dual-channel feature provides redundant operation to ensure a continuous field of coverage for the area protected by the light curtains.

With the EcoTrim ET-1024 System, the safety light curtains are set up to protect personnel who might unintentionally enter the MSR rotary positioner area during the positioner sweeping process. In Play mode, if the positioner is sweeping and the operator steps into the safety zone (defined by the light curtain Send and Receive units), servo power is removed from the EcoTrim ET-1024 System, and all MSR positioner motion stops. Servo power can be reapplied and the operation resumed (after the operator is clear of the protected area) by pressing SERVO ON and START on the Operator Station panel. Refer to *section 3.5* for the alignment of the safety light curtains in the EcoTrim ET-1024 System.

2.7.3 Emergency Stops (E-STOPS)

In addition to the safety features described above, the EcoTrim ET-1024 System incorporates large, red Emergency Stop (E-STOP) push buttons that are placed in accessible locations. When any E-STOP push button is activated (pushed in), the E-STOP circuitry immediately stops all system operation and robot movement.

E-STOP push buttons are found in the following locations:

- The door of DX200 controller
- The Programming Pendant
- The Operator Station pedestal

2.7.4 Programming Pendant's Enable Switch

The Enable switch is a three-position switch located on the left rear of the Programming Pendant (see *Fig. 2-6*). It is a safety feature that controls servo power while the system is in Teach mode. When pressed in, this switch allows the operator to turn servo power ON. However, if the operator releases the switch or grasps it too tightly, servo power is immediately removed, thus preventing further robot movement. For detailed information about the operation of the Enable switch, refer to the *Operator's Manual* included with your EcoTrim ET-1024 System (see *section 1.3*).

2.7.5 Emergency Braking System

The MH24 manipulator incorporates a series of brakes that are designed to protect the robot and other system components from damage in the event of a software or hardware robot control failure. Upon activation, the brake system stops all robot motion. The brake system incorporates a feature that allows the operator to release the brake of a specific robot axis when drive power has been removed from the system. Use the Programming Pendant to access the brake release function. Refer to *section 4.4.3* for brake release procedures.

2.7.6 Interlocked Work-cell Doors

A dual-redundant safety interlock is installed on each work-cell access door. If either one of the work-cell doors is opened while the robot is in PLAY mode, the robot emergency braking system activates, all servo power is removed from the system, and all positioner motion stops.

3 Installation



CAUTION

- The EcoTrim ET-1024 System should be installed by qualified personnel who are familiar with the installation and setup of a robotic system.
- The EcoTrim ET-1024 System is a robust industrial design. It is also, however, a sophisticated robotic system that can be damaged by rough handling. Be sure to handle all components with care.

The EcoTrim ET-1024 System can be installed in a short amount of time by two or three qualified technicians. Always comply with the established safety instructions and precautions given throughout this manual during the installation process.

The instructions given in this section are general guidelines for installing the EcoTrim ET-1024 System. Refer to your system drawings and relevant system component manuals for specific installation information (see *section 1.3*).

3.1 Required Materials

All system components and most hardware required for installation of the EcoTrim ET-1024 System are included with your shipment. There are, however, some required items that the customer must supply (hand tools, special anchor bolts, etc.). These are not included with your shipment.

3.1.1 Customer-supplied Items

- Local electrical service
- Earth ground wires for the MH24 robot, DX200 controllers, and peripheral equipment
- Chemical (optional) to increase the conductivity of soil in the vicinity of the ground system
- Clean, dry air supply (15 scfm @ 90 psi)
- Stepladder
- Forklift and/or overhead crane

3.1.2 Recommended List of Hand Tools and Equipment

- Hard hat
- Safety glasses
- Face shield
- Gloves (protective, leather)
- Levels (short and long)
- Ratchet handle (with 3/4-inch hex socket)
- Adjustable wrench
- Hammer drill with appropriate concrete bits
- Phillips and flat-blade screwdrivers
- Hammers (dead-blow and steel)
- Hammer (non-marring)
- Socket sets (SAE and Metric)
- Air-impact gun (with 3/4-inch hex socket)
- Open-end wrench sets (SAE and Metric)
- Socket head wrench sets (Allen[®], Bondhaus[®], etc.)



Special anchor bolts (lag bolts) are supplied by the customer. Refer to *section 6* for a listing of special bolts that are required for anchoring the common equipment bases and other components of the EcoTrim ET-1024 System.

3.2 Site Preparation



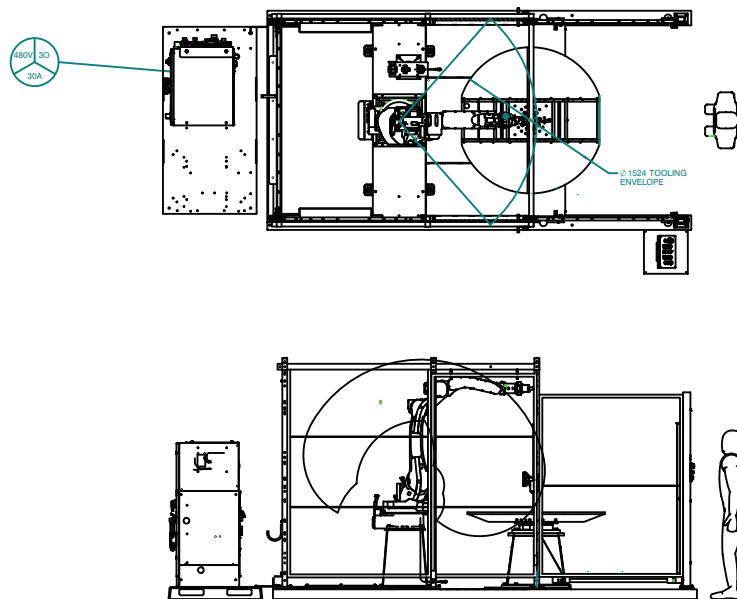
WARNING

Be sure to allow for sufficient room for maintenance on the robot, DX200 controllers, and other peripheral equipment. Failure to observe this precaution could result in injury to personnel during system maintenance.

