FANUC Robot series

R-30*i*A MATE CONTROLLER

P-50*i*B
Mechanical Unit
Operator's Manual

MAROTP50I11111E REV B

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This manual can be used with controllers labeled R-30*i*A or R-J3*i*C. If you have a controller labeled R-J3*i*C, you should read R-30*i*A as R-J3*i*C throughout this manual.

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FANUC Robotics conducts courses on its systems and products on a regularly scheduled basis at the company's world headquarters in Rochester Hills, Michigan. For additional information contact

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Patents

One or more of the following U.S. patents might be related to the FANUC Robotics products described in this manual.

FANUC Robotics America Corporation Patent List

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Conventions

⚠WARNING

Information appearing under the "WARNING" caption concerns the protection of personnel. It is boxed and bolded to set it apart from the surrounding text.

⚠CAUTION

Information appearing under the "CAUTION" caption concerns the protection of equipment, software, and data. It is boxed and bolded to set it apart from the surrounding text.

Note Information appearing next to NOTE concerns related information or useful hints

Safety

FANUC Robotics is not and does not represent itself as an expert in safety systems, safety equipment, or the specific safety aspects of your company and/or its work force. It is the responsibility of the owner, employer, or user to take all necessary steps to guarantee the safety of all personnel in the workplace.

The appropriate level of safety for your application and installation can be best determined by safety system professionals. FANUC Robotics therefore, recommends that each customer consult with such professionals in order to provide a workplace that allows for the safe application, use, and operation of FANUC Robotics systems.

According to the industry standard ANSI/RIA R15-06, the owner or user is advised to consult the standards to ensure compliance with its requests for Robotics System design, usability, operation, maintenance, and service. Additionally, as the owner, employer, or user of a robotic system, it is your responsibility to arrange for the training of the operator of a robot system to recognize and respond to known hazards associated with your robotic system and to be aware of the recommended operating procedures for your particular application and robot installation.

Ensure that the robot being used is appropriate for the application. Robots used in classified (hazardous) locations must be certified for this use.

FANUC Robotics therefore, recommends that all personnel who intend to operate, program, repair, or otherwise use the robotics system be trained in an approved FANUC Robotics training course and become familiar with the proper operation of the system. Persons responsible for programming the system–including the design, implementation, and debugging of application programs–must be familiar with the recommended programming procedures for your application and robot installation.

The following guidelines are provided to emphasize the importance of safety in the workplace.

CONSIDERING SAFETY FOR YOUR ROBOT INSTALLATION

Safety is essential whenever robots are used. Keep in mind the following factors with regard to safety:

- The safety of people and equipment
- Use of safety enhancing devices
- Techniques for safe teaching and manual operation of the robot(s)
- Techniques for safe automatic operation of the robot(s)
- Regular scheduled inspection of the robot and workcell
- Proper maintenance of the robot

Keeping People Safe

The safety of people is always of primary importance in any situation. When applying safety measures to your robotic system, consider the following:

- External devices
- Robot(s)
- Tooling
- Workpiece

Using Safety Enhancing Devices

Always give appropriate attention to the work area that surrounds the robot. The safety of the work area can be enhanced by the installation of some or all of the following devices:

- Safety fences, barriers, or chains
- Light curtains
- Interlocks
- Pressure mats
- Floor markings
- Warning lights
- Mechanical stops
- EMERGENCY STOP buttons
- DEADMAN switches

Setting Up a Safe Workcell

A safe workcell is essential to protect people and equipment. Observe the following guidelines to ensure that the workcell is set up safely. These suggestions are intended to supplement and not replace existing federal, state, and local laws, regulations, and guidelines that pertain to safety.

- Sponsor your personnel for training in approved FANUC Robotics training course(s) related to your application. Never permit untrained personnel to operate the robots.
- Install a lockout device that uses an access code to prevent unauthorized persons from operating the robot.
- Use anti–tie–down logic to prevent the operator from bypassing safety measures.
- Arrange the workcell so the operator faces the workcell and can see what is going on inside the cell.
- Clearly identify the work envelope of each robot in the system with floor markings, signs, and special barriers. The work envelope is the area defined by the maximum motion range of the robot, including any tooling attached to the wrist flange that extend this range.
- Position all controllers outside the robot work envelope.
- Never rely on software or firmware based controllers as the primary safety element unless they comply with applicable current robot safety standards.
- Mount an adequate number of EMERGENCY STOP buttons or switches within easy reach of the operator and at critical points inside and around the outside of the workcell.
- Install flashing lights and/or audible warning devices that activate whenever the robot is operating, that is, whenever power is applied to the servo drive system. Audible warning devices shall exceed the ambient noise level at the end–use application.
- Wherever possible, install safety fences to protect against unauthorized entry by personnel into the work envelope.
- Install special guarding that prevents the operator from reaching into restricted areas of the work envelope.
- Use interlocks.
- Use presence or proximity sensing devices such as light curtains, mats, and capacitance and vision systems to enhance safety.

- Periodically check the safety joints or safety clutches that can be optionally installed between the robot wrist flange and tooling. If the tooling strikes an object, these devices dislodge, remove power from the system, and help to minimize damage to the tooling and robot.
- Make sure all external devices are properly filtered, grounded, shielded, and suppressed to prevent hazardous motion due to the effects of electro–magnetic interference (EMI), radio frequency interference (RFI), and electro–static discharge (ESD).
- Make provisions for power lockout/tagout at the controller.
- Eliminate *pinch points*. Pinch points are areas where personnel could get trapped between a moving robot and other equipment.
- Provide enough room inside the workcell to permit personnel to teach the robot and perform maintenance safely.
- Program the robot to load and unload material safely.
- If high voltage electrostatics are present, be sure to provide appropriate interlocks, warning, and beacons.
- If materials are being applied at dangerously high pressure, provide electrical interlocks for lockout of material flow and pressure.

Staying Safe While Teaching or Manually Operating the Robot

Advise all personnel who must teach the robot or otherwise manually operate the robot to observe the following rules:

- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Know whether or not you are using an intrinsically safe teach pendant if you are working in a hazardous environment.
- Before teaching, visually inspect the robot and work envelope to make sure that no potentially hazardous conditions exist. The work envelope is the area defined by the maximum motion range of the robot. These include tooling attached to the wrist flange that extends this range.
- The area near the robot must be clean and free of oil, water, or debris. Immediately report unsafe working conditions to the supervisor or safety department.
- FANUC Robotics recommends that no one enter the work envelope of a robot that is on, except for robot teaching operations. However, if you must enter the work envelope, be sure all safeguards are in place, check the teach pendant DEADMAN switch for proper operation, and place the robot in teach mode. Take the teach pendant with you, turn it on, and be prepared to release the DEADMAN switch. Only the person with the teach pendant should be in the work envelope.

> **WARNING**
>
> **Never bypass, strap, or otherwise deactivate a safety device, such as a limit switch, for any operational convenience. Deactivating a safety device is known to have resulted in serious injury and death.**

- Know the path that can be used to escape from a moving robot; make sure the escape path is never blocked.
- Isolate the robot from all remote control signals that can cause motion while data is being taught.
- Test any program being run for the first time in the following manner:

> **WARNING**
>
> **Stay outside the robot work envelope whenever a program is being run. Failure to do so can result in injury.**

  - Using a low motion speed, single step the program for at least one full cycle.
  - Using a low motion speed, test run the program continuously for at least one full cycle.

  - Using the programmed speed, test run the program continuously for at least one full cycle.
- Make sure all personnel are outside the work envelope before running production.

Staying Safe During Automatic Operation

Advise all personnel who operate the robot during production to observe the following rules:

- Make sure all safety provisions are present and active.
- Know the entire workcell area. The workcell includes the robot and its work envelope, plus the area occupied by all external devices and other equipment with which the robot interacts.
- Understand the complete task the robot is programmed to perform before initiating automatic operation.
- Make sure all personnel are outside the work envelope before operating the robot.
- Never enter or allow others to enter the work envelope during automatic operation of the robot.
- Know the location and status of all switches, sensors, and control signals that could cause the robot to move.
- Know where the EMERGENCY STOP buttons are located on both the robot control and external control devices. Be prepared to press these buttons in an emergency.
- Never assume that a program is complete if the robot is not moving. The robot could be waiting for an input signal that will permit it to continue its activity.
- If the robot is running in a pattern, do not assume it will continue to run in the same pattern.
- Never try to stop the robot, or break its motion, with your body. The only way to stop robot motion immediately is to press an EMERGENCY STOP button located on the controller panel, teach pendant, or emergency stop stations around the workcell.

Staying Safe During Inspection

When inspecting the robot, be sure to

- Turn off power at the controller.
- Lock out and tag out the power source at the controller according to the policies of your plant.
- Turn off the compressed air source and relieve the air pressure.
- If robot motion is not needed for inspecting the electrical circuits, press the EMERGENCY STOP button on the operator panel.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- If power is needed to check the robot motion or electrical circuits, be prepared to press the EMERGENCY STOP button, in an emergency.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.

Staying Safe During Maintenance

When performing maintenance on your robot system, observe the following rules:

- Never enter the work envelope while the robot or a program is in operation.
- Before entering the work envelope, visually inspect the workcell to make sure no potentially hazardous conditions exist.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Consider all or any overlapping work envelopes of adjoining robots when standing in a work envelope.
- Test the teach pendant for proper operation before entering the work envelope.
- If it is necessary for you to enter the robot work envelope while power is turned on, you must be sure that you are in control of the robot. Be sure to take the teach pendant with you, press the DEADMAN switch, and turn the teach pendant on. Be prepared to release the DEADMAN switch to turn off servo power to the robot immediately.
- Whenever possible, perform maintenance with the power turned off. Before you open the controller front panel or enter the work envelope, turn off and lock out the 3–phase power source at the controller.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.

⚠WARNING

Lethal voltage is present in the controller WHENEVER IT IS CONNECTED to a power source. Be extremely careful to avoid electrical shock. HIGH VOLTAGE IS PRESENT at the input side whenever the controller is connected to a power source. Turning the disconnect or circuit breaker to the OFF position removes power from the output side of the device only.

- Release or block all stored energy. Before working on the pneumatic system, shut off the system air supply and purge the air lines.
- Isolate the robot from all remote control signals. If maintenance must be done when the power is on, make sure the person inside the work envelope has sole control of the robot. The teach pendant must be held by this person.
- Make sure personnel cannot get trapped between the moving robot and other equipment. Know the path that can be used to escape from a moving robot. Make sure the escape route is never blocked.
- Use blocks, mechanical stops, and pins to prevent hazardous movement by the robot. Make sure that such devices do not create pinch points that could trap personnel.

⚠WARNING

Do not try to remove any mechanical component from the robot before thoroughly reading and understanding the procedures in the appropriate manual. Doing so can result in serious personal injury and component destruction.

- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.
- When replacing or installing components, make sure dirt and debris do not enter the system.
- Use only specified parts for replacement. To avoid fires and damage to parts in the controller, never use nonspecified fuses.
- Before restarting a robot, make sure no one is inside the work envelope; be sure that the robot and all external devices are operating normally.

KEEPING MACHINE TOOLS AND EXTERNAL DEVICES SAFE

Certain programming and mechanical measures are useful in keeping the machine tools and other external devices safe. Some of these measures are outlined below. Make sure you know all associated measures for safe use of such devices.

Programming Safety Precautions

Implement the following programming safety measures to prevent damage to machine tools and other external devices.

- Back–check limit switches in the workcell to make sure they do not fail.
- Implement ‘‘failure routines” in programs that will provide appropriate robot actions if an external device or another robot in the workcell fails.
- Use *handshaking* protocol to synchronize robot and external device operations.
- Program the robot to check the condition of all external devices during an operating cycle.

Mechanical Safety Precautions

Implement the following mechanical safety measures to prevent damage to machine tools and other external devices.

- Make sure the workcell is clean and free of oil, water, and debris.
- Use DCS (Dual Check Safety, software limits, limit switches, and mechanical hardstops to prevent undesired movement of the robot into the work area of machine tools and external devices.

KEEPING THE ROBOT SAFE

Observe the following operating and programming guidelines to prevent damage to the robot.

Operating Safety Precautions

The following measures are designed to prevent damage to the robot during operation.

- Use a low override speed to increase your control over the robot when jogging the robot.
- Visualize the movement the robot will make before you press the jog keys on the teach pendant.
- Make sure the work envelope is clean and free of oil, water, or debris.
- Use circuit breakers to guard against electrical overload.

Programming Safety Precautions

The following safety measures are designed to prevent damage to the robot during programming:

- Establish *interference zones* to prevent collisions when two or more robots share a work area.
- Make sure that the program ends with the robot near or at the home position.
- Be aware of signals or other operations that could trigger operation of tooling resulting in personal injury or equipment damage.
- In dispensing applications, be aware of all safety guidelines with respect to the dispensing materials.

NOTE: Any deviation from the methods and safety practices described in this manual must conform to the approved standards of your company. If you have questions, see your supervisor.

ADDITIONAL SAFETY CONSIDERATIONS FOR PAINT ROBOT INSTALLATIONS

Process technicians are sometimes required to enter the paint booth, for example, during daily or routine calibration or while teaching new paths to a robot. Maintenance personnel also must work inside the paint booth periodically.

Whenever personnel are working inside the paint booth, ventilation equipment must be used. Instruction on the proper use of ventilating equipment usually is provided by the paint shop supervisor.

Although paint booth hazards have been minimized, potential dangers still exist. Therefore, today's highly automated paint booth requires that process and maintenance personnel have full awareness of the system and its capabilities. They must understand the interaction that occurs between the vehicle moving along the conveyor and the robot(s), hood/deck and door opening devices, and high–voltage electrostatic tools.

⚠ CAUTION

Ensure that all ground cables remain connected. Never operate the paint robot with ground provisions disconnected. Otherwise, you could injure personnel or damage equipment.

Paint robots are operated in three modes:

- Teach or manual mode
- Automatic mode, including automatic and exercise operation
- Diagnostic mode

During both teach and automatic modes, the robots in the paint booth will follow a predetermined pattern of movements. In teach mode, the process technician teaches (programs) paint paths using the teach pendant.

In automatic mode, robot operation is initiated at the System Operator Console (SOC) or Manual Control Panel (MCP), if available, and can be monitored from outside the paint booth. All personnel must remain outside of the booth or in a designated safe area within the booth whenever automatic mode is initiated at the SOC or MCP.

In automatic mode, the robots will execute the path movements they were taught during teach mode, but generally at production speeds.

When process and maintenance personnel run diagnostic routines that require them to remain in the paint booth, they must stay in a designated safe area.

Paint System Safety Features

Process technicians and maintenance personnel must become totally familiar with the equipment and its capabilities. To minimize the risk of injury when working near robots and related equipment, personnel must comply strictly with the procedures in the manuals.

This section provides information about the safety features that are included in the paint system and also explains the way the robot interacts with other equipment in the system.

The paint system includes the following safety features:

- Most paint booths have red warning beacons that illuminate when the robots are armed and ready to paint. Your booth might have other kinds of indicators. Learn what these are.
- Some paint booths have a blue beacon that, when illuminated, indicates that the electrostatic devices are enabled. Your booth might have other kinds of indicators. Learn what these are.
- EMERGENCY STOP buttons are located on the robot controller and teach pendant. Become familiar with the locations of all E–STOP buttons.
- An intrinsically safe teach pendant is used when teaching in hazardous paint atmospheres.
- A DEADMAN switch is located on each teach pendant. When this switch is held in, and the teach pendant is on, power is applied to the robot servo system. If the engaged DEADMAN switch is released or pressed harder during robot operation, power is removed from the servo system, all axis brakes are applied, and the robot comes to an EMERGENCY STOP. Safety interlocks within the system might also E–STOP other robots.

WARNING

An EMERGENCY STOP will occur if the DEADMAN switch is released on a bypassed robot.

- Overtravel by robot axes is prevented by software limits. All of the major and minor axes are governed by software limits. DCS (Dual Check Safety), limit switches and hardstops also limit travel by the major axes.
- EMERGENCY STOP limit switches and photoelectric eyes might be part of your system. Limit switches, located on the entrance/exit doors of each booth, will EMERGENCY STOP all equipment in the booth if a door is opened while the system is operating in automatic or manual mode. For some systems, signals to these switches are inactive when the switch on the SOC is in teach mode.
- When present, photoelectric eyes are sometimes used to monitor unauthorized intrusion through the entrance/exit silhouette openings.
- System status is monitored by computer. Severe conditions result in automatic system shutdown.

Staying Safe While Operating the Paint Robot

When you work in or near the paint booth, observe the following rules, in addition to all rules for safe operation that apply to all robot systems.

WARNING

Observe all safety rules and guidelines to avoid injury.

WARNING

Never bypass, strap, or otherwise deactivate a safety device, such as a limit switch, for any operational convenience. Deactivating a safety device is known to have resulted in serious injury and death.

WARNING

Enclosures shall not be opened unless the area is known to be nonhazardous or all power has been removed from devices within the enclosure. Power shall not be restored after the enclosure has been opened until all combustible dusts have been removed from the interior of the enclosure and the enclosure purged. Refer to the Purge chapter for the required purge time.

- Know the work area of the entire paint station (workcell).
- Know the work envelope of the robot and hood/deck and door opening devices.
- Be aware of overlapping work envelopes of adjacent robots.
- Know where all red, mushroom–shaped EMERGENCY STOP buttons are located.
- Know the location and status of all switches, sensors, and/or control signals that might cause the robot, conveyor, and opening devices to move.
- Make sure that the work area near the robot is clean and free of water, oil, and debris. Report unsafe conditions to your supervisor.
- Become familiar with the complete task the robot will perform BEFORE starting automatic mode.
- Make sure all personnel are outside the paint booth before you turn on power to the robot servo system.
- Never enter the work envelope or paint booth before you turn off power to the robot servo system.
- Never enter the work envelope during automatic operation unless a safe area has been designated.
- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Remove all metallic objects, such as rings, watches, and belts, before entering a booth when the electrostatic devices are enabled.
- Stay out of areas where you might get trapped between a moving robot, conveyor, or opening device and another object.
- Be aware of signals and/or operations that could result in the triggering of guns or bells.
- Be aware of all safety precautions when dispensing of paint is required.
- Follow the procedures described in this manual.

Special Precautions for Combustible Dusts (Powder Paint)

When the robot is used in a location where combustible dusts are found, such as the application of powder paint, the following special precautions are required to insure that there are no combustible dusts inside the robot.

- Purge maintenance air should be maintained at all times, even when the robot power is off. This will insure that dust can not enter the robot.
- A purge cycle will not remove accumulated dusts. Therefore, if the robot is exposed to dust when maintenance air is not present, it will be necessary to remove the covers and clean out any accumulated dust. Do not energize the robot until you have performed the following steps.

1. Before covers are removed, the exterior of the robot should be cleaned to remove accumulated dust.
2. When cleaning and removing accumulated dust, either on the outside or inside of the robot, be sure to use methods appropriate for the type of dust that exists. Usually lint free rags dampened with water are acceptable. Do not use a vacuum cleaner to remove dust as it can generate static electricity and cause an explosion unless special precautions are taken.
3. Thoroughly clean the interior of the robot with a lint free rag to remove any accumulated dust.
4. When the dust has been removed, the covers must be replaced immediately.
5. Immediately after the covers are replaced, run a complete purge cycle. The robot can now be energized.

Staying Safe While Operating Paint Application Equipment

When you work with paint application equipment, observe the following rules, in addition to all rules for safe operation that apply to all robot systems.

> **WARNING**
> **When working with electrostatic paint equipment, follow all national and local codes as well as all safety guidelines within your organization. Also reference the following standards: NFPA 33 Standards for Spray Application Using Flammable or Combustible Materials, and NFPA 70 National Electrical Code.**

- **Grounding**: All electrically conductive objects in the spray area must be grounded. This includes the spray booth, robots, conveyors, workstations, part carriers, hooks, paint pressure pots, as well as solvent containers. Grounding is defined as the object or objects shall be electrically connected to ground with a resistance of not more than 1 megohms.
- **High Voltage**: High voltage should only be on during actual spray operations. Voltage should be off when the painting process is completed. Never leave high voltage on during a cap cleaning process.
- Avoid any accumulation of combustible vapors or coating matter.
- Follow all manufacturer recommended cleaning procedures.
- Make sure all interlocks are operational.
- No smoking.
- Post all warning signs regarding the electrostatic equipment and operation of electrostatic equipment according to NFPA 33 Standard for Spray Application Using Flammable or Combustible Material.
- Disable all air and paint pressure to bell.
- Verify that the lines are not under pressure.

Staying Safe During Maintenance

When you perform maintenance on the painter system, observe the following rules, and all other maintenance safety rules that apply to all robot installations. Only qualified, trained service or maintenance personnel should perform repair work on a robot.

- Paint robots operate in a potentially explosive environment. Use caution when working with electric tools.
- When a maintenance technician is repairing or adjusting a robot, the work area is under the control of that technician. All personnel not participating in the maintenance must stay out of the area.
- For some maintenance procedures, station a second person at the control panel within reach of the EMERGENCY STOP button. This person must understand the robot and associated potential hazards.
- Be sure all covers and inspection plates are in good repair and in place.
- Always return the robot to the ‘‘home’’ position before you disarm it.
- Never use machine power to aid in removing any component from the robot.
- During robot operations, be aware of the robot’s movements. Excess vibration, unusual sounds, and so forth, can alert you to potential problems.
- Whenever possible, turn off the main electrical disconnect before you clean the robot.
- When using vinyl resin observe the following:
  - Wear eye protection and protective gloves during application and removal.
  - Adequate ventilation is required. Overexposure could cause drowsiness or skin and eye irritation.
  - If there is contact with the skin, wash with water.
  - Follow the Original Equipment Manufacturer’s Material Safety Data Sheets.
- When using paint remover observe the following:
  - Eye protection, protective rubber gloves, boots, and apron are required during booth cleaning.
  - Adequate ventilation is required. Overexposure could cause drowsiness.
  - If there is contact with the skin or eyes, rinse with water for at least 15 minutes. Then seek medical attention as soon as possible.
  - Follow the Original Equipment Manufacturer’s Material Safety Data Sheets.

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1 OVERVIEW

The P-50iB is a six axis robot designed for efficient process equipment integration with feature such as a hollow-wrist -designed to integrate paint application equipment easily.

The P-50iB has the ability to “flip-over” axis 2 and 3 to provide a very large work envelope and maximum flexibility for painting.

The offset-arm design provides excellent near reach capability.

The P-50iB robot is capable of paint speeds of up to 2000 mm/sec. if the wrist payload is 5 kg or less.

The wrist payload for long arm floor, wall and invert mounted robots is 10 kg at a 50 mm radial and 300 mm axial offset and max arm payload is 10 kg.

The wrist payload for short arm floor, wall and invert mounted robots is 15 kg at a 50 mm radial and 300 mm axial offset and max arm payload is 10 kg.

1.1 Robot Configurations

This manual supports the following robot configurations:
P-50iB/15 - 700mm and P-50iB/10L - 900mm Metal Outer Arm Robot.

This manual supports the following mounting configurations:
Floor, Wall, Angle and Invert mount – Standard, Pedestal Plate & Pedestal

Figure 1-1 ET-6414-846-001_SHT1, P50iB/15 & P50iB/10L FLOOR MNT ZERO POS ROBOT NAMING & NUMBERING

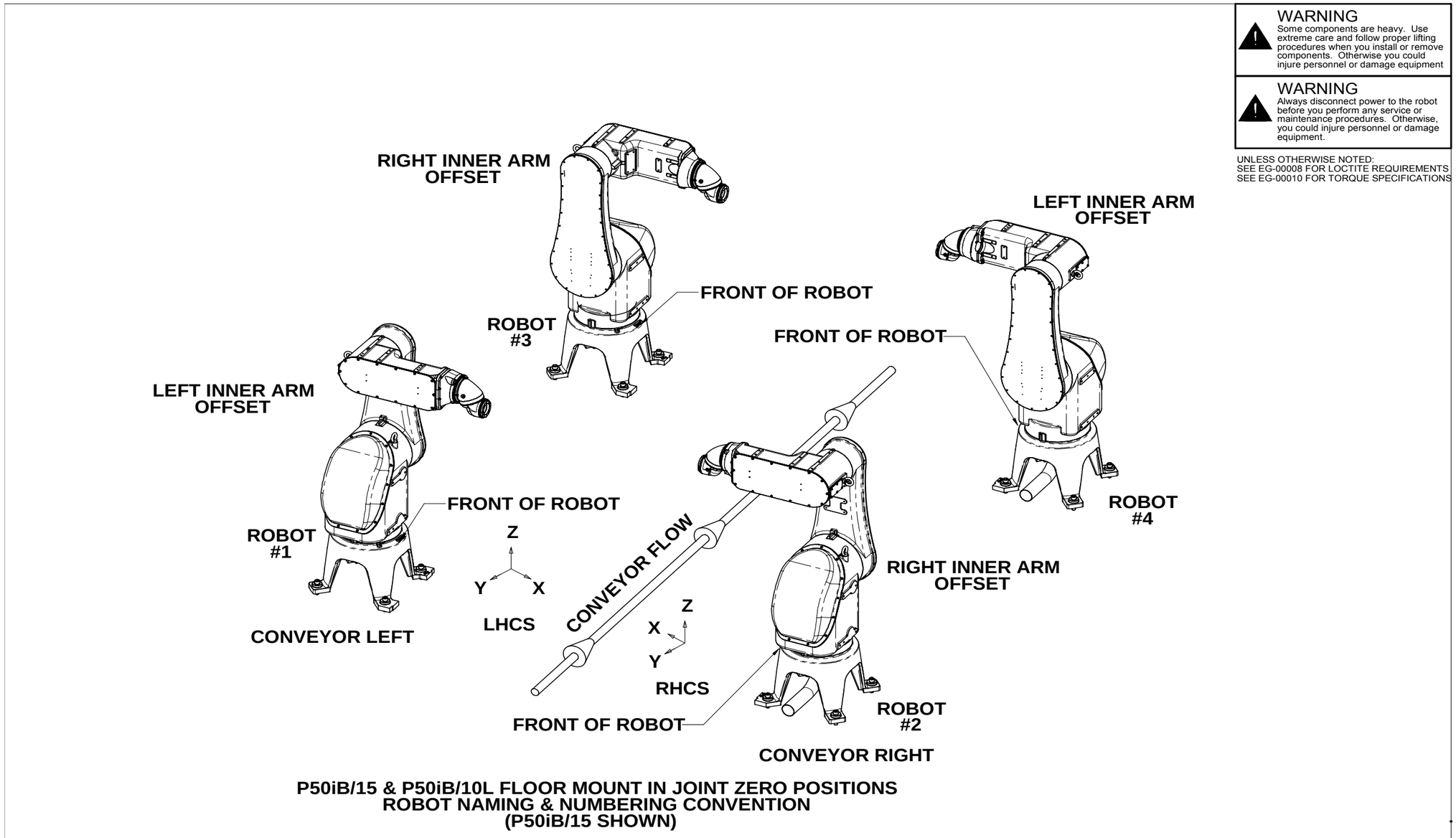


Figure 1-2 ET-6414-846-001 SHT2, P50iB/15 & 10L INVERT MNT ZERO POS ROBOT NAMING & NUMBERING

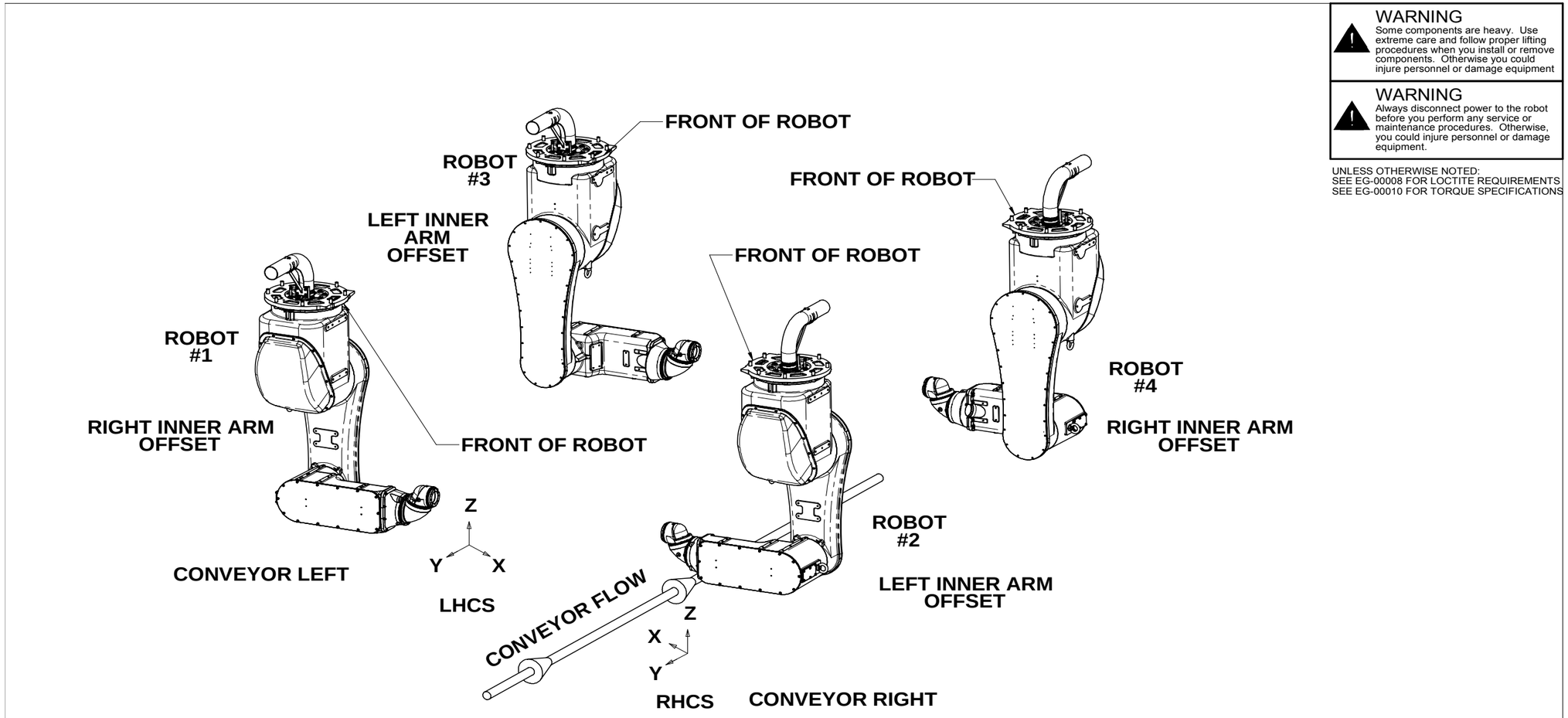


Figure 1-3 ET-6414-846-001_SHT3, P50iB/15 & 10L WALL MNT ZERO POSITIONS ROBOT NAMING & NUMBERING

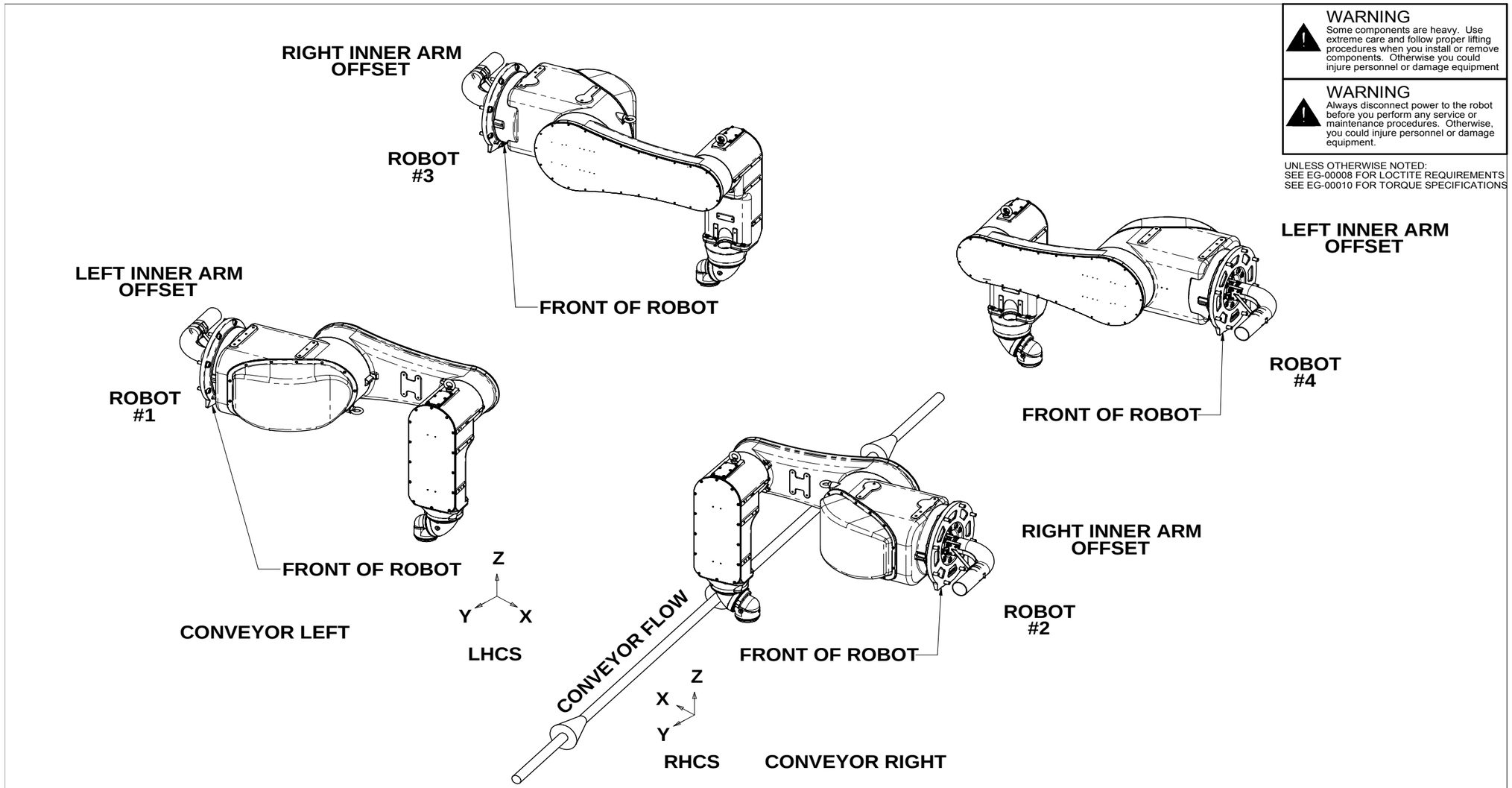


Figure 1-4 ET-6414-846-001_SHT4, P50iB/15 & 10L WALL PRL MNT FACE IN ZERO POSITIONS ROBOT NAMING & NUMBERING

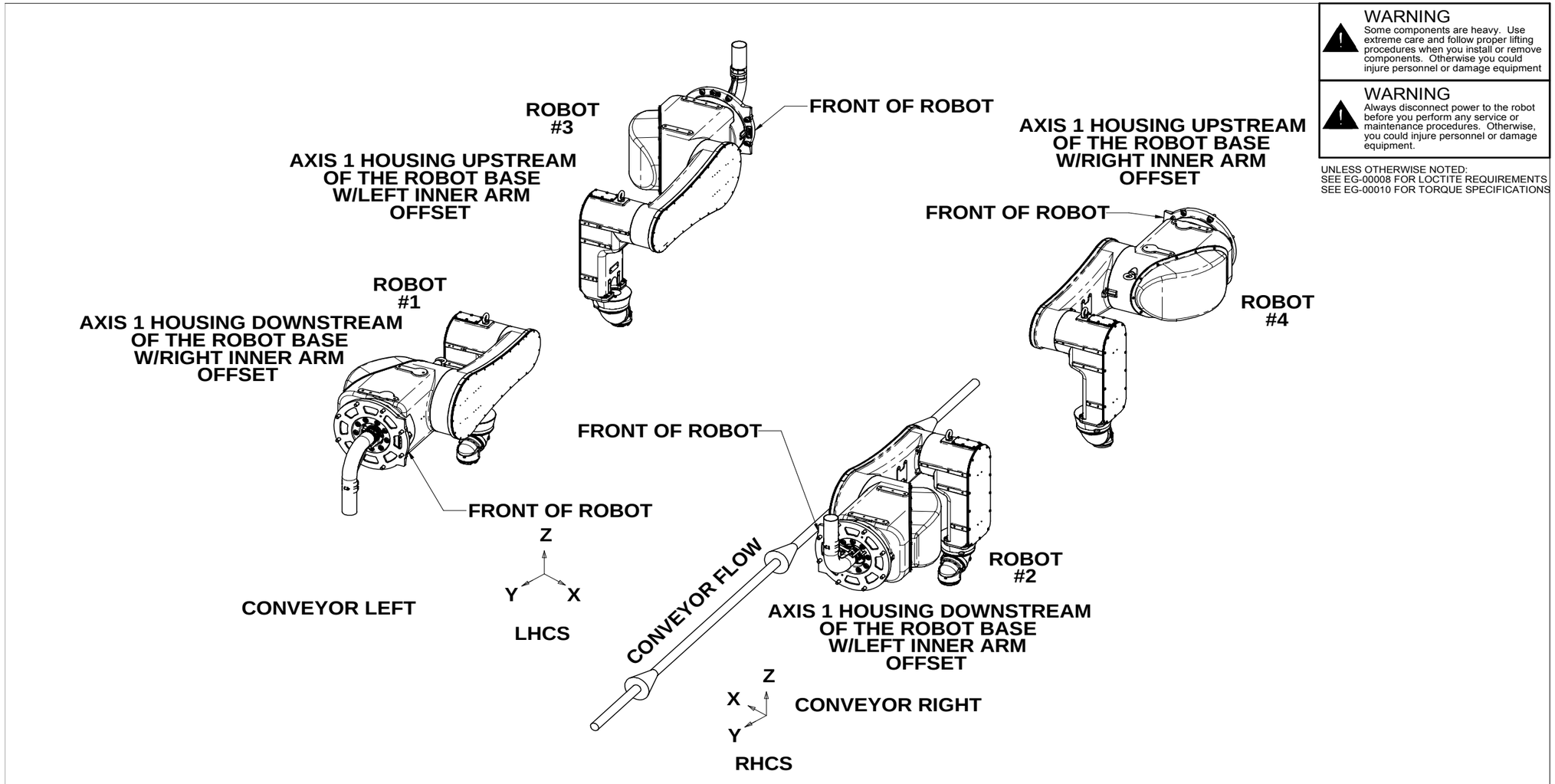
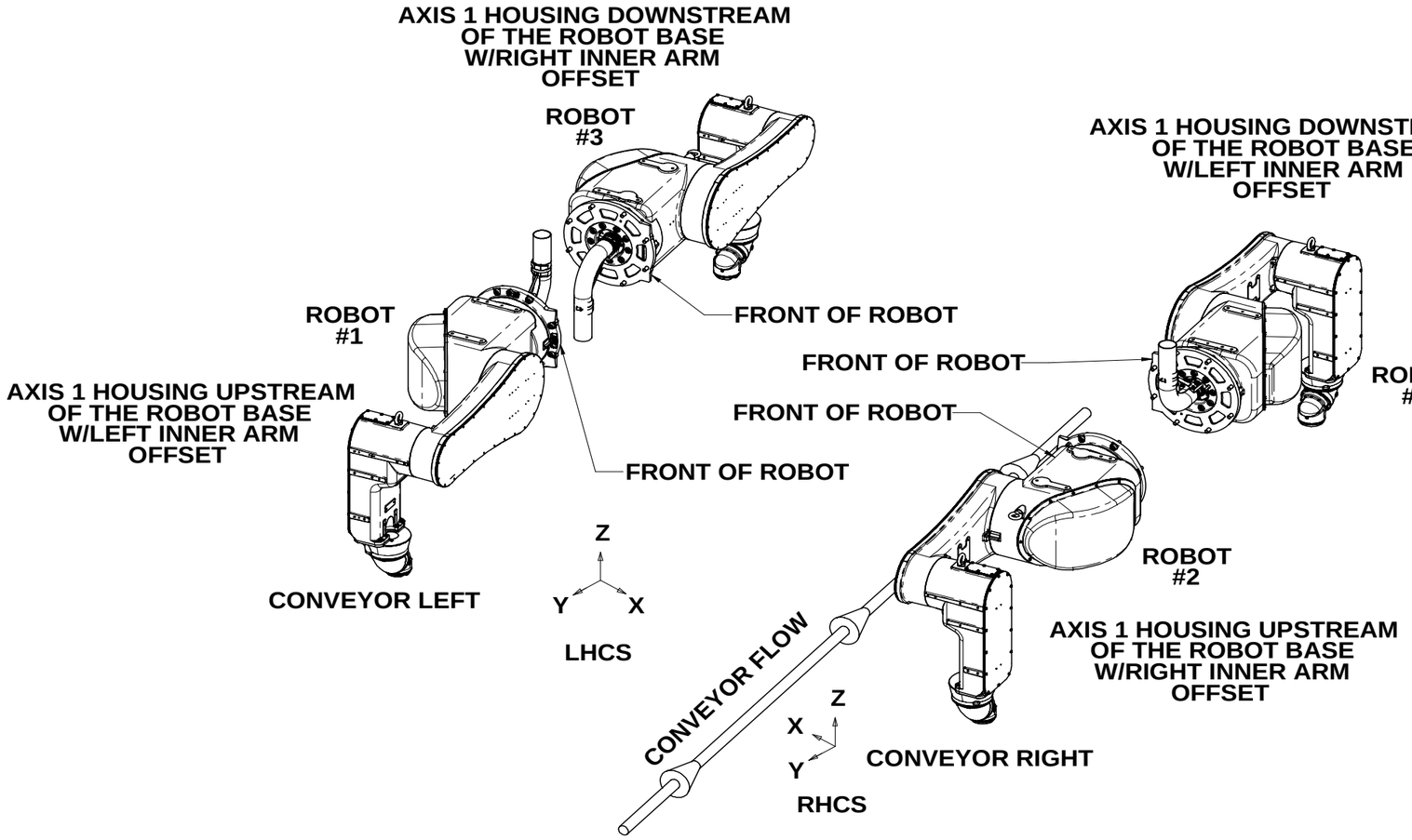


Figure 1-5 ET-6414-846-001 SHT5, P50iB/15 & 10L PARALELL MNT FACE OUT ZERO POS ROBOT NAMING & NUMBERING



WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

P50iB/15 & P50iB/10L WALL PARALLEL MOUNT - FACING OUTWARD IN JOINT ZERO POSITIONS
ROBOT NAMING & NUMBERING CONVENTION
(P50iB/15 SHOWN)

[ET-6414-846-001_SHT5] REV A
P50iB/15 & 10L PARALELL MNT FACE OUT ZERO POS
ROBOT NAMING & NUMBERING

Figure 1-6 ET-6414-847-001 SHT1, P50iB/15 & 10L PEDESTAL MNT ZERO POS AXIS DIR

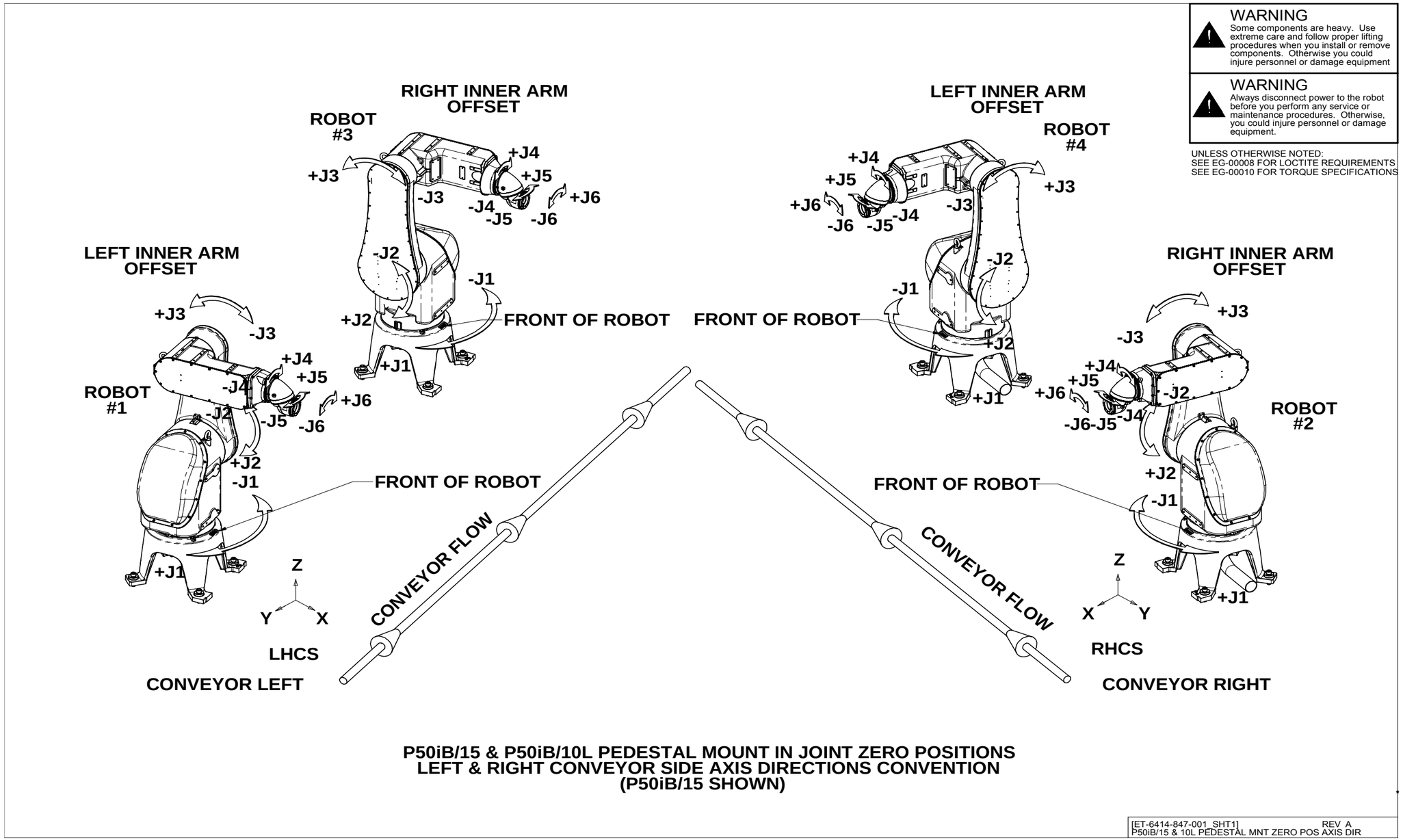


Figure 1-7 ET-6414-847-001_SHT2, P50iB/15 & 10L INVT MNT ZERO POS AXIS DIR

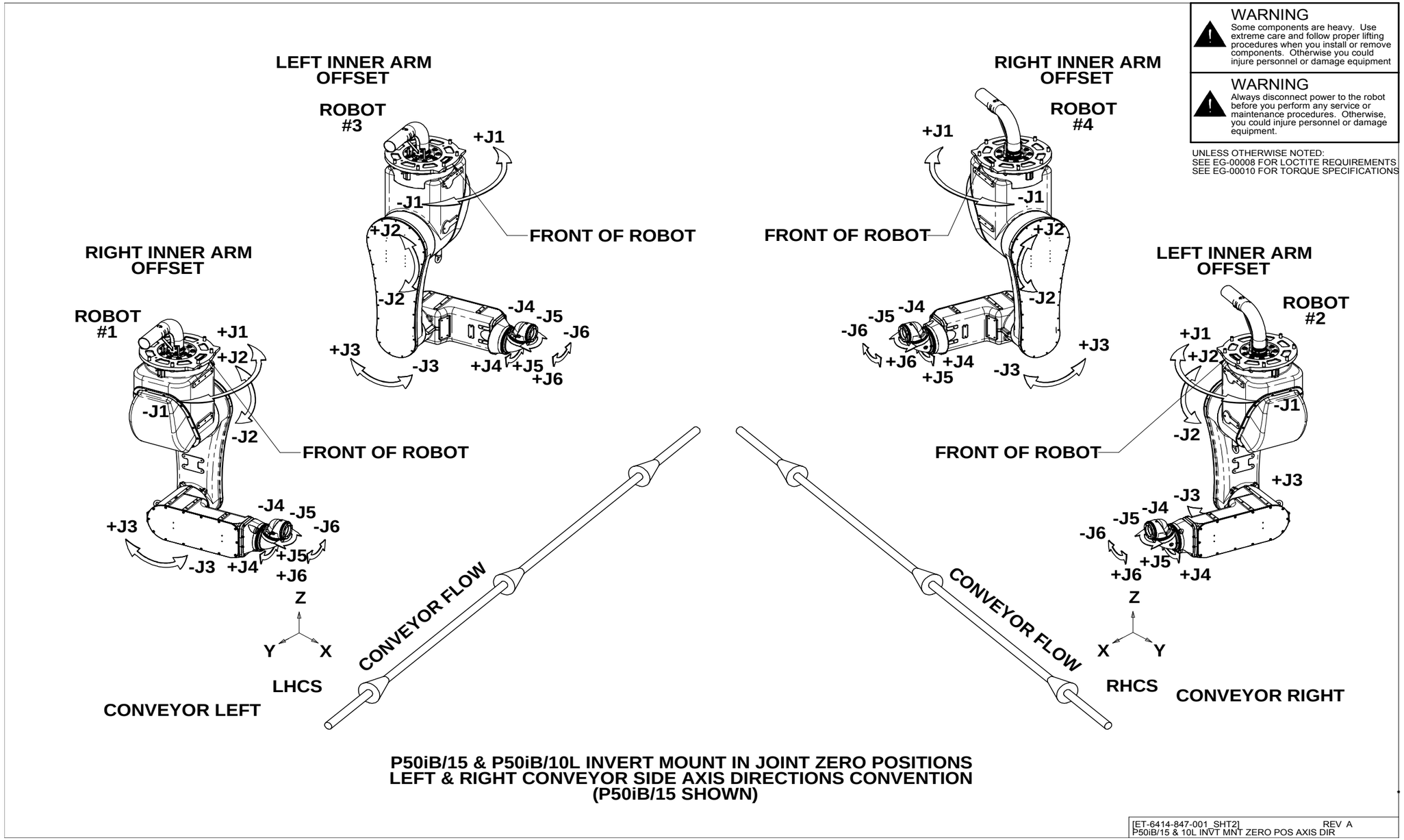


Figure 1-8 ET-6414-847-001 SHT3, P50iB/15 & 10L WALL MNT ZERO POS AXIS DIR

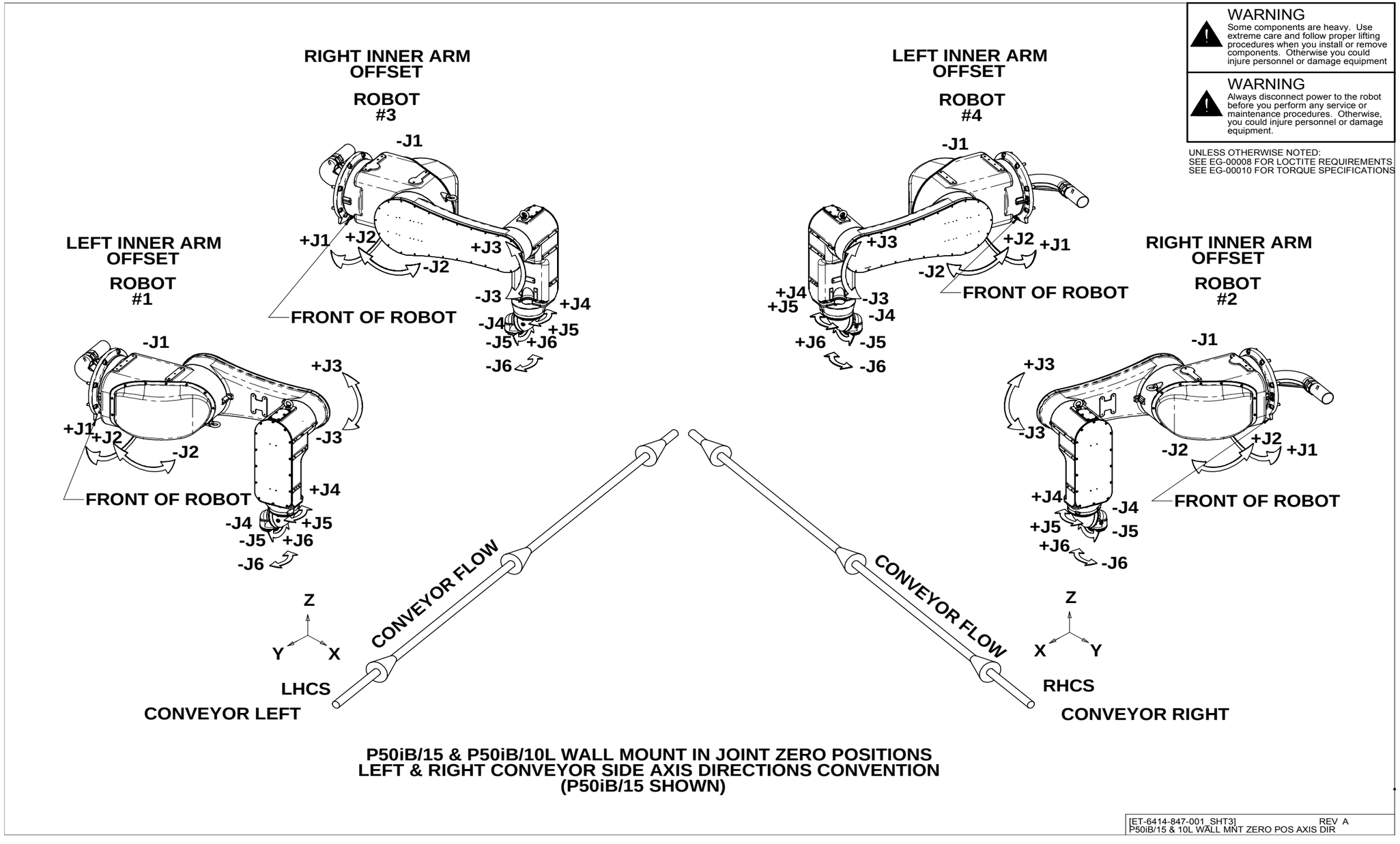


Figure 1-9 ET-6414-847-001 SHT4, P50iB/15 & 10L PARALLEL WALL MNT ZERO POS AXIS DIR

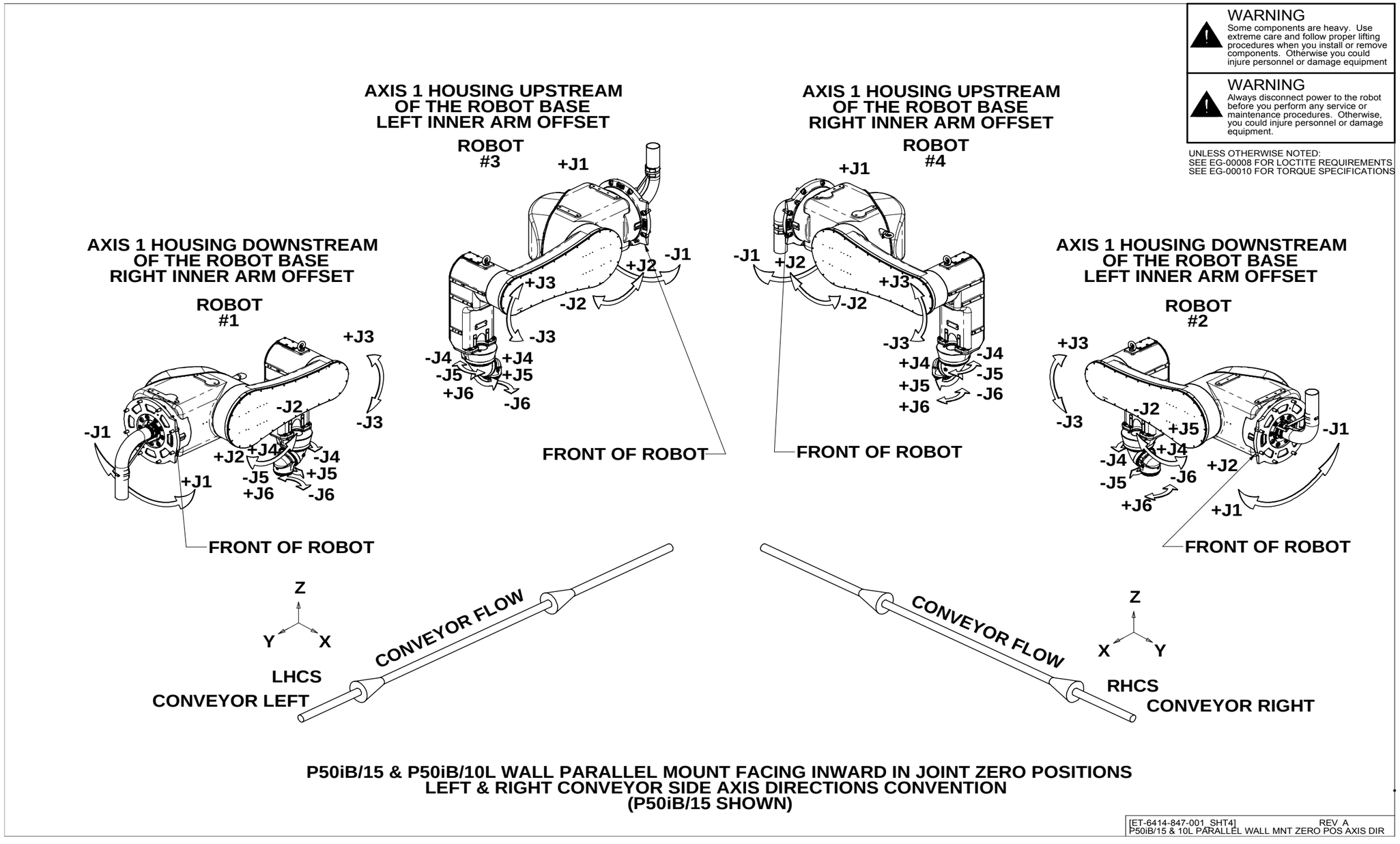
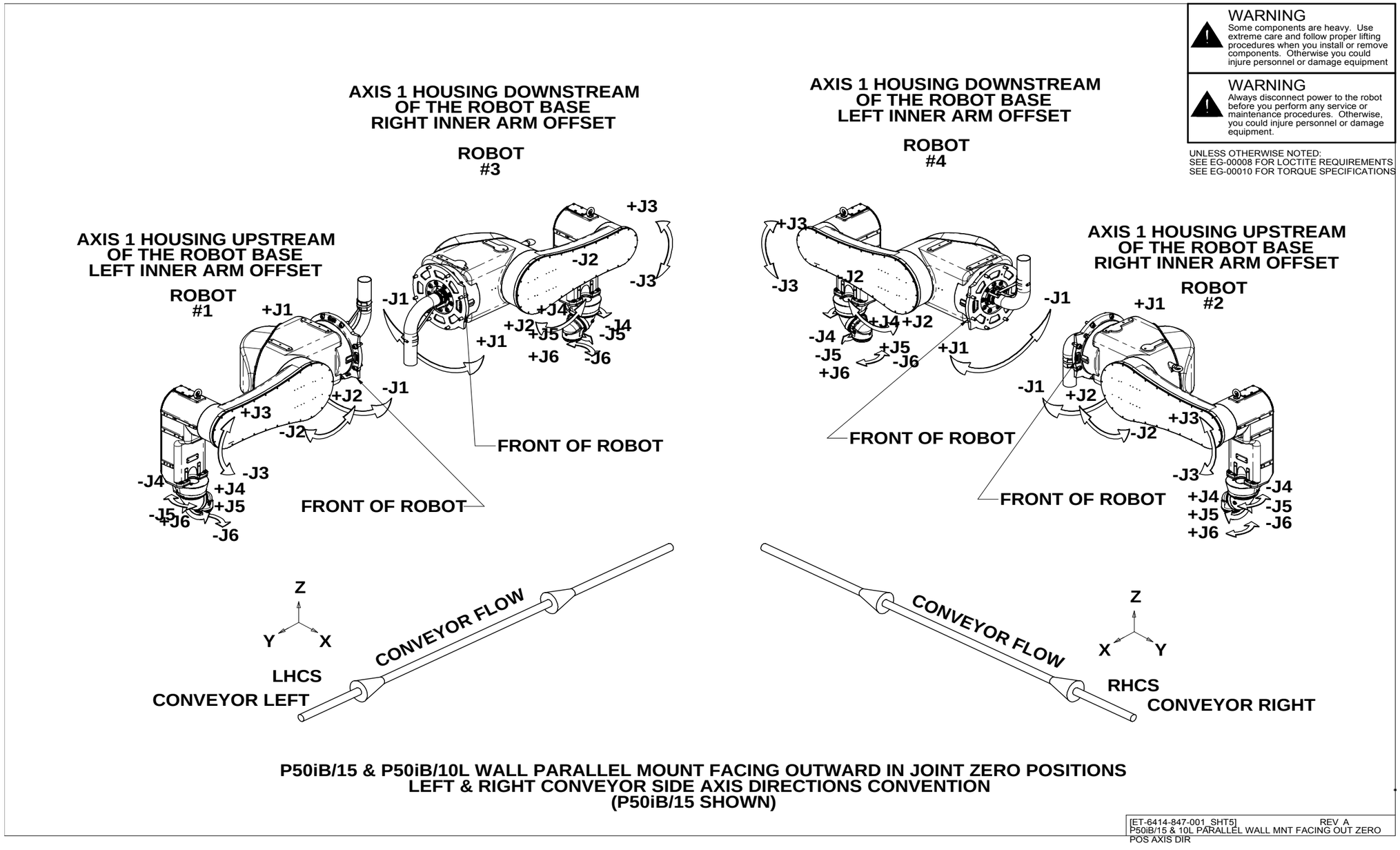
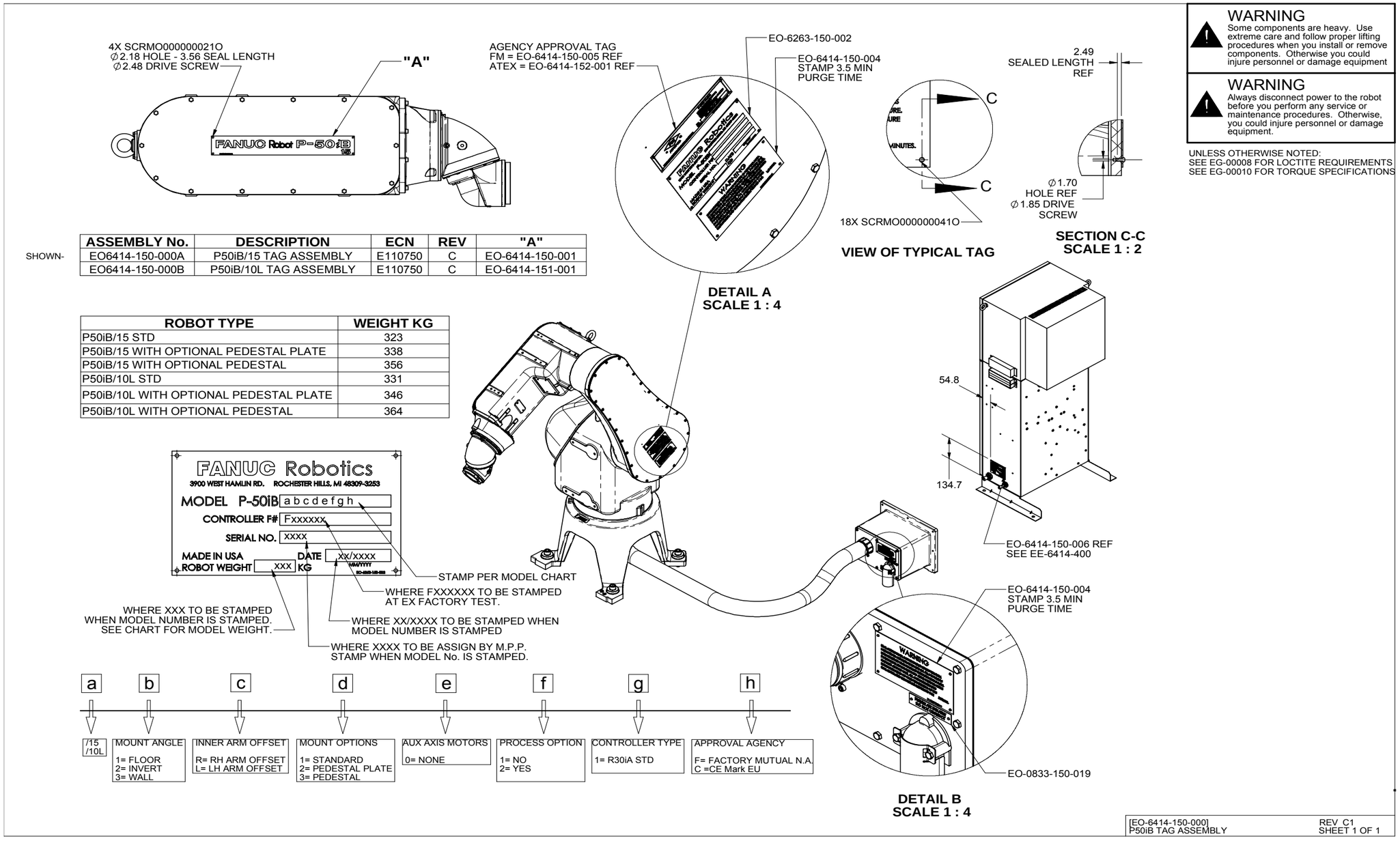


