FANUC Robot series

R-30/B CONTROLLER
PROCESS LOGGER

SETUP AND OPERATIONS MANUAL

Version 8.10 and later

MAROBPLOG04121E REV. B

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

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Patents

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

FANUC Robotics America Corporation Patent List

 $\begin{array}{l} 4,630,567\ 4,639,878\ 4,707,647\ 4,708,175\ 4,708,580\ 4,942,539\ 4,984,745\ 5,238,029\ 5,239,739\ 5,272,805\ 5,293,107\ 5,293,911\ 5,331,264\ 5,367,944\ 5,373,221\ 5,421,218\ 5,434,489\ 5,644,898\ 5,670,202\ 5,696,687\ 5,737,218\ 5,823,389\ 5,853,027\ 5,887,800\ 5,941,679\ 5,959,425\ 5,987,726\ 6,059,092\ 6,064,168\ 6,070,109\ 6,086,294\ 6,122,062\ 6,147,323\ 6,204,620\ 6,243,621\ 6,253,799\ 6,285,920\ 6,313,595\ 6,325,302\ 6,345,818\ 6,356,807\ 6,360,143\ 6,378,190\ 6,385,508\ 6,425,177\ 6,477,913\ 6,490,369\ 6,518,980\ 6,540,104\ 6,541,757\ 6,560,513\ 6,569,258\ 6,612,449\ 6,703,079\ 6,705,361\ 6,726,773\ 6,768,078\ 6,845,295\ 6,945,483\ 7,149,606\ 7,149,606\ 7,211,978\ 7,266,422\ 7,399,363 \end{array}$

FANUC CORPORATION Patent List

4,571,694 4,626,756 4,700,118 4,706,001 4,728,872 4,732,526 4,742,207 4,835,362 4,894,596 4,899,095 4,920,248 4,931,617 4,934,504 4,956,594 4,967,125 4,969,109 4,970,370 4,970,448 4,979,127 5,004,968 5,006,035 5,008,834 5,063,281 5,066,847 5,066,902 5,093,552 5,107,716 5,111,019 5,130,515 5,136,223 5,151,608 5,170,109 5,189,351 5,267,483 5,274,360 5,292,066 5,300,868 5,304,906 5,313,563 5,319,443 5,325,467 5,327,057 5,329,469 5,333,242 5,337,148 5,371,452 5,375,480 5,418,441 5,432,316 5,440,213 5,442,155 5,444,612 5,449,875 5,451,850 5,461,478 5,463,297 5,467,003 5,471,312 5,479,078 5,485,389 5,485,552 5,486,679 5,489,758 5,493,192 5,504,766 5,511,007 5,520,062 5,528,013 5,532,924 5,548,194 5,552,687 5,558,196 5,561,742 5,570,187 5,570,190 5,572,103 5,581,167 5,582,750 5,587,635 5,600,759 5,608,299 5,608,618 5,624,588 5,630,955 5,637,969 5,639,204 5,641,415 5,650,078 5,658,121 5,668,628 5,687,295 5,691,615 5,698,121 5,708,342 5,715,375 5,719,479 5,727,132 5,742,138 5,742,144 5,748,854 5,749,058 5,760,560 5,773,950 5,783,922 5,799,135 5,812,408 5,841,257 5,845,053 5,872,894 5,887,122 5,911,892 5,912,540 5,920,678 5,937,143 5,980,082 5,983,744 5,987,591 5,988,850 6,023,044 6,032,086 6,040,554 6,059,169 6,088,628 6,097,169 6,114,824 6,124,693 6,140,788 6,141,863 6,157,155 6,160,324 6,163,124 6,177,650 6,180,898 6,181,096 6,188,194 6,208,105 6,212,444 6,219,583 6,226,181 6,236,011 6,236,896 6,250,174 6,278,902 6,279,413 6,285,921 6,298,283 6,321,139 6,324,443 6,328,523 6,330,493 6,340,875 6,356,671 6,377,869 6,382,012 6,384,371 6,396,030 6,414,711 6,424,883 6,431,018 6,434,448 6,445,979 6,459,958 6,463,358 6,484,067 6,486,629 6,507,165 6,654,666 6,665,588 6,680,461 6,696,810 6,728,417 6,763,284 6,772,493 6,845,296 6,853,881 $6.888,089\ 6.898,486\ 6,917,837\ 6,928,337\ 6,965,091\ 6,970,802\ 7,038,165$ 7,069,808 7,084,900 7,092,791 7,133,747 7,143,100 7,149,602 7,131,848 7,161,321 7,171,041 7,174,234 7,173,213 7,177,722 7,177,439 7,181,294 7,181,313 7,280,687 7,283,661 7,291,806 7,299,713 7,315,650 7,324,873 7,328,083 7,330,777 7,333,879 7,355,725 7,359,817 7,373,220 7,376,488 7,386,367 7,464,623 7,447,615 7,445,260 7,474,939 7,486,816 7,495,192 7,501,778 7,502,504 7,508,155 7,512,459 7,525,273 7,526,121

Conventions

AWARNING

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

ACAUTION

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

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

Safety

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

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

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

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

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

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

CONSIDERING SAFETY FOR YOUR ROBOT INSTALLATION

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

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

Keeping People Safe

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

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

Using Safety Enhancing Devices

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

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

Setting Up a Safe Workcell

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

- Sponsor your personnel for training in approved FANUC Robotics training course(s) related to your application. Never permit untrained personnel to operate the robots.
- Install a lockout device that uses an access code to prevent unauthorized persons from operating the robot.
- Use anti-tie-down logic to prevent the operator from bypassing safety measures.
- Arrange the workcell so the operator faces the workcell and can see what is going on inside the cell.
- Clearly identify the work envelope of each robot in the system with floor markings, signs, and special barriers. The work envelope is the area defined by the maximum motion range of the robot, including any tooling attached to the wrist flange that extend this range.
- Position all controllers outside the robot work envelope.

- Never rely on software or firmware based controllers as the primary safety element unless they comply with applicable current robot safety standards.
- Mount an adequate number of EMERGENCY STOP buttons or switches within easy reach of the operator and at critical points inside and around the outside of the workcell.
- Install flashing lights and/or audible warning devices that activate whenever the robot is operating, that is, whenever power is applied to the servo drive system. Audible warning devices shall exceed the ambient noise level at the end–use application.
- Wherever possible, install safety fences to protect against unauthorized entry by personnel into the work envelope.
- Install special guarding that prevents the operator from reaching into restricted areas of the work envelope.
- Use interlocks.
- Use presence or proximity sensing devices such as light curtains, mats, and capacitance and vision systems to enhance safety.
- Periodically check the safety joints or safety clutches that can be optionally installed between the robot wrist flange and tooling. If the tooling strikes an object, these devices dislodge, remove power from the system, and help to minimize damage to the tooling and robot.
- Make sure all external devices are properly filtered, grounded, shielded, and suppressed to prevent hazardous motion due to the effects of electro—magnetic interference (EMI), radio frequency interference (RFI), and electro—static discharge (ESD).
- Make provisions for power lockout/tagout at the controller.
- Eliminate *pinch points*. Pinch points are areas where personnel could get trapped between a moving robot and other equipment.
- Provide enough room inside the workcell to permit personnel to teach the robot and perform maintenance safely.
- Program the robot to load and unload material safely.
- If high voltage electrostatics are present, be sure to provide appropriate interlocks, warning, and beacons.
- If materials are being applied at dangerously high pressure, provide electrical interlocks for lockout of material flow and pressure.

Staying Safe While Teaching or Manually Operating the Robot

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

- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Know whether or not you are using an intrinsically safe teach pendant if you are working in a hazardous environment.

- Before teaching, visually inspect the robot and work envelope to make sure that no
 potentially hazardous conditions exist. The work envelope is the area defined by the
 maximum motion range of the robot. These include tooling attached to the wrist
 flange that extends this range.
- The area near the robot must be clean and free of oil, water, or debris. Immediately report unsafe working conditions to the supervisor or safety department.
- FANUC Robotics recommends that no one enter the work envelope of a robot that is on, except for robot teaching operations. However, if you must enter the work envelope, be sure all safeguards are in place, check the teach pendant DEADMAN switch for proper operation, and place the robot in teach mode. Take the teach pendant with you, turn it on, and be prepared to release the DEADMAN switch. Only the person with the teach pendant should be in the work envelope.

