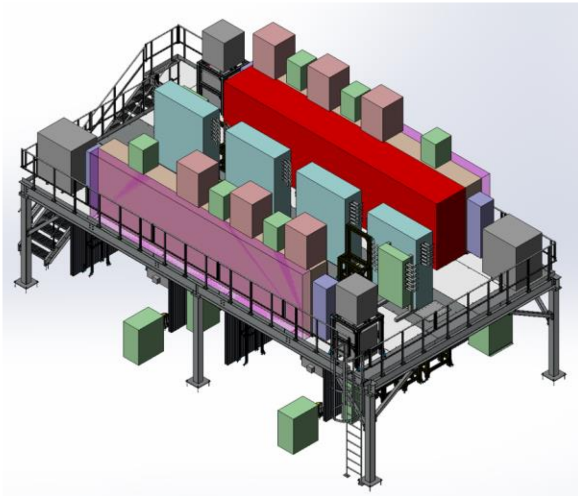
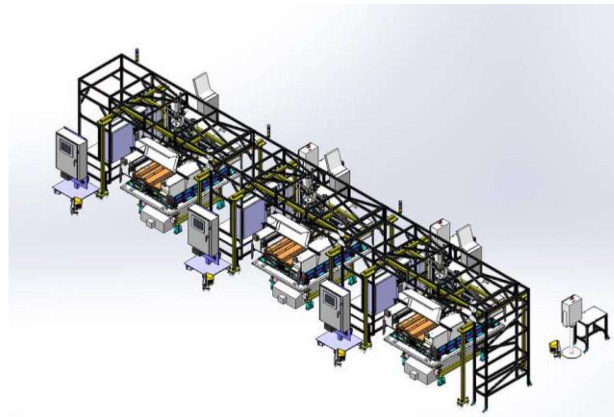


EP280 and EP580



EP680

# *Battery Pack Test and Cover Leak Test*
# *EP280, EP580, and EP680*
# *Operation and Maintenance Manual*

Designed and Built By

ASSEMBLY & TEST

ATS Wixom Job T665
July 2022

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*This document was created by the Technical Documentation Department of ATS Wixom.*

# CONTENTS

# PREFACE

## MANUAL REVISION HISTORY

Revisions made to this manual are listed below. Revision history information includes:

- Revision Level – When a manual is first published, it is considered a release and is identified as revision 0. All subsequent revisions to the manual are identified with a letter designation (A, B, C, etc.).
- Date – When the revision (or release) is effective.
- Description – Provides a brief explanation of why the revision was made. For example, if a machine was modified to test a new model and changes made to the machine affected pages in the manual.
- Affected Pages – Lists pages (including section number) affected by the revision.

| Rev. | Date | Description | Affected Pages |
|---|---|---|---|
| 0 | 07/2022 | Document release | All |
| 1 | 10/2022 | Added additional Cycle Stop Button on 280 and 580 | Chapter 3-8 |
| | | | |
| | | | |

## ABOUT YOUR DOCUMENTATION

Your documentation package includes this Operation and Maintenance Manual and an OEM Literature package. The following sections describe the contents of each of the documentation media.

### Content

The following chapters compose the Operation and Maintenance Manual:

- ***Chapter 1 – Master Task List***. This chapter details the operation, electrical and mechanical maintenance, and repair tasks that must be performed.
- ***Chapter 2 – Safety***. This chapter details battery safety and describes the system safety-related equipment.
- ***Chapter 3 – System Description***. This chapter details the system equipment and utilities.
- ***Chapter 4 – System Operations***. This chapter details the operator interface equipment, describes the HMI screens, and describes the common operating procedures.
- ***Chapter 5 –Maintenance***. This chapter describes the maintenance tasks.
- ***Chapter 6 – Troubleshooting***. This chapter describes the system troubleshooting procedures.
- ***Chapter 7 – Assembly and Disassembly***. This chapter describes the methods for taking apart and putting together end of arm tooling and other mechanisms.
- ***Chapter 8 – Installation***. This chapter describes the methods for installing the equipment in a facility.
- ***Chapter 9 – Process Parameters***. This chapter describes the setpoints and critical parameter settings for the equipment.

## Significance

This Operation and Maintenance Manual was written for the personnel responsible for the Battery Pack Test and Cover Leak Test Systems. It is important to read, understand, and pay attention to every aspect of it.

The complete Operation and Maintenance Manual should be kept near the system for future reference.

The Operation and Maintenance Manual describes special details of the system necessary for trouble-free operation. Knowledge of these operating instructions will help avoid system faults.

Should you experience problems still, please contact our customer service department, someone will be happy to help you. Please refer to the contact information on the cover of this manual.

## Graphics

All drawings, illustrations and photographs are provided to expand and enhance the text explanations. These graphics are representations only. They may not be drawn to scale. For accurate drawings, refer to the ATS mechanical and electrical drawings supplied to your company.

## Style Conventions

This Operation and Maintenance Manual uses the following styles to indicate different kinds of information:

- **Bold Blue Times New Roman Text** indicates a chapter or section heading (in all chapters except for the Preface, the chapters and sections are numbered sequentially).
- SMALL CAPITAL TEXT indicates a physical button on the cell.
- **BOLD SMALL CAPITAL TEXT** indicates a button on an HMI screen.
- `Courier New Text` indicates on-screen software messages.
- A **Bold Blue Arial Letter** (such as **C**) refers to a pointer in the previous or identified figure.
- Bullets indicate listed items where order is of no significance.
- Numbered items indicate a step-by-step procedure or ordered list.

## Special Notations

Throughout the Operation and Maintenance Manual, special symbols and notations alert the reader to safety concerns, which, if procedures are not properly performed, could cause death, serious injury or equipment damage. They may also indicate important or supplemental information, and where to find it. Boxed notations always appear immediately before or after the information or step to which they pertain.

| | |
|---|---|
| **WARNING!** | ***Warning messages identify actions or conditions that could result in personal injury, health hazard, or loss of life.*** |
| **CAUTION!** | ***Caution messages identify conditions or practices that could result in machine operating faults or damage to equipment.*** |
| **NOTE** | ***Notes are generally used to highlight a suggestion or stress important information; they may also bring attention to a unique operating condition or provide a clarifying statement.*** |
| **REFERENCE** | ***References are used to call attention to a piece of literature provided by a third-party OEM equipment supplier.*** |

Due to variations found in the operating conditions of certain applications and their working environments, the special notations in this manual cannot identify all potential problems or hazards. Caution and discretion must always be used while operating machinery, especially when using electrical power. Equipment should be operated and maintained only by qualified and trained personnel.

## OEM Literature Package

The OEM Literature Package includes copies of the third-party equipment manuals, cut sheets, and associated product information. The hard copies are sorted alphabetically in an accordion-style folder. This package contains information as received by the product vendor. In the event any product information is missing or is out-of-date, please contact the product manufacturer directly.

# 1. MASTER TASK LIST

| Number | Task Description | Manual Reference Location |
|---|---|---|
| **CHAPTER 2 – SAFETY** | | |
| 1. | Battery Safety Overview | Section 2.1, Page 2-3 |
| 2. | Health and Safety Statement | Section 2.2, Page 2-4 |
| 3. | General Safety Guidelines | Section 2.3, Page 2-4 |
| 4. | Personal Safety | Section 2.4, Page 2-5 |
| 5. | Work Area Safety | Section 2.5, Page 2-6 |
| 6. | ECPL Placards and Tags | Section 2.6, Page 2-7 |
| 7. | Tool Usage | Section 2.7, Page 2-8 |
| 8. | Machine Safety | Section 2.8, Page 2-8 |
| 9. | Safety Device Summary | Section 2.9, Page 2-9 |
| 10. | Energy Control Device Descriptions | Section 2.10, Page 2-13 |
| **CHAPTER 3 – SYSTEM DESCRIPTION** | | |
| 11. | BET/BEV3 Battery Pack Test and Cover Leak Test Summary | Section 3.1, Page 3-3 |
| 12. | BET/BEV3 Battery Pack Test and Cover Leak Test System Layouts | Section 3.2, Page 3-5 |
| 13. | BET/BEV3 Battery Pack Test and Cover Leak Test Utilities | Section 3.3, Page 3-7 |
| 14. | BET/BEV3 Battery Pack Test and Cover Leak Test Equipment | Section 3.4, Page 3-8 |
| **CHAPTER 4 – SYSTEM OPERATION** | | |
| 15. | Operator Interface Devices | Section 4.1, Page 4-4 |
| 16. | HMI Screens | Section 4.2, Page 4-19 |
| 17. | Common Operating Procedures | Section 4.3, Page 4-45 |
| 18. | Modes of Operation | Section 4.4, Page 4-50 |
| **CHAPTER 5 – MAINTENANCE** | | |
| 19. | General Service Guidelines | Section 5.1, Page 5-3 |
| 20. | Hazardous Energy Guidelines | Section 5.2, Page 5-3 |
| 21. | Lockout/Tagout | Section 5.3, Page 5-4 |
| 22. | Preventive Maintenance Reference | Section 5.4, Page 5-6 |
| 23. | Lubrication Charts Reference | Section 5.5, Page 5-6 |
| 24. | Maintenance Task Instruction Sheets Reference | Section 5.6, Page 5-7 |
| 25. | Seal Maintenance O-Rings and Retaining Springs | Section 5.7, Page 5-8 |

# 2. SAFETY

## Table of Contents

## Table of Figures

## 2.1. BATTERY SAFETY OVERVIEW

| | |
|---|---|
| **WARNING!** ⚠ | ***Refer to the SDS for the Lithium-Ion Polymer Battery. Be aware of all hazards, air measures, fire hazards, leakage, handling and storage, toxicological data, environmental effects, and transportation requirements. Severe injury or potential harmful exposure is possible if these warnings are not followed.*** |

| | |
|---|---|
| **WARNING!** ⚠ | One hand on the battery unless specified by standard work**.** ***Battery voltage may be lethal. Always assume a battery is charged. Follow all warnings and related safety procedures as described by your company. Severe injury or death may occur if this warning is not followed.*** |

Assembly line personnel must comply with the following safety rules:

- One hand on the battery unless specified by standard work.
- Never reach across the battery for any reason.
- Always wear appropriate personal protective equipment.
- Remove or properly cover all personal metal objects (watches, rings, earrings, piercings, necklaces, badges, and belt buckles).
- Never touch anyone working on a battery.
- Never distract anyone working on a battery.
- Keep all battery terminals covered except when needed for operations.

## 2.2. HEALTH AND SAFETY STATEMENT

Operate all assemblies, electrical components, and parts of this assembly line with care. Routinely inspect and maintain the cell as described in Section 5.4 “Preventive Maintenance”.

Automation Tooling Systems (ATS) makes every effort to design and integrate automation systems that operate in a safe and predictable manner.

Each system employs safety devices that reduce the risk of personal injury. Safety devices include, but are not limited to, guarding around moving devices, emergency stop controls, and status indicators. It is the customer’s responsibility to ensure that personnel using the system are properly trained in the system’s operating, safety, and emergency procedures, industry safety standards (OSHA/OHSA) and to ensure that these procedures and practices are adhered to.

Any system modifications (including software and hardware) not authorized by Automation Tooling Systems may affect the safe operation of the system and result in personal injury.

Failure to meet these responsibilities or any unauthorized attempt to modify the system will void ATS-provided warranties.

## 2.3. GENERAL SAFETY GUIDELINES

The general safety guidelines, outlined below, are an overview of the safety topics covered in this section. While these guidelines provide information that will help prevent personnel injury and damage to equipment, read the entire section for a thorough understanding of safety practices and specific devices related to this equipment.

- Read this entire manual and become thoroughly familiar with the cell operation before working on any part of the cell.
- Adopt good work habits regarding safety when working on or around the cell.
- Avoid working on the cell when poor physical or mental health may affect job-related judgment.
- Always dress properly for the job and use appropriate sight and hearing protection.
- Always maintain a clean and safe work area.
- Read and obey all signs posted on and around the cell.
- Know the location of all Energy Control and Power Lockout (ECPL) placards and properly follow all posted procedures.
- Use tools properly and safely whenever working on the cell.
- Follow all Electrical and Mechanical System safety precautions outlined in this manual and dictated by plant safety specifications.
- Follow all System Operating Safety precautions outlined in this manual.
- Become thoroughly familiar with the location and function of all safety devices on the system including EMERGENCY STOP pushbuttons and lockout valves.

# 2.4. PERSONAL SAFETY

## 2.4.1. Overview

Accidents often do not occur as the result of a single cause, but may occur because of an interaction between working conditions, human error, and other events. Given the complexity of machine technology, some accidents will inevitably occur. However, an error in judgment will always be the weakest link in the chain of events leading to an accident. Even under the best circumstances, judgment is affected by:

- Knowledge (and lack of knowledge) of the cell and peripheral equipment.
- Personal work habits on the job.
- Physical and mental fitness on the job.

## 2.4.2. Knowledge First

It is vitally important for anyone working on the cell to become thoroughly familiar with its operation before working with it. Knowledge of the cell will help to avoid accidents. Read and understand all safety instructions before setting up, operating, maintaining, or servicing the cell. Know the location and function of all safety devices provided with the cell and check regularly to ensure proper operation.

## 2.4.3. Work Habits

Personal safety combines knowledge, positive attitudes, and good work habits into a proactive awareness of potential hazards. Safe actions occur when an awareness of the importance of safety is combined with an understanding of tasks and becomes part of daily work habits on the job.

You have a responsibility to conduct your daily work actions safely. Adopt a professional attitude toward safety and develop personal safety skills you can depend on – for life!

## 2.4.4. Fitness for Duty

"Fitness for duty" is the state of being physically and mentally fit to perform job-related duties. It is important to reduce or eliminate anything that impairs job-related judgment.

Alertness is essential for sound judgment and nothing affects alertness more adversely than fatigue. Several causes are:

- Lack of sleep – The most common cause of fatigue; continued loss of sleep causes increased nervousness and decreased reaction time. The ability to react quickly to a situation is affected.
- Poor eyesight – Tired eyes lead to drowsiness, decrease your depth perception, and reduce field of vision.
- Emotional stress – A buildup of emotional stress causes tension, irritability, and mental distraction.
- Anger – If not managed appropriately, it causes drowsiness, impairs concentration and job performance.
- Physical problems – Even minor ailments (headache, indigestion, sore throat) and other conditions-such as consuming a heavy meal can impair judgment, cause sluggishness, or make you drowsy.
- Drug and alcohol use – The resulting drowsiness, nausea, or dizziness dulls reflexes and turns you into an "accident waiting to happen".

### 2.4.5. Dressing for Safety

Unless plant safety specifications indicate otherwise, always observe the following guidelines:

- Do not wear loose or baggy clothes. They should fit close to the body, *but not so tight as to hinder free movement*.
- Do not wear ties or scarves around the system at any time.
- Do not wear jewelry such as rings, bracelets, and necklaces around the system at any time. Medical alert jewelry should be worn with caution.
- Do not wear gloves unless handling hot, rough, or sharp surfaces.
- Wear shoes approved by plant safety specifications.
- Wear the correct protective clothing, especially when a job calls for it.
- Tie back long hair or restrain it with a cap or net.
- Wear a hard hat or other appropriate protection when a job requires it or where a risk of falling objects may exist.

### 2.4.6. Eye Protection

To reduce the risk of eye injury, wear the proper eye protection. Choose eye protection equipment that will best protect your eyes against an injury that may result from the type of work being performed. Unless plant safety specifications indicate otherwise, safety glasses with side shields will be sufficient for normal system operation. Always keep eyewear clean.

### 2.4.7. Hearing Protection

To reduce the risk of long-term hearing damage, use hearing protection appropriate for the job. Choose hearing protection equipment (foam ear plugs, padded headset) that protects against noise levels produced by the cell and surrounding equipment. However, do not select hearing protection that will totally muffle all noise. During assembly line operation, it is important to hear any unusual noises that may indicate a problem. Check with your plant safety specifications to determine the best hearing protection for the job and the area where the job is performed.

### 2.4.8. Head Protection

To reduce the risk of damage to your head, wear a bump cap when working under equipment, within an automated cell, and when appropriate for the job. Check with your plant safety specifications to determine the best bump cap for the job and the area where the job is performed.

### 2.4.9. Foot Protection

To reduce the risk of damage to your feet, wear safety-rated composite toed shoes appropriate for the job. Check with your plant safety specifications to determine the best shoes for the job and the area where the job is performed.

## 2.5. WORK AREA SAFETY

### 2.5.1. Cleanliness

Keep work areas clean and free of hazardous obstructions. Be aware of protruding machine components. Keep floors clean and dry. Clean up chemical (cleaning solvent, beverage) and process fluid (hydraulic oil) spills immediately. Follow plant-approved procedures to clean up all spills.

### 2.5.2. Warning Signs

Warning signs are posted to alert workers of hazardous conditions. Observe all warning signs when working on/around the cell. Warning signs should always be clearly visible. Do not cover, paint over, alter or deface signs, or remove warning signs from the cell. Replace signs that become unreadable.

### 2.5.3. Traffic Areas

Aisles, pathways, and catwalks must be kept clear of obstructions to allow free movement in all directions. Do not block traffic areas with items such as boxes, tool chests or ladders. This is especially true in case of an emergency, where rescue personnel must have quick access to an injured worker.

### 2.5.4. Unsafe Conditions

Immediately report any unsafe working conditions to your supervisor or safety department. Faulty safety devices, damaged hoses, and loose or broken parts all pose a safety hazard. Report all fluid leaks (oil) and unusual odors (excessive vapors, overheated metal).

### 2.5.5. Cell Guarding

The guarding used in the BET/BEV3 Battery Pack Assembly Line forms a protective housing around automated equipment that allows for safe operation. The guarding is comprised of a metal framework fitted with fixed guarding panels. The guarding should never be removed or modified except by qualified technicians familiar with the cell.

### 2.5.6. Automated Guided Cart (AGC) Safety

Operators and maintenance personnel must be aware of all safety hazards before operating around or maintaining an Automated Guided Cart (AGC) and associated equipment.

| **NOTE** | ***Consult your GM Automated Guided Cart (AGC) training and manuals for a proper understanding of the AGC system.*** |
|---|---|

## 2.6. ECPL PLACARDS AND TAGS

Energy Control and Power Lockout (ECPL) placards identify the primary, associated, and stored energy or power sources of the cell. The ECPL placard(s) are usually located on the main electrical enclosure. Color-coded lockout tags corresponding to the source icons (such as E-1, A-1) on the placard help locate the same sources on the cell. These tags are mounted near, or hanging directly on, the energy and power source locations.

## 2.7. TOOL USAGE

Tool usage safety guidelines, as they apply to the cell, are as follows:

- Do not leave any tools (hand or electric) on or around the cell. Any machine vibration may cause tools to fall into moving automation and cause extensive damage.
- When repairing or adjusting any part of the cell, use the proper tool for the job. The incorrect size or type of tool may damage the cell components.

## 2.8. MACHINE SAFETY

### 2.8.1. Electrical Safety

Electrical safety precautions are outlined below:

- Cell troubleshooting or maintenance should be performed only by qualified technicians familiar with the cell, using an up-to-date set of schematics.
- Before performing maintenance or service on any part of the Electrical System, perform all applicable ECPL procedures. Before proceeding, verify that power is removed from all circuits.

| WARNING! | ***Before working on electrical or mechanical problems with a cell (whenever possible), place the MAIN DISCONNECT SWITCH in the OFF position and lockout the switch. Severe injury or death may occur if this warning is not followed.*** |
|---|---|

- If it is necessary to perform troubleshooting with the power on, know where power is present and proceed with extreme caution. Whenever possible, use electrically insulated tools.
- When servicing electrical enclosures, follow all PPE (personal protective equipment) requirements per posted arc flash warnings in accordance with plant safety specifications.
- Always use an appropriate fuse puller. Never attempt to replace a specified fuse with a higher-rated fuse (such as replacing a 5-amp fuse with a 10-amp fuse).

### 2.8.2. Pneumatic Safety

Pneumatic safety precautions are outlined below:

- Cell troubleshooting, or maintenance should be performed only by qualified technicians familiar with the cell, using an up-to-date set of schematics.
- Before performing maintenance or service on the Pneumatic System, shut off the air supply at the main shutoff valve and bleed air from pneumatic lines. Perform all applicable ECPL procedures.
- Purge from pneumatic lines any trapped air that was not relieved by performing the ECPL procedure(s); for example, air trapped by a pilot- operated check valve.
- Use extreme caution around automation (such as clamps, slides, or lifts) that may move when air is relieved from the cell. Before relieving air from lines, secure all such automation.
- Avoid manually actuating solenoid valves, especially if others are working in the area.

| | |
|---|---|
| **WARNING!** | ***The inherent danger of electrical energy is well known. Similarly, compressed air energy is powerful and may also be very dangerous. Before attempting to remove a component from an air line, always disconnect the supply air and thoroughly exhaust the line or system. Failure to heed the following precautions could result in serious even fatal, personal injury.*** |

### 2.8.3. Mechanical Safety

Mechanical safety precautions are outlined below:

- Mechanical maintenance, adjustments or repairs should be performed only by qualified technicians familiar with the cell.
- Before performing any maintenance or repairs on an upper platen, ensure safety pins are properly placed. Refer to the ECPL placard if such conditions exist.
- If mechanical service does not require cell power, perform the appropriate ECPL procedures to disconnect or dissipate energy sources.
- Keep all moving parts of machinery and surrounding areas free of rags, dirt, excessive oil, and metal debris.
- Before operating any moving machinery, all protective guards must be in place and secured.

## 2.9. SAFETY DEVICE SUMMARY

The figures that follow identify the locations of the various safety devices used in each of the work cells. Section 2.10 describes each of these safety devices. Refer to the cell Energy Control Lockout Placards for specific information about the energy control device

## 2.9.1. Safety Device Locations for Cell EP280 and EP580 - Mezzanine

**Cell EP280 and EP580 - Mezzanine**

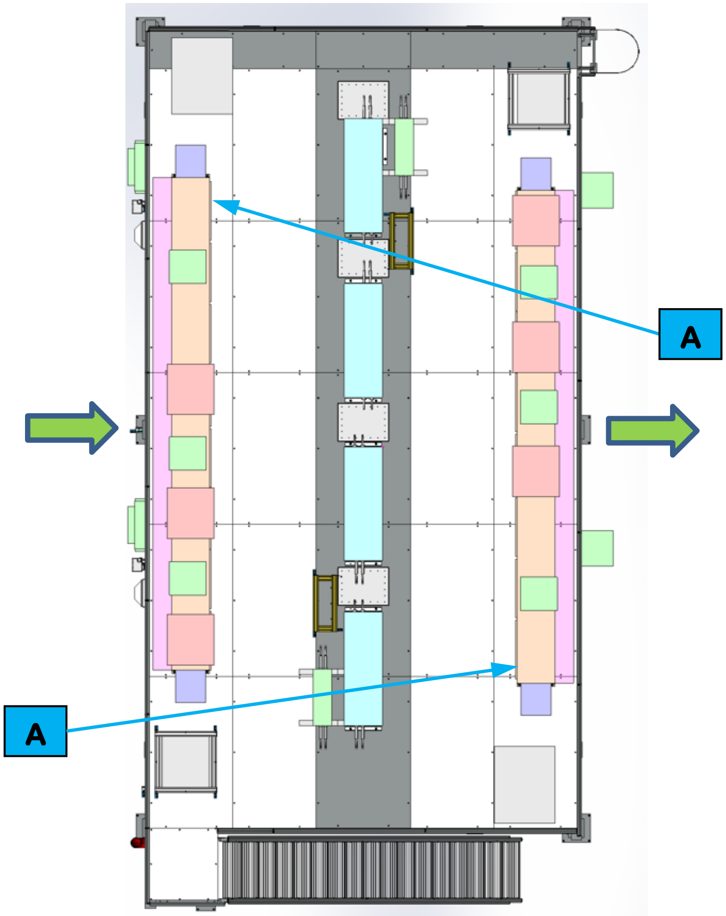



*Figure 2-1. Cell EP280 and EP580 Safety Device Locations - Mezzanine.*

| Safety Device Callouts | |
|---|---|
| A | Cell Load Cycler (E-3) |

## 2.9.2. Safety Device Locations for Cell EP280 and EP580 – Under Mezzanine

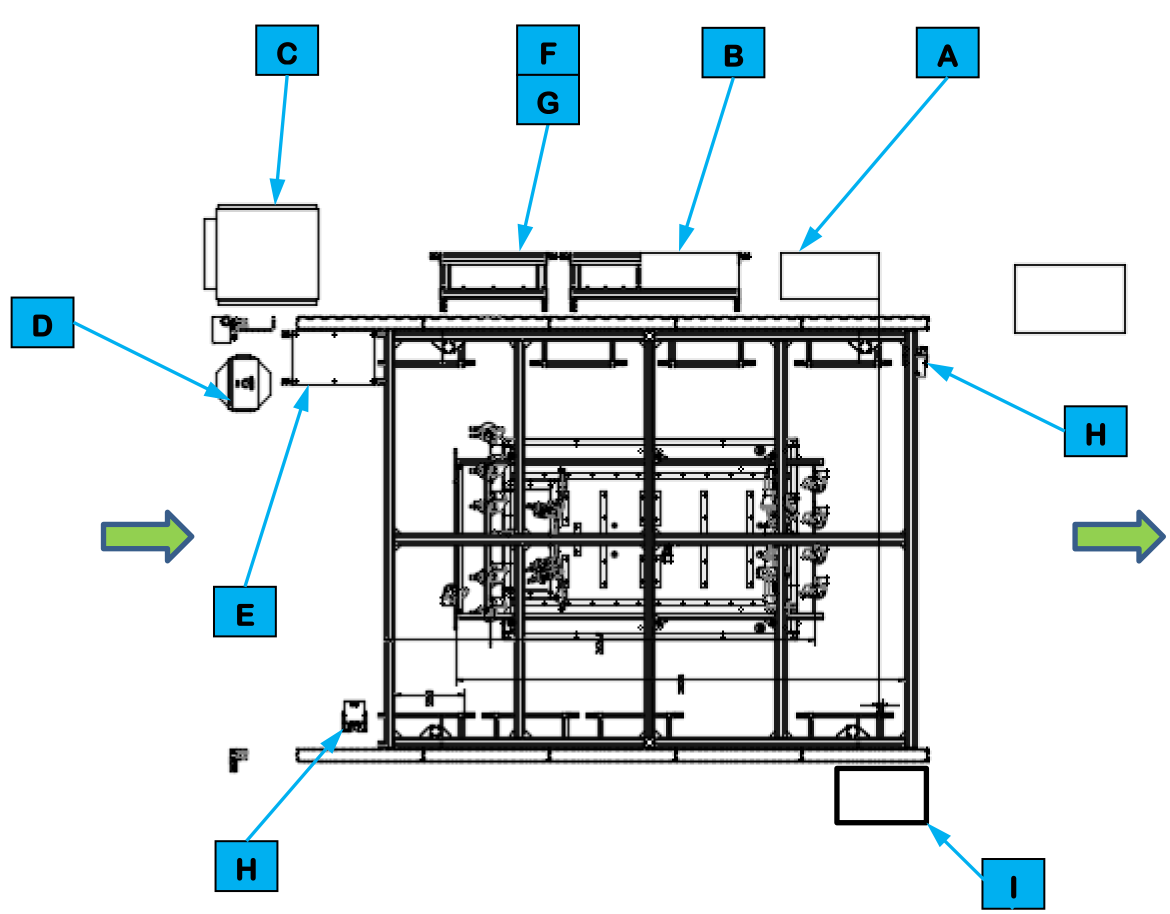



*Figure 2-2. Cell EP280 and EP580 Safety Device Locations – Under Mezzanine.*

| Safety Device Callouts | | | |
|---|---|---|---|
| A | Cell Power Distribution Panel<br>(E-1 outside panel door and E-2 inside panel) | E | Operator E-Stop (next to Cycle Start button) |
| B | Cell Remote Power Panel (E-4) | F | Cell Main Air (A-1) |
| C | Cell PC Enclosure, Bauer (E-5) | G | Cell Main Air Maintenance Shutoff (A-2) |
| D | Operator E-Stop (on HMI) | H | Sick Floor Scanner (2) |
| I | Leak Test Pneumatic Disconnect (A-3) | | |

### 2.9.3. Safety Device Locations for Cell EP680

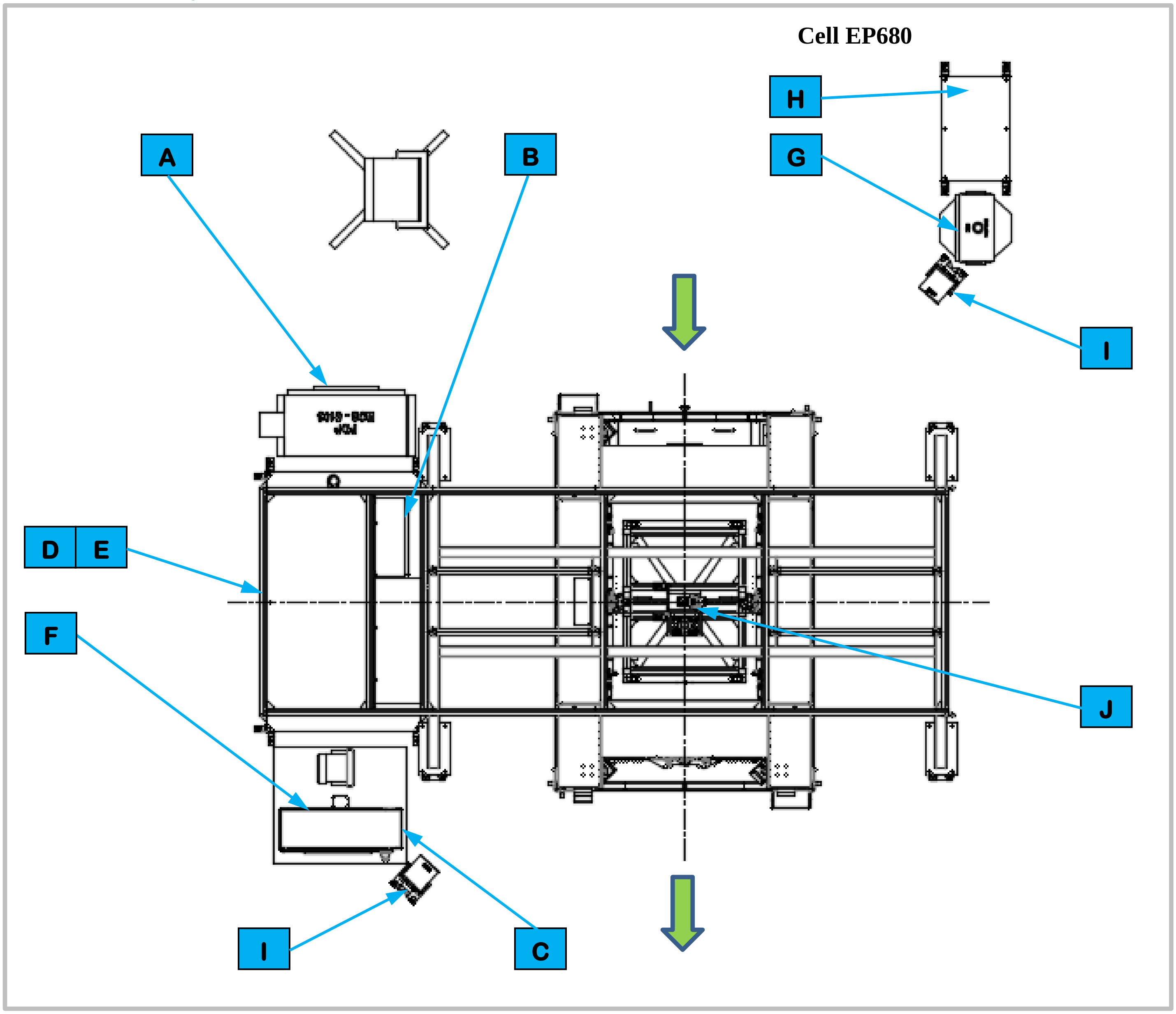



*Figure 2-3. Cell EP680 Safety Device Locations.*

| Safety Device Callouts | | | |
|---|---|---|---|
| A | Cell Power Distribution Panel (E-1 outside panel and E-2 inside panel) | F | Station Air Shutoff (A-3) |
| B | Cell Disconnect, Bauer (E-3) | G | Operator E-Stop (on HMI) |
| C | Cell Leak Test Disconnect, CTS (E-4) | H | Operator E-Stop (next to Cycle Start button) |
| D | Cell Main Air (A-1) | I | Sick Floor Scanner (2) |
| E | Cell Main Air Maintenance Shutoff (A-2) | J | Cell Gravity Pin (G1) |

# 2.10. ENERGY CONTROL DEVICE DESCRIPTIONS

There are many different types of energy control devices used throughout the test cells. Some of the devices include lockable disconnects and are part of the Energy Control and Power Lockout (ECPL) program. Lockable devices are shown on the ECPL placards affixed to each of the main PDP enclosures. The section that follows describes the various energy control devices, their locations (refer to Section ***2.9.1***, ***2.9.2***, and ***2.9.3***), and their uses.

## 2.10.1. Common Control Device Descriptions

### 2.10.1.1. Cell Power Distribution Panel

Each cell has a single Power Distribution Panel (PDP) that is used to distribute control power to the related equipment and to communicate with the cell processor. The PDP features indicators that illuminate to identify when control power is on. A fused disconnect (Lockout Point E-1) is located on the outside of the PDP and is used to enable or disable control power for the cell. Inside the PDP is an additional disconnect (Lockout Point E-2) that provides auxiliary power control. Refer to the GM standards and to the ATS electrical drawings for more information about the PDP equipment and functionality. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

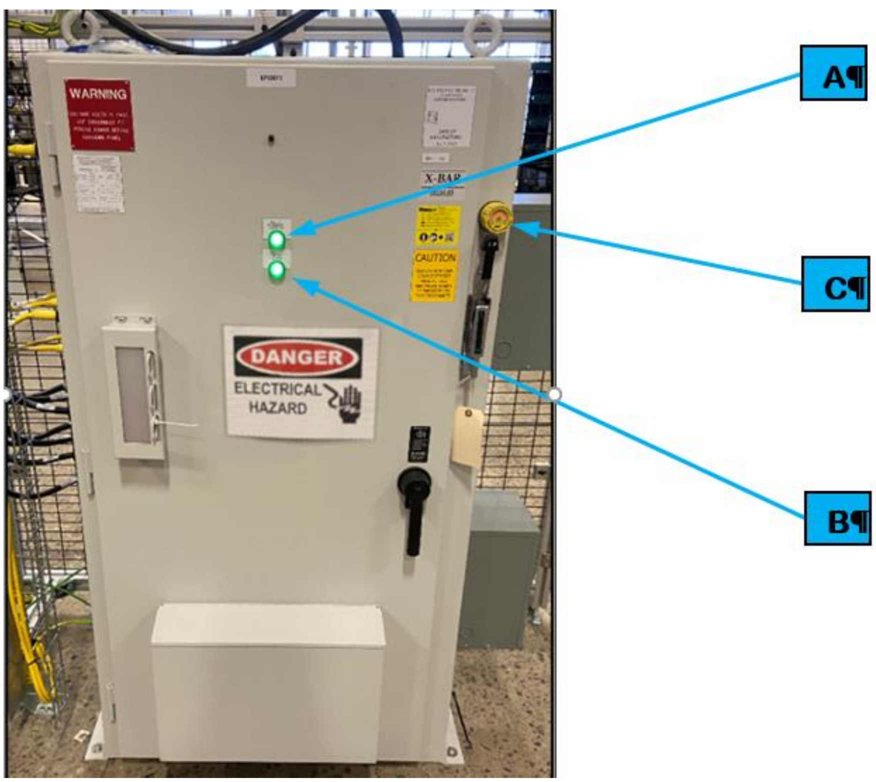



***Figure 2-4. Power Distribution Panel.***

| Device Callouts | |
|---|---|
| A | PROCESSOR POWER ON button |
| B | CONTROL POWER ON button |
| C | 3-Phase Indicator |

### 2.10.1.2. Cell Main Pneumatic Disconnect

Each cell requires compressed air and has its own air processing equipment that processes air supplied from the plant and distributes the processed air to the cell equipment. The air processing equipment has a shutoff valve (Lockout Point A-1) that removes the flow of processed air from the plant through the cell equipment. Turning the valve to the off position disconnects air pressure to the cell valve packs and vents the pressure through a muffler. A lockout hole in the handle of the valve allows a lock to be installed for energy control purposes. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

### 2.10.1.3. Emergency Stop (E-Stop) Button

| **WARNING!** | ***Press an*** EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.*** |
|---|---|

Each cell has one or more Emergency Stop (E-Stop) Button(s) that when used will remove all power from a cell and bring all tooling and other devices to a full stop. Emergency stop buttons are located on HMI panels and on the Cycle Start Button box in each cell. The Emergency Stop button requires the button to be pulled back out after it has been pressed in. After pressing an Emergency Stop button, follow the recovery procedure outlined in Chapter 4.

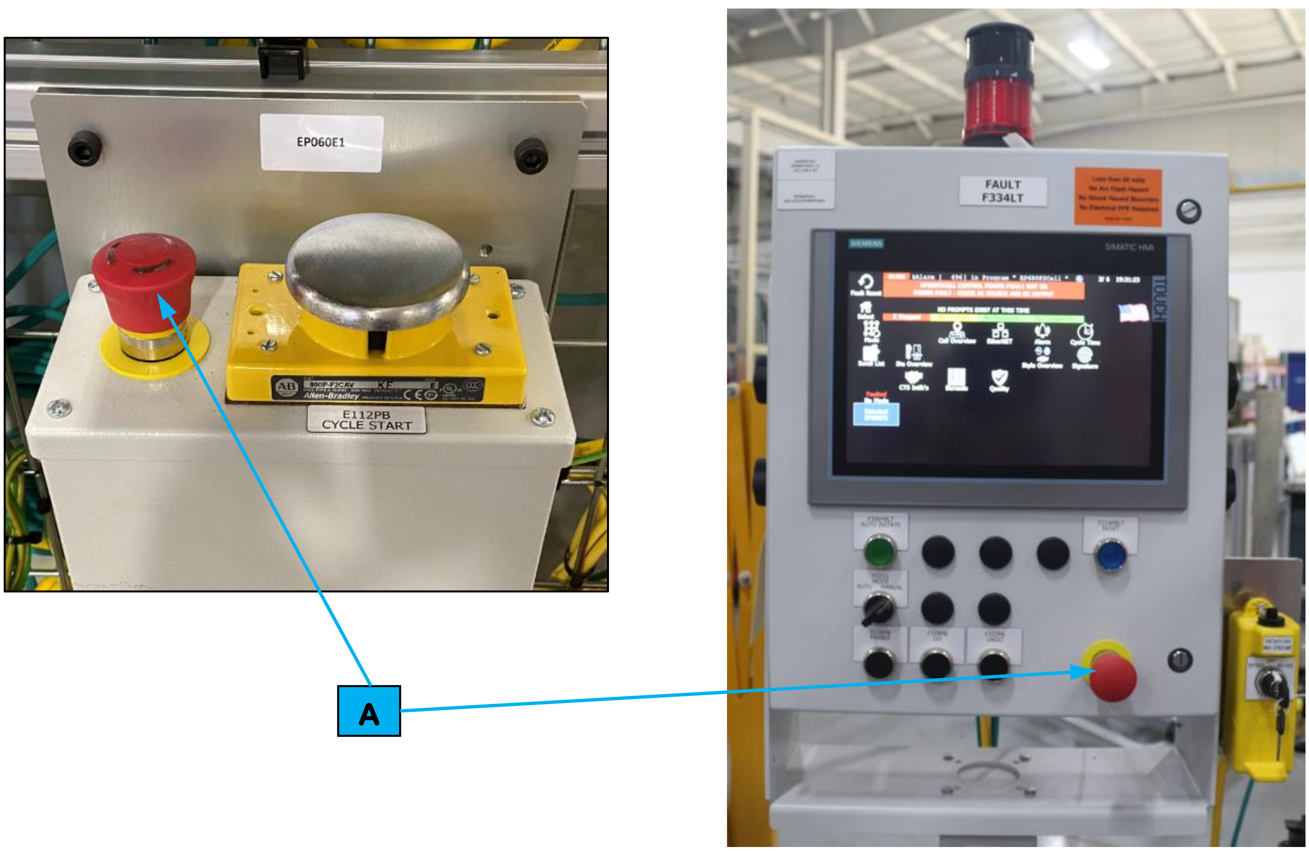



***Figure 2-5. E-Stop Button.***

| Device Callouts | |
|---|---|
| **A** | E-Stop button |

### 2.10.1.4. SICK Safety Laser Scanner

The purpose for the SICK Safety Laser Scanner is to prevent someone from entering the station while a test is in-process. If someone enters the area that the scanner is monitoring the safety PLC monitoring the scanners will execute an emergency stop routine to stop the test.

The SICK Safety Laser Scanner is an Active Opto-Electric Protective Device that responds to Diffuse Reflections (AOPDDR). It has a 4m protective field range to safely detect an object, a 40m warning field range, and up to 4-independent protective fields monitored simultaneously. It transmits a pulse of light (pulsed laser diode) that will hit an object or not and come back, then using the Time-of-Flight principle, based on the speed of light, it can be determined how far away the object is.

The SICK Safety Laser Scanner uses internal mirrors that rotate up to 275 degrees to take multiple measurements to build up a two-dimensional (2D) profile of the area being scanned and has Common Industrial Protocol (CIP Safety) capability that is designed to allow for safe integration into different control system networks and to be used with a shared protocol.

| **REFERENCE** | ***For more information about SICK Safety Laser Scanner microScan3, Model #MICS3-ABAZ40IZ1P01, Part #1082015 and Heavy-duty mounting kit, Part #2102289 equipment, refer to the equipment supplier documentation (dataSheet_MICS3-ABAZ40IZ1P01_1082015_en.pdf, mounting_instructions_microscan3_mounting_kits_heavy_duty_mounting_kit_de_en_im0081201.pdf, operating_instructions_microscan3_ethernet_ip™_en_im0075174.pdf, dataSheet_Heavy-duty-mounting-kit-for-fl_2102289_en.pdf, and mounting_instructions_microscan3_efi_pro_microscan3_ethercat®_microscan3_profinet_m12_microscan3_e_thernet_ip™_de_en_im0083919.pdf)*** |
|---|---|



***Figure 2-6. SICK Safety Laser Scanner and Heavy-duty mounting kit.***

### 2.10.1.5. Stack Light

On the station framing is a stack light with five colored indicator lights and a horn, where the sound/tone is a beep. The lights and horn are used to indicate the status of the cell and the MPS system. When activated, each indicator identifies the following condition:

- Horn (multiple beeps) - notification alert
- Horn (one beep) – scan passed
- Blue Indicator (Flashing) – operator load prompt
- Blue Indicator (Fast Flashing) – N/A
- Blue Indicator (Solid) – in cycle
- White Indicator (Flashing) – Flexnet gate check query in progress
- White Indicator (Fast Flashing) – Flexnet gate check failed
- White Indicator (Solid) – Flexnet gate check passed
- Red Indicator (Flashing) – N/A
- Red Indicator (Fast Flashing) – Maintenance call
- Red Indicator (Solid) – station faulted
- Yellow Indicator (Flashing) – over cycle
- Yellow Indicator (Fast Flashing) – Responder call
- Yellow Indicator (Solid) – approaching end of cycle
- Green Indicator (Flashing) – ready for cycle
- Green Indicator (Fast Flashing) – N/A
- Green Indicator (Solid) – process complete

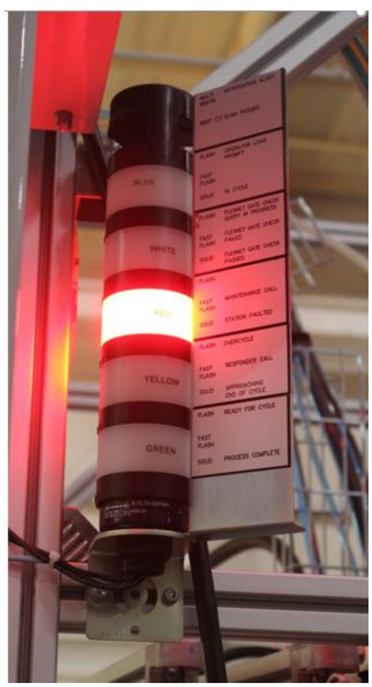



***Figure 2-7. Stack Light Indicator.***

### 2.10.1.6. Status Beacon

The status beacon sits on top of the Operator Console HMI box with one colored indicator light. The light is used to indicate an alarm. When activated, the indicator identifies the following condition:

- Red Indicator (Flashing) – Maintenance (high priority fault) alarm present
- Red Indicator (Solid) – Non-maintenance (low priority fault) alarm present


***Figure 2-8. Status Beacon.***

### 2.10.2. EP280 and EP580 Control Device Descriptions

#### 2.10.2.1. EP280 and EP580 Leak Test Cart Electrical and Pneumatic Disconnect

The ATEQ test cart requires compressed air and has its own air processing equipment that processes air supplied from the Cell Main Pneumatic supply.

The ATEQ test cart air processing equipment has a shutoff valve (Lockout Point A-3) that removes the flow of processed air from the Cell Main Pneumatic supply. Turning the valve to the off position disconnects air pressure to the ATEQ cart valve packs and vents the pressure through a muffler. A lockout hole in the handle of the valve allows a lock to be installed for energy control purposes.

Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

### 2.10.3. EP680 Control Device Descriptions

#### 2.10.3.1. EP680 Cell Gravity Pin

The Cell Gravity Pin (G-1, service detent pin with lanyard) is used when the hood assembly needs to be serviced.

The hood assembly's vertical slide assembly must be in the home position to be serviced. When in the home position, two cross drilled holes are aligned. One hole is in **DETAIL A**, one hole is in **DETAIL B**.

The service pin is manually inserted through the aligned holes, where the detent keeps the pin from coming out of the holes, and the pin prevents the hood assembly from free falling.

The service pin resides in a nest when not in use. There is a proximity switch to detect when the pin is in the nest. The station cannot be put into automatic mode, nor can there be vertical motion if the pin is not in its nest.

## 2.11. SDS REFERENCES

Following is the chemical product used in the operation and maintenance of Packers KROMER Balancers used for Battery Pack Test cells EP280 and EP580. Refer to the following Safety Data Sheet for safe handling of this chemical.

| Device | Product | Manufacturer | File Name |
|---|---|---|---|
| Packers KROMER Balancers | LUBRIPLATE 1241 | LUBRIPLATE | *Lubriplate No. 1241 SDS-United States.pdf* |

# 3. SYSTEM DESCRIPTION

## Table of Contents



## Table of Figures

# 3.1. BET/BEV3 BATTERY PACK TEST AND COVER LEAK TEST SUMMARY

The BET/BEV3 Battery Pack Tests and Cover Leak Test are part of the Pack Main Line that is part of a larger BET/BEV3 Battery Pack Assembly System.

The Battery Pack Tests and Cover Leak Test consists of manual and semi-automated cells that each perform different operations in testing battery assemblies for cars (BEV3) and trucks (BET). Battery assemblies are processed on automated guided carts (AGCs). Different model configurations, three (3) BEV3 and ten (10) BET are processed with tool adaptations at each cell for the different models.

| **REFERENCE** | Refer to the GM Test Plan for specifics of the coolant leak, electrical test, and cover leak operations. |
|---|---|

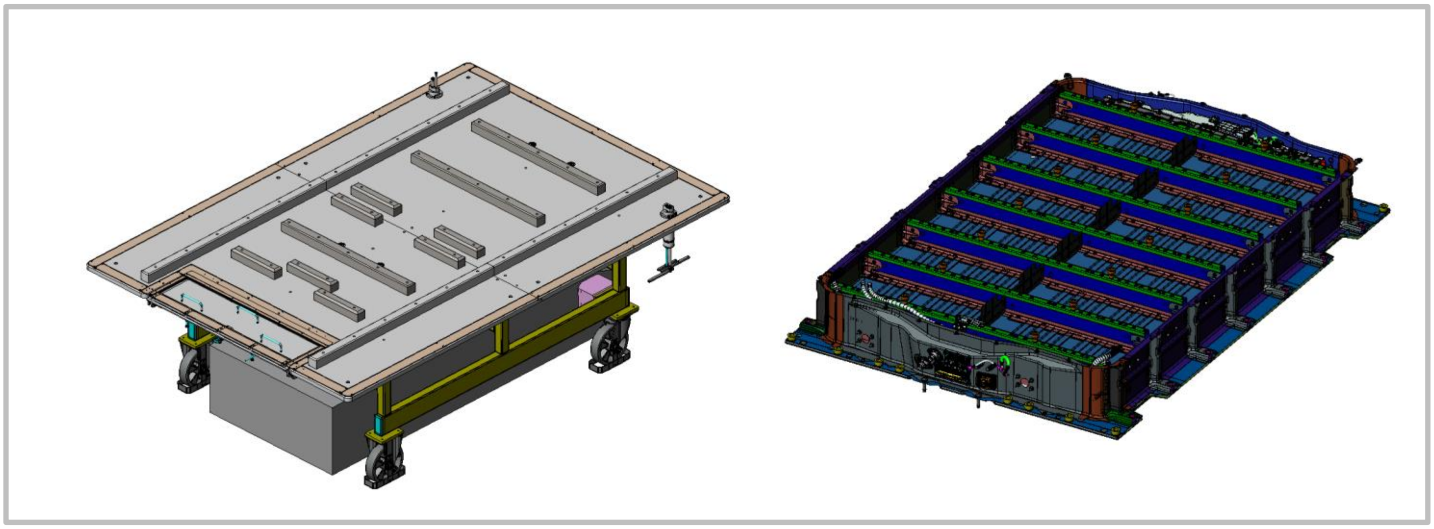


*Figure 3-1. Automated Guided Cart and a 24 Module Long Wheelbase Battery Assembly*

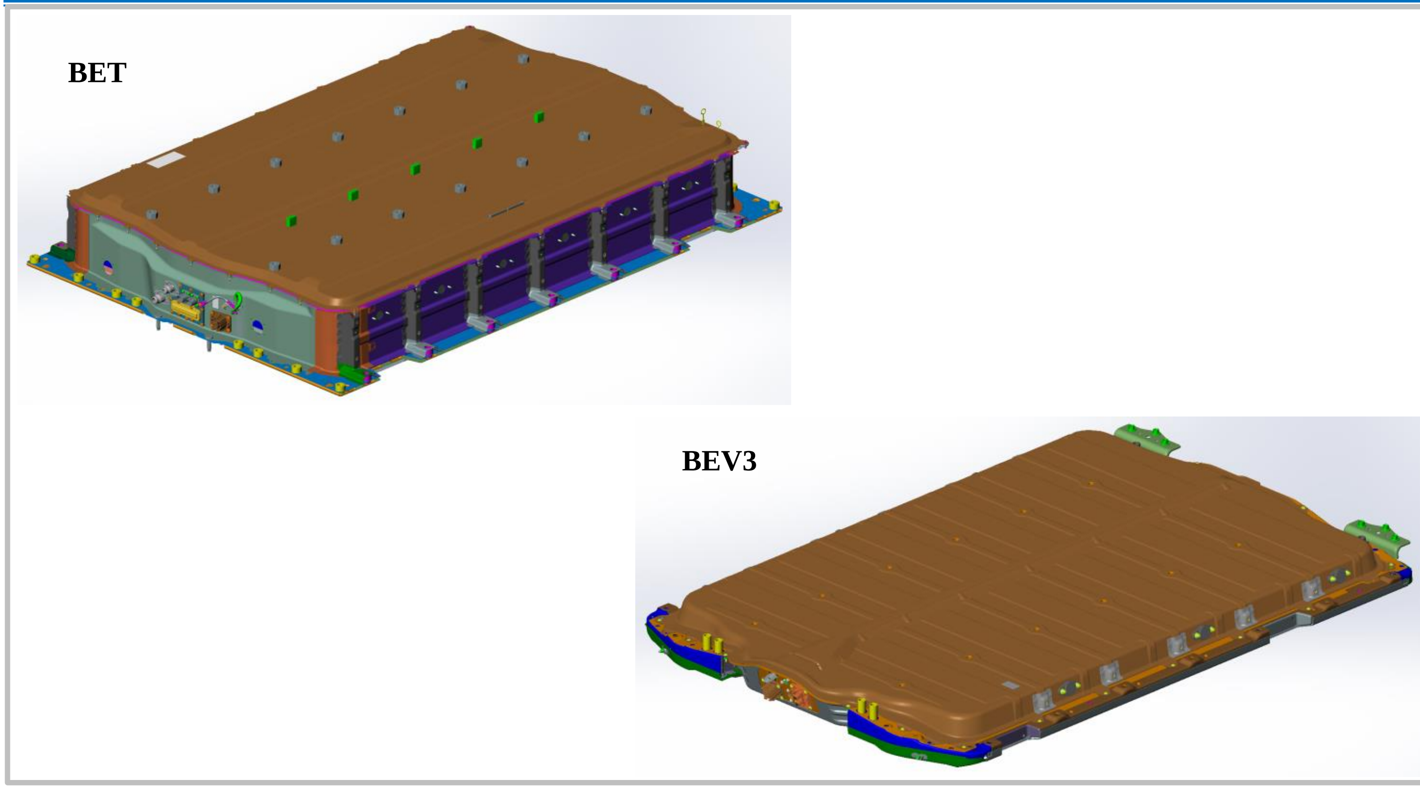



***Figure 3-2. BET and BEV3 Battery Assembly with Cover***

The following lists the 13 battery assembly types handled by the Battery Pack Tests and Cover Leak Test:

| Pack Type | Assembly Type | Modules Per Assembly | Layers |
|---|---|---|---|
| BET | 24 Module Long Wheelbase Off-road | 24 | 2 |
| BET | 24 Module Long Wheelbase | 24 | 2 |
| BET | 20 Module Long Wheelbase Off-road | 20 | 2 |
| BET | 20 Module Long Wheelbase | 20 | 2 |
| BET | 16 Module Long Wheelbase | 16 | 2 |
| BET | 10 Module Long Wheelbase | 10 | 2 |
| BET | 20 Module Short Wheelbase Off-road | 20 | 2 |
| BET | 20 Module Short Wheelbase | 20 | 2 |
| BET | 16 Module Short Wheelbase | 16 | 2 |
| BET | 12 Module Short Wheelbase | 12 | 2 |
| BEV3 | 12 Module Rear Wheel Drive | 12 | 1 |
| BEV3 | 12 Module All Wheel Drive | 12 | 1 |
| BEV3 | 10 Module Rear Wheel Drive | 10 | 1 |

# 3.2. BET/BEV3 BATTERY PACK TEST AND COVER LEAK TEST SYSTEM LAYOUTS

## 3.2.1. Battery Pack Test System Layout

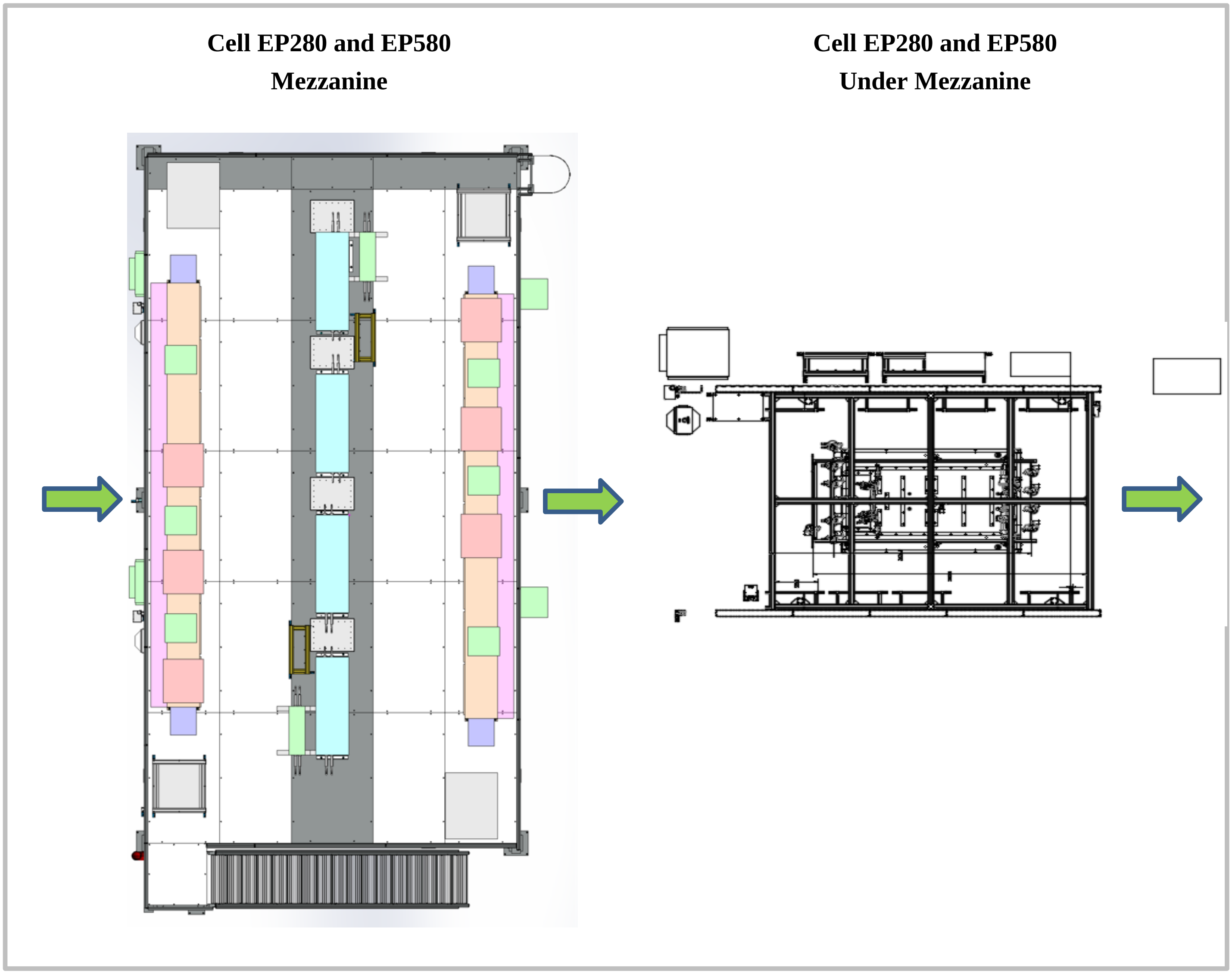



*Figure 3-3. Cell EP280 and EP580 System Layout*

## 3.2.2. Cover Leak Test System Layout

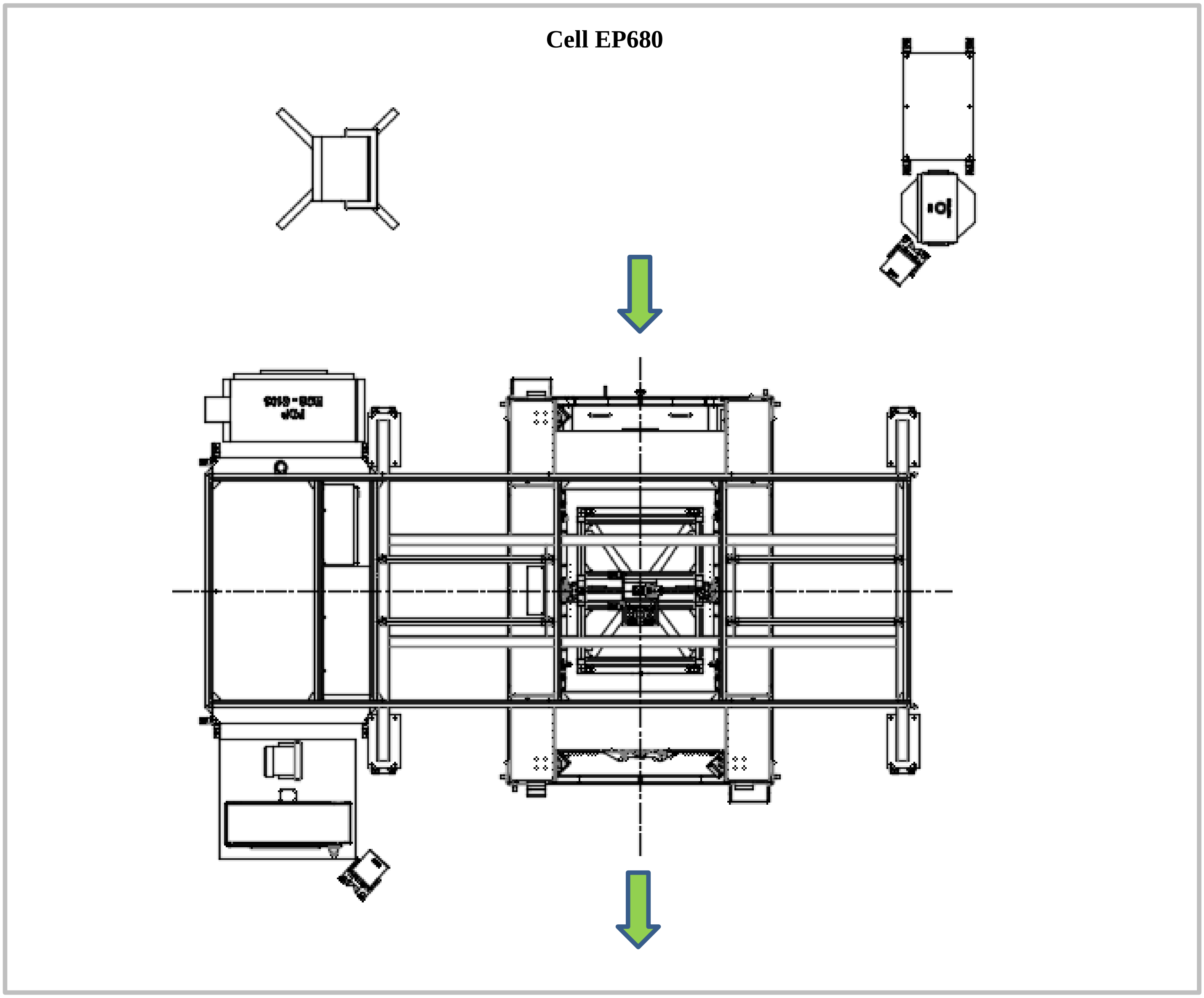



***Figure 3-4. Cell EP680 System Layout***

# 3.3. BET/BEV3 BATTERY PACK TEST AND COVER LEAK TEST UTILITIES

## 3.3.1. Battery Pack Test and Cover Leak Test Utilities – Manual Stations

| | | 280 | 580 | 680 |
|---|---|---|---|---|
| **Compressed Air Supply** | **Air Pressure (PSI)** | **65** | **65** | **65** |
| | **Max CFM** | **8.76** | **8.76** | **8.72** |
| | **Supply Pipe Size** | **0.75”** | **0.75"** | **0.75"** |
| **Electrical Supply** | **Equipment Volts** | **480** | **480** | **480** |
| | **Equipment Phase** | **3** | **3** | **3** |
| | **Main 3nect Amps** | **100** | **100** | **100** |
| **Electrical Supply for Cycler Panel** | **Equipment Volts** | **480** | **480** | **N/A** |
| | **Equipment Phase** | **3** | **3** | **N/A** |
| | **Main Disconnect Amps** | **1200** | **1200** | **N/A** |

# 3.4. BET/BEV3 BATTERY PACK TEST AND COVER LEAK TEST EQUIPMENT

Table *3.4.1* is an equipment matrix for the BET/BEV3 Pack Test and Cover Leak Test. Section *0* contains descriptions of common equipment found between Pack Test and Cover Leak Test. Section *3.4.3* contains equipment descriptions of equipment specific to EP280 and EP580. Section *3.4.4* contains equipment descriptions of equipment specific to EP680.

## 3.4.1. Equipment Matrix – Manual Stations

| Item | 280 | 580 | 680 |
|---|---|---|---|
| Air Preparation Unit | 1 | 1 | 1 |
| Leak Test Cart | 1 | 1 | N/A |
| Barcode Reader | 1 | 1 | 1 |
| Bauer Test Computer | 1 | 1 | N/A |
| Bauer Leak Test Data Collection PC | N/A | N/A | 1 |
| Bypass/Release Toggle Switch | 1 | 1 | 1 |
| Cell Gravity Pin | N/A | N/A | 1 |
| Cincinnati Test Systems Leak Test Instrumentation | N/A | N/A | 1 |
| Cycle Start Button | 2 | 2 | 1 |
| FLIR Thermal Camera | 3 | 3 | N/A |
| Label Printer | 1 | 1 | 1 |

| Item | 280 | 580 | 680 |
|---|---|---|---|
| Load Cycler | 1 | 1 | N/A |
| Operator Console HMI | 1 | 1 | 1 |
| Operator E-Stop | 2 | 2 | 2 |
| Operator Push Button Box | 1 | 1 | 1 |
| Power Distribution Panel | 1 | 1 | 1 |
| Sick Floor Scanner | 2 | 2 | 2 |
| Stack Light | 1 | 1 | 1 |
| Status Beacon | 1 | 1 | 1 |
| Tool Balancer - Small | 7 | 7 | N/A |
| Tool Balancer - Medium | 1 | 1 | N/A |
| Tool Balancer - Large | 6 | 6 | N/A |

## 3.4.2 Common Equipment Descriptions

### 3.4.2.1 Air Preparation Unit

The air preparation unit is a combination of filter, lubricator, and regulator assembled into a single unit that ensures that air pressure service to the cell is in a condition that is appropriate for use by tooling in the cell, Automated Guided Cart (AGC)

### 3.4.1.1.

The Automated Guided Cart (AGC) is a wheel-based automated load carrier that travels along a floor based magnetic path throughout the facility. The movements of the AGC are controlled by an onboard computer with precise and predictable acceleration, deceleration, and stopping locations.

Controlled by Bauer F620.

(1) Calibration orifice w/ orifice valve.
(1) Unit: 5 bar / 10 Pa

Calibrated pressure = 25.057 psig, Rate=1.96 cc/min

Coil 1=10L, Coil 2=2L

The AGC brings the battery pack into the stations front leading.

### 3.4.1.2. Barcode Reader

***Figure 3-5. Barcode Reader***

Each manual and semi-automatic station is equipped with a handheld Honeywell Granit 1911i Industrial Scanner barcode reader. Barcode scanners are used to scan Battery Identification Numbers (BIN) part labels during operations and all scans are tracked by the HMI system. The Barcode Reader consists of a handheld scanner and a base mount charging holder. The scanner is operated by pulling on the scanner trigger.

| | |
|---|---|
| **REFERENCE** | ***For more information about the barcode reader, refer to the equipment supplier documentation (Xenon/Granit Area-Imaging Scanners User Guide).*** |

#### 3.4.2.2 Bypass/Release Toggle Switch

The Bypass/Release toggle switch is used to allow the Automated Guided Cart (AGC) to go through the cell without testing or not come into the station at all (Bypass) or to release the AGC from the cell (Release).

This is not used when in Auto Mode.

This is used when in Manual Mode for such reasons as troubleshooting, set-up, product issues, etc.


***Figure 3-6. Bypass/Release Toggle Switch***

### 3.4.2.3 Cycle Start Button


| Device Callouts | |
|---|---|
| A | Cycle Start button |
| B | E-Stop button |

*Figure 3-7. Cycle Start Button.*

**WARNING!**

***Press an*** EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.***

Each manual cell has a Cycle Start Button that when pressed by the Operator will release the Automated Guided Cart.

Each manual cell has an Emergency Stop (E-Stop) Button that when used will removed all power from a cell and bring all tooling and other devices to a stop. The Emergency Stop button requires the button to be pulled back out after it has been pressed in. After pressing an Emergency Stop button, follow the recovery procedure outlined in ***4.3.2 Starting Cell***.

### 3.4.2.4 Label Printer

The label printed identifies that the cover leak test was performed on the battery pack.

| **REFERENCE** | ***For more information about the Label Printer, refer to the equipment supplier documentation (Zebra ZT510-User Manual.pdf).*** |
| --- | --- |

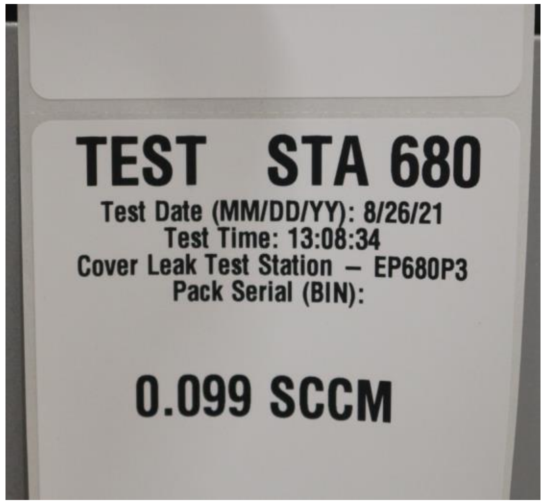
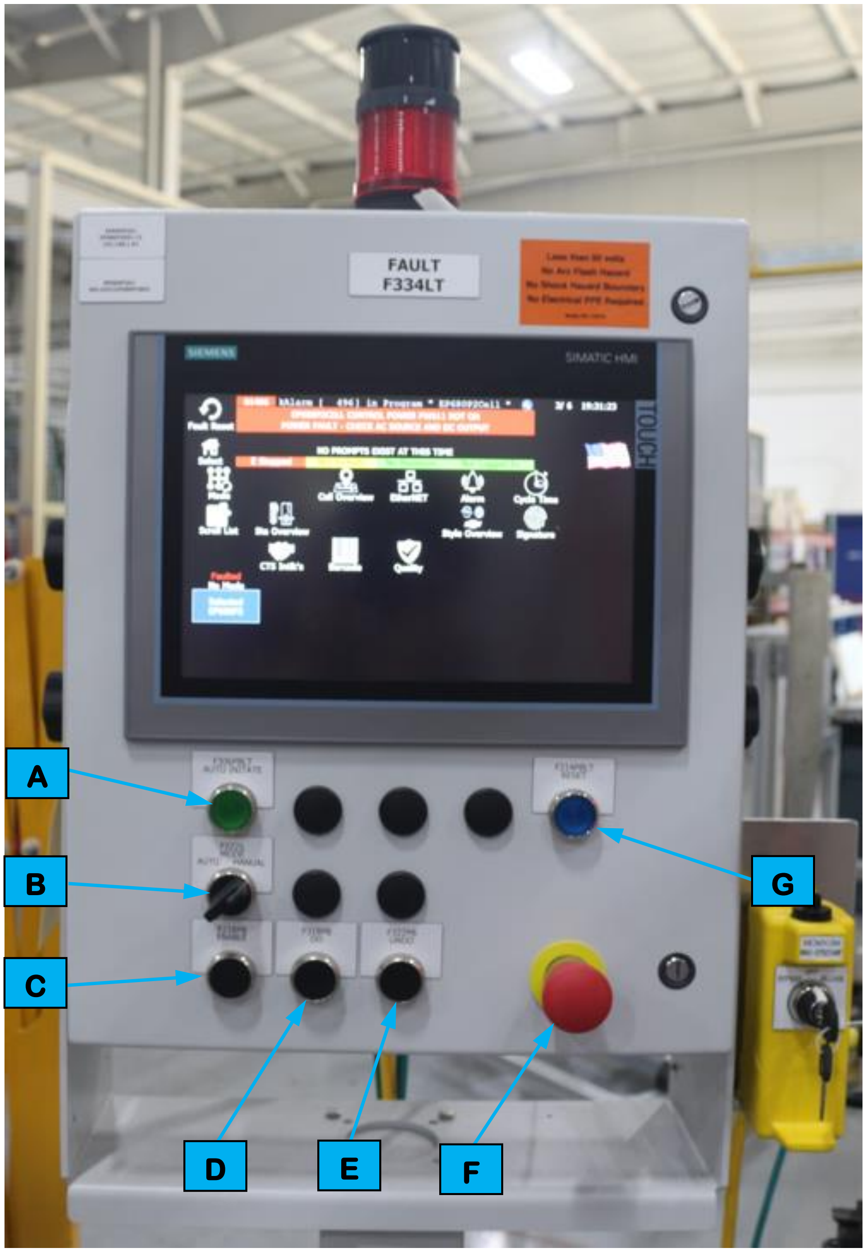




***Figure 3-8. Label Printer and a Label***

### 3.4.2.5 Operator Console Human Machine Interface (HMI)




| Device Callouts | |
|---|---|
| A | AUTO INITIATE button |
| B | AUTO / MANUAL toggle switch |
| C | ENABLE button |
| D | DO button |
| E | UNDO button |
| F | E-Stop button |
| G | RESET button |

***Figure 3-9. Human Machine Interface (HMI).***

The Human Machine Interface (HMI) is a free-standing device which permits the Operator to interact with the machine, device, or system. Common uses are for displaying data, tracking production time, overseeing Key Performance Indicators (KPI), and monitoring machine inputs and outputs.

### 3.4.2.6 Operator E-Stop

**WARNING!** ***Press an*** EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.***

Each cell has one or more Emergency Stop (E-Stop) Button(s) that when used will remove all power from a cell and bring all tooling and other devices to a full stop. Emergency stop buttons are located on HMI panels and on the Cycle Start Button box in each cell. The Emergency Stop button requires the button to be pulled back out after it has been pressed in. After pressing an Emergency Stop button, follow the recovery procedure outlined in Chapter 4.

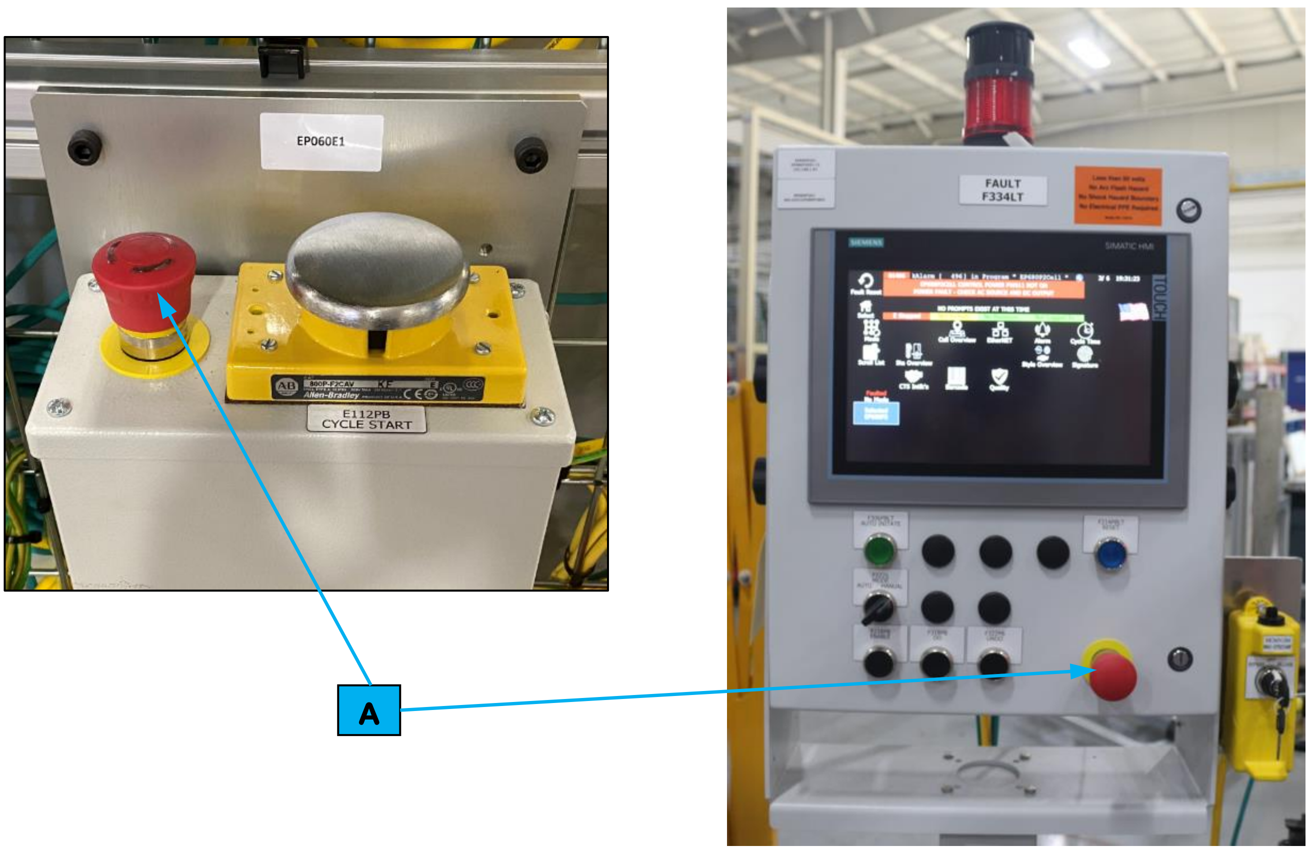
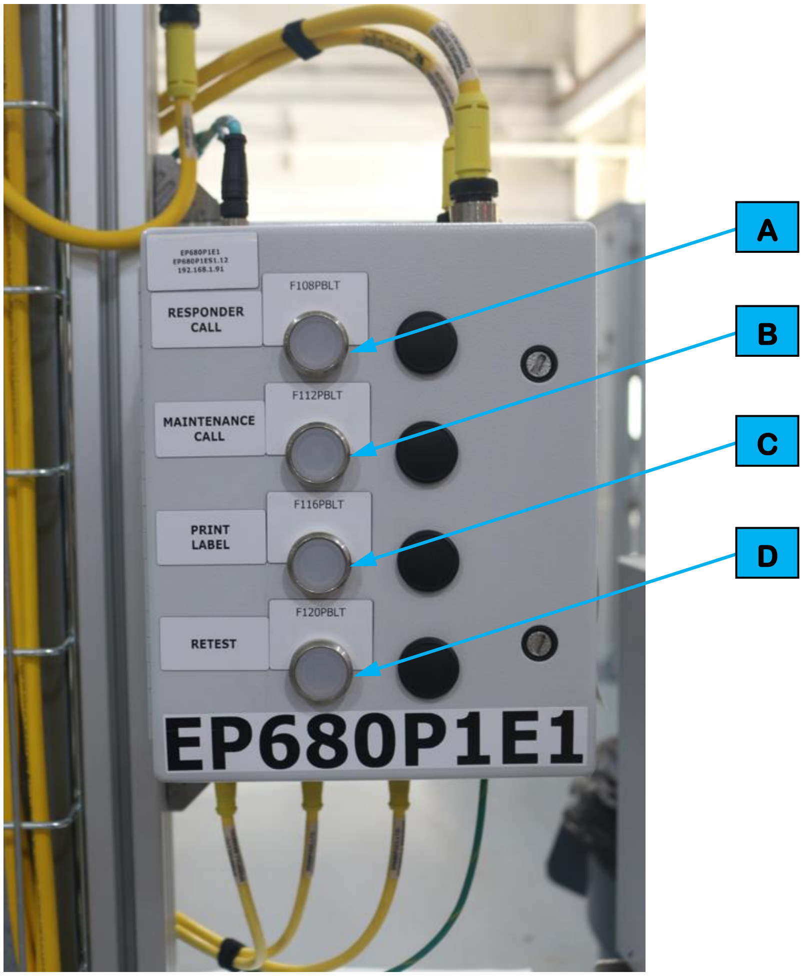



***Figure 3-10. E-Stop Button.***

| Device Callouts | |
|---|---|
| A | E-Stop button |

### 3.4.2.7 Operator Push Button Box

Operators can use buttons of the Operator Push Button Box to call for maintenance personnel, print a label, and other functions.




| Device Callouts | |
|---|---|
| A | RESPONDER CALL button |
| B | MAINTENANCE CALL button |
| C | PRINT LABEL button |
| D | RETEST button |

***Figure 3-11. Operator Push Button Box.***

**RESPONDER CALL BUTTON**

The RESPONDER CALL button is used to call a Team Lead.

**MAINTENANCE CALL Button**

The MAINTENANCE CALL button is used to call Maintenance Personnel.

**PRINT LABEL Button**

The PRINT LABEL button is used to reprint a label if the original printed label is damaged.

**RETEST Button**

The RETEST button is NOT USED.

### 3.4.2.8 Cell Power Distribution Panel

Each cell has a single Power Distribution Panel (PDP) that is used to distribute control power to the related equipment and to communicate with the cell processor. The PDP features indicators that illuminate to identify when control power is on. A fused disconnect (Lockout Point E-1) is located on the outside of the PDP and is used to enable or disable control power for the cell. Inside the PDP is an additional disconnect (Lockout Point E-2) that provides auxiliary power control. Refer to the GM standards and to the ATS electrical drawings for more information about the PDP equipment and functionality. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

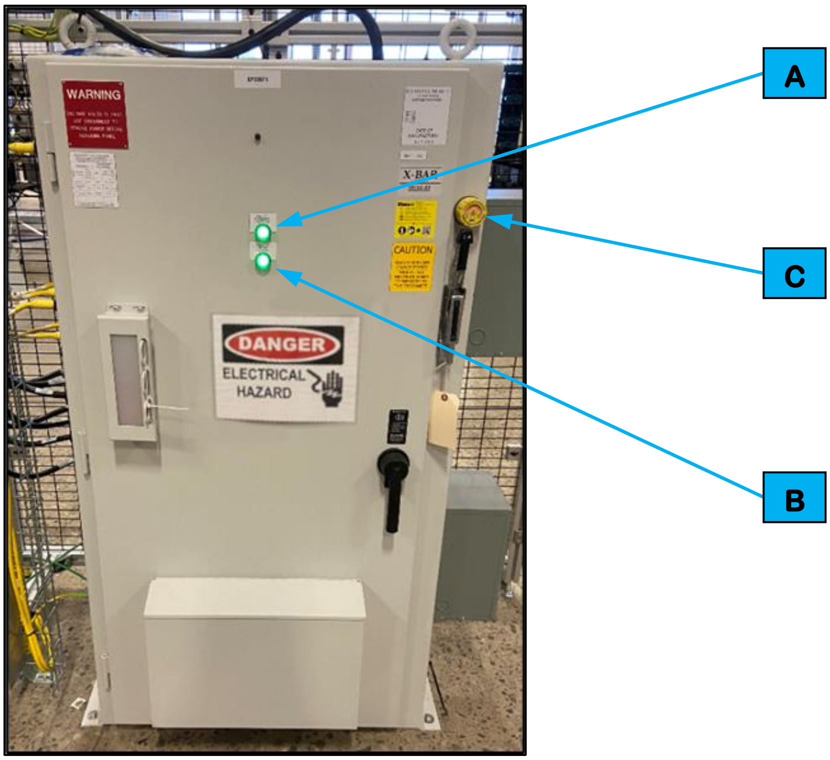



*Figure 3-12. Power Distribution Panel.*

| Device Callouts | |
|---|---|
| A | PROCESSOR POWER ON button |
| B | CONTROL POWER ON button |
| C | 3-Phase Indicator |

### 3.4.2.9 SICK Safety Laser Scanner

The purpose for the SICK Safety Laser Scanner is to prevent someone from entering the station while a test is in-process. If someone enters the area that the scanner is monitoring the safety PLC monitoring the scanners will execute an emergency stop routine to stop the test.

The SICK Safety Laser Scanner is an Active Opto-Electric Protective Device that responds to Diffuse Reflections (AOPDDR). It has a 4m protective field range to safely detect an object, a 40m warning field range, and up to 4-independent protective fields monitored simultaneously. It transmits a pulse of light (pulsed laser diode) that will hit an object or not and come back, then using the Time-of-Flight principle, based on the speed of light, it can be determined how far away the object is.

The SICK Safety Laser Scanner uses internal mirrors that rotate up to 275 degrees to take multiple measurements to build up a two-dimensional (2D) profile of the area being scanned and has Common Industrial Protocol (CIP Safety) capability that is designed to allow for safe integration into different control system networks and to be used with a shared protocol.

| | |
|---|---|
| **REFERENCE** | ***For more information about SICK Safety Laser Scanner microScan3, Model #MICS3-ABAZ40IZ1P01, Part #1082015 and Heavy-duty mounting kit, Part #2102289 equipment, refer to the equipment supplier documentation (dataSheet_MICS3-ABAZ40IZ1P01_1082015_en.pdf, mounting_instructions_microscan3_mounting_kits_heavy_duty_mounting_kit_de_en_im0081201.pdf, operating_instructions_microscan3_ethernet_ip™_en_im0075174.pdf, dataSheet_Heavy-duty-mounting-kit-for-fl_2102289_en.pdf, and mounting_instructions_microscan3_efi_pro_microscan3_ethercat®_microscan3_profinet_m12_microscan3_e_thernet_ip™_de_en_im0083919.pdf)*** |



***Figure 3-13. SICK Safety Laser Scanner and Heavy-duty mounting kit.***

## 3.4.2.10 Stack Light

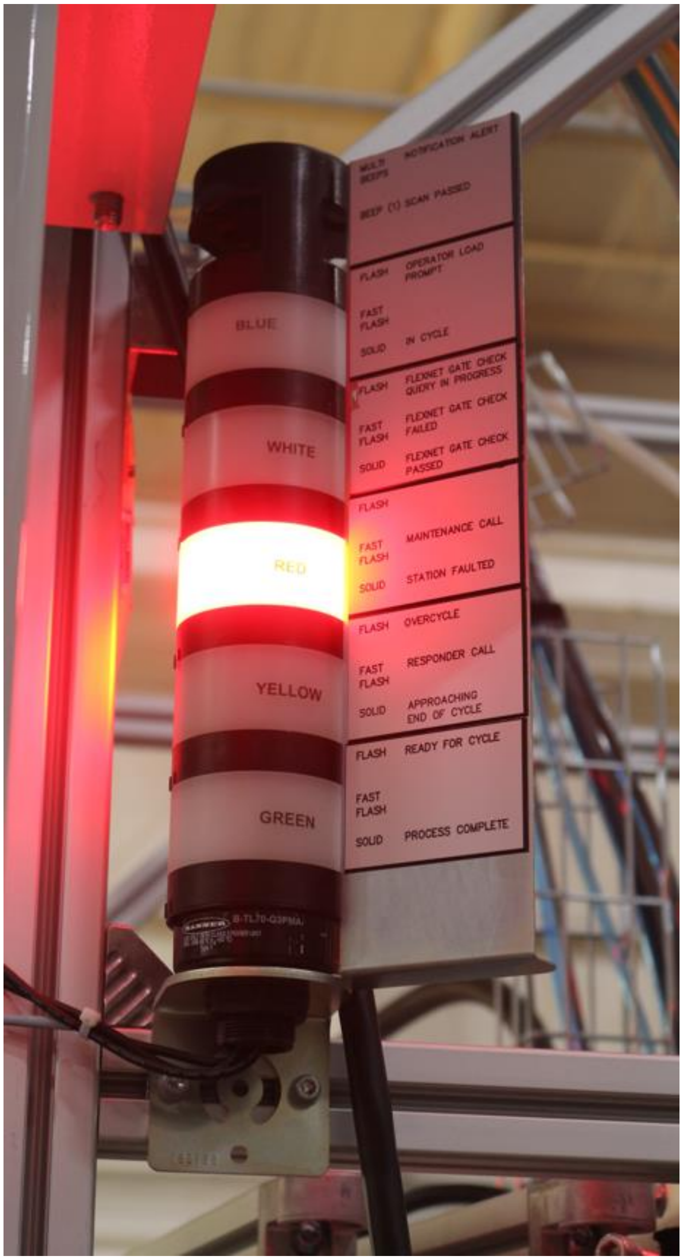



***Figure 3-14. Stack Light Indicator.***

On the station framing is a stack light with five colored indicator lights and a horn, where the sound/tone is a beep. The lights and horn are used to indicate the status of the cell and the MPS system. When activated, each indicator identifies the following condition:

- Horn (multiple beeps) - notification alert
- Horn (one beep) – scan passed
- Blue Indicator (Flashing) – operator load prompt
- Blue Indicator (Fast Flashing) – N/A
- Blue Indicator (Solid) – in cycle
- White Indicator (Flashing) – Flexnet gate check query in progress
- White Indicator (Fast Flashing) – Flexnet gate check failed
- White Indicator (Solid) – Flexnet gate check passed
- Red Indicator (Flashing) – N/A
- Red Indicator (Fast Flashing) – Maintenance call
- Red Indicator (Solid) – station faulted
- Yellow Indicator (Flashing) – over cycle
- Yellow Indicator (Fast Flashing) – Responder call
- Yellow Indicator (Solid) – approaching end of cycle
- Green Indicator (Flashing) – ready for cycle
- Green Indicator (Fast Flashing) – N/A
- Green Indicator (Solid) – process complete

### 3.4.2.11 Status Beacon

The status beacon sits on top of the Operator Console HMI box with one colored indicator light. The light is used to indicate an alarm. When activated, the indicator identifies the following condition:

- Red Indicator (Flashing) – Maintenance (high priority fault) alarm present
- Red Indicator (Solid) – Non-maintenance (low priority fault) alarm present


***Figure 3-15. Status Beacon.***

### 3.4.3 Electrical and Coolant Leak Test Station EP280 and EP580 Equipment Descriptions

**Cell EP280 and EP580 - Mezzanine**

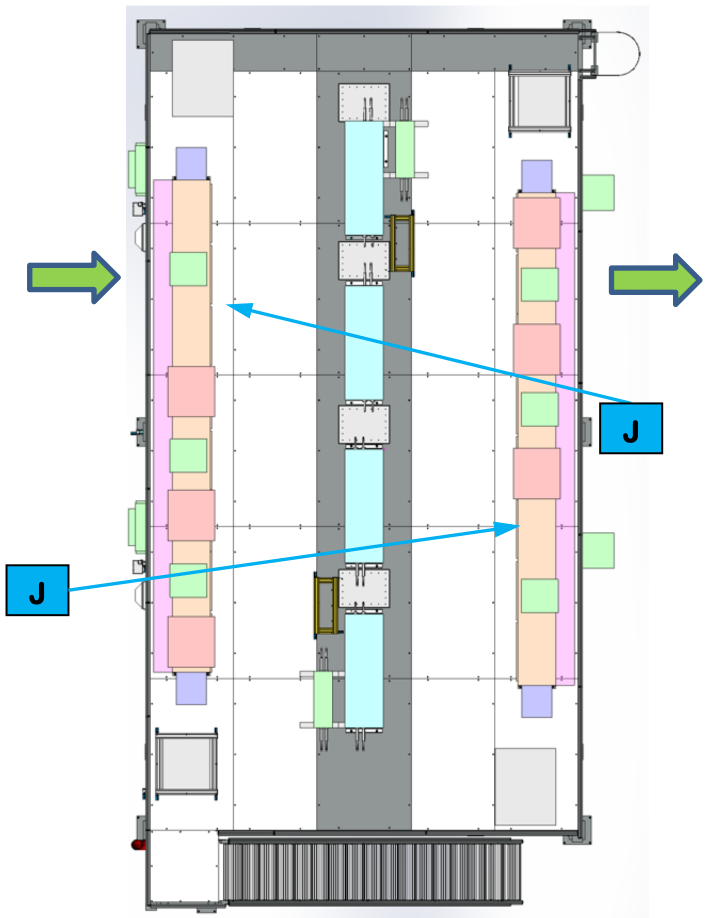



*Figure 3-16. Electrical Leak Test Station EP280 & EP580 Top View - Mezzanine.*

| Equipment Callouts in Station EP280 & EP580 | | | |
|---|---|---|---|
| A | Air Preparation Unit | K | Operator Console HMI |
| B | Leak Test Cart | L | Operator E-Stop (2) |
| C | Barcode Reader | M | Operator Push Button Box |
| D | Bauer Test Computer | N | Sick Floor Scanner (2) |
| E | Bypass/Release Toggle Switch | O | Stack Light |
| F | Cell Power Distribution Panel | P | Status Beacon |
| G | Cycle Start Button | Q | Tool Balancer – Small<br>(6) at the front and (1) at rear of the Battery Pack |
| H | FLIR Thermal Camera (3) | R | Tool Balancer – Medium<br>(1) at the rear of the Battery Pack |
| I | Label Printer | S | Tool Balancer – Large<br>(2) at the front and (4) at the rear of the Battery Pack |
| J | Load Cycler (2) | | |

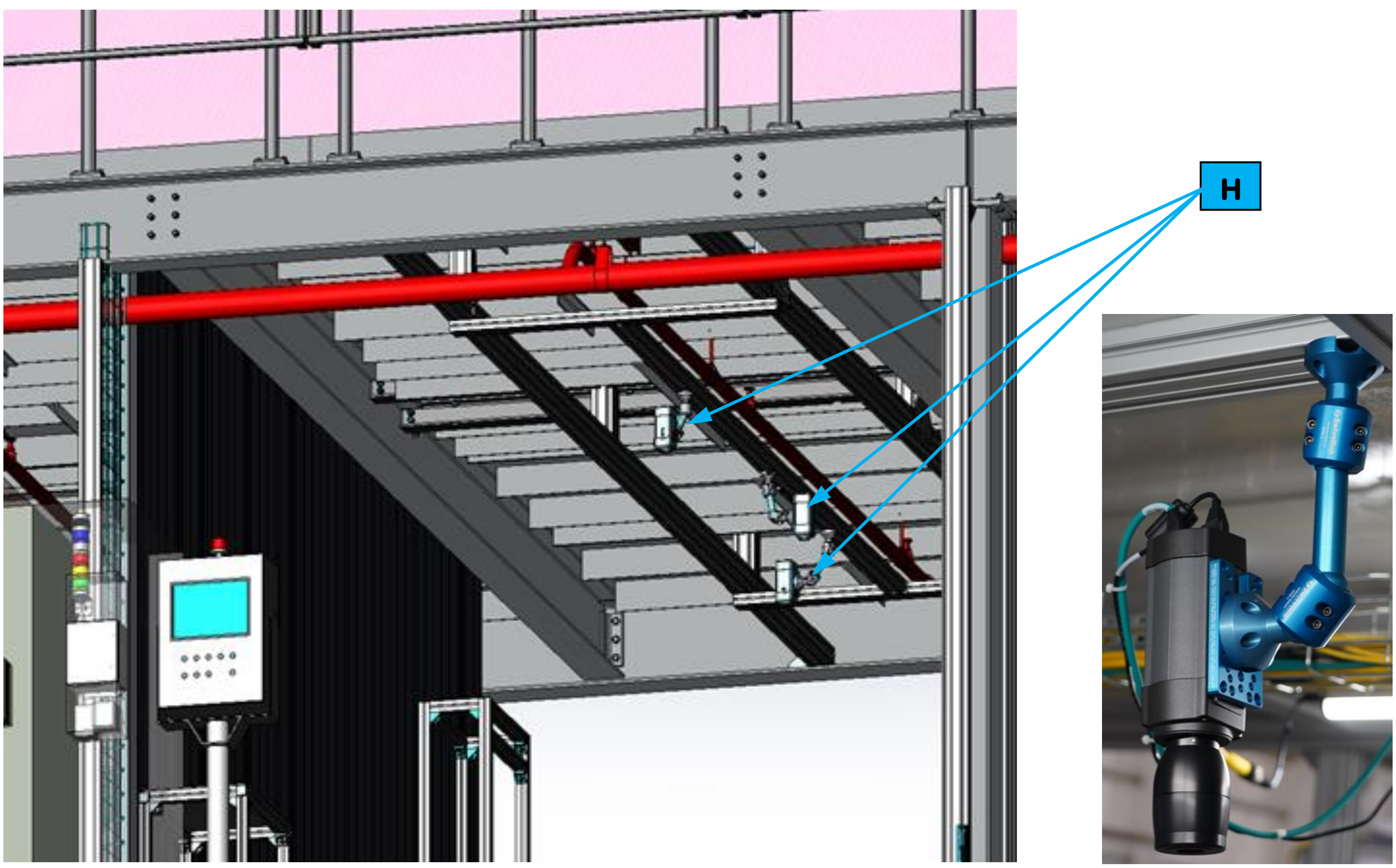



***Figure 3-17. Electrical Leak Test Station EP280 & EP580 – Under Mezzanine.***

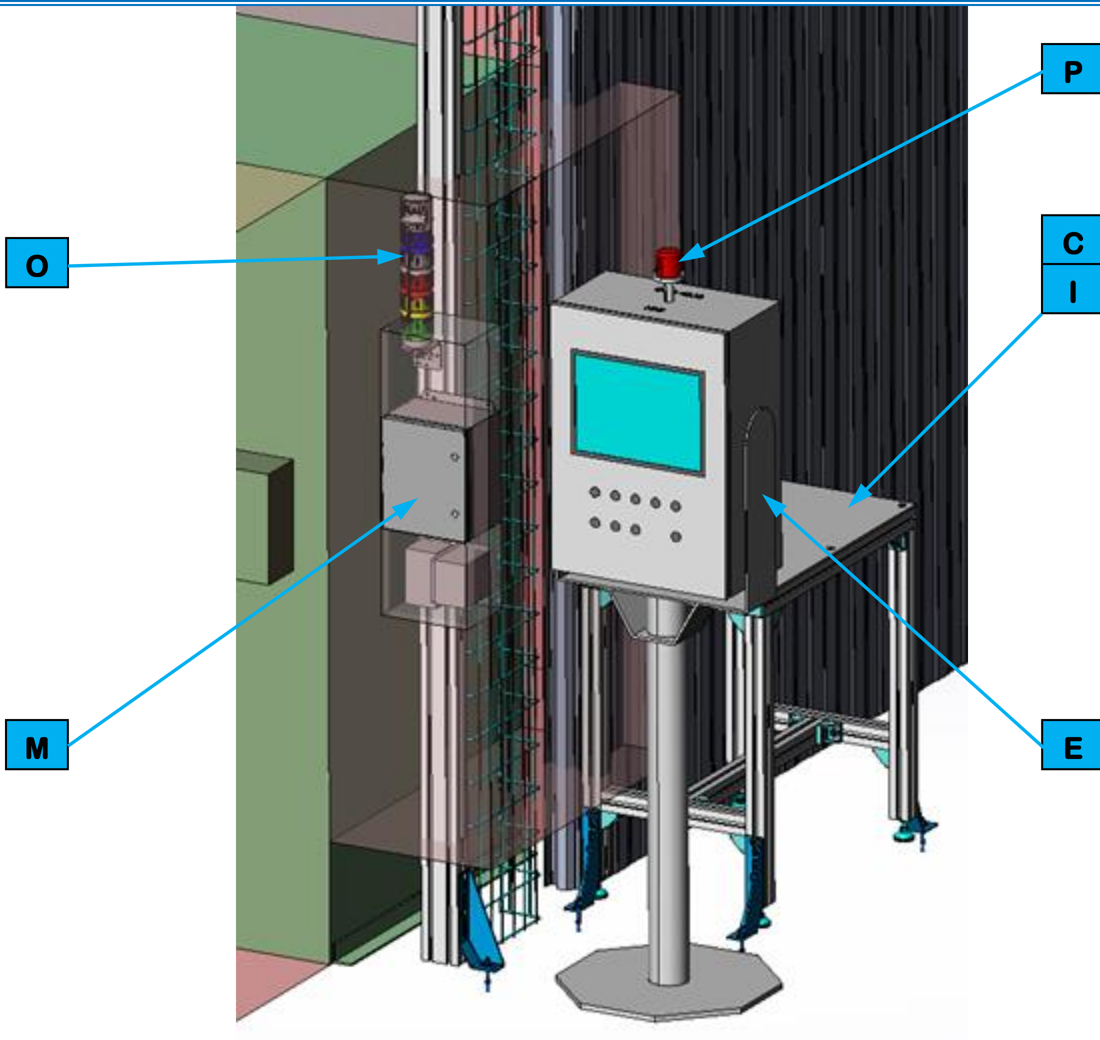



***Figure 3-18. Electrical Leak Test Station EP280 & EP580 – Under Mezzanine.***

**Cell EP280 and EP580 – Under Mezzanine**

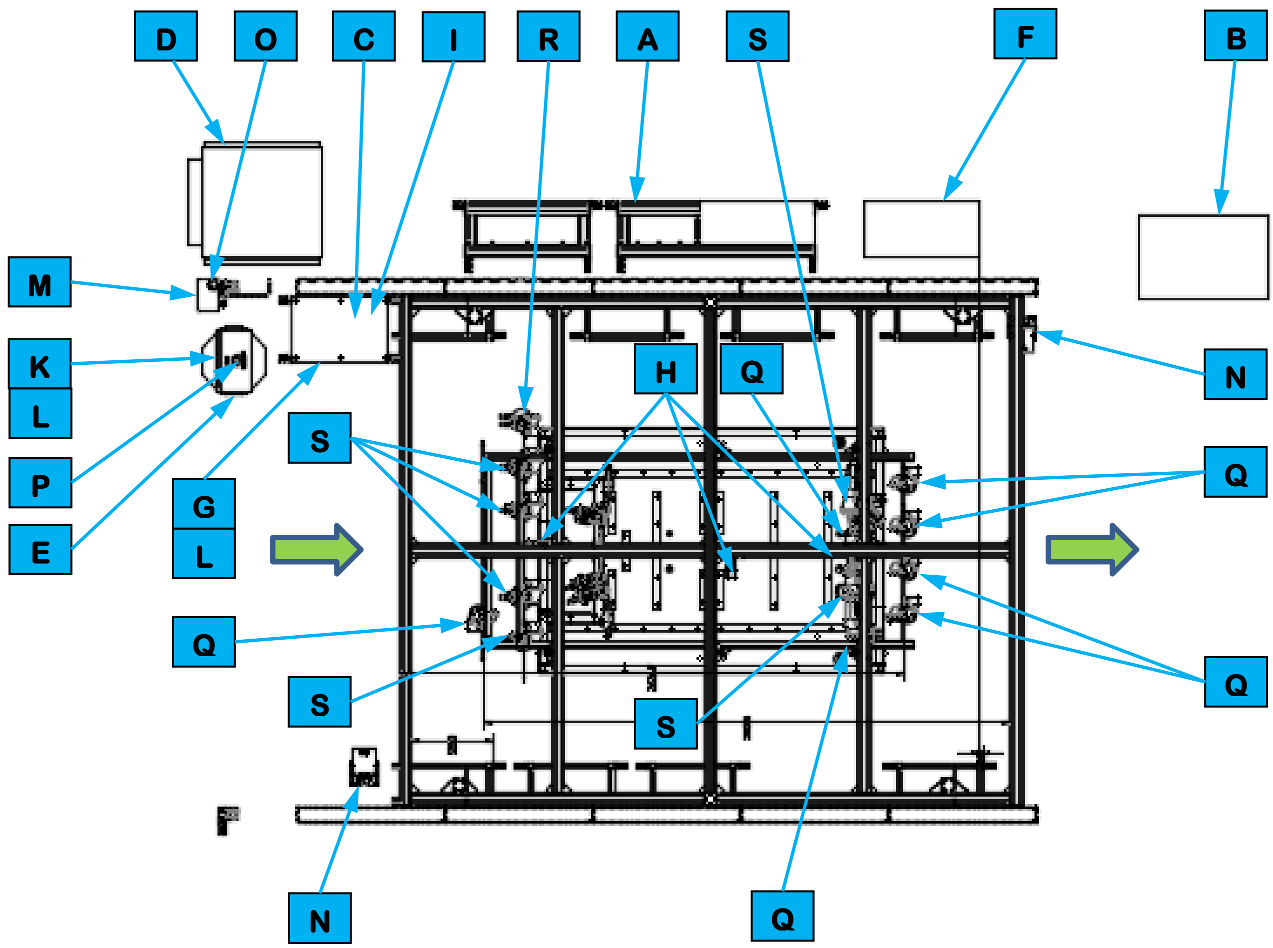



*Figure 3-19. Electrical Leak Test Station EP280 & EP580 Top View – Under Mezzanine.*

### 3.4.3.1 Station Description

Cell EP280 and EP580 are semi-automatic test stations for performing a Coolant Leak Test and an Electrical Test on BET and BEV3 battery assemblies. An AGC enters this station where an Operator performs a manual dress of electrical and coolant connectors to prepare the battery assembly for the Coolant Leak Test and the Electrical Test.

### 3.4.3.2 Sequence of Operation

The Battery Pack Test equipment completes the following operations during a normal cycle:

| Sequence of Operation | |
|---|---|
| **Sequence** | **Description** |
| 1 | SCAN TEST AREA CLEAR, CART ENTERS STATION |
| 2 | **OPERATOR ENTERS STATION** |
| 3 | *ENGAGE TEST HEADS FRONT* |
| 4 | HEATER CONNECTOR CONNECTED<br>ACEC CONNECTOR CONNECTED |
| 5 | FRONT PIM CONNECTOR CONNECTED |
| 6 | OUTLET COOLANT PORT CONNECTED |
| 7 | INLET COOLANT PORT CONNECTED |
| 8 | *FRONT LV CONNECTOR CONNECTED PIP SWITCH* |
| 9 | DCFC CONNECTOR CONNECTED PIP SWITCH |
| 10 | GROUND CONNECTOR 2 CONNECTED PIP SWITCH |
| 11 | *ENGAGE TEST HEADS REAR* |
| 12 | LH PIM CONNECTOR CONNECTED |
| 13 | RH PIM CONNECTOR CONNECTED |
| 14 | 20 PINS LV CONNECTOR (LEFT) CONNECTED<br>20 PINS LV CONNECTOR (RIGHT) CONNECTED |
| 15 | DCFC HV CONNECTOR CONNECTED |
| 16 | IPE HV CONNECTOR CONNECTED |
| 17 | GROUND CONNECTOR 1 CONNECTED PIP SWITCH |
| 18 | **OPERATOR EXITS STATION** |
| 19 | OPERATOR PRESSES START BUTTON |
| 20 | STA. VERIFIES PIP SWITCHES ENGAGED |
| 21 | FLIR CAMERAS ON |
| 22 | LEAK TEST SYSTEM EXECUTES |
| 23 | ELECTRICAL TEST PER SPEC |
| 24 | DATA COLLECTED |
| 25 | PASS/FAIL STATUS SENT TO QUALITY GATE |
| 26 | **OPERATOR ENTERS STATION** |
| 27 | *DISENGAGE TEST HEADS FRONT* |
| 28 | HEATER CONNECTOR RETRACTED<br>ACEC CONNECTOR RETRACTED |
| 29 | FRONT PIM CONNECTOR RETRACTED |
| 30 | OUTLET COOLANT PORT RETRACTED |
| 31 | INLET COOLANT PORT RETRACTED |
| 32 | *FRONT LV CONNECTOR RETRACTED* |

| Sequence of Operation | |
|---|---|
| **Sequence** | **Description** |
| 33 | DCFC CONNECTOR RETRACTED |
| 34 | *GROUND CONNECTOR 2 RETRACTED* |
| 35 | *DISENGAGE TEST HEADS REAR* |
| 36 | LH PIM CONNECTOR RETRACTED |
| 37 | RH PIM CONNECTOR RETRACTED |
| 38 | 20 PINS LV CONNECTOR (LEFT) RETRACTED<br>20 PINS LV CONNECTOR (RIGHT) RETRACTED |
| 39 | DCFC HV CONNECTOR RETRACTED |
| 40 | IPE HV CONNECTOR RETRACTED |
| 41 | GROUND CONNECTOR 1 RETRACTED |
| 42 | **OPERATOR EXITS STATION** |
| 43 | OPERATOR RELEASES PACK AUTO\MANUAL |
| 44 | FLIR CAMERAS OFF |
| 45 | PACK EXITS STATION |

#### 3.4.3.3 Leak Test Cart

The Leak Test Cart pressurizes the battery pack coolant circuit and determines if it is leak tight using a differential pressure decay test method.

The Leak Test Cart contains one ATEQ Primus F620 Differential Pressure Decay leak test instrument (5 bar / 10 Pa). The unit measures air flow in Standard Cubic Centimeters per Minute (SCCM or $cm^3$/min).

The Leak Test Cart also contains one orifice and one orifice valve. Nominal orifice flow is 2 sccm at 25 psig.

The ATEQ F620 Compact Leak Tester is a flow meter which measures a drop in pressure with a differential sensor (transducer) which is placed at the extremities of a calibrated flow tube OR is a compact air/air leak detector based on the measurement of a small variation or drop in differential pressure between the test and reference parts, when both are filled to an identical pressure.

The Computer (PC) Workstation Enclosure holds the data collection (GM standard data acquisition system) OR Bauer does the data acquisition (GM standard data acquisition system).

The Bauer test computer communicates with the ATEQ instrument via Ethernet to select and start the appropriate test program and obtain results from the leak test.

| | |
|---|---|
| **REFERENCE** | ***For more information about the ATEQ® Instrument equipment, refer to the equipment supplier documentation (ATEQ® PRIMUS F SERIES F620 User Manual, and GM's Data Acquisition Specifications).*** |

#### 3.4.3.4 Bauer Test Computer

The Bauer test computer communicates with the ATEQ F620 instrument to start the coolant leak test, communicates with the Motion Control Corporation Cell Load Cycler to control the charge and discharge of the battery for the electrical test, and is used for data acquisition (GM standard data acquisition system) of the coolant leak test and electrical test results.


*Figure 3-20. Bauer Test Computer*

| Device Callouts | |
|---|---|
| A | COMPUTER MONITOR |
| B | CONTROL SYSTEM OK button |
| C | POWER RECEPTICAL |
| D | USB PORT |
| E | Keyboard and Mouse<br>(inside pull down) |

#### 3.4.3.5 FLIR Thermal Camera

The FLIR Thermal Cameras detect heat. Bauer software monitors the cameras during testing and will abort the test if any part of the battery pack exceeds a preset temperature in the software.

| | |
|---|---|
| **REFERENCE** | ***For more information about the FLIR equipment, refer to the equipment supplier documentation (29249-000.pdf, Document Number: 29249-000, Version: 5, Issue Date: February 2, 2015).*** |

#### 3.4.3.6 Load Cycler

The Motion Control Corporation Cell Load Cycler panel is an 8-door unit consisting of three conjoined enclosures.

The Cell Load Cycler charges and discharges the Battery Pack for the electrical test and is controlled by the Bauer Test Computer.

#### 3.4.3.7 Tool Balancer – Small

Packers KROMER Light-Duty "Zero Gravity" Tool Balancer #7228-1 is an adjustable cable system suspended from the cell frame that allows tools to hang within reach of the Operator.  They are used to facilitate the Operator in plugging in connectors to the battery that is to be tested.  Six (6) hang at the front of the battery pack and one (1) hangs at the rear of the battery pack.

| | |
|---|---|
| **REFERENCE** | ***For more information about the Packers KROMER Tool Balancer equipment, refer to the equipment supplier documentation (Packers Kromer 7228-Operating-Instructions.pdf).*** |

##### 3.4.3.7.1 BEV3 X1 LV Connector

The BEV3 X1 LV electrical connector is used to connect to the front Molex style 20-pin product header in the battery pack during the Pack Electrical Test on the BEV3 product. This connector contains twenty commercial contacts and a PIP switch to validate the connection.

The BEV3 X1 LV electrical connector hangs at the front of the battery pack.

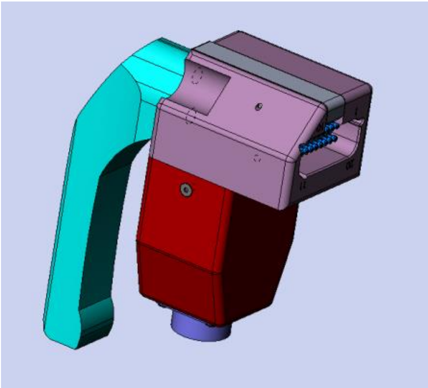


***Figure 3-21. BEV3 X1 LV Connector.***

### 3.4.3.7.2 BET Ground Connector 2

The BET Ground Connector 2 is used during the electrical test when the Hipot test is performed.

The BET Ground Connector 2 hangs at the rear of the battery pack.

***Figure 3-22. BET Ground Connector 2.***

### 3.4.3.7.3 BEV3 Outlet Coolant Connector

The BEV3 Outlet Coolant leak test connector is used to seal the coolant circuit within the battery pack by sealing to the exterior coolant orifice on the front of the battery pack. This 16.3mm diameter unit connects to the outlet coolant port of the BEV3 product only.

The BEV3 Outlet Coolant Connector hangs at the front of the battery pack.

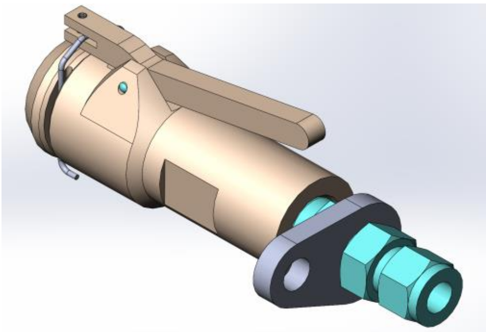


***Figure 3-23. BEV3 Outlet Coolant Connector.***

### 3.4.3.7.4 BET Outlet / BEV3 Inlet Coolant Connector

The BET Outlet / BEV3 Inlet Coolant leak test connector is used to seal the coolant circuit within the battery pack by sealing to the exterior coolant orifice on the front of the battery pack. This 22.3mm diameter unit connects to the outlet coolant port of the BET product and to the inlet coolant port of the BEV3 product.

The BET Outlet / BEV3 Inlet Coolant Connector hangs at the front of the battery pack.

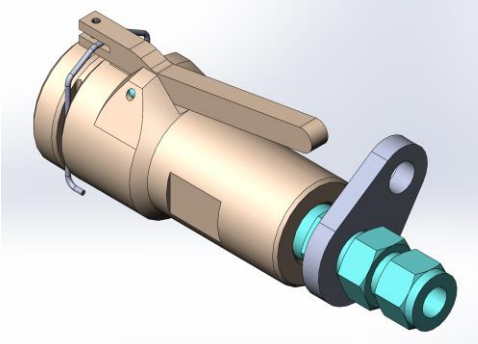


*Figure 3-24. BET Outlet / BEV3 Inlet Coolant Connector.*

### 3.4.3.7.5 BET Inlet Coolant Connector

The BET Inlet Coolant leak test connector is used to seal the coolant circuit within the battery pack by sealing to the exterior coolant orifice on the front of the battery pack. This 26.3mm diameter unit connects to the inlet coolant port of the BET product only.

The BET Inlet Coolant Connector hangs at the front of the battery pack.

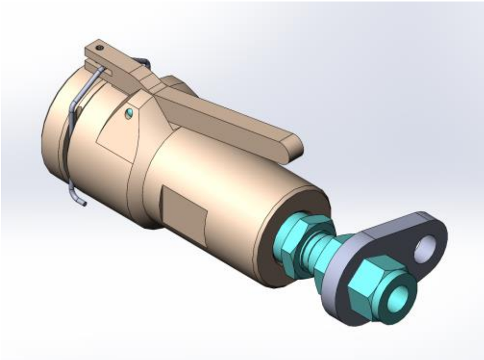


*Figure 3-25. BET Inlet Coolant Connector.*

### 3.4.3.7.6 BET Heater Connector & BET ACEC Connector

The BET Heater electrical connector is used to connect to the front Heater input product header in the battery pack during the Pack Electrical Test on the BET product. This connector contains two manufactured contacts and a PIP switch to validate the connection.

The BET ACEC electrical connector is used to connect to the front ACEC input product header in the battery pack during the Pack Electrical Test on the BET product. This connector contains two manufactured contacts and a PIP switch to validate the connection.

The BET Heater Connector and BET ACEC Connector hang at the rear of the battery pack.

**BET Heater Connector** **BET ACEC Connector**

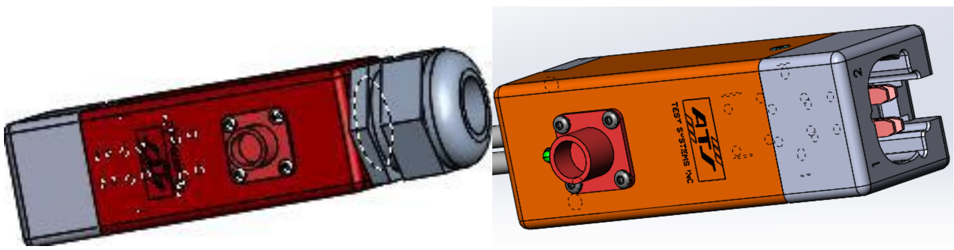


***Figure 3-26. BET Heater and BET ACEC Connectors.***

### 3.4.3.7.7 BET / BEV3 Ground Connector 1

The BET / BEV3 Ground Connector 1 is used during the electrical test when the Hipot test is performed.

The BET / BEV3 Ground Connector 1 hangs at the front of the battery pack.

***Figure 3-27. BET / BEV3 Ground Connector 1.***

### 3.4.3.8 Tool Balancer – Medium

Packers KROMER Light-Duty "Zero Gravity" Tool Balancer #7228-2 is an adjustable cable system suspended from the cell frame that allows a tool to hang within reach of the Operator. This is used to facilitate the Operator in plugging in a connector to the battery that is to be tested. One (1) hangs at the rear of the battery pack.

| **REFERENCE** | ***For more information about the Packers KROMER Tool Balancer equipment, refer to the equipment supplier documentation (Packers Kromer 7228-Operating-Instructions.pdf).*** |
|---|---|

#### 3.4.3.8.1 BET X8 LV Connector & BET X9 LV Connector

The BET X8 LV and BET X9 LV electrical connectors are used to connect to front Molex style 20-pin product headers in the battery pack during the Pack Electrical Test on the BET product. These connectors contain twenty commercial contacts and a PIP switch to validate the connection.

The BET X8 LV and BET X9 LV connectors hang at the rear of the battery pack.

**BET X8 LV Connector** **BET X9 LV Connector**

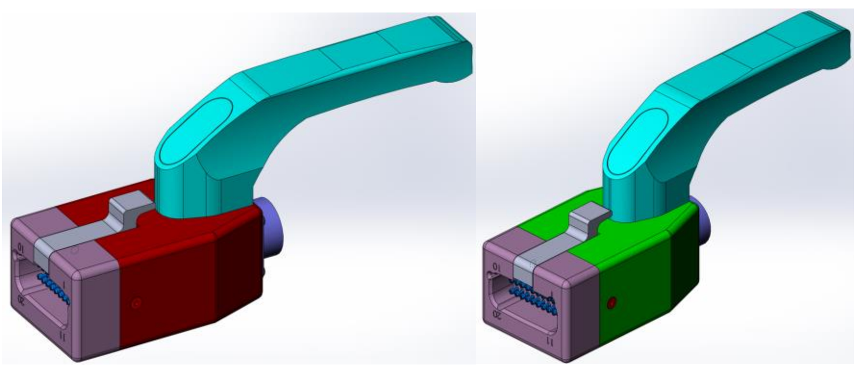


*Figure 3-28. BET X8 LV and BET X9 LV Connectors.*

### 3.4.3.9 Tool Balancer – Large

Packers KROMER Medium-Duty "Zero Gravity" Tool Balancer #7231-1 is an adjustable cable system suspended from the cell frame that allows tools to hang within reach of the Operator. They are used to facilitate the Operator in plugging in connectors to the battery that is to be tested. Two (2) hang at the front of the battery pack and four (4) hang at the rear of the battery pack.

| **REFERENCE** | ***For more information about the Packers KROMER Tool Balancer equipment, refer to the equipment supplier documentation (Packers Kromer 7230-Operating-Instructions.pdf).*** |
|---|---|

#### 3.4.3.9.1 BEV3 DCFC Connector

The BEV3 Direct Current Fast Charge (DCFC) electrical connector is used to connect to the DCFC product header in the battery pack during the Pack Electrical Test on the BEV3 product. This connector contains two manufactured contacts and a PIP switch to validate the connection.

The BEV3 DCFC Connector hangs at the front of the battery pack.

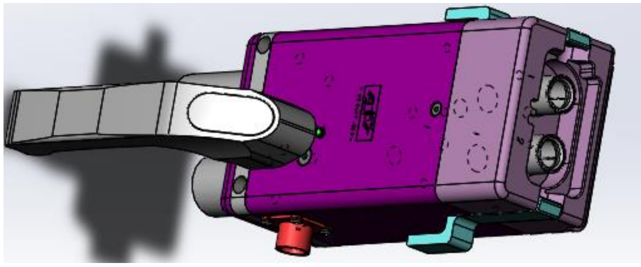


*Figure 3-29. BEV3 DCFC Connector.*

### 3.4.3.9.2 BET FPIM / BEV3 IPE Connector

The BET FPIM / BEV3 IPE electrical connector is used to connect to the front power input product header in the battery pack during the Pack Electrical Test on the BET product and the IPE header connection on the BEV3 product. This connector contains two manufactured contacts and a PIP switch to validate the connection.

The BET FPIM / BEV3 IPE Connector hangs at the front of the battery pack.

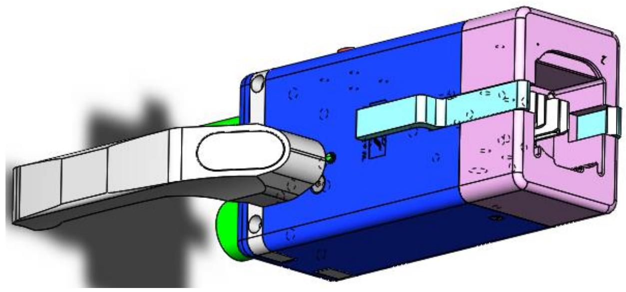


*Figure 3-30. BET FPIM / BEV3 IPE Connector.*

### 3.4.3.9.3 BET LPIM Connector

The BET LPIM electrical connector is used to connect to the left rear power input product header in the battery pack during the Pack Electrical Test on the BET product. This connector contains two manufactured contacts and a PIP switch to validate the connection.

The BET LPIM Connector hangs at the rear of the battery pack.

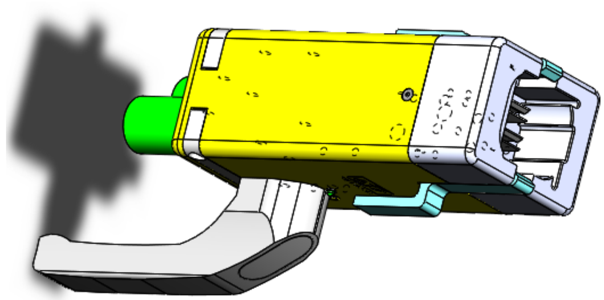


*Figure 3-31. BET LPIM Connector.*

### 3.4.3.9.4 BET RPIM Connector

The BET RPIM electrical connector is used to connect to the right rear power input product header in the battery pack during the Pack Electrical Test on the BET product. This connector contains two manufactured contacts and a PIP switch to validate the connection.

The BET RPIM Connector hangs at the rear of the battery pack.

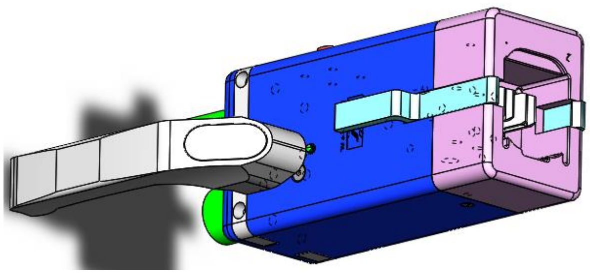


*Figure 3-32. BET RPIM Connector.*

### 3.4.3.9.5 BET DCFC Connector

The BET Direct Current Fast Charge (DCFC) electrical connector is used to connect to the DCFC product header in the battery pack during the Pack Electrical Test on the BET product. This connector contains two manufactured contacts and a PIP switch to validate the connection.

The BET DCFC Connector hangs at the rear of the battery pack.

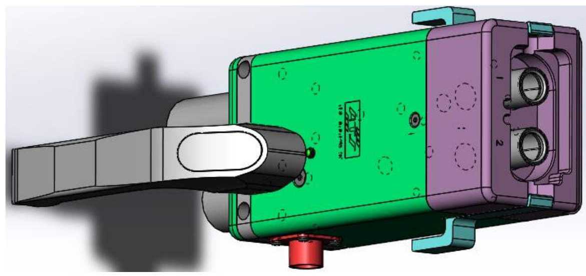


***Figure 3-33. BET DCFC Connector.***

### 3.4.3.9.6 BET IPE / BEV3 RDU Connector

The BET IPE/BEV3 RDU electrical connector is used to connect to the front power input product header in the battery pack during the Pack Electrical Test on the BET product and the RDU header connection on the BEV3 product. This connector contains two manufactured contacts and a PIP switch to validate the connection.

The BET IPE / BEV3 RDU Connector hangs at the rear of the battery pack.

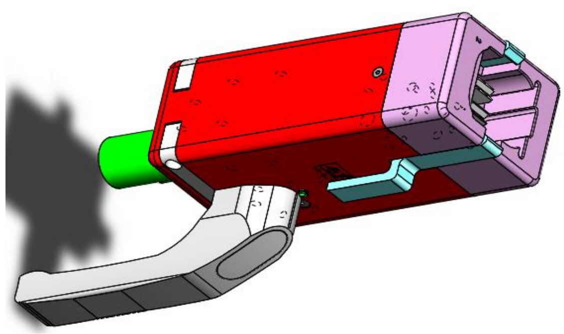


***Figure 3-34. BET IPE / BEV3 RDU Connector***

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### 3.4.4 Cover Leak Test Station EP680 Equipment Descriptions

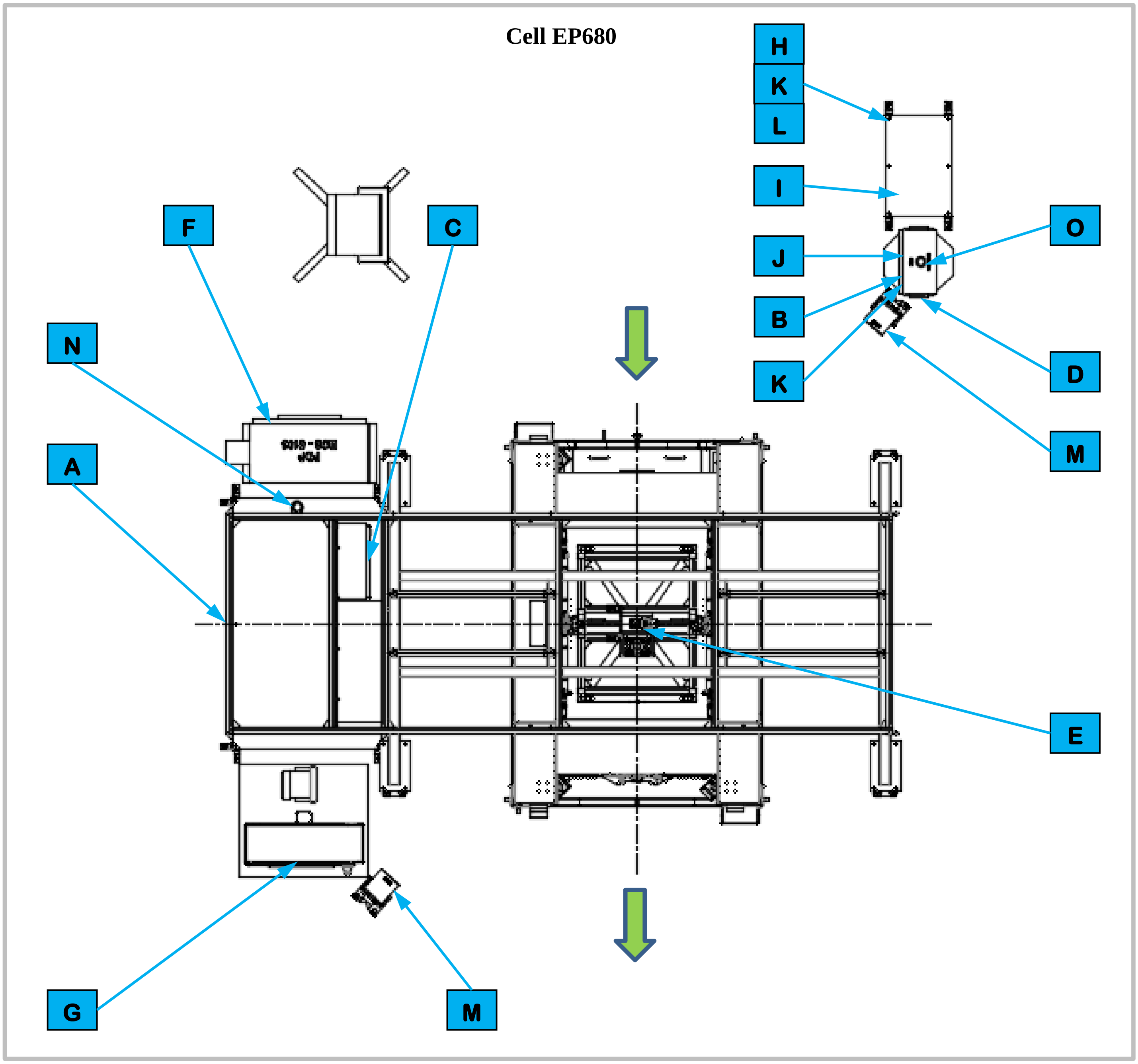



*Figure 3-35. Cover Seal Leak Test Station EP680 Top View*

| Equipment Callouts in Station EP680 | | | |
|---|---|---|---|
| A | Air Preparation Unit | I | Label Printer |
| B | Barcode Reader | J | Operator Console HMI |
| C | Bauer Leak Test Data Collection PC | K | Operator E-Stop<br>One (1) on HMI and one (1) next to Cycle Start Button |
| D | Bypass/Release Toggle Switch | L | Operator Push Button Box |
| E | Cell Gravity Pin | M | Sick Floor Scanner (2) |
| F | Cell Power Distribution Panel | N | Stack Light |
| G | Cincinnati Test Systems Leak Test Instrumentation | O | Status Beacon |
| H | Cycle Start Button | | |

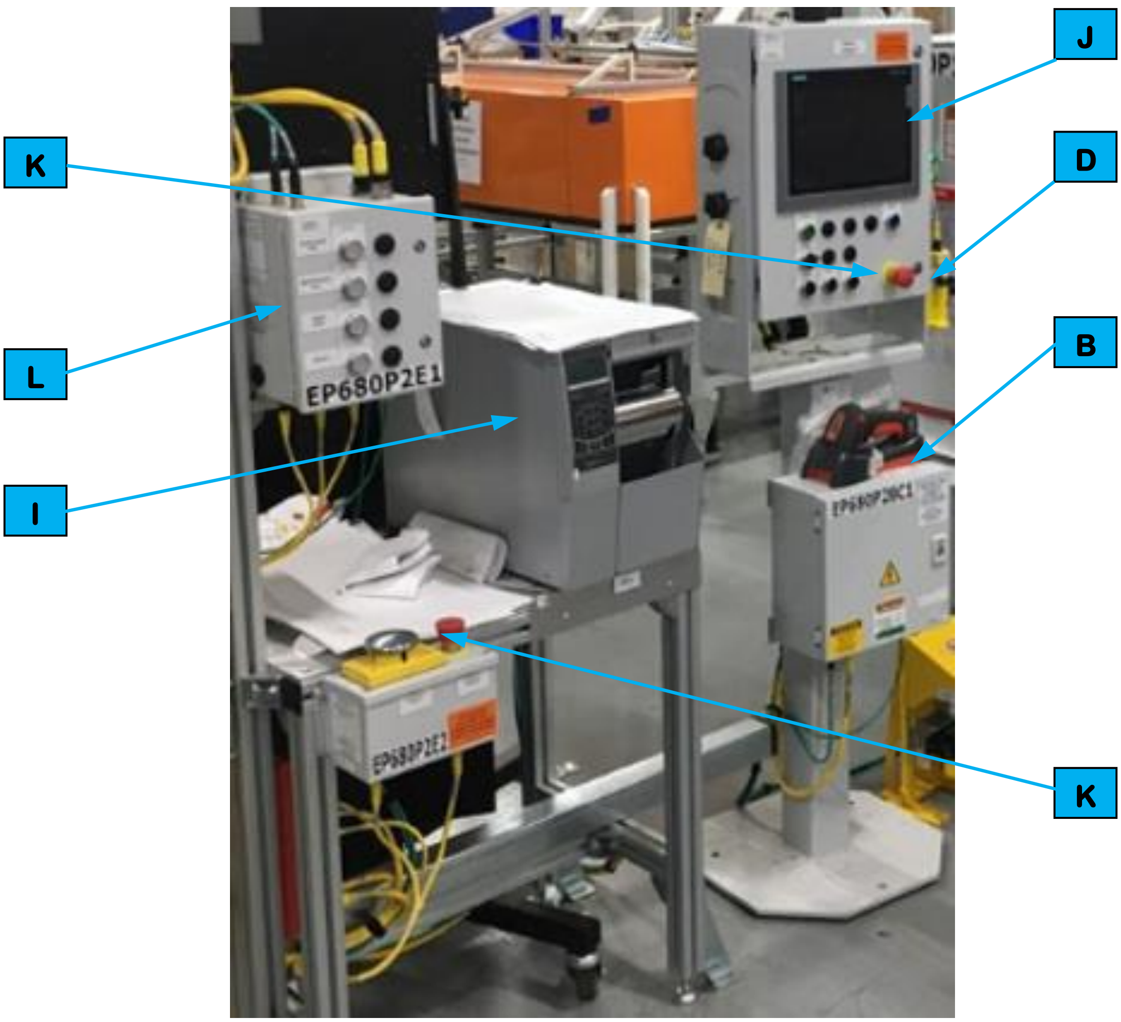



*Figure 3-36. Cover Seal Leak Test Station EP680*

### 3.4.4.1 Station Description

Cell EP680 is a semi-automatic test station for performing a Cover Seal Leak Test on BET and BEV3 battery assemblies. An AGC enters this station where an Operator performs a manual dress of header plugs and vacuum connectors to prepare the battery assembly for the Cover Seal Leak Test.

### 3.4.4.2 Sequence of Operation

The Cover Seal Leak Test equipment completes the following operations during a normal cycle:

| Sequence of Operation | |
|---|---|
| **Sequence** | **Description** |
| 1 | SCAN TEST AREA CLEAR, CART ENTERS STATION |
| 2 | **OPERATOR ENTERS STATION** |
| 3 | OPERATOR ENGAGES DUMMY PLUG "B" |
| 4 | OPERATOR ENGAGES DUMMY PLUG "C" |
| 5 | OPERATOR ENGAGES DUMMY PLUG "D" |
| 6 | OPERATOR ENGAGES DUMMY PLUG "A" |
| 7 | OPERATOR CONNECTS (2) FRONT SEAL ASSY BET ONLY |
| 8 | OPERATOR CONNECTS REAR SEAL ASSY ~ BEV ONLY |
| 9 | **OPERATOR EXITS STATION** |
| 10 | OPERATOR PRESSES START TEST BUTTON |
| 11 | ADV.VERTICAL CYL. 1 TO HALFWAY POSITION |
| 12 | DISENGAGE HOOD LOCATOR |
| 13 | ADV. VERTICAL CYL. 2 TO FULL POSITION |
| 14 | LEAKTEST PER SPECIFICATION |
| 15 | RET. VERTICAL CYL. 2 TO FULL RAISED POSITION |
| 16 | RET. VERTICAL CYL. 1 TO FULL RAISED POSITION |
| 17 | ENGAGE HOOD LOCATOR |
| 18 | **OPERATOR ENTERS STATION** |
| 19 | OPERATOR DISCONNECTS FRONT SEAL ASSY, LEAK TEST CONNECTOR IN NEST ~ BET ONLY |
| 20 | OPERATOR DISENGAGES DUMMY PLUG "A" |
| 21 | OPERATOR DISENGAGES DUMMY PLUG "B" |
| 22 | OPERATOR DISENGAGES DUMMY PLUG "C" |
| 23 | OPERATOR DISENGAGES DUMMY PLUG "D" |
| 24 | **OPERATOR DISCONNECTS REAR SEAL ASSY, LEAK TEST CONNECTOR IN NEST ~ BET ONLY** |
| 25 | **OPERATOR EXITS STATION** |
| 26 | OPERATOR RELEASES CART |
| 27 | SENSE LOCK OUT PIN IN NEST |
| 28 | HOOD FALL RATCHET CYLINDER IN OPEN POSITION |
| 29 | **CART EXITS STATION** |

### 3.4.4.3 EP680 Bauer Leak Test Data Collection PC

The Bauer Leak Test Data Collection PC archives test data only (GM standard data acquisition system) from the test performed by the Cincinnati Test Systems (CTS) equipment.


*Figure 3-37. Bauer Leak Test Data Collection PC*

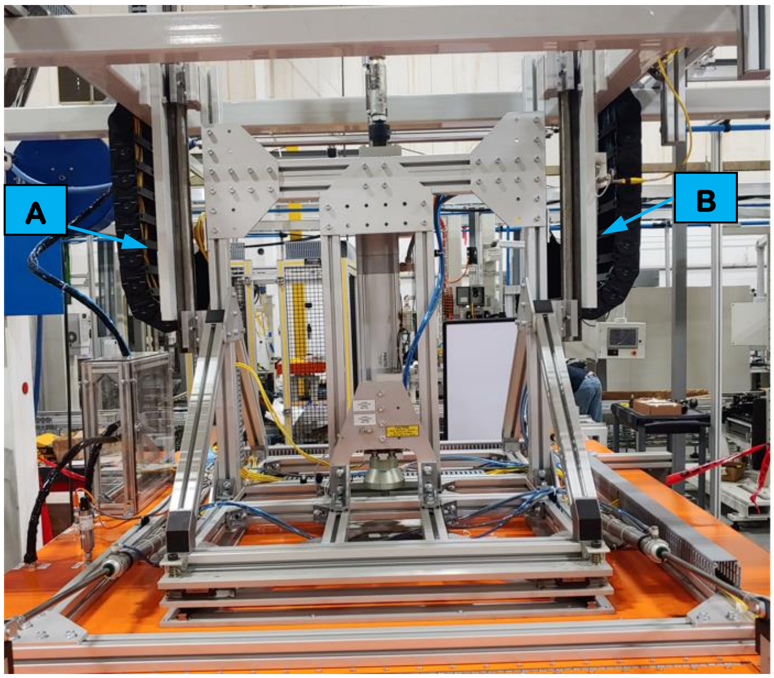
### 3.4.4.4 Cell Gravity Pin

The Cell Gravity Pin (G-1, service detent pin with lanyard) is used when the hood assembly needs to be serviced.

The hood assembly's vertical slide assembly must be in the home position to be serviced. When in the home position, two cross drilled holes are aligned. One hole is in **DETAIL A**, one hole is in **DETAIL B**.

The service pin is manually inserted through the aligned holes, where the detent keeps the pin from coming out of the holes, and the pin prevents the hood assembly from free falling.

The service pin resides in a nest when not in use.  There is a proximity switch to detect when the pin is in the nest.  The station cannot be put into automatic mode, nor can there be vertical motion if the pin is not in its nest.




| Gravity Pin Callouts | |
|---|---|
| **A** | DETAIL A |
| **B** | DETAIL B |

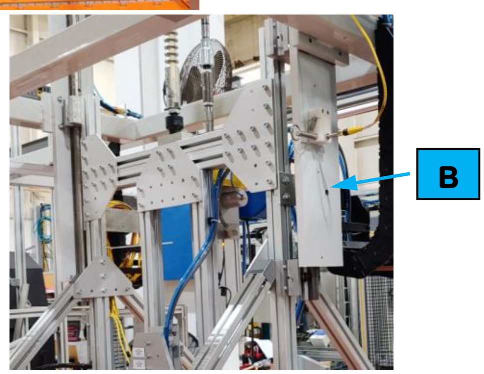




***Figure 3-38. Cell Gravity Pin.***

#### 3.4.4.5 Cincinnati Test Systems Leak Test Instrumentation

The Cincinnati Test Systems (CTS) leak test equipment performs the cover leak test.

The Station PLC tells the CTS equipment to run the cover leak test. The CTS leak test system performs a vacuum decay leak test on the internal cavity of the battery pack and determines if it is leaking. At the end of the leak test, the CTS system sends test files to the Bauer Leak Test Data Collection PC to be archived.

The CTS leak test equipment contains 1-calibration orifice that is used to setup the leak test system and periodically verify the system is working properly.

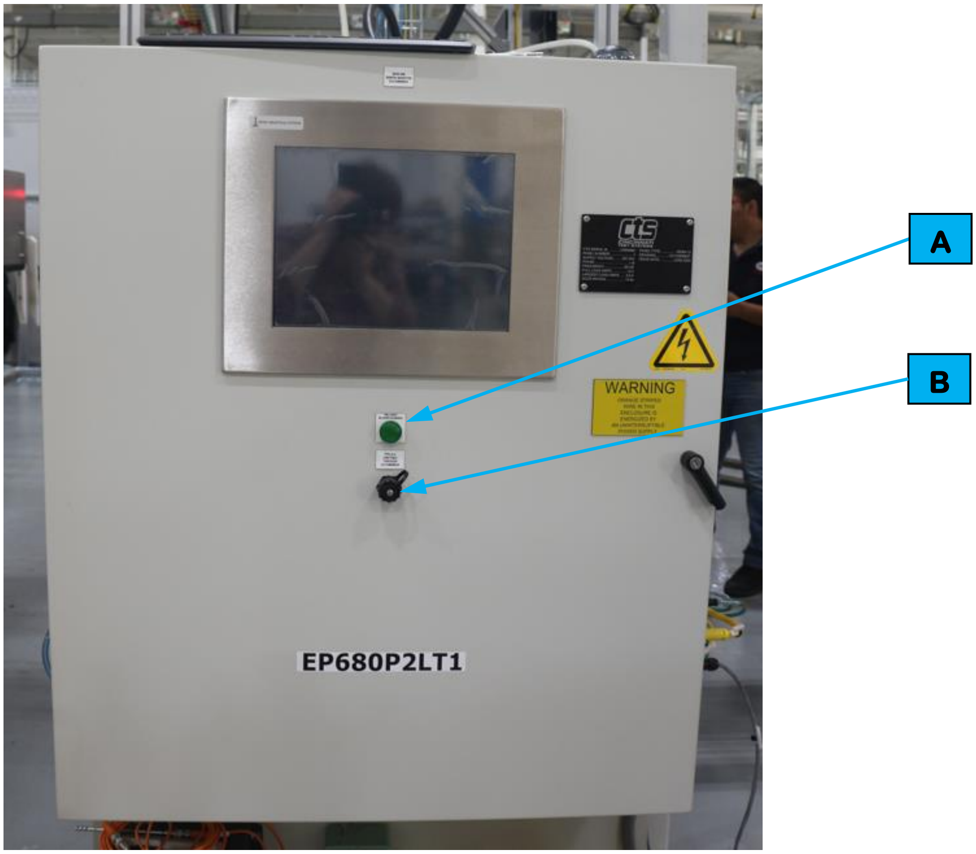



*Figure 3-39. Cincinnati Test Systems Leak Test Instrumentation*

| Device Callouts | |
|---|---|
| A | BLOWER RUNNING button |
| B | USB FEED THROUGH port |

### 3.4.4.6 BET Heater & ACEC Header Plug

The BET Heater and BET ACEC Header Plugs hang at the rear of the battery pack.

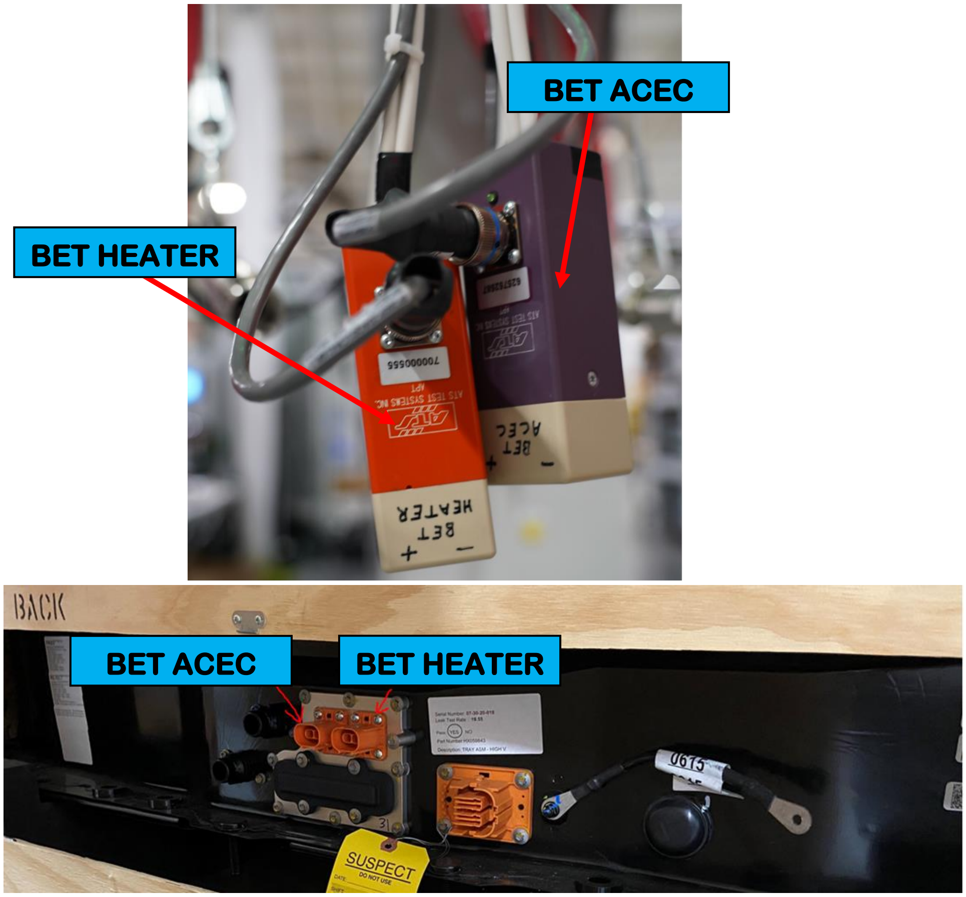



*Figure 3-40. BET Heater & ACEC Header Plugs & Connections.*

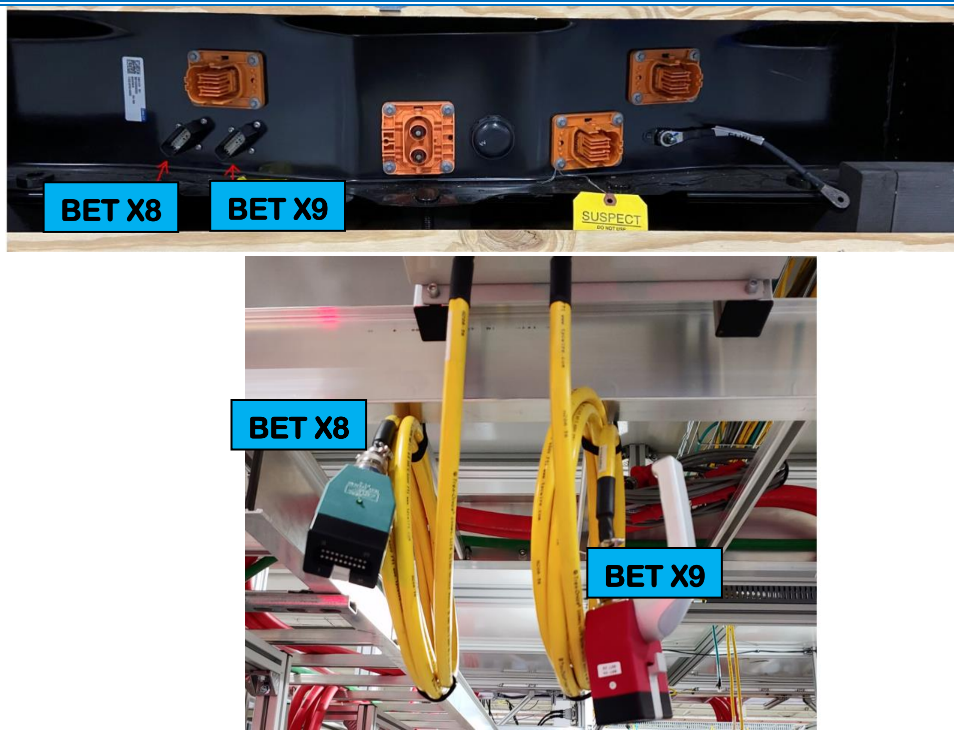



*Figure 3-41. BET LV X8 & X9 Header Plugs & Connections*

### 3.4.4.7 BET / BEV LV Header Plug

The BEV3 X1 LV Header Plug hangs at the front of the battery pack.

The BET X8 LV and BET X9 LV Header Plugs hang from the rear of the battery pack.

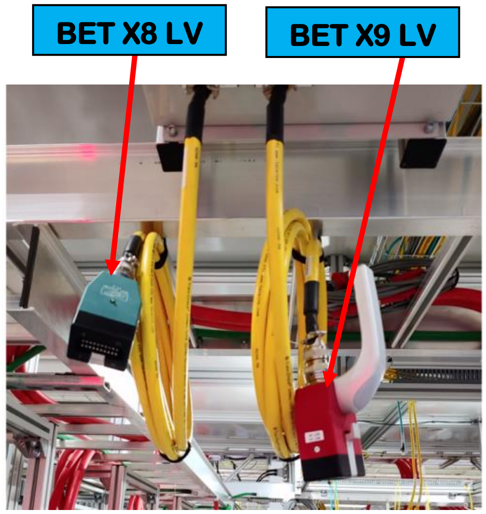




***Figure 3-422. BET / BEV LV Header Plug***

### 3.4.4.8 BET / BEV DCFC Header Plug

The BEV3 DCFC Header Plug hangs from the front of the battery pack.

The BET DCFC Header Plug hangs from the rear of the battery pack.


*Figure 3-433. BET / BEV DCFC Header Plug*

### 3.4.4.9 BET / BEV HV Header Plug

The BET FPIM and BEV3 IPE Header Plugs hang at the front of the battery pack.

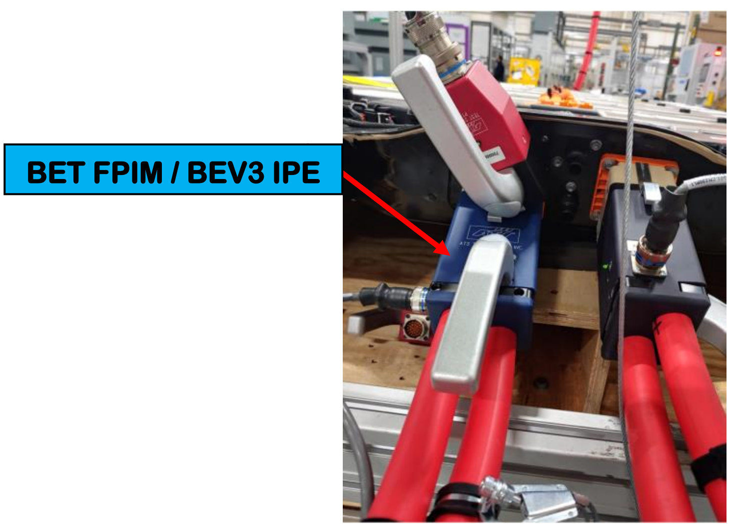



*Figure 3-444. BET FPIM / BEV3 IPE Header PLUG*

The BET RPIM, BET LPIM, BET IPE, and BEV3 RDU Heater Plugs hang at the rear of the battery pack.

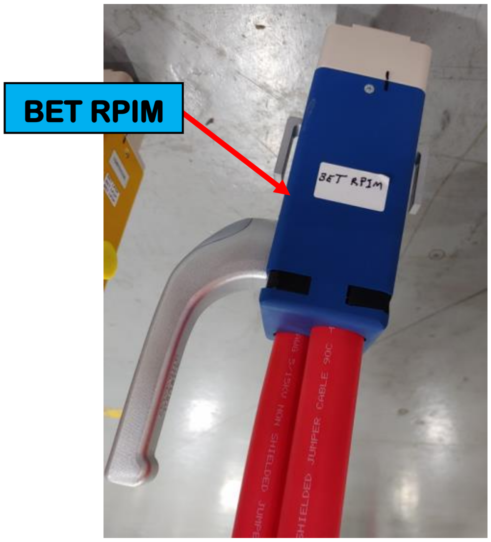



***Figure 3-455. BET RPIM Heater PLUG***

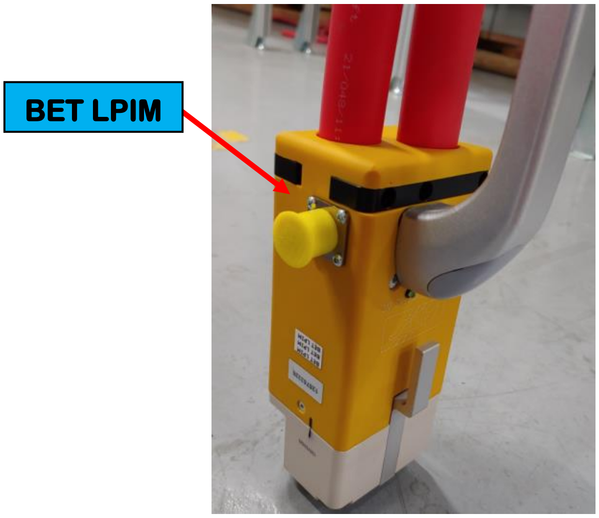



***Figure 3-466. BET LPIM Heater PLUG***

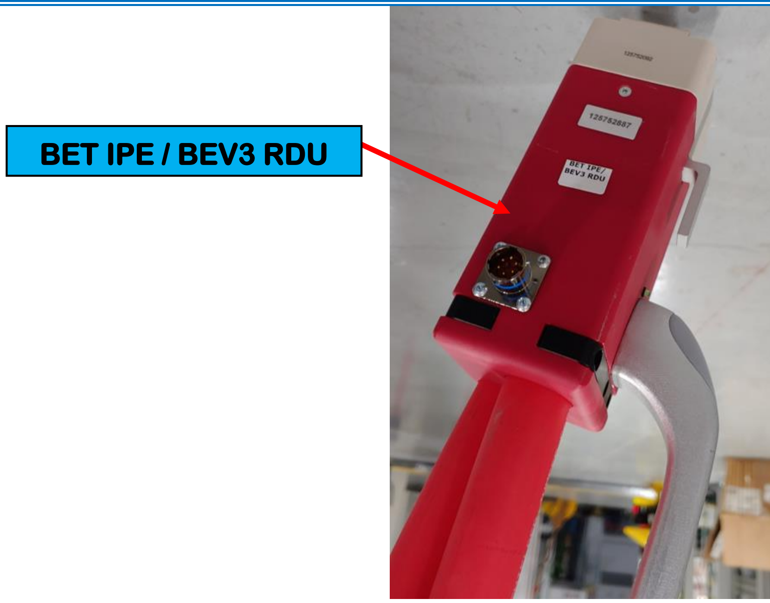



***Figure 3-477. BET IPE / BEV3 RDU Heater PLUG***

#### 3.4.4.10 Hood Assembly

The Hood Assembly isolates the battery pack and test area from environmental changes.

***Figure 3-488. Hood Assembly***

### 3.4.4.11 BET Vacuum Connector

The BET Vacuum Connector attaches at the front and rear of the battery pack.

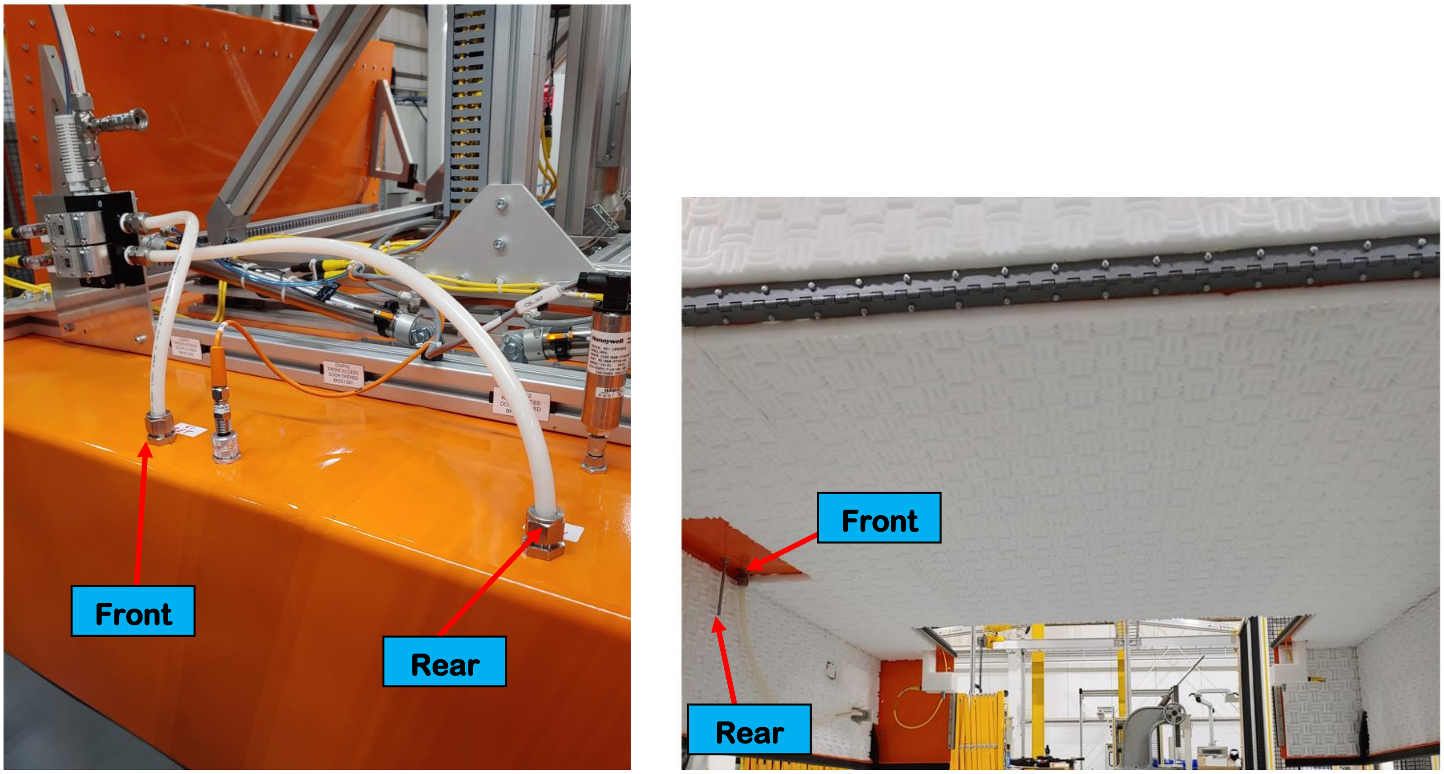



*Figure 3-49. BET Vacuum Connector*

### 3.4.4.12 BEV3 Vacuum Connector

The BEV3 Vacuum generator is attached behind the CTS panel that goes to the front and rear of the Hood assembly vacuum hoses.


***Figure 3-50. BEV3 Vacuum Connector***

### 3.4.1.3. Unico Drive Removal Cart

The Unico Drive Removal Cart is a manually pushed cart to service the Unico drive.

*Figure 3-51. Unico Drive Removal Cart*

### 3.4.1.4. Cover Leak Solenoid Valve

Pneumatic solenoid valves that control the ports for the CTS.

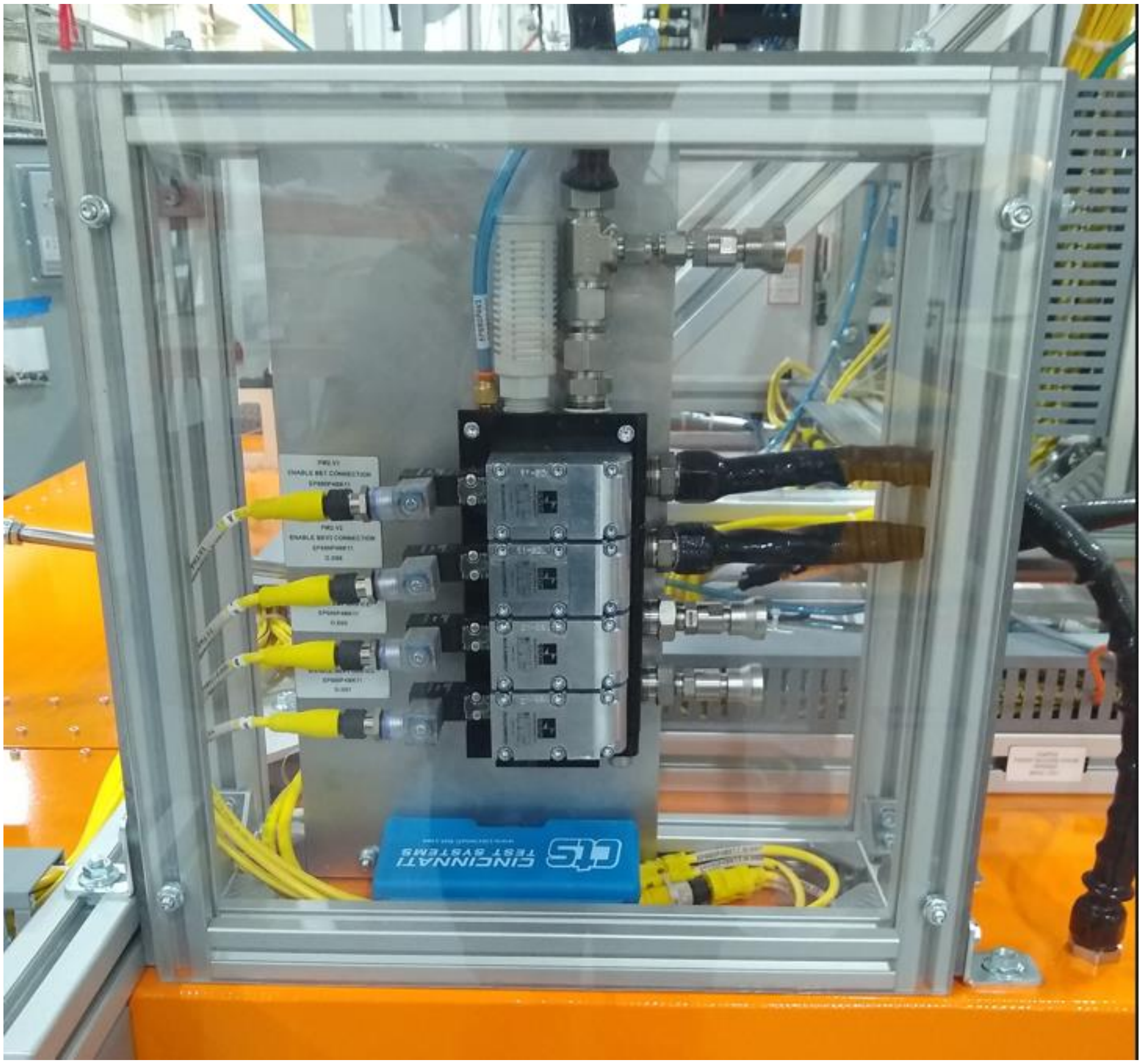



*Figure 3-52. Cover Leak Solenoid Valve*

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# 4. SYSTEM OPERATION

## Table of Contents

## Table of Figures

# 4.1. OPERATOR INTERFACE DEVICES

## 4.1.1. Summary

The following table identifies the common interface devices that are located at each cell.

## 4.1.2. Interface Device Table – Manual Stations

| Item | 280 | 580 | 680 |
|---|---|---|---|
| Barcode Reader | 1 | 1 | 1 |
| Bauer Test Computer | 1 | 1 | N/A |
| Bauer Leak Test Data Collection PC | N/A | N/A | 1 |
| Bypass/Release Toggle Switch | 1 | 1 | 1 |
| Cincinnati Test Systems Leak Test Instrumentation | N/A | N/A | 1 |
| Cycle Start Button | 1 | 1 | 1 |
| Label Printer | 1 | 1 | 1 |
| Operator Console HMI | 1 | 1 | 1 |
| Operator E-Stop | 2 | 2 | 2 |
| Operator Push Button Box | 1 | 1 | 1 |
| Power Distribution Panel | 1 | 1 | 1 |
| Stack Light | 1 | 1 | 1 |
| Status Beacon | 1 | 1 | 1 |

## 4.1.3. Common Interface Devices

### 4.1.3.1. Barcode Reader

*Figure 4-1. Barcode Reader*

Each manual and semi-automatic station is equipped with a handheld Honeywell Granit 1911i Industrial Scanner barcode reader. Barcode scanners are used to scan Battery Identification Numbers (BIN) part labels during operations and all scans are tracked by the HMI system. The Barcode Reader consists of a handheld scanner and a base mount charging holder. The scanner is operated by pulling on the scanner trigger.

| **REFERENCE** | ***For more information about the barcode reader, refer to the equipment supplier documentation (Xenon/Granit Area-Imaging Scanners User Guide).*** |
|---|---|

#### 4.1.3.2. Bypass/Release Toggle Switch

The Bypass/Release toggle switch is used to allow the Automated Guided Cart (AGC) to go through the cell without testing or not come into the station at all (Bypass) or to release the AGC from the cell (Release).

This is not used when in Auto Mode.

This is used when in Manual Mode for such reasons as troubleshooting, set-up, product issues, etc.


***Figure 4-2. Bypass/Release Toggle Switch***

### 4.1.3.3. Cycle Start Button


| Device Callouts | |
|---|---|
| A | Cycle Start button |
| B | E-Stop button |

*Figure 4-3. Cycle Start Button.*

| WARNING! | ***Press an*** EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.*** |
|---|---|

Each manual cell has a Cycle Start Button that when pressed by the Operator will release the Automated Guided Cart.

Each manual cell has an Emergency Stop (E-Stop) Button that when used will removed all power from a cell and bring all tooling and other devices to a stop. The Emergency Stop button requires the button to be pulled back out after it has been pressed in. After pressing an Emergency Stop button, follow the recovery procedure outlined in ***4.3.2 Starting Cell***.

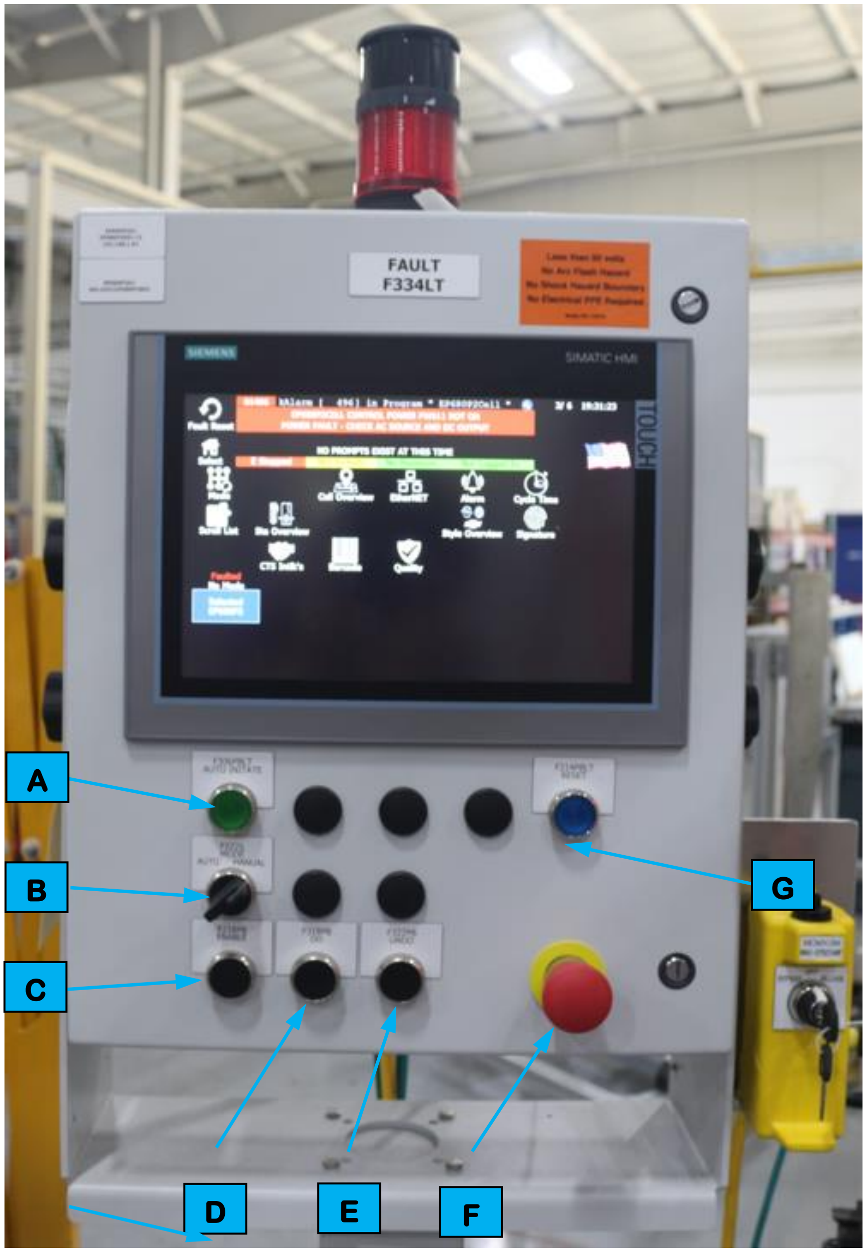
### 4.1.3.4. Label Printer

The label printed identifies that the cover leak test was performed on the battery pack.

| REFERENCE | ***For more information about the Label Printer, refer to the equipment supplier documentation (Zebra ZT510-User Manual.pdf).*** |
|---|---|


*Figure 4-4. Label Printer and a Label*

## 4.1.3.5. Operator Console Human Machine Interface (HMI)




| Device Callouts | |
|---|---|
| **A** | AUTO INITIATE button |
| **B** | AUTO / MANUAL toggle switch |
| **C** | ENABLE button |
| **D** | DO button |
| **E** | UNDO button |
| **F** | E-Stop button |
| **G** | RESET button |

***Figure 4-5. Human Machine Interface (HMI).***

The Human Machine Interface (HMI) is a free-standing device which permits the Operator to interact with the machine, device, or system. Common uses are for displaying data, tracking production time, overseeing Key Performance Indicators (KPI), and monitoring machine inputs and outputs.

### 4.1.3.6. Operator E-Stop

| **WARNING!** | ***Press an*** EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.*** |
|---|---|

Each cell has one or more Emergency Stop (E-Stop) Button(s) that when used will remove all power from a cell and bring all tooling and other devices to a full stop. Emergency stop buttons are located on HMI panels and on the Cycle Start Button box in each cell. The Emergency Stop button requires the button to be pulled back out after it has been pressed in. After pressing an Emergency Stop button, follow the recovery procedure outlined in Chapter 4.

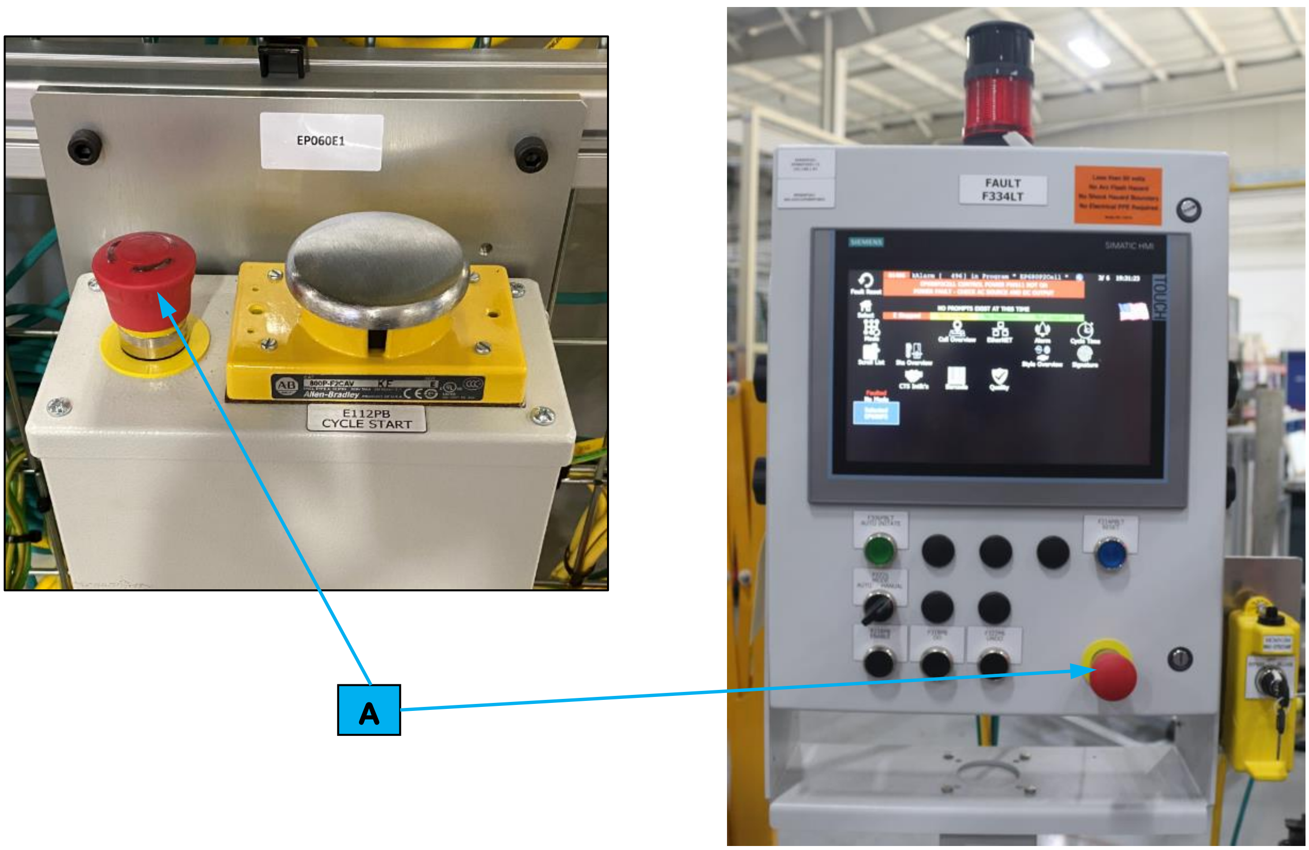
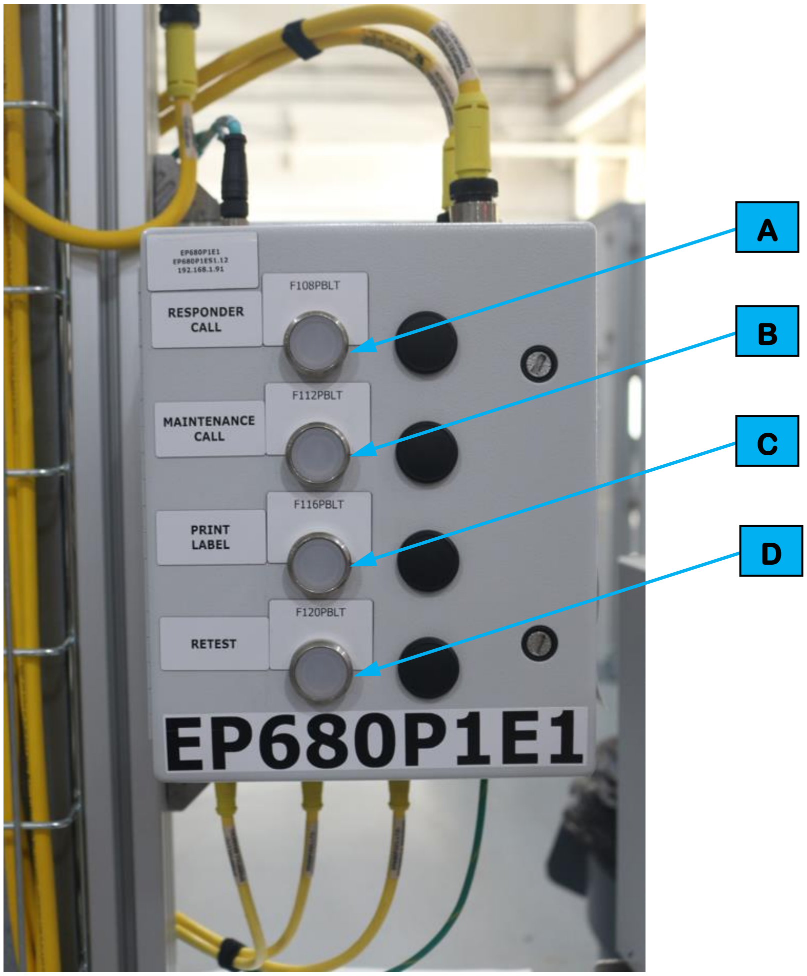



***Figure 4-6. E-Stop Button.***

| Device Callouts | |
|---|---|
| **A** | E-Stop button |

### 4.1.3.7. Operator Push Button Box

Operators can use buttons of the Operator Push Button Box to call for maintenance personnel, print a label, and other functions.




| Device Callouts | |
|---|---|
| **A** | RESPONDER CALL button |
| **B** | MAINTENANCE CALL button |
| **C** | PRINT LABEL button |
| **D** | RETEST button |

***Figure 4-7. Operator Push Button Box.***

**RESPONDER CALL BUTTON**

The RESPONDER CALL button is used to call a Team Lead.

**MAINTENANCE CALL Button**

The MAINTENANCE CALL button is used to call Maintenance Personnel.

**PRINT LABEL Button**

The PRINT LABEL button is used to reprint a label if the original printed label is damaged.

**RETEST Button**

The RETEST button is NOT USED.

### 4.1.3.8. Cell Power Distribution Panel

Each cell has a single Power Distribution Panel (PDP) that is used to distribute control power to the related equipment and to communicate with the cell processor. The PDP features indicators that illuminate to identify when control power is on. A fused disconnect (Lockout Point E-1) is located on the outside of the PDP and is used to enable or disable control power for the cell. Inside the PDP is an additional disconnect (Lockout Point E-2) that provides auxiliary power control. Refer to the GM standards and to the ATS electrical drawings for more information about the PDP equipment and functionality. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

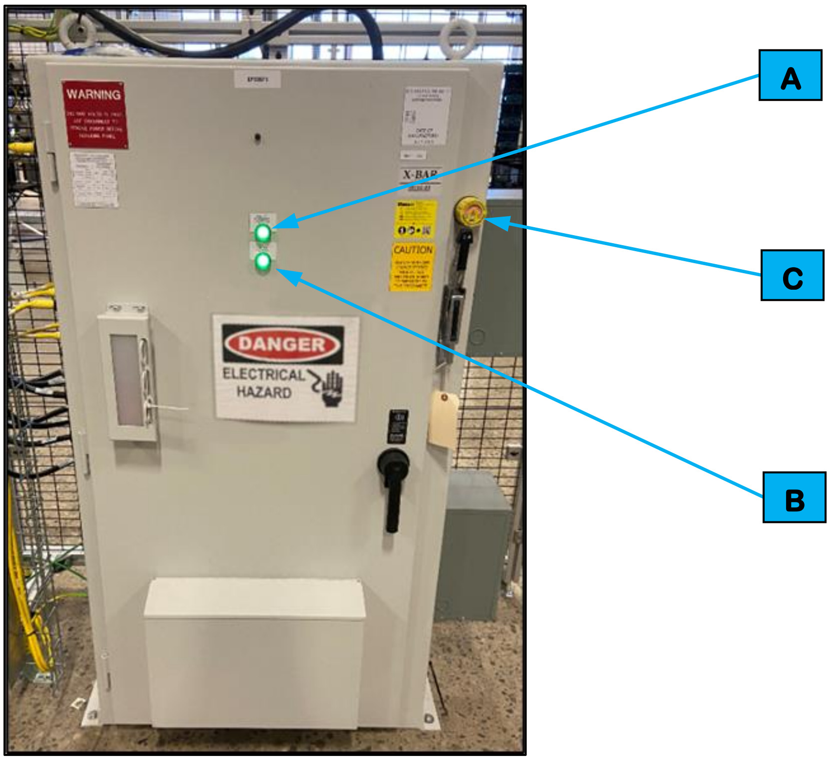



***Figure 4-8. Power Distribution Panel.***

| Device Callouts | |
|---|---|
| **A** | PROCESSOR POWER ON button |
| **B** | CONTROL POWER ON button |
| **C** | 3-Phase Indicator |

#### 4.1.3.9. Stack Light

On the station framing is a stack light with five colored indicator lights and a horn, where the sound/tone is a beep. The lights and horn are used to indicate the status of the cell and the MPS system. When activated, each indicator identifies the following condition:

- Horn (multiple beeps) - notification alert
- Horn (one beep) – scan passed
- Blue Indicator (Flashing) – operator load prompt
- Blue Indicator (Fast Flashing) – N/A
- Blue Indicator (Solid) – in cycle
- White Indicator (Flashing) – Flexnet gate check query in progress
- White Indicator (Fast Flashing) – Flexnet gate check failed
- White Indicator (Solid) – Flexnet gate check passed
- Red Indicator (Flashing) – N/A
- Red Indicator (Fast Flashing) – Maintenance call
- Red Indicator (Solid) – station faulted
- Yellow Indicator (Flashing) – over cycle
- Yellow Indicator (Fast Flashing) – Responder call
- Yellow Indicator (Solid) – approaching end of cycle
- Green Indicator (Flashing) – ready for cycle
- Green Indicator (Fast Flashing) – N/A
- Green Indicator (Solid) – process complete


***Figure 4-9. Stack Light Indicator.***

#### 4.1.3.10. Status Beacon

The status beacon sits on top of the Operator Console HMI box with one colored indicator light. The light is used to indicate an alarm. When activated, the indicator identifies the following condition:

- Red Indicator (Flashing) – Maintenance (high priority fault) alarm present
- Red Indicator (Solid) – Non-maintenance (low priority fault) alarm present


***Figure 4-10. Status Beacon.***

## 4.1.4. Electrical and Coolant Leak Test Station EP280 and EP580 Interface Devices

### 4.1.4.1. Bauer Test Computer

The Bauer test computer communicates with the ATEQ F620 instrument to start the coolant leak test, communicates with the Motion Control Corporation Cell Load Cycler to control the charge and discharge of the battery for the electrical test, and is used for data acquisition (GM standard data acquisition system) of the coolant leak test and electrical test results.


*Figure 4-11. Bauer Test Computer*

| Device Callouts | |
|---|---|
| A | COMPUTER MONITOR |
| B | CONTROL SYSTEM OK button |
| C | POWER RECEPTICAL |
| D | USB PORT |
| E | Keyboard and Mouse |

## 4.1.5. Cover Leak Test Station EP680 Interface Devices

### 4.1.5.1. EP680 Bauer Leak Test Data Collection PC

The Bauer Leak Test Data Collection PC archives test data only (GM standard data acquisition system) from the leak test performed by the Cincinnati Test Systems (CTS) equipment.


*Figure 4-12. Bauer Leak Test Data Collection PC*

### 4.1.5.2. Cincinnati Test Systems Leak Test Instrumentation

The Cincinnati Test Systems (CTS) leak test equipment performs the cover leak test.

The Station PLC tells the CTS equipment to run the cover leak test. The CTS leak test system performs a vacuum decay leak test on the internal cavity of the battery pack and determines if it is leaking. At the end of the leak test, the CTS system sends test files to the Bauer Leak Test Data Collection PC to be archived.

The CTS leak test equipment contains 1-calibration orifice that is used to setup the leak test system and periodically verify the system is working properly.

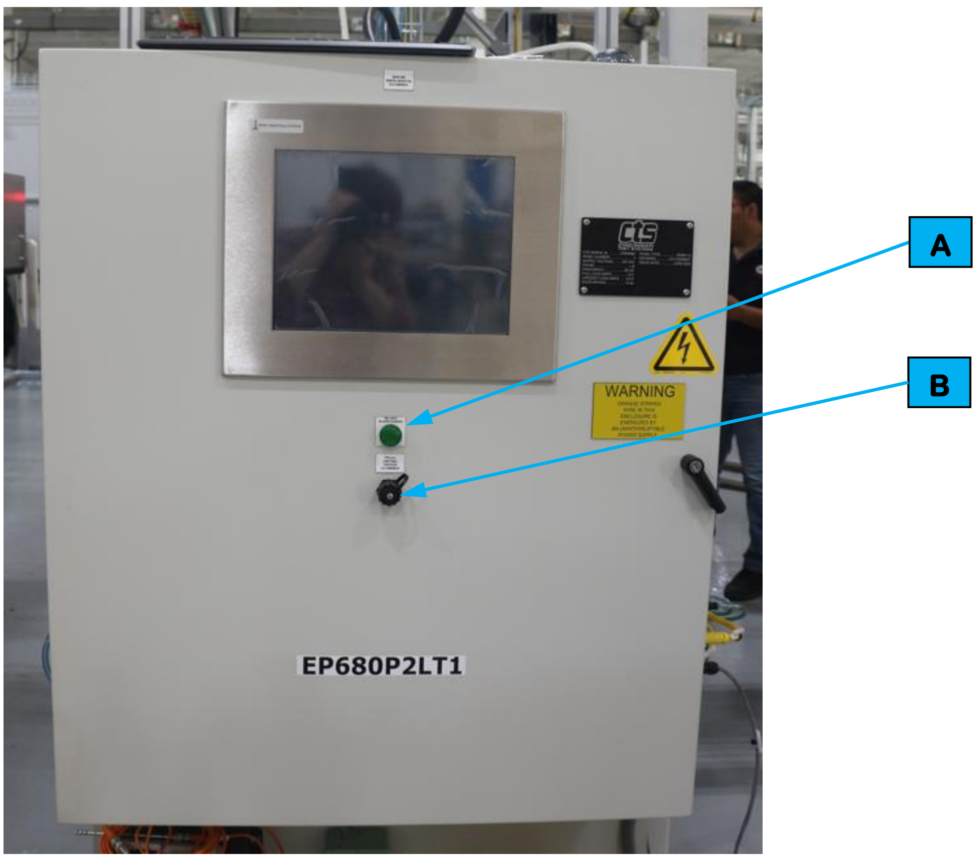



***Figure 4-13. Cincinnati Test Systems Leak Test Instrumentation***

| Device Callouts | |
|---|---|
| A | BLOWER RUNNING button |
| B | USB FEED THROUGH port |

## 4.2. HMI SCREENS

The following flow chart identifies the screen navigation paths.

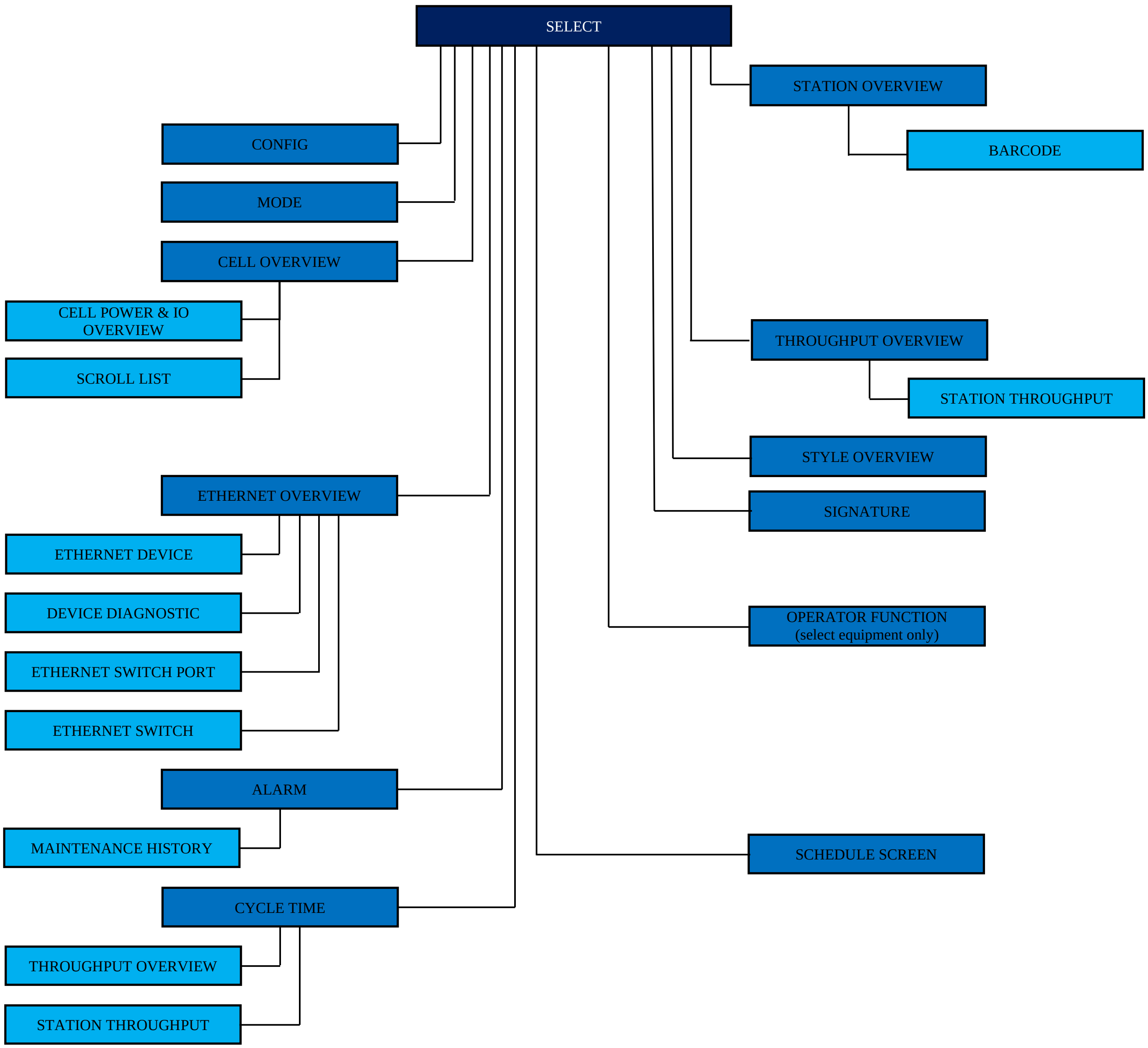



***Figure 4-14. Screen Navigation Paths.***

The following identifies the HMI screens that are used at each of the Cells.