Figure 1-10 ET-6414-847-001 SHT5, P50iB/15 & 10L PARALLEL WALL MNT FACING OUT ZERO POS AXIS DIR



1.2 Robot Identification Tags

Figure 1-11 EO-6414-150-000, P50iB TAG ASSEMBLY



SHOWN-

ASSEMBLY No.	DESCRIPTION	ECN	REV	"A"
EO6414-150-000A	P50iB/15 TAG ASSEMBLY	E110750	C	EO-6414-150-001
EO6414-150-000B	P50iB/10L TAG ASSEMBLY	E110750	C	EO-6414-151-001

ROBOT TYPE	WEIGHT KG
P50iB/15 STD	323
P50iB/15 WITH OPTIONAL PEDESTAL PLATE	338
P50iB/15 WITH OPTIONAL PEDESTAL	356
P50iB/10L STD	331
P50iB/10L WITH OPTIONAL PEDESTAL PLATE	346
P50iB/10L WITH OPTIONAL PEDESTAL	364

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

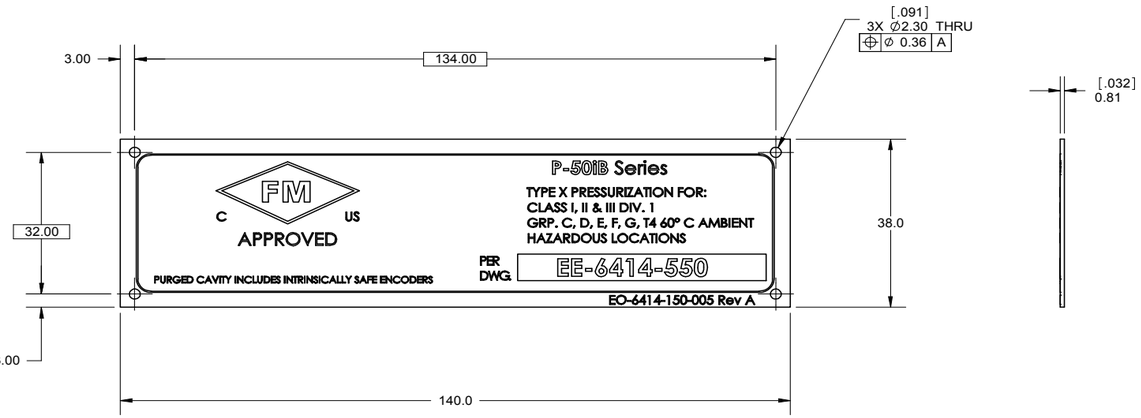
[EO-6414-150-000] REV C1
P50iB TAG ASSEMBLY SHEET 1 OF 1

Figure 1-12 EO-6414-150-005, P50iB FM APPROVAL TAG

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



NOTE:

1. MATERIAL: METAL PHOTO MATTE FINISH
2. COLOR: ALL TEXT BLACK
   BACKGROUND PLAIN
3. NO BATCH CODE OR SERIAL NUMBER REQUIRED

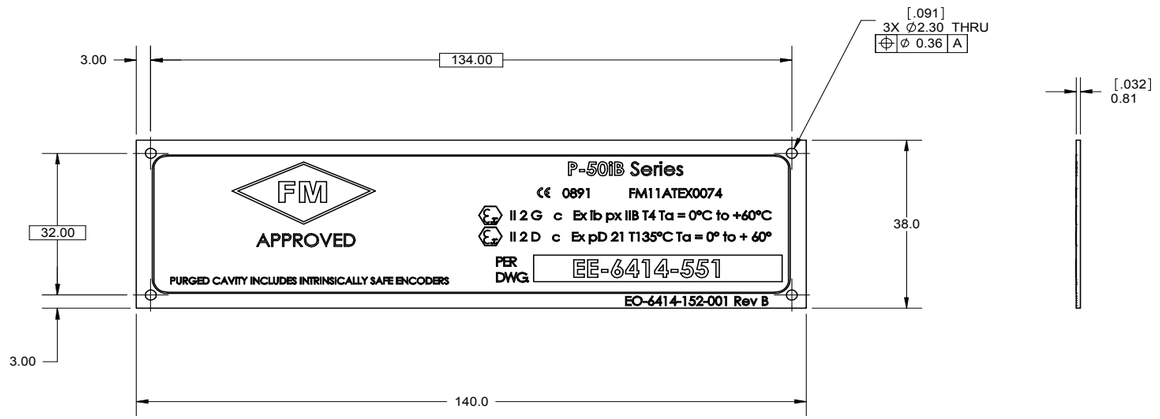
[EO-6414-150-005] P50iB FM APPROVAL TAG	REV A SHEET 1 OF 1

Figure 1-13 EO-6414-152-001, P50iB ATEX APPROVAL TAG

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

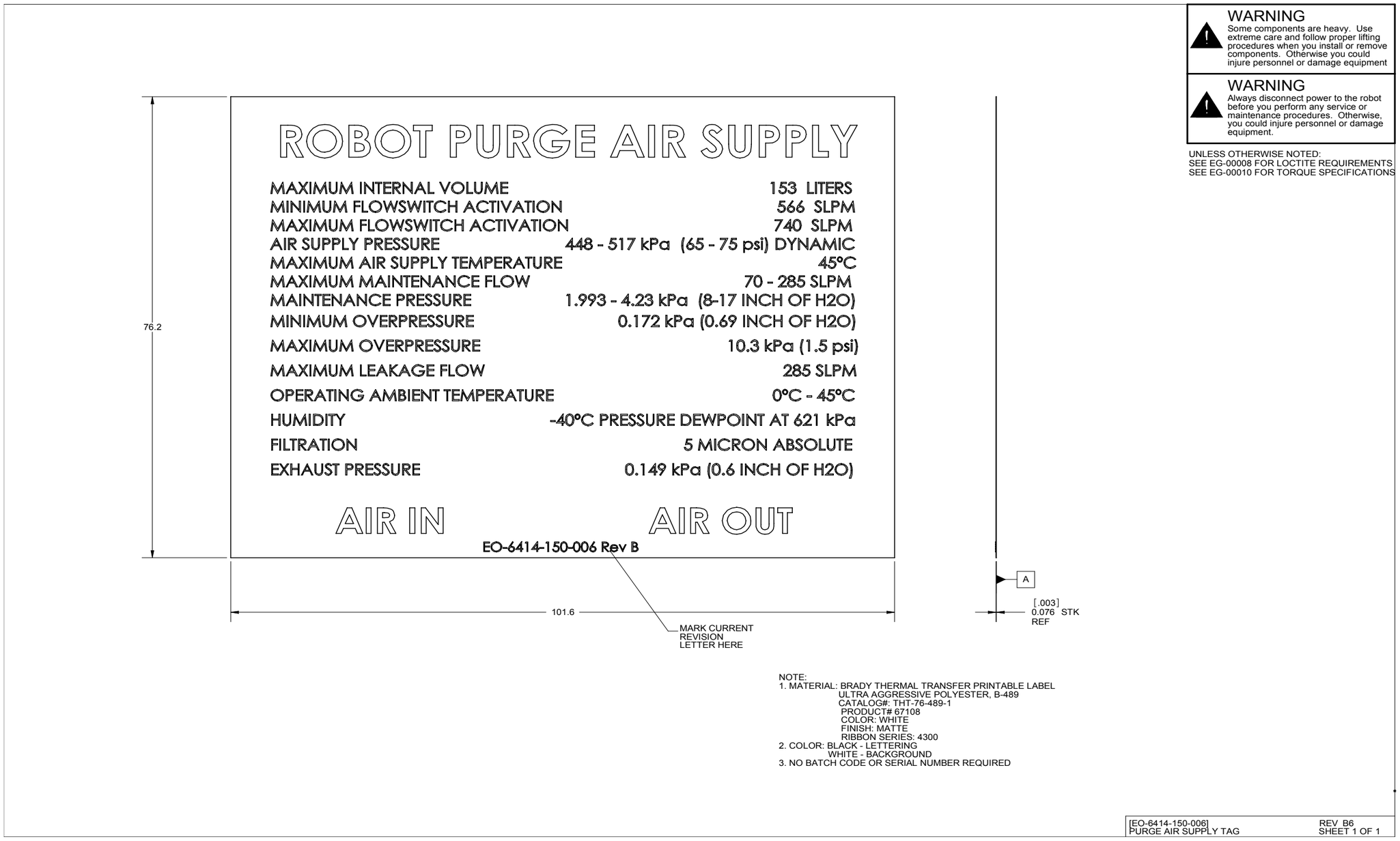


NOTE:

1. MATERIAL: METAL PHOTO MATTE FINISH
2. COLOR: ALL TEXT BLACK
   BACKGROUND PLAIN
3. NO BATCH CODE OR SERIAL NUMBER REQUIRED

[EO-6414-152-001] P50iB ATEX APPROVAL TAG	REV B SHEET 1 OF 1

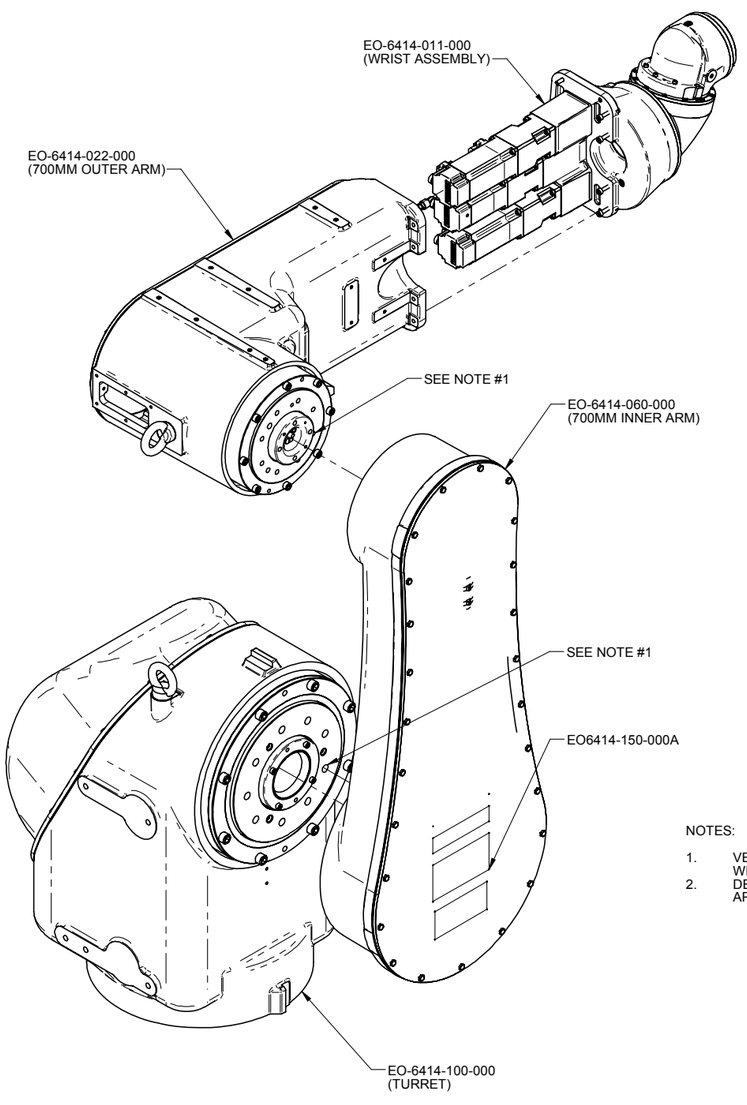
Figure 1-14 EO-6414-150-006, PURGE AIR SUPPLY TAG

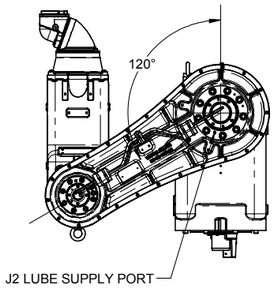


1.3 Major Components and Drive Overview

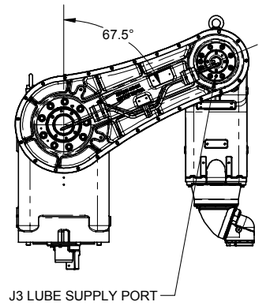
The robot uses both gear trains and RV (rotating vector) reducers. Axes 1, 2 and 3 use an RV reducer that is driven by an intermediate gear. Axes 4, 5 and 6 use planetary reducers with drive shafts and a 140 degree offset wrist.

Figure 1-15 EO-6414-001-000, P50iB/15 CORE ROBOT ASSEMBLY





INNER ARM ORIENTATION REQUIRED FOR J2 LUBRICATION



INNER & OUTER ARM ORIENTATIONS REQUIRED FOR J3 LUBRICATION

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

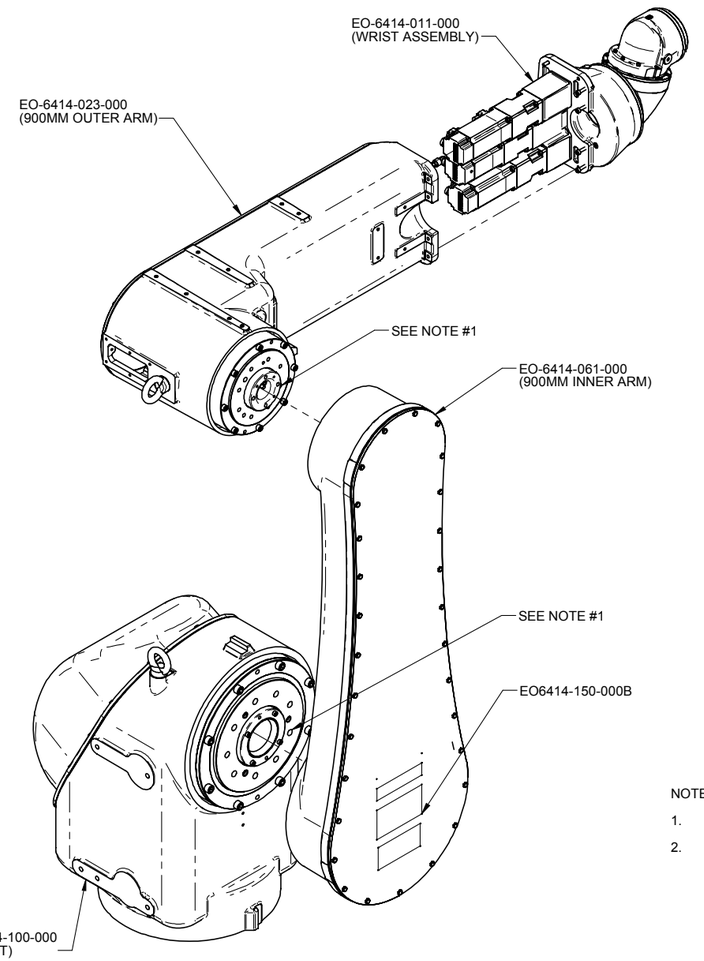
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

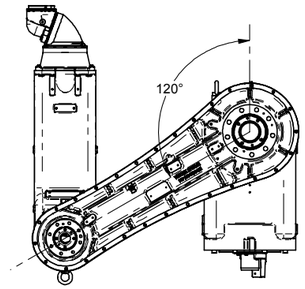
NOTES:

1. VERIFY THAT LUBE HOLES IN AXIS #2 AND #3 RV REDUCERS ARE ALIGNED WITH THE MATING LUBE HOLES IN THE INNER ARM ASSEMBLY.
2. DETERMINE J1 MOUNTING REQUIREMENTS FOR ROBOT. SELECT APPROPRIATE ASSEMBLY BASE TO ASSEMBLY ROBOT ONTO.

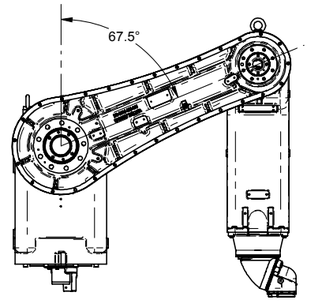
[EO-6414-001-000] P50iB/15 CORE ROBOT ASSEMBLY	REV B SHEET 1 OF 1

Figure 1-16 EO-6414-002-000, P-50iB/10L CORE ROBOT ASSEMBLY





INNER ARM ORIENTATION REQUIRED FOR J2 LUBRICATION



INNER & OUTER ARM ORIENTATIONS REQUIRED FOR J3 LUBRICATION

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
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UNLESS OTHERWISE NOTED:
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SEE EG-00010 FOR TORQUE SPECIFICATIONS

NOTES:

1. VERIFY THAT LUBE HOLES IN AXIS #2 AND #3 RV REDUCERS ARE ALIGNED WITH THE MATING LUBE HOLES IN THE INNER ARM ASSEMBLY.
2. DETERMINE J1 MOUNTING REQUIREMENTS FOR ROBOT. SELECT APPROPRIATE ASSEMBLY BASE TO ASSEMBLY ROBOT ONTO.

[EO-6414-002-000] P-50iB/10L CORE ROBOT ASSEMBLY	REV B SHEET 1 OF 1

2 BASIC SPECIFICATIONS

2.1 P-50iB Robot Work Envelope

Figure 2-1 ET-6414-801-001_SHT1, P-50iB/15 UNRESTRICTED WORK ENVELOPE - FLOOR MNT

P-50iB/15 E-Stop Time & Distance						
	J1	J2	J3	J4	J5	J6
E-Stop Distance (degree)	13.3471	13.4502	27.5879	12.3673	27.7770	16.8450
E-Stop Time (sec)	0.28	0.28	0.348	0.168	0.248	0.192

	DEFAULT JOINT ANGLE SOFTWARE LIMITS		DCS JOINT RANGE (DEG)
JOINT NO.	MAX	MIN	
J1	+160°	-160°	± 162°
J2	+120°	-120°	± 122°
J3	+292°	-112°	+ 294° / - 114°
J4	+540°	-540°	-
J5	+540°	-540°	-
J6	+540°	-540°	-

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WARNING
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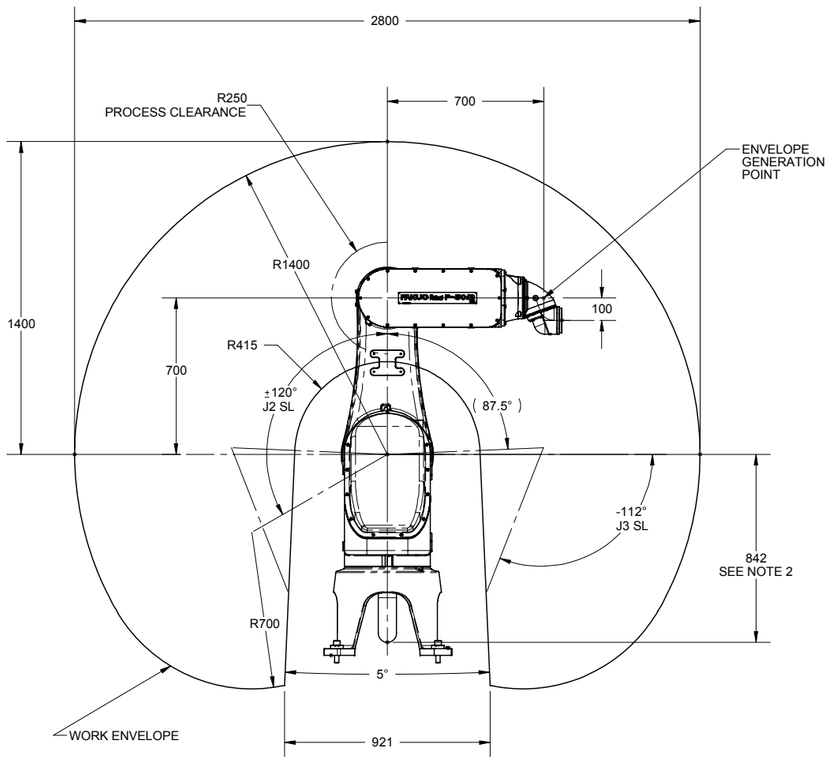
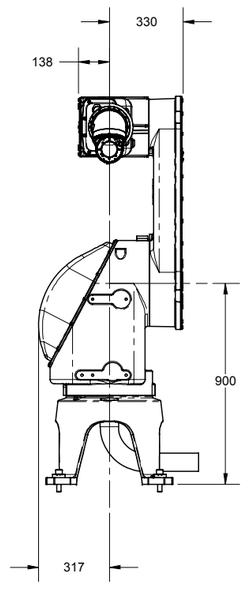
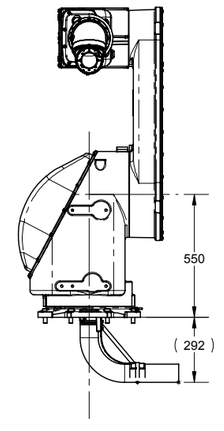
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

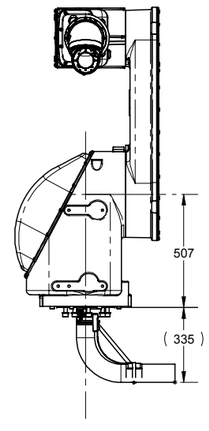


LH INNER ARM OFFSET CONFIGURATION SHOWN





LH INNER ARM OFFSET PEDESTAL PLATE MOUNT CONFIGURATION SHOWN



LH INNER ARM OFFSET STANDARD MOUNT CONFIGURATION SHOWN

NOTES:

1. ROBOT SHOWN WITH OPTIONAL PEDESTAL.
2. FLEX FIELD MIN OPERATION RADIUS MUST NOT BE VIOLATED.

[ET-6414-801-001_SHT1] REV B1
P-50iB/15 UNRESTRICTED WORK ENVELOPE - FLOOR MNT

Figure 2-2 ET-6414-801-001_SHT2, P-50iB/15 UNRESTRICTED WORK ENVELOPE - FLOOR MNT

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
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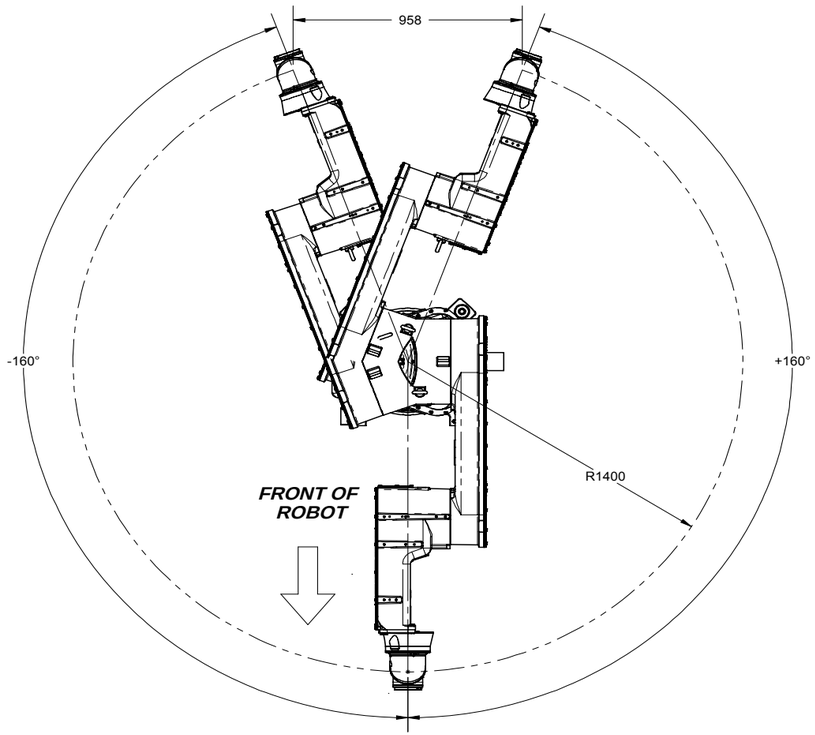
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



LH INNER ARM OFFSET
RH CONVEYOR
CONFIGURATION SHOWN

[ET-6414-801-001_SHT2] REV A
P-50iB/15 UNRESTRICTED WORK ENVELOPE - FLOOR MNT

Figure 2-3 ET-6414-801-002 SHT1, P-50iB/15 RESTRICTED WORK ENVELOPE - FLOOR MNT

P-50iB/15 E-Stop Time & Distance						
	J1	J2	J3	J4	J5	J6
E-Stop Distance (degree)	13.3471	13.4502	27.5879	12.3673	27.7770	16.8450
E-Stop Time (sec)	0.28	0.28	0.348	0.168	0.248	0.192

	DEFAULT JOINT ANGLE SOFTWARE LIMITS FOR RESTRICTED ENVELOPE		DCS JOINT RANGE (DEG)
JOINT NO.	MAX	MIN	
J1	+105°	-105°	± 107°
J2	+120°	-40°	+ 122° / - 42°
J3	+90°	-112°	+ 92° / - 114°
J4	+540°	-540°	-
J5	+540°	-540°	-
J6	+540°	-540°	-

WARNING
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WARNING
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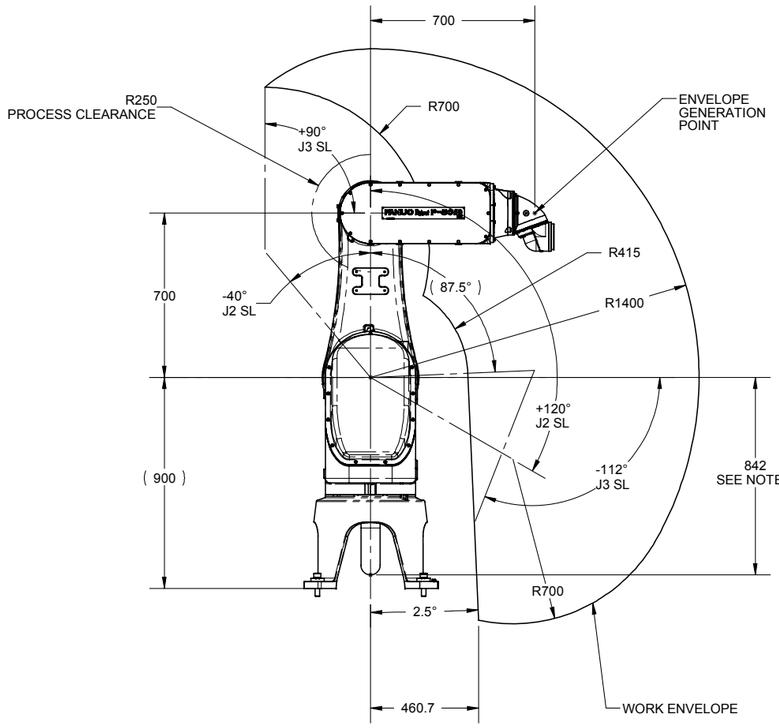
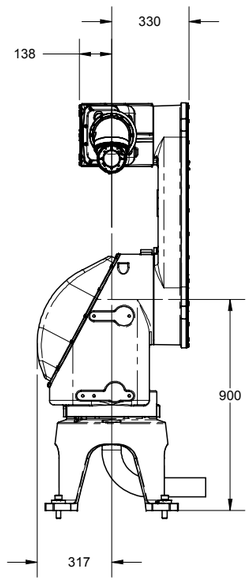
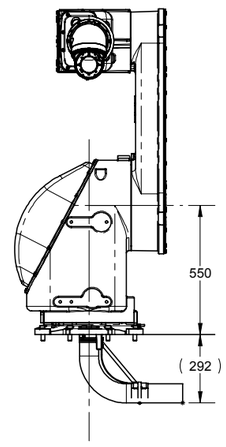
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

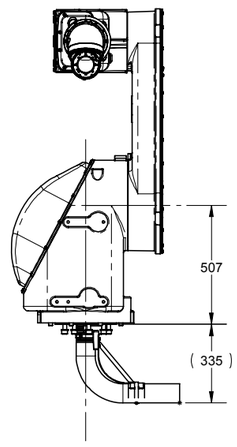


LH INNER ARM OFFSET CONFIGURATION SHOWN





LH INNER ARM OFFSET PEDESTAL PLATE MOUNT CONFIGURATION SHOWN



LH INNER ARM OFFSET STANDARD MOUNT CONFIGURATION SHOWN

NOTES:
1. ROBOT SHOWN WITH OPTIONAL PEDESTAL.
2. FLEX FIELD MIN OPERATION RADIUS MUST NOT BE VIOLATED.

[ET-6414-801-002_SHT1] REV B1
P-50iB/15 RESTRICTED WORK ENVELOPE - FLOOR MNT

Figure 2-4 ET-6414-801-002_SHT2, P-50iB/15 RESTRICTED WORK ENVELOPE - FLOOR MNT

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
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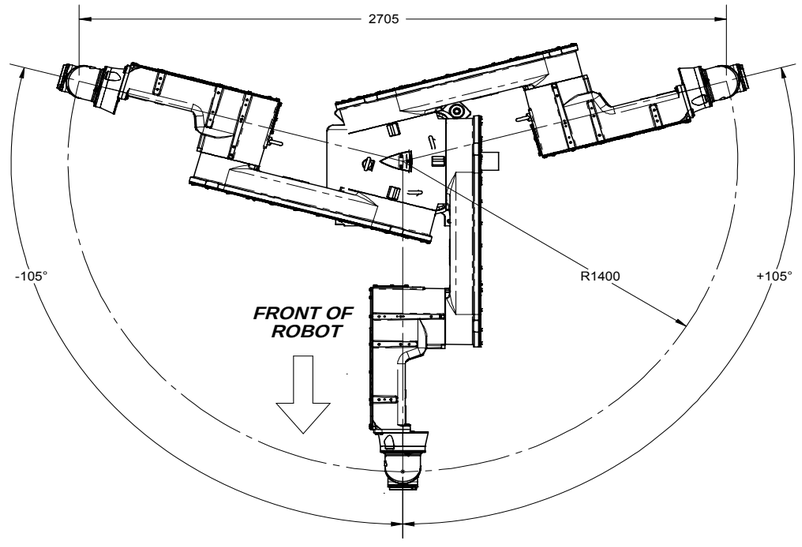
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

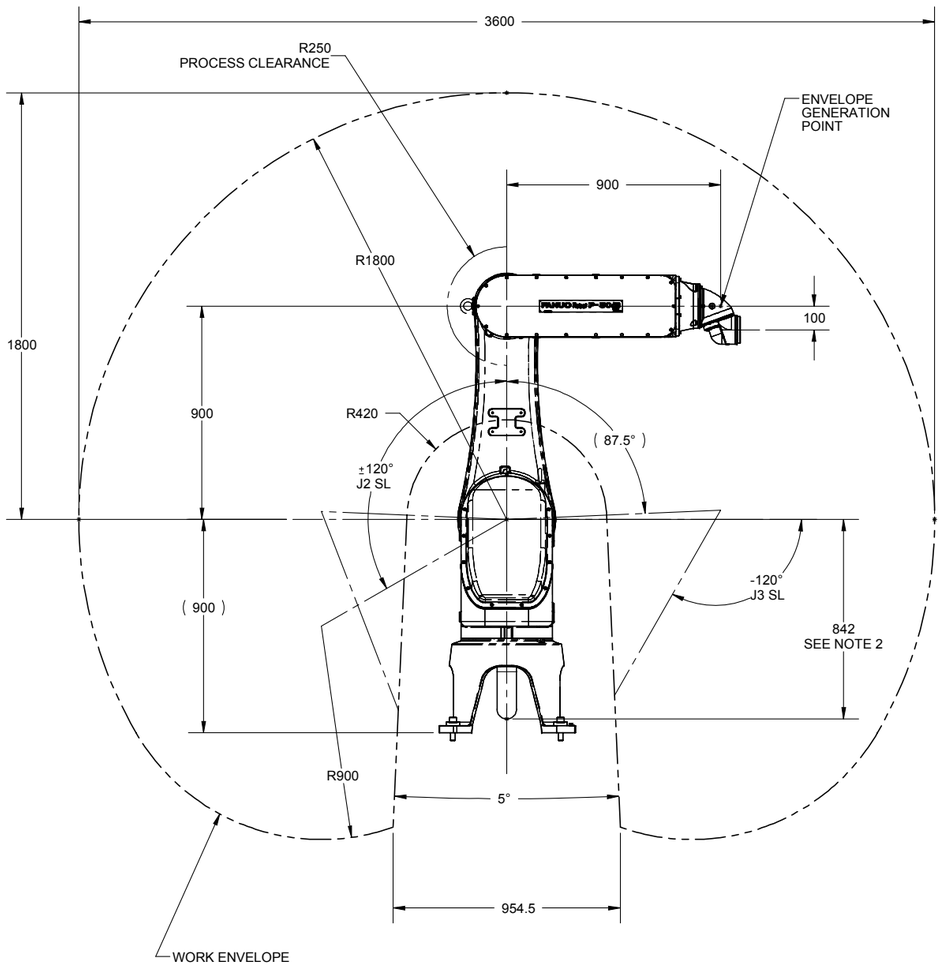


LH INNER ARM OFFSET
RH CONVEYOR
CONFIGURATION SHOWN

[ET-6414-801-002_SHT2] REV A
P-50iB/15 RESTRICTED WORK ENVELOPE - FLOOR MNT

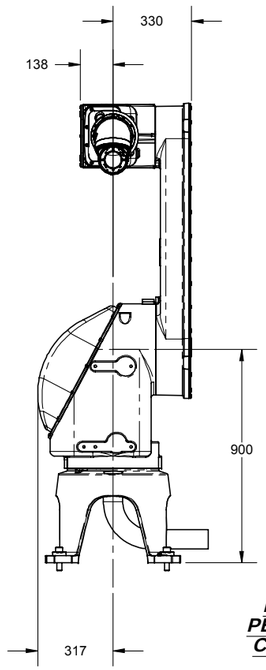
Figure 2-5 ET-6414-804-001_SHT1, P-50iB/10L UNRESTRICTED WORK ENVELOPE - FLOOR MNT

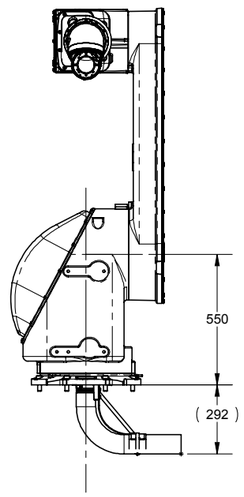
P-50iB/10L E-Stop Time & Distance						
	J1	J2	J3	J4	J5	J6
E-Stop Distance (degree)	11.8516	15.1948	27.4504	12.3673	11.9462	16.1316
E-Stop Time (sec)	0.288	0.32	0.4	0.208	0.184	0.2



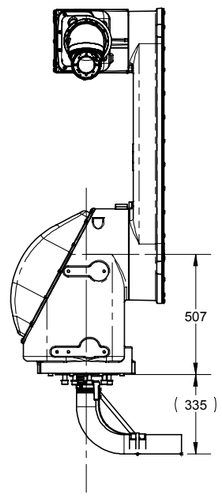
LH INNER ARM OFFSET CONFIGURATION SHOWN

	DEFAULT JOINT ANGLE SOFTWARE LIMITS		DCS JOINT RANGE (DEG)
JOINT NO.	MAX	MIN	
J1	+160°	-160°	± 162°
J2	+120°	-120°	± 122°
J3	+300°	-120°	+ 302° / - 122°
J4	+540°	-540°	-
J5	+540°	-540°	-
J6	+540°	-540°	-





LH INNER ARM OFFSET PEDESTAL PLATE MOUNT CONFIGURATION SHOWN



LH INNER ARM OFFSET STANDARD MOUNT CONFIGURATION SHOWN

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

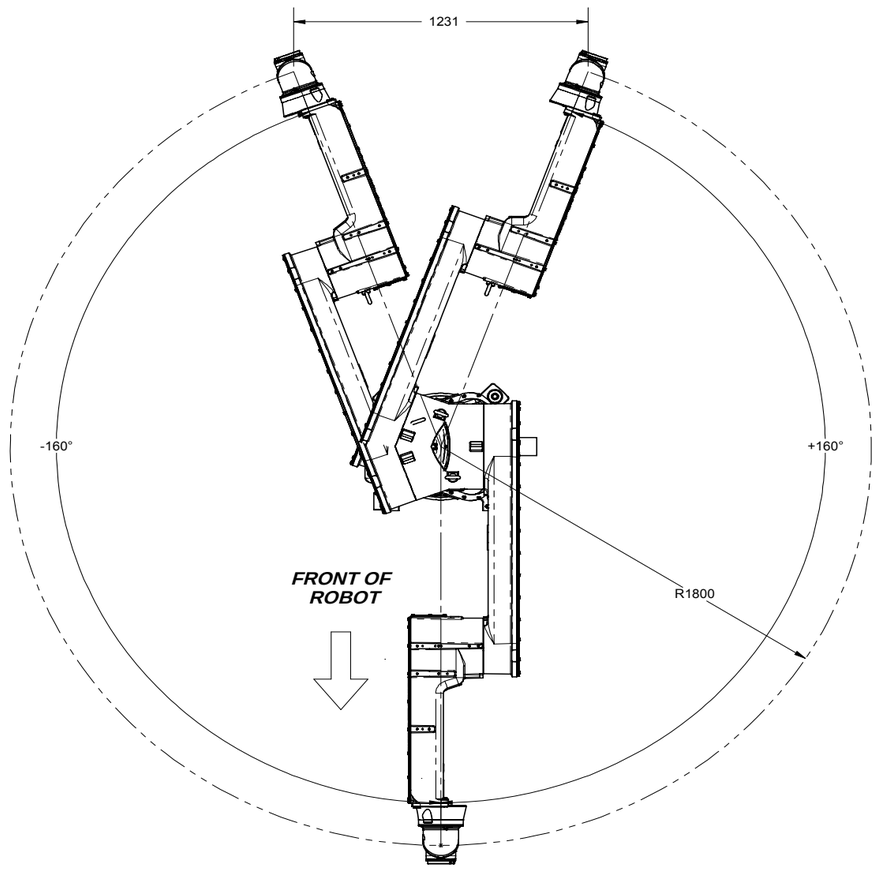
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

NOTES:
1. ROBOT SHOWN WITH OPTIONAL PEDESTAL.
2. FLEX FIELD MIN OPERATION RADIUS MUST NOT BE VIOLATED.

[ET-6414-804-001_SHT1] REV B1
P-50iB/10L UNRESTRICTED WORK ENVELOPE - FLOOR MNT

Figure 2-6 ET-6414-804-001 SHT2, P-50iB/10L UNRESTRICTED WORK ENVELOPE - FLOOR MNT



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WARNING
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UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

LH INNER ARM OFFSET
RH CONVEYOR
CONFIGURATION SHOWN

[ET-6414-804-001 SHT2] REV A
P-50iB/10L UNRESTRICTED WORK ENVELOPE - FLOOR MNT

Figure 2-7 ET-6414-804-002_SHT1, P-50iB/10L RESTRICTED WORK ENVELOPE - FLOOR MNT

P-50iB/10L E-Stop Time & Distance						
	J1	J2	J3	J4	J5	J6
E-Stop Distance (degree)	11.8516	15.1948	27.4504	12.3673	11.9462	16.1316
E-Stop Time (sec)	0.288	0.32	0.4	0.208	0.184	0.2

	DEFAULT JOINT ANGLE SOFTWARE LIMITS FOR RESTRICTED ENVELOPE		DCS JOINT RANGE (DEG)
JOINT NO.	MAX	MIN	
J1	+105°	-105°	± 107°
J2	+120°	-40°	+ 122° / - 42°
J3	+90°	-120°	+ 92° / - 122°
J4	+540°	-540°	-
J5	+540°	-540°	-
J6	+540°	-540°	-

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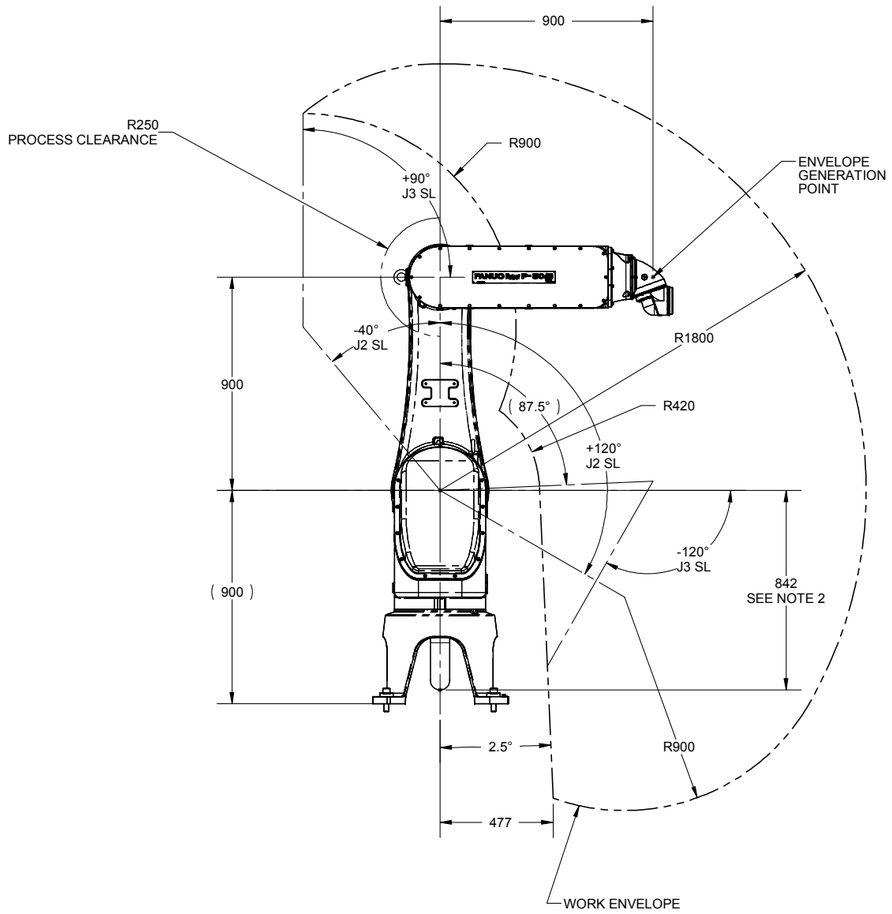
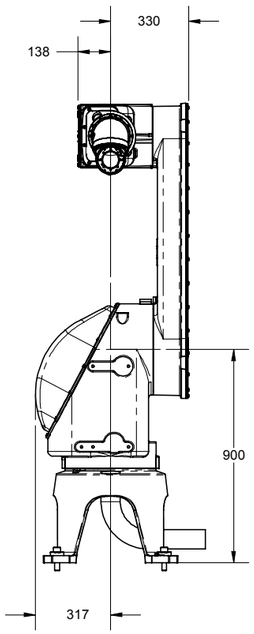
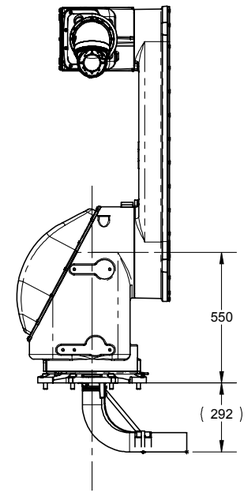
SEE EG-00010 FOR TORQUE SPECIFICATIONS

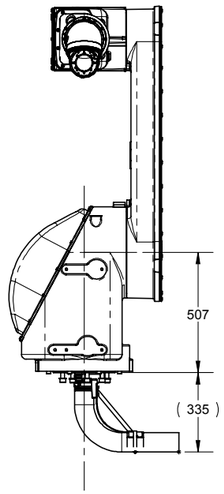


LH INNER ARM OFFSET CONFIGURATION SHOWN





LH INNER ARM OFFSET PEDESTAL PLATE MOUNT CONFIGURATION SHOWN



LH INNER ARM OFFSET STANDARD MOUNT CONFIGURATION SHOWN

NOTES:
1. ROBOT SHOWN WITH OPTIONAL PEDESTAL.
2. FLEX FIELD MIN OPERATION RADIUS MUST NOT BE VIOLATED.

[ET-6414-804-002_SHT1] REV B1
P-50iB/10L RESTRICTED WORK ENVELOPE - FLOOR MNT

Figure 2-8 ET-6414-804-002_SHT2, P-50iB/10L RESTRICTED WORK ENVELOPE - FLOOR MNT

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

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UNLESS OTHERWISE NOTED:
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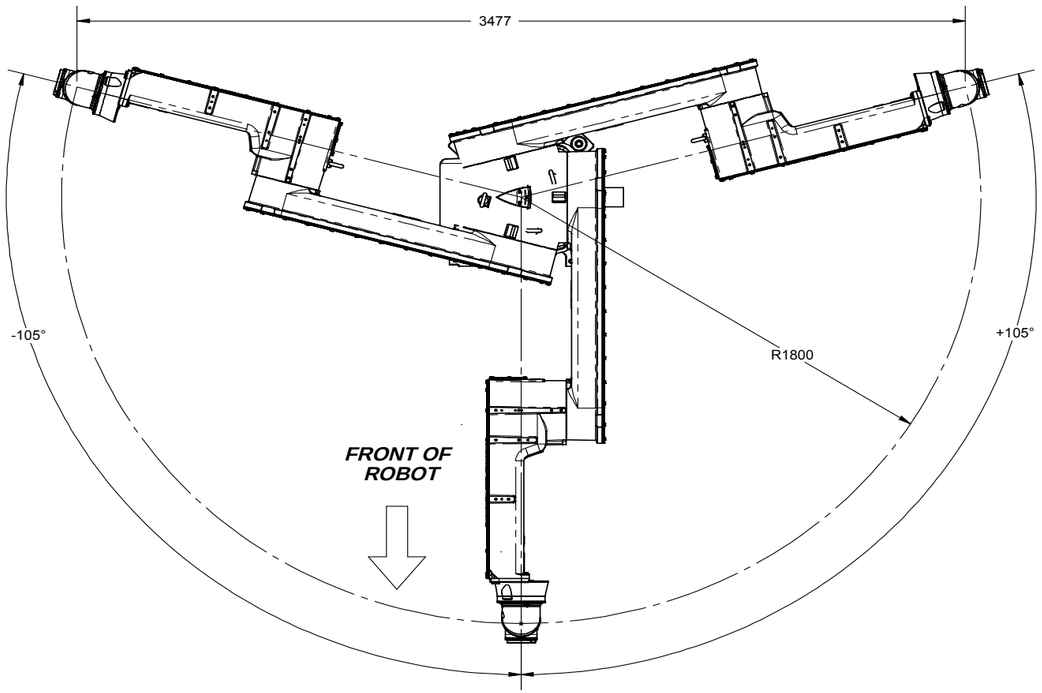
SEE EG-00010 FOR TORQUE SPECIFICATIONS



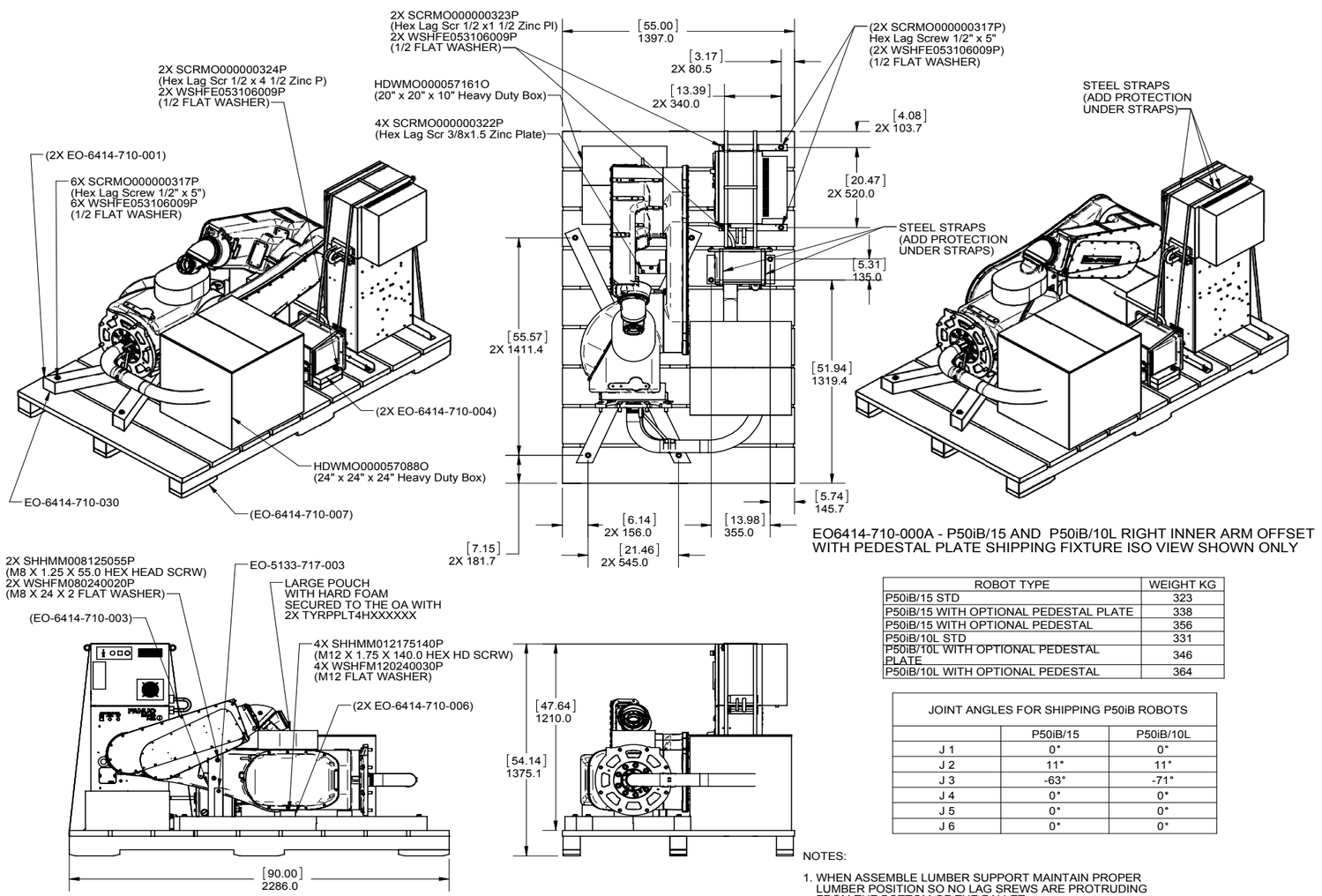
LH INNER ARM OFFSET
RH CONVEYOR
CONFIGURATION SHOWN

[ET-6414-804-002_SHT2] REV A
P-50iB/10L RESTRICTED WORK ENVELOPE - FLOOR MNT

3 TRANSPORTATION AND INSTALLATION

3.1 Shipping and Handling

Figure 3-1 EO-6414-710-000_SHT1, P50iB SHIPPING FIXTURE



EO6414-710-000A - P50iB/15 AND P50iB/10L RIGHT INNER ARM OFFSET WITH PEDESTAL PLATE SHIPPING FIXTURE ISO VIEW SHOWN ONLY

EO6414-710-000A - P50iB/15 AND P50iB/10L LEFT INNER ARM OFFSET WITH PEDESTAL PLATE SHIPPING FIXTURE SHOWN

FANUC ASM NO.	DESCRIPTION	SHIPPING KIT	COMMENTS
EO6414-710-000A	P50iB WITH PEDESTAL PLATE SHIPPING FIXTURE	EO-6414-710-030	SEE SHEET 1
EO6414-710-000B	P50iB WITH CAST PEDESTAL SHIPPING FIXTURE	EO-6414-710-031	SEE SHEET 2

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
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UNLESS OTHERWISE NOTED:
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SEE EG-00010 FOR TORQUE SPECIFICATIONS

ROBOT TYPE	WEIGHT KG
P50iB/15 STD	323
P50iB/15 WITH OPTIONAL PEDESTAL PLATE	338
P50iB/15 WITH OPTIONAL PEDESTAL	356
P50iB/10L STD	331
P50iB/10L WITH OPTIONAL PEDESTAL PLATE	346
P50iB/10L WITH OPTIONAL PEDESTAL	364

JOINT ANGLES FOR SHIPPING P50iB ROBOTS		
	P50iB/15	P50iB/10L
J 1	0°	0°
J 2	11°	11°
J 3	-63°	-71°
J 4	0°	0°
J 5	0°	0°
J 6	0°	0°

NOTES:

1. WHEN ASSEMBLE LUMBER SUPPORT MAINTAIN PROPER LUMBER POSITION SO NO LAG SREWS ARE PROTRUDING FROM THE BOTTOM OF THE PALLET.
2. FOR INTERNATIONAL SHIPPING

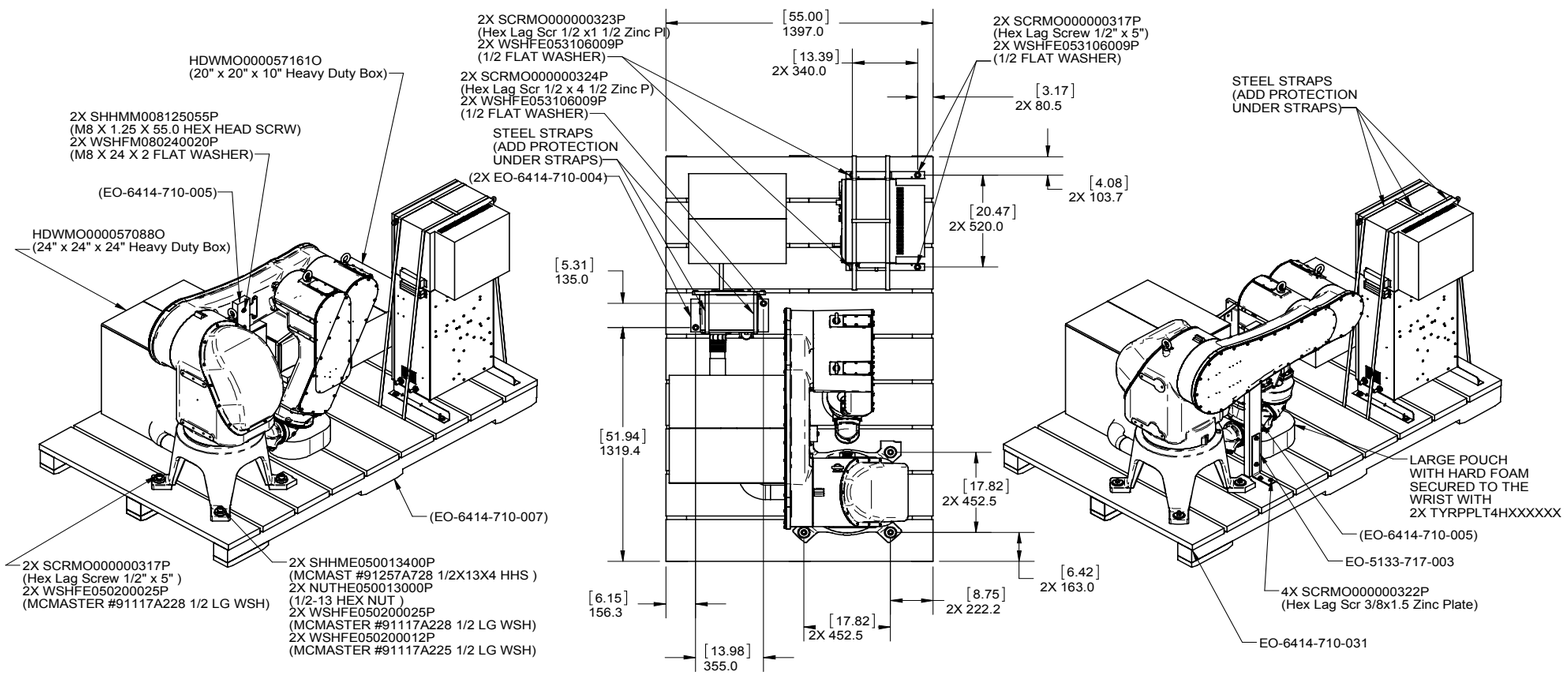
   ALL WOOD MUST BE STERILIZED TO ISPM -15 STANDARD AND DISPLAY THIS STAMP EVERY 2 ft:
3. FOR ROBOTS LIFTING POSITIONS SEE SHEET 3 THRU 9.