AWARNING

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:

AWARNING

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

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

Staying Safe During Automatic Operation

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

• Make sure all safety provisions are present and active.

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

Staying Safe During Inspection

When inspecting the robot, be sure to

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

Staying Safe During Maintenance

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

- Never enter the work envelope while the robot or a program is in operation.
- Before entering the work envelope, visually inspect the workcell to make sure no potentially hazardous conditions exist.

- Never wear watches, rings, neckties, scarves, or loose clothing that could get caught in moving machinery.
- Consider all or any overlapping work envelopes of adjoining robots when standing in a work envelope.
- Test the teach pendant for proper operation before entering the work envelope.
- If it is necessary for you to enter the robot work envelope while power is turned on, you must be sure that you are in control of the robot. Be sure to take the teach pendant with you, press the DEADMAN switch, and turn the teach pendant on. Be prepared to release the DEADMAN switch to turn off servo power to the robot immediately.
- Whenever possible, perform maintenance with the power turned off. Before you open the controller front panel or enter the work envelope, turn off and lock out the 3-phase power source at the controller.
- Be aware that when you remove a servomotor or brake, the associated robot arm will fall if it is not supported or resting on a hard stop. Support the arm on a solid support before you release the brake.

AWARNING

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.

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

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

KEEPING MACHINE TOOLS AND EXTERNAL DEVICES SAFE

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

Programming Safety Precautions

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

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

Mechanical Safety Precautions

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

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

KEEPING THE ROBOT SAFE

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

Operating Safety Precautions

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

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

Programming Safety Precautions

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

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

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

ADDITIONAL SAFETY CONSIDERATIONS FOR PAINT ROBOT INSTALLATIONS

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

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

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

A CAUTION

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

Paint robots are operated in three modes:

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

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

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

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

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

Paint System Safety Features

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

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

The paint system includes the following safety features:

Most paint booths have red warning beacons that illuminate when the robots are armed and ready to paint. Your booth might have other kinds of indicators. Learn what these are.

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



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

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

Staying Safe While Operating the Paint Robot

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



Observe all safety rules and guidelines to avoid injury.

AWARNING

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.

A 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
- 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.



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

- **Grounding**: All electrically conductive objects in the spray area must be grounded. This includes the spray booth, robots, conveyors, workstations, part carriers, hooks, paint pressure pots, as well as solvent containers. Grounding is defined as the object or objects shall be electrically connected to ground with a resistance of not more than 1 megohms.
- **High Voltage**: High voltage should only be on during actual spray operations. Voltage should be off when the painting process is completed. Never leave high voltage on during a cap cleaning process.
- Avoid any accumulation of combustible vapors or coating matter.
- Follow all manufacturer recommended cleaning procedures.
- Make sure all interlocks are operational.

- No smoking.
- Post all warning signs regarding the electrostatic equipment and operation of electrostatic equipment according to NFPA 33 Standard for Spray Application Using Flammable or Combustible Material.
- Disable all air and paint pressure to bell.
- Verify that the lines are not under pressure.

Staying Safe During Maintenance

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

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

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1 Overview

1 OVERVIEW

1.1 DESCRIPTION OF PROCESS LOGGER

Process Logger is an option (R758) for application products. It collects process specific data during each execution of the application process (SPOT, Weld Start to Weld End, Seal Start to Seal End, Gun ON to Gun OFF). It stores a data record for each process executed each time the program is run, creating a historical log. Viewing and analyzing the logged data can be helpful in understanding the process and in preventing or diagnosing problems.

Each application process (Spot, Arc, Dispense, Paint, etc.) has predefined the data to log as one record. The total number of data records which can be stored for each process instruction is also predefined for each application. The amount of memory which will be used to store process data is limited and configurable.

A Process ID is used to uniquely identify each weld (or seam, etc.) in a user's Teach Pendant program. The Process ID and the TP program name are stored in the log and are used to uniquely identify the data.

There are several ways to access and view the collected data, including:

- o viewing the TP Editor with a related view,
- o using the TP STATUS Reporting menu,
- o accessing the Robot web server with a browser
- o using FTP to pull the data file to a remote PC.

Process Logger Interface

2

2 PROCESS LOGGER INTERFACE

2.1 USING PROCESS LOGGER

- o Process Logger collects data automatically during process execution. Spot welding requires only one application instruction. A data record is saved for each SPOT instruction, each time the instruction is executed. Continuous process applications are modal, requiring Start and End instructions. For these applications, a data record is saved when the End instruction is executed.
- o The first time a program is executed, the data is not saved until the program ends. So if power was cycled before the program was completed the first time, then the data would be lost. Once the program ends the first time, then the data will be saved. All subsequent executions will always be saved.
- There is a configuration sysvar associated with Process Logger. It is \$PRCREP, and contains the following items.
 - o \$PRCREP.\$ENABLE: When set to FALSE, will stop Process Logger from logging data.
 - o \$PRCREP.\$MMEM_SIZE: This is the maximum amount of memory that Process Logger should use. This value is in bytes. The default is 1000000 which is 1Meg of memory.
 - \$PRCREP.\$DAT_RSET_DI: This is the Digital Input index to allow remote clearing of the process data. When this input is turned on, then Process Logger will clear all its process data. It will then turn on DOUT[\$PRCREP.\$DAT_RSET_DO] until this DIN is turned off.
 - o \$PRCREP.\$DAT_RSET_DO: This is the Digital Output index that Process Logger uses to indicate it has received the remote clear data signal, and has performed the action.
 - \$PRCREP.\$MIN_FROM: This is the low FROM threshold for Process Logger to stop logging new data for new Process Instructions. This value is specified in Kilobytes. The default is 2000 which is 2Meg of FROM.
 - \$PRCREP.\$MIN_DRAM: This is the low DRAM threshold for Process Logger to stop logging new data for new Process Instructions. This value is specified in Kilobytes. The default is 2000 which is 2Meg of DRAM.
 - \$PRCREP.\$DSP_CMNT: When this item is TRUE, and if supported by the application, Process Logger will display the instructions comment field in the Process Data menu.
 - o \$PRCREP.\$DSP_TCHUP: When this item is TRUE, and if supported by the application, Process Logger will display the last Touchup/Taught time of the instruction.
- Clearing Process Logger data
 - o There are 2 ways to clear the Process Logger data.
 - 1. From the Process Data Status menu, Press Next, then F1 [CLR_DAT]. You will be prompted to confirm clearing of the data.
 - 2. Using the above mentioned Digital Input from a remote device. The remote input is specified in \$PRCREP.\$DAT_RSET_DI.

2.2 Viewing Process Logger data on the Pendant.

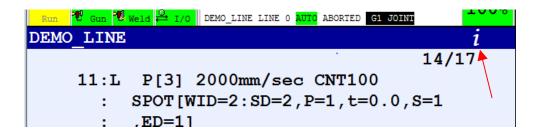
Procedure 2-3 Process Logger related view.

Conditions

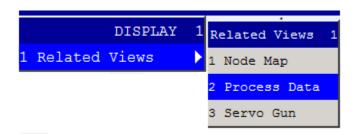
• The program to be examined has been executed and process data was recorded.

Step

- 1 Use the SELECT menu to choose the program you want to view.
 - **a** In the editor, an italicized *i* in the far right of the title bar, indicates related information is available. Refer to the application-specific Setup and Operations Manual for more information.

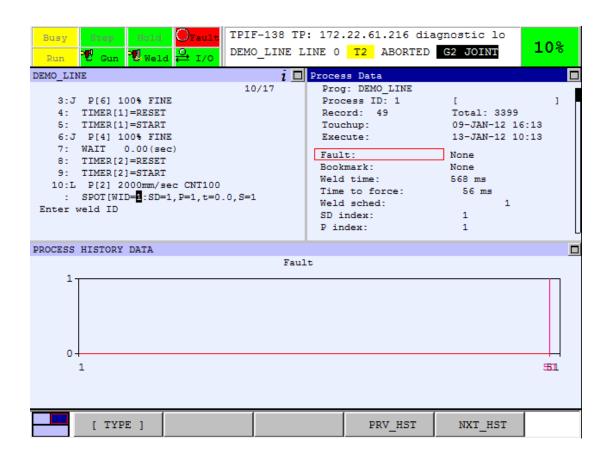


- **b** Position the cursor on an application instruction. In a SPOT program, it can be anywhere in the SPOT[...] instruction. For applications like Arc and dispense, then place the cursor anywhere in the Weld End or Seal End instruction.
- **c** If you have a touch screen, you can tap the *i* in the title bar.
- **d** If you don't have a touch screen, hold down the i key and press FCTN.
- **e** A list of related views similar to the following will appear.