To prepare your site, proceed as follows:

1. Clear the floor space needed for the EcoTrim ET-1024 System (see *Fig. 3-1*). Allow an additional 1.2 to 1.5 m (4 to 5 ft) on all sides of the work cell to facilitate installation.
2. Gather all customer-supplied items and required tools (refer to *section 3.1*).

Fig. 3-1: Installation Dimensions for the EcoTrim-1024 System



3.3 Installing and Leveling the Common Base

The common base is shipped on a wooden platform. To install the common base, refer to your system drawings and proceed as follows:

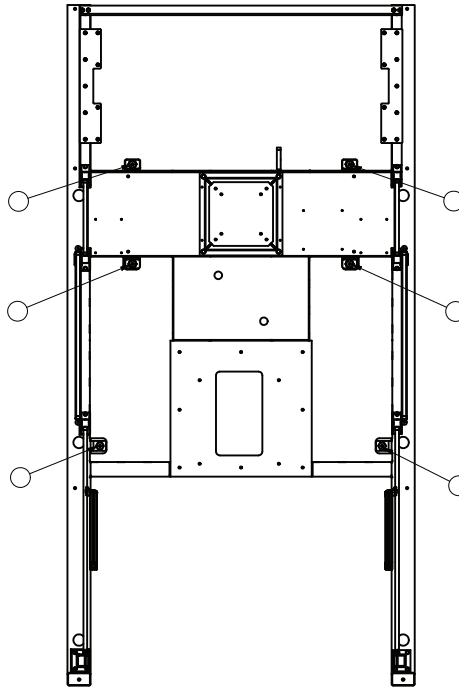


CAUTION

Handle system components carefully. Some components can be damaged if dropped or otherwise handled roughly.

1. Unbolt the common base from the platform. The bolts that secure the common base to the wooden platform go down through the hollow leveling screws and are threaded into the wooden platform (see *Fig. 3-2*). It may be necessary to hold the leveling screws in place with a suitable open-end wrench while removing the shipping bolts.

Figure 3-2: Stabilizing and Lag Points (Robot/Positioner Common Equipment Base)



WARNING

As shipped, the robot/positioner common base (with equipment) weighs approximately 2200 kg (4409 lbs). Use a forklift that is rated for this amount of weight load.

2. Using a forklift, lift the common base from the wooden platform. Discard or recycle the wooden shipping skid.

3 Installation

3.3 Installing and Leveling the Common Base

3. Place the common base in position (see *Fig. 3-1*).



Make sure that there is adequate room on all sides of the robot/positioner common base for the Operator Station, the light curtains, and the auxiliary equipment common bases (see *Fig. 3-1*).

4. Carefully remove the protective plastic wrapping from the robot, torches, and rotary positioner.
5. Inspect the robot, torches, and rotary positioner for shipping damage.



If you notice any equipment damage, notify your shipping contractor as soon as possible.

6. Use an M36 socket to loosen or tighten each leveling bolt to level the common base (see *Fig. 3-2*).



CAUTION

Be absolutely certain of the correct location for the common base before securing the base with anchor (lag) bolts.

7. Secure the common base to the floor. Use a suitable concrete drill bit and special anchor (lag) bolts (refer to *chapter 6 "Anchor Requirements"* for the correct drill bit and anchor bolt). Be sure to remove all concrete dust from the drilled hole before driving each anchor bolt.

3.4 Installing the Operator Station Pedestal (Option)

To install the Operator Station pedestal, proceed as follows:

1. Locate the Operator Station pedestal.
2. Carefully remove the protective plastic wrapping from the Operator Station pedestal.
3. Inspect the Operator Station pedestal for shipping damage.



If you notice any equipment damage, notify your shipping contractor as soon as possible.

4. Place the Operator Station pedestal outside the light curtain fence panels (see *Fig. 3-1*) for the recommended location).



CAUTION

Be absolutely certain of the correct location for the Operator Station pedestal before securing the pedestal with anchor (lag) bolts.

5. Secure the Operator Station pedestal to the floor. Use a suitable concrete drill bit and special anchor (lag) bolts (refer to *section 6* for the correct drill bit and anchor bolt). Be sure to remove all concrete dust from the drilled hole before driving each anchor bolt.

3.5 Light Curtain Alignment

The light curtain Send unit and Receive unit must be accurately positioned, relative to each other, to ensure correct operation. Complete alignment procedures are included in the light curtain documentation that is included with your EcoTrim ET-1024 System (refer to *section 1.3*).

3.6 Cable Connections

After the EcoTrim ET-1024 System components and peripherals are secured in their correct locations, unwrap the cables from around the equipment and route them according to the cable diagrams included in the documentation supplied with your EcoTrim ET-1024 System. All cables and connectors are labeled for ease of installation.



A small gap exists between the bottom of the work-cell safety fence and the robot/positioner common base. This gap provides a passage for cables that run between components outside the work cell and those inside the work cell.

3.6.1 Connection to Earth Ground



WARNING

Do not use the EcoTrim ET-1024 System unless specified components are connected to a low-resistance earth ground. Do not connect the earth ground wire with the wires for the electric power source. The low-resistance earth ground must be a “dedicated” ground that is a direct connection between the component and the earth ground point. Operator injury or death, as well as equipment damage, can result from an inadequate or defective earth ground system.

