KEROTEST®
SINCE 1909

Operators Manual

Shannon
Portafuse III

TRACEABILITY CAPABLE

MADE IN U.S.A.

SALES
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SERVICE
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SAFETY

- Please read and understand this instruction manual before using ***Shannon or Portafuse III Electrofusion Processors.***
- Gas company safety standards and precautions should be followed at all times.
- Do not use or store ***Shannon or Portafuse III Electrofusion Processors*** where volatile gas concentrations may be present.
- Only properly trained and qualified personnel should operate ***Shannon or Portafuse III Electrofusion Processors.***
- Treat all electrical equipment as a potential source of ignition and follow proper practices for working in an explosive atmosphere.
- The power source and the electrofusion processor must be located out of the trench.
- For protection against the risk of electric shock, connect ***Shannon Electrofusion Processors*** to properly grounded outlets only.
- When operating a ***Portafuse III Electrofusion Processor***, remember to regularly inspect the battery pack and charger for damage. The charger does not contain any serviceable components. If the charger gets damaged it will need to be replaced.
- Only use fusion information supplied by the manufacturer of the fitting.
- Under no circumstances should the enclosure of a ***Shannon or Portafuse III Electrofusion Processor*** be opened. All warranties are void if the factory seal has been broken.
- Before any fusion is performed, it is the responsibility of the operator to always verify that all the information displayed is correct per the fitting manufacturer's recommendations for fusing the attached fitting under the current ambient conditions.

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WARRANTY AND LIMITATION OF LIABILITY

1. EF TECHNOLOGIES, INC. warrants Kerotest Electrofusion Processors against defects resulting from faulty workmanship or materials for a period of one year from the date of the new unit calibration. Any Processor repaired or replaced pursuant to this warranty within the original warranty period will be warranted for the remainder of the original warranty period. EF TECHNOLOGIES, INC. also warrants the calibration and repair services it provides on the Processor against defects resulting from faulty workmanship for a period of 60 days upon which the calibration or repair services are complete.

2. If EF TECHNOLOGIES, INC. receives notice of such defects during the warranty period, EF TECHNOLOGIES, INC. will repair or replace, free of charge, including ground shipping charges, any Processors or Services which are found to be defective in workmanship or material, provided that the following conditions are met:

    a) EF TECHNOLOGIES, INC. is notified in writing of such defect immediately upon discovery of same and the defective Processor is promptly returned to EF TECHNOLOGIES, INC. (at the location designated by EF TECHNOLOGIES, INC. for those purposes), freight prepaid. Claimant must provide documentary evidence of failure, as well as the components that are alleged to have failed and agree to inspection by EF TECHNOLOGIES, INC. of the circumstances in which the alleged defective Processor(s) was/were used.

    b) The Processor has been maintained, calibrated, serviced and used in full compliance with this Manual and other technical information or literature provided by EF TECHNOLOGIES, INC. from time to time.

    c) the Processor has not been altered or modified after leaving EF TECHNOLOGIES, INC.'S premises, shows no evidence of disassembly or tampering, is not and has not been subjected to abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair and the defect is not due, without limitation, to faulty installation, maintenance, calibration or use, improper site preparation or maintenance, ordinary wear and tear, corrosion, acts of nature such as earthquakes, fire, flood or lightning or any other event of force majeure.

    d) EF TECHNOLOGIES, INC. does not warrant that the operation of Kerotest Electrofusion Processors will be uninterrupted or error free.

    e) Replacement Processor may be either new or like-new.

3. EF TECHNOLOGIES, INC. disclaims any liability or responsibility:

    a) for labor, materials and/or other expenses required to replace the defective Processor or Service or to repair any damage resulting from the use thereof.

    b) for loss or damage resulting from failure to abide by manufacturer's warnings, safety instructions or other precautionary guidelines.

4. ANY CLAIM OF LIABILITY ASSERTED AGAINST EF TECHNOLOGIES, INC WHETHER IN CONTRACT OR IN TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, WITH RESPECT TO OR ARISING OUT OF THE SALE, DELIVERY, INSTALLATION, REPAIR OR USE OF ANY PROCESSORS OR SERVICES SOLD BY EF TECHNOLOGIES, INC. SHALL NOT EXCEED THE PURCHASE PRICE OF THE PROCESSORS OR SERVICES FOUND TO BE DEFECTIVE. It is the responsibility of the owner to obtain and pay for emergency repairs.

5. EF TECHNOLOGIES, INC.'S LIABILITY IN RESPECT TO THE SALE IS STRICTLY LIMITED TO THE REPLACEMENT OF PROCESSORS OR SERVICES AS HEREINBEFORE SPECIFIED AND EF TECHNOLOGIES, INC. SHALL NOT, IN ANY EVENT, BE LIABLE FOR ANY DAMAGES WHETHER FOR THE LOSS OF USE OR BUSINESS INTERRUPTION OR ANY OTHER CLAIM FOR INCIDENTAL, CONSEQUENTIAL, SPECIAL OR PUNITIVE DAMAGES.

6. THE ABOVE MENTIONED WARRANTIES ARE THE SOLE AND EXCLUSIVE WARRANTIES TO ANY PURCHASER, CUSTOMER OR USER OF THE PROCESSOR OR SERVICES. THERE IS NO WARRANTY, CONDITION OR REPRESENTATION OF ANY NATURE WHATSOEVER, EXPRESSED OR IMPLIED, BY STATUTE OR OTHERWISE, EXCEPT AS HEREIN CONTAINED AND EF TECHNOLOGIES, INC. DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS OF ITS PROCESSORS OR SERVICES FOR A SPECIAL PURPOSE OR OTHER WARRANTY OF QUALITY.

INTRODUCTION

Preface

The information contained herein is the technical data and specifications for the following ***Kerotest Electrofusion Processors:***

- ***Shannon USB***
- ***Shannon Bluetooth***
- ***Portafuse III***

This publication was written to assist trained personnel in the proper procedures and operating functions of a ***Kerotest Electrofusion Processor.***

Operation of KEROTEST MANUFACTURING CORP equipment should only be performed by trained and qualified personnel.

The technical data and advice contained herein is based upon tests and information believed to be reliable. However, the operator should not rely upon it absolutely for specific applications. All data is given and accepted at the user's risk and confirmation of its validity and suitability in particular cases should be obtained independently. KEROTEST MANUFACTURING CORP makes no guarantee of results and assumes no obligation or liability in connection with its advice. The integrity of the piping system is the ultimate responsibility of the installer. This publication is not to be taken as a license to operate under, or recommendation to infringe, any patents.

Features

Kerotest Electrofusion Processors are reliable, easy-to-use, rugged tools designed to withstand conditions found at typical construction sites throughout the world.

Kerotest Electrofusion Processors are splash proof and highly shock resistant.

Kerotest Electrofusion Processors can fuse all manufacturers' fittings requiring outputs that are within the voltage and current values listed in the *Specifications Table* on page 8.

Kerotest Electrofusion Processors operate most efficiently and reliably in the Barcode Fusion Mode; however, they can be operated in Alternate Fusion Modes. **The Barcode Fusion Method is always preferred and should be used whenever possible.**

Kerotest Electrofusion Processors have an intuitive user interface that is easy to learn.

Kerotest Electrofusion Processors are equipped with internal memory for data storage and can be downloaded to determine installation conditions and fusion cycle status.

Kerotest Electrofusion Processors are capable of scanning and recording both ASTM F2897-11 and ISO 12176-4 Traceability barcodes.

Shannon Electrofusion Processors can be operated from any AC power source meeting the input power requirements listed in the *Specifications Table* on page 8.

The ***Portafuse III Electrofusion Processor*** is powered by a 48 volt 9ah lead acid battery pack and is capable of fusing all fittings with a current requirement of 35 amps or less.

Processor Overview

Shannon

The ***Shannon*** is a full-featured, transformer-based Electrofusion Processor designed to meet all of your electrofusion needs in one convenient package. The internal transformer ensures access to the full output capability of the processor every time you take it to a job site.

Portafuse III

The ***Portafuse III*** is a full featured, battery-powered Electrofusion Processor designed to meet all of your small diameter electrofusion needs in one convenient package. When powered by the 48V 9ah SLA battery pack, the ***Portafuse III*** can fuse any fitting with a current requirement of 30 amps or less without the use of an AC power source. If your job requires more than 30 amps, the ***Portafuse III*** can connected to an optional external transformer to increase the output capability to a level equal to that of the ***Shannon***.

Specifications

Parameters	Shannon AC	Portafuse III Battery
Supply Voltage	97 VAC to 150 VAC	48 Volts DC
		97 VAC to 150 VAC with the optional AC transformer
Supply Frequency	47 Hz to 70 Hz	N/A
		47 Hz to 70 Hz with optional transformer
Supply Waveform	Sine Wave or Square Wave	DC
		Sine Wave or Square Wave with optional AC transformer
Maximum Supply Current	30 Amps	
Output Voltage	8 VAC to 48 VAC +/- 1.5%	
Output Current	4 AAC to 60 AAC +/- 1.5% (80 AAC @ 42 VAC output)	Powered by Battery 30 Amps
		With External Transformer Same as Shannon
Storage Temperature	0°F to 140°F	0°F to 140°F (Processor) 41°F to 104°F (Batteries)
Operating Temperature Range	0°F to 140°F	
Operating Modes	Barcode, Manual Barcode, Manual	
Output Cable Length	12 feet	
Fitting Adapters	Field replaceable 90 degree (4.7 & 4.0mm)	
Input Cable Length	12 feet	N/A
Fusion Information Storage	1000 Fusions	
Downloading	USB Models have a USB A type connector for connecting a USB flash drive to download fusion data. Bluetooth Models have an Internal Bluetooth module for downloading fusion data to the EF Utilities app.	
Languages	English	
Environmental Protection	IP54 Splash-Proof	
Calibration Interval	3 Years	
Warranty	1 Year	
Scanning	Barcode wand or interchangeable SMART Scanner™	
GPS	Optional when using a SMART Scanner™ with GPS	
IEC Protection Class	Class 1 Grounded	
Calibration/Service	Field calibration capable	
AutoCal® Compatibility	This device is fully compatible with the AutoCal® field calibration system.	

Descriptions of Controls

NOTES

1 References to controls in this section are displayed exactly as they appear throughout the remainder of this document.

2 The **START button** may mean START, CONTINUE, OK or SAVE depending upon the context of the operation being performed at the time.

3 The **STOP button** may mean STOP, RESET or CANCEL depending upon the context of the operation being performed at the time.

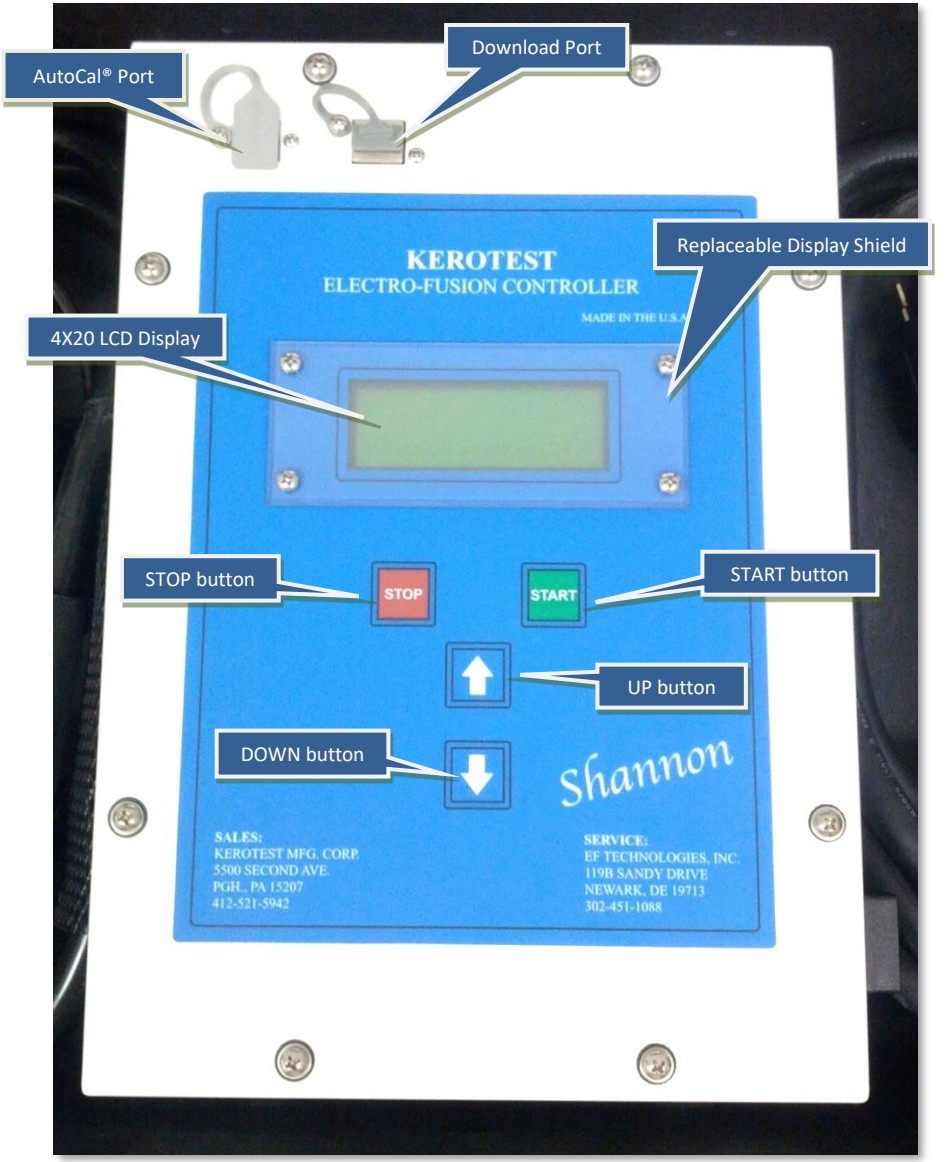
4 The **UP button** and **DOWN button** are used to scroll through the various menus. These buttons should be used when the processor menu displays +/- selection options. (UP button for "+"; DOWN button for "-").