I P P C
US - 000
HT

Standard Hardware Descriptions	
FANUC Part No.	Description
SHHMM008125055P	M8 X 1.25 X 55mm LG. Plated Steel Hex Head Machine Screw
SHHMM012175140P	M12 X 1.75 X 140mm LG. Plated Steel Hex Head Machine Screw
WSHFE053106009P	1/2 Plated Steel Flat Washer
WSHFE053106009P)	1/2 Flat Washer
WSHFM080240020P	M8 Plated Steel Flat Washer
WSHFM120240030P	M12 Plated Steel Flat Washer

[EO-6414-710-000_SHT1] REV *7
P50iB SHIPPING FIXTURE

Figure 3-2 EO-6414-710-000 SHT2, P50iB SHIPPING FIXTURE



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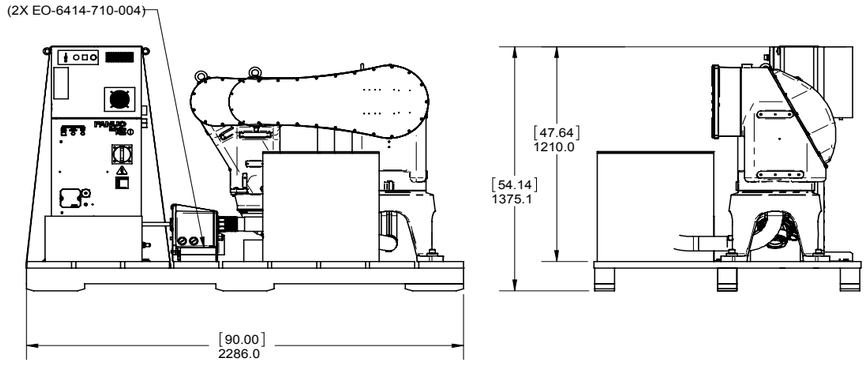
SEE EG-00010 FOR TORQUE SPECIFICATIONS



EO6414-710-000B - P50iB/15 AND P50iB/10L LEFT INNER ARM OFFSET WITH CAST PEDESTAL SHIPPING FIXTURE SHOWN

EO6414-710-000B - P50iB/15 AND P50iB/10L RIGHT INNER ARM OFFSET WITH CAST PEDESTAL SHIPPING FIXTURE ISO VIEW SHOWN ONLY

JOINT ANGLES FOR SHIPPING P50iB ROBOTS		
	P50iB/15	P50iB/10L
J 1	0°	0°
J 2	90°	90°
J 3	-90°	-120°
J 4	0°	0°
J 5	0°	0°
J 6	0°	0°

NOTES:

1. WHEN ASSEMBLE LUMBER SUPPORT MAINTAIN PROPER LUMBER POSITION SO NO LAG SREWS ARE PROTRUDING FROM THE BOTTOM OF THE PALLET.
2. FOR INTERNATIONAL SHIPPING

   ALL WOOD MUST BE STERILIZED TO ISPM -15 STANDARD AND DISPLAY THIS STAMP EVERY 2 ft:
3. FOR ROBOTS LIFTING POSITIONS SEE SHEET 3 THRU 9

IPPC US - 000 HT

Standard Hardware Descriptions	
FANUC Part No.	Description
NUTHE050013000P	1/2-13 Plated Steel Hex Nut
SHHME050013400P	1/2-13 X 4 LG. Plated Steel Hex Head Machine Screw
SHHMM008125055P	M8 X 1.25 X 55mm LG. Plated Steel Hex Head Machine Screw.
WSHFE050200012P	1/2 Plated Steel Flat Washer
WSHFE050200025P	1/2 Plated Steel Flat Washer
WSHFE053106009P	1/2 Plated Steel Flat Washer
WSHFM080240020P	M8 Plated Steel Flat Washer

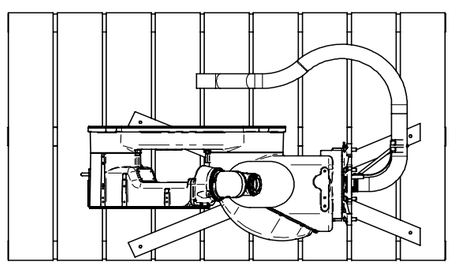
[EO-6414-710-000 SHT2] REV *7
P50iB SHIPPING FIXTURE

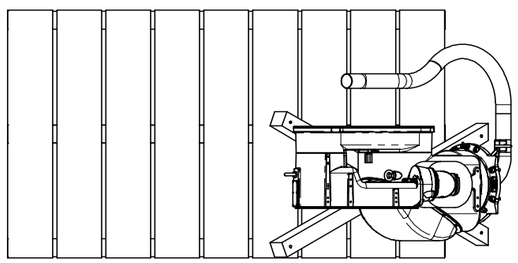
Figure 3-3 EO-6414-710-000 SHT3, P50iB SHIPPING FIXTURE

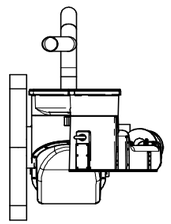
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

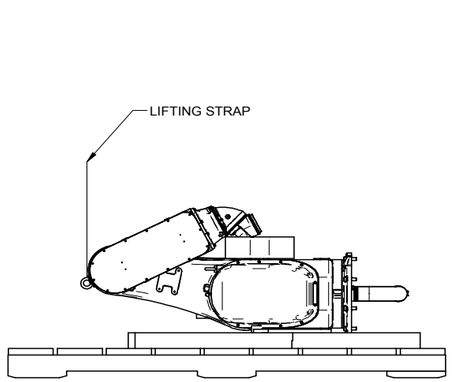
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

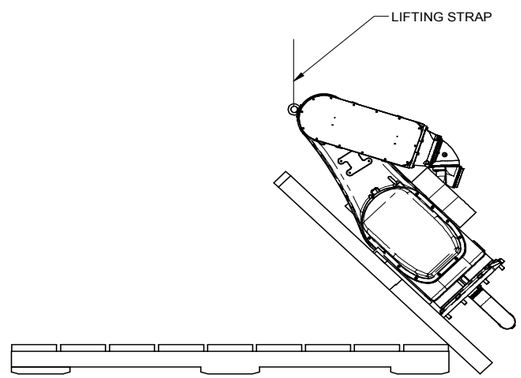




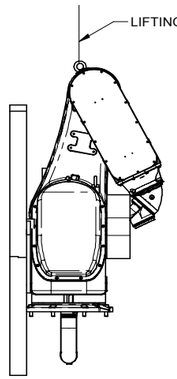




STAGE 1
ROBOT ON THE PALLET



STAGE 2
ROBOT LIFTED FROM THE PALLET

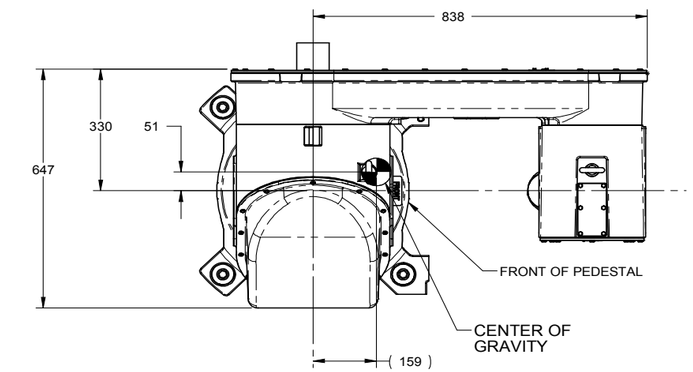


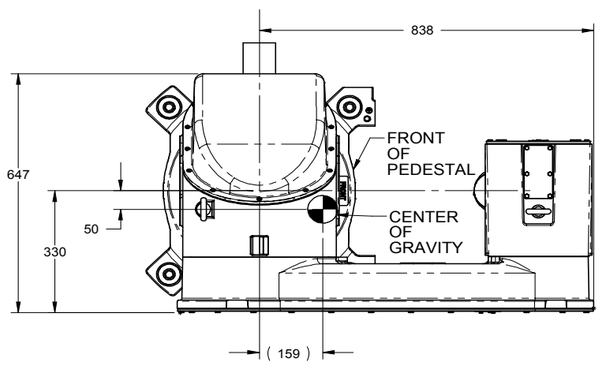
STAGE 3
ROBOT IN VERTICAL POSITION

P50iB/15 AND P50iB/10L STDANDARD & PEDESTAL PLATE MOUNT LIFTING POSITIONS
(P50iB/15 LEFT INNER ARM OFFSET ROBOT WITH PEDESTAL PLATE SHOWN)

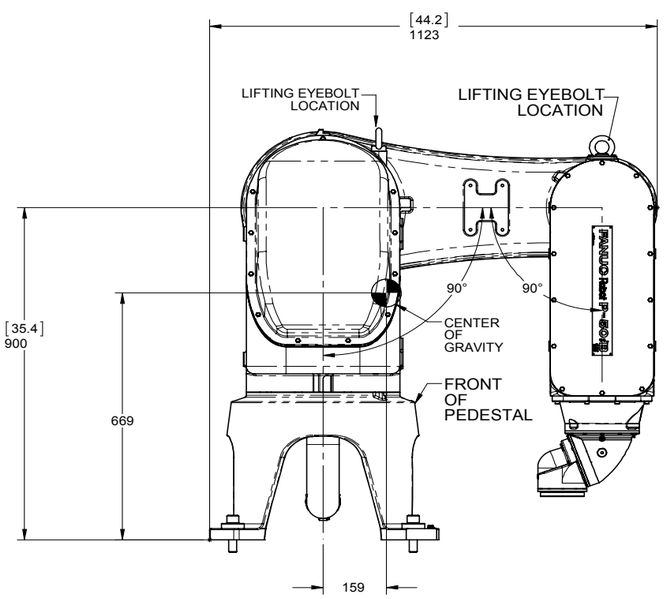
[EO-6414-710-000_SHT3] REV *7
P50iB SHIPPING FIXTURE

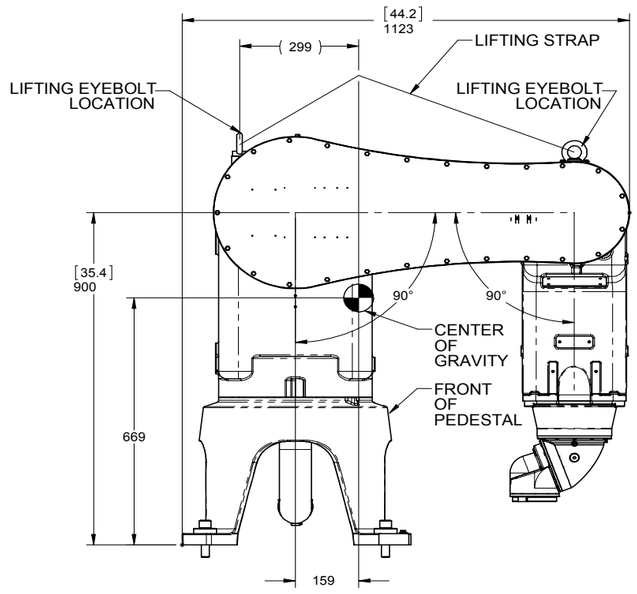
Figure 3-4 EO-6414-710-000 SHT4, P50iB SHIPPING FIXTURE





P-50iB/15 LEFT INNER ARM OFFSET ROBOT





P-50iB/15 RIGHT INNER ARM OFFSET ROBOT

P-50iB/15 WITH CAST RISER LIFTING POSITIONS

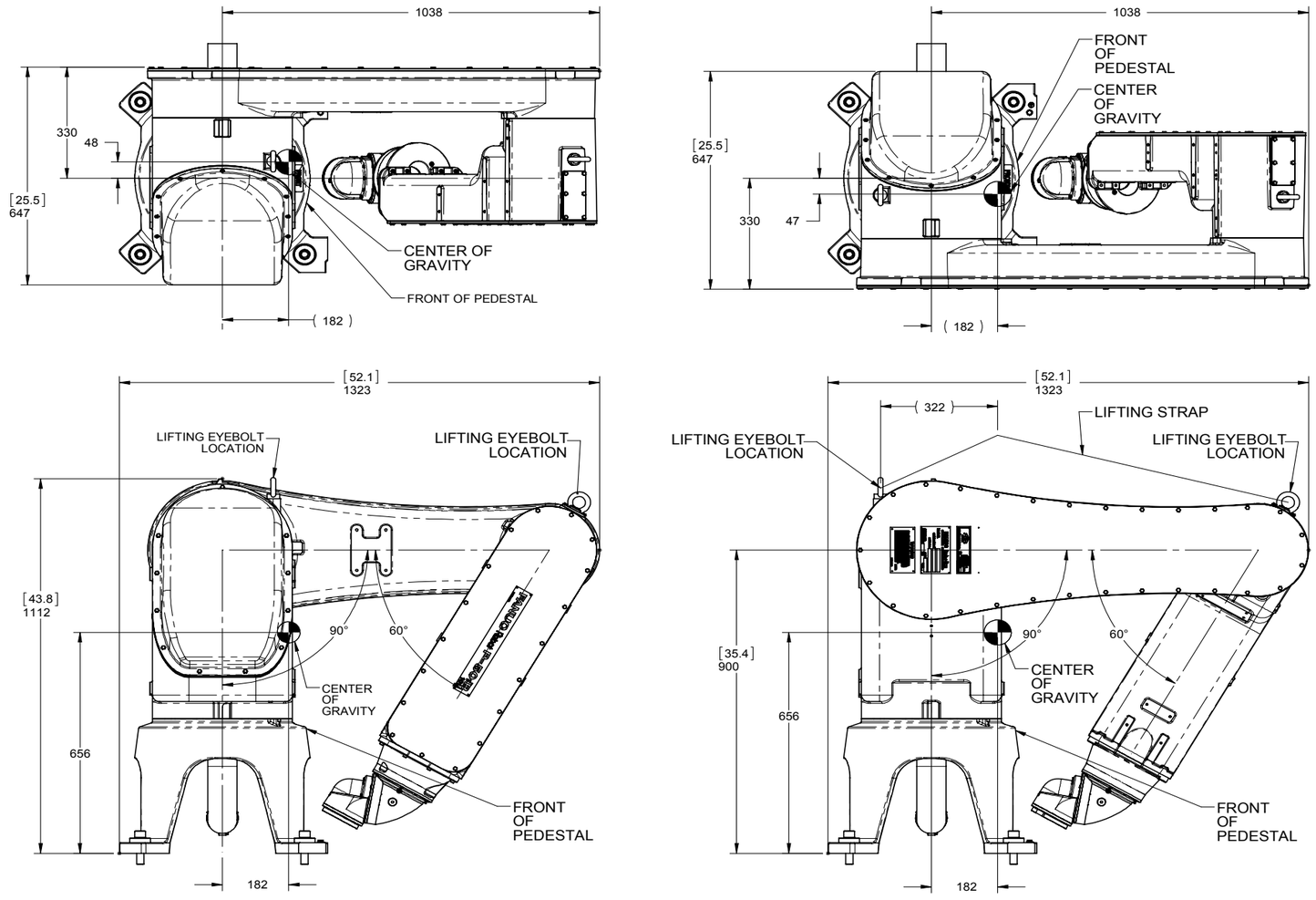
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

[EO-6414-710-000_SHT4] REV *7
P50iB SHIPPING FIXTURE

Figure 3-5 EO-6414-710-000 SHT5, P50iB SHIPPING FIXTURE



P-50iB/10L LEFT INNER ARM OFFSET ROBOT

P-50iB/10L RIGHT INNER ARM OFFSET ROBOT

P-50iB/10L WITH CAST RISER LIFTING POSITIONS

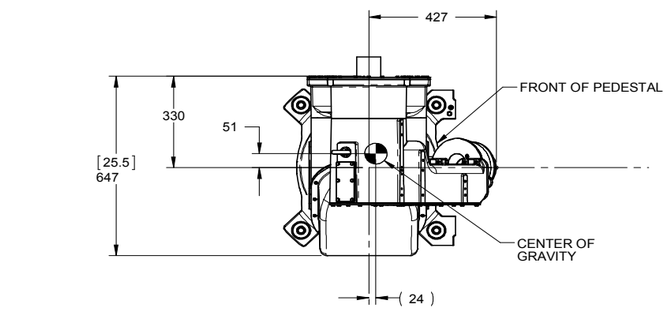
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

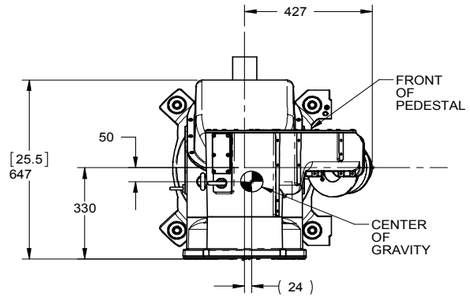
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

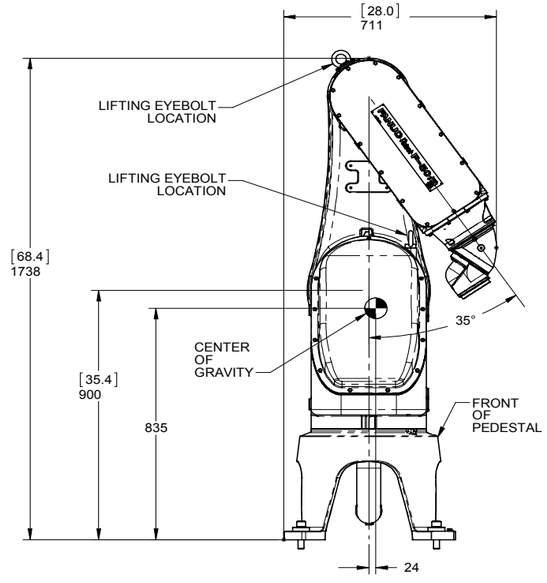
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

[EO-6414-710-000_SHT5] REV *7
P50iB SHIPPING FIXTURE

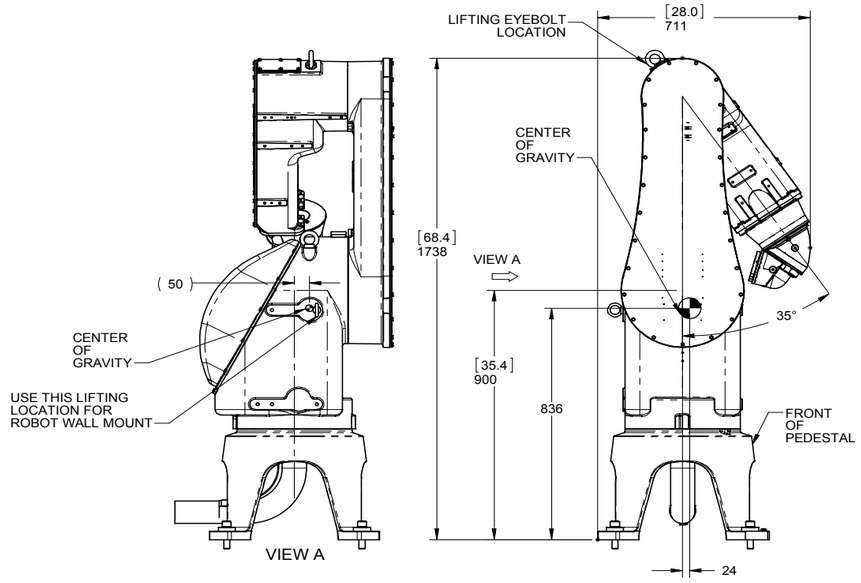
Figure 3-6 EO-6414-710-000 SHT6, P50iB SHIPPING FIXTURE







P-50iB/15 LEFT INNER ARM OFFSET ROBOT



P-50iB/15 RIGHT INNER ARM OFFSET ROBOT

P-50iB/15 WITH CAST RISER LIFTING POSITIONS

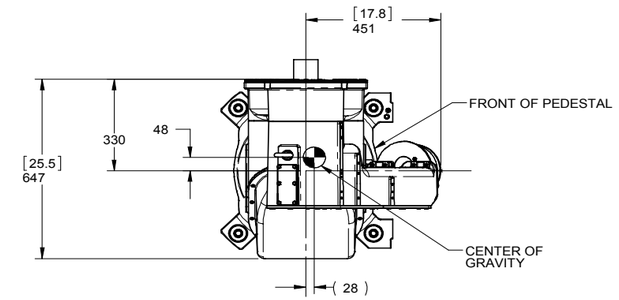
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

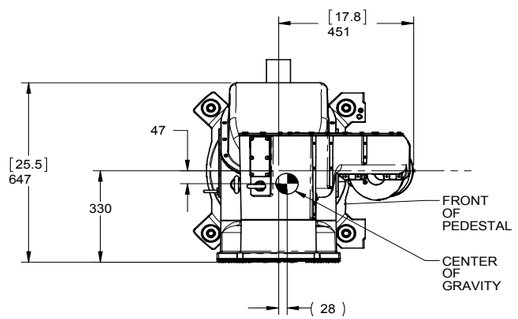
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

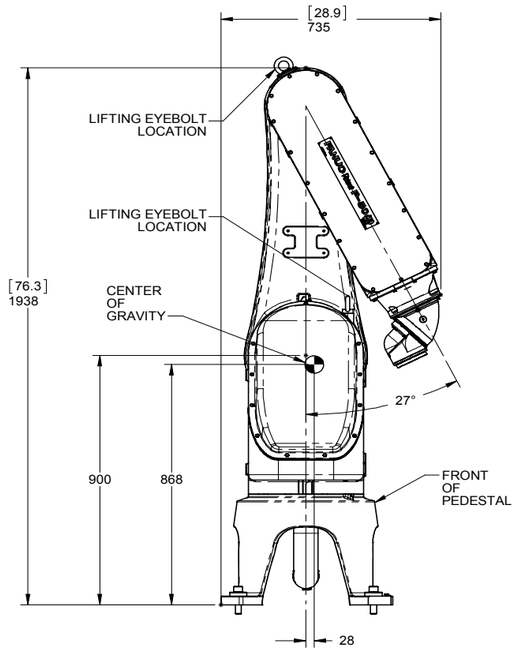
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

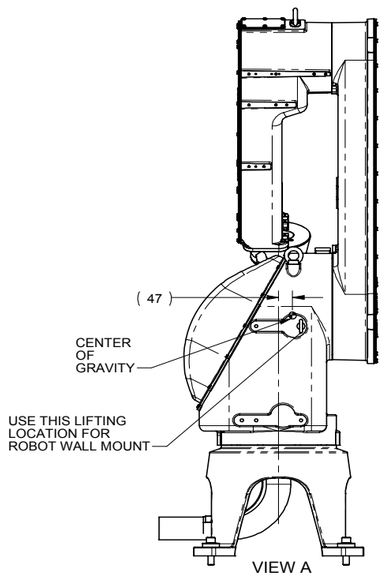
[EO-6414-710-000_SHT6] REV *7
P50iB SHIPPING FIXTURE

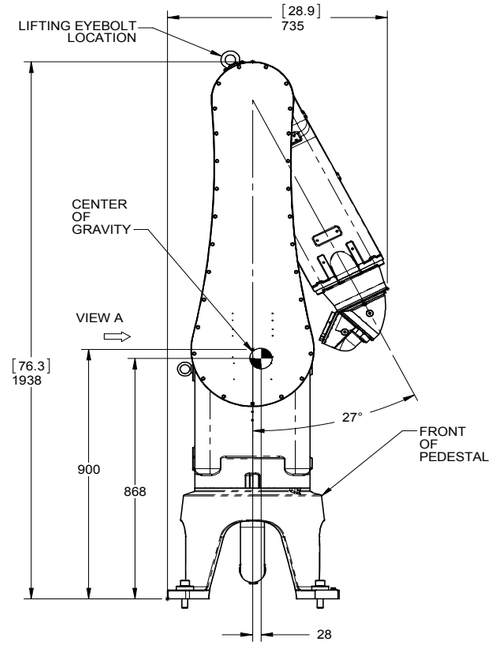
Figure 3-7 EO-6414-710-000 SHT7, P50iB SHIPPING FIXTURE











P-50iB/10L LEFT INNER ARM OFFSET ROBOT

P-50iB/10L RIGHT INNER ARM OFFSET ROBOT

P-50iB/10L WITH CAST RISER LIFTING POSITIONS

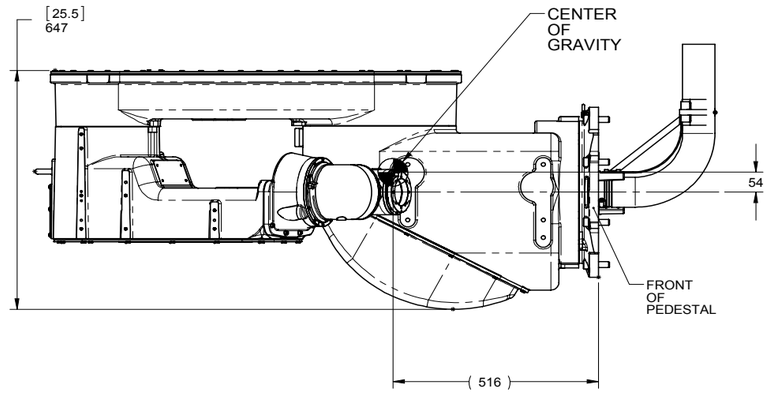
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

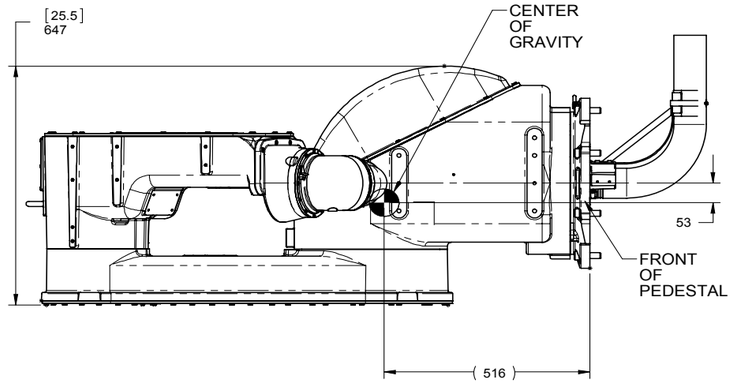
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

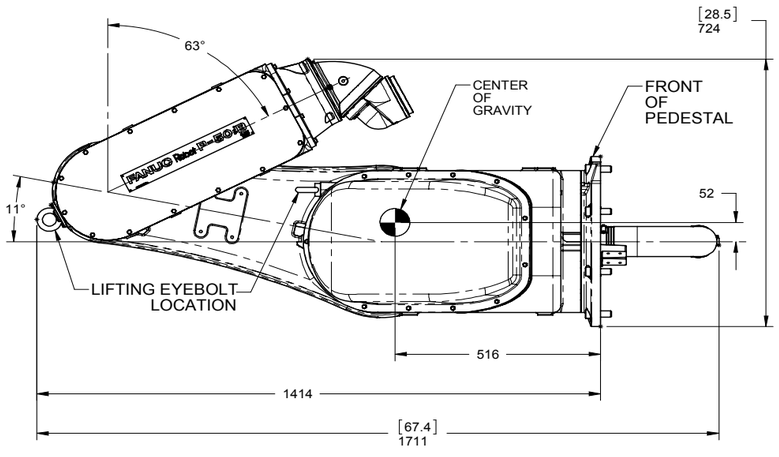
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

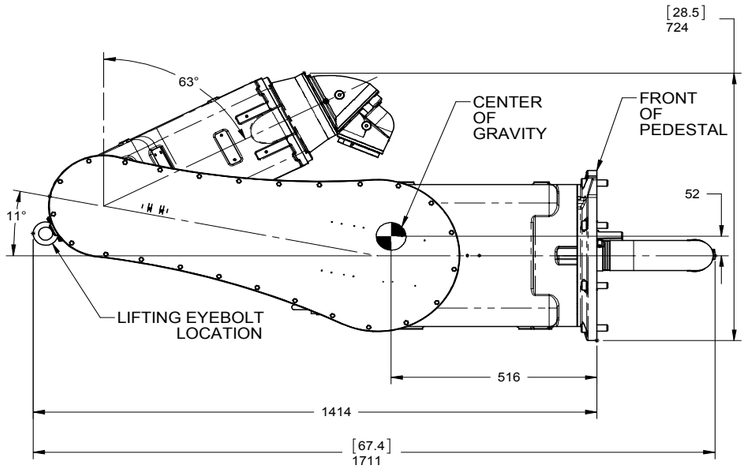
[EO-6414-710-000_SHT7] REV *7
P50iB SHIPPING FIXTURE

Figure 3-8 EO-6414-710-000 SHT8, P50iB SHIPPING FIXTURE









P-50iB/15 LEFT INNER ARM OFFSET ROBOT

P-50iB/15 RIGHT INNER ARM OFFSET ROBOT

P-50iB/15 WITH PEDESTAL PLATE IN SHIPPING POSITIONS LIFTING

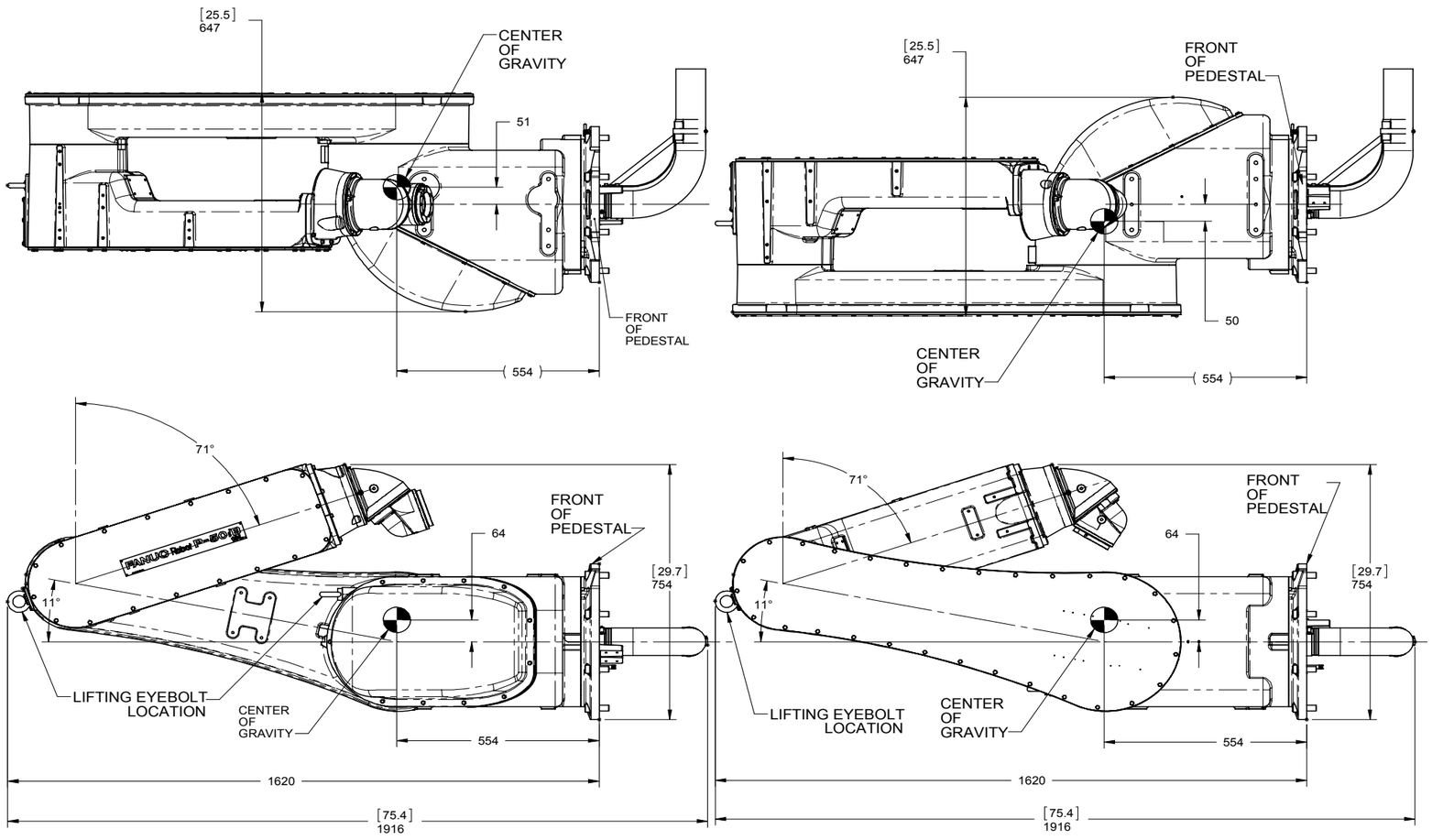
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

[EO-6414-710-000_SHT8] REV *7
P50iB SHIPPING FIXTURE

Figure 3-9 EO-6414-710-000 SHT9, P50iB SHIPPING FIXTURE



WARNING
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WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

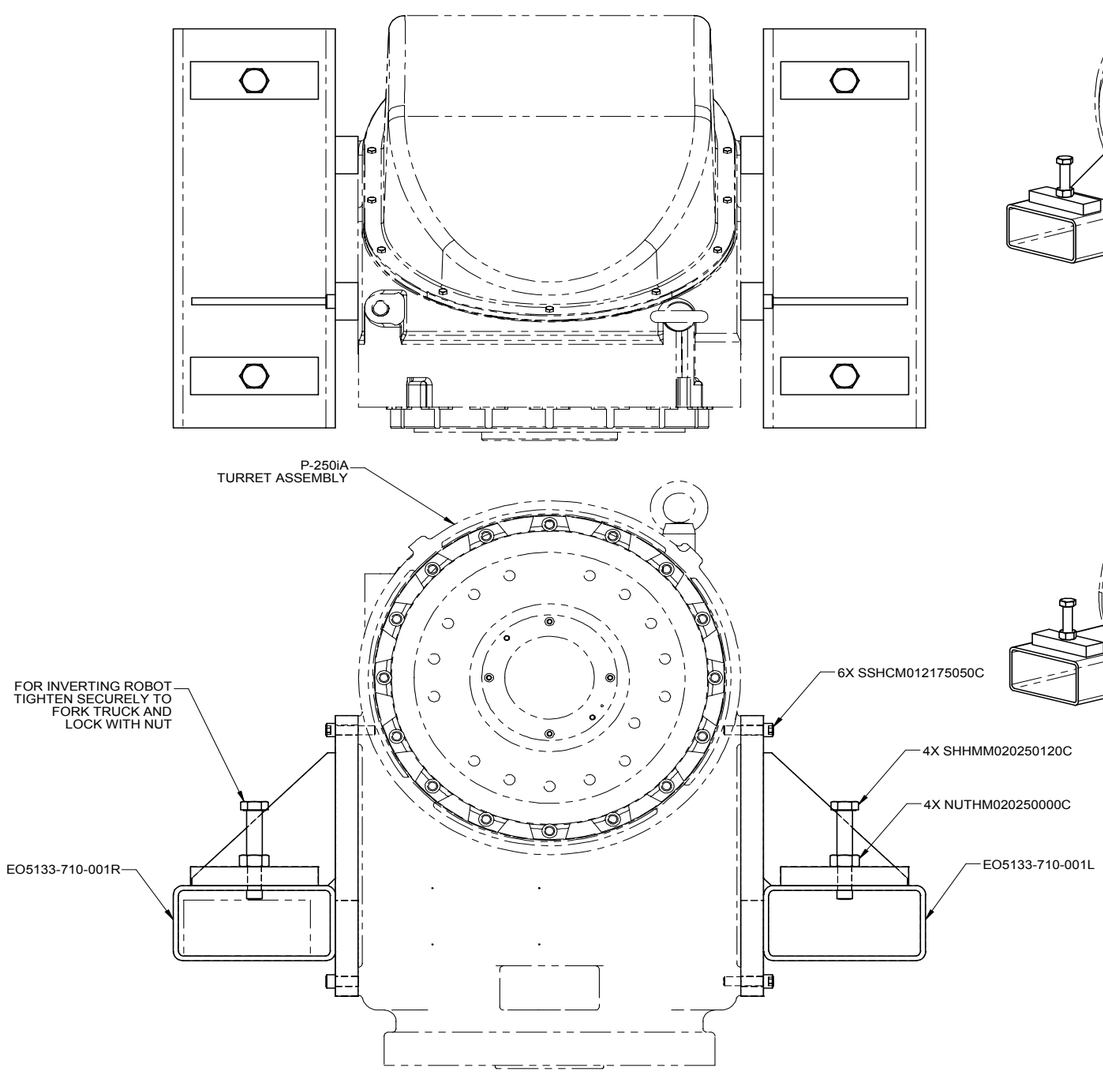
P-50iB/10L LEFT INNER ARM OFFSET ROBOT

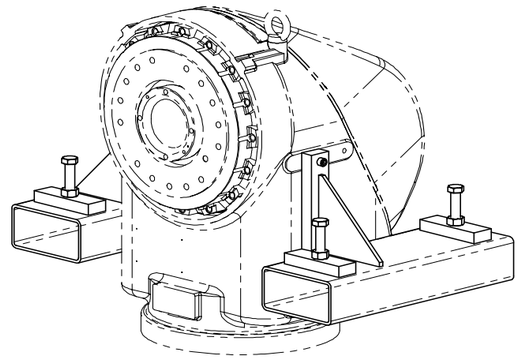
P-50iB/10L RIGHT INNER ARM OFFSET ROBOT

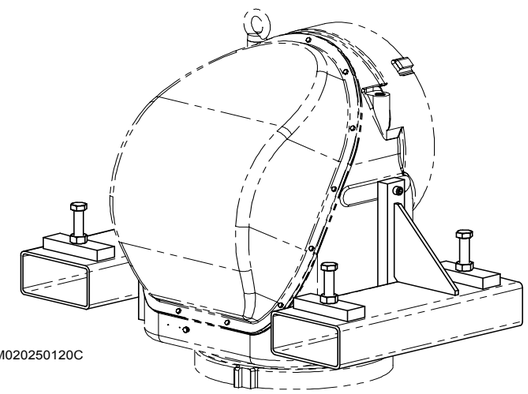
P-50iB/10L WITH PEDESTAL PLATE IN SHIPPING POSITIONS LIFTING

[EO-6414-710-000_SHT9] REV *7
P50iB SHIPPING FIXTURE

Figure 3-10 EO-5133-710-000, FORK POCKET ASSEMBLY







WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

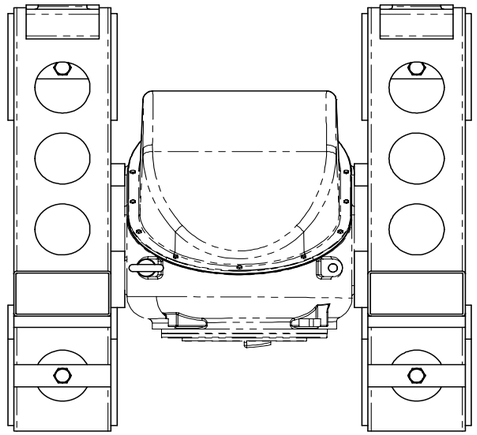
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

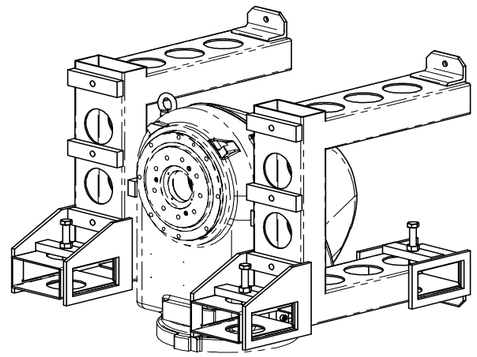
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

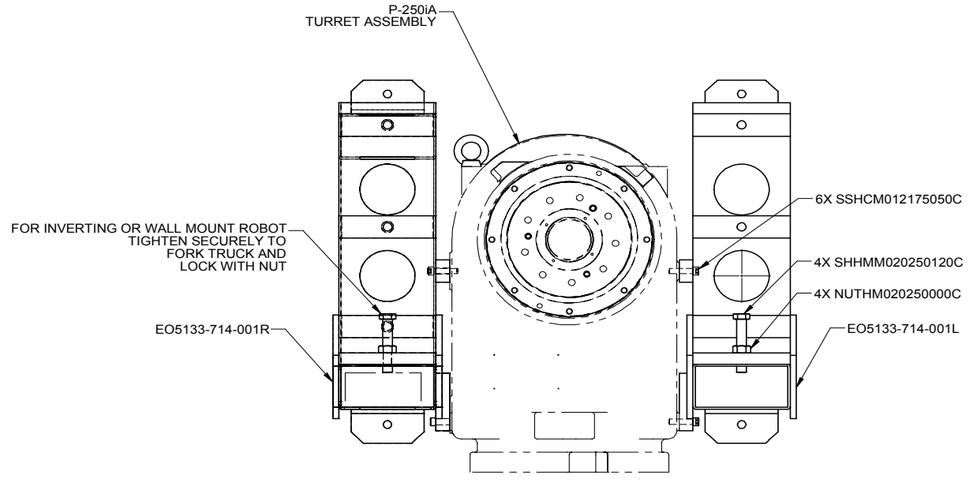
Standard Hardware Descriptions	
FANUC Part No.	Description
NUTHM020250000C	M20 X 2.5 Steel Hex Nut
SHHMM020250120C	M20 X 2.5 X 120mm LG. Steel Hex Head Machine Screw
SSHCM012175050C	M12 X 1.75 X 50mm LG. Steel Socket Head Cap

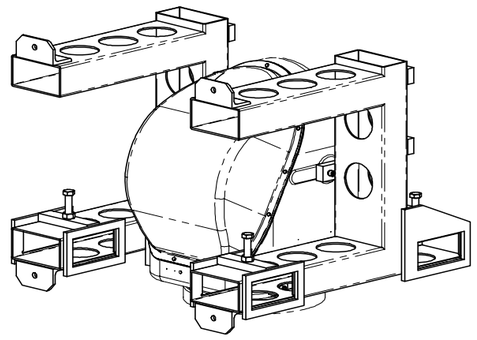
[EO-5133-710-000] REV A
FORK POCKET ASSEMBLY SHEET 1 OF 1

Figure 3-11 EO-5133-714-000, FORK POCKET ASM FOR WALL MNT









WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

Standard Hardware Descriptions	
FANUC Part No.	Description
NUTHM020250000C	M20 X 2.5 Steel Hex Nut
SHHMM020250120C	M20 X 2.5 X 120mm LG. Steel Hex Head Machine Screw
SSHCM012175050C	M12 X 1.75 X 50mm LG. Steel Socket Head Cap

[EO-5133-714-000]
FORK POCKET ASM FOR WALL MNT
REV A
SHEET 1 OF 1

3.2 Installation Guidelines

Figure 3-12 ET-6414-810-001, P-50iB Installation

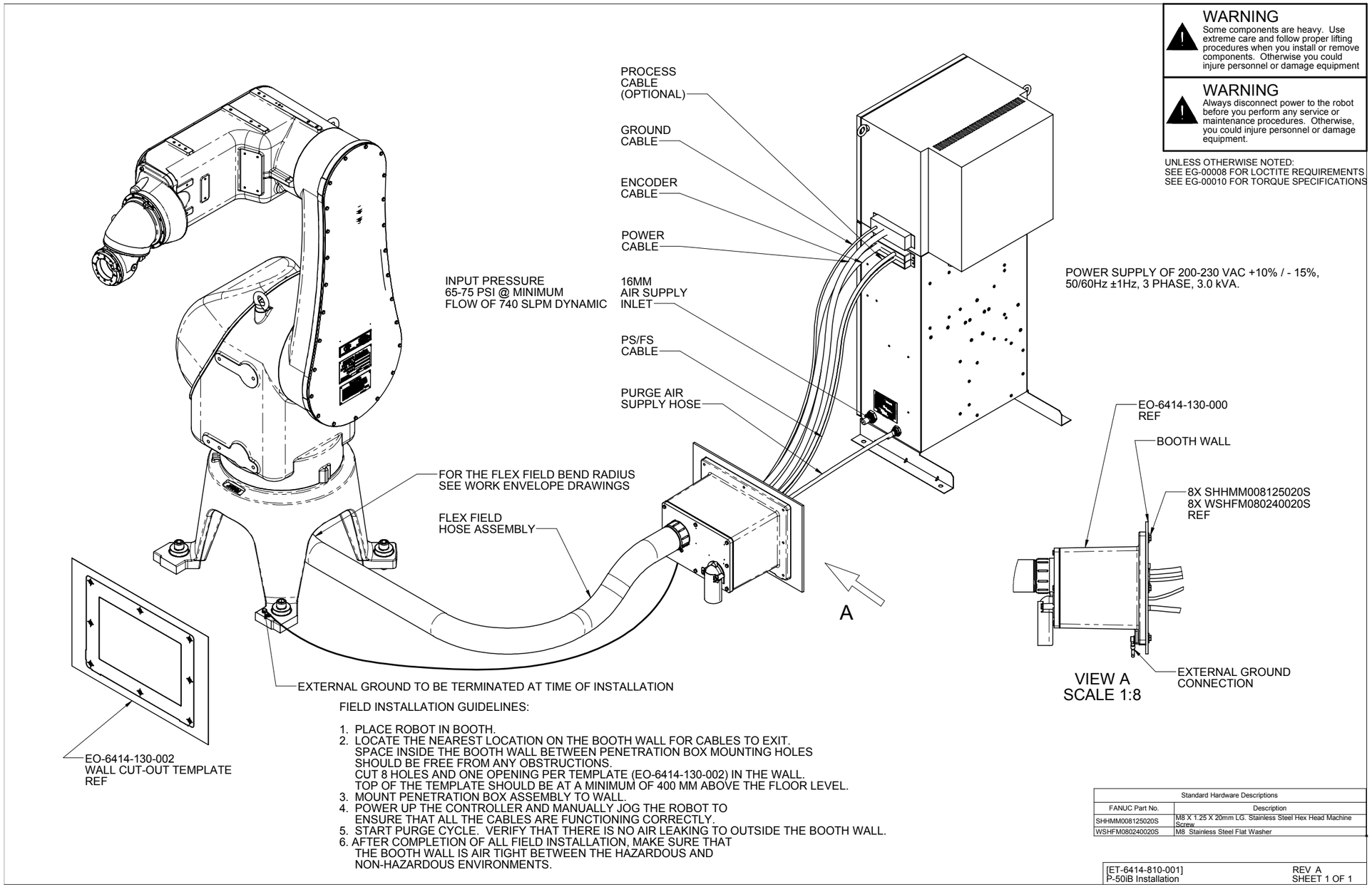
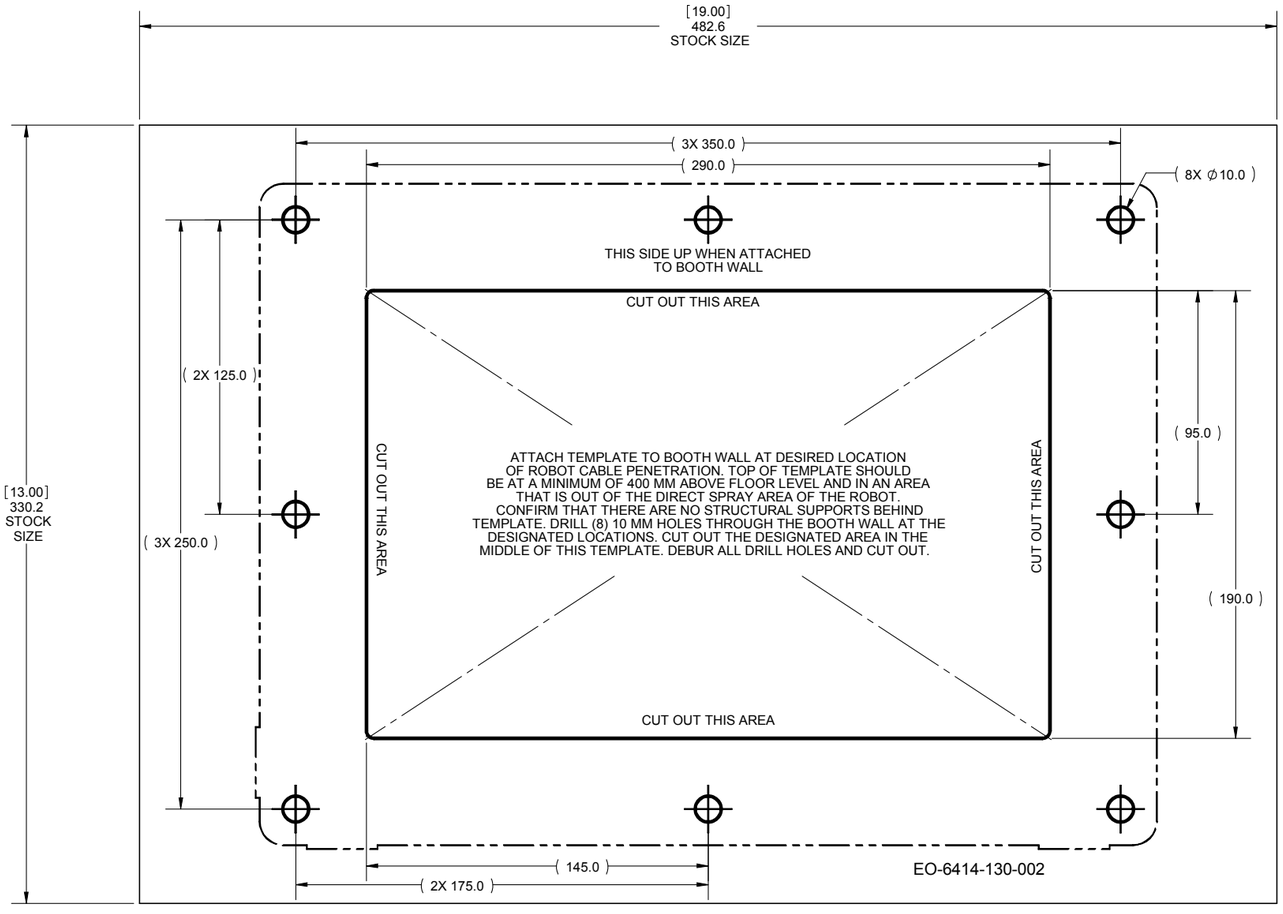


Figure 3-13 EO-6414-130-002, TEMPLATE – BOOTH WALL



WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

REPRODUCE THIS IMAGE AT 100% ON 13" X 19"
11.5MIL MATTE PHOTO PAPER. STAPLES # 564123
OR EQUIVALENT

IMAGE SHOULD BE CENTERED ON SHEET.

