CINCINNATI TEST SYSTEMS

Sentinel I28

User Manual

D34-595 v8.0

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IMPORTANT INFORMATION

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Because of the variety of uses for this equipment and because of the differences between this solid-state equipment and electromechanical equipment, the user of and those responsible for applying this equipment must satisfy themselves as to the acceptability of each application and use of the equipment. In no event will Cincinnati Test Systems be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The illustrations, charts, and layout examples shown in this manual are intended solely to illustrate the text of this manual. Because of the many parameters and requirements associated with any particular installation, Cincinnati Test Systems cannot assume responsibility or liability for actual use based on the illustrative uses and applications.

CAUTION **–** When you see this warning symbol on the product, refer to the instruction manual for information before proceeding.

CAUTION **–** To avoid personal injury due to electric shock, disconnect all power services before servicing.

If this instrument is not used according to the instructions of this manual, the protection provided by this equipment design may be compromised.

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Table of Contents

Chapter 1 – Introduction

This chapter explains the external pneumatic and electrical connections, and introduces the simple menu structure and navigation of the instrument.

Thank you for purchasing the Sentinel I28™ precision leak test instrument. The Sentinel I28 is capable of testing using a variety of pre-packaged test algorithms designed to get you testing as quickly and easily as possible. Let's get started!

Unpacking

Carefully remove the instrument from the shipping carton. Locate the AC power cord or the DC cable supplied with the instrument. The test port should have a Colder™ quick connect test port with Self-Test cap. Alternatively, you may install any suitable 1/4" NPTM fitting into the manifold test port. If this is not a standard instrument, see the print packet that shipped with your instrument for the proper thread specifications.

Instrument Attachment & Clearance

There are four (4) rear mounting holes for ¼ inch (6 mm) socket head cap screws, 3½ inches (90 mm) long (for a ¼ inch ***minimum*** mounting plate thickness). The instrument is supplied with four (4) ¼ inch – 28 x 3½ inch socket head cap screws for convenience.

Please allow 4 inch (100 mm) clearance under the instrument for installation of test line and for hand clearance.

> ***Note: These recommendations are also clarified in Appendix F with detailed hole to hole dimensions in detailed "full scale" reference to the clearance dimension.***

Installation

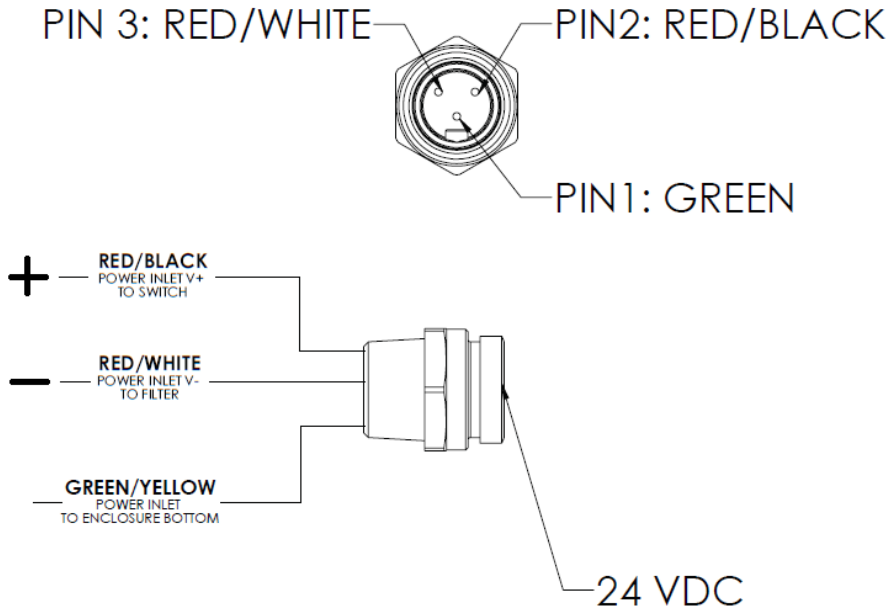
The leak test instrument is a modular, flexible instrument designed to operate in a manufacturing, clean room, or lab environment. To operate trouble-free, it requires:

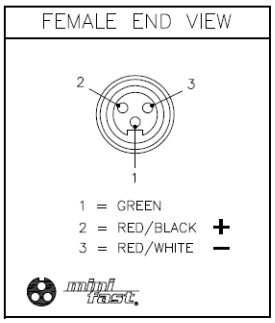
- Clean, dry instrument air for test and pilot air (recommend 0.3 and 5.0-micron coalescing filter)
  - ISO 8573-1, Class 2 filters are recommended, with class 3 being acceptable.
- Vacuum for vacuum test applications
- Supply power: 24 VDC or 88-264 VAC 50/60 Hz auto sensing/switching electrical (based on configuration)
- I/O: Switch to select internal or external 24 VDC electrical power for the inputs and outputs

Because this is a precision instrument, it is preferable to locate this instrument at least 15 feet (5 meters) away from high electromagnetic energy devices (induction heat treat equipment and welders) whenever possible. In addition, plants having poor quality electrical power or ground systems should consider using isolation transformers on the power drops.

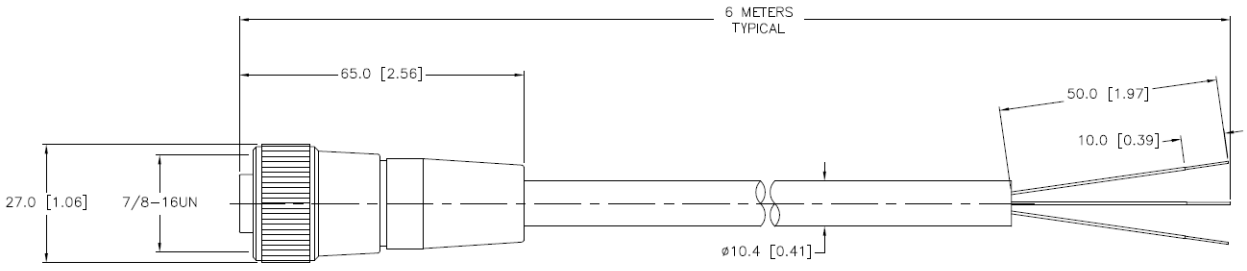
Note: When supplying power, always be certain that there is nearly zero voltage (< 1 V) difference between the neutral and earth ground wires connected to the instrument.

DC Power Connection





SPECIFICATIONS	
CONTACT CARRIER MATERIAL/COLOR	TPU/YELLOW
MOLDED HEAD MATERIAL/COLOR	TPU/YELLOW
CONTACT MATERIAL/PLATING	BRASS/GOLD
COUPLING NUT MATERIAL/FINISH	BRASS/NICKEL
RATED CURRENT [A]	9.0 A
RATED VOLTAGE [V]	600 V
OUTER JACKET MATERIAL/COLOR	PVC/YELLOW
CONDUCTOR INSULATION MATERIAL	PVC
NUMBER OF CONDUCTORS [AWG]	3x16 AWG
TEMPERATURE RANGE	−40°C to +105°C (−40°F to +221°F)
PROTECTION CLASS	MEETS NEMA 1,3,4,6P AND IEC IP67



CTS Part Number: **CABLE,TURCK,RKM35D-6M**

User Interface Navigation

There are multiple monitoring screens available for the instrument. Selecting the Monitor icon will give you access to all of these screens. This menu is also where the user selects to view the graphs available with the unit.

The instrument is designed with a simple graphical icon-based interface. The Main Menu is activated by pressing the Main Menu button.

The Arrow/Enter Selection buttons are used to navigate through the icons on the screen and select the appropriate menus. The center arrow is the Enter button. It is used to select parameters for editing and saving the edits once they are complete.

The Cancel/Back button is used go back to the previous menu. Multiple presses will eventually exit you out of the menu structure entirely and place you on the Monitor Screen. This button is also used to cancel out of any edits before saving.

The Information button is used to get a help screen that is associated with the parameter corresponding to where the cursor is located.

The USB button is a shortcut directly to the USB menu.
The USB menu is located in **Main Menu > Global Config > USB** icon.

Note: When a USB memory stick mounted in the USB port, holding this button down until it beeps will take a screen shot of the screen and save it to the USB memory stick. Do not remove the USB memory stick until the instrument tells you it is finished writing the image.

The instrument is capable of storing up to 99 different programs. Switching between these programs is done with the Program Select buttons on the front of the instrument. The current program is shown in the lower right hand corner of the screen designated by "P" and then a two-digit number corresponding to the current program number.

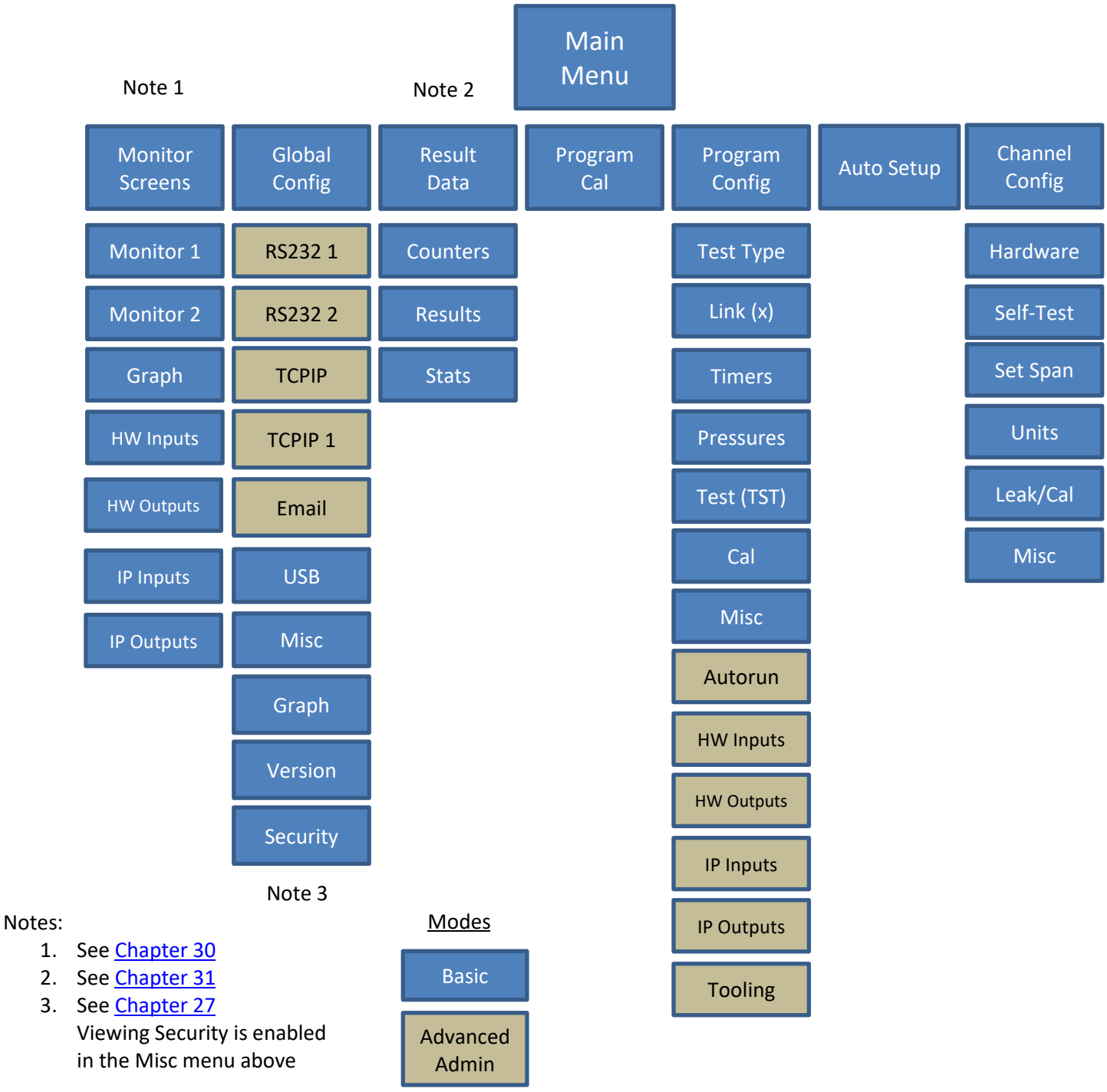
Hint: Press the "+" button for 2 seconds to prompt a screen to display in where the value of a program may be selected using the arrow buttons. The up and down arrows will increment and decrement the ones digit. The right and left arrows will increment and decrement the tens digit.

Note: The Program may also be changed using Digital I/O (see Chapter 21), using EtherNet/IP™ (see Chapter 22), or using RS232 or TCP/IP Communication Methods (see Chapter 24).

Menu Structure

Below is an overview of the menu structure for the instrument.

Note: Not all menus are available for all hardware configurations and Test Types.



Notes:

1. See Chapter 30
2. See Chapter 31
3. See Chapter 27
   Viewing Security is enabled in the Misc menu above

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Chapter 2 – Setup

In this chapter, you are asked how you plan to use the instrument to conduct the test or sequence of tests for the intended application. Based on the answers, you will be directed to modify certain instrument settings.

Setting up the instrument to meet specific application requirements is most effectively accomplished by answering a few questions. These questions will guide you through the initial stages of the setup and point you to the appropriate chapters that detail specific instructions based on the answers.

It is highly recommended that each type of part being tested, whether they differ in volume or construction, have their own set of parameters defined in the instrument using individual Programs. Both Pressure decay leak testing and Differential Pressure decay leak testing are a volume dependent function. Flow testing can be setup to be volume independent; however, to optimize the testing, it is recommended that each type of part have its own set of parameters. In certain cases, it is possible to group similar parts together to use the same parameters. In this case we recommend you talk to a CTS applications specialist to assure proper functionality.

Program Linking & Sequencing

The instrument is capable of conducting multiple tests on one part. For instance, it may be desirable to conduct a mass flow test and a pressure decay test on a single part (some configurations do not have mass flow capability). The instrument is also able to conduct these multiple tests on a part with multiple chambers by multiplexing through multiple test ports (if configured).

Question:

Are you planning to conduct multiple tests on one part?

Yes: It is important that you understand the concepts of Parent Program Linking **. See** Chapter 14 **and then come back and continue the setup.**

No: Proceed.

The instrument is capable of conducting tests on multiple parts in a set sequence (if configured). This may be done to increase the efficiency of the operator. An operator may load up to four parts (if four test ports were configured) and press start. The instrument will conduct leak tests on all four parts by multiplexing through the different test ports, one at a time.

Question:

Are you planning to conduct tests on multiple unique parts?

Yes: It is important that you understand the concepts of Sequential Linking. See the last page of Chapter 14 **and then come back and continue the setup.**

No: Proceed.

Selection of Test Types

The first step in setting up the instrument is to select the type of test you want to conduct from the pre-packaged test sequences. Repeating this step under a different program number will enable you to configure up to 99 different test configurations. The **Test Type Table** on the following page includes the different test types available in the instrument, a brief description, and the associated chapter that details the pre-packaged test program. The availability of these test types is based on the hardware configuration of the instrument.

Once you determine which test type is appropriate for your application go to Program 1 (press the + or – buttons until you see a P01 in the lower right hand corner of the screen.

Press the Main Menu button to view the icons in the Main Menu screen.

Select Program Config icon using the Arrow/Enter Selection buttons.

Select the Test type icon using the Arrow/Enter Selection buttons.

Select the appropriate test type using the Enter button to enable editing and then the up and down arrows to view the options. When you see the desired selection press the Enter button to select.

To simplify the instructions in this manual, the steps above are reduced to something similar to the following: The **Test Type** menu is located in **Main Menu > Program Config > Tst type** icon.

Test Type Table

Test Type	Description
Pressure Decay-ΔP Chapter 3	Measures the Pressure Loss (ΔP) over a fixed time. Determined from the pressure loss over the duration of the test timer. The result is presented in units of delta pressure.
Pressure Decay-ΔP/ΔT Chapter 4	Measures the Pressure Loss (ΔP/ΔT) over unit time. Determined from the pressure loss over the duration of the test timer divided by the test time. The result is presented in units of delta pressure over delta time.
Pressure Decay-Leak Std Chapter 5	Calculates the Leak Rate, based on pressure loss. Determined from the pressure loss over the duration of the test timer relating to the pressure loss of the leak standard and of the non-leaking master part. The result is presented in units of flow.
Occlusion Chapter 6	Measures the Back Pressure (part blockage). Determined from the pressure at the end of the test timer. The result is presented in units of pressure.
Pressure Verify Chapter 7	Measures the Pressure at the isolated test port (no fill). Determined from the pressure at the end of the Test segment timer. The result is presented in units of pressure.
Mass Flow Chapter 8	Measures the Mass Flow needed to maintain the part at a set pressure. Typically used in applications where flow is expected. The result is presented in units of flow.
Mass Flow-Leak Std Chapter 9	Measures the Mass Flow needed to maintain the part at a set pressure. Typically used in low leak applications. The result is presented in units of flow.
Ramp to ΔP Event Chapter 10	Measures the peak pressure before a Pressure Loss (ΔP) Event. Determines the maximum pressure before the pressure loss limit is exceeded as well as records the duration of time before the event. The results are presented in units of pressure and time.
Ramp to Input Event Chapter 11	Measures the pressure at an Input Event. During test pressure ramp, monitors for trigger event on a digital input, then determines the pressure as well as records the duration of time before the event. The results are presented in units of pressure and time.
Ramp to Flow Event Chapter 12	Primarily used for testing the cracking point of a check valve. Measures the point at which the flow crosses a threshold. Determines the maximum pressure before the Flow Event limit is exceeded as well as records the duration of time before the event. The results are presented in units of pressure and time.

Test Type	Description
Ramp to Proof Test Chapter 13	Designed to make sure component can hold a pressure for a fixed period of time. Result determined from the maximum pressure during the test and duration of the test timer. The result is presented in units of pressure.
Parent Program Linking Chapter 14	Facilitates linking individual programs into a single test sequence for conducting multiple tests on one part or one part with multiple chambers. Contains tooling control parameters and link definitions. Each link defines the target program to execute and evaluation conditions for additional program execution.
Sequential linking Chapter 14	Facilitates testing multiple unique parts (often with multiple test ports). Each link defines the target program to execute and evaluation conditions for additional program execution.
Percent Volume Chapter 15	Primarily used to test sealed parts where a convectional pressure or vacuum decay tests could fill up the volume of a gross leaking part during the fill stage.
Percent Volume, Pressure Decay-Leak Std Chapter 16	Primarily used to test sealed parts where a convectional pressure or vacuum decay tests could fill up the volume of a gross leaking part during the fill stage. The volumetric fill test will test for gross leaks while the pressure decay – leak std test will test for fine leaks.
Differential Pressure (DP) Decay-ΔP Chapter 17	This test type is used for conducting a pressure decay test measuring a pressure loss over time utilizing a Differential Pressure (DP) transducer. The result of this test is the pressure loss (or gain for a vacuum test) measured over a fixed period of time, presented in units of pressure.
Diff Decay-Leak Rate Chapter 18	This test type is used for conducting a Diff Decay-Leak rate test measuring leak rate by utilizing a Differential Pressure (DP) transducer. The result of this test is the leak presented in units of flow.
Differential Pressure (DP) Decay-Leak Std Chapter 19	This test is used for conducting a Differential Pressure (DP) Decay Test with Leak Standard. Pressure loss is measured utilizing a Differential Pressure (DP) transducer. The pressure loss is correlated to a leak rate using a leak standard. This test requires a two-cycle calibration routine to correlate the pressure loss to a flow rate. The result of this test is presented in units of flow.

Before we begin setting the parameters of the program we need to determine some of the capabilities and features required for the application.

Tooling Control

The instrument is capable of controlling tooling to possibly eliminate the need for a PLC or other computer that would control cylinders and sealing.

Question:

Are you planning to use the Sentinel I28 to control any sealing operations?

Yes: It is important that you understand the concepts and safety requirements of Tooling Control. See Chapter 20 and then come back and continue the setup.

No: Proceed.

Programming the Inputs and Outputs

The instrument comes with 12 inputs and 12 outputs (24VDC) that are user configurable for each program.

Question:

Are you planning to use the Sentinel I28 to control any ancillary devices using discrete I/O or EtherNet/IP™, or communicate with a PLC?

Yes: See Chapter 21 - Inputs and Outputs, Chapter 22 - EtherNet/IP, or Chapter 24 - Communication, and then come back and continue the setup.

No: Proceed.

Channel Configuration

Setting the Units of Measure

The instrument has the capability to utilize different units of measure for each configured program. In order to keep things simple and user friendly if you always use the same units of measure, you can set the units in one place and have them apply instrument wide. This is done in the Channel Configuration menu.

Question:

Are you planning to use the same units of measure for every program?

Yes: Press the Main Menu button, select the Channel Config icon, then select the Units icon. Change the Unit/Prec Define parameter to "Channel". Set the

desired units of measure on that same screen. These units will apply to every program.

