FANUC Robot series

Application Equipment Manual

MARMCP7AP07071E REV B

FANUC Robotics America Corporation
3900 W. Hamlin Road
Rochester Hills, Michigan 48309-3253

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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WARNING

This equipment generates, uses, and can radiate radiofrequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of the equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measure may be required to correct the interference.

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

FANUC Robotics America Corporation
Training Department
3900 W. Hamlin Road
Rochester Hills, Michigan 48309-3253
www.fanucrobotics.com

For customer assistance, including Technical Support, Service, Parts & Part Repair, and Marketing Requests, contact the Customer Resource Center, 24 hours a day, at 1-800-47-ROBOT (1-800-477-6268). International customers should call 011-1-248-377-7159.

Send your comments and suggestions about this manual to: product.documentation@fanucrobotics.com

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 best be 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 Robotic 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 and Equipment Safe

The safety of people is always of primary importance in any situation. However, equipment must be kept safe, too. When prioritizing how to apply safety to your robotic system, consider the following:

- People
- 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 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 an applicator bell cup can continue to spin at a very high speed even if the robot is idle. Use protective gloves or disable bearing air and turbine air before servicing these items.
- 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 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 personal 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 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. 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 VERSABELL II APPLICATOR

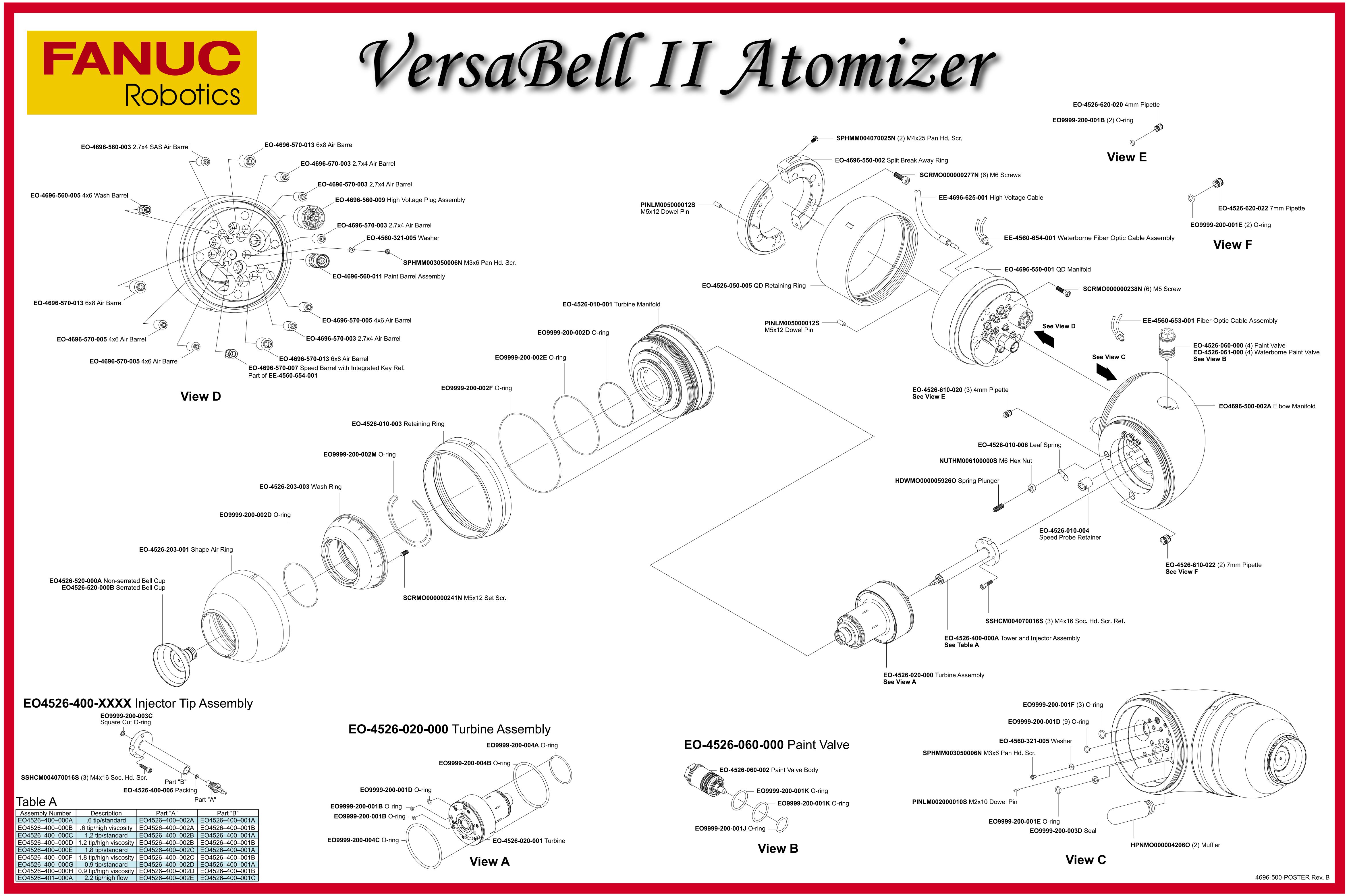


Table A

Assembly Number	Description	Part "A"	Part "B"
EO4526–400–000A	.6 tip/standard	EO4526–400–002A	EO4526–400–001A
EO4526–400–000B	.6 tip/high viscosity	EO4526–400–002A	EO4526–400–001B
EO4526–400–000C	1.2 tip/standard	EO4526–400–002B	EO4526–400–001A
EO4526–400–000D	1.2 tip/high viscosity	EO4526–400–002B	EO4526–400–001B
EO4526–400–000E	1.8 tip/standard	EO4526–400–002C	EO4526–400–001A
EO4526–400–000F	1.8 tip/high viscosity	EO4526–400–002C	EO4526–400–001B
EO4526–400–000G	0.9 tip/standard	EO4526–400–002D	EO4526–400–001A
EO4526–400–000H	0.9 tip/high viscosity	EO4526–400–002D	EO4526–400–001B
EO4526–401–000A	2.2 tip/high flow	EO4526–400–002E	EO4526–400–001C

2 HIGH VOLTAGE CONTROLS

2.1 Overview - ITW Ransburg High Voltage Control System

2.1.1 Introduction

The ITW Ransburg High Voltage Controller A12311-00 in conjunction with the Cascade A12295-00 (legacy type) or Cascade A12296-00 (integrated type) is used to provide high voltage for electrostatic application equipment.

The ITW Ransburg High Voltage Controller uses a combination of proven high voltage generation technology microprocessor-based control with diagnostic and communication functions. It uses a variable voltage output to drive a cascade that amplifies the voltage to a high value. It also uses feedback with both current and voltage information to attempt to maintain actual value at set point. The processor circuitry provides the maximum in applicator transfer efficiency, while maintaining the maximum safety.

2.1.2 Specifications

2.1.2.1 Environmental / Physical

Operating Temperature:
0°C to +55°C

Storage and Shipping: Temperature:
40°C to +85°C

Humidity:
95% Non-Condensing

Physical Size:
5.5" tall X 7.5" wide X 3.5" deep

2.1.2.2 Electrical

Power Required:
24VDC ± .5 V @ 2.5 Amps maximum (@ sea level), regulated, with over-voltage protection.
Note: For every 1000 ft. of increased elevation, the maximum current is increased by 3%.

High Voltage Output:
24 Volts, 1Amp Form C relay contact

Controller Operating Range:
High Voltage: 0-100kV, settable in 1kV increments
Current: 0-150 micro amps

Communication Requirements
Control and Reporting: Ethernet IP
NOTE: A unique MAC ID will be assigned for each High Voltage Controller.

2.1.3 Mounting Dimensions

The ITW HV Controller is intended to be mounted into a cutout of a grounded metal enclosure. This provides display and access to the front panel and protects the rear of the power supply.

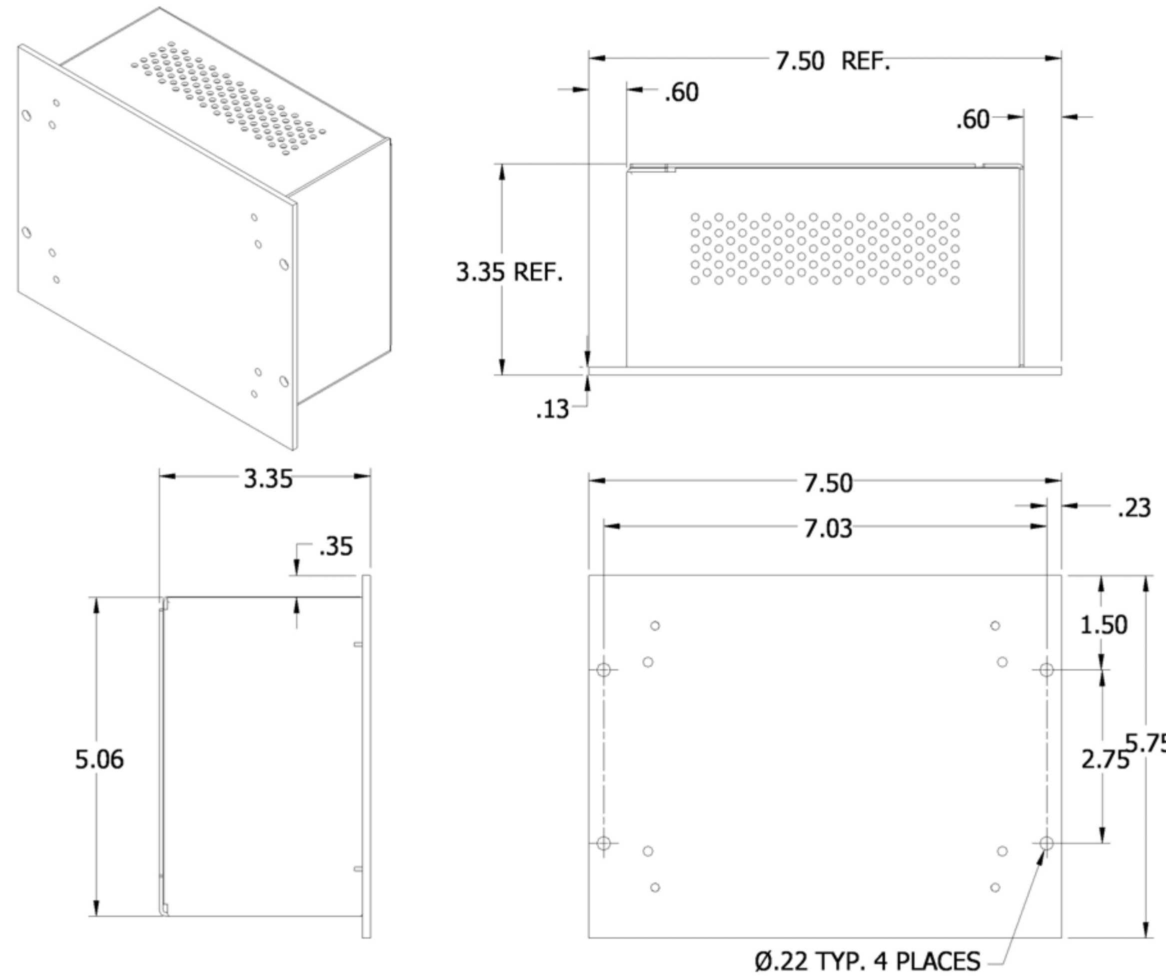


Figure 2-1: ITW HV mounting dimensions

2.1.4 System Components

The ITW High Voltage Controller A12311-00 is shown below:

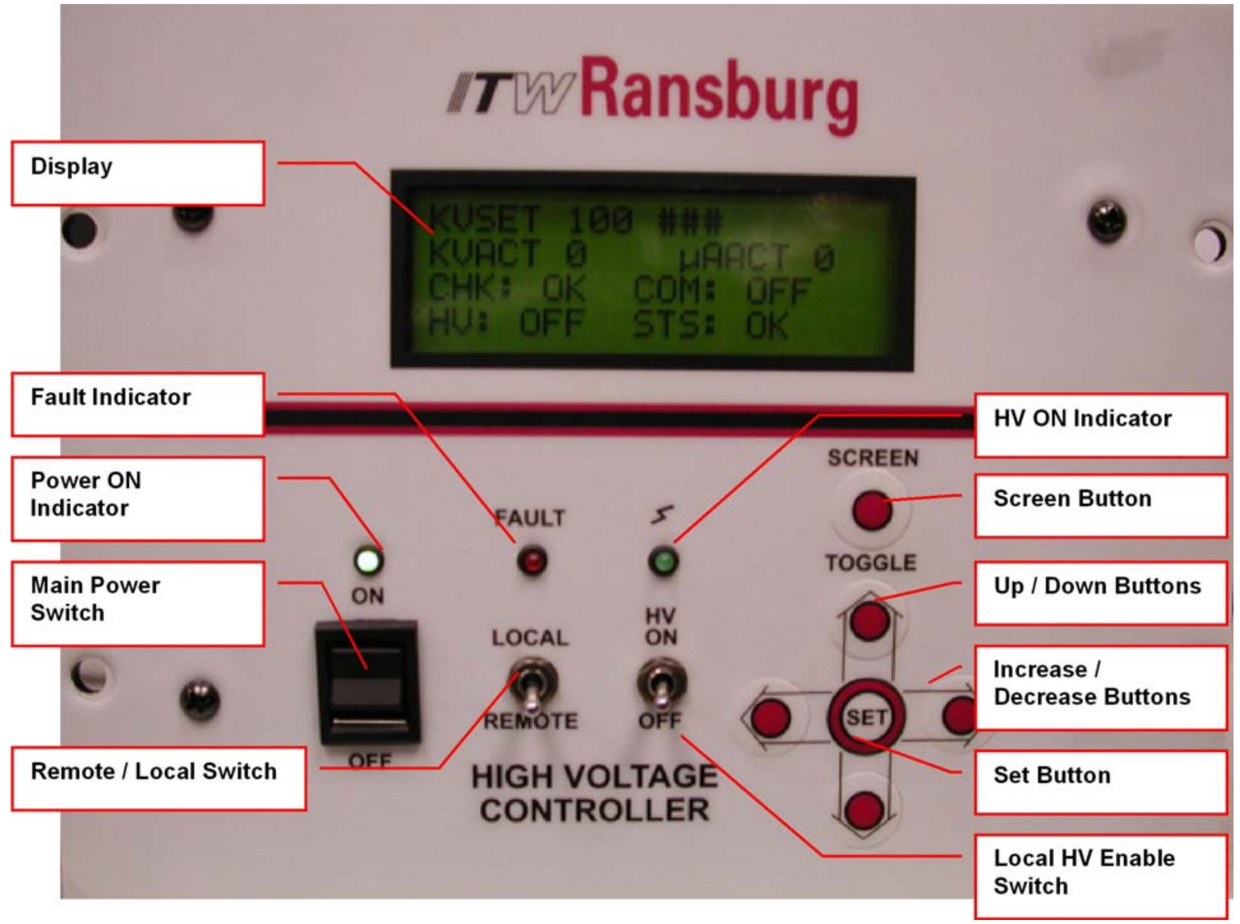


Figure 2-2: High Voltage Controller Layout

2.1.4.1 Display

The front panel displays the high voltage and current output from the cascade as true readings. They are derived from feedback signals in the low voltage cable between the controller and cascade.

2.1.4.2 Switches

Power Switch

The rocker switch on the left and the LED directly above it are for power On/Off selection and display. The green LED is on when the power is On to the controller.

Local/Remote Switch

This is used to determine if the Local (Front Panel) controls have priority or it the Remote (Ethernet Connection) controls have priority. If the switch is up (Local Mode) the Front Panel controls may change parameters, enable or disable the high voltage, and clear faults. The Remote Ethernet connection may look at parameters and values, but may not change them or enable/disable the high voltage output. If the switch is down (Remote Mode) the opposite is true except that the Front Panel switch may be changed to local mode at any time to disable the Remote Controls and to enable the Local Controls.

HV On/Off Switch

This is a floating toggle switch. It is active if the Local/Remote mode switch is in Local. It is used to enable and disable the High Voltage output and to clear system faults. When the System Checks and Current Status are OK flipping the switch to the up position (HV On) will enable High Voltage Output. Flipping it to the down position (HV Off) will disable the High Voltage Output. If there is a system fault, flipping this switch to the OFF position (also known as the Reset position) it will reset (clear) any faults currently detected by the system.

2.1.4.3 LED indicators

Power LED
If the Green Power LED is on, then the system power to the controller is On.

Fault LED
The red Fault LED is lit when the system detects a fault condition. When operating in "Local Mode", it is cleared by flipping the HV On/Off switch to the Off (Reset) position. If the system is still in a fault condition, it will immediately be lit as the system detects the fault.

High Voltage LED
The green High Voltage LED displays the current state of the High Voltage Output. This LED is illuminated whenever High Voltage is being supplied.

2.1.4.4 Buttons

The six buttons used to control the viewing and entry of information on the 4 X 20 character display are:

Screen Button
The Screen Button (at the top) is used to change (toggle) to the next Menu screen. The menu screens wrap around so that after the last screen it will return to the first screen.

Up and Down Buttons
The buttons above and below the Set Button in the middle (the Up and Down Buttons) are used to change which value on the screen is to be changed.

Set Button
This labeled button (in the middle) is used to select the value to change and to enter the change after it has been made.

Increase and Decrease Buttons
The buttons to the right and left of the Set Button are the Increase and Decrease Buttons. They are used to change the value selected by the Set Button.

2.1.4.5 Connections

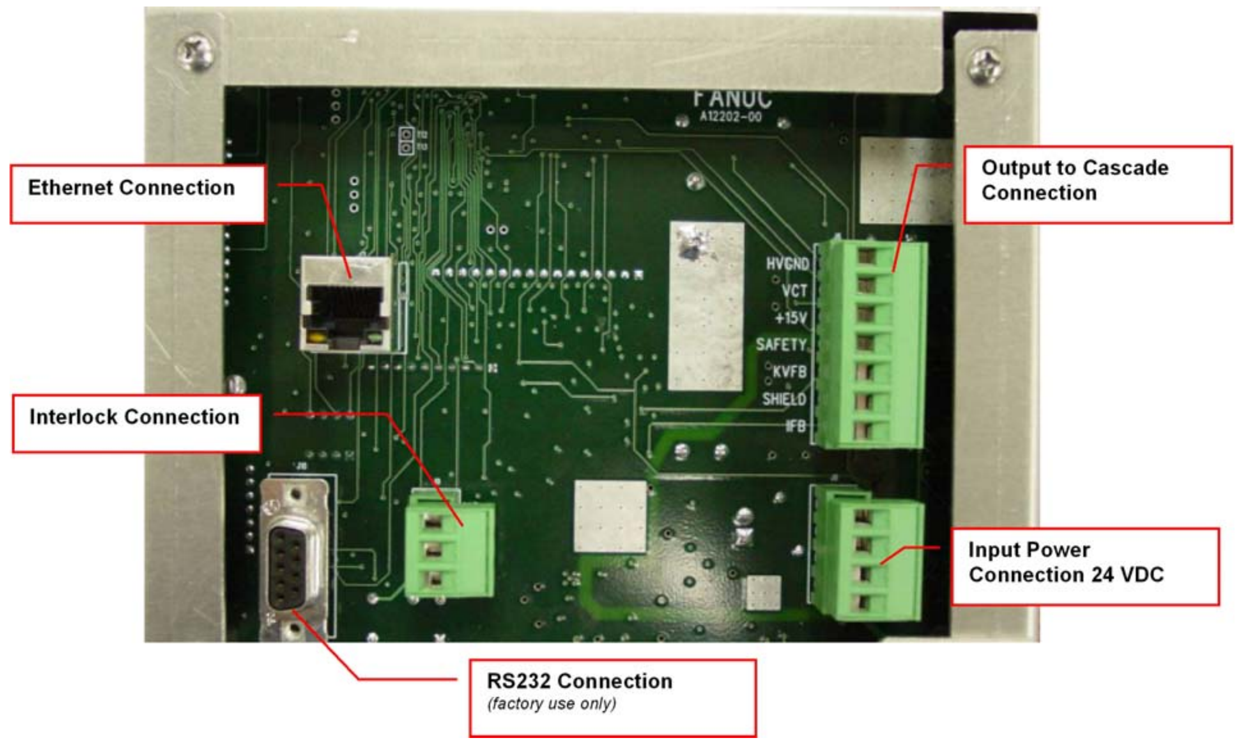


Figure 2-3: ITW HV controller connections

Input Power Connections

Input power must be supplied from a regulated DC power Supply. The connection is made at J8 with +VIN at 24VDC ± .5V, GND at 24VDC return, CGND at Earth Ground. The 24 VDC supply must be protected against excessive current as well as
Over Voltage protected.

Note: The ITW Ransburg High Voltage Controller has a built in resettable fuse so if it draws a current in excess of 2.5 amps it will open. Reset is achieved by turning controller power OFF for 5 minutes then back ON.

Ethernet Connector

Use the appropriate 10/100BASE Ethernet wiring (Straight EIA/TIA 568A) for your installation using a RJ-45 plug to connect to the ITW High Voltage Controller.

Interlock Connection

J9 is supplied to give a hardwire connection thru relay dry contacts (rated at 24 VDC @ 1 amp maximum) for when the controller operating power is turned OFF or a fault condition exists. They are marked as COM (Common) NC (normally closed) or NO (normally open) and can be used by end user.

Output to Cascade Connection

Make connections from J6 of the controller to the cascade per the following table.

HVC-J6	Cascade A12295-00 (FRA# EE-4526-800) or A12296-00 (FRA# EE- 4626-801)
HVGND	Pin 1 0 VDC for R+ and E+ Power
R+	Pin 2 Analog DC Cascade Drive Signal
E+	Pin 3 Nominal 15VDC for Cascade Electronics
GND	Pin 4 0 VDC for Analog Cascade Voltage Feedback
U-FB	Pin 5 Analog Cascade for Voltage Feedback Signal
SC	Pin 6 0 VDC for Analog Cascade Current Feedback
I-FB	Pin 7 Analog Cascade Current Feedback Signal

Table 2-1: ITW HV Output to Cascade pin detail

RS232 Connection
This connector is a service connection for the ITW Ransburg factory.

2.1.5 Cascades

There are two types of ITW cascades used in FANUC Robotics paint application HV control systems:

The ITW (legacy type - EE-4526-800) cascade is shown below:

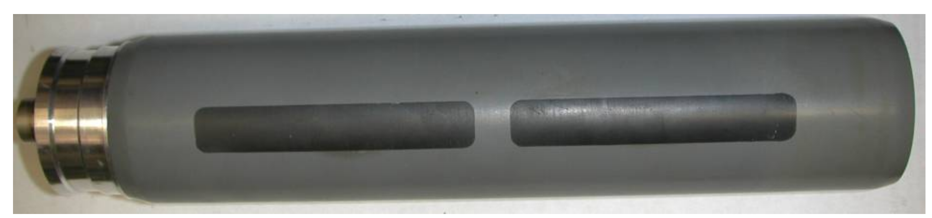


Figure 2-4: ITW legacy cascade (EE-4526-800)

The legacy style cascade is used on P-700iA Flex, VersaBell I, and ServoBell application systems. The ITW (integrated type - EE-4526-801) cascade is shown below:

Figure 2-5: ITW integrated cascade (EE4526-801)

The integrated style cascade is used on P-250iA, P-500, P-500iA, and P-700iA (non Flex) application systems.

2.1.5.1 High Voltage Cables

When used with a VersaBell II type applicator, there is a high voltage cable that connects the high voltage generated by the cascade to the paint applicator. This cable has specific lengths used on a particular robot model / configuration.

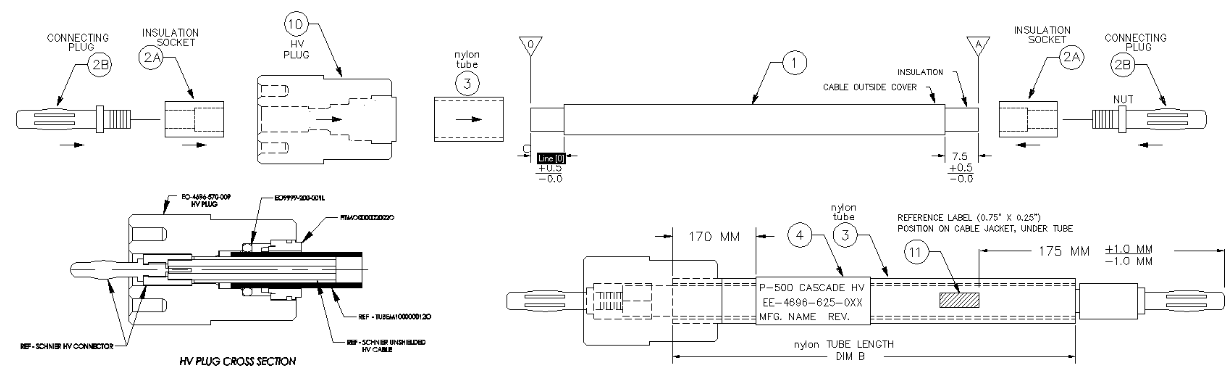


Figure 2-6: High voltage cable

HV Cable Assembly #:	Robot Model / Configuration:
EE-4696-625-001	P-500
EE-4696-625-002	P-500 Long Arm
EE-4696-625-003	P-700iA
EE-4696-625-004	P-250iA Short Arm
EE-4696-625-005	P-250iA Standard Arm
EE-4696-625-006	P-700iA Flex
EE-4696-625-007	P-500iA Flex Standard Arm
EE-4696-625-008	P-500iA Flex Long Arm

Table 2-2: HV cable assemblies

For High Voltage Cable Installation see Remote mode – High voltage Controller FB-200 HVU section.

2.1.6 Overview - ITW Ransburg High Voltage Control System

The ITW Ransburg High Voltage Controller A12311-00 in conjunction with the Cascade A12295-00 (legacy type) or Cascade A12296-00 (integrated type) is used to provide high voltage for electrostatic application equipment.

The ITW Ransburg High Voltage Controller uses a combination of proven high voltage generation technology microprocessor-based control with diagnostic and communication functions. It uses a variable voltage output to drive a cascade that amplifies the voltage to a high value. It also uses feedback with both current and voltage information to attempt to maintain actual value at set point. The processor circuitry provides the maximum in applicator transfer efficiency, while maintaining the maximum safety.

2.2 Operation and Setup – ITW HV Controller

On all of the menus, if there is a parameter that can be changed there are a number of "#" characters to show that it is an enterable value. If there is more than one enterable value, pressing the Up or Down Buttons will move the "#'s" to the next changeable value. When the "#'s" are next to the value you wish to change, press the Set Button. This will bring up the Password Menu to allow you to enter the password and change the value. Once the password has been entered, it will remain active for an appropriate amount of time and then time out, requiring you to re-enter it.

When a valid password has been entered for any value (even if the value has not been changed) different menus will be available. These Menus are the Display Contrast Menu, the IP Address Menu, and the Enter New Password Menu.

When a numeric value is being changed (using the buttons to the left and right of the SET Button) the numeric will increase with the right button and decrease with the left button until it passes the maximum or minimum allowed value at which time it will "roll over" to the other limit.

2.2.1 Start-Up Menu

This is the menu that displays on the unit for 5 seconds (approximately) at power up. It displays the Model Number, Copyright Date, Serial Number, Software Version, and Hardware Version of the unit. It then changes to the Run Menu.

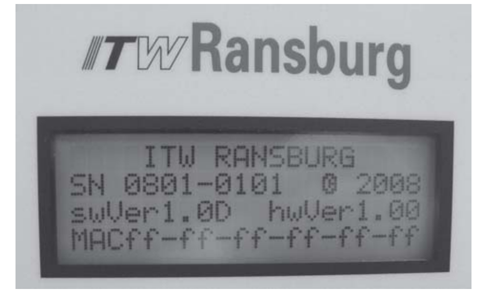


Figure 2-7: ITW Start-Up Menu

2.2.2 Run Menu

This menu displays the set point (KVSET if in Voltage Mode, uASET if in Current Mode), the current actual KV value, the current uA value, the current hardware check value, the High Voltage status, and the current controller status. The set point (KVSET or uASET) is the only changeable value on this menu.

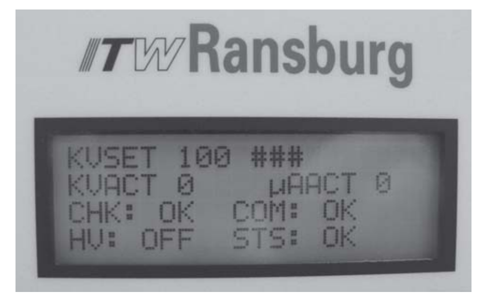


Figure 2-8: ITW Run Menu

2.2.3 Mode Menu

This menu displays the current mode (Voltage or Current) and the high and low limits allowed for the Dependent Value in that mode. **Consult FANUC Robotics before changing any of these values.**

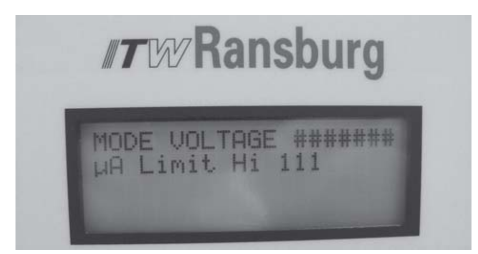


Figure 2-9: ITW Mode Menu

2.2.4 Sensitivity Menu

This menu displays the current di/dt or dv/dt limit value and the enable status for di/dt or dv/dt depending on the mode. **Consult FANUC Robotics before changing any of these values.**

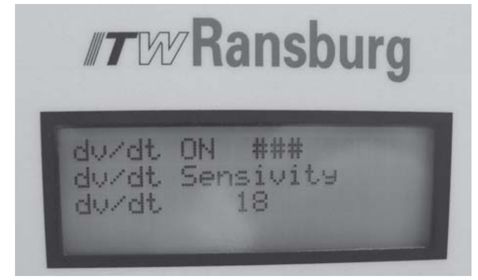


Figure 2-10: ITW Sensitivity Menu

2.2.5 Fault Menu

This menu displays the latest fault and is displayed automatically upon the fault detection.

Figure 2-11: ITW Fault Menu

2.2.6 IP Address Menu

This menu allows the setting of the units IP Address. When the new IP Address has been entered, the unit must have the power cycled before the new IP Address will be used.

Figure 2-12: ITW IP Address Menu

2.2.7 Password Menu

This menu is different in that the "#'s" are displayed below the password digit being changed instead of beside them. When the password is entered, the menu will return to the value being changed.

2.2.8 Enter new Password Menu

This menu is different in that the "#'s" are displayed below the password digit being changed instead of beside them. When the new password is entered, it will now be used for all values being changed.

2.2.9 Parameters and Settings Menu

2.2.9.1 Mode

The operating mode can be set to either Voltage or Current mode. The mode selection determines which independent set point is the basis for control.

2.2.9.2 kVSet

This is the voltage set point, used in Voltage Mode. The system attempts to keep the voltage at this value.

2.2.9.3 uASet

This is the current set point, used in Current Mode. The systems attempts to keep the current at this value.

2.2.9.4 kV Limit Hi

This parameter determines the level where a kV Limit Fault occurs. When the voltage falls below this value, it issues a kV limit Fault. It only applies in Voltage Mode. Consult FANUC Robotics before changing this value.

2.2.9.5 uA Limit Hi

This parameter determines the level where a Current Limit Fault occurs. When the current rises above this value, it issues a Current Limit Fault. It only applies in Voltage Mode. Consult FANUC Robotics **before changing this value.**

2.2.9.6 Di/dt Sensitivity

When a rapid current change occurs where current rises faster than this value in approximately 100 ms, it issues a di/dt fault. This is only active in Voltage Mode. Consult FANUC Robotics before changing this value.

2.2.9.7 Dv/dt Sensitivity

When a rapid voltage change occurs where voltage falls faster than this value in approximately 100 ms, it issues a dv/dt fault. This is only active in Current Mode. Consult FANUC Robotics before changing this value.

2.2.9.8 Dx/Dt

This parameter enables or disables the di/dt or dv/dt fault limits. Consult FANUC Robotics before changing this value.

2.3 Control Conditions – ITW HV Controller

2.3.1 Power Up

On power up, the system does several checks to determine hardware status. It checks various signals to determine that there are no faults, including feedback from the Variable Voltage Output and High Voltage Inputs to determine system status. If it determines that it is OK to start, the Check display on the run menu changes from NoGo to OK and System Status changes to OK.

2.3.2 HV On

When the HV On signal is received, the system status changes to "Starting" and the Variable Voltage Output is increased until the Independent Value rises to within a tolerance window (currently +/-3) of the set point value. Then the System Status changes to "Running".

2.3.3 Set Point Changed

If the set point changes outside the control window, the status changes to "Rising" or "Falling" until the Independent Value again reaches the window at which point it returns to "Running".

2.3.4 HV Off

On HV Off the system immediately sets the Variable Voltage Output to zero volts, disables the HV Relay and goes to Stop Mode. The System Check goes to NoGo until the High Voltage and Variable Voltage Output feedback again reach the pre-determined value.

2.4 System Status (STS) – ITW HV Controller

2.4.1 OK

System is off and ready to start.

2.4.2 Starting/Rising/Falling

System is changing from one voltage/current value to another. Di/dt and dv/dt checks are disabled.

2.4.3 Running

System is attempting to keep a steady value on Set point (the Independent Value). All enabled checks are active.

2.4.4 Stopping

System is off and waiting to transient voltages/currents to stop.

2.4.5 Warning

System has detected a current or voltage condition within 10% of the limit settings.

2.4.6 Fault

System has detected a fault condition, stopped and will not allow starting until the fault is cleared. If the fault condition has not been cleared, it may immediately fault without starting.

2.5 System Check (CHK) – ITW HV Controller

2.5.1 OK

System has passed the checks and is ready to start.

2.5.2 NoGo

System has detected excessive voltage on the High Voltage or Variable Voltage Output Feedbacks and will not allow a start.

2.6 Ethernet I/P Interface – ITW HV Controller

The Ethernet IP Interface is defined as a set of four 16 bit IO words of input and a set of four 16 bit words of output.

2.6.1 Ethernet I/P Configuration

2.6.1.1 MAC ADDRESS: Unique hard coded by manufacturer, displayed on unit

IP ADDRESS: User settable from front panel
INPUT INSTANCE: 113
INPUT WORDS: 4
INPUT WORD SIZE: 16 bits
OUTPUT INSTANCE: 112
OUTPUT WORDS: 4
OUTPUT WORD SIZE: 16 bits
CONFIG INSTANCE: 100
RPI: 32ms

2.6.2 I/P Address Configuration

1. Turn on the power supply with the rocker switch on the front.
2. Press and release the SCREEN key until the IP address is displayed.
3. Use the up and down arrow keys to select the field to edit.
4. Press SET to be prompted for a password.
5. The password is 4723.
6. Use the up and down arrow keys to select the password digit.
7. Use the right and left arrow keys to scroll through available numeric values.
8. Press SET after each digit is selected.
9. Scroll through and enter the I/P address as needed.
10. Cycle power with the rocker switch after you are finished.

2.6.3 Ethernet I/O

2.6.3.1 Output Words

There are 4 output words of 16 bits each mapped to inputs on the robot controller.

BIT	OUTPUT WORD 1 DESCRIPTION	OUTPUT WORD 2 DESCRIPTION	OUTPUT WORD 3 DESCRIPTION	OUTPUT WORD 4 DESCRIPTION
0	IN CONTROL	Over CURRENT WARNING	param data word bit 0	actual KV bit 0
1	RAMPING	Over VOLTAGE WARNING	param data word bit 1	actual KV bit 1
2	CONTROL OK TO START	Under VOLTAGE WARNING	param data word bit 2	actual KV bit 2
3	REMOTE MODE		param data word bit 3	actual KV bit 3
4	HV On Echo		param data word bit 4	actual KV bit 4
5	Warning		param data word bit 5	actual KV bit 5
6	Fault	COMM FAULT	param data word bit 6	actual KV bit 6
7		H/W FAULT	param data word bit 7	actual KV bit 7
8		LOW VOLTAGE FAULT	parameter bit 0	actual uA bit 0
9		DV/DT FAULT	parameter bit 1	actual uA bit 1
10		DI/DT FAULT	parameter bit 2	actual uA bit 2
11		MINIMUM OUTPUT FAULT	parameter bit 3	actual uA bit 3
12		MAXIMUM OUTPUT FAULT	parameter bit 4	actual uA bit 4
13		OVER VOLTAGE FAULT	parameter bit 5	actual uA bit 5
14		OVER CURRENT FAULT	parameter bit 6	actual uA bit 6
15	HEARTBEAT	CABLE FAULT	parameter acknowledge	actual uA bit 7

Table 2-3: ITW Output Words

2.6.3.2 Output Bit Details

IN CONTROL: The control parameter is within 3KV or 3uA of the set point.

RAMPING: The KV or uA is ramping up or down tot he set point.

CONTROL OK TO START: The power supply is ready for an ENABLE signal.

REMOTE MODE: The REMOTE/LOCAL toggle switch is in REMOTE.

HV ON ECHO: The high voltage is ON.

WARNING: There is a warning present, see warning bits.

FAULT: There is a fault present, see fault bits.

HEARTBEAT: This output is cycled on and off every second.

OVER CURRENT WARNING: Warning active, see Warning section and Troubleshooting section for additional information.

OVER VOLTAGE WARNING: Warning active, see Warning section and Troubleshooting section for additional information.

UNDER VOLTAGE WARNING: Warning active, see Warning section and Troubleshooting section for additional information.

COMM FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

H/W FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

LOW VOLTAGE FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

DV/DT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

DI/DT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

MINIMUM OUTPUT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

MAXIMUM OUTPUT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

OVER VOLTAGE FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

OVER CURRENT FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

CABLE FAULT: Fault active, see Warning section and Troubleshooting section for additional information.

PARAM DATA WORD BIT 0-7: Used to tell the system the value of a parameter.

PARAMETER BIT 0-6: Used to tell the system which parameter is being displayed.

PARAMETER ACKNOWLEDGE: Used to acknowledge a parameter read or write request.

ACTUAL KV BIT 0-7: Real time feedback of the voltage at the output of the cascade.

ACTUAL UA BIT 0-7: Real time feedback of the current draw from the output of the cascade.

2.6.3.3 Input Words

There are 4 input words of 16 bits each mapped to outputs on the robot controller.

	INPUT WORD 1 DESCRIPTION	INPUT WORD 2 DESCRIPTION	INPUT WORD 3 DESCRIPTION	INPUT WORD 4 DESCRIPTION
0	HV ENABLE	KV Set Point word bit 0	param data word bit 0	
1	RESET FAULT	KV Set Point word bit 1	param data word bit 1	
2	CURRENT MODE	KV Set Point word bit 2	param data word bit 2	
3		KV Set Point word bit 3	param data word bit 3	
4		KV Set Point word bit 4	param data word bit 4	
5		KV Set Point word bit 5	param data word bit 5	
6		KV Set Point word bit 6	param data word bit 6	
7		KV Set Point word bit 7	param data word bit 7	
8		uA Set Point word bit 0	set param bit 0	request param bit 0
9		uA Set Point word bit 1	set param bit 1	request param bit 1
10		uA Set Point word bit 2	set param bit 2	request param bit 2
11		uA Set Point word bit 3	set param bit 3	request param bit 3
12		uA Set Point word bit 4	set param bit 4	request param bit 4
13		uA Set Point word bit 5	set param bit 5	request param bit 5
14		uA Set Point word bit 6	set param bit 6	request param bit 6
15		uA Set Point word bit 7	set param strobe	request param strobe

Table 2-4: ITW Input Words

2.6.3.4 Input Bit Details

HV ENABLE: Enables high voltage if conditions are OK at the rising edge.

RESET FAULT: The rising edge clears any fault that no longer exists.

CURRENT MODE: Turned OFF for Voltage mode and ON for Current mode.

KV SET POINT WORD BIT 0-7: The voltage setting in voltage mode or the voltage ceiling in current mode.

UA SET POINT WORD BIT 0-7: The current set point in current mode.

PARAM DATA WORD BIT 0-7: The data word used to set parameters.

SET PARAM BIT 0-6: The parameter number to be set.

SET PARAM STROBE: The indication to set the indicated parameter to the specified value.

REQUEST PARAM BIT 0-6/REQUEST PARAM STROBE: The parameter to be read and the read request.

2.6.4 Ethernet I/O Parameter Configuration

There are 10 parameters to control power supply performance accessible via Ethernet I/O. Consult FANUC Robotics before changing any of these values.

PARAMETERS						
	DESCRIPTION	READ/WRITE	UNITS	DEFAULT VALUE	MIN VALUE	MAX VALUE
1	DV/DT LIMIT	READ/WRITE	KV/100ms	16	3	24
2	DI/DT LIMIT	READ/WRITE	uA/100ms	40	8	50
3	V-MAX	READ/WRITE	KV	103	20	103
4	I-MAX	READ/WRITE	uA	80	10	150
5	V-MIN	READ/WRITE	KV	0	0	80
6	DX/DT ENABLE	READ/WRITE	n/a	1	0	1
7	USER PW DIGIT 1	READ ONLY	n/a	0	0	9
8	USER PW DIGIT 2	READ ONLY	n/a	0	0	9
9	USER PW DIGIT 3	READ ONLY	n/a	0	0	9
10	USER PW DIGIT 4	READ ONLY	n/a	0	0	9

Table 2-5: ITW Ethernet I/O Parameter Configuration

2.6.4.1 TO READ A PARAMETER:

1. Set input word 4 bits 8-14 to indicate the desired parameter
2. Set input word 4 bit 15 to request the parameter
3. Output word 3 bit 15 will come on
4. Read output word 3 bits 8-14 to verify you are getting the requested parameter
5. Read output word 3 bits 0-7 to get the parameter data
6. Reset input word 4 bit 15
7. Output word 3 bit 15 will turn off
8. Reset input word 4 bits 8-14

2.6.4.2 TO WRITE A PARAMETER:

1. Set the data for the parameter on input word 3 bits 0-7
2. Set the parameter to change on input word 3 bits 8-14
3. Set the parameter strobe on input word 3 bit 15
4. The parameter acknowledge on output word 3 bit 15 will turn on
5. Reset the parameter strobe on input word 3 bit 15
6. The parameter acknowledge on output word 3 bit 15 will turn off
7. Reset the data for the parameter on input word 3 bits 0-7
8. Reset the parameter to change on input word 3 bits 8-14\

2.7 Manual Operation – ITW HV Controller

2.7.1 Front Panel Display

Table 2-6: ITW Boot up screen

Table 2-7: ITW Voltage mode status

Table 2-8: ITW Current mode status

2.7.2 Local Mode

1. Turn the power supply rocker switch to ON.
2. Turn the LOCAL/REMOTE toggle switch to LOCAL.
3. Move the cursor to the Voltage or Current, depending on the operating mode.
4. Press SET to select the data field.
5. Use the right and left arrow keys to set the desired value.
6. Press SET to select the value.
7. Use the HV ON/OFF toggle switch to turn on and off the electrostatic voltage/current.
8. Should a fault occur, select HV OFF momentarily to reset the fault.

2.8 Remote Operation – ITW HV Controller

2.8.1 Voltage Mode

1. See Section 3.6.2 to set the Ethernet I/P address as desired.
2. Turn the power supply rocker switch to ON.
3. Turn the LOCAL/REMOTE toggle switch to REMOTE.
4. Initiate Ethernet I/P communication from the host.
5. See FAULT RESET to clear any fault.
6. Set the requested estat voltage level on input word 2 bits 0-7.
7. The estats will be energized when ENABLE(input work 1 bit 0) goes hi if OK TO START(output work 1 bit 2) is on.
8. Voltage feedback can be read from output word 4 bits 0-7.
9. Current feedback can be read from output word 4 bits 8-15.
10. The set voltage and enable may be changed at will.

2.8.2 Current Mode

1. See Section 3.6.2 to set the Ethernet I/P address as desired.
2. Turn the power supply rocker switch to ON.
3. Turn the LOCAL/REMOTE toggle switch to REMOTE.
4. Initiate Ethernet I/P communication from the host.
5. See FAULT RESET to clear any fault.
6. Set CURRENT MODE(input word 1 bit 2).
7. Set the requested estat voltage ceiling on input word 2 bits 0-7.
8. Set the requested estat current level on input word 2 bits 8-15.
9. The estats will be energized when ENABLE(input work 1 bit 0) goes hi if OK TO START(output work 1 bit 2) is on.
10. Voltage feedback can be read from output word 4 bits 0-7.
11. Current feedback can be read from output word 4 bits 8-15.
12. The set voltage and enable may be changed at will.

2.8.3 Fault Reset

1. Clear the opportunity that caused the fault.
2. Read the fault bits(input word 2 bits 6-15)
3. Reset the ENABLE(input work 1 bit 0).
4. Set FAULT RESET(input word 1 bit 1)
5. Reset FAULT RESET(input word 1 bit 1)

2.9 Maintenance and Repair

2.9.1 Cautions and Warnings

See ITW High Voltage Controller Manual LN-9623-00 for specific safety precautions.

2.10 Troubleshooting

2.10.1 Fault Descriptions

- The system has detected a communication failure after an Ethernet IP connection was initiated.
- An out of range data was sent to the HV Controller over remote I/O.
- The HV Controller has detected a fatal system error. Replace HV Controller.
- In current mode, the power supply has detected a feedback voltage lower than KV LIMIT LO. Check the setup for KV LIMIT LO.
- In current mode with DX/DT enabled, the measured rate of voltage rise over time has exceeded the DV/DT limit.
- In voltage mode with DX/DT enabled, the measured rate of current rise over time has exceeded the DV/DT limit.
- The power supply detects an actual voltage or current greater then zero with no command voltage.
- The power supply has attained the maximum command voltage and the set point could not be achieved. The system has raised the Variable Voltage Output to the system maximum, but could not reach the set point.
- The measured feedback voltage of the cascade has exceeded the KV LIMIT HI setting.
- The measured feedback current of the cascade has exceeded the uA LIMIT HI setting.
- The system has detected a loss of the High Voltage Feedback signal from the cascade which should always be from 4mA to 20mA.
- The system has detected a loss of the Current Feedback signal from the cascade which should always be from 4mA to 20mA.

2.10.2 Warning Descriptions

- The measured feedback current of the cascade is approaching the uA LIMIT HI setting.
- The measured feedback voltage of the cascade is approaching the KV LIMIT HI setting.
- In current mode, the power supply has detected a feedback voltage approaching the KV LIMIT LO setting.

2.10.3 PaintTool Alarm Codes

ALARM #	ALARM DESC.	CAUSE	REMEDY
PNT1-949	ESTAT Over uA warning	While operating in Voltage mode the current draw is within 10% of the limit.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-950	ESTAT Over KV warning	The actual Voltage is within 10% of the internal safety limit.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-951	ESTAT Under KV warning	While operating in current mode, the load is so great that the voltage is within 110% of the low threshold.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-955	ESTAT H/W fault	A serious internal fault has occurred, or the High Voltage was enable while a Fault existed.	Verify the voltage was not enabled during a fault and replace the power supply.
PNT1-956	ESTAT Comm. fault	One of the parameters was sent to the power supply out of the expected range.	Review the process setup and verify parameters are used within their range limits.
PNT1-957	ESTAT Low KV fault	While operating in current mode, the applicator draws so much current that the	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator

		power supply was not able to attain a minimal KV value.	too close to part being processed.
PNT1-958	ESTAT DV/DT fault	While operating in Voltage mode with DX/DT enabled, the rate of voltage rise over time exceeded the DV/DT set point.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-959	ESTAT DI/DT fault	While operating in Voltage mode with DX/DT enabled, the rate of current rise over time exceeded the DI/DT set point.	Possible sources include: dirty applicator covering, a line not blown out during color change, or applicator too close to part being processed.
PNT1-960	ESTAT Min. output fault	Either Voltage or Current feedback has been detected with the minimum output of the power supply.	Check cable(s) between the power supply and cascade, replace the cascade.
PNT1-961	ESTAT Max. output fault	Either Voltage or Current feedback was not able to reach the set point before reaching the maximum output of the power supply.	Check cable(s) between the power supply and cascade, replace the cascade.
PNT1-962	ESTAT Over KV fault	The KV feedback from the cascade has exceeded the internal safety limit or the parameter KV limit.	Review the application to verify the limit is set correctly. Clean applicator and adjust the path as needed.
PNT1-963	ESTAT Over uA fault	The KV feedback from the cascade has exceeded the parameter uA limit.	Review the application to verify the limit is set correctly. Clean applicator and adjust the path as needed.
PNT1-964	ESTAT Cable fault	Either a short circuit or open circuit has been detected with the voltage or current feedback circuit from the cascade to the power supply.	Check the cable(s) from the power supply to the cascade to verify insulation has not been compromised.

Table 2-9: ITW PaintTool alarm codes

2.11 Spare Parts

2.11.1 Spare Parts

Part Number	Description	Replacement Period
EE-4526-300	High Voltage Controller A12311-00	Upon failure
EE-4526-800	Cascade A12295-00 (legacy type)	Upon failure
EE-4526-801	Cascade A12296-00 (integrated type)	Upon failure
EE-4696-625-XXX	High Voltage Cable – Robot configuration specific lengths. See **Section 3.1.6** for table of robot model specific HV cable lengths.	4000 Hours

Table 2-10: ITW spare parts list

2.12 Overview – High voltage Controller FB-200 HVU

2.12.1 Introduction

The High Voltage Control Unit (FB 200-HVU) controls electrostatics for the FANUC Robotics America VersaBell I, VersaBell II and ServoBell applicators.

This Operating Manual must be read, fully understood and observed in all respects by all persons who are responsible for the devices and the electrostatic installation. For these reasons the Operating Manual should always be available to the operating, maintenance and service personal.

Only with the knowledge of this Operating Manual faults can be avoided and a trouble-free operation guaranteed. Therefore it is important that the Operating Manual is known to all persons involved. FANUC Robotics North America, Inc. (in the following called FRNA) will not assume any responsibility resulting from the failure to comply with the Operating Manual!

2.12.2 Specifications

2.12.2.1 Environmental / Physical

Temperature / Humidity:
The HV control unit FB 200-HVU may only be used in electrostatic coating installations within the temperature range of 15°C to 45°C and a relative humidity of between 10% to 70% (non-condensing).

Physical Size:

Dimensions H/W/D	3 U / 42 HP / 175mm
Serial number	see label
Year of construction	see label

2.12.2.2 Electrical

Power Required:
Input voltage: 85-265V AC, singe phase
Input frequency: 47- 63Hz
Input current: 1A
Max. power dissipation: 20 W

High Voltage Output:
Output voltage: 0 – 24V DC
Output current: max. 2A

Controller Operating Range:
Constant Voltage Operation
High voltage: 0-100kV adjustable in single kV-steps
Static current switch off: 0-275µA adjustable in single µA-steps
High voltage ramp rate: 1-250kV/s adjustable in single kV/s-steps.
The actual ramp rate is limited by the capacity of the HV-system and is approximately <100kV/s

Constant Current Operation
Current: 0-275µA adjustable in single µA-steps
Max. voltage limitation: 0-100kV adjustable in single kV-steps
Min. voltage limitation: 0-100kV adjustable in single kV-steps
High voltage ramp rate: 1-999µA/s adjustable in single µA/s-steps.

2.12.3 Mounting / Installation

ATTENTION!

The high voltage control unit must be mounted into a grounded 19" Rack. The backplane has to be screwed onto the back of the rack with ten metric 2.5 x 8mm screws.

2.12.4 System Components

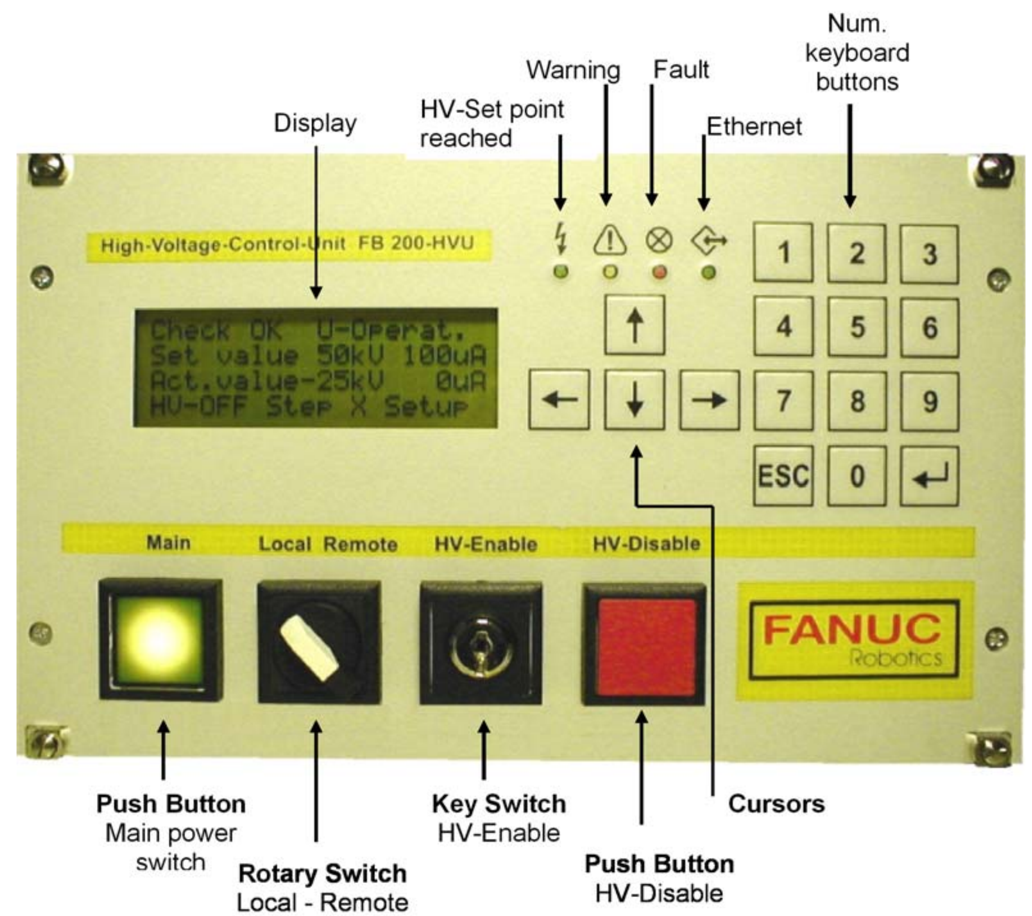


Figure 2-13: High voltage system components

After having switched on the main switch, the start-up display appears for 5 seconds, monitoring the hardware and software version. “HW:” displays the hardware version, while”SW:” displays the software version.

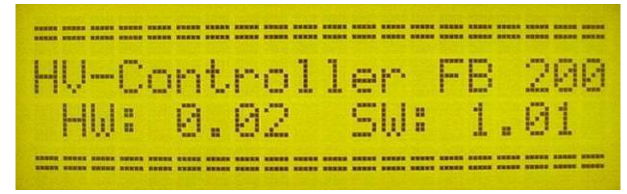


Figure 2-14: High voltage start up screen

After 5 seconds, the main display appears.

Figure 2-15: High voltage main menu

Line 1 of the main window displays the safety check status and the operating mode. 'OK' indicates safety check has passed and 'NOK' means the safety check failed (see 7.3.9). 'U-Operat.' is Voltage Operating mode and 'I-Operat.' is Current operating mode. Line 2 displays the set value for voltage in kV and current in µA. Line 3 displays the actual value for voltage in kV and current in µA. Line 4 shows the condition of HV (HV-OFF, HV-Enable and HV-ON), shows which step is selected, and provides access to the E-stat setup parameters. Note: Steps are explained in detail later in this manual.

Local / Remote Switch
The Local / Remote Switch determines which operator interface has control over the HV Controller. In Local mode, the front panel controls the operation of the HV Controller. In Remote mode, the wired connections to the robot I/O have control over the operation of the HV Controller.

HV Enable Key Switch
The HV Enable switch is used to enable high voltage output from the HV Controller when the unit is in Local mode. This is a momentary switch; the high voltage remains enabled after the switch has been released.

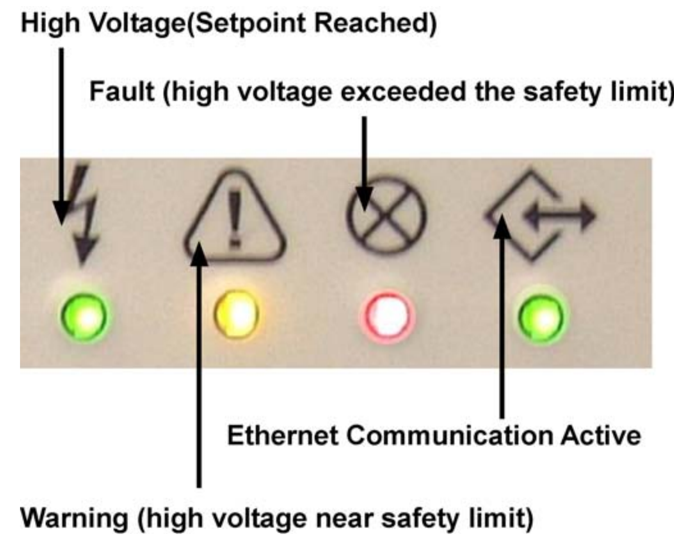


Figure 2-16: High voltage controller LED indicators

Main Power Switch

The Main Power Switch enables 120V AC to the DC power supplies located inside the HV Controller chassis. Pressing the button will retain the button in the ON position. The lamp inside the button will illuminate. Pressing the button again will shutoff power to the HV Controller and the illuminated light will shutoff.

HV Disable Button

HV Disable button is used to disable high voltage output from the HV Controller in Local mode. The HV disable is a momentary button that returns to position after it is released.

Cursor Buttons

The Cursor buttons are used to scroll through menu items and select them.

Numeric Keypad Buttons

The Numeric Keypad buttons are used to input numbers 0 – 9. The ESC button is used to escape out of a menu item. The arrow button is used as an “Enter” button. When a menu item is to be modified, press the arrow button to enable the value to be modified. Enter the new data via the 0 – 9 buttons, then press the arrow button again to set the new parameter data.

2.12.5 Backplane Connections

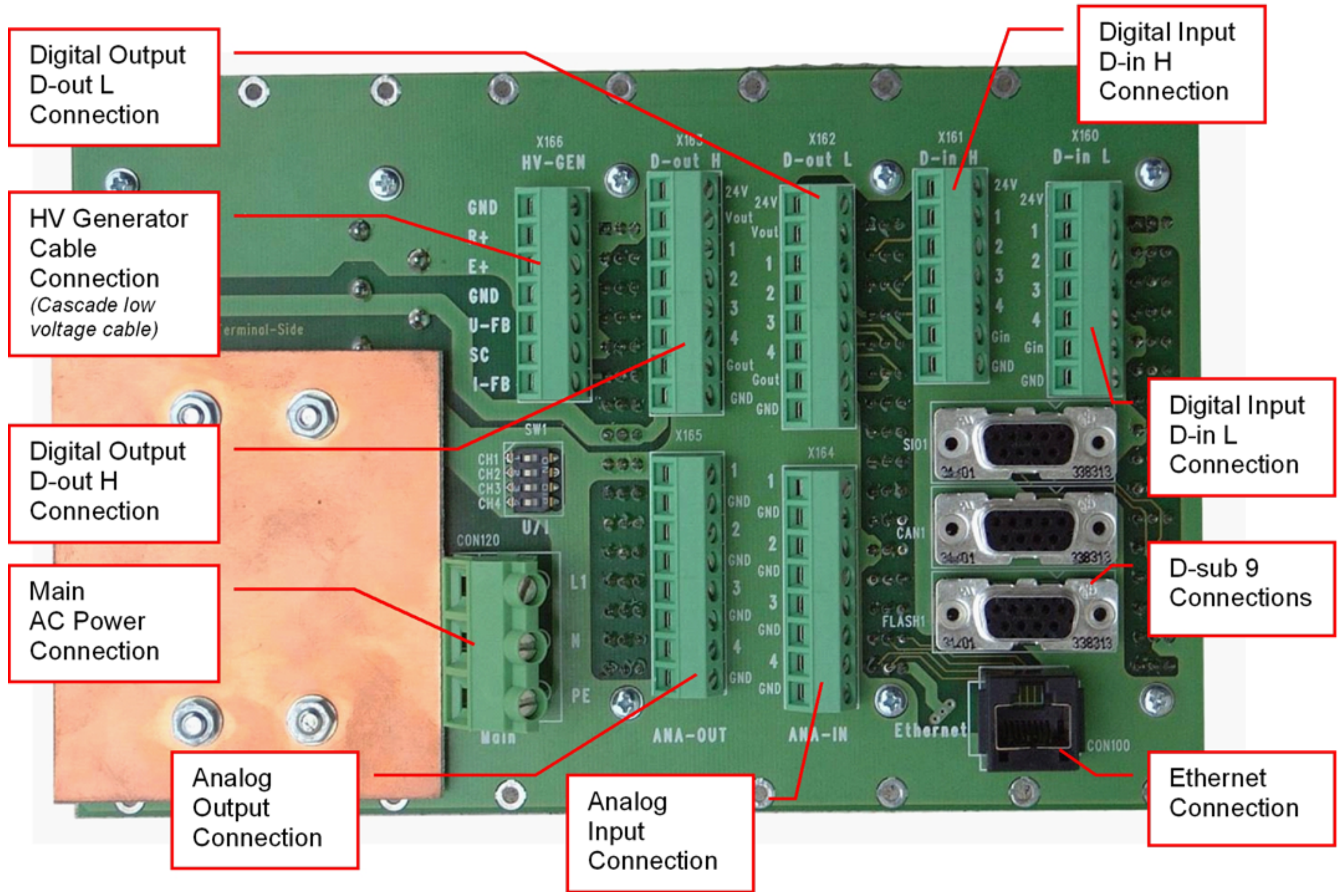


Figure 2-17: High voltage backplane

2.12.5.1 Main

The power requirements state specific voltage levels for line 1 (85-265VAC) and neutral (0VAC), an ungrounded system may either split the voltage or reverse it.

CON 120 / Main		
	Description	Signal
	Single phase input 1	85-265V AC
	Neutral	0V AC
	Protection Ground	PE GND

Table 2-11: High voltage controller main ac power pin detail

2.12.5.2 Generator

X 166 / HV-GEN				
Pin	Description	Signal	Generator	Wire color
GND	Ground	GND	Pin 1	White
R+	Power	0-24V DC	Pin 2	Red
E+	Electronic supply	15V DC	Pin 3	Blue
SHLD	Shield	GND	Pin 4	Orange
U-FB	Feedback voltage	4-20mA	Pin 5	Yellow
SC	Safety check	0-20mA	Pin 6	Black
I-FB	Feedback current	4-20mA	Pin 7	Brown

Table 2-12: High voltage Output to Cascade pin detail

2.12.5.3 Digital Outputs

X163 / D-out H		
Pin	Description	Signal
24V	Internal 24V output	24V DC
Vout	Ext. supply for outputs	24V DC
1	Ground switch	24V DC
2	Check OK	24V DC
3	Remote/Local	24V DC
4	Unused	24V DC
Gout	Ext. ground for outputs	GND
GND	Internal ground	GND

X162 / D-out L		
Pin	Description	Signal
24V	Internal 24V output	24V DC
V out	Ext. supply for outputs	24V DC
1	HV-ON	24V DC
2	HV-Set point reached	24V DC
3	HV-Warning	24V DC
4	HV-Fault	24V DC
G out	Ext. ground for outputs	GND
GND	Internal ground	GND

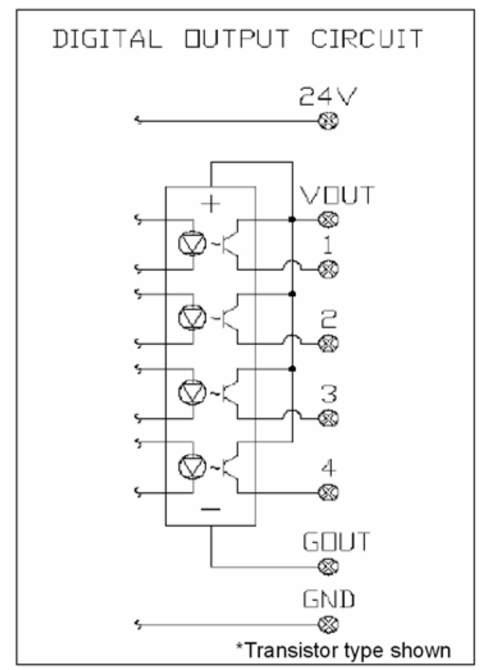


Table 2-13: High voltage digital output pin detail

- For using the digital Outputs with the internal supply (24V DC) connect pin ‘24V’ with Pin ‘V out’ and pin ‘G out’ with pin ‘GND’.
- For using the digital outputs with an external supply (24V DC) connect pin ‘V out’ with 24V DC from the external supply. If it is necessary to have potential free outputs don’t connect pin ‘Gout’ with pin ‘GND’.
- The digital outputs are separable from internal ground and from internal 24V DC with bridge in two blocks.
- Output voltage: 15-24V DC externally supplied or 24V DC + 5/-10% internally supplied.
- Output current: 100mA over-current protected, switch-off at 350mA

N°.	Description	Function	Indicators
1	HV-ON	High, if the high voltage is on or if the unit senses any stored energy above a safe level	Display set point and actual V and I
2	HV-Set point reached	High, if a value pre-set from 0 to 100% is achieved. In the V-mode V and in the I-mode I.	LED green (HV-arrow)
3	HV-Warning	High, if a value pre-set from 0 to 100% of the statically switching-off is achieved.	LED yellow
4	HV-Fault	High, if a dynamically or statically switching-off happens.	LED red Display
5	Ground switch	High, if the HV is switched on and is adjustably triggered from 0 to 100s.	
6	Check OK	Low, if the safety check has not been fulfilled. (see Remaining Energy Time section)	Display “Check OK” -or- “Check NOK”
7	Remote/Local Mode	High if the unit is in remote mode	
8	Rem.Energ.OK	Low if the allowed remaining energy is too high (see Capacity section)	

Table 2-14: High voltage digital output discriptions

2.12.5.4 Digital Inputs

X161 / D-In H		
Pin	Description	Signal
24V	Internal 24V output	24V DC
1	Unused	24V DC
2	Step bit 1	24V DC
3	Step bit 2	24V DC
4	Step bit 3	24V DC
Gin	Ext. ground for inputs	GND
GND	Internal ground	GND

X160 / D-In L		
Pin	Description	Signal
24V	Internal 24V output	24V DC
1	HV-ON	24V DC
2	U/I-Operating mode	24V DC
3	Unused	24V DC
4	Safety check	24V DC
Gin	Ext. ground for inputs	GND
GND	Internal ground	GND

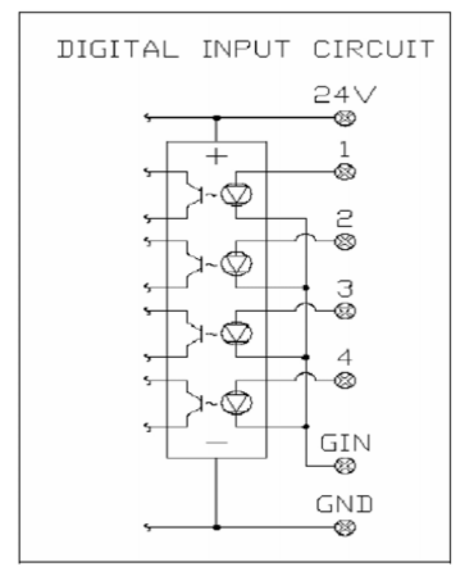


Table 2-15: High voltage digital input pin detail

- If it isn’t necessary to have potential free inputs connect pin ‘Gin’ with ‘GND’.
- The digital inputs are separable from internal ground and from internal 24V DC with bridge in two blocks
- Input voltage: 24V DC + 20%, H-level ≥ 13V.
- Input current: Max. 10mA @ 29V DC / each channel

N°.	Description	Function
1	HV-ON	External signal to switch on the high voltage in the remote mode
2	V/I-Operating mode	High = I-mode, Low = V-mode
3	Unused	Unused
4	Safety check	High = Start signal for the safety check (rising edge)
5	Unused	Unused
6	Steps bit 1	To realize 8 steps Binary 1
7	Steps bit 2	To realize 8 steps Binary 2
8	Steps bit 3	To realize 8 steps Binary 4

Table 2-16: High voltage digital input descriptions

2.12.5.5 Analog outputs

X165 / ANA-Out			
Pin	Description	Signal	Range
1	I-Actual	0-10V DC	0V = 0uA
GND	Ground	GND	10V = 307.2 uA
2	U-Actual	0-10V DC	0V = 0V
GND	Ground	GND	10V = 100kV
3	I-Actual	4-20mA	4mA = 0uA
GND	Ground	GND	20mA = 307.2 uA
4	U-Actual	4-20mA	4mA = 0kV
GND	Ground	GND	20mA = 100kV

Table 2-17: High voltage analog output pin detail

N°.	Description	Function	
1	I - actual	Readout of the actual value for the current	0 – 10V DC / 1 K Ohm
2	V- actual	Readout of the actual value for the voltage	0 – 10V DC / 1 K Ohm
3	I- actual	Readout of the actual value for the current	4-20 mA / 250 Ohm
4	V- actual	Readout of the actual value for the voltage	4-20 mA / 250 Ohm

Table 2-18: High voltage analog output descriptions

2.12.5.6 Analog inputs

X164 / ANA-In			
Pin	Description	Signal	Range
1	I-Set point	0-10V	0V = 0uA
GND	Ground	GND	10V = 307;2 uA
2	U-Set point	0-10V	0V = 0V
GND	Ground	GND	10V = 100kV
3	I-Set point	4-20mA	4mA = 0uA
GND	Ground	GND	20mA = 307.2 uA
4	U-Set point	4-20mA	4mA = 0kV
GND	Ground	GND	20mA = 100kV

Table 2-19: High voltage analog input pin details

To command voltage or current using 0 - 10 Volts (Analog Input channels 1 and 2), 4-20 milliamps (Analog Input channels 3 and 4), or Step Bits (Digital Inputs 2, 3, and 4 on X161) set the dip switch settings on the back plane as follows:

Command Input Type	Dip Switches (SW 1)			
	CH 1	CH 2	CH 3	CH 4
4-20 mA	OFF	OFF	OFF	OFF
0-10 V	OFF	OFF	ON	ON
Step Bits	ON	ON	ON	ON

Table 2-20: High voltage dip switch settings

N°.	Description	Function	
1	I-set point	Set point for the HV operating voltage	4-20 mA 249 Ohm
2	V- set point	Set point for the HV operating current	4-20 mA 249 Ohm
3	I-set point	Set point for the HV operating voltage	0-10 V >100 kOhm
4	V- set point	Set point for the HV operating current	0-10 V >100 kOhm

Table 2-21: High voltage analog input descriptions

2.12.5.7 Sub-D 9 connectors

SIO1 unused
CAN1 unused
FLASH1 For Software update via serial cable (not crossed)
Ethernet 10BaseT RJ45 connection

2.12.5.8 Ethernet connection

Integrated protocols: TCP/UDP/ IP socket, FTP
Help protocols: ARP, RARP, DHCP/BOOTP, PING, RIP

2.12.6 Cascades

There are two types of high voltage cascades used in FANUC Robotics paint application HV control systems.

Figure 2-18: High voltage legacy cascade (EO-4526-110-000)

The legacy style cascade is used on P-700iA Flex, VersaBell I, and ServoBell application systems. The integrated style cascade is used on P-250iA, P-500, P-500iA, and P-700iA (non Flex) application systems.

Figure 2-19: High voltage integrated cascade (EE-4696-800)

2.12.7 High Voltage Cables

When used with a VersaBell II type applicator, there is a high voltage cable that connects the high voltage generated by the cascade to the paint applicator. This cable has specific lengths used on a particular robot model / configuration.

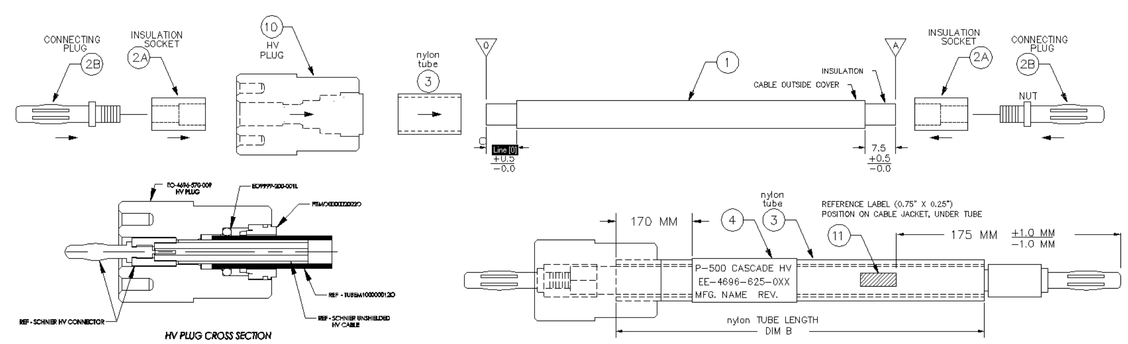


Figure 2-20: High voltage cable

HV Cable Assembly #:	Robot Model / Configuration:
EE-4696-625-001	P-500
EE-4696-625-002	P-500 Long Arm
EE-4696-625-003	P-700iA
EE-4696-625-004	P-250iA Short Arm
EE-4696-625-005	P-250iA Standard Arm
EE-4696-625-006	P-700iA Flex

EE-4696-625-007	P-500iA Flex Standard Arm
EE-4696-625-008	P-500iA Flex Long Arm

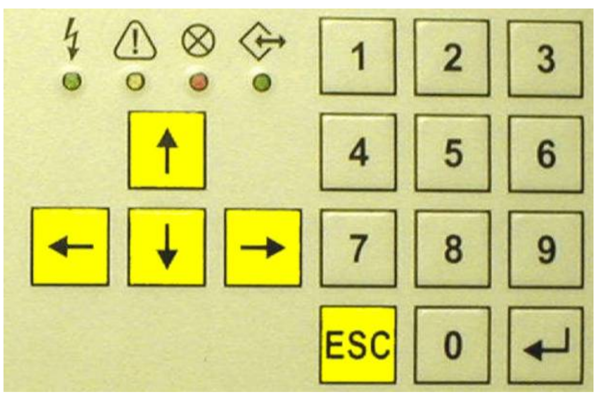
Table 2-22: High voltage cascade assemblies

Note: See Maintenance and Repair – high voltage Controller FB-200 HVU section for reference to Engineering Guideline EG-00450 for instructions on proper high voltage cable installation.

2.13 Operation and Setup – High voltage Controller FB-200 HVU

2.13.1 Select Language

The cursor appears in the display by selecting one of the cursor-buttons. To change the displayed language, select one of the cursor-buttons and the 'ESC' button at the same time. English is the default language and German is the secondary language.



2.13.2 Parameter Edit Mode

When the cursor is on a value than can be changed, the edit mode is achieved by activating the ‘Return’ push button. When in edit mode, all the LED’s are activated. When 'Return' is selected, the old value first changes to 0. The new value may be entered from the numeric key pad. Values such as On/Off, and I/U, may be changed with the right and left cursor push buttons. Pushing ‘ESC’ while in Edit mode cancels the change and returns the previous value. Pushing ‘Return’ stores the new value.

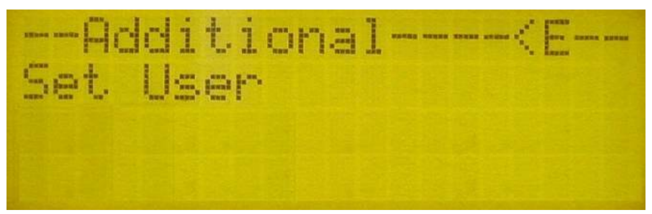
2.13.3 Setup

To enter Setup mode, cursor to 'Setup' and by press ‘Return’. The Setup window displays the parameters which can be changed with the current password level assigned. In the ‘Parameter-Assignment’ the plant administrator may determine which parameter may be changed with respect to the password level assigned. The default set point values for U and I for step X are visible without password entry.

The first line shows the active window and the Setup window navigation. An arrow to the right of the 'E' means that the next window is opened by pressing the right cursor. An arrow to the left of the 'E' means that the next window is opened by pressing the left cursor.

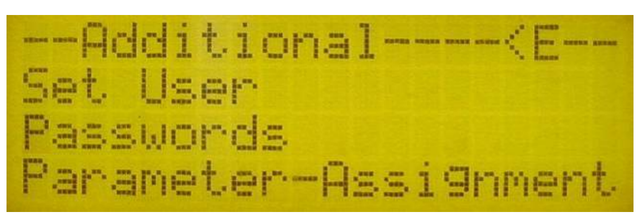
2.13.4 Passwords

To enter a password, enter 'Setup' mode and select the right cursor until the 'Additional' setup window is displayed. The cursor automatically moves onto 'Set User'. Press the 'Return' button. The user is prompted to enter a password. Depending on the security level of the password entered, different variables are available for edit.

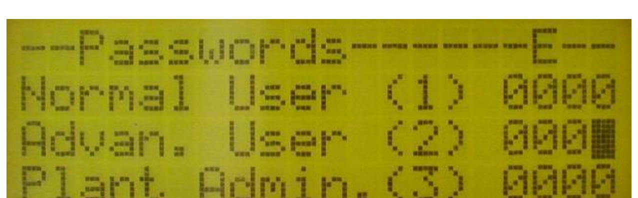


2.13.5 Assigning Passwords

The plant administrator with the administrative password has the opportunity to set all passwords and to activate the parameter assignment.

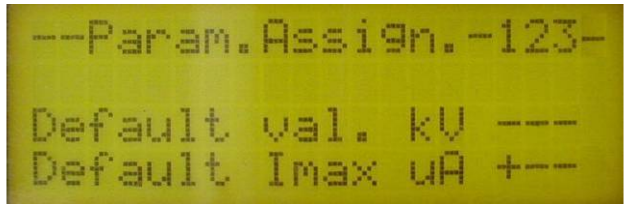


Passwords are assigned by selecting 'Passwords' from the 'Setup Additional' screen. Cursor to the password level to modify and change the password using the procedure described in Operation and Setup – High voltage section, Press 'ESC' to return to the 'Additional' window.



2.13.6 Parameter Assignment

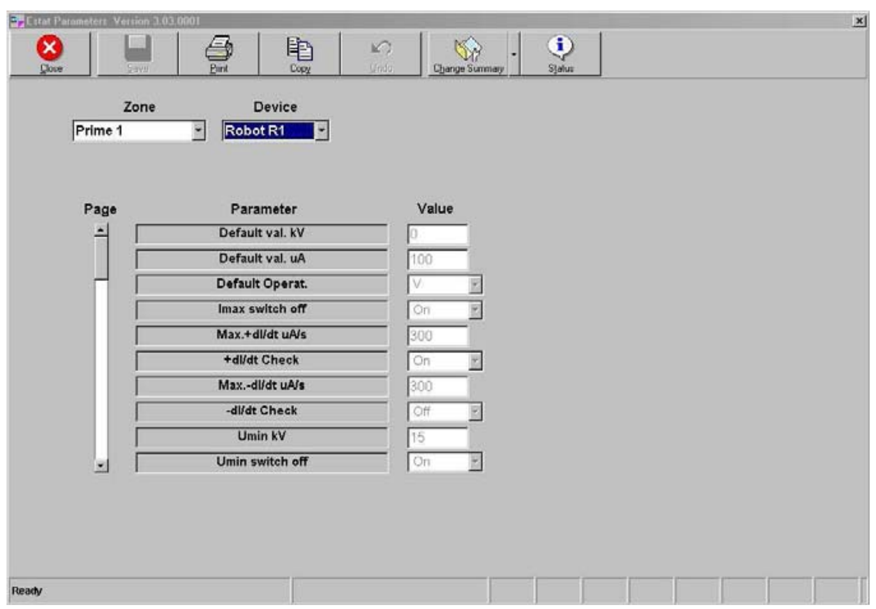
Select ‘Parameter-Assignment’ to assign the password level to edit a parameter.



The global administrator assigns a password level for each parameter. There are five password levels that can be assigned: No password needed, Normal User (1), Advanced User (2), Plant Administrator (3), and Global Administrator (G). To change the security level for a variable, cursor to the variable and select 'return'. Use the arrow keys to position the '+' key to the appropriate level. If there is not a '+' selected, the parameter may be changed by anybody without a password. The "Default val. KV" parameter above is an example of this. In the ‘Default Imax uA’ variable, the '+' is under the 1. This means password level 1 or higher (2,3,G) is required to change this parameter. When the ‘+’ is underneath the ‘2’, a password level 2, 3 or G is required to edit variables. When the ‘+’ is underneath the ‘3’ a password level, 3 or G is required. Only Global Administrators can edit variables where 'G' is selected. Press ‘ESC’ to return to the 'Additional' window.

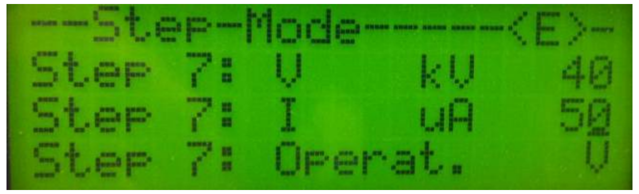
2.13.7 Paintworks Parameter Access

The High Voltage parameters can also be viewed from the PaintWorks "Estat Parameters" screen. The Estat Parameters screen is shown below. Press the scroll bar to the left of the parameters to view additional parameters.



2.13.8 Step Mode Settings

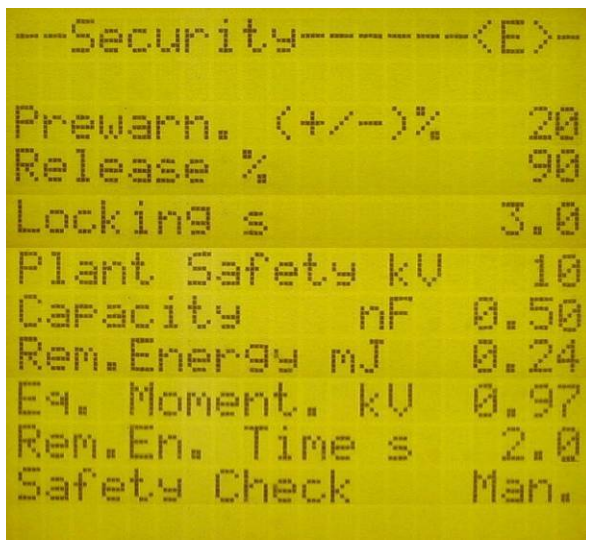
The Step Mode window is displayed by selecting 'Setup' from the main screen and navigating through the various 'Setup' windows.



This screen is to assign the voltage and current set-point values and to select the operating mode for Steps 1 through 7. Change the value using the procedure described in Parameter Edit Mode of the Operation and Setup – High voltage section. Note: Only Step 7 is available for the common user to edit. Please consult FANUC Robotics America, Inc if alternate step settings are required.

2.13.9 Parameter Security

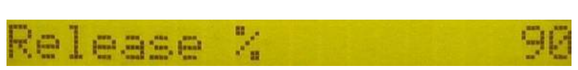
The Parameter Security window displays all parameters relevant for the safety of the system. The screen is displayed by selecting 'Setup' from the main screen and navigating through the various 'Setup' windows.



2.13.10 Pre-warning

The Pre-Warning is the percentage of the switch-off threshold that the warning appears. For example, if in U-operation the I-static-switch-off value is 100 µA, the warning is set when the current reaches 20% of the value (80µA). The warning is set in I-operation at 20% before U-Min is achieved. The pre-warning is shown by the ‘Pre-warning’ LED and the discrete output ‘HV-warning’ is activated.

2.13.11 Release



The Release % is the percentage of the set-point value where the 'Set Point Reached' signal is set. For example, if the set point in U-operation is 100kV, the set point reached signal is set at 90% of the value (90 KV). The release is shown by the ‘Set Point Reached' LED and the discrete output ‘HV set-point reached’ is activated.

2.13.12 Locking

The Locking Time (in seconds) is a pre-adjusted time delay for the discrete output ‘Ground switch’ after switching off the HV. The output ‘Ground switch’ is activated with ‘HV-ON’ and is deactivated with HV-OUT plus the duration of the Locking Time.

2.13.13 Plant Safety

The Plant Safety setting is the voltage at which it is safe for humans work with the High Voltage unit.

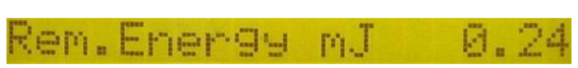
ATTENTION,. This value depends on the total capacity of the plant and whether the cleaning is done with solvent-containing agents.
It has to be adjusted according to the safety standards applied.

A value of 0-100kV may be entered. After the High Voltage unit is switched off, the output ‘HV-ON’ remains activated until the actual KV is below the Plant Safety value.

2.13.14 Capacity

Each plant may be used to store electrical energy (like a battery). If a discharge happens, an energy results from this capacity and the voltage. Here the plant capacity to calculate the energy supervision necessary may be adjusted.

2.13.15 Remaining Energy

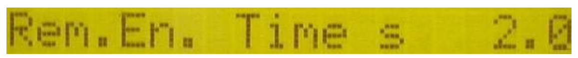


Remaining Energy is the electrical energy held by the system at a given moment. The remaining energy may be adjusted to the maximum energy allowed when it is permissible to be touched. According to EN 50176 the maximum energy allowed is 350mJ before contact is permitted. However, if the cleaning is done with solvent-containing agents the maximum permitted energy is 0.24mJ, which, in principle, is the energy which might combust solvent. A value from 0.01 mJ to 600.00 mJ may be entered.

2.13.16 Calculated momentum voltage

The Eq. Moment. kV shows the value calculated from the remaining energy (3.13.14) and the capacity. This value is the maximum permissible value upon touching the bell/diffuser in order not to surpass the adjusted energy (3.13.15) at the pre-adjusted capacity.

2.13.17 Remaining Energy Time



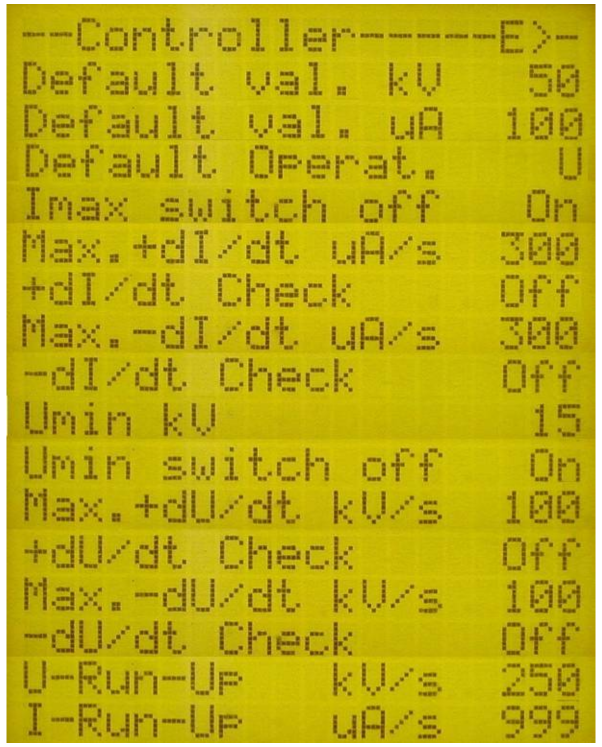
The Remaining Energy Time is the time required by a person to enter a spray booth and touch the bell/diffuser. The worst case (shortest time) is when the cabin door is opened, how long it will take the user to touch the bell/diffuser. The HV-control automatically supervises if the actual kV value is higher than the specified Remaining Energy after the Remaining Energy Time has passed.

2.13.18 Safety check

The safety check is an automatic test of the Imax switch off. A safety check can be initiated by the controller before HV-ON (rising edge of HV-ON, value set to 1) or after HV-ON (falling edge of HV-ON, value set to 0). If the value is preset to 2 the test must be initiated by hand or the PLC. **When the test runs the high voltage is disabled.** The test needs around 2 seconds to complete. If the safety check is successful, the display will show ‘Check OK’ and the discrete output ‘Check OK’ is set to high. If the safety check is not achieved the display will show ‘Check NOK’ and the discrete output ‘Check OK’ is set to ‘low’.

2.13.19 Parameter Controller

The Parameter Controller window displays all parameters needed for the control of the system. The screen is displayed by selecting 'Setup' from the main screen and navigating through the various 'Setup' windows.
SEE DEFAULT PARAMETERS SECTION FOR DEFAULT PARAMETERS VALUES.



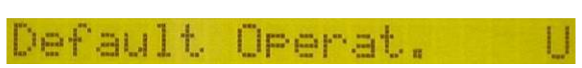
2.13.20 Default U kV

The default value for the output voltage may be adjusted from 0-100kV. The value is permanently stored and is available when the supply voltage is powered on, but it is only used for Step X (local) operations.

2.13.21 Default I µA

The default value for the output current may be adjusted from 0 to 27µA. The value is permanently stored and is available when the supply voltage is powered on, but it is only used for Step X (local) operations.

2.13.22 Default Operation



In this line, the default operating mode may be adjusted between I-operation and U-operation. The operating mode is being stored and is valid after switching on the supply voltage, but ins only relevant for step X (test operation).

2.13.23 Imax switch off

1. Imax switch off accounts for the static current switch-off in Voltage operation. If the Imax switch-off stands on 'ON', the HV-control switches off once the operating current has reached the pre-adjusted set value. If an Imax switch-off happens, the digital output 4 ‘HV-fault’ is activated, the red LED ‘Fault’ lights up and the display shows the fault. The static current switch-off may be de-activated in this line with the input mode (see 3.13.2), the display than shows ‘Imax switch Off Off’. Once the operating current has reached the pre-adjusted set value with switched-off Imax, the voltage is regulated back.

2.13.24 Max. +di/dt µA/s

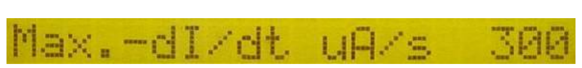
In this line the value for the dynamic current switch-off from 0 to 999 µA/s (only in U-operation) may be adjusted with rising current, which is a positive edge. This means if the current rises faster than the value adjusted in this line, the HV-control switches off. With a dynamic current switch-off the digital output 4 ‘HV-fault’ is activated, the red LED ‘Fault’ lights up and the display shows the fault. The dynamic current switch-off may be deactivated as described in 3.13.24.

2.13.25 +di/dt Check

Here the input mode for supervising the positive current edge (see 3.13.23) - +di/dt.- may be deactivated.

ATTENTION: This value is a safety relevant parameter and may only be handled by trained personnel.

2.13.26 Max. -di/dt µA/s



In this line, the value for the dynamic current switch-off from 0 to 999 µA/s (only with U-operation) in case of a power failure, that is with a negative current edge may be adjusted. That means, if the current is reduced faster as the pre-adjusted value at this time, the HV-control is switched-off. With a dynamic current switch-off the digital output 4 ‘HV-fault’ is activated, the red LED ‘Fault’ lights up and the display shows the fault. The dynamic current switch-off may be deactivated as described in 3.13.23

2.13.27 -di/dt Check

Here the input mode (see 3.13.2) may be used to deactivate the supervision of the negative current edge – di/dt.

ATTENTION: This value is a safety relevant parameter and may only be handled by trained personnel.

2.13.28 Umin kV

Umin switch-off stands for the static voltage switching-off from 0 to 100 kV in I-operation. The HV-control switches off if the operating voltage is regulated back to the previously adjusted set value. With a Umin switch-off, the digital output 4 'HV-fault' is activated, the red LED 'Fault' lights up and the display shows the fault. The static current switch-off may be adjusted in this line with the input mode and may deactivated as described in 3.13.28.

2.13.29 Umin switch off

Here with the input mode (see 3.13.2) the static voltage switch-off in I-operation may be deactivated. If the voltage switch-off in I-operation is deactivated, the voltage isn't regulated back anymore upon reaching the set value but is kept constant.

2.13.30 Max. +dU/dt µA/s

In this line the value for the dynamic voltage switch-off from 0 to 999 kV/s (only in I-operation) may be adjusted if the voltage increases, i.e. with a positive edge. That means, if the voltage rises faster that the value set at this time, the HV-control switches off. With a dynamic voltage switch-off the digital output 4 'HV-fault' is activated, the red LED 'Fault' lights up and the display shows the fault. The dynamic current switch-off may be deactivated as described in 3.13.24.

2.13.31 +dU/dt Check

Here with the input mode (see 3.13.2) the supervision of the positive current edge +dU/dt may be deactivated.

ATTENTION: This value is a safety relevant parameter and may only be handled by trained personnel.

2.13.32 Max. -dU/dt µA/s

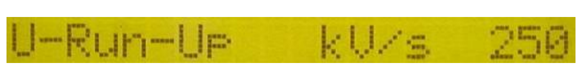
In this line the value for the dynamic current switch-off from 0 to 999 kV/s (only in I-operation) upon reducing the voltage, i.e. with negative edge, may be adjusted. That means if the voltage is reduced faster than the value pre-adjusted in this line, the HV-control switches off. With a dynamic voltage switch-off the digital output 4 “HV-fault” is activated, the red LED “fault” lights up and the display shows the fault. The dynamic current switch off may be de-activated as described in 3.13.26.

2.13.33 -di/dt Check

Here with the input mode (see 3.13.2) the supervision of the negative current edge –dU/dt. may be de-activated.

ATTENTION: This value is a safety relevant parameter and may only be handled by trained personnel.

2.13.34 U-Run-Up kV/s



In this line with the input mode (see 3.13.2) the run-up ramp from 0 to 250 kV/s for U-operation may be adjusted. 250kV/s is the maximal value, i.e. the faster run-up time is only a theoretical value as this would conform to a run-up time of 0-100kV in 0,4s. The run-up time depends on the total capacity of the spray system. Values up to 100kV/s are realistic. With low capacities a run-up time 0-100kV of 0.7s approx. may be possible which corresponds with a value of 143kV/s approx.

2.13.35 I-Run-Up µA/s

In this line with the input mode (see 3.13.2) the run-up ramp from 0 to 999µA/s for I-operation may be adjusted.

2.13.36 dX/dT Averages (For Display Only)

The dX/dT Averages is the number of samples of the current and voltage feedback the controller will monitor before determining there is a high voltage fault. The value for dX/dT Averages is set to 50. Each sample is approximately 5 ms. After the initial 50 samples, the HV Controller drops the oldest sample and performs fault control on the most recent 50 samples.

2.13.37 Ana. Input Ch.

The Analog Input Channel setting specifies which group of Analog Inputs the controller is monitoring for remote voltage or current command. Channels 1&2 are voltage inputs and Channels 3&4 are current inputs. The default value is 3 (Channels 3&4)

2.13.38 Act. I Output

The Actual Current Output setting specifies which HV Controller Analog output channel the actual current feedback is displayed on. The default is 4 which is the HV Controller AO Channel 1 (Voltage).

2.13.39 Max-I load % (only software 1.21f or higher)

Voltage operation only
Max-I load limits the current used during voltage ramp-up. A value of 100% disables this function. To enable Max-I load, use value lower than 100%. A good value for a plant must be found by testing with different values at the plant. 50% - 70% are reasonable values. This feature is designed to control the voltage ramp on a high capacitance (water based) systems to reduce the number of IMAX (over current) faults.

Operation: If the actual current is higher than the percentage of the Max-I load the voltage is reduced, the voltage ramp-up is slowed or stopped until the current returns to a value lower than 'Max-I load '. There is an internal delay provoked by averaging the values in the HV controller, so the current can be higher than the value set by Max-I load before the voltage is reduced. **Imax switch off is not disabled in this time.** If an over current or other fault occurs, for example by a spark, the high voltage is switched off.

For example, the Voltage set point is 50 KV and 60 uA. The Max I Load % is set to 50%. During the ramp, the current rises quickly over 30 uA. Instead of continuing the ramp and potentially having an IMAX fault, the software will stop the Voltage ramp until the current is below 30 uA.

2.13.40 Count I load (only software 1.23f to 1.23Fc)

This variable defines the number of cycles (one cycle is approximately 5ms) that the current limiter operates. After the count is exceed, the 'Max-I load' switches off and the run up ramp for high voltage is stopped. Also, the digital output 'HV-fault' is activated, the red LED 'Fault' indicator is on, and the 'V-Ramp stopped' alarm message is displayed on the main screen. The purpose of this feature is to prevent the entire vehicle from being sprayed with low High Voltage because the system is constantly operating with the current limited. The value for this field is 0 – 999 counts.

Note: In the 1.23F and 1.23Fc software, there is a software bug that causes the Count I Load not to work if the value is greater than 125. This software problem was fixed with version 1.23Fd and enhanced with the time based I Load Time Out in version 1.23fE.

2.13.41 I load Time Out (only software 1.23Fe)

This variable defines the time (seconds) that the current limiter operates when the Max I Load% is enabled. After the actual time that current limiter is invoked exceeds this variable, the ‘Max-I load’ switches off and the run up ramp for high voltage is stopped, the digital output ‘HV-fault’ is activated, the red LED ‘Fault’ indicator is on, and the ‘V-Ramp stopped’ alarm message is displayed on the main screen.

The purpose of this feature is to prevent the entire vehicle from being sprayed with low High Voltage because the system is constantly operating with the current limited. The valid values for this field are 0 – 99.9 seconds. If the Max I Load% is enabled and the I Load Time Out is 0, the HV Controller ignores the time and will run continuously in current limiter mode. The timer for the current limiter is reset each time the HV On signal is commanded on and each time the Step command changes (1). If the I Load Time Out time is longer than the spray time for a single High Voltage command, the V Ramp alarm will not occur.

2.13.42 I-max off (only software 1.23f or higher)

When enabled, I Max off limits the current in voltage mode (without faulting) when the current exceeds the I-max set point for the commanded voltage. But the high voltage will still shut off if the actual current is higher than ‘I-max off’ value. This feature allows the system to run in fold back mode but with all the safety checks still enabled. This function is helpful on water base plants to compensate temporary over currents. This feature is enabled by setting the value higher than 0μA. The valid values for I-Max off are 0-275 μA. To properly use this function, the value for I-Max Off should be higher than the I-Max set point.

Example: The preset value is 80 KV and 90 uA. The maximum value for I-Max is 150 uA. If the actual current exceeds 90 uA, the system will limit the voltage until the current drops below 90 uA. This is know a fold back mode and operates similar to current mode. However, the system will still fault if there is a sharp current rise that exceeds 150 uA.

2.14 Default Parameters – High voltage Controller – FB-200 HVU

Below is a listing of the default parameters as of version 1.25f0:

Index	Default Solventborne Value (Defaults)	Default Waterborne Value P-500 / P-700	Default Waterborne Value P-200	Description
1	0	0	0	Default val. kV
2	100	100	100	Default val. uA
3	0	0	0	Default Operat.
4	16	16	16	Imax switch off
5	300	300	300	Max.+dI/dt uA/s
6	1024	1024	1024	+dI/dt Check
7	300	300	300	Max.-dI/dt uA/s
8	0	0	0	-dI/dt Check
9	15	15	15	Vmin kV
10	32	32	32	Vmin switch off
11	100	100	100	Max.+dV/dt kV/s
12	0	0	0	+dV/dt Check
13	100	100	100	Max.-dV/dt kV/s
14	0	0	0	-dV/dt Check
15	20	20	20	Prewarn. (+/-)%
16	10	10	10	Release %

17	30	30	30	Locking s
18	10	10	10	Plant Safety kV
19	50	50	50	Capacity nF
20	24	24	24	Rem.Energy mJ
21	97	97	97	Eq. Moment. kV
22	90	90	90	Step 1: V kV
23	100	100	100	Step 1: I uA
24	0	0	0	Step 1: Operat.
25	85	85	20	Step 2: V kV
26	95	95	100	Step 2: I uA
27	0	0	0	Step 2: Operat.
28	80	80	25	Step 3: V kV
29	90	90	100	Step 3: I uA
30	0	0	0	Step 3: Operat.
31	70	70	30	Step 4: V kV
32	80	80	100	Step 4: I uA
33	0	0	0	Step 4: Operat.
34	60	60	35	Step 5: V kV
35	70	70	100	Step 5: I uA
36	0	0	0	Step 5: Operat.
37	50	50	50	Step 6: V kV
38	60	60	100	Step 6: I uA
39	0	0	0	Step 6: Operat.
40	40	40	40	Step 7: V kV
41	50	50	100	Step 7: I uA
42	0	0	0	Step 7: Operat.
43	50	25	25	V-Run-Up kV/s
44	50	25	25	I-Run-Up uA/s
45	0	0	0	Rem.En. Time s
46	2	2	2	Safety Check
47	0	0	0	Step 0:V kV
48	50	50	50	Step 0: I uA
49	50	50	50	dX/dt averages
50	3	3	3	Analog Input Channel
51	4	4	4	Actual Current Output
52	100	50	50	Max I Load
53	0	100	100	Timeout I Load
54	0	0	0	I-Max Off uA
55	2	2	2	Step 0 Mode

Table 2-23: High voltage default parameter settings

2.15 Manual Operation – High voltage Controller – FB-200 HVU

2.15.1 Local Mode

2.15.1.1 Step X

Step X is reserved for testing operations in local mode only. Values adjusted in this mode are not stored. After switching off and on the power supply, these values are reset to the default values. Step X default values are set in the Setup Mode.

Switching over the operating mode in step X
With the cursor buttons one may move the cursor onto the ‘U’ of voltage operation. Pressing ’Return’ toggles the operating mode from voltage to current operation.

Figure 2-21: High voltage Step X

Adjusting the set point value kV in step X
With the cursor buttons, move to the ‘set value’ for kV. Press the ’Return’ button to enter edit mode. Change the value using the procedure described in Parameter Edit Mode section.

Figure 2-22: High voltage set voltage

Adjusting the set-point value µA in step X
With the cursor buttons, move to the ‘set value’ for µA. Press the ’Return’ button to enter edit mode. Change the value using the procedure described in Parameter Edit Mode section.

Figure 2-23: High voltage set current

2.15.1.2 Activate HV in local mode

By turning the key switch 'HV enable' in local mode, the HV-OFF display changes to HV-On. The HV is now activated.

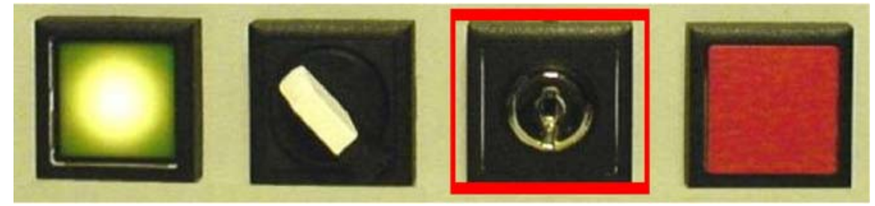


Figure 2-24: High voltage local mode key switch

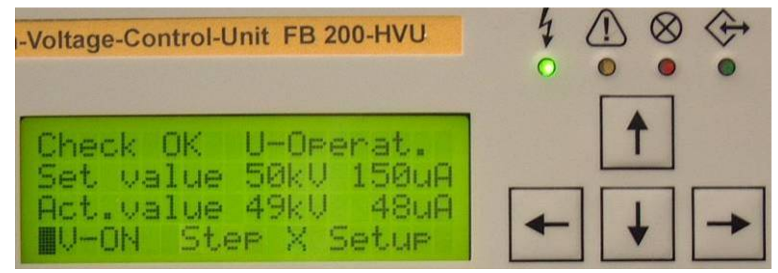


Figure 2-25: High voltage high voltage controller unit in Step X mode

'Act. Value' shows the actual values. Shortly before the set value is reached, the 'Set Point Reached' LED is activated.
Note: HV can be activated without the key switch enabled via the external remote signal when the unit is in remote mode.

De-activate HV in local mode
To de-activate the HV, push the 'HV disable' button.

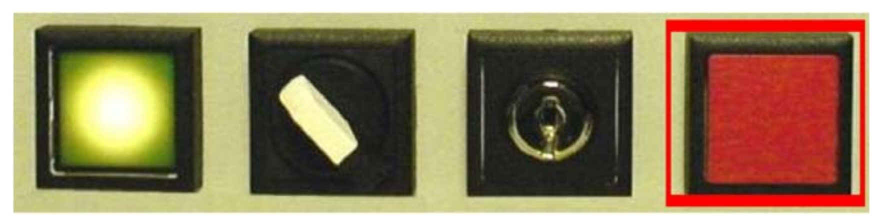


Figure 2-26: High voltage HV disable button

2.15.1.3 Step selecting in local mode

To change the step, cursor to the 'Step X' input, as shown in Figure 21. Press the 'Return' button to enter edit mode. Use the cursor to select the step and press return. Step values from 1 to 7 can be selected. The step 1 to 7 values for current set-point, voltage set-point and operating mode are stored in Setup. Step X is used when manually selecting the Set values. Step 0 is used only in remote mode for external analog control or if high voltage is disabled.

2.16 Remote mode – High voltage Controller FB-200 HVU

2.16.1 Step selection

Via the inputs 6 to 8, the steps 0 to 7 may be binary selected in the remote mode as follows:

	Input 1	Input 2	Input 3
Step 0	0	0	0
Step 1	0	0	1
Step 2	0	1	0
Step 3	0	1	1
Step 4	1	0	0
Step 5	1	0	1
Step 6	1	1	0
Step 7	1	1	1

Table 2-24: Binary table of high voltage steps

For steps 1 to 7 the pre-set points are adjustable via the front keys as described in 3.13.7. Step 0 uses the analog inputs 1 – 4. In U-operation the voltage pre-set point is given by analog input 2 (0-10V) or 4 (4 – 20mA). In I-operation the current pre-set point is given by analog input 1 (0-10V) or 3 (4 – 20mA). The pre-set point for Imax resp. Umin are adjustable in step mode (see 3.13.7)

2.16.2 Selecting the operating mode in step 0

The operating mode is selected via digital input 2 “V/I-Operating mode”. High = I-mode, low = V-mode.

2.16.3 Activate high voltage in remote mode.

The high voltage is activated via the digital input 1 “HV-ON”. High = HV-ON, low = HV-OFF.

2.16.4 Start safety check in remote mode.

Via digital input 4 “Safety Check” the safety check is started. For details to the safety check, please see 3.13.17. To start, an impulse is sufficient.

2.17 Maintenance and Repair – High voltage Controller FB-200 HVU

2.17.1 HV Cable Installation

This documents the procedure to replace the Electrostatic High Voltage cable on the P-250, P-500, and P-700 robots. The P-500 robot is used as an example, but the operations are fundamentally the same. This guideline has been developed to ensure maximum cable life, prevent damage to the robot and process hardware, and safeguard personnel performing the task.

2.17.1.1 HV Cable Installation Procedure

1. Obtain the appropriate replacement cable. See table in the Overview ITW section.

2. Run the Super Purge Cycle to clean out the applicator and lines.

3. Position the robot outer arm so it is accessible with J4, J5, and J6 near 0° (Only J4 and J5 if P-500 robot). This unwinds the process bundle through the wrist to allow ease of installation and promotes maximum cable/hose life.