[EO-6414-130-002] TEMPLATE - BOOTH WALL	REV B3 SHEET 1 OF 1

4 CONNECTING THE END OF ARM TOOLING TO THE ROBOT

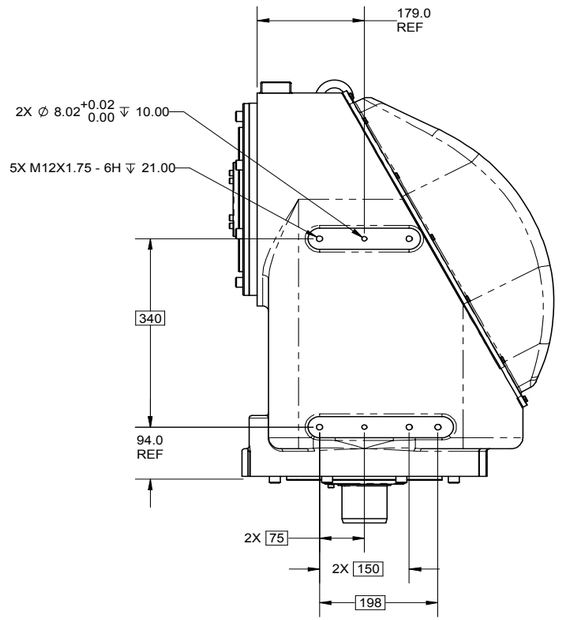
4.1 Interface

Figure 4-1 ET-6414-830-001_SHT1, TURRET INTERFACE

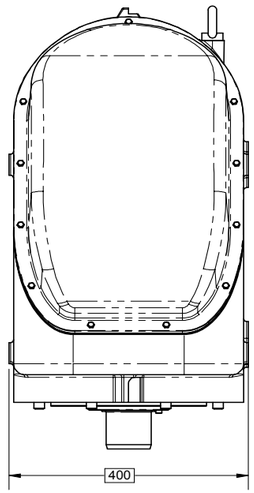
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

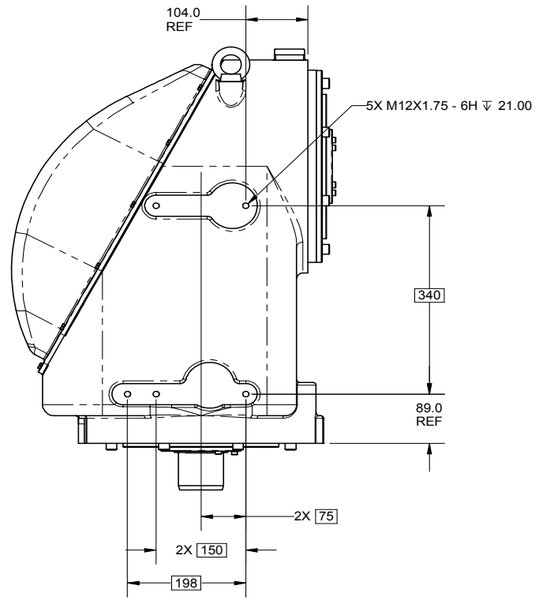
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



TURRET LEFT SIDE VIEW

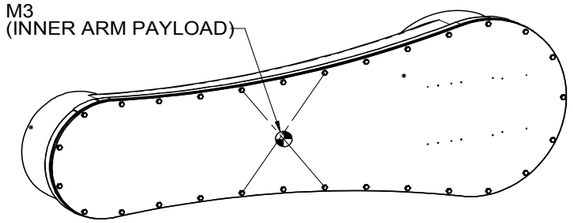




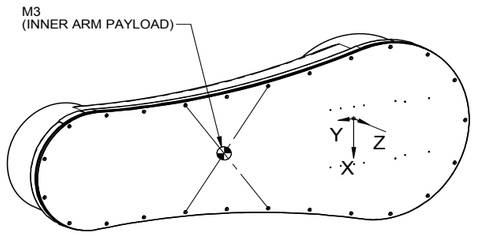
TURRET RIGHT SIDE VIEW

[ET-6414-830-001_SHT1] REV A
TURRET INTERFACE

Figure 4-2 ET-6414-830-001 SHT10, WRIST, OA & IA PAYLOADS



(X3, Y3, Z3) IS THE INNER ARM PAYLOAD CG LOCATION

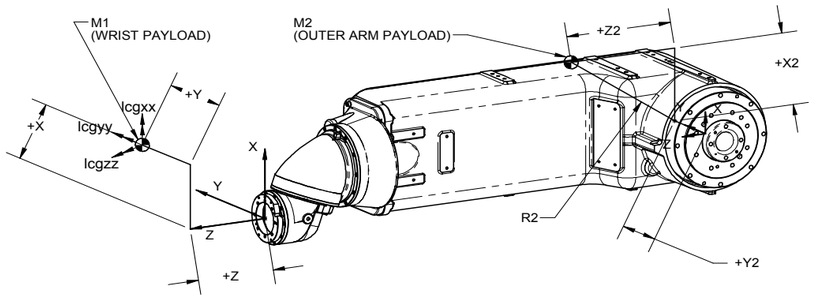


(X3, Y3, Z3) IS THE INNER ARM PAYLOAD CG LOCATION

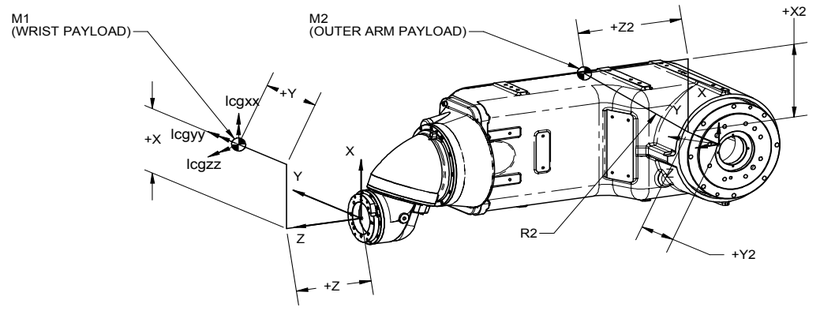
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



(X, Y, Z) IS THE WRIST PAYLOAD CG LOCATION
(X2, Y2, Z2) IS THE OUTER ARM PAYLOAD CG LOCATION



(X, Y, Z) IS THE WRIST PAYLOAD CG LOCATION
(X2, Y2, Z2) IS THE OUTER ARM PAYLOAD CG LOCATION

P-50iB/10L FLOOR, WALL & INVERT MOUNT					
M1 = MAXIMUM WRIST PAYLOAD = 10Kg @	Z ≤ 300mm	and	$\sqrt{X^2+Y^2}$	≤	50mm
M2 + M3 = MAXIMUM ARM PAYLOAD = 10Kg @	R 2=	$\sqrt{Z2^2+X2^2}$	≤	300mm	
WRIST MOMENTS N-m (kgf-m)	J4	43.45 (4.42)			
	J5	36.86 (3.76)			
	J6	4.90 (0.5)			
WRIST LOAD INERTIA kg-m²	J4	1.954			
	J5	1.413			
	J6	0.025			

P-50iB/15 FLOOR, WALL & INVERT MOUNT					
M1 = MAXIMUM WRIST PAYLOAD = 15Kg @	Z ≤ 300mm	and	$\sqrt{X^2+Y^2}$	≤	50mm
M2 + M3 = MAXIMUM ARM PAYLOAD = 10Kg @	R 2=	$\sqrt{Z2^2+X2^2}$	≤	300mm	
WRIST MOMENTS N-m (kgf-m)	J4	65.02 (6.63)			
	J5	55.29 (5.64)			
	J6	7.36 (0.75)			
WRIST LOAD INERTIA kg-m²	J4	2.931			
	J5	2.119			
	J6	0.038			

NOTE:

1. ALL MASSES ARE IN KILOGRAMS (kg)
2. DISTANCES ARE IN MILLIMETERS (mm)
3. FOR AMBIENT TEMPERATURE BELOW 10° C [50 ° F] CONTACT FANUC ROBOTICS AMERICA FOR APPLICATION ASSISTANCE. A WARM-UP CYCLE MAY BE REQUIRED.
4. FOR PAYLOADS OTHER THAN LISTED IN CHART CONTACT FANUC ROBOTICS ENGINEERING.

[ET-6414-830-001_SHT10] REV A
WRIST, OA & IA PAYLOADS

Figure 4-3 ET-6414-830-001_SHT2, P-50iB/15 & P-50iB/10L IA INTERFACE

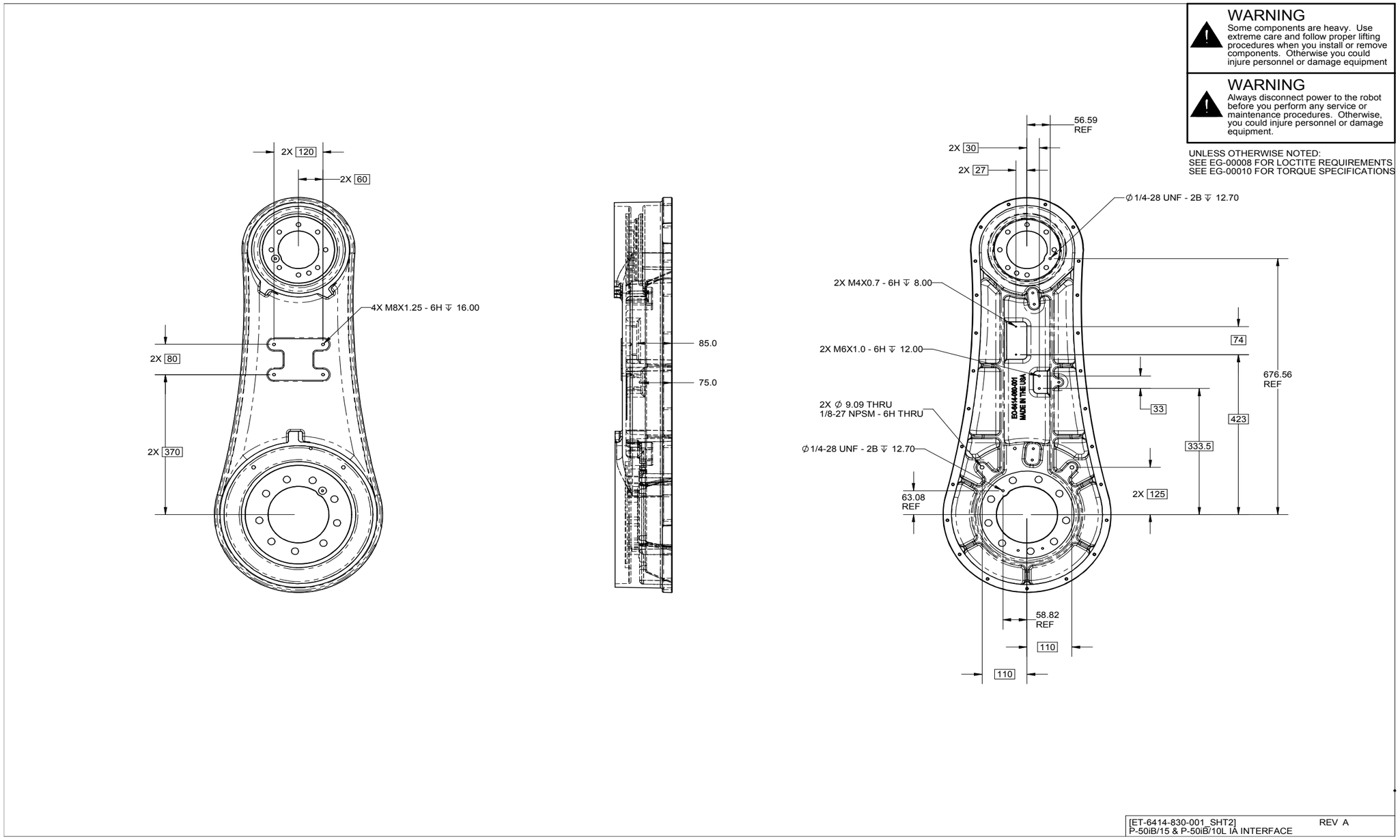


Figure 4-4 ET-6414-830-001_SHT3, P-50iB/10L IA INTERFACE

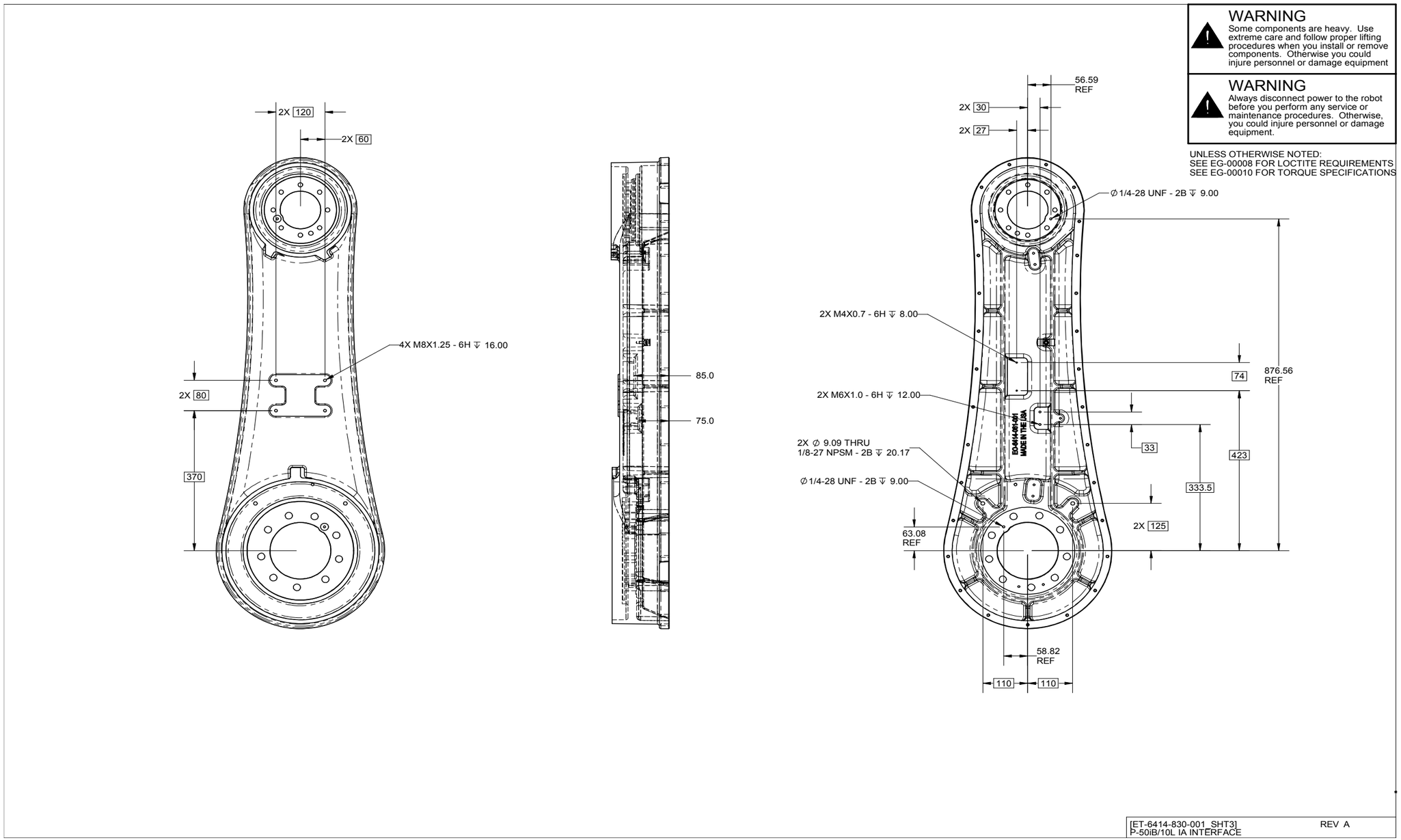


Figure 4-5 ET-6414-830-001_SHT4, P-50iB/15 OA INTERFACE

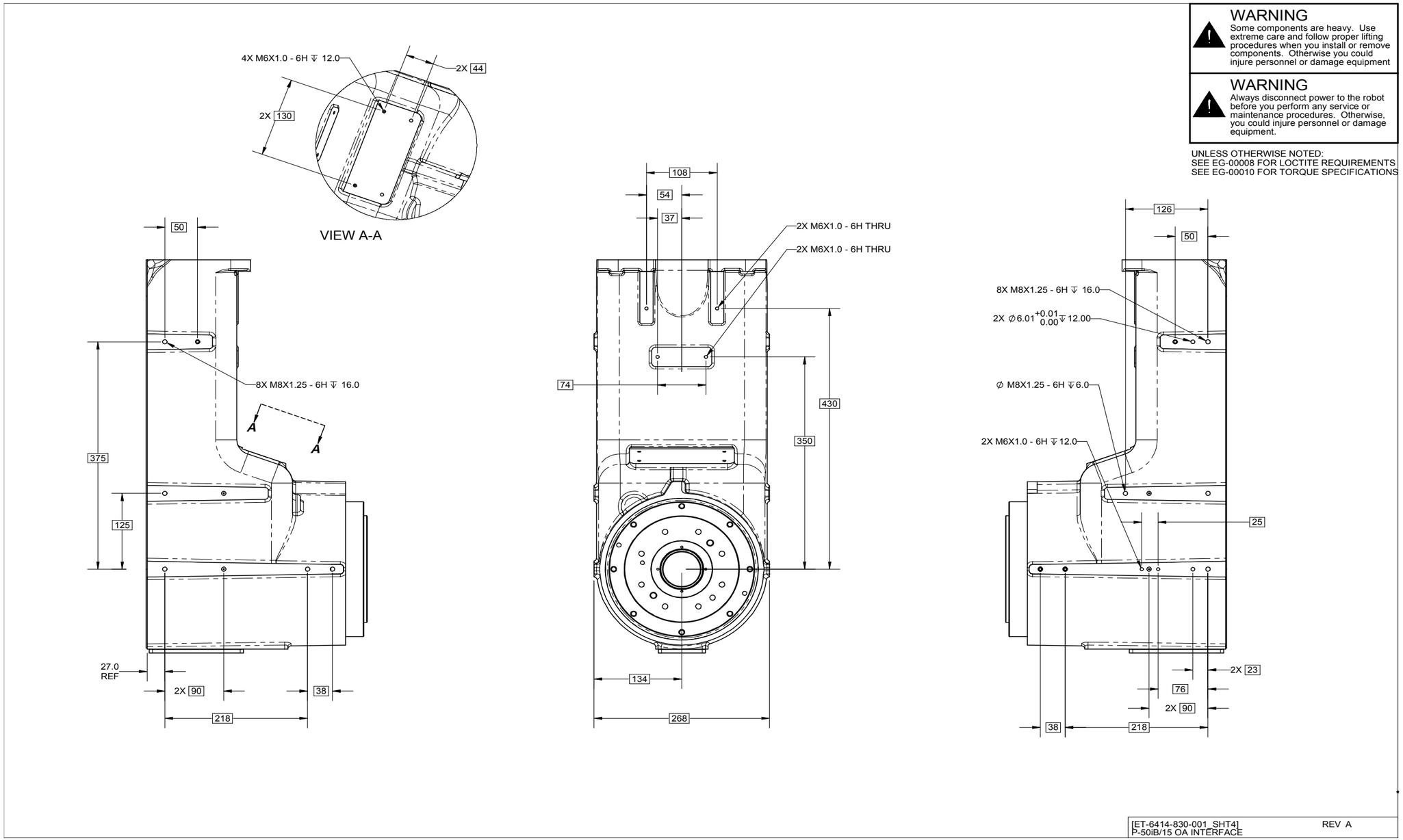


Figure 4-6 ET-6414-830-001_SHT5, P-50iB/10L OA INTERFACE

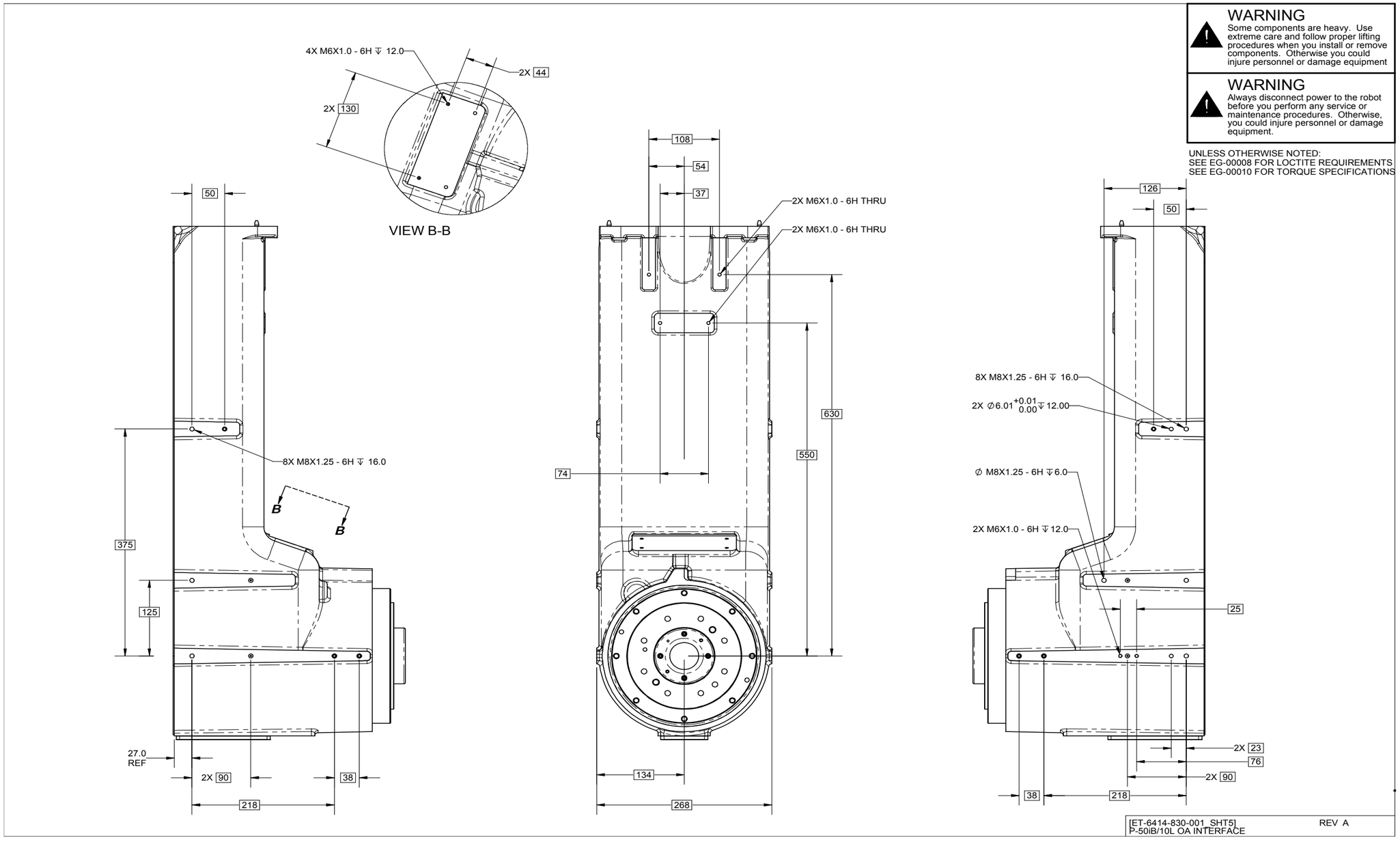
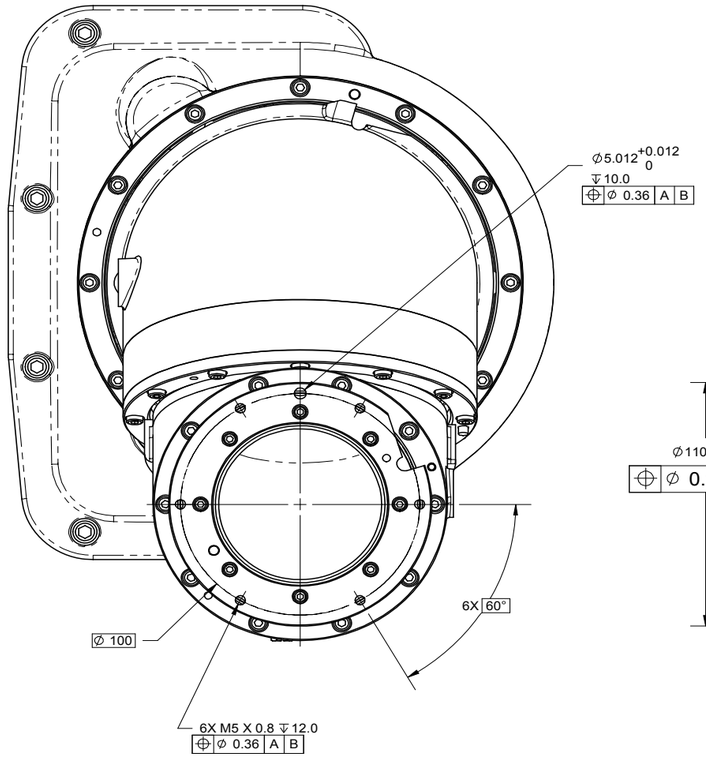


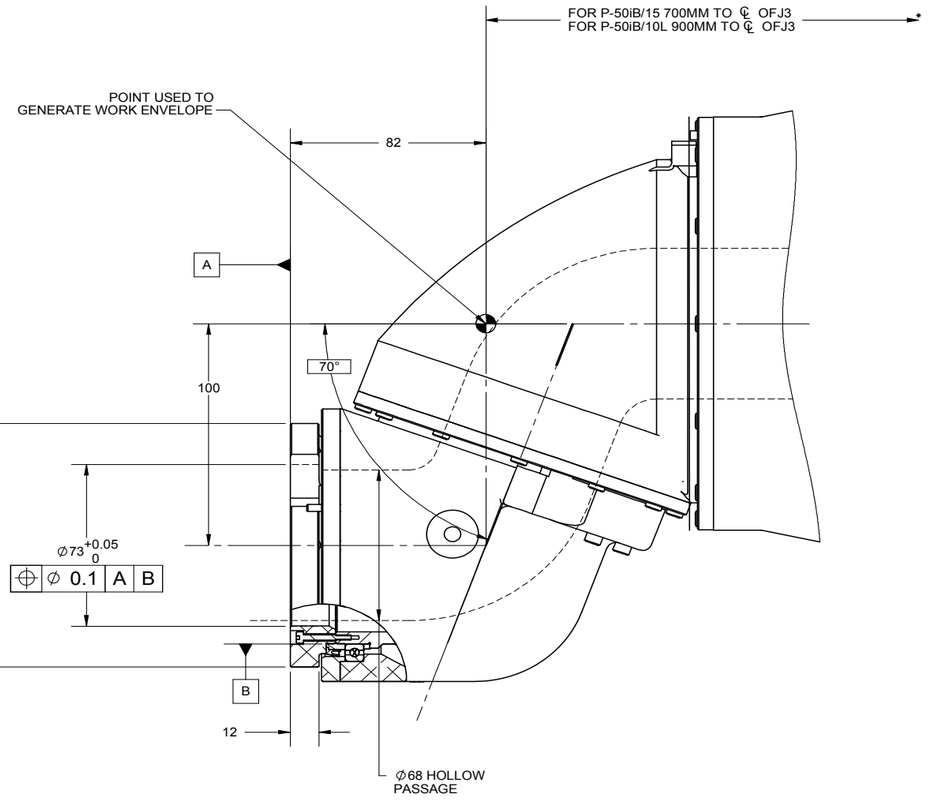
Figure 4-7 ET-6414-830-001_SHT6, WRIST INTERFACE

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

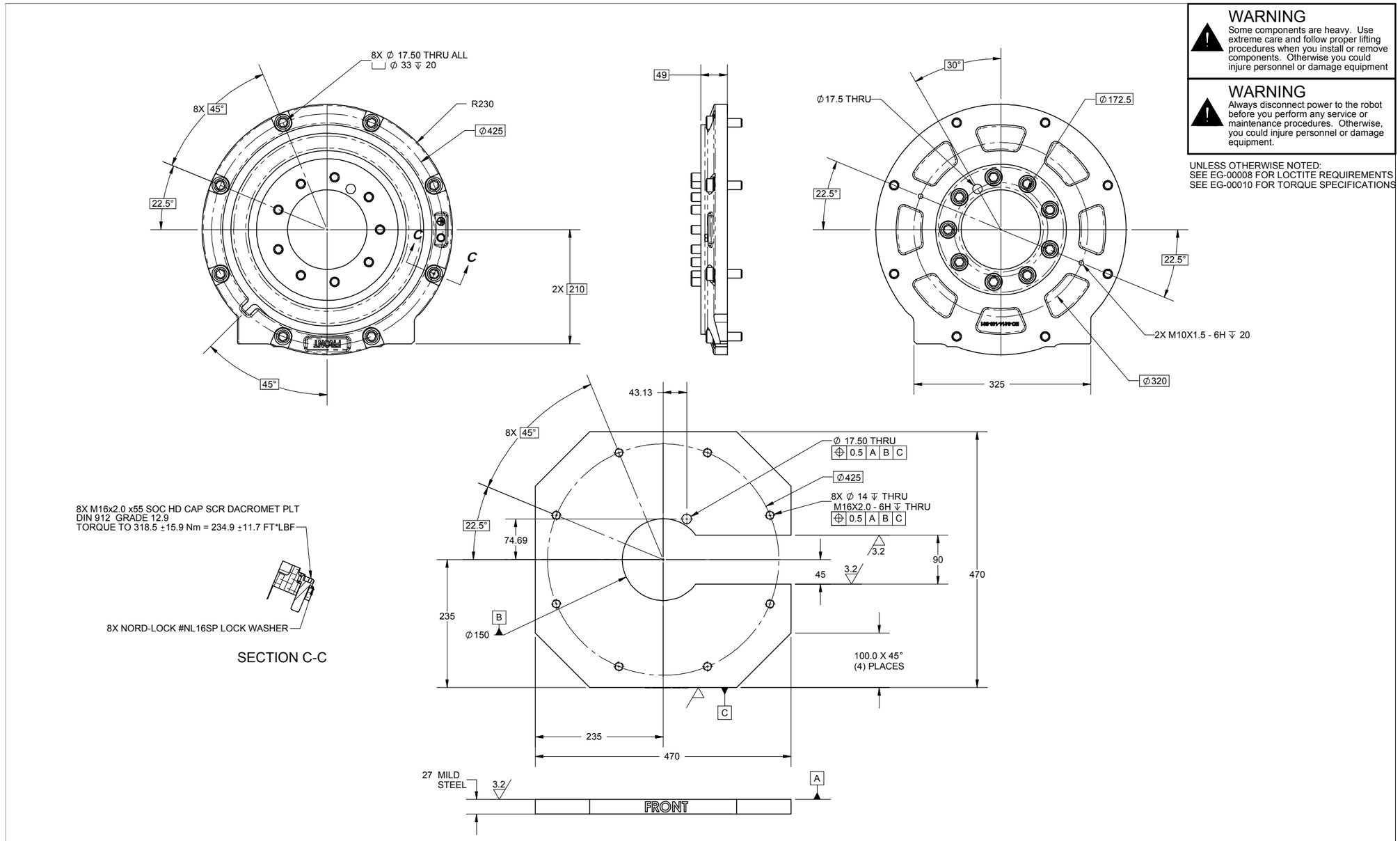
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS





[ET-6414-830-001_SHT6] WRIST INTERFACE REV B4

Figure 4-8 ET-6414-830-001_SHT7, PEDESTAL PLATE INTERFACE



EXAMPLE OF THE TOP PLATE OF THE CUSTOMER PROVIDED MOUNTING RISER FOR TURRET PEDESTAL PLATE MOUNT

Figure 4-9 ET-6414-830-001_SHT8, CAST PEDESTAL MNTG INTERFACE

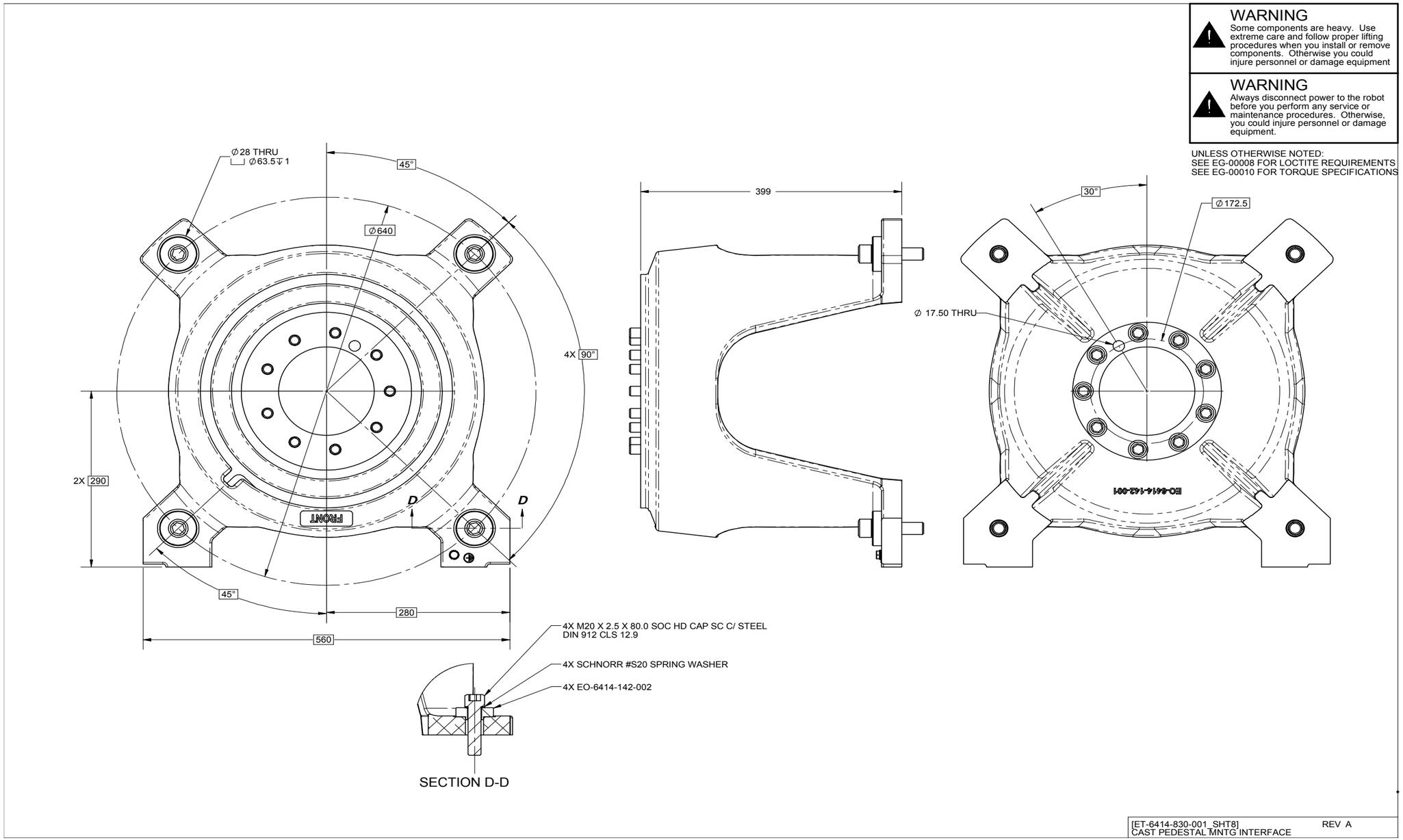
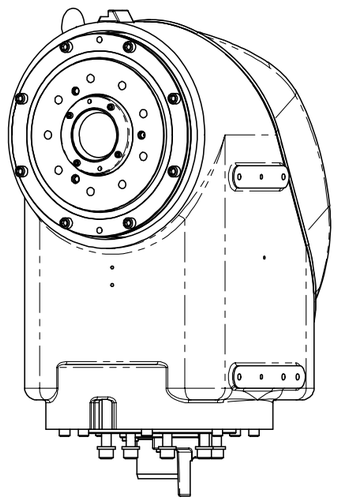
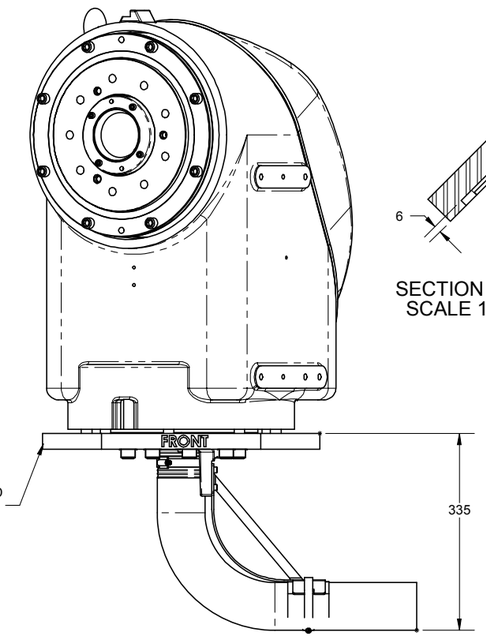
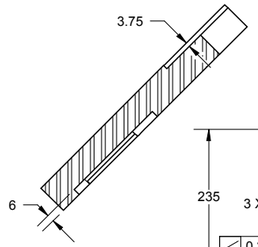


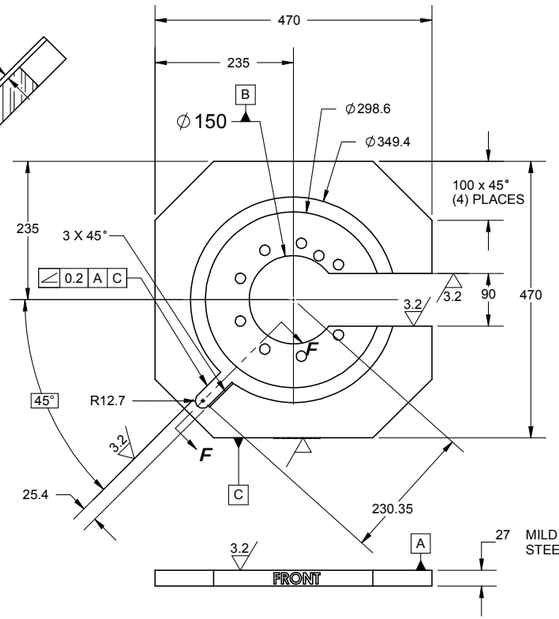
Figure 4-10 ET-6414-830-001_SHT9, STANDARD TURRET MNTG INTERFACE

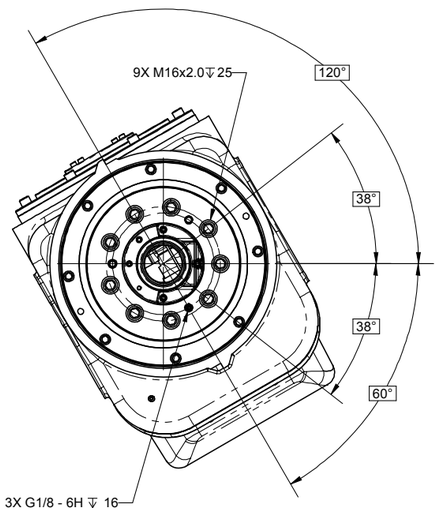




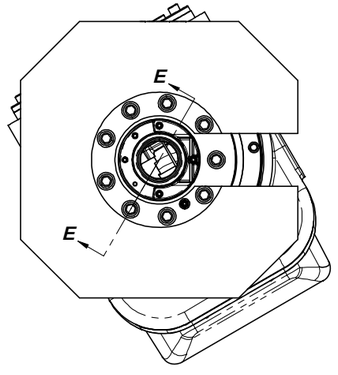


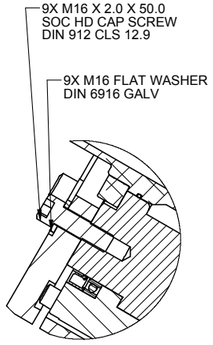
SECTION F-F
SCALE 1 : 4





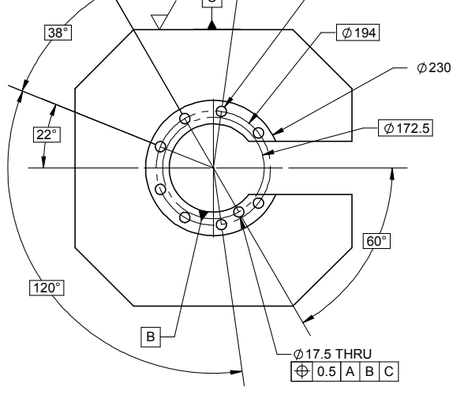
STANDARD MOUNT TURRET INTERFACE





SECTION E-E
SCALE 1 : 4

STANDARD MOUNT TURRET INTERFACE WITH THE CUSTOMER PROVIDED MNTG RISER (EXAMPLE OF THE RISER TOP PLATE SHOWN (FLEX FIELD HIDDEN FOR VIEW CLARITY)



EXAMPLE OF THE TOP PLATE OF THE CUSTOMER PROVIDED MOUNTING RISER FOR TURRET STANDARD MOUNT

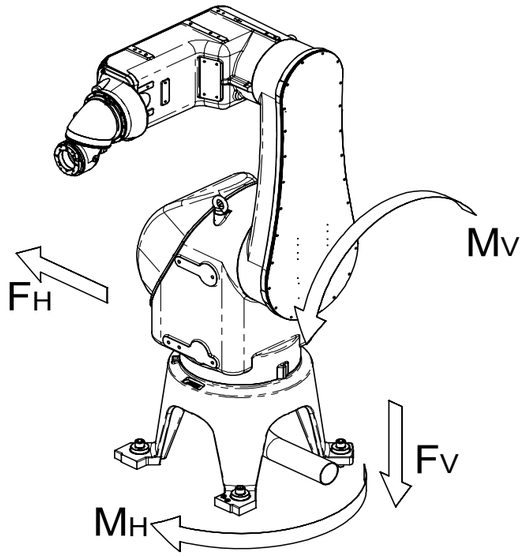
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

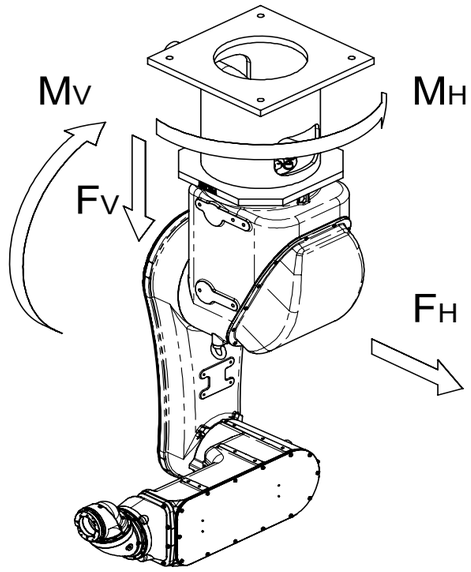
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

[ET-6414-830-001_SHT9] REV A
STANDARD TURRET MNTG INTERFACE

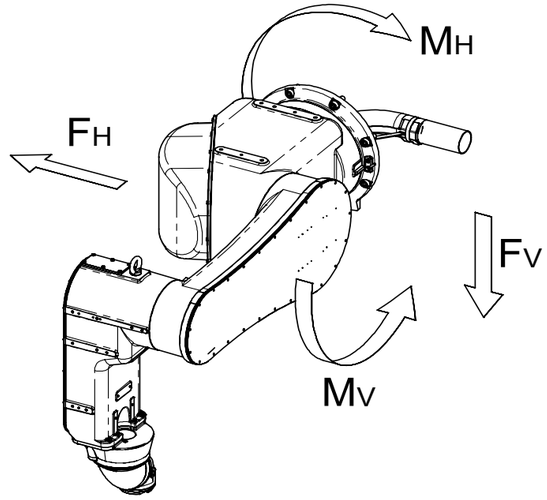
Figure 4-11 ET-6414-820-001 SHT1, MOMENTS & FORCES APPLIED TO MNTG INTERFACE



FLOOR MOUNT
SCALE 1:16



INVERT MOUNT
SCALE 1:16



WALL MOUNT
SCALE 1:16

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SEE EG-00010 FOR TORQUE SPECIFICATIONS

MOMENTS AND FORCES APPLIED TO THE PEDESTAL & PEDESTAL PLATE OR STANDARD MOUNT

P-50iB/15 Floor Mount				
State	Bending Moment Mv [kgf*m] (N*m)	Vertical Load Fv [kgf] (N)	Torsion Moment Mh [kgf*m] (N*m)	Horizontal Load Fh [kgf] (N)
At Rest	[105] (1031)	[338] (3315)	[0] (0)	[0] (0)
Accelerating or Decelerating	[205] (2008)	[424] (4158)	[106] (1036)	[86] (843)
At Emergency Stop	[304] (2985)	[510] (5001)	[211] (2073)	[172] (1686)

P-50iB/15 Invert Mount				
State	Bending Moment Mv [kgf*m] (N*m)	Vertical Load Fv [kgf] (N)	Torsion Moment Mh [kgf*m] (N*m)	Horizontal Load Fh [kgf] (N)
At Rest	[105] (1031)	-[338] (3315)	[0] (0)	[0] (0)
Accelerating or Decelerating	[205] (2008)	-[424] (4158)	[106] (1036)	[86] (843)
At Emergency Stop	[304] (2985)	-[510] (5001)	[211] (2073)	[172] (1686)

P-50iB/15 Wall Mount				
State	Bending Moment Mv [kgf*m] (N*m)	Vertical Load Fv [kgf] (N)	Torsion Moment Mh [kgf*m] (N*m)	Horizontal Load Fh [kgf] (N)
At Rest	[233] (2290)	[338] (3315)	[105] (1031)	[0] (0)
Accelerating or Decelerating	[333] (3268)	[424] (4158)	[210] (2060)	[86] (843)
At Emergency Stop	[433] (4245)	[510] (5001)	[315] (3090)	[172] (1686)

P-50iB/10L Floor Mount				
State	Bending Moment Mv [kgf*m] (N*m)	Vertical Load Fv [kgf] (N)	Torsion Moment Mh [kgf*m] (N*m)	Horizontal Load Fh [kgf] (N)
At Rest	[129] (1267)	[339] (3325)	[0] (0)	[0] (0)
Accelerating or Decelerating	[276] (2706)	[445] (4364)	[153] (1502)	[106] (1040)
At Emergency Stop	[423] (4146)	[551] (5404)	[306] (3004)	[212] (2080)

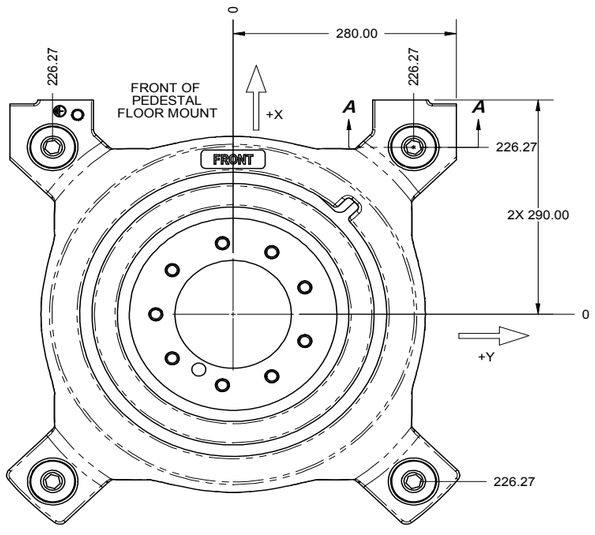
P-50iB/10L Invert Mount				
State	Bending Moment Mv [kgf*m] (N*m)	Vertical Load Fv [kgf] (N)	Torsion Moment Mh [kgf*m] (N*m)	Horizontal Load Fh [kgf] (N)
At Rest	[129] (1267)	-[339] (3325)	[0] (0)	[0] (0)
Accelerating or Decelerating	[276] (2706)	-[445] (4364)	[153] (1502)	[106] (1040)
At Emergency Stop	[423] (4146)	-[551] (5404)	[306] (3004)	[212] (2080)

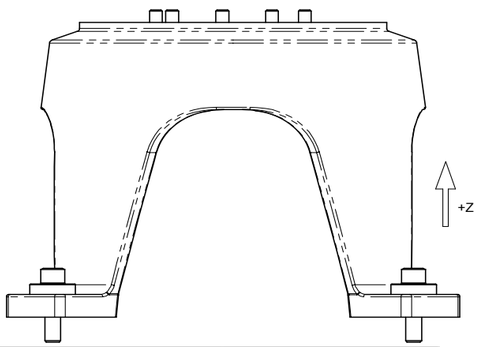
P-50iB/10L Wall Mount				
State	Bending Moment Mv [kgf*m] (N*m)	Vertical Load Fv [kgf] (N)	Torsion Moment Mh [kgf*m] (N*m)	Horizontal Load Fh [kgf] (N)
At Rest	[301] (2955)	[339] (3325)	[130] (1270)	[0] (0)
Accelerating or Decelerating	[448] (4395)	[445] (4364)	[282] (2764)	[106] (1040)
At Emergency Stop	[595] (5835)	[551] (5404)	[434] (4259)	[212] (2080)

NOTE: ALL ACCELERATION, DECELERATION AND E-STOP LOADS INCLUDE GRAVITY WHERE APPLICABLE.

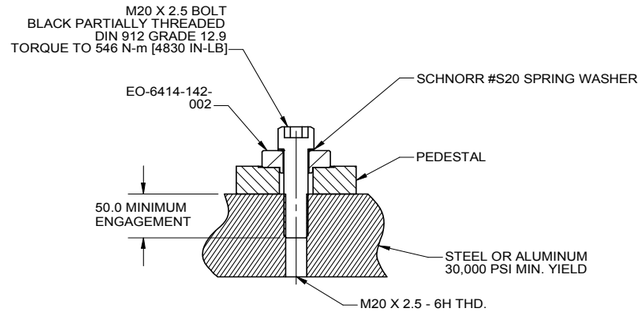
[ET-6414-820-001_SHT1] REV A
MOMENTS & FORCES APPLIED TO MNTG INTERFACE

Figure 4-12 ET-6414-820-001 SHT2, PEDESTAL MNT FLOOR LOADING

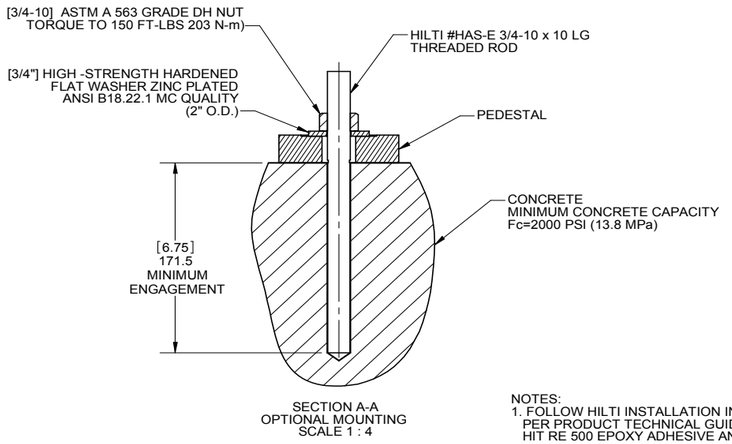




FLOOR MOUNT



SECTION A-A
SCALE 1 : 4



SECTION A-A
OPTIONAL MOUNTING
SCALE 1 : 4

P-50iB/15		
	MIN MOUNTING STIFFNESS REQUIRED AT EACH FOOT	MAX LOAD AT E-STOP PER FOOT
X	2,200 N/mm [12,600 LB/IN]	+/-1710 N [384 LB]
Y	2,200 N/mm [12,600 LB/IN]	+/-1710 N [384 LB]
Z	8,760 N/mm [50,000 LB/IN]	+3100 N [696 LB]
		-6250 N [1400 LB]

P-50iB/10L		
	MIN MOUNTING STIFFNESS REQUIRED AT EACH FOOT	MAX LOAD AT E-STOP PER FOOT
X	2,200 N/mm [12,600 LB/IN]	+/-2350 N [529 LB]
Y	2,200 N/mm [12,600 LB/IN]	+/-2350 N [529 LB]
Z	8,760 N/mm [50,000 LB/IN]	+4540 N [1020 LB]
		-8950 N [2010 LB]

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

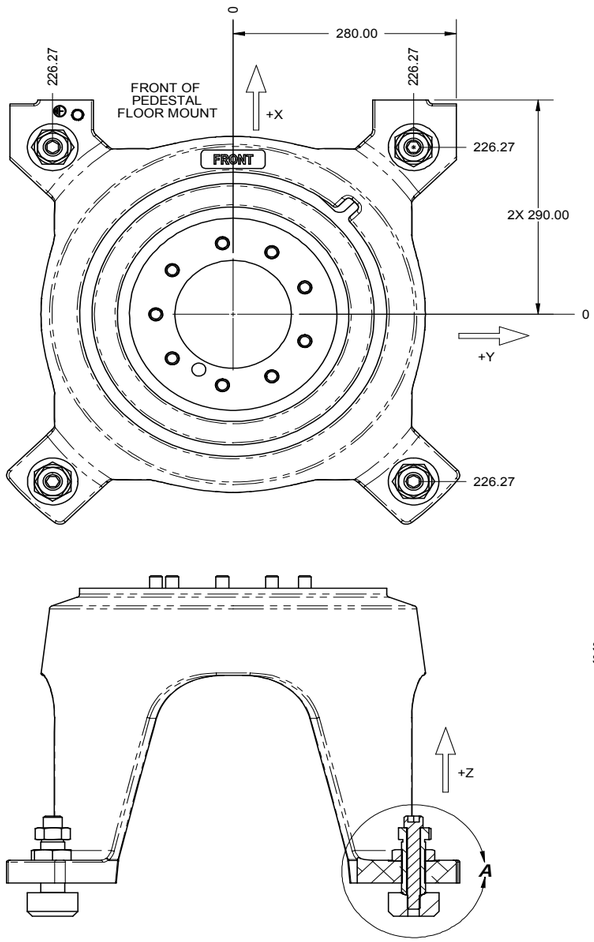
NOTES:
1. FOLLOW HILTI INSTALLATION INSTRUCTIONS
PER PRODUCT TECHNICAL GUIDE
HIT RE 500 EPOXY ADHESIVE ANCHOR 4.2.6

FILL HOLE APPROXIMATLEY 1/2 TO 1/3 FULL
OF HILTI ADHESIVE RE 500. APPORXIMATE
ADHESIVE VOLUME REQUIRED PER
ANCHOR = 6.75 IN X 0.326IN^3/IN = 2.2 IN^3.
CLEAN OIL FROM STUD AND NUT.

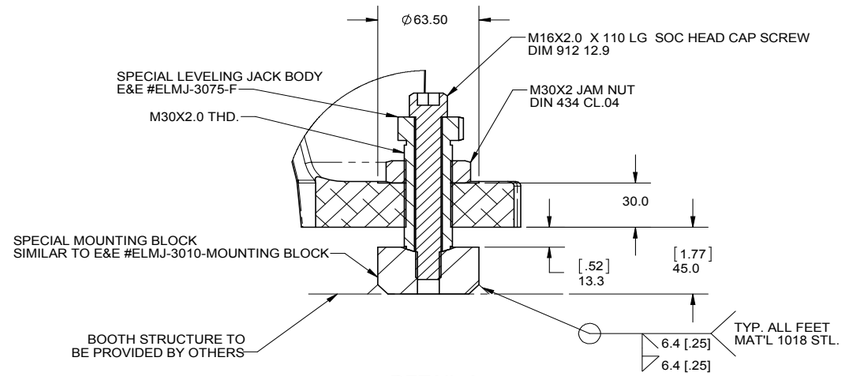
2. HILTI INSTALLATION IS FOR FLOOR MOUNT ONLY.

[ET-6414-820-001_SHT2] REV A
PEDESTAL MNT FLOOR LOADING

Figure 4-13 ET-6414-820-001 SHT3, PEDESTAL MNT FLOOR LOADING LEV SCR



FLOOR MOUNT LEVELING JACK MOUNTING OPTION



DETAIL A
SCALE 1 : 3

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

P-50iB/15		
	MIN MOUNTING STIFFNESS REQUIRED AT EACH FOOT	MAX LOAD AT E-STOP PER FOOT
X	2,200 N/mm [12,600 LB/IN]	+/-1710 N [384 LB]
Y	2,200 N/mm [12,600 LB/IN]	+/-1710 N [384 LB]
Z	8,760 N/mm [50,000 LB/IN]	+3100 N [696 LB]
		-6250 N [1400 LB]

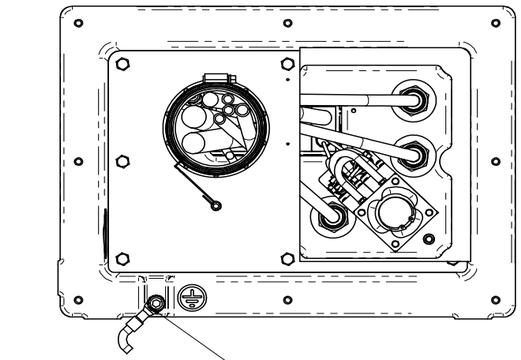
P-50iB/10L		
	MIN MOUNTING STIFFNESS REQUIRED AT EACH FOOT	MAX LOAD AT E-STOP PER FOOT
X	2,200 N/mm [12,600 LB/IN]	+/-2350 N [529 LB]
Y	2,200 N/mm [12,600 LB/IN]	+/-2350 N [529 LB]
Z	8,760 N/mm [50,000 LB/IN]	+4540 N [1020 LB]
		-8950 N [2010 LB]

NOTE:

1. LEVELING JACK OPTION (ASM - EO-9999-410-002) IS FOR FLOOR MOUNT ONLY.

[ET-6414-820-001_SHT3] REV A
PEDESTAL MNT FLOOR LOADING LEV SCR

Figure 4-14 EO-6414-193-000_SHT3, CABLE AND PURGE ROUTING PENETRATION BOX



EXTERNAL GROUND CONNECTION

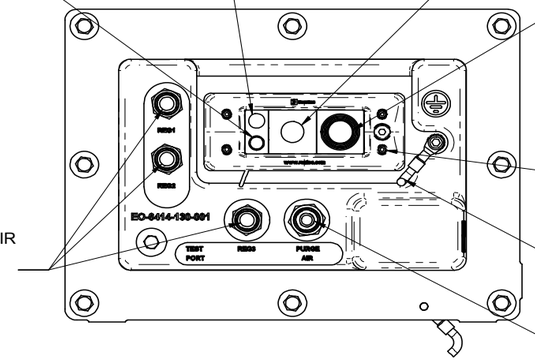
"G"
PS/FS
CABLE
REF.
REMOVE 5 LAYERS
FROM THE ROXTEC
SEALING MODULE

PROCESS
CABLE
(OPTIONAL)
REMOVE 7 LAYERS
FROM THE ROXTEC
SEALING MODULE

"C"
POWER
CABLE
REF.
REMOVE 6 LAYERS
FROM THE ROXTEC
SEALING MODULE

"B"
ENCODER
CABLE
REF.
REMOVE 8 LAYERS
FROM THE ROXTEC
SEALING MODULE

EO-HOSE-011-010
∅10 MM PROCESS AIR
SUPPLY HOSE
(OPTIONAL)

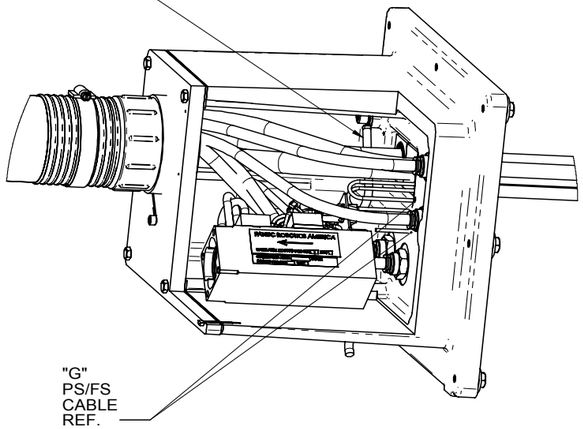


TORQUE
SCREWS TO
5 - 7 Nm

"F"
GROUND CABLE
REF.

"E"
EO-HOSE-011-012
PURGE AIR
SUPPLY HOSE
REF.

"D"
GROUND CABLE
REF.