- f Choose "Process Data".
- **q** The pendant will automatically switch to the 3 pane display mode shown below.
- **h** The upper left pane (pane 1) will contain the editor, the upper right pane (pane 2) will contain the process data for the instruction you are viewing in the left pane. The lower wide pane

(pane 3) will contain a chart of the last X histories of the current process field the cursor is on in pane 2.



Note: The selected pane is still shown as active by having a dark blue title bar. The other 2 non selected panes instead of being the standard gray are a light blue. This light blue indicates that the panes are linked together and following. In this case, pane 2 follows what you are looking at in the editor in pane 1, and pane 3 charts the current item you have the cursor on in pane 2. If you change any of the menus in the related view config, the link is considered broken. You will notice the non selected title bars will return to gray. Even if you return the menu you changed to the correct one, the link is still broken, you will need to re-initiate the related view to get them linked up again, and at this point, the non selected panes title bars will return to light blue to show they are linked and following again.

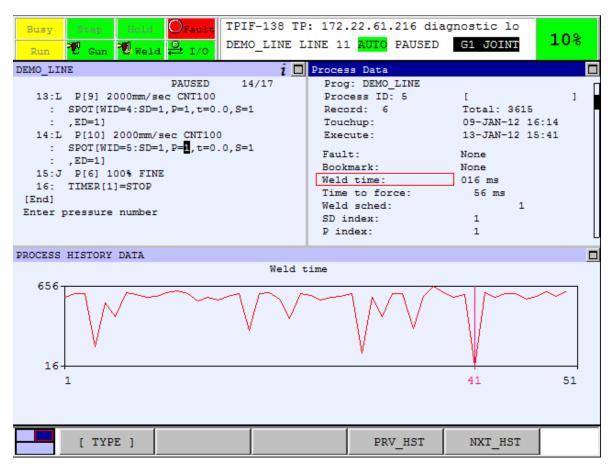
- i The top 5 lines shown in pane 2 describe the current instruction you are on in pane 1.
 - a) PROG: is the name of the program you are currently viewing in pane 1.
 - b) PROCESS ID is the ID of the instruction you are viewing in pane 1.
 - (1) For Spotwelding, the PROCESS ID = the Weld ID or WID field in the SPOT[...] instruction.
 - (a) You must have Weld ID enabled on the Spot Config SETUP menu to use Process Logger with SpotWelding.
 - (b) By default Auto Weld ID (\$spotconfig.\$auto_wldid) will be on when Process Logger is loaded. Auto Weld ID for Spotwelding means that when you teach a SPOT[...] instruction by performing

- (c) SHIFT-SPOT in the editor, the WELD ID field in the SPOT instruction will automatically be set to the Position ID * 10 for gun #1, and Position ID * 10 + 1 for gun #2. This is very convenient if you have no specification or naming convention for WELD ID. In this case, you don't have to set a WELD ID every time you teach a SPOT[...]. If you want to manually assign WELD ID's, or they were created offline, then set \$spotconfig.\$auto_wldid = FALSE.
- (2) For Arcwelding, the PROCESS ID = the Weld ID or WID field in the Arc End instruction.
- (3) For Sealing, the PROCESS ID = the POSITION ID of the Seal End instruction, unless it is a stand alone instruction. If it is a stand alone instruction, then the PROCESS ID = line number of the instruction.
- (4) For Paint, the PROCESS ID is not used, as the process parameters will not be collected on a per instruction basis, but on a per Program basis. Because there is no Process ID for paint, its related view will be from the SELECT menu. As you cursor up and down in the select menu with the Process Logger related view active, the data for different programs will be displayed in the right pane.
- c) Next to PROCESS ID is [], this is the comment, which if supported by the application, and enabled via \$PRCREP.\$DSP_CMNT will display the comment from the position comment in the TP program for the current instruction.
- d) RECORD tells you the current record you are viewing of the XX histories available for the current instruction.
- e) TOTAL tells you the total number of executions of this instruction since the data was last reset.

Note: Although there are only X histories available on the controller, where X is determined by the application, Process Logger keeps a long time running MIN, MAX, AVG, for each process field being collected until the data is cleared. These MIN, MAX, AVG are viewing in the web view or available in the STATUS→Process Reporting menu.

- f) Touchup, if supported by the application, and enabled via \$PRCREP.\$DSP_TCHUP is the last time the position was taught or touched up.
- **j** After the top 5 common lines, then follows the application specific process data being collected for the current record you are viewing.
- **k** Use the DISP key to move focus to pane 2.
- Use the cursor keys to cursor up and down (if you have a touch screen, you can touch the item you want) and view the specific process item. As you choose a new process item, the last X number of histories for that specific Process instruction (Weld, Weld Seam, Seal Seam, etc...) are automatically charted for you in pane 3.
- **m** Note that there is a sample marker in the chart (see image below). When the Process Data related view is first displayed, the sample marker is placed at the far right of the chart as this represents the latest process data.

n Use F4/F5 or left arrow/right arrow to move the sample marker one record at a time in the chart. Holding SHIFT while pressing the above keys will allow the sample marker to move by 10 records.



- As you move the sample marker up and down the records history, the process data for each history record updates in pane 2 so you can see the exact value of the parameter you are looking at, along with the value of other process parameters for that history.
- **p** The chart in pane 3 has it's MIN and MAX auto-scaled by the data in last X histories, so just by viewing the chart, you can see the min and max that have happened in the last X histories.
- **q** If your focus is on the editor in pane one, as you cursor up and down the TP program to different process instructions with different process ID's, pane 2 and pane 3 will update to provide the data for the process ID you are viewing in pane 1. Using this feature allows you to compare specific process parameters between different welds, weld seams, seal seams, etc...

2.4 Generating reports using Process Logger.

Procedure 2-5 TP STATUS Process Reporting menu.

Conditions

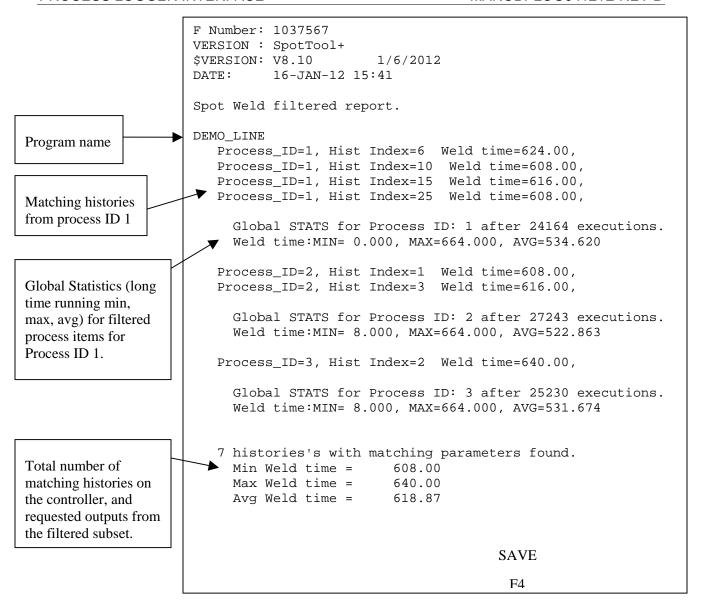
Programs have been executed and collected process data.

Step

- 1 From the STATUS menu, choose "Process Report"
 - **a** The Process Reporting menu provides a database query type interface into your already logged process data.
 - **b** On this menu you can choose the following items.
 - a) Application: Application from which you wish to see data for.
 - b) Report Type: The report type is either User Defined from which the user can input the filters he wants to use, or the Report Type is considered a "canned" report, which is one provided as a default report type for the user where no other inputs are required.
 - c) Filters: The user will have 5 filters to use. The filters are the data items being collected. The comparator for the filter can be >, <, or =, and the user can specify the value to which to compare the field to.
 - d) Outputs: The user will have 3 outputs for the report, the outputs will be the items being collected, and the user can specify a MIN, MAX, or AVG for the output item for the data set found for the filters.
 - **c** A report will be generated that shows all matching results of the filters.
 - **d** Filter 1 can be specified to be execution time so that you can filter on data from a specific date/time or range of time. Below is an example of a user defined filter.

```
PROCESS REPORTING
                                           7/13
       1:Exec time
        Start date:16/JAN/12 TIME:00:00:00
       End Date :16/JAN/12 TIME:23:59:00
       2:Weld time
                              600.00
                          >
                              0.00
       3:NONE
                          =
                              0.00
       4:NONE
                              0.00
       5:NONE
     OUTPUTS
               Weld time
       1:MIN
               Weld time
      2:MAX
       3:AVG
               Weld time
     [ TYPE ]
                          EXEC
                                            CLEAR
```

e The results of executing the above report would be something like the following. Since we are limited to the number of histories we can store on the robot, for each weld, MIN, MAX, and AVG are calculated and stored until they are reset, this way you can have statistical data for a long time, and not just from your 50 or 100 history These are called GLOBAL STATISTICS.