4. Remove and lockout all sources of hazardous energy to the entire robotic cell.

5. Remove robot over spray covers if applicable.

6. Remove the outer arm hard cover to expose the High Voltage Cable if applicable.

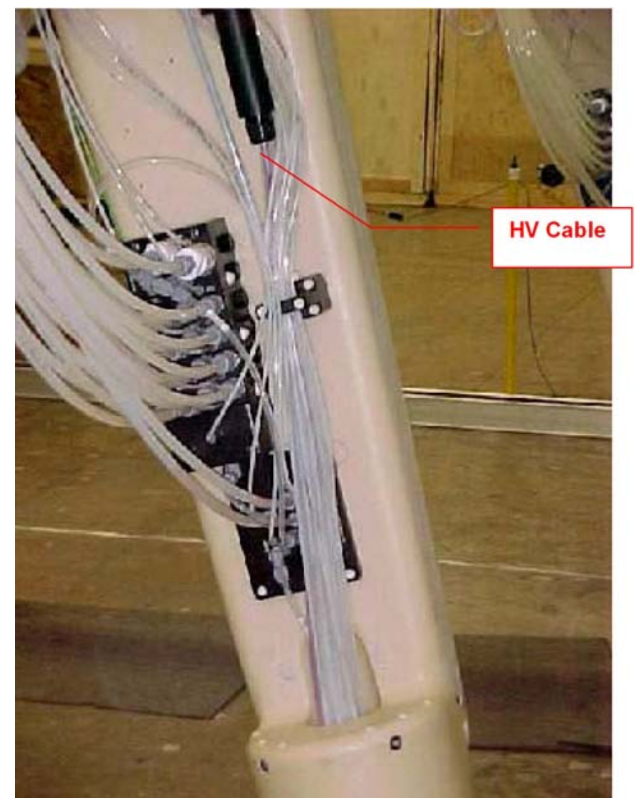


Figure 2-27: P-500 HV cable

1. Use a spanner wrench to remove the applicator. P-500 Robot applicator shown for example.

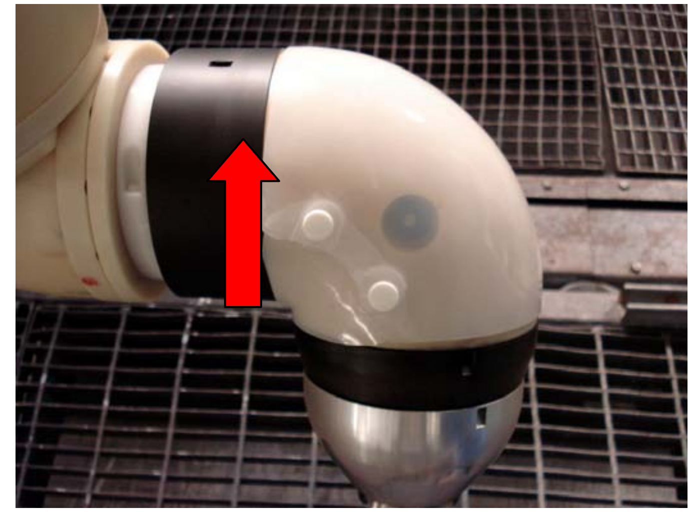


Figure 2-28: P-500 applicator quick disconnect

2. Loosen the two bolts in the process bundle clamp.

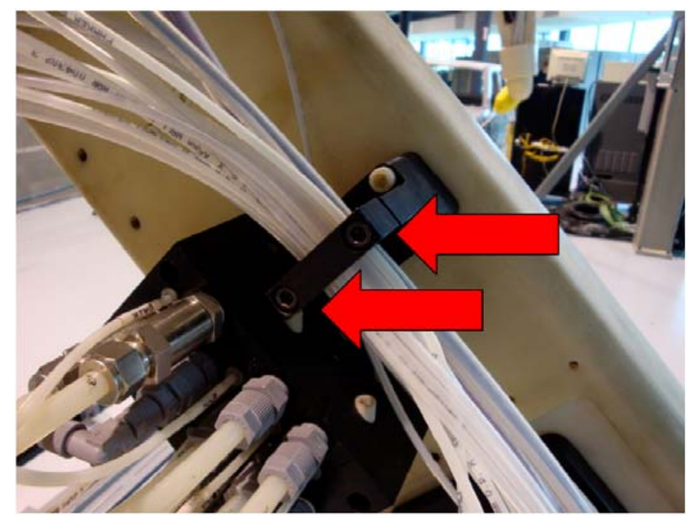


Figure 2-29: P-500 process bundle clamp

3. Loosen the cord grip and remove the HV Cable from the cascade.

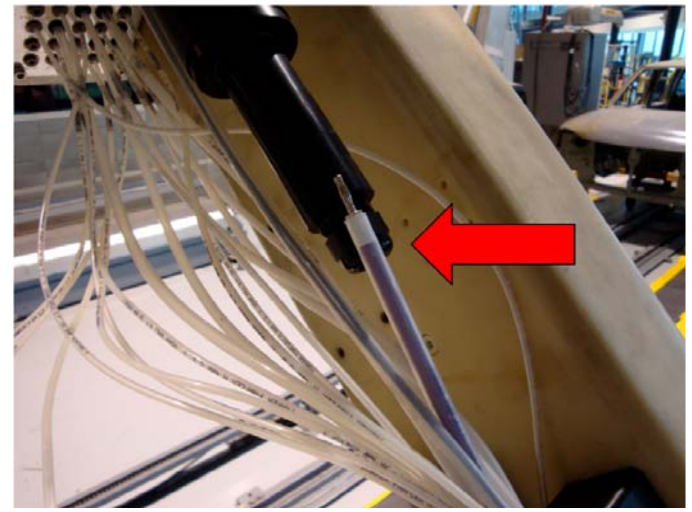


Figure 2-30: P-500 HV cable / cascade connection

4. Locate and remove the part number label from the tubing on the High Voltage cable that will be removed. The clearance between the tubing and the hole through the quick disconnect will not allow the label to pass.

Figure 2-31: HV cable part number label

5. Pull the HV Cable out through the applicator QD plate. Put the part number tag back on if sending the cable to FANUC Robotics.

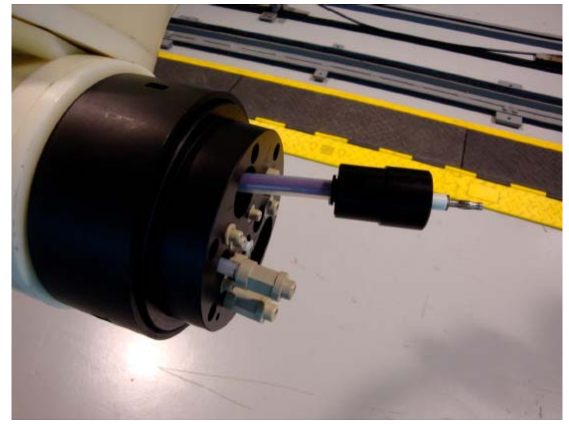


Figure 2-32: HV Cable in applicator QD

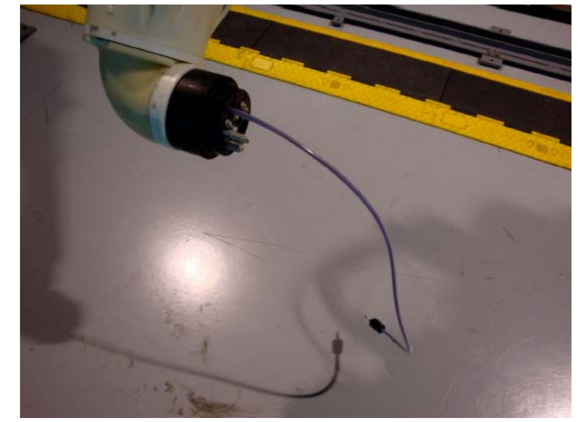


Figure 2-33: HV Cable pulled through applicator QD

6. Remove the part number label from the tubing on the new cable, save to reapply.

7. Verify the hose bundle is not crossed or tangled as it runs through the wrist and outer arm.

8. Feed the new HV Cable through the applicator QD and into the arm.

Figure 2-34: HV cable inside of robot wrist

9. Feed the HV Cable under the tubing clamp in the center of the process bundle.

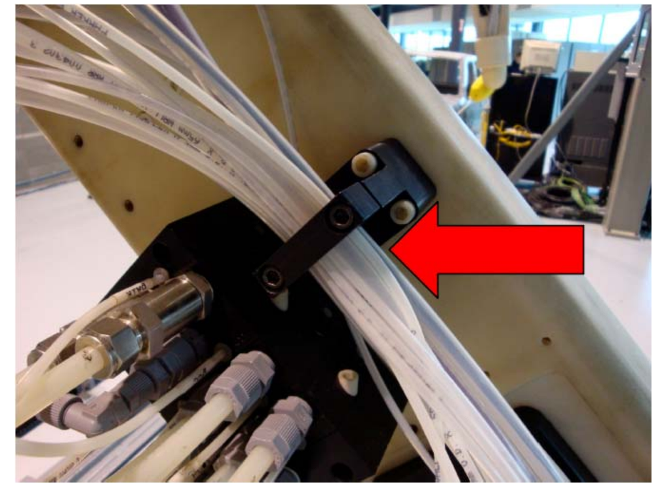
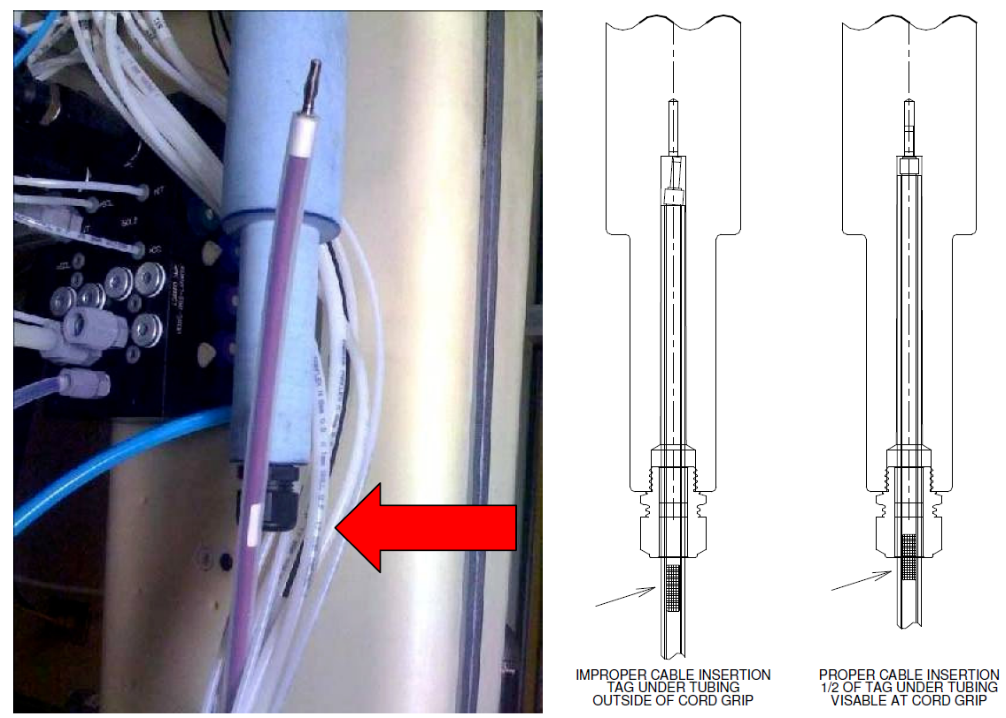


Figure 2-35: HV cable fed back through process bundle clamp

10. Feed the HV Cable through the cord grip and into the cascade. The white insertion gauge should remain half exposed when the cable is fully inserted.



CAUTION—Improper HV Cable insertion may cause premature failure of the HV Cable, Cascade, HV Controller, or poor transfer efficiency.

Figure 2-36: HV cable / cascade connection

11. Tighten the cord grip on the cascade to 120 in/lbs.

12. Tighten the two bolts on the outer arm process bundle clamp to 11 in/lbs.

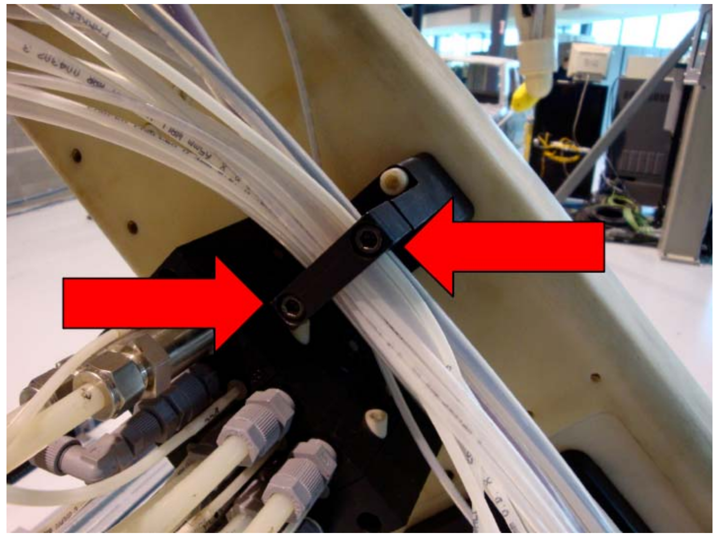


Figure 2-37: Process bundle clamp bolt position

13. Reapply the part number label to the nylon tube covering the HV cable between the outer arm clamp and wrist.

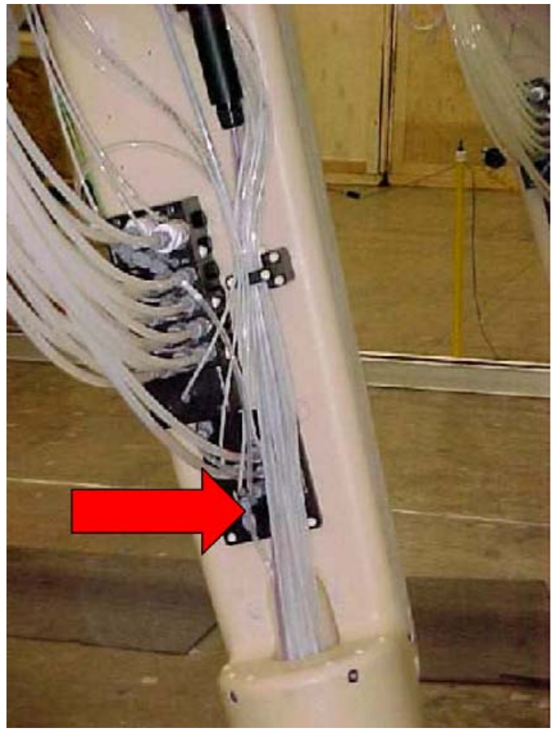
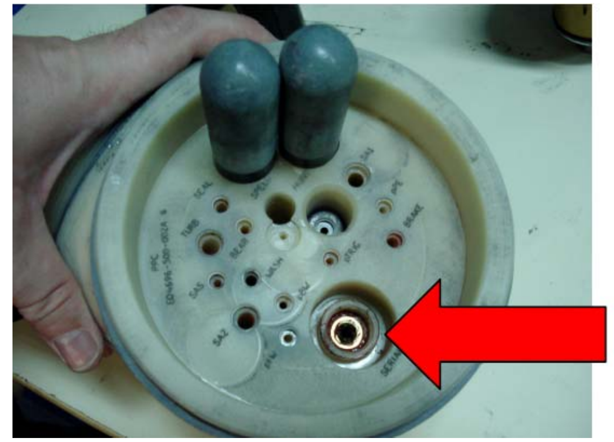


Figure 2-38: HV cable part number position

14. Apply Dielectric grease to the applicator and HV Cable petticoats. Be careful not to get grease on the metal pin or socket.



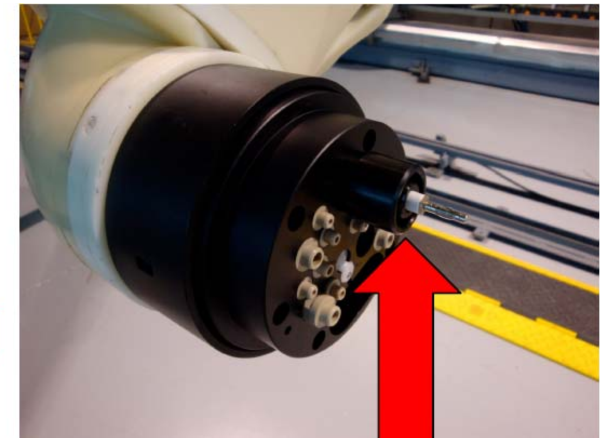


Figure 2-39: Dielectric grease locations

15. Reinstall the applicator using the spanner wrench.

16. Reinstall the outer arm cover.

17. Reinstall robot over spray pajamas if applicable.

18. Perform manual HV Tests below and then run "Ghost" simulation jobs to confirm that the new HV Cable is operating correctly.

• Reset the system in Manual mode and send the applicator shaping air shroud clear of all grounded metal.

• From the GUI Fluid Maintenance screen, run a High Voltage test at 60KV(step5) for 60 seconds.
Verify the voltage feedback is within 5KV of the set point and the current feedback is less than 5uA.

• Move the applicator shaping air shroud within 50-100mm(2-4") of a well grounded metal object.

• From the GUI Fluid Maintenance screen, run a High Voltage test at 60KV(step5) for 60 seconds. Verify the voltage feedback is within 5KV of the set point and the current feedback is greater than 10uA. Current draw may be excessive and cause an I-max or di/dt fault.

TEST	ROBOT POSITION	KV SETPOINT	KV ACTUAL	I ACTUAL
ISOLATION	CLEAR OF GROUND	60KV	60 +/-5KV ________	<5uA ________
CURRENT	WITHIN 50-100mm (2-4") OF GROUND	60KV	60 +/-5KV ________	>10uA ________

Table 2-25: High voltage test positions and conditions

2.17.2 Legacy Cascade Maintenance - Greasing Procedure

This procedure is used for legacy style cascades used on VersaBell Applicators, ServoBell Applicators, and P-700 Flex Application systems**.**

For used cascades, clean all old grease out of the cascade petticoat area using cotton swabs. When clean of all grease use an alcohol moistened swab to remove any residual grease. Wipe off the outer cascade body with clean rags and wipe clean with an alcohol moistened clean rag or pad to remove remaining grease. Let dry.

Figure 2-40: Clean grease locations

New Cascades:
Wipe all areas with provided alcohol pad.

1. Anytime a cascade is replaced, clean all old grease out of the cascade petticoat area in the manifold using cotton swabs. When clean of all grease use an alcohol moistened swab to remove any residual grease. Let dry.

Figure 2-41: High voltage petticoat location

2. Cover the HV-contact and petticoat area with a light coat of dielectric grease. Use only the recommended grease (Polytac #2) and not Vaseline. Use a small brush to apply a light coat to the petticoat area. The area must be covered 100%. **Too much grease will not allow for proper seating of the cascade in the applicator**. The appropriate amount of grease is shown below.

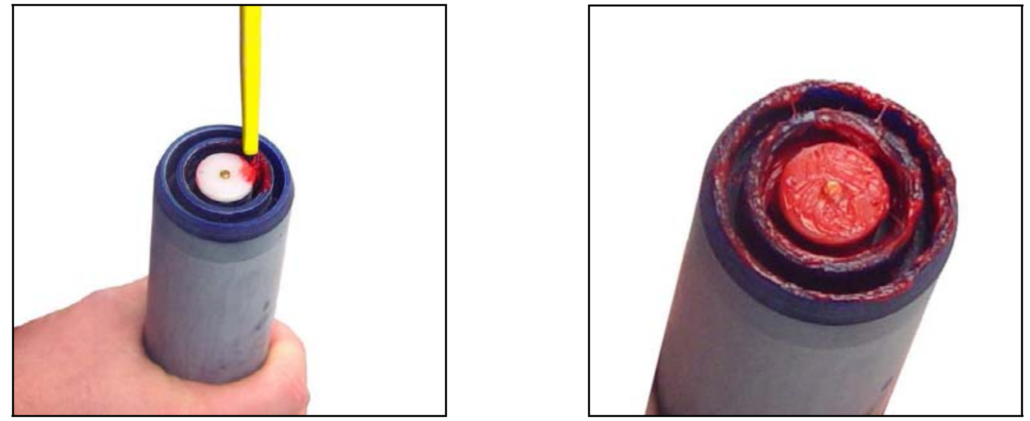
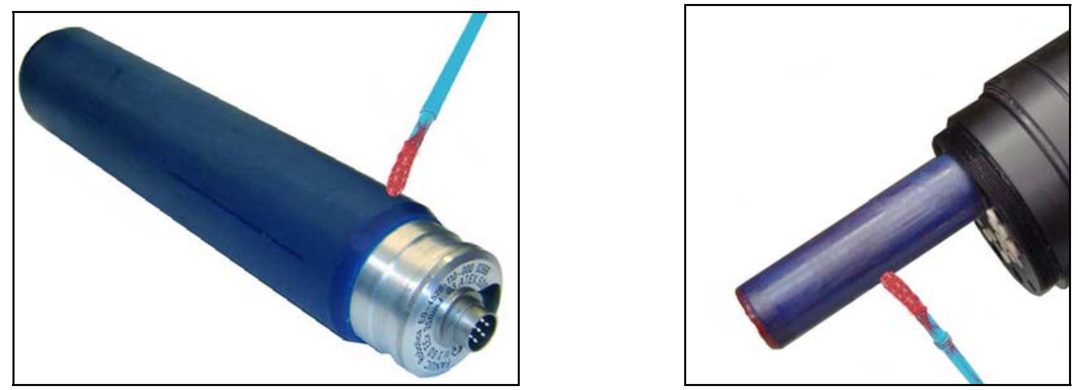


Figure 2-42: Dielectric grease applied to a cascade

FANUC Robotics Dielectric Grease
Part Number: EO-4526-050-009

Figure 2-43: Fanuc Robotics dielectric grease

3. Cover the outside diameter from the metal area to two inches to the front of the cascade with a **VERY LIGHT** coat of dielectric grease. The area must be covered 100%. Do not cover the metal area or the low voltage connector with any grease. **Too much grease will not allow for proper seating of the cascade in the applicator.**



<u>Figure 2-44: Cascade dielectric locations</u>

4. Install the cascades into the manifold. Tighten the cascade holding screw and than cover the outside diameter with a VERY LIGHT coat of dielectric grease. The area must be covered 100%. **No gaps. Too much grease will not allow for proper seating of the cascade in the applicator.**

2.17.3 Integrated Cascade Maintenance

The P-500iA, P-700iA (non-Flex) and P-250iA integrated cascades do not require the application of any dielectric grease to be applied. Grease SHOULD NOT be applied into the well of the high voltage cable.

<u>Figure 2-45: Cascade loaction for NO dielectric grease</u>

2.18 Troubleshooting – High voltage Controller FB-200 HVU

2.18.1 HV Control Unit Alarms

The following faults are displayed on the High Voltage Controller:

2.18.1.1 Switched-Off because of CABLE-BREAK

This fault indicator appears if a wire fails, i.e. has broken or is not connected on the cable between power supply and cascade. The high voltage is switched off and the "HV-fault" is activated. The HV controller can detect three different CABLE-BREAK conditions, both of the feedback signals and for R+. After the CABLE-BREAK is a text character (I,U, or R). The descriptive text character is displayed for software version 1.21f and later. This character indicates on which wire the cable-break was detected.

Possible causes are:

1. Cause: A broken low voltage wire section between the high voltage power supply and the cascade.
Remedy: Ring out the wiring for continuity and replace the broken wire or cable. See the appropriate diagram below for cable locations in your particular system. Refer to the system electrical prints for wiring functionality.

2. Cause: A loose connection at the one of the low voltage terminal strips for one of the low voltage cables.
Remedy: Check screw connections on all terminal strips, this includes the Phoenix connector within the Robot FRP unit in the P200E and Amphenol connector in the P500.

3. Cause: A loose or damaged connection/pin at the cascade low voltage connector.
Remedy: Check the pins to see if they are bent or broken or the solder joint is loose. Attempt to straighten/solder or replace the pins if bent, if broken on the cascade replace the cascade.

4. Cause: A loose/ broken connection at the high voltage power supply back-plane,
Remedy: Check all wires to see if they are properly connected into the terminal strips and are correctly tightened.

5. Cause: Cascade holder bolts are loose causing intermittent connection of the cascade to the connector.
Remedy: Tighten the bolts

6. Cause: VersaBell applicator or cascade in VersaBell not properly tightened allowing the cascade connection to the connector to be marginal.
Remedy: Tighten the applicator using the correct spanner wrench.

7. Cause: In P500 systems only, the cascade holder connection nut within in the FRP unit has loosened causing an intermittent and marginal electrical connection.
Remedy: Remove the black cascade holder from the FRP, check the connection nut for tightness. If loose use Loctite 242 sealant on the threads and tighten properly.

8. Cause: A defective high voltage cascade.
Remedy: Remove the cascade and replace with a new one.

2.18.1.2 Switched-Off because of dV/dt-FAULT

This fault indicates the rate of current change (in Voltage operation) is rising faster than expected. The high voltage is switched off and the "HV-fault" is activated.

Possible causes are:

1. Cause: Applicator covers are built up with excessive paint overspray.
Remedy: Change the cover.

2. Cause: Clean washed covers vs. new covers were placed on the applicator and faults occurred.
Remedy: Replace with unwashed covers and contact cover suppler for non-conductive covers.

3. Cause: Distance between the applicator bell cup and/or shaping air assembly is too close to a vehicle.
Remedy: Check for the following possible situations and/or problems and correct it:
a) Vehicle is skewed in the booth on the carrier. Check the vehicle and skid tolerance.
b) Check that the proper job is in the booth.

c) Vehicle skid is bent. Tag skid for repair.
d) Vehicle may have slipped on the conveyor and is not being tracked correctly.
e) Vehicle gas door is open or out of position
f) Vehicle door or tailgate is open or out of position.
g) Door clip or fixture is out of position and is too close to applicator.
h) Path may have been adjusted and is now too close to the vehicle. Target should be 1 inch per 10KV + 1 inch between vehicle bell cup and side of the shaping air assembly.
i) Path preset step value was changed (increased) without regard to target distance.
j) Step setting values may have been changed. Compare to original values.
k) Booth humidity too high. Adjust if possible.
l) Paint resistivity is too high. Check the paint kitchen to see if new paint or solvent was added to the paint tanks. High aluminum flake content may cause problems.
m) Applicator had excessive solvent used for cleaning and may have seeped between the applicator components.
n) Paint leak in wrist. Check for a loose connection, electrostatic pin-holing or broken hose.
o) Solvent leak in wrist. Check for a loose connection, electrostatic pin-holing or broken hose.
p) Wash line is not properly purged with air after a color change. Check the purge cycle to insure it is blown down.
q) One of the paint valves is leaking either externally or internally.
r) Possible electrical noise from improper shield or ground connections.

2.18.1.3 Switched-Off because of dI/dt-FAULT

This fault indicates the rate of current change (in Voltage operation) is rising faster than expected. The high voltage is switched off and the "HV-fault" is activated.

Possible causes are:

1. Cause: Applicator covers are built up with excessive paint overspray.
   Remedy: Change the cover.

2. Cause: Clean washed covers vs. new covers were placed on the applicator and faults occurred.
   Remedy: Replace with unwashed covers and contact cover suppler for non-conductive covers.

3. Cause: Distance between the applicator bell cup and/or shaping air assembly is too close to a vehicle.
   Remedy: Check for the following possible situations and/or problems and correct it:
   a) Vehicle is skewed in the booth on the carrier. Check the vehicle and skid tolerance.
   b) Check that the proper job is in the booth.
   c) Vehicle skid is bent. Tag skid for repair.
   d) Vehicle may have slipped on the conveyor and is not being tracked correctly.
   e) Vehicle gas door is open or out of position
   f) Vehicle door or tailgate is open or out of position.
   g) Door clip or fixture is out of position and is too close to applicator.
   h) Path may have been adjusted and is now too close to the vehicle. Target should be 1 inch per 10KV + 1 inch between vehicle bell cup and side of the shaping air assembly.
   i) Path preset step value was changed (increased) without regard to target distance.
   j) Step setting values may have been changed. Compare to original values.
   k) Booth humidity too high. Adjust if possible.
   l) Paint resistivity is too high. Check the paint kitchen to see if new paint or solvent was added to the paint tanks. High aluminum flake content may cause problems.
   m) Applicator had excessive solvent used for cleaning and may have seeped between the applicator components.
   n) Paint leak in wrist. Check for a loose connection, electrostatic pin-holing or broken hose.
   o) Solvent leak in wrist. Check for a loose connection, electrostatic pin-holing or broken hose.
   p) Wash line is not properly purged with air after a color change. Check the purge cycle to insure it is blown down.

q) One of the paint valves is leaking either externally or internally.
r) Possible electrical noise from improper shield or ground connections.

2.18.1.4 Switched-Off because of EXCEEDING POWER DISSIPATION

This fault indicates exceeding power dissipation of the HV-generator. If this fault indicator appears, the HV-generator is defective or is overheated. The high voltage is switched off and the "HV-fault" is activated.

1. Cause: The cascade is defective.
   Remedy: Replace the cascade.

2.18.1.5 Switched-Off because of OVERLOAD (Vmin)

This fault indicates the Voltage is below the minimum allowed for the requested current. The high voltage is switched off and the "HV-fault" is activated.

Possible causes are:

1. Cause: Applicator covers are built up with excessive paint overspray.
   Remedy: Change the cover.

2. Cause: Clean washed covers vs. new covers were placed on the applicator and faults occurred.
   Remedy: Replace with unwashed covers and contact cover suppler for non-conductive covers.

3. Cause: Distance between the applicator bell cup and/or shaping air assembly is too close to a vehicle.
   Remedy: Check for the following possible situations and/or problems and correct it:
   a) Vehicle is skewed in the booth on the carrier. Check the vehicle and skid tolerance.
   b) Check that the proper job is in the booth.
   c) Vehicle skid is bent. Tag skid for repair.
   d) Vehicle may have slipped on the conveyor and is not being tracked correctly.
   e) Vehicle gas door is open or out of position
   f) Vehicle door or tailgate is open or out of position.
   g) Door clip or fixture is out of position and is too close to applicator.
   h) Path may have been adjusted and is now too close to the vehicle. Target should be 1 inch per 10KV + 1 inch between vehicle bell cup and side of the shaping air assembly.
   i) Path preset step value was changed (increased) without regard to target distance.
   j) Step setting values may have been changed. Compare to original values.
   k) Booth humidity too high. Adjust if possible.
   l) Paint resistivity is too high. Check the paint kitchen to see if new paint or solvent was added to the paint tanks. High aluminum flake content may cause problems.
   m) Applicator had excessive solvent used for cleaning and may have seeped between the applicator components.
   n) Paint leak in wrist. Check for a loose connection, electrostatic pin-holing or broken hose.
   o) Solvent leak in wrist. Check for a loose connection, electrostatic pin-holing or broken hose.
   p) Wash line is not properly purged with air after a color change. Check the purge cycle to insure it is blown down.
   q) One of the paint valves is leaking either externally or internally.
   r) Possible electrical noise from improper shield or ground connections.

2.18.1.6 Switched-Off because of OVERLOAD (Imax)

This fault indicates that the operating current has exceeded the maximum allowed value for the requested Voltage. The high voltage is switched off and the "HV-fault" is activated.

Possible causes are:

1. Cause: Applicator covers are built up with excessive paint overspray.
   Remedy: Change the cover.

2. Cause: Clean washed covers vs. new covers were placed on the applicator and faults occurred.
   Remedy: Replace with unwashed covers and contact cover suppler for non-conductive covers.

3. Cause: Distance between the applicator bell cup and/or shaping air assembly is too close to a vehicle.
   Remedy: Check for the following possible situations and/or problems and correct it:
   a) Vehicle is skewed in the booth on the carrier. Check the vehicle and skid tolerance.
   b) Check that the proper job is in the booth.
   c) Vehicle skid is bent. Tag skid for repair.
   d) Vehicle may have slipped on the conveyor and is not being tracked correctly.
   e) Vehicle gas door is open or out of position
   f) Vehicle door or tailgate is open or out of position.
   g) Door clip or fixture is out of position and is too close to applicator.
   h) Path may have been adjusted and is now too close to the vehicle. Target should be 1 inch per 10KV + 1 inch between vehicle bell cup and side of the shaping air assembly.
   i) Path preset step value was changed (increased) without regard to target distance.
   j) Step setting values may have been changed. Compare to original values.
   k) Booth humidity too high. Adjust if possible.
   l) Paint resistivity is too high. Check the paint kitchen to see if new paint or solvent was added to the paint tanks. High aluminum flake content may cause problems.
   m) Applicator had excessive solvent used for cleaning and may have seeped between the applicator components.
   n) Paint leak in wrist. Check for a loose connection, electrostatic pin-holing or broken hose.
   o) Solvent leak in wrist. Check for a loose connection, electrostatic pin-holing or broken hose.
   p) Wash line is not properly purged with air after a color change. Check the purge cycle to insure it is blown down.
   q) One of the paint valves is leaking either externally or internally.
   r) Possible electrical noise from improper shield or ground connections.

4. Cause: Cascade holder bolts or cascade connector is loose causing an intermittent connection of the cascade to the connector
   Remedy: Tighten the bolts or estat cable connector nut. Apply Loctite 242 sealant to prevent loosening.

5. Think about using points Max-I load (3.13.49) and I-max off (3.13.32) on water based systems.

2.18.2 PaintTool HV Alarms

The following faults are displayed on the Teach Pendant and GUI Alarms screen:

2.18.2.1 PAIN-351 "Estat controller warning"

Cause: The FB-200-HVU High Voltage Controller detected a Warning. This indicates a potential system fault that is not yet at the fault level.
Remedy: Check the status screen on the FB-200-HVU High Voltage Controller. Monitor for conditions such as high current or low voltage while painting that may cause the warning to occur.

2.18.2.2 PAIN-352 "Estat controller fault"

Cause: The FB-200-HVU High Voltage Controller detected a fault. The FB-200-HVU sends this fault signal to the robot controller so that all painting is stopped.
Remedy: Check the operator console GUI for a fault and/or fault status on the panel and display of the FB-200-HVU High Voltage Controller. If the fault is not displayed on the GUI after 5 seconds check the FB-200 HVU display for fault details.

2.18.2.3 PAIN-353 "Estats disabled"

Cause: The Estat Disconnect Switch is off or the Enable Key Switch on the FB-200-HVU High Voltage Controller is off.
Remedy: Turn the Disconnect switch to ON or turn the FB-200-HVU High Voltage Controller, Enable Key Switch to ON.

2.18.2.4 PAIN-354 "Estat controller not in remote"

Cause: The Local / Remote Rotary switch on the FB-200-HVU High Voltage Controller is in the Local Mode.
Remedy: Turn the toggle switch on the FB-200-HVU High Voltage Controller to the REMOTE mode.

2.18.2.5 PAIN-355 "Estat HVON Failed"

Cause: This is a real alarm not a nuisance, when the message occurs the paint job quality is poor due to no high voltage present at the applicator. The root cause of the problem is that the robot controller sent the HVON signal to the FB-200-HVU High Voltage Controller but did not get a signal back indicating it received the signal. The HV On Alarm is a PaintTool generated alarm not an actual high voltage alarm from the FB-200 HVU High Voltage Controller. When the robot controller commands voltage, the robot controller turns on the HV ON output that is wired to the FB-200-HVU High Voltage Controller input. The FB-200 HVU High Voltage Controller sends the voltage command to the cascade when it receives the HV ON signal. When the FB-200-HVU High Voltage Controller senses any energy in the system, it turns on the HV ON output that is wired to the input card in the robot controller. When PaintTool turns on the HV ON output, it looks for the HV ON input echo from the FB-200-HVU High Voltage Controller. If it does not get the signal after a predetermined time (HVON Input Timeout), the robot controller issues a Warning.

Remedy: Confirm that this is a real problem by monitoring the display on the FB-200-HVU High Voltage Controller. If the step value is between 1 and 7 and the HV ON signal is on and the Actual KV value is 0, then there is a problem in the system. To debug this problem, start by looking at the FB-200 HVU High Voltage Controller. If the HV On signal is on only when there is a valid step command and the feedback is correct, look at the pendant and confirm the Digital Input HV ON signal is on. For the P-500 check (DI 257 (Eq1) DI 385 (Eq2)). For P-155 and P-200 compare with another robot to check these Digital Input Signals as many configurations are possible. If any signals are missing, check the wiring to the I/O card and back plane. If this doesn't clear the problem, start checking ALL the cable connectors and terminal connections associated with the low voltage wiring of the high voltage system.

Possible causes are:
1. Cascade is defective.
2. Defective high voltage cable (purple) from the cascade to the applicator.
3. Problem with FB-200-HVU High Voltage Controller.
4. Problem with wiring on FB-200-HVU High Voltage Controller back plane or FANUC I/O card (HV ON signal or step signal) in the robot controller cabinet.
5. Defective robot controller I/O card.
6. The FB-200 High Voltage Controller not seeing feedback from the cascades(cable / wiring problem)
7. The FB-200 High Voltage Controller not commanding Voltage (cable / wiring problem - see cable break fault)
8. No Step command with HV ON command. Possible causes are: The preset is set to an invalid value, a wiring problem exist, or the step I/O was mapped incorrectly at the robot controller).

2.18.2.6 PAIN-356 "Estat set point not reached"*

***Note:**
PaintTool V5.30-1 to V6.22-1
PAIN-356
PaintTool V6.31-1 to V7.30-1

PNT1-678 (Eq1)
PNT1-691 (Eq2)

Cause: The set point reached signal from the FB-200-HVU High Voltage Controller was not received by the robot controller within the appropriate time limit.
Remedy: Check the voltage and set point reached light on the FB-200-HVU High Voltage Controller. The system may be having trouble reaching the requested voltage. If not adjust the set point reached time out setting.

2.19 Spare Parts – High voltage Controller FB-200 HVU

2.19.1 Spare Parts

Part Number	Description	Replacement Period
PWRSO0000000052O	SCHNIER #FB-200-HV V1.25 UNIT	Upon failure
PWRSO0000000047O	SCHNIER #FB-200-HV V1.24 UNIT	Upon failure
PWRSO0000000043O	SCHNIER #FB-200-HV V1.23 UNIT	Upon failure
PWRSO0000000042O	SCHNIER #FB-200-HV V1.21 UNIT	Upon failure
PWRSO0000000001O	SCHNIER #FB-200-HV V1.16 UNIT	Upon failure
EO-4526-110-000 ALT: EE-4526-800	Cascade #810230 (legacy type) ALT: ITW A12295-00 (legacy type) Note: To use ITW cascade with Schnier HV Controller, then Schnier V1.16 software is required. Other hardware modifications may be required. Contact FANUC Robotics.	Upon failure
EE-4526-801 ALT: EE-4526-801	Integrated Cascade ALT: ITW A12296-00 (integrated type) Note: To use ITW cascade with Schnier HV Controller, then Schnier V1.16 software is required. Other hardware modifications may be required. Contact FANUC Robotics.	Upon failure
EE-4696-625-XXX	High Voltage Cable – Robot configuration specific lengths. See Overview ITW section for table of robot model specific HV cable lengths.	4000 Hours

Table 2-26: Spare parts and replacement schedule

3 BELL SPEED CONTROL SYSTEM

3.1 Overview

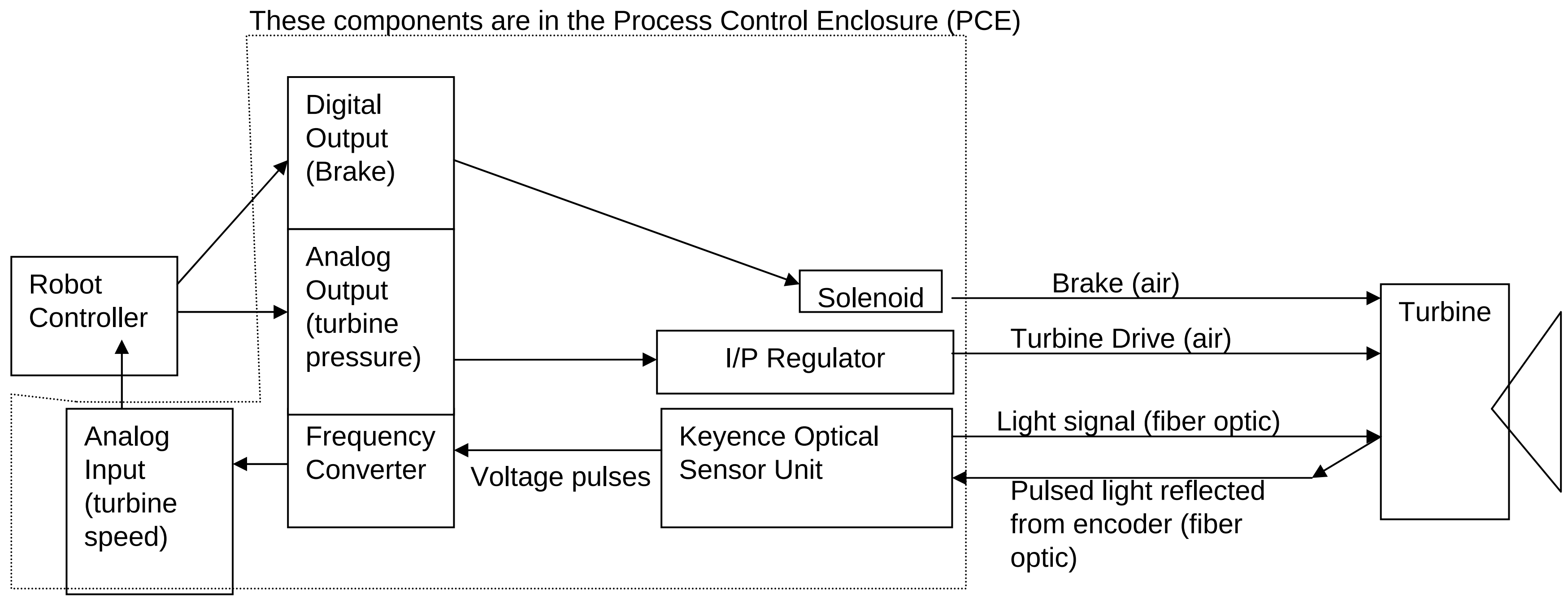
3.1.1 Introduction

The Bell Speed Control System adjusts the pressure of the drive air supplied to the turbine in order to maintain the commanded bell speed. The closed-loop control of this system is provided by the PaintTool software. Bell speed is monitored by the fiber optic feedback system. This feedback is used to determine what adjustments need to be made to the I/P regulator on the turbine drive air in order to control turbine speed. An air brake is used to quickly reduce speed or stop the turbine when necessary.

The fiber optic feedback also allows the software to monitor and report problems with the Bell Speed Control System. Abrupt changes in bell speed, slow transition between set-points, turbine over-speed, and insufficient turbine speed are all diagnosed and reported as faults and warnings by the Bell Speed Control System.

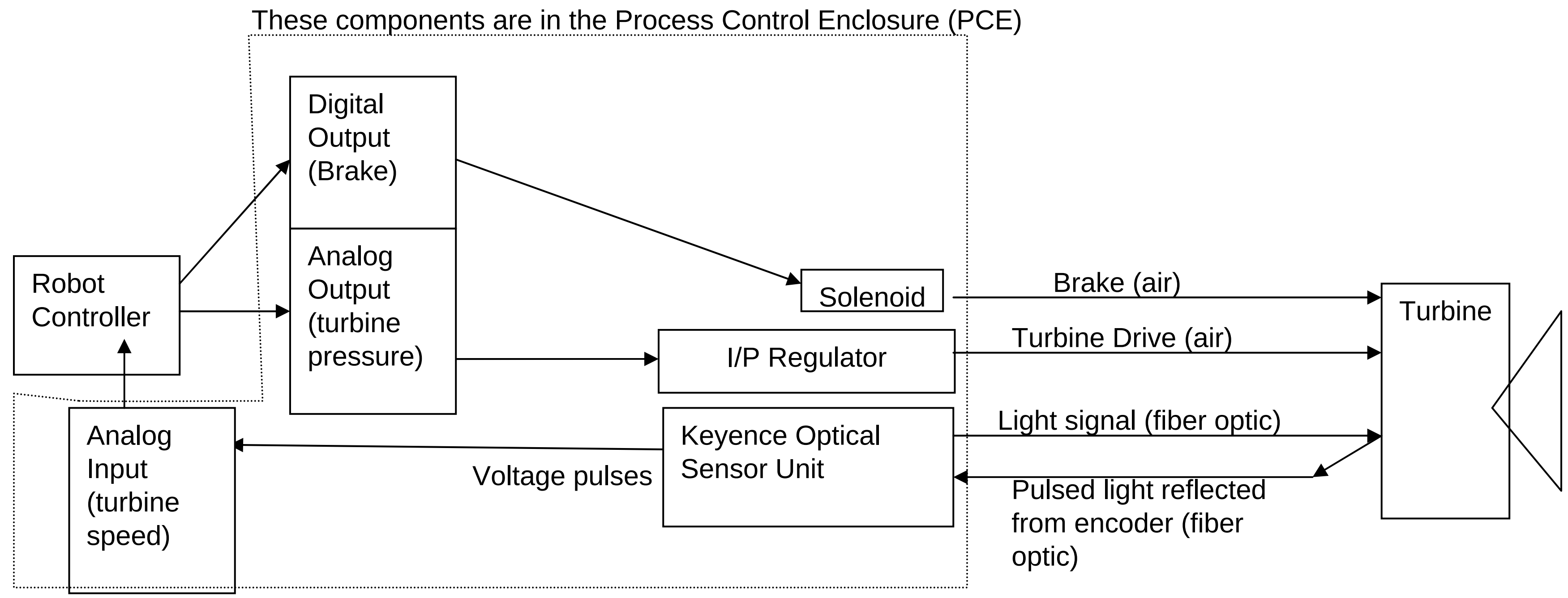
The components in the fiber optic feedback system are calibrated at assembly. An automatic setup procedure is used to set the cruise speed (or idle speed) of the turbine.

3.1.2 System Components – Block Diagram Overview



Turbine is driven by air.
Air pressure for turbine drive is commanded by robot controller.
Fiber optic system measures speed of spinning turbine and provides feedback for closed loop control
Brake is air driven also.
Braking air is commanded when actual speed is higher than command speed.

Figure 3-1: D/Q PCE Block Diagram



Turbine is driven by air.
Air pressure for turbine drive is commanded by robot controller.
Fiber optic system measures speed of spinning turbine and provides feedback for closed loop control
Brake is air driven also.
Braking air is commanded when actual speed is higher than command speed.

Figure 3-2: Flowmeter Block Diagram Overview

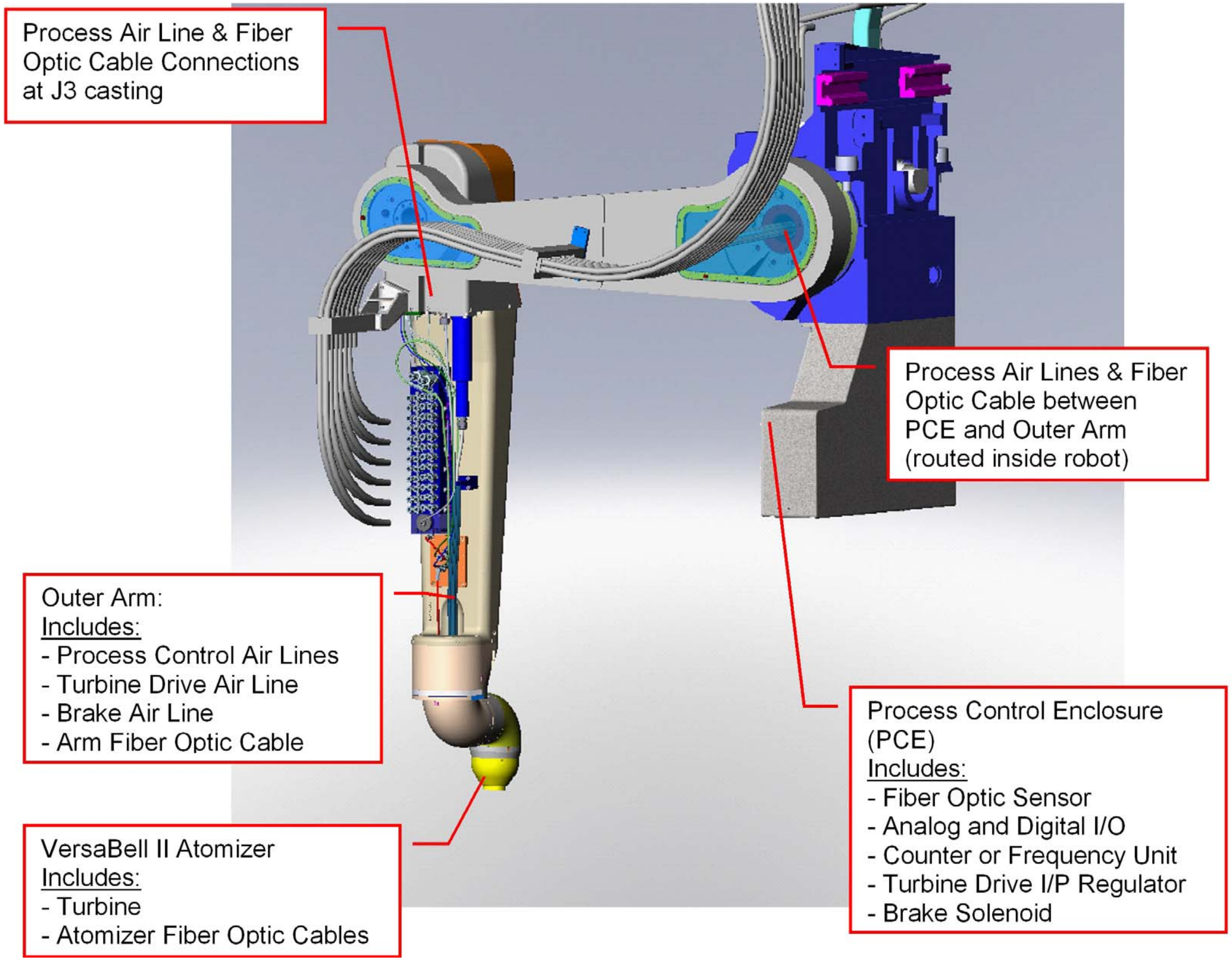


Figure 3-3: P-500iA 1k Arm with VersaBell II Applicator – Bell Speed Control Components Overview

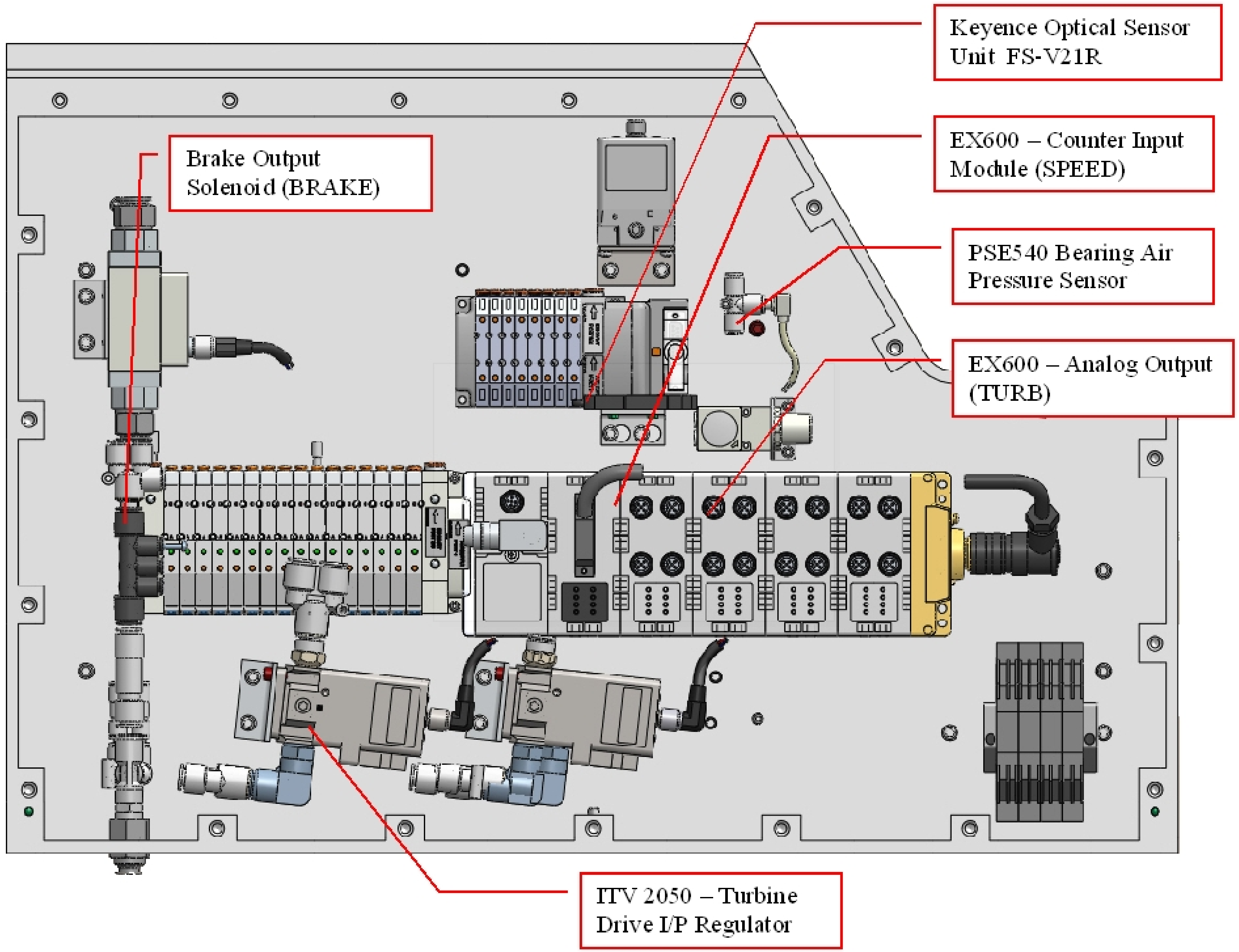


Figure 3-4: P-500iA Process Control Enclosure with Air Flowemeter – Bell Speed Control Components

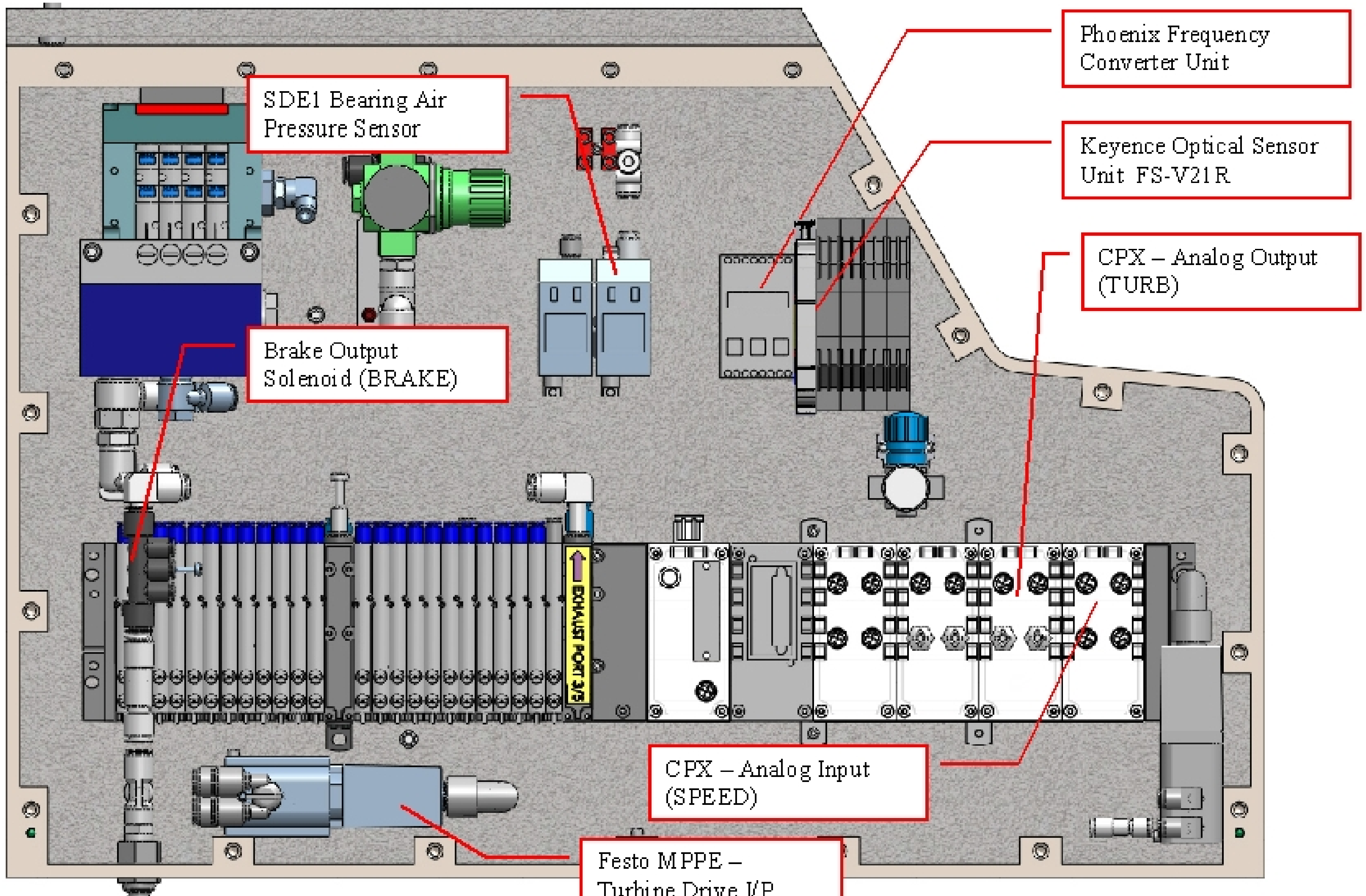


Figure 3-5: P-500iA D/Q Process Control Enclosure – Bell Speed Control Components

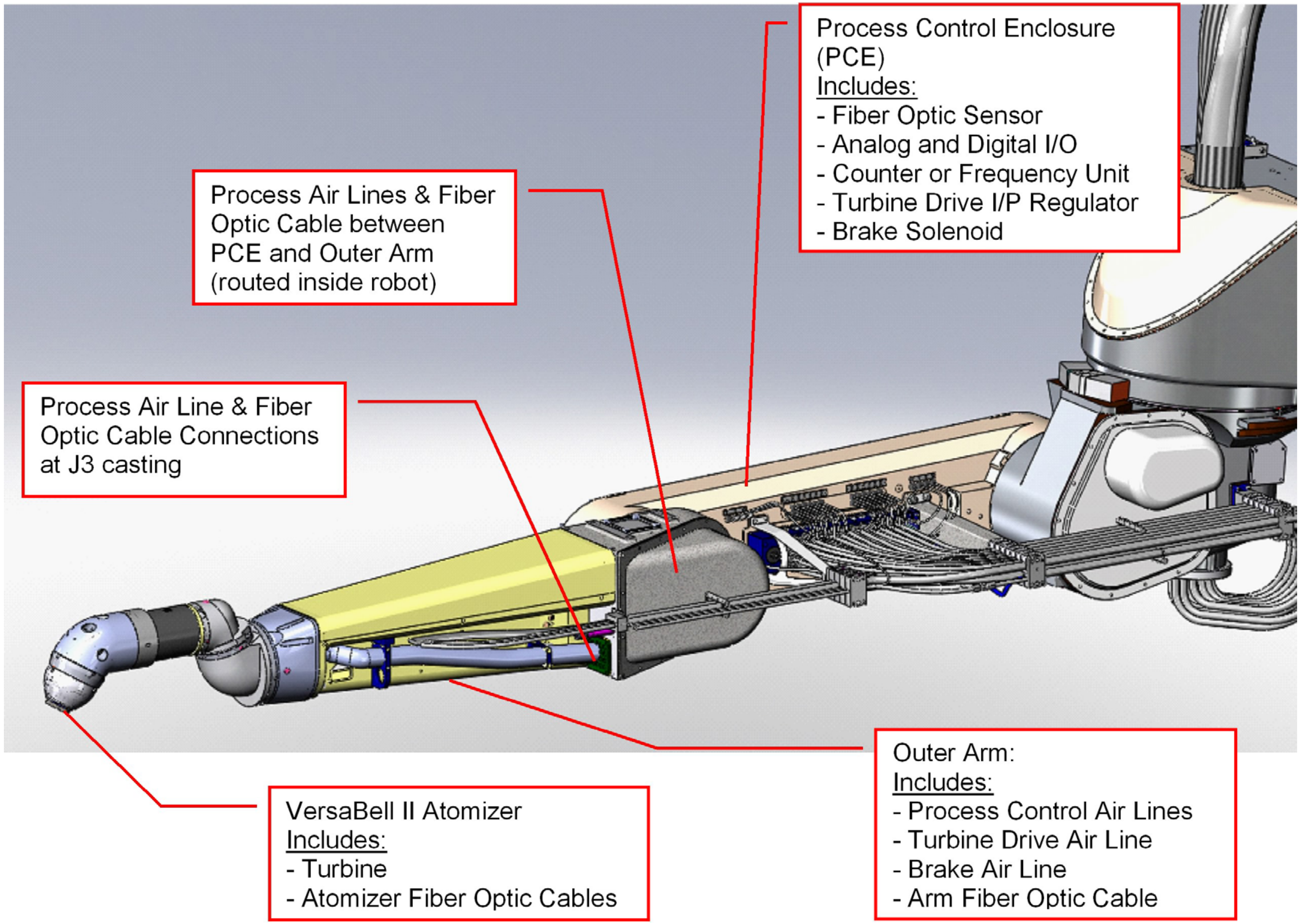


Figure 3-6: P-700iA 1k Arm with VersaBell II Applicator – Bell Speed Control Components Overview

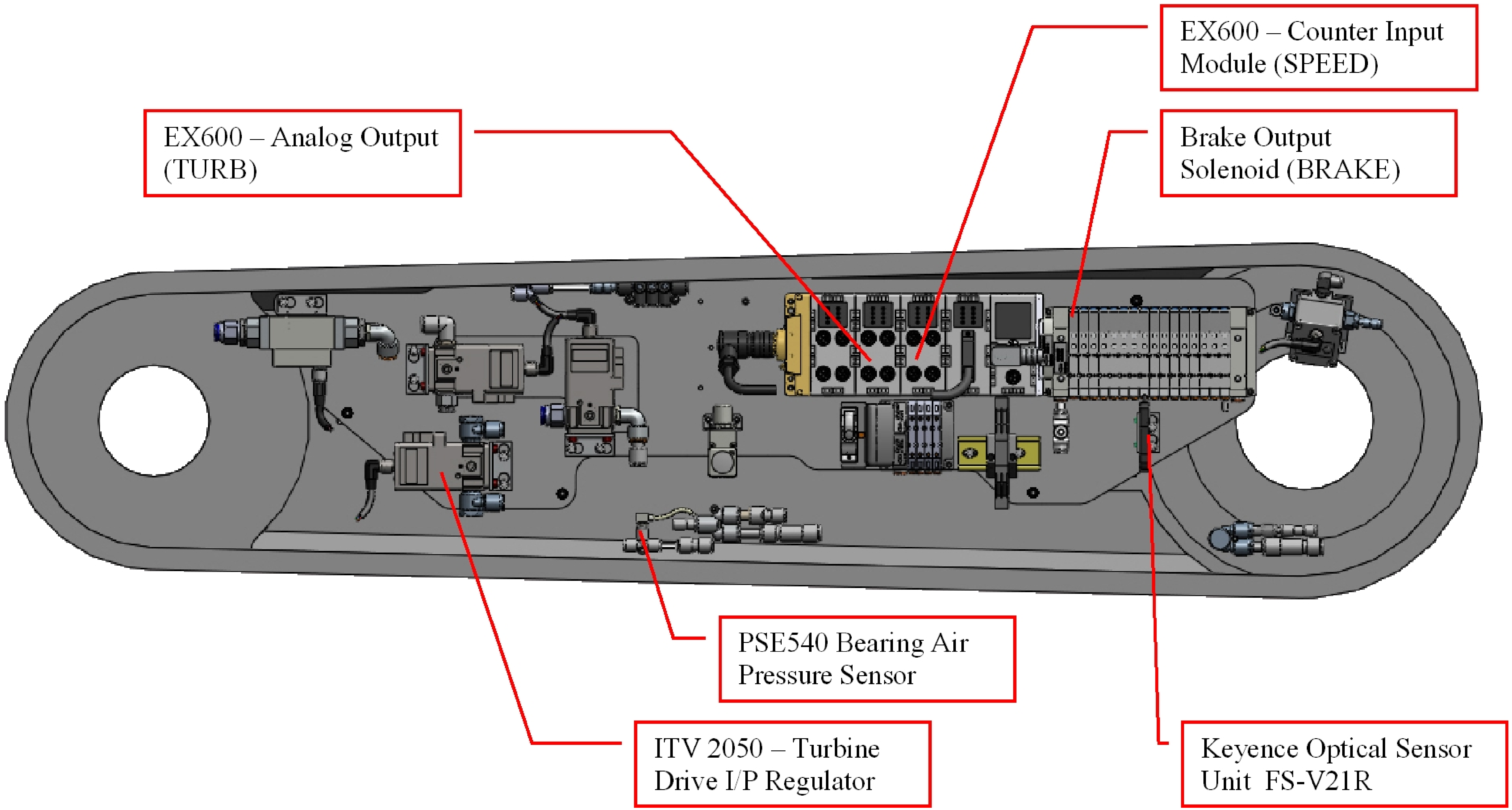


Figure 3-7: P-700iA Process Control Enclosure with Air Flowmeter – Bell Speed Control Components

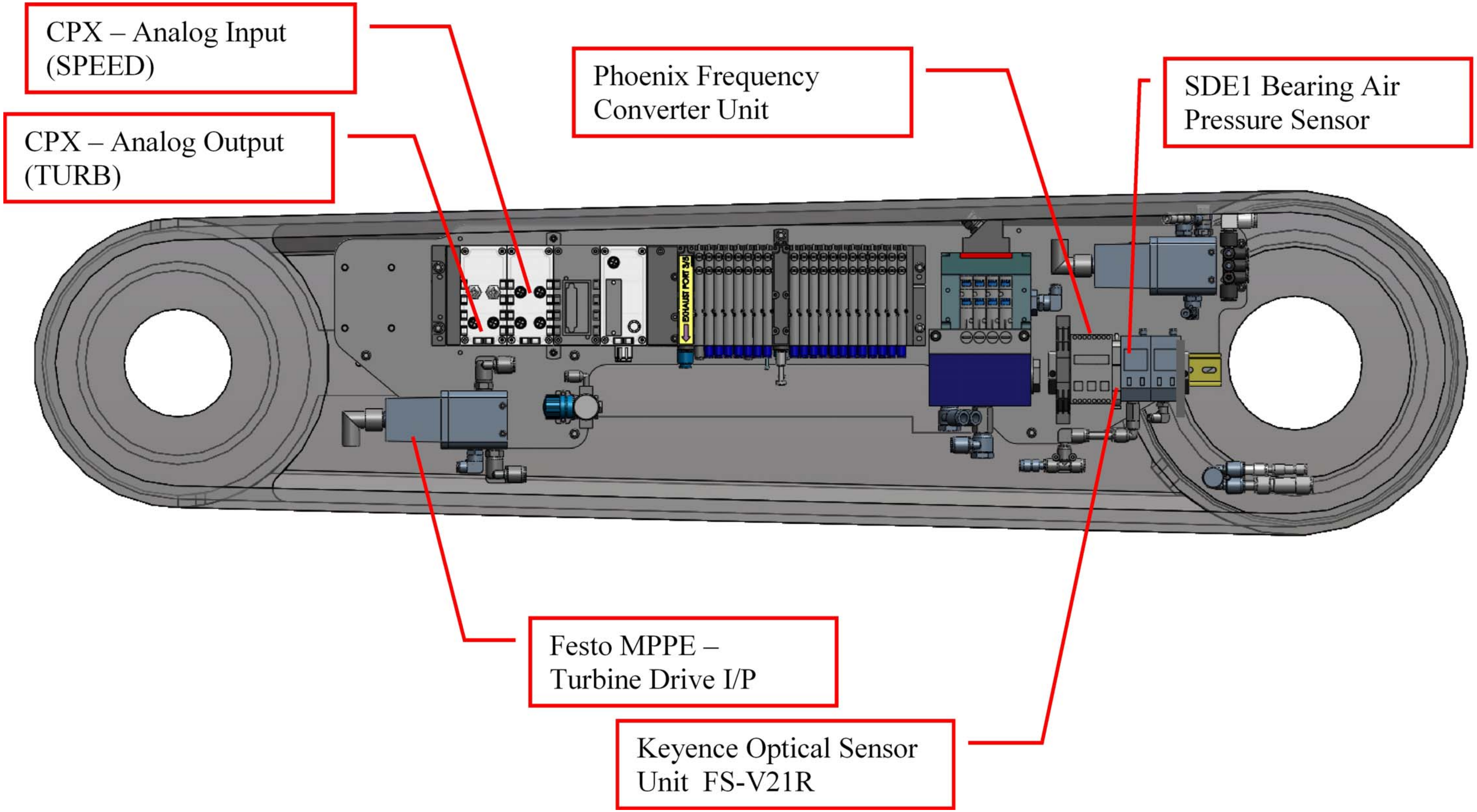


Figure 3-8: P-700iA D/Q Process Control Enclosure – Bell Speed Control Components

3.2 Operation and Setup

The following sections describe the installation of the components of the Bell Speed Control System and any software setup that is required for this system.

3.2.1 Pressure Regulator (I/P)

The I/P (analog input to pressure) is an electronically controlled pressure regulator that is used to control the turbine drive air. The Pneumatic Control System receives the command signal from the PaintTool application in the robot controller and transmits this signal to the I/P. The I/P adjusts the turbine drive air pressure according to the command. The pressure is increased in order to increase turbine speed or in response to increased load. The pressure is decreased in order to decrease turbine speed or in response to decreased load.

3.2.1.1 Installation

The I/P is mounted by two 4mm screws that attach to a mounting plate through holes in the body of the device.

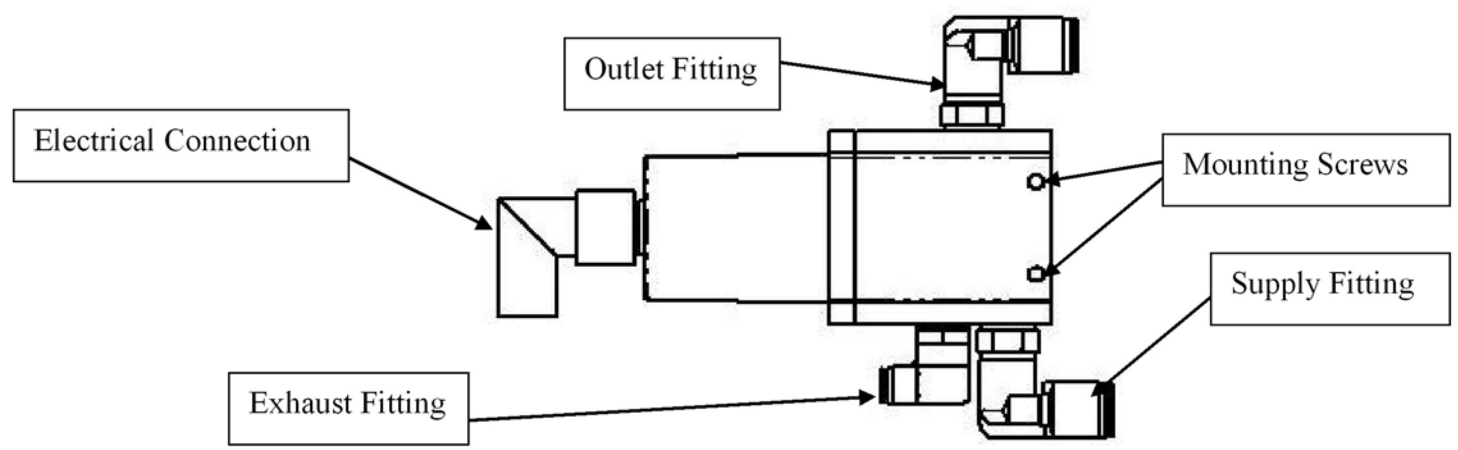


Figure 3-9: MPPE - Turbine Drive I/P

The electrical cable connects the I/P to an analog output on the Pneumatic Control System. The turbine supply hoses connect to the supply fitting and deliver air from the air supply manifold. The turbine drive hoses connect to the outlet fitting and regulated air to the turbine drive at the applicator. The exhaust hose connects to the exhaust fitting, and directs the I/P exhaust to the exhaust manifold.

The I/P requires no other setup.

3.2.2 Fiber Optic Sensor (O/E)

The O/E (optical to electrical convertor) emits a light beam to one element of the fiber optic cable. The light is reflected off of an indicator wheel in the turbine that has alternating reflective and non-reflective sections. The reflected light is transmitted back up the other element of the fiber optic cable to the receiver in the O/E. The O/E then converts the reflected light pulse to an electrical voltage pulse and outputs this chain of pulses to the Frequency Converter

(F/I). The O/E display shows current value (CV) of the received light intensity in red (0-4095) and the preset valve (PV) in green.

3.2.2.1 Installation

The O/E is mounted to a DIN rail by a snap-on connector. To install the O/E hook the fixed side of the device over the lip of the DIN rail and push the end in the direction of arrow 2 until a snapping sound indicates the connector is engaged. To remove the O/E from the rail, push the device in the direction of arrow 1 and then pull off the rail in the direction of arrow 3.

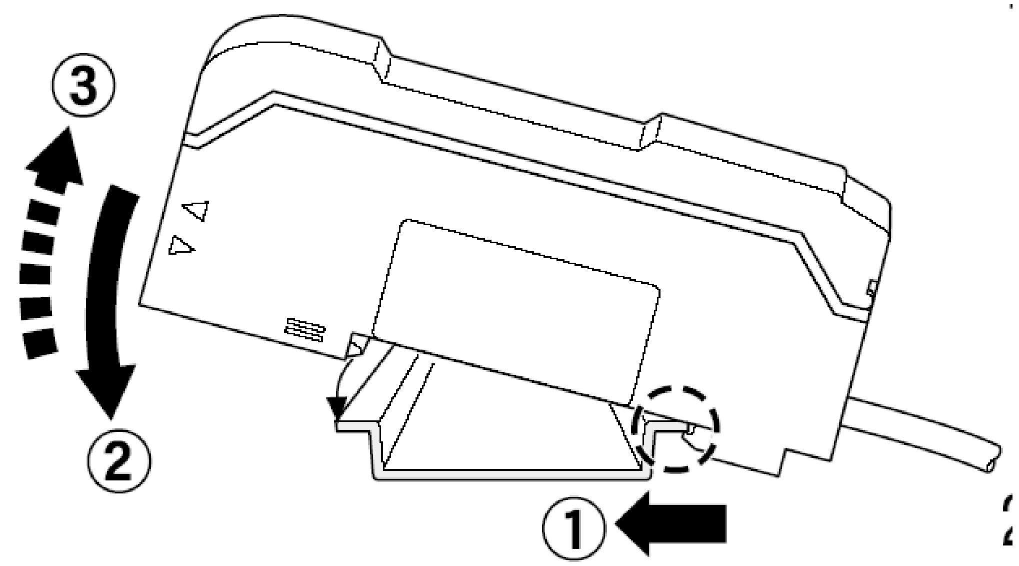


Figure 3-10: O/E Installation

Install the optical fibers as shown below. Open the dust cover in the direction of arrow 1. Move the fiber lock lever in the direction of arrow 2. Ensure that the ends of the optical fibers are free of dust and debris. Insert an optical fiber into each of the insertion holes to the depth of the fiber insertion sign on the side of the device (approximately 14mm). Return the fiber lock lever to its original position by moving it in the direction of arrow 4.

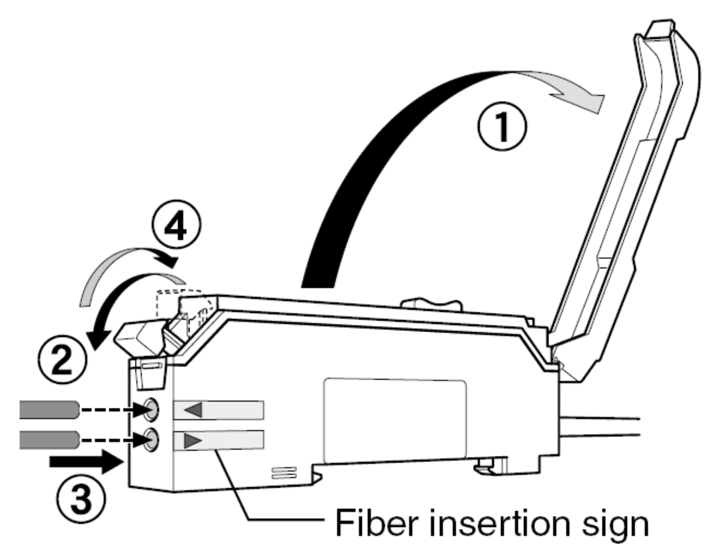


Figure 3-11: Optical Fiber Insertion

The electrical connection to the O/E is permanently attached to the device. Terminate the ends of this cable in the Frequency Converter (F/I) as indicated by the electrical schematic. For process I/O systems that in clued an air flowmeter, the Keyence sensor is connected directly to a frequency counter input that is part of the EX600 process I/O rack.

3.2.2.2 Setup

The O/E has a number of functional modes. The procedures below are used to setup the proper mode for use in the Bell Speed Control System. These procedures are performed during assembly at FRA and are only required if the O/E is replaced.

3.2.2.3 Preset Valve Programming

The O/E requires calibration to establish the levels of light and dark regions on the indicator in the turbine. Level Calibration is set during assembly and should only be necessary if the O/E is replaced. To set the Level Calibration, open the dust cover as shown in Figure X. Change the Preset Value (PV) to **1400** by pressing the manual button in the direction indicated to increase or decrease the value displayed in green.

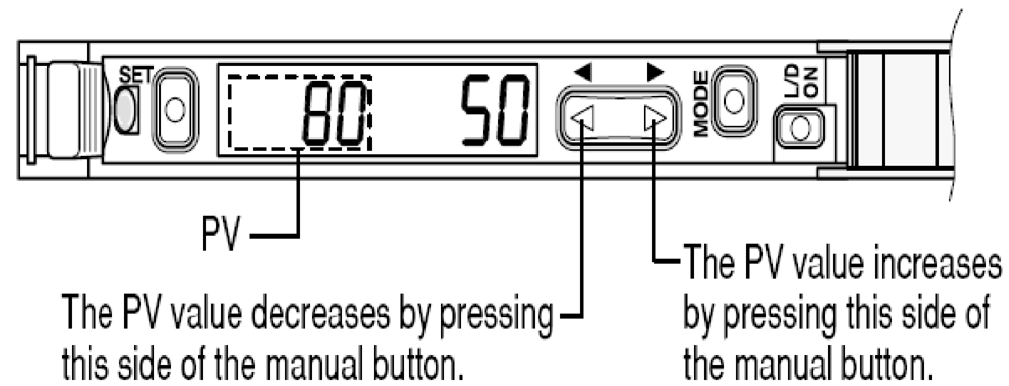


Figure 3-12: O/E Level Setting

Mode Selection

The O/F should be set to the following settings for use in the Bell Speed Control System:

- Access mode: easy
- Power mode: fine
- Timer function: toff

These parameters are set during assembly. If they are inadvertently changed to then they can be restored with the following procedure.

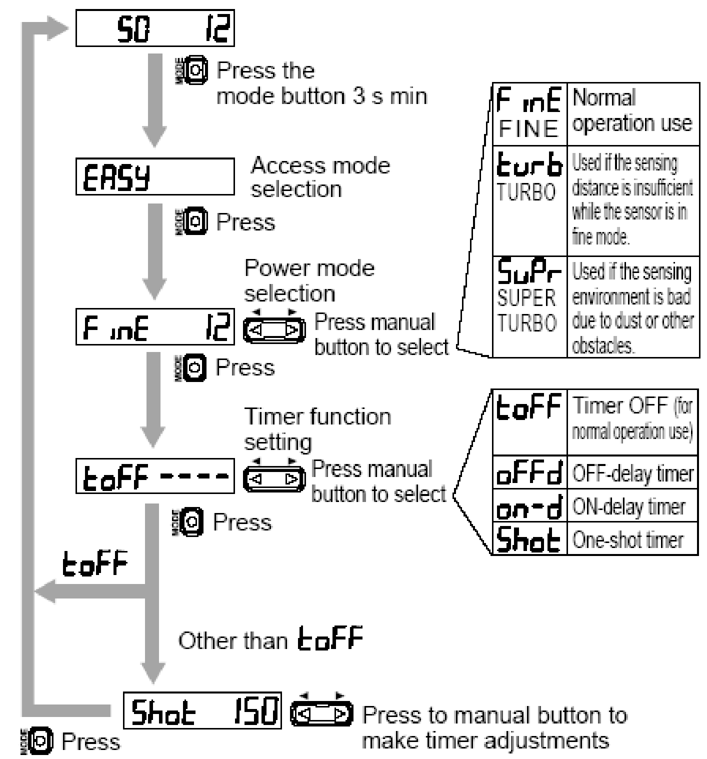


Figure 3-13: O/E Mode selection

Press the mode button for at least 3 seconds then use the manual button to select ‘easy mode’. Press the mode button again and then use the manual button to select ‘fine’. Press the mode button again and then use the manual button to select ‘toff’. Press the mode button again to exit the mode selection menu.

Key Lock

The function keys on the front of the O/E can be locked so that accidental inputs do not change settings. To lock the function keys, simultaneously press the mode and manual buttons for at least 3 seconds. The display will read ‘Loc’ when the keys have been locked. To unlock the keys simultaneously press the mode and manual buttons for 3 seconds again.

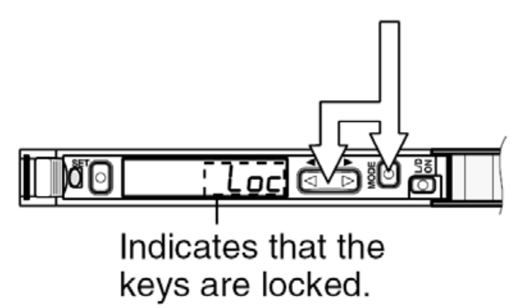


Figure 3-14: O/E key lock display

3.2.3 Frequency Converter (F/I)

The F/I device measures the frequency of the pulse chain from the F/I and converts it into an analog signal that reports the turbine speed to the control system. For a CPX based configuration, the F/I is a standalone unit that converts a frequency based signal from the O/E to a 4-20 mA signal. For EX600 based systems, there is no need for a F/I device, as the EX600 has an counter input module that accepts the O/E electrical pulses and converts them to a frequency count reading that is transmitted over the Ethernet/IP connection to the robot controller.

3.2.3.1 Installation

The F/I is mounted to a DIN rail by a snap-on connector. To install the F/I, hook the top of the device over the lip of the DIN rail and push the device in the direction of arrow 1 (shown in the figure below) until a snapping sound indicates the connector is engaged. To remove the F/I from the rail, insert a screwdriver into the silver slot on the bottom of the device, near the DIN rail. Tip the device in the direction of arrow 2 and pull it off of the rail.

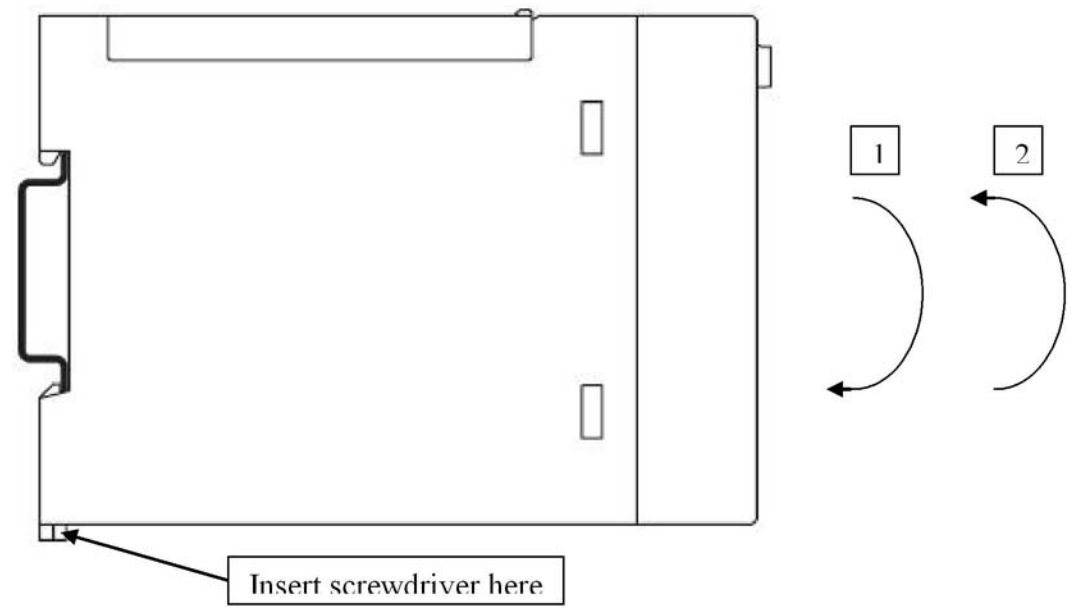


Figure 3-15: F/I – side view

If replacing an existing F/I, the terminal strips can be disconnected from the body of the device and then reattached to the replacement part. This allows the user to replace the F/I without having to disconnect and reconnect each lead in the cables. To disconnect a terminal strip, insert a small screwdriver in the notch shown in figure below, and pry the terminal strip out.

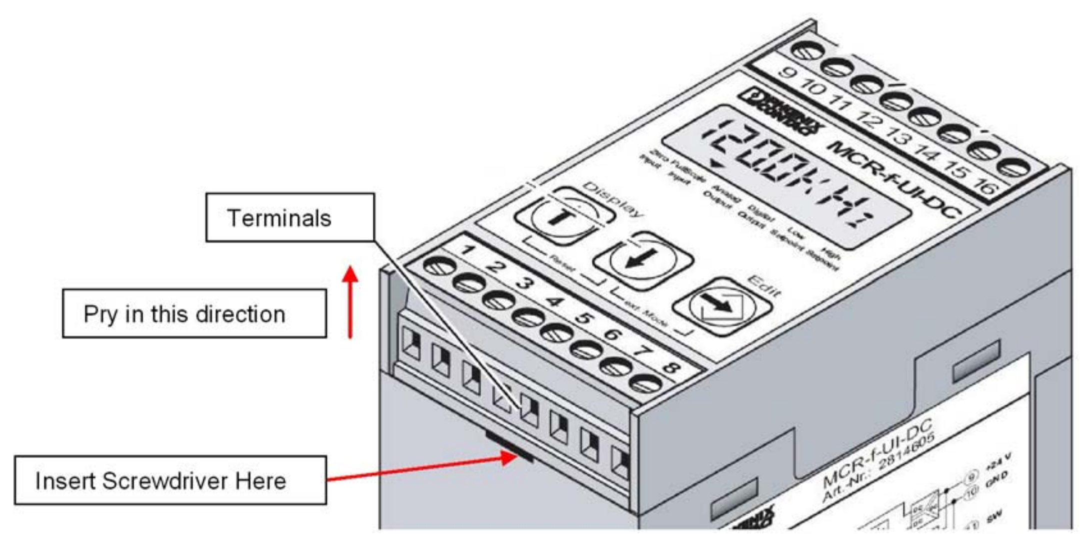


Figure 3-16: F/I Terminal Connections

See the product specific process equipment manual for the proper termination of cables at the F/I. Insert the leads of the cables in the terminals as shown and secure by tightening the screw with a small flat-head screwdriver.

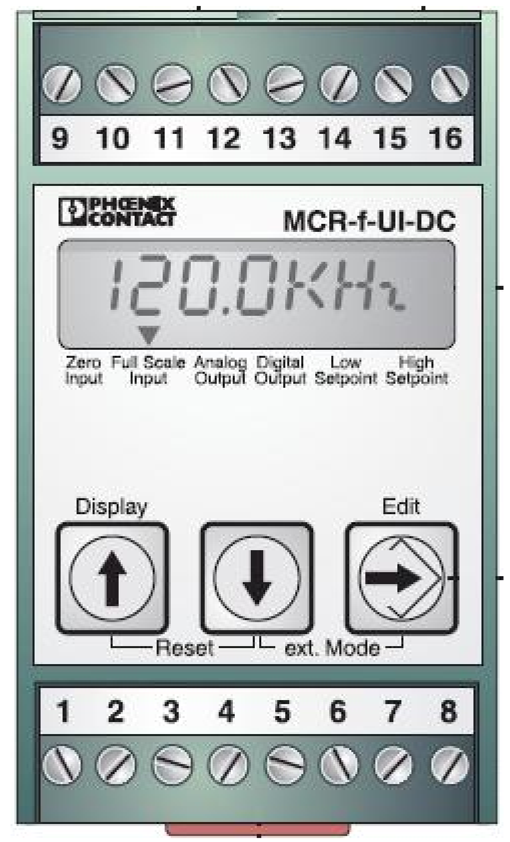


Figure 3-17: F/I Faceplate

The F/I comes pre-programmed for the bell speed control system. If settings have been accidentally changes, see EG-00305 for instruction on reprogramming the F/I.

3.2.4 Turbine

Refer to the Applicator Poster for information on the Turbine.

3.2.5 Fiber Optic Cable

The Fiber Optic Cable between the O/E and the indicator wheel on the turbine is split into three sections.

- Refer to robot manual for the specific process equipment manual for information on the section that attaches to the O/E.
- Refer to robot manual for specific applicator hose bundle for information on the section that connects the Applicator to the terminal in the FRP.
- Refer to applicator poster for information on the section that passes through the Applicator to the Turbine.

3.2.6 Software Setup

The bell speeds that are used while processing a job are commanded by entering the requested values as entries in System Color Preset table data. Bell speed commands during color change are entered as parameters in Color Change Presets. The PaintTool software application in the robot control system sends these commands to the Bell Speed Control System.

Setting Cruise Speed
The cruise speed is the commanded bell speed when the robot is not processing a job or is idle. The cruise speed is typically 30,000 RPM.

3.3 Troubleshooting

This section provides troubleshooting guidelines for faults generated by the Bell Speed Control System. This section is organized by PaintTool fault number (note that PNT1 faults are documented here, but PNT2 faults with the same fault name would have the same troubleshooting procedure.). PNT1 faults generally reference robot equipment 1 and 2 (eq1,andeq2) . PNT2 faults generally reference equipment 3 through 6 Each bell speed fault has its PaintTool manual description and remedy. The most common faults are then followed by a "Troubleshooting procedure" which offers instruction on steps to take to isolate the malfunction.

3.3.1 PNT1-701 PAUS %sMax. output has speed < setpoint

Cause: With a maximum control output the speed was measured to be lower than the setpoint (requested speed). This can occur if:

1. The gun is clogged.
2. The turbine air or turbine pilot air line is pinched.
3. The turbine air pressure is too low.

Remedy: Check the turbine lines for pinching, especially at places where they flex. Check the turbine air supply pressure. Check and replace the I/P transducer, if necessary.

Troubleshooting procedure:

1. Verify process air supply pressure is 85 to 87 psi (5.8 to 6.0 Bar). If pressure is out of range, correct and test turbine. If pressure is in range then continue troubleshooting.
2. Verify bearing air supply pressure is at least 75 psi (5.1 bar). If pressure is below 75 psi, correct and test turbine. If pressure is correct then continue troubleshooting.
3. First, verify bearing air is turned on then check turbine. If spindle won't turn easily by hand then replace turbine.
4. If spindle turns, then

a. Replace turbine with a part that is known to be good.

b. Command replacement turbine at speeds up to set point. If each speed is met with no alarms, then replace turbine.
c. If PNT1-701 alarm reoccurs, then check turbine air lines for kink or other issues.
d. If no issues with hose, perform Keyence optical feedback test.
e. If either maximum value is less than 2000 then perform Bell speed feedback troubleshooting.
f. If both maximums are 2000 or greater, then replace I/P Transducer (in PCE).The original turbine may be returned to the applicator.

3.3.2 PNT1-702 WARN %sRequested speed over valid range

Cause: The requested turbine speed output command is above the range that is considered valid Adjust the turbine speed command that is used in the preset table so it is within an acceptable range.

Remedy: N/A

3.3.3 PNT1-703 WARN %sFailed to reach setpoint

Cause: The turbine speed failed to come within the Tolerance Band setting within the time setting of Min. set point reached (ms) value. This can be caused by noise in the speed sensor signals, low air supply pressure or other failures. This may occur with the alarm Max. output has speed < setpoint . If the Max. output has speed < setpoint alarm is also in the alarm log follow the remedies for that alarm. Examine the displayed turbine speed and evaluate if it is bouncing a lot. If so decrease the PID gains. Possibly increase the Tolerance Band parameter by about 30% to 50%, for example from 1.8% to 2.3%. Increase the Min. set point reached value by about 30% to 50%.

Remedy: N/A

Troubleshooting procedure:

1. Verify process air supply pressure is 85 to 87 psi (5.8 to 6.0 Bar). If pressure is out of range, correct and test turbine. If pressure is in range then continue troubleshooting.
2. Verify bearing air supply pressure is at least 75 psi (5.1 bar). If pressure is below 75 psi, correct and test turbine. If pressure is correct then continue troubleshooting.
3. Check bell speed setup parameters:
   a. On teach pendant, choose SETUP menu for BELL SPEED
   b. The SET POINT REACHED TOLERANCE (%) value is near the bottom of the list. The default is 3. If the actual value is less than 3, change the value to 3 and re-test bell speed.
4. IF PNT1-703 alarm reoccurs then continue troubleshooting.
5. First, verify bearing air is turned on then check turbine. If spindle won't turn easily by hand then replace turbine.
6. If spindle turns, then check bell speed fiber optic circuit as follows:
   a. Perform Keyence optical feedback test and Bell speed feedback troubleshooting (if necessary).
   b. If both maximum values are greater than 2000, then
      - Run a ghost job and collect bell speed DMON data, and send the data to FRA for analysis.
      - Replace the turbine

3.3.4 PNT1-704 PAUS %sZero turbine speed timeout

Cause: All of the conditions were set for the turbine to be spinning but a zero speed was measured for a set time period. This might be due to no turbine air pressure or pilot air pressure. One of the following items might be broken: the I/P transducer, speed sensor pickup, speed sensor interface. The Zero speed timeout might be set too short.

Remedy: If the turbine can be seen spinning, check the following: the speed sensor interface and speed sensor pickup. Otherwise, check the other items listed above. Possibly increase the Zero speed timeout by about 50%.

Troubleshooting procedure:

1. Observe the bell. If it is spinning during the alarm then:
   a. Check bell speed setup parameters:
      - On teach pendant, choose SETUP menu for BELL SPEED
      - The ZERO SPEED TIMEOUT (ms) value is near the bottom of the list. The default is 3000 (3000 ms = 3 seconds). If the actual value is less than 3000, change the value to 3000 and re-test bell speed.
2. If PNT1-704 re-occurs then there is a feedback issue
      - Perform the Keyence optical feedback test.
      - Perform the Bell speed feedback troubleshooting procedure.
   b. If the bell is not spinning

3. If the bell is not spinning
   a. Verify process air supply pressure is 85 to 87 psi (5.8 to 6.0 Bar). If pressure is out of range, correct and test turbine. If pressure is in range then continue troubleshooting.
   b. Verify bearing air supply pressure is at least 75 psi (5.1 bar). If pressure is below 75 psi, correct and test turbine. If pressure is correct then continue troubleshooting.

4. Verify bearing air is turned on then check turbine. If spindle won't turn easily by hand then replace turbine.

5. If spindle turns, then verify connections to turbine drive I/P transducer (in PCE):
   a. Verify electrical cable is connected properly.
   b. Verify air connections are plumbed properly.

6. If no issues are found with the connections of the I/P transducer, then replace the I/P transducer.

3.3.5 PNT1-705 PAUS %sTurbine over speed

Cause: While the turbine was operating the RPM level was above the Over speed limit . When this error occurs, braking will be applied to bring the turbine speed to within the acceptable operating range. Check and replace the I/P transducer if necessary. Possibly increase the Over speed limit value.

Remedy: N/A

Troubleshooting procedure:

1. Check bell speed setup parameters:
   a. On teach pendant, choose SETUP menu for BELL SPEED
   b. The MAXIMUM SPEED (krpm) default value is 65. If the actual value is less than 65, change the value to 65 and re-test bell speed.

2. If the fault continues with MAXIMUM SPEED set to 65, then reset the I/P transducer:
   a. Put the controller in TEACH Mode.
   b. Cycle power on the controller.

3. If the fault continues to occur then perform the Keyence optical feedback test
   a. If either maximum value from the Keyence optical feedback test is less than 2000, then perform the Bell speed feedback troubleshooting procedure.
   b. If both maximum values are above 2000, then replace the turbine drive I/P transducer.

3.3.6 PNT1-706 WARN %sTurbine under speed fault

Cause: While the turbine was operating and the gun was on or enabled, the RPM level was below the Under speed limit . Check and replace the I/P transducer if necessary. Check the supply and pilot air pressures, if either one is low, increase it. Possibly decrease the Under speed limit value.

Remedy: N/A

Troubleshooting procedure:

1. Check bell speed setup parameters:
    a. On teach pendant, choose SETUP menu for BELL SPEED
    b. The AUTO UNDER SPEED LIMIT (krpm) should be set to 0.
    c. The MANUAL UNDER SPEED LIMIT (krpm) should be set to 0.
    d. Correct the parameter values.

3.3.7 PNT1-707 WARN %sTurbine under speed warning

Cause: While the gun was off or disabled and the turbine was operating the RPM level was below the Under speed limit, Manual . Check and replace the I/P transducer if necessary. Check the supply and pilot air pressures, if either one is low, increase it. Possibly decrease the Under speed limit, Manual value.

Remedy: N/A

Troubleshooting procedure:

1. Check bell speed setup parameters:
    a. On teach pendant, choose SETUP menu for BELL SPEED
    b. The AUTO UNDER SPEED LIMIT (krpm) should be set to 0.
    c. The MANUAL UNDER SPEED LIMIT (krpm) should be set to 0.
    d. Correct the parameter values.

3.3.8 PNT1-708 WARN %sSpeed avg. error excessive

Cause: Checks for how far the speed is from the set point have been too high. Possible causes are:

- A sticking I/P transducer
- Low supply air pressure
- Low pilot air pressure
- PID Gains that are too large.

Remedy: Check and replace the I/P transducer if necessary. Check the supply and pilot air pressures. If either one is low, increase it. Possibly decrease the Max. error from setpoint parameter.

3.3.9 PNT1-709 PAUS %sBearing Air NOT OK

Cause: The digital input signal indicating the Bear Air is above the minimum pressure is not ON. Check the supply pressure to the Bearing Air or verify the digital input signal is working correctly.

Remedy: N/A

Troubleshooting

1. Verify bearing air supply pressure is at least 75 psi (5.1 bar). If pressure is below 75 psi, correct. If pressure is correct then continue troubleshooting.
2. Use a gage that is known to be good and verify the pressure reading of the bearing air sensor. Replace the bearing air sensor if its reading is incorrect.

3.3.10 PNT1-710 WARN %sCruise Speed not established

Cause: The Cruise Speed determined during the Bell Speed Startup Test could not be established.

Remedy: Redo the Bell Speed Startup Test to determine a new Cruise Speed, or check the turbine or regulator.

3.3.11 PNT1-716 WARN %sTurbine Startup Test Not Complete

Cause: The Bell Speed Control Startup Test for the turbine is not complete. This test must be performed before running the turbine.

Remedy: Check the Start Mode field on the Bell Speed SETUP menu to check the status of the Startup Test. If it has not been performed, run the Bell Speed Control Startup Test.

3.3.12 PNT1-717 PAUS %sMax.dV/dT detected

Cause: A velocity change within a measured time has exceeded the maximum dV/dT setting for this turbine.

Remedy: Check the hardware to determine if the feedback signal from the turbine is consistent.

3.3.13 PNT1-718 PAUS %sMax. output has speed < setpoint

Cause: With a maximum control output the speed was measured to be lower than the setpoint (requested speed). The gun might be clogging. The turbine air or turbine pilot air line might be pinched. The turbine air pressure might have become too low.

Remedy: Check the turbine lines for pinching, especially at places where they flex. Check the turbine air supply pressure. Check and replace the I/P transducer if necessary.

Troubleshooting procedure:

1. Verify process air supply pressure is 85 to 87 psi (5.8 to 6.0 Bar). If pressure is out of range, correct and test turbine. If pressure is in range then continue troubleshooting.

2. Verify bearing air supply pressure is at least 75 psi (5.1 bar). If pressure is below 75 psi, correct and test turbine. If pressure is correct then continue troubleshooting.

3. First, verify bearing air is turned on then check turbine. If spindle won't turn easily by hand then replace turbine.

4. If spindle turns, then
    a. Replace turbine with a part that is known to be good.
    b. Command replacement turbine at speeds up to set point. If each speed is met with no alarms, then replace turbine.
    c. If PNT1-718 alarm reoccurs, then check turbine air lines for kink or other issues.
    d. If no issues with hose, perform Keyence optical feedback test.
    e. If either maximum value is less than 2000 then perform Bell speed feedback troubleshooting.
    f. If both maximums are 2000 or greater, then replace I/P Transducer (in PCE).The original turbine may be returned to the applicator.

3.3.14 PNT1-719 WARN %sRequested speed over valid range

Cause: The requested turbine speed output command is above the range that is considered valid Adjust the turbine speed command that is used in the preset table so it is within an acceptable range.

Remedy: N/A

3.3.15 PNT1-720 WARN %sFailed to reach setpoint

Cause: The turbine speed failed to come within the Tolerance Band setting within the time setting of Min. set point reached (ms) value. This can be caused by noise in the speed sensor signals, low air supply pressure or other failures. This might occur with the Max. output has speed < setpoint alarm.

Remedy: If the Max. output has speed < setpoint alarm is also in the alarm log, follow the remedies for that alarm. Examine the displayed turbine speed and evaluate if it is bouncing a lot. If so, decrease the PID gains. Possibly increase the Tolerance Band parameter by about 30% to 50%, for example from 1.8% to 2.3%. Increase the Min. set point reached value by about 30% to 50%.

Troubleshooting procedure:

1. Verify process air supply pressure is 85 to 87 psi (5.8 to 6.0 Bar). If pressure is out of range, correct and test turbine. If pressure is in range then continue troubleshooting.

2. Verify bearing air supply pressure is at least 75 psi (5.1 bar). If pressure is below 75 psi, correct and test turbine. If pressure is correct then continue troubleshooting.

3. Check bell speed setup parameters:
    a. On teach pendant, choose SETUP menu for BELL SPEED

b. The SET POINT REACHED TOLERANCE (%) value is near the bottom of the list. The default is 3. If the actual value is less than 3, change the value to 3 and re-test bell speed.

4. IF PNT1-720 alarm reoccurs then continue troubleshooting.

5. First, verify bearing air is turned on then check turbine. If spindle won't turn easily by hand then replace turbine.

6. If spindle turns, then check bell speed fiber optic circuit as follows:
   a. Perform Keyence optical feedback test and Bell speed feedback troubleshooting (if necessary).
   b. If both maximum values are greater than 2000, then:
      - Run a ghost job and collect bell speed DMON data, and send the data to FRA for analysis.
      - Replace the turbine

3.3.16 PNT1-721 PAUS %sZero turbine speed timeout

Cause: All of the conditions were set for turbine to be spinning and a zero speed was measured for a set time period. This may be due to no turbine air pressure or pilot air pressure. One of the following items may be broken: the I/P transducer, speed sensor pickup, speed sensor interface. The Zero speed timeout may be set too short. If turbine can be seen spinning, check: speed sensor interface, speed sensor pickup. Otherwise check the other items listed above. Possibly iwncrease the Zero speed timeout by about 50%.

Remedy: N/A

Troubleshooting procedure:
1. Observe the bell. If it is spinning during the alarm then:
   a. Check bell speed setup parameters:
      - On teach pendant, choose SETUP menu for BELL SPEED
      - The ZERO SPEED TIMEOUT (ms) value is near the bottom of the list. The default is 3000 (3000 ms = 3 seconds). If the actual value is less than 3000, change the value to 3000 and re-test bell speed.
   b. If PNT1-721 re-occurs then there is a feedback issue:
      - Perform the Keyence optical feedback test.
      - Perform the Bell speed feedback troubleshooting procedure.

2. If the bell is not spinning:
   a. Verify process air supply pressure is 85 to 87 psi (5.8 to 6.0 Bar). If pressure is out of range, correct and test turbine. If pressure is in range then continue troubleshooting.
   b. Verify bearing air supply pressure is at least 75 psi (5.1 bar). If pressure is below 75 psi, correct and test turbine. If pressure is correct then continue troubleshooting.

3. Verify bearing air is turned on then check turbine. If spindle won't turn easily by hand then replace turbine

4. If spindle turns, then verify connections to turbine drive I/P transducer (in PCE):
      - Verify electrical cable is connected properly.
      - Verify air connections are plumbed properly.

5. If no issues are found with the connections of the I/P transducer, then replace the I/P transducer.

3.3.17 PNT1-722 PAUS %sTurbine over speed

Cause: While the turbine was operating the RPM level was above the Over speed limit . When this error occurs, braking will be applied to bring the turbine speed to within the acceptable operating range. Check and replace the I/P transducer if necessary. Possibly increase the Over speed limit value.

Remedy: N/A

Troubleshooting procedure:

1. Check bell speed setup parameters:
   a. On teach pendant, choose SETUP menu for BELL SPEED
   b. The MAXIMUM SPEED (krpm) default value is 65. If the actual value is less than 65, change the value to 65 and re-test bell speed.

2. If the fault continues with MAXIMUM SPEED set to 65, then reset the I/P transducer:
   a. Put the controller in TEACH Mode.
   b. Cycle power on the controller.

3. If the fault continues to occur then
   a. perform the Keyence optical feedback test
      - If either maximum value from the Keyence optical feedback test is less than 2000, then perform the Bell speed feedback troubleshooting procedure.
      - If both maximum values are above 2000, then replace the turbine drive I/P transducer.

3.3.18 PNT1-723 WARN %sTurbine under speed fault

Cause: While the turbine was operating and the gun was on or enabled, the RPM level was below the Under speed limit . Check and replace the I/P transducer if necessary. Check the supply and pilot air pressures, if either one is low, increase it. Possibly decrease the Under speed limit value.

Remedy: N/A

Troubleshooting procedure:

1. Check bell speed setup parameters:
   a. On teach pendant, choose SETUP menu for BELL SPEED
   b. The AUTO UNDER SPEED LIMIT (krpm) should be set to 0.
   c. The MANUAL UNDER SPEED LIMIT (krpm) should be set to 0.
   d. Correct the parameter values

3.3.19 PNT1-724 WARN %sTurbine under speed warning

Cause: While the gun was off or disabled and the turbine was operating the RPM level was below the Under speed limit, Manual . Check and replace the I/P transducer if necessary. Check the supply and pilot air pressures, if either one is low, increase it. Possibly decrease the Under speed limit, Manual value.

Remedy: N/A

Troubleshooting procedure:

1. Check bell speed setup parameters:
    a. On teach pendant, choose SETUP menu for BELL SPEED
    b. The AUTO UNDER SPEED LIMIT (krpm) should be set to 0.
    c. The MANUAL UNDER SPEED LIMIT (krpm) should be set to 0.
    d. Correct the parameter values

3.3.20 PNT1-725 WARN %sSpeed avg. error excessive

Cause: Checks for how far the speed is from the set point have been too high. Possible causes are:

- A sticking I/P transducer
- Low supply air pressure
- Low pilot air pressure
- PID Gains that are too large.

Remedy: Check and replace the I/P transducer if necessary. Check the supply and pilot air pressures. If either value is low, increase it. Possibly decrease the Max. error from setpoint parameter.

3.3.21 PNT1-726 PAUS %sBearing Air NOT OK

Cause: The digital input signal indicating the Bear Air is above the minimum pressure is not ON. Check the supply pressure to the Bearing Air or verify the digital input signal is working correctly.

Remedy: N/A

Troubleshooting

1. Verify bearing air supply pressure is at least 75 psi (5.1 bar). If pressure is below 75 psi, correct. If pressure is correct then continue troubleshooting.
2. Use a gage that is known to be good and verify the pressure reading of the bearing air sensor. Replace the bearing air sensor if its reading is incorrect.

3.3.22 PNT1-727 WARN %sCruise Speed not established

Cause: The Cruise Speed determined during the Bell Speed Startup Test could not be established.

Remedy: Redo the Bell Speed Startup Test to determine a new Cruise Speed, or check the turbine or regulator.

3.4 Troubleshooting Procedure

3.4.1 Keyence optical feedback test:

This test will evaluate the strength of the optical signal used to control the bell speed. The Keyence fiber optic sensor sends and receives an optical signal that is reflected off a spinning surface in the applicator turbine. The strength of the reflected signal is displayed in a digital readout on the fiber optic sensor the maximum value is 4095. At FANUC robotics, systems are verified to read between 3850 and 4095 under ideal conditions. When values of the signal reflected from the mirror are below 2000, the fiber optic system should be repaired.