"G"
PS/FS
CABLE
REF.

PENETRATION BOX SHOWN WITH PARTIAL CUTOUT FOR CABLE ROUTING CLARIFICATION
SCALE 1:2

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

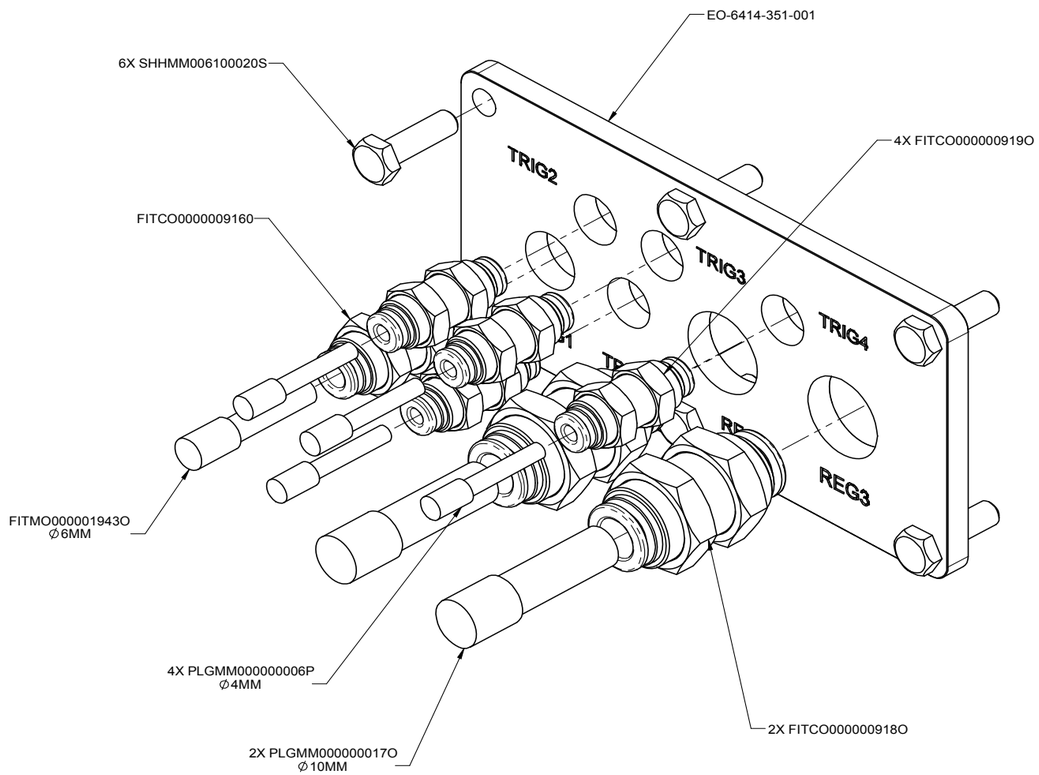
NOTE:

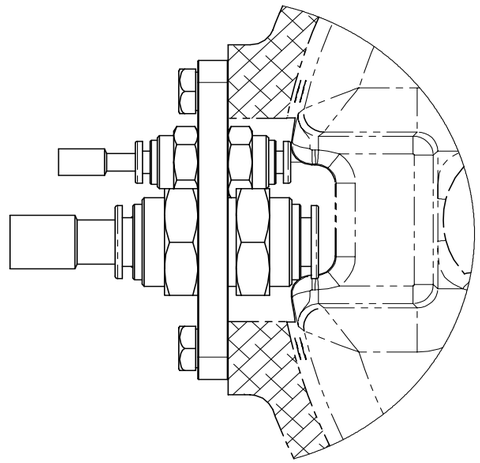
WHEN INSTALLING CABLES INTO THE ROXTEC FRAME FOLLOW MANUFACTURER RECOMMENDATIONS:

PAY SPECIAL ATTENTION TO CLAMP CABLES FIRST THEN MOUNT THE FRAME (APPLY ROXTEC LUBRICANT AS NEEDED),
SLIDE CABLES AS NEEDED, BUT MAKE SURE
NOT TO PULL SEALING MODULES OUT OF THE POSITION.

[EO-6414-193-000_SHT3] REV *1
CABLE AND PURGE ROUTING PENETRATION BOX

Figure 4-15 EO-6414-351-000, PROCESS MANIFOLD PLATE ASM





WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

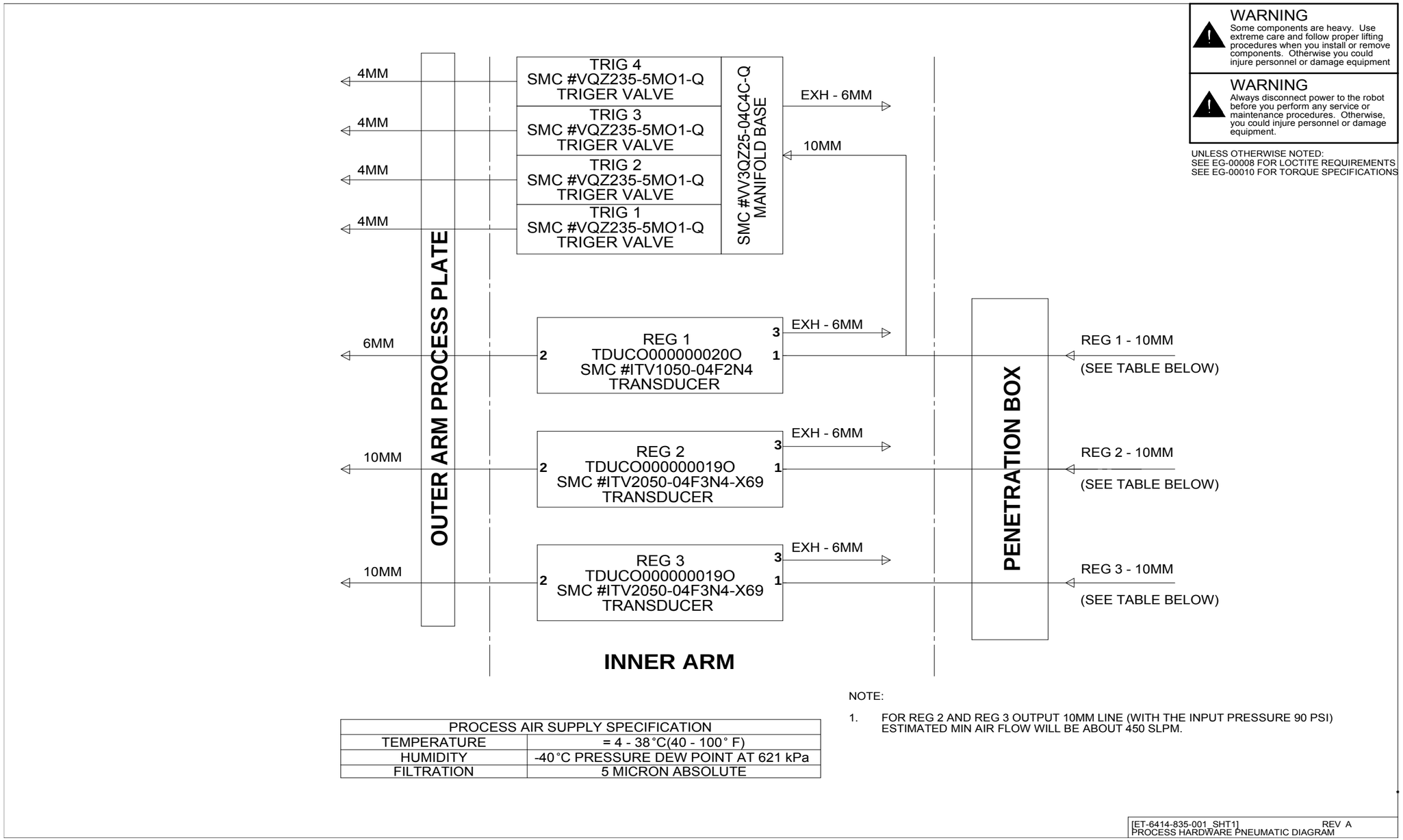
NOTES:

1. CONNECT INTERNAL PROCESS LINES TO THE MANIFOLD. MATCH THE LABEL OF EACH LINE TO THE PORT LABEL ON THE MANIFOLD PLATE.
2. APPLY LOCTITE #518 GASKET ELIMINATOR #HDWMO000003248O TO MANIFOLD MOUNTING SURFACE PRIOR TO ATTACHING ASSEMBLY TO THE ROBOTS OUTER ARM.

Standard Hardware Descriptions	
FANUC Part No.	Description
SHHMM006100020S	M6 X 1.0 X 20mm LG. Stainless Steel Hex Head Machine Screw

[EO-6414-351-000] REV C1
PROCESS MANIFOLD PLATE ASM SHEET 1 OF 1

Figure 4-16 ET-6414-835-001_SHT1, PROCESS HARDWARE PNEUMATIC DIAGRAM



PROCESS AIR SUPPLY SPECIFICATION	
TEMPERATURE	= 4 - 38°C(40 - 100° F)
HUMIDITY	-40°C PRESSURE DEW POINT AT 621 kPa
FILTRATION	5 MICRON ABSOLUTE

NOTE:

1. FOR REG 2 AND REG 3 OUTPUT 10MM LINE (WITH THE INPUT PRESSURE 90 PSI) ESTIMATED MIN AIR FLOW WILL BE ABOUT 450 SLPM.

[ET-6414-835-001_SHT1] REV A
PROCESS HARDWARE PNEUMATIC DIAGRAM

4.2 Robot Payload Setting

4.2.1 Overview

Robot payload is the weight of the robot end-of-arm tooling and workpiece. If you have not set up the proper robot payload during software installation, or if you need to change the robot payload because you have changed end-of-arm tooling or the workpiece, you must set the robot payload.

Note Be sure to set payload values as accurately as possible. The more accurate the values, the more effective features such as Collision Guard will be.

Note More accurate values can also improve position accuracy and cycle time.

You can define up to ten different payload schedules. You can then specify a payload schedule by using the payload setup screens and by using the payload teach pendant program instructions. You can set up payload schedules from the MOTION PERFORMANCE screen. Refer to Section 4.2.2 for more information on the payload teach pendant program instructions.

4.2.2 Setting the Active Payload Schedule

You can set the active payload schedule:
• Manually (Procedure **4-1**)
• In a teach pendant instruction (Procedure 4-2)
Refer to Table 4-1 through Table 4-4 for information on each Payload screen item.

Table 4-1 MOTION PERFORMANCE Screen Items

ITEM	DESCRIPTION
No.	This item displays the payload schedule number.
PAYLOAD[kg]	This item displays the payload in kilograms.
Comment	This item displays any comments associated with each payload schedule.

Table 4-2 MOTION/PAYLOAD SET Screen Items

ITEM	DESCRIPTION
Schedule No [ ]	This item displays the payload schedule number.
PAYLOAD Units: kg	This item is the weight of the end-of-arm tooling.Note : There are 2.21 pounds in a kilogram.
PAYLOAD CENTER X Units: cm	This item is the up and down offset of the payload center of gravity from the center of the faceplate. Positive (+) values are up. There are 0.39 inches per centimeter.
PAYLOAD CENTER Y Units: cm	This item is the side offset of the payload center of gravity from the center of the faceplate. Positive (+) values are to the right of the faceplate when viewed from behind the faceplate. There are 0.39 inches per centimeter.
PAYLOAD CENTER Z Units: cm	This item is the offset of the payload center of gravity from the center of the faceplate. Positive (+) values are out from the faceplate. There are 0.39 inches per centimeter.
PAYLOAD INERTIA X Units: kgfcms^2	This item is the moment of inertia of the payload around an axis parallel to the X-direction for the tool frame and through the center of gravity of the payload.
PAYLOAD INERTIA Y Units: kgfcms^2	This item is the moment of inertia of the payload around an axis parallel to the Y-direction for the tool frame and through the center of gravity of the payload.
PAYLOAD INERTIA Z Units: kgfcms^2	This item is the moment of inertia of the payload around an axis parallel to the Z-direction for the tool frame and through the center of gravity of the payload.

Procedure 4-1 Manually Setting the Active Payload Schedule

Note You cannot update payload values when a program is running or if the active schedule number is the same as the schedule you want to modify.

Conditions

- SRDY is on.
- No motion commands have been issued.
- $PARAM_GROUP[].$MOUNT_ANGLE has not been set.
- Robot mastering/calibration has been performed.

Steps

1. Press MENUS.
2. Select SYSTEM.
3. Press F1, [TYPE].
4. Select Motion. You will see a screen similar to the following

```
MOTION PERFORMANCE
Group 1
No.  PAYLOAD[kg]  Comment
1    120.00       [                ]
2    120.00       [                ]
3    120.00       [                ]
4    120.00       [                ]
5    120.00       [                ]
6    120.00       [                ]
7    120.00       [                ]
8    120.00       [                ]
9    120.00       [                ]
10   120.00       [                ]
Active PAYLOAD number = 1
```

5. To set the active payload, you must do the following:

a. Press PREV until the payload schedule listing screen is displayed.

b. Press F5, SETIND.

Note If you see the message, "Running program already exists," you will not be able to change the index. You cannot change the index when a teach pendant program is running. Check whether any teach pendant program is running and abort it, if possible. Then, repeat the step.

c. Type the number of the payload schedule you want and press ENTER.

Procedure 4-2 Using Teach Pendant Instructions to Set the Active Payload Schedule

Note Some applications and the Collision Guard function require the proper setting of payload information. If the payload changes during your application, you must use the PAYLOAD[x] instruction to select the appropriate payload schedule.

Note The PAYLOAD[x] instruction allows you to specify the payload schedule to use. You can specify up to 10 different sets of payload information. Each set of payload information corresponds to a schedule number.

Conditions

- You have set up the payload schedule that corresponds to the one you specify.
- For a multi-group application, you must use the PAYLOAD[GPx:y] instruction to select the appropriate payload schedule, y, for the specified motion group, x. Refer to the Program Elements for details on the PAYLOAD[GPx:y] instruction.

Steps

1. Edit the teach pendant program in which you want to include PAYLOAD instructions.

a. Press NEXT, until F2, [INST], is displayed then press F2, [INST].

b. Select Payload and press ENTER.

c. Select PAYLOAD[...] and press ENTER.

2. Type the value of the of the payload schedule:

• Direct - type a schedule number and press ENTER.

• Indirect - select INDIRECT, type a register number, and press ENTER.

4.2.3 Setup of Payload Schedules

There are two ways of setting the payload schedule parameters:

• Manual entry - Refer to Procedure 4-3 for more details.

• Automatic estimation - Refer to Procedure 4-4 for more details.

Note Automatic robot payload estimation is available for some robot models. If your robot model does not have the payload setting feature, the message, "IDENT is not supported to this robot," will be displayed when you press F2, IDENT.

If you change any mechanical parts on the robot, such as a motor, you need to perform payload calibration before payload estimation.
If you do not want to perform payload estimation, but want to return the payload settings to the default values, you can reset them to the default values.
Table 4-3 lists the items on the Motion/Payload ID screen.
Table 4-4 lists the items on the Motion/ID POS1 ID screen.
Use Procedure 4-3 to set up the Robot Payload Schedule.

Table 4-3 MOTION/PAYLOAD ID Items

ITEM	DESCRIPTION
PAYLOAD ESTIMATION	This item allows you to estimate payload automatically.
MASS IS KNOWN	This item allows you to set whether or not the mass is known and the value, ranging from 0 to 999.99 kg.
CALIBRATION MODE	This item allows you to calibrate the robot.
CALIBRATION STATUS	This item indicates whether the robot has been calibrated.

Table 4-4 MOTION/ID POS1 ID Items

ITEM	DESCRIPTION
POSITION FOR ESTIMATION	This item can be changed, depending on whether you want to use POSITION1 or POSITION2 for estimation.
J5 Default: -90.000	This item displays the J5 robot position.
J6 Default: -90.000	This item displays the J6 robot position.
SPEED Range: 1% - 100% Low default: 1% High default: 100%	This item displays the Low and High speeds.
ACCL Range: 1% - 100% Low default: 1% High default: 100%	This item displays the Low and High acceleration rates.

Procedure 4-3 Manually Setting Robot Payload Schedule

Note You cannot update payload values when a program is running and the active schedule number is the same as the schedule you want to modify.

Conditions

- SRDY is on.
- No motion commands have been issued.
- $PARAM_GROUP[].$MOUNT_ANGLE has not been set.
- Robot mastering/calibration has been performed.
- The active payload schedule is set. Refer to Section 4.2.2 .

Steps

1. Press MENUS.
2. Select SYSTEM.

3. Press F1, [TYPE].
4. Select Motion. You will see a screen similar to the following.

```
MOTION PERFORMANCE
Group 1
No.  PAYLOAD[kg]  Comment
1    120.00       [                  ]
2    120.00       [                  ]
3    120.00       [                  ]
4    120.00       [                  ]
5    120.00       [                  ]
6    120.00       [                  ]
7    120.00       [                  ]
8    120.00       [                  ]
9    120.00       [                  ]
10    120.00       [                  ]
Active PAYLOAD number = 1
```

5. To set up payload information manually for the schedule you chose, move the cursor the payload schedule you want and press F3, DETAIL. You will see a screen similar to the following.

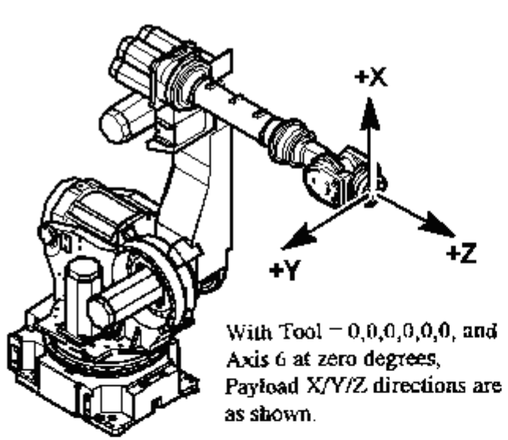
```
MOTION/PAYLOAD SET
Group 1
1 Schedule No[  1]:      [******************]
2 PAYLOAD                [kg]          120.00
3 PAYLOAD CENTER X       [cm]           30.00
4 PAYLOAD CENTER Y       [cm]           25.00
5 PAYLOAD CENTER Z       [cm]           25.00
6 PAYLOAD INERTIA X      [kgfcms^2]     77.00
7 PAYLOAD INERTIA Y      [kgfcms^2]    306.00
8 PAYLOAD INERTIA Z      [kgfcms^2]    306.00
```

a. To display help for the items on the screen, press F5, HELP. To display more information, use the arrow keys. When you are finished displaying help information, press PREV.
b. To set the value, move the cursor to the items you want to set and set them as desired. When you set payload, you set the values of several items related to payload. Refer to Table 4-5 for a short description of the items you must set. Direction is relative to the robot tool frame with x, y, z, w, p, and r set to zero, and robot joint angles at the zero positions. Refer to Figure 4-18 for additional equations used to calculate payload inertias.

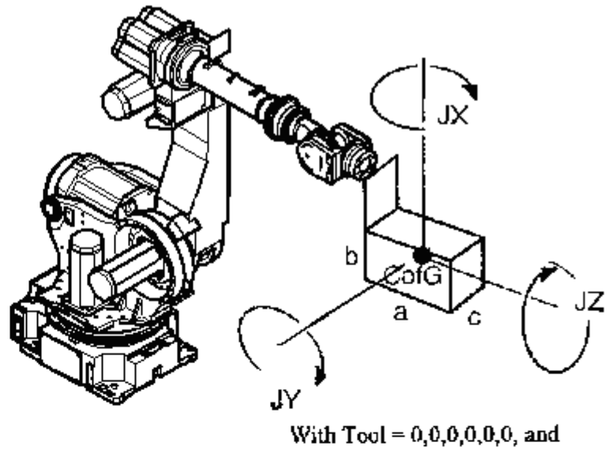
Table 4-5 SYSTEM Payload Screen

Payload (kg)	This item is the weight of the end-of-arm tooling. There are 2.21 pounds in a kilogram.
Payload Center X (cm)	This item is the up and down offset of the payload center of gravity from the center of the faceplate. Positive (+) values are up. There are 0.39 inches per centimeter.
Payload Center Y (cm)	This item is the side offset of the payload center of gravity from the center of the faceplate. Positive (+) values are to the right of the faceplate when viewed from behind the faceplate. There are 0.39 inches per centimeter.
Payload Center Z (cm)	This item is the offset of the payload center of gravity from the center of the faceplate. Positive (+) values are out from the faceplate. There are 0.39 inches per centimeter.
Payload Inertia X (kgfcm s 2)	This item is the moment of inertia of the payload around an axis parallel to the X-direction for the tool frame and through the center of gravity of the payload.
Payload Inertia Y (kgfcms 2)	This item is the moment of inertia of the payload around an axis parallel to the Y-direction for the tool frame and through the center of gravity of the payload.
Payload Inertia Z (kgfcms 2)	This item is the moment of inertia of the payload around an axis parallel to the Z-direction for the tool frame and through the center of gravity of the payload.
Arm load axis #1 (kg)	This item is the additional weight mounted to axis 1.
Arm load axis #3 (kg)	This item is the additional weight mounted to axis 3.

Figure 4-17 Inertia Formula Example



With Tool = 0,0,0,0,0,0, and
Axis 6 at zero degrees,
Payload X/Y/Z directions are
as shown.



With Tool = 0,0,0,0,0,0, and
Axis 6 at zero degrees
JX = Payload Inertia X
JY = Payload Inertia Y
JZ – Payload Inertia Z

In the example shown above, assume a = 60cm, b = 15cm, c = 10cm
(Material = steel, density = 0.00783 kg/cm^3)
Then M = Mass = 60 x 15 x 10 x 0.00783 = 70kg

From this, using standard Inertia formulae, the Payload Inertias can be calculated:

$$J_x = \frac{M}{12}\left(a^2 + c^2\right) = \frac{70}{12}\left(60^2 + 10^2\right) = 21583kg.cm^2 = 22.0kgf.cm.s^2$$

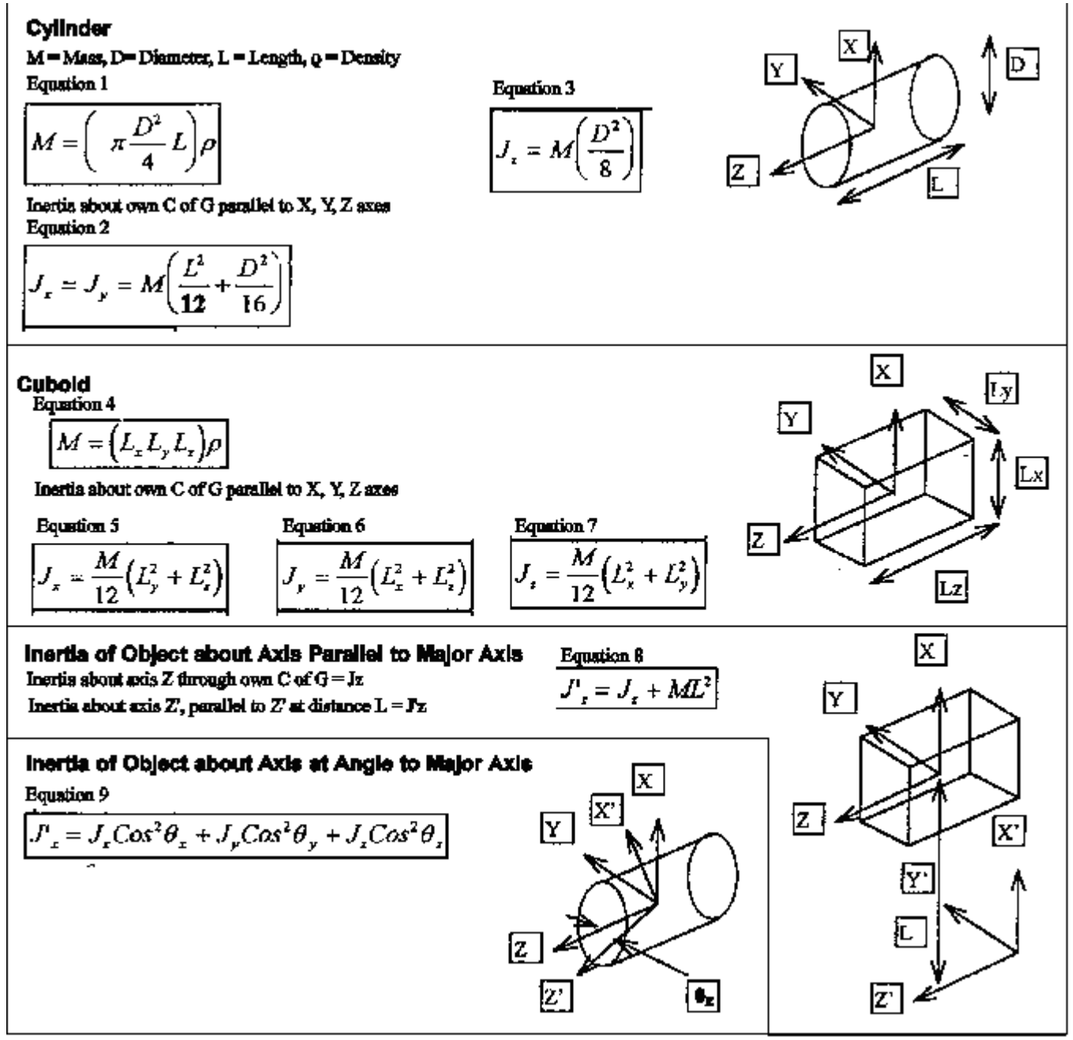
$$J_y = \frac{M}{12}\left(a^2 + b^2\right) = \frac{70}{12}\left(60^2 + 15^2\right) = 22312kg.cm^2 = 22.7kgf.cm.s^2$$

$$J_z = \frac{M}{12}\left(b^2 + c^2\right) = \frac{70}{12}\left(15^2 + 10^2\right) = 1896kg.cm^2 = 1.9kgf.cm.s^2$$

Note 1: $(1kgf.cm.s^2 = 980kg.cm^2)$

Note 2: Equation $\left(J_n = \frac{M}{12}\left(width^2 + depth^2\right)\right)$ only applies to simple load shape shown. Other shape loads will require different inertia calculation formulae.

Figure 4-18 Inertia Equations



6. To select a different motion group, press F2, GROUP, and specify the motion group you want.
7. To select a different schedule number, press F3, NUMBER, and enter the number of the payload schedule for which you want to set up payload information manually.
8. To set payload values to the default values set at FANUC Robotics, press and hold SHIFT and press F4, DEFAULT, and then perform one of the following:

- To confirm the change to the factory default values, press F4, YES.
- To cancel the default settings and return to the previous settings, press F4, NO.

Procedure 4-4 Automatic Payload Estimation

Note You cannot update payload values when a program is running and the active schedule number is the same as the displayed schedule you want to modify.

Conditions

- SRDY is on.
- No motion commands have been issued.
- $PARAM_GROUP[].$MOUNT_ANGLE has not been set.
- Robot mastering/calibration has been performed.

Steps

1. Press MENUS.
2. Select SYSTEM.
3. Press F1, [TYPE].
4. Select Motion. You will see a screen similar to the following.

```
MOTION PERFORMANCE
Group 1
No.  PAYLOAD[kg]  Comment
1    120.00       [                ]
2    120.00       [                ]
3    120.00       [                ]
4    120.00       [                ]
5    120.00       [                ]
6    120.00       [                ]
7    120.00       [                ]
8    120.00       [                ]
9    120.00       [                ]
10   120.00       [                ]
Active PAYLOAD number = 1
```

Note Automatic robot payload estimation is available for some robot models. If your robot model does not have the payload setting feature, the message, "IDENT is not supported to this robot," will be displayed when you presscF2, IDENT.

5. To perform automatic payload estimation:
   a. Press PREV until the payload schedule listing screen is displayed.
   b. Press NEXT, >, and then press F2, IDENT. You will see a screen similar to the following.

```
MOTION/PAYLOAD ID
Group 1
Schedule No[  1]:     [****************]
1  PAYLOAD ESTIMATION            **********
Previous Estimated value    (Maximum)
Payload [Kg] :       0.00   (  165.00)****
Axis Moment  [Nm]
J4:              0.00E+00  (  9.02E+02)
J5:              0.00E+00  (  9.02E+02)
J6:              0.00E+00  (  4.41E+02)
Axis Inertia [Kgf cm^2]
J4:              0.00E+00  (  8.82E+05)
J5:              0.00E+00  (  8.82E+05)
J6:              0.00E+00  (  4.41E+05)
2 MASS IS KNOWN   [NO ]       165.000  [Kg]
3 CALIBRATION MODE                    [OFF]
4 CALIBRATION STATUS
```

c. Check the calibration status:

- If the status is DONE, continue to Step 7 .
- If the status is not DONE, you must perform payload calibration first. Refer to Step 6 .

6. If calibration status is not DONE, perform the following steps for Payload Calibration:

Note If the calibration values for the robot are known, they may be entered directly into the system variables. The values are entered at $PLCL_GRP [n] .$TRQ_MGN []. Set the proper values for each axis. When this is done, set $PLCL_GRP [n] .$CALIB_STAT=1.

Note If axis 5 or axis 6 motors are replaced, the robot must be re-calibrated. To ensure that this is done, set $PLCL_GRP[n].$CALIB_STAT=0, when one of these motors are replaced. This will change the calibration status from DONE, back to ****. After calibration is completed, $PLCL_GRP[n].$CALIB.STAT will be set to 1.

CAUTION:
Do not use calibration data from a different robot. Otherwise, estimation might become inaccurate.

a. Make sure that the end-of-arm tooling is **not attached** to the robot arm.

CAUTION:
Make sure the end-of-arm tooling is not attached to the robot arm. Otherwise, payload calibration will not be correct.

b. Jog the robot to the position of the calibration. The suggested position for calibration is the zero position for all axes.

Note When the calibration is executed, the J5 and J6 axes move between POS1 and POS2, set on the ID POS1 and ID POS2 screens. Axes 1-4 will not move during calibration.

c. For calibration, the values of POS1 and POS2 must be set to the default.
d. Press NEXT, >, and then press F4, DETAIL. You will see a screen similar to the following.

```
MOTION/ID POS1
Group 1
1  POSITION for ESTIMATION         POSITION1
J1                              <**********>
J2                              <**********>
J3                              <**********>
J4                              <**********>
2  J5                              <   -90.000>
3  J6                              <   -90.000>
J7                              <**********>
J8                              <**********>
J9                              <**********>
4   SPEED           Low  <  1%>  High <100%>
5   ACCEL           Low  <100%>  High <100%>
```

e. Press F2, POS2. You will see a screen similar to the following.

```
MOTION/ID POS2
Group 1
1  POSITION for ESTIMATION         POSITION2
J1                              <**********>
J2                              <**********>
J3                              <**********>
J4                              <**********>
2  J5                              <    90.000>
3  J6                              <    90.000>
J7                              <**********>
J8                              <**********>
J9                              <**********>
4   SPEED           Low  <  1%>  High <100%>
5   ACCEL           Low  <100%>  High <100%>
```

Note: Speed and accel must be set to DEFAULT. The default values are shown on the above screen.

f. Press F3, DEFAULT.
g. Press PREV until the PAYLOAD ID screen is displayed.
h. Move the cursor to CALIBRATION MODE and press F4, ON.

Note After calibration has been performed, CALIBRATION MODE automatically turns OFF.

CAUTION:
Do not change the CALIBRATION MODE during the calibration estimation process. Otherwise, the calibration will be incorrect or incomplete.

i. Turn the teach pendant ON/OFF switch to OFF and release the DEADMAN switch.
j. Move the cursor to Calibration Status.
k. Press F4, EXEC. You will see a screen similar to the following.

```
Robot moves and estimates. Ready?
          YES NO
```

WARNING:
In the next step, the robot will move. Make sure all personnel and unnecessary equipment are out of the workcell and that all safeguards are in place; otherwise, you could injure personnel or damage equipment.

l. Decide whether to run the calibration:
- To run the calibration, press F4, YES.
- To cancel the calibration, press F5, NO.

When the robot has stopped moving, the payload calibration has been completed and you can continue to payload estimation.

7. Continue the automatic payload estimation:

a. Jog the robot to the position of the estimation.

CAUTION:
If calibration status is not DONE, you must perform calibration (Step 6) before payload estimation. If you do not perform calibration first, the payload estimation will be incorrect.

Note When the estimation is executed, the J5 and J6 axes move between POS1 and POS2, set on the ID POS1 and ID POS2 screens, and the other axes keep the current positions. (Step 7f and Step 7h)

Note If the axis of J5 rotation is vertical (J4 is at ±90 degrees), the estimation cannot be done. Make sure that the axis of J5 rotation is as horizontal as possible.

b. Press F3, NUMBER, and enter the number of the payload schedule for which you want to perform payload estimation.

c. If the mass of the payload is known, move the cursor to MASS IS KNOWN, select YES, type the mass of the payload, and press ENTER.

Note Specifying the value of the mass is recommended.

d. A good estimation needs the following conditions:
- The range of J5 between POS1 and POS2 is 180 degrees.
- The range of J6 between POS1 and POS2 is 180 degrees.
- The x and/or y CG values of the payload to be estimated must be significant for the payload to be a viable candidate for estimation. If both the x and y values are near or at zero the estimation might be inaccurate. See Figure 4-19 for more detail.
- POS1 and POS2 are recommended to be set such that the (user-estimated) center of gravity (CG) will be on the plane formed by the axis of rotation of J5 and the axis or rotation of J6. See Figure 4-20 .

Figure 4-19 Valid Payload Configuration for Accurate Estimation

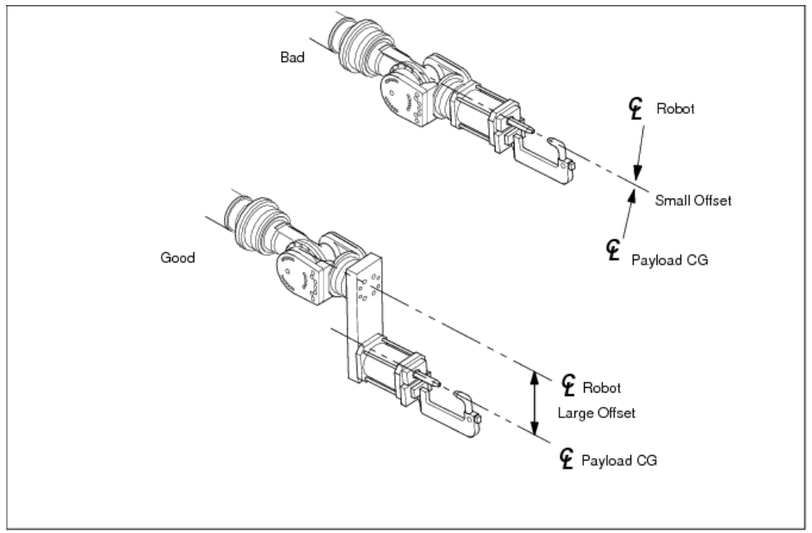
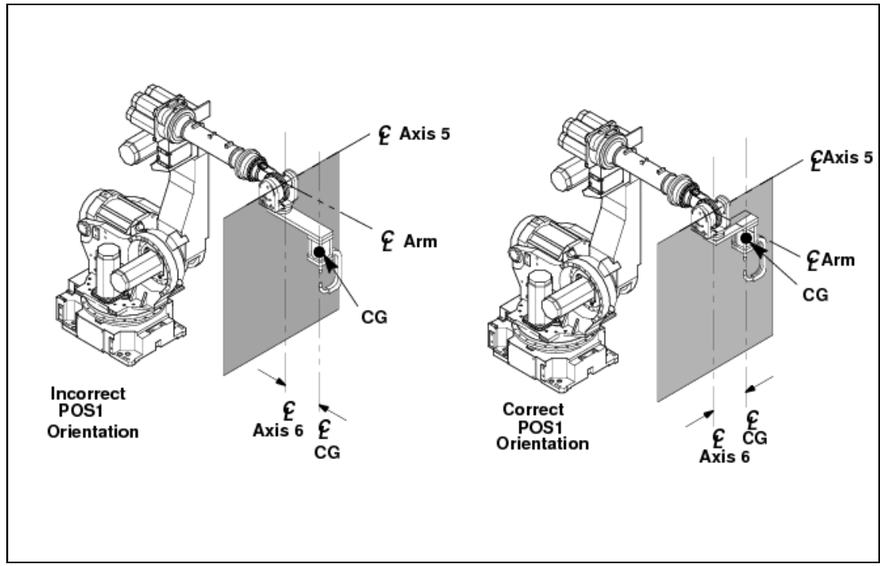


Figure 4-20 J5 and J6 Orientation for POS1



e. Press NEXT, >, and then press F4, DETAIL. You will see a screen similar to the following.

```
MOTION/ID POS1
Group 1
1  POSITION for ESTIMATION         POSITION1
J1                              <**********>
J2                              <**********>
J3                              <**********>
J4                              <**********>
2  J5                              <   -90.000>
3  J6                              <   -90.000>
J7                              <**********>
J8                              <**********>
J9                              <**********>
4   SPEED           Low  <  1%>  High <100%>
5   ACCEL           Low  <100%>  High <100%>
```

f. Perform **one** of the following:

- Type the angle of each axis of POS1 (in degrees),or
- Jog axes J5 and J6 to the position you want to record as POS1 and press SHIFT and F5, RECORD, to record the J5 and J6 axis positions.

g. Press F2, POS.2. You will see a screen similar to the following.

```
MOTION/ID POS2
Group 1
1  POSITION for ESTIMATION         POSITION2
J1                              <**********>
J2                              <**********>
J3                              <**********>
J4                              <**********>
2  J5                              <    90.000>
3  J6                              <    90.000>
J7                              <**********>
J8                              <**********>
J9                              <**********>
4   SPEED           Low  <  1%>  High <100%>
5   ACCEL           Low  <100%>  High <100%>
```

h. Perform **one** of the following:

- Type the angle of each axis of POS2 (in degrees),or
- Jog axes J5 and J6 to the position you want to record as POS2 and press SHIFT and F5, RECORD, to record the J5 and J6 axis positions.

i. The high and low accel values (item 5 on the previous Motion/ID POS1 screen) can be modified, under certain conditions, to optimize estimation. If the actual mass of the payload is less than the maximum for the robot model, then refer to Figure 4-21 for the equation to calculate the new values.

Figure 4-21 Acceleration Equation

$$\frac{\text{Maximum Payload}}{\text{Actual Payload}} \times 100 = \text{Accel value (max 255)}$$

- If calculated values exceed the maximum value of 255, set the values to 255. The high and low accel values must be set to the same number.
- If excessive vibration occurs during estimation, reduce the values and repeat the estimation. Continue to reduce the values until the vibration diminishes.

j. Press PREV until the PAYLOAD ID screen is displayed.
k. Turn the teach pendant ON/OFF switch to OFF and release the DEADMAN switch.
l. Press F4, EXEC. You will see a screen similar to the following.

```
Robot moves and estimates. Ready?
          YES NO
```

WARNING:
In the next step, the robot will move. Make sure all personnel and unnecessary equipment are out of the workcell and that all safeguards are in place; otherwise, you could injure personnel or damage equipment.

m. Decide whether to run the payload estimation:
- To run the calibration, press F4, YES.
- To cancel the calibration, press F5, NO.

The robot will perform the estimation at the current robot position for axes 1 through 4. When the robot has stopped moving, the payload has been estimated and the screen will be updated to the new values.

WARNING:
Do not attempt to adjust the override while the robot performs the estimation. This will cause the results to be inaccurate.

n. Press F5, APPLY, to apply the estimated value to the payload schedule. You will see a screen similar to the following.

```
Path and Cycletime will change. Set it?
       YES NO
```

WARNING:
Make sure that the payload schedule you define matches the correct payload information before you continue; otherwise, the robot will not move the way you expect, and could injure personnel or damage equipment.

o. Decide whether to accept the estimated payload:
- To accept the payload, press F4, YES.
- To reject the payload, press F5, NO.

p. **If the load is over the specification**, you will see a screen similar to the following.

```
Load is OVER spec ! Accept ?
YES NO
```

q. Decide whether to accept the estimated payload:
- To accept the payload, press F4, YES.
- To reject the payload, press F5, NO.

8. To select a different motion group, press F2, GROUP, and specify the motion group you want.

Note If you see the message, "Running program already exists," you will not be able to change the index. You cannot change the index when a teach pendant program is running.

Note If you have installed the Material Handling Shell option, the program MULTI_IO.TP runs every time you turn on the controller. You cannot abort this program. To avoid getting this message, go to MENUS, SETUP, Shell Config.

Set the Using Multiio task item to NO from YES and then turn off the controller and turn it on. After you have set the index and want to run MULTI_IO.TP again, go back to the Shell Config screen, set NO to YES, and then cycle power again.

4.2.4 Setting Up Arm Load Information

Table 4-6 displays the items you can set up on the Motion/Armload screen.
Use Procedure 4-5 to set up arm load information.

Table 4-6 MOTION/ARMLOAD SET Items

ITEM	DESCRIPTION
ARM LOAD AXIS #1 [kg] Units: kg	This item is the additional weight mounted to axis 1.
ARM LOAD AXIS #3 [kg] Units: kg	This item is the additional weight mounted to axis 3.

Procedure 4-5 Arm Load Information

Steps

1. To set arm load information, press PREV until the payload schedule listing screen is displayed, and press F4, ARMLOAD. You will see a screen similar to the following.

```
MOTION PERFORMANCE
Group 1
1 ARM LOAD AXIS #1 [kg] 250.00
2 ARM LOAD AXIS #3 [kg] 20.00
Please power off/on after modification
```

a. **To display help** for the items on the screen, press F5, HELP. To display more information, use the arrow keys. When you are finished displaying help information, press PREV.
b. Move the cursor to the item you want to set and set it as desired.

Note Arm load includes any additional weight, such as tooling that is mounted on robot axes.

2. When you are finished setting all arm load payload information, CYCLE POWER.
a. Press FCTN.
b. Select CYCLE POWER, and press ENTER.
c. Select OK and press ENTER.

5 PURGE SYSTEM

For purge system troubleshooting, refer to Chapter 8 Troubleshooting.

The Purge and Pressurization control system for the P-50*i*B cell is based on the FANUC Robotics Purge Module II (EE-5404-001-005). This performs the following functions:
• Turn on and off the purge solenoid for the control of purge and pressurization air flow
• Monitor the status of the various pressure switches and flow switches
• Initiate and monitor the purge timing functions
• Enable the robot controller to be turned on

The major components of this system include:
• The Purge Module II in the main controller
• Purge solenoid located inside the robot base.
• Redundant pressure and flow switches in all purge cavities

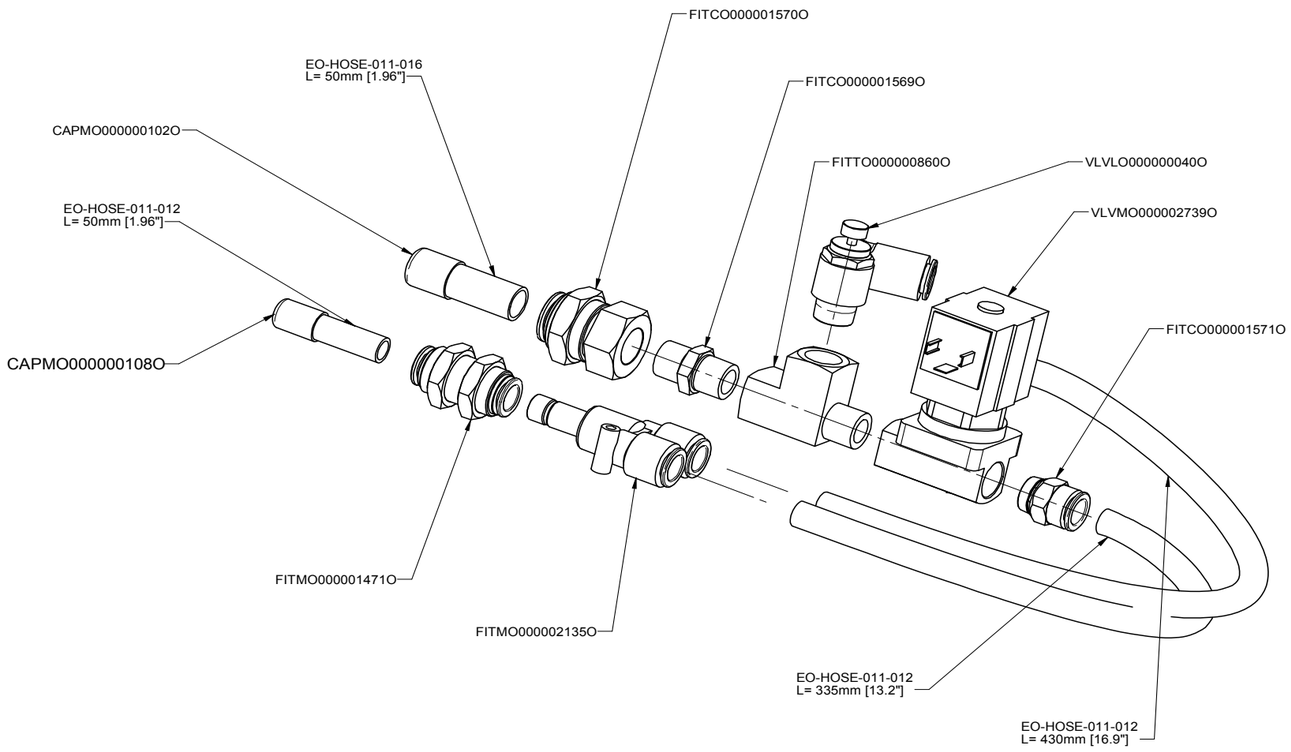
The P-50*iB* robots need to be purged and pressurized.

The Purge sequence for all units is initiated at each main controller. When the Purge Enable pushbutton is activated, the purge air solenoid(s) is turned on. The Purge Module II monitors the pressure switches (PS) and flow switches (FS) for each unit.

When the purge is compete the Purge Module II turns off the purge air and allows maintenance air to flow through the robot. Additionally the Purge Complete indicator for that controller is then activated and the controller may be turned on.

All robot units have series circuits for their PS and FS functions.

Figure 5-1 EO-6414-190-001, PURGE VALVE ASSEMBLY



WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

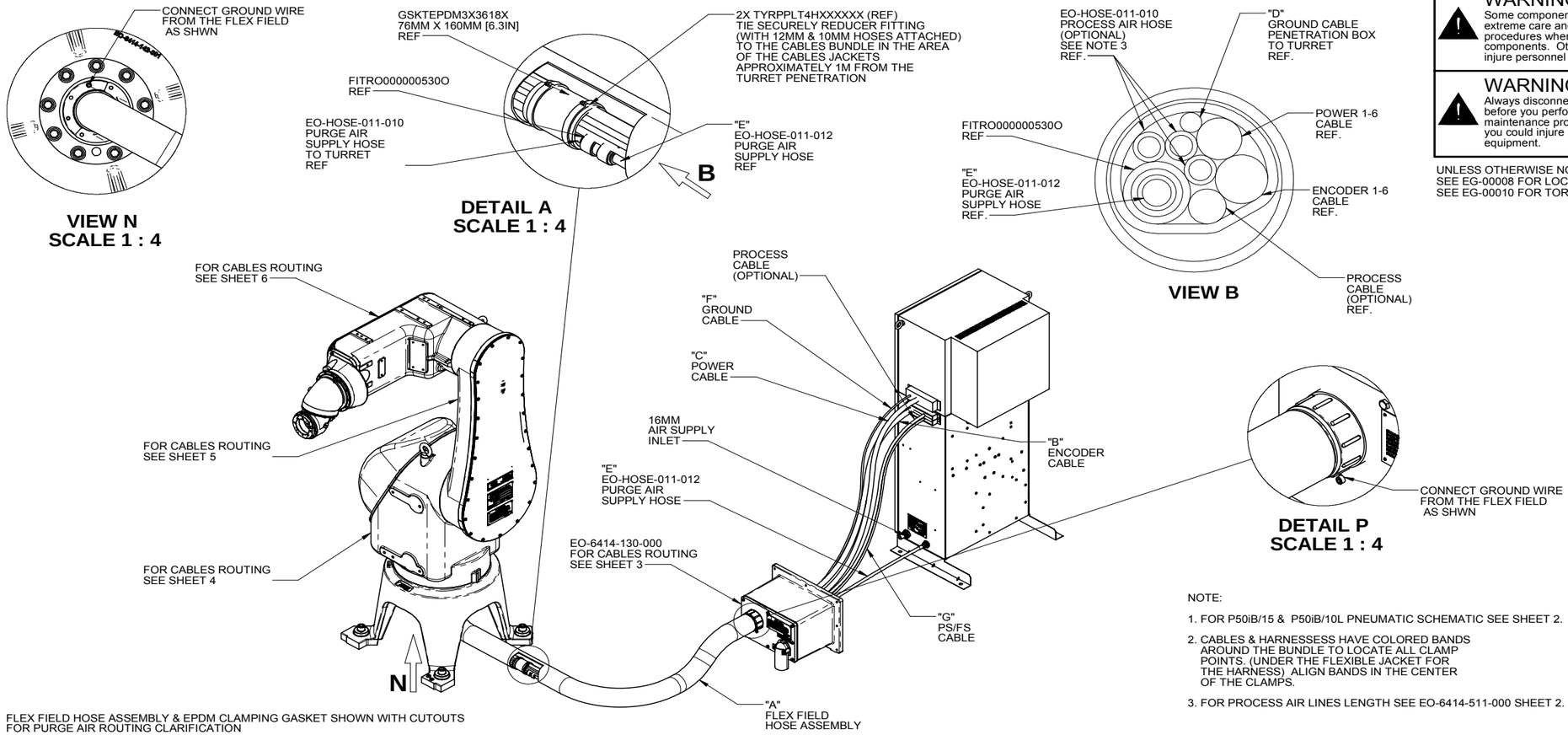
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

NOTE:

1. APPLY SMALL AMOUNT OF PERMATEX "NO MORE LEAKS" HDWMO0000038860 ON BARE FITTING THREADS WHERE APPROPRIATE.

[EO-6414-190-001]	REV B
PURGE VALVE ASSEMBLY	SHEET 1 OF 1

Figure 5-2 EO-6414-193-000 SHT1, CABLE AND PURGE ROUTING



FLEX FIELD HOSE ASSEMBLY & EPDM CLAMPING GASKET SHOWN WITH CUTOUTS FOR PURGE AIR ROUTING CLARIFICATION

NOTE:

1. FOR P50iB/15 & P50iB/10L PNEUMATIC SCHEMATIC SEE SHEET 2.
2. CABLES & HARNESSESS HAVE COLORED BANDS AROUND THE BUNDLE TO LOCATE ALL CLAMP POINTS. (UNDER THE FLEXIBLE JACKET FOR THE HARNESS) ALIGN BANDS IN THE CENTER OF THE CLAMPS.
3. FOR PROCESS AIR LINES LENGTH SEE EO-6414-511-000 SHEET 2.

ASSEMBLY No.	DESCRIPTION	"A"	"B"	"C"	"D"	"E"	"F"	"G"
		FLEX FIELD	ENCODER CABLE 7M	POPWER CABLE 7M	GROUND CABLE PENETRATION BOX TO TURET	PURGE AIR LINE COTROLLER TO PENETRATION BOX	GROUND CABLE CONTROLLER TO PENETRATION BOX	PS/FS CABLE CONTROLLER TO PENETRATION BOX
EO6414-193-000A	2M FLEX FIELD W/ 7M CABLES ASM	EO6414-135-000A	EE-6414-301-001	EE-6414-302-001	EE-6414-316-004	5 M	EE-6414-316-009	EE-6414-303-008
EO6414-193-000B	3.5M FLEX FIELD W/ 7M CABLES ASM	EO6414-135-000B	EE-6414-301-001	EE-6414-302-001	EE-6414-316-007	3.5 M	EE-6414-316-006	EE-6414-303-007
EO6414-193-000C	5.5M FLEX FIELD W/ 7M CABLES ASM	EO6414-135-000C	EE-6414-301-001	EE-6414-302-001	EE-6414-316-011	1.5 M	EE-6414-316-002	EE-6414-303-005
EO6414-193-000D	2M FLEX FIELD W/ 14M CABLES ASM	EO6414-135-000A	EE-6414-301-002	EE-6414-302-002	EE-6414-316-004	12 M	EE-6414-316-023	EE-6414-303-012
EO6414-193-000E	3.5M FLEX FIELD W/ 14M CABLES ASM	EO6414-135-000B	EE-6414-301-002	EE-6414-302-002	EE-6414-316-007	10.5 M	EE-6414-316-021	EE-6414-303-011
EO6414-193-000F	5.5M FLEX FIELD W/ 14M CABLES ASM	EO6414-135-000C	EE-6414-301-002	EE-6414-302-002	EE-6414-316-011	8.5 M	EE-6414-316-016	EE-6414-303-010
EO6414-193-000G	7.5M FLEX FIELD W/ 14M CABLES ASM	EO6414-135-000D	EE-6414-301-002	EE-6414-302-002	EE-6414-316-015	6.5 M	EE-6414-316-012	EE-6414-303-009
EO6414-193-000H	9.5M FLEX FIELD W/ 14M CABLES ASM	EO6414-135-000E	EE-6414-301-002	EE-6414-302-002	EE-6414-316-019	4.5 M	EE-6414-316-008	EE-6414-303-002
EO6414-193-000J	11M FLEX FIELD W/ 14M CABLES ASM	EO6414-135-000F	EE-6414-301-002	EE-6414-302-002	EE-6414-316-022	3 M	EE-6414-316-005	EE-6414-303-006

[EO-6414-193-000_SHT1] REV *2-*3
CABLE AND PURGE ROUTING

Figure 5-3 EO-6414-193-000 SHT2, CABLE & PURGE ROUTING PNEUMATIC SCHEMATIC

ABNORMAL PROCESSING

1. IF FLOW SWITCH (7) DOES NOT CLOSE DUE TO NOT-SUFFICIENT AIR FLOW, ETC., TIMING WILL NOT START. AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
2. IF THE PRESSURE SWITCH (10) IS NOT CLOSED DUE TO NOT-ENOUGH AIR PRESSURE (<0.172kPa), TIMING WILL NOT START. AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
3. IF THE FLOW SWITCH (7) OPENS AFTER PURGING HAS STARTED, TIMER (9) WILL BE RESET, PURGE FAULT INDICATION (3) WILL LIGHT. AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
4. AFTER PURGE IS COMPLETE, IF PRESSURE SWITCH (10) OPENS, THE OUTPUT CONTACTS (11) WILL OPEN, THE PURGE COMPLETE INDICATION (14) WILL GO OUT, AND PURGE FAULT INDICATION (3) WILL BE ON. AND THEREFORE, THE ROBOT CONTROLLER POWER IS IMMEDIATELY SHUT DOWN.
5. RELIEF VALVE (13) WILL OPEN AT 1.893kPa TO PREVENT EXCESSIVE PRESSURE IN THE EVENT OF AN AIR SUPPLY FAILURE.

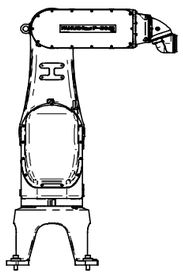
PURGE SEQUENCE

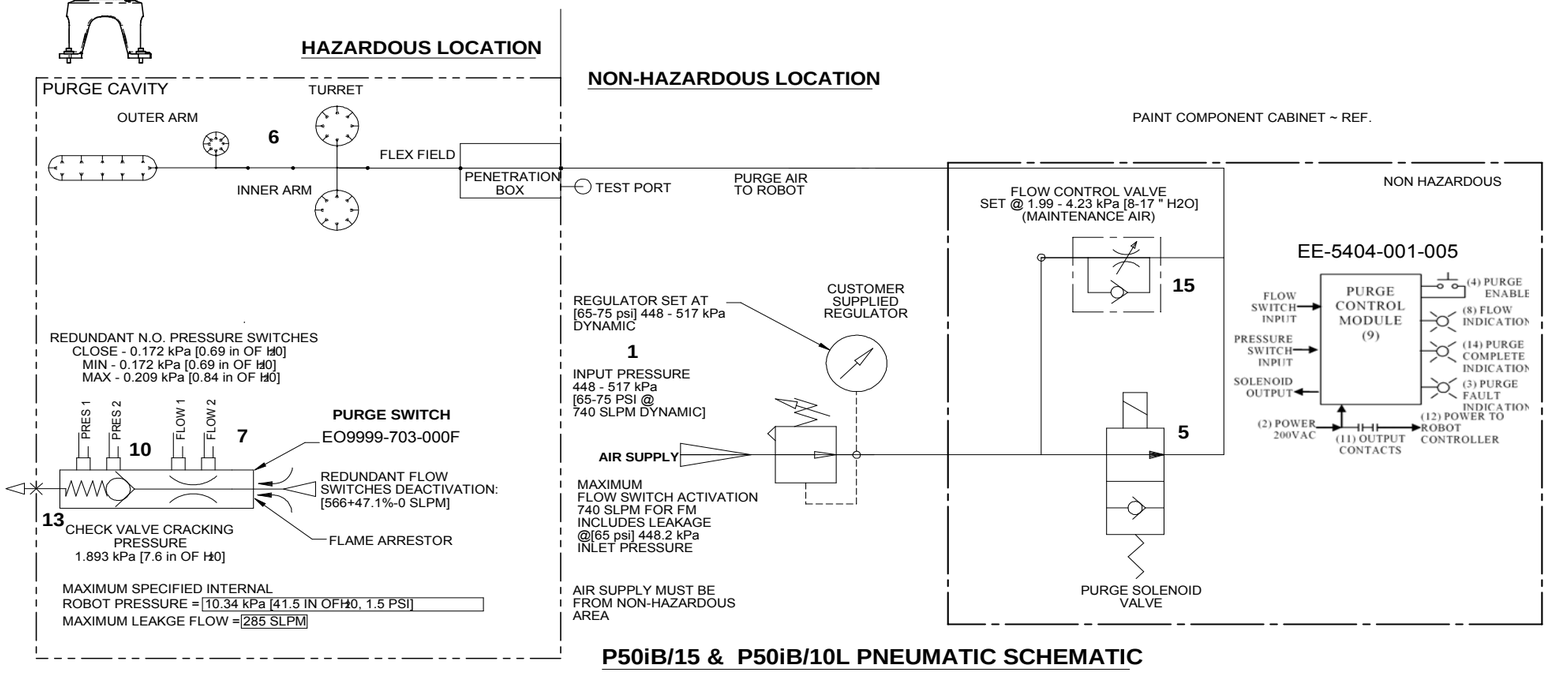
1. THE OPERATOR CONNECTS AIR SUPPLY TO ROBOT(1). PRESSURE SWITCH (10) CLOSES, AND REMAINS CLOSED AS LONG AS AIR IS SUPPLIED (0.172kPa MIN).
2. THE OPERATOR PROVIDES POWER TO CONTROLLER TERMINALS (2). AFTER POWER IS PROVIDED, THE PURGE FAULT INDICATION (3) TURNS ON.
3. THE OPERATOR PRESSES AND HOLDS PURGE ENABLE BUTTON(4).
4. PURGE CONTROL MODULE (9) SWITCHES THE SOLENOID VALVE (5) TO DISTRIBUTION LINES (6) TO START FLOW OF PURGE AIR. AIR WILL BE DISTRIBUTED THROUGHOUT ROBOT CAVITY BY DISTRIBUTION LINES (6).
5. FLOW IS MONITORED BY THE FLOW SWITCH (7) AT AIR OUTLET. WHEN FLOW REACHES 566 L/MIN, FLOW SWITCH (7) CLOSES THE ELECTRIC CONTACTS, FLOW INDICATION (8) WILL COME ON AND THE PURGE CONTROL MODULE (9) START TIMING. AT THE SAME TIME, PURGE FAULT INDICATION (3) TURNS OFF.
6. WHEN FLOW INDICATION COMES ON (8), THE OPERATOR CAN RELEASE THE PURGE ENABLE BUTTON (4).
7. PURGE FLOW CONTINUES FOR 3.5 MINUTES TO ENSURE 10 AIR CHANGES. TIME IS MEASURED BY HARDWARE LOGIC IN THE PURGE CONTROL MODULE (9). (MINIMUM PURGE TIME) = 10*(TOTAL CAPACITY OF ROBOT AND HOSE) / (FLOW RATE) = 10x153/566=2.7 MINUTES.
8. AFTER 3.5 MINUTES, PURGE IS COMPLETE. PURGE CONTROL MODULE (9) SWITCHES THE SOLENOID VALVE (5) TO MAINTENANCE AIR (15), AND CLOSES THE OUTPUT CONTACTS (11) TO PROVIDE POWER TO ROBOT CONTROLLER, AND TURNS THE PURGE COMPLETE INDICATION (14) ON. THE AIR PRESSURE IN THE CAVITY DECREASES, AND CHECK VALVE (13) CLOSES TO PREVENT LOSS OF MAINTENANCE AIR.
9. ROBOT CAN NOW BE TURNED ON. AS LONG AS PURGE IS COMPLETE, ROBOT MAY BE TURNED ON AND OFF AS DESIRED.