### 4.2.1. Screen Header

Each screen that displays on the touch panel features a common header.

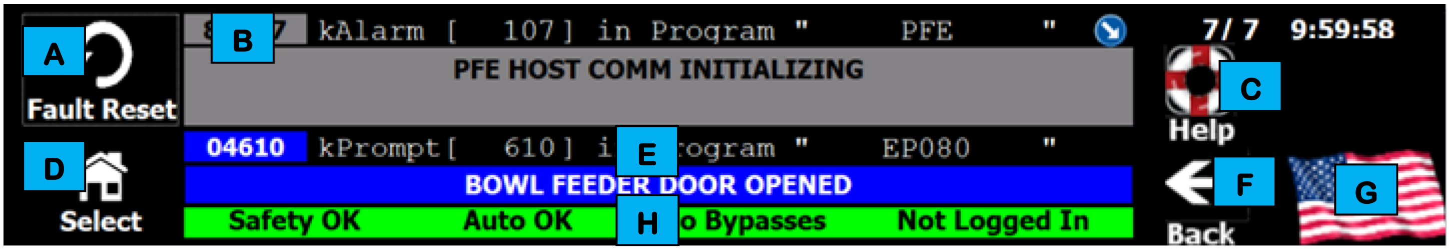



*Figure 4-15. Screen header.*

Each header features several areas of information and control, used as follows:

- **A** This touch-button clears the alarm message detailed on the screen.
- **B** This part of the header details the highest priority alarm. When an alarm displays, this area details the message number, message detail, program issuing the message, and the message itself. When no alarms are active, this area displays the screen name. Critical alarms that indicate the machine is stopped display in red.
- **C** This touch-button (when available) navigates to a Help screen that may provide further details regarding the alarm message. When no alarm is active, the area displays the date and time.
- **D** The function of this button varies and can be used for the following, depending upon what screen is displayed:
  - **Select Screen** – Navigates to the Select screen.
  - **Config Screen** – Navigates to the Config screen.
  - **Return** – Navigates back to the previously displayed screen.
- **E** This part of the header details operator prompts. When a prompt displays (in blue or yellow), this area details the message number, message detail, program issuing the message, and the message itself. When no prompts are active "`No Prompts Exist At This Time`" is displayed.
- **F** This touch screen button returns to the previous screen.
- **G** This touch-button toggles the language displayed on the touch panel.
- **H** This area of the header (bottom) displays various states, depending upon the selections on the screen below. States displayed in this area include: `Gates OK`, `Bypasses Present`, and `All Processes On`.

### 4.2.2. Select Screen

Touching the **SELECT** button on the top of any screen navigates directly to a screen that provides a menu of the screens available at the terminal.

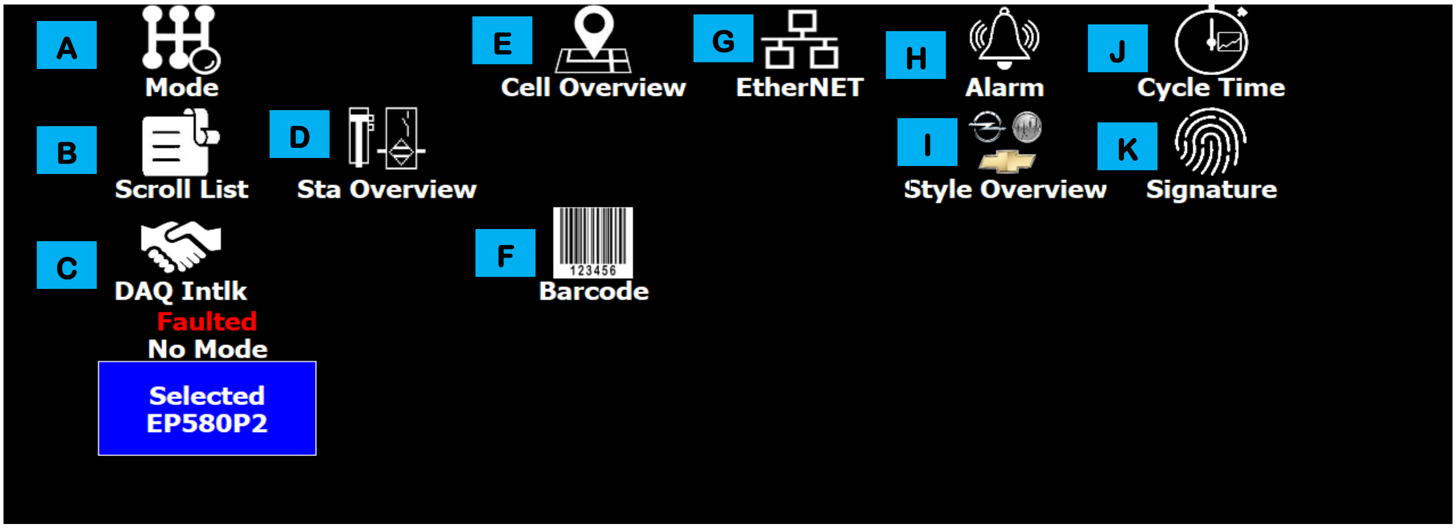



***Figure 4-16. Select screen.***

Each Select screen features several areas of information and control, used as follows:

**A** This touch-button opens the Mode Select screen.

**B** This touch-button opens the Scroll List screen.

**C** This touch-button opens the DAQ (Bauer PC) Interlock screen.

**D** This touch-button opens the Station Overview screen.

**E** This touch-button opens the Cell Overview screen.

**F** This touch-button opens the Barcode screen.

**G** This touch-button opens the EtherNet screen.

**H** This touch-button opens the Alarm screen.

**I** This touch-button opens the Style Overview screen.

**J** This touch-button opens the Cycle Time screen.

**K** This touch-button opens the Signature screen.

### 4.2.3. Mode Screen

Touching the **MODE** button on the Select screen navigates directly to a screen that can be used to toggle the system operating mode.

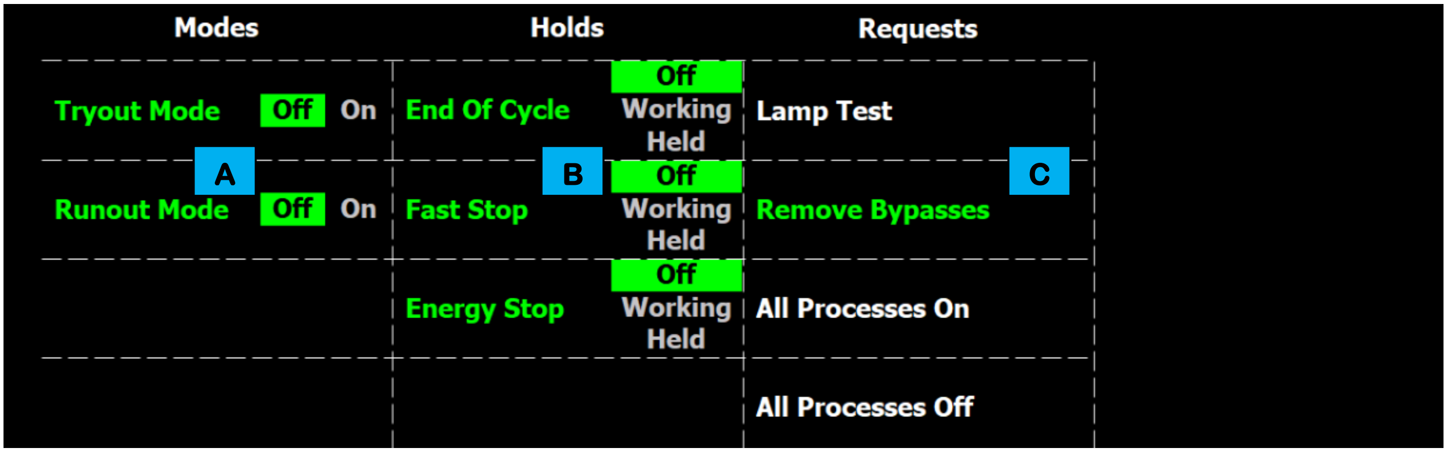



***Figure 4-17. Mode screen.***

Each Mode screen features several areas of information and control, used as follows:

**A** This column provides selection of the following modes:

- *Tryout Mode* – When active, the area devices actuate through their cycles without using parts. This mode simulates the area actions without performing any actual work on the parts. This function should only be necessary during setup and for troubleshooting.
- *Runout Mode* – When active, new pallets of parts are no longer presented to the area, allowing the pallets currently in the area to complete processing. Once the pallets currently in the area have completed processing, the area comes to a stop.

**B** This column provides selection of the following holds:

- *End of Cycle* – When activated, the area completes the current cycle and then comes to a controlled stop.
- *Fast Stop* – When activated, the area equipment terminates the current cycle and comes to a stop.
- *Energy Stop* – When activated, the system comes to a controlled stop for a low-energy shutdown, such as over a weekend.

**C** This column provides selection of the following actions:

- *Lamp Test* – When activated, the various physical indicator lights and audible devices associated with the system (stack lights, button indicators, etc.) are enabled. All devices remain enabled while the button is touched and return to their live states once the button is released. This function is useful for checking for dead light bulbs.
- *Remove Bypasses* – When activated, all bypasses available are removed from the equipment.
- *All Processes On* – When activated, all available processes are enabled.
- *All Processes Off* – When activated, all available processes are disabled.

### 4.2.4. Scroll List Screen

Touching the **SCROLL LIST** button on the Select screen navigates directly to a screen that identifies the current state of devices and provides the ability to manually actuate device functions within the selected station.

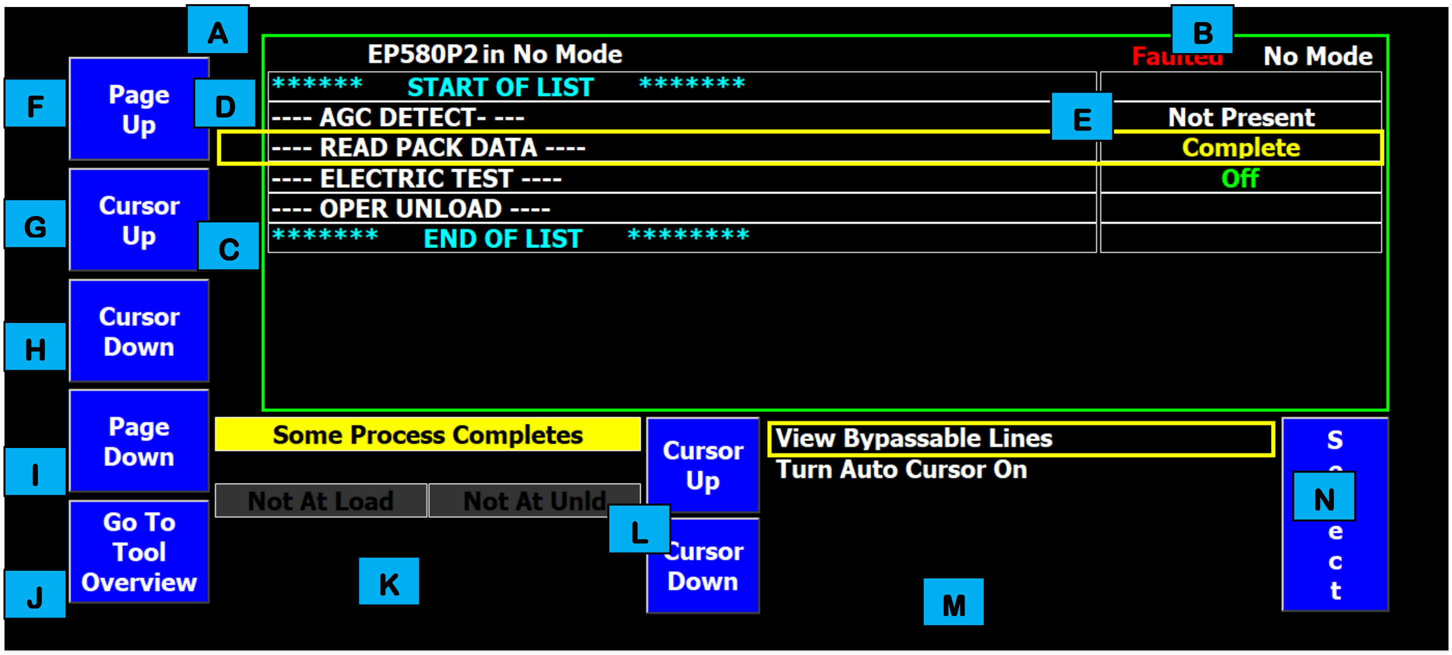



*Figure 4-18. Scroll List screen.*

Each Scroll List screen features several areas of information and control, used as follows.

- **A** This indicator identifies the selected station and if the scroll list is enabled (blue). When the scroll list is disabled, it will either prompt the operator (yellow) (area **D**) to re-enable the scroll list or display red, indicating another HMI has manual control of the station.
- **B** These indicators identify the current state and mode of the station.
  The program mode must be set to Manual for the screen to be operational.
  The switch on the HMI cabinet must also be set to Manual.
- **C** This row uses indicators to identify if a motion is clear (green) or is unavailable (black). Attempting to actuate a non-clear motion will display a prompt as to what tooling interference is restricting operation.
- **D** This row lists the sequential actions for the station, one page at a time. A yellow box denotes the selected action. Use the touch-buttons on the left side of the screen [items **F** through **I**] for list navigation.
- **E** This row identifies the current state of each action.
- **F** This touch-button scrolls the action list [area **D**] up one page.
- **G** This touch-button scrolls the action selector [top] upward one action.
- **H** This touch-button scrolls the action selector [top] down one action.
- **I** This touch-button scrolls the action list [area **D**] down one page.
- **J** This touch-button displays the selected station Tool Overview screen.
- **K** This area uses built-in and user-configurable indicators to identify the progress of the station cycle.
- **L** These touch-buttons scroll the Scroll List Function List (bottom) selector up or down, one option at a time.
- **M** This area lists the options for the selected action, one page at a time.
  A yellow box denotes the selected function. Use the **SELECT** button [item **N**] to interface with the option (interface in top list).
- **N** This touch-button chooses the selected function [item **M**].

## 4.2.5. DAQ Interlock Screen

Touching the **DAQ INTERLOCK SCREEN** button on the Select screen navigates directly to a screen that identifies inputs and outputs between PLC and DAQ (Data Acquisition) PC. Yellow text are outputs from PLC to DAQ PC, and blue text are Inputs from DAQ PC to PLC.

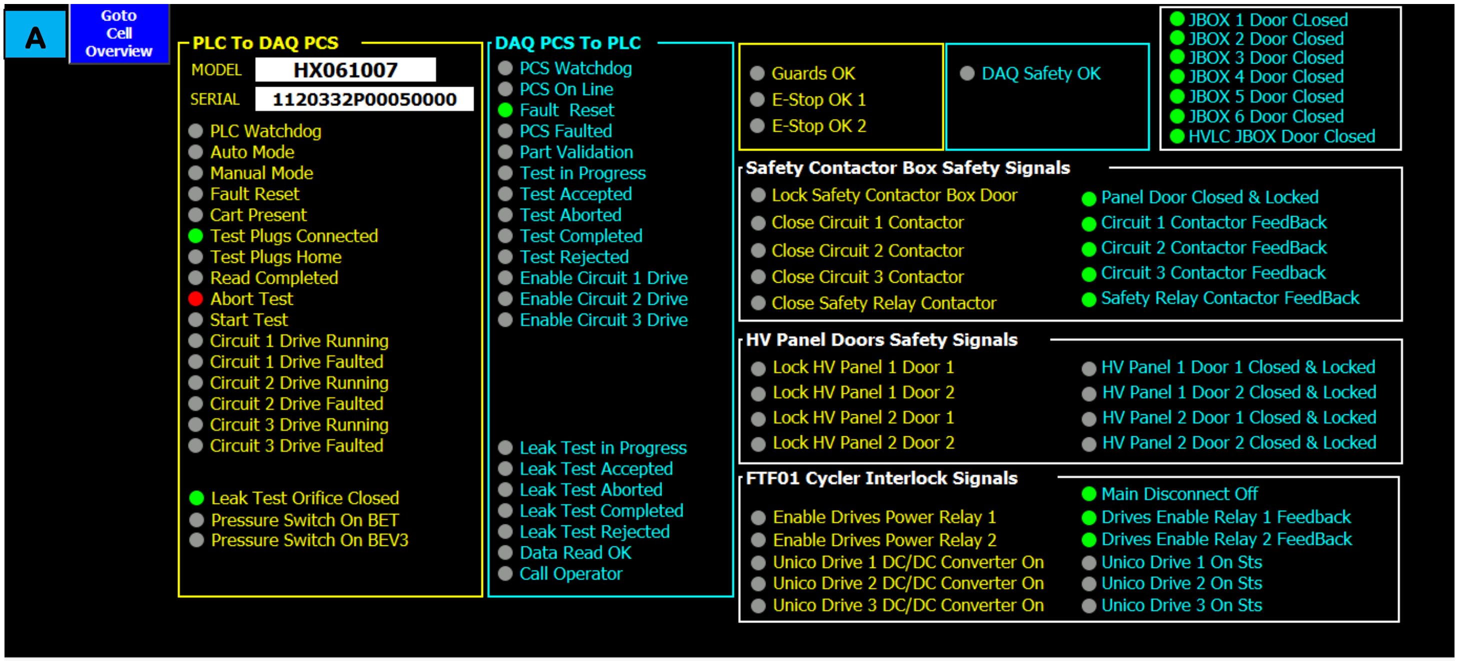



*Figure 4-19. Station Interlock screen.*

Each DAQ Interlock screen features several areas of information and control, used as follows.

**A** This touch-button displays the Cell Overview screen.

## 4.2.6. Station Overview Screen

Touching the **STA OVERVIEW** button on the Select screen navigates to a screen that displays station data.

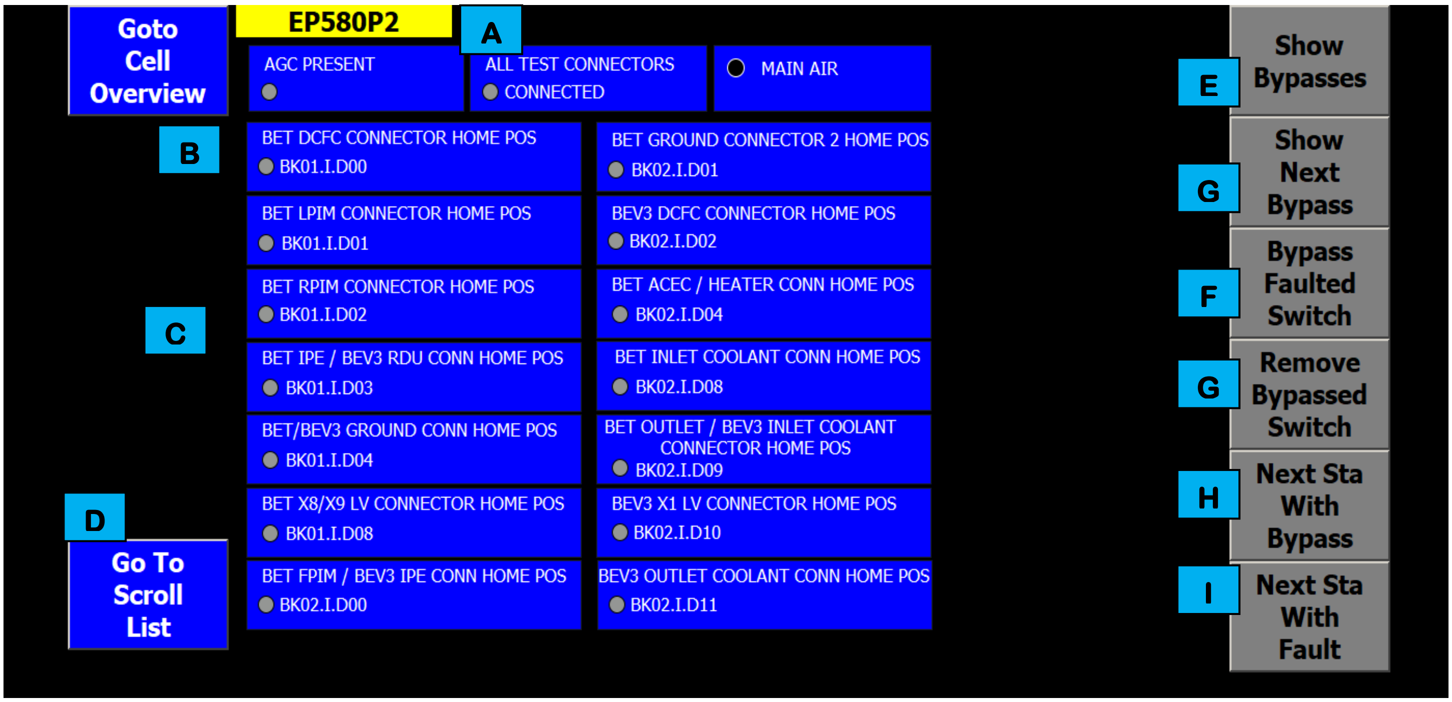



*Figure 4-20. Station Overview screen.*

Each Station Overview screen features several areas of information and control, used as follows.

- **A** This indicator identifies which station is being displayed.
- **B** These touch-buttons display the Cell Overview and Barcode Screens.
- **C** This area displays the status of the electrical connectors. Solid green when connector is home.
- **D** This touch-button displays the scroll list screen.
- **E** If more than one sensor is bypassed, this touch-button will cycle the screen display to show the next bypass.
- **F** If a faulted sensor has been configured in the PLC code as able to be bypassed, this touch-button will override the faulted device switch. The machine will default to the device fault timer for continued operation.
- **G** This touch-button removes an override from the displayed bypassed device switch.
- **H** This touch-button will select the next station with an active bypass. The Station Overview screen for the next station will replace the graphics shown for the currently selected Station Overview screen.
- **I** This touch-button selects the next station with an active alarm. The Station Overview screen for the next station will replace the graphics shown for the currently selected Station Overview screen.

## 4.2.7. Cell Overview Screen

Touching the **CELL OVERVIEW** button on the Select screen navigates directly to a screen that provides a graphical representation of the cell. It identifies the operational or faulted state of the cell level equipment and if stations within that cell have an active fault.

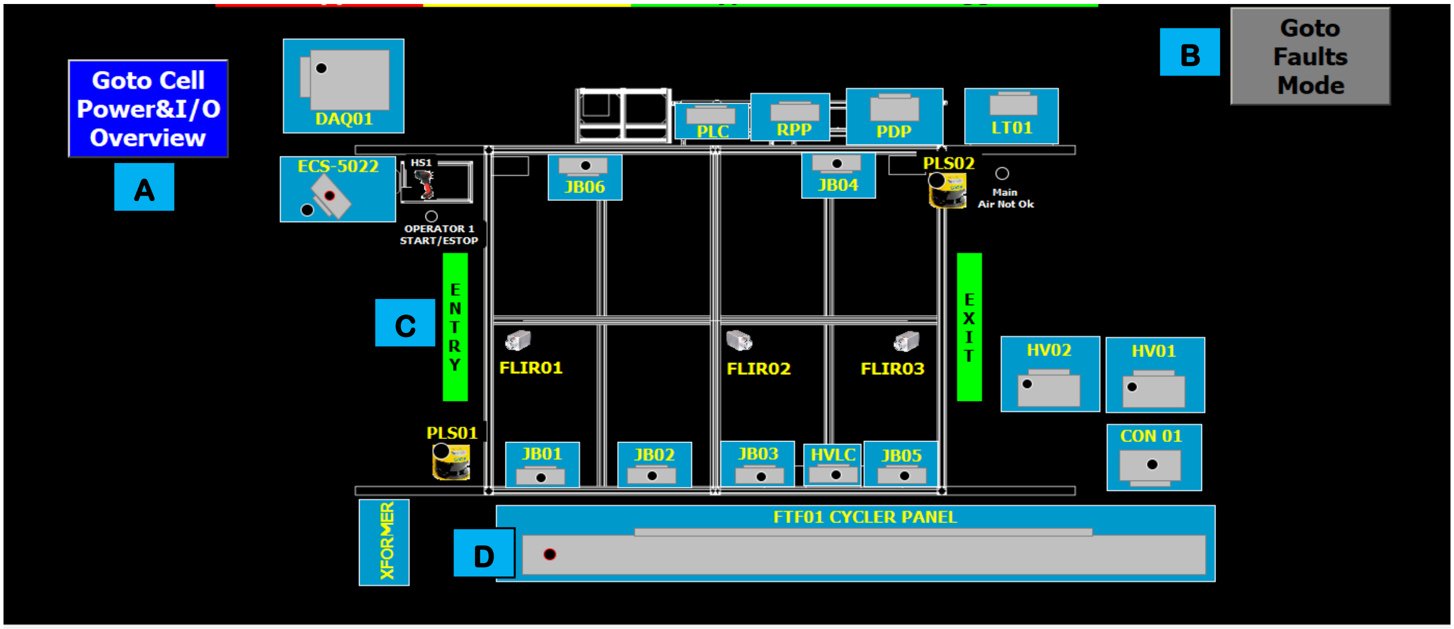



*Figure 4-21. Cell Overview screen.*

Each Cell Overview screen features several areas of information and control, used as follows.

**A** This touch-button displays the Cell Power & I/O Overview screen.

**B** This indicator identifies the state of the cell control program. Green denotes the equipment is operational. Red denotes an active fault.
The indicator also serves as a button with multiple actions, depending on the screen set up. When `Goto Faults Mode` is active (blue button, touching the indicator displays the related fault message in the screen header. When `Goto Faults Mode` is inactive (gray button), touching the button navigates to the Station (Tool) Overview screen.

**C** This indicator shows the status of the floor entry laser scanner. It will turn red when violated. Same applies for the exit scanner

**D** This area shows the status of the Cycler panel. It is flashing red when faulted. This applies to all other panels on this screen.

## 4.2.8. Cell Power and I/O Screen

Touching the **GOTO CELL POWER&IO OVERVIEW** button on the Cell Overview screen navigates directly to a screen that identifies the status of the cell power supplies and safe I/O blocks.

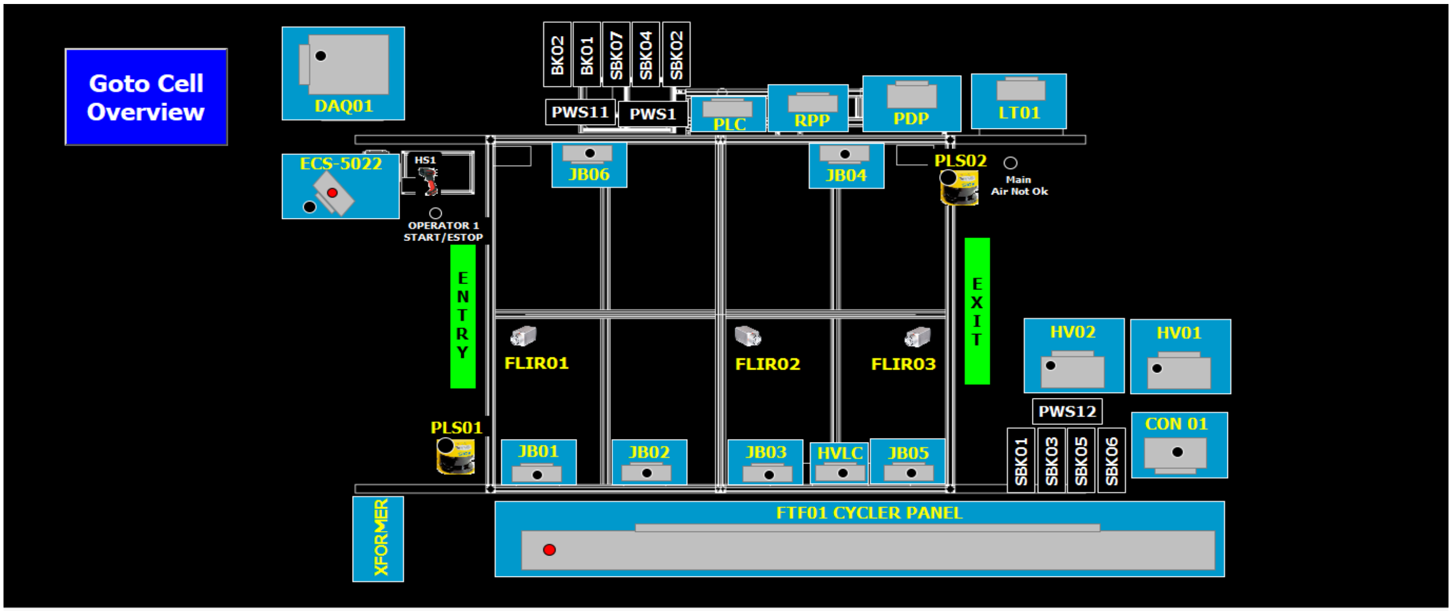



*Figure 4-22. Cell Power and I/O screen.*

The screen is a display only. Black indicators identify a non-faulted state. Red indicators identify devices with power or other faults.

### 4.2.9. Barcode Screen

Touching the **BAR CODE** button on the Station screen navigates directly to a screen that provides interface with the cell handheld barcode scanner.

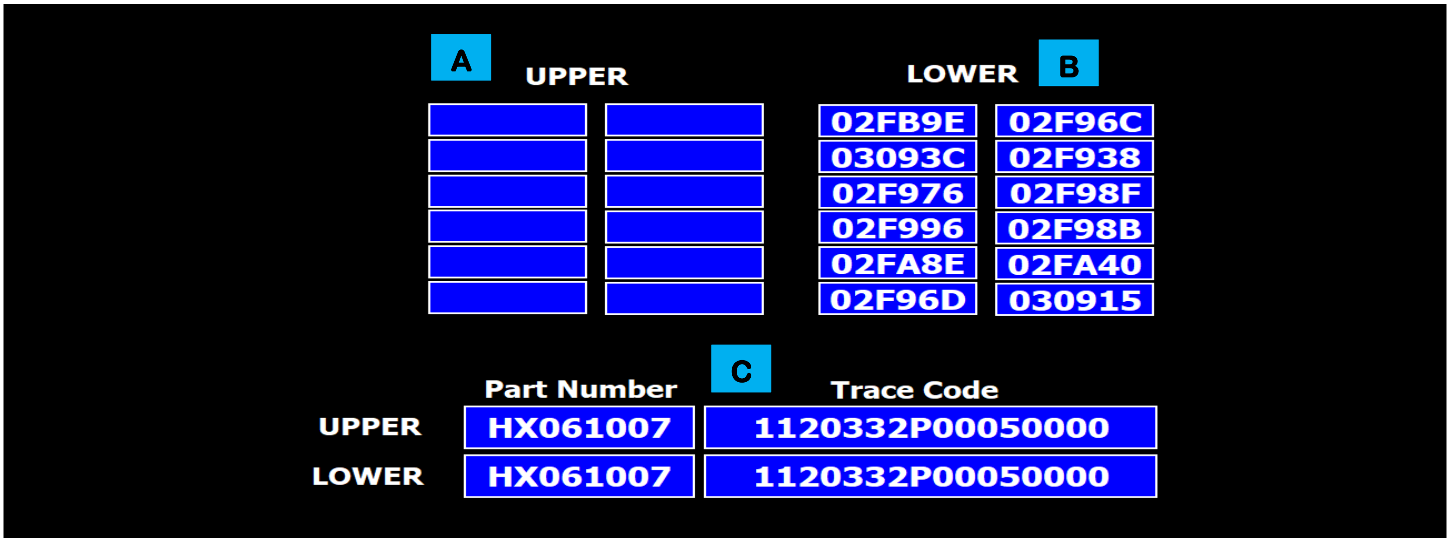



***Figure 4-23. Barcode screen.***

Each Barcode screen features several areas of information and control, used as follows.

**A** Upper field identifies the scanned Module ID numbers for the upper layer of the pack.

**B** Lower field identifies the scanned Module ID numbers for the lower layer of the pack.

**C** These fields identify the scanned part number for the complete upper and lower halves of the pack, along with a trace code.

### 4.2.10. EtherNet Public Screen

Touching the **ETHERNET** button on the Select screen navigates directly to a screen that identifies the current state of each public EtherNet connection at the cell.

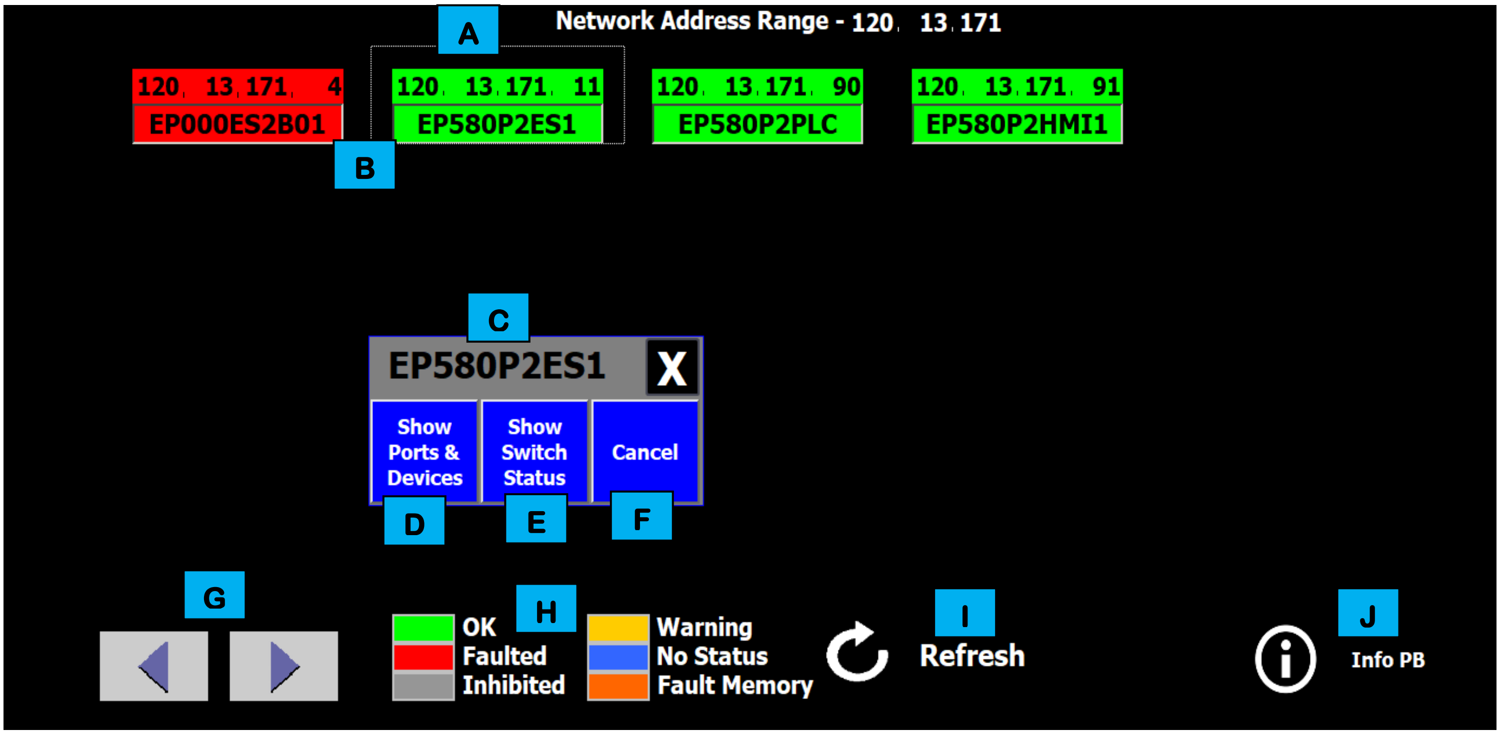



*Figure 4-24. EtherNet Public screen.*

Each EtherNet screen features several areas of information and control, used as follows.

- **A** This area of the screen identifies the EtherNet network currently displayed.
- **B** Each device features a two-part indicator. The top of the indicator identifies the node number associated with the device. The bottom of the indicator identifies the device program name.
- **C** When the EtherNet Switch touch-button is pressed it will display a pop-up menu.
- **D** This touch-button displays the Ports and Devices of the CELL ETHERNET switch.
- **E** This touch-button displays the Status of the CELL ETHRNET switch.
- **F** This button closes the pop-up menu.
- **G** These buttons will display the Next Page (EtherNet Private network).
- **H** The bottom of the screen identifies the meaning of each indicator color.
- **I** This touch-button will refresh the EtherNet screen.
- **J** This touch-button will display information about the EtherNet screen.

## 4.2.11. Switch Ports and Devices Screen

Touching the **PORTS AND DEVICES** button on the EtherNet pop-up menu navigates directly to a screen that displays the status of the Ports and Devices of the Switch.

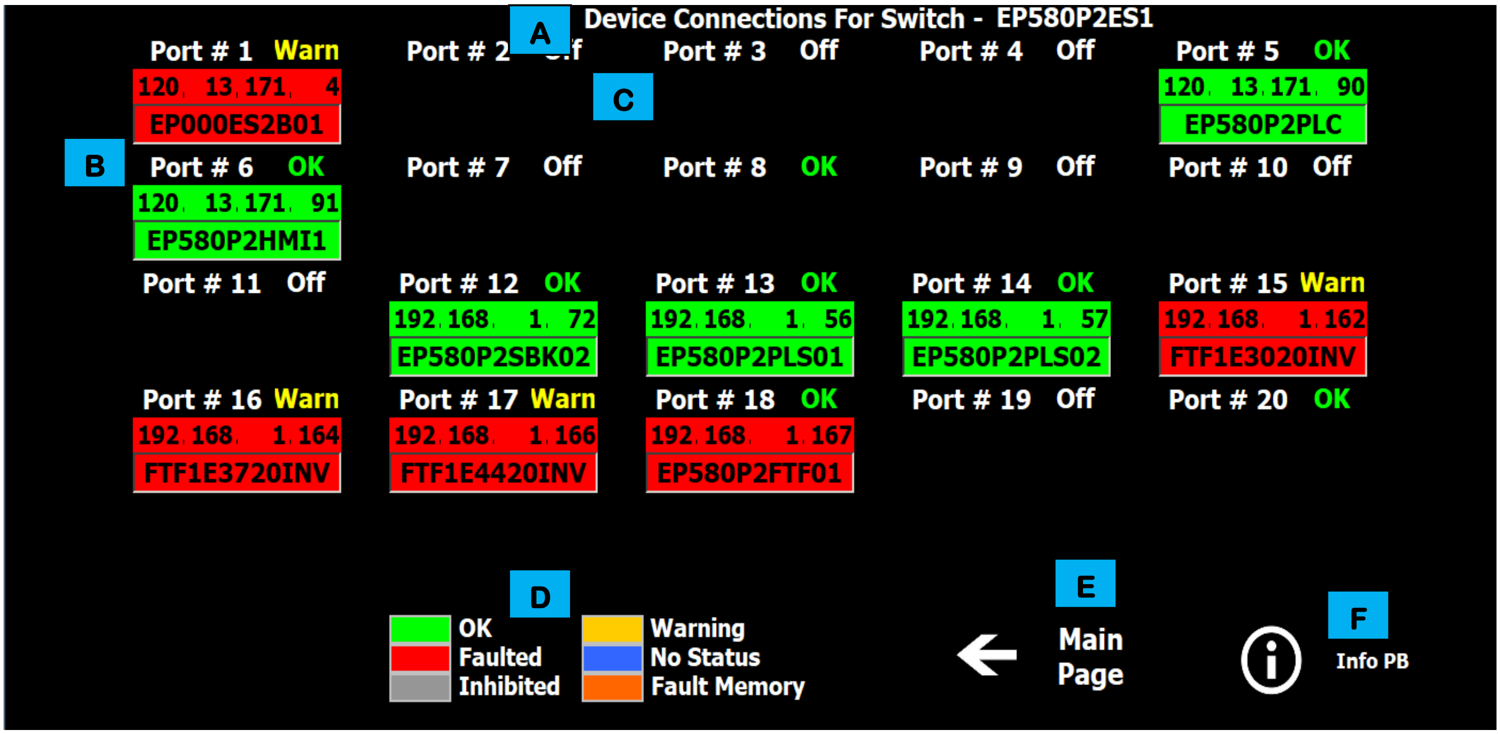



*Figure 4-25. Switch Ports and Devices screen.*

Each Ports and Device screen features several areas of information and control, used as follows.

- **A** This area of the screen identifies the Switch currently displayed.
- **B** Each device features a two-part indicator. The top of the indicator identifies the node number associated with the device. The bottom of the indicator identifies the device program name.
- **C** This area of the screen identifies which devices are connected to the Switch, and what port they are connected to.
- **D** The bottom of the screen identifies the meaning of each indicator color.
- **E** This touch-button displays the previous page.
- **F** This touch-button displays information about the Ports and Devices screen.

### 4.2.12. Switch Status Screen

Touching the **SWITCH STATUS** button on the EtherNet pop-up menu navigates directly to a screen that displays the Status of the Switch.

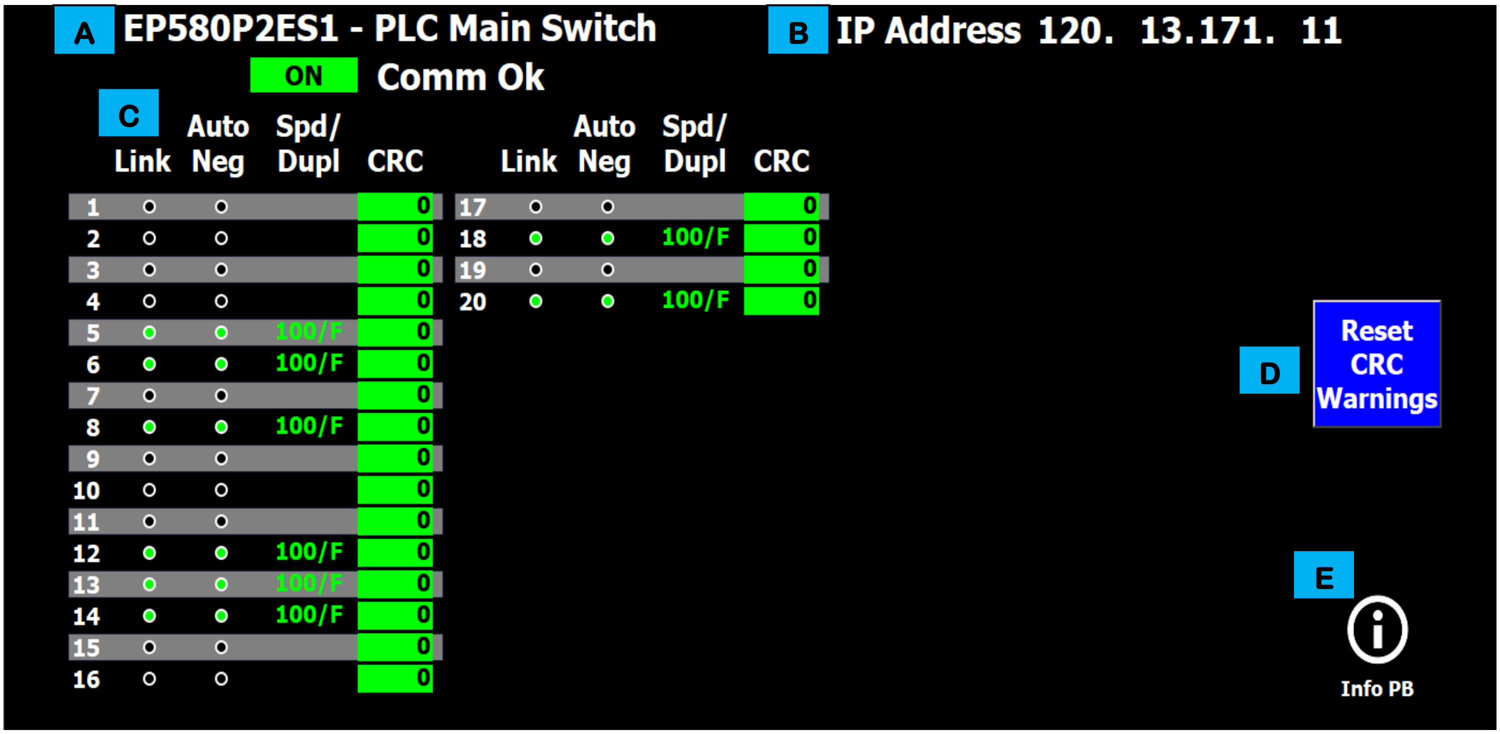



*Figure 4-26. Switch Status screen.*

Each Switch Status screen features several areas of information and control, used as follows.

**A** This area of the screen identifies the Switch currently displayed.

**B** This area of the screen identifies the IP address of the switch.

**C** This area of the screen displays the status of the Switch. Green lights indicate that there is a connection, and the current transmitted speed through the ports in use.

**D** This touch-button resets the communication warnings.

**E** This touch-button displays information about the Switch Status screen.

### 4.2.13. EtherNet Private Screen

Touching the **NEXT PAGE** button on the EtherNet Public screen navigates directly to a screen that displays the Private EtherNet addresses and status.

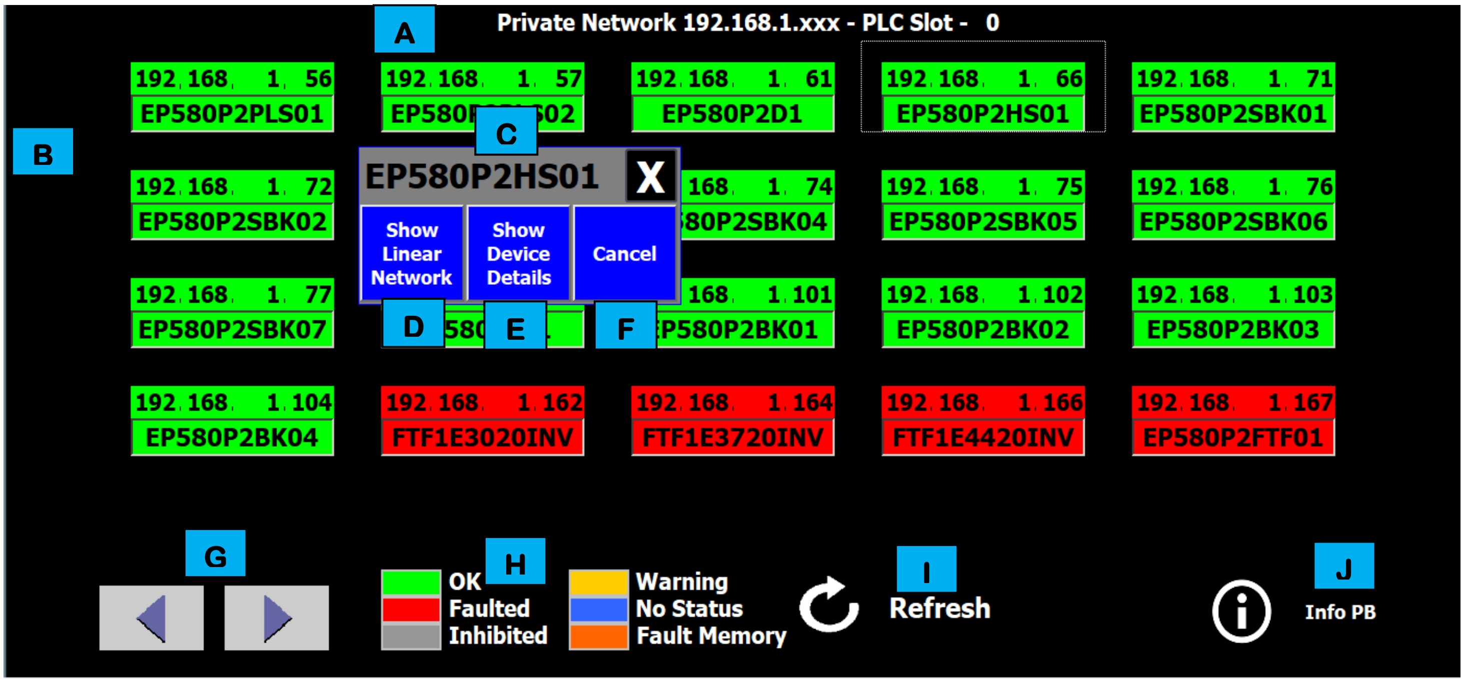



*Figure 4-27. EtherNet Private screen.*

Each EtherNet screen features several areas of information and control, used as follows.

- **A** This area of the screen identifies the EtherNet network currently displayed.
- **B** Each device features a two-part indicator. The top of the indicator identifies the node number associated with the device. The bottom of the indicator identifies the device program name.
- **C** When the EtherNet network device is touched it will display a pop-up menu.
- **D** This touch-button displays the Linear Network of the selected device.
- **E** This touch-button displays the Device Details of the selected device.
- **F** This touch-button closes the pop-up menu.
- **G** These buttons will display the Next Page (EtherNet Public network).
- **H** The bottom of the screen identifies the meaning of each indicator color.
- **I** This touch-button will refresh the EtherNet screen.
- **J** This touch-button displays information about the EtherNet screen.

## 4.2.14. Linear Network Screen

Touching the **LINEAR NETWORK** button on the EtherNet pop-up menu navigates directly to a screen that displays the Device Linear Network.

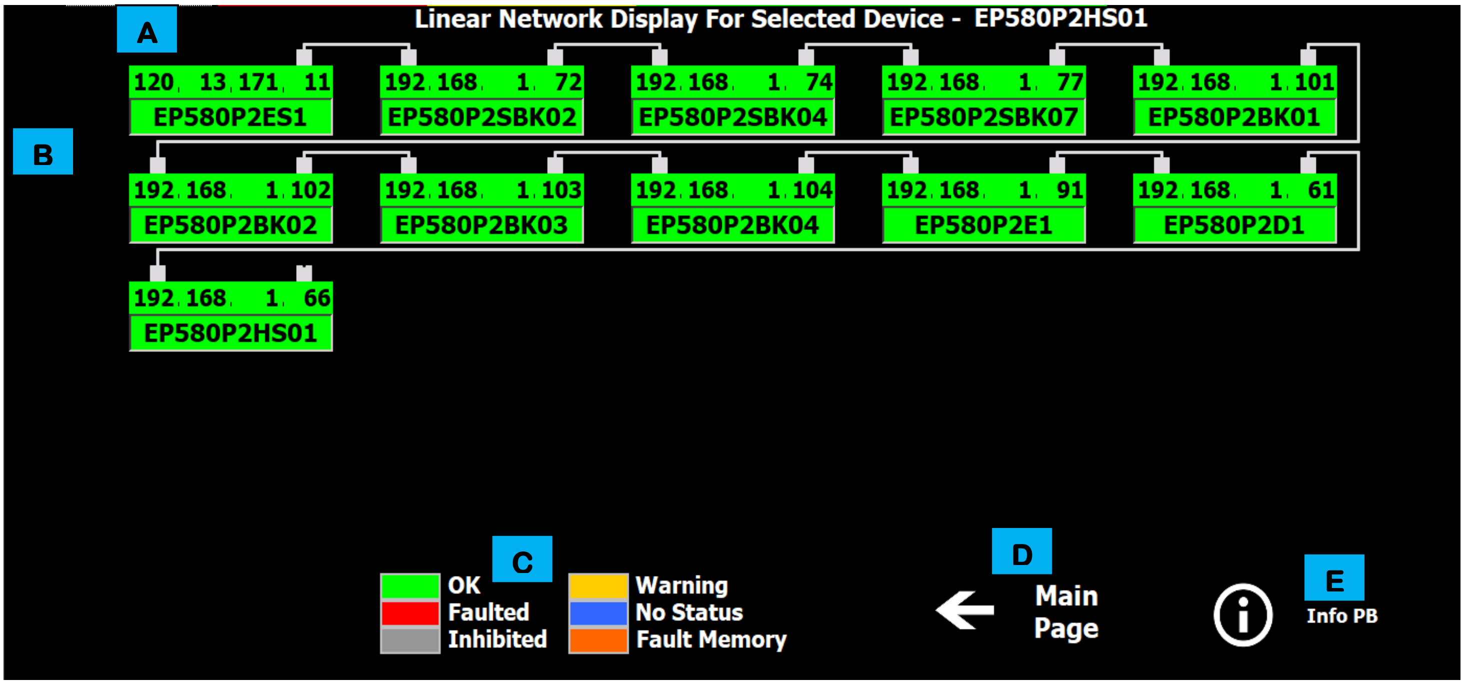



*Figure 4-28. Linear Network screen.*

Each Linear Network screen features several areas of information and control, used as follows.

**A** This area of the screen identifies the EtherNet Device currently displayed.

**B** Each device features a two-part indicator. The top of the indicator identifies the node number associated with the device. The bottom of the indicator identifies the device program name. It also displays which device it communicates with.

**C** The bottom of the screen identifies the meaning of each indicator color.

**D** This touch-button displays the previous page.

**E** This touch-button displays information about the Linear Network screen.

### 4.2.15. Device Details Screen

Touching the **DEVICE DETAILS** button on the EtherNet pop-up menu navigates directly to a screen that displays the Device Status.

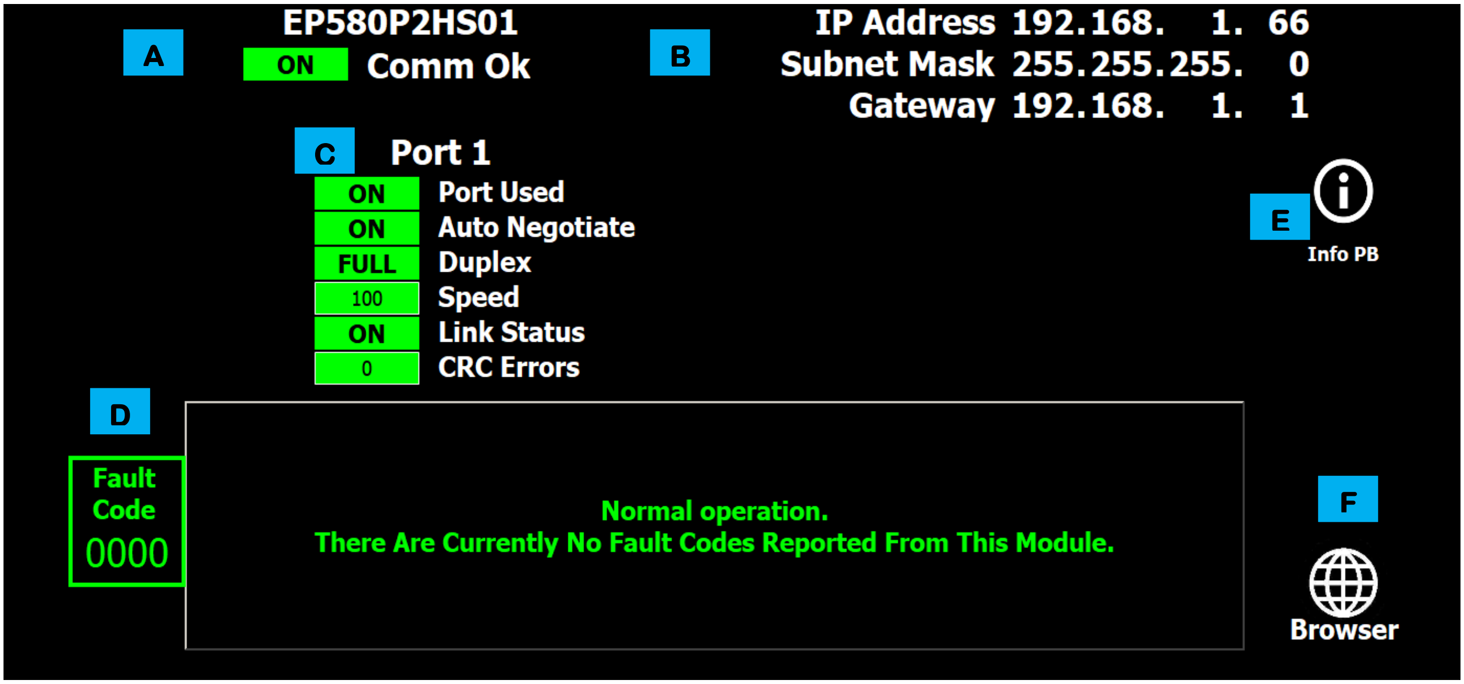



*Figure 4-29. Device Details screen.*

Each Device Details screen features several areas of information and control, used as follows.

- **A** This area of the screen identifies the EtherNet Device currently displayed.
- **B** This area of the screen identifies the IP, Subnet Mask, and Gateway of the device.
- **C** This area of the screen identifies the port in which this device is connected and the status of the port.
- **D** This area of the screen identifies any Fault Codes and description of the fault
- **E** This touch-button displays information about the Device Details screen.
- **F** This touch-button opens a browser that displays more information about the device.

## 4.2.16. Alarm Screen

Touching the **Alarm Screen** button on the Select screen navigates directly to a screen that identifies currently active alarms.

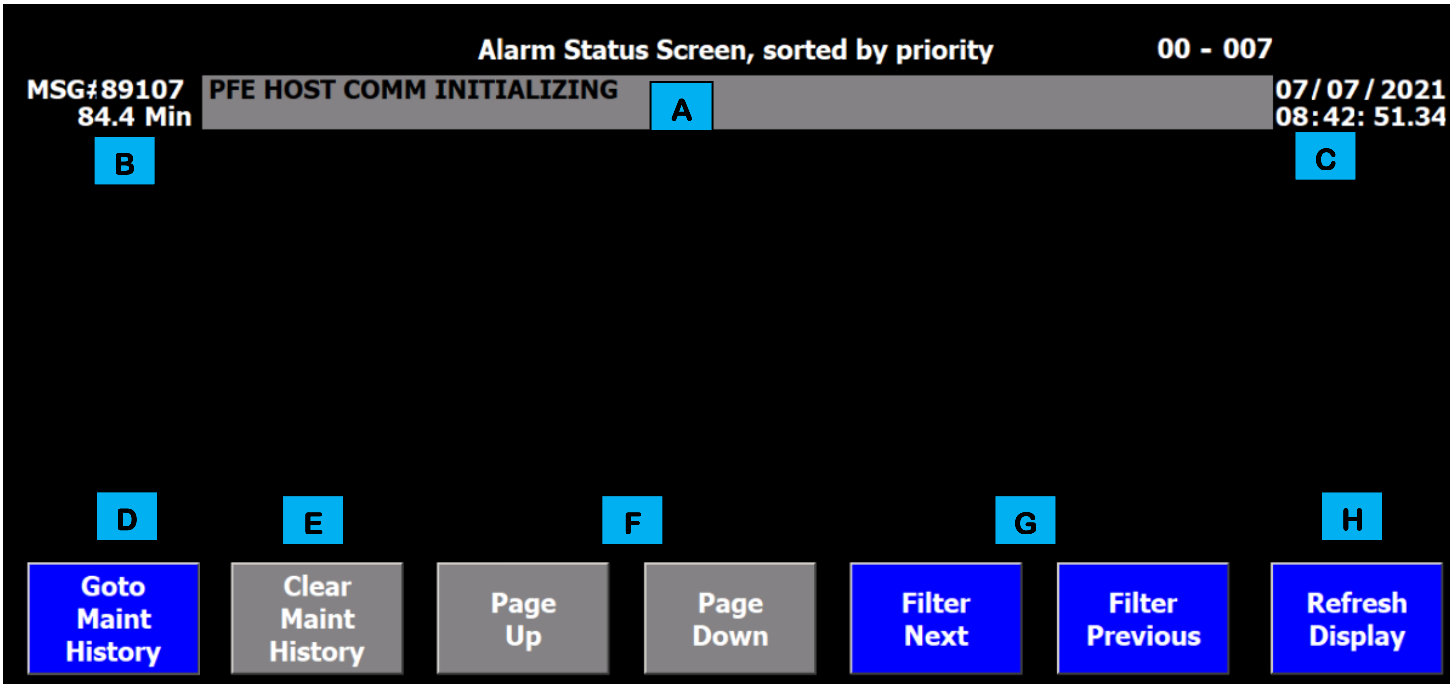



***Figure 4-30. Alarm screen.***

Each Alarm screen features several areas of information and control, used as follows.

- **A** This area lists the current alarm messages, with the highest priority at the top and descending in order.
- **B** This area lists the alarm number associated with the message and the time elapsed since the alarm occurred.
- **C** This area lists the time and data of the alarm occurrence.
- **D** This touch-button opens a screen that displays past alarm messages.
- **E** This touch-button is not used on the active Alarm screen.
- **F** These touch-buttons scroll up or down through the list of alarms until the highest priority alarm is displayed first or the lowest priority alarm is displayed last.
- **G** These touch-buttons toggle filters used to sort the alarms listed.
- **H** This touch-button refreshes the messages on the screen to identify the highest priority alarm.

## 4.2.17. Maintenance History Screen

Touching the **GOTO MAINT HISTORY** button on the Alarm screen navigates directly to a screen that lists alarms that have previously occurred.

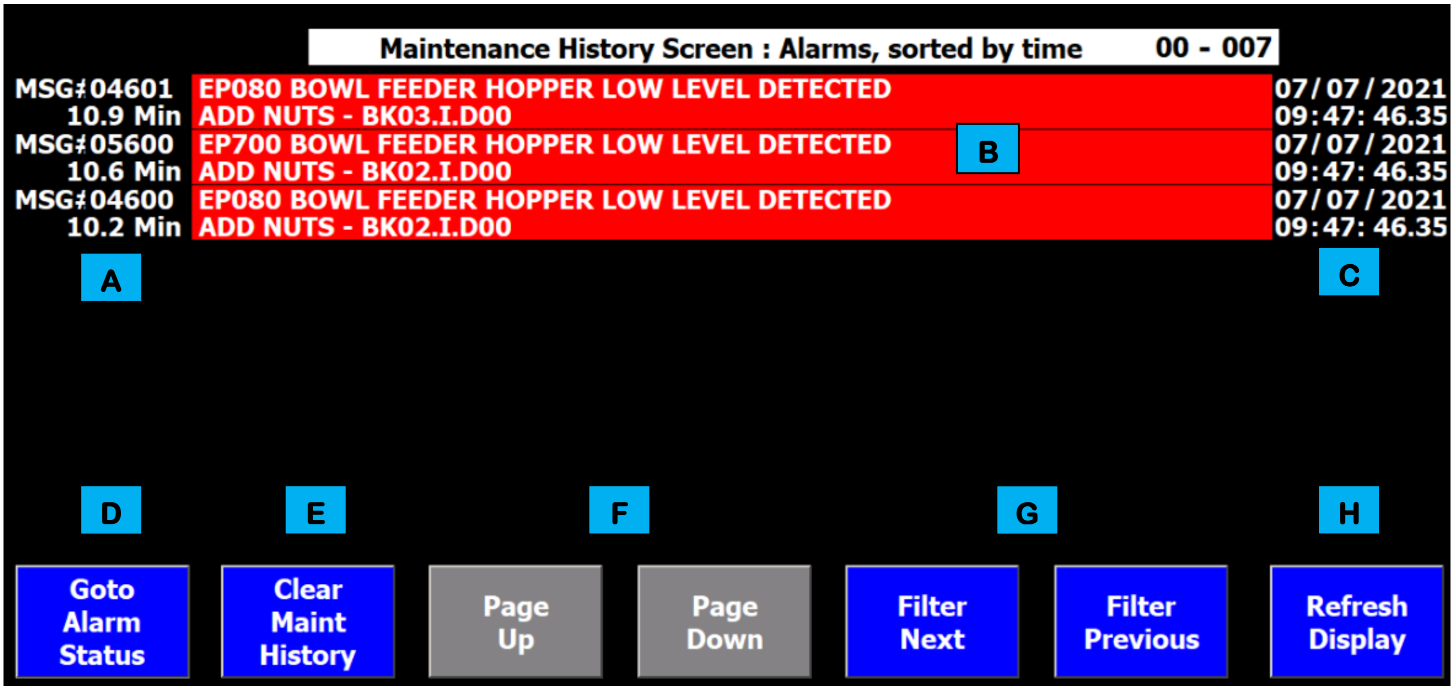



*Figure 4-31. Maintenance History screen.*

Each Maintenance History screen features several areas of information and control, used as follows.

**A** This area of the screen lists the alarm number associated with the message and the time elapsed since the alarm occurred. Each alarm displayed on the screen has its own alarm number and elapsed time indicator.

**B** This area of the screen lists the historical alarm messages, with the most recent at the top and descending in order. Up to eight messages can be displayed.

**C** This area of the screen indicates when the alarm was initially active.

**D** This touch-button returns to the active Alarm screen.

**E** This touch-button erases the data on the Maintenance History screen (historical fault data).

**F** These touch-buttons scroll up and down through the list of alarms (from oldest to most recent) until the newest alarm is displayed first.

**G** These touch-buttons allow the historical alarms to be sorted by priority or time.

**H** This touch-button refreshes the messages on the screen to identify the latest recovered alarms.

## 4.2.18. Cycle Time Screen

Touching the **CYCLE TIME** button on the Select screen navigates directly to a screen that displays data about the system cycle.

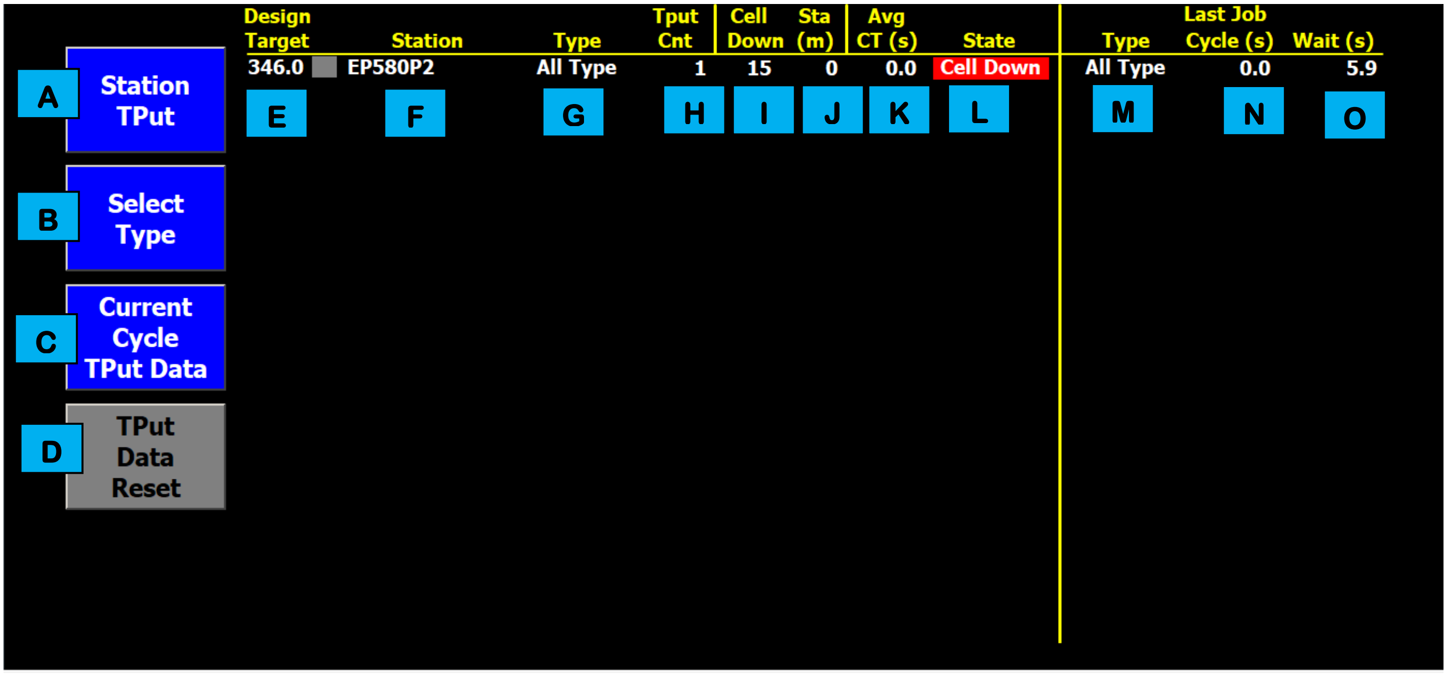



*Figure 4-32. Cycle Time screen.*

Each Throughput Overview screen features several areas of information and control, used as follows.

- **A** This touch-button opens a screen that provides more detailed cycle data for a single station.
- **B** This touch-button displays a dialog menu that allows the list to display for all types or for a specific type. Touch the **CLOSE** button in the dialog to close the menu.
- **C** This touch-button toggles the data fields (items **M**, **N**, and **O**) to display either the current cycle data or the last cycle data.
- **D** This touch-button resets the data on the screen.
- **E** This column identifies the programmed target cycle time.
- **F** This column identifies the station names.
- **G** This column identifies the type of part (toggled by the **SELECT TYPE** button).
- **H** This column identifies the quantity produced.
- **I** This column identifies the number of minutes of faulted system downtime.
- **J** This column identifies the number of minutes of faulted station downtime.
- **K** This column identifies the average cycle time.
- **L** This column identifies the current status.
- **M** This column identifies the current/last type of part.
- **N** This column identifies the current/last cycle time.
- **O** This column identifies the current/last wait time.

## 4.2.19. Station Throughput Screen

Touching the **STATION TPUT** button on the Throughput Overview screen navigates directly to a screen that displays detailed production data for a specific station.

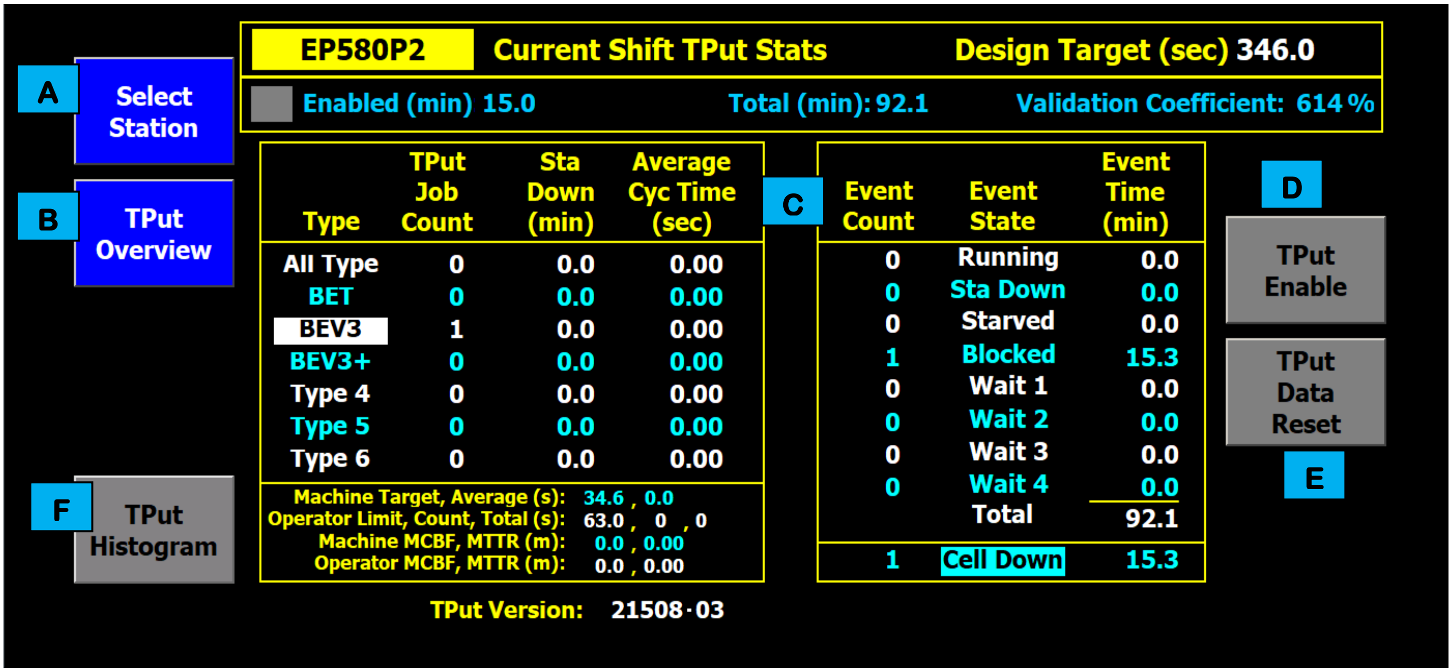



*Figure 4-33. Station Throughput screen.*

Each Station Throughput screen features several areas of information and control, used as follows.

- **A** This touch-button changes the station currently displaying data.
- **B** This touch-button returns to the Throughput Overview screen.
- **C** This area of the screen displays detailed production statistics.
- **D** This touch-button toggles the station data collection on or off.
- **E** This touch-button resets the station data on the screen.
- **F** This touch-button displays the Throughput data histogram

## 4.2.20. Configuration Screen

Touching the **GOTO CONFIG** button on the Select screen navigates directly to a screen that displays the configuration options for the HMI.

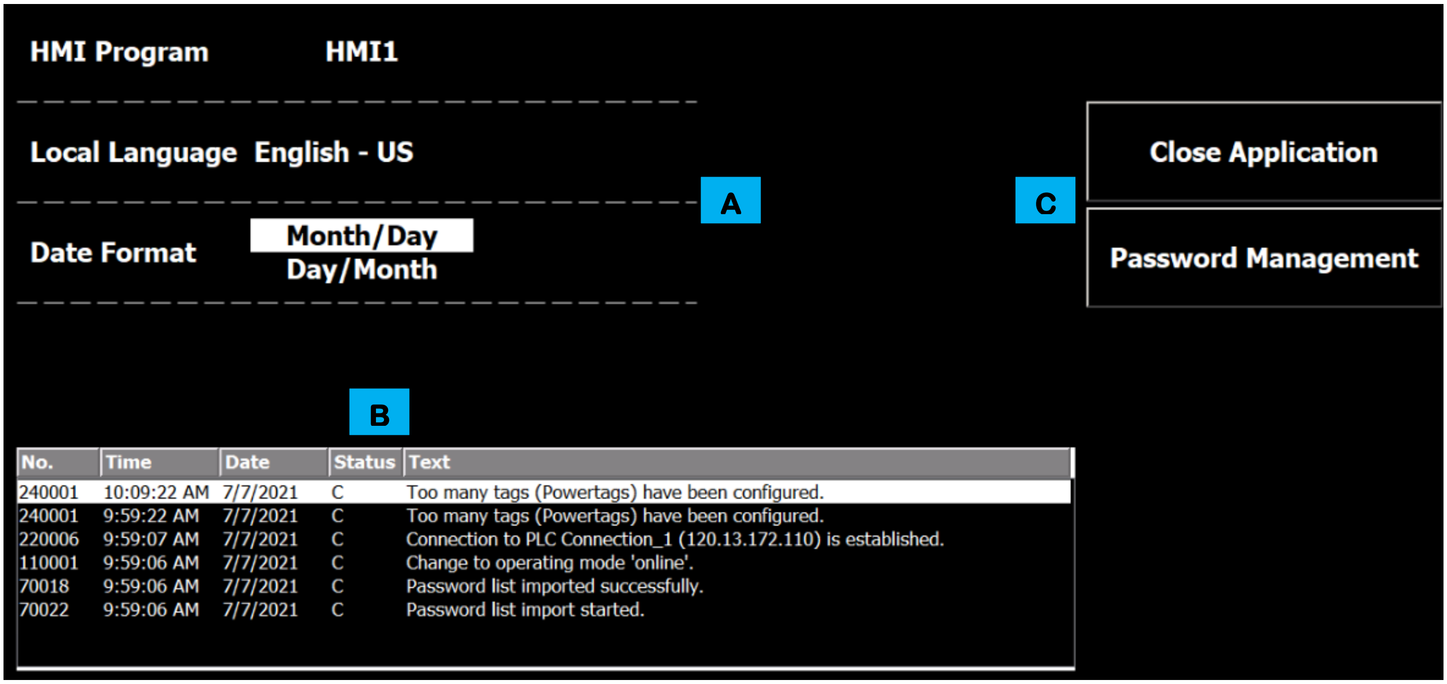



***Figure 4-34. Configuration screen.***

Each Configuration screen features several areas of information and control, used as follows.

- **A** This area of the screen identifies current HMI program in use, selected language, and date format.
- **B** This area of the screen identifies settings that have previously been set in the HMI.
- **C** These touch-buttons will close the Configuration screen and open the Password Management screen.

## 4.2.21. Signature Screen

Touching the **SIGNATURE** button on the Select screen navigates directly to a screen that identifies the status of the safety-type devices associated with the cell. Refer to your company operating procedures for more information about this screen.

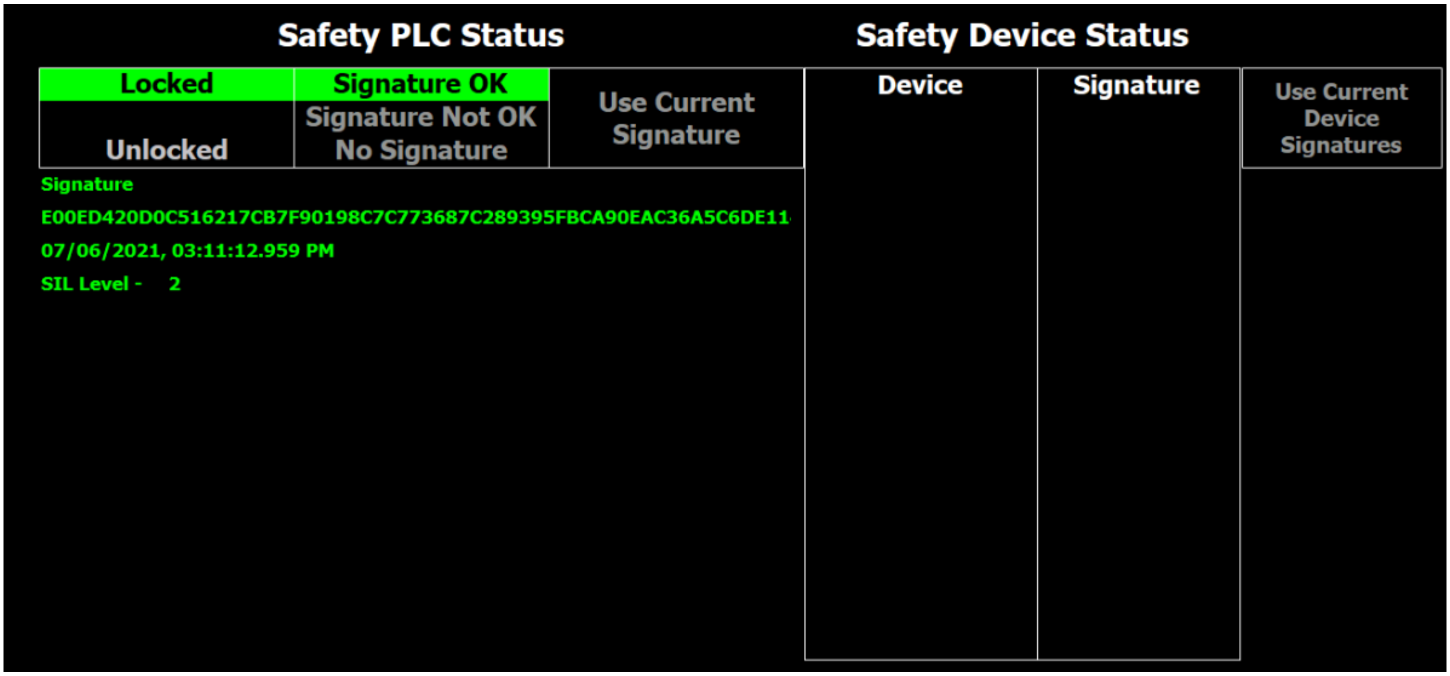



*Figure 4-35. Signature screen.*

## 4.2.22. Style Overview Screen

Touching the **STYLE OVERVIEW** button on the Select screen navigates directly to a screen that displays style data. Touch the **EDIT** button to change a part number as needed. Refer to your company operating procedures for the proper use of this screen.

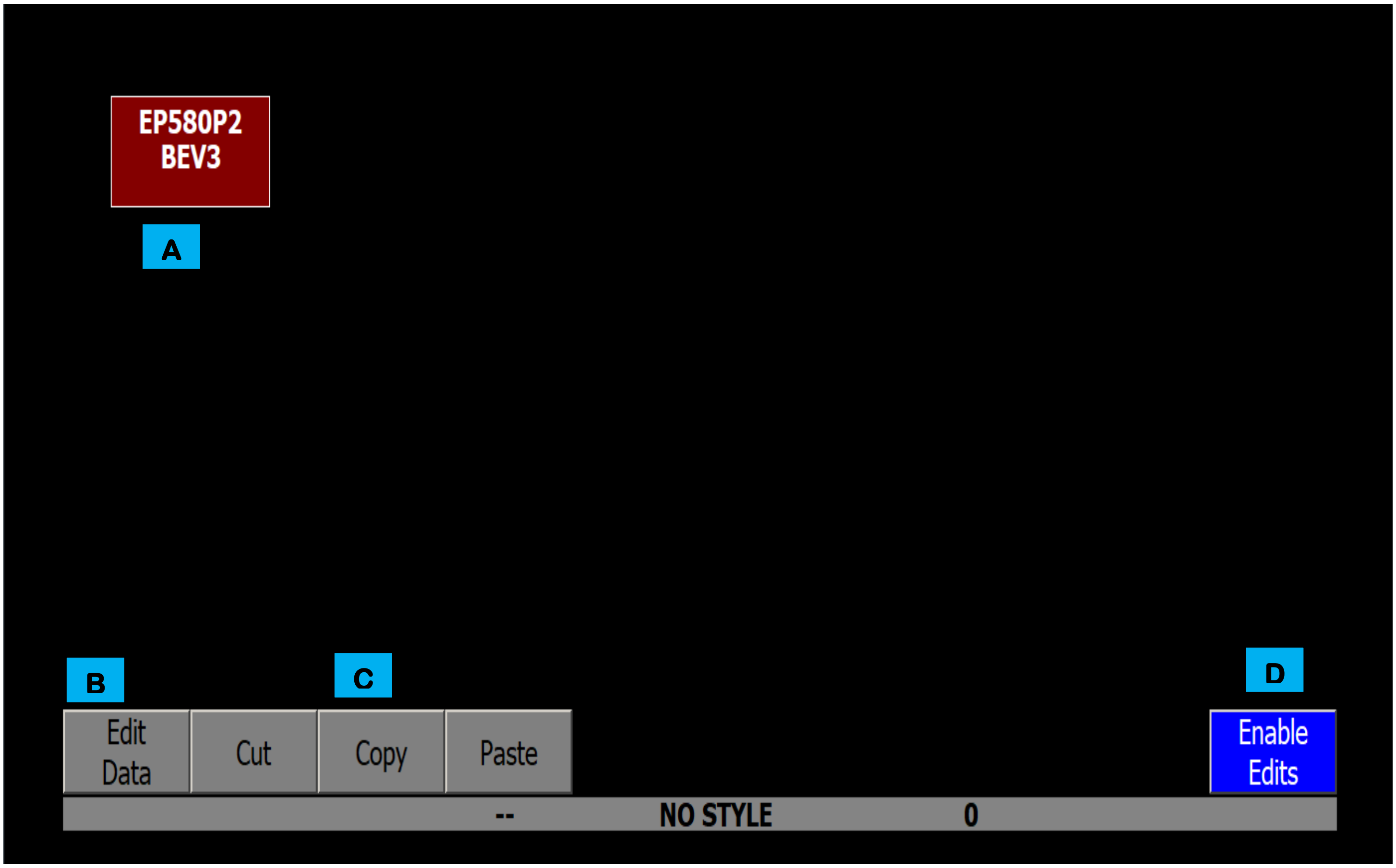



***Figure 4-36. Style Overview screen.***

Each Style Overview screen features several areas of information and control, used as follows.

- **A** This area of the screen identifies the current style selected
- **B** This touch-button will display the Style Overview Edit Data screen.
- **C** These touch-buttons will cut, copy, or paste the selected style.
- **D** This indicator will display the status of the edits, enabled or disabled. The indicator turns yellow when edits are enabled.

## 4.2.23. Style Overview Edit Data Screen

Touching the **EDIT DATA** button on the Style Overview screen navigates directly to a screen that allows user to edit styles. Refer to your company operating procedures for the proper use of this screen.

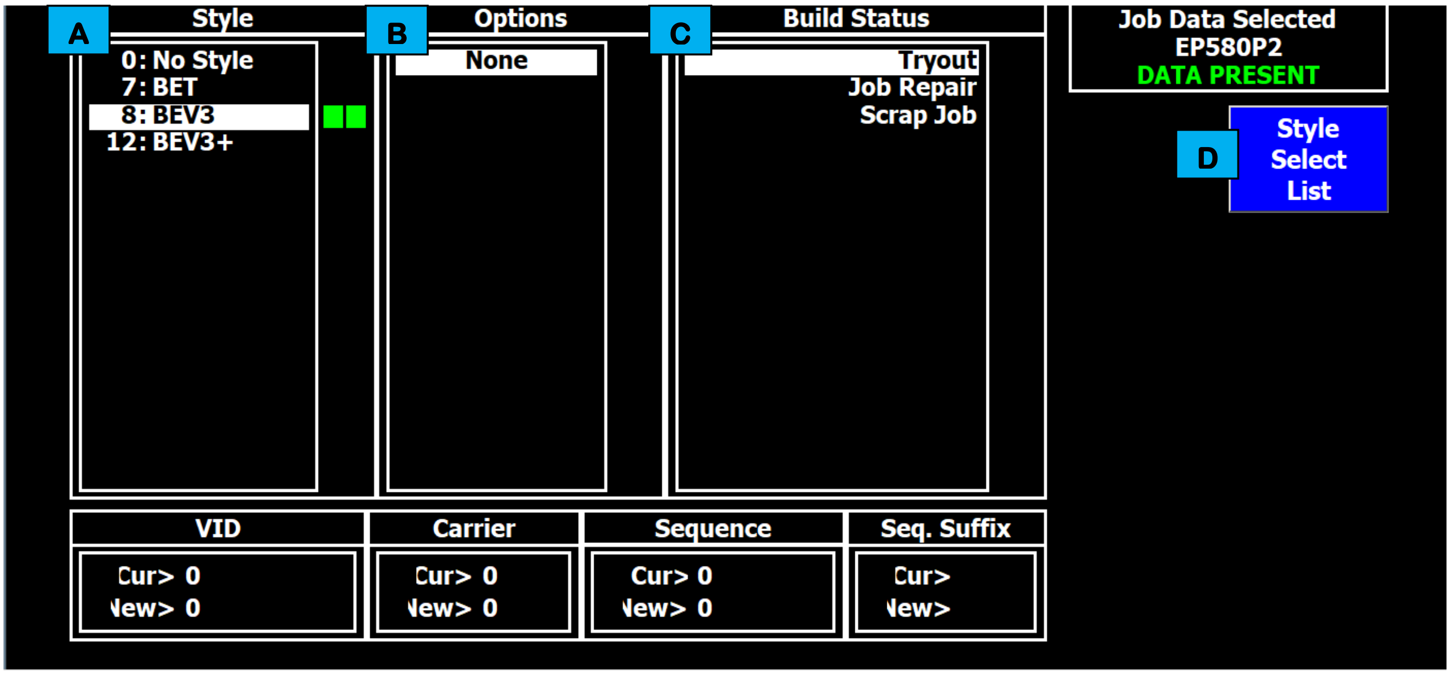



***Figure 4-37. Style Overview Edit Data screen.***

Style Overview Edit Data screen features several areas of information and control, used as follows.

- **A** This area of the screen displays the current Style selected.
- **B** This area of the screen displays the current Options selected.
- **C** This area of the screen displays the current Build Status selected.
- **D** This touch-button will display a list of Job Data to select.

## 4.2.24. Quality Screen

Touching the **QUALITY** button on the Select screen navigates directly to a screen that identifies the number of cycles left before a seal change is needed and time until next calibration is needed.

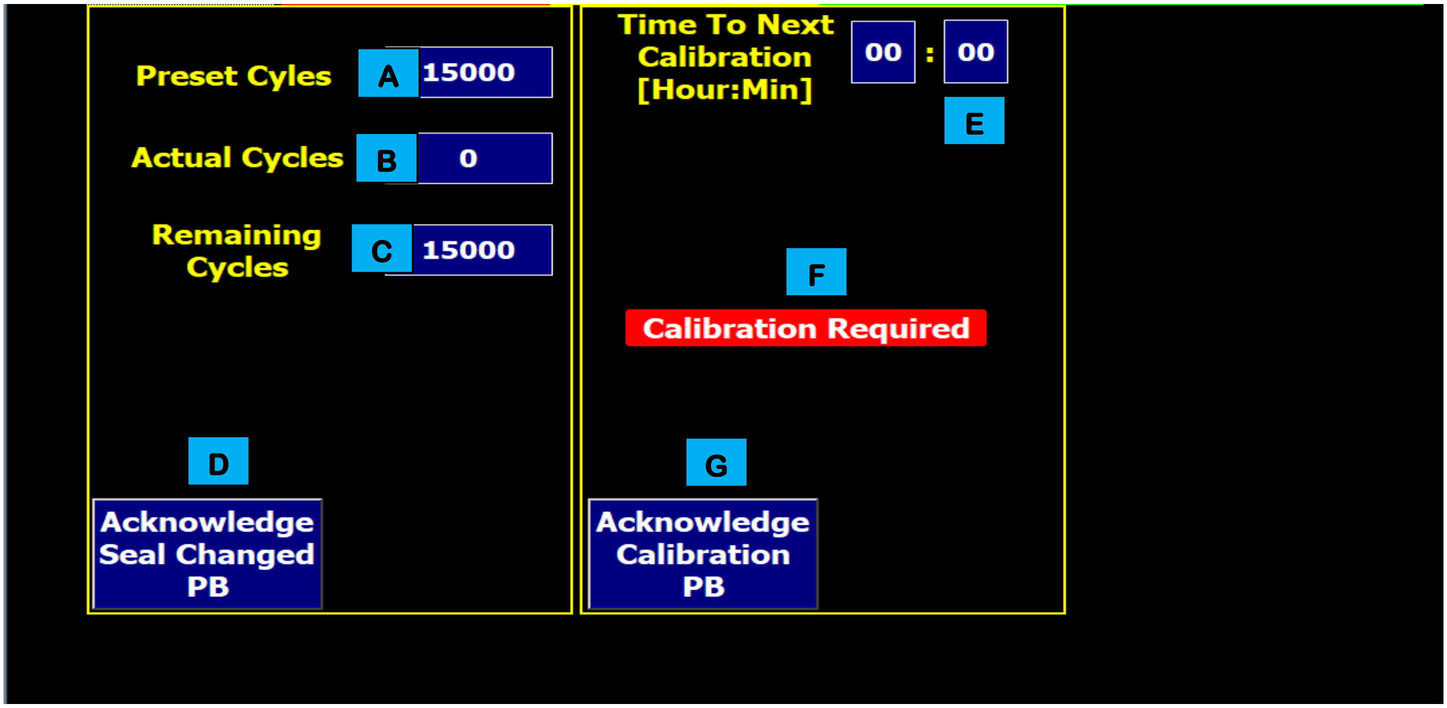



*Figure 4-38. Quality screen.*

Each Quality screen features several areas of information and control, used as follows.

- **A** This field identifies the preset cycle amount.
- **B** This field identifies the number of cycles ran.
- **C** This field identifies the number of cycles remaining.
- **D** This touch-button resets the alarm and cycles.
- **E** This field identifies the time remaining before the next calibration
- **F** This field is an alarm that displays if a calibration or change of seal is needed. Each one of the two displays will contain their own alarm.
- **G** This touch-button resets the alarm and time for the next calibration.

# 4.3. COMMON OPERATING PROCEDURES

Only trained operators are to operate the assembly line. Operators use this section to operate the assembly line daily. This section describes the procedures for inspecting, starting, running, stopping, shutting down, emergency stopping, and recovering from faults on the assembly line.

## 4.3.1. Inspecting the Line

The following checklist outlines actions that, when completed, help to ensure the proper and safe operation of the equipment. This checklist should be used prior to startup of each cell, such as at the beginning of the day or a shift. Complete the following checks to ensure proper cell operation:

- Ensure that all cell operators have been thoroughly trained and instructed in safety procedures and in cell operation. Do not allow untrained personnel to operate the cell.
- Ensure the cell air supply shutoff valve is on.
- Ensure the PDP main disconnect switch is in the on position.
- Ensure that all mechanisms are clear for cell operation.
- Ensure that all necessary safety guards and doors are closed.
- Ensure that all safety mechanisms are in proper working order.
- Ensure that all mechanical devices have had proper preventive maintenance and are properly cleaned.
- Ensure that no one is working on, or near, automated cell devices.

## 4.3.2. Starting Cell in Manual Mode

Use the following procedure to start a cell in manual mode. After completing this procedure, the cell will be started. To start a cell in manual mode:

1. Ensure all cell disconnects are not disabled and that control power is present. Ensure the cell pneumatic equipment is enabled and up to pressure.
2. Return the AUTO/MANUAL key switch to the MANUAL position.
3. If any faults are displayed at the top of the screen, touch the Fault Reset button in the screen header to reset each fault.

### 4.3.3. Starting Cell in an Automatic Mode

Use the following procedure to start a cell in auto mode. After completing this procedure, the cell will be started and cycling. To start an auto cycle in one of the automated cells:

1. Ensure all enclosure disconnects are not disabled and that control power is present. Ensure the cell pneumatic equipment is enabled and up to pressure.
2. A reset is required of all equipment. If the equipment is appropriately located, the RESET button on the HMI terminal will be flashing blue. If the button is not flashing, the equipment is not appropriately located. Check the equipment status on the touch screens.
3. When the equipment is appropriately located and the RESET button is flashing blue, press the RESET button. After the equipment resets the blue button indicator illuminates steady.
4. Turn the AUTO/MANUAL key switch on the HMI terminal to the MANUAL position. Navigate to the Scroll List screen, select ***** `START OF LIST` ***** in the Function List, and press the DO button to drive all equipment to the load positions.
5. Return the AUTO/MANUAL key switch to the AUTO position.
6. If any faults are displayed at the top of the screen, touch the Fault Reset button in the screen header to reset each fault.
7. Check the indicator in the AUTO INITIATE button. All mode selector switches on the system must be set to auto before the cycle can be started. If the green indicator in the button is dark or is rapidly flashing, one or more stations are not ready for auto. Use the alarm messages to identify why the cell and stations within the cell may not be ready for auto.
8. When the AUTO INITIATE button indicator is flashing steadily (not rapidly), press and hold the button. The alarm horn sounds three times and the cell initiates auto mode. Release the button after the alarm horn ceases. The indicator illuminates steady.

### 4.3.4. Stopping a Cycle

There are two methods for stopping the cycle at the cell: cycle stopping, and emergency stopping.

#### 4.3.4.1. Emergency Stop

| | |
|---|---|
| **WARNING!** ⚠ | ***Press an*** EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.*** |

Push a red EMERGENCY STOP button in to immediately interrupt control power in the cell.

### 4.3.5. Shutting Down

Use the following procedure to shut down a cell. Use this procedure any time a cell needs to be completely powered down, such as for maintenance. To completely shut down a cell:

| NOTE | ***To shut down the entire Pack Main Line, this procedure must be completed on each of the cells until no power remains in the line.*** |
|---|---|

1. Turn the main disconnect switch to the off position at the PDP main control panel. Verify that the CONTROL POWER ON indicator is dark at the main control panel and at the cell operator interface.
2. If necessary, push the air processing equipment air dump and turn the air shutoff valve to the off position to remove pneumatic energy.
3. If maintenance is to be performed, refer to the Hazardous Energy Guidelines section in Chapter 5.

### 4.3.6. Recovering from an Emergency Stop

| **WARNING!** | ***Press an*** EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.*** |
|---|---|

Complete the following steps to recover after an EMERGENCY STOP button has been pressed:

1. Visually confirm the status of the devices. If the equipment is in a recoverable position (no collisions will result upon movement), pull out the EMERGENCY STOP button that was depressed.
2. If any faults are displayed at the top of the screen, touch the **FAULT RESET** button in the screen header to reset each fault.
3. Check the indicator in the AUTO INITIATE button. If the green indicator in the button is dark or is rapidly flashing, one or more stations are not ready for auto. Use the alarm messages to identify why the cell and stations within the cell may not be ready for auto.
4. When the AUTO INITIATE button indicator is flashing steadily (not rapidly), press and hold the button. The alarm horn sounds three times and the cell initiates auto mode.
5. Release the button after the alarm horn ceases. The indicator illuminates steady.

### 4.3.7. Recovering from a Fault

A fault occurs anytime there is an interruption in the automatic cycle. There are various conditions that can result in fault, such as: the failure of a sensor, a part blockage or jam, or any number of other situations.

When a fault occurs, the cell cycle is stopped, and the operator is alerted to the situation. The HMI provides a detailed fault message with the associated fault number and I/O (when applicable). In some situations, the fault message also provides recovery information.

For most faults, recovery is to remove any jam, reset the system, and resume automatic operations. Refer to Chapter 6 for more specific information.

### 4.3.8. Mastering Sequence for Pack Coolant Leak Test

A copper coil with 9.7-liter volume is used as the Master Part. The Master Part is enclosed inside an insulated extrusion frame. Three ports are provided on the outside of the insulated enclosure to manually connect the three leak test tools of the test stand.

Mastering Process Steps:

1. At the beginning of each day the system will notify the Operator to run the master process.
2. Operator connects three leak test tools to the Master Part.
3. Operator verifies the Leak Orifice ball valve that is located on the leak test cart is Closed.
4. Operator Runs production leak test program from the Bauer computer.
5. Operator Opens the Leak Orifice ball valve.
6. Operator Runs production leak test program from the Bauer computer.
7. Verify results are 0.0 sccm for no leak and 2.0 sccm with leak orifice enabled, +/-0.3 sccm.

### 4.3.9. Mastering Sequence for Pack Cover Leak Test

Each battery assembly type will have a Zero Leak Master Part stored on a dedicated AGC. When Mastering needs to be performed, the Operator will Call for the Master Part to come to the station.

Mastering Process Steps:

1. Operator Calls for the Master Part to come to the test station.
2. Operator connects the leak test tools to the Master part.
3. Operator verifies the Leak Orifice ball valve that is located on the leak test cart is Closed.
4. Operator Runs production leak test program from the HMI.
5. Operator Opens the Leak Orifice ball valve.
6. Operator Runs production leak test program from the HMI.
7. Verify results are 0.0 sccm for no leak and 10.0 sccm with leak orifice enabled, +/-1.0 sccm.

# 4.4. MODES OF OPERATION

## 4.4.1. Manual Station Operation

Auto mode is the standard operating mode for a manual cell. While in auto mode, the cell processor monitors the operation of the associated equipment and receives inputs from the operation through the HMI and associated cell equipment.

When there is an interruption in the cycle (such as the occurrence of a fault), auto mode is not typically dropped. If recovery is possible without manual operator intervention, the automatic cycle resumes upon recovery. If the fault was severe, such as a utility loss or equipment jam, the cell will stop all equipment. Once the fault has been corrected, refer to ***4.3.2 Starting Cell in Manual Mode*** to restore operation.

## 4.4.2. Automated Station Operation - Auto Mode

Auto mode is the standard operating mode for an automated cell. While in auto mode, the cell processor directs and monitors the operation of the associated equipment.

When there is an interruption in the cycle (such as the occurrence of a fault), auto mode is not typically dropped. If recovery is possible without manual operator intervention, the automatic cycle resumes upon recovery. If the fault was severe, such as a utility loss or a communication fault, equipment within the cell may have lost automatic mode. Once the fault has been corrected, refer to ***4.3.3 Starting Cell in an Automatic*** to restore operation.

## 4.4.3. Automated Station Operation - Manual Mode

Manual mode for automated stations provides the ability to individually move mechanisms using the operator interface. Manual mode can be used for fault recovery, troubleshooting, setup, and for numerous other reasons.

There are three sections that follow: entering manual mode, example manual motion, and example manual cycling. Complete the steps as necessary for the desired manual operations.

### 4.4.3.1. Entering Manual Mode

The following steps detail the operations required to operate the cell in manual mode.

1. Turn the AUTO/MANUAL key switch to the MANUAL position on the operator interface terminal.
2. On the operator interface touch screen, touch the **SELECT** button in the screen header and select the appropriate station option.
3. After the Select screen displays, touch the **SCROLL LIST** button.
4. Utilize the Scroll List screen and the DO button on the operator interface terminal for manual operations.
5. If additional manual actions are needed, repeat Steps 2 through 4 for the action and option.

### 4.4.3.2. Example Manual Cycling

The steps that follow detail the operations required to perform an example cycle manually. Use this procedure as a guide for manually cycling a cell.

1. Complete the procedure in ***4.4.3.1 Entering Manual Mode***.
2. With ***** `START OF LIST` ***** highlighted, use the Scroll List Function List **CURSOR UP** or **CURSOR DOWN** button until `Turn Auto Cursor On` is displayed and selected with the yellow box.
3. Touch the **SELECT** button on the screen. The cell is now prepared to step through the complete cycle manually.
4. Press the DO button on the operator interface terminal. The Scroll List cursor automatically advances to the next step. Each press of the DO button completes each step of the sequence.

#### 4.4.3.3. Tryout Mode

Tryout mode is provided to allow the cell mechanisms to cycle without running any parts. Tryout mode is used for setup and recovery to verify the cell process is operational. Complete the following steps to toggle cell operation to tryout mode.

1. Remove all parts from the cell. Tryout mode is not available if sensors detect parts in the cell.
2. On the operator interface touch screen, touch the **SELECT** button in the screen header.
3. After the Select screen displays, touch the **MODE** button.
4. After the Mode screen displays, touch the **TRYOUT MODE ON** button.
5. Put the operator interface AUTO/MANUAL key switch in the AUTO position and initiate automatic mode. Refer to the procedure ***4.3.3 Starting Cell in an Automatic Mode***.
6. To cancel tryout mode, stop the cell using **END OF CYCLE HOLD** (refer to ***4.4.3.5 End of Cycle Hold Mode***), move the operator interface AUTO/MANUAL key switch to the MANUAL position, and touch the **TRYOUT MODE ON** button again.

#### 4.4.3.4. Runout Mode

Runout mode is provided to allow a cell to complete the assembly of the remaining product without beginning production of anything new. Runout mode is used to empty the cell of product. Complete the following steps to toggle the cell operation to runout mode.

1. On the operator interface touch screen, touch the **SELECT** button in the screen header.
2. After the Select screen displays, touch the **MODE** button.
3. After the Mode screen displays, touch the **RUNOUT MODE ON** button.
4. To cancel runout mode, touch the **RUNOUT MODE ON** button again.

#### 4.4.3.5. End of Cycle Hold Mode

End of Cycle Hold mode is provided to bring a cell to a controlled stop and to the end of the current cycle. Complete the following steps to toggle the cell operation to end of cycle hold mode.

1. On the operator interface touch screen, touch the **SELECT** button in the screen header.
2. After the Select screen displays, touch the **MODE** button.
3. After the Mode screen displays, touch the **END OF CYCLE HOLD** button.
4. To cancel End of Cycle Hold mode, touch the **END OF CYCLE OFF** button.

# 5. MAINTENANCE

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## 5.1. GENERAL SERVICE GUIDELINES

Review the necessary sections of this User Manual and any relevant third-party device manufacturer literature before attempting to service the system. In addition to the general safety rules at the beginning of this Operation and Maintenance Manual, use the following guidelines when cleaning, servicing, or adjusting system mechanisms:

- Entering or servicing the controls enclosure while it is still electrically or pneumatically activated is extremely hazardous.

**WARNING!**

***Press an EMERGENCY STOP button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell for maintenance. Severe injury or death may occur if this warning is not followed.***

- Do not perform service work alone. Do not attempt internal service or adjustment unless another person capable of rendering first aid is present.
- Do not substitute parts or modify equipment. Due to the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product.
- Shut off electrical power and air pressure to the cell before servicing it, unless otherwise specified.
- Follow the general safety rules found at the beginning of this manual.
- Before troubleshooting or servicing the cell, make sure to have up-to-date drawings.
- Never enter or reach into an enclosure without the presence of another person capable of rendering aid.
- Do not wear metal items such as rings, metal necklaces, watches, and jewelry. They are electrical hazards. Wear medical alert jewelry with caution.
- Wear approved safety glasses.
- Use insulated tools when working with electrical equipment.
- When the repair is complete, check that all fittings and connections are tight.
- Use approved fuse pullers when changing fuses (or remove electrical power).
- Never use jumper wires or fuse substitutes to replace fuses.
- For continued fire protection, replace the line fuses only with fuses of the same voltage and current rating and type. Do not use repaired fuses or short-circuited fuse holders.
- Be prepared for proper handling of electrical fires by always keeping dry powder or carbon dioxide extinguishers handy.
- Do not use compressed air to clean cell devices. Use only clean cloths or a vacuum cleaner. Compressed air causes dirt and lubricants to become airborne, potentially contaminating sensitive tooling and products under assembly.
- Do not apply lubricants in a spray form. Apply lubricants by brush, oil can, cloth, or grease gun.

## 5.2. HAZARDOUS ENERGY GUIDELINES

This section describes the energy in the cell, its potential dangers, and the proper precautions that must be observed when working on the cell.

The system utilizes both pneumatic and electrical energy to provide automated motion. Both energy sources pose the potential for serious injury or death through contact, either directly or indirectly. Any time mechanical, electrical, or pneumatic adjustments are required, whenever preventive maintenance is to be performed, or at any other time where unsafe conditions may be present, always remove hazardous energy from the cell.

Electrical circuits carry relatively high voltages within the cell. Electrical hazards may result from damaged or broken wires and open electrical boxes or control panels. In the event of these or other kinds of electrical hazards, stop the equipment and disable power at the MAIN DISCONNECT switch. Do not enable power to the cell until an electrical technician has corrected the problem.

Pneumatic circuits carry relatively high pressures within the cell. Crushing or pinching injuries may be incurred from devices actuated by this compressed air. Compressed air injected into the bloodstream through a skin puncture may also cause severe injuries, as can debris propelled by uncontrolled compressed air. When working on devices in the pneumatic circuit (including the hoses and connectors), place the air processing equipment shutoff valve in the off position and vent the pneumatic circuit by pressing an EMERGENCY STOP button.

## 5.3. LOCKOUT/TAGOUT

Any time maintenance is to be performed on the cell, all cell energy sources must be locked out and tagged. The next section details the procedure to use when locking out and tagging the energy sources. This section describes the proper locks and tags that should be used.

**Lock Considerations** – When performing a lockout tagout procedure, proper locks should be installed. A good lock should:

- Be provided by the employer to ensure standardization and eliminate the use of inferior locks
- Be made by a reputable manufacturer
- Be standardized with all other locks used for lockouts (same size, shape, and color)
- Withstand heat, cold, and humidity
- Be strong enough that it cannot be removed with heavy force
- Not be a combination lock, must have a key
- Have only one key, held by one person
- Not be able to be opened by any other means than by key

**Tag Considerations** – When performing a lockout tagout procedure, proper tags should be attached to the locks. A good tag should:

- Feature a clear warning
- Be easy to read (both legible and clearly worded)
- Contain the identification mark of the individual who installed the tag
- Be durable and able to withstand extreme temperatures, fumes, and caustic chemicals
- Be secure enough to withstand accidental removal (not tear off)
- Be secured with something like a nylon cable tie that is self-locking, can be attached by hand, can resist release with less than 50-pounds of pressure, and cannot be reused

**NOTE**

***A tag can never be substituted for a lock. A tag is a visual warning but does not provide vital physical protection.***

### 5.3.1. Lock, Tag, and Try Procedure

Any time maintenance is to be performed on a cell, the following steps must be completed to ensure the safety of all personnel. For the most up-to-date information regarding lockout, always refer to the energy control lockout placard on the front of the cell PDP main control panel. In general, complete the following steps to lockout the primary energy sources in a cell:

1. Safely stop the cell by navigating to the Service (or Maintenance) screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the main disconnect switch to the off position at the PDP main control panel. Verify that the POWER ON indicator is dark at the main control panel and at the cell operator interface.
3. Install a lock and tag to the switch detailing the time and date of the lockout, the reason for the lockout, and the person responsible for the lockout.
4. Push in on and turn the air processing equipment shutoff valve to the off position to disconnect the cell pneumatic supply. Install a lock and tag detailing the time and date of the lockout, the reason for the lockout, and the person responsible for the lockout.
5. Make sure to lockout any other primary energy control sources identified on the cell lockout placard before performing any maintenance activities.
6. Check the cell operator interface for indicator illumination. If any indicators are illuminated, electrical energy is still present.
7. At the air processing equipment, check the pressure gage and ensure no residual pressure is present.
8. With the cell safely locked out, tagged out, and verified, maintenance can begin. When maintenance is complete, close all guard doors and remove the locks and tags. Refer to Chapter 4 for startup information.

### 5.3.2. Additional Safety Recommendations

The following actions will contribute to the safety of all personnel:

- A lockout/tagout center should be established under the control of one individual
- All locks and tags should be of the same type and stored and distributed by the individual responsible for the lockout/tagout center
- Technicians should retrieve locks and tags from the responsible person and then should install them on the system themselves
- When service spans a shift change, the new technician should install new locks and tags before the previous technician removes the previous locks and tags
- After removing locks and tags, return them to the lockout/tagout center

## 5.4. PREVENTIVE MAINTENANCE REFERENCE

Preventive maintenance must be performed at established intervals to keep the Main Pack Line equipment operating at peak performance. Follow your company preventive maintenance program when performing these activities. In addition to the maintenance activities already established by your company for commonly used equipment, ATS has provided preventive maintenance instructions specific to components critical to the equipment operation. The *documents provided* are as follows:

| Job Plan Number | Task Description | Task Frequency | Task Instruction Number |
|---|---|---|---|
| HLB_KROMER_GM00001__ | HLB_KROMER_7241 SERIES_SPRING BALANCER INSPECTION_T_3_MONTHS | 3 MONTHS | N/A |

## 5.5. LUBRICATION CHARTS REFERENCE

Proper lubrication is required to keep some of the Main Pack Line equipment operating at peak performance. ATS has provided lubrication charts for equipment requiring lubrication. The following charts have been provided:

| Number | Chart Name |
|---|---|
| 1 | EP280 Battery Pack Leak Test (*Lubrication Chart-Balancer Cable-EP280.docx*) |

# 5.6. MAINTENANCE TASK INSTRUCTION SHEETS REFERENCE

The Main Pack Line equipment requires periodic maintenance to keep the equipment operating at peak performance. ATS has provided Task Instruction Sheets as guides to completing these maintenance activities. The following Task Instruction Sheets have been provided:

| Task Instruction Number | Task Description |
|---|---|
| **EP280** | |
| 600 | 8-Replace Leak Testing Unit (*TIS-600 Replace Leak Testing Unit.xlsx*) |
| 601 | 11-Troubleshoot inside Electrical Panels (*TIS-601Troubleshoot inside Electrical Panels.xlsx*) |
| 602 | 10-Teach/Program/Replace Area Scanners (*TIS-602 Teach_Program_Replace Area Scanners.xlsx*) |
| 603 | 15-Replace Leak Test Connectors (*TIS-603 Replace Leak Test Connectors.xlsx*) |
| 604 | 16-Replace Leak Test Hose (*TIS-604 Replace Leak Test Hose.xlsx*) |
| 605 | 13-Replace Electrical Componenets (Stacklight, Push Buttons, E-Stops, Printer, IR Cameras) (*TIS-605 Replace Label Printer.xlsx*) |
| 606 | 1-Connect Electrical and Leak Test Adaptors (Operation) (*TIS-606 Connect Electrical and Leak Test Adaptors (Operation).xlsx*) |
| 607 | 3-Disconnect Electrical and Leak Test Adaptors (Operation) (*TIS-607 Disconnect Electrical and Leak Test Adaptors (Operation).xlsx*) |
| 609 | 5-Replace Tool Balancers (*TIS-609 Replace Tool Balancer.xlsx*) |
| 610 | 14-Replace Electrical Connectors (*TIS-610 Replace Electrical Connectors.xlsx*) |
| 611 | 17-Replace LV Electrical Cable Harnesses (*TIS-611 Replace LV Electrical Cable Harnesses.xlsx*) |
| 612 | 6-Replace and Adjust J-Boxes (*TIS-612 Replace and Adjust J-Boxes.xlsx*) |
| TBD | 7-Perform Dead-Head Verification (*Xxxx.xlsx*) |
| **EP680** | |
| 613 | 2-Connect Leak Test Adaptors-Front Connections (*Xxxx.xlsx*) |
| 614 | 6-Disconnect Leak Test Adaptors-Front and Rear (Operation) |
| 618 | 12-Troubleshoot inside Electrical Panels |
| 619 | 13-Replace inside Electrical Panels |
| 620 | 10-Replace Air Lines and Leak Test Connectors(Maintenance) |
| 621 | 4-Perform Leak test (Operation) |
| 622 | 11-Trobleshoot Pneumatic Components |

## 5.7. SEAL MAINTENANCE – O-RINGS AND RETAINING SPRINGS

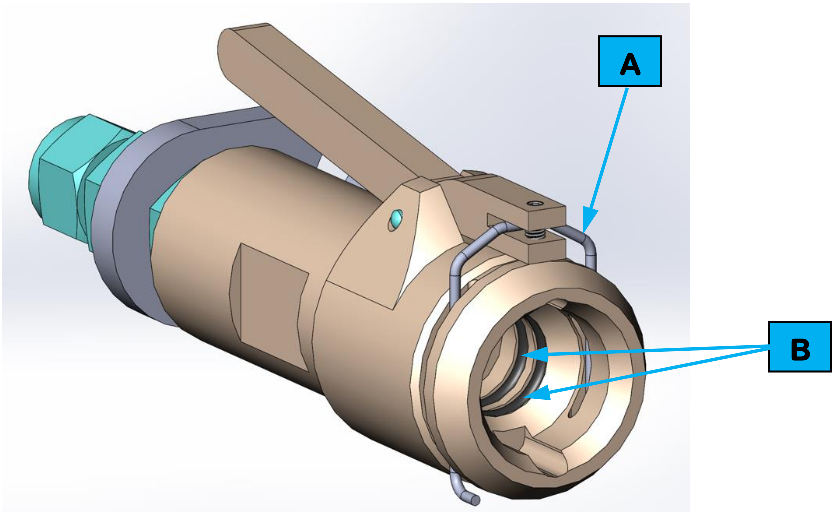
Following is the list of O-Rings and Retaining Springs for battery pack test tools:

| O-RING and RETAINING SPRING LIST | | | | | |
|---|---|---|---|---|---|
| **TOOL** | **BATTERY PACK VIEW** | **FACE SEAL** | **INTERNAL SEAL** | **BORE SEAL** | **RETAINING SPRING** |
| **EP280** | | | | | |
| BEV3 Outlet Coolant Connector 16.3mm | Front | N/A | N/A | Parker O-Ring N0674-70 #2-114 Qty. 2 | ATS #700029825 16mm Opening Qty. 1 |
| BEV3 Inlet Coolant Connector 22.3mm | Front | N/A | N/A | Parker O-Ring N0674-70 #2-118 Qty. 2 | ATS #700029807 22mm Opening Qty. 1 |
| **EP680** | | | | | |
| ACEC Header Plug | Rear (2) | N/A | O-Ring P/N TBD Qty. 1 | N/A | N/A |
| BEV3 LV Header Plug | BEV3 X1-Front (1) | N/A | O-Ring P/N TBD Qty. 1 | N/A | N/A |
| BEV3 DCFC Header Plug | BEV3-Front (1) | N/A | O-Ring P/N TBD Qty. 1 | N/A | N/A |
| BEV3 HV Header Plug | BEV3 IPE-Front (2)<br><br>BEV3 RDU-Rear (4) | N/A | O-Ring P/N TBD Qty. 1 | N/A | N/A |
| BEV3 Vacuum Connector | Rear | O-Ring P/N TBD Qty. 2 | N/A | N/A | N/A |

O-Rings are removed using a hook and pick tool.

***Figure 5-1. Hook & Pick tool set***

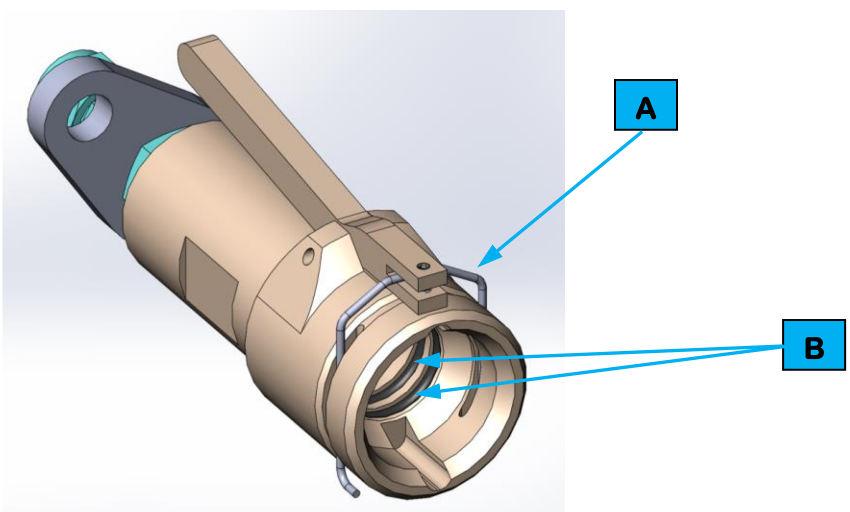
### 5.7.1. BEV3 Outlet Coolant Connector O-Rings and Retaining Spring




| | |
|---|---|
| A | Retaining Spring |
| B | O-Rings |

*Figure 5-2. BEV3 Outlet Coolant Connector O-Rings and Retaining Spring*

### 5.7.2. BEV3 Inlet Coolant Connector O-Rings and Retaining Spring




| | |
|---|---|
| A | Retaining Spring |
| B | O-Rings |

*Figure 5-3. BEV3 Inlet Coolant Connector O-Rings and Retaining Spring*

### 5.7.3. Pack Electrical Test Coolant Leak Test 16.3 MM O.D. Connector

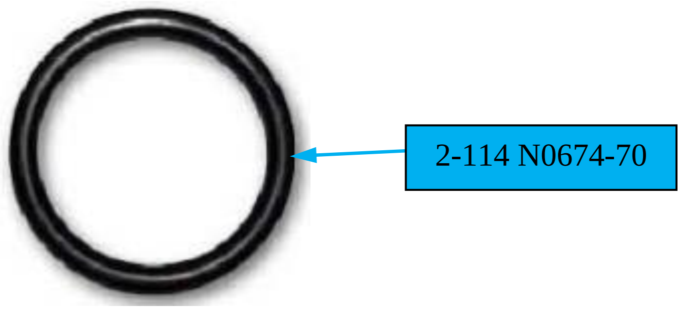



*Figure 5-4. External Part Face Seal*

### 5.7.4. Pack Electrical Test Coolant Leak Test 22.3MM O.D. Connector

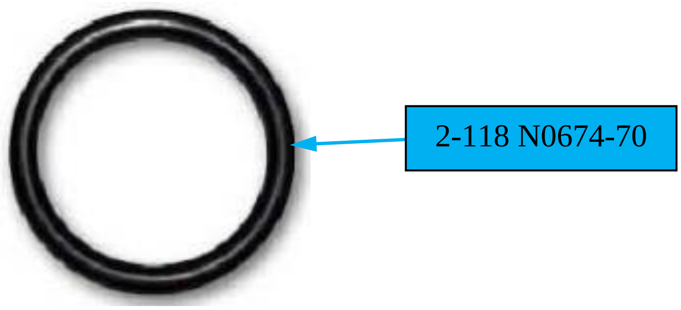



*Figure 5-5. External Part Face Seal*

### 5.7.5. Pack Electrical test Coolant Leak Test 26.3MM O.D. Connector

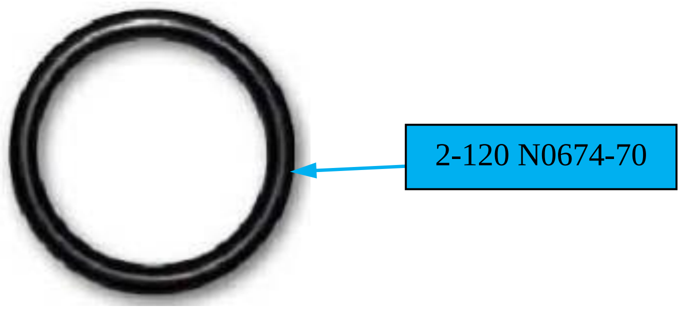



*Figure 5-6. External Part Face Seal*

### 5.7.6. Cover Leak Test Burst Valve Opening Leak Test Connector

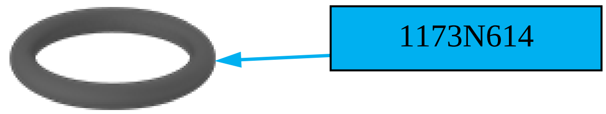



*Figure 5-7. Part Face Seal*

### 5.7.7. Cover Leak test Burst Valve Opening Leak Test Connector

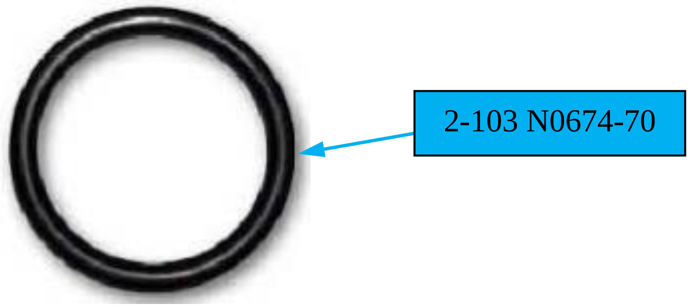



*Figure 5-8. Internal Shaft Seal*

### 5.7.8. High Voltage Connector Plug

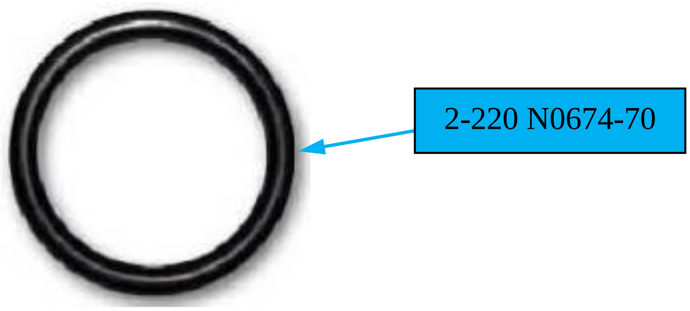



*Figure 5-9. Internal Part Face Seal*

### 5.7.9. DC Fast Charge Electrical Connector Sealing Assembly

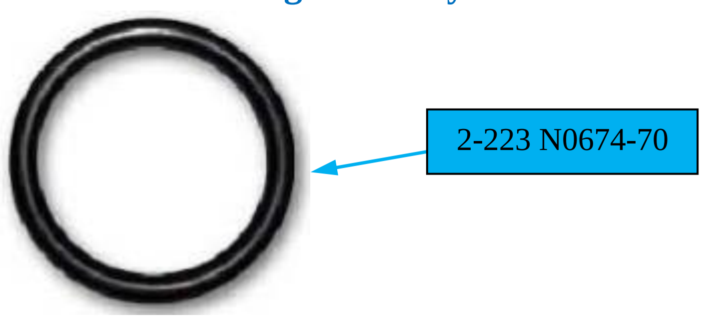



*Figure 5-10. Internal Part Face Seal*

### 5.7.10. High Voltage Bat Connector Plug

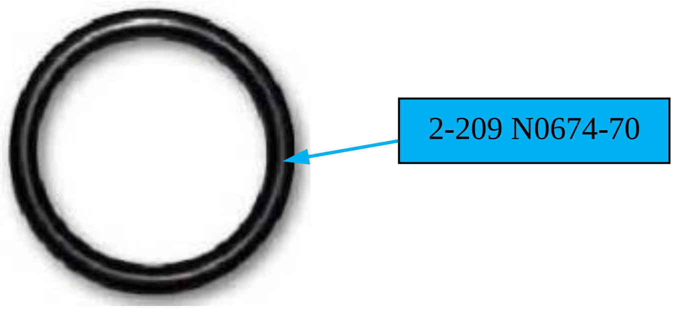



*Figure 5-11. Internal Part Face Seal*

### 5.7.11. Molex 20 Way Low Voltage Electrical Connector Sealing Assembly

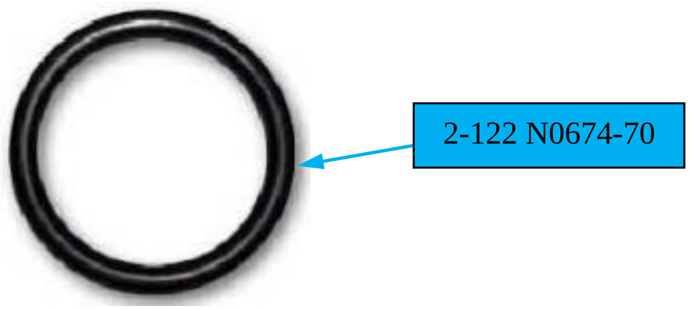



*Figure 5-12. Internal Part Face Seal*

| PACK ELECTRICAL TEST STATION - EP280P1,P2 | |
|---|---|
| **Manufacturer & Part Number** | **Life Cycle** |
| Parker 2-114 N0674-70 | 1500-3000 CYCLES |
| Parker 2-118 N0674-70 | 1500-3000 CYCLES |
| Parker 2-120 N0674-70 | 1500-3000 CYCLES |

| COVER LEAK TEST STATION - EP680P1-P3 | |
|---|---|
| **Manufacturer & Part Number** | **Life Cycle** |
| McMaster Carr 1173N614 | 3000-5000 CYCLES |
| Parker 2-103 N0674-70 | 5000-8000 CYCLES |
| Parker 2-220 N0674-70 | 1500-3000 CYCLES |
| Parker 2-223 N0674-70 | 1500-3000 CYCLES |
| Parker 2-209 N0674-70 | 1500-3000 CYCLES |
| Parker 2-122 N0674-70 | 1500-3000 CYCLES |

## 5.7.12. Procedure for Adding a New program to an ATEQ F620 Leak Test Instrument

The ATEQ leak test instrument can have many programs configured and these programs can be executed based on the part type being tested. When part types have the same internal volume, the same program can be called for those part types. If a new part type is going to be tested that has a different internal volume, then a new program needs to be added.

The easiest way to add a new program is to Copy an existing program that has a similar sequence, then modify the copied program to test the new part type correctly. Listed below are steps for copying and modifying a program for a new part type. You will need a known GOOD zero leak part to configure this New test program correctly.

**NOTE: It is highly recommended that the person creating New programs for production use have a good knowledge of leak test principals and can confirm all aspects of the New test program are working properly before deploying to production testing.**

1. With the instrument power turned ON, the Main Status screen should appear on the instrument as shown in image below.

2. Press the ESC button one time and the Main Menu screen will appear as shown in image below.

3. Press the Arrow keys to highlight PARAMETERS, then press OK. A list of configured programs will appear as shown in image below. Using the Arrow keys, scroll through the list of programs and determine which program number you want to copy AND which Empty program number you want the new program to be assigned to. Once this is determined, use the Arrow keys to scroll to the TOP of the Parameters list so the Yellow Triangle is pointing to Copy-Paste.

4. Press the OK button and PARAM/Copy/Paste screen will appear as shown in image below. Press the OK button again to select the COPY from program you want to use. Use the Arrow Keys to scroll to the COPY program then press OK (In this example we chose program 001).

5. Press the Down Arrow once to select PASTE the press OK. Use the Arrow Keys to scroll to the program number you want to copy the program to (In this example we chose program 004). Press the OK button to start the copying process. Note that the instrument will start copying as soon as you press OK. If you have made a mistake or want to exit this menu, Press the ESC button. When the Copy is complete, press the ESC button to go back to the PARAMETERS screen.


6. Use the arrow keys to scroll to your newly copied program in the parameters list (in this example we copied to program Pr:04). Notice that the Name of the program is the same as the program we copied it from. The next steps will describe how to change the program name.

7. Press OK to access the Parameters for program Pr004. When the parameter screen appears, use the Down Arrow button to scroll to the bottom of the list labeled FUNCTIONS then press the OK button to access the Functions screen.

8. When the FUNCTIONS screen appears, the cursor will be pointing to NAME: (left image). Press OK to start editing the Name of the program (right image). The name is changed One character at a time. The selected character has the flashing "#" symbol. Use the Arrows keys to select the desired character, then press OK to move to the next character. When you reach the last character and press OK the cursor will jump back to the NAME and your edits will be accepted. In this example we change the name to "NEW PROGRAM".


9. There are several parameters that need to be determined when setting up a test for a new model type. The first is setting the proper Fill time to achieve the test pressure. In this example our test pressure is 25 psig. The program that you copied might have Pre-Fill and normal Fill times. Press the ESC button until the Main Screen is displayed (left image). Use the Arrow keys to scroll through the available programs and scroll to the New program you just created.

   Connect the new model part to the system and Run a test by pressing the Green play button. If the pressure does not achieve the 25 psig setpoint, adjust the Pre-Fill and Fill times in the program and run the test again after waiting a least 1 minute for the test part to completely vent. Timer values are adjusted by using Arrow keys to scroll to the Pre-Fill or Fill time options, press the OK button, use Arrow keys to increase or decrease the timer value, Press OK to accept or ESC to cancel. Note you can hold down the Arrow key to increase/decrease the timer value quickly (right image).



10. The next step is to determine the internal volume of the new part type. Use the Arrow keys to scroll to the DUMP TIME and OK. Use the down Arrow to set the Dump Time to 0.00 seconds and press OK.


11. Run a test by pressing the Green play button and write down the leak rate reported on the screen. The part will stay pressurized because the dump time is set to zero seconds. Run several more test until the reported leak rate value stabilizes to a consistent value. Ideally this consistent value should be close to zero sccm, but if the part has a leak, it will be some positive value. Compute the average of the last three consistent leak rates reported. This will be your LeakRateNoOrifice value (LRNO).
12. Enable a known leak orifice in the test circuit using whatever method is provided. This might be a quick connect fitting, manual ball valve, or solenoid operated valve. Make note of the leak rate of the orifice because this will be used in a calculation and will be your OrificeLeakRate (OLR). Run several tests with the leak orifice enabled and compute the average of the last three consistent leak rates reported. This will be your LeakRateWithOrifice value (LRWO).
13. Next, we need to know what the current volume setting is in our new program. Go to the Parameters screen and select your new program and scroll down to view the VOLUME setting. Make note of this value and it will be your CurrentVolume (CV). In this example the VOLUME is 9.5 liters which is 9500 cubic centimeters (cc).


14. Compute the NewVolume (NV) of the test part using the equation below. IMPORTANT: Make sure that all Volumes are in units of cubic centimeters (cc).

$$NV = \frac{OLR}{(LRWO - LRNO)} \times 10400$$

15. Enter the New Volume value into the VOLUME parameter of your new program. Note that you need to convert from cc to liters by multiplying by 1000.

16. Note that the test part is still pressurized and should be very stable by now.
    Repeat step 11 and verify the LeakRateNoOrifice is stable.
    Repeat step 12 and verify the LeakRateWithOrifice is stable AND is EQUAL to (LeakRateNoOrice + OLR)
    If the LeakRateWithOrifice is not equal to (LeakRateNoOrifice + OLR) then repeat steps 13, 14 and 15.

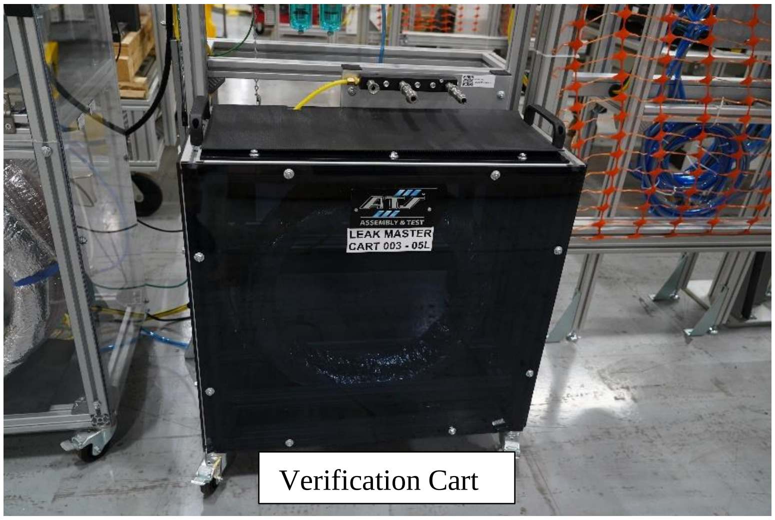
17. Set the Dump time back to 1.0 second, run one more test by pressing the Green play button and the part will vent at the end of test. Wait 3 minutes for the pat to completely vent and stabilize to its normal state.

18. The next step is to confirm the Stabilize time is correct for the new part type. For example, our Max leak rate limit is 5 sccm so we would like our reported leak rate for a known zero leak part to be 1.5 sccm or lower. The internal volume of these coolant circuits is large, so we do not have enough cycle time to wait for a result that is reporting close to zero sccm. Make sure the Leak Orifice is disabled, then Run a test by pressing the pressing the Green play button. If the reported leak rate is greater than 1.5 sccm, add some Stabilize time to the program. Wait 3 minutes and run another test. Repeat this process until your reported leak rate is less than 1.5 sccm. NOTE this is assuming you have a zero leak part you are testing.

## 5.8. VERIFICATION PROCESS FOR PACK COOLANT LEAK TEST

For the Pack Coolant Leak Test a cart with a copper coil test volume is provided to verify the coolant leak test is working properly at the beginning of each shift, or when issues are encountered with the leak test system. Ports are provided on the outside of the verification cart to manually connect the leak test tools of the test stand.

Two verification carts will be provided:



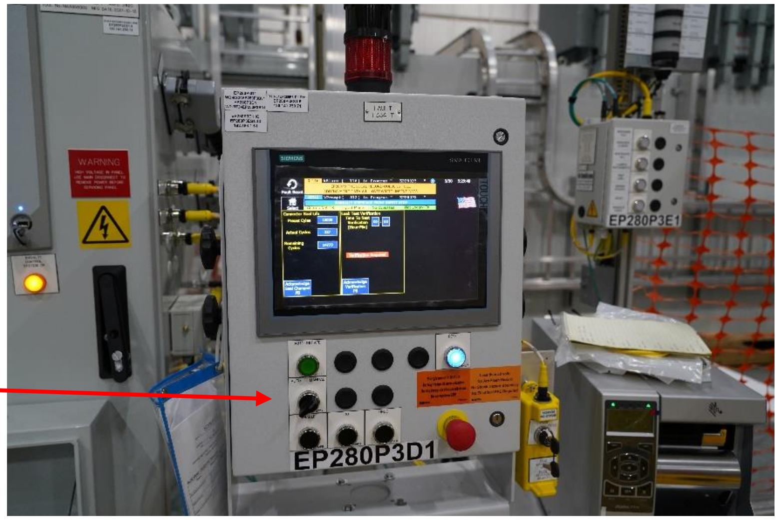
Verification Cart

- 5 liter copper coil cart to be used on the Op280 stations.
- 10 liter copper coil cart to be used on the Op580 stations.

## 5.8.1. Verification Process Steps

1. At the beginning of each shift, the operator will run the verification process.
2. Operator places station in Auto Mode.

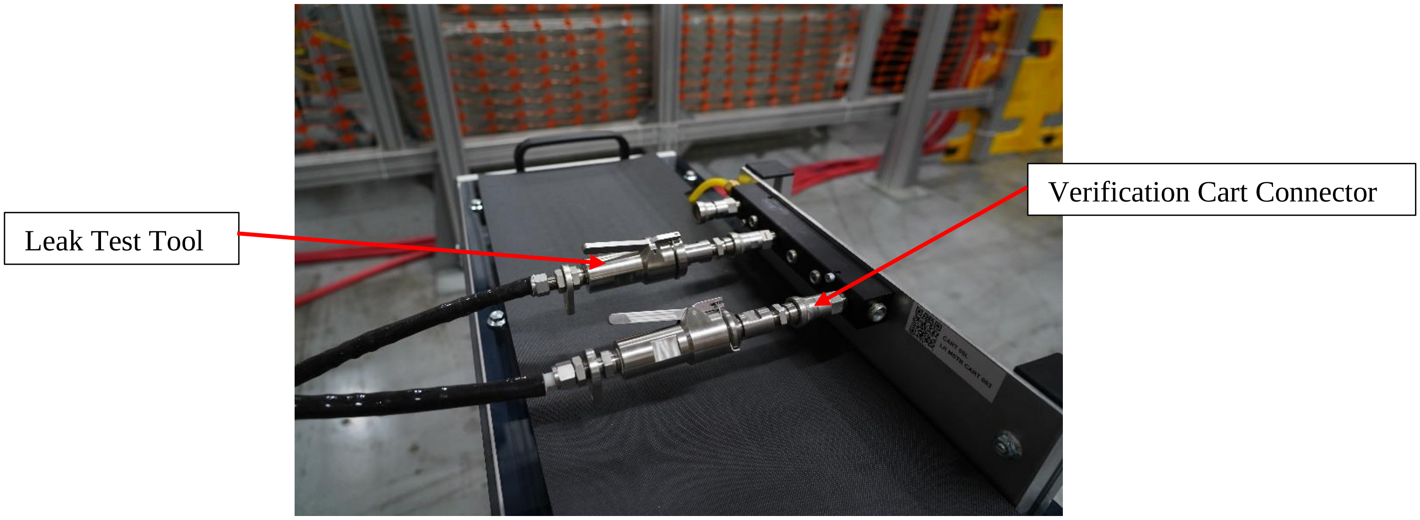
Auto Mode/HMI




3. Operator will roll the Verification cart into the station near the leak test tools in the space where the AGC cart would normally be parked.

Verification Cart

4. Operator connects ALL the leak test tools to the Verifications cart.




5. Operator scans the barcode label on the Verification cart.

6. Operator exists the test area and Presses the Cycle start Button.

Cycle Start Button


7. The Bauer software will run the correct Leak Test Verification program WITHOUT orifice enabled, wait a predetermined rest time, then run the same Verification program again WITH a calibrated orifice enabled.
8. The test result WITHOUT orifice enabled should be 0.00 sccm +/-0.20 sccm.
9. The test result WITH orifice enabled should be: [(Orifice sccm) + (Leak without orifice sccm)] +/-0.20 sccm
10. Operator disconnects leak test tools from the verification cart and place cart in storage location.

| **NOTE** | ***Stations that run BEV packs only will use the 5 liter cart and 1.2 sccm orifice*** <br> ***Stations that run BEV and lower-level BET packs will use the 5 liter cart and 1.2 and 3.0 sccm orifices.*** <br> ***Stations that run only Fully Assembled BET packs will use the 10 liter cart and 5.0 sccm orifice..*** |
|---|---|

# 6. TROUBLESHOOTING

## Table of Contents

# 6.1. CELL BASE FAULTS

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| Any Ethernet I/O Communication Faults | Bad or disconnected cable | Check Ethernet cable for damage, replace cable |
| | Bad module | Check module for errors, replace module |
| ETHERNET PORT STATUS ERROR | A PORT IS RUNNING WRONG SPEED OR DUPLEX | CHECK CONFIGURATION OF MODULE AND ETHERNET SWITCH |
| ETHERNET PORT CRC FAULTS | BAD CABLE OR CONNECTION | CHECK ETHERNET CABLES / RECEPTACLES |
| ETHERNET COMM NOT OK NETWORK NOT OK | COMMUNICATION WARNING MESSAGE | CHECK ETHERNET CABLES / RECEPTACLES |
| E-Stop PB Pressed Fault | Any Estop Button Pressed | Check HMI for fault message to identify which E-Stop is pressed and reset |
| Cell E-Stop Condition Exists Fault | High Voltage Panel doors, Safety Contactor Panel door or Junction Boxes doors are not closed | Check HMI for fault message to identify which door is open and close door |
| | Any Estop Button Pressed | Check HMI for fault message to identify which E-Stop is pressed and reset |
| ANY CB OK NOT ON | Circuit braker off or tripped | Check HMI for fault message to identify which circuit braker is tripped and check corresponding panel for braker status |
| Any Power supply Off fault | Control panel disconnect off | Turn On Disconnect |
| | Circuit braker tripped in control panel | Reset braker |
| Air Off Fault | Air supply manual valve is off | Turn valve on |
| | Pressure switch cable bad or disconnected | Check switch cable |
| Barcode Scanner Communication Fault | Bad or disconnected cable | Check Ethernet cable for damage, replace cable |
| | GFI receptacle Braker Tripped | Check Junction box and reset GFI receptacle |
| PRINTER COMMUNICATION ERROR | Ethernet Communication Issue | CHECK CONNECTION (CABLES AND IP ADDRESS) |

## 6.2. STATION & FIXTURE FAULTS

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| Part Number Invalid Fault (manual mode only) | Part number scanned is not valid, not found in PLC list | Check for bad label or incorrect part in station |
| SCANNED BARCODE NOT A VALID MODULE TRACE CODE | Bad or missing trace code | Check for bad label |
| DATA COULD NOT BE SENT TO PRINTER | Printer power is off | Check printer power |
| | Cable disconnected | CHECK CONNECTION AND PRINTER |
| Hood Fall Ratchet Engaged / Disengaged Missing | Hood Fall Ratchet obstructed | Remove the obstruction |
| | Input switch for hood fall ratchet engaged / disengaged is out of alignment | Check switch alignment |
| | Input switch cable is damaged | Inspect switch cable |
| Upper Hood Cylinder Lowered / Raised Missing | Upper hood cylinder is obstructed | Remove the obstruction |
| | Input switch for upper hood cylinder lowered / raised is out of alignment | Check switch alignment |
| | Input switch cable is damaged | Inspect switch cable |
| Hood Locator Cylinder Lowered / Raised Missing | Hood Locator cylinder is obstructed | Remove the obstruction |
| | Input switch for hood locator cylinder lowered / raised is out of alignment | Check switch alignment |
| | Input switch cable is damaged | Inspect switch cable |
| Lower Hood Cylinder Lowered / Raised Missing | Lower hood cylinder is obstructed | Remove the obstruction |
| | Input switch for lower hood cylinder lowered / raised is out of alignment | Check switch alignment |
| | Input switch cable is damaged | Inspect switch cable |
| Front Access Door | Front access door is obstructed | Remove the obstruction |
| | Input switch front access door closed / open is out of alignment | Check switch alignment |

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| Closed / Open Missing | Input switch cable is damaged | Inspect switch cable |
| Rear Access Door Closed / Open Missing | Rear access door is obstructed | Remove the obstruction |
| | Input switch rear access door closed / open is out of alignment | Check switch alignment |
| | Input switch cable is damaged | Inspect switch cable |
| LOCKOUT PIN NOT IN HOLDER | Lockout pin not in holder or switch cable disconnected | Check pin holder |
| | Switch out of adjustment | Adjust switch |

## 6.3. BAUER SYSTEM FAULTS

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| DAQ01 ETHERNET FAULT | Bad or disconnected cable | Check Ethernet cable for damage, replace cable |
| | Bauer PC is turned off | Power on PC |
| DAQ01 ETHERNET PORT CRC FAULTS | Ethernet communication fault | CHECK ETHERNET CABLES / RECEPTACLES |
| ETHERNET PORT STATUS ERROR | A PORT IS RUNNING WRONG SPEED OR DUPLEX | CHECK ETHERNET SWITCH PORT SETTINGS |
| BAUER PCS COMM NOK | Application on PC not running, watchdog issue | Start application, Check Bauer PC for Details |
| BAUER PCS FAULT | Alarm from Bauer PC | Check Bauer PC for detailed information |
| BAUER PCS SYSTEM FAULTED | System Alarm from Bauer PC | System Alarm from Bauer PC |
| BAUER PCS FAILED READ VALIDATION | Bauer cannot validate part number | Check label and part number |
| BAUER PCS TEST ABORTED | Electrical Test aborted | Check Bauer PC for detailed information |
| PANEL DOOR NOT CLOSED & LOCKED | Any Panel door not properly closed or locked | Check HMI alarm screen to identify the correct door |
| | | Check MCC panel disconnect is ON |
| PANEL DOOR UNLOCKED | Any panel door unlocked | Check HMI alarm screen to identify the correct door |
| | | Check MCC panel disconnect is ON |
| JUNCTION BOX DOOR CLOSED NOT ON | Check for any junction box not properly closed | Check HMI alarm screen to identify the correct door and close the door |

## 6.4. CYCLER PANEL FAULTS

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| FTF01 ETHERNET COMM FAULT | ETHERNET COMMUNICATION FAULT WITH PANEL REMOTE I/O | CHECK HMI ENET SCREEN IP ADDRESS FOR DETAILS |
| | | Check cable and connection |
| FTF01_E3020INV ETHERNET COMM FAULT | ETHERNET COMMUNICATION FAULT WITH DRIVE E3020 | CHECK HMI ENET SCREEN IP ADDRESS 192.168.1.161 FOR DETAILS<br>CHECK DRIVE POWER IS ON |
| FTF01_E3720INV ETHERNET COMM FAULT | ETHERNET COMMUNICATION FAULT WITH DRIVE E3720 | CHECK HMI ENET SCREEN IP ADDRESS 192.168.1.162 FOR DETAILS<br>CHECK DRIVE POWER IS ON |
| FTF01_E4420INV ETHERNET COMM FAULT | ETHERNET COMMUNICATION FAULT WITH DRIVE E4420 | CHECK HMI ENET SCREEN IP ADDRESS 192.168.1.163 FOR DETAILS<br>CHECK DRIVE POWER IS ON |
| CON01 HVHC CIRCUIT 1,2 & 3 ENABLE ON FAULT | CONTACTOR 1, 2 OR 3 FEEDBACK ON SIGNAL NOT RECEIVED | Check Contactors in contactor panel<br>Call technician |
| CON01 HVHC CIRCUIT 1,2 & 3 ENABLE OFF FAULT | CONTACTOR 1, 2 OR 3 FEEDBACK OFF SIGNAL NOT RECEIVED | Check Contactors in contactor panel<br>Call technician |
| FTF01 CYCLER DRIVE ENABLE RELAY 1 or 2 ON FAULT | DRIVE ENABLE RELAY 1 OR 2 FEEDBACK ON SIGNAL NOT RECEIVED | Check DRIVE ENABLE RELAY 1 & 2 IN CYCLER PANEL<br>Call technician |
| FTF01 CYCLER DRIVE ENABLE RELAY 1 or 2 OFF FAULT | DRIVE ENABLE RELAY 1 OR 2 FEEDBACK OFF SIGNAL NOT RECEIVED | Check DRIVE ENABLE RELAY 1 & 2 IN CYCLER PANEL<br>Call technician |
| E402AC AIRCONDITIONER OK NOT ON EP280P1FTF01.I20100 | Air conditioner E402 Issue | Check air conditioner #1 in cycler panel |
| E418AC AIRCONDITIONER OK NOT ON EP280P1FTF01.I20102 | Air conditioner E418 Issue | Check air conditioner # 2 in cycler panel |
| E208PWS LINE SIDE 24VDC PWS OK NOT ON EP280P1FTF01.I20103 | Power supply failure | Check power supply E208PWS in cycler panel |
| E358PWS LOAD SIDE 24VDC PWS 2 OK NOT ON EP280P1FTF01.I20105 | Power supply failure | Check power supply E358PWS in cycler panel |
| PANEL TEMPERATURE OK NOT ON EP280P1FTF01.I20106 | PANEL IS OVERHEATED | Check AC is on and operating properly |

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| ANY CIRCUIT BRAKER TRIPPED | CIRCUIT BRAKER TURNED OFF OR TRIPPED | CHECK CIRCUIT BRAKER IN CYCLER PANEL |
| CYCLER DRIVE POWER NOT ENABLED FTF01.O20500/01 | DRIVE POWER NOT ENABLED FEEDBACK SIGNAL MISSING | CHECK DRIVE POWER CONTACTOR CALL TECHNICIAN |
| HV CIRCUIT 1,2 OR 3 UNICO DRIVE FAULTED FTF01 E3020INV, E3720INV,E4420INV | HIGH VOLTAGE CIRCUITS FAULTED FOR UNICO DRIVE 1 2 OR 3 | CHECK DRIVES CALL TECHNICIAN |

## 6.5. CTS LEAK TEST FAULTS

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| CTS01 ETHERNET COMM FAULT | Bad or disconnected cable | Check Ethernet cable for damage, replace cable<br>CHECK ENET SCREEN IP ADDRESS 192.168.1.183 for detailed information |
| | CTS PC is turned off | Power on PC |
| CTS01 ETHERNET PORT CRC FAULTS | CTS Ethernet Communication issue | CHECK ETHERNET CABLES / RECEPTACLES - 192.168.1.183 |
| CTS01 PORT STATUS ERROR | A PORT IS RUNNING WRONG FSPEED OR DUPLEX | Check Ethernet Configuration |
| CTS Leak System Fault | Alarm triggered by CTS Leak System | CHECK CTS COMPUTER FOR DETAILS |
| CON01 CTS MASTER CONTROL RELAYS ENABLE ON FAULTS | CTS Power ON Contactor on feedback signal not received | Check Contactor in CTS panel<br>Call technician |
| CON01 CTS MASTER CONTROL RELAYS ENABLE OFF FAULTS | CTS Power On Contactor OFF feedback signal not received | Check Contactor in CTS panel<br>Call technician |
| LEAK TEST PART DATA NOT RECEIVED | CTS system did not receive part data information | Check communication with CTS PC |
| VACUUM MOTOR DID NOT TURN ON I100.0 | No running feedback signal from motor starter | Check motor starter in CTS panel |
| VACUUM MOTOR TEMPERATURE FAULT I100.1 | Vacuum Motor Overheated | Check Motor |
| VACUUM MOTOR OVERLOAD FAULT I100.2 | Vacuum Motor Starter Tripped | Reset Motor starter<br>Call Technician |

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| VACUUM SWITCH FAULT I100.3 | Vacuum reading is higher than setting on switch | Check vacuum system |
| VACUUM MOTOR NOT OFF I100.0 | No Off-feedback signal from motor starter | Check motor starter in CTS panel |

## 6.6. FLOOR SAFETY LASER SCANNERS FAULTS

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| ETHERNET COMM FAULTED SICK LASER SCANNER | Bad or disconnected cable | Check Ethernet cable for damage, replace cable |
| | Scanner configuration issue | Check scanner for errors, replace module |
| LASER SCANNER NOT ACTIVE CHECK SAFETY PROGRAM | Scanner safety field configuration issue | Connect to scanner and check configuration |
| | FIELD SELECT MAY BE WRONG | Connect to scanner and check field selection |
| LASER SCAN CONTAMINATION WARNING | Dirty lens | CHECK AND CLEAN LASER SCANNER LENS |
| LASER SCAN CONTAMINATION FAULT | Dirty lens | CHECK AND CLEAN LASER SCANNER LENS |
| LASER SCANNER SIGNATURE READ FAULT | PLC MSG instruction programming issue | CHECK LASER SCANNER MESSAGE INSTRUCTION<br>CALL PLC TECHNICIAN |
| LASER SCANNER SIGNATURE MISMATCH | LASER SCANNER CONFIGURATION CHANGE DETECTED | Connect to scanner and check configuration |
| LASER SCANNER FAULTED SCANNER C1 FAULT | -BAD CONFIGURATION | Connect to scanner and check configuration |
| LASER SCANNER FAULTED SCANNER C2, E3, E4 FAULT | - SYSTEM PLUG FAULT | Ethernet connector damaged, Change Scanner Ethernet connector |
| LASER SCANNER FAULTED SCANNER C3 FAULT | FIRMWARE FAULT | Connect to scanner and check firmware revision |
| LASER SCANNER FAULTED SCANNER E1 FAULT | INTERNAL FAULT | - REBOOT SCANNER |
| LASER SCANNER FAULTED SCANNER L8 FAULT | INPUT TIED DOWN ISSUE | RESET INPUT TIED DOWN |
| LASER SCANNER FAULTED SCANNER NX FAULT - | INVALID MONITORING CASE | Connect to scanner and check monitoring case configuration |
| LASER SCANNER FAULTED | TEMPERATURE FAULT | Check scanner |

| Fault | Possible Cause | Corrective Procedure |
|---|---|---|
| SCANNER T1 FAULT | | |
| LASER SCANNER FAULTED SCANNER W1 FAULT | - TOO MANY WARNINGS - | Connect to scanner and check warnings |
| LASER SCANNER SIGNATURE =0 | PLC MSG instruction programming issue | CHECK LASER SCANNER MESSAGE INSTRUCTION<br>CALL PLC TECHNICIAN |

## 6.7. LEAK TEST TROUBLESHOOTING

The Leak Test Equipment will fault after a reject. The operator will then be able to retest via the push button on the operator push box. If a reject occurs again the part will go to a repair area. Following are the steps to determine the cause and to resolve this issue:

1. If the machine continues to reject parts or if the machine is rejecting on the same sequence and circuit then do the following:
    a. Visually inspect the seals corresponding to the rejects. Look for any extraneous matter on the sealing surface(s) which could cause a leak path. Examine the seals for wear or possible damage.
    b. Replace any worn or damaged seal(s).
    c. Clean all sealing surfaces.
    d. Start the machine and continue running parts.
2. If the machine continues to reject parts, then do the following:
    a. Clean all sealing surfaces again.
    b. Run the Zero Master part.
    c. If the Zero Master part passes, then investigate the parts.
    d. If the Zero Master part fails, follow steps below.
    e. Use the prescribed Leak Test Snoop Test (Soap Solution) and apply it on the sealing area that is failing on the Zero Master. This is done to verify the source of the leak.
    f. If a leak is indicated, then change the seal(s) corresponding to the rejects.
    g. Reset the fault and restart the machine. Restarting forces to run a Zero Master system check. Verify that the new seal resolved the issue.
3. If the machine is still failing on the Zero Master call maintenance.

## 6.8. COMMON FAULTS TROUBLESHOOTING

Specific troubleshooting procedures for common fault types are documented in the GM NOK Checklists. Please refer to these checklists for recovery information.

# 7. ASSEMBLY AND DISASSEMBLY

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# 7.1. EP680 HOOD ASSEMBLY

*Figure 7-1. EP680 Hood Assembly*

## 7.1.1. Removing the Hood Assembly

Hood Removal Instructions:

1. Bring the AGC cart into the station at defined position.
2. Extend Lower and Upper Cylinder to lower the hood on top of the cart.
3. Make sure Hood is properly located and rested on the top of AGC.
4. Remove all the test lines connections from the test enclosure mounted on the hood.
5. Remove all the electrical and pneumatic lines for the Sensors, Cylinders, Seal Connectors, Indicator Lights and Nests from the Hood.
6. Unscrew (4) shoulder bolts with springs to separate Hood along with XY Slide Assembly from the aluminum extrusion frame of Vertical Slide Assembly.
7. Make sure Shoulder Bolts and Springs are properly stored for reinstallation.
8. Retract both upper and lower cylinder so that Hood along with XY Slide Assembly detached from the Aluminum frame.
9. Bring the AGC along with the Hood out of the station.
10. Please follow the process in reverse order for the installation of the Hood.

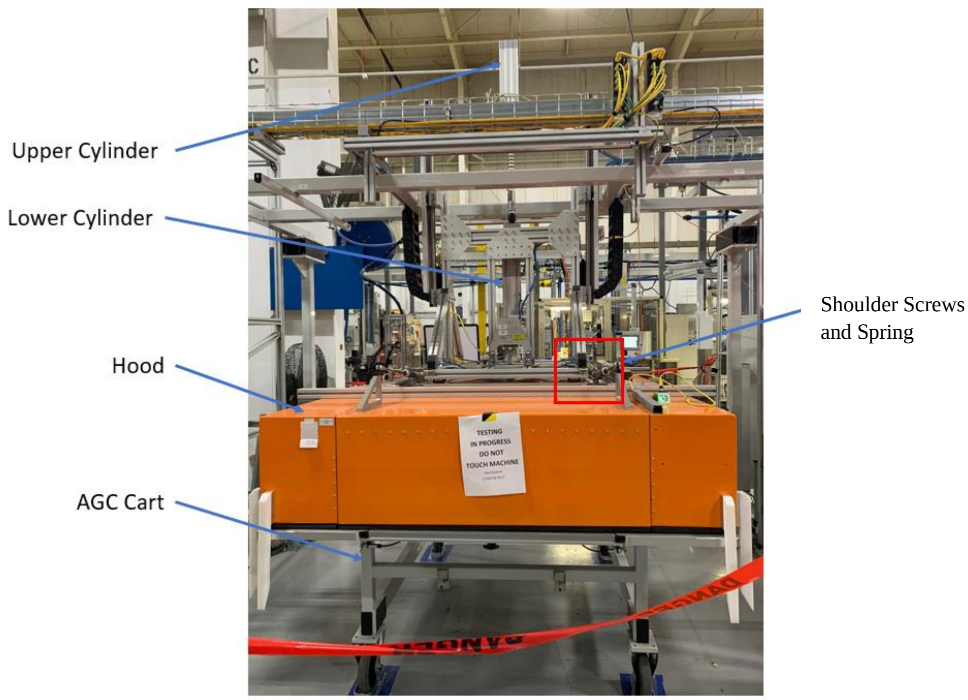


***Figure 7-2. Hood Assembly***


***Figure 7-3. Hood Assembly***

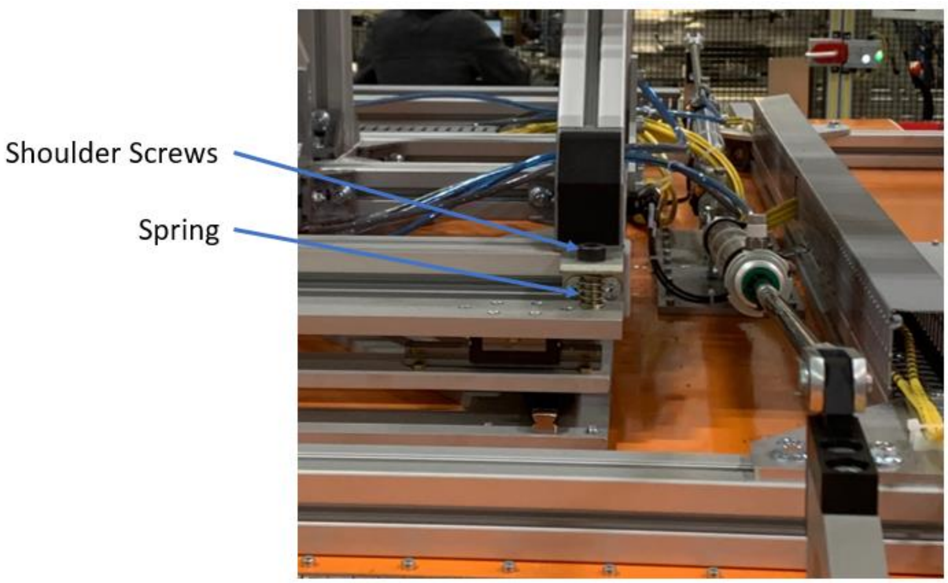


***Figure 7-4. Hood Assembly***

# 8. INSTALLATION

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# 8.1. LONG TERM STORAGE

If the system is not installed immediately after delivery, it must be stored in a protected and dry location. It must be covered up appropriately to prevent moisture infiltration.

If the shipping cover is removed the machine is not protected, the system must not be stored outside. Components that are not protected with long-term preservation against climatic influences can corrode and or wear down. Electrical cabinets and other electrical equipment are not rainproof.

# 8.2. COMMISSIONING

This section outlines procedures for installing the Pack Main Line. After the Factory Acceptance Test at the manufacturing facility, the system is broken up into major assemblies which are then vacuum sealed into an appropriate shipping material and secured inside custom-built wooden crating, then delivered to the GM facility. Care should be taken when unpacking system components.

In General, ATS personnel are ready to install, configure, and troubleshoot the installation of the Pack Main Line. If the system is installed or moved without ATS assistance the following instructions are to be used as a guideline.

For a new install, it is recommended to install components as they are delivered from the manufacturer, as opposed to waiting for the full delivery. For example, as one Cell tooling arrives, install before starting the remaining Cells.

For the previously disassembled system, it is recommended to install according to the teardown map created in the removal section of this document. For example, ensure all of one Cell components are present in the staging area before beginning the installation.

## 8.2.1. Required Personnel

All installations are to be conducted by trained and ATS-approved personnel. During installation, all personnel within the work area must be ATS-approved installation personnel, unless otherwise approved by the ATS project (or program) manager.

## 8.2.2. Installation Facility

The main requirement is a facility that meets the minimum space needs of the project, as shown in the engineering documents supplied by ATS. The facility must have a flat, reinforced concrete floor with a minimum thickness that complies with local building code. The facility must also be capable of delivering the required facility resources.

## 8.2.3. Installation Overview

Install the Pack Main Line in the following general steps.

### 8.2.3.1. Draw Installation Locations on Facility Floor

On the facility floor, indicate with chalk markings or other marking system exactly where conveyors, electrical enclosures, and tooling are to be installed. Refer to engineering drawings supplied by ATS. Only authorized ATS personnel should perform this task.

#### 8.2.3.2. Unpack Shipped Components

Carefully unpack all components shipped from the manufacturer, using heavy lifting equipment where necessary to remove components from the vacuum-sealed wooden crates. Check contents against the shipping documents. Place unpacked components for assembly in a suitable staging area as close as possible to the layout marked out on the facility floor.

#### 8.2.3.3. Install Main Structure

Install the main structure for the Cell.

#### 8.2.3.4. Install Zone Tooling

Install all robots, lift assists, feed systems, jib cranes, and other tooling system to the cell.

#### 8.2.3.5. Install Electrical Enclosure and Pneumatic Controls

Install the electrical enclosure and pneumatic controls unit for the cell.

#### 8.2.3.6. Connect the Facility Electrical Supply

When safe to do so, connect the facility electrical supply to the cell.

#### 8.2.3.7. Connect Facility Air Supply

When safe to do so, connect the facility air supply to the cell.

#### 8.2.3.8. Install All Safety Guarding

Where suitable install safety guarding to the cell

# 8.3. LIFTING POINTS

**WARNING!** ***To prevent severe injury and equipment damage, use only appropriate lifting equipment and use caution when lifting and handling equipment. Always follow local laws and regulations and third-party guidelines.***

## 8.3.1. PDP / Cabinet Lifting

Lift each PDP using the eyebolts on the top of the cabinet.


***Figure 8-1. PDP Lifting Points.***

# 8.4. BET/BEV3 BATTERY PACK TEST AND COVER LEAK TEST UTILITIES

The Battery Pack Test and Cover Leak Test have the following utility requirements:

## 8.4.1. Battery Pack Test and Cover Leak Test Utilities – Manual Stations

| | | 280 | 580 | 680 |
|---|---|---|---|---|
| **Compressed Air Supply** | **Air Pressure (PSI)** | **65** | **65** | **65** |
| | **Max CFM** | **8.76** | **8.76** | **8.72** |
| | **Supply Pipe Size** | **0.75”** | **0.75"** | **0.75"** |
| **Electrical Supply** | **Equipment Volts** | **480** | **480** | **480** |
| | **Equipment Phase** | **3** | **3** | **3** |
| | **Main 3nect Amps** | **100** | **100** | **100** |
| **Electrical Supply for Cycler Panel** | **Equipment Volts** | **480** | **480** | **N/A** |
| | **Equipment Phase** | **3** | **3** | **N/A** |
| | **Main Disconnect Amps** | **1200** | **1200** | **N/A** |

### 8.4.2. Supply Connection Points for Cell EP280 and EP580

**Cell EP280 and EP580**

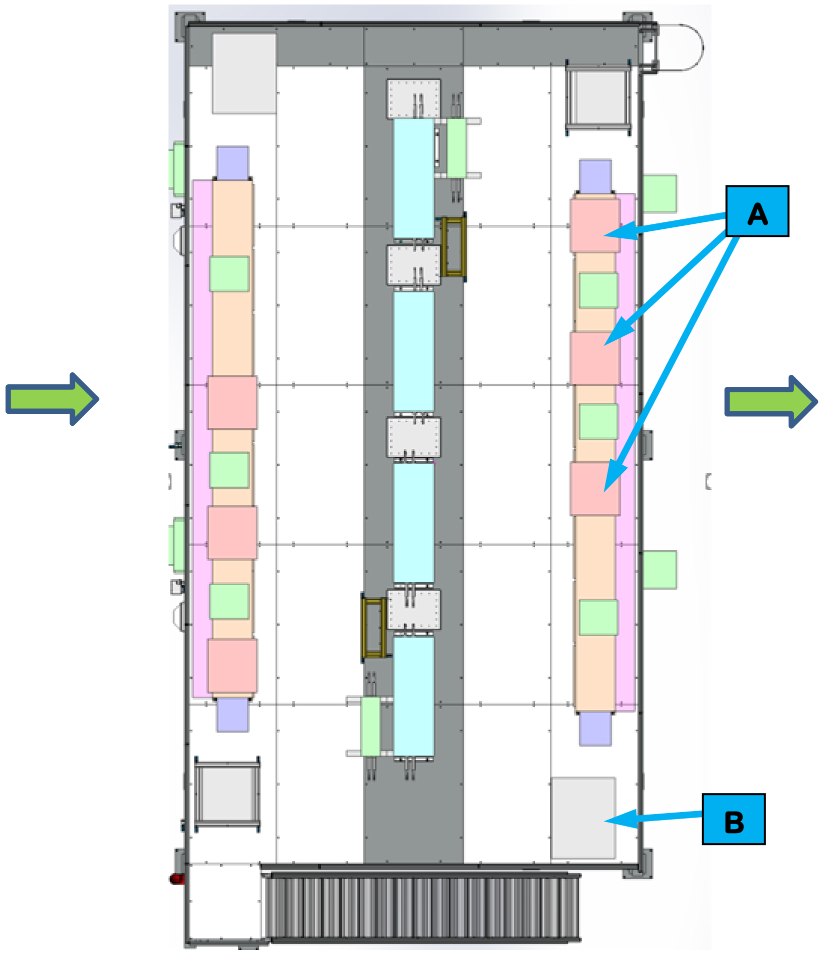


***Figure 8-2. Cell EP280 and EP580 Supply Connection Points***

| Supply Connection Points | | | |
|---|---|---|---|
| A | Electrical Supply<br>480 Volt, 3 Phase AC, 60 Amps | B | Compressed Air Supply<br>60 PSI, 56 Max CFM |

### 8.4.3. Supply Connection Points for Cell EP680

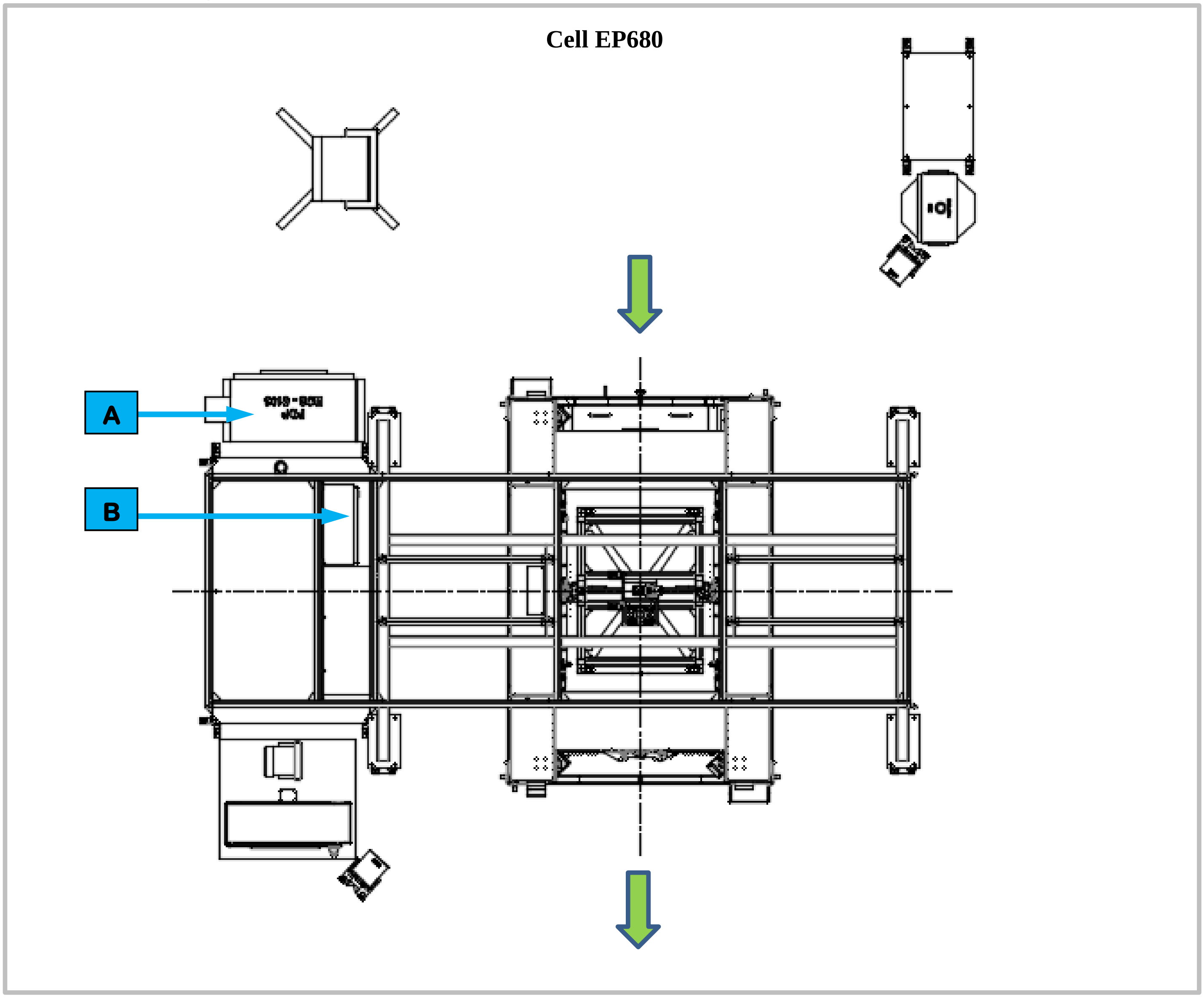


*Figure 8-3. Cell EP680 Supply Connection Points*

| Supply Connection Points | | | |
|---|---|---|---|
| A | Electrical Supply<br>480 Volt, 3 Phase AC, 60 Amps | B | Compressed Air Supply<br>60 PSI, 56 Max CFM |

# 8.5. DECOMMISSIONING

This section outlines procedures for disassembling for moving or removal of Pack Main Line along with a section disposing of the Line if necessary.

In General, ATS personnel are ready to disassemble, reconfigure, and assist in moving the Pack Main Line. If the system is disassembled or moved without ATS assistance the following instructions are to be used as a guideline.

## 8.5.1. Disassembly Planning

Before the disassembly process, a disassembly plan should be created. This plan should outline:

1. The General Manager of the disassembly operation and their team.
2. Local staging area for disassembled components (the "Teardown Map").
3. Moving and Shipping strategy.
4. Destination staging area for disassembled components.
5. Final reassembly location for assembling disassembled components.
6. A disposal plan, if necessary.

## 8.5.2. Disassembly Overview

The following steps are a high-level overview of the disassembly process.

### 8.5.2.1. Observe Safety Precautions

All personnel involved with the disassembly should review safety and potential safety hazards as described in ***Chapter 2-Safety.*** All hazardous energy sources must be isolated from the machine prior to disassembly.

### 8.5.2.2. Review to the Teardown Map

All personnel involved with the disassembly should fully understand the Teardown Map prior to the disassembly.

### 8.5.2.3. Label Each Item Clearly

All components, tooling, guarding, and devices should be labeled before disassembly to ensure correct reassembly, including labelling all wiring, air lines, and cabling.

### 8.5.2.4. Ensure System is Clear

Ensure the system is clear of all workpieces, including inside enclosures. Ensure all air lines have been vented, feeder lines cleared, and all products have been removed from the cells and equipment.

### 8.5.2.5. Disassemble and Remove Electrical Enclosure and Pneumatic Controls

Disconnect and remove the electrical enclosure and pneumatic controls unit from the cell.

### 8.5.2.6. Disassemble and Remove All Safety Guarding

Disassemble and remove safety guarding from the cell.

### 8.5.2.7. Disassemble and Remove Tooling

Disconnect and remove all robots, lift assists, feed systems, jib cranes, and other tooling systems from the cell.

### 8.5.2.8. Disassemble and Remove Main Structure

Disassemble and remove the main structure for the Cell.

## 8.6. DISPOSAL

If the entire Main Pack Line is to be disposed of (i.e., at the end of the product's lifecycle) the disassembly process will follow the Disassembly Plan for the disposal contingency, with the addition of the following general, disposal guidelines:

1. All third-party components on the machine should be disposed of in accordance with relevant OEM product documentation.
2. All hazardous materials should be disabled or isolated to prevent accidental re-use in the wrong hands. Disposal of such hazardous materials will be done either through original manufacturer or in accordance with local hazardous waste disposal rules.
3. Where possible and practical, disassembled components should be salvaged for re-use
4. Careless disposal of the product that may pollute the environment should be avoided.
5. All remaining miscellaneous materials should be disposed of in accordance with local laws and regulations and any applicable national regulations.

# 9. PROCESS PARAMETERS

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# 9.1. ELECTRICAL AND COOLANT LEAK TEST STATION EP280 & EP580 PARAMETERS

## 9.1.1. Parameter Settings

| Battery Pack Variant | Process Step | Device | Parameter Setting | Parameter Value |
|---|---|---|---|---|
| BET/BEV | All | Air Preparation Unit | Air Pressure Regulator | 60 psig |
| | | ATEQ Coolant Leak Test Cart | Air Pressure Regulator REG1-Fast Fill Pressure | 47 psig |
| | | | Air Pressure regulator REG2-Test Pressure | 25 psig |

## 9.1.2. Leak Pressures

| Battery Pack Variant | Process Step | Device | Leak Rate |
|---|---|---|---|
| BET/BEV | All | Coolant Leak Orifice | Nominal 2.0 sccm |
| | | Coolant Leak PASS | < 5.0 sccm |
| | | Coolant Leak Zero Leak Master Copper Coil | 0.0 sccm |

## 9.1.3. Test Sequence

| Coolant Leak Test Sequence | |
|---|---|
| **Sequence** | **Description** |
| 1 | FastFill |
| 2 | Fill |
| 3 | Stabilize |
| 4 | Test |

# 9.2. COVER LEAK TEST STATION EP680 PARAMETERS

## 9.2.1. Parameter Settings

| Battery Pack Variant | Process Step | Device | Parameter Setting | Parameter Value |
|---|---|---|---|---|
| BET/BEV | All | Air Preparation Unit | Air Pressure Regulator | 60 psig |
| | | Cincinnati Test Systems Leak Tester | | |

## 9.2.2. Leak Pressures

| Battery Pack Variant | Process Step | Device | Leak Rate |
|---|---|---|---|
| BET/BEV | All | Cover Leak Orifice | Nominal 10.0 sccm |
| | | Cover Leak PASS | < 10.0 sccm |
| | | Cover Leak Zero Leak Battery Pack | 0.0 sccm |

## 9.2.3. Test Sequence

| Cover Leak Test Sequence | |
|---|---|
| **Sequence** | **Description** |
| 1 | FastFill |
| 2 | Fill |
| 3 | Stabilize |
| 4 | Test |

# 9.3. PROCEDURE FOR ADDING A NEW PROGRAM TO AN ATEQ F620 LEAK TEST INSTRUMENT

## 9.3.1. Procedure:

The ATEQ leak test instrument can have many programs configured and these programs can be executed based on the part type being tested. When part types have the same internal volume, the same program can be called for those part types. If a new part type is going to be tested that has a different internal volume, then a new program needs to be added.

To add a new program, copy an existing program that has a similar sequence. Modify the copied program to test the new part type correctly. Listed below are steps for copying and modifying a program for a new part type. You will need a known GOOD zero leak part to configure this New test program correctly.

**<u>NOTE:</u> It is highly recommended that the operator creating New programs for production use have good knowledge of leak test principals and can confirm all aspects of the New test program are working properly before deploying to production testing.**

1. With the instrument power turned ON, the Main Status screen should appear on the instrument.

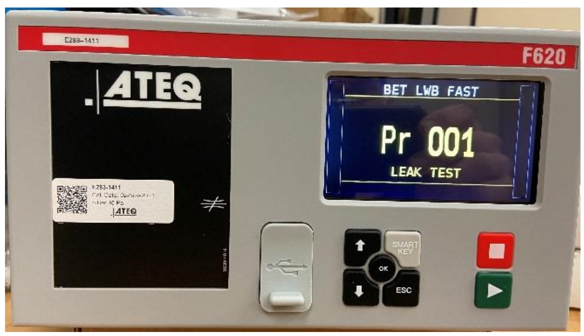


**Figure 9-1. Main Status Screen.**

2. Press the ESC button one time and the Main Menu screen will appear.


**Figure 9-2. Main Menu Screen.**

3. Press the Arrow keys to highlight PARAMETERS, then press OK. A list of configured programs will appear as shown in image below. Using the Arrow keys, scroll through the list of programs and determine which program number you want to copy AND which Empty program number you want the new program to be assigned to. Once this is determined, use the Arrow keys to scroll to the TOP of the Parameters list so the Yellow Triangle is pointing to Copy-Paste.


**Figure 9-3. Parameters Screen.**

4. Press the OK button and the PARAM/Copy-Paste screen will appear. Press the OK button again to select the COPY from program you want to use. Use the Arrow Keys to scroll to the COPY program then press OK (In this example we chose program 001).


**Figure 9-4. Param/ Copy-Paste Screen.**

5. Press the Down Arrow once to select PASTE the press OK. Use the Arrow Keys to scroll to the program number you want to copy the program to (In this example we chose program 004). Press the OK button to start the copying process. Note that the instrument will start copying as soon as you press OK. If you have made a mistake or want to exit this menu, Press the ESC button. When the Copy is complete, press the ESC button to go back to the PARAMETERS screen.

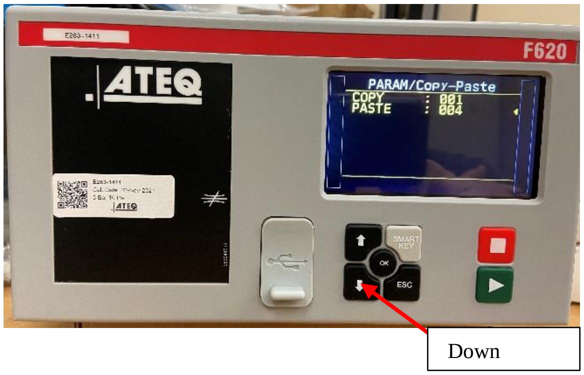



**Figure 9-5. Param Copy-Paste Screen.** **Figure 9-6. Copy In Progress Screen.**

6. Use the arrow keys to scroll to your newly copied program in the parameters list (this example is copied to program Pr:04). The Name of the program is the same as the program it is copied from. The next steps will describe how to change the program name.

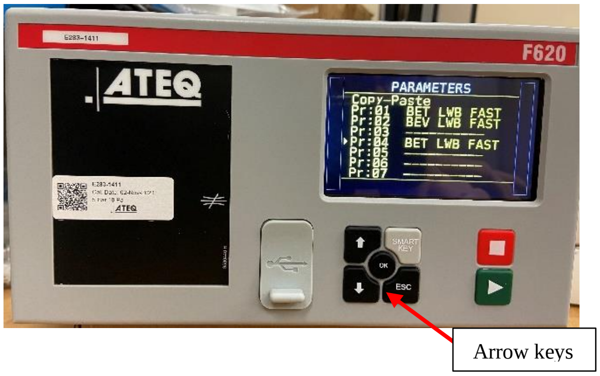


**Figure 9-7. Parameters Screen.**

7. Press OK to access the Parameters for program Pr004. When the parameter screen appears, use the Down Arrow button to scroll to the bottom of the list labeled FUNCTIONS then press the OK button to access the Functions screen.


**Figure 9-8. Param/Program Screen.**

8. When the FUNCTIONS screen appears, the cursor will be pointing to NAME: (left image). Press OK to start editing the Name of the program (right image). The name is changed One character at a time. The selected character has the flashing "#" symbol. Use the Arrow keys to select the desired character, then press OK to move to the next character. When you reach the last character and press OK the cursor will jump back to the NAME and your edits will be accepted. In this example we change the name to "NEW PROGRAM".

9.

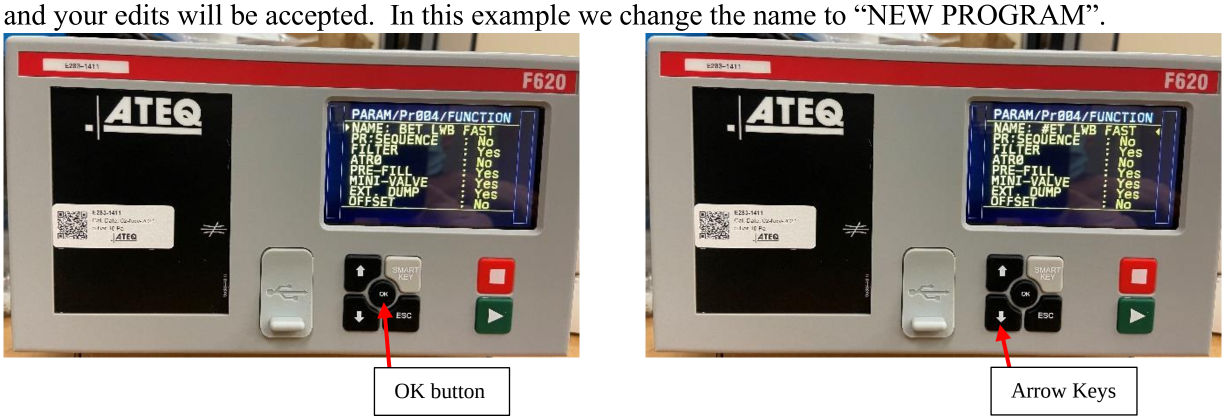


**Figure 9-9. Param/Program/Function Screen.**

10. There are several parameters that need to be determined when setting up a test for a new model type. The first is setting the proper Fill time to achieve the test pressure. In this example our test pressure is 25 psig. The program that you copied might have Pre-Fill and normal Fill time. Press the ESC button until the Main Screen is displayed (left image). Use the Arrow keys to scroll through the available programs and scroll to the New program you just created.
    Connect the new model part to the system and Run a test by pressing the Green play button. If the pressure does not achieve the 25 psig setpoint, adjust the Pre-Fill and Fill times in the program and run the test again after waiting a least 1 minute for the test part to completely vent. Timer values are adjusted by using the Arrow keys to scroll to the Pre-Fill or Fill Time options, press the OK button, use Arrow keys to increase or decrease the timer value, Press OK to accept or ESC to cancel. Note you can hold down the Arrow key to increase/decrease the timer value quickly (right image).


**Figure 9-10. New Program Screen.**

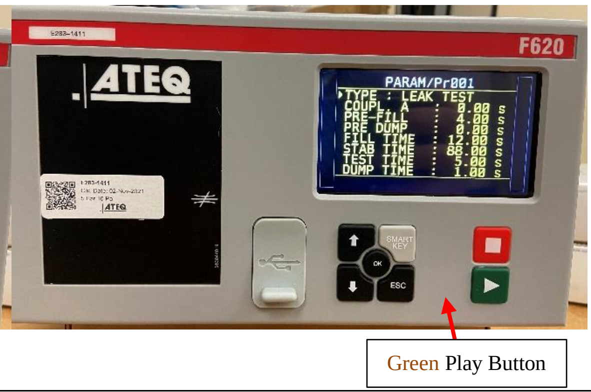


**Figure 9-11. Param/Program Screen.**

11. To determine the internal volume of the new part type, use the Arrow keys to scroll to the DUMP TIME and press OK. Use the down Arrow to set the Dump Time to 0.00 seconds and press OK.

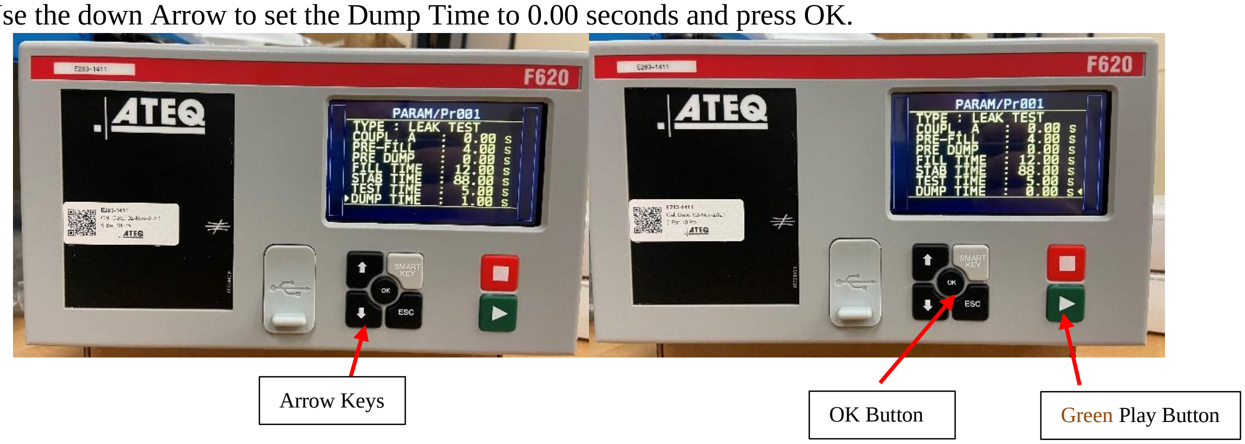


**Figure 9-12. Param/ Program Screen.**

12. Run a test by pressing the Green play button and write down the leak rate reported on the screen. The part will stay pressurized because the dump time is set to zero seconds. Run several more test until the reported leak rate value stabilizes to a consistent value. A consistent value should be close to zero sccm. If the part has a leak, there will be some positive value. Compute the average of the last three consistent leak rates reported. This will be your LeakRateNoOrifice value (LRNO).

13. Enable a known leak orifice into the test circuit using whatever method is provided. This might be a quick connect fitting, manual ball valve, or solenoid operated valve. Make note of the leak rate of the orifice because this will be used in a calculation and will be your OrificeLeakRate (OLR). Run several tests with the leak orifice enabled and compute the average of the last three consistent leak rates reported.
    This will be your LeakRateWithOrifice value (LRWO).
14. To know what the current volume setting is in a new program, go to the Parameters screen and select your new program and scroll down to view the VOLUME setting. Make note of this value and it will be your CurrentVolume (CV). In this example, the VOLUME is 9.5 liters which is 9500 cubic centimeters (cc).


**Figure 9-13. Param/Program Screen.**

15. Compute the NewVolume(NV) of the test part using the equation below. **IMPORTANT**: Make sure that all Volumes are in units of cubic centimeters (cc).

$$NV = \frac{OLR}{(LRWO - LRNO)} \times 10400$$

16. Enter the New Volume value into the VOLUME parameter of your new program. Note that you need to convert from cc to liters by multiplying by 1000.

17. Note that the test part is still pressurized and should be very stable by now.
    Repeat step 11 and verify the LeakRateNoOrifice is stable.
    Repeat step 12 and verify the LeakRateWithOrifice is stable AND is EQUAL to (LeakRateNoOrifice + OLR)
    If the LeakRateWithOrifice is not equal to (LeakRateNoOrifice + OLR) then repeat steps 13, 14, 15.

18. Set the Dump time back to 1.0 second, run one more test by pressing the Green play button, and the part will vent at the end of test. Wait 3 minutes for the part to completely vent and stabilize to its normal state.