Carrying Case

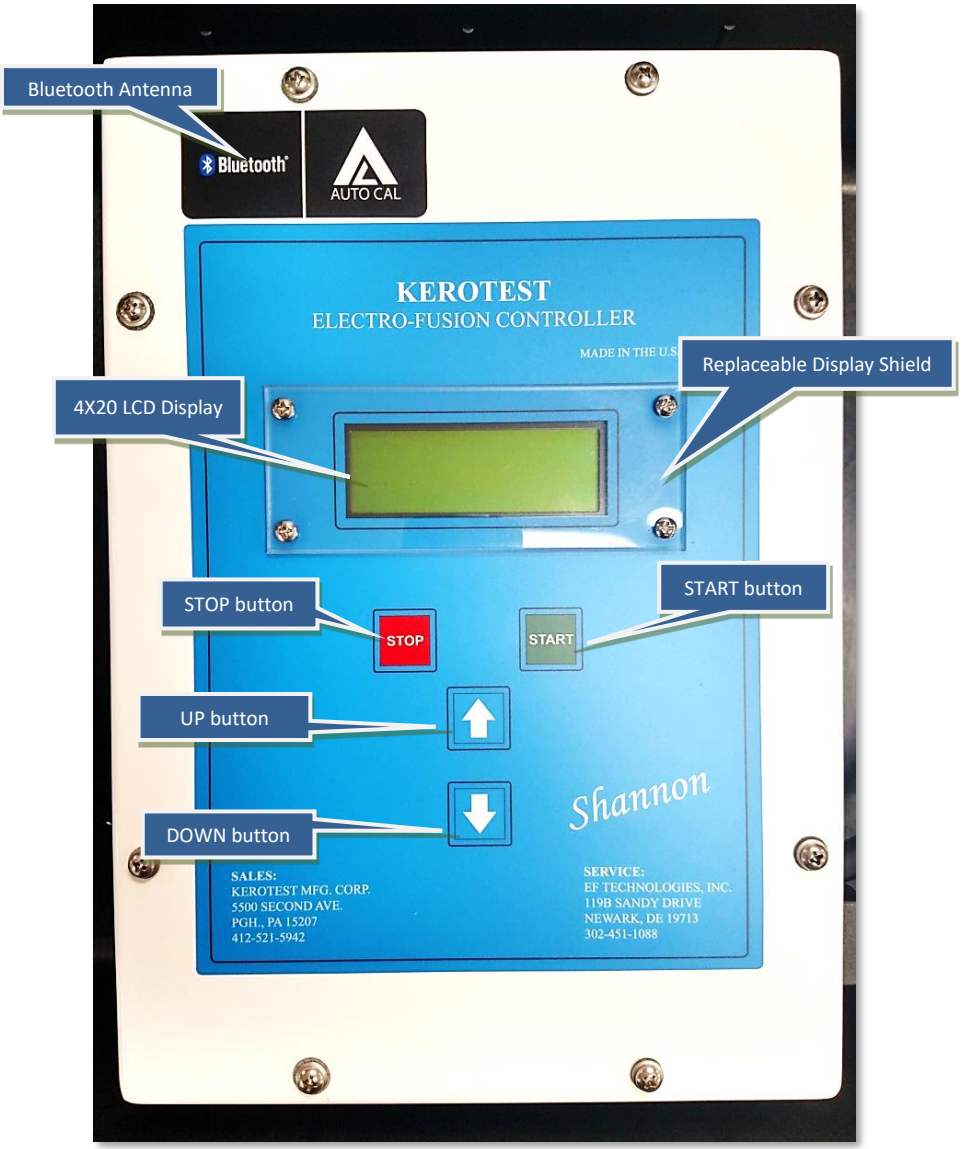
Shannon

Portafuse III

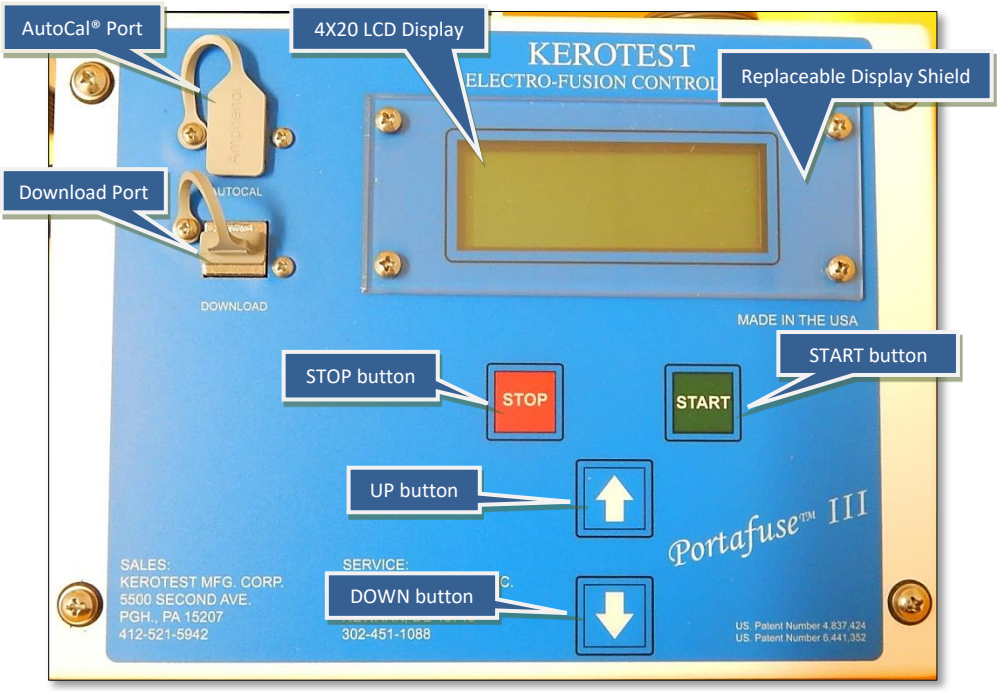
Faceplate View: *Shannon USB*



Faceplate View: *Shannon Bluetooth*

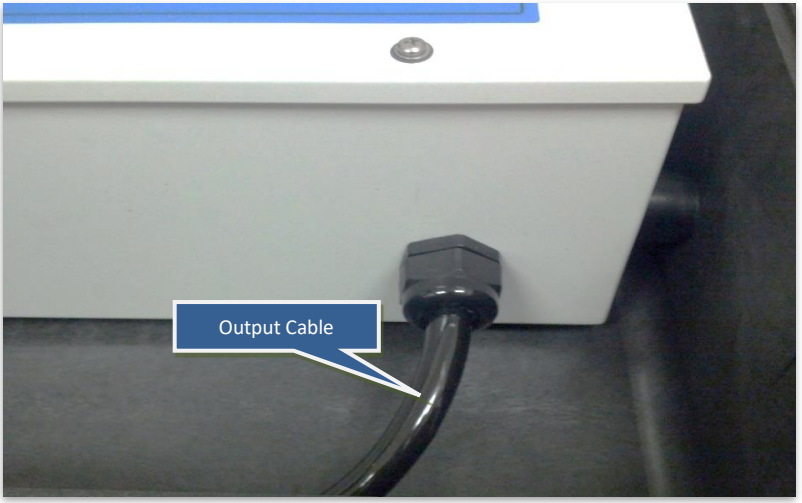


Faceplate View: *Portafuse III*

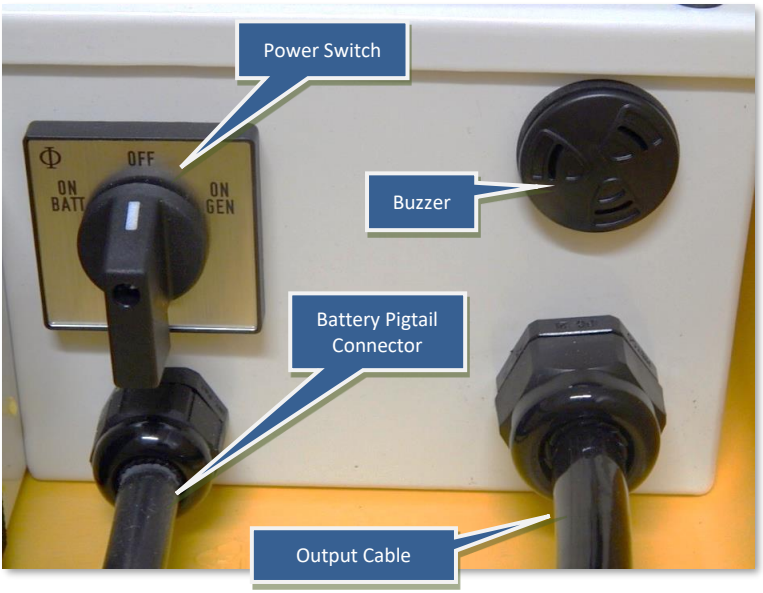


Left Side View

Shannon

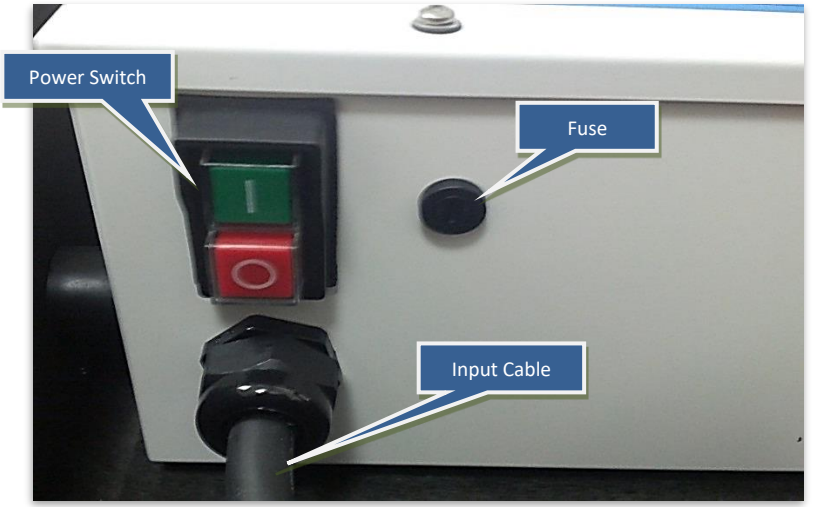


Portafuse III



Right Side View

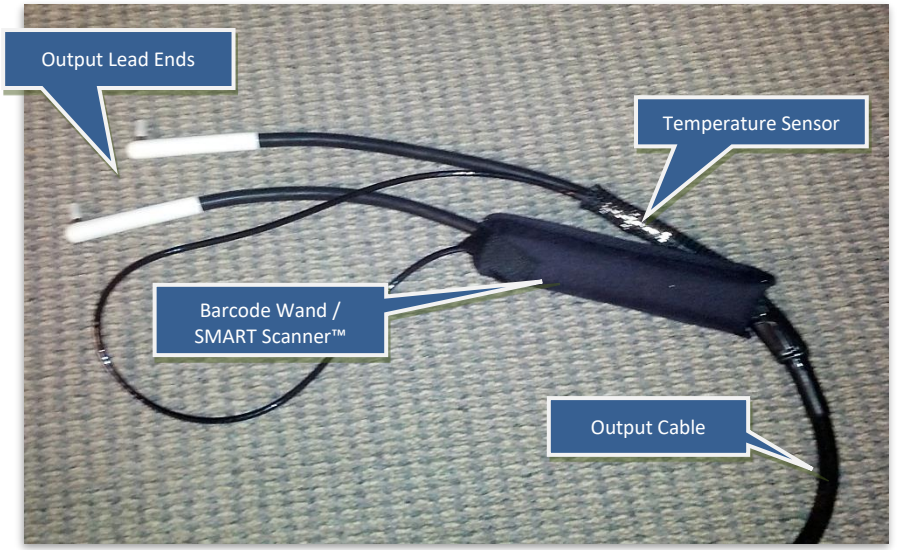
Shannon



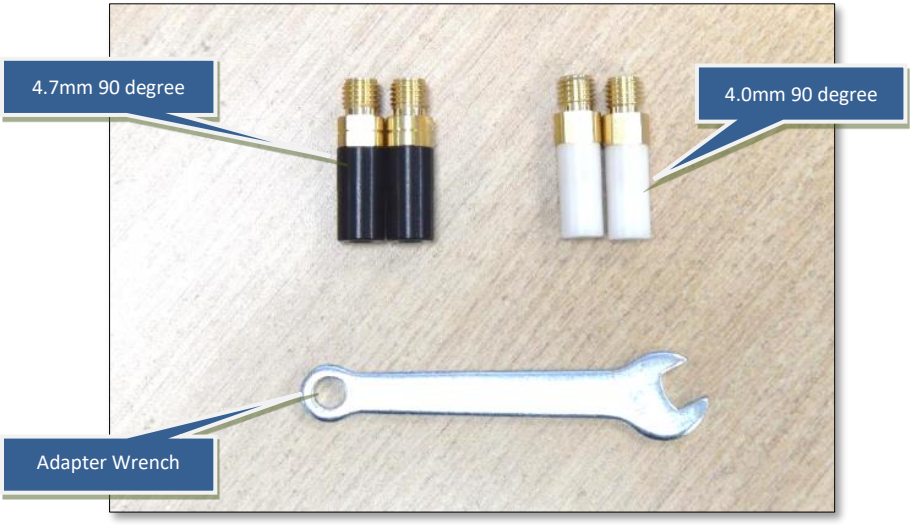
Back Side View

Portafuse III

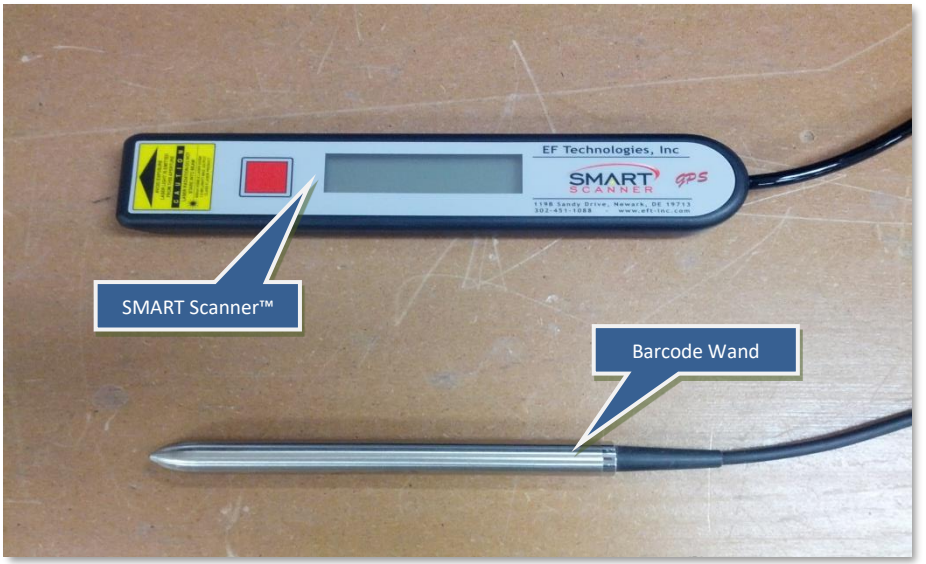
Output Cable Options



Fitting Adapters



Scanner Options



Customer Responsibilities

Kerotest Electrofusion Processors are reliable, easy-to-use, rugged tools designed to withstand the conditions found at construction sites around the world. With proper care, your processor will perform for many years.

Here are some general guidelines that should be followed to extend the life of your processor and keep it in warranty:

<table>
<tr><th>Shannon</th><th>Portafuse III</th></tr>
<tr><td colspan="2">Kerotest Electrofusion Processors are splash resistant, NOT WATERPROOF. They should be stored in a clean, dry environment. DO NOT STORE THE PROCESSORS OUTSIDE. DO NOT WASH THE PROCESSORS WITH A HOSE.</td></tr>
<tr><td colspan="2">The enclosures are very durable and shock resistant; however, do not subject the processors to any unnecessary shocks or stresses including but not limited to:
Tossing the processor into or out of a vehicle
Dropping the processor
Dragging the processor by the cables or leads</td></tr>
<tr><td>N/A</td><td>Fully charge the battery pack after each day’s use.</td></tr>
<tr><td>N/A</td><td>When not in use, recharge the battery pack at least once per month. It is recommended that the battery pack be left on charge when not in use.</td></tr>
<tr><td>N/A</td><td>Turn the processor OFF after each use to prevent the batteries from discharging. It is recommended that the battery pigtail be disconnected after use to ensure the unit is not accidentally turned ON. LEAVING THE PROCESSOR ON WHILE IN STORAGE <u>WILL</u> DESTROY THE BATTERY PACK. THIS IS CONSIDERED CUSTOMER ABUSE AND IS NOT COVERED UNDER WARRANTY.</td></tr>
<tr><td colspan="2">Subscribe to the recommended calibration service offered by the manufacturer (see page 18).</td></tr>
</table>

Kerotest Electrofusion Processors provide the proper outputs for a complete fusion based on the inputs received from a scanned barcode (in Barcode Mode) or from the operator (in one of the alternate fusion modes). **Whenever possible, Barcode Mode should be used.**

Always scan the fitting manufacturer’s barcode affixed directly to the fitting about to be fused. If this barcode is missing or damaged to the point it cannot be scanned, use the barcode from an **<u>identical</u>** fitting made by the same manufacturer.

UNDER NO CIRCUMSTANCES SHOULD THE BARCODE FROM A SIMILAR FITTING BE USED.

Always verify the voltage and time displayed on the LCD are the same as the values specified by the fitting manufacturer. In many cases these values are printed on a tag affixed to the fitting, however, this is not always true. Remember that manual temperature compensation may be required when fusing fittings in Manual Mode.

When in doubt, always check the fusion information with data supplied from the fitting manufacturer.

FAILURE TO VERIFY THAT THE FUSION INFORMATION IS CORRECT BEFORE S TARTING A FUSION COULD RESULT IN SIGNIFICANT DAMAGE TO PROPERTY, PERSONAL INJURY, AND/OR DEATH.

Service Recommendations

Customer Maintenance

There are a few simple services that can be performed by the user that will help ensure proper operation:

1. Keep the area around the Temperature Sensor clean and free of obstructions by wiping with a soft dry towel. This is a critical area to keep clean, as dirt will affect the ambient temperature reading. The temperature reading is used to compensate fusion times based on the ambient temperature during a barcode fusion. If this sensor is reading incorrectly, fusion times may be affected, and the integrity of the fusion may be compromised.

2. Make sure the fitting adapters are clean and properly attached to the Output Lead Ends. Failure to do so may result in an improper output applied to the fitting.

3. Pull the Output Lead Ends straight off the fitting when disconnecting and avoid side loads.

4. Make sure that power sources are appropriately rated and operating at the manufacturer's specified capacity. *Refer to page 50 for instructions and guidelines to use when choosing a power source.*

5. Always store the barcode wand or SMART Scanner™ in its sheath when not in use.

Proper care of the processor and output cable will greatly extend the life of your ***Kerotest Electrofusion Processor*** and help reduce service times and costs.

Calibration Recommendations

It is strongly recommended that each processor be calibrated at least once every three (3) years. This will help ensure that the ***Kerotest Electrofusion Processor*** is in proper calibration and should enable any potential problems to be identified early.

When the calibration period has expired the processor will display the message, "**Error 113: Calibration Required,"** informing the operator that the calibration date has passed. This will not prevent the processor from performing fusions; however, the processor should be calibrated as soon as possible.

THE CORRECT OUTPUT VOLTAGE CANNOT BE ASSURED IF THE PROCESSOR IS NOT CALIBRATED AT LEAST ONCE EVERY THREE (3) YEARS.