- **f** Press F4 to save the report results to the currently set device To change the device, use the [UTIL] feature on the File Menu.
- **g** To clear the Process Data, press the NEXT key, and then press F6 CLR_DAT. You will be prompted to confirm you want to clear the data. The data can also be cleared remotely via a PLC by using the Digital inputs mapped in the \$PRCREP.\$DAT_RSET_DI, and reset confirmation echoed on \$PRCREP.\$DAT_RSET_DO.

2.6 Viewing Process Logger data Remotely

Procedure 2-7 Robot Web server Interface

Conditions

- Programs have been executed and collected process data.
- Robot is on Ethernet network.
- There are two ways to view the data.
 - 1. As a web page in table format
 - 2. As a .csv file that can be downloaded and directly imported into a program like Microsoft ® Excel.

Step

1 To view as a web page, do the following: Using a web browser on your PC, bring up the robots home page. You should see a screen similar to the following:



- **2** Choose the "Error/Diagnostic files (text) available on MD:" link:
- **3** Each application will have its own web interface file.
- **4** All Process Logger web interface files are named PRCXXSUM.DG. Where XX represents the 2 letter application abbreviation. i.e SW=SPOT, AW= ARC, SL = SEAL, etc...
- **5** Click the link for the application you want.

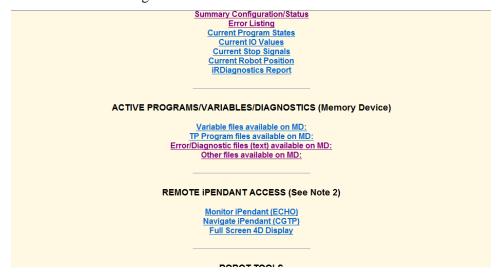
- **6** All the recorded data for the selected application will be displayed in a spreadsheet type format as shown below:
 - **a** The data is presented as each record of all the histories stored. The data is grouped first by Program name, then each Process ID and its histories for that program.

F Number: 1037567											
		-	TOUCHUP_TIME	Exec_time	Fault	Bookmark	Weld time (ms)	Time to force (ms)	Weld sched		P index
1	DEMO_LINE	1	09-JAN-12 16:13	18-JAN- 12 13:44	None	00-0-80 00:00	560	112	1	1	1
2	DEMO_LINE	1	09-JAN-12 16:13	18-JAN- 12 13:45	None	00-0-80 00:00	600	56	1	1	1
3	DEMO_LINE	1	09-JAN-12 16:13	18-JAN- 12 13:45	None	00-0-80 00:00	608	56	1	1	1
4	DEMO_LINE	1	09-JAN-12 16:13	18-JAN- 12 13:45	None	00-0-80 00:00	552	64	1	1	1
5	DEMO_LINE	1	09-JAN-12 16:13	18-JAN- 12 13:46	None	00-0-80 00:00	568	56	1	1	1
6	DEMO_LINE	1	09-JAN-12 16:13	18-JAN- 12 13:46	None	00-0-80 00:00	360	56	1	1	1
7	DEMO_LINE	1	09-JAN-12 16:13	18-JAN- 12 13:46	None	00-0-80 00:00	592	56	1	1	1
8	DEMO_LINE	1	09-JAN-12 16:13	18-JAN- 12 13:46	None	00-0-80 00:00	584	56	1	1	1

To download the comma separated file, do the following:

Step

1 Using a web browser on your PC, bring up the robots home page. You should see a screen similar to the following:



- **2** Choose Other files available on MD:
- **3** Each application will have its own .csv file.
- **4** All Process Logger .csv files are named PRCXXSUM.CSV. Where XX represents the 2 letter application abbreviation. i.e SW=SPOT, AW= ARC, SL = SEAL, etc...
- **5** Click the link for the application you wish to save data for.

Procedure 2-8 Accessing Process Logger data via FTP

Conditions

- Programs have been executed and collected process data.
- Robot is on Ethernet network.

Step

- 1 Use your FTP client to login to the robot.
- **2** Once logged in, you will be on the MD: device.
- **3** USE your FTP client to get PRCXXSUM.DG, or PRCXXSUM.CSV. Where XX represents the 2 letter application abbreviation. i.e SW=SPOT, AW= ARC, SL = SEAL, etc...

Note: These files are also obtained when performing a "backup all" from the File Menu.

Note: All items in manual section 2.7 and later require software version V8.20 or later.

2.7 Process Logger Monitoring

Overview

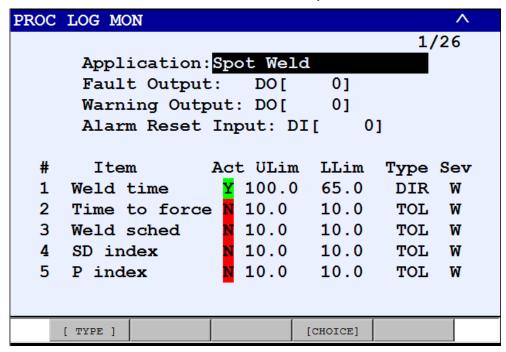
- Process Logger Monitoring allows the user to set limits on process parameters as they
 are collected by Process Logger, and post faults if the process parameters exceed those
 limits.
- The fault severity can be set to Warning or Fault(Fault severity will pause the robot). If you have R818 (iRConnect option) loaded, then the fault severity can also be set to Warning with iRConnect, or Fault with iRConnect.

Conditions

 You have process parameters you want to monitor to make sure they are within some limits.

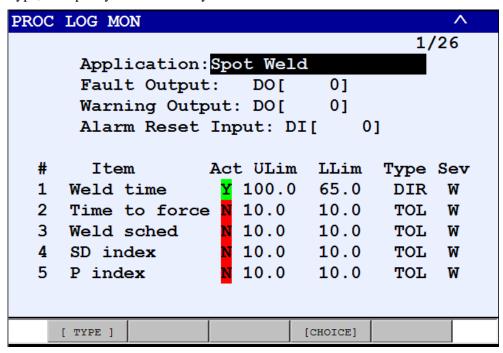
Step

1 From the SETUP menu, choose "Process Monitor" and you will see a screen like the following.



- **a** The Process Monitor menu provides a method to allow setting tolerances on the process parameters being collected, and enabling the monitoring of those tolerances.
- **b** On this menu you can set the following items.
 - a) Application: Chosen Application to see data from.

- b) Fault Output: This output can be mapped to the PLC. This Output will be turned on when any of the items being monitored are out of tolerance, and the severity is set to FAULT.
- c) Warning Output: This output can be mapped to the PLC. This Output will be turned on when any of the items being monitored are out of tolerance, and the severity is set to Warning.
- d) Alarm Reset Input: This item can be mapped to the PLC. When this input is turned on, the Fault Output and Warning Output to the PLC will be turned off.
- e) Enable an item to be monitored, Set Upper and Lower limits, specify a Limit Type, and specify a Fault Severity.



- **c** Cursor down to an item you want to monitor.
 - a) Specify the Limit Type by cursoring over to the Type column and choose either DIRect or TOLerance.
 - b) When choosing DIRect, this means that Upper and Lower limits are the direct values to compare the process item's value to.
 - c) When choosing TOLerance, , then the ULim and LLim values are a percentage value around an average, this means the process item's value is compared to a tolerance band around this average.

Note that the limits are GLOBAL limits. They apply to all Welds, Seal Seams, Paint Strokes, etc... Because these limits are Global, most of the time you will set the Limit Type to Tolerance type, which will then provide limits around a learned average for each individual Weld, Seal seam, Paint Stroke, etc...