19. The next step is to confirm the Stabilize time is correct for the new part type. For this example, our Max leak rate limit is 5 sccm so we would like our reported leak rate for a known zero leak part to be 1.5 sccm or lower. The internal volume of these coolant circuits is large, so we do not have enough cycle time to wait for a result that is reporting close to zero sccm. Make sure the Leak Orifice is disabled, then Run a test by pressing the Green play button. If the reported leak rate is greater than 1.5 sccm, add some Stabilize time to the program. Wait 3 minutes and run another test. Repeat this process until your reported leak rate is less than 1.5 sccm. NOTE this is assuming you have a zero leak part you are testing.

# 1. CTS BAUER CONTROLS MANUAL

**BAUER CONTROLS**
**GM B3T BATTERY LEAK TEST SYSTEM**
**CTS JOB NUMBER CU133609M6**
**MACHINE MANUAL**

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# 1.0 – Safety

If you ever have any questions regarding the safe operation or maintenance of this machine, immediately call:

**Cincinnati Test Systems**
**Service Department**
**(513) 202-5108**

## *Safety Precautions*

**Important**

These safety precautions for this Cincinnati Test Systems machine have been prepared to assist the maintenance personnel in practicing good shop safety procedures. Operator and maintenance personnel must read and understand these precautions completely before operating, setting up, running, or performing maintenance on the machine. These precautions are to be used as a guide to supplement safety precautions and warnings in the following:

a. All other manuals pertaining to the machine.
b. Local, plant, and shop safety rules and codes.
c. National safety laws and regulations.

## General Safety Instructions and Considerations

### Personal Safety

Machine owners, operators, setup personnel, maintenance, and service personnel must be aware of the fact that constant day--to--day safety procedures are a vital part of their job. Accident prevention must be one of the principal objectives of the job regardless of what activity is involved. Know and respect your machinery. Read and practice the prescribed safety and checking procedures. Make sure that everyone who works for, with, or near you fully understands and -- more importantly -- complies with the following safety precautions and procedures when operating this machine. Sudden movements, loud noises, horseplay, etc., must be avoided. These distractions may result in unsafe conditions for those working near the machinery.

Observe and follow safety instructions such as “NO SMOKING”, “High Voltage”, “DANGER”, etc., in your working area. Accidents can occur that result in serious personal injury to you or others due to clothing and other articles becoming entangled in cutters, hand wheels, levers, or moving machine elements. The following suggestions, if followed, will help you to avoid such accidents: Neckties, scarves, gloves (except as worn for protection when handling sharp edged cutting tools or rough, sharp or hot parts) loose hanging clothing, and jewelry such as watches, rings, or necklaces must not be worn around moving machinery. Restrain long hair with a cap or net. Wear gloves only when handling rough, sharp, or hot parts. Use safety protective equipment. Wear clean approved eye or face protection. Safety--toe shoes with slip--proof soles can help you avoid injury. Keep your protective equipment in good condition. Never operate or service this equipment if affected by alcohol, drugs or other substances or conditions which decrease alertness or judgment.

### Work Area Safety

Always keep your work area clean. Dirty work areas with such hazards as oil, debris, or water on the floor may cause someone to fall to the floor, into the machine, or onto other objects resulting in serious personal injury. Make sure your work area is free of hazardous obstructions and be aware of protruding machine members.

Return tools and similar equipment to their proper storage place immediately after use. Keep work benches neat, orderly, and clean. Report unsafe working conditions to your supervisor or safety department. Items such as: worn or broken flooring, ladders, and handrails, unstable or slippery platforms, or scaffolds must be reported and repaired before use. Do not use skids, work pieces, stock, machines, tote pans, and boxes as makeshift climbing aides.

**Lifting and Carrying Safety**
Contact supervision if you have any questions or are not sure about the proper procedures for lifting and carrying. Before lifting or carrying an object, determine the weight and size by referring to such things as tags, shipping data, labels, marked information, or manuals.

Use power hoists or other mechanical lifting and carrying equipment for heavy, bulky, or hard to handle objects. Use hookup methods recommended by your safety department and know the signals for safely directing a crane operator.

Never place any part of your body under a suspended load or move a suspended load over any part of another person's body. Before lifting, be certain that you have a safe spot for depositing the load. Never work on a component while it is hanging from a crane or other lifting mechanism. If in doubt as to the size or type of lifting equipment, method, and procedures for lifting, contact Cincinnati Test Systems before proceeding to lift the machine or its components.

Always inspect slings, chains, hoists, and other lifting devices prior to use. Do not use lifting devices found to be defective or questionable. Never exceed the safety rated capacity of cranes, hoists, slings, eyebolts, and other lifting equipment. Follow, National and local, standards and instructions applicable to any lifting equipment you use. Before inserting an eyebolt, be certain that both the eyebolt and the hole have the same size and type threads. To attain safe working loads, at least 90% of the threaded portion of a standard forged eyebolt must be engaged.

**Installation and Relocation Safety**
Before lifting the machine, consult the machine manual or Cincinnati Test Systems for proper methods and procedures. An electrician must read and understand the electrical schematics prior to connecting the machine to the power source. After connecting the machine, test all aspects of the electrical system for proper functioning. Always make sure the machine is grounded properly. Place all selector switches in their OFF or neutral (disengaged) position. The doors of the main electrical cabinet must be closed and the main disconnect switch must be in the OFF position after the power source connection is complete. Always lock the main disconnect device in the OFF position if the machine is left unattended, unless machine is part of an unmanned manufacturing system and in a production cycle.

**Setup and Operation Safety**

Read and understand all the safety instructions before setting up, operating, or servicing this machine. Assign only qualified personnel, instructed in safety and all machine functions, to operate or service this machine. Operators and maintenance personnel must carefully read, understand, and fully comply with all machine mounted warning and instruction plates. Do not paint over, alter, or deface these plates or remove them from the machine. Replace all plates which become illegible. Replacement plates can be purchased from Cincinnati Test Systems. Safety guards, shields, barriers, covers, and protective devices must be connected or in place before operating the machine. All safety features, disengagements, and interlocks must be in place and functioning correctly prior to operation of this equipment. Never bypass or wire around any safety device. Never brake or slow down moving machinery with your hand or with some makeshift device. Never lean on a machine or reach over or through a machine -- you can become entangled in tooling and other moving elements or you may accidentally activate start buttons, feed controls, rapid traverse controls, power work holding control, or similar devices.

During operation, be attentive to the process. Excessive vibration, unusual sounds, etc., can indicate problems requiring your immediate attention. Shut off power to the machine when leaving the operating area or at the end of your work period. Never leave the machine running unattended, unless it has been designed to do so. Turn the master disconnect device to the OFF position before cleaning the machine at the end of the working day or when guards or covers are removed that expose hazardous areas.

**Maintenance Safety**

Do not attempt to perform maintenance on this machine until you read and understand all the safety instructions. Assign only qualified service or maintenance personnel, to perform maintenance and repair work on this machine. Before performing maintenance or service work, Warning or Danger signs must be placed conspicuously about the machine. Before detaching counterweights or driving mechanisms, vertical sliding members must be blocked properly.

Before removing or opening any electrical enclosure, cover, plate, or door, be sure that the Main Disconnect Switch is in the OFF position. If any tool is required to remove a guard, cover, bracket, or any basic part of this machine, place the Main Disconnect Switch in the OFF position, lock it in the OFF position. If possible, post a sign at the disconnect switch indicating that maintenance is being performed. Whenever maintenance is to be performed in an area away from the disconnect and the disconnect is not locked, tag all start button stations with a “DO NOT START” tag. Adequate precautions, such as locks on circuit breakers, warning notices, or other equally effective means must be taken to prevent electrical equipment from being electrically activated when maintenance work is being performed.

Before attempting to adjust, repair, or perform maintenance on electrical circuits connected with yellow or orange wires, first find the source of power, turn it off, and lock it in the OFF position. Machine tool interlock control circuits connected with yellow or orange wires are powered from a source away from the machine and carry voltage even when the machine's main disconnect device is turned to the OFF position.

When removing electrical equipment, place number or labeled tags on those wires not marked. If wiring is replaced, be sure it is of the same type, length, size, and has the same current carrying capacity. Close and securely fasten all guards, shields, covers, plates, or doors before power is reconnected.

An electrical technician must analyze the electrical system to determine the possible use of power retaining devices such as capacitors. Such power retaining devices must be disconnected, discharged, or made safe before maintenance is performed.

Working space around electrical equipment must be clear of obstructions. Provide adequate illumination to allow for proper operation and maintenance.

### LIFTING DEVICES

#### GENERAL

The use of lifting devices is subject to certain hazards that cannot be met by mechanical means but only by the exercise of intelligence, care, and common sense. It is, therefore, essential to have competent and careful operators, physically and mentally fit, thoroughly trained to the safe operation of the equipment and the handling of the loads. Serious hazards are overloading, dropping or slipping of the load caused by improper hitching or slinging, standing or crawling under a load, swinging loads, obstruction to the free passage of the load, using equipment for a purpose or a manner for which it was not intended or designed.

### DANGER

#### HIGH VOLTAGE

**Lethal voltages are present in the magnetics and electrical control cabinets when the MACHINE MAIN DISCONNECT is 'ON'. Current and voltage measurements should be attempted only by qualified electrical maintenance personnel. Before working on any electrical circuits, turn the machine Main Disconnect Device 'OFF' and lock It. Unless expressly stated in applicable Cincinnati Test Systems, Inc. documentation or by the appropriate Cincinnati Test Systems, Inc. Field Service Representative, do NOT work with electrical power 'ON'. If such express statement of advice exists, working with electrical power 'ON' should be performed by a Cincinnati Test Systems Service Representative. The customer and subsequent transferees must determine that any other person performing work with electrical power 'ON' is trained and technically qualified. FAILURE TO FOLLOW THIS INSTRUCTION MAY RESULT IN DEATH OR SERIOUS PERSONAL SHOCK INJURY.**

# 2.0 – System Overview

## *Basic Machine Operation*

This machine is designed as a single station, semi-automatic, stand-alone leak test machine designed to leak test the B3T battery assembly. Semi-automatic indicates a manually loaded test stand.

When the part arrives at the test station the operator will install the seals, connect the test line and press the Start button on the HMI Main screen. An automatic vacuum decay leak test with a reject rate of 10 scc/m @ 0.5 psiv will begin.

> The basic principle of operation of a pressure/vacuum decay leak test instrument is to fill/evacuate the test part to a specified target test pressure, isolate the test part from the pressure or vacuum source, allow the pressure/vacuum to stabilize, and then measure the pressure loss/vacuum gain due to a leak over a defined time.

If the part passes the leak test, the Main screen will illuminate green.

If the part fails the leak test, the Main screen will illuminate red.

The operator will disconnect the part and remove the seals.

## *Control*

The leak test is performed by the CTS Sentinel 3520 Leak Test Instrument.

Cincinnati Test Systems, Inc. has manufactured this test system in accordance with the highest manufacturing standards. Our years of practical experience in developing and applying this technology will provide you with a complement of options to meet your testing requirements.

# 3.0 – Installation

## *Utility Requirements*

Machine Electrical Power:

| |
|---|
| 120 VAC |
| Single Phase 60Hz |
| 12 Amps |

Machine Air Pressure Supply:

| |
|---|
| 70 psig Minimum |
| 120 psig Maximum |

## *General Installation*

Extreme care must be used when lifting and moving components to the final assembly point. Carefully unpack all shipping containers. Visually inspect all components for obvious transit damage and contact CINCINNATI TEST SYSTEMS, INC. immediately, should damage be observed. Check all items received against the shipper to ascertain receipt of the complete system. After inspection of the equipment, protect all materials from the elements prior to final installation.

**NOTE!**

1. DO NOT! Use the pneumatic cylinders, clevis pins, or piping for lift line attachment points.
2. DO NOT! Use vacuum manifolds, air lines, or operator panels for lift line attachment points.
3. DO NOT! Use conduit or junction boxes for lifting installations.
4. DO! Place hardwood blocks or other suitable material at strategic points while lifting to protect all plumbing and electrical fixtures from damage.
5. DO! Use care during transportation to final installation position.

INSTALLATION

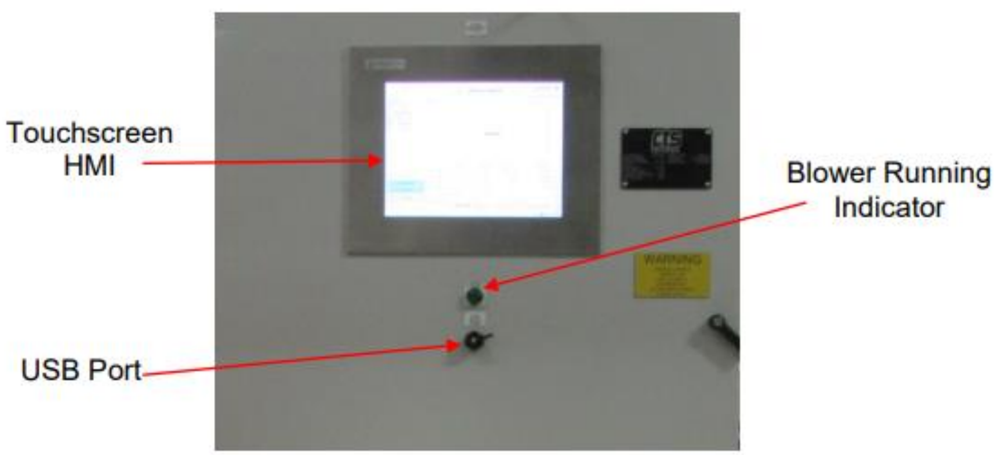
**The machine is loaded and shipped only after customer approved operation at Cincinnati Test Systems, Inc.** Therefore, installation will amount to placing the machine and its peripheral devices in their final positions. The interconnection of pneumatic hoses, connecting the control panel(s), applying proper A.C. power, is basically all that is required to complete the installation.

Prior to shipment, all Cincinnati Test Systems, Inc. machines undergo a final operational evaluation. Depending on the type of part being tested, it may be necessary to have a CTS technician at the installation site until personnel become familiar with the machine. All major components have been inspected and tested prior to shipping. Field start up normally will amount to the connection of utilities, and phasing power correctly.

# 4.0 – Operator Control

*Hardware Lights & Buttons*


**Sentinel 3520**



## SigPod

For detailed explanation of SigPod screen controls see the SigPOD PSV User Guide


The SigPod has been configured for automatic measurement and reporting and should require no operator intervention or viewing other than that described in this Manual.

# 5.0 – Start-Up / Shutdown Procedure

## *Start-Up Procedure*

1. Turn the **Main Power Disconnect,** located on the side of the main electrical cabinet, to the on position.

Main Power Disconnect

2. Turn the **Main Air Disconnect** to the supply position.

Note: It is recommended to calibrate the test instrument if the machine has been idle.

## Shut-Down Procedure

1. Remove any test parts from the machine.
2. Turn the **Main Air Disconnect** to the exhaust position.
3. Turn the **Main Power Disconnect** to the off position.

Warning: this machine is equipped with a Uninterruptible Power Supply. Some components remain energized after the main disconnect is switched off.

# 6.0 – Operator Instructions

## Calibration

Due to the length of the test cycle and the requirement to wait 30 minutes between tests, it is not practical to perform a standard calibration cycle. The calibration factor will be calculated from previously charted test cycles.

In order to report results in leak rate units, a calibration factor is needed. We will start with leak rate derivation from the Ideal Gas Law.

$$LeakRate_{sccm} = \left(\frac{P_{leak} - P_{no\ leak}}{time}\right)\left(\frac{Volume * 60}{P_{atm}}\right)$$

Pressure drop over time is measured from runs without a leak standard and runs with a leak standard.

$$Pressure\ drop\ over\ time = \left(\frac{P_{leak} - P_{no\ leak}}{time}\right)$$

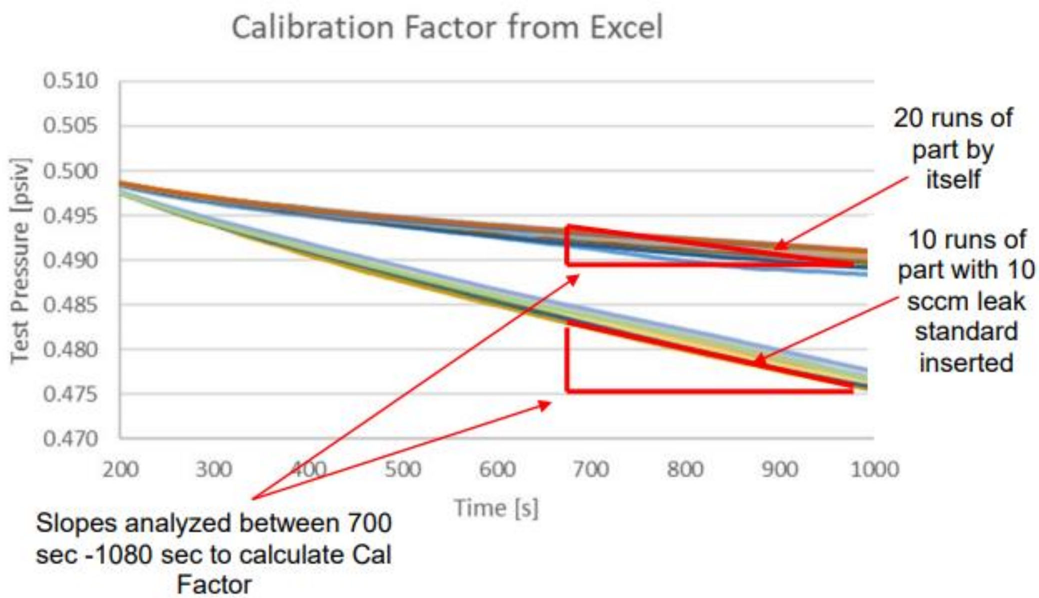
Calibration Factor is then calculated once the above runs are performed.

$$\left(\frac{Volume * 60}{P_{atm}}\right) = Cal\ factor$$

Example shown here using the below information on a 30Hz sample of data (small subset for illustration purposes):

- 20 runs of the part by itself were performed.
- 10 runs of the part with 10 sccm leak standard were performed.

OPERATOR INSTRUCTIONS




- Average pressure drop of no leak runs calculated at 700 s & 1080 s
- Average pressure drop of 10 sccm leak runs calculated at 700 s & 1080 s
- Deltas taken for each of these results to obtain a slope
- Calibration factor calculated according to leak rate equation:

$$LeakRate_{sccm} = \left(\frac{P_{leak} - P_{noleak}}{time}\right) * (Cal\ Factor)$$

$$Cal\ factor = \frac{LeakRate_{sccm}}{\left(\frac{P_{leak} - P_{noleak}}{time}\right)}$$

## 7.0 – Parts List

| MFR | PART | DESCRIPTION | SUPPLIER | PRICE* (EA) |
|---|---|---|---|---|
| AB | 1492-EAJ35 | AB END ANCHOR | CTS | $3.61 |
| AB | 1492-EBJ3 | AB END BARRIER | CTS | $1.34 |
| AB | 1492-J4 | AB TERMINAL | CTS | $1.88 |
| AB | 1734-AENTR | AB DUAL ETHERNET POINT IO MODULE | CTS | $1,196.80 |
| AB | 1734-IB8S | AB POINT IO 8PT SAFETY INPUT | CTS | $947.85 |
| AB | 1734-OB8S | AB POINT IO 8PT SAFETY OUTPUT | CTS | $1,102.75 |
| AB | 1734-TB | AB POINT IO MODULE BASE AND SCREW TERMINAL | CTS | $48.68 |
| AIRTECH | 3BA1300-7AS15 | AIRTECH REGENERATIVE BLOWER | CTS | $1,692.50 |
| AMAZON | usb_ext | usb extnesion cable | CTS | $14.66 |
| CABLES TO GO | 28103 | USB TYPE A MALE TO TYPE B MALE 3METER | CTS | $8.83 |
| CABLES TO GO | 28106 | 2M USB CABLE | CTS | $7.29 |
| CABLES TO GO | 50215 | VGA CABLE 15FT | CTS | $51.54 |
| FESTO | 197386 | FESTO 10MM TUBEING 50 M BOX | CTS | $290.13 |
| HIRSCHMANN | 942 133 270 | HIRSCHMANN 8PORT D-CODED 24VDC ENET SWITCH | CTS | $2,127.50 |
| HOFFMANN | CP4236 | HOFFMANN SUBPANEL 42X30 | CTS | $230.89 |
| HOFFMANN | CSD423610 | HOFFMANN 42 36 CONCEPT BOX | CTS | $899.99 |
| HOFFMANN | CWHPTO | HOFFMANN LOCKABLE HANDLE FOR CSD | CTS | $247.01 |

PARTS LIST

| MFR | PART | DESCRIPTION | SUPPLIER | PRICE* (EA) |
|---|---|---|---|---|
| | | BOX | | |
| HOFFMANN | HG0400404 | HOFFMAN VENT | CTS | $63.33 |
| HOFMANN | AS050LG | 1/2" HOLE PLUG LIGHT GRAY | CTS | $14.31 |
| HOPE | HIS-ML15-STTH | HOPE INDUSTRIAL 15" SS PANEL MOUNT MONITOR | CTS | $1,980.00 |
| JOHNSON PLASTICS | LZ2906 | SHEET-24"X48",2MIL ADA TAPE | CTS | $221.33 |
| KENDALL | 1601UL1015TCBLU | 16 MTW BLUW WITH ORG STRIP, 500' ROLL | CTS | $330.00 |
| KENDALL | 1601UL1015TCWHT | 16 MTW WHT WITH ORG STRIPE 500' SPOOL | CTS | $330.00 |
| LOGITECH | 920-002836 | WIRELESS KEYBOARD AND MOUSE | CTS | $80.82 |
| MCMASTER | 1786N113 | MCMASTER 1/4 BSPT FEMALE; 1/4 NPT MALE | CTS | $22.44 |
| MCMASTER | 1786N114 | MCMASTER 3/8 BSPT FEMALE; 3/8 NPT MALE | CTS | $34.62 |
| MCMASTER | 1786N115 | MCMASTER 1/2 BSPT FEMALE; 1/2 NPT MALE | CTS | $52.11 |
| MCMASTER | 1786N138 | MCMASTER Straight Adapter, 1/2 NPT Female x 1/2 BSPP Male | CTS | $58.69 |
| MCMASTER | 2333N188 | Nickel-Plated Brass Push-to-Connect Fitting for Air, Adapter for 6mm Tube OD x 10-32 UNF Male | CTS | $22.91 |
| MCMASTER | 2725K54 | Low-Pressure Brass Pipe Fitting with Sealant Bushing Adapter, 1/2 NPT Male x 1/4 NPT Female | CTS | $9.21 |
| MCMASTER | 38465K42 | MCMASTER COMPOUND GAUGE, SPEC 0-15 PSI | CTS | $69.19 |
| MCMASTER | 4399K43 | AIR INTAKE FILTER 1"NPT | CTS | $129.64 |

PARTS LIST

| MFR | PART | DESCRIPTION | SUPPLIER | PRICE* (EA) |
|---|---|---|---|---|
| MCMASTER | 44605K134 | "Low-Pressure Pipe Fitting Iron, 90 Degree Elbow Adapter, 1/2 NPT Female x Male" | CTS | $12.43 |
| MCMASTER | 44605K136 | Low-Pressure Pipe Fitting, Iron, 90 Degree Elbow Adapter, 1 NPT Female x Male | CTS | $15.10 |
| MCMASTER | 44605K154 | "Low-Pressure Pipe Fitting Iron, Tee Connector, 1/2 NPT Female" | CTS | $8.03 |
| MCMASTER | 44605K156 | Low-Pressure Pipe Fitting, Iron, Tee Connector, 1 NPT Female | CTS | $19.77 |
| MCMASTER | 44605K244 | "Low-Pressure Pipe Fitting Steel, Hex Bushing Adapter, 1/2 NPT Male x 3/8 NPT Female" | CTS | $3.14 |
| MCMASTER | 44605K278 | Iron, Straight Reducer, 1 x 1/2 NPT Female | CTS | $17.41 |
| MCMASTER | 44605K281 | ron, Hex Bushing Adapter, 1-1/4 NPT Male, 1 NPT Female | CTS | $13.42 |
| MCMASTER | 44605K422 | "Low-Pressure Pipe Fitting Iron, 90 Degree Elbow Reducer, 1 x 1/2 NPT Female" | CTS | $16.34 |
| MCMASTER | 44615K414 | "Standard-Wall Steel Pipe Nipple Fully Threaded, 1/2 NPT" | CTS | $3.49 |
| MCMASTER | 44615K416 | Standard-Wall Steel Pipe Nipple, Fully Threaded, 1 NPT | CTS | $5.75 |
| MCMASTER | 44615K476 | "Standard-Wall Steel Pipe Nipple Threaded on Both Ends, 1 NPT, 5"" Long" | CTS | $9.85 |
| MCMASTER | 4619K15 | Gradual On/Off Valve with Bronze Body and Gate, Wheel Handle and Nonrising Stem, Class 125, 1 NPT Female | CTS | $117.65 |

PARTS LIST

| MFR | PART | DESCRIPTION | SUPPLIER | PRICE* (EA) |
|---|---|---|---|---|
| MCMASTER | 4757T44 | Extreme-Pressure Brass Threaded Pipe Fitting Tee Connector, 1/2 NPTF Female | CTS | $67.46 |
| MCMASTER | 5218K718 | Plastic Barbed Hose Fitting for Water, Adapter, 1-1/4" Hose ID, 1 NPT Male, 150 PSI | CTS | $3.38 |
| MCMASTER | 5225K713 | Push-to-Connect Tube Fitting for Air, Straight Adapter, 6 mm Tube OD x 1/4 NPT Male | CTS | $14.03 |
| MCMASTER | 5225K731 | Push-to-Connect Tube Fitting for Air, Straight Adapter, 10 mm Tube OD x 1/2 NPT Male | CTS | $27.31 |
| MCMASTER | 6111K63 | LEVELING MOUNT 3/4-10 THD x 4.00 LG | CTS | $66.50 |
| MCMASTER | 6605K24 | BLACK, 10 PACK 13" HOOK AND LOOP CABLE TIES | CTS | $31.16 |
| MCMASTER | 9865K44 | Compact High-Flow Muffler, 304 Stainless Steel, 1/2 NPT Male | CTS | $98.92 |
| MOLEX | 847000003 | MOLEX USB FEED THROUGH DUST COVER | CTS | $32.73 |
| MOLEX | 847290003 | MOLEX USB PANEL MOUNT FEED THROUGH | CTS | $58.27 |
| MOLEX | BH-114030K12M020 | 4P MALE STR/FEM STR A-SIZE 2M | CTS | $119.94 |
| MOLEX | BH-884030K05M020 | 4P FEM STR/MALE STR M12 2M | CTS | $87.64 |
| MOLEX | BH-E11A06004M020 | MIC 4P D-CODE M/ME 2PR 2M TPE | CTS | $129.04 |
| MOLEX | BH-E11A06004M030 | MIC 4P D-CODE M/ME 2PR 3M TPE | CTS | $140.47 |
| MOLEX | BH-E11A06004M050 | Micro-Change (M12) Double-Ended Cordset 4 pos Male (Straight) to Male (Straight) 24 AWG Unshielded High Flex TPE Teal 5.0m (16.40') Length D-Coded Keyway | CTS | $161.15 |

PARTS LIST

| MFR | PART | DESCRIPTION | SUPPLIER | PRICE* (EA) |
|---|---|---|---|---|
| MOLEX | BH-ERWPAB3002M020 | M12 D-Coded to RJ45 Straight 2.0m (6.56') Length | CTS | $104.50 |
| MOLEX | ERWPAB3004M010 | MOLEX,RECEPTACLE,ETHERNET,4 PIN,MICRO | CTS | $139.12 |
| MOLEX_EMPIRE | BH-1R4000A39M020 | MODLEX, 7/8 RECPET. FLYING LEAD 2 M | CTS | $65.73 |
| MOLEX_EMPIRE | BH-8R4000A16M020 | M12 RECEPECTCLE 1/2 NPT | CTS | $59.42 |
| PARKER | NN-8-062-0250 | PARKER N SERIES PARAFLEX 1/2" 250' | CTS | $1,468.75 |
| SCIEMETRIC | 10500-1200-DIN0 | SCIEMETRIC SIGPOD DIN RAIL MOUNT | CTS | $371.25 |
| SCIEMETRIC | 10500-1204-0H00 | SIGPOD MODEL 1204 | CTS | $7,936.50 |
| SCIEMETRIC | 10500-3520-H0CC | 3520 LEAK TESTER | CTS | $16,733.40 |
| SCIEMETRIC | 10500-3520-MC31 | 3/2 way external leak test valve for use with a 3520 Series C model. Includes 3m cable. | CTS | $1,862.50 |
| SCIEMETRIC | 10500-3520-RTDA | AMBIENT AIR TEMP PROBE | CTS | $440.00 |
| SCIEMETRIC | 10500-3520-RTDC | TEMP PROBE CABLE | CTS | $96.25 |
| SCIEMETRIC | 10500-3520-RTDP | TEMP PROBE | CTS | $302.50 |
| SCIMETRIC/HONEYWELL | 50000-1000-0002 | XDUCER CABLE | CTS | $814.00 |
| SCIMETRIC/HONEYWELL | 50011-0000-0001 | TRANS56 - PRESSURE TRANSDUCER 10-21 PSIA | CTS | $3,193.09 |
| SIEMENS | 3LD2103-0TK53 | SIEMENS 3POLE NON FUSED DISCONNECT | CTS | $276.68 |
| SIEMENS | 3RH2122-1BB40 | SIEMENS FORCE GUIDED RELAYS 24VDC 2NO 2NC | CTS | $61.85 |
| SIEMENS | 3RQ3118-1AB01 | 24VDC SLIM RELAY | CTS | $83.60 |
| SIEMENS | 3RT2016-1FB41 | SIEMENS 9A 24VDC COIL MS 1NO | CTS | $112.67 |

PARTS LIST

| MFR | PART | DESCRIPTION | SUPPLIER | PRICE* (EA) |
|---|---|---|---|---|
| SIEMENS | 3RV2011-1HA15 | SIEMENS COMBO MSP 5.5-8 1NO 1NC | CTS | $258.36 |
| SIEMENS | 3SU1051-6AA40-0AA0 | SIEMENS 22MM METAL MEATL LIGHT | CTS | $16.67 |
| SIEMENS | 3SU1401-1BB40-3AA0 | SIEMENS 22MM GRN LED MODULE 24VDC | CTS | $63.00 |
| SIEMENS | 3SU1550-0AA10-0AA0 | SIEMENS 22MM CONTACT HOLDER METAL | CTS | $8.22 |
| SIEMENS | 5SJ4103-7HG40 | SIEMENS TYPE HSJ 3A C CURVE CB | CTS | $64.21 |
| SIEMENS | 5SJ4106-7HG40 | SIEMENS TYPE HSJ 6A D CURVE CB | CTS | $64.21 |
| SIEMENS | 5SJ4108-8HG40 | SIEMENS TYPE HSJ 8A D CURVE CB | CTS | $64.21 |
| SIEMENS | 5SJ4110-7HG40 | SIEMENS TYPE HSJ 10A C CURVE CB | CTS | $64.21 |
| SIEMENS | 5ST2 504 | SIEMENS 1 POLE DB | CTS | $68.12 |
| SIEMENS | 5ST3-663-0HG | SIEMENS 6 MCBs 1POLE BUSBAR | CTS | $13.61 |
| SIEMENS | 5ST3-666-0HG | SIEMENS INFEED TO MCBS | CTS | $15.62 |
| SIEMENS | 5ST3-666-1HG | SIEMENS INFEED TOUCH PROTECTION | CTS | $3.38 |
| SIEMENS | 5ST3-666-2HG | SIEMENS INFEED TO BUSBARS | CTS | $17.63 |
| SIEMENS | 6EP1334-2BA20 | SIEMENS POWER SUPPLY 24VDC | CTS | $513.32 |
| SIEMENS | 6EP4133-0GB00-0AY0 | SIEMENS BATTERY MODULE 24V 3.2AH | CTS | $352.36 |
| SIEMENS | 6EP4134-3AB00-1AY0 | SIEMENS UPS UNIT 24 IN AND OUT 10A | CTS | $773.44 |
| SMC | AF40-F04-6-A | SMC 5u FILTER 1/2' G | CTS | $66.63 |
| SMC | AFM40-F04-6-A | SMC 0.3u FILTER 1/2"G | CTS | $99.44 |
| SMC | ANA1-02 | SMC 1/4 R MUFFLER | CTS | $10.48 |
| SMC | ANA1-03 | SMC 3/8 R MUFFLER | CTS | $11.25 |
| SMC | ANA1-04 | SMC 1/2 R MUFFLER | CTS | $15.70 |
| SMC | AR40-F04-A | SMC REGULATOR W/GAUGE 1/2" G | CTS | $52.25 |
| SMC | ISG290-030 | SMC -10 TO -100 KPA VACUUM SWITCH R THREAD | CTS | $182.90 |
| SMC | K50-MP1.0-01MS | SMC Gauge for AR40-F04-A regulator | CTS | $19.42 |

PARTS LIST

| MFR | PART | DESCRIPTION | SUPPLIER | PRICE* (EA) |
|---|---|---|---|---|
| SMC | KQ2H10-G04A | SMC 10MM TO 1/2 G STRAIGHT | CTS | $5.23 |
| SMC | KQ2H10-U02A | SMC 10MM TO 1/4 NPT UNI THREAD STRAIGHT | CTS | $5.58 |
| SMC | KQ2L10-G04A | SMC 10MM TO 1/2 G ELBOW | CTS | $6.55 |
| SMC | KQ2V10-U02A | SMC 10MM TO 1/4 NPT UNI THREAD ELBOW | CTS | $9.98 |
| SMC | VHS40-F04B | SMC AIR SHUTOFF G THREAD 1/2" | CTS | $77.72 |
| SMC | Y400-A | SMC SPACER | CTS | $9.85 |
| SMC | Y400T-A | SMC MOUNTING SPACER | CTS | $12.24 |
| SOLBERG | 19P | SOLBERG FILTER ELEMENT | CTS | $31.24 |
| SOLBERG | FS-19P-100 | SOLBER 1-1/4" NPT SILENCER | CTS | $91.80 |
| SOLBERG | PF18 | SOLBERG FILTER PRE-ELEMENT | CTS | $4.43 |
| STARTECH | ST7300U3M | STARTECH 7 PORT USB HUB | CTS | $217.66 |
| STARTECH | ST7300USBME | StarTech.com 7-Port Industrial Grade USB 3.0 Hub with ESD & 350W Surge Protection - Rack mountable metal USB port expander splitter | CTS | $245.55 |
| TIGERFLEX | F-125X100 | TIGERFLEX 100 FOOT ROLE 1-1/4 SUCTION SERIES | CTS | $789.25 |
| WAYGO | 51045379 | KENDALL ID: 4126561; 40 PIECE BOX 5 LEVER CONNECOTRS | CTS | $48.32 |
| WEIDMULLER | 1607720000 | CABLE LABEL SHEET | CTS | $6.60 |
| WEIDMULLER | 1631910000 | WKM 8/30 BAG OF 50 | CTS | $206.25 |

*Pricing valid for 60 days after machine shipment

# 2. CTS SENTINEL 3520 LEAK TESTER QUICK START AND TROUBLESHOOTING GUIDE

## CTS Sentinel 3520 Leak Tester

### Quick Start and Troubleshooting Guide

*Revision 1.4*

*07 October 2021*

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# Contents

# 1.0 Introduction

This document has been put together to support customer understanding and operation of the CTS 3520 and SigPOD leak test instrument. This document will go into specific details regarding the test stand at General Motors in the Brownstown Battery Assembly Plant (BAP) in Michigan, USA. The intent of this document is to address the most important items for the customer, and continuous revisions will be made as information is added to this. Relevant screenshots are included in this document to allow for ease of understanding of key features of the unit. This document is meant to supplement the existing 3520 and SigPOD PSV user manuals, and should not be interpreted as a replacement of these manuals. Relevant information has been retrieved from those manuals and included here when appropriate.

The leak test instrument consists of two units:

1. Sentinel 3520
   a. Pressure sensor
   b. Mass flow meter
   c. Temperature sensors (if used)
   d. External exhaust I/O
2. SigPOD
   a. Analog input for barometric pressure sensor

The 3520 instrument contains the hardware for the leak test: flow meter, pressure transducer, electronic regulators, valving, etc. The 3520 unit also stores the calibration on it, in the event that the SigPOD becomes corrupted or the 3520 needs to be replaced. The SigPOD unit contains the analog input for the barometric pressure sensor and stores the calibration for this sensor. The SigPOD saves the test data and allows for user-operation to set the test parameters such as timers, pressures, models, etc. the SigPOD sends the Start and Stop/Abort commands to the 3520.

The SigPOD executes the leak test in a program called PSV, which is pre-loaded onto the SigPOD. PSV resides inside a shell called Inspection. When initially booted up, the SigPOD main screen is the Inspection shell. When the user pushes the green RUN button on the main page, this loads the PSV software that contains the leak test program. For normal operation, PSV is running on the screen the entire time. Figure 1.1below shows ine Inspection shell prompt when the SigPOD powers on.


**Figure 1.1 – Inspection shell**

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# 2.0 Starting a Test

This section will discuss the steps required to start a test, and will depend on what menu is currently present on the instrument as well as if the instrument is set up to currently receive the Start bit from the PLC or not. This navigation between the two menus and disabling the Start bit if necessary is discussed below.

## 2.1 Background

There are two important menus inside the PSV software: the MAIN menu and the SETUP menu. The number of menu options shown in blue on the left hand side will easily identify to the user which menu the user is currently in. The MAIN menu is where the leak test is executed, while the SETUP menu is where the leak test is configured. Figure 2.1 below shows an image of the MAIN menu. Figure 2.2 below shows an image of the SETUP menu.

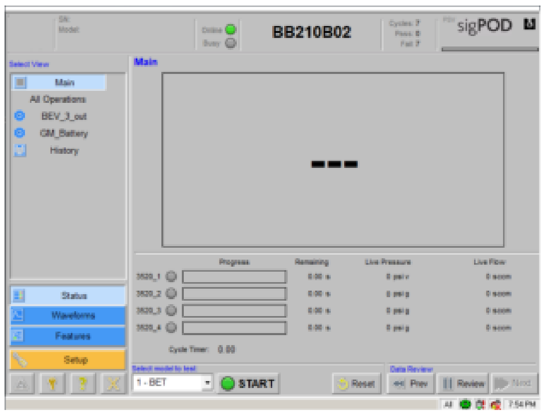


**Figure 2.1 – Main menu in PSV**

The MAIN screen as shown above has the STATUS, WAVEFORMS, and FEATURES sections identified on the left hand side of the screen in blue. From this screen, a leak test can be started, and the parameters of interest can be monitored live during a test by selecting FEATURES.

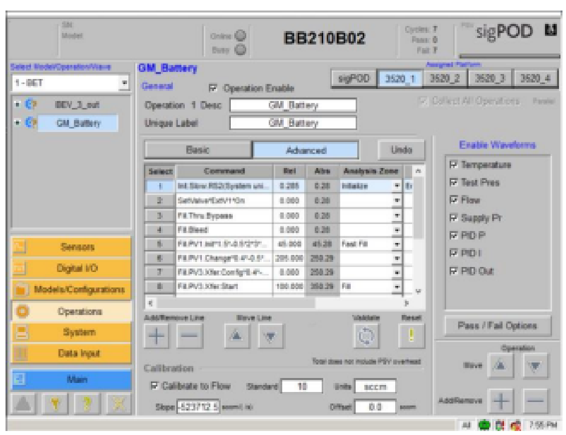


**Figure 2.2 – SETUP menu in PSV with Operations screen shown here**

The SETUP screen is shown above, and gives the user additional options of menus on the left hand side to configure the instrument: SENSORS, DIGITAL I/O, MODELS/CONFIGURATIONS, OPERATIONS, SYSTEM, and DATA INPUT. The leak test can be setup by making changes to these options within the SETUP menu.

## 2.2 Procedure to Start a Test

The sequence below will step the user through navigating to the MAIN screen from the SETUP screen, and beginning a test.

1. If the SETUP screen is currently displayed. navigate to MAIN screen by pressing MAIN in the lower left hand side as shown below in Figure 2.3.

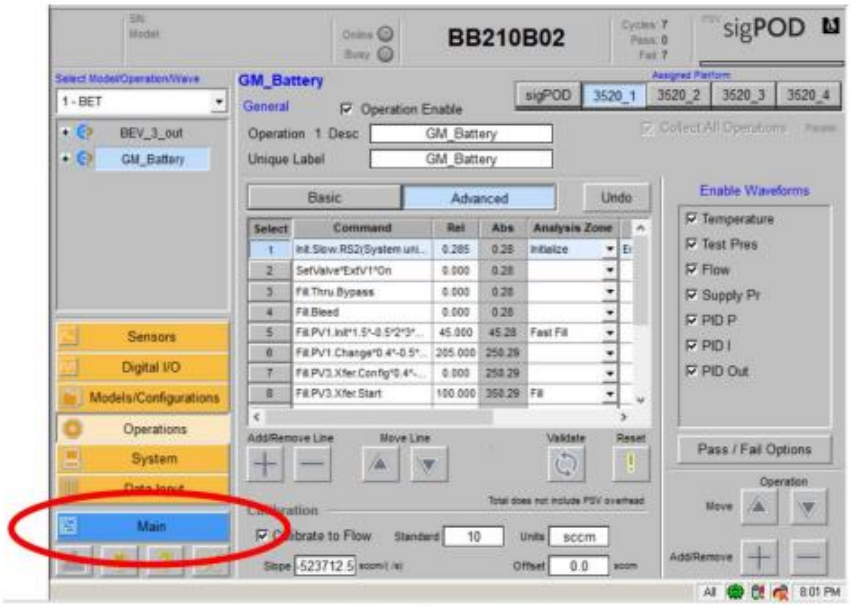


**Figure 2.3 – Navigation to MAIN screen**

2. From the MAIN screen, select the Model that the user would like to run as shown below in Figure 2.4 and press the START button. The test will start.

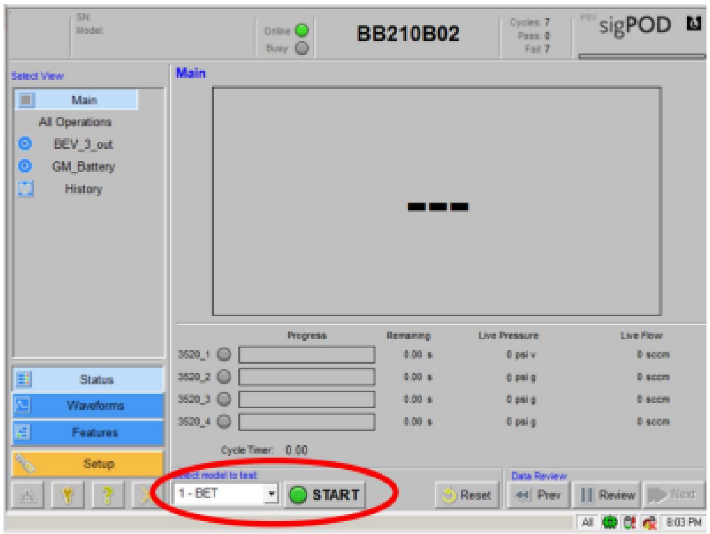


**Figure 2.4 – Select Model and press START**

3. If the Model selection is not accessible on the MAIN screen, navigate to SETUP as shown below in Figure 2.5 by pressing SETUP twice.

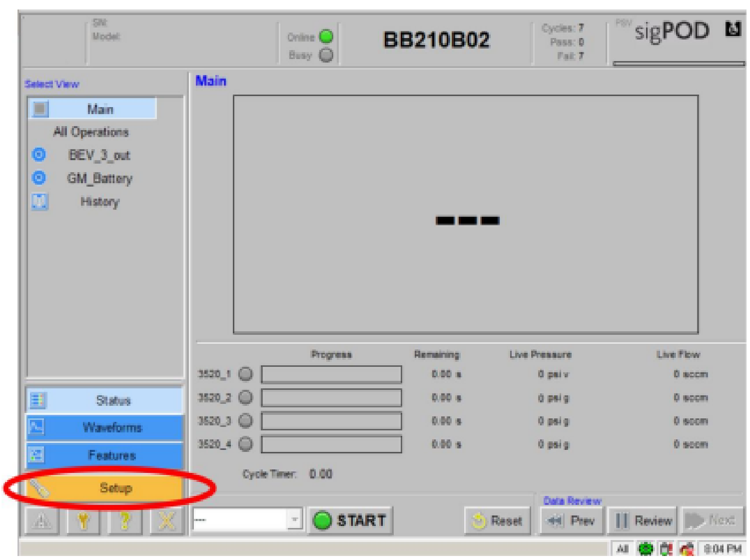


**Figure 2.5 – Navigation to SETUP screen**

4. From the SETUP screen, navigate to the I/O screen as shown below in Figure 2.6

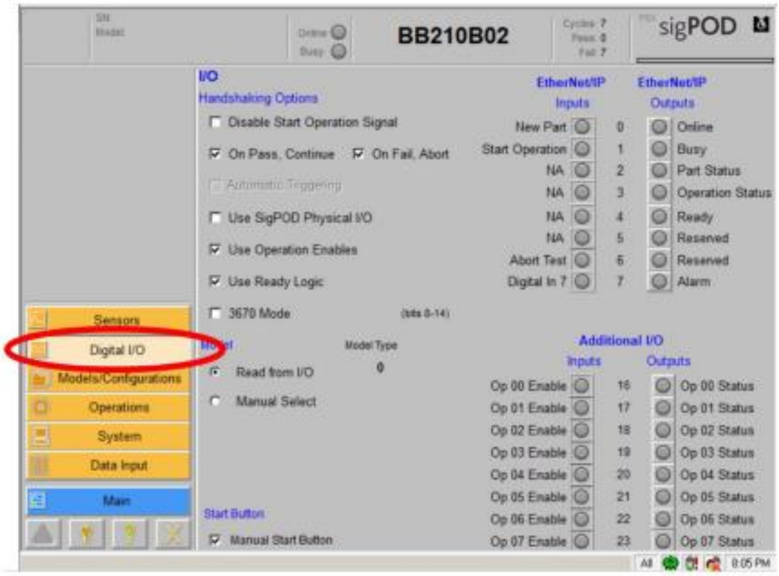

**Figure 2.6 – Navigation to I/O screen**

5. From the I/O screen, press the MANUAL SELECT radio button as shown below in Figure 2.7. This will disable the PLC Start sequence and will allow the user to begin a test from the instrument directly.

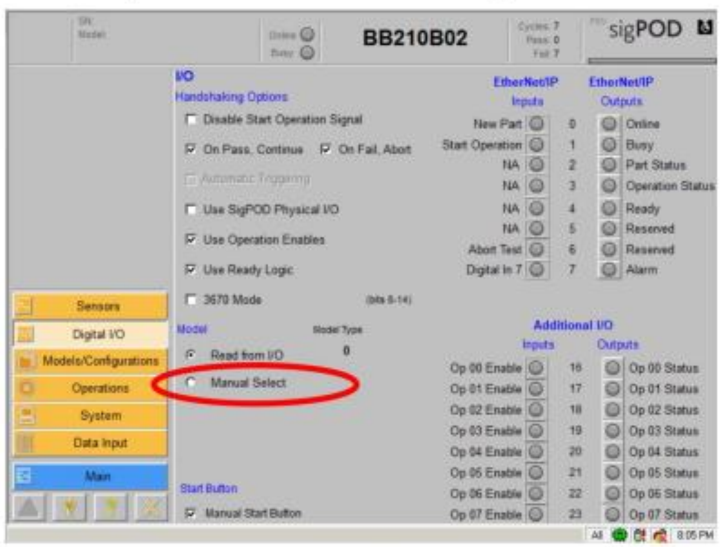

**Figure 2.7 – Disable PLC start command**

6. From the SETUP screen, navigate to the MAIN screen, as shown below in Figure 2.8.

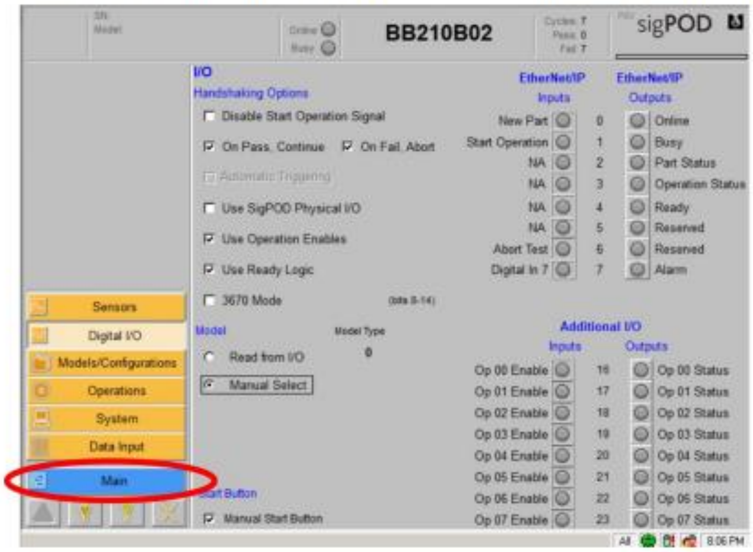


**Figure 2.8 – Navigation to SETUP screen**

7. From the MAIN screen, select the Model that the user would like to run as shown below in Figure 2.9 and press Start. The test will begin.


**Figure 2.9 – Select Model and press START**

## 2.3 Procedure to Start a Series of Tests

Below is a procedure to begin a series of back to back tests with a set RELAX time in between testing.

1. Navigate to the MAIN menu screen as shown in Figure 2.10 below.

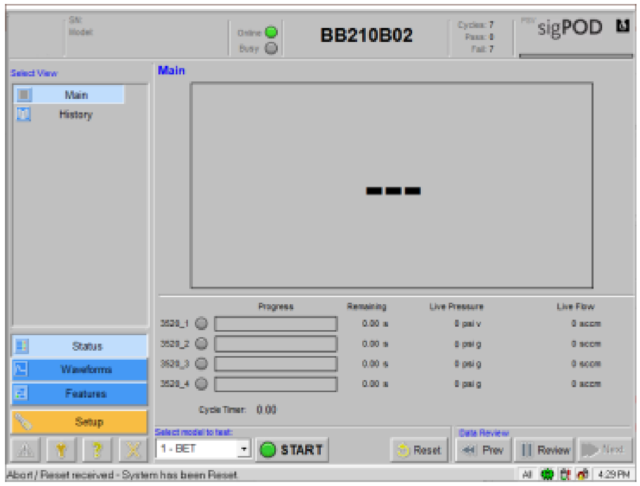


**Figure 2.10 – MAIN menu**

2. Press “Alt + 2” on the keyboard to bring up the REPEATABILITY screen as shown in Figure 2.11 below.


**Figure 2.11 – REPEATABILITY screen**

3. Choose the Model that the user would like to run as shown in Figure 2.12 below.

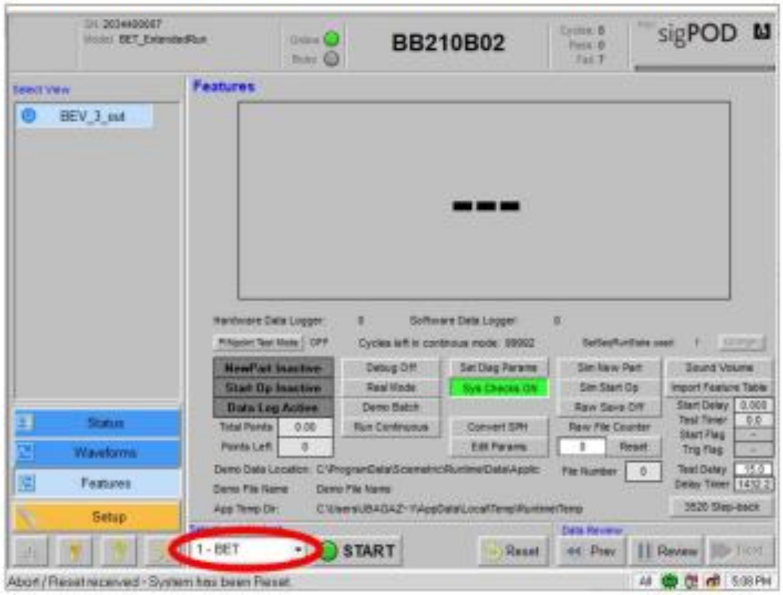


**Figure 2.12 – Model Selection**

4. Input the desired TEST DELAY into the menu shown below in Figure 2.13.

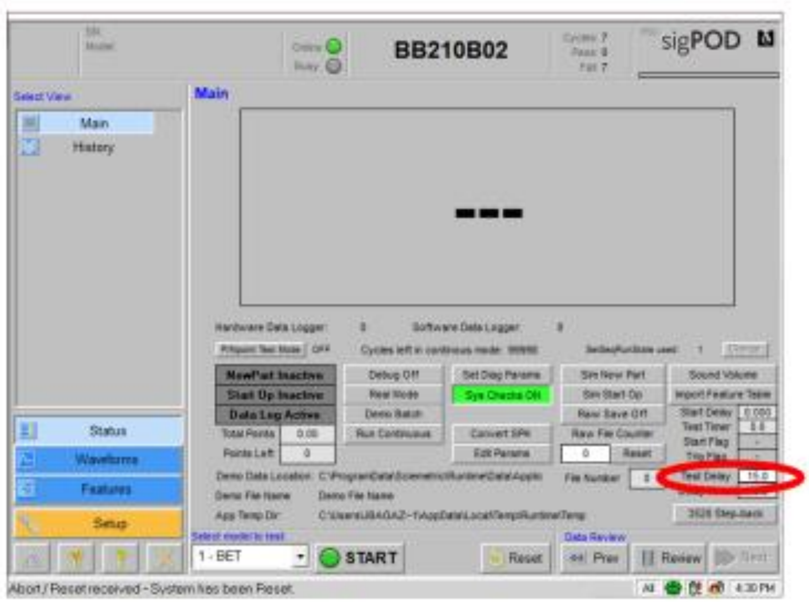


**Figure 2.13 – TEST DELAY box**

5. Press the RUN CONTINUOUS box shown below in Figure 2.14.

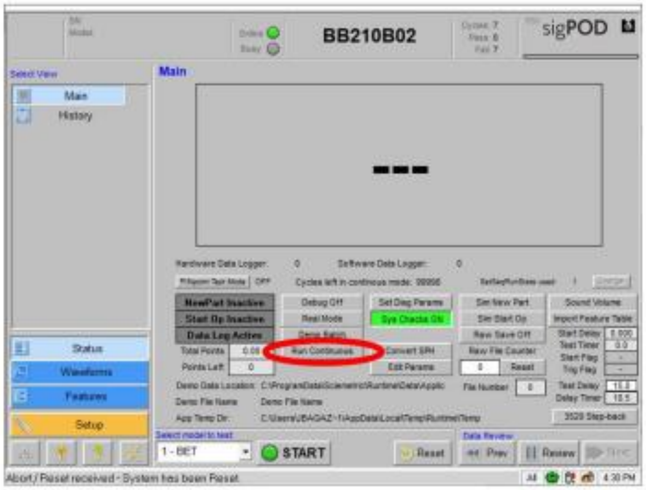


**Figure 2.14 – RUN CONTINUOUS selection**

6. Insert the desired number of cycles to run continuously and press OK as shown below in Figure 2.15. The first cycle will begin when OK is pressed.


**Figure 2.15 – Confirm selection and begin test sequence**

# 3.0 Model Structure

Different programs are stored on the SigPOD as "Models". This section will discuss the structure that is set up currently to manage the different part types (BEV3 vs BET) as well as different test types (0.5 psiv vs 0.22 psiv, etc.). Models store the parameters relevant to the leak test (test pressures, test timers, leak test procedure, etc.)

## 3.1 Background

Within the SETUP menu, there is a MODELS/CONFIGURATIONS tab that will allow the user to add/delete/rename all the Models within the SigPOD. The unit can store up to 99 different Models, however, Models 90-99 are reserved as template setup Models. Figure 3.1 below shows how to access the MODELS/CONFIGURATIONS from the SETUP screen.

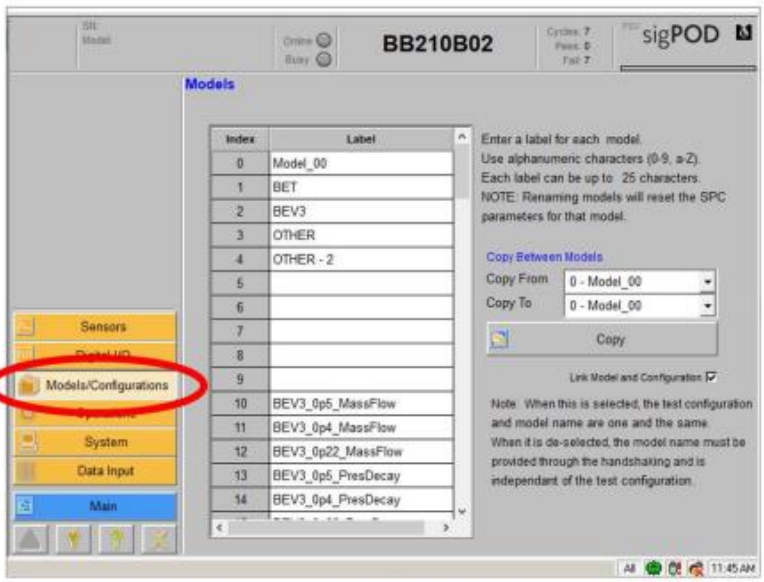


**Figure 3.1 – Models/Configuration page**

## 3.2 Current Structure

The current structure of all Models on the SigPOD is broken down into the following categories:

- Models #0-9: Production models that will be called from the PLC
  - BET
  - BEV3
  - OTHER
- Models #10-19: BEV3 stored models
  - Pressure Decay
  - Mass Flow
  - Extended Runs to measure no leak and leak in single run
- Models #20-29: BET stored models
  - Pressure Decay

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  - Mass Flow
  - Extended Runs to measure no leak and leak in single run
- Models #30-89: Debug stored models
  - Hose Check to verify mass flow sensor returns 0 sccm
- Models #90-99: Reserved template models (Do Not Edit)
  - Fast-fill pressure decay
  - Pressure decay
  - Fast-fill Mass Flow
  - Mass Flow

## 3.3 Procedure to Change Production Models

The sequence below will be used to copy a different reserve model into the production model if needed. For example, say that the PLC starts a BET Mass Flow test at 0.4 psiv. If we want to change this so that the PLC starts a BET Mass Flow test at 0.5 psiv, then we can follow the procedure below.

1. Navigate to the MODELS/CONFIGURATIONS menu from the SETUP screen as shown below in Figure 3.2.

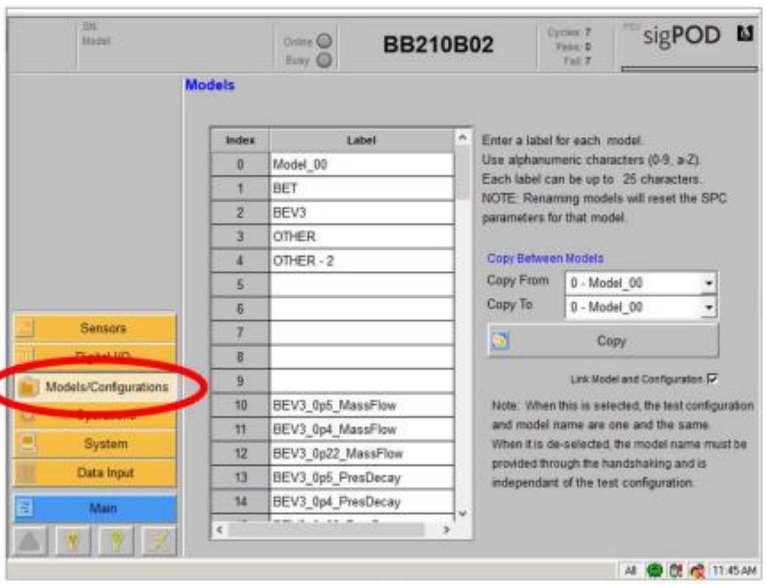


**Figure 3.2 – MODELS/CONFIGURATIONS page**

2. On the right-hand side, choose the model the you wish to copy from as well as the destination model selected as shown below in Figure 3.3. In this example, we will select to copy from Model #20 (BET_0p5_MassFlow) and copy to Model #1 (BET).

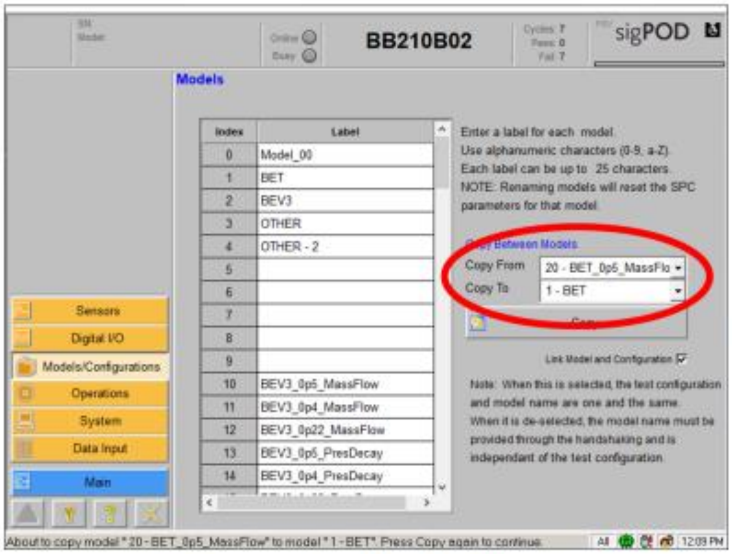


**Figure 3.3 – Copy Between Models Selection**

3. Press the COPY button twice to copy the model into the desired destination. A test can now be started from the PLC.

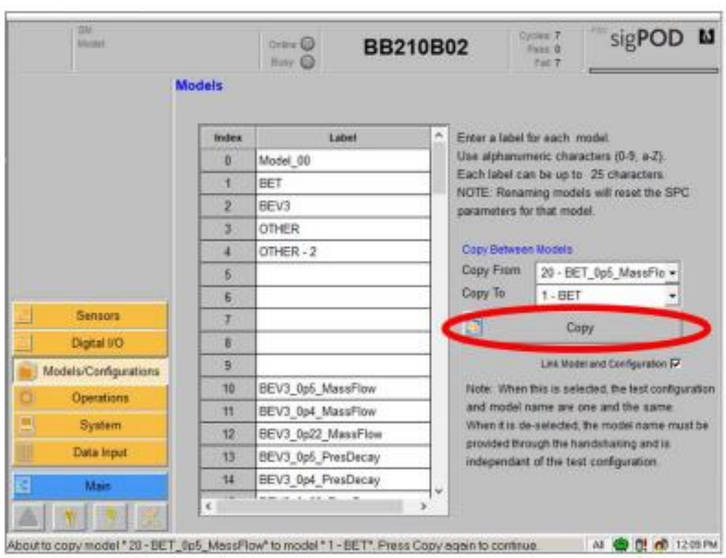


**Figure 3.4 – COPY model over to desired destination**

# 4.0 MAIN Screen Navigation

This section will walk through the different options available on the MAIN menu screen. This screen is used to view the live test results as well as query historical information of tests that have just completed.

## 4.1 STATUS Menu

The STATUS option on the MAIN menu can be accessed by selecting the top blue button on the left hand side as shown on Figure 4.1 below.

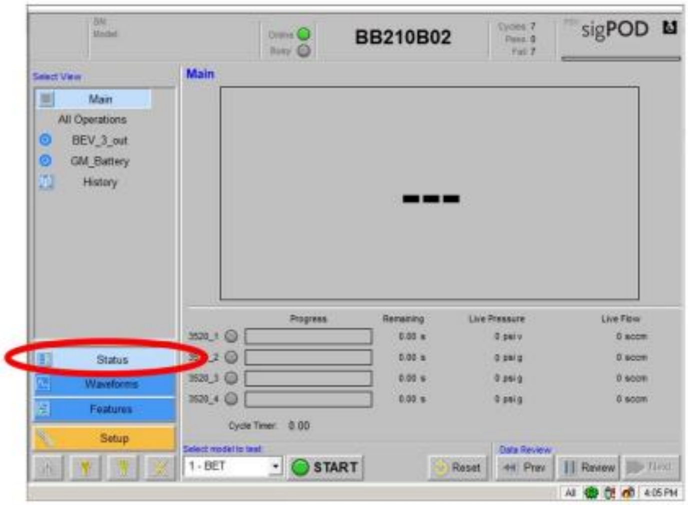


**Figure 4.1 – STATUS menu selection**

The sub-menus within this screen are identified on the upper left, and can be chosen depending on the STATUS of interest to the user. Figure 4.2 below shows how to choose the Main STATUS window, which will display a TESTING, PASS or FAIL depending on the current state of the instrument.

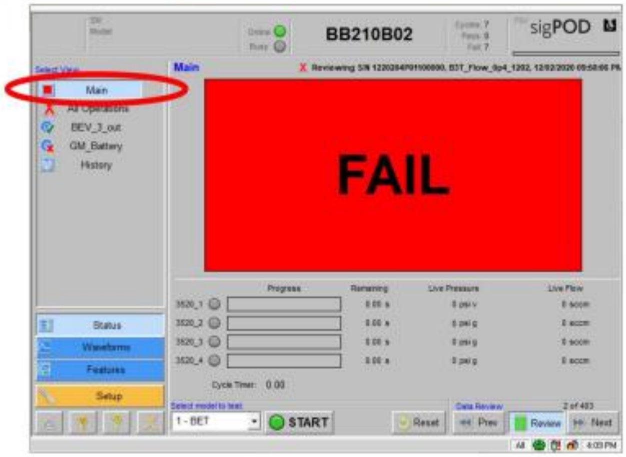


**Figure 4.2 – Selection of the Main option**

The ALL OPERATIONS screen can be selected by choosing this from the top left menu tree and will show a graphical disaply of features that have passed and failed within a single test. Figure 4.3 below shows this selection. The user will see either a green checkmark if the test passed, or a red “x” if the test failed.

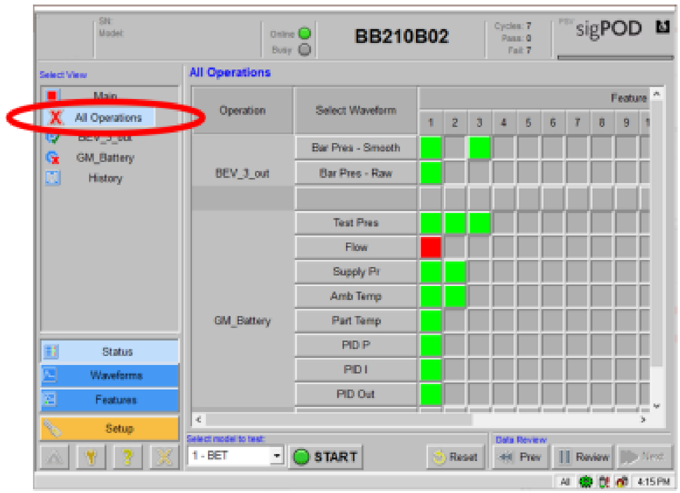


**Figure 4.3 – ALL OPERATIONS selection**

The individual operations can be identified as well by choosing the options on the left hand side below the ALL OPERATIONS selection. In this case, we can see a graphical readout for BEV_3_out and GM_Battery by themselves instead of all together. Figures 4.4 and 4.5 show both of these screens.

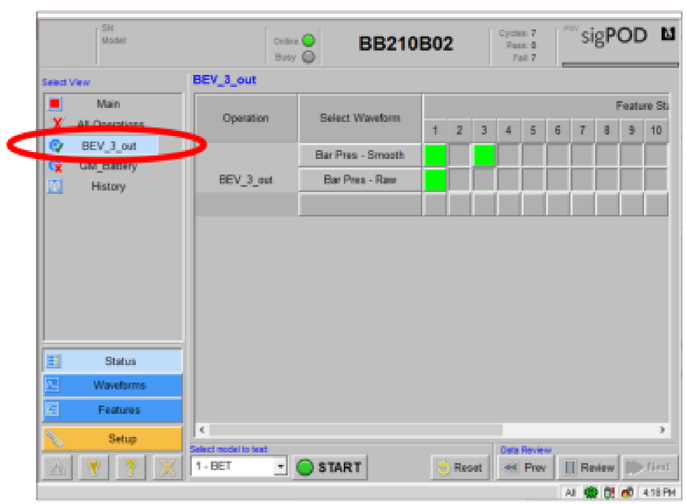


**Figure 4.4 – BEV_3_out operations**


**Figure 4.5 – GM_Battery operations**

Finally, the historical data results can be viewed and accessed from here as well by choosing the History option on the left hand side. Figure 4.6 below shows how to do this.

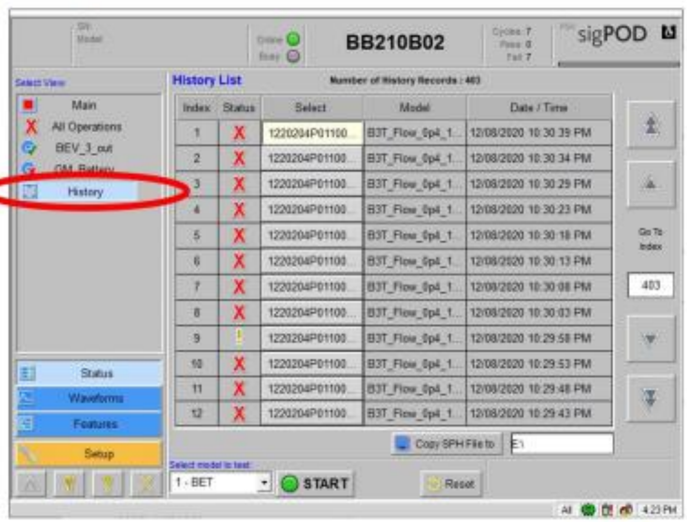


**Figure 4.6 – History data results viewing**

## 4.2 WAVEFORMS Menu

The WAVEFORMS option on the MAIN screen allows the user to quickly make a glance at the various live results at a single time. This options does not have to be used frequently, as further interrogation of the waveforms is best accessed by the FEATURES menu. Figure 4.7 below shows this WAVEFORMS menu below. Aas you can see below, different operations can be chosen on the left hand side depending on what you are interested in viewing at a glance.

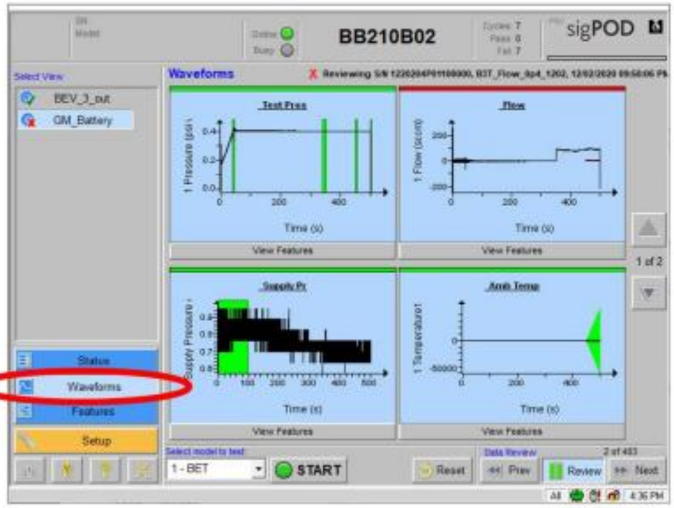


**Figure 4.7 – WAVEFORMS Menu**

## 4.3 FEATURES Menu

The FEATURES menu is one of the most heavily used menus to interrogate the test results stored on the system. There is much complexity to this menu, and this section will only address the high-level items. Figure 4.8 below shows where the FEATURES menu can be found.

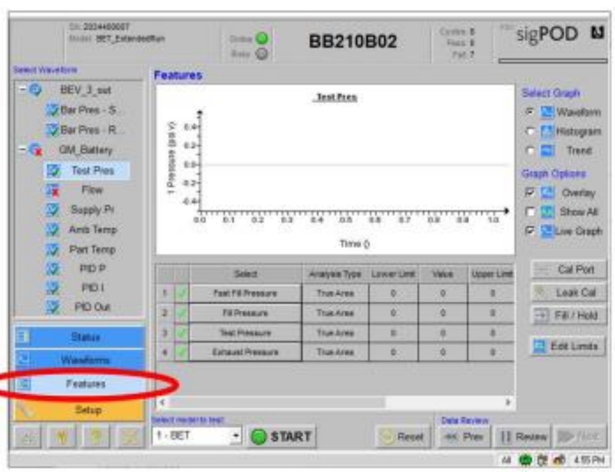


**Figure 4.8 – FEATURES Menu**

From this menu, the user has access to all data being recorded. This is a very useful tool to ensure that a test is being conducted successfully and also to overlay previous results on each other. To choose the data to view, the user can select the Processes on the left hand side of the screen. Figure 4.9 below shows the screen available when Test Pres is chosen.

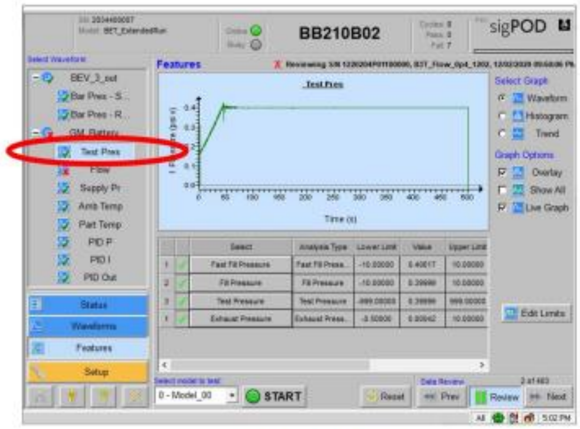


**Figure 4.9 – Test Pres FEATURE shown**

If additional detail is of interest, the user can double-click anywhere in the white screen that shows the plot, and additional menus will come up in that screen. Figure 4.10 shows how to choose the ZOOM icon to zoom in on a portion of the pressure plot selected. Figure 4.11 below shows a zoomed in version of the same data.

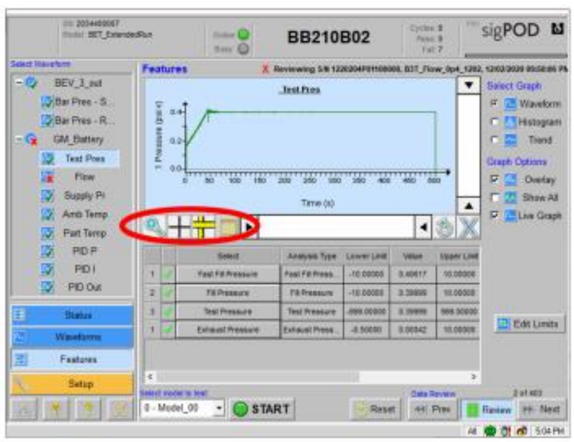


**Figure 4.10 – Additional graphical tools by double-clicking**

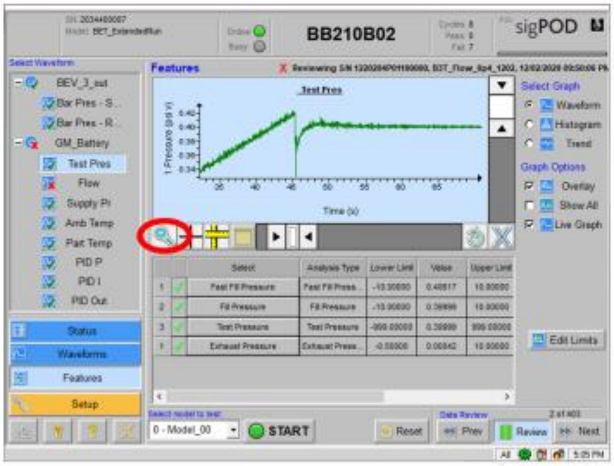


Figure 4.11 – ZOOM feature on plot

Finally, when this step is complete, the user can select the "X" in the bottom right corner to return the plot to normal as shown in Figure 4.12 below.

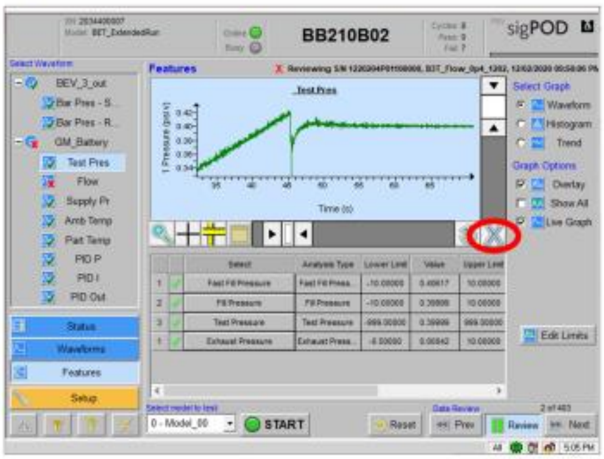


Figure 4.12 – Close the ZOOM window on graph

# 5.0 Verifying Successful Start of Test

Since the test times are very long (300+ seconds), it is advisable to ensure that when the START button is pressed, that the test begins properly. There are a few different ways to do this, and this section is broken down according to different locations to check to make sure that the test has begun.

## 5.1 Verify that Historical Data is not Currently Displayed

The MAIN menu on the SigPOD has the ability to allow the user to view results of previous runs. Sometimes, if a previous run is being viewed, then when a new test begins, the screen may still be showing that previous data, leading the user to think that the new test has not started. Figure 5.1 below shows the MAIN menu with the Data Review buttons circled below. If the REVIEW button is highlighted in green as shown below, this means the system is in REVIEW mode and will not show the live results during a test.

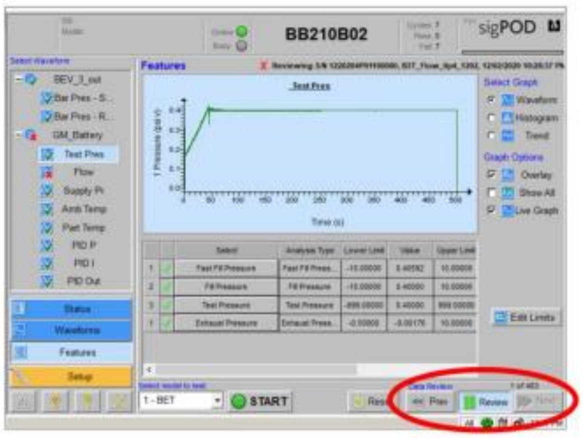


**Figure 5.1 – MAIN menu with DATA REVIEW section highlighted**

As shown above, this is the primary indication that a previous data set is being viewed on the screen. The user can also note that at the top of the page, there is language indicating that a previous data set is being viewed, and this is circled in red in Figure 5.2 below.

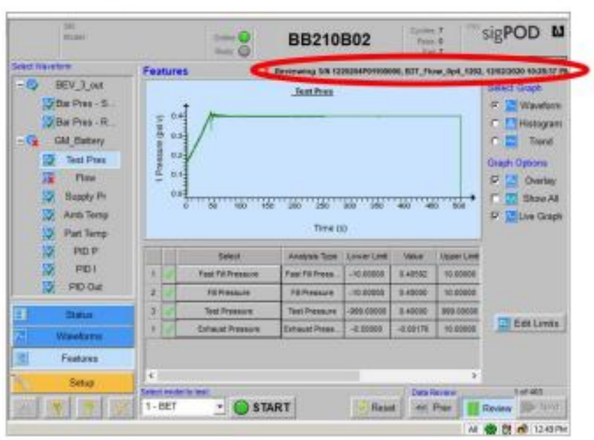


**Figure 5.2 – Language showing the serial number of previous data currently shown**

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If the user sees that the screens shown previously is active, then the REVIEW button on the bottom right hand side can be pressed to return the instrument to the current active display. Figure 5.3 below shows the REVIEW button location and Figure 5.4 below shows what the screen looks like when the system has been returned to normal active operation.

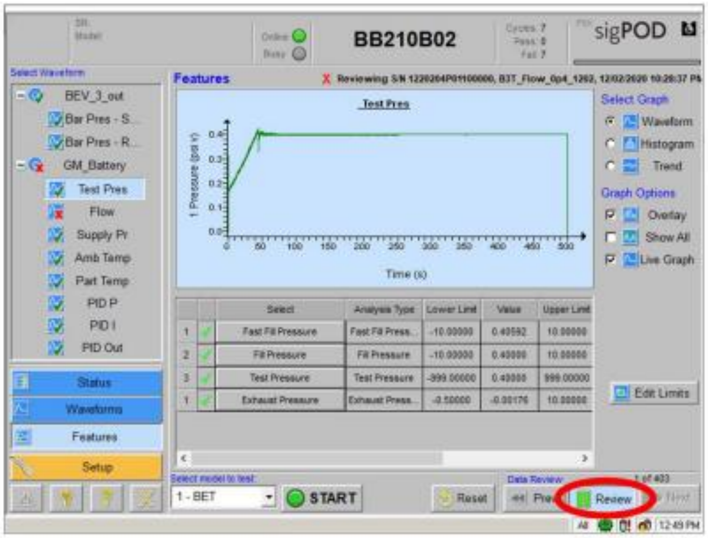


**Figure 5.3 – REVIEW button to be pressed to remove historical data viewing**

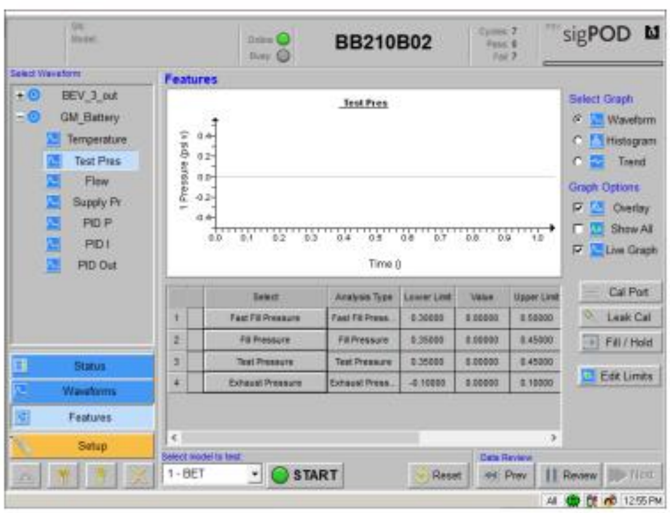


**Figure 5.4 – MAIN menu screen showing the active data set (if testing)**

## 6.0 Adjusting FEATURE Parameters

On the CTS 3520 leak tester, different PASS and FAIL limits can be set corresponding to the FEATURE of interest. For example, it is recommended that limits around the FILL, TEST, EXHAUST, and LEAK RATE all be set at a minimum to verify that the leak test runs successfully. This Section will discuss how to make changes to the FEATURES menu, using an example to change the average time span that the mass flow data is collected.

### 6.1 Mass Flow Time Window Adjustment

This section will discuss how to adjust the time window of the mass flow test, using Model #10 as an example. The first step is to go into the OPERATIONS page from the SETUP screen as shown in Figure 6.1 below.

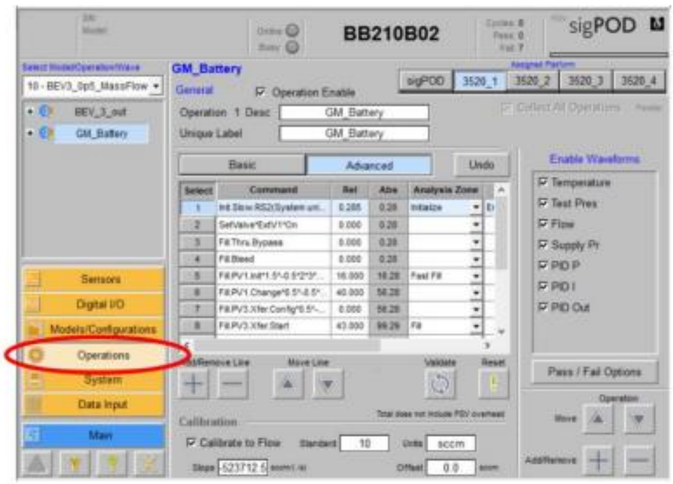


**Figure 6.1 – OPERATIONS Menu from the SETUP screen**

Next, select Model #10 as shown below in Figure 6.2

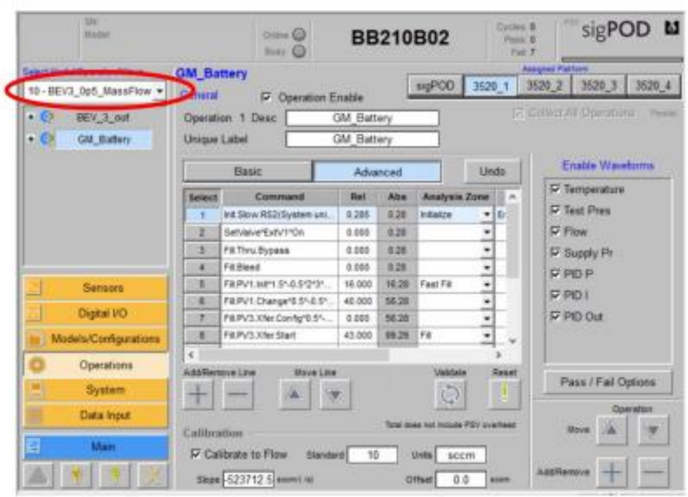


**Figure 6.2 – Model Selection within OPERATIONS Menu**

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Next, on the left hand side choose the 3520 PROCESS called "Flow" under the Operation called "GM_Battery" as shown below in Figure 6.3.

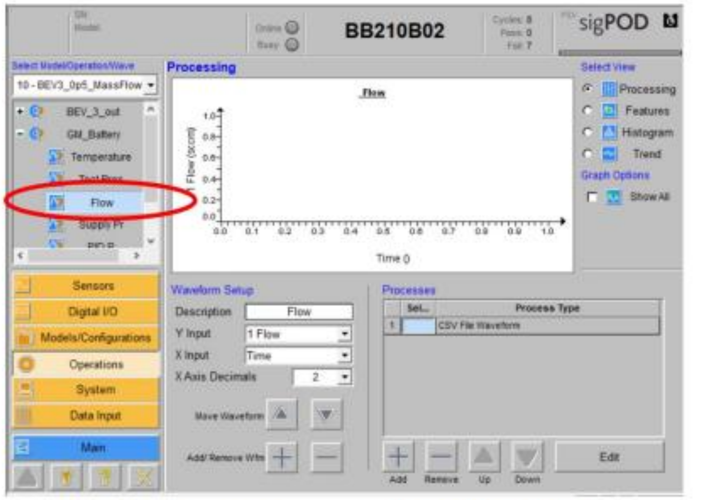



**Figure 6.3 – "Flow" Process within the 3520 OPERATIONS**

Next, choose the FEATURES from the right hand side to bring up the FEATURES of this Flow Process as shown below in Figure 6.4.

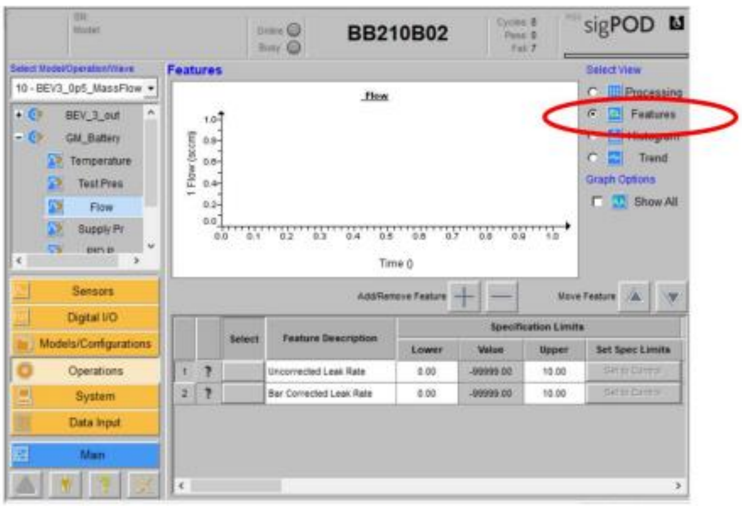



**Figure 6.4 – "Flow" FEATURES Screen**

Using the Scroll Bar at the bottom of the screen, scroll to the right side where the Analysis Range is visible as shown below in Figure 6.5.

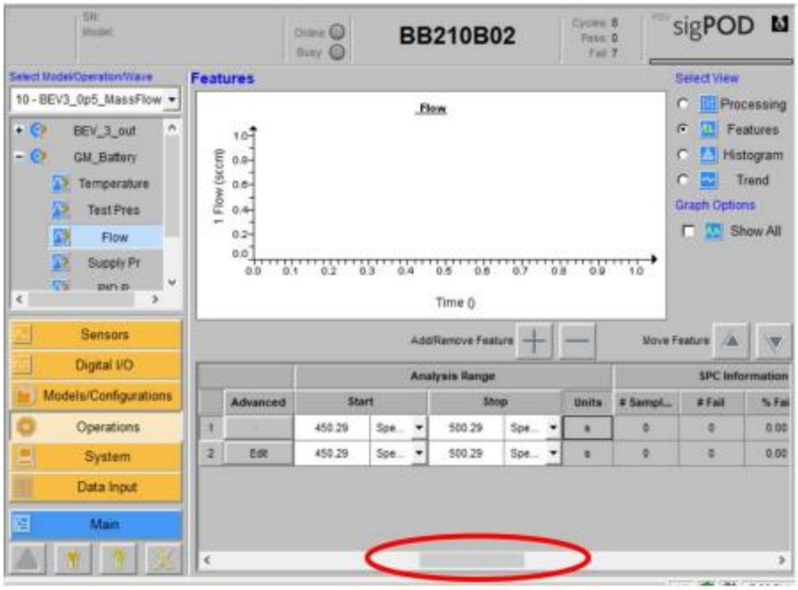



**Figure 6.5 – Analysis Range of "Flow" FEATURE**

Finally, Under the "START" column, use the drop-down menu to choose "TEST" to change this value to return the reading from within the TEST window and press ENTER.

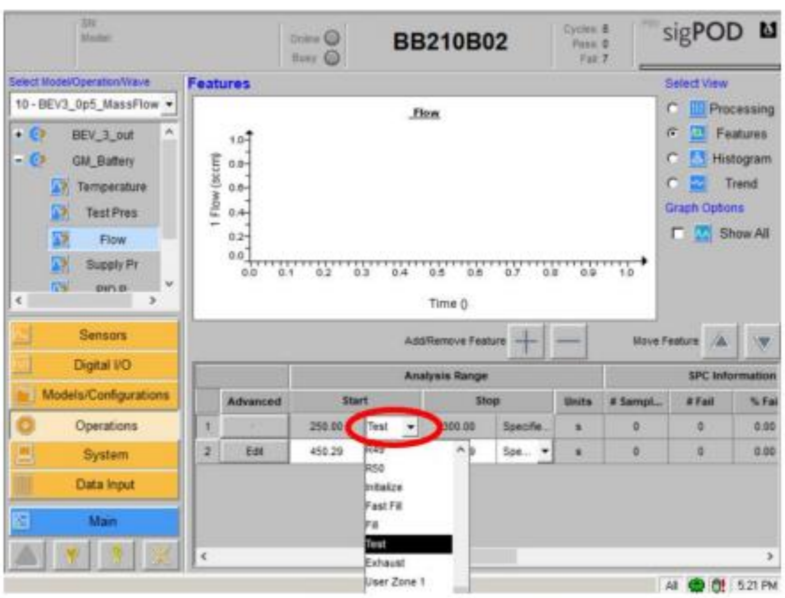



**Figure 6.6 – Changing to Start and Stop Times of Data Collection**

Confirm that the new START and END times have been adjusted to correspond to the TEST Zone as shown below in Figure 6.7.

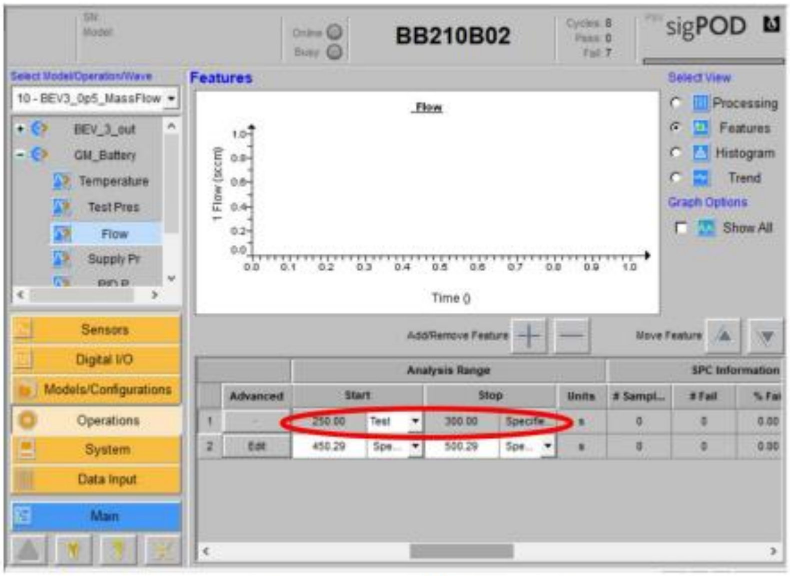



**Figure 6.7 – Confirmation of Window Adjustment**

# 7.0 Communication with Bauer Post-Processing Software

The SigPOD has the ability to save results in the form of CSV files for output to the Bauer control software. These files are located on the SigPOD at: D:\Runtime\Data\Application\CSV Output Files.

## 7.1 Adding a WAVEFORM to the CSV Output File

There are up to five waveform columns in the CSV file. To add a waveform to the CSV file, go to the processing for the waveform, and add a process as shown in Figure 7.1 below.

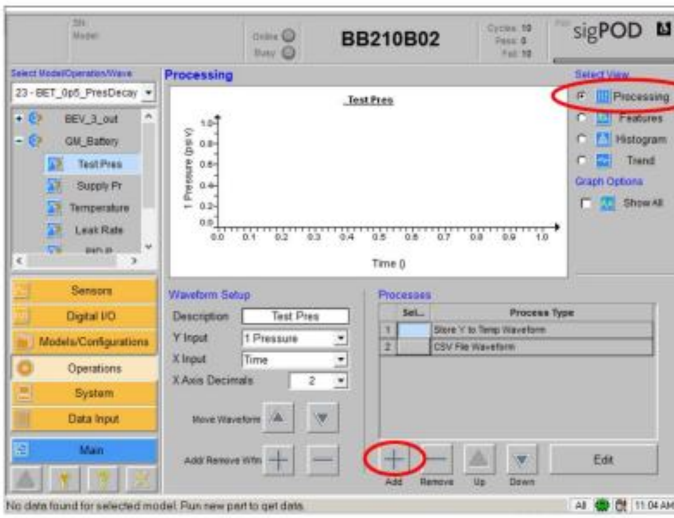



**Figure 7.1 – Process for waveform**

Press the "Edit" button when the new blank process shows up as shown in Figure 7.2 below.

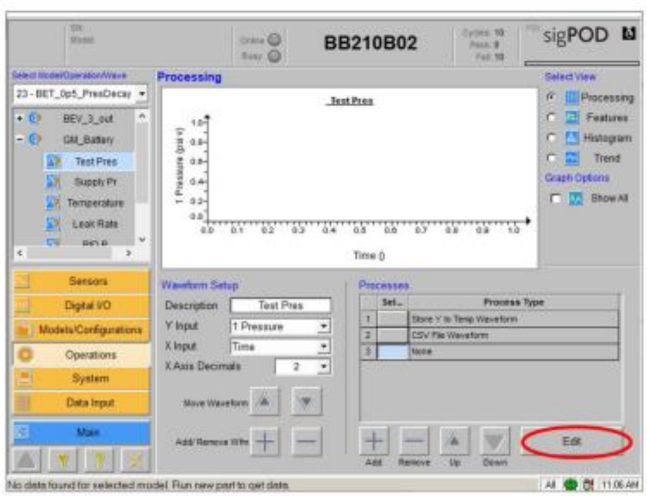



**Figure 7.2 – Select new blank process to edit**

Switch the process to "CSV File Waveform" and select the columns that the waveform will appear under in the csv file as shown in Figure 7.3 below. There are up to five columns. For the time column, the X Axis column will need to be selected for one of the waveforms. In the file example in this document, Pressure Y Axis column is 2, Pressure X Axis Column is 1.

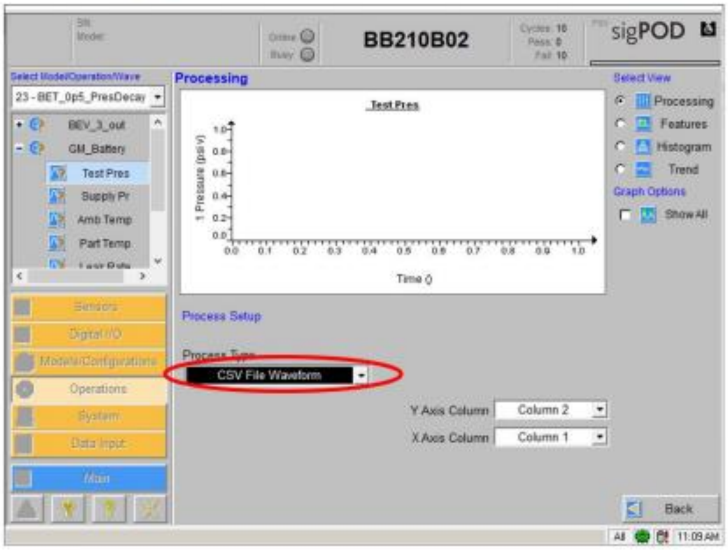



**Figure 7.3 – CSV File to Waveform Selection**

Press the BACK button when complete.

## 7.2 Adding a FEATURE to the CSV Output File

Multiple FEATURES can be added to the file, and there is no limit to how many can be included. Navigate to the FEATURES page and choose the FEATURE on interest as shown below in Figure 7.4.

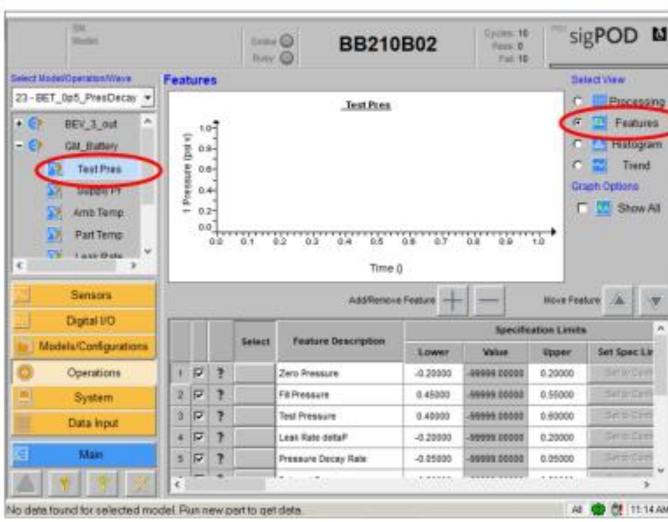


**Figure 7.4 – FEATURES Page**

From this page, choose the FEATURE of interest and scroll to the right side where it says "PINpoint Info" at the top of the page as shown below in Figure 7.5

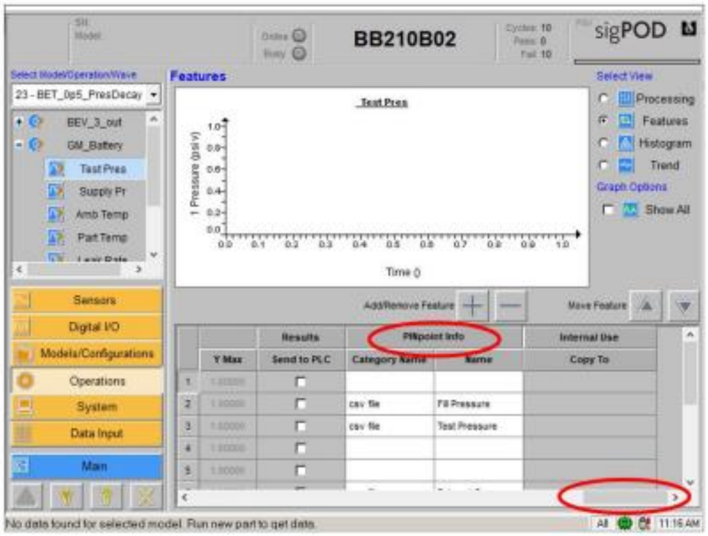



**Figure 7.5 – CSV File FEATURE to be saved**

In the "Category Name" field, type "CSV File" – note this does not need to be case sensitive. In the "Name" field, type the name that you would like this to be displayed in the Bauer software. Press ENTER when complete as shown in Figure 7.6 below.

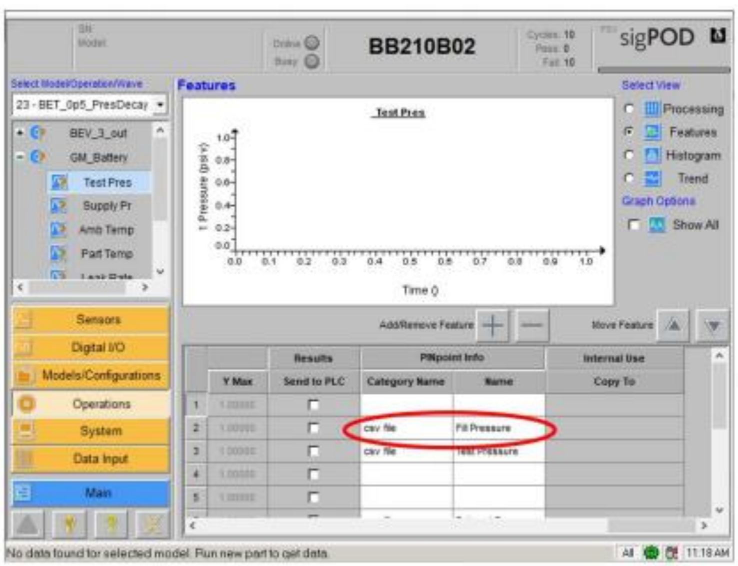



**Figure 7.6 – FEATURE name to be shown in the Bauer Software**

## 7.3 Date File Format and Location

This section describes the format of the data file as well is its location on the SigPOD. The folder will need to be shared in order to access the file from a different machine. It is the responsibility of the receiving program delete the file once it has been copied. Also, "Ready logic" should be used in the handshaking so that the file is not retrieved until it is completely written.

### 7.31 Filename Format

The filename is in the format:

```
<SerialNumber>-YYYY-mmm-ddHHMMss.CSV
An example filename would be:
ABCDEFG-2020Jun05103921.CSV
```

### 7.32 File Format

The following is an example format for the file. Note that all sections are always present whether or not data was set up for that section:

```
-Begin Header
Serial Number, ABCDEFG
Date/Time,2020Jun05103921
Overall Test Result,Pass
-End Header
-Begin Features
Feature Name,Value
Test Pressure,11.74 KPa
Leak Rate,8.67 sccm
-End Features
-Begin Waveform Data
Waveform Name,Time,Presure,Flow
Units,sec,V,V
,0.00000,9.05784,8.62532
,0.00002,8.64373,8.62815
,0.00004,8.56213,8.63293
,0.00006,8.62893,8.63889
,0.00008,8.66147,8.64539
,0.00010,8.58022,8.65194
,0.00012,8.40652,8.65814
,0.00014,8.17960,8.66366
,0.00016,7.77735,8.66819
,0.00018,6.76368,8.67141
,0.00020,4.63495,8.67282
,0.00022,1.40694,8.67151
-End Waveform Data
```

## 8.0 Setting up Passwords

Passwords can be set up for multiple levels from the Inspection screen before the PSV application is opened. From the Inspection screen, click on SETUP as shown in Figure 8.1 below.


**Figure 8.1 – SETUP menu on Inspection screen**

From the SETUP screen, choose SECURITY > SETUP to allow options for the Security Setup as shown below in Figure 8.2.

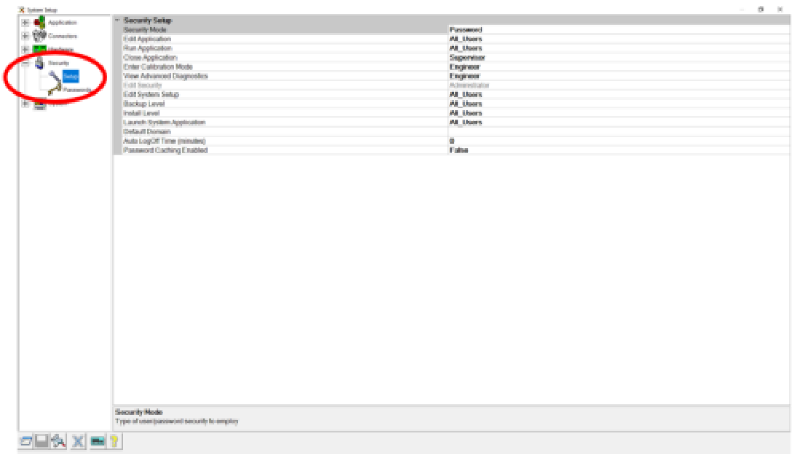


**Figure 8.2 – SECURITY SETUP page**

After the SETUP page has been configured, go to PASSWORDS page as shown in Figure 8.3 to set the different passwords corresponding to the four levels below:

- OPERATOR
- SUPERVISOR
- ENGINEER
- ADMINISTRATOR

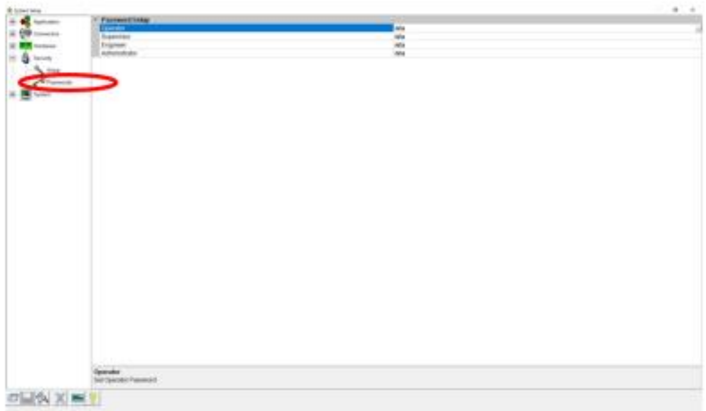


**Figure 8.3 – PASSWORDS page**

Once these have been set up, on order to enter the PASSWORD choose the KEY button on the lower left—hand side as shown below in Figure 8.4

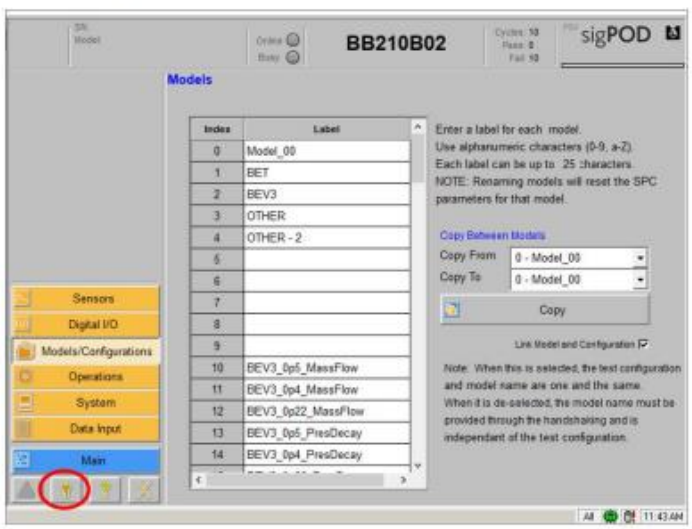



**Figure 8.4 – PASSWORD button**

# 9.0 Updating the Calibration & Correction Parameters

This section will discuss how to update the barometric and temperature correction factors as well as the Calibration Factor and Offset values. Note that these values will need to be updated for every model, and care should be taken to make sure that the proper calibration factors are input into the appropriate models.

## 9.1 Updating Calibration Parameters - Cal Factor and Offset

This section will walk through the process of updating the Calibration Factor. The Calibration Factor scales the pressure drop signal from psi/s to sccm and is a function of the part volume as measured by the leak test unit.

1. From the SETUP page, choose OPERATIONS on the left hand side as indicated in Figure 9.1 below and select "Test Pres" on the left hand side as shown below.

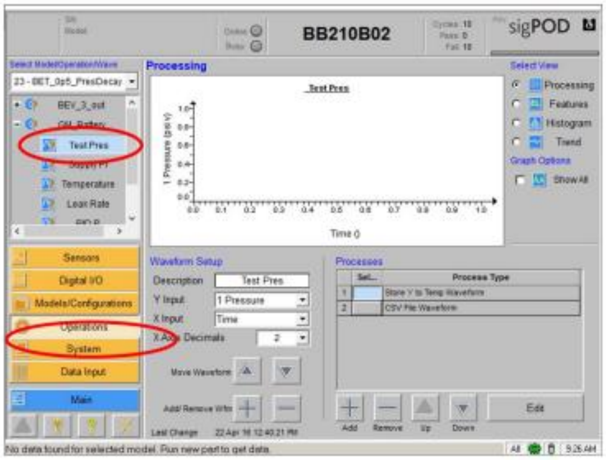



**Figure 9.1 – OPERATIONS page for BET**

2. Next, choose the FEATURES icon on the top right side of the screen as shown below in Figure 9.2.

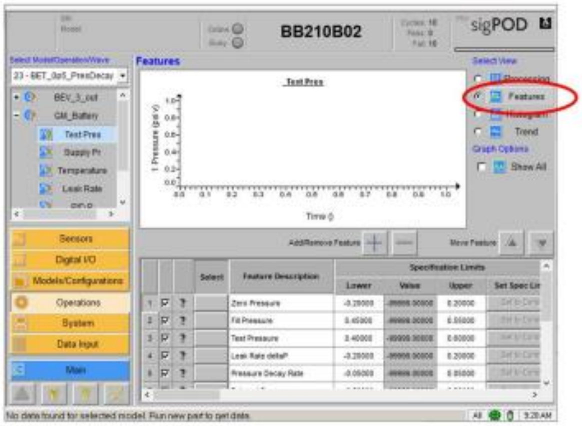



**Figure 9.2 – FEATURES view for BET**

3. Next, scroll down to where the items "PDCal – Slope" and "PDCal – Offset" can be seen as shown below in Figure 9.3.

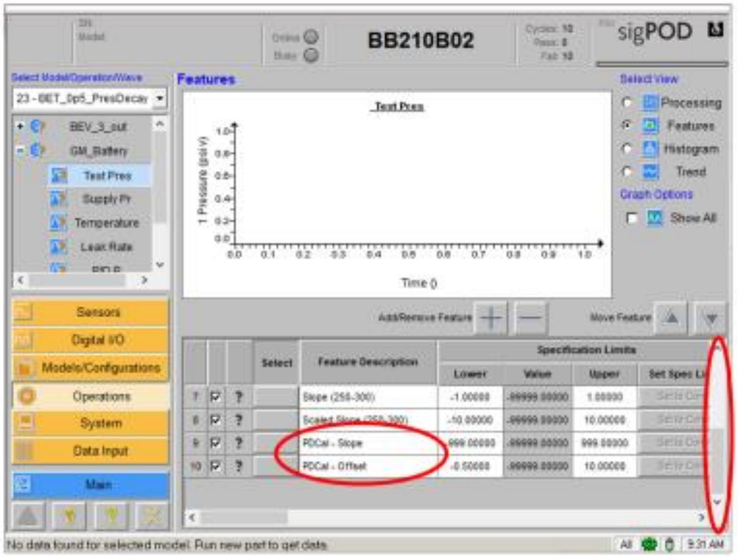



**Figure 9.3 – PDCal parameters listed**

4. Scroll to the right where the ANALYSIS PARAMETERS are listed and select the EDIT button as shown below in Figure 9.4.

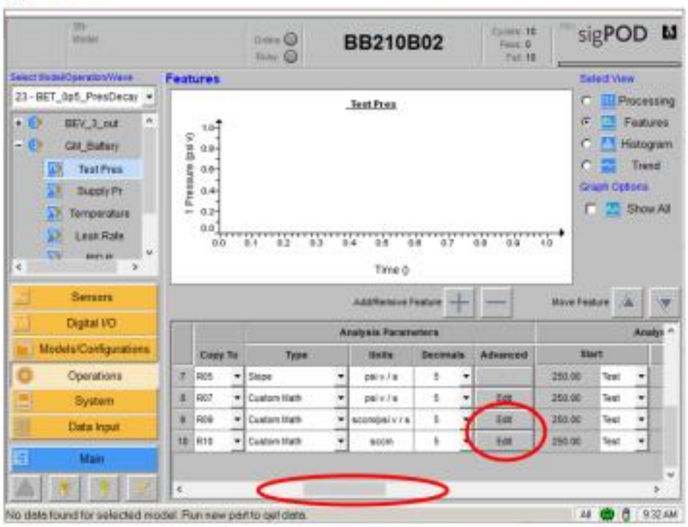



**Figure 9.4 – ADVANCED selection for PDCal parameters**

5. Manually enter the value calculated for the PDCal Slope or Offset into the corresponding row and press RETURN when complete as shown below in Figure 9.5.

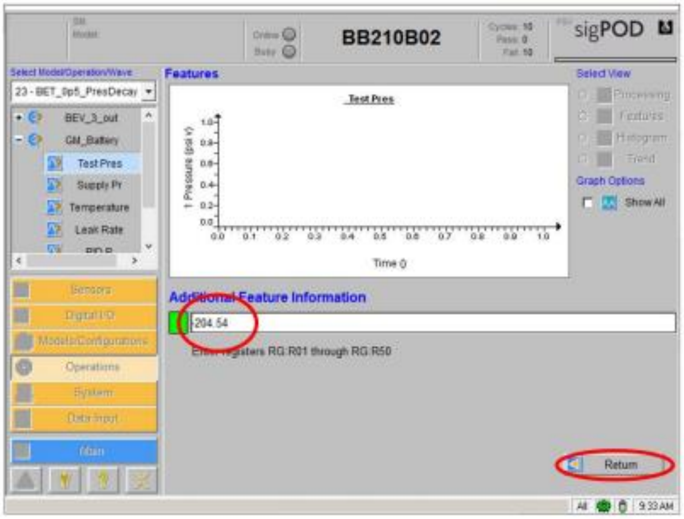



**Figure 9.5 – PDCal slope input shown here**

Now, the values entered will be used for the calculation of conversion from pressure drop to leak rate anytime this program is run. Note that there is no automatic update of the Cal Factor (PDCal – Slope) and Offset (PDCal – Offset)– they must all be hand entered.

## 9.2 Updating the Correction Factors – Ambient Pres and Temp

This section will walk through updating the barometric pressure correction factor and the temperature correction factor. These factors scale the corresponding input signal (barometric pressure or temperature) so that it can be used to adjust the pressure drop signal. Similar to the calibration factors, these correction factors must be calculated offline and then manually input into the Model desired.

1. From the SETUP page, choose OPERATIONS on the left hand side as indicated in Figure 9.1 below and select "Leak Rate" on the left hand side as shown below in Figure 9.6.

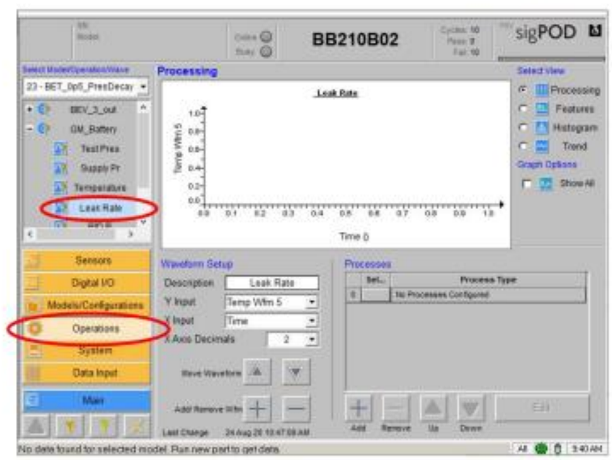



**Figure 9.6 – OPERATIONS page for BET**

2. Next, choose FEATURES from the right hand side to bring up the FEATUES menu as shown below in Figure 9.7.

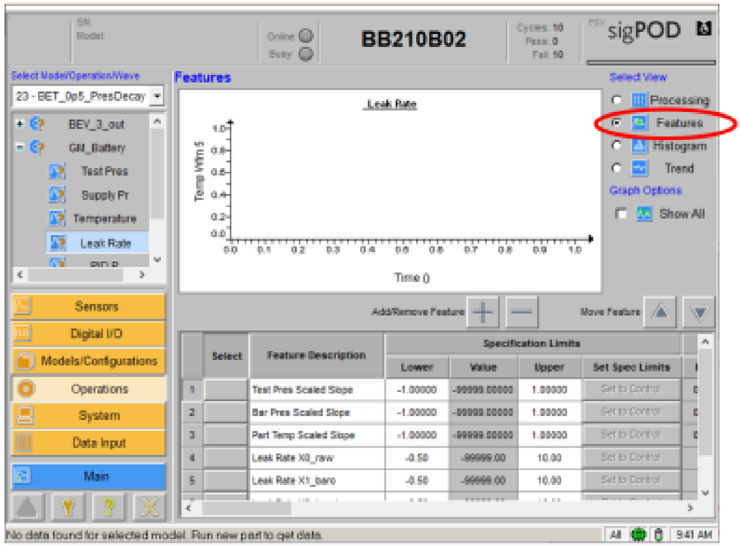



**Figure 9.7 – FEATURES menu for Leak Rate**

3. Next, scroll down to "Leak Rate X1_baro" as shown in Figure 9.8 below.

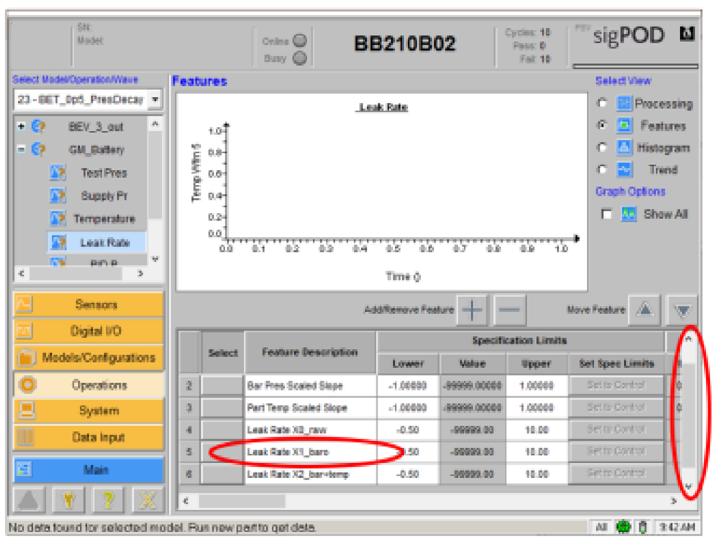



**Figure 9.8 – Corrected Leak Rate FEATURE**

4. Scroll to the right where the ANALYSIS PARAMETERS are listed and select the EDIT button as shown below in Figure 9.9.

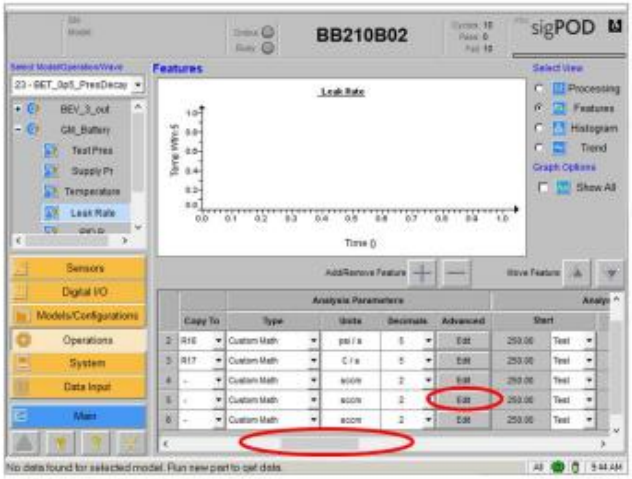



**Figure 9.9 – ADVANCED section for corrected leak rate equation**

5. Manually enter the barometric correction factor here as a multiplier before RG:R16. Note that here the factor is input to be 0.2838. Change this value to what is the new value and press RETURN when complete as shown below in Figure 9.10.

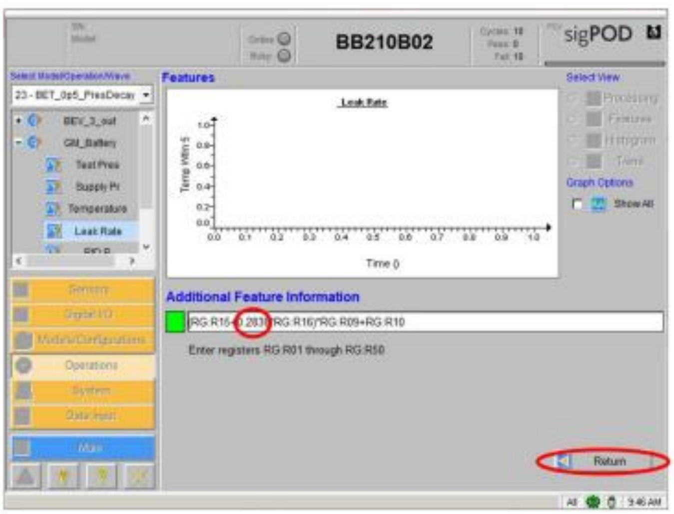



**Figure 9.10 – Barometric correction factor input**

6. If the temperature correction factor is to be updated, follow the procedure listed above but choose to EDIT the ADVANCED menu from Line #6 "Leak Rate X2_bar+temp" instead. Figure 9.11 below shows the barometric correction factor and temperature correction factors that will need to be updated as well.

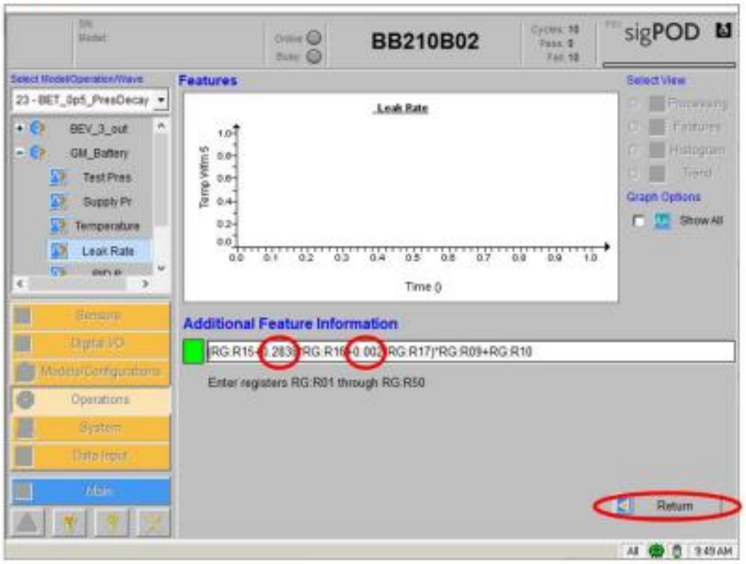



**Figure 9.11 – Barometric and Temperature correction factors input**

# 10.0 Changing the SigPOD Data Sampling Rate

The sampling rate of sensors on the SigPOD can be changed manually. If a long test is desired, then the sampling rate can be set to a low value so that data can be collected over an extended run. This portion of the manual will show how to do this.

## 10.1 Change the SigPOD Sample Rate and Duration

From the SETUP screen, go to the OPERATIONS menu and click on the SigPOD Operation on the top as shown below in Figure 10.1.

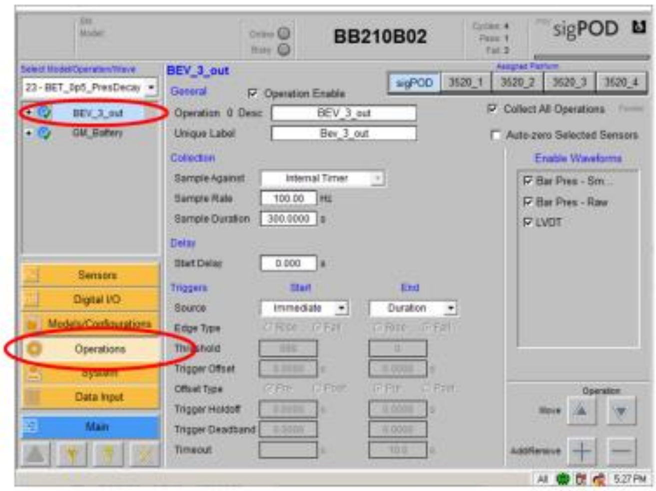



**Figure 10.1 – SigPOD OPERATIONS page**

On the SigPOD OPERATIONS page, change the Sample Rate and Sample Duration to be the desired settings as shown below in Figure 10.2.

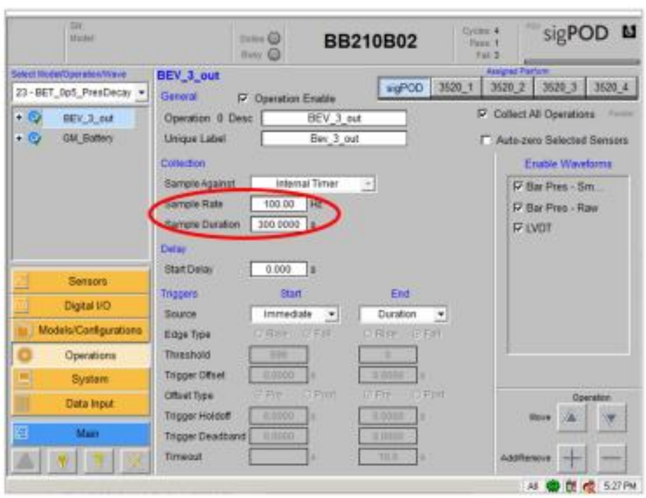



**Figure 10.2 – Sample Rate and Sample Duration**

# 11.0 Removing the PV3 Precision Fill

This section will show the process of removing the PV3 precision fill from the Pressure decay Program.

## 11.1 Remove PV3 Precision Fill

Navigate to the SETUP > OPERATIONS menu as shown below in Figure 11.1 and choose the Model that you would like to edit.

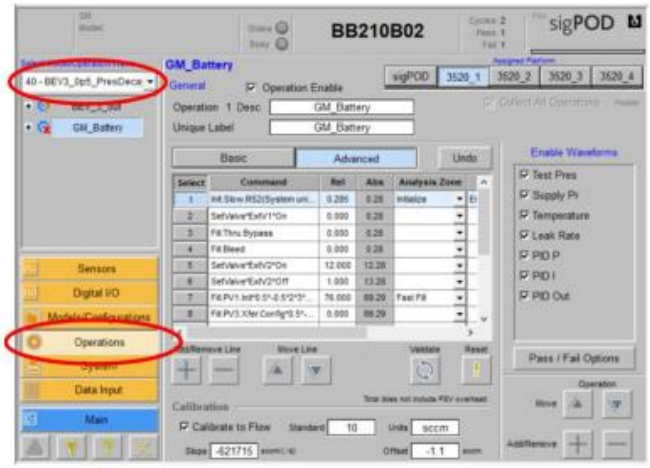


**Figure 11.1 – OPERATIONS**

In the ADVANCED MENU, Navigate until you see Fill.PV3 line items – these are the PV3 sequence as shown below in Figure 11.2.

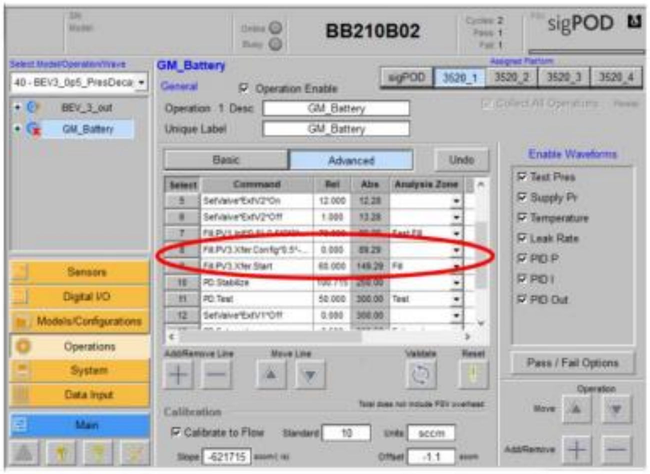


**Figure 11.2 – PV3 Line Items**

Highlight these rows and press REMOVE LINE for these two line items as shown below in Figure 11.3.

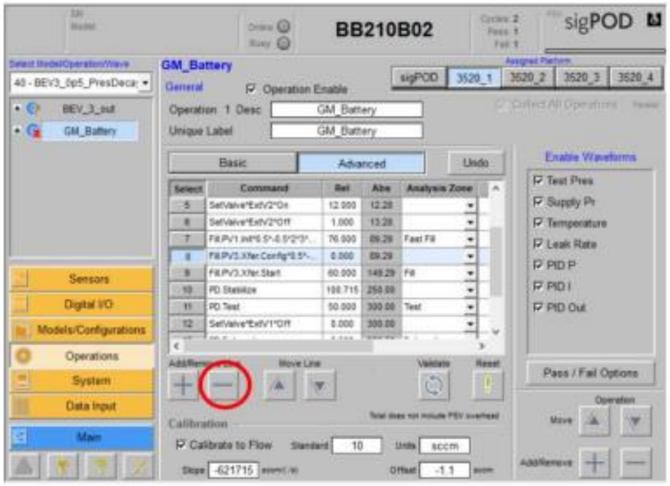


**Figure 11.3 – REMOVE LINES**

When this is complete, both PV3 line items should no longer show in this list as shown below in Figure 11.4.

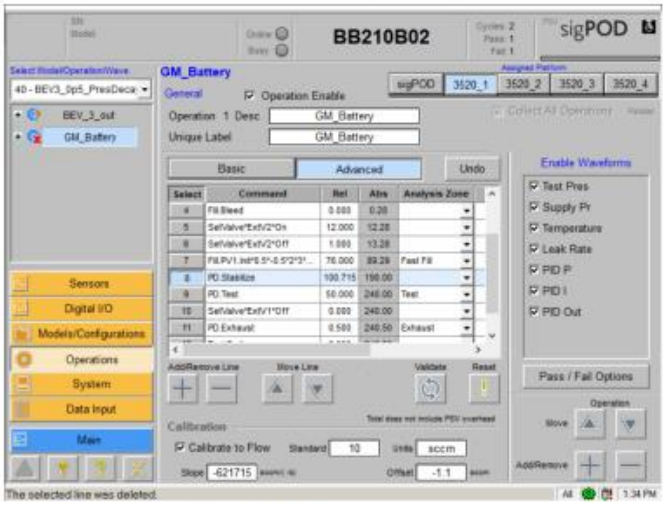


**Figure 11.4 – Advanced Menu**

# 12.0 Disconnect SigPOD and 3520 from PLC

If we need to disconnect the 3520 and SigPOD from the PLC, there are four options that need to be selected so that we can run the leak test instrument in a standalone mode. If these are not performed, an Error Code -106 or 600 is displayed, indicating that these steps were not taken.

**Background**

We have two "Operations" within a single test – one operation collects data on the SigPOD from the barometric pressure sensor, and the other operations collects pressure and temperature data from the 3520. For our purposes, these two operations will be running in parallel for everything we do since we collect all the data at the same time. The SigPOD has the ability to let the PLC start individual operations on its own, not just a complete test on its own. This is useful for other applications, but not useful for our purposes. Additionally, the PLC will be connected via Ethernet to the SigPOD, we will need to disable this Ethernet communication so that the SigPOD does not receive conflicting signals from the PLC when it tries to start a test.

**What we need to do**

This means is that when we want to disconnect the SigPOD and 3520 from the PLC we will need to perform four actions:

1. On the "Data Input" page, select "Generate Internally" to generate the serial number internally from the SigPOD as shown below in Figure 12.1.

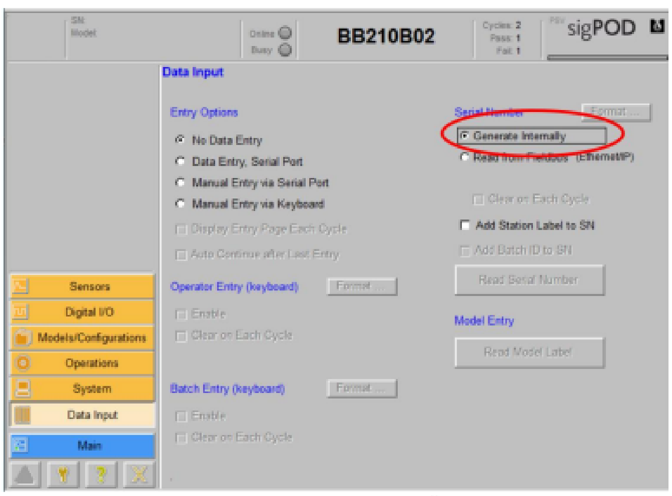



**Figure 12.1 – SN Generate Internally**

2. On the "Digital I/O" page, select "Manual Select" to allow for the user to choose different models as shown below in Figure 12.2.

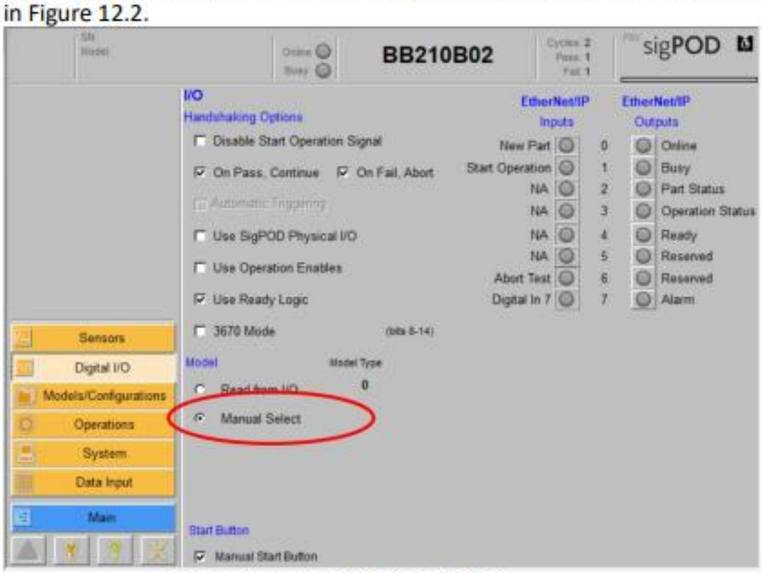



**Figure 12.2 – Manual Program Select**

3. On the "Digital I/O" page, de-select "Use Operation Enables" because we will not be starting individual operations when we run a manual test, we will be simply starting the entire test at the same time. See picture below where this check box is at, as shown below in Figure 12.3.

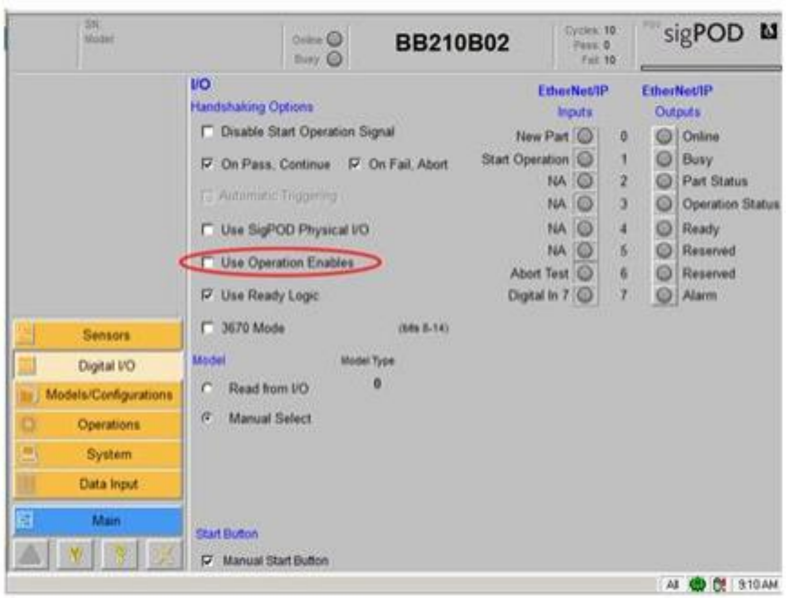



**Figure 12.3 – Use Operation Enables selection**

4. On the "Digital I/O" page, select "Use SigPOD Physical I/O" button to disconnect the SigPOD from using Ethernet I/P inputs from the PLC as shown in Figure 12.4 below.


**Figure 12.4 – Use SigPOD Physical I/O selection**

# 13.0 Backup and Install Features

These sections will address how to save backups and install updates from the PSV software. They will require a USB thumb drive to transfer the data files physically to and from the SigPOD.

## 13.1 Save a Backup of PSV

To save a backup of the current application, exit out of the PSV application by pressing the "X" in the lower left hand corner two times. At the Inspection screen, press the BACKUP button to enter the backup screen as shown below in Figure 13.1.

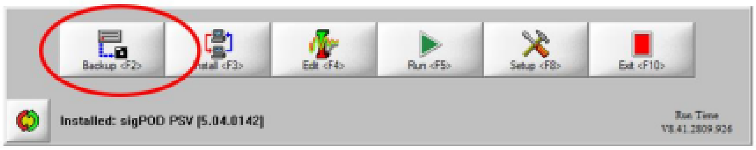



**Figure 13.1 – Inspection setup screen**

1. Place a USB thumb drive into the USB port on the back of the SigPOD and on the BACKUP screen below, choose <DRIVES OR NETWORK> and press the three buttons to the right to open a Windows Explorer navigation page as shown below in Figure 13.2.

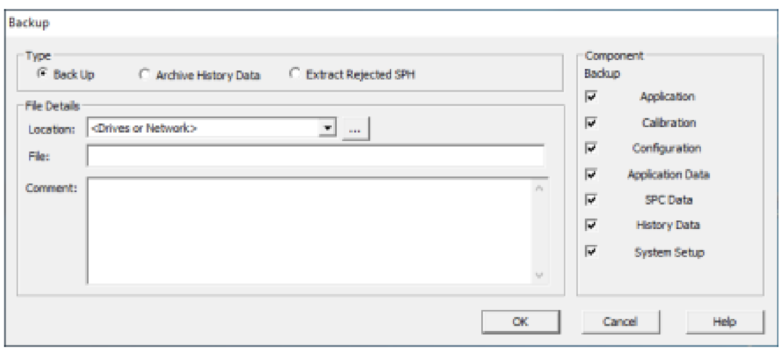



**Figure 13.2 – Navigate to the USB location**

2. Next, navigate to the USB location and type in a file name to save the backup. Press OK when this is complete, and then press the OK button on the BACKUP screen to begin the backup process. If there is significant historical data saved on the SigPOD, this process may take some time to complete. There will be a progress bar that displays the status of the backup while this is taking place and wait for it to complete.

## 13.2 Install Updated Configurations

From time to time, there may be modifications made to the software as new features are added or new Models are created. These can be modified offline and loaded onto the existing PSV application. To do this, follow thes steps below.

1. To install a backup of the current application, exit out of the PSV application by pressing the "X" in the lower left hand corner two times. At the Inspection screen, press the INSTALL button to enter the backup screen as shown below in Figure 13.3.

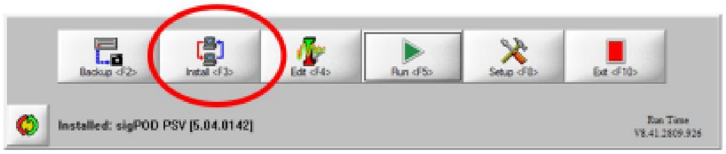



**Figure 13.3 – INSTALL screen**

2. Choose <Drives or Network> from the drop down list and press the the three buttons to the right to open a Windows Explorer window.

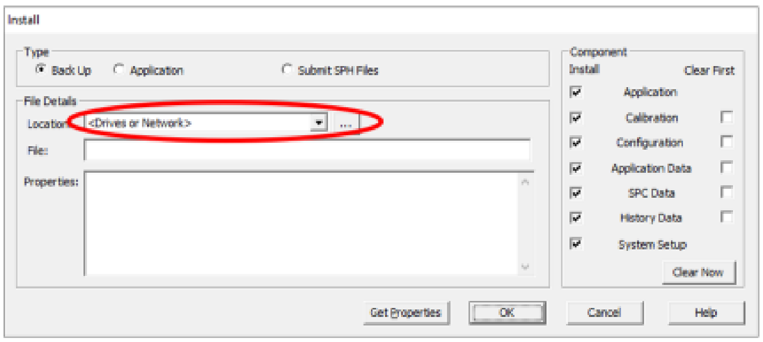



Figure 13.4 – Dorive or Network option

3. Next, Navigate to the location of the backup on the USB folder and press OK. On the right hand side of the screen, deselect all options except CONFIGURATION. This will ensure that only the Model updates are properly loaded onto the system. Figure 13.5 below shows what this looks like.

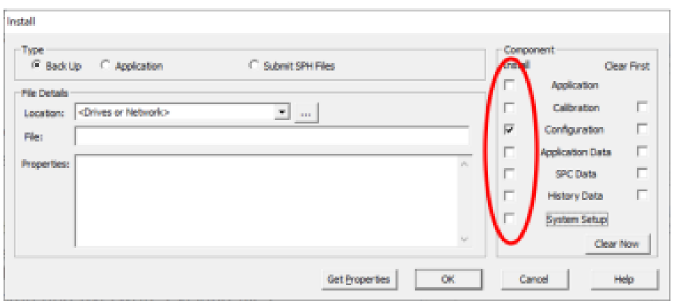



**Figure 13.5 – Correct selection of files to be uploaded**

4. Press OK to begin the upload. Figure 13.6 below shows information regarding what the different options do.

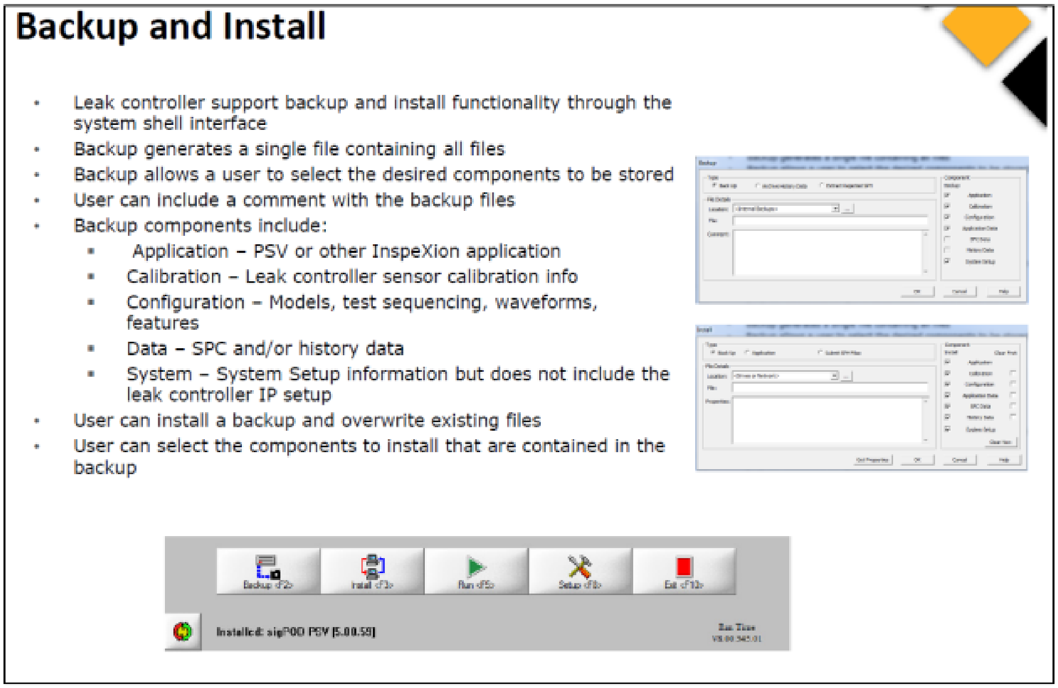
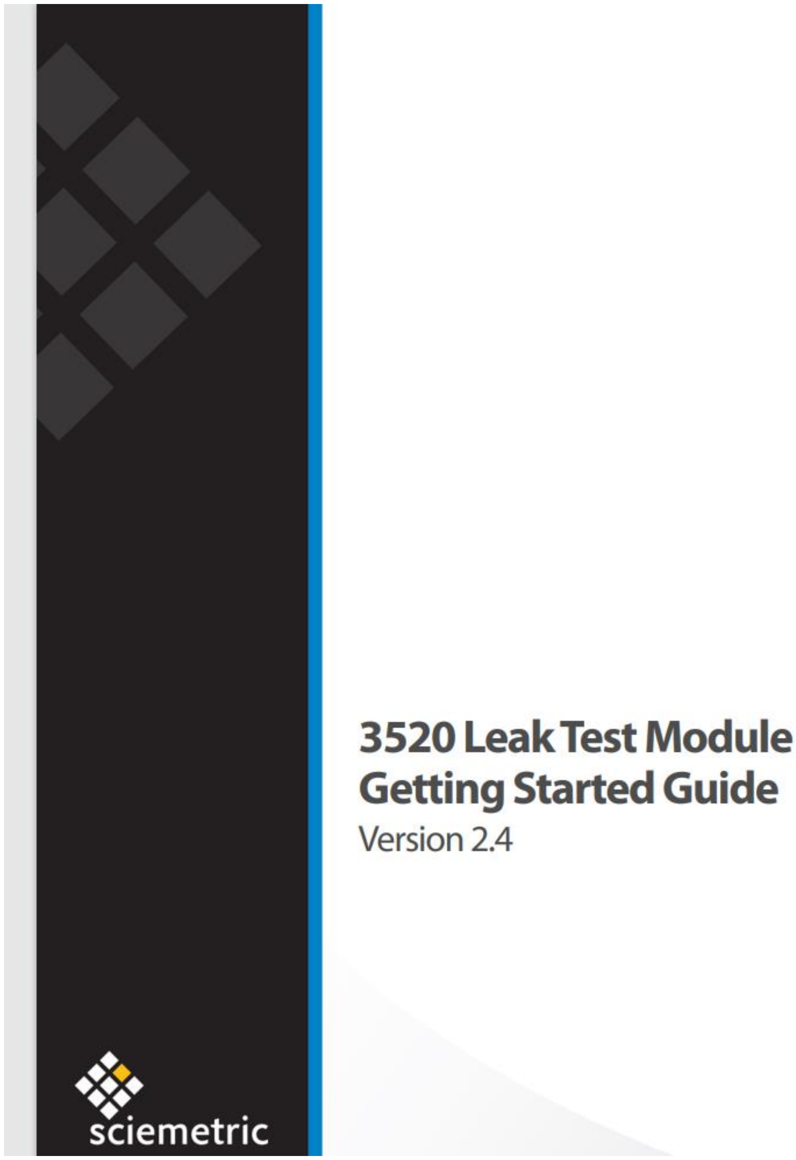



**Figure 13.6 – Install options**

# 3. 3520 LEAK TEST MODULE GETTING STARTED GUIDE



# Table of Contents

# 1.0 Introduction to the 3520 Leak Test module

The 3520 Leak Test module is an advanced Ethernet-based leak tester designed for industrial production quality control. It uses a sigPOD or PC running Sciemetric InspeXion software (PSV, IPT, or custom) as a controller and communicates with this controller using an OPC UA (Unified Architecture) protocol over the Ethernet.

The controller can be placed in an optimal location for the operator and interfaces with the PLC, QualityWorX database (if applicable) and operator to download the control sequence to the 3520. The 3520 module can be placed in immediate proximity to the part under test, minimizing hose length and volume. It runs the sequence independently and sends the data collected to the controller. The controller then performs the analysis and final pass/fail decision. Up to four leak channels can be controlled with one sigPOD or instance of PSV software; higher channel counts are available with IPT Suite or custom software. For an example of a system configuration, see *Figure 1*.

The 3520 Leak Test module is available in two main configurations:

- High-flow manifold for testing larger part volumes from 300 cc to over 400 L (Model number x0xC, also called C type)
- Low-volume manifold for testing part volumes of <1 cc to 1 L (Model number x0xB, also called B type)

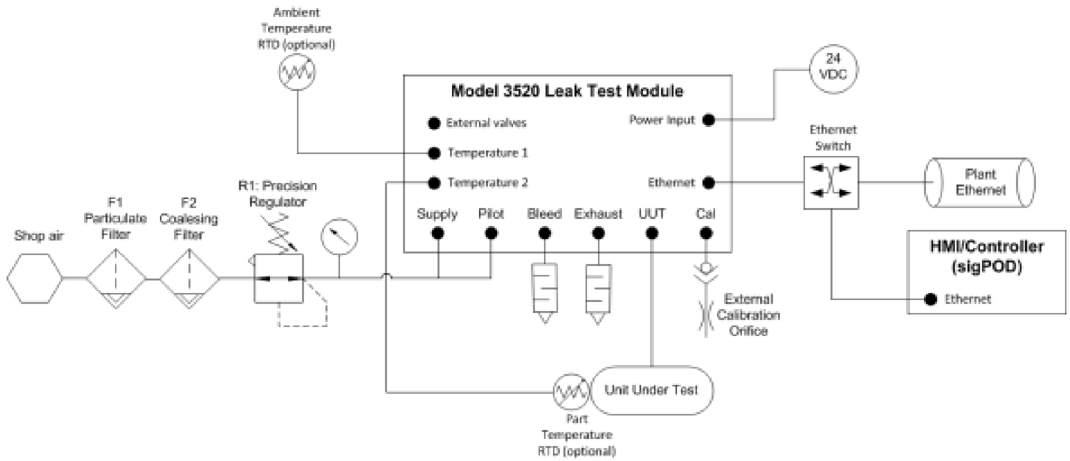



*Figure 1 Example configuration of a 3520 Series Leak Test System*

## 1.1 The 3520 operator interface

The front panel of both the 3520 B and C configuration models provides access to all features and controls of the module. There are some differences between the front panels. For more information on the controls of the front panels and operator interface, see the *3520 Leak Test Module, Model B, Service and Maintenance Guide,* and *3520 Leak Test Module, Model C, Service and Maintenance Guide*.

## 1.2 Multiplexer valve control accessories

Sciemetric offers several types of external multiplexer valve control accessories which allow you to test different chambers or parts, or route exhaust gases. They also allow you to run more than one test configuration or to use different supply sources, such as shop air, vacuum or helium. The multiplexers allow the 3520 to perform evacuation and fill procedures automatically, with test zones at each stage.

See the *3520 Leak Test Module User Guide* for more information on connecting and mounting multiplexers.

***Note*** 1: If you are connecting a different external valve interface to your 3520 Leak Test module, ensure it meets the *"Technical Specifications" on page 39*.

***Note*** 2: If you are testing more than one part or leak circuits, you can test them only one at a time.

# 2.0 Unpacking the 3520 Leak Test module

The 3520 Leak Test module is fully inspected, calibrated, and tested before shipping.

While unpacking the carton:

- Observe the safety precautions (see *"Safety" on page 13*).
- Retain the box and packing material for future shipments.
- Inspect all equipment for damage.

The 3520 Leak Test module ships with the following standard components:

- 3520 Leak Test module
- Power connector (M12 T-code 4-pin socket, field-wireable unshielded)
- 24 VDC power supply, universal input 120/240 VAC, NA power cord (not NEMA-rated)
- Ethernet connector (M12 D-code 4-pin plug, field-wireable, shielded)
- Ethernet cable (M12 4-pin D-code straight shielded plug to RJ45 connection, 5 m long)
- Latching valve services tool (shipped only with B configurations)
- Resin silencers (not installed when shipped):

  - Bleed port 1/4 NPT silencer

  - Exhaust port 1/4 NPT silencer for B configuration (low-volume) or 1/2 NPT silencer for C configuration (high-flow)
- Vibration mount kit (must be used for electrical and vibration isolation)

The following optional accessories are available:

- Temperature sensors:
  - Air temperature resistance temperature device (RTD) (Platinum, Class A, 100 Ohm, 6 inch, M12 A-code plug, 1/4 NPT connection, wire code 1)
  - Cu tipped RTD (Platinum, Class A, 100 Ohm, 6 inch, M12 A-code plug, 1/4 NPT connection, wire code 1)
  - RTD cable (M12 4-pin A-code straight plug to M12 4 pin A-code straight socket, non-shielded, 5 m long)
- Electrical:
  - 5-port Ethernet switch 10/100/1000 Wide Temp
  - Ethernet cable (M12 4-pin D-code straight shielded plug to RJ45 connection, 10 m long)
  - 3520 Multiplexer cable - M12 8-pin A-code straight shielded plug to 4 x DIN from C 9.4 mm lighted connectors, 3 m long (includes DIN gaskets)
- Pneumatic:
  - Custom-specified orifice metal flow standard (with Swagelok QC4 connection). Specify test pressure (vacuum to 90 psi) and leak rate in sccm (for example, 5 sccm at 15 psig).

- Custom-specified orifice metal flow standard (with Staubli RBE 03 connection). Specify test pressure (vacuum to 90 psi) and leak rate in sccm (for example, 5 sccm at 15 psig).
- Precision, preregulator with mounting bracket (1/2 NPT ports, max 500 psig in, 2-150 psig out, 40 SCFM, 0.1% supply pressure effect)
- Calibration port quick connect (SS Swagelok QC4 body 1/4 NPT Male)
- Calibration port quick connect (SS Staubli RBE 1/4 NPT Male IA / W)
- 4-station multiplexer valve assembly for the 3520 C Leak Test module and solenoid replacement kit. 2-way piloted NC valves, 1/2 NPT ports, 24 V, 2.5 W each valve. 10-32 Pilot port. Includes multiplexer cable: M12 8-pin A-code straight shielded plug to 4 x DIN form C 9.4 mm lighted connectors, 3 m long. The solenoid replacement allows conversion of any or all valves from NC to NO. The kit includes 8 bolts, 4 NO solenoids, 4 rubber seals, and 4 NO adapters.
- 4-station multiplexer valve assembly for the 3520 C Leak Test module: 3-way 2-position air-piloted valves, 1/2 NPT ports, 24 V, 2.5 W each valve. 10-32 Pilot port. Includes multiplexer cable: M12 8-pin A-code straight shielded plug to 4 x DIN form C 9.4 mm lighted connectors, 3 m long.
- 2-station multiplexer valve assembly for the 3520 C Leak Test module: 3-way 2-position air-piloted valves, 1/2 NPT ports, 24 V, 2.5 W each valve. 10-32 Pilot port. Includes multiplexer cable: M12 8-pin A-code straight shielded plug to 2x DIN form C 9.4 mm lighted connectors, 3 m long.
- 1-station external exhaust valve assembly for the 3520 C Leak Test module: 3-way 2-position air-piloted external valve, 1/2 NPT ports, 24 V, 2.5 W each valve. 10-32 Pilot port. Includes multiplexer cable: M12 8-pin A-code straight shielded plug to 1 x DIN form C 9.4 mm lighted connectors, 3 m long.
- 2-station multiplexer valve assembly for the 3520 B Leak Test module: 3-way 2-position latching valves, 1/4 NPT ports, 2x 1/8 NPT Exhaust ports. Includes multiplexer cable, 3 m long.
- A portable, adjustable flow standard kit for leak test trials. Use to create leaks of -50 to +50 sccm with test pressures of 10 to 5 psiv and 5 to 30 psig without needing to source specific calibrated flow standards. This accessory ships with a carrying case, Staubli and Swagelok quick-connect fittings, and the tools needed to swap the quick-connects.
- Druck DPI 104 30 psia pressure transfer standard with Swagelok QC4 fitting*. To be paired with 3520 models A0xx, B0xx, C0xx, G0xx, H0xx and I0xx.
- Druck DPI 104 30 psia pressure transfer standard with Staubli RBE 03 fitting*. To be paired with 3520 models A0xx, B0xx, C0xx, G0xx, H0xx and I0xx.
- Druck DPI 104 100 psia pressure transfer standard with Swagelok QC4 fitting*. To be paired with 3520 models D0xx, E0xx, F0xx.
- Druck DPI 104 100 psia pressure transfer standard with Staubli RBE 03 fitting*. To be paired with 3520 models D0xx, E0xx, F0xx.

*Due to the expiry of the transfer standard calibration, transfer standards are NOT stocked items and are purchased to order. Expect long lead times.

If you notice any shortages, contact the Sales Division of Sciemetric Instruments Inc. See the back of this Getting Start Guide for contact information.

Sciemetric Instruments Inc. warrants that the equipment was inspected prior to packing, and that the shipper received the carton in an undamaged condition. All claims for damage related to shipping and handling should be directed to the shipping company.

*Figure 2* shows the 3520 Leak Test module with all accessories.


*Figure 2 3520 Leak Test module with standard and optional accessories*

# 3.0 Safety

Before operating the module, read this section which includes important safety and care information for the 3520 Leak Test module.

**IMPORTANT**

The equipment has no direct connection to mains. There are no live hazardous parts and no risk of electrical shock.

**CAUTION**

If the 3520 Leak Test module is used in a manner not specified by Sciemetric, the protection provided by the equipment may be impaired.

## 3.1 Power requirements

The 3520 Leak Test module requires power supply voltage of 24 V DC (22 – 26 V DC).

**CAUTION**

- To avoid electrical shock, do not operate the equipment if any part of its exterior surface, such as the outer casing or panels, shows any sign of damage.
- Before performing any maintenance procedures, disconnect all external electrical connections.

**DANGER**

To avoid the risk of serious injury, always observe the following precautions before operating the 3520 Leak Test module:

- Use only a power supply cord with a protective earthing terminal.
- Always connect the power supply cord to a power outlet equipped with a protective earth contact. Never connect to an extension cord that is not equipped with this feature.
- Do not interrupt the protective earth connection.
- Never plug the module into a voltage source different than the one specified in the data sheet.
- The type of external power supply you use must be approved and certified by the authorities in the country where the equipment is installed and used.

## 3.2 Pneumatic safety

Before handling the pressurized air equipment, observe the following:

- Ensure the supply and pilot air pressures do not exceed the air pressure rating of the 3520 Leak Test module. See *"Technical Specifications" on page 39*.
- Always wear safety goggles and ear protection when working with pressurized air. Parts filled with pressurized air can burst or accidentally release air which, in turn, can result in flying particles or excessive noise.
- Before disconnecting the air pressure hose from the Supply port or the Pilot port of the 3520 Leak Test module, ensure that the air pressure source is closed off and/or isolated, and the air pressure has been fully exhausted.
- When you have completed a leak test, disconnect the part that is being tested only after the air pressure has fully exhausted. Failure to do so can result in physical injury.

## 3.3 Operating environment

The 3520 Leak Test module enclosure is designed to meet IP65 requirements. The enclosure is intended for indoor use and protects against dust and, to some extent, from falling dirt and dripping non-corrosive liquids.

The module vents air through the Exhaust and Bleed ports. The provided silencers are not sufficient to keep water or fine particles from entering the module, but these ports may be routed elsewhere if there is a risk of dust or water ingress. Keep oil, solvents, dust, debris and excessive heat away from this equipment.

Operating Temperature: 5 – 40°C

Operating Humidity: 8% – 90%

**CAUTION**

Do not place the 3520 Leak Test module in direct sunlight.

In order for the 3520 module to operate accurately, the air supplied to the module must be prepared according to the instructions in the "Connecting the Supply and Pilot air" in the *3520 Leak Test Module User Guide*.

# 4.0 Connecting the 3520 Leak Test module

- *Connecting power*
- *Connecting to the Leak test controller*
- *Connecting to the Ethernet*
- *Connecting accessories*

***Note*** For information on connecting pneumatics, see *"Pneumatic Ports" on page 21*. For information on electrical connections, see *"Electrical connections" on page 23*.

For information on connecting multiplexer valve accessories, see the *3520 Leak Test Module User Guide*.

Before you start connecting the module, ensure your set-up includes the following

- 24 VDC power (40 W max). See the Electrical section in *"Technical Specifications" on page 39*.
- Ethernet connection
- A PC or sigPOD controller with an InspeXion software program that supports the 3520 module
- Clean air for the Supply and Pilot ports. See *"Supply and Pilot air supplies" on page 21* and *"Technical Specifications" on page 39* for the supply and pilot air requirements.

**IMPORTANT**

Using air supply that does not meet the 3520 Technical specifications voids the warranty of the 3520 leak test unit.

- Stable supply pressure. See the Supply pressure section in the *"Technical Specifications" on page 39*.
- Vibration-free mounting during test cycles. See *"Mounting the 3520 Leak Test module" on page 27*.
- A 3520 module mounted as close as possible to the Unit Under Test (UUT) to minimize test volume.
- A UUT free of any contaminants, including oil or water.

## 4.1 Connecting power

The 3520 Leak Test module requires an external 24 V DC (40 W max) power supply. You can use either the supplied AC power supply offered by Sciemetric, or you can use your own power supply rated for 24 V DC (22 to 26 V DC) output.

**CAUTION 1**

- If you are not using the power supply offered by Sciemetric, consult the *"Technical Specifications" on page 39* for all power requirements.
- The type of external power supply you use must be approved and certified by the authorities in the country where the equipment is installed and used.

**CAUTION 2**

The ground of the power connector of the sigPOD controller and the ground of the power supply of the 3520 Leak Test module must be at the same potential. Otherwise, ground loops are created and the 3520 Leak Test module may not function correctly.

***Note*** . The chassis of the 3520 is connected to power ground. The chassis must be electrically isolated through the supplied Vibration mounts to avoid a ground loop.

**CAUTION 3**

The shield of the 3520 electrical connections is connected internally to the ground of the 3520 power supply. When using shielded Ethernet cables, a ground loop can be created through the network switch. If this is an issue, use a non-shielded Ethernet connection.

### To connect the 3520 Leak Test module to power

1. Ensure that all safety requirements have been met. See *Safety*.
2. Ensure that all pneumatics and accessories are connected properly.
3. Ensure the 24 V power supply is on, and that the power connector supplied with the 3520 Leak Test module is wired correctly.
4. Connect the power connector to the Power port on the front panel of the 3520 Leak Test module.

   The Power indicator on the front panel of the 3520 Leak Test module should light up green as soon as power is established, and all status indicator LEDs will flash a test pattern.

   ***Note:*** If the power indicator does not light immediately, ensure the power connector is properly and fully threaded.

## 4.2 Connecting to the Leak test controller

Since the 3520 Leak Test module is an Ethernet-based leak tester, you can securely connect, operate, diagnose, or update the equipment from any computer on the same network as the 3520 Leak Test module.

If required, you can place the 3520 Leak Test module in a close proximity to the controller, and directly connect to it using the Ethernet port on the 3520 front panel.

## 4.3 Connecting to the Ethernet

The Network port of the 3520 Leak Test module allows connection to the 3520 controller. A 3520 controller can be a sigPOD test and monitoring system or any Windows-based PC with an InspeXion software program that supports the 3520 Leak Test module.

Setting up the Ethernet connection involves connecting the Ethernet hardware to the front panel and then setting up the IP address. Once connected to the controller, the 3520 Leak Test module can receive test configuration commands and collect and transfer back data.

### To connect the 3520 Leak Test module to the Ethernet

1. Wire an Ethernet cable to the Ethernet connector shipped with the module, or use one of the optional Ethernet cables. See *"Ethernet Communications (Required)" on page 24* for the pinouts of the Ethernet connector.
2. Insert the Ethernet connector with cable in the Network port on the front panel of the 3520 Leak Test module.
3. Connect the other end of the Ethernet cable to any computer with an Internet browser.
4. Configure the network parameters of the 3520 Leak Test module on its webpage. See *"Opening the webpage of a 3520 Leak Test module for the first time" on page 31* and *"Configuring a valid IP address and network name for a 3520 Leak Test module" on page 34*.
5. When the 3520 network parameters are fully configured, connect the Ethernet cable to the sigPOD controller or to the PC that has the correct InspeXion software for communicating with the 3520 Leak Test module.
6. Set up the 3520 IP address in the InspeXion System Setup software installed on the 3520 controller. See *"Configuring the 3520 IP address in the InspeXion System Setup" on page 35*.

   ***Note:*** The Network status indicator on the front panel of the 3520 Leak Test module flashes green when the 3520 Leak Test module is ready to receive a connection from a controller. When the light turns solid green, the 3520 Leak Test module is fully connected to the controller.

***Table 1*** *Network status indicator - color code*

| Color of the indicator | Description |
|---|---|
| Solid green | The 3520 OPC-UA server is connected to an OPC-UA client (leak test controller)<br>***Note*** OPC-UA stands for Object Linking and Embedding for Process Control-Unified Architecture. The 3520 unit communicates with the leak test controller using an OPC-UA protocol over an Ethernet connection. |
| Flashing green | The 3520 OPC-UA server has started and is waiting for an OPC-UA client (leak test controller) to respond |

***Table 1*** *Network status indicator - color code*

| Color of the indicator | Description |
|---|---|
| Solid orange | The 3520 operating system has started and is waiting for the 3520 OPC-UA server to start |
| Flashing orange | The 3520 operating system is booting up |
| Flashing red | The 3520 firmware is updating or a power cycle delay is in progress |

## 4.4 Connecting accessories

You can increase the efficiency and accuracy of your leak testing by connecting any of the following optional accessories:

- External valves - through the Digital Outputs port
- A temperature sensor to measure the temperature of the ambient air - through the Aux in 2 port
- A temperature sensor to measure the temperature of the Unit Under Test (UUT) - through the Aux in 1 port

**IMPORTANT**

When you receive the 3520 Leak Test module, the auxiliary connectors are covered with protective caps. These caps are required to maintain the IP ratings of the 3520 Leak Test module. Do not remove the caps unless you are using the auxiliary ports and have the appropriate accessory connected.


*Figure 3* *Example of a leak test system consisting of a 3520 Leak Test module, a sigPOD 1200 controller and an external valve multiplexer*

### 4.4.1 Connecting temperature sensors

The 3520 Leak Test module has two channels for high accuracy temperature input (100 Ω Platinum RTD with a 24-bit A/D resolution ~ 0.000 02° C). You can either purchase the optional temperature sensors from Sciemetric or provide your own. If you use sensors that are not supplied by Sciemetric, ensure they meet the Temperature Input requirements as outlined in the "Technical Specifications" on page 39.

#### To connect optional temperature sensors

1. Remove the protective plastic caps from the Aux in 1 and Aux in 2 ports on the front panel of the 3520 model.
2. Connect one end of a RTD cable to the Aux in 1 port and the other end to the air temperature sensor.
3. Connect one end of a RTD cable to the Aux in 2 port and the other end to the part temperature sensor.

# 5.0 Pneumatic Ports

- *Supply and Pilot air supplies*
- *Bleed and Exhaust ports*
- *Unit Under Test (UUT)*
- *Calibration*

***Note*** For more information on these ports, see the *3520 Leak Test Module User Guide*.

## 5.1 Supply and Pilot air supplies

The Supply and Pilot air supplies must meet or exceed ISO standard 8573.1:2001 Class 1.4.2 or better and must be prepared according to the *"Technical Specifications" on page 39*.

Preregulation of the supply pressure is necessary. An external precision supply regulator with a supply pressure effect of < 0.1 psig per 100 psig change is required. Otherwise, changes to the pressure supply during fill and flow testing will affect the leak test accuracy.

The Supply and Pilot air supplies must have all water vapor removed down to a dew point of 3°C (Class 4) or less, and must be prefiltered with a 5-micron particulate filter. In addition, ensure the supply pressure is stable and meets the *"Technical Specifications" on page 39*.

For more details on Supply and Pilot air supplies, refer to the *3520 Leak Test Module* User Guide.

## 5.2 Bleed and Exhaust ports

The Bleed port allows internal bleed, pilot and self-test gas flows to exhaust out of the 3520 Leak Test module. The internal regulators require a bleed flow to operate properly. The Bleed port may be routed externally to control venting of the gas.

**WARNING**

The Exhaust port allows for the exhaust of the test air in the UUT. With high test pressures, very fast gas flows can occur. Ensure that the noise generated by the exhaust stage is safe for operators in the vicinity. The exhaust port may be routed externally to control venting of gas.

Do not block or severely restrict the flow out of the bleed and exhaust ports.

**IMPORTANT**

Do not draw vacuum on the bleed port. This may cause the system to reset or malfunction.

We recommend that you use the silencers (that are shipped with the 3520 Leak Test module) because the pressurized air that comes out of these ports can be loud and a safety hazard.

If the Exhaust or Bleed air must be ported elsewhere, remove the silencers and install the desired pneumatic fittings before running any leak tests.

## 5.3 Unit Under Test (UUT)

The UUT port connects to the part being tested.

We recommend that you mount the 3520 Leak Test module as close as possible to the UUT to minimize test volume and reduce hose restriction.

Design the pneumatic connections for the 3520 Leak Test module to minimize the pressure differential between the 3520 and the UUT at the desired fill rate. For UUT volumes > 1 L, a minimum Cv > 2 should be targeted for the pneumatic connection between the part and the 3520 C model. A Cv of 0.25 - 0.5 for a 3520 B model is sufficient.

When connecting the part to be tested to the UUT port, ensure that the hose diameter is adequate for the volume of the part.

## 5.4 Calibration

The calibration port is for external flow standard connection. Quick-connect fittings such as the Swagelok QC4 and Staubli RBE 03 are recommended and available as optional accessories. A calibrated flow standard can be left plugged into this quick-disconnect and engaged for calibration periodically, using the 3520 internal Calibration control valve. If the calibration port is not going to be used, install a plug or silencer.

The use of the calibration port is optional but highly recommended. The 3520 Leak Test module does not ship with a calibration port fitting but offers two quick-connect fittings as optional accessories.

Sciemetric offers custom metal flow standard as optional accessories that plug into the quick-connect fittings. These flow standards are screened to protect the flow element and you must specify the test pressure (vacuum to 90 psi) and leak rate (for example 5 sccm at 15 psig) when ordering. We recommend that you purchase a leak standard for every pressure-leak rate combination.

# 6.0 Electrical connections

- *24 VDC Power Input*
- *Ethernet Communications (Required)*
- *External valve control (Optional)*
- *Temperature input channels (Optional)*

***Note*** For more information on these connections, see the *3520 Leak Test Module User Guide*.

## 6.1 24 VDC Power Input

- Power (Max): 40 W (including all accessories)
- Power (Typical): 10 W (single channel leak test)
- AWG 16-18
- Pin 4 is advanced GND
- Cable diameter 8-10 mm
- Use pins 2 and 3 for sense leads if supported by power supply

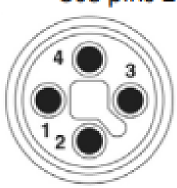



*Figure 4 3520 connector: Socket M12 4-pin T-code*

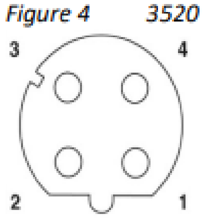



*Figure 5 Cable connector: Plug M12 4-pin T-code*

***Note*** Pinouts are:

1. +24
2. +24
3. COM
4. COM

## 6.2 Ethernet Communications (Required)

- Sciemetric supplies field-wireable connectors.
- AWG 18-24
- Cable diameter 6-8 mm
- Connector supports shield connections. See *Connecting to the Ethernet*.

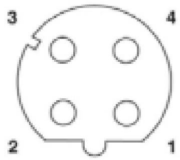



*Figure 6 3520 connector Plug M12 4-pin D-code*

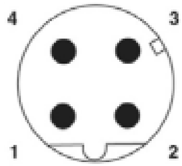



*Figure 7 Cable connector: Socket M12 4-pin D-code*

***Note*** Pinouts are:

1. TX+

2. RX+

3. TX-

4. RX-

## 6.3 External valve control (Optional)

To be used only with multiplexer cables and valves supplied by Sciemetric

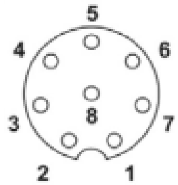



*Figure 8 3520 connector: Plug M12 8-pin A-code*

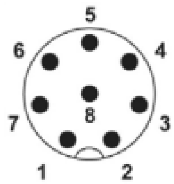



*Figure 9 Cable connector: Socket M12 8-pin A-code*

***Note*** Pinouts are:

1. V10-
2. V11+
3. V11-
4. V8-
5. V9+
6. V8+
7. V10+
8. V9-

## 6.4 Temperature input channels (Optional)

For use with 4-wire 100 Ω platinum RTDs. RTDs are available with M12 connections and different wiring codes. Ensure that the wiring code of the RTD matches the pinouts.

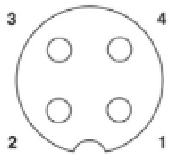



*Figure 10 3520 connector: Plug M12 4-pin A-code*

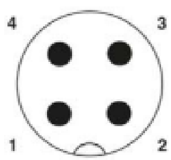



*Figure 11 Cable connector: Socket M12 4-pin A-code*

***Note*** Pinouts are:

1. RTD+ (1.25 mA excitation+)

2. RTD- (sense -)

3. RTD- (1.25 mA excitation -)

4. RTD+ (sense +)

# 7.0 Mounting the 3520 Leak Test module

You can mount the 3520 Leak Test module and optional external multiplexer valve accessories on a desktop or on a wall. The wall-mount allows you to secure the module to any solid surface such as a workbench or a wall using the integral mount brackets and vibration mounts. When mounting the module, we recommend that you first attach the vibration mounts to the solid surface, and then the 3520 Leak Test module to the vibration mounts.

For information on mounting the multiplexer valve accessories, see the *3520 Leak Test Module User Guide*.

**Installation Requirements**

- The module must be installed on a solid surface where limited or no vibration occurs.
- To ensure accurate leak test results, you must use the vibration mount kit, which includes the following:
    - Four thread-locking socket head cap screws, alloy steel, 1/4”- 20 thread, 5/8” length
    - Four neoprene vibration damping sandwich mounts, M/F 1/4” - 20 x 1/2” H, 1”W, further referred to as vibration mounts
    - Four 18-8 Stainless steel type A SAE flat washers, 1/4” screw size, 5/8 OD, 0.5”- 0.8” thick
- Ensure that the surface can accommodate the weight of the module. See the *"Technical Specifications" on page 39* for weight values.

### To wall-mount the 3520 Leak Test module

1. On the surface against which the 3520 Leak Test module will be mounted, mark out the hole locations for the fastening screws. See *Figure 12* and *Figure 14* for relevant dimensions.
2. Make four 1/4”- 20 tapped holes for the vibration mounts.
3. Screw the four vibration mounts into the mounting surface.
4. Hold the 3520 Leak Test module against the mounting surface with the front panel facing you and the mounting holes aligned with the vibration mounts.
5. Take a socket head cap screw from the vibration mount kit, remove everything but the small flat washer, and insert the screw through one of the 3520 mounting holes on the integrated fins.
6. Secure the screw to the vibration mount.
7. Repeat steps 5 and 6 for the other three mounting holes.

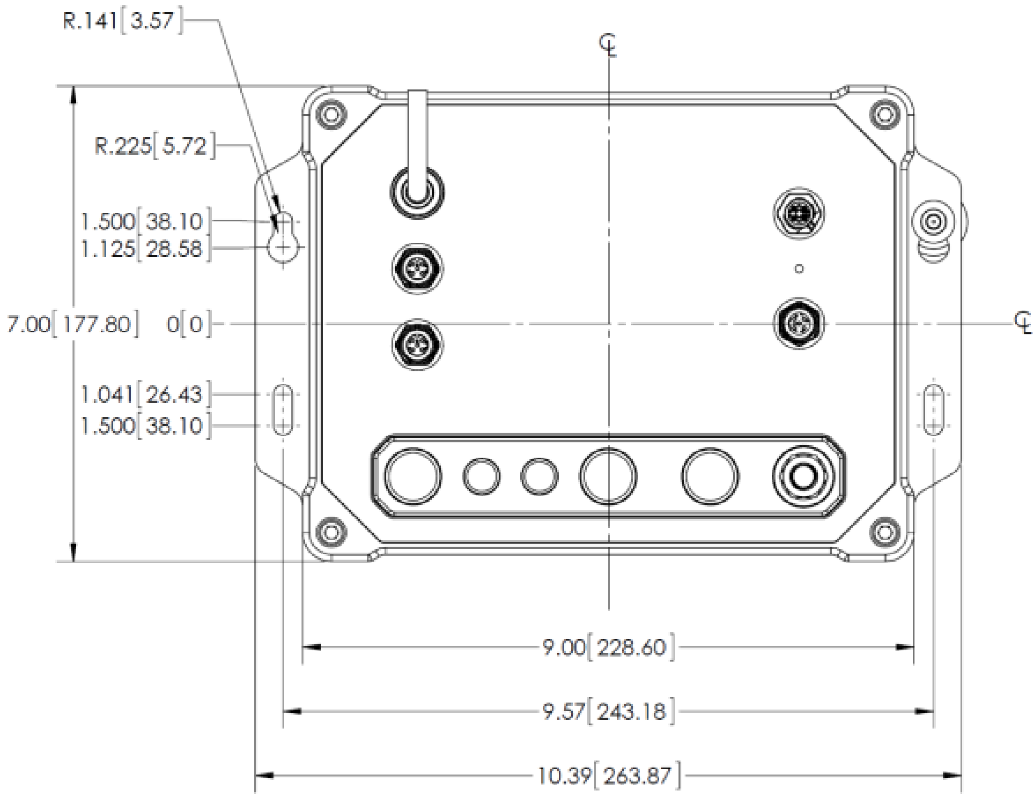



*Figure 12 The 3520 Leak Test module dimensions in inches [mm] - front view*

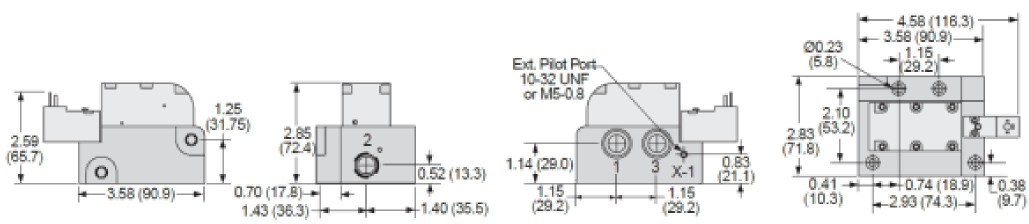



*Figure 13 10500-3520-MC31 3520 C multiplexer valve accessory - dimensions in inches [mm]*

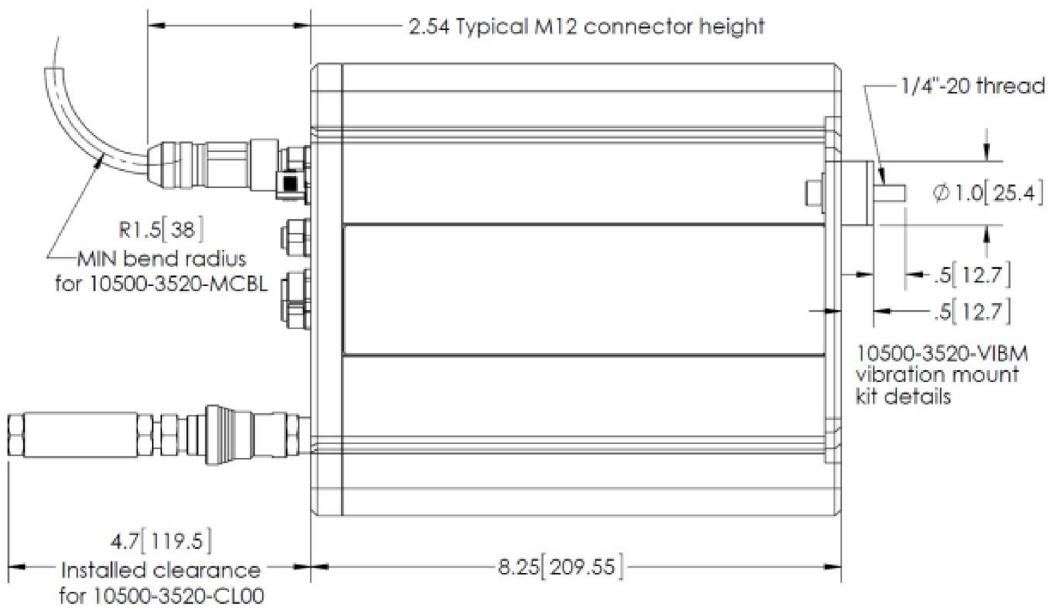



*Figure 14 The 3520 Leak Test module dimensions in inches [mm] - side view*

# 8.0 Configuring a 3520 Leak Test module

You can view the 3520 Leak Test module webpage on an Internet browser, but not all the functionality of the webpage is supported on all browsers.

For information on monitoring and updating the 3520 Leak Test module, see the *3520 Leak Test Module User Guide*.

The 3520 Leak Test system provides pressure control using PID controller software. To ensure parts get filled optimally and quickly, the PID parameters and test timings must be specified correctly. You can use the Leak Tuner Assistant to automate this tuning process to determine optimal parameters. For more information, see the *Leak Tuner Assistant User Guide* available from Support.

## 8.1 Configuring a 3520 Leak Test module

Configuring a 3520 Leak Test module involves:

1. *Opening the webpage of a 3520 Leak Test module for the first time*.
2. *Configuring a valid IP address and network name for a 3520 Leak Test module*.

   ***Note:*** You can also change the default password for access to the network, configuration, and security settings. See *Logging in and out of the 3520 Leak Test module webpage* and *Changing the default password for a 3520 Leak Test module*.
3. *Configuring the 3520 IP address in the InspeXion System Setup*.

### *8.1.1 Opening the webpage of a 3520 Leak Test module for the first time*

You can open the webpage of a 3520 Leak Test module for the first time by connecting the module to any laptop or PC and entering the default IP address (Link-local address) in an Internet browser.

#### To open the webpage of a 3520 Leak Test module for the first time

1. Connect the Ethernet port of a 3520 Leak Test module to the LAN port of a PC.
2. On the PC, open an Internet browser, and enter the default IP address of the 3520 Leak Test module as it appears on the white production label on the right side of the module.

   The webpage of the 3520 Leak Test module opens.

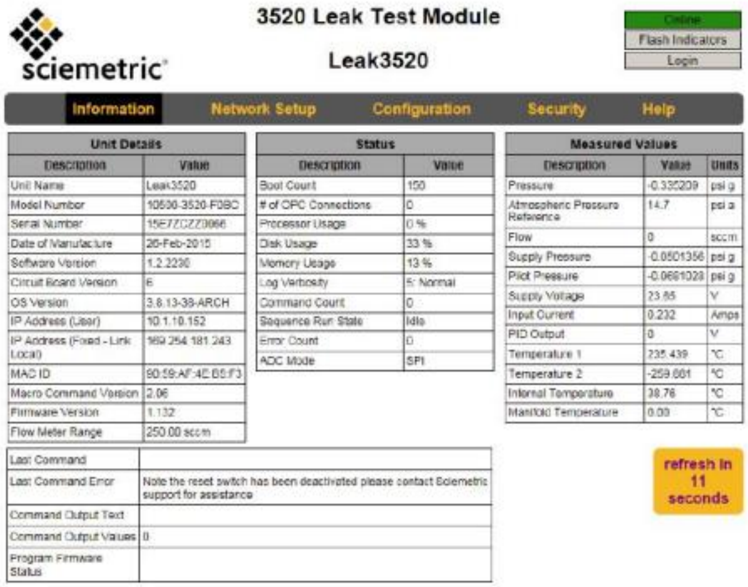



*Figure 15 3520 Leak Test module web page*

## 8.2 Logging in and out of the 3520 Leak Test module webpage

You can change any of the network, configuration, or security settings on the 3520 Leak Test module webpage only if you are logged in with a valid password. Without a password login, you have read-only access to the **Information**, **Network Setup**, and **Help** tabs.

### To log into the 3520 Leak Test module webpage

**1.** Open the webpage of the 3520 Leak Test module.

By default, the webpage opens onto the **Information** tab.

***Note:*** If you have not setup a valid IP address for the module yet and do not know how to open the webpage, see *Opening the webpage of a 3520 Leak Test module for the first time*. Otherwise, enter its IP address in an Internet browser on the 3520 controller (a Windows-based PC or sigPOD).

**2.** If you have more than one module connected to the 3520 controller, click **Flash Indicators** in the top-right of the 3520 Leak Test module webpage to ensure you log into the correct 3520 Leak Test module.

All LEDs on the front panel of the connected 3520 Leak Test module flash five times in approximately five seconds.

**3.** Click **Login** in the top-right of the 3520 Leak Test module webpage.

**4.** In the **User name** box, type “user”.

5. In the **Password** box, enter the default password "sciemetric," or the current password if you have already changed the default.

   ***Note:*** To reset the password to the default password, press the **Reset** button between the power and Ethernet connectors on the front panel of the 3520 Leak Test module. Hold the Reset button for more than three seconds. All indicators on the front of the 3520 Leak Test module blink five times, indicating the password has been reset. The Reset password function is ignored when the module is running a test sequence.

   ***Note:*** For information about setting a custom password, see *To change the default password for a 3520 Leak Test module*.

   The Login button now reads Logout, indicating your are logged in.

### To log out of the 3520 Leak Test module webpage

1. Click **Logout** in the top-right of the 3520 Leak Test module webpage.
2. Click **OK**.

   ***Note:*** You must close the browser to fully log out of the 3520 Leak Test module webpage.

## *8.2.1 Changing the default password for a 3520 Leak Test module*

You can set up, edit, save, or update a configuration for a 3520 module only if you are logged in with a valid password. The 3520 module comes from the factory with a default password which can be changed on the **Security** tab of the 3520 webpage (see *Figure 16 on page 34*).

**Note 1:** To reset the password to the default factory password ("sciemetric"), ensure the 3520 module is not running a leak test sequence. Then, press the **Reset** button, located between the Power and Network ports, on the front panel of the module, and hold for more than three seconds. All indicators on the front of the 3520 will blink five times, indicating the that password has been reset. The Reset password is ignored when the module is running a test sequence.

**Note 2:** Do not push the **Reset** button using a tool or a sharp object, because you might accidentally pierce the assembly, which in turn will violate the IP rating of the 3520 module.

### To change the default password for a 3520 Leak Test module

1. Open the webpage of the 3520 Leak Test module.

   By default, the webpage opens onto the **Information** tab (*Figure 15*).

   **Note**: If you have not setup a valid IP address for the module yet and do not know how to open the webpage, see *Opening the webpage of a 3520 Leak Test module for the first time*. Otherwise, enter its IP address in an Internet browser on the 3520 controller (a Windows-based PC or sigPOD).
2. Click **Login** in the top-right of the 3520 Leak Test module webpage.
3. In the **User name** box, type "user".
4. In the **Password** box, type "sciemetric".
5. Click the **Security** tab.

7. Re-enter the password in the **Confirm New Password** box.
8. Click **Change** to save the new password.

   ***Note:*** You must restart the browser for the password change to take effect.

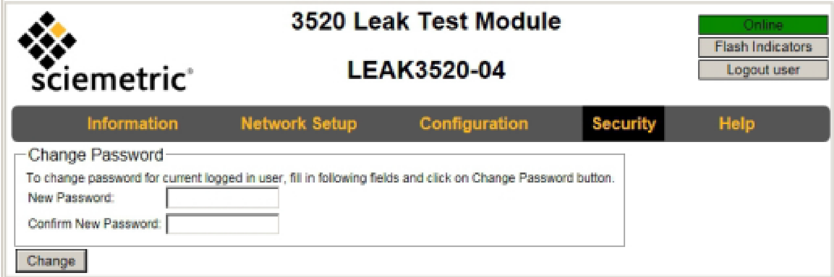



*Figure 16 Security tab*

## *8.2.2 Configuring a valid IP address and network name for a 3520 Leak Test module*

You can configure valid IP address settings and network name for a 3520 Leak Test module on the **Network Setup** tab.

If the default password has been changed, you must know the new password to access the 3520 configuration settings. See *Changing the default password for a 3520 Leak Test module* for information about resetting the module to the default password, if necessary.

Before you can start the network setup of the 3520 Leak Test module, you must obtain an approved IP address, default gateway, and a DNS server (if applicable) for the module from your IT department. The IP address must be of the IPV4 type.

### To set the IP address and network name of a 3520 Leak Test module

1. Open the webpage of the 3520 Leak Test module using its Default IP address (Link-local address). See *To open the webpage of a 3520 Leak Test module for the first time*.

   The webpage opens to the **Information** tab. The green **Online** indicator in the top-right of the webpage indicates that the module is on the local network.
2. Log into the 3520 Leak Test module webpage. See *Logging in and out of the 3520 Leak Test module webpage*.
3. Click the **Network Setup** tab.
4. In the **IP address** area of the page, enter the IP address, and Subnet mask, and Default Gateway values.
5. In the **DNS server** area, enter values for the preferred and alternate DNS servers.