No: Press the Main Menu button, select the Channel Config icon, then select the Units icon. Change the Unit/Prec Define parameter to "Program". The Units icon will now appear under the Program Config menu. When a program is created, the units for the program will use the units under the Channel Config menu as the default settings but the units can now be changed per program.

Note: The units set on the Channel Config screen are also the units used for Self-Test, Auto Setup and transducer Set/Span routines.

Note: The precision displayed for each unit may also be set on this screen.

Setting the Leak Standard Values

The instrument has the capability to utilize different leak standards for each configured program that uses a leak standard. In order to keep things simple and user friendly if you always use the same leak standard, you can set the leak standard value and pressure in one place and have it apply instrument wide to any program that uses a leak standard. This is done in the Channel Configuration menu.

Question:

Are you planning to use the same leak standard for every program that requires a leak standard?

Yes: **Press the Main Menu button, select the Channel Config icon, then select the Leak/Cal icon. Change the Leak Std/Cal Define parameter to "Channel". Set the leak standard value and the pressure at which it was calibrated on that same screen. This leak standard value will apply to every program that utilizes a leak standard for calibration.**

No: **Press the Main Menu button. Select the Channel Config icon. From the Channel Config menu select the Leak/Cal icon. Change the Leak Std/Cal Define parameter to "Program". The leak standard parameters will now appear on the TST:*** screen under the Program Config menu. When a program is created, the units for the program will use the leak standard value under the Channel Config menu as the default settings but now can be changed per program.**

Note: Every time the leak standard value changes due to a calibration or when a new leak standard is used this value needs to be modified to reflect the new value.

Note: The parameter that determines where the physical leak standard is located (either inside the instrument or connected to a port on the outside) is also located in the Leak/Cal menu or the TST menu. However, to view this parameter you must be in the Display User Level. To change the Display User Level, see Chapter 28 *– Features.*

Remember: Press the information button with the cursor on that parameter if you want to know the definition of the options.

Program Configuration

Now that you have created a program, configured the tooling and associated I/O, and set the channel level parameters, it is time to set the regulators to the correct test pressure.

Pressure Select

To select the proper source for the test, we need to inform the instrument which regulator to use for this program. This is located in **Main Menu > Program Config > Misc** icon. The parameter called Pressure Select will need to be set to match the proper source. Find the regulator with the proper range. Locate the label that has the Source Number on it and select that source for the Pressure Select parameter. There are many possible options for this setting, depending on the hardware configuration. Options may include Pressure, Vacuum, Venturi, Tank, Reference, Flow, Internal Leak Std, Downstream Flow, or Sequential Test Ports. Instruments with only one pressure source will not allow editing of the Pressure Source parameter.

Tank Source

If the Pressure Select is configured as a Tank Source, then an additional sub-parameter "Shut Off Delay" is displayed. The Shut Off Delay is the user configured timer, defining how long to keep the Tank Source valve active after usage. During typical test operation: after the Fill valve has de-energized the Shut Off Delay timer will activate, and once expired the Tank Source valve will de-energize.

Selecting the Test Port

Next, select the proper test port (if the instrument hardware is configured with multiple test ports).

Question:

Does your instrument have multiple test ports (optional configuration)?

Yes: From the same Program Config - Misc menu select the Test Port Number you want to conduct the test on. The port numbers will count upwards from left to right.

No: Proceed.

Setting the Pneumatic Regulator

Question:

Does the pressure source you are using for this program have an electronic regulator?

Yes: The electronic regulator has been setup and calibrated at the factory and is ready to use. For calibrating the electronic regulator, see Chapter 29 **– Instrument Calibration.**

No: Setting a mechanical pressure regulator is done in the Channel Config screen under the Set/Span menu. In order to set the regulator, the test port

will need to be blocked which will allow the instrument to hold pressure. Standard units are supplied with a Colder™ quick connect fitting with an attached Self-Test cap. If this instrument is not a standard setup this may be done with a plug put in the test port. For proper plug thread specifications, consult the print set shipped with your instrument.

Setting the Test Parameters

It is time to set the test parameters to fit your application. Refer to the chapter that is associated with the test type chosen from Test Type Table earlier in this chapter.

Verifying Setup

Once you have everything programmed, run a repeatability study based on your company's quality standards to assure you are getting the results you desire.

Security

Now that the instrument is setup the way you want, make sure to lock down the parameters that you don't want changed until a key or password is used. See Chapter 27 – Security.

Backup the Instrument Settings

The setup of the instrument for one program is completed. You may now go back and setup multiple programs. Once you have completed, it is highly recommended that you save a backup of the instrument on a (FAT32) USB memory stick. For Instrument Backup and Restore see Chapter 28 – Features.

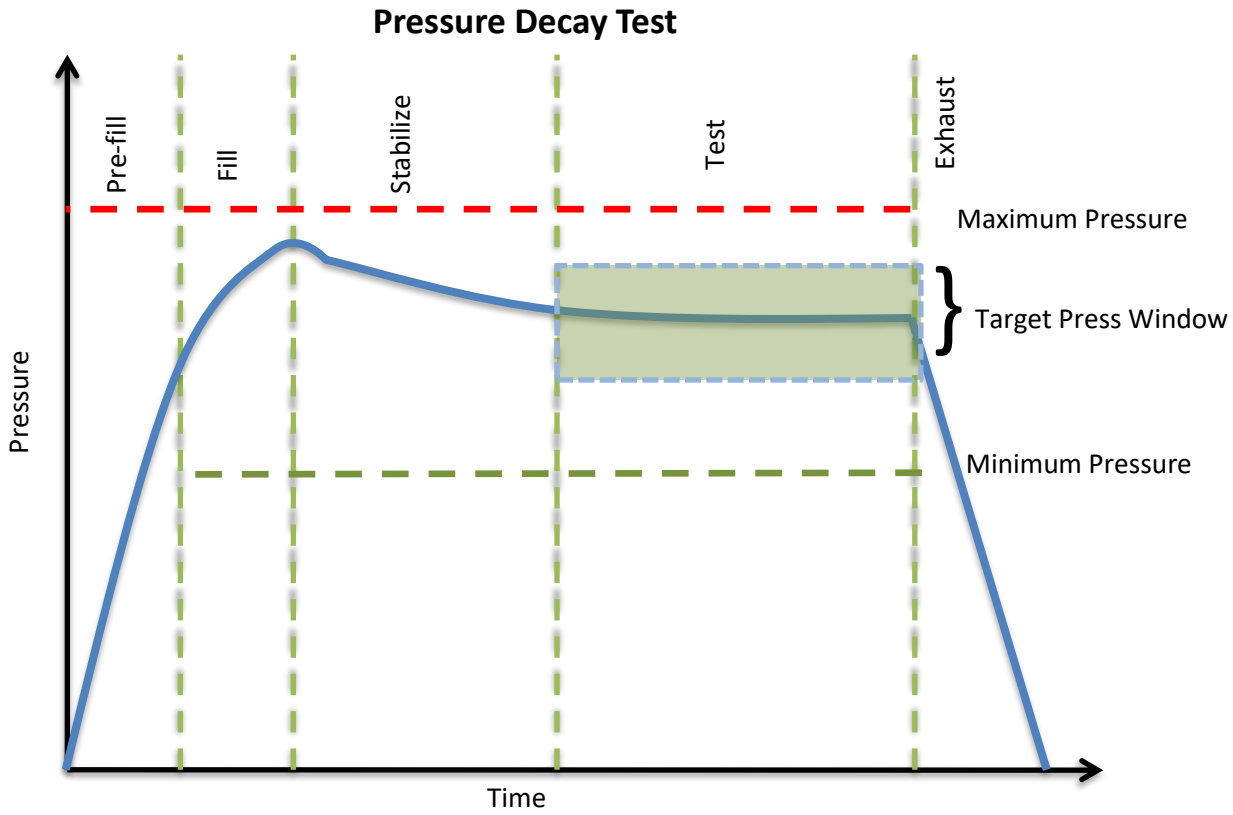
Chapter 3 – Pressure Decay-ΔP

This chapter explains the theory and parameters for conducting a pressure decay test measuring a pressure loss over time. The result of this test is the pressure loss (or gain for a vacuum test) measured over a fixed period of time, presented in units of pressure.

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

The Charts below give an overview of the parameters used to set up a Pressure Decay-ΔP Test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 ***– Features.***



Timer Parameters

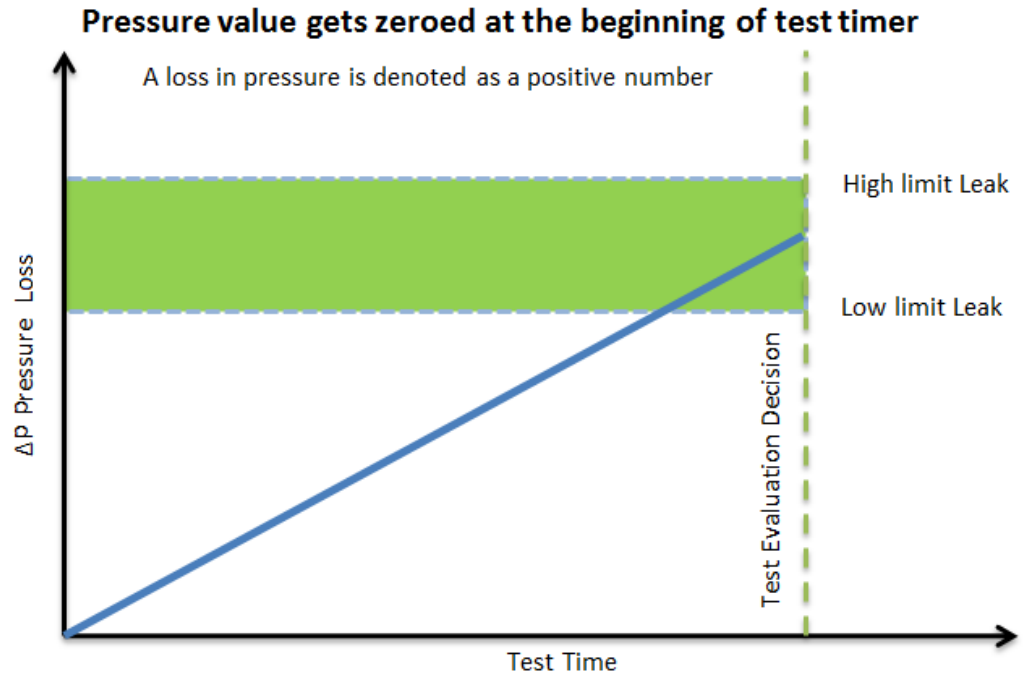
The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Prefill	Checks for excessively leaking parts or lack of pressure. May be set to "Percent of Fill Time" (default), for fixed fill time tests, or set to "Not to Exceed Time". For Changing the Functionality of the Prefill Timer, see Chapter 28 – Features. Maximum time to reach the minimum pressure. If the variable is set to "Not to Exceed Time", this segment will exit to the next once the Minimum Pressure value is reached.	Advanced, Admin
Fill	Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air.	Basic Advanced, Admin
Stabilize	Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test	The precise time over which to measure pressure drop or decay or the precise end time to measure pressure rise.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Part Mark	This is used as the duration for an external part marking device, and is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Minimum Pressure	The value that must be reached before the Prefill setpoint is reached and must be maintained through fill and stabilization segments or the testing cycle will end as a Severe Leak.	Basic Advanced, Admin
Target Pressure	The specified test pressure for the part. For vacuum test pressures enter a positive value if psiv was selected as the pressure unit, or enter a negative value if psig was selected as the pressure unit. ((For example, the test pressure 9.7 psia would be entered as 5 psiv or -5 psig.) Pressure loss may be corrected to the Target Pressure.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Target Pressure Window	This is a window (default +/– 100%) set around the Target Pressure that must be maintained during the Test segment of the testing cycle. It generates a Target Pressure Low or High Malfunction if the actual pressure falls outside this window during test.	Advanced, Admin



Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:PLO** icon.

TST Parameter	Description	Display User Level
Low Limit Loss	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Loss	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
EDC Enable	Activates Environmental Drift Correction. See Appendix C.	Advanced, Admin
EDC Percentage	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix C.	Advanced, Admin
EDC Quantity	See Appendix C.	Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

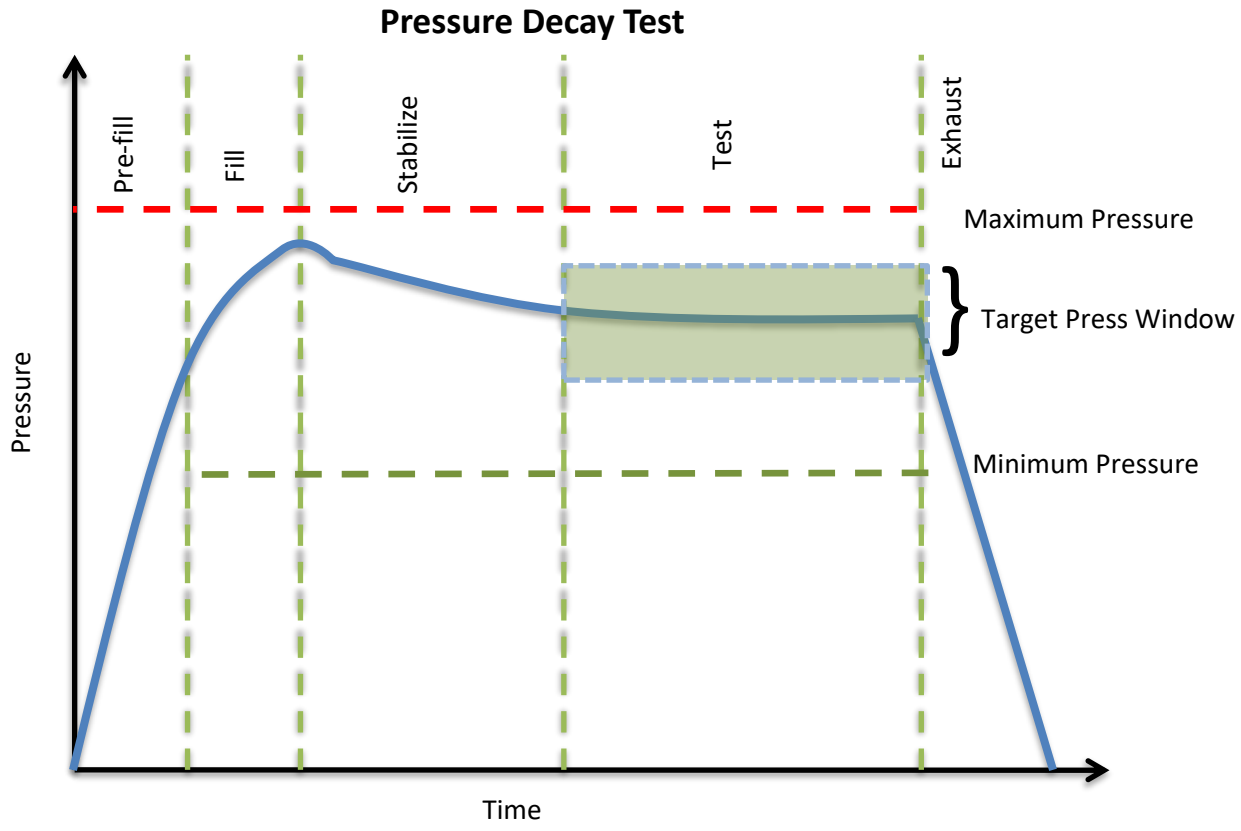
Chapter 4 – Pressure Decay-ΔP/ΔT

This chapter explains the theory and parameters for conducting a pressure decay test measuring the rate of change of pressure loss / time. The result of this test is the rate of pressure change measured over a selected unit of time.

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

The Charts below give an overview of the parameters used to set up a Pressure Decay-ΔP/ΔT Test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 – *Features.*



Timer Parameters

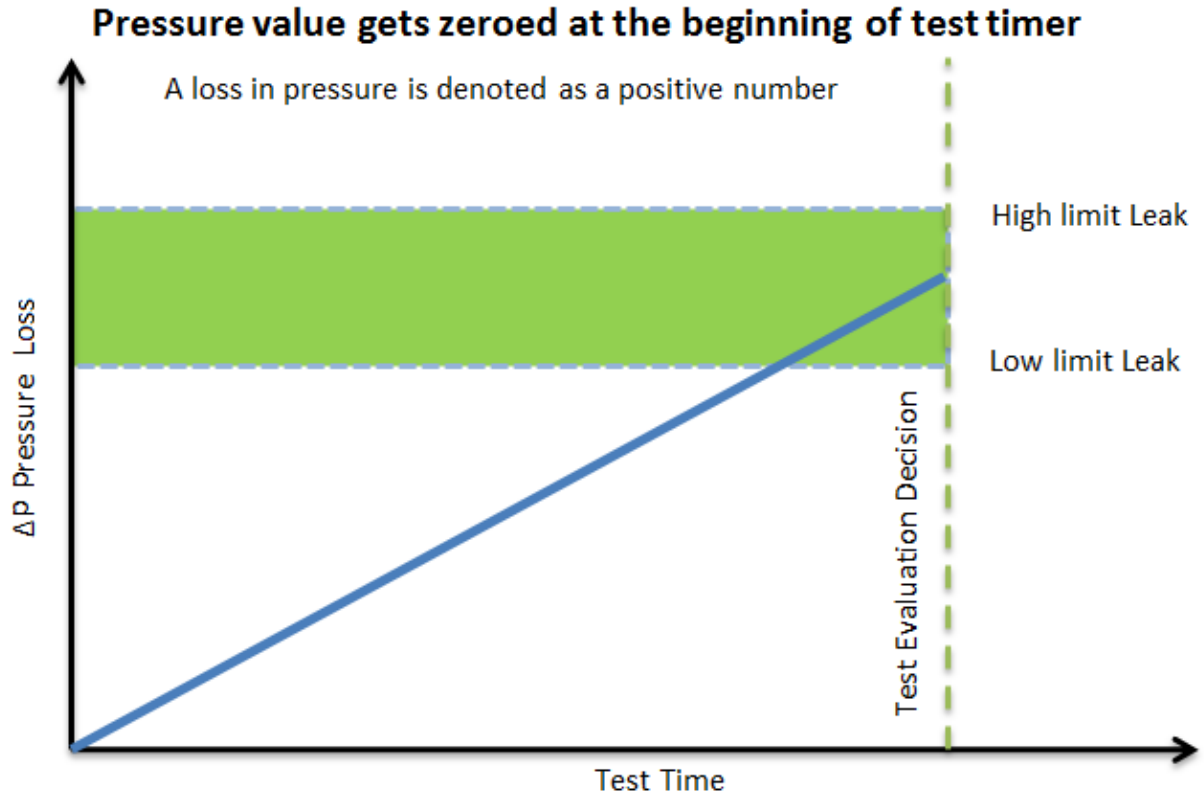
The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Prefill	Checks for excessively leaking parts or lack of pressure. May be set to "Percent of Fill Time" (default), for fixed fill time tests, or set to "Not to Exceed Time. For Changing the Functionality of the Prefill Timer, see Chapter 28 – Features. Maximum time to reach the minimum pressure. If the variable is set to "Not to Exceed Time", this segment will exit to the next once the Minimum Pressure value is reached.	Advanced, Admin
Fill	Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air.	Basic Advanced, Admin
Stabilize	Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test	The precise time over which to measure pressure drop or decay or the precise end time to measure pressure rise.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Minimum Pressure	The value that must be reached before the Prefill setpoint is reached and must be maintained through fill and stabilization segments or the testing cycle will end as a Severe Leak.	Basic Advanced, Admin
Target Pressure	The specified test pressure for the part. For vacuum test pressures enter a positive value if psiv was selected as the pressure unit, or enter a negative value if psig was selected as the pressure unit. ((For example, the test pressure 9.7 psia would be entered as 5 psiv or -5 psig.) Pressure loss may be corrected to the Target Pressure.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Target Press Window	This is a window (default +/– 50%) set around the Target Pressure that must be maintained during the Test segment of the testing cycle. It generates a Target Pressure Low or High Malfunction if the actual pressure falls outside this window during test.	Advanced, Admin


Pressure value gets zeroed at the beginning of test timer
A loss in pressure is denoted as a positive number
High limit Leak
Low limit Leak
ΔP Pressure Loss
Test Evaluation Decision
Test Time

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:DPT** icon.