Service Contact Information

There are two (2) options for calibrating your *Kerotest Electrofusion Processor:*

1. Send the processor in to a KEROTEST MANUFACTURING CORP service center and let our technicians do it. This is the recommended method and will help ensure the maximum service life of the processor.

2. Rent one of our field calibration systems and perform as many calibrations as you would like at your facility and at your convenience.

Call **(302) 451-1088** to make arrangements for service and to obtain an RMA number for the return. Every effort will be made to return processors within two (2) business days.

Consult your carrier for the proper method of packaging the unit for return shipments.

Always insure the package for the full replacement value.

Keep in mind that most carriers will not honor insurance claims if the product is not shipped in accordance with their guidelines.

KEROTEST MANUFACTURING CORP is not responsible for damage caused in shipping.

GENERAL OPERATION

Modes of Operation

Kerotest Electrofusion Processors have multiple modes of operation:

Primary Fusion Mode

Barcode Fusion Mode

Barcode Fusion Mode infers that fusion parameters are input into the processor by scanning a barcode label attached to the fitting being fused. When the barcode label is scanned at the appropriate prompt, the processor reads the fitting's specific fusion parameters. Barcode labels generally provide the following details needed to fuse that particular fitting: manufacturer, type, size, energy (voltage), fusion time, cool time, resistance, tolerance, and compensation factors.

It is strongly recommended that Barcode Fusion Mode be used to perform fusions whenever possible. Barcode Fusion Mode includes additional automated features and pre-fusion machine checks which are not always available when using Alternate Fusion Modes. Some of these additional features include:

- Automatic calculation of fusion time adjustments based on ambient temperature.
- Pre-fusion resistance checks against manufacturer-specified tolerances.

These features help ensure that the proper fusion parameters are entered**. However, it is important to understand that no amount of machine checks will ever negate the requirement for a well-trained observant operator to make a final GO/NO GO decision, regardless of which Mode of Operation is being used.**

FAILURE TO VERIFY THAT THE FUSION INFORMATION IS CORRECT BEFORE STARTING A FUSION COULD RESULT IN SIGNIFICANT DAMAGE TO PROPERTY, PERSONAL INJURY, AND/OR DEATH.

Alternate Fusion Modes

Alternate Fusion Modes are used when the barcode scanning device (i.e. barcode wand or SMART Scanner™) is malfunctioning or unavailable. Alternate Fusion Modes require additional care and attentiveness on the part of the operator to ensure that the proper fusion parameters are entered. **For this reason, the following Alternate Fusion Modes should ONLY be performed by a fully trained operator using the fitting manufacturer's specifications regarding fusion time, voltage, and cooling time:**

Manual Barcode Mode

Infers that the fusion parameters are obtained from the 24 digit barcode number that the operator manually inputs from the keypad.

Manual Mode

FOR EXPERT OPERATORS ONLY! Manual Mode infers that the fusion voltage and time are obtained directly from the operator at the time of the fusion. ***Manual Mode should only be used when the barcode is malfunctioning or unavailable***. The temperature compensation must be calculated and entered manually, making it difficult to ensure the proper implementation of time/temperature compensation for fittings requiring this feature. **Since compensation factors vary for different fitting types and manufacturers, the fitting manufacturer should always be consulted to verify proper fusion time, voltage, and cooling time.**

FAILURE TO VERIFY THAT THE FUSION INFORMATION IS CORRECT BEFORE STARTING A FUSION COULD RESULT IN SIGNIFICANT DAMAGE TO PROPERTY, PERSONAL INJURY, AND/OR DEATH.

Power Up

Shannon

NOTE:

The **Shannon Electrofusion Processor** *cannot be turned ON until it has been connected to an adequate source of AC power. This feature is designed to protect the processor from input voltage spikes during the power up sequence.* ***This feature will not protect the processor from voltage spikes after initial power up.*** *When the processor is first turned ON each day, you may need to press and hold the green button for approximately one (1) second until the unit powers up.*

DO NOT, UNDER ANY CIRCUMSTANCES, PRESS AND HOLD THE POWER SWITCH IN THE "ON" POSITION WHILE STARTING A GENERATOR THAT THE PROCESSOR IS PLUGGED INTO. DOING SO WILL BYPASS THE PROTECTION CIRUIT AND EXPOSE THE PROCESSOR TO VERY HIGH INPUT VOLTAGE SPIKES WHICH WILL LIKELY CAUSE INTERNAL DAMAGE.

The correct power up sequence is as follows:

1. Make sure the ***Shannon Electrofusion Processor*** is OFF and disconnected from the generator.
2. Start the generator. Make sure the generator is running smoothly in high speed manual mode before plugging in the ***Shannon Electrofusion Processor***.
3. Plug the ***Shannon Electrofusion Processor*** into the appropriately sized receptacle on the generator. It is strongly recommended that the ***Shannon Electrofusion Processor*** is the only device being powered by that generator. Do not use an extension cord if it is at all possible. If an extension cord must be used, see page 52 for guidelines on selecting an appropriately sized cord.
4. Press and hold the green button on the power switch until the processor powers up.