   ***Note:*** If you do not have a DNS server, type **8** in all boxes.

6. In the **Unit Name** box, enter a unique name for the 3520 Leak Test module; for example, *OilLeakTest02*.

   ***Note:*** To specify the unit name, follow the **RFC1123** Internet standard for valid host names. The name can contain only the ASCII letters 'a' through 'z' (in a case-insensitive manner), the digits '0' through '9', dots (.) and the hyphen ('-'). No other symbols, punctuation characters, or white spaces are permitted. Also, the maximum number of characters allowed between dots is 63, and the maximum length of the entire name is 255 characters.

7. Click **OK**.
8. On the **Save Changes** page, click **Save**.

   ***Note:*** If you do not want to save the entered values, click **Cancel** or click any other tab of the 3520 Leak Test module webpage. When you cancel the changes, the **Network Setup** tab displays the factory settings or the last saved settings (if you have already changed the factory settings).

9. On the **Reboot to Apply Changes** page, choose to Reboot Now or Reboot Later.

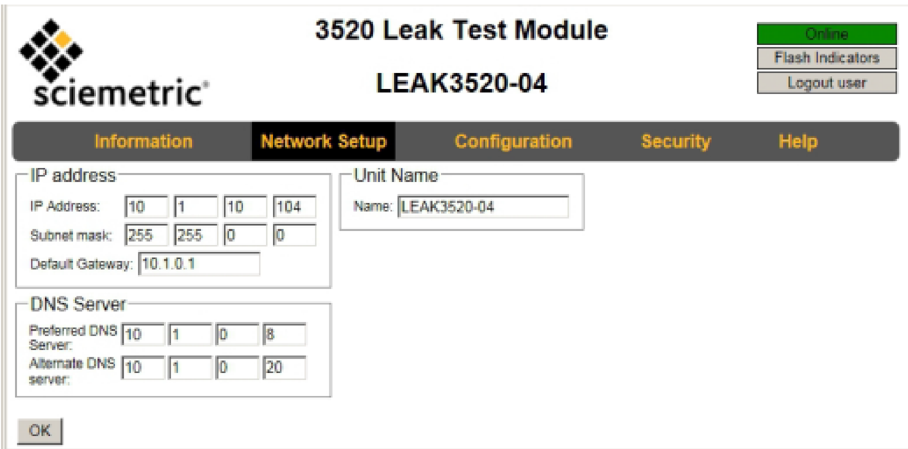



*Figure 17 Network Setup tab*

## 8.2.3 Configuring the 3520 IP address in the InspeXion System Setup

You can view the current IP address and name for the 3520 module on the **Information** tab of its webpage next to **IP Address (User)** and **Unit Name**.

### To configure the 3520 IP address in the InspeXion System Setup

1. Open the InspeXion System Setup application by doing one of the following:
   - On a sigPOD, click the **Setup** button in the **InspeXion Shell** toolbar which comes up when you power up the sigPOD.
   - On a regular PC, click the **Start** button, point to **All Programs**, and click **Sciemetric**, **System Setup**.
2. On the navigation bar of the **System Setup** screen, click the plus sign next to **Hardware** to display all **Hardware** options (see *Figure 19 on page 38*).

3. Click **OPC UA** under **Hardware** to display a list of the 3520 modules connected to the controller.
4. Under **Device Info**, click the arrow next to the name of the module you are configuring.

   The relevant information about the module will appear as follows:

   - **Enabled** box - **True**.

     **Note**: If the value is not **True**, open the drop-down list and select **True.**
   - **Server** box - it will either be empty or with the default **opc.tcp://10.1.10.100:4842** address.
5. In the **Server** box, replace **10.1.10.100** with the 3520 module IP address you have set up for the module (See *"Configuring a valid IP address and network name for a 3520 Leak Test module" on page 34*).

   For example, if the IP address of the 3520 module is 10.1.10.125, the value in the **Server** box should appear as **opc.tcp://10.1.10.125:4842.**

   **Note:** If the he **Server** box is empty, type **opc.tcp://xx.x.xx.xxx:4842** where **xx.x.xx.xxx** is the IP address you have set up for the module.
6. In the bottom-left corner of the screen, click the **Save** button to save the current configuration.
7. In the bottom-left corner of the screen, click the **Exit** button to close the **System Setup** screen.

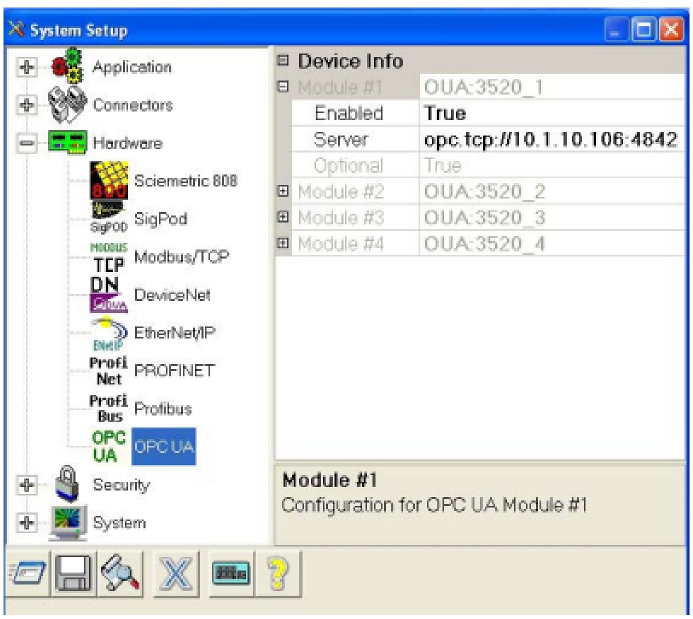



*Figure 18 Example of the InspeXion System Setup Screen*

view the current IP address and name for the 3520 Leak Test module on the **Information** tab of its webpage next to **IP Address (User)** and **Unit Name**.

**IMPORTANT**

If you change the IP address of the 3520 Leak Test module after you complete the InspeXion System Setup procedure, you must repeat the procedure with the new IP address. In other words, every time a new IP address is configured on the webpage of a 3520 Leak Test module, that IP address must be registered with the InspeXion System Setup on the 3520 controller.

For more information on the InspeXion System Setup, refer to the *InspeXion System Setup User Guide* or *Online Help*.

### To configure the 3520 IP address in the InspeXion System Setup

1. Open the InspeXion System Setup application by:
   - On a sigPOD, click **Setup** in the **InspeXion Shell** toolbar which comes up when you power up the sigPOD.
   - On a regular PC, click **Start**, **All Programs**, **Sciemetric**, **System Setup**.
2. On the navigation bar of the **System Setup** screen, expand **Hardware** to display all **Hardware** options.
3. Click **OPC-UA** to display a list of the 3520 Leak Test modules connected to the controller.
4. Under **Device Info**, click the arrow next to the name of the module you are configuring.
5. In the Device Enable box, select **True** (if not already True).
6. In the Server box, replace **10.1.10.100** (from the opc.tcp//10.1.10.100:4842 address) with the 3520 Leak Test module IP address you have set up for the module (See *"Configuring a valid IP address and network name for a 3520 Leak Test module" on page 34*).

   For example, if the IP address of the 3520 Leak Test module is 10.1.10.125, the value in the **Server** box should appear as **opc.tcp//10.1.10.125:4842.**

   ***Note:*** If the **Server** box is empty, type **opc.tcp//xx.x.xx.xxx:4842** where **xx.x.xx.xxx** is the IP address you have set up for the module.

- In the bottom-left corner of the screen, click **Save**.

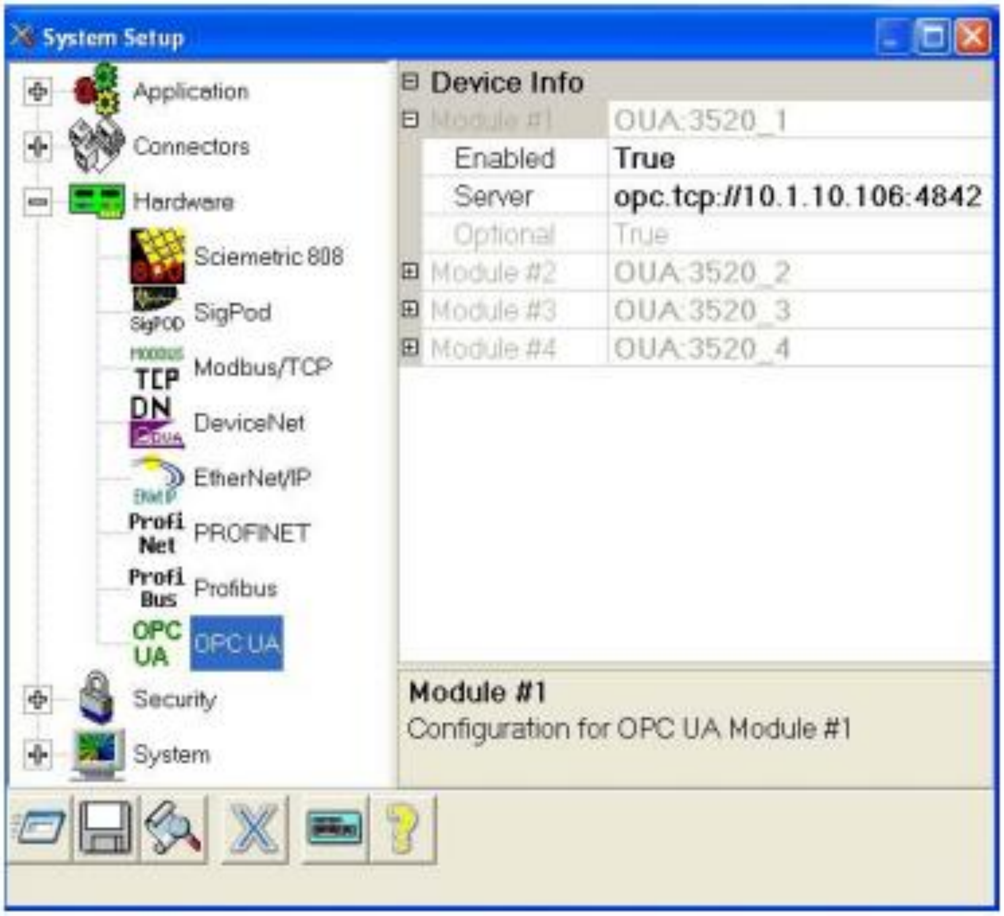



*Figure 19 InspeXion System Setup Screen*

# 9.0 Technical Specifications

## 9.1 General

- **Dimensions (HxWxD):** 117.8 x 264 x 210 mm (7" x 10.4" x 8.25")
- **Operating temperature:** 5 – 40°C
- **Operating humidity:** 8 – 90%
- **Finish:** powder-coated aluminum
- **Environmental:** IP65, Pollution Degree 2
- **Elevation:** ≤500 m*
- **Mounting options:** Integrated wall mount brackets
- **Vibration mounts:** Included and required for operation
- **Weight:** 10.2 kg (22.5 lbs.)
- **Approvals**: CE, cNEMKOus

* For elevation 500 – 2000 m, contact Sciemetric for a custom solution.

## 9.2 Electrical

**Power**

- **Connector:** M12 4 pin T-code plug
- **Supply:** 24 V (22 to 26 VDC)
- **Ripple:** <250 mV peak to peak
- **Power (Max):** 40 W (including all accessories)
- **Power (Typ):** 10 W (single channel leak test)
- **Power (Idle):** 6 W
- **Inrush current:** 5 A for 0.25 s

**Ethernet**

- **Connector**: M12 4 pin D-code socket
- **Data rate:** 100/10 Mbps

**External valve interface**

- **Connector:** M12 8 pin A-code socket
- **Valves:** (4×) 2.5 W at 24 V

**Temperature Input (×2)**

- **Connector:** M12 4 pin A-code socket

- **Sensor:** 100 Ω Platinum RTD
- **Excitation:** 1.25 mA
- **Range:** 0°C to 200°C
- **Noise:** < 0.001°C rms
- **Bandwidth:** 10 Hz

## 9.3 Pneumatic

**Leak Test System**

- **Number of test channels per 3520:** 1
- **Valve Life Rating:**
  10,000,000 cycles (high flow manifold); 100,000,000 cycles (low volume manifold)
- **System Leak:** <0.02 SCCM at 10 psig
- **Fill rate (max):** 300 SLPM (high flow manifold); 20 SLPM (low volume manifold)

**Air Supply Preparation for Supply and Pilot**

- **Standard:** ISO 8573.1:2001 Class 1.4.2 or better
- **Pre-filter:** ≤ 5 µm
- **Air Dryness:** ≤ 3°C Dew Point
- **Oil Concentration:** ≤ 0.1 mg/m3
- **Gas compatibility:** Air, Helium (consult factory for compatibility with other gases)

**Supply Pressure**

- **Maximum:** 100 psig for positive pressure; 5-3 psi below desired test pressure for vacuum pressure
- **Minimum:** 5-20 psi above test pressure for positive pressure; 13.75 psiv (28" Hg) for vacuum pressure
- **Required Flow Capacity:** 1000 SLPM (35 SCFM) or higher at 100 psig
- **Stability:** ±0.1 psi
- **Pre-Regulation:** Precision input regulator with supply pressure effect < 0.1 psi per 100 psi input pressure change is required.

**Pilot Pressure (high-flow manifold only)**

- **Minimum:** 30 psig or supply pressure, whichever is greater
- **Maximum:** 135 psig

**Test Pressure Sensor**

- **Range Selection:** (see model chart)
- **Accuracy:** ±0.25% of FS, best-fit straight line

- **Temperature error band:** ±1.0% of FS from 4°C to 60°C
- **Noise**:

  ≤ 10 ppm rms of FS (<0.001% of FS) – 300 Hz bandwidth

  ≤ 1 ppm rms of FS (<0.0001% of FS) – 1 Hz bandwidth
- **Resolution**: 0.06 ppm of FS

**Flow Meter (flow models only)**

- **Range Selection:** (see *"Ordering information" on page 44*)
- **For Full Scale Ranges ≤ 3000 SCCM**

  **Accuracy at 25°C:**[1]
  - ±1% of reading when value is > 10% of FS
  - ±0.2% of FS when value is < 10% of FS

  **Accuracy over full temperature range:**[1]
  - ±2% of reading when value is > 10% of FS
  - ±0.5% of FS when value is < 10% of FS

  **Repeatability:**[1]
  - ±0.1% of reading when value is > 10% of FS
  - ±0.1% of FS when value is < 10% of FS

  **Pressure coefficient:** ±0.014% of reading/psi

  **Response time:** 4 ms (0.004s)

  **Full scale of flow sensor is switchable with two ranges as follows:**
  - 10 SCCM and 50 SCCM
  - 100 SCCM and 250 SCCM
  - 1000 SCCM and 3000 SCCM
- **For Full Scale Ranges ≥10 SLPM**

  **Accuracy:** ±1.5% of FS (15 to 25°C)

  **Repeatability:** ±0.5% of FS

  **Temperature coefficient:** < 0.15% of FS/°C

  **Pressure coefficient:** < ±0.01% of FS/psi

  **Response time:** 6s for ±2% of FS for readings of 25 to 100% of FS
- **Over-range protection**: Pressure is reduced to ensure no damage to flow meter
- **Minimum resolution:** 0.02%
- **Bandwidth:** 10 Hz

  [1] 10 SCCM range values are 2 x higher.

  UUT = Unit Under Test

  FS = Full Scale
- **Maximum allowable flow:**

  - x0Ax: 50 sccm -> 1000 sccm max
  - x0Bx: 250 sccm -> 2000 sccm max
  - x0Cx: 3000 sccm -> 10000 sccm max
  - x0Dx: 10 sLpm -> no max
  - x0Ex: 30 sLpm -> no max

  Flow above the maximum allowable flow can damage the flow meter and will cause the flow meter to read over-range.

- **Maximum fill rate for models with flow meters:**
  - x0AB = 290 psi/s
  - x0BB = 580 psi/s
  - x0CB = 2900 psi/s
  - x0AC = 15 psi/s
  - x0BC = 30 psi/s
  - x0CC = 150 psi/s

  Exceeding the maximum fill rate will exceed the maximum allowable flow and can damage the flow meter.

## 9.4 General Features

- Valve-operated calibration port
- Supply pressure sensor
- Pilot pressure sensor
- Internal variable flow self-test orifice
- UUT isolation valve
- Internal temperature sensor
- Diagnostic waveforms (supply voltage, supply current, control P, I, D and output values, PID response time)
- Fully adjustable control loop settings for electronic regulators
- Air-piloted valves to reduce effects of heat in high-flow manifold version
- Latching valves reduce effects of heat in low volume manifold version

## 9.5 Optional external multiplexer valve to 3520 B

- Can be connected to the UUT port:
  - Multiple parts
  - Multiple chambers on one part
  - Select test fixture
- **Connector:** M12 8 pin A-code socket
- **Operating pressure:** max 50 psig

## 9.6 Optional external multiplexer valve to 3520 C

### *9.6.1 10500-3520-MPXR*

- Can be connected to the supply input to select supply source:
  - Helium (trace gas)
  - Vacuum
  - Air (evacuate and fill)
- Can be connected to the UUT port:
  - Multiple parts
  - Multiple chambers on one part
  - Select test fixture
- **Pilot pressure:** min 30 psig or the supply pressure value, whichever is greater.
- **Connector:** M12 8 pin A-code socket

### *9.6.2 10500-3520-MC34, 10500-3520-MC32, 10500-3520-MC31*

- Can be connected to the UUT port:
  - Multiple parts
  - Multiple chambers on one part
  - Select test fixture
- **Pilot pressure:** min 50 psig or the supply pressure value, whichever is greater.
- **Connector:** M12 8 pin A-code socket

## 9.7 Ordering information

| | Pressure Range | | Flow Meter Range | Fill Configuration |
|---|---|---|---|---|
| 10500-3520- | Y | 0 | Y | Y |
| | A – 0 to 5 psig | 0 | 0 – no flow meter | B – Low volume manifold (20 SLPM fill rate) |
| | B – 0 to 10 psig | 0 | A – 10 / 50 SCCM [2] | C – High flow manifold (300 SLPM fill rate) |
| | C – 0 to 15 psig | 0 | B – 100 / 250 SCCM [2] | |
| | D – 0 to 30 psig | 0 | C – 1000 / 3000 SCCM [2] | |
| | E – 0 to 50 psig | 0 | D – 10 SLPM | |
| | F – -15 to 95 psig | 0 | E – 30 SLPM | |
| | G – -15 to 0 psig | 0 | | |
| | H – -5 to 0 psig | 0 | | |

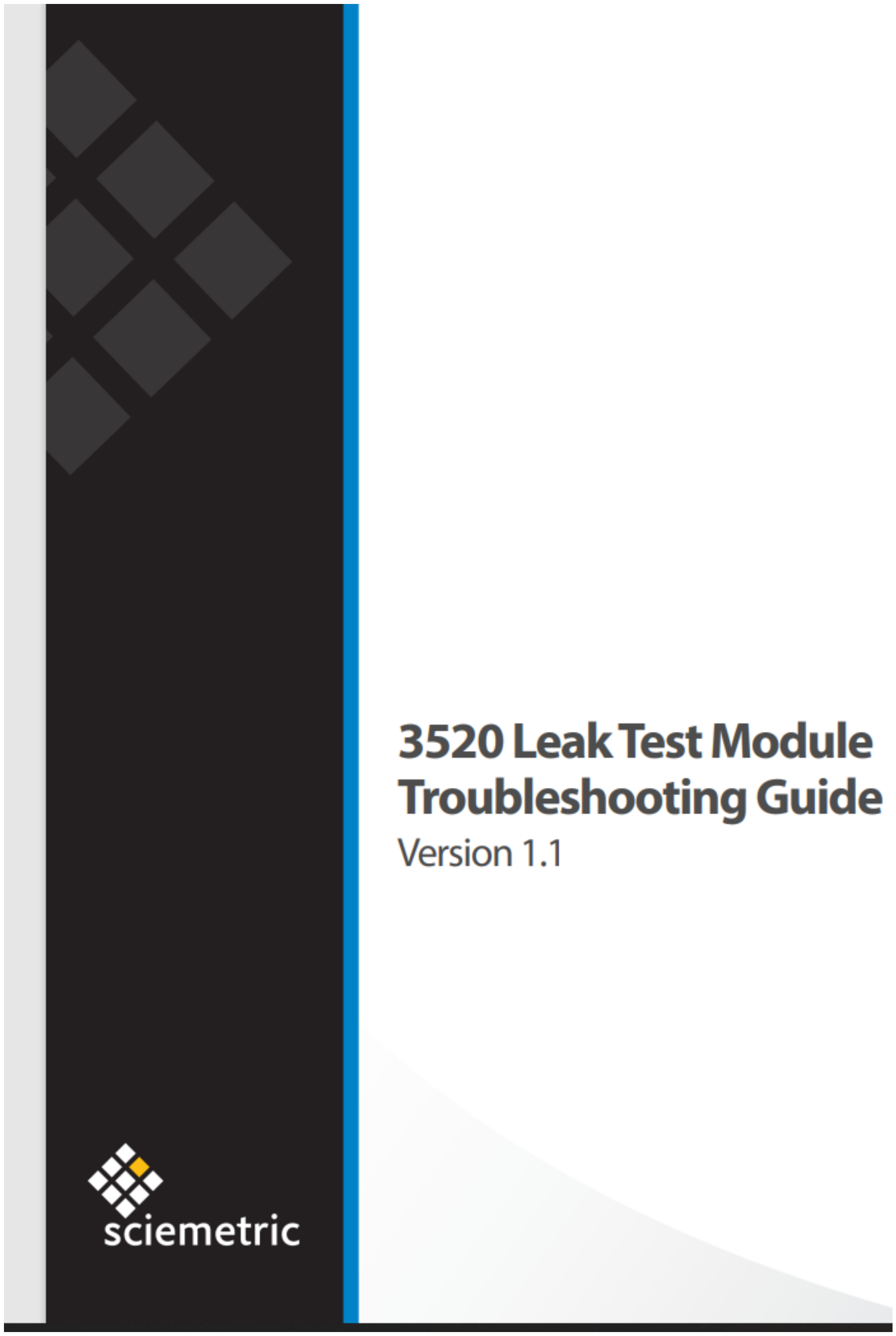
[2] the A, B, and C are dual range flow meters; for example, A can be configured to operate as either a 10 SCCM or 50 SCCM Full Scale flow Meter. Selection is performed remotely by the controller software.

**Example:** 10500-3520-D0AC stands for

3520 Leak Test module optimized for large part volumes, 0 to 30 psig absolute pressure transducer, 10/50 SCCM mass flow meter range, dual precision electronic regulators, 2 temperature inputs and 4 digital outputs. Includes power and Ethernet connectors and vibration mounts.

Specify target system volume, test pressure, and leak rates when ordering a 3520 Leak Test module and custom flow standards.

# 4. 3520 LEAK TEST MODULE TROUBLESHOOTING GUIDE



# Table of Contents

# 1.0 Introduction

This guide is intended to help maintenance and engineering personnel troubleshoot any errors or issues that can occur on a 3520 Leak Test Module. For more information on configuring a 3520 module, see the 3520 Leak Test Module Getting Started Guide and the sigPOD PSV User Guide.

For instructions on how to replace or service any of the internal components of the 3520 module, see the 3520 Leak Test Module, Service B Service and Maintenance Guide or 3520 Leak Test Module, Service C Service and Maintenance Guide.

This guide covers troubleshooting information for the following:

- *Pneumatic schematic*
- *Self-test sequences*
- *External valves*
- *Pressure sensor*
- *Flow meter*
- *Network communications*
- *Reset button*

## 1.1 Pneumatic schematic

There are two types of 3520 module manifolds:

- B type, low-volume manifold (see *Figure 1 on page 6*)
- C type, high-volume manifold (see *Figure 2 on page 7*)

***Note*** For more information on pneumatic schematics, see the 3520 Leak Test Module User Guide.

*Figure 1 3520 module, B type low-volume manifold pneumatic schematic*

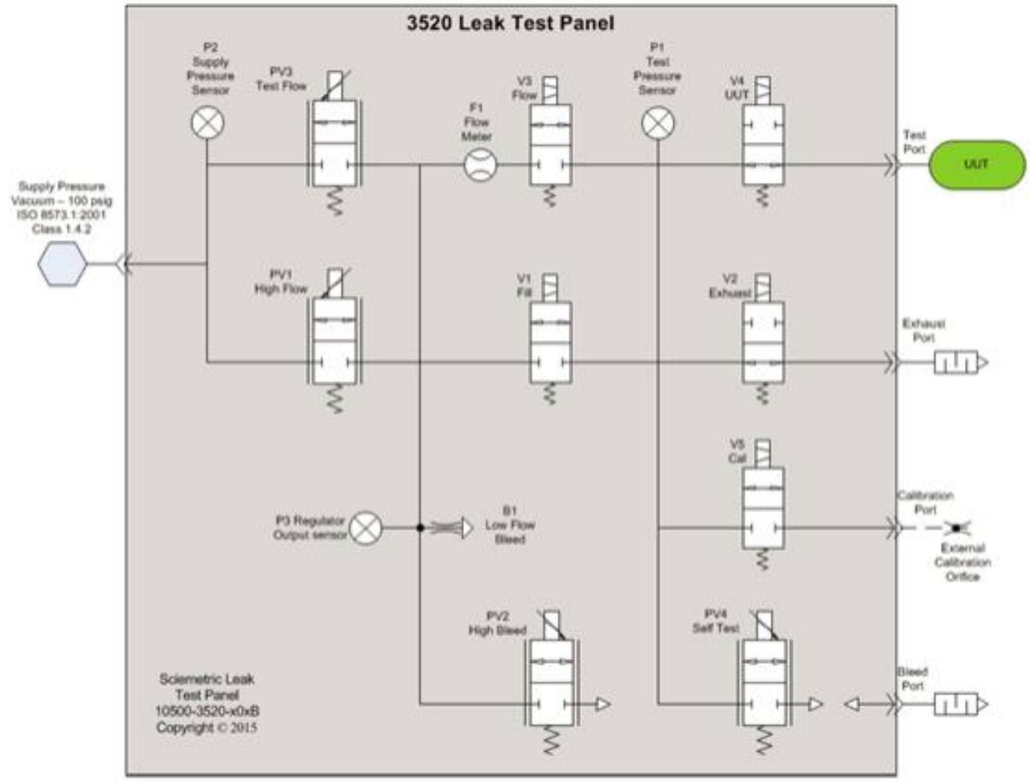


*Figure 2 3520 module, C type high-volume manifold pneumatic schematic*

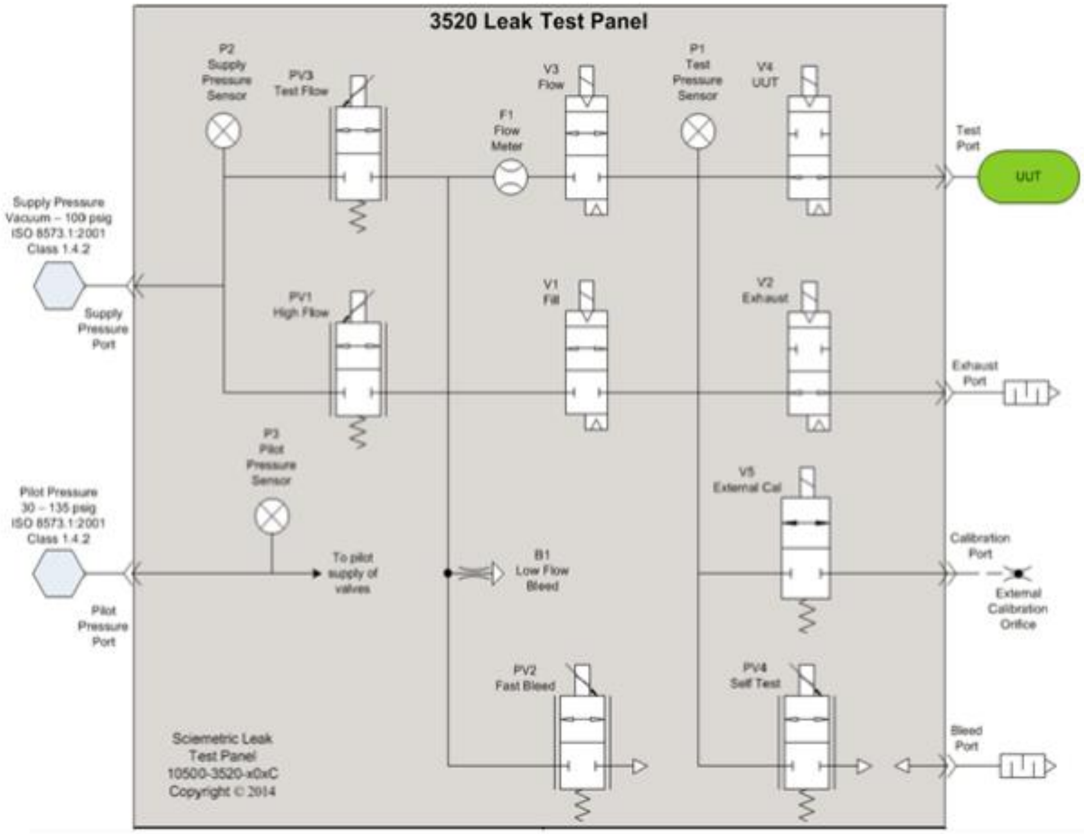



*Table 1 on page 8* shows the function of each valve in the 3520 module.

**Table 1** *Internal Valves in the 3520 module (low-volume and high-flow manifold)*

| Valve number | Valve name | Valve type | | Valve description |
|---|---|---|---|---|
| | | 10500-3520-x0xC high flow models | 10500-3520-x0xB low flow models | |
| V1 | Fill | NC air-piloted | NC latching | Bypasses the flow meter to rapidly fill the part that is being tested, that is, the Unit Under Test (UUT) and isolating the part from the regulator. This valve is active during fill operations and closed during flow tests, pressure decay tests, and exhaust cycles. |
| V2 | Exhaust | NO air-piloted | NC latching | Exhausts the test chamber and depressurizes the system. This valve is always activated except during zeroing, exhaust, and some self-test operations. |
| V3 | Flow | NC air-piloted | NC latching | Connects the flow meter to the test chamber. This valve is active during flow tests. |
| V4 | UUT | NC air-piloted | NC latching | Isolates the 3520 module for self-test functionality. This valve is active during zeroing and self-test operations. |
| V5 | Calibration | NC electronic | NC latching | Connects the test chamber to the calibration port. |
| PV1 | High Flow | NC high flow proportional | NC medium flow proportional | Allows high flow electronic regulation. |
| PV2 | Fast Bleed | NC medium flow proportional | NC low flow proportional | Allows a high bleed to balance high flow electronic regulation. |
| PV3 | Test Flow | NC precision flow proportional | NC precision flow proportional | Allows precision flow electronic regulation. |
| PV4 | Self-Test | NC low flow proportional | NC low flow proportional | Simulates a variable leak on the test chamber for self-test functionality. |

*Table 2 on page 9* shows the possible causes of certain failures depending on the valve number.

***Table 2*** *Valve failure modes*

| Valve | Failure modes | Possible causes |
|---|---|---|
| V1 - V5 | Failure to seal | • Insufficient Pilot Pressure (C manifold)<br>• Obstruction (Teflon tape, dirt)<br>• Poor electrical connection to valve |
| | Failure to Open | • Jammed (debris/water in valve)<br>• Poor electrical connection |
| PV1 - PV4 | Slow to function | The 3520 module has not been used for a long time. Cycle unit multiple times (Self-Test), then retest. |
| | Fail to seal | • Debris/water in valve<br>• Wear (B manifold designed for 1 Billion+ cycles, C Manifold 100 Million+) |
| | Failure to open | • Electric connection failure |

## 1.2 Self-test sequences

The 3520 module features an internal macro command that allows testing of all internal pneumatic components. For information on configuring the self-tests, see the 3520 Leak Test Module, Service B Service and Maintenance Guide or 3520 Leak Test Module, Service C Service and Maintenance Guide.

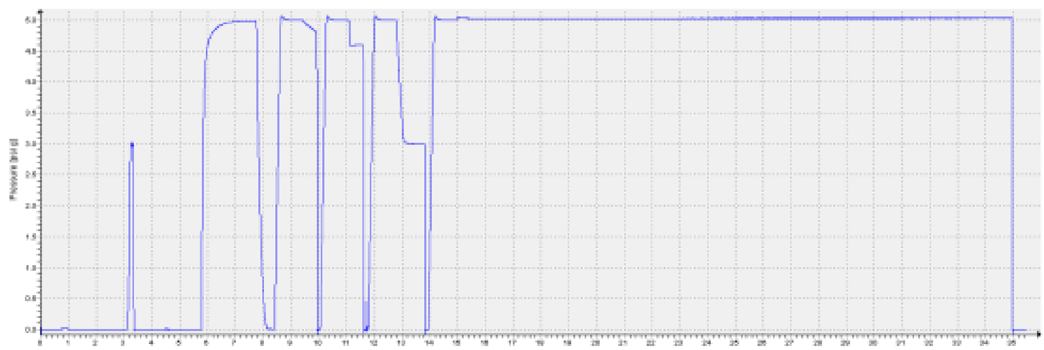
The self-test records all available outputs from the 3520 module and features that exist on all waveforms.

If a self-test operation fails once, re-run the test twice. A 3520 module that has not operated for a long time can have valves that have trouble opening and closing. If this happens, cycle the module.

If there is an issue with the self-tests, check the Atmospheric Pressure Reference and ensure it is the right magnitude for the units selected. If it is wrong, the system was zeroed incorrectly. For more information on the Atmospheric Pressure Reference, see the 3520 Leak Test Module User Guide.

*Figure 3 on page 10* shows a self-test pressure waveform.

*Figure 3 Pressure waveform*



The pressure waveform allows you to see how the pneumatic circuit inside the 3520 module is performing. *Figure 4 on page 10* shows a self-test current waveform.

*Figure 4 Current waveform*

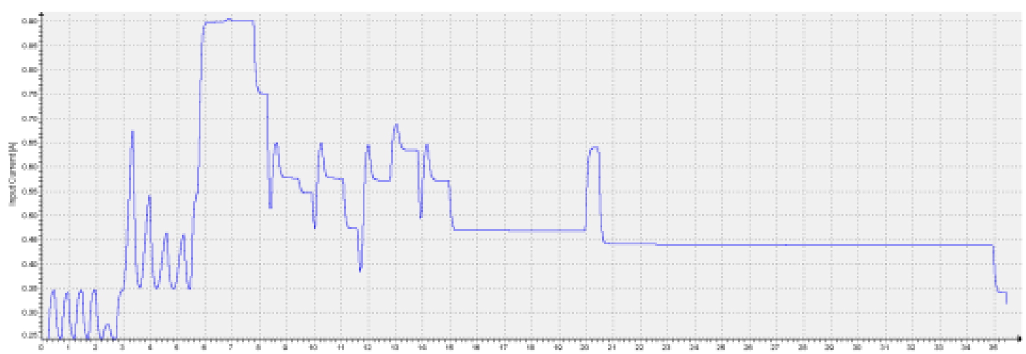


*Table 3 on page 11* lists the different feature checks you can perform on the pressure waveform.

**Table 3** *Self-test pressure waveform matrix*

| Feature | Description | Observed failure | Possible cause | Solution |
|---|---|---|---|---|
| PV1 Fill | Test Fill through PV1 to 5 psi | Pressure not obtained | Exhaust or UUT valve stuck open | Service V2 or V5 |
| | | Fill profile does not match visual aid | PV1 sticking | Clean PV1 |
| PV2 Exhaust | Exhaust to 0 psi | Pressure remained at 5psi | Stuck Exhaust Valve | Service V2 |
| | | Pressure decreased but did not hit 0PSI | PV1 stuck open | Service PV1 |
| PV3 Fill 1, 2, 3, or 4 | Fill Pressure | Did not hit pressure | System Leak | Check for other failed checks |
| | | Over-pressure | PV1 stuck open | Service PV1 |
| Bleed Check | Checks bleed orifice | Did not bleed pressure | PV2 bleed orifice clogged | Service PV2 |
| | | Bleeds too fast | PV2 stuck open | Service PV2 |
| V5 Check | Opens the calibration port valve. | Pressure drop too small | V5 leak/stuck open | Service V5 |
| PV4 Fill | PV4 Bleed Pressure | Pressure too high | PV4 did not open correctly | Service PV4 |
| | | Pressure Too Low | PV4 opened too long | Service PV4 |
| PD w Back Pressure | System Pressure decay test with pressure on backside of V1/V3 | Pressure Rose too high | Leak in V1 or V3 | Service V1/V3 |
| PD System Leak | System Pressure decay test | Pressure decay Positive above limit | System Leak, should have failed PD w Back Pressure | Service V1/V3 |
| | | Pressure decay negative below limit | System leak | Check for other failed checks. |
| PD Pressure | Pressure Decay Test Pressure | Pressure out of limits | System Leak | Check for other failed checks. |
| System Leak | Pressure Decay | Pressure decay Positive above limit | System Leak, should have failed PD w Back Pressure | Service V1/V3 |
| | | Pressure decay negative below limit | System leak | Check for other failed checks. |

## 1.3 External valves

Sciemetric supplies a variety of multiplexing and external exhaust valves for the 3520 module. See the 3520 Leak Test Module User Guide for information.

***Note*** The external valves are the same basic configuration as internal valves V1 - V4.

## 1.4 Pressure sensor

For issues with the pressure sensor:

- Check the Atmospheric Pressure Reference and ensure it is the right magnitude for the units selected. If it is wrong, the system was zeroed incorrectly. For more information on the Atmospheric Pressure Reference, see the 3520 Leak Test Module User Guide.
- If pressure readings have errors, verify the calibration of the pressure sensor. For more information on calibrating the pressure sensor, see the sigPOD PSV User Guide.
- If calibrating the pressure sensors does not fix the errors, check the electrical connections inside the 3520 module between the pressure transducer and the control board. If the connections are clean and tight, remove the sensors and ensure there is no dirt or contaminates in the sensor orifice. If all of the previous steps pass, the sensors are damaged and must be replaced.

*Table 4 on page 12* lists the design specifications for the slope and offset of the various pressure sensors available within the 3520 module.

***Table 4*** *Pressure sensor range and calibration values*

| Pressure Code (HE = High Elevation) | | Sensor Range (psia) | | Approximate Calibration | |
|---|---|---|---|---|---|
| **Option** | **Description** | **Min** | **Max** | **Slope** | **Offset** |
| A | 5 psig | 12.75 | 21 | 4.9.17E-07 | 12.75 |
| | 5 psig (HE) | 10 | 21 | 6.557E-07 | 10 |
| B | 10 psig | 12.75 | 26 | 7.898E-07 | 12.75 |
| | 10 psig (HE) | 10 | 26 | 9.537E-07 | 10 |
| C | 15 psig | 12.75 | 31 | 1.088E-06 | 12.75 |
| | 15 psig (HE) | 10 | 31 | 1.252E-06 | 10 |
| D | 30 psig | 12.75 | 46 | 1.982E-06 | 12.75 |
| | 30 psig (HE) | 10 | 46 | 2.146E-06 | 10 |
| E | 50 psig | 12.75 | 66 | 3.174E-06 | 12.75 |
| | 50 psig (HE) | 10 | 66 | 3.338E-06 | 10 |

***Table 4*** *Pressure sensor range and calibration values (Continued)*

| Pressure Code (HE = High Elevation) | | Sensor Range (psia) | | Approximate Calibration | |
|---|---|---|---|---|---|
| **Option** | **Description** | **Min** | **Max** | **Slope** | **Offset** |
| F | 150 psig (max 85 psig) | 0 | 150 | 8.941E-06 | 0 |
| G | 16 psia (vacuum) | 0 | 16 | 9.537E-07 | 0 |
| H | 5 psiv (vacuum) | 7.75 | 16 | 4.917E-07 | 7.75 |
| | 5 psiv (vacuum HE) | 5 | 16 | 6.557E-07 | 5 |
| I | 30 psia (vacuum) | 0 | 30 | 1.788E-06 | 0 |

## 1.5 Flow meter

There are two types of flow meters used inside the 3520 module:

- dual range flow meters - cover up to 3000 sccm flow rates (digital)
- high flow 10 sLpm and 30 sLpm meters (analog)

*Table 5 on page 13* lists the different ranges and slope values.

### If the readings contain errors

1. Calibrate the flow meter, as outlined in the sigPOD PSV User Guide.
2. If your measurements still contain errors, check all electrical connections between the flow meter and the control board.
3. Remove the flow meter and ensure there is no dirt or debris inside the flow meter.

   If all of the previous steps pass, the meters have been damaged. Replace the meter.

   ***Note*** For the digital sensor models, a "pegged" flow reading (either at zero or full scale), during test can mean that the meter is damaged. To verify if the meter is damaged, replace the meter.

***Table 5*** *Flow meter range and calibration values*

| Flow code | | Range 1 | | | Range 2 | | | Offset |
|---|---|---|---|---|---|---|---|---|
| **Option** | **Description** | **Max** | **Slope** | | **Max** | **Slope** | | |
| | | | **Digital** | **Analog** | | **Digital** | **Analog** | |
| A | 10/50 sccm | 50 | 0.005 | 5.96.46E-06 | 10 | 0.001 | 1.19209E-06 | 0 |
| B | 100/250 sccm | 250 | 0.025 | 2.98023E-05 | 100 | 0.01 | 1.19209E-06 | 0 |
| C | 1/3 slpm | 3 | 0.3 | 0.000357628 | 1 | 0.1 | 0.000119209 | 0 |

***Table 5*** *Flow meter range and calibration values (Continued)*

| Flow code | | Range 1 | | | Range 2 | | | Offset |
|---|---|---|---|---|---|---|---|---|
| Option | Description | Max | Slope | | Max | Slope | | |
| | | | Digital | Analog | | Digital | Analog | |
| D | 10 sLpm | 10 | - | 0.00119209 | - | - | - | 0 |
| E | 30 sLpm | 30 | - | 0.003576 | - | - | - | 0 |

## 1.6 Network communications

The 3520 module network communications follow typical Ethernet communication protocols. If issues with communicating with the 3520 module arise, ensure that communication can be established between the 3520 module and the controlling SigPOD or PC.

*Table 6 on page 14* details the feedback from the Network Status Indicator LED.

***Table 6*** *Network Status Indicator LED - color code*

| Indicator color | Description |
|---|---|
| Solid green | The 3520 module OPC UA is connected to an OPC UA client (leak test controller). |
| Flashing green | The 3520 module OPC UA server has started and is waiting for an OPC UA client (leak test controller) to respond. |
| Solid orange | The 3520 module operating system has started and is waiting for the 3520 module OPC UA to start. |
| Flashing orange | The 3520 module operating system is booting up. |
| Flashing red | The 3520 module firmware is being updated or a power cycle delay is in progress. |

Also ensure:

- the IP address of the controller and the 3520 module are configured properly
- the correct OPC server is configured in InspeXion System Setup. Instructions on the entire network setup are available in the 3520 Leak Test Module User Guide.

## 1.7 Reset button

The **Reset** button on the front panel of the 3520 module resets the user name and password for the web interface of the 3520 module to “user” and “sciemetric”.

***Note 1:*** Pushing **Reset** has no other effects on the system.

***Note 2:***The **Reset** button may not function on 3520 modules with hardware versions lower than 2.6. If this is the case, the 3520 module issues an error message when you start the module.

# 2.0 Replacing a 3520 Leak Test Module

If your 3520 Leak Test Module has failed, you must replace it with a new unit.

### To replace a 3520 Leak Test Module

1. Ensure the air supply on the failed 3520 Leak Test Module is de-energized and there is no air pressure supplied to the 3520 Leak Test Module.
2. Ensure there is no air pressure present at the UUT port of the 3520 Leak Test Module. If so, release the pressure in a controlled and safe manner.
3. Disconnect the power connector from the Power port on the front panel of the failed 3520 Leak Test Module.
4. Remove all remaining electrical connections from the failed 3520 Leak Test Module.
5. Remove all the pneumatic connections from the failed 3520 Leak Test Module.
6. Install the new 3520 Leak Test Module. See the *3520 Leak Test Getting Started Guide* for more information.

# 3.0 Frequently Asked Questions (FAQs)

**1. My Flow Test does not maintain a constant pressure.**

Ensure the PID loop is configured properly. This can be seen in a pressure waveform with 1 of 3 different characteristics:

1: an oscillating pressure waveform with a consistent pattern to it. This may look sinusoidal, or have a "saw-tooth" pattern.

2: a constantly rising pressure

3: a constantly falling pressure

To confirm if the PID setting is the cause, check the P, I, D, and PID Out waveforms.

If the pressure is oscillating, the PID Out waveform has oscillations as well. If the pressure is rising or falling, the PID waveform is either increasing or decreasing to account for the difference between target and actual pressure.

If this is a system that has been operating for some time and has developed this issue, it is likely a system leak has developed at some point. To test this:

- Test on a good part to make sure that it is not a part leak causing the issue.
- Run the self-check test to ensure no leaks internal to the 3520 module.
- Check all hoses and the connections to the part under test.
- Check that the part under test is not missing any plugs or seals.

**2. I get different leak rates when I test a part at different times through the day.**

It is likely that you are experiencing temperature effects.

The heating and cooling of the part in its ambient environment affects the internal air temperature, causing expansion/contraction of the air, pressure changes, and changes in flow independent of the leak rate. This is most apparent on large volume parts where a very minor difference in temperature can cause a large change in the flow required to maintain the part pressure. If the temperature effects are large relative to the leak limit, temperature compensation is required when testing the part.

**3. The leak rate of measured by the 3520 module does not match the leak rate of my flow standard.**

The standard temperature and pressure used to certify the leak standard can be different than the standard temperature and pressure used to certify the flow meter. This can lead to discrepancies on the order of 10%. For further information, please refer to Solution #893 Adjust 3520 Flow for Temperature and Pressure from Support.

**4. The error "Fault: Flow meter over range" appears when running a flow test.**

The flow meters within the 3520 module are designed for specific maximum flow ranges. Continued operation above these values results in damage to the flow meter. To guard against this, the 3520 module shuts down the leak test if the flow meter is above its designed range for a specified dwell time. By default the dwell time is set to 100 ms.

There are two main causes of this fault:

- a missing plug or fitting on the part resulting in a gross leak
- incorrectly set up leak test where the flow meter is placed in the leak test circuit before the part is fully pressurized

Adjusting the dwell time allows you to determine the time frame that the over-range condition is allowed to continue. See the sigPOD PSV User Guide for more information.

**5. Cannot hit pressure on high pressure test.**

Run a self-check to ensure there is no system leak. Increase the supply pressure if it is less than 100 psig. Ensure PV2 (fast bleed) is closed.

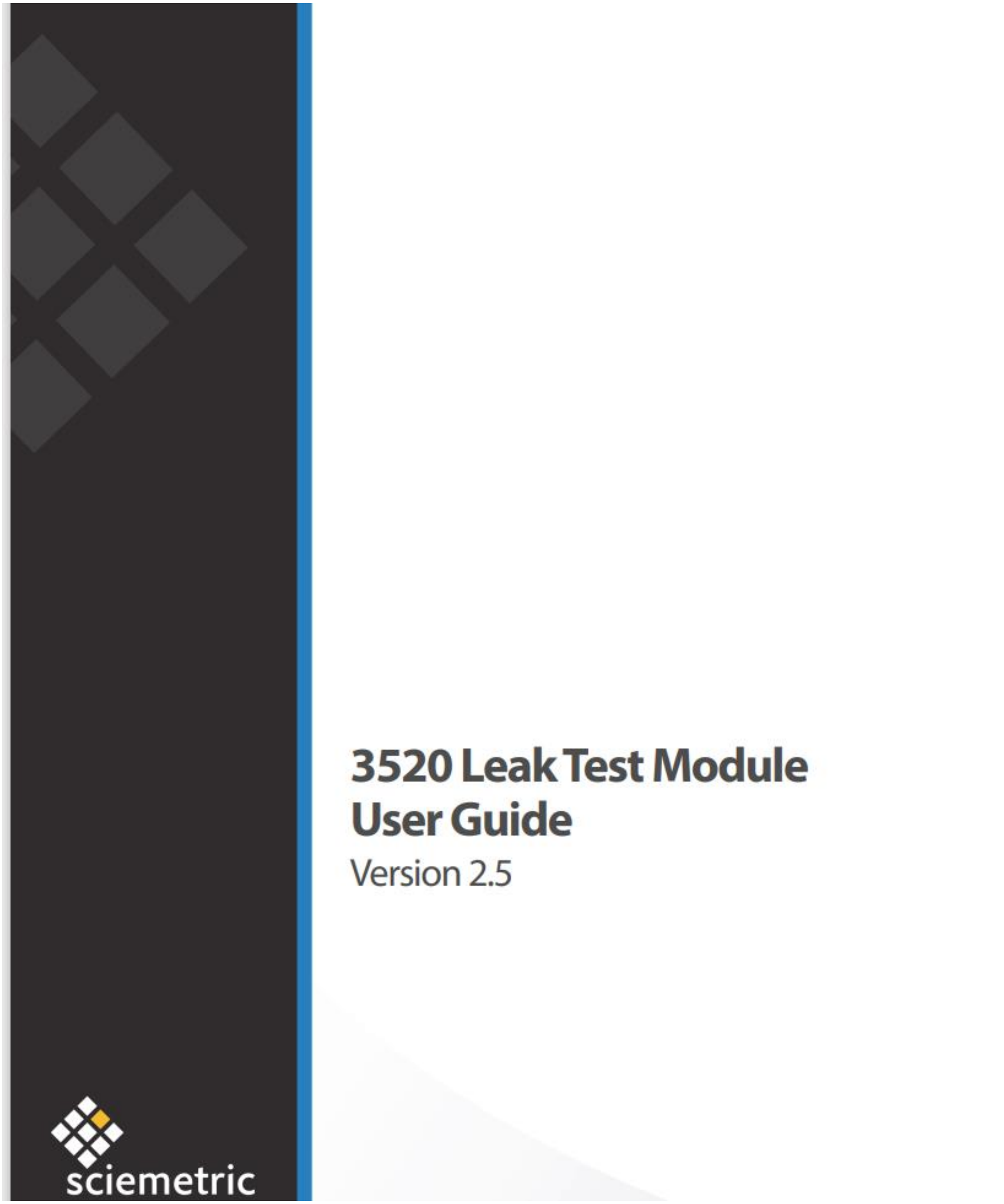
If PV2 is open during a test, then a high frequency hiss can be heard inside the 3520 module.

# 4.0 Common 3520 module error codes

***Table 7*** *Common 3520 module error codes*

| Error | Message | Description | Cause | Solution |
|---|---|---|---|---|
| 1 | UnsupportedCommand | | Invalid command name | Check the command syntax. |
| 2 | ErrorinCommandFormat | | Invalid parameter in OPC command | Check the OPC command list and ensure the parameters are entered correctly. |
| 14 | PressureOutofRange | PID is out of control: Reported pressure is above maximum level | PID values are not appropriate for part.<br>***Note*** If pressure over-range condition cannot be seen, check that no processing or filtering is being applied to the pressure waveform. | • Ensure test part conditions match previous tests<br>• Observe P,I and PID Out waveforms to find which is oscillating and reduce value<br>• Extend dwell time to oscillation frequency |
| | | | Obstruction on fill point or hose | Ensure hoses and fill point are free of obstructions and restrictions. |
| 27 | FlowOutofRange | Flow Sensor over-range | Part Seal Missing | Ensure Part seals are in place and no gross leaks. Use Fill and Hold to find problems. |
| | | | Flow range 3520 set to Flow Range 2. (3000 sccm units and below) | Adjust Flow range to 1. See sigPOD PSV User Guide and 3520 Leak Test Module User Guide. |
| | | | Obstruction on fill point or hose | Ensure hoses and fill point are free of obstructions and restrictions. |

# 5. 3520 LEAK TEST MODULE USER GUIDE



3520 Leak Test Module
User Guide
Version 2.5

sciemetric

# Table of Contents

# 1.0 Introduction to the 3520 Leak Test module

Congratulations on your purchase of the 3520 Leak Test module, the industry's fastest and most accurate leak tester!

The 3520 Leak Test module is an advanced Ethernet-based leak tester designed for industrial production quality control. It uses a sigPOD or PC running Sciemetric InspeXion software (PSV, IPT or custom) as a controller and communicates with this controller using an OPC UA (Unified Architecture) protocol over the Ethernet.

The controller can be placed in an optimal location for the operator and interfaces with the PLC, QualityWorX database (if applicable) and operator to download the control sequence to the 3520. The 3520 module can be placed in immediate proximity to the part under test, minimizing hose length and volume. It runs the sequence independently and sends the data collected to the controller. The controller then performs the analysis and final pass/fail decision. Up to four leak channels can be controlled with one sigPOD or instance of PSV software; higher channel counts are available with IPT Suite or custom software. For an example of a system configuration, see *Figure 1*.

The 3520 Leak Test module is available in two main configurations:

- High-flow manifold for testing larger part volumes from 300 cc to over 400 L (Model number x0xC, also called C type)
- Low-volume manifold for testing part volumes of <1 cc to 1 L (Model number x0xB, also called B type)

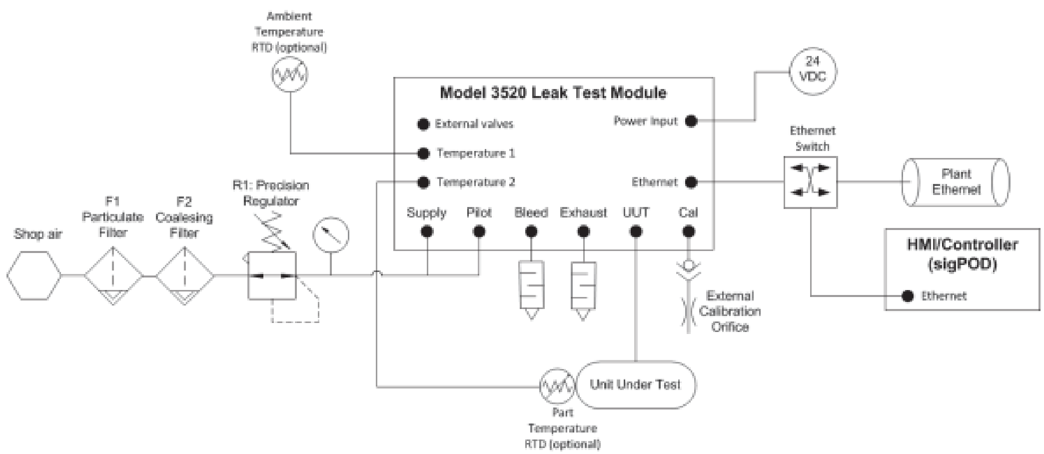



*Figure 1 Example configuration of a 3520 Series Leak Test System*

## 1.1 The 3520 operator interface

The front panels of the 3520 B and 3520 C configuration models provide access to all features and controls of the modules and differ as follows:

- Port sizes are not the same, except for the Bleed and Calibration ports.
- There is no Pilot port on the front panel of the B type low-volume manifold, because latching valves are being used instead of air-piloted valves. See *Figure 2 on page 9* and *Figure 3 on page 10*.

For more information about the pneumatic and electrical connections in each of the B and C models, see *Table 13 on page 40* and *Table 14 on page 42*.

The controls on the front panel of the B and C models are as follows:

- Pneumatic ports
    - Supply — for the test air supply
    - Pilot — for the air which opens the air-piloted valves (C type high-fill manifold only)
    - Bleed — for exhaust of the internal bleed, pilot and self-test gas flows out of the 3520 module; The internal regulators require a bleed flow to operate properly. Comes with a silencer.
    - Exhaust — for exhaust of the test air that is in the Unit Under Test (UUT); comes with a silencer

      **Note:** If the air out of the Bleed and Exhaust ports must be ported elsewhere, remove the silencers and install the desired pneumatic fittings. It is recommended to do such installation prior to configuring any leak tests because the additional hosing on the Exhaust port may affect test timing.
    - Unit Under Test — for connection to the part that is being tested
    - Calibration — for connection to external calibration equipment to calibrate the sensors
- Digital Outputs port — for control of up to four external valves
- Auxiliary ports (Aux in 1 and Aux in 2) — for connection to external temperature sensors: air and Unit Under Test (UUT) temperature
- Power port—connects to the power supply
- Ethernet port — connects the module to the network
- Status indicators
    - Fill — On while the UUT is being filled with air
    - Test — On while test measurements are being taken
    - Exhaust — On while the test air is vented out
    - Diag — On while the UUT isolate or Calibration valves of the 3520 module are On, or during a self-test cycle.
    - Pass — On when the UUT has passed the quality test
    - Fail — On when the UUT has failed the quality test
    - Power — On when the 3520 module is connected to power

  - Network — Indicates the status of the network connection. See Table 16 on page 52 for what each indicator color stands for.
- Reset button — resets the 3520 webpage password to the default password "sciemetric".

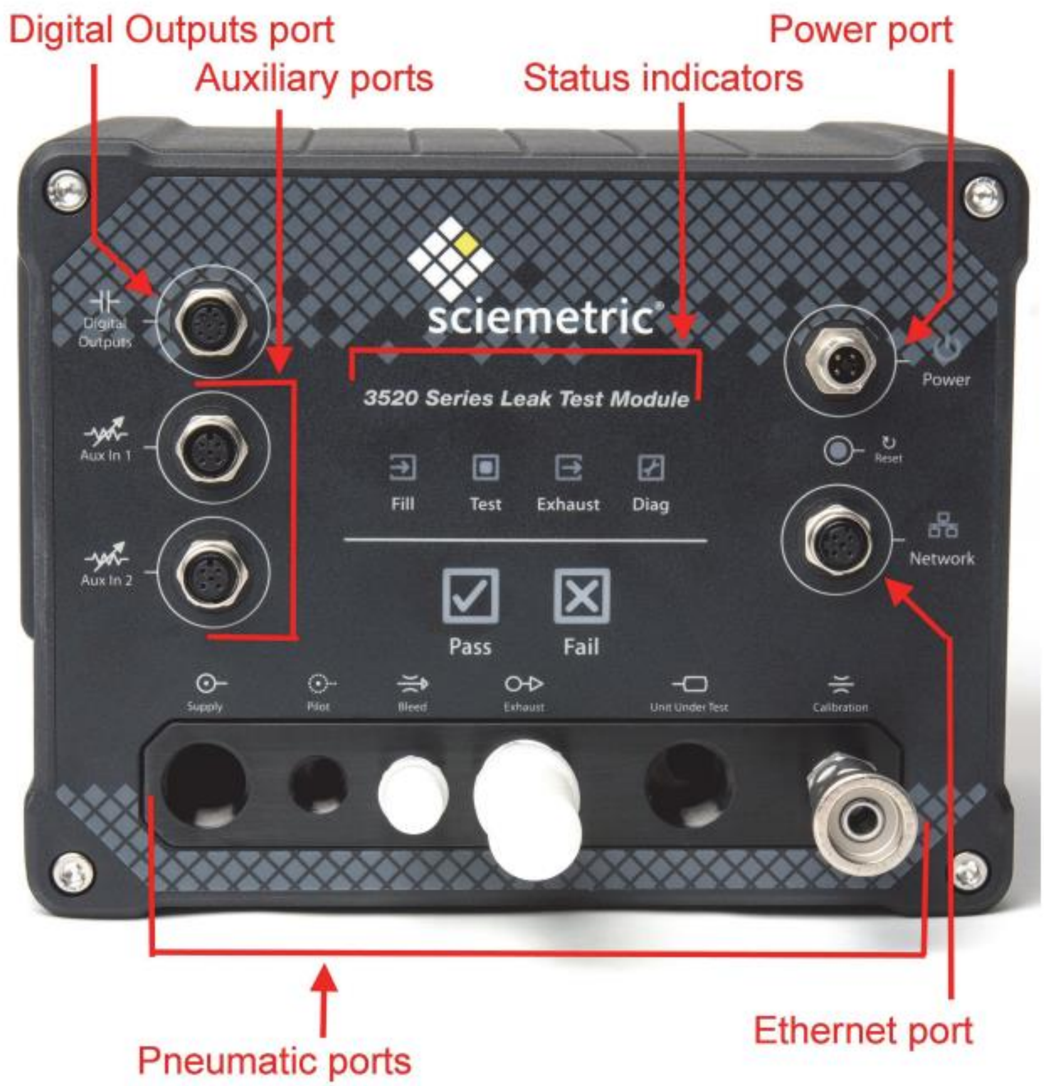



*Figure 2 3520 Leak Test module, C type high-flow manifold — front panel*


*Figure 3* *3520 Leak Test module, B type low-volume manifold front panel (ports covered in orange protective dust caps)*

## 1.2 Multiplexer valve control accessories

Sciemetric offers several types of external multiplexer valve control accessories (*Figure 4 on page 11*) which allow you to test different chambers or parts, or route exhaust gases. They also allow you to run more than one test configuration or use different supply sources, such as shop air, vacuum or helium. The multiplexers allow the 3520 to perform evacuation and fill procedures automatically, with test zones at each stage. See *Figure 5 on page 12* and *Figure 6 on page 12* for examples of multiplexer usage.

**Note 1:** If you are connecting a different external valve interface to your 3520 Leak Test module, ensure it meets the *"Technical Specifications" on page 81*.

**Note 2:** If you want to test more than one parts or leak circuits, you can test them only one at a time.

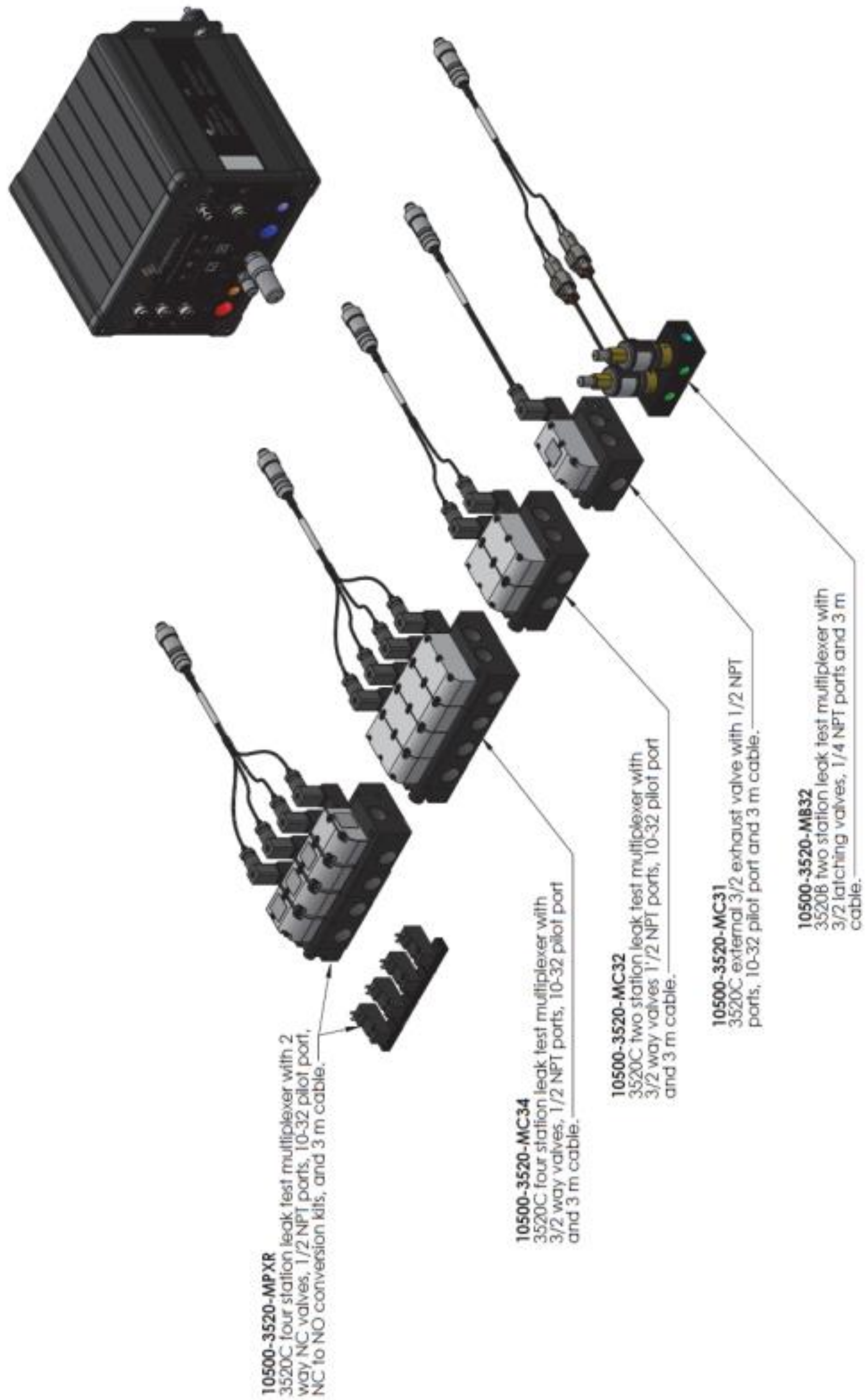



*Figure 4 Multiplexer valve control accessories for the 3520 Leak Test module, Model B and C*

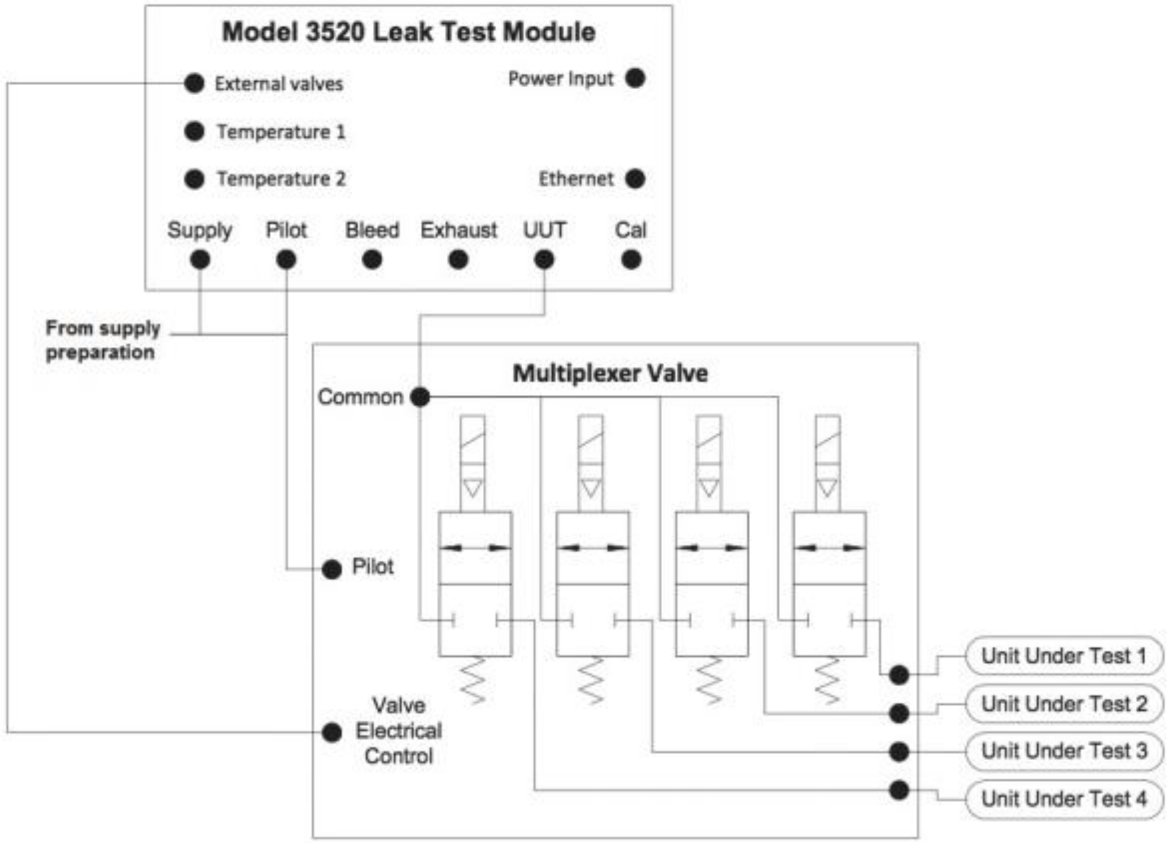



*Figure 5 Example configuration: a multiplexer valve unit connected to a 3520 C Leak Test module*

*Figure 6 Example of a leak test system consisting of a 3520 C Leak Test module, a sigPOD 1200 controller, and an external valve multiplexer*

### 1.2.1 Multiplexer valve control for the 3520 module, Model B

There is one small-volume multiplexer valve accessory (10500-3520-MB32) designed for the 3520 Model B leak test module. This optional accessory can be used for multiplexing and testing up to two parts while exhausting the part that is not under test.

For more information about the 10500-3520-MB32 multiplexer, see the following:

- For product details, see *Table 1 on page 13*.
- For mounting information, see *"Mounting the 3520 B multiplexer valve accessory" on page 35*.
- For connecting the multiplexer, see *"Connecting external multiplexer valve control to 3520 B" on page 52*.
- For commands needed to toggle the 10500-3520-MB32 valves, see *Table 2 on page 13*.

**CAUTION**

The 3520 B multiplexer valve accessory (10500-3520-MB32) has a maximum operating pressure of 50 psig.

***Table 1*** *3520 B multiplexer valve accessory*

| Part number | Valve type | Number of valves | UUT port size | Common port size | Exhaust port size | Use in vacuum systems |
|---|---|---|---|---|---|---|
| 10500-3520-MB32 | 3-way 2-position Normally Closed (NC) latching | 2 | 1/4 NPT | 1/4 NPT | 1/8 NPT | Consult the factory for your specific application |

***Table 2*** *10500-3520-MB32 multiplexer valve commands*

| Action | Command | Note |
|---|---|---|
| **To open valve 1** | SetCmdtoPIC*0x1A 0xE1 | The valve ports are labeled on the multiplexer manifold. See *Figure 21 on page 53*. Match the cable labels to the valve ports. |
| **To close valve 1** | SetCmdtoPIC*0x1A 0xE0 | |
| **To open valve 2** | SetCmdtoPIC*0x1A 0xF1 | |
| **To close valve 2** | SetCmdtoPIC*0x1A 0xF0 | |

### 1.2.2 Multiplexer valve control for the 3520 module, Model C

There four types of large-volume multiplexer valve accessories for the 3520 Leak Test module, Model C: 10500-3520-MPXR, 10500-3520-MC34, 10500-3520-MC32, and 10500-3520-MC31. They are suitable for use as external exhausts or to multiplex and test multiple parts and jigs.

The multiplexers feature air-piloted poppet valves and easy maintenance involving only cartridge replacement (same as for the 3520 Model C). Each valve is rated for over 10 million cycles.

The 2-way air-piloted valves on the 10500-3520-MPXR are controlled by solenoids which are in a normally closed (NC) state. This means that without power, the valves seat is down and no air passes through them. If your leak test setup requires valves in a normally open (NO) state as a fail-safe mechanism (for example, using the multiplexer on the exhaust side), the 10500-3520-MPXR multiplexer allows you to do that by installing new solenoids from the solenoid replacement kit supplied with the multiplexer. See *"Converting the Normally Closed (NC) valves in the 10500-3520-MPXR multiplexer to Normally Open (NO) valves" on page 57*.

The 3-way air-piloted valves on the 10500-3520-MC34, 10500-3520-MC32, and 10500-3520-MC31 multiplexers are in a normally exhausted state.

For more information about the multiplexer valve accessories for the 3520 Model C, see the following:

- For multiplexer details, see *Table 3 on page 14*.
- For mounting information, see *"Mounting the 3520 C multiplexer valve accessories" on page 36*.
- For connecting the multiplexers, see *"Connecting external multiplexer valve control to 3520 C" on page 54*.
- For commands to toggle the valves, see *Table 4 on page 15* and *Table 5 on page 15*.

***Table 3*** *3520 C multiplexer valve accessories*

| Part number | Valve type | Number of valves | UUT, Common, Exhaust port size | Pilot port thread | Use in vacuum systems |
|---|---|---|---|---|---|
| 10500-3520-MPXR | 2-way NC or 2-way NO* air-piloted | 4 | 1/2 NPT | 10-32 UNF | Yes |
| 10500-3520-MC34 | 3-way 2-position air-piloted | 4 | 1/2 NPT | 10-32 UNF | No |
| 10500-3520-MC32 | 3-way 2-position air-piloted | 2 | 1/2 NPT | 10-32 UNF | No |
| 10500-3520-MC31 | 3-way 2-position air-piloted | 1 | 1/2 NPT | 10-32 UNF | No |

*To convert the valves from NC to NO, install the solenoid replacement kit shipped with the multiplexer. See *"Converting the Normally Closed (NC) valves in the 10500-3520-MPXR multiplexer to Normally Open (NO) valves" on page 57*.

*Table 4 10500-3520-MPXR valve commands*

| Action | Command | Comments |
|---|---|---|
| **To open a NC valve** | SetValve*ExtVx*On | • Replace the x in Vx with the valve number as indicated on the cable label. Valid values are 1, 2, 3, and 4, i.e., ExtV1, ExtV2, ExtV3, ExtV4.<br>E.g., to open valve 1, use SetValve*ExtV1*On<br>• For the 10500-3520-MPXR valves, SetValve*ExtVx*On means “Activate”, i.e.: On=Open for NC valves<br>On=Close for NO valves |
| **To close a NC valve** | SetValve*ExtVx*Off | |
| **To open a NO valve** | SetValve*ExtVx*Off | |
| **To close a NO valve** | SetValve*ExtVx*On | |
| **To turn off simultaneously all valves** | ResetUnit | |

*Table 5 10500-3520-MC34, 10500-3520-MC32, and 10500-3520-MC31 valve commands*

| Action | Command | Comment |
|---|---|---|
| **To connect the Common port to a UUT port** | SetValve*ExtVx*On | Replace the x in Vx with the valve number as indicated on the cable label. Valid values are as follows:<br>For 0500-3520-MC34 — ExtV1, ExtV2, ExtV3, ExtV4<br>For 0500-3520-MC32 — ExtV1 and ExtV2<br>For 0500-3520-MC31 — ExtV1<br>E.g., to connect the multiplexer Common port to the UUT1 port, use SetValve*ExtV1*On.<br>To exhaust the UUT that is connected to the UUT1 port of the multiplexer, use SetValve*ExtV1*Off. |
| **To exhaust a UUT** | SetValve*ExtVx*Off | |

# 2.0 About this user guide

The 3520 Leak Test Module user guide is intended for production engineering staff that installs and operates a leak test module from the 3520 series. This user guide covers mounting, connections, and configuration for the 3520 module and its accessories.

The 3520 Leak Test Module user guide is to be used in conjunction with any of the following documents available from the Sciemetric Support Center at *http://support.sciemetric.com*:

- Mounting information
- sigPOD PSV user guide, v.10.X, describing PSV v. 5.X

## 2.1 Conventions

The following icons identify different types of information

Important information

Caution

Danger

## 2.2 Acronyms and abbreviations

*Table 6* lists the acronyms and abbreviations used in this user guide.

***Table 6*** *Acronyms and abbreviations*

| Acronym / Abbreviation | Description |
|---|---|
| A/D | Analog/Digital |
| ADC | Analog-to-digital converter |
| FS | Full Scale |
| IP Code | International Protection Rating or Ingress Protection Rating |
| I/O | Input / Output |
| NC | Normally Closed |
| NO | Normally Open |
| NPT | National Pipe Thread, a United States standard for tapered threads used to join pipe and fittings |
| OPC UA | OLE for Process Control Unified Architecture |
| P1, P2, P3 | Abbreviations for the pressure sensors used in the 3520 Leak Test module. For specific information about each sensor, see *Table 12 on page 32*. |
| PD | Pressure Decay |
| PID control | Proportional-Integral-Derivative control (Instrumentation process control) |
| PV1, PV2, PV3, PV4 | Abbreviations for the proportional valves used in the 3520 Leak Test module. For specific information about each valve, see *Table 11 on page 31*. |
| RTD | Resistance Temperature Device |
| SPC | Statistical Process Control |
| TTL | Transistor-Transistor Logic |
| UNF | Unified Fine Thread, the fine thread series of the Unified Thread Standard |
| UTS | Unified Thread Standard, the standard that defines thread form and series for screw threads commonly used in the United States and Canada |
| UUT | Unit Under Test |
| V1, V2, V3, V4, V5 | Abbreviations for the two-way valves used in the 3520 Leak Test module. For specific information about each valve, see *Table 11 on page 31*. |

# 3.0 Safety

This section includes important safety and care information for the 3520 Leak Test module and should be read by all personnel before operating the module. The two main safety concerns when operating the module are related to the electrical system and the pneumatics.

**IMPORTANT**

The equipment has no direct connection to mains. There are no live hazardous parts and no risk of electrical shock.

**CAUTION**

If the 3520 module is used in a manner not specified by Sciemetric, the protection provided by the equipment may be impaired.

## 3.1 Power requirements

The 3520 module requires power supply voltage of 24 VDC (22 – 26 VDC).

**CAUTION**

- Do not operate the equipment if any part of its exterior surface, such as the outer casing or panels, shows any sign of damage.
- Before performing any maintenance procedures, disconnect all external electrical connections.

**DANGER**

To avoid the risk of serious injury, always observe the following precautions before operating the 3520 module:

- Use only a power supply cord with a protective earthing terminal.
- Always connect the power supply cord to a power outlet equipped with a protective earth contact. Never connect to an extension cord that is not equipped with this feature.
- Do not interrupt the protective earth connection.
- Never plug the module into a voltage source different than the one specified in the data sheet.
- The type of external power supply you use must be approved and certified by the authorities in the country where the equipment is installed and used.

## 3.2 Pneumatic safety

Before handling pressurized-air equipment, observe the following:

- Ensure the supply and pilot air pressures do not exceed the air pressure rating of the 3520 module. See *"Technical Specifications" on page 81*.
- Always wear safety goggles and ear protection when working with pressurized air. Parts filled with pressurized air can burst or accidentally release air which, in turn, can result in flying particles or excessive noise.
- Before disconnecting the air pressure hose from the Supply port or the Pilot port of the 3520 module, ensure that the air pressure source is closed off and isolated, and the air pressure has been fully exhausted.
- When you have completed a leak test, disconnect the part that is being tested only after the air pressure has fully exhausted. Failure to do so can result in physical injury.

## 3.3 Operating environment

The 3520 module enclosure is designed to meet IP65 requirements. The enclosure is intended for indoor use and protects against dust and to some extent from falling dirt and dripping non-corrosive liquids.

The 3520 module vents air through the Exhaust and Bleed ports. The provided silencers are not sufficient to keep water or fine particles from entering the module, but these ports may be routed elsewhere if there is a risk of dust or water ingress. Keep oil, solvents, dust, debris and excessive heat away from this equipment.

Operating Temperature: 5 – 40°C

Operating Humidity: 8% – 90%

**CAUTION**

Do not place the 3520 module in direct sunlight.

In order for the 3520 module to operate accurately, the air supplied to the module must be prepared according to the instructions in the *"Connecting the Supply and Pilot air" on page 44*.

# 4.0 Unpacking the 3520 Leak Test module

The 3520 Leak Test module is fully inspected, calibrated, and tested before shipment.

Follow these recommendations while unpacking the carton:

- Observe the safety precautions (see *"Safety" on page 19*).
- Retain the box and packing material for future shipments.
- Inspect all equipment for damage.

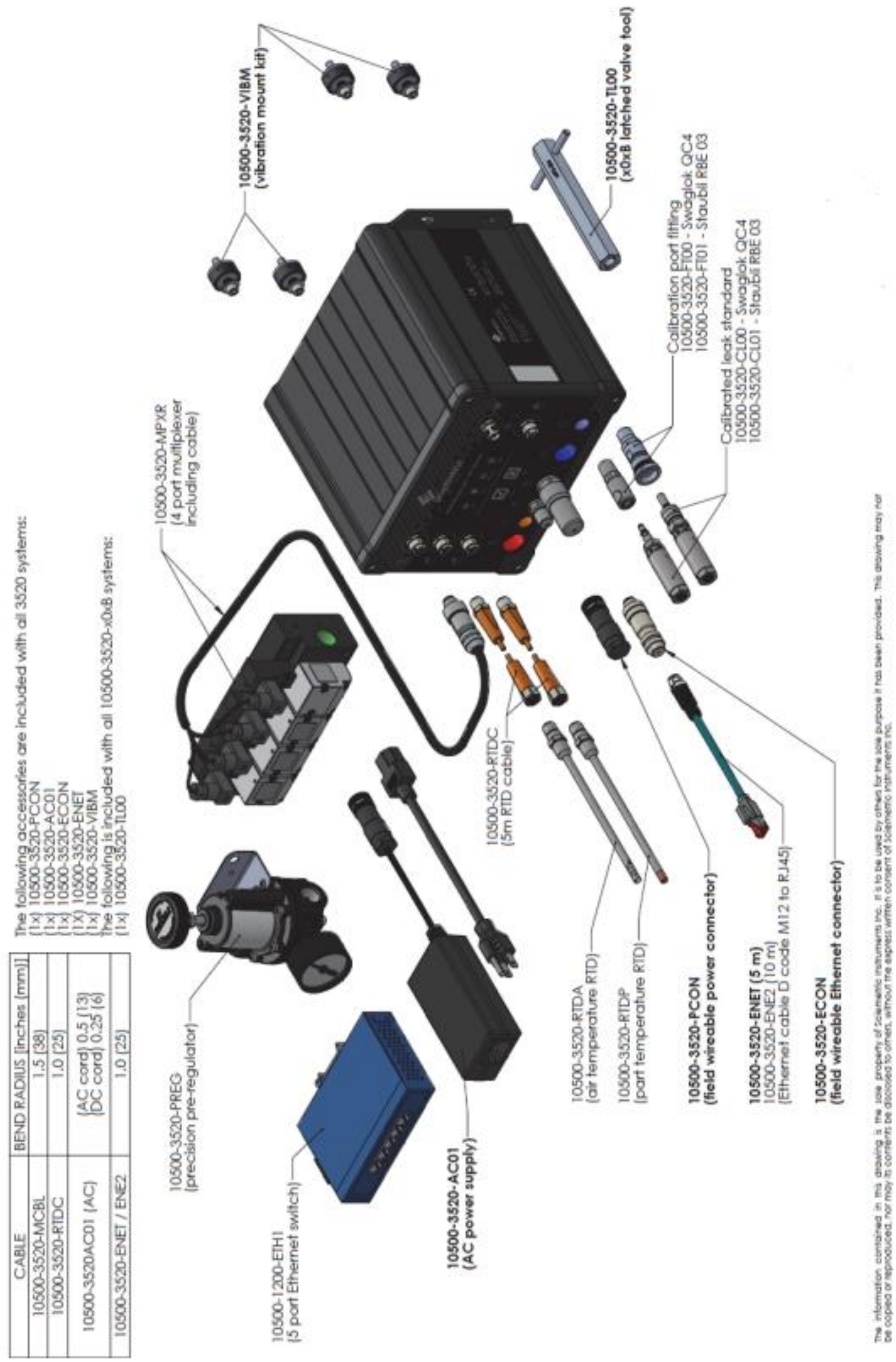
Check that the following items are present:

- 3520 Leak Test module
- Power connector
- 24 VDC power supply, universal input 120/240 VAC, NA power cord
- Ethernet connector
- Ethernet cable
- Latching valve service tool (shipped only with B models)
- Resin silencers (not installed when shipped):
  – Bleed port 1/4 NPT silencer
  – Exhaust port 1/4 NPT silencer for B models (low-volume) or 1/2 NPT silencer for C models (high-flow)
- Vibration mount kit (must be used for electrical and vibration isolation)

See *Figure 7 on page 24* for a picture of the 3520 module with all standard and optional accessories. See *Table 7 on page 25*, *Table 8 on page 25*, *Table 9 on page 26* and *Table 10 on page 26* for a list of the accessories and their part numbers.

If you notice any shortages, please contact the Sales Division of Sciemetric Instruments ULC. See the inside front cover of this user guide for contact information.

Sciemetric Instruments ULC warrants that the equipment was inspected prior to packing and that the shipper received the carton in an undamaged condition. All claims for damage related to shipping and handling should be directed to the shipping company.




| CABLE | BEND RADIUS [inches (mm)] |
|---|---|
| 10500-3520-MCBL | 1.5 (38) |
| 10500-3520-RTDC | 1.0 (25) |
| 10500-3520AC01 (AC) | (AC cord) 0.5 (13)<br>(DC cord) 0.25 (6) |
| 10500-3520-ENET / ENE2 | 1.0 (25) |

*Figure 7 3520 module with standard and optional accessories*

***Table 7*** *Standard accessories (included with every 3520 module)*

| Part Number | Description |
|---|---|
| 10500-3520-PCON | Power connector, M12 T-code 4-pin socket, field wireable unshielded  |
| 10500-3520-AC01 | 24 VDC power supply for 3520 Leak Test module, universal input 120/240 VAC, NA power cord (not NEMA-rated)  |
| 10500-3520-ECON | Ethernet connector, M12 D-code 4-pin plug, field wireable, shielded  |
| 10500-3520-ENET | Ethernet Cable - M12 4-pin D-code straight shielded plug to RJ45 connection, 5 m long  |
| 10500-3520-VIBM | Vibration mount kit  |
| 10500-3520-TL00 | Latching valve service tool (shipped only with B models)  |

***Table 8*** *Optional accessories - temperature sensors*

| Part Number | Description |
|---|---|
| 10500-3520-RTDA | Air temperature RTD, Platinum, Class A, 100 Ohm, 6 inch, M12 A-code plug, 1/4 NPT connection, wire code 1  |

***Table 8*** *Optional accessories - temperature sensors (Continued)*

| Part Number | Description |
|---|---|
| 10500-3520-RTDP | Cu tipped RTD, Platinum, Class A, 100 Ohm, 6 inch, M12 A-code plug, 1/4 NPT connection, wire code 1  |
| 10500-3520-RTDC | RTD cable - M12 4-pin A-code straight plug to M12 4 pin A-code straight socket, non-shielded, 5 m long  |

***Table 9*** *Optional accessories - electrical*

| Part Number | Description |
|---|---|
| 10500-3520-ETH1 | Gigabit Ethernet switch 5-Port 10/100/1000 Wide Temp  |
| 10500-3520-ENE2 | Ethernet Cable - M12 4-pin D-code straight shielded plug to RJ45 connection, 10 m long  |
| 10500-3520-MCBL | 3520 Multiplexer cable - M12 8-pin A-code straight shielded plug to 4 x DIN from C 9.4 mm lighted connectors, 3 m long (includes DIN gaskets) |

***Table 10*** *Optional accessories - pneumatic*

| Part Number | Description |
|---|---|
| 10500-3520-CL00 | Custom-specified metal orifice flow standard with Swagelok QC4 connection. Specify test pressure (vacuum to 90 psi) and leak rate in sccm (for example, 5 sccm at 15 psig).  |
| 10500-3520-CL01 | Custom-specified metal orifice flow standard with Staubli RBE 03 connection. Specify test pressure (vacuum to 90 psi) and leak rate in sccm (for example, 5 sccm at 15 psig).  |
| 10500-3520-REG0 | Precision pre-regulator for the 3520 module with mounting bracket, 1/2 NPT ports, max 500 psig in, 2-150 psig out, 40 SCFM, 0.1% supply pressure effect  |

*Table 10 Optional accessories - pneumatic (Continued)*

| Part Number | Description |
| --- | --- |
| 10500-3520-FT00 | Calibration port quick connect, SS Swagelok QC4 body 1/4 NPT Male  |
| 10500-3520-FT01 | Calibration port quick connect, SS Staubli RBE 1/4 NPT Male IA / W  |
| 10500-3520-MPXR | 4-station multiplexer valve assembly for the 3520 C Leak Test module and a solenoid replacement kit: 2-way air-piloted NC valves, 1/2 NPT ports, 24 V, 2.5 W each valve. 10-32 Pilot port. Includes multiplexer cable: M12 8-pin A-code straight shielded plug to 4 x DIN form C 9.4 mm lighted connectors, 3 m long<br>The solenoid replacement kit allows conversion of any or all valves from NC to NO. The kit includes the following: 8 bolts, 4 NO solenoids, 4 rubber seals, 4 NO adapters  |
| 10500-3520-MC34 | 4-station multiplexer valve assembly for the 3520 C Leak Test module: 3-way 2-position air-piloted valves, 1/2 NPT ports, 24 V, 2.5 W each valve. 10-32 Pilot port. Includes multiplexer cable: M12 8-pin A-code straight shielded plug to 4 x DIN form C 9.4 mm lighted connectors, 3 m long  |
| 10500-3520-MC32 | 2-station multiplexer valve assembly for the 3520 C Leak Test module: 3-way 2-position air-piloted valves, 1/2 NPT ports, 24 V, 2.5 W each valve. 10-32 Pilot port. Includes multiplexer cable: M12 8-pin A-code straight shielded plug to 2x DIN form C 9.4 mm lighted connectors, 3 m long  |
| 10500-3520-MC31 | 1-station external exhaust valve assembly for the 3520 C Leak Test module: 3-way 2-position air-piloted external valve, 1/2 NPT ports, 24 V, 2.5 W each valve. 10-32 Pilot port. Includes multiplexer cable: M12 8-pin A-code straight shielded plug to 1 x DIN form C 9.4 mm lighted connectors, 3 m long  |
| 10500-3520-MB32 | 2-station multiplexer valve assembly for the 3520 B Leak Test module: 3-way 2-position latching valves, 1/4 NPT ports, 2x 1/8 NPT Exhaust ports. Includes multiplexer cable, 3 m long  |

***Table 10*** *Optional accessories - pneumatic (Continued)*

| Part Number | Description |
|---|---|
| 10500-3520-AJFS | A portable, adjustable flow standard kit for leak test trials. Use to create leaks of -50 to +50 sccm with test pressures of 10 to 5 psiv and 5 to 30 psig without needing to source-specific calibrated flow standards. This accessory ships with a carrying case, Staubli and Swagelok quick-connect fittings, and the tools needed to swap the quick-connects. |
| 10500-3520-T030 | Druck DPI 104 30 psia pressure transfer standard with Swagelok QC4 fitting*<br>To be paired with 3520 models A0xx, B0xx, C0xx, G0xx, H0xx and I0xx  |
| 10500-3520-T031 | Druck DPI 104 30 psia pressure transfer standard with Staubli RBE 03 fitting*<br>To be paired with 3520 models A0xx, B0xx, C0xx, G0xx, H0xx and I0xx  |
| 10500-3520-T100 | Druck DPI 104 100 psia pressure transfer standard with Swagelok QC4 fitting*<br>To be paired with 3520 models D0xx, E0xx, F0xx  |
| 10500-3520-T101 | Druck DPI 104 100 psia pressure transfer standard with Staubli RBE 03 fitting*<br>To be paired with 3520 models D0xx, E0xx, F0xx  |

* Due to the expiry of the transfer standard calibration, transfer standards are NOT stocked items and are purchased to order. Expect long lead times.

# 5.0 Pneumatic schematics

*Figure 8 on page 29* and *Figure 9 on page 30* show the pneumatic schematics of the 3520 module for the low-volume manifold and the high-flow manifold. These schematics differ only in terms of types of valves used and role of the sensor P3.

The common pneumatic components for both manifolds are as follows:

- Four proportional valves
- Dual electronic regulators
- Flow meter (optional component)
- Absolute pressure sensors
- A separate Bleed port for sealed operation or for removing gases
- Quick-disconnect Calibration port with control valve (an optional fitting)

In addition to the above, the high-flow manifold has 1/2 NPT Supply, Exhaust, and Unit Under Test (UUT) ports, four high-flow air-piloted valves, a Pilot pressure port and a Pilot pressure sensor. The small volume manifold has five latching valves and a regulator output sensor.

For a description of the valve functions, see *Table 11 on page 31*. For a description of the other pneumatic elements, see *Table 12 on page 32*.

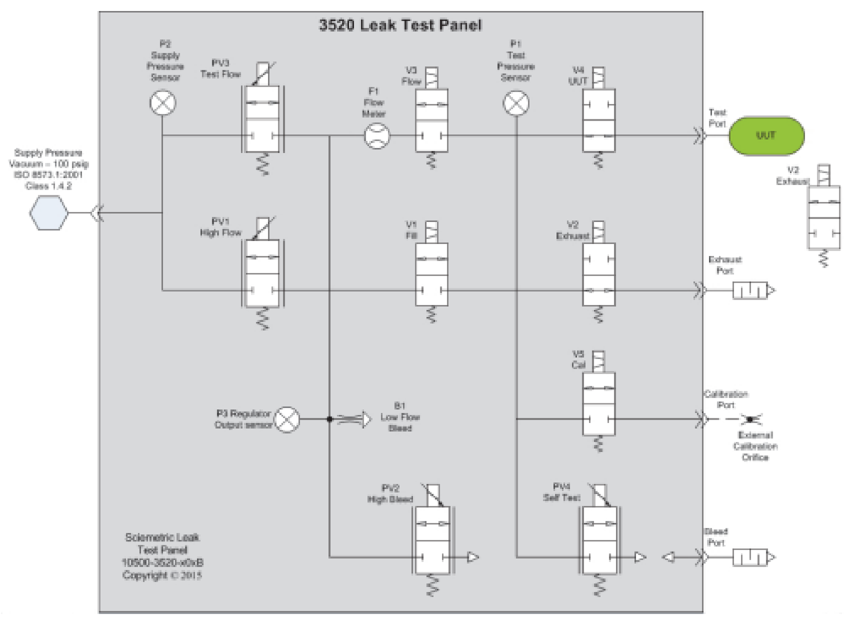



*Figure 8 3520 module, B type low-volume manifold pneumatic schematics*

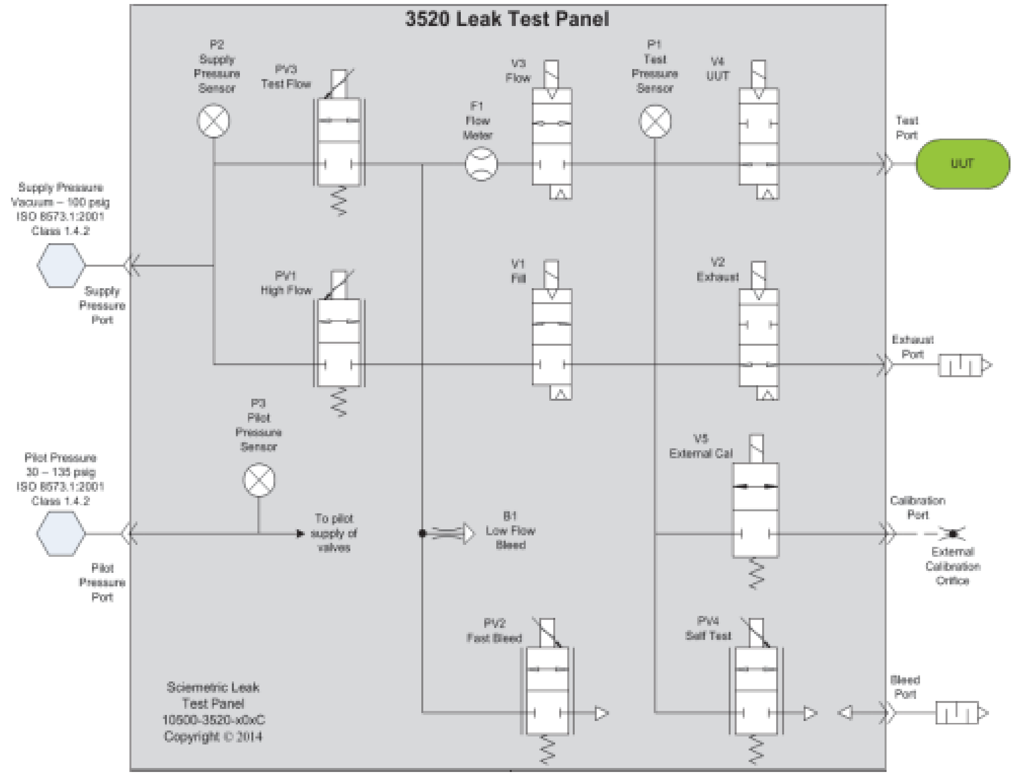



*Figure 9 3520 module, C type high-flow manifold pneumatic schematics*

***Table 11*** *Valves in the 3520 module (low-volume and high-flow manifold)*

| Valve number | Valve name | Valve type in high-flow manifold | Valve type in low-volume manifold | Valve function |
|---|---|---|---|---|
| V1 | Fill | NC air-piloted | NC latching | Allows rapid filling of the part that is being tested, i.e., the Unit Under Test (UUT) and isolating the part from the regulator. This valve is active during fill operations and closed during flow tests, pressure decay tests, and exhaust cycles. |
| PV1 | High Flow | large flow NC proportional | medium flow NC proportional | Variable orifice between Supply port and the UUT, acting as a high-flow rate regulator. |
| V2 | Exhaust | NO air-piloted | NC latching | De-pressurizes the system. This valve is always activated except during zeroing, exhaust, and some self-test operations. |
| PV2 | Fast Bleed | medium flow NC proportional | small flow NC proportional | A rapid bleed for use with PV1 to improve pressure regulation. |
| V3 | Flow | NC air-piloted | NC latching | Switches the flow meter in series between the regulator and the test chamber. This valve is active during flow tests. |
| PV3 | Test Flow | precision NC proportional | precision NC proportional | Variable orifice between Supply port and the UUT, acting as a low flow rate precision regulator. |
| V4 | UUT | NC air-piloted | NC latching | Isolates the interior of the 3520 module from the UUT. This valve is active during zeroing and self-test operations. |
| PV4 | Self-Test | small flow NC proportional | small flow NC proportional | A variable orifice between the test chamber and the atmosphere to act as a controlled internal leak for internal diagnostic tests. |
| V5 | Calibration | NC solenoid | NC latching | This valve switches the external calibration port. |

***Table 12*** *Other pneumatic components in the 3520 module (low-volume and high-flow manifold)*

| Component number | Component name in low-volume manifold | Component name in high-flow manifold | Details |
|---|---|---|---|
| P1 | Test Pressure sensor | Test Pressure sensor | Monitors the test pressure into the Unit Under Test (UUT). Specified by the 1st option code in the model number and is the reference for all pressure testing and control. |
| P2 | Supply Pressure sensor | Supply Pressure sensor | Monitors the supply pressure into the 3520 module (0-150 psia). |
| P3 | Flow Inlet sensor | Pilot Pressure sensor | The Regulator Output sensor monitors the output of PV3 and PV1.<br>The Pilot Pressure sensor monitors the pilot pressure for the air-piloted valves. (See V1, V2, V3, V4 in *Table 11 on page 31*.) |
| B1 | Low-flow Bleed orifice | Low-flow Bleed orifice | The orifice is combined with the Test Flow valve (See PV3 in *Table 11 on page 31*) to form a high- precision, low-flow regulator. |
| F1 | Flow meter | Flow meter | Optional Flow meter for testing and control; specified by the third option code in the model number. |

# 6.0 Mounting the 3520 Leak Test module and external multiplexer valve accessories

The 3520 Leak Test module and any of the optional external multiplexer valve accessories can be placed on a desktop or can be wall-mounted.

## 6.1 Wall-mounting the 3520 Leak Test module

The wall mount allows you to secure the module to any solid surface such as a workbench or a wall using the integral mount brackets and vibration mounts. When mounting the module, it is recommended that you first attach the vibration mounts to the solid surface, and then the 3520 module to the vibration mounts.

**Installation requirements**

- The module must be installed on a solid surface where limited or no vibration occurs.
- To ensure accurate leak test results, you must use the vibration mount kit (see *Table 7 on page 25*), which includes the following:
  - Four thread-locking socket head cap screws, alloy steel, 1/4”- 20 thread, 5/8” length
  - Four neoprene vibration damping sandwich mounts, M/F 1/4” - 20 x 1/2” H, 1”W, further referred to as vibration mounts
  - Four 18-8 Stainless steel type A SAE flat washers, 1/4” screw size, 5/8 OD, 0.5”- 0.8” thick
- Ensure that the surface can accommodate the weight of the module. See the *"Technical Specifications" on page 81* for weight values.

### To wall-mount the 3520 module

1. On the surface against which the 3520 module will be mounted, mark out the hole locations for the fastening screws. See *Figure 10 on page 34* and *Figure 11 on page 35* for relevant dimensions.
2. Make four 1/4”- 20 tapped holes for the vibration mounts.
3. Screw the four vibration mounts into the mounting surface.
4. Hold the 3520 module against the mounting surface with the front panel facing you and the mounting holes aligned with the vibration mounts.
5. Take a socket head cap screw from the vibration mount kit, remove everything but the small flat washer, and insert the screw through one of the 3520 mounting holes on the integrated fins.
6. Secure the screw to the vibration mount.
7. Repeat steps 5 and 6 for the other three mounting holes.

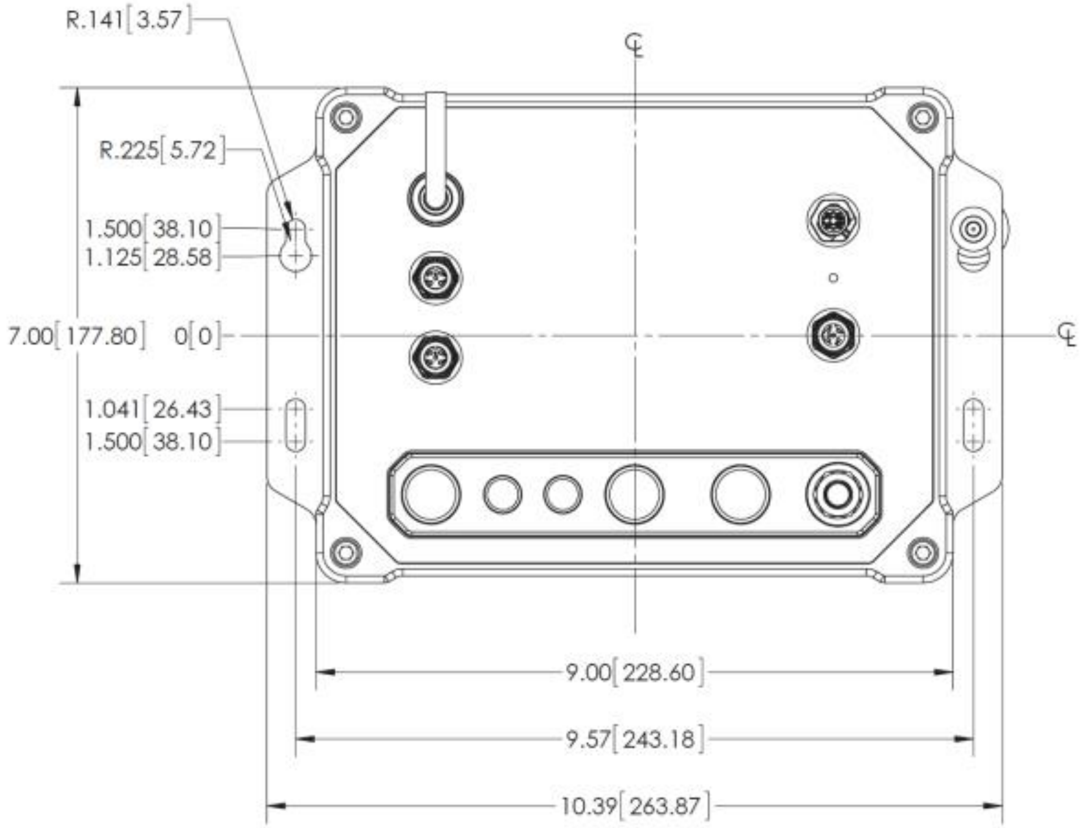



*Figure 10 The 3520 module dimensions in inches [mm] - front view*

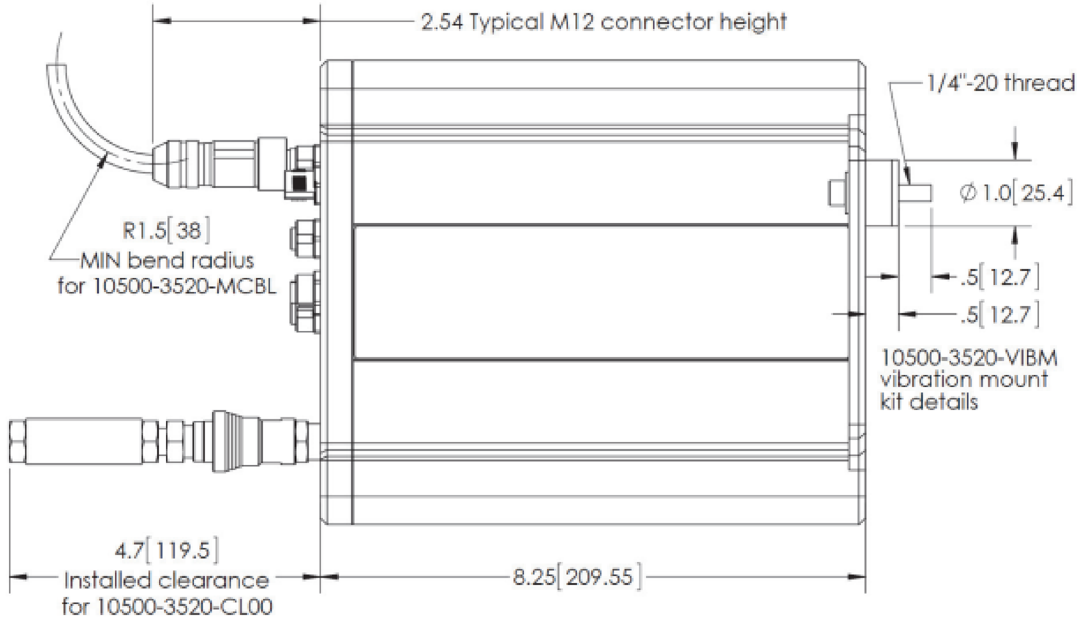



*Figure 11 The 3520 module dimensions in inches [mm] - side view*

## 6.2 Mounting the 3520 B multiplexer valve accessory

**Required parts and tools**

- Two socket head cap screws size #10-32 or #10-24
- Hex driver for the size of socket head cap screws you've selected

### To mount the 3520 B multiplexer valve accessory (10500-3520-MB32)

1. On the surface against which 10500-3520-MB32 will be mounted, mark out the multiplexer location. See *Figure 12 on page 36* for relevant dimensions.
2. Mark out the hole locations for the fastening screws.
3. Make two tapped holes for the screws.
4. Insert one of the socket head cap screws into the multiplexer holes and screw into the mounting surface.
5. Repeat for the other screw.

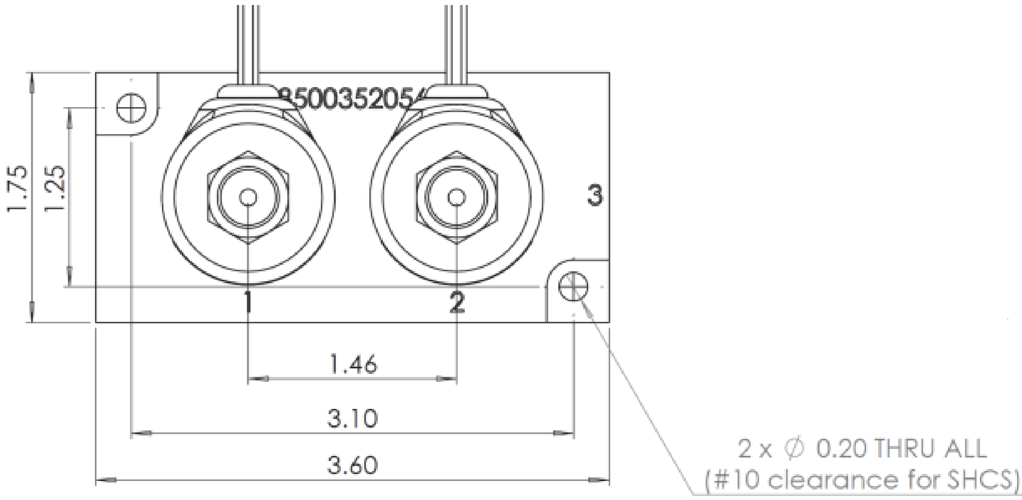



*Figure 12 10500-3520-MB32 3520 B multiplexer valve accessory - dimensions in inches [mm]*

## 6.3 Mounting the 3520 C multiplexer valve accessories

**Required parts and tools**

- Socket head cap screws as follows:
    - For 10500-3520-MPXR, three socket head cap screws up to size # 10 (max cap clearance 0,38", max hole 021")
    - For 10500-3520-MC34, 10500-3520-MC32, and 10500-3520-MC31, four socket head cap screws up to size # 1/4 (max cap clearance 0,38", max hole 0.23").
- Hex driver for the size of socket head cap screws you've selected

### To mount any of the 3520 C multiplexer valve accessories

1. On the surface against which the 3520 C multiplexer accessory will be mounted, mark out the multiplexer location. See the following figures for relevant dimensions.:
    - For 10500-3520-MPXR, see *Figure 13 on page 37*
    - For 10500-3520-MC34 and 10500-3520-MC32, see *Figure 14 on page 37*
    - For 10500-3520-MC31, see *Figure 15 on page 37*
2. Mark out the hole locations for the fastening screws.
3. Make tapped holes for the screws.
4. Insert one of the socket head cap screws into the multiplexer holes and screw into the mounting surface.
5. Repeat for the other screws.

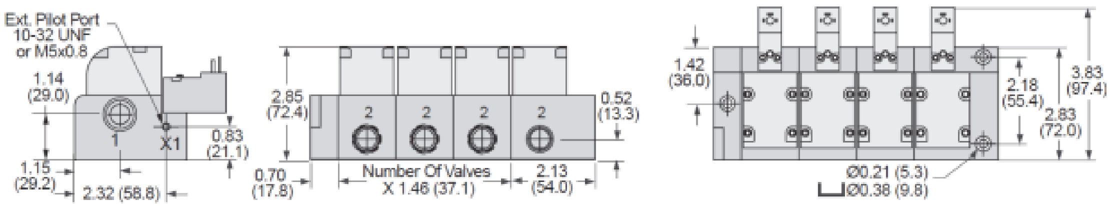



*Figure 13* *10500-3520-MPXR 3520 C multiplexer valve accessory - dimensions in inches [mm]*

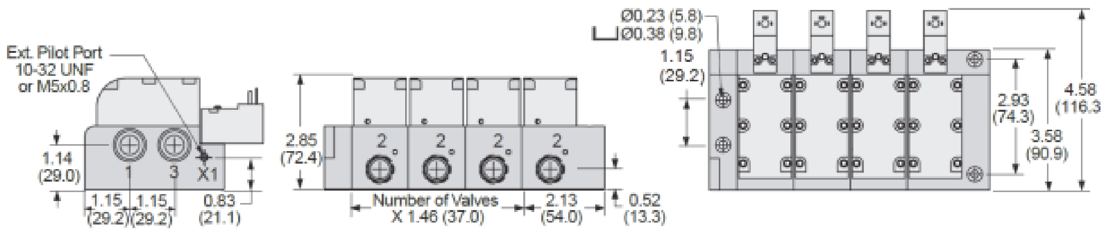



*Figure 14* *10500-3520-MP32 & 10500-3520-MP34 3520 C multiplexer valve accessories - dimensions in inches [mm]*

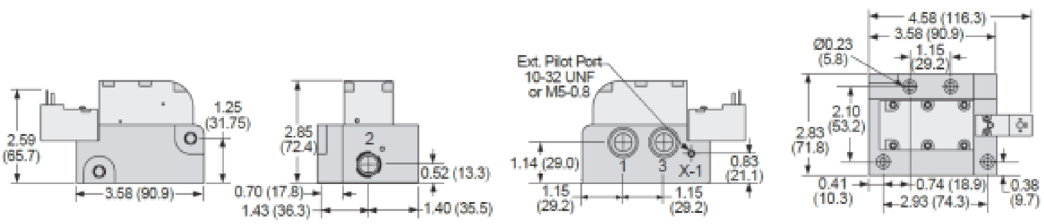



*Figure 15* *10500-3520-MC31 3520 C multiplexer valve accessory - dimensions in inches [mm]*

# 7.0 Connecting the 3520 Leak Test module

This section covers the pneumatic, communication, power, and accessory connections to the 3520 Leak Test module.

**CAUTION**

Protect the 3520 module from electro-static discharge:

Do not discharge static into the pins of the 3520 module front panel connectors.

Before you start connecting the module, ensure your set-up includes the following:

- 24 VDC power (40 W max). See the Electrical section in *"Technical Specifications" on page 81*.
- Ethernet connection
- A PC or sigPOD controller with an InspeXion software program that supports the 3520 module
- Clean air for the Supply and Pilot ports. See *"Connecting the Supply and Pilot air" on page 44* and *"Technical Specifications" on page 81* for the supply and pilot air requirements.

**IMPORTANT**

Using air supply that does not meet the 3520 Technical specifications voids the warranty of the 3520 leak test unit.

- Stable supply pressure. See the Supply pressure section in the *"Technical Specifications" on page 81*.
- Vibration-free mounting during test cycles. See *"Mounting the 3520 Leak Test module and external multiplexer valve accessories" on page 33*.
- A 3520 module mounted as close as possible to the Unit Under Test (UUT) to minimize test volume. See the UUT port section in *Table 13 on page 40* for more information.
- A UUT free of any contaminants, including oil or water.

*Table 13 on page 40* and *Table 14 on page 42* summarize what you should know about the electrical and pneumatic connections. For more detailed description of how to connect each component, see the following subsections.

***Table 13*** *Pneumatic Connections*

| Port | Connection in low- volume manifold | Connection in high- flow manifold | Details |
|---|---|---|---|
| Supply | 1/4 NPT | 1/2 NPT | This port is the supply air source.<br>The air supply must meet or exceed ISO standard 8573.1:2001 Class 1.4.2 or better and must be prepared according to the *"Technical Specifications" on page 81*.<br>Pre-regulation of the supply pressure is necessary. An external precision supply regulator with a supply pressure effect of < 0.1 psig per 100 psig change is required. Otherwise, changes to the pressure supply during fill and flow testing will affect the leak test accuracy. |
| Pilot | N/A | 1/4 NPT | This port is the pilot pressure source for the air-piloted valves.<br>The air supply must meet or exceed ISO standard 8573.1:2001 Class 1.4.2 or better.<br>Pilot pressure range: 30 psig to 135 psig<br>The pilot pressure must be equal to or greater than the supply pressure. The Pilot port can be connected to the same source as the Supply port, as long as the minimum pilot supply pressure is provided. |
| Bleed | 1/4 NPT | 1/4 NPT | This port allows internal bleed, pilot and self-test gas flows to exhaust out of the 3520 module. The internal regulators require a bleed flow to operate properly.<br>The bleed port may be routed externally to control venting of the gas.<br>Do not block or severely restrict the flow out of the Bleed port. Do not draw vacuum on the Bleed port.<br>A ¼ NPT resin silencer for the Bleed port is shipped with the 3520 module. |
| Exhaust | 1/4 NPT | 1/2 NPT | This port allows for the exhaust of the test air that is in the Unit Under Test (UUT).<br>With high test pressures, very fast gas flows can occur here. Ensure that the noise generated by the exhaust stage is safe for operators in the vicinity.<br>The exhaust port may be routed externally to control venting of the gas.<br>Do not block or severely restrict the flow out of this port.<br>A resin silencer for the Exhaust port is shipped with each 3520 module: a 1/4 NPT silencer for B model (low- volume manifold) and a 1/2 NPT silencer for C model (high-flow manifold) |

*Table 13 Pneumatic Connections (Continued)*

| Port | Connection in low- volume manifold | Connection in high- flow manifold | Details |
|---|---|---|---|
| Unit Under Test (UUT) | 1/4 NPT | 1/2 NPT | This port is for connection to the Unit Under Test (UUT).<br>It is recommended that you mount the 3520 module as close as possible to the UUT to minimize test volume and reduce hose restrictions.<br>The pneumatic connections for the 3520 module should be designed to minimize the pressure differential between the 3520 and the UUT at the desired fill rate. For UUT volumes > 1 L, a minimum Cv > 2 should be targeted for the pneumatic connection between the part and the 3520 C model. A Cv of 0.25 - 0.5 for a 3520 B model is sufficient. |
| Calibration | 1/4 NPT | 1/4 NPT | This port is for external orifice connection. Quick-connect fittings such as the Swagelok QC4 and Staubli RBE 03 are recommended and available as optional accessories (see *Table 10 on page 26*.) A calibrated orifice can be left plugged into this quick-disconnect and engaged for calibration periodically, using the 3520 internal Calibration control valve. If the calibration port is not going to be used, a plug or silencer should be installed. |

***Table 14*** *Electrical connections*

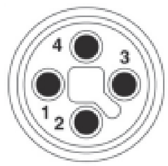
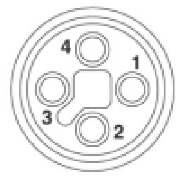
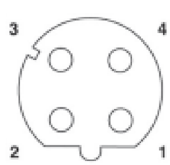
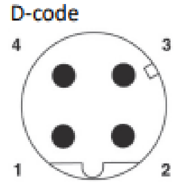
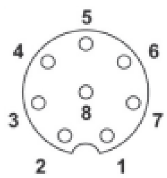
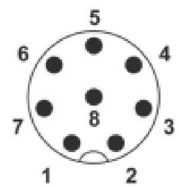
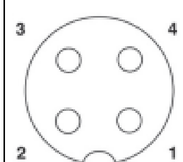
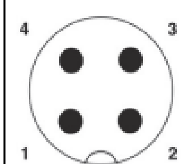
| Signal | 3520 connector | Cable connector | Accessory connector | Pinout | Notes |
|---|---|---|---|---|---|
| 24 VDC Power Input<br>[Required] | Socket 4-pin M12<br>T-code<br> | Plug M12 4-pin<br>T-code<br> | SCI: 10500-3520-PCON or<br>10500-3520-AC01 | 1. +24<br>2. +24<br>3. COM<br>4. COM | 24 VDC power supply<br>See the Electrical section in the *"Technical Specifications" on page 81.*<br>Power (Max): 40 W (including all accessories)<br>Power (Typical): 10 W (single channel leak test)<br>AWG 16-18<br>Pin 4 is advanced GND<br>Cable diameter 8-10 mm<br>Use pins 2 and 3 for sense leads if supported by power supply.<br>For more information, see *"Connecting power" on page 50.* |
| Ethernet Commu-nications<br>[Required] | Plug 4-pin M12<br>D-code<br> | Socket M12 4-pin<br>D-code<br> | SCI: 10500-3520-ECON or<br>10500-3520-ENET | 1. TX+<br>2. RX+<br>3. TX-<br>4. RX- | Sciemetric supplies field wireable connectors and optional cable assemblies.<br>AWG 18-24<br>Cable diameter 6-8 mm<br>Connector supports shield connections.<br>See *"Connecting to the Ethernet" on page 51* |

***Table 14*** *Electrical connections (Continued)*

| Signal | 3520 connector | Cable connector | Accessory connector | Pinout | Notes |
|---|---|---|---|---|---|
| External Valves Control<br>[optional] | Plug 8-pin M12<br>A-code<br> | Socket M12 8-pin<br>A-code<br> | Cable:<br>included with each multiplexer<br>Multiplexer for 3520 B:<br>10500-3520-MB32<br>Multiplexers for 3520 C:<br>10500-3520-MPXR<br>10500-3520-MC34<br>10500-3520-MC32<br>10500-3520-MC31 | 1. V10-<br>2. V11+<br>3. V11-<br>4. V8-<br>5. V9+<br>6. V8+<br>7. V10+<br>8. V9- | To be used only with multiplexer cables and valves supplied by Sciemetric.<br>For more information, see *"Connecting external multiplexer valve control to 3520 B" on page 52* and *"Connecting external multiplexer valve control to 3520 C" on page 54*. |
| Tempera-ture Input Channels<br>(1 and 2)<br>[optional] | Plug 4-pin M12<br>A-code<br> | Socket M12 4-pin<br>A-code<br> | 10500-3520-RTDC | 1. RTD+<br>(1.25 mA excitation+)<br>2. RTD-<br>(sense -)<br>3. RTD-<br>(1.25 mA excitation -)<br>4. RTD+<br>(sense +) | For use with 4-wire 100 Ω platinum RTDs. RTDs are available with M12 connections and different wiring codes. Ensure that the wiring code of the RTD matches the pin out in this table.<br>For example, 10500-3520-RTDA or 10500-3520-RTDP.<br>For more information, see *Table 8 on page 25* and *"Connecting temperature sensors" on page 60*. |

## 7.1 Cabling and shielding

When installing cable runs, ensure the bend radius is greater than 1.5", and avoid kinks and excessive cable twisting. Effective strain relief should be used on both the 3520 module and connectors, and its controller (a sigPOD test and monitoring system or supported Windows PC). Excessive strain can damage the connectors and may cause the leak test system to stop working.

## 7.2 Connecting pneumatics

Pneumatic connections are made through the ports along the bottom edge of the front panel (see *Figure 2 on page 9*) and include the following:

- *"Connecting the Supply and Pilot air" on page 44*
- *"Connecting the part to be tested" on page 46*
- *"Connecting to the Bleed and Exhaust ports" on page 46*
- *"Connecting to the Calibration port" on page 47*

There are many types of fittings on the market that you can use for the 3520 pneumatic ports. Choose according to the specific requirements of your tests and see *"Recommended fittings" on page 47* for what Sciemetric considers most appropriate for the 3520 module. See *Table 13 on page 40* for a summary of the pneumatic connections to each port.

### *7.2.1 Connecting the Supply and Pilot air*

The Supply port provides the test air and the Pilot port provides the air which opens the air-piloted valves.

Before you make connections to any of these ports, ensure that the air is prepared according to the 3520 module technical specifications as follows:

- The supply and pilot air must meet ISO standard 8573.1:2001 Class 1.4.2 or better.
- The supply and pilot air must have all water vapor removed down to a dew point of 3°C (Class 4) or less. Typically this process can be accomplished at the source of the shop air supply by using air-conditioning or desiccant-type dryers. The example in *Figure 16 on page 45* shows an after-cooler near the compressor to remove the majority of water and a desiccant dryer local to the 3520 module.

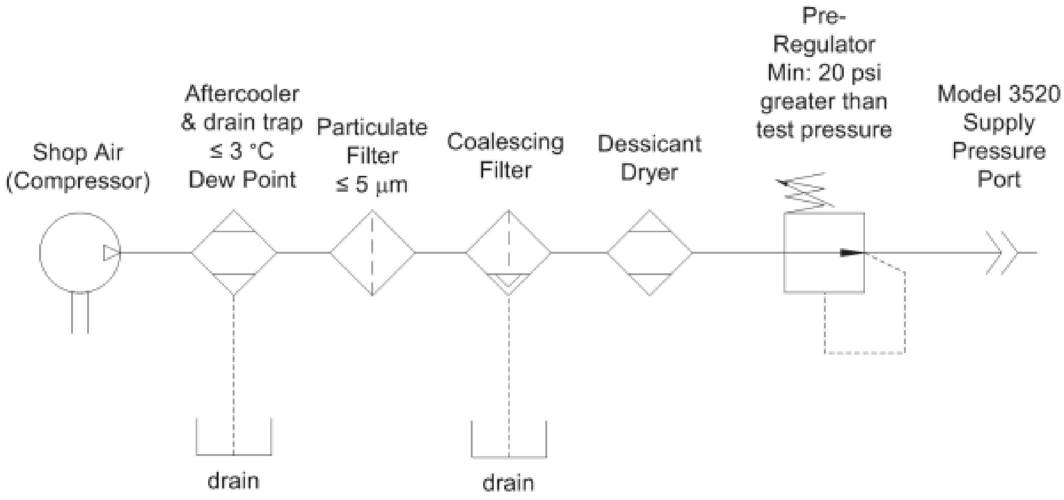



*Figure 16 A typical supply air preparation arrangement for the 3520 module*

**CAUTION**

If the air supply is not sufficiently dry, water may accumulate inside the 3520 module. Water accumulated in the valves will affect their operation.

**IMPORTANT:** If water does get into the 3520 module, you can resolve the issue by opening the module to allow the internal components to dry out. You can also perform an extended blowout of the system to clean the water out of the valves and the pneumatic components.

- The supply and pilot air must be pre-filtered with a 5-micron particulate filter. This is a pre-filter for the coalescing filter (See *Figure 16*).
- A coalescing filter must be used to ensure the air meets the ISO 8573.1 particulate (Class 1) and oil (Class 2) ratings. In addition, ensure the supply pressure is stable and meets the *"Technical Specifications" on page 81*. You must use a precision regulator at the supply air input to achieve this.

**CAUTION**

Coalescing filters usually have an automatic discharge at the bottom of the bowl. This discharge should be routed with a hose to an appropriate drain to ensure no oil or water gets onto the floor and creates a potential hazard.

- The air input pressure must meet the requirements listed in *Table 15*. This is accomplished by pre-regulating the air before it enters the 3520 module.

***Table 15*** *Requirements for supply and pilot pressure*

| | **Supply pressure** |
|---|---|
| **Required flow capacity** | 35 SCFM (1000 SLPM) or higher at 100 psig |
| **Stability** | ±0.1psi |
| **Pre-regulation** | An external precision input regulator with a supply pressure effect of < 0.1 psig per 100 psig change is required. |
| | **Pilot pressure (high-flow manifold only)** |
| **Minimum** | 30 psig or the value of the supply pressure, whichever is greater |
| **Maximum** | 135 psig |
| **Pre-regulation** | Recommended |

**IMPORTANT:** Supply and pilot pressure variations can cause test pressure variations and decrease accuracy. These effects are most significant in flow-based leak testing. A high quality precision pre-regulator will reduce pressure changes in the 3520 module.

## 7.2.2 Connecting the part to be tested

When connecting the part to be tested to the Unit Under Test port, ensure that the hose diameter is adequate for the volume of the part. See the UUT details section in *Table 13 on page 40* and *"Recommended fittings" on page 47*.

## 7.2.3 Connecting to the Bleed and Exhaust ports

Sciemetric recommends that you use the silencers (shipped with the 3520 module) for the Bleed and Exhaust ports; the pressurized air that comes out of these ports can be loud and a safety hazard. See

If the exhaust or bleed air must be ported elsewhere, remove the silencers and install the desired pneumatic fittings before running any leak tests. Note that additional hosing on the Exhaust port may affect the test timing; so, it is recommended to do such installation prior to configuring any leak tests.

**IMPORTANT:** Do not draw vacuum on the bleed port. This may cause the system to reset or malfunction.

### 7.2.4 Connecting to the Calibration port

The use of the calibration port is optional but highly recommended. The 3520 module does not ship with a calibration port fitting but offers two quick-connect fittings as optional accessories. For more information, see *Table 10 on page 26*.

Sciemetric also offers custom metal flow standards as optional accessories that plug into the quick-connect fittings described above. These flow standards are screened to protect the flow element. You must specify the test pressure (vacuum to 90 psi) and leak rate (for example 5 sccm at 15 psig) when ordering. It is highly recommended that you purchase a leak standard for every pressure-leak rate combination.

### 7.2.5 Recommended fittings

The UUT, Supply, and Exhaust ports are 1/4 NPT threads on the 3520 low-volume manifold and 1/2 NPT threads on the high-flow manifold. The Pilot, Bleed, and Calibration ports are 1/4 NPT threads. These ports work with all 1/2 and 1/4 NPT fittings and universal 1/2” and 1/4” fittings (for example, swift-fit). Other types of fittings (such as R, G, SAE, Metric) must not be used as these will not seal correctly and will damage the ports. Note that Sciemetric does not provide the Calibration, Supply, Pilot and UUT port fittings. For information about the pneumatic optional accessories, see *Table 10 on page 26*.

**IMPORTANT:** When you replace fittings, be careful to clean out any contaminants (for example, shredded Teflon tape) from the 3520 module ports. Failure to do so may result in valve malfunction, gross leaks, poor repeatability and reproducibility, and contaminated parts. If using thread sealants, observe the recommended curing times before performing any leak tests.

1/2 and 1/4 NPT fittings should be installed finger-tight, plus 1.5 to 3 turns. When installing universal fittings, consult the manufacturer’s installation instructions.

Sciemetric recommends universal 1/2” and 1/4” fittings over NPT fittings. See *Figure 17 on page 48* for an example of a Universal fitting. Universal 1/2” and 1/4” fittings make pressure-tight joints by sealing the manifold against a deformable O-ring or gasket. Universal 1/2” and 1/4” fittings are less likely than NPT fittings to cause thread wear, and thread sealant or Teflon tape is not required. If reinstalling these fittings, replace the O-ring or gasket if it is damaged to ensure a good seal.

**IMPORTANT:** If using elbow fittings, Sciemetric recommends using swivel fittings, because fixed elbows will, typically, not seal at the desired angle. This is particularly true of NPT elbow fittings.

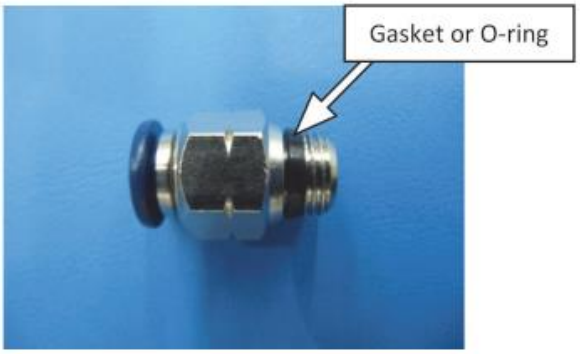



*Figure 17 An example of a Universal fitting (Gasket or O-ring style)*

If you are using NPT fittings, note that NPT fittings use tapered threads to make pressure-tight joints by an interference fit. NPT fittings require thread sealant to fill the voids between male and female threads. Sciemetric recommends the use of thread sealant such as Loctite 567 or Teflon tape. Many NPT fittings include pre-applied sealant as shown in *Figure 18*. Sciemetric recommends adding Teflon tape or thread sealant even if the NPT thread on the fitting was shipped with pre-applied sealant. NPT fittings should be discarded if they have been installed into a manifold more than 5 times.

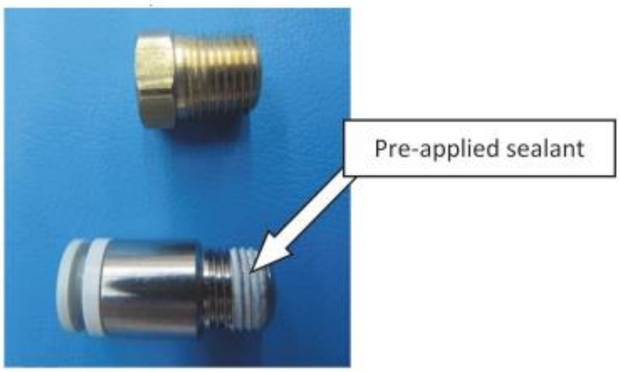



*Figure 18 An example of an NPT fitting*

When you begin to apply Teflon tape to a tapered pipe thread, keep the following points in mind:

- Start the tape back one thread. This method prevents the tape from getting stuck in the valves and contaminating the 3520 module (see *Figure 19*).

- On a right-hand thread (all 3520 ports are right-handed), with the leading edge of the threads facing you, apply the tape in a clockwise direction. This method allows the Teflon tape to remain in place while the fitting is tightened into the right-hand thread port and will not unravel (see *Figure 20*).
- Two turns of Teflon tape are sufficient.

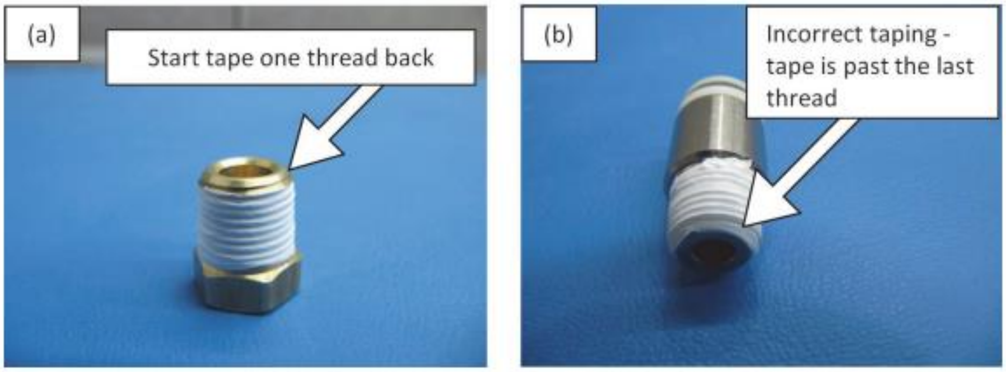



*Figure 19 (a) Correct taping of threads (the start position is one thread back) (b) Incorrect taping of threads (the tape overlaps the end of the fitting)*

*Figure 20 An example of tape correctly applied (clockwise direction) to a right-hand thread*

## 7.3 Connecting power

The 3520 module requires an external 24 VDC (40 W max) power supply. You can use either the AC power supply shipped with the unit (see *Table 7 on page 25* for standard accessories), or you can use your own power supply rated for 24 VDC (22 to 26 VDC) output.

**CAUTION 1**

- If you plan on using a power supply different than the one offered by Sciemetric, ensure that you consult the *"Technical Specifications" on page 81* for all power requirements beforehand.
- The type of external power supply you use must be approved and certified by the authorities in the country where the equipment is installed and used.

**CAUTION 2**

The ground of the power connector of the sigPOD controller and the ground of the power supply of the 3520 module must be at the same potential. Otherwise, ground loops will be created and the 3520 module may not function correctly. Note that the chassis of the 3520 is connected to power ground. The chassis must be electrically isolated through the supplied Vibration mounts to avoid a ground loop.

**CAUTION 3**

The shield of the 3520 electrical connections is connected internally to the ground of the 3520 power supply. When using shielded Ethernet cables, it is possible that a ground loop may be created through the network switch. If this is an issue, use a non-shielded Ethernet connection.

### To connect the 3520 module to power

1. Ensure that all safety requirements have been met. See *"Safety" on page 19*.
2. Ensure that all pneumatics and accessories are connected properly. See *"Connecting pneumatics" on page 44* and *"Connecting accessories" on page 52*.
3. Ensure the 24 V power supply is on, and that the power connector supplied with the 3520 module is wired correctly.
4. Connect the power connector to the Power port on the front panel of the 3520 module. (For location of the Port, see *Figure 2 on page 9*.)

   The Power indicator on the front panel of the 3520 module should light up green as soon as power is established, and all status indicator LEDs will flash a test pattern.

   **Note**: If the power indicator does not light immediately, ensure the power connector is properly and fully threaded.

## 7.4 Connecting to the Leak test controller

Since the 3520 module is an Ethernet-based leak tester, there is no need for direct physical connection to the leak test controller (a sigPOD test and monitoring system or any other Windows-based PC). You can securely connect, operate, diagnose, or update the equipment from any computer on the same network as the 3520 module.

If required, you can place the 3520 module in a close proximity to the controller, and directly connect to it using the Ethernet port on the 3520 front panel. For more information, see the following section.

## 7.5 Connecting to the Ethernet

The Network port of the 3520 Leak Test module allows connection to a 3520 controller. A 3520 controller can be a sigPOD test and monitoring system or any Windows-based PC with an InspeXion software program that supports the 3520 module.

Setting up the Ethernet connection involves connecting the Ethernet hardware to the front panel and then setting up the IP address. Once connected to the controller, the 3520 module can receive test configuration commands, run a leak test, as well as collect and transfer data.

### To connect the 3520 module to the Ethernet

1. Wire the Ethernet cable to the field-wireable Ethernet connector shipped with the module (see *Table 7 on page 25*).

   **Note 1**: If you need a longer cable, Sciemetric offers a 10 m Ethernet cable as an optional accessory (see *Table 9 on page 26*). A variety of third-party molded cable sets are also available (e.g., M12 to RJ45).

   **Note 2**: For information about the pinouts of the Ethernet connector, see *Table 14 on page 42*.

2. Insert the Ethernet connector with cable in the Network port on the front panel of the 3520 module (see *Figure 2 on page 9*).

3. Connect the other end of the Ethernet cable to any computer with an Internet browser.

   ***Note:*** Sciemetric provides an Ethernet switch for use in electrical panels and cabinets as an optional accessory. See *Table 9 on page 26*.

4. Configure the network parameters of the 3520 module on its webpage. See *"Opening the webpage of the 3520 module for the first time" on page 62* and *"Configuring a valid IP address and network name for the 3520 module" on page 65*.

5. When the 3520 network parameters are fully configured, connect the Ethernet cable to the sigPOD controller or to the PC that has the correct InspeXion software for communicating with the 3520 module.

6. Set up the 3520 IP address in the InspeXion System Setup software installed on the 3520 controller. See *"Configuring the 3520 IP address in the InspeXion System Setup" on page 67*.

   ***Note:*** The Network status indicator on the front panel of the 3520 module should start flashing green when the 3520 Module is ready to receive a connection from a controller. When the light turns solid green, the 3520 module is fully connected to the controller. For explanation of the colors of the Network status indicator, see *Table 16* that follows.

***Table 16*** *Network status indicator - color code*

| Color of the indicator | Meaning |
|---|---|
| Solid green | The 3520 OPC UA server is connected to an OPC UA client (leak test controller) |
| Flashing green | The 3520 OPC UA server has started and is waiting for an OPC UA client (leak test controller) to respond |
| Solid orange | The 3520 operating system has started and is waiting for the 3520 OPC UA server to start |
| Flashing orange | The 3520 operating system is booting up |
| Flashing red | The 3520 firmware is being updated or a power cycle delay is in progress |

## 7.6 Connecting accessories

You can increase the efficiency and accuracy of your leak testing by connecting any of the following optional accessories:

- External valves - through the Digital Outputs port
- A temperature sensor to measure the temperature of the ambient air - through the Aux in 2 port
- A temperature sensor to measure the temperature of the UUT - through the Aux in 1 port

See *Table 10 on page 26* and *Table 8 on page 25* for description of the pneumatic accessories and temperature sensors you can purchase from Sciemetric. See *Figure 7 on page 24* and *Figure 4 on page 11* for a visual of all mandatory and optional accessories.

**IMPORTANT**

When you receive the 3520 module, the auxiliary connectors are covered with protective caps. These caps are required to maintain the IP ratings of the 3520 module. Do not remove the caps unless you are using the auxiliary ports and have the appropriate accessory connected.

### *7.6.1 Connecting external multiplexer valve control to 3520 B*

Before you connect the 10500-3520-MB32 multiplexer valve accessory to the 3520 B module, ensure that the following requirements are met.

**Requirements:**

- The firmware version on the 3520 B module must be 1.128 or later. To check the firmware version on your 3520 B module, review the Unit Details table on the Information tab of its webpage. See *"To*

*view 3520 system information" on page 68*. If you need to upd
*module" on page 72*.

- The pressure in the 10500-3520-MB32 must be less than 50 ps

**CAUTION**

10500-3520-MB32 has a maximum operating
supply pressure for the 3520 leak test modul

- Ensure you have the cable that was shipped with the multiplex the Digital Outputs port of 3520 B module.
- Ensure, you have the appropriate pneumatic fittings for conne
  - The 3520 B UUT port (1/4 NPT) at one end and the Comm the other end.
  - Hoses to the multiplexer UUT1 and UUT2 ports
  - Exhaust hoses from the multiplexer exhaust ports (1/8 N

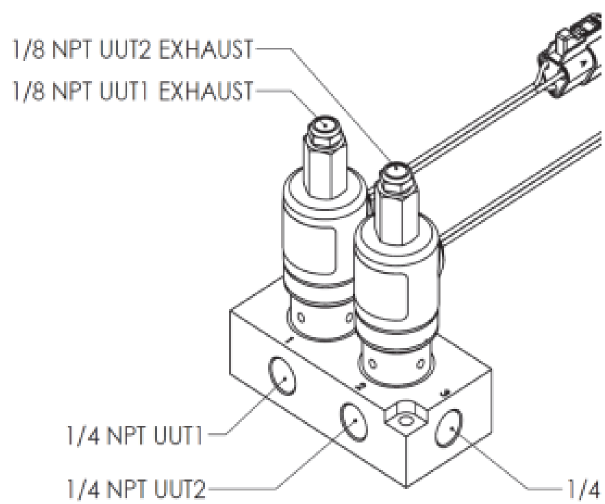



*Figure 21 10500-3520-MB32 ports*

### To connect an external multiplexer valve unit (10500-35

1. Remove the protective plastic cap from the Digital Outputs po 3520 B module.
2. Remove the dust caps from the multiplexer ports.
3. Connect one end of the multiplexer cable to the 3520 Digital C
4. Connect the two cable ends to the latching valves by matching

5. Connect the UUT port of the 3520 B module to the Common port of the external multiplexer using appropriate pneumatic fittings.
6. Connect the UUT1 and UUT2 ports of the multiplexer to the parts to be tested using appropriate pneumatic fittings.
7. If you want to route the exhaust gas from the multiplexer, remove the silencers from the Exhaust ports of the multiplexer, and install the appropriate pneumatic fittings.

**IMPORTANT**

Once you connect the 10500-3520-MB32 multiplexer, you need to alter the leak test sequence to include the commands to toggle the multiplexer valves. See *Table 2 on page 13* for a list of the available commands.

### *7.6.2 Connecting external multiplexer valve control to 3520 C*

Before you connect any of the multiplexer valve accessories to the 3520 C module, ensure that the following requirements are met.

**Requirements:**

- Ensure you have the connection cable that was shipped with the multiplexer
- Ensure, you have the appropriate pneumatic fittings for connecting the following:
  - the 1/4 NPT Pilot port of 3520 C to the #10-32 Pilot port of the multiplexer.
  - the multiplexer external valves (UUT1 to UUT4)
  - the 1/2 NPT Common port of the multiplexer to the 1/2 NPT UUT port of the 3520 C module
- If you are connecting the 10500-3520-MPXR as a Normally Open (NO) external valve unit, ensure the valve conversion has been done. See *"Converting the Normally Closed (NC) valves in the 10500-3520-MPXR multiplexer to Normally Open (NO) valves" on page 57*.
- If you don't plan to route exhaust gas through the multiplexer Exhaust port, Sciemetric recommends installing the silencer that was shipped with the multiplexer
- It is recommended you have plugs for any UUT ports (1/2NPT) that you are not planning to use
- The pilot pressure must be a min of 30 psig.

**IMPORTANT**

The pilot pressure requirements for the 3520 Model C multiplexer valve accessories are the same as the pilot pressure requirement for the 3520 leak test module, Model C. See *Table 15 on page 46*.

## To connect an external multiplexer valve unit to 3520 C

1. Remove the protective plastic cap from the Digital Outputs port connector on the front panel of the 3520 C module.
2. Remove the dust caps from multiplexer ports you are going to use.
3. Connect one end of the multiplexer cable to the 3520 Digital Outputs port and the other ends to the UUT ports of the external multiplexer. For location of the ports, see as follows:
   - For 10500-3520-MPXR, see *Figure 22 on page 55*
   - For 10500-3520-MC34, see *Figure 23 on page 56*
   - For 10500-3520-MC32, see *Figure 24 on page 56*
   - For 10500-3520-MC31, see *Figure 25 on page 56*
4. Connect the Pilot port of the 3520 C module to the Pilot port of the multiplexer using appropriate pneumatic fittings. For location of the Pilot port in each multiplexer, see the appropriate graphic as listed in the previous step.
5. Connect the Common port of the multiplexer to the UUT port of the 3520 C module. For location of the Common port in each multiplexer, see the appropriate graphic as listed in step 3.
6. If you don't want to route the exhaust gas, install the silencer on the Exhaust port of the multiplexer; otherwise, install the appropriate pneumatic fittings for the exhaust hoses.

   **Note:** Each multiplexer was shipped with a silencer for the Exhaust port.
7. Connect as many UUT ports as required by your test setup.

   **Note:** It is recommended that you install a plug on each port that is not in use.

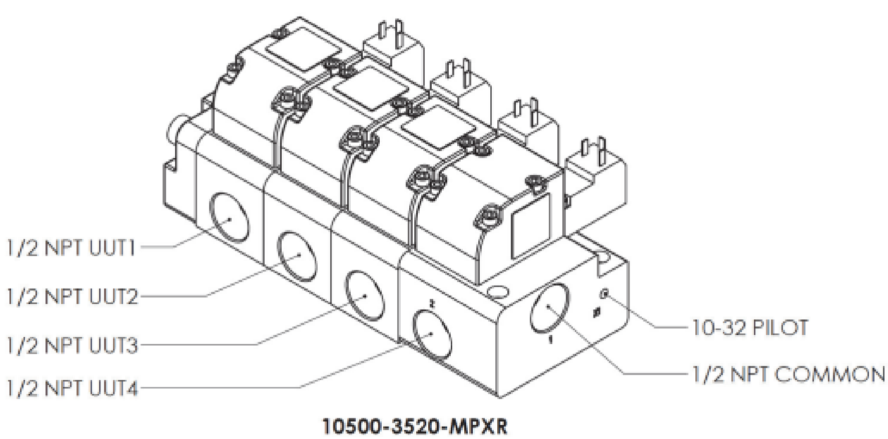



*Figure 22 10500-3520-MPXR ports*

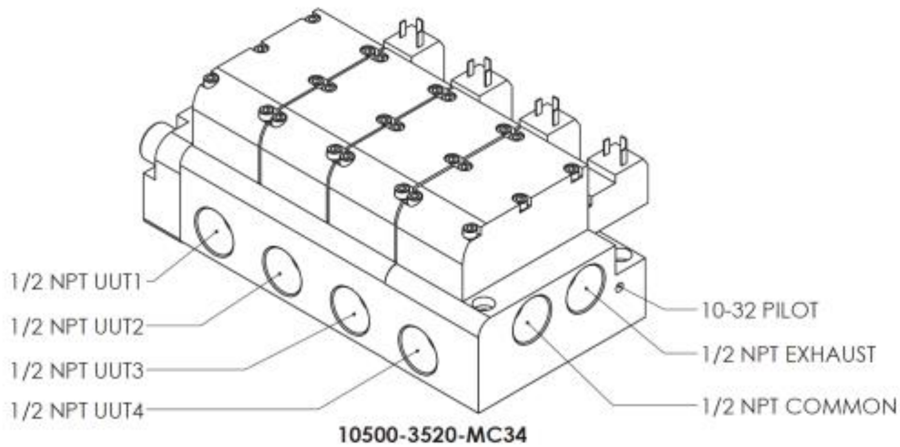



*Figure 23 10500-3520-MC34 ports*

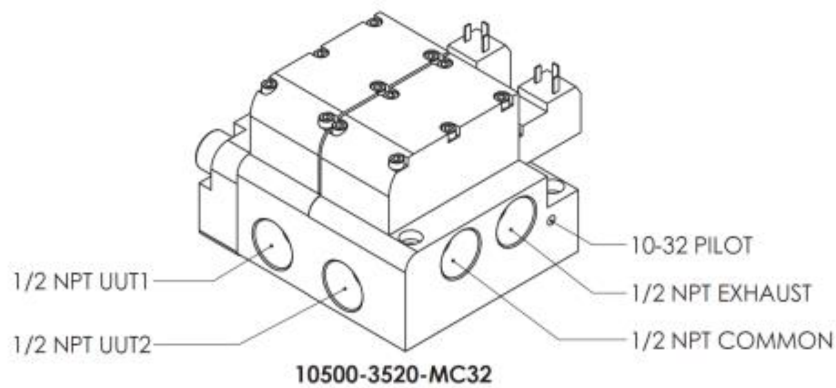



*Figure 24 10500-3520-MC32 ports*

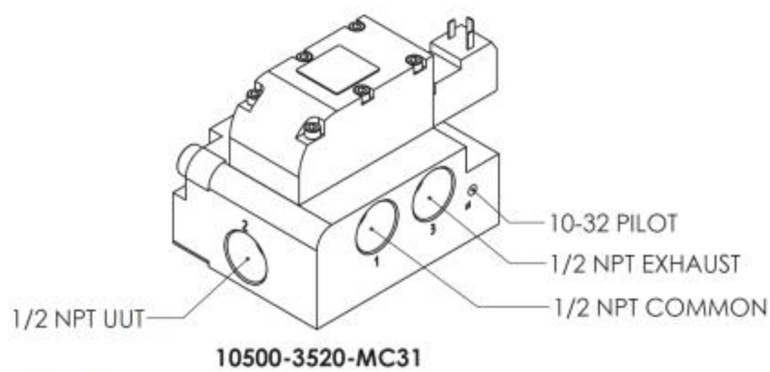



*Figure 25 10500-3520-MC31 ports*

### *7.6.2.1 Converting the Normally Closed (NC) valves in the 10500-3520-MPXR multiplexer to Normally Open (NO) valves*

You can convert any of the air-piloted valves in the 10500-3520-MPXR multiplexer valve accessory to normally open (NO) operation by replacing the normally closed (NC) solenoids that control the valves with the spare NO solenoids shipped with the 10500-3520-MPXR.

**Required tools and parts:**

- No 1 Phillips screw driver
- For each air-piloted valve to be converted, the following parts from the solenoid replacement kit: two bolts, a rubber seal, NO adapter, and NO solenoid. See *Figure 27 on page 59*. For a list of all parts in the kit, see the 10500-3520-MPXR row in *Table 10 on page 26*.

#### To convert the multiplexer NC valves to NO valves

1. On the multiplexer valve unit, locate the air-piloted valve that you want to convert to NO operation (see *Figure 26*).
2. Using a No 1 Phillips screw driver, undo the bolt attaching the connector to the NC solenoid that controls the valve, and put the bolt and connector aside See *Figure 26*.
3. Undo the two bolts attaching the NC solenoid to the air-piloted valve, and discard them. Set the solenoid aside. See *Figure 26*.
4. Ensure that the existing rubber seal under the solenoid is in place. See *Figure 27*.
5. Take the NO adapter from the solenoid replacement kit, and position on top of the existing seal, in the orientation shown in *Figure 27*. The balled holes of the adapter should be aligned with those on the air-piloted valve.
6. Install the new seal on top of the NO adapter. See *Figure 27*.
7. Position the new NO solenoid on top of the NO adapter by aligning the screw holes with those of the adapter.
8. Insert the new bolts into the NO solenoid, and screw it in place by tightening to approximately 12 in-lb.
9. Repeat steps 1 through 8 for any of the other three air-piloted valves, if required.

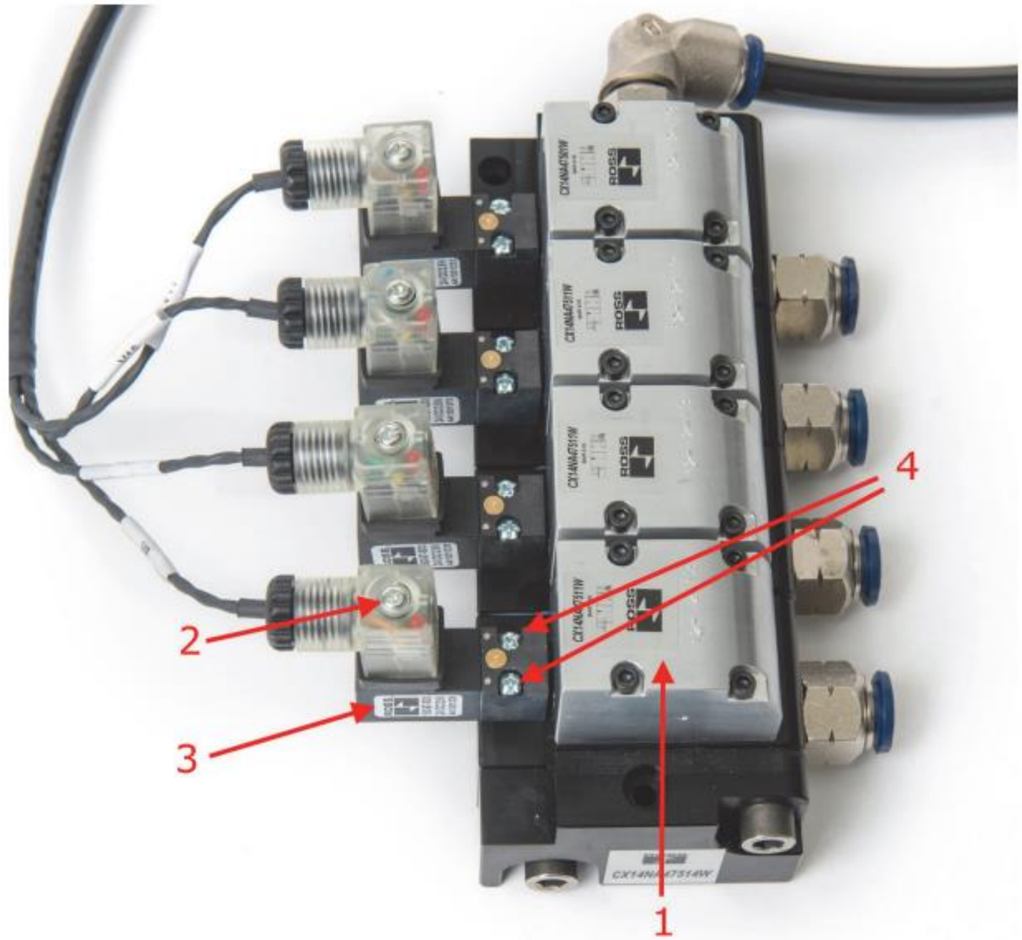



*Figure 26 10500-3520-MPXR multiplexer parts identified for NC solenoid replacement: 1. Air-piloted valve; 2. Bolt through the connector and NC solenoid; 3. NC solenoid; 4. bolts connecting the NC solenoid to the air-piloted valve*

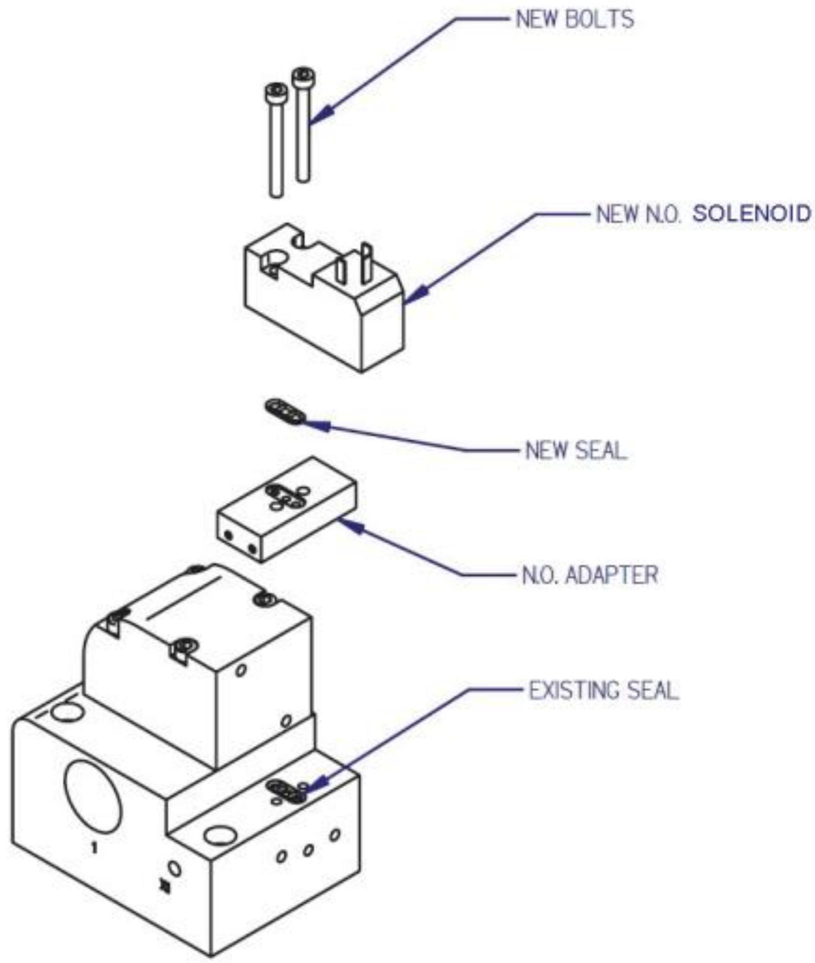



*Figure 27 Assembly of the new NO solenoid*

### 7.6.3 Connecting temperature sensors

The 3520 module has two channels for high accuracy temperature input (100 Ω Platinum RTD with temperature reading noise of 0.001 °C rms). You can either purchase the optional temperature sensors from Sciemetric (see *Table 8 on page 25*), or provide your own. If you use sensors that are not supplied by Sciemetric, ensure they meet the Temperature Input requirements as outlined in the *"Technical Specifications" on page 81*.

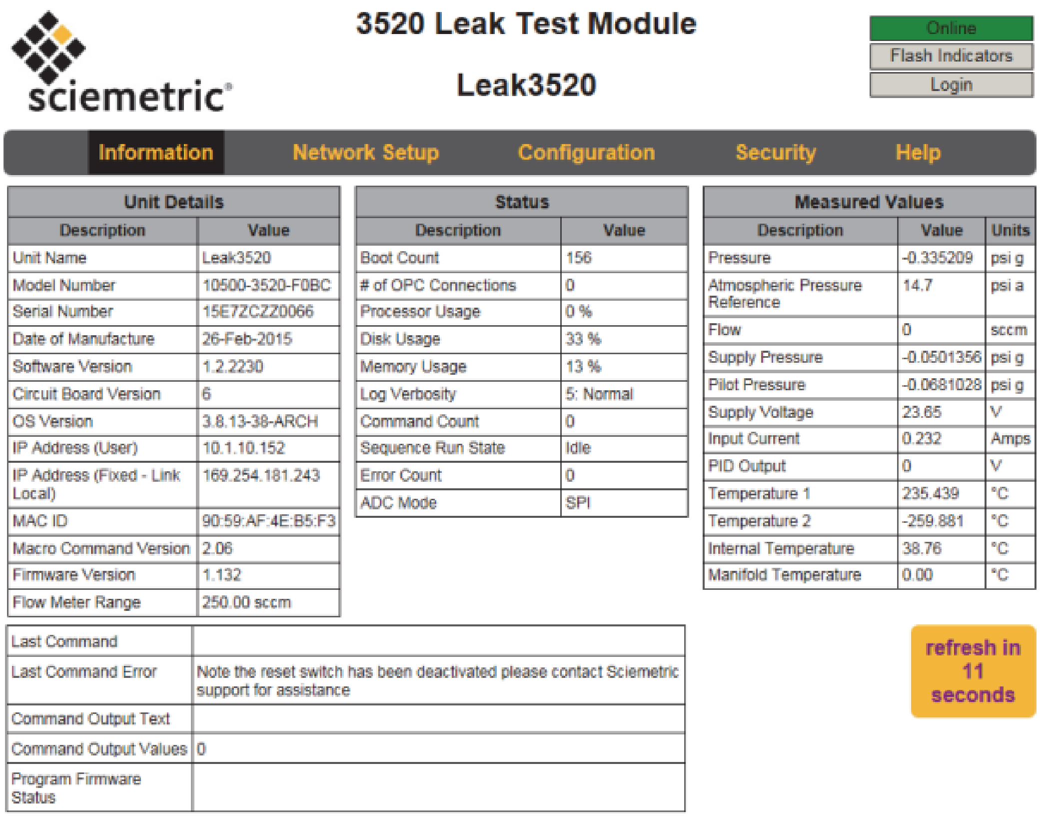
#### To connect optional temperature sensors

1. Remove the protective plastic caps from the Aux in 1 and Aux in 2 ports on the front panel of the 3520 model.
2. Connect one end of a RTD cable to the Aux in 1 port and the other end to the air temperature sensor.
3. Connect one end of a RTD cable to the Aux in 2 port and the other end to the part temperature sensor.

# 8.0 Configuring, monitoring, and updating the 3520 module

Configuring the 3520 Leak Test module involves setting up the 3520 IP address and name on the 3520 webpage and setting up the IP address in the InspeXion System Setup application. The webpage of each 3520 module allows you to monitor all important statistics of the module related to performance, properties, and configured values. The webpage also allows you to update the software of the module.

**Note:** The 3520 webpage can be viewed with an Internet browser, but not all the functionality of the webpage is supported by all browsers.




| Unit Details | |
|---|---|
| Description | Value |
| Unit Name | Leak3520 |
| Model Number | 10500-3520-F0BC |
| Serial Number | 15E7ZCZZ0066 |
| Date of Manufacture | 26-Feb-2015 |
| Software Version | 1.2.2230 |
| Circuit Board Version | 6 |
| OS Version | 3.8.13-38-ARCH |
| IP Address (User) | 10.1.10.152 |
| IP Address (Fixed - Link Local) | 169.254.181.243 |
| MAC ID | 90:59:AF:4E:B5:F3 |
| Macro Command Version | 2.06 |
| Firmware Version | 1.132 |
| Flow Meter Range | 250.00 sccm |

| Status | |
|---|---|
| Description | Value |
| Boot Count | 156 |
| # of OPC Connections | 0 |
| Processor Usage | 0 % |
| Disk Usage | 33 % |
| Memory Usage | 13 % |
| Log Verbosity | 5: Normal |
| Command Count | 0 |
| Sequence Run State | Idle |
| Error Count | 0 |
| ADC Mode | SPI |

| Measured Values | | |
|---|---|---|
| Description | Value | Units |
| Pressure | -0.335209 | psi g |
| Atmospheric Pressure Reference | 14.7 | psi a |
| Flow | 0 | sccm |
| Supply Pressure | -0.0501356 | psi g |
| Pilot Pressure | -0.0681028 | psi g |
| Supply Voltage | 23.65 | V |
| Input Current | 0.232 | Amps |
| PID Output | 0 | V |
| Temperature 1 | 235.439 | °C |
| Temperature 2 | -259.881 | °C |
| Internal Temperature | 38.76 | °C |
| Manifold Temperature | 0.00 | °C |

| | |
|---|---|
| Last Command | |
| Last Command Error | Note the reset switch has been deactivated please contact Sciemetric support for assistance |
| Command Output Text | |
| Command Output Values | 0 |
| Program Firmware Status | |

*Figure 28 Example of the 3520 webpage, Information tab*

## 8.1 Configuring the 3520 module

Configuring the 3520 module involves three steps:

1. Accessing its webpage. You can use any computer on your network and an Internet connection is not required. See *"Opening the webpage of the 3520 module for the first time" on page 62*.
2. Configuring a valid IP address for your network and a unique name for the 3520 module. See *"Configuring a valid IP address and network name for the 3520 module" on page 65*. You can also change the default password for access to the network, configuration, and security settings. See *"Logging in and out of the 3520 webpage" on page 63*, and *"Changing the default password for the 3520 module" on page 64*.
3. Specifying the module IP address in the InspeXion System Setup application so that the sigPOD or PC controller can communicate with the 3520 module. See *"Configuring the 3520 IP address in the InspeXion System Setup" on page 67*.

### *8.1.1 Opening the webpage of the 3520 module for the first time*

You can open the webpage of a 3520 module for the first time by connecting the module to any laptop or PC and entering the default IP address (Link-local address) in an Internet browser. A Link-local address is valid only with direct connections and will not typically work over a router/switch. A Link-local IP address starts with the values 169.254 and is a special address that does not require network setup to create a connection between computers. The 3520 unit has both a fixed Link-local IP address and a user-settable IP address. The Link-local address allows easy connection without complex network setup. The last two digits of the Link-local address are the last two digits of the MAC address of the 3520 module.

**Requirements**

To perform this procedure, ensure you have the following:

- A PC with an Internet browser

  **Note:** Live Internet connection is not required. Only a browser.
- The Default IP address located on the production label of the 3520 module. The production label is the white sticker on the right side of the module.

#### To open the webpage of the 3520 module for the first time

1. Connect the Ethernet port of your 3520 module to the LAN port of a PC.
2. On the PC, open an Internet browser, and enter the Default IP address of the 3520 module as it appears on the production label of the module.

   The webpage of the 3520 module opens.

### 8.1.2 Logging in and out of the 3520 webpage

You can change any of the network, configuration, or security settings on the 3520 webpage only if you are logged in. Without a password login, you have read-only access to the **Information**, **Network Setup**, and **Help** tabs.

#### To login to the 3520 webpage

1. Open the webpage of the 3520 module.

   By default, the webpage opens onto the **Information** tab (see *Figure 28 on page 61*).

   **Note**: If you have not setup a valid IP address for the module yet and don't know how to open the webpage, see *"Opening the webpage of the 3520 module for the first time" on page 62*. Otherwise, enter its IP address in an Internet browser on the 3520 controller (a windows-based PC or sigPOD).
2. If you have more than one module connected to the 3520 controller, click **Flash Indicators** in the top-right of the 3520 webpage to ensure you will login to the correct 3520 module.

   All LEDs on the front panel of the connected 3520 module will flash 5 times in approximately 5 seconds.
3. Click **Login** in the top-right of the 3520 webpage.
4. In the **User name** box, type "user".
5. In the **Password** box, enter the default password "sciemetric," or the current password if you have already changed the default.
6. Click OK.

   The **Login** button changes to **Logout user**, indicating that you are currently logged in.

   ***Note:*** For information about setting up a custom password, see *"To change the default password for the 3520 module" on page 64*

#### To log out of the 3520 webpage

1. Click **Logout user** in the top-right of the 3520 webpage.
2. Click **OK** in the confirmation dialog box.

   ***Note:*** You must close the browser to fully log out of the 3520 webpage.

### *8.1.3 Changing the default password for the 3520 module*

You can set up, edit, save, or update a configuration for a 3520 module only if you are logged in with a valid password. The 3520 module comes from the factory with a default password which can be changed on the **Security** tab of the 3520 webpage (see *Figure 29 on page 65*).

**Note 1:** To reset the password to the default factory password (“sciemetric”), ensure the 3520 module is not running a leak test sequence. Then, press the **Reset** button, located between the Power and Network ports, on the front panel of the module, and hold for more than three seconds. All indicators on the front panel will blink five times, indicating the that password has been reset. The Reset password function is ignored when the module is running a test sequence.

**Note 2:** Do not push the **Reset** button using a tool or a sharp object, because you might accidentally pierce the assembly, which in turn will violate the IP rating of the 3520 module.

#### To change the default password for the 3520 module

1. Open the webpage of the 3520 module.

   By default, the webpage opens onto the **Information** tab.

   **Note**: If you have not setup a valid IP address for the module yet and don’t know how to open the webpage, see *"Opening the webpage of the 3520 module for the first time" on page 62*. Otherwise, enter its IP address in an Internet browser on the 3520 controller (a windows-based PC or sigPOD).
2. Click **Login** in the top-right of the 3520 webpage.
3. In the **User name** box, type “user”.
4. In the **Password** box, type “sciemetric”.
5. Click the **Security** tab.
6. Enter a password in the **New Password** box.
7. Re-enter the password in the **Confirm New Password** box.
8. Click **Change** to save the new password.

   ***Note:*** The password change will take effect when you click **Logout user** in the top-right of the 3520 webpage, and restart the browser.

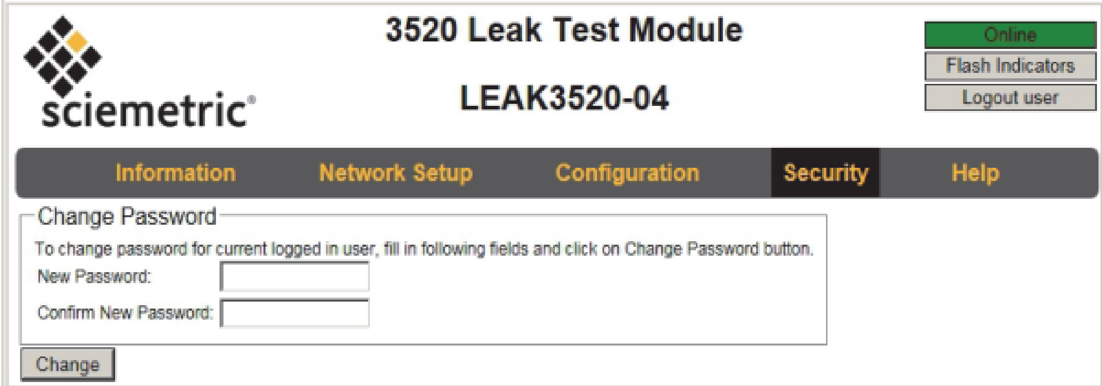



*Figure 29 Example of the 3520 webpage, Security tab*

## 8.1.4 Configuring a valid IP address and network name for the 3520 module

You can configure valid IP address settings and network name for a 3520 module on the **Network Setup** tab of its webpage.

**Requirements:**

- If the default password has been changed, you must know the new password to access the 3520 configuration settings. See *"Changing the default password for the 3520 module" on page 64* for information about resetting the module to the default password, if necessary.
- Before you can start the network setup of the 3520 module, you must have obtained an approved IP address, default gateway, and a DNS server (if applicable) for the module from your IT department. The IP address must be of the IPV4 type.

### To set the IP address and network name of the 3520 module

1. Open the webpage of the 3520 module using its Default IP address (Link-local address). See *"To open the webpage of the 3520 module for the first time" on page 62*.

   The webpage opens to the **Information** tab (see *Figure 28 on page 61*). The green **Online** indicator in the top-right of the webpage indicates that the module is on the local network.
2. Login into the 3520 webpage. See *"Logging in and out of the 3520 webpage" on page 63*.
3. Click the **Network Setup** tab.
4. In the **IP address** area of the page, enter the IP address, and Subnet mask, and Default Gateway values (see *Figure 30 on page 66*).
5. In the **DNS server** area, enter values for the preferred and alternate DNS servers.

   **Note 1:** If you don't have a DNS server, you can use a public DNS server. For example, you can use Google Public DNS severs 8.8.8.8 or 8.8.4.4.

   **Note 2:** If you have a DNS server, but you want to disable it, type 0.0.0.0 in the **DNS server** boxes.
6. In the **Unit Name** box, enter a unique name for the 3520 module; for example, *OilLeakTest02*.

***Note:*** In specifying the unit name, follow the **RFC1123** Internet standard for valid host names. Namely, the name may contain only the ASCII letters 'a' through 'z' (in a case-insensitive manner), the digits '0' through '9', dots (.) and the hyphen ('-'). No other symbols, punctuation characters, or white spaces are permitted. Also, the maximum number of characters allowed between dots is 63, and the maximum length of the entire name is 255 characters.

7. Click **OK** to save the network settings.

   **Note:** If a "Warning, Gateway is not a subnet" message appears, do not proceed with saving the network settings. Instead, type new values in the **Default Gateway** boxes. The default gateway must be on the same subnet as the IP address.

8. On the **Save Changes** page, click **Save**.

   **Note:** If you don't want to save the entered values, click **Cancel** or click any other tab of the 3520 webpage. When you cancel the changes, the **Network Setup** tab displays the factory settings or the last saved settings (if you have already changed the factory settings).

9. On the **Reboot to Apply Changes** page, do one of the following:
   - Click **Reboot Now**, and see step 10.
   - Click **Reboot Later**, and reboot the computer at a later point to complete the network setup.

10. In the reboot confirmation dialog box, click **OK**.

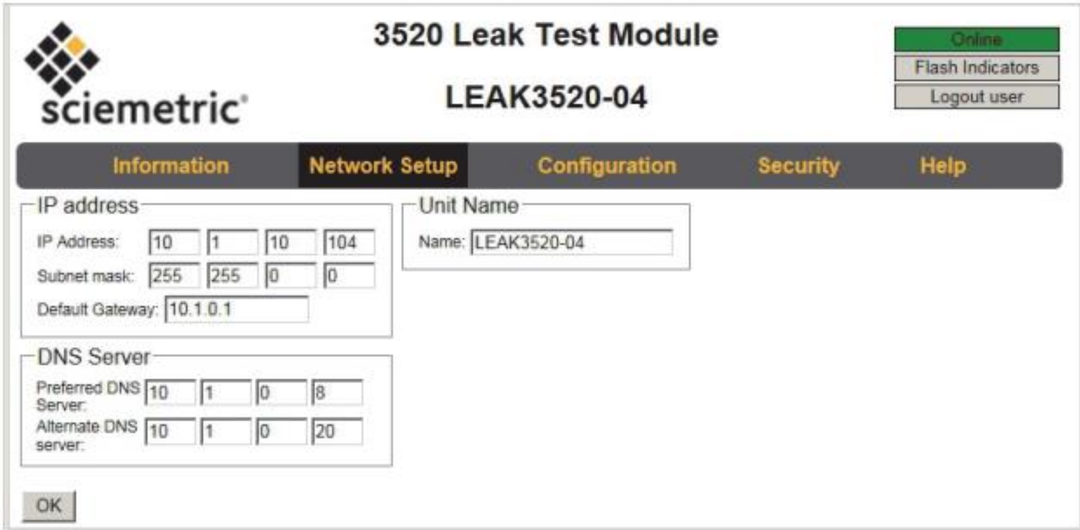



*Figure 30 Example of the 3520 webpage, Network Setup tab*

### 8.1.5 Configuring the 3520 IP address in the InspeXion System Setup

After you configure a 3520 module with a valid IP address and name, you must register this IP address with the InspeXion System Setup application on the 3520 controller (a windows-based PC or sigPOD), so that the controller can find the 3520 module on the network.

**IMPORTANT:** If you change the IP address of the 3520 module after you complete this procedure, you must repeat the InspeXion System Setup procedure with the new IP address. In other words, every time a new IP address is configured on the webpage of a 3520 module, that IP address must be registered with the InspeXion System Setup on the 3520 controller.

**Requirement**

- Ensure a valid IP address and name for the 3520 module have been configured on the **Network Setup** tab of its webpage. See *"Configuring a valid IP address and network name for the 3520 module" on page 65*. You can view the current IP address and name for the 3520 module on the **Information** tab of its webpage next to **IP Address (User)** and **Unit Name**.

#### To configure the 3520 IP address in the InspeXion System Setup

**1.** Open the InspeXion System Setup application by doing one of the following:
   - On a sigPOD, click the **Setup** button in the **InspeXion Shell** toolbar which comes up when you power up the sigPOD.
   - On a regular PC, click the **Start** button, point to **All Programs**, and click **Sciemetric**, **System Setup**.

**2.** On the navigation bar of the **System Setup** screen, click the plus sign next to **Hardware** to display all **Hardware** options (see *Figure 31 on page 68*).

**3.** Click **OPC UA** under **Hardware** to display a list of the 3520 modules connected to the controller.

**4.** Under **Device Info**, click the arrow next to the name of the module you are configuring.

   The relevant information about the module will appear as follows:
   - **Enabled** box - **True**.

   **Note**: If the value is not **True**, open the drop-down list and select **True.**
   - **Server** box - it will either be empty or with the default **opc.tcp://10.1.10.100:4842** address.

**5.** In the **Server** box, replace **10.1.10.100** with the 3520 module IP address you have set up for the module (See *"Configuring a valid IP address and network name for the 3520 module" on page 65*).

   For example, if the IP address of the 3520 module is 10.1.10.125, the value in the **Server** box should appear as **opc.tcp://10.1.10.125:4842.**

   **Note:** If the **Server** box is empty, type **opc.tcp://xx.x.xx.xxx:4842** where **xx.x.xx.xxx** is the IP address you have set up for the module.

**6.** In the bottom-left corner of the screen, click the **Save** button to save the current configuration.

**7.** In the bottom-left corner of the screen, click the **Exit** button to close the **System Setup** screen.

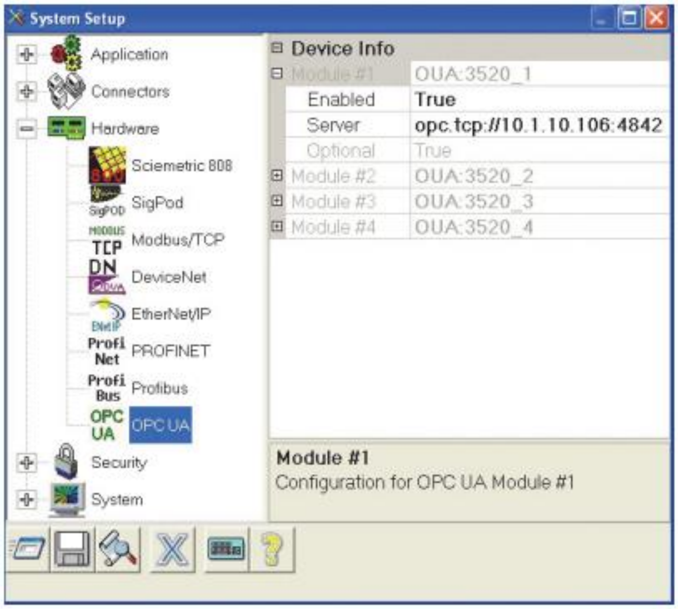



*Figure 31 Example of the InspeXion System Setup Screen*

## 8.2 Monitoring the 3520 module

The **Information** tab of the 3520 webpage (see *Figure 28 on page 61*) displays not only static information such as unit name, model and serial number, software version, and default IP address, but it also displays system performance and diagnostic parameters such as processor, disk and memory usage, command, error, and boot count, last command and last command error, and more.

### To view 3520 system information

1. Open the webpage of the 3520 module by typing its IP address in an Internet browser on the 3520 controller PC or sigPOD.

   By default, the webpage opens onto the **Information** tab.

   **Note**: You can also open the webpage of the 3520 module through the InspeXion software application that supports the 3520 module. See the User Guide of this application for details.
2. If you have more than one module connected to the controller, click **Flash Indicators** in the top-right of the 3520 webpage to ensure you are monitoring the correct 3520 module.

   All LEDs on the front panel of the connected module will flash.
3. Review system and performance related information in the **Unit Details**, **Status,** and **Measured Values** sections of the **Information** tab. See *Table 17*, *Table 18*, and *Table 19* for explanation of the parameters.

***Table 17*** *3520 webpage, Information tab, Unit Details section*

| Parameter | Description |
|---|---|
| **Unit Name** | Unique identifier for the 3520 leak module; You must define the Unit Name on the Network Setup tab of the 3520 webpage. |
| **Model Number** | The model number of the 3520 module as it appears on the production label of the module* |
| **Serial Number** | The serial number of the 3520 module as it appears on the production label of the module* |
| **Date of Manufacture** | The date the module was manufactured |
| **Software Version** | The version of the 3520 software |
| **Circuit Board Version** | The version of the circuit board hardware |
| **OS Version** | The version of the installed operating system |
| **IP Address (User)** | The IP address that is provided by your network administrator and that you have subsequently saved on the Network Setup tab of the 3520 webpage. This IP address must be entered in the InspeXion System Setup application as well. |
| **IP Address (Fixed - Link Local)** | The Link Local IP address as it appears on the production label of the module*. For use with direct network connections between the 3520 module and the its controller. |
| **MAC ID** | The MAC ID (Media Access Control address) of the 3520 Network port. It also appears on the production label of the module* |
| **Macro Command Version** | The version of the 3520 macro command file |
| **Firmware Version** | The version of the embedded firmware |
| **Flow Sensor Range** | The selected flow sensor range value, in the specified modules |
| **Last Command** | The last OPC command issued to the 3520 module |
| **Last Command Error** | Error text (if any) generated by the last OPC command |
| **Command Output Text** | Output text generated by the last OPC command |
| **Command Output Values** | A list of values generated by the last OPC command |
| **Program Firmware Status** | The progress of the firmware upgrade |

***Note*** *The production label is the white sticker that appears on the right side of the module.

***Table 18*** *3520 webpage, Information tab, Status section*

| Parameter | Description |
|---|---|
| **Boot Count** | Number of times the OPC server application has been initialized |
| **# of OPC Connections** | The number of OPC clients currently connected to the OPC server application |
| **Processor Usage** | CPU usage |
| **Disk Usage** | Hard disk usage |
| **Memory Usage** | RAM usage |
| **Log Verbosity** | The verbosity of the 3520 application log.<br>The list of verbosity (severity) levels is as follows:<br>0 Emergency: System is unusable<br>1 Alert: Action must be taken immediately<br>2 Critical: Critical conditions<br>3 Error: Error conditions<br>4 Warning: Warning conditions<br>5: Notice: Normal but significant condition (default)<br>6 Informational: Informational messages<br>7 Debug: debug-level messages |
| **Command Count** | Total number of OPC commands that were executed in the current session |
| **Sequence Run State** | The status of the last test sequence:<br>0: Idle<br>1: Running<br>2: Completed<br>3: Fault Occurred<br>4: Aborted |
| **Error Count** | The total number of errors in the error buffer. This number is reset each time the system is restarted. |
| **ADC Mode** | Analog to Digital Collection mode: either RS-232 (legacy) or SPI. Circuit Board versions 5 and higher support SPI mode. |

*Table 19 3520 webpage, Information tab, Measured value section*

| Parameter | Description |
|---|---|
| **Pressure** | Live reading of the Test Pressure sensor |
| **Atmospheric Pressure Reference** | Current estimate of the atmospheric pressure, updated by reading the Test Pressure sensor at the beginning of each test cycle |
| **Flow** | Live reading of the Flow meter (if present) |
| **Supply Pressure** | Live reading of the Supply Pressure sensor |
| **Pilot Pressure** | Live reading of the Pilot Pressure sensor (in C Models) or the Regulator Output sensor (in B Models) |
| **Supply Voltage** | Live reading of the power supply voltage to the 3520 module |
| **Input Current** | Live value of the input current drawn by the 3520 module |
| **PID Output** | Live value of the output of the PID (Proportional-Integral-Derivative) controller in the 3520 module |
| **Temperature 1** | Live reading of the Temperature sensor connected to Aux in 1 port on the 3520 front panel |
| **Temperature 2** | Live reading of the Temperature sensor connected to Aux in 2 port on the 3520 front panel |
| **Internal Temperature** | The temperature of the Printed Circuit Board (PCB) located near the Supply Pressure sensor |
| **Manifold Temperature** | The temperature of the 3520 manifold (B Models only) |

## 8.3 Updating the 3520 module

You can install updates to a 3520 module on the **Configuration** tab of its webpage (see *Figure 32 on page 73*). The updates include the software, the firmware, the macro commands, and the OS patches.

**Requirement**

- Before you start this procedure, ensure you have already downloaded the system update file (*.lbk file) from the Sciemetric Support Center at *http://support.sciemetric.com*.

### To update the 3520 module

1. Open the webpage of the 3520 module by typing its IP address in an Internet browser on the 3520 controller PC or sigPOD.

   By default, the webpage opens onto the **Information** tab.

   **Note**: You can also open the webpage of the 3520 module through the InspeXion software application that supports the 3520 module. See the User Guide of this application for details.
2. Login to the 3520 webpage. See *"Logging in and out of the 3520 webpage" on page 63*.
3. Click the **Configuration** tab.
4. In the **Update 3520 Leak Tester** area, click **Browse**.
5. In the **Choose File to Upload** dialog box, navigate to the folder that contains the system update file (*.lbk), and click **Open**.
6. In the **Configuration** tab of the 3520 webpage, click **Upload**.
7. On the confirmation page, click **Apply**.

   The module automatically goes offline and a notification page informs you of the progress of the update. As soon as the update is complete, the module goes back online.

   **IMPORTANT**

   Depending on your 3520 setup, the update can take some time.

   - Do not interrupt the process until you get a confirmation message that the update is complete.
   - Do not cycle power during the update process.
8. When the update is complete, do one of the following:
   - Click **Reboot Now**, and see step 9.
   - Click **Reboot Later**, and restart the computer at a later point to complete the module update.
9. In the confirmation dialog box, click **OK**.

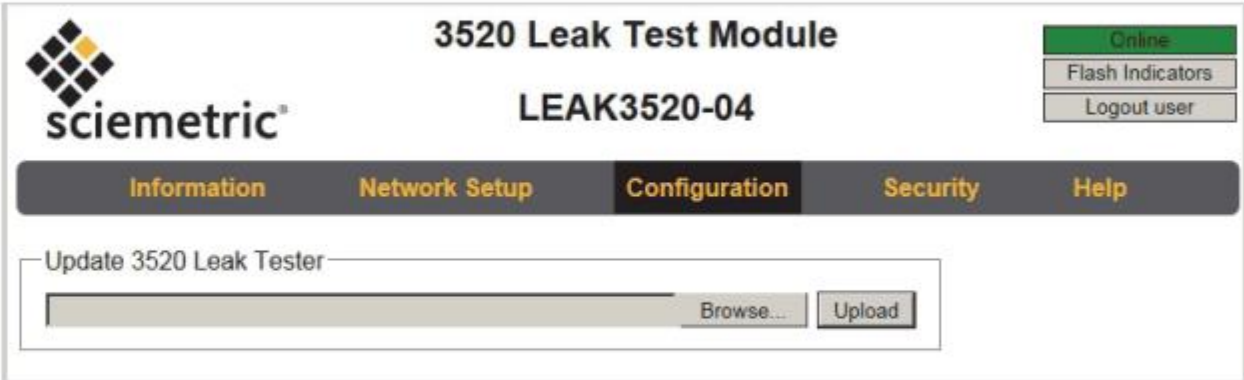



*Figure 32 Example of the 3520 webpage, Configuration tab*

# 9.0 Running leak testing

Before you run any leak testing, ensure that you have performed the required hardware and software setup procedures:

- The correct test pressure for the test configuration has been set
- The correct part is attached to the Unit Under Test port
- If necessary, the correct calibration device is attached to the Calibration port
- A compressed air source, prepared according to the instructions in the *"Connecting the Supply and Pilot air" on page 44*, is connected to the Supply and Pilot ports of the 3520 module.
- All connections to the unit are setup properly. See *"Connecting the 3520 Leak Test module" on page 39*.
- The leak tester configuration and sensor calibration procedures have been performed. See the User Guide of the InspeXion application software that supports the 3520 module.

## 9.1 Pressure decay test calibration to report units in sccm

In a flow-based leak test, the leak rate is measured directly by a flow meter as the volume of total gas leakage out of the part in flow units (for example, sccm, standard cubic centimeters per minute). In a pressure decay leak test, by contrast, a pressure sensor monitors the pressure drop as the air leaks out. The leak rate can then be calculated based on the change of pressure over certain period of time, and is available as a psi /s value (pound-force per square inch per second). If you want the value in flow units, you a need a conversion formula. To facilitate calibration, the 3520 has an integral valve that can switch the calibration port into the pneumatic circuit. With a calibrated flow standard (for example, 10500-3520-CL00) connected to the calibration port, the 3520 module can perform an extended pressure decay calibration sequence. The calibration sequence measures the leak rate with and without a calibration orifice, and then calculates the necessary conversion constants to convert pressure decay rates to leak rates.

For instructions how to calibrate a leak test for reporting pressure decay in flow units, see the User Guide of the InspeXion application software that supports the 3520 module. You can perform this calibration every six months, or every shift, or as desired.

# 10.0 Service and maintenance

Regular service and maintenance of the 3520 module ensures safe and fault-free functioning of the equipment, minimal downtime, and accuracy of the leak test results. Review the summary of 3520 maintenance tasks recommended by Sciemetric in this section.

**WARNING**

Service and maintenance of the 3520 module is to be carried out only by qualified technicians, either Sciemetric personnel or personnel trained and authorized by Sciemetric.

Sciemetric is not responsible for damage or decreased performance of the 3520 module as a result of customer or third-party unauthorized service. Any evidence of such service of the unit or sub-components will void the 3520 module warranty.

**WARNING**

Before performing any service or maintenance procedures, ensure the following:

- No Unit Under Test (UUT) is connected to the system.
- The 3520 module is disconnected from power.
- The 3520 module is disconnected from air supply.

## 10.1 Air Supply maintenance

It is important to maintain the air supply to the 3520 leak test module. Air-preparation equipment should be locally supplied, and spare filters and parts should be kept on hand. If the 3520 module is exposed to water, oil or particulates through the air supply, it may stop functioning and require servicing.

## 10.2 Pressure Sensor calibration

The pressure channel on the 3520 module should be calibrated on a yearly basis. The lowest cost method for calibrating a pressure transducer is to maintain a pressure transfer standard. This standard is sent out for re-calibration according to manufacturer's instructions and can be used to calibrate multiple 3520 modules during a scheduled shutdown. For pressure calibration procedures, see the user guide of the InspeXion leak test software that supports your 3520 module.

If your leak test software does not support pressure sensor recalibration, or if you prefer to send the 3520 module in for servicing, it is also possible to return a 3520 module to an authorized service center for recalibration

The 3520 module uses absolute pressure transducers. If you are considering purchasing a pressure transfer standard, contact Sciemetric support to ensure your pressure transfer standard is correct for your leak application.