Each robot and DX200 controller must be connected to an earth ground. If a ground stake is used, it should be driven at least 2.43 m (8 ft) into the soil. The soil surrounding the driven ground stake should be treated with a chemical that increases the soil conductivity in the vicinity of the driven ground stake. This is often referred to as a “low-resistance earth ground” and may require quite a bit more than a single driven ground rod, depending on soil conditions. Multiple ground stakes (bonded together) or even a bonded network of buried copper sheeting (plus conduction-enhancing chemicals) may be required, depending on local soil condition. In any event, the “low-resistance earth ground” must indicate a resistance of **100 ohms or less** (when measured directly between grounded equipment and the earth ground system). Be advised that specialized measuring equipment is usually required to get an accurate “resistance-to-ground” reading. Consult a specialist in this field, if required.



The customer must supply all wires associated with the earth ground. The customer is responsible for establishing and maintaining an adequate earth ground (must maintain a resistance of 100 ohms or less).

Connect robot and DX200 controller to the earth ground as follows:

1. Connect one end of an earth ground wire to the lug marked Earth Ground on the connector panel of MH24 robot. Connect the other end of the earth ground wire to the low-resistance earth ground.
2. Connect one end of an earth ground wire to the Common Ground Bus B on the DX200 controller. Connect the other end of the earth ground wire to the low-resistance earth ground.

3.6.2 Connection to Local Electrical Service**WARNING**

Connection of the EcoTrim ET-1024 System to local electrical service must be done by a qualified, licensed electrician. Electrical and grounding connections must comply with the National Electrical Code (NEC), as well as local electrical codes.

After all the system components have been properly installed and interconnected, connect local electrical service to the fused QS1 switch. This connection point is located inside the DX200 controller. (see *Fig. 1-1* and *Fig. 2-5* and the system diagram supplied with the system.).



The EcoTrim ET-1024 System is configured for three-phase 480 V AC primary power. For additional information, please refer to the electrical drawings and schematics that are included with your EcoTrim ET-1024 System.



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3.7 Safety/Operation Check

Before installing the tooling and fixtures for your application, take a few minutes to perform the following safety/operation check:

3. Ensure correct alignment and operation of the safety light curtain Send and Receive units.
4. Ensure that both work-cell access doors are closed and latched and door interlocks engaged.
5. Check the torque and security of all cable connections.
6. Verify that local electrical service is correctly wired into the DX200 controller. (Refer to *section 3.6.2*).
7. Verify that the local electrical service complies with the voltage and phase requirements for your EcoTrim ET-1024 System.



CAUTION

The EcoTrim ET-1024 System is now ready for power-up. Ensure that qualified, trained operators who are familiar with the EcoTrim ET-1024 System perform this power-up sequence.

8. Switch ON the power ON-OFF switch on DX200 controller to ON (see *Fig. 2-5*).



WARNING

Before operating the robot, check each E-STOP push button to verify that servo power will be disabled by activation of the E-STOP. Injury to personnel or equipment damage can result from an E-STOP circuit fault. The E-STOP push buttons must be able to immediately stop robot and positioner movement during an emergency situation.

9. Check for correct operation of system E-STOP push buttons.
10. Check for correct operation of the system HOLD buttons on the Programming Pendant and Operation Station (ROBOT HOLD). Refer to the *Operator's Manual* for more information on the pendant's HOLD button (see *section 1.3*). Refer to *section 2.4* for more information on the Operator Station's ROBOT HOLD button.
11. Ensure correct action of the safety interlocks on both work-cell access doors.

3.8 Installation of Tooling and Fixtures

Your EcoTrim ET-1024 System is now ready for the installation of tooling and fixtures for your particular application. Personnel who are familiar with the operation of the EcoTrim ET-1024 System should do the installation. After the installation, test the MSR positioner for correct operation.



NOTE All tooling and fixtures for the MSR rotary positioner are supplied by the customer.

4 Operation

The EcoTrim ET-1024 System is a fully integrated robotic work cell. The Motoman robot trims on one side of the MSR rotary positioner while the operator loads the opposite side with the next part. Once the robot is finished, it returns to HOME (Safe) position. The operator then enables the positioner sweep, allowing the robot to start trimming on the next part. This section provides operation instructions for the EcoTrim ET-1024 System.

4.1 Programming

The operation of this system is programming dependent. The following operating instructions are based on one possible configuration of this system. Your system configuration and job structure may differ slightly from that presented here; however, basic operation will be the same. For additional programming procedures and information, refer to the DX200 controller and operator documentation that is included with your EcoTrim ET-1024 System (refer to *section 1.3*).

Any changes made to your system configuration and/or job structure will alter the operation of the system. Motoman recommends that you **do not** modify the original jobs and system configuration of your EcoTrim ET-1024 System.

If you determine a need to modify the original jobs and system configuration, make any modifications to a copy of the original. Keep the original as a backup. Do not modify the original.

Modifications must be performed by trained and experienced personnel who are familiar with the operation of the EcoTrim ET-1024 System. If you have questions concerning the configuration of your EcoTrim ET-1024 System, please contact Motoman 24-hour Customer Support (refer to *section 1.4*).

4.2 Sweeping the Positioner



The robot must be in HOME position before you can sweep the positioner.