1. The Keyence fiber optic sensor is visible thru window in PCE.
2. The Keyence Fiber-optic unit displays two numbers. The green number is the signal threshold (factory setting = 1400) and the red number is the signal value.
3. While slowly turning the bell cup by hand observe the signal value (red number on the Fiber-optic sensor).
4. As bell is turned one full rotation, the signal value should rise and fall twice. Record the two maximum values (they should occur about 180 degrees apart).
5. If either maximum value is 2000 or less then perform the Bell speed feedback troubleshooting procedure.

3.4.2 Bell speed feedback troubleshooting procedure.

Use this procedure when Keyence optical feedback test produces maximum feedback values less than 2000. When bell speed feedback is weak, there are three components which may be the cause of the feedback losses: the fiber optic wrist cable, the applicator fiber optic cable and the turbine. This procedure may help identify which of these components is causing the problem.

1. Remove applicator and perform inspections of bell speed feedback system.
2. Remove turbine and verify all 3 o-rings on back face of turbine are installed correctly.
3. Inspect mirror (silver region) of speed wheel . This is visible through the hole adjacent to an alignment pin (near the turbine exhaust). Gently turn spindle to observe speed wheel. If mirror dirty, clean it (through the hole) with alcohol and a lint-free cloth. **IMPORTANT!: Do not disassemble turbine. Re-assembly without the proper tools can damage the turbine.**

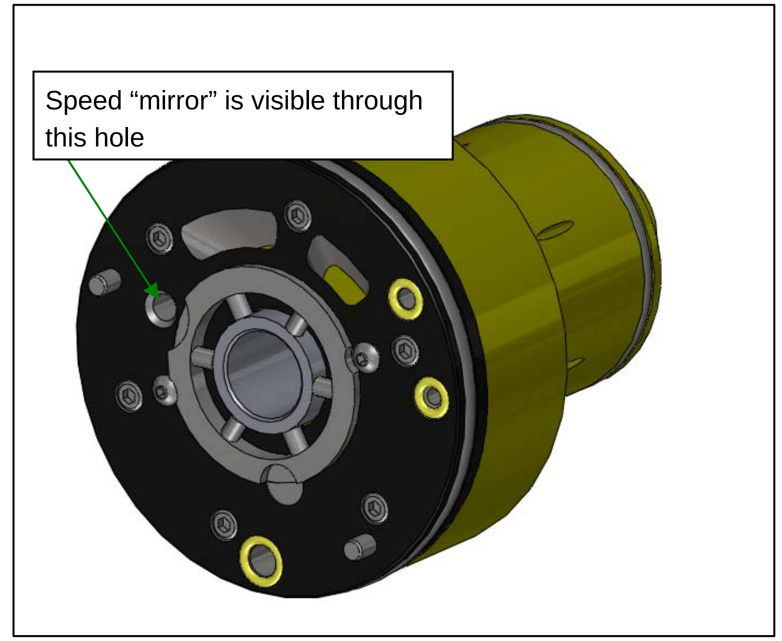


Figure 3-18: Turbine speed wheel mirror location

4. Inspect turbine end of applicator fiber optic cable. If fiber ends appear damaged or scratched, replace the applicator fiber optic cable. Clean the fiber ends with a soft cloth if necessary. **Use only water or alcohol to clean the fiber (other solvents will damage the fiber).**

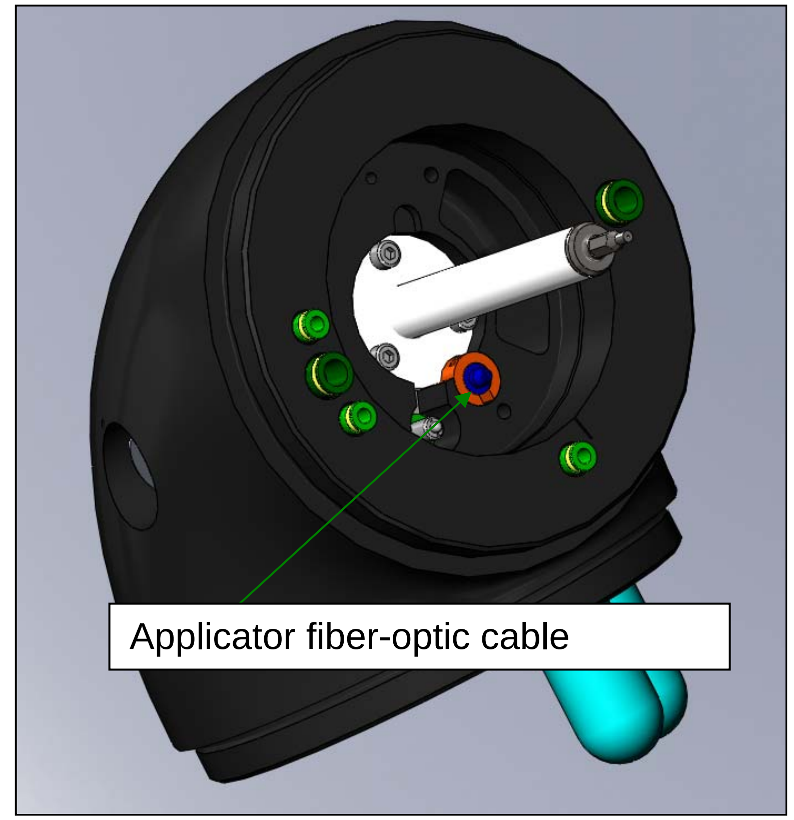


Figure 3-19: Applicator fiber-optic cable nose location

Inspect the quick disconnect end of the applicator fiber optic cable. If fiber optic ends appear damaged or scratched replace the applicator fiber optic cable. Clean the fiber ends with a soft cloth if necessary. **Use only water or alcohol to clean the fiber (other solvents will damage the fiber).**

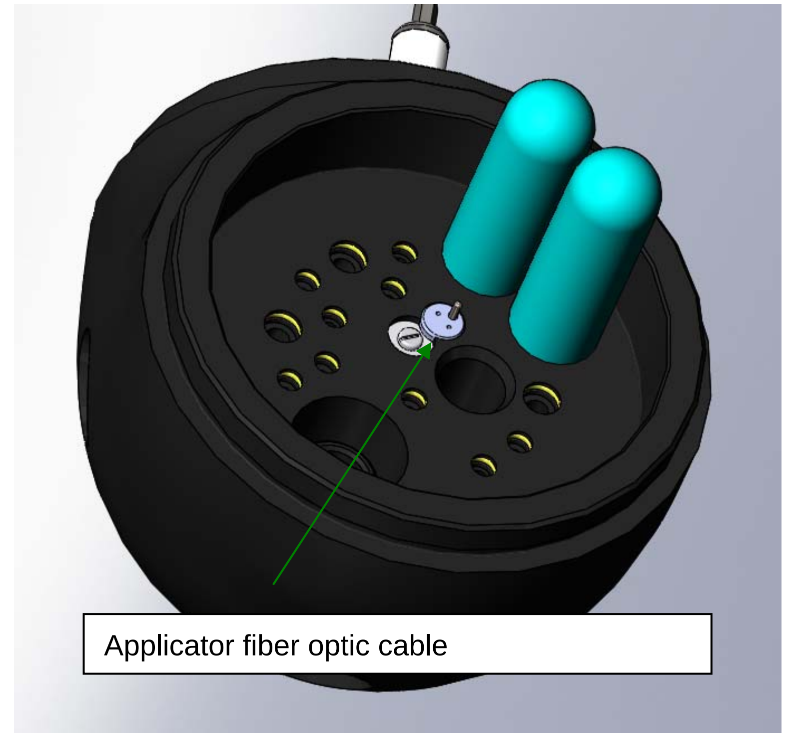


Figure 3-20: Applicator fiber-optic rear location

5. Inspect the quick disconnect end of the wrist fiber optic cable. If fiber optic ends appear damaged or scratched replace the wrist fiber optic cable (see EG-00439 or EB-03658 for proper procedure). Clean the fiber ends with a soft cloth if necessary. Use only water or alcohol to clean the fiber (other solvents will damage the fiber.

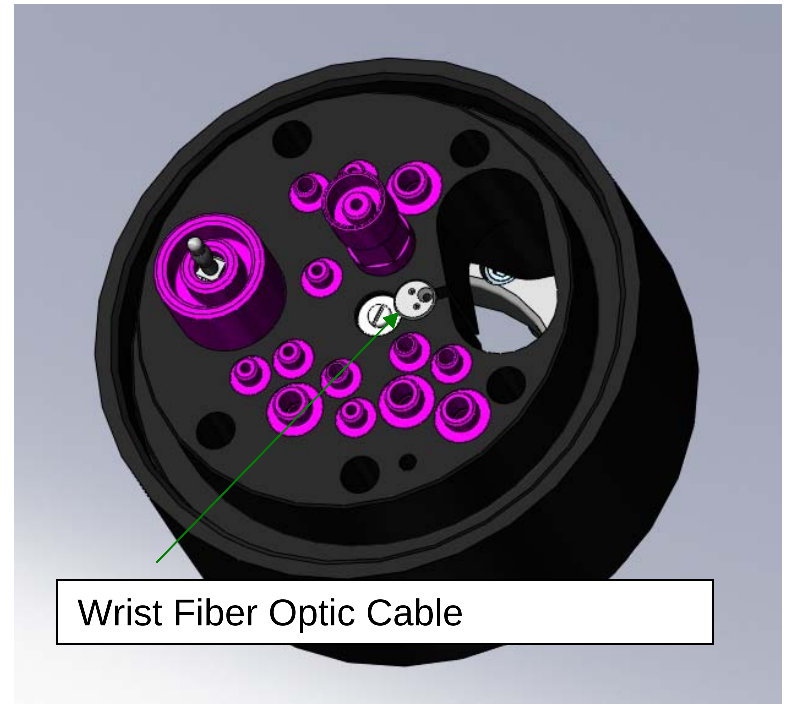


Figure 3-21: Wrist Fiber-Optic Cable

1. If changes were made based on the above inspections, re-assemble the applicator and repeat Keyence optical feedback test. If both maximum feedback numbers are below 2000, or if no changes were made, continue troubleshooting.
2. Inspect connection of wrist fiber optic cable at connector at the FRP. Verify that the connectors are retained by the plastic clips by pulling gently on the connectors. If the connection was loose, correct it and repeat the Keyence optical feedback test.
3. If none of these inspections reveal a clear problem, then replace the components in this order (repeat the Keyence optical feedback test after each replacement to observe the impact of the new component.

   i. Fiber optic wrist cable
   ii. Turbine
   iii. Applicator fiber optic cable.

3.5 Spare Parts & Tools

3.5.1 Spare Parts Required

Bell Speed Fiber Optic Cable Assembly	Current Rev.	Location	Robot Model / Version
EE-4560-651-001	E	Servo Bell Applicator	N/A / N/A
EE-4560-652-002	F	Servo Bell Applicator	N/A / N/A
EE-4526-653-001	E	VersaBell I Applicator	N/A / N/A
EE-4560-653-001	F	VersaBell II Applicator (90 deg)	N/A / N/A
EE-4560-653-002	C	VersaBell II Applicator (60 deg)	N/A / N/A
EE-4560-654-001	H	Outer Arm - FRP to QD	P-500 / 1k (Short Arm)
EE-4560-654-002	E	Outer Arm - FRP to QD	P-500 / WB (Short Arm)
EE-4560-654-003	E	Outer Arm - FRP to QD	P-700 / All Versions P-500 / 1k (Long Arm)
EE-4560-654-004	E	Outer Arm - FRP to QD	P-500 / WB (Long Arm)
EE-4560-654-005	E	Outer Arm - FRP to QD	NOT USED
EE-4560-654-006	D	Outer Arm - FRP to QD	P-250 / 1k (Short Arm)
EE-4560-654-007	D	Outer Arm - FRP to QD	P-250 / 1k (Long Arm)
EE-4560-655-001	E	Inner Arm - PCE - FRP	P-500 / N/A
EE-4560-655-002	A	Inner Arm - PCE - FRP	P-700 / N/A

Table 3-1: Spare parts required

Keyence O/E Converter Assemblies	Current Rev.	Robot Model / Version
EE-4696-020	B	P-500 / P-700iA with CPX process I/O package
EE-4696-021	A	P-500iA / P-700iA with EX600 process I/O package
EE-4696-022	B	P-700iA with EG / EX600 process I/O package
EE-4696-023	A	P-250iA with Remote PCE
Frequency F/I Converter Assembly		
EE-4696-010	A	P-500 / P-700iA with CPX process I/O package

Table 3-2: Keyence O/E assemblies

3.5.2 Tools Required

No special tools are required for servicing the bell speed control system other than the tools specified for servicing the VersaBell applicator.

4 BEARING AIR CONTROL

4.1 Overview

4.1.1 Introduction

The bearing air supply and monitoring system supplies air to the turbine bearing and verifies that the pressure stays above 75 psi. The bearing air of the turbine keeps the turbine rotor (shaft) floating so that the turbine rotor is allowed to rotate freely and not come into contact with the turbine housing.

The bearing air must always be on when the turbine is spinning. If the turbine is commanded to rotate when the bearing air is off, the turbine shaft will come into contact with the turbine housing while rotating and damage the turbine. All air delivered to the turbine must be clean and dry to prevent damage to the bearing surfaces.

4.1.2 System Components

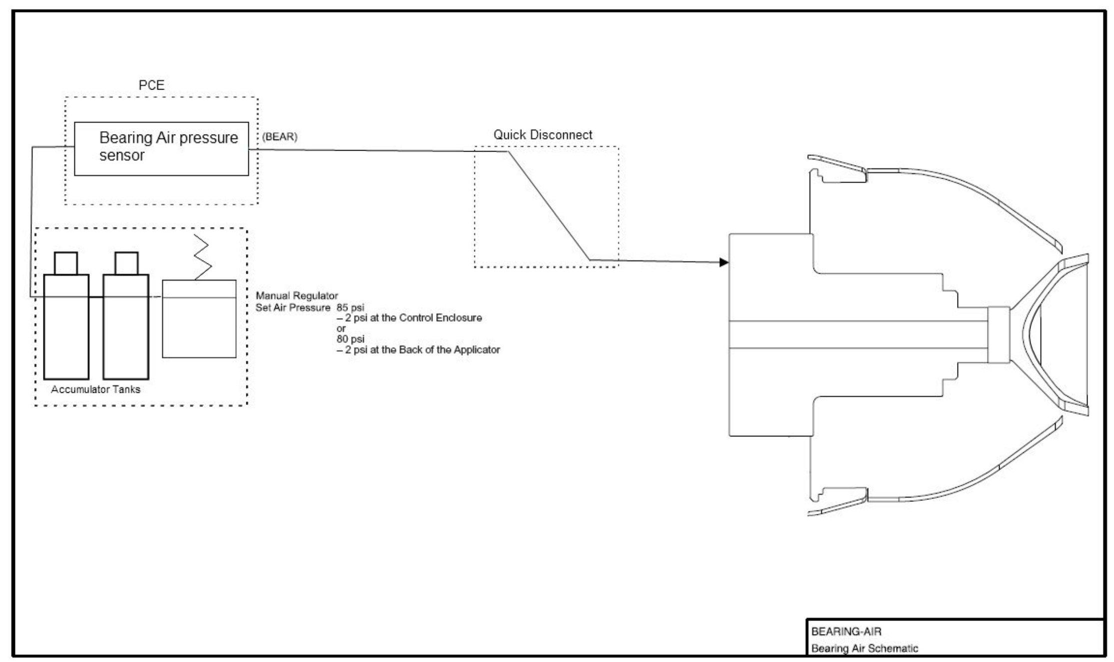


Figure 4-1: Bearing Air Schematic

4.2 Operations and Setup

The bearing air circuit starts at the supply panel manual regulator. The manual regulator at the supply panel connects to 2 accumulator tanks. The outlet of the accumulator tanks connects to a 8mm push to lock fitting. A dedicated 6 x 8 mm nylon hose runs from the supply panel, through the cattrac, to the PCE. Inside the PCE, the 8mm line plugs into a fitting a Y-fitting that also connects to the Bearing Air P/I Pressure Sensor. The Y-fitting outlet is 6mm. The bearing air is then supplied through a 4 x 6 mm nylon hose to the applicator wrist manifold, where it connects to a 6mm barrel fitting. The identifying mark on the FRP plate and the quick disconnect manifold is BEAR.

4.2.1 Manual regulator at supply panel

The manual regulator located at the supply panel regulates the flow of the air supplied to the robots connected to each pneumatic panel. The pressure setting for this regulator is 6 bar measured dynamically, i.e. when the robots are spraying material.

Figure 4-2: Manual supply pressure regulator on the Pneumatic Supply Regulator

4.2.2 Accumulator Tanks

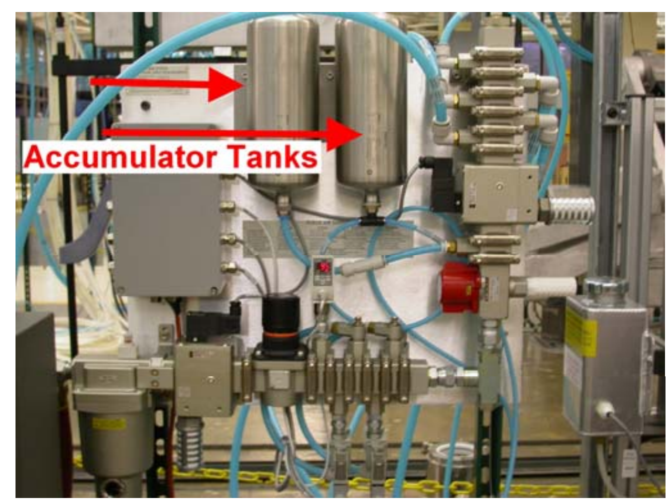


Figure 4-3: Accumulator tank location on the Pneumatic Supply Panel

4.2.3 Bearing Air P/I

The Bearing Air P/I reads the pressure of the Bearing Air line inside the PCE, and sends the analog feedback value to the control system via the BEAR cable. Please see the robot specific manual for bearing air P/I location.

4.3 Maintenance and Repair

There is no preventative maintenance for this system.

4.4 Troubleshooting

4.4.1 PNT1-709 PAUS %sBearing Air NOT OK

Cause: The digital input signal indicating the Bear Air is above the minimum pressure is not ON.

Remedy:

- If the Bearing Air pressure is below the specified value, verify that the pressure sensor at the Pneumatic Air Supply panel is at least 85psi dynamic. If not, use the manual regulator located at the Pneumatic Air Supply panel to increase the pressure to the correct level
- If the Pneumatic Air Supply panel pressure is at the correct level, check the Bearing Air line for any leaks. If necessary, change any fittings or lines that have leaks.
- If there are no leaks and the Bearing Air low pressure is not a problem for all robots in the zone, switch applicators with another robot that has a verified Bearing Air pressure value higher than the threshold.

5 SHAPE AIR CONTROL SYSTEM - D/Q

5.1 Overview

5.1.1 Introduction

The Shape Air Control System delivers the requested shape air flow rate to the applicator using a mechanical closed loop device to compensate for downstream pressure fluctuations and the Shape Air Sense (SAS) feedback to monitor the system for leaks or plugged shape air nozzles. The Shape Air Sense feedback watches the manifold pressure at the Shape Air Nozzle and compares the measured value to the expected value. If the measured value falls outside the allowed range, a warning or fault is posted to alert the user of a problem in the shape air system.

The flow control system is calibrated during assembly and does not need to be recalibrated in the field. A simple automatic procedure is used to calibrate the Shape Air Sense monitoring for the particular shape air nozzle or applicator that is installed.

5.1.2 System Components

The schematic below shows the components of the Shape Air Control System and how they are connected to each other.

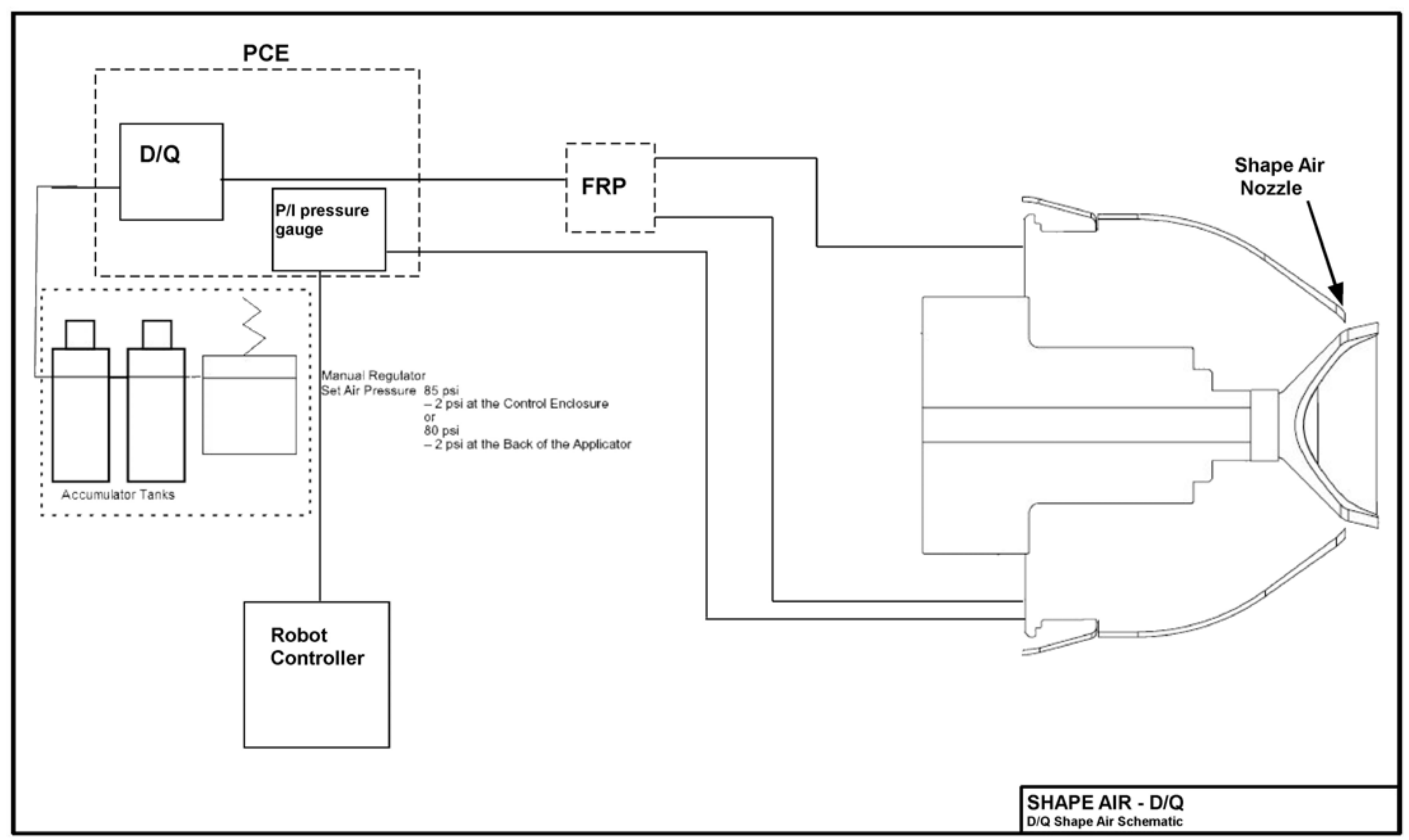


Figure 5-1: D/Q Shape Air Schematic

5.2 Operation and Setup

The following sections describe the installation of the components of the Shape Air Control System and the software setup features that are required for operation.

5.2.1 D/Q Air Flow Control Valve

The DQ Air Flow Control Valve (Digital to Flow) controls the shaping air flow rate in the Shape Air Control System. It receives the commanded flow rate from the Pneumatic Control System via the communication system. Internal valves are opened or closed to deliver the requested shaping air flow rate. A mechanical closed loop flow control device continuously makes fine adjustments to compensate for down stream pressure fluctuations.

Installation

The DQ valve is connected to the Pneumatic Control System by a 9-pin communication cable as shown in the schematic in section 6.1.2. The communication cable is connects to the top of the D/Q Valve and is secured with small screws retained by the cable connector. It may be necessary to connect the cable and tighten the screws before mounting the D/Q Valve in the robot.

The D/Q valve is mounted to the robot with two 6 mm socket head screws through the body of the valve.

The air inlet and Shape Air outlet ports on the bottom of the DQ valve are 3/8 G thread. The exhaust port on the side of the D/Q valve is a 1/4 G thread. Pipe dope or Teflon tape should not be applied to the threads of the fittings. Tighten the fittings until the seal of the G fitting is tight against the body of the DQ Valve.

The D/Q Valve air supply must be dry, filtered, and regulated to 85 psig (air quality per DIN ISO 8573-1: 3.4.4). Depending on air usage, the system pressure regulator may need to be set to 87-89 psig in order to maintain 85 psig at the D/Q Valve inlet. Inconsistent supply pressure to the D/Q Valve will cause errors in the shape air flow regulation.

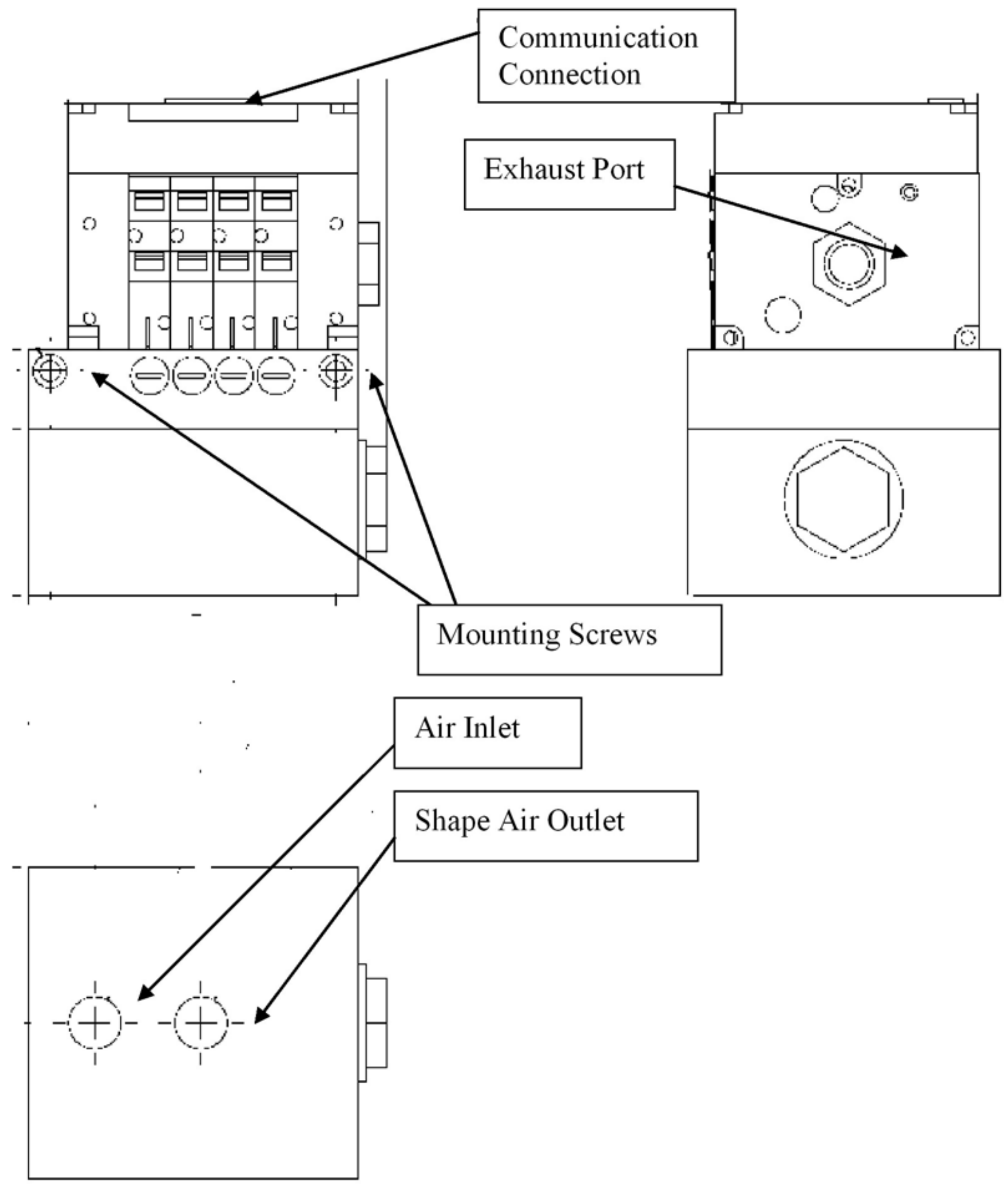


Figure 5-2: D/Q valve block

5.2.2 P/I (analog output pressure gage)

The P/I is the pressure sensor in the Shape Air Sense system. It reads the manifold pressure from the Shape Air Sense (SAS) line and sends the analog feedback value to the control system via the SAS cable.

Installation

The P/I is mounted to a DIN rail by a spring-loaded clip. A push-lock fitting receives the 4mm air line (SAS). The electrical cable is connected at the top of the sensor. The sensor is set to the proper units during assembly and does not need to be adjusted in the field.

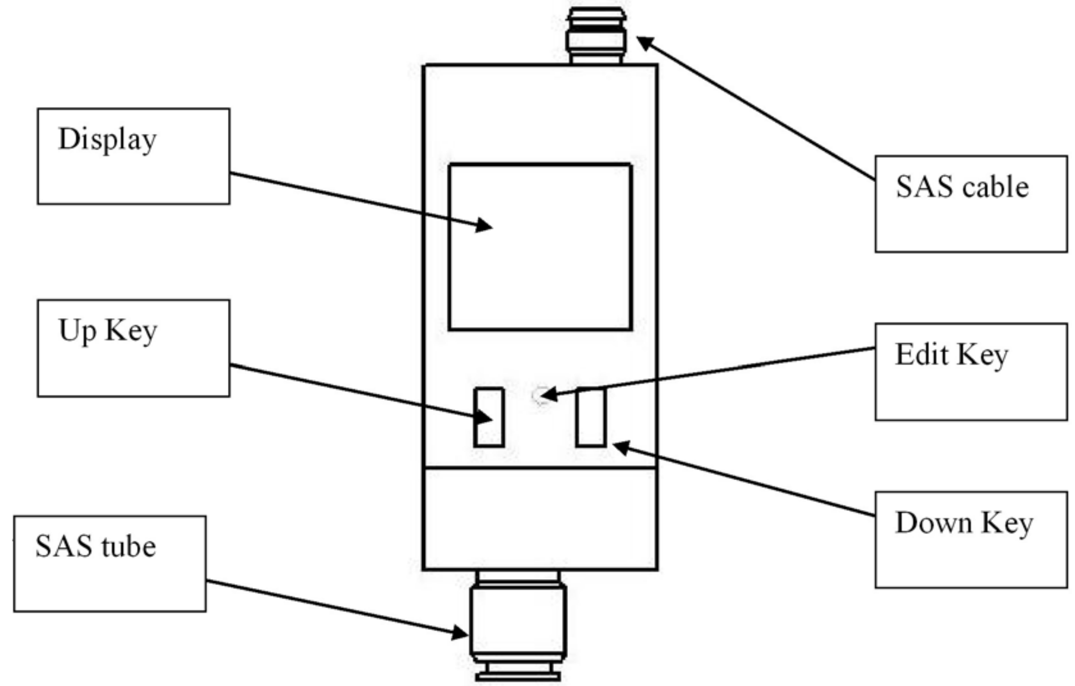


Figure 5-3: Pressure Sensor (P/I)

5.2.3 Software Setup

Shaping air flow rates that are used while processing a job are commanded by entering the requested values as entires in System Color Preset table data. Shaping air flow rate commands during color change are entered as parameters in Color Change Presets. The PaintTool software application in the robot control system sends these commands to the Shape Air Control System.

5.2.3.1 D/Q Air Control Valve Calibration

D/Q Valve calibration is only necessary if the D/Q valve is replaced or if the calibration table stored the controller memory is lost. Note: You must have the proper security level to change the D/Q calibration. A calibration table is supplied with each D/Q Valve and is associated to the D/Q Valve by serial number.

Warning: D/Q Valve Calibration requires that the D/Q Valve supply pressure is 85 psig. If the supply pressure is greater or less than 85 psig, the actual flow rate will be higher or lower than expected.

To edit the calibration table for D/Q valve, enter the 'DQ Shaping Air Calibration' screen in Paint Works.

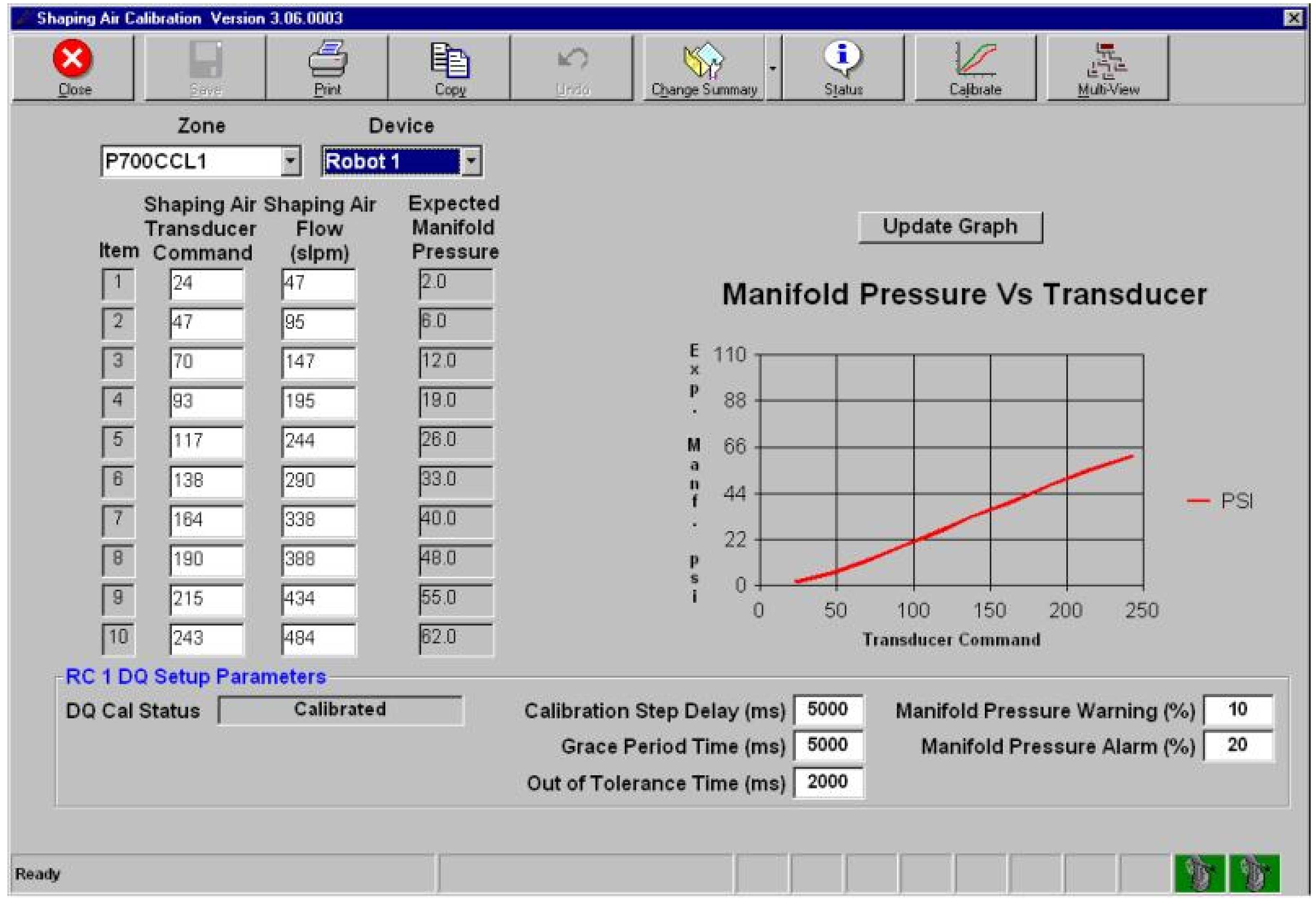


Figure 5-4: D/Q Valve Calibration Screen in PaintWorks

To calibrate the Shape Air Sense feature:

- Choose 10 data points of Command Value and Flow (SLPM) from the calibration table.
- Choose points that represent the full range of flow rates (for example: 25, 50, 75, 100, 125, 150, 175, 200, 225, & 250 Command Values).
- Enter these data points in the given fields on the DQ Calibration Screen.
- After updating the D/Q Valve Calibration you should perform Shape Air Sense Calibration (see section 6.2.3.2).

Shape Air Sense Calibration

In order to provide maximum sensitivity, the Shape Air Sense feature must be calibrated whenever the Shape Air Nozzle or Applicator is changed.

Warning: Only calibrate the Shape Air Sense feature on newly cleaned Shape Air Nozzles! Calibrating using a dirty Shape Air Nozzle will reduce the sensitivity of Shape Air Sense and may result in nuisance alarms.

To calibrate the Shape Air Sense feature:

- Select the calibrate button on the Shaping Air Calibration screen.

- Select the robot(s) to calibrate and select the Auto Calibrate button. It takes about two minutes for the calibration to finish.
- The expected pressure for each flow value is saved in the calibration table. These values are used to set warning and fault limits for the Shape Air Sense feature.

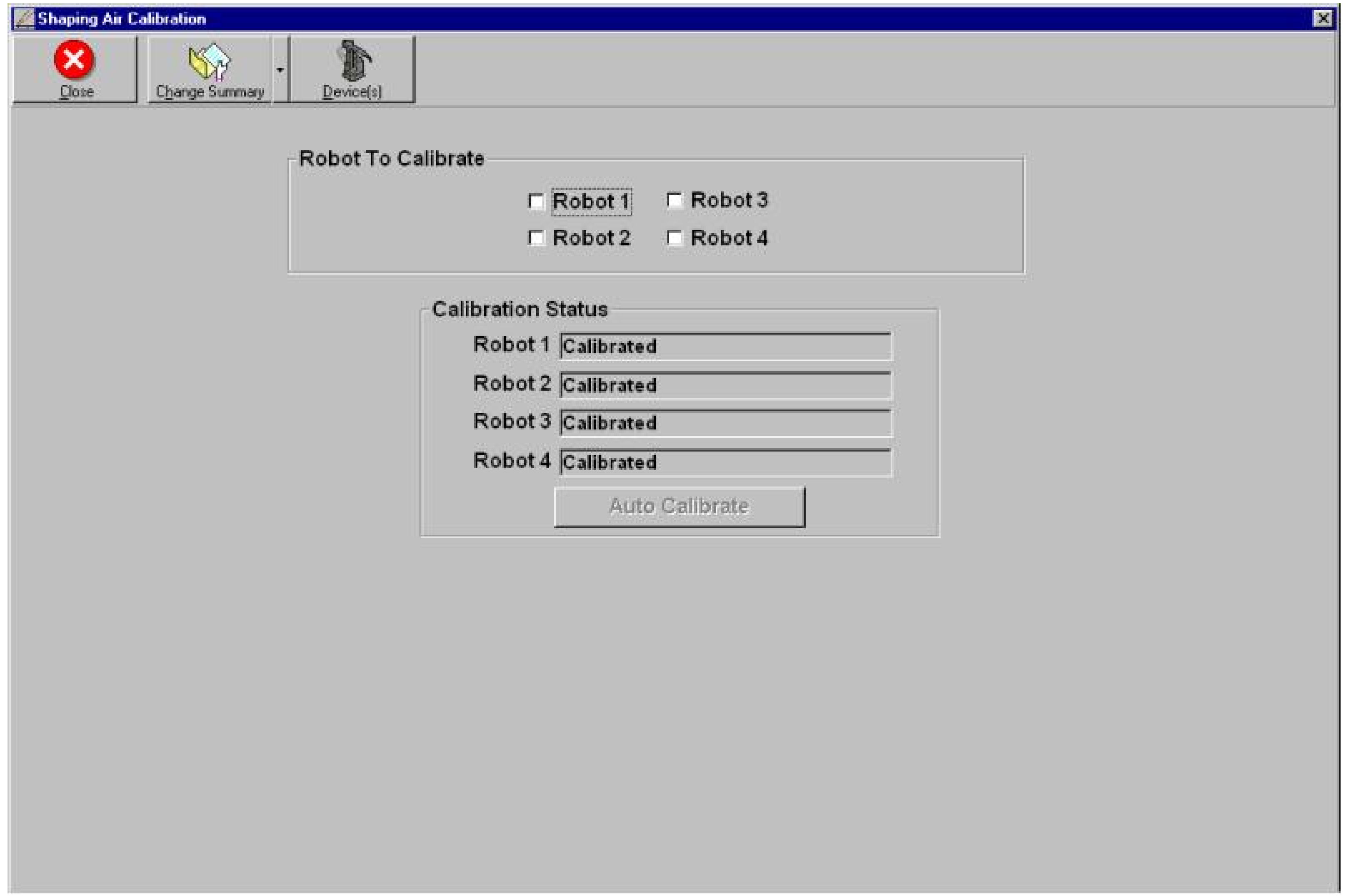


Figure 5-5: Shape Air Sense Calibration Screen in PaintWorks

Startup Test

After the D/Q Valve and Shape Air Sense have been calibrated, a startup test can be performed on the Shape Air Control System in order to verify that it is working properly. To perform this test:

- Verify that the robot is in Manual Mode and at its home position.
- Verify that the applicator is enabled.
- Open the Fluid Maintenance Screen in Paint Works.

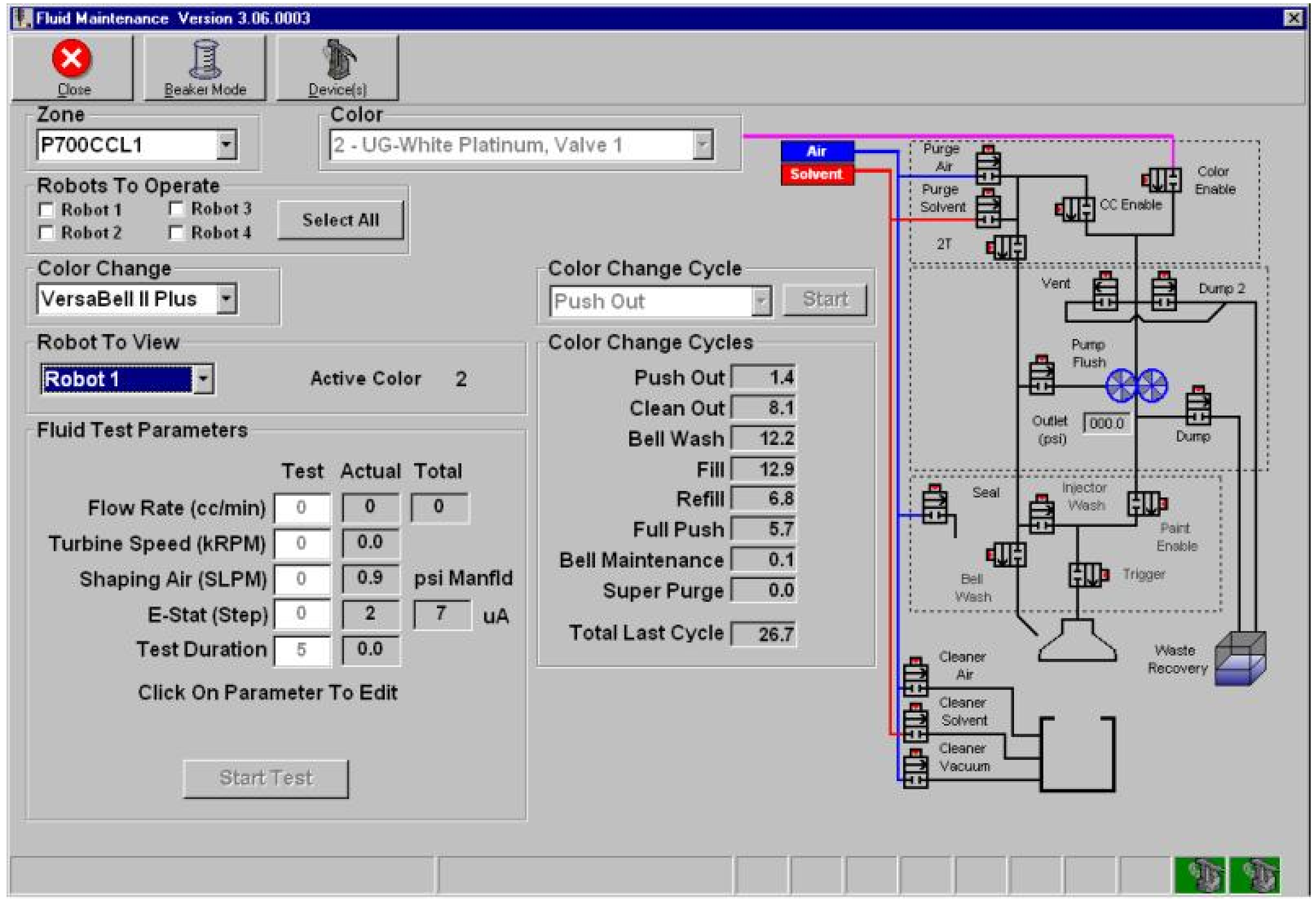


Figure 5-6: Fluid Mantenance Screen in PaintWorks.

- Select the robot to be tested.
- Enter a valid Shape Air flow rate (50-500) in the Shaping Air (SLPM) field.
- Enter a time (in seconds) for the Test Duration field
- Press the ‘Start Test’ button.
- The manifold pressure (as measured by SAS) is reported in the Actual field.
- The system is working properly if this value matches the Expected Manifold Pressure within the tolerance.

5.2.3.2 Shape Air Control System Parameters

The following parameters can be viewed on the DQ Calibration Screen or Shape Air Sense calibration screen in Paint Works.

DQ Cal Status

Displays the result of the Shape Air Sense calibration for the DQ Valve.

Calibration Step Delay (ms)
Default: 5000
Range: 1000-9999
During calibration, the DQ system increases the command output to the DQ valve in even increments, waiting this length of time at each level, and records the air pressure on the output and manifold transducers. This value should be long enough for the system to react to the command change and stabilize

Grace Period (ms)
Default: 5000
Range: 0-9999
This item is the delay time that needs to expire before the Output and Manifold pressures are monitored. The Grace period time and the Calibration step delay should be equal, allowing the DQ system to react and stabilize before pressures are monitored

Out of Tolerance Time (ms)
Default: 5000
Range: 0-9999
This item is the time duration that the pressure needs to be out of tolerance before a warning or an alarm is posted. This time duration starts when the grace period time ends.

Manifold Pressure Warning (%)
Default: 10
Range: 1-15
This item is the percent warning tolerance of the manifold pressure that is being monitored. If the current pressure exceeds the ideal pressure by this percentage value for the duration specified by the Out Of Tolerance Time, a warning is posted.

Manifold Pressure Alarm (%)
Default: 20
Range: 16-30
This item is the percent alarm tolerance of the manifold pressure that is being monitored. When the current pressure exceeds the ideal pressure by this percentage value for the duration specified by Out of tolerance time, an alarm is posted.

5.3 Maintenance and Repair

The Shape Air Control System is designed to function without planned maintenance for the life of the robot. Occasionally a failure of the supply air filter system can cause contamination the D/Q Valve and degrade its performance. The following procedures can be used to clean the D/Q Valve of this contamination.

5.3.1 Cautions & Warnings

The following cautions and warnings should be observed every time a D/Q Valve is serviced.

Never Adjust Calibration Screws
The caps identified the figure below, cover (4) calibration screws for the D/Q Valve. There are (4) additional calibration screws under the Name Plate on the front of the valve. Adjustment of any of these screws is not necessary during the service life of the D/Q Valve. Adjustment of these screws will result in inaccurate Shape Air flow rates, and require the unit be returned to the manufacturer for recalibration.

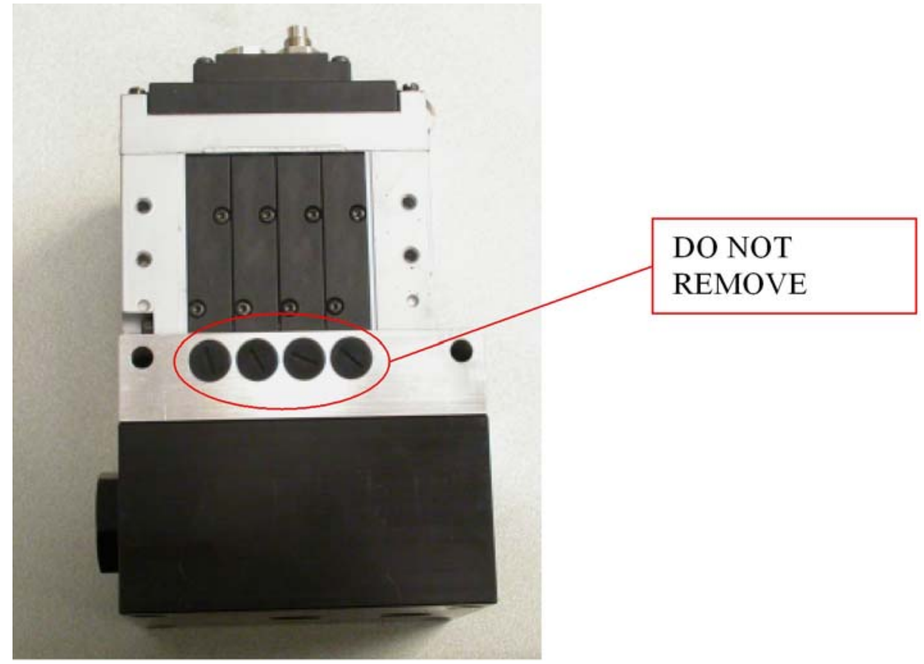


Figure 5-7: Calibration Screw Covers

Never Interchange Internal Components between D/Q Valves
The piston, cylinder, and spring significantly affect the performance of the D/Q Valve. During cleaning, care should be taken to ensure that these components are reinstalled into the same valves from which they were removed. Interchanging components between D/Q Valves may result in inaccurate Shape Air flow rates.

Replacement of Lost or Damaged Parts
Replacement parts for the D/Q Valve are available in the D/Q Valve Spare Parts Kit (EO-4696-110-031). Refer to Section 3 of this Engineering Bulletin for a replacement procedure. Any components that are not included in this kit (for example the piston, cylinder, or spring) are not available as spare parts. If a component that is not part of the Spare Parts Kit is lost or damaged, the D/Q Valve must be returned to the manufacturer to be rebuilt and recalibrated.

5.3.2 D/Q Valve Cleaning Procedure

This procedure provides instruction on the proper way to clean a D/Q Valve. This procedure can be used to clean all D/Q Valves

1. Using a 3/16" hex wrench, remove the (4) stainless steel screws in the bottom of the D/Q Valve and separate the upper valve block (aluminum) and the lower valve block (black delrin).

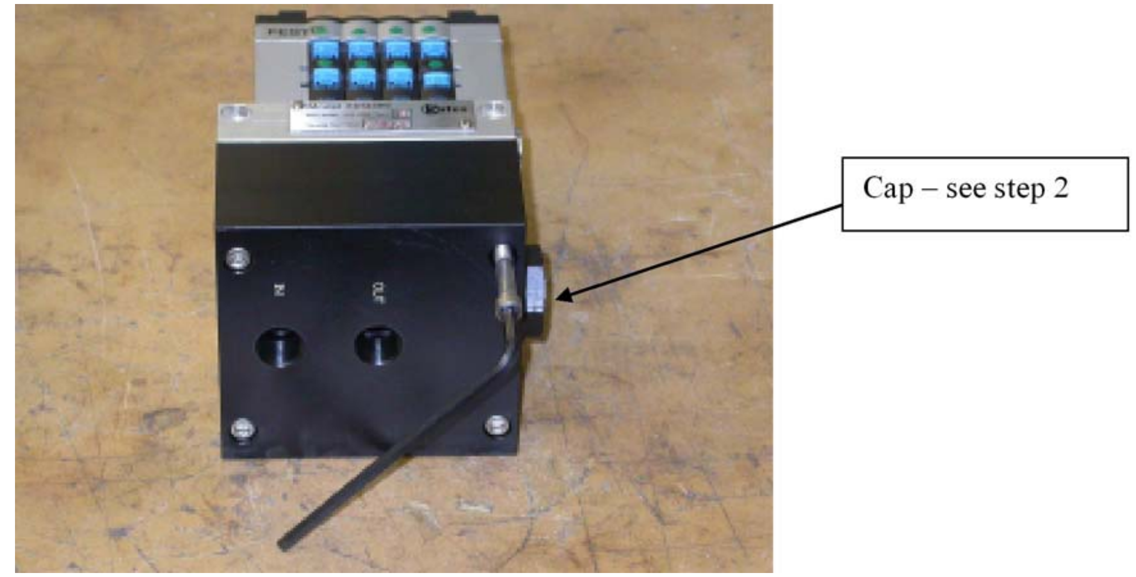


Figure 5-8: Upper & lower valve block orientation

2. Using a 30mm socket or wrench, remove the cap (shown above), spring seat, spring, piston, and cylinder from the side of the lower valve block. If the piston and cylinder remain in the block after the cap is removed, carefully extract them by hand.
3. Using a clean rag, wipe all oil and debris from the internal parts and blow them off with compressed air.
4. Insert the piston into the cylinder and ensure that the piston moves freely in the cylinder. This can be accomplished by gently shaking the cylinder assembly along its axis. There should be virtually no resistance to the piston traveling the full length of the cylinder.

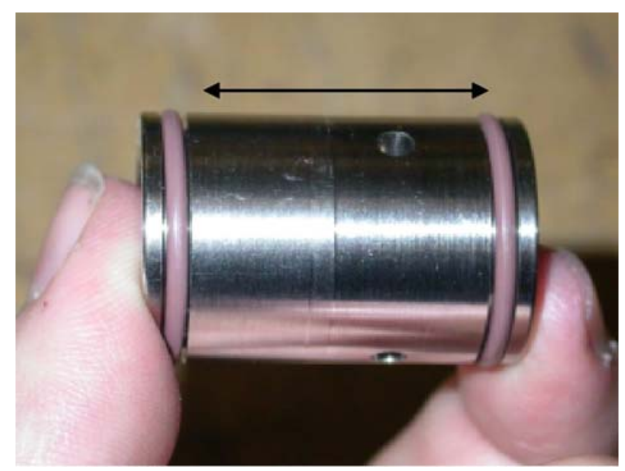


Figure 5-9: Evaluation of piston in cylinder

5. Using a 5mm hex wrench, remove the Pipe Plug and Seal from the lower valve block.

Figure 5-10: Pipe Plug & Seal Removal

6. Using a 3/32” hex wrench, carefully remove the small Orifice from the lower valve block.

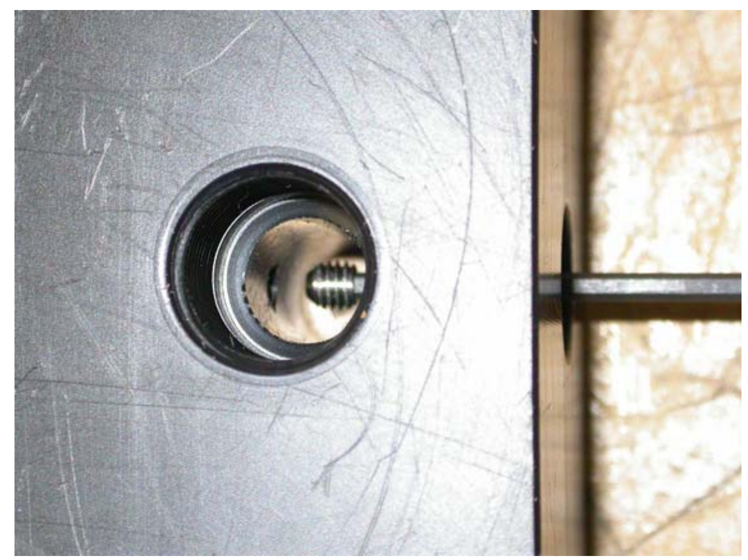


Figure 5-11: Orifice Removal

7. Using a #73 drill bit in a Pin Vice, carefully clear the Orifice of any debris.

Figure 5-12: Orifice Removal

8. Blow out the Orifice with compressed air.
9. Using a clean rag, wipe all debris and oil out of all passages in the lower valve block and all visible passages upper valve block.
10. Using compressed air, blow out all passages in the lower valve block, and all visible passages in the upper valve block.
11. Using a 3/32" hex wrench, install the Orifice in the lower valve block. Take care not to cross-thread the Orifice.
12. Using a 5mm hex wrench install the Pipe Plug and white (Teflon) Seal in the lower valve block.
13. Assemble the internal parts in the orientation shown and install the assembly in the lower valve block using a 30mm socket or wrench. Ensure that the cylinder bottoms out in the lower valve block, but do not over-tighten the plastic threads.

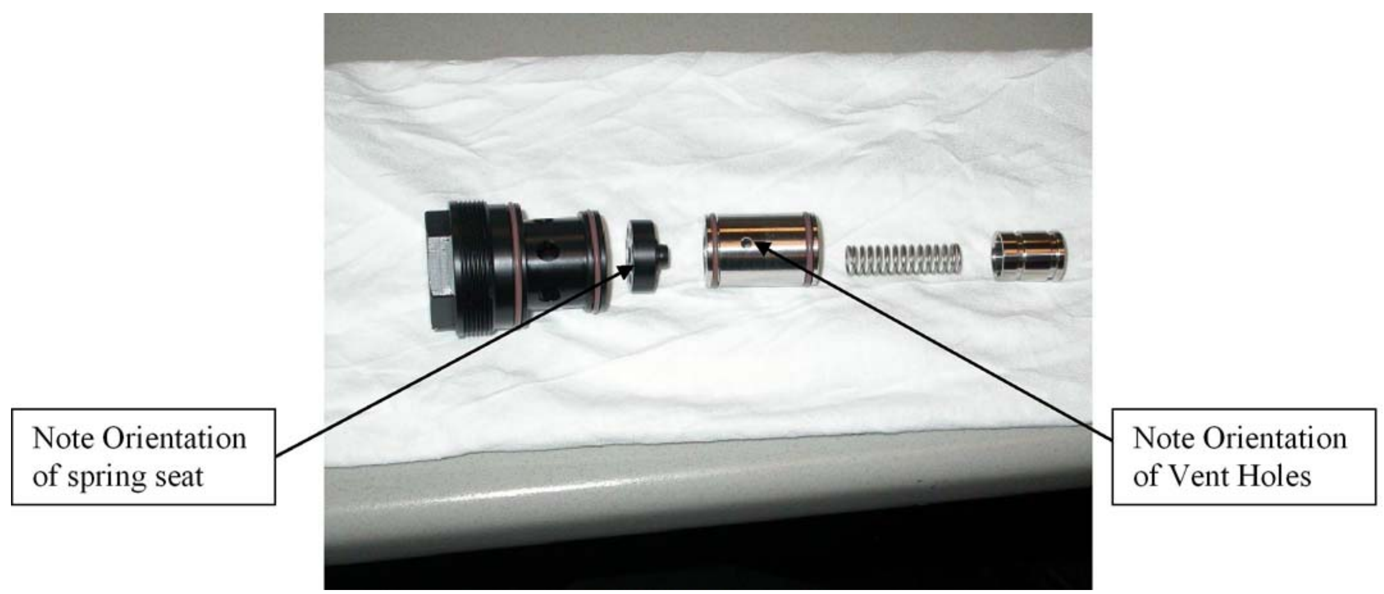


Figure 5-13: Orientation of Internal Parts for Assembly

14. Align the lower valve block and the upper valve block as shown in the figure above. Reattach the upper and lower valve blocks using the (4) stainless steel screws and the 3/16" hex wrench.

5.3.3 D/Q Valve Spare Parts Replacement Procedure

This procedure provides instruction on the replacement of D/Q Valve parts that may have been lost or damaged during cleaning. It is not necessary to replace all of the components at once. The parts in the kit may be installed individually as needed.

5.3.3.1 Replacing Lower Valve Block O-Rings

This procedure provides instruction on the replacement of the static seal O-Rings in the lower valve block of the D/Q Valve.

1. Using a 30mm socket or wrench, remove the cap, spring seat, spring, piston, and cylinder from the side of the lower valve block. If the piston and cylinder remain in the block after the cap is removed, carefully extract them by hand.
2. Remove existing O-Rings by pinching around the Outer Diameter in order to slip the O-Ring out of its groove as shown in the figure below.

Figure 5-14: O-Rings Removal

3. Install the proper sized O-Ring in each location as noted in the figure below..

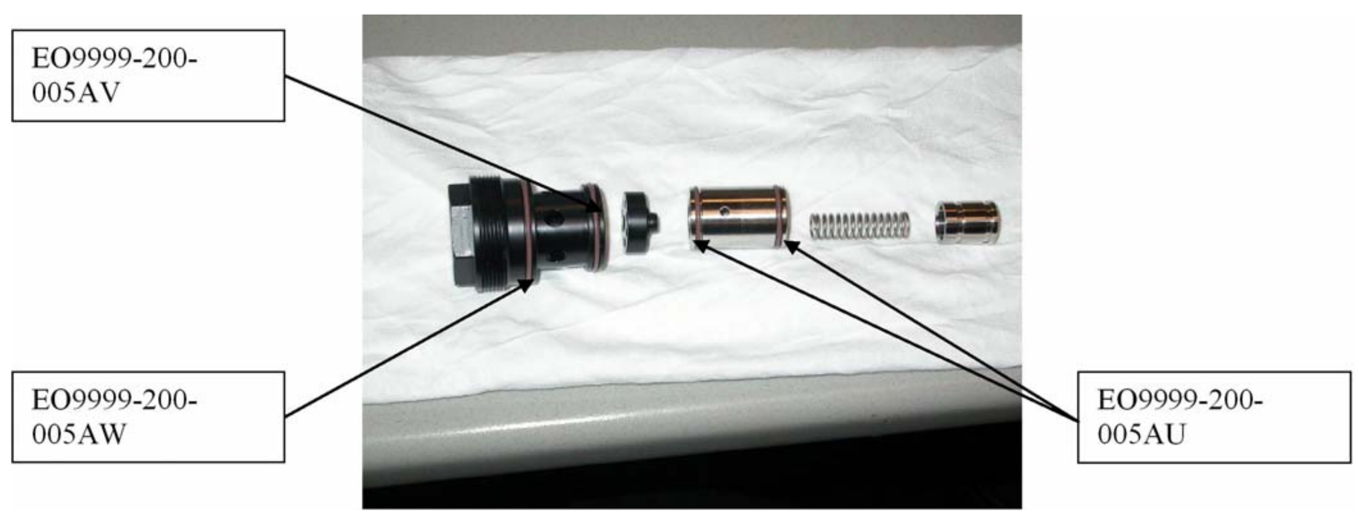


Figure 5-15: Location of O-Rings

4. Assemble the internal parts in the orientation shown above and install the assembly in the lower valve block using a 30mm socket or wrench. Ensure that the cylinder bottoms out in the lower valve block, but do not over-tighten the plastic threads.

5.3.3.2 Replacing Upper Valve Block O-Rings

This procedure provides instruction on the replacement of the static seal O-Rings in the upper valve block of the D/Q Valve.

1. Using a 3/16" hex wrench, remove the (4) stainless steel screws in the bottom of the D/Q Valve and separate the upper valve block (aluminum) and the lower valve block (black delrin).

Figure 5-16: Upper & Lower Valve Block Orientation

Figure 5-17: Upper Valve Block O-Rings

2. Insert a small knife or pin into a tool access pocket in the O-Ring gland as shown in the figure below.

3. Use the tool to pry each O-Ring out of its gland. O-Rings removed in this manner must be discarded.

Figure 5-18: O-Ring Removal

4. Install a new O-Ring of the proper size into each gland as shown below.

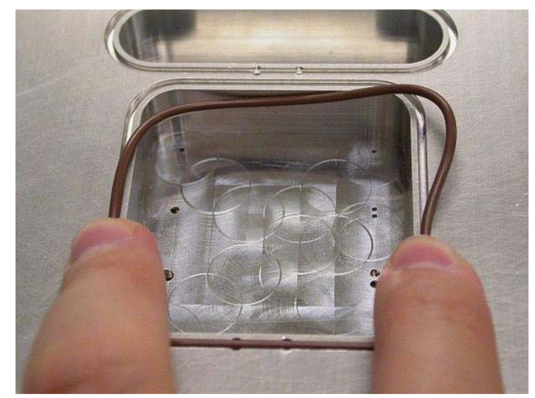


Figure 5-19: O-Ring Installation

5. Ensure that each O-Ring is completely seated in its gland.
6. Reassembly the Upper and Lower Valve Blocks using the 3/16" hex wrench and (4) stainless steel screws.

5.3.3.3 Replacing the Pipe Plug and Orifice

This procedure provides instruction on the replacement of the Pipe Plug and Orifice.

1. Using a 5mm hex wrench, remove the Orifice Plug and Seal from the lower valve block.

Figure 5-20: Removal of Pipe Plug with Seal

2. Using a 3/32” hex wrench, carefully remove the small Orifice from the lower valve block.

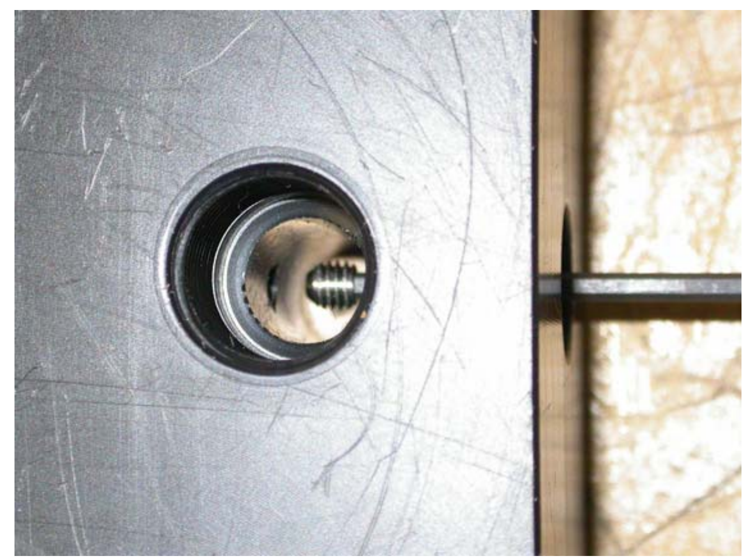


Figure 5-21: Orifice Removal

3. Replace the Orifice (EO-4696-110-032), Pipe Plug and Seal (EO-4696-110-033), taking care not to cross-thread any of the components.

5.3.3.4 Replacing the D/Q Cup Seals

This procedure provides instruction on the replacement of the D/Q Cup Seals between the upper valve block and the D/Q manifold.

- Use a Phillips screw driver to remove the (4) screws retaining the cap from the D/Q manifold as shown in the figure below

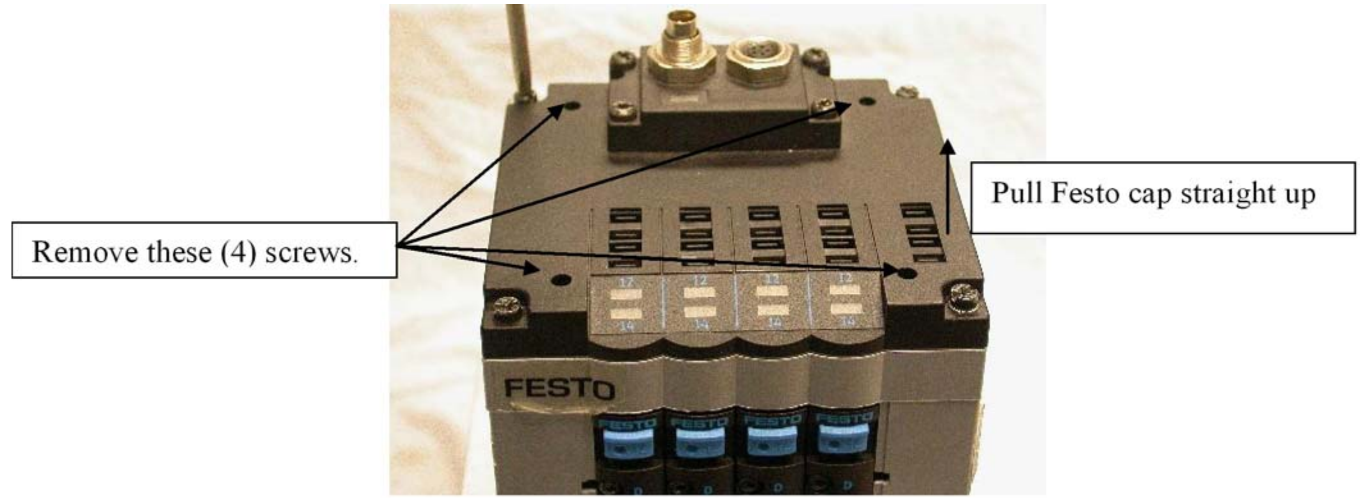


Figure 5-22: D/Q cap Removal

- Use the 3mm hex wrench to remove the (4) screws that attach the D/Q manifold to the upper valve block as shown in figure below.

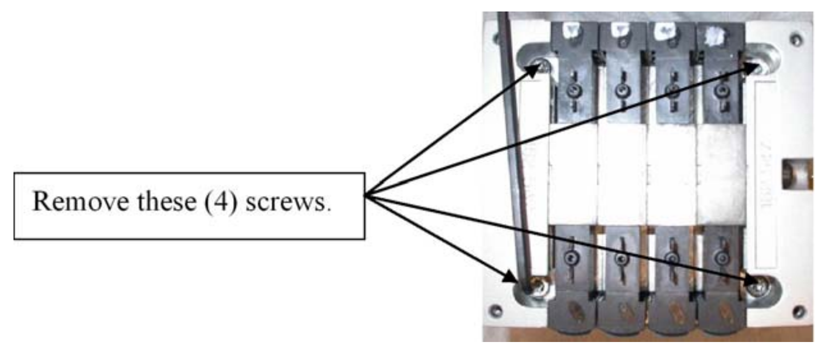


Figure 5-23: D/Q Manifold Removal

- Remove and replace the D/Q cup seals (SEALM000000022O) by hand.

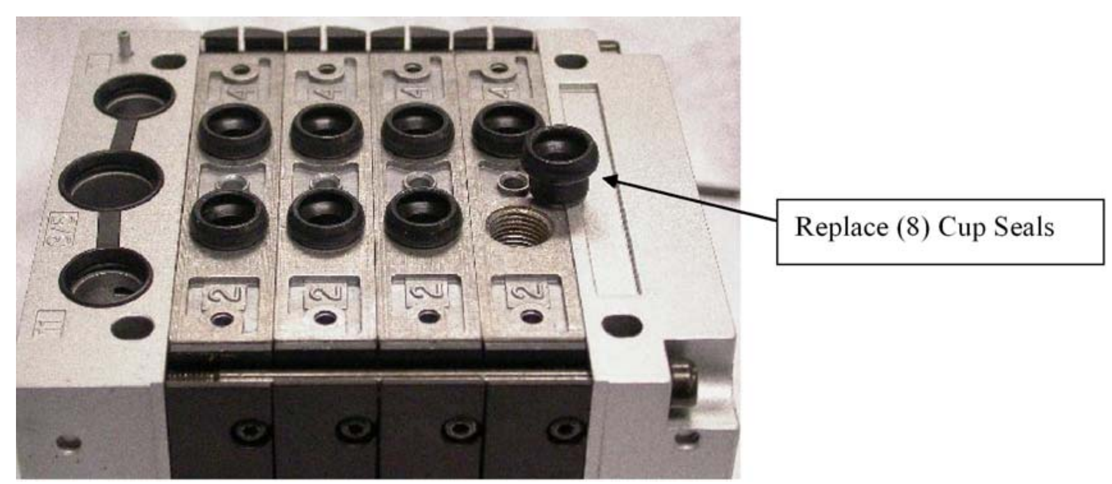


Figure 5-24: D/Q Cup Seals

- Align the D/Q manifold with the upper valve block as shown in Figure 19 and reattach using the (4) screws and the 3mm hex wrench.

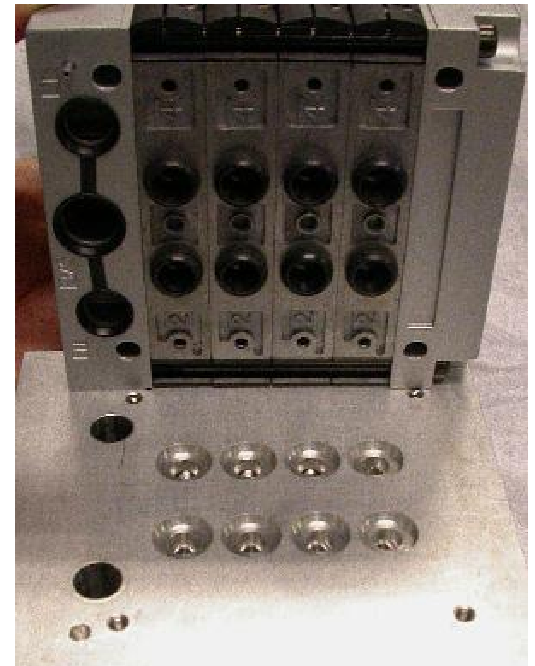


Figure 5-25: D/Q Manifold Alignment

- Secure the D/Q cap to the manifold using the (4) screws and the Phillips screw driver.

5.3.3.5 Pressure Sensor (P/I)

This component requires no maintenance.

5.4 Troubleshooting

This section provides troubleshooting guidelines for faults generated by the Shape Air Control System. Possible causes and remedies are listed for each fault. The error codes listed below are of the form:

<Equipment 1 fault> / <Equipment 2 fault> "<description>

For example: PNT1-845-WARN 1 / PNT1-861 WARN 2 "Manifold Press low warning"
The two faults have the same meaning but were posted by different paint robots on this controller.

5.4.1 PNT1-845 WARN 1 / PNT1-861 WARN 2 "Manifold Press low warning"

The pressure in the shape air nozzle, which is measured by the Shape Air Sense feature, was lower than the expected value and outside the tolerance limit.

5.4.1.1 Cause: Uncalibrated Shape Air Sense

The Shape Air Sense must be calibrated when the applicator or shape air nozzle is changed.

Remedy: Perform Shape Air Sense Calibration (section 6.2.3.2) if one of these parts was changed and the Shape Air Sense was not recalibrated.

Warning: Only calibrate the Shape Air Sense feature on newly cleaned Shape Air Nozzles! Calibrating using a dirty Shape Air Nozzle will reduce the sensitivity of Shape Air Sense and may result in nuisance alarms.

5.4.1.2 Cause: Air Leak due to Loose Applicator

If the applicator was not tightly connected to the quick-disconnect (QD) a leak could occur in the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS). See <applicator section x.x.x.x> for more information.

Remedy: Reinstall the applicator tightly on the QD.

5.4.1.3 Cause: Air Leak due to Missing O-ring in Applicator

If one or more of the radial o-rings in the Applicator for the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS) were not installed, a leak here could cause this fault. See <applicator section x.x.x.x> for more information.

Remedy: Remove the Applicator and reinstall the missing o-ring.

5.4.1.4 Cause: Air Leak due to Missing O-ring in Shape Air Nozzle

If one or more of the o-rings in the Shape Air Nozzle are missing, a leak here could cause this fault. See <applicator section x.x.x.x> for more information.

Remedy: Remove the Shape Air Nozzle and reinstall the missing o-ring.

5.4.1.5 Cause: Air Leak due to Loose line in Push-Lock Fitting

If one of the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS) is not fully inserted into a push-lock fitting, it could cause an intermittent leak.

Remedy: Check that the hoses are fully inserted at the following locations:

- Process Air Supply Manifold on outer arm. (check both sides of the manifold)
- SA1 & SA2 at the outlet of the D/Q Valve
- SAS at the P/I sensor

Reinsert loose hoses.

5.4.1.6 Cause: Air Leak due to Damaged Hose

Damage to one of the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS) could cause a leak. Inspect these lines for cracks, cuts, or pinholes.

Remedy: Replace damaged hose.

5.4.1.7 Cause: Supply Pressure Fluctuation

Decreasing the supply pressure to the D/Q Valve will decrease the flow rate of shaping air and could cause this warning. Confirm that the air supply regulator is set correctly and is regulating to a constant pressure.

Remedy: Reset the air supply regulator to the prescribed setting (usually 85-89 psig). If 85 psig cannot be maintained at the supply regulator, investigate the air delivery system for the source of air starvation.

5.4.2 PNT1-846 WARN 1 / PNT1-862 WARN 2 “Manifold Press high warning”

The pressure in the shape air nozzle, which is measured by the Shape Air Sense feature, was higher than the expected value and outside the tolerance limit.

5.4.2.1 <u>Cause: Uncalibrated Shape Air Sense</u>

The Shape Air Sense must be calibrated when the applicator or shape air nozzle is changed.

Remedy: Perform Shape Air Sense Calibration (section 6.2.3.2) if one of these parts was changed and the Shape Air Sense was not recalibrated.

Warning: Only calibrate the Shape Air Sense feature on newly cleaned Shape Air Nozzles! Calibrating using a dirty Shape Air Nozzle will reduce the sensitivity of Shape Air Sense and may result in nuisance alarms.

5.4.2.2 <u>Cause: Plugged Shape Air Nozzle Holes</u>

The most common cause of this warning, while processing a job, is a Shape Air Nozzle that has become dirty and has holes that are partially plugged with paint.

Remedy: Clean the Shape Air Nozzle holes as shown in <applicator section x.x.x.x>. Or replace the Shape Air Nozzle with a clean unit and perform Shape Air Sense Calibration as shown in section 6.2.3.2.

5.4.2.3 <u>Cause: Supply Pressure Fluctuation</u>

Increasing the supply pressure to the D/Q Valve will increase the flow rate of shaping air and could cause this warning. Confirm that the air supply regulator is set correctly and is regulating to a constant pressure.

Remedy: Reset the air supply regulator to the prescribed setting (usually 85-89 psig).

5.4.3 <u>PNT1-849 PAUS 1 / PNT1-865 PAUS 2 “Manifold Press low alarm”</u>

The pressure in the shape air nozzle, which is measured by the Shape Air Sense feature, was lower than the expected value and outside the tolerance limit.

5.4.3.1 <u>Cause: Uncalibrated Shape Air Sense</u>

The Shape Air Sense must be calibrated when the applicator or shape air nozzle is changed. Perform Shape Air Sense Calibration (section 6.2.3.2) if one of these parts was changed and the Shape Air Sense was not recalibrated.

Warning: Only calibrate the Shape Air Sense feature on newly cleaned Shape Air Nozzles! Calibrating using a dirty Shape Air Nozzle will reduce the sensitivity of Shape Air Sense and may result in nuisance alarms.

5.4.3.2 <u>Cause: Missing Shape Air Nozzle</u>

If a Shape Air Nozzle was not installed in the Shroud this alarm will prevent accidental processing of a job without effective shaping air.

Remedy: Install the appropriate Shape Air Nozzle <see Applicator x.x.x.x> and perform Shape Air Sense Calibration (section 6.2.3.2).

Warning: Only calibrate the Shape Air Sense feature on newly cleaned Shape Air Nozzles! Calibrating using a dirty Shape Air Nozzle will reduce the sensitivity of Shape Air Sense and may result in nuisance alarms.

5.4.3.3 <u>Cause: Air Leak due to Loose Applicator</u>

If the applicator was not tightly connected to the quick-disconnect (QD) a leak could occur in the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS). See <applicator section x.x.x.x> for more information.

Remedy: Reinstall the applicator tightly on the QD.

5.4.3.4 <u>Cause: Air Leak due to Missing O-ring in Applicator</u>

If one or more of the radial o-rings in the Applicator for the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS) were not installed, a leak here could cause this fault. See <applicator section x.x.x.x> for more information.

Remedy: Remove the Applicator and reinstall the missing o-ring.

5.4.3.5 Cause: Air Leak due to Missing O-ring in Shape Air Nozzle

If one or more of the o-rings in the Shape Air Nozzle are missing, a leak here could cause this fault. See applicator poster for more information.

Remedy: Remove the Shape Air Nozzle and reinstall the missing o-ring.

5.4.3.6 Cause: Air Leak due to Loose line in Push-Lock Fitting

If one of the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS) is not fully inserted into a push-lock fitting, it could cause an intermittent leak. Check that the hoses are fully inserted at the following locations:

- Process Air Supply Manifold on outer arm. (check both sides of the manifold)
- SA1 & SA2 at the outlet of the D/Q Valve
- SAS at the P/I sensor

Remedy: Reinsert the loose hose.

5.4.3.7 Cause: Air Leak due to Damaged Hose

Damage to one of the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS) could cause a leak. Inspect these lines for cracks, cuts, or pinholes.

Remedy: Replace damaged hose.

5.4.3.8 Cause: Supply Pressure Fluctuation

Decreasing the supply pressure to the D/Q Valve will decrease the flow rate of shaping air and could cause this alarm. Confirm that the air supply regulator is set correctly and is regulating to a constant pressure.

Remedy: Reset the air supply regulator to the prescribed setting (usually 85-89 psig). If 85 psig cannot be maintained at the supply regulator, investigate the air delivery system for the source of air starvation.

5.4.4 PNT1-850 PAUS 1 / PNT1-866 PAUS 2 “Manifold Press high alarm”

The pressure in the shape air nozzle, which is measured by the Shape Air Sense feature, was higher than the expected value and outside the tolerance limit.

5.4.4.1 Cause: Uncalibrated Shape Air Sense

The Shape Air Sense must be calibrated when the applicator or shape air nozzle is changed. Perform Shape Air Sense Calibration (section 6.2.3.2) if one of these parts was changed and the Shape Air Sense was not recalibrated.

Warning: Only calibrate the Shape Air Sense feature on newly cleaned Shape Air Nozzles! Calibrating using a dirty Shape Air Nozzle will reduce the sensitivity of Shape Air Sense and may result in nuisance alarms.

5.4.4.2 Cause: Plugged Shape Air Nozzle Holes

The most common cause of this alarm, while processing a job, is a Shape Air Nozzle that has become dirty and has holes that are partially plugged with paint.

Remedy: Clean the Shape Air Nozzle holes as shown in <applicator section x.x.x.x>. Or replace the Shape Air Nozzle with a clean unit and perform Shape Air Sense Calibration as shown in section 6.2.3.2.

5.4.4.3 Cause: Supply Pressure Fluctuation

Increasing the supply pressure to the D/Q Valve will increase the flow rate of shaping air and could cause this alarm. Confirm that the air supply regulator is set correctly and is regulating to a constant pressure.

Remedy: Reset the air supply regulator to the prescribed setting (usually 85-89 psig).

5.4.5 PNT1-851 PAUS 1 / PNT1-867 WARN 2 “Calibration successful”

Shape Air Sense calibration was successful

Remedy: None.

5.4.6 PNT1-852 PAUS 1 / PNT1-868 WARN 2 “Calibration aborted”

The Shape Air Sense calibration was not completed successfully.

5.4.6.1 Cause: Robot mode of operation incorrect

Shape Air Sense calibration was aborted because the robot was not in the correct mode to perform calibration.

Remedy: The robot must be in manual mode at the home position, with process air on, and with all faults reset.

5.4.6.2 Cause: Calibration interrupted by another fault

Another fault occurred during calibration and calibration could not be completed successfully.

Remedy: Determine what fault interrupted the calibration, correct it, and repeat the calibration procedure.

5.4.7 PNT1-853 PAUS 1 / PNT1-869 WARN 2 “Non-incr cal table”

Shape Air Sense calibration was aborted because the Shape Air Sense (SAS) pressure did not increase when the commanded flow rate increased.

5.4.7.1 Cause: Air supply regulator set incorrectly

If the supply pressure regulator is set too low, the air supply pressure to the D/Q Valve will be low and the D/Q Valve will not deliver the commanded flow rate.

Remedy: Adjust supply pressure regulator to provide correct pressure.

5.4.7.2 Cause: Loose line in Push-Lock Fitting

If one of the supply lines is not fully inserted into a push-lock fitting, the leak will reduce the pressure of the air supplied to the D/Q Valve.

Remedy: Check the following locations for loose tubes in the push-lock fittings.

- DQ1 & DQ2 at D/Q Valve
- DQ1 & DQ2 at the air supply manifold in the robot carriage
- Air lines on top of the rail, in the rail, or in the cross beams. Note: leaks at these locations will also affect other devices that rely on process air (turbine, Pneumatic Control System, etc…)

Reconnect any tubes that are found to be loose.

5.4.7.3 Cause: Damaged Hose

Damage to one of the supply lines could cause a leak.

Remedy: Inspect these lines for cracks, cuts, or pinholes.

- DQ1 & DQ2 between D/Q Valve and air supply manifold
- Process air supply. Note: leaks at these locations will also affect other devices that rely on process air (turbine, Pneumatic Control System, etc…)

Replace damaged hoses.

5.4.8 PNT1-854 PAUS 1 / PNT1-870 WARN 2 "Zero Pressure"

Shape Air Sense calibration was aborted because the Shape Air Sense (SAS) pressure measured zero psig after the flow command was issued.

5.4.8.1 Cause: Air supply regulator set incorrectly

If the supply pressure regulator is set too low, the D/Q Valve will not deliver the commanded flow rate.

Remedy: Adjust supply pressure regulator to provide correct pressure.

5.4.8.2 Cause: Disconnected line in Push-Lock Fitting

If one of the supply lines is not fully inserted into a push-lock fitting, the leak will reduce the pressure of the air supplied to the D/Q Valve.

Remedy: Check the following locations for loose tubes in the push-lock fittings.

- DQ1 & DQ2 at D/Q Valve
- DQ1 & DQ2 at the air supply manifold in the robot carriage
- Air lines on top of the rail, in the rail, or in the cross beams. Note: leaks at these locations will also affect other devices that rely on process air (turbine, Pneumatic Control System, etc…)

Reconnect any tubes that are found to be loose.

5.4.8.3 Cause: Damaged Hose

Damage to one of the supply lines (DQ1 & DQ2, or process air supply) could cause a leak.

Remedy: Inspect the following lines for cracks, cuts, or pinholes.

- DQ1 & DQ2 between D/Q Valve and Air supply manifold in carriage.
- Process air supply lines (in catrack, in rail, or in cross beams) Note: leaks at these locations will also affect other devices that rely on process air (turbine, Pneumatic Control System, etc…)

Replace damaged hose.

5.4.8.4 Cause: Leak in Shape Air Sense line

If the shape air sense line is disconnected, the Shaping Air Control System will report zero manifold pressure.

Remedy: Inspect the SAS line for leaks due to damage or a loose connection at the following locations:

- Process air manifold in Axis 3 housing
- SAS Pressure sensor (P/I) in process enclosure
- Barrel fitting at applicator quick disconnect

Replace damaged lines or reconnect loose hoses in push-lock fittings

5.4.8.5 Cause: Missing Shape Air Nozzle

If a Shape Air Nozzle was not installed in the Shroud this alarm will prevent accidental processing of a job without effective shaping air.

Remedy: Install the appropriate Shape Air Nozzle and perform Shape Air Sense Calibration, described in the section above.

Warning: Only calibrate the Shape Air Sense feature on newly cleaned Shape Air Nozzles! Calibrating using a dirty Shape Air Nozzle will reduce the sensitivity of Shape Air Sense and may result in nuisance alarms.

5.4.8.6 Cause: Air Leak due to Loose Applicator

If the applicator was not tightly connected to the quick-disconnect (QD) a leak could occur in the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS). See <applicator section x.x.x.x> for more information.

Remedy: Reinstall the applicator tightly on the QD.

5.4.8.7 Cause: Air Leak due to Missing O-ring in Applicator

If one or more of the radial o-rings in the Applicator for the shape air supply lines (SA1 & SA2) or the shape air sense line (SAS) were not installed, a leak here could cause this fault. See <applicator section x.x.x.x> for more information.

Remedy: Remove the Applicator and reinstall the missing o-ring.

5.4.8.8 Cause: Air Leak due to Missing O-ring in Shape Air Nozzle

If one or more of the o-rings in the Shape Air Nozzle are missing, a leak here could cause this fault. See <applicator section x.x.x.x> for more information.

Remedy: Remove the Shape Air Nozzle and reinstall the missing o-ring.

5.5 Spare Parts & Tools

5.5.1 Spare Parts Required

The following spare parts are used to service the Shape Air Control System.

D/Q Valve Spare Parts Kit (EO-4696-110-031)

- Includes:
  - (2) Orifice (EO-4696-110-032) (1 required for each D/Q Valve, 2 included for convenience)
  - Pipe Plug with Seal (EO-4696-110-033)
  - Viton O-Ring #2-018 (EO9999-200-005AU)
  - Viton O-Ring #2-023 (EO9999-200-005AV)
  - Viton O-Ring #2-027 (EO9999-200-005AW)
  - Viton O-Ring #2-030 (EO9999-200-005T)
  - Viton O-Ring #2-035 (EO9999-200-005AX)
  - (8) D/Q Cup Seal #354076 (SEALM0000000022O)
- P/I pressure sensor has no spare parts
- See Applicator Quick Disconnect section x.x.x.x for hose bundle spare part information
- See Applicator section x.x.x.x for Applicator spare part information

5.5.2 Tools Required

The following tools are required to perform maintenance on the Shape Air Control System.

- 30mm socket or wrench
- 3/16” hex wrench
- 3/32” hex wrench
- 3mm hex wrench
- 5mm hex wrench
- Small Phillips Screw Driver
- Small knife or pin
- Pin Vice – Brown & Sharpe #599-790-1 (0-.040”)
- #73 (0.024”) drill bit

6 SHAPE AIR CONTROL SYSTEM - ACCUAIR

6.1 Overview

6.1.1 Introduction

The Shape Air Control System delivers the requested shape air flow rate to the applicator using a closed loop control system to compensate for downstream pressure fluctuations. The pressure transducer watches the flow output from the flow meter and adjusts the pressure accordingly so that the flow meter can supply the requested air flow to the applicator.

The flow control system is calibrated during assembly and does not need to be recalibrated in the field. A simple automatic procedure is used to update the pressure transducer calibration table for the particular shape air nozzle or applicator that is installed.

6.1.2 System Components

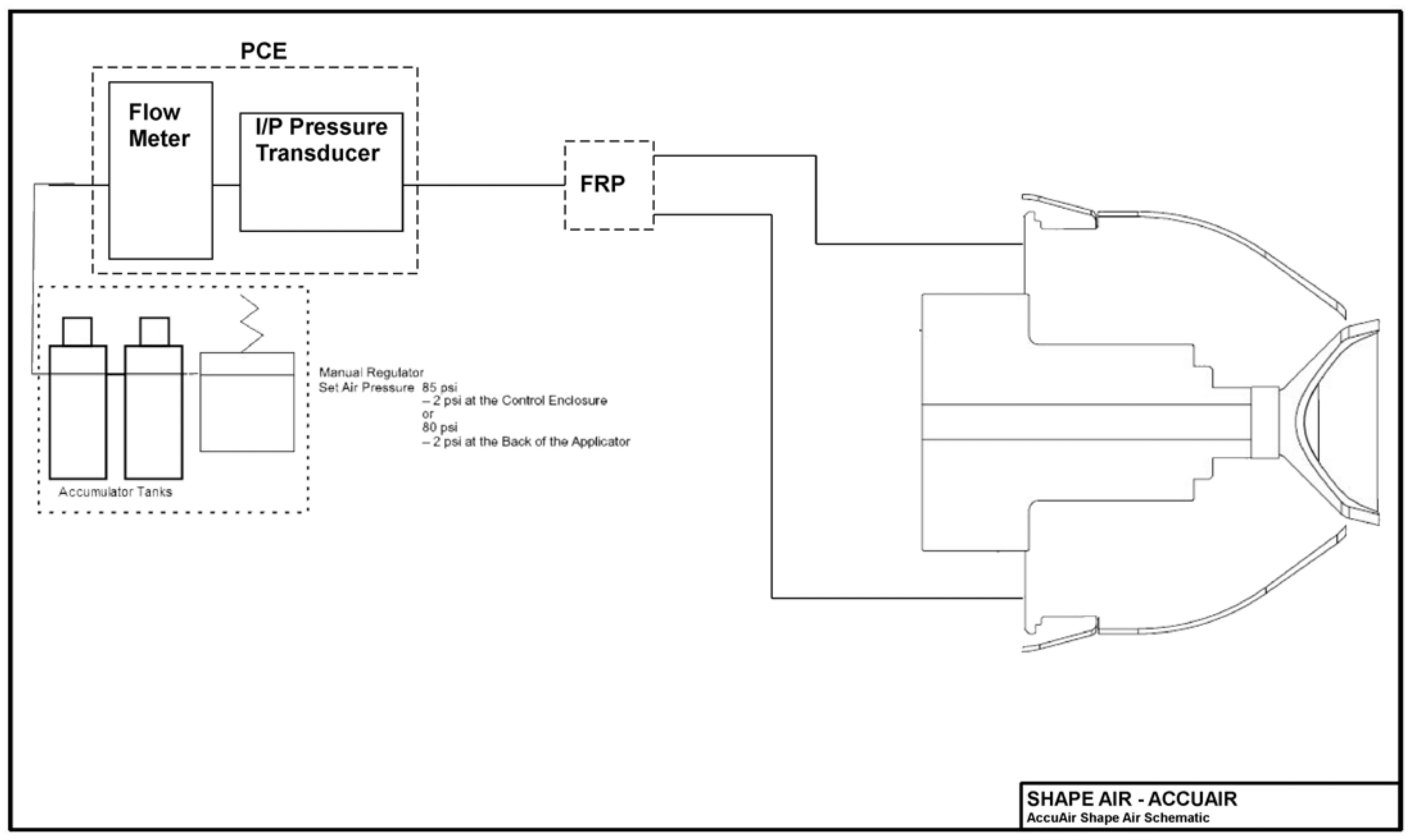


Figure 26: Single Shape Air AccuAir Schematic

Note:

- Detailed information on the Pneumatic Control System can be found in the robot specific manual
- Detailed information on the Shape Air Nozzle can be found in section 1.

6.2 Maintenance and Repair

6.3 Operation and Setup

The following sections describe the installation of the components of the Shape Air Control System and the software setup features that are required for operation.

6.3.1 Flow Meter

The flow meter measures the shaping air flow rate in the Shape Air Control System, and sends the measured flow back to the Pneumatic Control System via the communication system.

Installation
The flow meter is connected to the Pneumatic Control System by a 4-pin communication cable that connects to the top of the flow meter. The flow meter is held in place by 4 screws included with the device. These screws can be attached to the PCE itself, or to a bracket inside of the PCE. The Flow meter position and components are shown in the figure below.

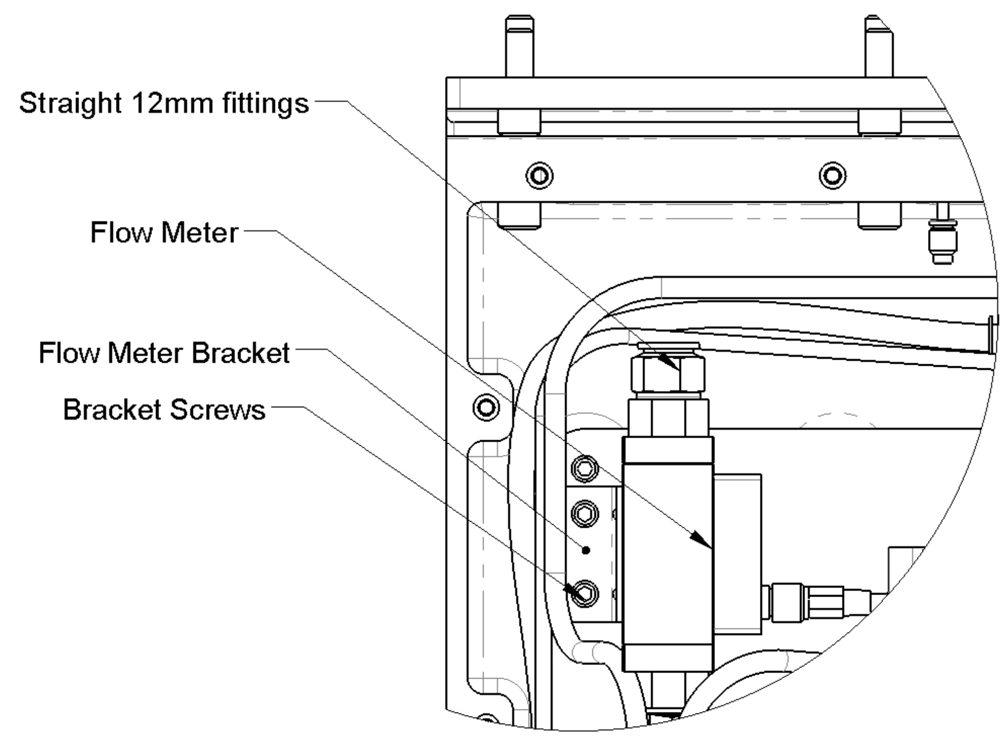


Figure 27: Flow meter components. P-500iA PCE shown for example

The air inlet ports at the top and outlet ports on the bottom of the flow meter are 3/8 G thread. A straight 12mm push-lock fitting is connected to each port. Pipe dope or Teflon tape should not be applied to the threads of the fittings. Tighten the fittings until the seal of the G fitting is tight against the body of the flow meter.

The shape air supply must be dry and filtered (air quality per DIN ISO 8573-1: 3.4.4).

6.3.2 Pressure Transducer

The pressure transducer regulates the pressure based on a command value from the controller or teach pendant.

Installation
The pressure transducer is mounted inside the PCE either directly to the PCE body or to a bracket that is connected to the PCE body. A push-lock fitting receives the 12mm air line from the flow meter. Another push-lock fitting connects to the outlet of the transducer, which leads to the applicator. The electrical cable is connected at the top of the transducer. .

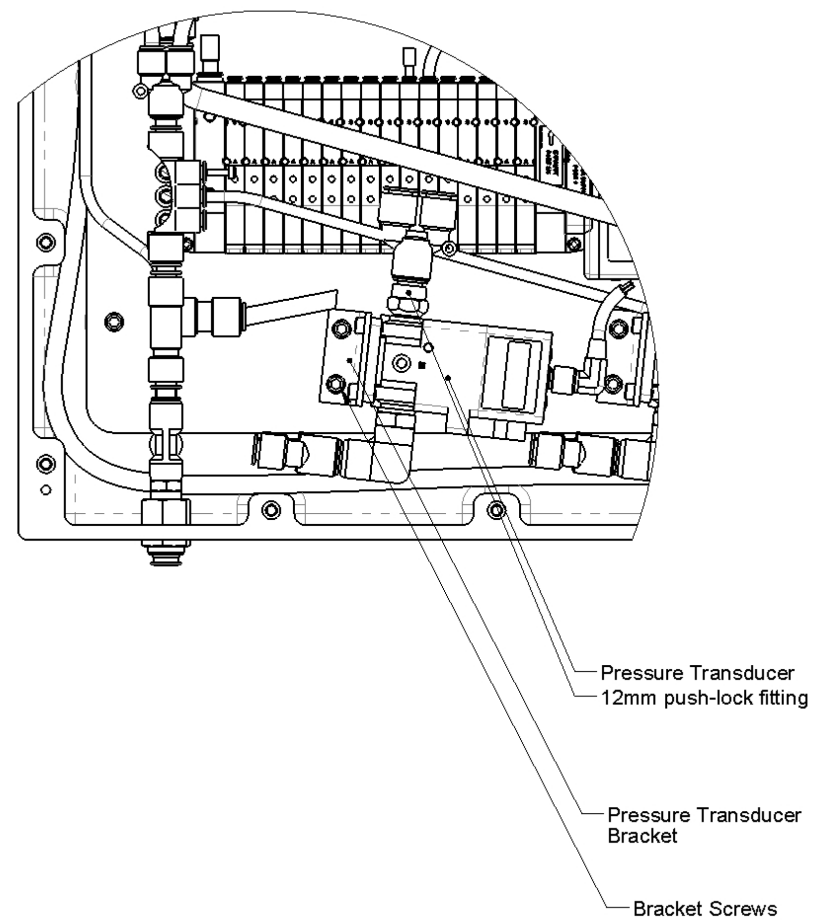


Figure 28: Pressure Transducer

6.3.3 Software Setup

Shaping air flow rates that are used while processing a job are commanded by entering the requested values as entries in System Color Preset table data. Shaping air flow rate commands during color change are entered as parameters in Color Change Presets. The PaintTool software application in the robot control system sends these commands to the Shape Air Control System.

6.3.3.1 Shape Air Calibration

Shape air calibration table
In order to provide maximum sensitivity, the shape air calibration table must be updated whenever the Shape Air Nozzle or Applicator is changed. To calibrate the shape air system, use the calibration procedure in PaintTool.

Warning: Only update the shape air calibration table feature on newly cleaned Shape Air Nozzles! Calibrating using a dirty Shape Air Nozzle will reduce the sensitivity of Shape Air Sense and may result in redundant alarms.

The Shape Air Control System is designed to function without planned maintenance for the life of the robot. Occasionally a failure of the supply air filter system can cause contamination the flow meter or pressure transducer and degrade its performance. In this situation, replace the faulty component.

6.4 Troubleshooting

This section provides troubleshooting guidelines for faults generated by the Shape Air Control System. Possible causes and remedies are listed for each fault. The errors posted here are in the form of <Error Number><Warning or Fault> %s <Description>, where %s is a placeholder for Shape Air 1, or optionally Shape Air 2, depending on which shape air system is being used.

6.4.1 PNT1-616 WARN %sCalibration successful

Cause: Used to notify the cell controller that a calibration has been completed successfully.

Remedy: None.

6.4.2 PNT1-617 WARN %sCalibration aborted

Cause: AccuAir calibration could not complete. Possible reasons for aborting the calibration are:

- The air supply being off.
- Incorrect setup parameters.
- Incomplete hardware setup.

Remedy: Check for other alarms in the log The best remedy might be found from the previous alarm in the log. Request proper air flow at the cap, and check that it occurs. Check that the Sensor scale and various other parameters are set properly. Increase the Calibration time out parameter.

6.4.3 PNT1-618 WARN %sCal. low flow rate reset

Cause: This is a warning not a failure. During AccuAir calibration the low flow rate could not be properly reached. A new flow rate was established. The target minimum flow rate is Point no. 2 of the calibration table in the parameter setup screen.

Remedy: The new flow rate is shown as point 2 in the calibration table. This value can be visually checked and accepted. Increase the yield of the system by increasing air line diameters to the applicator. Point no. 2 of the calibration table in the parameter setup menu can be increased (by about 100%).

6.4.4 PNT1-619 WARN %sCal. max. flow rate reset

Cause: This is a warning, not a failure. During AccuAir calibration, the expected maximum flow rate could not be reached at the maximum output. A new maximum flow rate was established.

Remedy: The new maximum flow rate is shown as point 10 in the calibration table. This value can be visually checked, and accepted

6.4.5 PNT1-647 WARN %sCalibration successful

Cause: Used to notify the cell controller that a calibration has been completed successfully.

Remedy: None**.**

6.4.6 PNT1-648 WARN %sCalibration aborted

Cause: AccuAir calibration could not complete. Possible reasons for aborting the calibration are:

- The air supply being off.
- Incorrect setup parameters.
- Incomplete hardware setup.

Remedy: Check for other alarms in the log The best remedy might be found from the previous alarm in the log. Request proper air flow at the cap, and check that it occurs. Check that the Sensor scale and various other parameters are set properly. Increase the Calibration time out parameter.

6.4.7 PNT1-649 WARN %sCal. low flow rate reset

Cause: This is a warning not a failure. During AccuAir calibration the low flow rate could not be properly reached. A new flow rate was established. The target minimum flow rate is Point no. 2 of the calibration table in the parameter setup screen.

Remedy: The new flow rate is shown as point 2 in the calibration table. This value can be visually checked and accepted. Increase the yield of the system by increasing air line diameters to the applicator. Point no. 2 of the calibration table in the parameter setup menu can be increased (by about 100%).

6.4.8 PNT1-650 WARN %sCal. max. flow rate reset

Cause: This is a warning, not a failure. During AccuAir calibration the expected maximum flow rate could not be reached at the maximum output. A new maximum flow rate was established.

Remedy: The new maximum flow rate is shown as point 10 in the calibration table. This value can be visually checked and accepted.

6.4.9 PNT1-626 WARN %sMax. output has flow < setpoint

Cause: With a maximum control output, the flow rate was measured to be lower than the setpoint (requested flow). The maximum control out (ms) parameter affects the sensitivity of this alarm. This is likely caused by a dirty shape air nozzle ring. This might also be caused by:

- Pinched air lines
- A broken I/P transducer
- A broken air flow sensor

Note: AccuAir temporarily and automatically changes to Open Loop when this alarm occurs.

Remedy: Check, clean, and possibly replace the air cap. If air is observed to be flowing (when commanded), possibly replace the air flow sensor. Also check the following:

- Check for a pinched air line.
- Check and repair the I/P transducer.
- Increase the Max. control out (ms) parameter (by about 50%), if possible.

6.4.10 PNT1-632 WARN %s0 air flow rate timeout

Cause: All of the conditions were set for air to be flowing but a zero flow rate was measured for longer than the Zero flow timeout parameter. This might be caused by:

- A clogged air nozzle
- Broken air lines
- A loss of air supply pressure
- A broken air flow sensor
- A broken cable to the flow sensor
- A Zero flow time-out value that is too short.

Note: AccuAir temporarily and automatically changes to Open Loop when this alarm occurs.

Remedy: Check the following:

- Check, clean, and possibly replace the air nozzle.
- If air was observed to be flowing, check and possibly replace the air flow sensor.
- Check for a broken air line.
- Increase the Zero flow timeout parameter by about 25%, if possible.

Increase the Zero flow time-out parameter (by about 25%), if possible.

6.4.11 PNT1-657 WARN %sMax. output has flow < setpoint

Cause: With a maximum control output, the flow rate was measured to be lower than the setpoint (requested flow). The maximum control out (ms) parameter affects the sensitivity of this alarm. This is likely caused by a dirty shape air nozzle ring. This might also be caused by:

- Pinched air lines
- A broken I/P transducer
- A broken air flow sensor

Note: AccuAir temporarily and automatically changes to Open Loop when this alarm occurs.

Remedy: Check, clean, and possibly replace the air cap. If air is observed to be flowing (when commanded), possibly replace the air flow sensor. Also check the following:

- Check for a pinched air line.
- Check and repair the I/P transducer.
- Increase the Max. control out (ms) parameter (by about 50%), if possible.

6.4.12 PNT1-663 WARN %s0 air flow rate timeout

Cause: All of the conditions were set for air to be flowing but a zero flow rate was measured for longer than the Zero flow timeout parameter. This might be caused by:

- A clogged air nozzle
- Broken air lines
- A loss of air supply pressure
- A broken air flow sensor
- A broken cable to the flow sensor
- A Zero flow time-out value that is too short.

Note: AccuAir temporarily and automatically changes to Open Loop when this alarm occurs.

Remedy: Check the following:

- Check, clean, and possibly replace the air nozzle.
- If air was observed to be flowing, check and possibly replace the air flow sensor.
- Check for a broken air line.
- Increase the Zero flow timeout parameter by about 25%, if possible.

7 SEAL AIR CONTROL

7.1 Overview

Seal air pressure is set with a manual air regulator located in the PCE on the outer arm. A 4 x 6 mm nylon hose (SEAL) connects from the regulator to the applicator wrist manifold. The purpose of Seal Air is to help maintain a clean surface on the back of the bell cup, as well as the front face of the turbine.

7.2 Operations and Setup

The manual regulator is located in the PCE as shown below. The 4 x 6 mm hose connects to the above regulator and connects to the Quick Disconnect manifold. The manual regulator should be set such that the flow rate is to 120 slpm. (approximately 20 psig).