## 10.3 Flow Sensor calibration

The flow sensor channel on the 3520 module should be calibrated on a yearly basis. Typically, the lowest-cost method for calibrating a flow sensor is to maintain a flow standard and do a two-point calibration (zero and at flow) on a yearly basis. This flow standard should be sent out for re-calibration according to manufacturer's instructions and can be used to calibrate multiple leak testers during a scheduled shutdown. For flow calibration procedures, see the User Guide of the InspeXion leak test software that supports your 3520 module.

If your leak test software does not support flow sensor recalibration, or if you prefer to send the 3520 module in for servicing, it is also possible to return the 3520 to an authorized service center for recalibration.

## 10.4 Temperature Sensor calibration

The 3520 module has connections for two 100 Ω Platinum RTDs. These channels are calibrated at the factory and should not require recalibration. If you suspect your temperature sensors are not reporting correctly, contact Sciemetric support. If the InspeXion leak test software supports temperature sensor calibration, then you can follow the procedures in the software user guide to recalibrate these sensors.

## 10.5 Self-Test sequences

The InspeXion leak test software on your 3520 controller may support a self-test sequence that can be run on the 3520 module. If a self-test sequence is present, this sequence will run and verify that the 3520 module is performing according to its specifications. In general, these types of sequences can be run at the start of each shift, or whenever the 3520 module is suspected of being the cause of failure for a particular test. For more information regarding the self-test sequence, see the user guide of the InspeXion leak test software that supports your 3520 module.

## 10.6 Pressure Decay to Flow calibration

Pressure decay test applications typically support converting pressure decay units (e.g., psi/s) to flow units (e.g., sccm) by using a flow standard. Flow standards are designed to generate a repeatable leak at a specified pressure, and are to be calibrated at as per manufacturer's instructions (typically a yearly interval).

Pressure decay to flow calibrations should be performed in the following cases:

- The test fixture is altered or maintained
- There is a change in the part geometry or material
- There is a change in the test timing or sequencing
- It is suspected that the system leak has changed
- Any time there is a systematic change in any other system variable (e.g., supply pressure)

For more information regarding the pressure decay calibration sequence, see the User Guide of the InspeXion leak test software that supports your 3520 module.

## 10.7 Supply and Pilot Pressure sensor calibration

The supply or pilot pressure sensors are for diagnostic purposes only and should not require recalibration. If you suspect your supply or pilot pressure sensors are not reporting correctly, contact Sciemetric support. If the InspeXion leak test software on your 3520 controller supports Supply and Pilot pressure calibration, then you can follow the procedures in the software user guide to recalibrate these sensors.

## 10.8 Valve cycle life

The valve cycle life (On/Off) of the 3520 models varies with the manifold type. The valves in low-volume manifolds (model codes ending in "B", e.g., 10500-3520-A0DB) are rated for 100 million cycles. The valves in high-flow manifolds (model codes ending in "C" e.g., 10500-3520-A0DC) are rated for 10 million cycles.

Most test protocols will cycle the valves once. If you keep track of how many leak test cycles have been run, then you can estimate how far into the valve cycle life you are. If your application is likely to exceed the valve cycle life, it is highly recommended that you maintain a pool of spare systems and arrange a 3520 maintenance program. Contact Sciemetric support for further assistance. See the inside cover page of this manual for contact information.

**Note**: If you are running more than 20000 tests per day on a "B" type manifold, or more than 2000 tests per day on a "C" type manifold, then it is likely that your 3520 systems will exceed the valve cycle life within 10 years.

# 11.0 Technical Specifications

## 11.1 General

- **Dimensions (HxWxD):** 117.8 x 264 x 210 mm (7" x 10.4" x 8.25")
- **Operating temperature:** 5 – 40°C
- **Operating humidity:** 8 – 90%
- **Finish:** powder-coated aluminum
- **Environmental:** IP65, Pollution Degree 2
- **Elevation:** ≤500 m[1]
- **Mounting options:** Integrated wall mount brackets
- **Vibration mounts:** Included and required for operation
- **Weight:** 10.2 kg (22.5 lbs.)
- Approvals: CE, cNEMKOus

[1] For elevation 500 - 2000 m, contact Sciemetric for a custom solution.

## 11.2 Electrical

**Power**

- **Connector:** M12 4-pin T-code plug
- **Supply:** 24 V (22 to 26 VDC)
- **Ripple:** <250 mV peak to peak
- **Power (Max):** 40 W (including all accessories)
- **Power (Typ):** 10 W (single channel leak test)
- **Power (Idle):** 6 W
- **Inrush current:** 5 A for 0.25 s

**Ethernet**

- **Connector**: M12 4-pin D-code socket
- **Data rate:** 100/10 Mbps

**External valve interface**

- **Connector:** M12 8 pin A-code socket
- **Valves:** (4×) 2.5 W at 24 V

**Temperature input (×2)**

- **Connector:** M12 4 pin A-code socket
- **Sensor:** 100 Ω Platinum RTD
- **Excitation:** 1.25 mA
- **Range:** 0°C to 200°C
- **Noise:** < 0.001°C rms
- **Bandwidth:** 10 Hz

## 11.3 Pneumatic

**Leak test system**

- **Number of test channels per 3520:** 1
- **Valve life rating:** 10,000,000 cycles (high-flow manifold); 100,000,000 cycles (low volume manifold)
- **System leak:** <0.02 SCCM at 10 psig
- **Fill rate (max):** 300 SLPM (high-flow manifold); 20 SLPM (low-volume manifold)

**Air supply preparation for supply and pilot**

- **Standard:** ISO 8573.1:2001 Class 1.4.2 or better
- **Pre-filter:** ≤ 5 µm
- **Air dryness:** ≤ 3°C Dew Point
- **Oil concentration:** ≤ 0.1 mg/m3
- **Gas compatibility:** Air, Helium (consult factory for compatibility with other gases)

**Supply pressure**

- **Maximum:** 100 psig for positive pressure; 5-3 psi below desired test pressure for vacuum pressure

- **Minimum:** 5-20 psi above test pressure for positive pressure; 13.75 psiv (28" Hg) for vacuum pressure
- **Required flow capacity:** 1000 SLPM (35 SCFM) or higher at 100 psig
- **Stability:** ±0.1 psi
- **Pre-Regulation:** Precision input regulator with supply pressure effect < 0.1 psi per 100 psi input pressure change is required.

**Pilot pressure (high-flow manifold only)**

- **Minimum:** 30 psig or supply pressure, whichever is greater
- **Maximum:** 135 psig

**Test pressure sensor**

- **Range selection:** (see model chart)
- **Accuracy:** ±0.25% of FS, best-fit straight line
- **Temperature error band:** ±1.0% of FS from 4°C to 60°C
- Noise:

  ≤ 10 ppm rms of FS (<0.001% of FS) – 300 Hz bandwidth

  ≤ 1 ppm rms of FS (<0.0001% of FS) – 1 Hz bandwidth
- Resolution: 0.06 ppm of FS

**Flow meter (flow models only)**

- **Range selection:** (see *"Ordering information" on page 84*)
- **For full scale ranges ≤ 3000 SCCM**

  **Accuracy at 25°C:**[2]

  - ±1% of reading when value is > 10% of FS
  - ±0.2% of FS when value is < 10% of FS

  **Accuracy over full temperature range:**[2]

  - ±2% of reading when value is > 10% of FS
  - ±0.5% of FS when value is < 10% of FS

  **Repeatability:**[2]

  - ±0.1% of reading when value is > 10% of FS
  - ±0.1% of FS when value is < 10% of FS

  **Pressure coefficient:** ±0.014% of reading/psi

  **Response time:** 4 ms (0.004 s)

  **Full scale of flow sensor is switchable with two ranges as follows:**

  - 10 SCCM and 50 SCCM
  - 100 SCCM and 250 SCCM
  - 1000 SCCM and 3000 SCCM
- **For full scale ranges ≥10 SLPM**

  **Accuracy:** ±1.5% of FS (15 to 25°C)

  **Repeatability:** ±0.5% of FS

  **Temperature coefficient:** < 0.15% of FS/°C

  **Pressure coefficient:** < ±0.01% of FS/psi

  **Response time:** 6 s for ±2% of FS for readings of 25 to 100% of FS
- **Over-range protection:** Pressure is reduced to ensure no damage to flow meter
- **Minimum resolution:** 0.02%
- **Bandwidth:** 10 Hz

  [2] 10 SCCM range values are 2x higher.

  UUT = Unit Under Test

  FS = Full Scale
- **Maximum allowable flow:**
  - x0Ax: 50 sccm -> 1000 sccm max
  - x0Bx: 250 sccm -> 2000 sccm max
  - x0Cx: 3000 sccm -> 10000 sccm max
  - x0Dx: 10 sLpm -> no max
  - x0Ex: 30 sLpm -> no max

  Flow above the maximum allowable flow can damage the flow meter and will cause the flow meter to read over-range.

- **Maximum fill rate for models with flow meters:**
  - x0AB = 290 psi/s
  - x0BB = 580 psi/s
  - x0CB = 2900 psi/s
  - x0AC = 15 psi/s
  - x0BC = 30 psi/s
  - x0CC = 150 psi/s

  Exceeding the maximum fill rate will exceed the maximum allowable flow and can damage the flow meter.

## 11.4 General Features

- Valve-operated calibration port
- Supply pressure sensor
- Pilot pressure sensor
- Internal variable flow self-test orifice
- UUT isolation valve
- Internal temperature sensor
- Diagnostic waveforms (supply voltage, supply current, control P, I, D and output values, PID response time)
- Fully adjustable control loop settings for electronic regulators
- Air-piloted valves to reduce effects of heat in high-flow manifold version
- Latching valves reduce effects of heat in low-volume manifold version

## 11.5 Optional external multiplexer valve to 3520 B

- Can be connected to the UUT port:

  - Multiple parts

  - Multiple chambers on one part

  - Select test fixture
- **Connector:** M12 8 pin A-code socket
- **Operating pressure:** max 50 psig

## 11.6 Optional external multiplexer valve to 3520 C

### 11.6.1 10500-3520-MPXR

- Can be connected to the supply input to select supply source:

  - Helium (trace gas)

  - Vacuum

  - Air (evacuate and fill)
- Can be connected to the UUT port:

  - Multiple parts

  - Multiple chambers on one part

  - Select test fixture
- **Pilot pressure:** min 30 psig or the supply pressure value, whichever is greater.
- **Connector:** M12 8 pin A-code socket

### 11.6.2 10500-3520-MC34,10500-3520-MC32,10500-3520-MC31

- Can be connected to the UUT port:

  - Multiple parts

  - Multiple chambers on one part

  - Select test fixture
- **Pilot pressure:** min 50 psig or the supply pressure value, whichever is greater.
- **Connector:** M12 8-pin A-code socket

## 11.7 Ordering information

| | Pressure Range | | Flow Meter Range | Fill Configuration |
|---|---|---|---|---|
| 10500-3520- | Y | 0 | Y | Y |
| | A – 0 to 5 psig | 0 | 0 – no flow meter | B – Low volume manifold (20 SLPM fill rate) |
| | B – 0 to 10 psig | 0 | A – 10 / 50 SCCM[3] | C – High flow manifold (300 SLPM fill rate) |
| | C – 0 to 15 psig | 0 | B – 100 / 250 SCCM[3] | |
| | D – 0 to 30 psig | 0 | C – 1000 / 3000 SCCM[3] | |
| | E – 0 to 50 psig | 0 | D – 10 SLPM | |
| | F – -15 to 95 psig | 0 | E – 30 SLPM | |
| | G – -15 to 0 psig | 0 | | |
| | H – -5 to 0 psig | 0 | | |

[3] the A, B, and C are dual-range flow meters; for example, A can be configured to operate as either a 10 SCCM or 50 SCCM Full Scale flow meter. Selection is performed remotely by the controller software.

**Example:** 10500-3520-D0AC stands for

3520 Leak Test module optimized for large part volumes, 0 to 30 psig absolute pressure transducer, 10/50 SCCM mass flow meter range, dual precision electronic regulators, 2 temperature inputs and 4 digital outputs. Includes power and Ethernet connectors and vibration mounts.

Specify target system volume, test pressure, and leak rates when ordering a 3520 Leak Test module and custom flow standards.

# 12.0 Appendix A - 3520 macros v. 2.13, test sequence examples, and OPC commands

The 3520 Leak Test module communicates with the leak test controller using an OPC UA (Unified Architecture) protocol over the Ethernet. You can program and run leak test sequences for the 3520 module using a set of OPC commands in the InspeXion software application on the 3520 controller (sigPOD or regular PC). Macro functions of these commands have been compiled to simplify the number of commands that 3520 users need to process in order to make powerful leak sequences. However, the leak test doesn't end with the macro commands. 3520 applications should be configured to build sequences out of macros, but also support direct OPC commands to the 3520 module, as this approach offers the most flexibility and power.

This chapter provides information about the latest 3520 Macro commands, version 2.13, and direct OPC commands. For information about the previous version of these macro command, version 1.x, see *"Upgrading from 3520 macro list version 1.x to 2.x" on page 113* and *"Appendix B - 3520 macro commands v. 1.x" on page 149*.

**Note:** OPC UA is an industrial M2M communication protocol for interoperability developed by the OPC Foundation. It is the successor to OPC (OLE for process control).

## 12.1 Creating and running 3520 macro command sequences

The InspeXion software applications that support the 3520 Leak Test module use the 3520 macros to allow for various methods for creating leak tests.

Most of these software applications provide interface for entering the essential parameters for the leak test, and then the applications automatically generate the leak test sequence of commands.

Some also let you manually configure macro parameters and use OPC commands for complete control of the 3520 module. No matter which method you choose, when you run the leak test, the software application on the 3520 controller compiles the script, uploads it to the unit, and executes the test. For more details, see the User Guide of the InspeXion software application that supports your 3520 leak test modules.

If you are an advanced user and would like to manually create and run macro sequences, see the sections that follow.

### *12.1.1 Creating a 3520 macro sequence*

When you create a 3520 macro command sequence, you have to submit each macro command (macro) with timing and parameters as part of a **SetSeq** command.

The general format is:

```
SetSeq;{DURATION IN MILLISECONDS}:{FUNCTION}.{MACRO COMMAND}*{Parameter 1}*{Parameter 2}*…;
```

EXAMPLE:

IF you have Macro Command 1 with two parameters and Macro Command 2 with no parameters, you can create the following sequence:

```
SetSeq;500:Function.MacroCommand1*A*B;250:Function.MacroCommand2;350:Function.MacroCommand1*E*
F;
```

**Note 1:** Each macro has a minimum duration in ms that is required for the macro to run. If you enter a value less than this minimum duration, you will get an error in most cases.

**Note 2:** Unlike regular OPC commands, which you can run individually (for example, SetValveV1*On), you can run macro commands only as part of a sequence.

**Note 3:** When you submit the sequence, the OPC variable **Operation.Status.State** is set to 0.

### 12.1.2 Running a 3520 macro sequence

To run a macro sequence, you have to submit it with **SetSeqRunState*1** or **SetSeqRunState*2** command at the start the sequence. Both commands can start the sequence, but are recommended for specific scenarios. See *Table 20* for more details.

***Table 20*** *Use of SetSeqRunstate commands*

| Command | When to use |
|---|---|
| SetSeqRunState*1 | Use when trying to achieve synchronization across multiple platforms. In run state 1, all sequence timing is relative to when the sequence started; so, timing of commands before SetADCF is respected. This means you need to give sufficient delay before calling SetADCF to ensure the sequence timing is repeatable. |
| SetSeqRunState*2 | Use when synchronization across platforms is not important, and you want to minimize inter-cycle delays and timing. In this case, all sequence timing before SetADC is ignored, and the first data point collected after SetADC is assigned a time value of 0. All sequence timing is then relative to this first data point. |

When running a sequence, the following is true:

- When the sequence starts, Operation.Status.State = 1. This value indicates that the sequence is running.
- When the sequence finishes, Operation.Status.State = 2. This value indicates that the sequence finished without errors.
- If there was an error in the sequence, then it will abort and result in Operation.Status.State = 3.
- If the sequence was manually aborted, then the result is Operation.Status.State = 4.

## 12.2 The 3520 macro commands

The 3520 Macro commands are organized in the following functions:


- "Config" on page 87
- "Open" on page 89
- "Close" on page 90
- "Ramp" on page 90
- "Init" on page 91
- "Fill" on page 92
- "FillRamp" on page 94
- "Flow" on page 95
- "PD" on page 96
- "Test" on page 96
- "Diag" on page 98
- "Pdecay" on page 100
- "FillPV1" on page 101
- "FillPV3" on page 103
- "SelfTest" on page 104


### 12.2.1 Config

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Config.EU.

***Table 21*** *Config Macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| EU | 1 | 0 | P1 = CalMode start <2><br>P2 = Pressure units <psi><br>P3 = Pressure a/v/g <g><br>P4 = Supply units <psi><br>P5 = Supply a/v/g <g><br>P6 = Pilot units <psi><br>P7 = Pilot a/v/g <g><br>P8 = Flow units <sccm><br>P9 = Temperature units <C><br>P10 = CalMode end <2> | Use to set Engineering units (EU) at the beginning of a test. Note that ResetUnit restores the default EU. If you want to set the default EU, then this sequence should be called with P9 = 1 and P10 = 0. |

***Table 21*** *Config Macro commands (Continued)*

| **Cmd** | **Level** | **Time (ms)** | **Parameters <DEFAULT>** | **Description** |
|---|---|---|---|---|
| PID | 1 | 0 | P1 = Set Point<br>P2 = Low Pressure Limit<br>P3 = High Pressure Limit<br>P4 = Kp (Proportional Gain)<br>P5 = Ki (Integral Gain)<br>P6 = Kd (Derivative Gain) <0><br>P7 = Bias <3><br>P8 = Feedback Type <0><br>P9 = Output Limit <11><br>P10 = Proportional Limit <8><br>P11 = Integral Limit <8><br>P12 = Derivative Limit <8><br>P13 = Output Acceleration <0><br>P14 = Integral Control Bit Mask <7><br>P15 = Integral Control Pre Charge <0><br>P16 = Flow Hold Point <0><br>P17 = Flow Maximum <0> | Call to set all PID parameters at once.<br><br>**Note 1:** This command does not start the PID. It just configures all available PID settings.<br>**Note 2:** This call does not support PID ramping; so, if you want to Ramp, call Config.PID and then do a separate call to SetPID_SetPt with the parameters associated with a ramp. |
| PID. Stop | 1 | 0 | None | Stops the PID, turns off PV1 and PV3, and returns PV1 and PV3 DACs to 0. |

### *12.2.2 Open*

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Open.V1.

***Table 22*** *Open Macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| V1 | 1 | 0 | None | Opens or closes the valve and turns the appropriate LED on.<br>Call in place of SetValve + SetIndicators.<br>Minimizes confusion for NO/NC valves.<br><br>**Note:** MB32 functions require PIC version 1.128 or higher to run correctly. |
| V2 | | | | |
| V3 | | | | |
| V4 | | | | |
| V5 | | | | |
| MB32.ExtV1 | | | | |
| MB32.ExtV2 | | | | |
| MB32.ExtV3 | | | | |
| MB32.ExtV4 | | | | |
| PV1 | 1 | 0 | P1 = Voltage <11> | |
| PV2 | | | | |
| PV3 | | | | |
| PV4 | | | | |

### 12.2.3 Close

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Close.V1.

***Table 23*** *Close Macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| V1 | 1 | 0 | None | Opens or closes the valve and turns the appropriate LED on.<br>Call in place of SetValve and SetIndicators.<br>Minimizes confusion for NO/NC valves.<br>For PV drivers, sets DAC to 0 V in addition to turning off FET.<br>**Note:** MB32 functions require PIC version 1.128 or higher to run correctly. |
| V2 | | | | |
| V3 | | | | |
| V4 | | | | |
| V5 | | | | |
| MB32.ExtV1 | | | | |
| MB32.ExtV2 | | | | |
| MB32.ExtV3 | | | | |
| MB32.ExtV4 | | | | |
| PV1 | | | | |
| PV2 | | | | |
| PV3 | | | | |
| PV4 | | | | |

### 12.2.4 Ramp

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Ramp.PV1.

***Table 24*** *Ramp macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| PV1 | 1 | 0 | P1 = Start voltage <0><br>P2 = End voltage <11><br>P3 = Ramp duration <100> | Use to ramp a PV to a specific voltage in a single function call. PV number syntax is PV1/PV2/PV3/PV4. Valve voltage is a float between 0 and 11. |
| PV2 | | | | |
| PV3 | | | | |
| PV4 | | | | |

### 12.2.5 Init

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Init.Fast.RS2.

*Table 25 Init macro commands*

<table>
<tr><th>Cmd</th><th>Level</th><th>Time (ms)</th><th>Parameters <DEFAULT></th><th>Description</th></tr>
<tr><td>Fast.RS2</td><td>2</td><td>25</td><td rowspan="4">P1 = Pressure units <psi><br>P2 = Pressure a/v/g <g><br>P3 = Supply units <psi><br>P4 = Supply a/v/g <g><br>P5 = Pilot units <psi><br>P6 = Pilot a/v/g <g><br>P7 = Flow units <sccm><br>P8 = Temperature units <C><br>P9 = ADC1_Mode <Flow><br>P10 = Flow Range <1><br>P11 = ADC Rate <800><br>P12 = Zero sensor pts <10 / 80><br>P13 = Flow over-range dwell time in ms. <20000><br>P14 = CalMode start <1><br>P15 = CalMode end <0></td><td>Initializes the test by calling ResetUnit, clearing waveforms, setting the engineering units, starting the ADC and performing a zero-sensor to get atmospheric reference. This sequence assumes that the panel is empty (that is, exhausted).</td></tr>
<tr><td>Slow.RS2</td><td>2</td><td>285</td><td>Same as Fast.RS2, but does not assume the panel is exhausted and uses V4 to ensure a good atmospheric reference.<br><br>Use P10 to ensure synchronization and timing determinism at the start of a sequence. Values > 150 ms are typical for reasonable determinism. Default value = 0 is good only if using RunState*2. May end up with sequence getting behind errors.</td></tr>
<tr><td>Fast.RS1</td><td>2</td><td>350</td><td>Same as Fast.RS2 but with a 325 ms (i.e., 350 ms – 25 ms) start-up delay for deterministic test initialization</td></tr>
<tr><td>Slow.RS1</td><td>2</td><td>585</td><td>Same as Slow.RS2 but with a 300 ms (i.e., 585 ms – 285 ms) start-up delay for deterministic test initialization</td></tr>
</table>

## 12.2.6 Fill

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Fill.Thru.Bypass.

***Table 26*** *Fill Macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| Thru.Bypass | 2 | P1 | P1 = time to leave V1 open before closing V2 <0> | PREREQUISITE: ResetUnit<br>Configures valves to fill through V1 (bypass fill) |
| Thru.Flowmeter | 2 | P1 | P1 = time to leave V3 open before closing V2 <0> | PREREQUISITE: ResetUnit<br>Configures valves to fill through V3 (flow) |
| Bleed | 2 | 0 | P1 = PV2 bleed voltage <11> | Opens PV2 by calling PV.Open*PV2*<P1>. |
| Bleed.Ramp | 2 | 0 | P1 = Start voltage <0><br>P2 = End voltage <11><br>P3 = Ramp duration <100> | Ramps PV2 by calling PV.Ramp*PV2*<P1>*<P2>*<P3>. This alternative bleed arrangement is helpful when you don't need the bleed valve open right away. |
| PV1.Init | 2 | 0 | P1 = Set Point<br>P2 = Low Pressure Limit<br>P3 = High Pressure Limit<br>P4 = Kp (Proportional Gain)<br>P5 = Ki (Integral Gain)<br>P6 = Kd (Derivative Gain) <0><br>P7 = Bias <3><br>P8 = Feedback Type <0><br>P9 = Output Limit <11><br>P10 = Proportional Limit <8><br>P11 = Integral Limit <8><br>P12 = Derivative Limit <8><br>P13 = Output Acceleration <0><br>P14 = Integral Control Bit Mask <7><br>P15 = Integral Control Pre- Charge <0><br>P16 = Flow Hold Point <0><br>P17 = Flow Maximum <0> | PREREQUISITE: Fill.Thru.Bypass/ Fill.Thru.Flowmeter<br>Recommended Prerequisite: Fill.Bleed<br>Call to start a PID on PV1 from scratch. Uses SetPID*0x85 to set the pre-charge value, update all PID settings, and start the PID. |

***Table 26** Fill Macro commands (Continued)*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| PV1.Change | 2 | 0 | Same as PV1.Init. See previous cell in this column. | PREREQUISITE: Fill.PV1.Init<br>Call to transition from fast fill to test fill on PV1. Uses SetPID*0x0D to do a bumpless transfer, update parameters and start PID on PV1. |
| PV3.Init | 2 | 0 | | PREREQUISITE: Fill.Thru.Bypass/ Fill.Thru.Flowmeter<br>Call to start a PID on PV3 from scratch. Uses SetPID*0xA5 to set the pre-charge value, update all PID settings and start the PID. |
| PV3.Change | 2 | 0 | | PREREQUISITE: Fill.PV3.Init<br>Call to transition from fast fill to test fill on PV3. Uses SetPID*0x2D to do a bumpless transfer, update parameters, and start PID on PV3. |
| PV3.Xfer.Config | 2 | 0 | | PREREQUISITE: Fill.PV1.Init<br>Call to transfer from PV1 to PV3 for a flow test. Configures the PID on PV3, but does not start the PID (see Fill.PV3.Xfer.Start in the next row). Leaves the system in a state ready to start PID. |
| PV3.Xfer.Start | 1 | 0 | None | PREREQUISITE: Fill.PV3.Xfer.Start<br>Starts the PID on PV3 with 0xA5; similar to PV3.Init in terms of behavior with PID settings |
| PV1.Change.Simple | 1 | 0 | P1 = Set Point | PREREQUISITE: Fill.PV1.Init<br>Call to transition from fast fill to test fill on PV1. Uses SetPID*0x0D to do a bumpless transfer, update parameters, and start PID on PV1. |
| PV3.Change.Simple | 1 | 0 | P1 = Set Point | PREREQUISITE: Fill.PV3.Init<br>Call to transition from fast fill to test fill on PV3. Uses SetPID*0x2D to do a bumpless transfer, update parameters and start PID on PV3. |

### 12.2.7 FillRamp

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, FillRamp.PV1.Init.

*Table 27 FillRamp Macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| PV1.Init | 2 | 0 | P1 = Start Point<br>P2 = End Point<br>P3 = Duration (ms)<br>P4 = Low Pressure Limit<br>P5 = High Pressure Limit<br>P6 = Kp (Proportional Gain)<br>P7 = Ki (Integral Gain)<br>P8 = Kd (Derivative Gain) <0><br>P9 = Bias <3><br>P10 = Feedback Type <0><br>P11 = Output Limit <11><br>P12 = Proportional Limit <8><br>P13 = Integral Limit <8><br>P14 = Derivative Limit <8><br>P15 = Output Acceleration <0><br>P16 = Integral Control Bit Mask <7><br>P17 = Integral Control Pre Charge <0><br>P18 = Flow Hold Point <0><br>P19 = Flow Maximum <0> | PREREQUISITE: Fill.Thru.Bypass/ Fill.Thru.Flowmeter<br>Recommended Prerequisite: Fill.Bleed<br>Call to start a PID on PV1 from scratch. Uses SetPID*0x85 to set the pre-charge value, update all PID settings, and start the PID. |
| PV3.Init | 2 | 0 | Same as PV1.Init. See previous cell in this column. | PREREQUISITE: Fill.Thru.Bypass/ Fill.Thru.Flowmeter<br>Call to start a PID on PV3 from scratch. Uses SetPID*0xA5 to set the pre-charge value, update all PID settings and start the PID. |

### 12.2.8 Flow

In addition to v. 2.13 macro commands, the Flow macro list includes some v. 1.x commands. For more information, see "Upgrading from 3520 macro list version 1.x to 2.x" on page 113.

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Flow.Stabilize.PV1.

***Table 28*** *Flow macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| Stabilize.PV1 | 2 | 25 + P2 + P3 | P1 = Flow dwell time <100><br>P2 = V3 open delay <0><br>P3 = V1 close delay <0> | PREREQUISITE: Fill.PV1.Init<br>Call to switch in the flow meter with PV1 control. Use P2 and P3 to stop the PID so that valve ringing does not mess up the controller. Increase P1 if flow over-ranges are a problem. In a well-designed test, this command should not over-range the flow-meter; so, be cautious increasing P1. |
| Stabilize.PV3 | 2 | 25 + P2 + P3 | P1 = Flow dwell time <100><br>P2 = V3 open delay <0><br>P3 = V1 close delay <0> | PREREQUISITE: Fill.PV3.Init/Xfer.Start<br>Call to switch in the flow meter with PV3 control. Use P2 and P3 to stop the PID so that valve ringing does not mess up the controller. Increase P1 if flow over-ranges are a problem. In a well-designed test, this command should not over-range the flow-meter; so, be cautious increasing P1. |
| Test | 1 | 0 | None | PREREQUISITE: Flow.Stabilize.PV1/PV3<br>Turns on the test LED. Effectively is a placeholder for test zones. |
| Exhaust | 2 | P1 | P1 = V3 close delay <25><br>P2 = PV2 bleed level <11> | PREREQUISITE: Flow.Test<br>Stops the PID, turns off all PV drivers, turns off V3, and exhausts the UUT. Turns on PV2 to bleed down the inlet side. |
| StabilizePV1 | 1 | 200 + P1 | P1 = Delay to hold-off PID start after closing V1. | Backwards compatible. Stabilize.PV1 is a better command choice. |
| StabilizePV3 | 1 | 200 + P1 | P1 = Delay to hold-off PID start after closing V1. | Backwards compatible. Stabilize.PV3 is a better command choice. |

### 12.2.9 PD

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, PD.Stabilize.

*Table 29 PD Macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| Stabilize | 2 | P1 + P2 | P1 = Valve close delay <100><br>P2 = PV2 bleed off duration <100> | PREREQUISITE: Fill.PV1/PV3.Init<br>Stops the PID and switches off V1/V3 to isolate the panel for a PD test. Use P1 to ensure V1/V3 are closed prior to activating PV2. Use P2 to ensure the panel is exhausted behind V1 and V3 so that no leaks are masked. |
| Test | 1 | 0 | None | PREREQUISITE: PD.Stabilize<br>Turns on the test LED. Effectively a placeholder for test zones. |
| Exhaust | 2 | 0 | None | PREREQUISITE: PD.Test<br>Opens V2 to exhaust the panel and turns Test LED off. |

### 12.2.10 Test

In addition to v. 2.13 macro commands, the Test macro list includes some v. 1.x commands. For more information, see "Upgrading from 3520 macro list version 1.x to 2.x" on page 113.

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Test.End.

*Table 30 Test macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| End | 1 | 0 | None | Turns off PID, closes all PV drivers and stops ADC reporting. |
| Initialize | 1 | 250 | P1 = Low pressure limit<br>P2 = High pressure limit<br>P3 = Sample rate <100><br>P4 = Flow over-range dwell <20000> | **Do not use this macro.**<br>Use Init.Slow command instead.<br>This command runs ADC at 100 Hz.<br>**Note:** V2.00 removes calls to 0x33 through 0x3F, as well as PilotPrsHigh and Low / Supply High and Low as these are EU dependent. Adds 100 ms up to SetADC_RateInt*4. |

***Table 30*** *Test macro commands (Continued)*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| Initialize. Fast | 2 | 160 | P1 = Low pressure limit<br>P2 = High pressure limit<br>P3 = Sample rate <333><br>P4 = Flow over-range dwell <20000> | **Do not use this macro.**<br>Use Init.Fast command instead.<br>Runs ADC at 333 Hz. |
| Exhaust | 2 | 100 | P1 = Time to close V3 before opening V2 <100> | **Do not use this macro.**<br>Use specific Flow.Exhaust or PD.Exhaust command instead.<br>This is a general exhaust sequence that stops the PID, turns off all PV drivers, opens valves to exhausts the UUT and turns Test LED off. |
| Pass | 1 | 0 | None | Run at the end of a test to configure LEDs in a PASS / FAIL state.<br>**Note:** In this case, it is more efficient to send direct OPC commands instead of running a macro sequence. See *"OPC Commands" on page 127* for the list of common OCP commands, |
| Fail | 1 | 0 | None | |
| EngUnits | 1 | 0 | P1 = Pressure units <psi><br>P2 = Pressure a/v/g <g><br>P3 = Supply units <psi><br>P4 = Supply a/v/g <g><br>P5=Pilot units <psi><br>P6 = Pilot a/v/g <g><br>P7 = Flow units <sccm><br>P8 = Temperature units <C> | Do not call this command in tests. Use only to write EU for permanent usage.<br>Turns CalMode on (1), writes all EU, and then turns CalMode off. |

### 12.2.11 Diag

In addition to v. 2.13 macro commands, the Diag macro list includes some v. 1.x commands. For more information, see *"Upgrading from 3520 macro list version 1.x to 2.x" on page 113*.

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Diag.CalValve.

***Table 31*** *Diag macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| CalValve | 1 | 0 | P1 = DIAG valve On/Off<br>P2 = Diag LED On/Off | This is a v. 1.x macro command.<br>Do not use. Use V5.Open or V5.Close commands instead. |
| UUTValve | 1 | 0 | P1 = UUT valve On/Off<br>P2 = Diag LED On/Off | This is a v. 1.x macro command.<br>Do not use. Use V5.Open or V5.Close commands instead. |
| AtmRef | 2 | 1000 | None | 1 s sequence to get a clean atmospheric reference. |
| C_SelfTest_5psi | - | - | - | This is a v. 1.x macro command that is no longer supported. The command is not compatible with new firmware. |
| C_SelfTest_5psi_Flow | - | - | - | This is a v. 1.x macro command that is no longer supported. The command is not compatible with new firmware. |

***Table 31*** *Diag macro commands (Continued)*

<table>
<tr><th>Cmd</th><th>Level</th><th>Time (ms)</th><th>Parameters<br><DEFAULT></th><th>Description</th></tr>
<tr><td>FillPV3</td><td>3</td><td>600</td><td rowspan="2">P1 = set pressure in (default psig)<br>P2 = Pressure units <psi><br>P3 = Pressure a/v/g <g><br>P4 = Supply units <psi><br>P5 = Supply a/v/g <g><br>P6 = Pilot units <psi><br>P7 = Pilot a/v/g <g><br>P8 = Flow units <sccm><br>P9 = Temperature units <C><br>P10 = ADC1_Mode <Flow><br>P11 = Flow Range <1><br>P12 = Low Pressure Limit <-15><br>P13 = High Pressure Limit <100><br>P14 = Kp (Proportional Gain) <5, 0.1><br>P15 = Ki (Integral Gain) <12, 0.5><br>P16 = Kd (Derivative Gain) <0><br>P17 = Bias <3><br>P18 = Feedback Type <0><br>P19 = Output Limit <11><br>P20 = Proportional Limit <8><br>P21 = Integral Limit <8><br>P22 = Derivative Limit <8><br>P23 = Output Acceleration <0><br>P24 = Integral Control Bit Mask <7><br>P25 = Integral Control Pre Charge <0><br>P26 = Flow Hold Point <0><br>P27 = Flow Maximum <0><br>P28 = Bleed voltage <11> (PV1 only)</td><td>Starts a PID on PV3 with UUT closed and leaves it running for calibration diagnostic purposes.</td></tr>
<tr><td>FillPV1</td><td>3</td><td>600</td><td>Starts a PID on PV1 with UUT closed and leaves it running for calibration diagnostic purposes.</td></tr>
<tr><td>SetADC1_Flow</td><td>1</td><td>0</td><td>None</td><td>Calls command SetADC1_Mode*Flow</td></tr>
<tr><td>SetADC1_Temperature</td><td>1</td><td>0</td><td>None</td><td>Calls command SetADC1_Mode*Temperature</td></tr>
</table>

*Table 31 Diag macro commands (Continued)*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| Exh_Valve_Test.<br>Fill_PV3 | 2 | 200 | P1 = Set point<br>P2 = Kp<br>P3 = Ki<br>P4 = Kd | This is a v. 1.x macro command that is similar to Fill.PV3.Intialize but does not turn off the exhaust valve. Maintained for backwards compatibility only.<br>Use to check if the exhaust valve is leaking. |

## 12.2.12 Pdecay

In addition to v. 2.13 macro commands, the Pdecay macro list includes some v. 1.x commands. For more information, see "Upgrading from 3520 macro list version 1.x to 2.x" on page 113.

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, Pdecay.Isolate.

*Table 32 Pdecay macro*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| Isolate | 1 | 100 | None | Stops filling the system. Turns off V1 and V3 for 100 ms to ensure valves are closed before turning off PV1/PV3. Turns on PV2 at the end of the test. Need to leave in this state long enough for PV2 to exhaust behind V1 and V2.<br>**Note:** This sequence needs to be on at least 150 ms to ensure it succeeded. Using the minimum time is not recommended. |
| Stabilize | 1 | 0 | None | Turns off PV2 and turns on Test LED. |
| Test | 1 | 0 | None | Turns the Test LED on and acts as a placeholder. |

### 12.2.13 FillPV1

In addition to v. 2.13 macro commands, the FillPV1 macro list includes some v. 1.x commands. For more information, see *"Upgrading from 3520 macro list version 1.x to 2.x" on page 113*.

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, FillPV1.P_Initialize.

***Table 33*** *FillPV1 Macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| P_Initialize<br>P_Initialize_Kplim | 2 | 150 | P1 = Set Point<br>P2 = Kp (Proportional Gain)<br>P3 = Ki (Integral Gain)<br>P4 = Kd (Derivative Gain)<br>P5 = PV2 end point <65535><br>P6 = PV2 ramp increment <65535><br>P7 = Kplimit <8><br>P8 = PID Output limit <11><br>P9 = Bias <3><br>P10 = Kilimit <8><br>P11 = Kdlimit <8><br>P12 = Output acceleration <0><br>P13 = Intcontrol bit mask <7><br>P14 = Integral pre-charge <0><br>P15 = Feedback mode <0><br>P16 = Flow hold <0><br>P17 = Flow max <0> | **Note:** These commands are fully backwards compatible. |
| Stop | | | | Discontinued. Same as Config.PID.Stop. |

***Table 33*** *FillPV1 Macro commands (Continued)*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| P_Bumpless | 2 | 0 | P1 = Set Point<br>P2 = Kp (Proportional Gain)<br>P3 = Ki (Integral Gain)<br>P4 = Kd (Derivative Gain)<br>P5 = PV2 set point <FFFF><br>P6 = PV2 transient Setpoint <0><br>P7 = Kplimit <8><br>P8 = PID Output limit <11><br>P9 = Bias <3><br>P10 = Kilimit <8><br>P11 = Kdlimit <8><br>P12 = Output acceleration <0><br>P13 = Intcontrol bit mask <7><br>P14 = Integral pre-charge <0><br>P15 = Feedback mode <0><br>P16 = Flow hold <0><br>P17 = Flow max <0> | Parameterization has been modified in version 2.13 of the command to accommodate P6 and the rest of the parameters. P6 used to be 0. Actually, the ideal scenario is P6 = P5.<br><br>**Note**: When P6 = FFFF, this command is a hex pass to the PIC. |
| PF_Initialize | 2 | 150 | P1 = Set Point<br>P2 = Kp (Proportional Gain)<br>P3 = Ki (Integral Gain)<br>P4 = Kd (Derivative Gain)<br>P5 = PV2 end point <65535><br>P6 = PV2 ramp increment <65535><br>P7 = Bias <3><br>P8 = PID Output limit <11><br>P9 = Kplimit <8><br>P10 = Kilimit <8><br>P11 = Kdlimit <8><br>P12 = Output acceleration <0><br>P13 = Intcontrol bit mask <7><br>P14 = Integral pre-charge <0><br>P15 = Feedback mode <0><br>P16 = Flow hold <0><br>P17 = Flow max <0> | Used in a specific test at Means. Maintained for backwards compatibility. |

### 12.2.14 FillPV3

In addition to v. 2.13 macro commands, the FillPV1 macro list includes some v. 1.x commands. For more information, see "Upgrading from 3520 macro list version 1.x to 2.x" on page 113.

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, FillPV3.P_Initialize.

***Table 34** FillPV3 Macro commands*

| Cmd | Level | Time (ms) | Parameters, DEFAULT> | Description |
|---|---|---|---|---|
| P_Initialize<br>P_Initialize_Kplim | 2 | 150 | P1 = Set Point<br>P2 = Kp (Proportional Gain)<br>P3 = Ki (Integral Gain)<br>P4 = Kd (Derivative Gain)<br>P5 = Kplimit <8><br>P6 = PID Output limit <11><br>P7 = Bias <3><br>P8 = Kilimit <8><br>P9 = Kdlimit <8><br>P10 = Output acceleration <0><br>P11 = Intcontrol bit mask <7><br>P12 = Integral pre-charge <0><br>P13 = Feedback mode <0><br>P14 = Flow hold <0><br>P15 = Flow max <0> | This command was used to start a fill on PV3 through V1 (Bypass fill).<br><br>**Replaced with:**<br>Fill.Thru.Bypass<br>Fill.PV3.Init |
| P_Bumpless | 1 | 0 | | **Pre-requisite:** FillPV3.P_Initialize or FillPV3.P_Transfer<br><br>**Replaced with:**<br>Fill.PV3.Bumpless |
| P_Transfer | 2 | P16 | P1 ... P15 are the same as P1 ... P15 for FillPV3.P_Initialize. See the first cell in this column.<br>P16 = Delay before starting PID <0> | **Pre-requisite:** FillPV1.P_Initialize<br><br>**Replaced with:**<br>Fill.PV3.Xfer.Config<br>Fill.PV3.Xfer.Start |
| Flow_Init | 2 | 150 | P1 ... P15 are the same as P1 ... P15 for FillPV3.P_Initialize, except for:<br>P13 = Feedback <1><br>See the first cell in this column. | This command was used to start a fill on PV3 through V3 (Flow meter)<br><br>**Replaced with:**<br>Fill.Thru.Flowmeter<br>Fill.PV3.Init |
| Stop | | | | Discontinued. |

### 12.2.15 SelfTest

In a sequence, each macro command must always be preceded by the function name as follows: {FUNCTION}.{MACRO COMMAND}. For example, SelfTest.BiasHunt.

***Table 35** SelfTest Macro commands*

| Cmd | Level | Time (ms) | Parameters <DEFAULT> | Description |
|---|---|---|---|---|
| BiasHunt | 2 | 5525 | P1 = PV to test <PV1><br>P2 = Trip pressure high <0.05><br>P3 = Trip pressure low <-1> | Use to determine bias control of PV1 or PV3. The command zeros the sensor; then, performs a ramp on the specified PV. The sequence will abort when the gauge pressure goes above 0.050 psi.<br>The bias voltage = 11*(sequence run time – 500 ms)/5000<br>Always run this command with RunState*2. |
| OpenLoop .Single | 2 | 400 + P6 | P1 = Pressure Units<br>P2 = a/v/g for pressure<br>P3 = Pressure Lower Limit<br>P4 = Pressure Upper Limit<br>P5 = PV1 / PV3 <PV1><br>P6 = Run time in ms <5000><br>P7 = Set point (Volts) <5><br>P8 = PV2 On/Off <0><br>P9 = PV2 level <11> | Single-point open-loop test.<br>**Pre-requisite:**<br>To set P7 properly, you must know the bias value beforehand. |
| OpenLoop .Step | 2 | 400 + P6*11 | P1 = Pressure Units<br>P2 = a/v/g for pressure<br>P3 = Pressure Lower Limit<br>P4 = Pressure Upper Limit<br>P5 = PV1 / PV3 <PV1><br>P6 = Step time in ms <1000><br>P7 = PV2 On/Off <0><br>P8 = PV2 level <11> | Step size is 1 V. |

***Table 35*** *SelfTest Macro commands (Continued)*

| **Cmd** | **Level** | **Time (ms)** | **Parameters <DEFAULT>** | **Description** |
|---|---|---|---|---|
| x0xB.5psig | 3 | 35235 | P1 = PV1 Kp <0.5><br>P2 = PV1 Ki <2.5><br>P3 = PV1 Kd <0><br>P4 = PV1 B <0><br>P5 = PV1 Klim <11><br>P6 = PV3 Kp <6><br>P7 = PV3 Ki <10><br>P8 = PV3 Kd <0><br>P9 = PV3 B <1><br>P10 = PV3 Klim <10><br>P11 = PV4 Kp <-5><br>P12 = PV4 Ki <-15><br>P13 = PV4 Kd <0><br>P14 = PV4 B <3><br>P15 = PV4 Klim <8> | Used on all positive pressure x0xB systems to verify the 3520 function at 5 psig.<br><br>**Note:** PV power ramp checks are not done because they are redundant with the functional test and can damage the system.<br><br>Default PID settings are to work for a wide range of supply pressures (20 to 100 psig). Better PID control is possible with tuning for specific supply pressures. |
| x0xC.5psig | 3 | 35460 | P1 = PV1 Kp <0.8><br>P2 = PV1 Ki <3><br>P3 = PV1 Kd <0.025><br>P4 = PV1 B <3><br>P5 = PV1 Klim <8><br>P6 = PV3 Kp <16><br>P7 = PV3 Ki <256><br>P8 = PV3 Kd <0.05><br>P9 = PV3 B <3><br>P10 = PV3 Klim <8><br>P11 = PV4 Kp <-30><br>P12 = PV4 Ki <-100><br>P13 = PV4 Kd <0><br>P14 = PV4 B <5><br>P15 = PV4 Klim <6> | Used on all positive pressure x0xC systems to verify the 3520 module function at 5 psig |

### 12.2.15.1 Using SelfTest.BiasHunt

The SelfTest.BiasHunt is a 5525 ms macro command that is used to determine the bias voltage for PV1 and PV3.

SelfTest.BiasHunt seals the 3520 panel by closing V4 and V2. Then, it opens V1 and ramps PV1 or PV3. While this ramp is occurring, a PID with a trip point of 0.05 psig is running on PV4 with a zero set point and no gain. When the pressure in the panel reaches 0.05 psig, the test will abort (exit to Operation.Status.State = 3). Since the timing of the sequence is deterministic, you can derive the valve voltage when the sequence tripped.

#### To use the SelfTest.BiasHunt macro command

1. Send SetSeq;5525:BiasHunt*<PV1/3>*<0.05>*<-1>.
2. Send SettSeqRunState*2.

   **Note 1:** To run properly, SelfTest.BiasHunt must always be run with SettSeqRunState*2. For more information, see *Table 20 on page 86*.

   **Note 2:** When the sequence completes, it will abort to Operation.Status.State = 3. This is an "Abort" behavior and generates an "Over Pressure" error. This error is expected and can be ignored.

   **Note 3**: This macro command is parameterized in the event that PV1 or PV3 have a small leak. In this case, you may need to increase the trip pressure from 0.05 to a higher value. If the leak is large, there's no option of saving the test, and the 3520 module must be serviced.

#### To perform feature checks

1. Verify Operation.Status.State = 3.
2. Get the number of points of the Pressure waveform < 4420.
3. Calculate: Bias = (N-0.525/800)/(5*800)*11 (value is in Volts).

#### Waveforms

The SelfTest.BiasHunt resultant waveforms in *Figure 33* and *Figure 34* show the pressure change associated with V4, V1 and V2 closing. You may observe some small forward leaks through the PV. In this case, you may need to increase the pressure trip to get a good bias estimate. The input current waveforms in *Figure 35* and *Figure 36* show the pulses / delta for the binary valves, followed by the slow ramp for the PV driver.

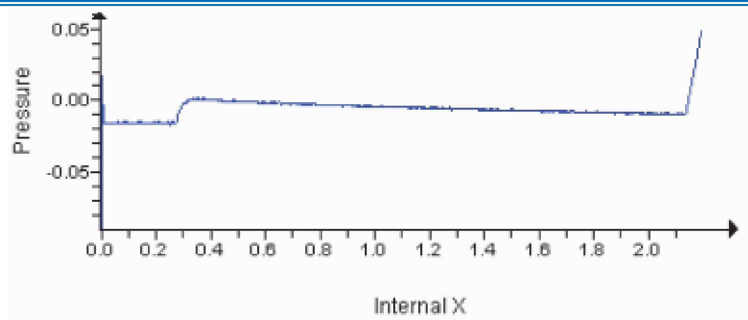



*Figure 33 SelfTest.BiasHunt pressure waveform - example 1*

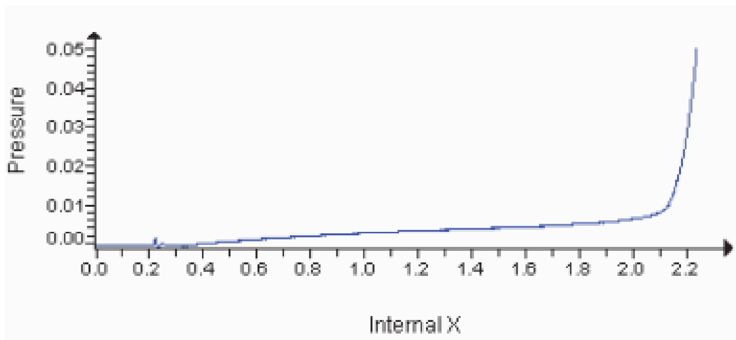



*Figure 34 SelfTest.BiasHunt pressure waveform - example 2*

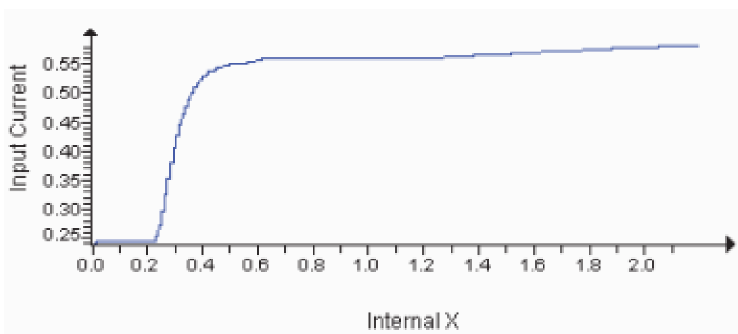



*Figure 35 SelfTest.BiasHunt input current waveform - example 1*

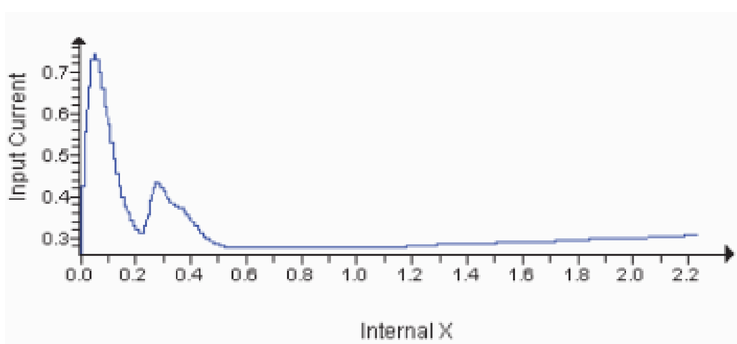



*Figure 36 SelfTest.BiasHunt input current waveform - example 2*

### *12.2.15.2 Using SelfTest.OpenLoop.Single*

The SelfTest.OpenLoop.Single macro command is designed to toggle a valve to a set point so that you can measure the valve response and calculate the PID parameters. The test duration is a function of P7, so this fact should be accounted for in the test design. P8 gives the option to turn on PV2.

SelfTest.OpenLoop.Single starts the ADC, zeros the sensor, and then runs the PV at the specified valve voltage. Over-pressure protection is provided by running a PID on PV4 with no gain.

In order to get a good open loop value for the valve, select a voltage that is not very large relative to the bias. Using the value produced by SelfTest.BiasHunt often does a good job. The BiasHunt voltage is typically a few mV higher than the real bias.

#### To use the SelfTest.OpenLoop.Single macro command

1. Send SetSeq;<400+P6>:SelfTest.OpenLoop.Single*<pressure unit>*<a/v/g>*<low limit>*<high limit>*<PV1/3>*<run duration>*<set point>*<PV2 on/off>*<PV2 voltage 11>.
2. Send SetSeqRunState*2.

   **Note 1:** To run properly, SelfTest.OpenLoop.Single must always be run with SettSeqRunState*2. For more information, see *Table 20 on page 86*.

   **Note 2:** If the pressure over-ranges, the sequence may abort to Operation.Status.State = 3. This is not a problem and can be ignored.

#### Waveforms

The SelfTest.OpenLoop.Single pressure waveform will show a ramp indicating the fill rate for the set voltage used. For example, see *Figure 37*. This waveform indicates the speed at which the valve can fill the part.

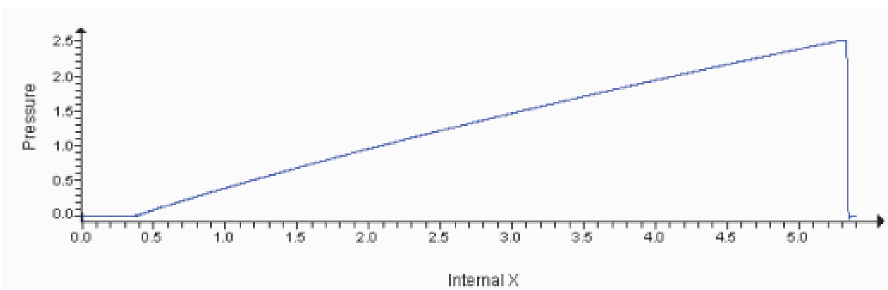



*Figure 37 SelfTest.OpenLoop.Single pressure waveform - example 1*

If the graph tapers off flat (see *Figure 38*), this waveform indicates the pressure is moving towards the steady state where it is balancing the open-loop flow with the open-loop bleed.

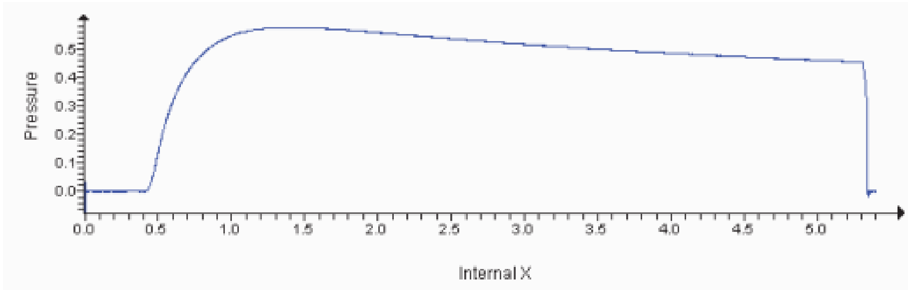



*Figure 38 SelfTest.OpenLoop.Single pressure waveform - example 2*

### 12.2.15.3 Using SelfTest.OpenLoop.Step

The SelfTest.OpenLoop.Step macro command toggles PV1 or PV3 through 0 to 11 V in 1 V increments. It is designed to find the bias point, but also for you to identify differences in the open loop response based on voltage changes.

The SelfTest.OpenLoop.Step macro command is similar to the SelfTest.OpenLoop.Single command, but the step response sends PV commands from 1 to 11 V in order.

#### To use the SelfTest.OpenLoop.Step macro command

1. Send SetSeq;<400+P6*11>:SelfTest.OpenLoop.Step*<pressure unit>*<a/v/g>*<low limit>*<high limit>*<PV1/3>*<step duration>*<set point>*<PV2 on/off>*<PV2 voltage 11>.
2. Send SetSeqRunState*2.

   **Note 1:** To run properly, SelfTest.OpenLoop.Step must always be run with SettSeqRunState*2. For more information, see *Table 20 on page 86*.

   **Note 2:** If the pressure over-ranges, the sequence may abort to Operation.Status.State = 3. Running this sequence on PV1 will often produce an abort condition, because it can pressurize parts very quickly.

#### Waveforms

The SelfTest.OpenLoop.Step pressure waveform will show a ramp indicating the fill rate for the different voltages used (see *Figure 39*). Once the pressure gets above zero, you've passed the bias of the valve.

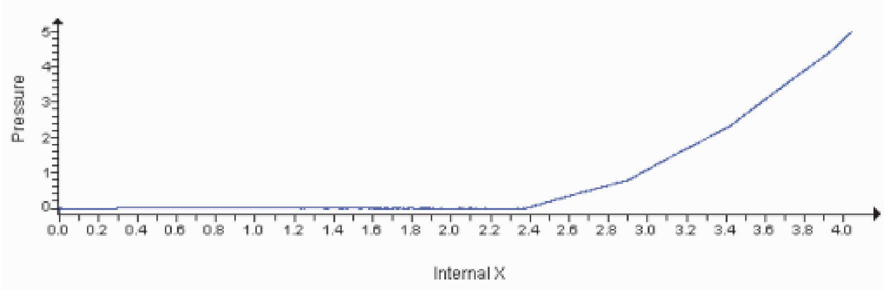



*Figure 39 SelfTest.OpenLoop.Step pressure waveform - example 1*

If the graph tapers off flat (see *Figure 40*), this waveform indicates the pressure is moving towards the steady state where it is balancing the open-loop flow with the open-loop bleed. In this case, you can see the response for PV1 is doing this multiple times.

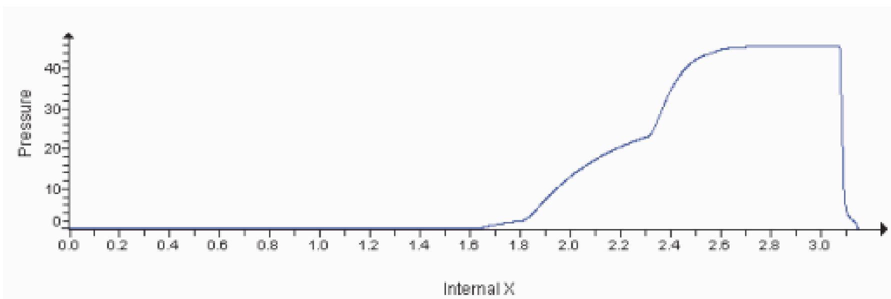



*Figure 40 SelfTest.OpenLoop.Step pressure waveform - example 2*

### 12.2.15.4 SelfTest.x0xC.5psi waveforms

The SelfTest.x0xC.5psi macro command is used on all positive pressure leak test systems model 0xC to verify the 3520 function at 5 psig.

*Figure 41* through *Figure 48* show example waveforms from the 3520 sensors.

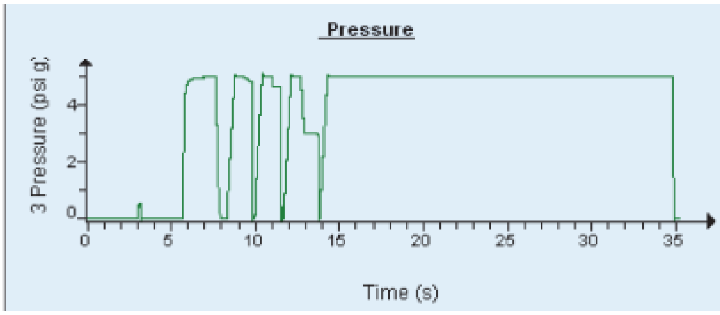



*Figure 41 An example of a SelfTest.x0xC.5psi pressure waveform*

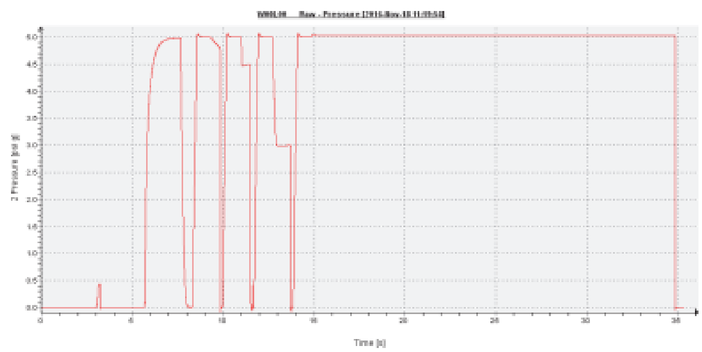


*Figure 42 An example of a SelfTest.x0xC.5psi pressure waveform at 60 psi supply*

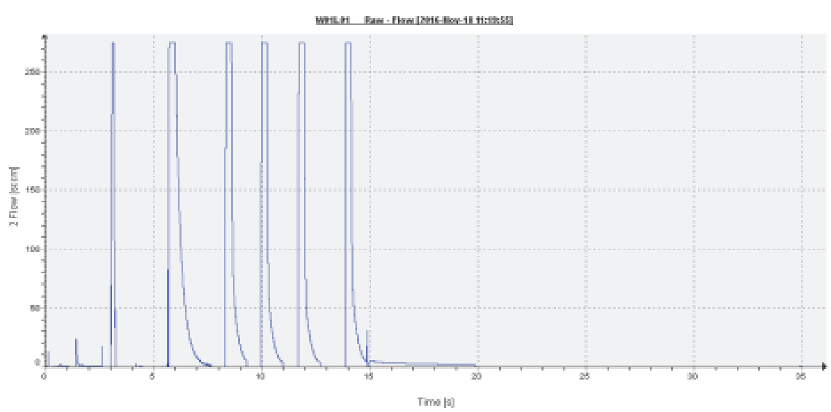


*Figure 43 An example of a SelfTest.x0xC.5psi flow waveform at 60 psig supply*

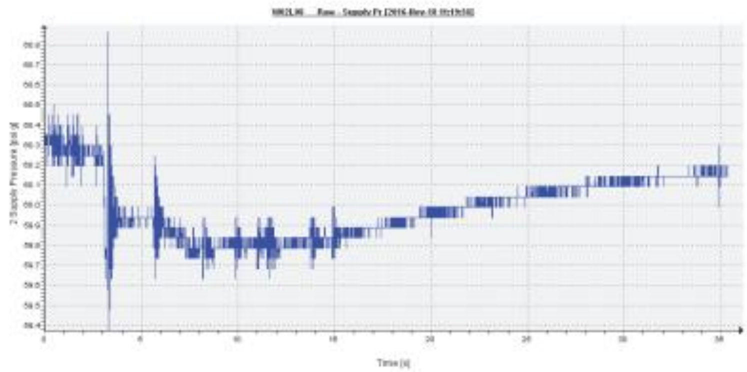


Figure 44 An example of a SelfTest.x0xC.5psi supply pressure waveform at 60 psi supply

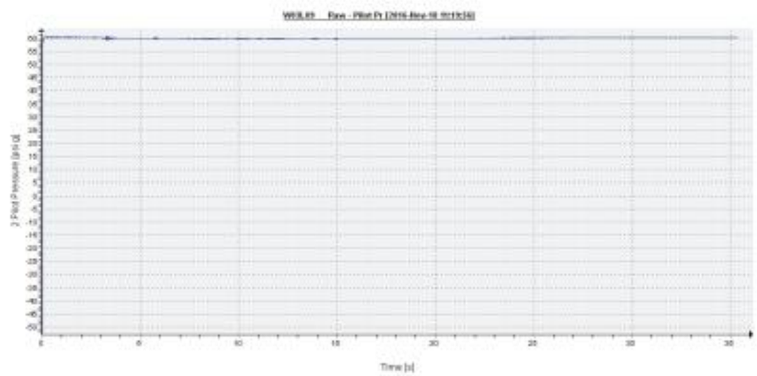


Figure 45 An example of a SelfTest.x0xC.5psi pilot pressure waveform at 60 psi supply

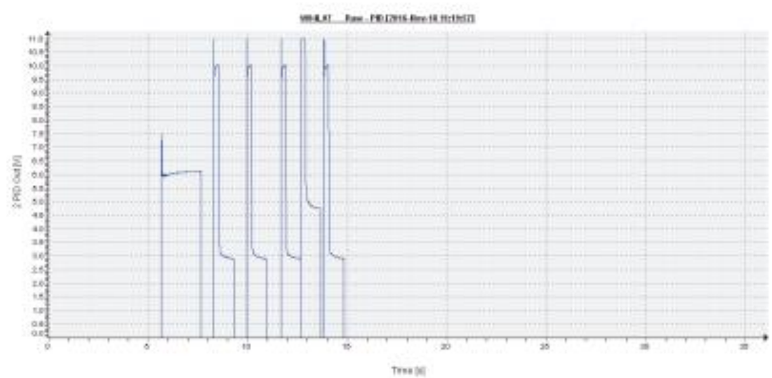


Figure 46 An example of a SelfTest.x0xC.5psi PID output waveform at 60 psi supply

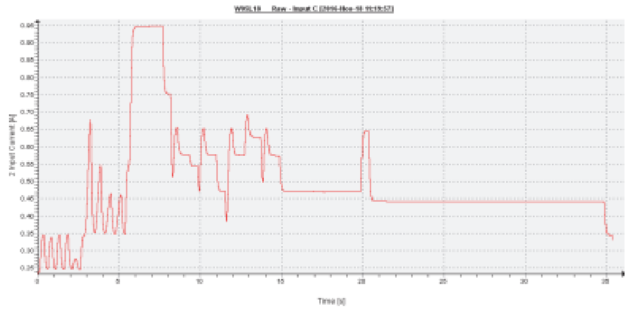


*Figure 47 An example of a SelfTest.x0xC.5psi input current waveform at 60 psi supply*

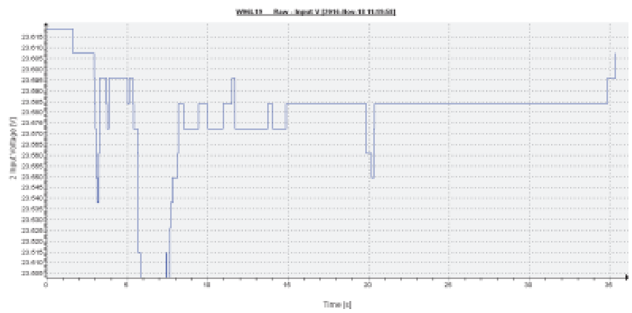


*Figure 48 An example of a SelfTest.x0xC.5psi input voltage waveform at 60 psi supply*

## 12.3 Upgrading from 3520 macro list version 1.x to 2.x

The 3520 Macro list version 2.x has a number of extensions and enhancements to make programming 3520 leak tests more flexible and intuitive. The legacy of macro functions in old applications requires backwards compatibility; however, maintaining the old macro usage in many cases is not the best practice. Some 3520 macros v. 1.x are redundant and have been discontinued. Other v. 1.x macros are still available, but should no longer be used. he following table lists the 3520 version 1.x macros that are no longer supported and will give errors if called.

***Table 36*** *Discontinued 3520 version 1.x macros*

| Macro | Reason for discontinuing support |
|---|---|
| C_SelfTest_5psi | This sequence is not backwards compatible and is no longer used. |
| C_SelfTest_5psi_Flow | This sequence is not backwards compatible and is no longer used. |
| FillPV1.Stop | This sequence has the same functionality as Config.PID.Stop. |

*Table 36 Discontinued 3520 version 1.x macros (Continued)*

| Macro | Reason for discontinuing support |
|---|---|
| FillPV3.Stop | This sequence the same functionality as Config.PID.Stop. |

The following table lists macro commands that are still available in the command inventory, for various reasons, but should no longer be used. There are new macros that can achieve the desired result more efficiently.

*Table 37 3520 macro commands v. 1.x replaced by v.2.13*

| Macro cmd v. 1.x | Macro cmd v. 2.13 to be used instead of v. 1.x | Reason for replacement |
|---|---|---|
| Test.Initialize | Init.Slow | These macros do not properly configure manifold temperature mode, engineering units, or the flow range, resulting in a non-deterministic test initialization. They also have PID parameters for over-range conditions that currently don't apply in a test configuration. They could not be changed to maintain backwards compatibility. |
| Test.Initialize.Fast | Init.Fast | |
| Test.Exhaust | Flow.Exhaust or PD.Exhaust | This general exhaust sequence is not as good or as fast as the flow/PD-specific exhaust sequences. |
| Test.Pass<br>Test.Fail | N/A | Macro commands need to be run in a sequence. For example, in order to set the LEDs to the Test.Pass state, you need to call: **SetSeq;0:Test.Pass,** followed by **SetSeqRunState*1,** and then verify that the sequence completes.<br>A more efficient way to achieve the same result is using **SetIndicators*Pass*1;SetIndicators*Fail*0;**<br>This is important particularly in short-cycle testing, because each command you have to handshake uses 10-100 ms to handshake. |
| Test.EngUnits | Config.EU | **Test.EngUnits** always uses **CalMode = 1** and sets **CalMode = 0** at the end of the sequence. This command should not be called every test. The replacement macro command **Config.EU** is configurable and defaults **CalMode = 2**. |
| Diag.SetADC1_Flow | N/A | There is no reason to call this command. Instead, use **SetADC1_Mode*Flow** in the sequence. Note that these calls are integrated into **Init.Fast** and **Init.Slow.** |
| Diag.SetADC1_Temperature | N/A | There is no reason to call this command. Instead, use **SetADC1_Mode*Temperature** in the sequence. Note that these calls are integrated into **Init.Fast** and **Init.Slow.** |

*Table 37 3520 macro commands v. 1.x replaced by v.2.13 (Continued)*

| Macro cmd v. 1.x | Macro cmd v. 2.13 to be used instead of v. 1.x | Reason for replacement |
|---|---|---|
| Pdecay.Isolate followed by<br>Pdecay.Stabilze | PD.Stabilize | The isolate timing is now fully parameterized inside **PD.Stabilize**; so, the replacement command is more flexible. Since Isolate was such a short part of the overall sequence, it makes more sense to just skip it. Also, since a Flow sequence does not include an Isolate stage, **PD.Stabilize** is the correct command. |
| FillPV1.P_Intialize | Fill.Thru.Bypass<br>Fill.Bleed<br>Fill.PV1.Init | **FillPV1.P_Intialize** uses a PV ramp which is overly complicated for most use cases and also limits the options for methods to fill.<br>With the replacement commands, you can construct whether you are using the Bypass fill (V1) or the Flow meter (V3) by choosing **Fill.Thru**. |
| FillPV1.P_Bumpless | Fill.PV1.Change | **Fill.PV1.Change** is fully parameterized and doesn't require any change or commands for the bleed valve. The bleed valve can be independently adjusted before or after this call. |
| FillPV3.P_Initialize | Fill.Thru.Bypass<br>Fill.PV3.Init | **FillPV3.P_Initialize** is limited to Bypass fill only. **Fill.PV3.Init** is better parameterized and has more common parameter function. |
| FillPV3.P_Bumpless | Fill.PV3.Change | **FillPV3.P_Bumpless** is more limited in parameterization than **Fill.PV3.Change**. |
| FillPV3.P_Transfer | Fill.PV3.Xfer.Config<br>Fill.PV3.Xfer.Start | **FillPV3.P_Transfer** needs extra parameter which is timing for **Fill.PV3.Xfer.Config**. **Fill.PV3.Xfer.Start** is better parameterized. |
| FillPV3.Flow_Init | Fill.Thru.Flowmeter<br>Fill.PV3.Init | **FillPV3.Flow_Init** is limited to Flow fill only. **Fill.PV3.Init** is better parameterized and has more common parameters. |
| Flow.StabilizePV1 | Flow.Stabilize.PV1 | **Flow.StabilizePV1** has delays of 100 ms. **Flow.Stabilize.PV1** also gives control over the flow meter over-range dwell time. |
| Flow.StabilizePV3 | Flow.Stabilize.PV3 | **Flow.StabilizePV3** has delays of 100 ms. **Flow.Stabilize.PV3** compacts delays and gives better control over timing. **Flow.Stabilize.PV3** also gives control over the flow meter over-range dwell time. |

## 12.4 Module 3520 sample leak sequences

This sections presents the following examples of common leak sequences that you can use as a starting point when building your own tests:


- *"Large Volume Flow Test sequence with high pressure fast fill" on page 116*
- *"Large Volume Flow Test sequence using high flow regulator" on page 119*
- *"Flow Test sequence for small volumes" on page 120*
- *"Pressure Decay Test sequence with a fast fill" on page 121*
- *"Pressure Decay Test sequence with a single fill pressure" on page 122*
- *"Pressure Decay Test sequence for small volumes" on page 124*


### 12.4.1 Large Volume Flow Test sequence with high pressure fast fill

A Fast Fill zone (which is essentially a high pressure zone) is recommended when you have a large-volume part or a long hose to the part, or both, and you want to pressurize the part as quickly as possible at the beginning of the test cycle to minimize cycle time.

Use this test sequence to overcome hose resistance between the 3520 Leak Test module and a large-volume part. The sequence provides a high pressure fast fill zone to get air into the part at an accelerated rate. See *Figure 49 on page 118* for an example flow and pressure waveforms.

Do not use this sequence if there is a very good connection between the 3520 module and the part, as this sequence will almost certainly result in over-pressurizing the part, or provide no cycle time improvements.

Do not use Fast Fill sequences when your part volume varies largely from test to test. The Fast Fill time is linked to the volume of the part; so, if you developed the Fast Fill time for a large part, and then switch to a small part, you will over-pressurize the part.

***Table 38*** *Example of a Large Volume Flow Test sequence with high pressure fast fill*

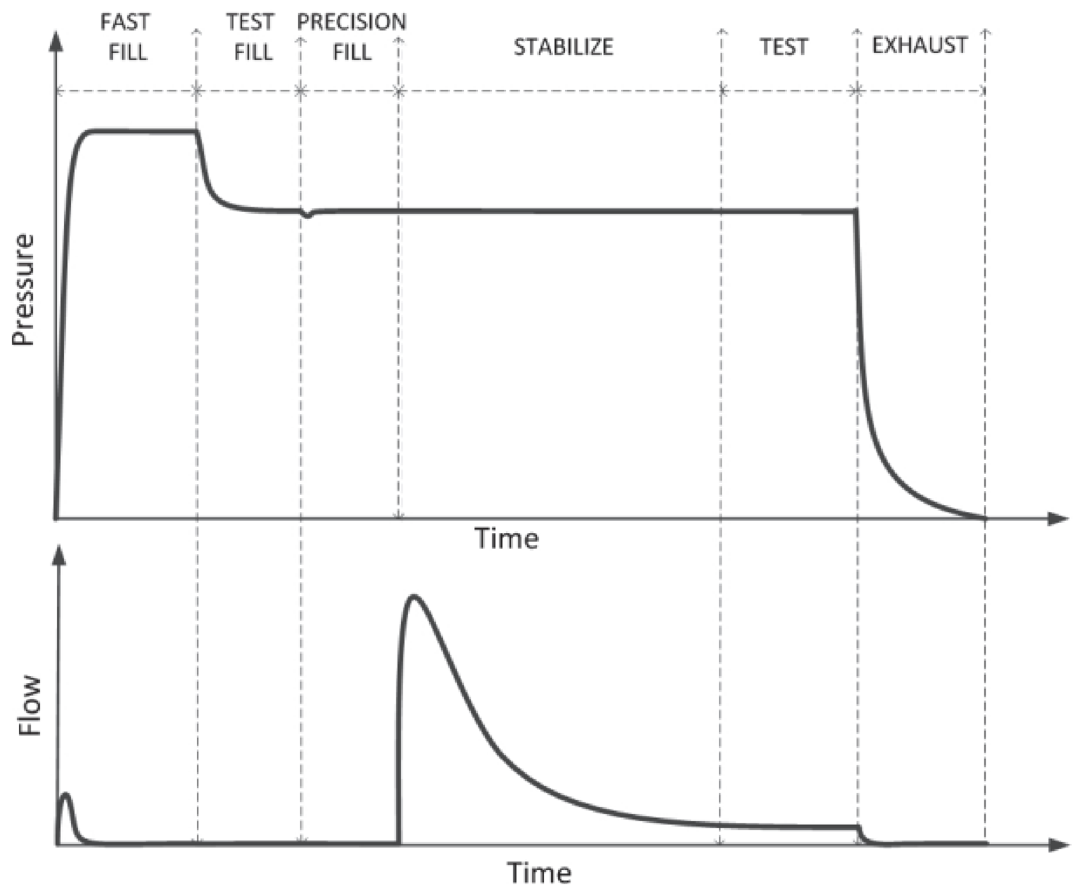
| No | Function.Macro | Test Zone | Duration (in ms) / Additional details* |
|---|---|---|---|
| 0 | Init.Slow | Initialize | 300 |
| 1 | Fill.Thru.Bypass | | |
| 2 | Fill.Bleed | | |
| 3 | Fill.PV1.Init | Fast Fill | Time to get the part up to pressure with an elevated fill pressure |
| 4 | Fill.PV1.Change | Test Fill | Time to get the part up to the test pressure and the flow into the part < 2 sLpm |

***Table 38*** *Example of a Large Volume Flow Test sequence with high pressure fast fill (Continued)*

| No | Function.Macro | Test Zone | Duration (in ms) / Additional details* |
|---|---|---|---|
| 5 | Fill.PV3.Xfer.Config | | The Precision fill fine-tunes the pressure to the test pressure. Switches in PV3 when the input flow is < 2 sLpm; otherwise, the pressure will fall because PV3 can't keep up.<br>**Note:** PV3 is the Test Flow valve which is a variable orifice between the supply port and the UUT, acting as a low flow rate precision regulator. |
| 6 | SetFilter*0*XXXX | | Optional time to inject filter command. This may improve controller performance. See *"OPC Commands" on page 127* for settings. |
| 7 | Fill.PV3.Xfer.Start | Precision Fill | The Precision fill fine-tunes the pressure to the test pressure. Switches in PV3 when the input flow is < 2 sLpm; otherwise, the pressure will fall because PV3 can't keep up.<br>**Note:** PV3 is the Test Flow valve which is a variable orifice between the Supply port and the UUT, acting as a low-flow rate-precision regulator. |
| 8 | Flow.StabilizePV3 | Flow Stabilize | When the flow is in range of the flow meter, switches the flow meter in. |
| 9 | Flow.Test | Flow Test | When the flow is well stabilized and it is time to make a measurement, switches the Test LED on. |
| 10 | Test.Exhaust | Exhaust | The Exhaust duration should be long enough to get the part to a safe exhaust level so that you can disconnect it. Usually, this duration is equal to or greater than the Fast Fill duration (see No 1 in this sequence). |
| 11 | Test.End | | 0 |

*For description of the macro commands, see *"The 3520 macro commands" on page 87*.

*Figure 49 An example of a waveform of a Flow or PD test with a Fast Fill, Test Fill, and Precision Fill zones*



### 12.4.2 Large Volume Flow Test sequence using high flow regulator

Use this test sequence with parts that require the high-flow electronic regular valve (PV1). Because you are setting the PIDs to the target pressure, there is no risk of over-pressurization. Once you have established the Fill characteristics, adding a Fast Fill zone may be a good idea.

***Table 39*** *Example of a Flow Test sequence using high-flow regulator*

| No | Macro | Test Zone | Duration (in ms) / Additional details* |
|---|---|---|---|
| 0 | Init.Fast | Initialize | 300 |
| 1 | Fill.Thru.Bypass | | |
| 2 | Fill.Bleed | | |
| 3 | Fill.PV1.Init | Fast Fill | Time to get the part up to pressure with an elevated fill pressure. |
| 4 | Fill.PV3.Xfer.Config | | The Precision fill fine-tunes the pressure to the test pressure. Switches in PV3 when the input flow is < 2 sLpm; otherwise, the pressure will fall because PV3 can't keep up.<br>**Note:** PV3 is the Test Flow valve which is a variable orifice between the supply port and the UUT, acting as a low-flow-rate precision regulator. |
| 5 | SetFilter*0*XXXX | | Optional time to inject filter command. This may improve controller performance. See *"OPC Commands" on page 127* for settings. |
| 6 | Flow.StabilizePV3 | Flow Stabilize | When the flow is in range of the flow meter, switches the flow meter in. |
| 7 | Flow.Test | Flow Test region | When the flow is well stabilized and it is time to make a measurement, switches the Test LED on. |
| 8 | Test.Exhaust | Exhaust | The Exhaust duration should be long enough to get the part to a safe exhaust level so that you can disconnect it. Usually, this duration is equal to or greater than the Fill duration (see No 1 in this sequence). |
| 9 | Test.End | | 0 |

*For description of the macro commands, see *"The 3520 macro commands" on page 87*.

### 12.4.3 Flow Test sequence for small volumes

Use this test sequence when you want to test a part with a small internal volume. It only uses the precision regulator valve (PV3) and saves the step of transitioning between PV1 and PV3.

***Note*** PV1 is the High-Flow valve, which is a variable orifice between the Supply port and the UUT, acting as a high-flow rate regulator. PV3 is the Test Flow valve which is a variable orifice between the Supply port and the UUT, acting as a low-flow-rate precision regulator. See *Figure 9 on page 30*.

***Table 40*** *Example of a Flow Test sequence for small volumes*

| No | Function.Macro | Test Zone | Duration (in ms) / Additional details* |
|---|---|---|---|
| 0 | Init.Fast | Initialize | 300 |
| 1 | Fill.Thru.Bypass | | Configures valves to fill through V1 (bypass fill) |
| 2 | FillPV3.P_Init | Test Fill | Test Fill duration. Time to get the part up to pressure and the flow into the range of the flow meter. |
| 3 | Flow.StabilizePV3 | Flow Stabilize | When the flow is in range of the flow meter, switches the flow meter in. |
| 4 | Flow.Test | Flow Test region | When the flow is well stabilized and it is time to make a measurement, switches the Test LED on. |
| 5 | Flow.Exhuast | Exhaust | The Exhaust duration should be long enough to get the part to a safe exhaust level so that you can disconnect it. Usually, this duration is equal to or greater than the Fill duration (see No 2 in this sequence) |
| 6 | Test.End | | 0<br>Turns off PID, closes all PV drivers and stops ADC reporting. |

*For description of the macro commands, see *"The 3520 macro commands" on page 87*.

### 12.4.4 Pressure Decay Test sequence with a fast fill

Use this sequence for large-volume Pressure Decay tests and when connection to the part is poor, requiring an elevated Fast Fill pressure.

***Table 41*** *Example of a Pressure Decay Test sequence with a fast fill*

| No | Macro | Test Zone | Duration (in ms) / Additional details* |
|---|---|---|---|
| 0 | Init.Slow | Initialize | 300 |
| 1 | Fill.Thru.Bypass | | |
| 2 | Fill.Bleed | | |
| 3 | Fill.PV1.Init | Fast Fill | Time to get the part up to pressure with an elevated fill pressure |
| 4 | Fill.PV1.Change | Test Fill | Fill duration. Ensure that the part is at the correct test pressure. |
| 5 | | | |
| 6 | PD.Stabilize | Stabilize | Wait for thermal decay to occur. |
| 7 | PD.Test | Test | Make the pressure decay measurement. Switches the Test LED on. |
| 8 | TPD.Exhaust | Exhaust | Exhausts the part. The Exhaust duration should be long enough to get the part to a safe exhaust level so that you can disconnect it. Usually, this duration is equal to or greater than the Fast Fill duration. |
| 9 | Test.End | | 0 |

*For description of the macro commands, see *"The 3520 macro commands" on page 87*.

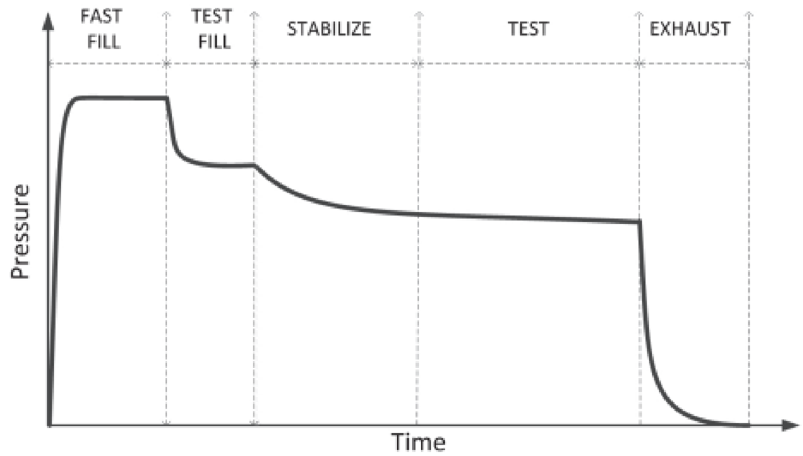



*Figure 50 An example of a waveform of a Pressure Decay test with a Fast Fill and Test Fill zone*

## 12.4.5 Pressure Decay Test sequence with a single fill pressure

Use this test sequence for large-volume Pressure Decay tests when there is a good connection to the part.

Note that it is possible to do this type of test using a Fast Fill pressure in addition to the regular Fill Pressure, and bypassing the test where you stabilize to the Test pressure. In some cases, this second scenario (i.e., using a Fast Fill) may produce better results. However, keep in mind that a Fast Fill usually makes the test susceptible to supply pressure and temperature effects.

***Table 42*** *Example of a Pressure Decay Test sequence with a single fill pressure*

| No | Macro | Test Zone | Duration (in ms) / Additional details* |
|---|---|---|---|
| 0 | Init.Slow | Initialize | 300 |
| 1 | Fill.Thru.Bypass | | |
| 2 | Fill.Bleed | | |
| 3 | Fill.PV1.Init | Test Fill | Ensure that the part is at the correct test pressure. |
| 4 | | | |
| 5 | PD.Stabilize | Stabilize | Wait for thermal decay to occur. |
| 6 | PD.Test | Test | Make the pressure decay measurement. Switches the Test LED on. |

### 12.4.6 Pressure Decay Test sequence for small volumes

Use this sequence for small-volume Pressure Decay tests when there is a good connection to the part.

***Table 43*** *Example of Pressure Decay Test sequence for small volumes*

| No | Macro | Test Zone | Duration (in ms) / Additional details* |
|---|---|---|---|
| 0 | Init.Fast | Initialize | 300 |
| 2 | Fill.Thru.Bypass | | |
| 3 | Fill.PV3.Init | Test Fill | Ensure that the part is at the correct test pressure. |
| | | | |
| 4 | PD.Stabilize | Stabilize | Wait for thermal decay to occur. |
| 5 | PD.Test | Test | Make the pressure decay measurement. Switches the Test LED on. |
| 6 | PD.Exhaust | Exhaust | Exhausts the part. The Exhaust duration should be long enough to get the part to a safe exhaust level so that you can disconnect it. Usually, this duration is equal to or greater than the Fast Fill duration. |
| 6 | Test.End | | 0 |

*For description of the macro commands, see *"The 3520 macro commands" on page 87*.

### 12.4.7 Fill-Through Flow Meter Flow Test sequence (A0DB model)

Use this sequence when you want to measure the volume of the air filling a part (pressure test) or removed from a part (vacuum test) to ensure proper part volume.

**Note:** Over-ranging the flow sensor is likely if its measurement range was selected based on the leak limit as opposed to the flow rate during the fill stage.

***Table 44*** *Example of Fill-Through Flow Meter Flow Test sequence*

| No | Macro | Test Zone | Duration (in ms) / Additional details* |
|---|---|---|---|
| 0 | Init.Fast | Initialize | |
| 1 | Fill.Thru.Flowmeter | | |
| 2 | Fill.Bleed | | |
| 3 | Fill.PV1.Init | Fill and Stabilize | Time to get the part up to pressure with an elevated fill pressure |
| 4 | Flow.Test | Evaluate Flow | When the flow is well stabilized and it is time to make a measurement, switches the Test LED on. |
| 5 | Flow.Exhaust | Exhaust | The Exhaust duration should be long enough to get the part to a safe exhaust level so that you can disconnect it. |
| 6 | Test.End | | 0 |

*For description of the macro commands, see *"The 3520 macro commands" on page 87*.

## 12.5 Breakdown of Test Initialization

Test initialization needs to run a number of commands before starting the ADC. *Table 45* outlines a sample test initialization sequence.

***Table 45*** *Example of a Test Initialization sequence*

| Command | Actual Run Duration (ms) | Function |
|---|---|---|
| ResetUnit | 160 | Ensures valves are in fail safe, and system is at known configuration. Background sampling is on. |
| ClearWave*All | 3 | Clears the FIFO. |
| Config.EU | < 1 | Sets the engineering units. |
| SetADC1_Mode | 11 | Sets the ADC1 mux appropriately. |
| SetFlowRange | 90 | Sets the digital flow meter to the correct setting. |
| Total | 265 (Verbosity 6)<br>235 (Verbosity 5) | |

When running tests with SetSeqRunState*2, the timing in *Table 45* can be ignored. Use Init.Fast.RS2 or Init.Slow.RS2.

When running tests with SetSeqRunState*1, the timing in *Table 45* must be respected and reflected in the sequence offset. This extra time is always included in the Init.Fast or Init.Slow run time. When the sequence gets more than 100 ms behind, it will throw an error; so, it is critical that appropriate initialization times are given.

## 12.6 OPC Commands

The macros are comprised of the generic OPC commands listed in *Table 46*. These commands offer all of the flexibility of the 3520 and can be used in addition to the macro commands.

Unlike 3520 macro commands that can be run only in a macro sequence, you can run individual OPC commands using the following syntax:

```
{command}*{P1}{P2}{P3} ...
```

**Note:** There is one level of commands below this command level, PIC commands, which this document does not describe.

***Table 46*** *OPC commands*

| Command | Parameters | Function |
|---|---|---|
| ClearWave | <channel><br>Or All | Clears waveform buffers. |
| SetCalMode | <On, Off, 0, 1, 2> | Sets the calibration mode.<br>The Operation.Status.CalMode element indicates the status of the calibration mode.<br>Some OPC elements and commands can be sent only in calibration mode. Turning on the calibration mode allows certain functions like the ability to change the Slope and Offset values directly in the OPC UA space and programming the PIC.<br>**Calibration Mode 0** – If already in mode 0, nothing happens. In Calibration mode 0 some commands are not permitted. When the command is sent to return to calibration mode 0, a CRC check is done, and the /usr/bin/3520Config.cfg file is over-written.<br>**Calibration Mode 1** – The mode for writing calibration information to the configuration file. Required for certain commands.<br>**Calibration Mode 2** – Used to set values for a test, but these values are not held on ResetUnit and nothing is written to the config file. |
| SetChannelSlope | <Channel><br><Slope> | Sets the channel slope. CalMode needs to be 1. |
| SetChannelOffset | <Channel><br><Offset> | Sets the channel offset. CalMode needs to be 1. |
| SetChannelCalDate | <Channel>,<br><Date> | Sets the channel calibration date. CalMode needs to be 1. |

*Table 46 OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| GetInfo | <OPC Element Name> | Allows retrieving the value of any OPC element status using programming. Return information:<br>• The floating point value is returned in the Operation.Cmd.Parm<br>• String text is returned in the Operation.Cmd.Output<br>The parameter <Information To Get> is the full OPC UA element name. For example:<br>• GetInfo, Unit.AppVersion will return the application version in the Operation.Cmd.Output.<br>• GetInfo,Sensor.Flow.Range will return the flow sensor range in the customers engineering units. |
| | ADC1_Mode | Returns either <Temperature> or <Flow> in string, and 0 for Flow or 1 for Temperature in the parameters |
| | ChannelCalibration,<br><ChannelIndex><br>Or<br><Sensor.ChannelName> | Sensor calibration information can be read using GetInfo,ChannelCalibration,<Channel Index> or GetInfo*Sensor.<ChannelName><br>• {Slope, offset, filter level and live value} are returned in the Operation.Cmd.Parm<br>• Calibration date is returned in the Operation.Cmd.Output<br>for example, "GetInfo,Sensor.Pressure" returns as follows:<br>• Operation.Cmd.Parm = {Sensor.Pressure.Slope, Sensor.Pressure.Offset, Sensor.Pressure.Filter, Sensor.Pressure.Live}<br>• Operation.Cmd.Output = Sensor.Pressure.CalDate |
| | GetInfo,Sequence | Operation.Cmd.Output = the current Sequence set from a SetSeq command. This is the expanded sequence, so macro names will not appear. |
| | PICCommandCounts | Returns the number of commands sent to the PIC |
| | GetInfo*PICToPRUCheck SumErrorCounts | Returns the number of checksum errors from PRU / PIC |

*Table 46 OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| | EngUnits,<br><Channel Type> | Operation.Cmd.Output = the engineering units for the channel.<br><br><ChannelType> can be one of:<br>1. Pressure<br>2. SupplyPressure<br>3. PilotPressure<br>4. Flow<br>5. Temperature |
| GetLastError | - | As long as there are errors in the log file, this command puts the oldest not-read error in the ErrorCode and ErrorString.<br>When there are no more errors in the log to read out, the value of 0 and text of “no error” is sent. |
| GetWave | <Channel><br><Import Type> | Instructs the 3520 to load a waveform into the OPC waveform output element.<br>< Channel > parameter selects the channel.<br>< Import Type > parameter selects what is done to the FIFO data:<br>0: Extract and leave the data in the FIFO<br>1: Extract and remove the data from the FIFO<br>Need to adhere to a waveform size limit as set in the OPC element. 64 K is the current server limitation.<br>• The size of the waveform that is in the Operation.Wave.Out is returned in Parm1. Note this can be smaller than the total samples of the waveform due to the limitation of the OPC array size.<br>• The sample interval is returned in Parm2 |
| GetWaveSize | <Channel> | Requests the sample count in the FIFO buffer for the <Channel> specified.<br>• The total sample count is returned in Parm1 and Operation.Wave.Samples.<br>• The sample interval is returned in Parm2. |
| PowerCycle | | Shuts down the OpcUaSvr and calls a PIC command to power cycle the unit. Note that this will not work if PIC communication is down. |

***Table 46*** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| ProgramPic | <file name> | Causes the 3520 server to program the PIC micro-controller on the 3520C PCB with the file that is given by the file name. Note that CalMode must be on to have the programming work. The file needs to be a hex file generated for the PIC chip.<br>For example, send the commands:<br>SetCalMode,On;ProgramPic,/usr/bin/3521db.hex |
| ResetErrors | | Resets and clears the error log. Returns Operation.Error.Count to zero. |
| ResetUnit | | • Sets all the outputs and registers to default power-on states.<br>• Stops any running PID and Sequence.<br>• Sends 0x1D to the 3520 PCB to call the soft reset routine which takes care of setting all the on-board parameters.<br>• Items set automatically with this command are:<br>0x12 (echo off)<br>0x11 (stop sampling)<br>0x04 0x0000 (all valves off)<br>0x05 0x0000 (all LEDs off)<br>0x06 0x00 (Reference cal set to AGND)<br>0x06 0x40, 0x06 0x50, 0x06 0x60, 0x06 0x70 (All channels set to channel input)<br>0x07 0x00 (All prop valves off)<br>0x0F 0x02 (Short on RTD inputs)<br>0x2F 0x00 (Stop PID)<br>0x09 0x00 0x0000 0x09 0x01 0x0000 0x09 0x02 0x0000 0x09 0x03 0x0000 0x09 0x04 0x0000 (All DACs at 0 VDC) |
| ResetServer | | Causes the 3520 Server code to stop and restart.<br>Boot count should increment as a result. |

***Table 46*** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetADC<br>(Backwards compatibility only; use SetADCF) | <Rate>,<br><Channels>,<br>[<Samples>]<br>or<br><"Stop"> | • Starts and stops the analog to digital collection.<br>• The parameter <Rate> tests the number of ms between samples. Valid values are as follows:<br>- Hexadecimal values 0x00 to 0x255, where 0x00 stops the sampling<br>- The word "stop" which sends 0 to the rate. The parameters <Channels> and <Samples> are not required and not sent to the 3520 processor if Stop is used.<br>• The parameter <Channels> sets the bit-wise value with which channels are to be collected. The channels are listed below. The PID versions are from the PIC and not used unless we cannot get the BBB to be real time.<br>• The parameter <samples> is optional and if included sends the number of samples to collect to the 3520 processor.<br>• Sends out the command 0x11 Stream ADC readings. The syntax is 0x11 0xtt 0xbbbb 0xssss where:<br>"tt" is the interval time in ms<br>"bbbb" is the bit wise channel selection<br>"ssss" is the optional number of samples to take. If this is not included in the command, then is it not included in the command sent to the 3520 processor.<br>**IMPORTANT:** You must set the appropriate SetADC_RateInt for the collection rate, or this command will not work. The SetADC_RateInt must be faster than the collection rate used. |
| SetADCF | <Rate in Hz>,<br>[<Samples>]<br>or<br><"Stop"> | Starts and stops ADC collection to the FIFO buffer.<br><Rate in Hz><br>• The first parameter is the collection rate in Hz.<br>• The min rate is 30 and the max is 1600.<br>• The command automatically sets the SetADC_RateInt to the largest value for the given collection rate resulting in the lowest noise signal. There is no need to send the SetADC_RateInt command when using SetADCF.<br>• All channels that can be collected will be collected.<br>• Sending a value of 0 for the rate will stop the collection to the FIFO. |

**Table 46** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetADCF (Continued) | | [<Samples>]<br>• Optionally the number of samples can be specified as the second parameter to the rate. The exact number of samples will be collected to the FIFO buffers.<br><"Stop"><br>• Sending SetADCF,Stop will stop the collection to the FIFO buffer.<br>This command is for use with SPI collection. |
| SetADC_RateInt | <RateSel> | Sets the internal rate of the ADC<br>Parameter <RateSel> can be either hex or decimal:<br>1x Sampling<br>0: 6.8 Hz<br>1: 13.75 Hz<br>2: 27.5 Hz<br>3: 55 Hz<br>4: 110 Hz [Default = 4]<br>5: 220 Hz<br>6: 440 Hz<br>7: 880 Hz<br>8: 1760 Hz<br>9: 3520 Hz<br>2X Sampling:<br>0a = 13.75 Hz<br>0b = 27.5 Hz<br>0c = 55 Hz<br>0d = 110 Hz<br>0e = 220 Hz<br>0f = 440 Hz<br>10 = 880 Hz<br>11 = 1760 Hz<br>12 = 3520 Hz<br>13 = 7030 Hz<br>Uses the ADC_RateIn command 0x25. The syntax is 0x25 0xdd. Where 0xdd is the <RateSel> value in Hex. |

***Table 46*** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetADCMode | <Mode> | Sets the Analog-to-digital converter mode. A ResetServer command is automatically called once the mode has been changed.<br>0: RS-232 mode<br>• compatible with all revisions<br>• Required for rev 4 PCB<br>1: SPI mode<br>• Compatible only with PCB revision 5 and higher<br>• Allows faster collection<br>• Enables more channels for measurement |
| SetADCBackground | <rate> | Sets the ADC background mode with the <rate> in ms. Updates the config file. |
| SetADC1_Mode | "Flow" or "Temperature" | Behavior:<br>IF the flow meter model code is 0, A, B or C then:<br>IF the unit is in digital flow meter mode then:<br>If the Manifold Temperature Sensor Present is True then:<br>Default to <Temperature><br>Allow the SetADC1_Mode command to operate and change the mode<br>Else<br>Set the SetADC1_Mode to <Flow><br>Do not allow the SetADC1_Mode command<br>Issue error if the SetADC1_Mode command is issued and trying to set the Mode to <Temperature><br>END<br>ELSE<br>Set the SetADC1_Mode to <Flow><br>Do not allow the SetADC1_Mode command to operate<br>Issue one error if the SetADC1_Mode command is issued and trying to set the Mode to <Temperature><br>END |

*Table 46 OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| | | ELSE - (If the flow meter model code is D or E type then)<br>Default to ADC1 using the flow meter mode<br>IF the Manifold Temperature Sensor Present is True then:<br>Allow the SetADC1_Mode command to operate and change the mode<br>ELSE<br>Set the SetADC1_Mode to <Flow><br>Do not allow the SetADC1_Mode command to operate<br>Issue one error if the SetADC1_Mode command is issued and trying to set the Mode to <Temperature><br>END<br>END |
| SetCmdtoPIC | <Command> | Sends the <Command> directly to the PIC chip.<br>Note that the command can have spaces. For example "SetCmdtpPIC,0x05 0x0000;" would send 0x05 0x0000 to the 3520 PCB processor.<br>Any return from the PIC should be captured and put in the Command Out String |
| SetEngUnits | <Channel Type>,<br><Units Type>,<br>[a, v, g] | Sets the engineering units used on the 3520.<br><ChannelType> can be one of:<br>1. Pressure<br>2. SupplyPressure<br>3. PilotPressure<br>4. Flow<br>5. Temperature<br><br>[a, g, or v]<br>• Required for Pressure and Supply pressure only and not allowed for the other channel types<br>• Sets whether to use gauge, vacuum or absolute pressure |

***Table 46*** *OPC commands (Continued)*

<table>
<tr><th>Command</th><th>Parameters</th><th>Function</th></tr>
<tr><td>SetFlowRange</td><td><Range Number></td><td>Sets the flow meter range for flow meters that are using the digital flow meter type.<br><br><Range Number> is the range number 1 to 8. Currently only two ranges are supported for the A, B or C flow meter types.<br><br>Note: This command is ONLY for flow meter types A, B and C. It will give an error if sent to a unit that is a flow meter type 0, D or E.<br><br>
<table>
<tr><th>Flowmeter Type</th><th>Range 1</th><th>Range 2</th><th>Units</th></tr>
<tr><td>0</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>A</td><td>50</td><td>10</td><td>sccm</td></tr>
<tr><td>B</td><td>250</td><td>100</td><td>sccm</td></tr>
<tr><td>C</td><td>3000</td><td>1000</td><td>sccm</td></tr>
<tr><td>D</td><td>10</td><td>NA</td><td>slpm</td></tr>
<tr><td>E</td><td>30</td><td>NA</td><td>slpm</td></tr>
</table></td></tr>
<tr><td>SetIndicators</td><td><Indicator><br><br><State></td><td>Sets the indicator states. This command works on individual indicators as well as all indicators.<br><br>That is, the < Indicator > parameter can be either “All” or Individual indicator name or number.<br><br>All”<br><br>“All”—sets all Indicator states at the same time:<br>
• This sets all the Indicators to the <State> parameter.<br>
• This sends command 0x05 Set Indicators. The syntax is 0x05 0xbbbb where b is the hex value for the valve states.<br>
• The valid options for <State> are:<br>
“Off” - in this case 0 is sent<br>
“On” - in this case 0x0FFFF is sent<br>
Hex value in the format 0x0000 - which is directly sent.<br>
• Pulse to pulse them all on for 2 seconds. The indicators return to the previous state.</td></tr>
</table>

***Table 46** OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetIndicators (Continued) | <Indicator><br><State> | Individual Indicator name or number<br>• In this case only the Indicator selected is set to the condition in the <state> parameter; all other Indicators are left in their previous state.<br>• This sends command 0x19 Set Single Indicator. Syntax is 0x19 0xVS, where V is the indicator number 0 to 8 and S is the indicator 0 or 1.<br>• Valid < Indicator > names and numbers:<br>0: Pass<br>1: Fail<br>2: Fill<br>3: Exhaust<br>4: Test<br>5: Diag<br>6: Online (Controlled by the main process as status so not allowed)<br>7: DiagYellow<br>8: DiagRed<br>• The valid options for <State> are:<br>1 or "On" sets it to a 1<br>0 or "Off" sets it to a 0 |
| SetInfo | LoadPICTemperatureCal | Reads in the slope and offset for temperature channel 1 and 2 from the values stored in the PIC memory. The ADC collection momentarily stops to allow the serial communications. |
| | ManifoldTemperature | Accepts input 0 or 1 to indicate whether the manifold temperature is present. |
| | Unit.ModelNumber | Requires Cal Mode |
| | Unit.SerialNumber | Requires Cal Mode |
| | Unit.DateofManufacture | Requires Cal Mode |
| | SystemCrash | Generates a core dump *DON'T USE |
| | SequenceTimeErrorLevel | Enter number of ms before sequence times out and gives an error. |

**Table 46** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetInfo<br>(Continued) | Sys.Logfile.Verbosity | SetInfo,Sys.Logfile.Verbosity,<Verbosity Value>.<br>Requires Cal Mode on. The <Verbosity Value> can be between 0 and 6;<br>Issues an error only if outside this range: "Error log verbosity must be in the range of 0 to 6". As usual, the verbosity will be reset to 5 after a power cycle or ResetServer command. |
| | MaxPICToPRUCheckSum Err | Requires CalMode = 1<br>Sets the number of PIC to PRU errors before an error message is logged. Default is 3. |
| | PICNumberRetries | Requires CalMode = 1. Sets the number of retries permitted for PIC communication on checksum failure. Default value is 3. Values 0 to 3 are accepted. |
| SetMux | <Mux> <State> | Sets the analog multiplexers for 3520 PCB.<br>Parameter <Mux> selects the mux to set. Valid parameters for mux are:<br>• Mux number:<br>Number between 0 and 8<br>• Mux name:<br>0: RefCal<br>1: Proportional<br>2: Supplies<br>3: Sensors<br>4: ADC0<br>5: ADC1<br>6: ADC2<br>7: ADC3<br>8: ADC_All<br>Parameter <State> selects the state of the mux. This value is a number between 0 and 15.<br>This command sends the command 0x06 Set Muxes to the 3520 PCB. The syntax is 0x06 0xMD where M is the mux number and D is the state number. |

***Table 46*** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetPID | <State>,<br>[<PID channel>] | Controls the operation of the PID.<br>Parameter <State> is a bit-wise control as follows:<br>Bit 0: PID running state<br>0: Stopped<br>1: Running<br>Bit 1: Integral held in rest<br>0: Not held<br>1: Held in rest (preload)<br>Bit 2: Update values:<br>This bit allows new PID parameters to be transferred one at a time; then, once complete, updates all at once<br>0: Don't update PID parameters<br>1: Update PID parameters at the same time<br>Bit 3: Bumpless Transfer:<br>0: Do not use bumpless transfer<br>1: Use bumpless transfer<br>Bit 6-4: Selects the DAC to control<br>0: DAC0 (PV1 Fast Fill)<br>1: DAC1 (PV2 Fast Bleed)<br>2: DAC2 (PV3 Precision Fill)<br>3: DAC3 (PV4 Self Check)<br>Bit 7: Reset Values<br>0: Leave values as is<br>1: Reset accumulator to prechange value and Reset Kout initial value to Bias<br>[Default = 0x00] |
| SetPID_Bias | <Value> | Sets the Bias for the PID (in output terms) (float) [Default = 3] |
| SetPID_DerGain | <Value> | Sets the Derivative gain term of the PID (float). [Default = 0] |
| SetPID_DerLim | <Value> | Sets the absolute limit of the Derivative term (float) [Default = 8] |
| SetPID_Feedback | <Value> | 0: Use pressure signal as feedback only [Default]<br>1: Use flow signal as feedback only<br>2: Use pressure signal as feedback with flow protection on; so, switch to flow input as required (not implemented yet) |

*Table 46 OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetPID_FlowHold | <Value> | Sets the flow hold value that is used as the set point for controlling the pressure at near max flow in the flow protection mode. For example, if the flow meter maximum is set to 98 sccm, this value could be 94 sccm. This value is held until the pressure reaches the original pressure target.<br>[Default = 0] |
| SetPID_FlowMax | <Value> | Sets the max flow limit that triggers switching to flow protection mode. For example, if the flow meter is 100 sccm flow meter, this value could be 98 sccm.<br>[Default = 0] |
| SetPID_IntControl | <Control><br><PreCharge> | Sets the control of the integral accumulator.<br><Control> parameter:<br>Bit 0: PID Clamp On/Off. If this is set when the proportional term is in limit mode, the accumulated integral values is held at the <PreCharge> value.<br>Bit 1: Integral self-limit on/off. If the output of the integral term is itself being limited, then the accumulated error count is reduced to match that integral limit.<br>Bit 2: Output self-limit on/off. If the PID output is itself being limited, then the accumulated error count can be reduced, such that the PID output matches that limit.<br>The final value of the accumulator is the lowest value forced by any of the overriding mechanisms.<br><PreCharge> parameter sets the value for the integral pre-charge. When the PID is started, or if this command is issued as the PID is running, the value in the accumulator is set to the <PreCharge>.<br>[Default = 0, 0] |
| SetPID_IntGain | <Value> | Sets the Integral gain term of the PID (float). [Default = 0] |
| SetPID_IntLim | <Value> | Sets the absolute limit of the Integral term (float) [Default = 8] |
| SetPID_OutAccel | <Value> | Sets the max acceleration of the PID output (output terms/second), applied in both the positive and negative direction (float)<br>0 = deactivated [Default] |
| SetPID_OutLim | <Value> | Sets the high output clip for the PID (float). [Default = 11] |
| SetPID_ProGain | <Value> | Sets the Proportional gain term of the PID (float). [Default = 0] |
| SetPID_ProLim | <Value> | Sets the absolute limit of the Proportional term (float). [Default = 8] |

***Table 46** OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetPID_PrsLimH | <Value> | Sets the high limit for the pressure sensor (float). If reached, the PID is shut down.<br>[Default = 5] |
| SetPID_PrsLimL | <Value> | Sets the low limit for the pressure sensor (float). If reached, the PID is shut down.<br>[Default = -1] |
| SetPID_SetPt | <Value>,<br>[EndValue],<br>[Duration] | If a single parameter is given, then this sets the Set-point for PID. Units are input terms. (float) [Default = 0]<br>If three parameters are given, then the pressure ramp is used. The parameters are as follows:<br>• Start point for ramp. Units are input terms.<br>• End point for ramp. Units are input terms.<br>• Duration in ms |
| SetPID_SetPtAccel | <Value> | Sets the max acceleration of the set-point (input terms/ second), applied in both the positive and negative direction (float)<br>0 = deactivated [Default] |
| SetPilotPrsHigh | <Value> | Sets the pilot pressure high limit. [Default = 100] |
| SetPilotPrsLow | <Value> | Sets the pilot pressure low limit. [Default = 30] |

***Table 46** OPC commands (Continued)*

<table>
<tr><th>Command</th><th>Parameters</th><th>Function</th></tr>
<tr><td>SetPropLevel</td><td><DAC/Proportional Valve Channel>,<br><br><Value></td><td>Sets one of the DACs which can control proportional valves to a specific voltage.<br><br><DAC/Proportional Valve Channel> parameter is the DAC channel to set. Valid parameters for this are:
<ul>
<li>DAC channel index between 0 and 5<br>Note this is zero based.</li>
<li>Proportional Valve number PVn (or)</li>
<li>Proportional Valve name:</li>
</ul>
<table>
<tr><th>DAC channel index</th><th>Proportional Valve number</th><th>Proportional Valve name</th></tr>
<tr><td>0</td><td>PV1</td><td>HighFlow</td></tr>
<tr><td>1</td><td>PV2</td><td>HighBleed</td></tr>
<tr><td>2</td><td>PV3</td><td>TestFlow</td></tr>
<tr><td>3</td><td>PV4</td><td>SelfTest</td></tr>
<tr><td>4</td><td>PV5</td><td></td></tr>
</table>
< Value > parameter is the voltage to set the DAC output to.
<ul>
<li>This parameter converts the voltage to counts using the slopes read from the PIC internal memory on boot-up. The command sent to the PIC is 0x09 0x0d 0xmmmm, where d is the DAC channel number and mmmm is the hex value to set the DAC output.</li>
<li>[Default = 0 V]</li>
</ul></td></tr>
<tr><td>SetPropValve</td><td><Valve>, <On/Off></td><td>Sets the proportional valve states. This command works on individual valves, as well as all valves.<br><br><Valve> parameter can be either "All" for set all proportional valve states at the same time, OR Individual valve name or Vn:<br><br>"All":
<ul>
<li>Sets all the valves to the <State> parameter.</li>
<li>Sends command 0x07 Set Prop Control Bit. The syntax is 0x07 0x0b where b is the hex value for the valve states.</li>
<li>The valid options for <State> are:<br>"Off" in this case 0x00 is sent<br>"On" in this case 0x0FF is sent<br>Hex value in the format 0x00 which is directly sent.</li>
</ul></td></tr>
</table>

***Table 46*** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| | | Individual valve name or Vn:<br>• In this case, only the valve selected is set to the condition in the <state> parameter; all other valves are left in their previous state.<br>• This value sends command 0x1B Set single prop Valve. Syntax is 0x1B 0xVS, where V is the bit number 0 to 3 and S is the state 0 or 1.<br>• Valid <Valve> names:<br>0: PV1 or HighFlow<br>1: PV2 or HighBleed<br>2: PV3 or TestFlow<br>3: PV4 or SelfTest<br>• The valid options for <State> are:<br>1 or “On” sets it to a 1<br>0 or “Off” sets it to a 0 |
| SetSeq | <Delay>:<br><Command>;<br><Delay>:<br><Command>] | Loads a sequence into memory.<br>Sequence is a series of combinations of <Delay> values in ms followed by commands separated by “:”<br>Example: SetSeq;10:SetValve,All,Off;1000:SetValve,Fill,On |
| SetSeqRunState | <State> | Sets the state of the sequence machine.<br><State> parameter can be:<br>0: Stop [Default] – also imitates abort function<br>1: Start and honor all sequence timing<br>2: Start and only track sequence timing after first ADC sample point |
| SetSuppPrsHigh | <Value> | Sets the supply pressure high limit. [Default = 100] |
| SetSuppPrsLow | <Value> | Sets the supply pressure low limit (added to pressure set point). [Default = 20] |

***Table 46*** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetValve | <Valve>, <State> | Set the binary valve states. This command works on individual valves as well as all valves.<br><Valve> parameter can be either "All" for setting all valve states at the same time OR individual valve name or Vn (valve number)<br>"All"<br>• Sets all the valves to the <State> parameter.<br>• Sends command 0x04 Set Binary valves. The syntax is 0x04 0xbbbb where bbbb is the hex value for the valve states.<br>• The valid options for <State> are:<br>- "0" or "Off" in this case 0x0000 is sent<br>- "1" or "On" in this case 0xFFFF is sent<br>- Hex value in the format 0xbbbb which is directly sent to the PIC. For example, SetValve,All,0xABCD the command 0x04 0xABCD is sent to the PIC. The State must include the "0x" to indicate that it is hex.<br>- Always need to send 4 nibbles with 0x in front. Pad value with 0 if less than 4 nibbles are given. For example, 0xFF will send 0x04 0x00FF.<br>- Issue error message if greater than 0xFFFF is provided.<br>- Issue error if decimal value other that 0 or 1 is sent. |

*Table 46 OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetValve (Continued) | <Valve>, <State> | Individual valve name or Vn (valve number):<br>• In this case only the valve selected is set to the condition in the <state> parameter; all other valves are left in their previous state.<br>• This sends command 0x1A Set individual Binary Valve. Syntax is 0x1A 0xVS, where V is the bit number 0 to 11 and S is the state 0 or 1.<br>• Valid <Valve> names:<br>0 or V1 or Fill<br>1 or V2 or Exhaust<br>2 or V3 or Flow<br>3 or V4 or UUT<br>4 or V5 or Calibration<br>8 or ExtV1<br>9 or ExtV2<br>10 or ExtV3<br>11 or ExtV4<br>**Note:** Valves 5, 6, and 7 are not present in the system.<br>• The valid options for <State> are:<br>1 or "On" sets it to a 1<br>0 or "Off" sets it to a 0 |
| ZeroSensor | <Channel>,<br><Samples> | The command performs an average of the last N samples in the FIFO and writes this to the calibration value for the zero of the sensor.<br>This action is performed for the channel index specified.<br>Cal mode must be on in order to run this command. |
| SetSensorPrsLim | (% FS) | • Sends command 0x33 with decimal value in ADC counts<br>• Percent of FS takes a floating point value<br>• Scale 0 to 100% FS between 0 to 2^24 counts<br>• Default is 98%<br>• Issue error if values out of 0 to 100 are sent |
| SetSensorPrsLimDwell | (time in ms) | • Sends command 0x3E with decimal value of ms<br>• Default is 0 ms<br>• Error if negative or over max 60,000 ms |

***Table 46*** *OPC commands (Continued)*

| Command | Parameters | Function |
|---|---|---|
| SetSensorFlowLim | (% FS) | • Sends command 0x3D with decimal value in ADC counts<br>• Percent of FS takes a floating point value<br>• If in Digital FM mode:<br>Scale 0 to 110% FS between 0 to 11,000 counts<br>Default is 105%<br>• If in Analog FM mode:<br>Scale 0 to 110% FS between where 0 = 0 and 100% = 2^23 / counts (or 110% = 2^23 * 1.1)<br>Default 105%<br>• Issue error if values out of 0 to 110% are sent |
| SetSensorFlowLim Dwell | (Time in MS) | • Sends command 0x3F with decimal value of ms<br>• Default is 10,000 ms<br>• Error if negative or over max 60,000 ms |
| SetFilter | <channel><br><number of samples> | • Specifies the filter level for a given channel.<br>• Note that channels 0,1,2,3,6,8,9,10,11,14,18,19 are valid. All other channels issue an error. |
| GetPICCommands | <All> | • Returns the last PIC command<br>• With GetPICCommands*All returns whole FIFO |

## 12.7 3520 OPC Channel Map

In many commands, you will be required to list an argument "Channel". The channel map is listed in *Table 47*. Note that channels 12 through 15 for PID 2 are not currently enabled. Also note that the PID_D filter is not effective.

***Table 47*** *3520 Channel map*

| Index | Name | Exposed Slope/ Offset | Filter | Cal Date | Cal Source | Units Calibration Type | Notes |
|---|---|---|---|---|---|---|---|
| 0 | Pressure | Yes | Yes | Yes | Config | Pressure | Main pressure sensor |
| 1 | Flow | Yes | Yes | Yes | Config | Flow | Flow meter value |
| 2 | Temperature1 | Yes | Yes | Yes | Config | Temperature | External temperature sensor 1 |
| 3 | Temperature2 | Yes | Yes | Yes | Config | Temperature | External temperature sensor 2 |
| 4 | PID_P | | | | none | Fixed V | |
| 5 | PID_I | | | | none | Fixed V | |
| 6 | PID_D | | Yes | | none | Fixed V | |
| 7 | PID_Out | | | | PIC mem | Fixed V | |
| 8 | SupplyPressure | Yes | Yes | Yes | Config | SupplyPressure | Supply pressure sensor |
| 9 | PilotPressure | Yes | Yes | Yes | Config | PilotPressure | Pilot pressure sensor |
| 10 | InternalTemperature | | | | Config | Temperature | |
| 11 | ManifoldTemperature | | Yes | | PIC mem | Temperature | |
| 12 | PID2_P | | | | none | Fixed V | Not used |
| 13 | PID2_I | | | | none | Fixed V | Not used |
| 14 | PID2_D | | Yes | | none | Fixed V | Not used |
| 15 | PID2_Out | | | | PIC mem | Fixed V | Not used |

*Table 47 3520 Channel map (Continued)*

| Index | Name | Exposed Slope/ Offset | Filter | Cal Date | Cal Source | Units Calibration Type | Notes |
|---|---|---|---|---|---|---|---|
| 16 | PID_Response | | | | none | Fixed ms | From the PIC |
| 17 | RealTimeInc | | | | none | Fixed ms | This is from the BBB timer |
| 18 | InputCurrent | | Yes | | From PIC | Fixed Amps | |
| 19 | SupplyVoltage | | Yes | | From PIC | Fixed V | |

## 12.8 Macrofunctions.cfg syntax

The macrofunctions.cfg file supports a range of syntax options to make it easier to edit and read.

You can use sequences of shorter strings (that is, CR/LF) to format very long strings. For example, the two examples below are equivalent, but the version on the left uses CF/LF to make it easier to read each command.

| | |
|---|---|
| `{`<br>`command = "V1";`<br>`action = "0:SetValve*Fill*1;"`<br>`"0:SetIndicators*Fill*1;";`<br>`},` | `{`<br>`command = "V1";`<br>`action = "0:SetValve*Fill*1;0:SetIndicators*Fill*1;";`<br>`},` |

Three types of comments are allowed in the macrofunctions.cfg file:

1. All text beginning with a '#' char to the end of the line is ignored (preferred)
2. All text between a starting '/*' sequence and an ending '*/' sequence is ignored.
3. All text beginning with a '//' sequence to the end of line is ignored

For example, the highlighted text below is ignored. Usually, only the # comment style is used.

```
{
    command = "V1";
    /* This command opens the fill valve */
    action =            "0:SetValve*Fill*1;"                  #This is a comment
                    "0:SetIndicators*Fill*1;":         // This is also a comment
    `
```

# 13.0 Appendix B - 3520 macro commands v. 1.x

*Table 48* provides details about the original list of 3520 macro commands. For information which of these commands are discontinued (or still present but not supported) in v 2.1 of the 3520 macro list, see *"Upgrading from 3520 macro list version 1.x to 2.x" on page 113*.

***Table 48*** *3520 macro commands v.1.x*

| | Function.Cmd | Duration (ms) | Description | Parameters |
|---|---|---|---|---|
| 1 | **Test.Initialize** | 300 | Sets Fail-safe test limits. Starts the ADC, zeros the pressure sensor for gauge reference | P1 - Low pressure limit for test (pressure units)<br>P2- High pressure limit for test (pressure units) |
| 2 | **Test.Initialize.Fast** | 80 | Same as Test.Initialize but reduces the time for faster tests - assumes that the valves are in exhaust state when coming in | P1 - Low pressure limit for test (pressure units)<br>P2- High pressure limit for test (pressure units) |
| 3 | **Test.Exhaust** | 150 | Turns off all PIDs and exhaust the part without stopping the test or the ADC | |
| 4 | **Test.End** | 25 | Stops the ADC and all PIDs | |
| 5 | **Test.Pass** | 25 | PASS LED on. FAIL LED off | |
| 6 | **Test.Fail** | 25 | FAIL LED on, PASS LED off | |
| 7 | **Test.EngUnits** | 0 | Sets Eng units for the system | P1 - Pressure Units<br>P2 - a /g / v*<br>P3 - Supply Pressure Units<br>P4 - a / g / v*<br>P5 - Pilot pressure units<br>P6 - a / g / v*<br>P7 - Flow Units<br>P8 - Temperature Units<br><br>*a = absolute, g = gauge, v = vacuum |
| 8 | **Diag.CalValve** | 0 | Sets the Diag valve configuration | P1 - Cal valve state (1,0/ On, Off)<br>P2 - Diag LED state (1,0/On, Off) |

*Table 48 3520 macro commands v.1.x (Continued)*

| | Function.Cmd | Duration (ms) | Description | Parameters |
|---|---|---|---|---|
| 9 | Diag.UUTValve | 0 | Sets the UUT valve configuration | P1 - UUT valve state (0, 1, On, Off)<br>P2 - Diag LED state (0, 1, On, Off) |
| 10 | Diag.AtmRef | 1000 | Takes 1 s to get a solid atmospheric reference measurement | |
| 11 | Diag.FillPV3 | 225 | Isolates, exhausts, and then fills the 3520 to the desired test pressure. Does not zero the pressure sensor. Leaves PID and ADC running on sequence completion in order to hold pressure. | P1 - Set Pressure (pressure units) |
| 12 | Diag.C_SelfTest_5psi | 45375 | Performs a self-test sequence that runs at 5 psi on the 3520 C. Flashes lights, toggles all valves, tests fast fill, slow fill, and all PVs. | |
| 13 | Diag.C_SelfTest_5psi_Flow | 55675 | Performs a self-test sequence that runs at 5 psi on the 3520 C. Flashes lights, toggles all valves, tests fast fill, slow fill, all PVs. Runs flow control at the end to test the flow meter. | |
| 14 | Diag.SetADC1_Flow | 0 | Sets the ADC1 to Flow mode | |
| 15 | Diag.SetADC1_Temperature | 0 | Sets the ADC1 to Temperature mode | |
| 16 | Diag.Exh_Valve_Test.Fill_PV3 | 200 | Same as the FillPV3.P_Initialize but does not turn off the Exhaust valve. To be used to debug if the Exhaust valve is leaking. Need to plug the Exhaust port manually. | P1 - Set Pressure (pressure units)<br>P2 - Proportional Gain (volts / pressure)<br>P3 - Integral Gain (volts / pressure)<br>P4 - Derivative Gain (volts / pressure)<br>P5 - PV2 level (0 to 65535)<br>P6 - PV2 ramp (DAC counts / 10 ms) |

**Table 48** *3520 macro commands v.1.x (Continued)*

| | Function.Cmd | Duration (ms) | Description | Parameters |
|---|---|---|---|---|
| **17** | **Pdecay.Isolate** | 250 | Sets valves in PD state. Stops PID on PV1 and PV3, turns on PV2 to vent behind V1 and V3. Fill LED off. Test LED On. | |
| **18** | **Pdecay.Stabilize** | 100 | Turns off PV2. Test LED On. | |
| **19** | **Pdecay.Test** | 25 | Test LED on. | |
| **20** | **Flow.StabilizePV1** | 275 | Switches from FillPV1 to flow test. Fill LED off. Test LED on. | P1 - Delay between Fill off and PID restart. Wait for hose oscillations to stop. |
| **21** | **Flow.StabilizePV3** | 275 | Switches from FillPV3 to flow test. Fill LED off. Test LED on. | P1 - Delay between Fill off and PID restart. Wait for hose oscillations to stop. |
| **22** | **Flow.Test** | 25 | Test LED On. | |
| **23** | **FillPV1.P_Initialize** | 200 | Starts a fill operation with PV1, using PV2 as the fast bleed. Ramps PV2 from 0 to <P4> using <P5> to define ramp duration. | P1 - Set Pressure (pressure units)<br>P2 - Proportional Gain (volts / pressure)<br>P3 - Integral Gain (volts / pressure)<br>P4 - Derivative Gain (volts / pressure)<br>P5 - PV2 level (0 to 65535)<br>P6 - PV2 ramp (DAC counts / 10 ms) |

*Table 48 3520 macro commands v.1.x (Continued)*

| | Function.Cmd | Duration (ms) | Description | Parameters |
|---|---|---|---|---|
| 24 | FillPV1.P_Initialize_KpLim | 200 | Starts a fill operation with PV1, using PV2 as the fast bleed. Ramps PV2 from 0 to <P4> using <P5> to define ramp duration. | P1 - Set Pressure (pressure units)<br>P2 - Proportional Gain (volts / pressure)<br>P3 - Integral Gain (volts / pressure)<br>P4 - Derivative Gain (volts / pressure)<br>P5 - PV2 level (0 to 65535)<br>P6 - PV2 ramp (DAC counts / 10 ms)<br>Proportional Gain Limit (volts) |
| 25 | FillPV1.P_Bumpless | 50 | Changes the test pressure or PID settings on PV1 when using PV2 as a fast bleed. Does a seamless transfer and uses a constant value for PV2. | P1 - Set Pressure (pressure units)<br>P2 - Proportional Gain (volts / pressure)<br>P3 - Integral Gain (volts / pressure)<br>P4 - Derivative Gain (volts / pressure)<br>P5 - PV2 level (0 to FFFF) |
| 26 | FillPV1.Stop | 25 | Stops PID on PV1. Turns off PV2. | |
| 27 | FillPV3.P_Initialize | 200 | Starts a fill operation with PV3. | P1 - Set Pressure (pressure units)<br>P2 - Proportional Gain (volts / pressure)<br>P3 - Integral Gain (volts / pressure)<br>P4 - Derivative Gain (volts / pressure) |

*Table 48 3520 macro commands v.1.x (Continued)*

| | Function.Cmd | Duration (ms) | Description | Parameters |
|---|---|---|---|---|
| **27** | **FillPV3.P_Initialize_KpLim** | 200 | Starts a fill operation with PV3, and exposes the Pro limit. | P1 - Set Pressure (pressure units)<br>P2 - Proportional Gain (volts / pressure)<br>P3 - Integral Gain (volts / pressure)<br>P4 - Derivative Gain (volts / pressure)<br>P5 - Proportional Gain Limit (volts) |
| **28** | **FillPV3.P_Transfer** | 50 | Transfers from FillPV1 to FillPV3. Stops the PID on PV1 and turns off PV2.<br>Starts a PID on PV3. | P1 - Set Pressure (pressure units)<br>P2 - Proportional Gain (volts / pressure)<br>P3 - Integral Gain (volts / pressure)<br>P4 - Derivative Gain (volts / pressure) |
| **29** | **FillPV3.P_Bumpless** | 50 | Changes the test pressure or PID settings on PV3. Does a seamless transfer. | P1 - Set Pressure (pressure units)<br>P2 - Proportional Gain (volts / pressure)<br>P3 - Integral Gain (volts / pressure)<br>P4 - Derivative Gain (volts / pressure) |
| **30** | **FillPV3.Stop** | 25 | Stops PID on PV3 | |
| **31** | **FillPV3.Flow_Init** | 200 | Flow control initializes on PV3 | P1 - Set Flow (flow units)<br>P2 - Proportional Gain (volts / flow)<br>P3 - Integral Gain (volts / flow)<br>P4 - Derivative Gain (volts / flow) |

# 14.0 Appendix C - 3520 units conversion tables

The default engineering units for the 3520 sensors are as follows:

- psig—for the pressure sensors
- sccm—for the flow meter
- °C—for the temperature sensors

Using the InspeXion software application on the 3520 controller and the information in *Table 49*, *Table 50*, *Table 51*, and *Table 52*, you can change the default engineering units of a specific 3520 Leak Test module. The default engineering units cannot be changed globally for all connected 3520 modules; they must be specified for each module individually.

**WARNING**

Any change of the engineering units must be done before any leak tests are configured. If you decide to change the units after you have configured the leak tests, you must go back and edit all control and analysis parameters in your test configurations. Otherwise, you may create a safety hazard. The units are not automatically converted in the operation configurations.

**IMPORTANT**

Standard pressure and standard temperature are used to convert volumetric flow (for example, cubic centimeters per minute or "ccm") to mass flow (for example, standard cubic centimeters per minute or "sccm"). All 3520 modules ship configured as follows:

- standard pressure = 101.325 kPa
- standard temperature = 0°C

At present, Sciemetric does not support an option of changing this standard temperature and pressure.

***Table 49*** *3520 pressure conversion units*

| Unit text | Ideal Abbreviation | Actual Units in 3520 | Conversion from psi slope (unit/psi) |
|---|---|---|---|
| Atmosphere | atm | atm | 0.068045964 |
| Millibar | mbar | mbar | 68.94757293 |
| Bar | bar | bar | 0.068947573 |
| Pascal | Pa | Pa | 6894.757293 |
| Hectopascal | hPa | hPa | 68.94757293 |
| Kilopascal | kPa | kPa | 6.894757293 |
| Megapascal | MPa | MPa | 0.006894757 |
| Millimeter of Mercury at 0°C | mmHg@0°C | mmHg | 51.71493257 |
| Centimeter of Mercury at 0°C | cmHg@0°C | cmHg | 5.171493257 |
| Meter of Mercury at 0°C | mHg@0°C | mHg | 0.051714933 |
| Inch of Mercury at 0°C | inHg@0°C | inHg | 2.036020967 |
| Millimeter of Water at 4°C | mmH2O@4°C | mmH2O | 703.0879704 |
| Centimeter of Water at 4°C | cmH2O@4°C | cmH2O | 70.30879704 |
| Meter of Water at 4°C | mH2O@4°C | mH2O | 0.70308797 |
| Inch of Water at 4°C | inH2O@4°C | inH2O | 27.68062875 |
| Gram per sq Centimeter | g/cm2 | g/cm-2 | 70.30695796 |
| Kilogram per Sq Centimeter | kg/cm2 | kg/cm-2 | 0.070306958 |
| Kilogram per Sq Meter | kg/m2 | kg/m-2 | 703.0695796 |
| Pound per Sq Inch | lb/in2 | lb/in-2 | 1 |
| Pound per Sq Foot | lb/ft2 | lb/ft-2 | 144 |
| Pound per Sq Yard | lb/yd2 | lb/yd-2 | 1296 |
| PSI | psi | psi | 1 |
| Torr | Torr | Torr | 51.71493257 |

*Table 50   3520 module options for pressure conversion offset*

| Option | Reading | Units |
|---|---|---|
| gauge | (pressure - gauge reference)*slope | unit<space>g |
| absolute | pressure*slope | unit<space>a |
| vacuum | (gauge reference - pressure)*slope | unit<space>v |

*Table 51   3520 module temperature conversion units*

| Unit text | Ideal Abbreviation | Actual Units in 3520 | Conversion from °C, slope (unit / °C) | Offset |
|---|---|---|---|---|
| Celsius | °C | C | 1.00 | 0 |
| Kelvin | K | K | 1.00 | 273.15 |
| Fahrenheit | °F | F | 1.80 | 32 |
| Rankine | °R | R | 1.80 | 491.67 |

*Table 52   3520 module flow conversion units*

| Unit text | Alt abbreviations | Actual Units in 3520 | Conversion from sccm slope (unit/sccm) |
|---|---|---|---|
| standard cubic centimeters per hour | scc/h, scm3/h | scch | 60.00000 |
| standard cubic centimeters per minute | scc/min, scm3/min | sccm | 1.00000 |
| standard cubic centimeters per second | scc/s, scm3/s | sccs | 0.01666667 |
| standard cubic feet per hour | scf/h, sft3/h | scfh | 0.002118880 |
| standard cubic feet per min | scf/min, sft3/min | scfm | 0.0000353147 |
| standard cubic feet per second | scf/s, sft3/s | scfs | 0.00000058857780 |
| standard cubic inch per hour | sci/h, sin3/h | scih | 3.661425 |
| standard cubic inch per min | sci/min, sin3/min | scim | 0.0610 |
| standard cubic inch per second | sci/s, sin3/s | scis | 0.00101706 |
| standard liters per hour | sL/h | sLph | 0.06000 |
| standard liters per minute | sL/min | sLpm | 0.00100 |
| standard liters per second | sL/s | sLps | 0.00001666667 |

# 15.0 Registration notice

Sciemetric Instruments ULC offers registration for the 3520 leak test module. If you choose to register, you benefit by

- Receiving upgrade notices on a timely basis
- Gaining access to the Sciemetric Support Center reference library, which includes user guides, software releases, and product notices

You can choose to register either online or by phone:

- To register by phone, call Customer Support at:
  1-877-581- 0112 (North America) or
  001-877-581-0112 (International)
- To register online, in your browser, go to *http://www.sciemetric.com/productregister*

# 6. SIGPOD PSV USER GUIDE


sigPOD PSV User Guide

Version 12.6

sciemetric

# Table of Contents

# About this guide

This guide provides detailed information about the features of the PSV application and how you can use the sigPOD as your monitoring solution. It also provides instructions for configuring and operating the leak template. For more information, see *"Setting up a leak test with the Leak template" on page 188*.

The ***sigPOD PSV User Guide*** is to be used in conjunction with the ***3520 Leak Test Module User Guide*** and ***3520 Leak Test Module Troubleshooting Guide*** available through the Sciemetric Support Center at *http://support.sciemetric.com*.

## Who should use this guide

This guide is intended for manufacturing, quality and process engineers who are responsible for monitoring the quality of the production processes.

## Conventions used in this guide

To help you locate and identify information easily, this guide uses visual cues and text formats. *Table 1* lists the document conventions used in this guide.

***Table 1*** *Document Conventions*

| Convention | Description |
|---|---|
| **Bold** | Refers to button and field names in the application. For example, "Click the **Back** button." |
| *Italics* | Refers to other reference manuals. |
|  | Highlights Warnings, Cautions and other important Safety Information. |

## Abbreviations used in this guide

*Table 2* lists the abbreviations used in this guide:

**Table 2** *Abbreviations*

| Abbreviation | Definition |
|---|---|
| A/D | Analog/Digital |
| BOSFET | Bi-directional Output Switch Field Effect Transistor |
| FIFO | First In First Out |
| ICP® | Integrated Circuit - Piezoelectric. ICP® is a registered trademark of PCB Group, Inc. |
| I/O | Input/Output |
| LVDT | Linear Variable Differential Transformer |
| PLC | Programmable Logic Controller |
| SPC | Statistical Process Control |
| SPST | Single Pole Single Throw |
| SSR | Solid-state Relays |
| TTL | Transistor-transistor Logic |

## Terms used in this guide

*Table 3* lists the terms and Sciemetric nomenclature used in this guide.

**Table 3** *Terms/Nomenclature*

| Sciemetric Nomenclature | Definition | Other Terms |
|---|---|---|
| Analysis Region | The area bounded by the analysis range on the X-Axis and the specification limits on the Y-Axis | |
| Cycle | An entire test of a single part at one station that may include multiple operations | |
| Date Time Index | Date and time view on trend graph of locally stored data | |
| Envelope | A region on an X-Y graph that must contain some part of the test signature waveform in order for the part to pass. Often the upper and lower limits are themselves made up of waveforms. | Template, Mask, Acceptance Test Case |
| Feature | A scalar result representing some information about the waveform or process - for example, the peak pressure of a waveform or the area under a curve. | Result, Test result, Feature result |

**Table 3** *Terms/Nomenclature (Continued)*

| Sciemetric Nomenclature | Definition | Other Terms |
|---|---|---|
| Line | A section or group of sections of an assembly line. | Assembly Line |
| Model | Holds unique data collection processing and analysis configurations as well as unique SPC Data and QWX data. It is used to handle variations in a given Part Type. By default, Model is linked to Test Configuration. If EtherNet/IP, PROFINET, or Modbus TCP is enabled, you can have the Test Configuration number received separately from the Model label, and you can run multiple test configurations per model. When Model and Test Configuration are separate, the Model holds the SPC and QWX data, while the Test Configuration holds the data collection processing and analysis parameters. | |
| Operation | A single step in a sequence of one or more steps that forms a test or assembly function performed on a part, e.g. 100 RPM test, 300 RPM test. With Sciemetric systems, an operation is normally associated with a single data collection action which can collect one or more channels of data and then analyze the results. | Test Phase, Step |
| Part Type | Name of the part that is being tested. For example Motor, Bearing, etc. | |
| Section | A sub part or portion of a line. Normally contains stations that operate on a part or assembly. | |
| Signature | A set of measured values used to depict the physical characteristics of a part or process. | |
| Station | Place where tests or operations are performed on a part. | Machine, Test Stand |
| Test Configuration | By default, Test configuration data is linked to Model data and received as one input. If EtherNet/IP, PROFINET, or Modbus TCP is enabled, you can have the Test Configuration number received separately from the Model label, and you can run multiple test configurations per model. When Model and Test Configuration are separate, the Model holds the SPC and QWX data, while the Test Configuration holds the data collection processing and analysis parameters. | |
| Upper Control Limit, Lower Control Limit | Statistically computed values that are based on N times the standard deviation of a process, normally used to indicate if the process is in control or not. | Control Limits |
| Upper Specification Limit, Lower Specification Limit | Upper and lower values used to determine if the feature result is a pass or fail - in other words, the pass and fail limits. | Limits, Pass and Fail Limits, Spec Limits |

**Table 3** *Terms/Nomenclature (Continued)*

| Sciemetric Nomenclature | Definition | Other Terms |
|---|---|---|
| Warning Limits | Low and high limit used to indicate a trend towards spec limits | |
| Waveform | A collection of data points that is treated as an object for analysis and display purposes. | Signature, Trace |
| X-Axis Analysis Range | The range or zone or domain of the X-Axis for which the feature analysis will be performed. | Analysis Zone |

## What's in this guide

This guide is organized according to the following topics:

- *PSV installation and requirements*
- *Getting to know the application*
- *Configuring the sigPOD and common system parameters*
- *Configuring tests with a third-party leak tester*
- *Leak testing with a third-party leak tester*
- *Configuring tests with a 3520 leak test module*
- *Leak testing with a 3520 leak test module*
- *Appendix A: Error messages*
- *Appendix B: EtherNet/IP setup guide*
- *Appendix C: PROFINET setup guide*
- *Appendix D: The Leak Tuner Assistant*

## Registration notice

Sciemetric Instruments ULC offers product registration for the sigPOD product suite. If you choose to register, you benefit by

- Receiving upgrade notes on a timely basis
- Gaining access to the sigPOD online reference library, which includes user guides, software releases, and product notices

You can choose to register either online or by phone:

- To register by phone, call Customer Support at 1-877-581- 0112 (North America only).
- To register online, in your browser, go to *http://www.sciemetric.com/productregister*

# PSV installation and requirements

PSV version 5.4 requires InspeXion software v. 8.1.436 or higher to run.

Any sigPOD purchased after April 2015 comes with PSV 5.X and InspeXion 8.X pre-installed at the factory. If your test system controller is not a sigPOD but a Windows-based PC or laptop, you must install both InspeXion v. 8.1.436 or higher and PSV 5.4, and license the applications.

PSV 4.X, or earlier versions, require upgrading the configuration to 5.X. Contact Sciemetric Support for more details at *support@sciemetric.com*.

You can also save any PSV 5.1/5.2/5.3 configuration and calibration setup in a backup file, and then install the backup file to a test system controller (sigPOD or regular PC) with a previously installed PSV 5.4 software. For more information, see *Installing a PSV 5.1/5.2/5.3 configuration onto PSV 5.4*.

## Installing a PSV 5.1/5.2/5.3 configuration onto PSV 5.4

You can transfer any PSV 5.1/5.2/5.3 test configuration setup to a sigPOD or PC running PSV 5.4 by first saving it as a backup file, and then installing it onto PSV 5.4. The backup file contains all system component files, such as sensor calibration files, configuration files, application data, SPC data, and history data.

**Note 1**: For information about creating a backup file, see the "Performing a backup" section in the InspeXion System Shell online help. To access the InspeXion System Shell online help, click the **Backup** button on the System Shell toolbar, and click **Help**.

**Note 2**: If you are upgrading an older configuration to PSV 5.4 on a PROFINET network, and you have separated Model Label from Test Configuration, you must also edit the PLC configuration. See *"Configuring PROFINET on the PLC" on page 227*.

### To install a PSV 5.1/5.2/5.3 system configuration onto PSV 5.4

1. If the PSV 5.1/5.2/5.3 backup file is on a USB flash drive, insert the drive into the USB port of the sigPOD or the PC controller.
2. On the **System Shell** toolbar, click **Install** to open the **Install** dialog box.

   **Note:** If you are installing the configuration on a PC controller, and **the System Shell** toolbar is not open, click the **Start** button on the Windows task bar and point to **All Programs, Sciemetric, InspeXion, System Shell** on Windows 7, or to **Sciemetric, System Shell** on Windows 10 IoT.

   **Tip:** You can also open the **Install** dialog box by pressing **F3** on the keyboard.
3. In the **Type** area, select **Back Up**.
4. From the **Location** drop-down list, select one of the following options:
   - **X:\[Removable]** – if the backup file is on a USB flash drive
   - **<Network Places>** – if the backup file is on a network drive
5. Click the **View more** button next to the **Location** drop-down list.

6. In the **Open** dialog box, navigate to the folder that contains the backup file (.SBK) to be installed.
7. Click the filename, and click **Open**.
8. Review the information in the **Properties** area to ensure you are about to install the correct file.
9. In the **Component** area, **Install** column, ensure there is no check mark in the **Application** check box, that is, the check box is deselected.
10. In the **Component** area, **Install** column, select the check boxes for the test configuration components you want to transfer onto the new test system.
11. Click **OK**, and then click **Yes** in the warning dialog box.

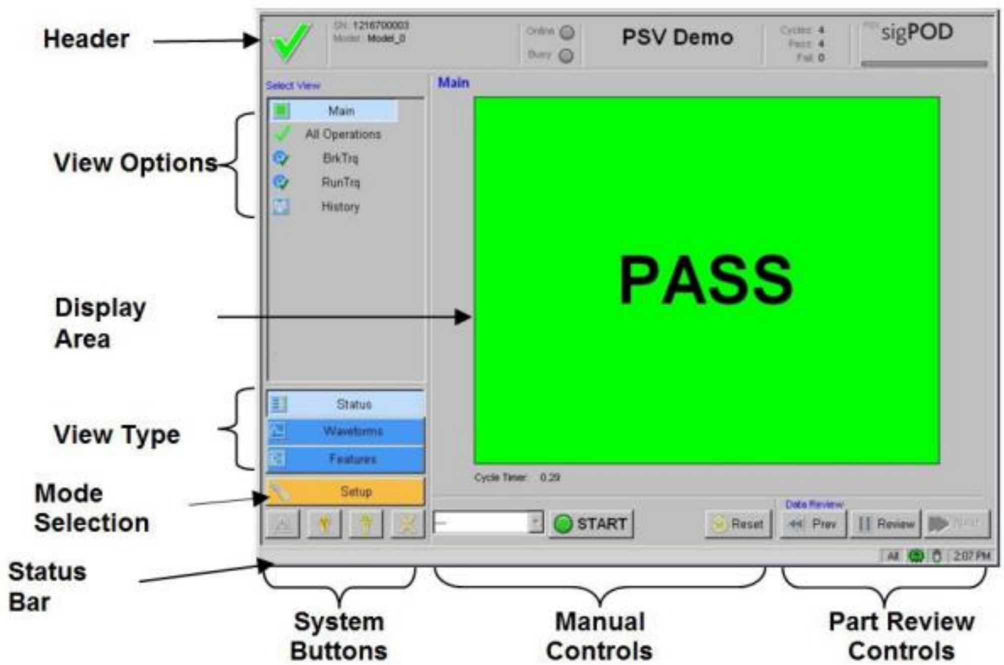
# Getting to know the application

The PSV application screens display system information, show test results in tables and graphs, and provide icon-based buttons to navigate quickly and easily from one test and assembly monitoring function to another.

The PSV application runs in the background, and provides signature analysis and data processing to enable the sigPOD to identify defects in real-time processes, pinpoint and analyze root causes, and archive data for quality traceability.

When the PSV application starts, the main screen opens in Status View (see *Figure 1*).

*Figure 1 PSV Main Screen - Status View*




## Main Screen

The PSV main screen comprises the following areas:

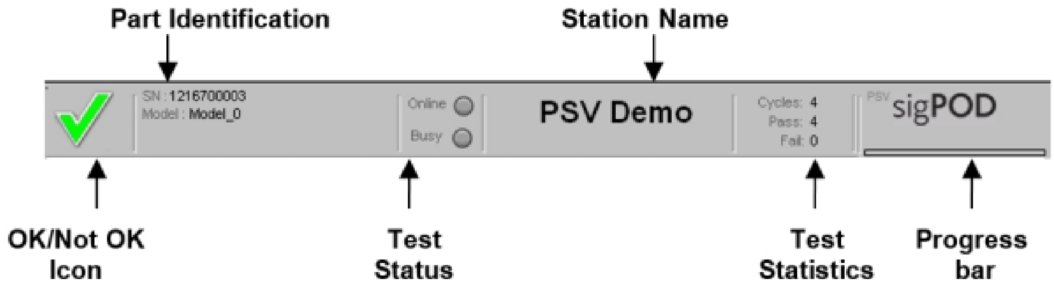
- *Header*
- *Status Bar*
- *Mode Selection* (main operation or setup)

- View Selection including *View Type and View Options*
- *Display Area*
- *System Buttons*
- *Manual Buttons* (if enabled)
- *Review Buttons*

## Header

The header (see *Figure 2*) identifies the system and parts being tested and displays the real-time status information of the test system.

*Figure 2 PSV Screen Header*




- The header contains the following information:
- **OK/NOK** Icon - indicates the status:
  - pass
  - fail
  - fault

  **Note:** If multiple operations are run on multiple parts with different serial numbers, the overall pass/fail status is an aggregate of the status for all operations run for all parts.
- **Part Identification** - displays details of a part:
  - **Serial Number** - can be determined from an external device or generated automatically. For tests configured to run multiple operations on multiple parts, the header displays up to 8 serial numbers separated by comma. For serial number information, see *Table 44 on page 143* and *"Sciemetric Input – serial number" on page 104*.
  - **Model** - can be determined from an external device or selected manually. For information on selecting the model, see the second row in *Table 17 on page 89*. For information on naming and setting up models, see *"Setting up Models" on page 107*.

    **Note:** If **EtherNet/IP** or **PROFINET** is enabled and you have separated the Model data from the Test Configuration data, the header also displays the Test Configuration number. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

- **Test Status** - indicates the Online status of the sigPOD as well as the Busy status (Busy is on during a test cycle). These indicators reflect the status of the cycle control handshaking outputs from the sigPOD.
- **Station Name (ID)** - identifies the test station. For information on changing the Station Name (ID), refer to *"Configuring the sigPOD and common system parameters" on page 84*.
- **Test Statistics** - indicates the total number of parts tested, and the breakdown of parts that passed and failed. You can reset the counters manually or automatically. For further information, refer to *"Configuring the sigPOD and common system parameters" on page 84*.
- **Progress bar** - shows the progress of the current operation (0-100% completed). If more than one operations are running simultaneously, the bar shows the progress of the longest operation.
- **sigPOD Logo** -Identifies the sigPOD application. For example, PSV or Press.

## Status Bar

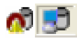
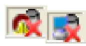
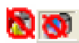
The Status Bar (see *Figure 1*) displays information on the status of the system. In addition to messages, the status bar also shows the user logged into the system and the current date and time.

The status bar also includes two icons indicating the state of key system components: the Engine Status and the Gateway Status (see *Table 4*).

***Table 4*** *Status Bar Icons*

| **Type** | | **Color** | **Description** |
|---|---|---|---|
| Engine - Test Manager |  | Green | Connected |
| |  | Yellow | Offline |
| |  | Red | Disconnected |
| Gateway - Manager for all data outputs |  | Green | No files backlogged |
| |  | Yellow | Files backlogged |
| |  | Red | Backlog is full (i.e., all history records are backlogged and no space for more records). |
| |  | Green, yellow or red, with red exclamation mark | Files in the reject directory |

**Table 4** *Status Bar Icons (Continued)*

| Type | | Color | Description |
|---|---|---|---|
| Outputs - External connections (for example, QWX Store)<br>**Note**: Icons for disabled outputs are not shown. |  | Multicolor icon | Connected |
| |  | Multicolor icon with red cross | Not connected |
| |  | Multicolor icon with red circle and slash | Trial license has expired. |

## *Mode Selection*

There are two main modes in the sigPOD: Operation and Setup.

In Main Operation mode, the sigPOD is online and ready to run tests. It also offers extensive review capabilities including review of individual parts and SPC data. The review of data can occur while tests are being performed in the background.

The Setup mode allows you to configure sigPOD sensors, models, operations, test configurations, and system setup. To access Setup mode, you must be logged in with the minimum Engineer security level. When the system is in setup mode, it is taken offline. When you press the Setup button the first time, a warning appears in the status bar - “Make Selection again to go Offline and enter setup” - and you are required to press the Setup button again to confirm. For more information, see *"Configuring the sigPOD and common system parameters" on page 84*.

The mode can be toggled by clicking the mode selection button in the lower-left corner of the screen (see *Figure 1 on page 17*). The text of the button toggles between **Setup** when the system is in main operation mode and **Main** when the system is in setup mode.

## *View Type and View Options*

The View Type buttons and the View Options buttons select what appears in the Display Area of the PSV screen (see *Figure 1*). For the Operation mode, the View Type selections are Status, Waveforms and Features. *Table 5* lists the icons that go with these selections.

***Table 5*** *View Type Selection Icons*

| Icon | Name |
|---|---|
|  | Status |
|  | Waveforms |
|  | Features |

Icons and text in the **View Options** section, above the **View Type**, indicate choices you can select in these areas. Each icon also indicates the status of an operation or waveform. *Table 6*, *Table 7* and *Table 8* list the icons and their meaning.

***Table 6*** *View Options Icons*

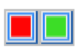
| Icon | Name |
|---|---|
|  | Main Screen (Part Pass/Fail Status) |
|  | History View |
|  | All Operations Status |
|  | Operation Status Icons, see *Table 7* |
|  | Waveform Status Icons, see *Table 8* |

***Table 7*** *Operation Status Icons*

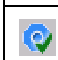
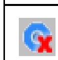
| Icon | Meaning |
|---|---|
|  | Operation not enabled (Setup only) |
|  | Operation passed |
|  | Operation failed |

***Table 7*** *Operation Status Icons (Continued)*

| Icon | Meaning |
|---|---|
|  | Operation faulted or aborted in run mode<br>**Note:** A faulted or aborted status is reflected only on the operation-level and does not affect waveform or feature status. For example, if an operation is aborted before complete, the waveforms and features in this operation can have a green status (passed). |
|  | No data available (Setup only) |
|  | Operation running (Main mode only) |
|  | Operation blank (Not tested yet, or in Trend or Histogram View Mode) |

***Table 8*** *Waveform Status Icons*

| Icon | Meaning |
|---|---|
|  | Waveform not enabled (Setup only) |
|  | Waveform passed |
|  | Waveform failed |
|  | No data available (Setup only) |
|  | Waveform blank (Not tested yet, or in Trend or Histogram View Mode) |

## *Display Area*

The **Display Area** can show summary tables, waveform graphs, trend or histogram graphs, feature status indicators or feature details, depending on the view selection options chosen.

*Table 9* below lists the various **View Types** and **View Options** and indicates what is shown in the **Display Area** during the Operation/Review Mode. For information on the display options in the Setup Mode, refer to *"Setup" on page 50*.

The operations and waveforms that can be selected using the View Options buttons are determined by which operations and waveforms were enabled for that particular part when it was tested. The Histogram and Trend views only show the operations and waveforms that are currently configured. The setup can be edited using the Setup Mode - Operations screen (see *Figure 29*). Any changes are applied to new tests only, not to tests that were performed in the past. Using the Setup - Operations screen, the names of the operations can be changed, while the names of the waveforms can be changed using the Setup - Operation - Waveform - Processing screen. For more information, see "Setup" on page 50.

***Table 9*** *View Selection Options for Navigating Main Operations*

| View Type | View Option | Display Area |
|---|---|---|
| **Status** | Main | Displays large pass/fail indicator for overall part status and a Cycle Timer in the bottom-left corner. The Cycle Timer is especially helpful when you are using automatic triggering. See *Figure 1 on page 17*.<br>The main screen will also display an Abort status for any operation in a test cycle that was stopped and not completed.<br>For 3520 leak test configurations, the main screen shows the leak tester name, connection status, progress bar, remaining leak test time, live pressure sensor reading and flow sensor reading below the large part status indicator. |
| | All Operations | Displays grid of waveforms vs. feature status for all operations. If only one operation is enabled, this option does not appear. See *Figure 7 on page 27*. |
| | Operation(s) | Displays grid of waveforms vs. feature status for selected operation only. see *Figure 6 on page 26*. |
| | History | Displays a list of the parts that have been tested with serial number, model status and test date. See *Figure 9 on page 29* |
| **Waveforms** | Operation(s) | Shows up to four separate waveforms at the same time, on four graphs, with feature analysis regions shown for the operation selected. See *Figure 13 on page 33*. |
| **Features** | Select the waveforms you wish to view, grouped by operation | Waveform option: displays a graph with the waveform selected and feature results in a table underneath. See *Table 10 on page 35*. |
| | | Histogram option: displays a histogram of the feature selected and stats in a table underneath. See *Table 10 on page 35*. |
| | | Trend option: displays a trend of the feature selected and stats in a table underneath. See *Table 10 on page 35*. |

## System Buttons

The system buttons (see *Figure 3*) include, from left to right:

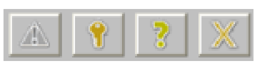
- **Faults** - displays a table listing any faults that have occurred since the last time the fault list was cleared. For more information, see *"Faults" on page 48*.
- **Login** - allows you to change your log in security level on the sigPOD using your password. When you start up the sigPOD, you are automatically logged in as **All Users**. A password is not required. As an operator, you can perform all view and review functions.

  For more information on logging in, see *"Logging In (optional)" on page 85*.

  For more information on changing your password or security level, see "Configuring the Security Setup Settings" in the InspeXion System Setup online help.
- **Help** - allows you to launch the online help.
- **Exit** - allows you to exit the PSV application and access the System Shell toolbar. When you click this button once, a message appears in the status bar, "WARNING – System will go off line, press selection again to exit." Clicking the Exit button again takes the system offline, closes the PSV application and displays the System Shell toolbar.

  **Note** For information about the System Shell toolbar and the InspeXion applications accessed through it, see the online help of each application, or the Getting Started Guide of the sigPOD running the PSV application.

*Figure 3 System Buttons*



## Manual Buttons

The Manual buttons (see *Figure 4*) allow you to select the model or test configuration for the part that you are testing, start a test and reset any faults. The manual Model or Test Configuration Select option can be enabled or disabled in the Setup – I/O screen (see *"Configuring Digital I/O" on page 89*). The manual data **Entry** button can be enabled and configured in the Setup Data Entry screen (see *"Data Entry View" on page 31* and *"Configuring Digital I/O" on page 89*), and the manual **Start** option can be enabled or disabled in the Setup - Digital I/O screen (see *"Digital I/O" on page 55*). For information about the **Reset** button, see *"Faults" on page 48*.

*Figure 4 Manual Buttons toolbar when models and test configurations are linked*

Note that by default, Model and Test configuration are linked. If EtherNet or PROFINET is enabled, you can separate the Model label from the Test configuration. In this case, the UI label of the drop-down list changes from **Select Model to test** to **Select test configuration**.

### *Review Buttons*

The Review buttons allow you to enable Review Mode and move between parts reviewed. For more information, see *"Review Mode" on page 30*.

*Figure 5 Review Buttons*


## Status View

The Status View displays the pass/fail status of current tests and of past tests. You can use the **View Options** buttons to choose:

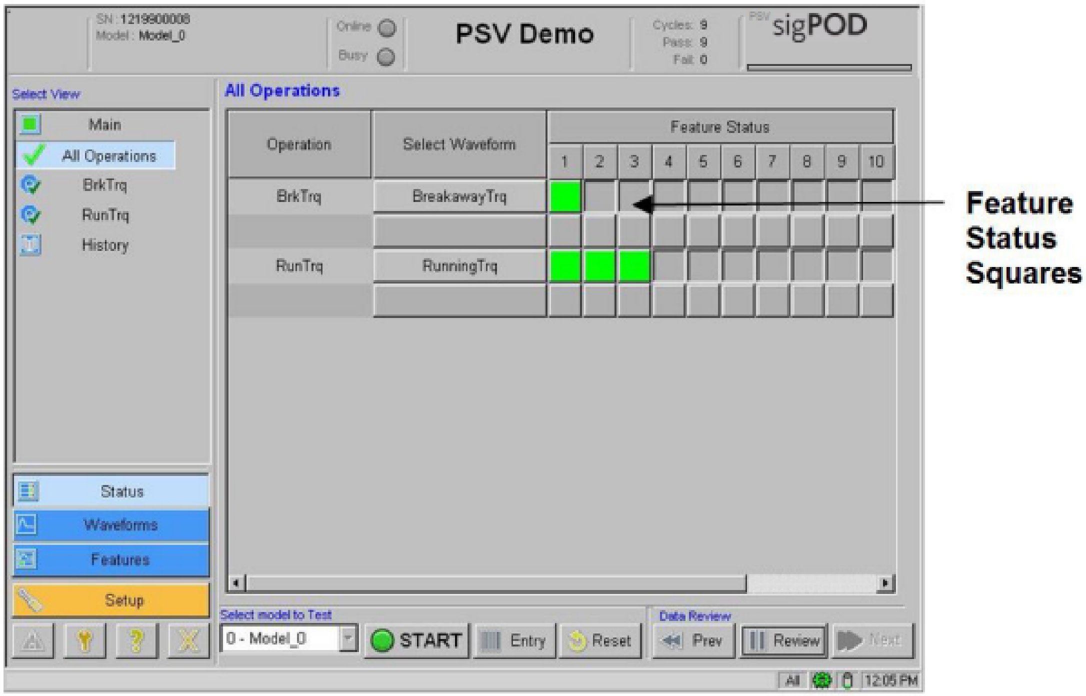
- **Main** Status screen: to show the overall part pass/fail status (see *Figure 1*).
- **All Operations**: to display a grid of status information for each feature grouped by waveform for all the operations of the current part (see *Figure 6*). If there is only one operation, this option is not available.
- Individual **Operation** by name: to display a grid of status information for the chosen feature grouped by waveform for a particular operation of the current part (see *Figure 8*).
- **History**: to display a list of the parts that have been tested with serial number, model, status and test date. The list starts with the most recent (see *Figure 9*).

### *All Operations*

This screen shows the live status of the current operation or, in review mode, the status of the part selected. In the display area, a grid of feature status squares is arranged by waveform for all operations (see *Figure 6*). The colors for the feature status squares are

- gray - not tested or no information
- green - pass
- red - fail or fault

*Figure 6 Status View - All Operations*

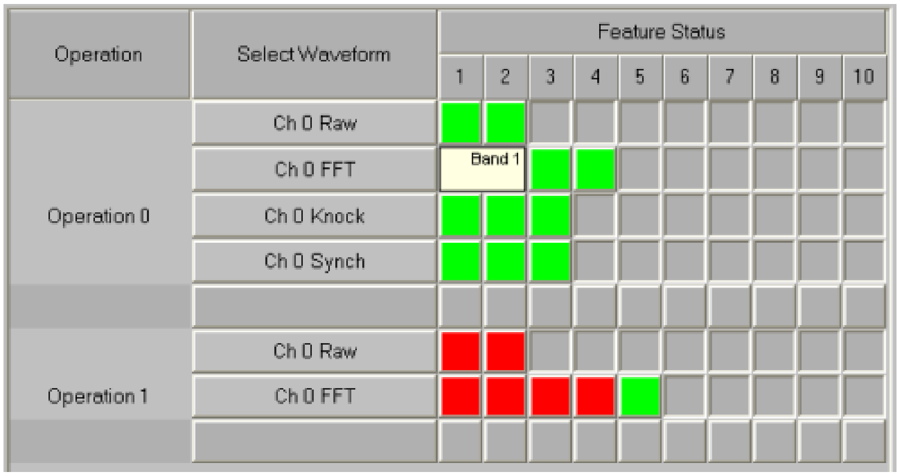



**Note:** When Model data is separate from Test Configuration data, the Select Model to Test drop-down list is labeled Select Test Configuration. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

This screen allows you access to more information in the following ways:

- Clicking a particular feature status square brings up the Features View screen associated with that waveform for that part, with the feature highlighted in the graph and the feature table.
- Clicking the waveform name brings up the Features View screen with no feature selected.
- Hovering the mouse pointer over a feature status square causes the full feature name to pop up (see *Figure 7*). For information on changing feature names, refer to *"Waveform – Features" on page 62*.

*Figure 7 Status View - All Operations, with Pop Up Feature Name*




## *Individual Operation*

This screen shows the live status of the current operation or, in review mode, the status of the part selected. In the display area, a grid of feature status squares is arranged by waveform for the chosen operation (see *Figure 8*). The colors for the feature status squares are

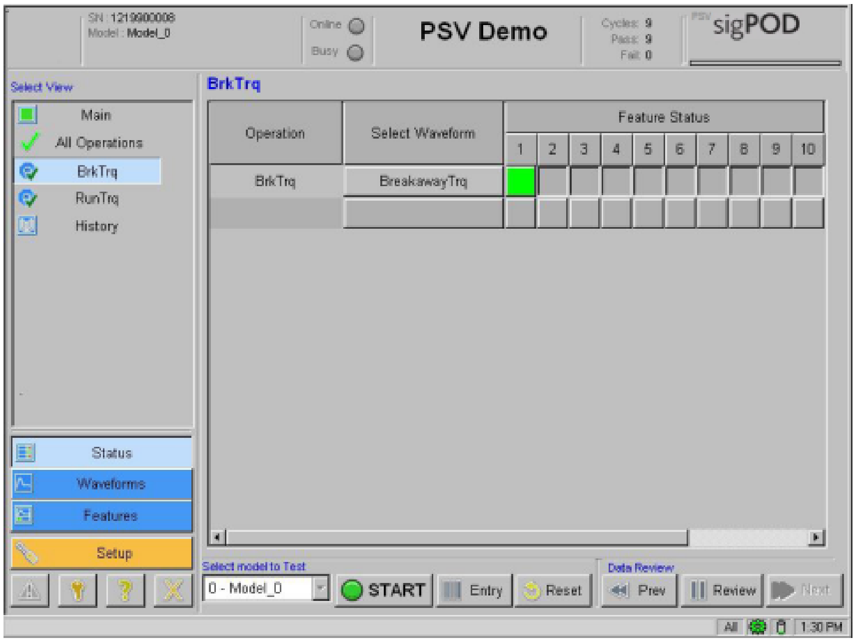
- gray - not tested or no information
- green - pass
- red - fail or fault

This screen allows you access to more information in the following ways:

- Clicking on a particular feature status square brings up the Features View screen associated with that waveform for that part, with the feature highlighted in the graph and the feature table.
- Clicking on the waveform name brings up the Features View screen with the selected waveform and no feature selected.
- Hovering the mouse pointer over a feature status square causes the full feature name to pop up (see *Figure 7*).

  **Note** For information on changing operation names and other operation parameters, refer to *"Operations – Operation Level" on page 58*. For information on changing waveform names and other waveform parameters, refer to *"Waveform – Features" on page 62*.

Figure 8 Status View - Individual Operation




**Note:** When Model data is separate from Test Configuration data, the Select Model to Test drop-down list is labeled Select Test Configuration. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

## History

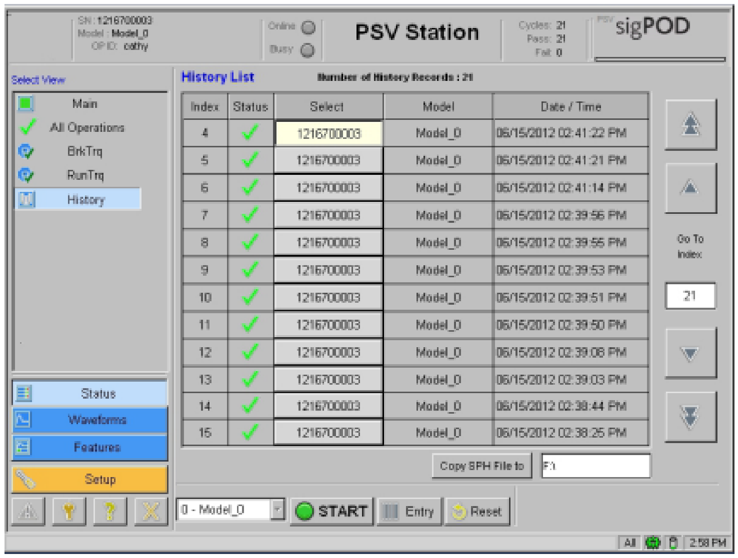
The History view displays a First In First Out (FIFO) table of the parts tested (see *Figure 9*). This screen lists the status, serial numbers, models and test date and time for parts that have undergone testing. If the system is in live mode, the list starts with the most recent and is updated each time a cycle finishes.

If the system is in review or pause mode, the part under review is highlighted in the list. For more information on Review Mode, refer to *"Review Mode" on page 30*.

Clicking on the serial number in the **Select** column turns the Review mode on and brings up the Status View screen for the operation that was last selected or for all operations, if that was the screen last selected. This allows fast drill-down to the waveform or feature of interest.

You can save the part history data for a single part to an SPH file. The SPH files can be opened (one at a time) with the Sciemetric Single Part History Viewer software.

*Figure 9 History View*




The History View table contains the following columns:

- **Index**, a temporary index number assigned to each part, with the most recent part that was tested being "1"
- **Status** of the test (Pass or Fail/Fault)
- **Select**, the serial number of the part tested
- **Model** label of the part tested
- **Date** and **Time** of the test.

## To use the History View

1. In the left pane of a Status View Type screen, click **History**. The History View screen opens.
2. Use the History navigation buttons to scroll through the locally stored test records FIFO:

    move up by 50 test records
    move up by 10 test records
    move down by 50 test records
    move down by 10 test records

   You can also move to the exact test record you want by entering the index number of the part record to view in the **Go To** Index field.

3. In the **Select** column, click on the serial number of the part you want to view. The Feature Status screen opens in Review Mode, and displays the feature status grid for the operation or all operations screen depending on which one was viewed last.

   **Note 1:** During Review Mode, all screen updates other than the header are frozen.

   **Note 2:** The number of parts that can be stored in the History list is set in the System Setup utility, which can be run from the InspeXion System Shell toolbar. For information on how to set this value, refer to "Configuring the Local Store Settings" in the InspeXion System Setup online help.

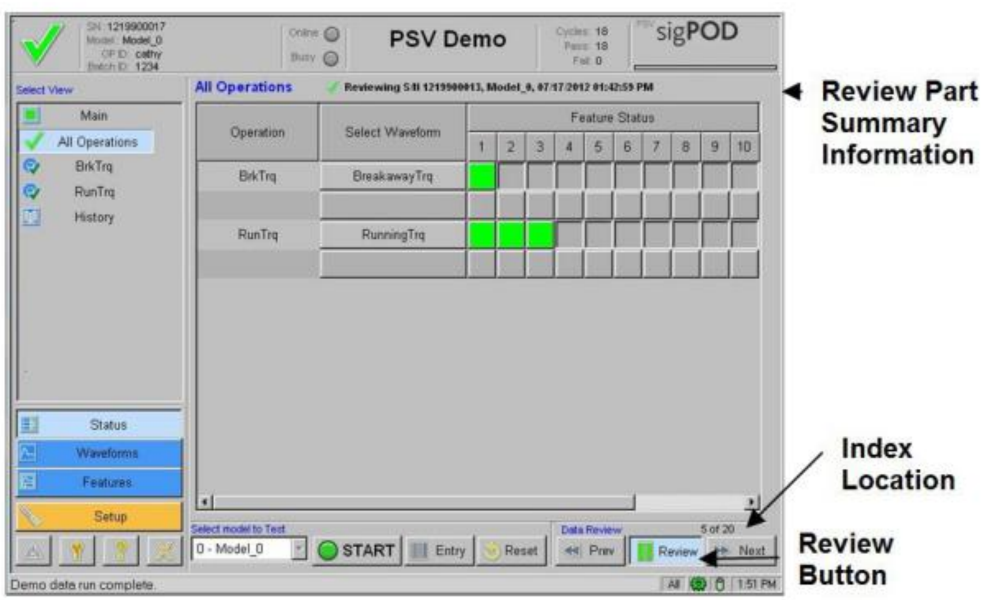
4. If you want to save the part history data to a file, specify location for the file in the box located in the bottom-right of the screen, and click the **Copy SPH file to** button.

## Review Mode

Review Mode allows you to view the full details of a part tested in the past. All the screens are available as in live mode, but they now relate to the part under review. The status, serial number and test time of the part under review are displayed at the top of the Display Area (see *Figure 10*). Tests continue to run in the background, but are not displayed in the display data area. The status for live tests is displayed only in the header. For further information, refer to *"Header" on page 18*.

For tests with multiple operations with multiple parts, the **Review** screen shows the completed operations for all parts.

*Figure 10 Status Screen, showing Review Part Summary for one part*



**Note:** When Model data is separate from Test Configuration data, the **Select Model to Test** drop-down list is labeled **Select Test Configuration**. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

The **Zoom** and **Pan** buttons on graphs are always available for detailed investigation into the reviewed waveform, histogram or trend data. For further information, see *"Graph Zoom Options" on page 40*.

## *Using Review Mode*

### To use Review Mode

1. In Status, Waveforms or Features View, click the **Review** button. The **Review** button is highlighted and information about the part under review is displayed in the Review Part Summary section of the Review screen (see *Figure 10*). Review Mode is also indicated by a light blue background on all waveform graphs and on the **Review** button, and the **Pause** icon on the review button changes to green. To scroll through the part history list, click the **Prev** (previous) and **Next** buttons. The index number of the test in view appears above the **Review** button, and the appropriate data appears in the display area. All graphs and other information for a review part can be displayed in the same ways as for a live part.
2. Click the **Review** button again to exit Review Mode. The **Review** button turns gray and the screen now displays information on the latest test.

   Out of Review mode, the real-time data updates on the display area as cycles are completed.

# Data Entry View

The Data Entry view (see *Figure 11*) is shown if the **Entry** button is pressed on any of the main screens, or if the option **Clear Each Cycle** is enabled on the Setup Data Input screen and a test is started. This feature allows the user to view and enter information such as serial number and the model to test. All of these entries are dependent on the setup options found in the Setup Data Input screen. For further information, refer to *"Configuring Data Input" on page 143*. For information about Serial Number entry for models with multiple operations for multiple parts, see *"Serial numbers for multiple operations with multiple parts" on page 104*.

In *Figure 11*, the operator has entered an Operator ID and a Batch ID, chosen a model and pressed the enter key on the keyboard. All entries are valid since their backgrounds are white.

When a field is empty, the background is yellow and the **Continue** button is not available. When any field has an incorrect entry, the background becomes red, a message appears in the message line and the **Continue** button is not available. The serial number in this example is grayed out, indicating that the serial number is generated internally.

When Model data is separate from Test Configuration data, the Data Entry view allows you to select a Test Configuration from the drop-down list and to manually enter a default Model label which overwrites the

Model each cycle. See *Figure 12*. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

*Figure 11 Data Entry View when Model and Test Configurations are linked*

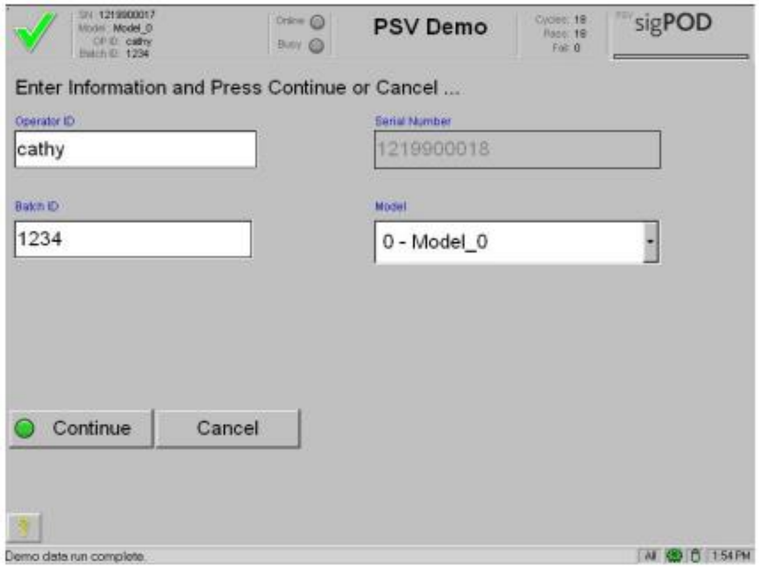
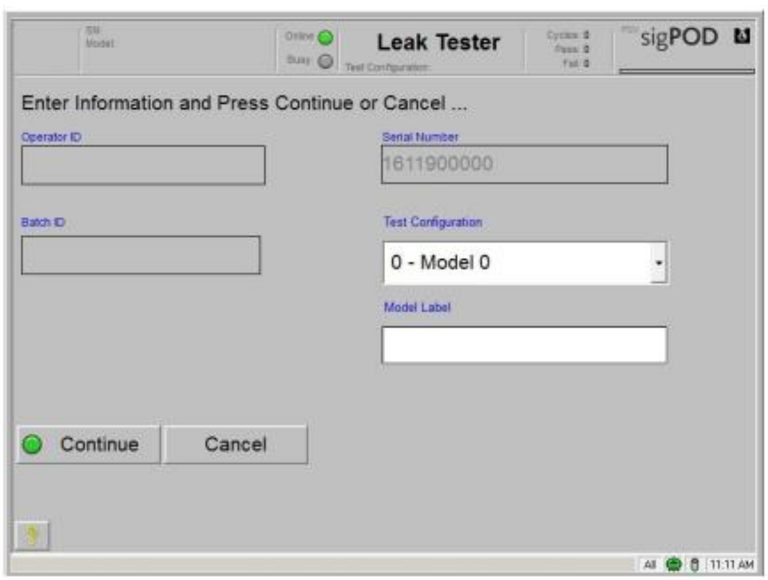



*Figure 12 Data Entry View when Model and Test Configurations are separate and Manual Keyboard Entry is enabled*



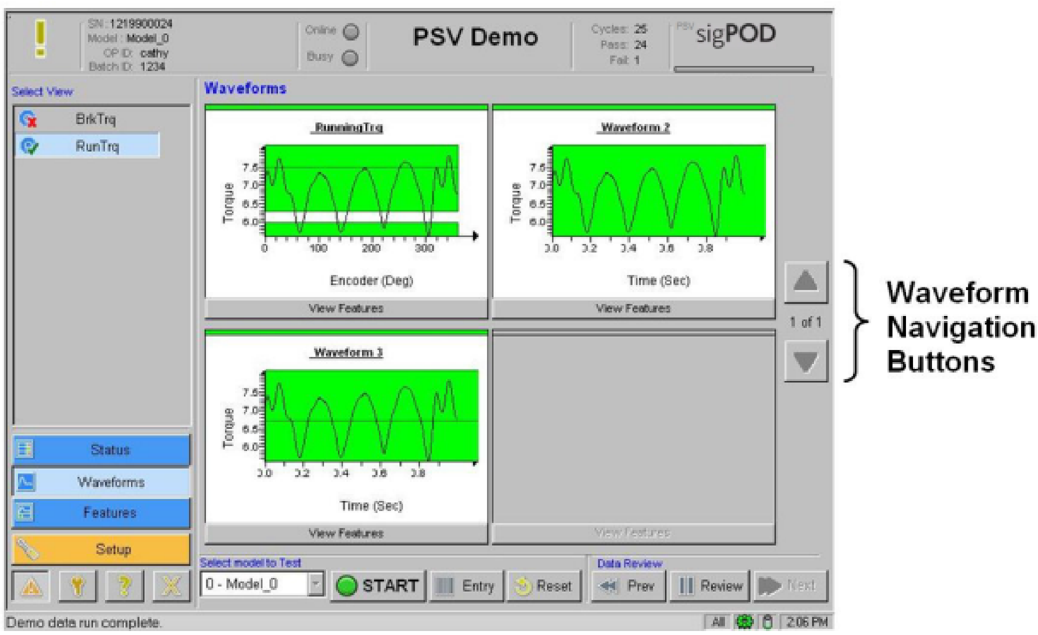
## Waveforms View

The Waveforms View displays graphs of all waveforms associated with the selected operation and part (see *Figure 13*). You can choose the operation you wish to view by clicking its name in the Select View list. You can view a detailed list of features for each Waveform by clicking the **View Features** bar beneath each Graph. The status result of each waveform is indicated in a thin color bar above each graph.

The feature analysis regions are highlighted on the graphs. The color of the analysis regions indicates the status of the feature. A feature with a failed result is indicated by red and a feature with a passed result is indicated by green.

At any time, you can access the graph zoom and pan options by double-clicking on any graph. For further information on these graph options, refer to *"Graph Zoom Options" on page 40*.

*Figure 13 Waveforms View*

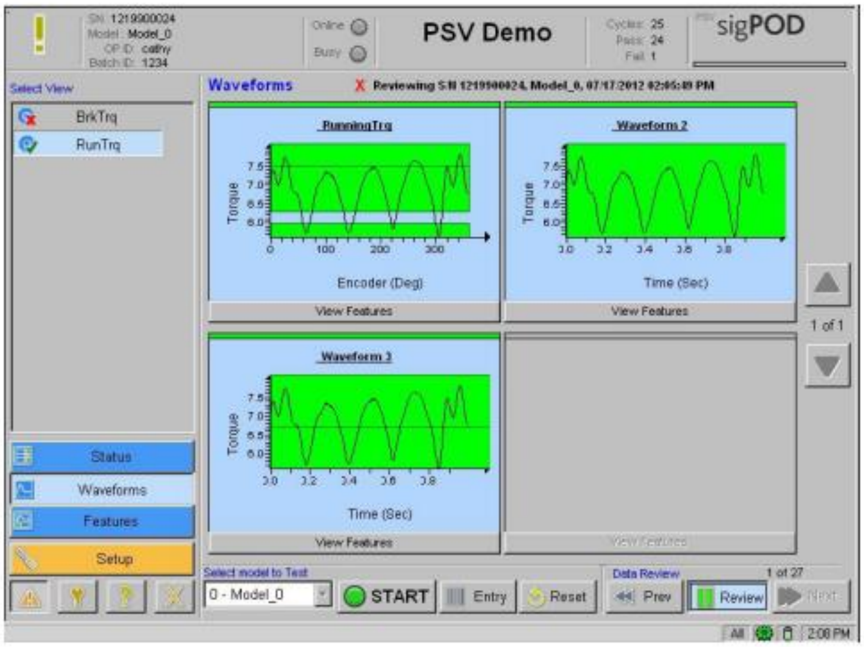



**Note:** When Model data is separate from Test Configuration data, the Select Model to Test drop-down list is labeled Select Test Configuration. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

You can click the downward arrow to see the next page of waveforms, if needed, or the upward arrow to return to the previous page of waveforms for the viewed part and operation. The current graph page number and the total number of graph pages are indicated between the waveform navigation buttons.

The feature analysis regions are highlighted on the graphs. The background color of the graph indicates the review status: white for live mode and light blue for review mode (see *Figure 14*). In Review Mode, the information for the current part appears above the graphs. For more information about Review Mode, refer to *"Review Mode" on page 30*.

*Figure 14 Waveforms View in Review Mode*




**Note:** When Model data is separate from Test Configuration data, the **Select Model to Test** drop-down list is labeled **Select Test Configuration**. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

## Features View

Using the Features view, you can access details about all the features of a test including values, limits, status and SPC information. The display area of the Features View contains a graph of the selected waveform from the Select Waveform list and a table listing all the features enabled for that waveform. The information displayed in the graph and table is determined by your choice of the option buttons under **Select Graph** on the upper right of the screen. The options are **Waveform, Histogram** and **Trend** (see *Table 10*).

***Table 10*** *Features View - Select Graph Options*

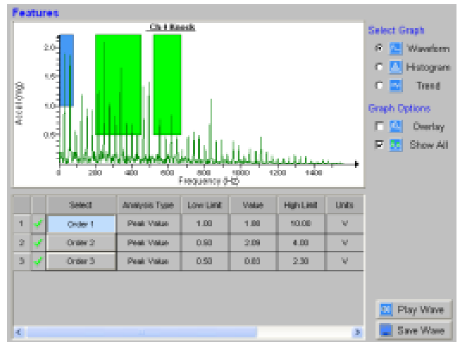
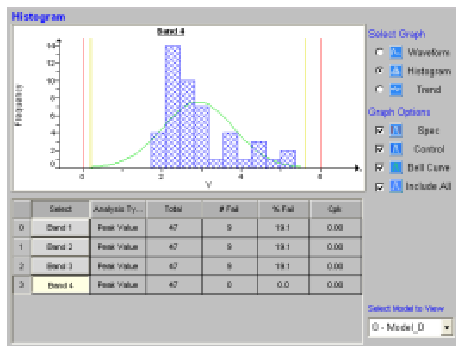
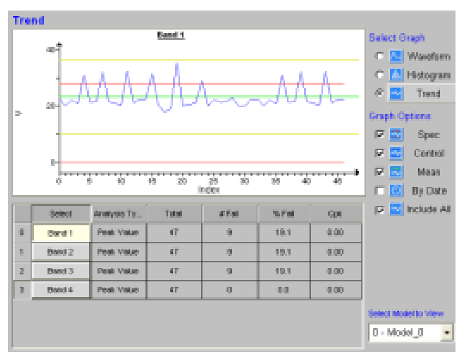
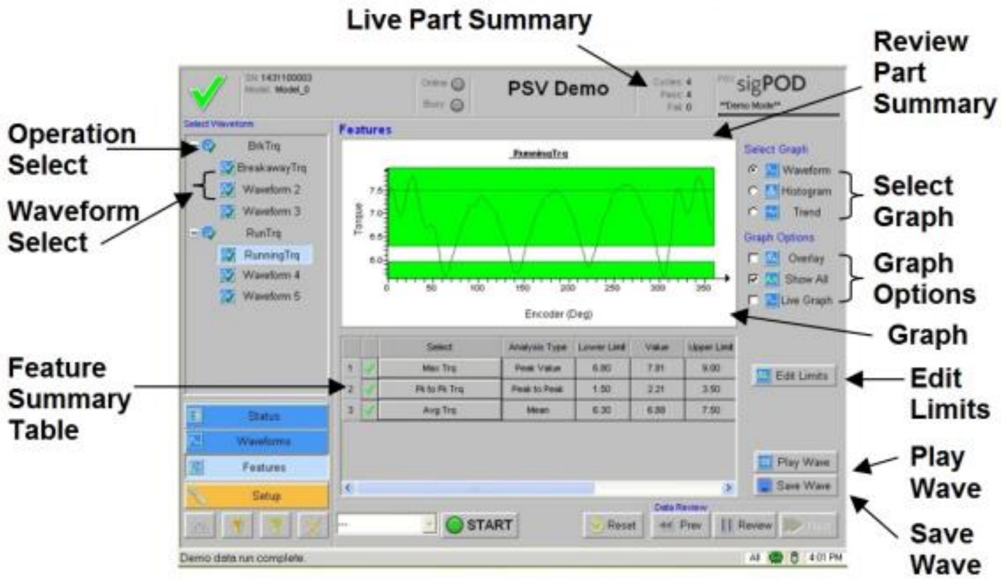
| **Select Graph Information** | **Display** |
|---|---|
| The Waveform option displays a graph of the selected waveform, with feature results in a table underneath. |  |
| The Histogram option displays a histogram of the selected feature, with all feature SPC summary information in a table underneath. |  |
| The Trend option displays a trend graph of the selected feature, with all feature SPC summary information in a table underneath. |  |

*Figure 15 Features View*




**Note:** When Model data is separate from Test Configuration data, the Select Model to Test drop-down list is labeled Select Test Configuration. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

The Features View (see *Figure 15*) displays the following information:

- **Live Part Summary** header - shows, at the top of the screen, the part result, serial number, and model for the current part under test. It can also show the Test Configuration number. For further information, refer to *"Header" on page 18*.
- **Review Part Summary** - shows, above the graph, the part result, serial number, model, date and time stamp of the review part. If the system is not in Review Mode, this area is blank. For further information, refer to *"Review Mode" on page 30*.
- **Feature Summary Table** - lists the analysis features for the waveform displayed, including the upper and lower test limits, measured value, units for the feature, analysis range start and stop, as well as Y-Axis units. You can select a feature from the **Select** column of the table to highlight the analysis region on the graphical display or choose that feature to display in the Histogram or Trend view.

  The feature information displayed depends on the selected operation and waveform as well as the features that were enabled for the part when it was tested. Information on editing the operation, waveform and feature names and settings can be found in *"Configuring Operations for Data Processing and Analysis" on page 115*. Edits apply to future tests only. When the chosen Select Graph option is Histogram or Trend, the operations, waveforms and features listed are for the current setup only. The analysis region start and stop and axis units can be found by scrolling the table to the left.
- **Graph Options** - enables and disables Show All and Overlay options.

- **Show All** - selects whether to show the analysis regions on the graph for all features or only one. If this option is disabled, only the highlighted feature is displayed as red or green. If it is enabled, all the features for which **Show With All Features** has been selected, are shown on the graph, and the highlighted feature is displayed as blue. See the Show With All Feature parameter in *Table 40 on page 136*.

  The analysis regions of the waveform are highlighted on the graph according to the following color codes:

  - Green indicates the feature value has passed.

  - Red indicates the feature value has failed.

  - Blue indicates the feature is selected in the feature table and the **Show All** graph option has been selected.

- **Overlay** - selects whether to overlay more than one waveform record. For further information on this option, refer to *"Overlay" on page 39*.

- **Live Graph** - provides real-time updates of the waveform graph during a test cycle with a data collection rate of 5 Hz.

  **Note 1: T**he Live Graph option is not available for expansion modules and must be selected before the beginning of the test cycle.

  **Note 2:** The Live Graph option will auto-scale the entire graph if no features are selected. If a feature is selected in the table below, the graph will use the feature's graph limits.

  **Note 3:** The Live Graph will stop updating if a test cycle exceeds 30 minutes.

- **Graph pane** - displays the graph of the waveform selected in the View Options table in the left pane. Highlighting a feature in the Feature Summary Table highlights the corresponding analysis region on the graph. The way each analysis region is displayed depends on the feature analysis type. *Table 11* shows the way that the cursors and regions are shown for various analysis types. The graph also provides zoom and pan features (refer to *"Graph Zoom Options" on page 40*). The graph by default is auto-scaled to the waveform and envelope data. The graph can have manual scaling on a feature by feature basis (see Main Graph Limits in *Table 38 on page 129*).

- **Edit Limits** button - after confirming this choice by clicking this button again, takes you directly to the Setup -Features screen for the feature, operation and model being analyzed. After making changes, you can return directly to the Features View by clicking the **Main** button.

- **Play Wave** and **Save Wave** buttons - allow you to listen to and save .wav files. For further information, refer to *"Play Wave and Save Wave" on page 42*.