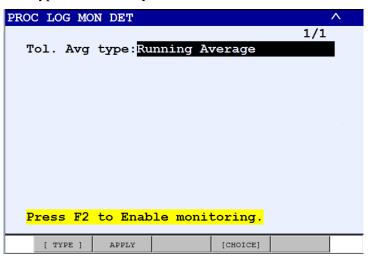
- **d** Cursor to Sev to choose the out of tolerance Severity. Your choices are shown below, where items 3 and 4 only show up if the iRConnect (R818) option is loaded.
 - a) Warning severity will post an error message to the alarm log, but the robot will continue with it's process.
 - b) Fault severity will post an error message to the alarm log, but the robot will pause.

```
1 W (Warning)
2 F (Fault)
3 WR (Warning + iRConnect)
4 FR (Fault + iRConnect)
5
```

e If you choose iRConnect as your severity, then the system will send XX number of history records to the iRConnect system so you can see which history was out of tolerance, and a number of previous histories. The number of histories sent is controlled by \$Prcrep.\$hsts_to_snd. The default value is 1. Here is a sample of what is sent to the iRConnect system, in this case \$Prcrep.\$hsts_to_snd was set to 5. The record that was out of tolerance is shown at the bottom, with previous histories above it. The item that was out of tolerance has it's value highlighted in yellow with red text.

Weld time of	out of tol for P	ROG ZZWELD	, PROCESS ID=11	<mark>O</mark>							
Upp=325.0	,Low=299.0,	Act=0.0									
HIST_IDX	PROGRAM	PROCESS_ID	TOUCHUP_TIME	Exec_time	Fault	Bookmark	Weld time	Time to force	Weld		P inde
35	ZZWELD	110	23-JAN-13 16:20:36	24-JAN- 13 08:57:44	None	00-0-80 00:00:00	0000	48	1	1	1
36	ZZWELD	110	23-JAN-13 16:20:36	29-JAN- 13 14:52:22	None	00-0-80 00:00:00	0000	60	1	1	1
37	ZZWELD	110	23-JAN-13 16:20:36	29-JAN- 13 14:53:26	None	00-0-80 00:00:00	0000	60	1	1	1
38	ZZWELD	110	23-JAN-13 16:20:36	29-JAN- 13 14:53:52	None	00-0-80 00:00:00	0000	60	1	1	1
39	ZZWELD	110	23-JAN-13 16:20:36	29-JAN- 13 14:54:16	None	00-0-80 00:00:00	0000	60	1	1	1

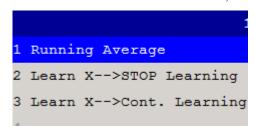
- **f** To activate monitoring on an item, Cursor down to the row of the item you want to monitor, then cursor over to the Act column. Press F4 Y to enable monitoring.
 - a) If your Lim type is DIR, then the monitoring will become active immediately. If your Lim Type is TOL, then you will see a screen similar to the following:



- b) By default, Running Average is the default Average type. Running average means to use the already existent long term average for this item.
- c) Press F4 choice to choose another tolerance Average Type. The other 2 choices are:

Item #2 means to learn the next X welds, then stop learning.

Item #3 means to learn the next X welds, then continue learning.

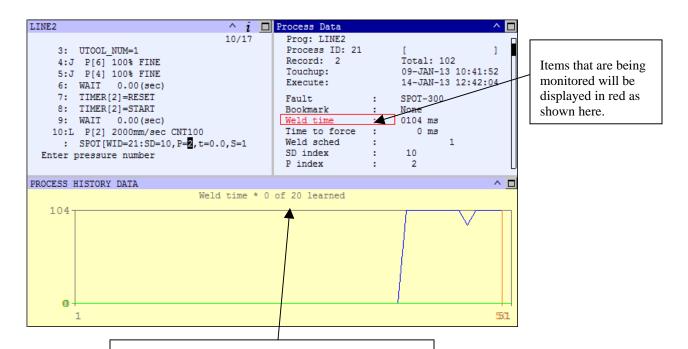


g If you choose item #2 or item #3, then a new item will be displayed to allow you to set the value of X. This is the number of samples you want to use to learn the average.

Note: After making choices on this menu, you must press F2 APPLY for the monitoring to become active.

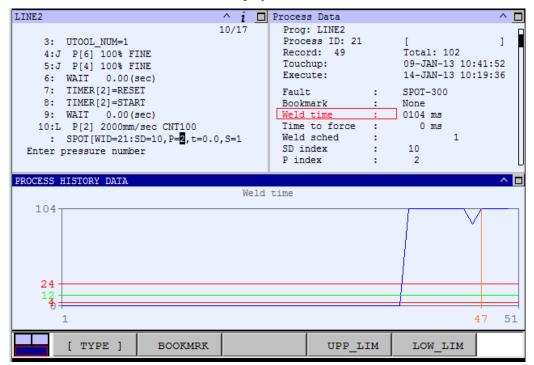
Note: If you chose one of the Learn X choices, then the alarm monitoring will not take place until X samples have been learned for a given weld.

h Now that monitoring is enabled and set up, the following related view screens will have new information on them.



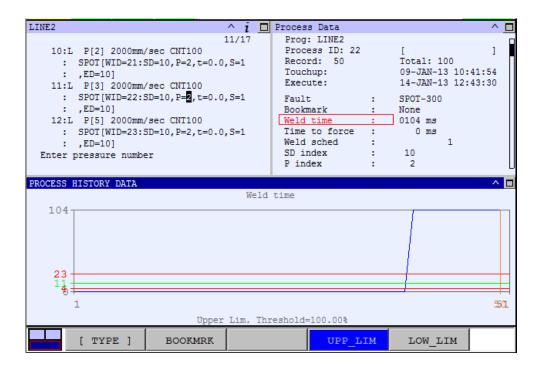
If an item's average has not been "learned" yet, then the background for the chart will be a pale yellow instead of the standard blue, and the item name at the top of the chart will display the current learn count.

i Once an item being monitored has its status changed to learned, the following related views will have additional information displayed on them.



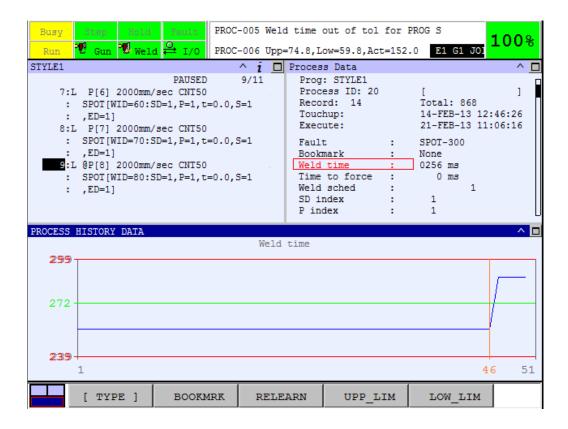
In the chart in Pane 3, the data for the given item will be displayed in blue. The Average being used for monitoring will be displayed in green. The Upper limit will have a red data marker, and the lower limit will have a red data marker.

- **j** To change the upper and lower limits from the related view chart menu, press F4 UPP_LIM, or F5 Low_LIM.
- **k** Once you press F4 or F5, the current limits value will be displayed as shown below:



- With UPP_LIM or LOW_LIM active, use the up arrow key and down arrow key on the pendant to adjust the chosen limit.
- **m** The limit values that you change in the chart menu are the same limit values you previously set in the Process Monitor SETUP menu.

- **n** If you are using a learned average setup for your Process Monitoring, there may be a situation where your learned average is incorrect (due to process parameter changes, or perhaps a new batch of parts.) If you want to relearn the average there are 2 ways to do this.
 - 1. If you want to relearn for all welds, then you can do this on the Process Monitor SETUP menu by disabling the Monitor and then re-enabling it. This will reset the learned average for ALL welds on the controller.
 - 2. If you want to relearn for just ONE weld, then use the editor related view function.
 - a. In the editor select your desired TP program, and choose the weld you wish to relearn.
 - Initiate the Process Data related view menu by choosing i-FCTN→PROCESS DATA.
 - c. In Pane 2, cursor to the item you wish to relearn. This item will have red text showing it is a monitored item.
 - d. Press F3 RELEARN to clear the learned average for only this current weld, and current item you are viewing. (This can also be done in Pane 3 by using the F3 RELEARN) key.