MANUAL mode allows you to sweep the MSR positioner without activating the robot. Parts can be loaded onto the fixture to achieve the most efficient configuration and then swept into the trimming zone before teaching the robot a series of moves. To sweep Side A or Side B of the positioner into the robot's trimming zone, proceed as follows:

1. Place the robot in HOME position (refer to *section 4.3.2*).
2. Make sure that the Operator Station is enabled (Programming Pendant's Mode Select Switch set to REMOTE).
3. Set the Operator Station's POSITIONER AUTO/MANUAL switch to MANUAL mode and start the Control Master job (see *section 4.3.3*). Normally, the robot will not move out of HOME position when the POSITIONER switch is set to MANUAL. (This depends on the job structure.)



Control of the positioner uses collaborative motion between the robot and the positioner external axis.

Collaborative motion is active when jogging the tooling axis, loading, or unloading parts.



Cycle Start latching is not operative in Manual mode.

4. Press the CYCLE START/CYCLE LATCHED button on the Operator Station (the MSR positioner sweeps each time this button is pressed).

4.3 Daily Operation

The procedures below represent the typical operating sequence from power-up to shutdown. Your basic operating procedures may vary depending on your situation.

- Perform the start-up procedure (refer to *section 4.3.1*).
- Move the robot to HOME position (refer to *section 4.3.2*).
- Select the Control Master job (refer to *section 4.3.3*).
- Perform the operation cycle (refer to *section 4.3.4*).
- Perform the shutdown procedure (refer to *section 4.3.5*).

4.3.1 Start-up Procedure

To start up the EcoTrim ET-1024 System work cell from a power-off condition, proceed as follows:

1. Set the power ON-OFF switch on DX200 controller to ON (see *Fig. 2-5*).
2. Open the main shutoff valve.
3. Make sure that both work-cell doors are closed and operating properly and the door safety interlocks are engaged.
4. Make sure that all E-STOP buttons are released. E-STOP buttons are installed at the following locations:
 - Programming Pendant
 - Door of DX200 controller
 - Operator Station pedestal
5. Select TEACH mode on the Programming Pendant.
6. Place the robot in HOME position (refer to *section 4.3.2*).

4.3.2 Robot HOME Position

To move the robot to HOME position:

1. Select TEACH mode on the Programming Pendant.
2. Select MAIN MENU on the Programming Pendant touch screen.
3. Select JOB on the Programming Pendant touch screen.
4. Select SELECT JOB on the Programming Pendant touch screen (a job list appears on the screen).
5. Use the navigation cursor key to move the cursor to SAFE job and press SELECT (the job appears on the display screen).
6. Turn servo power on by pressing SERVO ON and holding in the ENABLE switch.
7. Use the FWD button on the Programming Pendant to move the robot to HOME position.

4 Operation

4.3 Daily Operation

4.3.3 Control Master Job

With the system powered up and in TEACH mode, call up the Control Master job:

1. Select JOB on the Programming Pendant touch screen.
2. Select CTRL MASTER on the Programming Pendant touch screen.
3. Press SELECT twice to activate the Control Master job.
4. Select PLAY mode on the Programming Pendant and press the PLAY MODE ENABLE button on the door of DX200 controller (job playback operation is enabled).
5. Press the SERVO ON button on the Programming Pendant.
6. Press the START button on the Programming Pendant (the Control Master job cycles, waiting for a Cycle Start input from the Operator Station).
7. Transfer control to the Operator Station by selecting REMOTE on the Programming Pendant's Mode Select Switch.

The EcoTrim ET-1024 System work cell is now ready for operation.

4.3.4 Operation Cycle

The following is the typical sequence of operation for the EcoTrim ET-1024 System work cell after start-up:



Control of the positioner uses collaborative motion between the robot and the positioner external axis.

Collaborative motion is active when jogging the tooling axis, loading, or unloading parts.



1. The operator loads the fixture (on the operator side of the positioner) with parts to be processed.
2. The operator steps out of the safety zone created by the safety light curtain system and moves to the front of the Operator Station.
3. The operator presses the green CYCLE START/CYCLE LATCHED button on the Operator Station. The MSR positioner sweeps 180°, placing parts to be trimmed into the robot work area. The robot then begins to trim the part (Optional Pedestal Operator Station's POSITIONER AUTO/MANUAL switch must be set to AUTO).
4. While the robot is trimming, the operator loads the operator side of the positioner with the next group of parts to be processed.
5. The operator again moves to the Operator Station pedestal and presses the green CYCLE START/CYCLE LATCHED button. When the robot is are finished trimming, it returns to HOME position. The MSR positioner then sweeps 180° to return completed, processed parts to the operator position while moving the next group of parts into the robot work area.
6. The operator moves back to the operator side of the MSR positioner and unloads the completed parts.

4.3.5 Shutdown Procedure

Use the following procedure to perform a normal shutdown of the EcoTrim ET-1024 System:

1. Make sure that the robot is in HOME position.
2. Turn off system servo power by pressing the E-STOP button on the Operator Station pedestal or Programming Pendant.
3. Select TEACH mode on the Programming Pendant.
4. Set the DX200 controller's power ON-OFF switch to the OFF position.
5. Close the main shutoff valve.
6. Switch all electrical service disconnect boxes to OFF.

The EcoTrim ET-1024 System is now shut down.

4.4 System Recovery

When a system error or alarm occurs, you must clear the error or alarm to return the system to normal operation. The paragraphs below describe the different types of alarms and errors you might encounter and how to clear them.

4.4.1 Alarms and Errors

There are three levels of alarms and errors that will stop the program:

- Error messages
- Minor alarms
- Major alarms

For more detailed information on alarm and error recovery, refer to the DX200 controller and MH24 robot documentation that is included with your EcoTrim ET-1024 System (refer to *section 1.3*).

4.4.1.1 Error Messages

Error messages are usually the result of simple, easily cleared operation errors. One example of this type of error is pressing the START button when the robot is not in PLAY mode.