***Table 11*** *Analysis Type Definitions and Graph Information (see footnote)*

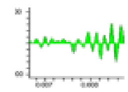
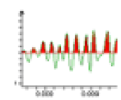
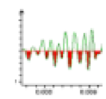
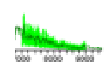
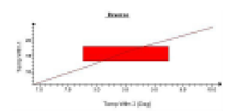
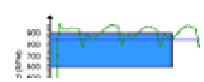
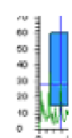
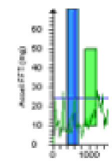
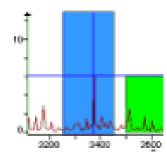
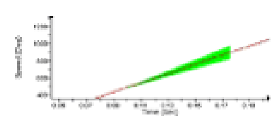
| Analysis Type | Region Type | Cursors | Example |
|---|---|---|---|
| True Area | The area between the X-Axis and the waveform is filled in. | None |  |
| Area Above X-Axis | The area between the X-Axis and the waveform is filled in when the waveform is above the X-Axis. | None |  |
| Area Below X-Axis | The area between the X-Axis and the waveform is filled in when the waveform is below the X-Axis. | None |  |
| Envelope | The envelope is displayed. | None |  |
| Fit Window | A window with top and bottom edges defined by the upper and lower limits along with the start and stop parameters. | None |  |
| Mean, Median, Power Sum, RMS | A rectangle bound by the analysis range start and stop and the upper and lower specification limit. | A horizontal cursor placed at the value of the feature |  |
| Min Value, Peak Value | A rectangle bound by the analysis range start and stop and the upper and lower specification limit. | Cross hair placed at min or peak value |  |

**Table 11** *Analysis Type Definitions and Graph Information (see footnote) (Continued)*

| Analysis Type | Region Type | Cursors | Example |
|---|---|---|---|
| Min Location, Peak Location | Vertical region with the X-Axis start and stop values based on the specification limits for the location. | Cross hair placed at min or peak value |  |
| Peak to Peak | Two regions are posted that float with the mean of the wave for that section. These regions represent where the positive and negative peaks must fall in order to pass. | None |  |
| Peak/RMS | Vertical region based on the analysis range start and stop. | Cross hair placed on the peak value |  |
| Slope | Pie slice region displayed over the analysis range. It starts at a point and expands out with the upper and lower bounds showing the upper and lower slope limits. | None |  |

For a complete list of analysis types including definitions refer to *Table 39 on page 133*.

## *Overlay*

The **Overlay** option allows the waveforms from multiple tests to be shown on top of each other on the same graph. This option is enabled or disabled by clicking the check box.

When **Overlay** is enabled, the graph retains each waveform as a test is completed so that you can see the pattern of test results (*Figure 16*). The latest waveform is either green or red depending if all the features in the waveform for the current part passed or failed. The waveforms for the other parts are gray.

The overlay option works in both normal mode and review mode. In Review mode, pressing the **Previous** or **Next** review buttons brings up another part that is added to the graph. For more information about Review Mode, refer to *"Review Mode" on page 30*.

The number of waveforms to be displayed at the same time is set to 5 at the factory, but you can set it to any number between **1** and **20**. For further information, refer to *"Configuring the System" on page 140*.

When **Overlay** is disabled, the only waveform displayed is for the current part in Live mode or for the last part reviewed in Review mode.

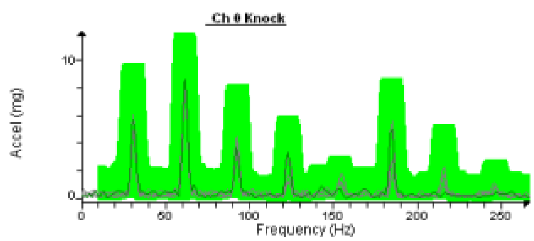
**Note:** History records can be overlaid when in Review Mode.

## *Using Overlay*

### To use the overlay feature

1. Ensure that you have specified the number of waveforms to overlay (refer to *"Configuring the sigPOD and common system parameters" on page 84*).
2. Click the **Overlay** check box to enable it (see *Figure 15*).
3. Do one of the following:
   - Click the **Previous** or **Next** button to enter Review mode and add waveforms to the graph.
   - Ensure that you are out of Review mode and test more parts, new tests are posted to the screen with overlay.
4. Click the **Overlay** check box to disable Overlay mode.

*Figure 16 Graph with Overlay Enabled*




## *Graph Zoom Options*

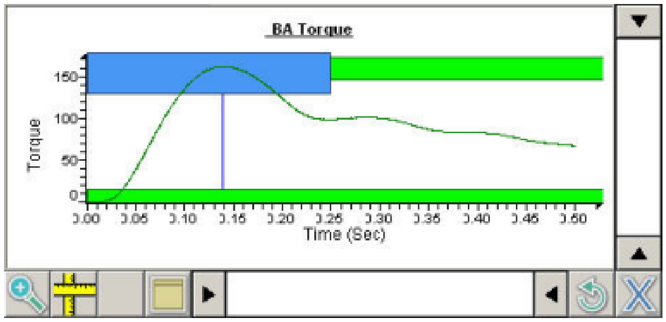
All graphs, including waveforms, histograms and trend plots, provide extensive zoom and pan features (see *Figure 17*).

### To access the Zoom and Pan features, as well as the Coordinates, Full Screen, Close and Reset buttons

- Double-click the center of the graph.

  The **Zoom, Full Screen, Close** and **Reset** buttons and **Pan** bars appear below the graph.

*Figure 17 Graph Zoom view*




### To zoom in on a particular area of the graph

- Click the **Zoom** button, and then click and drag the mouse pointer over the area of the graph you wish to enlarge.

### To view coordinates along the curve

- Click on the **Coordinates** button and use the cursor to trace the curve. The coordinates appear in a callout box. You can keep the coordinates on the graph by clicking the right-hand button on your mouse.

### To return to the original view of the graph

- Click the **Reset** button.

### To scroll across the enlarged region

- Click and drag the **Pan** bars.

### To expand the graph to full screen

- Click the **Full Screen** button.

### To remove the zoom, pan, reset and full screen features

- Click the **Close** button.
  **Note:** The Zoom mode stays on as long as you leave it on. New tests or pressing the **Previous** or **Next** buttons posts the new waveform to the graph in the Zoom mode.

### Play Wave and Save Wave

The **Play Wave** and the **Save Wave** buttons on the Features - Waveform screen (*Figure 31 on page 62*) allow you to listen to and save .wav files. This feature is very useful for diagnostic purposes. You can listen to the original sound and determine if this should have been a failure or not. It is also very good for checking sensor connections.

Clicking the Play Wave button plays the waveform on the built-in system speakers. You can also connect a USB headphone set to the sigPOD and set preferred audio playback options on the System setup screen. For more information, see *"Configuring the System" on page 140*.

Clicking the Save Wave button saves a .wav file to a USB flash drive connected to a USB port on the sigPOD. The name of the saved audio file is in the following format: Serial Number-Operation Name-Waveform Name-Feature Name.wav. The feature name is included in the file name only if the feature is selected in the Feature table.

The actual .wav file played or saved to disk depends on the processing type of the waveform selected and if a feature is selected in the Feature Table:

- If the waveform had **none** or **Synchronous Average** for its processing type, the program simply plays or saves the raw waveform. Having a feature selected makes no difference.
- If the waveform used the **FFT** processing type and no Feature is selected, the raw time domain Y input is filtered by the maximum of the FFT. If a feature is selected, the raw time domain Y input is band pass filtered using the Analysis Range Start and Stop values of the selected feature.

  For example, if the waveform you are on is an FFT of Channel 0 and the feature you have selected is a peak between 1 kHz and 3 kHz, and you press the Play Wave:

  - The program searches for a waveform that had Channel 0 as its Y input and had none selected as its processing type. This is now the raw time domain Y data.
  - This raw time domain data is band pass filtered using the start and stop analysis range of the feature selected. In our example, the band pass filter allows signals between 1 kHz and 3 kHz to pass. A fourth order band pass filter is used.
  - The resulting waveform is played on the USB headphones.
  - This waveform is the one saved to the USB flash drive if you pressed the Save Wave button.
- If the waveform used the **Running RMS** or **Knock Detection** processing types, the raw time domain Y input is filtered by the Band Pass Filter or Part Natural Frequency respectively and selecting a feature makes no difference.

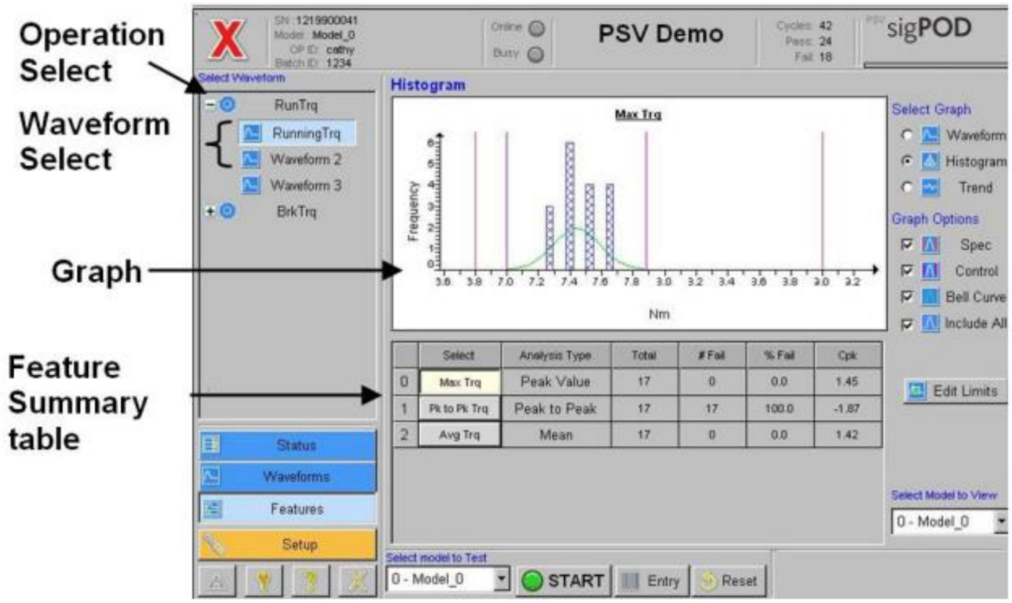
  **Note 1**: For the Play Wave and Save Wave features to function, the part must have the Y Input sensor used in a waveform with no processing applied. The program searches the waveforms in the operation for this test automatically. For more information on configuring the inputs for Play Wave and Save Wave, refer to *"Waveform – Processing" on page 61*.

  **Note 2:** See *Table 31 on page 111* for more information on enabling waveforms. See *"Waveform Processing Options" on page 116* for more information on selecting the Y input and Processing Type. See *"Waveform Analysis Options" on page 128* for more information on setting the analysis range start and stop for a feature.

## Histogram View

The Histogram view displays the data in histogram format (see *Figure 18*). Note that the review buttons are not available in this view.

*Figure 18 Histogram View*




**Note:** When Model data is separate from Test Configuration data, the Select Model to Test drop-down list is labeled Select Test Configuration. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

The Histogram View displays the following information:

- **Feature Summary Table** - lists the overall statistics for the selected waveform. The features listed depend on the selected operation and waveform. If you select one of the analysis features in the table, the histogram data for that feature is graphically displayed. The feature table displays, for each feature, the total number of data entries used in the SPC, the number of tests that failed the feature, the percent failure rate and the Cpk or process capability index.

  The number of data entries for each feature depends on the number of times parts were run for the selected model when this feature was enabled. It also depends on the date set for each feature in the **Start of SPC Data**. All tests run with this feature enabled for this model, from the date in the Start of SPC Data until present, are included. For more information, refer to *Table 38 on page 129*.

  **Note:** If a feature has less than five test records, no data is displayed in the graph or in the table. A Cpk or process capability index of more than 1.33 is generally considered being in control. Cpk is calculated using the minimum of (Mean - LSL) and (USL-Mean) then dividing by/ N * Std.dev. N can be set on a feature-by-feature basis in *Table 38 on page 129*. The default for N is three (3).

- **Graph** - displays data as a population distribution for the current selected feature in the Feature Summary Table. The Histogram has a default X-axis that can be set to auto scale or manually scaled on a feature-by- feature basis (see SPC Graph Limits in *Table 38 on page 129*). The graph can also display the control and specification limits, as well as a Bell Curve. If there are less than five parts in the SPC FIFO, the graph is blank.

  **Note**: At any point the graph can be double-clicked to enter into a zoom mode. For further information, see *"Graph Zoom Options" on page 40*.
- Graph Options:
  - Specification Limits (**Spec**) - displays the current specification limits as two red vertical lines, which determine whether a test has passed or failed.
  - **Control** Limits - displays, as two magenta vertical lines, the control limits based on SPC data and N- standard deviations. You can set the Specification Limits to the statistically calculated Control Limits in Setup Mode.
  - **Bell Curve** - displays a green curve that represents the nominal distribution.
  - **Include All** - allows the inclusion or removal of "fliers" or data points that are far from the normal data set. If this is enabled, all data in the SPC FIFO for this feature from the Start of SPC Data is used and displayed in calculations (see the section SPC Graph Limits in *Table 40 on page 136*). If this option is disabled, only those data points that are inside certain bounds calculated from the specification limits are included. The upper bound is determined by taking the upper specification limit and adding 10 times the difference between the upper and lower specification limits. The lower bound is determined in a similar way by taking the lower specification limit and subtracting 10 times the difference between the upper and lower specification limit.
- **Edit Limits** button - after confirming this choice by pressing this button again, takes you directly to the Setup -Histogram screen for the feature, operation and model being analyzed. After making changes, you can return directly to the Histogram View by pressing the **Main** button.
- **Model** - allows you to select a model from the drop-down list and view the data for that model.

  **Note 1:** In the Histogram view, the operations, waveforms and features listed are for the current setup not for a specific part in the history list. Only the operations, features and waveforms that are enabled in the current setup are displayed.

  **Note 2:** In the Histogram view, the pass/fail status of the operations, waveforms and features is removed from the icons and tables.

### *Using the Histogram View*

#### To use the Histogram View

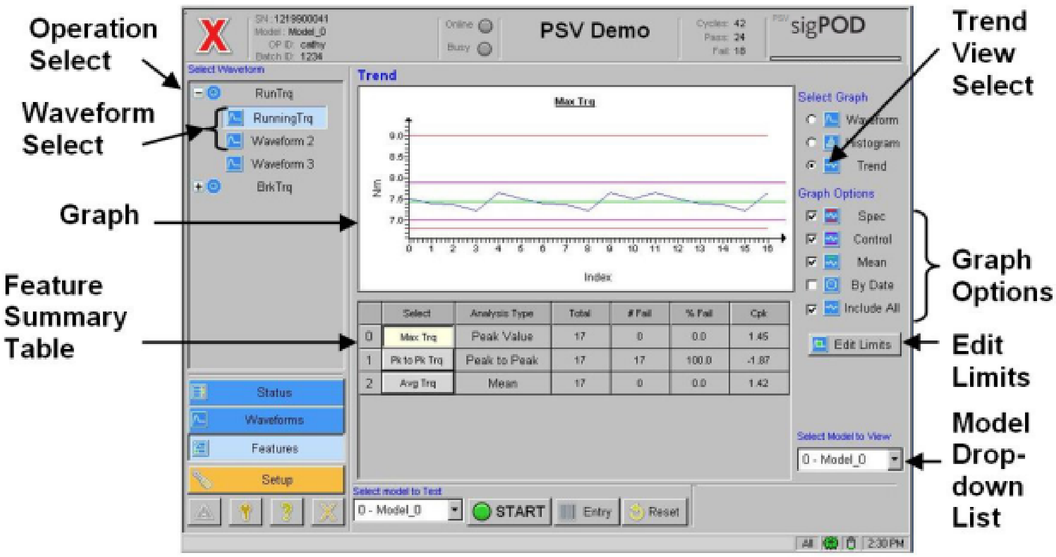
1. In the Features view under **Select Graph**, click the **Histogram** button.
2. From the **Select Model to View** drop-down list, select the model you wish to view.
3. Expand the operation you wish to view (for example, **Operation 0**) by clicking on either the operation name or the **+** button beside the operation name.
4. Under the operation name, select a waveform name (for example, **Ch 0 FFT**) to view the associated feature information.
5. In the **Feature Summary Table**, under **Select**, click the feature you wish to view. The histogram data for that feature is displayed.
6. Do any of the following:
    - To view the data in a Bell Curve format, click the **Bell Curve** check box. To disable the **Bell Curve**, click the Bell Curve check box again.
    - To view the current specification limits, click the **Spec** check box. To disable this view, click the **Spec** check box again.
    - To view the control limits, click the **Control** check box. To disable this view, click the **Control** check box again.
    - To view all the data including "Fliers," click the **Include All** check box.
    - To zoom the graph, double-click the graph area.

    **Note:** For detailed description of these options, see the reference information before this procedure.
7. Choose another view to exit the Histogram screen.

## Trend View

The Trend view displays the data in a trend format (see *Figure 19*). Note that the review buttons are not available in this view.

Figure 19 Trend View Screen




**Note:** When Model data is separate from Test Configuration data, the **Select Model to Test** drop-down list is labeled **Select Test Configuration**. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

The Trend view displays the following information:

- **Feature Summary Table** - lists the overall statistics for the selected waveform. The feature information displayed depends on the selected operation button and **Waveform** button. If you select one of the analysis features in the table, the trend data for that feature is graphically displayed. The feature table displays, for each feature, the total number of data entries used in the SPC, the number of tests that failed the feature, the percent failure rate, and the **Cpk** or process capability index.

  The number of data entries for each feature depends on the number of times parts were run when this feature was enabled. It also depends on the date set for each feature in the **Start of SPC Data** column in the Feature Setup table. All tests run with this feature enabled for this model, from the date in the Start of SPC Data until present, are included. For more information, refer to *Table 38 on page 129*.

  **Note** If a feature has less than five test records, no data is displayed in the graph or in the table. A Cpk or process capability index of more than 1.33 is generally considered being in control. Cpk is calculated using the minimum of (Mean - LSL) and (USL-Mean) then dividing by/ N * Std.dev. N can be set on a feature-by-feature basis in *Table 38 on page 129*. The Default for N is three (3).

- **Graph** - displays data as a trend for the current selected feature in the **Feature Summary Table**. The trend graph has a default Y-Axis that can be set to auto scale or can be manually scaled on a feature by feature basis (see SPC Graph Limits in *Table 38 on page 129*). The graph can also display the control and specification limits as well as the mean. Data can be viewed by index, where 0 is the oldest data displayed, or by date/time. If there are less than five parts in the SPC FIFO, the graph is blank.

**Note** At any point the graph can be double-clicked to enter into a zoom mode. For further information, see *"Graph Zoom Options" on page 40*.

- Graph Options:
  - Specification Limits (**Spec**) - displays the graph of the upper and lower specification limits, which determine whether a test has passed or failed. The specification limits are indicated by red curves. On the graph, you can see how the limits have changed over time.
  - **Control** Limits - displays, as two magenta horizontal lines, the current control limits based on SPC data and N- standard deviations. You can set the Specification Limits to the statistically calculated Control Limits in Setup Mode. Refer to *Table 38 on page 129*, Specification Limits section for information on how to set specification limits to control limits.
  - **Mean** - displays a green horizontal line in the location of the mean of all the data used in the SPC calculations.
  - **By Date** - if enabled, displays the trend data in the graph as a scatter plot with the date and time of the test on the X-Axis. This allows you to view when parts were tested, and to determine periods of inactivity. If this option is not enabled, the trend graph is displayed by test index with 0 being the oldest record.
  - **Include All** - allows the inclusion or removal of "fliers" or data points that are far from the normal data set. If this is enabled, all data in the SPC FIFO for this feature from the Start of SPC Data is used and displayed in calculations (see *Table 38 on page 129*, Start of SPC Data section). If this option is disabled, only those data points that are inside certain bounds calculated from the specification limits are included. The upper bound is determined by taking the upper specification limit and adding 10 times the difference between the upper and lower specification limits. The lower bound is determined in a similar way by taking the lower specification limit and subtracting 10 times the difference between the upper and lower specification limit.
- **Edit Limits** button - after confirming this choice by pressing this button again, takes you directly to the Setup -Trend screen for the feature, operation and model being analyzed. After making changes, you can return directly to the Trend View by pressing the Main button.
- **Model** - allows you to select a model from the drop- down list and view the data for that model.

### *Using the Trend View*

#### To use the Trend view

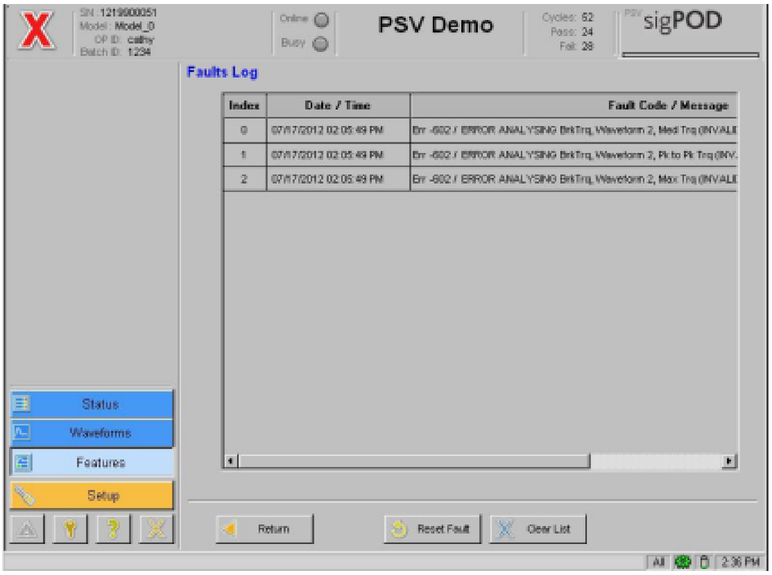
1. In the Features view under **Select Graph**, click the **Trend** button.
2. From the **Select Model to View** drop-down list, select the model you wish to view.
3. Expand the operation you wish to view (for example, **Operation 0**) by clicking on either the operation name or the **+** button beside the operation name.
4. Under the operation name, select a waveform name (for example, Ch 0 FFT) to view the associated feature information.
5. In the Feature Summary Table, under Select, click the feature you wish to view. The trend data for that feature is displayed.
6. Do any of the following:
    - To view the specification limits, click the **Spec** check box. Two red waveforms representing the specification limits appear in the graph. To disable this view, click the **Spec Limits** button again.
    - To view the control limits, click the **Control** check box. Two horizontal magenta lines representing the control limits appear in the graph. To disable this view, click the **Control** check box again.
    - To view the data mean, click the **Mean** button. A horizontal green line displays the mean. To disable this view, click the **Mean** button again.
    - To view the date and time that parts were tested and when there were periods of inactivity, click the **By Date** check box. A blue scatter plot appears in the graph. To disable this view, click the **By Date** check box again.
    - To view all the data including "Fliers" click the **Include All** check box.
    - To zoom the graph, double-click the graph area.
7. Click any of the buttons in the toolbar to exit the **Trend** screen.

## Faults

The Faults screen lists any errors that have occurred while the system is in use, and indexes each entry in chronological order (see *Figure 20*). You can access the Faults screen by pressing the **Fault** button in the System Buttons menu at the bottom of the screen. The Icon indicates if there are any new faults present since the last time that you view the Fault list. The icon for no new faults has a gray background . If there are new faults present, the icon has a yellow background and looks pressed in .

Each entry contains the date and time the error occurred, and a fault code and message describing the error.

*Figure 20 Faults View*




The Faults screen also allows you to reset the system from a fault condition, thus bringing the system back online and ready for a new test. For help with error messages, refer to *"Appendix A: Error messages" on page 201*.

**Note:** If a critical fault occurs, the online signal is disabled.

## *Deleting Fault Entries*

To delete the fault list, you must be logged in as **Engineer**.

### To delete all fault list entries

***WARNING:*** The entries cannot be restored once you have deleted them.

- Click the **Clear List** button.
  All fault entries are removed.

## *Resetting the System*

### To reset the system and bring it back online after a fault condition

- In the Fault screen, click the **Reset Fault** button, or in a status screen, click the **Reset** button. The system resets and returns to an online and ready to test state. The online output is enabled.

# Setup

This section describes the Setup screens and how to access them in order to configure the sigPOD system. For complete information on how to use the Setup screens to configure the sigPOD, refer to *"Configuring the sigPOD and common system parameters" on page 84*.

If you have Leak Sequencing for third-party leak testers enabled, or 3520 Leak Functionality enabled, some of the screens have additional controls. For more information, see *"Leak sequencing for third-party leak testers - setup screens" on page 70* or *"3520 module functionality - setup screens" on page 78*.

You must be logged in as (minimum) **Engineer** to enable the Setup feature.

The Setup screens allow you to configure settings related to the following:

- All Sensors and Digital input/output (I/O)
- Models and Test Configurations
- Operations
- System
- Data Entry

When you click the **Setup** button in any of the Main Operation Mode screens, the message "Make the selection again to go off line and enter Setup" is displayed at the bottom of the screen in the status bar. Clicking the **Setup** button again takes the system off line and the system enters setup mode. The sigPOD does not enter Setup mode if it is actively testing a part.

The View Type menus on the lower left change to the setup Toolbar menus and the **Setup** button now becomes the **Main** button to allow you to return to the main operation mode. The **Setup Mode** buttons are yellow to indicate Setup Mode.

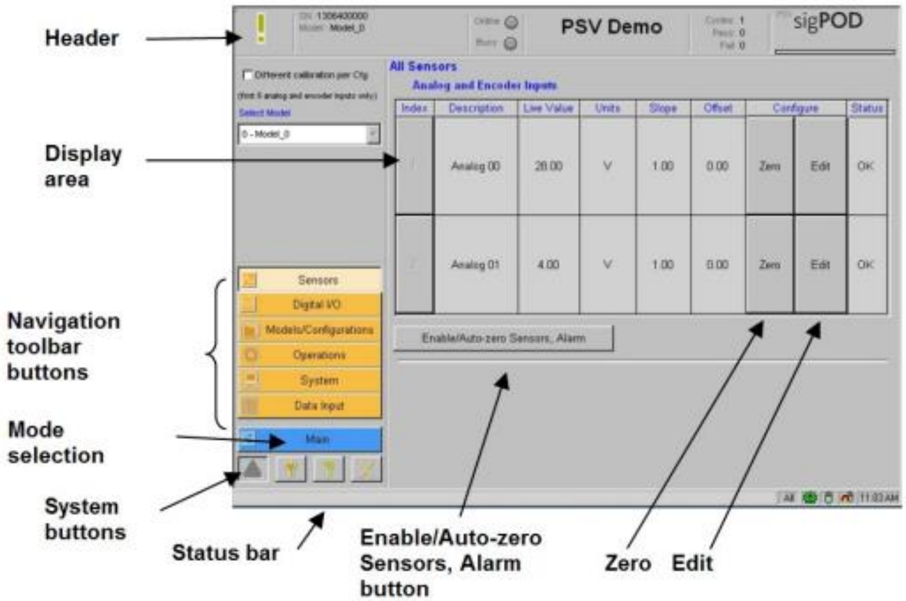
## *Navigating Setup*

The Setup screens all have very similar layouts. The default opening screen is the All Sensors screen, as shown in *Figure 21 on page 51*. When the system returns to Setup Mode, the first screen shown has the same view type as the last time the system was in Setup Mode.

Each setup screen contains the following:

- Header: For more information, refer to *"Header" on page 18*.
- View Options
- Toolbar buttons
- Mode Selection button
- Status Bar
- System Buttons: For more information, refer to *"System Buttons" on page 24*.
- Display Area

*Figure 21 Sensors Screen*




The navigation toolbar buttons allow you to setup Sensors, Digital I/O, Models/Test Configurations, Operations, the System, or Data input.

*Table 12* shows the information that is shown in the Display Area for each menu option.

***Table 12*** *Displays Associated with Operations setup screen*

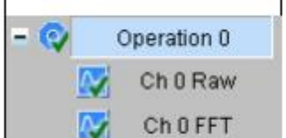
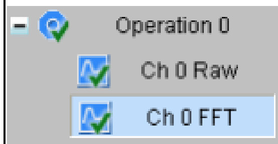
| View Options | Display Area |
|---|---|
| Operation Name<br><br>For explanation of icons, see *Table 7*. | Operation name, data collection rate, delays, triggers, waveform enables. See *Figure 29 on page 59* |

*Table 12 Displays Associated with Operations setup screen (Continued)*

| View Options | Display Area |
|---|---|
| Wave Name | Processing option under select view (upper right of display area) displays waveform processing configuration. See *Figure 30 on page 61*. |
|   | Features option under select view (upper right of display area) displays a waveform and feature configuration in table below. See *Figure 31 on page 62*. |
| For explanation of icons, see *Table 8*. | Histogram option under select view (upper right of display area) displays a histogram of the feature selected and feature configuration in table below. See *Figure 32 on page 63* |
| | Trend option under select view (upper right of display area) displays a trend of the feature selected and feature configuration in table below. See *Figure 33 on page 64*. |

For information on how to use the Setup screens to manually configure the sigPOD, see *"Configuring the sigPOD and common system parameters" on page 84*.

## *All Sensors*

The Sensors screens allow the setup of all analog and position (encoder) sensors. Clicking the **Sensors** button opens the **All Sensors** screen (see *Figure 21 on page 51*) containing a table of analog and position sensors, where you can view the live values and units, zero the sensors, calibrate and enter sensor information, and view messages alerting you to whether the hardware is not present.

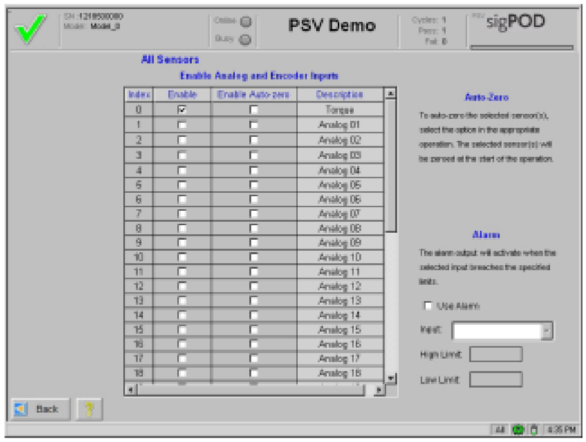
If you have 3520 functionality enabled, you must first select the platform (sigPOD or 3520) whose sensor information you want to view.

The **Different Calibration per Model** check box, in the top-left corner of the screen, provides model-dependent calibration slope and offset for each sensor. When Model data is separate from Test Configuration data, the **Different Calibration per Model** check box is labeled **Different Calibration per Config**. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

**Note:** Only the core 8 Analog channels and 2 Encoder channels are supported for model-dependent calibration. Expansion channels have only the base calibration applied to them.

Clicking the **Enable/Auto-zero Sensors, Alarm** button in the All Sensors screen opens the **Enable Analog and Encoder Inputs** screen (see *Figure 22*) or the **Enable 3520 channels screen**, if you have 3520 functionality enabled (see *Figure 49 on page 80*). All sensors that are available to use are listed to allow you access to the unused sensors at a later date. This screen also allows you to auto-zero a sensor and to configure alarm for one of the following channels: Analog 0, Analog, 1, or Encoder 0. Note that when leak sequencing is enabled, physical digital outputs are not available, including the alarm output. For more information, see *"Enabling leak sequencing for a third-party leak tester" on page 146*.

*Figure 22 Enable Analog and Encoder Inputs screen*

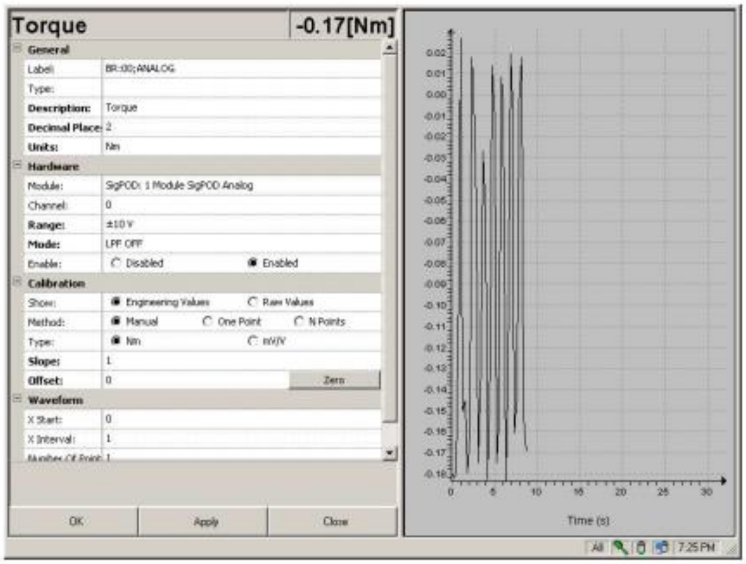



To enter information and settings for each sensor, click the **Edit** button for the sensor you wish to configure. The Sensor Calibration screen (see *Figure 23*) opens with a graph of the real-time data on the right-hand side and settings on the left-hand side.

The Sensor Calibration screen allows you to view information and configure settings related to the following:

- General information:
  - Description (name)
  - Number of decimal places to display
  - Engineering units
- Hardware:
  - Module attached
  - Channel used
  - Enabled or disabled
- Calibration:
  - Show engineering values or raw values
  - Choice of method: Manual, One-point or N-points
- Calibration type:
  - Slope (analog sensor) or Pulses/Deg (position/encoder sensor)
  - Offset
- Waveform:
  - X Start
  - X Interval
  - Number of points

*Figure 23 Sensor Calibration Screen*




For information on how to use the Sensor screens to manually configure the sigPOD, see *"Configuring Sensors" on page 86*.

For information about the additional controls available on the All Sensors screen when leak sequencing or 3520 functionality is enabled, see the see the *"All Sensors – leak sequencing for third-party leak testers" on page 71* and *"All Sensors – 3520 module functionality" on page 80*.

## Digital I/O

When you click the **Digital I/O** button in the Navigation pane, the Digital I/O screen opens. The screen looks different depending on whether discrete I/O is being used (*Figure 24*), or one of the soft fieldbus interfaces, EtherNet/IP (see *Figure 25*) or PROFINET, or if there is a 1608 expansion module connected to the sigPOD (see *Figure 26*).

*Figure 24 Digital I/O Screen- physical I/O*

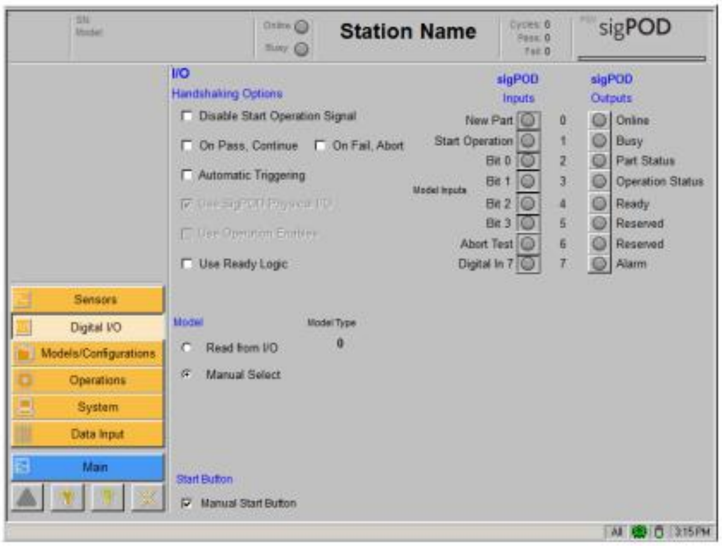
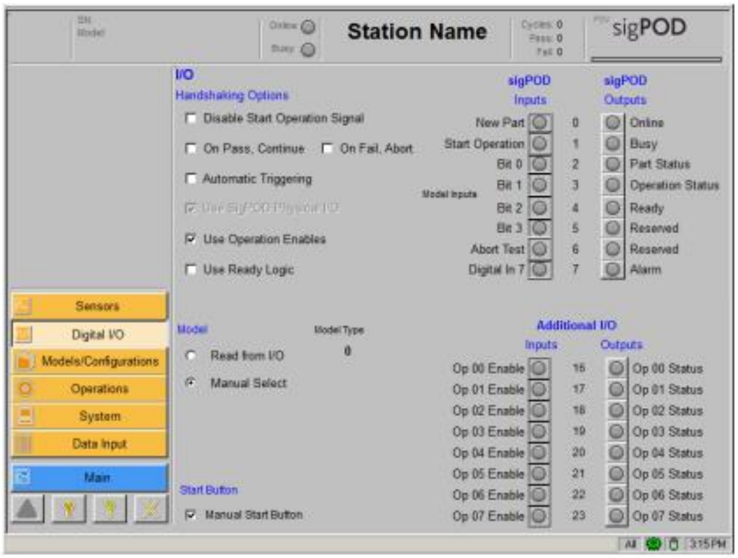



*Figure 25 Digital I/O Screen- EtherNet/IP*

*Figure 26 Digital I/O Screen – sigPOD 1608 expansion module connected*




The I/O screen allows you to see the live digital input and output status, as well as to configure settings related to

- Handshaking options
- Model / test configuration number selection
- Toggle outputs for digital I/O
- Toggle outputs for 1608 Module #1 I/O
- Manual Start button (enabling)
- PINpoint functionality

**Note:** When leak sequencing for third-party leak testers is enabled, the following digital I/O are not available:

- Physical digital outputs for cycle handshaking
- Physical model selection digital inputs

For information about the additional controls available on the Digital I/O screen when leak sequencing is enabled, see *"Digital I/O – leak sequencing for third-party leak testers" on page 71*.

For information about how to use the I/O screens to manually configure the sigPOD, see *"Configuring Digital I/O" on page 89*.

## Models / Test Configurations

When you click the **Models/Configurations** button in the Navigation pane in any Setup screen, the Models screen opens (see *Figure 27*). If you disable the Link Model and Configuration check box on the Models screen, Model data is separated from Test Configuration data, and the screen and its controls refer to Test configurations (see *Figure 28*). For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

The Models / Test configurations screen allows you to configure settings related to the following:

- Model / Test Configuration name
- Model / Test Configuration index
- Adding and deleting models or test configurations
- Copying configurations from one model to another
- Separating the configuration from the model label

For information on how to use the Models screen to manually configure the sigPOD, see *"Setting up Models" on page 107*.

*Figure 27 Models Screen*

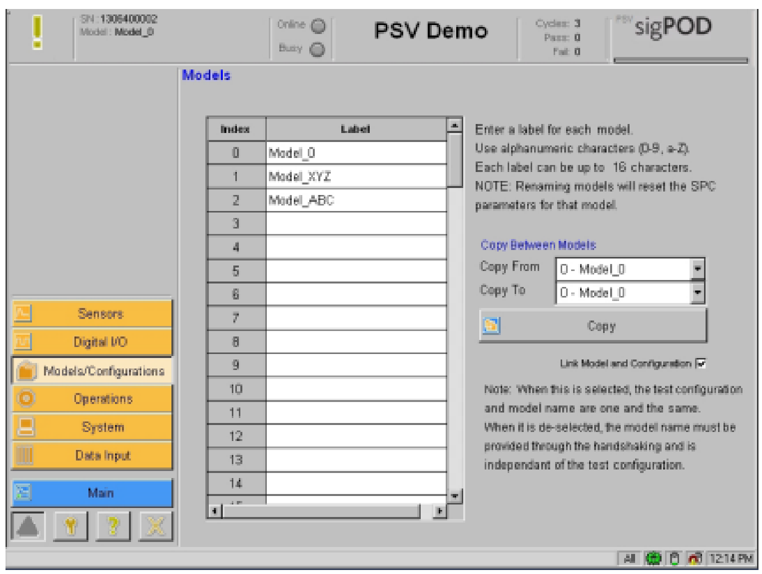
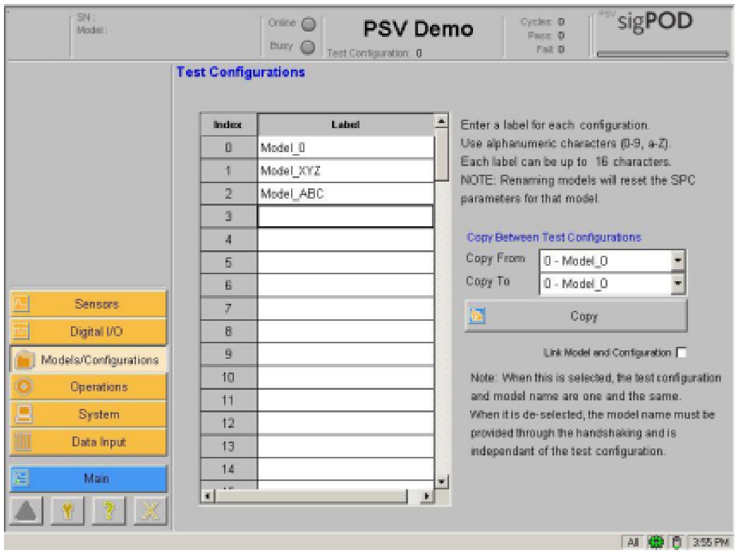


*Figure 28 Test Configurations Screen*

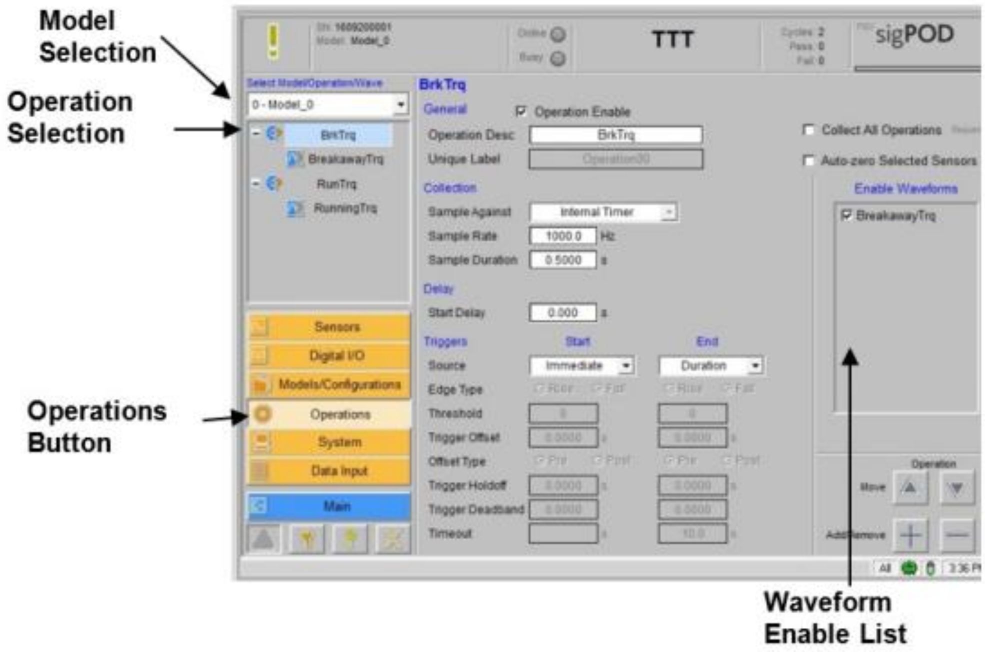



## *Operations – Operation Level*

The Operations screens allow you to configure all operations, including settings for data collection, triggering, waveforms and features.

When the **Operations** button in the Navigation pane is clicked, the view options section (see *Figure 29*) allows selection of Model or Test configuration, Operation and Waveform. Clicking the plus sign beside the name of each operation opens the list of waveforms enabled for that operation. Beside the name of each operation listed is an icon that indicates the status of the operation based on the data from the last part tested for the chosen model (or test configuration) re-analyzed against the current setup configuration. *Table 7 on page 21* lists the operation status icons and their meanings.

*Figure 29 Operations Screen*




The following can be set up on this screen:

- Enabling or disabling operations (1-40)
- Adding, removing, or changing the order of operations
- The name of the operation
- The operation QualityWorX (QWX) label (if you have enabled editing of QWX labels on the System setup screen)
- Data collection: data to sample against, sample rate, sample duration
- Start Delay
- Trigger information, for both start and end, including source, edge type, threshold, trigger offset, trigger hold off, trigger deadband and timeout
- Enabling or disabling waveforms (1-20). Once waveforms are enabled for an operation, you can access screens for each waveform to configure settings related to Data Processes and Analysis, by clicking on the waveform name in the **View Options** list (now called **Select Model/ Operation/ Waveform** or **Select Config/ Operation/Waveform**).

For information about navigating the setup screens, see *"Navigating Setup" on page 50*.

If you have 3520 functionality enabled, you can assign each operation to either the sigPOD or a 3520 platform.

For information on how to use the Operations screen to manually configure the sigPOD, see *"Configuring Operations for Data Collection" on page 110* and *"Configuring Operations for Data Processing and Analysis" on page 115*.

For information about configuring operations for a 3520 module, see *"Operations – leak sequencing for third-party leak testers" on page 77*.

For information about the additional controls available on the Operations screen when 3520 functionality is enabled, see *"Operations – 3520 module data collection setup" on page 82*.

### *Operation description and Operation unique label*

The Operations setup screen allows you to specify two important operation parameters: operation description and operation label.

The operation description is the operation name that is used in all PSV screens related to the sigPOD configuration and the review of test data.

The operation label is a unique identifier for the operation data in the QualityWorX database and history data, and is not visible in the PSV application.

By default, PSV automatically generates a label for each operation. This label is unique within the model, but common across all models. For example, in all models, the first operation is automatically labeled "Operation00", the second operation is labeled "Operation01", and so forth.

This default labeling scheme is desirable when models are similar; that is, models are configured with similar tests, but with different limits or analysis regions. For example, if the tests performed under "Operation01" are the same for all models, the label and description for this operation can and should be the same in all models. Therefore, by default, editing of the automatically generated operation labels in the PSV application is disabled.

The default labeling scheme has limitations in certain cases. If some models include different types of tests and the station is to be connected to a QWX database, you should provide a unique label for each operation across models. This unique label will properly identify and separate the data in the QWX database. For example, consider the scenario where the first operation in model A is a press operation and the first operation in model B is a leak test. If the default labels were used (they are identical across models), both the Press data from model A and the leak test data from model B would be grouped together in the database. To solve this issue, first you must enable QWX label editing in PSV and then edit the default labels. By making the labels different between the two models, the data sets are separated, allowing the Press data from model A to be accessed independently from the Leak test data from model B within the database hierarchy.

## *Waveform – Processing*

When the Operations button is clicked, the view options section allows selection of Model or Test Configuration, Operation and Waveform. Clicking the plus sign next to an operation name expands the list of waveforms for that operation under the operation name.

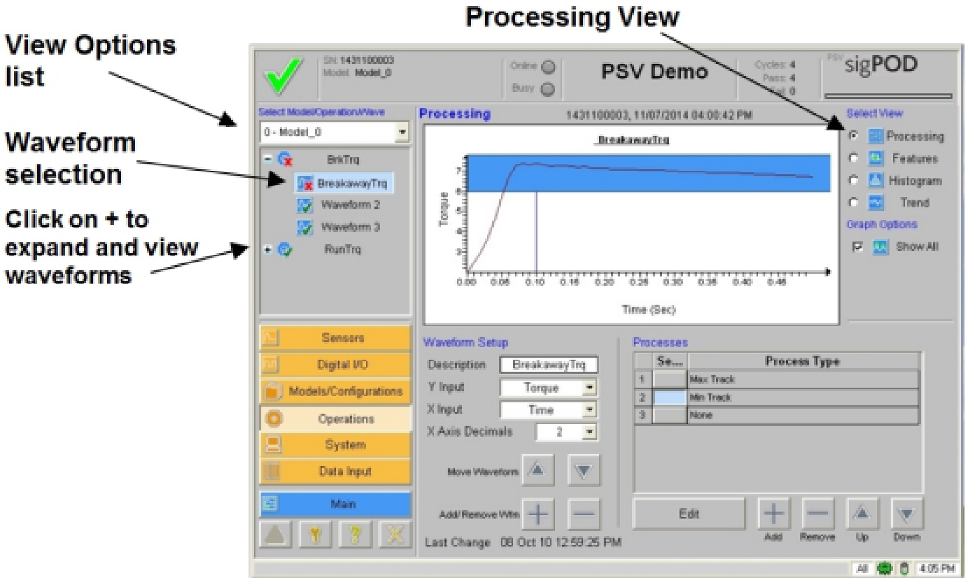
After you select a **Waveform**, information about the waveform processing and features can be set up. The Processing page can be accessed from any Waveform setup screen by clicking the **Processing** button in the **Select View** list on the right-hand side of the screen. The Waveform - Processing screen opens (see *Figure 30*).

If the waveform is available, it is displayed as a graph, above the setup parameters and information including

- Description
- Y input sensor
- X input sensor
- Processing type (see *Table 33 on page 119*) for a full list of available processes)
- Move and Add/Remove Waveform buttons
- X-Axis decimals
- Last Change date
- Graph and view options.

Further setup options for each processing type are shown in the area below the graph.

*Figure 30 Waveform - Processing Screen*



For information on how to navigate the setup screens, see "Navigating Setup" on page 50.

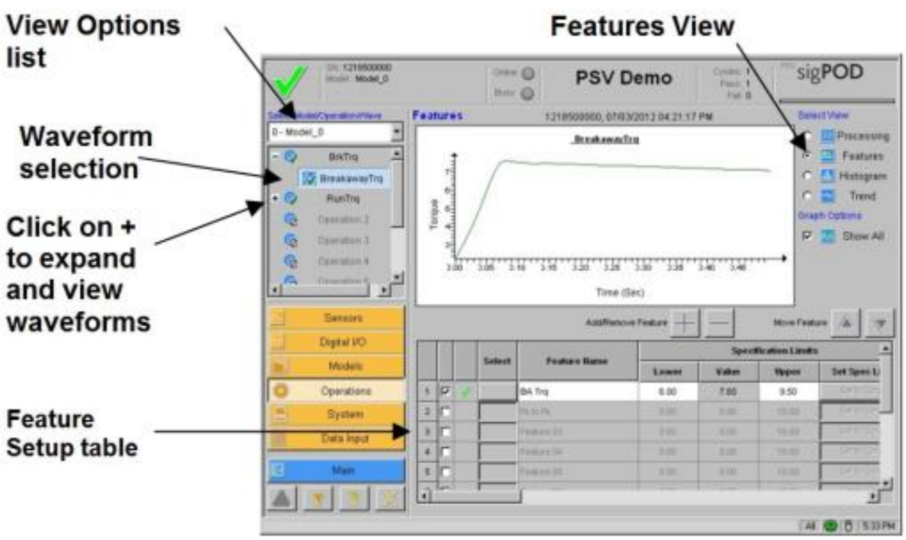
For information on how to use the Waveform -Processing screen to manually configure the sigPOD, see "Waveform Processing Options" on page 116.

## Waveform – Features

When the **Operations** button is clicked, the view options section allows selection of **Model, Operation** and **Waveform**. Clicking the plus sign next to an operation name expands the list of waveforms for that operation under the operation name.

After you select a **Waveform**, information about the waveform processing and features can be setup. The waveform feature parameters can be accessed from any Waveform setup screen by clicking the **Features** button in the **Select View** list on the right-hand side of the screen. The Waveform - Feature screen opens (see *Figure 31*).

*Figure 31 Waveform - Feature Screen*




If the waveform is available, it is displayed as a graph, above a table containing feature setup parameters and information including:

- Feature enable, status, name
- Analysis type and X-Axis range
- Feature value, units and decimals
- Specification limits: Lower and Upper, set to control limits button
- SPC control limits: Lower and Upper, number of sigma to use
- SPC Information: # Samples, # fail, % Fail, Cpk

- Start of SPC data, date and time, and Reset button
- Show with all feature options
- SPC graph limits: Auto-enable or min, max
- Main graph limits: Auto-enable or X min, X max, Y min, Y max
- Include or exclude features from the results data sent to a PLC or stored in a log file

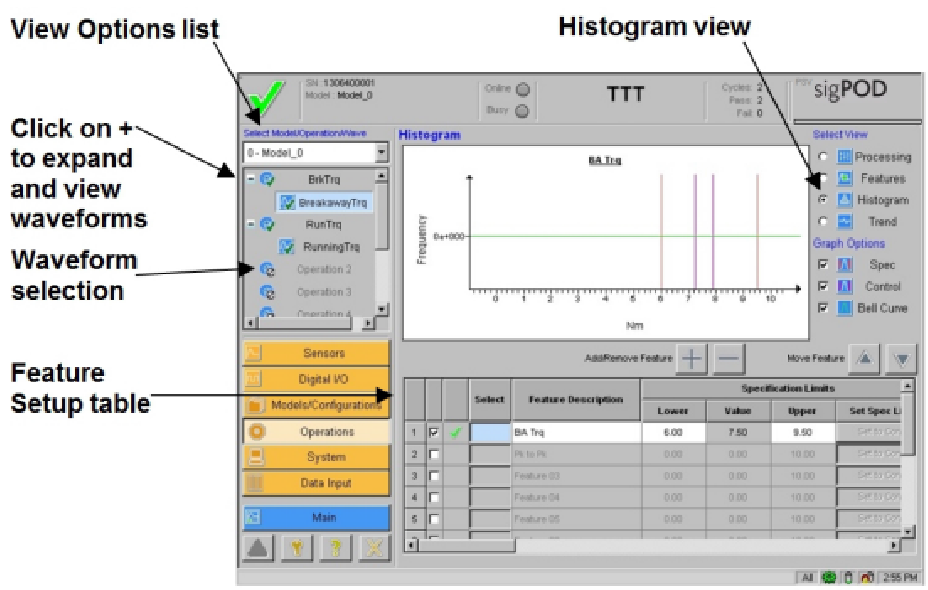
For information on how to use the Waveform -Feature screen to manually configure the sigPOD, see *"Waveform Analysis Options" on page 128*.

## *Waveform – Histogram*

When the Operations button is clicked, the view options section allows selection of Model or Test Configuration, Operation and Waveform. Clicking the plus sign next to an operation name expands the list of waveforms for that operation under the operation name.

After you select a **Waveform**, information about the waveform processing and features can be setup. The histogram parameters can be accessed from any Waveform setup screen by clicking the **Histogram** button in the **Select View** list on the right-hand side of the screen. The Waveform - Histogram screen opens (see *Figure 32*).

*Figure 32 Waveform - Histogram Screen*




If more than five SPC data points are available, a histogram is displayed above the feature setup table. This table is the same as that in the Waveform -Feature screen (see *Figure 31 on page 62*).

The Waveform - Histogram screen contains the following additional graph options:

- Enable/disable displaying Spec limits
- Enable/disable displaying Control limits
- Enable/disable displaying Bell curve

**Note** These options work the same as in the *"Histogram View" on page 43*.

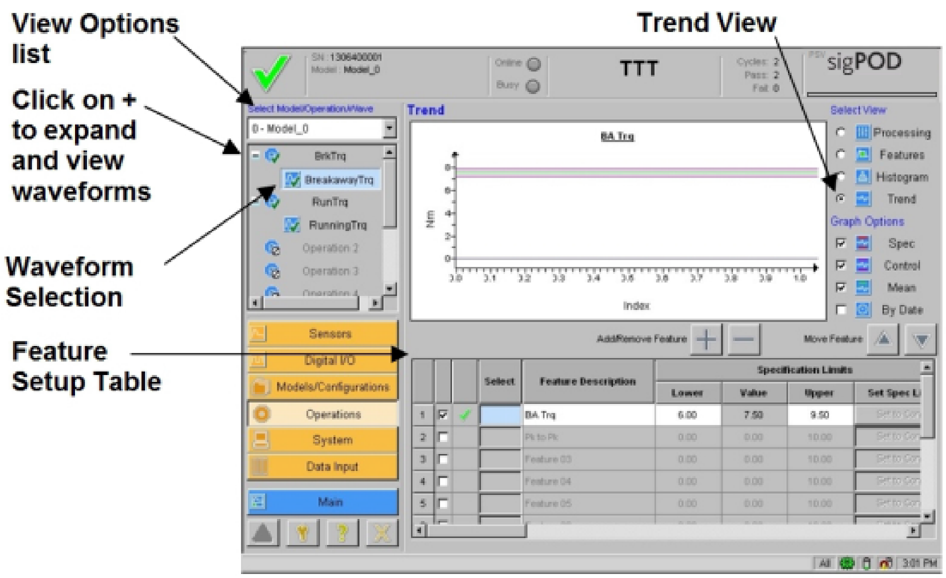
For information on how to use the Waveform -Histogram screen to manually configure the sigPOD, see *"Waveform Analysis Options" on page 128*.

## *Waveform –Trend*

When the Operations button is clicked, the view options section allows selection of Model or Test Configuration, Operation and Waveform. Clicking the plus sign next to an operation name expands the list of waveforms for that operation under the operation name.

After you select a **Waveform**, information about the waveform processing and features can be setup. The Trend view can be accessed from any Waveform setup screen by clicking the **Trend** button in the **Select View** list on the right-hand side of the screen. The Waveform -Trend screen opens (see *Figure 33*). If more than five SPC data points are available, a trend graph is displayed above the feature setup table. This table is the same as that in the Waveform - Feature screen (see *Figure 31 on page 62*).

*Figure 33 Waveform - Trend Screen*



The Waveform -Trend screen contains the following additional graph options:

- Enable/disable displaying Spec limits
- Enable/disable displaying Control limits
- Enable/disable displaying Mean line
- Display the trend data by date or by index

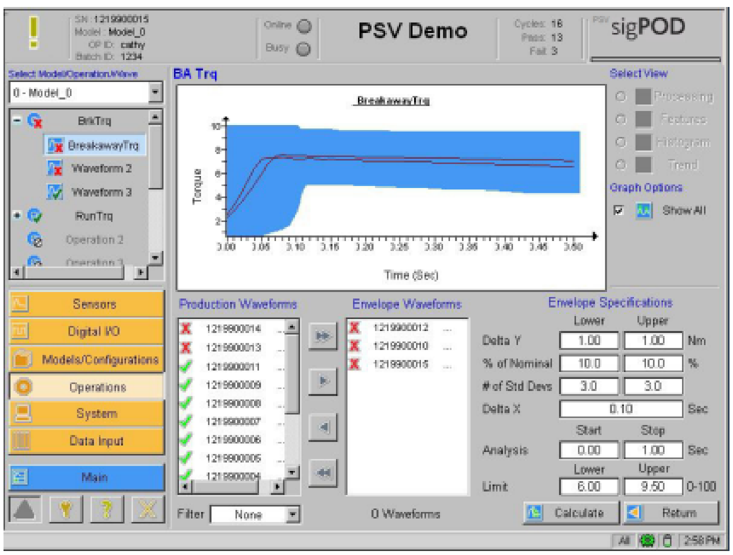
**Note** These options work the same as in *"Trend View" on page 45*.

For information on how to use the Waveform -Trend screen to manually configure the sigPOD, see *"Waveform Analysis Options" on page 128*.

## *Waveform – Envelope Edit*

When you choose an Envelope Analysis type for a feature of a waveform, the **Edit** button in the **Advanced** column of the **Feature Setup Table** is enabled. Clicking this button opens the Waveform - Envelope Edit screen (see *Figure 34*).

*Figure 34 Waveform - Envelope Edit Screen*




This screen allows you to generate an envelope for the feature. Setup parameters and information include the following:

- Production waveforms, listing part pass/fail status, serial number and test date and time
- Production list filter setting
- Envelope waveforms, listing waveform status and serial number, as well as envelope feature result and original test date and time
- Control buttons to move the waveforms from one list to another

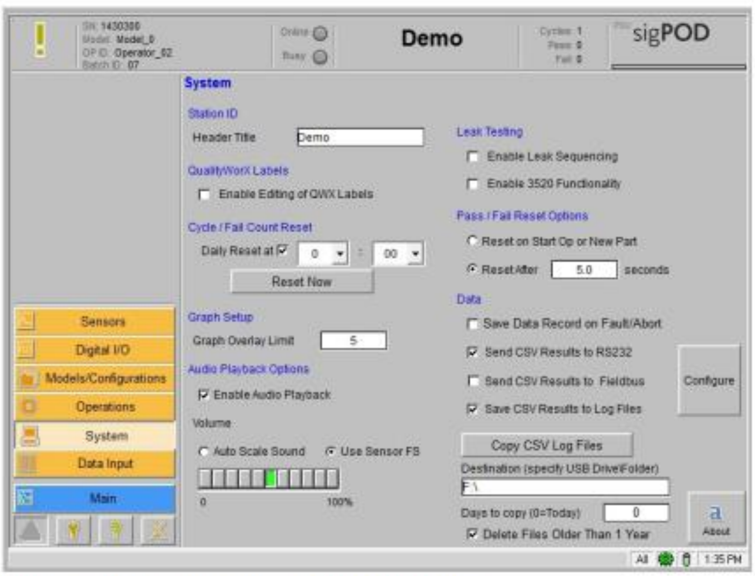
- Envelope specifications: Delta Y upper and lower, % of nominal upper and lower, number of standard deviations upper and lower, Delta X
- Analysis range start and stop
- Specification Lower and Upper limits
- Calculate Envelope button

For information on how to use the Envelope Edit screen to manually configure the sigPOD, see *"Configuring Envelopes" on page 136*.

## System

When you click the **System** button in the Navigation pane in any Setup screen, the System setup screen opens (see *Figure 35*).

*Figure 35 System Screen*




The System screen allows you to configure settings related to

- Station ID
- Cycle/Fail Count Reset
- QualityWorX labels
- Graph Overlay Limit
- Leak Sequencing or 3520 module functionality
- Pass/Fail Reset Options
- Results Data
- Audio Playback Options

You can choose to configure either common System settings or the 3520-specific settings.

Clicking the **Configure** button in the **System** screen opens the **System - Results Configuration** screen that allows you to specify a custom format for the results data.

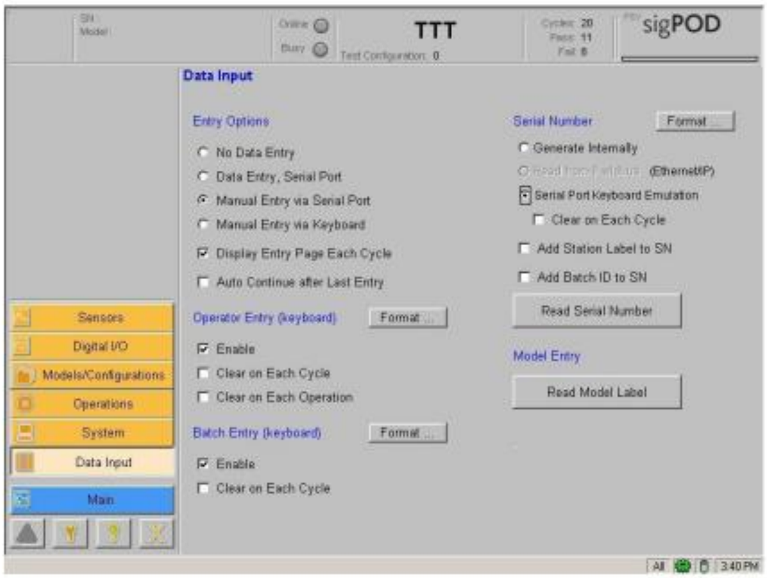
*Figure 36 System Setup, Results Configuration screen*


For information on how to use the System screen to manually configure the sigPOD, see *"Configuring the System" on page 140.*

## *Data Input*

When you click the **Data Input** button in the Navigation pane in any Setup screen, the **Data Input** setup screen opens (see *Figure 37*).

*Figure 37 Data Input Screen*




The Data Input setup screen allows you to set up data input parameters, such as type of operator ID entry, batch ID entry, ways of retrieving the serial number and format of the operator ID, batch ID, or serial number.

Each entry parameter can be verified against a preset format (see *Figure 38*).

*Figure 38 Setup Serial Number Format*


For information on how to use the Data Input screen to manually configure the sigPOD, see *"Configuring Data Input" on page 143*.

## Leak sequencing for third-party leak testers - setup screens

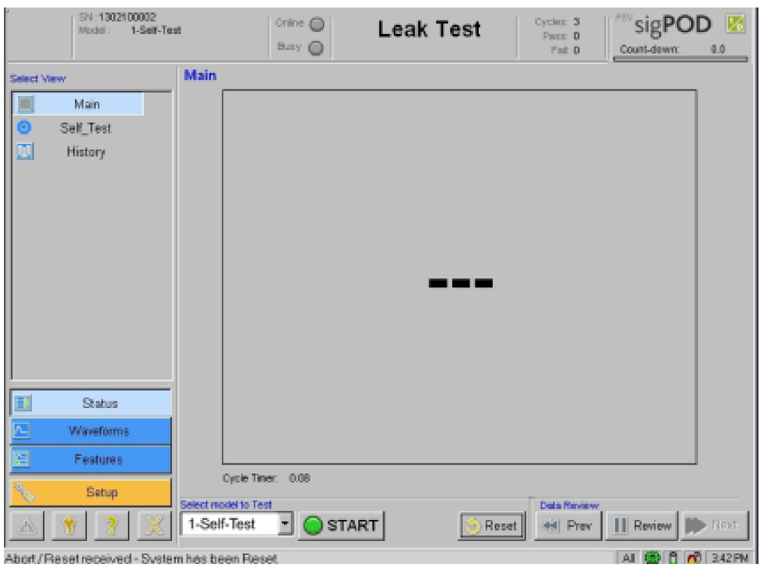
When you enable leak sequencing in the PSV application for use with third-party leak testers, the following setup screens have additional controls:

- All Sensors
- Digital I/O
- Operations

See the sections that follow for more information. For information about enabling leak sequencing, see *"Enabling leak sequencing for a third-party leak tester" on page 146*.

Also, the header in the Main operations screen has a count-down timer that displays the time remaining till the end of the leak test sequence (see *Figure 39*).

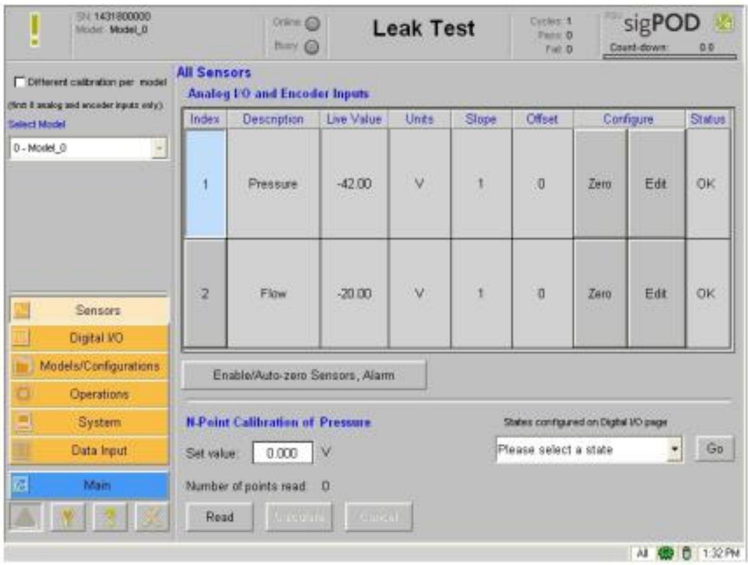
*Figure 39 Main screen when leak sequencing for third-party leak testers is enabled*



## All Sensors – leak sequencing for third-party leak testers

With leak sequencing enabled for third-party leak testers, the All Sensors screen has additional controls that allow you to perform N-point calibration and to run individual steps (states) from the test configuration (see *Figure 40*).

*Figure 40 All sensors screen when leak sequencing functionality is enabled*




## Digital I/O – leak sequencing for third-party leak testers

When leak sequencing for third-party leak testers is enabled, the Digital I/O provides access to the Leak Panel Status Input screen, which allows you to configure the status inputs, and the State Setup screen which allows you to create a state table for the leak equipment you are using (see *Figure 41*, *Figure 42*, and *Figure 43*).

The following digital I/O are not available when leak sequencing for third-party leak testers is enabled:

- Physical digital outputs for cycle handshaking
- Physical model selection digital inputs (see *Table 13 on page 73*)

  **Note** When leak sequencing is disabled, Model selection digital inputs are available on channels 2 through 5.

*Figure 41 Digital I/O screen when leak sequencing with third-party leak testers is enabled*

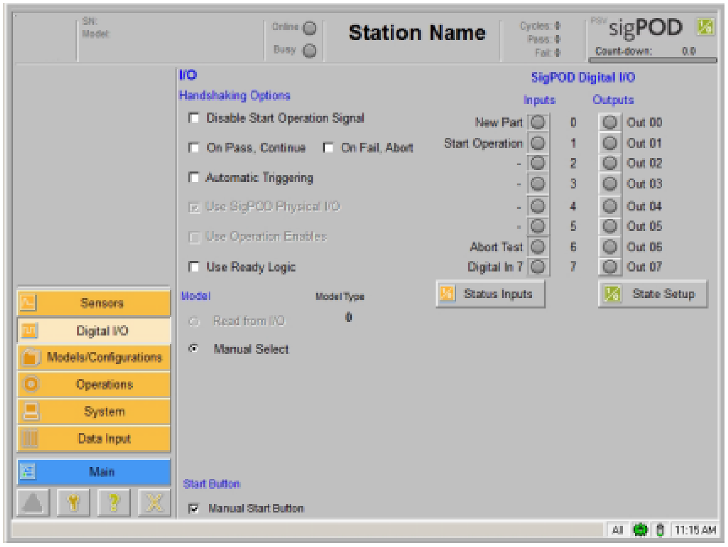
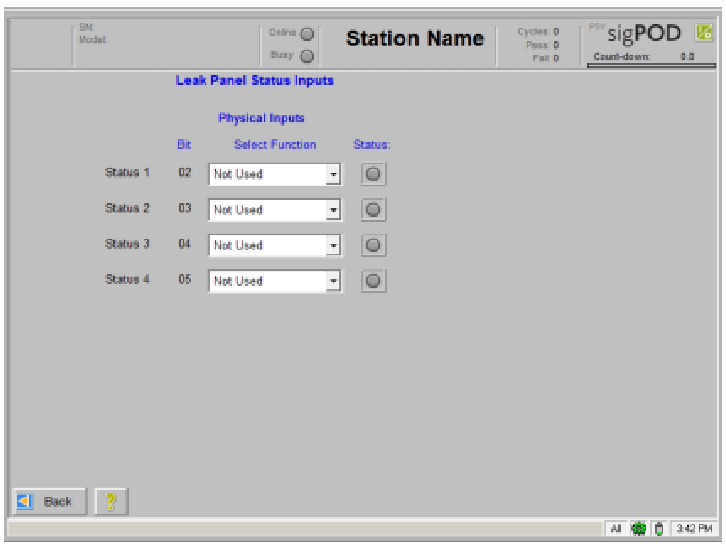



*Figure 42 Leak Panel Status Inputs screen*




If you have configured any panel status bits, use the Leak Panel Status Inputs screen to view real-time status. The Digital I/O screen may not accurately reflect the status bits in certain cases and should not be used for diagnosis.

**Table 13** *Digital Input assignment when leak testing sequencing for third-party leak testers is enabled*

| Digital Channel | Assignment in the PSV application |
|---|---|
| 0 | New part |
| 1 | Start Operation |
| 2 – 5 | Can be enabled for use as leak panel status input signals |
| 6 | Abort Test |
| 7 | Multi-purpose digital input |

For information about the available status input parameters, see *"Configuring online status inputs for a third-party leak tester" on page 152*. For information about leak sequencing states, see the following section.

## State Setup for third-party leak testers

The State Setup screen (*Figure 43*) allows you to create a custom State Setup table for your leak test unit.

The State Setup table defines all available configuration states of valves, sensors, and indicators in your leak test unit. See *Figure 44* for an example of a state table and *Table 14* for a description of the states in this example.

To create a custom State Setup table, see the *"Creating a custom state table for a third-party leak tester" on page 152*.

*Figure 43 Leak sequencing State Setup screen*

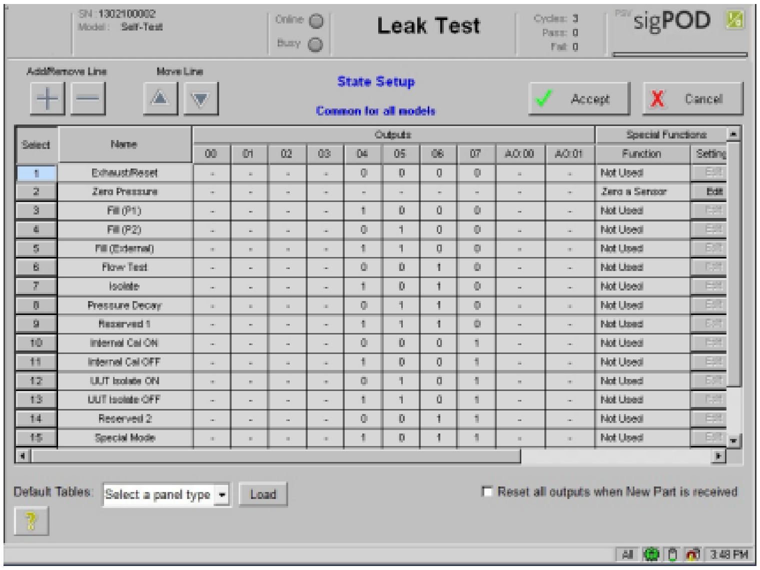



*Figure 44 Example state table for a third-party leak test module*

| Select | Name | Outputs | | | | | | | | | | Special Functions | | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | AO:00 | AO:01 | Function | Settings | |
| 1 | Exhaust/Reset | - | - | - | - | 0 | 0 | 0 | 0 | - | - | Not Used | Edit | Resets panel all valves off exhaust state |
| 2 | Zero Pressure | - | - | - | - | - | - | - | - | - | - | Zero a Sensor | Edit | Performs a zero on the pressure sensor |
| 3 | Fill (P1) | - | - | - | - | 1 | 0 | 0 | 0 | - | - | Not Used | Edit | Fill state pressure to P1 |
| 4 | Fill (P2) | - | - | - | - | 0 | 1 | 0 | 0 | - | - | Not Used | Edit | Fill state pressure to P2 |
| 5 | Fill (External) | - | - | - | - | 1 | 1 | 0 | 0 | - | - | Not Used | Edit | Fill state set pressure to External input |
| 6 | Flow Test | - | - | - | - | 0 | 0 | 1 | 0 | - | - | Not Used | Edit | Open flow meter path |
| 7 | Isolate | - | - | - | - | 1 | 0 | 1 | 0 | - | - | Not Used | Edit | Isolate state Fill and Flow off |
| 8 | Pressure Decay | - | - | - | - | 0 | 1 | 1 | 0 | - | - | Not Used | Edit | Pressure Decay state |
| 9 | Reserved 1 | - | - | - | - | 1 | 1 | 1 | 0 | - | - | Not Used | Edit | Reserved for future use |
| 10 | Internal Cal ON | - | - | - | - | 0 | 0 | 0 | 1 | - | - | Not Used | Edit | Internal orifice on |
| 11 | Internal Cal OFF | - | - | - | - | 1 | 0 | 0 | 1 | - | - | Not Used | Edit | Internal orifice off |
| 12 | UUT Isolate ON | - | - | - | - | 0 | 1 | 0 | 1 | - | - | Not Used | Edit | Turn the UUT Isolate valve on |
| 13 | UUT Isolate OFF | - | - | - | - | 1 | 1 | 0 | 1 | - | - | Not Used | Edit | Turn the UUT Isolate valve off |
| 14 | Reserved 2 | - | - | - | - | 0 | 0 | 1 | 1 | - | - | Not Used | Edit | Reserved for future use |
| 15 | Special Mode | - | - | - | - | 1 | 0 | 1 | 1 | - | - | Not Used | Edit | Enters Special Mode for more options |
| 16 | Pass Indicator | - | - | - | - | 0 | 1 | 1 | 1 | - | - | Not Used | Edit | Set Pass Indicator On |
| 17 | Fail Indicator | - | - | - | - | 1 | 1 | 1 | 1 | - | - | Not Used | Edit | Set Fail Indicator On |

***Table 14*** *Example of a leak tester state table – description of states*

| State Index | Dig Outputs to the leak tester | Leak tester State | State Name | Description | Valves See Note 1 | | | | | | | | Indicator Lights See Notes 1 and 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | P | F | Fill | Ex | Tst | Dg |
| 1 | 0000 | 0 | Exhaust/ Reset | Regulator is set to 0 V, All valves off, Pass/Fail indicators off, Exit Special Mode, Set to use High Flow regulator | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 2 | - | - | Zero Pressure | Performs a zero on the pressure sensor | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | 0001 | 1 | Fill (P1) | Fill state, pressure to P1 | 1 | 0 | - | 1 | - | 0 | 0 | 0 | - | - | 1 | 0 | 0 | 0 |
| 4 | 0010 | 2 | Fill (P2) | Fill state, pressure to P2 | 1 | 0 | - | 1 | - | 0 | 0 | 0 | - | - | 1 | 0 | 0 | 0 |
| 5 | 0011 | 3 | Fill (External) | Fill state, set pressure to External input | 1 | 0 | - | 1 | - | 0 | 0 | 0 | - | - | 1 | 0 | 0 | 0 |
| 6 | 0100 | 4 | Flow Test | Open flow meter path | 0 | 1 | - | 1 | - | 0 | 0 | 0 | - | - | 0 | 0 | 1 | 0 |
| 7 | 0101 | 5 | Isolate | Isolate state | 0 | 0 | - | 1 | - | 0 | 0 | 0 | - | - | 1 | 0 | 0 | 0 |
| 8 | 0110 | 6 | PD (EPD) Test | Switch to PD state (Ch2 = Elec Diff) | 0 | 0 | - | 1 | - | 0 | 0 | 0 | - | - | 0 | 0 | 1 | 0 |
| 9 | 0111 | 7 | Reserved | Reserved for Differential PD or Flow | 0 | 0 | - | 1 | - | 0 | 0 | 0 | - | - | 0 | 0 | 1 | 0 |
| 10 | 1000 | 8 | Internal Cal On | Internal orifice on | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |

**Table 14** *Example of a leak tester state table – description of states (Continued)*

| State Index | Dig Outputs to the leak tester | Leak tester State | State Name | Description | Valves See Note 1 | | | | | | | | Indicator Lights See Notes 1 and 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | P | F | Fill | Ex | Tst | Dg |
| 11 | 1001 | 9 | Internal Cal Off | Internal orifice off | - | - | - | - | 0 | - | - | - | - | - | - | - | - | - |
| 12 | 1010 | 10 | UUT Isolate On | Turn the UUT Isolate valve on | - | - | 1 | - | - | - | - | - | - | - | - | - | - | 1 |
| 13 | 1011 | 11 | UUT Isolate Off | Turn the UUT Isolate valve off | - | - | 0 | - | - | - | - | - | - | - | - | - | - | 0 |
| 14 | 1100 | 12 | Precision Reg | Switch to Precision regulator | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 15 | 1101 | 13 | Special Mode | Enters Special Mode for more options | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | 1110 | 14 | Pass Indicator | Set Pass indicator On | - | - | - | - | - | - | - | - | 1 | 0 | - | - | - | - |
| 17 | 1111 | 15 | Fail Indicator | Set Fail indicator On | - | - | - | - | - | - | - | - | 0 | 1 | - | - | - | - |

**Note 1**: "-" means "no change"

**Note 2**: Indicator lights: P= pass, F=Fail, Ex=Exhaust, Tst=Test, and Dg=Diagnose

## Operations – leak sequencing for third-party leak testers

When leak sequencing for third-party leak testers is enabled, the Operations screen provides access to the Sequencing Setup screen, which allows you to setup your specific leak test configuration (see *Figure 45* and *Figure 46*). For more information about creating a leak test, see *"Creating a leak test sequence for a third-party leak tester" on page 155*.

*Figure 45 Operations screen when sequencing for third-party leak testers is enabled*

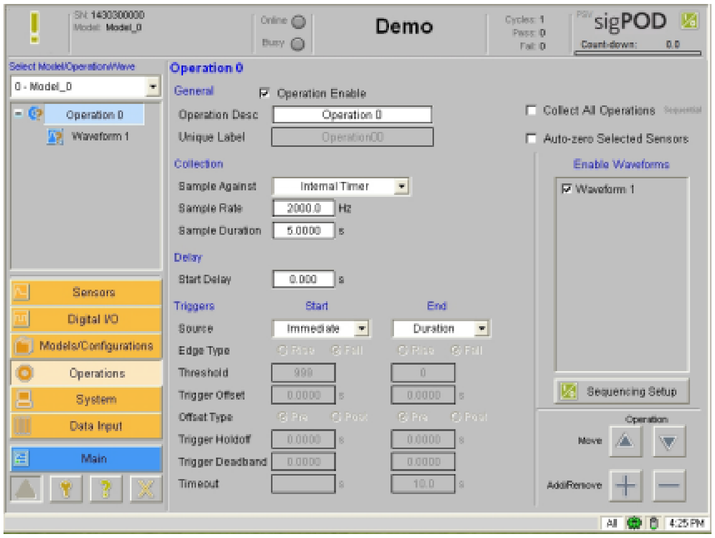
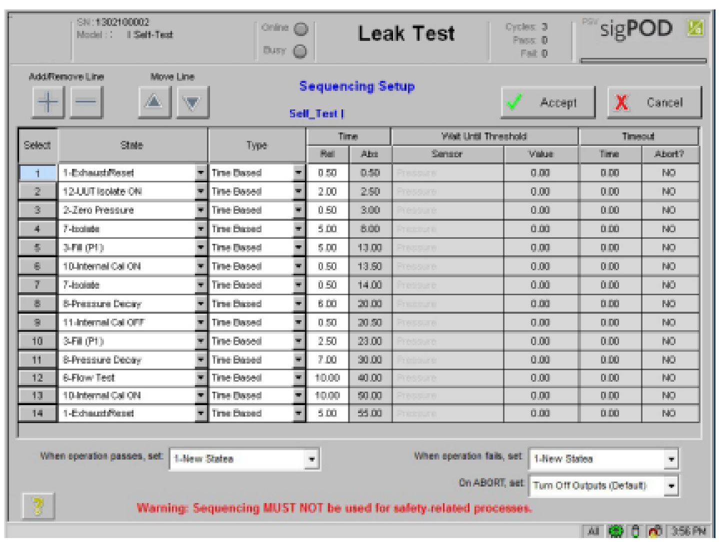



*Figure 46 Leak Sequencing setup screen*



## 3520 module functionality - setup screens

When you enable 3520 module leak testing in the PSV application, the following setup screens have additional configuration options:

- All Sensors
- Digital I/O
- Operations
- System

In addition, during a test cycle, the Main status screen displays the following information for each supported 3520 module:

- A cycle progress bar and a count-down timer (see *Figure 47*).
- The live pressure and flow
- Connection status indicated by the LED next to the unit label. Green color means connected and online.

Also, the Features screen has controls that allow you to open the Calibration port during leak testing, use the Fill and Hold or Fill and Flow leak functions, or perform a pressure decay to flow calibration (see *Figure 48*).

For information how to enable leak testing with the 3520 module, see *"Enabling 3520 functionality" on page 163*.

*Figure 47 An example of the Main screen during a leak test with a module labeled "3520_1" running*

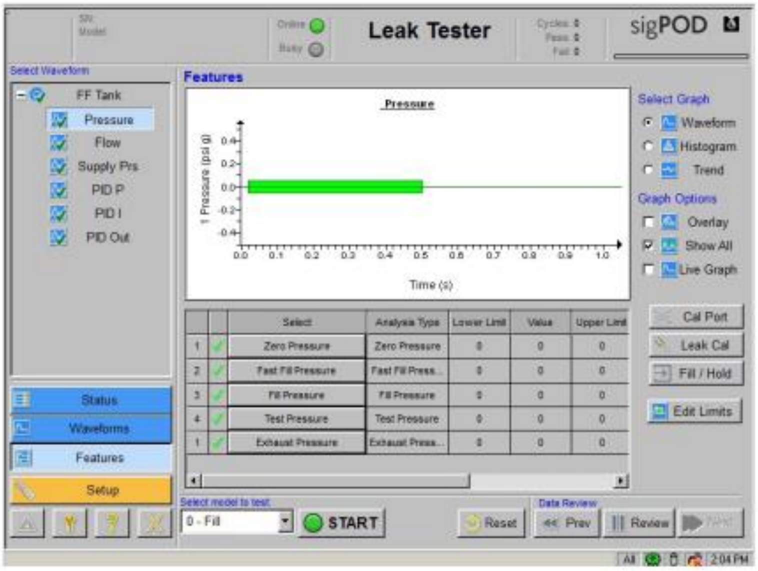
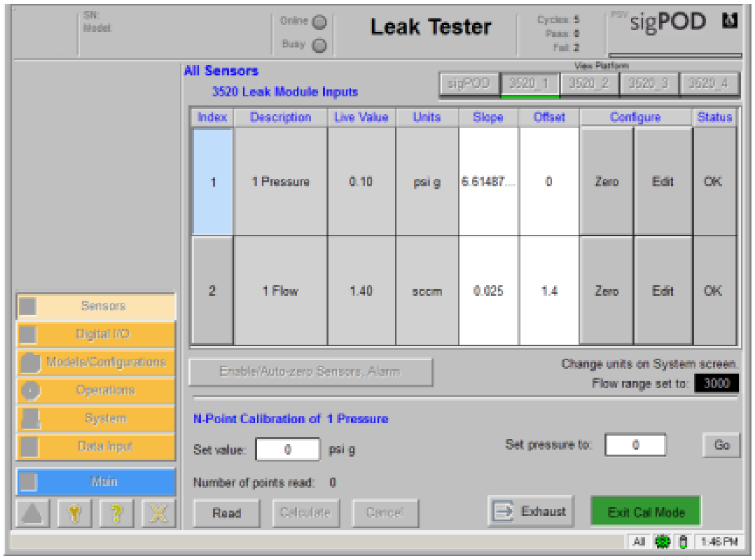



*Figure 48 An example of the Features, Waveform screen when leak testing with the 3520 module is enabled.*

## All Sensors – 3520 module functionality

With 3520 functionality enabled, the All Sensors screen has a platform selection table which allows you to view and configure either the sigPOD sensors or the 3520 module sensors. You can have up to four 3520 modules connected to a sigPOD or any PC controller with installed PSV application. The 3520 All Sensors screen also allows you to perform N-point calibration for the 3520 sensors (see *Figure 49*).

*Figure 49 All sensors screen for the 3520 module sensors, Calibration mode*



## Digital I/O screen – 3520 module functionality

With 3520 functionality enabled, the Digital I/O screen allows you to enable Model 3670 Leak test station functions which include control of the air-supply valve and control of the stack lights. If you have fieldbus installed, you can also toggle the display between fieldbus outputs and 3670 (that is, physical) outputs (see *Figure 50* and *Figure 51*).

**Note:** A 3670 Leak test station can contain up to four 3520 leak test modules.

*Figure 50 Digital I/O screen with 3670 functions enabled and physical outputs displayed*

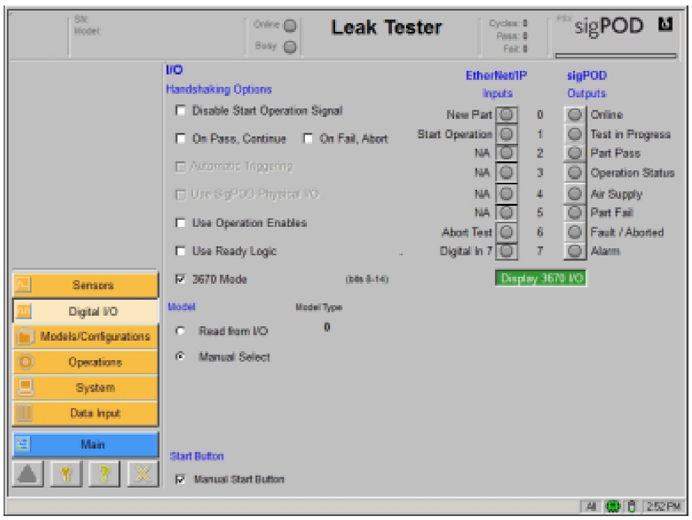
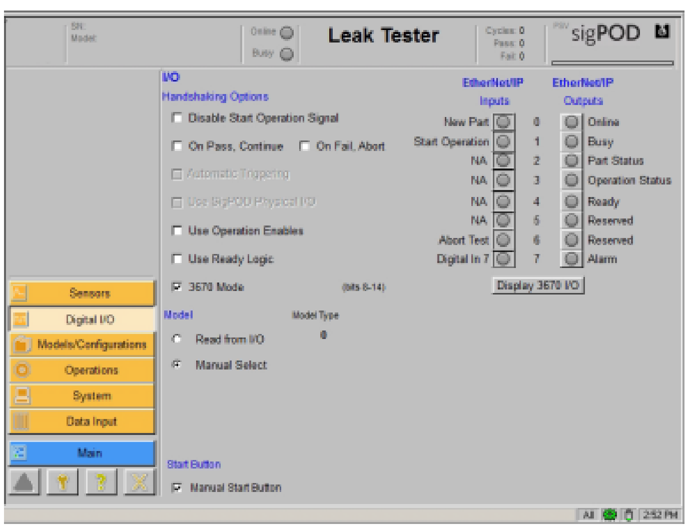



*Figure 51 Digital I/O screen with 3670 functions enabled and fieldbus outputs displayed*



## Operations – 3520 module data collection setup

When 3520 functionality is enabled, the Operations screen allows you to select a platform for each operation: the sigPOD hardware or any of the 3520 leak modules (up to four modules) connected to the controller (see *Figure 52*). If an operation is associated with a 3520 module (versus sigPOD hardware), you can use either the Basic or the Advanced method for configuring a leak test with that module (see *Figure 52* and *Figure 53*).

*Figure 52 Operations, Basic configuration screen for a 3520 module*

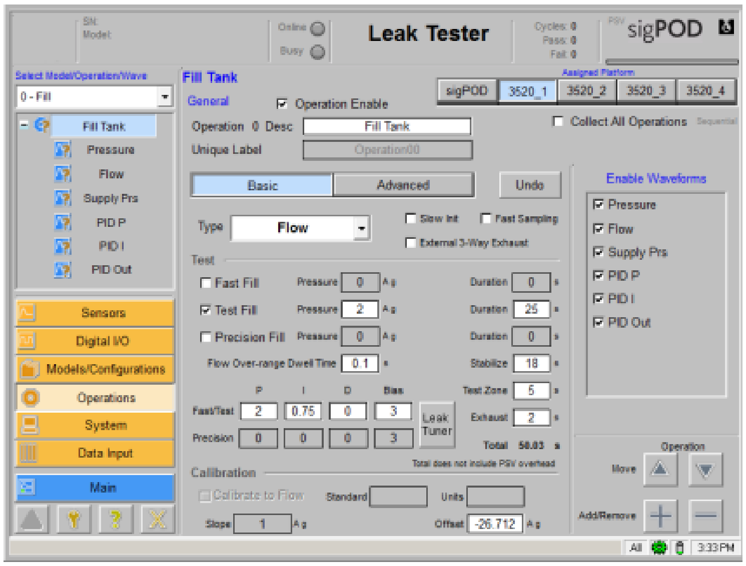
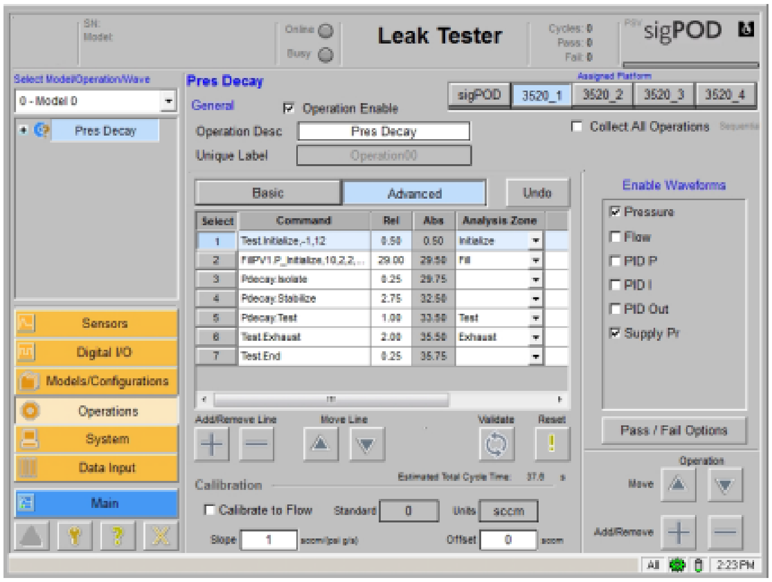


*Figure 53 Operations, Advanced configuration screen for a 3520 module*




## System – 3520 module functionality

When 3520 functionality is enabled, the System screen displays information about the connected 3520 module and allows you to access its configuration web page. You can also clear any 3520 configuration errors and change the default engineering units for the sensors of the 3520 module (see *Figure 54*).

*Figure 54 Example - the System screen of a 3520 leak test module*

# Configuring the sigPOD and common system parameters

This section provides detailed instructions on configuring the sigPOD and parameters that are common to the 3520 hardware platform and the 3520 controller (sigPOD or any other PC). If passwords are enabled, you must log in with a security level of Engineer or Administrator before entering Setup Mode.

**Note:** Setup mode cannot be entered while a part is actively being tested. You must wait for the test to complete. If no part is being tested and you click the Setup button, a dialog box comes up asking you to confirm that you want to take the system offline.

Configuring the sigPOD involves the following procedures:

- *Logging In (optional)*
- *Entering Setup Mode*
- *Configuring Sensors*
- *Configuring Digital I/O*
- *Configuring Fieldbuses*
- *Configuring Handshaking (Cycle Control)*
- *Setting up Models*
- *Separating Model and Test Configuration data (optional)*
- *Setting up Test Configurations (optional)*
- *Configuring Operations for Data Collection*
- *Configuring Operations for Data Processing and Analysis*
- *Configuring the System*
- *Configuring Data Input*

## Logging In (optional)

By default, there are no passwords configured on the sigPOD, which means that by opening the PSV application you are automatically logged in. The following procedure is valid only if you have previously set up security levels and passwords for the sigPOD. For more information about security levels and passwords, see "Configuring the Security Setup Settings" in the InspeXion System Setup online help.

### To log in to the sigPOD

1. From any screen, click the **Login** button .
2. In the **Log On** dialog box, select the correct security level from the Level drop-down list.

   For a list of the security log-in levels, see *Table 15*.
3. Enter your password, and click **OK**.

***Table 15*** *Security Log In Levels*

| Function | Minimum Log In Level Required |
|---|---|
| View current and historical data | All Users |
| Setup/Calibration/Limits | Engineer |
| Exit Application | All Users |

## Entering Setup Mode

### To enter setup mode

1. On the navigation toolbar along the left side of the PSV screen, click **Setup**.

   If no part is being tested, you are prompted to confirm that you want to take the system offline. If a part is being tested, click **Setup** after the part has finished testing.
2. Confirm by clicking **Setup** again.

   If this is the first time you are opening the PSV application in Setup mode, the **All Sensors** screen opens. If you have previously opened the PSV application in Setup mode, the screen that opens is the one you used the last time you exited the Setup mode.

## Configuring Sensors

You can configure the sensors connected to your test system on the All Sensors screen. This procedure is about configuring the sigPOD sensors. For information about configuring third-party leak test equipment, see *"Calibrating the sensors of a third-party leak tester" on page 147*. For information about configuring a 3520 module, see *"Performing an N-point calibration for a pressure sensor and a flow meter on a 3520 module" on page 167*.

### To configure the sigPOD sensors

**1.** Enter the Setup mode. See *Entering Setup Mode*.

**2.** In any of the Setup mode screens, click the **Sensors** button.

**3.** On the **All Sensors** screen, do one of the following:

- If you have 3520 functionality enabled, click the sigPOD button in the platform selection table (top-right corner of the screen) to view and configure the sigPOD sensors, and see step 4.
- If you don't have 3520 functionality enabled, skip this step, and see step 4.

  **Note**: The platform selection table is visible only when 3520 functionality is enabled. For more information, see *"Enabling 3520 functionality" on page 163*.

**4.** To enable or disable sensors, click the **Enable/ Auto-Zero Sensors, Alarm** button.

**5.** Enable any sensors that are connected to the sigPOD.

**6.** Do any of the following:

- To reset a sensor to zero, select the **Enable Auto-zero** check box next to it.

  The selected sensor will be reset at the start of the selected operation.

- To configure an Alarm output for Analog 0, Analog 1, or Encoder 0 channel, enable the **Use alarm** check box. Then, choose the sensor from the drop-down box, and specify values in the **High limit** and **Low limit** boxes.

  **Note 1:** If the selected channel goes above or below the specified alarm limits, Digital Output bit 7 is turned on (for both discrete I/O or installed fieldbus). If the sensor returns within the specified limits, the alarm output is automatically turned off.

  **Note 2:** If leak sequencing is enabled, the alarm output is not available. For more information, see *"Enabling leak sequencing for a third-party leak tester" on page 146*.

**7.** Click **Back** to return to the All Sensors screen.

**8.** To zero the **Live Value**, click **Zero**.

**9.** Click the **Edit** button corresponding to the name of the sensor you wish to configure.

The sensor configuration screen opens (see *Figure 23 on page 54*).

**10.** View, enter, or change the sensor configuration parameters (see *Table 16*).

**11.** To save your changes without exiting the screen, click **Apply**; to save your changes and exit the screen, click **OK**; or to close the screen without saving your changes, click **Close**.

**Note:** The number of analog channels you have available depends on the model of sigPOD you are using.

*Table 16 Sensor Parameters*

| Feature | Parameters |
|---|---|
| **General** | • View the **Label** and the **Type** of sensor.<br>• Enter or change the **Description** of the sensor (e.g., Accel, Mic). This description is used in all lists to refer to the sensor. The length can be from one to 12 characters. Allowed characters are a-z, 0-9, <space> ( ) / [ \ ] . <space> by itself is not a legal sensor description.<br>• Set the number of **Decimals** from **0** to **5**, for display purposes only.<br>• Enter or change the **Units** of measurement (e.g., mg, Nm, lbs). **Units** must be between one and six characters long. Allowed characters are a-z, 0-9, <space> ( ) / [ \ ] . <space> by itself is not a legal unit name. Some names are reserved and cannot be used, such as "IN". |
| **Hardware** | • View **Module** - the description of the physical hardware to which the object is connected.<br>• View the **Channel** number used for this sensor.<br>• Indicates whether the object is **Enabled** or **Disabled**. |
| **Calibration (Analog Type Sensor) - Values** | • Select Values to Show - Engineering Values or Raw Values. |
| **Calibration (Analog Type Sensor) - Method** | • Select a method of calibration, including:<br>  • Manual – to manually enter calibration parameters.<br>  • One Point - to perform a one-point calibration (assumes the device has previously been set to zero and recalculates the calibration slope to make the current reading become a set value)<br>  • N Points – to perform a multiple point calibration (calibrates the slope and the offset simultaneously, reads the current set points, and calculates the calibration offset and slope in such a way that the readings match the set points). |
| **Calibration (Analog Type Sensor) - Type** | • Select Calibration **Type** - either in the units set under the heading **General** or **mV/V**. If **mV/V** is chosen, **Full Scale** and **Excitation** fields are added to the **Calibration** settings table.<br>• If the **Type** is selected to match the units set above, values for **Slope** and **Offset** are entered:<br>  • Enter the **Slope** from the sensor data information sheets. The value needs to be in sensor units/V.<br>  • In the **Offset** field, enter a number in sensor units. |

***Table 16*** *Sensor Parameters (Continued)*

| Feature | Parameters |
|---|---|
| **Calibration (Analog Type Sensor) - mV/V Type is selected** | • If the **mV/V Type** is selected, values for **mV/V**, **Offset**, **Full Scale** and **Excitation** are entered:<br>• Enter a value for mV/V from the sensor data information sheets.<br>• In the Offset field, enter a number in sensor units.<br>• In the Full Scale field, enter the full scale rating of the sensor, as it appears in the sensor data sheet. This value should be stated in the calibrated engineering units<br>• In the Excitation field, enter the voltage that is applied to the excitation or supply inputs of the sensor. |
| **Calibration**<br>**(Encoder or Position Type Sensor)** | • Select values to Show - Engineering Values or Raw Values.<br>• Method - Manual, One Point, or N Points<br>**Note:** See the description for each method in the cell above.<br>• View Calibration **Type** - either in **Degrees** or in the units set under the heading **General**.<br>• If the **Type** is selected to match the units set above, values for **Pulses/Deg** and **Offset** are entered:<br>• Enter the Pulses/Deg from the sensor data information sheets.<br>• In the Offset field, enter a number in sensor units. |
| **Waveform** | Set the **X Start** - the X location of the first data point in the waveform.<br>Set the **X Interval** - the X interval between data points in the waveform.<br>Set the **Number of Points** - the number of data points currently in the waveform. |

# Configuring Digital I/O

## To configure the digital I/O for a sigPOD and 3520 module

1. Enter the Setup mode. See *"Entering Setup Mode" on page 85*.
2. In any of the Setup mode screens, click the **Digital I/O** button.

   The **I/O screen** opens (see *Figure 24 on page 55*).
3. View, enter, or change the I/O sensor configuration parameters (see *Table 17*).
4. Click any button on the navigation toolbar to exit the **I/O** screen.

***Table 17*** *Digital I/O Parameter*

| Feature | Parameters |
|---|---|
| **Handshaking Options** | • **Disable Start Operation Signal** - choose this check box to test without the Start Operation control signal; this option is mainly used in situations with only one operation where simple handshaking is acceptable<br>If the **Disable Start Operation Signal** is selected, only the **New Part** input is required to start the operation. When New Part signal is received, model information is loaded and the first enabled operation is performed. If there is more than one enabled operation, they are performed after another New Part pulse is received. The Abort input can be used to stop the operation and save all data up until that point.<br>**Note 1**: It is recommended that, if possible, the full handshaking be used with Start Operation. See *"Cycle Control (Handshaking) Logic" on page 93* for more information on digital I/O handshaking.<br>**Note 2**: You can save records from any operation that failed or ended before completing by selecting the **Save Data Record on Fault/Abort** check box on the **System** setup page. |
| | • **On Pass, Continue** - select this check box to have each operation automatically start when the previous operation completes successfully. An initial Start signal is required. When this check box is not selected, each operation waits for a Start command when the previous operation completes successfully.<br>• **On Fail Abort** - select this check box to end a test when an operation fails. When this check box not selected, the application waits for PLC input when an operation fails (default).<br>**Note:** You can have the **On Pass Continue** and **On Fail Abort** check boxes selected simultaneously. |

*Table 17 Digital I/O Parameter (Continued)*

| Feature | Parameters |
|---|---|
| **Handshaking Options (cont.)** | • **Automatic Triggering** – select this check box to allow automatic data collection on the state of the input signal. With this option, PSV functions without handshaking for the first enabled operation only. Instead of using the PLC to start and end the operation, you program one of the sensors as start and end trigger on the Operations Setup screen. Note: Before enabling this option, ensure the trigger sensor is connected and calibrated properly, with a valid threshold value. Otherwise, the system could be stuck in a loop and the auto-triggering will happen continuously. To stop this continuous auto-triggering, exit the program, or enter Setup mode.<br>**Note:** Automatic Triggering is not supported on a 3520 module platform.<br>• **Use Operation Enables** - select this check box to enable the 1608 Module #1 or fieldbus to determine whether operations are performed. The 8 digital input bits are monitored at the start of the cycle to determine which operations to run. If bit 1 is on, then the first operation will be enabled, and so on. The Operation Enable check box on the Operations screen should be selected for this option to work properly (that is, operations must be enabled by default).<br>• **Use Ready Logic** - Select this check box if you want to use the Ready Output. For more information, see *"Cycle Control (Handshaking) Logic" on page 93*. If there is PINpoint functionality installed on your system, this check box is enabled by default and cannot be deselected. PINpoint requires the Ready bit to send commands to the sigPOD. |
| **Model or Test Configuration** | • **Read from I/O** - click to read the model or test configuration through the digital inputs from the PLC controller and load the model or configuration based on that value. If you are using discrete I/O or a fieldbus, see the sections on Digital Inputs or Fieldbus connections in the Getting Started Guide of the sigPOD running the PSV application.<br>**Note**: By default, the Model Label and Test Configuration are linked. With this default option, the Model label cannot be read from the PLC; it is taken from the table in the Models setup screen.<br>• If you disable the default option and separate the Model Label and Test Configuration, the Model label input must be provided by a PLC.<br>• **Manual Select** - click to select the model or test configuration manually with a drop-down list on the Main Operations screens. The serial number and model are read at the beginning of the New Part. To control the New Part manually as well, see **Other Options** in *Table 43 on page 141*. |
| **Start Button** | • Enable the **Manual Start Button** option to have a start button appear on the main screens. Clicking the start button begins a test cycle just as if the PLC New Part signal was received followed by a Start Operation signal. By default, the Start button is not enabled.<br>**Note 1:** When the sigPOD is in demo mode, clicking the Start button runs all operations enabled sequentially.<br>**Note 2:** When the sigPOD is in real mode, clicking the Start button runs only the first operation enabled. If there are more operations enabled, you must press the Start button again in order to run these. A message appears in the status bar indicating that "Operation Complete - Operation Name. Waiting for next Operation ..." |

***Table 17*** *Digital I/O Parameter (Continued)*

| Feature | Parameters |
|---|---|
| **sigPOD Digital I/O** | • **Inputs** - provides live digital input status information. If the indicator is green, the input is on; if gray, the input is off. Use for diagnostics to check handshaking connections.<br>• **Outputs** - provides live digital output status information. If the indicator is green, the output is on; if gray, the output is off. Clicking on the indicator toggles the digital output. Use for diagnostics to check handshaking connections |
| **1608 Module #1 I/O**<br>(only when **Use Operation Enables** check box is selected) | The 1608 Module #1 obtains information from a PLC on whether an operation is to be performed at a particular time, without the operator having to change model numbers. The inputs and outputs are read-only.<br>• **Inputs** - provides live digital input status information. If the indicator is green, the input is on; if gray, the input is off. Use for diagnostics to check handshaking connections.<br>• **Outputs** - provides live digital output status information. If the indicator is green, the output is on; if gray, the output is off. Clicking on the indicator toggles the digital output. Use for diagnostics to check handshaking connections. |
| **PINpoint Listening IP Address** | This option is available only if you have PINpoint functionality installed on your sigPOD. The default value that appears in the box is 127.0.0.1. To enable communication between PINpoint and the sigPOD, enter the IP address of the network adapter of your sigPOD (only a static address is allowed). |

**Note:** For additional information on wiring digital inputs or outputs see the *Getting Started Guide* of the sigPOD running the PSV application. For information on handshaking and timing, see *"Test Cycle Control Check" on page 92*.

## Configuring Fieldbuses

All sigPOD test and monitoring systems support a number of optional Ethernet-based fieldbuses, such as EtherNet/IP or PROFINET, while the 1200 models can also be built with hardware-based fieldbus interface cards, such as Profibus or DeviceNet. The fieldbuses offer direct communication between the PLC and the PSV application for real-time handshaking and data exchange. When a fieldbus is installed on a sigPOD test and monitoring system, the physical digital inputs and outputs can be disabled internally (except for Digital Input 7) and all digital inputs and outputs are directed to the PLC through the fieldbus interface. The analog and encoder inputs are not affected.

All of the sigPOD models support the following Ethernet-based fieldbus standards:

- Modbus TCP
- EtherNet/IP
- PROFINET

The 1200 models also support the following hardware-based fieldbus interfaces:

- Profibus and DeviceNet

**Note:** Sciemetric discontinued the optional DeviceNet fieldbus card for the sigPOD 1200 models effective February 2017 and the Profibus card, effective February 2018.

The following handshaking can be communicated over the fieldbus interface:

- Inputs: Model, New Part, Start Operation, and Abort Test
- Outputs: Online, Busy, Part Status, Operation Status, and Alarm

In addition, Serial Number input can be retrieved and Results Data output can be sent out via the EtherNet/IP and PROFINET fieldbuses or through the serial port RS-232. For more information about these parameters, see *Table 18*, and *"Sciemetric Input – serial number" on page 104* and *"Data Output Format" on page 105*. For information about enabling Results Data output, see *"Configuring the System" on page 140*.

Before you can use a fieldbus interface, you have to install and configure it. For Profibus, DeviceNet, and Modbus TCP, see the relevant sections in the *InspeXion System Setup User Guide* and *InspeXion Integrated Development Environment User Guide* available through the Sciemetric Support Center at *http://support.sciemetric.com*. For EtherNet/IP and PROFINET, see *"Appendix B: EtherNet/IP setup guide" on page 210* and *"Appendix C: PROFINET setup guide" on page 227*.

## Configuring Handshaking (Cycle Control)

The Digital I/O setup screen allows the user to test the interlock interface with the PLC or any other controller to ensure that the digital signals are functional.

The hardware digital inputs and outputs are available when no fieldbus is installed in the sigPOD system. If a fieldbus is installed, the inputs and outputs are directed to the PLC through the fieldbus interface only.

### *Test Cycle Control Check*

On the Digital I/O setup screen, you can manually activate outputs to the PLC and verify inputs from the PLC.

The source of the data varies, depending on whether a fieldbus PLC interface, such as EtherNet/IP, has been installed. If a fieldbus is installed, the inputs and outputs are directed to the PLC through the fieldbus interface only (see *Figure 25 on page 55* and *Figure 26 on page 56*). If discrete I/O is being used, the status indicators represent the status at the digital input and output connectors on the connector panel of the sigPOD (see *Figure 24 on page 55*). The channel number is shown in the name of the signal. One exception is **Ch 7: Digital In**; this indicator is always connected to the discrete logic input.

Handshaking signals can also be tested in the Setup - Digital I/O screen. See *"Configuring Digital I/O" on page 89* for more information.

## *Conducting a Test Cycle Control Check*

### To check the test cycle control settings

1. From the PLC, enable the output relays that are connected to sigPOD Digital Inputs to check that the correct input indicator is highlighted on the screen.
2. Select an output indicator on the sigPOD screen to toggle the output to the PLC and check that the signal is correctly received at the PLC. Click on the indicator to toggle the output status.
3. If a foot or proximity switch has been connected to indicate that a part is present, test it and check that **digital input New Part** indicator is lit when the switch is activated.

   **Note:** Depending on your manufacturing setup, the input signal can come directly from the switch or indirectly from the PLC.

## *Cycle Control (Handshaking) Logic*

The PLC and sigPOD are interlocked to confirm signals and ensure the process runs properly. When configuring the PLC-sigPOD communication, you can choose between Standard or Ready Logic handshaking for the beginning of each new test cycle. If PINpoint functionality is installed on the sigPOD, Ready Logic is your only option, enabled by default.

When using standard handshaking, the Busy Output is used both to indicate the beginning of a New Part cycle and the beginning of each operation. For descriptions of the handshaking signals between the sigPOD controller and the sigPOD, see *Table 18*.

***Table 18*** *Handshaking Signals (Standard or Ready Logic)*

| Signal | Description |
|---|---|
| **Serial Number** | An optional signal, the Serial Number is an alphanumeric value used to identify the part being tested. This signal can be transmitted via a fieldbus connection, when equipped. Note the Serial Number must be updated before the New Part signal is activated. It can also be automatically generated or sent via the serial port (see *"Configuring Digital I/O" on page 89*). Refer to *Fieldbus Interface Layout* for interface details.<br><br>PSV allows you to configure and run tests with multiple operations for up to 8 different parts (serial numbers). For more information, see *"Serial numbers for multiple operations with multiple parts" on page 104*. |
| **Model / Test Configuration** | An optional BCD input signal. The Model identifies what part is currently being tested. The Model signal must be updated before the New Part signal is activated (i.e., before the operation starts). |

*Table 18 Handshaking Signals (Standard or Ready Logic) (Continued)*

| Signal | Description |
|---|---|
| **New Part** | The New Part input signal identifies when a New Part is about to be tested.<br><br>With standard handshaking, when the New Part signal is received, the Busy signal is set, all status outputs are reset, and the serial number and model are read. Once the sigPOD has completed its initialization from the New Part signal, the Busy signal is reset. Typically, the Busy signal remains high for 40 - 200 ms before it is reset.<br><br>With Ready Logic handshaking, when the New Part signal is received, the Ready Bit goes high to indicate that a new test cycle is starting and the sigPOD is ready for the first operation. The Ready bit stays high until all operations are completed for that part. |
| **Start Op** | The Start Op input signal identifies when an operation is about to begin. The signal should be set when the operation is initiated, last a minimum of approximately 250 ms to eliminate any timing issues, and reset when the operation is complete. |
| **Abort** | Cancels any cycle, regardless of its current state, and returns the sigPOD to the state where it is looking for a new part. If an ABORT input is received while in the middle of an operation, the results are stored only if you have selected the **Save Data Record on Fault/Abort** option on the **System** setup page. Any operations prior to receiving the Abort signal are saved by default for the part. The ABORT signal should be sent as an active high pulse, lasting at least 250 ms. |
| **Online** | Online is an output that identifies the state of the sigPOD. When this signal is set, the sigPOD is ready to test parts. When the signal is reset, there is a sigPOD fault condition or the sigPOD is in Setup Mode. |
| **Busy** | When standard handshaking is used:<br><br>The Busy output signal identifies when the sigPOD is active. There are two reasons for the Busy to go high: initializing the system upon receipt of a New Part, and collecting and analyzing data for the current operation.<br><br>During a New Part stage, the Busy signal is set while the sigPOD is initiating the display, resetting outputs, and reading the serial number/model. It stays on for at least 30 ms.<br><br>During the Data Collection stage, the Busy signal is set while the sigPOD is collecting and analyzing data. The Busy signal is reset once the Op and Part Status signals are updated.<br><br>**Note:** It is recommended that the station controller interlocks the actual test operation with the Busy signal in order to ensure that the test does not start (i.e. Don't start drive, or don't move press ram) until the Busy signal is set. The station controller should have a polling rate of at least 40 Hz.<br><br>When Ready Logic is used:<br><br>The Ready signal is used (instead of the Busy signal) to initialize the system upon receipt of a New Part. The Busy signal goes high only during the data collection and analysis of an individual operation and is reset at the end of the Operation Status signal. |
| **Part Status** | The Part Status is an output signal indicating that the current part passed or failed up to this point. This signal is updated at the end of the operation, and is the cumulative status of the operations that have been run on the part so far. It is cleared when a New Part signal is received. A high state denotes that all operations run on the current part have passed. If any operation fails on the current part, the Part Status for that part is a fail. It is ready to be read when the Busy signal is low. |

*Table 18 Handshaking Signals (Standard or Ready Logic) (Continued)*

| Signal | Description |
|---|---|
| **Operation Status** | Operation Status is an output signal indicating that the current operation passed or failed. The signal is updated at the end of the operation, and is cleared when a Start Op or New Part is received. A high state denotes that the operation has passed. It is ready to be read when the Busy signal is low. |
| **Ready** | The Ready output is available when you are using Ready Logic handshaking (**Use Ready Logic** check box on the **Digital I/O** setup screen is selected). The Ready bit replaces the Busy blip at the beginning of a test cycle. The Ready signal goes high when the new part information has been read and the system is ready to run operations. The signal stays on for the entire test cycle and goes low when the test cycle is complete.<br><br>**Note**: If PINpoint functionality is installed on your test and analysis system, the Ready Logic is activated by default and cannot be disabled. |
| **Alarm** | Alarm is a digital output signal which you can configure for any of the following sensor channels: Analog 0, Analog 1, and Encoder 0. It is available for both discrete I/O or installed fieldbus and is turned on if the specified channel goes above or below the specified limits. If the sensor returns within the specified limits, the alarm output is automatically turned off. When Leak Sequencing is enabled, the Alarm output is not available. |

*Figure 55* provides an example of Standard handshaking for a test cycle with two operations. *Figure 56* shows the same test cycle with Ready Logic handshaking. In both figures, the operation status output indicates a pass for operation 1 and a fail for operation 2 (located at event 5 and event 7 respectively). The part status is cumulative; therefore, part status is indicated as pass at the end of the first operation but shown as a fail at the end of the second operation. If there were additional operations to complete, the Part status in these examples would remain low for the remainder of the operations.

For descriptions of the events that occur during standard or Ready Logic handshaking, see *Table 19*. The event numbers in *Table 19* coincide with those at the bottom of *Figure 55* and *Figure 56*. The differences between the two test cycles occur in Event 3 and Event 7.

For description of standard and Ready Logic handshaking signals, see *Table 18*.

Figure 55 Standard Handshaking Method -Multiple Operations

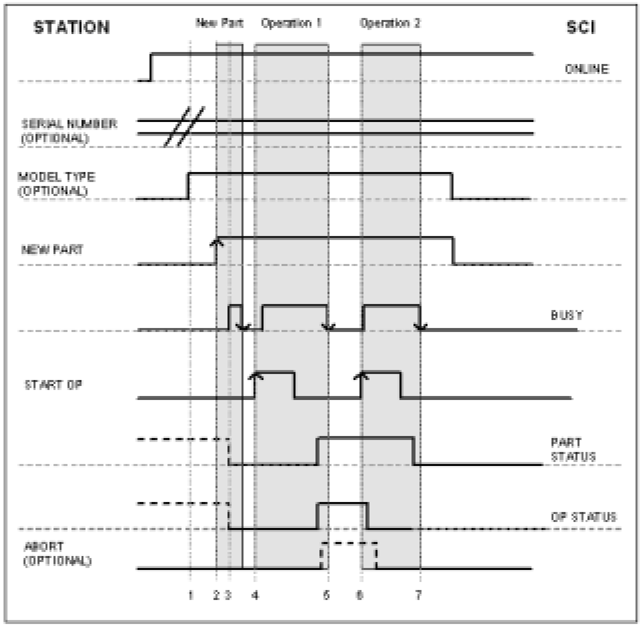



Figure 56 Ready Logic Handshaking Method -Multiple Operations

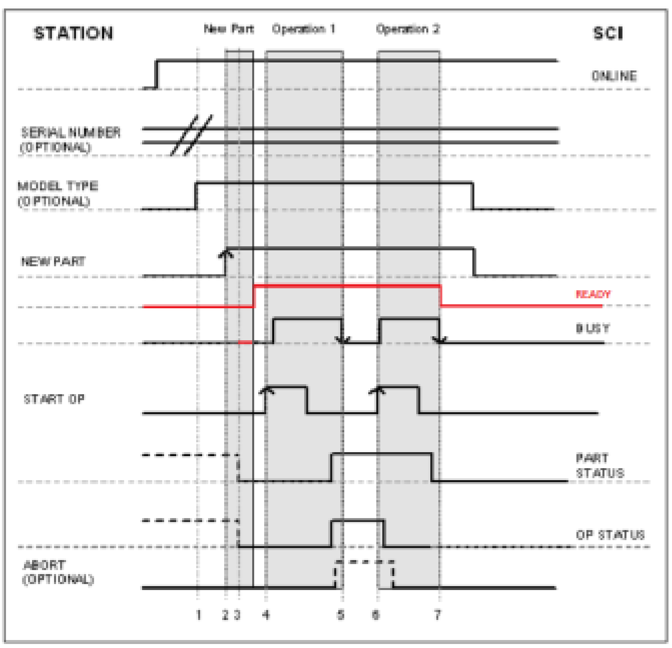


***Table 19*** *Standard and Ready Logic Handshaking Events*

| Event Number | Description |
|---|---|
| 1 | Station Controller sets Serial Number and Model (optional). |
| 2 | The New Part signal is set by the controller once the test is about to begin. |
| 3 | With Standard handshaking:<br>sigPOD resets Status signals, then sets the Busy signal to indicate it is reading the Serial Number and Model. The Busy signal is then reset to indicate that the sigPOD is ready for the first operation.<br>With Ready Logic handshaking:<br>sigPOD resets Status signals, and when the New Part signal is received, it sets the Ready signal to indicate that the New Part operation has been read and that the sigPOD is ready for the first operation. The Ready signal stays high until the end of the test cycle when all operations are complete. |
| 4 | The Start Op signal is set by the controller to indicate that the first operation is about to begin. sigPOD resets Op Status signal, then sets the Busy signal to indicate it is collecting data. Upon receipt of the Busy signal, the controller should initiate the test event. |
| 5 | After collecting and analyzing the data, the Op and Part Status signals are updated to indicate the status of the operation. Shortly thereafter, the Busy signal is reset. |
| 6 | If there are more operations enabled, the Start Op signal is set by the controller to indicate that the second operation is about to begin. sigPOD resets Op Status signal, then sets the Busy signal to indicate it is collecting data. Upon receipt of the Busy signal, the controller should initiate the test event. |
| 7 | With Standard handshaking:<br>After collecting and analyzing the data, the Op and Part Status signals are updated to indicate the status of the operation. Shortly thereafter, the Busy signal is reset.<br>With Ready Logic handshaking:<br>After collecting and analyzing the data, the Op and Part Status signals are updated to indicate the status of the operation. Shortly thereafter, the Busy signal is reset to indicate the end of the operation and the Ready signal is reset to indicate the end of the test cycle. |

The example in *Table 19* shows the events of a two-operation test. With standard handshaking, if the test cycle consists of a single operation, then steps 6 and 7 would not be performed. If the test consists of more than two operations, steps 6 and 7 would be repeated for each subsequent operation.

With Ready Logic handshaking, if the test cycle consists of only one operation, the Busy and Ready signals will be reset at the same time at the end of the operation. If the test cycle consists of more than two operations, then the Busy signal is reset at the end of each operation, while the Ready signal stays high until the end of the last operation. The Ready signal is reset at the end of the test cycle.

In some cases, it may be desirable to stop the testing if one of the operations fails. In this case, the controller needs to issue an Abort signal to the sigPOD. This signal can be pulsed with an active high pulse of a minimum 250 ms. The sigPOD detects the signal, saves the current data that it has obtained up to that point, and resets for the next cycle.

**Note 1:** If the option to Disable Start Operation Signal is on (see *"Configuring Digital I/O" on page 89*), the need for the Start Operation control signal is removed. This should mainly be used when there is only one operation and simple handshaking is required. If this is enabled, only the New Part input is required to start a test. When New Part is received, the model or test configuration is loaded, if different than the last test, and the first enabled operation is performed. If there are more enabled operations, these are performed after another New Part pulse is received. The Abort input can be used to stop the test and save all data up until that point.

**Note 2:** It is recommended that, if possible, the full handshaking be used with Start Operation.

## *Installing PINpoint*

### To install PINpoint

1. Get the PINpoint installation file PinpointInterfaceSetup.exe from the Sciemetric Support Center at *http://support.sciemetric.com*.
2. Run the file from the USB drive.

   **Note:** The DLL is not included in this interface, but is attached to the PSV application.
3. Run the sigPODPSV.
4. From the **Digital I/O** screen (see *"Digital I/O Screen- physical I/O" on page 55*) enter the IP address for the local machine.

   This tells the driver which IP address to use for communication. After the IP address is entered, the interface starts working automatically.

## *PINpoint functionality and Ready Logic Handshaking*

The Ready Logic Handshaking is enabled by default and mandatory when PINpoint functionality is installed on the sigPOD. If there is no PINpoint present on your sigPOD, the Ready Logic is optional.

When PINpoint is used, the PLC communicates independently with PINpoint to know when to start running a test cycle. PINpoint sends a Start command when a new part is to be tested. The Start command contains the Serial Number, the Model name and Test Configuration. The Start command replaces the New Part signal from the PLC.

The PLC waits for the Ready bit to go high before it sends the first Start Operation. The Busy bit goes high at the first operation’s collection and analysis stage and goes low at the end of the operation. Subsequent operations follow standard handshaking protocol, as described in *Table 19 on page 97*.

The Ready signal stays high for the entire test cycle and goes low when the test cycle is complete. At the end of the test, overall results, in addition to feature results, if previously configured, are sent to PINpoint. For more information, see the last row in *Table 38 on page 129*.

PINpoint can also send a Stop command to terminate a test. This command is equivalent to Abort Test. All Abort results are returned as a Fault condition to PINpoint. Otherwise, a Pass or Fail condition is returned.

Note that even with PINpoint installed, if the PLC initiates a cycle by sending New Cycle information (Serial Number, Model Number, and Configuration), the PLC would then handshake directly with the sigPOD, independently of PINpoint, but not at the same time as PINpoint is being used.

## *Digital Interface (Standard)*

Digital interfaces use the handshaking shown in the configurations in *Table 20* for the digital input interface and *Table 21* for the digital output interface. Note that when leak sequencing is enabled, physical digital outputs are not available, including the alarm output. For more information, see *"Enabling leak sequencing for a third-party leak tester" on page 146*.

***Table 20*** *Digital Input Channel Assignments (Left to Right on Connector*

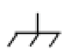
| Channel | Assignment |
|---|---|
| **0** | New Part |
| **1** | Start Op |
| **2-5** | Model or Test Configuration |
| **6** | Abort |
| **7** | Digital Trigger In (Physical input only) |
| **COM** | Common, either +24 V or Common of the PLC supply |
|  | Shield |

***Table 21*** *Digital Output Channel Assignments (Left to Right on Connector)*

| Channel | Assignment |
|---|---|
| **0** | Online |
| **1** | Busy |
| **2** | Part Status |
| **3** | Operation Status |
| **4** | Ready |
| **5** | Spare |
| **6** | Spare |

*Table 21 Digital Output Channel Assignments (Left to Right on Connector) (Continued)*

| Channel | Assignment |
|---|---|
| **7** | Alarm |
| **COM** | Common, either +24 V or Common of the PLC supply |
|  | Shield |

## *Fieldbus Interface Layout*

All fieldbus interfaces except for EtherNet/IP and PROFINET use the first byte of inputs and outputs for handshaking, using the configurations listed in *Table 22* and *Table 23*. For EtherNet/IP handshaking inputs and outputs, see *"Appendix B: EtherNet/IP setup guide" on page 210*. For PROFINET handshaking inputs and outputs, see *"Appendix C: PROFINET setup guide" on page 227*.

When using discrete I/O for handshaking, the Input and Output configuration below applies to the channels on the rear of the unit.

**Note:** If a fieldbus is implemented, the Digital I/O channels on the rear of the unit are not available; only the fieldbus is active. In this case, you still have the option of forcing discrete handshaking by enabling the **Use sigPOD Digital I/O** check box on the Digital I/O setup screen. When this check box is enabled, the system uses the sigPOD Digital I/O for handshaking, even when a fieldbus is active.

*Table 22 Handshaking Input*

| Byte | Bit / Channel | Length | Description |
|---|---|---|---|
| 0 | 0 | 1 bit | New Part |
| | 1 | 1 bit | Start Op |
| | 2-5 | 4 bits | Model/Test Config (0-15) |
| | 6 | 1 bit | Abort/Reset |
| | 7 | 1 bit | Spare |

***Table 23*** *Handshaking Output*

| Byte | Bit / Channel | Length | Description |
|---|---|---|---|
| 0 | 0 | 1 bit | Online |
| | 1 | 1 bit | Busy |
| | 2 | 1 bit | Part Status |
| | 3 | 1 bit | Op Status |
| | 4 | 1 bit | Ready |
| | 5-6 | 2 bits | Spare |
| | 7 | 1 bit | Alarm |

**Note:** When leak sequencing is enabled, physical digital outputs are not available, including the alarm output. For more information, see *"Enabling leak sequencing for a third-party leak tester" on page 146*.

Because of the limitations involved with transferring fieldbus data, and the varying requirements of data formats, numerical output data (i.e. result data) is available only through the EtherNet/IP and PROFINET fieldbus outputs. For more information, see *"Data Output Format" on page 105*.

## Profibus Interface

Profibus uses a default of 16 bytes for the serial number. Input bytes 16 - 31 (Block 2) are used for this purpose. For a list of Profibus input and output configurations, see *Table 24*.

**Default Setup**

Slave Station: 0

Number of Rx Blocks: 2 (a block is configured as 16 bytes)

Number of Tx Blocks: 1

**Note:** Sciemetric discontinued the optional Profibus fieldbus card for the sigPOD 1200 models effective February 2018.

***Table 24*** *Profibus Input and Output Configurations*

| Inputs: Byte | Inputs: Description | Outputs: Byte | Outputs: Description |
|---|---|---|---|
| 0 | Handshaking | 0 | Handshaking |

*Table 24 Profibus Input and Output Configurations (Continued)*

| Inputs: Byte | Inputs: Description | Outputs: Byte | Outputs: Description |
|---|---|---|---|
| 1-15 | Spare | 1-15 | Spare |
| 16-31 | Serial Number | | |

**Note:** Allowable Serial Number characters are ASCII code 47 (/) through 122(z) inclusive.

## DeviceNet Interface

DeviceNet uses a default of 16 bytes for the serial number.

**Default Setup**

Device Type: Slave; Input Bytes: 17; Output Bytes: 1

**Note:** Sciemetric discontinued the optional DeviceNet fieldbus card for the sigPOD 1200 models effective February 2017.

For a list of DeviceNet input and output configurations, see *Table 25*.

*Table 25 DeviceNet Input and Output Configurations*

| Inputs: Byte | Inputs: Description | Outputs: Byte | Outputs: Description |
|---|---|---|---|
| 0 | Handshaking | 0 | Handshaking |
| 1-16 | Serial Number | | |

**Note:** Allowable Serial Number characters are ASCII code 47 (/) through 122(z) inclusive.

## Modbus TCP

With the Modbus TCP driver license installed, the application communicates with the PLC via the Ethernet interface using the following configuration. In addition, the Sciemetric test station functions as a master Modbus TCP device.

*Table 26 Modbus TCP Input Configuration*

| Sciemetric Inputs (Holding registers) | Description |
|---|---|
| 40000 | bit0 New Part |
| ... | bit1 Start Op |

**Table 26** *Modbus TCP Input Configuration (Continued)*

| Sciemetric Inputs (Holding registers) | Description |
|---|---|
| ... | bit2 |
| ... | bit6 Abort/Reset Bit |
| ... | bit7 |
| ... | bit8 Model Bit 0 |
| ... | ... |
| 405400 | Model label (See Note) |

**Note:** The model label can be up to 25 characters in length and would be sent to address 405400 from the PLC when model and configuration are not linked.

**Table 27** *Modbus TCP Output Configuration*

| Sciemetric Outputs (Holding registers) | Description |
|---|---|
| 40500 | bit0 Online |
| ... | bit1 Busy |
| ... | bit2 Part Status |
| ... | bit3 Op Status |
| ... | bit4 Ready |
| ... | bit5 Alarm |
| 410000 | CSV Results |

**Table 28** *Modbus TCP Serial Number Input Configuration*

| Serial Number Input (Registers) | Description |
|---|---|
| 405000 | Serial Number Byte 1 |
| 405001 | Serial Number Byte 2 |
| ... | ... |
| 405063 | Serial Number Byte 64 |

**Note:** Serial number information must be set in the above registers before a new part is provided to the sigPOD.

## PROFINET Interface

PROFINET is configured for handshaking and serial number and model label input using the following setup.

**Table 29** *PROFINET Input and Output Configurations*

| Slot | Function | Description | Details |
|---|---|---|---|
| 1 | Digital I/O 32 bits | Handshaking | Input bits 0-23 used for handshake inputs.<br>Output bits 0-23 used for handshake outputs. |
| 2 | Virtual I/O 64 bytes | Serial Number | Bytes 0-63 used for serial number input |
| 3 | Virtual I/O 128 bytes | Results | A variable that depends on the number of features. Can be up to 4000 bytes |
| 4 | Virtual I/O 64 bytes | Model label | Bytes 0-63 used for model label input |

For more information, see *"Appendix C: PROFINET setup guide" on page 227*.

## EtherNet/IP

For information on EtherNet/IP input and output configuration, see *"Configuring EtherNet/IP on the PLC" on page 210*.

## Sciemetric Input – serial number

When the serial number is retrieved through the serial port, it is read in as a string of up to 64 characters (all data beyond the 64 bytes are ignored). When the serial number is retrieved through Profibus or DeviceNET, it is read in as a string of up to 16 characters (all data beyond the 16 bytes are ignored). When the serial number is retrieved through any other fieldbus, it is read in as a string of up to 64 characters (all data beyond the 64 bytes are ignored). For fieldbuses, the serial number of the part that is being tested is handled as parameter data. For more information how the serial number is handled through EtherNet/IP and PROFINET, see the **Serial Number** sections in *"Appendix B: EtherNet/IP setup guide" on page 210* and *"Appendix C: PROFINET setup guide" on page 227*.

**Note:** Sciemetric discontinued the optional DeviceNet fieldbus card for the sigPOD 1200 models effective February 2017 and the Profibus card - effective 2018.

## Serial numbers for multiple operations with multiple parts

If a single serial number (that is, a single part) is sent for testing, PSV saves the results of all operations in one part record.

However, if you want to use a single sigPOD with different parts (serial numbers) at the same time in a test station, PSV allows you to do that by providing a separate part record for each serial number. For example, a sigPOD controlling four 3520 leak testers can have four separate part fixtures testing four unique parts with four unique serial numbers.

In tests with multiple operations for multiple parts, PSV will provide part records for each serial number if the following conditions are true:

- All operations for the parts must be configured under one model or test configuration. In other words, the model number (test configuration) for all parts must be the same. For example, in *Figure 29 on page 59*, both operations **BrkTrq** and **RunTrq** belong to **0-Model_0 test**.

  **Note**: This functionality is available with both parallel and sequential operations.

- The serial numbers must be separated by comma in the serial string. In this case, PSV will parse the string and split it into multiple serial numbers, removing the commas. The first serial number will be associated with the first operation, the second serial number with the second operation, and so forth. For example, if a model is configured with five operations and a serial number string "12, 34, 56, 78, 91" is sent, a unique part record will be created for each operation. The serial number for the first part will be "12" and the record will contain only the first operation. The serial number for the second part will be "34" and the record will contain only the second operation, and so forth.
- There's a maximum of eight unique serial numbers specified for the eight operations enabled in handshaking.

  **Note 1:** If more than eight serial numbers are sent (that is, there are eight or more commas), an error is issued.

  **Note 2:** Extra serial numbers beyond the enabled operations are ignored.

- The first operation must have a serial number. In other words, there should be no commas at the beginning of the serial number string. Otherwise, an error is issued. For example, the following serial number string will result in an error: ",123,456".
- If any in-between operation is to remain within the same part record as the previous operation, a "blank serial number" can be sent for that operation. For example, if the following serial number string is sent "12,,,,91", the first operation will be within the "12" part record, the next three operations will also be within the "12" part record, and the fifth operation will be in a new "91" part record.

## *Serial Interface*

The serial interface uses port settings of 9600 baud, 8 data bits, no parity, and 1 stop bit (9600, N, 8, 1). For reference, the serial port on the sigPOD is COM 2, although there is only one serial port accessible on the sigPOD (model dependent). A start transmission byte is not required, but each transmission should end with a carriage return and line feed (CR + LF). If multiple parameters are part of one transmission, they must be separated by commas.

## *Data Output Format*

If the sigPOD is configured to send results data by the serial interface, EtherNet/IP, PROFINET, or to a log file, data is sent at the end of every operation in a CSV file format. Results are written out as an ASCII string with each feature value separated by a comma. The default format of the results data for each operation is as follows:

**Cycle Number, Operation Index, Serial Number, Model Label, Operation Status, Feature1 Value, Feature2 Value, FeatureN Value**

For tests with multiple operations with multiple serial numbers, there is a separate line for each operation, the same way as in a single-serial-number results file; however, each operation will have the correct serial number associated with it.

You can customize the format of the result data by omitting some of the parameters or by adding an extra parameter, Feature Limits. For description of each parameter, see *Table 30*. For more information about handling and formatting results data, see *"Configuring the System" on page 140*. You can also select the features that you want to include in the results data. For more information, see *"Waveform Analysis Options" on page 128*.

**Note 1**: When sending results data over the PROFINET interface, the default CSV format is followed only for the data from the first operation. For information about the format of the data from subsequent operations, see *"Configuring PROFINET on the PLC" on page 227*.

**Note 2:** Results data is transmitted at the end of each operation before the Busy signal is reset. Each parameter in the transmission is separated by a comma, and the end of the transmission is terminated with a carriage return -line feed (<CR><LF>).

***Table 30*** *Data Output Format*

| Data Parameter | Description |
|---|---|
| Cycle Number | An integer value that is incremented every test cycle. It is reset daily (if enabled), or manually. |
| Operation Index | An integer value indicating the index of the operation. |
| Serial Number | The serial number of the part being tested. |
| Model Label | The model of the part being tested. |
| Operation Status | The status of the current operation. A 'P' denotes that the operation passed all feature checks. An 'F' denotes that the operation failed one or more feature checks. |
| Feature 1 Value | The result value of the first feature. This is the numerical result of the feature check. |
| Feature 1 Lower Limit | The value of the lower specification limit of the first feature. |
| Feature 1 Upper Limit | The value of the upper specification limit of the first feature. |
| Feature 2 Value | The result value of the second feature. This is the numerical result of the feature check. |
| Feature 2 Lower Limit | The value of the lower specification limit of the second feature. |

**Table 30** *Data Output Format (Continued)*

| Data Parameter | Description |
|---|---|
| Feature 2 Upper Limit | The value of the upper specification limit of the second feature. |
| Feature N Value | The result value of the last feature. This is the numerical result of the feature check. |
| Feature N Lower Limit | The value of the lower specification limit of the last feature. |
| Feature N Upper Limit | The value of the upper specification limit of the last feature. |

## Setting up Models

You can create a new model (test configuration) for a sigPOD, third-party leak tester, or a 3520 module on the Models setup screen.

**Note:** By default, Model data is linked to Test Configuration data and received as one data input. However, you can separate them. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108* and *"Setting up Test Configurations (optional)" on page 109*.

### To set up a model

1. Enter the Setup mode. See *"Entering Setup Mode" on page 85*.
2. In any of the Setup mode screens, click the **Models/Test Configurations** button on the navigation toolbar on the left.

   The Models screen opens (see *Figure 27 on page 57*).
3. To add a model, enter the new model name in one of the blank lines in the **Label** column.

   **Note 1:** The label must be no longer than 25 characters. Legal characters are a-z, 0-9, <space> and ()-/[\]_. <space> by itself is not a legal label.

   **Note 2:** The test configuration is taken from the currently selected configuration. The Index number next to the Model label is the digital input model code that selects the model. See *"Configuring Digital I/O" on page 89* to view the digital inputs for model selection.
4. To delete a model, delete the text in the **Label** column for the Model that you wish to delete. Ensure that there is no text and no empty **<space>** character.

   A message appears in the status bar that confirms the model was deleted. Deleting the Model permanently deletes the configuration data from the unit. It is recommended that you make a backup of the configuration before major edits. For more information, see “Backing Up the System” in the InspeXion System Shell online help.
5. To copy the complete configuration from one model to another

   - Select the model to copy from in the **Copy From** drop-down list.
   - Select the model to copy to in the **Copy To** drop-down list.

- Click the **Copy** button.

  A message appears in the status bar asking you to confirm the action by clicking the **Copy** button again. After the model is copied, a message appears in the status bar confirming the copy action.

  **Note:** The copy function is disabled if there is only one Model with a valid label in the list.

6. To rename a model, type a new name in the **Label** column.

   **Note**: Renaming a model resets the SPC data for that model index. SPC parameters like N Sigma remain the same.

7. Close the **Models** screen by clicking any other navigation toolbar button.

   **Note**: The label of the model must be entered on the Models screen before the model can be selected from the PLC.

For further information about connecting digital inputs for the Model selection, refer to the section on connecting Digital Inputs in the Getting Started Guide of the sigPOD running the PSV application. For further information about the live status of the Model digital inputs, see *"Configuring Digital I/O" on page 89*.

## Separating Model and Test Configuration data (optional)

By default, Model data is linked to Test Configuration data and received as one input. If EtherNet/IP or PROFINET is enabled, you can have the Test Configuration number received separately from the Model label, and you can run multiple test configurations per model. When Model and Test Configuration are separate, the Model holds the SPC and QWX data, while the Test Configuration holds the data collection processing and analysis parameters.

You can separate Model from Test Configuration on the Models setup screen.

**Note:** If you have **Manual Entry via Keyboard** option selected on the **Data Input** setup screen, and model and test configurations are separated, you can also manually enter a Model label separate from the test configurations on the Data Entry page (see *"Data Entry View" on page 31*).

### Requirement:

Before performing this procedure, ensure that the sigPOD has an active EtherNet/IP or PROFINET connection.

### To separate Model from Test Configuration data

1. Enter the Setup mode. See *"Entering Setup Mode" on page 85*.
2. In any of the Setup mode screens, click the **Models/Configurations** button on the navigation toolbar on the left.
3. On the Models screen, deselect the **Link Model and Configuration** check box.

   The screen name changes to **Test Configurations**.

## Setting up Test Configurations (optional)

You can set up Test Configurations for a sigPOD, third-party leak tester, or a 3520 module on the Test Configurations setup screen.

**Note**: By default, Test Configuration data is linked to Model data and received as one data input. However, you can separate them. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

### To set up test configurations

1. Enter the **Setup** mode. See *"Entering Setup Mode" on page 85*.
2. In any of the Setup mode screens, click the **Models/ Configurations** button on the navigation toolbar on the left.

   The **Test Configurations** screen opens.
3. To add a test configuration, enter a name for the new test configuration in one of the blank lines in the **Label** column.

   **Note 1:** The test configuration label must be no longer than 25 characters. Legal characters are a-z, 0-9, <space> and ()-/[\]_. <space> by itself is not a legal test configuration label.

   **Note 2:** The configuration is taken from the currently selected configuration.

   **Note 3:** The Index number next to the test configuration label is the digital input model code that selects the test configuration. See *"Configuring Digital I/O" on page 89* to view the digital inputs for test configuration selection.
4. To delete a test configuration, delete the text in the Label column for the test configuration that you want to delete. Ensure that there is no text and no empty <space> character.

   A message appears in the status bar that confirms the test configuration was deleted. Deleting the test configuration permanently deletes the associated data from the sigPOD unit. It is recommended that you make a backup of the configuration before major edits. See “Backing Up the System” in the InspeXion System Shell online help.
5. To copy the complete setup from one test configuration to another:
   - Select the test configuration to copy from in the **Copy From** drop-down list.
   - Select the test configuration to copy to in the **Copy To** drop-down list.
   - Click the **Copy** button.

     A message appears in the status bar asking you to confirm the action by clicking the Copy button again. After the test configuration is copied, a message appears in the status bar confirming the copy action.

     **Note**: The copy function is disabled if there is only one test configuration with a valid label in the list.
6. To rename a test configuration, type a new name in the Label column over the old name.
7. Close the **Test configurations** screen by clicking any other navigation toolbar button.

   **Note:** The label of the test configuration must be entered in the **Test configurations** screen before the test configuration can be selected from the PLC.

## Configuring Operations for Data Collection

You can configure up to 40 operations. Each operation can contain up to 20 waveforms and 20 features per waveform, with a maximum of 100 features per operation. This procedure is about configuring operations on a sigPOD. For information about configuring operations for a 3520 leak test module, see *"Configuring tests with a 3520 leak test module" on page 163*.

### To configure data collection options for each operation

1. Enter the Setup mode. See *"Entering Setup Mode" on page 85*.
2. In any of the Setup mode screens, click the **Operations** button.

   The first time you do this, the Configuration screen for the first operation opens.
3. From the drop-down list in the upper left-hand corner of the screen, choose the model or test configuration that you want to edit.
4. From the **Select Model/Operation/Wave** list, choose the Operation that you wish to edit.

   The **Operations** screen opens (see *Figure 29 on page 59*).

   **Note 1:** You can recognize the operation by the operation status icon (see *Table 7 on page 21* for the meaning of different icons).

   **Note 2:** When Model data is separate from Test Configuration data, the **Select Model/Operation/Wave** list is labeled **Select Config/Operation/Wave** list. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.
5. If 3520 functionality is enabled, click the **sigPOD** button in the platform selection table(top-right corner of the screen) to select the sigPOD hardware for the operation.

   **Note 1:** The platform selection table is visible only when 3520 functionality is enabled. For more information, see *"Enabling 3520 functionality" on page 163*.

   **Note 2:** To configure operations for a 3520 module, see *"Setting up a 3520 leak test" on page 172*.
6. Select appropriate parameters as defined in *Table 31*.
7. Clicking the plus sign beside the name of each operation opens the list of waveforms enabled for that operation. Select an enabled waveform, or another model/test configuration, or operation to continue configuration, or click any button on the toolbar to exit the **Operations** screen.

***Table 31*** *Operations Data Collection Parameters*

| Feature | Parameters |
|---|---|
| **Select Model/ Operation/ Wave** or **Select Config/ Operation/ Wave** | • The icon next to the operation name indicates the status of the operation, based on the data from the last part tested for the chosen model or test configuration, re-analyzed using the current processing and analysis checks. (See *Table 7 on page 21* for information about the Operation Status Icons.)<br>• The status is based on the status of the waveforms that are enabled in the operation. It is dynamically calculated based on the latest changes made to the configuration.<br>• Clicking the plus sign next to an operation expands the list to show all the waveforms under the operation. Clicking the minus sign collapses the waveform list.<br>• If you select a name next to a waveform icon ( ), the Operation - Waveform screen opens. For more information, refer to *"Waveform Processing Options" on page 116* or *"Waveform Analysis Options" on page 128*<br>• To add more waveforms to an operation, enable them in the **Enable Waveforms for Operation** list. See below for more information. |
| **Operation Enable** | • Select the **Operation Enable** check box to enable the operation, or deselect, to disable the operation. At least one operation must be enabled for each model. If you try to disable the last remaining operation, a warning message appears. |
| **Operation Description** | • Type a descriptive name for the operation in the Operation Desc box. The operation description entered here is used in all operation lists in the review and setup of the sigPOD. It is also used in other software packages, such as QualityWorX (QWX) or Part History Viewer, where data can be reviewed. The name length can be from 1 to 25 characters. Allowed characters are a-z, 0-9, <space> ! # $ & ( ) * + <comma> - <period> / : ; < = > ? @ [ \ ] ^.<br>**Note 1:** <space> by itself is not a valid name.<br>**Note 2:** Renaming an operation does not reset any SPC data.<br>**Note 3:** If you are using QWX and the operation description is not updating in the QWX data correctly, use the QWX Configuration Tool to change the description; you can edit it under the Process Definition section. See the QWX Configuration Tool documentation for more information. |

**Table 31** *Operations Data Collection Parameters (Continued)*

| Feature | Parameters |
|---|---|
| **Unique Label** | This box is available only when you have enabled editing of QualityWorX (QWX) labels on the System setup screen.<br>**Note:** By default, PSV automatically generates a label for each operation within a model.<br>If the test station is not going to be connected to a QWX database, ignore this option – the default labels generated by PSV are adequate for all configurations and don't need editing. However, if you are going to use any of the QWX reporting tools, you may consider specifying unique operation labels across models to keep each model's data separate in the QWX database. For more information, see *"Operation description and Operation unique label" on page 60*.<br>• Type a unique identifier for the operation in the Unique Label box. This unique label is used in the QualityWorX database for identifying the operation's data and does not affect how this data is viewed in the PSV application.<br>• The label length can be from 1 to 12 characters. Allowed characters are a-z, 0-9, ( ) - / \ [ ] _. |
| **Collection** | • You can sample against only an internal timer.<br>• Set or change the data collection Sample Rate and Sample Duration.<br>  • It is recommended that the sample rate be set at least 2.56 times the maximum bandwidth of interest. The maximum sample rate is 1 MHz (sigPOD model 1508) and the minimum is 1 Hz.<br>  • For maximum accuracy in an FFT process, the number of data points collected should be more than 2.56 times the number of lines of the FFT. For example, if the FFT has 1600 lines, the minimum number of data points is 4,096. Set the duration so that enough points are collected. The FFT process automatically zero pads the data if there are not enough data points, but the amplitude of frequencies in the FFT scales down.<br>  • The maximum number of points in a data collection is 1,000,000.<br>  • The minimum Sample Duration is 0.0001 sec and the maximum is 240 sec. |
| **Collection (continued)** | **Note:** To guarantee alias-free analog data for an NVH application, the sample rate should be 2.56 times the anti-aliasing filter value. For example:<br>• When using a sigPOD 1200 with only the built-in hardware anti-aliasing filter of 20 kHz (default), a sample rate of 51200 Hz will guarantee alias-free data.<br>• When using a sigPOD 1200 with the selectable 1 KHz low-pass filter enabled (in the sensor diagnostics), a sample rate of 2560 Hz will guarantee alias-free data.<br>• When using an ICP module with the 10 kHz filter turned on, a sample rate of 25600 Hz will guarantee alias-free data. |
| **Delay** | • Start Delay is a delay that is inserted after the handshaking trigger is received, and before the data collection begins looking for the Start Trigger. The value can be set to between 0 and 100 seconds. |

***Table 31*** *Operations Data Collection Parameters (Continued)*

| Feature | Parameters |
|---|---|
| **Triggers/Start/End Start Source and End Source** | • Select the trigger **Start Source** from the drop-down list (see Note 1):<br>  • **Immediate** - the data collection starts as soon as the start operation digital handshaking signal is received and the **Start Delay** time has passed. The selection of **Immediate** disables the other start trigger options.<br>  • Analog Sensors<br>  • Position (Encoder) Sensors<br>  • Digital Input 7 (Physical input only)<br>  • **Speed** - the selection of **Speed** input is derived from the derivative of the encoder sensors. (See Note 2)<br>  • New Part<br>  • Start Operation<br>• Select the trigger **End Source** from the drop-down list (see Note 3):<br>  • **Duration** - the data collection ends when the **Sample Duration** has passed from the time that the start trigger has been found. The selection of **Duration** disables the other end trigger options.<br>  • Analog Sensors<br>  • Encoder Sensors<br>  • Digital Input 7<br>  • **Speed** - the selection of **Speed** input is derived from the derivative of the encoder sensors. (See Note 2)<br>  • New Part<br>  • Start Operation<br>**Note 1:** The Start trigger source is read at the data collection Sample Rate.<br>**Note 2:** More specifically, to obtain the X and Y input Speed waveforms, the corresponding encoder is interpolated down to 200 Hz, a 10-point derivative is applied and the resultant waveform is multiplied by 0.16667 to convert from degrees to RPM.<br>**Note 3:** The End trigger source is read at the data collection **Sample Rate**. |

*Table 31 Operations Data Collection Parameters (Continued)*

| Feature | Parameters |
|---|---|
| **Triggers/Start/End and Edge Type, Threshold, Offset Type, Offset, Holdoff, Deadband and Timeout** | • If available, select the start and end trigger **Edge Type: Rising** or **Falling**<br>• If available, set the start and end trigger **Threshold** in the units of the source sensor. This is the value that the trigger source must pass through in order to have a valid trigger. For digital sensors the value of **0.5** is automatically posted.<br>• If available, set the start and end trigger **Offset Type** as **Pre** or **Post**.<br>• If available, set the start and end **Trigger Offset** value in seconds. This is the offset in time from the start or end trigger.<br>  • If **Pre** Offset Type has been selected, the start of the data set occurs before the trigger by the amount of the Offset. This is possible because, as soon as the start operation digital handshaking signal is received and the Start Delay is over, the data collection starts and data is passed into a circular memory buffer. When the trigger is found, the actual start of the data is offset by the trigger Offset amount. For example, if you want the start of your data collection to be 1 second before the rising edge of a signal, select the signal as the start trigger, **Pre** as the trigger type and enter **1** in the Trigger Offset.<br>  • If **Pre**-trigger type is used, the **Trigger Offset** must be less than the sample duration. If **Post**-trigger type is used, the **Trigger Offset** must be less than **100** seconds.<br>• If available, set the **Trigger Holdoff** in seconds. This is the time that the trigger must remain true in order to be a valid trigger. It is useful for ignoring false triggering. For example, if you want to use **Speed** as your start trigger, but want the speed to be above 1000 RPM for at least 2 seconds before you consider it a valid trigger, then set the start trigger **Source** to **Speed**, Trigger **Threshold** to **1000** and Trigger **Holdoff** to **2**.<br>The **Trigger Holdoff** must be less than **100** seconds.<br>• If available, set the **Trigger Deadband**, in units of the trigger source sensor. This defines a small area of "noise" to ignore on the Input trigger signal. For example, if the **Threshold** is set to **1** and the **Deadband** is set to **0.5**, the trigger is not seen as valid unless the input is above 1.25 for rising or below 0.75 for falling. Typically, this value is set to **0** except for special cases.<br>• If available, set the Trigger Start **Timeout** in seconds. This option is used to abort the data collection if the start trigger takes too long to arrive. An error is posted to the Fault Log if a start trigger time out occurs.<br>**Note 1:** The Trigger Timeout must be less than 100 seconds.<br>**Note 2:** The Trigger End **Timeout** is reserved for future use and is not editable. |
| **Collect All Operations** | This option is available only for the first operation. Checking this box causes all other operations to be performed at the same time as the first operation, using the same data collection parameters as the first operation. |

*Table 31 Operations Data Collection Parameters (Continued)*

| Feature | Parameters |
|---|---|
| **Auto-zero Selected Sensors** | • Select the check box to reset selected sensors to zero at the start of each operation. |
| **Enable Waveforms for Operation** | • Check the boxes to select the waveforms that you want to have analyzed in the operation. The name of each waveform and what it does are completely customizable. The names listed when you first use the application are the default configuration. For further information on how to change the setup of a waveform, refer to *"Waveform Processing Options" on page 116*. Up to 20 waveforms can be selected for each operation.<br>**Note 1:** You must have at least one waveform enabled per operation. A message is posted in the status bar if you try to disable the only enabled waveform.<br>**Note 2:** As you enable a waveform it is added to the list of waveforms under the Operation name in the **Select Model/Operation/Waveform** list. (When Model data is separate from Test Configuration data, the Select Model/Operation/Wave list is labeled Select Config/Operation/Wave list). Therefore, if you want to edit a waveform setup, you must enable it in the **Enable Waveforms for Operation** list, and then select it from the **Select Model/Operation/Waveform** list on the left side of the screen.<br>• Click the **Move Operation arrow** buttons to move the operation name up or down in the **Select Model/Operation/Wave** navigation list on the left side of the screen.<br>• Click the **Add/Remove Op plus** button to add a new operation.<br>**Note:** Each added operation is given the default name "New Operation." To avoid confusion, immediately rename.<br>• Click the **Add/Remove Op minus** button to delete the selected operation in the **Select Model/Operation/Wave** navigation list. |

## Configuring Operations for Data Processing and Analysis

Configuring operations for data processing and analysis includes

- *Waveform Processing Options* for each waveform of each operation
- *Waveform Analysis Options* for each feature of each waveform

**Note** For information about general waveform processing options, see *Table 32 on page 117*.

## Waveform Processing Options

You can configure up to 15 operations. Each operation can contain up to 20 waveforms and 20 features per waveform, with up to a maximum of 100 features per operation. This procedure applies both to the sigPOD and the 3520 module.

### To configure waveform processing options for each waveform

1. Enter the Setup mode. See *"Entering Setup Mode" on page 85*.
2. In any of the Setup mode screens, click the **Operations** button.
3. Choose the model or test configuration that you wish to edit from the drop-down list in the upper left-hand corner.
4. Expand the waveform list under the Operation you wish to edit in the **Select Model/Operation/ Wave** List, by clicking the plus sign next to an operation.

   Note: When Model data is separate from Test Configuration data, the **Select Model/Operation/ Wave** list is labeled **Select Config/Operation/Wave**. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.
5. Click the Waveform you wish to edit under the chosen Operation. Waveform names in this list are indicated by a waveform status icon (see *Table 8 on page 22*). If a Waveform screen other than the Processing one opens, click the **Processing** button under **Select View** on the upper right-hand side of the screen to open the Waveform - Processing screen (see *Figure 30 on page 61*).

   **Note:** To display more waveforms under an operation, refer to **Enable Waveforms for Operation** in the last row of *Table 31*.
6. To configure waveform processing, select or enter the appropriate parameters. For configuration information on common items, see *Table 32*.

   **Note:** When any changes are made to the parameters that affect the processing, the program searches for the raw data for the X and Y input sensor where the processing type is none. If the unprocessed data for the X and Y input waveforms has been saved in the last test record for the chosen model, the program reprocesses the raw data and shows you the new results. Therefore, it is recommended that you have raw or unprocessed waveforms configured for the sensors for which you wish to edit the processing parameters.
7. Select another model or test configuration/operation/waveform to continue configuration, or click any button on the toolbar to exit the **Waveform** screen.

***Table 32*** *Operations Waveform Processing*

| Section | Parameters |
|---|---|
| **Select Model/ Operation/ Wave**<br>**or**<br>**Select Config/ Operation/ Wave** | • The icon next to the waveform name indicates the status of the waveform, based on the data from the last part tested for the chosen model, re-analyzed with the current processing and analysis checks. (See *Table 8 on page 22* for information about the Waveform Status Icons.)<br>• The status is dynamically calculated based on the latest changes made to the configuration. If any feature under the waveform fails, the waveform is a fail.<br>• Clicking the plus sign next to an operation waveform expands the list to show all the waveforms under the operation. Clicking the minus sign collapses the waveform list for that operation.<br>• If you select a name next to an operation icon ( ) the Operation - Data Collection screen opens. For more information, refer to *"Configuring Operations for Data Collection" on page 110*.<br>• To add more waveforms to an operation enable them in the Enable Waveforms for Operation list. For more information, refer to **Enable Waveforms for Operation** (the last row) of *Table 31 on page 111*. |
| **Waveform Setup- Waveform Description** | Enter the Waveform Description. The waveform description entered here is used in all waveform lists in the review and setup of the sigPOD. It is also used in other software packages, such as QWX and Part History Viewer, where data can be reviewed. The length can be from one to 25 characters. Allowed characters are a-z, 0-9, <space> ! # $ & ( ) * + <comma> - <period> / : ; < = > ? @ [ \ ] ^.<br>**Note 1:** <space> by itself is an illegal name.<br>**Note 2:** Renaming a waveform does not reset any SPC data.<br>**Note 3:** If you are using QWX and the waveform name is not updating in the QWX data correctly, use the QWX Configuration Tool to change the name, editing the waveform name under the Process Definition section. See the QWX Configuration Tool documentation for more information. |
| **Waveform Setup - Y Input** | Select the waveform Y Input for processing. The options are any of the enabled sensors, **Digital Input 7**, **Speed 0** or **Speed 1**. The Sensors are listed by sensor description. The Sensors are listed by sensor description. To change the description of the sensors, see *"Configuring Sensors" on page 86*.<br>**Note:** To obtain the Speed waveforms, the corresponding encoder is interpolated down to 200 Hz, a 10-point derivative is applied, and the resultant waveform is multiplied by 0.16667 to convert from degrees to RPM. |

*Table 32 Operations Waveform Processing (Continued)*

| Section | Parameters |
|---|---|
| **Waveform Setup - X Input** | Select the waveform **X Input** for processing. The X input forms the X-Axis of the waveform for processing. The options are **Time**, any of the enabled sensors, **Digital Input 7, Speed 0 or Speed 1, or a number of Temporary waveforms**. The X-Axis sensor affects the way the data is processed; for example, if you wish to have a time-based FFT, choose **Time** as the X Input, or if you wish to perform an Order-based FFT, choose the **Encoder Sensors**. The Sensors are listed by sensor description. To change the description of the sensors, see *"Configuring Sensors" on page 86*.<br><br>**Note 1:** You can use a Temporary waveform for the X input if you want to collect leak test data against an encoder.<br><br>**Note 2:** To obtain the Speed waveforms, the corresponding encoder is interpolated down to 200 Hz, a 10-point derivative is applied, and the resultant waveform is multiplied by 0.16667 to convert from degrees to RPM. |
| **Waveform Setup- X-Axis Decimals** | Use the drop-down list to select the **X-Axis Decimals**, from **0** to **5**. This setting does not affect the accuracy, but only the display of the number of decimals shown in the Features Table for values in the Analysis Range start and stop and the Main Graph X Min and X Max. See *"Waveform Analysis Options" on page 128*. |
| **Waveform Setup - Move Waveform** | • Click the **Move Waveform** arrow buttons to move the waveform up or down in the **Select Model/Operation/Wave** navigation list on the left side of the screen. (When Model data is separate from Test Configuration data, the Select Model/Operation/Wave list is labeled Select Config/Operation/Wave list) |
| **Waveform Setup- Add/ Remove Wfm** | • Click the **Add/Remove Wfm** plus button to add a new waveform for the operation.<br>Note: Each added waveform is given the default name "New Waveform." To avoid confusion, immediately rename.<br>• Click the **Add/Remove Wfm** minus button to delete the selected waveform in the **Select Model/Operation/Wave** navigation list. (When Model data is separate from Test Configuration data, the Select Model/Operation/Wave list is labeled Select Config/ Operation/Wave list) |
| **Waveform Setup- Processes** | Set the **Processes** for the waveform. On the right side of the display area, a table of processes appears that can be modified for the waveform. Up to 20 processes can be added and configured for each waveform. The order of the processing occurs from top to bottom, that is, the output of the first process is used as the input for the second process, the output of the second process is used as the input for the third, and so on. Processes can be moved up or down in the order of the table by pressing **Select** for the appropriate process and pressing the **Up** or **Down** button. Each process can also be edited pressing **Select** and pressing the **Edit** button to open a new screen where the process type and parameters can be set or changed. Finally, any process can be deleted by pressing **Select** and pressing the **Delete** button. For description of processes, see the following table, *Table 33*. |
| **Graph Options** | Enable **Show All** to have all the feature regions displayed on the graph at once. The regions of all features with the **Show with all Features** parameter enabled are displayed on the graph. See "Show with All Features" in *Table 38 on page 129* for more information. |

***Table 32*** *Operations Waveform Processing (Continued)*

| Section | Parameters |
|---|---|
| **Last Change** | The date and time of the last processing setup change is recorded in the bottom of the display area. Any updates other than Description and Decimals sets it to the current date and time. This is used to tell the system if the waveform processing parameters have changed and whether the raw data needs to be re-processed. |
| **Part Information** | The information about the part used for analysis is posted above the graph, including the part serial number, test date and time. |

***Table 33*** *Waveform Process Types*

| Process Type | Description |
|---|---|
| **Band Pass Filter** | Frequencies within a given bandwidth are allowed to pass from the Input to the Output and all others are attenuated. Common filter types are supported:<br>• **Butterworth** - provides the flattest pass band at the expense of the sharpness of the attenuation band.<br>• **Chebyshev** - provides a steeper attenuation than Butterworth at the expense of ripple, or distortion, in the pass band.<br>• **Bessel** - provides a filter with near constant phase delay across all frequencies thus best preserving the wave shape of the filtered signals in the passband.<br>The **filter order**, or rate of attenuation, can be selected between 2 (low) and 8 (high). |
| **Clipper** | Hard limits are forced on the collected data. Any data outside of the defined upper and lower limits are set (or 'clipped') to these limits. |
| **Derivative** | Numerical differentiation is performed on the independent variable over the entire Input waveform. The derivative process can be applied more than once to create a second derivative. The derivative can be used to bring out certain features of the graph making it easier (or possible) to create a signature to detect. Moreover, as with Integral, the derivative application can be used to transform the sampled variable into another physical variable more applicable to the test |
| **Extract Waveform** | One waveform is created from another. Typically, it is used to segment the Input waveform for more concise analysis.<br>If the operation is associated with a 3520 leak test module, the Extract process also allows you to extract a waveform using the leak test analysis zones as start and stop parameters.<br>**Note:** The Extraction process occurs from the beginning of the first specified zone to the end of the second specified zone. For example, if you pick the Fill zone as the “Extract From” parameter, then PSV uses the start of the Fill zone. If you pick the Fill zone as the “To” parameter, then PSV uses the end of the Fill zone. |

***Table 33*** *Waveform Process Types (Continued)*

| Process Type | Description |
|---|---|
| **FFT** | A Fast Fourier Transform process is applied to the Y and X input data. This allows viewing the frequency content of the waveform and is best used to look at frequency signals that are continuous in nature. For time-based FFT, choose **Time** as the X Input, and for order-based FFT, choose the **Encoder Sensors** as the X Input. See *Table 34 on page 124* for parameter information.<br>The FFT process down-samples the source data internally before the FFT is applied to 2.56 times the Max Freq parameter. |
| **High Pass Filter** | Signals with higher frequencies are allowed to pass from the Input to the Output while lower frequencies are rejected. Common filter types are supported:<br>• **Butterworth** - provides the flattest pass band at the expense of the sharpness of the attenuation band.<br>• **Chebyshev** - provides a steeper attenuation than Butterworth at the expense of ripple, or distortion, in the pass band.<br>• **Bessel** - provides a filter with near constant phase delay across all frequencies thus best preserving the wave shape of the filtered signals in the passband.<br>• Set the Value for the Low Cut (Hz).<br>• **The filter order**, or rate of attenuation, can be selected between 2 (low) and 8 (high). |
| **Integral** | A classic definite integral is implemented with the limits of integration over the entire sample interval. In general, there are two reasons to use the integral process. The integral might transform the input into some other physical quantity of more interest than the original data array or the integral may filter certain undesirable characteristics of the waveform, rendering a more reliable pass/fail determination. |
| **Knock Detection** | A special algorithm is applied to the input waveforms that has been optimized for detecting repetitive impulse energy. It is best used when a certain frequency repeats itself, for example, a nick in a bearing or a tick in a fan. See *Table 35 on page 126* for parameter information. |
| **Linear** | Each point of the Input waveform is applied to the following equation:<br>Y=mX+b, where<br>Y is the new data point in the Output waveform.<br>m is the **Slope** factor applied to the Input data point.<br>X is the Input waveform data point.<br>b is the **Offset** factor applied to the Input data point. |

***Table 33*** *Waveform Process Types (Continued)*

| Process Type | Description |
|---|---|
| **Low Pass Filter** | Signals with lower frequencies are allowed to pass from the Input to the Output while higher frequencies are rejected. This filter is typically used to remove random noise. Common filter types are supported:<br>• **Butterworth** - provides the flattest pass band at the expense of the sharpness of the attenuation band.<br>• **Chebyshev** - provides a steeper attenuation than Butterworth at the expense of ripple, or distortion, in the pass band.<br>• **Bessel** - provides a filter with near constant phase delay across all frequencies thus best preserving the wave shape of the filtered signals in the passband.<br>• Set the Value for the High Cut (Hz).<br>• **The filter order**, or rate of attenuation, can be selected between 2 (low) and 8 (high). |
| **Max Track** | Each point in the Input waveform is compared to the maximum value obtained. If the data point is less than the current maximum, the data point is equated to the current maximum. However, if the data point is greater than the current maximum, the data point remains unchanged, and the maximum value is equated to the current point. |
| **Min Track** | Each point in the Input waveform is compared to the minimum value obtained. If the data point is greater than the current minimum, the data point is equated to the current minimum. However, if the data point is less than the current minimum, the minimum value is equated to the current point. |
| **None** | No processing is performed on the original sensor waveforms. **None** is a useful setting, because the raw time domain data is stored with the test record, which is useful for several reasons. It allows playback over USB headphones and saving of a wav file to a USB flash drive (see *"Play Wave and Save Wave" on page 42* for more information). It allows dynamic reprocessing of the data in setup mode when parameters are changed. It is also useful for reprocessing offline in QWX Engineering Workstation. The only down side is that raw data can be large in size and require a larger storage capacity if storing all data in QWX. Also larger waveforms take slightly longer to display on the graphs. |
| **Notch Filter** | The Notch Filter is a type of Band-Reject filter. It is a high Q-factor filter that rejects frequencies within its Y-band up to 90dB. It is very effective at removing a narrow band of frequencies from a waveform. |
| **Pop Noise Filter** | Random noise can be removed from a waveform or data set. This can be useful when data spikes are introduced into data from an external source during data collection. Allowable values are 1 to 1000 points. |
| **Remove DC Filter** | The average value of the entire waveform is subtracted from each element of the waveform. This is used to shift the DC component of a waveform to 0. |
| **Remove Idle Data** | The Y input is evaluated and up to the point where the Y data has not deviated by a percentage of its full scale, the leading data is eliminated. The X input data is also extracted to match the Y data. This process is commonly used in press monitoring to eliminate collected data up to the point of the press contact point. |

**Table 33** *Waveform Process Types (Continued)*

| Process Type | Description |
|---|---|
| **Remove Reversed** | The X input is evaluated and data is extracted up to the point where the X data ceases to travel in a positive direction, and starts to move in a negative direction. The Y input is extracted at the same point as the X. This process is commonly used in press monitoring, and is used to eliminate any data where the press ram is reversing direction. |
| **Running RMS** | A band pass filter and running RMS process are applied to the input waveforms. This process is useful for isolating the amplitude modulation of waveforms in the time or position domain. See *Table 36 on page 127* for parameter information. |
| **Smoother** | A simple, unweighted moving average filter is applied to a waveform. $$Y = \frac{X_i + X_{i-1} + \cdots + X_{i-N+1}}{N}$$ where N is the Smoother - Size parameter. Allowable values are 1 to 1000 points. |
| **Synch Average** | A synchronous average process is applied to the input waveforms. Synchronous average separates the input waveform into equal parts as defined by the fold interval. It then returns the mean average of the same data point in each sub waveform and generates the output waveform accordingly. It is useful for removing background noise and pulling out the repetitive parts of a waveform. See *Table 37 on page 127* for parameter information. |
| **Waveform Math** | Two inputs can be selected from the available list and a mathematical process is applied to the two waveforms to yield a new output waveform. The two waveforms can be any of the collected Analog inputs, the encoders or the current waveform which is the output of the previous process, or if this is the first process, the selection made for the waveform's Y-Input. The options are addition, subtraction, multiplication and division. |
| **Store Y to Temp Waveform** | Allows you to store the Y axis values to a temporary waveform. Select the name of the temporary waveform from the **Store to** drop-down list. This option is useful if you want to apply processing to a waveform, store it, and recall it later for use or further processing. |
| **Absolute of Input Y** | Negative points in the waveform become positive and retain their magnitude. |
| **Merge X_Y Inputs** | Takes the Input Y waveform and changes its X-axis to the input X waveform. This process is helpful if you want the waveforms combined before doing math. For example, adding two “WaveformY vs WaveformX” profiles require the merge process because math works only on the Y portions. Leave the X-interval value as 0, or specify a new value. The value determines the resolution of the output waveform: higher values produce lower resolution. The default value of 0 uses the current resolution of the X axis. |
| **Swap X_Y Inputs** | Allows you to temporarily swap the X and Y axes. Since the X-axis cannot be manipulated, i.e. processed, this option allows you to get around this limitation. After you process the axis, you have to swap it back to its original axis. |

*Table 33 Waveform Process Types (Continued)*

| Process Type | Description |
|---|---|
| **Make Line** | Allows you to create a smooth line from a source waveform by specifying the slope and offset. This is especially useful for part profiles that need to be subtracted from a surface that is imperfect or has gaps in it. Either type the slope and offset values in the text boxes, or from the drop-down lists, select the storage registers to use.<br>**Note:** The number of points in the resulting waveform will be equal to the number of points in the Y Input. |
| **Change Graph Labels** | Allows you to specify custom units of measure and custom labels for both the X and Y waveform axes.<br>**Note 1:** The X axis label is editable only if X Input is defined and no FFT-based processing is used.<br>**Note 2:** Leave the fields blank to keep the default parameters. |
| **PD to Flow** | This waveform process type takes in a Pressure waveform and converts it to an estimated Flow waveform using a moving time window. This is a method for estimating Flow without a flow meter. The following parameters are required to compute the conversion:<br>Volume (cc): The volume of the part (including hose).<br>Window (s): The duration, in seconds, of the time window. A longer window uses more data for each converted flow value and reduces noise, but takes longer to compute and decreases the bandwidth of the flow waveform.<br>X-interval (s): The step size, in seconds, of the time window as it moves across the Pressure curve. A smaller value will give you more data points in the output Flow waveform, but it will take longer to compute.<br>Conversion factor: The atmospheric pressure in absolute pressure units (for example, 14.7 psi, 101.325 kPa). **Note:** This value cannot be 0. |

## FFT Processing

The FFT processing applies a Fast Fourier Transform to the Y input data. This allows viewing the frequency content of the waveform. For Time based FFT, choose Time as the X Input, and for Order based FFT, choose the encoder sensor as the X Input.

An Order based FFT resolves the frequency content into revolutions using the information from the encoder sensor. For example, all the energy content at Order one is the energy that occurs once per rotation, and Order two is energy that occurs two times per rotation. It is a very useful way to make test limits more reliable and provide compensation for some level of speed variation. The benefit of using order based analysis is that if the speed of the motor changes, the order based output keeps the location of the data the same for frequencies that are based on rotation. The FFT Processing is best used to look at frequency signals that are continuous in nature. The process down-samples the source data internally before the FFT is applied to 2.56 times the Max Freq parameter. See *Table 34* for parameter information.

*Table 34 FFT Processing Parameters*

| Group | Parameters |
|---|---|
| **Input Range Used** | • **Use full waveform** - enable this to have the waveform processing use the entire Y and X input sensor waveforms. If the **Use full waveform** is disabled, the **X Start** and **X Stop** fields become editable.<br>• **X Start and X Stop** - select the slice of input data that you wish to use for processing. The units are the units of the X Input, e.g. Sec. when X is Time.<br>Note: This is a useful feature if there is a unique section in the input data that you wish to analyze. For example, if the input data contains two separate speed sections, you can use this feature to pull out and analyze the speed zones separately in two different processed waveforms |
| **FFT Processing - Auto and Max Frequency** | • Select the **Auto** option to use **Max Freq** (Maximum Frequency) if you want the FFT processing to use the full bandwidth that the data collection rate allows. This is equal to the sample rate / 2.56. The max frequency is shown in the Max Freq box below the option. The value is in Hz if the X input is Time, Order if the X input is the Encoder sensor or 1/ (X-Axis units) if any other sensor.<br>• If you want to reduce the FFT maximum frequency, then deselect the **Max Freq Auto** Option and enter the value you wish for the Maximum Frequency in the Max Freq data entry box. All the lines of the FFT are used between 0 and the max frequency you enter. The frequency reduction is accomplished by filtering then decimating the data before an FFT is performed. |
| **FFT Processing - number of Lines** | Select the number of Lines of the FFT you would like to have. The number of lines is the number of unique frequency bins in the FFT output. The options are 200, 400, 800, 1600, 3200 and 6400. When less lines are used more averaging can take place resulting in more accurate values. When more lines are used you have greater frequency resolution and less frequency bleeding from bin to bin. The default is 1600 lines, which is adequate for most applications. |
| **FFT Processing - Averaging** | Select the FFT **Averaging** as **None**, **Mean** or **Peak Hold**. The Averaging setting defines what happens with the output of each of the FFT Blocks. See **# of Blocks** below in the last row of this table (**FFT Information** row) for a description of FFT Blocks. With **None** selected only one FFT block is used on the first section of data. With **Mean** selected the FFT output for each block is averaged line by line (FFT Frequency bin by bin) together to produce the final FFT. With **Peak Hold** selected the peak value for each FFT line is used across all FFT Blocks. The default is **Mean**. Use **Peak Hold** when impulse or impact type signals need to be analyzed, and **Mean** when continuous sources need to be analyzed. |

*Table 34 FFT Processing Parameters (Continued)*

| Group | Parameters |
|---|---|
| **FFT Processing - Window Type** | Select the **Window Type** as **None**, **Triangle**, **Hanning**, **Hamming** or **Flat Top**. All FFT Processing algorithms expect the input to be made up of continuous sine waves with the last data point lining up with the first data point. In reality, the inputs are rarely sine waves and rarely line up. Windowing takes care of making the input and output line up and removing some of the effects of the discontinuity between the last point and the first point. The default type is **Hanning**, which is good for most applications.<br>• **None** - data assumed continuous. There is no window processing applied.<br>• **Triangle** - takes the input data values and creates a transform that goes from the lowest value up to the highest and back down in straight lines (starting and ending on 0).<br>• **Hanning** - used for noise and vibration. It creates a transform that goes from the lowest value up to the highest and back down in a synchronous curve (starting at 0).<br>• **Hamming** - similar to Hanning, but creates a transform that starts and ends on the lowest value of the input (not absolute 0).<br>• **Flat Top** - is typically used for calibration and has the best accuracy. |
| **FFT Processing - Block overlap** | Set the Block Overlap to control the amount that FFT Data Blocks overlap from one to the next. See **# of Blocks** in the next row below for a description of FFT Blocks. The range is 0 to 90%. The higher the number the more the FFT Data Blocks are overlapped and the more FFT Data Blocks are used. This can increase the accuracy of the FFT results. |
| **FFT Information**<br>(read only) | The FFT Information updates with changes in the FFT parameters.<br>• The **Resolution** is the width of a single FFT line. It is the Maximum Frequency divided by the number if Lines. You can have finer frequency resolution by increasing the number of Lines of the FFT or by decreasing the Max Freq setting. The value is in Hz if the X input is Time, Order if the X input is the Encoder sensor or 1/(X-Axis units) if any other sensor.<br>• The **# of Blocks** indicates the number of FFT Data Blocks that is used in the input data stream. An FFT always uses a fixed number of data points for the input. The number of points is 2.56 times the number of lines used. These points are called an FFT block. If the input data has many more data points than required for one FFT, many unique FFTs can be performed using the many unique FFT Blocks over the data set. If Averaging is set to Mean then increasing the number of blocks can typically increase the accuracy of the frequency information. You can increase the number of blocks used by increasing the Block Overlap, decreasing the number of lines, increasing the Max Freq or by increasing the number of data points available. |

## Knock Detection

The Knock Detection Processing type uses a special algorithm that has been optimized for detecting repetitive impulse energy. It is most useful when a certain frequency repeats itself, for example, a nick in a bearing or a tick in a fan. First, a band pass filter is applied to the time domain signal of the Y Input sensor. This isolates the frequency of interest. Next, the signal is processed and the output is an FFT that shows the frequency content of the amplitude modulation of the input signal.

The following example illustrates how knock detection works:

If the housing of a motor is being hit by a defective part every rotation of the motor, we expect the resonant or natural frequency of the motor housing to be excited every rotation. The natural frequency of a part can be determined by capturing the sound of impacting the part, and performing an FFT analysis of the sound. If the natural frequency of the motor housing is 2 kHz, we expect to see a burst of 2 kHz energy once every rotation. To detect this defect, you set the part natural frequency settings of the Knock Detection algorithm to bracket the resonant natural frequency, in our example, to 1.5 kHz (**Start**) and 2.5 kHz (**End**). If the motor is being rotated at 60 RPM (1 Rotation per second), the knock detection algorithm produces a waveform with a spike at 1 Hz indicating that the 2 kHz frequency has a 1 Hz amplitude modulation on it.

If you had an encoder or position input available connected to the shaft of the motor it would be best to choose this as the X Input in the Processing setup. This would now perform an Ordered based Knock Detection and the resulting waveform would have a spike at Order 1, which means it occurs once per rotation. The benefit of using order based analysis is that if the speed of the motor changes, the order based output always has the spike at 1 order while with the time based one, the location of the spike moves with the change in motor speed.

See *Table 35* for knock detection parameter information.

***Table 35*** *Operations Processing Options for Knock Detection*

| Group | Parameters |
|---|---|
| **Input Range Used** | The parameters in this group are the same as for the FFT processing type, see *Table 34 on page 124* for more information. |
| **FFT Processing and FFT Information** | The parameters in these groups are the same for the FFT processing type, see *Table 34 on page 124* for more information. |
| **Part Natural Frequency** | Enter the natural frequency (resonant frequency) **Start** and **End** in Hz for the frequency of interest. Choose the frequency range that best isolates the energy of the defect that you are trying to detect. |

## Running RMS

The running RMS process first applies a band pass filter to isolate the frequencies of interest. Then a running RMS process is applied. The running RMS process is useful for isolating the amplitude modulation of waveforms in the time or position domain. See *Table 36* for parameter information.

**Table 36** *Operations Processing Options for Running RMS*

| Group | Parameters |
|---|---|
| **Input Range Used** | The parameters in this group are the same as for the FFT processing type, see *Table 34 on page 124* for more information. |
| **Band Pass Filter** | Enter the start and end of the frequencies that you would like to perform a running RMS process on. Enter the values in Hz. The band pass filter is applied to the Y input in the time domain before the running RMS process. |
| **Running RMS Parameters** | The **Points Used** sets the number of points that are used to compute the running RMS. Each point in the output waveform is made up of an RMS of the input waveform using the number of points set in the **Points Used** parameter. If this value is increased, more input points are used to compute each output point, increasing the filtering of the amplitude modulation output signal. If the value is decreased, it reduces the filtering effect and shows more detail. The default value is **10**. Adjust this until you see the amplitude modulation signal you expect or until the defect is clearly observed. The allowable values are 1 to 250. |

## Synchronous Average

The synchronous average process separates the Input waveform into equal parts defined by the **Fold Interval**. It then returns the mean average of the same data point in each sub waveform and generates the output waveform accordingly. It is useful for removing background noise which is not repetitive and pulling out the repetitive parts of a waveform. See *Table 37* for parameter information.

**Table 37** *Operations Processing Options for Synchronous Average*

| Group | Parameters |
|---|---|
| **Input Range Used** | The parameters in this group are the same as for the FFT processing type, see *Table 34 on page 124* for more information. |
| **Position Based Synchronous Average** | Enter the Fold Interval in units of the X Input Sensor. This is the interval used to separate the input waveform into sub waveforms or fold it on top of itself. These sub waveforms are then averaged together point by point to produce a single output waveform that is has the fold Interval length. |

## Waveform Analysis Options

This procedure applies both to the sigPOD and the 3520 module. However, the waveform analysis type options in *Table 39 on page 133*, do not apply to the 3520 waveforms. 3520 leak test-specific analysis types are listed in *Table 48 on page 178*.

### To configure waveform analysis options for each feature

1. Enter the Setup mode. See *"Entering Setup Mode" on page 85*.
2. In any of the Setup mode screens, click the **Operations** button.
3. Choose the Model or Test configuration that you wish to edit from the drop-down list in the upper left-hand corner.
4. Expand the waveform list under the Operation you wish to edit in the Select Model/Operation/Wave List, by clicking on the plus sign next to an operation.

   Note: When Model data is separate from Test Configuration data, the Select Model/Operation/Wave list is labeled Select Config/Operation/Wave list. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.
5. Click on the Waveform you wish to edit under the chosen Operation. Waveform names in this list are indicated by a waveform status icon (see *Table 8 on page 22*).

   **Note:** To display more waveforms under an operation, refer to **Enable Waveforms for Operation** in *Table 32 on page 117*.
6. Click the **Features** button under **Select View** on the upper right-hand side of the screen to open the Waveform - Features screen (see *Figure 31 on page 62*).
7. To configure waveform features, select or enter the appropriate parameters. You can configure any of the settings in the Feature table under the graph. You can scroll the table with the scroll bars on the bottom and right-hand side of the table. See *Table 38* for configuration information.

   **Note:** 1: You can move the feature up or down in the feature table list by using the Move arrow button, or add and remove features by using the **Add** and **Remove** plus and minus buttons.

   **Note:** 2: If you are using the Sciemetric QualityWorX traceability solution, the connection of future data from previous test records will be lost for the moved features.

   **Note:** 3: Each time you edit a parameter, the data is reanalyzed and new results posted to the graph and the table. Reprocessing the data can take a couple of seconds. Please edit one item at a time, and ensure that the system has responded completely before editing another item, otherwise some edits may be lost.
8. To configure other options on the screen, see *Table 40*.
9. If a feature is an Envelope type, also see *"Configuring Envelopes" on page 136*.
10. Select another model or test configuration/operation/waveform to continue configuration, or click any button on the toolbar to exit the **Waveform** screen.