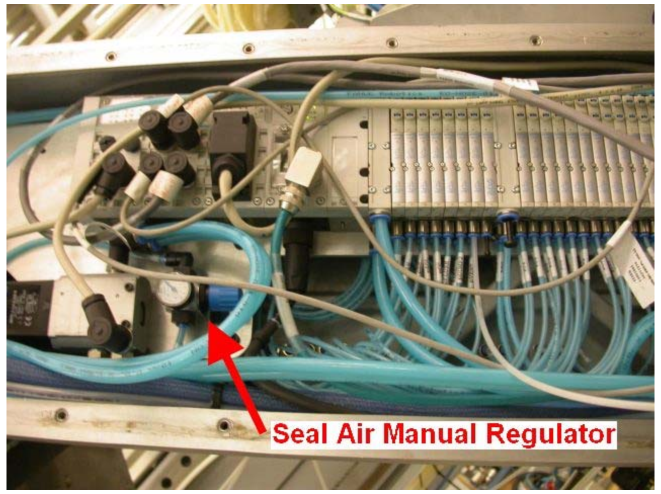


Figure 7-1: P-700 Seal air manual regulator

7.3 Maintenance and Repair

There is no scheduled maintenance for this item.

7.4 Troubleshooting

- If the back face of the bell cup continues to become contaminated, disassemble the applicator to the Seal Air Nozzle. Check to verify that the slots and holes in the Seal Air Nozzle are clean. If not, clean the Seal Air Nozzle.
- Check the seal air line for leaks.
- Verify Seal Air flow.
- If the flow rates are the same, replace manual regulator.

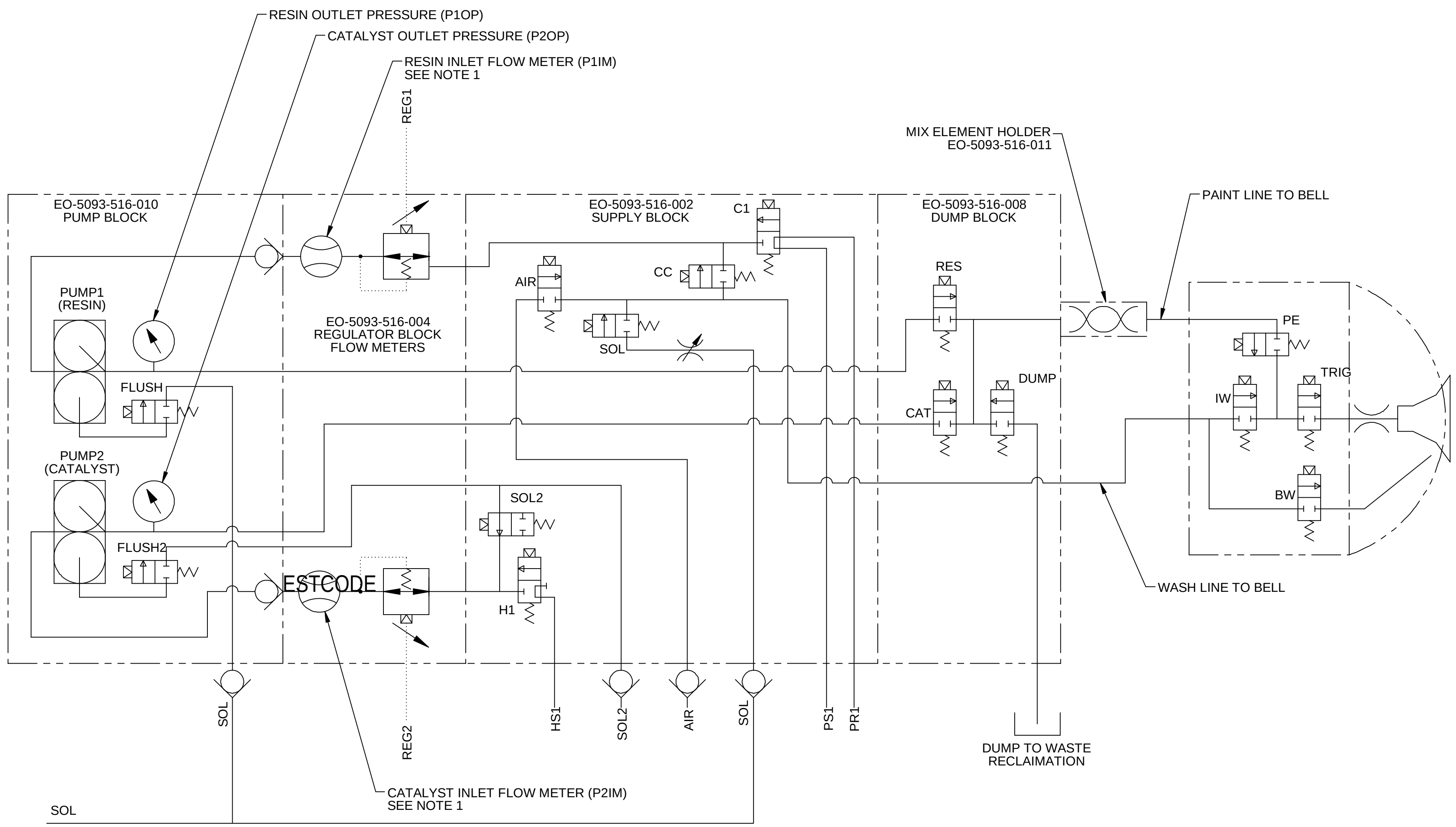
7.5 Spare Parts and Tools

No special tools.

No wearable parts.

8 IPC PAINT DELIVERY SYSTEM

Figure 8-1 EG-00384, P-700 2K 1+1 SCHEMATIC - VAR. REG.



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

NOTES:

1. INLET FLOW METERS (EO-5093-516-004) ARE REPLACED WITH INLET PRESSURE SENSORS (EO-5093-516-006) IN SOME CONFIGURATIONS. THE INLET SENSOR LABELS (P1IM & P2IM) ARE REPLACED WITH P1IP & P2IP.

EO5093-895-003J SHOWN
CIRCULATING RESIN
NON-CIRCULATING CATALYST
VARIABLE PRESSURE REGULATORS
INLET FLOW METERS

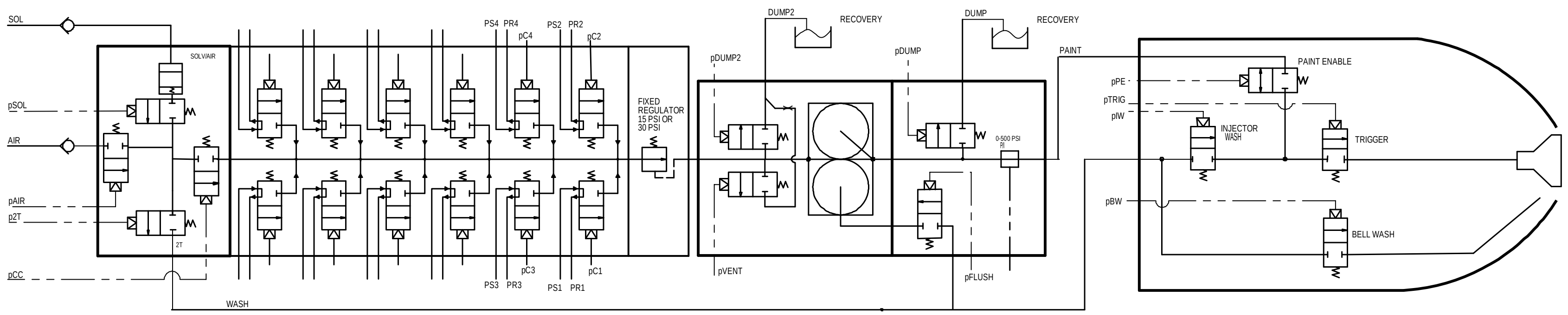
[EG-00384] P-700 2K 1+1 SCHEMATIC - VAR. REG.	REV E1 SHEET 2 OF 4

Figure 8-2 EG-00385, P-700 1K WITH FIX REG SCHEMATICS

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.

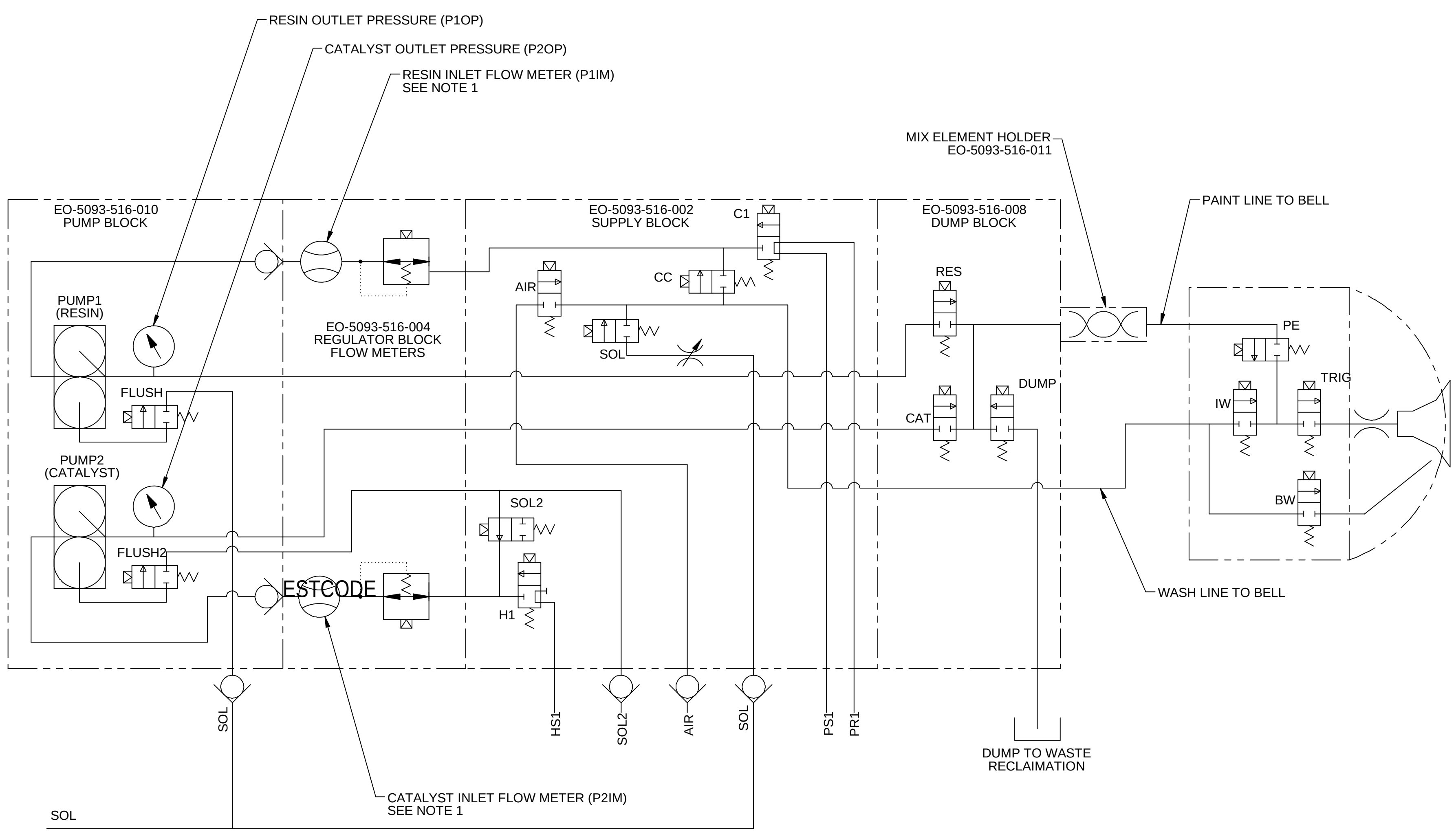
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



FLUID DELIVERY SCHEMATIC
1K GEAR PUMP W/ FIXED REGULATOR

[EG-00385] P-700 1K WITH FIX REG SCHEMATICS	REV C1 SHEET 2 OF 3

Figure 8-3 EG-00387, P-700 2K 1+1 SCHEMATIC - FIXED REG.



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

NOTES:

1. INLET FLOW METERS (EO-5093-516-004) ARE REPLACED WITH INLET PRESSURE SENSORS (EO-5093-516-006) IN SOME CONFIGURATIONS. THE INLET SENSOR LABELS (P1IM & P2IM) ARE REPLACED WITH P1IP & P2IP.

EO5093-895-003H SHOWN
CIRCULATING RESIN
NON-CIRCULATING CATALYST
FIXED PRESSURE REGULATORS
INLET FLOW METERS

[EG-00387] P-700 2K 1+1 SCHEMATIC - FIXED REG.	REV D2 SHEET 2 OF 4

Figure 8-4 EG-00388, MULTIRESIN 2K SCHEMATIC - VAR. REG.

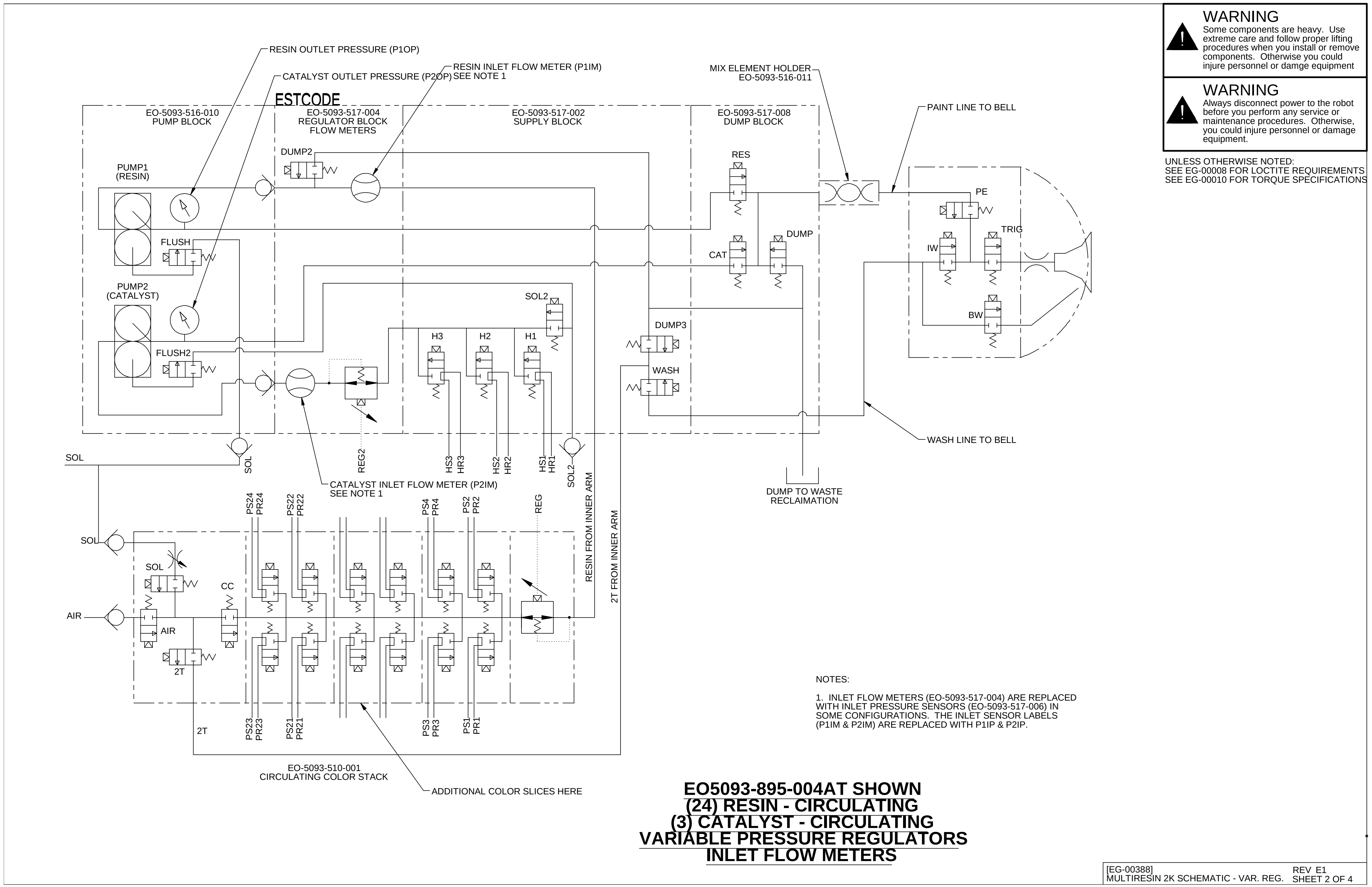
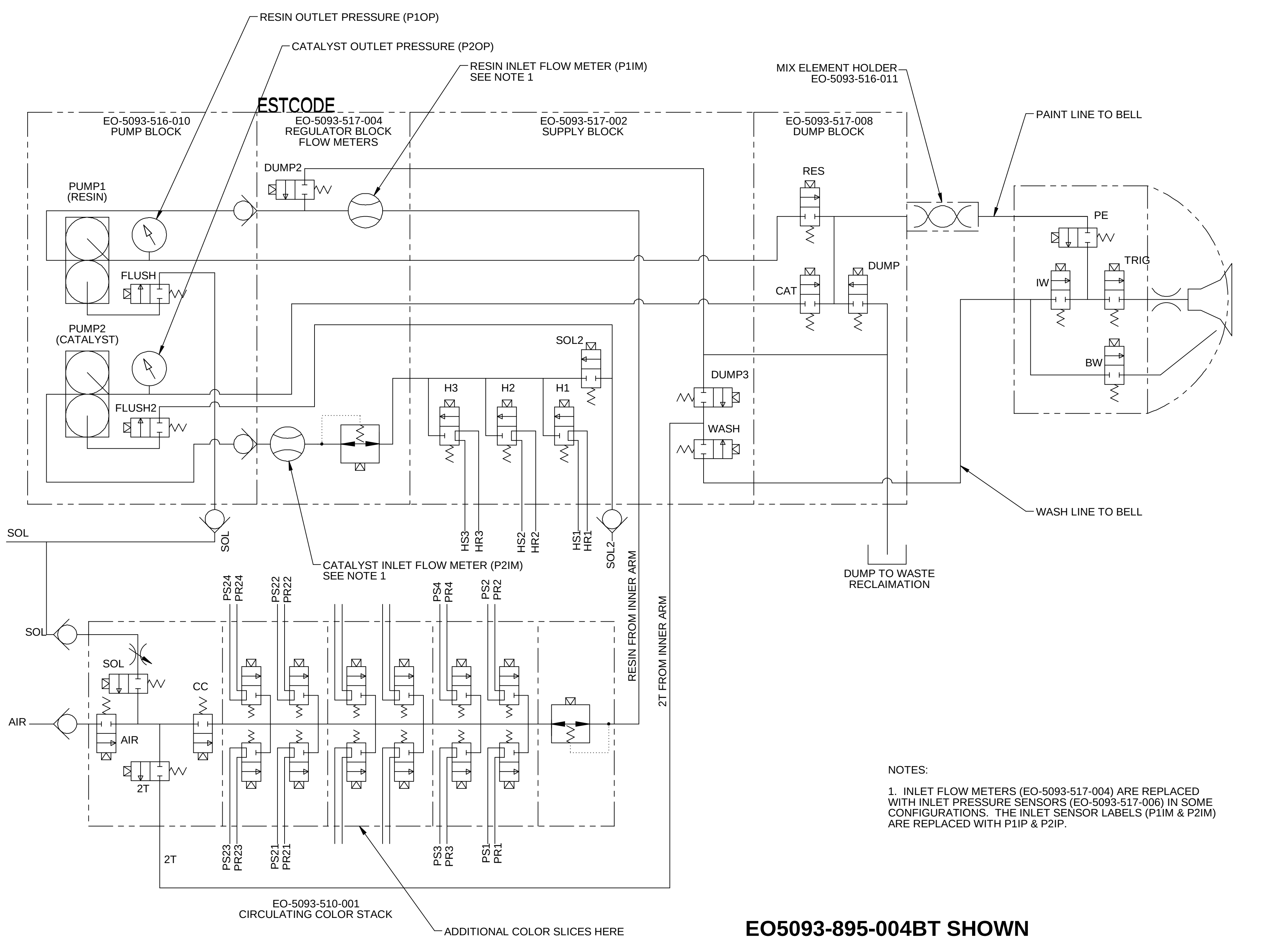


Figure 8-5 EG-00389, MULTIRESIN 2K SCHEMATIC - FIX REG



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

NOTES:

1. INLET FLOW METERS (EO-5093-517-004) ARE REPLACED WITH INLET PRESSURE SENSORS (EO-5093-517-006) IN SOME CONFIGURATIONS. THE INLET SENSOR LABELS (P1IM & P2IM) ARE REPLACED WITH P1IP & P2IP.

EO5093-895-004BT SHOWN
(24) RESIN - CIRCULATING
(3) CATALYST - CIRCULATING
FIXED PRESSURE REGULATORS
INLET FLOW METERS

[EG-00389] REV E2
MULTIRESIN 2K SCHEMATIC - FIX REG SHEET 2 OF 4

Figure 8-6 EG-00390, P-700 WB SCHEMATICS

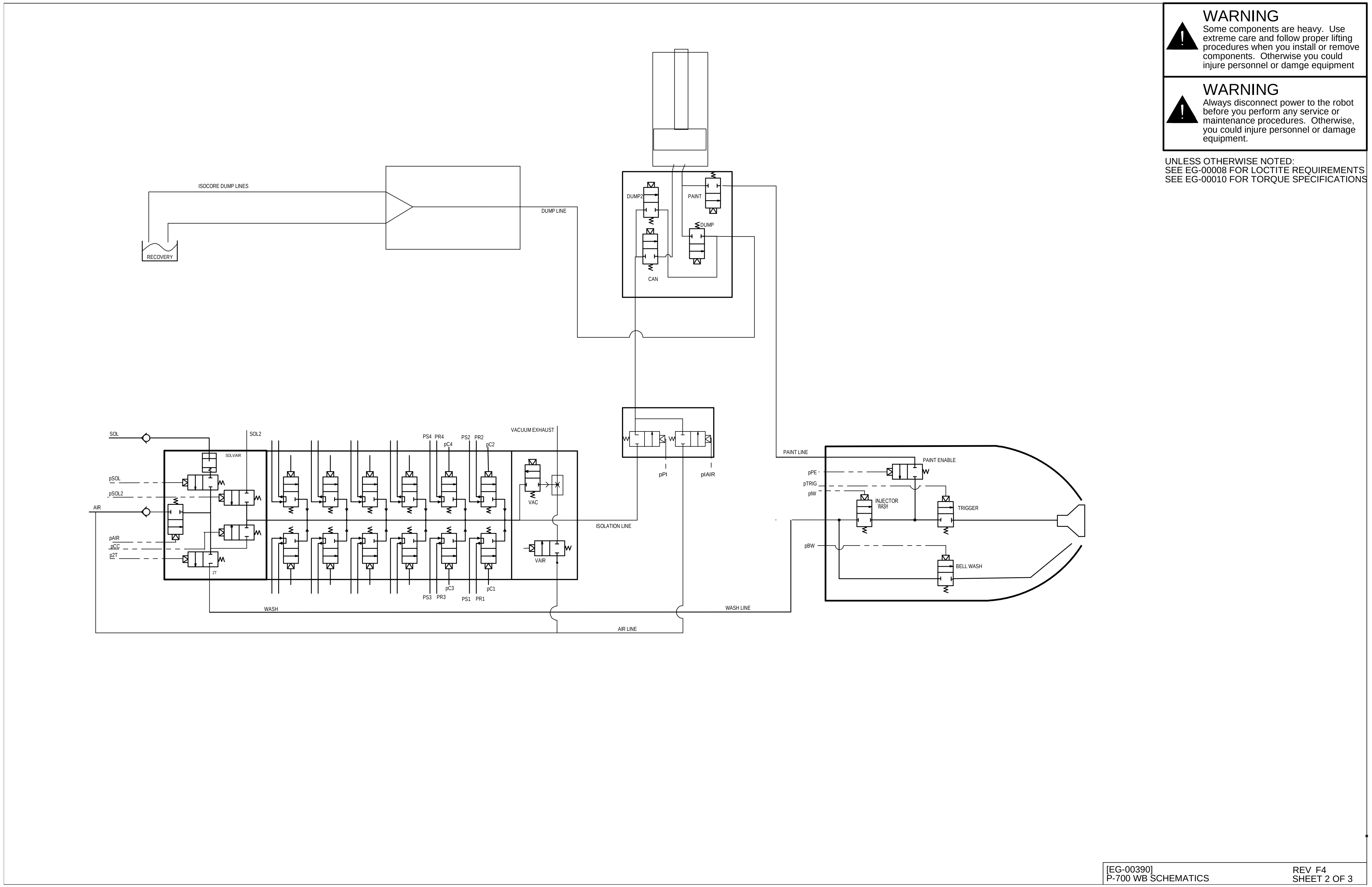
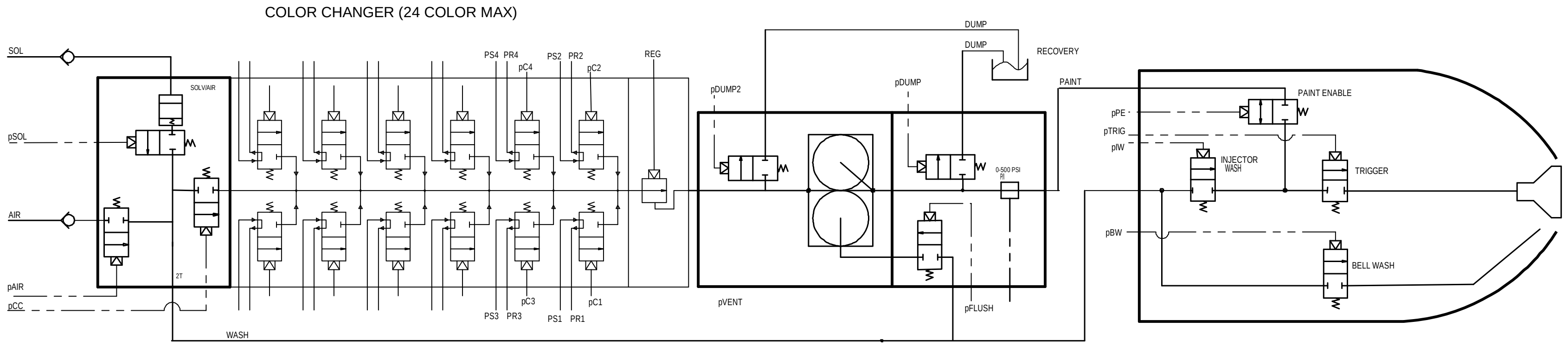


Figure 8-7 EG-00401, 1K WITH REG SCHEMATICS



FLUID DELIVERY SCHEMATIC
1K GEAR PUMP W/ REGULATOR

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

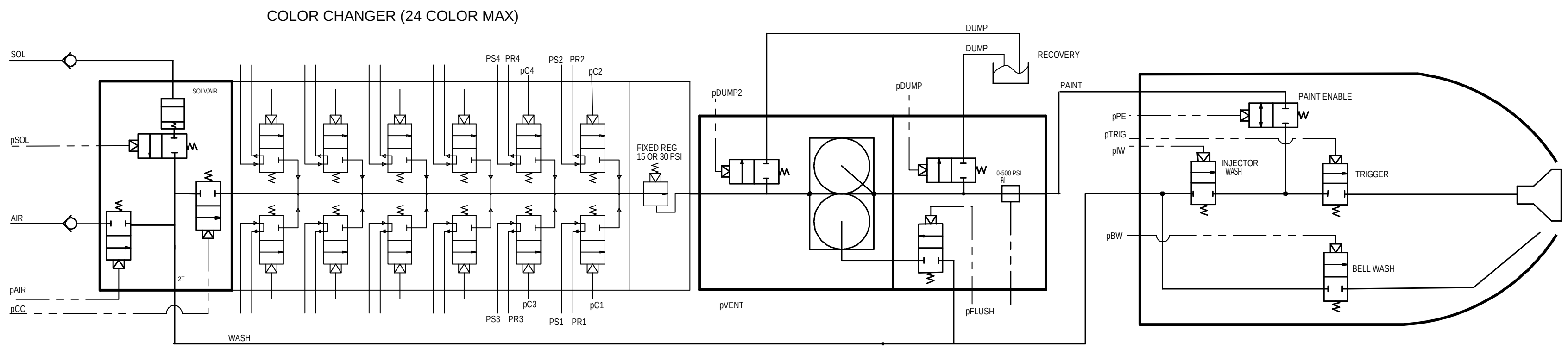
[EG-00401]	REV A
1K FESTO WITH REG SCHEMATICS	SHEET 2 OF 3

Figure 8-8 EG-00402, P-500iA 1K W/ FIXED REG SCHEM

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



FLUID DELIVERY SCHEMATIC
1K GEAR PUMP W FIXED REGULATOR

[EG-00402]	REV A
P-500iA 1K W/ FIXED REG SCHEM	SHEET 2 OF 3

Figure 8-9 EG-00403, P-500iA WATERBORNE SCHEM

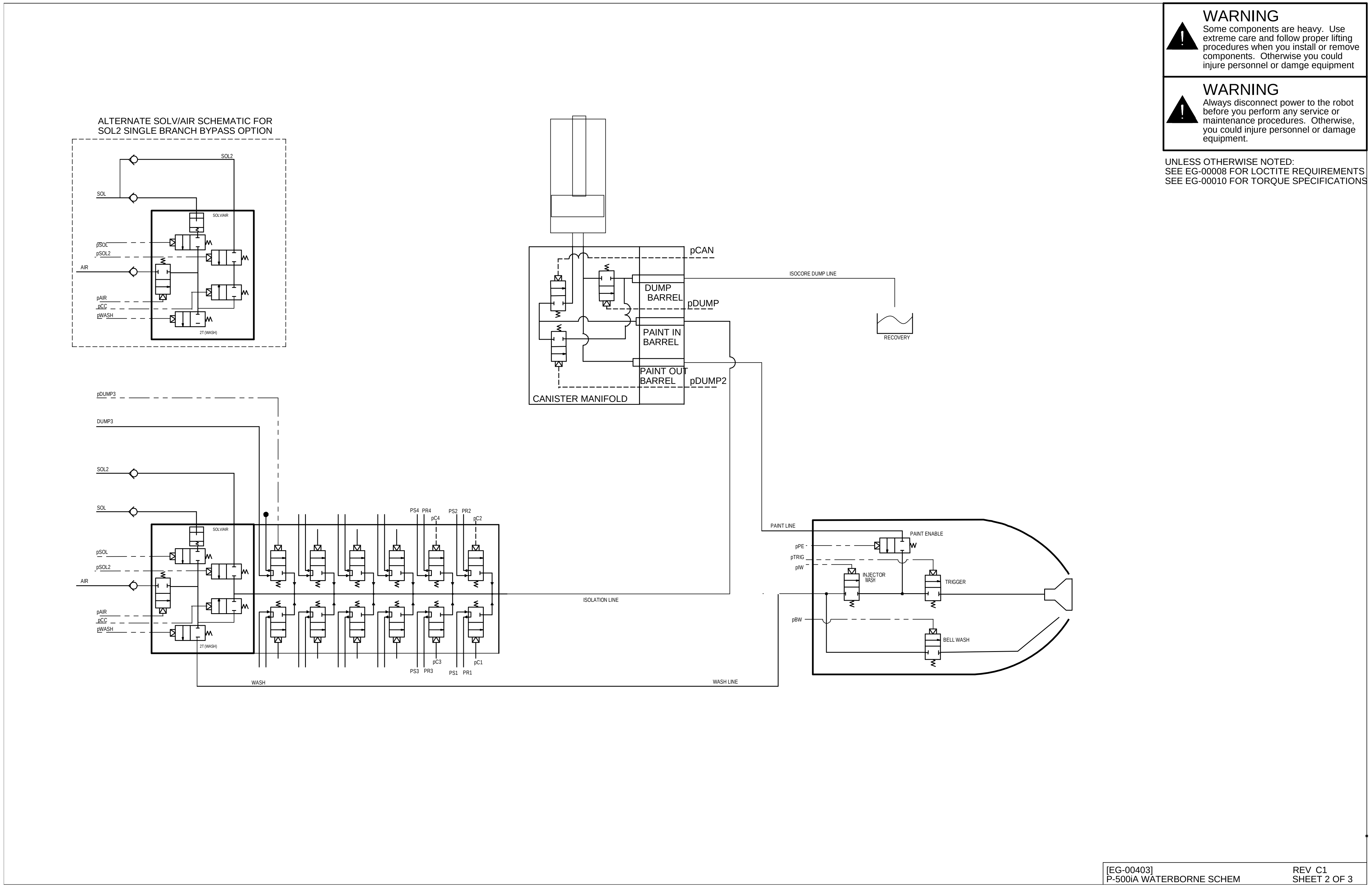
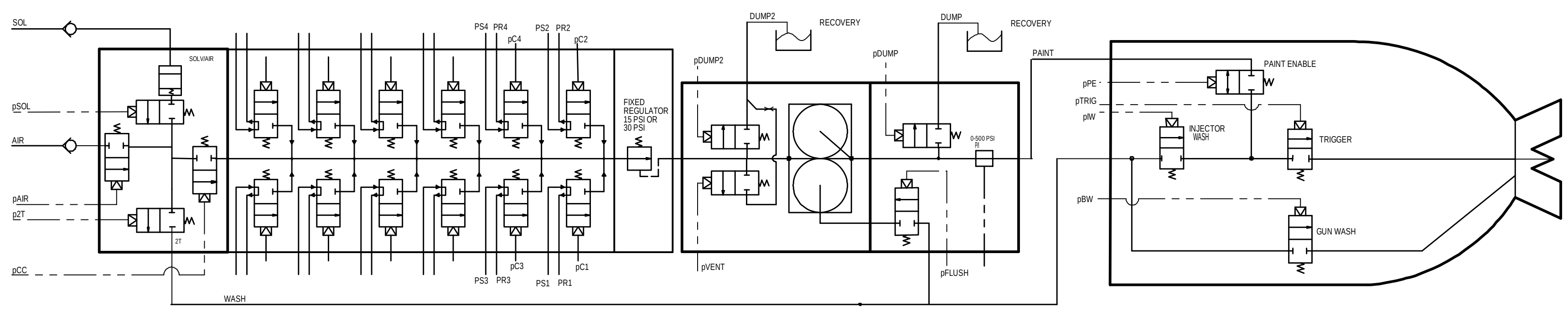


Figure 8-10 EG-00410, P-700 GUN OPTION 1K WITH FIX REG SCHEMATICS



FLUID DELIVERY SCHEMATIC
GUN OPTION 1K GEAR PUMP W/ FIXED REGULATOR

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

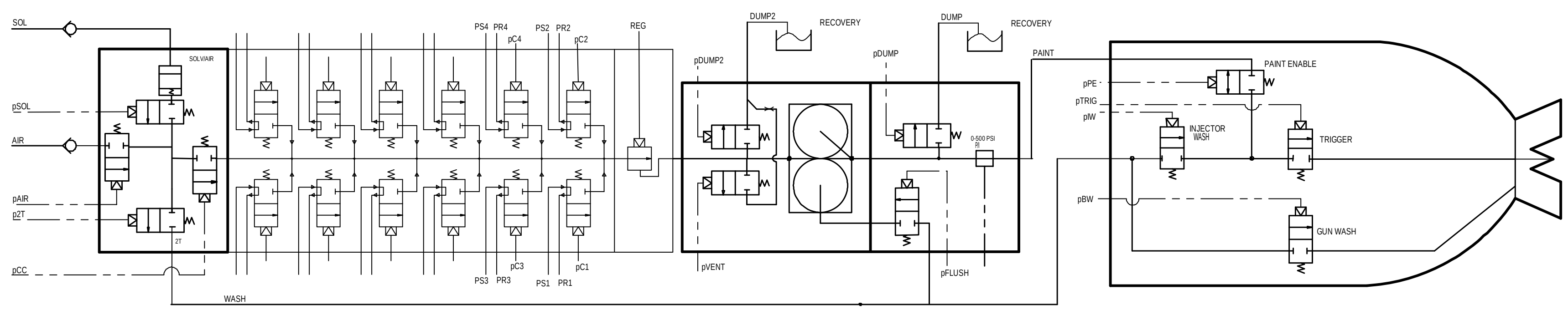
[EG-00410] P-700 GUN OPTION 1K WITH FIX REG SCHEMATICS	REV B SHEET 2 OF 3

Figure 8-11 EG-00411, P-700 GUN OPTION 1K WITH REG SCHEMATICS

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



FLUID DELIVERY SCHEMATIC
GUN OPTION 1K GEAR PUMP W/ REGULATOR

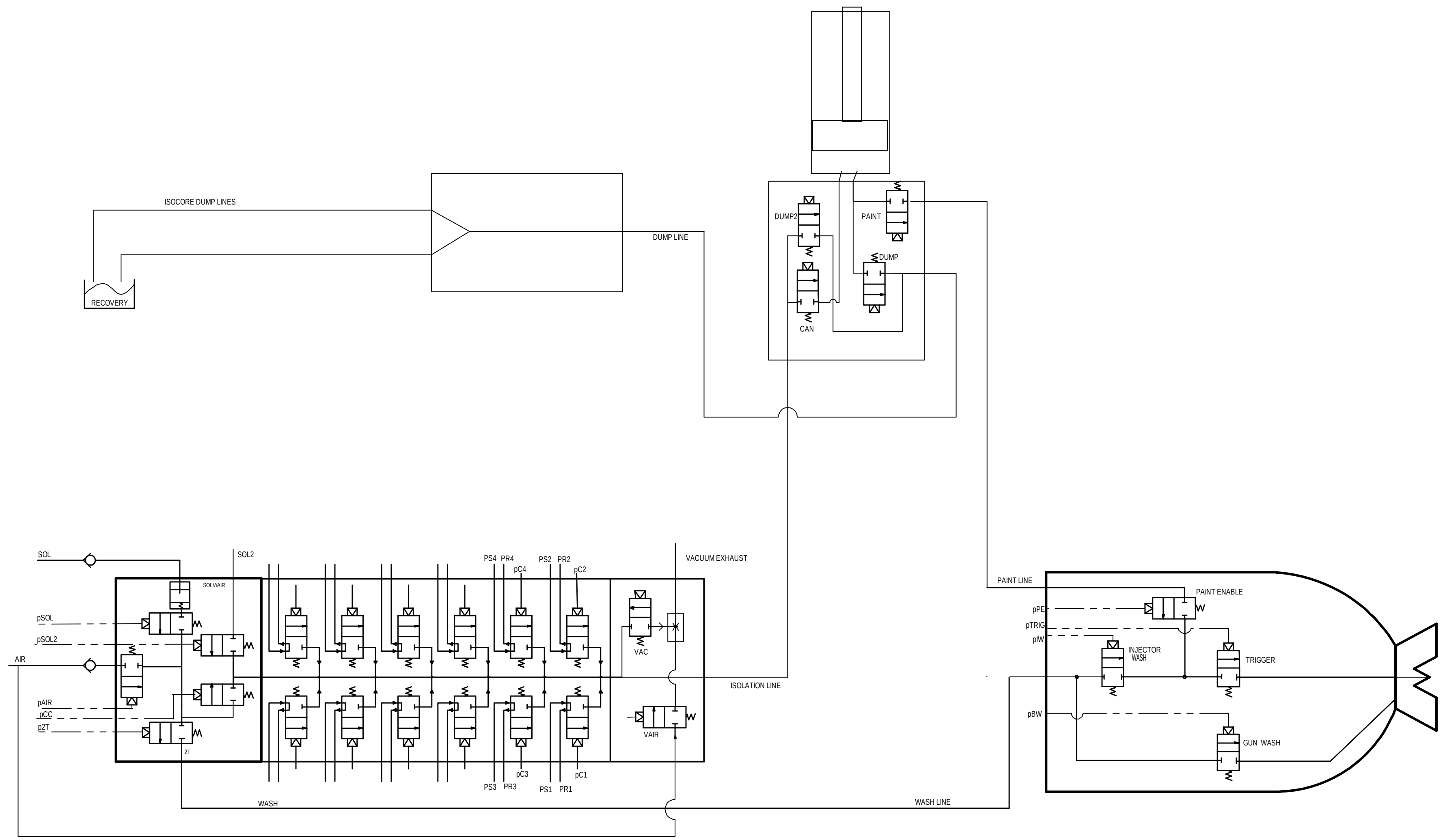
[EG-00411] P-700 GUN OPTION 1K WITH REG SCHEMATICS	REV C1 SHEET 2 OF 3

Figure 8-12 EG-00412, P-700 GUN OPTION WB SCHEMATICS

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

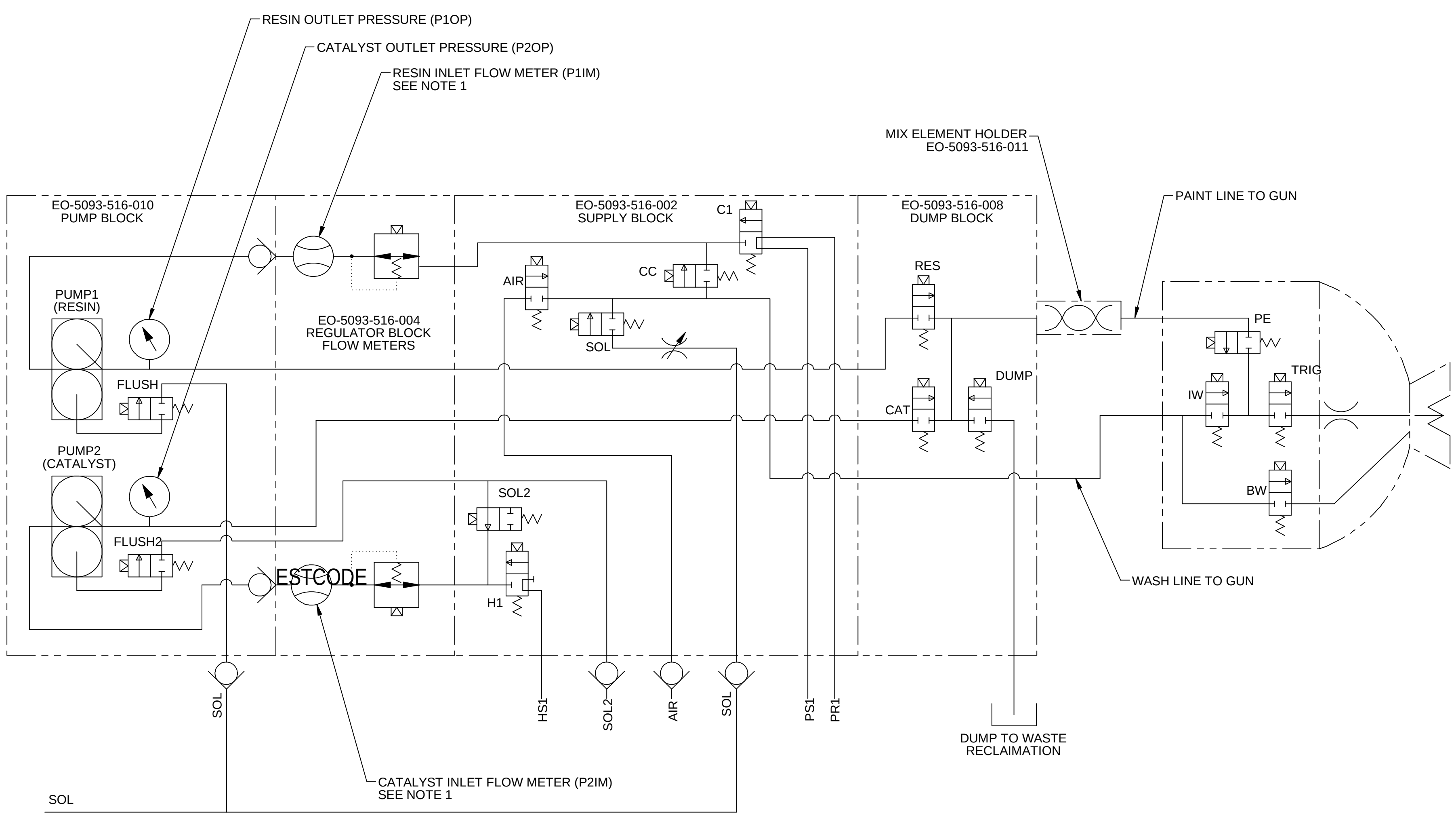
WARNING
Always disconnect power to the robot before you perform any service or maintenance procedures. Otherwise, you could injure personnel or damage equipment.

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



[EG-00412]	REV B
P-700 GUN OPTION WB SCHEMATICS	SHEET 2 OF 3

Figure 8-13 EG-00413, P-700 GUN OPTION 2K 1+1 SCHEMATICS - FIXED REG.



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

NOTES:

1. INLET FLOW METERS (EO-5093-516-004) ARE REPLACED WITH INLET PRESSURE SENSORS (EO-5093-516-006) IN SOME CONFIGURATIONS. THE INLET SENSOR LABELS (P1IM & P2IM) ARE REPLACED WITH P1IP & P2IP.

EO5093-895-007H SHOWN
GUN OPTION CIRCULATING RESIN
NON-CIRCULATING CATALYST
FIXED PRESSURE REGULATORS
INLET FLOW METERS

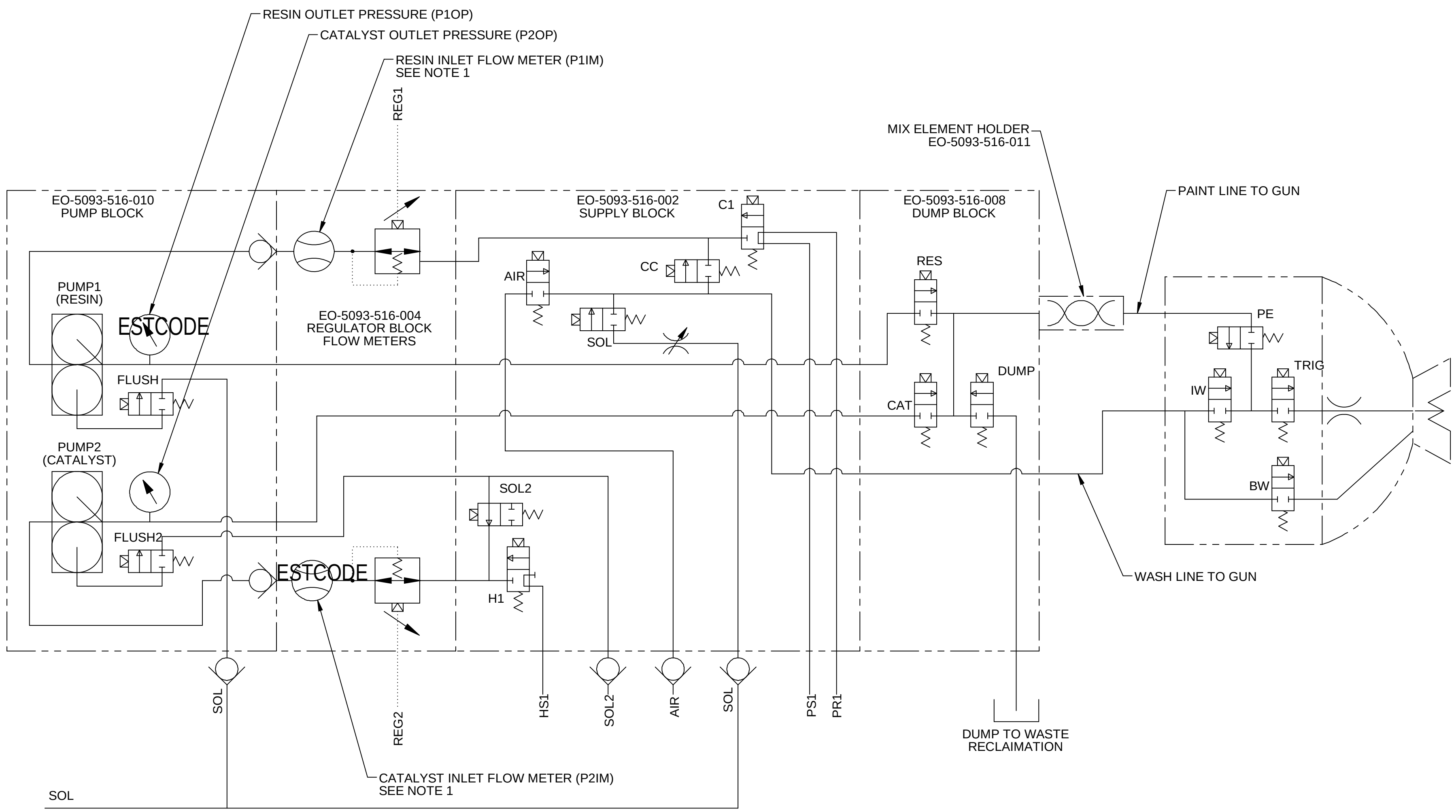
[EG-00413] REV B
P-700 GUN OPTION 2K 1+1 SCHEMATICS - SHEET 2 OF 4
FIXED REG.

Figure 8-14 EG-00414, P-700 GUN OPTION 2K 1+1 SCHEMATIC - VAR. REG.

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



NOTES:

1. INLET FLOW METERS (EO-5093-516-004) ARE REPLACED WITH INLET PRESSURE SENSORS (EO-5093-516-006) IN SOME CONFIGURATIONS. THE INLET SENSOR LABELS (P1IM & P2IM) ARE REPLACED WITH P1IP & P2IP.

EO5093-895-007J SHOWN
GUN OPTION CIRCULATING RESIN
NON-CIRCULATING CATALYST
VARIABLE PRESSURE REGULATORS
INLET FLOW METERS

[EG-00414]	REV C1
P-700 GUN OPTION 2K 1+1 SCHEMATIC - VAR. REG.	SHEET 2 OF 4

Figure 8-15 EG-00416, GUN OPTION MULTIRESIN 2K SCHEMATIC - VAR. REG.

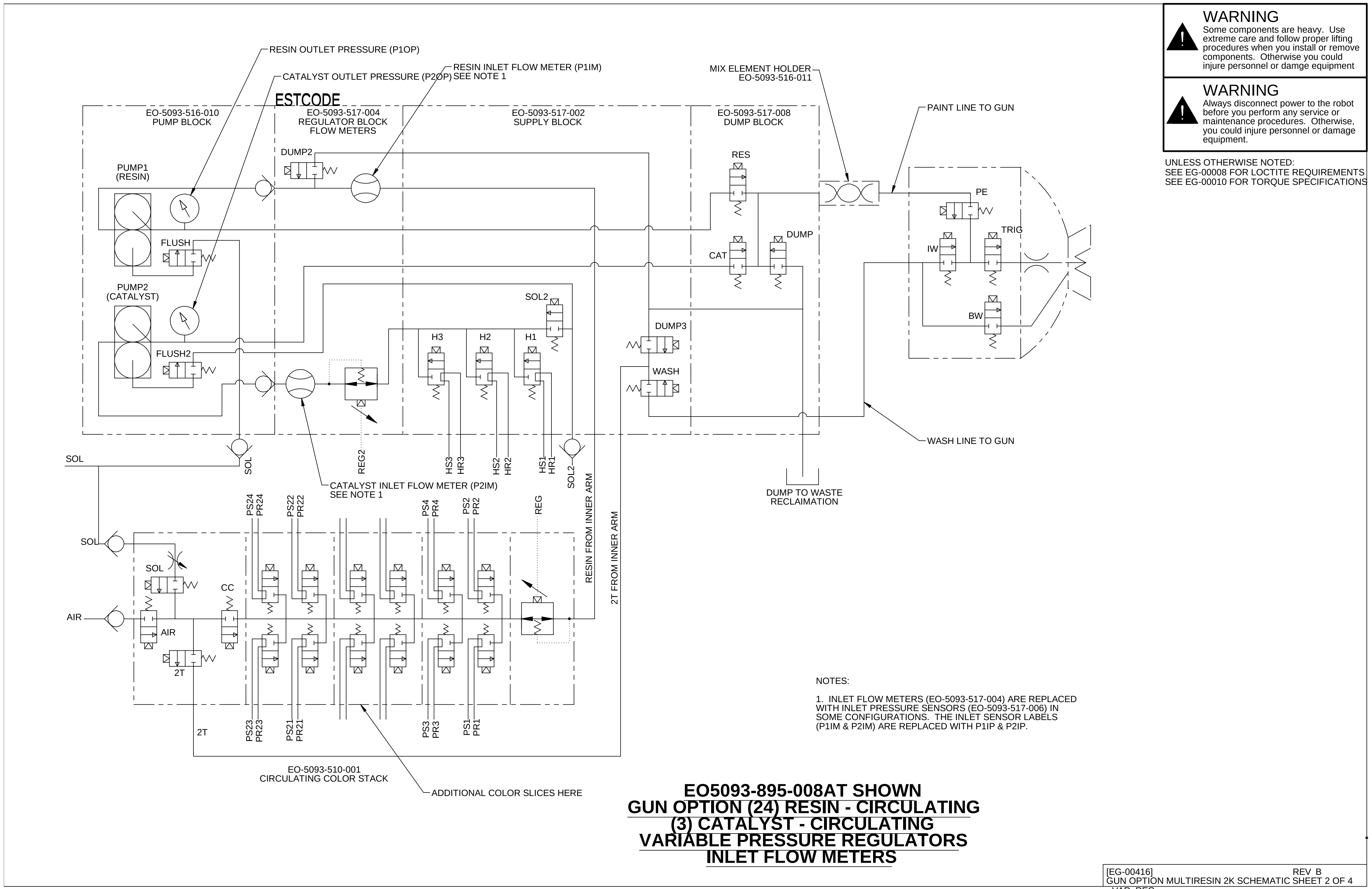
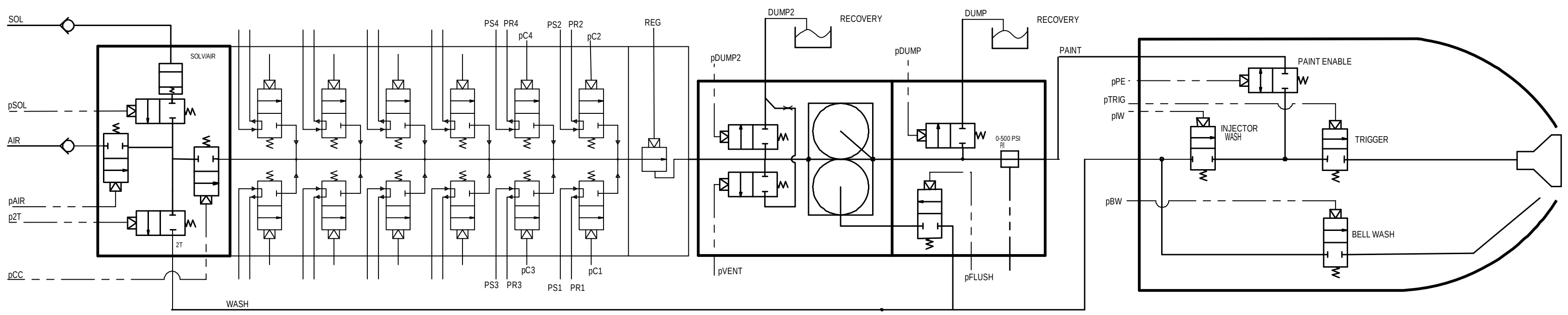


Figure 8-16 EG-00440, P-700 SMC 1K WITH REG SCHEMATICS

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



FLUID DELIVERY SCHEMATIC
1K GEAR PUMP W/ REGULATOR

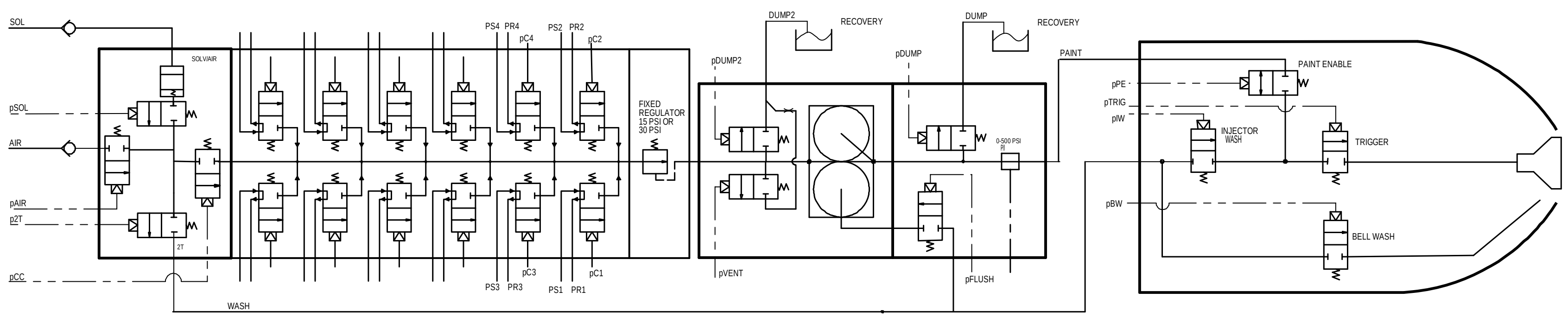
[EG-00440]	REV B
P-700 SMC 1K WITH REG SCHEMATICS	SHEET 2 OF 3

Figure 8-17 EG-00441, P-700 SMC 1K FIXED REG SCHEMATICS

> **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



FLUID DELIVERY SCHEMATIC
1K GEAR PUMP W/ REGULATOR

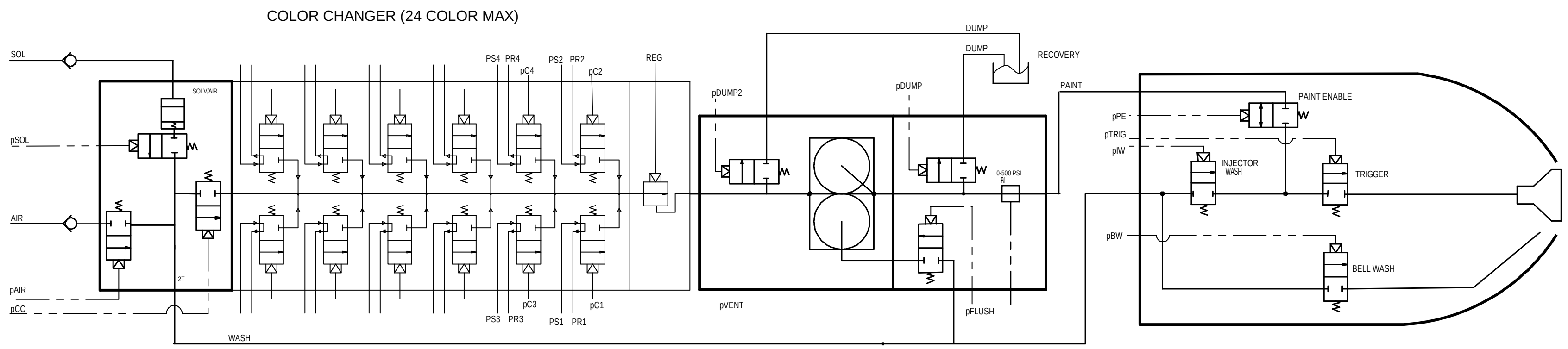
[EG-00441]	REV B
P-700 SMC 1K FIXED REG SCHEMATICS	SHEET 2 OF 3

Figure 8-18 EG-00442, 1K SMC WITH REG SCHEMATICS

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



FLUID DELIVERY SCHEMATIC
1K GEAR PUMP W/ REGULATOR

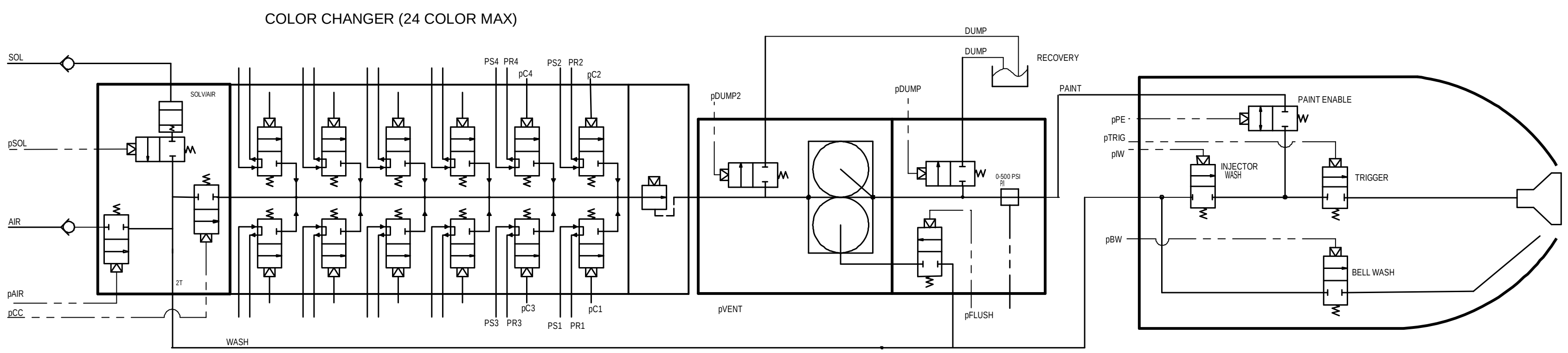
[EG-00442] 1K SMC WITH REG SCHEMATICS	REV C SHEET 2 OF 4

Figure 8-19 EG-00444, 1K WITH FIXED REG SCHEMATICS

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



FLUID DELIVERY SCHEMATIC
1K GEAR PUMP W/ REGULATOR

[EG-00444] 1K WITH FIXED REG SCHEMATICS	REV C SHEET 2 OF 4

Figure 8-20 EG-00446, SMC WB/Single Shape Air Schematics

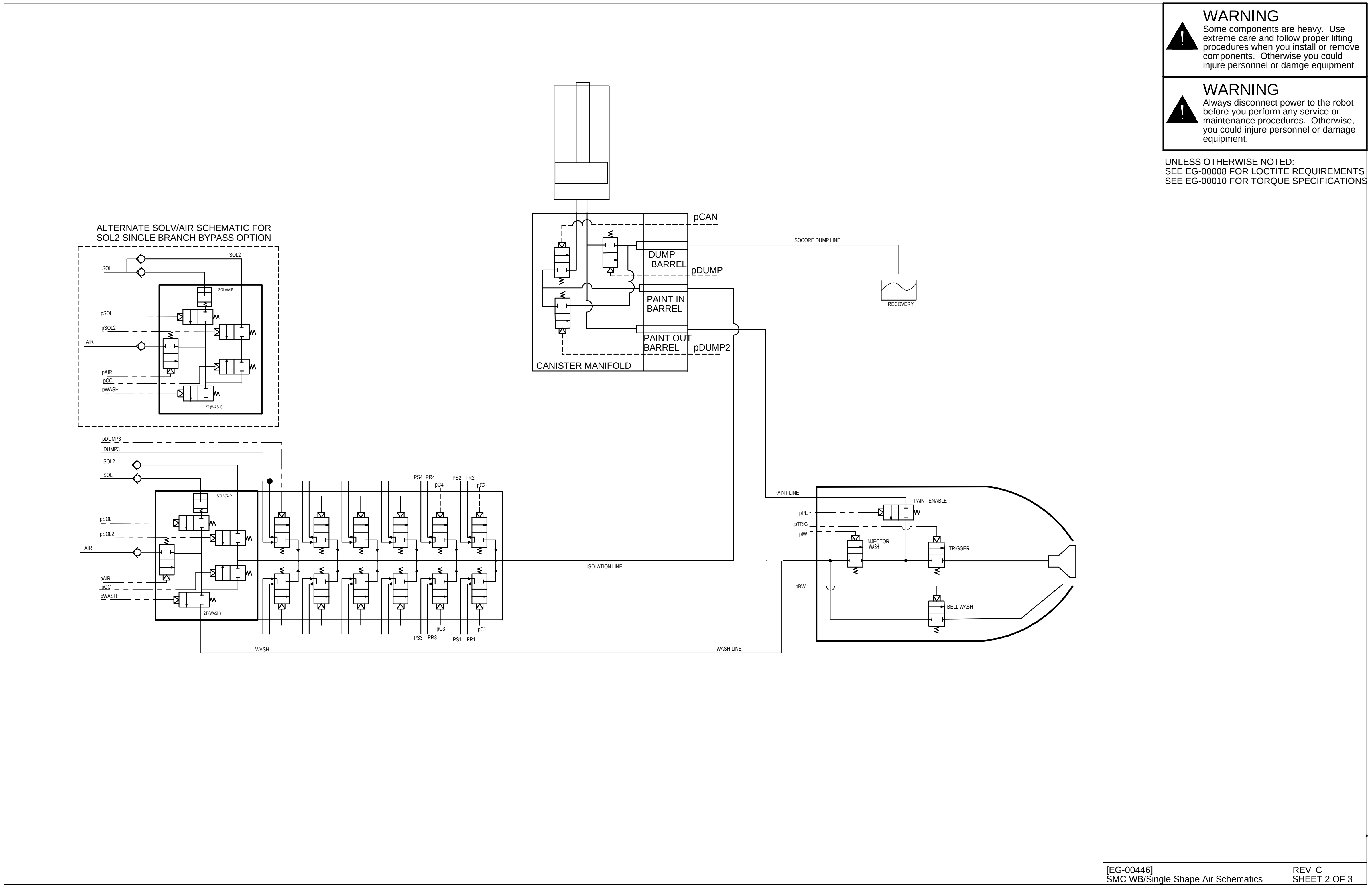


Figure 8-21 EG-00456, P-700 SMC WB SCHEMATICS

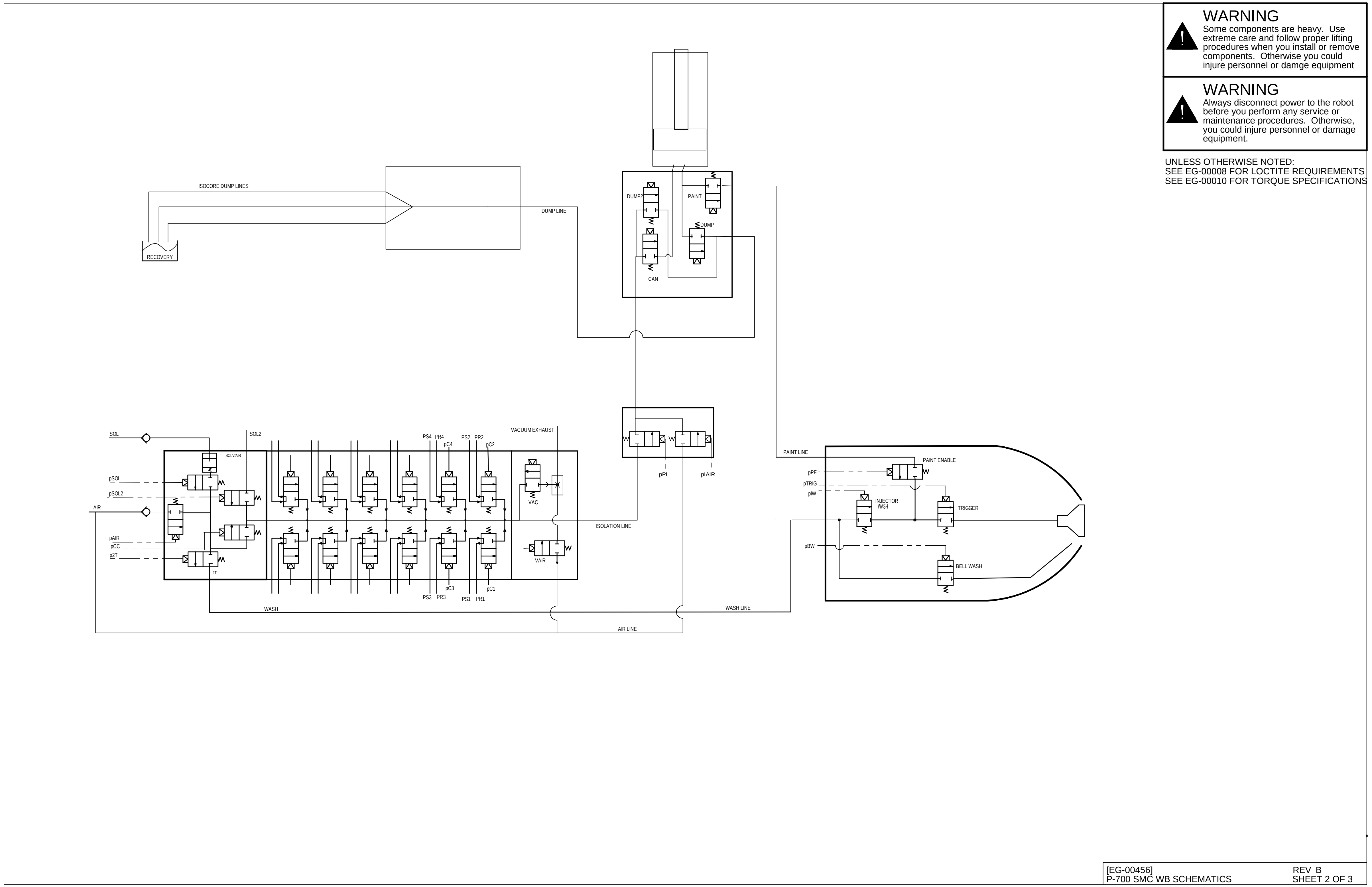
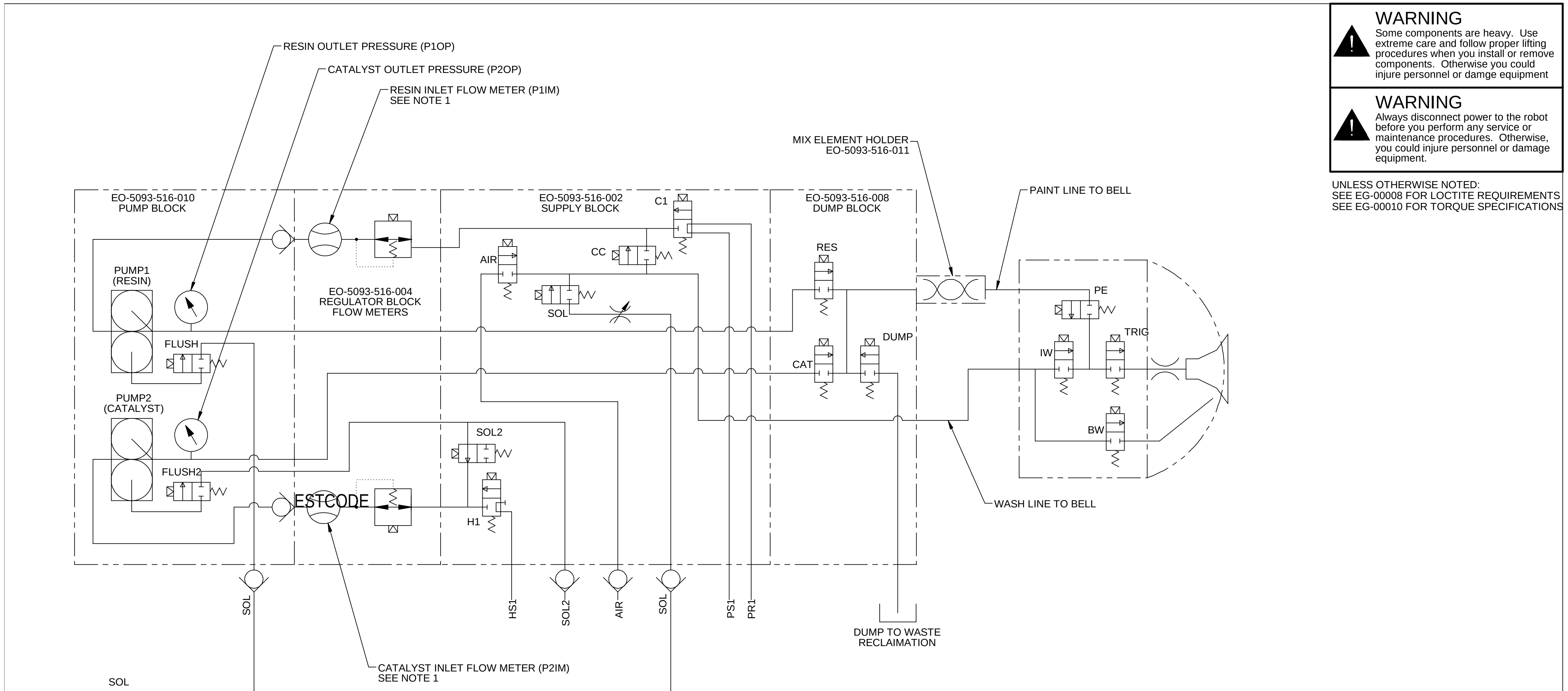


Figure 8-22 EG-00457, P-700 SMC 2K 1+1 FIX REG SCHEMATIC



NOTES:

1. INLET FLOW METERS (EO-5093-516-004) ARE REPLACED WITH INLET PRESSURE SENSORS (EO-5093-516-006) IN SOME CONFIGURATIONS. THE INLET SENSOR LABELS (P1IM & P2IM) ARE REPLACED WITH P1IP & P2IP.

EO6246-895-003H SHOWN
CIRCULATING RESIN
NON-CIRCULATING CATALYST
FIXED PRESSURE REGULATORS
INLET FLOW METERS

[EG-00457]	REV A
P-700 SMC 2K 1+1 FIX REG SCHEMATIC	SHEET 2 OF 4

Figure 8-23 EG-00458, P-700 SMC 2K 1+1 WITH REG SCHEMATIC

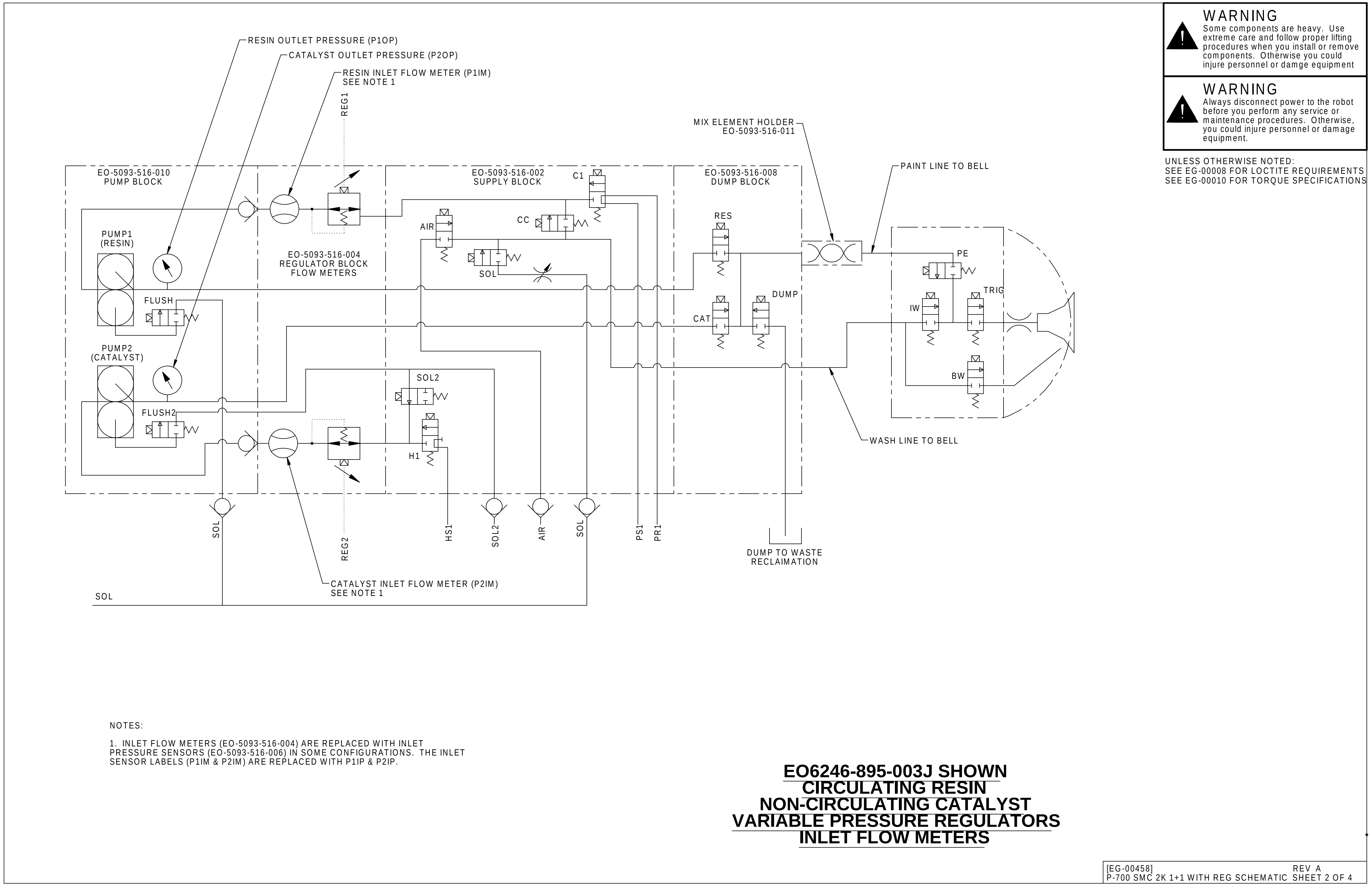


Figure 8-24 EG-00485, P700 SMC 2K 24+3 SCHEMATIC FIXED REG

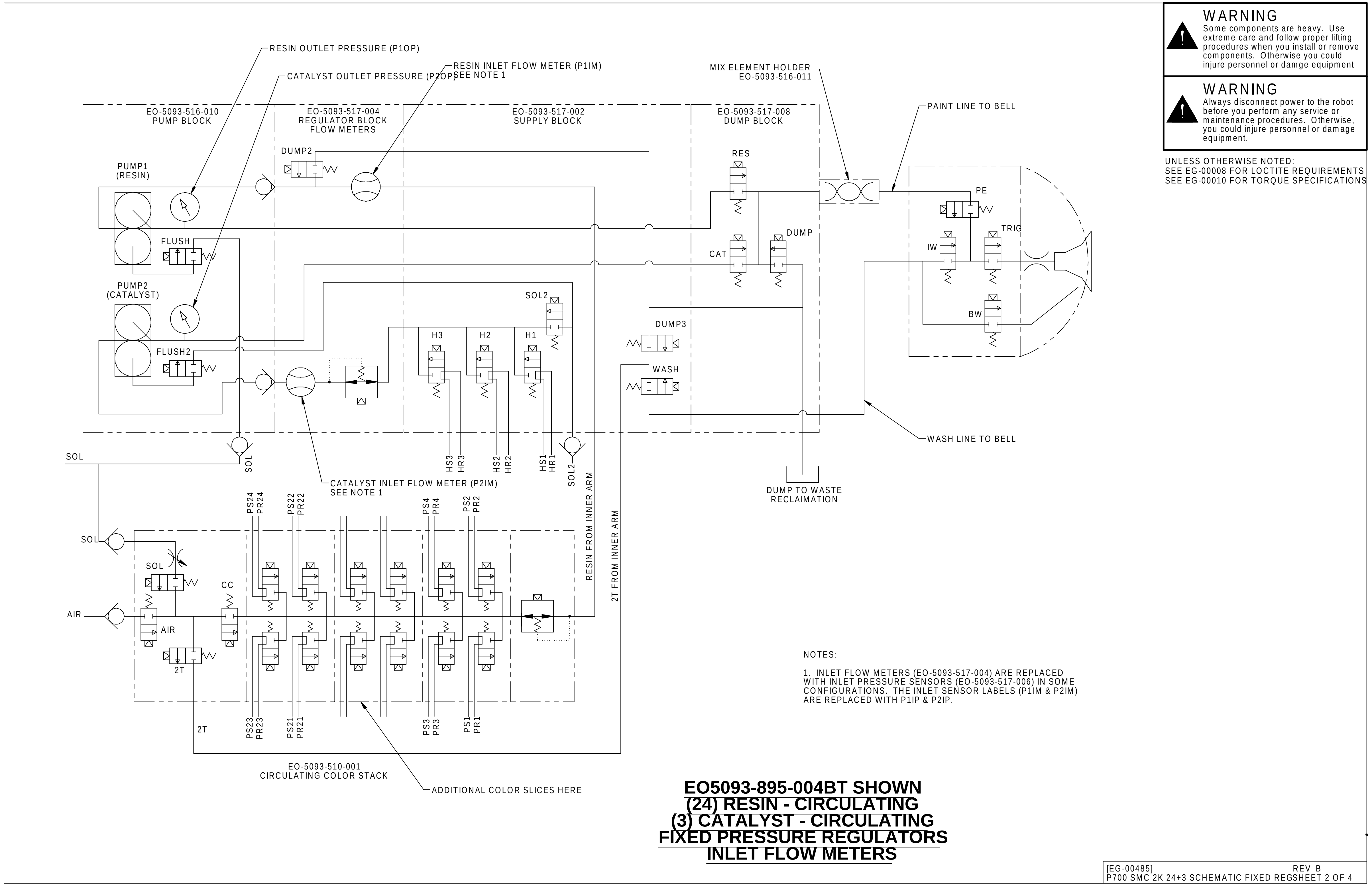


Figure 8-25 EG-00486, P700 SMC 2K 24+3 VAR REG SCHEMATIC

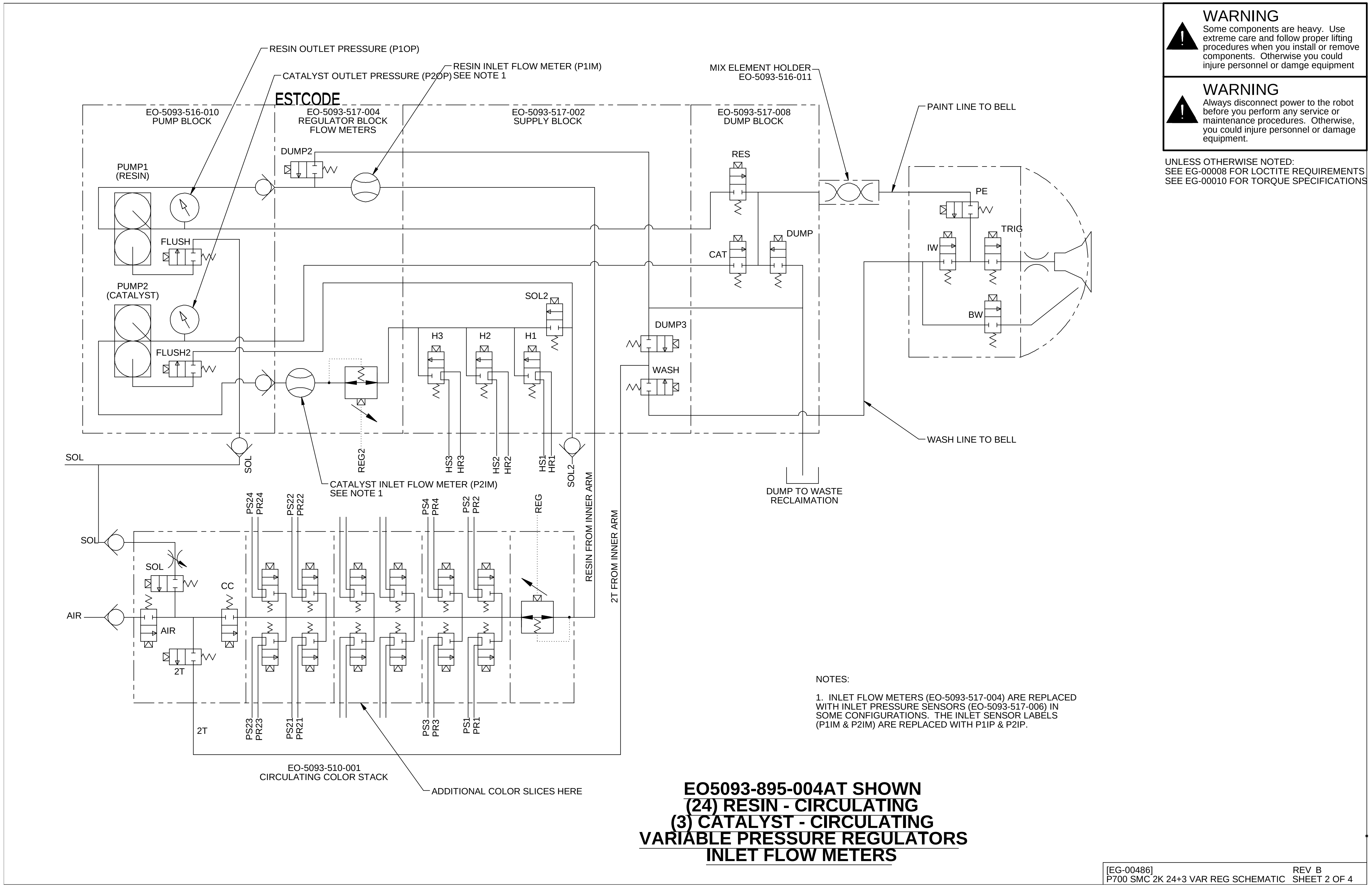


Figure 8-26 EG-00494, P500 SMC 2K 24+3 VAR REG SCHEMATIC

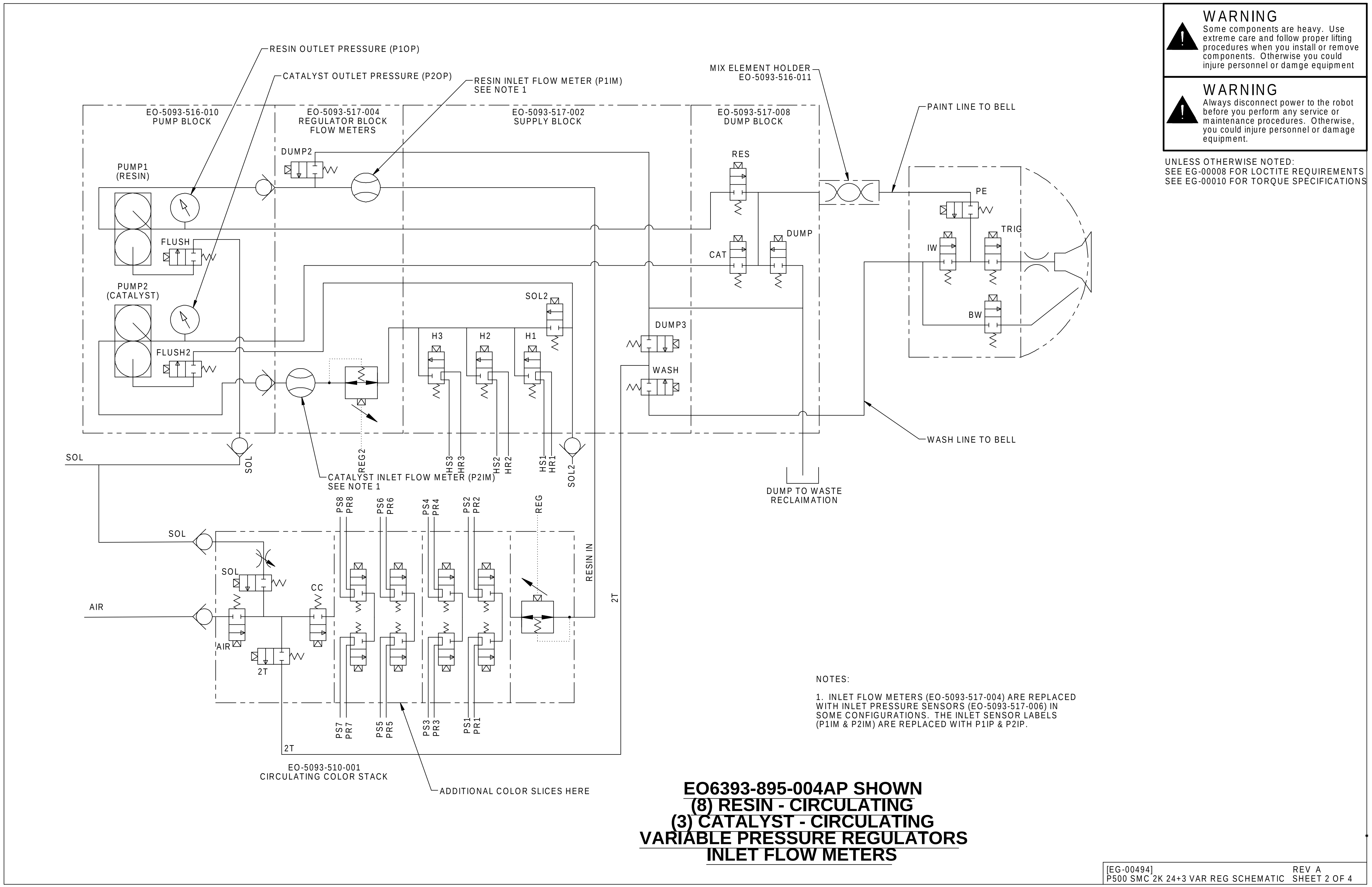
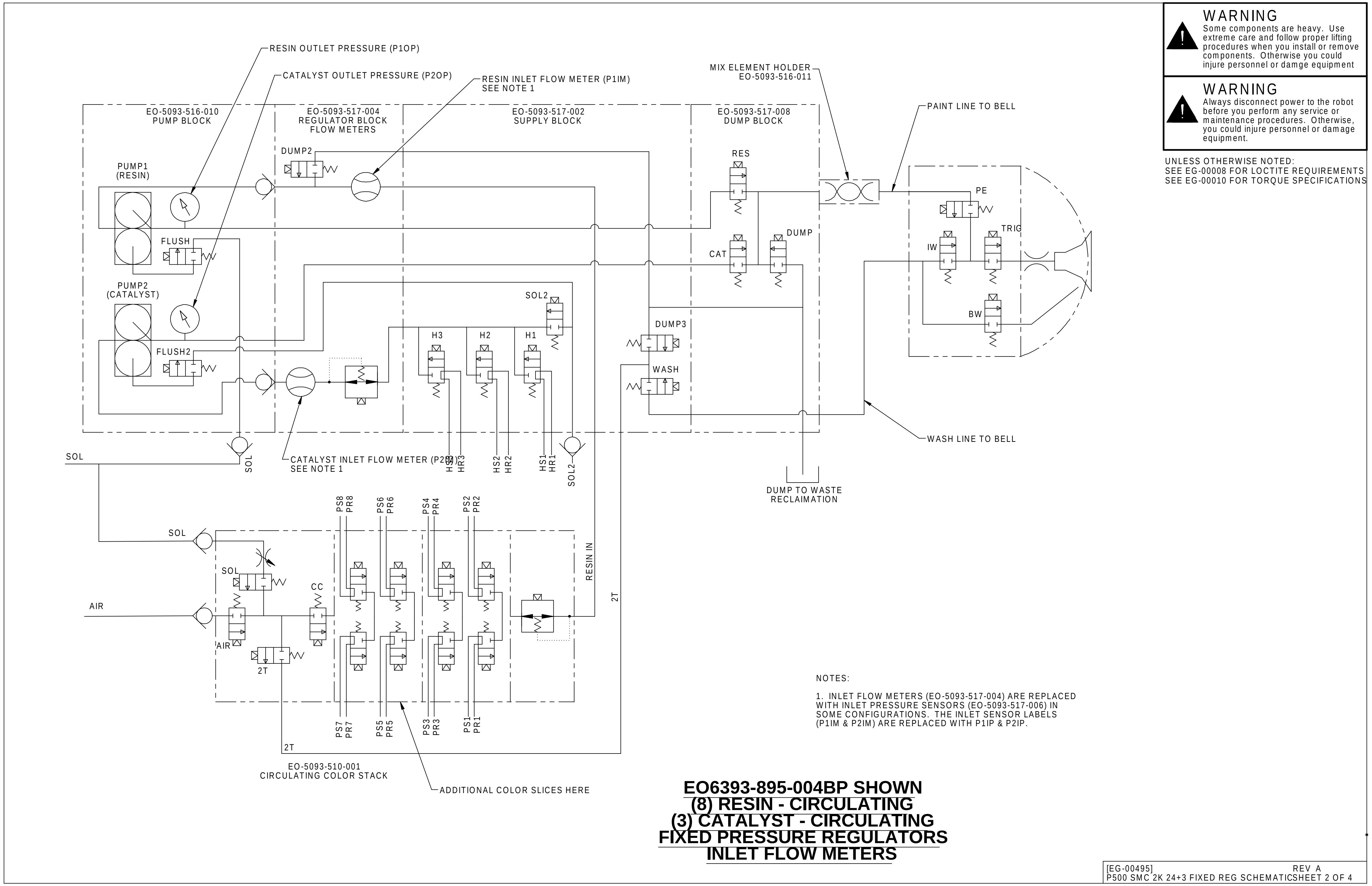


Figure 8-27 EG-00495, P500 SMC 2K 24+3 FIXED REG SCHEMATIC



8.1 Overview

The FANUC Robotics Integral Pump Control (IPC) system is a precision gear pump metering system for paint. The system uses FANUC Robotics servo motors and control along with 3cc/rev and 6cc/rev gear pumps. The metering system is integrated into the robot controller. The robot controls ratio, flow rate, monitors pressures, and faults. All setup and operation of the IPC system can be done from the robot Teach Pendant or the System GUI (if configured with one). Each color can be configured with its own ratio (if required). The IPC system monitors the outlet pressure of the gear pump. The outlet sensor works in conjunction with the inlet regulator to ensure optimal pressure differential across the pump.

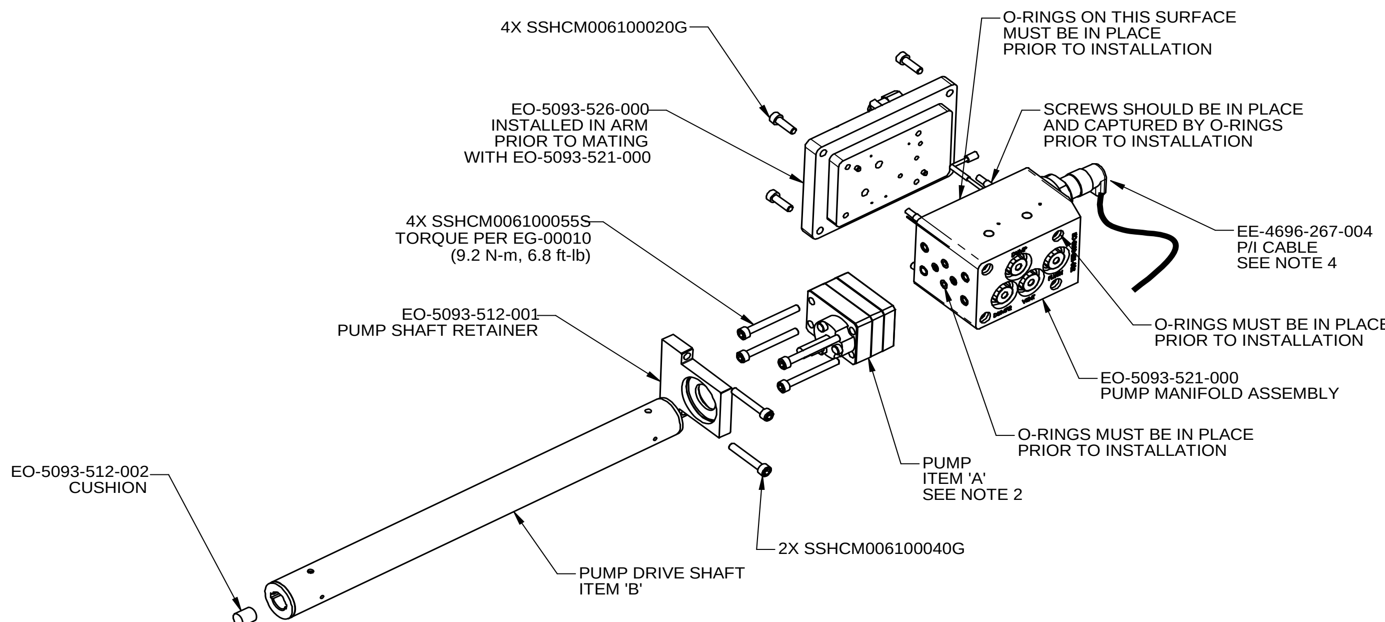
8.2 Operations and Setup

Figure 8-28 ET-5093-890-007 Sheet 1 of 2, 1K PUMP

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



EXPLODED ISO VIEW
SCALE 1:5

NOTES:

1. UNLESS OTHERWISE SPECIFIED TORQUE ALL FASTNERS PER EG00010.
2. THE FOLLOWING STEPS SHOULD BE FOLLOWED TO INSTALL THE KEY IN THE KEYWAY ON THE PUMP SHAFT.
   a. APPLY LOCTITE PRIMER 'N' TO KEY & KEYWAY. WAIT 30 SECONDS.
   b. APPLY A SMALL AMOUNT OF LOCTITE 680 TO KEYWAY ON PUMP SHAFT. CAUTION: PRODUCT CURES QUICKLY
   c. IMMEDIATELY INSTALL KEY IN KEYWAY.
   d. IMMEDIATELY WIPE ALL EXCESS LIQUID FROM PUMP SHAFT.
3. PLUG UNUSED RETAINER MOUNTING HOLES
4. SEE OUTER ARM ASSEMBLY EO5093-020-000A FOR ADDITIONAL CABLE ROUTING
5. CAP PILOT LINES USING CAPMO000000101O FOR STORAGE OF THIS SUBASSEMBLY

ASSEMBLY NOTES:

1. INSTALL P/I CABLE (EE-4696-267-004) INTO CORD GRIP (CGRPO000000398O)
2. INSTALL PUMP QD ASM (EO5093-526-000) INTO OUTER ARM (EO5093-020-001A)
3. INSTALL CUSHION (EO-5093-512-001) INTO PUMP DRIVE SHAFT (EO5093-020-012B)
4. INSTALL PUMP DRIVE SHAFT (EO5093-020-012B) ONTO PUMP MOTOR OUTPUT SHAFT IN OUTER ARM (EO5093-020-001A)
5. INSTALL PUMP SHAFT RETAINER (EO-5093-512-001) AS NOTED INTO OUTER ARM (EO5093-020-001A)
6. INSTALL GEAR PUMP (EO-4657-511-000) ONTO PUMP MANIFOLD (EO-5093-521-000)
7. INSTALL PUMP MANIFOLD (EO-5093-521-000) AND GEAR PUMP (EO-4657-511-000) INTO OUTER ARM (EO5093-020-001A)

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100020G	M6 X 1.0 X 20mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100040G	M6 X 1.0 X 40mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100055S	M6 X 1.0 X 55mm LG. Stainless Steel Socket Head Cap

[ET-5093-890-007] REV A
TEMPLATE SHEET 1 OF 2

Figure 8-29 ET-5093-890-007 Sheet 2 of 2, 1K PUMP

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.

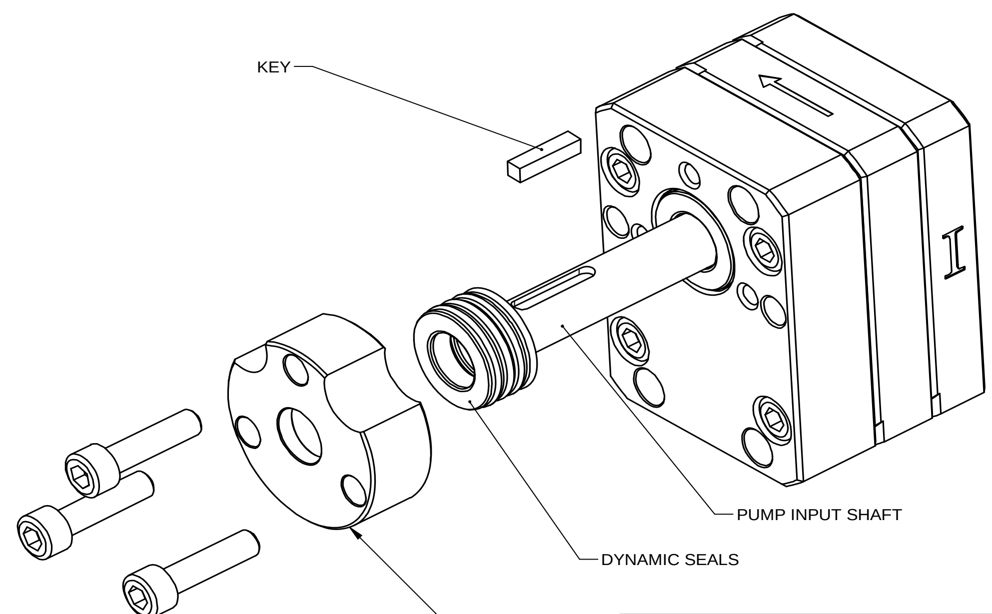
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

GEAR PUMP PREVENTIVE MAINTENANCE

- FLUSH PUMP WITH SOLVENT EVERY FOUR HOURS, AT BREAK AND END OF SHIFT.
- REPLACE PUMP DYNAMIC SEALS ACCORDING TO THE RECOMMENDED SCHEDULE. THE PROPER PROCEDURE AND REQUIRED TOOLS ARE EXPLAINED IN EG00381.

WEEKLY MAINTENANCE

1. VISUALLY INSPECT THE PUMP FOR ANY LEAKS. EXAMINE PUMP INPUT SHAFT, SEAL PLATE, AND PAINT FITTINGS. IF ANY LEAK IS FOUND, REMOVE FROM SERVICE AND INSPECT. LEAK SERVICE MAY BE PERFORMED BY CUSTOMER PERSONNEL ACCORDING TO THE PROCEDURE IN THE MANUAL.
2. CHECK FLOWRATES OF DIFFERENT MATERIALS WITH A BEAKER. AS A GENERAL RULE, A PUMP OUTPUT VARIATION OF 10% OR MORE INDICATES A NEED TO REPLACE OR REBUILD THE PUMP. RETURN TO FANUC ROBOTICS AMERICA.
3. LISTEN FOR ANY NOISE FROM THE PUMP WHILE IT DISPENSES PAINT. SOME NOISE IS EXPECTED DURING SOLVENT FLUSH, BUT THE PUMP SHOULD RUN SMOOTHLY WHILE DISPENSING PAINT. IF EXCESSIVE NOISE IS FOUND, REPLACE THE PUMP AND RETURN TO FANUC ROBOTICS AMERICA.



PERIODIC REPLACEMENT OF DYNAMIC SEALS FOR GEAR PUMP

USAGE PATTERN	REPLACE IN
PRIMER WITH NO PERIODIC FLUSHING	6 MONTHS
PRIMER WITH PERIODIC FLUSHING	9 - 12 MONTHS
BASECOAT WITH PERIODIC FLUSHING	15 - 18 MONTHS
CLEARCOAT WITH PERIODIC FLUSHING	24 MONTHS

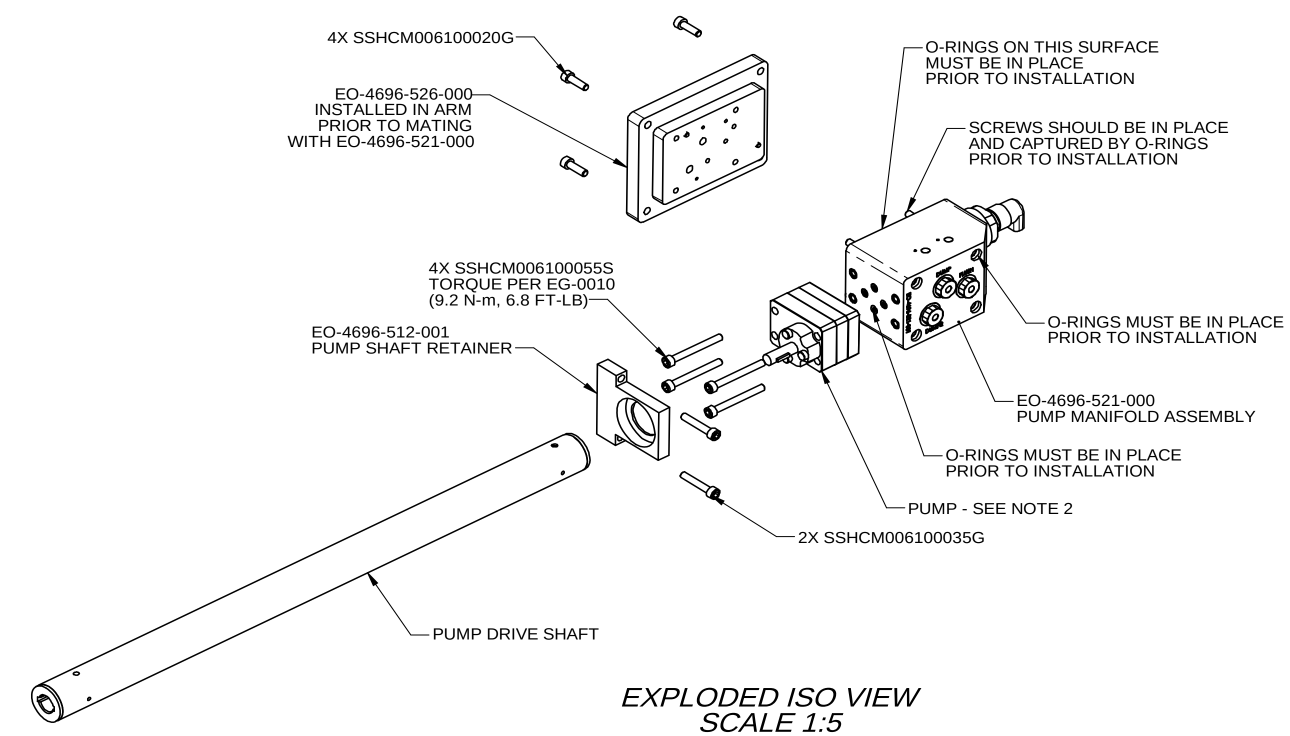
[ET-5093-890-007] REV A
TEMPLATE SHEET 2 OF 2

Figure 8-30 ET-6102-890-007 Sheet 1 of 2, ZENITH PUMP MAINTENANCE

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



EXPLODED ISO VIEW
SCALE 1:5

NOTES:

1. UNLESS OTHERWISE SPECIFIED TORQUE ALL FASTNERS PER EG-00010.
2. THE FOLLOWING STEPS SHOULD BE FOLLOWED TO INSTALL THE KEY IN THE KEYWAY ON THE PUMP SHAFT.
   a. APPLY LOCTITE PRIMER 'N' TO KEY & KEYWAY. WAIT 30 SECONDS.
   b. APPLY A SMALL AMOUNT OF LOCTITE 680 TO KEYWAY ON PUMP SHAFT. CAUTION: PRODUCT CURES QUICKLY
   c. IMMEDIATELY INSTALL KEY IN KEYWAY.
   d. IMMEDIATELY WIPE ALL EXCESS LIQUID FROM PUMP SHAFT.
3. PLUG UNUSED RETAINER MOUNTING HOLES
4. CAP PILOT LINES USING CAPMO000000101O FOR STORAGE OF THIS SUBASSEMBLY

ASSEMBLY NOTES:

1. INSTALL P/I CABLE (EE-4696-267-002) INTO CORD GRIP (CGRPO000000398O)
2. INSTALL PUMP QD ASM (EO4696-526-000) INTO OUTER ARM (EO4696-021-001A)
3. INSTALL PUMP DRIVE SHAFT ONTO PUMP MOTOR OUTPUT SHAFT IN OUTER ARM
4. INSTALL PUMP SHAFT RETAINER (EO-4696-512-001) AS NOTED INTO OUTER ARM (EO4696-021-001A)
5. INSTALL GEAR PUMP (EO-4657-511-000) ONTO PUMP MANIFOLD (EO-4696-521-000)
6. INSTALL PUMP MANIFOLD (EO-4696-521-000) AND GEAR PUMP (EO-4657-511-000) INTO OUTER ARM (EO4696-021-001A)

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100020G	M6 X 1.0 X 20mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100035G	M6 X 1.0 X 35mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100055S	M6 X 1.0 X 55mm LG. Stainless Steel Socket Head Cap

[ET-6102-890-007] REV B1
ZENITH PUMP MAINTENANCE SHEET 1 OF 2

Figure 8-31 ET-6102-890-007 Sheet 2 of 2, ZENITH PUMP MAINTENANCE

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.