TST Parameter	Description	Display User Level
Low Limit Loss	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Loss	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
EDC Enable	Activates Environmental Drift Correction. See Appendix C.	Advanced, Admin
EDC Percentage	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix C.	Advanced, Admin
EDC Quantity	See Appendix C.	Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

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Chapter 5 – Pressure Decay-Leak Std

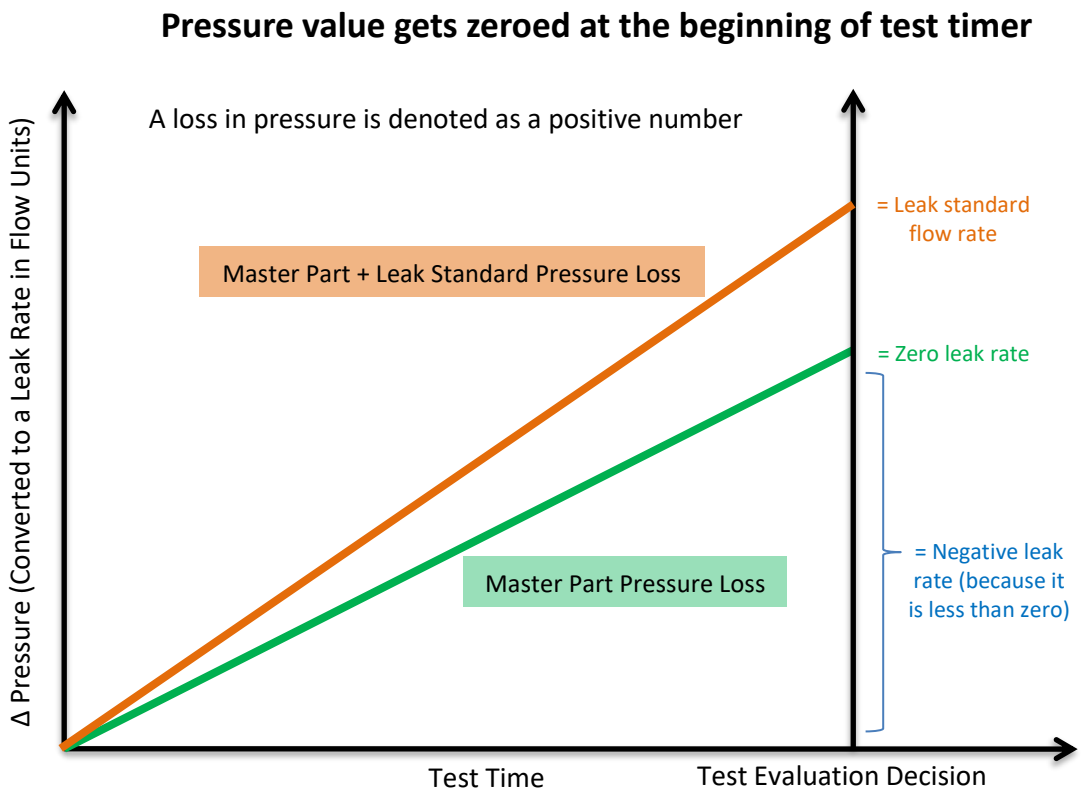
This chapter explains the theory and parameters for conducting a pressure decay test and correlating the pressure loss to a leak rate using a leak standard. This test requires a two cycle calibration routine to correlate the pressure loss to a flow rate. The result of this test is presented in units of flow.

This test type utilizes a two-point calibration sequence with a non-leaking master part to record the zero leak pressure loss value and the additional pressure loss value due to the flow rate of the leak standard on the second calibration cycle.

The basic principle of operation of a pressure decay leak test instrument is to fill the test part to a specified target test pressure, isolate the test part from the source air and allow the pressure to stabilize, and then measure the pressure loss due to a leak over a defined time. The leak test instrument translates the pressure loss value measured over the fixed test time to a leak or flow rate.

The charts in this chapter give an overview of the parameters used to set up a Pressure Decay Test and correlate the results to a flow rate using a leak standard. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 – *Features.*



Auto Setup Sequence

The easiest way to setup the proper timers in the instrument, when using the leak rate test type, is by using the Auto Setup routine. The Auto Setup routine resets the Input and Output functions for a program to the default (inactive) values. Therefore, Auto Setup must be performed with the part manually sealed. After completing the Auto Setup routine, the inputs, outputs, and tooling functions for the program will need to be reconfigured.

> ***Note: If you want to set up the program parameters manually or don't want to have to reconfigure the inputs and outputs after running Auto Setup, then proceed to Timer Parameters.***

The Auto Setup routine is a unique patented process developed by Cincinnati Test Systems for the Sentinel I28 instrument that makes the initial setup of the instrument to a new test part quick, easy and efficient. The process will determine the best time sequence to test a part within the limits of a desired maximum cycle time. If the desired maximum cycle time is set too short, the final test will not produce repeatable results. Any leak test needs a certain amount of cycle time to achieve sufficient resolution and repeatability that are dependent on the part volume, leak rate, test pressure, and part characteristics. The Auto Setup routine will set the best possible test cycle within the maximum cycle time specified for the test.

Parameter	Description	Display User Level
Test Type	Set this to Pressure Decay-Leak Std.	Basic Advanced, Admin
Apply to Program #	Defines the program in which the parameters will be written. This process will overwrite the current parameters within the defined program.	Basic Advanced, Admin
Desired Cycle Time	This is the total desired time to complete the test on the part excluding tooling motions. The Auto Setup sequence will determine the best possible sequence of testing within this maximum cycle time. This optimized setup cannot produce acceptable resolution and repeatability if the total time is too short for the part volume, leak rate, test pressure, and part construction. Utilize all the available time in the manufacturing process to conduct this test. When acceptable results are achieved, you may be able to repeat the process and reduce the total cycle time.	Basic Advanced, Admin
Target Pressure	This is the specified test pressure for the part. Auto Setup will preset the Minimum Pressure at 80% and Maximum Pressure at 120%.	Basic Advanced, Admin
Pressure Select	Set to the same pressure source as you did in Chapter 2 - Pressure Select.	Basic Advanced, Admin

Parameter	Description	Display User Level
High Limit Leak	This is the specified leak rate for the part. Auto Setup will preset the Low Limit Leak at –20% of the High Limit Leak. It will also set the Test Evaluation to FPF. FPF means "Fail over Hi Limit, Pass between Hi and Lo Limit and Fail if under Lo Limit". These values and settings can be changed after completing the Auto Setup sequence.	Basic Advanced, Admin
Leak Std Value	This is the leak rate value on the calibrated leak standard mounted either internal to the instrument on the pneumatic manifold or using an external leak standard.	Basic Advanced, Admin
Leak Std Pressure	This is the pressure value on the calibrated leak standard.	Basic Advanced, Admin
Cal Method	This defines whether one or two parts are used in the calibration procedure. It also specifies if the Leak Standard is located internally on the manifold where the Calibration Valve will automatically activate in the calibration procedure or located externally where it will be added to the process by the operator or system control.	Basic Advanced, Admin
Start Auto Setup	This starts the Auto Setup procedure.	Basic Advanced, Admin

Upon successful completion of the Auto Setup routine there is no need to continue the setup parameters in the rest of this chapter unless you want to adjust parameters.

Timer Parameters

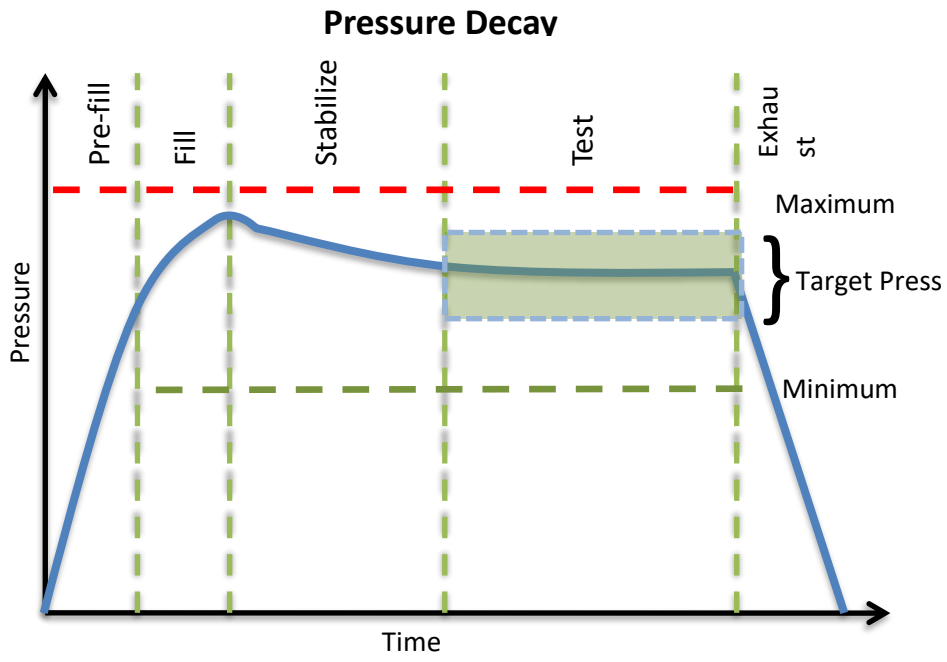
The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Prefill	Checks for excessively leaking parts or lack of pressure. May be set to "Percent of Fill Time" (default), for fixed fill time tests, or set to "Not to Exceed Time". For Changing the Functionality of the Prefill Timer, see Chapter 28. Maximum time to reach the minimum pressure. If the variable is set to "Not to Exceed Time", this segment will exit to the next once the Minimum Pressure value is reached.	Advanced, Admin
Fill	Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air.	Basic Advanced, Admin
Stabilize	Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test	The precise time over which to measure pressure drop or decay or the precise end time to measure pressure rise.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Basic Advanced, Admin
Relax	Timer used during Program Cal sequence as a delay between calibration cycles to allow the master part to recover to repeatable virgin state. (Too short relax times result in decreasing pressure losses/flow results in successive tests.)	Basic Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Minimum Pressure	The value that must be reached before the Prefill setpoint is reached and must be maintained through fill and stabilization segments or the testing cycle will end as a Severe Leak.	Basic Advanced, Admin
Target Pressure	The specified test pressure for the part. For vacuum test pressures enter a positive value if psiv was selected as the pressure unit, or enter a negative value if psig was selected as the pressure unit. ((For example, the test pressure 9.7 psia would be entered as 5 psiv or -5 psig.) Pressure loss may be corrected to the Target Pressure.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Target Press Window	This is a window (default +/– 50%) set around the Target Pressure that must be maintained during the Test segment of the testing cycle. It generates a Target Pressure Low or High Malfunction if the actual pressure falls outside this window during test.	Advanced, Admin



Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:PLR** icon.

TST Parameter	Description	Display User Level
Low Limit Rate	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Rate	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
Min Master Loss	Minimum pressure loss allowed during the first test in the Program Cal routine. Prevents the acceptance of a calibration of a blocked part or test line.	Basic Advanced, Admin
Max Master Loss	Maximum pressure loss allowed during the first test in the Program Cal routine. Prevents the acceptance of a calibration with a leaking part or fixture leaks.	Basic Advanced, Admin
Min Mstr+Leak Loss	Minimum pressure loss allowed during the second test in the Program Cal routine. Prevents the acceptance of a calibration with a blocked part or test line.	Basic Advanced, Admin
Max Mstr+Leak Loss	Maximum pressure loss allowed during the second test in the Program Cal routine. Prevents the acceptance of a calibration with excessive pressure loss due to part or fixture leaks. Set slightly higher than max loss during Program Cal.	Basic Advanced, Admin
Min Leak Loss	Minimum pressure loss allowed that represents the pressure loss due to the Leak Standard used to calibrate the instrument.	Basic Advanced, Admin
Max Leak Loss	Maximum pressure loss allowed that represents the pressure loss due to the Leak Standard used to calibrate the instrument.	Basic Advanced, Admin
Min Perform Factor	Minimum value for Performance Factor calculated at completion of Program Cal routine. Resultant evaluation of ratio of Master Part Loss to Master+Leak Loss, Test Pressure, and loss due to Leak Std.	Basic Advanced, Admin

Leak Std Cal Flow	Certified flow value of Leak Standard used to calibrate instrument. This parameter is only viewable in this location if the Leak Std/Cal Define parameter is set to "Program".	Basic Advanced, Admin
Leak Std Cal Press	Certified pressure at which Leak Standard Flow was calibrated. This parameter is only viewable in this location if the Leak Std/Cal Define parameter is set to "Program".	Basic Advanced, Admin
Quik Test Enable	Activates Quik Test. See Appendix B.	Advanced, Admin
Quik Test Timer	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix B.	Advanced, Admin
Quik Test LL Band	See Appendix B.	Advanced, Admin
Quik Test HL Band	See Appendix B.	Advanced, Admin
EDC Enable	Activates Environmental Drift Correction. See Appendix C.	Advanced, Admin
EDC Percentage	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix C.	Advanced, Admin
EDC Quantity	See Appendix C.	Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

Note: If the instrument is configured multiple internal leak standards the user must select which leak standard is to be used in the Program. See Selecting the Proper Internal Leak Standard in Chapter 28 – Features.

Program Calibration

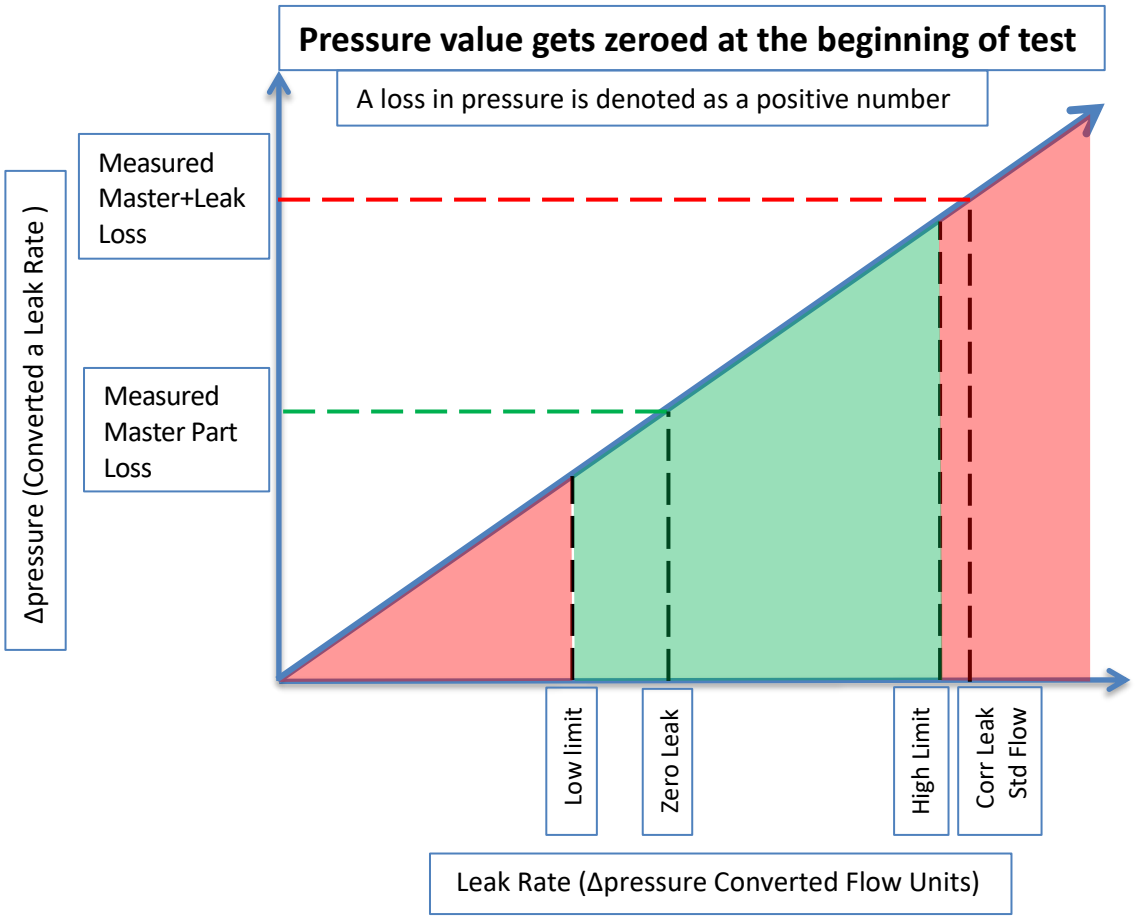
In order to convert the pressure loss measured by the instrument to a leak (flow) rate, the instrument uses a leak standard and needs to run the "Program Cal" procedure. This procedure requires at least one known non-leaking part referred to as a "master part". This procedure tests a non-leaking master part connected to the instrument using the timers and pressures established for the program. The procedure automatically tests the non-leaking master part twice with the Relax timer delay between tests. Within each program that uses a leak standard, Program Cal can be configured to use one of four methods. See **Setting the Cal Method and Leak Standard Location** in Chapter 28 – Features.

Remember: The Leak/Cal menu has a parameter called Leak Std/Cal Define that determines the location for the leak standard settings.

When set to "Channel", leak standard settings are located in the Channel Config menu.

When set to "Program", leak standard settings are located in the Program menu.

Determine how you plan to use your leak test instrument. Review Setting the Leak Standard Values section on page 14. It is critical to make sure the leak standard values are set correctly for proper use. To view the Cal Method parameter, you must be in the Advanced or Admin Display User Level. To change the Display User Level, see Chapter 28– Features.



Initiating the Program Cal Sequence

To initiate a Program Cal sequence, go to **Main Menu > Program Cal** icon, select **OK** and press **Enter**. The Program Cal wizard will tell you to connect a non-leaking master part. Connect the non-leaking master part to the instrument. Push the Start button to initiate the Program Cal sequence. The system will conduct an initial test of the non-leaking master part to measure the pressure loss associated with a non-leaking part. This represents the typical offset associated with testing parts within the environment of the test system. The pressure loss value is saved as the Master Part Loss. The system will conduct a second test on a non-leaking master part with a known calibrated leak standard included in the test. The pressure loss value result for this test is saved as the Master+Leak Loss.

Performance Factor

Upon the successful completion of the Program Cal routine, the display will show the calculated Performance Factor for the calibration. The Performance Factor is an estimate of the quality of the calibration. It combines the ratio of the Hi Limit Leak result to the non-leaking master part result, the test pressure, and difference between the Hi Lim result and the non-leaking master part result to scale its anticipated performance. This value ranges from 0 to 100. It is generally desirable to have a Performance Factor of 35 to 100. The actual acceptable Performance Factor can vary depending on the desired Gage R&R performance of the test. Here is the Performance Factor equation:

Performance Factor = **Cal Ratio** x **Pressure Loss Penalty** x **Time Penalty** x **100**

The pressure loss penalty is greater for smaller pressure loss values. The time penalty is greater for shorter Test cycle timer values. Generally, longer stabilize and test cycle timer settings will produce higher Performance Factors and improved Gage R&R performance.

> ***Note: The instrument will require a Program Cal Sequence if any parameters that affect the calibration are modified.***

Conditions for a Successful Calibration

Several conditions must be met during the Program Calibration procedure for the instrument to accept and store the calibration results. The conditions are based on the following measurements or calculations:

1. Master Part Loss
    a. Must be greater than the Min Master Loss limit
    b. Must be less than the Max Master Loss limit
    c. Must be less than the Master+Leak Loss measurement
2. Master+Leak Loss
    a. Must be greater than the Min Mstr+Leak Loss limit
    b. Must be less than the Max Mstr+Leak Loss limit
    c. Must be greater than the Master Loss measurement
3. Leak Loss
    a. Must be greater than the Min Leak Loss limit
    b. Must be less than the Max Leak Loss limit
4. Performance Factor
    a. Must be greater than the Min Perform Factor limit

If the procedure does not meet these conditions, error messages are displayed at the completion of tests.

If the Program Cal routine is successfully completed, "PROGRAM CALIBRATION PASSED" will be displayed. If there are any problems during the Program Cal sequence an error will be displayed. If there is an error, see Appendix A - Message and Error Codes.

Calibration Parameters

The Calibration parameters menu is located in the **Main Menu > Program Config > CAL:PLR** icon. These calibration parameters are values that are measured or calculated as a result of the Program Cal routine for a Pressure Decay-Leak Std test.