Clear errors of this type by pressing the CANCEL button on the Programming Pendant.

4.4.1.2 Minor Alarms

Minor alarms usually involve programming errors. Clear alarms of this type by pressing the CANCEL button on the Programming Pendant.

4.4.1.3 Major Alarms

Major alarms usually involve hardware failures. Examples of this type of error include an overload condition and abnormal speed.

Clear alarms of this type by cycling the DX200 controller (switch the Power ON-OFF switch on each controller to OFF, then back to ON).

4.4.2 E-STOP Recovery

An E-STOP (emergency stop) will occur under any of the following conditions:

- An E-STOP button is pushed in (activated).
- A work-cell access door is opened while the robot is not in TEACH mode.
- The safety light curtain system is triggered while the MSR positioner is sweeping.

4 Operation

4.4 System Recovery

To restart the EcoTrim ET-1024 System after an E-STOP condition occurs, follow the procedures below.

1. To clear the E-STOP condition, perform any of the following actions that apply:
 - Release the activated E-STOP push button.
 - Close the work-cell access door(s).
 - Clear the area in front of the MSR positioner that is protected by the safety light curtain system.



CAUTION

If an emergency stop condition occurs while the positioner is sweeping, the positioner will continue the sweep when the EcoTrim ET-1024 System is restarted.

2. Press the SERVO ON button on the Operator Station or Programming Pendant.
3. Ensure that the Programming Pendant is in REMOTE mode (Programming Pendant's Mode Select Switch set to REMOTE).
4. Press the green START button on the Operator Station.

The EcoTrim ET-1024 System is now ready to continue operation.

4.4.3 Brake Release

The robot brakes are designed to protect the robot and other system components from damage in the event of a system or robot failure, a loss of drive power, or any other occurrence that activates the brakes. It is then necessary to release the brakes on the robot in order to move it. To release the brakes, proceed as follows:



WARNING

Always support the robot axis to be released **before** you release it. Without adequate robot axis support, brake release could cause personal injury or machine damage.

1. On the Programming Pendant, select TEACH mode.
2. Select ROBOT on the Programming Pendant touch screen.
3. Select the BRAKE RELEASE option.
4. Select the control group (R1, R2, S1).
5. While pressing in on the pendant's ENABLE switch, hold down the minus key for the axis to be released (S-, L-, U-, etc.). The brake for the selected axis releases.

5 Maintenance

Maintenance of the EcoTrim ET-1024 System and components must be performed by authorized personnel who are familiar with the EcoTrim ET-1024 System. Perform the procedures given in this section as needed. Be sure to read and understand the documentation for a particular component before doing repair or preventive maintenance on that component. Be sure that you understand the maintenance procedures, have the proper tools at hand, and comply with all safety instructions and precautions given throughout this manual.

Be advised that the maintenance intervals given in *Table 5-1* are recommendations only. Adjust the frequency and level to suit your specific equipment schedules and shop environment.

For periodic maintenance procedures and schedules for the individual components of your EcoTrim ET-1024 System, refer to the documentation that is included with your EcoTrim ET-1024 System (refer to *section 1.3*).

Table 5-1: Periodic Maintenance

FREQUENCY	COMPONENT	PROCEDURE
Daily	All safeguard items – work-cell door interlocks, E-STOP push buttons, safety light curtains, etc.	Check the physical condition of the safeguard item and ensure that the safeguard item is working correctly.
Monthly	EcoTrim ET-1024 System Work Cell	Remove accumulated dirt, grease, and debris from inside and outside the work cell.

6 Anchor Requirements

The purchaser must determine all anchoring and foundation requirements and supply the appropriate anchoring hardware for a particular installation. Before installing the EcoTrim ET-1024 System, refer to *Table 6-1* to determine special anchor and foundation requirements.



WARNING

Do not mount robot directly to the floor without the indicated floor plate. Failure to follow floor-plate requirements can result in equipment damage or injury to personnel.

Table 6-1: Minimum Recommended Equipment Anchor Requirements

EQUIPMENT	MINIMUM HILTI® ANCHOR ROD DIAMETER/TYPE	MINIMUM FLOOR-PLATE REQUIREMENTS	MINIMUM FOUNDATION REQUIREMENTS
ROBOTS UP6, UP20, UP20-6, EA1400, EA1900	5/8-inch HVA Chemical Style Anchor (Note 3)	600 mm (24 in.) Length 600 mm (24 in.) Width 38.1 mm (1.5 in.) Thick	30 in. x 30 in. x 7 in. Thick 4000 psi Reinforced Concrete
ROBOTS UP20M, UP50, SP80 (Note 2)	7/8-inch HVA Chemical Style Anchor (Note 3)	900 mm (35 in.) Length 900 mm (35 in.) Width 50.8 mm (2 in.) Thick	60 in. x 60 in. x 9 in. Thick 4000 psi Reinforced Concrete
ROBOTS UP120, UP130, UP165, SP100, SP160, SP250, SP400 (Note 2)	7/8-inch HVA Chemical Style Anchor (Note 3)	1200 mm (47 in.) Length 1200 mm (47 in.) Width 50.8 mm (2 in.) Thick	72 in. x 72 in. x 9 in. Thick 4000 psi Reinforced Concrete
ROBOTS UP200	7/8-inch HVA Chemical Style Anchor (Note 3)	1200 mm (47 in.) Length 1200 mm (47 in.) Width 50.8 mm (2 in.) Thick	72 in. x 72 in. x 9 in. Thick 4000 psi Reinforced Concrete
ROBOTS UP350, UP500, SK300X	7/8-inch HVA Chemical Style Anchor (Note 3)	1500 mm (59 in.) Length 1500 mm (59 in.) Width 50.8 mm (2 in.) Thick	72 in. x 72 in. x 9 in. Thick 4000 psi Reinforced Concrete
POSITIONER Rotary Style	5/8-inch HVA Chemical Style Anchor (Note 3)	Not Applicable	Not Applicable
POSITIONER Trunnion Style	7/8-inch HVA Chemical Style Anchor (Note 3)	Not Applicable	Not Applicable
PERIPHERAL EQUIPMENT	1/2-inch Kwik Bolt II Style Anchor (Note 4)	Not Applicable	3-inch minimum thickness or 1.3 embedment depth (whichever is larger) 4000 psi Reinforced Concrete