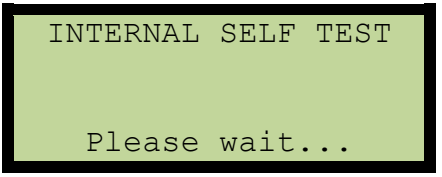
Portafuse III

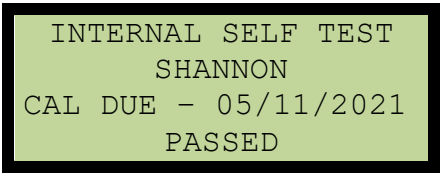
The correct power up sequence for the ***Portafuse III Electrofusion Processor*** depends on whether you are powering the processor with the battery pack or with the external transformer. The correct sequence for each scenario is as follows:

Powered with Battery Pack	Powered with External Transformer
1. Place the battery pack in its mounting bracket located in the back of the carrying case. *See page 51 for guidelines on the installation and removal of the battery pack from its mounting bracket*.	1. Attach the output pigtail for the external transformer to the generator-in connector on the back of the ***Portafuse III Electrofusion Processor*** (see picture on page 14).
2. Plug the battery pack pigtail into the receptacle located on the left side of the processor. The connectors are color coded and should mate easily with little force. ***DO NOT FORCE THE CONNECTORS TOGETHER.***	2. Start the generator. Make sure the generator is running smoothly in high speed manual mode.
3. Rotate the power switch on the left side of the unit counterclockwise to the ON BATT position (see page 13). The processor will now boot.	3. Plug the external transformer into the generator. Rotate the power switch on the **transformer** clockwise to the ON position.
	4. Rotate the power switch on the ***Portafuse III Electrofusion Processor*** clockwise to the ON GEN position (see page 13). The processor will now boot.

Boot Sequence

After the processor has turned ON, start-up screens similar to the following will be displayed one after another:





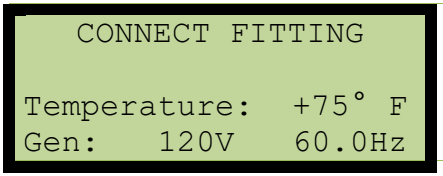
NOTE:

The name displayed on the second INTERNAL SELF TEST screen will correspond with the processor you are using.

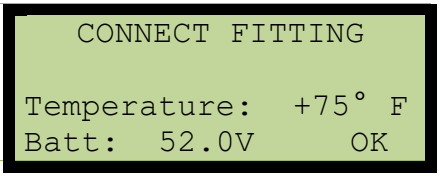
After the INTERNAL SELF TEST, if the feature is enabled, the TRACEABILITY screen will be displayed, allowing you to enter Operator Traceability Data. *If this screen appears, see page 42 for instructions how to enter the data.*

After the Operator Traceability Data is entered, the processor will display the CONNECT FITTING screen. Examples of the CONNECT FITTING screen are shown below:

AC Powered Processors



Battery Powered Processors

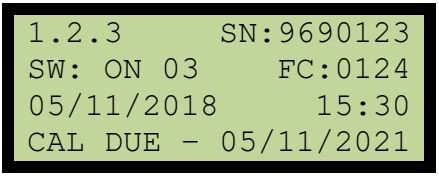


The second line indicates the ambient temperature the processor is measuring and will be used to modify the fusion time if required by the fitting manufacturer.

Check to make sure the temperature reading is accurate. If the processor has been in direct sunlight or has been moved from a hot or cold environment, the temperature may not be correct. If the temperature indicated is not correct, allow the processor time to adapt to the correct temperature, approximately 15-20 minutes.

The last line indicates the status of the processor's power source. If operating an ***AC Powered Processor***, the voltage and frequency of the generator are displayed. If operating a ***Battery Powered Processor***, the voltage and charge state of the battery are displayed. It is important that the voltage measurement is within the allowable range and the frequency is stable, or that the battery state is "OK."

Pressing and holding down the **UP button** while the processor is at the CONNECT FITTING screen will show a screen similar to the following:



This screen shows the following information:

- Software version of the processor (In this case, version 1.2.3).
- Processor serial number (In this case, 9690123).
- SMART Scanner™ status (In this case, ON).
- The number of fusions the processor has completed (In this case, 124).
- The Date and Time (In this case, May 11, 2018 at 3:30 PM)
- The date the processor will be due for calibration (In this case, May 11, 2021)

Release the **UP button** to return to the CONNECT FITTING screen.

To begin the fusion process, follow the instructions in the following section that corresponds to the fusion method that you wish to perform.

Barcode Fusions

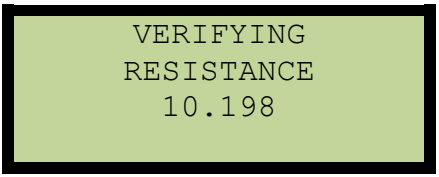
The Barcode Fusion Method is always preferred and should be used whenever possible.

When beginning a Barcode Fusion, start from the CONNECT FITTING screen.

Secure the correct fitting adapters to the **Output Lead Ends.**

Connect both **Output Lead Ends** to the fitting.

When the **Output Lead Ends** are connected to the fitting, the processor will measure the fitting resistance and display a screen similar to the following:



After measuring the fitting resistance, the processor will display the following screen:

Remove the scanning device (i.e. barcode wand or SMART Scanner™) from the protective sheath. Scan the barcode from the fitting about to be fused. See page 36 for scanning techniques and suggestions.

Whenever possible, use the barcode label attached to the fitting about to be fused. If this is not possible, use a barcode from an **identical** fitting made by the same manufacturer to ensure that the fusion parameters are correct.

UNDER NO CIRCUMSTANCES SHOULD A BARCODE FROM A SIMILAR FITTING BE USED.

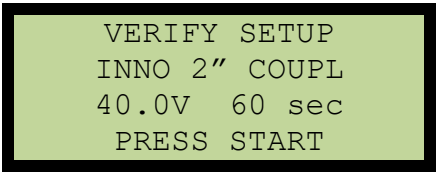
NOTE:

If the scanning device is inoperative, see page 26 for details about how a fusion can be completed without using a scanning device.

Once the barcode has been successfully scanned, the ***Kerotest Electrofusion Processor*** will display a screen similar to the following:

NOTE:

If Pipe/Fitting Traceability is set to ON or OPT, the operator will be prompted to scan traceability data at this time. Refer to the appropriate section on page 41 for instructions that detail how to gather this data.



The VERIFY SETUP screen shows the following information:

- The fitting type (Innogaz 2” Coupler).
- The requested output (40.0 Volts).
- The total temperature-compensated fusion time in seconds (In this case, 60 seconds).

The VERIFY SETUP screen allows the operator a final opportunity to verify that the fusion parameters displayed are correct and match the parameters specified by the fitting manufacturer before starting the fusion. ALWAYS pay close attention and verify the information on this screen is correct before pressing START.

IT IS THE RESPONSIBILITY OF THE OPERATOR TO VERIFY THAT ALL THE INFORMATION DISPLAYED IS CORRECT PER THE FITTING MANUFACTURER’S RECOMMENDATIONS FOR FUSING THE ATTACHED FITTING UNDER THE CURRENT AMBIENT CONDITIONS.

The processor will BEEP once per second and the text “PRESS START” on the bottom line of the display will flash on and off.

Once you have verified that all measurements and parameters are correct, press the **START button** to begin the fusion.

FAILURE TO VERIFY THAT THE FUSION INFORMATION IS CORRECT BEFORE STARTING A FUSION COULD RESULT IN SIGNIFICANT DAMAGE TO PROPERTY, PERSONAL INJURY, AND/OR DEATH.

NOTE:

If Calculated Resistance is enabled and the operator receives a Warning Code 55, refer to the appropriate section on page 42 for instructions that detail how to proceed.

See page 29 for instructions on monitoring the progress of a fusion.

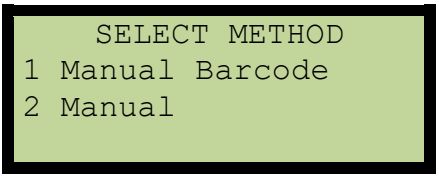
Alternate Fusion Methods

Manual Barcode Entry

****The Barcode Fusion Method is always preferred and should be used whenever possible.** *Manual Barcode Entry Fusions require additional care and attentiveness on the part of the operator to ensure that the appropriate fusion parameters are entered. For this reason, Manual Barcode Fusions should ONLY be performed by a fully trained operator using specifications provided by the fitting's manufacturer.*

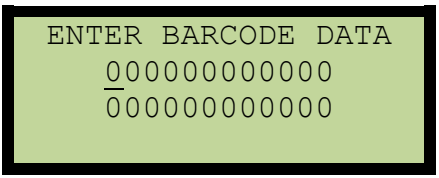
The Alternate Fusion selection screen can be accessed by pressing the **UP button** and the **DOWN button** at the same time when the processor is displaying the SCAN BARCODE screen.

The Alternate Fusion selection screen looks like the following:



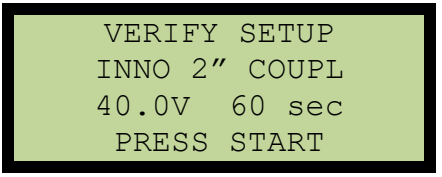
Select the desired method by using the **UP button** and the **DOWN button**. When the desired method is highlighted, press the **START button**.

While in Manual Barcode Mode, the operator can manually input the numbers from the barcode label attached to the fitting to be fused. The following screen will be displayed:



The cursor will begin under the first digit of the barcode. Enter the data from the barcode attached to the fitting using the keypad *(See page 40).* When the **START button** is pressed after the last character is entered, the processor will move to the next screen.

If no errors were encountered, the ***Kerotest Electrofusion Processor*** will display a screen similar to the following:



The VERIFY SETUP screen allows the operator a final opportunity to verify that the fusion parameters displayed are correct and match the parameters specified by the fitting manufacturer before starting the fusion. ALWAYS pay close attention and verify the information on this screen is correct before pressing START.

IT IS THE RESPONSIBILITY OF THE OPERATOR TO VERIFY THAT ALL THE INFORMATION DISPLAYED IS CORRECT PER THE FITTING MANUFACTURER'S RECOMMENDATIONS FOR FUSING THE ATTACHED FITTING UNDER THE CURRENT AMBIENT CONDITIONS.

The processor will BEEP once per second and the text "PRESS START" on the bottom line of the display will flash on and off.

Once you have verified that all measurements and parameters are correct, press the **START button** to begin the fusion.

If errors were encountered while decoding the barcode number that was manually entered, you will receive an Error Message and will be forced to check the number and reenter it.

FAILURE TO VERIFY THAT THE FUSION INFORMATION IS CORRECT BEFORE STARTING A FUSION COULD RESULT IN SIGNIFICANT DAMAGE TO PROPERTY, PERSONAL INJURY, AND/OR DEATH.

NOTE:

If Calculated Resistance is enabled and the operator receives a Warning Code 55, refer to the appropriate section on page 42 for instructions that detail how to proceed.

See page 29 for instructions on monitoring the progress of a fusion.

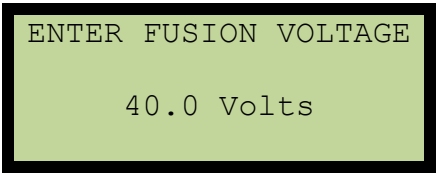
Manual Data Entry

****The Barcode Fusion Method is always preferred and should be used whenever possible.** ***Manual Mode should only be used when the barcode is malfunctioning or unavailable. FOR EXPERT OPERATORS ONLY.*** *Manual Data Entry Fusions require additional care and attentiveness on the part of the operator to ensure that the appropriate fusion parameters are entered. For this reason, Manual Fusions should ONLY be performed by a fully trained operator using specifications provided by the fitting manufacturer.*

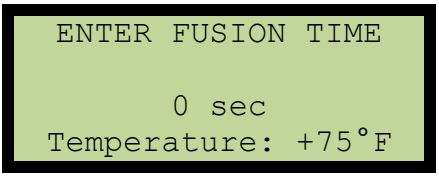
NOTE:

The **Kerotest Electrofusion Processor** *provides outputs for a complete fusion based on parameters manually entered by the operator. Remember to enter all parameters* **EXACTLY** *as specified by the fitting manufacturer.*

After selecting Manual Fusion Mode from the Alternate Fusion selection screen (see page 26), the following screen will be displayed:

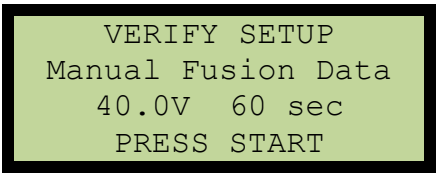


Enter the voltage by using the **UP button** and **DOWN button** to increment and decrement the value. As either button is held, the numbers will continue to scroll, slowly at first and then faster as time passes. When the desired voltage is displayed, press the **START button**. The following screen will be displayed and you will be able to enter the fusion time:



Enter the total number of **SECONDS** to fuse using the **UP button** and **DOWN button** to increment and decrement the current value by one (1) second. As either button is held, the numbers will continue to scroll, slowly at first and then faster as time passes. When the desired number of seconds are displayed, press the **START button**.