Parameter	Description	Display User Level
Performance Factor	Resultant evaluation of ratio of Master Part Loss to Master+Leak loss, Test Pressure, and loss due to Leak Std.	Basic Advanced, Admin
Master Part Press	Measured pressure at the beginning of the test segment during the first test of the Program Cal process for the non-leaking master part.	Basic Advanced, Admin
Master+Leak Press	Measured pressure at the beginning of the test cycle of second test during Program Cal process for the non-leaking master part with the leak standard introduced to the pneumatic test circuit.	Basic Advanced, Admin
Master Part Loss	Measured pressure loss for the non-leaking master part during the first test of Program Cal process.	Viewable in Basic & Advanced **Editable in Admin**
Master+Leak Loss	Measured pressure loss during the second test of Program Cal for the non-leaking master part with the leak standard introduced to the pneumatic test circuit.	Viewable in Basic & Advanced **Editable in Admin**
Leak Loss	Calculated pressure loss, based upon measured pressure losses during the Program Cal routine. Corresponds to the actual pressure loss related to the leak standard.	Viewable in Basic & Advanced **Editable in Admin**
Corr. Leak Std Flow	The calculated leak standard flow rate based on the Program Target Pressure, the leak standard calibrated pressure, and the leak standard calibrated flow rate.	Basic Advanced, Admin

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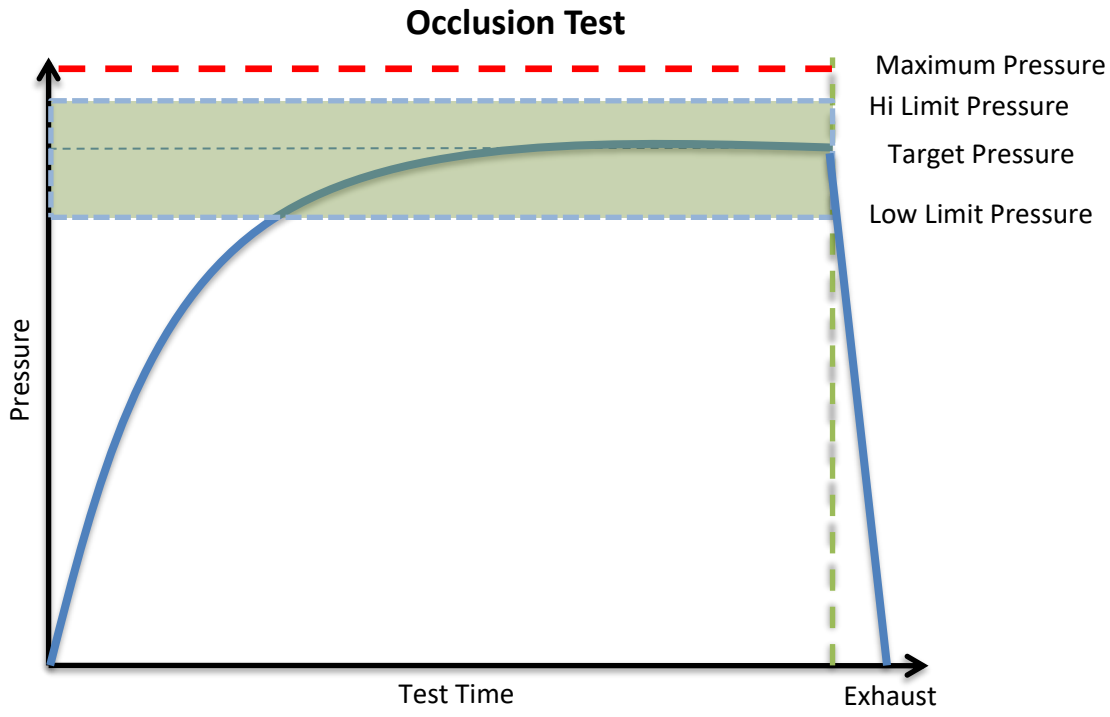
Chapter 6 – Occlusion

This chapter explains the theory and parameters for conducting an Occlusion Test. The result of this test is the measured back pressure at the expiration of the Test sequence.

The Occlusion Test is a back pressure test. The part is pressurized throughout the test from a fixed pressure regulator setting. At the end of the Test timer the actual test pressure is compared to the Low Limit Pressure and High Limit Pressure settings. Low Limit Pressure indicates high flow or minimum blockage or low back pressure. High Limit Pressure indicates low flow or maximum blockage or high back pressure.

The Chart below give an overview of the parameters used to set up an Occlusion Test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 ***– Features.***



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Test	At the end of this timer, the instrument will read the pressure on the pressure transducer. This pressure is due to the backpressure created in the pneumatic circuit and part.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Target Pressure	Target test pressure.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:OCC** icon.

TST Parameter	Description	Display User Level
Low Limit Pressure	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Pressure	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

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Chapter 7 – Pressure Verify

This chapter explains the theory and parameters for conducting a Pressure Verify test.

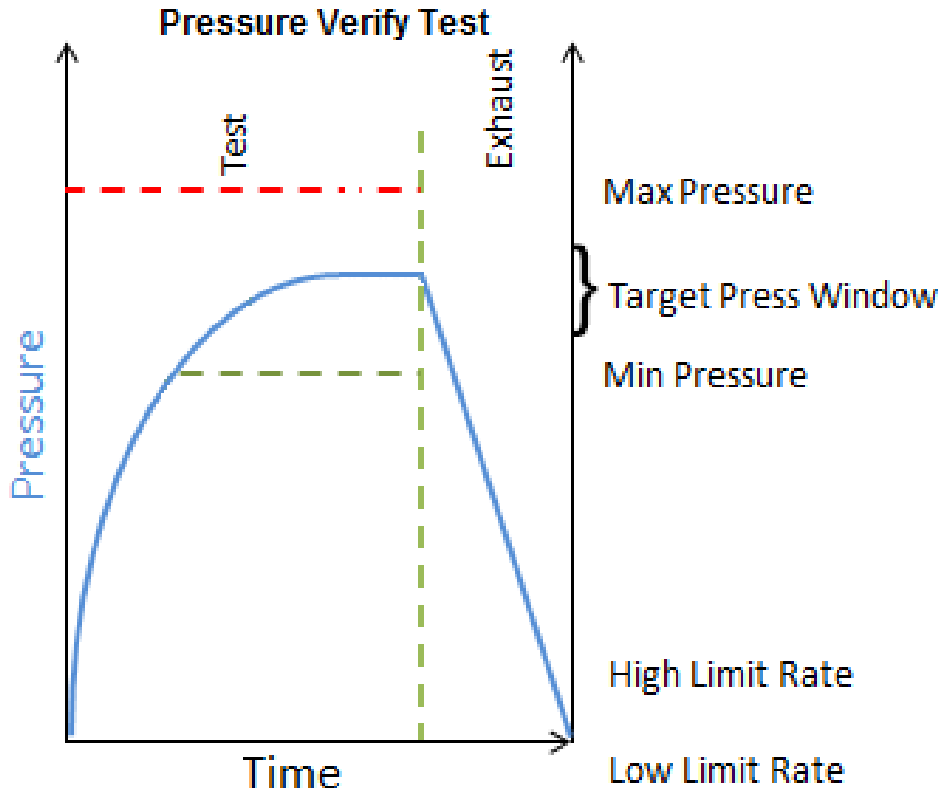
The Pressure Verify test is intended to test parts that generate vacuum or pressure, or to verify that the part was pre-charged to the correct pressure, or to verify that the part was evacuated or filled by an external source.

The principle of operation is to close the isolation valve on the internal manifold to isolate the part. The pressure transducer then reads the vacuum or pressure generated by the part or that is already in the part. At the end of the test timer, the test pressure is compared to the low limit pressure and high limit pressure settings. The Test Result is recorded with an overall ACCEPT/REJECT

If the Pressure Verify test was performed with the Self-Test cap on the test port, the only pressure measured will be the small pressure that is trapped by the isolation valve as it actuates to close.

The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28***– Features.***



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	User Display Mode
Test	Amount of time allocated to each segment for execution before continuing. The pressure measurement is made at the end of the Test segment.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	User Display Mode
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:PVF** icon.

TST Parameter	Description	User Display Mode
Low Limit Pressure	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Pressure	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: Above high limit, Between limits, and Below low limit. See Table below for codes	Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (Default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

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Chapter 8 – Mass Flow

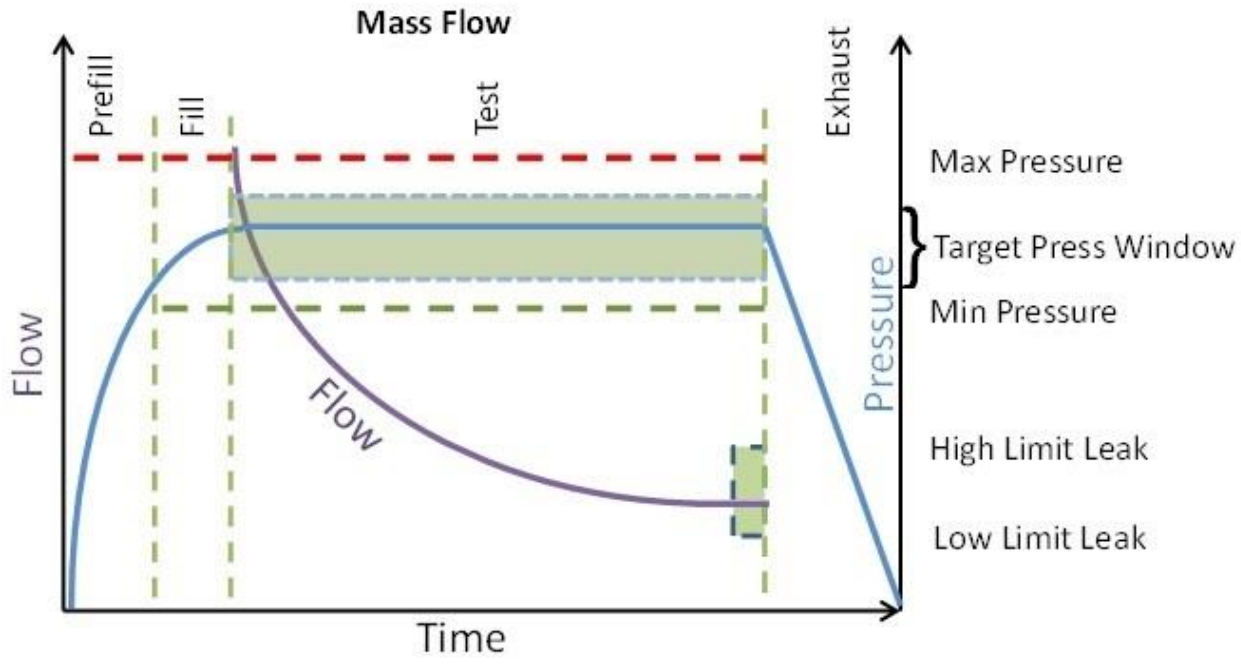
This chapter explains the theory and parameters for conducting a Mass Flow Test. The result of this test is the measured flow rate at the moment the Test cycle timer decrements to zero time. This test type is typically used for applications where a "good" part is expected to flow a desired amount.

This test type utilizes a single calibration cycle with a non-leaking master part to set the zero flow value. It is important to note that this calibration process creates a linear offset of all the flow readings based on this single calibration point.

The basic principle of operation of a mass flow test leak test instrument is to fill the test part to a specified target test pressure and allow the pressure regulator to maintain the target pressure in the part. The instrument will measure the flow of air required to keep the part at the target pressure.

The Charts below give an overview of the parameters used to set up a Mass Flow Test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28– *Features.*



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Prefill	Checks for excessively leaking parts or lack of pressure. May be set to "Percent of Fill Time" (default), for fixed fill time tests, or set to "Not to Exceed Time". For Changing the Functionality of the Prefill Timer, see Chapter 28. Maximum time to reach the minimum pressure. If the variable is set to "Not to Exceed Time", this segment will exit to the next once the Minimum Pressure value is reached.	Advanced, Admin
Fill	Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air.	Basic Advanced, Admin
Stabilize	Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test	The precise time over which to measure pressure drop or decay or the precise end time to measure pressure rise.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Minimum Pressure	The value that must be reached before the Prefill setpoint is reached and must be maintained through fill and stabilization segments or the testing cycle will end as a Severe Leak.	Basic Advanced, Admin
Target Pressure	The specified test pressure for the part. For vacuum test pressures enter a positive value if psiv was selected as the pressure unit, or enter a negative value if psig was selected as the pressure unit. ((For example, the test pressure 9.7 psia would be entered as 5 psiv or -5 psig.) Pressure loss may be corrected to the Target Pressure.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Target Press Window	This is a window (default +/– 50%) set around the Target Pressure that must be maintained during the Test segment of the testing cycle. It generates a Target Pressure Low or High Malfunction if the actual pressure falls outside this window during test.	Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:FLW** icon.

TST Parameter	Description	Display User Level
Low Limit Flow	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Flow	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
Max Master Flow	The maximum value allowed for the Master Flow Offset parameter located on the Cal menu.	Basic Advanced, Admin
Min Master Flow	The minimum value allowed for the Master Flow Offset parameter located on the Cal menu.	Basic Advanced, Admin
EDC Enable	Activates Environmental Drift Correction. See Appendix C.	Advanced, Admin
EDC Percentage	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix C.	Advanced, Admin
EDC Quantity	See Appendix C.	Advanced, Admin
Enable Calibration	Typically used with low leak applications. Enables the Program Cal function which allows a zero offset to be created for a non-leaking master part.	Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

Program Calibration

In some applications, particularly low leak applications, it is advantageous to create a flow offset based on testing a non-leaking master part. To enable flow offset, go to **Main Menu > Program Config > TST:FLW** icon. Change the Enable Calibration parameter to "Yes".

Initiating the Program Cal Sequence

To initiate a Program Cal sequence, go to **Main Menu > Program Cal** icon, select **OK** and press **Enter**. The Program Cal wizard will tell you to connect a non-leaking master part. Connect the non-leaking master part to the instrument. Push the **Start button** to initiate the Program Cal sequence. The system will conduct a test of the non-leaking part to measure the flow associated with a non-leaking part. This represents the typical offset associated with testing parts within the environment of the test system. The flow value is saved as the Master Part Offset.

> ***Note: The instrument will require a Program Cal Sequence if any parameters that affect the calibration are modified.***

One condition must be met during the Program Calibration procedure for the instrument to accept and store the calibration result. The condition is:
The Master (part) Flow must be between the Min Master Flow and Max Master Flow limits.
If the procedure does not meet this condition, an error message is displayed at the completion of test.

If the Program Cal routine is successfully completed, "PROGRAM CALIBRATION PASSED" will be displayed. If there are any problems during the Program Cal sequence an error will be displayed. See Appendix A - Messages & Error Codes.

Calibration Parameters

The Calibration parameters menu is located in **Main Menu > Program Config > CAL:FLW** icon. These calibration parameters are values that are measured or calculated as a result of the Program Cal routine for a Mass Flow test.

Parameter	Description	Display User Level
Master Flow Offset	The flow value measured during a Program Calibration sequence is created as a zero offset. This value is stored in this parameter and is used as an offset to subtract from the actual flow value.	Viewable in Basic & Advanced **Editable in Admin**

Direct Flow Parameter

The Direct Flow Parameter is viewed by going to the **Main Menu > Program Config > Misc** icon. This parameter determines how the flow transducer is inserted in to the test circuit.

If the parameter is set to "Enabled: Prefill-Test" then the transducer is active during the Prefill through Test timer. If the parameter is set to "Enabled: Fill-Test" then the transducer is active during the Fill to test timer. If the parameter is set to "Disabled", the transducer is bypassed during the Prefill and Fill timer and active only during the Test timer.

> ***Note: It may be advantageous to use direct flow when short test cycles are needed with parts that are expected to flow a certain amount. With direct flow, the flow transducer is inserted into the test circuit earlier and gives the flow sensor the entire cycle to stabilize before making the final measurement at the end of the test segment.***

Chapter 9 – Mass Flow-Leak Std

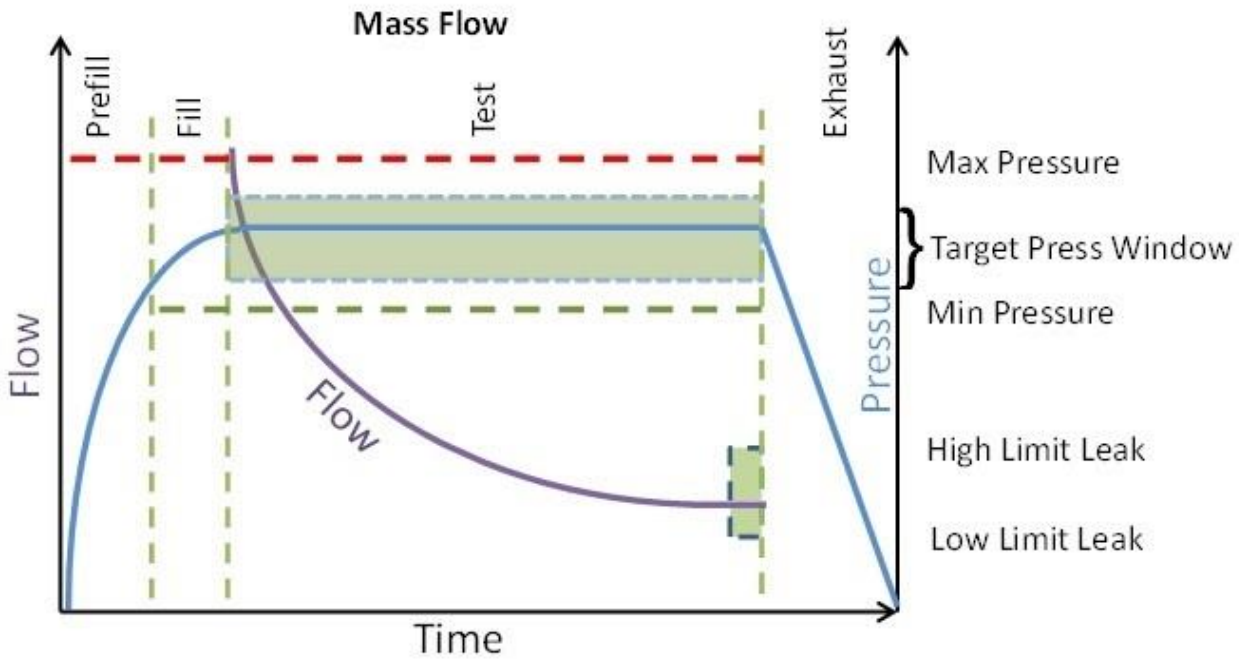
This chapter explains the theory and parameters for conducting a Mass Flow Test with a leak standard. The result of this test is the measured flow rate at the moment the Test cycle timer decrements to zero time. This test type is typically used for low leak applications.

The basic principle of operation of a mass flow test leak test instrument is to fill the test part to a specified target test pressure and allow the pressure regulator to maintain the target pressure in the part. The instrument will measure the flow of air required to keep the part at the target pressure.

This test type utilizes a two-point calibration sequence with a non-leaking master part to set the zero flow value and the flow value at the leak standard value. It is important to note that this calibration process creates a linear offset of the flow readings based on these two points.

The charts in this chapter give an overview of the parameters used to set up a Mass Flow Test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28– *Features.*



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Prefill	Checks for excessively leaking parts or lack of pressure. May be set to "Percent of Fill Time" (default), for fixed fill time tests, or set to "Not to Exceed Time". For Changing the Functionality of the Prefill Timer, see Chapter 28 – Features. Maximum time to reach the minimum pressure. If the variable is set to "Not to Exceed Time", this segment will exit to the next once the Minimum Pressure value is reached.	Advanced, Admin
Fill	Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air.	Basic Advanced, Admin
Stabilize	Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test	The precise time over which to measure pressure drop or decay or the precise end time to measure pressure rise.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Basic Advanced, Admin
Relax	Timer used during Program Cal sequence as a delay between calibration cycles to allow the master part to recover to repeatable virgin state. (Too short relax times result in decreasing flow results in successive tests.)	Basic Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Minimum Pressure	The value that must be reached before the Prefill setpoint is reached and must be maintained through fill and stabilization segments or the testing cycle will end as a Severe Leak.	Basic Advanced, Admin
Target Pressure	The specified test pressure for the part. For vacuum test pressures enter a positive value if psiv was selected as the pressure unit, or enter a negative value if psig was selected as the pressure unit. ((For example, the test pressure 9.7 psia would be entered as 5 psiv or -5 psig.) Pressure loss may be corrected to the Target Pressure.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Target Press Window	This is a window (default +/– 50%) set around the Target Pressure that must be maintained during the Test segment of the testing cycle. It generates a Target Pressure Low or High Malfunction if the actual pressure falls outside this window during test.	Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:FLC** icon.

TST Parameter	Description	Display User Level
Low Limit Flow	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Flow	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
Min Master Flow	The minimum flow allowed for the first test during the Program Calibration sequence.	Basic Advanced, Admin
Max Master Flow	The maximum flow allowed for the first test during the Program Calibration sequence.	Basic Advanced, Admin
Min Master + Leak Flow	The minimum flow allowed for the second test during the Program Calibration sequence when the leak standard is in the test circuit.	Basic Advanced, Admin
Max Master + Leak Flow	The maximum flow allowed for the second test during the Program Calibration sequence when the leak standard is in the test circuit.	Basic Advanced, Admin
Min Leak Flow	The minimum value allowed that represents the flow due to the Leak Standard used to calibrate the instrument.	Basic Advanced, Admin
Max Leak Flow	The maximum value allowed that represents the flow due to the Leak Standard used to calibrate the instrument.	Basic Advanced, Admin
Quik Test Enable	Activates Quik Test. See Appendix B.	Advanced, Admin
Quik Test Timer	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix B.	Advanced, Admin
Quik Test LL Band	See Appendix B.	Advanced, Admin
Quik Test HL Band	See Appendix B.	Advanced, Admin
EDC Enable	Activates Environmental Drift Correction. See Appendix C.	Advanced, Admin
EDC Percentage	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix C.	Advanced, Admin

EDC Quantity	See Appendix C.	Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

Note: If the instrument is configured with multiple internal leak standards, the user must select which leak standard is to be used in the Program. See Selecting the Proper Internal Leak Standard in Chapter 28 ***– Features.***

Program Calibration

In order to scale the flow transducer to the "zero flow" reading measured by testing a non-leaking part and the "reject" reading measured by testing the non-leaking part with a leak standard incorporated in the circuit, the instrument needs to run the "Program Cal procedure". This procedure requires at least one known non-leaking part referred to as a "master part". This procedure tests a non-leaking master part in the seal fixture using the timers and pressures established for the program. The procedure automatically tests the non-leaking master part twice with the Relax timer delay between tests. Within each program that uses a leak standard, Program Cal can be configured to use one of four methods. See **Setting the Cal Method and Leak Standard Location** in Chapter 28 – Features**.**

Remember: The Leak/Cal menu has a parameter called Leak Std/Cal Define that determines the location for the leak standard settings.