- Process Logger Monitoring also provides local override control via a TP macro.
 - a) For example, you may want to only monitor one weld that is giving you a problem. So instead of turning on monitoring globally for all welds, you can just enable it for the one weld you want.
 - b) Process Monitoring local override is controlled via the karel macro prlogmon()
 - c) Optionally you can use the prlogmonover.tp macro which calls prlogmon() karel macro. Prlogmonover.tp is listed below, it just wraps the karel macro with comments about the parameters.

```
PRLOGMONOVER.TP
 1: !Process Logger Monitor ;
 2: !Local Override ;
 3:
    !;
 4: !Calling prlogmon provides a ;
    !one-shot override to a specific ;
     !weld for a specific process ;
 7: !monitor setting. ;
 8: !;
9: !There are 6 possible parameters ;
10: !The first 4 are required. ;
11: !The last 2 are optional. ;
12: !;
    !PARM1=PROC_ID to apply ;
13:
14: !
                    override to. ;
15: !PARM2=ENABLE/DISABLE ;
16: !PARM3=Item Index from SETUP Menu ;
17:
    !PARM4=Sev. 1=W,2=F,3=iRW,4=iRF;
18: !PARM5=Option Upp Lim (Direct) ;
19: !PARM6=Option Low Lim (Direct) ;
20:
    1 ;
21: !Fill in values for the 4-6;
22: !parameters below. ;
23:
    ! ;
24: CALL PRLOGMON(AR[1],AR[2],AR[3],AR[4],AR[5],AR[6]);
```

- d) There can only be one active override at a time, so if you call prlogmon() before a previous prlogmon() has been applied to the specified weld, it will override the previous prlogmon settings.
- e) There are 6 possible parameters for this macro. The first 4 are required, the last 2 are optional.
- f) prlogmon(Process ID, Enable/Disable, item index, severity, upp lim, low lim)
 - (1) Process_ID; The Process ID of the instruction you want the override applied to.
 - (2) ENABLE/DISABLE; 1=Enable, 0 = Disable
 - (3) Item_index; This is which Process Parameter you want the override applied to. Item_index is the # number from the process monitor setup menu.
 - (4) Severity; This is the alarm severity if the Process Item is out of tolerance. 1=warning, 2=fault, 3=warning with iRConnect, 4=fault with iRConnect.
 - (5) Upp lim; optional parameter if you want to change the upper limit.
 - (6) low lim; optional parameter if you want to change the lower limit.

- (a) Note, when using this local override macro, the limit values are the direct limit values to compare the process items value to.
- g) Here are a few examples of how you can use the local override macro prlogmon().
 - (1) SPOT Example 1: Fault if "Time to Force" is more than 200ms for WID=10
 - 13: CALL PRLOGMON(10, 1, 2, 2, 200,0)
 - 14: L P[3] 2000 mm/sec CNT100
 - 15: L P[4] 2000 mm/sec CNT50
 - : SPOT(WID=10,SD=1,P=1,t=3.0,S=1,ED=1)
 - (2) SPOT example 2: Disable "Weld Time" monitoring for WID=20
 - 13: CALL PRLOGMON(20, 0, 1, 2)
 - 14: L P[3] 2000 mm/sec CNT100
 - 15: L P[4] 2000 mm/sec CNT50
 - : SPOT(WID=10,SD=1,P=1,t=3.0,S=1,ED=1)

2.8 Process Logger for HandlingTool

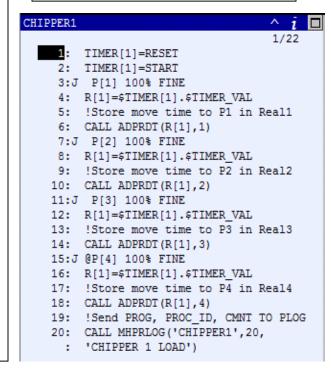
Overview

- Process logger is designed to collect data when the robot executes Application Process Instructions.
- HandlingTool has no true Application Process Instructions, so it can't automatically collect any data, plus each HandlingTool setup could be executing/controlling a different type of process.
- Because of the above 2 reasons, Process Logger has a way to "customize" itself to handle these unknown process control setups.
- Process Logger for HandlingTool provides the following:
 - o 25 possible real data values to log for each process execution.
 - Data can be stored via TP or KAREL
 - Data can be sent to Process Logger via TP or KAREL
 - o Data is configured via XML as shown below

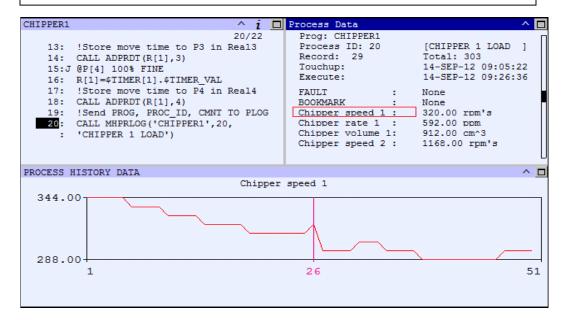
MAROBPLOG04121E REV B

```
<PRCLOG>
<!-- for itemcount, do not include NONE below as a counted item. ALL
OTHER ITEMS ARE INCLUDED IN THIS COUNT. -->
 <!-- for LABEL, the first 4 LABELS MUST be NONE, EXEC_TIME,
FAULT, BOOKMARK -->
 <!-- dont change the first 4 labels, and don't change their order -->
 <!-- label is the text you want displayed for the item being collected. --
 <!-- Label text is limited to 17 characters. If you go over, it will be
truncated. -->
 <!-- -->
 <!-- unit is the items units in text like mm/s or rpm's. -->
<!-- If your item has no unit, then just set it as a empty string like unit="" -->
 <!-- -->
 <!-- Put a space before your unit value in the double quotes if you -->
 <!-- don't want the unit placed right up against your process value, i.e.
unit=" mm" -->
 <!-- -->
 <!-- format is the items C format string to be used when displaying the
value. -->
 <!-- Like %d, %3.1f, etc... -->
 <NUMITEMS itemcount="6" />
 <LABEL label="NONE" unit="" format="%s" />
 <LABEL label="EXEC_TIME" unit="" format="%s" />
 <LABEL label="FAULT" unit="" format="%s" />
 <LABEL label="BOOKMARK" unit="" format="%s" />
 <LABEL label="Chipper speed 1" unit="rpm's" format="%3.2f" />
 <LABEL label="Chipper rate 1" unit="ppm" format="%3.2f" />
 <LABEL label="Chipper volume 1" unit="cm^3" format="%3.2f" />
</PRCLOG>
```

Example Chipper Process with all data stored and logged via TPP.



User defined item Labels from XML file are used to reference all items in Process Logger Data, Chart, and Report screens



Conditions

User has a HandlingTool Process for which they want to collect data.

Step

- **1** Decide what a single execution of your "Process" is. (Perhaps is a complete execution of Pick a part, Process a part, Drop a part.)
- **2** Create .XML file called MHPRCLOG.XML as shown above with labels, units, and formatting of items you want to collect for your complete process.
- **3** Your items will get stored in structure elements real1 real25.
- **4** Make sure you set **<NUMITEMS** itemcount="X" /> It should equal the number of items you are collecting + 3 (for EXEC, FAULT, and BOOKMARK)
- **5** Place MHPRCLOG.XML onto FR: device on the controller.
- **6** Decide if you want to collect and send the data from KAREL or TPP.
- **7** If you are collecting data from TPP you will use the ADPRDT karel macro whenever you want to log a piece of process data during the execution of your single execution of your complete process.
 - a ADPRDT stands for Add Process DATA.

- **b** ADPRDT takes 2 parameters. The first is the data you want stored, and the second is the "slot" or index your want it stored in. (This is your 1-25 reals)
- **c** The data type you can send it can be an integer or a real value.
- **d** The data will be stored locally in controller memory until you execute the send command which will send all the collected data to the Process Logger system to log it for you.
- **e** For example if you are collecting 3 pieces of data for each "Process Execution", then you would call ADPRDT(value1,1), then call ADPRDT(value2,2), the call ADPRDT(value3,3) at the appropriate times during a single process execution.
- Once you have completed your process execution, but before you start another process execution, you would need to then send the data to the Process Logger system.
- **g** To send the data to the Process Logger system, you can call MHPRLOG.
 - a) MHPRLOG takes 3 parameters
 - (1) PROG_NAME Prog_name logging the data
 - (2) PROCESS_ID Any integer value you want to use, maybe you only have 1 process (for example Pick part, process part, drop part).