***Table 38*** *Waveform Analysis Configuration Parameters*

| Element | Parameters |
|---|---|
| **Feature Number** | Assigned automatically **1-10**. This can be used for tracking purposes. |
| **Enable** | Click to enable or disable the feature. The rest of the options in the table are grayed out if a feature is not enabled. |
| **Status** | Shows the feature status using the data from the last part for the chosen model or test configuration, re-processed with the latest processing for this waveform and tested with the latest feature setup. The status can be<br>• ✓ Green check mark, feature passed<br>• X Red X, feature failed<br>• ? Question mark, no data available<br>• ! Exclamation mark, fault in the analysis. Possible causes: the Analysis Range Start or Stop is outside of the waveform X-Axis range or, if the feature type is an envelope, the envelope has not been defined. |
| **Select** | Toggle the button beside the feature, to select or de-select the feature. Selecting the feature highlights the analysis region for that feature, or displays the Histogram or Trend graph if Histogram or Trend view is selected. See **Graph Options** in *"Features View" on page 34* for information on highlighting graph regions with the **Show All** option. |
| **Feature Description** | Enter a descriptive name for the feature. The feature name entered here is used whenever the feature is displayed. It is also used in other software packages, such as QWX and Part History Viewer, where data can be reviewed. The length can be from one to 25 characters. Allowed characters are a-z, 0-9, <space> ! # $ & ( ) * + <comma> - <period> / : ; < = > ? @ [ \ ] ^.<br>**Note 1:** Renaming a feature does not reset any SPC data.<br>**Note 2:** If you are using QWX and the feature name is not updating in the QWX data correctly, use the QWX Configuration Tool to change the name, editing the feature name under the Process Definition section. See the QWX Configuration Tool documentation for more information. |

*Table 38 Waveform Analysis Configuration Parameters (Continued)*

| Element | Parameters |
|---|---|
| **Specification Limits** | • Enter the **Upper** and **Lower Specification Limits**. The Feature Value is tested against these limits to determine if the feature is a failure or a pass. The Units and Decimals are set in the Analysis Parameters section of the table (see below).<br>**Note 1:** You can also type in a register name or an equation directly in the text boxes.<br>**Note 2:** The text boxes turn red if you are entering invalid values (for example, Upper Limit value lower than Lower limit, or entering an equation whose calculated value is invalid in InspeXion.<br>• Press the **Set to Control** button under the column **Set Spec Limits** to set the specification limits to the current values for the SPC control limits. This button is only available if there are more than 5 parts in the SPC data for this feature. This button sets the limits based on statistical data. Check the SPC Control Limits by looking at the Histogram and Trend views to ensure that they are good values to use. |
| **SPC Control Limits** | • The non-editable Upper and Lower SPC Control Limits, generated from SPC data, are shown in the table. The Specification Limits can be set to the SPC Control Limits by pressing the Set to Control button under the Specification Limits section of this table.<br>• Set the N Sigma (default is 3) to change the number of standard deviations that are used to form the Upper and Lower Control Limits. This can be used to customize, where the SPC Control limits are relative to your data. |
| **Copy To** | Registers R01 through R50 can be selected for storage of the feature value for later use. The feature value can be used in start/stop range entries for subsequent features, and in some feature entry inputs.<br>**Note:** Each time a register value is assigned, PSV remembers the value; that is, the value is available after restart of the PSV application. |
| **Analysis Type** | Click on the drop-down list to choose the analysis type for the feature and press enter (or click on another entry). When a new analysis type is chosen, units for the feature are automatically suggested and the SPC data for the feature is reset. The region displayed on the graph is also updated. See *Table 11 on page 38* for more information on how regions are displayed. The new feature type is reanalyzed with the current data and the new resulting value is posted under the column **Feature Value**. All feature checks are performed on the input waveform within the **X Axis Analysis Range**. For description of the different analysis types, see *Table 39 on page 133*. |

***Table 38*** *Waveform Analysis Configuration Parameters (Continued)*

| **Element** | **Parameters** |
|---|---|
| **Analysis Parameters** | • Enter the units for the feature. If the Feature Analysis Type is changed, the feature units are automatically updated with suggested values. The units can be changed at any time. The length can be from one to 12 characters. Allowed characters are a-z, 0-9, <space> ! # $ & ( ) * + <comma> - <period> / : ; < = > ? @ [ \ ] ^.<br>• Select the number of **Decimals** for the feature value, from 0 to 5. This setting does not affect the accuracy, but only the display of the number of decimals shown for Feature Value, Specification Limits, Control Limits, SPC Graph Limits and Y Min and Y Max values for the Main Graph Limits.<br>• **Advanced** - This is available only for the following features: envelope, cusp value and location, get y at x, knee value and location, rise/fall time, threshold count and threshold crossing. Clicking the Edit button allows access to further setup screens for the feature.<br>**Note 1:** When configuring additional parameters for these features, you can type a number in each text box. or you can also type a register name or an equation directly in the text box.<br>**Note 2:** The text boxes turn red if you are entering invalid values (for example, entering an equation whose calculated value is invalid in InspeXion).<br>• See *"Configuring Envelopes" on page 136* for further information on envelope features. |
| **Analysis Range** | • Enter **Start** and **Stop** values or from the drop-down lists, select a register to define the **Analysis Range** for the feature. You can also type in a register name or an equation directly. The feature only uses the waveform data between the Start and Stop, with the exception of the THD feature.<br>**Note 1:** The text boxes turn red if you are entering invalid values (for example, Stop value smaller than Start, or an equation whose calculated value is invalid in InspeXion).<br>**Note 2:** If the analysis range start and stop has been changed substantially and you want to reset the SPC data, see **Start of SPC Data** in this table.<br>**Note 3:** The number of decimals for the **Start** and **Stop** can be set in the *"Waveform Processing Options" on page 116*. See X-Axis Decimals under Waveform setup in *Table 32 on page 117*. Units are read-only and are taken automatically from the X-axis input for the processed waveform.<br>**Note 4:** The start and end ranges can be selected from registers R01 through R50. If selected, the values of the registers selected will overwrite any values entered for start and stop in the feature table. |

*Table 38 Waveform Analysis Configuration Parameters (Continued)*

| Element | Parameters |
|---|---|
| **SPC Information**<br>(read only) | • **# Samples** indicates the number of test results that the SPC database has for this particular feature on the selected waveform, operation and model or test configuration. Duplicate tests on the same part increment this number.<br>• **# Fail** indicates the number of tests that failed this feature.<br>• **% Fail** indicates the failure rate in percent of **# Samples**.<br>• The process capability index for this feature is shown in the **Cpk** column. A value higher than 1.33 is generally desirable for a process that is in control.<br>**Note 1:** All the values for the SPC information read **0** until there are at least 5 parts.<br>**Note 2:** Changing the **Feature Type** resets the SPC data unless the same feature type has been tested with the same feature number in the past.<br>**Note 3:** You can clear out the SPC data by clicking **Reset** in **Start of SPC Data** at any time. |
| **Start of SPC Data** | • **Date** displays the start date and time from which the SPC data uses all samples available up to and including the current part.<br>• Click the **Reset** button to set the **Start of SPC Data** to the present date and time. This effectively erases all historical SPC data for this feature. This is useful if the Analysis Region has been substantially changed, and the historical data does not relate to the current setup. |
| **Show with All Features** | • Enable this parameter to display the analysis region for this feature in a waveform graph when the **Show All** graph option is selected. See Graph Options in *"Features View" on page 34* for more information on how regions are displayed.<br>**Note:** This feature is useful when feature analysis regions overlap each other and create confusion when the **Show All** graph option is used. In that case, you should disable the **Show with All Features** option on the features that you do not want to have displayed at the same time. |
| **SPC Graph Limits** | • Enable **Auto** to automatically generate the Min and Max range for the SPC graph from SPC data.<br>• Disable **Auto** to manually set Min and Max ranges for the SPC graphs. These values are used for the Histogram X-Axis and the Trend Y-Axis when this feature is selected. This is useful if you want to have the display show a consistent range making it easier to compare.<br>**Note**: The decimals shown can be edited by setting the value for this feature in **Decimals** under **Feature** in the Feature table. Select the number of Decimals for the feature value, from 0 to 5. This setting does not affect the accuracy, but only the display of the number of decimals shown for Feature Value, Specification Limits, Control Limits, SPC Graph Limits and Y Min and Y Max values for the Main Graph Limits. |

***Table 38*** *Waveform Analysis Configuration Parameters (Continued)*

| Element | Parameters |
|---|---|
| **Main Graph Limits** | • Enable **Auto** to automatically generate the waveform X- and Y-Axis graph limits.<br>• Disable **Auto** to manually set **X Min**, **X Max**, **Y Min** and **Y Max Ranges** for the waveform graphs when this feature is selected.<br>**Note 1:** The decimals shown for **X Min** and **X Max** can be edited in the Operations - Waveform Processing X-Axis Decimals. See X-Axis Decimals under Waveform setup in *Table 32 on page 117* for more information.<br>**Note 2:** The decimals shown can be edited by setting the value for this feature in **Decimals** under **Feature** in the Feature table. Select the number of Decimals for the feature value, from 0 to 5. This setting does not affect the accuracy, but only the display of the number of decimals shown for Feature Value, Specification Limits, Control Limits, SPC Graph Limits and Y Min and Y Max values for the Main Graph Limits. |
| **Results (Send to PLC or saved to log files)** | • Enable the check boxes for the features you want to be included in the results data. For more information about results data, see *"Data Output Format" on page 105*. |
| **PINpoint Info (Category Name and Name)** | These fields are applicable only if you have PINpoint functionality installed on your system.<br>Enter a category name and name for the feature results that you want sent back to PINpoint at the end of each test. If you leave these fields blank, this particular feature will not be sent to PINpoint. |

***Table 39*** *Waveform Analysis Types*

| Analysis Type | Description |
|---|---|
| **True Area** | The difference between the area above the x-axis and the area below the x-axis. The result can be a positive or negative number. |
| **Area Above X-Axis** | The area between the curve and the x-axis, where the curve is above the x-axis. The area between the curve and the x-axis where the curve is below the x-axis is ignored. The result has a value greater than or equal to 0.<br>If a side edge is crossed, the feature will fail. If the top edge fails, the analysis returns a feature value higher than the Upper Limit. If the bottom edge fails, the analysis returns a feature value lower than the Lower Limit. In some cases, if the resolution of the waveform isn't high enough, the feature value will not correctly identify the failed edge. If the analysis passes, the feature is assigned a value equal to (Upper Limit + Lower Limit) / 2. |
| **Area Below X-Axis** | The area between the curve and the x-axis, where the curve is below the x-axis. The area between the curve and the x-axis where the curve is above the x-axis is ignored. The result has a value greater than or equal to 0. |
| **Envelope*** | A pre-defined set of upper and lower limits for Y values, statistically generated on a point by point basis. |

*Table 39 Waveform Analysis Types (Continued)*

| Analysis Type | Description |
|---|---|
| **Cusp Location*** | The location of the occurrence, within a defined Analysis Range, of the maximum second derivative of the input waveform, in engineering units of the X-Axis. |
| **Length** | An index or value of the input waveform. |
| **Get Y at X*** | The value of Y at the defined X location within the input waveform. |
| **Knee Value*** | The value of the occurrence, within a defined Analysis Range, of the minimum second derivative of the input waveform, in engineering units of the Y-Axis. |
| **Knee Location*** | The location of the occurrence, within a defined Analysis Range, of the minimum second derivative of the input waveform, in engineering units of the X-Axis. |
| **Number of Points** | The number of data points, in the input Y waveform, within the Analysis Range. |
| **Rise/Fall Time*** | A measurement given in engineering units of the X-Axis between two specified points on the Y-Axis. Based on the values given for the Start and Stop Values, this function returns either the amount of rise or fall along the X-Axis between the two. If either the Start or the Stop Value is not achieved within the Analysis Range, the Fault Value is returned. |
| **Standard Deviation** | The square root of the variance, in engineering units of the input data. |
| **Threshold Crossing*** | The location, in engineering units, where the threshold value is exceeded by the data point in the input waveform, as defined by the transition and deadband. |
| **Threshold Count*** | The number of times that a specified threshold has been crossed within a given input waveform. |
| **Custom Math*** | Algorithm entered as a string. Format is checked upon entry. Standard calculator functions available using registers R01 through R50. |
| **Kurtosis** | The Kurtosis type is an n-dimensional analysis that characterizes the relative peakness or flatness of a distribution, compared to a normal distribution. Positive Kurtosis indicates a relatively peaked dispersal of data points. Conversely, negative Kurtosis indicates a relatively flat distribution. |
| **Skew** | The Skew type returns a non-dimensional value to the output register after performing a secondary calculation on the input data. Skewness characterizes the relative degree of asymmetry as compared to normal distribution. This analysis provides information about those data points at the outer edges of normal distribution. A positive value of skewness defines a distribution whose tail extends outward more to the positive x, and a negative value more towards a negative x. |

**Note** * When these analysis types are selected, the **Edit** button in the Advanced column becomes available. You need to press this button to set additional analysis parameters. For 3520 leak test-specific analysis types, see *Table 48 on page 178*.

***Table 39*** *Waveform Analysis Types (Continued)*

| Analysis Type | Description |
|---|---|
| **Fit Window*** | A pre-defined window whose boundaries are defined by the Upper and Lower Limits along with the Start and Stop parameters. Suitable for vertical lines going through the top, bottom, or both top and bottom of the window. Only the top and bottom edges of the window (defined by the Upper and Lower Limits) are analyzed.<br>If a side edge is crossed, the feature will fail. If the top edge fails, the analysis returns a feature value higher than the Upper Limit. If the bottom edge fails, the analysis returns a feature value lower than the Lower Limit. In some cases, if the resolution of the waveform isn't high enough, the feature value will not correctly identify the failed edge. If the analysis passes, the feature is assigned a value equal to (Upper Limit + Lower Limit) / 2. |
| **Mean** | A value that is computed by dividing the sum of the points by the number of points |
| **Median** | The value where the number of points above and below are equal. |
| **Min Value** | The data point with the least numerical value of the input waveform. |
| **Min Location** | The point on the X-Axis (in engineering units of the X-Axis) where the Min Y Value is to be found. |
| **Peak Value** | The data point with the greatest numerical value of the input waveform. |
| **Peak Location** | The point on the X-Axis (in engineering units of the X-Axis) where the Peak Y Value is to be found. |
| **Peak to Peak** | The difference between the maximum and minimum values of a data set. |
| **Peak/RMS** | The ratio between the maximum value of a data set and the RMS of the data set. |
| **Power Sum** | Works in conjunction with the Fast Fourier Transform (FFT) process. After applying an FFT to a waveform, the Power Sum supplies the total power of all frequency bars within the defined range. This analysis solves the problem of isolating single frequencies within an FFT. FFT assumes that the waveform does not end, and the combination of resolution and periodicity produces smearing. This means that there is almost always more than one bar representing a single frequency range. For more information on FFT, refer to *"FFT Processing" on page 123.* |
| **RMS** | The square root of the arithmetic mean of the squares of the Y values for a feature curve. |
| **Slope** | A value equating to a singular value decomposition to a least squares fit algorithm based on the data points within the Analysis Range of the input waveform. |
| **THD (Total Harmonic Distortion)** | Used in an FFT Waveform, performs a ratio calculation between the maximum in the analysis range and the maximum outside the analysis range, expressed in percent. |
| **Cusp Value*** | The value of the occurrence, within a defined Analysis Range, of the maximum second derivative of the input waveform, in engineering units of the Y-Axis. |

***Table 40*** *Other Features Options*

| Element | Parameters |
|---|---|
| **Move** | • Two buttons allow features to be moved up or down in the feature list. The up arrow will move the selected feature up in the list order. The down arrow will move the selected feature down in the list order. |
| **Show All** | • Enable **Show All** to have all the analysis regions for enabled features shown on the graph. See Graph Options and Graphs under *"Features View" on page 34* for more information on how regions are displayed with the Show All option. |
| **Play Wave** | • Click on **Play Wave** to hear the current waveform played over a USB headphone set. See *"Play Wave and Save Wave" on page 42* for a full description of the Play Wave feature. |

## *Configuring Envelopes*

### To configure envelope analysis options

1. Open the **Envelope Edit** Screen.
2. If necessary, enable and configure the operation and waveform for which you wish to configure an envelope analysis. For further information, refer to the earlier procedures in this chapter.
3. Click on the **Features** button under **Select View** on the right-hand side of the screen to open the **Waveform - Features** screen (see *Figure 31 on page 62*).
4. In the **Feature Setup** Table, enable (if necessary) and select the feature that you wish to configure as an envelope type.
5. Select **Envelope** from the drop-down list in the column **Analysis Type**.
6. Click on the **Edit** button in the **Advanced** column for the chosen feature. The **Operation -Waveform - Envelope Edit** screen opens (see *Figure 34 on page 65*).
7. From the drop-down list below **Production Waveforms**, select a **Filter** for the **Production Waveforms List**. Choose from **None, Part Pass, Every 10th, Every 25th** or **Every 50th**. See Filter in *Table 41*.
8. In the list of **Production Waveforms**, highlight the serial numbers associated with the parts records you want to use to calculate the data envelope, and transfer them to the small right-hand window, which is entitled **Envelope Waveforms**, using the **Envelope Selection** buttons between the two small windows (see **Production Waveforms in** *Table 41*).
9. Adjust the **Envelope Specifications** (see E**nvelope Specifications** in *Table 41*) and click **Calculate** each time to see the resulting envelope.
10. If necessary, adjust the specifications until the envelope is as desired, and then click **Calculate** again.
11. Click **Return** to go back to the **Feature Setup** Table.

    For further information about the settings and features in the Envelope edit screen, see *Table 41*.

    **Note:** At any time, the zoom options of the graph can be enabled (see *"Graph Zoom Options" on page 40*).

***Table 41*** *Operation - Waveform - Envelope Edit Features*

| Element | Parameters |
|---|---|
| **Production Waveforms** | • This list is populated with serial numbers for up to 25 parts according to the Filter selection below the table. Changing the **Filter** setting causes a rescan of the production data.<br>• Parts already used in the **Envelope Waveforms** do not appear in the **Production Waveforms** list, but count as part of the 25 waveforms.<br>• The parts must have the same waveform processing setup as the current setup. This is confirmed using the date next to **Last Change** on the waveform processing setup screen. For more information, see **Last Change** in *Table 32 on page 117*.<br>• You can select multiple serial numbers in the Production list by clicking on multiple entries. Selected parts are shown with a blue background behind the serial number. As the parts are selected the waveforms for the selected parts appear in the graph in dark blue. Clicking on a selected part toggles the selection off. As parts are deselected they are removed from the graph.<br>• The pass/fail status of the part when it was originally tested is shown on the left hand side of the table with a red X or a green check mark.<br>• You can get the test date and time for the part by hovering the mouse pointer over the "..." on the right side of the serial number in the table. |
| **Filter** | • Select the **Filter** for the parts used in the **Production Waveforms** list. The options are<br>  • **None** uses the last 25 parts regardless of test status.<br>  • **Part Pass** uses the last 25 parts that have a pass status.<br>  • **Every 10th, 25th** or **50th** use every 10th, 25th or 50th part.<br>**Note 1**: The list is filled up with as many parts as possible to a maximum of 25 parts.<br>**Note 2:** If there are parts that would have been in the Production List but are in the Envelope List they are counted as part of the 25.<br>**Note 3:** The setting of the **Filter** option is remembered globally, not by feature. |

*Table 41 Operation - Waveform - Envelope Edit Features (Continued)*

| Element | Parameters |
|---|---|
| **Envelope Waveforms** | • If this is a new envelope setup, the **Envelope Waveforms** list is blank.<br>• If the envelope has already been setup, the serial numbers of the parts used to make the envelope are listed in the **Envelope Waveforms** list and the waveforms are shown on the graph.<br>• The number of waveforms in the **Envelope Waveforms** list is indicated below the list. The maximum number is 15.<br>• The status of the envelope check for the serial number as tested against the envelope the last time the **Calculate** button was pressed, is shown on the left-hand side of the serial number. The Status is shown with a red X for fail, a green check for pass and a yellow question mark for not yet tested. The color of each of the Envelope waveforms on the graph also shows the status. Red means fail and green means pass.<br>• Selecting a serial number in the Envelope Waveforms list changes the color of the waveform to blue in the graph.<br>• Hovering the mouse pointer over the "..." on the right-hand side of the serial number reveals the result of the envelope check and the date and time that the part was originally tested. |
|  | • Press this to move all the parts in the **Production Waveform List** to the **Envelope Waveform List**, whether they are selected or not. The parts already in the **Envelope Waveform List** remain there. Parts are moved until the **Envelope Waveform List** reaches the maximum of 20 parts. You must press the button twice to confirm the selection. The waveforms that are brought over are highlighted in the **Envelope Waveform List**. |
|  | • Press this to move the selected parts in the **Production Waveform List** to the **Envelope Waveform List**. The initial status of parts is not known, indicated by a question mark in the status indicator. Click **Calculate** to generate a new envelope and test the new waveforms against the new envelope. |
|  | • Press this to move the selected parts in the **Envelope Waveform List** to the **Production Waveform List**.<br>• If the serial numbers were in the **Production Waveform List** they are placed in the order that they were tested in. If not, they are placed at the end of the list. |
|  | • Press this to move all the waveforms out of the **Envelope Waveform List** whether they are selected or not, and puts them in the **Production Waveform List**. |
| **Envelope Specification** | *Calculation of the envelope:* The upper and lower envelope is calculated in several steps. The point by point mean of all the Envelope waveforms combined is calculated, and this is called the nominal waveform. The upper and lower Delta Y, % of nominal and Std Deviations are added together, then added to the nominal waveform to form the Upper boundary, and subtracted from the nominal to form the Lower boundary. These upper and lower waveforms are moved in the X-Axis by the Delta X value to smear the X-Axis. See the table that follows, *Table 42*, for information about the Envelope Specification parameters. To have the envelope updated with selected values, press the **Calculate** button. |

***Table 41*** *Operation - Waveform - Envelope Edit Features (Continued)*

| **Element** | **Parameters** |
|---|---|
| **Calculate** | Press this button to recalculate the envelope and check the waveforms in the Envelope List against the new envelope. The **Calculate** button must be pressed to see updates to the **Envelope Waveforms** list, **Delta Y, % Nominal, # of Std Devs** and **Delta X** parameters in the envelope setup. The Analysis Range **Start** and **Stop** as well as the **Lower** and **Upper Limits** automatically update the graph and the Waveform status in the **Envelope Waveforms** list. |
| **Return** | Press this button to return to the Features table. You can also exit by pressing another waveform or operation in the Select Model/Operation/Wave list or any other toolbar button. |

***Table 42*** *Envelope Specification parameters*

| **Parameter** | **Description** |
|---|---|
| **Delta Y** | The **Upper** value is added to the upper boundary waveform. **Lower** value is subtracted from the lower boundary waveform. The value is in the Y-Axis units of the waveform.<br>**Note:** The decimals shown can be edited by setting the value for Decimals for the Y input Sensor in the Sensors Setup Screen. See *"Configuring Sensors" on page 86*. |
| **% Nominal** | The **Upper** value is multiplied by the nominal waveform, then added to the upper boundary waveform. The **Lower** value is multiplied by the nominal waveform, and then subtracted from the lower boundary waveform. Valid entries are between **0** and **100**, and units are %. |
| **# of Std Devs** | The **Upper** value is multiplied by the standard deviation of each point in the Envelope waveforms then added to the upper boundary waveform. The **Lower** value is multiplied by the standard deviation of each point in the Envelope waveforms then subtracted from the lower boundary waveform. Valid entries are between **0** and **10**. |
| **Delta X** | The delta x value expands the envelope in the x direction by the amount in the Delta X entry. This is essential for allowing jitter in the X-Axis of the waveforms. To update the envelope with changes, press the **Calculate** button.<br>Note: The number of decimals for **Delta X** can be set in the Operations - Waveform Processing screen, X Axis Decimals. |

*Table 42 Envelope Specification parameters (Continued)*

| Parameter | Description |
|---|---|
| **Start and Stop values** | Enter the **Start** and **Stop** values to define the **Analysis Range** for the feature. The envelope uses only the values between the **Start** and **Stop** values. The units are the units of the X-Axis for the processed waveform. The envelope automatically updates including the graph and the waveform status in the Envelope Waveforms list.<br>Note: The number of decimals for **Start** and **Stop** can be set in the Operations - Waveform Processing, X-Axis Decimals. |
| **Upper and Lower Limits** | Enter the **Upper** and **Lower Limits**. The Feature Value must occur within these limits to pass. The units of an envelope feature are in % of points out of the envelope bounds (% **Out**). The output of an envelope check can be between **0** and **100%**. A value of **-99999** means that there was an error in the analysis. Typically, this means that the envelope was not generated or is outside of the bounds of the waveform X-Axis range. When the upper or lower specification limit is changed the status of the Envelope Waveforms is automatically rechecked and updated in the table and on the graph.<br>Note: The decimals shown can be edited by setting the value for this feature in **Decimals** under **Feature** in the Feature table. Select the number of Decimals for the feature value, from 0 to 5. This setting does not affect the accuracy, but only the display of the number of decimals shown for Feature Value, Specification Limits, Control Limits, SPC Graph Limits and Y Min and Y Max values for the Main Graph Limits. |

## Configuring the System

Configuring the sigPOD system parameters includes

- System information, such as the station identification name, graph overlay limit, sound level settings and other options.
- Enabling leak sequencing or 3520 leak functionality

  The 3520 functionality and leak sequencing for third-party leak testers cannot be enabled simultaneously.
- Enabling editing of QualityWorX operation labels
- Reset options for the status handshaking signals
- Result data transmission mode and format

This procedure allows you to configure system parameters that are common to the 3520 hardware platform and the 3520 controller (sigPOD or any other PC). You can configure the IP address and name of each 3520 module on its configuration web page. For more information, see the 3520 Leak Test Module User Guide available through the Sciemetric Support Center at http://support.sciemetric.com.

In PSV, you can change the default Engineering units for all 3520 sensors on the System setup screen. For more information, see *"Changing the default engineering units for the 3520 sensors" on page 164*.

### To configure the common system parameters

1. Enter the Setup mode. See *"Entering Setup Mode" on page 85*.
2. Click the **System** button on the navigation bar on the left.

   The System screen opens (see *Figure 35 on page 66*).
3. Click the **Common** button in the platform selection table, top-right corner of the **System** page.

   **Note:** If sigPOD hardware is present, a green bar appears under the Common button.
4. Click or enter the appropriate parameter(s). See *Table 43* for configuration information.
5. Click any button on the navigation toolbar to save your selections and exit the **System** page.

***Table 43*** *System Parameters*

| Element | Parameters |
|---|---|
| **Station ID** | Edit the **Header Title** to change the text that appears in the middle of the header on each screen. This is used as a text station title only. If you are using QualityWorX (QWX), this is not the same as the Station Name in the QWX Store parameters in the System Setup software. For more information on setting this parameter, see the connectors section of the InspeXion System Setup online help.<br>**Note:** The Header Title must be between 1 and 12 characters. Allowed characters are a-z, 0-9, <space> ! # $ & ( ) * + <comma> - <period> / : ; < = > ? @ [ \ ] ^. |
| **QualityWorX operation labels** | Select this check box to allow editing of QWX labels. This option enables the Unique Label box on the Operations setup screen where you can specify unique QWX label for each operation. |
| **Cycle/Fail Count Reset: sets cycle information reset time** | • Enable **Daily Reset** at option to engage a daily reset of the Cycle counter information.<br>• If the **Daily Reset** at option is enabled enter the time (hh:mm) at which you want the cycle information to reset. The hours are in 24-hour time.<br>• Click **Reset Now** to reset the cycle information immediately.<br>• The **Cycle** count can be used to automatically make up a serial number. See Serial Number in *Table 18 on page 93*.<br>• The cycle number is the same number that is in the Header information section. See Test Statistics under *"Header" on page 18*.<br>**Note:** This does not affect the SPC data counts. |
| **Enable Leak Sequencing** | • Select this check box to enable leak testing with third-party equipment.<br>**Note 1:** Leak sequencing should not be used for safety-related procedures.<br>**Note 2:** When leak sequencing is enabled, physical digital outputs for cycle handshaking and model selection digital inputs are not available. |
| **Enable 3520 Functionality** | • Select this check box to enable leak testing with a 3520 module.<br>**Note:** When this check box is selected, the Enable Leak Sequencing check box is grayed out. In PSV, you cannot simultaneously run leak testing with third-party leak testers and with 3520 modules. |

***Table 43*** *System Parameters (Continued)*

| Element | Parameters |
|---|---|
| **Pass/Fail Reset Options** | • Determines when to reset the status handshaking signals. The two options include resetting on the next start test, and resetting after a preset number of seconds.<br>• **Reset on Start Op or New Part** - enable to reset the pass and fail signals on the next start test.<br>• **Reset After xx Seconds** - enter the number of seconds after which you want the reset of the pass and fail signals to occur once they have been set at the end of the cycle. |
| **Graph Setup** | • **Graph Overlay Limit** - enter the desired number of curves allowed on the graph in overlay mode. The range is from **1** to **20**. |
| **Data** | • Enable **Save Data Record on Fault/Abort** to have the system save records from any operation that did not complete.<br>**Results** data options:<br>Default format for the results data is as follows: cycle count, operation number, serial number, model label, operation status (P = pass, F = fail), enabled features in application order, comma separated. Click the **Configure** button to open the **Results Configuration** screen and specify a custom format for the results data by omitting some of the data parameters or by adding an optional Feature Limits parameter. For more information, see *"Data Output Format" on page 105*.<br>• Enable **Send Results to Serial Port** to allow the system to send results data to the PLC through the serial port at the end of each operation. Serial port settings: 9600 baud, 8 bit, no parity, 1 stop bit, no prefix, end character = Carriage Return Line Feed (CR + LF).<br>• Enable **Send Results to Fieldbus** to allow the system to send results data to the PLC through the EtherNet/IP, PROFINET, or Modbus TCP interfaces at the end of each operation. For more information about fieldbus-specific setup, see *"Appendix B: EtherNet/IP setup guide" on page 210*, *"Appendix C: PROFINET setup guide" on page 227*, and *"Modbus TCP" on page 102*.<br>• Enable **Save Results to Log File** to allow the system to save results data to a log file at the end of each cycle.<br>• Specify file location in the **Destination (Specify USB Drive\Folder)** box and click **Copy Log Files** button to copy the log file to the specified folder. In the **Days to Copy** box, specify for how many days log files will be copied to the destination folder.<br>• Enable the **Delete Files Older than 1 Year** check box to delete all CSV result files that are older than 1 year at the time specified in the **Daily Reset** boxes on the **System** setup page. |

*Table 43* *System Parameters (Continued)*

| Element | Parameters |
|---|---|
| **Audio Playback Options** | • Enable or disable Audio Playback.<br>• Set the Volume by selecting Auto Scale Sound or Use Sensor FS.<br>• Choose a volume level between 0 and 100%, by clicking on the scale. |
| **About** | Press the **About** button in the lower right-hand corner to see sigPOD configuration information including InspeXion software version and build and sigPOD application version and build. |

## Configuring Data Input

Configuring the data input includes

- Entry options
- Operator entry options, including format
- Batch ID entry options, including format
- Serial number entry options, including format

This procedure applies both to the sigPOD and the 3520 module.

### To configure data input information

1. Enter the Setup mode. See *"Entering Setup Mode" on page 85*.
2. In a Setup screen, click the **Data Input** button.

   The **Data Input** screen opens.
3. Click or enter the appropriate parameter(s). See *Table 44* for configuration information.
4. Click any button on the toolbar to exit the **Data Input** screen.

*Table 44* *Data Input Parameters*

| Feature | Parameters |
|---|---|
| **Entry Options** | • **No Data Entry** - click to permit the operations to be performed without identifying the operator. If this is selected, Operator Entry and Batch Entry options are not available. This option is also used for fieldbus serial number input.<br>• **Data Entry, Serial Port** - click if the serial number is read automatically from the serial port<br>• **Manual Entry via Serial Port** - click if the serial number input is serial port keyboard emulation.<br>• **Manual Entry via Keyboard** - click to enter the serial number via the keyboard. |

*Table 44 Data Input Parameters (Continued)*

| Feature | Parameters |
|---|---|
| **Entry Options (Cont.)** | • **Display Entry Page Each Cycle** - click to require the operator to identify him/ herself before every part cycle.<br>• **Auto Continue after Last Entry** - click to close the Data Entry screen after last entry, without clicking the **Continue** button. |
| **Operator Entry** | • **Enable** - select to require operator ID before the session is begun. If this is not selected, no other Operator Entry options are available.<br>• **Format** (available only if **Operator Entry** is enabled) - click to open the Operator ID Format screen, where you can specify the following:<br>  • the length of the ID string (default between one and 25 characters)<br>  • whether the ID is numeric only (default unselected)<br>  • a prefix (default unselected)<br>  • a suffix (default unselected)<br>  • a custom evaluation (using Perl regular Expressions) (default unselected)<br>• **Clear on Each Cycle** (available only if **Operator Entry** is enabled) - select to require operator ID before each cycle.<br>• **Clear on Each Operation** (available only if **Operator Entry** is enabled) - select to require operator ID before each operation. |
| **Batch Entry** | • **Enable** - select to require batch ID before the session is begun. If this is not selected, no other Batch Entry options are available.<br>• **Format** (available only if **Batch Entry** is enabled) - click to open the Batch ID Format screen, where you can specify the following:<br>  • the length of the ID string (default between one and 25 characters)<br>  • whether the ID is numeric only (default unselected)<br>  • a prefix (default unselected)<br>  • a suffix (default unselected)<br>  • a custom evaluation (using Perl regular Expressions) (default unselected)<br>• **Clear on Each Cycle** (available only if **Batch Entry** is enabled) - select to require batch ID before each cycle. |
| **Serial Number - Format** | • Available only when one of the following options is selected: **Read from Serial Port (RS232), Serial Port Keyboard Emulation,** or **Manual Entry**)<br>• Click to open the Serial Number Format screen, where you can specify the following:<br>  • the length of the SN string (default between one and 64 characters)<br>  • whether the SN is numeric only (default unselected)<br>  • a prefix (default unselected)<br>  • a suffix (default unselected)<br>  • a custom evaluation (using Perl regular Expressions) (default unselected) |

*Table 44 Data Input Parameters (Continued)*

| Feature | Parameters |
|---|---|
| **Serial Number - Generate Internally** | Click to enable the system to assign a serial number based on YYJJJCCCCC, where YY are the last two digits of the year, JJJ is Julian Day and CCCCC is the cycle number. The cycle number increments by one each time a test is set. The cycle number can be automatically reset. See Cycle/Fail Count Reset in *Table 43 on page 141*. The cycle number is the same number that is in the Header information section. See Test Statistics under *"Header" on page 18*. |
| **Serial Number - Read options** | • **Read from Fieldbus** - click to enable the system to read the serial number from the PLC controller through the installed fieldbus. If no fieldbus is installed, this option is not available. For more information on fieldbuses, see *"Configuring Fieldbuses" on page 91*.<br>• **Read from Serial Port (RS232)** - click to enable the system to read the serial number from the serial port. Serial port settings: 9600 baud, 8 bit, no parity, 1 stop bit, no prefix, end character = Carriage Return Line Feed (CR + LF).<br>• **Serial Port Keyboard Emulation** - click to enable the system to read the serial number from the serial port RS232 in a keyboard emulation mode.<br>• **Serial Port Keyboard Emulation** - click to enable the system to read the serial number from the serial port RS232 in a keyboard emulation mode.<br>• **Read Serial Number** button (available only when one of the following options is selected: **Read from Serial Port (RS232), Serial Port Keyboard Emulation,** or **Manual Entry**) - click to cause the system to read the data on the serial port immediately for diagnostics purposes. The data is shown after the text **Serial Number read ->** in the status bar. |
| **Serial Number - Manual Entry** | Click to enter the serial number via the keyboard manually. |
| **Serial Number - Clear on Each Cycle** | Available only when one the following options is selected: Read from Serial Port (RS232), Serial Port Keyboard Emulation, or Manual Entry). |
| **Serial Number - Add Station Label to SN** | Click to add the station name as a prefix to the serial number. You can only add either the station name or the batch ID. |
| **Serial Number - Add Batch ID to SN** | Click to add the batch ID as a prefix to the serial number. You can only add either the station name or the Batch ID. |
| **Serial Number -Read Model Label** | • Available only when there is an active EtherNet/IP, PROFINET, or Modbus TCP connection and the default option of linking Model and Test Configuration is disabled.<br>• Click to read the label from the PLC immediately for diagnostics purposes. The model label is shown after the text **Model read ->** in the status bar. |

# Configuring tests with a third-party leak tester

Before you run any leak tests with third-party equipment, your test setup should involve some or all of the following steps:

- *"Enabling leak sequencing for a third-party leak tester" on page 146*
- *"Calibrating the sensors of a third-party leak tester" on page 147*
- *"Configuring online status inputs for a third-party leak tester" on page 152* (if applicable)
- *"Creating a custom state table for a third-party leak tester" on page 152*
- *"Creating a leak test sequence for a third-party leak tester" on page 155*

You can also define new steps in a leak test by performing any of the following procedures:

- *"Configuring the Zero a Sensor function for a third-party leak tester" on page 154*
- *"Setting an analog output based on an analog sensor for a third-party leak tester" on page 154*

## Enabling leak sequencing for a third-party leak tester

You can enable leak sequencing for third-party leak testers in the PSV application through the System setup screen.

**Note 1:** If a valid Leak Sequencing license is activated, leak sequencing for third-party leak testers is automatically enabled.

**Note 2:** In PSV, you cannot simultaneously run leak testing with third-party leak testers and with 3520 modules. So, the Leak Sequencing check box is grayed out when you enable 3520 functionality.

**Note 3:** When you enable leak sequencing for third-party leak testers, the following digital I/O are not available:

- Physical digital outputs for cycle handshaking
- Model selection digital inputs

### To enable leak sequencing for third-party leak testers

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar along the left side of the screen, click **System** to open the System screen.
3. In the **Leak Testing** area, select the **Enable Leak Sequencing** check box.

   **Note:** The **Enable Leak Sequencing** check box is grayed out if a valid Leak Sequencing license for the PSV application is not activated or if 3520 functionality is enabled. For information about activating a license, see the "Import a License" procedure in the InspeXion System Setup User Guide available through the Sciemetric Support Center at http://support.sciemetric.com.
4. Click **OK** in the warning dialog box.

## Calibrating the sensors of a third-party leak tester

You can calibrate the leak sensors from the Sensors screen. The four critical parameters that you need to specify are as follows:

- Units

  The analog input signal is proportional to pressure or flow. The recommended unit for pressure sensors is psi, and the recommended unit for flow meters is sccm.
- Range

  The range denotes the full-scale analog to digital conversion range for the analog input channel in volts.

  When choosing the range, you should select a voltage range that most closely matches the output of the sensor. For example, for a 5V sensor output, choose ±5 V from the drop-down list of values. For an 8V output, choose ±10 V which is closest to 8 out of the available values in the drop-down list.
- Slope

  Before you enter the slope value, you need to calculate it using the sensor data sheet and the formula specified in the user manual of your leak test equipment. The slope values can be positive or negative.
- Offset

  The sensor offset indicates the zero reference for your test. Typically, this value is the sensor reading that indicates 0 psi or 0 sccm. After you exhaust the sensor to atmospheric pressure, you can set the offset value to the current sensor reading on the **All Sensors** screen by clicking **Zero**.

See any of the following procedures:

- *"Calibrating the pressure sensor of a third-party leak tester" on page 147*
- *"Calibrating the flow meter of a third-party leak tester" on page 148*
- *"Performing N-point calibration of the flow and pressure sensors of a third-party leak tester" on page 149*

### *Calibrating the pressure sensor of a third-party leak tester*

Use this procedure to calibrate the pressure sensor of a third-party leak tester. For general information about calibrating analog sensors, see *"Configuring Sensors" on page 86*.

#### Requirements

Before calibrating the sensor:

- Review *"Calibrating the sensors of a third-party leak tester" on page 147* to familiarize yourself with the parameters you need to specify.
- Ensure you have the sensor data sheet supplied by the manufacturer handy.
- Using the formula recommended in your leak test equipment manual and the sensor data sheet, calculate the slope parameter.

### To calibrate the pressure sensor of a third-party leak tester

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Sensors**.
3. Ensure that the sensor is enabled. See *"Configuring Sensors" on page 86*.
4. In the **Configure** column, click **Edit** for the pressure sensor you want to calibrate.
5. The calibration screen for the selected analog input channel opens.
6. Click the plus sign next to **General** to open the **General** area.
7. In the **Description** filed, delete Analog XX and type a name for the pressure sensor; for example, type **Pressure**.
8. In the **Decimal place** filed, type 3.
9. In the **Units** field, type **psi**.
10. Click the plus sign next to **Hardware** to open the **Hardware** area.
11. Click in the **Range** field to open the drop-down list and select the appropriate voltage range according to the pressure sensor data sheet. For example, select **±10**.
12. In the **Calibration** area, **Type** field, ensure that the correct option is selected (V or psi).
13. In the **Slope** field, type the slope value you've already calculated. See the **Requirements** section for this procedure. For example, type 3.325.
14. Click **OK** to save the calibration data and return to the **All Sensors** screen.
15. From the **States configured on Digital I/O page** drop-down list, choose a reset state, and click **Go**.

    **Note**: These are states available in the state setup table created for your third-party leak tester. See *"Creating a custom state table for a third-party leak tester" on page 152*.
16. From the **States configured on Digital I/O page** drop-down list, choose an isolate state, and click **Go**.
17. In the **Analog I/O and Encoder Inputs** table, Pressure row, click **Zero**.

    The value in the **Live Value** column for the pressure sensor should read **0**.

## *Calibrating the flow meter of a third-party leak tester*

Use this procedure to calibrate the flow meter of a third-party leak tester. For general information about calibrating analog sensors, see *"Configuring Sensors" on page 86*.

### Requirements

Before calibrating the sensor:

- Review *"Calibrating the sensors of a third-party leak tester" on page 147* to familiarize yourself with the parameters you need to specify.
- Ensure you have the flow meter data sheet supplied by the manufacturer handy.
- Using the formula recommended in your leak test equipment manual and the sensor data sheet, calculate the slope parameter.

#### To calibrate the flow meter of a third-party leak tester

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Sensors**.
3. Ensure that the sensor is enabled. See *"Configuring Sensors" on page 86*.
4. In the **Configure** column, click **Edit** for the flow meter you want to calibrate.
5. The calibration screen for the selected analog input channel opens.
6. Click the plus sign next to **General** to open the **General** area.
7. In the **Description** filed, delete Analog XX and type **Flow**.
8. In the **Decimal** place filed, type **2**.
9. In the **Units** field, type **sccm** for standard cubic centimeters per minute.
10. Click the plus sign next to **Hardware** to open the **Hardware** area.
11. Click in the **Range** field to open the drop-down list, and select the appropriate voltage range according to the flow meter data sheet. For example, select ±5.
12. In the **Calibration** area, **Type** field, ensure that the V option is selected.
13. In the **Slope** field, type the slope value you've already calculated. See the **Requirements** section for this procedure. For example, type 20.
14. In the **Offset** field, type 0.
15. Click **OK** to save the calibration data and return to the **All Sensors** screen.
16. From the **States configured on Digital I/O page** drop-down list, choose a reset state, and click **Go**.

    **Note**: These are states available from the state setup table created for your leak tester. See *"Creating a custom state table for a third-party leak tester" on page 152*.
17. In the **Analog I/O and Encoder Inputs** table, Flow row, click **Zero**.

    The value in the **Live Value** column for the flow meter should read **0**.

### *Performing N-point calibration of the flow and pressure sensors of a third-party leak tester*

N-point calibration is available for both pressure and flow sensors. N-point calibration allows you to perform calibration with external transfer standard for an "n" number of points for up to 10 points. The procedures in this section describe an end-to-end calibration procedure, which is recommended by Sciemetric over disassembling units and sending sub-components out for external calibration.

#### To perform an N-Point calibration of the pressure sensor of a third-party leak tester

**Requirement**

Before calibrating the sensor, ensure you have an external pressure transfer standard or a pressure calibrator that can be connected to the calibration or test port of the leak test unit. A transfer standard is calibrated. A pressure calibrator usually contains a transfer standard in addition to some method of controlling the pressure.

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Sensors**.
3. Ensure that the sensor you want to calibrate is enabled. See *"Configuring Sensors" on page 86*.
4. On the **All Sensors** screen, **Analog I/O and Encoder Inputs** table, **Index** column, click the number for the sensor you are calibrating.
5. Connect your external transfer standard to the calibration or test port.
6. Exhaust the leak test unit and the transfer standard by doing one of the following:
   - If you use the internal regulator of the leak test unit to supply pressure, select a reset state from the **States configured on Digital I/O page** drop-down list.
   - If the pressure calibrator supplies its own pressure, select a pressure decay state from the States configured on Digital I/O page drop-down list.
7. Click Go.
8. In the **Set value** box, type the value provided by the transfer standard (for example, 0.05), and click **Read**.

   **Note**: The status bar displays the value of the entered calibration point. For example: "Calibration points read 0.05"
9. Pressurize the leak test unit and the transfer standard by doing one of the following:
   - If you use the internal regulator of the leak test unit to supply pressure, select a fill state from the **States configured on Digital I/O page** drop-down list.
   - If the pressure calibrator supplies its own pressure, select a pressure decay state from the States configured on Digital I/O page drop-down list.
10. Click **Go**.
11. In the **Set value** box, type the value provided by the transfer standard (for example, 9.85), and click **Read**.

    **Note**: The status bar displays the value of the entered calibration points. For example: "Calibration points read 0.05, 9.85."

    **WARNING:** When performing N-Point calibration in PSV, you must always enter the values in ascending or descending order. For example, 0 psi, 5 psi, 10 psi, 20 psi. You should not use random order of values; for example, order of 0 psi, 20 psi, 5 psi is not acceptable.
12. To make the best use of the N-point calibration, take several readings across the full range of the pressure sensor, and relate each pressure value back to the transfer standard.
13. When you have finished taking readings, click **Calculate**.

    Note 1: The program recalculates the slope and offset values – see the **Slope** and **Offset** columns for the sensor you are calibrating.

    Note 2: The calibration can be verified by varying the regulator pressure and ensuring that the pressure values in the Live Value column match the pressure values on the transfer standard.

14. From the **States configured on Digital I/O page drop-down** list, choose a reset state, and click **Go**.

    **Note**: The value for the pressure in the Live value column for the sensor you are calibrating should be 0 or very close to 0.

### To perform an N-Point calibration of the flow meter of a third-party leak tester

#### Requirement

Before calibrating the flow meter, ensure you have an external flow standard that can be connected to the calibration or test port of the leak test unit. A flow standard is typically a precision orifice that is known to leak at a constant rate for a given test pressure.

**Note:** This procedure is valid only when the pressure is set using the regulator and the pressure sensor inside the leak test unit.

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Sensors**.
3. Ensure that the sensor you want to calibrate is enabled. See *"Configuring Sensors" on page 86*.
4. On the **All Sensors** screen, **Analog I/O and Encoder Inputs** table, **Index** column, click the number for the sensor you are calibrating.
5. From the **States configured on Digital I/O page** drop-down list, choose a reset state, and click **Go**.

   **Note**: Now the sensor is pointing to atmospheric pressure.
6. In the **Set value** box, type 0, wait for the flow reading to stabilize, and click **Read**.

   **Note**: The status bar displays the value of the entered calibration point: "Calibration points read 0.0000." This step effectively zeroes any leak of the test unit.
7. From the **States configured on Digital I/O** page drop-down list, choose a fill state, and click **Go**.
8. Adjust the pressure regulator to the pressure indicated in the flow standard calibration data (for example, 10 psig), and wait until the flow stabilizes.
9. From the **States configured on Digital I/O page** drop-down list, choose a flow test state, and click **Go**.
10. In the **Set value** box, copy the flow value from the calibration data for the specific test pressure (for example, 9.85 sccm at 10 psig), and click Read.

    Note: The status bar displays the value of the entered calibration points. For example: "Calibration points read 0.00, 9.85."
11. Repeat steps 8 and 9 for each pressure value in the flow standard calibration data.

    **Note**: To make the best use of the N-point calibration, take several readings across the full range of the flow sensor, and relate each pressure value back to the transfer standard.

    **WARNING:** When performing N-Point calibration in PSV, you must always enter the values in ascending or descending order. For example, 0 psi, 5 psi, 10 psi, 20 psi. You should not use random order of values; for example, order of 0 psi, 20 psi, 5 psi is not acceptable.

12. Click **Calculate**.

    **Note 1:** The program recalculates the slope and offset values – see the Slope and Offset columns for the sensor you are calibrating.

    **Note 2:** The calibration can be verified by varying the regulator pressure and ensuring that the values in the Live Value column match the values on the external standard.

13. From the **States configured on Digital I/O page** drop-down list, select a reset state, and click **Go**.

## Configuring online status inputs for a third-party leak tester

There can be up to four (4) third-party leak testers connected to a sigPOD controller. Each of them can send out an online status signal reporting to the sigPOD controller, if that status signal is supported.

In the PSV application, for each third-party leak test unit, you can specify to which digital channel each online status is connected.

### To configure the online status input for a third-party leak tester

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Digital I/O**.
3. On the **Digital I/O screen**, click **Status Inputs**.
4. On the **Leak panel status inputs** screen, open the Status 1 drop-down list, and choose a parameter (see *Table 45*).
5. Click **Back** to return to the **Digital I/O** screen.

***Table 45*** *Leak panel status inputs*

| Feature | Parameters |
|---|---|
| **Status 1-4** | **Not Used**<br>• Not used for leak panel status<br>**Active High** or **Active Low**<br>• Use for any third-party leak tester<br>• The presence of this signal indicates that the third-party leak tester has performed internal diagnostics and is ready for operation. |

## Creating a custom state table for a third-party leak tester

You can create a custom state table for a third-party leak tester on the State Setup screen.

The custom state table is available until you load another state table. You can save the custom state table for future use by saving a PSV backup file (SBK) with the current PSV configuration and reinstalling this SBK file when needed. For information about saving and installing a backup file, see the "Backing up the system" and "Installing a system backup file" procedures in the InspeXion System Shell User Guide available through the Sciemetric Support Center at http://support.sciemetric.com.

### To create a custom state table

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar along the left side of the screen, click **Digital I/O**.
3. On the **Digital I/O** screen, click **State Setup**.
4. In the **State Setup** screen, click the **Add Line** button.
5. In the **Name** column, type a name for the new state and ensure that the name meets the following criteria:
   - Is up to 17 characters in length and is not duplicate of an existing name
   - Does not contain commas, colons, and semi-colons
   - Clearly indicates the purpose of the state; for, example, if the state advances rams to hold part Y for model FX1, use "Advance Rams FX1" for the name.

   See *Table 14 on page 75* for example states defined in a sample state table.

   **Note**: In the state table, only fields that appear in white are editable.
6. Do any of the following:
   - For the digital outputs, select the correct value from the drop-down lists in each of the 00 to 07 Outputs columns.

     Note: "-" means "no change"
   - For the analog outputs, type a value in the AO:00 and AO:01 columns.
7. Depending on the type of state you are defining, open the drop-down list in the Function column, and select one of the following:
   - **Not Used** – if there is no special function related to this state
   - **Zero a sensor** – to automatically zero an analog sensor on a third-party leak tester at any point during a test sequence
   - **Dynamic IO** – to read a sensor on a third-party leak tester, and set the analog output to that sensor value

     Note: If you choose Zero a sensor or Dynamic IO, click the Edit button next to it to open the State Special Function screen and set the required parameters. For more information about these parameters, see *"Configuring the Zero a Sensor function for a third-party leak tester" on page 154* and *"Setting an analog output based on an analog sensor for a third-party leak tester" on page 154*.
8. In the **Description** field, type a description of the state.

   **Note**: Do not use commas, colons, and semi-colons in the description text.
9. Repeat steps 4 through 8 for all states in the leak test sequence.
10. To finalize the table, do any of the following:
    - To reorder states, select a state by clicking its number in the **Select** column, and click the **Move Line Up** or **Down** buttons.

- To delete a state, click its number in the **Select** column, click the **Remove Line** button, and click **Yes** in the confirmation dialog box.

11. If you want all outputs to be reset with each New Part digital input, select the **Reset all outputs when New Part is received** check box.
12. When you have completed the state table, click **Accept** to save the changes and return to the **Digital I/O setup** screen, and click **OK** in the confirmation dialog box.

    **Note**: If you want to cancel the changes and return to the **Digital I/O setup** screen, click **Cancel**.

## Configuring the Zero a Sensor function for a third-party leak tester

On the State Setup screen, you can configure a Zero a Sensor function to automatically zero a sensor at any point during a test sequence with a third-party leak tester. You must select the appropriate sensor to be zeroed for any reset state in the state table for your leak tester.

### To configure the Zero a Sensor function for a third-party leak tester

1. On the Navigation toolbar, click **Digital I/O**.
2. On the **Digital I/O** screen, click the **State Setup** button to open the table you have created for your leak tester

   **Note**: If you have not created a table yet, see *"Creating a custom state table for a third-party leak tester" on page 152*.
3. Add a new state with a Zero a Sensor function.

   **Note:** For information how to add a new state to a state table, see steps 4 through 8 in *"Creating a custom state table for a third-party leak tester" on page 152*.
4. In **Special Functions, Settings** column, click the **Edit** button next to the **Zero a Sensor function** for the state you want to configure.
5. In the **State Special Function** screen, open t**he Analog sensor to zero** drop-down list, and select the analog channel connected to the sensor you want to zero.
6. Click **Back** to return to the **State Setup** screen.
7. Click **Accept** to save the changes, and click **OK** in the confirmation dialog box.

## Setting an analog output based on an analog sensor for a third-party leak tester

Some leak test units can read an analog sensor and allow you to set an analog output to the value of that sensor. You can do this by selecting the appropriate options for the Dynamic IO function in the state table created for your leak test unit. For information about creating a state table, see *"Creating a custom state table for a third-party leak tester" on page 152*.

### To set an analog output based on an analog sensor for a third-party leak tester

1. On the Navigation toolbar, click **Digital I/O**.
2. On the **Digital I/O** screen, click the **State Setup** button to open the table you have created for your leak tester

   **Note**: If you have not created a table yet, see *"Creating a custom state table for a third-party leak tester" on page 152*.
3. Do one of the following:
   - If the state table already contains a state with a Dynamic I/O function, see step 4.
   - If the state table does not contain a state with a Dynamic I/O function, add a new state with a Dynamic I/O function. Then, continue with this procedure. For information how to add a new state to a state table, see steps 4 through 8 in *"Creating a custom state table for a third-party leak tester" on page 152*.
4. In **Special Functions**, **Settings** column, click **Edit** next to the **Dynamic IO** function
5. In the **State Special Function** screen, open the **Analog input to set output to** drop-down list, and choose the analog sensor to take the reading from.
6. From the **Choose analog output** drop down-list, choose the analog output that will be set to the value of the analog input.
7. In the **Apply offset** box, type an offset value to be added to the analog input reading.

   **Note:** The analog output value will be the resulting sum of the analog input reading and the offset value.
8. Click **Back** to return to the **State Setup** screen.
9. Click **Accept** to save the changes, and click **OK** in the confirmation dialog box.

## Creating a leak test sequence for a third-party leak tester

The first step in creating a test configuration (model) is to create and label a container for it. See *"Setting up Models" on page 107*.

The second step is to set up all parameters for this test configuration. See the procedure that follows.

### To define a test sequence for a third-party leak tester

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Operations**.
3. From the **Select Model/Operation/Wave** drop-down list in the top-left corner of the screen, choose the model (leak test sequence) you want to configure. For example, choose **Model XYZ**.

   **Note:** When Model data is separate from Test Configuration data, the Select Model/Operation/Wave list is labeled Select Config/Operation/Wave list. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*
4. On the **Operations** screen, click **Sequencing Setup**.

5. On the **Sequencing Setup** screen, do any of the following to define the sequence:
   - To add a sequence line, click the **Add line** button, and then choose a state from the **State** drop-down list (second column).

     **Note**: You can use only test states that are defined in the current state table for the third-party leak tester. See *Table 14 on page 75* for example states in a state table. For information about creating a state table, see *"Creating a custom state table for a third-party leak tester" on page 152*.
   - To delete a sequence line, click its number in the **Select** column, click the **Remove line** button, and click Yes in the confirmation dialog box.

     **Note**: You can select only one line at a time.
   - To reorder sequence lines, select a line by clicking its number in the **Select** column, and click the **Move Line Up** or **Down** buttons.
   - To replace a state, choose a new state from the **State** drop-down list (second column).
   - To set the state parameters, choose a type from the **Type** drop-down list for each state (third column). See *Table 46 on page 157* for description of State parameters.

     **Note:** Only fields that appear in white are editable.
6. Do any of the following:
   - If you choose **Time Based** for type, adjust the length of the state in the **Time Rel** column.

     **Note:** For Pressure Decay and Flow sequences, you must specify the Fill, Test, and Exhaust times for the part you are testing.
   - If you choose a **Sensor Below, Sensor Above, Abort Above, Abort Below** for the state type, enter the appropriate parameters in the **Sensor, Value,** and **Timeout** columns. See *Table 46 on page 157* for available parameters.
7. If your leak tester has a Pass light on the front panel, from the **When operation passes, set** drop-down list, choose a state that will light up the Pass light, indicating that the test is completed successfully.

   **Note 1:** See *Table 14 on page 75* for an example.

   **Note 2:** If the leak test module you are using does not have a Pass indicator on the front panel, choose the **Do nothing** option from the drop-down list.
8. If your leak tester has a Fail light on the front panel, from the **When operation fails, set** drop-down list, choose a state that will light up the Fail light, indicating that the test has failed.

   **Note 1:** See *Table 14 on page 75* for an example.

   **Note 2:** If the leak test module you are using does not have a Fail indicator on the front panel, choose the **Do nothing** option from the drop-down list.
9. When you have completed editing the test sequence, note the entire duration of the sequence, and click **Accept**.

   **Note 1:** The total duration of the sequence appears in the last row of the sequence, **Time Abs** column.

   **Note 2:** If you want to cancel the changes and return to the **Operations** screen, click **Cancel**.

10. In the **Operations** screen, it is a good practice to ensure that the value that appears in the **Sample duration** box is equal to or greater than the entire test sequence.

*Table 46 Leak Sequencing Setup screen – available parameters*

| UI element | Function / Available Parameters |
|---|---|
| **Select** column | Indicates the order of the steps in the leak sequence. Each step is a configuration state of the settings of valves, sensors, and indicators for the specific third-party leak hardware.<br>Click to select a step in order to modify its parameters. |
| **State** column | Each drop-down list contains all available states for the selected leak test hardware. For example, see *Table 14 on page 75* for the available states in a sample state table. |
| **Type** column | Select one of the available types for the selected state: (See *Table 47 on page 158* for results from possible parameter combinations for states that are not time-based)<br>• Not used – Skips this state in the sequence<br>• Time Based – Proceeds to the next state in the sequence after the specified length of time<br>• Sensor Above – Requires that you specify a threshold value for the selected sensor and a timeout interval. If the signal stays below this threshold during the timeout interval, there will be an error message and the operation proceeds with the next state, or the test is aborted.<br>• Sensor Below - Requires that you specify a threshold value for the selected sensor and a timeout interval. If the signal stays above this threshold during the timeout interval, there will be an error message and the operation proceeds with the next state, or the test is aborted.<br>• Abort Above – Requires that you specify a threshold value for the selected sensor and a timeout interval. If the signal stays below this threshold during the timeout interval, the test continues.<br>• Abort Below - Requires that you specify a threshold value for the selected sensor and a timeout interval. If the signal stays above this threshold during the timeout interval, the test continues. |
| **Time** (**Rel** and **Abs**) | Rel – If the state is time-based, type the length of time for this state, in seconds; if the state is not time-based, this parameter is not editable.<br>Abs – Displays the cumulative test time. This parameter is not editable. |

***Table 46*** *Leak Sequencing Setup screen – available parameters (Continued)*

| UI element | Function / Available Parameters |
|---|---|
| **Wait until Threshold (Sensor, Value)** | Available only for states that are not time-based<br>Sensor – From the drop-down list, choose the sensor that is being used for the sequence step (for example, Pressure or Flow)<br>Value – Type a threshold value for the selected sensor. |
| **Timeout (Time, Abort?)** | Available only for states that are not time-based<br>Time – type the value of the timeout interval, in seconds.<br>Abort: Choose No from the drop-down list to continue with the operation, even if the signal has not reached the threshold within the specified timeout period.<br>Choose Yes from the drop-down list to stop the test if the signal has not reached the threshold within the specified timeout period. An error message will be reported. |

***Table 47*** *Parameter combinations when editing states that are not time-based*

| Parameter combination for selected state and signal behavior | Expected result |
|---|---|
| Type = Sensor Above<br>Timeout Abort? = No<br>The signal stays below the threshold during the timeout interval | There is an error message and the operation proceeds with the next state. |
| Type = Sensor Above<br>Timeout Abort? = No<br>The signal stays or goes above the threshold during the timeout interval. | The operation continues with no error messages generated. |
| Type = Sensor Above<br>Timeout Abort? = Yes<br>The signal stays below the threshold during the timeout interval | There is an error message and the operation aborts. |
| Type = Sensor Above<br>Timeout Abort? = Yes<br>The signal stays or goes above the threshold during the timeout interval. | The operation continues with no error messages generated. |
| Type = Sensor Below<br>Timeout Abort? = No<br>The signal stays above the threshold during the timeout interval | There is an error message and the operation proceeds with the next state. |

*Table 47 Parameter combinations when editing states that are not time-based (Continued)*

| Parameter combination for selected state and signal behavior | Expected result |
|---|---|
| Type = Sensor Below<br>Timeout Abort? = No<br>The signal stays or goes below the threshold during the timeout interval. | The operation continues with no error messages generated. |
| Type = Sensor Below<br>Timeout Abort? = Yes<br>The signal stays above the threshold during the timeout interval | There is an error message and the operation aborts. |
| Type = Sensor Below<br>Timeout Abort? = Yes<br>The signal stays or goes below the threshold during the timeout interval. | The operation continues with no error messages generated. |
| Type = Abort Above<br>Timeout Abort? = No<br>The signal reaches threshold. | The operation aborts with the message: "Analog signal reached upper threshold." |
| Type = Abort Above<br>Timeout Abort? = No<br>The signal does not reach threshold. | The operation continues with no error messages generated |
| Type = Abort Above<br>Timeout Abort? = Yes<br>The signal reaches threshold. | The operation aborts with the message: "Analog signal reached upper threshold." |
| Type = Abort Above<br>Timeout Abort? = Yes<br>The signal does not reach threshold. | The operation aborts with the message: "Sequence timeout – analog signal did not reach threshold." |
| Type = Abort Below<br>Timeout Abort? = No<br>The signal reaches threshold. | The operation aborts with the message: "Analog signal reached lower threshold." |
| Type = Abort Below<br>Timeout Abort? = No<br>The signal does not reach threshold. | The operation continues with no error messages generated |

***Table 47*** *Parameter combinations when editing states that are not time-based (Continued)*

| Parameter combination for selected state and signal behavior | Expected result |
|---|---|
| Type = Abort Below<br>Timeout Abort? = Yes<br>The signal reaches threshold. | The operation aborts with the message: “Analog signal reached lower threshold.” |
| Type = Abort Below<br>Timeout Abort? = Yes<br>The signal does not reach threshold. | The operation aborts with the message: “Sequence timeout – analog signal did not reach threshold.” |

# Leak testing with a third-party leak tester

You can run an entire leak test sequence or just selected steps from a test sequence for a third-party leak tester. See *"Running a test sequence for a third-party leak tester" on page 161* or *"Running a test sequence step for a third-party leak tester" on page 162*.

## Running a test sequence for a third-party leak tester

You can run a leak test sequence for a third-party leak tester on the Main screen of the PSV application.

**WARNING**: You should not use Leak Test sequencing for safety-related procedures.

### Requirements

Before you run a leak test sequence for a third-party leak tester, ensure that you have performed the required hardware and software setup procedures:

- The correct test pressure for the model has been set (for example, 10 psi for the self-test sequence)
- The correct part is attached to the test port
- If necessary, the correct calibration device is attached to the Calibration port on the leak test unit.
- A compressed air source, prepared according to the instructions in the leak hardware manual, is connected to the supply port of the leak test unit.
- All required PSV configuration procedures have been performed. See *"Configuring tests with a third-party leak tester" on page 146* for more information.

### To run a leak test sequence for a third-party leak tester

1. In the PSV application, do one of the following:
   - If a setup screen is open, click **Main** in the bottom-left corner of the PSV screen to switch to Main Operation mode.
   - If the **Main** screen is already open, see step 2.
2. From the **Select model to test** drop-down list, select the leak sequence for the third-party leak tester you want to run.

   **Note:** When Model data is separate from Test Configuration data, the Select Model to Test drop-down list is labeled Select Test Configuration. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.
3. Click **Start**.

   **Note 1:** A PLC can also initiate the test if you are using a fieldbus.

   **Note 2:** The count-down timer in the top-right corner of the screen provides information about the progress of the test sequence.

   **Note 3:** If the test completes successfully, no states are reset until the next sequence is run. If the test faults or is aborted, all states are automatically reset to zero.

## Running a test sequence step for a third-party leak tester

You can run individual steps from a configured test for a third-party leak tester on the **All Sensors** screen.

### To run a step from a test sequence for a third-party leak tester

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Sensors**.
3. Ensure that the sensors to be used in the test are enabled. See *"Configuring Sensors" on page 86*.
4. On the **All Sensors** screen, **Analog and Encoder Inputs** table, **Index** column, click the number of the sensor to be tested or calibrated. For example, click the number next to the Pressure sensor.
5. From the **States configured on Digital I/O page** drop-down list, choose a state; for example, choose an Exhaust or Reset state.

   **Note:** Only states that are defined in the current State Setup table are available in the **States configured on Digital I/O page** drop-down list. For information about creating a state table and defining its components, see *"Creating a custom state table for a third-party leak tester" on page 152*.
6. Click **Set**.

   For example, if you chose **Exhaust** or **Reset** in the previous step, the pressure sensor should go to atmospheric pressure.

# Configuring tests with a 3520 leak test module

You can have up to four 3520 leak test modules connected to a leak test controller. Before you can run a test with any of these modules, for each of them you must setup the correct IP address on the configuration web page for the specific unit, and in the InspeXion System Shell. For information how to set up the IP address, see the *3520 Leak Test Module User Guide* available through the Sciemetric Support Center at http://support.sciemetric.com.

Once you have a 3520 module fully set up, the PSV test setup may involve some or all of the following steps:

- *"Enabling 3520 functionality" on page 163*
- *"Changing the default engineering units for the 3520 sensors" on page 164*
- *"Enabling and disabling 3520 sensors" on page 166*
- *"Performing an N-point calibration for a pressure sensor and a flow meter on a 3520 module" on page 167*
- *"Setting up a 3520 leak test" on page 172*
- *"Pressure decay test calibration to report leak rate in flow units" on page 184*

You can also use any of the sample leak template configurations as a starting point in setting up your leak test. For more information, see *"Setting up a leak test with the Leak template" on page 188*.

## Enabling 3520 functionality

You can enable the 3520 leak test module functionality in the PSV application through the System setup screen.

**Important:**

1. Before you enable the 3520 functionality, ensure you perform a system backup of your PSV configuration if one already exists. For information about performing a system backup, see the ***InspeXion System Shell User Guide*** available through the Sciemetric Support Center at http://support.sciemetric.com.
2. Once you enable the 3520 functionality, you cannot disable it through the System screen; you can disable it by clearing the current configuration. For more information, see *"Disabling 3520 functionality" on page 164*.
3. The 3520 functionality and leak sequencing for third-party leak testers cannot be enabled simultaneously.

### To enable 3520 leak functionality in the PSV application

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar along the left side of the screen, click **System** to open the **System** screen.
3. In the **Leak Testing** area, select the **Enable 3520 functionality** check box.

4. Click **OK** in the warning dialog box.

## Disabling 3520 functionality

You can disable the 3520 leak test module functionality only through the InspeXion System Shell.

**WARNING:** Disabling 3520 functionality deletes all current configuration files. It is recommended that you perform a system backup of your current PSV configuration. For information about performing a system backup, see the InspeXion System Shell User Guide available from the Sciemetric Support Center at http://support.sciemetric.com.

### To disable 3520 functionality

1. In the bottom-left corner of the PSV screen, click the **Exit** button.
2. On the **InspeXion System Shell** navigation bar, click **Install**.

   **Note:** If you are working on a PC controller, and **the System Shell** tool bar is not open, click the **Start** button on the Windows task bar and point to **All Programs, Sciemetric, InspeXion, System Shell** on Windows 7, or to **Sciemetric, System Shell** on Windows 10 IoT.

   **Tip:** You can also open the **Install** dialog box by pressing **F3** on the keyboard.
3. In the **Install** dialog box, select all check boxes in the **Clear First** column.
4. Click **Clear now**.
5. Click **OK** in the confirmation dialog box.
6. Click **Cancel** to close the **Install** dialog box.

## Changing the default engineering units for the 3520 sensors

The default engineering units for the 3520 sensors are as follows:

- psig - for the pressure sensors
- sccm - for the flow meter
- C - for any of the temperature sensors

You can change the default engineering units of a specific 3520 module using the **System** set up page for that module. As soon as you specify the new units on the **System** page, they will be updated on the **All Sensors** page and on the configuration web-page. The default engineering units cannot be changed globally for all connected 3520 modules; they must be specified for each module individually.

**WARNING:** Any change of the engineering units must be done before any leak tests are configured. If you decide to change the units after you have configured the leak tests, you must go back and edit all control and analysis parameters in your test configurations. Otherwise, you may create a safety hazard. The units are not automatically converted in the operation configurations.

**Note:** You cannot set up any engineering units for the 3520 module through the **All Sensors** page. Any edits to the units on the **Sensor Diagnostics** screen (accessed through the **Sensors** page) will automatically be overwritten by the units specified on the **System** page (see the procedure that follows).

### Requirement

Before you can edit the default engineering units for the selected 3520 module, you must set up the network IP address for that module both on its configuration web-page and in the InspeXion System Shell. For information about setting up the IP address, see the ***3520 Leak Test Module User Guide***.

### To change the default engineering units for the sensors

1. Enter **Setup** mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **System**.
3. On the **System** page, click the **3520** button for the unit you are setting up, in the platform selection table (top-right corner of the page).

   The **System** page for the specified 3520 unit opens.
4. In the **Engineering Units** area, select one of the following options for the Pressure (test pressure), Supply Pressure, and Pilot Pressure measurements:
   - **Gauge** - To measure the pressure relative to atmospheric pressure. The formula used is (pressure - gauge reference)* slope.
   - **Absolute** - To measure the pressure relative to perfect vacuum. The formula used is pressure* slope.
   - **Vacuum** - To measure the pressure below atmospheric pressure, showing the difference between that low pressure and atmospheric pressure (i.e., negative gauge pressure). The formula used is (gauge reference - pressure)* slope.
5. Select a value from the **Pressure** drop-down list to set the units for the Pressure channel (test pressure sensor).
6. Select a value from the **Supply Pressure** drop-down list to set the units for the Supply pressure sensor.
7. Select a value from the **Pilot Pressure** drop-down list to set the units for the Pilot pressure sensor.
8. Select a value from the **Flow** drop-down list to set the units for the Flow meter.

   **Note:** The flow meter is available only in some models.
9. From the **Select Range** drop-down list, select a setting for the flow meter range.

   **Note 1:** The valid settings are **1, 2,** or **N/A** for 3520 modules without a flow meter. When you select 1 or 2, the actual flow meter range is displayed beside the drop-down list.

   **Note 2:** The flow range is also displayed on the **Sensors Setup** screen.
10. Select a value from the **Temperature** drop-down list, to set the units for the following sensors: External temperature 1, External temperature 2, Internal Temperature, Manifold Temperature.
11. Click another button on the navigation toolbar on the left to leave the **Setup** page and save the changes.

    The engineering units for the sensors will be changed to match the new values you specified.

## Enabling and disabling 3520 sensors

You can enable or disable any of the 3520 module sensors on the 3520 Channels page. Only sensors that are enabled appear listed on the All Sensors - 3520 Leak Module Inputs page for further configuration or calibration. To disable a sensor, you must not only remove it from the list of sensors on the All Sensors - 3520 Leak Module Inputs page, but you must also reassign or disable its associated waveforms.

### To enable a 3520 sensor

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Sensors**.

   The **All Sensors Analog I/O and Encoder inputs** page opens.
3. In the platform selection table (top-right corner of the page), click the 3520 button for the unit you are calibrating.

   The **All Sensors - 3520 Leak Module Inputs** page opens.

   **Note**: The platform selection table is visible only when 3520 functionality is enabled. For more information, see *"Enabling 3520 functionality" on page 163*.
4. Click the **Enable/ Auto-Zero Sensors, Alarm** button.
5. In the **Enable** column, select the check box for the sensor you want to enable.
6. Click the **Back** button to return to the **3520 Leak Module Inputs** page.

### To disable a 3520 sensor

1. Open the **All Sensors - Enable 3520 Channels** page for the 3520 module you are configuring. (See steps 1 through 4 from the previous procedure.)
2. In the **Enable** column, deselect the check box for the sensor you want to disable.
3. Click the **Back** button to return to the **3520 Leak Module Inputs** page.
4. In the navigation bar on the left, click the **Operations** button.
5. Do one of the following:
   - Reassign the waveform associated with the disabled sensor by selecting the waveform in the navigation bar, and on its Processing page, selecting another sensor from the **Y Input** drop-down list.

     **Note**: If the **Processing** page is not open when you select the waveform, select the **Processing** option in the top-right corner of the screen.

OR

   - Disable the waveform associated with this sensor by selecting the operation it belongs to in the navigation bar, and then on the **Operations** page, deselecting the waveform check box in the **Enable Waveforms** list.

     **Note:** If there is only one waveform associated with an operation, you cannot disable it. In PSV, there always must be at least one waveform associated with an operation.

## Performing an N-point calibration for a pressure sensor and a flow meter on a 3520 module

The 3520 module leak sensors are calibrated at the factory; however, Sciemetric recommends yearly end-to-end calibration of the 3520 module to ensure consistent results in subsequent years of operation.

**WARNING:** Disassembling units and sending sub-components out for external calibration is not recommended and will void the 3520 leak test module warranty.

N-point calibration is available for the pressure sensor and flow meter on the 3520 module. N-point calibration allows you to perform calibration with an external transfer standard or flow standard for "n" number of points, up to 10 points. The minimum number of points is 2. A transfer standard is typically a pressure sensor that is more accurate than the pressure sensor that is being calibrated. A pressure calibrator usually contains a transfer standard and sometimes a method of controlling the pressure. A flow standard is typically a precision orifice that is known to leak at a constant rate for a given test pressure. See the Pneumatic accessories section of the ***3520 Leak Test Module User Guide*** for details about the model offered by Sciemetric.

To make the best use of the N-point calibration, it is recommended that you take several readings across the full range of the sensor or flow meter, and relate each value back to the transfer or flow standard. For information about performing a 2-point calibration for a pressure sensor, see *"Performing an N-Point calibration for a pressure sensor on a 3520 module" on page 167*. For information about methods of calibrating a flow meter, see *"Performing a 2-point calibration for a 3520 flow meter with a flow standard always connected" on page 169* and *"Performing an N-point calibration for a 3520 flow meter" on page 170*.

**Note:** Some sensors cannot be calibrated.

### *Performing an N-Point calibration for a pressure sensor on a 3520 module*

#### Requirement

Before calibrating the sensor:

- Ensure you have an external pressure transfer standard or a pressure calibrator that can be connected to the Calibration port of the 3520 leak test module.
- The transfer standard or pressure calibrator must have the ability to read and display the pressure. Do not use a pressure source; use a pressure-reading device; for example, you can use a Druck 6xx series portable calibrator or DPI 104 digital pressure gauge, both manufactured by GE.

#### To perform an N-Point calibration for a pressure sensor on a 3520 module

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Sensors**.

   The **All Sensors Analog I/O and Encoder inputs** page opens.

3. In the platform selection table (top-right corner of the page), click the **3520** button for the unit you are calibrating.

   The **All Sensors - 3520 Leak Module Inputs** page opens.

4. Ensure a green bar appears under the platform button indicating that there is a live connection to the 3520 module. Otherwise, power up the 3520 module and connect it to your computer network.

   **Note**: You can calibrate the 3520 module only if it is online.

5. If the sensor you want to calibrate is not listed in the **3520 Leak Module Inputs** table, enable it.

   **Note**: Only sensors that are enabled appear in the table. For information how to enable a sensor, see *"Enabling and disabling 3520 sensors" on page 166*.

6. Click the **Calibration Mode** button in the bottom-right corner of the **All Sensors** page.

   **Note**: The **Calibration Mode** button turns dark green when the leak test module is in Calibration mode.

7. In the **3520 Leak Module Inputs** table, **Index** column, click the number for the sensor you are calibrating.

8. Connect your external transfer standard to the Calibration port of the 3520 module.

9. In the **Set Pressure To** box, enter a value that is 20% of the sensor full-scale, and click Go. For example, for a 5 psi gauge sensor, enter 1 psi.

   **WARNING**: When performing N-Point calibration in PSV, you must always enter the values in ascending or descending order. For example, 0 psi, 5 psi, 10 psi, 20 psi. You should not use random order of values; for example, order of 0 psi, 20 psi, 5 psi is not acceptable.

10. In the **Set value** box, enter the value provided by the transfer standard (for example, 1.053 psi), and click **Read**.

    **Note 1:** The status bar displays the value of the entered calibration point. For example: "Calibration point read: 1.053"

    **Note 2:** If you enter an incorrect value in the **Set value** box, click **Cancel** to restart the calibration, then repeat step 10.

11. In the **Set Pressure To** box, enter a value that is 80% of the sensor full-scale, and click **Go**. For example, for a 5 psi gauge sensor, enter 4 psi.

12. In the **Set value** box, type the value provided by the transfer standard (for example, 4.726), and click **Read**.

    **Note**: The status bar displays the value of the entered calibration points. For example: "Calibration points read: 1.053, 4.726"

13. If you want, take more readings across the full range of the pressure sensor, and then relate each pressure value back to the transfer standard. Otherwise, proceed to the next step.

14. When you have finished taking readings, click **Calculate**.

    **Note**: The program recalculates the slope and offset values (see the **Slope** and **Offset** columns for the sensor you are calibrating), and the changes are automatically saved when you leave the **All Sensors Analog I/O and Encoder inputs** page.

## *Performing a 2-point calibration for a 3520 flow meter with a flow standard always connected*

Use this procedure to calibrate a 3520 flow meter when you need to leave the flow standard connected to the 3520 module; for example, when the 3520 module is behind a safety curtain, is far away from the HMI, or is not easily accessible. You can calibrate the flow meter by setting the first calibration point with no pressure, and setting the second point with the pressure at which the flow standard is calibrated.

See *"Performing an N-point calibration for a 3520 flow meter" on page 170* for another method of calibrating a 3520 flow meter.

### Requirements:

- Before calibrating the flow meter, ensure an external flow standard (or flow controller with calibrated read out) is connected to the Calibration port of the 3520 module.
- Ensure you have the flow standard data sheet supplied by the manufacturer handy.

**Note:** This procedure is valid only when the pressure is set using the electronic regulator and the pressure sensor inside the 3520 leak test module.

### To perform a 2-point calibration for a 3520 flow meter with a flow standard always connected

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation toolbar, click **Sensors**.

   **Note:** The **All Sensors Analog I/O and Encoder inputs** page opens.
3. In the platform selection table (top-right corner of the page), click the 3520 button for the unit you are calibrating.

   The **All Sensors - 3520 Leak Module Inputs** page opens.
4. Ensure a green bar appears under the 3520 platform button indicating that there is a live connection to the 3520 module. Otherwise, power up the 3520 module and connect it to your computer network.

   **Note**: You can calibrate the 3520 module only if it is online.
5. If the flow meter you want to calibrate is not listed in the **3520 Leak Module Inputs** table, enable it.

   **Note**: Only sensors that are enabled appear in the table. For information how to enable a sensor, see *"Enabling and disabling 3520 sensors" on page 166*.
6. Click the **Calibration Mode** button in the bottom-right corner of the **All Sensors** page.

   **Note**: The **Calibration Mode** button turns dark green when the leak test module is in Calibration mode.
7. In the **3520 Leak Module Inputs** table, **Index** column, click the number for the flow meter to be calibrated.

**9.** In the **Set value** box, enter 0, and click **Read**.

**Note 1:** The status bar displays the value of the entered calibration point: "Calibration point read 0.0000." This step effectively zeroes any leak reading of the 3520 module.

**Note 2:** If you enter an incorrect value in the **Set value** box, click **Cancel** to restart the calibration process.

**WARNING**: When performing N-Point calibration in PSV, you must always go in ascending or descending order of values. For example, 0 psi, 5 psi, 10 psi, 20 psi. You should not use random order of values; for example, 0 psi, 20 psi, 5 psi.

**10.** In the **Set pressure To** box, enter the pressure value from the flow standard data sheet, and click **Go**. For example, if you have a flow standard calibrated for 140 sccm at 5 psig, you would enter 5.

**11.** Confirm that there was a change in the **Live Value** column next to the Flow meter in the **3520 Leak Module Inputs** table.

**Note**: If the flow value did not change, there is something wrong with the 3520 module, and you must troubleshoot the problem.

**12.** In the **Set value** box, enter the sccm value that corresponds to the pressure entered in step 10, and click **Read**. You can find the sccm value in the flow standard data sheet. For example, for a flow standard calibrated for 140 sccm at 5 psig, you would enter 140 sccm.

**Note**: The status bar displays the value of the entered calibration points. For example: "Calibration points read 0.00, 140."

**13.** Click **Calculate**.

**Note**: The program recalculates the slope and offset values – see the **Slope** and **Offset** columns for the flow meter you are calibrating.

## *Performing an N-point calibration for a 3520 flow meter*

Use this procedure to calibrate a 3520 flow meter when you want to use a flow standard is that is calibrated at multiple pressures, or when you want to use several flow standards that are calibrated at the same pressure for different flow values. In addition, you must have an easy access to the 3520 module, so that you can connect and disconnect the flow standard whenever you want. The example below illustrates using a flow standard calibrated at multiple pressures. The first calibration point is set by setting a pressure with the flow standard disconnected. The subsequent calibration points are set at different pressures, with the flow standard connected.

For another method of calibrating a 3520 flow meter, see *"Performing a 2-point calibration for a 3520 flow meter with a flow standard always connected" on page 169*.

**Requirement:**

- Before calibrating the flow meter, ensure you have an external flow standard (or flow controller with calibrated read out) that can be connected to the Calibration port of the 3520 module.
- Ensure you have the flow standard data sheet supplied by the manufacturer handy.

**Note**: This procedure is valid only when the pressure is set using the electronic regulator and the pressure

### To perform an N-point calibration for a 3520 flow meter

1. Ensure the flow standard is disconnected from the **Calibration** port of the 3520 module.
2. In the PSV application, enter **Setup** mode. See *"Entering Setup Mode" on page 85*.
3. On the navigation toolbar, click **Sensors**.

   The **All Sensors Analog I/O and Encoder inputs** page opens.
4. In the platform selection table (top-right corner of the page), click the **3520** button for the unit you are calibrating.

   The **All Sensors - 3520 Leak Module Inputs page** opens.
5. Ensure a green bar appears under the platform button indicating that there is a live connection to the 3520 module. Otherwise, power up the 3520 module and connect it to your computer network.

   **Note**: You can calibrate the 3520 module only if it is online.
6. If the flow meter you want to calibrate is not listed in the **3520 Leak Module Inputs** table, enable it.

   **Note**: Only sensors that are enabled appear in the table. For information how to enable a sensor, see *"Enabling and disabling 3520 sensors" on page 166*.
7. Click the Calibration Mode button in the bottom-right corner of the **All Sensors** page.

   **Note**: The **Calibration Mode** button turns dark green when the leak test module is in **Calibration** mode.
8. In the **3520 Leak Module Inputs** table, **Index** column, click the number for the flow meter you are calibrating.
9. In the **Set pressure To** box, enter a value for the pressure, indicated in the flow standard calibration data, and click **Go**.

   For example, for a flow standard with a calibration table as follows:

   140 sccm at 5 psig

   204 sccm at 10 psig

   255 sccm at 15 psig

   you would enter 5 psig in the **Set** pressure box.
10. In the **Set value** box, enter 0, and click **Read**.

    **Note 1:** The status bar displays the value of the entered calibration point: "Calibration points read 0.0000." This step effectively zeroes any leak of the test unit.

    **Note 2:** If you enter an incorrect value in the **Set value** box, click **Cancel** to restart the calibration process.
11. Connect your external flow standard to the Calibration port of the 3520 module and wait for the flow reading to stabilize.

    **Note**: You can have the flow standard connected from the very beginning of the procedure. If you do, you must skip step 11 and proceed to step 12 instead.

    **WARNING**: When performing N-Point calibration in PSV, you must always go in ascending or descending order of values. For example, 0 psig, 5 psig, 10 psig, 20 psig. You should not use random order of values; for example, 0 psig, 20 psig, 5 psig.

12. In the **Set value** box, enter the sccm value from the data sheet that corresponds to the pressure entered in step 9, and click **Read**. For example, for the flow standard with the table above, you would enter 140 sccm.
13. In the **Set pressure To** box, enter the second pressure value from the flow standard calibration sheet and click **Go**. For example, for the flow standard with the table above, you would enter 10 psig.
14. In the **Set value** box, enter the sccm value from the data sheet that corresponds to the pressure entered in step 13, and click **Read**. For example, for the flow standard with the table above, you would enter 204 sccm.

    **Note**: The status bar displays the value of the entered calibration points. For example: "Calibration points read 0.00, 140, 204."
15. If you want, take more readings across the full range of the flow meter, and relate each value back to the flow standard. For example, for the flow standard with the data sheet table above, you would set a third calibration point with the values of 15 psig in the **Set pressure To** box and 255 sccm in the **Set value** box. Otherwise, proceed to the next step.
16. When you have finished taking readings, click **Calculate**.

    **Note**: The program recalculates the slope and offset values – see the **Slope** and **Offset** columns in the **3520 Leak Module Inputs** table for the flow meter you are calibrating.

## Setting up a 3520 leak test

Setting up a leak test consists of the following three steps:

- Creating a label and container for the test configuration (model). See *"Setting up Models" on page 107*.
- *"Configuring the general leak operation parameters" on page 173*.
- Configuring the leak test parameters using the Basic or the Advanced method.

The Basic configuration method involves setting up the most important parameters for the leak test and having the application generate the leak sequence automatically. See *"Setting up a 3520 leak test using the Basic Configuration method" on page 174*.

The Advanced configuration method involves manually configuring the leak test sequence using the 3520 module OPC commands. See *"Setting up a 3520 leak test using the Advanced Configuration method" on page 181*.

For a Pressure Decay leak test, you can also perform additional setup for reporting the leak in sccm units. See *"Pressure decay test calibration to report leak rate in flow units" on page 184*.

## *Configuring the general leak operation parameters*

Before you configure the stages for the PD or Flow test, using the Basic or Advanced method, you must specify some general parameters for the leak operation, such as a name and which of the 3520 modules it belongs to.

**Requirement:**

Before specifying the leak operation parameters, you must have done the following:

- Created and labeled the test model on the **Models Configuration** screen. See *"Setting up Models" on page 107*,*"Setting up Test Configurations (optional)" on page 109*, and *"Separating Model and Test Configuration data (optional)" on page 108*.
- Ensured that the default engineering units for all sensors are the units you want to use. If not, specify the correct units. See *"Changing the default engineering units for the 3520 sensors" on page 164*.

### To configure the general leak operation parameters

1. Ensure 3520 functionality is enabled. See *"Enabling 3520 functionality" on page 163*.
2. Enter **Setup** mode. See *"Entering Setup Mode" on page 85*.
3. On the navigation bar, click the **Operations** button.

   The **Operations** screen opens.
4. From the **Select Model/Operation/Wave** drop-down list in the upper-left corner of the screen, select the model or test configuration that you want to set up.

   **Note**: When Model data is separate from Test Configuration data, the **Select Model/Operation/Wave** list is labeled **Select Config/Operation/Wave** list. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.
5. On the navigation bar on the left, select an operation.

   **Note**: You can recognize the operation by the operation status icon (see *Table 7 on page 21* for the meaning of different icons).
6. Click the **3520** button for the unit you are configuring in the platform selection table in the top-right corner of the page.

   **Note 1:** An operation can be associated with either the sigPOD hardware or a 3520 module. It cannot be associated with multiple platforms.

   **Note 2:** If the selected 3520 module is connected and online, a green bar appears under its button.

   **Note 3:** You can set up the leak test when the 3520 unit is either online or offline.
7. If the **Operation Enable** check box is not selected, select it.
8. In the **Operation Desc** box, enter a descriptive name for the operation and ensure the description meets the following criteria:
   - Is up to 25 characters in length and is not a duplicate of an existing name
   - Allowed characters are a-z, 0-9, <space> ! # $ & ( ) * + <comma> - <period> / : ; < = > ? @ [ \ ] ^.
   - Clearly indicates the purpose of the operation; for example, an end-of-line leak test configuration for an engine may have four leak-test operations: Oil chamber, Coolant, Fuel rail, and Turbo

9. If you plan to add several operations assigned to different platforms in the current model, and you want all data from the operations collected simultaneously, select the **Collect All Operations** check box.
10. Select the type of leak test and its parameters by continuing with one of the following procedures:
    - *"Setting up a 3520 leak test using the Basic Configuration method" on page 174*
    - *"Setting up a 3520 leak test using the Advanced Configuration method" on page 181*

## Setting up a 3520 leak test using the Basic Configuration method

Use the Basic configuration method to set up a leak test when you want to configure a leak test quickly. The **Basic** tab on the **Operations** screen allows you to enter the most important parameters for the leak test; then, the application automatically generates the leak test sequence of OPC commands. These commands are hidden in Basic view and visible only in Advanced view.

**Note:** Clicking the **Undo** button cancels the changes made in the current setup session for the selected model. The session ends when you exit Setup mode (that is, when you click **Main**) or switch to a different model/ test configuration. Then, any changes you have made on the **Basic** screen for this configuration are saved to the model/ test configuration.

For examples of waveforms of Pressure Decay and Flow tests, see *Figure 57 on page 180*, *Figure 58 on page 180*, and *Figure 59 on page 181*.

**Requirements:**

Before setting up the leak test, you must have done the following:

- Created and labeled the test model on the **Models Configuration** screen. See *"Setting up Models" on page 107*,*"Setting up Test Configurations (optional)" on page 109*, and *"Separating Model and Test Configuration data (optional)" on page 108*.
- Ensured that the default engineering units for all sensors are the units you want to use. If not, specify the correct units. See *"Changing the default engineering units for the 3520 sensors" on page 164*.

### To set up a leak test using the Basic configuration method

1. Specify the general leak operation parameters. See the previous procedure, *"Configuring the general leak operation parameters" on page 173*.
2. Select the **Basic** button.

   **Note**: Basic is the default setting for new configurations.
3. From the **Type** drop-down list, select the leak test type.
4. If you choose to use slow initialization, select the **Slow Init** check box (located next to **Type** drop-down list).

   **Note 1:** Slow initialization is recommended for part volumes greater than 0.5 L or test pressure higher than 5 psig.

   **Note 2:** Fast initialization (that is, the **Slow Init** check box is deselected) is recommended if you are confident that the panel and part are exhausted before the leak test.

5. Depending on your test setup, select or clear the **Fast Sampling** check box.

   **Note 1**: For new PSV 5.4 installations, the **Fast Sampling** check box is selected by default. For configurations upgraded from PSV 5.0, this check box is deselected to maintain the PID configurations and backwards compatibility.

   **Note 2:** When **Fast Sampling** is selected, the 3520 module samples the pressure, flow, and temperature at a rate of 800 Hz. Since the 3520 module is limited to 1,000,000-point waveforms, it can handle cycles up to 20 min long at this sampling rate.

   **Note 3:** When **Fast Sampling** is deselected, the sampling rate is 100 Hz. If you need to run a test longer than 20 minutes, this slow sampling rate is recommended.

   **Note 4:** Selecting **Fast Sampling** changes the PID performance; in most cases, it is improved.

6. If you are using a 10500-3520-MC31 external exhaust valve, select the **External 3-Way Exhaust** check box.

7. If you want to add a High Pressure Fast Fill zone in addition to the regular Test Fill zone, as part of the leak test cycle, select the **Fast Fill** check box.

   **Note**: A Fast Fill zone is recommended when you have a large-volume part or a long hose to the part, or both, and you want to pressurize the part as quickly as possible at the beginning of the test cycle to avoid a large pressure drop and to minimize cycle time. This step is optional. See *Figure 58 on page 180* and *Figure 59 on page 181* for sample waveforms of leak tests with a Fast Fill zone.

8. If you selected a Fast Fill zone in the previous step, enter the values for the fast fill pressure and time length in the **Pressure** and **Duration** boxes located next to the **Fast Fill** check box. For example, if the regular Test Fill pressure is 5 psi, the desired Fast Fill pressure may be 10 psi. Otherwise, proceed to the next step.

   **Note**: Negative values or 0 are not allowed in any of the **Duration** boxes.

9. Ensure the **Test Fill** check box is selected.

   **Note 1:** You must have either the **Test Fill** or the **Precision Fill** check box selected. The Test Fill zone fills the UUT to the desired test pressure. The Precision Fill is usually used in flow tests where precision pressure control is necessary. *Figure 57 on page 180* illustrates a waveform of a Pressure Decay (PD) test with a Test Fill or Precision Fill.

   **Note 2:** It is not allowed to have only the **Fast Fill** check box selected out of the three Fill check boxes.

   **Note 3:** You can have all three Fill check boxes selected if you want the Fast Fill, Test Fill and Precision Fill zones to be part of the entire leak test cycle. For an example, see *Figure 58 on page 180*.

10. If you selected a Test Fill zone in the previous step, enter the values for the test pressure and time length in the **Pressure** and **Duration** boxes located next to the **Test Fill** check box. Otherwise, proceed to the next step.

11. If you want to add a Precision Fill zone to the leak test cycle, select the **Precision Fill** check box. This step is optional if you already have a regular Test Fill zone as part of your test cycle. You must have either the **Test Fill** or the **Precision Fill** check box selected.

    **Note**: A Precision Fill zone is recommended in the following cases:

    - You are doing a flow test looking for flows less than 1000 sccm
    - Your part volume is less than 0.1 L (in this case Fast Fill and Test Fill are not recommended)

12. If you selected Precision Fill zone in the previous step, enter the values for the fill pressure and time length in the **Pressure** and **Duration** boxes located next to the **Precision Fill** check box. Otherwise, proceed to the next step.
13. Enter the Proportional Integral and Derivative controller gains in the **P**, **I** and **D** boxes for Fast/Test and Precision where not grayed out.

    **Note**: Default values are provided as a guideline. Some adjustment / tuning of controller gains is expected in order to get optimal performance.
14. Enter Bias values between 0 and 11 in the **Bias** boxes where not grayed out.

    **Note**: A default Bias value of 3 allows backwards compatibility with PSV 5.0 configurations and is the recommended starting Bias for new configurations.
15. In the **Stabilize** box within the **Test** area, enter the length of the stabilization zone (in seconds) that allows the air in the part to thermally stabilize, that is, the air heat to dissipate after pressurizing. The length of this time is part-dependent: larger-volume parts typically require more time.

    **Note**: If the stabilization time is too short, the elevated rate of change of air temperature might affect the accuracy of the test. The best practice when trying to determine stabilization times is to start with longer stabilization times and work backwards until optimal stabilization time is achieved.
16. In the **Test Zone** box, enter the total time to monitor the part for leaks, that is, the actual test zone from the entire test cycle.
17. In the **Exhaust** box, enter the total time it takes to release the pressurized air from the part. At the end of the Exhaust time, the pressure should be zero.

    **Note 1:** When you enter all times for the analysis zones, the **Total** box displays the sum total of these values, including an extra 0.02 s (or 0.29 s if **Slow Initialization** is selected to initialize the leak test).

    **Note 2:** If at any time during the test setup you want to cancel all changes made on the **Basic** screen, click the **Undo** button. Clicking the **Undo** button resets the **Basic** screen to the state when you first opened it in the current PSV editing session. If you switch the model or exit Setup mode, the previous changes cannot be undone.
18. To further adjust the test parameters, click the **Leak Tuner** button, and follow the instructions in *"Running the Leak Tuner Assistant" on page 235*. (This is an optional step.)

    **Note**: To purchase the Leak Tuner Assistant application, contact Sales at *inquiries@sciemetric.com*.
19. Do one of the following:
    - If you are configuring a flow test, proceed to the next step.
    - If you are configuring a pressure decay test, skip to step 22.
20. If you are configuring a flow test, ensure that the default value of 0.1 appears in the **Flow Over-range Dwell time** box.

    **Note:** This value can be changed; However, the over-range value protects the flow meter from damage. If the flow meter goes above its maximum range for more than the over-range dwell time, the 3520 aborts the test and exhausts the part.

21. Enter a value in the **Offset** box. Then continue to step 24.

    **Note 1:** If you don't have a value, enter 0.

    **Note 2:** The calibrated Offset value is used by the Leak Rate Flow feature. The Leak Rate Flow feature uses the mean of the Flow value (as measured in the Test zone) plus the calibrated Offset value, to compute the leak rate.

22. Select the **Calibrate to Flow** check box in the **Calibration** area if you want to report the pressure decay test results in flow units, that is, to have the pressure readings automatically converted to volumetric leak rate (sccm - standard cubic centimeters per minute).

    **Note**: Configuring parameters in the **Calibration** area is optional.

23. In the **Standard** box, enter the value of the calibrated leak standard.

    **Note**: You can get the leak standard value from the calibration certificate that came with your leak standard.

24. In the **Units** box, enter the leak standard measuring units.

25. Keep the values in the **Slope** and **Offset** boxes or enter new values if you want.

    **Note 1:** The **Slope** and **Offset** boxes allow you to enter not only numbers, but registers and formulas as well.

    **Note 2**: For a pressure decay test, the default values in the **Slope** and **Offset** boxes are 1 and 0 respectively, but you can enter new values to be applied to the test zone output. These values should be changed only by advanced users.

26. If you want to see the automatic leak sequence that has been generated on the basis of your selections in the **Basic** configuration page, click the **Advanced** button. Click back the **Basic** button to return to the **Basic** page.

    **Note**: Viewing the generated sequence is for information only. It is not recommended to edit the sequence and go back to **Basic**; any changes on the **Advanced** page are overwritten when you switch to the **Basic** page. If you are an advanced PSV user and would like to define a leak test manually using OPC commands, see *"Setting up a 3520 leak test using the Advanced Configuration method" on page 181*.

27. Configure the waveforms for the operation. See the procedure that follows.

### To configure the leak operation waveforms

1. Ensure you have performed all steps from the previous procedure, *To set up a leak test using the Basic configuration method*.

2. In the navigation bar on the left, select the first waveform for the operation, and configure it for data processing and analysis as follows:

   - If you are setting up a Pressure Decay test, you must configure at least one Pressure waveform.
   - If you are setting up a Flow test, you must configure at least two waveforms - Pressure and Flow.
   - The waveform may contain some or all of the required leak-specific analysis type features. See *Table 48* in this procedure for the complete list of features.

     See *"Configuring Operations for Data Processing and Analysis" on page 115* for information

**Note:** When you are configuring the Start and Stop range for a generic analysis type (that is, non-leak, such as True Area or Mean) that is applied to a leak waveform, you can have the **Start** and **Stop** values automatically calculated by PSV by selecting one of the leak analysis zones from the **Start** drop-down list: Initialize, Fast fill, Fill, Test, Exhaust. These zones are listed at the very end of the **Start** drop-down list, after the register values.

3. To add more waveforms, click the **Add Waveform** button on the **Waveforms Processing** screen. For information how to open this screen, see *"Configuring Operations for Data Processing and Analysis" on page 115*.
4. If you want, perform any of the optional steps:
   - To add more operations to the model, click the **Add** button in the **Operation** panel, bottom-right corner of the page. A confirmation dialog box appears. Click **Yes** if you want the new operation to be identical to the currently selected operation. Then, edit the parameters you want to change. Click **No** in the dialog box to configure all operation parameters from scratch.
   - To delete an operation, select it in the list of operations on the navigation bar on the left, and then click the **Remove** button in the **Operation** panel.
   - To change the order of operations, select an operation in the list of operations on the navigation bar on the left, and then click the **Move Up** or **Move Down** buttons in the **Operation** panel.
5. Click any of the buttons on the navigation bar on the left to save the configured model and leave the **Operations** screen.

***Table 48*** *3520 leak-specific analysis type features*

| Feature name | Description | Sensor to be used with this feature | Test zone used | Start of feature analysis | End of feature analysis |
|---|---|---|---|---|---|
| Zero Pressure | Captures the average value when the sensor is zeroed | Pressure | Initialization | Start of test cycle, plus step-back value* | End of Initialization zone |
| Fast Fill Pressure | Captures the average pressure at the end of the Fast Fill zone | Pressure | Fast Fill | Last 10% of Fast Fill zone | End of Fast Fill zone, minus step-back value* |
| Fill Pressure | Captures the average Fill pressure at the end of the Fill zone | Pressure | Test Fill | Last 10% of Fill zone | End of Test Fill zone, minus step-back value* |
| Test Pressure | Captures the average Test pressure at the beginning of the Test zone | Pressure | Test | Start of Test zone | First 10% of Test zone |

**Table 48** *3520 leak-specific analysis type features (Continued)*

| Feature name | Description | Sensor to be used with this feature | Test zone used | Start of feature analysis | End of feature analysis |
|---|---|---|---|---|---|
| Leak Rate Delta P | Captures the change in pressure in the Test zone | Pressure | Test | Start of Test zone | End of Test zone |
| Leak Rate Delta P/T | Captures the pressure rate of change in the Test zone (psi/sec) | Pressure | Test | Start of Test zone | End of Test zone |
| Leak Rate Cal (for Pressure Decay test) | The Pressure decay slope in the Test zone is converted to a flow value by multiplying by the calibrated leak rate Slope and adding the calibrated leak rate Offset | Pressure | Test | Start of Test zone | End of Test zone |
| Leak Rate Flow | Calculated as the sum of the mean flow rate in the Test Zone plus the calibrated Leak Rate Offset | Flow | Test | Start of Test zone | End of Test zone |
| Exhaust Pressure | The average value is calculated | Pressure | Exhaust | Last 10% of Exhaust time | End of Exhaust zone |
| Pressure Compensation | Calculates pressure decay rate compensated for environmental influences using process-specific parameters:<br>• Source (Reference)<br>• Factor 1<br>• Factor 2 | Pressure | – | Start of the Analysis Range | Stop of the Analysis Range |

*The default step-back value is 0.02s. This adjustment is necessary to avoid signal changes caused by switching valves.

**Note:** If a test zone is not defined, the corresponding feature Start/Stop values will be zero and the feature will report a fault when a cycle is run.

*Figure 57 An example waveform of a Pressure Decay test with a Test Fill or a Precision Fill zone*

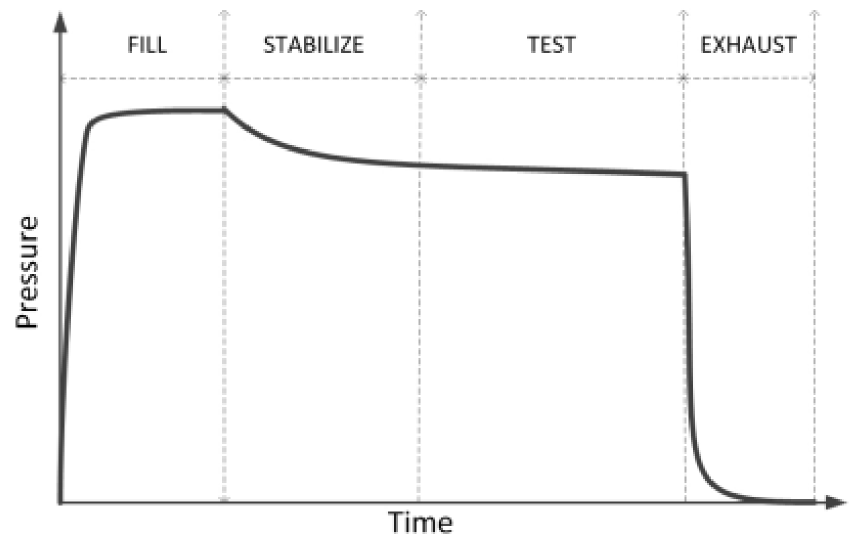



*Figure 58 An example waveform of a Flow test with Fast Fill, Test Fill, and Precision Fill zones*

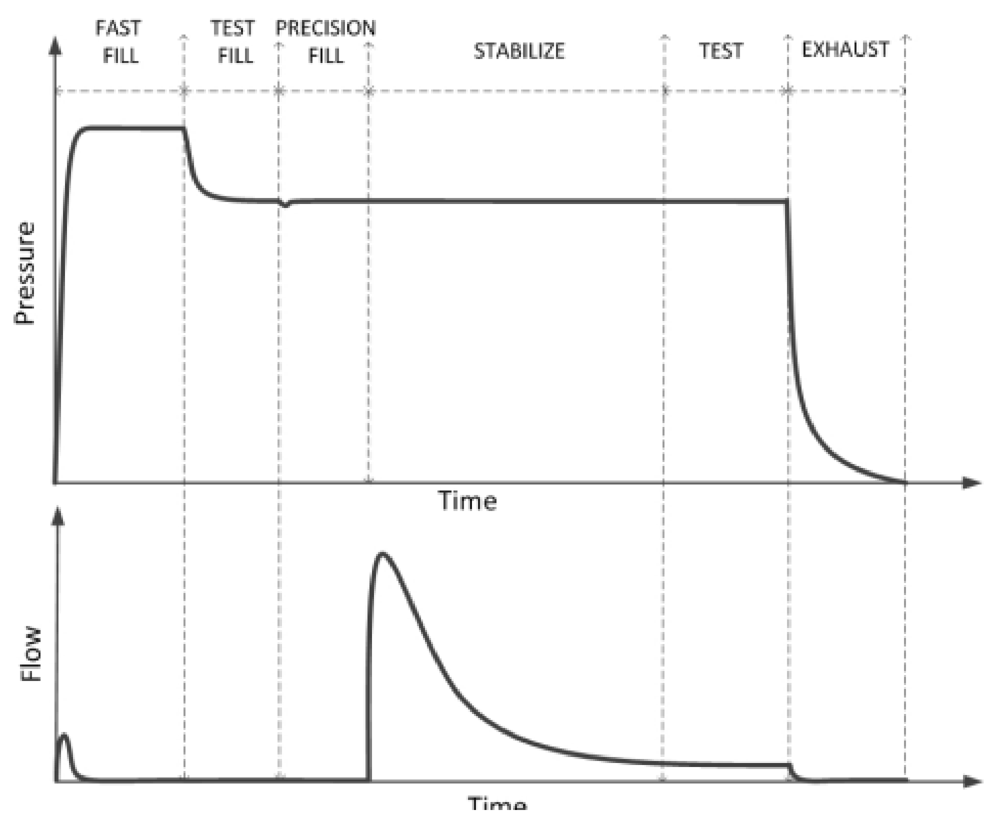
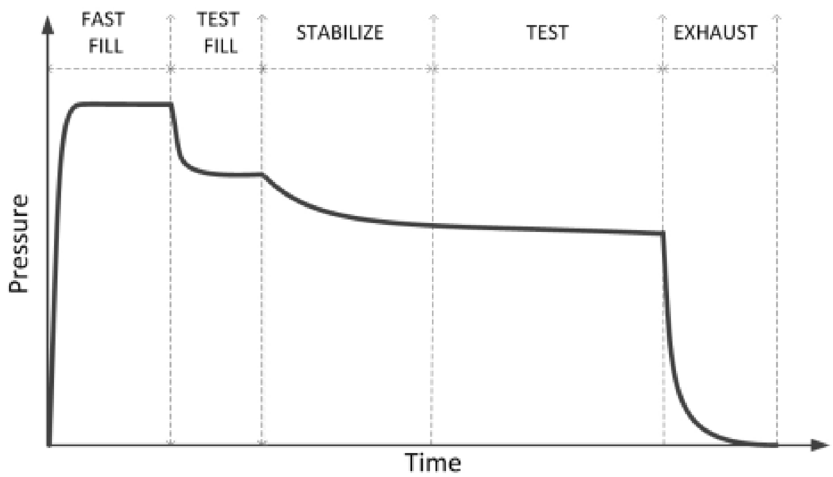


*Figure 59 An example waveform of a Pressure Decay test with a Fast Fill and a Test Fill zone*




## *Setting up a 3520 leak test using the Advanced Configuration method*

Use the Advanced configuration method to set up a leak test by manually entering OPC commands for the 3520 module and selecting the command order. Use the **Advanced** tab on the **Operations** screen only if you are an experienced PSV user.

**Note:** Clicking the **Undo** button cancels the changes made in the current setup session for the selected model. The session ends when you exit Setup mode (that is, when you click **Main**) or switch to a different model/ test configuration. Then, any changes you have made on the **Advanced** screen for this configuration are saved to the model/ test configuration.

**Requirements**

Before setting up the leak test, you must have done the following:

- Created and labeled the test model on the **Models Configuration** screen. See *"Setting up Models" on page 107*,*"Setting up Test Configurations (optional)" on page 109*, and *"Separating Model and Test Configuration data (optional)" on page 108*.
- Ensured that the default engineering units for all sensors are the units you want to use. If not, specify the correct units. See *"Changing the default engineering units for the 3520 sensors" on page 164*.

### To set up a leak test using the Advanced configuration method

1. Specify the general leak operation parameters. See *"Configuring the general leak operation parameters" on page 173*.
2. Click the **Advanced** button.

3. Configure the command table as desired. See the following procedure *"To configure the 3520 command table for an operation" on page 183*.

   **Note:** If at any time during the test setup you want to cancel all changes made on the **Advanced** screen, click the **Undo** button. Clicking the **Undo** button resets the **Advanced** screen to the state when you first opened it in the current editing session.

4. To execute additional commands for each operation result (pass or fail), see steps 5-10. Otherwise, proceed with step 11.

5. Click the **Pass/Fail Options** button.

   The **Pass/Fail Options** screen for the selected operation opens.

   **Note**: This is an optional step.

6. In the **On Pass, run commands** box, type a command, or set of commands, to be executed when the operation completes successfully. For a list of valid commands, see the ***3520 Leak Test Module User Guide*** available through the Sciemetric Support Center at http://support.sciemetric.com.

7. Click the **Run now** button to test the command.

   **Note 1:** If you want to stop the execution of the command, click **Abort**.

   **Note 2:** You will get a confirmation message if the command ran successfully, or an error message in the status bar.

8. In the **On Fail, run commands** box, type a command, or a set of commands, to be executed when the operation does not complete successfully. For a list of valid commands, see the ***3520 Leak Test Module User Guide***.

9. Click the **Run now** button to test the command.

   **Note**: You will get a confirmation message if the command ran successfully, or an error message in the status bar.

10. Click **Back** to save your settings and return to the **Operations** screen.

11. Select the **Calibrate to Flow** check box in the **Calibration** area if you want to report the pressure decay test results in flow units, i.e., to have the pressure readings automatically converted to volumetric leak rate (e.g., sccm - standard cubic centimeters per minute).

    **Note**: Configuring parameters in the **Calibration** area is optional.

12. In the **Standard** box, enter the value of the calibrated leak standard.

    **Note**: You can get the leak standard value from the calibration certificate that came with your leak standard.

13. In the **Units** box, enter the leak standard measuring units.

14. Keep the values in the **Slope** and **Offset** boxes or enter new values.

    **Note**: For a pressure decay test, the default values in the **Slope** and **Offset** boxes are 1 and 0 respectively but you can enter new values to be applied to the test zone output. These values should be changed only by advanced users.

15. Configure the waveforms for the operation. See the procedure *"To configure the leak operation waveforms" on page 177*.

### To configure the 3520 command table for an operation

1. Ensure you are on the **Operations** screen for the selected operation assigned to the 3520 platform.

   **Note**: If you don't know how to get to the correct screen, see steps 1 to 2 from the previous procedure.

2. On the **Advanced** configuration method page, edit the command table by doing any of the following:

   - To select a command, click its number in the **Select** column and wait until the selected line is highlighted in blue.
   - To add a command, click the **Add Line** button.

     A default **ResetUnit** command is added at the end of the command list.

     Overwrite **ResetUnit** with the name of the new command. For a list of valid commands, see the ***3520 Leak Test Module User Guide*** available through the Sciemetric Support Center at http://support.sciemetric.com.

   - To assign analysis zone to the command, select the command, and then choose an option from the **Analysis Zone** drop-down list.

     **Note:** You can define custom analysis zones by using any of the following parameters from the drop-down list: User Zone 1, User Zone 2, User Zone 3. Then you can use these zones for feature analysis or the Extract process.

   - To adjust the duration of the phase of a test, type a value for the length of time in seconds in the **Rel** column.

     **Note**: The **Abs** column displays the cumulative test cycle time and is not editable. Only fields that appear in white are editable.

   - To replace a command, click the cell you want to edit (in the **Command** column), and type the new command.
   - To delete a command, select it, click the **Remove line** button, and click **Yes** in the confirmation dialog box.

     **Note**: You can select only one line at a time.

   - To change the order of a command, select it, and click the **Move Line Up** or **Down** buttons.
   - To test the entire sequence of commands, click the **Validate** button.

     The commands are validated for errors by the 3520 unit (they are not performed, only validated). To run a test cycle, see *"Running a 3520 leak test" on page 197*.

   - To reset the 3520 leak test module to its default exhaust state, click the **Reset** button.

3. When you have completed editing the command sequence, note the entire duration of the leak test. The total duration of the test appears in the **Abs** column.

## Pressure decay test calibration to report leak rate in flow units

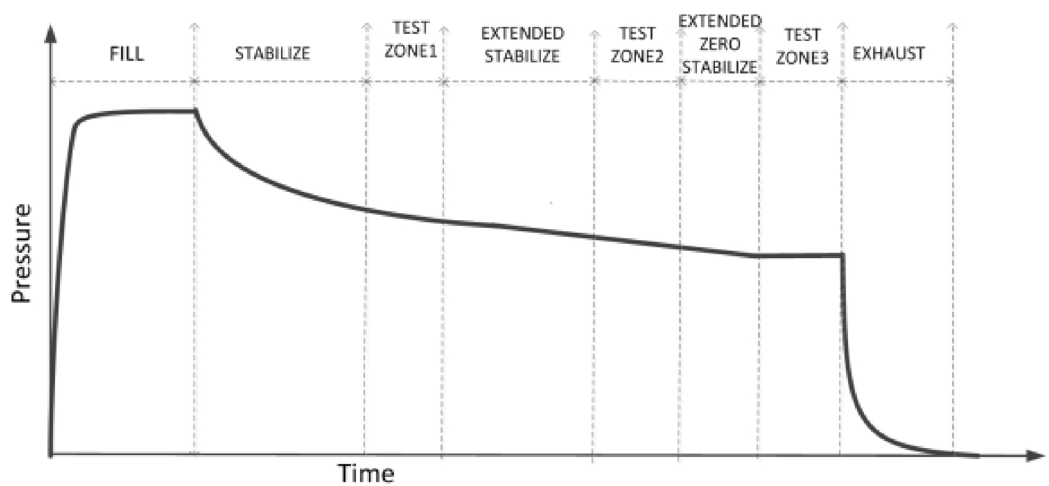
Use this procedure after you have configured a pressure decay test and you want to automatically calibrate the test to convert the pressure decay slope from psi/s to a flow based value. You can choose a single-cycle or multi-cycle calibration method.

In a single-cycle calibration sequence, the 3520 module runs a long cycle, in which it opens and then closes the calibration port, takes measurements at each stage, and relates both to calculate the slope and offset factors.

See *Figure 60* for an example waveform of a Pressure Decay (PD) test calibration to report PD units in flow units using the single-cycle calibration method. The description of each zone in *Figure 60* is as follows:

- Test Zone 1: Pressure decay measurement during the normal test time with the leak standard connected to the circuit.
- Extended Stabilize Time: Time delay added for calibration purposes to ensure that the pressure has completely stabilized. Extended Stabilization is required if the pressure is not fully stabilized by the end of the Test Zone 1.
- Test Zone 2: Pressure decay measurement after extended stabilization with the leak standard connected to the circuit. The duration of Test Zone 2 is the same as the normal test zone (that is, Test Zone 1).
- Extended Zero Stabilize Time: Second stabilization phase added for greater precision.
- Test Zone 3: Pressure decay measurement with the leak standard removed from the circuit. The duration of Test Zone 3 is the same as the normal test zone (that is, Test Zone 1).

*Figure 60 An example waveform of Pressure Decay (PD) test calibration, single cycle to report PD units in flow units*



In a multi-cycle calibration sequence, the 3520 module runs a number of regular cycles (as specified by the user and as shown in *Figure 57 on page 180*) with the calibration port open and then the same number of cycles with the calibration port closed, and then calculates the following:

- The average of the test zone slopes when the calibration port is opened (value A)
- The average of the test zone slopes when the calibration port is closed (value B)
- The calibration slope, using the formula: (Leak Standard value)/ (A-B)
- The calibration offset, using the formula: (new slope)*(B)*(-1)

For example, if on the **Pressure Decay Flow Calibration** screen, you specify a multi-cycle calibration with 3 calibration cycles, the software runs 3 cycles with the valve closed, and takes the average; next, it runs 3 more cycles with the valve open, and takes the average. Finally, it calculates the new calibration slope and offset.

### Requirements

Before performing the procedure, ensure that:

- You've configured a pressure decay (PD) leak test using the Basic or Advanced configuration method, and the **Calibrate to Flow** check box at the bottom of the **Basic** or **Advanced** configuration screen is selected. See *"Setting up a 3520 leak test using the Basic Configuration method" on page 174* or *"Setting up a 3520 leak test using the Advanced Configuration method" on page 181*.
- This PD leak test consists of an operation with a waveform containing a Leak Rate Cal feature. For a complete list of available 3520-module leak-related features, see *Table 48 on page 178*.

  **Note**: It is recommended to have a Fill Pressure feature type configured for the waveform.
- You have the calibration orifice (leak standard) inserted in the Calibration port of the 3520 leak test module.
- You have the value of the leak test standard from the leak standard data sheet, and the Leak Standard value is reported in the same units as the Leak Rate Cal feature. If not, you must convert one or the other.
- The 3520 leak test module is connected.

### To calibrate a leak test for reporting pressure decay in flow units using single cycle calibration

1. In the PSV application, do one of the following:
   - If a setup screen is open, click **Main** in the bottom-left corner of the PSV screen to switch to Main Operation mode.
   - If the **Main** screen is already open, see step 2.
2. On the navigation bar on the left, click the **Features** button.
3. From the **Select model to test** drop-down list, located above the bottom edge of the screen, select the 3520 pressure decay test you want to calibrate. If a PLC determines the selected Model, ensure that the appropriate model is selected by the PLC.

**Note:** When Model data is separate from Test Configuration data, the **Select Model to Test** drop-down list is labeled **Select Test Configuration**. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

4. Click the **Leak Cal** button to open the **Pressure Decay Flow Calibration** screen.
5. Ensure the name of the correct leak test appears next to **Model**. If the name is not correct, click **Back** and repeat step 3.
6. From the **Operation** drop-down list, select the operation that meets the criteria for pressure decay test calibration. See the *Requirements* section of this procedure.
7. Ensure the ID of the correct 3520 leak test module appears next to **Leak Test Module**. If the ID is not correct, go back to the **Operations** setup screen for this operation and ensure the correct leak test module is associated with it. See *"Setting up a 3520 leak test using the Basic Configuration method" on page 174*.
8. From the **Calibration Method** drop-down list, select **Single Extended Cycle**.
9. In the **Extended Leak Stabilize Time** box, enter the time to wait for the thermals to settle completely.

   **Note 1**: Only positive values are considered valid values in this box.

   **Note 2**: The system automatically calculates Extended Zero Stabilize Time which is added to the cycle to make the results more precise. See *Figure 60 on page 184*.
10. In the **Calibration Standard** area, ensure the calibration flow rate for the flow standard (measured flow at the test pressure; for example, 30 sccm) displays the correct value. If not, go back to the **Operations** setup page and enter the correct value. See *"Setting up a 3520 leak test using the Basic Configuration method" on page 174*, or *"Setting up a 3520 leak test using the Advanced Configuration method" on page 181*.

    **WARNING:** You can find this value in the leak standard data sheet; however, the engineering units must be the same type of units as specified for the Leak Rate Cal feature in the feature table. Otherwise, the calibration will not produce correct results. See the *Requirements* section of this procedure.
11. If the part being tested is a zero leak master part, select the **Zero Leak Part** check box.
12. Click the **Start Calibration** button to start the calibration cycle.

    The **Test Progress** bar displays the progress of the calibration, counting down, and the **Live Pressure** line displays the real-time value of the pressure. Also, the Results Table displays the new Slope and Offset values that will be used by the Leak Rate Calibration feature, if you decide to save them.

    **Note**: If you want to cancel the process, click the **Stop Calibration** button.
13. When the calibration cycle is complete, do one of the following:
    - If you want to save the new calibration values, click **Accept**.
    - If you want to discard the new calibration values, click **Cancel**.

      **Note**: Clicking **Cancel** restores the previous calibration values.
14. Click **Back** to return to the **Features** screen.

### To calibrate a leak test for reporting pressure decay in flow units using multi-cycle calibration

1. Perform steps 1 through 7 from the previous procedure, *To calibrate a leak test for reporting pressure decay in flow units using single cycle calibration*.
2. If you need to perform calibration using more than one 3520 leak test unit, select the **Run Parallel Operations** check box.

   **Note 1**: Selecting the **Run Parallel Operations** check box runs all operations in the **Operation** drop-down list simultaneously.

   **Note 2**: The **Run Parallel Operations** check box is visible only if you have selected **Collect All Operations** check box on the **Operations** setup screen (see *Figure 52 on page 82*).
3. From the **Calibration Method** drop-down list, select **Multi-Cycle**.
4. Enter a number in the **Number of Cycles** box.

   **Note**: If you specify 3 cycles, for example, PSV will double this number and will run 6 cycles: 3 cycles with the valve closed and 3 with the valve open, and then will calculate the average slope and offset value as explained in the introduction to this procedure. The final Slope and Offset calculated values are the values used in the Leak Rate Calibration feature.
5. Enter a number in the **Delay Between Cycles** box.
6. In the **Calibration Standard** area, ensure the calibration flow rate for the flow standard (measured flow at the test pressure; for example, 30 sccm) displays the correct value. If not, go back to the **Operations** setup page and enter the correct value. See *"Setting up a 3520 leak test using the Basic Configuration method" on page 174*, or *"Setting up a 3520 leak test using the Advanced Configuration method" on page 181*.

   **WARNING:** You can find this value in the leak standard data sheet; however, the engineering units must be the same type of units as specified for the Leak Rate Cal feature in the feature table. Otherwise, the calibration will not produce correct results. See the *Requirements* to this section.
7. Click the **Start Calibration** button to start the calibration cycle.

   The **Test Progress** bar displays the progress of each calibration cycle, counting up, and the **Live Pressure** line displays the real-time value of the pressure. Also the Results Table displays the Slope values from each cycle and the final Slope and Offset that will be used by the Leak Rate Calibration feature, if you decide to save them. (The Offset is displayed only after the final calculations, but is not applicable for each cycle.) The graph area displays the waveforms from each cycle overlaid on top of each other and a rectangle indicating the zone where the slope of the pressure waveform is being calculated. Waveforms from cycles with the port closed or open appear in different color.

   **Note**: If you want to cancel the process, click the **Stop Calibration** button.
8. When the calibration cycle is complete, do one of the following:
   - If you want to save the new calibration values, click **Accept**.
   - If you want to discard the new calibration values, click **Cancel**.

     **Note**: Clicking **Cancel** restores the previous calibration values.
9. Click **Back** to return to the **Features** screen.

## Setting up a leak test with the Leak template

The Leak template is a collection of sample leak test configurations that allow you to quickly begin testing with a 3520 leak module.

The template is set up for testing a 4-liter container at a pressure of 5 psig. Each of the models / test configurations in the template is intended as a starting point, and the leak parameters should be modified to ensure the sample test is fully tailored to your needs. The settings you choose will depend on the type of part, volume, and test pressure you are using.

## Installing the Leak template

The Leak template is compatible with sigPOD PSV version 5.1.3220 or higher and can be used on any sigPOD or PC controller with at least one available 3520 leak module to set up.

**For brand new sigPOD installations**

If you have purchased a sigPOD as a leak test controller, the Leak template is already installed on your sigPOD at the factory.

If you purchase a sigPOD leak test license after you have purchased the sigPOD, or if you are using a PC as a controller for your 3520 Leak test modules, see the following sections.

**For brand new PSV installations**

If you are adding the Leak template to a newly installed PSV software, follow the standard procedure for installing a backup configuration file. See *"Installing a PSV 5.1/5.2/5.3 configuration onto PSV 5.4" on page 15*. You can obtain a copy of the template by contacting Sciemetric Support at *support@sciemetric.com*.

**Note:** When installing a backup configuration, including the Leak template, any previous PSV configurations on the sigPOD or PC are deleted and replaced by the new backup file. That is why installing the template as a backup file is recommended only for new PSV installations.

**For existing PSV installations**

If you've had the PSV 5.X software for some time, and need to preserve an existing test configuration on the sigPOD or PC controller, contact Sciemetric Support at *support@sciemetric.com* for instructions on installing the Leak template.

## Waveforms and channels in the Leak template

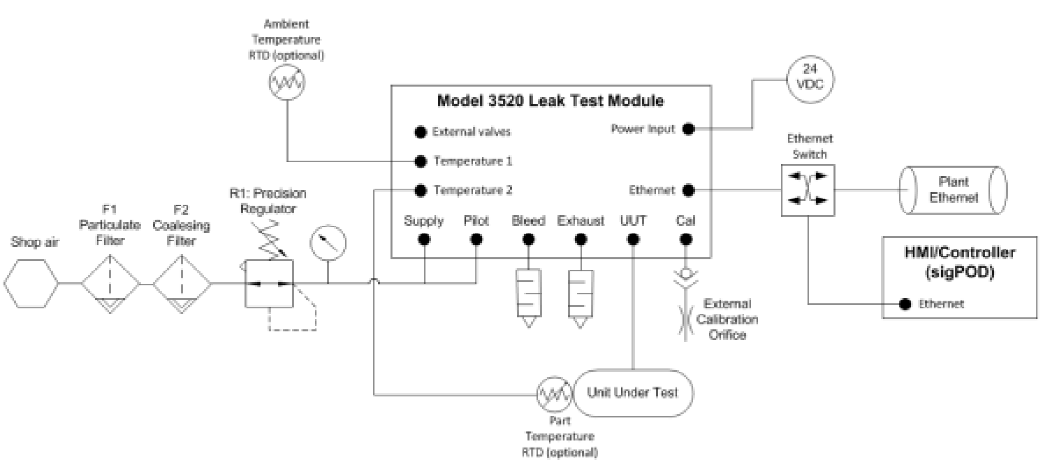
The Leak template is configured to use the built-in sensors in the 3520 leak module. *Table 49* lists the input channels enabled in the template. Additional sensor channels are available and can be enabled for monitoring.

In general, up to four leak modules can be controlled with one sigPOD or one instance of PSV software; higher module counts are an option with IPT suite or other custom software. For an example of a 3520 Leak Test System, see *Figure 61 on page 189*.

***Table 49*** *Enabled input channels in the Leak template*

| Channel | Description |
|---|---|
| **Pressure** | Measures the test pressure inside the part. |
| **Flow** | Measures the flow of pressurized air leaking from the part. |
| **PID Proportional** | Measures the proportional term of the pressure PID controller, which produces an output value that is proportional to the current error value. |
| **PID Integral** | Represents the sum of the instantaneous error over time and gives the accumulated offset that should have been corrected previously by the pressure PID controller. |
| **PID Out** | Represents the total output of the pressure PID controller. The maximum value is 11, which equals fully open valves. |
| **Supply Pressure** | Measures the pressure of the air supply to the 3520 module. |

*Figure 61 Example configuration of a 3520 Series Leak Test system*



The Leak template contains the following models/test configurations and their history files (for reference purposes only):

- Pressure Decay
- Fast Fill Pressure Decay
- Flow
- Fast Fill Flow
- Volume

  **Note:** The Volume model requires a 3520 module with a built-in flow sensor.
- x0xB 5psi Self

  **Note:** The x0xB self-test does not display a flow waveform for 3520 models ending in DB or EB (for example, 10500-3520-D0DB). In other words, the flow waveform will be zero.
- x0xC 5psi Self

Each model/test configuration contains one operation and the waveforms and features listed in *Table 50 on page 190* and *Table 51 on page 191*. See *Figure 62 on page 192* through *Figure 67 on page 194* for example waveforms.

***Table 50*** *Waveform definitions in the Leak template*

| Waveform | Y-input | X -input | Waveform Processing | Description |
|---|---|---|---|---|
| Pressure | 1 Pressure | Time | None | Part pressure |
| Flow | 1 Flow | Time | None | Flow rate of part |
| Supply Prs | 1 Supply Pressure | Time | None | Air supply pressure |
| PID P | 1 PID Proportional | Time | None | PID controller proportional term.<br>Disabled by default |
| PID I | 1 PID Integral | Time | None | PID controller integral term.<br>Disabled by default |
| PID Out | 1 PID Out | Time | None | PID controller output |

***Table 51*** *Feature definitions in the Leak template*

| Waveform | Feature name | Feature type | Refe-rence | Available in models / test configs | When to use | Failure modes |
|---|---|---|---|---|---|---|
| Pressure | Zero Pressure | Zero Pressure | A | All | Using the Initialization analysis zone, to ensure there is no initial pressure in the part at the start of a test cycle | Incorrect configuration, part not fully exhausted from previous cycle |
| | Fast Fill Pressure | Fast Fill Pressure | B | FF Pres Decay, FF Flow | To find the pressure that the part was filled to at the end of the Fast Fill analysis zone | Leaking part, fitting or air line, incorrect pressure or configuration |
| | Fill Pressure | Fill Pressure | C | All | To find the pressure that the part was filled to at the end of the Test Fill analysis zone | Leaking part, fitting or air line, incorrect configuration |
| | Test Pressure | Test Pressure | D | All | To find the pressure at the beginning of the Test analysis zone | Leaking part, fitting or air line |
| | Leak Rate deltaP | Leak Rate deltaP | E | Pres Decay, FF Pres Decay | To find the pressure drop within the Test analysis zone | Leaking part, fitting or air line |
| | Pressure Decay Rate | Leak Rate deltaP/T | F | Pres Decay, FF Pres Decay | To find the pressure rate of change within the Test analysis zone | Leaking part, fitting or air line |
| | Exhaust Pressure | Exhaust Pressure | G | All | Using the Exhaust analysis zone, to ensure there is no remaining pressure in the part at the end of a test cycle. | Blocked exhaust valve, incorrect configuration, part not fully exhausted |
| Supply Pr | Average | Mean Value | A | All | To ensure that the supply pressure is adequate | Incorrect supply pressure |
| | Peak | Peak Value | B | All | To ensure that the supply pressure is adequate | Incorrect supply pressure |
| | Min | Min Value | C | All | To ensure that the supply pressure is adequate | Incorrect supply pressure |

**Table 51** *Feature definitions in the Leak template (Continued)*

| Waveform | Feature name | Feature type | Refe-rence | Available in models / test configs | When to use | Failure modes |
|---|---|---|---|---|---|---|
| Flow | Leak Rate | Leak Rate Flow | A | Flow, FF Flow | To determine the leak rate by calculating the average value within the Test zone and adding the calibration offset | Leaking part, fitting or air line |
| PID P | Peak | Peak Value | A | Pres Decay, FF Pres Decay, Flow, FF Flow | To view the proportional term graphed for configuration purposes | Fill cycle too fast or slow |
| PID I | Peak | Peak Value | A | Pres Decay, FF Pres Decay, Flow, FF Flow | To view the integral term graphed for configuration purposes | Fill cycle too fast or slow |
| PID Out | Peak | Peak Value | A | Pres Decay, FF Pres Decay, Flow, FF Flow | To view the PID controller output included for setup purposes. The maximum value is 11. | - |

*Figure 62* *Leak template - example of a Pressure waveform*

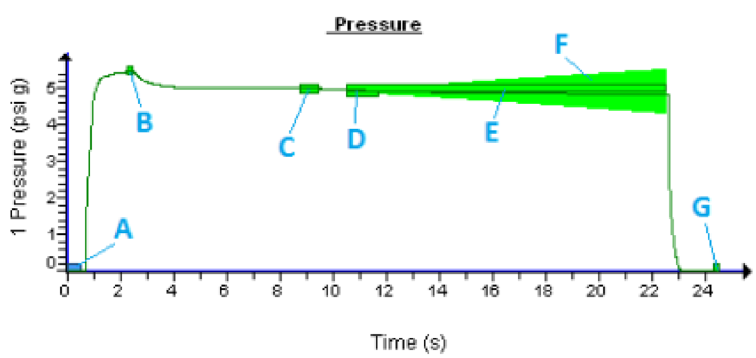


*Figure 63 Leak template - example of a Flow waveform*

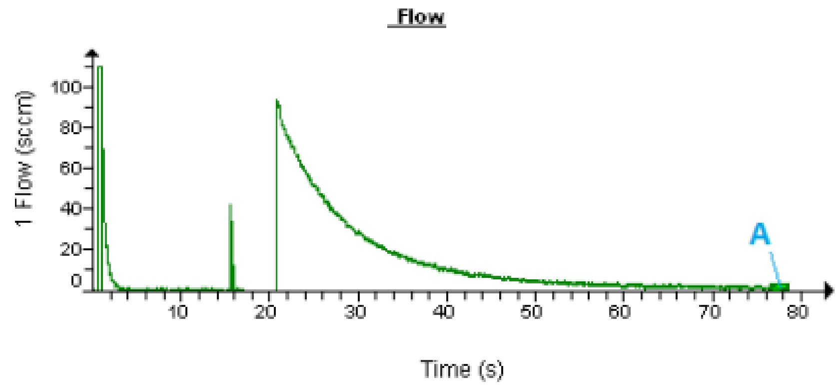



*Figure 64 Leak template - example of a Supply Pressure waveform*

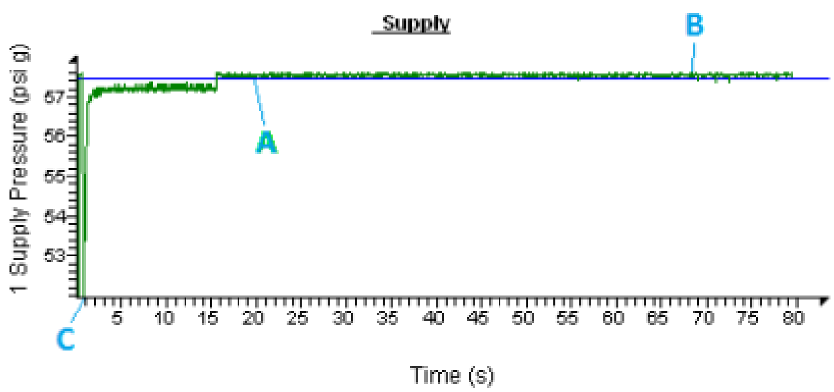



*Figure 65 Leak template - example of a PID P waveform*

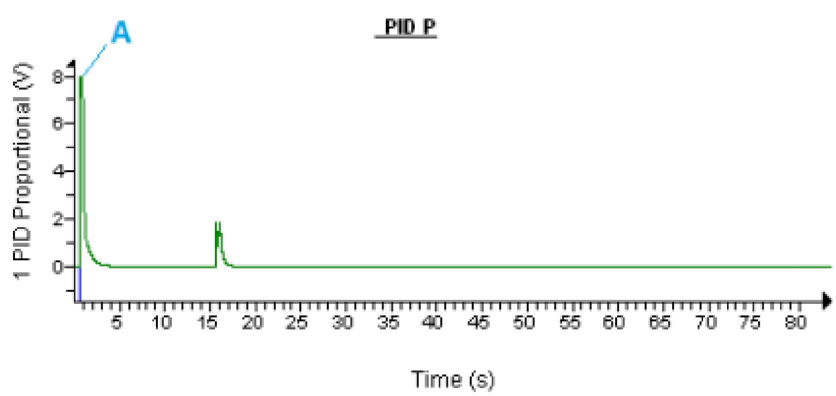


*Figure 66 Leak template - example of a PID I waveform*

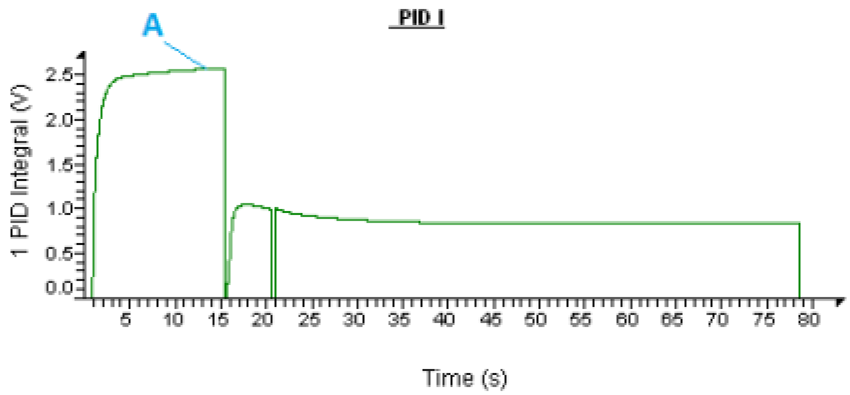
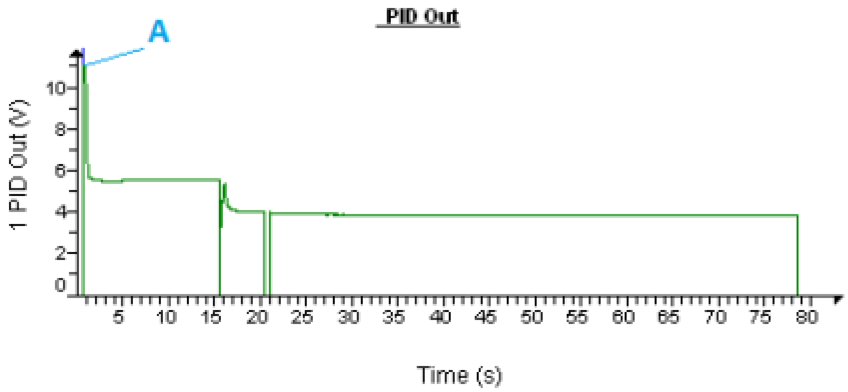



*Figure 67 Leak template - example of a PID Out waveform*



## *Using the Leak template*

To use any of the models/test configurations in the Leak template, you must copy the model as a base for a new model, and then modify the parameters according to the type and volume of the part being tested, and according to the test pressure.

It is not recommended that you modify any of the seven default sample models in the template so that they are always available for new configurations in the future.

### To use a sample test from the Leak template

**1.** Create a new model/test configuration by copying one of the models in the Leak template. See *"Setting up Models" on page 107*.

**Note 1:** On the **Models/Configurations** setup page, the leak template models can be found at indexes 90 through 97.

**Note 2:** If available, use Index 0 for your first custom model.

**2.** Using the Basic or Advanced configuration method, modify the test parameters from the template to reflect your test specifics: part type, part volume, test pressure, and test zones. See *"Setting up a 3520 leak test" on page 172*.

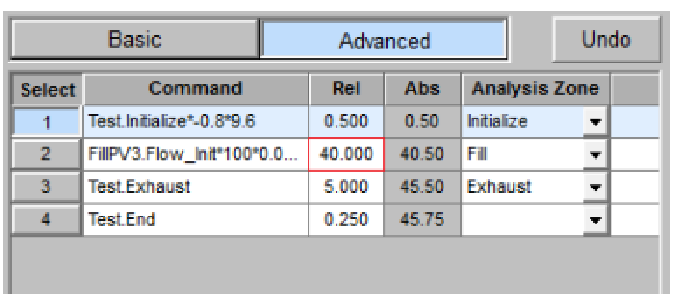
**Note 1:** If a fast-fill configuration is required, it is recommended to first finalize the test parameters without the fast fill zone, and then add the fast fill.

**Note 2:** For every model, you should adjust the Average, Peak and Min feature limits for the Supply Pr waveform to suit your setup. Significant changes in the supply pressure may affect the 3520 PID behavior and test results.

**Note 3:** If you are using the sample Volume leak test model, keep in mind that the volume calculation works only if the flow sensor units are sccm. Also, the volume calculation has an expected error of up to 10% for volumes between 2 L and 25 L. The hose volume and internal 3520 volume (0.05 L) are included. For volumes less than 2 L, reduce the fill duration in the operation configuration to 20 s or less to improve the accuracy. For volumes greater than 25 L, increase the duration to 60 s or more. See *Figure 68*.

**Note 4:** If you change any sensor units, you must also change the feature units within any associated waveforms to match.

*Figure 68 Leak template - the Volume model*




| Select | Command | Rel | Abs | Analysis Zone |
|---|---|---|---|---|
| 1 | Test.Initialize*-0.8*9.6 | 0.500 | 0.50 | Initialize |
| 2 | FillPV3.Flow_Init*100*0.0... | 40.000 | 40.50 | Fill |
| 3 | Test.Exhaust | 5.000 | 45.50 | Exhaust |
| 4 | Test.End | 0.250 | 45.75 | |

# Leak testing with a 3520 leak test module

This section contains the following subsections:



## Running a 3520 leak test

You can run a 3520 leak test configuration on the Main screen of the PSV application.

**Requirements**

Before you run a 3520 leak test configuration, ensure that you have performed the required hardware and software setup procedures. See the ***3520 Leak Test Module User Guide*** available through the Sciemetric Support Center at http://support.sciemetric.com. In addition, ensure the following is true:

- The correct part is attached to the Unit Under Test port of the 3520 leak test module.
- If necessary, the correct calibration device is attached to the Calibration port of the 3520 leak test module.
- A compressed air source, prepared according to the instructions in the ***3520 Leak Test Module User Guide***, is connected to the Supply and Pilot ports of the leak test module.
- All required PSV configuration procedures have been performed. See *"Configuring tests with a 3520 leak test module" on page 163* for more information.

### To run a 3520 leak test configuration

1. In the PSV application, do one of the following:
   - If a setup screen is open, click **Main** in the bottom-left corner of the PSV screen to switch to Main Operation mode.
   - If the **Main** screen is already open, see step 2.
2. If you want to open the Calibration port of the 3520 leak unit during an operation, see steps 3 and 4. Otherwise, proceed to step 5.
3. In the navigation bar on the left, click **Features** to open the **Features** page.
4. Click the **Cal Port** button located right below the **Graph Options** area to select it.

   When selected, the **Cal Port** button changes color from gray to light blue.

   **Note 1:** Steps 3 and 4 are optional. You might want to have the Calibration port open for diagnostic or troubleshooting purposes.

   **Note 2:** At the end of the test, the **Cal Port** button automatically gets deselected, and the Calibration valve on the 3520 leak test module automatically closes.
5. In the navigation bar on the left, click **Status** to display the **Main** status screen.

6. From the **Select model to test** drop-down list, select the 3520 leak test you want to run.

   **Note 1:** Alternatively, if using a PLC to select the model, ensure that the correct model is specified.

   **Note 2:** When Model data is separate from Test Configuration data, the **Select Model to Test** drop-down list is labeled **Select Test Configuration**. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

7. Click **Start** or send a New Part or Start signal from a PLC.

   The Main PSV screen provides the following information about the test progress:

   - The circular LED next to each unit label is green when the 3520 module is connected and online.
   - The progress bar and count-down timer show the time remaining until the end of the test sequence.
   - The Live Pressure and Live Flow columns show the real-time values of pressure and flow.

## Checking for leaks with a 3520 module using Fill and Hold or Fill and Flow

The Fill and Hold or Fill and Flow function allows you to search for the location of a leak while a part is pressurized.

For 3520 models with a flow meter, you can troubleshoot the leak by seeing the live flow reading during the **Fill and Hold** process without running another test cycle. This process pressurizes the part and puts the flow meter inline.

### To use the Fill and Hold or Fill and Flow function

1. Do one of the following:

   - If a setup screen is open, click **Main** in the bottom-left corner of the screen to switch to **Main** Operation mode.
   - If the **Main** screen is already open, see step 2.

2. From the **Select model to test** drop-down list, select the 3520 leak test that the part has failed. Alternatively, if using a PLC to select the model, ensure that the PLC is specifying the correct model.

   **Note 1:** This step ensures that the fill sequence is correct for the particular part model.

   **Note 2:** When Model data is separate from Test Configuration data, the **Select Model to Test** drop-down list is labeled **Select Test Configuration**. For more information, see *"Separating Model and Test Configuration data (optional)" on page 108*.

3. In the navigation bar on the left, click the **Features** button to open the **Features** main screen.

4. Click the **Fill / Hold** button located in the bottom-right area of the screen to open the **Fill and Hold** screen.

5. Ensure that the name of the correct leak test configuration (applicable to the part), appears next to **Model**. If the name is not correct, repeat step 2.

6. Do one of the following:
   - If you want to run only one 3520 unit, from the **Operation** drop-down list, select the test operation that contains the correct fill state for the part. Ensure the **Run Parallel Operations** check box is deselected.
   - If you want to run multiple operations in parallel (for example, if you have multiple 3520 units operating on a part), select the **Run Parallel Operations** check box.

     **Note 1**: Selecting the **Run Parallel Operations** check box runs all operations in the **Operation** drop-down list simultaneously, even though before you open the drop-down list, only the first operation is visible.

     **Note 2**: The **Run Parallel Operations** check box is visible only if you have selected **Collect All Operations** check box on the **Operations** setup screen (see *Figure 52 on page 82*).
7. In the **Timeout** box, specify the length of time (in minutes) after which the system will automatically exhaust the part if you do not manually exhaust it in the meantime.
8. Click the **Fill and Hold** or **Fill and Flow** button.

   The leak test will run up to the end of the first Test Fill state. If a fault is reported by the 3520 module, the error message is displayed in the status bar and the **Live Pressure** box on the screen will display the value of the part pressure in real time.

   **Note 1**: If the test contains a Fast Fill state, it must be followed by a Test Fill state. If the test contains a Fast Fill state only, the test sequence will not work. For information about configuring Fast Fill and Test Fill as part of a test sequence, see *"Setting up a 3520 leak test using the Basic Configuration method" on page 174*.

   **Note 2**: If a flow over-range condition occurs, a message appears "Gross leak detected, please use Fill and Hold (without Flow) to find the leak."

   **Note 3**: When the part is pressurized, the Busy signal goes high and the Busy indicator on the **Fill and Hold** screen stays green. The Busy indicator turns off when the part is emptied.
9. Determine the leak location using a process that is appropriate for the part. (For example, spray the part with soap and water, use snoop, or use an ultrasonic probe).
10. When you have found the location of the leak, click the **Exhaust** button to empty the part before fixing the source of the leak.

    **Note:** If the leak controller receives an Abort signal from the PLC, the 3520 module will automatically empty the part.
11. Click **Back** to return to the **Features** screen.

# Leak testing with Model 3670 - enabling outputs

Before you can run leak tests with a Model 3670 Leak Test Station, you must enable the 3670 functions on the **Digital I/O** page so that control of the air-supply valve and control of the stack lights is enabled.

**Requirement**

Since the 3670 Leak Test station houses 3520 leak modules (up to 4), you must have the 3520 Leak test functionality enabled before performing this procedure. See *"Enabling 3520 functionality" on page 163*.

## To enable 3670 outputs

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. On the navigation bar in the bottom-left of the screen, click the **Digital I/O** button.
3. On the **Digital I/O** setup page, select the **3670 Mode** check box to enter 3670 operation mode.

   In 3670 operation mode, the names next to the Digital Outputs channels change, because the digital outputs are re-assigned for the 3670 functions as described in *Table 52*.

   **Note:** If you have Ethernet-based fieldbus installed, you can use it in conjunction with the 3670 mode. Use the **Display 3670 I/O** button to toggle the view between fieldbus and 3670 outputs.

***Table 52*** *Digital Output Channel Assignments for 3670 leak test station*

| Output Channel | Color of the 3670 stack lights | Assignment |
|---|---|---|
| **0** | | Online |
| **1** | Yellow | Test in progress (Busy)<br>The light is on from the start to the end of the test. |
| **2** | Green | Part pass (Part status)<br>The light is on until the start of the next test. |
| **3** | | Operation status |
| **4** | | Control of the Air supply valve<br>This output is linked to the Online output |
| **5** | Red | Part fail<br>The light is on until the start of the next test. |
| **6** | White | Station fault or Test aborted<br>The light is on until the start of the next test or until faults are cleared. |
| **7** | | Alarm |

# Appendix A: Error messages

This section lists errors and associated probable solutions for startup, sensors and input/output, data collection and miscellaneous errors. Not all error messages appear in all applications.

## Start Up Error Messages

### *Error Code: N/A*

**Message**: Software is not installed

**Problem**: The system is unable to start due to a missing driver.

#### Probable Solution:

1. Verify that all drivers are correctly installed in the System Setup.
2. Do one or both of the following:
    - If there is no resolution, make a backup of the current configuration, if required, and perform a factory reset.
    - If the problem persists, the problem may be a hardware issue. Contact Sciemetric.

## Sensors and Input/Output Error Messages

### *Error Code: 1008*

**Message**: Signal Overrange

**Problem**: One of the input signals exceeded its selected voltage range during a data collection or in Diagnostics.

#### Probable Solution:

1. From the Setup -Sensor screen, check to ensure the sensor range is set correctly to match the expected voltage output of the sensor.
2. Check that the sensor wiring is intact and is not shorted.
3. Ensure that the sensor is functioning correctly. To do so, use a voltmeter and measure the signal across the +Sig and -Sig pins on the channel.
4. Using a voltmeter, check between +Sig and the power supply ground. Ensure that the voltage is not greater than 10 volts. If it is, the sensor is exceeding the common mode voltage of the system. Either an alternate sensor must be sourced, or an alternate power supply configuration must be used to reduce the common mode.

## Error Code: N/A

**Message**: N/A

### Problem 01: Digital Input does not change states.

Probable Solution:

1. In the Setup - Digital I/O screen, view the digital input status. Remember that this represents the status of the physical digital I/O if there is no fieldbus present. If there is a fieldbus present, it represents the fieldbus I/O status. Digital input 7 is the exception and is always connected to the rear panel digital I/O. It is not available in Ethernet/IP, PROFINET, or Modbus TCP.
2. With the output control forced to a high state (whether it is a PLC output or a switch), use a voltmeter across the digital input terminals (channel to input common) to verify that at least 16 volts is measured. Twenty-four volts is the nominal voltage that should be present.
3. With the output control forced to a high state (whether it is a PLC output or a switch), use a voltmeter across the digital input terminals (channel to input common) to verify that at least 16 volts is measured. Twenty-four volts is the nominal voltage that should be present.
4. If there is no voltage present at the input channel, then there is either a wiring problem between the stations, a control power supply problem or an output relay problem with the PLC. If the correct voltage is present and the input does not change state, then the input relay may be damaged. Contact Sciemetric.

### Problem 02: Digital Output does not change states.

Probable Solution:

1. In the Setup - Digital I/O screen, select and force the digital output.
2. Using a voltmeter, check the voltage at the output of the channel (the channel to control common or input common). The voltage measured should be 24 volts.
3. If there is no voltage present, verify that there is 24 volts at the output common terminal. If voltage is present at the output common, but there is no voltage measured at the output in question, then the output relay may be damaged. Contact Sciemetric.

### Problem 03: Sensor does not respond to any physical actions (e.g. load or distance).

Probable Solution:

1. Using a voltmeter, check the sensor excitation.
2. Refer to the data sheet for the correct voltage.
3. Check the slope in the sensor setup to ensure it is not zero.
4. Check the sensor wiring.
5. Swap out the sensor with an equivalent one to determine if the problem is with the sensor.

### Problem 04: Sensor is extremely noisy (>1% of its full scale).

Probable Solution:

1. Ensure that the sensor has shielded cable, and that the shield is terminated to ground of the Sciemetric chassis.
2. Ensure that the shield is not grounded on the sensor end. All sensor cables between the sensor and the test system must be in a metal cable duct, and isolated from any high voltage or current sources.

## Data Collection Error Messages

### *Error Code: 6001*

**Message**: Data Overrun

**Problem**: The system cannot collect data fast enough to meet the requested sample requirements.

#### Probable Solution:

- In the Setup - Data Collection screen, lower the sample rate.

### *Error Code: 6033*

**Message**: Stop Trigger Timeout

**Problem**: The data collection timed out before the stop trigger was met.

#### Probable Solution:

- In the Setup - Data Collection screen, verify whether the stop trigger threshold needs to be adjusted or if the timeout needs to be increased.

### *Error Code: 7031*

**Message**: Frequency greater than half the sampling rate.

**Problem**: A filter being applied to the data has a cutoff frequency that is greater than half of the sample rate.

#### Probable Solution:

#### Do one of the following:

- In the Sensor - Processing screen, lower the cut-off frequency.
- In the Setup - Data Collection screen, increase the sample rate.

### *Error Code: 22092*

**Message**: Low Scan Interval

**Problem**: The system cannot collect data fast enough to meet the requested sample requirements.

#### Probable Solution:

- In the Setup - Data Collection screen, lower the sample rate.

## Miscellaneous Error Messages

### *Error Code: 5011*

**Message**: Cannot Open File

**Problem**: A file-open attempt has failed due to a missing file or an incorrect path.

#### Probable Solution:

- Verify the path and filename of the file.

### *Error Code: 5030*

**Message**: Permission Denied

**Problem**: A file-open/save attempt failed due to the user having insufficient access rights.

#### Probable Solution:

- Verify that the system has the sufficient security rights to access the file.

### *Error Code: -101*

**Message**: Model or Test configuration not set up

**Problem**: A model number was received by the controller, and it does not exist in the system yet.

#### Probable Solution:

- Check the model or test configuration number received from the controller and verify that a configuration exists for the model to be tested by entering Setup and selecting the model or test configuration in question from the model or test configuration pull-down list. If the model or test configuration is not in the list, add a new model or test configuration to the list on the Setup, Models / Test Configurations screen.

## Error Code: -103

**Message**: Serial number is blank

**Problem**: A blank serial number was received from the controller.

### Probable Solution:

- Ensure the fieldbus/serial connection has been established. Manually send the serial number from the controller, and attempt to read the serial number manually from the digital I/O view. Verify the serial number that was sent from the controller. The serial number must contain at least 1 ASCII character to be valid.

## Error Code: -104

**Message**: Start op received before new part

**Problem**: A 'Start Op' signal was received from the controller, and the 'NewPart' signal was not yet received.

### Probable Solution:

- Verify that the signals can be sent and received properly using diagnostics. Check the logic on the controller side to ensure it follows the rules set in the handshaking specification. Follow the system Handshaking table found in the help or user guide.

## Error Code: -105

**Message**: Serial number invalid

**Problem**: The received serial number does not match the formatting parameters specified.

### Probable Solution:

- Verify that the serial number has been entered/ received correctly. Verify the formatting parameters specified for the serial number in the batch entry setup view.

## Error Code: -106

**Message**: Batch ID invalid

**Problem**: The received batch ID does not match the formatting parameters specified.

### Probable Solution:

- Verify that the batch ID has been entered or received correctly. Verify the formatting parameters specified for the batch ID in the batch entry setup view.

## *Error Code: -107*

**Message**: Operator ID invalid

**Problem**: The received operator ID does not match the formatting parameters specified.

### Probable Solution:

- Verify that the operator id has been entered/received correctly. Verify the formatting parameters specified for the operator id in the batch entry setup view.

## *Error Code: -110*

**Message**: Timeout reading serial number

**Problem**: A timeout occurred while reading the serial number through the serial port.

### Probable Solution:

- Verify that the serial port connection has been established. Manually send a serial number from the controller, and attempt to read the serial port from the Digital I/O View.

## *Error Code: -111*

**Message**: No data from serial port

**Problem**: An error occurred reading the entry data from the serial port. No data was found.

### Probable Solution:

- Verify that the serial port connection has been established. Manually send a serial number from the controller, and attempt to read the serial port from the Digital I/O View.

## *Error Code: -201*

**Message**: Internal temperature out of allowable range

**Problem**: The internal temperature of the sigPOD is outside of its allowable limits - 5 to 50 degrees Celsius.

### Probable Solution:

- If used in extreme conditions, the sigPOD should be enclosed in an air-conditioned cabinet.

## *Error Code: -202*

**Message**: Gateway Warning – Rejected data files = X

**Problem**: Saved history files are being rejected by the Gateway, and are not being sent to the QualityWorX database.

### Probable Solution:

- Probable cause is an invalid model name, serial number, operation, waveform or feature description. Refer to the QualityWorX documentation for the allowable characters that can be used in each description. Note that rejected files must either be deleted or repaired manually in order to be sent to QualityWorX.

## *Error Code: -203*

**Message**: Gateway Warning – Backlogged data files = X

**Problem**: Saved history files are being backlogged by the Gateway, and are not being sent to the QualityWorX server.

### Probable Solution:

- Probable cause is a network or server outage. Once the connection has been restored, the backlogged files will automatically be sent to the QualityWorX server.

## *Error Code: -301*

**Message**: Error reading demo data files for current cycle

**Problem**: No demo data was available for the current cycle.

### Probable Solution:

- Demo data must be placed in the \Runtime\ Data\Application\DemoData folder, and have the filename CCC_OO.WFM where CCC is the cycle count, and OO is the op number.

## *Error Code: -302*

**Message**: Error reading demo data files for current op

**Problem**: No demo data was available for the current operation.

### Probable Solution:

- Demo data must be placed in the \Runtime\ Data\Application\DemoData folder, and have the filename CCC_OO.WFM where CCC is the cycle count, and OO is the op number.

## Error Code: -400

**Message**: "Collect Against" Sensor index invalid

**Problem**: The sensor index that is used to determine which sensor to collect against for the data collection is invalid.

### Probable Solution:

- In the operation configuration table verify the Sample Against sensor selection is properly configured.

## Error Code: -600

**Message**: Processing sensor

**Problem**: A problem occurred while converting the encoder signal to a speed waveform.

### Probable Cause:

- The encoder is not functioning properly.
- The encoder failed to move during the test cycle.

## Error Code: -601

**Message**: Processing waveform

**Problem**: There was a problem processing the specified waveform.

### Probable Solution:

- Ensure that the sensors associated with the waveform are functioning properly.
- Ensure that the processes applied to the waveform have the correct parameters.

## Error Code: -602

**Message**: Analysis error

**Problem**: The feature Start/Stop window is set incorrectly, or there are no waveform points that fall within the analysis range of the feature.

### Probable Solutions:

- Verify that the collected waveform looks correct and compare the range along the X-axis with the feature Start/Stop values.
- Adjust the feature analysis range, or resolve any fault conditions as necessary. For more information, see ***Solution 447: Resolve Fault Err -602 (INVALID FEATURE) in PSV, Feature value -99999*** available through the Sciemetric Support Center at http://support.sciemetric.com.

## *Error Code: -800*

**Message:** 3520 not connected

**Problem:** The leak controller (sigPOD or PC) cannot reach the 3520 leak module.

### Probable Solution:

Verify the network connection and that power is supplied to the target 3520 leak module.

## *Error Code: -806*

**Message**: Command error

**Problem**: The 3520 leak test module received an invalid command or parameter.

### Probable Solution:

If you have configured an operation in Advanced mode, check that all commands are valid by clicking the **Validate** button on the **Operations** setup screen. Review the fault defaults on the **Faults** page for additional clues.

## *Error Code: -809*

**Message**: Waveform configuration error

**Problem**: A waveform within the operation is not referencing to the proper platform (sigPOD or 3520 leak test unit).

### Probable Solution:

Review all waveforms within the operation and verify that the Y Input and X Input as set correctly.

## 3520 Leak Test error messages

For error messages related to tests with the 3520 Leak Test Module, see the **3520 Leak Test Module Troubleshooting Guide** available through the Sciemetric Support Center at *http://support.sciemetric.com*.

# Appendix B: EtherNet/IP setup guide

This section outlines the EtherNet/IP configuration and troubleshooting steps for stations running sigPOD PSV version 5.1 or higher and InspeXion version 8.X or higher.

Configuring the EtherNet/IP for the sigPOD test and monitoring system includes the following steps:

- *Configuring EtherNet/IP on the PLC*
- *Configuring EtherNet/IP on the sigPOD*

For some of the programming terms used in this section, see *Table 53*.

***Table 53*** *Definitions of programming terms*

| Term | Definition |
|---|---|
| Class or Object Class | a group of Objects or Instances |
| Instance | an Object |
| Service | a code that defines a request, e.g. Get_Attribute_Single |
| Attribute | the actual data that can be read or written for a Class or Instance in a Class |

## Configuring EtherNet/IP on the PLC

Configuring EtherNet/IP on the PLC side includes the following steps:

- *Configuring handshaking on the PLC side*
- *Configuring the serial number on the PLC side (Optional step)*
- *Configuring the Model label on the PLC side (Optional step)*
- *Configuring results data on the PLC side (Optional step)*

### *Configuring handshaking on the PLC side*

To configure the PLC handshaking, you need the electronic device data sheet file (.EDS) available through the Sciemetric Support Center at *http://support.sciemetric.com*. The data element configurations must be programmed manually and are summarized as comments in the EDS file for the convenience of the PLC programmer.

**Note:** Since PLC software varies, the EDS file is not always necessary. For example, if you are using a Compact Logix with RS 5000 software, you do not need the EDS file. However, if you are using a SLC Family Allen Bradley PLC, you must use the EDS file.

sigPOD PSV uses two Class 1 Assembly connections to support real-time exchange of digital inputs and outputs for handshaking:

Assembly 100 – Data Consumer (i.e. Digital Inputs) of 4 bytes

Assembly 101 – Data Producer (i.e. Digital Outputs) of 4 bytes

This interface uses *implicit* messaging to transfer data which occurs automatically in the background and is also referred to as real-time I/O control.

InspeXion uses CIP Parameter Objects for the exchange of the serial number and result data. This interface uses explicit messaging to transfer data which occurs only upon request.

See *Table 54* and *Table 55* for handshaking inputs and outputs. Note that when leak sequencing for third-party leak testers is enabled, physical digital inputs are not available, including the alarm output. For more information, see *"Enabling leak sequencing for a third-party leak tester" on page 146*.

When the sigPOD activates an output, the appropriate bit in the input byte on the PLC will activate. When the PLC activates an output bit, the appropriate input on the sigPOD will activate. Refer to *Figure 69 on page 213* for a setup of an automatic cycle.

***Table 54*** *Handshaking – Sciemetric Inputs (Consumer), Byte 0 for EtherNet/IP and PROFINET*

| Input Bit | Description of the Signal |
|---|---|
| 0 | New part |
| 1 | Start operation |
| 2 | Not used |
| 3 | Not used |
| 4 | Not used |
| 5 | Not used |
| 6 | Abort test |
| 7 | Not used |
| 8 | Model bit 0 |
| 9 | Model bit 1 |
| 10 | Model bit 2 |
| 11 | Model bit 3 |
| 12 | Model bit 4 |
| 13 | Model bit 5 |
| 14 | Model bit 6 |
| 15 | Not used |

***Table 54*** *Handshaking – Sciemetric Inputs (Consumer), Byte 0 for EtherNet/IP and PROFINET*

| Input Bit | Description of the Signal |
|---|---|
| 16 | Operation 0 enable |
| 17 | Operation 1 enable |
| 18 | Operation 2 enable |
| 19 | Operation 3 enable |
| 20 | Operation 4 enable |
| 21 | Operation 5 enable |
| 22 | Operation 6 enable |
| 23 | Operation 7 enable |

**Note:** See *Table 17 on page 89* for information about using the **Operation Enable** inputs.

***Table 55*** *Handshaking – Sciemetric Outputs (Producer), Byte 0 for EtherNet/IP and PROFINET*

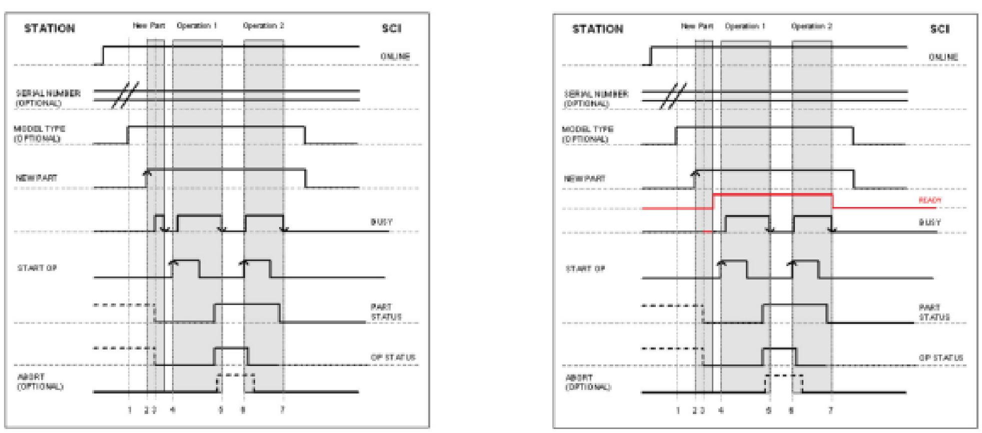
| Output bit | Description of the signal |
|---|---|
| 0 | Online |
| 1 | Busy |
| 2 | Overall part status |
| 3 | Operation status (for the last operation) |
| 4 | Ready |
| 5 | Not used |
| 6 | Not used |
| 7 | Alarm |
| 8 | Not used |
| 9 | Not used |
| 10 | Not used |
| 11 | Not used |
| 12 | Not used |

*Table 55 Handshaking – Sciemetric Outputs (Producer), Byte 0 for EtherNet/IP and PROFINET*

| Output bit | Description of the signal |
|---|---|
| 13 | Not used |
| 14 | Not used |
| 15 | Not used |
| 16 | Operation 0 status |
| 17 | Operation 1 status |
| 18 | Operation 2 status |
| 19 | Operation 3 status |
| 20 | Operation 4 status |
| 21 | Operation 5 status |
| 22 | Operation 6 status |
| 23 | Operation 7 status |

**Note:** When the **Use Operation Enables** check box is selected on the Digital I/O screen, each "Operation X status" bit will reflect its corresponding operation status at the end of the test.

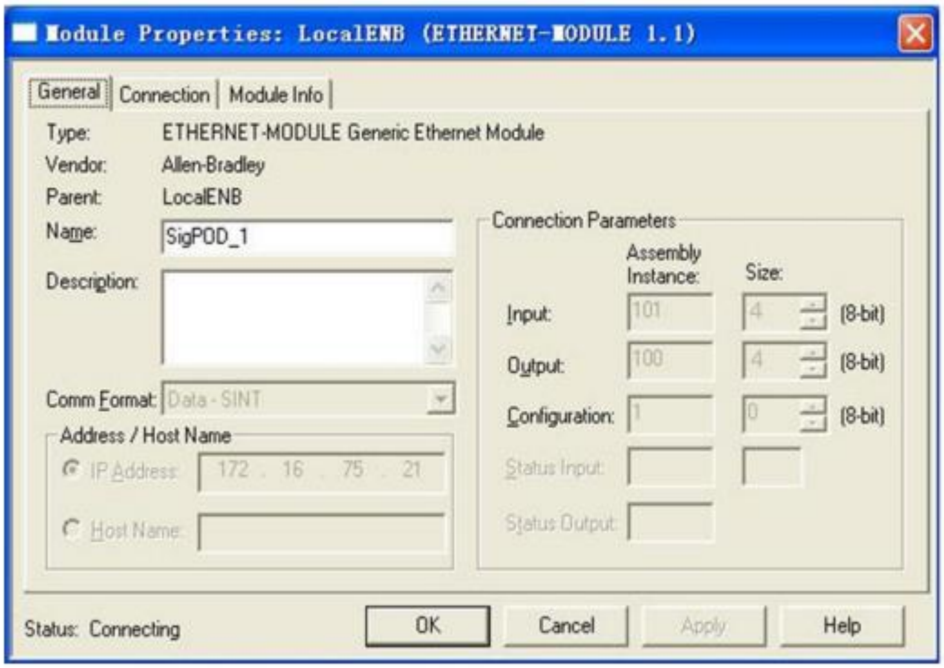
*Figure 69 sigPOD PSV handshaking timing diagrams - standard and ready-bit*



For the PLC handshaking configuration, use the following parameter values. See *Figure 70* for an example.

- Connection Module type – set to Generic Ethernet Module
- Module IP address – set to match the IP address of the sigPOD
- Input Instance – connection point set to 101 and data size to 4 bytes (32 bits)
- Output Instance – connection point set to 100 and data size to 4 bytes (32 bits)
- Configuration Instance – connection point set to 1 and data size to zero (0)

*Figure 70 Example: PLC RS-Logix setup for handshaking communication*




## *Configuring the serial number on the PLC side (Optional step)*

The serial number is handled as Parameter data (explicit messaging). It is read in as a string of up to 64 characters (all data beyond the first 64 bytes are ignored). Only the following characters are valid for use in the serial number: all alphanumeric characters, <space> ( ) - / [ \ ] _

To transfer the serial number from the PLC, a 'write' message instruction must be created in the ladder logic. Set the following configuration within the message instruction of the Generic Ethernet Module:

**Service = 10 (Set_Attribute_Single)**

**Class = 0F (For Parameter Object Class)**

**Instance = 09 (For Part Serial Number)**

**Attribute = 01 (For Parameter Value)**

When the serial number setup is ready, the PLC programmer can then issue a send request command to transfer the serial number to the sigPOD PSV application (execute the message instruction).

On the sigPOD, in the PSV application, the user can retrieve the serial number by clicking the **Read Serial Number** button on the **Data Input** setup screen.

For information about testing multiple parts at the same time, see *"Serial numbers for multiple operations with multiple parts" on page 104*, and *"Data Output Format" on page 105*.

### *Example 1*

See *Figure 71* and *Figure 72* for an example setup on a PLC RS-Logix. In these example screens, notice the following settings:

- The Source Element parameter (*Figure 71*) must be the string in the PLC that contains the serial number.
- The Source Length must be equal to or greater than the length of the source string plus the header size.
- In the Communication tab (*Figure 72*), the Path points to the connected sigPOD module whose EDS file you used to configure the handshaking.
- The Connected check box (*Figure 72*), is selected to enable communication.

### *Example 2*

Example Request Data = 08 00 49 50 51 52 53 54 55 56

“08 00” = Size of the serial number in bytes. This is part of the header and sometimes not seen. In this case, the header size is 2 bytes.

“49 50 51 52 53 54 55 56” = The serial number in ASCII format. In this example, the serial number to be sent is “12345678”

**Note:** On some PLC configuration programs, the header data may not be visible and is automatic in the exchange of data. For most newer Allen Bradley PLCs, the header size is 4 bytes. Ensure you have set the correct header size in the *System Shell* setup screen. The default setting is the System Shell is 2 bytes, but you can change it to 4. To change the header size, see *"Configuring EtherNet/IP parameters in the System shell" on page 219*.

## *Configuring the Model label on the PLC side (Optional step)*

By default, Model Label and Test Configuration input are linked. With this default option, the Model label cannot be read from the PLC; it is taken from the table in the Models setup screen.

If you disable the default option and separate Model Label and Test Configuration data, the Model label input must be read from the PLC and is handled as Parameter data (explicit messaging). It is read in as a string of up to 25 characters (all data beyond the first 25 bytes are ignored). Only the following characters are valid for use in the Model label: all alphanumeric characters, <space> ( ) - / [ \ ] _

To transfer the Model label from the PLC, a 'write' message instruction must be created in the ladder logic. Set the following configuration within the message instruction of the Generic Ethernet Module:

**Service = 10 (Set_Attribute_Single)**

**Class = 0F (For Parameter Object Class)**

**Instance = 25 or 19 hex (For Model label)**

**Attribute = 01 (For Parameter Value)**

When the Model label setup is ready, the PLC programmer can then issue a send request command to transfer the Model label to the sigPOD PSV application (execute the message instruction).

On the sigPOD, in the PSV application, the user can retrieve the Model label by clicking the **Read Model Label** button on the **Data Input** setup screen.

## *Configuring results data on the PLC side (Optional step)*

The results data is sent to the PLC starting at instance 10. If each operation is run separately (one at a time), the result will always be stored to instance 10. If in the PSV application, **Operations** setup screen, the **Collect All Operations** check box is enabled, each operation result will be stored to a separate instance as indicated in *Table 56*. To transfer the results data to the PLC, a 'read' message instruction must be created in the ladder logic for each instance. *Table 56* summarizes the available data.

**Note:** If the results string is longer than 492 characters, and sequential operations are used (**Collect All Operations** on the **Operations** setup screen is not enabled), the string will be split into chunks across multiple subsequent instances. Up to 8 instances can be accommodated (i.e., 3936 characters).

***Table 56*** *Instances*

| Instance | Input | Output | Format |
|---|---|---|---|
| 9 | Serial Number | | String (csv) |
| 10 | | Operation 0 Results (or the most recent operation, if operations are run in sequence) | String (csv) |
| 11 | | Operation 1 Results if at same time | String (csv) |
| 12 | | Operation 2 Results if at same time | String (csv) |
| 13 | | Operation 3 Results if at same time | String (csv) |
| 14 | | Operation 4 Results if at same time | String (csv) |

**Table 56** *Instances (Continued)*

| Instance | Input | Output | Format |
|---|---|---|---|
| 15 | | Operation 5 Results if at same time | String (csv) |
| 16 | | Operation 6 Results if at same time | String (csv) |
| 17 | | Operation 7 Results if at same time | String (csv) |
| 18 | | Operation 8 Results if at same time | String (csv) |
| 19 | | Operation 9 Results if at same time | String (csv) |
| 20 | | Operation 10 Results if at same time | String (csv) |
| 21 | | Operation 11 Results if at same time | String (csv) |
| 22 | | Operation 12 Results if at same time | String (csv) |
| 23 | | Operation 13 Results if at same time | String (csv) |
| 24 | | Operation 14 Results if at same time | String (csv) |
| 25 | Model label | | String (csv) |

To read data into the PLC, set the following configuration within the 'read' message instruction of the Generic Ethernet Module:

**Service = 0E (Get_Attribute_Single)**

**Class = 0F (For Parameter Object Class)**

**Instance = 10 or 0A hex *(or whichever Instance is to be read, see *Table 56*)**

**Attribute = 1 (For Parameter Value)**

## *Example 1*

See *Figure 71* and *Figure 72* for an example setup on a PLC RS-Logix. In these example screens, notice the following settings:

- The Destination parameter (*Figure 71*) must be the tag where the data will be saved in the PLC. This tag must be formatted to match the format of the instance that is read.
- In the Communication tab (*Figure 72*), the Path points to the connected sigPOD module whose EDS file you used to configure the handshaking.
- The Connected check box (*Figure 72*) is selected to enable communication.

Figure 71 Example PLC RS Logix setup - Configuration tab

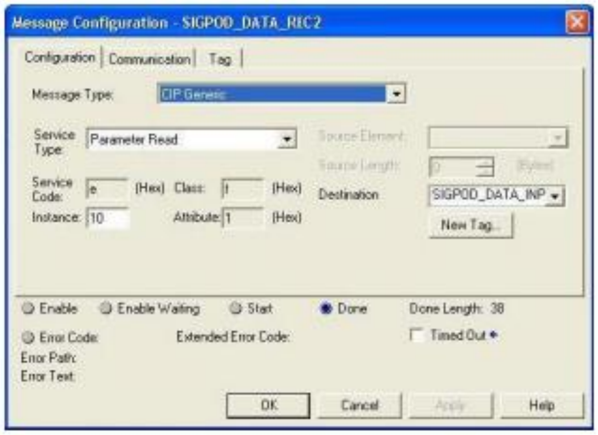
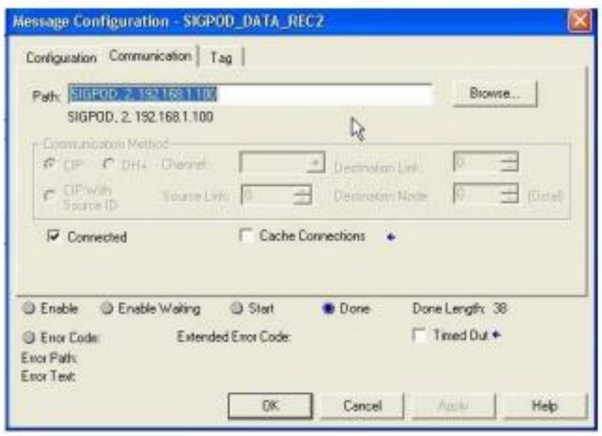



Figure 72 Example PLC RS Logix setup - Communication tab




## *Example 2: excerpt from an EDS file*

In the EDS file excerpt below, instance 9 (Param9) is the serial number input string and instance 10 (Param10) is the results data output string.

Param8 =

0, $ reserved, shall equal 0

,, $ Link Path Size, Link Path

0x0010, $ Descriptor

0xC7, $ Data Type

2, $ Data Size in bytes

"App Ver Minor", $ name

"", $ units

"", $ help string

0,0xFFFF,5, $ min, max, default data values

,,,, $ mult, div, base, offset scaling

,,,, $ mult, div, base, offset links

; $ decimal places

Param9 = 0, ,"", 0x0000, 0xD0, 1, "SN;EIP;STRING", "", "", 0,494,"", ,,,, ,,,, ;

Param10 = 0, ,"", 0x0000, 0xD0, 1, "EIP;Resultsd;01", "", "", 0,494,"", ,,,, ,,,, ;

## Configuring EtherNet/IP on the sigPOD

Configuring EtherNet/IP on the sigPOD includes the following steps:

- *Configuring EtherNet/IP parameters in the System shell*
- *Setting a fixed TCP/IP address*
- *Configuring handshaking in the PSV application*
- *Configuring Serial Number input in the PSV application*
- *Configuring Results data in the PSV application (optional step)*

### *Configuring EtherNet/IP parameters in the System shell*

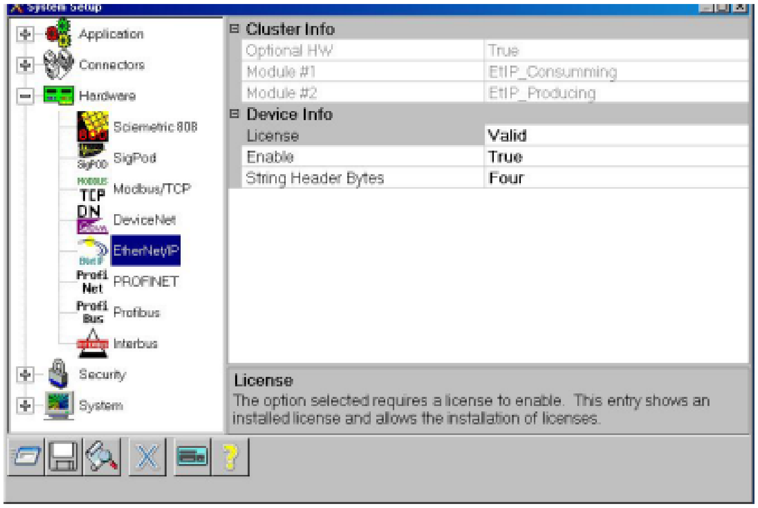
Before you can configure the EtherNet/IP parameters in the System shell, ensure that a valid EtherNet/IP driver license has been installed. For information about requesting and importing a license, see the "Licensing Process" section in the ***InspeXion System Setup User Guide*** available through the InspeXion system shell help.

#### To configure the EtherNet/IP parameters in the System Shell

1. Click the **Setup <F8>** button on the **System Shell** toolbar.
2. In the **System Setup** dialog box, left panel, click the plus sign next to **Hardware** to display the Hardware options, and select **EtherNet/IP**.
3. In the **Device Info** area, ensure the **License** value is **Valid** (see *Figure 73*).
4. Click in the **Enable** field, and choose **True** from the drop-down list.
5. Click in the **String Header Bytes** field, and choose the number of string header bytes to match the PLC output.

**Note** The available values are **Two** and **Four** and the correct value depends on the PLC model.

*Figure 73 System Setup dialog box, Hardware, EtherNet/IP screen*



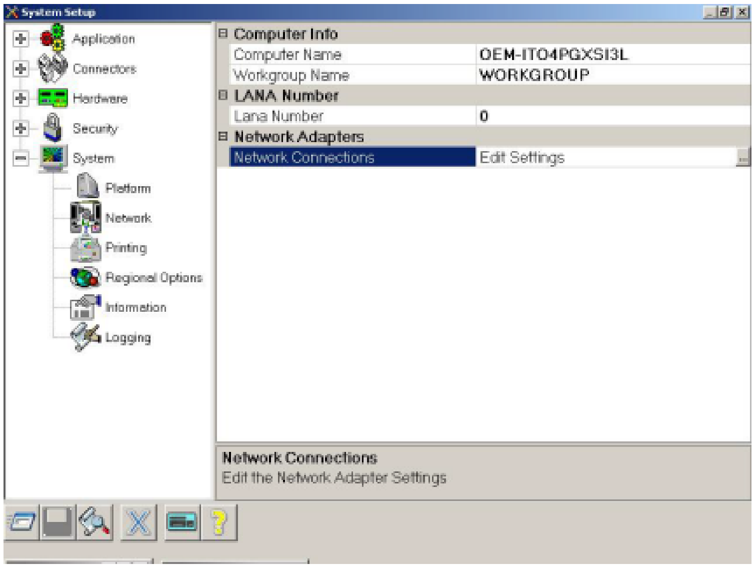

## *Setting a fixed TCP/IP address*

You can set a fixed TCP/IP address through the **Local Area Connection Properties** dialog box.

### To set a fixed TCP/IP address

1. Click the **Setup <F8>** button on the **System Shell** toolbar.
2. In the **System Setup** dialog box, left panel, click the plus sign next to **System** to display the System options, and select **Network** (see *Figure 74*).
3. In the **Network Adapters** area, click in the **Network Connections** field, and then click the **View more** button to open the **Network Connections** dialog box.
4. Right-click the **Local Area Connection** icon, and click **Properties** from the pop-up menu to open the **Local Area Connection Properties** dialog box.
5. In the **General** tab, scroll in the list, select **Internet Protocol (TCP/IP)**, and click the **Properties** button.
6. In the **Internet Protocol (TCP/IP) Properties** dialog box, enable the **Use the following IP address** option, and type the IP address.

Figure 74 System Setup dialog box, Network screen




## Configuring handshaking in the PSV application

When EtherNet/IP is installed on the sigPOD test system, the physical digital inputs and outputs are disabled internally (except for Digital Input 7) and all digital inputs and outputs are directed to the PLC through the EtherNet/IP.

For PLCs that do not support implicit messaging, (i.e., handshaking through the EtherNet/IP), you can force the PSV application to use physical I/O instead of EtherNet/IP.

### To configure handshaking in the PSV application

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. In the Navigation pane, click the **Digital I/O** button to open the **Digital I/O** setup screen.
3. Ensure that the **Use sigPOD physical I/O** check box is disabled. (See *Figure 75*.)

   **Note** If your PLC does not support handshaking over EtherNet/IP, enable the **Use sigPOD physical I/O** check box to force discrete handshaking.

*Figure 75 Digital I/O setup screen*


## Configuring Serial Number input in the PSV application

To be able to retrieve the part serial number over the EtherNet/IP, you have to configure the serial number entry in the **Data Input** setup screen.

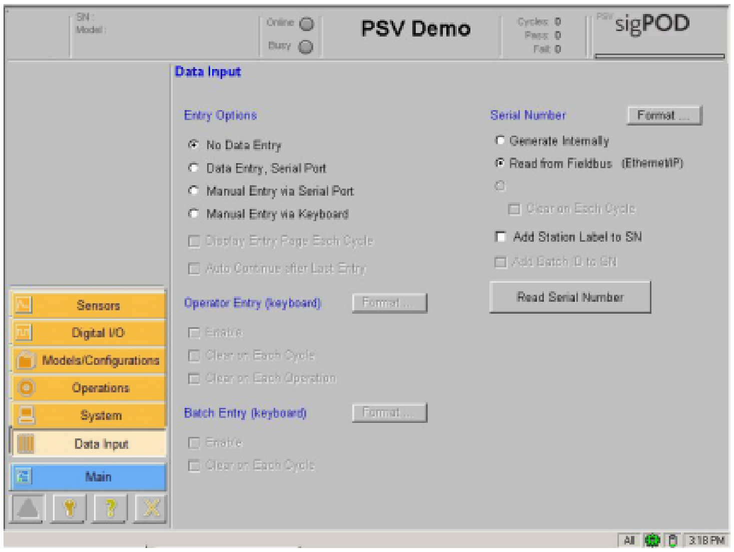
### To configure the serial number input

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. In the Navigation pane, click the **Data Input** button to open the **Data Input** setup screen.
3. In the **Entry Options** area, choose **No data entry**. (See *Figure 76*).
4. In the **Serial Number** area, choose **Read from fieldbus (EtherNet/IP)** option.

   **Note 1:** If you want to specify a custom format for the serial number, click the **Format** button in the **Serial Number** area, choose the desired options in the **Serial Number Format** screen, and click the **Back** button.

   **Note 2:** If the PLC is programmed correctly, clicking the **Read Serial Number** button displays the serial number in the bottom-left corner of the **Data Input** setup screen.

*Figure 76 Data Input setup screen*




## *Configuring Results data in the PSV application (optional step)*

By default, results data is not sent out by the sigPOD to the PLC. If your sigPOD test system has an active Ethernet driver, you can enable this option. You can also specify a custom format for the results data by omitting some of the parameters or adding an optional **Feature Limits** parameter.

The results are written out as an ASCII string with each feature value separated by a comma (CSV format). The default format of the results data for each operation is as follows:

**Cycle Number, Operation Index, Serial Number, Model Label, Operation Status, Feature1 Value, Feature2 Value,...FeatureN Value**

If you include the optional **Feature Limits** parameter, the results data is as follows:

**Cycle Number, Operation Index, Serial Number, Model Label, Operation Status, Feature1 Value, Feature1 Lower Limit, Feature1 Upper Limit, Feature2 Value, Feature2 Lower Limit, Feature2 Upper Limit, ...FeatureN Value, FeatureN Lower Limit, FeatureN Upper Limit**

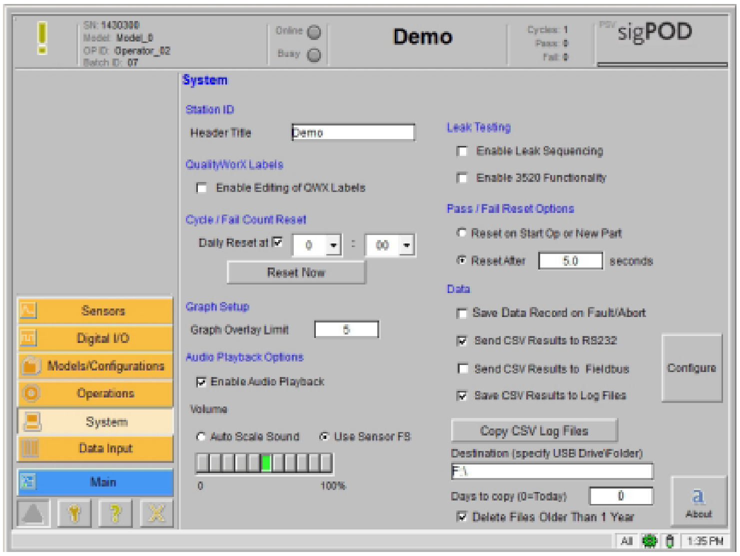
For more information about results data, see *"Data Output Format" on page 105*.

### To configure the Results data

1. Enter Setup mode. See *"Entering Setup Mode" on page 85*.
2. In the Navigation pane, click the **System** button to open the **System** setup screen.
3. In the **Results Data** area, enable the **Send Results to Ethernet/IP** check box (see *Figure 77*).

**Note** If you want to specify a custom format for the results data, click the **Configure** button in the **Results Data** area, choose the desired options in the **Results Configuration** screen, and click the **Back** button.

*Figure 77 System setup screen*




## Troubleshooting

**Problem**: The handshaking signals are not working.

Possible causes and solutions:

- If a “connection request error – module owned and configured by another controller” occurs on the PLC, you have the same connection point for two instances in the Generic Ethernet Module configuration.
- If an Invalid Segment Type error occurs on the PLC, you have the wrong data size selected for one or more instances.
- If a “connection timeout” error occurs on the PLC, the network link is broken or the IP address on the sigPOD configuration does not match the IP address on the PLC Generic Ethernet Module configuration.
- If handshaking cannot be established after the above steps are completed, ensure that there are no software firewalls blocking communication on both the PLC and the sigPOD.

**Problem**: The serial number is not being read by the sigPOD.

Possible causes and solutions:

- Certain PLCs may not require header data to be added manually to the string when sending data (the header is sent automatically in the background). Please consult with the PLC manufacturer or programmer to verify what may be required.
- Change the number of header bytes in the InspeXion System shell, System Setup screen, Hardware, EtherNET/IP screen (see *Figure 73 on page 220*).
- Verify that the serial number contains only alphanumeric characters or any of the following: <space> ( ) - / [ \ ] _
- Verify that the IP address is correct and the PLC can be pinged from the sigPOD.
- The serial number must be explicitly sent by the PLC ladder logic.
- The serial number must be sent before the New Part or Start triggers.
- The serial number must be written to instance 9.

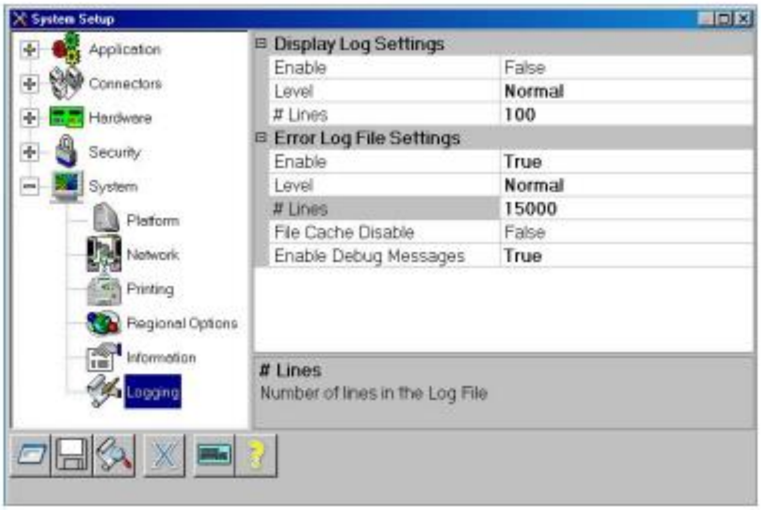
### To solve all other issues not covered in this section

1. Enable Error Logging and Debug messaging. See the following procedure.
2. Recreate the issue and send the following to Sciemetric Support:
   - Full back up of your system
   - Examples of data string sent or received, or copies of Logic being used

### To enable error logging and debug messaging

1. Click the **Setup <F8>** button on the **System Shell** toolbar.
2. In the **System Setup** dialog box, left panel, click the plus sign next to **System** to display the System options, and select **Logging** (see *Figure 78*).
3. In the **Error Log File Settings** area, click in the **Enable** field, and choose **True** from the drop-down list.
4. Click in the **Level** field, and choose **Normal** or **Maximum** from the drop-down list.
5. In the **# Lines** field, type **15000** or a higher value.
6. Click in the **Enable Debug Messages** field, and choose **True** from the drop-down list.

Figure 78 System Setup dialog box, Error Logging screen



# Appendix C: PROFINET setup guide

Sciemetric hardware is supported on the PROFINET network as a "PROFINET IO Device" and is connected to the PLC through an RJ-45 connector.

Configuring PROFINET for the sigPOD test and monitoring system includes the following steps:

- *"Configuring PROFINET on the PLC" on page 227*
- *"Configuring PROFINET on the sigPOD" on page 228*

## Configuring PROFINET on the PLC

Configuring PROFINET on the PLC is usually done by the plant control engineer.

**Requirement**

Before you begin the PROFINET setup, ensure you have the following files:

- GSDML-V2.1-Sciemetric-PNIO-20100323.xml to be used with Win 7

  InspeXion 8.00 - 8.01.422 only.
- GSDML-V2.32-Sciemetric-PNIO-20170706.xml to be used with Win 7 /

  Win 10 with InspeXion 8.01.436 or later only.
- SciemetricLogo1.bmp

  You can obtain these files from the InspeXion application engineer.

### To configure PROFINET on the PLC

1. Install the appropriate GSDML file and the SciemetricLogo1.bmp files in the PLC program.

   **Note:** These instructions are valid for Siemens Step 7 or similar engineering software.
2. In the PLC program, insert the Sciemetric Device into the PROFINET network.
3. In the PLC program, add the four modules required by the InspeXion application to the Sciemetric Device:
   - Slot 1 - Digital 32 Bit Input/Output module (handshaking bits)

     For information about handshaking inputs and outputs, see *Table 54* and *Table 55*.
   - Slot 2 - Virtual 64 Byte Input/Output module - Serial Number

     **Note 1:** The first character of the Serial Number must be written to byte zero (0) of Slot 2. It can be up to 64 characters in length.

     If you disable the default option and separate Model Label and Test Configuration data, the Model label input must be provided by the PLC.

     **Note 2:** For information about testing multiple parts at the same time, see *"Serial numbers for multiple operations with multiple parts" on page 104*, and *"Data Output Format" on page 105*.
   - Slot 3 - Virtual 128 Byte Input/Output module (results)

     Slot 3 is a 128 bytes virtual I/O with a usable size of 4000 bytes and contains all results output.

**Note:** For instructions on retrieving the results, see Solution 00000517 “Communicate via PROFINET (Usable Size)” available through the Sciemetric Support Center at *http://support.sciemetric.com*.

- Slot 4 - Virtual 64- Byte Input/Output module (Model label when Model and Test Configuration are separated).

  **Note:** The Model label can be up to 25 characters in length.

The following is true for the PROFINET results output:

- The standard results data format is followed only for the data from the first operation. For more information, see *"Data Output Format" on page 105*.
- The results data from each subsequent operation (i.e., after the first operation) is appended to the existing data string, in order, and does not include the following values: Cycle Number, Serial Number, and Model Label. Also, a hash character (#) is appended at the end of each operation’s results data.