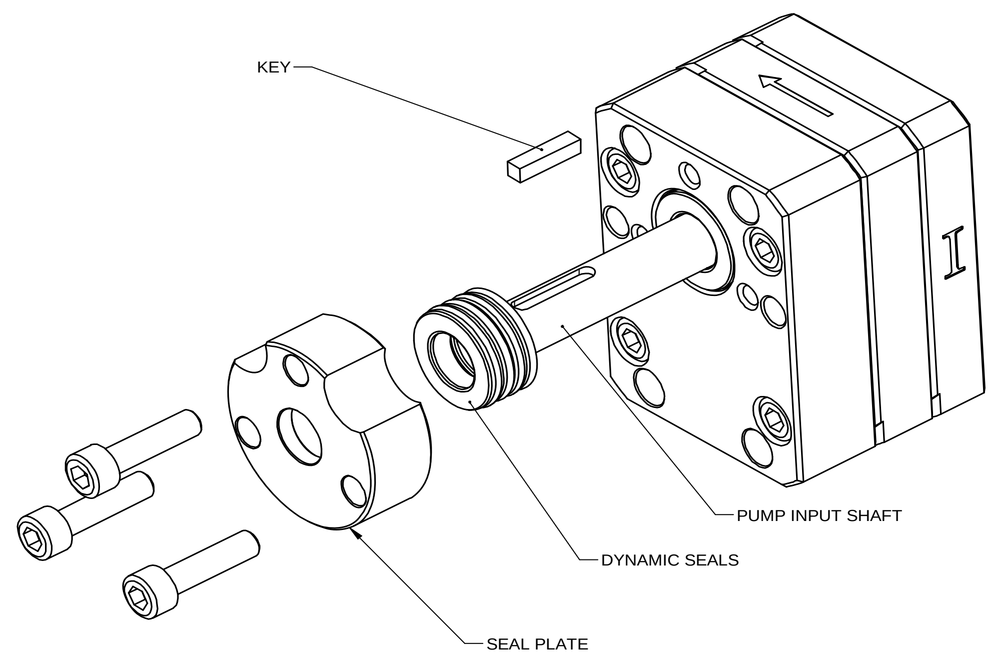
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

GEAR PUMP PREVENTIVE MAINTENANCE

- FLUSH PUMP WITH SOLVENT EVERY FOUR HOURS, AT BREAK AND END OF SHIFT.
- REPLACE PUMP DYNAMIC SEALS ACCORDING TO THE RECOMMENDED SCHEDULE. THE PROPER PROCEDURE AND REQUIRED TOOLS ARE EXPLAINED IN EG00381.

WEEKLY MAINTENANCE

1. VISUALLY INSPECT THE PUMP FOR ANY LEAKS. EXAMINE PUMP INPUT SHAFT, SEAL PLATE, AND PAINT FITTINGS. IF ANY LEAK IS FOUND, REMOVE FROM SERVICE AND INSPECT. LEAK SERVICE MAY BE PERFORMED BY CUSTOMER PERSONNEL ACCORDING TO THE PROCEDURE IN THE MANUAL.
2. CHECK FLOWRATES OF DIFFERENT MATERIALS WITH A BEAKER. AS A GENERAL RULE, A PUMP OUTPUT VARIATION OF 10% OR MORE INDICATES A NEED TO REPLACE OR REBUILD THE PUMP. RETURN TO FANUC ROBOTICS AMERICA.
3. LISTEN FOR ANY NOISE FROM THE PUMP WHILE IT DISPENSES PAINT. SOME NOISE IS EXPECTED DURING SOLVENT FLUSH, BUT THE PUMP SHOULD RUN SMOOTHLY WHILE DISPENSING PAINT. IF EXCESSIVE NOISE IS FOUND, REPLACE THE PUMP AND RETURN TO FANUC ROBOTICS AMERICA.



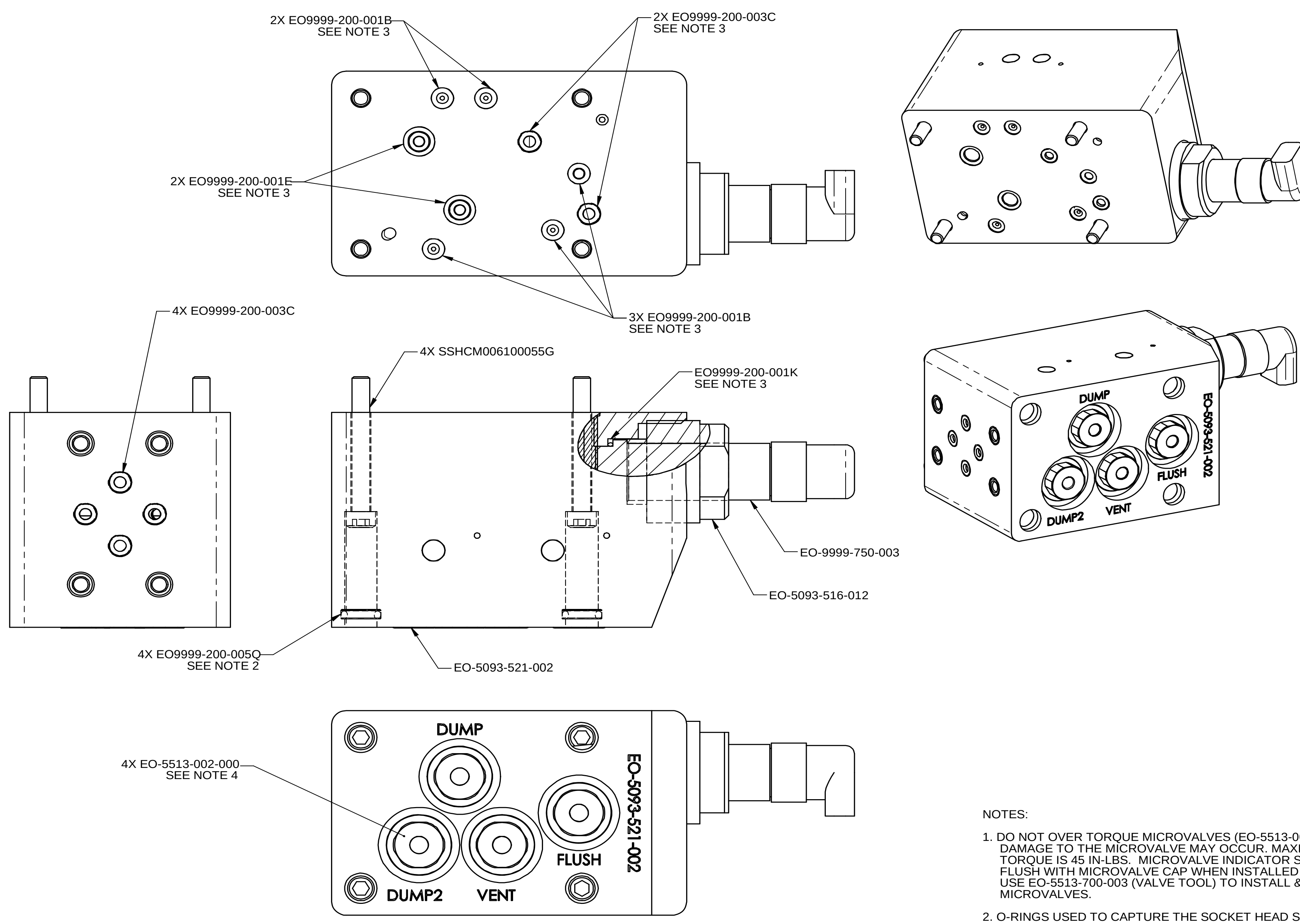
PERIODIC REPLACEMENT OF DYNAMIC SEALS FOR GEAR PUMP	
REPLACE IN	USAGE PATTERN
6 MONTHS	PRIMER WITH NO PERIODIC FLUSHING
9 - 12 MONTHS	PRIMER WITH PERIODIC FLUSHING
15 - 18 MONTHS	BASECOAT WITH PERIODIC FLUSHING
24 MONTHS	CLEARCOAT WITH PERIODIC FLUSHING

[ET-6102-890-007] REV B1
ZENITH PUMP MAINTENANCE SHEET 2 OF 2

The procedures for installation of the IPC drive shaft, pump, pump block, and pump block are available in within the specified ET drawing for your IPC and robot configuration.

8.2.1 1K Pump Manifold Block

Figure 8-32 EO-5093-521-000, PUMP MANIFOLD 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 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

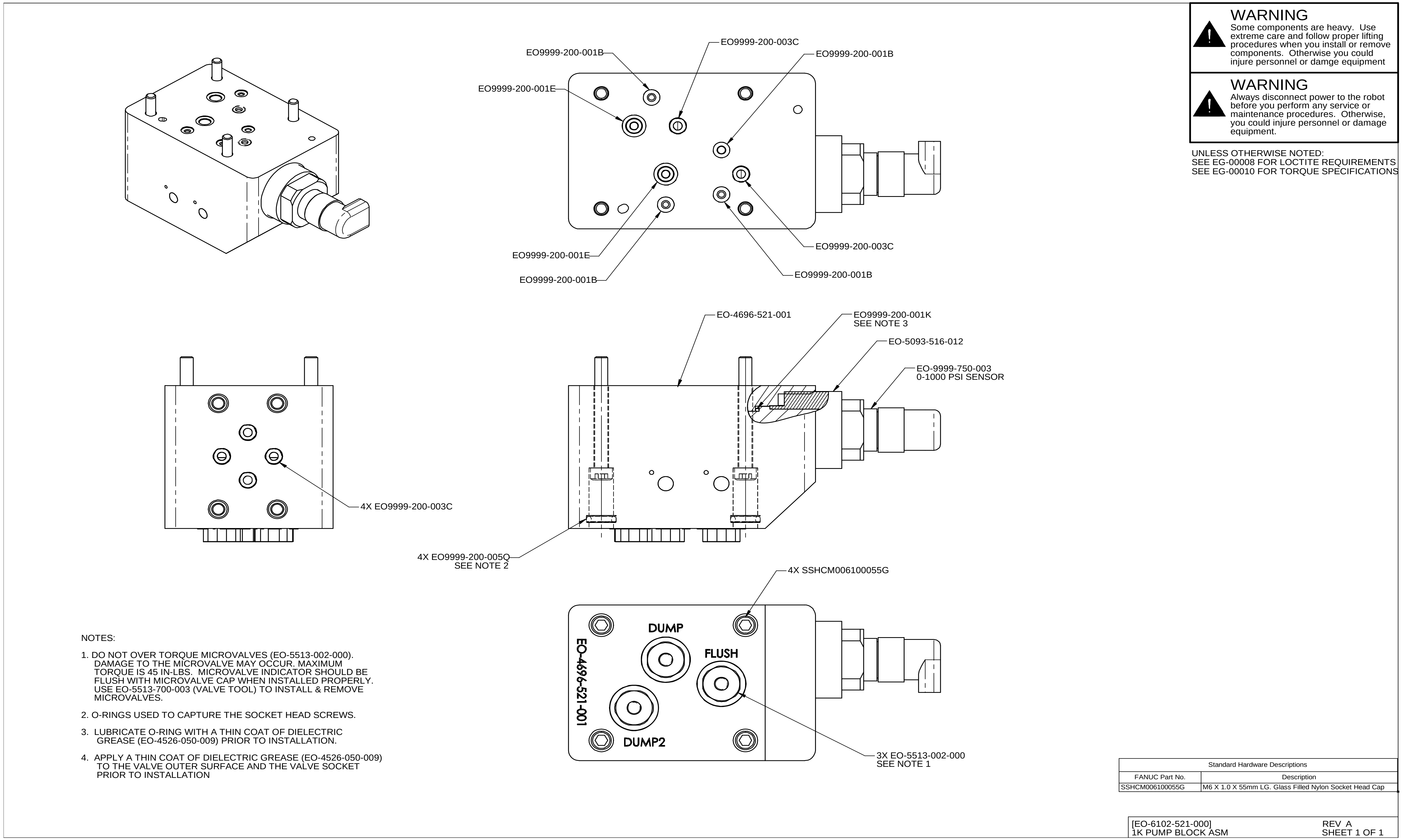
NOTES:

1. DO NOT OVER TORQUE MICROVALVES (EO-5513-002-000). DAMAGE TO THE MICROVALVE MAY OCCUR. MAXIMUM TORQUE IS 45 IN-LBS. MICROVALVE INDICATOR SHOULD BE FLUSH WITH MICROVALVE CAP WHEN INSTALLED PROPERLY. USE EO-5513-700-003 (VALVE TOOL) TO INSTALL & REMOVE MICROVALVES.
2. O-RINGS USED TO CAPTURE THE SOCKET HEAD SCREWS.
3. LUBRICATE O-RING WITH A THIN COAT OF DIELECTRIC GREASE (EO-4526-050-009) PRIOR TO INSTALLATION.
4. APPLY A THIN COAT OF DIELECTRIC GREASE (EO-4526-050-009) TO THE VALVE OUTER SURFACE AND THE VALVE SOCKET PRIOR TO INSTALLATION

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100055G	M6 X 1.0 X 55mm LG. Glass Filled Nylon Socket Head Cap

[EO-5093-521-000] REV B3
PUMP MANIFOLD ASSEMBLY SHEET 1 OF 1

Figure 8-33 EO-6102-521-000, 1K PUMP BLOCK ASM



Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100055G	M6 X 1.0 X 55mm LG. Glass Filled Nylon Socket Head Cap

The 1K Pump Manifold (EO-5093-512-000) is located on the outer arm of the robot. It houses 4 paint valves (EO-5513-002-001). The block is connected to the pump manifold with 4 screws (SSHCM006-G). This connection also mounts the pump block to the outer arm.

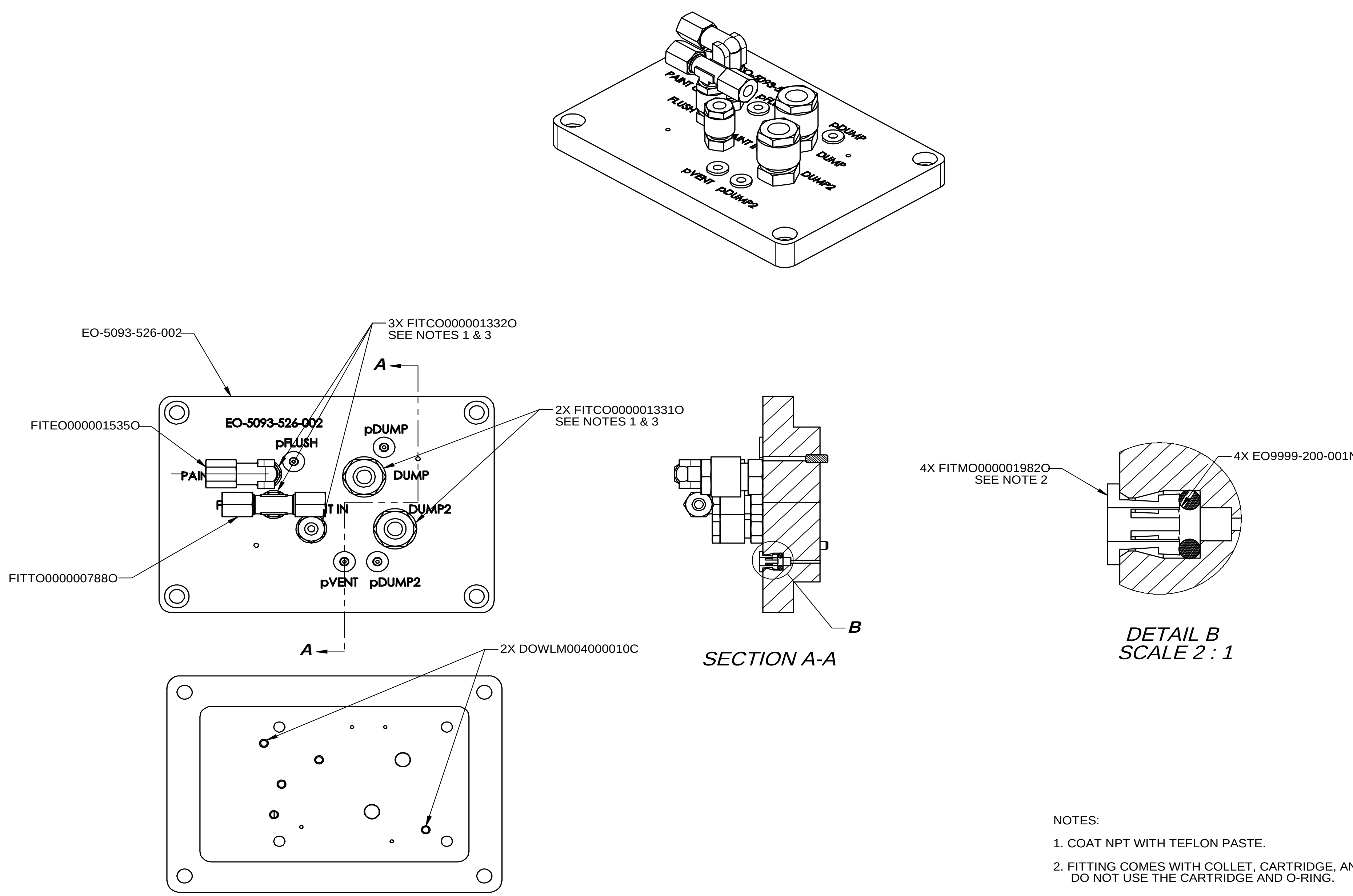
8.2.2 Pump QD

Figure 8-34 EO-5093-526-000, 1K Pump W/ Vent QD ASSY

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



NOTES:

1. COAT NPT WITH TEFLON PASTE.
2. FITTING COMES WITH COLLET, CARTRIDGE, AND O-RING. DO NOT USE THE CARTRIDGE AND O-RING.
3. FITTINGS SHOULD BE INSTALLED UNTIL THEY BOTTOM OUT ON THE MANIFOLD AS SHOWN

Standard Hardware Descriptions	
FANUC Part No.	Description
DOWLM004000010C	M4 10 LG. Steel Dowl Pin

[EO-5093-526-000] REV A
1K Pump W/ Vent QD ASSY SHEET 1 OF 1

The pump quick disconnect attaches to the outer arm of the robot, opposite the pump block. The pump quick disconnect ports fluid and pilot lines to the pump block. The pilot lines ported through the pump quick disconnect are pFLUSH, pDUMP, and pDUMP2. The fluid lines ported through the quick disconnect are PAINT IN, PAINT OUT, PUMP FLUSH, DUMP, DUMP2, and an optional pVENT. DUMP and DUMP2 use plastic hex fittings (FITCO000001331O) to connect the fluid lines. PAINT OUT, PUMP FLUSH, and PAINT IN use plastic hex fittings (FITCO000001361O)

8.2.3 FRA Fast-Flush Regulator

See Color Changer (1K) Section

8.2.4 Gear Pump

See robot manual for gear pump assembly choices.

The gear pump connects to the pump block with 4 screws (SSHCM006-G). Pump number 11-62851-5000-0 is a 3cc gear pump, while number 11-62852-5000-0 is a 6cc gear pump. The pump shaft and key align to the pump drive shaft depending on the pump and robot configuration. The drive shaft is held in guided by the pump shaft retainer . The pump shaft retainer is held in place with two screws (SSHCM006-G).

Pump Calibration Setup

The calibration settings are found in the IPC Setup menu. To view the calibration settings, use the following procedure:

1. Press MENUS.
2. Select Setup.
3. Press F1, [TYPE].
4. Select pumps.

Two component systems will have setup menus for Pump 1 and Pump 2. One component systems will only show Pump 1.
The screen for a 2k system should look like the following:

PUMP 1 Resin Pump
Size: 6.0cc/rev (check the system documentation for the pump size)
Max Speed: 250rpm
Motor/Pump Reduction: 12:1
PUMP 2 Hardener Pump
Size: 3.0cc/rev (check the system documentation for the pump size)
Max Speed: 250rpm
Motor/Pump Reduction: 10:1

Any changes required as a result of the calibration measurements will be done to the Size section of the screen shown above.
Before starting the pump calibration procedure remove the shaping air ring, and bell cup.

Pump Calibration Procedure

Figure 8-35 EG-00422 Sheet 1 of 8, Standard Flow Rate Measurement Procedure - Paint

Introduction

This document describes two methods for verifying the accuracy of the flow rates delivered by FRA paint robots. 'Method A' is a simple volume collection method. 'Method B' is a mass collection method that requires more effort, but can achieve greater accuracy. The accuracy of the measurement method must be considered when verifying the accuracy of the fluid delivery. For example, if the measurement method is accurate to ±0.5% and the accuracy of the flow rate is expected to be ±2.0%, then measurements of flow rates within ±2.5% are considered acceptable.

Method A – Timed Volume Collection

The timed volume collection method is a quick method of verifying volume flow rates on FRA paint robots. When performed according to this procedure, the timed volume collection method will measure volume flow rates with the accuracies described below.

Table 1: Measurement Uncertainty of Method A

Flow Rate	Uncertainty
less than 50 cc/min	± 0.25 cc
at least 50 cc/min but less than 100cc/min	± 0.40 cc
at least 100 cc/min but less than 500cc/min	± 2.00 cc

Required Equipment

- Graduated Glass Cylinder (50 cc, 100 cc or 500 cc)
  - ASTM E1272 – 02* Class A, Type I Specifications for Classification, Dimensions, and Tolerances
  - The Science Company – Sibata http://secure.sciencecompany.com/
- Serological Pipette, 5cc
  - ASTM E 1044** Style 1 Class A specifications for tolerance limitations
  - The Science Company – Sibata http://secure.sciencecompany.com/
- Distilled Water
  - McMaster-Carr http://www.mcmaster.com/
  - #3190K901

Flow Rate Measurement

Caution:

- For transparent liquids, lower meniscus should be read.
- For opaque liquids, upper meniscus should be read.

1. Collect the dispensed liquid in graduated cylinder of appropriate capacity.
2. Note the graduation reading above meniscus position on the graduated cylinder. This is the higher graduation
3. Fill the 5 CC pippet with distilled water.
4. Dispense water from the pippet into the graduated cylinder (water filling up on top of the liquid) till water meniscus touches the noted higher graduation mark.
5. Note the amount of water dispensed from the pippet.
6. Subtract pippet reading from the higher graduation reading = this is the actual amount of liquid originally in the cylinder.

Figure 8-36 EG-00422 Sheet 2 of 8, Standard Flow Rate Measurement Procedure - Paint

Table 2: Collected Data Form

Sample No	A: Higher Graduation Mark (cc)	B: Pippet Dispense (cc)	=A-B Liquid Volume (cc)

Example:

Say the liquid level in the 100 cc cylinder falls between 75 cc and 80 cc.
Water is dispensed from the pippet into the cylinder to fill the level up to 80 cc.
Pippet reading is 3.45 cc.
Volume of liquid in the Cylinder = 80 - 3.45 = 76.55 cc
* ASTM E1272 - 02(2007) Standard Specification for Laboratory Glass Graduated Cylinders
** ASTM E1044-96(2001) Standard Specification for Glass Serological Pipets

Figure 8-37 EG-00422 Sheet 3 of 8, Standard Flow Rate Measurement Procedure - Paint

Method B – Timed Mass Collection

The timed mass collection method is a high accuracy method of verifying volume flow rates on FRA paint robots. When performed according to this procedure, the timed mass collection method will measure volume flow rates with the accuracies described below.

Table 3: Measurement Uncertainty of Method B

Flow Rate	Relative Uncertainty
greater than 10 cc/min but less than 50 cc/min	±0.5%
at least 50 cc/min but less than 250cc/min	±0.2%
250cc/min or greater	±0.1%

The timed mass collection method has the following steps:

1. Verify pyknometer volume
2. Measure sample density
3. Flow rate measurement

Required Equipment

- Pyknometer
  - o Paul N. Gardner Company, Inc. 1-800-762-2478
  - o #WG-SS-83.2 or equivalent
- Electronic scale
  - o A&D http://www.andweighing.com/
  - o #GX-2000 or equivalent
- Bomex Beaker (600mL)
  - o Science Company http://secure.sciencecompany.com/
  - o #NC-5582 or equivalent
- Partial Immersion Glass Thermometer
  - o McMaster-Carr http://www.mcmaster.com
  - o # 38935K19 or equivalent
- A sample (~350cc) of the paint material to be tested
- Solvent for clean-up
- Clean Rags

Fluid Weight Measurement with a Pyknometer

1. Thoroughly clean the pyknometer cup and lid with solvent and dry it with a clean rag.
2. Place the scale on a flat stable surface and ensure that it is level as indicated by the bubble level.
3. Set the units on the scale to grams (g).
4. Re-zero the scale.
5. Gently place the empty pyknometer on the center of the scale and record its weight in the 'Tare' column of the data sheet. (Note: a draft, such as the downdraft in a paint booth, will affect the reading of the scale.)

Figure 8-38 EG-00422 Sheet 4 of 8, Standard Flow Rate Measurement Procedure - Paint

Figure 1 – Pyknometer on Electronic Scale

6. Fill the cup with the test fluid to within 1mm of the top as shown in Figure 2.
    a. If fluid temperature is required, use the glass thermometer to measure the temperature and record it in the data sheet. The thermometer must be inserted nearly to the bottom of the pyknometer for an accurate measurement.
    b. If fluid temperature is not required continue to step 7.

Figure 2 – Filled Pyknometer Cup

7. Carefully place the lid on the cup and slowly rotate it while pressing it onto the cup. This will cause excess fluid to escape from the vent hole as shown in Figure 3.
8. Wipe all excess fluid from the lid and exterior of the cup. Any fluid on the exterior will cause an error in the measurement.

Figure 8-39 EG-00422 Sheet 5 of 8, Standard Flow Rate Measurement Procedure - Paint

Before Cleaning

After Cleaning

Figure 3 – Filled Pyknometer

9. Gently place the filled pyknometer on the center of the scale and record its weight in the 'Sample' column of the data sheet.
10. Empty the pyknometer, discarding the sample material.
11. Thoroughly clean the pyknometer cup and lid with solvent and dry it with a clean rag.

Verification of Pyknometer Volume

1. Perform the "Fluid Weight Measurement with a Pyknometer" using water as a test fluid. Record the measurements, including fluid temperature, in Table 4, below.

Table 4: Calibration Data Form

Tare (g)	Sample (g)	Fluid (g)	Temperature (°F)

2. Subtract the weight in grams in the 'Tare' column from the weight in grams in the 'Sample' column. Record the result in the 'Fluid' column.
3. Look up the temperature in Table 5, on the following page. If the weight measured in the 'Fluid' column of Table 4 is within the tolerance listed for the corresponding temperature, then the previous cup calibration volume can be used. Otherwise, the pyknometer must be recalibrated using the 'Calibration of Pyknometer' procedure.

Figure 8-40 EG-00422 Sheet 6 of 8, Standard Flow Rate Measurement Procedure - Paint

Table 5: Weight Tolerance

Temp (°F)	Min (g)	Max (g)	Temp (°F)	Min (g)	Max (g)
65	83.63	83.51	73	83.71	83.59
66	83.64	83.52	74	83.72	83.60
67	83.65	83.53	75	83.74	83.62
68	83.66	83.54	76	83.75	83.63
69	83.67	83.55	77	83.76	83.64
70	83.68	83.56	78	83.77	83.65
71	83.69	83.57	79	83.78	83.66
72	83.70	83.58	80	83.80	83.68

Measurement of Sample Density

1. Perform the "Fluid Weight Measurement with a Pyknometer" procedure three times using the fluid that will be dispensed from the robot. Thoroughly cleaning the pyknometer between each sample. Record the measurements in Table 6, below. Fluid temperature is not required.
2. Calculation of Density
   a. For each sample subtract the weight in grams in the 'Tare' column from the weight in grams in the 'Sample' column. Record the result in the 'Fluid' column.
   b. Divide the weight in grams in the 'Fluid' column by the volume of the cup (included with the cup). Record the result in the 'Density' column.
   c. Add the three results in the 'Density' column and divide the total by 3. Enter the result in the 'Average Density' field. The Average Density in grams/cc will be used in the flow tests to convert the collected mass to a volume flow rate.

Table 6: Density Measurement Data Form

	Tare (g)	Sample (g)	Fluid (g)	Density (g/cc)
Sample 1				
Sample 2				
Sample 3				
Pyknometer Volume (cc):		**Average Density (g/cc):**		

Flow Rate Measurement

A sample data sheet is shown in Table 7.

1. Remove the bell cup from the robot to be tested.
2. Thoroughly clean the beaker with solvent and dry it with a clean rag.
3. Place the scale on a flat stable surface and ensure that it is level as indicated by the bubble level.
4. Set the units on the scale to grams (g).
5. Re-zero the scale.
6. On the data sheet, record the average density of the test fluid as measured by the 'Measurement of Sample Density' procedure.
7. Weigh the beaker on the scale and record its weight in the 'Tare' row of the data sheet.
8. Place the beaker under the applicator, near the injector tip to avoid splashing.
9. From the Operator Console, initiate a flow test at the flow rate to be tested with 60 second duration. (Note: a shorter duration will decrease the accuracy of the measurement)
10. When the test is complete, weigh the filled beaker on the scale, and record its weight in the 'Sample' row under the appropriate flow rate on the data sheet.
11. On the Teach Pendant, press the 'Status' button. Select 'System'. Record the volume dispensed in the last job in the 'Volume Commanded' row under the appropriate flow rate on the data sheet.
12. Press F4 [RESTOT] then '2. All Equipment' to reset the totals.
13. Empty the beaker of fluid and ensure that there is no fluid on the exterior or lip of the beaker that could drip.
14. Repeat steps 5 through 13 for the remaining flow rates.
15. Calculation of Error:
    a. For each sample subtract the weight in grams in the 'Tare' row from the weight in grams in the 'Sample' row. Record the result in the 'Fluid' row.
    b. Divide the weight in grams in the 'Fluid' row by the 'Average Density' of the fluid. Enter the result in the 'Volume Dispensed' row.
    c. Subtract the 'Volume Commanded' from the 'Volume Dispensed'. Enter the Result in the 'Absolute Error' row under the appropriate flow rate on the data sheet.
    d. Divide the 'Absolute Error' by the 'Volume Commanded' and enter the result in the 'Relative Error' row. This is the percentage error in the flow rate.
    e. Repeat steps 'a' through 'd' for all flow rates.

Figure 8-41 EG-00422 Sheet 7 of 8, Standard Flow Rate Measurement Procedure - Paint

Table 7: Flow Rate Measurement Data Sheet

Ave. Density =	**50 cc/min**	**100 cc/min**	**200 cc/min**	**300 cc/min**	**400 cc/min**	**500 cc/min**
Tare (g)						
Sample (g)						
Fluid (g)						
Volume Commanded (cc)						
Volume Dispensed (cc)						
Absolute Error (cc)						
Relative Error (%)						

Calibration of Pyknometer

Damage to the pyknometer such as nicks or dents can change the volume that it will hold. The Pyknometer can be recalibrated using the procedure below.

Required Equipment

- Pyknometer to be calibrated
- Electronic scale
  - A&D http://www.andweighing.com/
  - #GX-2000 or equivalent
- Distilled Water (not deionized, not purified)
  - McMaster-Carr http://www.mcmaster.com/
  - #3190K901

Calibration Procedure

1. Perform the "Fluid Weight Measurement with a Pyknometer" procedure three times using **Distilled Water**. Thoroughly dry the pyknometer between each sample. Record the measurements, including fluid temperature, in Table 8, below.
2. Using the measured fluid temperature look up the 'Distilled Water Density' in Table 9, below, and record it in the appropriate field in Table 8.

3. Volume Calculation
   a. For each sample subtract the weight in grams in the 'Tare' column from the weight in grams in the 'Sample' column. Record the result in the 'Fluid' column.
   b. Divide the weight in grams in the 'Fluid' column by the 'Distilled Water Density'. Record the result in the 'Volume' column.
   c. Add the three results in the 'Volume' column and divide the total by 3. Enter the result in the 'Average Pyknometer Volume' field. The Average Pyknometer Volume in cc will be used to measure the density of sample materials.
4. Store the Calibration Data Form with the Pyknometer for future reference.

Table 8: Calibration Data Form

Serial No:	**Tare (g)**	**Sample (g)**	**Fluid (g)**	**Volume (cc)**
Sample 1				
Sample 2				
Sample 3				
Distilled Water Density (g/cc):		**Pyknometer Volume (cc):**		

Table 9: Density of Distilled Water

Temperature (°F)	**Density (g/cc)**	**Temperature (°F)**	**Density (g/cc)**
65	0.99854	73	0.99759
66	0.99843	74	0.99746
67	0.99832	75	0.99733
68	0.99821	76	0.99719

Figure 8-42 EG-00422 Sheet 8 of 8, Standard Flow Rate Measurement Procedure - Paint

69	0.99809	77	0.99705
70	0.99797	78	0.99690
71	0.99785	79	0.99676
72	0.99772	80	0.99661

Tools Required

- Glass beaker— a glass beaker with 2cc graduations is recommended.
- Applicator (spanner) wrench (for removing the shaping air ring).
- Applicator bell cup wrench.

Note Review the system documentation for the procedure to dispense paint manually when you are not in production mode. This procedure is for calibrating the gear pump with the robot controller. Each gear pump might vary slightly so this should be done each time a pump is replaced. The calibration should be done periodically to correct for wear over the life of the pump. It is recommended that a log be kept on the line side to record calibration dates, settings, and other system changes. After a pump calibration number varies by 10% from the original number, it should then be replaced.

1. In Setup –Type IPC, set the cc/rev to 3.06 if using the 3.0cc pump. If using the 6cc pump, set the value to 6.12cc/rev.
2. Position Robot for dispensing fluid.
3. From the PW3 Operate Fluid Maintenance screen, select the robot to calibrate.
4. Press MENUS and select Man Functions.
5. Press F1 [TYPE], and select Color Change.
6. Select the Fill Cycle from the Color Change Cycle dropdown menu.
7. Select Start.
8. Position the beaker under fluid nozzle of applicator (bell or gun). This can be held in place by a fixture or by placing the beaker on a flat surface.
9. Unlock and reset the robot.
10. Type the desired flow rate in the flow rate field on the fluid maintenance screen (volume based on beaker size. Example: 100-500cc/min for 60 seconds depending on size of beaker).

Note: The maximum recommended flow rate for Versa Bell is 700cc/min.

Note: It is advised that you use process flowrates used in production for Beakering trials

11. Type the amount of time for the measurement (example 60 seconds) in the test duration field.
12. Select Start Test.
13. Lock out the robot and retrieve the beaker.
14. If the amount of liquid in the beaker is less than expected, decrease the cc/rev value from step 1. Increase the cc/rev setting from step 1 if the amount of liquid in the beaker is greater than expected.

It is recommended that this procedure be repeated before making an actual change. Check the adjusted value. Clean out the lines by selecting Color Change and go to next pump (if the system contains more than one pump). Repeat the process but select Pump 2 for hardener.

8.2.5 2K Specific Hardware

Figure 8-43 EO-5093-516-000, 2K 1+1 MANIFOLD ASSEMBLY

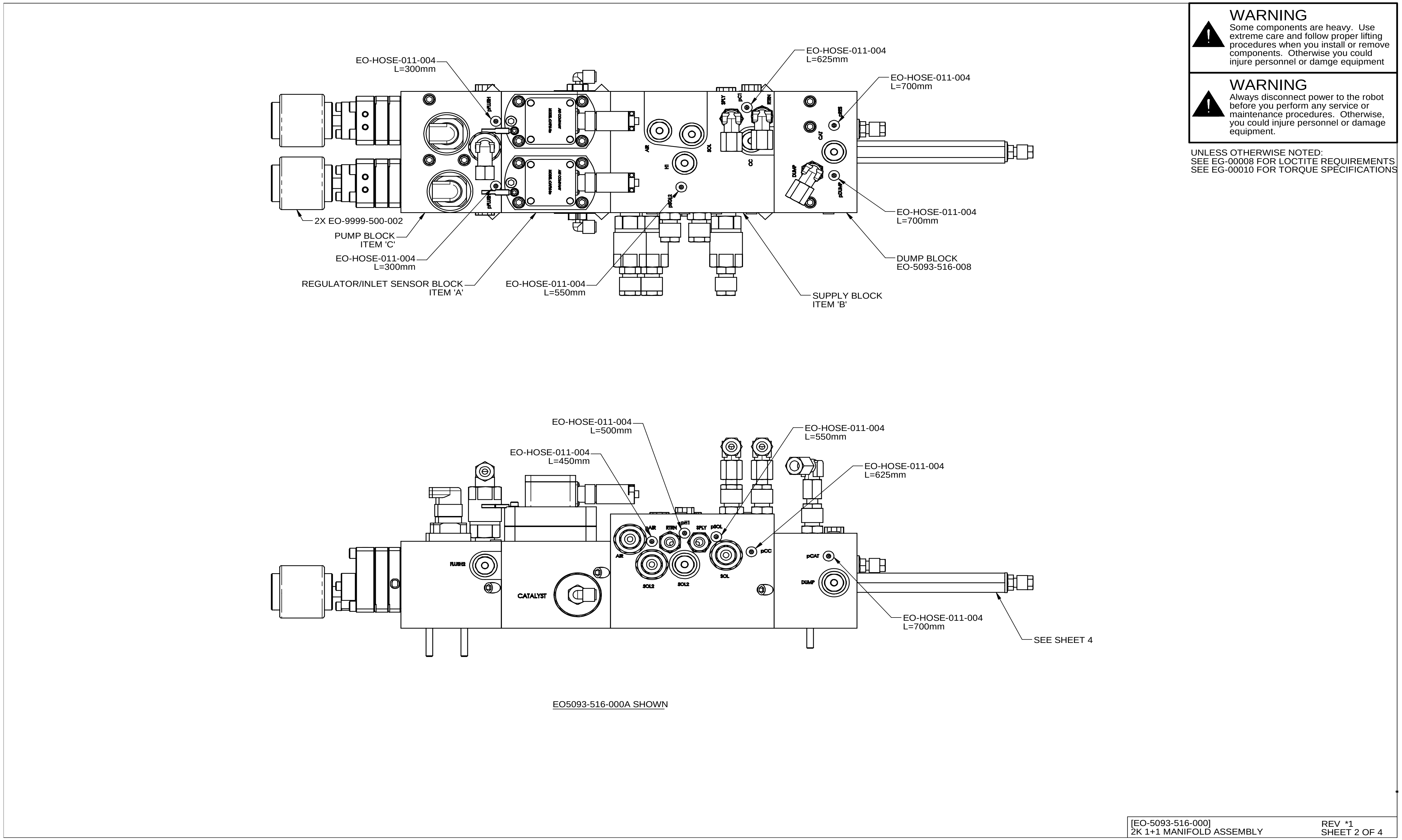
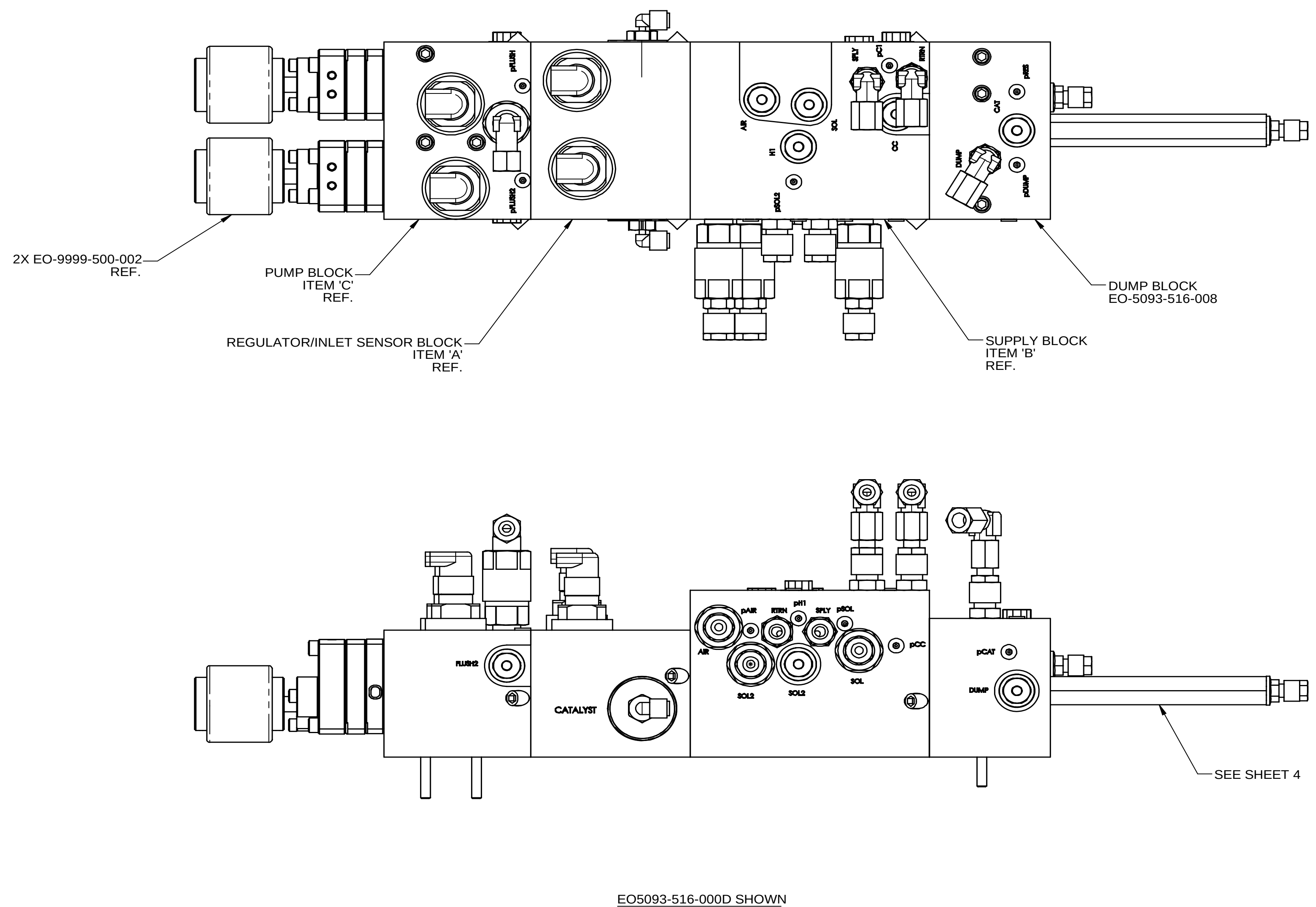


Figure 8-44 EO-5093-516-000, 2K 1+1 MANIFOLD ASSEMBLY



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 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

[EO-5093-516-000] 2K 1+1 MANIFOLD ASSEMBLY	REV *1 SHEET 3 OF 4

Inlet Pressure Sensor

Pump outlet pressure is sensed by the pressure sensor mounted prior to the inlet flow meter on the 2K outer arm. The pressure signal is sent to the robot controller via the analog input module in pneumatic control systemThe inlet pressure sensor is used to determine if there is a loss of inlet pressure, and raises an alarm if outside of the working range.

Inlet Flow Meter

The flow rate is measured by the inlet flow meter mounted upstream of the pump. The flow rate is sent back to the robot controller via the analog input module in the pneumatic control system. Paint Tool compares total flow for a job measured to the commanded volume of paint. If the total flow is outside of the warning limit or fault limit, the either a warning or fault will be posted.

8.3 Maintenance and Repair

Figure 8-45 ET-6102-890-006 Sheet 1 of 2, P-500iA 1K PM SCHEDULES

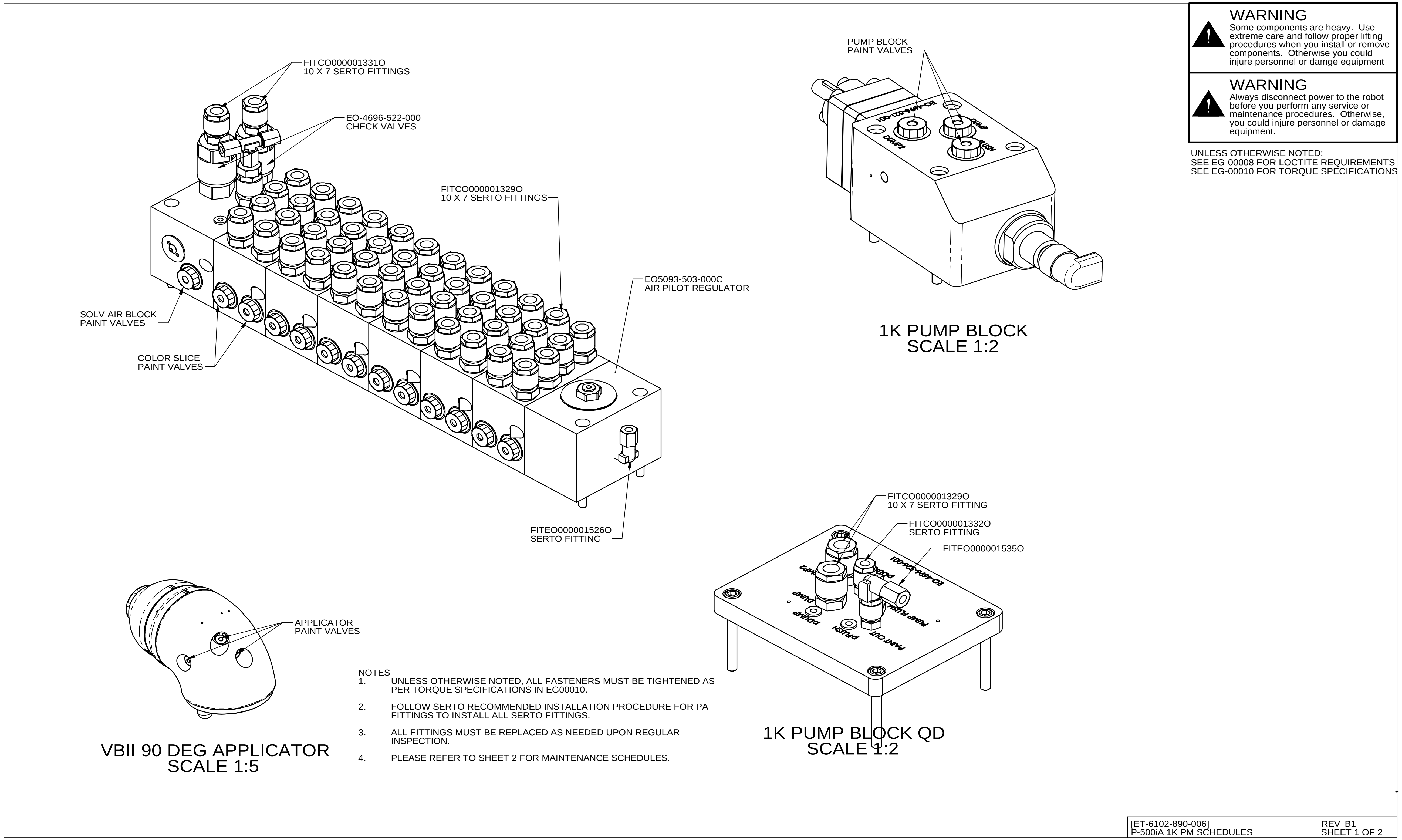


Figure 8-46 ET-6102-890-006 Sheet 2 of 2, P-500iA 1K PM SCHEDULES

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

PAINT VALVES - GENERAL MAINTENANCE GUIDLINES
1. INSPECT ALL PAINT VALVES DURING WEEKLY MAINTENANCE FOR LEAKS AND/OR MALFUNCTION.
2. PAINT VALVE IS NOT FIELD SERVICEABLE UNIT.
3. PAINT VALVE MUST BE REPLACED AS A WHOLE.
4. REPLACE A DAMAGED VALEVE WITH A NEW VALVE.
5. DISCARD DAMAGED PAINT VALVES PROMPTLY - DO NOT STORE THEM.
6. LIFE OF A PAINT VALVE UNDER NORMAL OPERATION IS 2,000,000 (TWO MILLION) CYCLES, *SEE NOTE1
7. REPLACE PAINT VALVES ACCORDING TO THE FOLLOWING SCHEDULE:

TABLE 1: 6 BAR AND 10 BAR SYSTEMS (*SEE NOTE 1)

PAINT VALVE LOCATION	AVG CYCLES PER JOB	REPLACE AFTER HOURS IN USE	NO. OF YEARS WITH ONE 10HR SHIFT	NO. OF YEARS WITH TWO 10HR SHIFTS		
COLOR STACK	1	30,000	10 YRS 2 QTRS	5 YRS 1 QTR		
SOLV-AIR BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS		
PUMP BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS		
APPLICATOR	3	10,000	3 YRS 2 QTRS	1 YR 3 QTR		

HOSES - GENERAL MAINTENANCE GUIDLINES

1. INSPECT ALL HOSES DURING WEEKLY MAINTENANCE.
2. MAKE SURE THAT THERE IS NO FLUID OF ANY KIND IN AIR PILOT HOSES.
3. REPLACE DAMAGED OR FAULTY HOSES AS NEEDED.
4. REPLACE HOSE ALONG WITH FITTINGS AT BOTH ENDS.
5. REPLACE HOSES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT SUPPLY HOSES - FROM PAINT DROP TO COLOR STACK - AS NEEDED
SOLVENT AND AIR SUPPLY HOSES - AS NEEDED
PILOT HOSES ON INNER ARM - AS NEEDED
WASH LINE - FROM SOLV AIR BLOCK TO PUMP BLOCK - AS NEEDED
PAINT-IN LINE - FROM REGULATOR TO PUMP BLOCK - AS NEEDED
HOSE BUNDLE - EO-6102-545-000 ASSEMBLY - AS NEEDED

SERTO FITTINGS AND JOHN GUESS COLLETS
1. INSPECT ALL FITTINGS DURING WEEKLY MAINTENANCE.
2. ALL FITTINGS MUST BE REPLACED AS NEEDED UPON REGULAR INSPECTION.
3. DISCARD THE REPLACED FITTINGS - DO NOT STORE THEM.

OTHER PARTS MAINTENANCE SCHEDULE
1. CHECK VALVES - ANNUAL
2. PRESSURE SENSOR - AS NEEDED
3. 3CC GEAR PUMP - REFER TO GEAR PUMP MAINTENANCE (ET-6102-890-007)
4. FIBER OPTIC CABLE FROM J3 HOUSING TO APPLICATOR - ANNUAL
5. HIGH VOTAGE CABLE FROM CASCADE TO APPLICATOR - ANNUAL

NOTES:

1. FOR 5 BAR SYSTEMS: PAINT VALVE LIFE IS REDUCED TO 1,000,000 (1 MILLION) CYCLES. DIVIDE LIFE ESTIMATES IN TABLE 1 BY 2.0

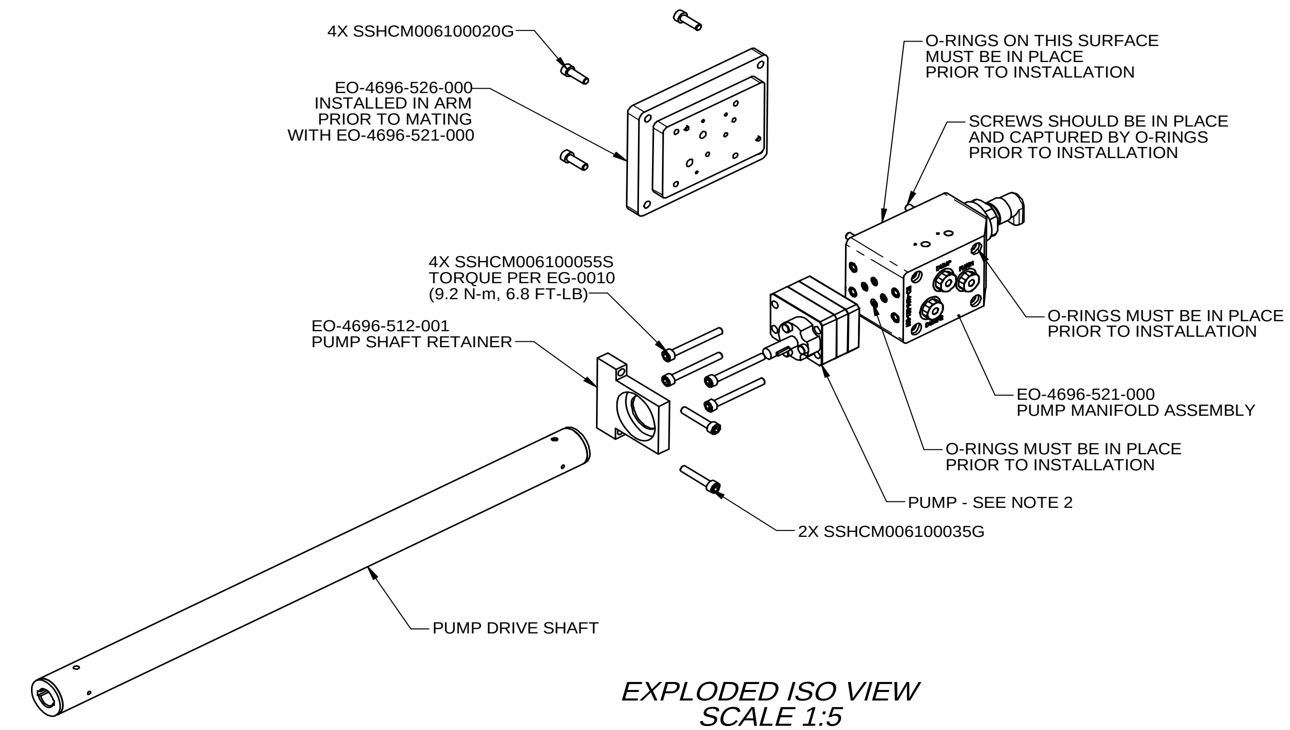
[ET-6102-890-006]	REV B1
P-500iA 1K PM SCHEDULES	SHEET 2 OF 2

Figure 8-47 ET-6102-890-007 Sheet 1 of 2, ZENITH PUMP MAINTENANCE

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



EXPLODED ISO VIEW
SCALE 1:5

NOTES:

1. UNLESS OTHERWISE SPECIFIED TORQUE ALL FASTNERS PER EG-00010.
2. THE FOLLOWING STEPS SHOULD BE FOLLOWED TO INSTALL THE KEY IN THE KEYWAY ON THE PUMP SHAFT.
   a. APPLY LOCTITE PRIMER 'N' TO KEY & KEYWAY. WAIT 30 SECONDS.
   b. APPLY A SMALL AMOUNT OF LOCTITE 680 TO KEYWAY ON PUMP SHAFT. CAUTION: PRODUCT CURES QUICKLY
   c. IMMEDIATELY INSTALL KEY IN KEYWAY.
   d. IMMEDIATELY WIPE ALL EXCESS LIQUID FROM PUMP SHAFT.
3. PLUG UNUSED RETAINER MOUNTING HOLES
4. CAP PILOT LINES USING CAPMO000000101O FOR STORAGE OF THIS SUBASSEMBLY

ASSEMBLY NOTES:

1. INSTALL P/I CABLE (EE-4696-267-002) INTO CORD GRIP (CGRPO000000398O)
2. INSTALL PUMP QD ASM (EO4696-526-000) INTO OUTER ARM (EO4696-021-001A)
3. INSTALL PUMP DRIVE SHAFT ONTO PUMP MOTOR OUTPUT SHAFT IN OUTER ARM
4. INSTALL PUMP SHAFT RETAINER (EO-4696-512-001) AS NOTED INTO OUTER ARM (EO4696-021-001A)
5. INSTALL GEAR PUMP (EO-4657-511-000) ONTO PUMP MANIFOLD (EO-4696-521-000)
6. INSTALL PUMP MANIFOLD (EO-4696-521-000) AND GEAR PUMP (EO-4657-511-000) INTO OUTER ARM (EO4696-021-001A)

Standard Hardware Descriptions

FANUC Part No.	Description
SSHCM006100020G	M6 X 1.0 X 20mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100035G	M6 X 1.0 X 35mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100055S	M6 X 1.0 X 55mm LG. Stainless Steel Socket Head Cap

[ET-6102-890-007] REV B1
ZENITH PUMP MAINTENANCE SHEET 1 OF 2

Figure 8-48 ET-6102-890-007 Sheet 2 of 2, ZENITH PUMP MAINTENANCE

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.

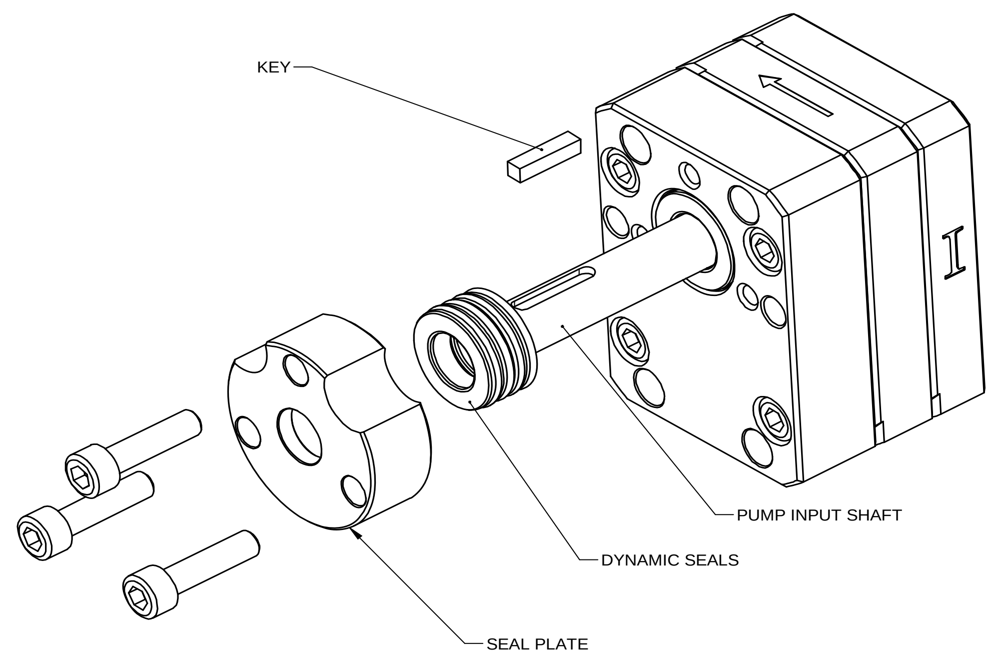
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

GEAR PUMP PREVENTIVE MAINTENANCE

- FLUSH PUMP WITH SOLVENT EVERY FOUR HOURS, AT BREAK AND END OF SHIFT.
- REPLACE PUMP DYNAMIC SEALS ACCORDING TO THE RECOMMENDED SCHEDULE. THE PROPER PROCEDURE AND REQUIRED TOOLS ARE EXPLAINED IN EG00381.

WEEKLY MAINTENANCE

1. VISUALLY INSPECT THE PUMP FOR ANY LEAKS. EXAMINE PUMP INPUT SHAFT, SEAL PLATE, AND PAINT FITTINGS. IF ANY LEAK IS FOUND, REMOVE FROM SERVICE AND INSPECT. LEAK SERVICE MAY BE PERFORMED BY CUSTOMER PERSONNEL ACCORDING TO THE PROCEDURE IN THE MANUAL.
2. CHECK FLOWRATES OF DIFFERENT MATERIALS WITH A BEAKER. AS A GENERAL RULE, A PUMP OUTPUT VARIATION OF 10% OR MORE INDICATES A NEED TO REPLACE OR REBUILD THE PUMP. RETURN TO FANUC ROBOTICS AMERICA.
3. LISTEN FOR ANY NOISE FROM THE PUMP WHILE IT DISPENSES PAINT. SOME NOISE IS EXPECTED DURING SOLVENT FLUSH, BUT THE PUMP SHOULD RUN SMOOTHLY WHILE DISPENSING PAINT. IF EXCESSIVE NOISE IS FOUND, REPLACE THE PUMP AND RETURN TO FANUC ROBOTICS AMERICA.



PERIODIC REPLACEMENT OF DYNAMIC SEALS FOR GEAR PUMP	
REPLACE IN	USAGE PATTERN
6 MONTHS	PRIMER WITH NO PERIODIC FLUSHING
9 - 12 MONTHS	PRIMER WITH PERIODIC FLUSHING
15 - 18 MONTHS	BASECOAT WITH PERIODIC FLUSHING
24 MONTHS	CLEARCOAT WITH PERIODIC FLUSHING

[ET-6102-890-007] REV B1
ZENITH PUMP MAINTENANCE SHEET 2 OF 2

Figure 8-49 ET-5093-890-006 Sheet 1 of 2, P700 1K PM SCHEDULES

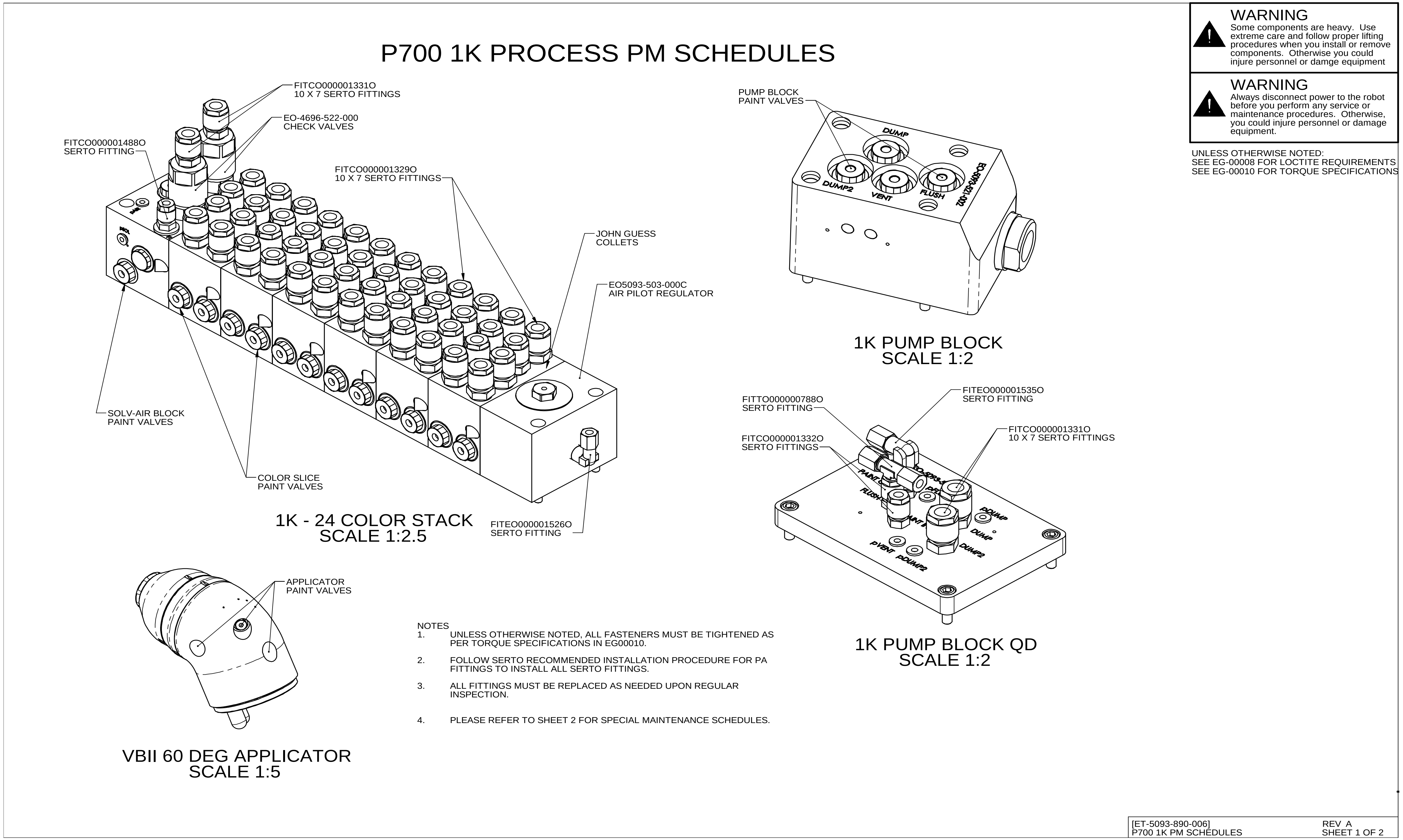


Figure 8-50 ET-5093-890-006 Sheet 2 of 2, P700 1K PM SCHEDULES

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

PAINT VALVES - GENERAL MAINTENANCE GUIDLINES
1. INSPECT ALL PAINT VALVES DURING WEEKLY MAINTENANCE FOR LEAKS AND/OR MALFUNCTION.
2. PAINT VALVE IS NOT FIELD SERVICEABLE UNIT.
3. PAINT VALVE MUST BE REPLACED AS A WHOLE.
4. REPLACE A DAMAGED VALEVE WITH A NEW VALVE.
5. DISCARD DAMAGED PAINT VALVES PROMPTLY - DO NOT STORE THEM.
6. LIFE OF A PAINT VALVE UNDER NORMAL OPERATION IS 2,000,000 (TWO MILLION) CYCLES.
7. REPLACE PAINT VALVES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT VALVE LOCATION	AVG CYCLES PER JOB	REPLACE AFTER HOURS IN USE	NO. OF YEARS WITH ONE 10HR SHIFT	NO. OF YEARS WITH TWO 10HR SHIFTS
COLOR STACK	1	30,000	10 YRS 2 QTRS	5 YRS 1 QTR
SOLV-AIR BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS
PUMP BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS
APPLICATOR	3	10,000	3 YRS 2 QTRS	1 YR 3 QTR

HOSES - GENERAL MAINTENANCE GUIDLINES

1. INSPECT ALL HOSES DURING WEEKLY MAINTENACE.
2. MAKE SURE THAT THERE IS NO FLUID OF ANY KIND IN AIR PILOT HOSES.
3. REPLACE DAMAGED OR FAULTY HOSES AS NEEDED.
4. REPLACE HOSE ALONG WITH FITTINGS AT BOTH ENDS.
5. REPLACE HOSES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT SUPPLY HOSES - FROM PAINT DROP TO COLOR STACK - ANNUAL
SOLVENT AND AIR SUPPLY HOSES - ANNUAL
PILOT HOSES ON INNER ARM - ANNUAL
WASH LINE - FROM SOLV AIR BLOCK TO PUMP BLOCK - ANNUAL
PAINT-IN LINE - FROM REGULATOR TO PUMP BLOCK - ANNUAL
HOSE BUNDLE - EO-5093-545-000 ASSEMBLY - 6 MONTHS

SERTO FITTINGS AND JOHN GUESS COLLETS
1. INSPECT ALL FITTINGS DURING WEEKLY MAINTENANCE.
2. ALL FITTINGS MUST BE REPLACED AS NEEDED UPON REGULAR INSPECTION.
3. DISCARD THE REPLACED FITTINGS - DO NOT STORE THEM.

OTHER PARTS MAINTENANCE SCHEDULE
1. CHECK VALVES - ANNUAL
2. PRESSURE SENSOR - AS NEEDED
3. 3CC GEAR PUMP - REFER TO GEAR PUMP MAINTENANCE (ET-5093-890-007)

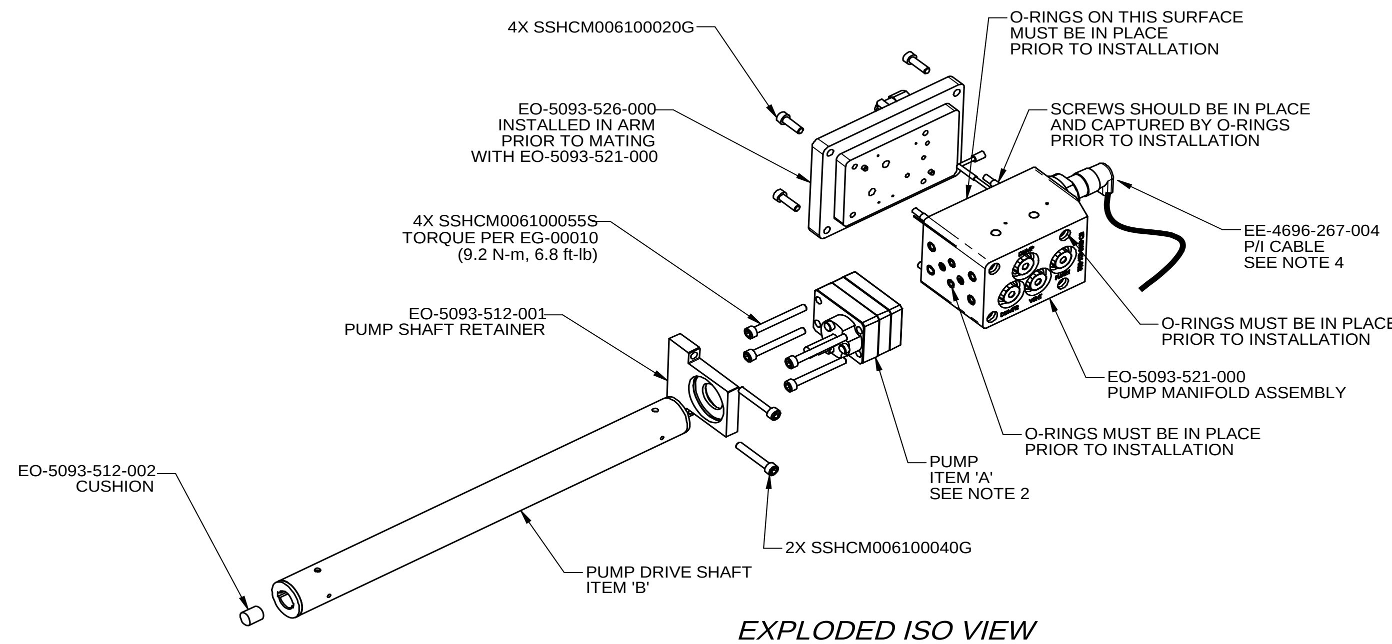
[ET-5093-890-006] REV A
P700 1K PM SCHEDULES SHEET 2 OF 2

Figure 8-51 ET-5093-890-007 Sheet 1 of 2, 1K PUMP

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



EXPLODED ISO VIEW
SCALE 1:5

NOTES:

1. UNLESS OTHERWISE SPECIFIED TORQUE ALL FASTNERS PER EG00010.
2. THE FOLLOWING STEPS SHOULD BE FOLLOWED TO INSTALL THE KEY IN THE KEYWAY ON THE PUMP SHAFT.
   a. APPLY LOCTITE PRIMER 'N' TO KEY & KEYWAY. WAIT 30 SECONDS.
   b. APPLY A SMALL AMOUNT OF LOCTITE 680 TO KEYWAY ON PUMP SHAFT. CAUTION: PRODUCT CURES QUICKLY
   c. IMMEDIATELY INSTALL KEY IN KEYWAY.
   d. IMMEDIATELY WIPE ALL EXCESS LIQUID FROM PUMP SHAFT.
3. PLUG UNUSED RETAINER MOUNTING HOLES
4. SEE OUTER ARM ASSEMBLY EO5093-020-000A FOR ADDITIONAL CABLE ROUTING
5. CAP PILOT LINES USING CAPMO000000101O FOR STORAGE OF THIS SUBASSEMBLY

ASSEMBLY NOTES:

1. INSTALL P/I CABLE (EE-4696-267-004) INTO CORD GRIP (CGRPO000000398O)

2. INSTALL PUMP QD ASM (EO5093-526-000) INTO OUTER ARM (EO5093-020-001A)

3. INSTALL CUSHION (EO-5093-512-001) INTO PUMP DRIVE SHAFT (EO5093-020-012B)

4. INSTALL PUMP DRIVE SHAFT (EO5093-020-012B) ONTO PUMP MOTOR OUTPUT SHAFT IN OUTER ARM (EO5093-020-001A)

5. INSTALL PUMP SHAFT RETAINER (EO-5093-512-001) AS NOTED INTO OUTER ARM (EO5093-020-001A)

6. INSTALL GEAR PUMP (EO-4657-511-000) ONTO PUMP MANIFOLD (EO-5093-521-000)

7. INSTALL PUMP MANIFOLD (EO-5093-521-000) AND GEAR PUMP (EO-4657-511-000) INTO OUTER ARM (EO5093-020-001A)

Standard Hardware Descriptions

FANUC Part No.	Description
SSHCM006100020G	M6 X 1.0 X 20mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100040G	M6 X 1.0 X 40mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100055S	M6 X 1.0 X 55mm LG. Stainless Steel Socket Head Cap

[ET-5093-890-007] REV A
TEMPLATE SHEET 1 OF 2

Figure 8-52 ET-5093-890-007 Sheet 2 of 2, 1K PUMP

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.

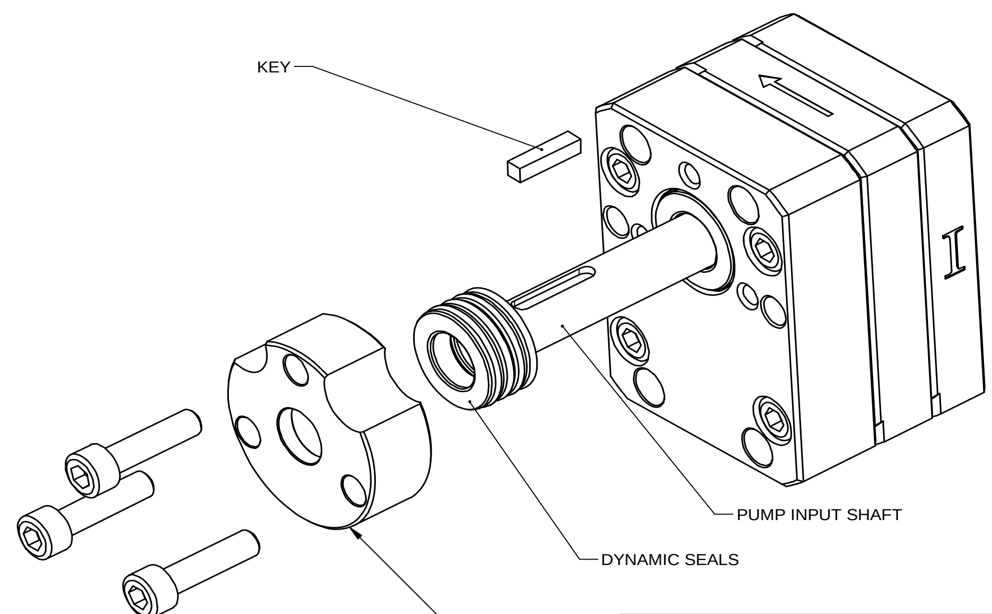
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

GEAR PUMP PREVENTIVE MAINTENANCE

- FLUSH PUMP WITH SOLVENT EVERY FOUR HOURS, AT BREAK AND END OF SHIFT.
- REPLACE PUMP DYNAMIC SEALS ACCORDING TO THE RECOMMENDED SCHEDULE. THE PROPER PROCEDURE AND REQUIRED TOOLS ARE EXPLAINED IN EG00381.

WEEKLY MAINTENANCE

1. VISUALLY INSPECT THE PUMP FOR ANY LEAKS. EXAMINE PUMP INPUT SHAFT, SEAL PLATE, AND PAINT FITTINGS. IF ANY LEAK IS FOUND, REMOVE FROM SERVICE AND INSPECT. LEAK SERVICE MAY BE PERFORMED BY CUSTOMER PERSONNEL ACCORDING TO THE PROCEDURE IN THE MANUAL.
2. CHECK FLOWRATES OF DIFFERENT MATERIALS WITH A BEAKER. AS A GENERAL RULE, A PUMP OUTPUT VARIATION OF 10% OR MORE INDICATES A NEED TO REPLACE OR REBUILD THE PUMP. RETURN TO FANUC ROBOTICS AMERICA.
3. LISTEN FOR ANY NOISE FROM THE PUMP WHILE IT DISPENSES PAINT. SOME NOISE IS EXPECTED DURING SOLVENT FLUSH, BUT THE PUMP SHOULD RUN SMOOTHLY WHILE DISPENSING PAINT. IF EXCESSIVE NOISE IS FOUND, REPLACE THE PUMP AND RETURN TO FANUC ROBOTICS AMERICA.



PERIODIC REPLACEMENT OF DYNAMIC SEALS FOR GEAR PUMP

USAGE PATTERN	REPLACE IN
PRIMER WITH NO PERIODIC FLUSHING	6 MONTHS
PRIMER WITH PERIODIC FLUSHING	9 - 12 MONTHS
BASECOAT WITH PERIODIC FLUSHING	15 - 18 MONTHS
CLEARCOAT WITH PERIODIC FLUSHING	24 MONTHS

[ET-5093-890-007] TEMPLATE	REV A SHEET 2 OF 2

Figure 8-53 ET-5093-895-002 Sheet 1 of 3, P-700iA 2K 24+3 MANIFOLD MAINTENANCE

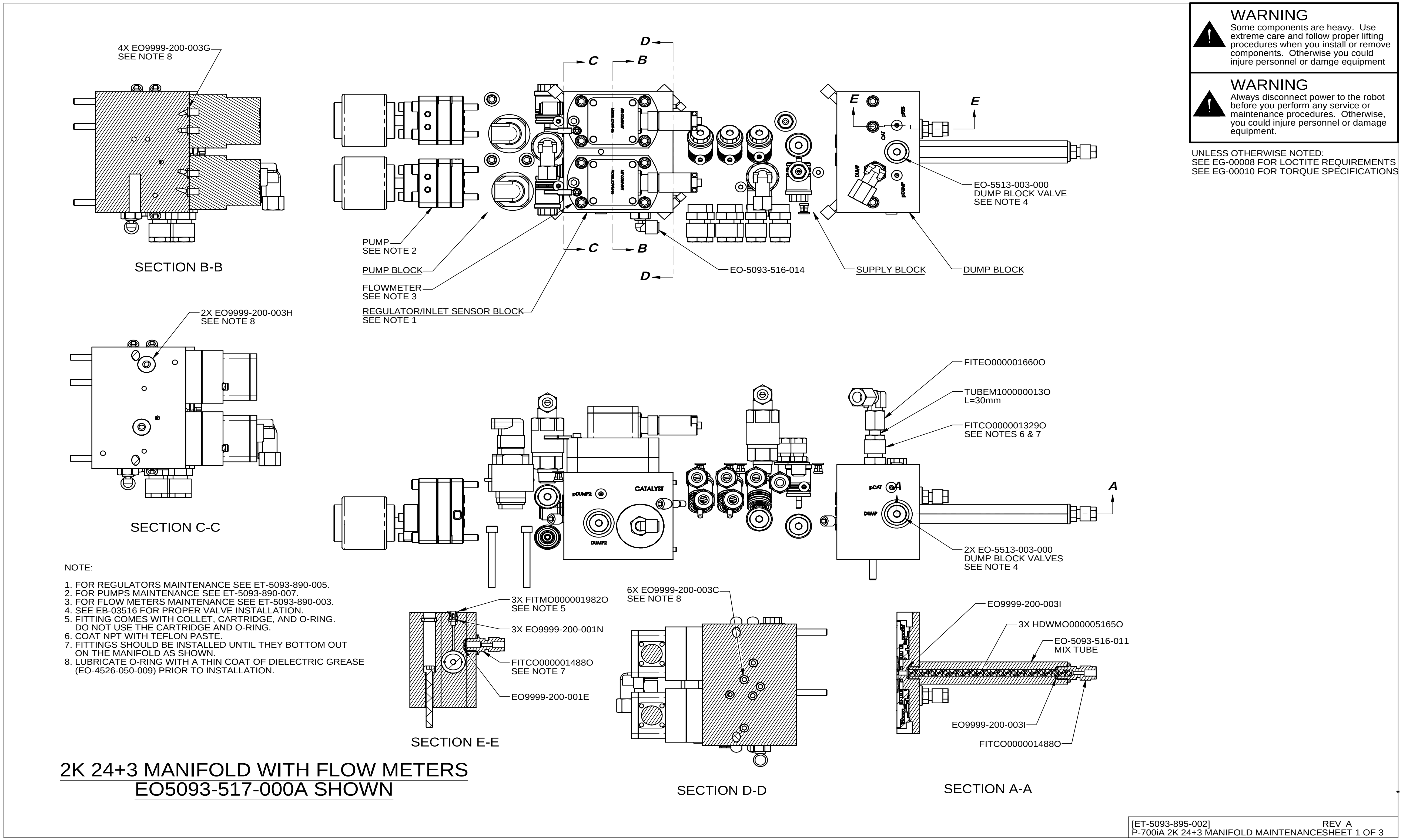


Figure 8-54 ET-5093-895-002 Sheet 2 of 3, P-700iA 2K 24+3 MANIFOLD MAINTENANCE

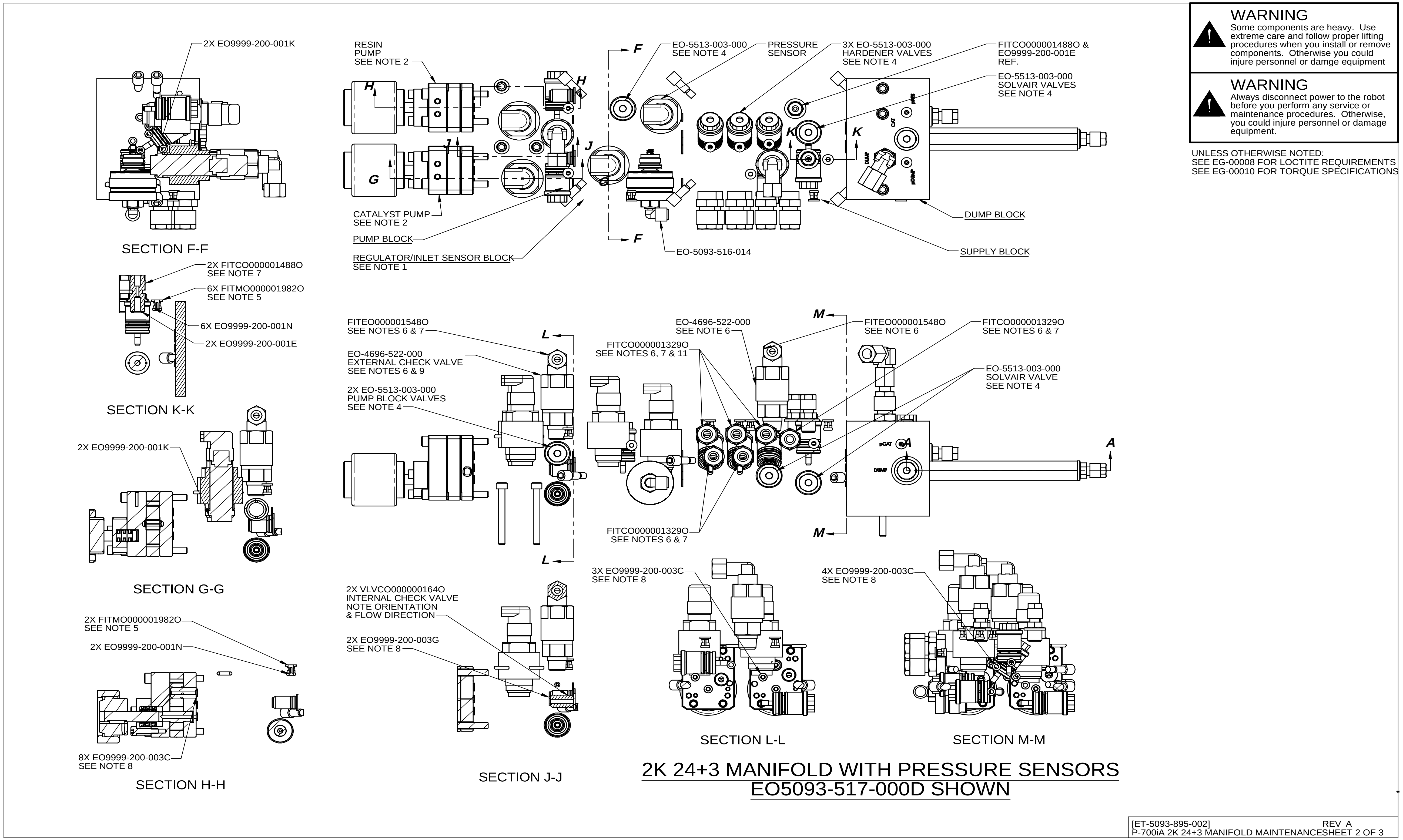


Figure 8-55 ET-5093-895-002 Sheet 3 of 3, P-700iA 2K 24+3 MANIFOLD MAINTENANCE

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

PAINT VALVES - GENERAL MAINTENANCE GUIDLINES
1. INSPECT ALL PAINT VALVES DURING WEEKLY MAINTENANCE FOR LEAKS AND/OR MALFUNCTION.
2. PAINT VALVE IS NOT FIELD SERVICEABLE UNIT.
3. PAINT VALVE MUST BE REPLACED AS A WHOLE.
4. REPLACE A DAMAGED VALVE WITH A NEW VALVE.
5. DISCARD DAMAGED PAINT VALVES PROMPTLY - DO NOT STORE THEM.
6. LIFE OF A PAINT VALVE UNDER NORMAL OPERATION IS 2,000,000 (TWO MILLION) CYCLES.
7. LIFE OF A PAINT VALVE USED AS A HARDENER VALVE IS 1,000,000 (ONE MILLION) CYCLES.
8. REPLACE PAINT VALVES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT VALVE LOCATION	AVG CYCLES PER JOB	REPLACE AFTER HOURS IN USE	NO. OF YEARS WITH ONE 10HR SHIFT	NO. OF YEARS WITH TWO 10HR SHIFTS
COLOR STACK	1	30,000	10 YRS 2 QTRS	5 YRS 1 QTR
SOLV-AIR BLOCK	1	30,000	10 YRS 2 QTRS	5 YRS 1 QTR
PUMP BLOCK	1	30,000	10 YRS 2 QTRS	5 YRS 1 QTR
APPLICATOR	3	10,000	3 YRS 2 QTRS	1 YR 3 QTR
DUMP BLOCK	3	10,000	3 YRS 2 QTRS	1 YR 3 QTR
HARDENER	1	15,000	5 YRS 1 QTR	2 YRS 2 QTRS

HOSES - GENERAL MAINTENANCE GUIDLINES

1. INSPECT ALL HOSES DURING WEEKLY MAINTENACE.
2. MAKE SURE THAT THERE IS NO FLUID OF ANY KIND IN AIR PILOT HOSES.
3. REPLACE DAMAGED OR FAULTY HOSES AS NEEDED.
4. REPLACE HOSE ALONG WITH FITTINGS AT BOTH ENDS.
5. REPLACE HOSES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT SUPPLY HOSES - FROM PAINT DROP TO COLOR STACK - ANNUAL
SOLVENT AND AIR SUPPLY HOSES - ANNUAL
PILOT HOSES ON INNER ARM - ANNUAL
WASH LINE - FROM SOLV AIR BLOCK TO PUMP BLOCK - ANNUAL
PAINT-IN LINE - FROM REGULATOR TO PUMP BLOCK - ANNUAL
HOSE BUNDLE - EO-5093-545-000 ASSEMBLY - 6 MONTHS

SERTO FITTINGS AND JOHN GUEST COLLETS
1. INSPECT ALL FITTINGS DURING WEEKLY MAINTENANCE.
2. ALL FITTINGS MUST BE REPLACED AS NEEDED UPON REGULAR INSPECTION.
3. DISCARD THE REPLACED FITTINGS - DO NOT STORE THEM.

OTHER PARTS MAINTENANCE SCHEDULE
1. CHECK VALVES - ANNUAL
2. PRESSURE SENSOR - AS NEEDED
3. 3CC GEAR PUMP - REFER TO GEAR PUMP MAINTENANCE (ET-5093-890-007)
4. MIX TUBE ASSEMBLY - AS NEEDED

[ET-5093-895-002] REV A
P-700iA 2K 24+3 MANIFOLD MAINTENANCE SHEET 3 OF 3

Figure 8-56 ET-5093-895-003, P-700iA 2K FLOW METER MAINTENANCE

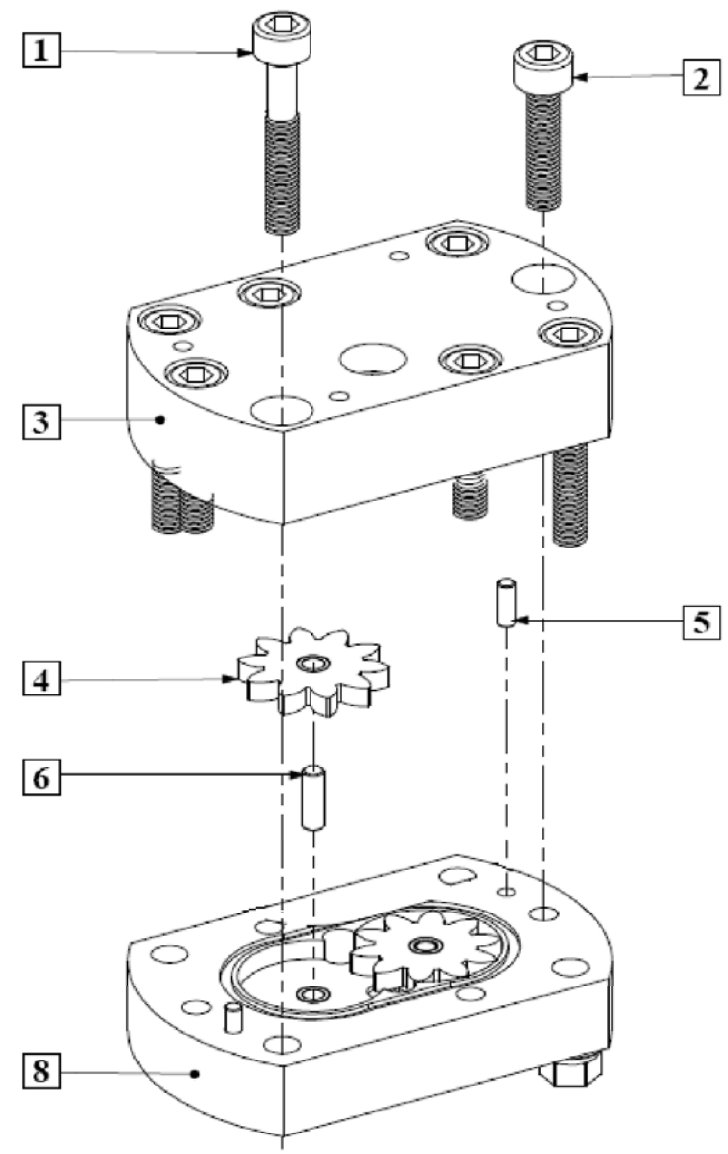
CLEANING & REPAIR PROCEDURE

1. REMOVE THE 4 CORNER HEX BOLTS (1) AND REMOVE THE FLOW METER FROM THE MANIFOLD
2. REMOVE THE REMAINING 4 HEX BOLTS (2) WITH A 5MM HEX KEY.
   a. REINSERT 2 OF THE BOLTS YOU JUST REMOVED, THE 2 ON OPPOSITE ENDS WORK BEST, SO THAT THEY ARE ONLY HOLDING BY A FEW THREADS. WHILE HOLDING THE UPPER HOUSING FIRMLY, TAP THE 2 BOLTS TO SEPARATE THE UPPER AND LOWER HOUSING (3 & 4). DO NOT PRY OR TWIST THE HOUSINGS TO SEPARATE THEM, AS THIS MAY DAMAGE INTERNAL PARTS OF THE METER.
3. ONCE THE HOUSINGS ARE SEPARATED:
   a. REMOVE THE GEARS (4) AND SHAFTS (6). LIFT THE GEARS STRAIGHT UP OFF OF THE SHAFTS TO AVOID DAMAGING THE SHAFTS.
   b. CLEAN THE GEARS, SHAFTS, METER BODIES, O-RING GROOVE AND SHAFT HOLES USING SOLVENT AND A SMALL BRUSH.
   c. INSPECT THE GEARS AND SHAFTS. THE GEARS SHOULD SPIN FREELY ON THE SHAFTS.
4. TO REASSEMBLE THE METER:
   a. REINSERT THE SHAFTS INTO THE SHAFT HOLES AND REINSERT THE GEARS AS WELL. MAKE SURE THE GEARS ARE SPINNING FREELY.
   b. KEEP THE METER HOUSINGS AS PARALLEL AS POSSIBLE DURING REASSEMBLY. LINE UP THE INDEX MARKS WHICH ARE LOCATED ON EITHER END OF THE UPPER AND LOWER HOUSINGS.
   c. REPLACE THE 4 HEX BOLTS (2) THAT WERE REMOVED LAST AND TIGHTEN THEM TO APPROXIMATELY 15Nm. DO NOT FORCE THE HOUSINGS TOGETHER AS YOU COULD DAMAGE THE METER. TIGHTEN THE BOLTS A FEW TURNS AT A TIME, SWITCHING TO ANOTEHR TO GENTLY SECURE THE HOUSING TOGETHER. OVER TIGHTENING WILL NOT DAMAGE THE METER BUT THE BOLTS CAN BREAK IF TIGHTENED TOO MUCH.
5. AFTER REASSEMBLY MAKE SURE THE GEARS SPIN FREELY BY GENTLY BLOWING AIR INTO THE INLET. YOU SHOULD BE ABLE TO HEAR THE GEAR SPIN GIVEN A MODERATE BACKGROUND NOISE LEVEL.
6. REINSERT THE 4 CORNER HEX BOLTS (1) AND TIGHTEN TO APPROXIMATELY 15Nm.

Detail No.	Description	Quantity	AW Part No.
1	M6x1.0 x 25mm	4	AG15070
2	M6 S.H.C.S. - see assembly	4	-
3	Upper Housing	1	n/a
4	GR-10CG Gear	2	AG10010
5	LP-CG Locating Pins	2	AG15030
6	ST-15SLGFS Shaft	2	AG15052
7	<open>	-	-
8	Lower Housing	1	n/a

NOTES:

1. THIS INFORMATION BASED ON AW MAINTENANCE GUIDE
2. FLOW METERS SHOULD TYPICALLY BE DISASSEMBLED, CLEANED, AND INSPECTED AT 6 MONTH INTERVALS, BUT MAINTENANCE INTERVALS WILL VARY DEPENDING ON PAINT MATERIAL AND DUTY CYCLE.
3. THE FLOW METERS ARE INDIVIDUALLY CALIBRATED AND SHOULD BE REINSTALLED IN THE SAME LOCATION FROM WHICH THEY WERE REMOVED.
4. DO NOT INTERCHANGE PARTS BETWEEN FLOW METERS.



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

[ET-5093-895-003]	REV A
P-700iA 2K FLOW METER MAINTENANCE	SHEET 1 OF 1

8.4 Troubleshooting

8.4.1 PNT1-733 WARN %sPump 1 IN low pressure warning

Cause: Pump #1 inlet pressure has been below the low warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:
The supply pressure is too low/shutoff.
The pilot line to resin color valve is removed or broken.
The resin color valve has failed to actuate
The supply line (hose, etc.) is removed or broken.
The resin inlet transducer has failed.
The inlet regulator has failed.

Remedy: Check the following:
Check the pilot line to resin color that is being used.
Verify that the resin color valve being used is not faulty.
Make sure the supply pressure is between 90 to 150psi.
Check the supply line from paint kitchen.
Check the resin inlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 600+ cnts (50-80 psi) during a color change cycle.
Check the inlet regulator as follows: Through the Analog I/O menu verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.2 PNT1-734 PAUS %sPump 1 IN low pressure fault

Cause: Pump #1 inlet pressure has been below the low fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:
The supply pressure is too low/shutoff.
The pilot line to resin color valve is removed or broken.
The resin color valve has failed to actuate
The supply line (hose, etc.) is removed or broken.
The resin inlet transducer has failed.
The inlet regulator has failed.

Remedy:
Check the pilot line to resin color that is being used.
Verify that the resin color valve being used is not faulty.
Make sure the supply pressure is between 90 to 150 psi.
Check the supply line from paint kitchen.
Check the resin inlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 600+ cnts (50-80 psi) during a color change cycle.
Check the inlet regulator as follows: Through the Analog I/O menu verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.3 PNT1-735 WARN %sPump 1 IN high pressure warning

Cause: Pump #1 inlet pressure has been above the high warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The supply pressure is set too high.
- The resin inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Make sure the supply pressure is between 90 to 150 psi.
- Check the resin inlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 600+ cnts (50-80 psi) during a color change cycle.
- Check the resin inlet regulator as follows: Through the Analog I/O menu verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.4 PNT1-736 PAUS %sPump 1 IN high pressure fault

Cause: Pump #1 inlet pressure has been above the high fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The supply pressure is set too high.
- The resin inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Check the resin inlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 600+ cnts (50-80 psi) during a color change cycle.
- Check the inlet regulator as follows: Through the Analog I/O menu verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.5 PNT1-737 WARN %sPump 1 OUT low pressure warning

Cause: Pump #1 outlet pressure has been below the low warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to resin color valve is removed or broken.
- The resin color valve has failed to actuate
- The supply pressure is too low/shutoff.
- The supply line (hose, etc.) is removed or broken.
- A broken coupling between the servo motor and pump.
- The resin outlet transducer has failed.
- The injector tip is too large for the paint material being used.
- Broken/Leaking Paint Line

Remedy: Check the following:

- Check the pilot line to resin color that is being used.
- Verify that the resin color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from paint kitchen.
- Verify that the pump is rotating with the motor.
- Check the resin outlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.6 PNT1-738 PAUS %sPump 1 OUT low pressure fault

Cause: Pump #1 outlet pressure has been below the low fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to resin color valve is removed or broken.
- The resin color valve has failed to actuate
- The supply pressure is too low/shutoff.
- The supply line (hose, etc.) is removed or broken.
- A broken coupling between the servo motor and pump.
- The resin outlet transducer has failed.
- Broken/Leaking Paint Line

Remedy: Check the following:
- Check the pilot line to the resin color that is being used.
- Verify that the resin color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Verify that the pump is rotating with the motor.
- Check the resin outlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 600+ cnts (50-80 psi) during a color change cycle.

8.4.7 PNT1-739 WARN %sPump 1 OUT high pressure warning

Cause: Pump #1 outlet pressure has been above the high warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:
- The problem is usually an obstructed trigger, tower, or paint line.
- The pilot line to mix resin or catalyst valve is removed or broken. (2K only)
- PE or TRIG valve failed to open.
- The mix resin valve has failed. (2K)
- The resin outlet transducer has failed.
- Clogged Mix tube (2K)

Remedy: Check the following:
- Make sure the lines, trigger, or check valve are not obstructed.
- Check the pilot line to mix resin valve. Verify that the mix resin valve is not faulty.
- Check the resin outlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.8 PNT1-740 PAUS %sPump 1 OUT high pressure fault

Cause: Pump #1 outlet pressure has been above the high fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:
- The problem is usually an obstructed trigger, tower, or paint line.
- The pilot line to mix resin or catalyst valve is removed or broken. (2K only)
- The mix resin valve has failed.
- The resin outlet transducer has failed.

Remedy: Check the following:
- Make sure the lines, trigger, or check valve are not obstructed.
- Check the pilot line to mix resin valve. Verify that the mix resin valve is not faulty.
- Check the resin outlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.9 PNT1-744 WARN %sPump 1 motor velocity limit

Cause: The motor velocity for pump #1 has exceeded its operating limit. The motor speed will be reduced to be within operating limit. The motor speed for pump #2 will be reduced to maintain a proper fluid ratio.

Remedy: Lower the flow rate to within the motor limit.
- 750 cc/min for a 3cc/rev pump
- 1500 cc/min for a 6cc/rev pump

8.4.10 PNT1-745 WARN %sPump 1 motor servo not ready

Cause: The servo power to pump #1 is not ready.

Remedy: Usually, the servo not ready occurs when servo power is turned off for some reason, such as E-stop condition or if the controller is machine locked. Correct the condition, and reset the controller.

8.4.11 PNT1-746 WARN %sPump 1 totals differ > tolerance

Cause: The actual total flow out of pump #1 as measured by the fluid flow meter has a value that is different than the commanded total flow. This difference is larger than the total flow tolerance.

Remedy:

- Perform a fluid flow test on pump #1 with a beaker and verify that the beaker amount matches the pump #1 size (cc/rev).
- Verify that the correct KFT factor has been entered for the fluid flow meter per the manufacturer's specification.
- Service the regulator and poppet seat.
- The flow meter could also require cleaning.
- Follow procedure in ET-5093-895-003.

8.4.12 PNT1-753 WARN %sPump 2 IN low pressure warning

Cause: Pump #2 inlet pressure has been below the low warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to hardener color valve is removed or broken.
- The hardener color valve has failed.
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or broken.
- The hardener inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Perform the following:

- Check the pilot line to verify the hardener color that is being used.
- Verify that the hardener color valve being used is not faulty.
- Make sure the supply pressure is 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Check the hardener inlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the inlet regulator as follows: Through the Analog I/O menu verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.13 PNT1-754 PAUS %sPump 2 IN low pressure fault

Cause: Pump #2 inlet pressure has been below the low fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to hardener color valve is removed or broken.
- The hardener color valve has failed to actuate
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or broken.
- The hardener inlet transducer has failed.
- The inlet regulator has failed.

Remedy:

- Check the pilot line to hardener color that is being used.
- Verify that the hardener color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Check the hardener inlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the inlet regulator as follows: Through the Analog I/O menu verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.14 PNT1-755 WARN %sPump 2 IN high pressure warning

Cause: Pump #2 inlet pressure has been above the high warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The supply pressure is set too high.
- The hardener inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

Check the hardener inlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

- Check the resin inlet regulator as follows: Through the Analog I/O menu verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.15 PNT1-756 PAUS %sPump 2 IN high pressure fault

Cause: Pump #2 inlet pressure has been above the high fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The supply pressure is set too high.
- The hardener inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Make sure the high pressure fault limit is appropriate.
- Make sure the high pressure sensitivity is appropriate.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the hardener inlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the hardener inlet regulator as follows: Through the Analog I/O menu verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.16 PNT1-757 WARN %sPump 2 OUT low pressure warning

Cause: Pump #2 outlet pressure has been below the low warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to hardener color valve is removed or broken.
- The hardener color valve has failed to actuate.
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or broken.
- A coupling is broken between the servo motor and pump.
- The hardener outlet transducer has failed.
- The injector tip being used is too large.
- Broken or leaking paint line.

Remedy: Check the following:

- Check the pilot line to hardener color that is being used.
- Verify that the hardener color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Verify that the pump is rotating with the motor.
- Check the hardener outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.17 PNT1-758 PAUS %sPump 2 OUT low pressure fault

Cause: Pump #2 outlet pressure has been below the low fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to hardener color valve is removed or broken.

- The hardener color valve has failed to actuate.
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or broken.
- A broken coupling between the servo motor and pump.
- The hardener outlet transducer has failed.
- The injector tip being used is too large.

Remedy: Check the following:

- Check the pilot line to hardener color that is being used.
- Verify that the hardener color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Verify that the pump is rotating with the motor.
- Check the hardener outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.18 PNT1-759 WARN %sPump 2 OUT high pressure warning

Cause: Pump #2 outlet pressure has been above the high warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The issue is almost always a tower, paint line, or check valve is obstructed.
- The pilot line to mix hardener valve is removed or broken.
- PE or TRIG valve failed to open.
- The mix hardener valve has failed. (2K only)
- The hardener outlet transducer has failed.
- The injector tip being used is too small. (2K only)

Remedy: Check the following:

- Make sure the lines, trigger, or check valve are not obstructed.
- Check the pilot line to mix hardener valve.
- Verify that the mix hardener valve is not faulty.
- Check the hardener outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260.+ cnts (50-80 psi) during a color change cycle.

8.4.19 PNT1-760 PAUS %sPump 2 OUT high pressure fault

Cause: Pump #2 outlet pressure has been above the high fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The issue is usually a paint line, tower, or check valve is obstructed.
- The pilot line to mix hardener valve is removed or broken.
- The mix hardener valve has failed.
- The hardener outlet transducer has failed.

Remedy: Check the following:

- Make sure the lines, trigger or check valve are not obstructed.
- Check the pilot line to mix hardener valve.
- Verify that the mix hardener valve is not faulty.
- Check the hardener outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.20 PNT1-761 WARN %sPump 2 fluid flow rate > set point

Cause: The actual flow rate out of pump #2 as measured by the fluid flow meter has been continuously greater than a set point window (a percentage) for a user configurable period of time.

Remedy: Perform the following:

- Perform a fluid flow test on pump #2 with a beaker and verify that the beaker amount matches the pump #2 size (cc/rev).
- Verify that the correct KFT factor has been entered for the fluid flow meter per the manufacturer's specification.
- Service the regulator and poppet seat.
- Clean the flow meter using the procedure in ET-5093-895-003.

8.4.21 PNT1-762 WARN %sPump 2 fluid flow rate < set point

Cause: The actual flow rate out of pump #2 as measured by the fluid flow meter has been continuously less than a set point window (a percentage) for a user configurable period of time.

Remedy: Perform the following:

- Perform a fluid flow test on pump #2 with a beaker and verify that the beaker amount matches the pump #2 size (cc/rev).
- Verify that the correct KFT factor has been entered for the fluid flow meter per the manufacturer's specification.
- Check the operation of the inlet regulator to verify that no "blow by" is occurring across the pump.
- Clean the flow meter using the procedure in ET-5093-895-003.

8.4.22 PNT1-763 WARN %sPump 2 zero fluid flow rate detected

Cause: Zero fluid flow out of pump #2 is detected. This condition is usually caused by one or more of the following:

- A loose mechanical coupling between the motor and pump.
- A broken line between the pump and trigger.

Remedy: Check the mechanical coupling between the motor and the pump. Make sure the line from paint line to trigger is ok.

8.4.23 PNT1-764 WARN %sPump 2 motor velocity limit

Cause: The motor velocity for pump #2 has exceeded its operating limit. The motor speed will be reduced to be within operating limit. The motor speed for pump #1 will be reduced to maintain a proper fluid ratio.

Remedy: Lower the flow rate to within the motor limit.

- 750 cc/min wit a 3 cc/rev pump
- 1500 cc/min with a 6 cc/rev pump

8.4.24 PNT1-765 WARN %sPump 2 motor servo not ready

Cause: The servo power to pump #2 is not ready. Usually, the servo not ready occurs when servo power is turned off during an E-stop condition, or if the machine is locked.

Remedy: Correct the condition, and reset the controller.

8.4.25 PNT1-766 WARN %sPump 2 totals differ > tolerance

Cause: The actual total flow out of pump #2 as measured by the fluid flow meter has a value that is different than the commanded total flow. This difference is larger than the total flow tolerance.

Remedy: Check the following:

- Perform a fluid flow test on pump #2 with a beaker and verify that the beaker amount matches the pump #2 size (cc/rev).
- Verify that the correct KFT factor has been entered for the flow meter per the manufacturer's specification.
- Check the operation of the inlet regulator to verify that no "blow by" is occurring across the pump.
- Verify that pump #2 does not have excessive wear.

8.4.26 PNT1-771 WARN %s Res:Hrd ratio is 0.0:0.0

Cause: The color identified in the error message has a default ratio (0.0:0.0) defined. The IPC pumps can only run when a non-zero ratio is defined.
Remedy: Change the default ratio for this color in the SETUP Color DETAIL menu.

8.4.27 PNT1-778 WARN %sPump 1 IN low pressure warning

Cause: Pump #1 inlet pressure has been below the low warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to resin color valve is removed or broken.
- The resin color valve has failed to actuate.
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or broken.
- The resin inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Check the pilot line to resin color that is being used.
- Verify that the resin color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Check the resin inlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the inlet regulator as follows: Through the Analog I/O menu, verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.28 PNT1-779 PAUS %sPump 1 IN low pressure fault

Cause: Pump #1 inlet pressure has been below the low fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to resin color valve is removed or broken.
- The resin color valve has failed to actuate.
- The supply pressure is too low/shutoff.
- The supply line (hose and so forth) is removed or broken.
- The resin inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Check the pilot line to resin color that is being used.
- Verify that the resin color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Check the resin inlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the inlet regulator as follows: Through the Analog I/O menu, verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.29 PNT1-780 WARN %sPump 1 IN high pressure warning

Cause: Pump #1 inlet pressure has been above the high warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The supply pressure is set too high.
- The resin inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Make sure the supply pressure is between 90 to 150 psi.
- Check the resin inlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the resin inlet regulator as follows: Through the Analog I/O menu, verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.30 PNT1-781 PAUS %sPump 1 IN high pressure fault

Cause: Pump #1 inlet pressure has been above the high fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The supply pressure is set too high.
- The resin inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Make sure the supply pressure is between 90 to 150 psi.
- Check the resin inlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the inlet regulator as follows: Through the Analog I/O menu, verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.31 PNT1-782 WARN %sPump 1 OUT low pressure warning

Cause: Pump #1 outlet pressure has been below the low warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to resin color valve is removed or is broken.
- The resin color valve has failed to actuate
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or is broken.
- A coupling is broken between the servo motor and pump.
- The resin outlet transducer has failed.
- The injector tip is too large.
- Broken or leaking paint line.