When set to "Channel", leak standard settings are located in the Channel Config menu.

When set to "Program", leak standard settings are located in the Program menu.

Determine how you plan to use your leak test instrument. Review Setting the Leak Standard Values ***section on page 14. It is critical to make sure the leak standard values are set correctly for proper use. To view the Cal Method parameter, you must be in the Advanced or Admin Display User Level. To change the Display User Level, see*** Chapter 28***– Features.***

Initiating the Program Cal Sequence

To initiate a Program Cal sequence, go to **Main Menu > Program Cal** icon, select **OK** and press **Enter**. The Program Cal wizard will tell you to connect a non-leaking master part. Connect the non-leaking master part to the instrument. Push the **Start button** to initiate the Program Cal sequence. The system will conduct an initial test of the non-leaking master part to measure the flow associated with a non-leaking part. This represents the typical offset associated with testing parts within the environment of the test system. The flow value is saved as the Master Part Flow. The system will conduct a second test on a non-leaking master

part with a known calibrated leak standard included in the test. The flow value result for this test is saved as the Master+Leak Flow.

Note: The instrument will require a Program Cal Sequence if any parameters that affect the calibration are modified.

Conditions for a Successful Calibration

Several conditions must be met during the Program Calibration procedure for the instrument to accept and store the calibration results. The conditions are based on the following measurements or calculations:

1. Master Part Flow
    a. Must be greater than the Min Master Flow limit
    b. Must be less than the Max Master Flow limit
    c. Must be less than the Master+Leak Flow measurement
2. Master+Leak Flow
    a. Must be greater than the Min Mstr+Leak Flow limit
    b. Must be less than the Max Mstr+Leak Flow limit
    c. Must be greater than the Master Flow measurement
3. Leak Flow
    a. Must be greater than the Min Leak Flow limit
    b. Must be less than the Max Leak Flow limit

If the procedure does not meet these conditions, error messages are displayed at the completion of tests.

If the Program Cal routine is successfully completed, "PROGRAM CALIBRATION PASSED" will be displayed. If there are any problems during the Program Cal sequence an error will be displayed. See Appendix A – Message and Error Codes.

Calibration Parameters

The Calibration parameters menu is located in the **Main Menu > Program Config > CAL:FLC** icon. These calibration parameters are values that are measured or calculated as a result of the Program Cal routine for a Mass Flow-Leak Std test.

Parameter	Description	Display User Level
Master Part Press	Measured pressure at the beginning of the test segment during the first test of the Program Cal process for the non-leaking master part.	Basic Advanced, Admin
Master+Leak Press	Measured pressure at the beginning of the test cycle of second test during Program Cal process for the non-leaking master part with the leak standard introduced to the pneumatic test circuit.	Basic Advanced, Admin
Master Part Flow	Measured flow for the non-leaking master part during the first test of Program Cal process.	Viewable in Basic & Advanced **Editable in Admin**
Master+Leak Flow	Measured flow during the second test of Program Cal for the non-leaking master part with the leak standard introduced to the pneumatic test circuit.	Viewable in Basic & Advanced **Editable in Admin**
Leak Flow	Calculated flow, based upon measured flows during the Program Cal routine. Corresponds to the actual flow related to the leak standard.	Viewable in Basic & Advanced **Editable in Admin**
Corr. Leak Std Flow	The calculated leak standard flow rate based on the Program Target Pressure, the leak standard calibrated pressure, and the leak standard calibrated flow rate.	Basic Advanced, Admin

Direct Flow Parameter

The Direct Flow Parameter is viewed by going to the Program Config ->Misc icon. This parameter determines how the flow transducer is inserted into the test circuit.

If the parameter is set to "Enabled: Prefill-Test" then the transducer is active during the Prefill to test timer.
If the parameter is set to "Enabled: Fill-Test" then the transducer is active during the Fill to test timer.
If the parameter is set to "Disabled", the transducer is bypassed during the Prefill and Fill timer and active only during the Test timer.

Note: It may be advantageous to use direct flow when short test cycles are needed with parts that are expected to flow a certain amount. With direct flow, the flow transducer is inserted into the test circuit earlier and gives the flow sensor the entire cycle to stabilize before making the final measurement at the end of the test segment.

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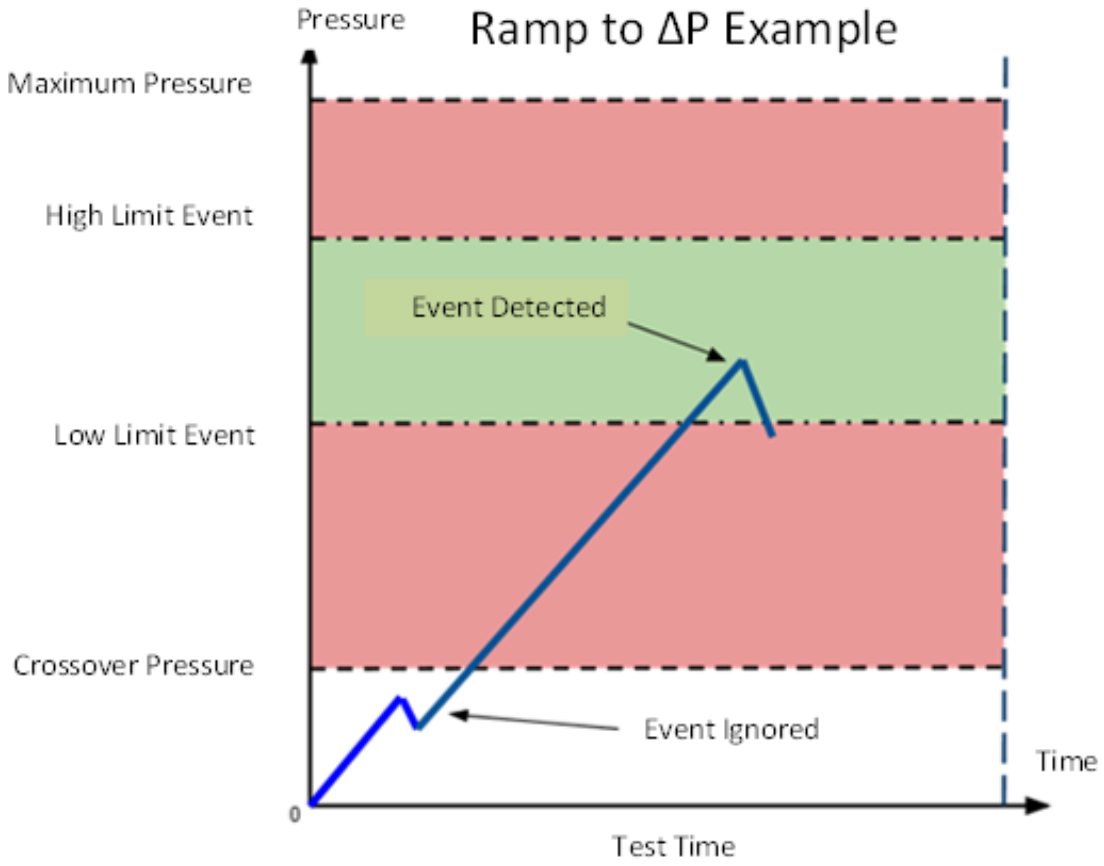
Chapter 10 – Ramp to ΔP Event

This chapter explains the theory and parameters for conducting a Ramp to Event Test. The result of this test is the measured pressure at the point in time an event occurs and the duration of time before the event.

A test type to evaluate parts that 'crack' or drastically change state under pressure that can be immediately detected by monitoring for a sudden significant change in system pressure. The system pressure is typically increased at a consistent rate (ramp) over a defined period of time. The pressure ramp can be controlled by the instrument with an electronic regulator, or by a mechanical regulator through a fixed restriction.

The Chart below gives an overview of the parameters used to set up a Ramp to Event Test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 ***– Features.***



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Test	Maximum duration timer that is a not-to-exceed value. If an event does not occur within this time period, the test will abort with a "NO EVENT" evaluation.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Ramp Method	Determines whether ramp is developed by electronic regulator, manual flow restrictor or combination of both. Options are visible only if the instrument is configured with an electronic regulator.	Basic Advanced, Admin
Starting Pressure	Starting Pressure, only when controlled by the instrument with an electronic regulator. This parameter is not visible if the Ramp Method is set to "None" or "Mech Reg, Flow Control".	Basic Advanced, Admin
Ramp Rate	Rate at which pressure is increased or decreased during the test time, only when controlled by the instrument with an electronic regulator. This parameter is not visible if the Ramp Method is set to "None", "Mech Reg, Flow Control" or "E-Reg Fixed, Flow Control".	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:RTE** icon.

TST Parameter	Description	Display User Level
Low Limit Event	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Event	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
Crossover Pressure	Pressure setpoint that must be crossed (ascending pressure ramp or descending pressure ramp) during the test timer before an event can be detected. This parameter prevents capturing initial part stretch or any other system noise during the ramp of pressure below this value. If set to "Zero", this requirement is disabled.	Basic Advanced, Admin
Event Type	Determines the method utilized to trap for an event: ΔP decrease from peak pressure, ΔP decrease over time or ΔP increase over time.	Basic Advanced, Admin
Event Δ Pressure	Minimum pressure differential (defined by the event type as the peak pressure minus current pressure or the change in pressure over the event time) that must be obtained for the part to have successfully had an 'Event'.	Basic Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

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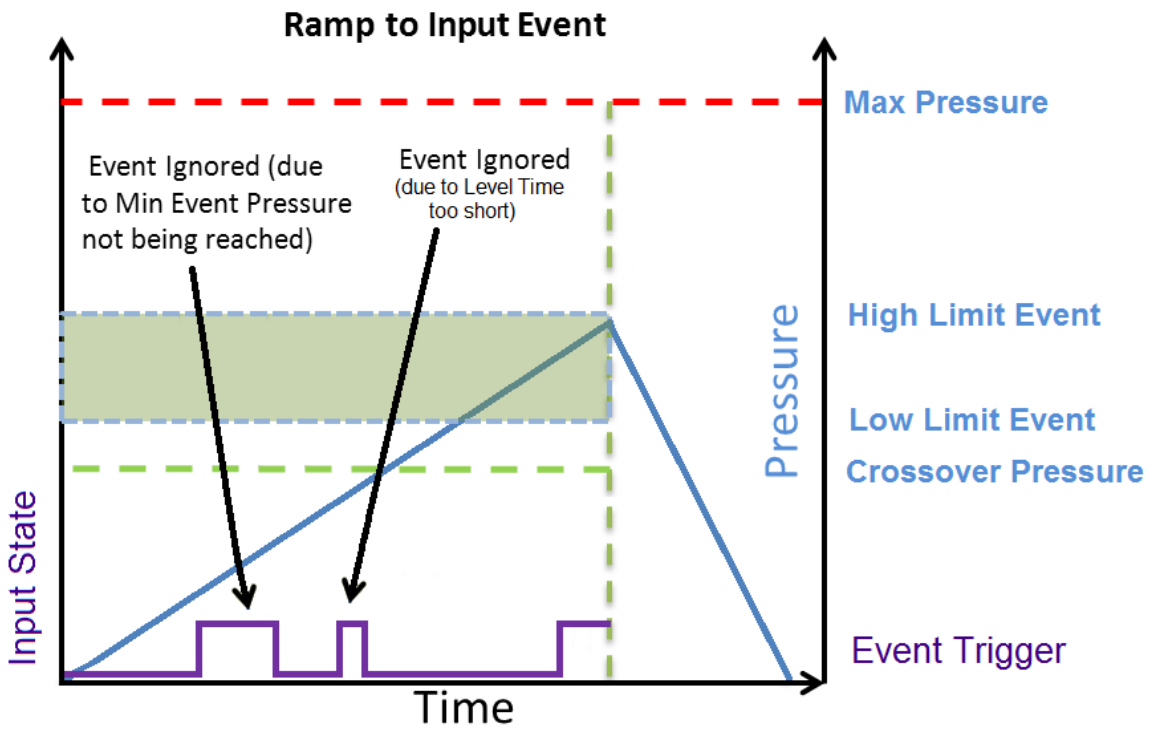
Chapter 11 – Ramp to Input Event

This chapter explains the theory and parameters for conducting a Ramp to Input Event Test, which is primarily used for testing the electrical state of a device. This test type measures the pressure at which the trigger event input occurs, determines the maximum pressure before the event is trapped, and records the pressure and duration of time before at the moment of the trigger event. The results are presented in units of pressure and time.

This test type is used to evaluate parts that change state under pressure, where the change can be immediately detected by monitoring a pressure switch, flow switch, or other device with a digital input. The system pressure is either increased or decreased (ramp) over a defined period of time. The pressure ramp can be controlled by the instrument via an electronic regulator, or by a mechanical regulator through a fixed restriction. The digital input on the instrument which is set to Event Trigger and monitors for a rising or falling edge or a level change from high to low or low to high. The Event Trigger can be ignored if the duration is less than the Level Time setting.

The Chart below gives an overview of the parameters used to set up a Ramp to Input Event test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28***– Features.***



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Test	Maximum duration timer that is a not-to-exceed value. If an event does not occur within this time period, the test will abort with a "NO EVENT" evaluation.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Ramp Method	Determines whether ramp is developed by electronic regulator, manual flow restrictor or combination of both. Options are visible only if the instrument is configured with an electronic regulator.	Basic Advanced, Admin
Starting Pressure	Starting Pressure, only when controlled by the instrument with an electronic regulator. This parameter is not visible if the Ramp Method is set to "None" or "Mech Reg, Flow Control".	Basic Advanced, Admin
Ramp Rate	Rate at which pressure is increased or decreased during the test time, only when controlled by the instrument with an electronic regulator. This parameter is not visible if the Ramp Method is set to "None", "Mech Reg, Flow Control" or "E-Reg Fixed, Flow Control".	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:RTI** icon.

TST Parameter	Description	Display User Level
Low Limit Event	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Event	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
Crossover Pressure	Pressure setpoint that must be crossed (ascending pressure ramp or descending pressure ramp) during the test timer before an event can be detected. This parameter prevents capturing initial part stretch or any other system noise during the ramp of pressure below this value. If set to "Zero", this requirement is disabled.	Basic Advanced, Admin
Event Type	Determines the method utilized to trap for an event: Edge (Rising or Falling) type requires a directional change in input state. Level type requires a specific input state for a specified duration.	Basic Advanced, Admin
Edge Type	Defines the direction of transition required on the input to determine if an event has occurred. Rising Edge is a level transition from Low to High and Falling Edge is a level transition from High to Low.	Basic Advanced, Admin
Level State	Defines the specific state the input must match to trap for an event.	Basic Advanced, Admin
Level Time	The period of time over which the input must be in the desired state to determine if an event has occurred.	Basic Advanced, Admin
Input Initial State	The required initial state of the input that is verified at the start of the test cycle.	Basic Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

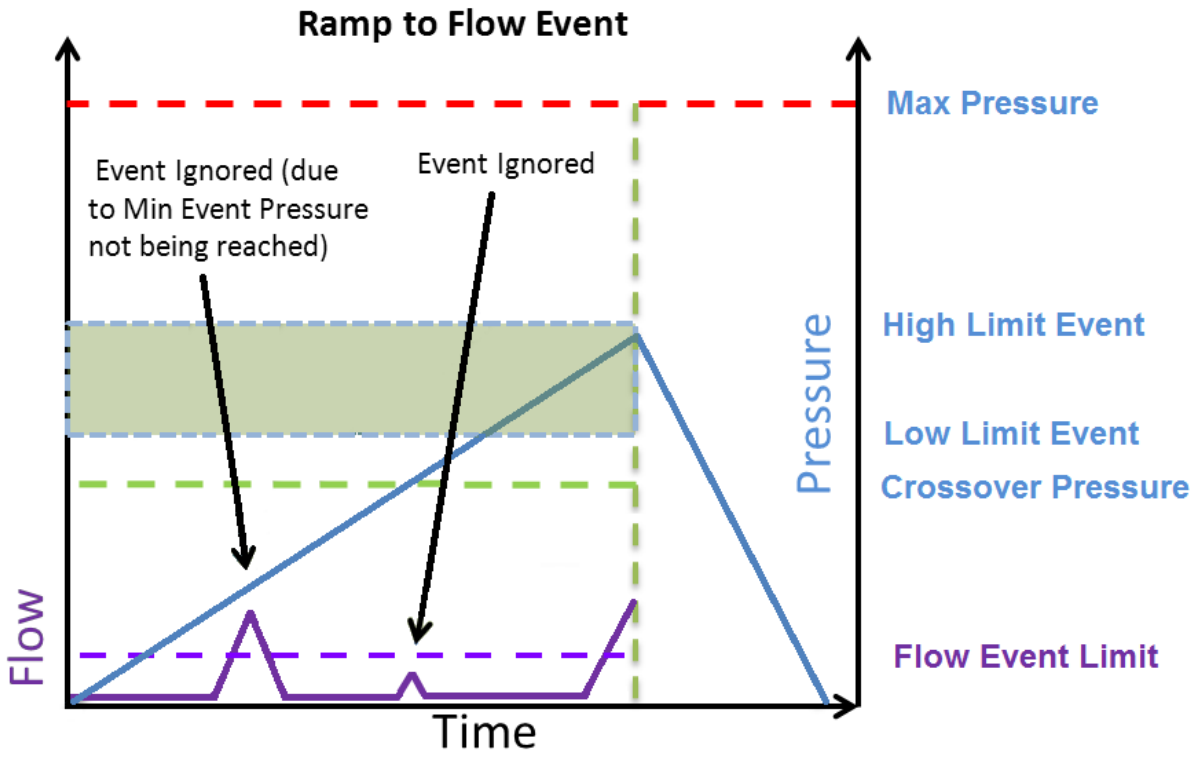
Chapter 12 – Ramp to Flow Event

This chapter explains the theory and parameters for conducting a Ramp to Flow Event Test, which is primarily used for testing the cracking point of a check valve. This test type measures the point at which the flow crosses a threshold, determines the maximum pressure before the Flow Event limit is exceeded, and records the duration of time before the event. The results are presented in units of pressure and time.

This test type is used to evaluate parts that change flow characteristics under pressure, where the change can be immediately detected by monitoring the flow on the outlet side of the device. The system pressure is either increased or decreased at a consistent rate (ramp) over a defined period of time. The pressure ramp can be controlled by the instrument via an electronic regulator, or by a mechanical regulator through a fixed restriction. The outlet side of the device is connected to the flow sensor port on the instrument and allows the instrument to measure downstream flow through the device as the pressure ramps up.

The Chart below gives an overview of the parameters used to set up a Ramp to Flow Event test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 – *Features.*



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Test	Maximum duration timer that is a not-to-exceed value. If an event does not occur within this time period, the test will abort with a "NO EVENT" evaluation.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Ramp Method	Determines whether ramp is developed by electronic regulator, manual flow restrictor or combination of both. Options are visible only if the instrument is configured with an electronic regulator.	Basic Advanced, Admin
Starting Pressure	Starting Pressure, only when controlled by the instrument with an electronic regulator. This parameter is not visible if the Ramp Method is set to "None" or "Mech Reg, Flow Control".	Basic Advanced, Admin
Ramp Rate	Rate at which pressure is increased or decreased during the test time, only when controlled by the instrument with an electronic regulator. This parameter is not visible if the Ramp Method is set to "None", "Mech Reg, Flow Control" or "E-Reg Fixed, Flow Control".	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:RTF** icon.