Table 6-1: Minimum Recommended Equipment Anchor Requirements

EQUIPMENT	MINIMUM HILTI® ANCHOR ROD DIAMETER/TYPE	MINIMUM FLOOR-PLATE REQUIREMENTS	MINIMUM FOUNDATION REQUIREMENTS
WORK-CELL FENCE POSTS	3/8-inch Kwik Bolt II Style Anchor (Note 4)	Not Applicable	3-inch minimum thickness or 1.3 embedment depth (whichever is larger) 4000 psi Reinforced Concrete
OPERATOR STATION PEDESTAL	1/4-inch Kwik Bolt II Style Anchor (Note 4)	Not Applicable	3-inch minimum thickness or 1.3 embedment depth (whichever is larger) 4000 psi Reinforced Concrete

NOTES:

- (1) Minimum robot lagging requirements are based on maximum repulsion forces and the *Hilti® Anchor Design Program* (v3.3b).
- (2) SP-series robots require base plates and/or risers to be level within $\pm 2^\circ$. Grout if necessary.
- (3) Reference source: *Hilti® Product Technical Guide* (section 4.2.1) for hardware specifications or equivalent.
- (4) Reference source: *Hilti® Product Technical Guide* (section 4.3.3) for hardware specifications or equivalent.
- (5) Robot manual requirements calling for cast-in anchors may be substituted with the recommendations listed.

Refer to <http://us.hilti.com> or <http://ca.hilti.com> for further information.

Appendix A

A.1 Checklist

This checklist is provided as a convenience to help with the proper installation, startup and maintenance of the work cell.

	Time/Date	Checked By
BEFORE APPLYING POWER (Refer to System Drawings)		
Check Mounting (Refer to Installation Section in all Mnls)		
Check Power (Refer to Connections, Controller Mnl)		
Check Ground (Refer to Grounding in all Mnls)		
Check Water (Refer to Operation and Vendor Mnls)		
Check Air (Refer to Manipulator and Vendor Mnls)		
Check Gas (Refer Operation and Vendor Mnls)		
Check Interlocks (Refer to Work Cells in all Mnls)		
Check Limiting Devices (Refer to Limits in all Mnls)		
Check Environment (Refer to Installation in Controller Mnl)		
Check Version (Refer to Confirmation of Software Version)		
Other Items to Check Before Applying Power (Vendor or Integrator Supplied)		

	Time/Date	Checked By
AFTER APPLYING POWER		
Check Control Switches (Refer to Operator Station, Controller Mnl)		
Check Axis Move and are Restricted (Refer to Basic Specifications, Manipulator Mnl)		
Check Emergency Stop(s) (Refer to E-Stop in all Mnls)		
Check External Power Disconnect (Refer to Turning OFF The Power Supply,		
Check Teach Mode (Refer to Teach Mode, Controller Mnl)		
Check Playback Mode (Refer to Play Mode, Controller Mnl)		
Check Environment (Refer to Location in Manipulator Mnl)		
Check Safeguards (Refer to Safeguards in all Mnls)		
Check Manual Mode (Refer to Manual Mode in Operations Mnl)		
Check Automatic Mode (Refer to Automatic Mode in Operations Mnl)		
Other Items to Check After Applying Power (Vendor or Integrator Supplied)		