Remedy: Check the following:

- Check the pilot line to resin color that is being used.
- Verify that the resin color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Verify that the pump is rotating with the motor.
- Check the resin outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 600+ cnts (50-80 psi) during a color change cycle.

8.4.32 PNT1-783 PAUS %sPump 1 OUT low pressure fault

Cause: Pump #1 outlet pressure has been below the low fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to resin color valve is removed or is broken.
- The resin color valve has failed to actuate.
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or broken.
- A coupling is broken between the servo motor and pump.
- The resin outlet transducer has failed.
- The injector tip is too large.
- Broken or leaking paint line.

Remedy: Check the following:

- Make sure the low pressure fault limit is appropriate.
- Make sure the low pressure sensitivity is appropriate.
- Check the pilot line to resin color that is being used.
- Verify that the resin color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Verify that the pump is rotating with the motor.
- Check the resin outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.33 PNT1-784 WARN %sPump 1 OUT high pressure warning

Cause: Pump #1 outlet pressure has been above the high warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The issue usually is an obstructed lines, trigger, or tower.
- The pilot line to mix resin valve is removed or is broken.
- PE or TRIG valve failed to open.
- The mix resin valve has failed. (2K only)
- The resin outlet transducer has failed.
- The injector tip is too small.
- Clogged mix tube (2K)

Remedy:

- Make sure the high pressure warning limit is appropriate.
- Make sure the high pressure sensitivity is appropriate.
- Make sure the pump start/stop anticipates are appropriate.
- Make sure the lines, trigger, or check valve are not obstructed.
- Check the pilot line to mix resin valve.
- Verify that the mix resin valve is not faulty.
- Check the resin outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.34 PNT1-785 PAUS %sPump 1 OUT high pressure fault

Cause: Pump #1 outlet pressure has been above the high fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The issue usually is an obstructed paint line, tower, or check valve.
- The pilot line to mix resin valve is removed or is broken.
- The mix resin valve has failed.
- The resin outlet transducer has failed.
- The injector tip is too small.

Remedy: Check the following:

- Make sure the lines, trigger, or check valve are not obstructed.
- Check the pilot line to mix resin valve.
- Verify that the mix resin valve is not faulty.
- Check the resin outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.35 PNT1-789 WARN %sPump 1 motor velocity limit

Cause: The motor velocity for pump #1 has exceeded its operating limit. The motor speed will be reduced to be within operating limit. The motor speed for pump #2 will be reduced to maintain a proper fluid ratio.
Remedy: Lower the flow rate to within the motor limit.

- 750 cc/min for a 3 cc/rev pump
- 1500 cc/min for a 6 cc/rev pump

8.4.36 PNT1-790 WARN %sPump 1 motor servo not ready

Cause: The servo power to pump #1 is not ready. Usually, the servo not ready occurs when servo power is turned off such as during an E-stop condition, or if the machine is locked.
Remedy: Correct the condition, and reset the controller.

8.4.37 PNT1-791 WARN %sPump 1 totals differ > tolerance

Cause: The actual total flow out of pump #1 as measured by the fluid flow meter has a value that is different than the commanded total flow. This difference is larger than the total flow tolerance.
Remedy: Check the following:

- Perform a fluid flow test on pump #1 with a beaker and verify that the beaker amount matches the pump #1 size (cc/rev).
- Verify that the correct KFT factor has been entered for the fluid flow meter per the manufacturer's specification.
- Check the operation of the inlet regulator to verify that no "blow by" is occurring across the pump.
- Verify that pump #1 does not have excessive wear.

8.4.38 PNT1-798 WARN %sPump 2 IN low pressure warning

Cause: Pump #2 inlet pressure has been below the low warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to hardener color valve is removed or is broken.
- The hardener color valve has failed to actuate.
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or is broken.
- The hardener inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Check the pilot line to hardener color that is being used.
- Verify that the hardener color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Check the hardener inlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the inlet regulator as follows: Through the Analog I/O menu, verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.39 PNT1-799 PAUS %sPump 2 IN low pressure fault

Cause: Pump #2 inlet pressure has been below the low fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to hardener color valve is removed or is broken.
- The hardener color valve has failed to actuate
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or is broken.

- The hardener inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Check the pilot line to hardener color that is being used.
- Verify that the hardener color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Check the hardener inlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the inlet regulator as follows: Through the Analog I/O menu, verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.40 PNT1-800 WARN %sPump 2 IN high pressure warning

Cause: Pump #2 inlet pressure has been above the high warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The supply pressure is set too high.
- The hardener inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Make sure the supply pressure is between 90 to 150 psi.
- Check the hardener inlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the resin inlet regulator as follows: Through the Analog I/O menu, verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.41 PNT1-801 PAUS %sPump 2 IN high pressure fault

Cause: Pump #2 inlet pressure has been above the high fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The supply pressure is set too high.
- The hardener inlet transducer has failed.
- The inlet regulator has failed.

Remedy: Check the following:

- Make sure the supply pressure is between 90 to 150 psi.
- Check the hardener inlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.
- Check the hardener inlet regulator as follows: Through the Analog I/O menu, verify the command 200-1000 cnts (0-100 psi) spanning by verifying the output psi at the transducer test port.

8.4.42 PNT1-802 WARN %sPump 2 OUT low pressure warning

Cause: Pump #2 outlet pressure has been below the low warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to hardener color valve is removed or is broken.
- The hardener color valve has failed to actuate.
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or is broken.
- A broken coupling between the servo motor and pump.
- The hardener outlet transducer has failed.
- The injector tip is too large.
- Broken or leaking paint line.

Remedy: Check the following:

- Check the pilot line to hardener color that is being used.

- Verify that the hardener color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Verify that the pump is rotating with the motor.
- Check the hardener outlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.43 PNT1-803 PAUS %sPump 2 OUT low pressure fault

Cause: Pump #2 outlet pressure has been below the low fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The pilot line to hardener color valve is removed or is broken.
- The hardener color valve has failed.
- The supply pressure is too low/shutoff.
- The supply line (hose and so on) is removed or is broken.
- A broken coupling between the servo motor and pump.
- The hardener outlet transducer has failed.
- The injector tip is too large.
- Broken or leaking paint line.

Remedy: Check the following:

- Check the pilot line to hardener color that is being used.
- Verify that the hardener color valve being used is not faulty.
- Make sure the supply pressure is between 90 to 150 psi.
- Check the supply line from the paint kitchen.
- Verify that the pump is rotating with the motor.
- Check the hardener outlet transducer as follows: Through the Analog I/O menu, verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.44 PNT1-804 WARN %sPump 2 OUT high pressure warning

Cause: Pump #2 outlet pressure has been above the high warning limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The issue usually is an obstructed paint line, tower, or check valve.
- The pilot line to mix hardener valve is removed or is broken.
- PE or TRIG valve failed to open.
- The mix hardener valve has failed. (2K)
- The hardener outlet transducer has failed.
- The injector tip is too small. (2K)

Remedy: Check the following:

- Make sure the lines, trigger, or check valve are not obstructed.
- Check the pilot line to mix hardener valve.
- Verify that the mix hardener valve is not faulty.
- Check the hardener outlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.45 PNT1-805 PAUS %sPump 2 OUT high pressure fault

Cause: Pump #2 outlet pressure has been above the high fault limit for a user configurable period of time. This condition is usually caused by one or more of the following:

- The high pressure fault limit is set too low.
- The high pressure sensitivity is set too short.

- The pump start/stop anticipate times are not set up correctly.
- The issue usually is an obstructed paint line, tower, or check valve.
- The pilot line to mix hardener valve is removed or is broken.
- The mix hardener valve has failed.
- The hardener outlet transducer has failed.
- The injector tip is too small.

Remedy: Check the following:

- Make sure the lines, trigger, or check valve are not obstructed.
- Check the pilot line to mix hardener valve.
- Verify that the mix hardener valve is not faulty.
- Check the hardener outlet transducer as follows: Through the Analog I/O menu verify the transducer is spanning from near 200 cnts (0 psi) to 260+ cnts (50-80 psi) during a color change cycle.

8.4.46 PNT1-806 WARN %sPump 2 fluid flow rate > set point

Cause: The fluid dispensed by pump #2 as measured by the fluid flow meter was greater than the tolerance of the last job.

Remedy:

- Do a fluid flow test on pump #2 with a beaker and verify that the beaker amount matches the pump #2 size (cc/rev).
- Verify that the correct KFT factor has been entered for the fluid flow meter per the manufacturer's specification.
- Check the operation of the inlet regulator to verify that no "blow by" is occurring across the pump.

8.4.47 PNT1-807 WARN %sPump 2 fluid flow rate < set point

Cause: The actual flow rate out of pump #2 as measured by the fluid flow meter has been continuously less than a set point window (a percentage) for a user configurable period of time.

Remedy: Check the following:

- Perform a fluid flow test on pump #2 with a beaker and verify that the beaker amount matches the pump #2 size (cc/rev).
- Verify that the correct KFT factor has been entered for the fluid flow meter per the manufacturer's specification.
- Check the operation of the inlet regulator to verify that no "blow by" is occurring across the pump.

8.4.48 PNT1-808 WARN %sPump 2 zero fluid flow rate detected

Cause: Zero fluid flow out of pump #2 is detected. This condition is usually caused by one or more of the following:

- A loose mechanical coupling between the motor and pump.
- A broken line between the pump and supply.

Remedy: Check the mechanical coupling between the motor and the pump. Make sure the line from color stack to pump is working correctly.

8.4.49 PNT1-809 WARN %sPump 2 motor velocity limit

Cause: The motor velocity for pump #2 has exceeded its operating limit. The motor speed will be reduced to be within operating limit. The motor speed for pump #1 will be reduced to maintain a proper fluid ratio.

Remedy: Lower the flow rate to within the motor limit.

- 750 cc/min for a 3 cc/rev pump
- 1500 cc/min for a 6 cc/rev pump.

8.4.50 PNT1-810 WARN %sPump 2 motor servo not ready

Cause: The servo power to pump #2 is not ready.

Remedy: Usually, the servo not ready occurs when servo power is turned off because of an E-stop condition or because the machine is locked. Correct the condition, and reset the controller.

8.4.51 PNT1-811 WARN %sPump 2 totals differ > tolerance

Cause: The actual total flow out of pump #2 as measured by the fluid flow meter has a value that is different than the commanded total flow. This difference is larger than the total flow tolerance.
Remedy: Check the following:

- Perform a fluid flow test on pump #2 with a beaker and verify that the beaker amount matches the pump #2 size (cc/rev).
- Verify that the correct KFT factor has been entered for the flow meter per the manufacturer's specification.
- Check the operation of the inlet regulator to verify that no "blow by" is occurring across the pump.
- Verify that pump #2 does not have excessive wear.

8.4.52 PNT1-816 WARN %s Res:Hrd ratio is 0.0:0.0

Cause: The color identified in the error message has a default ratio (0.0:0.0) defined. The IPC pumps can only run when a non-zero ratio is defined.
Remedy: Change the default ratio for this color in the SETUP Color DETAIL menu.

8.5 Spare Parts and Tools

9 CANISTER PAINT DELIVERY SYSTEM

9.1 Overview

9.1.1 Introduction

The Canister Paint Delivery System is a metered paint dispensing system that can be electrostatically isolated from the paint supply circuit. This feature allows this system to be used with conductive paint materials such as waterborne paints while still gaining the benefits of a direct charge system.

The central element of the system is the canister assembly which consists of a piston and sleeve in a housing and a valve manifold for controlling flow of paint and cleaning materials in and out of the canister. The piston and sleeve form a syringe which can store and dispense a precise quantity of paint. The motion of the piston is controlled by the process axis of the robot. This allows for the dispensed flow rate to be very accurate.

Like all paint delivery systems, the Canister Paint Delivery System is designed to be cleaned and loaded with a new color during Color Change. Electrostatic isolation of the canister is achieved as the last stage of the color change process. Electrostatic isolation is achieved by emptying and drying the line supplying the canister (called the paint isolation line), the wash line supplying solvent to the applicator and the canister's dump line.

9.1.2 System Components

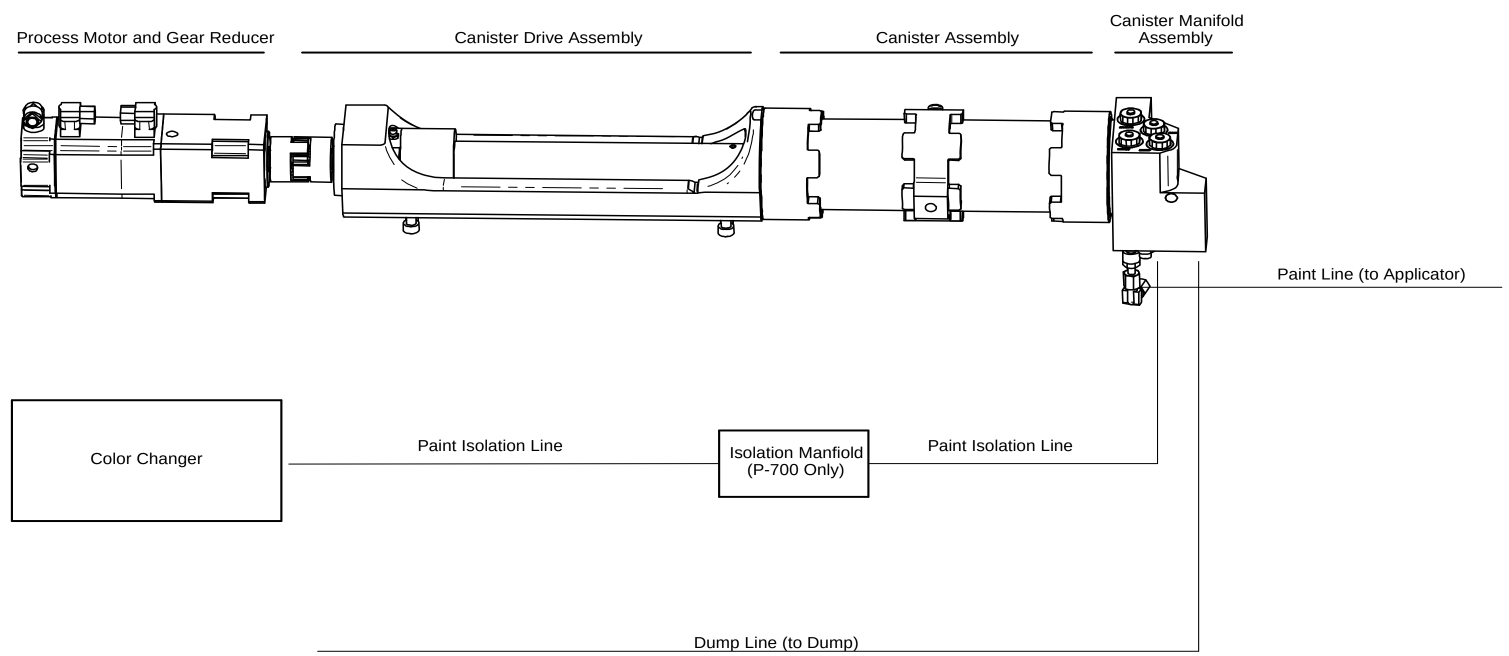
The schematic below shows the components of the Canister Paint Delivery System and how they are connected to each other.

Figure 9-1 DOC-5093-CPDS-Schematic, CANISTER SYSTEM SCHEMATIC

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



DOC-5093-CPDS-Schematic	REV A
CANISTER SYSTEM SCHEMATIC	SHEET 1 OF 1

9.2 Operation and Setup

The following sections describe the installation of the components of the Canister Paint Delivery System and the software setup features that are required for operation.

9.2.1 Canister Drive Assembly

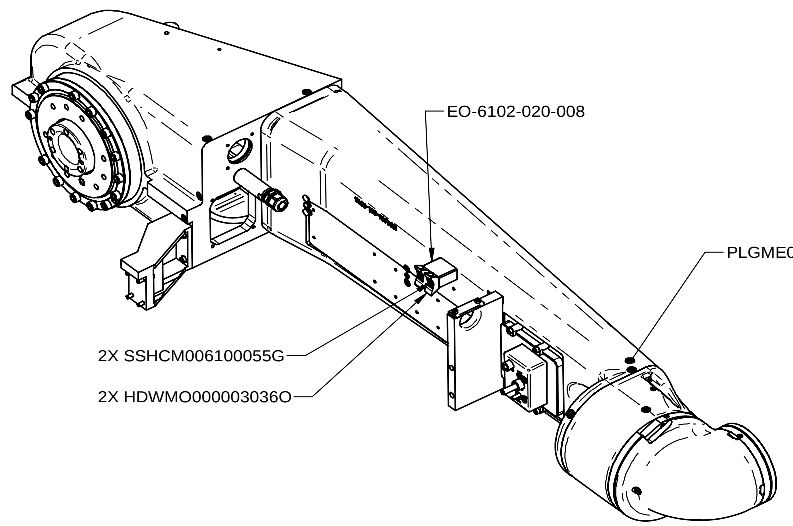
The canister drive assembly consists of a precision ball screw, ram and plastic drive bracket. It is mounted to the robot arm and driven by the output shaft of servomotor / gear reducer pair that is mounted in a purged enclosure of the robot. This motor is called the Process Axis Motor. The Process Axis Motor can be commanded automatically by Painttool software to extend and retract the ram. This is the method that is used to dispense paint and operate the canister system during a production cycle or during color change. The Process Axis Motor can also be commanded to extend or retract the ram using the JOG feature of the Waterborne SETUP menu on the teach pendant. “Extend” means to move the ram in the paint dispensing direction and “retract” means to move the ram in the opposite direction.

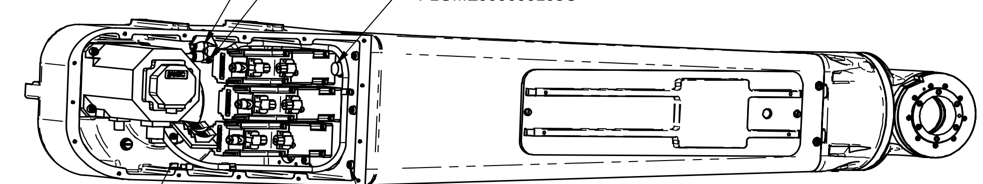
Figure 9-2 EO-6102-025-000 Sheet 1 of 2, P-500iA WB OUTER ARM

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





NOTES:

(1) THE (EO-9999-300-005) ASSEMBLY INCLUDES THE FOLLOWING COMPONENTS:
1. (EO-9999-300-006) - MAIN REDUCER BODY
2. (EO-9999-300-007) - 112 TOOTH CENTER GEAR
3. (EO-9999-300-008) - 22 TOOTH MOTOR PINION
4. (BRGBM0801000100) RADIAL BALL BEARING (QTY. 2)
REFER TO THE (EO-9999-300-005) ASSEMBLY DRAWING FOR INSTALLATION INSTRUCTIONS AND TIGHTENING TORQUE INFORMATION.

(2) NO ASSEMBLY REAMING NECESSARY. INSERT PIN SO ONLY THE STEEL INSERT IS CONTACTING THE PIN. THE PIN SHOULD BE RECESSED IN THE FIBERGLASS.

(3) LUBRICATE ALL O-RINGS WITH VASELINE OR MOLYWHITE PRIOR TO INSTALLATION.

(4) TIGHTENING TORQUE FOR MOTOR NUT IS 16.7N-M. USE LOCTITE 242.

(5) TIGHTEN CENTER TUBE FASTENERS TO 8 N-M.

(6) SNAP BUTTON (HDWMO000056615O) INCLUDED IN (EO-4696-020-016).

(7) PRIME ALL STEEL FASTENERS WITH PRIMER N AND USE LOCTITE PER EG-00008 UNLESS OTHERWISE NOTED. DO NOT USE ANY LOCTITE ON PLASTIC FASTENERS. UNLESS OTHERWISE NOTED, TIGHTEN ALL FASTENERS ACCORDING TO EG-00010.

(8) REFER TO (ET-6102-800-006) FOR LUBRICATION INSTRUCTIONS.

(9) USE PERMATEX "NO MORE LEAKS" HDWMO000003886O TO PLUG THREADS.

(10) PRIME FASTENERS WITH PRIMER N AND USE LOCTITE 222.

(11) FILL NOTED PORT WITH DIELECTRIC GREASE. SEE (EO-4696-011-000).

(12) LOCTITE 518 CAN BE USED TO HOLD O-RING IN PLACE DURING INSTALLATION

(13) SEE (EO-6102-512-000) FOR GEAR PUMP ASSEMBLY INSTRUCTIONS.

ASSEMBLY PART NO.	DESCRIPTION	A	B
EO6102-025-000A	1400 MM WB OUTER ARM	EO4696-021-001B	EO5093-020-003B
EO6102-025-000B	1550 MM WB OUTER ARM	EO4696-028-001B	EO5093-020-003C

Standard Hardware Descriptions

FANUC Part No.	Description
NUTHM006100000C	M6 X 1.0 Steel Hex Nut
NUTHM010125000C	M10 X 1.25 Steel Hex Nut
PINSM005000016C	M5 16 LG. Steel Spirol Pin
PINSM005000028C	M5 28 LG. Steel Spirol Pin
PINSM008000020C	M8 20 LG. Steel Spirol Pin
SFHSM004070012N	M4 X 0.7 X 12mm LG. Nylon Slotted Flat Head Screw
SPHMM006100016N	M6 X 1.0 X 16mm LG. Nylon Pan Head Machine Screw
SSHCM004070025C	M4 X 0.7 X 25mm LG. Steel Socket Head Cap
SSHCM005080012S	M5 X 0.8 X 12mm LG. Stainless Steel Socket Head Cap
SSHCM005080020G	M5 X 0.8 X 20mm LG. Glass Filled Nylon Socket Head Cap
SSHCM005080025C	M5 X 0.8 X 25mm LG. Steel Socket Head Cap
SSHCM006100012S	M6 X 1.0 X 12mm LG. Stainless Steel Socket Head Cap
SSHCM006100016C	M6 X 1.0 X 16mm LG. Steel Socket Head Cap
SSHCM006100020S	M6 X 1.0 X 20mm LG. Stainless Steel Socket Head Cap
SSHCM006100025G	M6 X 1.0 X 25mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100025P	M6 X 1.0 X 25mm LG. Plated Steel Socket Head Cap
SSHCM006100030G	M6 X 1.0 X 30mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100035G	M6 X 1.0 X 35mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100055G	M6 X 1.0 X 55mm LG. Glass Filled Nylon Socket Head Cap
SSHCM008125016S	M8 X 1.25 X 16mm LG. Stainless Steel Socket Head Cap
SSHCM008125025C	M8 X 1.25 X 25mm LG. Steel Socket Head Cap
SSHCM008125030C	M8 X 1.25 X 30mm LG. Steel Socket Head Cap
SSHCM010150090C	M10 X 1.5 X 90mm LG. Steel Socket Head Cap

[EO-6102-025-000] REV *
P-500iA WB OUTER ARM SHEET 1 OF 2

Figure 9-3 EO-6102-025-000 Sheet 2 of 2, P-500iA WB OUTER ARM

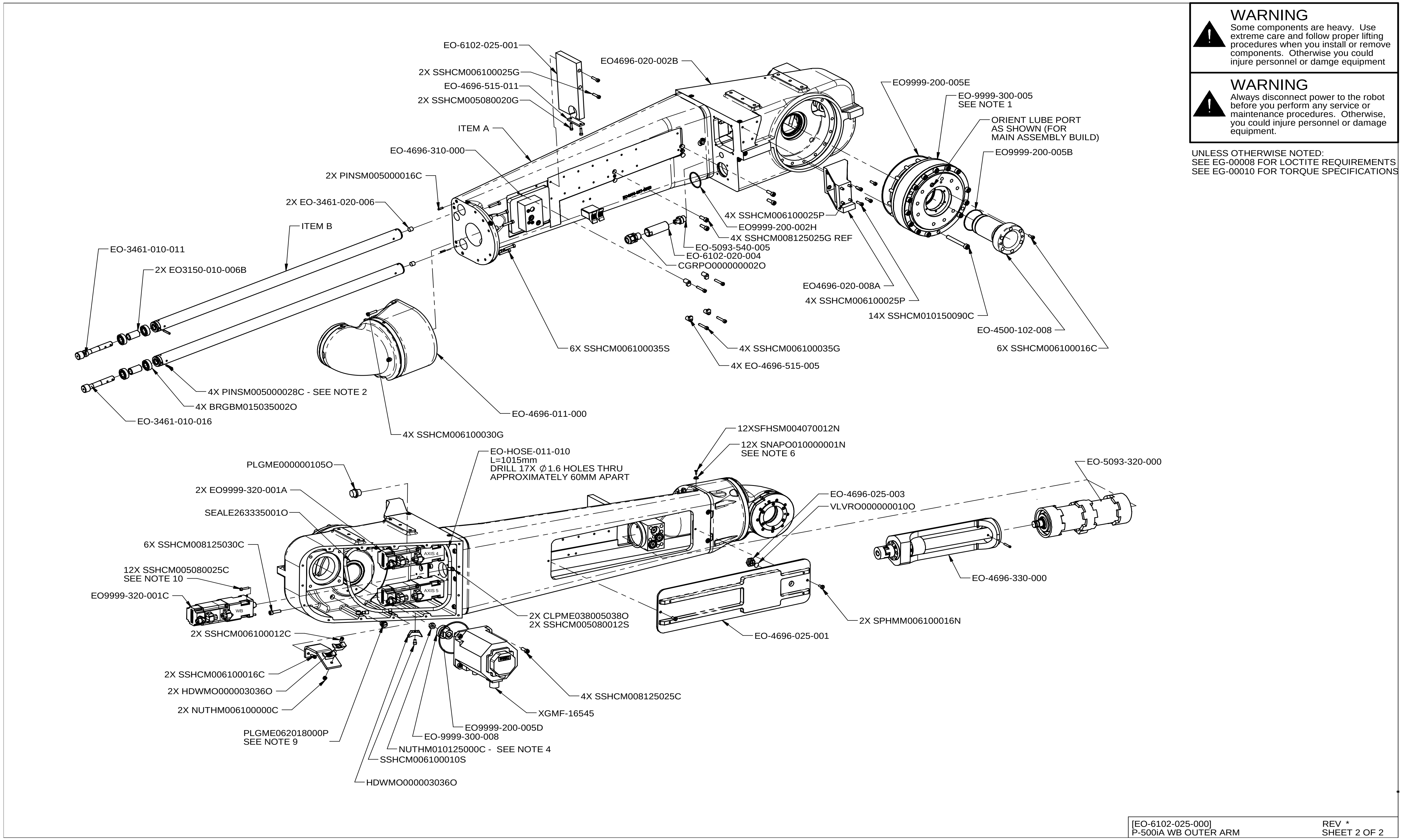
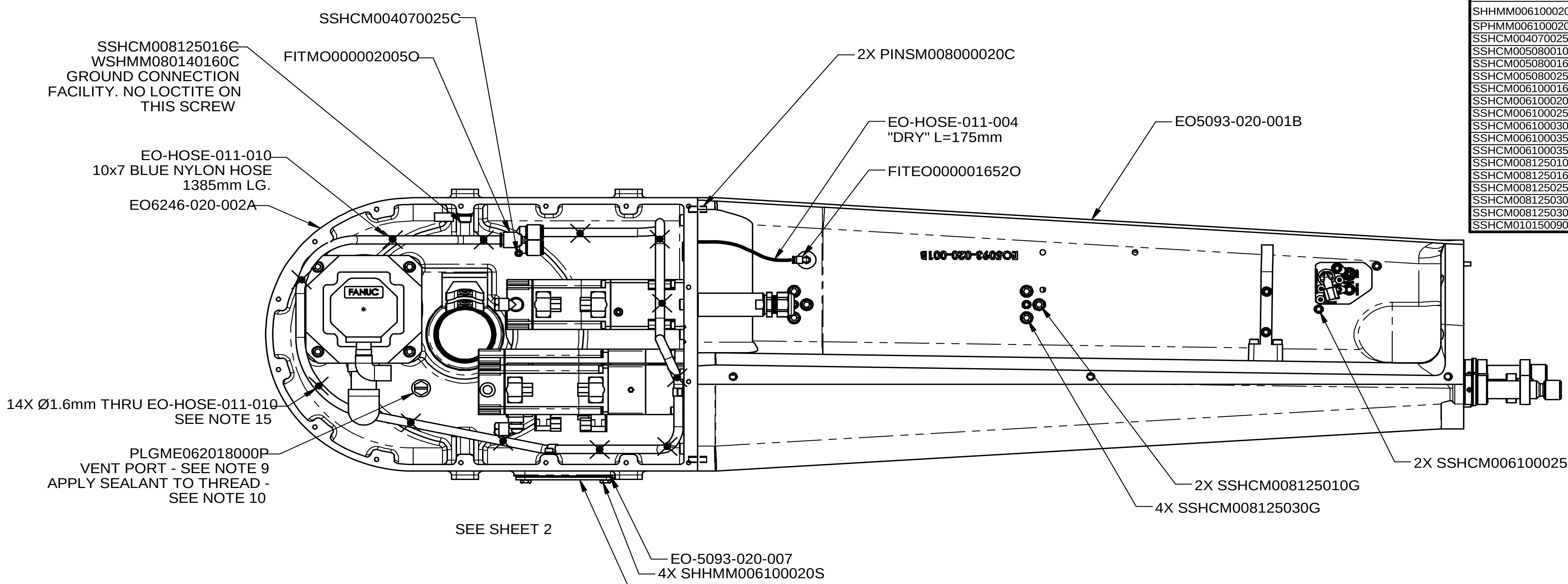


Figure 9-4 EO-6246-025-000 Sheet 1 of 4, P-700 FLEX WB OUTER ARM ASM

Standard Hardware Descriptions	
FANUC Part No.	Description
NUTHM006100000C	M6 X 1.0 Steel Hex Nut
PINSM005000016C	M5 16 LG. Steel Spirol Pin
PINSM005000028C	M5 28 LG. Steel Spirol Pin
PINSM008000020C	M8 20 LG. Steel Spirol Pin
SHHMM006100020S	M6 X 1.0 X 20mm LG. Stainless Steel Hex Head Machine Screw
SPHMM006100020N	M6 X 1.0 X 20mm LG. Nylon Pan Head Machine Screw
SSHCM004070025C	M4 X 0.7 X 25mm LG. Steel Socket Head Cap
SSHCM005080010S	M5 X 0.8 X 10mm LG. Stainless Steel Socket Head Cap
SSHCM005080016C	M5 X 0.8 X 16mm LG. Steel Socket Head Cap
SSHCM005080025C	M5 X 0.8 X 25mm LG. Steel Socket Head Cap
SSHCM006100016C	M6 X 1.0 X 16mm LG. Steel Socket Head Cap
SSHCM006100020C	M6 X 1.0 X 20mm LG. Steel Socket Head Cap
SSHCM006100025G	M6 X 1.0 X 25mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100030S	M6 X 1.0 X 30mm LG. Stainless Steel Socket Head Cap
SSHCM006100035G	M6 X 1.0 X 35mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100035S	M6 X 1.0 X 35mm LG. Stainless Steel Socket Head Cap
SSHCM008125010G	M8 X 1.25 X 10mm LG. Glass Filled Nylon Socket Head Cap
SSHCM008125016C	M8 X 1.25 X 16mm LG. Steel Socket Head Cap
SSHCM008125025C	M8 X 1.25 X 25mm LG. Steel Socket Head Cap
SSHCM008125030C	M8 X 1.25 X 30mm LG. Steel Socket Head Cap
SSHCM008125030G	M8 X 1.25 X 30mm LG. Glass Filled Nylon Socket Head Cap
SSHCM010150090C	M10 X 1.5 X 90mm LG. Steel Socket Head Cap



NOTES:

(1) THE EO-9999-300-005 ASSEMBLY INCLUDES THE FOLLOWING COMPONENTS:
1. EO-9999-300-006 - MAIN REDUCER BODY
2. EO-9999-300-007 - 112 TOOTH CENTER GEAR
3. EO-9999-300-008 - 22 TOOTH MOTOR PINION
4. BRGBM080100010O RADIAL BALL BEARING (QTY. 2)
PLEASE REFER TO THE EO-9999-300-005 ASSEMBLY DRAWING FOR INSTALLATION INSTRUCTIONS AND TIGHTENING TORQUE INFORMATION.

(2) REFER TO EG-00316 FOR INSTALLATION INSTRUCTIONS.

(3) NO ASSEMBLY REAMING NECESSARY. INSERT PIN SO ONLY THE STEEL INSERT IS CONTACTING THE PIN. THE PIN SHOULD BE RECESSED IN THE FIBERGLASS.

(4) LUBRICATE ALL O-RINGS WITH VASELINE OR VIGO GREASE PRIOR TO INSTALLATION.

(5) TIGHTENING TORQUE FOR MOTOR NUT IS 16.7N-M, USE LOCTITE 242.

(6) LOCTITE 518 CAN BE USED TO HOLD O-RING IN PLACE DURING INSTALLATION.

(7) OPEN

(8) PRIME ALL STEEL FASTENERS WITH PRIMER N AND USE LOCTITE 242 ON ALL STEEL FASTENERS UNLESS OTHERWISE NOTED. DO NOT USE ANY LOCTITE ON PLASTIC FASTENERS. UNLESS OTHERWISE NOTED, TIGHTEN ALL FASTENERS ACCORDING TO EG-00010.

(9) ADD VIGO GREASE P/N XGMF-16156 TO THE FILL PORT UNTIL IT COMES OUT OF THE VENT PORT. ARM MUST BE VERTICAL WHEN ADDING GREASE. REFER TO OPERATORS MANUAL FOR LUBRICATION INSTRUCTIONS.

(10) USE PERMATEX "NO MORE LEAKS" HDWMO000003886O TO PLUG THREADS.

(11) PRIME FASTENERS WITH PRIMER N AND USE LOCTITE 222.

(12) SEE EO-5093-011-000 FOR ASSEMBLY INSTRUCTIONS

(13) DRILL 14 HOLES THRU EO-HOSE-011-010 SPACED APPROXIMATELY 100mm APART AS SHOWN ON SHEETS 1 & 4

(14) WHEN USING A BALL NOSE DRIVER SUCH AS EO-4500-705-000 USE REDUCED TORQUE SPEC 4.3 N-m (3.1 ft-lbf)

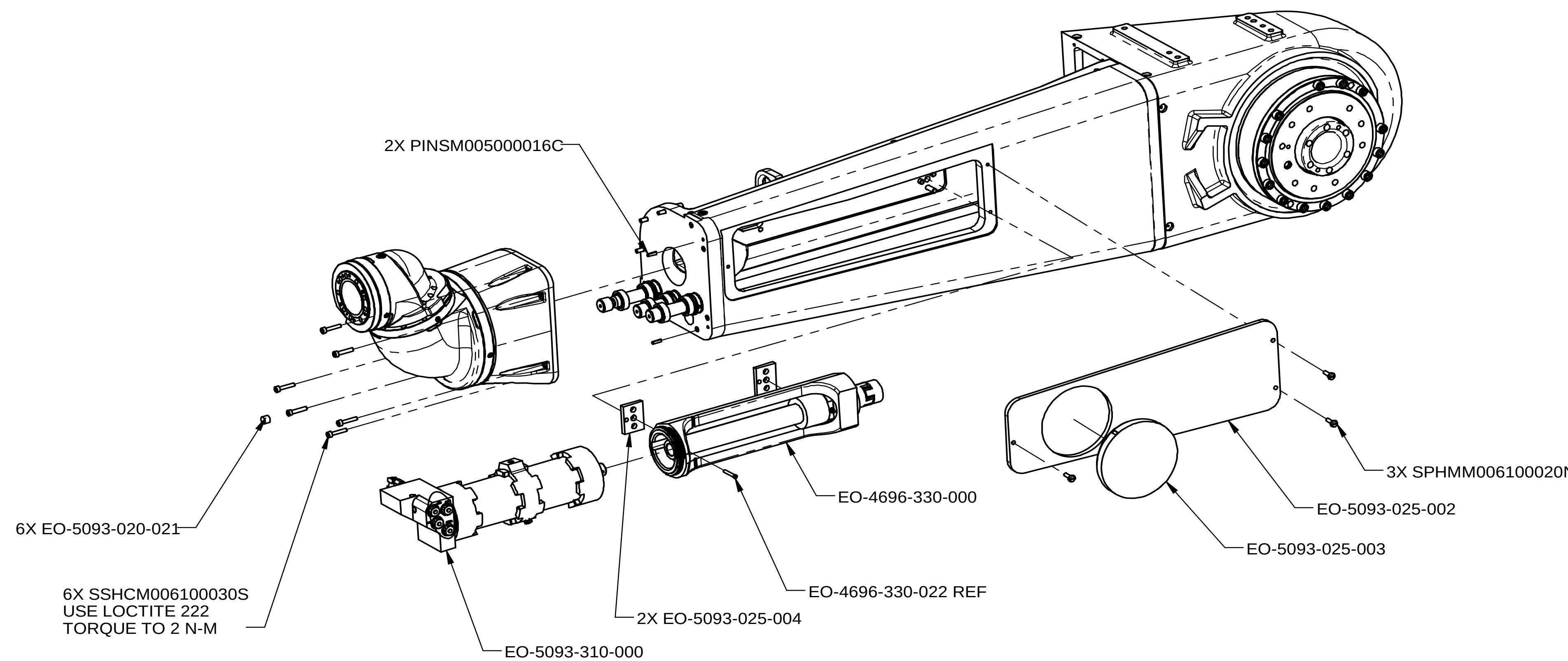
(15) REMOVE AND DISCARD MOTOR PURGE HOLE PLUGS.

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.

[EO-6246-025-000]	REV A
P-700 FLEX WB OUTER ARM ASM	SHEET 1 OF 4

Figure 9-5 EO-6246-025-000 Sheet 2 of 4, P-700 FLEX WB OUTER ARM ASM

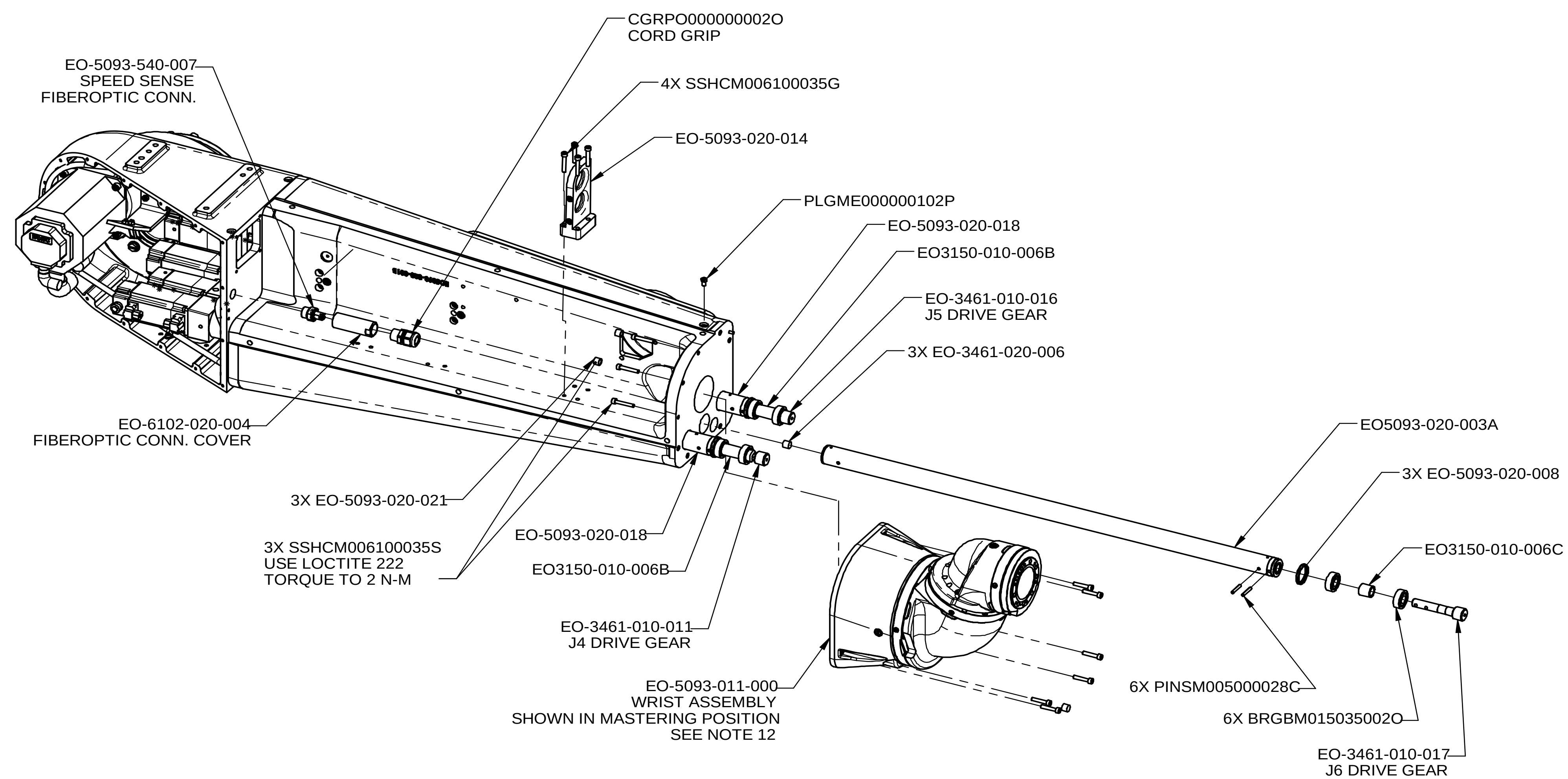


WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damge equipment

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

[EO-6246-025-000]	REV A
P-700 FLEX WB OUTER ARM ASM	SHEET 2 OF 4

Figure 9-6 EO-6246-025-000 Sheet 3 of 4, P-700 FLEX WB OUTER ARM ASM

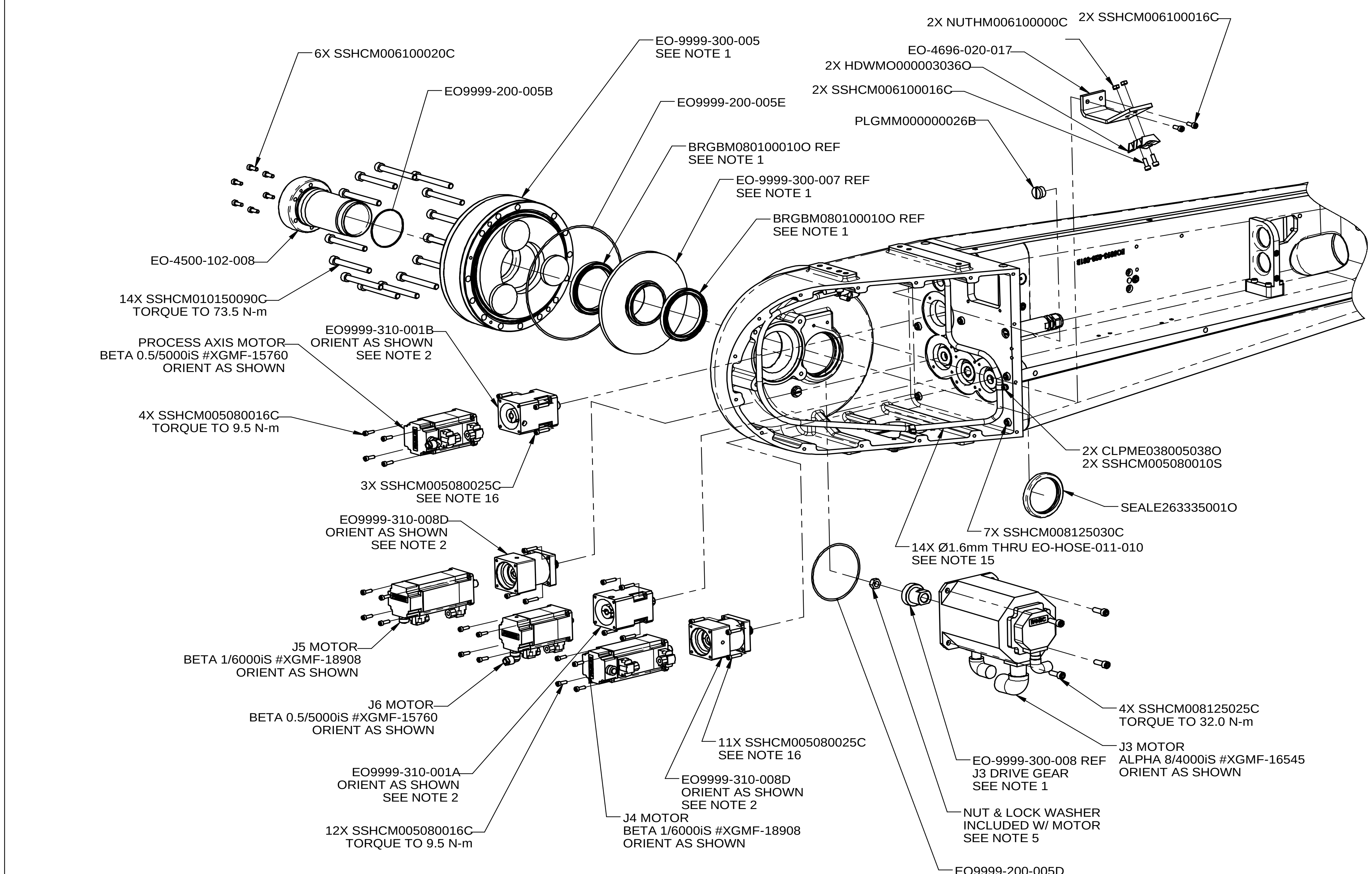


WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damge equipment

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

[EO-6246-025-000]	REV A
P-700 FLEX WB OUTER ARM ASM	SHEET 3 OF 4

Figure 9-7 EO-6246-025-000 Sheet 4 of 4, P-700 FLEX WB OUTER ARM ASM

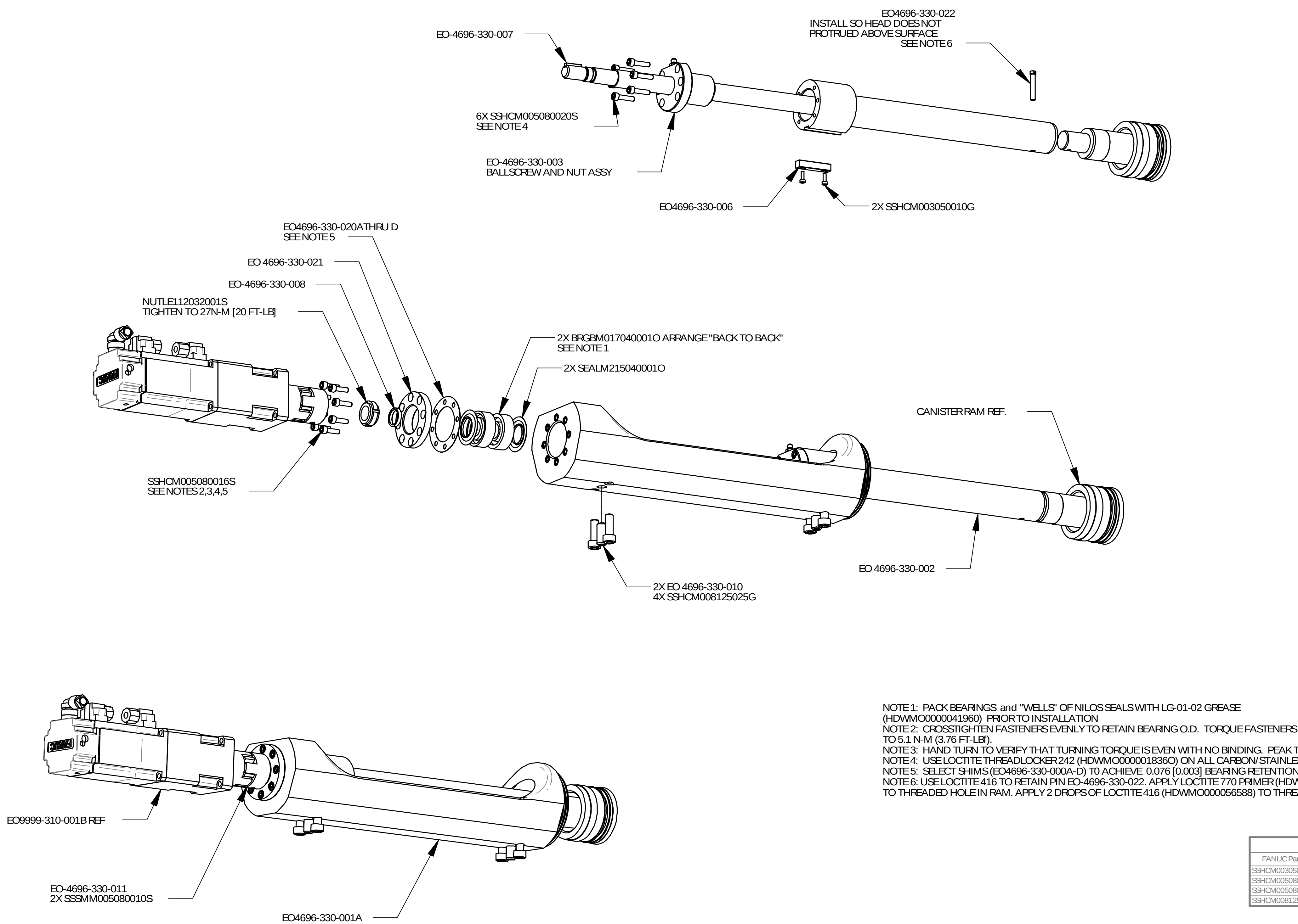


WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damge equipment

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

[EO-6246-025-000]	REV A
P-700 FLEX WB OUTER ARM ASM	SHEET 4 OF 4

Figure 9-8 EO-4696-330-000, CANISTER DRIVE 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 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

NOTE 1: PACK BEARINGS and "WELLS" OF NILOS SEALS WITH LG-01-02 GREASE (HDWMO0000041960) PRIOR TO INSTALLATION
NOTE 2: CROSSTIGHTEN FASTENERS EVENLY TO RETAIN BEARING O.D. TORQUE FASTENERS TO 5.1 N-M (3.76 FT-LBf).
NOTE 3: HAND TURN TO VERIFY THAT TURNING TORQUE IS EVEN WITH NO BINDING. PEAK TURNING TORQUE = 5.1 IN-LBf (0.576 N-M).
NOTE 4: USE LOCTITE THREADLOCKER 242 (HDWMO0000018360) ON ALL CARBON/STAINLESS STEEL FASTENERS.
NOTE 5: SELECT SHIMS (EO4696-330-000A-D) T0 ACHIEVE 0.076 [0.003] BEARING RETENTION.
NOTE 6: USE LOCTITE 416 TO RETAIN PIN EO-4696-330-022. APPLY LOCTITE 770 PRIMER (HDWMO0000060323) TO THREADED HOLE IN RAM. APPLY 2 DROPS OF LOCTITE 416 (HDWMO000056588) TO THREADS ON PIN ASSEMBLE IMMDIATELY.

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM003050010G	M3 X 0.5 X 10mm LG. Glass Filled Nylon Socket Head Cap
SSHCM005080016S	M5 X 0.8 X 16mm LG. Stainless Steel Socket Head Cap
SSHCM005080020S	M5 X 0.8 X 20mm LG. Stainless Steel Socket Head Cap
SSHCM008125025G	M8 X 1.25 X 25mm LG. Glass Filled Nylon Socket Head Cap

[EO-4696-330-000] REV Q1
CANISTER DRIVE ASSEMBLY SHEET 1 OF 1

Installation

The canister drive assembly is mounted to the arm with 4 M8 glass-filled nylon socket head screws. Between each pair of mounting screws is a special 10mm pull dowel (EO-4696-310-010). These pins locate the canister drive bracket precisely, relative to the robot arm.

Some robot models have 2 additional M8 x 10mm glass-filled nylon screws located in-line with the two special pull dowels. **These screws fasten alignment plates and should not be removed.**

To install the canister drive assembly, look inside the canister compartment toward the FRP and note the orientation of the key on the output shaft of the process axis output shaft. Arrange the keyway on the flexible coupling on the canister drive assembly so that it will mate with the key when installed in the arm. Carefully align the coupling and the output shaft so that the key and keyway engage.

Next, loosely install one of the 4 M8 mounting screws through the arm to engage the corresponding threaded holes on the drive bracket. Check the alignment of the other 3 holes and when in position, loosely install the 3 remaining M8 mounting screws. The drive bracket should be loose enough to allow for easy insertion of the special 10mm pull dowels. Engage the special 10mm pull dowels. Tighten the 4 mounting screws to x Nm torque. Complete the installation by gently tapping in the special 10mm pull dowels until they are flush with the surface of the arm.

9.2.2 Canister Assembly

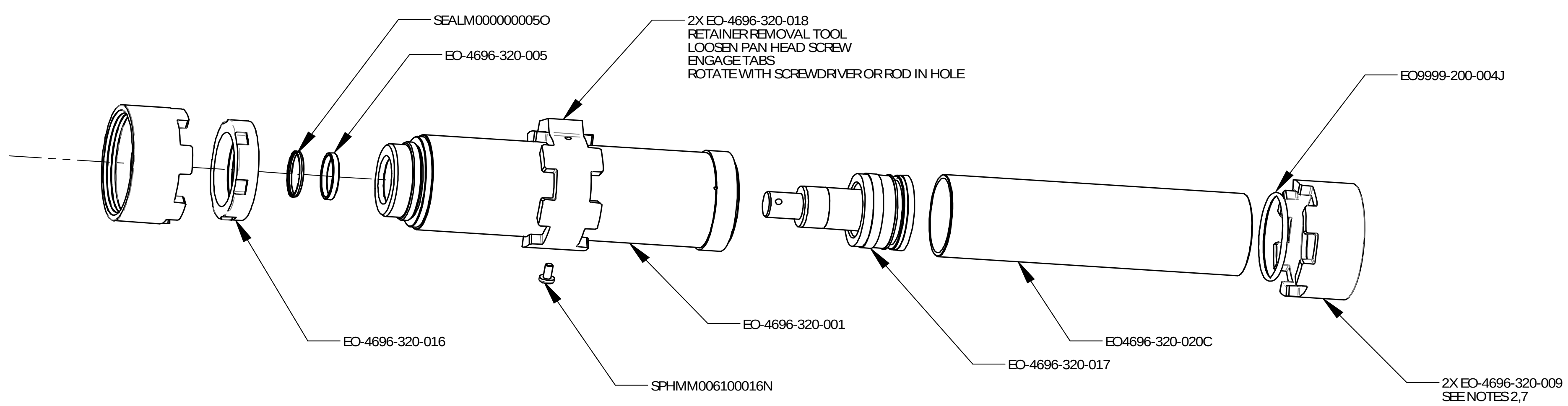
The canister assembly includes the piston, canister sleeve, canister body, manifold retainer nut and an integrated tool. The piston connects to the ram in the canister drive assembly with a special metal pin (EO-4696-320-022). The canister body connects to the plastic drive bracket of the canister drive assembly with a manifold retainer nut (EO-4696-320-009). A tool to engage the manifold retainer nut is built onto the canister assembly. It has a set screw that holds it in place for storage. To use the tool for installation or removal, loosen the set screw to free the tool and insert a suitable hand tool into the 9mm hole (an 8mm Allen wrench, for example) in the integrated tool to turn it. By engaging the tabs the tool can be used as a wrench.

Figure 9-9 EO-5093-320-000, CANISTER 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 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



NOTE 1: APPLY A LAYER OF DIELECTRIC GREASE TO THE SLEEVE OD PRIOR TO INSTALLATION INTO CANISTER.

NOTE 2: APPLY A LAYER OF DIELECTRIC GREASE (EO-4526-050-009) TO THREADS PRIOR TO ASSEMBLY.

NOTE 3: DIRT AND CONTAMINATION TRAPPED IN PISTON/SLEEVE CAN LEAD TO PREMATURE WEAR AND PISTON SEAL FAILURE. CLEAN PISTON (EO-4696-320-017) and SLEEVE (EO4696-320-020C) WITH HENKEL/LOCTITE NATUAL BLUE CLEANER (#82253) AND A CLEAN LINT FREE CLOTH PRIOR TO INSTALLATION.
NOTE 4: USE EO-4696-700-035 PISTON INSTALL TOOL TO LOAD PISTON INTO CYLINDER
NOTE 5: PISTON SEAL AND SLEEVE TO BE TESTED IN PISTON SEAL VALIDATION TEST STAND PRIOR TO INSTALL
NOTE 6: SET-UP DIMENSION TO VERIFY THAT SLEEVE IS LOADED IN COMPRESSION, IF DIMESNION IS GREATER, DISSASSEMBLE and INSPECT.
NOTE 7: TORQUE RETAINING NUT TO 33.9 N-M (25 FT-LBf).

Standard Hardware Descriptions	
FANUC Part No.	Description
SPHMM006100016N	M6 X 1.0 X 16mm LG. Nylon Pan Head Machine Screw

[EO-5093-320-000] REV A
CANISTER ASSEMBLY SHEET 1 OF 1

Installation
Prepare to install the canister assembly by moving the piston to the top of the canister body so that the stem of the piston is visible. Gently use a small screwdriver in the connection pin hole to adjust the orientation of the piston so that the hole in the piston will align with the hole in the ram when assembled. Use the JOG feature in the SETUP / WB screen on the Teach Pendant to retract the ram so that the hole in the ram is accessible and not beyond the end of the drive bracket.

Apply Loctite Primer 770 (HDWMO000060323) to the threaded hole in the ram.

Move the canister assembly into position and insert the end of the piston into the ram. Apply 2 drops of Loctite 416 (HDWMO000056588) on the threads of the pin for retention. Align the holes and insert the metal pin (EO-4696-330-022). Use a small screwdriver to complete the installation of the pin. The pin is properly installed when the surface of the head of the pin is below the surface of the ram, but not deeper than 0.5 mm. If the pin is installed incorrectly it will damage the seal on the top of the canister and lead to canister torque alarms.

Complete the installation by installing tightening the manifold retainer nut onto the canister drive bracket. Take care to engage the manifold retainer nut threads properly. It should turn on easily. Tighten the nut until it stops. The gap between the edge of the manifold retainer nut and the canister drive bracket should be approximately 1mm.

9.2.3 Canister Manifold Assembly

The canister manifold assembly contains the control valves and hose connections for the canister system. It connects to the canister assembly with a manifold retainer nut (EO-4696-320-009). A tool to engage the manifold retainer nut is built onto the canister assembly. It has a set screw that holds it in place for storage. To use the tool for installation or removal, loosen the set screw to free the tool and insert a suitable hand tool into the 9mm hole (an 8mm Allen wrench, for example) in the integrated tool to turn it. By engaging the tabs the tool can be used as a wrench.

Figure 9-10 EO-4696-310-000, CANISTER MANIFOLD

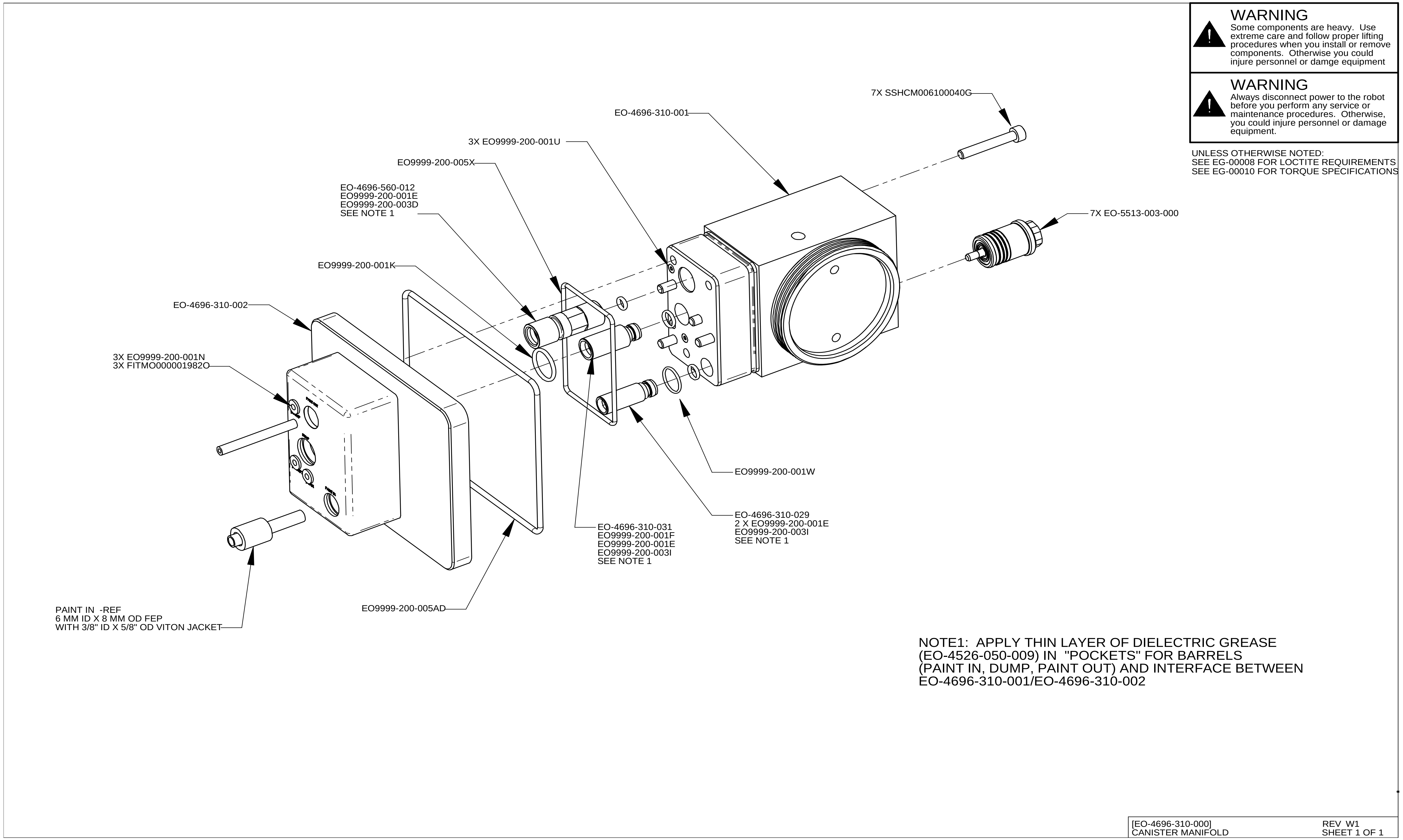
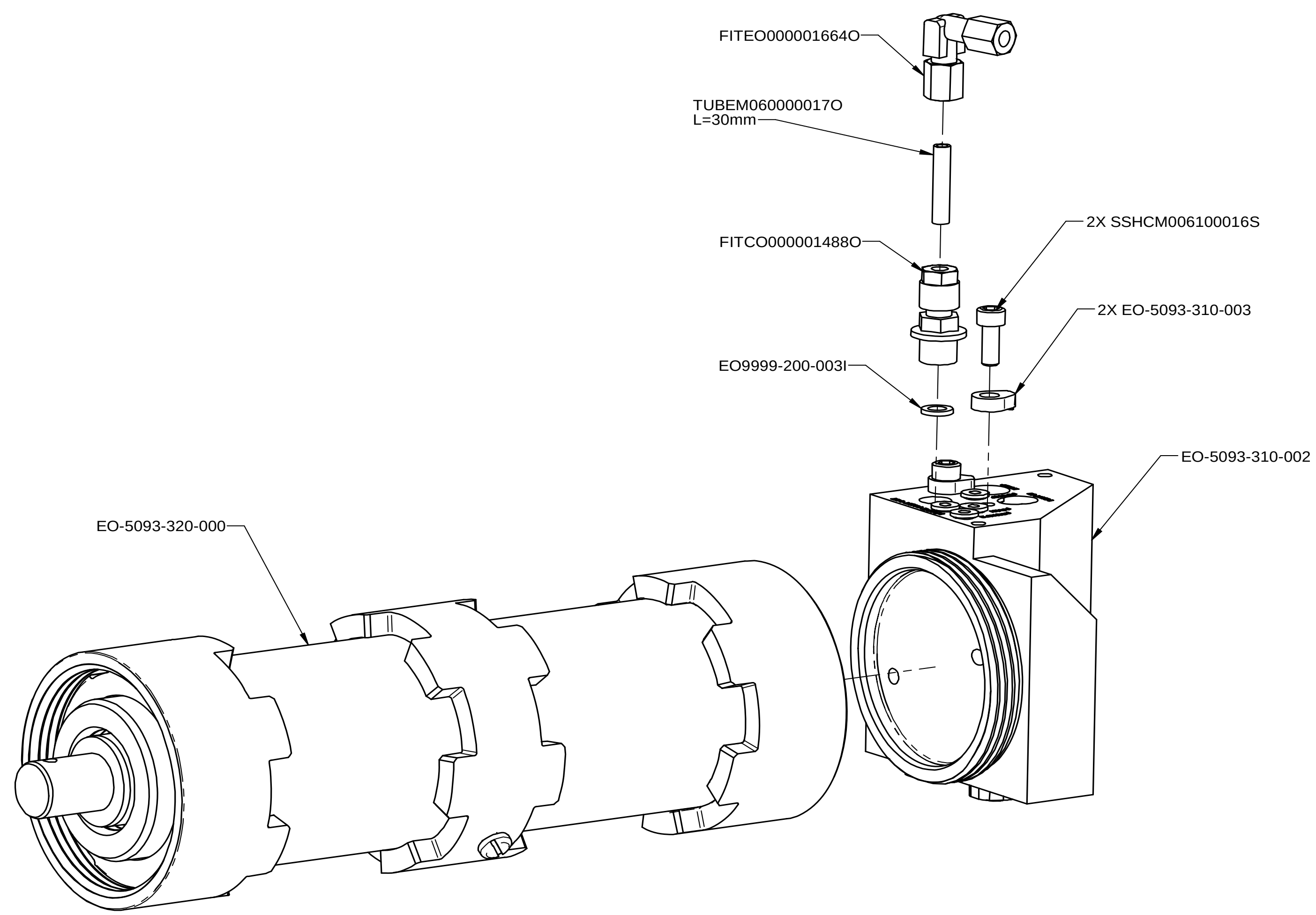


Figure 9-11 EO-5093-310-000, CANISTER MANIFOLD ASM

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 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



Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100016S	M6 X 1.0 X 16mm LG. Stainless Steel Socket Head Cap

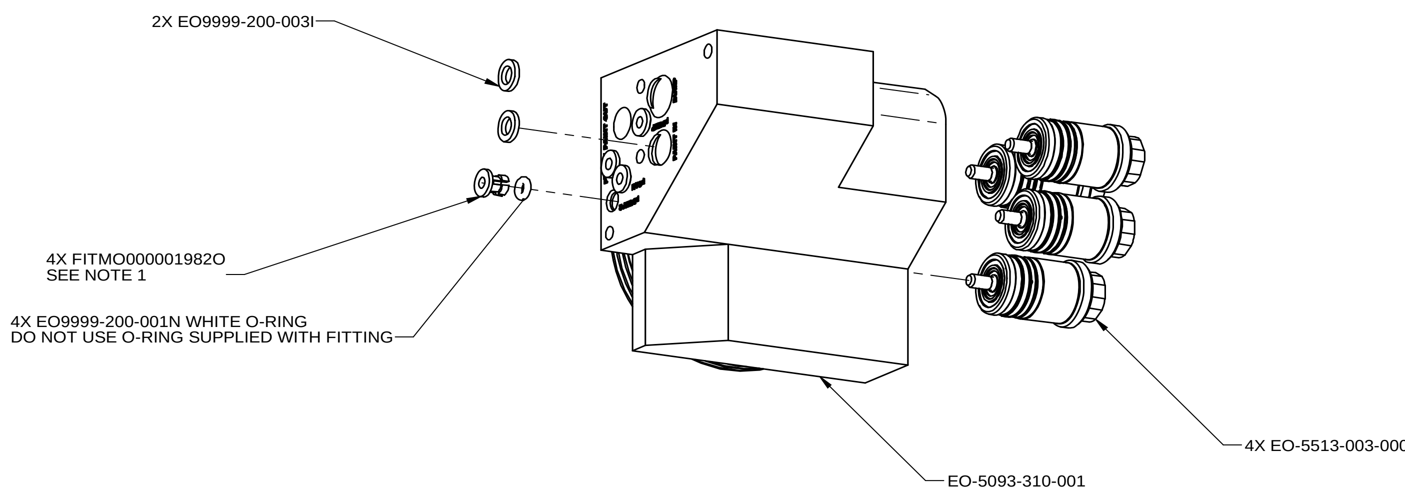
[EO-5093-310-000] REV E1
CANISTER MANIFOLD ASM SHEET 1 OF 1

Figure 9-12 EO-5093-310-002, CANISTER MANIFOLD 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 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



NOTES:

1. FITMO000001982 IS JOHN GUEST PART #MM2804N WHICH INCLUDES THE 4MM COLLET, BRASS BODY AND O-RING. DISCARD BRASS BODY AND O-RING.

[EO-5093-310-002] CANISTER MANIFOLD ASM	REV B1 SHEET 1 OF 1

Installation
It is best to install the canister manifold assembly to the canister assembly before the canister assembly is installed in the arm.

Prepare to install the canister manifold assembly onto the canister assembly by lubricating the static o-ring (EO9999-200-004J) with dielectric grease (EO-4526-050-009) and placing it on the outer diameter of the exposed canister sleeve. Lubricate the threads of manifold retaining nut with dielectric grease.

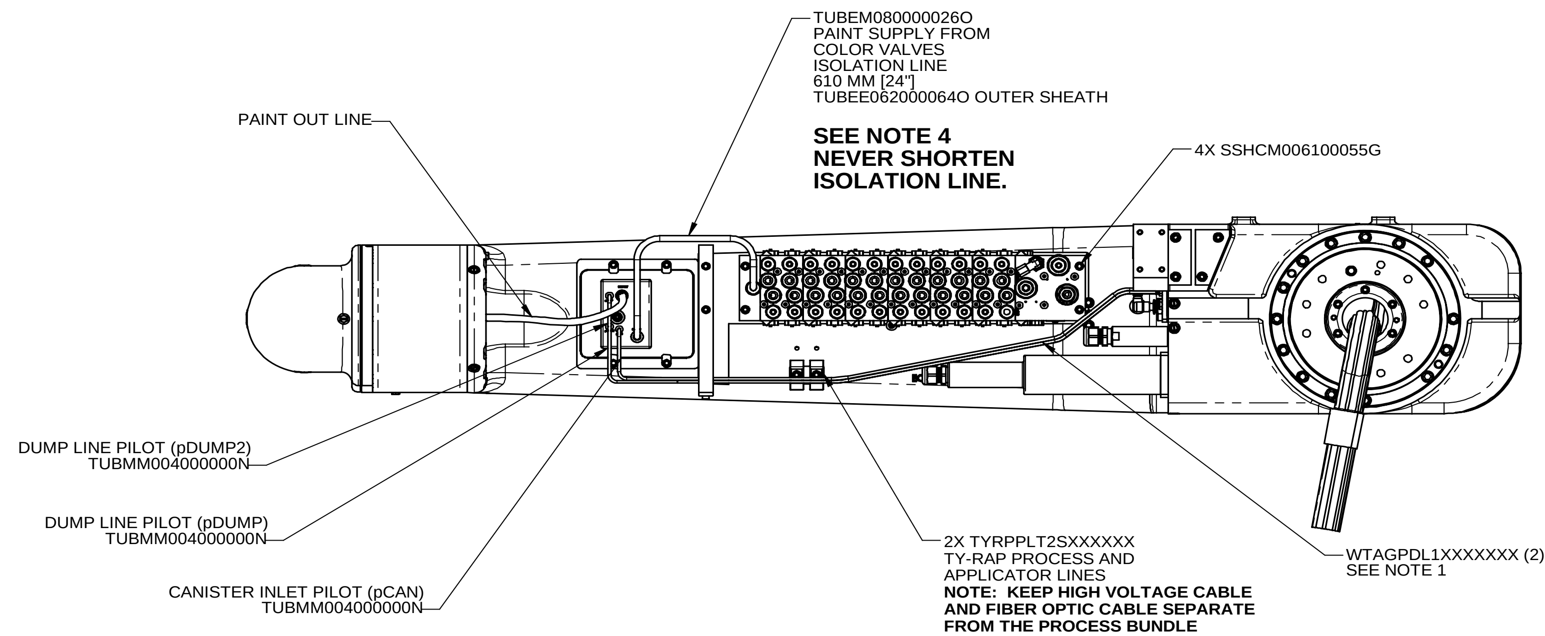
Insert the canister sleeve and static o-ring into the corresponding pocket on the canister manifold.

Complete the installation by installing tightening the manifold retainer nut onto the canister manifold. Take care to engage the manifold retainer nut threads properly. It should turn on easily. Tighten the nut until it stops. The gap between the edge of the manifold retainer nut and the canister manifold should be approximately 4 mm.

9.2.4 Paint Supply Components

The tubing and fittings which connect the color stack to the canister manifold are called “the isolation line”. This passage is cleaned of paint and dried with compressed air during the “FILL” color change cycle in order to establish electrostatic isolation. The internal volumes of this passage, together with the internal volume of the central passage of the color changer, form the “isolation volume”. The isolation volume is a value that is used in the set up of the Integrated Canister System in PaintTool.

Figure 9-13 EO-6102-800-004, P-500iA R30iA WB PAINTER 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 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

NOTES:

1. PLACE IDENTIFICATION TAGS (WTAGPDL1XXXXXXX) AT BOTH ENDS OF EACH PROCESS LINE PER THE LINE LENGTH CHART.
2. TORQUE ALL FASTENERS PER EG-00010. DO NOT USE LOCTITE ON PLASTIC FASTENERS.
3. PROCESS LINE LENGTHS ARE COLOR DEPENDANT BASED ON LINE LENGTH CHART.
4. PAINT SUPPLY LINE (ISOLATION LINE) MUST BE 610 MM (24") LONG. DO NOT SHORTEN. ALWAYS REPLACE WITH TUBEM080000026O (8 MM OD x 6 MM ID FEP), DO NOT SUBSITUTE WITH ANY OTHER PRODUCT!
5. SOLVAIR VALVE ALWAYS STAYS IN POSITION SHOWN FOR ALL COLOR COMBINATIONS.
6. ADD SSSM00600010N (QTY 10) TO ANY UNUSED M6 TAPPED HOLES IN OUTER ARM FOR COLOR VALVE COMBINATIONS. USE HDWMO000003658O (PRIMER N) AND HDWMO000003367O (LOCTITE 222)

	Description	Symbol	APPROXIMATE LINE LENGTH IN MM
1.	Solvair Solvent Pilot	pSOL	380
2.	Solvair Air Pilot	pAIR	350
3.	Solvair CC Outlet Pilot	pCC	390
4.	SolvAir 2T Pilot	pWASH	390
5.	SolvAir pSOL2/pDUMP3	pSOL2/pDUMP3	390
6.	pCAN, Canister Inlet	pCAN	870
7.	Dump valve 1	pDUMP	940
8.	Dump valve 2	pDUMP2	920
9.	Paint Supply Isolation Line	PS	610

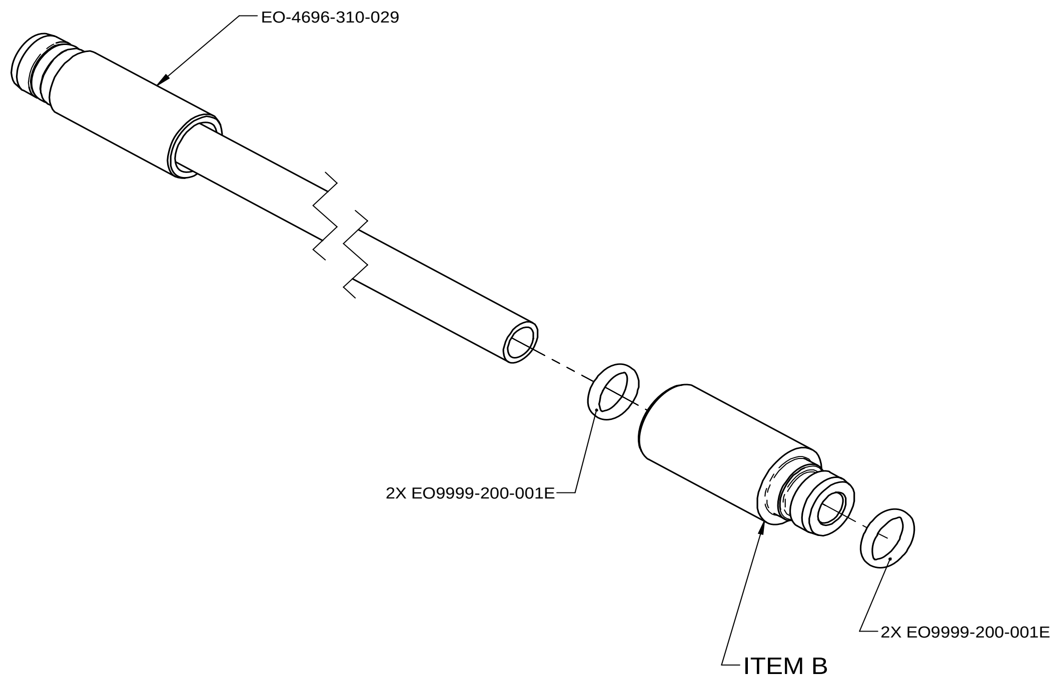
[EO-6102-800-004] REV *1
P-500iA R30iA WB PAINTER ASM SHEET 5 OF 5

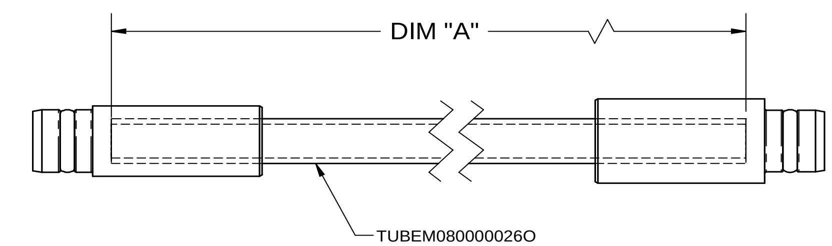
Figure 9-14 EO-5093-262-004, ISOLATION LINE

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





FANUC PART NO.	DESCRIPTION	DIM "A"	ITEM "B"
EO5093-262-004A	ISOLATION LINE - P-700 WB	1875mm	EO-4696-310-029
EO5093-262-004B	ISOLATION LINE - P-700 WB	1500mm	EO-4696-310-036
EO5093-262-004C	ISOLATION LINE - P-700 WB	350mm	EO-4696-310-036

NOTES:
1. TUBING MUST BE CUT SQUARE TO WORK PROPERLY WITH FITTINGS.

2. BARREL FITTING MUST BE REPLACED WHEN TUBING IS REPLACED.

3. MARK TUBE WITH "ISOLATION" USING WTAGPDL1XXXXXXX PLACE LABEL 50mm FROM END OF TUBING.

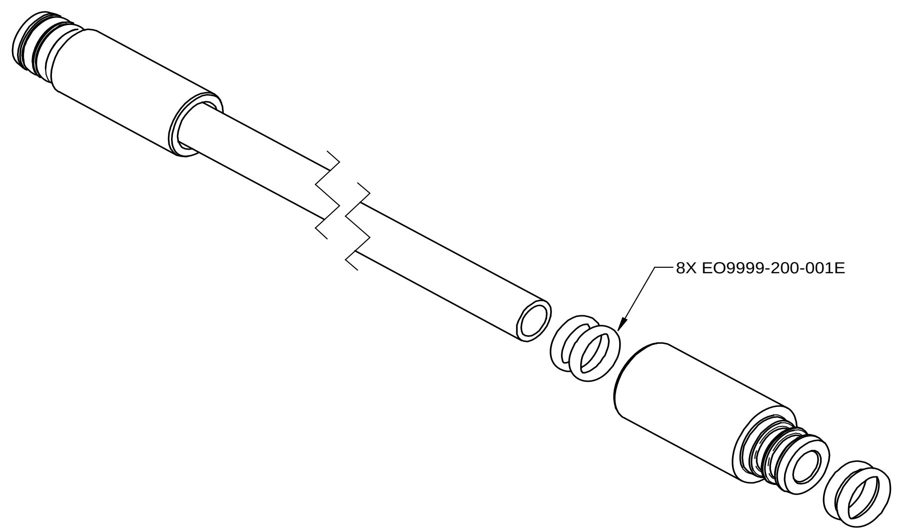
[EO-5093-262-004] REV *2
ISOLATION LINE SHEET 1 OF 1

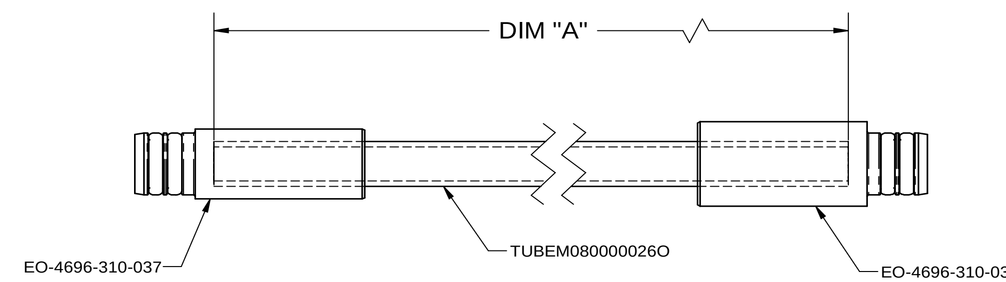
Figure 9-15 EO-5093-262-007, ISOLATION LINE

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





FANUC PART NO.	DESCRIPTION	DIM "A"
EO5093-262-007A	SHORT ISOLATION LINE	340mm
EO5093-262-007B	LONG ISOLATION LINE	1600mm

NOTES:
1. TUBING MUST BE CUT SQUARE TO WORK PROPERLY WITH FITTINGS.

2. BARREL FITTING MUST BE REPLACED WHEN TUBING IS REPLACED.

3. MARK TUBE WITH "ISOLATION" USING WTAGPDL1XXXXXXX PLACE LABEL 50mm FROM END OF TUBING.

[EO-5093-262-007] ISOLATION LINE	REV * SHEET 1 OF 1

Figure 9-16 EO-5093-310-011, ISOLATION MANIFOLD 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 damge equipment

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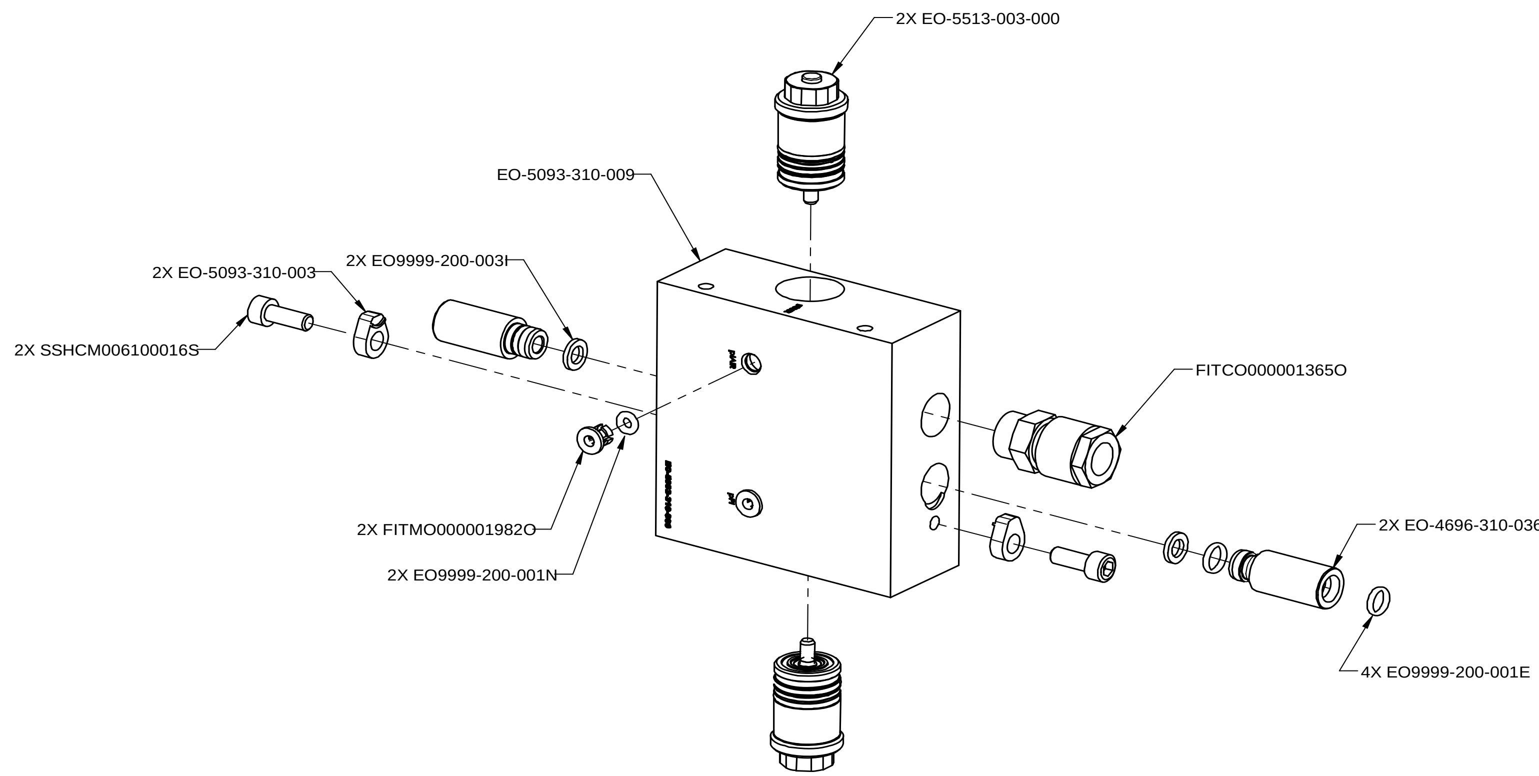
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100016S	M6 X 1.0 X 16mm LG. Stainless Steel Socket Head Cap

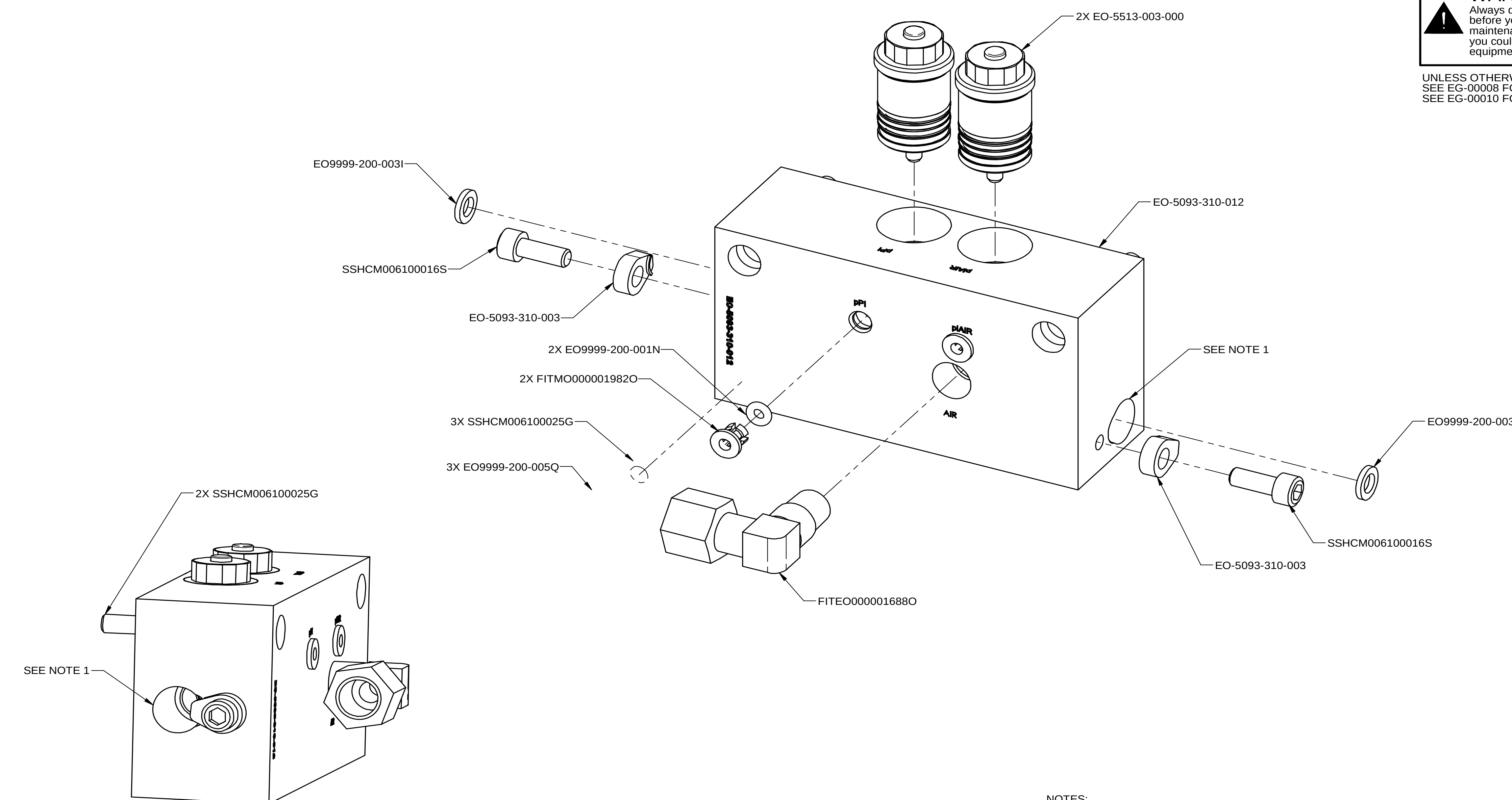
[EO-5093-310-011] REV C1
ISOLATION MANIFOLD ASSEMBLY SHEET 1 OF 1

Figure 9-17 EO-5093-310-013, ISOLATION MANIFOLD 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 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



NOTES:
1. TAPE NOTED HOLES TO RESTRAIN O-RINGS

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100016S	M6 X 1.0 X 16mm LG. Stainless Steel Socket Head Cap
SSHCM006100025G	M6 X 1.0 X 25mm LG. Glass Filled Nylon Socket Head Cap

[EO-5093-310-013] REV C2
ISOLATION MANIFOLD ASSEMBLY SHEET 1 OF 1

Installation

The isolation line is installed differently in the P-500 than it is in the P-700.

P-500 Installation:

On P-500, the isolation line consists of a 610 mm length of 6 x 8 mm FEP tubing (TUBEM080000026O), a barrel fitting (EO-4696-310-029), two o-rings (EO9999-200-001E) and a square-cut o-ring (EO9999-200-003I). Assemble this line by installing an o-ring into the gland inside the barrel and an o-ring into the gland on the outside of the narrow end of the barrel. Use hose tool EO-4526-700-008 to mark the engagement depth on the tubing with a permanent marker, then grip the tubing with hose wrench EO-4526-701-000 and twist the barrel onto the end of the tubing until the end of the barrel is even with the line drawn on the tubing. The line is now ready for installation.

Prepare to remove the isolation line by running a “Superpurge” cycle. Then remove the arm manifold (EO-4696-310-002) by removing 7 M6 plastic screws (SSHCM00610040G) from the valve side of the canister manifold and loosening 4 hold down screws on the hose side.. Disconnect the 3 barrel fittings from the Canister Manifold.

Next, disconnect the isolation line from the Serto fitting on the color changer assembly (EO-6102-510-005). Pull on the barrel to slide the isolation line through the insulating tube and arm manifold to remove. Remove the square cut o-ring in the bottom of the barrel socket.

Install a new isolation line assembly by passing the plain end of the FEP tubing through the arm manifold. Place the insulating tubing over the FEP tubing. Install a square cut o-ring into the barrel pocket of the canister manifold. Insert the 3 barrel fittings into the canister manifold. Replace the arm manifold and tighten the screws to finger tight plus ¼ turn. The flange of the arm manifold should touch the surface of the outer arm when the arm manifold is seated properly.

Complete the installation by placing the nut and ferrule of the Serto fitting 25 mm from the end of the tubing and reassembling the Serto fitting. Be certain that the tube is fully seated in the fitting before bringing the nut down and tightening. Tighten to finger tight then wrench tighten 1 ¾ revolutions. When replacing the tube, a new ferrule should be used.

P-700 Installation

On the P-700 the paint isolation line consists of two parts, a long paint isolation line and a short paint isolation line. The long paint isolation line connects the color changer assembly to the isolation air manifold. The short paint isolation line connects the isolation air manifold to the canister manifold. The lengths of these lines depends on the robot configuration. Please refer to the table below:

Line Description	Pedestal P-700 WB	Rail P-700 WB
Short Paint Isolation Line Assy	EO0593-262-004C	EO5093-262-007A
Short Paint Isolation Line Length	380 mm	340 mm
Long Paint Isolation Line Assy	EO5093-262-004B	EO5093-262-007B
Long Paint Isolation Line Length	1500 mm	1730 mm

Table 9-1: Paint Isolation Line Assemblies

Each line assembly consists of a barrel fitting at each end, a length of 6 x 8 mm FEP tube and 8 o-rings (4 for each barrel fitting). Refer to figure x for the construction of each line. Assemble each line by installing o-rings into the glands inside the barrels and o-rings into the glands on the outside of the narrow ends of the barrels. Use hose tool EO-4526-700-008 to mark the engagement depth on the tubing with a permanent marker, then grip the tubing with hose wrench EO-4526-701-000 and twist the barrel onto the end of the tubing until the end of the barrel is even with the line drawn on the tubing. The line is now ready for installation.

Prepare to remove the isolation line by running a “Superpurge” cycle. All the isolation lines are retained by a barrel clip (EO-5093-310-003) and M6 x 16mm long screw. To remove the barrel, loosen the screw, turn the clip so that it is no longer retaining the barrel and pull the barrel out. Remove the square cut o-ring (EO9999-200-003I) at the bottom of the barrel pocket.

Install the new line by inserting a new square cut o-ring (EO9999-200-003I) into the barrel pocket and then installing the barrel. Retain the barrel with the clip and tighten the M6 screw.

Route the line through hose guides and clamps as required. NOTE: to route the long isolation line, the arm should be moved to a position where the arm is fully extended at axis 3. When installing a new line be sure the line has no slack in this straight arm position before tightening the hose clamp near the FRP.

9.2.5 Dump Line Components

The tubing and fittings which connect the canister manifold to the paint booth paint waste system are called the “dump line”. This passage is blown dry with compressed air at the end of the “FILL” color change cycle in order to establish electrostatic isolation. Some portions of the dump line system use a special multi layered tubing that is designed to be resistant to electrostatic pin holes. This tubing requires special techniques to prepare its ends for use.

Figure 9-18 EO-6102-270-000 Sheet 1 of 2, STICK DUMP 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 damge equipment

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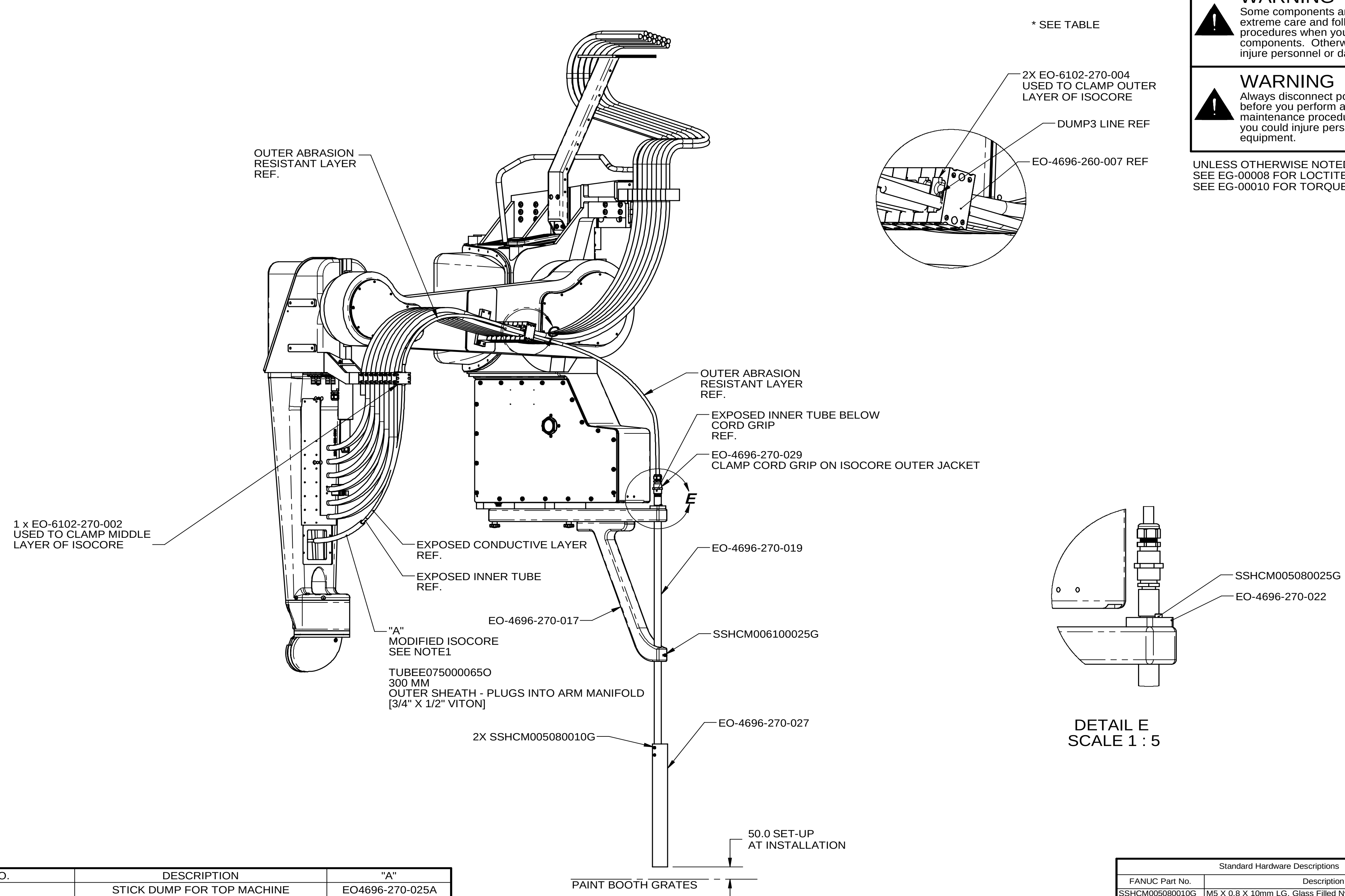
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



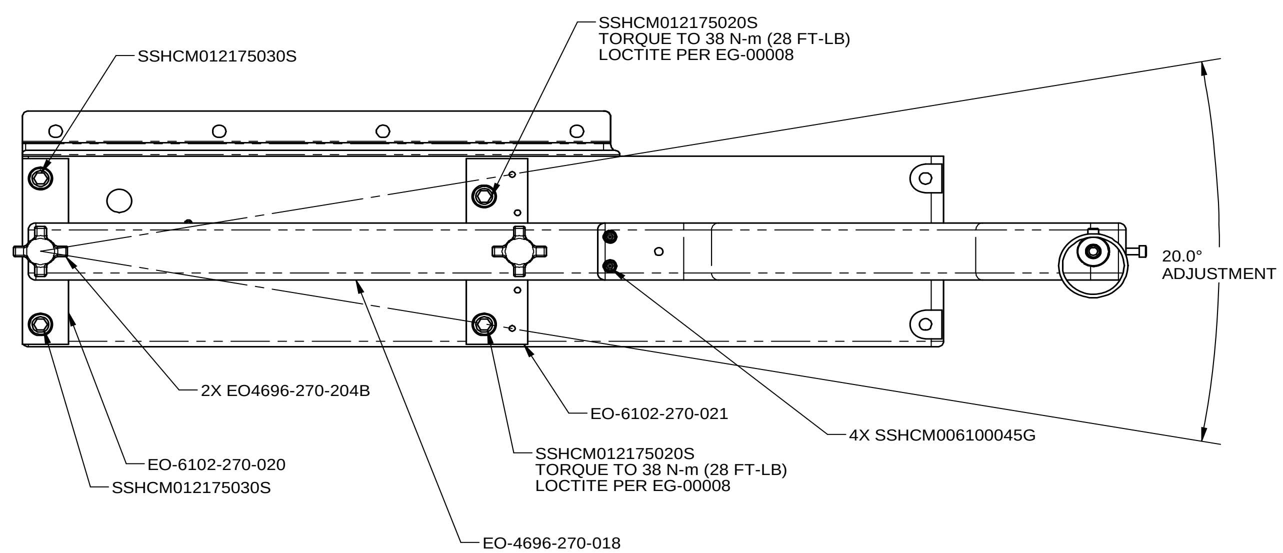
ASSEMBLY PART NO.	DESCRIPTION	"A"
EO6102-270-000A	STICK DUMP FOR TOP MACHINE	EO4696-270-025A
EO6102-270-000B	STICK DUMP FOR SIDE MACHINE	EO4696-270-025B

NOTES:
1. SEE EO-4696-271-000 SHEETS 3-13 FOR ISOCORE STRIPPING PROCEDURE

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM005080010G	M5 X 0.8 X 10mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100025G	M6 X 1.0 X 25mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100045G	M6 X 1.0 X 45mm LG. Glass Filled Nylon Socket Head Cap
SSHCM012175020S	M12 X 1.75 X 20mm LG. Stainless Steel Socket Head Cap
SSHCM012175030S	M12 X 1.75 X 30mm LG. Stainless Steel Socket Head Cap

[EO-6102-270-000] REV *3
STICK DUMP ASM SHEET 1 OF 2

Figure 9-19 EO-6102-270-000 Sheet 2 of 2, STICK DUMP ASM



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

[EO-6102-270-000] REV *3
STICK DUMP ASM SHEET 2 OF 2

Figure 9-20 EO-5093-515-010, DUMP ISOLATION LINE

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

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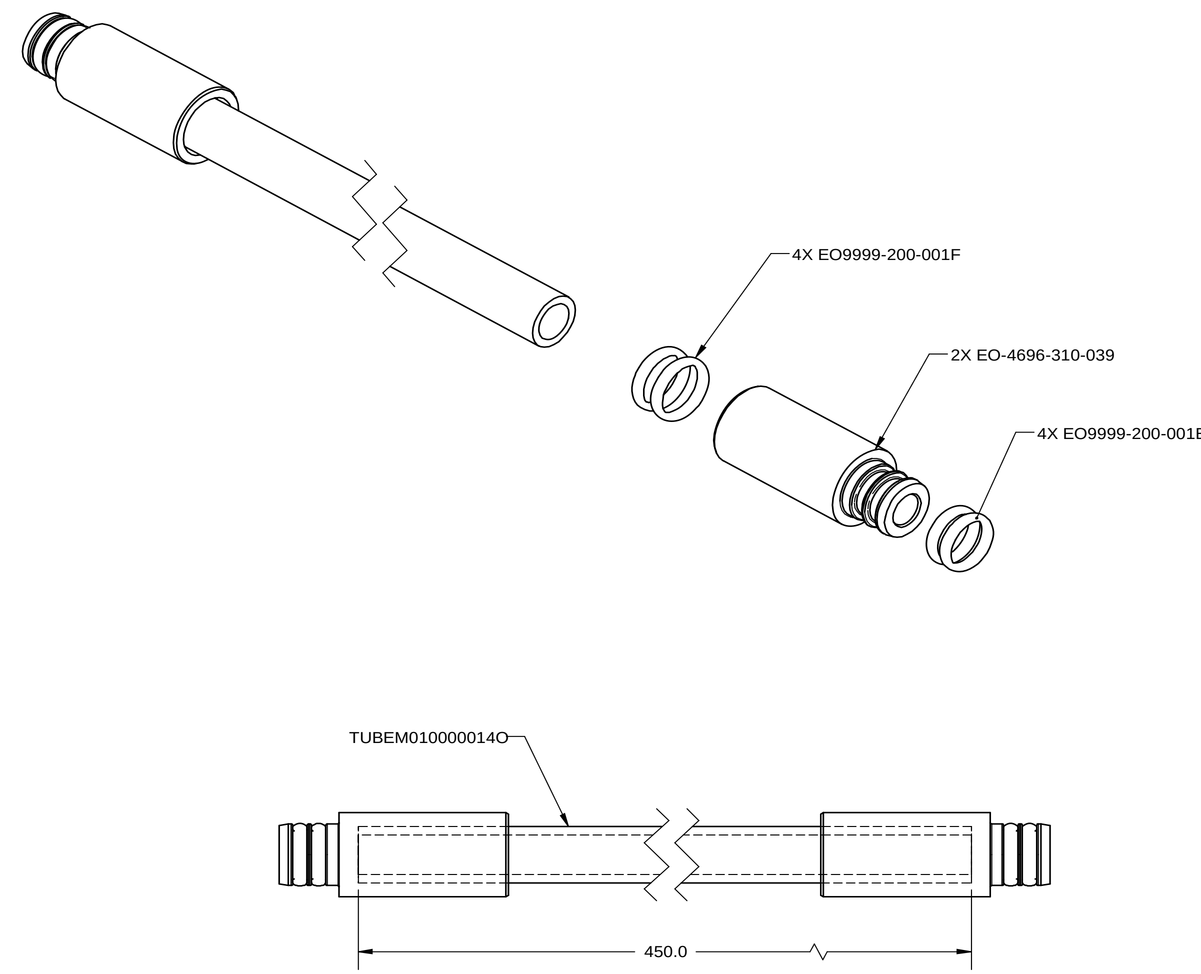
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



NOTES:

1. TUBING MUST BE CUT SQUARE TO WORK PROPERLY WITH FITTINGS.
2. BARREL FITTING MUST BE REPLACED WHEN TUBING IS REPLACED.

[EO-5093-515-010] DUMP ISOLATION LINE	REV A SHEET 1 OF 1

Figure 9-21 EO-5093-310-014, DUMP "Y" BLOCK

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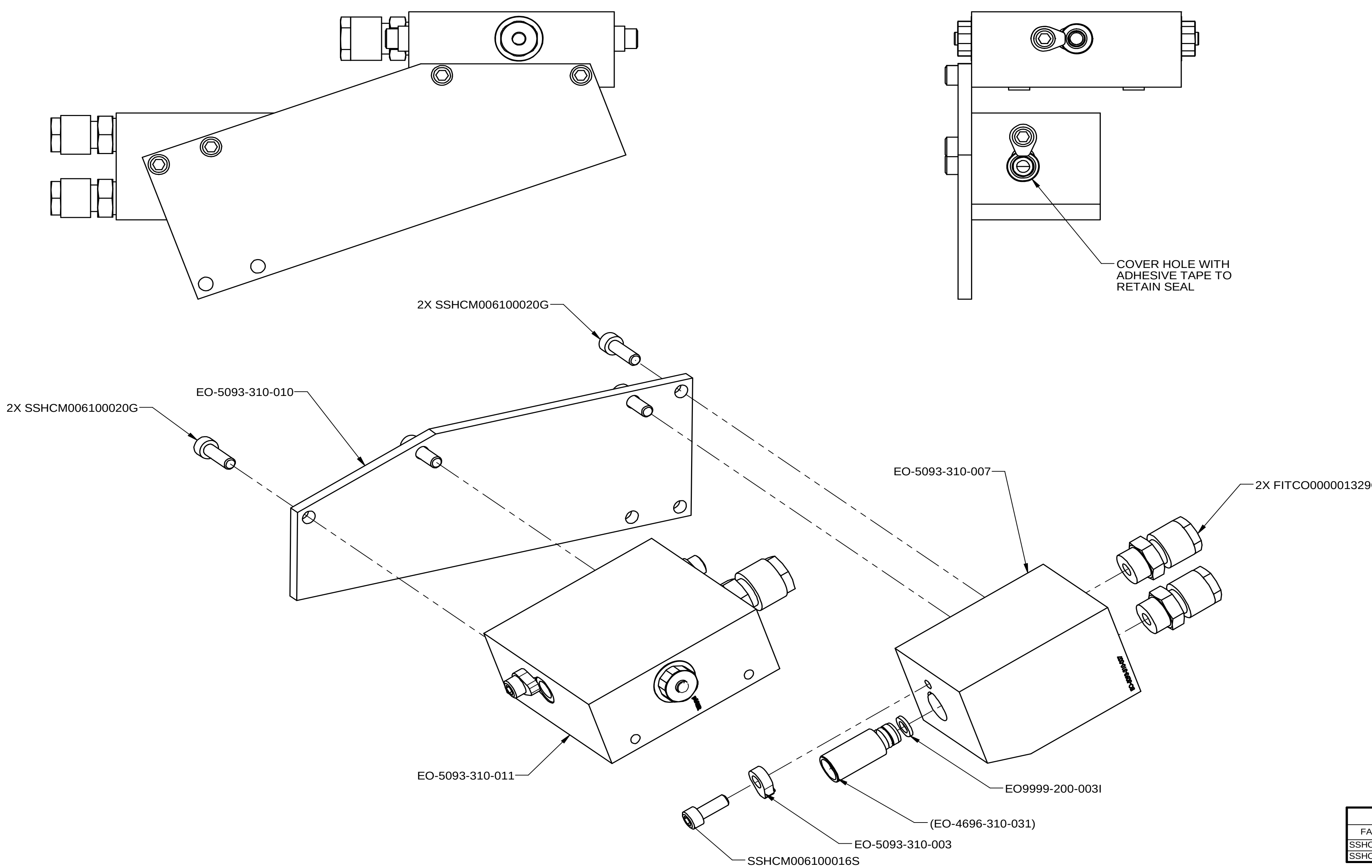
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100016S	M6 X 1.0 X 16mm LG. Stainless Steel Socket Head Cap
SSHCM006100020G	M6 X 1.0 X 20mm LG. Glass Filled Nylon Socket Head Cap

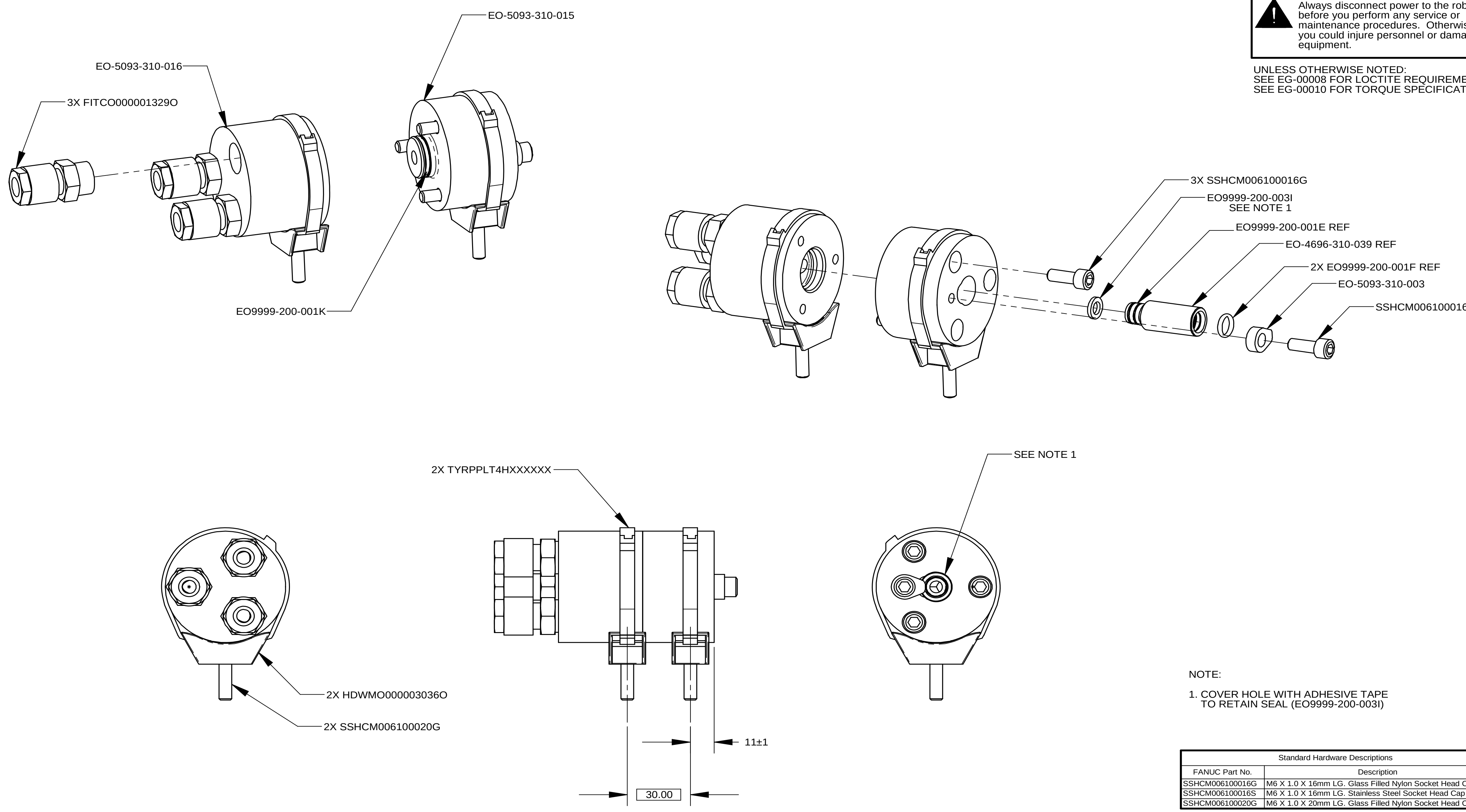
[EO-5093-310-014]
DUMP "Y" BLOCK
REV B1
SHEET 1 OF 1

Figure 9-22 EO-5093-310-017, 3 WAY MANIFOLD

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



NOTE:

1. COVER HOLE WITH ADHESIVE TAPE TO RETAIN SEAL (EO9999-200-003I)

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100016G	M6 X 1.0 X 16mm LG. Glass Filled Nylon Socket Head Cap
SSHCM006100016S	M6 X 1.0 X 16mm LG. Stainless Steel Socket Head Cap
SSHCM006100020G	M6 X 1.0 X 20mm LG. Glass Filled Nylon Socket Head Cap

[EO-5093-310-017]
3 WAY MANIFOLD
REV B1
SHEET 1 OF 1

Installation
The dump line is installed differently in the P-500 than it is in the P-700.