NOTE: It is to your benefit to make the PROCESS_ID the same as the program line number, then the related view will be able to be displayed when the cursor is on the line which has the MHRPLOG call, and i-Fctn PROCESS Data is chosen.

- (3) COMMENT Optional parameter which could be a description of your process.
- **8** If you are collecting data from KAREL, then you can store your data via karel by setting your data into variable
 - a mhhist rec: mhpat rec t from mhprlog
 - **b** You can reference the KAREL builtin to send the data to Process Logger and access the MH structure by including the following in your program:
 - %ENVIRONMENT patdef
 - %ENVIRONMENT patblt

9 You must set the following items in mhhist_rec variable.

```
Mhhist_rec.head.prog_name = required TP program name

mhhist_rec.head.process_id = Your process ID, you decide your numbering method maybe you only have one.

Mhhist_rec.head.proc_cmnt = Add a comment if you like, if not, set = NULL STRING ""

mhhist_rec.head.eq_num = 1 Not used, but set to 1

mhhist_rec.head.app_id = MH_APP MH_APP is defined as 17.

Mhhist_rec.hist_rec.exec_time you can set this by calling GET_TIME(mhhist_rec.hist_rec.exec_time)

mhhist_rec.hist_rec.fault = if you had a fault, set the error code here.

Mhhist_rec.hist_rec.bookmark = 0 - just initialize this to 0

now set your num_items pieces of data into

mhhist_rec.hist_rec.real1 = Your data item 1

mhhist_rec.hist_rec.real2 = Your data item 2

....

mhhist_rec.hist_rec.real25 = Your data item 25
```

- **10** If you do not use all 25 real values, initialize the unused ones to 0.
- **11** Once you have stored all your data in mhhist_rec, you can call the SEND_PAT() KAREL builtin to send the data to Process Logger to store it for you.

```
SEND PAT('MHPRLOG', 'mhhist rec', MH APP, status)
```

NOTE: The first time a program is executed, the data is not saved until the program ends. So if power was cycled before the program was completed the first time, then the data would be lost. Once the program ends the first time, then the data will be saved. All subsequent executions will always be saved.

4D Process Logger

3 4D PROCESS LOGGER

3.1 Overview

Process Logger function records several process parameters for each application automatically. This function provides a new 4D screen so users can confirm recorded data and process executed position of currently selected TP program on teach pendant screen graphically.

The principal features of this function are as follows.

- Show process executed points as map pins on 4D graphics screen.
- Show recorded data on pop-up text.
- Record Filtering.
- Calculate statistical information.
- Display record as time-series chart format.

Note

This function requires Process Logger function and 4D Graphics function.

This function supports spot welding and arc welding.

This function recommends to use touch panel type *i*Pendant

3.2 Home Screen

Procedure 3-1 Show home screen of 4D Process Logger

Step

- 1 Press MENU key.
- 2 Select "4D GRAPHICS".
- 3 Press F1[TYPE] key.
- 4 Select "4D Process Logger". The following screen is appeared.

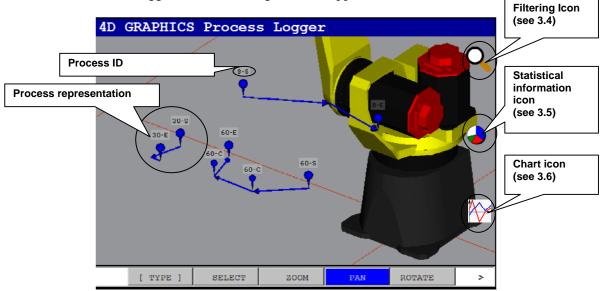


Fig 3.2 Descriptions items on home screen of 4D Process Logger (ArcTool)

3.3 Fundamental Features

3.3.1 Process representation

SpotTool+

With SpotTool+, positions executing SPOT instruction are represented as a map pin format and the process ID specified in SPOT instruction is displayed above of each map pin.

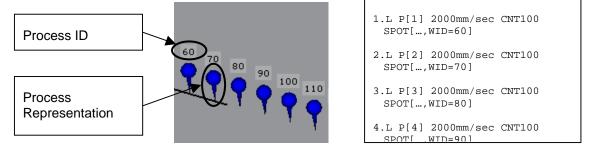


Fig 3.3.1(a) Process representation at SpotTool+

ArcTool

With ArcTool, positions executing Weld Start/Weld End instruction are represented as several map pins and arrows of welding path and the process ID is displayed above of the map pin with several suffixes.

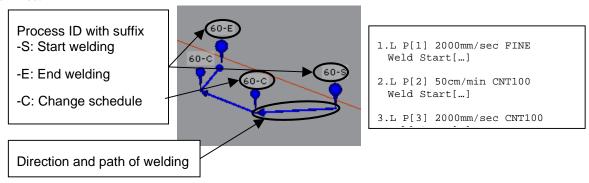


Fig 3.3.1(b) Process representation at ArcTool

3.3.2 Direction of Process Representation

User can change the direction of map pin between two different frames; WORLD frame and USER TOOL frame.

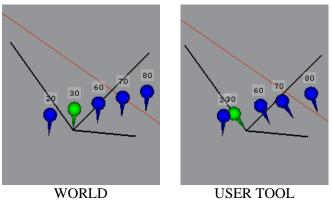


Fig 3.3.2 Two different map pin direction (SpotTool+)

Procedure 3-2 Change map pin direction

Step

Press F8 key then the frame of map pin direction toggles between WORLD frame and USER TOOL frame

3.3.3 Select process and popup

When a process is selected, the color of the process representation is changed to light green from blue and popup that shows latest history data appears near the process representation.

Procedure 3-3 Select a process on 4D Process Logger with touch

Condition

1 *i*Pendant has touch panel

Step

- 1 Touch a map pin that represents the process you would like to select.
- 2 If something other than process representations is selected, the selected process becomes unselected.

Procedure 3-4 Select Process on 4D Process Logger with key

Step

- Press UP key then a process that has the lowest process ID is selected when any process isn't selected.
- 2 Press UP key when you would like to select next process.
- 3 Press DOWN key when you would like to select previous process.

Procedure 3-5 Change displayed record in the process

Condition

A process has been selected and popup has been appeared.

Step

- 1 Press LEFT key then older history is displayed.
- 2 Press RIGHT key then later history is displayed.

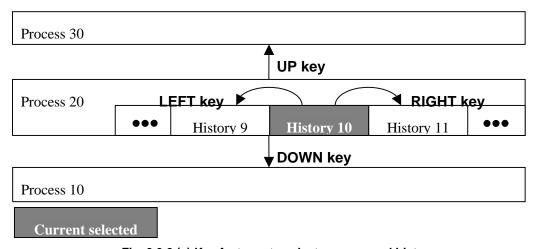


Fig. 3.3.2.(a) Key features to select process and history

3.3.4 Filtering

Filtering feature extracts processes that satisfy specified filtering conditions. When a process that has no records satisfy the filtering conditions, the process representation becomes invisible on 4D Process Logger screen and cannot select from touch, UP, DOWN key.

Procedure 3-6 Show and setup filtering condition setup dialog with touch

Condition

• *i*Pendant has touch panel

Step

1 Touch the following filtering icon.



Fig 3.4.(a) Filtering icon

- 2 The following dialog is appeared.
- 3 To change a target...
 - a. Touch the target item text box.
 - b. Item list box is appeared.
 - c. Select the item you would like to set to target from the list.
- 4 To change a comparison operator...
 - a. Touch comparison operator text box.
 - b. Operator list box is appeared.

- c. Select the comparison operator from the list.
- 5 To change a threshold value...
 - a. Touch threshold text box.
 - b. Input new threshold value.
- 6 After every filtering condition has been setup, press OK button.

Procedure 3-7 Show and setup filtering condition setup dialog with key

Condition

No dialog is displayed.

Step

- 1 Press F9 key once.
- 2 The following dialog is appeared.
- 3 To change a target...
 - a. Move cursor on the target item text box and press ENTER key.
 - b. Item list box is appeared.
 - c. Select the item you would like to set to target from the list.
- 4 To change a comparison operator...
 - a. Move cursor on the comparison operator text box and press ENTER key.
 - b. Operator list box is appeared.
 - c. Select the comparison operator from the list.
- 5 To change a threshold value...
 - a. Move cursor on the threshold text box and press ENTER key.
 - b. Input new threshold value.
- 6 After every filtering condition has been setup, move cursor on OK button and press ENTER key.