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

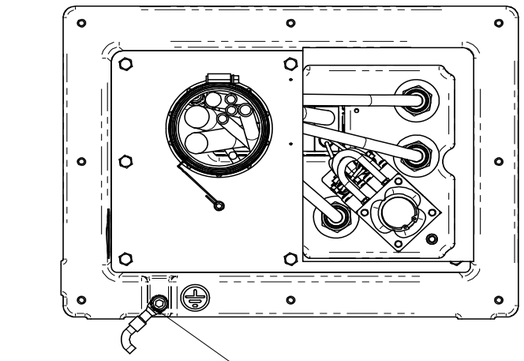




P50iB/15 & P50iB/10L PNEUMATIC SCHEMATIC

[EO-6414-193-000 SHT2] REV *1
CABLE & PURGE ROUTING PNEUMATIC SCHEMATIC

Figure 5-4 EO-6414-193-000 SHT3, CABLE AND PURGE ROUTING PENETRATION BOX



EXTERNAL GROUND CONNECTION

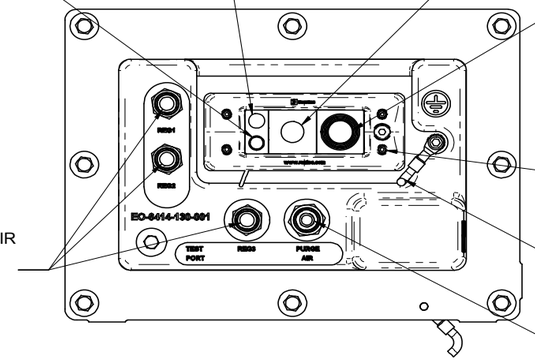
"G"
PS/FS
CABLE
REF.
REMOVE 5 LAYERS
FROM THE ROXTEC
SEALING MODULE

PROCESS
CABLE
(OPTIONAL)
REMOVE 7 LAYERS
FROM THE ROXTEC
SEALING MODULE

"C"
POWER
CABLE
REF.
REMOVE 6 LAYERS
FROM THE ROXTEC
SEALING MODULE

"B"
ENCODER
CABLE
REF.
REMOVE 8 LAYERS
FROM THE ROXTEC
SEALING MODULE

EO-HOSE-011-010
∅10 MM PROCESS AIR
SUPPLY HOSE
(OPTIONAL)

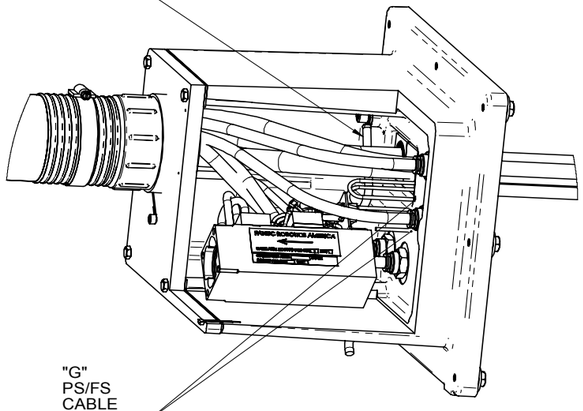


TORQUE
SCREWS TO
5 - 7 Nm

"F"
GROUND CABLE
REF.

"E"
EO-HOSE-011-012
PURGE AIR
SUPPLY HOSE
REF.

"D"
GROUND CABLE
REF.



"G"
PS/FS
CABLE
REF.

PENETRATION BOX SHOWN WITH PARTIAL CUTOUT FOR CABLE ROUTING CLARIFICATION SCALE 1:2

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

NOTE:

WHEN INSTALLING CABLES INTO THE ROXTEC FRAME FOLLOW MANUFACTURER RECOMMENDATIONS:

PAY SPECIAL ATTENTION TO CLAMP CABLES FIRST THEN MOUNT THE FRAME (APPLY ROXTEC LUBRICANT AS NEEDED),
SLIDE CABLES AS NEEDED, BUT MAKE SURE
NOT TO PULL SEALING MODULES OUT OF THE POSITION.

[EO-6414-193-000_SHT3] REV *1
CABLE AND PURGE ROUTING PENETRATION BOX

6 MASTERING

6.1 Overview

When you master a robot you define the physical location of the robot by synchronizing the mechanical information with the robot's positional information. A robot must be mastered to operate properly. Robots are usually mastered before they leave FANUC Robotics. However, it is possible that a robot might lose its mastering data and need to be remastered.

The robot axes are controlled by a closed loop servo system. The controller outputs a command signal to drive each motor. A feedback device mounted on the motor, called a serial pulse coder, sends a signal back to the controller. During robot operation, the controller constantly analyzes the feedback signal, and modifies the command signal to maintain proper location and velocity of the end effector at all times.

For the robot to move accurately to recorded positions, the controller has to "know" the position of each axis. It does this by comparing the serial pulse coder reading during operation with a reading taken at a known mechanical reference point on the robot. Mastering records the serial pulse coder reading at a known mechanical reference point. This mastering data is stored with other user data in the controller memory and backed up by a lithium battery so that it is maintained when the controller is shut down.

When the controller is shut down under normal conditions, each serial pulse coder's present reading is maintained in the pulse coder by backup batteries on the robot. (These batteries might be located in the controller or the robot auxiliary panel on P-series robots.) When the controller is turned on, the controller requests the stored reading from the serial pulse coder. When the controller receives the pulse coder reading, the servo system can operate normally. This process is called calibration. Calibration occurs automatically each time the controller is turned on.

When pulse coder backup battery power is interrupted while the controller is powered down, calibration fails at power up and the only robot motion possible is joint mode jogging. To restore proper operation, the robot must be mastered and calibrated.

WARNING:
When calibration has failed, the axis software travel limits will be ignored, allowing the robot to be jogged farther than normal. Be careful when jogging the robot in an uncalibrated condition or you could injure personnel or damage equipment.

WARNING:
If the robot has been configured with DCS (Dual Check Safety), consult the DCS manual for mastering instructions.

Note The following procedures might be password-protected on your robot. If passwords have been set, you will need access at the Install level to perform mastering. Obtain the Install level password and log in at the Install level, or you will be unable to perform the following procedures.

Before mastering the robot, you must clear any faults that prevent servo power from being restored or that prevent mastering completion.

Use Procedure 6-1 to clear common faults related to mastering and to prepare the robot for mastering. For more detailed information on fault recovery, refer to the *FANUC Robotics Controller Maintenance Manual.*

If you are using a FANUC Robotics A-series robot you should use a mastering fixture to master your robot. Fixture mastering is performed on **FANUC Robotics P-series robots** by aligning mastering pins and surfaces on the robot. Refer to the *Mechanical Unit Service Manual* specific to your robot model for procedures on how to set up and use a mastering fixture.

If you are using a FANUC Robotics M-series or S-series robot you can either master to a fixture or you can master to zero degrees. Refer to the *Mechanical Unit Service Manual* specific to your robot model for more information about either of these methods.

If you are using a FANUC Robotics P-series robot, and you have zero degree witness marks scored onto your robot, then you can master the robot to zero degrees. Refer to the *Mechanical Unit Service Manual* specific to your robot model for procedures on how to master your robot.

Quick mastering is a convenient way to master a robot **after** you have recorded a reference position. You cannot quick master a robot unless the reference position was taught before mastering was lost.

CAUTION:
Record the quick master reference position after the robot is installed to preserve the factory mastering settings for future remastering.

Table 6-1 SYSTEM Master/Cal Items

ITEM	DESCRIPTION
SET QUICK MASTER REF	This item allows you to set master reference positions. You can save the master reference positions to the default device in case the robot has lost mastery due to an electrical or software problem.
FIXTURE POSITION MASTER	This item allows you to master the robot to a fixture. When you master to a fixture, you use a mastering fixture to align the robot axes and then record their serial pulse coder readings. You can master any robot to a fixture.
SINGLE AXIS MASTER	This item allows you to master a single axis of the robot. You can master a single axis of any robot provided that there is a reference mark at a known position on that axis. When a single axis of a robot is mastered, mastering data for the other axes remains unchanged.
QUICK MASTER	This item allows you to quick master the robot. Quick mastering allows you to minimize the time required to remaster the robot using a reference position you established when the robot was properly mastered. You cannot quick master the robot unless you have previously recorded this quick master reference position. Record the quick master reference position when the robot is properly mastered. The best time to record the quick master reference position is when the robot is still factory-mastered.
ZERO POSITION MASTER	This item allows you to master the robot to zero degrees. When you master to zero degrees, you position all axes at their zero degree witness marks and record their serial pulse coder readings. You can master any M-series or S-series robot to zero degrees. If you are using a FANUC Robotics P-series robot, and you have witness marks scored onto your robot, you can master the robot to zero degrees.
CALIBRATE	This item allows you to calibrate the robot.
Message Field	This item is a status area at the bottom of the screen that lets you know when the robot has been successfully mastered or calibrated.

6.2 Resetting Alarms and Preparing For Mastering

When you turn on the robot after pulse coder backup battery power has been interrupted you will see a SRVO-062 BZAL alarm. You might also see a SRVO-038 Pulse Mismatch alarm. Before mastering the robot you must reset these alarms and rotate the motor of each axis that lost battery power to prepare the robot for mastering. Use Procedure 6-1 to reset these alarms and prepare the robot for mastering.

Procedure 6-1 Preparing the Robot for Mastering

Conditions

• You see a SRVO-062 BZAL or SRVO-038 Servo mismatch alarm.

• You are not mastering a P-200 robot.

Steps

1. If necessary, replace the robot batteries with four new 1.5 volt alkaline batteries, size D. Observe the direction arrows in the battery box for proper orientation of the batteries.
2. Press MENUS.
3. Select SYSTEM.
4. Press F1, [TYPE].
5. If Master/Cal is not listed on the [TYPE] menu, do the following; otherwise, continue to Step 6
   a. Move the cursor to VARIABLE and press ENTER.
   b. Move the cursor to $MASTER_ENB.
   c. Press the numeric key "1" and then press ENTER on the teach pendant.
   d. Press F1, [TYPE].
6. Select Master/Cal. You will see a screen similar to the following.

WARNING:
For the M-6i (ARC Mate 100i), M-16i (ARC Mate 120i), and M-16iL (ARC Mate 120iL) robots, setting TORQUE to OFF using the F4, TORQUE function key on the SYSTEM Master/Cal screen releases the robot brakes. When the brakes are released, the robot arm will drop suddenly unless it is supported. DO NOT use this function key unless instructed to do so, otherwise, you could injure personnel or damage equipment.

```
SYSTEM Master/Cal
TORQUE = ON
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
```

Note F4, TORQUE does not appear on the Master/Cal screen for all robot models. When F4, TORQUE appears on the Master/Cal screen, it allows the robot brakes to be released.

7. Press F3, RES_PCA. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Reset pulse coder alarm? [NO]
```

8. Press F4, YES. You will see a screen similar to the following.

```
SYSTEM Master/Cal
TORQUE = ON
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Pulse coder alarm reset!
```

Note If you exit the Master/Cal screen by pressing F5, DONE, the Master/Cal screen will be hidden. Master/Cal will not be available by pressing F1, [TYPE]. To display the Master/Cal screen again, perform Step 1 through Step 6 .

9. Turn off the controller.
10. Wait a few seconds, then turn the power disconnect circuit breaker on to turn the controller on again.
11. If the SRVO-062 BZAL alarm is still present; there is a battery, cable or pulsecoder problem. Refer to the *FANUC Robotics Controller Maintenance Manual* for further information.
12. If a SRVO-038 Pulse Mismatch alarm is present at this time, repeat Step 1 through Step 8 to reset it. It is not necessary to restart the robot after resetting to clear this alarm.
13. If a SRVO-075 Pulse Not Established alarm is present at this time, press the RESET key to clear it.
14. Rotate each axis that lost battery power by at least one motor revolution in either direction. Failure to do so will result in the SRVO-075 Pulse Not Established alarm recurring and mastering will not be possible.
    a. For each rotary axis, jog at least twenty degrees.
    b. For each linear axis, jog at least thirty millimeters.
15. Perform any of the mastering procedures from the MASTER/CAL menu.

6.3 Saving and Restoring Mastering Data

You can save the master reference positions to the default device in case the robot has lost mastery due to an electrical or software problem. Use Procedure 6-2 to save and restore master reference position data.

Procedure 6-2 Saving and Restoring Master Reference Position Data

Conditions

• The robot is mastered. Refer to Section 6.4 through Section6.6 to choose a mastering method and master your robot.
• The default device is set.
• The robot is on and is working properly.

Steps

1. Press MENUS.
2. Select SYSTEM.
3. Press F1, [TYPE].
4. Select Master/Cal.
If Master/Cal is not listed on the [TYPE] menu, do the following; otherwise, continue to Step 5
    a. Select VARIABLE from the [TYPE] menu.
    b. Move the cursor to $MASTER_ENB.
    c. Press the numeric key "1" and then press ENTER on the teach pendant.
    d. Press F1, [TYPE].
    e. Select Master/Cal. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press ‘Enter’ or number key to select.
```

Note F4, TORQUE does not appear on the Master/Cal screen for all robot models. When F4, TORQUE appears on the Master/Cal screen, it allows the robot brakes to be released.

5. Press FCTN.
6. Select SAVE. The file SYSMAST.SV is copied to the default device.
7. To restore the saved file, press F2, LOAD.

6.4 Single Axis Mastering

You can master a single axis of any robot provided that there is a reference mark at a known position on that axis. When a single axis of a robot is mastered, mastering data for the other axes remains unchanged. Use Procedure 6-3 to master a single axis.

Procedure 6-3 Mastering a Single Axis

Conditions

• You have cleared any servo faults that prevent you from jogging the robot.
• You have jogged each axis that has lost mastering at least one motor turn. See Procedure 6-1

Steps

1. Jog the unmastered axis of the robot to the single axis mastering position.
• **For M-series or S-series robots only:** Using the joint coordinate system, jog the unmastered axis of the robot to the zero degree witness mark. If you are single axis mastering the J2-axis, the J3-axis must first be lined up at its zero degree mark. Otherwise the positions of the other axes are unimportant. Refer to the *Mechanical Service Manual* specific to your robot model for the location of the zero degree witness marks.
• **For P-series robots only:** Using the joint coordinate system, jog the unmastered axis of the robot to the standard mastering location and align the mark, pin or surface using a mastering block or straight edge as required. If you are single axis mastering the J3-axis, the J2-axis must first be lined up at its standard mastering location. Otherwise, the positions of the other axes are not important.
2. Press MENUS.
3. Select SYSTEM.
4. Press F1, [TYPE].
5. If Master/Cal is not listed on the [TYPE] menu, do the following; otherwise, continue to Step 6
    a. Select VARIABLE.
    b. Move the cursor to $MASTER_ENB.
    c. Press the numeric key "1" and then press ENTER on the teach pendant.
    d. Press F1, [TYPE].
6. Select Master/Cal. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
```

Note F4, TORQUE does not appear on the Master/Cal screen for all robot models. When F4, TORQUE appears on the Master/Cal screen, it allows the robot brakes to be released.

7. Move the cursor to SINGLE AXIS MASTER and press ENTER. You will see a screen similar to the following

```
SINGLE AXIS MASTER
ACTUAL  POS     (MSTR POS)   (SEL)    [ST]
J1    0.000    (    0.000)    (0)      [2]
J2    3.514    (   35.000)    (0)      [0]
J3   -7.164    ( -100.000)    (0)      [2]
J4  -35.366    (    0.000)    (0)      [2]
J5   -1.275    (  -80.000)    (0)      [2]
J6    4.571    (    0.000)    (0)      [2]
E1    0.000    (    0.000)    (0)      [0]
E2    0.000    (    0.000)    (0)      [0]
E3    0.000    (    0.000)    (0)      [0]
```

Note A "0" in the [ST] column indicates that the axis is unmastered.

8. Move the cursor to the (MSTR POS) column and move it up or down to the unmastered axis. (Any unmastered axis will have the number 0 in the [ST] column).
9. For M-series or S-series robots only: Enter the position where single axis mastering is to be performed in the (MSTR POS) column for the unmastered axis.
a. For robots where single axis mastering is performed at the zero degree position, press the numeric key "0" and press ENTER.
b. For robots where single axis mastering is performed at the fixture position, enter the fixture position and press ENTER.

Note Some P-series robots are single axis mastered at the fixture position. All other robots are single axis mastered at the zero degree position.

10. Continuously press and hold the DEADMAN switch and turn the teach pendant ON/OFF switch to ON.
11. Press F4, GROUP. Enter the appropriate group number. Enter 1 for a left robot or 2 for a right robot. The left and right designation is determined by looking downstream of the conveyer travel.
12. Move the cursor to the SEL column and move it up or down to the unmastered axis.
13. Press the numeric key "1" and press ENTER.
14. Press F5, EXEC. Mastering will be performed automatically. You will see a screen similar to the following.

```
SINGLE AXIS MASTER
ACTUAL POS    (MSTR POS)   (SEL)   [ST]
J1    0.000   (    0.000)   (0)     [2]
J2    3.514   (    0.000)   (0)     [2]
J3   -7.164   (-100.000)    (0)     [2]
J4  -35.366   (    0.000)   (0)     [2]
J5   -1.275   ( -80.000)    (0)     [2]
J6    4.571   (    0.000)   (0)     [2]
E1    0.000   (    0.000)   (0)     [0]
E2    0.000   (    0.000)   (0)     [0]
E3    0.000   (    0.000)   (0)     [0]
```

Note The J2 axis is now mastered and a 2 is displayed in the [ST] column.

15. Press PREV.
16. Move the cursor to CALIBRATE and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Calibrate ? [NO]
```

17. Press F4, YES. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Robot Calibrated! Cur Jnt Ang(deg):
<0.000> <0.000> <-7.164>
<-35.366> <-1.275> <4.571>
```

Note If you exit the Master/Cal screen by pressing F5, DONE, the Master/Cal screen will be hidden. Master/Cal will not be available by pressing 1, [TYPE]. To display the Master/Cal screen again perform Step 1 through Step 6

6.5 Quick Mastering

Quick mastering allows you to minimize the time required to remaster the robot using a reference position you established when the robot was properly mastered. You cannot quick master the robot unless you have previously recorded this quick master reference position.

Record the quick master reference position when the robot is properly mastered. The best time to record the quick master reference position is when the robot is still factory-mastered.

If calibration fails because pulse coder backup battery power has been interrupted, you can use this reference position to master the robot in a minimum amount of time. When the zero position marks do not line up because of mechanical disassembly or repair, you must master to a fixture or perform zero degree mastering.

You can define a quick master reference position and perform quick mastering on any robot model.

Use Procedure 6-4 to record the quick master reference position. Use Procedure 6-5 to quick master the robot.

CAUTION:
Record the quick master reference position after the robot is installed to preserve the factory mastering settings for future remastering.

Procedure 6-4 Recording the Quick Master Reference Position

Conditions

• The robot is properly mastered.

Steps

1. Align each axis of the robot with the reference mark you have chosen as a quick master reference position.

Note It is convenient to use the zero degree marks for the quick master reference position Refer to the *Mechanical Unit Service Manual* specific to your robot model for the location of the zero degree marks. But if you prefer, you can use any robot position as long as you scribe witness marks on each axis at the reference point.

2. Press MENUS.
3. Select SYSTEM.
4. Press F1, [TYPE].
5. If Master/Cal is not listed on the [TYPE] menu, do the following; otherwise, continue to Step 6
   a. Select VARIABLE.
   b. Move the cursor to $MASTER_ENB.
   c. Press the numeric key "1" and then press ENTER on the teach pendant.
   d. Press F1, [TYPE].
6. Select Master/Cal. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
```

Note F4, TORQUE does not appear on the Master/Cal screen for all robot models. When F4, TORQUE appears on the Master/Cal screen, it allows the robot brakes to be released.

7. Move the cursor to SET QUICK MASTER REF and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Set quick master reference ? [NO]
```

8. Press F4, YES. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Quick Master Reference Set!
```

Note If you exit the Master/Cal screen by pressing F5, DONE, the Master/Cal screen will be hidden. Master/Cal will not be available by pressing F1, [TYPE]. To display the Master/Cal screen again, perform Step 1 through Step 6

Procedure 6-5 Quick Mastering the Robot

Conditions

• Calibration has failed because backup battery power has been interrupted.

Note If the zero degree marks do not line up because of mechanical disassembly or repair, you cannot perform this procedure. In this case, master to a fixture or master to zero degrees to restore robot mastering.

• The quick master reference position was recorded before calibration failed.
• You have cleared any servo faults that prevent you from jogging the robot.
• You have jogged each axis that has lost mastering at least one motor turn. See Procedure 6-1

Steps

1. Jog the robot to the quick master reference position that has previously been recorded.
2. Press MENUS.
3. Select SYSTEM.
4. Press F1, [TYPE].
5. If Master/Cal is not listed on the [TYPE] menu, do the following; otherwise, continue to Step 6
    a. Select VARIABLE.
    b. Move the cursor to $MASTER_ENB.
    c. Press the numeric key "1" and then press ENTER on the teach pendant.
    d. Press F1, [TYPE].
6. Move the cursor to Master/Cal and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press ’ENTER’ or number key to select.
```

Note F4, TORQUE does not appear on the Master/Cal screen for all robot models. When F4, TORQUE appears on the Master/Cal screen, it allows the robot brakes to be released.

7. Move the cursor to QUICK MASTER and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Quick master ? [NO]
```

8. Press F4, YES. Mastering will be performed automatically. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Robot Mastered!  Mastering Data:
<0> <11808249> <38767856>
<9873638> <122000309> <2000319>
```

9. Move the cursor to CALIBRATE and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Calibrate ? [NO]
```

10. Press F4, YES. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Robot Calibrated!  Cur Jnt Ang(deg):
<0.003> <-0.0012> <-0.050>
<0.009> <0.015> <-0.002>
```

Note If you exit the Master/Cal screen by pressing F5, DONE, the Master/Cal screen will be hidden. Master/Cal will not be available by pressing F1, [TYPE]. To display the Master/Cal screen again, perform Step 1 through Step 6

6.6 Mastering To A Fixture (Fixture Position Master)

When you master to a fixture, you use a mastering fixture to align the robot axes and then record their serial pulse coder readings. You can master any robot to a fixture. P-series paint robots do not use fixtures. A mastering block, and in some cases, a steel straight edge or ruler is used to align mastering surfaces on P-series paint robots.

A mastering block is used for aligning the mastering surfaces of the modular in-booth rail.
Use Procedure 6-6 to master to a fixture. **Note** that not all steps refer to paint robots.

Procedure 6-6 Mastering to a Fixture

Conditions

- You have the appropriate mastering fixture for your robot. (P-series robots require the robot to be put in a fixture position only. They do not actually use a fixture.)
- You have cleared any servo faults that prevent you from jogging the robot.
- You have jogged each axis that has lost mastering at least one motor turn. See Procedure 6-1

Steps

1. If automatic brake control is enabled, disable it as follows; otherwise continue to Step 2 . This step is not for paint robots.
   a. Press MENUS.
   b. Select SYSTEM.
   c. Press F1, [TYPE].
   d. Select VARIABLE.
   e. Move the cursor to $PARAM_GROUP and press ENTER twice.
   f. Move the cursor to $SV_OFF_ALL and press F5, FALSE.
   g. Move the cursor to $SV_OFF_ENB and press ENTER.
   h. Move the cursor to each line where the value is TRUE, and press F5, FALSE.
   i. Turn off the controller.
   j. Turn on the controller.

2. Install the mastering fixture on the robot and jog the robot into the mastering position. Refer to the *Mechanical Service Manual* specific to your robot model for the procedures for setup and use of a mastering fixture. For P-series robots align the mastering surfaces using the appropriate mastering block or straight edge. The modular in-booth rail uses a block.

3. Press MENUS.

4. Select SYSTEM.

5. Press F1, [TYPE].

6. If Master/Cal is not listed on the [TYPE] menu, do the following; otherwise, continue to Step 7
   a. Move the cursor to VARIABLE and press ENTER.
   b. Move the cursor to $MASTER_ENB.
   c. Press the numeric key "1" and then press ENTER on the teach pendant.
   d. Press F1, [TYPE].

7. Select Master/Cal. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press ’ENTER’ or number key to select.
```

Note F4, TORQUE does not appear on the Master/Cal screen for all robot models. When F4, TORQUE appears on the Master/Cal screen, it allows the robot brakes to be released. This step is not for paint robots.

8. Move the cursor to FIXTURE POSITION MASTER and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Master at master position ? [NO]
```

9. Press F4, YES. Mastering will be performed automatically. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Robot Mastered! Mastering Data:
<0> <11808249> <38767856>
<9873638> <122000309> <2000319>
```

10. Move the cursor to CALIBRATE and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Calibrate ? [NO]
```

11. Press F4, YES. You will see a screen similar to the following

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Robot Calibrated!  Cur Jnt Ang(deg):
  <0.000> <29.226> <-100.625>
  <0.000> <-79.375> <0.000>
```

Note If you exit the Master/Cal screen by pressing F5, DONE, the Master/Cal screen will be hidden. Master/Cal will not appear on the SYSTEM F1, [TYPE] submenu. To see the Master/Cal screen again perform Step 1 through Step 7. Steps 12 —15 are not for paint robots.

12. For all robots except paint robots, move the wrist clear of the mastering fixture and remove the mastering fixture from the robot. Refer to the *Mechanical Service Manual* or *Mechanical Connection and Maintenance Manual* specific to your robot model on how to use a mastering fixture.

13. If you have disabled automatic brake control (this step is not for paint robots) in Step 1 , enable it as follows:

a. Press MENUS.

b. Select SYSTEM.

c. Press F1, [TYPE]
d. Select VARIABLE.
e. Move the cursor to $PARAM_GROUP and press ENTER twice.
f. Move the cursor to $SV_OFF_ALL and press F4, TRUE.
g. Move the cursor to $SV_OFF_ENB and press ENTER.
h. Move the cursor to each line where you previously changed the value, and press F4, TRUE.

14. Turn off the controller.
15. Wait a few seconds, then press the ON/OFF button on the operator panel to turn the controller on again.

6.7 Zero Degree Mastering

When you master to zero degrees, you position all axes at their zero degree witness marks and record their serial pulse coder readings. You can master any M-series or S-series robot to zero degrees.
If you are using a FANUC Robotics P-series robot, and you have witness marks scored onto your robot, you can master the robot to zero degrees.
Use Procedure 6-7 to master to zero degrees

Procedure 6-7 Mastering to Zero Degrees

Conditions

• You have cleared any servo faults that prevent you from jogging the robot.
• You have jogged each axis that has lost mastering at least one motor turn. Refer to Procedure 6-1

Steps

1. Using the joint coordinate system, jog each axis of the robot to the zero degree witness mark. Refer to the *Mechanical Service Manual* specific to your robot model for the location of the witness marks.
2. Press MENUS.
3. Select SYSTEM.
4. Press F1, [TYPE].
5. If Master/Cal is not listed on the [TYPE] menu, do the following; otherwise, continue to Step 6
a. Select VARIABLE.
b. Move the cursor to $MASTER_ENB.
c. Press the numeric key "1" and then press ENTER on the teach pendant.
d. Press F1, [TYPE].
6. Select Master/Cal. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press ’ENTER’ or number key to select.
```

Note F4, TORQUE does not appear on the Master/Cal screen for all robot models. When F4, TORQUE appears on the Master/Cal screen, it allows the robot brakes to be released.

7. Move the cursor to ZERO POSITION MASTER and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Master at zero position ? [NO]
```

8. Press F4, YES. Mastering will be performed automatically. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Robot Mastered!  Mastering Data:
<0> <11808249> <38767856>
<9873638> <122000309> <2000319>
```

9. Move the cursor to CALIBRATE and press ENTER. You will see a screen similar to the following.