P-500 Installation:
On P-500, the isolation line consists of a length of Isocore tubing (see table), a barrel fitting (EO-4696-310-021), two o-rings (EO9999-200-001E and -001F) and a square-cut o-ring (EO9999-200-003I). The barrel fitting connects to one end of the dump line and the other end feeds through the dump stick assembly and is gripped by a special cord grip assembly (EO-4696-270-029).

Description	P-500 Top Machine	P-500 Side Machine
Modified Isocore Tubing Part Number	EO-4696-270-025A	EO-4696-270-025B
Length	4420 mm	4220 mm

Table 9-2: P-500 Dump Line Assemblies

Prepare to remove the dump line by running a "Superpurge" cycle. Then remove the arm manifold (EO-4696-310-002) by removing 7 M6 plastic screws (SSHCM00610040G) from the valve side of the canister manifold and loosening 4 hold down screws on the hose side. Disconnect the 3 barrel fittings from the Canister Manifold.

Next, disconnect the barrel from the dump line. The barrel is threaded on to the tube; remove it by turning it counter-clockwise. Remove the square cut o-ring from the bottom of the barrel socket. Remove the dump line from the process clamps and stick dump assembly.

Prepare to install the new dump line by installing the o-rings on the barrel. First, install an o-ring into the gland inside the barrel (EO9999-200-001F) and an o-ring into the gland on the outside of the narrow end of the barrel EO9999-200-001E). Then thread the end of the isocore tubing through insulating tubing and the arm manifold and attach the barrel as follows. Use hose tool EO-4526-700-008 to mark the engagement depth on the tubing with a permanent marker, then grip the tubing with hose wrench EO-4526-701-000 and twist the barrel onto the end of the tubing until the end of the barrel is even with the line drawn on the tubing.

Install a square cut o-ring into the barrel pocket of the canister manifold. Insert the 3 barrel fittings into the canister manifold. Replace the arm manifold and tighten the screws to finger tight plus ¼ turn. The flange of the arm manifold should touch the surface of the outer arm when the arm manifold is seated properly.

Route the line through hose guides and clamps as required. Complete the installation by feeding the long stripped end of the isocore tubing into the dump stick and securing the cord grip.

P-700 Installation:
On P-700, the dump line consists of two parts: A short length of FEP tubing and several longer lengths of isocore tubing (see chart).

Description	Pedestal P-700 WB	Rail P-700 WB
Dump Isolation Line Assy	EO-4696-270-025A	EO-4696-270-025B
Dump Isolation Line Length	4420 mm	4220 mm
Dump Manifold Assembly	EO-5093-310-007 (block only)	EO-5093-310-017
Number of Isocore Lines	2	3
Modified Isocore Line Part Number	EO-5093-526-005B	EO-5093-526-005B
Overall Length of Isocore Lines	25000 mm	25000 mm

Table 9-3: P-700 Dump Line Assemblies

Prepare to remove the dump isolation line by running a "Superpurge" cycle. The dump isolation line is retained on each end by a barrel clip (EO-5093-310-003) and M6 x 16mm long screw. To remove the barrel, loosen the screw, turn the clip so that it is no longer retaining the barrel and pull the barrel out. Remove the square cut o-ring (EO9999-200-003I) at the bottom of the barrel pocket.

Install the new line by inserting a new square cut o-ring (EO9999-200-003I) into the barrel pocket and then installing the barrel. Retain the barrel with the clip and tighten the M6 screw.

9.2.6 Waterborne System Parameters

Most waterborne system parameters are unaffected by system maintenance. However, a change in the length of the paint isolation line length might require a change in the isolation volume that is defined on the waterborne setup screen on the teach pendant.

9.2.6.1 Isolation Volume

The Isolation volume is volume of paint that will be drawn into the canister during the “Slow fill” step of the FILL cycle. It should be slightly less than the internal volume of the paint circuit from the color highest number color valve to the pCAN valve.

There are two methods for determining the isolation volume of the system.

Determining isolation volume by table
Refer to the tables below to determine the recommended isolation volume for your system. Note that the “recommended parameter setting” is 2 cc less than the “theoretical isolation volume” to minimize the chance of solvent contamination of the canister during the slow fill.

Number of Colors in Color Stack	Theoretical Isolation Volume (cc)	Recommended Parameter Setting (cc)
1-3	22.7	20.7
4-7	24.3	22.3
8-11	25.9	23.9
12-15	27.5	25.5
16-19	29.1	27.1
20-23	30.7	28.7

Table 9-4: P-500 Isolation Volumes

Number of Colors in Color Stack	Theoretical Isolation Volume (cc)	Recommended Parameter Setting (cc)
1-4	56.2	54.2
5-8	57.8	55.8
9-12	59.4	57.4
13-16	61.0	59.0
17-20	62.6	60.6
21-24	64.2	62.2

Table 9-5: P-700 Pedestal Isolation Volumes

Number of Colors in Color Stack	Theoretical Isolation Volume (cc)	Recommended Parameter Setting (cc)
1-4	61.9	59.9
5-8	63.5	61.5
9-12	65.1	63.1
13-16	66.7	64.7
17-20	68.3	66.3
21-24	69.9	67.9

Table 9-6: P-700 Rail Isolation Volumes

Determining isolation volume by direct measurement

The actual isolation volume of the system can be measured directly by filling the paint circuit with liquid, then capturing the part of the liquid between the color valves and the pCAN valve.

Procedure for P-500:

1. Run Superpurge cycle.
2. Remove bell cup from applicator and set up container to collect volume.
3. Fill system with solvent:
    a. Open pSOL, pCC, pDUMP2 for 3 seconds.
    b. Close all valves.
4. Air push solvent through applicator into container.
    a. Open pAIR, pCC, pCAN, pPE, pTRIG until all liquid is collected.
    b. Close all valves
5. Measure volume. This volume is the theoretical isolation volume.

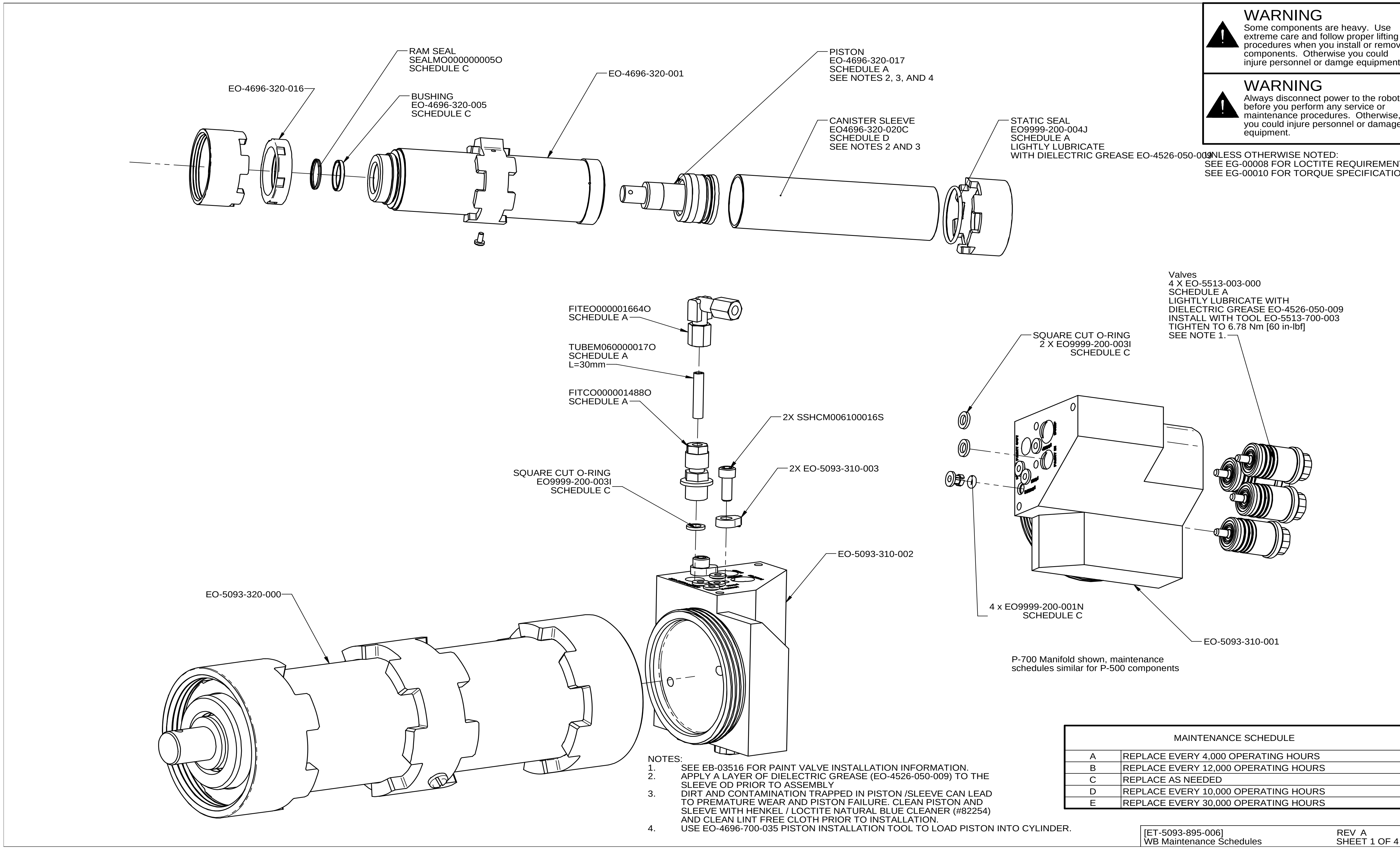
Procedure for P-700

1. Run Superpurge cycle.
2. Remove bell cup from applicator and set up container to collect volume.
3. Fill system with solvent:
    a. Open pSOL, pCC, pPI, pDUMP2 for 3 seconds.
    b. Close all valves.
4. Air push solvent through applicator into container.
    a. Open pAIR, pCC, pCAN, pPI, pPAINT, pPE, pTRIG until all liquid is collected.
    b. Close all valves
5. Measure volume. This volume is theoretical isolation volume.

9.3 Maintenance and Repair

9.3.1 Preventive Maintenance Schedules

Figure 9-23 ET-5093-895-006 Sheet 1 of 4, WB Maintenance Schedules



MAINTENANCE SCHEDULE	
A	REPLACE EVERY 4,000 OPERATING HOURS
B	REPLACE EVERY 12,000 OPERATING HOURS
C	REPLACE AS NEEDED
D	REPLACE EVERY 10,000 OPERATING HOURS
E	REPLACE EVERY 30,000 OPERATING HOURS

Figure 9-24 ET-5093-895-006 Sheet 2 of 4, WB Maintenance Schedules

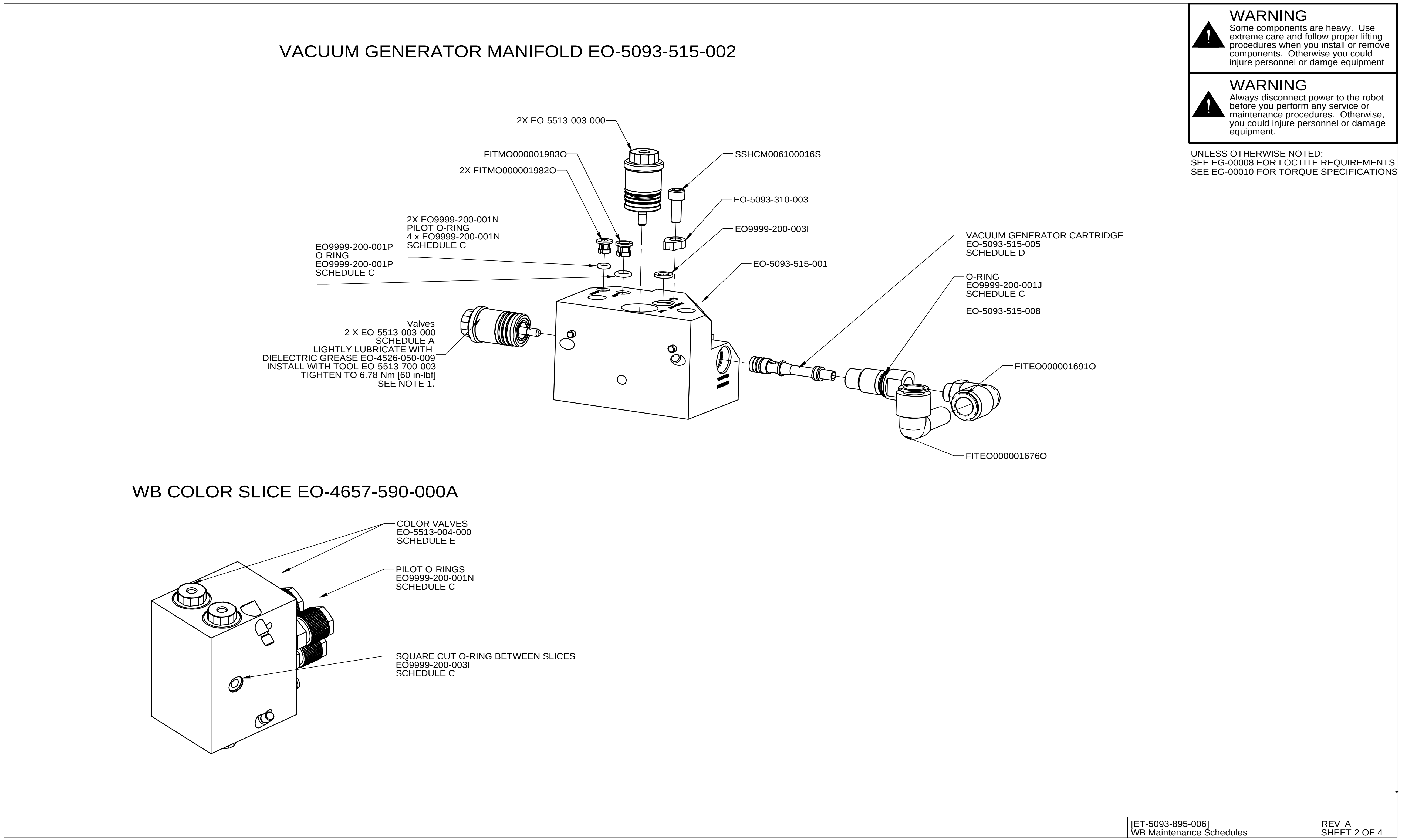


Figure 9-25 ET-5093-895-006 Sheet 3 of 4, WB Maintenance Schedules

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
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UNLESS OTHERWISE NOTED:
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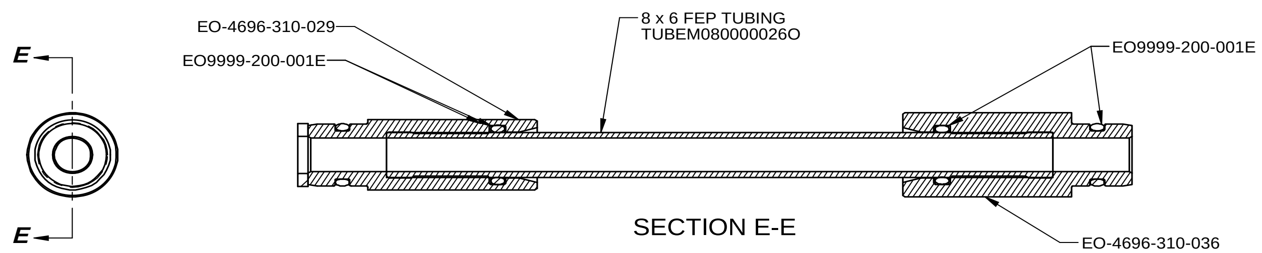
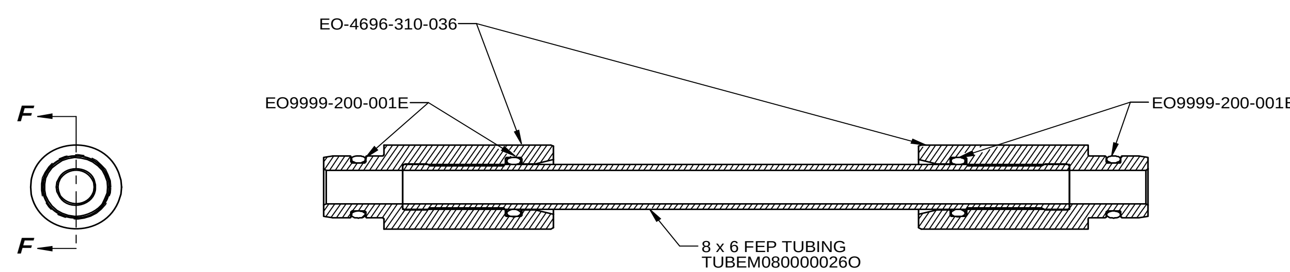
SEE EG-00010 FOR TORQUE SPECIFICATIONS

SPECIAL LINES, PEDISTAL CONFIGURATION



SECTION E-E

ISOLATION LINES
LONG LINE: EO5093-262-004B (FEP TUBE 1500 mm LONG)
SHORT LINE: EO5093-262-004C (FEP TUBE 380 mm LONG)



SECTION F-F

DUMP ISOLATION LINE
EO-5093-515-006 (FEP TUBE 575 mm LONG)

Component	Maintenance Schedule
Long Isolation Line	
Tubing	Clean Interior as needed; Replace every 2000 operation hours
Barrels	Replace every 4000 operation hours
O-Rings	Replace every 4000 operation hours
Short Isolation Line	
Tubing	Clean Interior as needed (500 hrs typical); Replace every 2000 operation hours
Barrels	Replace every 4000 operation hours
O-Rings	Replace every 2000 operation hours
Dump Isolation Line	
Tubing	Clean Interior as needed(500 hrs typical); Replace every 2000 operation hours
Barrels	Replace every 4000 operation hours
O-Rings	Replace every 2000 operation hours

NOTES
1. CLEAN INSIDE OF TUBES WITH SOFT CLOTH SOAKED IN ALCOHOL OR PURGE SOLVENT. TAKE CARE TO NOT SCRATCH INSIDE SURFACE OF TUBE.

[ET-5093-895-006] WB Maintenance Schedules	REV A SHEET 3 OF 4

Figure 9-26 ET-5093-895-006 Sheet 4 of 4, WB Maintenance Schedules

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

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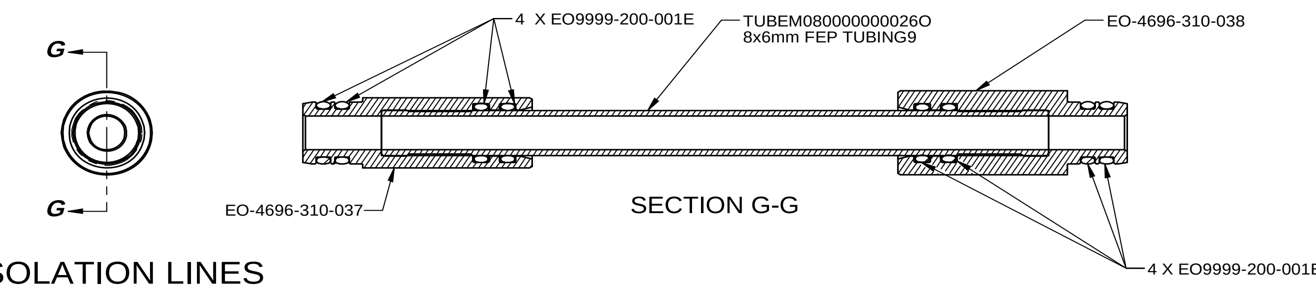
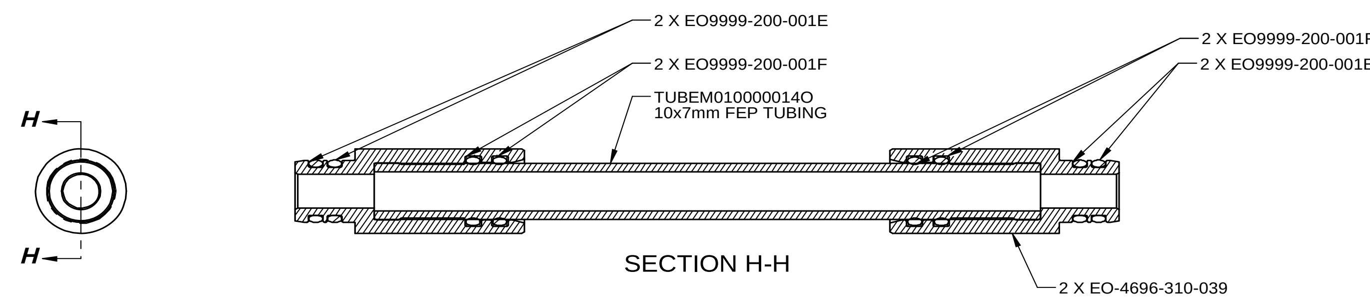
SEE EG-00010 FOR TORQUE SPECIFICATIONS

SPECIAL LINES, RAIL CONFIGURATION



ISOLATION LINES
SHORT LINE: EO5093-262-007A (FEP TUBE 340 mm LONG)
LONG LINE: EO5093-262-007B (FEP TUBE 1730 mm LONG)



DUMP ISOLATION LINE
EO-5093-515-010 (FEP TUBE 450 mm LONG)

Component	Maintenance Schedule
Long Isolation Line	
Tubing	Clean Interior as needed; Replace every 2000 operation hours
Barrels	Replace every 4000 operation hours
O-Rings	Replace every 4000 operation hours
Short Isolation Line	
Tubing	Clean Interior as needed (500 hrs typical); Replace every 2000 operation hours
Barrels	Replace every 4000 operation hours
O-Rings	Replace every 2000 operation hours
Dump Isolation Line	
Tubing	Clean Interior as needed (500 hrs typical); Replace every 2000 operation hours
Barrels	Replace every 4000 operation hours
O-Rings	Replace every 2000 operation hours

NOTES
1. CLEAN INSIDE OF TUBES WITH SOFT CLOTH SOAKED IN ALCOHOL OR PURGE SOLVENT. TAKE CARE TO NOT SCRATCH INSIDE SURFACE OF TUBE.

[ET-5093-895-006] REV A
WB Maintenance Schedules SHEET 4 OF 4

9.4 Troubleshooting

This section provides troubleshooting guidelines for faults generated by the Shape Air Control System. Possible causes and remedies are listed for each fault. The error codes listed below are of the form:

<Equipment 1 fault> / <Equipment 2 fault> "<description>

For example: PNT1-845-WARN 1 / PNT1-861 WARN 2 "Manifold Press low warning"
The two faults have the same meaning but were posted by different paint robots on this controller.

9.4.1 PNT1-894 WARN / PNT1-906 WARN "Low can Pressure after Fill: %s "

A fill cycle was just completed, but the fluid pressure in the can was found to be lower than the minimum expected.

Cause: Paint supply pressure is inadequate to meet Minimum Fill Torque requirement
Remedy: Check paint supply pressure. Correct paint supply pressure if abnormal. If paint supply pressure is normal, decrease the "Minimum torque after fill" in the setup screen.

Cause: Paint supply valve is not receiving pneumatic signal to open.
Remedy: Check function of paint supply valve solenoid. Replace if necessary.

Cause: Paint supply valve is stuck closed or slow to open.
Remedy: Replace paint supply valve. Take care to shut off paint supply and pilot line before removing valve. Thoroughly clean the valve pocket before installing a new valve.

9.4.2 PNT1-897 PAUS %s / PNT1-909 PAUS %s "HIGH Negative Canister TORQUE"

The maximum compression force on the ball screw has been exceeded. When this occurs, it is usually when the ball screw is extending.

Cause: Paint injector tip in applicator is obstructed.
Remedy: Clean applicator injector tip.

Cause: High paint flow rate is developing too much pressure.
Remedy: Use a larger injector tip to reduce back pressure in system.

Cause: A valve in the paint flow path is stuck closed or slow to open.
Remedy: Replace slow valve.

Cause: Canister mastered position is set incorrectly causing interference between the piston and the canister manifold.
Remedy: Remaster canister axis using visual witness marks as a starting point.

Cause: The main support bearing for the canister ball screw has failed.
Remedy: Replace canister drive assembly. The worn assembly can be rebuilt with a new bearing.

9.4.3 PNT1-898 PAUS %s / PNT1-910 PAUS %s “HIGH Positive Canister TORQUE”

The maximum tensile force on the ball screw has been exceeded. When this occurs, it s usually when the ball screw is retracting.

Cause: Canister mastered position is set incorrectly causing interference between the piston and the rear of the canister.
Remedy: Remaster canister axis using visual witness marks as a starting point.

Cause: Color change preset for retraction speed during fill is set too high.
Remedy: Change retraction speed to 6000 cc/min or less.

Cause: Electrostatic grease is blocking internal vent passage in canister body. This allows pressure to build as the piston retracts, compressing the air on the back side of the piston.
Remedy: Replace canister assembly. Canister assembly can be rebuilt taking care to keep the vent passage clean of grease.

9.4.4 PNT1-899 PAUS %s / PNT1-911 PAUS %s “Air in Canister detected”

The piston was retracted from the fluid after the Fill sequence and significant torque was still detected on the face of the piston.

Cause: Canister is improperly mastered above the surface of the canister manifold.
Remedy: Remaster the canister using the visual witness marks as a starting point.

Cause: Air is entrained in the paint supply.
Remedy: Check for air infiltration of the paint supply and correct.

Cause: Vacuum generator (if equipped) is not functioning properly.
Remedy: Replace vacuum generator assembly.

9.4.5 PNT1-900 WARN %s / PNT1-912 WARN %s “Low Trigger Torque”

The torque threshold on the canister motor did not reach the minimum torque threshold value during the fill through trigger step of the fill or refill cycle.

Cause: Paint supply pressure is inadequate to meet trigger torque threshold.
Remedy: Check paint supply pressure. Correct paint supply pressure if abnormal. If paint supply pressure is normal, decrease the “Min fill trigger torque” in the setup screen.

Cause: Paint supply valve is not receiving pneumatic signal to open.
Remedy: Check function of paint supply valve solenoid. Replace if necessary.

Cause: Paint supply valve is stuck closed or slow to open.
Remedy: Replace paint supply valve. Take care to shut off paint supply and pilot line before removing valve. Thoroughly clean the valve pocket before installing a new valve.

9.4.6 High Voltage Troubleshooting for the Canister Paint Delivery System

When using the canister paint delivery system with conductive materials such as waterborne paint, high voltage faults may occur that are specifically related to problems with the canister paint delivery system. This section provides guidance in diagnosing these kinds of faults.

The following high voltage faults are sometimes related to failures of components in the canister paint delivery system:

- Switched-Off because of dV/dt-FAULT
- Switched-Off because of dI/dt-FAULT
- Switched-Off because of OVERLOAD (Vmin)
- Switched-Off because of OVERLOAD (Imax)
- Estat set point not reached

Procedure 1: Dry Robot Test.

1. Place the robot in a position with the applicator in the center of the cell (i.e. away from grounded metal).
2. Blow down all the following lines for 90 seconds each:

    a. To dry the wash line open pAIR, p2T, pBW
    b. To dry the paint isolation line and dump line run a super purge then open pAIR, pCC and pDUMP2 (For P-700 also open pPI)
    c. To dry the Dump Line open pAIR, p pDUMP2

3. Close all the valves.
4. Enable the e-stats from the control box in “local” mode. Observe the current draw.

Result: If the robot draws more than 15 microamps after this procedure then there is an external ground path that is separate from the fluid delivery lines.

Remedy:

- Replace fabric covers with clean covers
- Check canister compartment for paint or solvent leaks
- Thoroughly clean arm with alcohol or acetone
- Verify that arm drying air is functioning

Result: If the robot does not draw more than 15 microamps after this procedure then issue lies with one of the 3 lines (wash line, dump line, paint line). Use Procedure 2 (below).

Procedure 2: Line Isolation Test

1. Run a fill cycle.
2. Turn on the e-stats locally and verify a current draw greater than 15 micro amps. If there current is less than 15 micro amps then stop and repeat procedure 1. Otherwise continue,
3. Turn off the e-stats.
4. Blow down the wash line for 1 minute:
    - Open pAIR, p2T and pBW

5. Close all valves.
6. Turn on the e-stats locally, if the current draw is less then 15 micro amps then replace the wash line. If not, continue.
7. Turn off the e-stats
8. Go into the booth and disconnect the paint isolation line from the canister manifold. Carefully tape or tie the end of the line away from the canister manifold. (this removes the ground path through the paint line without drying the dump line).
9. Turn on the e-stats locally, if the current draw is less then 15 micro amps then replace the paint isolation line (for P-700: replace both parts, the long one from the color changer and the short one that connects to the canister manifold. Replace the o-rings also). If the current is greater than 15 micro amps then replace the dump line.

9.5 Spare Parts & Tools

9.5.1 Spare Parts Required

The following spare parts are used to service the Canister Paint Delivery System.

- Paint valve EO-5513-003-000
- 6 x 8 FEP Tubing TUBEM08000000026O
- 7 x 10 FEP Tubing TUBEM010000014O
- Square cut o-ring EO9999-200-003I
- O-ring EO9999-200-001E
- O-ring EO9999-200-001F
- Glass Filled Nylon Screws SSHCM00610040G
- Connection Pin EO-4696-330-022
- Dielectric grease EO-4526-050-009
- Loctite Primer 770 HDWMO000060323
- Loctite 416 HDWMO000056588
- LG-01-02 Grease HDWMO0000041960

9.5.2 Tools Required

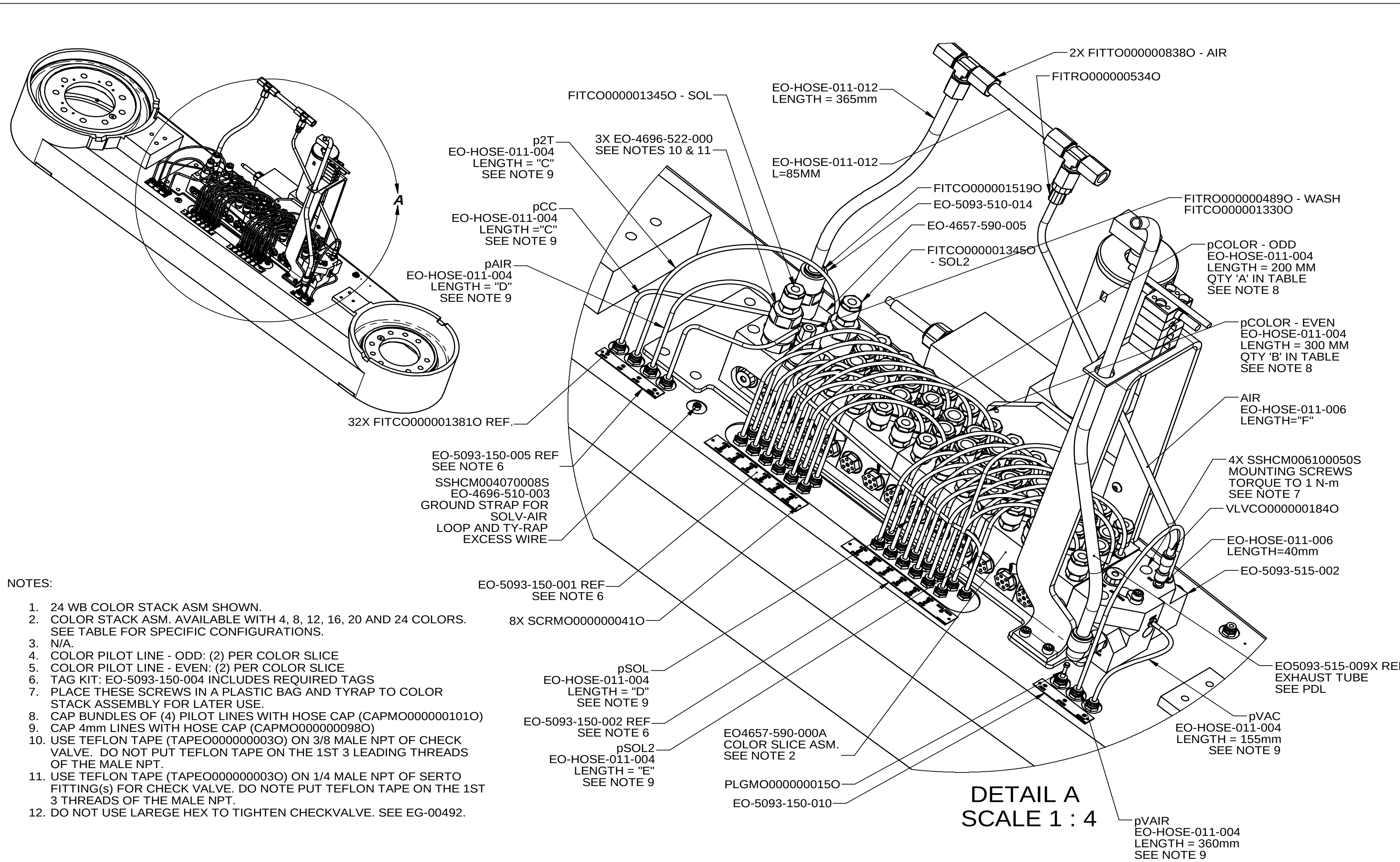
The following tools are required to perform maintenance on the Canister Paint Delivery System.

- Paint valve tool EO-5513-700-003
- 6 mm Allen wrench
- 8 mm Allen wrench
- Hose Tool EO-4526-700-008
- Hose Wrench EO-4526-701-000
- Tube cutter
- Small flat head screwdriver
- Piston Install Tool EO-4696-700-035

10 COLOR CHANGER – CANISTER

10.1 Overview

Figure 10-1 EO-5093-510-002, WB COLOR STACK ARM 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 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

NOTES:

1. 24 WB COLOR STACK ASM SHOWN.
2. COLOR STACK ASM. AVAILABLE WITH 4, 8, 12, 16, 20 AND 24 COLORS. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
3. N/A.
4. COLOR PILOT LINE - ODD: (2) PER COLOR SLICE
5. COLOR PILOT LINE - EVEN: (2) PER COLOR SLICE
6. TAG KIT: EO-5093-150-004 INCLUDES REQUIRED TAGS
7. PLACE THESE SCREWS IN A PLASTIC BAG AND TYRAP TO COLOR STACK ASSEMBLY FOR LATER USE.
8. CAP BUNDLES OF (4) PILOT LINES WITH HOSE CAP (CAPMO000000101O)
9. CAP 4mm LINES WITH HOSE CAP (CAPMO000000098O)
10. USE TEFLON TAPE (TAPEO000000003O) ON 3/8 MALE NPT OF CHECK VALVE. DO NOT PUT TEFLON TAPE ON THE 1ST 3 LEADING THREADS OF THE MALE NPT.
11. USE TEFLON TAPE (TAPEO000000003O) ON 1/4 MALE NPT OF SERTO FITTING(s) FOR CHECK VALVE. DO NOTE PUT TEFLON TAPE ON THE 1ST 3 THREADS OF THE MALE NPT.
12. DO NOT USE LAREGE HEX TO TIGHTEN CHECKVALVE. SEE EG-00492.

510 Assembly No.	Description	# of colors	# of Color Slices (EO4657-590-000A)	QTY 'A'	QTY 'B'	QTY 'C'	QTY 'D'	QTY 'E'	QTY 'F'	QTY 'G'
EO5093-510-002A	WB CC ASM: Rec, 4 clr	4	1	2	2	580	540	95	160	0
EO5093-510-002B	WB CC ASM: Rec, 8 clr	8	2	4	4	524	484	151	216	0
EO5093-510-002C	WB CC ASM: Rec, 12 clr	12	3	6	6	468	428	207	272	0
EO5093-510-002D	WB CC ASM: Rec, 16 clr	16	4	8	8	412	372	263	328	0
EO5093-510-002E	WB CC ASM: Rec, 20 clr	20	5	10	10	356	316	319	384	0
EO5093-510-002F	WB CC ASM: Rec, 24 clr	24	6	12	12	300	260	375	440	0
EO5093-510-002G	WB CC ASM: NRec, 4 clr	4	1	2	2	580	540	95	160	4
EO5093-510-002H	WB CC ASM: NRec, 8 clr	8	2	4	4	524	484	151	216	8
EO5093-510-002J	WB CC ASM: NRec, 12 clr	12	3	6	6	468	428	207	272	12
EO5093-510-002K	WB CC ASM: NRec, 16 clr	16	4	8	8	412	372	263	328	16
EO5093-510-002L	WB CC ASM: NRec, 20 clr	20	5	10	10	356	316	319	384	20
EO5093-510-002M	WB CC ASM: NRec, 24 clr	24	6	12	12	300	260	375	440	24

Standard Hardware Descriptions

FANUC Part No.	Description
SSHCM004070008S	M4 X 0.7 X 8mm LG. Stainless Steel Socket Head Cap
SSHCM006100050S	M6 X 1.0 X 50mm LG. Stainless Steel Socket Head Cap

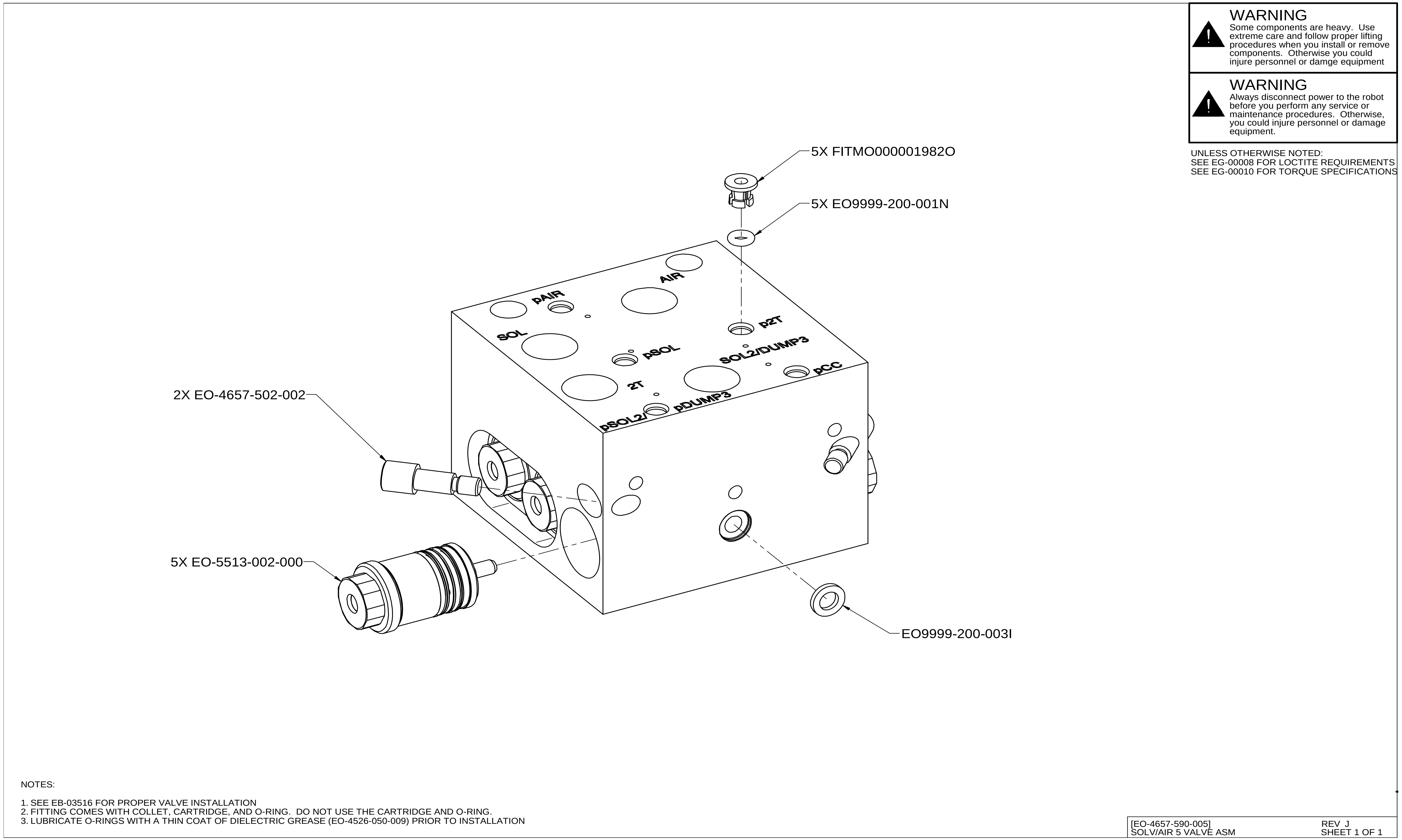
[EO-5093-510-002] REV *22
WB COLOR STACK ARM ASM SHEET 1 OF 1

The color changer enables the robot to switch between colors without color contamination, and provides a cleaning function to clean the paint lines from the color changer through the applicator. The Color Changer consists of the SolvAir module, at least one color module, an end block.

10.2 Operations and Setup

10.2.1 Five Valve SolvAir Module

Figure 10-2 EO-4657-590-005, SOLV/AIR 5 VALVE ASM



This module allows purge solvent and purge air to be simultaneously delivered to the Color Changer. This mechanical feature eliminates the need for added programming steps typically alternating a solvent then an air valve several times during a color change cleanout cycle. A secondary outlet, 2T is used for routing solvent, air, or aerated SolvAir mix to the applicator.

The SolvAir module is located at the rear of the Color Changer. It consists of five paint valves (EO-5513-002-000) to control the AIR, SOL, 2T, SOL2, and DUMP3 valves, as well as the SolvAir endcap (EO-4657-501-003)

SolvAir solvent regulator flow rates:

SG = 1.0 (water)
0.38 – 0.42 gpm = 24.0-26.5 cc/s

SG = 0.9
0.40 – 0.44 gpm = 25.3-27.9 cc/s

SG = 0.8 (Methyl Isobutyl Ketone)
0.42 – 0.47 gpm = 26.8-29.6 cc/s

The SolvAir Module connects to the color module using 2 color manifold screws (EO-4657-502-002) using a 6mm Allen wrench.

The SolvAir Module connects to the arm using 2 screws (SSHCM006100050C).

The paint valves screw into the SolvAir module using the Valve Tool as shown in the Special Tools Section. See EB-03516.

<caution: Do not remove Solv-Air flow control module.>

The pilot lines for the AIR, SOL, CC, 2T, SOL2, and DUMP3 valves plug into 5 fittings, FITMO0000019820.

Check valves (EO4696-522-000) are attached to the air inlet and solvent inlet ports.

The SolvAir module connects to the color module through an outlet port. The outlet port is surrounded by a face seal o-ring (EO9999-200-003C)

Caution: It is crucial to the operation of the SolvAir valve that the solvent inlet pressure is at least 10 PSI higher than the air inlet Pressure or the unit will not work properly and result color carry-over or high voltage faults.

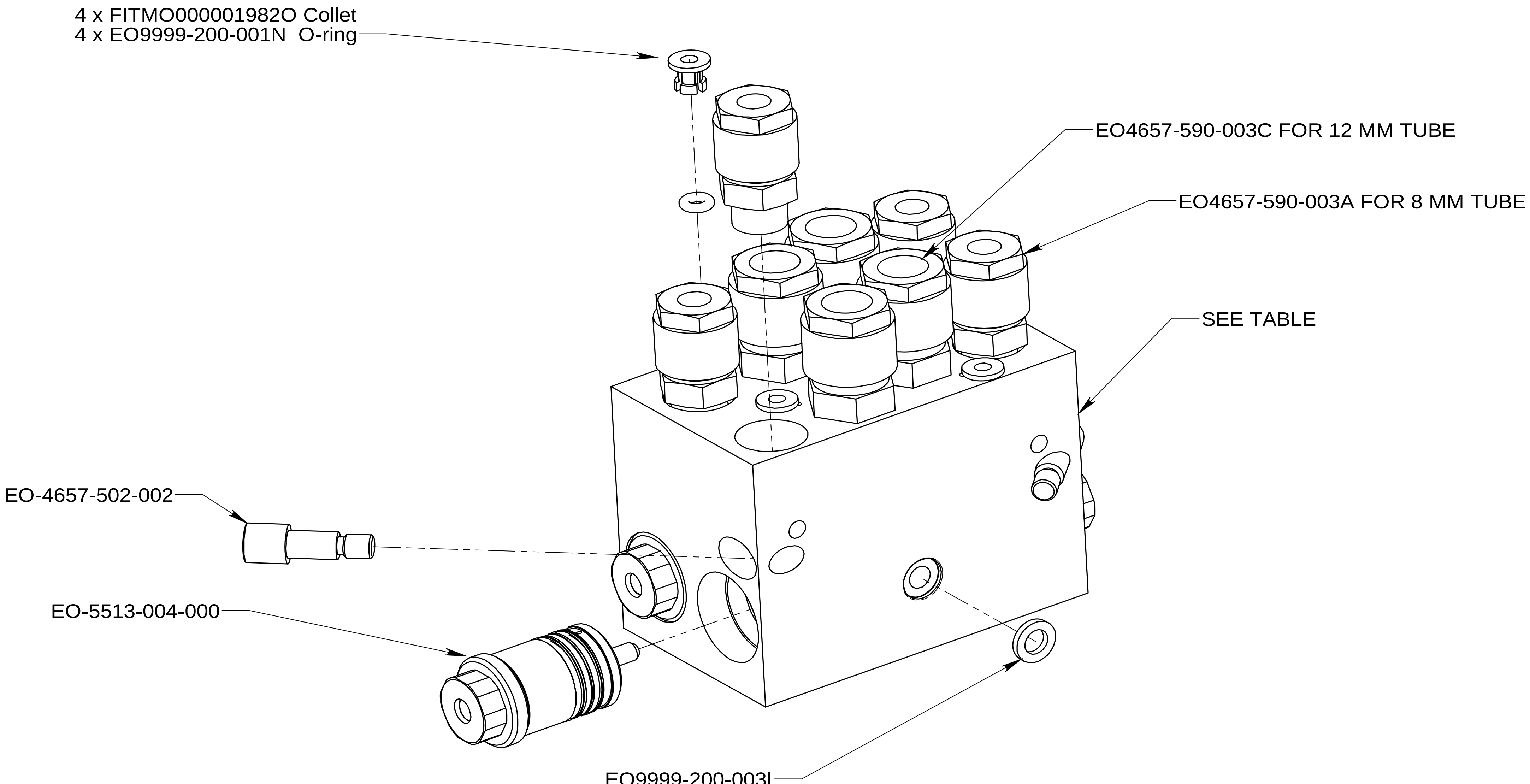
10.2.2 Color Module - Recirculating

Figure 10-3 EO-4657-590-000, WB COLOR SLICE

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



FANUC PART NO.	KATES PART NO.	DESCRIPTION
EO4657-590-000A	FR41	6 MM THRU PORT, W-FITTINGS, VALVES, FASTENERS, and GASKETS
EO4657-590-000B	FR45	6 MM THRU PORT, W- VALVES, FASTENERS, GASKETS, NO FITTINGS

[EO-4657-590-000]
WB COLOR SLICE

REV *2
SHEET 1 OF 1

The Color Module (EO4657-590-000A) is the point where the paint enters the Canister color system. It consists of 4 air piloted paint valves. Air pilots the valves to open, and a spring closes the valve shut. The valves that are used are EO-5513-004-000.

Each color valve has a supply and return paint circulation line, connected by a plastic fitting. The Supply line uses a 12mm plastic fitting (FITCO000001365O), and the return line uses an 8mm plastic fitting (FITCO000001371O). Install the hex fittings flush to block face.

The color block does not connect to the arm. Instead the color block connects to the adjacent blocks using 2 screws (EO-4657-502-002) with a 6mm Allen wrench. The fluid passage connects to the adjacent block with an outlet surrounded by a face seal o-ring (EO9999-200-003C)

Depending on the number of colors being used, the following block could be another recirculating Color Module or an end block if no more colors are being used.

10.2.3 Non-Recirculating Color Module

Figure 10-4 EO-4657-590-006, KATES FR60 NON RECIRC VALVE

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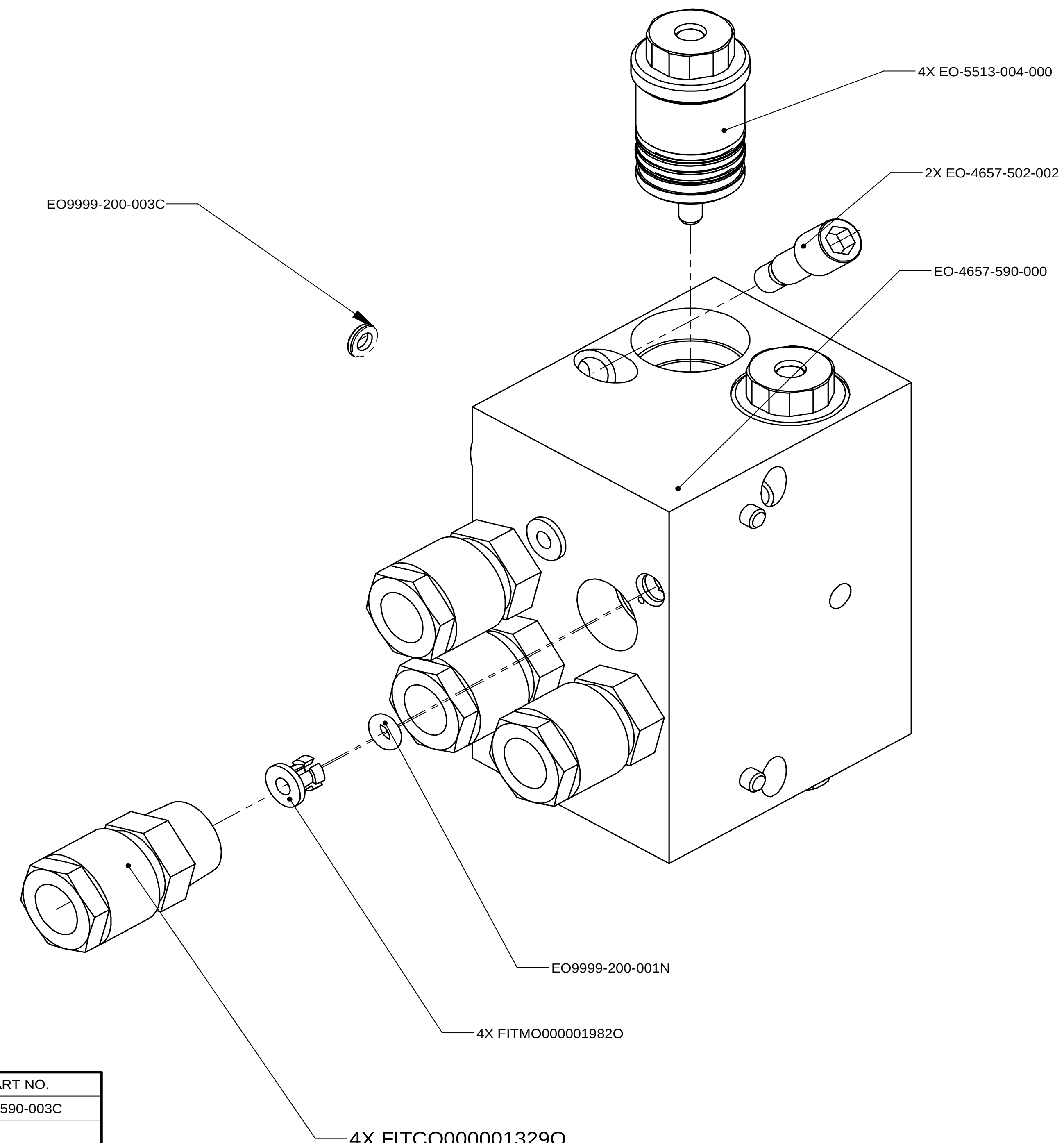
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



NOTES:
1. VENDOR CONTROL DRAWING
2. SUPPLIER: W.A. KATES
3. SEE TABLE FOR KATES PART NUMBER
4. THIS ASSMBLY INCLUDES COMPONENTS AS SHOWN AND AS LISTED IN TABLE
5. MARK BLOCK WITH "EO4657-590-006B" DO NOT INCLUDE REVISION NUMBER.
6. SHIPPING BOX MUST SHOW CORRECT PART NUMBER AND REVISION LETTER.

FANUC PART NO.	KATES PART NO.	DESCRIPTION	FITTING PART NO.
EO4657-590-006A	FR60	6 MM THRU PORT, W-FITTINGS	12/9:EO4657-590-003C
EO4657-590-006B	FR61	6 MM THRU PORT, NO FITTINGS	
			-

[EO-4657-590-006] REV C1
KATES FR60 NON RECIRC VALVE SHEET 1 OF 1

The Color Module (EO4657-590-006A) is the point where the paint enters the Canister color system. It consists of 4 air piloted paint valves. Air pilots the valves to open, and a spring closes the valve shut. The valves that are used are EO-5513-004-000.

Each color valve has a supply paint circulation line, connected by a plastic fitting (FITCO000001365O). Install the hex fittings flush to block face.

The color block connects to the following block using 2 screws (EO-4657-502-002) with a 6mm Allen wrench. The fluid line connects to the following block with an outlet surrounded by a face seal o-ring (EO9999-200-003C)

Depending on the number of colors being used, the following block could be another non circulating Color Module or a pressure regulator if no more colors are being used.

10.2.4 End Block

The End block is located at the bottom of the color valve assembly and routes the paint flow to the canister manifold.

10.2.5 Maintenance and Repair

Figure 10-5 ET-5093-890-006 Sheet 1 of 2, P700 1K PM SCHEDULES

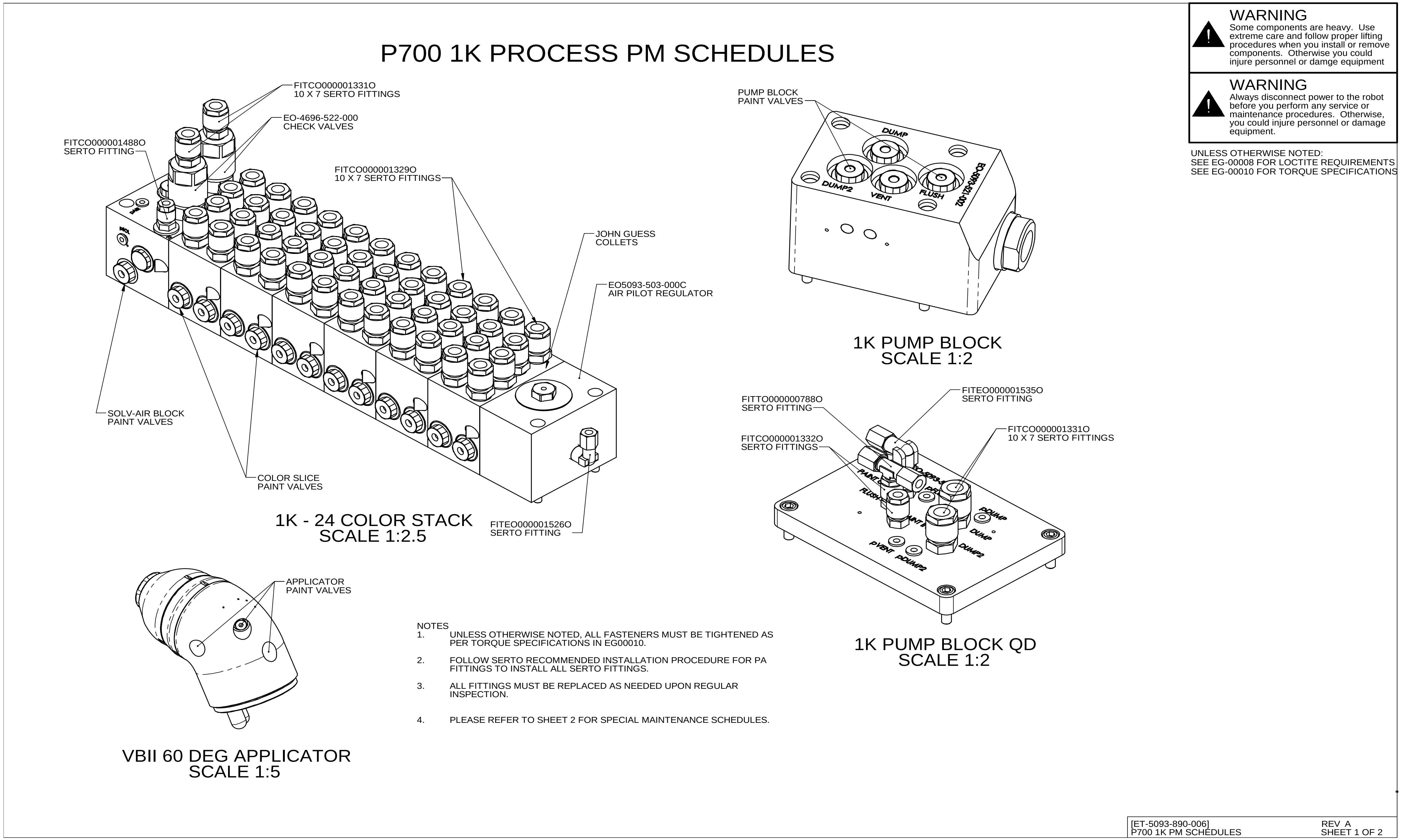


Figure 10-6 ET-5093-890-006 Sheet 2 of 2, P700 1K PM SCHEDULES

PAINT VALVES - GENERAL MAINTENANCE GUIDLINES
1. INSPECT ALL PAINT VALVES DURING WEEKLY MAINTENANCE FOR LEAKS AND/OR MALFUNCTION.
2. PAINT VALVE IS NOT FIELD SERVICEABLE UNIT.
3. PAINT VALVE MUST BE REPLACED AS A WHOLE.
4. REPLACE A DAMAGED VALEVE WITH A NEW VALVE.
5. DISCARD DAMAGED PAINT VALVES PROMPTLY - DO NOT STORE THEM.
6. LIFE OF A PAINT VALVE UNDER NORMAL OPERATION IS 2,000,000 (TWO MILLION) CYCLES.
7. REPLACE PAINT VALVES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT VALVE LOCATION	AVG CYCLES PER JOB	REPLACE AFTER HOURS IN USE	NO. OF YEARS WITH ONE 10HR SHIFT	NO. OF YEARS WITH TWO 10HR SHIFTS
COLOR STACK	1	30,000	10 YRS 2 QTRS	5 YRS 1 QTR
SOLV-AIR BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS
PUMP BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS
APPLICATOR	3	10,000	3 YRS 2 QTRS	1 YR 3 QTR

HOSES - GENERAL MAINTENANCE GUIDLINES

1. INSPECT ALL HOSES DURING WEEKLY MAINTENACE.
2. MAKE SURE THAT THERE IS NO FLUID OF ANY KIND IN AIR PILOT HOSES.
3. REPLACE DAMAGED OR FAULTY HOSES AS NEEDED.
4. REPLACE HOSE ALONG WITH FITTINGS AT BOTH ENDS.
5. REPLACE HOSES ACCORDING TO THE FOLLOWING SCHEDULE:

   PAINT SUPPLY HOSES - FROM PAINT DROP TO COLOR STACK - ANNUAL
   SOLVENT AND AIR SUPPLY HOSES - ANNUAL
   PILOT HOSES ON INNER ARM - ANNUAL
   WASH LINE - FROM SOLV AIR BLOCK TO PUMP BLOCK - ANNUAL
   PAINT-IN LINE - FROM REGULATOR TO PUMP BLOCK - ANNUAL
   HOSE BUNDLE - EO-5093-545-000 ASSEMBLY - 6 MONTHS

SERTO FITTINGS AND JOHN GUESS COLLETS
1. INSPECT ALL FITTINGS DURING WEEKLY MAINTENANCE.
2. ALL FITTINGS MUST BE REPLACED AS NEEDED UPON REGULAR INSPECTION.
3. DISCARD THE REPLACED FITTINGS - DO NOT STORE THEM.

OTHER PARTS MAINTENANCE SCHEDULE
1. CHECK VALVES - ANNUAL
2. PRESSURE SENSOR - AS NEEDED
3. 3CC GEAR PUMP - REFER TO GEAR PUMP MAINTENANCE (ET-5093-890-007)

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

[ET-5093-890-006] REV A
P700 1K PM SCHEDULES SHEET 2 OF 2

Figure 10-7 EO-4657-590-003, BSPP Fitting

* SEE CHART

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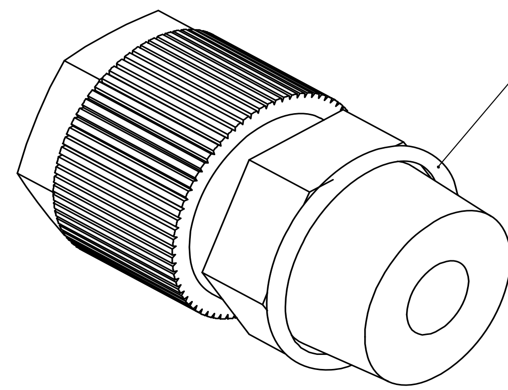
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



PART NUMBER	DESCRIPTION	TUBE SIZE	WAKates #
EO4657-590-003A	BSPP Fitting for 6 MM x 8 MM Hose	8 x 6 MM	FR50-1
EO4657-590-003B	BSPP Fitting for 10 MM x 7 MM Hose	10 x 7 MM	FR50-2
EO4657-590-003C	BSPP Fitting for 12 MM x 9 MM Hose	12 x 9 MM	FR50-3

[EO-4657-590-003] REV *2
BSPP Fitting SHEET 1 OF 1

1. Inspect all paint valves during weekly maintenance for leaks and/or malfunction, using procedures found in EB-03516.
2. The paint valve is not a field serviceable unit.
3. Paint valves must be replaced as a whole.

4. Replaced a damaged valve with a new valve.
5. Discard damaged paint valves promptly – do not store them.
6. Life of a paint valve under normal operation is 2,000,000 cycles.
7. Replace paint valves according to the following schedule from ET-5093-890-006 using procedures found in EB-03516.

Paint Valve Location	Avg Cycles per Job	Replace after hours in use.	No.of years with 1 hour shift	No. of years with 2 hour shift
Color Stack	1	30000	10 YRS 2 QTRS	5 YRS 1 QTR
Solv-Air Block	2	15000	5 YRS 1 QTR	2 YRS 2 QTR
Pump Block	2	15000	5 YRS 1 QTR	2 YRS 2 QTR
Applicator	3	10000	3 YRS 2 QTRS	1 YR 3 QTR

Table 10-1: Wear part replacement schedule

10.2.6 SolvAir Module

1. Replace valves in the SolvAir Module after 15,000 hours in use.

2. Replace check valves annually, as suggested in ET-5093-890-006.

10.2.7 Color Module

1. Inspect color module and valves during weekly maintenance.

2. Replace valves in color module after 30,000 hours in use.

3. Turn off all paint and solvent supplies to the color changer manifold. Relieve all potentially entrapped paint, solvent, or air pressure in the system undergoing maintenance.

4. Inspect valves for fresh fluid in the weep holes.

5. Disconnect pilot lines.

6. Remove the paint valve in question. Use the color valve tool EO-5513-700-003 or a 17mm wrench and grasp the hex head surfaces of the valve.

7. It may be necessary to remove paint lines in order to clean valve socket.

8. Clean the interior of the valve socket with solvent. Inspect the stainless steel valve seat for any damage.

9. Thoroughly clean valve socket and pilot passage before installing valve.

10. Discard the damaged valve and replace with a new one. Insure that the new valve is seated properly by observing the stem of the actuator. It should be flush with the top of the valve. If the valve is over tightened the stem will be protruding from the top of the valve. If the stem is recessed into the valve, the valve is not tightened sufficiently.

11. Turn off all paint and solvent supplies to the color changer manifold. Relieve all potentially entrapped paint, solvent, or air pressure in the system undergoing maintenance.

12. Inspect valves for fluid in the weep holes.

13. Disconnect pilot lines.

14. Remove the paint valve in question. Use the color valve tool EO-5513-700-003 or a 17mm wrench and grasp the hex head surfaces of the valve.

15. Clean the interior of the valve path with solvent. Inspect the stainless steel valve seat for any scarring or deformation.

16. Thoroughly clean valve socket before installing valve.

17. Discard the damaged valve and replace with a new one. Insure that the new valve is seated properly by observing the stem of the actuator. It should be flush with the top of the valve. If the valve is overtightened the stem will be protruding from the top of the valve. If the stem is recessed into the valve, the valve is not tightened sufficiently.

10.3 Troubleshooting

10.3.1 SolvAir Module

If no SolvAir is produced when requested check the following items:

1. Verify that the SOL, AIR, and 2T valves actuate by observing the valve poppets. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

2. Verify that the solvent pressure is at least 10 PSI above supply air pressure.

10.3.2 Color Module

Typically only two problems arise with this color valve:

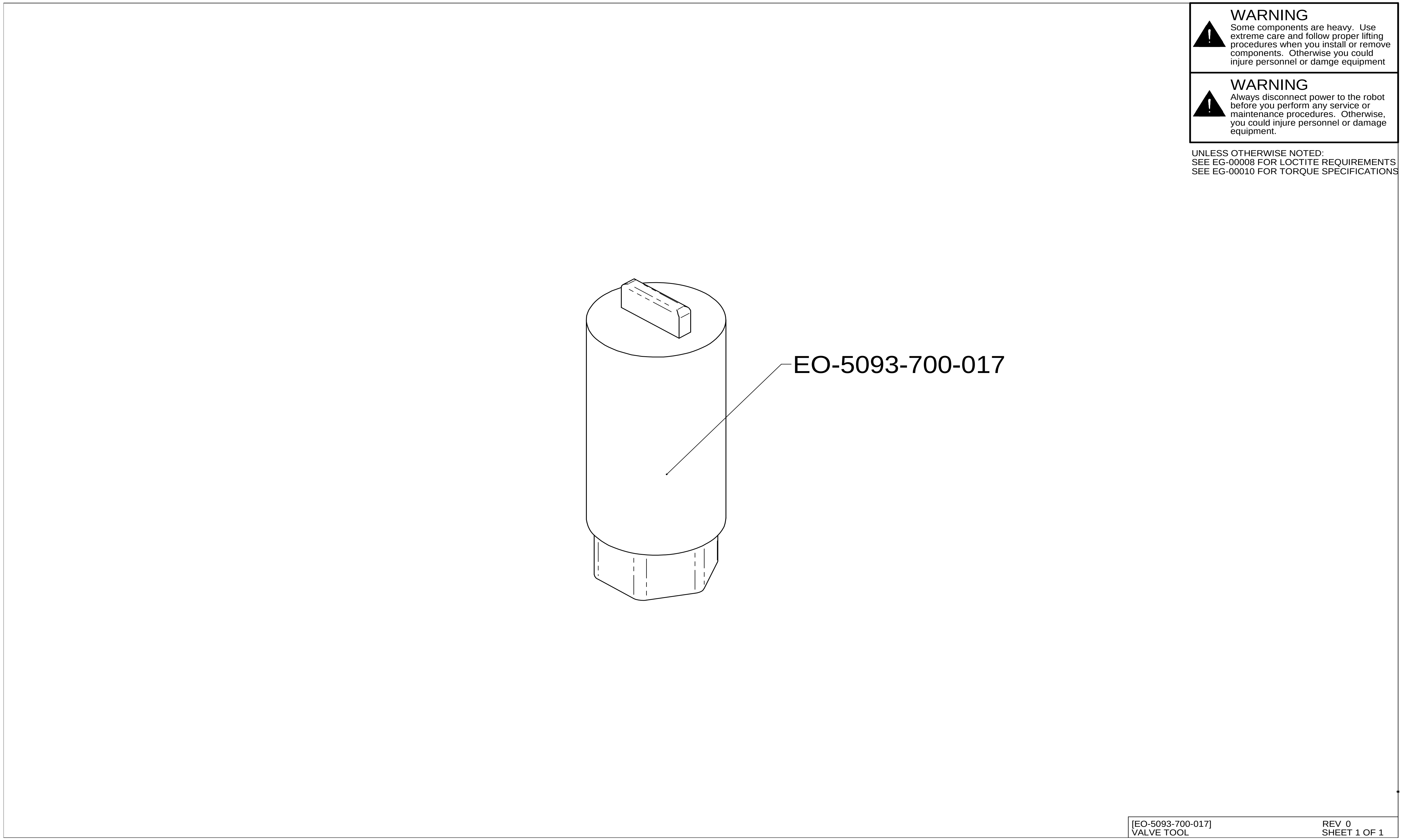
1. Leakage out the weep port or through a worn valve that is not seating properly. If leakage is observed, replace the worn valve using procedures found in EB-03516.

2. Improper actuation: This can be observed by viewing the stem of the valve poppet actuator. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

10.4 Spare Parts and Tools

Figure 10-8 EO-5093-700-005, FITTING WRENCH

Figure 10-9 EO-5093-700-017, VALVE TOOL



11 COLOR CHANGER – IPC

11.1 Overview

Figure 11-1 EO-5093-510-001 Sheet 1 of 2, 1K COLOR STACK ARM ASM

1K COLOR STACK ASSEMBLY WITH RECIRCULATING COLOR SLICE

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
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UNLESS OTHERWISE NOTED:
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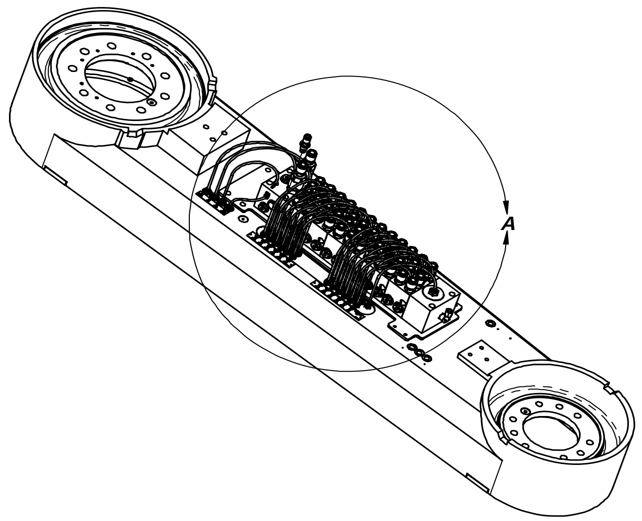
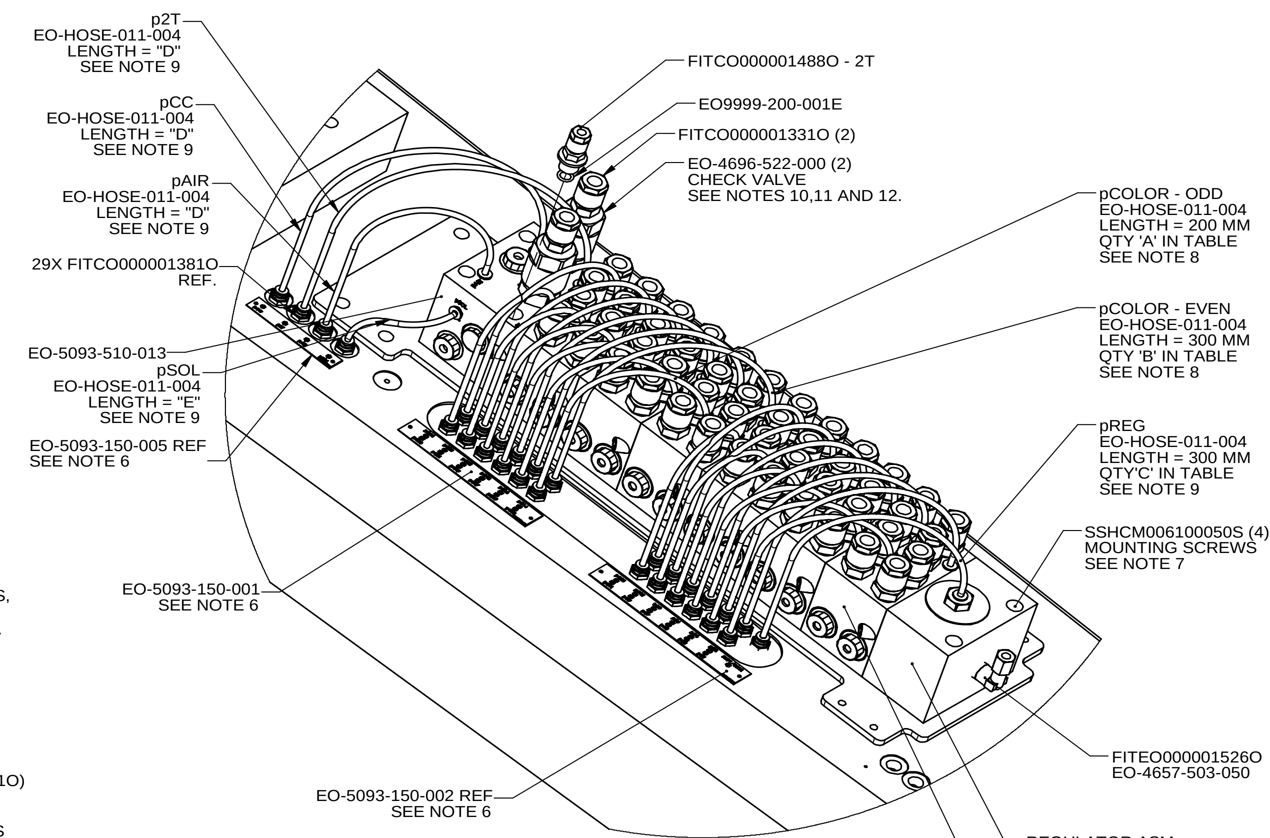
SEE EG-00010 FOR TORQUE SPECIFICATIONS





DETAIL A
SCALE 1 : 4

NOTES:

1. 1K COLOR STACK ASM SHOWN WITH RECIRCULATING COLOR SLICES, 24 COLORS AND AIR PILOT REGULATOR.
2. COLOR STACK ASM. AVAILABLE WITH 4, 8, 12, 16, 20 AND 24 COLORS. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
3. THREE REGULATORS AVAILABLE. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
4. COLOR PILOT LINE - ODD: (2) PER COLOR SLICE
5. COLOR PILOT LINE - EVEN: (2) PER COLOR SLICE
6. TAG KIT: EO-5093-150-004 INCLUDES REQUIRED TAGS
7. PLACE THESE SCREWS IN A PLASTIC BAG AND TYRAP TO COLOR STACK ASSEMBLY FOR LATER USE.
8. CAP BUNDLES OF (4) PILOT LINES WITH HOSE CAP (CAPMO000000101O)
9. CAP 4mm LINES WITH HOSE CAP (CAPMO000000098O)
10. USE TEFLON TAPE (TAPEO000000003O) ON 3/8 MALE NPT OF CHECK VALVE. DO NOT PUT TEFLON TAPE ON THE 1ST 3 LEADING THREADS OF THE MALE NPT.
11. USE TEFLON TAPE (TAPEO000000003O) ON 1/4 MALE NPT OF SERTO FITTING(s) FOR CHECK VALVE. DO NOTE PUT TEFLON TAPE ON THE 1ST 3 THREADS OF THE MALE NPT.
12. DO NOT USE LARGE HEX TO TIGHTEN CHECKVALVE. SEE EG-OO492.

510 Assembly No.	Description	Regulator Type	Regulator Part No.	# of colors	# of Color Slices (EO4657-502-000C)	QTY 'A'	QTY 'B'	QTY 'C'	Length 'D' mm	Length 'E' mm
EO5093-510-001A	1K CC ASM: Rec,vReg,4 clr	Air Pilot	EO5093-503-000C	4	1	2	2	1	580	400
EO5093-510-001B	1K CC ASM: Rec,vReg,8 clr	Air Pilot	EO5093-503-000C	8	2	4	4	1	524	344
EO5093-510-001C	1K CC ASM: Rec,vReg,12 clr	Air Pilot	EO5093-503-000C	12	3	6	6	1	468	288
EO5093-510-001D	1K CC ASM: Rec,vReg,16 clr	Air Pilot	EO5093-503-000C	16	4	8	8	1	412	232
EO5093-510-001E	1K CC ASM: Rec,vReg,20 clr	Air Pilot	EO5093-503-000C	20	5	10	10	1	356	176
EO5093-510-001F	1K CC ASM: Rec,vReg,24 clr	Air Pilot	EO5093-503-000C	24	6	12	12	1	300	120
EO5093-510-001N	1K CC ASM: Rec,15psi Reg,4 clr	15 psi fixed	EO5093-503-000A	4	1	2	2	0	580	400
EO5093-510-001P	1K CC ASM: Rec,15psi Reg,8 clr	15 psi fixed	EO5093-503-000A	8	2	4	4	0	524	344
EO5093-510-001Q	1K CC ASM: Rec,15psi Reg,12 clr	15 psi fixed	EO5093-503-000A	12	3	6	6	0	468	288
EO5093-510-001R	1K CC ASM: Rec,15psi Reg,16 clr	15 psi fixed	EO5093-503-000A	16	4	8	8	0	412	232
EO5093-510-001S	1K CC ASM: Rec,15psi Reg,20 clr	15 psi fixed	EO5093-503-000A	20	5	10	10	0	356	176
EO5093-510-001T	1K CC ASM: Rec,15psi Reg,24 clr	15 psi fixed	EO5093-503-000A	24	6	12	12	0	300	120
EO5093-510-001AA	1K CC ASM: Rec,30psi Reg,4 clr	30 psi fixed	EO5093-503-000B	4	1	2	2	0	580	400
EO5093-510-001AB	1K CC ASM: Rec,30psi Reg,8 clr	30 psi fixed	EO5093-503-000B	8	2	4	4	0	524	344
EO5093-510-001AC	1K CC ASM: Rec,30psi Reg,12 clr	30 psi fixed	EO5093-503-000B	12	3	6	6	0	468	288
EO5093-510-001AD	1K CC ASM: Rec,30psi Reg,16 clr	30 psi fixed	EO5093-503-000B	16	4	8	8	0	412	232
EO5093-510-001AE	1K CC ASM: Rec,30psi Reg,20 clr	30 psi fixed	EO5093-503-000B	20	5	10	10	0	356	176
EO5093-510-001AF	1K CC ASM: Rec,30psi Reg,24 clr	30 psi fixed	EO5093-503-000B	24	6	12	12	0	300	120

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100050S	M6 X 1.0 X 50mm LG. Stainless Steel Socket Head Cap

[EO-5093-510-001] REV *12
1K COLOR STACK ARM ASM SHEET 1 OF 2

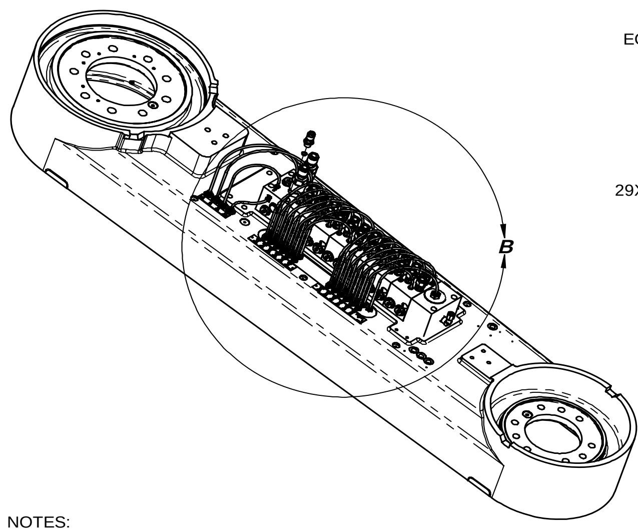
Figure 11-2 EO-5093-510-001 Sheet 2 of 2, 1K COLOR STACK ARM ASM

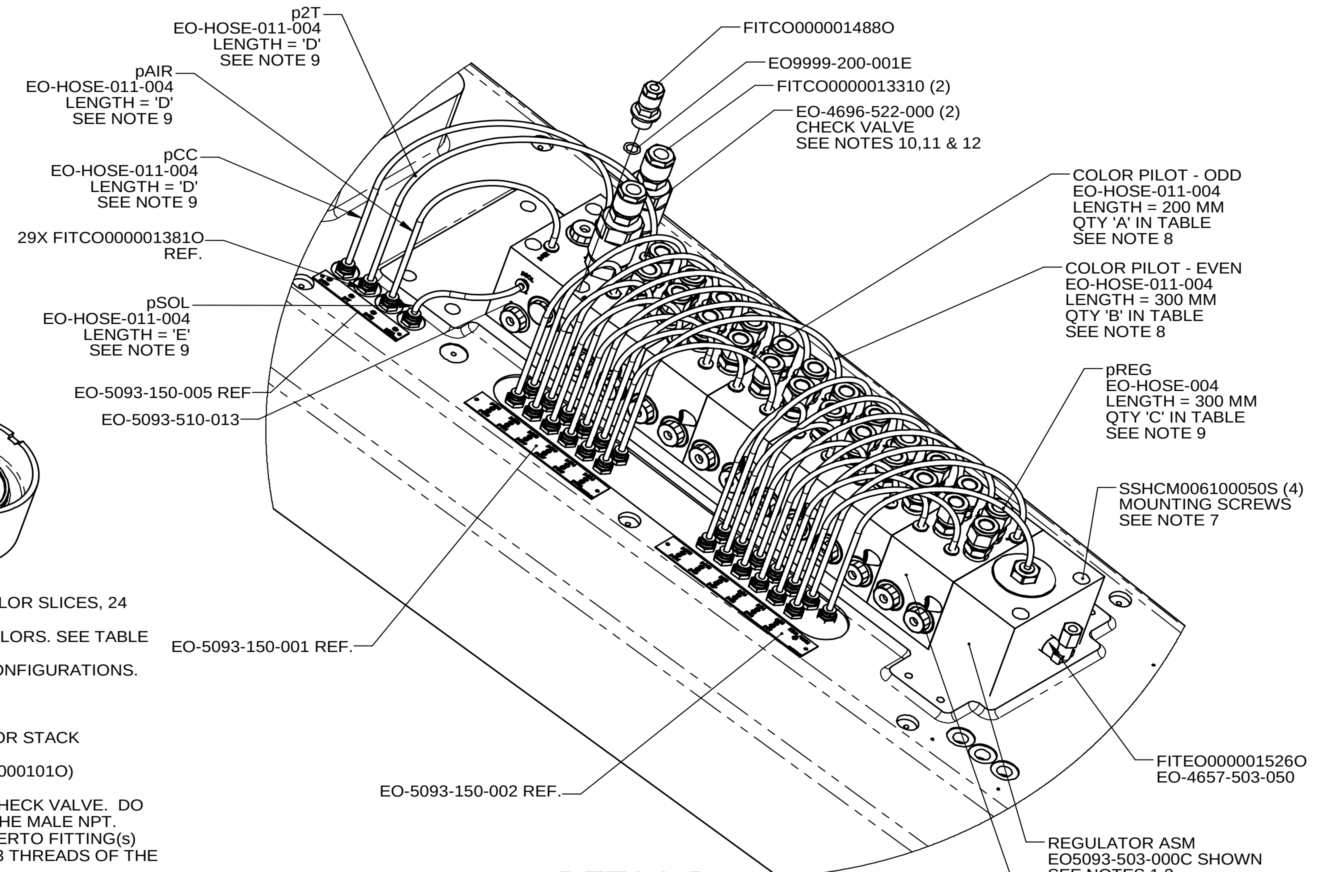
1K COLOR STACK ASSEMBLY WITH NON-RECIRCULATING COLOR SLICE

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





DETAIL B
SCALE 1 : 4

NOTES:

1. 1K COLOR STACK ASM SHOWN WITH NON-RECIRCULATING COLOR SLICES, 24 COLORS AND AIR PILOT REGULATOR.
2. COLOR STACK ASM. AVAILABLE WITH 4, 8, 12, 16, 20 AND 24 COLORS. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
3. THREE REGULATORS AVAILABLE. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
4. COLOR PILOT LINE - ODD: (2) PER COLOR SLICE
5. COLOR PILOT LINE - EVEN: (2) PER COLOR SLICE
6. TAG KIT: EO-5093-150-004 INCLUDES REQUIRED TAGS
7. PLACE THESE SCREWS IN A PLASTIC BAG AND TYRAP TO COLOR STACK ASSEMBLY FOR LATER USE.
8. CAP BUNDLES OF (4) PILOT LINES WITH HOSE CAP (CAPMO000000101O)
9. CAP 4mm LINES WITH HOSE CAP (CAPMO000000098O)
10. USE TEFLON TAPE (TAPEO000000003O) ON 3/8 MALE NPT OF CHECK VALVE. DO NOT PUT TEFLON TAPE ON THE 1ST 3 LEADING THREADS OF THE MALE NPT.
11. USE TEFLON TAPE (TAPEO000000003O) ON 1/4 MALE NPT OF SERTO FITTING(s) FOR CHECK VALVE. DO NOTE PUT TEFLON TAPE ON THE 1ST 3 THREADS OF THE MALE NPT.
12. DO NOT USE LARGE HEX TO TIGHTEN CHECKVALVE. SEE EG-00492.

510 Assembly No.	Description	Regulator Type	Regulator Part No.	# of colors	# of Color Slices (EO4657-505-000C)	QTY 'A'	QTY 'B'	QTY 'C'	Length 'D' mm	Length 'E' mm
EO5093-510-001G	1K CC ASM: NRec,vReg,4 clr	Air Pilot	EO5093-503-000C	4	1	2	2	1	580	400
EO5093-510-001H	1K CC ASM: NRec,vReg,8 clr	Air Pilot	EO5093-503-000C	8	2	4	4	1	524	344
EO5093-510-001J	1K CC ASM: NRec,vReg,12 clr	Air Pilot	EO5093-503-000C	12	3	6	6	1	468	288
EO5093-510-001K	1K CC ASM: NRec,vReg,16 clr	Air Pilot	EO5093-503-000C	16	4	8	8	1	412	232
EO5093-510-001L	1K CC ASM: NRec,vReg,20 clr	Air Pilot	EO5093-503-000C	20	5	10	10	1	356	176
EO5093-510-001M	1K CC ASM: NRec,vReg,24 clr	Air Pilot	EO5093-503-000C	24	6	12	12	1	300	120
EO5093-510-001U	1K CC ASM: NRec,15psi Reg,4 clr	15 psi fixed	EO5093-503-000A	4	1	2	2	0	580	400
EO5093-510-001V	1K CC ASM: NRec,15psi Reg,8 clr	15 psi fixed	EO5093-503-000A	8	2	4	4	0	524	344
EO5093-510-001W	1K CC ASM: NRec,15psi Reg,12 clr	15 psi fixed	EO5093-503-000A	12	3	6	6	0	468	288
EO5093-510-001X	1K CC ASM: NRec,15psi Reg,16 clr	15 psi fixed	EO5093-503-000A	16	4	8	8	0	412	232
EO5093-510-001Y	1K CC ASM: NRec,15psi Reg,20 clr	15 psi fixed	EO5093-503-000A	20	5	10	10	0	356	176
EO5093-510-001Z	1K CC ASM: NRec,15psi Reg,24 clr	15 psi fixed	EO5093-503-000A	24	6	12	12	0	300	120
EO5093-510-001AG	1K CC ASM: NRec,30psi Reg,4 clr	30 psi fixed	EO5093-503-000B	4	1	2	2	0	580	400
EO5093-510-001AH	1K CC ASM: NRec,30psi Reg,8 clr	30 psi fixed	EO5093-503-000B	8	2	4	4	0	524	344
EO5093-510-001AJ	1K CC ASM: NRec,30psi Reg,12 clr	30 psi fixed	EO5093-503-000B	12	3	6	6	0	468	288
EO5093-510-001AK	1K CC ASM: NRec,30psi Reg,16 clr	30 psi fixed	EO5093-503-000B	16	4	8	8	0	412	232
EO5093-510-001AL	1K CC ASM: NRec,30psi Reg,20 clr	30 psi fixed	EO5093-503-000B	20	5	10	10	0	356	176
EO5093-510-001AM	1K CC ASM: NRec,30psi Reg,24 clr	30 psi fixed	EO5093-503-000B	24	6	12	12	0	300	120

[EO-5093-510-001] REV *12
1K COLOR STACK ARM ASM SHEET 2 OF 2

The color changer enables the robot to switch between colors without color contamination, and provides a cleaning function to clean the paint lines from the color changer through the applicator. The Color Changer consists of the SolvAir module, at least one color module, and a pressure regulator.

11.2 Operations and Setup

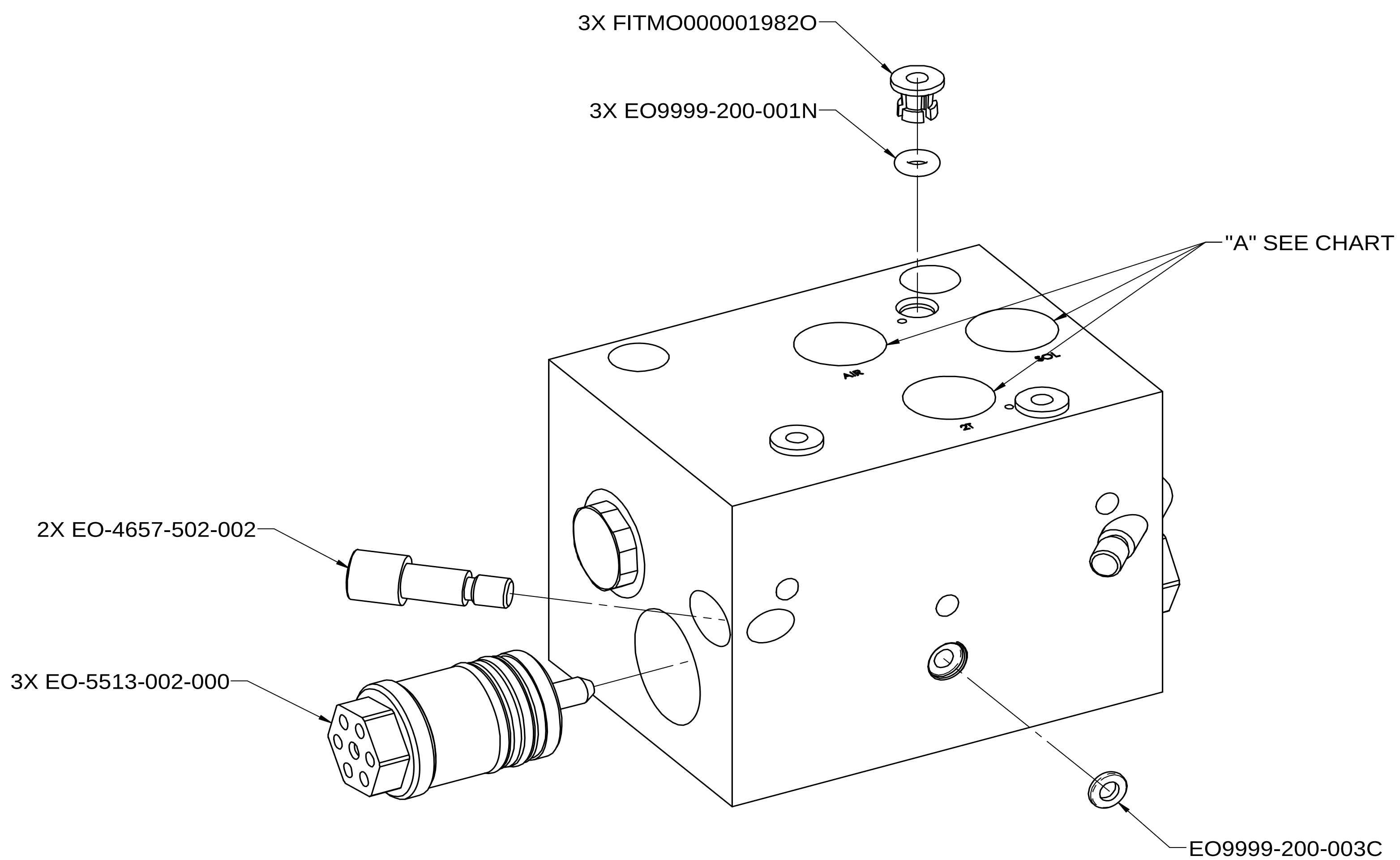
11.2.1 SolvAir Module

Figure 11-3 EO-4657-501-000, SOLV/AIR 3 VALVE 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 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



NOTES:

1. SEE EB-03516 FOR PROPER VALVE INSTALLATION
2. FITTING COMES WITH COLLET, CARTRIDGE, AND O-RING. DO NOT USE THE CARTRIDGE AND O-RING.
3. LUBRICATE O-RINGS WITH A THIN COAT OF DIELECTRIC GREASE (EO-4526-050-009) PRIOR TO INSTALLATION

FANUC ASSEMBLY NO.	DESCRIPTION	"A" SIZE
EO4657-501-000A	3/8 NPT SOLVAIR BLOCK	3/8 NPT
EO4657-501-000D	3/8 BSPT SOLVAIR BLOCK	3/8 BSPT

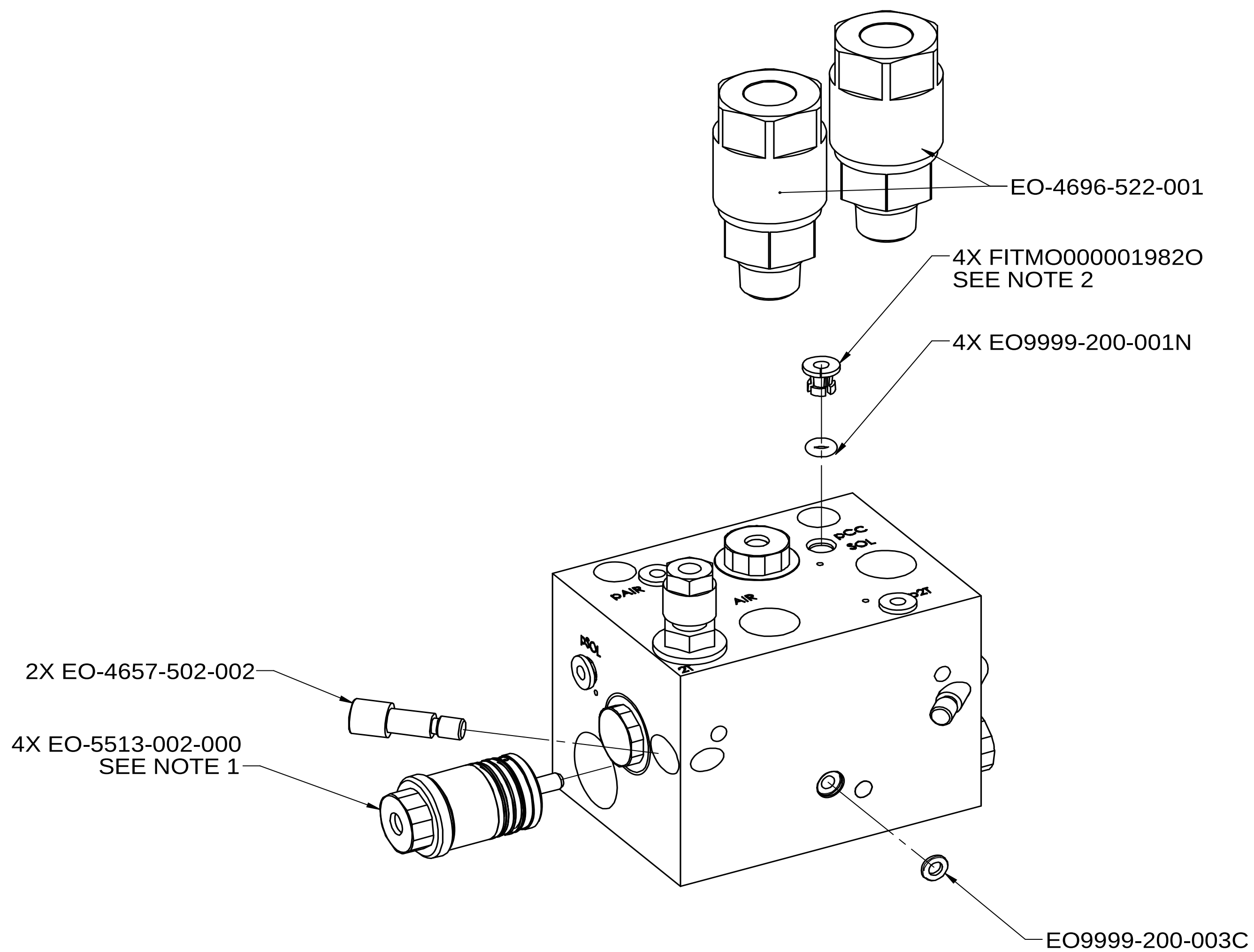
[EO-4657-501-000] REV *6
SOLV/AIR 3 VALVE ASM SHEET 1 OF 1

Figure 11-4 EO-5093-510-013, SOLV/AIR 4VALVE 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 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



NOTES:

1. SEE EB-03516 FOR PROPER VALVE INSTALLATION
2. FITTING COMES WITH COLLET, CARTRIDGE, AND O-RING. DO NOT USE THE CARTRIDGE AND O-RING.
3. LUBRICATE O-RINGS WITH A THIN COAT OF DIELECTRIC GREASE (EO-4526-050-009) PRIOR TO INSTALLATION

[EO-5093-510-013] REV B1
SOLV/AIR 4VALVE ASM SHEET 1 OF 1

This module allows purge solvent and purge air to be simultaneously delivered to the Color Changer. This mechanical feature eliminates the need for added programming steps typically alternating the SOL valve and then an air valve several times during a color change cleanout cycle. A secondary outlet, 2T is used for routing solvent, air, or aerated SolvAir mix to the applicator.

SolvAir solvent regulator flow rates:

SG = 1.0 (water)
0.38 – 0.42 gpm = 24.0-26.5 cc/s

SG = 0.9
0.40 – 0.44 gpm = 25.3-27.9 cc/s

SG = 0.8 (Methyl Isobutyl Ketone)
0.42 – 0.47 gpm = 26.8-29.6 cc/s

The SolvAir module is located at the rear of the Color Changer. It consists of three or four paint valves (EO-5513-002-000) to control the air inlet, solvent inlet, and the 2T valve, along with the SolvAir endcap,

The SolvAir Module connects to the color module using 2 color manifold screws (EO-4657-502-002) using a 6mm allen wrench.

The SolvAir Module connects to the arm using 2 screws (SSHCM006100055G).

The paint valves screw into the SolvAir module using the Valve Tool as shown in the Special Tools Section. See EB-03516.

Caution: Do not remove Solv-Air flow control module.

The pilot lines for the AIR, SOL, CC, and 2T valves plug into fittings, FITMO0000001982O.

Two check valves (EO4696-522-000) are attached to the air inlet and solvent inlet ports.

The SolvAir module connects to the color module through an outlet port. The outlet port is surrounded by a face seal o-ring (EO9999-200-003C)

Caution: It is crucial to the operation of the SolvAir valve that the solvent inlet pressure is at least 10 PSI higher than the air inlet Pressure or the unit will not work properly and result in color carry-over or high voltage faults.

The pilot lines for the AIR, SOL, CC, 2T, SOL2, and DUMP3 valves plug into 5 fittings, FITMO0000001982O.

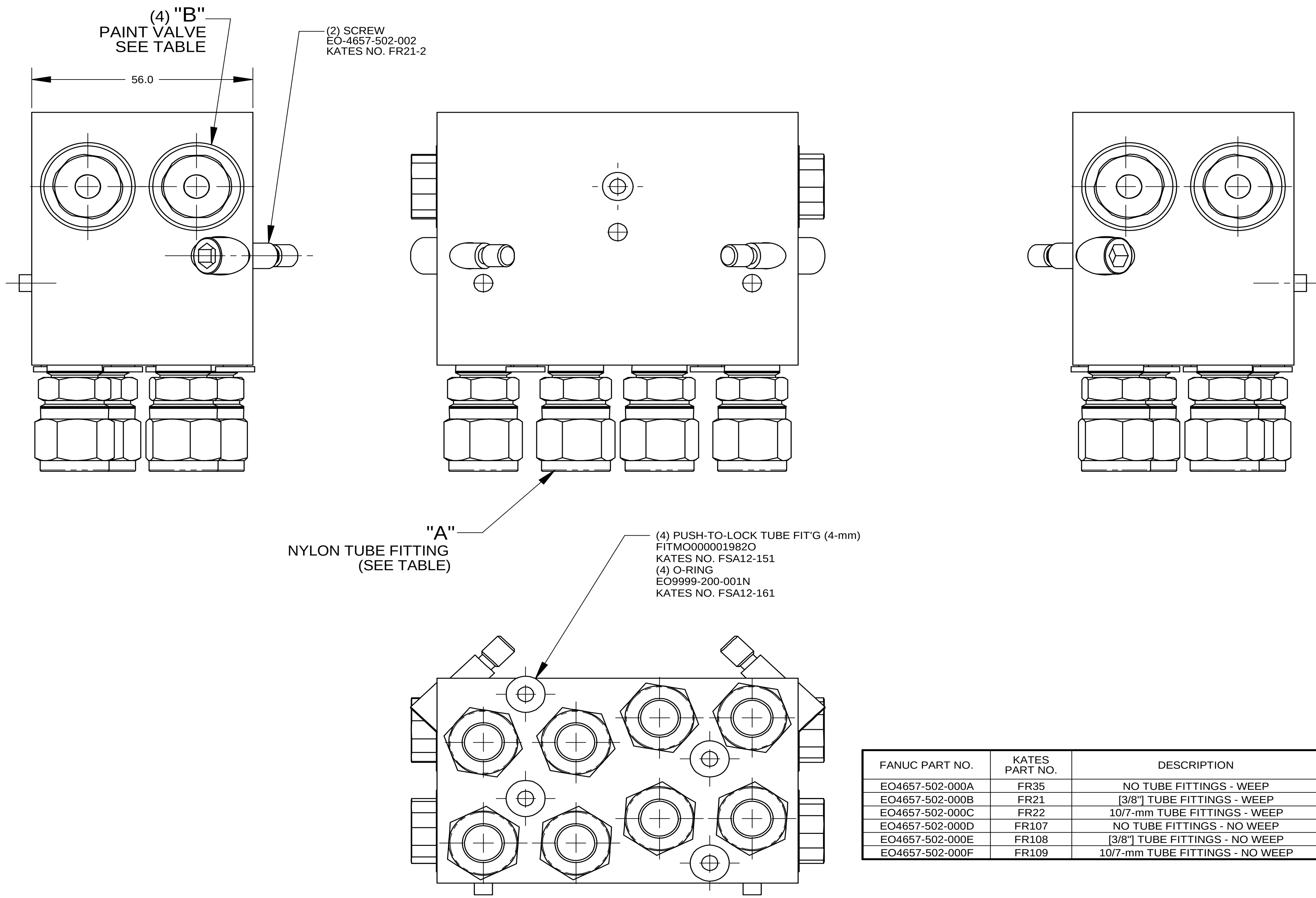
Check valves (EO4696-522-000) are attached to the air inlet and solvent inlet ports.