Once the data has been successfully entered, the ***Kerotest Electrofusion Processor*** will display a screen similar to the following:



The VERIFY SETUP screen allows the operator a final opportunity to verify that the fusion parameters displayed are correct and match the parameters specified by the fitting manufacturer before starting the fusion. ALWAYS pay close attention and verify the information on this screen is correct before pressing START.

IT IS THE RESPONSIBILITY OF THE OPERATOR TO VERIFY THAT ALL THE INFORMATION DISPLAYED IS CORRECT PER THE FITTING MANUFACTURER'S RECOMMENDATIONS FOR FUSING THE ATTACHED FITTING UNDER THE CURRENT AMBIENT CONDITIONS.

The processor will BEEP once per second and the text "PRESS START" on the bottom line of the display will flash on and off.

Once you have verified that all measurements and parameters are correct, press the **START button** to begin the fusion.

FAILURE TO VERIFY THAT THE FUSION INFORMATION IS CORRECT BEFORE STARTING A FUSION COULD RESULT IN SIGNIFICANT DAMAGE TO PROPERTY, PERSONAL INJURY, AND/OR DEATH.

See page 29 for instructions on monitoring the progress of a fusion.

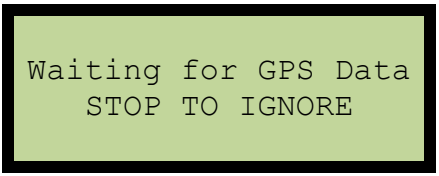
Monitoring a Fusion's Progress

Once the **START button** is pressed the fusion process will begin.

The fusion process begins with a Fitting Resistance Verification. The ***Kerotest Electrofusion Processor*** will display a screen similar to the following:

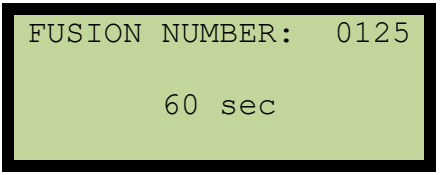
When operating in Barcode Fusion Mode, this resistance check is to make sure that the actual fitting connected matches the resistance of the fitting described in the fusion parameters. When operating in an Alternate Fusion Mode, this resistance check is used to verify that the fitting is still attached. **Although many fittings have similar resistance measurements and this check is NOT fool-proof, it will help to ensure that the correct fitting is attached.**

If equipped with the optional GPS, the processor will next attempt to read the GPS coordinates. A screen similar to the following will be displayed:



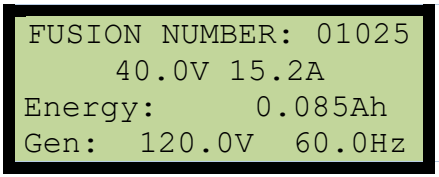
Once the coordinates are obtained, the fusion will proceed normally. To ignore the GPS data and force the fusion to begin, press the **STOP button**. **If the GPS screen is bypassed, *NO GPS DATA WILL BE STORED IN THE PROCESSOR'S MEMORY FOR LATER DOWNLOADS*.**

As the fusion proceeds, the following screen will be displayed:

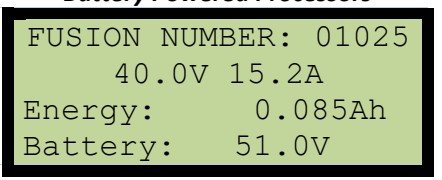


This screen shows the number of the current fusion as well as the time remaining (In this case, 60 seconds). If you want to see more detailed information, press and hold the **UP button** to display the following fusion information screen:

AC Powered Processors



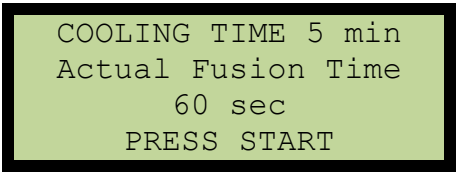
Battery Powered Processors



This screen displays the following information:

- The most recently measured voltage and current outputs of the processor.
- The total energy expended during this fusion, in amp-hours (In this case 0.085 amp-hours.). *This number increases during the fusion process as energy is expended.*
- The present measured voltage of the generator or battery (In this case 120.0 volts and 51.0 volts).
- The current generator frequency (In AC powered processors). This number should remain relatively constant throughout the fusion.

When the fusion is complete, the following screen will be displayed:



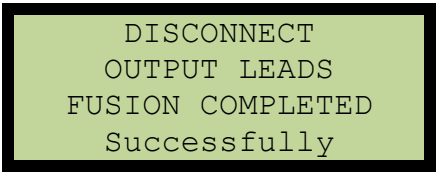
This screen displays the following information:

- The cooling time, if specified (In this case 5 minutes).
- The actual amount of time that the fitting was fused (In this case 60 seconds).

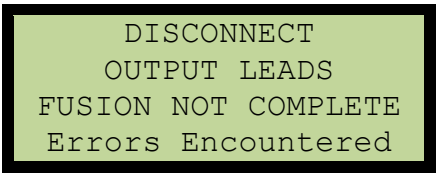
Press the **START button** to continue.

After the fusion process has ended, the processor will prompt the operator to disconnect the Output Lead Ends and will not recognize any other inputs until this task is complete.

If no errors were encountered during the fusion process, the following screen will be displayed:



If errors were encountered during the fusion process, an Error Code Message will be displayed (see page 53 for a list of possible Error Codes), and the following screen will be displayed after the error message screen:



After the Output Lead Ends are disconnected, the ***Kerotest Electrofusion Processor*** will return to the CONNECT FITTING screen and will be ready to accept information for the next fusion.

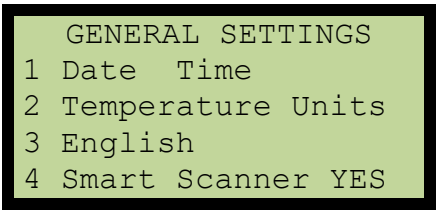
NOTE:

If Operator Traceability is enabled, remember that the Operator ID codes entered previously will remain attached to any additional fusions until the power is shut off or until the information is changed by the operator.

USER MENUS

Basic User Menu

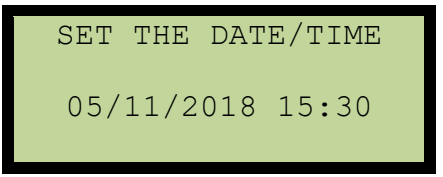
The Basic User Menu is accessed by holding the **UP button** when the processor is first powered up. Keep holding the **UP button** through the INTERNAL SELF TEST until the processor displays a screen similar to the following:



Use the **UP/DOWN buttons** to highlight the desired option. Press the **START button** to access the desired option. Press the **STOP button** to return to normal operation.

Setting the Date and Time

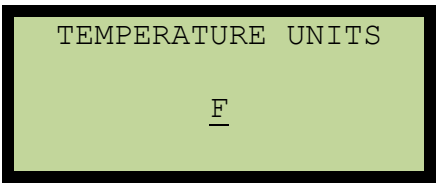
When Option 1 is highlighted, press the **START button** to select it. The following screen will be displayed:



With the keypad *(see page 40)*, enter the correct date using the MM/DD/YYYY format and the correct time using the 24 hour (military) format. Press the **START button** to save the information entered and return to the Basic User Menu.

Setting the Temperature Units

When Option 2 is highlighted, press the **START button** to select it. The following screen will be displayed:



Use the **UP/DOWN buttons** to toggle the default temperature unit setting between ºF and ºC. When the desired unit is displayed, press the **START button** to save and return to the Basic User Menu.

Setting the Language

When Option 3 is highlighted, press the **START button** to select it. Use the **UP/DOWN buttons** to toggle between all supported languages. When the desired language is displayed, press the **START button** to save. English is currently the only language supported by **Kerotest Electrofusion Processors.**

SMART Scanner™

When Option 4 is highlighted, press the **START button** to select it. Use the **UP/DOWN buttons** to toggle between the SMART SCANNER activation values. When the desired activation value is displayed, press the **START button** to save. A value of YES enables the display and remote button functionality on the SMART Scanner™. A value of NO disables this functionality. The SMART Scanner™ will scan a barcode with either setting.

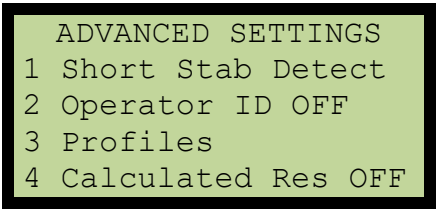
NOTE:

This option should be set based on the type of scanning device attached to the machine (i.e. barcode wand or SMART Scanner™). An incorrect setting may cause unexpected intermittent errors.

Advanced User Menu

NONE OF THE SETTINGS IN THE ADVANCED USER MENU SHOULD BE ADJUSTED WITHOUT SPECIFIC INSTRUCTIONS FROM THE FACTORY OR THE FITTING MANUFACTURER.

The Advanced User Menu is accessed by holding the **DOWN button** when the processor is first powered up. Keep holding the **DOWN button** through the INTERNAL SELF TEST screen, until you are prompted for a passcode that must be entered before proceeding. Contact an authorized representative (see page 19) to obtain the 4 digit passcode. The following example shows the options available in the Advanced User Menu once the correct passcode has been entered:



Use the **UP/DOWN buttons** to highlight the desired option. Press the **START button** to access the desired option. Press the **STOP button** to return to normal operation.

Short Stab Detect

Short stab detection is accomplished by tracking the lowest output current during the fusion and looking for a rise greater than an established percentage. This option allows the operator to set the percent rise in current above which an error will be generated.

BECAUSE THE SHORT STAB IS MEASURED INDIRECTLY THROUGH CURRENT, AUTOMATIC DETECTION OF A SHORT STAB IS NOT 100% GUARANTEED.

PROPER ASSEMBLY TECHNIQUES ARE THE RESPONSIBILITY OF THE OPERATOR.

Operator ID

This setting controls the Operator Traceability functions. This option is different than Pipe/Fitting Traceability. Pipe/Fitting Traceability is discussed below. Values for Operator Traceability are "OFF", "ON", or "SCAN":

- "OFF" disables the Operator Traceability function.
- "ON" enables the Operator Traceability function.
- "SCAN" enables the Operator Traceability function with a requirement to scan an ISO 12176-3 compliant Operator ID Badge.

When Option 2 is highlighted, press the **START button** to select it. Use the **UP/DOWN buttons** to toggle through available Operator Traceability function values. When the desired value is displayed, press the **START button** to save.

To obtain operator barcodes, contact an authorized representative (See page 19).

Profiles

The Profiles setting currently has no function. The processor will beep twice if it accessed.

Calculated Resistance

This setting controls the Calculated Resistance option. Values for Calculated Resistance are "OFF" or "ON."

- "OFF" - *RECOMMENDED*: The processor always measures resistance using a lab quality 4-wire measurement. This is the processor's primary method of resistance measurement and is frequently used during Quality Control testing by fitting manufacturers.
- "ON" – If a processor displays Warning Code 55 (see page 53), an operator has the option to perform a secondary Calculated Resistance check. During this secondary check, the unit calculates a resistance estimate based on fusion voltage and current.

DO NOT TURN CALCULATED RESISTANCE ON UNLESS A 4-WIRE MEASUREMENT FAILS.

TURNING ON CALCULATED RESISTANCE DOES NOT GUARANTEE THAT A FUSION WILL BE SUCCESSFUL.

BEFORE TURNING ON CALCULATED RESISTANCE, ALWAYS CONFIRM WITH THE FITTING MANUFACTURER THAT IT IS AN ACCEPTABLE METHOD OF MEASUREMENT FOR THEIR SPECIFIED FITTING.

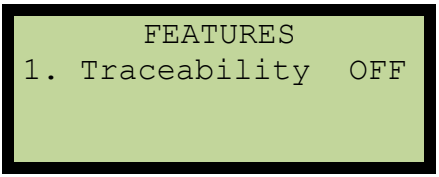
IT IS THE RESPONSIBILITY OF THE OPERATOR TO VERIFY THAT ALL THE INFORMATION DISPLAYED IS CORRECT PER THE FITTING MANUFACTURER'S RECOMMENDATIONS FOR FUSING THE ATTACHED FITTING UNDER THE CURRENT AMBIENT CONDITIONS.