```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Press 'ENTER' or number key to select.
Calibrate ? [NO]
```

10. Press F4, YES. You will see a screen similar to the following.

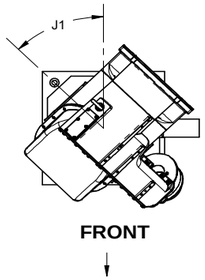
```
SYSTEM Master/Cal
1 FIXTURE POSITION MASTER
2 ZERO POSITION MASTER
3 QUICK MASTER
4 SINGLE AXIS MASTER
5 SET QUICK MASTER REF
6 CALIBRATE
Robot Calibrated!  Cur Jnt Ang(deg):
<0.000> <0.000> <0.000>
<0.000> <0.000> <0.000>
```

Note If you exit the Master/Cal screen by pressing F5, DONE, the Master/Cal screen will be hidden. Master/Cal will not be available by pressing F1, [TYPE]. To display the Master/Cal screen again perform Step 1 through Step 6

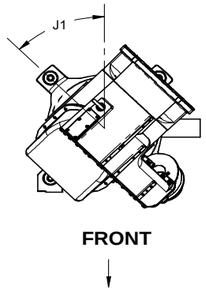
6.8 P-50iB Mastering Locations

Figure 6-1 ET-6414-845-001_SHT1, P50iB/15 MASTERING

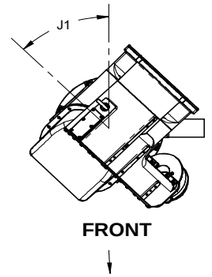
INNER ARM LEFT OFFSET (LH) P50iB/15 ROBOT ON USER OR INTEGRATOR RISER AXIS 1 MASTERING



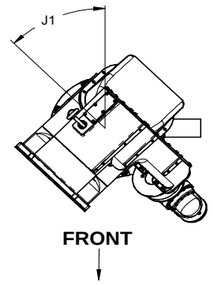
INNER ARM LEFT OFFSET (LH) P50iB/15 ROBOT ON FRA CAST PEDESTAL AXIS 1 MASTERING



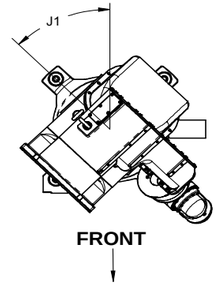
INNER ARM LEFT OFFSET (LH) P50iB/15 ROBOT ON FRA PEDESTAL PLATE AXIS 1 MASTERING



INNER ARM RIGHT OFFSET (RH) P50iB/15 ROBOT ON FRA PEDESTAL PLATE AXIS 1 MASTERING



INNER ARM RIGHT OFFSET (RH) P50iB/15 ROBOT ON FRA CAST PEDESTAL AXIS 1 MASTERING

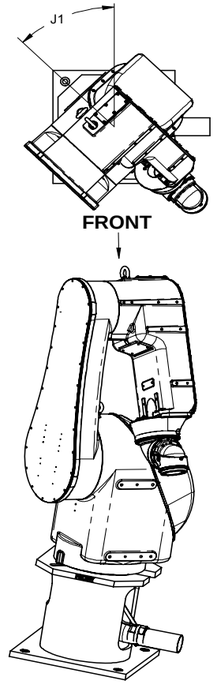


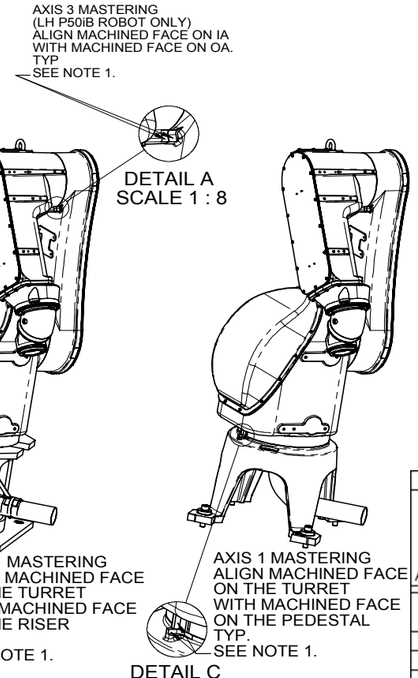
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

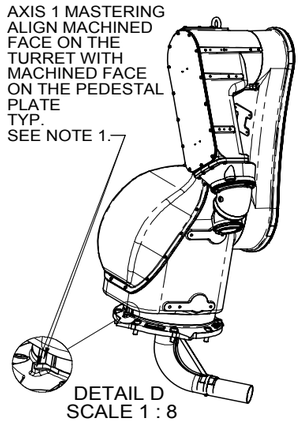
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

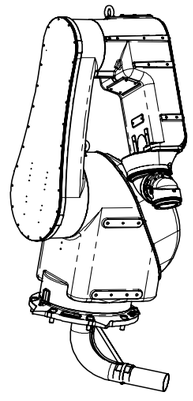
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

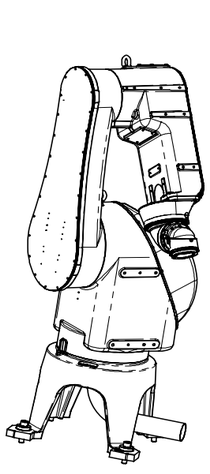
INNER ARM RIGHT OFFSET (RH) P50iB/15 ROBOT ON USER OR INTEGRATOR RISER AXIS 1 MASTERING











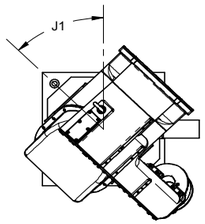
P50iB/15 FLOOR & WALL MOUNT MASTERING JOINT ANGLES					
AXIS #	CONVEYOR LEFT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR LEFT, INNER ARM RIGHT OFFSET, (RH)	CONVEYOR RIGHT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR RIGHT, INNER ARM RIGHT OFFSET, (RH)	COMMENTS
J1	-45°	-45°	+45°	+45°	SEE SHEET 1
J2	0°	0°	0°	0°	SEE SHEET 3
J3	-55°	-55°	-55°	-55°	SEE SHEET 1
J4	0°	180°	0°	180°	SEE SHEET 3
J5	0°	0°	0°	0°	SEE SHEET 3
J6	0°	0°	0°	0°	SEE SHEET 3

NOTE:
1. USE ANY SQUARE, STRAIGHT AND FLAT GAUGE OR OBJECT TO ALIGN MASTERING SURFACES FOR AXIS J1, J2 AND J3.
2. FOR AXIS: J4, J5 AND J6 - MASTER BY PLACING ANY SQUARE, STRAIGHT EDGE AND FLAT OBJECT ON THE MASTERING FACE. THEN ROTATE EACH AXIS UNTIL MASTERING PIN JUST TOUCHES THE MASTERING OBJECT.

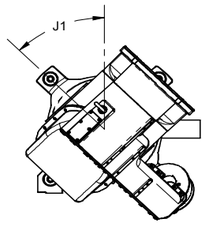
[ET-6414-845-001_SHT1] REV A
P50iB/15 MASTERING

Figure 6-2 ET-6414-845-001 SHT2, P50iB/10L MASTERING

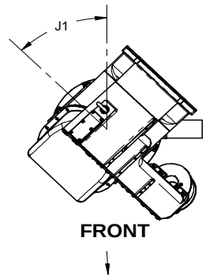
INNER ARM LEFT OFFSET (LH) P50iB/10L ROBOT ON USER OR INTEGRATOR RISER AXIS 1 MASTERING



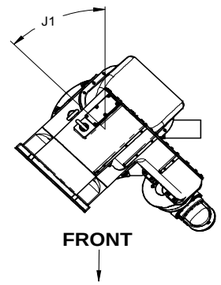
INNER ARM LEFT OFFSET (LH) P50iB/10L ROBOT ON FRA CAST PEDESTAL AXIS 1 MASTERING



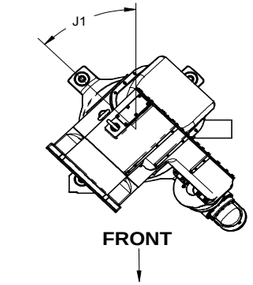
INNER ARM LEFT OFFSET (LH) P50iB/10L ROBOT ON FRA PEDESTAL PLATE AXIS 1 MASTERING



INNER ARM RIGHT OFFSET (RH) P50iB/10L ROBOT ON FRA PEDESTAL PLATE AXIS 1 MASTERING



INNER ARM RIGHT OFFSET (RH) P50iB/10L ROBOT ON FRA CAST PEDESTAL AXIS 1 MASTERING

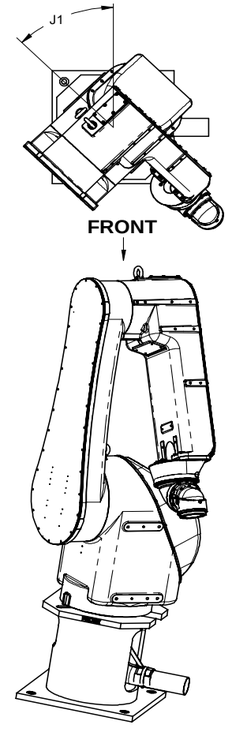


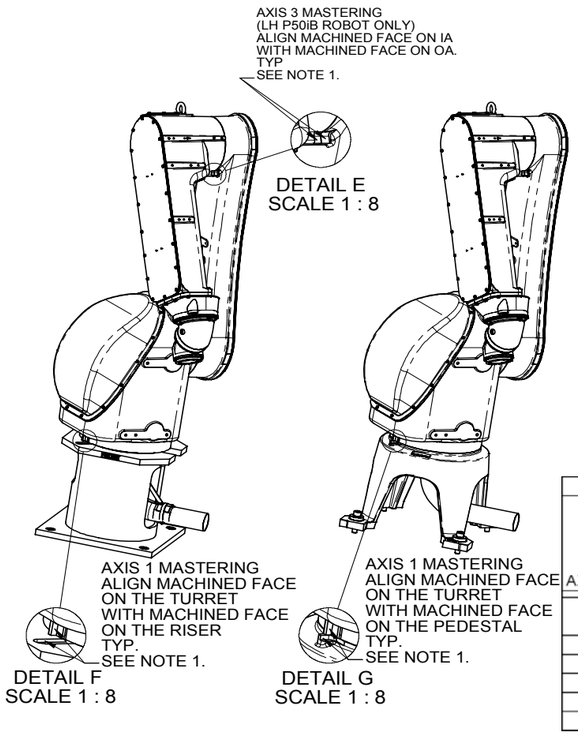
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

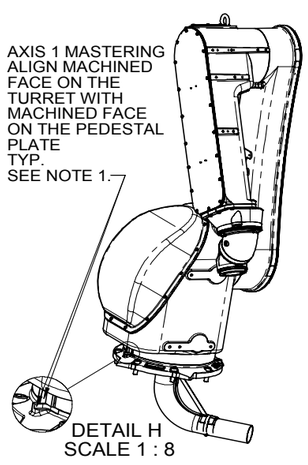
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

INNER ARM RIGHT OFFSET (RH) P50iB/10L ROBOT ON USER OR INTEGRATOR RISER AXIS 1 MASTERING







P50iB/10L FLOOR & WALL MOUNT MASTERING JOINT ANGLES					
AXIS #	CONVEYOR LEFT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR LEFT, INNER ARM RIGHT OFFSET, (RH)	CONVEYOR RIGHT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR RIGHT, INNER ARM RIGHT OFFSET, (RH)	COMMENTS
J1	-45º	-45º	+45º	+45º	SEE SHEET 2
J2	0º	0º	0º	0º	SEE SHEET 3
J3	-60º	-60º	-60º	-60º	SEE SHEET 2
J4	0º	180º	0º	180º	SEE SHEET 3
J5	0º	0º	0º	0º	SEE SHEET 3
J6	0º	0º	0º	0º	SEE SHEET 3

NOTE:
1. USE ANY SQUARE, STRAIGHT AND FLAT GAUGE OR OBJECT TO ALIGN MASTERING SURFACES FOR AXIS J1, J2 AND J3.
2. FOR AXIS: J4, J5 AND J6 - MASTER BY PLACING ANY SQUARE, STRAIGHT EDGE AND FLAT OBJECT ON THE MASTERING FACE. THEN ROTATE EACH AXIS UNTIL MASTERING PIN JUST TOUCHES THE MASTERING OBJECT.

[ET-6414-845-001 SHT2] REV A
P50iB/10L MASTERING

Figure 6-3 ET-6414-845-001 SHT3, MASTERING

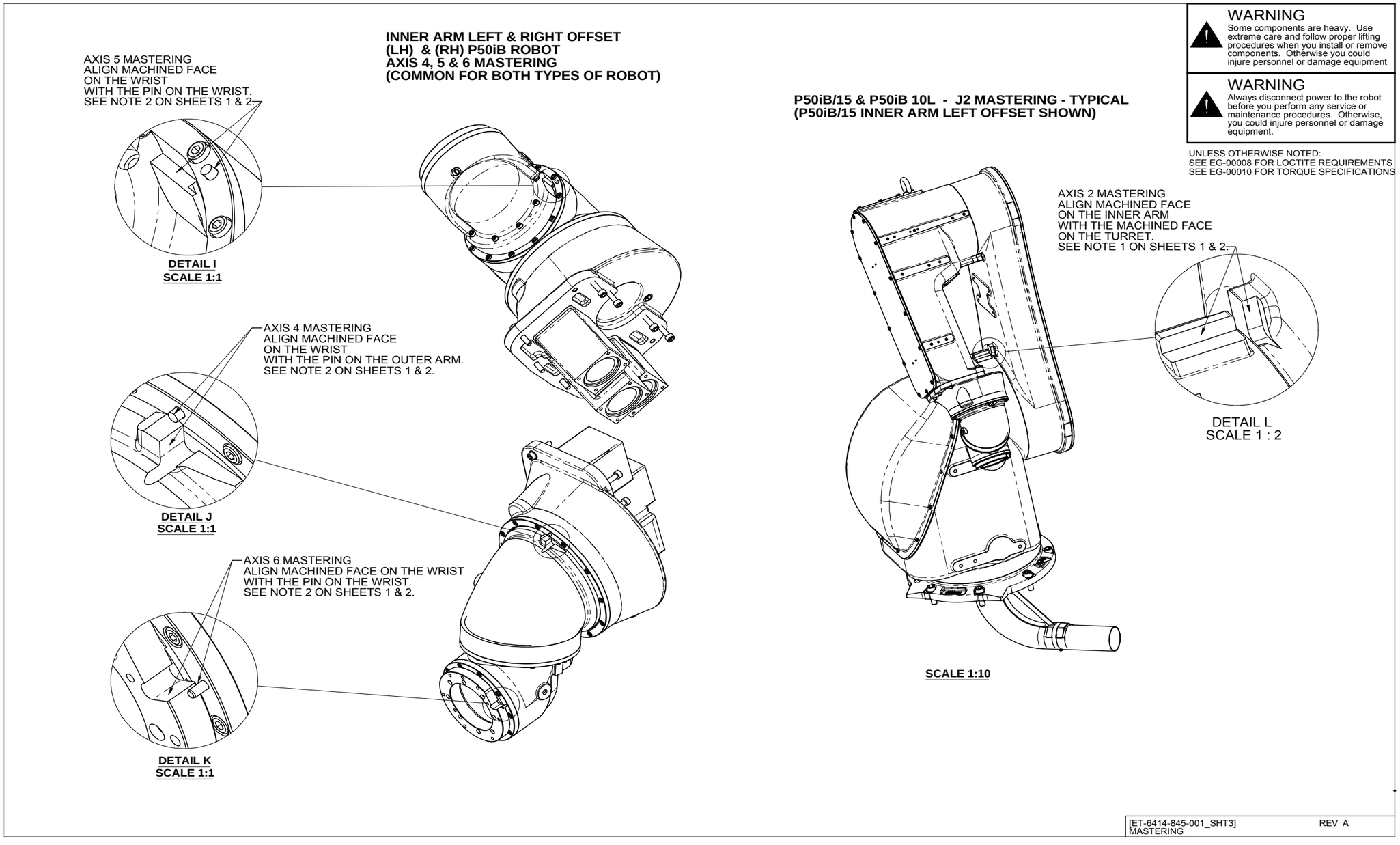


Figure 6-4 ET-6414-845-001_SHT4, P50iB/15 & P50iB/10L FLOOR MNT MASTERED POSITIONS

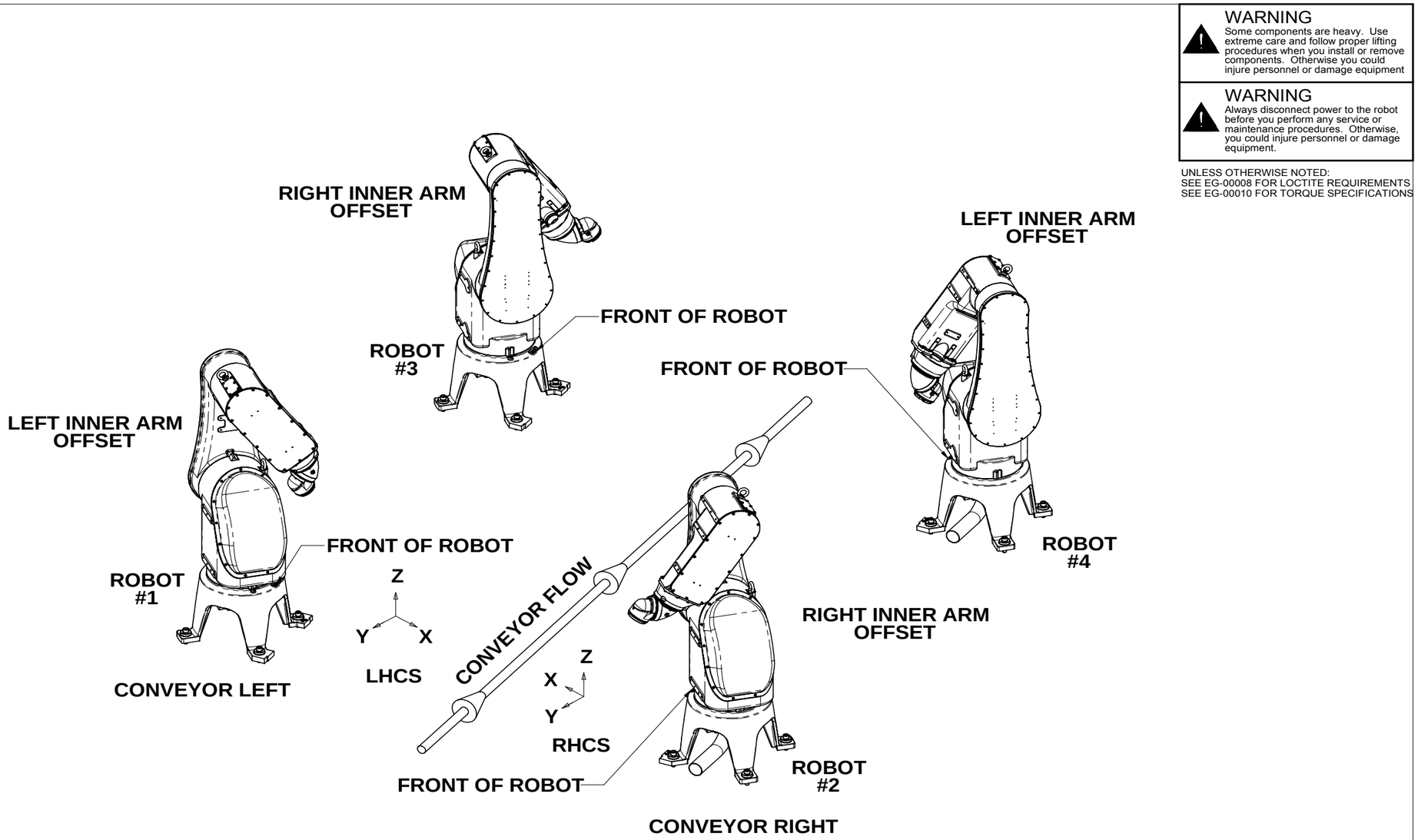
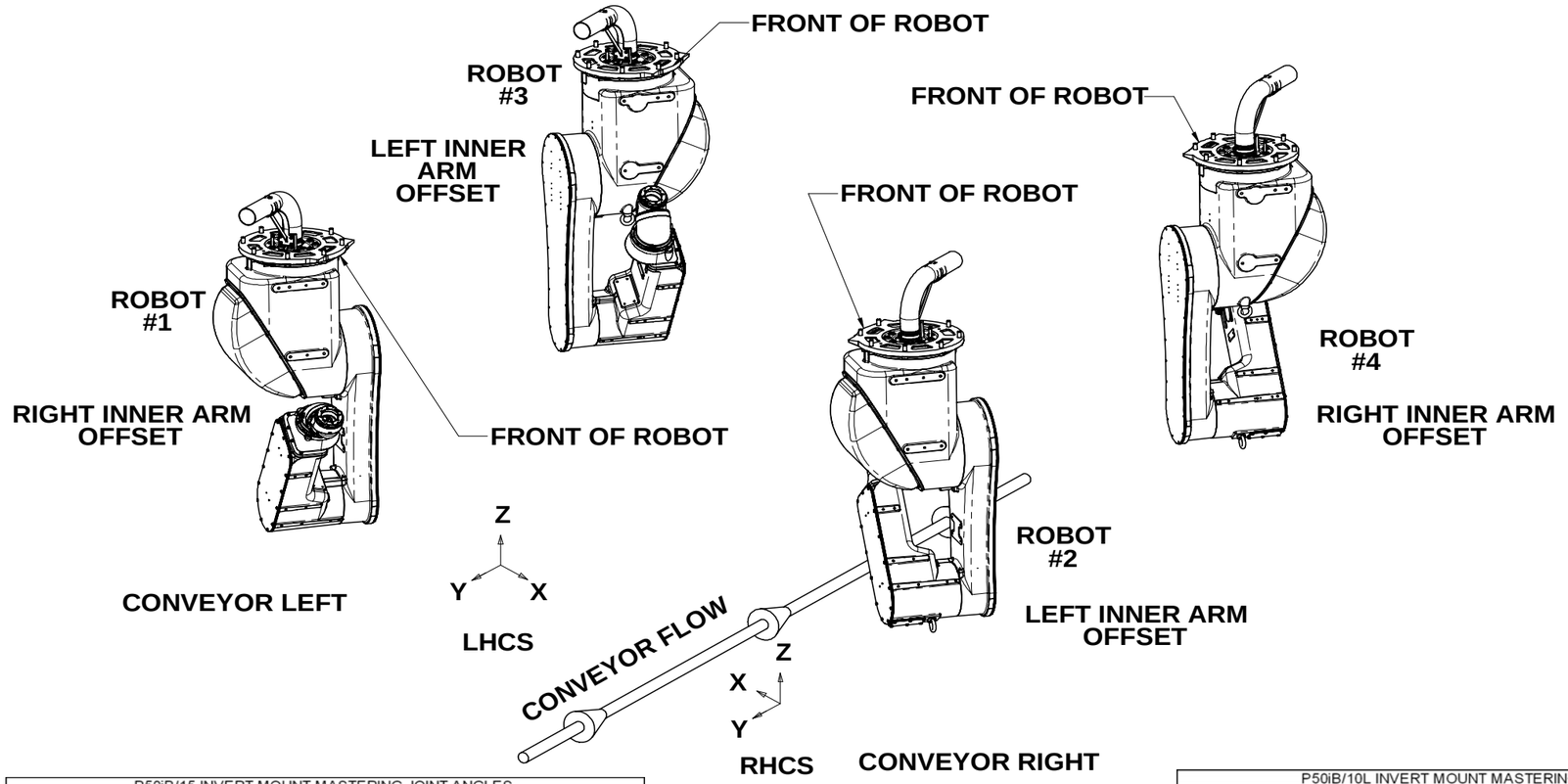


Figure 6-5 ET-6414-845-001 SHT5, P50iB/15 & 10L INVERT MNT MASTERED POSITIONS



WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

P50iB/15 INVERT MOUNT MASTERING JOINT ANGLES

AXIS #	CONVEYOR LEFT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR LEFT, INNER ARM RIGHT OFFSET, (RH)	CONVEYOR RIGHT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR RIGHT, INNER ARM RIGHT OFFSET, (RH)	COMMENTS
J1	-45º	-45º	+45º	+45º	SEE SHEET 1
J2	0º	0º	0º	0º	SEE SHEET 3
J3	-55º	-55º	-55º	-55º	SEE SHEET 1
J4	180º	0º	180º	0º	SEE SHEET 3
J5	0º	0º	0º	0º	SEE SHEET 3
J6	0º	0º	0º	0º	SEE SHEET 3

P50iB/10L INVERT MOUNT MASTERING JOINT ANGLES

AXIS #	CONVEYOR LEFT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR LEFT, INNER ARM RIGHT OFFSET, (RH)	CONVEYOR RIGHT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR RIGHT, INNER ARM RIGHT OFFSET, (RH)	COMMENTS
J1	-45º	-45º	+45º	+45º	SEE SHEET 2
J2	0º	0º	0º	0º	SEE SHEET 3
J3	-60º	-60º	-60º	-60º	SEE SHEET 2
J4	180º	0º	180º	0º	SEE SHEET 3
J5	0º	0º	0º	0º	SEE SHEET 3
J6	0º	0º	0º	0º	SEE SHEET 3

P50iB/15 & P50iB/10L INVERT MOUNT MASTERED POSITIONS (P50iB/15 SHOWN)

[ET-6414-845-001_SHT5] REV A
P50iB/15 & 10L INVERT MNT MASTERED POSITIONS

Figure 6-6 ET-6414-845-001 SHT6, P50iB/15 & 10L WALL MNT MASTERED POSITIONS

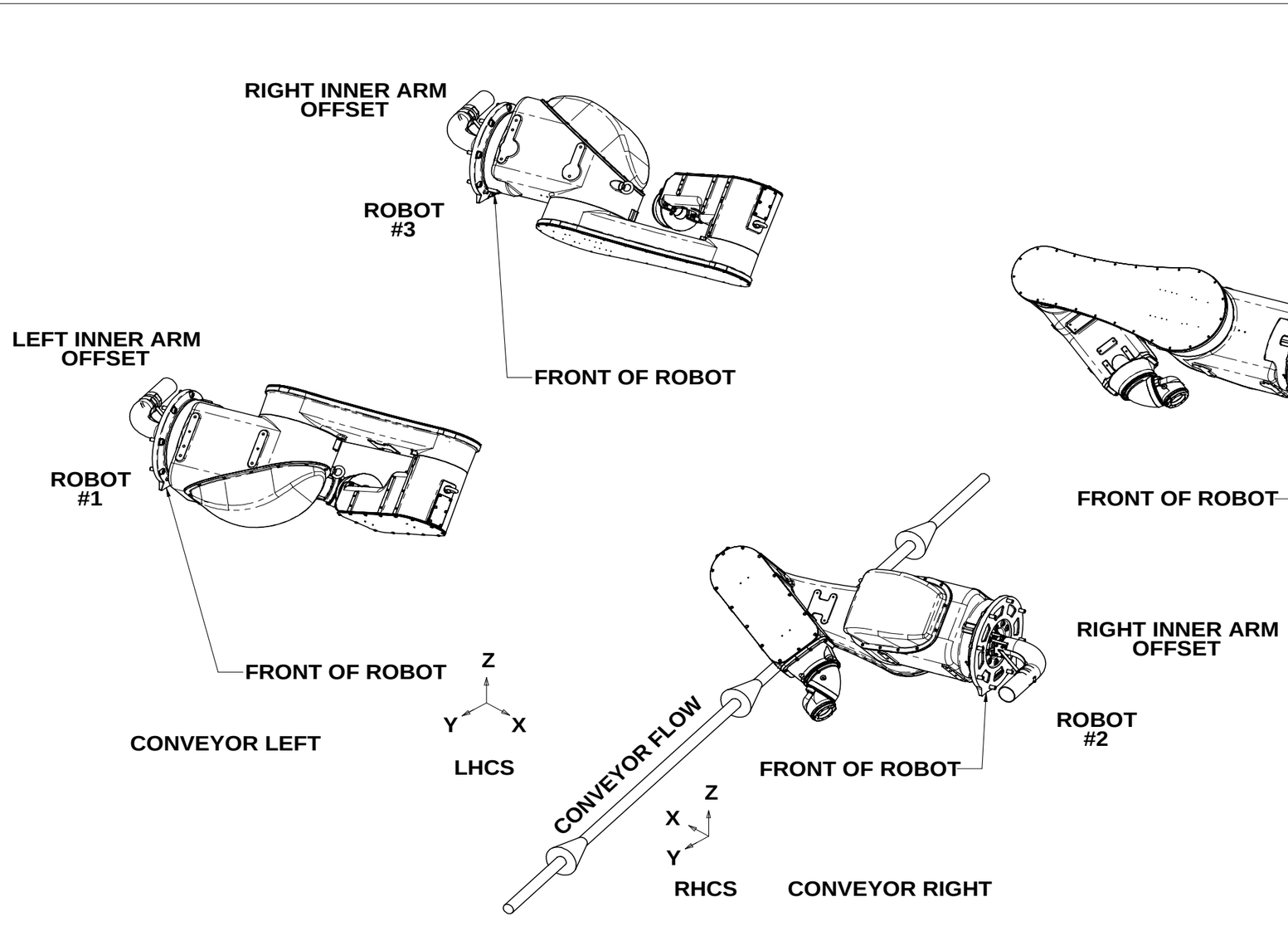
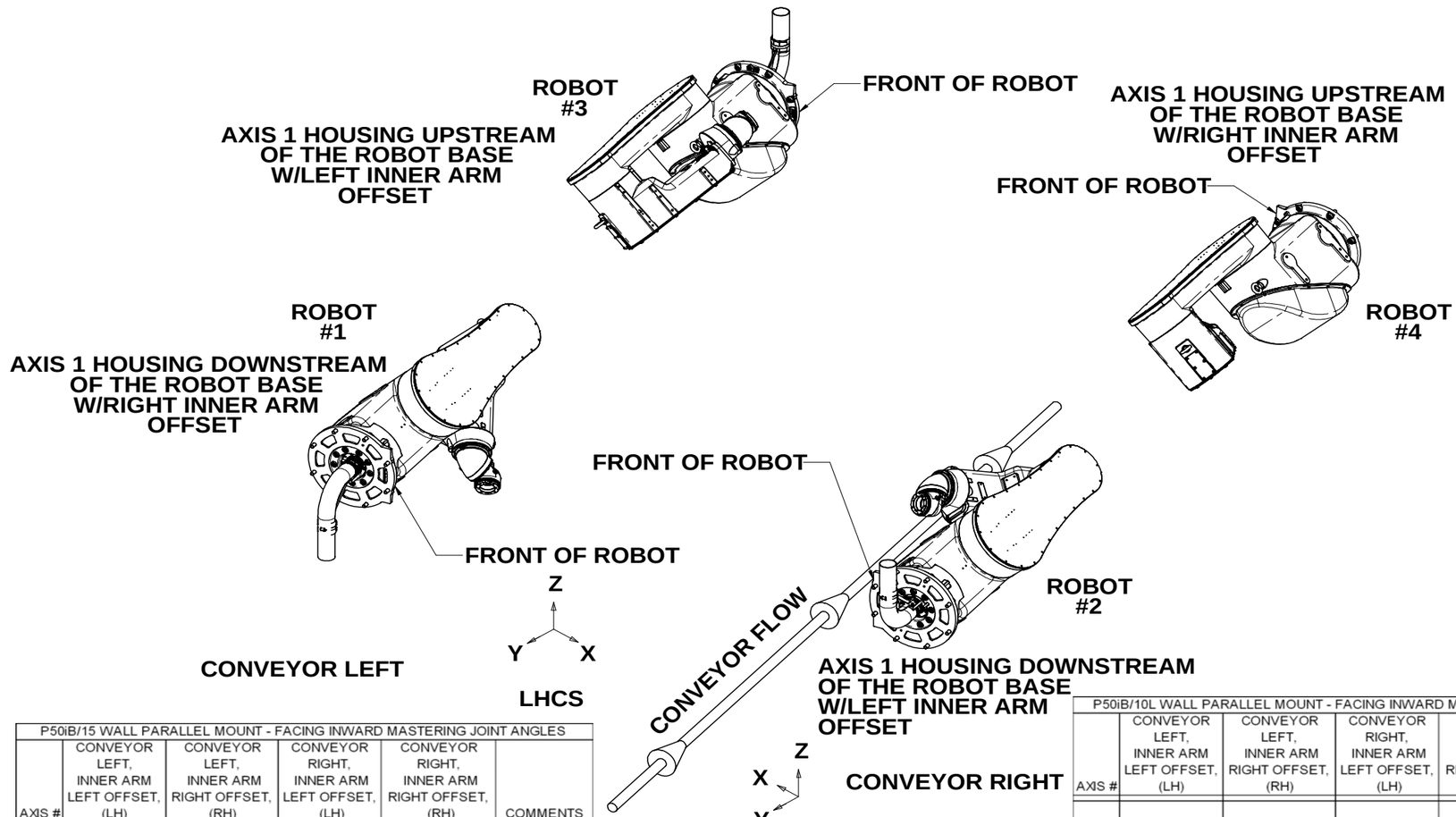


Figure 6-7 ET-6414-845-001_SHT7, P50iB/15 & 10L WALL PARALELL MNT FACE IN MASTERED POSITIONS



WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

P50iB/15 WALL PARALLEL MOUNT - FACING INWARD MASTERING JOINT ANGLES

AXIS #	CONVEYOR LEFT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR LEFT, INNER ARM RIGHT OFFSET, (RH)	CONVEYOR RIGHT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR RIGHT, INNER ARM RIGHT OFFSET, (RH)	COMMENTS
J1	-135º	+45º	+135º	-45º	SEE SHEET 1
J2	0º	0º	0º	0º	SEE SHEET 3
J3	-55º	-55º	-55º	-55º	SEE SHEET 1
J4	0º	180º	0º	180º	SEE SHEET 3
J5	0º	0º	0º	0º	SEE SHEET 3
J6	0º	0º	0º	0º	SEE SHEET 3

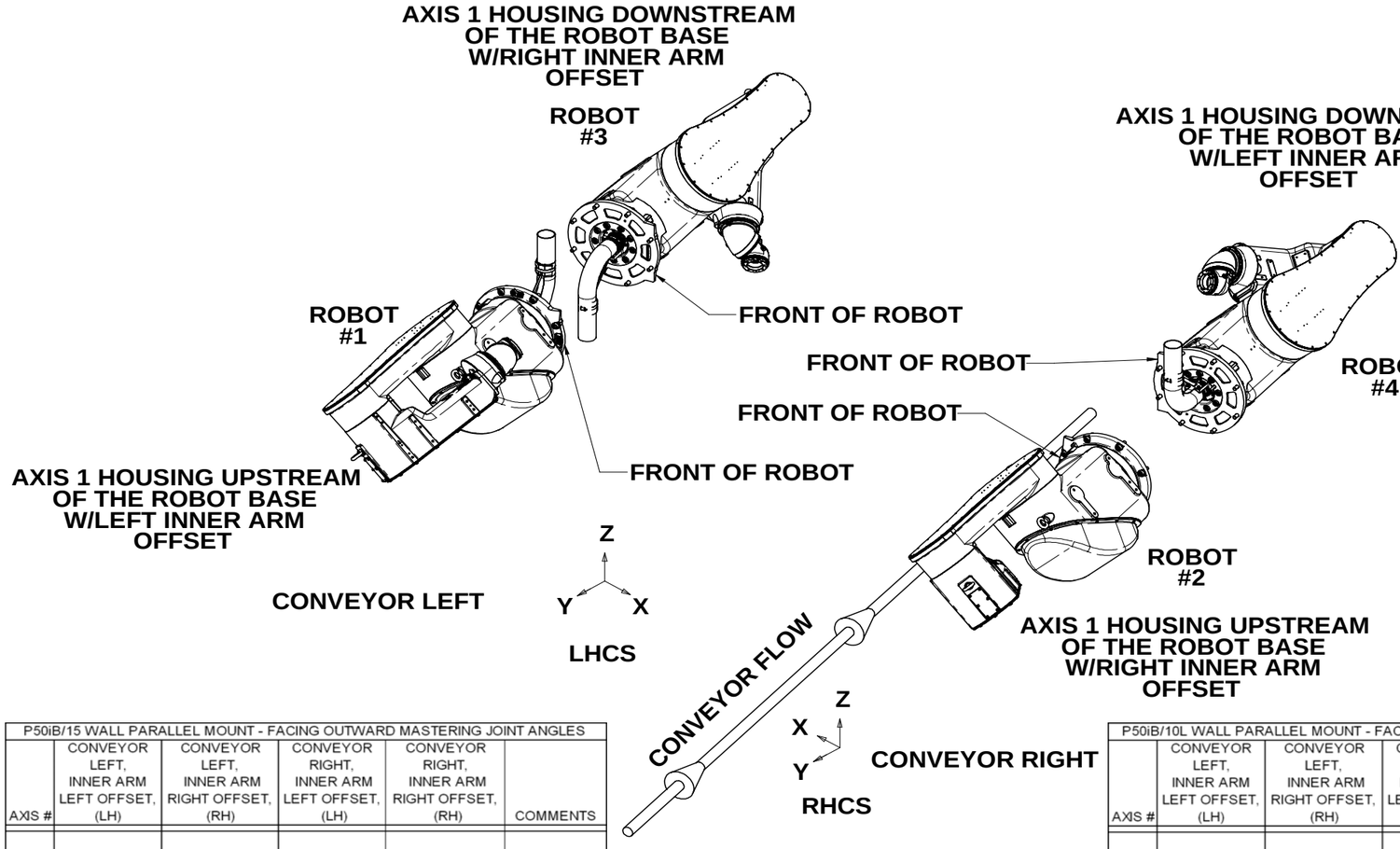
P50iB/10L WALL PARALLEL MOUNT - FACING INWARD MASTERING JOINT ANGLES

AXIS #	CONVEYOR LEFT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR LEFT, INNER ARM RIGHT OFFSET, (RH)	CONVEYOR RIGHT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR RIGHT, INNER ARM RIGHT OFFSET, (RH)	COMMENTS
J1	-135º	+45º	+135º	-45º	SEE SHEET 1
J2	0º	0º	0º	0º	SEE SHEET 3
J3	-60º	-60º	-60º	-60º	SEE SHEET 1
J4	0º	180º	0º	180º	SEE SHEET 3
J5	0º	0º	0º	0º	SEE SHEET 3
J6	0º	0º	0º	0º	SEE SHEET 3

P50iB/15 & P50iB/10L WALL PARALLEL MOUNT - FACING INWARD MASTERED POSITIONS (P50iB/15 SHOWN)

[ET-6414-845-001_SHT7] REV A
P50iB/15 & 10L WALL PARALELL MNT FACE IN MASTERED POSITIONS

Figure 6-8 ET-6414-845-001 SHT8, P50iB/15 & 10L PARALELL MNT FACE OUT MASTERED POSITIONS



WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

P50iB/15 WALL PARALLEL MOUNT - FACING OUTWARD MASTERING JOINT ANGLES					
AXIS #	CONVEYOR LEFT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR LEFT, INNER ARM RIGHT OFFSET, (RH)	CONVEYOR RIGHT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR RIGHT, INNER ARM RIGHT OFFSET, (RH)	COMMENTS
J1	-135º	+45º	+135º	-45º	SEE SHEET 1
J2	0º	0º	0º	0º	SEE SHEET 3
J3	-55º	-55º	-55º	-55º	SEE SHEET 1
J4	0º	180º	0º	180º	SEE SHEET 3
J5	0º	0º	0º	0º	SEE SHEET 3
J6	0º	0º	0º	0º	SEE SHEET 3

P50iB/10L WALL PARALLEL MOUNT - FACING OUTWARD MASTERING JOINT ANGLES					
AXIS #	CONVEYOR LEFT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR LEFT, INNER ARM RIGHT OFFSET, (RH)	CONVEYOR RIGHT, INNER ARM LEFT OFFSET, (LH)	CONVEYOR RIGHT, INNER ARM RIGHT OFFSET, (RH)	COMMENTS
J1	-135º	+45º	+135º	-45º	SEE SHEET 1
J2	0º	0º	0º	0º	SEE SHEET 3
J3	-60º	-60º	-60º	-60º	SEE SHEET 1
J4	0º	180º	0º	180º	SEE SHEET 3
J5	0º	0º	0º	0º	SEE SHEET 3
J6	0º	0º	0º	0º	SEE SHEET 3

P50iB/15 & P50iB/10L WALL PARALLEL MOUNT - FACING OUTWARD MASTERED POSITIONS (P50iB/15 SHOWN)

[ET-6414-845-001 SHT8] REV A
P50iB/15 & 10L PARALELL MNT FACE OUT MASTERED POSITIONS

7 CHECKS AND MAINTENANCE

Optimum performance of the P-50iB robot can be maintained by following the lubrication and periodic general maintenance procedures in this chapter.
Note All cleaning procedures require skilled trades or maintenance personnel to be properly trained in performing proper maintenance procedures.
Note Follow all Lockout and Safety procedures before you enter the paint booth.
Note Wear safety glasses and protective gloves to clean the components.
Note Perform the cleaning procedures in a well ventilated area.

Lubrication Maintenance
• See the following manual pages for lubrication maintenance intervals.

Daily Maintenance
• Clean the robot surface
• Clean the spray gun or applicator. See the appropriate applicator manual for more detailed information

Maintenance every 1000 hours
• Check the spray gun or applicator lines and cables.
• Clean the spray gun or applicator. See the appropriate applicator manual for more detailed information.

Maintenance every 4000 hours
• Check the robot cables.
• Check the paint lines.
• Visually check for grease leaks.
• Check the reducer grease levels.

Figure 7-1 EB-03642, PAINT ROBOT CLEANING AND COVERING RECOMMENDATIONS – ENG BULLETIN

FANUC Robotics

ENGINEERING BULLETIN NUMBER: 03642

Release Date:	06/25/09	Document Status:	Released
Revision Date:		Revision Level:	2.0
Page:	1 of 7		

FANUC Robotics America

Paint Robot Cleaning and Covering Recommendations

ROBOT MODEL	SOFTWARE
Paint Mate(s), P-50iA, P-250iA/10S, P-250iA/15, P-200E, P-10E, P-15E, P-500iA, P-700iA/15P, P-700iA/15, P-	N/A

SOURCE OF INFORMATION: ☐ FANUC ☒ FRA → HEB - Hardware Engineering Bulletin

REASON FOR ENGINEERING BULLETIN

☐ Error Correction → N/A	☐ Material Availability	☐ Mechanical Guidelines
☐ Product Improvement → N/A	☐ New Product Release	☐ Electrical Guidelines
☐ Other	☒ Information	☐ Software Guidelines

Paint Robot Covers:

- FANUC Robotics recommends the use of fabric covers with painting robots.
- Most robot models have custom fabric covers that have been validated by FANUC Robotics.
- Failure to use robot covers may allow excessive paint build-up which, over time, may cause the robot to become inoperable.
- FANUC Robotics suggests the following typical maintenance schedule, but it is only a guideline.
- Both re-usable and disposable covers are available.
- On the following page is a sample cover used for the Paint Mate, P-50iA, P-250iA/15, P-250iA/10S, P-200E, P-10E, P-15E, P-500iA, P-700iA/15P, P-700iA/15, & P-20iA robots.

Cover	Maintenance Frequency
Robot Covers	Monthly
Arm Covers	Weekly
Wrist Covers	Daily

Paint Robot Cleaning:

- The wrist/applicator may be cleaned using a lint free rag soaked with solvent.
- A soft paint brush should be used on the seals to clean the paint from them without damaging the seals.
- After cleaning, the seals of the wrist may be coated with petroleum jelly, to keep the paint from sticking to the seal and causing excessive friction in the wrist joint, which can cause collision guard or over current errors.
- Catrac cables can be cleaned with a lint free rag soaked with solvent as well. After cleaning the cables can also be coated with a layer of petroleum jelly to keep paint from sticking and to make it easier to clean the cables in the future.
- The front of a rail can be coated with petroleum jelly as well, to make it easer to remove paint.

Contact TDIC for the robot covers: www.tdic.com , Tel: (586) 731-2080

Figure 7-2 ET-6414-850-001_SHT1, MAINTENANCE

INITIAL OR REBUILD LUBE REQUIREMENT									MAINTENANCE LUBE SCHEDULE		
LUBE POINT	ASSEMBLY LOCATION	GREASE TYPE	TOTAL AMOUNT CUBIC CENTIMETERS (CUBIC INCHES)		NO. OF LUBE POINTS	AMOUNT PER LUBE POINT CUBIC CENTIMETERS (CUBIC INCHES)		NOTES	FREQUENCY (HOURS)	TOTAL AMOUNT CUBIC CENTIMETERS (CUBIC INCHES)	
1	OUTER KNUCKLE BEARINGS & GEARS	LG-01-02	150	(9.2)	1	150.0	(9.2)	2, 4, 5	4,000	5	(0.3)
2	INNER KNUCKLE BEARINGS & GEARS	LG-01-02	180	(11.0)	1	180.0	(11.0)	2, 4, 5	4,000	7	(0.4)
3	WRIST HOUSING BEARINGS & GEARS	LG-01-02	200	(12.2)	1	200.0	(12.2)	2, 4, 5	4,000	5	(0.3)
4	AXIS 3 RV	VIGO GREASE RE NO. 0	520	(31.7)	1	520.0	(31.7)	3,5,6,8	20,000	520	(31.7)
5	AXIS 2 RV	VIGO GREASE RE NO. 0	2069	(126.3)	1	2069.0	(126.3)	4,5,8,11	20,000	2069	(126.3)
6	AXIS 1 RV (FLOOR MOUNT)	VIGO GREASE RE NO. 0	3200	(195.3)	1	3200	(195.3)	4,5,7,8	20,000	3200	(195.3)
7	AXIS 1 RV (INVERT MOUNT)	VIGO GREASE RE NO. 0	3200	(195.3)	1	3200	(195.3)	4,5,7,8,9	20,000	3200	(195.3)
8	AXIS 1 RV (WALL MOUNT)	VIGO GREASE RE NO. 0	3200	(195.3)	1	3200	(195.3)	4,5,7,8,9	20,000	3200	(195.3)

STD. FANUC PART NO.	ZINC FREE FANUC PART NO.	GREASE TYPE - SIZE
HDWMO0000041940	HDWMO0000041670	LG-01-02 TUBE - 14 OZ.
HDWMO0000041950	HDWMO0000041680	LG-01-02 PAIL - 35 LB.
HDWMO0000041960	HDWMO0000041690	LG-01-02 KEG - 115 LB.
XGMF-16799		VIGO GREASE RE NO. 0 2 KG
XGMF-16156		VIGO GREASE RE NO. 0 16 KG

NOTES:
1. INITIAL & REBUILD LUBE DONE FROM FLOOR MOUNT POSITION.

2. WRIST ASSEMBLY - LUBE POINTS 1, 2 & 3:
BRUSH THICK GREASE ON GEAR TEETH AND HAND PACK BEARINGS AT ASSEMBLY. INSTALL WRIST, REMOVE ANY ONE PLUG FROM THE WRIST HOUSING (WRIST VENT- SEE VIEW FOR J3 LUBE) AND LUBE THROUGH 1, 2 & 3 PER SPECIFICATION. REINSTALL PLUG WHEN LUBE IS COMPLETE. USE PERMATEX "NO MORE LEAKS" HDWMO0000038860.

3. FOR LUBE POINT 4:
- INITIAL - USE GREASE VOLUME FROM THE CHART,
- REBUILT - LUBE UNTIL CLEAN GREASE COMES OUT THE VENT.

4. LUBE WITH THE CALIBRATED GREASE PUMP PER SPECIFICATION - LUBE POINTS: 1, 2, 3, 5, 6, 7 & 8.

5. REMOVE PLUGS (LUBE & VENT) BEFORE LUBE. REINSTALL PLUGS WHEN LUBE IS COMPLETE. USE PERMATEX "NO MORE LEAKS" HDWMO0000038860.

6. AXIS 3 - ROTATE INNER ARM 67.5° DOWN FROM VERTICAL POSITION,
- ROTATE OUTER ARM 90.0° DOWN FROM HORIZONTAL POSITION,
WITH AXIS 3 MOTOR ORIENTATION AS SHOWN, LH ROBOT SHOWN, SAME OUTER ARM POSITION FOR THE RH ROBOT.

7. AXIS 1 -
FLOOR MOUNT - REMOVE VENTING PLUG WHEN LUBE.
- REPLACE BOTTOM RV PLUG WITH J1 RV LUBE TOOL - EO-6414-703-000
- RE-INSTALL BOTH PLUGS AFTER LUBE IS COMPLETED.
INVERT & WALL MOUNT - REMOVE VENT PLUG. REINSTALL AFTER INITIAL LUBE IS COMMPLETE.

8. USE AXIS 3 GREASE VENT ADAPTER - EO-4696-700-043 FOR LUBE CONVENIENCE - LUBE POINTS 4 & 5.

9. FOR ROBOTS: INVERT MOUNT (IMMEDIATELY BEFORE OR AFTER INVERTING) AND WALL MOUNT (IMMEDIATELY BEFORE OR AFTER WALL MOUNTING)
- AXIS 1 GREASE CAVITY RELIEF SHOULD BE REPOSITIONED WITH THE PLUG.

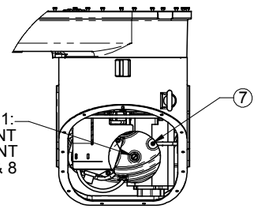
10. GREASE GUN TIP PRESSURE MUST BE UNDER 0.1Mpa WHEN GREASING AXIS 1 RV, AXIS 2 RV AND AXIS 3 RV.

11. AXIS 2 - ROTATE INNER ARM 120° DOWN FROM VERTICAL POSITION,
- ROTATE OUTER ARM 90.0° UP FROM HORIZONTAL POSITION,

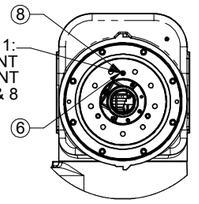
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



VIEW B



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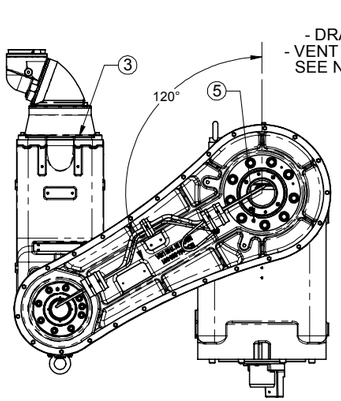

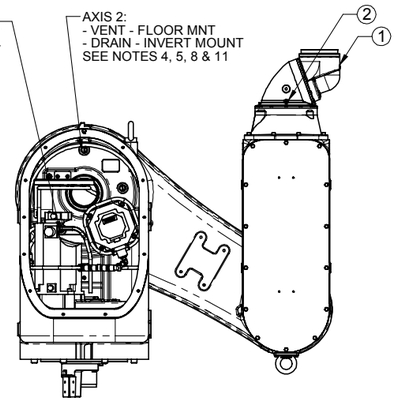

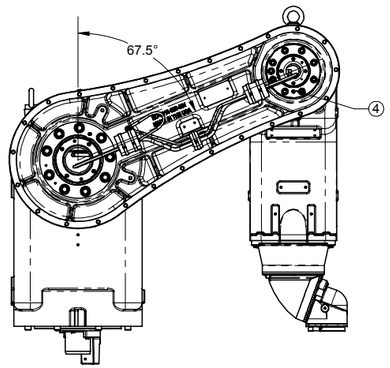

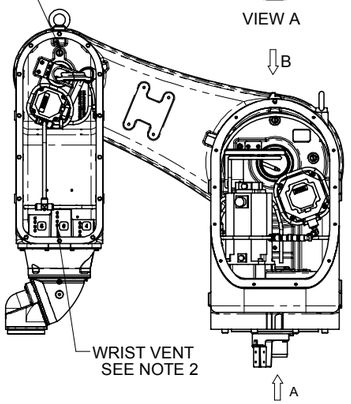

INNER & OUTER ARM ORINTATION REQUIRED FOR J2 LUBRICATION

INNER & OUTER ARM ORINTATION REQUIRED FOR J3 LUBRICATION

P-50iB/15 & P-50iB/10L INITIAL OR REBUILD LUBE IN FLOOR POSITION FOR: FLOOR, INVERT & WALL MOUNT (COVERS REMOVED FOR CLARITY, P-50iB SHOWN)

[ET-6414-850-001_SHT1] REV B1
MAINTENANCE

8 TROUBLESHOOTING

8.1 Mechanical Unit Troubleshooting

Table 8-1 shows the most common robot mechanical unit problems and their causes. If a cause or remedy is unclear, contact FANUC Robotics Tel: 1-800-iqRobot.

Table 8-1 Problems and Causes

Symptom	Cause	Remedy
The robot does not return to the zero position correctly	Low voltage of the memory backup battery.	Replace the battery.
	Unusual external start signal.	Investigate the cause.
	Incorrect parameter.	Revise parameters.
Position offset	The robot has been hit.	Revise the teaching points.
	Incorrect Mastering	Remaster Robot
	The robot is not firmly fastened to the base plate.	Retighten.
	Peripheral device was shifted.	Reposition.
	Incorrect parameters.	Revise parameters.
	Defective pulse coder cable.	Replace the cable.
	APC (Absolute Pulse Coder) malfunction.	Replace the motor or the pulse coder.
	Play in mechanical unit.	Refer to excessive play symptom in this table.
Vibration	The robot is not firmly fastened to the base.	Retighten.
	Excessive floor vibration (especially when installed above the first floor).	Investigate the installation location and adjust the robot location if necessary.
	An incorrect servo adjustment.	Adjust the servo.
	A defective cable.	Replace the cable.
	The robot is not grounded.	Connect to ground.
	A defective motor.	Replace the motor.
	A defective reducer.	Replace the reducer.
	Play in the mechanical unit.	Refer to the excessive play symptom in this table.
Excessive play	A loose screw or pin.	Tighten and apply LOCTITE as specified.
	A defective reducer.	Replace the reducer.
	An incorrect gear backlash.	Adjust the gears.
	Worn gears.	Replace the gears.
	Worn bearings.	Replace the bearings.
	A cracked casting.	Replace cracked parts.
Unusual noise	Insufficient gear or reducer lubrications.	Lubricate.
	Foreign matter in a gear or a reducer.	Clean and lubricate.
	A defective reducer.	Replace the reducer.
	An incorrect gear adjustment.	Adjust the gears.
	Worn gears.	Replace the gears.
	Worn bearings.	Replace the bearings.
	Cable pair damage.	Replace the cable pair.
	An incorrect servomotor adjustment.	Adjust the servomotor.
Over heating	Insufficient gear or reducer lubrication.	Lubricate.
	The specified grease was not used.	Replace with the specified grease.
	Excessive pressure on bearings.	Reduce the pressure on the bearings.
	Insufficient maintenance air	Increase maintenance air supply
	An excessive load on the wrist.	Reduce the load and restrict the movement conditions.
	An incorrect gear adjustment.	Adjust the gears.
	An incorrect time constant.	Revise the time constant.

Table 8-1 Problems and Causes, continued

Symptom	Cause	Remedy
The robot drops (10 mm or more) when the power supply is off	The brake gap is too large.	Replace the motor.
	Fused brake drive relay.	Replace the relay.
	Intrusion of grease into motor due to excessive quantity of grease.	Replace the motor and ensure proper grease level.
Grease leakage	Deteriorated O-ring, oil seal, or packing.	Replace the O-ring, oil seal, or packing.
	A cracked casting.	Replace the cracked parts.
	Loose screws.	Tighten the screws.
	Excessive quantity of grease.	Remove some of the grease.

8.2 P-50iB Purge cycle troubleshooting

8.2.1 P-50iB Purge Procedure and Troubleshooting

Figure 8-1 EB_03648, PURGE TROUBLESHOOTING – ENG BULLETIN

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PURGE TROUBLESHOOTING

ROBOT MODEL	SOFTWARE
P-50iA, P-50iB, P-250iA, P-500iA, Paint Mate 200iA, and P-700iA	N/A

SOURCE OF INFORMATION: ☐ FANUC ☒ FRA ☐ HEB - Hardware Engineering Bulletin

REASON FOR ENGINEERING BULLETIN

☐ Error Correction ☐ N/A	☐ Material Availability	☐ Mechanical Guidelines
☐ Product Improvement ☐ N/A	☐ New Product Release	☐ Electrical Guidelines
☐ Other	☒ Information	☐ Software Guidelines

This bulletin may be revised or updated.

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PURGE TROUBLESHOOTING

PURGE TROUBLESHOOTING

The purpose of this document is to explain how to troubleshoot purge problems on P-50iA, P-50iB, P-250iA, P-500iA, Paint Mate 200iA, and P-700iA FLEX painting robots. This document describes the electrical and mechanical components used to purge the robot and explains how the components work. The document also includes an explanation of the purge sequence and provides a troubleshooting flowchart to help debug purge problems.

PURGE MODULE II (EE-5404-001-0XX)

The Purge Module II is used on R-30iA P-50iA, P-50iB, P-250iA, P-500iA, Paint Mate 200iA, and P-700iA FLEX painting robots to control the environment inside the robot. It circulates clean air through the robot to so that no potentially explosive gases are inside the robot. The purge module also maintains the air in the robot at a slightly higher pressure than the surrounding environment, so that if there are any leaks, air flows out rather than in. The purge module consists of redundant timer circuits that can be set to the different lengths of time required to purge different size robots. The Purge Module II is configured with two Fuse Daughter Boards for a single robot redundant circuit or with 4 fuse daughter boards for two or four robot redundant circuits. The module is supplied single phase 50/60 Hz 220VAC(+10% / -15%) from the servo transformer except the Paint Mate.

ROBOT MODEL	ASSEMBLY PART NUMBER	QTY FUSE BOARDS	PURGE TIME
P-250iA(US, CA, CE)	EE-5404-001-005	2	3.5 minutes
P-50iA(US, CA)	EE-5404-001-005	2	3.5 minutes
P-50iA(CE)	EE-5404-001-006	2	1.78 minutes
Paint Mate 200iA	EE-5404-001-006	2	1.78 minutes
P-250iA with P-20 PED	EE-5404-001-007	4	3.5 minutes
P-500iA(US, CA, CE)	EE-5404-001-008	4	5.3 minutes
P-700iA FLEX(US, CA)	EE-5404-001-008	4	5.3 minutes
P-50iB(US, CA, CE)	EE-5404-001-005	2	3.5 minutes

TABLE 01

PICTURE 01

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PURGE TROUBLESHOOTING

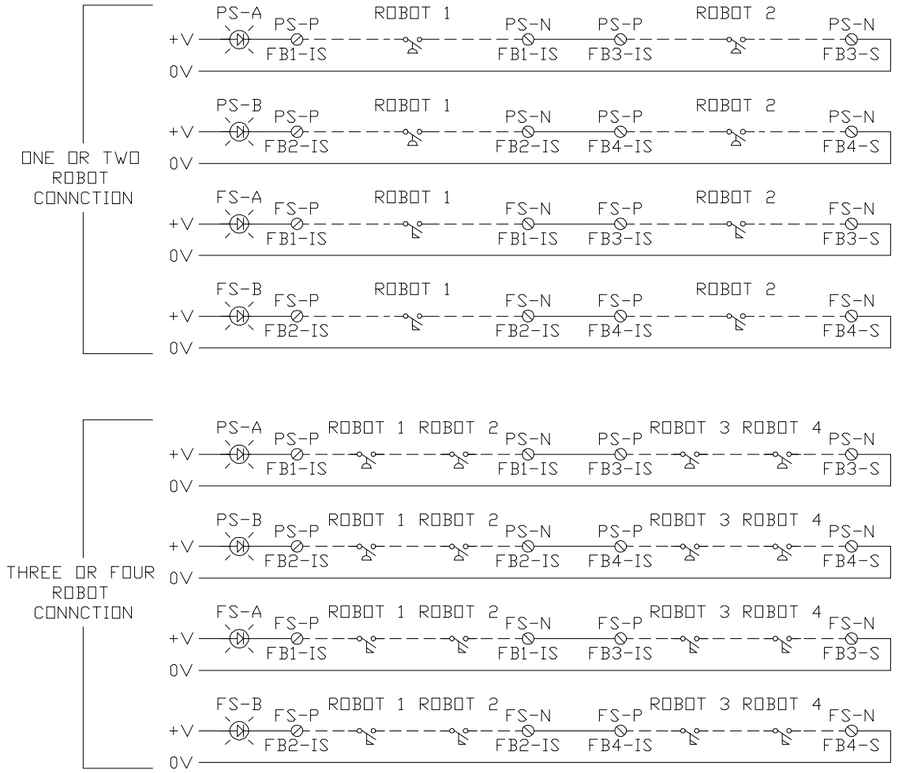
PURGE MODULE II LIGHTS

The Purge Module II can be connected to 1, 2, 3, or 4 robots. The diagram below shows the relationship between the field devices and the lights on the module.

PS-A Pressure switch A circuit, one pressure switch from each fuse board/robot
PS-B Pressure switch B circuit, one pressure switch from each fuse board/robot

FS-A Flow switch A circuit, one pressure switch from each fuse board/robot
FS-B Flow switch B circuit, one pressure switch from each fuse board/robot

PICTURE 02



PICTURE 03

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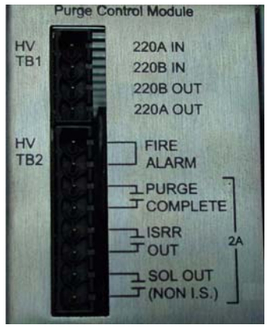
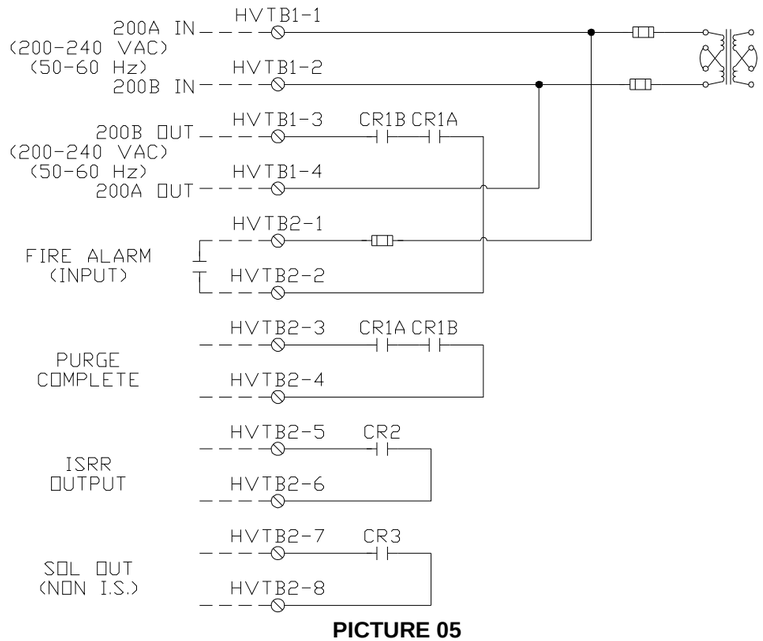
PURGE TROUBLESHOOTING

PURGE MODULE II HIGH VOLTAGE TERMINAL BLOCKS

The input power, output power, fire alarm interlock, purge complete interlock, ISRR output are terminated at terminal blocks HV-TB1 and HV-TB2 on the Purge Module. The 220 VAC input power is switched on from the controller disconnect. The 220 VAC outputs are connected to the controller Power Supply Unit and other devices that are only powered on after robot purge is complete. The FIRE ALARM input signal is a 200VAC signal that shuts down power to the robot when activated. The PURGE COMPLETE signal is available for use as needed by the system but can not exceed the rating of the contacts. The (PURGE) SOLENOID OUTPUT signal is used when the purge solenoid is located outside the booth. The ISRR OUTPUT is not currently used.



PICTURE 04



PICTURE 05

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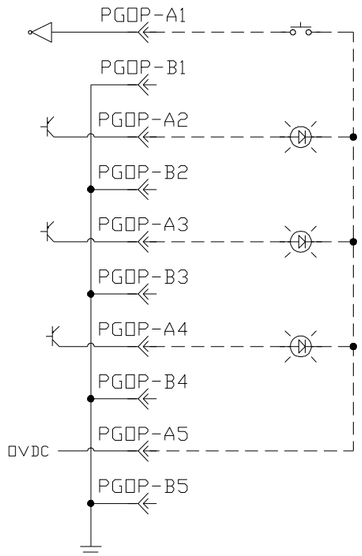
PURGE TROUBLESHOOTING

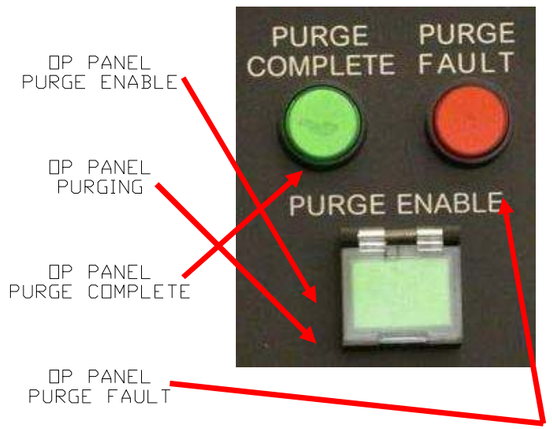
PURGE MODULE II OPERATOR PANEL SIGNALS

The purge control operator interface is located on the operator panel. The operator panel signals connect to the Purge Module PG OP connector using a cable harness. The purge enable signal is used to initiate the purge sequence. When the purge starts, the Purge Enable light is illuminated. Once the purge sequence starts, the Purge Enable button may be released. After purge is successfully complete, the Purge Enable light turns off, the Purge Fault light turns off and the Purge Complete light is illuminated. If the purge is not successful, the Purge Fault light will turn on.

PICTURE 06



PICTURE 07



PICTURE 08

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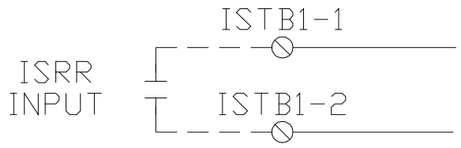
PURGE TROUBLESHOOTING

EE-5404-001-0XX(PURGE MODULE II) ISRR INPUT

A single intrinsically safe repeater contact is provided as part of the Purge Module II. This function is not used.



PICTURE 09

PICTURE 10

AIR SUPPLY RATING

You will find the air supply pressure information on the Purge Air supply tag on the robot, a typical tag is shown on the right.

AIR SUPPLY PRESSURE =
414-448 KPA (60-65PSI @ 740 NSLPM dynamic)

The purge air supply at the robot must be at least 60 PSI but no more than the maximum AIR SUPPLY PRESSURE shown on the tag (higher pressure wastes air) and must be capable of flowing the MAXIMUM PURGE FLOW ACTIVATION at this pressure. The robot will consume approximately 740 to 1100 NLPM depending upon the specific robot configuration during the purge cycle. After the purge cycle is complete, the air consumption decreases during the maintenance cycle to a range of approximately 40 to 360 NLPM depending upon the specific robot configuration. To have proper air flow for the robot purge, the air supply must have the proper capacity. The air flow capacity is impacted by the air compressor, surge tank, shutoff valves, regulators, other equipment that consumes compressed air, pipe, and tubing size and length.

PICTURE 11

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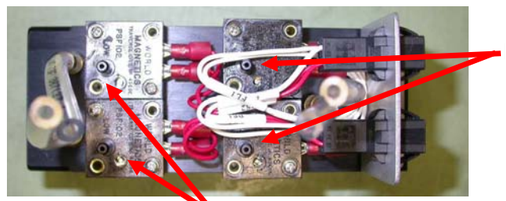
PURGE TROUBLESHOOTING

PURGE SWITCH

The pressure flow switch assembly is one multifunction device. It contains 2 pressure switches to verify maintenance air. It also contains 2 additional pressure switches that measure the differential pressure across the pilot tube to function as a flow switch. The other part of the flow switch is a pressure operated check valve. It takes approximately 7.6 in H2O of internal pressure to open the check valve. This allows for use of lower maintenance air while allowing a large flow for the required number of air exchanges during purge.

Purge Switch Assembly EO9999-703-000__

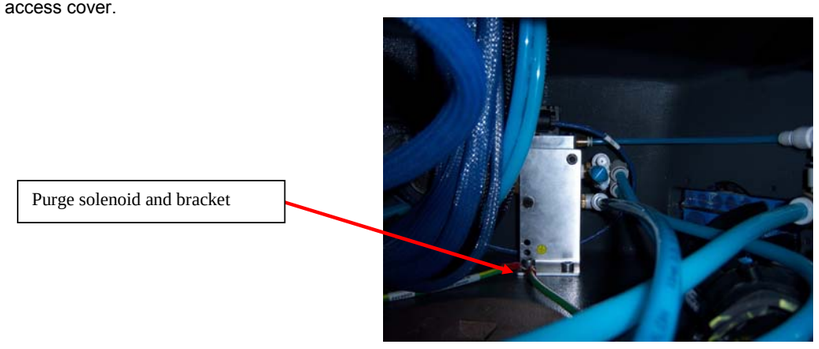


PICTURE 12

PURGE SOLENOID

The purge solenoid may be located inside the robot, inside the controller, or externally mounted. All variants of the solenoid require an air pilot to operate. When the solenoid is in the robot, an intrinsically safe solenoid must be approved for use in the hazardous location. When the solenoid is outside the booth, it does not need to be intrinsically safe and can be 24Vdc or 200Vac. The air pilot of the solenoid must have 60 PSI during flow to operate properly. If the pressure in the pilot line drops below 60 PSI, the solenoid valve will not fully open. If the solenoid valve does not fully open the required purge flow will not be established to complete the purge cycle.

Purge solenoid as seen through the P-250iA/15 pedestal access cover.



PICTURE 13

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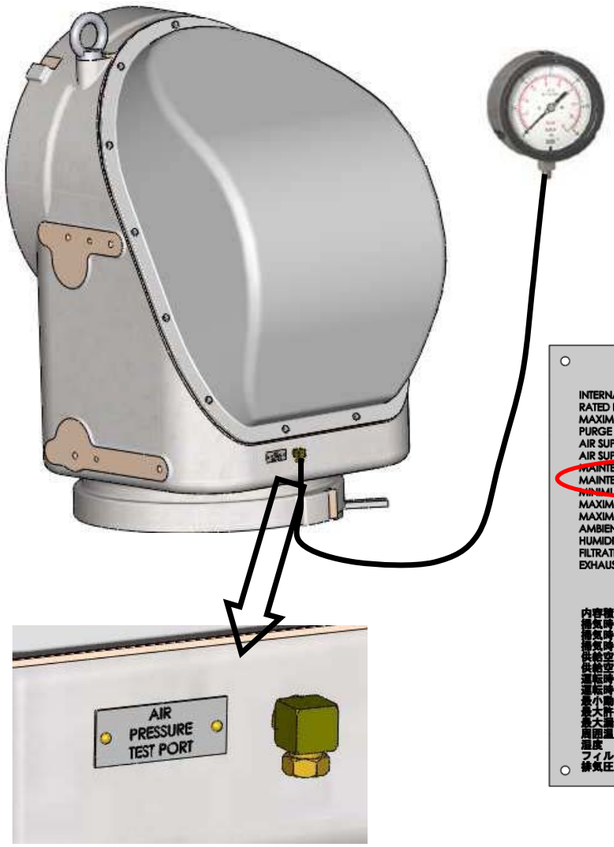
PURGE TROUBLESHOOTING

ROBOT PURGE AIR PRESSURE VERIFICATION

A low pressure gauge can used to check the air pressure within the robot. Simply remove the plug from the test port and connect a pressure gauge. The maintenance air pressure should be in the range specified on the AIR SUPPLY TAG. The picture below shows tubing to make the gauge easier to read.



PICTURE 14

PICTURE 15

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PURGE TROUBLESHOOTING

ROBOT PURGE EXHAUST INSPECTION

The purge exhaust is an integral part of the purge system. Inspection of the purge exhaust should be included when troubleshooting the purge system.

Step 1) Visually inspect the robot purge exhaust area for overspray.

Step 2) If this area is coated in overspray please follow EB-03670, SEVERE ENVIRONMENT REMOTE PURGE EXHAUST for repair and replacement parts.

Step 3) Please provide a photograph of the purge exhaust area.

PICTURE 16

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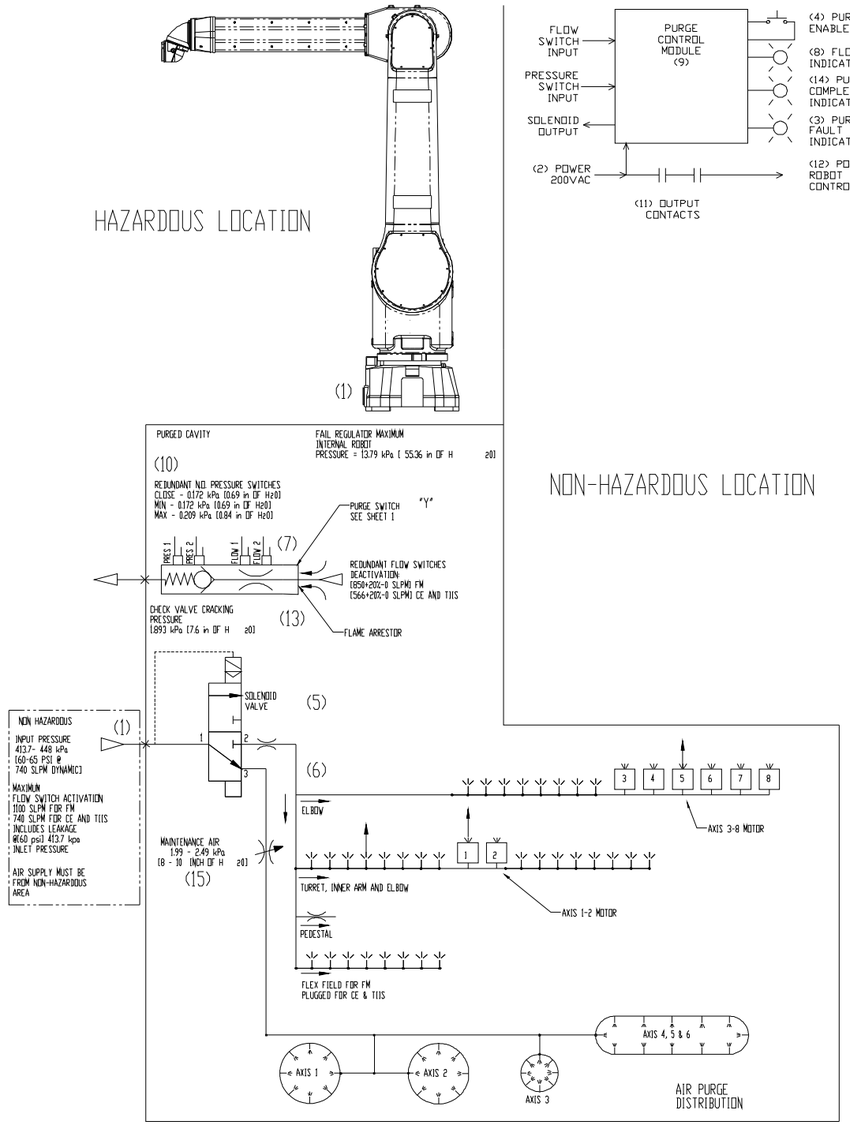
PURGE SEQUENCE



NON-HAZARDOUS LOCATION

PURGE SEQUENCE

1. THE OPERATOR CONNECTS AIR SUPPLY TO ROBOT(1). PRESSURE SWITCH (10) CLOSES, AND REMAINS CLOSED AS LONG AS AIR IS SUPPLIED (0.172 kPa MIN).
2. THE OPERATOR PROVIDES POWER TO CONTROLLER TERMINALS (2). AFTER POWER IS PROVIDED, THE PURGE FAULTINDICATION (3) TURNS ON.
3. THE OPERATOR PRESSES AND HOLDS PURGE ENABLE BUTTON(4).
4. PURGE CONTROL MODULE (9) SWITCHES THE SOLENOID VALVE (5) TO DISTRIBUTION LINES (6) TO START FLOW OFPURGE AIR. AIR WILL BE DISTRIBUTED THROUGHOUT ROBOT CAVITY BY DISTRIBUTION LINES (6).
5. FLOW IS MONITORED BY THE FLOW SWITCH (7) AT AIR OUTLET. WHEN FLOW REACHES 850 L/MIN, FLOW SWITCH (7) CLOSES THE ELECTRIC CONTACTS, FLOW INDICATION (8) WILL COME ON AND THE CONTROL MODULE (9) START TIMING. AT THE SAME TIME, PURGE FAULT INDICATION (3) TURNS OFF.
6. WHEN FLOW INDICATION COMES ON (8), THE OPERATOR CAN RELEASE THE PURGE ENABLE BUTTON (4).
7. PURGE FLOW CONTINUES FOR 3.5 MINUTES TO ENSURE 10 AIR CHANGES. TIME IS MEASURED BY HARDWARE LOGIC IN THE PURGE CONTROL MODULE (9). (MINIMUM PURGE TIME) = 10*(TOTAL CAPACITY OF ROBOT AND HOSE) / (FLOW RATE) = 10x259/850 = 3.04 MINUTES.
8. AFTER 3.5 MINUTES, PURGE IS COMPLETE. PURGE CONTROL MODULE (9) SWITCHES THE SOLENOID VALVE (5) TO MAINTENANCE AIR (15), AND CLOSES THE OUTPUT CONTACTS (11) TO PROVIDE POWER TO ROBOT CONTROLLER, AND TURNS THE PURGE COMPLETE INDICATION (14) ON. THE AIR PRESSURE IN THE CAVITY DECREASES, AND CHECK VALVE (13) CLOSES TO PREVENT LOSS OF MAINTENANCE AIR.
9. ROBOT CAN NOW BE TURNED ON. AS LONG AS PURGE IS COMPLETE, ROBOT MAY BE TURNED ON AND OFF AS DESIRED.

NORMAL POWER ON/OFF SEQUENCE

1. AS LONG AS PURGE IS COMPLETE, ROBOT MAY BE TURNED ON AND OFF AS DESIRED.

ABNORMAL PROCESSING

1. IF FLOW SWITCH (7) DOES NOT CLOSE DUE TO NOT-SUFFICIENT AIR FLOW, ETC., TIMING WILL NOT START, AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
2. IF THE PRESSURE SWITCH (10) IS NOT CLOSED DUE TO NOT-ENOUGH AIR PRESSURE (< 0.172 kPa), TIMING WILL NOT START, AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
3. IF THE FLOW SWITCH (7) OPENS AFTER PURGING HAS STARTED, TIMER (9) WILL BE RESET, PURGE FAULT INDICATION (8) WILL LIGHT. AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
4. AFTER PURGE IS COMPLETE, IF PRESSURE SWITCH (10) OPENS, THE OUTPUT CONTACTS (11) WILL OPEN, THE PURGE COMPLETE INDICATION (14) WILL GO OUT, AND PURGE FAULT INDICATION (8) WILL BE ON. AND THEREFORE, THE ROBOT CONTROLLER POWER IS IMMEDIATELY SHUT DOWN.
5. RELIEF VALVE (13) WILL OPEN AT 1.893 kPa TO PREVENT EXCESSIVE PRESSURE IN THE EVENT OF AN AIR SUPPLY FAILURE.

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PURGE TROUBLESHOOTING FLOWCHART

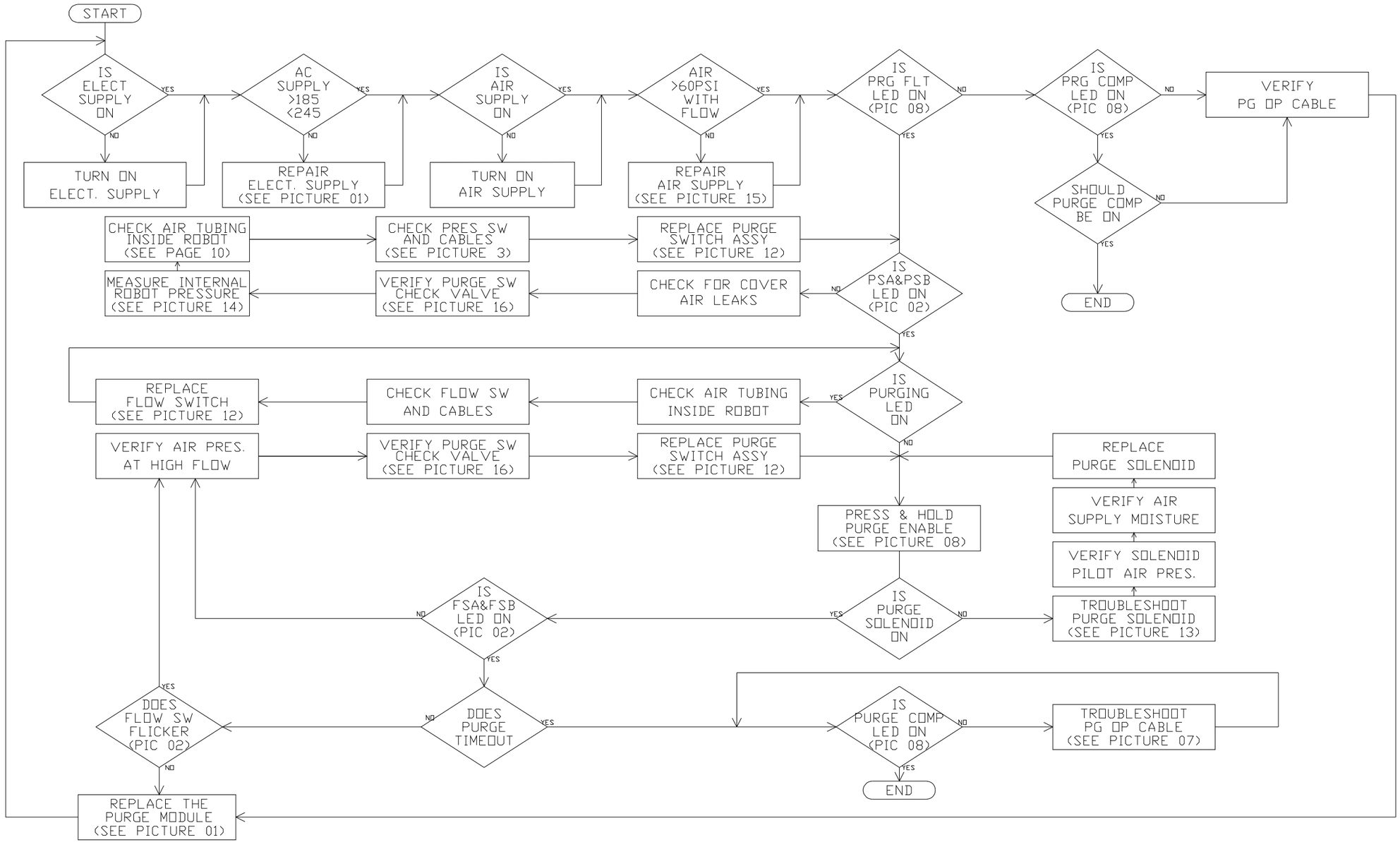


Figure 8-2 EO-6414-193-000 SHT2, CABLE & PURGE ROUTING PNEUMATIC SCHEMATIC

ABNORMAL PROCESSING

1. IF FLOW SWITCH (7) DOES NOT CLOSE DUE TO NOT-SUFFICIENT AIR FLOW, ETC., TIMING WILL NOT START. AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
2. IF THE PRESSURE SWITCH (10) IS NOT CLOSED DUE TO NOT-ENOUGH AIR PRESSURE (<0.172kPa), TIMING WILL NOT START. AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
3. IF THE FLOW SWITCH (7) OPENS AFTER PURGING HAS STARTED, TIMER (9) WILL BE RESET, PURGE FAULT INDICATION (3) WILL LIGHT. AND THEREFORE, YOU WILL NOT BE ABLE TO TURN THE ROBOT CONTROLLER POWER ON.
4. AFTER PURGE IS COMPLETE, IF PRESSURE SWITCH (10) OPENS, THE OUTPUT CONTACTS (11) WILL OPEN, THE PURGE COMPLETE INDICATION (14) WILL GO OUT, AND PURGE FAULT INDICATION (3) WILL BE ON. AND THEREFORE, THE ROBOT CONTROLLER POWER IS IMMEDIATELY SHUT DOWN.
5. RELIEF VALVE (13) WILL OPEN AT 1.893kPa TO PREVENT EXCESSIVE PRESSURE IN THE EVENT OF AN AIR SUPPLY FAILURE.

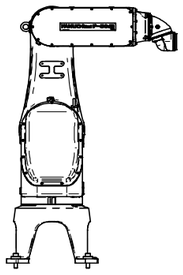
PURGE SEQUENCE

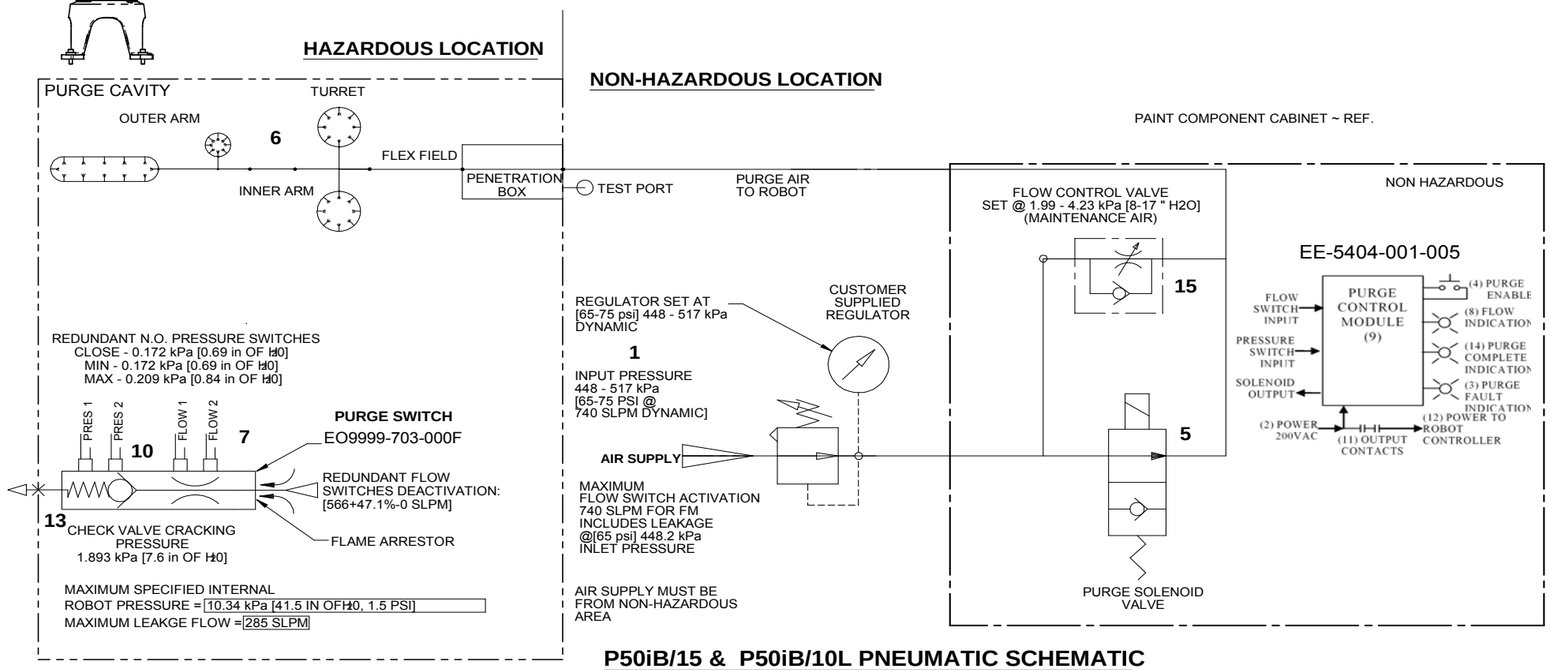
1. THE OPERATOR CONNECTS AIR SUPPLY TO ROBOT(1). PRESSURE SWITCH (10) CLOSES, AND REMAINS CLOSED AS LONG AS AIR IS SUPPLIED (0.172kPa MIN).
2. THE OPERATOR PROVIDES POWER TO CONTROLLER TERMINALS (2). AFTER POWER IS PROVIDED, THE PURGE FAULT INDICATION (3) TURNS ON.
3. THE OPERATOR PRESSES AND HOLDS PURGE ENABLE BUTTON(4).
4. PURGE CONTROL MODULE (9) SWITCHES THE SOLENOID VALVE (5) TO DISTRIBUTION LINES (6) TO START FLOW OF PURGE AIR. AIR WILL BE DISTRIBUTED THROUGHOUT ROBOT CAVITY BY DISTRIBUTION LINES (6).
5. FLOW IS MONITORED BY THE FLOW SWITCH (7) AT AIR OUTLET. WHEN FLOW REACHES 566 L/MIN, FLOW SWITCH (7) CLOSES THE ELECTRIC CONTACTS, FLOW INDICATION (8) WILL COME ON AND THE PURGE CONTROL MODULE (9) START TIMING. AT THE SAME TIME, PURGE FAULT INDICATION (3) TURNS OFF.
6. WHEN FLOW INDICATION COMES ON (8), THE OPERATOR CAN RELEASE THE PURGE ENABLE BUTTON (4).
7. PURGE FLOW CONTINUES FOR 3.5 MINUTES TO ENSURE 10 AIR CHANGES. TIME IS MEASURED BY HARDWARE LOGIC IN THE PURGE CONTROL MODULE (9). (MINIMUM PURGE TIME) = 10*(TOTAL CAPACITY OF ROBOT AND HOSE) / (FLOW RATE) = 10x153/566=2.7 MINUTES.
8. AFTER 3.5 MINUTES, PURGE IS COMPLETE. PURGE CONTROL MODULE (9) SWITCHES THE SOLENOID VALVE (5) TO MAINTENANCE AIR (15), AND CLOSES THE OUTPUT CONTACTS (11) TO PROVIDE POWER TO ROBOT CONTROLLER, AND TURNS THE PURGE COMPLETE INDICATION (14) ON. THE AIR PRESSURE IN THE CAVITY DECREASES, AND CHECK VALVE (13) CLOSES TO PREVENT LOSS OF MAINTENANCE AIR.
9. ROBOT CAN NOW BE TURNED ON. AS LONG AS PURGE IS COMPLETE, ROBOT MAY BE TURNED ON AND OFF AS DESIRED.

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damage equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS





P50iB/15 & P50iB/10L PNEUMATIC SCHEMATIC

[EO-6414-193-000_SHT2] REV *1
CABLE & PURGE ROUTING PNEUMATIC SCHEMATIC

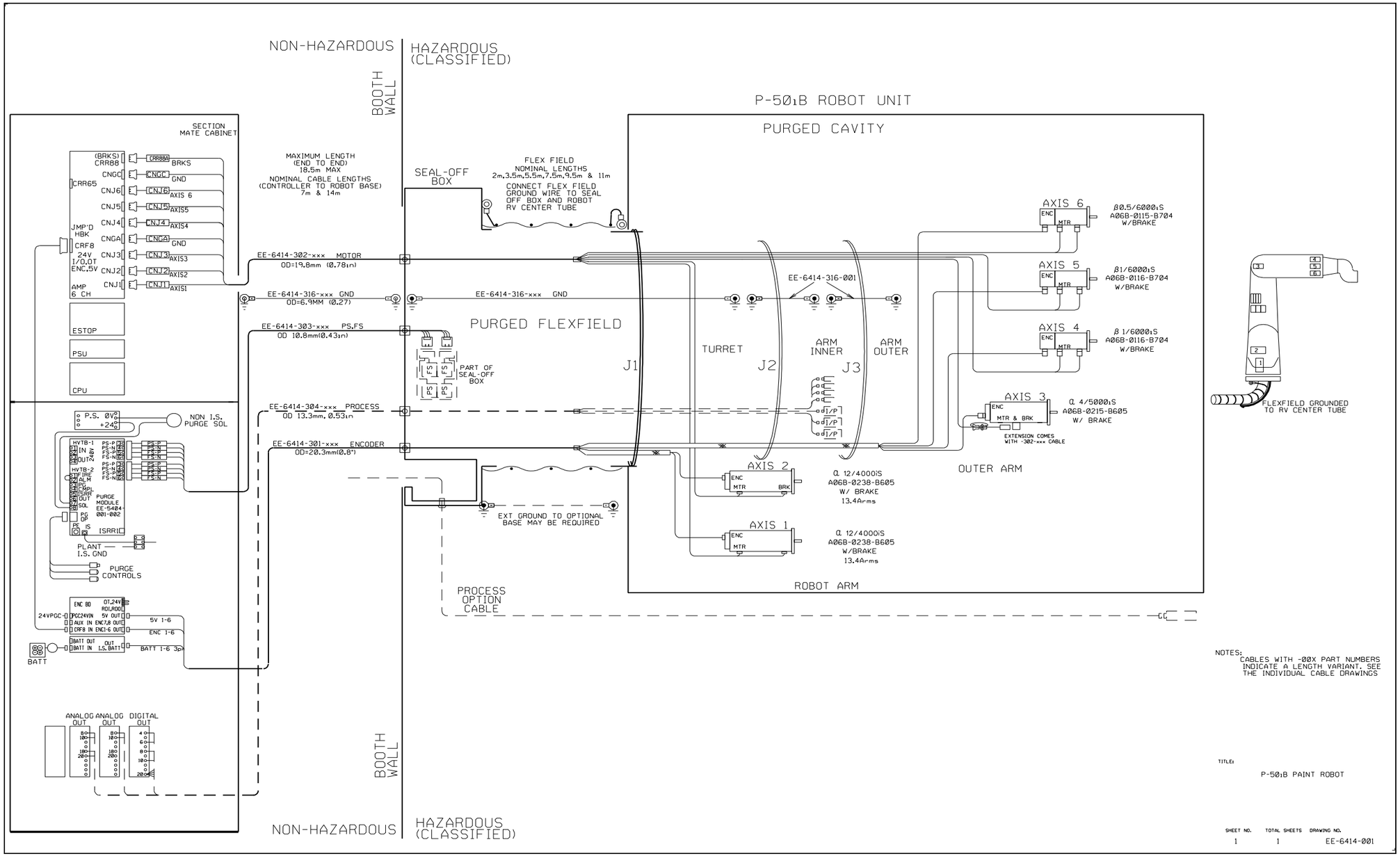
Table 8-2 Possible Purge Cycle Problems

PROBLEM	CAUSE	WHAT TO CHECK FOR
Inadequate air flow through the robot or opener	Air supply capacity inadequate	The air supply is inadequate. Check the air pressure at the pneumatic air supply.
Air leakage from robot or opener	Bad seal	Look for leakage around cover gaskets and bearing seals, at the cable entrance to the robot, holes where plugs or screws are missing, through unsealed conduit.
Pressure switch or air flow switch does not appear to work	Defective pressure switch or air flow switch	Perform the pressure switch test and air flow switch test to check components.
Inconsistent readings on the pressure gauge	Air leaks or other problems with the pneumatic air distribution	Check continuity of the pressure switch and air flow switch, during dynamic test conditions. Check pressure gauge.

CAUTION:
Both the Pressure Switches and the Air Flow Switches are adjusted and sealed at the factory or authorized vendor. They are not adjustable in the field. If you break or tamper with the seal you will void FM certification on the robot.

9 ELECTRICAL

Figure 9-1 EE-6414-001 Cable Layout, P-50iB Robot Cable Layout



10 ENGINEERING GUIDELINES

Figure 10-1 EG-00008 Sheet 1 of 6, Loctite Application

FANUC ROBOTICS ENGINEERING GUIDELINE Page 1 of 6
Title: LOCTITE APPLICATION **EG #: EG-00008**

The purpose of this engineering guideline is to define the different Loctite products used at FRA and to provide directions for proper use. This document is intended as a guideline only. Deviations are permitted and override this guideline when explicitly stated on engineering drawings/documentation.

1. Cleaning

Surfaces that are to have Loctite applied must be clean.

Acetone and Loctite "ODC-Free Cleaner & Degreaser" are approved cleaning agents.

Fasteners may be batch cleaned by submerging in acetone.

Critical areas where retaining compounds are used must be thoroughly cleaned to remove all preservative. Some preservatives are not visible and the parts may appear clean. Some preservatives contain nitrates which will stop Loctite from curing. All areas where retaining compound is used will have it's final cleaning with acetone.