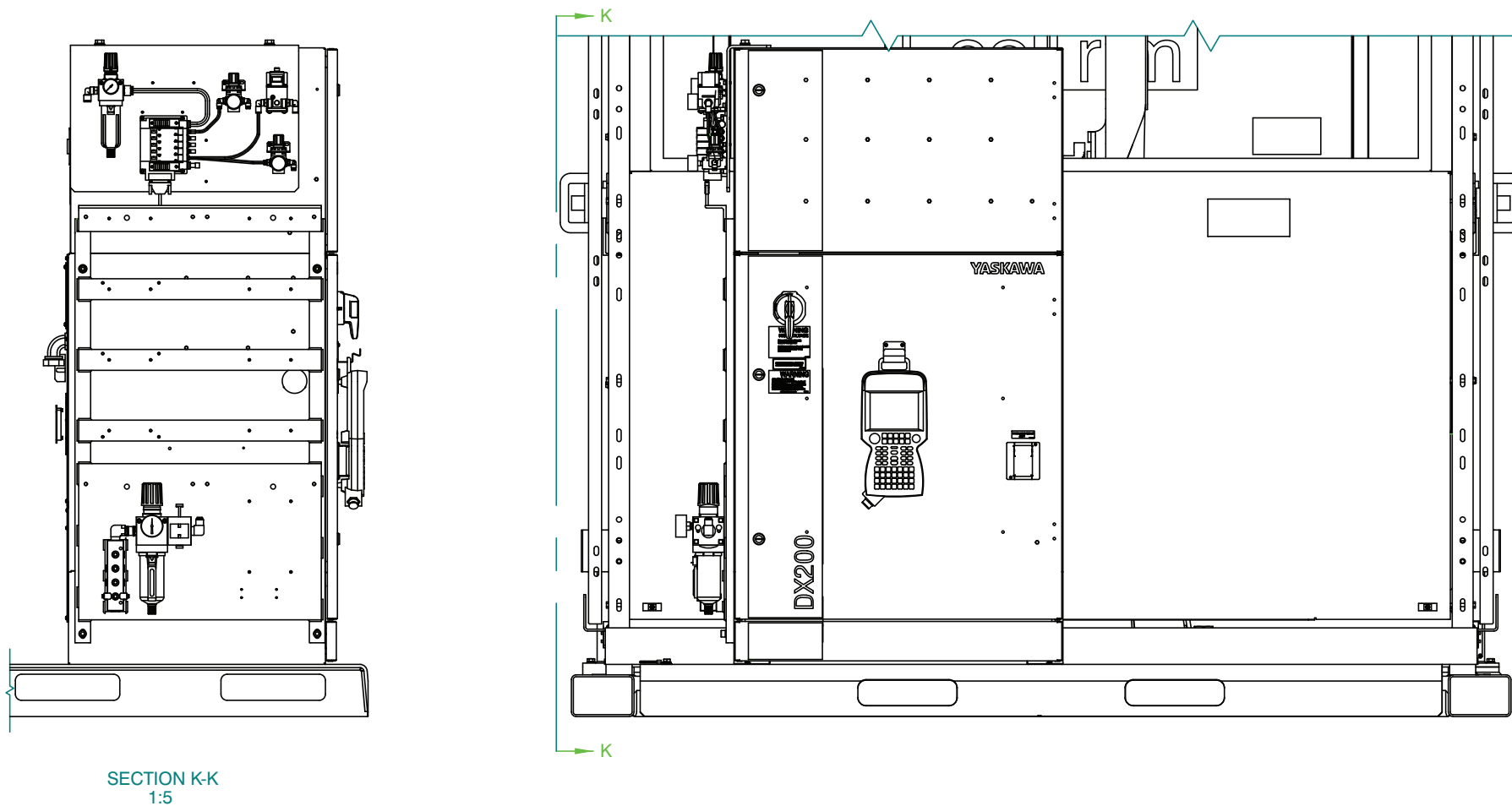
	Time/Date	Checked By
DOCUMENTATION INCLUDED		
System Drawings		
Modifications Made to Original Protective Equipment		
End Effector Load Analysis		
Instructions on Synchronized Motion <i>(More than one piece of equipment)</i>		
Programmed Limits		
Collaborative Operation Declaration <i>(Robot is suitable for integration that includes</i>		
Compliance Documents <i>(ANSI, ISO, RIA, etc.)</i>		
Risk Assessment		
Other Documents to Include <i>(Vendor or Integrator Supplied)</i> <i>(Vendor Manuals, Supplier Certifications, Compliance</i>		

	Time/Date	Checked By
MARKINGS INCLUDED ON EQUIPMENT		
Business Name, Address, Info		
Machinery Designation and Type		
Year Built		
Explosive Proof		
Order Number (Serial Number)		
Other Markings on Equipment (Vendor Machine Designation, Type, Serial No, Version, etc.)		
OTHER ITEMS		

Appendix B

B.1 EcoTrim ETU-1024 Pneumatics

Fig. B-1: EcoTrim ETU-1024 Pneumatics Location



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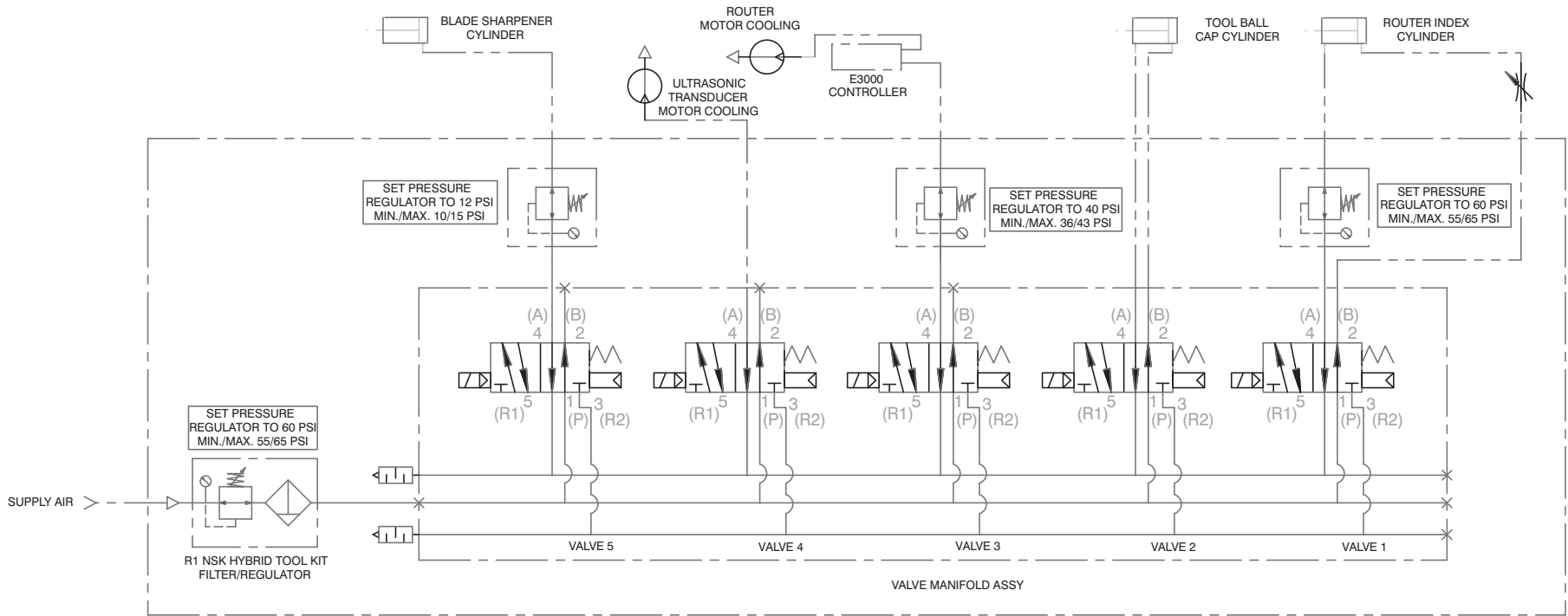
☎ +86-15876525394