When Option 4 is highlighted, press the **START button** to select it. Use the **UP/DOWN buttons** to toggle between the Calculated Resistance values. When the desired value is displayed, press the **START button** to save.

See page 42 for instructions how to operate the processor with Calculated Resistance.

Features Menu

The Features Menu is accessed by holding the **UP and DOWN buttons** at the same time when the processor is first powered up. Keep holding the **UP/DOWN buttons** through the INTERNAL SELF TEST screen, until the processor displays a screen similar to the following:



Use the **UP/DOWN buttons** to highlight the desired option. Press the **START button** to access the desired option. Press the **STOP button** to return to normal operation.

Traceability

This setting controls the Pipe/Fitting Traceability functions. Values are “OFF”, “ON” or “OPT”:

- “OFF” disables the Pipe/Fitting Traceability function.
- “ON” enables the Pipe/Fitting Traceability function. The machine WILL NOT allow a fusion to proceed unless at least one (1) traceability barcode is scanned.
- “OPT” (Optional) enables the Pipe/Fitting Traceability function but will allow a fusion to proceed if the operator decides not to scan a traceability barcode.

When Option 1 is highlighted, press the **START button** to select it. Use the **UP/DOWN buttons** to toggle through available Pipe/Fitting Traceability function values. When the desired value is displayed, press the **START button** to save.

PIPE AND FITTING TRACEABILITY WILL ONLY APPLY TO FUSIONS DONE IN BARCODE MODE.

To learn more about Pipe and Fitting Traceability, contact an authorized representative (See page 19).

APPENDIX

Scanning Barcodes

Barcode Wand

When using a Barcode Wand, make sure the SMART SCANNER setting is "OFF" (See page 33).

While holding the wand at a slight angle as you would a pencil, position the point slightly to one side of the label and move the wand rapidly across the barcode stopping at a point slightly off the label on the other side.

NOTE:

The barcode may be scanned left to right or right to left as long as the scan speed is brisk and consistent. Do not change the speed of the wand as it travels across the barcode label.

WHEN SCANNING, MOVING THE WAND FASTER IS BETTER THAN SLOWER.

SMART Scanner™

THE SMART SCANNER™ IS NOT MULTI LINGUAL. THE ONLY LANGUAGE AVAILABLE IS ENGLISH.

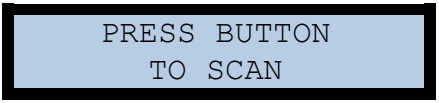
Smart Scan Mode

To operate the SMART Scanner™ in Smart Scan Mode, set the SMART SCANNER option in the Basic User Menu to "YES". In Smart Scan Mode, additional features not available in Scan Mode can be used. Smart Scan Mode allows you to:

- View fitting data on the SMART Scanner™ screen before beginning a fusion.
- START and STOP a fusion using the SMART Scanner™ button.
- Scan Pipe/Fitting Traceability barcodes.

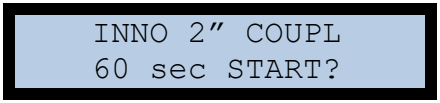
When operating in Smart Scan Mode, the SMART Scanner™ will provide operator feedback on the display to assist in the completion of the fusion without getting in and out of the ditch. When the SMART Scanner™ is powered up in Smart Scan Mode, the display will look something like this:

The processor is now ready for you to connect the Output Lead Ends to the fitting. Once you connect the fitting, the display will look something like this:



The processor is now ready for you to scan the fitting barcode and Pipe/Fitting Traceability barcodes (if enabled). See the Scanning Techniques section on page 39 for tips on how to reliably scan a barcode.

Once the barcode has been successfully scanned, the fitting information will be shown on the display. It could look something like this:



This should be the same data that is displayed on the screen of the processor and is an indication that the fusion is ready to be started. At this point in time the fusion can be started by pressing and holding the **button** on the SMART Scanner™ for a few seconds. As the fusion is in progress, the SMART Scanner™ display will look something like this:

At any time, you may press and hold the **button** to stop the fusion.

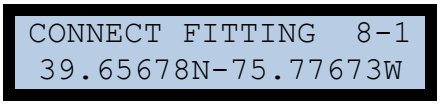
If errors are encountered during the fusion process, the SMART Scanner™ will alert the operator by showing the following message:

At this point, you should consult the display of the processor itself for the specific error code and take appropriate corrective action based on the information displayed.

GPS Mode

Operating the SMART Scanner™ in GPS Mode is the same as operating the SMART Scanner™ in Smart Scan Mode with the addition of GPS data. For this reason, only the differences are highlighted in this section.

When the SMART Scanner™ prompts the operator to connect the fitting, the current GPS position will be displayed after the satellites have been acquired. The screen will look something like this:



The display shows the current latitude and longitude as well as the number of satellites that the SMART Scanner™ is currently tracking and the Position Error Indicator. The SMART Scanner™ can only accurately report the current position when it is tracking more than 5 satellites. The example above shows that it is tracking 8 satellites, the level of signal confidence is 1 and the current position is 39.65678 degrees North latitude and 75.77673 degrees West longitude. In general, the higher the number of satellites and the lower the Position Error Indicator Number, the better the position accuracy will be.

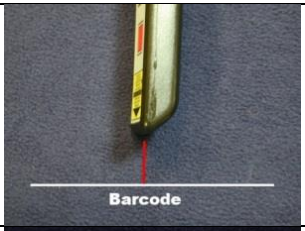
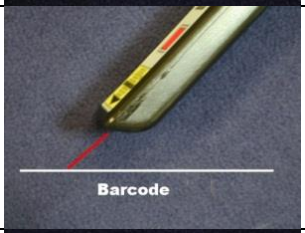
When the device is first started, it may take up to 2 minutes to acquire 5 satellites. During the acquisition process the display will look something like this:

If after a few minutes, the SMART Scanner™ still has not acquired 5 satellites, you may try to follow some of the suggestions in the GPS section on page 47, or you can bypass the GPS data by simply connecting the fitting. The SMART Scanner™ will show you a message similar to the following:

IF YOU CHOOSE TO PRESS THE BUTTON, YOU WILL BE ABLE TO SCAN THE BARCODE AND COMPLETE THE FUSION NORMALLY; HOWEVER, GPS DATA WILL NOT BE STORED WITH THE FUSION.

Scanning Techniques

To scan a barcode, start by holding the SMART Scanner™ about 6-8 inches from the barcode to be scanned. Next, press and hold the **button**. A red aiming light will emanate from the end of the device as long as the **button** is held. Simply move the light over the barcode to be scanned. The SMART Scanner™ will beep once when the barcode is recognized. After the barcode is recognized, release the button. The following pictures illustrate a few simple tips that will improve scanning reliability:

	YES	For best results, hold the SMART Scanner™ perpendicular to the barcode to be scanned.
	YES	The aiming light should be centered and evenly spaced over the barcode to be scanned.
	NO	Do not hold the SMART Scanner™ so that the beveled scanning end is parallel to the barcode to be scanned. Although there are many cases where this scanning technique will produce satisfactory results, it does not work in all cases.
	NO	Do not hold the aiming light at an angle to the barcode.
	NO	Make sure the aiming light completely covers the barcode.

Using an External Transformer

The ***Portafuse III Electrofusion Processor*** can be optionally equipped with an external transformer to increase its output capability from 30 amps to 80 amps. The transformer plugs into the red connector located on the back right corner of the processor (*also see page 14*).

Follow these general guidelines to ensure proper operation:

1. Only use a transformer that has been approved for use with the ***Portafuse III Electrofusion Processor***.

2. Plug the transformer into the processor before the processor is turned ON.

3. Make sure the transformer connector is fully mated with the connector on the processor before use. ***If mated incorrectly, the integrity of the fusion may be compromised.***

4. After the transformer is properly plugged into the processor, follow the normal power up sequence on described on page 22.

Entering Data with the Keypad

To enter data in any field manually, press the **UP button** or the **DOWN button** to scroll through the list of valid characters. When you find the one you wish to use press the **START button** to move to the next character. If an invalid character is entered, press the **STOP button** to back the cursor up to the previous character and change it. (If the **STOP button** is pressed while on the first character the processor will return to the previous screen.) Repeat this procedure until all data is entered. When the **START button** is pressed after the last character, the processor will move to the next screen (if the **START button** is pressed when a blank character is displayed, the processor will skip the rest of the field and move to the next screen).

NOTE:

The processor will not allow an operator to enter invalid or out of range data. Example: If the maximum number allowed in a field is 40.0, the processor will not allow the operator to enter a number greater than 40.0.

NOTE:

When entering data, the processor will acknowledge valid data with one beep and continue. If there is an error encountered the processor will beep twice and not continue.

Traceability

Pipe/Fitting

The Gas industry has been promoting the adoption of traceability barcodes by manufacturers of pipe and fittings, through the ASTM F2897-11 and ISO 12176-4 standards. These barcodes contain the manufacturer's data that pertains to the construction of the pipe/fittings that are being fused. For those manufacturers that have incorporated this traceability feature, it can be found on an additional barcode appearing on the pipe and fittings, separate from the standard fusion barcodes. Examples of these barcodes are shown below:

ASTM F2897-11	ISO 12176-4
	

The Pipe/Fitting Traceability option can only be enabled through the Features Menu (see page 35). When this option is set to "ON" or "OPT", in addition to the fitting barcode, the operator will be prompted to scan one or more traceability barcodes that are attached to the pipe and/or the fitting. This data will not affect the fusion; however, it will be associated with the fusion in the download.

If the Pipe/Fitting Traceability option is set to "ON" or "OPT", the operator will be prompted to scan the barcodes immediately after the fitting barcode is scanned. The screen will look similar to the following:

```
SCAN TRACEABILITY
    BARCODE 1

Press START if done.
```

You can scan one (1) or more traceability barcodes at this time, up to six (6) barcodes. When you scan multiple barcodes, the display will update accordingly to indicate the number of barcodes scanned.

THE OPERATOR MUST SCAN AT LEAST ONE (1) TRACEABILITY BARCODE UNLESS THE PIPE/FITTING OPTION IS SET TO "OPT" (OPTIONAL).

When you are finished scanning traceability barcodes, or if you do not wish to scan any traceability barcodes during this fusion, press the **START button** to advance to the VERIFY SETUP screen. Alternately, if the maximum number of traceability barcodes (6) has been scanned, the processor will automatically advance to the VERIFY SETUP screen.

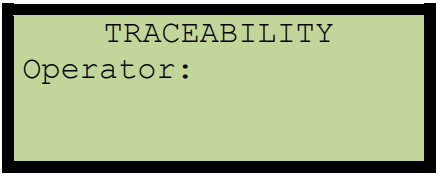
FOR DATA INTEGRITY REASONS, THERE IS NO METHOD TO MANUALLY INPUT TRACEABILITY DATA.

Operator ID

The Operator ID codes are an option that can only be enabled through the Advanced User Menu (See page 33). When enabled, Operator ID codes can be entered in two ways:

- "ON" requires the operator to manually enter an Operator ID code before a fusion may proceed.
- "SCAN" requires an operator to scan an ISO 12176-3 compliant Operator ID Badge before a fusion may proceed. Contact an authorized representative (See page 19) to find out more about generating this badge.

If Operator ID codes are enabled, the following screen will be displayed after the processor has passed its INTERNAL SELF TEST:



Operator ID codes entered here will be attached to all fusions performed by this processor until the power is turned off or the Operator ID code is changed. This Operator ID data will not affect the fusion but will be associated with each fusion in the download.

If the Operator ID function is set to "ON", manually enter the desired Operator ID code. *See page 40 for details on how to enter data with the keypad*. Manually entered Operator ID codes can contain up to 10 characters and include letters and/or numbers. When the **START button** is pressed after the last character, the processor will advance to the CONNECT FITTING screen. See page 20 for details on how to perform a fusion.

If the Operator ID function is set to "SCAN", use a barcode wand or SMART Scanner™ to scan the desired Operator ID barcode. Press the **START button** to accept the scanned Operator ID and advance to the CONNECT FITTING screen. See page 24 for details on how to perform a fusion.

Calculated Resistance

An operator can perform a secondary Calculated Resistance check. See page 34 for an explanation how Calculated Resistance works and instructions how to turn the option on.

NOTE:

A secondary Calculated Resistance check can only be performed when fusing in Barcode or Manual Barcode Modes. It will not work if fusing in Manual Mode.

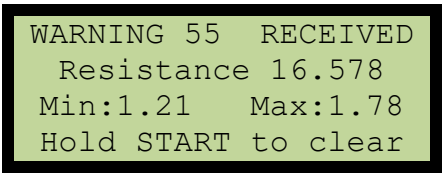
DO NOT TURN ON CALCULATED RESISTANCE UNLESS A 4-WIRE MEASUREMENT FAILS.

TURNING ON CALCULATED RESISTANCE DOES NOT GUARANTEE THAT A FUSION WILL BE SUCCESSFUL.