TST Parameter	Description	Display User Level
Low Limit Event	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Event	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
Crossover Pressure	Pressure setpoint that must be crossed (ascending pressure ramp or descending pressure ramp) during the test timer before an event can be detected. This parameter prevents capturing initial part stretch or any other system noise during the ramp of pressure below this value. If set to "Zero", this requirement is disabled.	Basic Advanced, Admin
Flow Event Limit	Minimum flow that must be obtained for the part to have successfully had an 'Event'.	Basic Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

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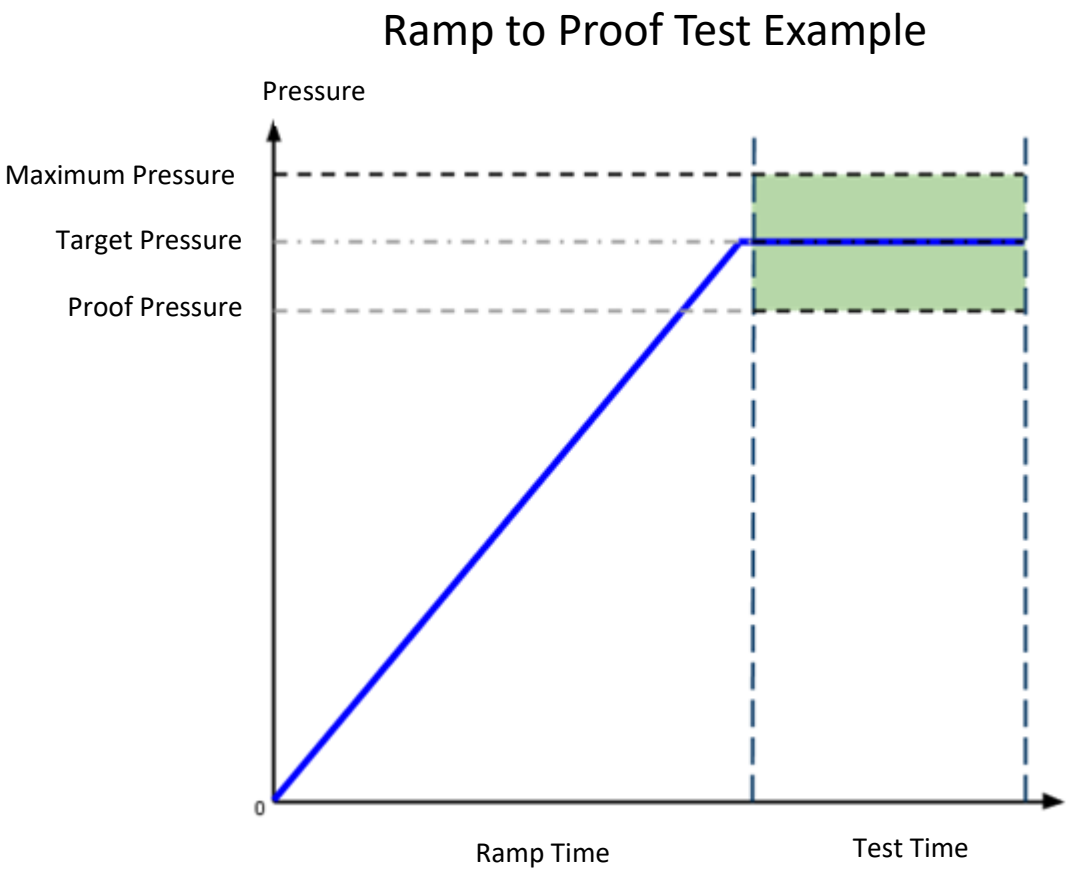
Chapter 13 – Ramp to Proof

This chapter explains the theory and parameters for conducting a Proof Test. The result of this test is the maximum measured pressure during the ramp and test sequences.

The system pressure is either increased or decreased at a consistent rate (ramp) over a period of time, and then held at pressure for an additional period of time. The pressure ramp can be controlled by the instrument with an electronic regulator or by a mechanical regulator through a fixed restriction. Parts are evaluated based on whether or not pressure was achieved and maintained for the test time period.

The Charts below give an overview of the parameters used to set up a Proof Test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 – *Features.*



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Ramp	Time period where the pressure ramp occurs. If an electronic regulator is installed, the instrument will increment the pressure according to the Ramp Rate up to the Target Pressure. During this period the system pressure is monitored, and if it exceeds the Maximum Pressure value the test is immediately aborted.	Basic Advanced, Admin
Test	Time period where the part is expected to maintain pressure. Ramping has completed and the system pressure is monitored; it must remain above the Proof Pressure parameter, and not exceed the Max Pressure parameter. If either scenario is violated, the test is immediately aborted.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Ramp Method	Determines whether ramp is developed by electronic regulator, manual flow restrictor or combination of both. Options are visible only if the instrument is configured with an electronic regulator.	Basic Advanced, Admin
Starting Pressure	Starting Pressure, only when controlled by the instrument with an electronic regulator. This parameter is not visible if the Ramp Method is set to "None" or "Mech Reg, Flow Control".	Basic Advanced, Admin
Target Pressure	Pressure at which the proof test is to be conducted. This parameter is not visible if the Ramp Method is set to "None", "Mech Reg, Flow Control" or "E-Reg Fixed, Flow Control".	Basic Advanced, Admin
Ramp Rate	Rate at which pressure is increased or decreased during the test time, only when controlled by the instrument with an electronic regulator. This parameter is not visible if the Ramp Method is set to "None", "Mech Reg, Flow Control" or "E-Reg Fixed, Flow Control".	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST:PRF** icon.

TST Parameter	Description	Display User Level
Proof Pressure	Minimum test pressure that must be maintained during the test time. If at any point during the test time pressure falls below this value, the test is immediately aborted and a Fail result is generated.	Basic Advanced, Admin

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Chapter 14 – Program Linking

This chapter explains the theory and parameters for conducting multiple tests by linking programs together.

The applications for program linking fall into three basic categories: conducting multiple tests on one part, one part with multiple chambers, or multiple unique parts.

Parent Program Linking

The Parent Program Linking test type is designed to group test results together for a single part. In certain applications, it is desirable to conduct multiple tests on one part. These tests may either be run on the same chamber within the part or on different chambers. In either case, it is desirable to group the test results together and produce a global or "Parent" result.

This test type facilitates the linking of individual programs into a testing sequence and provides the overall control of the tooling outputs and inputs, start and stop inputs, and program result outputs for the test sequence. The following functions within each individual test program are ignored and controlled by the Parent Program.

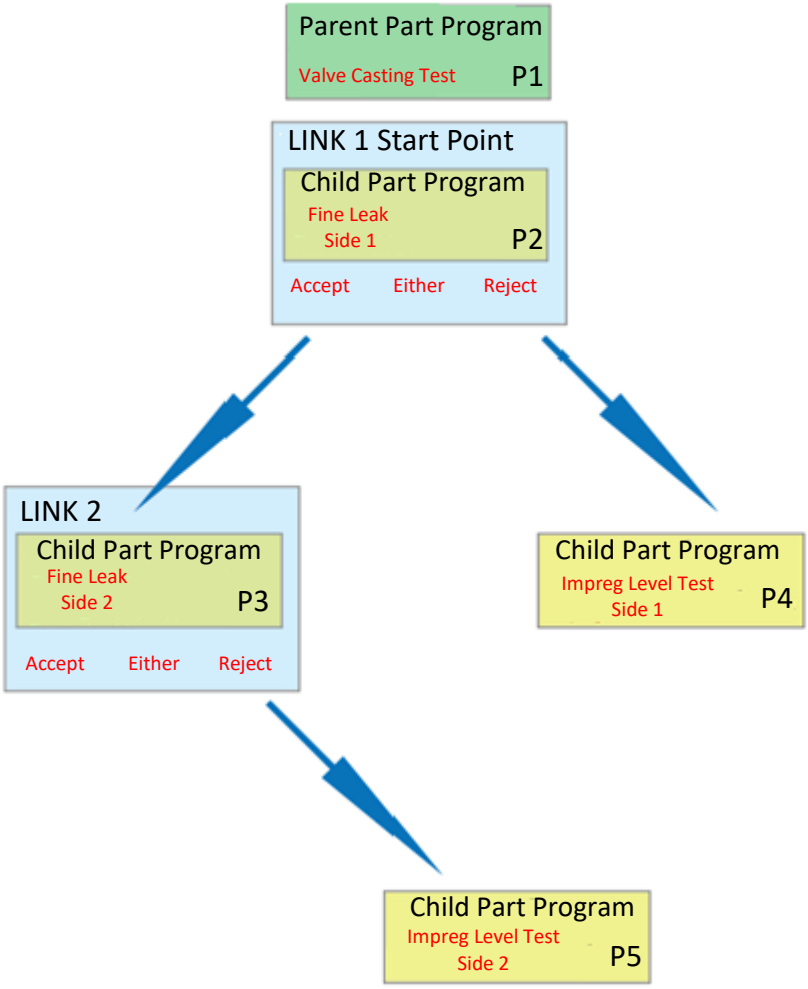
Functions Overridden and Controlled by the Parent Program Test Type
Tooling options (See **Advanced Tooling Control** in Chapter 20)
Calibration functions
Autorun Methods
Barcode storage
Relax timer.

Rules for Parent Program Linking

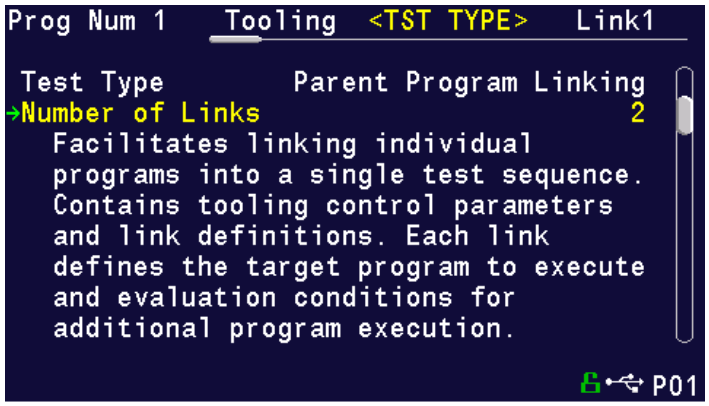
1. Child Programs may contain tooling logic, but only the tooling logic contained in the Parent Program will be executed. This is covered under **Advanced Tooling Control** in Chapter 20.
2. A 'Malfunction' at any time or place in the test logic will result in a Vent/Halt.
3. If any of the Child Programs results are Reject, the Parent program result will be Reject. (Child result evaluations will be logically AND'd.)
4. If the user starts a Parent Program, the Monitor screen will indicate that the Parent Program is running. The Stop/Reset event during any Child Programs will not navigate the system away from the Parent Program.

Example of Parent Program Linking

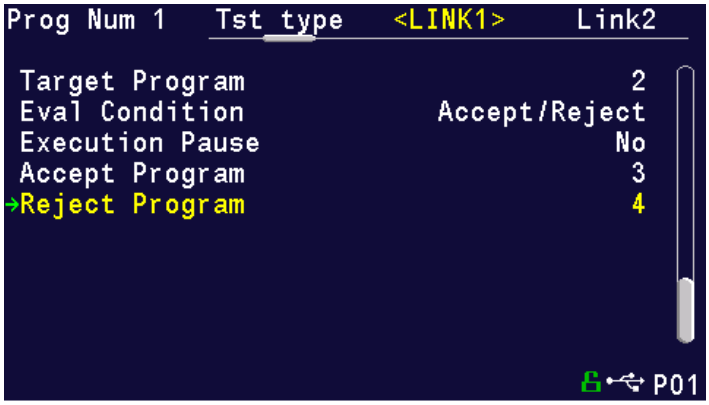
In the example sequence below the user is testing a valve. There are two sides of the valve that must pass a fine leak test. If either side fails the fine leak test, a mass flow test is run on the failed side to determine if it is possible to repair the leaking part.



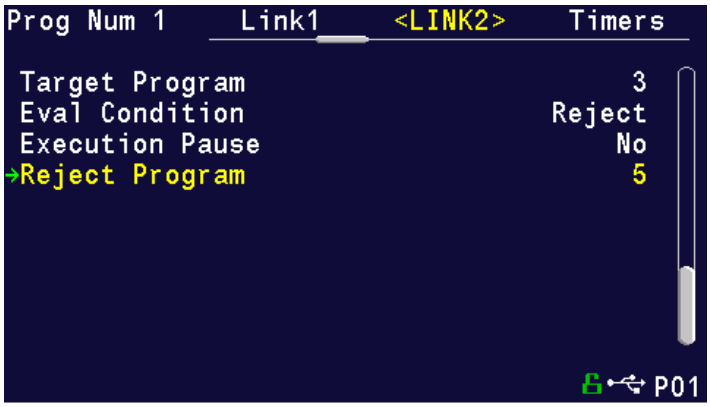
To program this test sequence, the user goes to Program Config and defines the test type for the Program 1 to be "Parent Program Linking" The test sequence example above requires two links.



The first link screen identifies the program where the testing in the Parent Program will begin and how additional tests are initiated or linked to the first program based on the first test result. The link defines the programs that will run next based on the Evaluation Condition.



The second link required by the example above targets Program 3. If Part 3 is Reject, then Program 5 will run. If Program 3 is Accepted, the test sequence stops with a Program Accept light and a Program Accept.



Evaluation Condition	Description
Accept	Directs only the accept parts for further testing using the program defined by "Accept Program". For rejects, severe leaks, and malfunctions the test sequence stops.
Reject	Directs only reject and severe leak parts for further testing using the program defined by "Reject Program". For accepts and malfunctions the test sequence stops.
Accept/Reject	Directs accept, reject and severe leak parts for further testing using the programs defined by "Accept Program" if the test passes or "Reject Program" if the test fails or a severe leak occurs. For malfunctions, the test sequence stops.
Any	Directs accept, reject and severe leak parts for further testing by one additional test program using the program defined by "Next Program" for accept, reject, or severe leak tests. For malfunctions, the test sequence stops.

Link Execution Pause

There are applications where it is desirable for the instrument to pause or delay execution between the target program and the next program when utilizing the Parent Program Linking or Sequential Linking test types. An example would be allowing the operator to manipulate a part between programs, such as opening a valve, inserting a component or any action that requires an external event to take place before testing can continue. This feature is defined within each link; thus it is possible to pause during one link and not another.

Parameter	Description	Display User Level
Execution Pause	This parameter will have three options: "No", "Continue on Start" and "Continue after Delay". The feature is disabled when set to "No". "Continue on Start" forces the instrument to pause and wait for a start indication to continue. "Continue after Delay" forces the instrument to delay until the timer expires then continue execution.	Basic Advanced, Admin
Delay	This parameter indicates the amount of time to delay after the target program, before execution can continue with the next program. The Delay timer is only visible when the Execution Pause option is set to "Continue after Delay"; otherwise the parameter has no affect.	Basic Advanced, Admin

Note: If you are using Parent Program Linking because you have part with multiple chambers and the instrument is configured with multiple test ports, remember to select the appropriate test port. This is described in the section titled Selecting the Test Port in Chapter 2 ***– Setup.***

Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five Extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five Retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Basic Advanced, Admin
Relax	Timer used during Program Cal sequence as a delay between Child Program Links to allow the part to recover to repeatable virgin state. (Too short relax times result in decreasing pressure losses or decreasing flow results in successive tests.)	Basic Advanced, Admin

Sequential Linking

The sequential linking test type is designed to run multiple unique parts conducting the tests by multiplexing (often with multiple sequential test ports). This allows the operator to load and unload the parts more efficiently. The test results are reported individually for each program. The functionality and setup of this test type is very similar to the **Parent Program Linking** test type. The only differences are that:

a) Each of the linked program results is stored individually.
b) Each result has no bearing on the accept/reject criteria of past or future linked programs unless they are conditionally linked.
c) The cycle counters increment with each linked program completed.
d) The tooling control uses the defined motions in each of the linked programs (there is no "Parental tooling control").

This is because this test type is designed to run multiple individual parts.

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Chapter 15 – Percent Volume

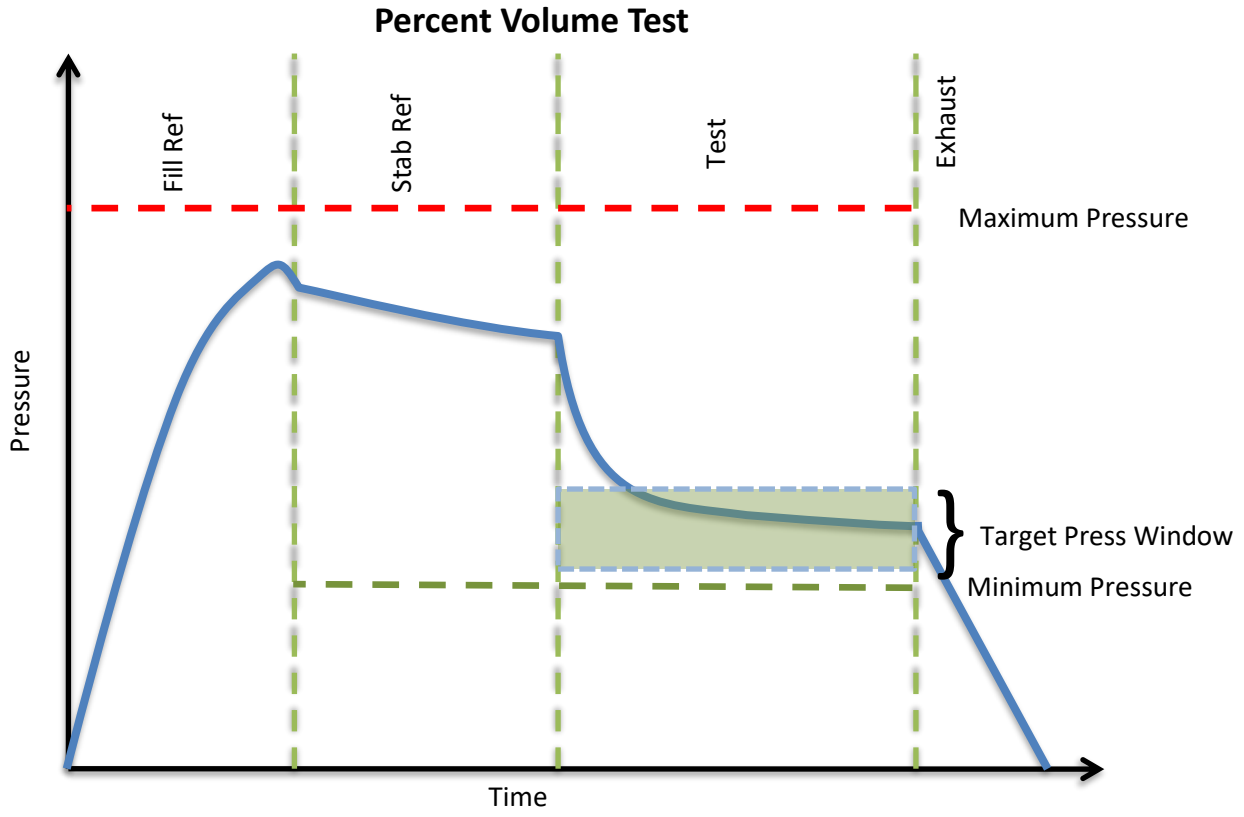
This chapter explains the theory and parameters for conducting a percent volume test for measuring the volume of a test part relative to a reference part.

The Percent Volume test type is used to test for gross leakage by measuring the escape of pressure or vacuum from a reference part filled with a metered volume of pressure or vacuum. Percent Volume test type is useful for parts with high elasticity, which readily change volume, by using a pre-defined volume to limit their maximum expansion during test. In addition, parts with internal openings connecting multiple volumes can be verified to be open or closed.

This test type is used to determine the volume of a test part compared to the volume of a reference part. The reference volume is initially filled and isolated from the supply. The test part remains isolated. The reference volume pressure is measured at this point. The reference volume is then released into the test part and allowed to stabilize. The pressure of the test part is measured at this point. The two pressure measurements are then used to calculate the ratio of the test part volume to the reference volume.