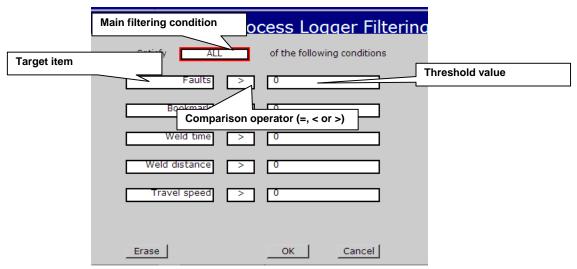


Fig 3.4.(b) Filtering condition setup dialog(ArcTool, Normal)

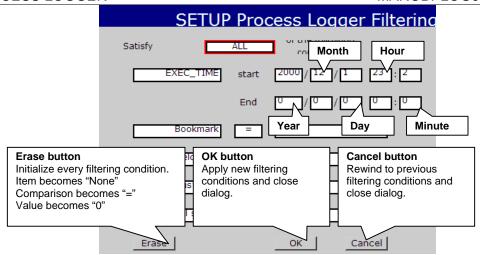


Fig 3.4.(c) Filtering condition setup dialog(ArcTool, 1st item is executed time)

SOME: Processes that satisfy any of the filtering conditions appears on 4D Process Logger screen.

ALL: Processes that satisfy all of the filtering conditions appears on 4D Process Logger screen.

DATA	Canditions	Decision				
DATA	Conditions	All	Some			
Fault is 2	Fault > 0	Not satisfy	Satisfy			
Bookmark is 1	Bookmark = 1	(Since, weld time doesn't	(Since, Fault satisfies the			
Weld time is 40	Weld time > 100	satisfy the condition 3)	condition 1)			

Fig 3.5.(c) Illustration of filtering condition.

When filtering is applied, sub window that shows filtering condition is appeared on the right-top of screen and record data of the target item of the filtering is appeared on pop-up text.

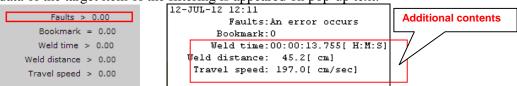


Fig 3.5.(d) Sub window and additional information on popup

When a filtering is applied, the data that doesn't satisfy the filtering condition isn't appeared on popup screen. Therefore, UP/DOWN/LEFT/RIGHT key features differ slightly when filtering isn't applied.

For example, in the following situations,

- Process 10 has some satisfying records.
- Process 20 has some satisfying records and current selected process.
 - > 9th record satisfies the condition.
 - ➤ 10th record satisfies the conditions and current selected history.
 - ≥ 11th record doesn't satisfy the conditions.
 - ≥ 12th record satisfies the conditions
- Process 30 doesn't have any records that satisfy the conditions.
- Process 40 has some satisfying records

Each key operation becomes as the followings.

UP key : Move to Process 40 by skip Process 30.

DOWN key : Move to Process 10.

LEFT key : Move to 9th record in Process 20

RIGHT key : Move to 12th record in Process 20 by skip Process 30.

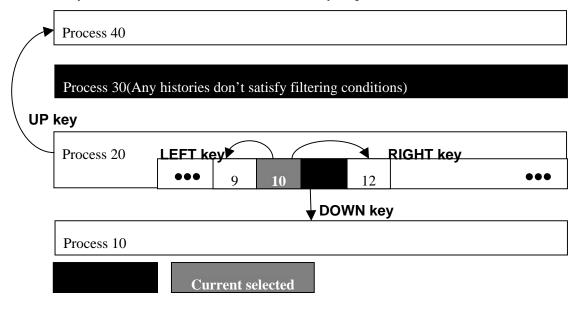


Fig 3.4.(e) Key features to select process and history with filtering

3.4 Statistical Information

Statistical information feature shows fundamental statistical information; minimum, maximum and average of selected items at sub window on 4D Process Logger screen.

Procedure 3-8 Show and setup statistical information dialog with touch

Condition

• *i*Pendant has touch panel

Step

1 Touch the following statistical information icon.



Fig 3.5.(a) Statistical information icon

- 2 The following dialog is appeared.
- 3 To change a target...
 - a. Touch the target item text box.
 - b. Item list box is appeared.
 - c. Select the item you would like to set to target from the list.
 - After every target has been setup, press OK button.

Procedure 3-9 Show and setup statistical information dialog with key

Condition

No dialog is displayed.

Step

- 1 Press F9 key twice
- 2 The following dialog is appeared.
- 3 To change a target...
 - a. Move cursor on the target item text box and press ENTER key.
 - b. Item list box is appeared.
 - c. Select the item you would like to set to target from the list.
- 4 After every target has been setup, move cursor on OK button and press ENTER key.

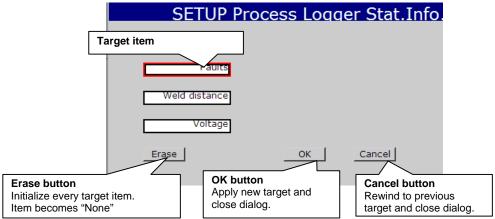


Fig 3.6.(a) Statistical information setup dialog

When statistical information is setup, the following sub window is appeared at right-middle of 4D Process Logger screen. This sub window shows statistical information of current selecting process.

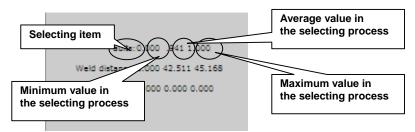


Fig 3.6.(b) Sub window for statistical information

3.5 Chart

Chart feature show time-series behavior of each target item in a process.

Procedure 3-10 Show and setup chart dialog with touch

Condition

• *i*Pendant has touch panel

Step

1 Touch the following statistical chart icon.



Fig 3.5.(a)Chart icon

- 2 The following dialog is appeared.
- 3 To change the selecting process...
 - a. Press ">" button on the top of dialog to forward the process.
 - b. Press "<" button on the top of dialog to backward the process.

The selecting process ID is displayed at the text box between the buttons.

- 4 To change a target...
 - a. Touch the target item text box.
 - b. Item list box is appeared.
 - c. Select the item you would like to set to target from the list.
- 5 To change the executed date of record...
 - a. Press ">" button on the bottom of dialog to forward executed date.
 - b. Press "<" button on the bottom of dialog to backward executed date.

The selecting executed date is displayed at the text box between the buttons.

When executed date is changed, the record data displayed below each record item text box is also changed.

Procedure 3-11 Show and setup chart dialog with touch

Condition

No dialog is displayed.

Step

- 1 Press F9 key three times.
- 2 The following dialog is appeared.
- 3 To change the selecting process...
 - a. Move cursor on ">" button on the top of dialog and press ENTER key to forward the process.
 - b. Move cursor on "<" button on the top of dialog and press ENTER key to backward the process.
 - The selecting process ID is displayed at the text box between the buttons.
- 4 To change a target...
 - a. Move cursor on the target item text box and press ENTER key.
 - b. Item list box is appeared.
 - c. Select the item you would like to set to target from the list.
- 5 To change the executed date of record...
 - a. Move cursor on ">" button on the bottom of dialog and press ENTER key to forward executed date.
 - b. Move cursor on "<" button on the bottom of dialog and press ENTER key to backward executed date.

The selecting executed date is displayed at the text box between the buttons.

When executed date is changed, the record data displayed below each record item text box is also changed.

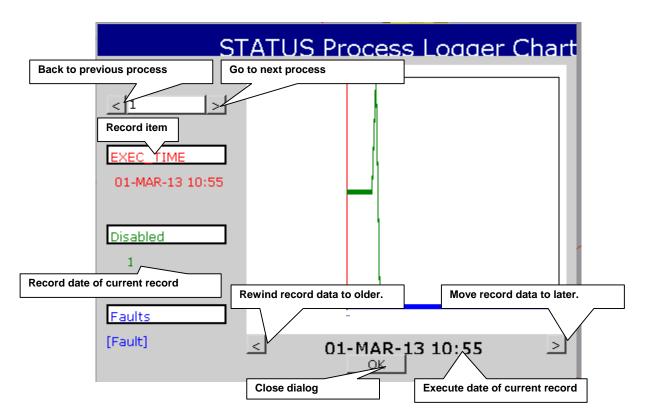


Fig 3.6.(a) Chart dialog on 4D Process Logger screen