The SolvAir module connects to the color module through an outlet port. The outlet port is surrounded by a face seal o-ring (EO9999-200-003C)

Caution: It is crucial to the operation of the SolvAir valve that the solvent inlet pressure is at least 10 PSI higher than the air inlet Pressure or the unit will not work properly and result color carry-over or high voltage faults.

11.2.2 Color Module - Recirculating

Figure 11-5 EO-4657-502-000, COLOR MODULE



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

FANUC PART NO.	KATES PART NO.	DESCRIPTION	"A" FITTING PART NO.	"B" PAINT VALVE PART NO.
EO4657-502-000A	FR35	NO TUBE FITTINGS - WEEP	-	EO-5513-002-000
EO4657-502-000B	FR21	[3/8"] TUBE FITTINGS - WEEP	KATES SP7535 & SP7645	EO-5513-002-000
EO4657-502-000C	FR22	10/7-mm TUBE FITTINGS - WEEP	KATES SP7539	EO-5513-002-000
EO4657-502-000D	FR107	NO TUBE FITTINGS - NO WEEP	-	EO-5513-001-000
EO4657-502-000E	FR108	[3/8"] TUBE FITTINGS - NO WEEP	KATES SP7535 & SP7645	EO-5513-001-000
EO4657-502-000F	FR109	10/7-mm TUBE FITTINGS - NO WEEP	KATES SP7539	EO-5513-001-000

[EO-4657-502-000] COLOR MODULE REV *10 SHEET 1 OF 1

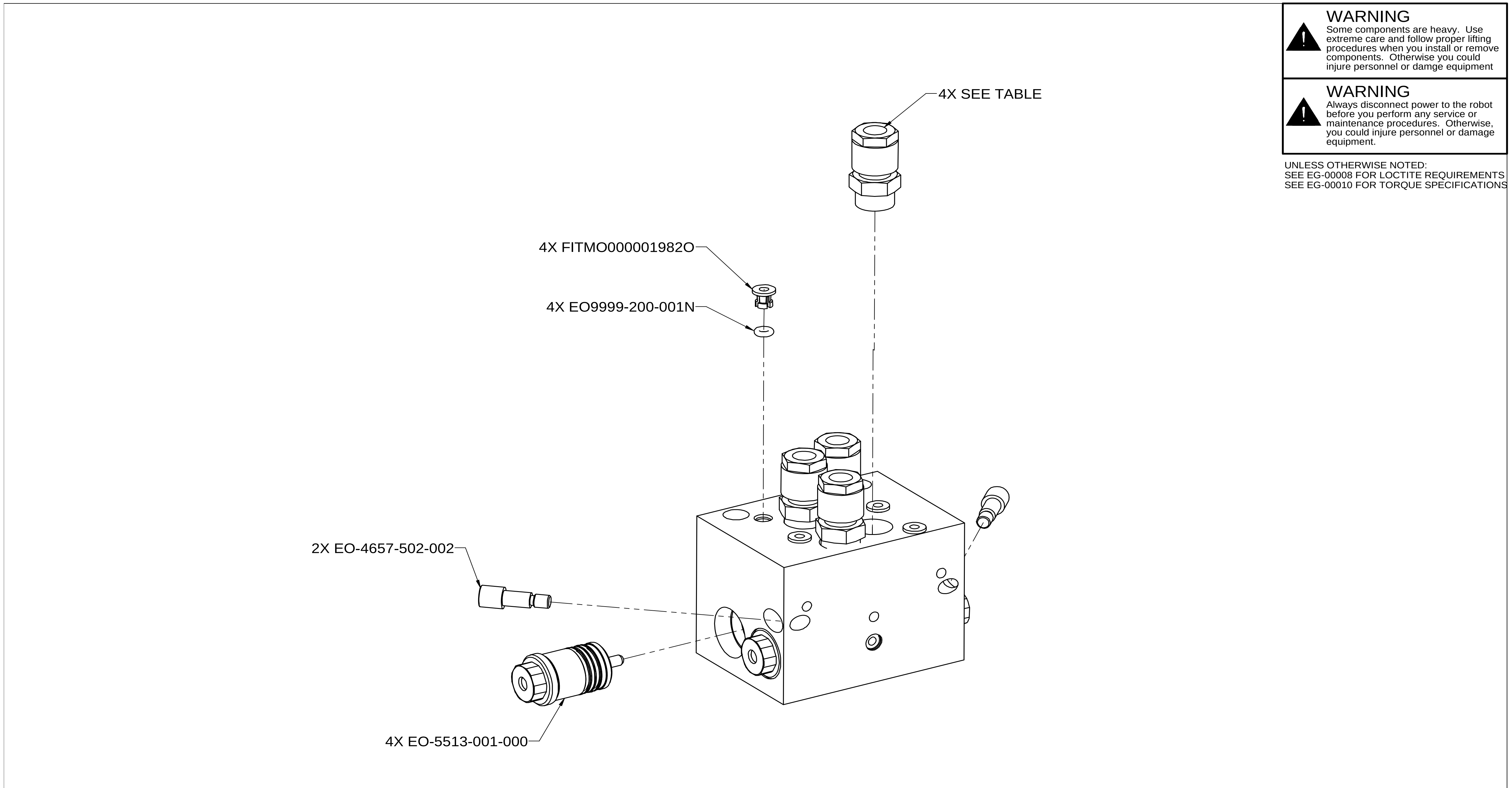
The circulating Color Module (EO-4657-502-000) is the point where the paint enters the IPC color system. It consists of 4 air piloted paint valves. Each color valve has a supply and return paint circulation line, connected by a fitting (FITCO0000013650). Install the plastic hex fittings flush to block face.

The color block connects to the adjacent block using 2 screws (EO-4657-502-002) with a 6mm Allen wrench. The fluid passage connects to the adjacent block with an outlet surrounded by a face seal o-ring (EO9999-200-003C)

Depending on the number of colors being used, the following block could be another recirculating Color Module, or a pressure regulator if no more colors are being used.

11.2.3 Non-Recirculating Color Module

Figure 11-6 EO-4657-504-000, NON-RECIRCULATING COLOR SLICE



FANUC PART NO.	DESCRIPTION	FITTING PART NO.
EO4657-504-000A	NO TUBE FITTINGS	-
EO4657-504-000B	[3/8"] TUBE FITTINGS (QTY: 4)	KATES SP7535 & SP7645
EO4657-504-000C	10/7-mm TUBE FITTINGS (QTY: 4)	KATES SP7539

The non circulating Color Module (EO-4657-504-000) is the point where the paint enters the IPC color system. It consists of 4 air piloted paint valves. Each color valve has a supply paint circulation line, connected by a plastic fitting (FITCO000001329O). Install the hex fittings flush to block face.

The color block connects to the adjacent block using 2 screws (EO-4657-502-002) with a 6mm allen wrench. The fluid passage connects to the adjacent block with an outlet surrounded by a face seal o-ring (EO9999-200-003C)

Depending on the number of colors being used, the following block could be another non circulating Color Module, or a pressure regulator if no more colors are being used.

11.2.4 Pressure Regulator

Figure 11-7 EO-5093-503-000, REGULATOR ASM

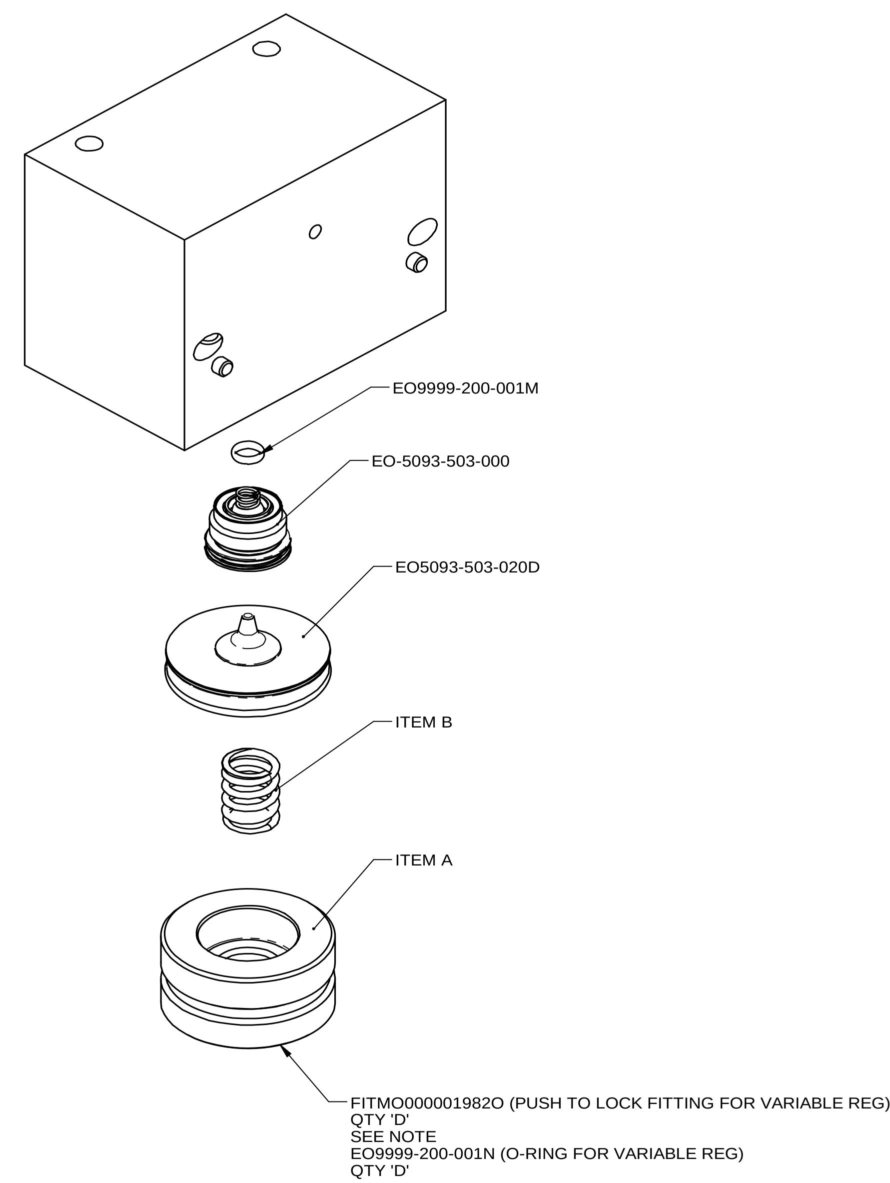
WARNING
Some components are heavy. Use extreme care and follow proper lifting procedures when you install or remove components. Otherwise you could injure personnel or damge equipment

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

NOTES:

1. THIS COMPONENT IS USED FOR PAINT DELIVERY. ALL INTERNAL PASSAGES MUST BE FREE OF DIRT, CUTTING FLUID, CHIPS, ETC. AND DRY BEFORE PACKAGING. ALL INTERNAL PASSAGES SHOULD BE PROTECTED (EITHER PLUGGED OR COVERED) DURING SHIPPING. NO SILICONES ARE TO BE USED FOR THE MANUFACTURING OF THIS PART AND MATERIAL SHOULD BE SILICONE FREE.
2. N/A
3. N/A
4. N/A
5. N/A.
6. ASSEMBLE THESE PARTS AS PER EG-00420
7. N/A
8. N/A



FOR REBUILDING THE REGULATOR USE THE FOLLOWING KITS:

Regulator Kit Part No	Description	Regulator type
EO5093-503-020A	Complete Rebuild Kit	15 PSI Fixed
EO5093-503-020B	Complete Rebuild Kit	30 PSI Fixed
EO5093-503-020C	Complete Rebuild Kit	Air Pilot
EO5093-503-020D	Soft Rebuild Kit	N/A

FANUC PART NO	DESCRIPTION	ITEM 'A'	ITEM 'B'	LABEL 'C'	QTY 'D'
EO5093-503-000A	15 PSI FIXED REGULATION	EO-5093-503-002	EO-5093-503-009	15	0
EO5093-503-000B	30 PSI FIXED REGULATION	EO-5093-503-002	EO-5093-503-012	30	0
EO5093-503-000C	VARIABLE REGULATION	EO-5093-503-013	<NONE>	<NONE>	1

[EO-5093-503-000] REGULATOR ASM REV *7 SHEET 1 OF 1

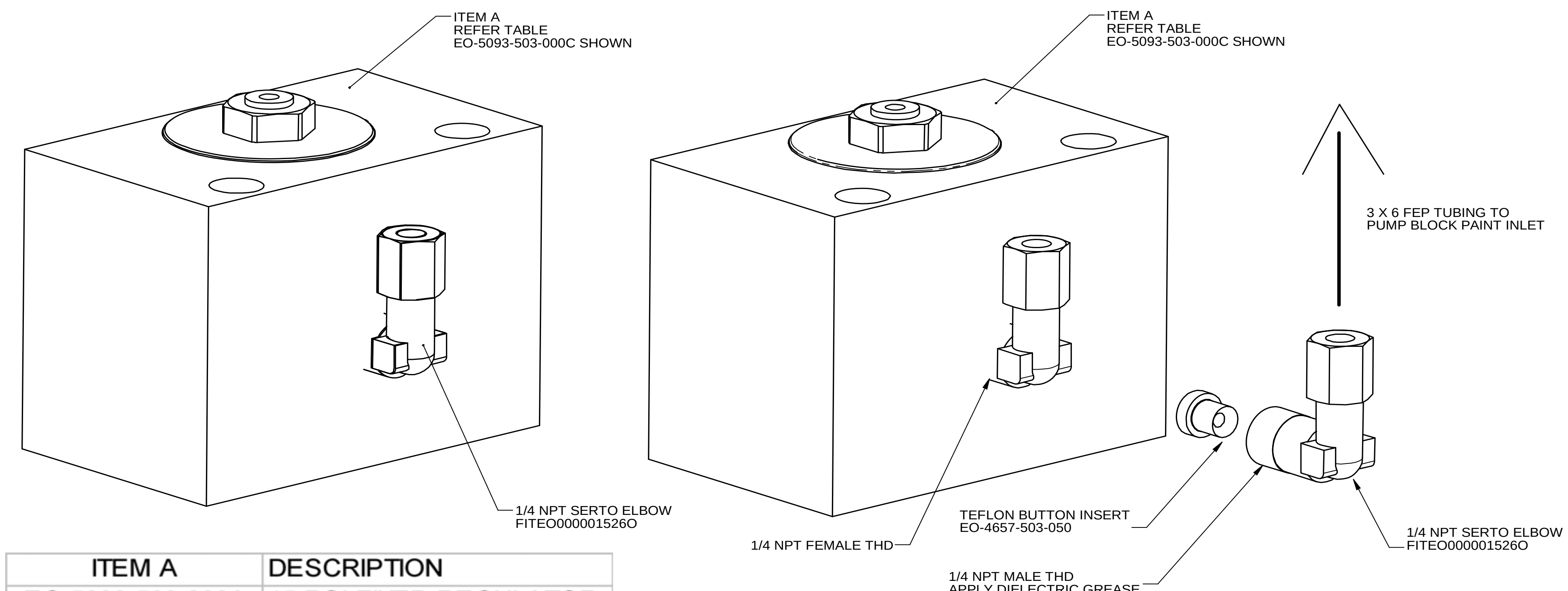
Figure 11-8 ET-5093-890-005 Sheet 1 of 3, 5093 REGULATOR

5093 REGULATOR

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.

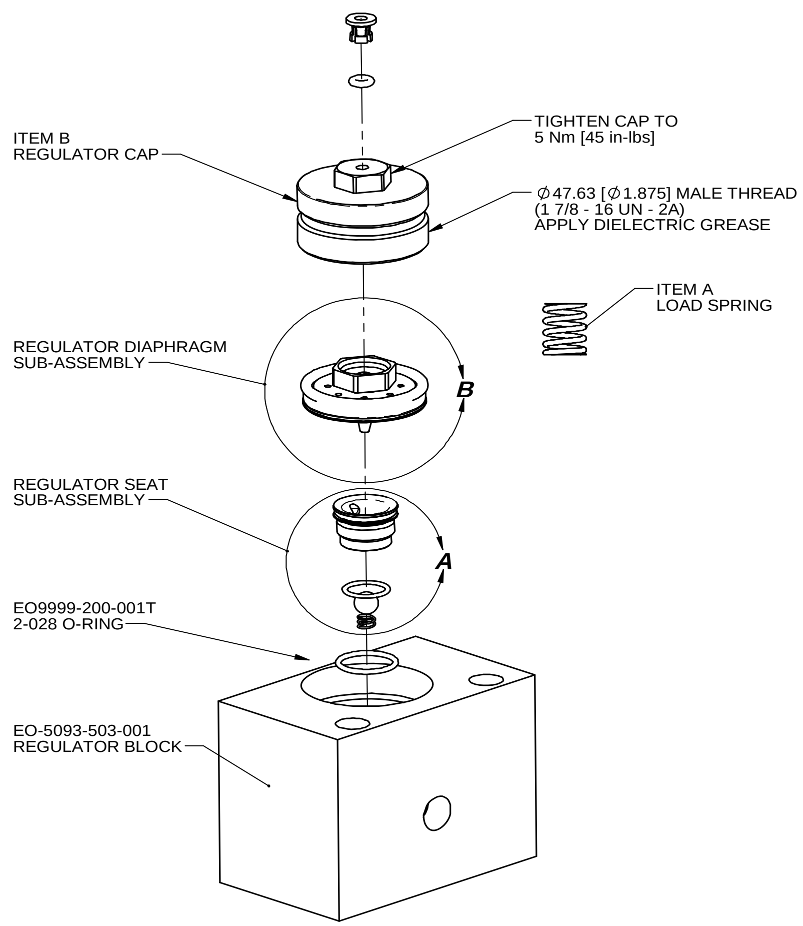
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



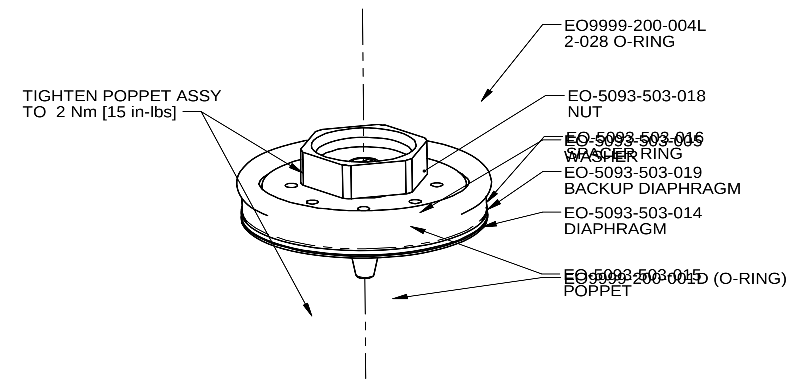
ITEM A	DESCRIPTION
EO-5093-503-000A	15 PSI FIXED REGULATOR
EO-5093-503-000B	30 PSI FIXED REGULATOR
EO-5093-503-000C	AIR PILOTED REGULATOR

[ET-5093-890-005] 5093 REGULATOR	REV B1 SHEET 1 OF 3

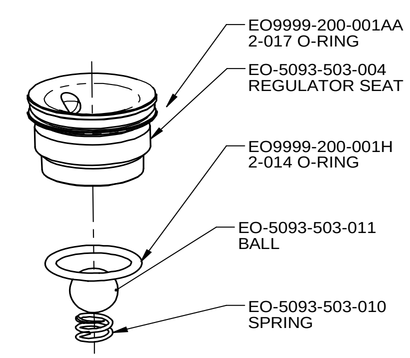
Figure 11-9 ET-5093-890-005 Sheet 2 of 3, 5093 REGULATOR



REGULATOR ASSEMBLY
INTERNAL PARTS



DETAIL B
SCALE 1 : 1



DETAIL A
SCALE 1 : 1

REGULATOR LOAD SPRING SELECTION

REGULATOR ASSM	ITEM A	DESCRIPTION
EO5093-503-000A	EO-5093-503-009	15 PSI FIXED REGULATION
EO5093-503-000B	EO-5093-503-012	30 PSI FIXED REGULATION
EO5093-503-000C	NONE	AIR PILOT

REGULATOR CAP SELECTION

REGULATOR ASSM	ITEM B	DESCRIPTION
EO5093-503-000A	EO-5093-503-002	PLAIN CAP
EO5093-503-000B	EO-5093-503-002	PLAIN CAP
EO5093-503-000C	EO-5093-503-013	AIR PILOT CAP

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

[ET-5093-890-005] REV B1
5093 REGULATOR SHEET 2 OF 3

Figure 11-10 ET-5093-890-005 Sheet 3 of 3, 5093 REGULATOR

REGULATOR MAINTENANCE AND REPAIR

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

REGULATOR MAINTENANCE SCHEDULE:
1. INSPECT REGULATORS DURING WEEKLY MAINTENANCE FOR LEAKS AND/OR MALFUNCTION.
2. MOST REGULATOR MALFUNCTIONS CAN BE REPAIRED IN FIELD BY REPLACING THE DIAPHRAGM - USE REGULATOR SOFT REBUILD KIT EO5093-503-020D.
3. REBUILD THE REGULATOR INTERNAL PARTS EVERY 5,000 HOURS OF USE. USE APPROPRIATE REBUILD KITS, EO5093-503-020A THRU C.
4. REPLACE SERTO ELBOW (FITEO000001526O) WHEN THE REGULATOR IS REBUILT.

MAINTENANCE PROCEDURES:
1. PERFORM A SUPER PURGE CYCLE BEFORE ANY REGULATOR MAINTENANCE.
2. DETACH THE REGULATOR FIRST FROM THE ROBOT ARM AND THEN FROM THE COLOR STACK.
3. PLACE THE REGULATOR WITH CAP POINTING UP ON A CLEAN HORIZONTAL SURFACE.
4. USE ONLY VALVE INSTALL TOOL (EO-5513-700-003) TO REMOVE AND INSTALL THE CAP.
5. USE REGULATOR REBUILD KIT (EO5093-503-020D) TO REPLACE DIAPHRAGM.
6. PLACE THE DIAPHRAGM-POPPET ASSEMBLY INTO THE REGULATOR WHILE THE REGULATOR IS IN UPRIGHT POSITION ONLY, TO PREVENT MISLAIGNMENT OF THE POPPET.
7. IF ALL THE INTERNAL PARTS OF THE REGULATOR ARE TO BE REPLACED, REMOVE THE REGULATOR TO A TABLE.
8. USE ONLY THE APPROPRIATE REBUILD KIT AS PER THE TABLE FOR REPLACING INTERNAL PARTS.

REGULATOR KIT PART NO	DESCRIPTION	REGULATOR	REGULATOR TYPE
EO5093-503-020A	Complete Rebuild Kit	EO5093-503-000A	15 PSI Fixed
EO5093-503-020B	Complete Rebuild Kit	EO5093-503-000B	30 PSI Fixed
EO5093-503-020C	Complete Rebuild Kit	EO5093-503-000C	Air Pilot
EO5093-503-020D	Soft Rebuild Kit	ALL	ALL

[ET-5093-890-005]	REV B1
5093 REGULATOR	SHEET 3 OF 3

The air piloted pressure regulator (EO5093-503-000C) is connected to the last Color Module. This module controls the pressure of the paint supplied to the gear pump. A pilot air signal is applied to an internal diaphragm which in turn controls a poppet valve within the regulator body.

11.2.5 Pressure Regulator (Fixed)

The fixed pressure regulator (EO5093-503-000B) is connected to the last Color Module. This module controls the pressure of the paint supplied to the gear pump. A constant force supplied by a spring is applied to an internal diaphragm which in turn controls a poppet valve within the regulator body.

11.2.6 Maintenance and Repair

Figure 11-11 ET-5093-890-006 Sheet 1 of 2, P700 1K PM SCHEDULES

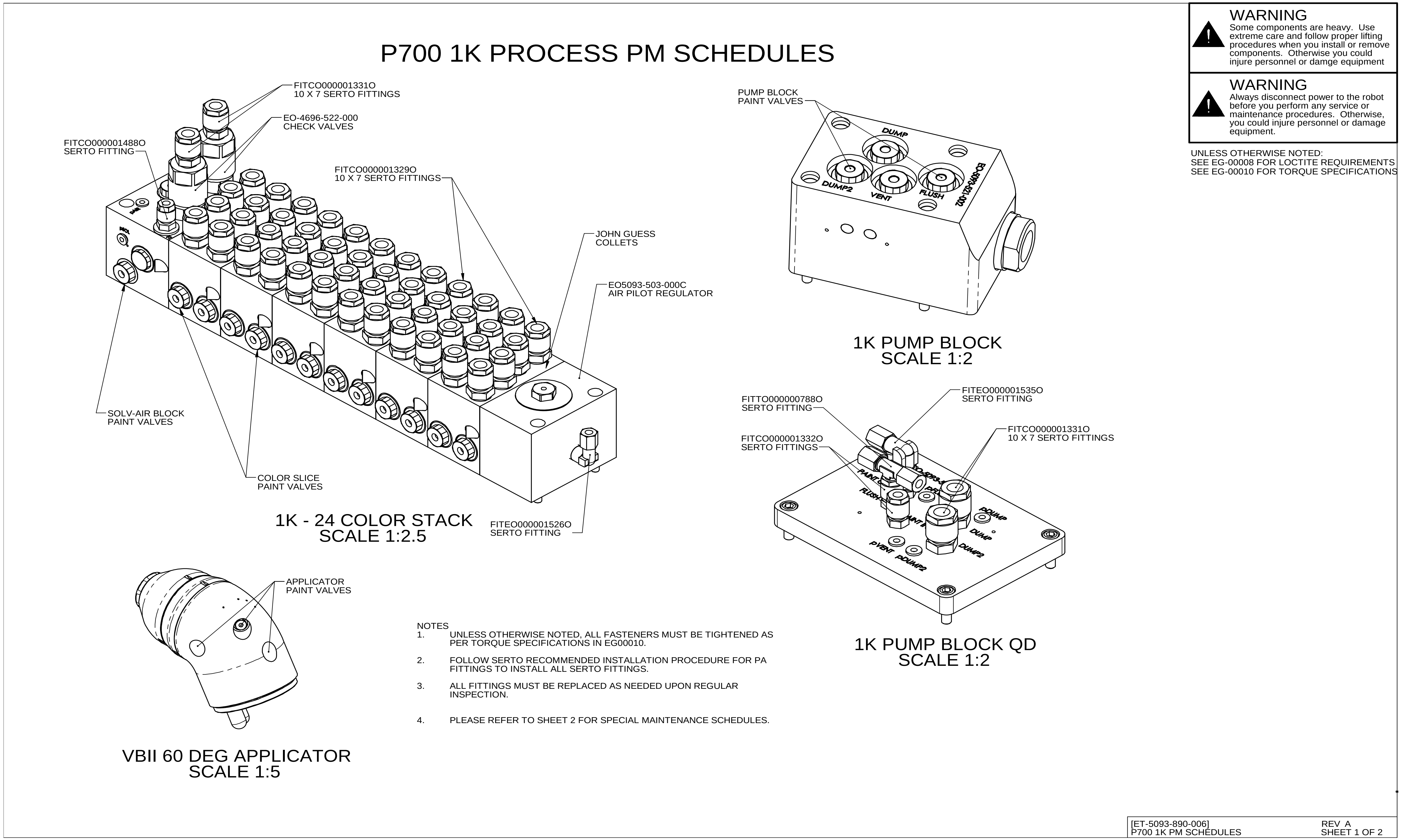


Figure 11-12 ET-5093-890-006 Sheet 2 of 2, P700 1K PM SCHEDULES

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

PAINT VALVES - GENERAL MAINTENANCE GUIDLINES
1. INSPECT ALL PAINT VALVES DURING WEEKLY MAINTENANCE FOR LEAKS AND/OR MALFUNCTION.
2. PAINT VALVE IS NOT FIELD SERVICEABLE UNIT.
3. PAINT VALVE MUST BE REPLACED AS A WHOLE.
4. REPLACE A DAMAGED VALEVE WITH A NEW VALVE.
5. DISCARD DAMAGED PAINT VALVES PROMPTLY - DO NOT STORE THEM.
6. LIFE OF A PAINT VALVE UNDER NORMAL OPERATION IS 2,000,000 (TWO MILLION) CYCLES.
7. REPLACE PAINT VALVES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT VALVE LOCATION	AVG CYCLES PER JOB	REPLACE AFTER HOURS IN USE	NO. OF YEARS WITH ONE 10HR SHIFT	NO. OF YEARS WITH TWO 10HR SHIFTS
COLOR STACK	1	30,000	10 YRS 2 QTRS	5 YRS 1 QTR
SOLV-AIR BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS
PUMP BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS
APPLICATOR	3	10,000	3 YRS 2 QTRS	1 YR 3 QTR

HOSES - GENERAL MAINTENANCE GUIDLINES

1. INSPECT ALL HOSES DURING WEEKLY MAINTENACE.
2. MAKE SURE THAT THERE IS NO FLUID OF ANY KIND IN AIR PILOT HOSES.
3. REPLACE DAMAGED OR FAULTY HOSES AS NEEDED.
4. REPLACE HOSE ALONG WITH FITTINGS AT BOTH ENDS.
5. REPLACE HOSES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT SUPPLY HOSES - FROM PAINT DROP TO COLOR STACK - ANNUAL
SOLVENT AND AIR SUPPLY HOSES - ANNUAL
PILOT HOSES ON INNER ARM - ANNUAL
WASH LINE - FROM SOLV AIR BLOCK TO PUMP BLOCK - ANNUAL
PAINT-IN LINE - FROM REGULATOR TO PUMP BLOCK - ANNUAL
HOSE BUNDLE - EO-5093-545-000 ASSEMBLY - 6 MONTHS

SERTO FITTINGS AND JOHN GUESS COLLETS
1. INSPECT ALL FITTINGS DURING WEEKLY MAINTENANCE.
2. ALL FITTINGS MUST BE REPLACED AS NEEDED UPON REGULAR INSPECTION.
3. DISCARD THE REPLACED FITTINGS - DO NOT STORE THEM.

OTHER PARTS MAINTENANCE SCHEDULE
1. CHECK VALVES - ANNUAL
2. PRESSURE SENSOR - AS NEEDED
3. 3CC GEAR PUMP - REFER TO GEAR PUMP MAINTENANCE (ET-5093-890-007)

[ET-5093-890-006] REV A
P700 1K PM SCHEDULES SHEET 2 OF 2

8. Inspect all paint valves during weekly maintenance for leaks and/or malfunction, using procedures found in EB-03516.
9. The paint valve is not a field serviceable unit.
10. Paint valves must be replaced as a whole.
11. Replaced a damaged valve with a new valve.
12. Discard damaged paint valves promptly – do not store them.
13. Life of a paint valve under normal operation is 2,000,000 cycles.
14. Replace paint valves according to the following schedule from ET-5093-890-006 using procedures found in EB-03516.

Paint Valve Location	Avg Cycles per Job	Replace after hours in use.	No.of years with 1 hour shift	No. of years with 2 hour shift
Color Stack	1	30000	10 YRS 2 QTRS	5 YRS 1 QTR
Solv-Air Block	2	15000	5 YRS 1 QTR	2 YRS 2 QTR
Pump Block	2	15000	5 YRS 1 QTR	2 YRS 2 QTR
Applicator	3	10000	3 YRS 2 QTRS	1 YR 3 QTR

Table 11-1: Wear part replacement schedule

11.2.7 SolvAir Module

3. Replace valves in the SolvAir Module after 15,000 hours in use.

4. Replace check valves annually, as suggested in ET-5093-890-006.

11.2.8 Color Module

18. Inspect color module and valves during weekly maintenance.

19. Replace valves in color module after 30,000 hours in use.

20. Turn off all paint and solvent supplies to the color changer manifold. Relieve all potentially entrapped paint, solvent, or air pressure in the system undergoing maintenance.

21. Inspect valves for fresh fluid in the weep holes.

22. Disconnect pilot lines.

23. Remove the paint valve in question. Use the color valve tool EO-5513-700-003 or a 17mm wrench and grasp the hex head surfaces of the valve.

24. It may be necessary to remove paint lines in order to clean valve socket.

25. Clean the interior of the valve socket with solvent. Inspect the stainless steel valve seat for any damage.

26. Thoroughly clean valve socket and pilot passage before installing valve.

27. Discard the damaged valve and replace with a new one. Insure that the new valve is seated properly by observing the stem of the actuator. It should be flush with the top of the valve. If the valve is over tightened the stem will be protruding from the top of the valve. If the stem is recessed into the valve, the valve is not tightened sufficiently.

28. Turn off all paint and solvent supplies to the color changer manifold. Relieve all potentially entrapped paint, solvent, or air pressure in the system undergoing maintenance.

29. Inspect valves for fluid in the weep holes.

30. Disconnect pilot lines.

31. Remove the paint valve in question. Use the color valve tool EO-5513-700-003 or a 17mm wrench and grasp the hex head surfaces of the valve.

32. Clean the interior of the valve path with solvent. Inspect the stainless steel valve seat for any scarring or deformation.

33. Thoroughly clean valve socket before installing valve.

34. Discard the damaged valve and replace with a new one. Insure that the new valve is seated properly by observing the stem of the actuator. It should be flush with the top of the valve. If the valve is overtightened the stem will be protruding from the top of the valve. If the stem is recessed into the valve, the valve is not tightened sufficiently.

11.3 Troubleshooting

11.3.1 SolvAir Module

If no SolvAir is produced when requested check the following items:

3. Verify that the SOL, AIR, and 2T valves actuate by observing the valve poppets. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

4. Verify that the solvent pressure is at least 10 PSI above supply air pressure.

11.3.2 Color Module

Typically only two problems arise with this color valve:

3. Leakage out the weep port or through a worn valve that is not seating properly. If leakage is observed, replace the worn valve using procedures found in EB-03516.

4. Improper actuation: This can be observed by viewing the stem of the valve poppet actuator. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

11.4 Troubleshooting

11.4.1 SolvAir Module

If no SolvAir is produced when requested check the following items:

1. Verify that the SOL, AIR, and 2T valves actuate by observing the valve poppets. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

2. Verify that the solvent pressure is at least 10 PSI above supply air pressure.

11.4.2 Color Module

Typically only two problems arise with this color valve:

1. Leakage out the weep port or through a worn valve that is not seating properly. If leakage is observed, replace the worn valve using procedures found in EB-03516.

2. Improper actuation: This can be observed by viewing the stem of the valve poppet actuator. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

11.5 Spare parts and special tools

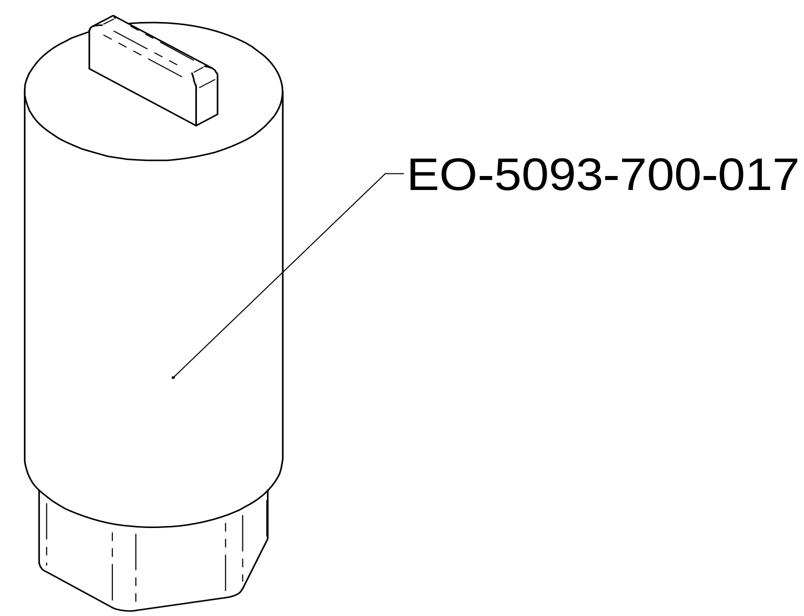
Figure 11-13 EO-5093-700-005, FITTING WRENCH

Figure 11-14 EO-5093-700-017, VALVE TOOL

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



[EO-5093-700-017] VALVE TOOL	REV 0 SHEET 1 OF 1

Overview

Figure 11-15 EO-5093-510-001 Sheet 1 of 2, 1K COLOR STACK ARM ASM

1K COLOR STACK ASSEMBLY WITH RECIRCULATING COLOR SLICE

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
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UNLESS OTHERWISE NOTED:
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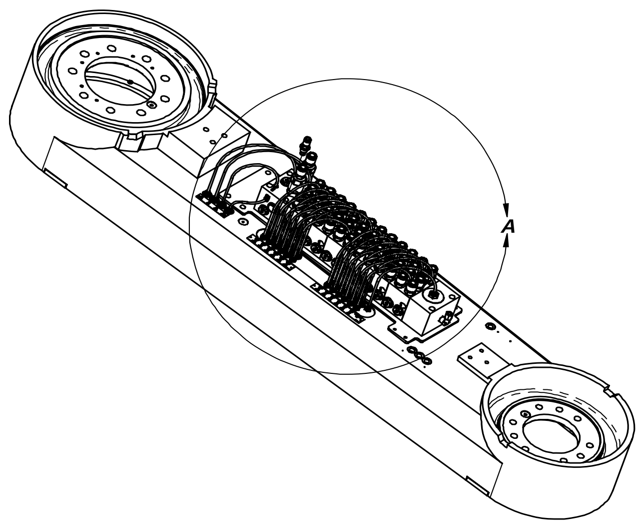
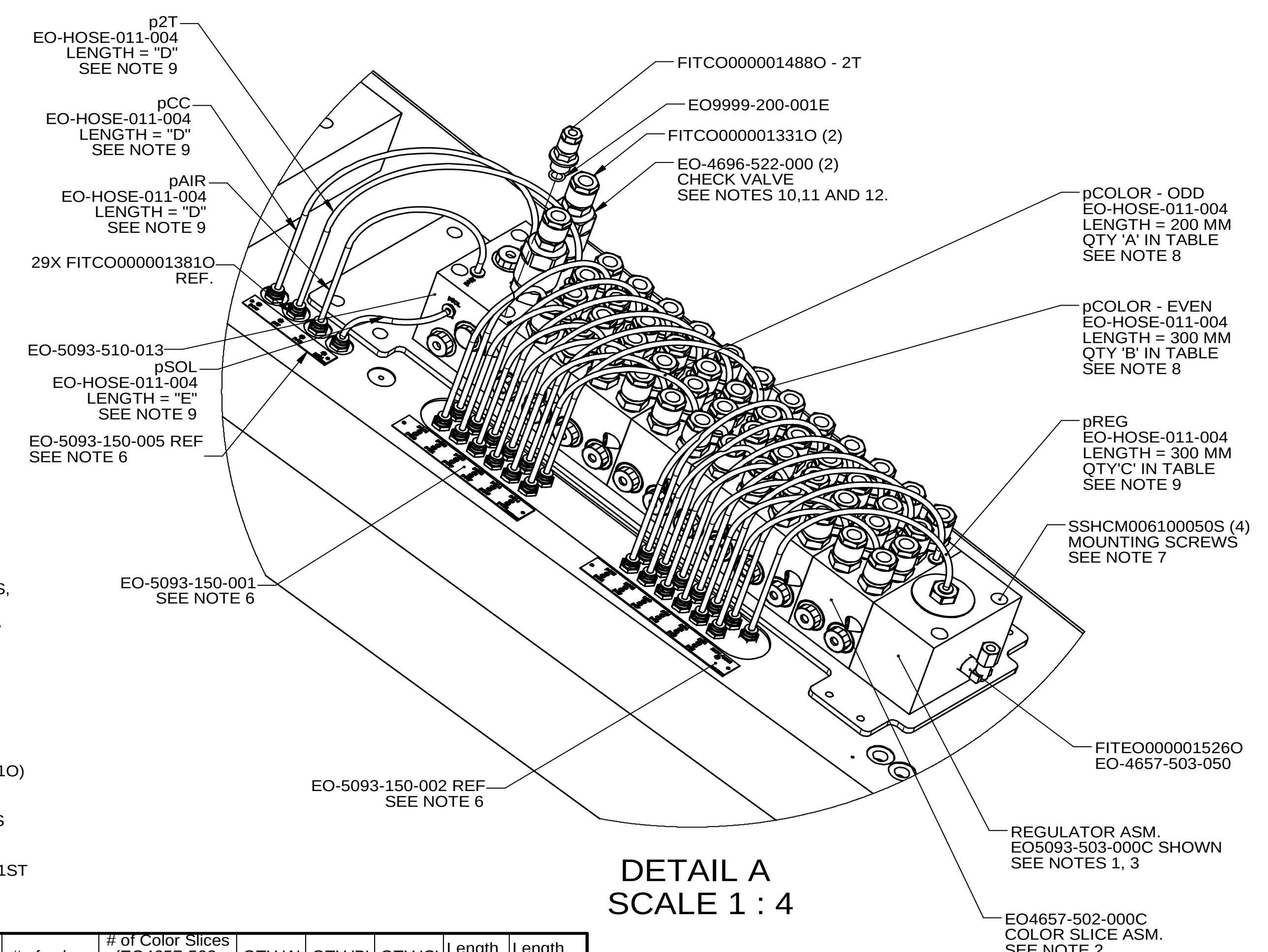
SEE EG-00010 FOR TORQUE SPECIFICATIONS





DETAIL A
SCALE 1 : 4

NOTES:

1. 1K COLOR STACK ASM SHOWN WITH RECIRCULATING COLOR SLICES, 24 COLORS AND AIR PILOT REGULATOR.
2. COLOR STACK ASM. AVAILABLE WITH 4, 8, 12, 16, 20 AND 24 COLORS. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
3. THREE REGULATORS AVAILABLE. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
4. COLOR PILOT LINE - ODD: (2) PER COLOR SLICE
5. COLOR PILOT LINE - EVEN: (2) PER COLOR SLICE
6. TAG KIT: EO-5093-150-004 INCLUDES REQUIRED TAGS
7. PLACE THESE SCREWS IN A PLASTIC BAG AND TYRAP TO COLOR STACK ASSEMBLY FOR LATER USE.
8. CAP BUNDLES OF (4) PILOT LINES WITH HOSE CAP (CAPMO000000101O)
9. CAP 4mm LINES WITH HOSE CAP (CAPMO000000098O)
10. USE TEFLON TAPE (TAPEO000000003O) ON 3/8 MALE NPT OF CHECK VALVE. DO NOT PUT TEFLON TAPE ON THE 1ST 3 LEADING THREADS OF THE MALE NPT.
11. USE TEFLON TAPE (TAPEO000000003O) ON 1/4 MALE NPT OF SERTO FITTING(s) FOR CHECK VALVE. DO NOTE PUT TEFLON TAPE ON THE 1ST 3 THREADS OF THE MALE NPT.
12. DO NOT USE LARGE HEX TO TIGHTEN CHECKVALVE. SEE EG-OO492.

510 Assembly No.	Description	Regulator Type	Regulator Part No.	# of colors	# of Color Slices (EO4657-502-000C)	QTY 'A'	QTY 'B'	QTY 'C'	Length 'D' mm	Length 'E' mm
EO5093-510-001A	1K CC ASM: Rec,vReg,4 clr	Air Pilot	EO5093-503-000C	4	1	2	2	1	580	400
EO5093-510-001B	1K CC ASM: Rec,vReg,8 clr	Air Pilot	EO5093-503-000C	8	2	4	4	1	524	344
EO5093-510-001C	1K CC ASM: Rec,vReg,12 clr	Air Pilot	EO5093-503-000C	12	3	6	6	1	468	288
EO5093-510-001D	1K CC ASM: Rec,vReg,16 clr	Air Pilot	EO5093-503-000C	16	4	8	8	1	412	232
EO5093-510-001E	1K CC ASM: Rec,vReg,20 clr	Air Pilot	EO5093-503-000C	20	5	10	10	1	356	176
EO5093-510-001F	1K CC ASM: Rec,vReg,24 clr	Air Pilot	EO5093-503-000C	24	6	12	12	1	300	120
EO5093-510-001N	1K CC ASM: Rec,15psi Reg,4 clr	15 psi fixed	EO5093-503-000A	4	1	2	2	0	580	400
EO5093-510-001P	1K CC ASM: Rec,15psi Reg,8 clr	15 psi fixed	EO5093-503-000A	8	2	4	4	0	524	344
EO5093-510-001Q	1K CC ASM: Rec,15psi Reg,12 clr	15 psi fixed	EO5093-503-000A	12	3	6	6	0	468	288
EO5093-510-001R	1K CC ASM: Rec,15psi Reg,16 clr	15 psi fixed	EO5093-503-000A	16	4	8	8	0	412	232
EO5093-510-001S	1K CC ASM: Rec,15psi Reg,20 clr	15 psi fixed	EO5093-503-000A	20	5	10	10	0	356	176
EO5093-510-001T	1K CC ASM: Rec,15psi Reg,24 clr	15 psi fixed	EO5093-503-000A	24	6	12	12	0	300	120
EO5093-510-001AA	1K CC ASM: Rec,30psi Reg,4 clr	30 psi fixed	EO5093-503-000B	4	1	2	2	0	580	400
EO5093-510-001AB	1K CC ASM: Rec,30psi Reg,8 clr	30 psi fixed	EO5093-503-000B	8	2	4	4	0	524	344
EO5093-510-001AC	1K CC ASM: Rec,30psi Reg,12 clr	30 psi fixed	EO5093-503-000B	12	3	6	6	0	468	288
EO5093-510-001AD	1K CC ASM: Rec,30psi Reg,16 clr	30 psi fixed	EO5093-503-000B	16	4	8	8	0	412	232
EO5093-510-001AE	1K CC ASM: Rec,30psi Reg,20 clr	30 psi fixed	EO5093-503-000B	20	5	10	10	0	356	176
EO5093-510-001AF	1K CC ASM: Rec,30psi Reg,24 clr	30 psi fixed	EO5093-503-000B	24	6	12	12	0	300	120

Standard Hardware Descriptions	
FANUC Part No.	Description
SSHCM006100050S	M6 X 1.0 X 50mm LG. Stainless Steel Socket Head Cap

[EO-5093-510-001]
1K COLOR STACK ARM ASM
REV *12
SHEET 1 OF 2

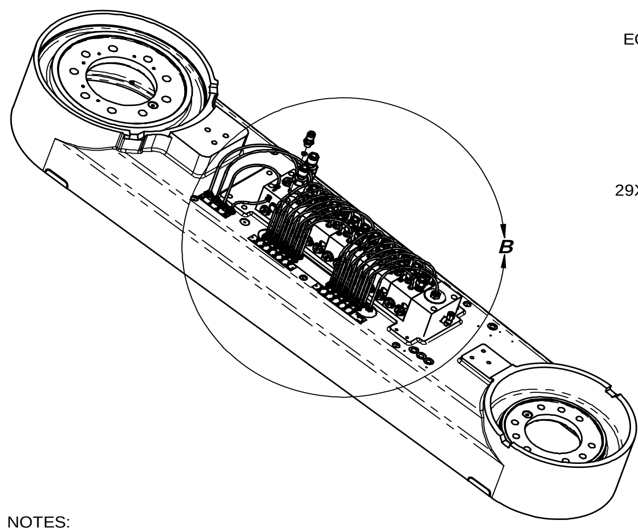
Figure 11-16 EO-5093-510-001 Sheet 2 of 2, 1K COLOR STACK ARM ASM

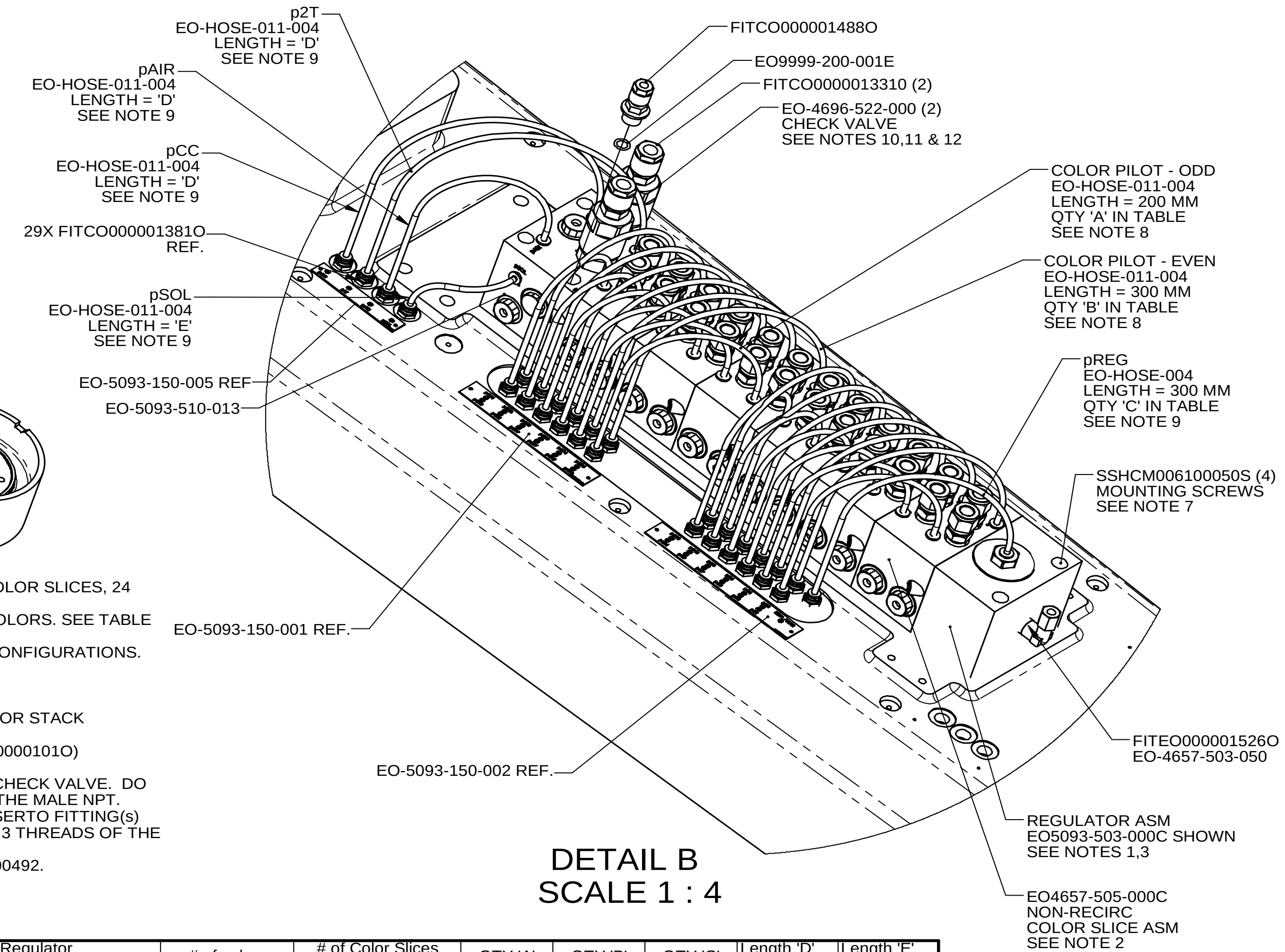
1K COLOR STACK ASSEMBLY WITH NON-RECIRCULATING COLOR SLICE

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





DETAIL B
SCALE 1 : 4

NOTES:

1. 1K COLOR STACK ASM SHOWN WITH NON-RECIRCULATING COLOR SLICES, 24 COLORS AND AIR PILOT REGULATOR.
2. COLOR STACK ASM. AVAILABLE WITH 4, 8, 12, 16, 20 AND 24 COLORS. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
3. THREE REGULATORS AVAILABLE. SEE TABLE FOR SPECIFIC CONFIGURATIONS.
4. COLOR PILOT LINE - ODD: (2) PER COLOR SLICE
5. COLOR PILOT LINE - EVEN: (2) PER COLOR SLICE
6. TAG KIT: EO-5093-150-004 INCLUDES REQUIRED TAGS
7. PLACE THESE SCREWS IN A PLASTIC BAG AND TYRAP TO COLOR STACK ASSEMBLY FOR LATER USE.
8. CAP BUNDLES OF (4) PILOT LINES WITH HOSE CAP (CAPMO000000101O)
9. CAP 4mm LINES WITH HOSE CAP (CAPMO000000098O)
10. USE TEFLON TAPE (TAPEO000000003O) ON 3/8 MALE NPT OF CHECK VALVE. DO NOT PUT TEFLON TAPE ON THE 1ST 3 LEADING THREADS OF THE MALE NPT.
11. USE TEFLON TAPE (TAPEO000000003O) ON 1/4 MALE NPT OF SERTO FITTING(s) FOR CHECK VALVE. DO NOTE PUT TEFLON TAPE ON THE 1ST 3 THREADS OF THE MALE NPT.
12. DO NOT USE LARGE HEX TO TIGHTEN CHECKVALVE. SEE EG-00492.

510 Assembly No.	Description	Regulator Type	Regulator Part No.	# of colors	# of Color Slices (EO4657-505-000C)	QTY 'A'	QTY 'B'	QTY 'C'	Length 'D' mm	Length 'E' mm
EO5093-510-001G	1K CC ASM: NRec,vReg,4 clr	Air Pilot	EO5093-503-000C	4	1	2	2	1	580	400
EO5093-510-001H	1K CC ASM: NRec,vReg,8 clr	Air Pilot	EO5093-503-000C	8	2	4	4	1	524	344
EO5093-510-001J	1K CC ASM: NRec,vReg,12 clr	Air Pilot	EO5093-503-000C	12	3	6	6	1	468	288
EO5093-510-001K	1K CC ASM: NRec,vReg,16 clr	Air Pilot	EO5093-503-000C	16	4	8	8	1	412	232
EO5093-510-001L	1K CC ASM: NRec,vReg,20 clr	Air Pilot	EO5093-503-000C	20	5	10	10	1	356	176
EO5093-510-001M	1K CC ASM: NRec,vReg,24 clr	Air Pilot	EO5093-503-000C	24	6	12	12	1	300	120
EO5093-510-001U	1K CC ASM: NRec,15psi Reg,4 clr	15 psi fixed	EO5093-503-000A	4	1	2	2	0	580	400
EO5093-510-001V	1K CC ASM: NRec,15psi Reg,8 clr	15 psi fixed	EO5093-503-000A	8	2	4	4	0	524	344
EO5093-510-001W	1K CC ASM: NRec,15psi Reg,12 clr	15 psi fixed	EO5093-503-000A	12	3	6	6	0	468	288
EO5093-510-001X	1K CC ASM: NRec,15psi Reg,16 clr	15 psi fixed	EO5093-503-000A	16	4	8	8	0	412	232
EO5093-510-001Y	1K CC ASM: NRec,15psi Reg,20 clr	15 psi fixed	EO5093-503-000A	20	5	10	10	0	356	176
EO5093-510-001Z	1K CC ASM: NRec,15psi Reg,24 clr	15 psi fixed	EO5093-503-000A	24	6	12	12	0	300	120
EO5093-510-001AG	1K CC ASM: NRec,30psi Reg,4 clr	30 psi fixed	EO5093-503-000B	4	1	2	2	0	580	400
EO5093-510-001AH	1K CC ASM: NRec,30psi Reg,8 clr	30 psi fixed	EO5093-503-000B	8	2	4	4	0	524	344
EO5093-510-001AJ	1K CC ASM: NRec,30psi Reg,12 clr	30 psi fixed	EO5093-503-000B	12	3	6	6	0	468	288
EO5093-510-001AK	1K CC ASM: NRec,30psi Reg,16 clr	30 psi fixed	EO5093-503-000B	16	4	8	8	0	412	232
EO5093-510-001AL	1K CC ASM: NRec,30psi Reg,20 clr	30 psi fixed	EO5093-503-000B	20	5	10	10	0	356	176
EO5093-510-001AM	1K CC ASM: NRec,30psi Reg,24 clr	30 psi fixed	EO5093-503-000B	24	6	12	12	0	300	120

[EO-5093-510-001] REV *12
1K COLOR STACK ARM ASM SHEET 2 OF 2

The color changer enables the robot to switch between colors without color contamination, and provides a cleaning function to clean the paint lines from the color changer through the applicator. The Color Changer consists of the SolvAir module, at least one color module, and a pressure regulator.

11.6 Operations and Setup

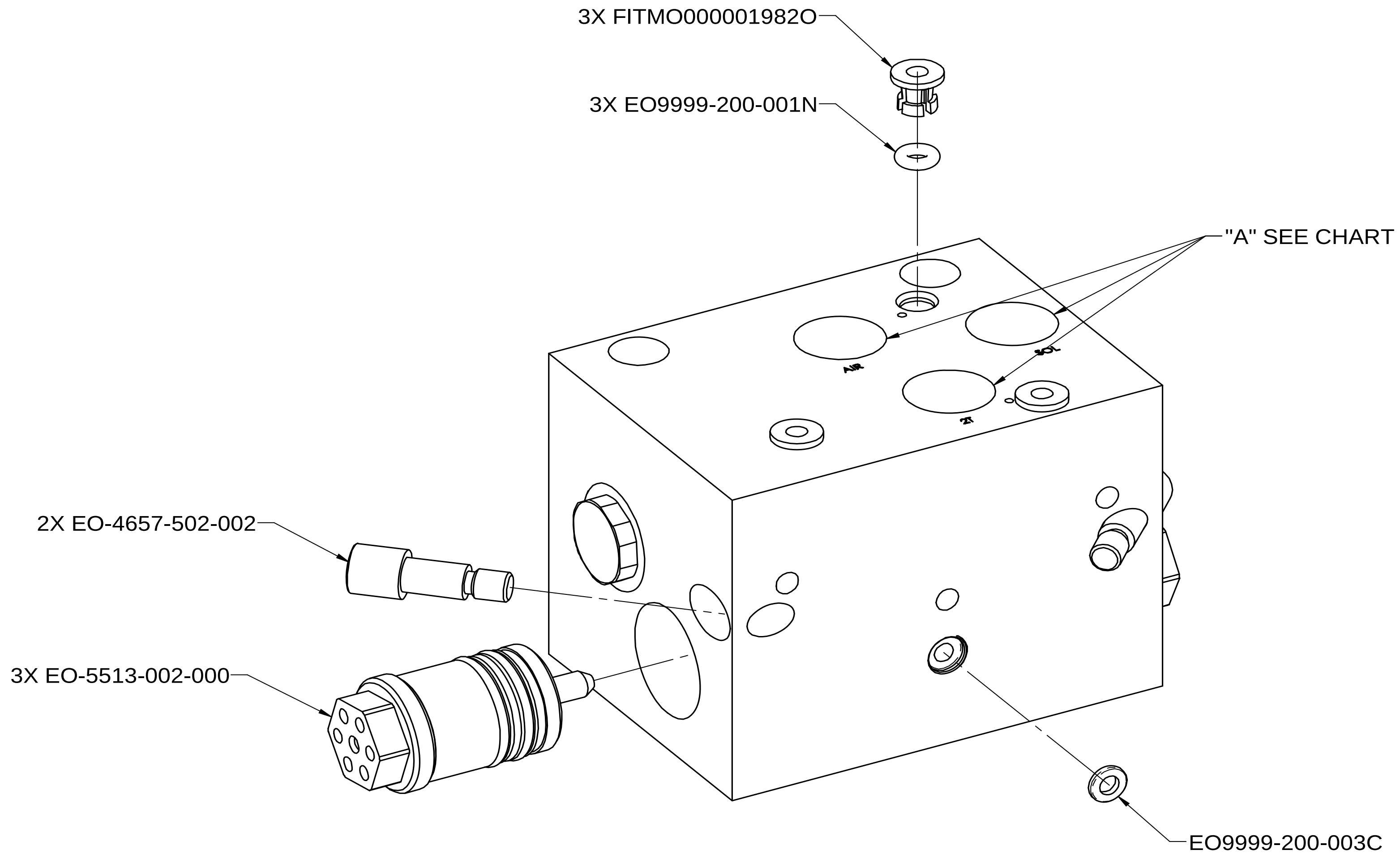
11.6.1 SolvAir Module

Figure 11-17 EO-4657-501-000, SOLV/AIR 3 VALVE 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 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



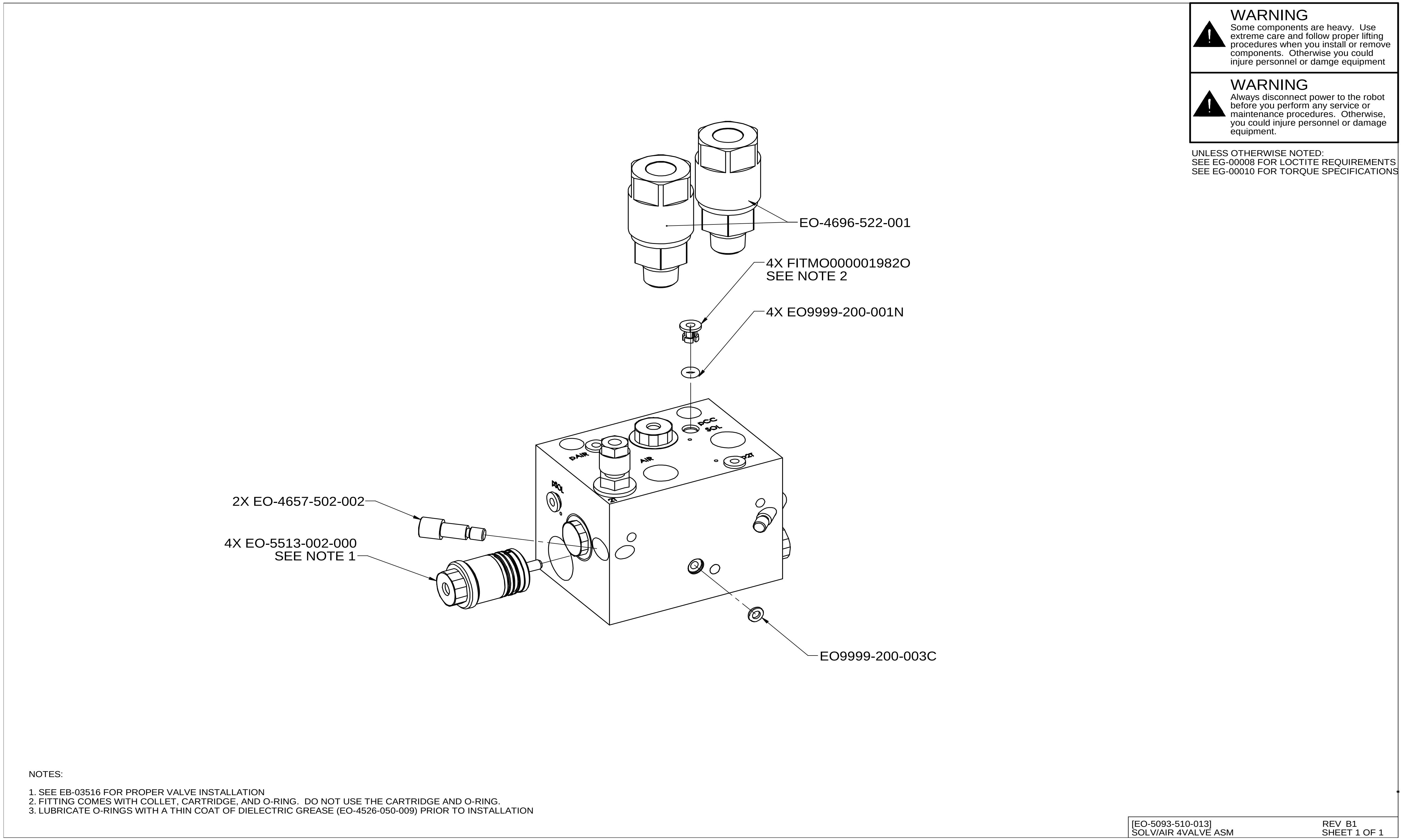
NOTES:

1. SEE EB-03516 FOR PROPER VALVE INSTALLATION
2. FITTING COMES WITH COLLET, CARTRIDGE, AND O-RING. DO NOT USE THE CARTRIDGE AND O-RING.
3. LUBRICATE O-RINGS WITH A THIN COAT OF DIELECTRIC GREASE (EO-4526-050-009) PRIOR TO INSTALLATION

FANUC ASSEMBLY NO.	DESCRIPTION	"A" SIZE
EO4657-501-000A	3/8 NPT SOLVAIR BLOCK	3/8 NPT
EO4657-501-000D	3/8 BSPT SOLVAIR BLOCK	3/8 BSPT

[EO-4657-501-000] REV *6
SOLV/AIR 3 VALVE ASM SHEET 1 OF 1

Figure 11-18 EO-5093-510-013, SOLV/AIR 4VALVE ASM



This module allows purge solvent and purge air to be simultaneously delivered to the Color Changer. This mechanical feature eliminates the need for added programming steps typically alternating the SOL valve and then an air valve several times during a color change cleanout cycle. A secondary outlet, 2T is used for routing solvent, air, or aerated SolvAir mix to the applicator.

SolvAir solvent regulator flow rates:

SG = 1.0 (water)
0.38 – 0.42 gpm = 24.0-26.5 cc/s

SG = 0.9
0.40 – 0.44 gpm = 25.3-27.9 cc/s

SG = 0.8 (Methyl Isobutyl Ketone)
0.42 – 0.47 gpm = 26.8-29.6 cc/s

The SolvAir module is located at the rear of the Color Changer. It consists of three or four paint valves (EO-5513-002-000) to control the air inlet, solvent inlet, and the 2T valve, along with the SolvAir endcap,

The SolvAir Module connects to the color module using 2 color manifold screws (EO-4657-502-002) using a 6mm allen wrench.

The SolvAir Module connects to the arm using 2 screws (SSHCM006100055G).

The paint valves screw into the SolvAir module using the Valve Tool as shown in the Special Tools Section. See EB-03516.

Caution: Do not remove Solv-Air flow control module.

The pilot lines for the AIR, SOL, CC, and 2T valves plug into fittings, FITMO0000001982O.

Two check valves (EO4696-522-000) are attached to the air inlet and solvent inlet ports.

The SolvAir module connects to the color module through an outlet port. The outlet port is surrounded by a face seal o-ring (EO9999-200-003C)

Caution: It is crucial to the operation of the SolvAir valve that the solvent inlet pressure is at least 10 PSI higher than the air inlet Pressure or the unit will not work properly and result in color carry-over or high voltage faults.

The pilot lines for the AIR, SOL, CC, 2T, SOL2, and DUMP3 valves plug into 5 fittings, FITMO0000001982O.

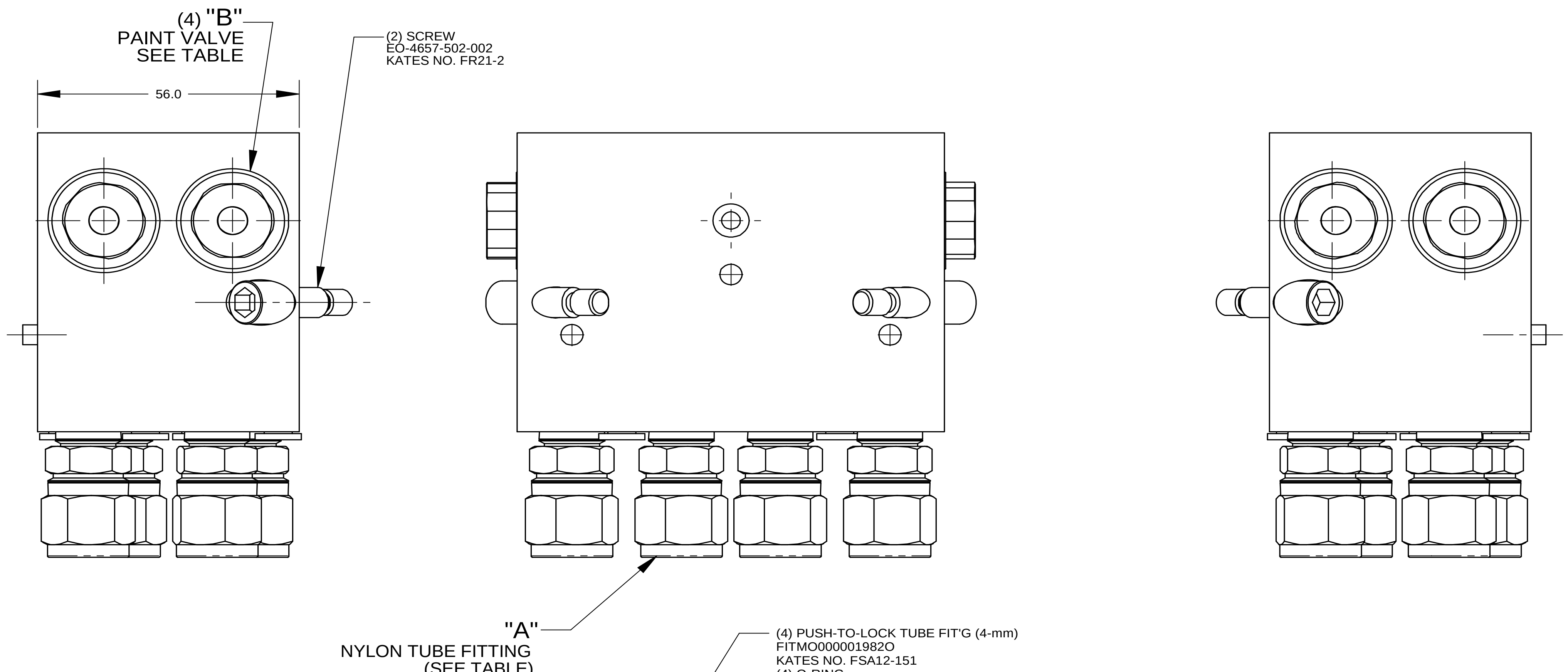
Check valves (EO4696-522-000) are attached to the air inlet and solvent inlet ports.

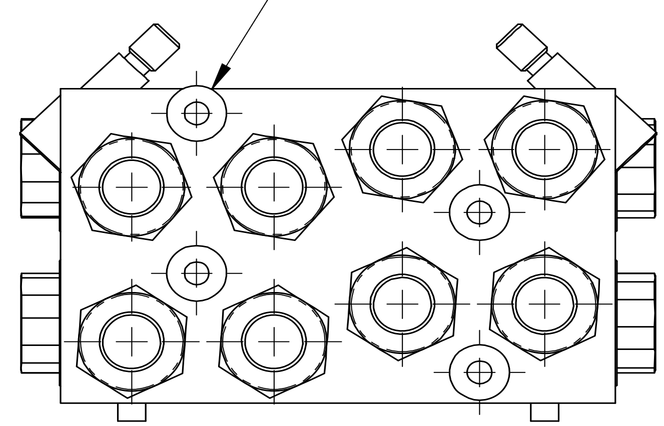
The SolvAir module connects to the color module through an outlet port. The outlet port is surrounded by a face seal o-ring (EO9999-200-003C)

Caution: It is crucial to the operation of the SolvAir valve that the solvent inlet pressure is at least 10 PSI higher than the air inlet Pressure or the unit will not work properly and result color carry-over or high voltage faults.

11.6.2 Color Module - Recirculating

Figure 11-19 EO-4657-502-000, COLOR MODULE





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

FANUC PART NO.	KATES PART NO.	DESCRIPTION	"A" FITTING PART NO.	"B" PAINT VALVE PART NO.
EO4657-502-000A	FR35	NO TUBE FITTINGS - WEEP	-	EO-5513-002-000
EO4657-502-000B	FR21	[3/8"] TUBE FITTINGS - WEEP	KATES SP7535 & SP7645	EO-5513-002-000
EO4657-502-000C	FR22	10/7-mm TUBE FITTINGS - WEEP	KATES SP7539	EO-5513-002-000
EO4657-502-000D	FR107	NO TUBE FITTINGS - NO WEEP	-	EO-5513-001-000
EO4657-502-000E	FR108	[3/8"] TUBE FITTINGS - NO WEEP	KATES SP7535 & SP7645	EO-5513-001-000
EO4657-502-000F	FR109	10/7-mm TUBE FITTINGS - NO WEEP	KATES SP7539	EO-5513-001-000

[EO-4657-502-000] REV *10
COLOR MODULE SHEET 1 OF 1

The circulating Color Module (EO-4657-502-000) is the point where the paint enters the IPC color system. It consists of 4 air piloted paint valves. Each color valve has a supply and return paint circulation line, connected by a fitting (FITCO000001365O). Install the plastic hex fittings flush to block face.

The color block connects to the adjacent block using 2 screws (EO-4657-502-002) with a 6mm Allen wrench. The fluid passage connects to the adjacent block with an outlet surrounded by a face seal o-ring (EO9999-200-003C)

Depending on the number of colors being used, the following block could be another recirculating Color Module, or a pressure regulator if no more colors are being used.

11.6.3 Non-Recirculating Color Module

Figure 11-20 EO-4657-504-000, NON-RECIRCULATING COLOR SLICE

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

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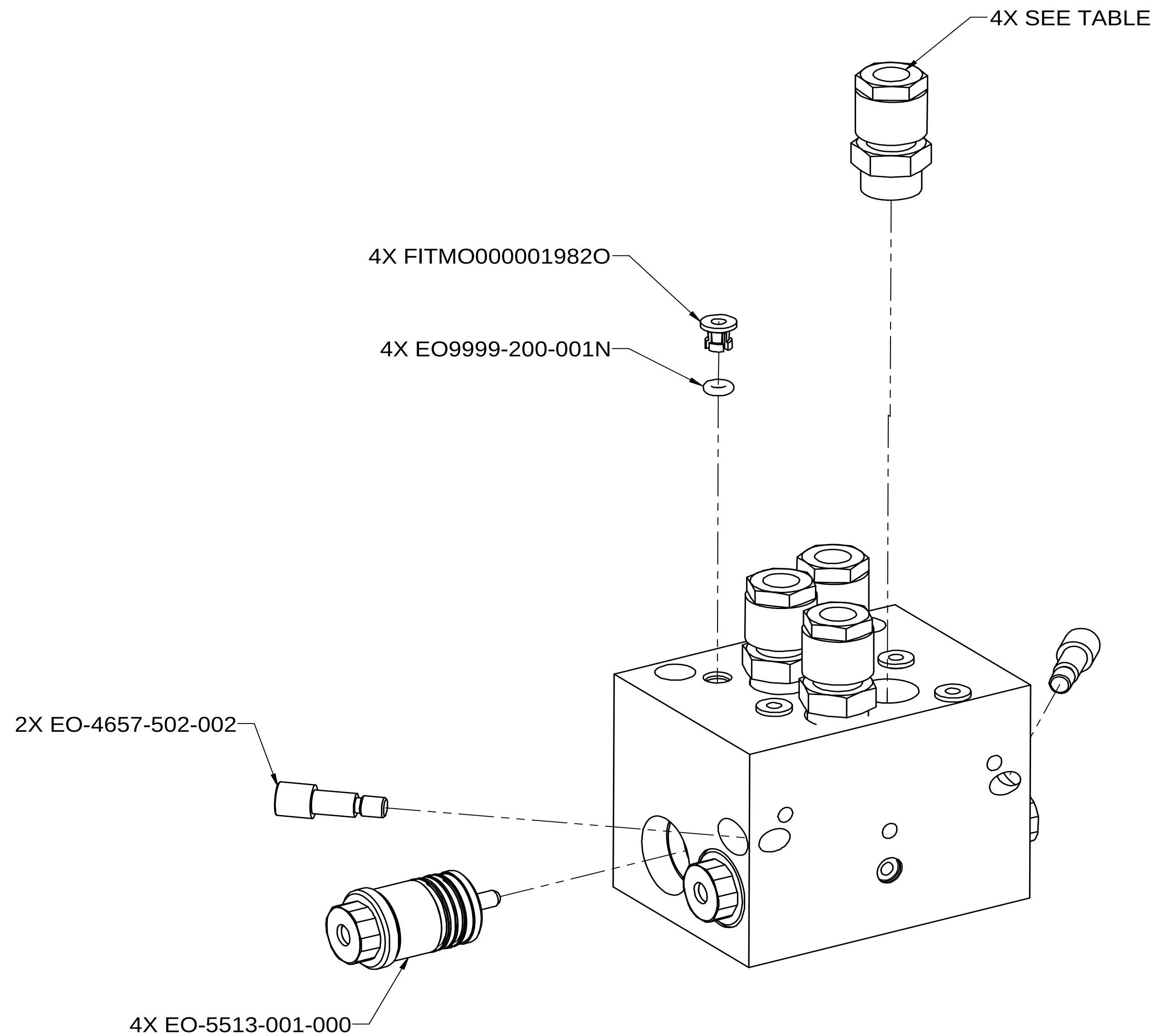
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



FANUC PART NO.	DESCRIPTION	FITTING PART NO.
EO4657-504-000A	NO TUBE FITTINGS	-
EO4657-504-000B	[3/8"] TUBE FITTINGS (QTY: 4)	KATES SP7535 & SP7645
EO4657-504-000C	10/7-mm TUBE FITTINGS (QTY: 4)	KATES SP7539

[EO-4657-504-000] REV *7
NON-RECIRCULATING COLOR SLICE SHEET 1 OF 1

The non circulating Color Module (EO-4657-504-000) is the point where the paint enters the IPC color system. It consists of 4 air piloted paint valves. Each color valve has a supply paint circulation line, connected by a plastic fitting (FITCO000001329O). Install the hex fittings flush to block face.

The color block connects to the adjacent block using 2 screws (EO-4657-502-002) with a 6mm allen wrench. The fluid passage connects to the adjacent block with an outlet surrounded by a face seal o-ring (EO9999-200-003C)

Depending on the number of colors being used, the following block could be another non circulating Color Module, or a pressure regulator if no more colors are being used.

11.6.4 Pressure Regulator

Figure 11-21 EO-5093-503-000, REGULATOR ASM

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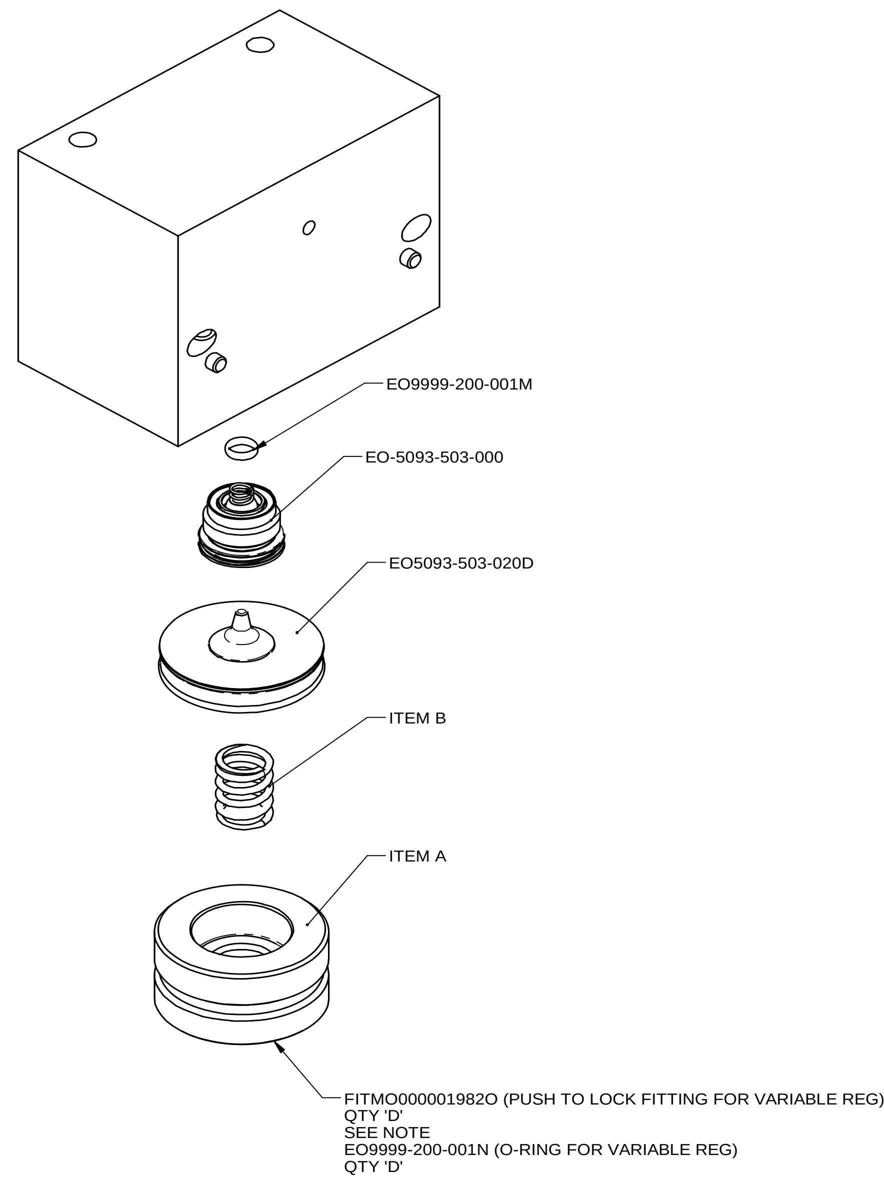
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS

NOTES:

1. THIS COMPONENT IS USED FOR PAINT DELIVERY. ALL INTERNAL PASSAGES MUST BE FREE OF DIRT, CUTTING FLUID, CHIPS, ETC. AND DRY BEFORE PACKAGING. ALL INTERNAL PASSAGES SHOULD BE PROTECTED (EITHER PLUGGED OR COVERED) DURING SHIPPING. NO SILICONES ARE TO BE USED FOR THE MANUFACTURING OF THIS PART AND MATERIAL SHOULD BE SILICONE FREE.
2. N/A
3. N/A
4. N/A
5. N/A.
6. ASSEMBLE THESE PARTS AS PER EG-00420
7. N/A
8. N/A



FOR REBUILDING THE REGULATOR USE THE FOLLOWING KITS:

Regulator Kit Part No	Description	Regulator type
EO5093-503-020A	Complete Rebuild Kit	15 PSI Fixed
EO5093-503-020B	Complete Rebuild Kit	30 PSI Fixed
EO5093-503-020C	Complete Rebuild Kit	Air Pilot
EO5093-503-020D	Soft Rebuild Kit	N/A

FANUC PART NO	DESCRIPTION	ITEM 'A'	ITEM 'B'	LABEL 'C'	QTY 'D'
EO5093-503-000A	15 PSI FIXED REGULATION	EO-5093-503-002	EO-5093-503-009	15	0
EO5093-503-000B	30 PSI FIXED REGULATION	EO-5093-503-002	EO-5093-503-012	30	0
EO5093-503-000C	VARIABLE REGULATION	EO-5093-503-013	<NONE>	<NONE>	1

[EO-5093-503-000] REV *7
REGULATOR ASM SHEET 1 OF 1

Figure 11-22 ET-5093-890-005 Sheet 1 of 3, 5093 REGULATOR

5093 REGULATOR

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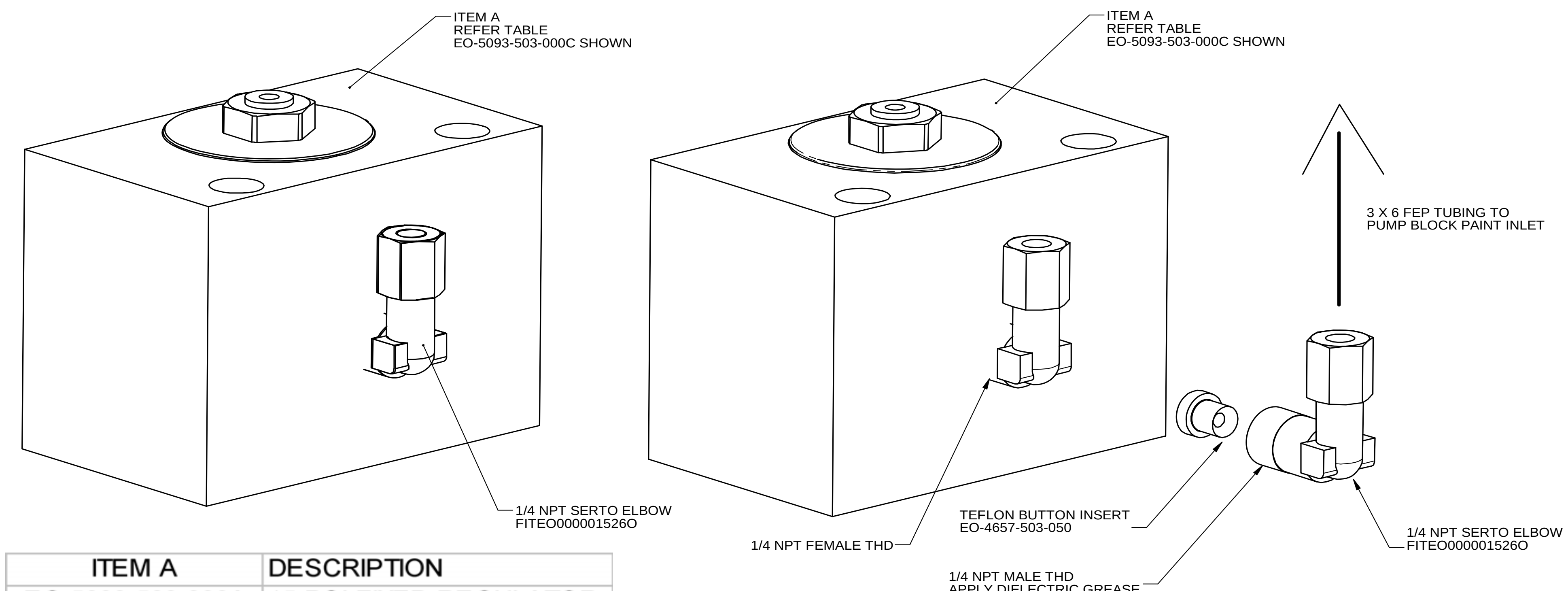
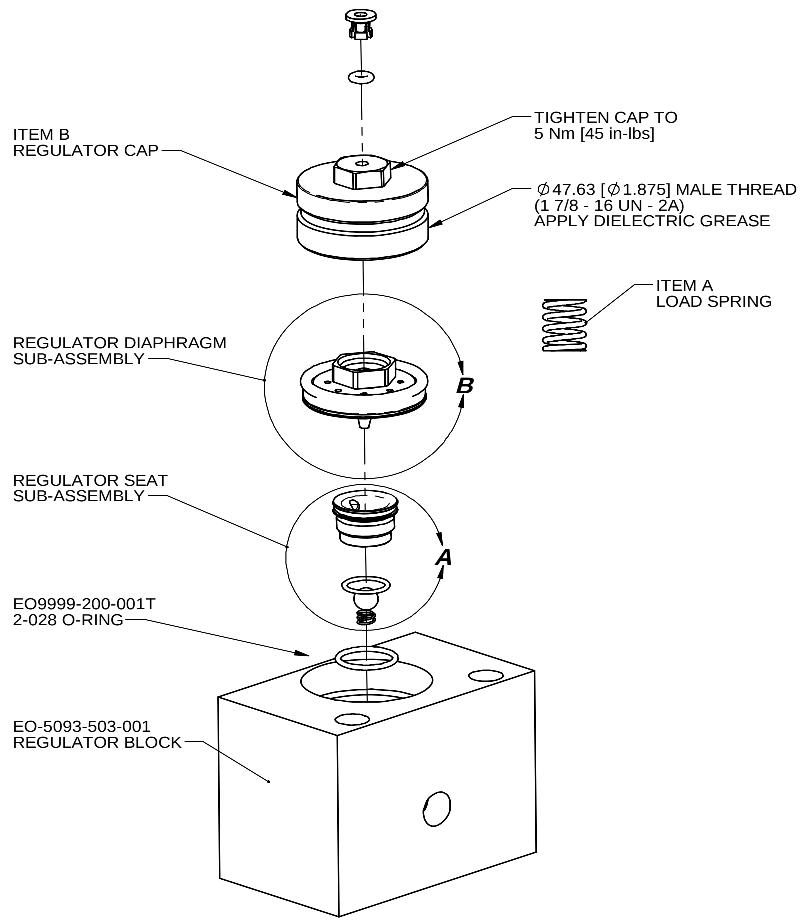
UNLESS OTHERWISE NOTED:
SEE EG-00008 FOR LOCTITE REQUIREMENTS
SEE EG-00010 FOR TORQUE SPECIFICATIONS



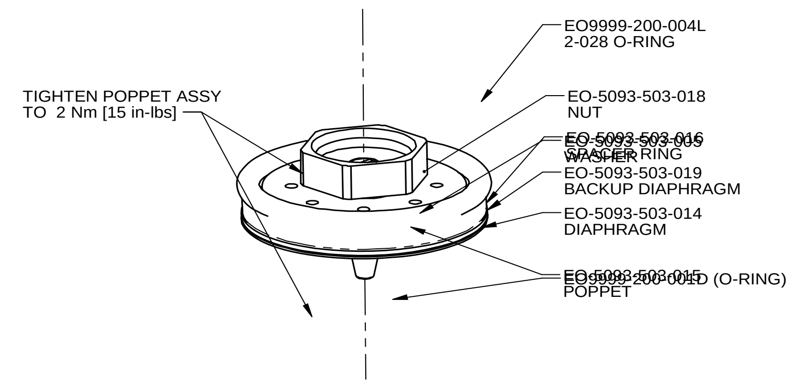
ITEM A	DESCRIPTION
EO-5093-503-000A	15 PSI FIXED REGULATOR
EO-5093-503-000B	30 PSI FIXED REGULATOR
EO-5093-503-000C	AIR PILOTED REGULATOR

[ET-5093-890-005] REV B1
5093 REGULATOR SHEET 1 OF 3

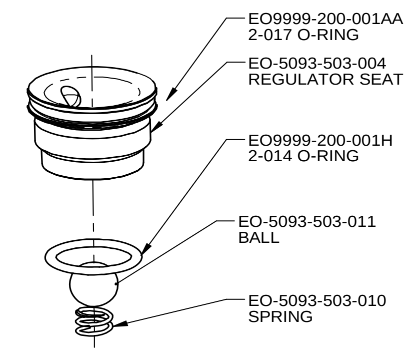
Figure 11-23 ET-5093-890-005 Sheet 2 of 3, 5093 REGULATOR



REGULATOR ASSEMBLY
INTERNAL PARTS



DETAIL B
SCALE 1 : 1



DETAIL A
SCALE 1 : 1

REGULATOR LOAD SPRING SELECTION

REGULATOR ASSM	ITEM A	DESCRIPTION
EO5093-503-000A	EO-5093-503-009	15 PSI FIXED REGULATION
EO5093-503-000B	EO-5093-503-012	30 PSI FIXED REGULATION
EO5093-503-000C	NONE	AIR PILOT

REGULATOR CAP SELECTION

REGULATOR ASSM	ITEM B	DESCRIPTION
EO5093-503-000A	EO-5093-503-002	PLAIN CAP
EO5093-503-000B	EO-5093-503-002	PLAIN CAP
EO5093-503-000C	EO-5093-503-013	AIR PILOT CAP

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

[ET-5093-890-005] 5093 REGULATOR	REV B1 SHEET 2 OF 3

Figure 11-24 ET-5093-890-005 Sheet 3 of 3, 5093 REGULATOR

REGULATOR MAINTENANCE AND REPAIR

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

REGULATOR MAINTENANCE SCHEDULE:
1. INSPECT REGULATORS DURING WEEKLY MAINTENANCE FOR LEAKS AND/OR MALFUNCTION.
2. MOST REGULATOR MALFUNCTIONS CAN BE REPAIRED IN FIELD BY REPLACING THE DIAPHRAGM - USE REGULATOR SOFT REBUILD KIT EO5093-503-020D.
3. REBUILD THE REGULATOR INTERNAL PARTS EVERY 5,000 HOURS OF USE. USE APPROPRIATE REBUILD KITS, EO5093-503-020A THRU C.
4. REPLACE SERTO ELBOW (FITEO000001526O) WHEN THE REGULATOR IS REBUILT.

MAINTENANCE PROCEDURES:
1. PERFORM A SUPER PURGE CYCLE BEFORE ANY REGULATOR MAINTENANCE.
2. DETACH THE REGULATOR FIRST FROM THE ROBOT ARM AND THEN FROM THE COLOR STACK.
3. PLACE THE REGULATOR WITH CAP POINTING UP ON A CLEAN HORIZONTAL SURFACE.
4. USE ONLY VALVE INSTALL TOOL (EO-5513-700-003) TO REMOVE AND INSTALL THE CAP.
5. USE REGULATOR REBUILD KIT (EO5093-503-020D) TO REPLACE DIAPHRAGM.
6. PLACE THE DIAPHRAGM-POPPET ASSEMBLY INTO THE REGULATOR WHILE THE REGULATOR IS IN UPRIGHT POSITION ONLY, TO PREVENT MISLAIGNMENT OF THE POPPET.
7. IF ALL THE INTERNAL PARTS OF THE REGULATOR ARE TO BE REPLACED, REMOVE THE REGULATOR TO A TABLE.
8. USE ONLY THE APPROPRIATE REBUILD KIT AS PER THE TABLE FOR REPLACING INTERNAL PARTS.

REGULATOR KIT PART NO	DESCRIPTION	REGULATOR	REGULATOR TYPE
EO5093-503-020A	Complete Rebuild Kit	EO5093-503-000A	15 PSI Fixed
EO5093-503-020B	Complete Rebuild Kit	EO5093-503-000B	30 PSI Fixed
EO5093-503-020C	Complete Rebuild Kit	EO5093-503-000C	Air Pilot
EO5093-503-020D	Soft Rebuild Kit	ALL	ALL

[ET-5093-890-005]	REV B1
5093 REGULATOR	SHEET 3 OF 3

The air piloted pressure regulator (EO5093-503-000C) is connected to the last Color Module. This module controls the pressure of the paint supplied to the gear pump. A pilot air signal is applied to an internal diaphragm which in turn controls a poppet valve within the regulator body.

11.6.5 Pressure Regulator (Fixed)

The fixed pressure regulator (EO5093-503-000B) is connected to the last Color Module. This module controls the pressure of the paint supplied to the gear pump. A constant force supplied by a spring is applied to an internal diaphragm which in turn controls a poppet valve within the regulator body.

11.6.6 Maintenance and Repair

Figure 11-25 ET-5093-890-006 Sheet 1 of 2, P700 1K PM SCHEDULES

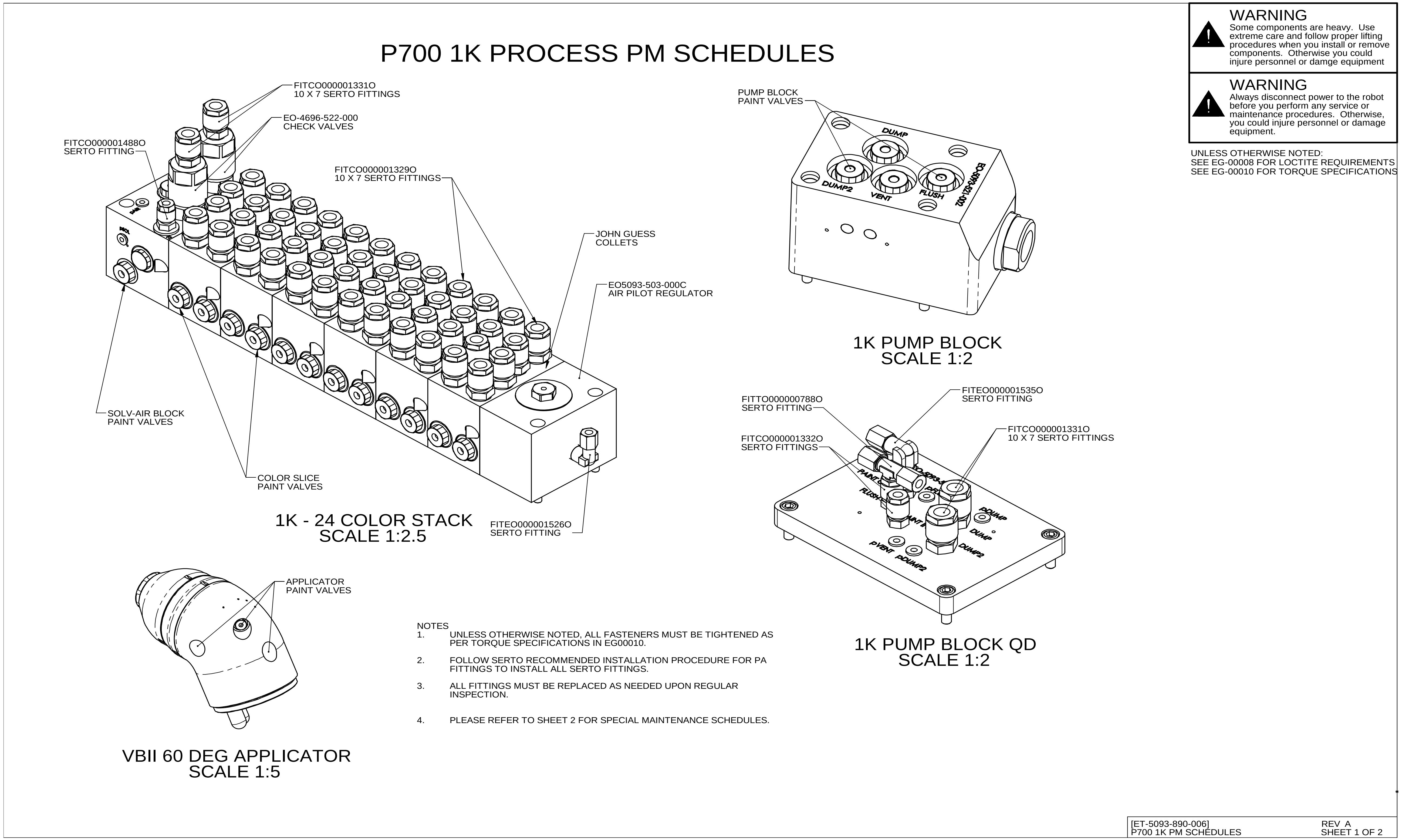

Figure 11-26 ET-5093-890-006 Sheet 2 of 2, P700 1K PM SCHEDULES

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

PAINT VALVES - GENERAL MAINTENANCE GUIDLINES
1. INSPECT ALL PAINT VALVES DURING WEEKLY MAINTENANCE FOR LEAKS AND/OR MALFUNCTION.
2. PAINT VALVE IS NOT FIELD SERVICEABLE UNIT.
3. PAINT VALVE MUST BE REPLACED AS A WHOLE.
4. REPLACE A DAMAGED VALEVE WITH A NEW VALVE.
5. DISCARD DAMAGED PAINT VALVES PROMPTLY - DO NOT STORE THEM.
6. LIFE OF A PAINT VALVE UNDER NORMAL OPERATION IS 2,000,000 (TWO MILLION) CYCLES.
7. REPLACE PAINT VALVES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT VALVE LOCATION	AVG CYCLES PER JOB	REPLACE AFTER HOURS IN USE	NO. OF YEARS WITH ONE 10HR SHIFT	NO. OF YEARS WITH TWO 10HR SHIFTS
COLOR STACK	1	30,000	10 YRS 2 QTRS	5 YRS 1 QTR
SOLV-AIR BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS
PUMP BLOCK	2	15,000	5 YRS 1 QTR	2 YRS 2 QTRS
APPLICATOR	3	10,000	3 YRS 2 QTRS	1 YR 3 QTR

HOSES - GENERAL MAINTENANCE GUIDLINES

1. INSPECT ALL HOSES DURING WEEKLY MAINTENACE.
2. MAKE SURE THAT THERE IS NO FLUID OF ANY KIND IN AIR PILOT HOSES.
3. REPLACE DAMAGED OR FAULTY HOSES AS NEEDED.
4. REPLACE HOSE ALONG WITH FITTINGS AT BOTH ENDS.
5. REPLACE HOSES ACCORDING TO THE FOLLOWING SCHEDULE:

PAINT SUPPLY HOSES - FROM PAINT DROP TO COLOR STACK - ANNUAL
SOLVENT AND AIR SUPPLY HOSES - ANNUAL
PILOT HOSES ON INNER ARM - ANNUAL
WASH LINE - FROM SOLV AIR BLOCK TO PUMP BLOCK - ANNUAL
PAINT-IN LINE - FROM REGULATOR TO PUMP BLOCK - ANNUAL
HOSE BUNDLE - EO-5093-545-000 ASSEMBLY - 6 MONTHS

SERTO FITTINGS AND JOHN GUESS COLLETS
1. INSPECT ALL FITTINGS DURING WEEKLY MAINTENANCE.
2. ALL FITTINGS MUST BE REPLACED AS NEEDED UPON REGULAR INSPECTION.
3. DISCARD THE REPLACED FITTINGS - DO NOT STORE THEM.

OTHER PARTS MAINTENANCE SCHEDULE
1. CHECK VALVES - ANNUAL
2. PRESSURE SENSOR - AS NEEDED
3. 3CC GEAR PUMP - REFER TO GEAR PUMP MAINTENANCE (ET-5093-890-007)

[ET-5093-890-006] REV A
P700 1K PM SCHEDULES SHEET 2 OF 2

15. Inspect all paint valves during weekly maintenance for leaks and/or malfunction, using procedures found in EB-03516.
16. The paint valve is not a field serviceable unit.
17. Paint valves must be replaced as a whole.
18. Replaced a damaged valve with a new valve.
19. Discard damaged paint valves promptly – do not store them.
20. Life of a paint valve under normal operation is 2,000,000 cycles.
21. Replace paint valves according to the following schedule from ET-5093-890-006 using procedures found in EB-03516.

Paint Valve Location	Avg Cycles per Job	Replace after hours in use.	No.of years with 1 hour shift	No. of years with 2 hour shift
Color Stack	1	30000	10 YRS 2 QTRS	5 YRS 1 QTR
Solv-Air Block	2	15000	5 YRS 1 QTR	2 YRS 2 QTR
Pump Block	2	15000	5 YRS 1 QTR	2 YRS 2 QTR
Applicator	3	10000	3 YRS 2 QTRS	1 YR 3 QTR

Table 11-2: Wear part replacement schedule

11.6.7 SolvAir Module

5. Replace valves in the SolvAir Module after 15,000 hours in use.

6. Replace check valves annually, as suggested in ET-5093-890-006.

11.6.8 Color Module

35. Inspect color module and valves during weekly maintenance.

36. Replace valves in color module after 30,000 hours in use.

37. Turn off all paint and solvent supplies to the color changer manifold. Relieve all potentially entrapped paint, solvent, or air pressure in the system undergoing maintenance.

38. Inspect valves for fresh fluid in the weep holes.

39. Disconnect pilot lines.

40. Remove the paint valve in question. Use the color valve tool EO-5513-700-003 or a 17mm wrench and grasp the hex head surfaces of the valve.

41. It may be necessary to remove paint lines in order to clean valve socket.

42. Clean the interior of the valve socket with solvent. Inspect the stainless steel valve seat for any damage.

43. Thoroughly clean valve socket and pilot passage before installing valve.

44. Discard the damaged valve and replace with a new one. Insure that the new valve is seated properly by observing the stem of the actuator. It should be flush with the top of the valve. If the valve is over tightened the stem will be protruding from the top of the valve. If the stem is recessed into the valve, the valve is not tightened sufficiently.

45. Turn off all paint and solvent supplies to the color changer manifold. Relieve all potentially entrapped paint, solvent, or air pressure in the system undergoing maintenance.

46. Inspect valves for fluid in the weep holes.

47. Disconnect pilot lines.

48. Remove the paint valve in question. Use the color valve tool EO-5513-700-003 or a 17mm wrench and grasp the hex head surfaces of the valve.

49. Clean the interior of the valve path with solvent. Inspect the stainless steel valve seat for any scarring or deformation.

50. Thoroughly clean valve socket before installing valve.

51. Discard the damaged valve and replace with a new one. Insure that the new valve is seated properly by observing the stem of the actuator. It should be flush with the top of the valve. If the valve is overtightened the stem will be protruding from the top of the valve. If the stem is recessed into the valve, the valve is not tightened sufficiently.

11.7 Troubleshooting

11.7.1 SolvAir Module

If no SolvAir is produced when requested check the following items:

5. Verify that the SOL, AIR, and 2T valves actuate by observing the valve poppets. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

6. Verify that the solvent pressure is at least 10 PSI above supply air pressure.

11.7.2 Color Module

Typically only two problems arise with this color valve:

5. Leakage out the weep port or through a worn valve that is not seating properly. If leakage is observed, replace the worn valve using procedures found in EB-03516.

6. Improper actuation: This can be observed by viewing the stem of the valve poppet actuator. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

11.8 Troubleshooting

11.8.1 SolvAir Module

If no SolvAir is produced when requested check the following items:

3. Verify that the SOL, AIR, and 2T valves actuate by observing the valve poppets. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

4. Verify that the solvent pressure is at least 10 PSI above supply air pressure.

11.8.2 Color Module

Typically only two problems arise with this color valve:

3. Leakage out the weep port or through a worn valve that is not seating properly. If leakage is observed, replace the worn valve using procedures found in EB-03516.

4. Improper actuation: This can be observed by viewing the stem of the valve poppet actuator. When the valve is actuated the stem should protrude slightly from the top of the valve. If the stem is recessed into the valve body without a signal applied, the valve is not seated properly, or the actuator/poppet is defective. If the valve is not actuating properly, replace the failed valve using procedures found in EB-03516.

11.9 Spare parts and special tools

Figure 11-27 EO-5093-700-005, FITTING WRENCH

Figure 11-28 EO-5093-700-017, VALVE TOOL

WARNING
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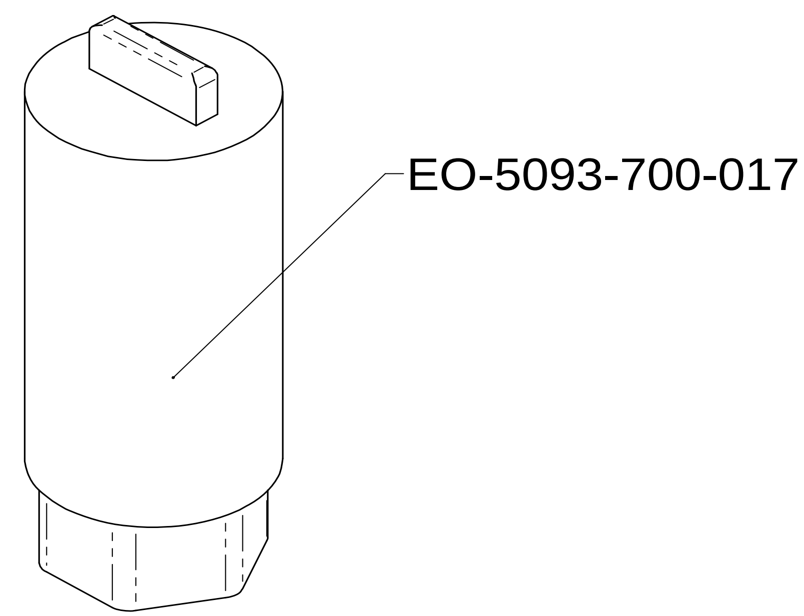

[EO-5093-700-017] REV 0
VALVE TOOL SHEET 1 OF 1