The parts on which retaining compounds are used shall be thoroughly cleaned and "scrubbed" with acetone at least two times with a clean cloth. They may be washed before hand in a solvent tank. The parts must then be wiped down and blown off before cleaning twice with acetone.

2. Primers

The engineering drawings shall call out primer when necessary.

Loctite 7649 (Primer N) & Loctite 7471 (Primer T)
Loctite brand primers are used to ensure cure when applying Loctite threadlocker to two inactive metals. Primers will also speed up cure time.

Figure 10-2 EG-00008 Sheet 2 of 6, Loctite Application

Active Metals	Inactive Metals
Iron	Plated Steel
Plain Steel	Anodized Aluminum
Copper	Stainless Steel
Brass	Galvanized Steel
Commercial Aluminum	Zinc
Bronze	Natural or Chemical Black Oxide
Kovar	Plastic
	Dacromet

Primers are only required when one material is inactive (from above). If a primer is required for faster curing, it should be specified on the drawing.

Directions for use

1) Clean mating surfaces to ensure all contamination has been removed.
2) Apply primer to both mating surfaces to be bonded.
3) Allow the primer time to evaporate under good ventilation until surfaces are completely dry.
4) After primer is applied, parts should be bonded within 7 days.

3A. Thread Locking – Conventional.

Loctite thread lockers are anaerobic and cure when confined in the absence of air between close fitting metal surfaces. Application of the product will prevent loosening of assembled parts that are subject to shock and vibration.

Loctite 222:

Loctite 222 is a low strength threadlocker designed to lock and seal threaded fasteners, which require easy disassembly. Unless explicitly stated on engineering drawings/documentation, Loctite 222 is to be used on all carbon and stainless steel fasteners 5mm and smaller. The uncured appearance of this product is a purple liquid.

Figure 10-3 EG-00008 Sheet 3 of 6, Loctite Application

Loctite 242 or 248(stick):
Loctite 242 is a medium strength treadlocker designed to lock and seal threaded fasteners that require normal disassembly with standard hand tools. Unless explicitly stated on engineering drawings/documentation, Loctite 242 is to be used on all carbon and stainless steel fasteners 6mm and above. The uncured appearance of this product is blue.

Loctite 262 or 268(stick):
Loctite 262 is a high strength threadlocker designed to permanently lock and seal threaded fasteners. This product should not be applied unless explicitly stated on engineering drawings/documentation. The uncured appearance of this product is red.

Loctite 277:
Loctite 277 is a high strength threadlocker designed to permanently lock and seal threaded fasteners. This product should not be applied unless explicitly stated on engineering drawings/documentation. The uncured appearance of this product is a red liquid.

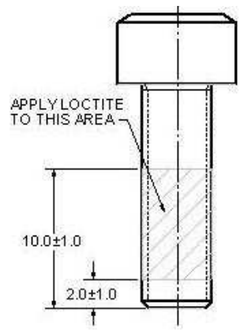
Directions for use

1) Clean mating surfaces to ensure all contamination has been removed.
2) Apply primer as required and allow to dry.
3) Select the specified product. Shake the liquid products before use.
4) **For Thru Holes,** apply several drops of the product onto the bolt at the nut engagement area.
5) **For Blind Holes,** the application method requires that product be applied to both parts. Apply several drops of the product down the internal threads to the bottom of the hole as well as the external treads of mating fastener. If product is only applied to the fastener, air pressure will force the liquid threadlocker to escape as the fastener is tightened down. Lack of uniform coverage creates air pockets, causing incomplete cures, which lead to failures.
6) Assemble and tighten as required. Fasteners must be torqued within 3 minutes.

3B. Tread Locking – Pre applied.

Loctite Dri Loc STS can be pre applied to fasteners provided the break away torque meets the FRA torque specification EG -00010. For M5 fasteners it should be diluted 50 % by weight and applied as shown below.

Figure 10-4 EG-00008 Sheet 4 of 6, Loctite Application



4. Retaining

Loctite retaining compounds form a strong bond between press-fitted and slip-fitted parts. The product fills the inner space between components and cures to form a strong bond.

Loctite 680 is a high viscosity-retaining compound for joining fitted cylindrical parts. The product cures when confined in the absence of air between close fitting metals.

Directions for use

1) Clean mating surfaces to ensure all contamination has been removed. Parts must be cleaned completely. Use acetone and scrub with a clean rag at least two times.
2) If parts are inactive metals or cure speed is too slow, spray with Loctite Primer 7471 or 7649 per the engineering drawing.
3) **For Slip Fitted Assemblies,** apply adhesive 360 degrees around OD and ID of mating parts. Use a rotating motion during assembly to ensure good coverage.
4) **For Press Fitted Assemblies,** apply adhesive 360 degrees around OD and ID of mating parts to insure the surfaces are completely coated during assembly. Assemble mating parts. When an undercut is provided, the adhesive shall be applied to the shaft to insure that the undercut is completely filled as the parts are pressed together.
5) Parts should not be disturbed until sufficient handling strength is achieved. Parts using Loctite 680 need to remain in fixture for 10 minutes. Full cure will be developed in 24 hours.

Figure 10-5 EG-00008 Sheet 5 of 6, Loctite Application

FANUC ROBOTICS ENGINEERING GUIDELINE Page 5 of 6
Title: LOCTITE APPLICATION **EG #: EG-00008**

5. Sealant

A thread sealant will seal and secure metal pipes and fittings, filling the space between threaded metal parts, and hardening to prevent leakage.

Loctite 567 is designed for locking and sealing metal tapered threads and fittings. The product cures when confined in the absence of air between close fitting metal surfaces and prevents loosening and leakage from shock and vibration. The product also provides lubrication, preventing galling between metal pipe threads and fittings.

Directions for use

1) Clean mating surfaces to ensure contamination has been removed.
2) Apply primer as required and allow to dry.
3) Apply a 360-degree bead of sealant to the leading threads of the male fitting, leaving the first thread free. Force the sealant into the threads to ensure all voids are filled.
4) Assemble and tighten fittings as required.
5) Properly tightened fittings will seal instantly and can withstand moderate pressure. For maximum pressure and solvent resistance allow the sealant to cure a minimum of 24 hours.

6. Gasketing

Gaskets are used to prevent fluid or gas leaks by forming impervious barriers that must remain intact and leak free for a prolonged period of time. Form-in-place gaskets are applied as a liquid sealant before parts are assembled. After assembly, the form-in-place gasket spreads and cures between assembled parts filling gaps, scratches and surface irregularities to provide a durable seal.

Loctite 518 Gasket Eliminator is medium strength, solvent resistant flexible seal that will not tear or decay. The product cures when confined in the absence of air between close fitting metals. The product will fill gaps up to 0.25mm.

Directions for use

1) Clean mating surfaces to ensure all contamination has been removed. The product gives best performance when surfaces are clean and free of grease.
2) Apply product in a continuous bead to one of the mating surfaces.
3) Assemble mating parts. Parts should be tightened as soon as possible after assembly.
4) Low pressure can be used to confirm a complete seal immediately after assembly. Allow time for full cure before applying high pressure.

Figure 10-6 EG-00008 Sheet 6 of 6, Loctite Application

FANUC ROBOTICS ENGINEERING GUIDELINE Page 6 of 6
Title: LOCTITE APPLICATION **EG #: EG-00008**

7. Gasket Adhesives

Gasket adhesives are used to bond a gasket to its cover for ease of assembly.

Loctite "High Tack" is a flexible material that will bond gaskets to its cover. It can be used on all paper, rubber, cork or metal gaskets.

Directions for use

1) Clean mating surfaces to ensure all contamination has been removed.
2) Apply product with brush or spray.
3) Assemble gasket to cover. Parts should be allowed to cure for 5 minutes minimum before the cover/gasket is installed.

8. List of the ND Industries part numbers – equivalent to Loctite.

Fanuc Item Number:	Current Item Description	New Item Description
HDWMO0000011450	LOCTITE #49550 ADHSV 1 OZBOTL	LOCTITE #49550 1oz / ND #39528
HDWMO0000011460	LOCTITE #242-41 SEALANT 250CC	LOCTITE #242-41 250cc/ND#12125
HDWMO0000011470 ALT:HDWMO0000023620	LOCTITE #271-41 THRDLCKR 250CC	LOCTITE #271-41 250cc/ND#14025
HDWMO0000018360	LOCTITE #242-31 SEALANT 50CC	LOCTITE #242-31 50cc/ND #12150
HDWMO0000023120	LOCTITE #515-31 GSKT SEALANT	LOCTITE #515-31 50cc/ND #73250
HDWMO0000023620 ALT:HDWMO0000011470	LOCTITE #271-31 SEALANT 50CC	LOCTITE #271-31 50cc/ND #14050
HDWMO0000024500	LOCTITE #26231 RETAIN COMPOUND	LOCTITE #26231 50cc/ND #13150
HDWMO0000030760	LOCTITE #680 RETAIN COMP 50CC	LOCTITE #680 50cc/ND #54150
HDWMO0000031480	LOCTITE #290-41 SEALANT 250CC	LOCTITE #290-31 50cc/ND#15050
HDWMO0000031850	LOCTITE #PST-56747 SEALANT 50M	LOCTITE#PST56747 50ml/ND#46050
HDWMO0000031860	LOCTITE #22241 SEALANT 250CC	LOCTITE #22241 250cc/ND #11125
HDWMO0000032480	LOCTITE #51831 SEALANT TUBE	LOCTITE #51831 50ml/ND #73050
HDWMO0000032490	LOCTITE #51845 SEALANT 300ML	LOCTITE #51845 300ml/ND#73025
HDWMO0000033670	LOCTITE #222-31 SEALANT 50 ML	LOCTITE #222-31 50ml/ND #11150
HDWMO0000036580	LOCTITE #21348 PRIMER N	LOCTITE #21348 PRI N/ND #61118
HDWMO00000603240	LOCTITE #45440 PRISM 454 ADHES	LOCTITE #45440 20gm/ND #35420
HDWMO0000565880	LOCTITE #41650 416 INST ADHEV	LOCTITE #41650 1oz/ND #31628

Figure 10-7 EG-00010 Sheet 1 of 5, Torque Specification

FANUC ROBOTICS ENGINEERING GUIDELINE Page 1 of 5

Title: Mechanical Development Torque Specifications **EG #: EG-00010**

Purpose: To define the torque and Loctite specifications for the most common fasteners used.

Scope: This torque specification applies only to Products designed in the Mechanical Development department (EO, ET drawing series). Deviations are permitted and override this specification when explicitly stated on the engineering drawing/documentation.

Tolerance: - Torque tolerance for all specified values is assumed to be +/- 6% unless otherwise specified on drawing.

Specification: For Metric Fasteners Only

NOTE: Unless otherwise specified:
All threaded fasteners have coarse threads
All Stainless Socket Head fasteners and Stainless Hex Head screws and all Hex Head Type Nuts will be grade A2.
All Carbon Steel Socket Cap screws will be grade 12.9.
All Dacromet plated Carbon Steel Socket Cap screws will be grade 12.9.
All zinc plated Carbon Steel Socket Cap screws will be grade 12.9. (torqued to 10.9 spec)
All Carbon Steel Shoulder Screws will be grade 12.9.
All Carbon Steel Socket Flat Head screws and Carbon Steel Socket Button Head fasteners will be grade 10.9.
All Carbon Steel Low Head Socket Cap screws will be grade 8.8.
All Carbon Steel Hex head screws will be grade 8.8
All Carbon Steel Hex nuts M6 and larger will be grade 10
All Carbon Steel Hex Nut M5 and smaller will be grade 6
All Carbon Steel Jam Nuts will be grade 4.
All Nylon fasteners are Polyamide 6.6 (nylon 6.6)
All Brass fasteners are Brass Ms 63 (cold formed)
Loctite #222 will be used on all carbon and stainless steel fasteners 5mm and under.
Loctite #242 will be used on all carbon and stainless steel fasteners 6mm and over.

Figure 10-8 EG-00010 Sheet 2 of 5, Torque Specification

FANUC ROBOTICS ENGINEERING GUIDELINE Page 2 of 5

Title: Mechanical Development Torque Specifications **EG #: EG-00010**

A. Standard Torque Specification for grade 12.9 Carbon Steel Socket Cap, grade 10.9 Hex Head Screws and grade 10 Hex Nuts (Except for Fasteners securing covers with gaskets) Dacromet coated Carbon Steel Socket Cap screws

	Torque (N-m)	**Torque (ft-lbs)**
M2 x .4	.5	0.4
M2.5 x .45	1.0	0.7
M3 x .5	1.7	1.3
M4 x .7	3.9	2.9
M5 x .8	7.9	5.9
M6 x 1.0	13.5	10.0
M8 x 1.25	32	23.6
M10 x 1.5	64	47.2
M12 x 1.75	112	82.5
M14 x 2.0	180	132
M16 x 2.0	280	206
M20 x 2.5	546	402
M24 x 3.0	944	696
M30 x 3.5	1825	1346
M36 x 4.0	3200	2360

B. Standard Torque Specification for grade 12.9 Carbon Steel Shoulder screws.

Thread Diameter and Pitch	**Shoulder Diameter**	**Torque (N-m)**	**Torque (ft-lbs)**	**Torque (in-lbs)**
M5 x .8	M6	7.9		70.0
M6 x 1.0	M8	13.5	10	119.4
M8 x 1.25	M10	32	23.6	
M10 x 1.5	M12	64	47.2	
M12 x 1.75	M16	112	82.5	
M16 x 2.0	M20	280	206	

Figure 10-9 EG-00010 Sheet 3 of 5, Torque Specification

FANUC ROBOTICS ENGINEERING GUIDELINE Page 3 of 5

Title: Mechanical Development Torque Specifications **EG #: EG-00010**

C. Standard Torque Specification for all Stainless fasteners and Nuts (Except for Fasteners securing covers with gaskets)

	Torque (N-m)	**Torque (ft-lbs)**
M2 x .4	0.33	0.25
M2.5 x .45	0.66	0.5
M3 x .5	1.1	0.8
M4 x .7	2.6	2.0
M5 x .8	5.4	4.0
M6 x 1.0	9.2	6.8
M8 x 1.25	22.0	16.2
M10 x 1.5	43.5	32.0
M12 x 1.75	76.0	56.0
M14 x 2.0	121	89.0
M16 x 2.0	189	138
M20 x 2.5	368	271
M24 x 3.0	636	469
M30 x 3.5	1263	932
M36 x 4.0	2207	1628

D. Torque Specification for all Metric Carbon and Stainless Fasteners securing Covers with Gaskets

	Torque (N-m)	**Torque (ft-lbs)**
M4 x .7	2.0	1.5
M5 x .8	4.0	3.0
M6 x 1.0	6.3	4.6
M8 x 1.25	7.5	5.5
M10 x 1.5	8.4	6.2

Figure 10-10 EG-00010 Sheet 4 of 5, Torque Specification

FANUC ROBOTICS ENGINEERING GUIDELINE Page 4 of 5
Title: Mechanical Development Torque Specifications **EG #: EG-00010**

E. Standard Torque Specification for grade 8.8 Carbon Steel Hex Head screws, grade 10.9 Carbon steel Flat Head Socket Screws, grade 10.9 Button Head Socket Screws, grade 8.8 Carbon Steel Low Head Socket Cap Screws, grade 6 Carbon Steel Hex Nuts and all Carbon Steel Jam Nuts (Except for Fasteners securing covers with gaskets), grade 12.9 Zinc plated Carbon Steel Socket Cap screws

	Torque (N-m)	**Torque (ft-lbs)**
M2 x .4	0.4	0.3
M2.5 x .45	0.7	0.5
M3 x .5	1.0	0.7
M4 x .7	2.2	1.6
M5 x .8	4.3	3.1
M6 x 1.0	7.5	5.5
M8 x 1.25	18.0	13.2
M10 x 1.5	36.0	26.5
M12 x 1.75	67.0	49.4
M14 x 2.0	106.0	78.0
M16 x 2.0	161.0	118.5
M20 x 2.5	315.0	232
M24 x 3.0	544.0	401
M30 x 3.5	1080.0	796
M36 x 4.0	1890.0	1394

F. Standard Torque Specification for all Nylon fasteners and Nuts

	Torque (N-m)	**Torque (ft-lbs)**
M3 x .5	0.1	0.07
M4 x .7	0.2	0.15
M5 x .8	0.5	0.37
M6 x 1.0	1.0	0.74
M8 x 1.25	2.0	1.4
M10 x 1.5	3.0	2.2
M12 x 1.75	4.0	3.0
M14 x 2.0	6.0	4.4
M16 x 2.0	7.5	5.5

Figure 10-11 EG-00010 Sheet 5 of 5, Torque Specification

FANUC ROBOTICS ENGINEERING GUIDELINE Page 5 of 5

Title: Mechanical Development Torque Specifications **EG #: EG-00010**

G. Standard Torque Specification for all Brass fasteners and Nuts

	Torque (N-m)	**Torque (ft-lbs)**
M2 x .4	0.14	0.10
M2.5 x .45	0.29	0.21
M3 x .5	0.5	0.37
M4 x .7	1.2	0.9
M5 x .8	2.2	1.6
M6 x 1.0	3.9	2.9
M8 x 1.25	9.0	6.6
M10 x 1.5	17.0	12.5

Figure 10-12 EG-00167, Zinc Free Robot Grease

FANUC ROBOTICS ENGINEERING GUIDELINE Page 1 of 1

Title: Zinc Free Robot Grease **EG #: EG-00167**

Subject: Zinc free Robot Greases to be used as a replacement for Fanuc Robotic standard robot greases LG-01-02 and LG-03..

Purpose: These zinc free greases can be used as a replacement for LG-01-02 and LG-03 robot greases for customers that require no heavy metals in the grease formulation. The corresponding zinc free robot greases will have the designations LG-01-02-ZF and LG-03-ZF. These new greases have a non metallic anti-wear additive to replace the zinc base anti-wear additives.

Grease part number cross reference chart:

Grease	Size	Standard Fanuc Robotics Part No.	Zinc Free Part No.
LG-01-02	Tube – 4.5 oz	SPARE0000000075	HDWMO000004167O
	Pail – 35 Lb	SPARE0000000505	HDWMO000004168O
	Keg – 120 lb	SPARE0000000497	HDWMO000004169O
LG-03	Tube – 4.5 oz	HDWMO000002580O	HDWMO000004170O
	Pail – 35 Lb	HDWMO0000002324O	HDWMO000004171O
	Keg – 120 lb	HDWMO00002325O	HDWMO000004172O

Designation:

NLGI Grade	Standard Formulation	Zinc Free Formulation
0	LG-01-03	LG-01-03-ZF
1	LG-03	LG-03-ZF

Figure 10-13 EG-00316 Sheet 1 of 5, Gear Head Mounting Instructins

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damge equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

BAYSIDE GEAR REDUCER

Gearhead Mounting Instructions

Featuring ... Patented ServoMount Design for Optimum Servo Performance!!!

Congratulations on your purchase of a Stealth Planetary Gearhead with the exclusive ServoMount mounting system! The following instructions will assist you in mounting the gearhead to your motor. If additional assistance is required, please call Bayside at (516) 484-5353, Monday through Friday, 8:00 am - 7:00 pm EST or visit our website at ***www.baysidemotion.com.***

Parts Supplied

- Bayside Precision Gearhead with ServoMount option (see Fig. 1)
- Socket Head Cap Screws (4) with Lock Washers
- Allen Wrench

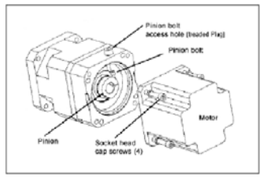


Fig. 1

Mounting Instructions

Step 1. Remove the threaded plug from the bolt access hole in the rear housing of the gearhead.

Step 2: Rotate the pinion until the head of the pinion bolt is aligned with the pinion screw access hole.

Step 3. Insert the supplied Allen wrench through the pinion bolt access hole into the head of the pinion bolt. This bolt should be loose. Do not tighten it. (Fig 2) NOTE: If the motor shaft has a flat, rotate the motor shaft so that the flat will be opposite to the pinon bolt.

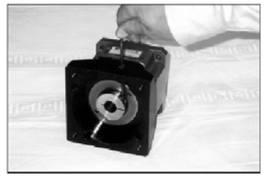


Fig. 2

Screw Tightening Torques

Frame Size (mm)	Motor Shaft Diameter inches	(mm)	Screw Size	Tightening Torque in-lbs.	(Nm)
40	<.250	(<6.35)	2.5	11	1.21
60	.230 - .630	(5.8 - 16)	M4	41	4.6
90	.250 - .630 .630 - .748	(6.4 - 16.0) (16.0 - 19.0)	M4 M5	41 84	4.6 9.5
115	.375 - .751 .787 - .946	(9.5 - 19.1) (20.0 - 24.0)	M5 M6	84 140	9.5 16
142	.500 - .945 1.00 - 1.379	(12.7 - 24.0) (25.4 - 35.0)	M6 M8	140 345	16 39
180	.624 - 1.378 1.496 - 1.654	(15.8 - 35.0) (38.0 - 42.0)	M8 M10	345 681	39 77
220	.945 - 1.388 1.496 - 2.165	(25.4 - 35.2) (38.0 - 55.0)	M10 M12	681 1195	77 135
300	All	All	M12	1195	135

[EG-00316] REV D2
Gear Head Mounting Instructins SHEET 1 OF 5

Figure 10-14 EG-00316 Sheet 2 of 5, Gear Head Mounting Instructins

Alpha Gear Reducer

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damge equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

Alpha Gear Reducers - CV models

Motor mounting

All gear reducers are treated with an anti-corrosion agent at the gear input and output.

Before mounting the gear reducer, remove any trace of anti-corrosion agent. Use a clean cloth moistened with a suitable cleaning agent (fat dissolving but non-aggressive).

Use calibrated torque wrenches for the respective torque range.

A setscrew and a slit spacer sleeve connect the motor shaft and the gear drive shaft

Clean the mounting surfaces of the motor and gear reducer with a clean cloth.
Check the surfaces for impurities and damage.
Do not put any devices into operation that show evidence of damage.

Turn the clamping hub so that the setscrew can be reached through the mounting holes in the adapter flange.

Take care that the slot of the spacer sleeve is positioned 90° to the setscrew.
Readjust the spacer sleeve if necessary.

Loosen the setscrew in the clamping hub by one turn.

Make sure that the motor allows itself to be moved into position "easily".

Position the motor so that the mounting surfaces fit together.

There is to be no gap between the motor and adapter flange.

Coat the motor mounting bolts with Loctite 242 and-screw the motor to the-adapter flange.
Torque motor mounting bolts.

Turn setscrew in the clamping hub to the tightening torque per chart.

Gear reducer size	Tightening Torque (N-M)	Hex Size mm
CV 040	5.6	3
CV 060	9.5	4
CV 080	23	5
Cv 115	45	6

Output Shaft Mounting

Mount gears, pulleys or drive shafts to out put without forcing. Never force or hammer.

During assembly, do not exceed the axial force per table below.

Gear reducer size	040	060	080	115
Max Force (N)	230	750	1600	2100

[EG-00316] REV D2
Gear Head Mounting Instructins SHEET 2 OF 5

Figure 10-15 EG-00316 Sheet 3 of 5, Gear Head Mounting Instructins

ZF Gear Reducer

Assembly Instructions

ZF-Servoplan PGE - Planetary Gearboxes

ZF Maschinenantriebe GmbH
ZF Industrial Drives

General:

A torsionally rigid and backlash free connection between motor and gearbox can quickly and easily be achieved by using the following assembly instructions.
Note: Please only use motors with a flange face and run out accuracy class DIN 42955 N or DIN 42955 R.

To avoid misalignment inside the power train, the PGE utilizes our new "open centering" design making the laborious task of centering with the flange and pilot obsolete. Simply slip the gearbox hollow shaft (6) over the motor shaft, tighten the clamping bolt (7) on the compression coupling (5), and attach the gearbox to the motor using the mounting holes (10).

The PGE planetary gearboxes are maintenance free and have lifetime lubrication.

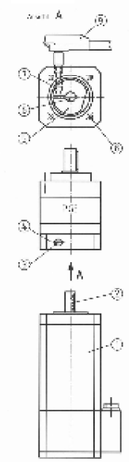
Motor Mounting Instructions:

1. If the motor shaft has a key (2), remove it. For applications with motor speeds over 3000 rpm, we recommend using a half key to completely fill the key way. The key may not stand out above the height of the motor shaft.
2. Remove vent plug (3) on the adapter flange (4) and put it aside, reserving it for later use.
3. Turn the compression coupling (5) until the head of the clamping bolt (7) is visible through the access hole.
4. If a PGE with an adapter flange (4) screwed on, is not directly mounted on the motor by using the adapter flange (4), then the adapter flange (4) must be removed from the PGE. Remove four hexagonal socket-head screws (8), then pull off the adapter flange (4) from the PGE.
5. Examine all contact surfaces on the motor flange and the adapter flange (4) to ensure they are clean and grease free. Also inspect the motor shaft and the hub to ensure they are free from damage (burrs, scoring, etc.).
6. Place motor (1) vertically on the work surface and secure it from falling. Ensure that the key way in the motor shaft is positioned opposite the slit (180°) in the compression coupling when assembled.
7. If a reduction bushing is used, ensure the slit in the bushing is aligned with the compression coupling slit.
8. If motor installation is as described under 4., then the previously removed adapter flange (4) must be placed onto the motor flange surface and then screwed on.
9. If the PGE is too heavy to lift manually, a suitable hoisting machine should be used. Slip gearbox hollow shaft (6) over motor shaft until the adapter flange mates with the motor flange over its **entire surface**. Do **not** strike the gearbox or use excessive force to ensure a good fit.
10. Tighten the clamping bolt (7) to the prescribed torque (see table tightening torque) using a suitable torque wrench (9).
11. Now bolt PGE with adapter flange (4) directly on motor (1) or if you have a motor installation as described under 4., bolt the PGE onto adapter flange (4). Screws (8) must be diagonally transferred and evenly tightened.
12. Then bolt PGE and motor together using the mounting holes (8) in the adapter flange. The bolts must be diagonally transferred and uniformly tightened.
13. Insert access hole plug (3) into adapter flange (4).

Note: Failure to follow assembly instructions may lead to gearbox and/or motor damage and will void any warranty either explicit or implied.

tightening torque for the clamping bolt (7)	
clamping screw DIN 912	tightening torque
M3	2,1 Nm
M4	4,2 Nm
M5	8,3 Nm
M8	43 Nm

View A



4172 758 101a
Version:19.07.2004

WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damge equipment

WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

[EG-00316] REV D2
Gear Head Mounting Instructins SHEET 3 OF 5

Figure 10-16 EG-00316 Sheet 4 of 5, Gear Head Mounting Instructins

Wittenstein (Alpha) TP+ GEAR REDUCER

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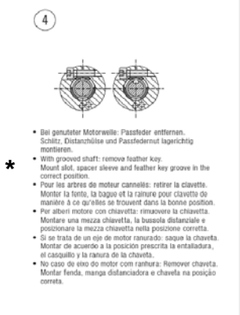
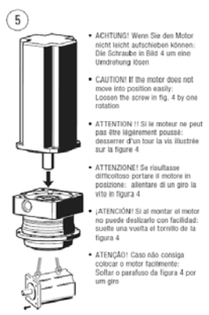
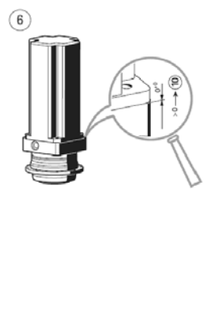
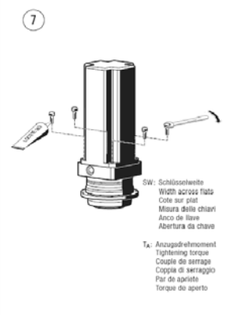


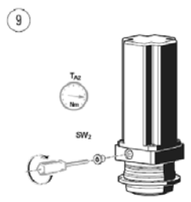




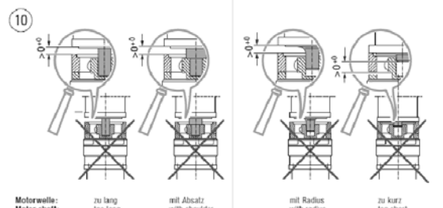


* SPACER SLEEVE MAY NOT BE PRESENT FOR SOME APPLICATIONS. USE OF A SPACER SLEEVE IS DEPENDENT ON MOTOR SHAFT DIAMETER.

SW_1 [mm]	T_{A1} [Nm]
3	4,1
4	9,5
5	16
6	39
8	79
10	135
14	330



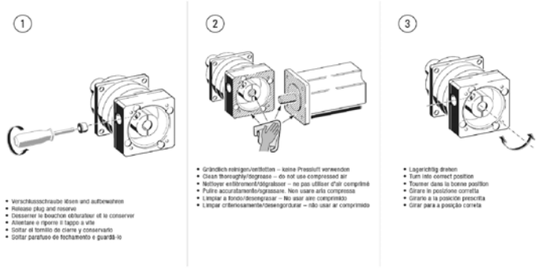
SW_2 [mm]	T_{A2} [Nm]
5	10
8	35
10	50
12	70

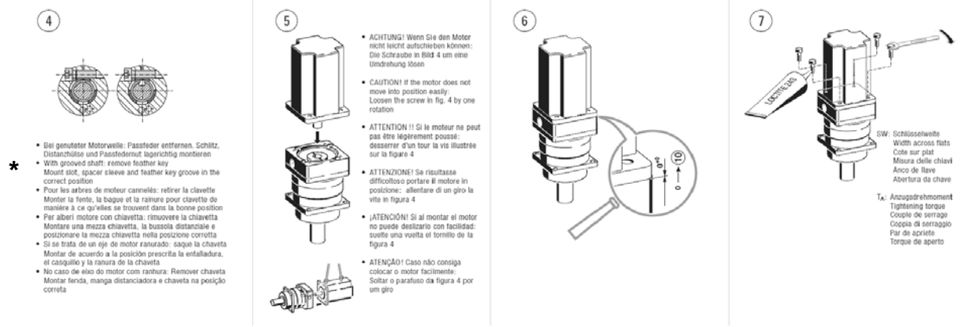


[EG-00316] REV D2
Gear Head Mounting Instructins SHEET 4 OF 5

Figure 10-17 EG-00316 Sheet 5 of 5, Gear Head Mounting Instructins

Wittenstein (Alpha) SP+ GEAR REDUCER





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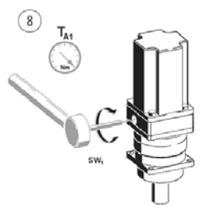
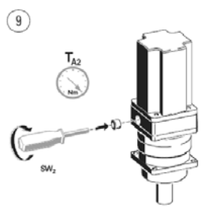
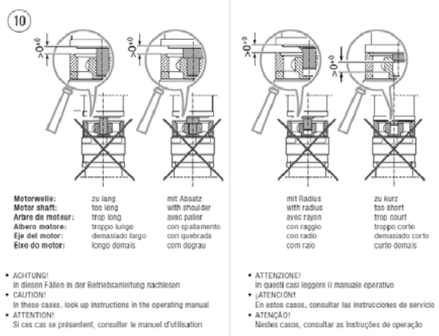


SW_1 [mm]	T_{A1} [Nm]
3	4,1
4	9,5
5	16
6	39
8	79
10	135
14	330



SW_2 [mm]	T_{A2} [Nm]
5	10
8	35
10	50
12	70



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[EG-00316] REV D2
Gear Head Mounting Instructins SHEET 5 OF 5

Figure 10-18 EG-00540 Sheet 1 of 3, P50iB Ruland Rigid Couplings Installation Procedure

FANUC ROBOTICS ENGINEERING GUIDELINE Page 1 of 3

Title: P50iB Ruland Rigid Couplings Installation Procedure **EG #: EG-00540**

Purpose: To describe proper Ruland one piece rigid shaft couplings installation procedure in the P50iB robot

1) Ruland rigid coupling assembly view:

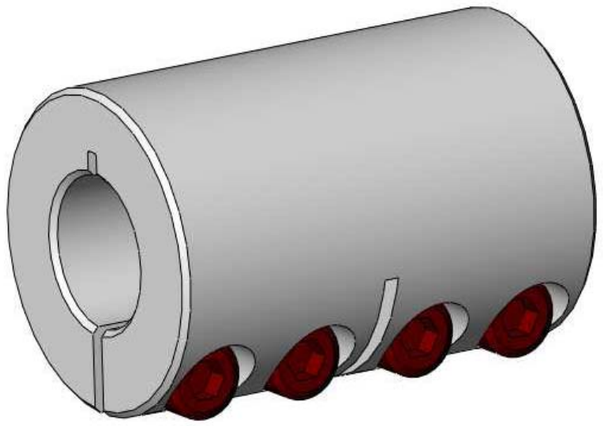

Figure 10-19 EG-00540 Sheet 2 of 3, P50iB Ruland Rigid Couplings Installation Procedure

FANUC ROBOTICS ENGINEERING GUIDELINE Page 2 of 3

Title: P50iB Ruland Rigid Couplings Installation Procedure **EG #: EG-00540**

1) P50iB Ruland one piece rigid shaft couplings installation procedure:

- Align the coupling on the two shafts to be connected in vertical position as shown with reducer key removed & coupling split opposite to the reducer keyway (see detail transparent view).

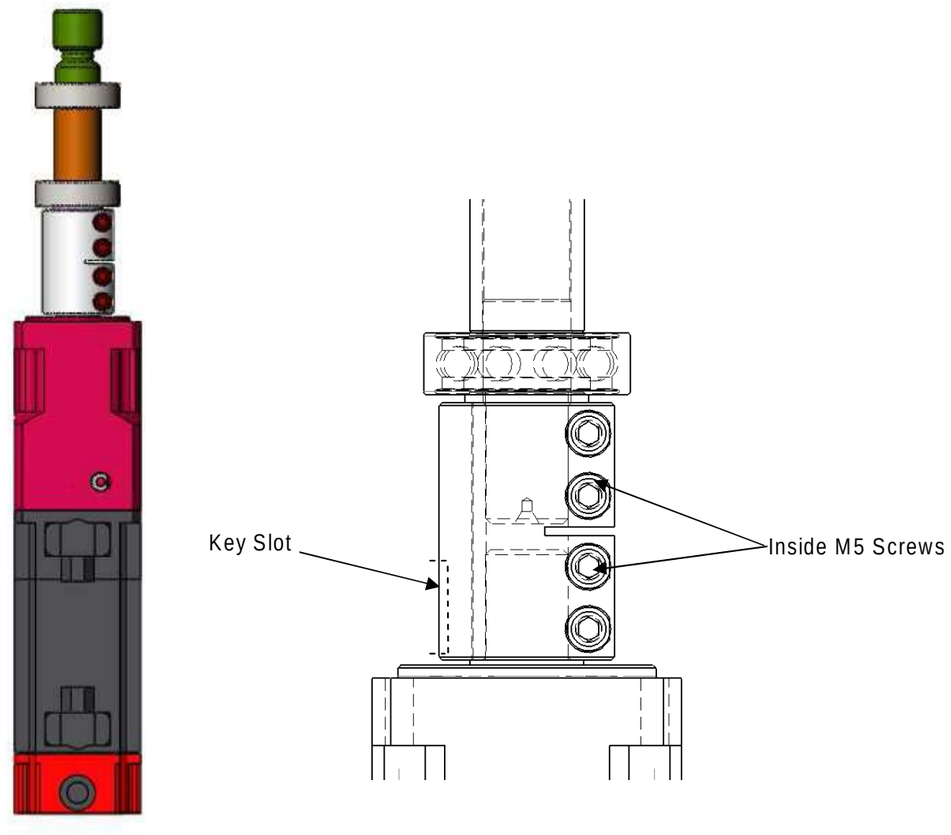

Figure 10-20 EG-00540 Sheet 3 of 3, P50iB Ruland Rigid Couplings Installation Procedure

- Tighten the Nypatch® clamp screws in two stages. Starting with the inside M5 screws, tighten to half of the recommended seating torque (see Table 1). Repeat for the outside screws, again tightening to half of the recommended seating torque.
- After inserting pre-assambled wrist pinions with bearings, spacers, motors & reducers into the wrist housing using its holes corresponding to each couplings - tighten couplings M5 screws to the full recommended seating torque (see Table 1) following the same pattern, beginning with the inside screws first.

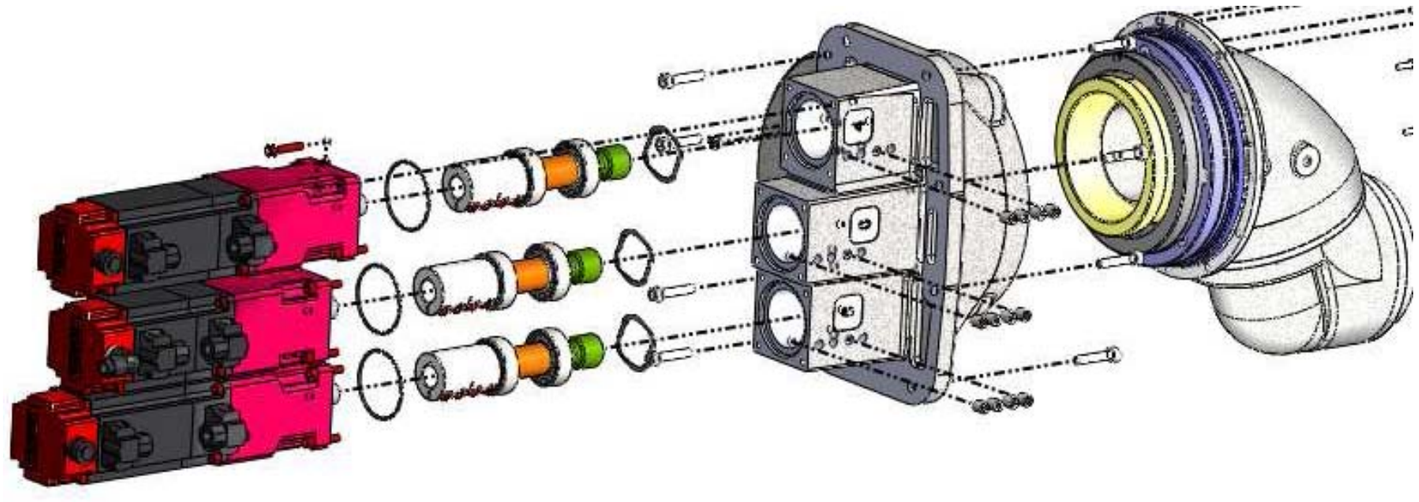

TABLE 1. Hardware Torque Chart

Metric Forged Socket Cap Screws

Metric Clamp Screwfi	Seating Torque (Nm) Alloyfi
M5	9.5

GLOSSARY

A

AA	Atomizing air.
AAP	Atomizing air pilot.
AAS	Atomizing air supply.
abrasive.	A substance used for smoothing or polishing.
ACAS	Applicator cleaner air supply.
accurate.	Conforming to a recognized standard.
ACSP	Applicator cleaner solvent pilot.
ACSS	Applicator cleaner solvent supply.
ACVS	Applicator cleaner vacuum supply.
anaerobic.	Pertaining to the absence of oxygen.
angular contact.	Contact which is at an angle to the axis of rotation.
apex dimension (gear).	The apex is the point where, for example if the teeth of a bevel gear were extended, they would meet.
apex dimension (bearing).	The point where for example if the angled working surfaces of a bearing were extended, they would meet.
arc.	A continuous portion of a curved line.
AVP	Application valve panel.

axial load.	A load parallel to the axis of rotation.

B

BA	Bearing air.
backlash.	The space between the thickness of a gear tooth and the space between gear teeth in the mating gear.
BAO	Bearing air okay.
BAT	Brake air turbine.
bearing.	A support and guide for a rotating object.
bell applicator high voltage cascade.	A component used to charge paint passing through a bell paint applicator.
bell applicator turbine.	The high speed (20,000 to 60,000 R.P.M.) turbine rotates the bell cup.
bell cup.	A bell applicator component that uses centrifugal force to force paint up the sides of the cup. The paint flows through the cup forming small threads of paint.
belt.	A continuous flexible band that transmits motion from one pulley to another.
bevel gear.	A gear having the teeth cut into a conical surface.
blind hole.	A hole that is closed at one end.
bonding.	Attaching a material to a surface.
brinelling.	A small indentation left by the pressure of a hardened steel ball.
burr.	A raised edge on the surface of a piece of metal.
bushing.	A cylindrical component used to resist wear or act as a guide.

BWP	Bell wash pilot.
BWS	Bell wash supply.

C

CA	Compensation air.
caliper.	An instrument used to measure thickness or a diameter.
cam.	An element which changes a rotary motion to a linear motion.
casting.	Something cast in a mold.
CCAS	Color change air supply.
CCSS	Color change solvent supply.
clearance.	The distance between two objects.
clevis.	A U-shaped device with a hole at each end to receive a pin or bolt.
CO2	Carbon dioxide supply.
concentricity.	Having a common center.
CP#	Color pilot (# = color)
cps (viscosity)	Centipoises per second
cycloidal gear teeth.	Gear teeth resembling a circle.

D

D	Dump.
DAT	Drive air turbine.
docking station.	Used with the waterborne paint applicator to change the paint color.
dowel pin.	A round pin (usually) that provide alignment or prevents slipping between two mating surfaces.
drill.	A tool used to create holes.
dump cycle	To remove impurities or other elements.
duplex.	Having two parts, double.

E

engagement.	Interlocked.
E-stat	Electrostatics.
expansion reamer.	A reamer with an adjusting screw to change the outside diameter of the reamer.

F

FA	Fan air.
FAP	Fan air pilot.
FAS	Fan air supply.
flared fitting.	A fitting that connects and seals a tube with a flared end.
flute.	One of the grooves in a drill or reamer.

F.E.P.	Flourinated Ethylene Propylene

G

gasket.	An item placed at a joint to make it water or air tight.
gauge.	A measuring instrument.
gear.	A disk or shaft with teeth cut to mesh with another gear to transmit motion.
grinding.	A process for removing material.

H

harmonic drive reducer.	A speed reducer that operates by radial, rather than a rotating, tooth mesh. The tooth mesh is created by flexing one element to create an inward and outward tooth motion, which allows a spline-like tooth engagement.
helical.	Spiral.
high voltage cascade.	The high voltage cascade provides an electrostatic charge.
high voltage control unit (hvcu).	The High Voltage Control Unit (HVCU) controls electrostatics for the FANUC Robotics VersaBell and ServoBell applicators.

I

I.D.	Inside diameter.
I.M.L.T.	Infant Mortality Life Test
indicator.	An instrument to measure variations.
involute.	Intricate.
IWP	Injector wash pilot.

IWS	Injector wash supply.

J

jig.	A device used to hold work.
joint.	The place where two items are joined.

K

key.	An item used to drive a shaft or gear.
keyway.	A groove used to locate a key.
knurl.	A raised surface on a diameter.

L

labyrinth.	A series of paths that make it difficult to enter or exit.
lapping.	A polishing process.
linear way	A precision guide for a linear bearing.
lubricant.	A substance that is used to reduce friction.
L. H.	Left hand

M

mating gear.	A gear meshing with another gear or rack.
MCP	Master control panel.

MI	Microphone in.
MIS	Manual input station.
MO	Microphone return air.
micrometer.	An instrument used to measure thickness or diameter.
mounted wheels.	An abrasive mounted to a shaft.

N

needle roller bearing.	A cylindrical roller bearing used to accept thrust.
nominal.	A name, number or dimension assigned to an object.

O

O.D.	Outside diameter.
O.D.C.	Ozone Depleting Chemical
O-ring.	A continuous ring of material to seal between two surfaces.
oilstone.	An abrasive tool that uses oil to help remove metal.

P

P	Paint.
Pa	A unit of pressure equal to one newton per square meter.
paint valve.	A valve used to start and stop the flow of paint or solvent.

PAP	Paint application panel.
PAP	Purge air pilot.
PCC	Pilot color change.
PCE	Process Control Enclosure.
PD	Purge dump
PDP	Power distribution panel
PFAP	Purge funnel air pilot.
PFAS	Purge funnel air supply.
PIE	Process interface enclosure.
pinion.	A gear with a small number of teeth usually engaging with a larger gear or a rack.
pitch diameter.	The diameter between the centers of adjacent gear teeth.
plain bearings.	A cylindrical component used to reduce friction or guide an object.
PLC	Programmable logic controller
PPVE	Paint process valve enclosure.
PPVP	Paint process valve panel.
PR	Pilot regulator.
PR#	Paint return (# = color).

precision.	The quality or state of being accurate or exact.
PS#	Paint supply (# = color).
psi	Pounds per square inch
PSP	Purge solvent pilot.
PT	Pilot trigger.
PTFE	Polytetraflouroethylene
PTS	Pilot trigger supply.
pulley.	A wheel with grooves around the outside diameter that rotates to transmit force.
purge	To remove impurities or other elements.

Q

Q.D.	Quick disconnect
quality.	A degree of excellence.

R

rack.	An item with teeth on one side to mesh with a pinion or gear.
radial load.	A load to the side of an object.
reamer.	A round tool with straight or helical flutes to finish or enlarge a hole.
retaining ring.	A retaining ring is used as an artificial shoulder. It can be either inserted into a housing or on a shaft. It is stamped from tempered steel (snap ring) or spiral-wound with usually two or three turns.

R. H.	Right hand
rotary file or rotary burr.	A metal removing tool mounted to a shaft usually made of high speed steel, carbide or diamond dust coated metal.
RP	Robot purge.
runout.	Variation.
RV reducer.	Rotating vector reducer.

S

SA	Shaping air.
SAP	Shaping air pilot.
SAS	Shaping air supply.
SCC	System control console.
SCE	System control enclosure.
scfm	Standard cubic feet per minute
SDP	System distribution panel.
sealed bearing.	A bearing with a device to prevent dirt, liquids or gasses from entering the bearing.
shaping air.	A bell applicator component used to shape the pattern of the paint threads being forced from the bell cup.
shielded bearing.	A bearing with a device to prevent dirt from entering the bearing.
slpm	Standard liters per minute

spiral bevel gears.	A gear having curved teeth cut into a conical surface.
sprocket.	A toothed wheel.
spur gear.	A gear that has teeth on the outside diameter that are cut straight and are parallel to the axis of rotation.
swage.	To form or shape.
swaged fitting.	A fitting that seals by shaping the tube end as it is tightened.

T

tandem.	A group of two or more arranged one behind the other or used in conjunction.
taper dowel pin.	A tapered pin used to locate or prevent an object from slipping.
TDP	Turbine drive pilot.
TDS	Turbine drive supply.
thru hole.	A hole that passes through an object.
thrust bearings.	A roller bearing used to accept a thrust load.
tolerance.	An allowable amount of error.
torque.	A force that tends to cause rotation.
total indicator reading.	The total amount of a dial indicator needle movement.
turbine.	A machine in which the kinetic energy of a moving fluid is converted into mechanical energy by causing a bladed rotor to rotate.

U

UHMW. Ultra high molecular weight plastic.

universal joint. A connection used when two shafts are not inline.

V

vernier scale. A scale used to provide additional accuracy.

W

Woodruff key. A key with a semi-circular shape.

worm gearing. Gearing used where accuracy is of importance rather than speed.

Y

yoke. A device which holds items on location.

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