B-1

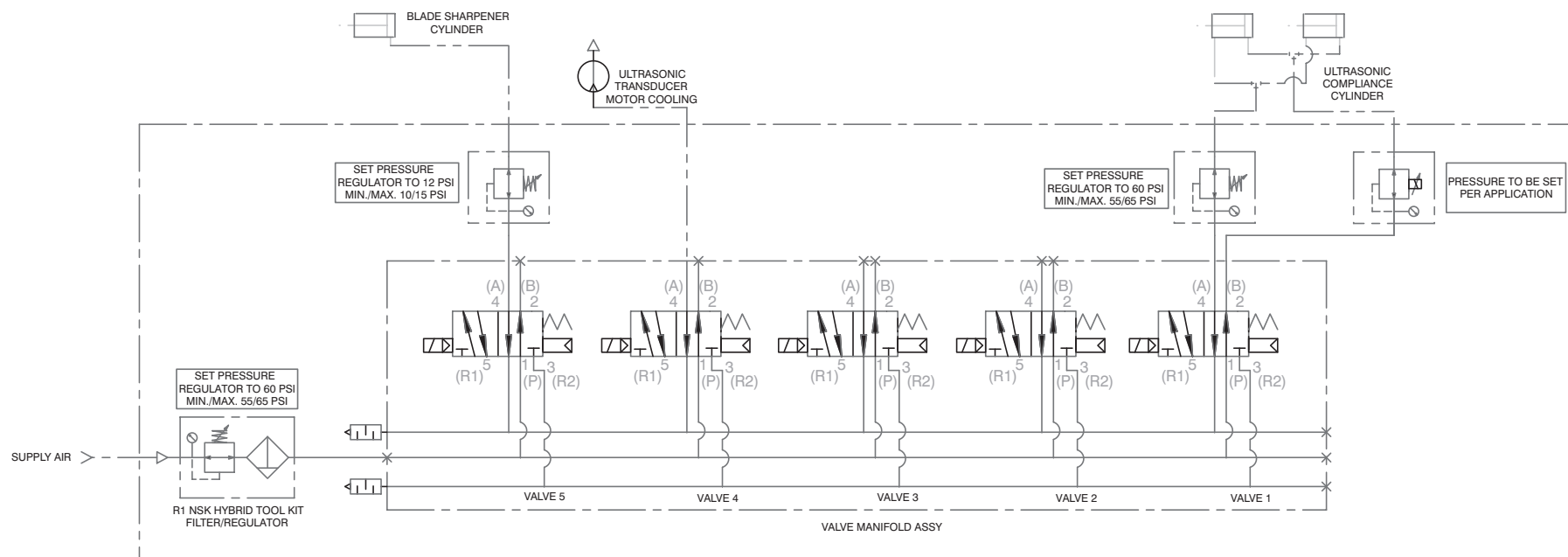
175932-1CD

B.1.1 Standard EcoTrim ETU-1024

Fig. B-2: EcoTrim ETU-1024 Pneumatic Schematic (Standard)



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B.1.2 Optional EcoTrim ETU-1024*Fig. B-3: EcoTrim ETU-1024 Pneumatic Schematic (Optional)*

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Appendix C

C.1 Optional Equipment

C.1.1 Replacement Blades

Part Number	Description
174862-1	Blade, Oscillator, Standard Style
174863-1	Blade, Oscillator, Single Edge, Half Style
174864-1	Blade, Oscillator, Compliant, Standard Style
174865-1	Blade, Oscillator, Compliant Single Edge Style
174866-1	Blade, Oscillator, Compliant Single Edge Half Style
174867-1	Blade, Oscillator, Single Edge, Tip Tracing Style
174868-1	Tool, Blade Fixing Screw

C.1.2 Blade Maintenance Accessories

Part Number	Description
174482-1	Accessory Kit, Blade, Sensor, Sharpening, Alignment (Includes 174474-1, 174860-1, 174457-1, 174454-1, Stand and Mounting Plate)
174474-1	Blade, Angle Adjuster Assembly
174860-1	Blade, Gauge, Parallel Alignment, Oscillator
174457-1	Blade, Sharpener Assy, NSK
174861-1	Tool, Sharpening Stone, #2000, Oscillator
174454-1	Sensor Assy, Blade Breakage
174869-1	Tool, Blade Holder, Oscillator

C.1.3 End Mill Accessories

Part Number	Description
174870-1	Tool, End Mill, Specially Designed
174874-1	Collet, Spindle Motor
174871-1	Controller, Amplifier, Multi-motor E4000
174872-1	Motor, Spindle, Brushless, 20000 RPM
174873-1	Cable, Power/Signal, E4000 Controller, 8M

EcoTrim ET-1024

SYSTEM MANUAL

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