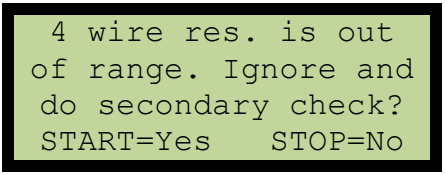
BEFORE TURNING ON CALCULATED RESISTANCE, ALWAYS CONFIRM WITH THE FITTING MANUFACTURER THAT IT IS AN ACCEPTABLE METHOD OF MEASUREMENT FOR THEIR SPECIFIED FITTING.

IT IS THE RESPONSIBILITY OF THE OPERATOR TO VERIFY THAT ALL THE INFORMATION DISPLAYED IS CORRECT PER THE FITTING MANUFACTURER'S RECOMMENDATIONS FOR FUSING THE ATTACHED FITTING UNDER THE CURRENT AMBIENT CONDITIONS.

If you press the **START button** to begin a fusion and receive Warning Code 55 (see page 53 for Error & Warning Code Definitions), the processor will display a screen similar to the following:



Press the **START button** to clear the warning code. The processor will display a screen similar to the following:

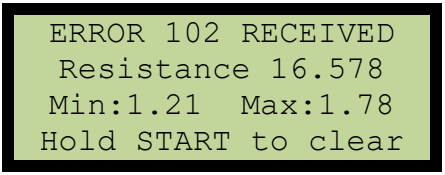


At this time, the operator has two options:

1. Cancel the fusion.
2. Perform the secondary check and attempt to continue fusing the fitting.

To CANCEL THE FUSION:

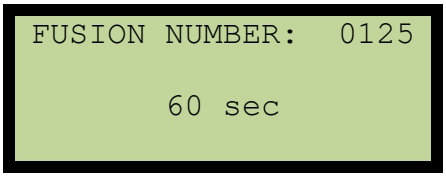
1. Press the **STOP button** to cancel the fusion now. The processor will display a screen similar to the following:



2. Press and hold the **START button** to clear the error code. Follow the prompts on the processor display. See page 54 for information how to troubleshoot an Error Code 102.

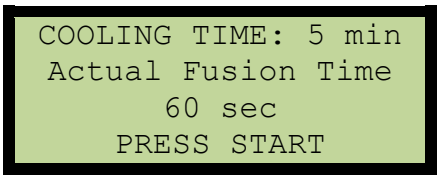
To PERFORM SECONDARY CHECK:

1. Press the **START button** to begin a Calculated Resistance check and attempt to continue the fusion. The processor will begin the fusion process and display a screen similar following:



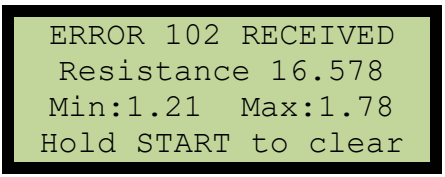
FAILURE TO VERIFY THAT THE FUSION INFORMATION IS CORRECT BEFORE STARTING A FUSION COULD RESULT IN SIGNIFICANT DAMAGE TO PROPERTY, PERSONAL INJURY, AND/OR DEATH.

2. If the Calculated Resistance check is successful, the fusion will proceed normally. When the fusion is complete, a screen similar to the following will be displayed:



Press the **START button** to continue.

3. If the Calculated Resistance check fails, the processor will display a screen similar to the following:



Press and hold the **START button** to clear the error code. Follow the prompts on the processor display. See page 54 for information how to troubleshoot an Error Code 102.

Downloading Data

Data Stored

The following data is stored for each fusion that the processor performs. Depending on the processor model, data stored in the processor can be downloaded to a USB Flash drive or wirelessly via Bluetooth with the EF Utilities app.

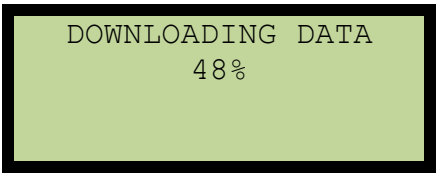
Field	Description
SN	The serial number of the unit.
Fusion #	The fusion number.
Date	Date and time the fusion was performed.
Cal Due	The date that the calibration is due.
Cal Req.	TRUE if the calibration date was expired when the fusion was completed.
Firmware	The firmware version of the processor loaded when the fusion was performed.
Result	The resulting error code.
Mode	The mode used for entering the fusion parameters.
Fitting	The fitting manufacturer type and size.
Control	The requested fusion output voltage.
Temp	The ambient temperature at the time of the fusion.
Nom. Time	The requested fusion time.
Comp Time	The fusion time after temperature compensation was applied.
Actual Time	The actual time the fitting was fused.
Mea Res	The resistance of the fitting specified in the barcode.
Tolerance	The specified resistance tolerance.
Mea Res Pre	The actual measured resistance of the fitting before the fusion.
Mea Res Post	The actual measured resistance of the fitting after the fusion.
Cooling time	The cooling time of the fitting specified in the barcode.
ID Res.	The measured value of the ID Resistor for ID Resistance fusions.
Input Volts	The measured generator voltage taken before the fusion.
High Volts	The highest measured generator voltage during the fusion.
Low Volts	The lowest measured generator voltage during the fusion.
Wave	The type of supply waveform identified during the fusion (Sine or Square).
Frequency	The measured generator frequency made before the fusion started.
High Freq	The highest measured generator frequency during the fusion.
Low Freq	The lowest measured generator frequency during the fusion.
L Out V	The lowest measured output voltage during the fusion.
H Out V	The highest measured output voltage during the fusion.
L Out A	The lowest measured output current during the fusion.
H Out A	The highest measured output current during the fusion.
Ah Out	The total number of Amp-Hours expended during the fusion.
Position	The GPS latitude and longitude at the time of the fusion.
Sat	The number of satellites used when determining the GPS fix.
Q	The GPS signal quality 0=no good, 1=GPS, 2=DGPS.
HDOP	GPS Horizontal Dilution of Precision
Operator	The operator ID code if enabled.
Traceability	The pipe/fitting traceability codes if enabled.

Downloading to a USB Flash Drive (USB models only)

Fusion data from a ***Kerotest USB Electrofusion Processor*** is downloaded onto an external USB flash drive. The data is output in a binary format that is compatible with a free macro-enabled Excel Spreadsheet available from KEROTEST MANUFACTURING CORP.

To download fusion data from the processor to a USB flash drive, perform the following steps:

1. Turn ON the processor and allow it to proceed through the INTERNAL SELF TEST until it reaches the CONNECT FITTING screen.
2. Plug a formatted USB flash drive into the USB host connector on the face of the processor.
3. The USB flash drive will be detected automatically and the fusion data will be written to the drive.
4. A progress screen similar to the following will be displayed as the download proceeds:



5. After the download is complete, the processor will return to the CONNECT FITTING screen. You may now disconnect the USB flash drive from the USB Host Port to resume normal operation.

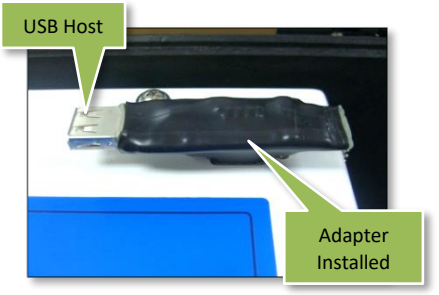
ONLY NEW FUSIONS PERFORMED SINCE THE LAST DOWNLOAD WILL BE WRITTEN TO THE DRIVE.

THE USB FLASH DRIVE MUST BE FORMATTED USING FAT OR FAT32 WITH A SECTOR SIZE OF 512 BYTES.

Serial Processors

Some ***Kerotest Electrofusion Processors*** may have a 9 pin D-sub connector instead of a USB host connector. To download fusion data from a serial processor onto a USB flash drive, you will need a USB to Serial Port adapter. This adapter is available for purchase from KEROTEST MANUFACTURING CORP. One adapter may be used with multiple processors.

The pictures below show a 9 pin D-sub connector and the installed adapter for your reference:



Downloading Wirelessly (Bluetooth models only)

Fusion data from a ***Shannon Bluetooth Electrofusion Processor*** is downloaded wirelessly through the EF Utilities app. Once the data has been downloaded, it can be viewed at any time with a smart phone, tablet, or computer.

To download fusion data from the processor to the EF Utilities app, perform the following steps:

a. Turn ON the processor and allow it to proceed through the INTERNAL SELF TEST until it reaches the CONNECT FITTING screen.
b. Open the EF Utilities app on your smart phone or tablet and select, "Connect to EF Machine."
c. Follow the download instructions in the app.

All progress indications and user feedback are communicated through the EF Utilities app which is available on iOS and Android app stores. To set up an account and register your Bluetooth electrofusion processor(s), contact KEROTEST MANUFACTURING CORP.

GPS

The option GPS in the SMART Scanner™ can be used to record the latitude and longitude of the processor where the fusion is done:

- The GPS coordinates are accurate to within 10-15 meters.
- The latitude and the longitude, as well as the number of satellites used when generating the fix, are stored with each fusion and output during the download.
- Once downloaded, the coordinates can be input into many commercially available mapping programs to obtain position information.

Trouble

The most common cause of GPS signal trouble is poor signal quality. This can be caused by:

1. Antenna orientation.
2. Obstructions such as buildings or trees.
3. Weather conditions.

Other than moving the receiver or waiting for the weather to clear, there is not a great deal of control that one has over a poor signal. Be sure to hold the device with the antenna (the side with the sticker) pointing up and with a clear view of the sky.

When the device is in the CONNECT FITTING screen, the "-" in between the latitude and the longitude measurement will flash. This flashing indicates that the SMART Scanner™ is receiving a signal from the GPS. If this dash is not flashing, there is a problem with the GPS receiver itself and it should be returned.

Position Accuracy

GPS accuracy is affected by a number of factors, including satellite positions, noise in the radio signal, atmospheric conditions, and natural barriers to the signal. Noise can create an error between 1 to 10 meters and results from static or interference from something near the receiver or something on the same frequency. Objects such as mountains, buildings, or even clouds in between the satellite and the receiver can also produce error, sometimes up to 30 meters. The most accurate determination of position occurs when the satellite and receiver have a clear view of each other and no other objects interfere.

THE SMART SCANNER™ WAS NEVER DESIGNED TO GIVE A POSITION ACCURATE ENOUGH TO GO FIND A FITTING AND DIG IT UP. IT IS PROVIDED TO ALLOW THE USER TO DETERMINE THE GENERAL LOCATION WHERE THE FITTING CAN BE FOUND.

Position Error Indicator

The Position Error Indicator gives the operator an indication of how much confidence they should place in the accuracy of the current position reading.

Value	Rating	Description
1	Ideal	This is the highest possible confidence level to be used for applications demanding the highest possible precision at all times.
1-2	Excellent	At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications.
2-5	Good	Represents a level that marks the minimum appropriate for making business decisions. Positional measurements could be used to make reliable in-route navigation suggestions to the user.
5-10	Moderate	Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended.
10-20	Fair	Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location.
>20	Poor	At this level, measurements are inaccurate by as much as 300 meters with a 6 meter accurate device (50 DOP × 6 meters) and should be discarded.

As a general rule, confidence indications above a Value of 2 should not be used although the SMART Scanner™ will not prohibit the operator from using any reading.

Although it is beyond the scope of discussion for this manual, the number we refer to as the Position Error Indicator is actually the “Horizontal Dilution of Precision” value (HDOP) rounded to the nearest integer for those with a more advanced knowledge of GPS terminology.

General Maintenance

Changing the Fuse (AC Processors Only)

Important Notes

- The fuse protects the internal electronic circuitry. If the display lights up when power is turned on, you DO NOT need to replace the fuse.
- This procedure should only be performed in a "shop" environment, never a "field" environment.
- The most probable cause of a fuse failure is a defective or inappropriately sized generator. If you have a fuse problem, check your generator first.

Tools Required

- 1/8" Flat Blade Screwdriver
- 5 X 20mm, 250V, 2 Amp Slow Blow Fuse.

Use a Cooper Bussmann Fuse Part Number BK1/S506-2-R or equivalent.

Procedure

1. Insert a screwdriver into the slot in the fuse holder cap. Press in slightly, while turning counter-clockwise, then remove the cap. The fuse should come out when the cap is removed.
2. Remove the old fuse and replace it with the new one.
3. Replace the fuse cap by pushing down and turning it clockwise.

AC Power Sources

When installing electrofusion fittings in field applications, it is necessary to have a reliable source of AC power for the electrofusion processor. This AC power source should:

- be well maintained and subjected to a periodic maintenance schedule.
- provide output voltage within the specified operating range.
- contain a matching outlet, which is required to connect with the plug equipped on the processor:
    - 115V models — 30 Amp, 125 Volt, NEMA L5, twist-lock

Utility Power

Utility power is a reliable and ideal source of energy for ***AC Powered Electrofusion Processors***. However, it is not always practical to access this kind of power source in field applications. When fusing with utility power, a dedicated connection to the service panel is recommended because the potential amperage draw is very high.