The Charts below give an overview of the parameters used to set up a Percent Volume Test. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28– *Features.*



Timer Parameters

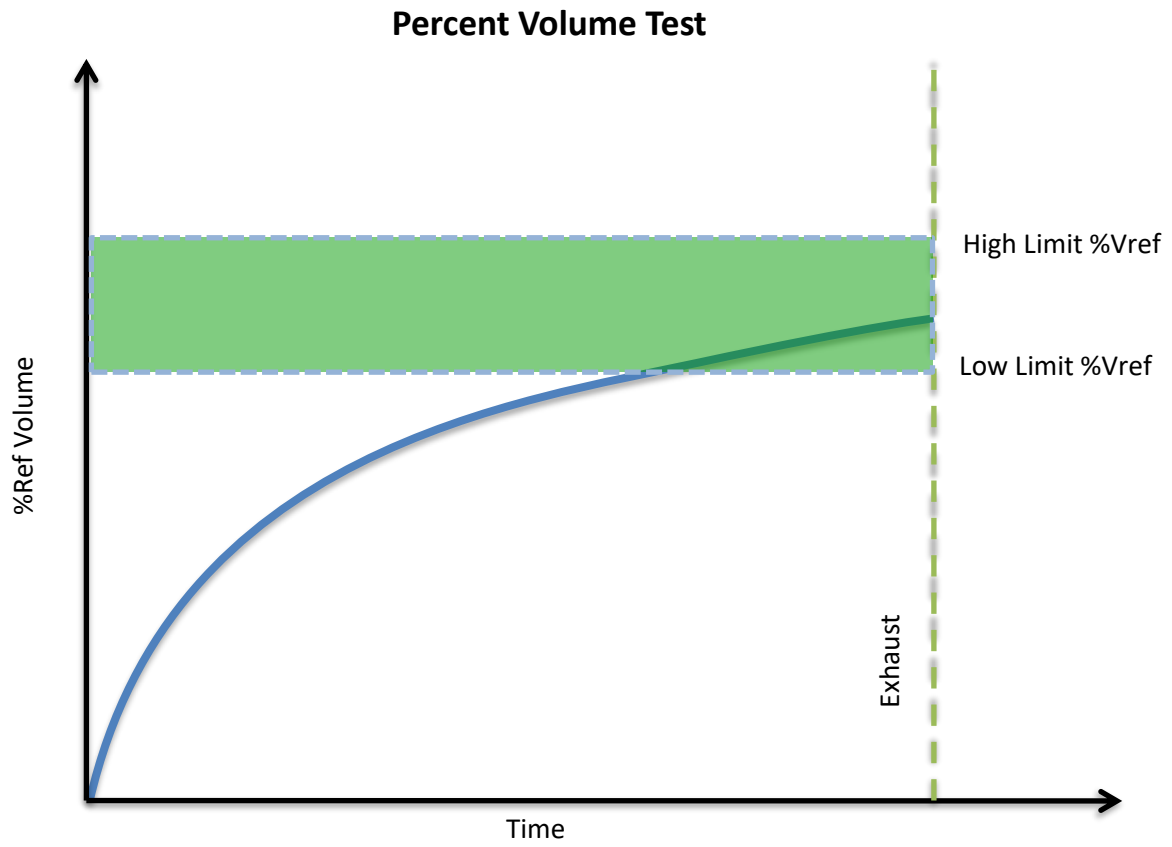
The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Fill Ref	Time to enable reference to reach the Target Pressure. It may also be used as time to stabilize reference part pressure with additional air.	Basic Advanced, Admin
Stab Ref	Time to stabilize reference pressure while isolated from the pressure regulator and test part. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test	The precise time over which to measure the relative volume difference between the reference part and the test part.	Basic Advanced, Admin
Exhaust	Time to relieve or vent test part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Minimum Pressure	The value that must be reached before the Fill Ref setpoint is reached and must be maintained through the stabilization segment or the testing cycle will end as a Severe Leak.	Basic Advanced, Admin
Target Pressure	The specified test pressure for the part. For vacuum test pressures enter a positive value if psiv was selected as the pressure unit, or enter a negative value if psig was selected as the pressure unit. ((For example, the test pressure 9.7 psia would be entered as 5 psiv or -5 psig.) Pressure loss may be corrected to the Target Pressure.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin



Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST: %VR** icon.

TST Parameter	Description	Display User Level
Low Limit %Vref	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit %Vref	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin

Chapter 16 – Percent Volume, Pressure Decay-Leak Std

This chapter explains the theory and parameters for conducting a Percent Volume, Pressure Decay Leak Test and correlating the pressure loss to a leak rate using a leak standard. This test requires a two cycle calibration routine to correlate the pressure loss to a flow rate. The result of this test is presented in units of flow.

This test type utilizes a two-point calibration sequence with a non-leaking master part to record the zero leak pressure loss value and the additional pressure loss value due to the flow rate of the leak standard on the second calibration cycle.

The Percent Volume, Pressure Decay – Leak Std test type is used to test for both severe and fine leaks by measuring the escape of pressure or vacuum from a reference part filled with a metered volume of pressure or vacuum. This test type is useful for parts with high elasticity, which readily change volume, by using a pre-defined volume to limit their maximum expansion during test. In addition, parts with internal openings connecting multiple volumes can be verified to be open or closed. The Percent Volume portion of this test type is used to find severe leaks, while the pressure decay – leak std portion is used to find fine leaks.

The basic principle of a Percent Volume, Pressure Decay Leak Test is to perform a percent volume test followed by a calibrated pressure decay leak test. Details for the basic operation of a percent volume test can be found in Chapter 15 – Percent Volume. Details for the basic operation of a pressure decay leak test, including how to perform the required calibration sequence, can be found in Chapter 5 – Pressure Decay-Leak std.

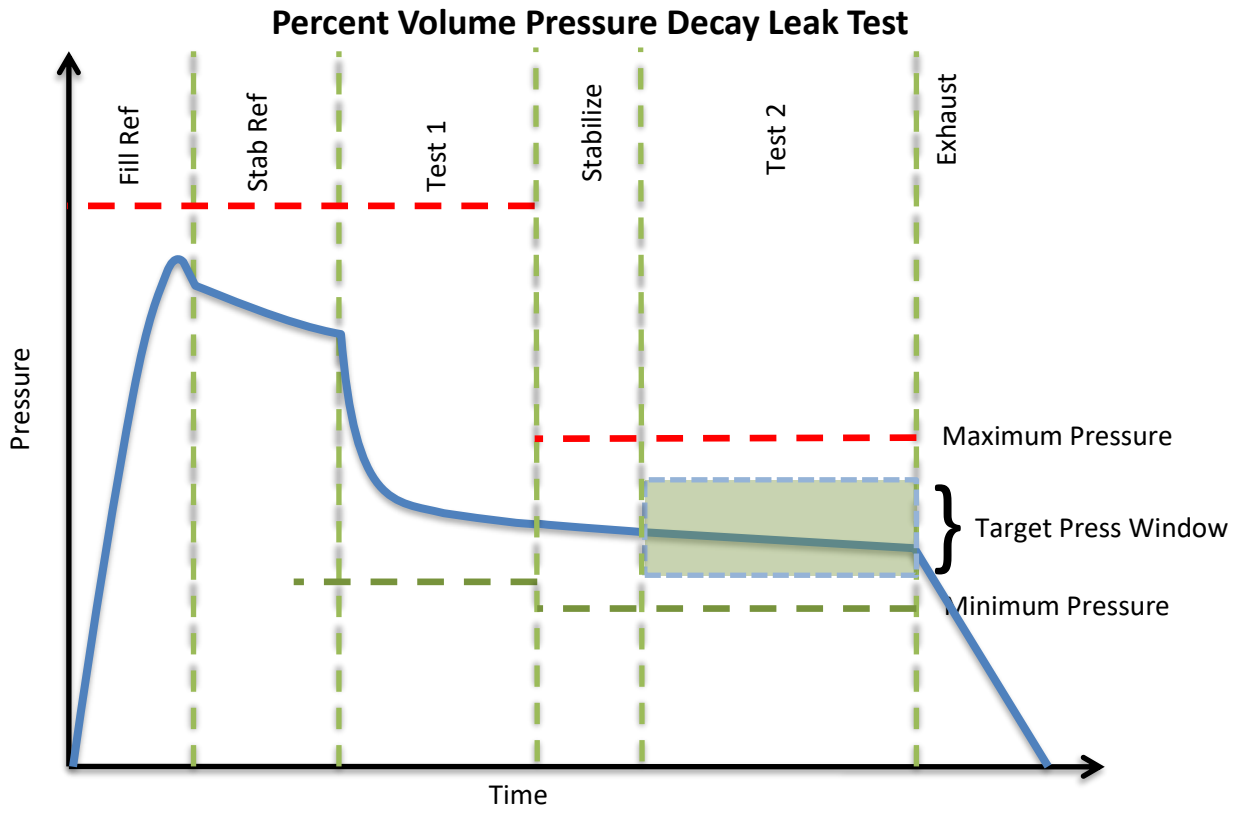
The charts in this chapter give an overview of the parameters used to set up a Percent Volume, Pressure Decay Leak Test and correlate the results of the Pressure Decay Leak Test portion to a flow rate using a leak standard. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28– Features.

Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	Display User Level
Tooling Extend	When tooling control is specified, there can be up to five extend timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Fill Ref	Time to enable reference to reach the Target Pressure. It may also be used as time to stabilize reference part pressure with additional air.	Basic Advanced, Admin
Stab Ref	Time to stabilize reference pressure while isolated from the pressure regulator and test part. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test 1	The precise time over which to measure relative volume difference between the reference part and the test part.	Basic Advanced, Admin
Stabilize	Time to stabilize test part pressure and reference part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test 2	The precise time over which to measure pressure drop or decay or the precise end time to measure pressure rise.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Basic Advanced, Admin
Relax	Timer used during Program Cal sequence as a delay between calibration cycles to allow the master part to recover to repeatable virgin state. (Too short relax times result in decreasing pressure losses/flow results in successive tests.)	Basic Advanced, Admin


Percent Volume Pressure Decay Leak Test
Fill Ref
Stab Ref
Test 1
Stabilize
Test 2
Exhaust
Pressure
Time
Maximum Pressure
Target Press Window
Minimum Pressure

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	Display User Level
Minimum Pressure 1	The value that must be reached before the Fill Ref setpoint is reached, and must be maintained through the Fill Stab segment or the testing cycle will end as a Severe Leak.	Basic Advanced, Admin
Target Pressure 1	The specified test pressure for the part during the Test 1 segment. For vacuum test pressures enter a positive value if psiv was selected as the pressure unit, or enter a negative value if psig was selected as the pressure unit. (For example, the test pressure 9.7 psia would be entered as 5 psiv or -5 psig.) Pressure loss may be corrected to the Target Pressure.	Basic Advanced, Admin
Maximum Pressure 1	The value that must not be exceeded at any time during the Fill Ref, Stab Ref or test 1 segments to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Minimum Pressure 2	The value that must maintained through Stabilize and Test 2 segments or the testing cycle will end as a Severe Leak.	Basic Advanced, Admin
Target Pressure 2	The specified test pressure for the part during the Test 2 segment. For vacuum test pressures enter a positive value if psiv was selected as the pressure unit, or enter a negative value if psig was selected as the pressure unit. ((For example, the test pressure 9.7 psia would be entered as 5 psiv or -5 psig.) Pressure loss may be corrected to the Target Pressure.	Basic Advanced, Admin
Maximum Pressure 2	The value that must not be exceeded at any time during the Stabilize or Test 2 segments to complete a successful test. If the pressure goes above the Maximum Test pressure, the testing cycle will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Target Press Window	This is a window (default +/– 50%) set around the Target Pressure that must be maintained during the Test segment of the testing cycle. It generates a Target Pressure Low or High Malfunction if the actual pressure falls outside this window during test.	Advanced, Admin

Test Parameters (Volume)

The Test parameters menu is located in the **Main Menu > Program Config > TST:%VR1** icon.

TST Parameter	Description	Display User Level
Low Limit %Vref	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit %Vref	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin

Test Parameters (Pressure Decay-Leak std)

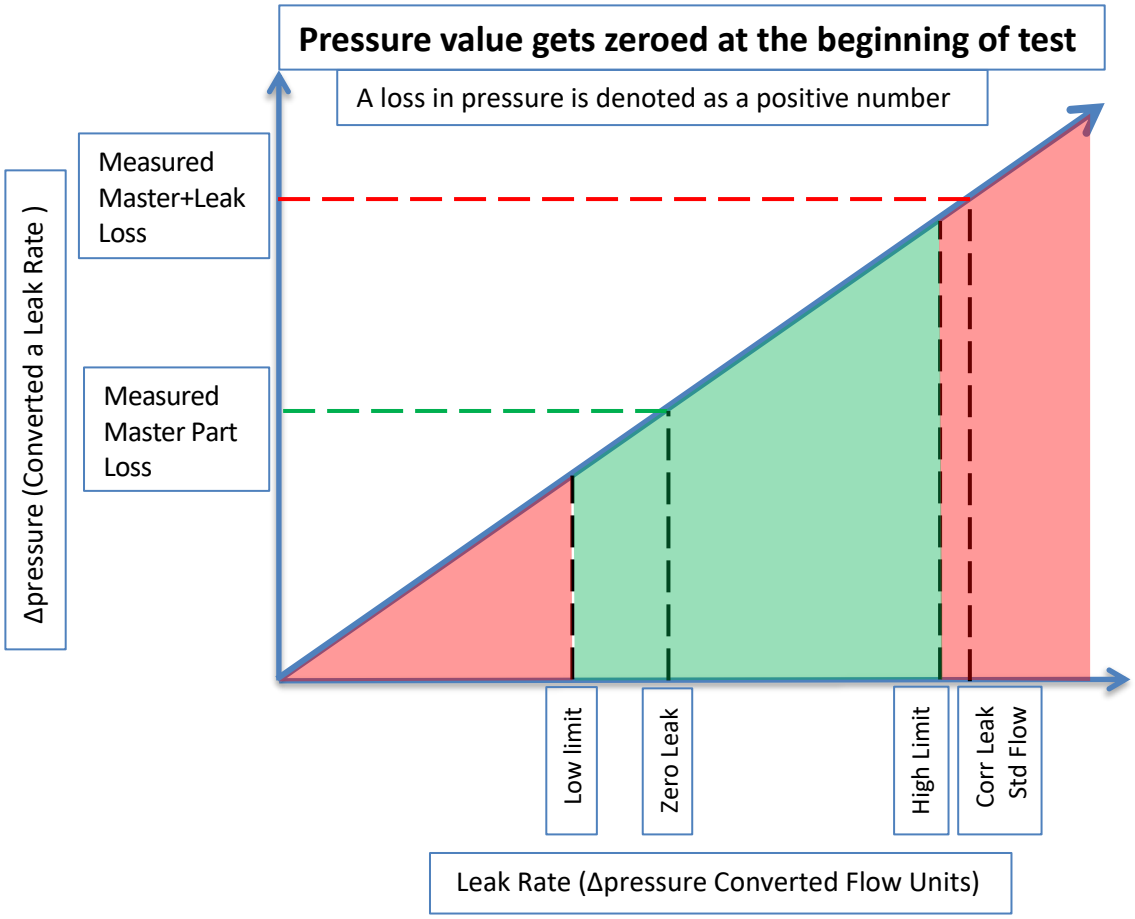
The Test parameters menu is located in the **Main Menu > Program Config > TST:PLR2** icon.

TST Parameter	Description	Display User Level
Low Limit Rate	Lower setpoint value used to evaluate test results.	Basic Advanced, Admin
High Limit Rate	Upper setpoint value used to evaluate test results.	Basic Advanced, Admin
Test Evaluation	Test results are compared to two setpoints for pass or fail status. There are three areas for evaluation of results: above high limit, between limits, and below low limit. See Table below for codes.	Advanced, Admin
Min Master Loss	Minimum pressure loss allowed during the first test in the Program Cal routine. Prevents the acceptance of a calibration of a blocked part or test line.	Basic Advanced, Admin
Max Master Loss	Maximum pressure loss allowed during the first test in the Program Cal routine. Prevents the acceptance of a calibration with a leaking part or fixture leaks.	Basic Advanced, Admin
Min Mstr+Leak Loss	Minimum pressure loss allowed during the second test in the Program Cal routine. Prevents the acceptance of a calibration with a blocked part or test line.	Basic Advanced, Admin
Max Mstr+Leak Loss	Maximum pressure loss allowed during the second test in the Program Cal routine. Prevents the acceptance of a calibration with excessive pressure loss due to part or fixture leaks. Set slightly higher than max loss during Program Cal.	Basic Advanced, Admin
Min Leak Loss	Minimum pressure loss allowed that represents the pressure loss due to the Leak Standard used to calibrate the instrument.	Basic Advanced, Admin

Max Leak Loss	Maximum pressure loss allowed that represents the pressure loss due to the Leak Standard used to calibrate the instrument.	Basic Advanced, Admin
Min Perform Factor	Minimum value for Performance Factor calculated at completion of Program Cal routine. Resultant evaluation of ratio of Master Part Loss to Master+Leak Loss, Test Pressure, and loss due to Leak Std.	Basic Advanced, Admin
Leak Std Cal Flow	Certified flow value of Leak Standard used to calibrate instrument. This parameter is only viewable in this location if the Leak Std/Cal Define parameter is set to "Program".	Basic Advanced, Admin
Leak Std Cal Press	Certified pressure at which Leak Standard Flow was calibrated. This parameter is only viewable in this location if the Leak Std/Cal Define parameter is set to "Program".	Basic Advanced, Admin
Quik Test Enable	Activates Quik Test. See Appendix B.	Advanced, Admin
Quik Test Timer	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix B.	Advanced, Admin
Quik Test LL Band	See Appendix B.	Advanced, Admin
Quik Test HL Band	See Appendix B.	Advanced, Admin
EDC Enable	Activates Environmental Drift Correction. See Appendix C.	Advanced, Admin
EDC Percentage	Options include 10%, 25%, 50%, 75%, and 90%. See Appendix C.	Advanced, Admin
EDC Quantity	See Appendix C.	Advanced, Admin

Test Evaluation Code	Description
Above Hi Limit > Between Limits > Below Lo Limit	Three zones of evaluation for Pass and Fail
P P F	Pass if above low limit
P F F	Pass if above high limit
F P F* (default)	Pass if between high and low limits
F P P	Pass if below high limit
F F P	Pass if below low limit
P F P	Pass if above the high limit or below the low limit

Note: If the instrument is configured multiple internal leak standards the user must select which leak standard is to be used in the Program. See Selecting the Proper Internal Leak Standard in Chapter 28 ***– Features.***


Pressure value gets zeroed at the beginning of test
A loss in pressure is denoted as a positive number
Measured Master+Leak Loss
Measured Master Part Loss
Δpressure (Converted a Leak Rate)
Low limit
Zero Leak
High Limit
Corr Leak Std Flow
Leak Rate (Δpressure Converted Flow Units)

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Chapter 17 – Differential Pressure (DP) Decay-ΔP

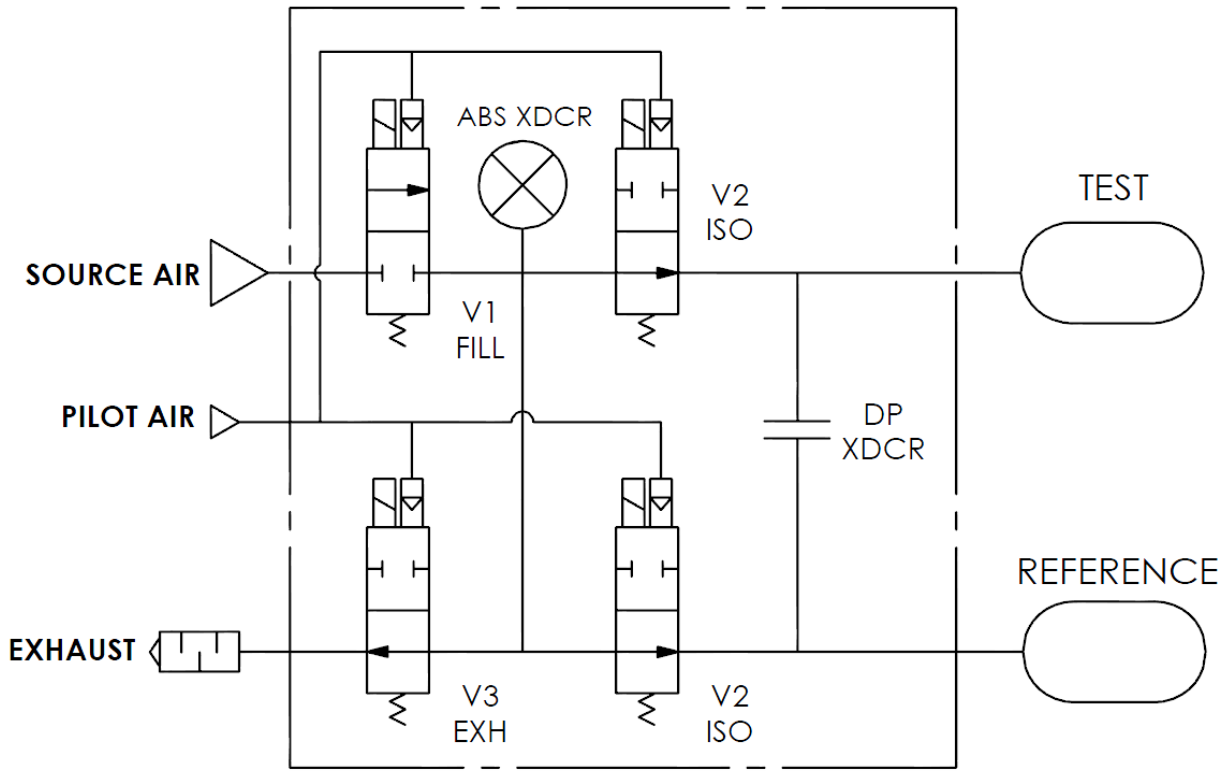
This chapter explains the theory and parameters for conducting a pressure decay test measuring a pressure loss over time utilizing a Differential Pressure (DP) transducer. The result of this test is the pressure loss (or gain for a vacuum test) measured over a fixed period of time, presented in units of pressure.

How it works

In order to detect leakage in a part, the change in pressure due to temperature and part elasticity must be allowed to settle before taking any pressure readings.

With differential pressure, a reference part volume (should be identical to the nominal test part volume) is pressurized simultaneously with the test part.

Leaks are determined by detecting the rate of pressure loss between the two parts.