  For example, if there are five operations and PROFINET results are used, the default results data would be as follows:

  Cycle Number, 0, Serial Number, Model Label, Operation Status, Feature1Value, Feature2Value,...FeatureNValue# 1, Operation Status, Feature1Value, Feature2Value,...FeatureNValue#2, Operation Status, Feature1Value, Feature2Value...FeatureNValue#3, Operation Status, Feature1Value, Feature2Value,...FeatureNValue#4, Operation Status, Feature1Value, Feature2Value,...FeatureNValue#

The results data is overwritten each time a part test is run.

## Configuring PROFINET on the sigPOD

Configuring PROFINET on the sigPOD is done in the InspeXion System Shell and the MS Network Connections panel.

### Requirements

Before you begin, ensure that the following requirements have been met:

- An application SPX file that supports PROFINET communications has been installed on the sigPOD or PC controller.
- You have the PROFINET Device name, IP address, and required SubNet Mask and Default Gateway (if required) for the Sciemetric device or PC. These should be agreed upon by the plant control engineer responsible for the PLC setup and the InspeXion application engineer.
- The sigPOD or PC has a valid PROFINET license. See *Activating a PROFINET license*.
- You have the PROFINET Adapter Driver name. See *Configuring PROFINET parameters in the InspeXion System Shell*.

## *Activating a PROFINET license*

You can activate a PROFINET license on Windows 7 or 10 operating system by entering the PROFINET product key in the Softing License Manager.

**Requirements:**

Before you can activate the PROFINET license, ensure that:

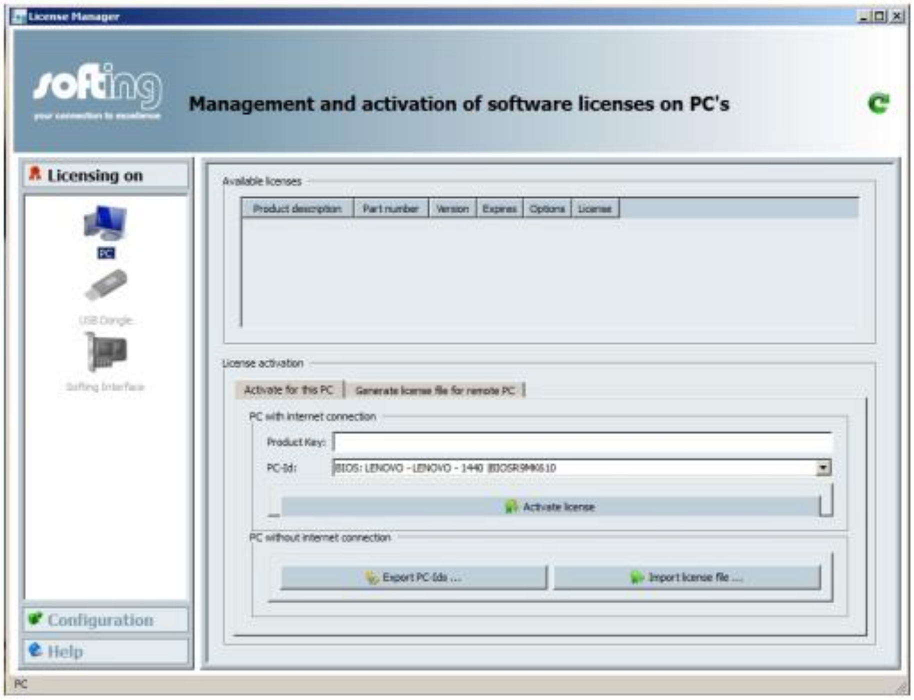
- You have the PROFINET product key. (You obtain the product key with your purchase of PROFINET.)
- The PC or sigPOD controller has an internet connection or there is another computer with an internet connection.

### To activate a PROFINET license

1. Click the **Setup <F8>** button on the **System Shell** toolbar top open the **System setup** screen.

   **Note:** If you are running PSV 5.X on a regular PC (i.e., not on a sigPOD), click the **Start** button on the Windows task bar and point to **All Programs, Sciemetric, System Setup** on Windows 7, or to **Sciemetric, System Setup** on Windows 10 IoT.
2. In the **System Setup** dialog box, left panel, click the plus sign next to **Hardware** to display the Hardware options, and select **PROFINET**.
3. In the **Device Info** area, click in the **License** field, and then click the **View more** [...] button to open the **Softing License Manager** dialog box (see *Figure 79*).
4. Do one of the following:
   - If the PC or sigPOD has an internet connection, enter the product key in the **Activate for this PC** tab, and click **Activate license**.
   - If the PC or sigPOD does not have an internet connection, click the **Help** button in the bottom left corner of the License Manager, and then click **License activation** in the Help navigation bar. Follow the procedure "Licensing on PC without internet connection".

*Figure 79 Softing License Manager dialog box*




## *Obtaining the PROFINET Adapter Driver name*

You can obtain the PROFINET Adapter Driver name through the Control Panel. The PROFINET Adapter Driver name allows the PROFINET driver to detect which network card to use for PROFINET communications on the Sciemetric system.

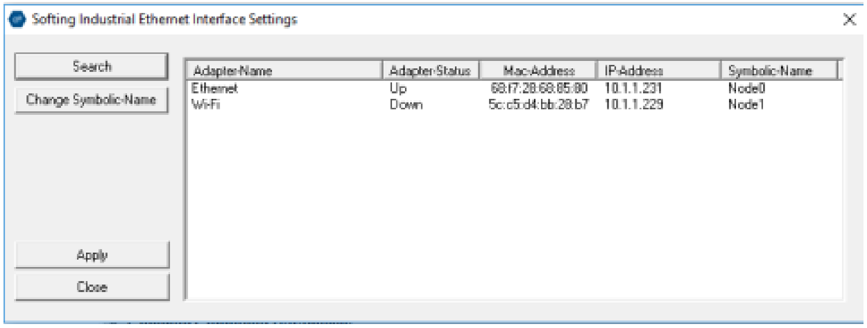
### To obtain the PROFINET Adapter Driver name

1. Click the **Setup <F8>** button on the **System Shell** toolbar.
2. Click , enter **control** in the **Run** dialog box, and click **OK**.

   The Control Panel opens.
3. Search for, then open **Softing Industrial Ethernet Interface Settings**.

   The Symbolic-Name column shows the name of the adapter. The Softing installation program assigns the default names Node0, Node1, Node2.

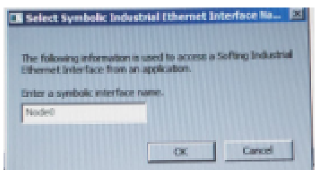
*Figure 80 Showing symbolic name*




You will need this symbolic name when you set up the PROFINET parameters in the InspeXion System Shell. You will enter this name in the InspeXion System Shell.

4. Click **Change Symbolic-Name**, then click **OK**. **This is important in order for the PROFINET driver to initialize properly, even if you choose not to change the symbolic name.**

*Figure 81 Changing symbolic name*




If you want to change the name, see *Changing the symbolic name*.

5. Click **Apply**, then **Close**.
6. Open the InspeXion System Setup, and select **Hardware, PROFINET**.
7. In the **Adapter Driver Name** field, enter the symbolic name from the **Softing Industrial Ethernet Interface Settings** dialog box.
8. Continue to configure PROFINET in the System Setup as needed.
9. Save your changes.

## *Changing the symbolic name*

You can change the symbolic name of the adapter.

### To change the symbolic name

1. Open **Softing Industrial Ethernet Interface Settings** and select an adapter name.
2. Click **Change Symbolic-Name**. See *Figure 81 on page 231*.
3. Enter the new name and click **OK**.
4. Click **Apply**, then **Close**.
5. Open the InspeXion System Setup, and select **Hardware, PROFINET**.

6. In the **Adapter Driver Name** field, enter the new symbolic name from the **Softing Industrial Ethernet Interface Settings** dialog box.
7. Continue to configure PROFINET in the System Setup as needed.
8. Save your changes.

## *Configuring PROFINET parameters in the InspeXion System Shell*

Before you configure the PROFINET parameters in the system shell, ensure you have the PROFINET Adapter Driver name, IP address, Subnet mask, and Default Gateway (if required) for the sigPOD test and monitoring system. For information about how to obtain these, see *"Requirements" on page 228*.

### To configure the PROFINET parameters in the System Shell

1. Click the **Setup <F8>** button on the **System Shell** toolbar.
2. In the **System Setup** dialog box, left panel, click the plus sign next to **Hardware** to display the Hardware options, and select **PROFINET**.
3. In the **Device Info** area, ensure the **License** value is **Valid**.
4. Click in the **Enable** field, and choose **True** from the drop-down list.
5. In the **Device Name** field, type the name of the sigPOD system as it appears in the PLC interface.
6. In the **Adapter Driver Name** field, type the PROFINET Adapter Driver name.
7. In the **IP address** field, type the IP address as it appears in the PLC interface.
8. In the **Subnet Mask** field, type the correct value.

   **Note:** The Subnet Mask value depends on the network configuration.
9. Click the plus sign next to **Module #1**, then click in the **Enabled** field, and choose **True** from the drop-down list.
10. Click the plus sign next to **Module #2**, then click in the **Enabled** field, and choose **True** from the drop-down list.
11. Click the plus sign next to **Module #3**, then click in the **Enabled** field, and choose one of the following:
    - **True** – if results are passed to the PLC
    - **False** – if results are not passed to the PLC
12. Click the plus sign next to **Module #4**, then click in the **Enabled** field, and choose one of the following:
    - **True** – if the model label is sent by the PLC
    - **False** – if the model label is not sent by the PLC

## *Setting the Internet Protocol (TCP/IP) properties*

When configuring PROFINET on the sigPOD test system, the values for the IP address, Subnet mask, and Default Gateway must be the same on the **PROFINET Setup** screen in the System Shell (see the previous procedure) and the **Internet Protocol (TCP/IP) Properties** screen for the network adapter the PROFINET cable is plugged into.

### To set the Internet Protocol (TCP/IP) properties

1. Click the **Setup <F8>** button on the **System Shell** toolbar.
2. In the **System Setup** dialog box, left panel, click the plus sign next to **System** to display the System options, and select **Network**.
3. In the **Network Adapters** area, click in the **Network Connections** field, and then click the **View more** button to open the **Network Connections** dialog box.
4. Right-click the **Local Area Connection** icon for the network to which the PROFINET cable is connected to, and click **Properties** from the pop-up menu to open the **Local Area Connection Properties** dialog box.

   **Note:** If the unit has more than one network adapter, ensure you right-click the icon for the adapter to which the PROFINET cable is plugged into.
5. In the **This connection uses the following items** list, select **Internet Protocol (TCP/IP)**, and click the **Properties** button.
6. In the **Internet Protocol (TCP/IP) Properties** dialog box, enable the **Use the following IP address** option.
7. Type the IP address as it appears in the PROFINET System Shell setup. See *"Configuring PROFINET parameters in the InspeXion System Shell" on page 232*.
8. Type the Subnet mask value as it appears in the PROFINET System Shell setup.
9. Type the Default gateway value as it appears in the PROFINET System Shell setup.
10. Click **OK**.

# Appendix D: The Leak Tuner Assistant

This section outlines how to operate the Leak Tuner Assistant and adjust the tuning settings and results. It is to be used in conjunction with the *3520 Leak Test Module User Guide*.

The 3520 Leak Test system provides pressure control using PID controller software. To ensure parts get filled optimally, the PID parameters must be specified correctly. Connection tube length and size, supply pressure, and part volume affect the PID values required to properly fill a part.

Previously, you would have to manually configure the PID settings and test timings to fill the part as quickly and accurately as possible using the PSV Operations, Basic Configuration screen (see *"Setting up a 3520 leak test using the Basic Configuration method" on page 174*). The Leak Tuner Assistant algorithms automate much of the tuning process to determine optimal parameters with some user input.

**Note:** These algorithms will also work if you are using a 10500-3520-MC31 external multiplexer valve accessory (that is, a 3/2-way external non-latching valve) with your 3520 Leak Test unit, Model C. However, currently the algorithms will not work with the other external multiplexer valve accessories.

## Before you start

Before you start the tuning process, keep in mind the following:

- If you are using the full PSV application, you can access the Leak Tuner Assistant screen from an Operations setup screen in Basic Configuration only. For more information, see *"Setting up a 3520 leak test using the Basic Configuration method" on page 174*.
- If you are using the stand-alone Leak Tuner application, the Leak Tuner Assistant is the only accessible screen.
- You can abort the current tuning process mid-cycle at any time.
- You cannot adjust parameters during the automated portion of the tuning process.
- You can input values and make manual tuning adjustments, when prompted, during the tuning process.
- Parameters that are automatically modified are displayed in bright blue font. User-specified settings are displayed in black font.
- If you are using the full PSV application, you cannot edit the model label, operation description, and 3520 module number on the Leak Tuner Assistant screen. You can edit these on other screens.

  **Note:** In PSV, you can click **Back** to return to the Operations setup screen. If any parameters are changed, a prompt to save the settings is displayed. The algorithm settings are saved under the selected operation. You can use different settings for different operations/models.

## Installing the Leak Tuner Assistant

You can run the Leak Tuner Assistant from PSV, or as a stand-alone application if you do not have PSV.

If you have PSV:

1. Contact Sciemetric Support at *support@sciemetric.com* to get the 3520 Leak Template with Leak Tuner Algorithms for PSV 5.2+ file.
2. From InspeXion, do the following:
   - Create a backup of the current setup.

     **Note**: For information about creating a backup, see the online help in the InspeXion Backup utility, which is accessed through the InspeXion System Shell.
   - Install, then run the 3520 Leak Template with Leak Tuner Algorithms for PSV 5.2+ file.

     **Note**: For information about installing the Leak template, see *"Installing the Leak template" on page 188*.

If you do not have PSV:

1. Contact Sciemetric Support at *support@sciemetric.com* to get the backup file of the Leak Tuner application.
2. From InspeXion, do the following:
   - Make a backup of the current setup.
   - Install then run the Leak Tuner application.
   - Record the Leak Test parameters.
   - Reload the backup that you made earlier, and enter the recorded Leak Test parameters.

     **Note:** You may need to fine-tune parameters and timings.

For more information about the InspeXion procedures, see *the InspeXion System Shell User Guide*.

## Running the Leak Tuner Assistant

The tuning process consists of:

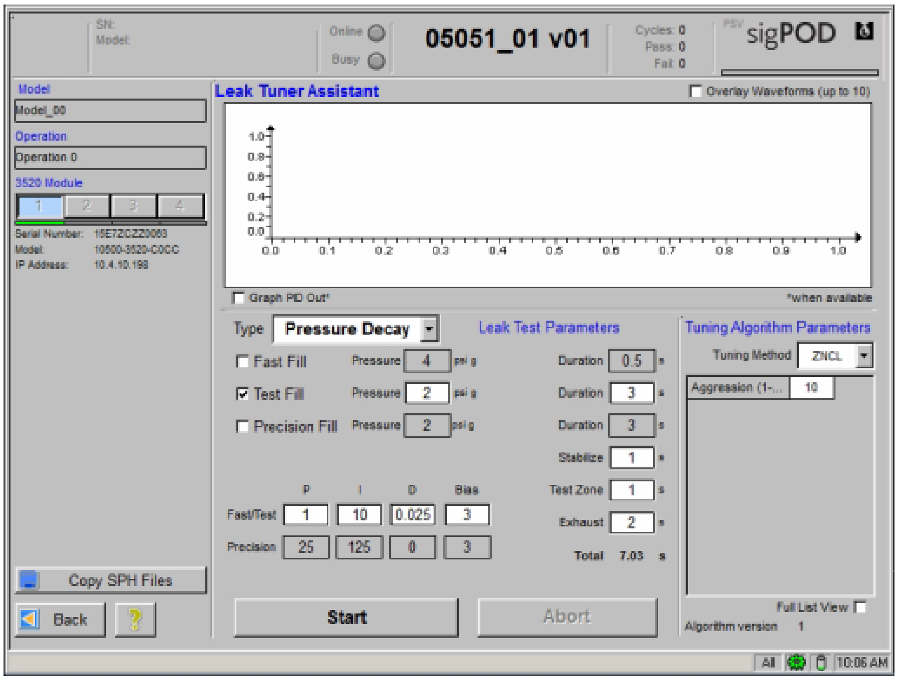
- *"Configuring the Leak Tuner Assistant" on page 236*
- *"Setting up the leak test" on page 240*
- *"Running the leak tuning process" on page 241*
- *"Accepting or rejecting parameters" on page 241*
- *"Confirming the process is running" on page 242*
- *"Exporting files" on page 244*

## Configuring the Leak Tuner Assistant

### To configure the Leak Tuner Assistant

1. Open the 3520 Operations, Basic Configuration screen, and click the **Leak Tuner** button to open the Leak Tuner Assistant.

*Figure 82 Leak Tuner Assistant*




2. From the **Type** drop-down, select **Pressure Decay** or **Flow**.

   **Note:** A **Flow test** does not require part-specific leak rate calibrations. **Pressure decay** can provide better repeatability and shorter cycle times than flow tests, but requires part-specific calibration to produce mass flow estimates of the leak rate.

3. Specify the Fill values as described in the following table.

***Table 57*** *Fill values*

| Phase | Description |
|---|---|
| Fast Fill | Allows you to perform a high-pressure initial fill to overcome the pressure drop between the part and the leak tester to get the part up to test pressure quickly. This leak phase has a pressure set point, timer setting, and PID P, I, and D term settings. Fast fill can reduce cycle times if the connection tube is long or has a small diameter (tube resistance is high), cycle time is short, or the part volume is large.<br>**Note:** We recommend not to over-pressurize the part as it can take longer for the fill phase to exhaust air, resulting in an extended cycle time. The specified Fast Fill test duration is correct when the pressure drops to the desired test pressure immediately after switching to the fill phase. |
| Test Fill | Allows you to perform a test pressure fill to get the part up to the desired test pressure. This pressure fill option has a pressure set point, timer setting, and shares the PID P, I, D, and Bias settings with the Fast Fill pressure option. This is enabled by default. |
| Precision Fill | Allows you to perform a more precise test pressure fill so that a stable flow reading can be obtained. This option is used for flow-based testing and to fill small volumes. The Precision Fill option has a pressure set point, timer setting, and PID P, I, D, and Bias settings.<br>**Note:** Precision fill is not required for pressure decay as the fill pressure option is sufficient to reach the desired test pressure accurately before isolating the part for the decay phase. If the part is small, it can be sufficient to fill the part using the Precision Fill and bypass the Fast Fill and Fill stages. |

**4.** Select one of the following tuning methods. (This step is optional).

***Table 58*** *Tuning method*

| Method | Description |
|---|---|
| SIMC OL | The SIMC OL (Skogestad Internal Model Control Open Loop) method uses a step change in test voltage to measure the open loop response of the system. This method always runs and is used to seed the proportional gain (Kp) for closed loop tests. The method typically produces good results on systems with symmetric fill and bleed responses (for example, small volumes, flow control). This test also refines the valve bias.<br>You must run the SIMC OL test after bias is determined. A seed test voltage $\Delta u$ and a maximum voltage increment are required. The proportional valves being tuned have a range of 0 V to 11 V, with 0 V being closed and 11 V being fully open. This operation iterates if it detects the bias is incorrect, or if the pressure is not close enough to the test pressure. A small test voltage (for example, 0.3 V) and a small voltage increment (for example, 0.1 V) converge on a solution with no user input; however, the number of iterations can be reduced by seeding these with an appropriate test voltage.<br>In general, a higher seed voltage is recommended for higher pressures. |

*Table 58 Tuning method (Continued)*

| Method | Description |
|---|---|
| SIMC CL | The SIMC CL (Skogestad Internal Model Control Closed Loop) method is a closed loop test that uses a seed $K_{p,}$ from the SIMC OL method. SIMC CL produces less aggressive tunings than the other methods. This method estimates the PID parameters from the first overshoot and first undershoot of the pressure waveform. |
| ZNCL | The ZN CL (Ziegler-Nichols Close Loop) method is a closed loop test that uses a seed $K_p$ from the SIMC OL method. The test drives the system with a seed proportional gain and iterates the gain to find the ultimate proportional gain Ku and the ultimate period Tu of the controller to produce steady state oscillations.<br><br>This method typically produces aggressive results and is the only method that produces a derivative term based on the system response. |

**5.** Modify the Tuning Algorithm Parameters. (This step is optional).

**Note:** By default, most parameters are hidden as they generally do not need to be changed. Select the **Full List View** check box to show all available parameters. See *Table 59* for information about the available parameters.

*Figure 83 Tuning Algorithm Parameters*

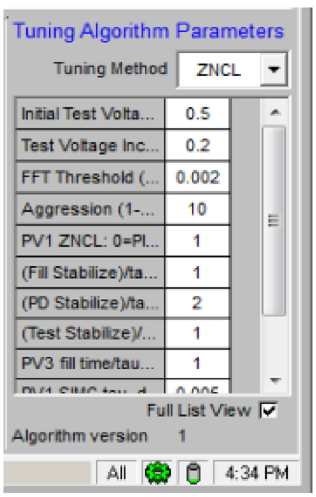


**Table 59** *Available parameters*

| Parameter | Description |
|---|---|
| Initial Test Voltage | In SIMC OL, the test voltage is added to the bias to estimate the open loop response. The initial test voltage can be altered to reduce the number of open loop iterations. The value must be between 0 V and 11 V.<br>If you have already tuned the controller once and know what the final test voltage is, the value can be entered here to minimize the number of iterations.<br>If you are testing at a low pressure and the test keeps aborting due to over-pressure conditions, decrease the initial test voltage. If you are testing at a high pressure and the test cannot converge, increase the initial test voltage. |
| Test Voltage Increment | When the SIMC OL test fails to meet the test pressure requirements, the test voltage is increased or decreased by the test voltage increment. Larger values change the voltage faster. The value must be less than 1 V. |
| FFT Threshold (V) | This is the threshold used to detect oscillation frequency while running ZNCL tests. If the operation is detecting sensor noise rather than oscillation, increase the threshold. If the operation is not detecting small oscillations, then reduce the threshold. The typical value is 0.002 V. |
| Aggression | This is the desired aggressiveness of the tuning, with value from 1 to 10, 10 being the most aggressive. The higher the aggression setting, the higher the PID gains will be, leading to more precise control. However, high gains can lead to controller oscillation, over-shoot and noise. Lower aggression settings translate into less precise control with lower risk of overshoot and oscillation. The default value is 10. Typically if an aggression of 10 does not work, you will achieve better results by changing the PID algorithm (for example from ZNCL to SIMC OL), then by decreasing aggression. |
| PV1 ZNCL: 0=PI; 1=PID | This is the flag used for valve PV1 to indicate whether to tune only P/I, or tune P/I/D values using the ZNCL method. This value is set by default to 1, as derivative gain usually improves the PID performance. |
| PV3 ZNCL: 0=PI; 1=PID | This is the flag used for valve PV3 to indicate whether to tune only P/I, or tune P/I/D values using the ZNCL method. This value is set by default to 1, as derivative gain usually improves the PID performance. |
| tau_stab | The stabilization time constant is measured by the Leak Tuner Assistant and cannot be adjusted manually. It represents the time constant of the thermal transfer of heat between the air and the part. The Leak Tuner Assistant expresses times as a function of the stabilization time constant. |
| (Fill Stabilize)/tau_stab | The number of stabilization time constants to wait after the part is full before switching to Precision Fill, Pressure Decay, or Flow testing.<br>Values of 1 or 2 are recommended. |
| (PV3 Fill)/tau_stab | The number of stabilization time constants to wait while using the Precision Fill before switching in the flow meter or switching to pressure decay.<br>Values of 1 or 2 are recommended. |

*Table 59 Available parameters (Continued)*

| Parameter | Description |
|---|---|
| (PD Stabilize)/tau_stab | The number of stabilization time constants to wait before estimating the leak. Values of 2-4 are recommended. |
| (Test Time)/tau_stab | The number of stabilization time constants over which to estimate the leak from the pressure decay or flow signals. Larger values give more precise results. |
| PV1 SIMC tau_d | This is a derivative time constant for the SIMC methods using PV1. A default value of 0.005 s is recommended. |
| PV3 SIMC tau_d | This is a derivative time constant for the SIMC methods using PV3. A default value of 0.005 s is recommended. |

## Setting up the leak test

As stated earlier, connection tube length and size, supply pressure, and part volume affect the PID values required to properly fill a part. To optimize the leak test cycle, consider the following guidelines before starting the tuning process:

1. The 3520 leak test model, shown in *Table 60*, is based on the test pressure requirement of the specific test case.

   **Note:** If fast fill is required to meet cycle time, the pressure sensor selection in the model number may require a higher pressure range. See the *3520 Leak Test Module User Guide* for available pressure sensor ranges.
2. The hose length can be minimized to reduce the time required to fill the part. Lengths shown in table 4 were selected for test cases only and can be longer as required.
3. The hose diameter can be selected based on the Hose OD column in *Table 60*. The PID control is dependent on pressure resistant across the hose; a small hose diameter and/or long length can provide the required pressure resistant. Therefore, a larger hose OD can be selected if the length is longer.
4. The tuning method should be selected based on the PV1 and PV3 Method columns in *Table 60*.

*Table 60 Leak Test Circuit Setup*

| Pressure | | Pressure | | Volume (L) | Leak Tester | Hose | | Supply (Psig) | PV1 Method | PV3 Method |
|---|---|---|---|---|---|---|---|---|---|---|
| Test (kPa) | FF (kPa) | Test (Psig) | FF (Psig) | | | OD | Length (m) | | | |
| 24 | 48 | 3.5 | 7 | 15 | B0BC | 3/8” | 2 | 70 | ZNCL | ZNCL |
| 24 | 48 | 3.5 | 7 | 30 | B0BC | 3/8” | 2 | 70 | ZNCL | ZNCL |
| 50 | 69 | 7.25 | 10 | 30 | B0BC | 3/8” | 2 | 70 | ZNCL | ZNCL |

*Table 60 Leak Test Circuit Setup (Continued)*

| Pressure | | Pressure | | Volume (L) | Leak Tester | Hose | | Supply (Psig) | PV1 Method | PV3 Method |
|---|---|---|---|---|---|---|---|---|---|---|
| Test (kPa) | FF (kPa) | Test (Psig) | FF (Psig) | | | OD | Length (m) | | | |
| 70 | -- | 70 | -- | 2 | B0BC | 1/4" | 2 | 70 | ZNCL | ZNCL |
| 24 | 48 | 3.5 | 7 | 60 | B0BC | 1/4" | 2 | 70 | ZNCL | ZNCL |
| 138 | -- | 20 | -- | 0.25 | E0CC | 1/4" | 0.3 | 60 | SIMC OL | SIMC OL |
| 190 | -- | 42 | -- | 0.5 | E0CC | 1/4" | 2 | 60 | SIMC OL | ZNCL |
| 138 | -- | 20 | -- | 1 | E0CC | 1/4" | 2 | 60 | ZNCL | ZNCL |
| 138 | -- | 20 | -- | 2 | E0CC | 1/4" | 0.3 | 60 | ZNCL | ZNCL |
| 138 | -- | 20 | -- | 5 | E0CC | 1/4" | 0.3 | 60 | ZNCL | ZNCL |
| 138 | -- | 20 | -- | 10 | E0CC | 3/8" | 2 | 60 | ZNCL | ZNCL |
| 6.9 | 14 | 1 | 2 | 17 | B0BC | 1/4" | 2 | 40 | ZNCL | ZNCL |
| -24 | -- | -3.5 | -- | 0.25 | G0CC | 1/4" | 0.3 | -12 | ZNCL | ZNCL |

## Running the leak tuning process

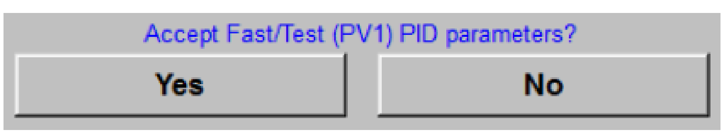
Once the tuning parameters have been set properly, perform the following steps to start the tuning process.

- Click **Start**.

## Accepting or rejecting parameters

As the tuning process runs, you are asked if you are satisfied with the current settings and results per each operation, as in the following example:

*Figure 84 Accept/reject parameters*




If you are satisfied with the current settings and results, click **Yes** to accept the operation's parameters.

If the parameters are not acceptable, click **No**. You are then asked if you want to change the Tuning Algorithm Parameters (see *Table 58 on page 237* and *Figure 83 on page 238*). Click **Yes**, adjust the settings, then continue.

The algorithm goes through the acceptance operations again.

**Note:** If required, the Leak Test parameters can also be adjusted.

Accepting the current tuning parameters is based on the waveform generated by the tuning process. Guidelines for accepting the tuning process waveform include:

1. Zoom into the pressure waveform and look for oscillation or a trend in the waveform in the area before the part is exhausted.
2. The oscillation can be minimal providing a consistent pressure value within at least +/- 0.001 from the desired pressure.
3. The trend can be minimal indicating that the PID control is maintaining the desired pressure when flowing through the flow sensor.
4. If the pressure waveform is oscillating or trending, select a different tuning method and repeat the acceptance operation. Review the pressure waveform to see if the oscillation or trending has improved.
5. High-frequency pressure oscillations are typically due to the proportional gain (Kp) being too large. Decreasing the aggression parameter or switching from ZNCL to one of the SIMC methods typically improves performance.
6. Low-frequency oscillations cannot be removed. These can be reduced by using a more restrictive hose and re-running the Leak Tuner Assistant. If changing the hose is not an option, then increasing the integral gain increases the frequency and decreases the amplitude of the oscillations. Decreasing the integral gain until the oscillations disappear is also possible, but typically produces poor and unresponsive pressure control.
7. Trending can be reduced by raising the PID I term value or increasing the aggression parameter.
8. Once the tuning process is completed and PID tuning values have been accepted, the PID tuning values can be adjusted to improve the results.

## *Confirming the process is running*

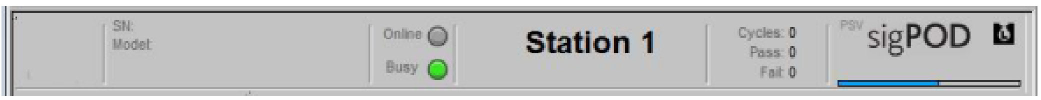
As the process runs, the following happens:

- The status bar in the bottom left-hand corner of the screen shows the status of the process with such messages as: Running <operation>, Retrieving data, Analyzing data, and any errors that can occur. *Figure 85* shows an example of a message in the status bar.

*Figure 85 Status bar*

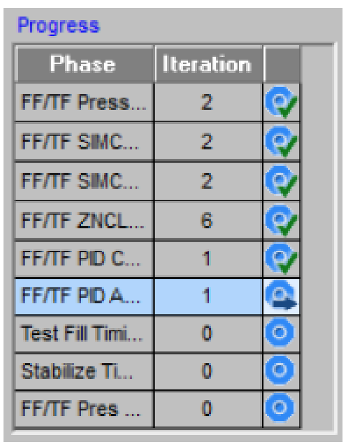

- In the Header (see *Figure 86*), the Busy test status is lit, and a blue progress bar runs.

*Figure 86 Header*




- A Progress table appears on the left-hand-side of the screen to show the status of each operation, or phase, as the tuning process runs through each operation. See *Figure 87*.

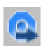
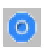
*Figure 87 Progress table*




The Progress table shows the following:

- The operation that is currently running, which is highlighted in light blue as the tuning process runs.
- The number of times, or iterations, the operation runs.
- Icons that represent the operation status. The status include running, pass, fail, or fault. See *Table 61* for the Operation Status icons.

*Table 61 Operation status icons*

| Icon | Meaning |
|---|---|
|  | Operation not enabled (Setup only) |
|  | Operation passed |
|  | Operation failed |
|  | Operation faulted or aborted in run mode<br>**Note:** A faulted or aborted status is reflected only on the operation-level and does not affect waveform or feature status. For example, if an operation is aborted before complete, the waveforms and features in this operation can have a green status (passed). |
|  | No data available (Setup only) |
|  | Operation running (Main mode only) |
|  | Operation blank (Not tested yet, or in Trend or Histogram View Mode) |

## *Exporting files*

You can export the SPH history files, generated by the Leak Tuner Assistant in main Review mode, to use for analysis or troubleshooting.

### To export the SPH files

1. From the Leak Tuner Assistant screen, click **Copy SPH Files** as shown in *Figure 82 on page 236*.
2. Enter a drive to which to save the files, and click **OK**.

   The files are saved in the specified drive under **\Leak Tuning\PID<automatically generated serial number>**.

# 1. B3T MODULE PRODUCTION ELECTRICAL TESTER

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|---|---|---|
| MAAC | B3T Module Production Electrical Tester | Issue Date: 10-Aug-21 |

**SUBJECT:** T&E Bulletin for B3T Module Electrical Tester, Tool No. MAA80703S-04S

**PURPOSE:** To establish uniform procedures and schedule for calibration (as required) and preventative maintenance of the B3T Module Production Electrical Tester.

**CONTENTS:**



**General Guidelines and Definitions**

1. Definitions:
   1.1. A machine is defined as in **'service'** if it is in regular rotation on production vehicles for that shift.
   1.2. A machine is defined as in **'standby'** if it is one that may be pulled into production as needed, to do a production job. Generally this unit is powered on and in Auto mode, but is not used unless another unit has an issue or production gets behind schedule.
   1.3. A machine is defined as **'idle'** if it is one that is not expected to be used in production for the present shift. Typically, this unit is powered down and is considered 'not ready.'
2. A machine that is in standby is subject to the same T&E requirements as any tool that is in service.
3. A machine that is idle may have specific maintenance requirements to bring them back into service. These will be listed in the specific task description under 'Frequency' where applicable.

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## SECTION I Critical Parameters & Operating Description

This section gives a detailed listing of all critical test parameters, including recommended values, descriptions and the effects on the equipment or process.

| B3T Module | | | |
|---|---|---|---|
| **Step** | **Parameter Name** | **Description/Process** | **Parameter Data** |
| 1 | Cell Group Voltage | Expected to be >40% SoC (State of Charge) for subsequent assembly processes at vehicle assembly plant<br>Note: Actual cell group voltage is TBD which correlates to the required shipping voltage | ≥ 2.80 VDC |
| 2 | 8-Cell module Voltage | The sum of 8 serial cell group voltages with approx. 28% state of charge | |
| 3 | 12-Cell module Voltage | The sum of 12 serial cell group voltages with approx. 28% state of charge | |
| 4 | Module Discharge Current | Current measured while battery is discharged | ≤ 400A |
| 5 | Tab Resistance | Measure resistance on tab welds | < 14 uOhms |

| Starting the Test Station | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | **Warning:** Disconnect cables from the module before opening or servicing the HVI cabinet.<br>1. Verify that the disconnect switch on the station's power distribution panel is in the **ON** position<br><br>2. Verify that there is no module in the station<br>3. At the Bauer DAQ cabinet, switch the **E106S1** Rotary Disconnect switch to the **ON** position. |

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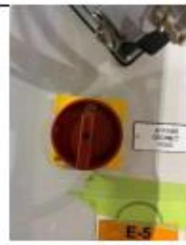
| | |
|---|---|
| |  4. At the cycler panel, verify that the disconnect is in the **ON** position.  |
| ***Data Records:*** | None |
| **Debugging Starting the Test Station** | |
| ***Frequency:*** | If cannot start the station or first-time power up the station in the plant |
| ***Tools:*** | None |
| ***Method/Action:*** | **Warning:** When the battery pack is attached to the test station connectors, deadly levels of voltage and current can be present throughout the cables even when the control power is switched off. Disconnect cables from the battery pack before opening or servicing the HVI cabinet.<br>1. Wear proper PPE, verify that the disconnect switch inside the station's power distribution panel is in the **ON** position. <br>2. Verify that the disconnect switch on the station's power distribution panel is in the **ON** position. |

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3. At the HMI cabinet, open the front door of the HMI cabinet.
4. Wear proper PPE, verify that all circuit breakers in the HMI cabinet are in the **ON** position, as shown in the following image.

5. Close the front door of the HMI cabinet.
6. Verify that there is no modules in the station.
7. Locate the Bauer LV cabinet and open the front door.


8. Wear proper PPE, verify that all the circuit breakers are switched to the **ON** position. When they are **ON**, the circuit breaker indicators are red.
9. Close and lock the LV enclosure door.
10. Locate the Bauer HVI cabinet and open the front door.

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11. Wear proper PPE, verify that all of the circuit breakers in the HVI enclosure are set to the **ON** position, as shown below. The indicators on the circuit breakers are red when in the ON position.

12. Close and lock the HVI enclosure door.
13. Move to the Bauer DAQ cabinet and open the front door of the Bauer DAQ cabinet.
14. Wear proper PPE , verify that all circuit breakers in the Bauer DAQ cabinet are in the **ON** position, as shown in the following images.

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15. Close the front door of the Bauer DAQ cabinet.
16. At the Bauer DAQ cabinet, switch the **E106S1** Rotary Disconnect switch to the **ON** position.


17. At the MCC cycler panel, verify that the disconnect is in the **ON** position.

| | |
|---|---|
| ***Data Records:*** | None |

**Starting the PCS Computer**

| | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |

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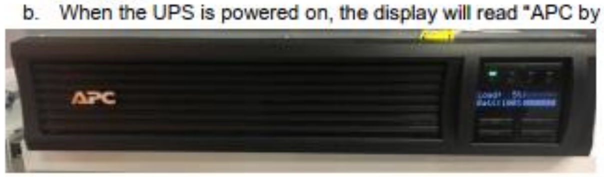
| | |
|---|---|
| ***Method/Action:*** | 18. Open the front door of the Bauer DAQ cabinet.<br><br>19. Locate and power on the station's Uninterruptible Power supply (UPS) as follows:<br>a. If the UPS is off, press the power button until the display reads "UPS startup pending".<br>b. When the UPS is powered on, the display will read "APC by Schneider".<br><br><br>20. Locate the Bauer PC and power it on.<br>a. At the lower left front of the PCS computer, press the switch, which starts Microsoft Windows and the PCS software.<br><br>21. Close the front door on the Bauer DAQ cabinet. |
| ***Data Records:*** | None |

| **Manually Starting the PCS Application** | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | 1. Click on the PCS icon on the window desktop to start the PCS software. The PCS software will start automatically in **Online** mode.<br>**Note**: PCS must be in Online mode to run tests. To manually enter Online, select the Online button from the Idle mode window. |

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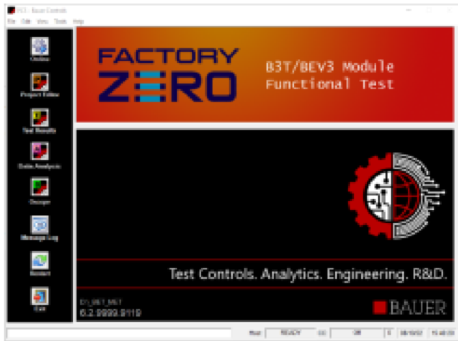
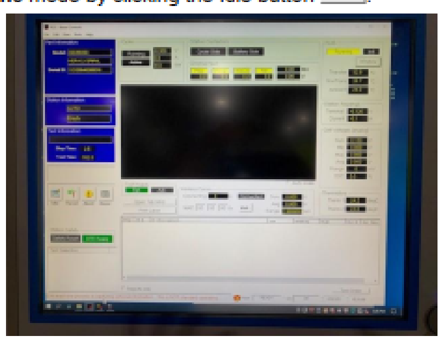
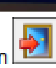
| | |
|---|---|
| | <br>**Note:** The Module Test uses the Module app, not the pack app. |
| ***Data Records:*** | None |

| **Power down the Station** | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | 1. Verify that all testing is complete and there is no module attached to the test station.<br>2. At the Bauer DAQ cabinet, shut down PCS as follows:<br>a. Go to **Offline** mode by clicking the Idle button .<br><br>b. In Offline mode, click on the Exit button . |

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3. Shut down the PC though the Windows Start menu.
4. Use proper PPE; open the front door of the Bauer DAQ cabinet.
5. Turn off the UPS by pressing and holding the power button until the UPS display reads "Output off by: local display".


6. Close the front door of the Bauer DAQ cabinet.
7. Turn the **E106S1** rotary disconnect to the **OFF** position.

   **Note:** When the power is disconnected, the UPS alarm will go off for 30 seconds while the UPS powers down.

8. At the front panel of power distribution panel, turn off the Disconnect switch.

9. At the front panel of the MCC cycler, turn off the Disconnect switch.

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| | |
|---|---|
| |  |
| **Data Records:** | None |

| | |
|---|---|
| **Data Records:** | None |

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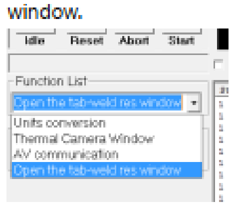
## SECTION II Verification Checks

Verification is a spot-check of the process to determine if it is running within required parameters and to identify if calibration or maintenance is required. Verification can also be used to periodically confirm that error-proofing or other critical processes are still functioning. This should generally be considered a pass/fail type check with minimal data recorded or retained.

| **A. Pogo Pin Verification** | |
|---|---|
| ***Frequency:*** | Daily |
| ***Tools:*** | None |
| ***Method/Action:*** | **A.** Visually inspect for bent or sticking spring-loaded pogo terminals. Pogo terminals with reduced tension shall also be repaired or replaced. |
| ***Data Records:*** | None |

| **B. Manual Cell Group Voltage Verification** | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | Adjustable Power supply (3 – 5Vdc) or Martel 2000A Voltage Calibrator<br>Test-Leads<br>6 ½ digit digital multi-meter (DMM) |
| ***Method/Action:*** | 1. Verify there is no Module in the station.<br>2. At the station's HMI, put the station into Manual mode.<br>3. At the DAQ PC, open the Analog Input Channels window and the Tab Weld Resistance Monitor window.<br>a. To open the Analog Input Channels window, either:<br>i. Select *View>I/O Display/Analog Inputs* from the PCS tool bar.<br>ii. Click the *F4* button on the keyboard.<br>b. To open the Tab Weld Resistance Monitor window, select "*Open the tab-weld res window*" from the *Function List* drop down in the PCS Manual mode window.<br><br><br>4. Enter the station.<br>5. Input a known voltage (4.2 V) on the CV pins. It is the bottom pogo pins on each side.<br>**Note:** The input voltage must be less than 5Vdc. |

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a. Connect the positive (+) test-lead of the power supply to the pogo pin for the CV location being validated. For example, if verifying CGV1, place the positive (+) test-lead on the pogo pin at the CV1 location on non-transfer side.

b. Connect the negative (-) test-lead of the power supply on the pogo pin for CV(## - 1). For example, if verifying CGV1, connect negative test-lead to the pogo pin at CV0 on transfer side bottom location.

Figure 1 - CV1 on Nontransfer side test head

Figure 2- CV0 on transfer side test head

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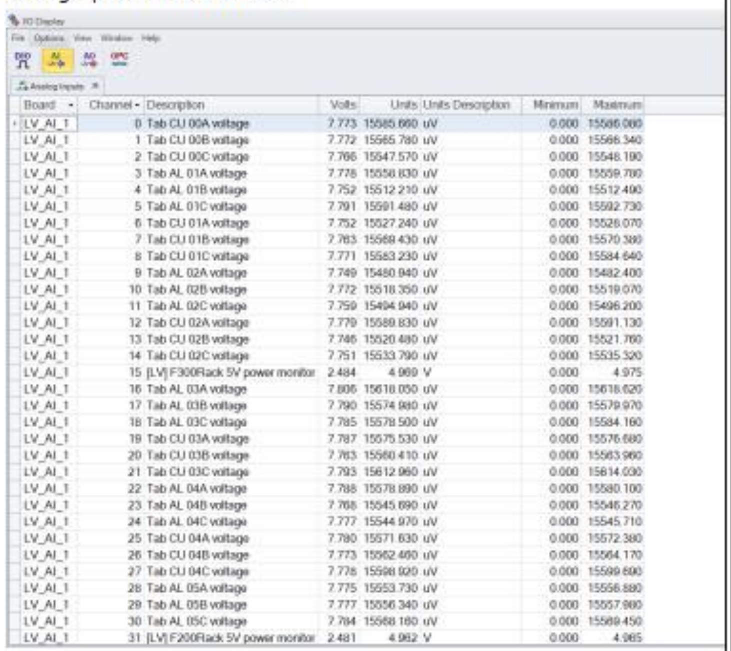
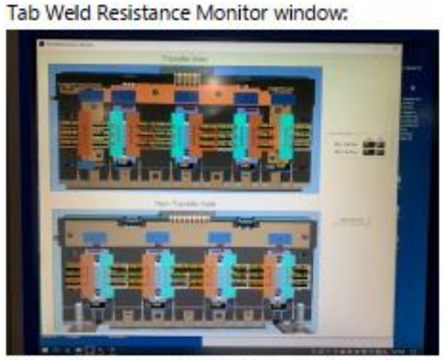
6. If the power supply is not calibrated, measure the voltage applied using a calibrated digital multi-meter.
7. In PCS, verify that the applied voltage measured is in the correct location and is the correct magnitude.
   a. Analog Input Channels window:



| Board | Channel | Description | Volts | Units | Units Description | Minimum | Maximum |
|---|---|---|---|---|---|---|---|
| LV_AI_1 | 0 | Tab CU 00A voltage | 7.773 | 15585.660 | uV | 0.000 | 15586.080 |
| LV_AI_1 | 1 | Tab CU 00B voltage | 7.772 | 15565.780 | uV | 0.000 | 15566.340 |
| LV_AI_1 | 2 | Tab CU 00C voltage | 7.766 | 15547.570 | uV | 0.000 | 15548.190 |
| LV_AI_1 | 3 | Tab AL 01A voltage | 7.778 | 15558.830 | uV | 0.000 | 15559.780 |
| LV_AI_1 | 4 | Tab AL 01B voltage | 7.752 | 15512.210 | uV | 0.000 | 15512.490 |
| LV_AI_1 | 5 | Tab AL 01C voltage | 7.791 | 15591.480 | uV | 0.000 | 15592.730 |
| LV_AI_1 | 6 | Tab CU 01A voltage | 7.752 | 15527.240 | uV | 0.000 | 15528.070 |
| LV_AI_1 | 7 | Tab CU 01B voltage | 7.783 | 15568.430 | uV | 0.000 | 15570.380 |
| LV_AI_1 | 8 | Tab CU 01C voltage | 7.771 | 15583.230 | uV | 0.000 | 15584.640 |
| LV_AI_1 | 9 | Tab AL 02A voltage | 7.749 | 15480.940 | uV | 0.000 | 15482.400 |
| LV_AI_1 | 10 | Tab AL 02B voltage | 7.772 | 15518.350 | uV | 0.000 | 15519.070 |
| LV_AI_1 | 11 | Tab AL 02C voltage | 7.759 | 15494.940 | uV | 0.000 | 15496.200 |
| LV_AI_1 | 12 | Tab CU 02A voltage | 7.779 | 15589.830 | uV | 0.000 | 15591.130 |
| LV_AI_1 | 13 | Tab CU 02B voltage | 7.746 | 15520.480 | uV | 0.000 | 15521.760 |
| LV_AI_1 | 14 | Tab CU 02C voltage | 7.751 | 15533.790 | uV | 0.000 | 15535.320 |
| LV_AI_1 | 15 | [LV] F300Rack 5V power monitor | 2.484 | 4.969 | V | 0.000 | 4.975 |
| LV_AI_1 | 16 | Tab AL 03A voltage | 7.806 | 15618.050 | uV | 0.000 | 15618.620 |
| LV_AI_1 | 17 | Tab AL 03B voltage | 7.790 | 15574.980 | uV | 0.000 | 15579.970 |
| LV_AI_1 | 18 | Tab AL 03C voltage | 7.785 | 15578.500 | uV | 0.000 | 15584.160 |
| LV_AI_1 | 19 | Tab CU 03A voltage | 7.787 | 15575.530 | uV | 0.000 | 15576.680 |
| LV_AI_1 | 20 | Tab CU 03B voltage | 7.763 | 15560.410 | uV | 0.000 | 15563.960 |
| LV_AI_1 | 21 | Tab CU 03C voltage | 7.793 | 15612.960 | uV | 0.000 | 15614.030 |
| LV_AI_1 | 22 | Tab AL 04A voltage | 7.788 | 15578.890 | uV | 0.000 | 15580.100 |
| LV_AI_1 | 23 | Tab AL 04B voltage | 7.768 | 15545.690 | uV | 0.000 | 15546.270 |
| LV_AI_1 | 24 | Tab AL 04C voltage | 7.777 | 15544.970 | uV | 0.000 | 15545.710 |
| LV_AI_1 | 25 | Tab CU 04A voltage | 7.780 | 15571.630 | uV | 0.000 | 15572.380 |
| LV_AI_1 | 26 | Tab CU 04B voltage | 7.773 | 15562.460 | uV | 0.000 | 15564.170 |
| LV_AI_1 | 27 | Tab CU 04C voltage | 7.778 | 15598.920 | uV | 0.000 | 15599.690 |
| LV_AI_1 | 28 | Tab AL 05A voltage | 7.775 | 15553.730 | uV | 0.000 | 15556.880 |
| LV_AI_1 | 29 | Tab AL 05B voltage | 7.777 | 15556.340 | uV | 0.000 | 15557.980 |
| LV_AI_1 | 30 | Tab AL 05C voltage | 7.784 | 15568.160 | uV | 0.000 | 15569.450 |
| LV_AI_1 | 31 | [LV] F200Rack 5V power monitor | 2.481 | 4.962 | V | 0.000 | 4.985 |

   b. Tab Weld Resistance Monitor window:



8. Compare the CGV reading in PCS to the applied value. Calibrate any CGV channel that is not within +- 3mV of the reference measurement following the procedures outlined in **Module III A. Cell Group Voltage Signals.**

***Data Records:***

Minimum Data:

- Date and time of verification performed

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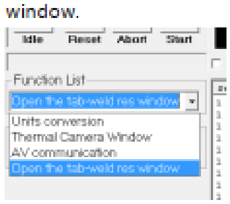
| | |
|---|---|
| | • Voltage readings<br><br><u>Minimum Retention Period</u>: To be retained in accordance with standard plant retention requirements. |

## C. Tab Weld Voltage Verification

| | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | Adjustable Power supply (0 – 10mVdc) or Martel 2000A Voltage Calibrator<br>Test-Leads<br>6 ½ digit digital multi-meter (DMM) |

***Method/Action:***

1. Verify there is no module in the station.
2. At the station HMI, put the station into Manual mode.
3. At the DAQ PC, open the Analog Input Channels window and the Tab Weld Resistance Monitor window.
   a. To open the Analog Input Channels window, either:
      i. Select *View>I/O Display/Analog Inputs* from the PCS tool bar.
      ii. Click the *F4* button on the keyboard.
   b. To open the Tab Weld Resistance Monitor window, select "*Open the tab-weld res window*" from the *Function List* drop down in the PCS Manual mode window.




4. Enter the station.
5. Input a known voltage (8 mV) on each of the Tab pins positions (A/B/C, AL or CU) vs common Busbar pin (CV##), that is the bottom pogo pins on each tab and one of the three pins above them.

   **Note:** The input voltage must be less than 10mV
6. To Verify AL tabs
   a. Connect the positive (+) test-lead of the power supply to the pogo pin for the CV location under the tab being validated. For example, if verifying Tab weld voltage drop AL TAB 1A, place the positive (+) test-lead on the common pogo pin at the CV1 location.

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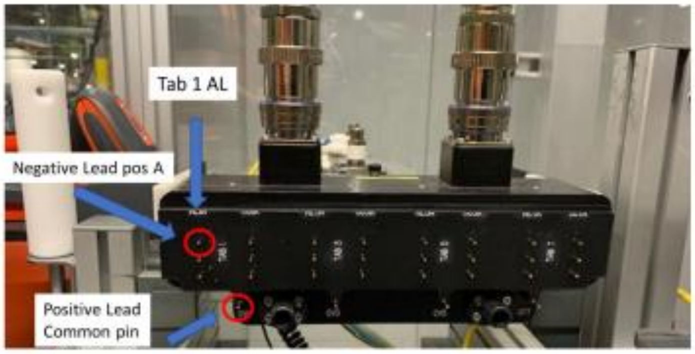
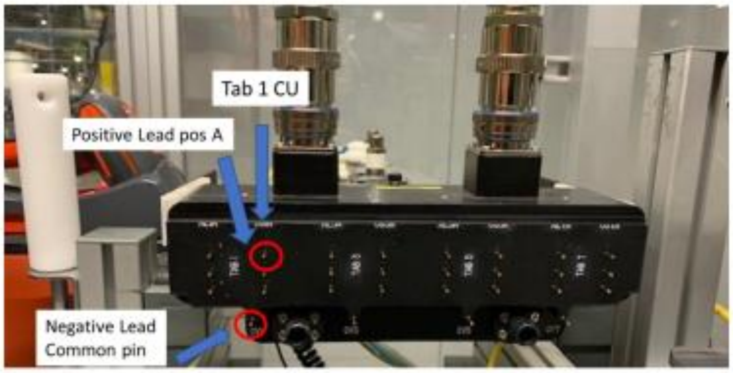
b. Connect the negative (-) test-lead of the power supply on the pogo pin for A/B/C position. For example, if verifying Tab weld voltage drop 1A, connect negative test-lead to Top pogo pin above CV1 location. Repeat this step for B and C position




7. To Verify CU tabs
    a. Connect the negative (-) test-lead of the power supply to the pogo pin for the CV location under the tab being validated. For example, if verifying Tab weld voltage drop CU TAB 1A, place the negative (-) test-lead on the common pogo pin at the CV1 location.
    b. Connect the positive (+) test-lead of the power supply on the pogo pin for A/B/C position. For example, if verifying Tab weld voltage drop 1A, connect negative test-lead to Top pogo pin above CV1 location. Repeat this step for B and C positions




8. If the power supply is not calibrated, measure the voltage applied using a calibrated digital multi-meter (in mV)
9. In PCS, verify that the applied voltage measured is in the correct location and is the correct magnitude.
    a. Analog Input Channels window:

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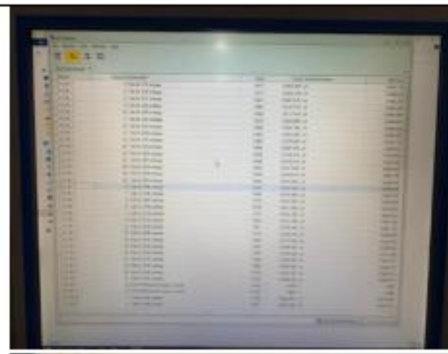

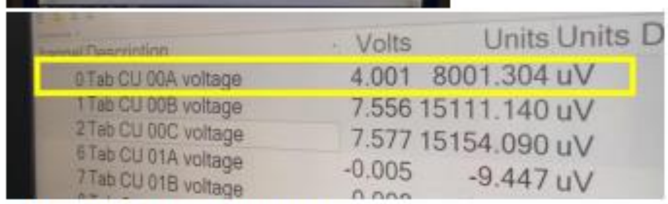


b. Tab Weld Resistance Monitor window:

10. Compare the tab weld voltage drop reading in PCS to the applied value. Calibrate any channel that is not within +- 0.2mV of the reference measurement following the procedures outlined in **Module III B. Tab Weld Voltage Signals**.

| | |
|---|---|
| ***Data Records:*** | Minimum Data:<br>• Date and time of verification performed<br>• Voltage readings<br><br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

**D. Battery Module System Voltage Verification**

| | |
|---|---|
| ***Frequency:*** | • Every six months of machine run time |

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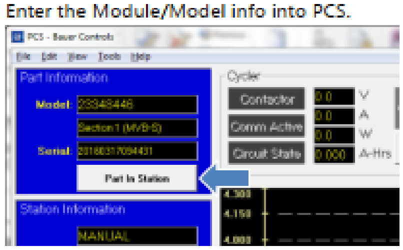
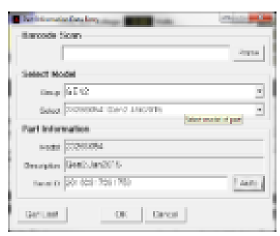
| | |
|---|---|
| | • After a calibration is performed |
| ***Tools:*** | Digital multi-meter: 4½ digit, 200mV to 1000V range, Cat III rated<br>**PPE:** As plant requires |
| ***Method/Action:*** | 1. Wear proper **PPE**.<br>2. Use the reference digital multi-meter to measure terminal voltage of a B3T Module.<br>3. Use the HMI to clamp the module in station and engage the automated terminal probes while in Manual Mode.<br>4. Compare terminal voltage reading in the *Station* region to the reference measurements.<br>a. If the readings are not within 1% of the reference measurement, calibrate the channel following the procedures outlined in **Module III E. Station Voltage Calibration**.<br><br> |
| ***Data Records:*** | Minimum Data: 1. Date and time of verification performed.<br>2. Voltage readings.<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

| **E. Infrared Thermal Camera Temperature Measurement Verification** | |
|---|---|
| ***Frequency:*** | Every six months of machine run time / when calibration is performed |
| ***Tools:*** | Laser IR Thermometer<br>Suggested Model: EX470 by Extech Instruments |
| ***Method/Action:*** | 1. Verify that a Module is located properly within the test cell.<br>2. Verify that PCS is Online and that the GM-FLIR program is running.<br>3. Enter the Module/Model info into PCS.<br><br><br><br><br>4. In the main window, select *Thermal Camera Window* from the Functions list, or click the *Window* button in the *FLIR* region. |

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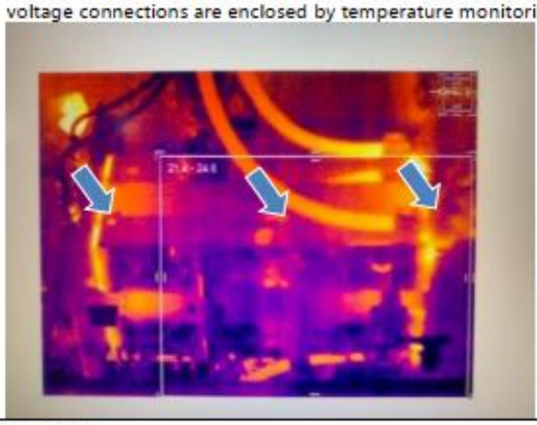
5. Observe and remember the maximum temperature location on the module from the flir program. Use a hand held IR Thermometer to point to the location where the maximum temperature is.
6. Verify the temperature reading displayed in the GM-FLIR program against the measurement from the IR thermometer. The GM FLIR software will show the maximum temperature in each region.
7. Review the test results and the display in the GM FLIR program. Verify that all the high voltage connections are enclosed by temperature monitoring regions of interest (ROI).



| | |
|---|---|
| ***Data Records:*** | Minimum Data:<br>• Date and time of verification performed<br><br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements |

## F. Mega Ohm Test(Hi-pot) Verification

| | |
|---|---|
| ***Frequency:*** | Every six months of machine run time / when calibration is performed |
| ***Tools:*** | Mega Ohm verification resistor (50M resistor inside) or 50M bare resistor |

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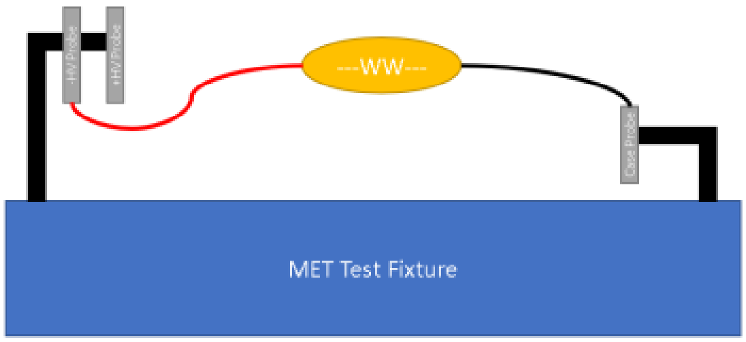
| | |
|---|---|
| ***Method/Action:*** | **Warning**: When performing Hi-pot verification, high voltage is applied to both ends of the resistor.<br>Apply 50 MΩ resistor between negative HVHC terminal in station and the module case megohm terminal. If using the verification resistor, simply connect with banana post jacks. If using bare resistor, Test leads should be 1kV rated and resistor needs to be suspended in the air.<br><br><br>1. At the station's HMI, ensure that the mode select switch indicates *Manual Mode*.<br>2. At the DAQ PC, check that PCS is Online.<br>3. Open the *Quadtech Meter* interface window.<br>a. Select "*Quadtech Meter*" from the *Function List* drop down list in the PCS *Manual mode* window.<br>4. Set up the window as the following screenshot. |

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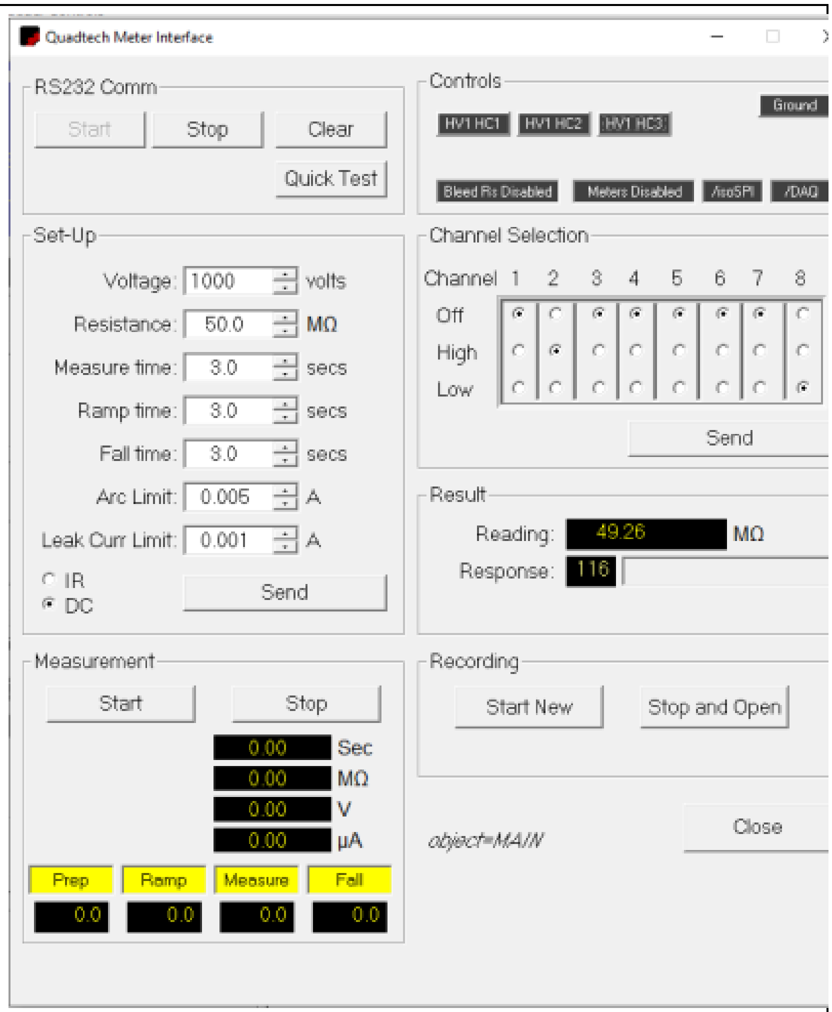


- Set meter to 1000V, 3 second ramp, 3 second test, 3 second fall
- Select HV channels
- Select 'section megohm' contactor and ensure meters are disabled

5. Run measurement with 'Start'; 'Reading' should be ~50 MΩ
6. Could repeat with different known resistor but one successful verification is sufficient

| | |
|---|---|
| ***Data Records:*** | Minimum Data:<br>• Date and time of verification performed<br><br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements |

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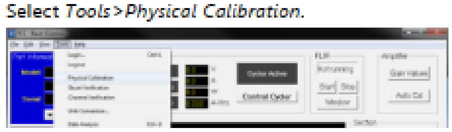
## MODULE III Calibration

Calibration is the infrequent adjustment of a gauge or sensor to a national or international (certified) standard. This can be based on a set frequency or be required if a verification check fails. Unless otherwise specified, procedures & data recorded should comply with The Global Quality Requirements Manual, Measurement System Analysis 11.00.

**Note**: The following devices or equipment that is used for the test station require calibration performed by professionals from device or equipment manufacturer and frequency of calibration should follow product manual:

1. **FLIR camera**
    - Manufacturer: FLIR Systems
    - Model: FLIR A315 20Hz
    - Serial Number: 429100592
2. **MCC Cycler**
    - Manufacturer: MCC Inc.
    - Model: N/A
    - Serial Number: N/A
3. **Hi Pot Meter**
    - Manufacturer: CHROMA
    - Model: N/A
    - Serial Number: N/A

| **A. Cell Group Voltage & Tab Weld Voltage Drop Signals** | |
|---|---|
| ***Frequency:*** | • As needed<br>• When a verification exercise fails |
| ***Tools:*** | 6 ½ digit digital multi-meter (DMM)<br>Power supply<br>Test-leads |
| ***Method/Action:*** | 1. At the station's human machine interface (HMI) ensure that the mode select switch indicates *Manual Mode*.<br>2. At the DAQ PC, check that PCS is Online.<br>3. Open the Physical Calibration window.<br>a. Select *Tools>Physical Calibration*.<br><br>b. Opening the Physical Calibration (Analog Channel Calibration) window will require a qualified user to log in. |

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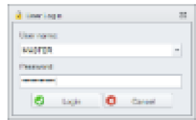
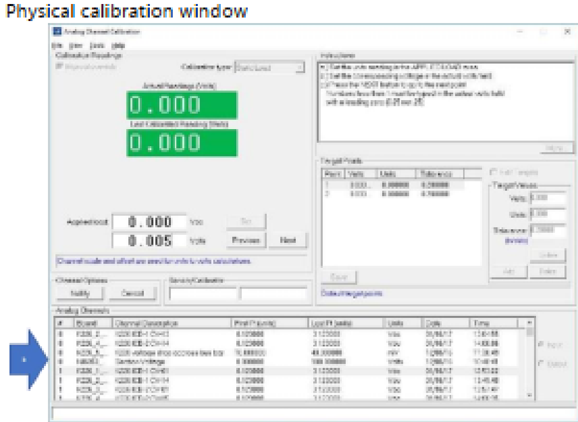
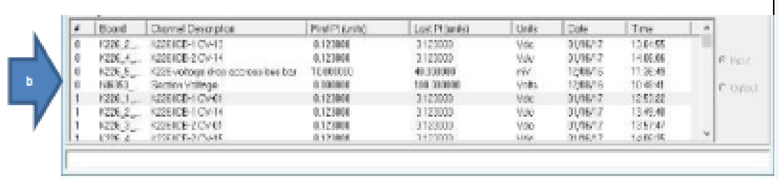


c. Physical calibration window



4. In the Analog Channels list box at the bottom of the window, Select the channel to calibrate
   a. To calibrate a Cell Group Voltage reading, Select the **CGV ##** channel
   b. To calibrate a Tab Weld Voltage drop, Select the Tab Voltage channel, as example **"Tab CU 00 A voltage"**



5. Enter the station.
6. To calibrate a Cell group voltage channel, follow the procedures in **Module II.B Manual Cell Group Voltage Verification** to connect the leads to the proper CV pins on the test heads, and apply the 2 calibration points as follows:
   a. Once the channel is selected on the *Physical Calibration window*, click on the first Target point on the list box at right side and apply Zero voltage using an Electrical Short or set power supply to zero. Note that the voltage should be less than or equal to 0.2Vdc.

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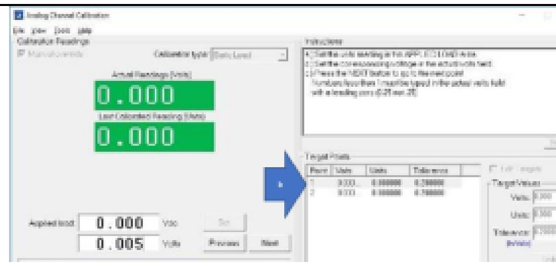
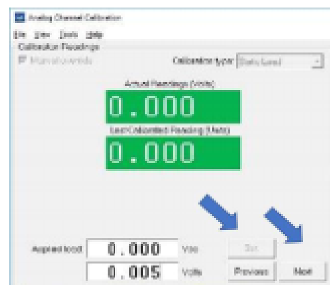
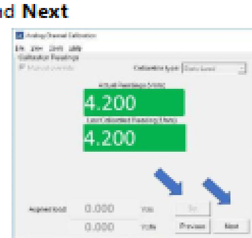



b. Check reading is Zero on Actual readings (Volts) and on Last calibrate readings (Units),Check the values on the testbox for Applied load (Units and Volts) are Zero, then click on **Set** and **Next**




c. Set power supply to **4.2 V** to apply the second calibration voltage to the Cell group voltage channel. Verify the reading on the Volts and Units box and then then click on **Set** and **Next**




If not using a calibrated constant voltage supply, measure the applied voltage with a calibrated Digital Multi meter and edit the target calibration point. Repeat for subsequent CGV channels

7. To calibrate a Tab Weld channel, following the procedures in **Module II.C Manual Tab Weld Voltage Verification** to connect the leads to the proper Tab pins on the test heads, and apply the 2 calibration points as follow:

   a. Once the channel is selected on the *Physical Calibration window*, click on the first Target point on the list box at right side and apply Zero voltage using an Electrical Short or set power supply to zero. Note that the voltage should be less than or equal to 0.2Vdc.

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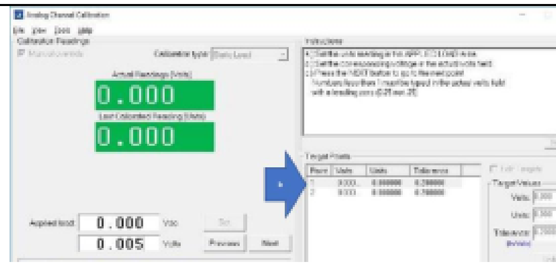
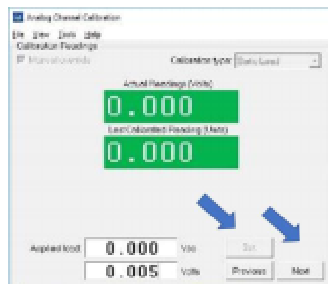
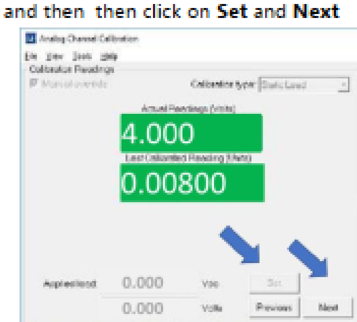


b. Check reading is Zero on Actual readings (Volts) and on Last calibrate readings (Units),Check the values on the testbox for Applied load (Units and Volts) are Zero, then click on **Set** and **Next**




c. Set power supply to **8mV**, to apply the second calibration voltage to the Cell group voltage channel. Verify the reading on the Volts are **4 VDC** and **0.008 V** on Units box and then then click on **Set** and **Next**




If not using a calibrated constant voltage supply, measure the applied voltage with a calibrated Digital Multi meter and edit the target calibration point. Repeat for subsequent Tab voltage channels.

8. After the calibration, close the calibration window and disconnect the instrument from the Test heads

***Data Records:*** Minimum Data: 1. Data and time of calibration performed.
Minimum Retention Period: To be retained in accordance with standard plant retention requirements.

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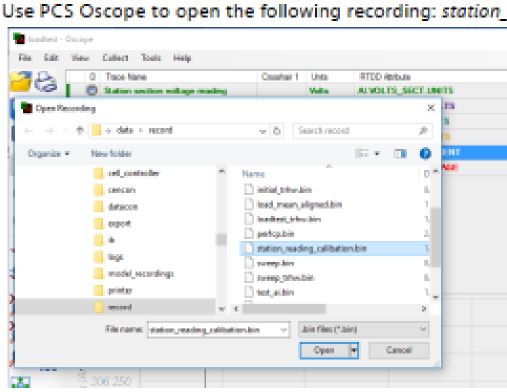
| **B. Station Current Shunt Calibration** | |
|---|---|
| ***Frequency:*** | Only when a verification exercise fails, or every six months of machine run time |
| ***Tools:*** | |
| ***Method/Action:*** | **Note:** The calibration procedure uses current value feedback from MCC Cycler as a reference, therefore before proceeding with the following procedure, make sure MCC Cycler calibration is up to date.<br><br>**Warning**: In this step we are controlling the current flow, stop the cycler someone is in the station.<br><br>1. At the Bauer PC, ensure that PCS is Online.<br>2. At the station's HMI verify that the mode selection switch indicates Manual mode.<br>3. Using the station's HMI, load a Module into the station.<br>4. Use PCS Oscope to open the following recording: *station_reading_calibration.bin*.<br><br>5. In PCS, open the control window by clicking the *Control Cycler* button in the Manual mode window.<br>6. In the Cycler Interface window:<br>a. Click on the *Enable* button to start the cycler communications. When the communications are running, the Set point will be current. |

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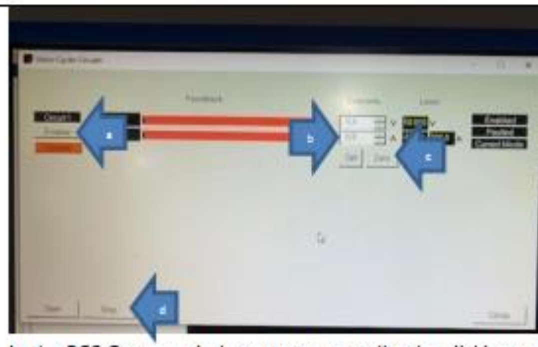
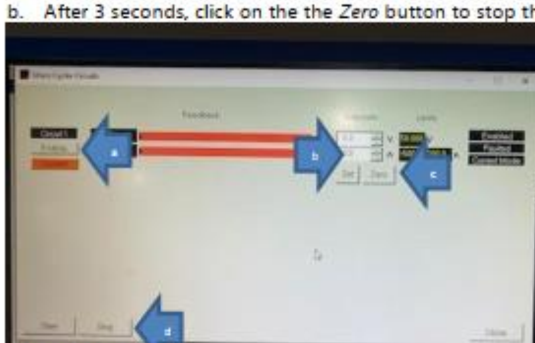



7. In the PCS Oscope window, start a recording by clicking on the start button ●.


8. Briefly run a -100 A load.
   a. Enter -100A into the *Setpoint* field and then press they *Tab* key on the keyboard.
   b. After 3 seconds, click on the the *Zero* button to stop the cycler.




9. Briefly run a 40A charge.
   a. Enter 40A into the *Setpoint* field and then press the Tab key on the keyboard.
   b. After 3 seconds, click on the *Zero* button to stop the cycler.
   c. Press the *Stop* button to stop communications to the cycler.
   d. Close the Cycler Control Interface window.

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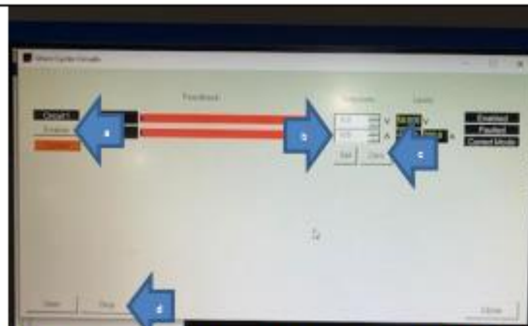
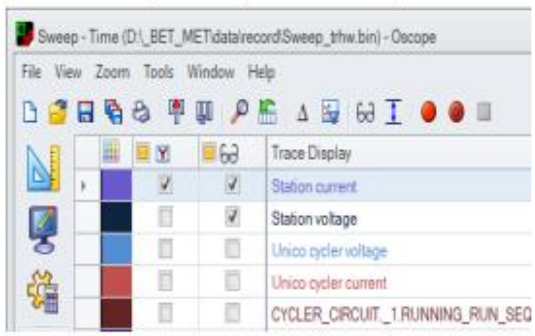
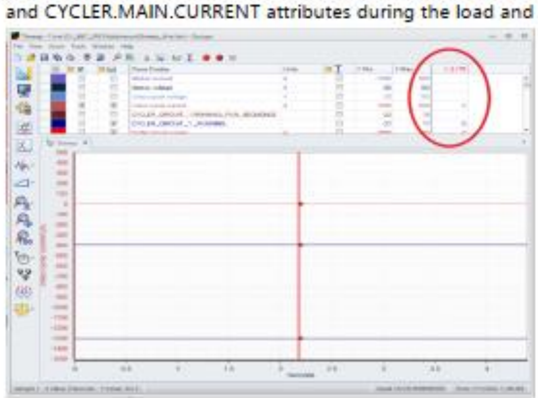


10. In the PCS Oscope window, click on the stop button to stop the recording.




11. In the Oscope window, use the cursors to record the values for AI.AMPS_SECT.VOLTS and CYCLER.MAIN.CURRENT attributes during the load and charge.



**Note:** For details on operating the PCS Oscope, open the *Online Help* by selecting *About This Window* from the Help menu.

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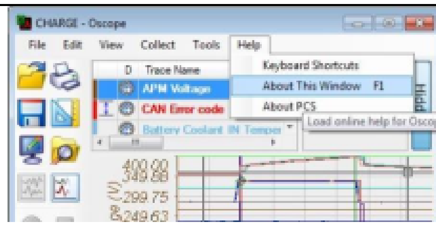
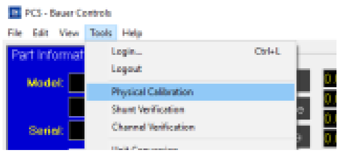
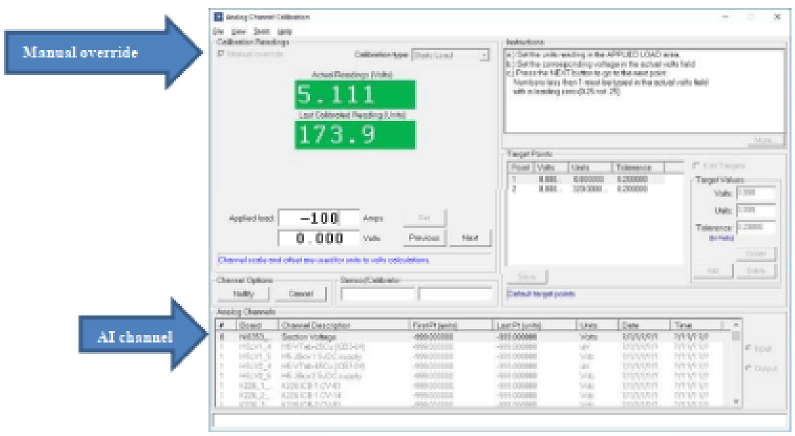


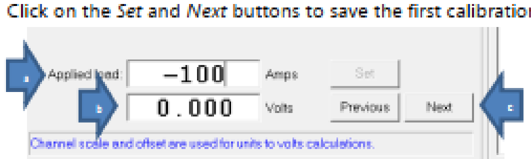

12. In PCS select *Tools > Physical Calibration*.




13. In the *Analog Channel Calibration* window, select the ***Station Current*** channel and select the *Manual override* checkbox.




14. In the Analog Channel Calibration window, enter the recorded values during the -100A load. You get these value through reading from recording.
    a. Enter the value for the trace named AI.AMPS_SECT.VOLTS into the *Volt* and the recorded.
    b. Enter the CYCLER.MAIN.CURRENT value in to the *Applied Load* field.
    c. Click on the *Set* and *Next* buttons to save the first calibration point.




15. In the *Analog Channel Calibration* window, enter the recorded values during the 40A charge. You get these value through reading from recording.

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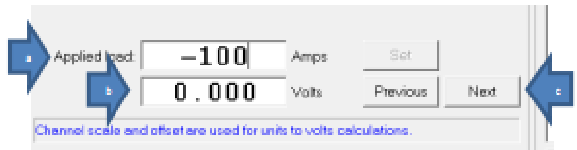
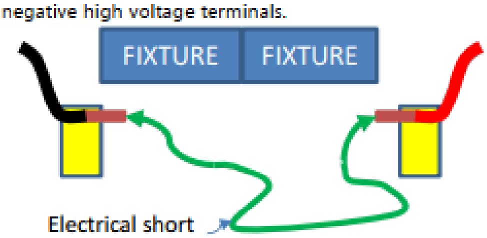
| | |
|---|---|
| | a. Enter the value for AI.AMPS_SECT.VOLTS into the *Volt* and the recorded.<br>b. Enter the CYCLER.MAIN.CURRENT value in to the *Applied Load* field.<br>c. Click the *Set* and *Next* buttons to save the second calibration point.<br><br><br>16. Close the *Analog Calibration Window.*<br>17. Use the station's HMI to remove the Module from the station. |
| ***Data Records:*** | Minimum Data: Follow the minimum data requirement as listed in Module II.<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

| **C. Station Voltage Calibration** | |
|---|---|
| ***Frequency:*** | Only when a verification exercise fails, or every six months of machine run time |
| ***Tools:*** | PPE<br>Jumper Wires<br>B3T Module<br>Calibrated DMM |
| ***Method/Action:*** | 1. At the Bauer PC, ensure that PCS is Online.<br>2. At the station's HMI verify that the mode selection switch indicates Manual mode.<br>3. Verify that there is no Module in the station.<br>4. Observing the proper lock-out tag-out procedure.<br>5. Enter the station.<br>6. Using a jumper wire, create an electrical short between the station's positive and negative high voltage terminals.<br><br><br>7. Exit the station.<br>8. At the station's HMI, reset the gate. Resetting the gate will close the station's contactors.<br>9. In PCS select *Tools > Physical Calibration.* |

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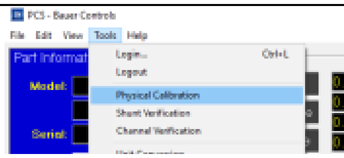
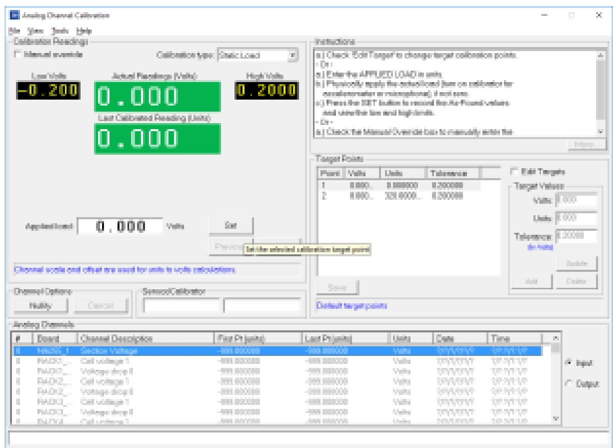
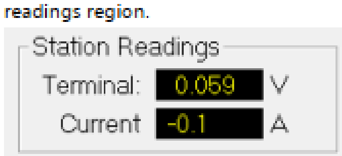



10. In the *Analog Channel Calibration* window:
    a. Select the ***Module Voltage***.
    b. Verify that the number in the Applied Load: region is 0.0 Volts.
    c. Click the *Set* button to apply first calibration point.




11. Observing the proper lock-out tag-out procedure, enter the station.
12. Remove the electrical short between the station's positive and negative high voltage terminals.
13. Exit the station.
14. At the station's HMI, reset the safety gate.
15. Observing proper PPE, measure and record a Module's terminal voltage using a calibrated volt meter.
16. Use the station's HMI to load and clamp to the previously measured Module.
17. In the PCS window, verify that the Module terminal voltage is present in the *Station* readings region.




18. In the Analog Calibration Window:
    a. Enter the measured Module voltage into the *Applied Load* region.
    b. Click the *Set* and *Next* buttons to apply the second calibration point.
    c. Close the Analog Calibration Window.

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| | |
|---|---|
| | 19. Use the station's HMI to unclamp and remove the Module from the station. |
| ***Data Records:*** | Minimum Data: Follow the minimum data requirement as listed in Module II.<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

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**MegaDAQ TNE**

Open the front door of the MegaDAQ Cabinet

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| **Manually Starting the PCS Application – MegaDAQ** |
|---|
| As required |
| None |
| 1. Click on the PCS icon on the window desktop to start the PCS software. The PCS software will start automatically in **Online** mode.<br>**Note:** PCS must be in Online mode to run tests. To manually enter Online, select the Online button from the Idle mode window. |

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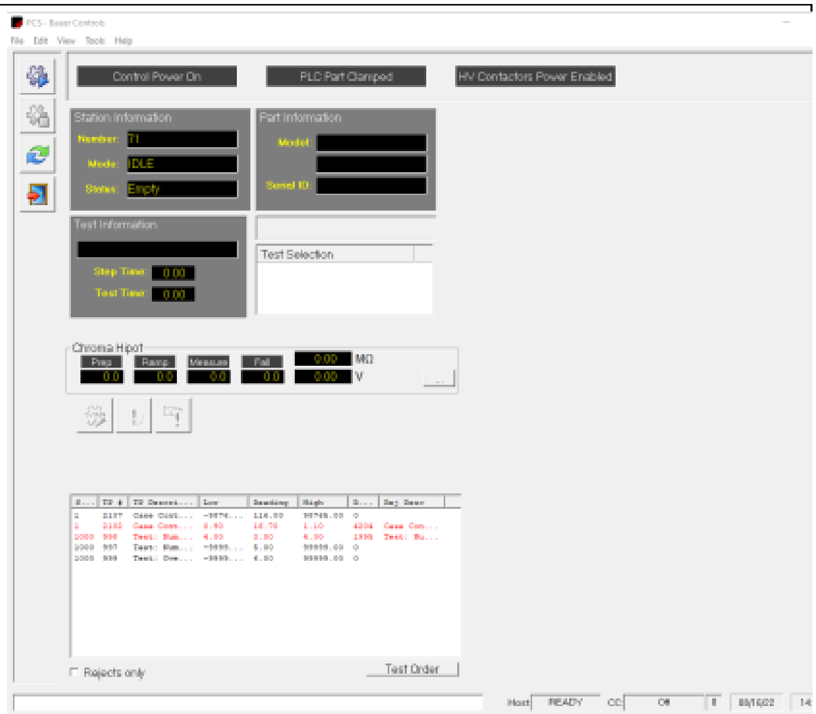


**Note:** The Module Test uses the Module app, not the pack app.

| **Power down the Station** |
|---|
| As required |
| None |

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|---|---|---|
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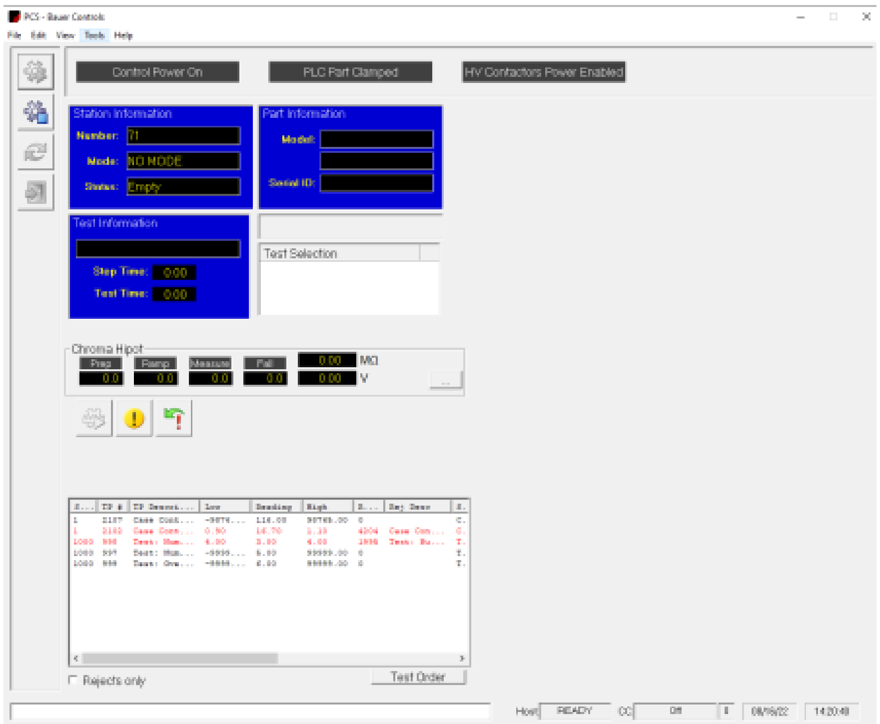


| G. Mega Ohm Test(Hi-pot) Verification | |
|---|---|
| ***Frequency:*** | Every six months of machine run time / when calibration is performed |
| ***Tools:*** | Mega Ohm verification resistor (50M resistor inside) or 50M bare resistor |
| ***Method/Action:*** | **Warning**: When performing Hi-pot verification, high voltage is applied to both ends of the resistor.<br>Apply 50 MΩ resistor between negative HVHC terminal in station and the module case megohm terminal. If using the verification resistor, simply connect with banana post jacks. If using bare resistor, Test leads should be 1kV rated and resistor needs to be suspended in the air. |

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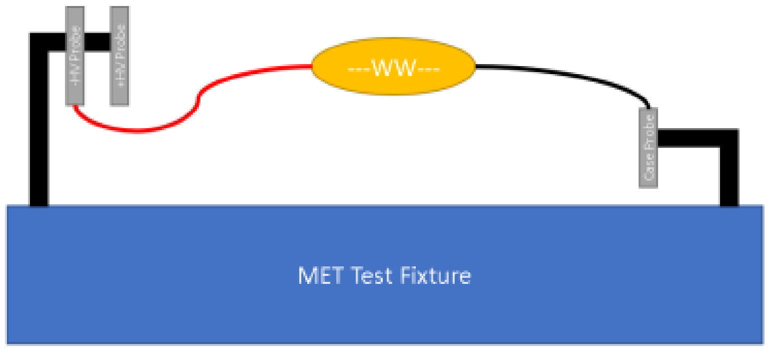


7. At the station's HMI, ensure that the mode select switch indicates *Manual Mode*.
8. At the DAQ PC, check that PCS is Online.
9. Open the *Quadtech Meter* interface window.
   b. Select "*Quadtech Meter*" from the *Function List* drop down list in the PCS *Manual mode* window.
10. Set up the window as the following screenshot.
    - Set meter to 1000V, 3 second ramp, 3 second test, 3 second fall
    - Select HV channels
    - Select 'section megohm' contactor and ensure meters are disabled
11. Run measurement with 'Start'; 'Reading' should be ~50 MΩ
12. Could repeat with different known resistor but one successful verification is sufficient

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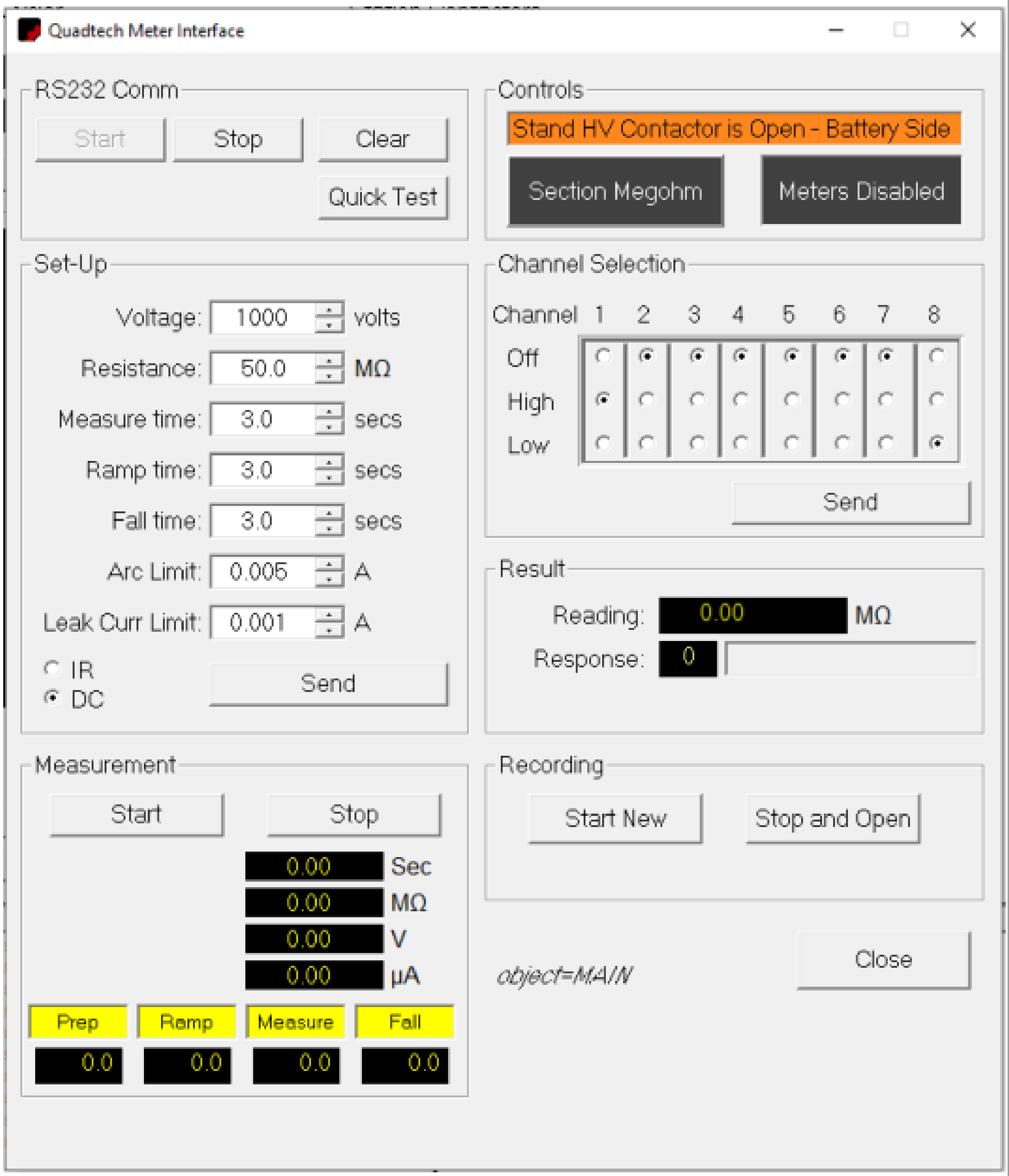

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## MODULE IV Process Validation

This Module includes process checks, which may be required to insure the defined process is still valid after a model year change, a critical component change within the vehicle, or a change in a machine component or parameter.

Note: If a specific T&E process validation requirement changes, the defined process does not have to be re-validated unless specifically stated in the Change History Module where the change in the validation requirements is documented.

| A. Module Electrical Test Process Validation | |
|---|---|
| ***Frequency:*** | When a battery cell's electrical characteristic(s) / electrical component of the battery Module has changed. |
| ***Tools:*** | Tools are described in Module II for Verification Checks. Please see Module II for details |
| ***Method/Action:*** | 1. Re-analyze the complete Module electrical test requirements.<br>2. Perform all verification checks described in Module II to verify the validity of Module electrical testing operation against the new product. |
| ***Data Records:*** | Minimum Data: Follow the minimum data requirement as listed in Module II.<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

## MODULE V Critical Maintenance

Critical maintenance items are those, which if neglected, will sacrifice the accuracy and repeatability of the equipment and affect quality. These items are the minimum mandatory checks that must be included in the plant's production or preventative maintenance plans.

| | # | Item | Freq Details | Description |
|---|---|---|---|---|
| Daily | | | | |
| | | | | |
| | | | | |
| | | | | |
| weekly | | Test Fixture Pogo Pins | Weekly | Visually inspect for bent or sticking spring-loaded pogo terminals. Pogo terminals with reduced tension shall also be repaired or replaced. In addition, repair or replace any worn or damaged blades. (Operator for inspection & Certified Technician for repair) |
| | | | | |
| | | | | |
| | | | | |
| Monthly | | | | |
| | | | | |
| | | | | |
| | | | | |

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| | # | Item | Freq Details | Description |
|---|---|---|---|---|
| Yearly | | Cycler Calibration | - | Calibrate the voltage and current analog readings. (Certified Technician) |
| | | | | |
| | | | | |
| | | | | |

## MODULE VI Recommended Best Practices

Note: Frequency is measured in the actual run time of machine for the number of packs assembled as specified.

| | # | Item | Freq Details | Description |
|---|---|---|---|---|
| Daily | | | | |
| | | | | |
| | | | | |
| Weekly | | Test Connectors – Pogo Pins and Bladed | Per 500 modules | Visually inspect for bent or sticking spring-loaded Pogo terminals. Pogo terminals with reduced tension shall also be repaired or replaced. In addition, repair or replace any worn or damaged blades. (Operator for inspection & Certified Technician for repair) |
| | | Test Connectors – Part-in-Place Switches | Per 500 modules | Verify for proper function. Clean, repair, and replace as needed. (Operator for inspection & Certified Technician for repair) |
| | | Test Cable Harnesses | Per 500 modules | Visually inspect and replace if any of worn or damaged harnesses is found. (Operator & Certified Technician) |
| Monthly | | Emergency Stop Buttons | Per 2,100 modules | Verify function by activating and resetting the E-stops. (Team Leader) |
| | | PC Chassis Cooling Fans | Per 2,100 modules | Inspect for proper rotation to ensure air is circulated throughout the unit. Clean and replace as needed (Certified Technician) |
| | | Air Fan Filters | Per 2,100 modules | Visually inspect, clean and replace if any of them is clogged with dirt, dust, or debris. (Operator) |
| | | Cable Balancers | Per 2,100 modules | Verify proper operation (i.e. full retraction). Replace as needed. (Team Leader) |
| | | Infrared Camera Lens | Per 2,100 modules | Clean camera lens gently with cotton wool and 96% isopropyl alcohol / commercial lens cleaning fluid with >30% isopropyl alcohol. Discard the cotton wool after use. |
| Yearly | | I/O channels (including thermal) & charging circuitry | Per 12,600 modules | Perform system calibration as per instructions in Module III above. (Certified Technician) |
| | | Circuit Breakers | Per 12,600 modules | Verify breaker function. (Team Leader) |
| | | Uninterruptible Power Supply (UPS) | Per 12,600 modules | Verify function. (Certified Technician) |

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| | | | | |
|---|---|---|---|---|
| | | Cabinets | Per 12,600 modules | Clean and dust exterior as needed. Remove any dirt buildup on air inlets. (Operator) |
| | | Internal High Voltage Bus Bar / Terminal Strip Connections | Per 25,200 modules | Inspect for loose connections. Tighten as needed (Certified Technician) |
| | | PC Air Conditioner | Per 25,200 modules | Verify thermostat function. (Certified Technician) |
| | | | | |

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## MODULE VII Change History

This is a chronological listing of all changes made to the T&E bulletin with the latest entry at the beginning of the list and the oldest entry at the end of the list.

| Date | Description of Change |
|---|---|
| August 9, 2021 | Initial release of T&E bulletin for the B3T Module electrical tester. |
| | |
| | |
| | |
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| | |
| | |
| | |

**(All new entries are to be place in the top row)**
(To add blank rows for new entries, click on the top latest entry row, then click on: "Table" "Insert" "Rows Above")
(To delete rows, click on the row(s) to be deleted, then click on: "Table" "Delete" "Rows")

# 2. B3T PACK PRODUCTION ELECTRICAL TESTER

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**SUBJECT:** T&E Bulletin for B3T Pack Electrical Tester, Tool No. MAA80700S-02S

**PURPOSE:** To establish uniform procedures and schedule for calibration (as required) and preventative maintenance of the B3T Pack Production Electrical Tester.

**CONTENTS:**



**General Guidelines and Definitions**

1. Definitions:
   1.1. A machine is defined as in **'service'** if it is in regular rotation on production vehicles for that shift.
   1.2. A machine is defined as in **'standby'** if it is one that may be pulled into production as needed, to do a production job. Generally, this unit is powered on and in Auto mode, but is not used unless another unit has an issue or production gets behind schedule.
   1.3. A machine is defined as **'idle'** if it is one that is not expected to be used in production for the present shift. Typically, this unit is powered down and is considered 'not ready.'
2. A machine that is in standby is subject to the same T&E requirements as any tool that is in service.
3. A machine that is idle may have specific maintenance requirements to bring them back into service. These will be listed in the specific task description under 'Frequency' where applicable.

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## SECTION I Critical Parameters & Operating Description

This section gives a detailed listing of all critical test parameters including recommended values, descriptions, and the effects on the equipment or process.

| B3T Pack | | | |
|---|---|---|---|
| **Step** | **Parameter Name** | **Description/Process** | **Parameter Data** |
| 1 | Cell Group Voltage | Individual cell group voltage | 3.50V – 4.00V |
| 2 | Pack Voltage | Total pack voltage measured in an uncharged state | 350V(parallel) 700(series) |
| 3 | Pack Discharge Current | Current measured while battery is discharged | ≤ 1600A |
| 4 | Pack Charge Current | Current measured while battery is charged | 85A - 400A |
| 5 | Thermistor Temperature | Ambient temperature measured by thermistors | 17°C - 45°C |

| Starting the Test Station | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | **Warning:** When the battery pack is attached to the test station connectors, deadly levels of voltage and current can be present throughout the cables even when the control power is switched off. Disconnect cables and remove the battery pack from the station before opening or servicing the HVI cabinet.<br><br>1. Verify that the disconnect switch on the station's power distribution panel is in the **ON** position.<br><br>2. At the Bauer DAQ cabinet, switch the **E0106S1** Rotary Disconnect switch to the **ON** position. |

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| | |
|---|---|
| |  3. At the MCC panel, verify that the disconnector is in the **ON** position.   4. At the MCC cycler panel, verify that the disconnector is in the **ON** position  |
| ***Data Records:*** | None |

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| Debugging starting the Test Station | |
|---|---|
| ***Frequency:*** | When failed to start the station or first-time power on the station |
| ***Tools:*** | None |
| ***Method/Action:*** | **Warning:** When the battery pack is attached to the test station connectors, deadly levels of voltage and current can be present throughout the cables even when the control power is switched off. Disconnect cables from the battery pack before opening or servicing the HVI cabinet.<br>**Warning:** wear proper PPE to open each cabinet.<br>1. Wear proper PPE , open the door of power distribution panel. Verify that the disconnect switch inside the station's power distribution panel is in the ON position.<br><br>2. Verify that the disconnect switch on the station's power distribution panel is in the **ON** position.<br><br>3. At the HMI cabinet, open the front door of the HMI cabinet. |

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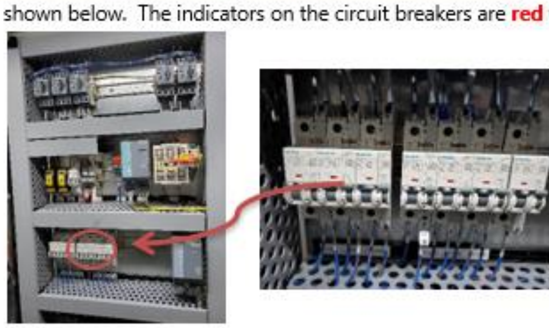
4. Wear proper PPE , verify that all circuit breakers in the HMI cabinet are in the **ON** position, as shown in the following image.

5. Close the front door of the HMI cabinet.
6. Wearing proper PPE, locate and open the front door of the HVI cabinet..
7. Verify that all of the circuit breakers in the HVI enclosure are set to the **ON** position, as

shown below. The indicators on the circuit breakers are **red** when in the ON position.



8. Close and lock the HVI enclosure door.

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9. Wearing proper PPE, move to the Bauer DAQ cabinet and open the front door of the Bauer DAQ cabinet.
10. Verify that all circuit breakers in the Bauer DAQ cabinet are in the **ON** position, as shown in the following images.

11. Close the front door of the Bauer DAQ cabinet.
12. At the Bauer DAQ cabinet, switch the **E0106S1** Rotary Disconnect switch to the **ON** position.

13. At the MCC Cycler panel, verify that Both disconnect switches are in the **ON** position

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| | |
|---|---|
| |   |
| ***Data Records:*** | None |

| **Starting the PCS Computer** | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | 1. Open the front door of the Bauer DAQ cabinet.<br><br>2. Locate and power on the station's Uninterruptible Power supply (UPS) as follows:<br>a. If the UPS is off, press the power button until the display reads "UPS startup pending".<br>b. When the UPS is powered on, the display will read "APC by Schneider".<br><br>3. Locate the Bauer PC and power it on.<br>a. At the lower left front of the PCS computer, press the switch , which starts Microsoft Windows and the PCS software. |

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| | |
|---|---|
| |  4. Close the front door on the Bauer DAQ cabinet. |
| ***Data Records:*** | None |

| **Manually Starting the PCS Application** | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | 1. Click on the PCS icon on the window desktop to start the PCS software. The PCS software will start automatically in **Online** mode.<br>**Note**: PCS must be in Online mode to run tests. To manually enter Online, select the online button from the Idle mode window.<br> |
| ***Data Records:*** | None |

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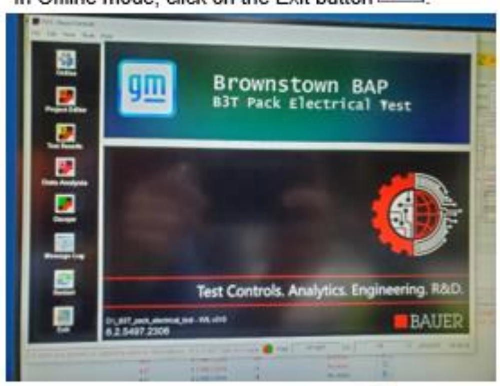
| Power down the Station | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | 1. Verify that all testing is complete and there is no pack attached to the test station.<br>2. At the Bauer DAQ cabinet, shut down PCS as follows:<br>a. Go to **Offline** mode by clicking the Idle button.<br><br>b. In Offline mode, click on the Exit button.<br><br><br>3. Shut down the PC though the Windows Start menu.<br>4. Wear proper PPE; open the front door of the Bauer DAQ cabinet.<br>5. Turn off the UPS by pressing and holding the power button until the UPS display reads "Output off by: local display". |

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6. Close the front door of the Bauer DAQ cabinet.
7. Turn the **E0102KS** rotary disconnect to the **OFF** position.

   **Note**: When the power is disconnected, the UPS alarm will go off for 30 seconds while the UPS powers down.

8. Turn off the disconnect switch on the station's power distribution panel.

9. At the front panel of the MCC, turn off the Disconnect switch.

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10. At the front panel of Cycler, turn off the Disconnect switches.

| | |
|---|---|
| ***Data Records:*** | None |

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## SECTION II Verification Checks

Verification is a spot-check of the process to determine if it is running within required parameters and to identify if calibration or maintenance is required. Verification can also be used to periodically confirm that error-proofing or other critical processes are still functioning. This should generally be considered a pass/fail type check with minimal data recorded or retained.

| Battery Pack System Voltage Verification | |
|---|---|
| ***Frequency:*** | As Plant required |
| ***Tools:*** | Digital Multimeter: 4½ digit, 200mV to 1000V range, Cat III rated<br>BEV3 Pack and B35 Pack<br>**Protective Personal Equipment (PPE):** As plant's requirements |
| ***Method/Action:*** | 1. Wear proper PPE.<br>2. Ensure that a pack is on an AGC and is located properly within the test cell.<br>3. Connect all connectors that apply to the selected pack model.<br>4. At the Bauer PC, verify that PCS is in Manual mode and Online.<br>5. Click on the *Open Pack Contactors Control* button to open the Pack Contactor Control window.<br><br>6. In the Pack Contactor Control window, click on *Open Mode 6*. |

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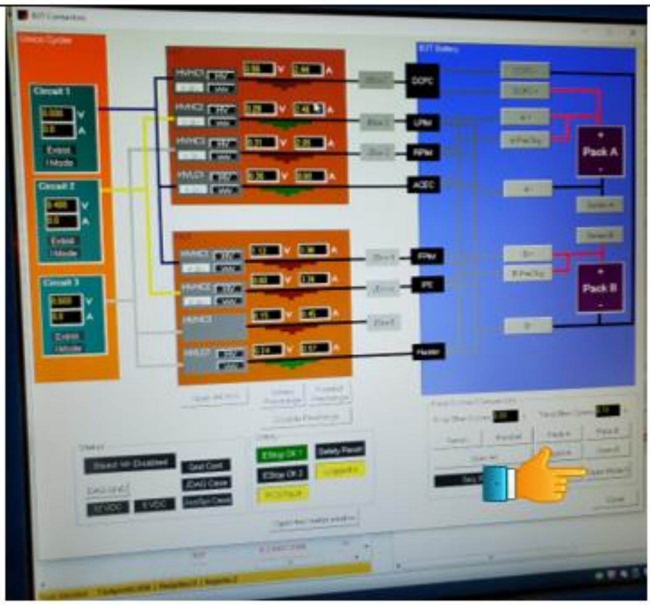

7. Using the calibrated volt meter, measure the pack voltage.
B3T:
- Verify for all 7 HV outputs of the pack (e.g. RPIM, IPE, etc.)
- Retrieve the pack HV measurement from the top of the BDU (configured in parallel):


8. Compare the readings in the *HV1 HV2* section against the measurements taken with the calibrated volt meter. If any of the stand reading channels has an offset that is larger than 2% of the measured voltage, the channel should be calibrated.

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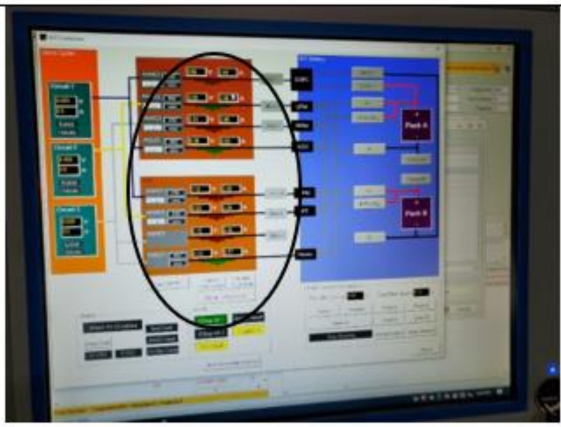
| | |
|---|---|
| |  9. After the comparison, click on the *Open All* button on the Pack Contactor Control window (shown above), and disconnect all of the connectors in correct sequence on the battery. |
| ***Data Records:*** | Minimum Data:<br>• Date and time of verification performed<br>• Voltage readings<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements |

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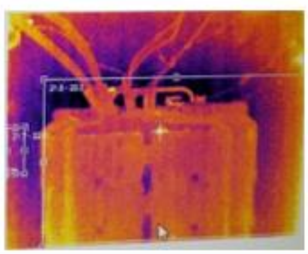
| Infrared Thermal Camera Temperature Measurement Verification | |
|---|---|
| ***Frequency:*** | Every six months of machine run time / when calibration is performed. |
| ***Tools:*** | Laser IR Thermometer<br>Suggested Model: EX470 by Extech Instruments |
| ***Method/Action:*** | 1. Ensure that a pack is on an AGC and is located properly within the test cell.<br>2. Verify that the stand is in Manual mode and Online, and that the GM-FLIR program is running.<br>3. Connect the connectors to the pack.<br>4. In the main PCS-Bauer Controls window, click on the *Start* button in the FLIR Inspection section.<br><br>5. Use the IR laser thermometer to measure the temperature on the battery pack according to the FLIR infrared image where the maximum temperature is located.<br> |

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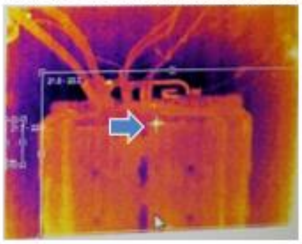
6. Verify the temperature reading displayed in the GM-FLIR program against the measurement from the IR thermometer. The GM FLIR software will show the maximum temperature in each region. Use the IR thermometer to verify the indicated reading.
7. In the GM FLIR software, verify that high voltage bus connections are enclosed by temperature-monitoring regions of interest (ROI).



8. In the main PCS-Bauer Controls window, click on the *Stop* button in the FLIR Inspection section.

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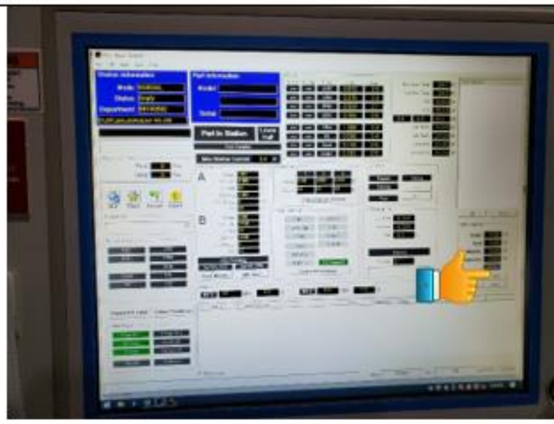
| |  |
| ***Data Records:*** | Minimum Data:<br>• Date and time of verification performed<br>• Temperature reading<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements |

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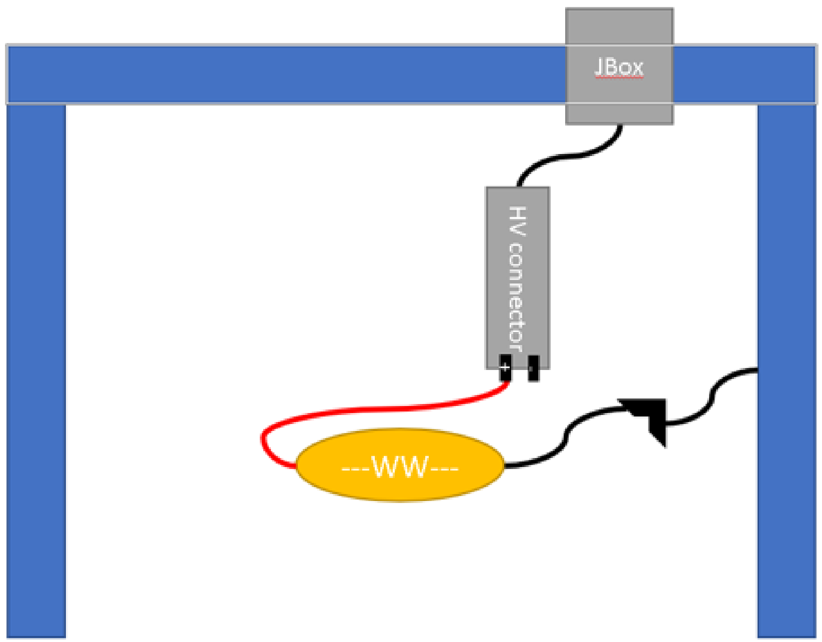
| Mega Ohm Test(Hi-pot) Verification | |
|---|---|
| ***Frequency:*** | Every six months of machine run time / when calibration is performed |
| ***Tools:*** | Mega Ohm verification resistor (50M resistor inside) or 50M bare resistor |
| ***Method/Action:*** | **Warning**: When performing Hi-pot verification, high voltage is applied to both ends of the resistor. Wear proper PPE to connect the resistor to the contactors.<br>1. Apply 50 MΩ resistor between negative/positive HVHC terminal in station and the module case megohm terminal. If using the verification resistor, simply connect with banana post jacks. If using bare resistor, Test leads should be 1kV rated and resistor needs to be suspended in the air.<br><br><br>2. At the station's human machine interface (HMI) ensure that the mode select switch indicates *Manual Mode.*<br>3. At the DAQ PC, check that PCS is Online.<br>4. Open the *Quadtech Meter* interface window.<br>a. Select *"Quadtech Meter"* from the *Function List* drop down list in the PCS *Manual mode* window.<br>5. Set up the window as the following screenshot. |

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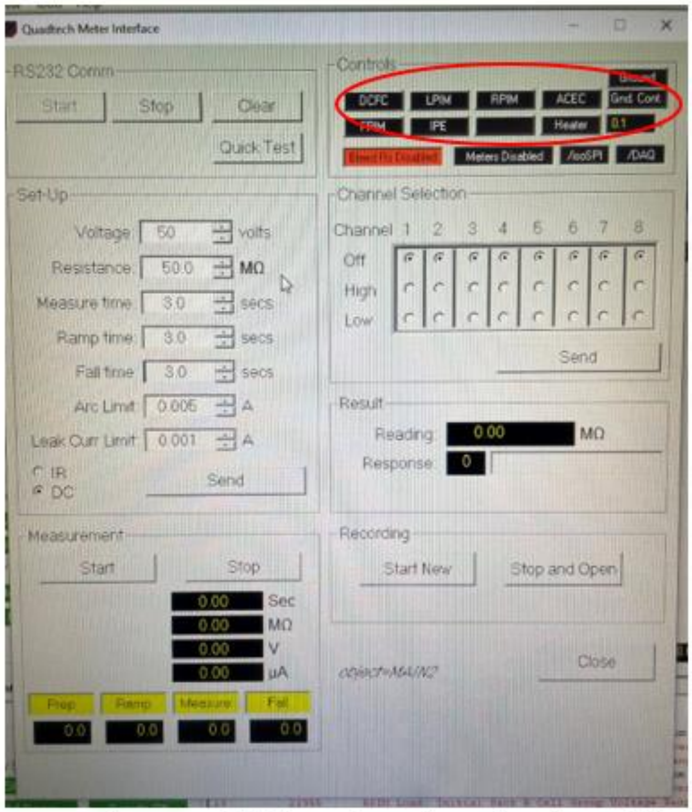
| | |
|---|---|
| | <br>• Set meter to 50V, 3 second ramp, 3 second test, 3 second fall<br>• Set resistance to 50MΩ<br>• Select HV channels<br>• Select the corresponding HV contactor that Resistor is connected (in red circle) and ensure meters are disabled<br>6. Run measurement with 'Start'; 'Reading' should be ~50 MΩ<br>7. Could repeat with different known resistor but one successful verification is sufficient |
| ***Data Records:*** | Minimum Data:<br>• Date and time of verification performed<br><br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements |

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## SECTION III Calibration

Calibration is the infrequent adjustment of a gauge or sensor to a national or international (certified) standard. This can be based on a set frequency or be required if a verification check fails. Unless otherwise specified, procedures & data recorded should comply with The Global Quality Requirements Manual, Measurement System Analysis 11.00.

**Note**: The following devices or equipment that is used for the test station require calibration performed by professionals from device or equipment manufacturer and frequency of calibration should follow product manual:

1. **FLIR camera**
   - Manufacturer: FLIR Systems
   - Model: FLIR A315 20Hz
2. **Cycler**
   - Manufacturer: MCC
   - Model: N/A
3. **Hi Pot Meter**
   - Manufacturer: CHROMA
   - Model: N/A
   - Serial Number: N/A

| Voltage Calibration | |
|---|---|
| ***Frequency:*** | Only when a verification exercise fails, or every <u>six months</u> of machine run time |
| ***Tools:*** | Digital Multimeter: 4½ digit, 200mV to 1000V range calibrated<br>B3T Pack and BEV3 Pack<br>Protective Personal Equipment (PPE): Per plant requirements |
| ***Method/Action:*** | The following procedure can be used to calibrate the Charger and voltage channels using a calibrated digital multimeter as a reference.<br>1. Leave the battery pack and contactor disconnected.<br>2. In PCS, select *Tools* > *Physical Calibration* to open the Analog Channel Calibration window. (This will require a qualified user to log in).<br>3. In the *Analog Channels* field, select the voltage channel for calibration. |

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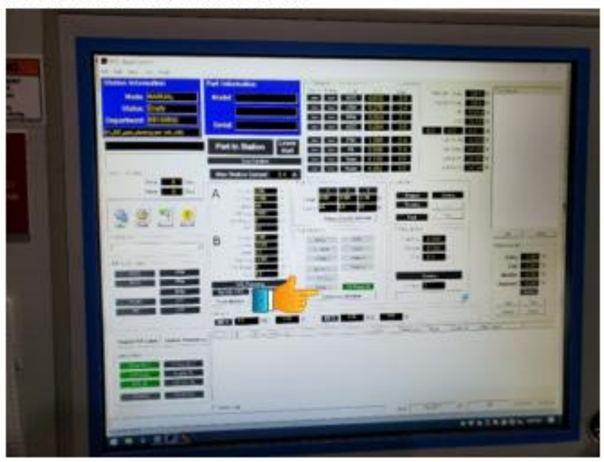
4. With PCS Online and in Manual mode, click the *Open Pack Contactor Control* button to open the Pack Contactor Control window.
5. set the applied load set to zero (0) volts in the Analog Channel Calibration window
6. Click on the *Set* and *Next* buttons.



7. Connect the battery pack to the stand.
8. In the Pack Contactor Control window, click on the *Open Mode 6.*

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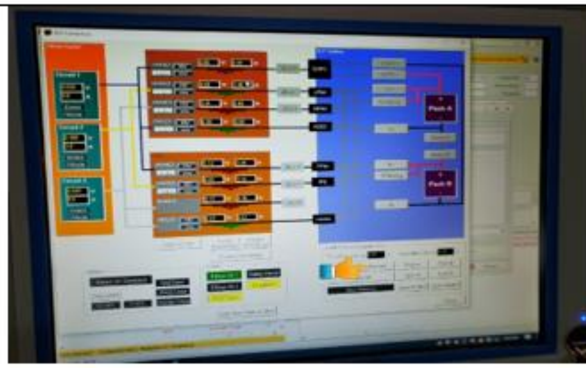

9. Using the calibrated multi-meter, measure the pack voltage.
B3T


10. Verify that the pack is connected by monitoring the readings in the *HV Readings* section of the Pack Contactor Control window.

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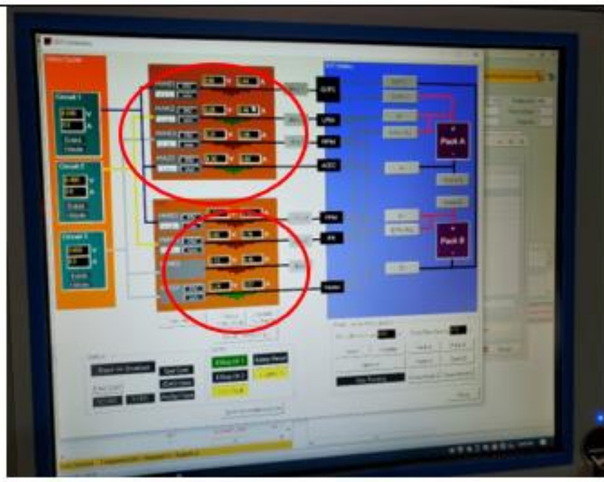
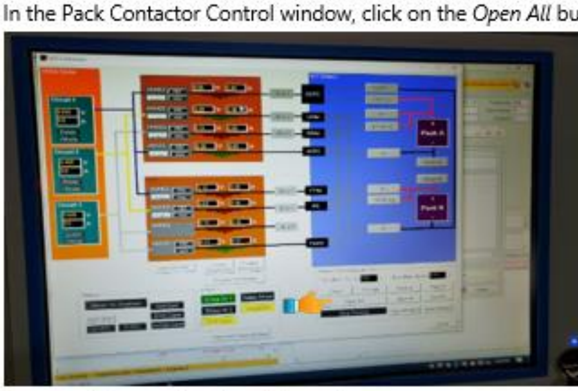
| | |
|---|---|
| | <br>11. In the Analog Channel Calibration window, enter the reading into the *Applied load* field, and then click on the *Set* and *Next* buttons.<br>12. In the Pack Contactor Control window, click on the *Open All* button.<br><br>13. Remove all connectors from the part.<br>14. Repeat the above procedure for the remaining voltage channels. |
| ***Data Records:*** | Minimum Data: Follow the minimum data requirement as listed in Section II.<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

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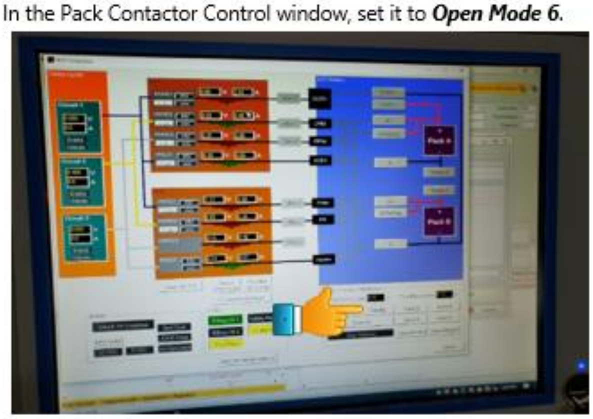
<table>
<tr><th colspan="2">MVSS305 Voltage Calibration</th></tr>
<tr><td>Frequency:</td><td>Only when a verification exercise fails, or every <u>Six Months</u> of machine run time</td></tr>
<tr><td>Tools:</td><td>Two identical Digital Multimeter: 4½ digit, 200mV to 1000V range calibrated<br>B3T Pack and BEV3 Pack<br>Protective Personal Equipment (PPE): Per plant requirements</td></tr>
<tr><td>Method/Action:</td><td>The following procedure can be used to calibrate the MVSS305 voltage channels. Note that this procedure needs two identical calibrated digital multimeter as a reference.<br>1. Wear proper protective personal equipment (PPE) for the following procedure.<br>2. Verify PCS is Online and in Manual mode as shown in the following image:<br><br>3. Click the Open Pack Contactor Control button.<br>4. In the Pack Contactor Control window, set it to Open Mode 6.<br><br>5. At the battery pack, measure the voltage of the battery pack using a calibrated digital multimeter between the most positive terminal and the most negative terminal as shown in the following image. Verify that it can read the full voltage of the battery (typical value for B3TVII is around 350V in Parallel).</td></tr>
</table>

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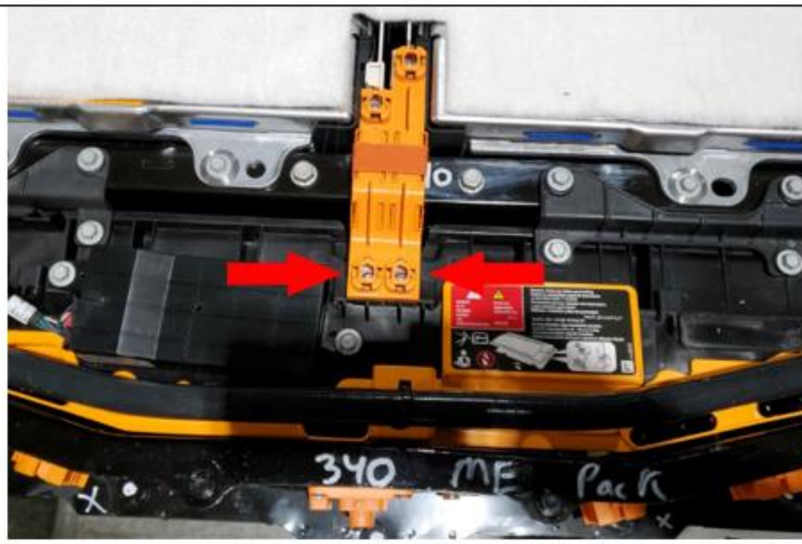
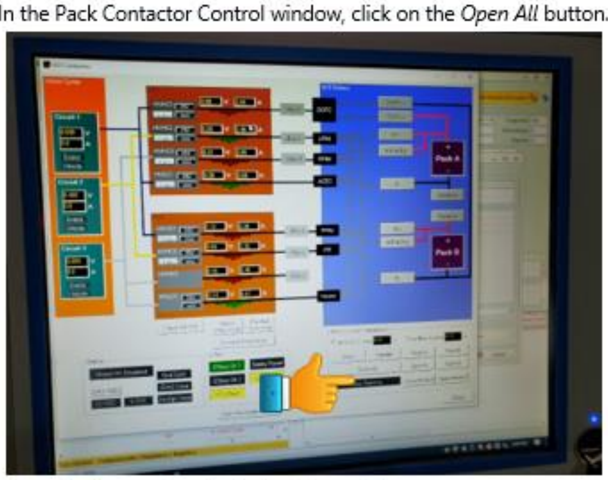
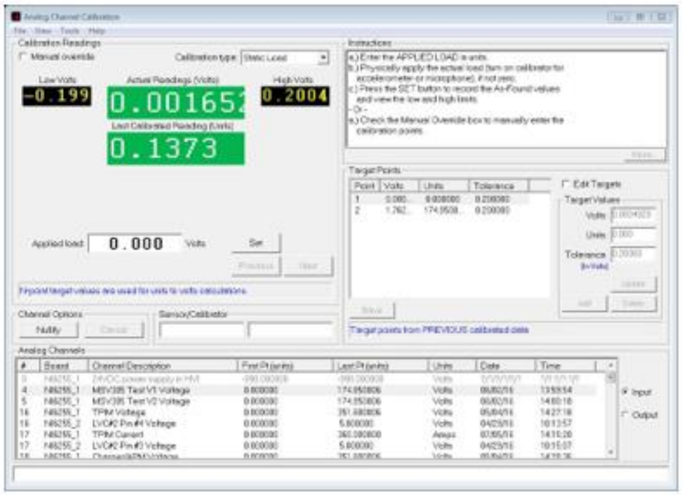



6. Have one person measure the voltage between the most positive terminal of the battery and the case ground of the pack (record value as V1) while another person measures the voltage between the most negative terminal of the battery and the case ground (record value as V2). Note both voltage values for V1 and V2.
7. In the Pack Contactor Control window, click on the *Open All* button.

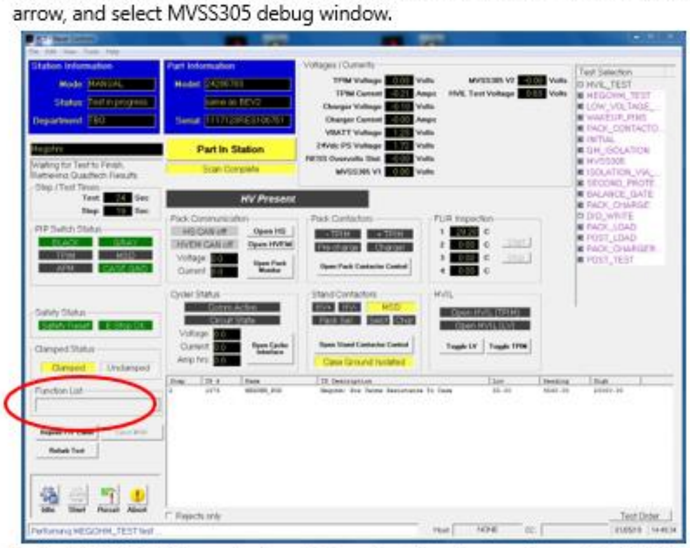


8. Connect all connectors to the battery pack.
9. In the main PCS Manual mode window, select *Tools > Physical Calibration* to open the Analog Channel Calibration window. This will require a qualified user to log in.
10. In the Analog Channel Calibration window, select the MVSS305 V1 (or V2) channel, as shown in the following image. Enter value 0 to the *Applied load* field, and click on the *Set*

and *Next* buttons.




11. In the main PCS Manual mode window, click on the Function List drop-down selection arrow, and select MVSS305 debug window.




12. In the MVSS305 debug window, click on the *Close* button, then click *MVSS305, V1* and *V2* buttons.
13. Verify that the V1 and V2 values are shown in the window, and both are approximately equal and about half of the full pack voltage.

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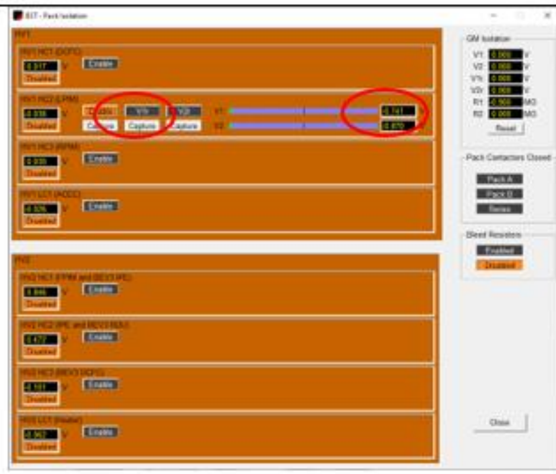
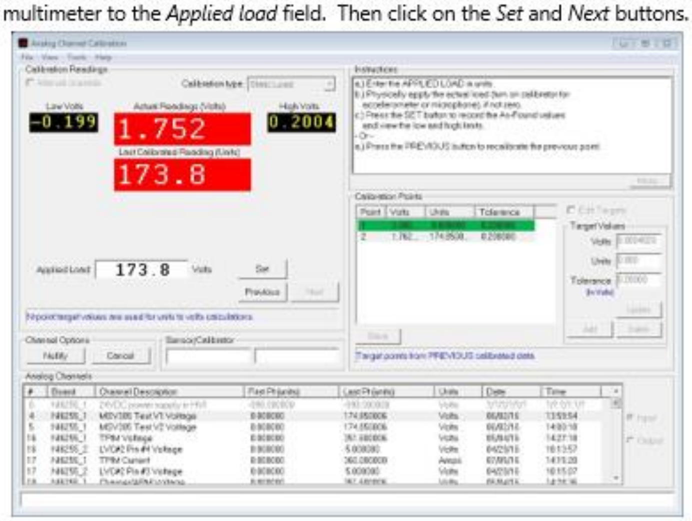


14. At the Analog Channel Calibration window, enter the V1 (or V2) values measured by the multimeter to the *Applied load* field. Then click on the *Set* and *Next* buttons.




15. At the MVSS305 debug window, click on the *Open* button.
16. Unplug all connectors from the battery.
17. Repeat the above procedure for the remaining MVSS305 channels for each high voltage channel.(HVHC1-3, HVLC1).

***Data Records:*** Minimum Data: Follow the minimum data requirement as listed in Section II.
Minimum Retention Period: To be retained in accordance with standard plant retention requirements.

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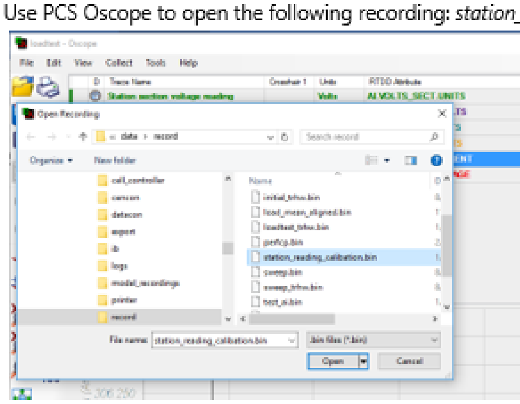
| B. Station Current Shunt Calibration | |
|---|---|
| ***Frequency:*** | Only when a verification exercise fails, or every <u>six months</u> of machine run time |
| ***Tools:*** | |
| ***Method/Action:*** | **Note:** The calibration procedure uses current value feedback from MCC Cycler as a reference, therefore before proceeding with the following procedure, make sure MCC Cycler calibration is up to date.<br><br>**Warning**: In this step we are controlling the current flow, stop the cycler if no one is at the station.<br><br>1. At the Bauer PC, ensure that PCS is Online.<br>2. At the station's HMI verify that the mode selection switch indicates Manual mode.<br>3. Using the station's HMI, load a Module into the station.<br>4. Use PCS Oscope to open the following recording: *station_reading_calibration.bin.*<br><br>5. In PCS, open the control window by clicking the *Control Cycler* button in the Manual mode window.<br>6. In the Cycler Interface window:<br>a. Click on the *Enable* button to start the cycler communications. When the communications are running, the Set point will be current. |

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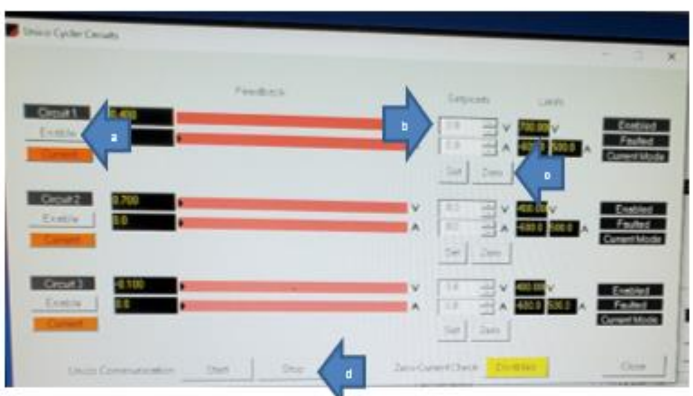
7. In the PCS Oscope window, start a recording by clicking on the start button.

8. Briefly run a -100 A load. Your can use any Cycler channel, recommend FPIM
   a. Enter -100A into the *Setpoint* field and then press they *Tab* key on the keyboard.
   b. After 3 seconds, click on the the *Zero* button to stop the cycler.



9. Briefly run a 40A charge.
   a. Enter 40A into the *Setpoint* field and then press the Tab key on the keyboard.
   b. After 3 seconds, click on the *Zero* button to stop the cycler.
   c. Press the *Stop* button to stop communications to the cycler.
   d. Close the Cycler Control Interface window.

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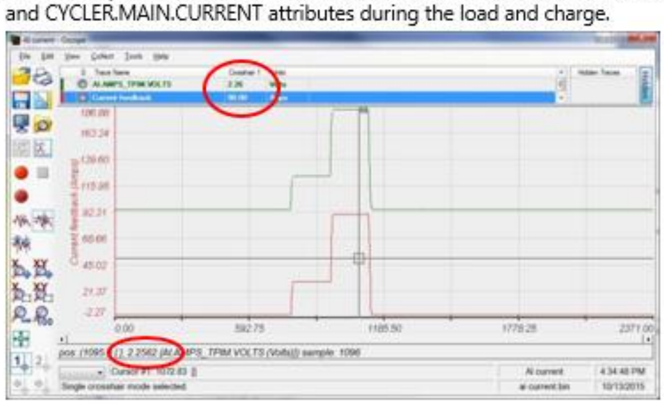
10. In the PCS Oscope window, click on the stop button to stop the recording.

11. In the Oscope window, use the cursors to record the values for AI.AMPS_SECT.VOLTS and CYCLER.MAIN.CURRENT attributes during the load and charge.



**Note:** For details on operating the PCS Oscope, open the *Online Help* by selecting *About This Window* from the Help menu.

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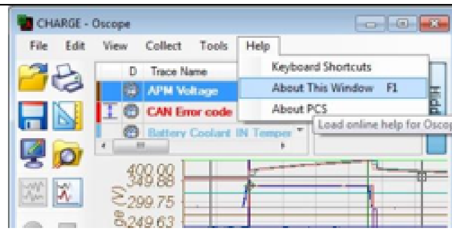
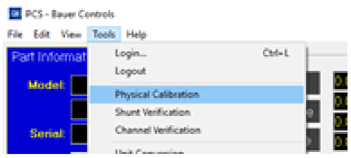
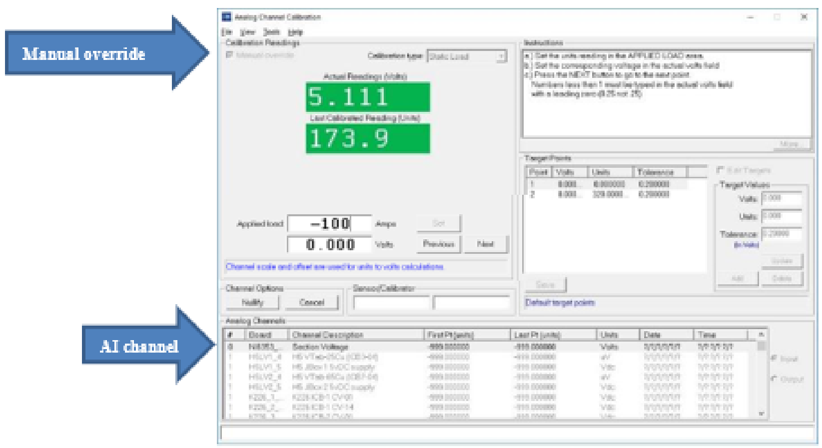



12. In PCS select *Tools* > *Physical Calibration.*




13. In the *Analog Channel Calibration* window, select the ***Station Current*** channel and select the *Manual override* checkbox.




14. In the Analog Channel Calibration window, enter the recorded values during the -100A load. You get these values through reading from recording.
    a. Enter the value for the trace named AI.AMPS_SECT.VOLTS into the *Volt* and the recorded.
    b. Enter the #CYCLER_CIRCUIT.MAIN.CURRENT value into the *Applied Load* field, depend on which cycler channel you are used in step 8/9
    c. Click on the *Set* and *Next* buttons to save the first calibration point.


15. In the *Analog Channel Calibration* window, enter the recorded values during the 40A

| | | |
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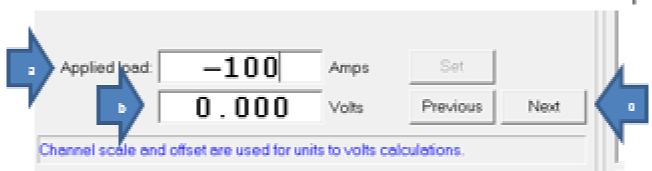
| | |
|---|---|
| | charge. You get these value through reading from recording.<br>a. Enter the value for AI.AMPS_SECT.VOLTS into the *Volt* and the recorded.<br>b. Enter the CYCLER.MAIN.CURRENT value in to the *Applied Load* field.<br>c. Click the *Set* and *Next* buttons to save the second calibration point.<br><br>16. Close the *Analog Calibration Window*.<br>17. Use the station's HMI to remove the Module from the station. |
| ***Data Records:*** | Minimum Data: Follow the minimum data requirement as listed in Module II.<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

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## SECTION IV Process Validation

This section includes process checks, which may be required to ensure the defined process is still valid after a model year change, a critical component change within the vehicle, or a change in a machine component or parameter.

**Note:** If a specific T&E process validation requirement changes, the defined process does not have to be re-validated unless specifically stated in the Change History Section where the change in the validation requirements is documented.

| **A. Pack Electrical Test Process Validation** | |
|---|---|
| ***Frequency:*** | When a battery cell's electrical characteristic(s) / electrical component of the battery pack has changed. |
| ***Tools:*** | Tools described in Section II for Verification Checks. Please see Section II for details |
| ***Method/Action:*** | 1. Re-analyze the complete pack electrical test requirements.<br>2. Perform all verification checks described in Section II to verify the validity of pack electrical testing operation against the new product. |
| ***Data Records:*** | Minimum Data: Follow the minimum data requirement as listed in Section II.<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

## SECTION V Critical Maintenance

Critical maintenance items are those, which if neglected, will sacrifice the accuracy and repeatability of the equipment and affect quality. These items are the minimum mandatory checks that must be included in the plant's production or preventative maintenance plans.

| | # | Item | Freq Details | Description |
|---|---|---|---|---|
| **Daily** | | | | |
| | | Connector inspection | Beginning of shift | Inspect all high voltage, low voltage and leak test connectors for wear and damage |
| | | | | |
| | | | | |
| **Weekly** | | | | |
| | | | | |
| | | | | |
| | | | | |
| **Monthly** | | | | |
| | | | | |
| | | | | |
| | | | | |
| **Yearly** | | Cycler Calibration | - | Calibrate the voltage and current analog readings. (Certified Technician) |
| | | | | |

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|---|---|---|---|---|
| | | | | |
| | | | | |

## SECTION VI Recommended Best Practices

Note: Frequency is measured in the actual run time of machine for the number of packs assembled as specified.

| | # | Item | Freq Details | Description |
|---|---|---|---|---|
| Daily | | | | |
| | | | | |
| | | | | |
| Weekly | | Test Connectors – Pogo Pins and Bladed | Per 500 packs | Visually inspect for bent or sticking spring-loaded Pogo terminals. Pogo terminals with reduced tension shall also be repaired or replaced. In addition, repair or replace any worn or damaged blades. (Operator for inspection & Certified Technician for repair) |
| | | Test Connectors – Part-in-Place Switches | Per 500 packs | Verify for proper function. Clean, repair, and replace as needed. (Operator for inspection & Certified Technician for repair) |
| | | Test Cable Harnesses | Per 500 packs | Visually inspect and replace if any of worn or damaged harnesses is found. (Operator & Certified Technician) |
| | | HV Test Cable Harnesses | Per 500 packs | Visually inspect HV cables for any cracks and/or nicks in the insulation. |
| Monthly | | Emergency Stop Buttons | Per 2,100 packs | Verify function by activating and resetting the E-stops. (Team Leader) |
| | | PC Chassis Cooling Fans | Per 2,100 packs | Inspect for proper rotation to ensure air is circulated throughout the unit. Clean and replace as needed (Certified Technician) |
| | | Air Fan Filters | Per 2,100 packs | Visually inspect, clean and replace if any of them is clogged with dirt, dust, or debris. (Operator) |
| | | Cable Balancers | Per 2,100 packs | Verify proper operation (i.e. full retraction). Replace as needed. (Team Leader) |
| | | Infrared Camera Lens | Per 2,100 packs | Clean camera lens gently with cotton wool and 96% isopropyl alcohol / commercial lens cleaning fluid with >30% isopropyl alcohol. Discard the cotton wool after use. |
| Yearly | | I/O channels (including thermal) & charging circuitry | Per 12,600 packs | Perform system calibration as per instructions in Section III above. (Certified Technician) |
| | | Circuit Breakers | Per 12,600 packs | Verify breaker function. (Team Leader) |
| | | Uninterruptible Power Supply (UPS) | Per 12,600 packs | Verify function. (Certified Technician) |
| | | Cabinets | Per 12,600 packs | Clean and dust exterior as needed. Remove any dirt buildup on air inlets. (Operator) |

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| | | | | |
|---|---|---|---|---|
| | | Internal High Voltage Bus Bar / Terminal Strip Connections | Per 25,200 packs | Inspect for loose connections. Tighten as needed (Certified Technician) |
| | | PC Air Conditioner | Per 25,200 packs | Verify thermostat function. (Certified Technician) |
| | | | | |

## SECTION VII Change History

This is a chronological listing of all changes made to the T&E bulletin with the latest entry at the beginning of the list and the oldest entry at the end of the list.

| Date | Description of Change |
|---|---|
| Aug 8, 2021 | Initial release of T&E bulletin for the B3T pack electrical tester. |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

**(All new entries are to be place in the top row)**

(To add blank rows for new entries, click on the top latest entry row, then click on: "Table" "Insert" "Rows Above")
(To delete rows, click on the row(s) to be deleted, then click on: "Table" "Delete" "Rows")

# 3. BEV3 PACK PRODUCTION ELECTRICAL TESTER

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**SUBJECT:** T&E Bulletin for BEV3 Pack Electrical Tester, Tool No. MAA80700S-02S

**PURPOSE:** To establish uniform procedures and schedule for calibration (as required) and preventative maintenance of the BEV3 Pack Production Electrical Tester.

**CONTENTS:**



**General Guidelines and Definitions**

1. Definitions:
   1.1. A machine is defined as in **'service'** if it is in regular rotation on production vehicles for that shift.
   1.2. A machine is defined as in **'standby'** if it is one that may be pulled into production as needed, to do a production job. Generally, this unit is powered on and in Auto mode, but is not used unless another unit has an issue or production gets behind schedule.
   1.3. A machine is defined as **'idle'** if it is one that is not expected to be used in production for the present shift. Typically, this unit is powered down and is considered 'not ready.'
2. A machine that is in standby is subject to the same T&E requirements as any tool that is in service.
3. A machine that is idle may have specific maintenance requirements to bring them back into service. These will be listed in the specific task description under 'Frequency' where applicable.

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## SECTION I Critical Parameters & Operating Description

This section gives a detailed listing of all critical test parameters including recommended values, descriptions, and the effects on the equipment or process.

| BEV3 Pack | | | |
|---|---|---|---|
| **Step** | **Parameter Name** | **Description/Process** | **Parameter Data** |
| 1 | Cell Group Voltage | Individual cell group voltage | 3.50V – 4.00V |
| 2 | Pack Voltage | Total pack voltage measured in an uncharged state | 350V |
| 3 | Pack Discharge Current | Current measured while battery is discharged | ≤ 550A |
| 4 | Pack Charge Current | Current measured while battery is charged | 85A - 400A |
| 5 | Thermistor Temperature | Ambient temperature measured by thermistors | 17°C - 45°C |

| Starting the Test Station | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | **Warning:** When the battery pack is attached to the test station connectors, deadly levels of voltage and current can be present throughout the cables even when the control power is switched off. Disconnect cables and remove the battery pack from the station before opening or servicing the HVI cabinet.<br><br>1. Verify that the disconnect switch on the station's power distribution panel is in the **ON** position.<br><br>2. At the Bauer DAQ cabinet, switch the **E0106S1** Rotary Disconnect switch to the **ON** position. |

| | | |
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3. At the MCC panel, verify that the disconnector is in the **ON** position.


4. At the MCC cycler panel, verify that the disconnector is in the **ON** position

***Data Records:*** None

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| Debugging the starting of Test Station | |
|---|---|
| ***Frequency:*** | When failed to start the station or first-time power on the station |
| ***Tools:*** | None |
| ***Method/Action:*** | **Warning:** When the battery pack is attached to the test station connectors, deadly levels of voltage and current can be present throughout the cables even when the control power is switched off. Disconnect cables from the battery pack before opening or servicing the HVI cabinet.<br>**Warning:** wear proper PPE to open each cabinet.<br>1. Wear proper PPE , open the door of power distribution panel. Verify that the disconnect switch inside the station's power distribution panel is in the ON position.<br><br>2. Verify that the disconnect switch on the station's power distribution panel is in the **ON** position.<br><br>3. At the HMI cabinet, open the front door of the HMI cabinet. |

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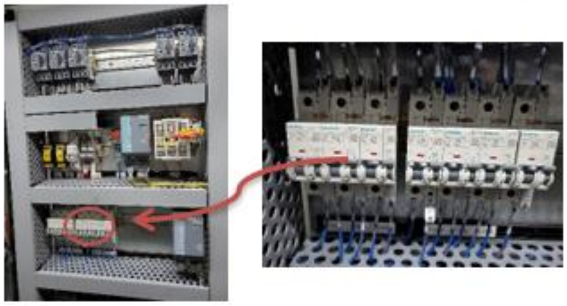
4. Wear proper PPE , verify that all circuit breakers in the HMI cabinet are in the **ON** position, as shown in the following image.

5. Close the front door of the HMI cabinet.
6. Wearing proper PPE, locate and open the front door of the HVI cabinet..
7. Verify that all the circuit breakers in the HVI enclosure are set to the **ON** position, as

shown below. The indicators on the circuit breakers are **red** when in the ON position.



8. Close and lock the HVI enclosure door.

| | | |
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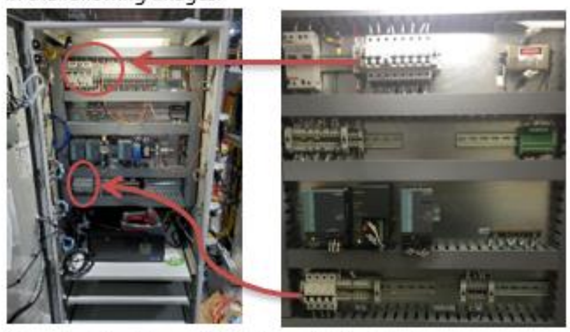
9. Wearing proper PPE, move to the Bauer DAQ cabinet and open the front door of the Bauer DAQ cabinet.
10. Verify that all circuit breakers in the Bauer DAQ cabinet are in the **ON** position, as shown in the following images.



11. Close the front door of the Bauer DAQ cabinet.
12. At the Bauer DAQ cabinet, switch the **E0106S1** Rotary Disconnect switch to the **ON** position.

13. At the MCC Cycler panel, verify that Both disconnect switches are in the **ON** position

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| | |
|---|---|
| ***Data Records:*** | None |

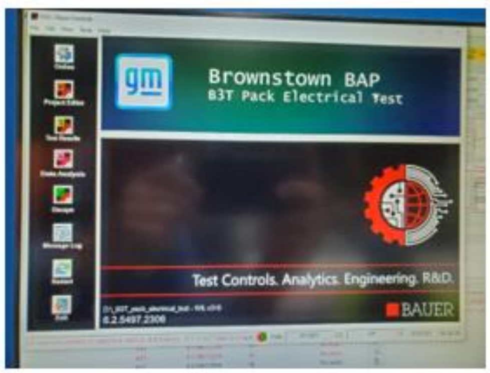
| **Starting the PCS Computer** | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | 1. Open the front door of the Bauer DAQ cabinet.  2. Locate and power on the station's Uninterruptible Power supply (UPS) as follows: a. If the UPS is off, press the power button until the display reads "UPS startup pending". b. When the UPS is powered on, the display will read "APC by Schneider".   3. Locate the Bauer PC and power it on. a. At the lower left front of the PCS computer, press the switch, which starts Microsoft Windows and the PCS software. |


4. Close the front door on the Bauer DAQ cabinet.

| | |
|---|---|
| ***Data Records:*** | None |

**Manually Starting the PCS Application**

| | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | 1. Click on the PCS icon on the window desktop to start the PCS software. The PCS software will start automatically in **Online** mode. **Note**: PCS must be in Online mode to run tests. To manually enter Online, select the online button from the Idle mode window. |




| | |
|---|---|
| ***Data Records:*** | None |

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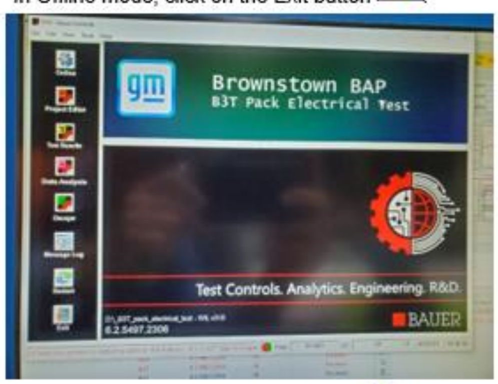
| Power down the Station | |
|---|---|
| ***Frequency:*** | As required |
| ***Tools:*** | None |
| ***Method/Action:*** | 1. Verify that all testing is complete and there is no pack attached to the test station.<br>2. At the Bauer DAQ cabinet, shut down PCS as follows:<br>a. Go to **Offline** mode by clicking the Idle button.<br><br>b. In Offline mode, click on the Exit button<br><br><br>3. Shut down the PC though the Windows Start menu.<br>4. Wear proper PPE; open the front door of the Bauer DAQ cabinet.<br>5. Turn off the UPS by pressing and holding the power button until the UPS display reads "Output off by: local display". |

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6. Close the front door of the Bauer DAQ cabinet.
7. Turn the **E0102KS** rotary disconnect to the **OFF** position.

**Note**: When the power is disconnected, the UPS alarm will go off for 30 seconds while the UPS powers down.

8. Turn off the disconnect switch on the station's power distribution panel.

9. At the front panel of the MCC, turn off the Disconnect switch.

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10. At the front panel of Cycler, turn off the Disconnect switches.

**Data Records:** None

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## SECTION II Verification Checks

Verification is a spot-check of the process to determine if it is running within required parameters and to identify if calibration or maintenance is required. Verification can also be used to periodically confirm that error-proofing or other critical processes are still functioning. This should generally be considered a pass/fail type check with minimal data recorded or retained.

| Battery Pack System Voltage Verification | |
|---|---|
| ***Frequency:*** | As Plant required |
| ***Tools:*** | Digital Multimeter: 4½ digit, 200mV to 1000V range, Cat III rated<br>BEV3 Pack and B35 Pack<br>**Protective Personal Equipment (PPE):** As plant's requirements |
| ***Method/Action:*** | 1. Wear proper PPE.<br>2. Ensure that a pack is on an AGC and is located properly within the test cell.<br>3. Connect all connectors that apply to the selected pack model.<br>4. At the Bauer PC, verify that PCS is in Manual mode and Online.<br>5. Click on the *Open Pack Contactors Control* button to open the Pack Contactor Control window.<br><br>6. In the Pack Contactor Control window, click on *Open Mode 6*. |

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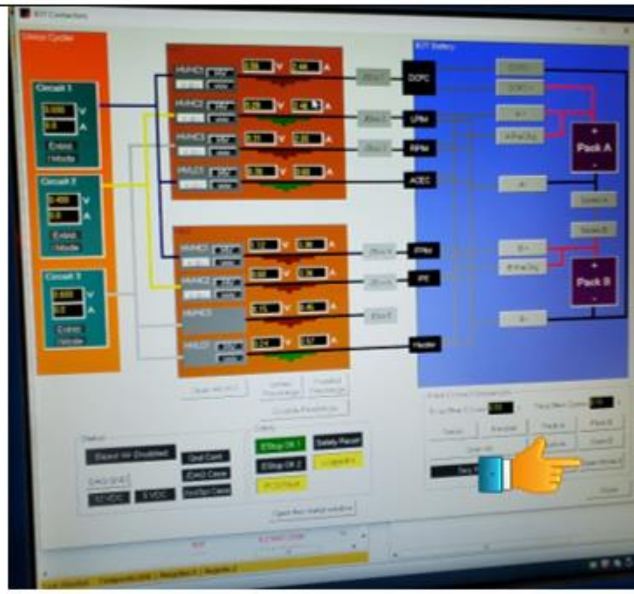

7. Using the calibrated volt meter, measure the pack voltage.
   BEV3:
   - Verify for all 3 HV outputs of the pack (e.g. RPIM, IPE, etc.)
   - Retrieve the pack HV measurement from the top of the BDU:

8. Compare the readings in the *HV1 HV2* section against the measurements taken with the calibrated volt meter. If any of the stand reading channels has an offset that is larger than 2% of the measured voltage, the channel should be calibrated.

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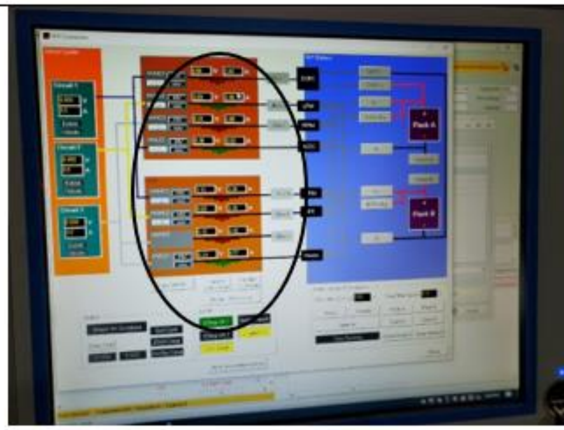
| | |
|---|---|
| |  9. After the comparison, click on the *Open All* button on the Pack Contactor Control window (shown above), and disconnect all of the connectors in correct sequence on the battery. |
| ***Data Records:*** | Minimum Data: • Date and time of verification performed • Voltage readings Minimum Retention Period: To be retained in accordance with standard plant retention requirements |

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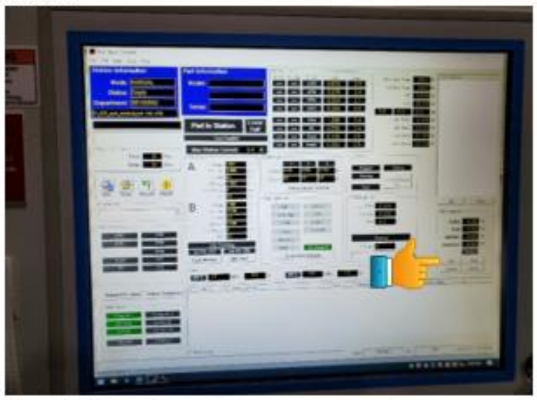
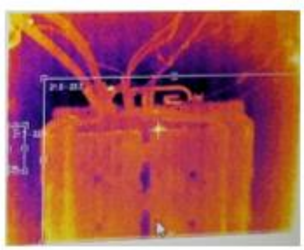
| Infrared Thermal Camera Temperature Measurement Verification | |
|---|---|
| ***Frequency:*** | Every six months of machine run time / when calibration is performed. |
| ***Tools:*** | Laser IR Thermometer<br>Suggested Model: EX470 by Extech Instruments |
| ***Method/Action:*** | 1. Ensure that a pack is on an AGC and is located properly within the test cell.<br>2. Verify that the stand is in Manual mode and Online, and that the GM-FLIR program is running.<br>3. Connect the connectors to the pack.<br>4. In the main PCS-Bauer Controls window, click on the *Start* button in the FLIR Inspection section.<br><br>5. Use the IR laser thermometer to measure the temperature on the battery pack according to the FLIR infrared image where the maximum temperature is located.<br> |

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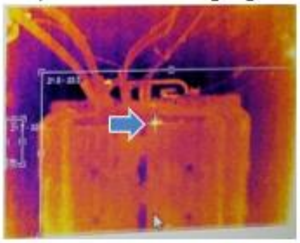
6. Verify the temperature reading displayed in the GM-FLIR program against the measurement from the IR thermometer. The GM FLIR software will show the maximum temperature in each region. Use the IR thermometer to verify the indicated reading.
7. In the GM FLIR software, verify that high voltage bus connections are enclosed by temperature-monitoring regions of interest (ROI).



8. In the main PCS-Bauer Controls window, click on the *Stop* button in the FLIR Inspection section.

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| | |
|---|---|
| |  |
| ***Data Records:*** | Minimum Data:<br>• Date and time of verification performed<br>• Temperature reading<br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements |

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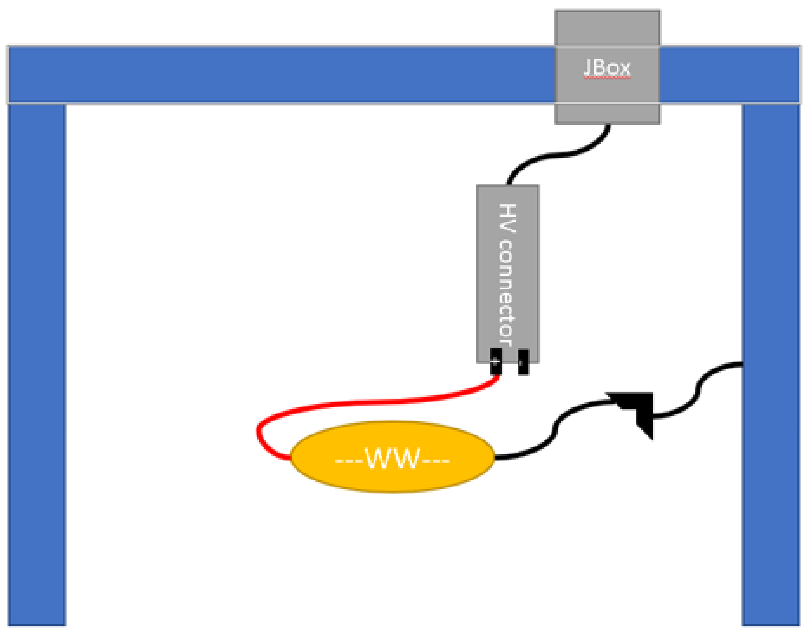
| Mega Ohm Test(Hi-pot) Verification | |
|---|---|
| ***Frequency:*** | Every six months of machine run time / when calibration is performed |
| ***Tools:*** | Mega Ohm verification resistor (50M resistor inside) or 50M bare resistor |
| ***Method/Action:*** | **Warning**: When performing Hi-pot verification, high voltage is applied to both ends of the resistor. Wear proper PPE to connect the resistor to the contactors.<br>1. Apply 50 MΩ resistor between negative/positive HVHC terminal in station and the module case megohm terminal. If using the verification resistor, simply connect with banana post jacks. If using bare resistor, Test leads should be 1kV rated and resistor needs to be suspended in the air.<br><br><br>2. At the station's human machine interface (HMI) ensure that the mode select switch indicates *Manual Mode*.<br>3. At the DAQ PC, check that PCS is Online.<br>4. Open the *Quadtech Meter* interface window.<br>a. Select "*Quadtech Meter*" from the *Function List* drop down list in the PCS *Manual mode* window.<br>5. Set up the window as the following screenshot. |

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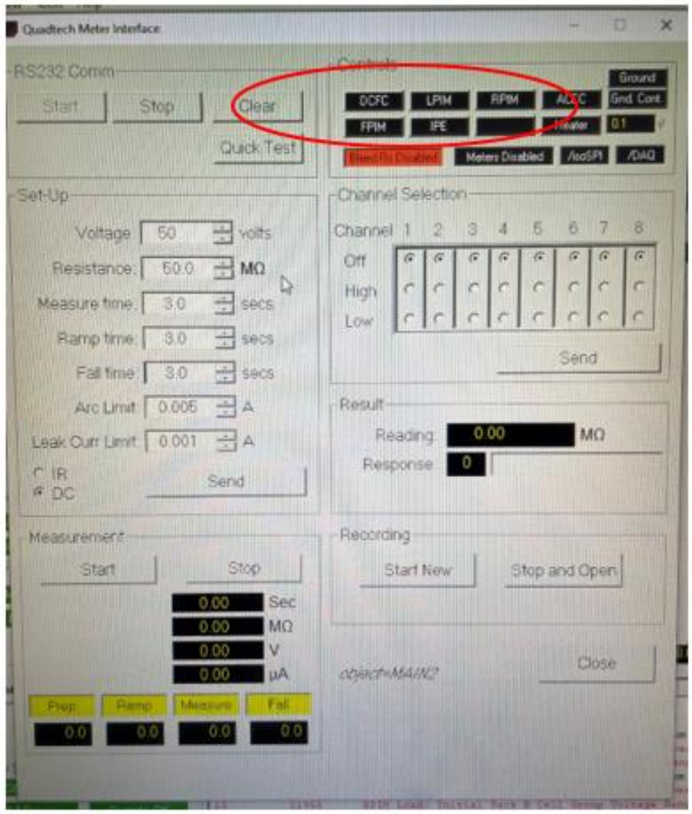


- Set meter to 50V, 3 second ramp, 3 second test, 3 second fall
- Set resistance to 50 MΩ
- Select HV channels
- Select the corresponding HV contactor that Resistor is connected (in red circle) and ensure meters are disabled

6. Select Set-Up: Send and then Channel Selection: Send
7. Run measurement with 'Start'; 'Reading' should be ~50 MΩ
8. Could repeat with different known resistor but one successful verification is sufficient

| | |
|---|---|
| ***Data Records:*** | Minimum Data:<br>• Date and time of verification performed<br><br>Minimum Retention Period: To be retained in accordance with standard plant retention requirements |

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## SECTION III Calibration

Calibration is the infrequent adjustment of a gauge or sensor to a national or international (certified) standard. This can be based on a set frequency or be required if a verification check fails. Unless otherwise specified, procedures & data recorded should comply with The Global Quality Requirements Manual, Measurement System Analysis 11.00.

**Note:** The following devices or equipment that is used for the test station require calibration performed by professionals from device or equipment manufacturer and frequency of calibration should follow product manual:

1. **FLIR camera**
   - Manufacturer: FLIR Systems
   - Model: FLIR A315 20Hz
2. **Cycler**
   - Manufacturer: MCC
   - Model: N/A
3. **Hi Pot Meter**
   - Manufacturer: CHROMA
   - Model: N/A
   - Serial Number: N/A

| Voltage Calibration | |
|---|---|
| ***Frequency:*** | Only when a verification exercise fails, or every <u>six months</u> of machine run time |
| ***Tools:*** | Digital Multimeter: 4½ digit, 200mV to 1000V range calibrated<br>B3T Pack and BEV3 Pack<br>Protective Personal Equipment (PPE): Per plant requirements |
| ***Method/Action:*** | The following procedure can be used to calibrate the Charger and voltage channels using a calibrated digital multimeter as a reference.<br>1. Leave the battery pack and contactor disconnected.<br>2. In PCS, select *Tools > Physical Calibration* to open the Analog Channel Calibration window. (This will require a qualified user to log in).<br>3. In the *Analog Channels* field, select the voltage channel for calibration. |

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4. With PCS Online and in Manual mode, click the *Open Pack Contactor Control* button to open the Pack Contactor Control window.
5. set the applied load set to zero (0) volts in the Analog Channel Calibration window
6. Click on the *Set* and *Next* buttons.

7. Connect the battery pack to the stand.
8. In the Pack Contactor Control window, click on the *Open Mode 6*.

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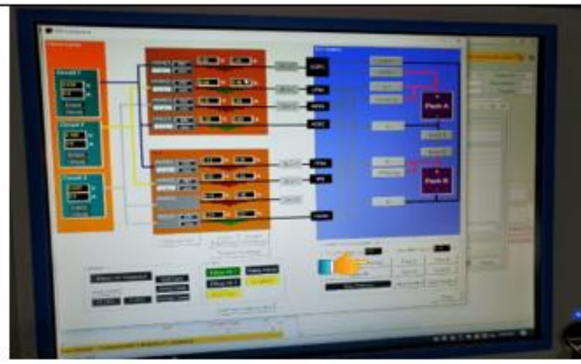

9. Using the calibrated multi-meter, measure the pack voltage.

BEV3 (Needs updated photo)


10. Verify that the pack is connected by monitoring the readings in the *HV Readings* section of the Pack Contactor Control window.

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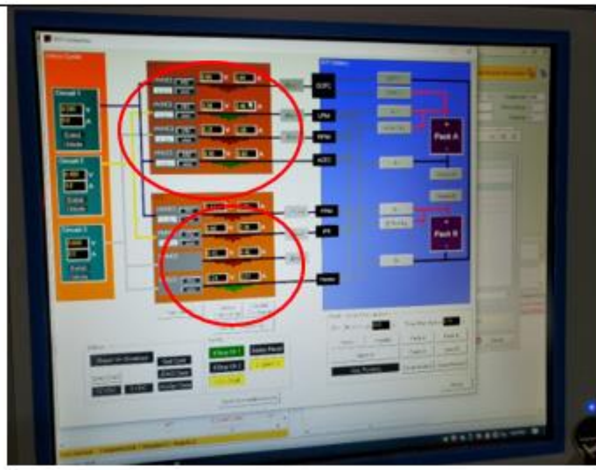
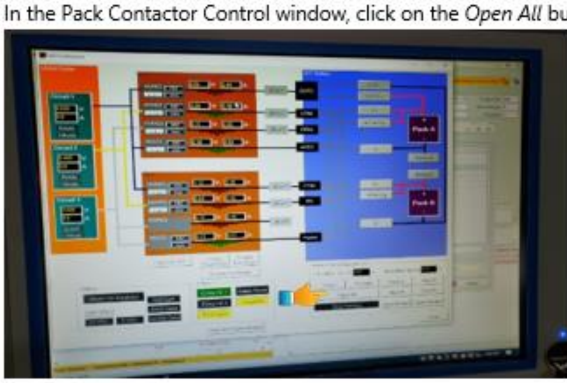


11. In the Analog Channel Calibration window, enter the reading into the *Applied load* field, and then click on the *Set* and *Next* buttons.
12. In the Pack Contactor Control window, click on the *Open All* button.



13. Remove all connectors from the part.
14. Repeat the above procedure for the remaining voltage channels.

| | |
|---|---|
| ***Data Records:*** | Minimum Data: Follow the minimum data requirement as listed in Section II. Minimum Retention Period: To be retained in accordance with standard plant retention requirements. |

| | | |
|---|---|---|
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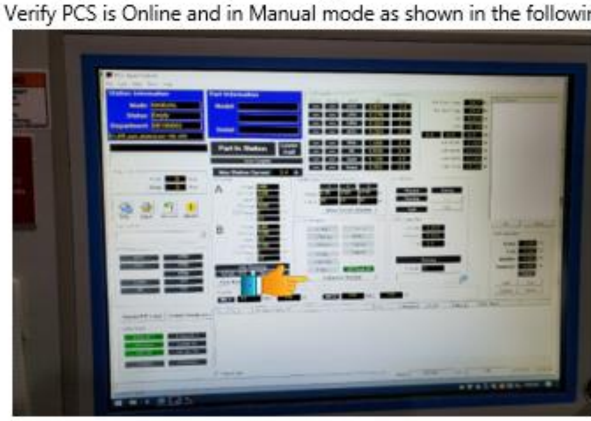
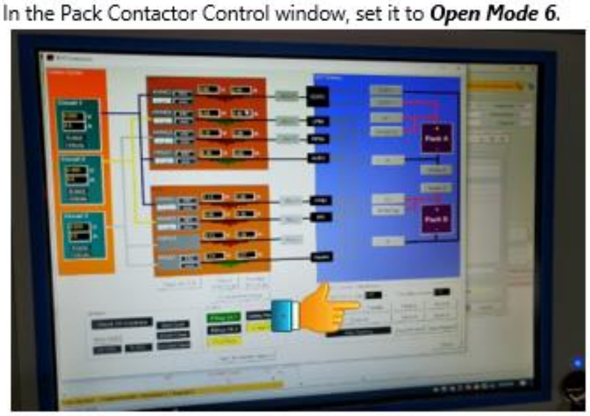
| MVSS305 Voltage Calibration | |
|---|---|
| ***Frequency:*** | Only when a verification exercise fails, or every <u>Six Months</u> of machine run time |
| ***Tools:*** | **Two identical** Digital Multimeter: 4½ digit, 200mV to 1000V range calibrated<br>B3T Pack and BEV3 Pack<br>Protective Personal Equipment (PPE): Per plant requirements |
| ***Method/Action:*** | The following procedure can be used to calibrate the MVSS305 voltage channels. Note that this procedure needs two identical calibrated digital multimeter as a reference.<br>1. Wear proper protective personal equipment (PPE) for the following procedure.<br>2. Verify PCS is Online and in Manual mode as shown in the following image:<br><br>3. Click the *Open Pack Contactor Control* button.<br>4. In the Pack Contactor Control window, set it to ***Open Mode 6***.<br><br>5. At the battery pack, measure the voltage of the battery pack using a calibrated digital multimeter between the most positive terminal and the most negative terminal as shown in the following image. Verify that it can read the full voltage of the battery (typical value for B3TVII is around E350V in Parallel). |

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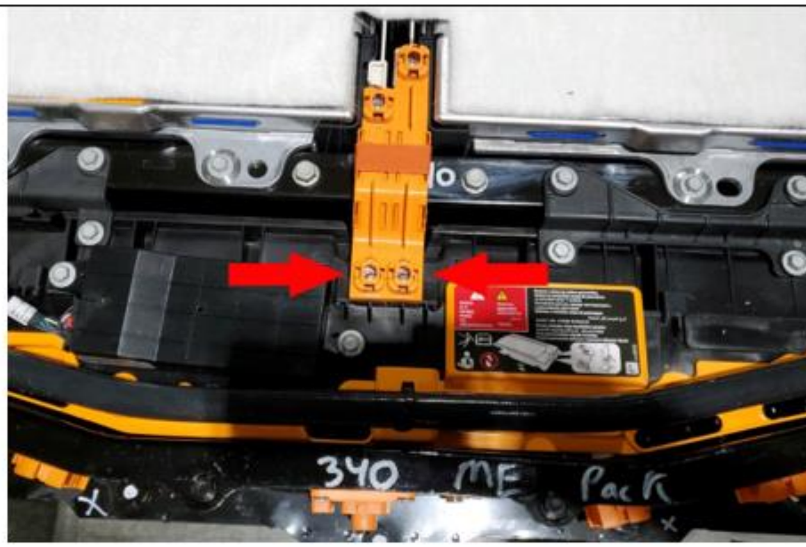
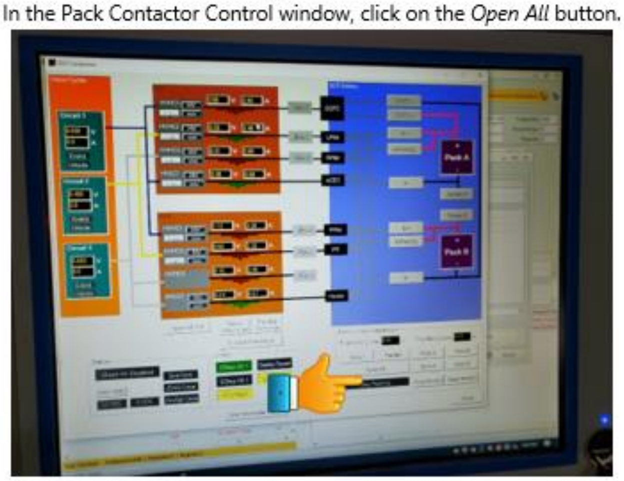



6. Have one person measure the voltage between the most positive terminal of the battery and the case ground of the pack (record value as V1) while another person measures the voltage between the most negative terminal of the battery and the case ground (record value as V2). Note both voltage values for V1 and V2.
7. In the Pack Contactor Control window, click on the *Open All* button.



8. Connect all connectors to the battery pack.
9. In the main PCS Manual mode window, select *Tools* > *Physical Calibration* to open the Analog Channel Calibration window. This will require a qualified user to log in.
10. In the Analog Channel Calibration window, select the MVSS305 V1 (or V2) channel, as shown in the following image. Enter value 0 to the *Applied load* field, and click on the *Set*

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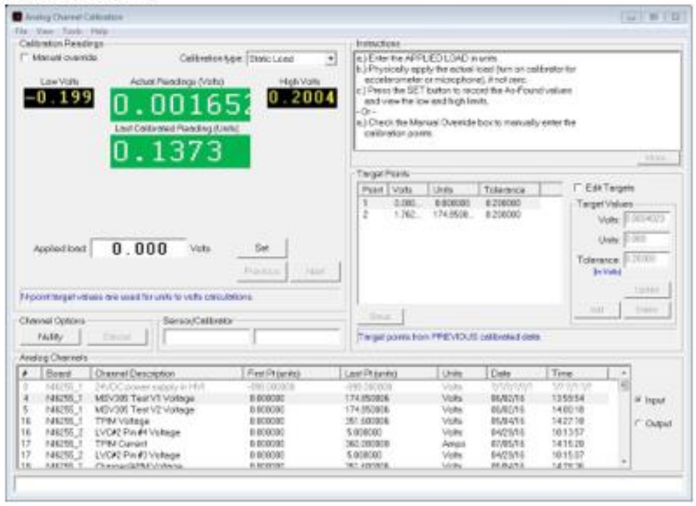
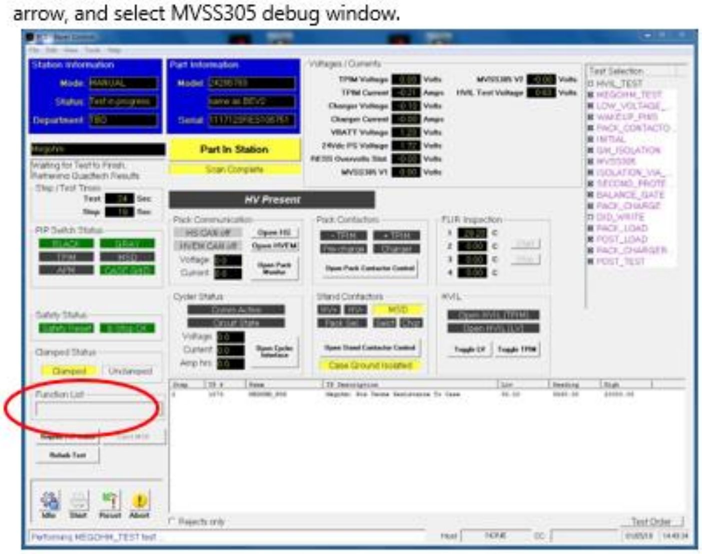
and *Next* buttons.




11. In the main PCS Manual mode window, click on the Function List drop-down selection arrow, and select MVSS305 debug window.




12. In the MVSS305 debug window, click on the *Close* button, then click *MVSS305, V1* and *V2* buttons.
13. Verify that the V1 and V2 values are shown in the window, and both are approximately equal and about half of the full pack voltage.

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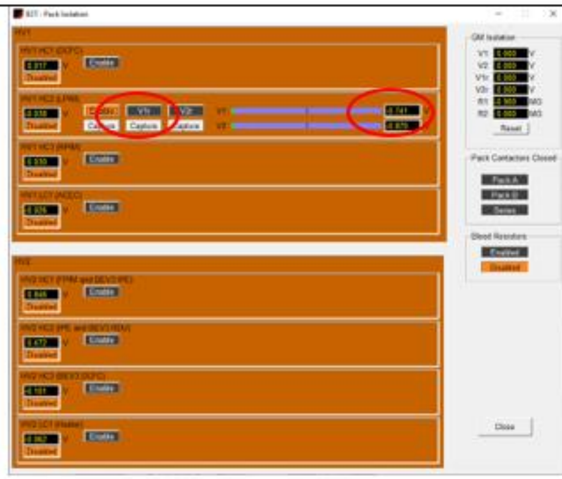
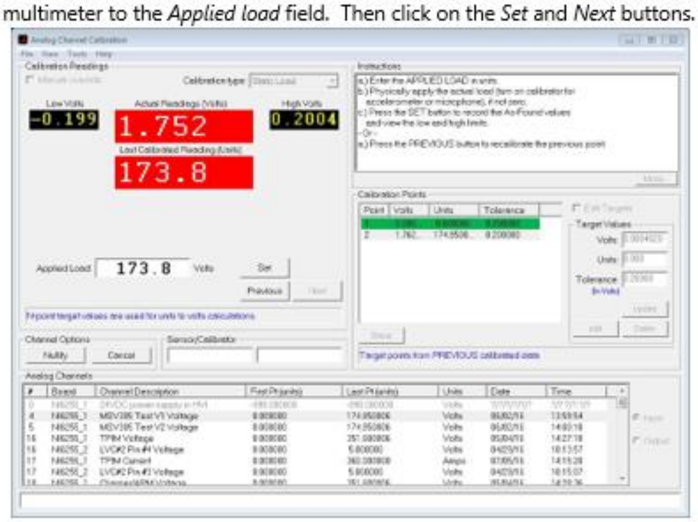


14. At the Analog Channel Calibration window, enter the V1 (or V2) values measured by the multimeter to the *Applied load* field. Then click on the *Set* and *Next* buttons.




15. At the MVSS305 debug window, click on the *Open* button.
16. Unplug all connectors from the battery.
17. Repeat the above procedure for the remaining MVSS305 channels for each high voltage channel.(HVHC1-3, HVLC1).

***Data Records:*** Minimum Data: Follow the minimum data requirement as listed in Section II.
Minimum Retention Period: To be retained in accordance with standard plant retention requirements.

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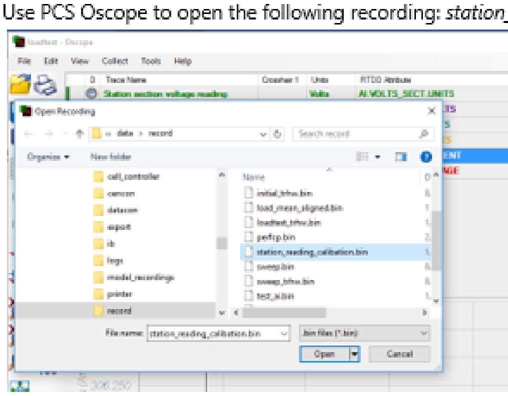
| B. Station Current Shunt Calibration | |
|---|---|
| ***Frequency:*** | Only when a verification exercise fails, or every <u>six months</u> of machine run time |
| ***Tools:*** | |
| ***Method/Action:*** | **Note:** The calibration procedure uses current value feedback from MCC Cycler as a reference, therefore before proceeding with the following procedure, make sure MCC Cycler calibration is up to date.<br><br>**Warning:** In this step we are controlling the current flow, stop the cycler if no one is at the station.<br><br>1. At the Bauer PC, ensure that PCS is Online.<br>2. At the station's HMI verify that the mode selection switch indicates Manual mode.<br>3. Using the station's HMI, load a Module into the station.<br>4. Use PCS Oscope to open the following recording: *station_reading_calibration.bin*.<br><br><br>5. In PCS, open the control window by clicking the *Control Cycler* button in the Manual mode window.<br>6. In the Cycler Interface window:<br>a. Click on the *Enable* button to start the cycler communications. When the communications are running, the Set point will be current. |

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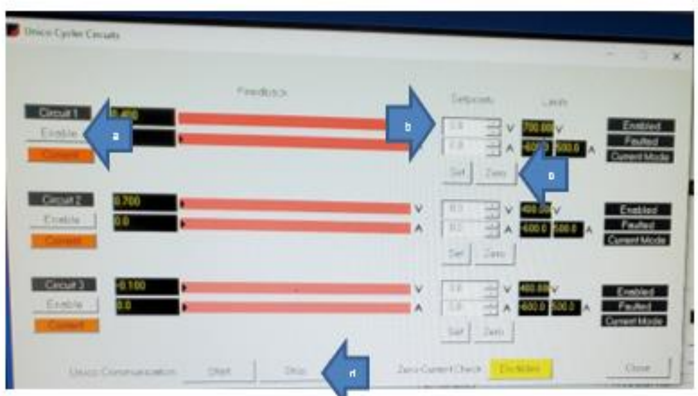
7. In the PCS Oscope window, start a recording by clicking on the start button.

8. Briefly run a -100 A load. Your can use any Cycler channel, recommend FPIM
   a. Enter -100A into the *Setpoint* field and then press they *Tab* key on the keyboard.
   b. After 3 seconds, click on the the *Zero* button to stop the cycler.



9. Briefly run a 40A charge.
   a. Enter 40A into the *Setpoint* field and then press the Tab key on the keyboard.
   b. After 3 seconds, click on the *Zero* button to stop the cycler.
   c. Press the *Stop* button to stop communications to the cycler.
   d. Close the Cycler Control Interface window.

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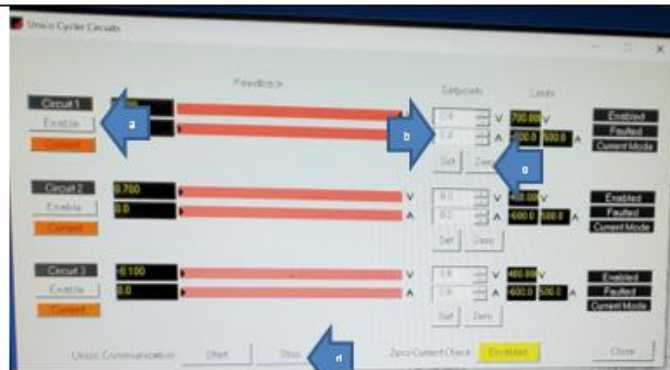
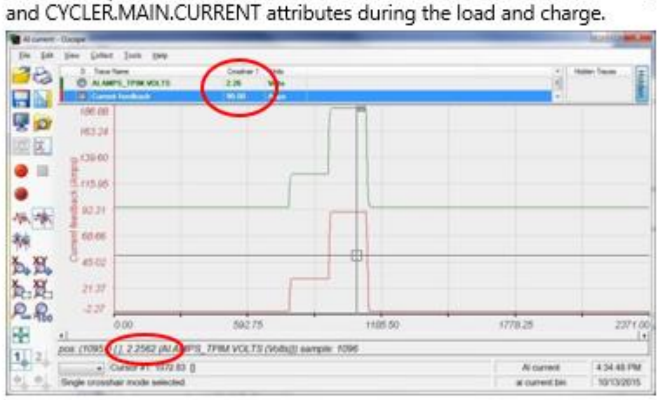


10. In the PCS Oscope window, click on the stop button ■ to stop the recording.

11. In the Oscope window, use the cursors to record the values for AI.AMPS_SECT.VOLTS and CYCLER.MAIN.CURRENT attributes during the load and charge.



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**Note:** For details on operating the PCS Oscope, open the *Online Help* by selecting *About This Window* from the Help menu.

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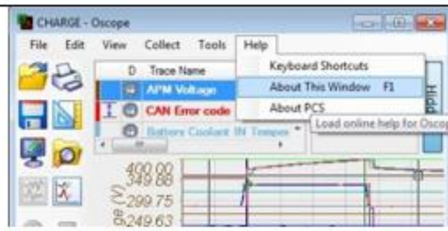
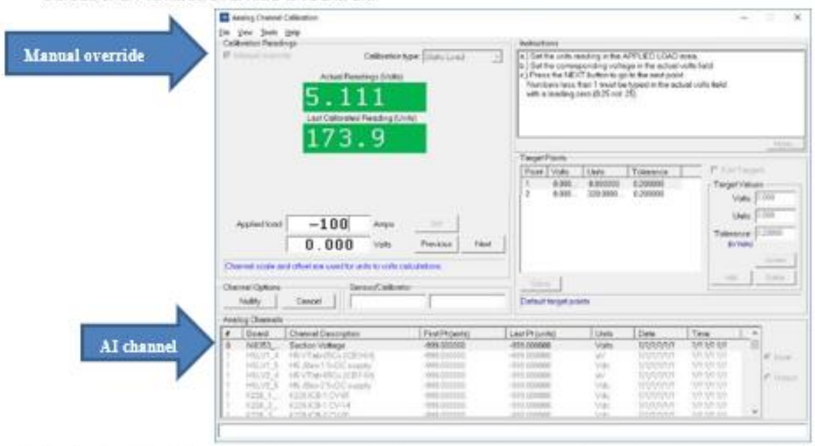



12. In PCS select *Tools > Physical Calibration.*


13. In the *Analog Channel Calibration* window, select the ***Station Current*** channel and select the *Manual override* checkbox.




14. In the Analog Channel Calibration window, enter the recorded values during the -100A load. You get these values through reading from recording.
    a. Enter the value for the trace named AI.AMPS_SECT.VOLTS into the *Volt* and the recorded.
    b. Enter the #CYCLER_CIRCUIT.MAIN.CURRENT value into the *Applied Load* field, depend on which cycler channel you are used in step 8/9
    c. Click on the *Set* and *Next* buttons to save the first calibration point.


15. In the *Analog Channel Calibration* window, enter the recorded values during the 40A