Generators

Fuel powered generators are also a good source of electrical power for ***AC Powered Electrofusion Processors***. Always make note of the minimum fitting power requirements. Additional power capacity is recommended for intangibles (i.e. powering other accessories, wear and tear, etc.). Before starting a fusion, it is important to make sure:

- the generator has enough fuel to complete the electrofusion cycle.
- the auto-throttle is disengaged (in anticipation of immediate power draw).

Inverters

Inverters are an acceptable AC power source for ***AC Powered Electrofusion Processors***, though some produce output waveforms that are troublesome with specific fittings. We recommend performing compatibility tests using the lightest and heaviest anticipated loads before approving an inverter system. Feel free to contact us to discuss issues regarding the use of inverters.

Sizing a Power Supply

KEROTEST MANUFACTURING and EF TECHNOLOGIES, INC. do not recommend or endorse any particular type or brand of generator.

Power requirements will vary depending on the fitting manufacturer, fitting size and ambient temperature.

Every generator manufacturer determines the size of their generators differently. For example, a 5,000 watt generator from one company may or may not be equivalent to a 5,000 watt generator from another company.

When determining the correct generator size, the operator must:

1. Determine the maximum current required to fuse a particular fitting. The information can be obtained from the fitting manufacturer. Please note, the largest fitting does not necessarily require the most current.
2. Once the maximum fitting current has been established, divide this number by 1.90 to calculate the amount of current required by the generator.
3. After the current required by the generator has been obtained, multiply that number by 120 to obtain the number of watts the generator will need to supply in order to successfully perform a fusion.

   Example:
   Maximum fitting current = 50 Amps
   50.0 Amps ÷ 1.9 = 26.3 Amps required by the generator
   26.3 Amps x 120 = 3156 Watts

In this example, to fuse a fitting requiring 50 amps, the operator needs a 3,200 watt generator capable of supplying 26.3 amps continuously. Also note that the generator must be capable of supplying this amount of current for sustained periods of time (10 or more minutes). Consult the generator's manufacturer to make sure the output meets this requirement.

NOTE:
This is an oversimplified calculation. However, it is a good rule of thumb and will work in most cases. Please contact our service department if you would like to discuss generator sizing issues in more detail (See page 19).

Battery Care & Maintenance

Battery Pack

The battery pack used in the ***Portafuse III Electrofusion Processor*** is a 48 volt 9 ah sealed lead acid design which contains internal short circuit protection.

UNDER NO CIRCUMSTANCES SHOULD THE BATTERY PACK ENCLOSURE BE OPENED OR TAMPERED WITH. THERE ARE NO FIELD SERVICABLE COMPONENTS INSIDE THE PACK AND THE WARRANTY WILL BE VOID IF THE FACTORY SEAL HAS BEEN BROKEN.

Charger/Charging

Proper charging and maintenance of the batteries can extend their life considerably and are required to maintain the warranty. Proper charging can only be assured if you charge the battery pack with the charger supplied with the unit when it was new.

The charger supplied with the unit is not designed for outdoor or field use. It is designed to be used in an office, lab or warehouse environment.

As a general rule, it is recommended that you completely charge the batteries after each day that the unit is used. If the batteries are not used, make sure that they are charged at least once per month. It is recommended that the batteries are left on charge until they are needed.

Battery Storage

The battery pack should always be stored fully charged in a cool dry place to maintain maximum service life. If the battery pack is stored for longer than three (3) months without being charged, its service life may be shortened. Do not store the battery pack at temperatures below 41° F or in excess of 104° F.

Battery Installation and Removal

The battery pack used in the ***Portafuse III Electrofusion Processor*** is held in place by a steel bracket and a strap which are attached to the back of the processor's carrying case.

Removing the battery pack from its mounting bracket is a simple 3-step process:

1. Disconnect the battery pigtail connecting the battery pack to the processor.
2. Loosen the strap.
3. Grasp the pack with two hands and lift it vertically out of the mounting bracket.

To reinstall the battery pack, simply perform the previous 3 steps in reverse:

1. Grasp the battery pack with two hands and lower it vertically into the mounting bracket**. During reinstallation, remember to orient the battery pack so the pigtail is pointing to your left.**
2. Tighten the strap.
3. Reconnect the battery pigtail to the processor.

The connection between the battery pack and the processor is polarity sensitive. The positive and negative terminals on the battery pack are color coded and the connectors themselves are designed to prevent incorrect installation.

UNDER NO CIRCUMSTANCES SHOULD THE CONNECTORS BE FORCED TOGETHER. IF FOR ANY REASON THIS CONNECTION BECOMES DAMAGED IT SHOULD BE REPAIRED IMMEDIATELY BEFORE BEING PUT BACK INTO SERVICE.

Extension Cords

Because electrofusion fittings produce a high amperage draw, the use of an extension cord is not encouraged. However, in the event such usage is necessary, the following lengths and wire gauges are recommended:

Cord Length	Wire Gauge
Less than 25 feet	12/3
Less than 50 feet	10/3
Less than 100 feet	8/3

Extension cords should not be used on 14" and larger couplers.

A pigtail converts a 30 amp twist-lock to a 15 amp straight-blade plug. It is designed to power the processor when a NEMA L5 socket is not available, especially while downloading. Its use is not recommended in field applications with electrofusion fittings.

Temperature Measurements

The processor's temperature sensor is located near the end of the output cable in the barcode wand/SMART Scanner™ connector. The temperature sensor does not respond immediately to thermal changes. In order to ensure accurate ambient temperature measurements, the output cable end should be left in the fitting environment for at least 15 minutes. Direct exposure to sun light and other heat sources will adversely affect accuracy.

Temperature Compensation

When using the ***Kerotest Electrofusion Processor*** in Barcode Fusion Mode or Manual Barcode Mode to fuse fittings that require temperature compensation, it is essential that care be given to ensure the correct initial fusion temperature is measured. The processor will automatically adjust the fusion time per the measured temperature as specified by the fusion parameters.

When using the processor in Manual Mode to fuse fittings that require temperature compensation, it is necessary to enter the appropriately adjusted time as specified by the fitting manufacturer.

THE PROCESSOR WILL NOT AUTOMATICALLY COMPENSATE FUSION TIME IN MANUAL MODE.

WARNING & ERROR CODES

Warning Codes

A warning code will be displayed when a situation exists that (in the manufacturer's opinion) may adversely affect the performance of the processor over time. Warning codes are designed for informational purposes only and have no effect on the outcome of a fusion. A warning code can be displayed either before or after a fusion and will require user acknowledgement before normal operation can resume.

IT IS STRONGLY RECOMMENDED THAT OPERATORS FAMILIARIZE THEMSELVES WITH ALL WARNING CODES AND THEIR CAUSES AND ADHERE TO THE RECOMMENDATIONS BELOW WHEN THEY ARE RECEIVED.

Code	Description	Cause	Recommendation
50	High Average Current	This warning occurs if the average output current during a fusion exceeds the maximum current rating of the batteries used to power the processor. This is a post fusion warning and only applies to battery powered processors.	Discontinue the use of the fitting that was fused when the warning was generated. The fusion parameters of the particular fitting exceed the operating specifications of the processor. ***FAILURE TO HEED THIS WARNING WILL REDUCE THE SERVICE LIFE OF THE BATTERIES.***
55	Resistance out of range	Occurs when the measured resistance does not match the resistance identified in the fitting barcode. Only applies when Calculated Resistance setting is turned on.	The operator may choose to continue and perform a secondary Calculated Resistance check, or they may cancel the fusion and resolve the problem. See Error Code 102 for possible resolutions. ***USING CALCULATED RESISTANCE IS NOT RECOMMENDED UNLESS A 4-WIRE MEASUREMENT FAILS. SEE PAGE 34 FOR DETAILS.***

Error Codes

Code	Problem	Resolution
100	The barcode was scanned successfully, however the processor cannot decode the information into valid fusion parameters.	This is not a barcode wand error or scanning problem. Verify that the barcode is an ISO standard 24 digit fitting barcode.
101	Ambient temperature is out of range.	Verify the temperature displayed in the CONNECT FITTING screen is reasonable and within the range specified in the Specification Table *(See page 8)*. If the temperature displayed differs significantly from the actual temperature, then there is a processor problem and it must be returned for service.
102	Measured resistance does not match resistance identified in the barcode.	Check Output Lead Ends and fitting adapters for excessive wear and/or damage. If the Output Lead Ends and fitting adapters are in good condition, reattach the processor to the fitting and try again. If the problem persists, there is more than likely a calibration or output cable malfunction.
103	Shorted Coil in Fitting.	Check for a short stab or a sorted coil.
105	Can't maintain output voltage.	Verify the Output Lead ends are clean, the power supply is sized correctly for the fitting you are fusing, and that the power supply is operating correctly.
108	The power supply was shut off during the previous fusion.	This could be anything from an improperly sized generator to someone switching the processor off during a fusion.
109	Reference voltage out of tolerance.	Processor must be returned for calibration. You cannot fuse if this error is detected.
110	STOP pressed during previous fusion.	Do not press the STOP button during the fusion unless in an emergency situation.
111	Fusion complete with no other errors.	There were no problems with this fusion.
112	Fitting disconnected.	Current drops close to 0 during the fusion. If the problem persists there is more than likely an output cable problem and the processor should be returned for service.
113	The calibration date has expired.	Send the processor in for calibration.
114	There is no valid calibration date set.	Send the processor in for calibration.

Code	Problem	Resolution
115	The processor is not capable of outputting the current required to fuse this fitting.	As long as the fitting's fusion requirements are within the specified output range of the processor. This could be an output cable error or a calibration error. Try cleaning the Output Lead Ends. If the problem persists, the processor will need to be returned for service.
116	The processor is not capable of outputting the voltage required to fuse this fitting.	
117	Input voltage is out of range and the fusion cannot start.	Verify that the input voltage and frequency displayed on the CONNECT FITTING screen are reasonable and within the range specified in the Specification Table *(See page 8)*. If the parameters displayed differ significantly from the actual input, then there is a processor problem and it must be returned for service.
118	Frequency is out of range and the fusion cannot start.	
119	Internal processor temperature is out of range.	Allow the processor to cool before fusing again. This error can be seen if multiple large fittings are fused one after the other.
120	A time of 0 seconds for the fusion was entered or calculated.	This is more than likely a temperature measurement problem. Verify the temperature displayed in the CONNECT FITTING screen is reasonable and within the range specified in the Specification Table *(See page 8)*. If the temperature displayed differs significantly from the actual temperature then there is a processor problem and it must be returned for service.
121	Invalid Operator ID card scanned.	Verify the system date is correct and if so, contact the agency that issued the Operator ID card.
122	Not an operator card.	Contact the agency that issued the Operator ID card.
123	The operator card scanned does not contain privileges for the functions this machine is capable of performing.	
124	Current offset is out of spec.	Processor must be returned for calibration. You cannot fuse if this error is detected.
125	Resistor ID fusion cannot be completed because the value was not decoded into a valid fusion time.	Verify the fitting and the processor support the Resistor ID method. If so the problem is with the fitting, the output cable, or the processor calibration. If the problem persists with multiple fittings, The processor will have to be returned for service.
130	The fitting was disconnected before the specified cooling time.	Do not disconnect the fitting before the manufacturer's recommended cooling time has expired.
131	An undefined error was received before the fusion time was completed.	Unit must be returned for service.

Code	Problem	Resolution
132	Control box supports voltage control only and fusion specified is not voltage control.	Not all control boxes support current or energy control. Attach a fitting that requires voltage control or contact an authorized representative *(See page 19)* to see if an update is available for your processor.
138	The fitting was disconnected before the specified countdown time elapsed.	Do not disconnect the fitting before the manufacturer's recommended countdown time has expired.
140	The fusion was shutoff to protect the processor from damage due to extremely high fusion current.	This is typically caused when a direct short is made across the Output Lead Ends. If there are no obvious problems with the fitting or the output cable, then the processor will need to be returned for service.
141	The ambient temperature is too low to fuse fittings of this type.	Same as error 101.
142	The processor believes that the same fitting was fused twice.	Do not fuse a fitting more than two (2) times unless directed so by the fitting manufacturer.
143	The fitting was disconnected before the specified heat soak time was observed.	Do not disconnect the fitting before the manufacturer's recommended heat soak time has expired.
144	The output is cycling and cannot be controlled to the requested level.	This is more than likely caused by a fluctuating power supply. Eliminate all extension cords and ensure that the processor is the only device operating on the circuit.
145	There is an error communicating with the USB Flash Drive.	Be sure the drive is formatted as FAT or FAT32 with a cluster size of 512 bytes.
149	No zero crossing detected during fusion.	A problem has been detected with the output circuit in the processor. The unit must be returned to the manufacturer for service.

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