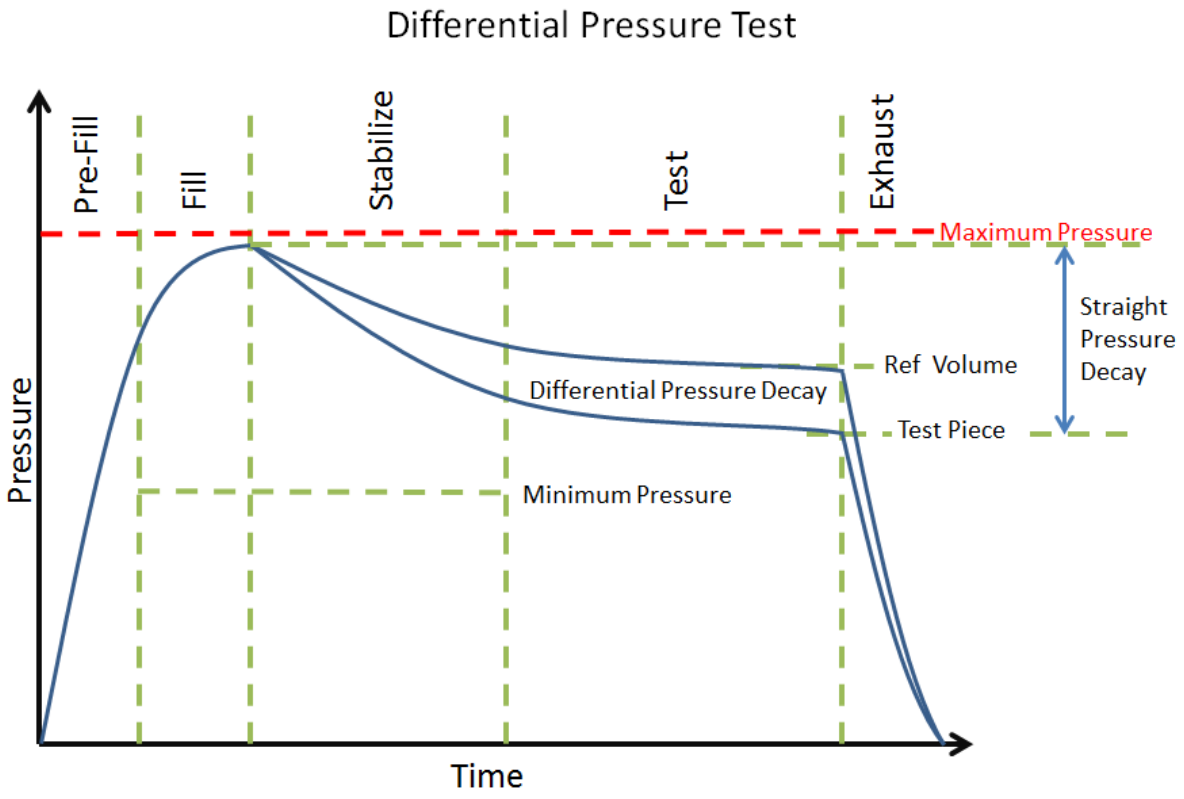
Test Setup

The test part and the reference volume are simultaneously pressurized to a preset pressure. The air in the system is then allowed to stabilize, with the supply valves all closed. After the stabilization time, the Differential Pressure Transducer is automatically zeroed.

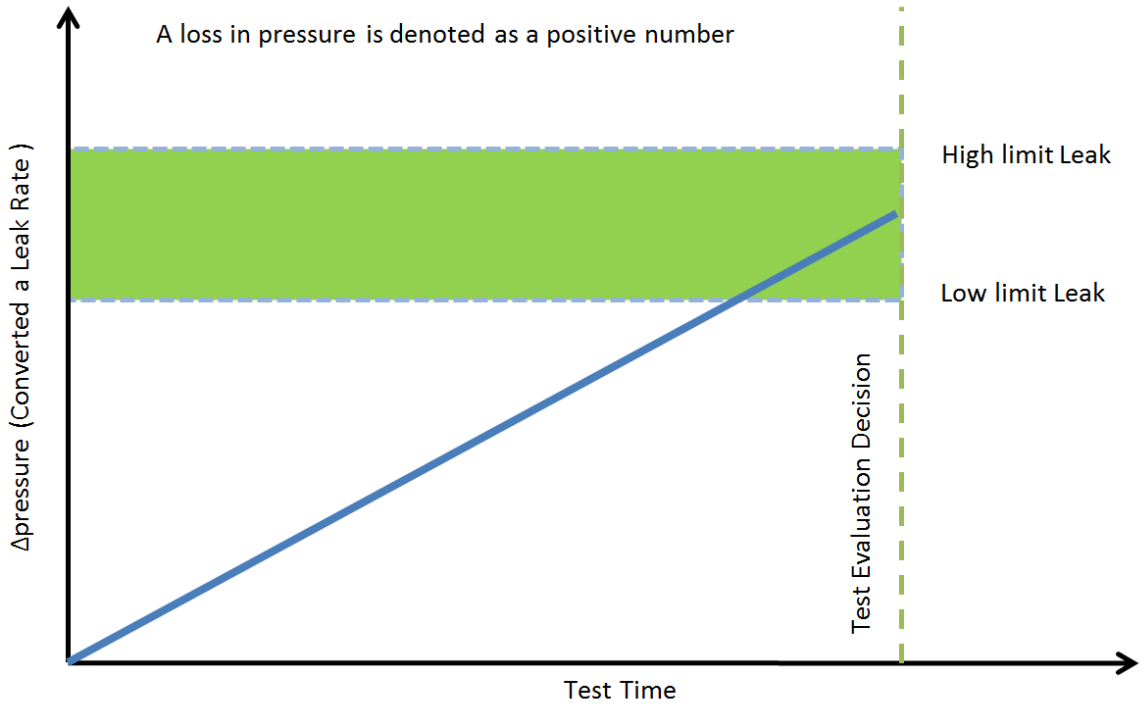
During test, the pressure change in the test piece is compared to the pressure change in the reference volume, using the Differential Pressure Transducer. If the test piece is leaking, the difference will increase and be measured; an alarm limit may be set for a pass/fail decision.

The charts in this chapter give an overview of the parameters used to set up a Pressure Differential Test and correlate the results to a flow rate using a leak standard. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 ***– Features***.



Pressure value gets zeroed at the beginning of test timer



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	User Display Mode
Tooling Extend	When tooling control is specified, there can be one extend timer for one tooling motion.	Basic Advanced, Admin
Prefill	Percentage of the fill timer where the minimum pressure limit is not monitored. This allows time within the fill stage for the instrument to achieve the minimum test pressure.	Advanced, Admin
Charge	Time to enable part to reach the Charge Target Pressure. At the end of this timer, the instrument will read the pressure on the pressure transducer. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Fill	Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air.	Basic Advanced, Admin
Isolation	Amount of stabilization time utilized to isolate the test part and reference volume prior to the test measurement.	Admin
Stabilize	Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test	At the end of this timer, the instrument will read the pressure on the differential pressure transducer. This pressure is due to the backpressure created in the pneumatic circuit and part.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract	When tooling control is specified, there can be one retract timers for one tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	User Display Mode
Minimum Pressure	Minimum test pressure that must be met within the Pre-fill timer and maintained during the Fill and Stabilization timers. This is an early indication of a major leak	Basic Advanced, Admin
Target Pressure	Target test pressure. Also used as a setpoint for the Electronic Regulator.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle (during Fill and Stabilization) will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Charge Min Press	Minimum charge pressure that must be met within the Charge timer and maintained before the Fill timer. This is an early indication of a major leak. If the pressure is measured below the Charge Min Press at end of Charge segment, the testing cycle will end as a Below Charge Malfunction. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Charge Target Press	Target Charge pressure. Also used as a setpoint for the Electronic Regulator in Charge segment. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Charge Max Press	The value that must not be exceeded at end of Charge segment. If the pressure is measured above the Charge Max Press at end of Charge segment, the testing cycle will end as an Above Charge Malfunction. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST: DPD** icon.

TST Parameter	Description	User Display Mode
Low Limit Loss	Lower set point value used to evaluate test results.	Basic Advanced, Admin
High Limit Loss	Upper set point value used to evaluate test results.	Basic Advanced, Admin
Decay Direction	Defines the method for calculating the part pressure decay during test: Loss – charged part decreasing pressure or evacuated part decreasing vacuum, Gain – part pressure increasing from external forces.	Basic Advanced, Admin
Loss Offset	Manual compensation value which is added to the measured loss when calculating the final pressure loss for the test.	Basic Advanced, Admin
EDC Enabled	When enabled, Environmental Drift Correction (EDC) monitors and continually corrects final Leak Rate calculations based on the moving average shift of test results within a band about the Master Part calibration curve.	Advanced, Admin
EDC Percentage	Percentage (Plus and Minus) band defined by a percentage of High Limit about the Master Part Curve. EDC continually accumulates and calculates an offset for the test results.	Advanced, Admin
EDC Quantity	Number of test results utilized in calculating the EDC factor.	Advanced, Admin

Chapter 18 – Diff Decay-Leak Rate

This chapter explains the theory and parameters for conducting a Diff Decay-Leak rate test measuring leak rate by utilizing a Differential Pressure (DP) transducer. The result of this test is the leak presented in units of flow.

How it works

In order to detect leakage in a part, the change in pressure due to temperature and part elasticity must be allowed to settle before taking any pressure readings.

With differential pressure, a reference part volume (should be identical to the nominal test part volume) is pressurized simultaneously with the test part.

The Leak Rate is determined from the measured differential loss between the test port and the reference volume over time, using the provided known part volume. This test will NOT require calibration, and a Leak Standard is NOT required to determine the final leak rate.

The Leak rate is calculated by the following formula,

$$Q = \left(\frac{\Delta P}{\Delta t} \times \frac{V_{inst} + V_{part}}{P_{std}} \times 60.0\right) + Offset_{EDC} + Offset_{Leak\ Rate}$$

Where:

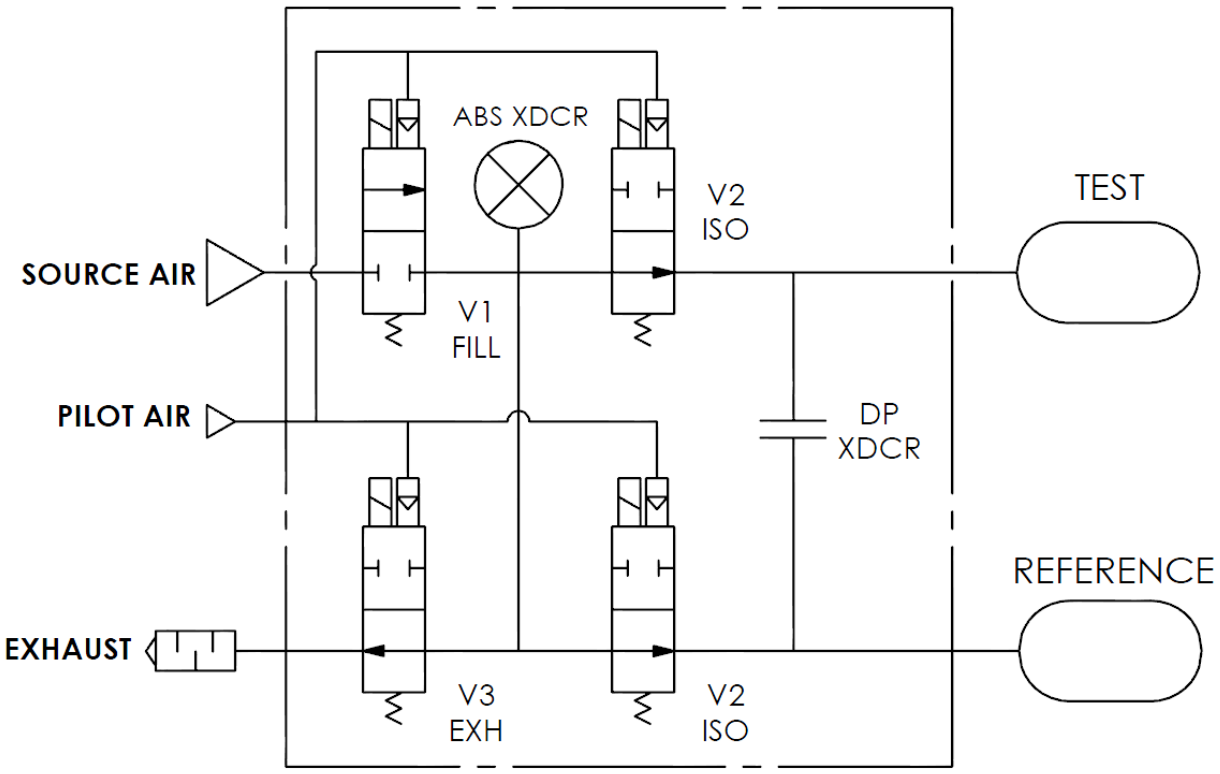
Q = Leak Rate

$\Delta P/\Delta t$ = Pressure Loss over time

P_{std} = **Standard Pressure (14.696 psig)**. This parameter is configured matching Standard Pressure definition used for instrument and leak calculation

V_{inst} = **Instrument Volume**. Volume of the instrument's isolated pneumatic circuit up to the test port. This parameter can be located at *Main Menu->Channel Config->Hardware*.

V_{part} = **Part Volume**.



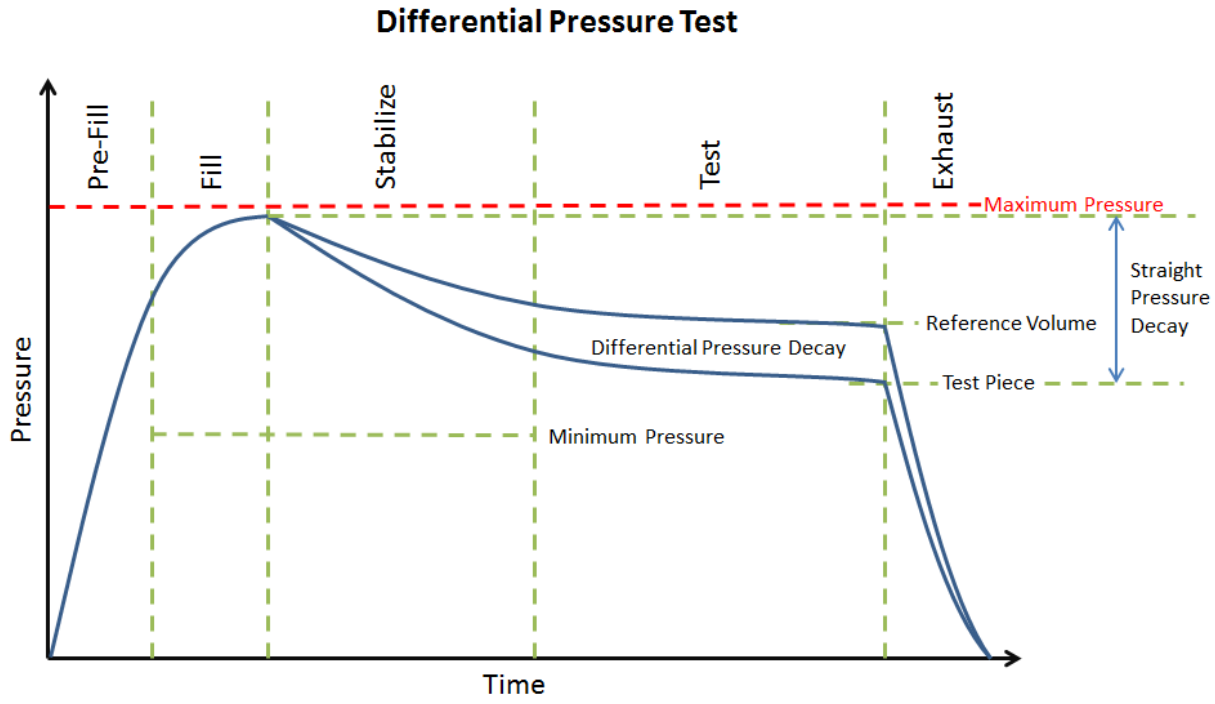
Test Setup

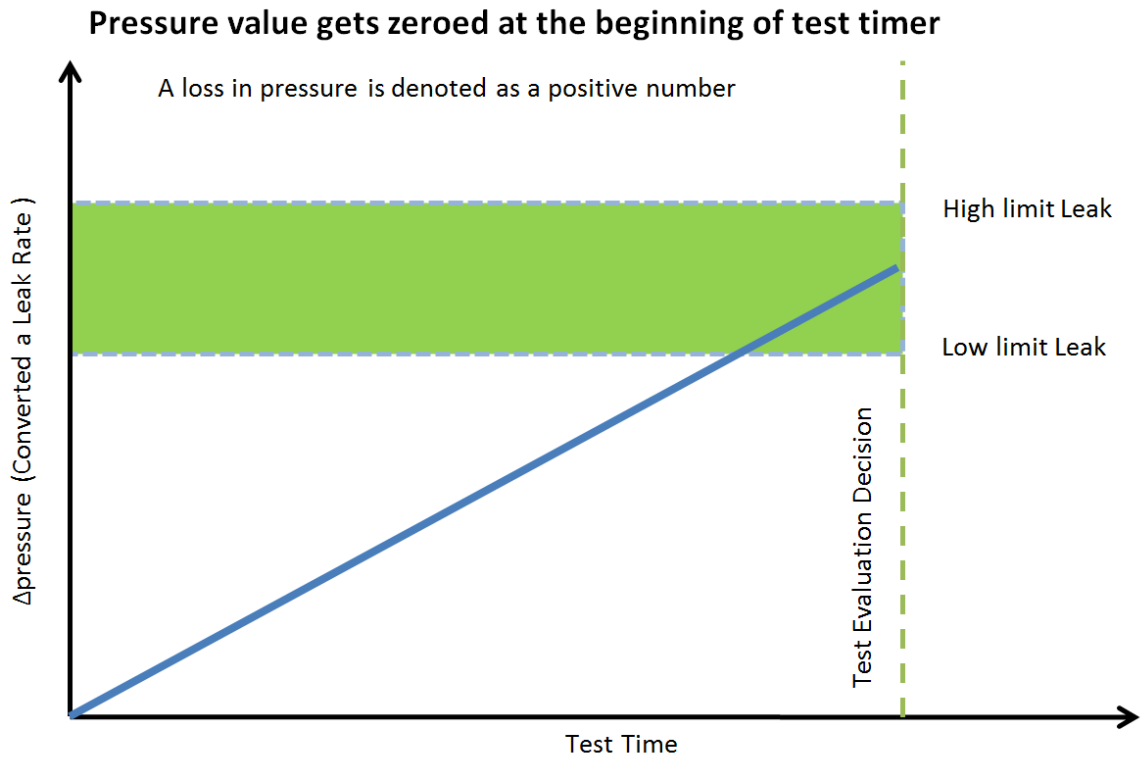
The test part and the reference volume are simultaneously pressurized to a preset pressure. The air in the system is then allowed to stabilize, with the supply valves all closed. After the stabilization time, the Differential Pressure Transducer is automatically zeroed. Before the beginning of the test measurement, the part and the reference volume are isolated from the supply valves for the time described in the Isolation parameter.

During test, the pressure change in the test piece is compared to the pressure change in the reference volume, using the Differential Pressure Transducer. If the test piece is leaking, the difference will increase and be measured; an alarm limit may be set for a pass/fail decision.

The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, Chapter 28 *– Features.*


Differential Pressure Test
Pre-Fill
Fill
Stabilize
Test
Exhaust
Maximum Pressure
Straight Pressure Decay
Reference Volume
Differential Pressure Decay
Test Piece
Minimum Pressure
Pressure
Time


Pressure value gets zeroed at the beginning of test timer
A loss in pressure is denoted as a positive number
High limit Leak
Low limit Leak
Δpressure (Converted a Leak Rate)
Test Evaluation Decision
Test Time

Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	User Display Mode
Tooling Extend 1	When tooling control is specified, there can be one extend timer for one tooling motion.	Basic Advanced, Admin
Prefill	Percentage of the fill timer where the minimum pressure limit is not monitored. This allows time within the fill stage for the instrument to achieve the minimum test pressure.	Advanced, Admin
Charge	Time to enable part to reach the Charge Target Pressure. At the end of this timer, the instrument will read the pressure on the pressure transducer. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Fill	Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air.	Basic Advanced, Admin
Stabilize	Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Isolation	Amount of stabilization time utilized to isolate the test part and reference volume prior to the test measurement.	Admin
Test	At the end of this timer, the instrument will read the pressure on the pressure transducer. This pressure is due to the backpressure created in the pneumatic circuit and part.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract 1	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Relax	Timer used during Program Cal routine as a delay between calibration cycles to allow the master part to recover to repeatable virgin state. (Too short relax times result in decreasing pressure losses/flow results in successive tests.)	Basic Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	User Display Mode
Minimum Pressure	Minimum test pressure that must be met within the Pre-fill timer and maintained during the Fill and Stabilization timers. This is an early indication of a major leak	Basic Advanced, Admin
Target Pressure	Target test pressure. Also used as a setpoint for the Electronic Regulator.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle (during Fill and Stabilization) will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Charge Min Press	Minimum charge pressure that must be met within the Charge timer and maintained before the Fill timers. This is an early indication of a major leak. If the pressure is measured below the Charge Min Press at end of Charge segment, the testing cycle will end as a Below Charge Malfunction. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Charge Target Press	Target Charge pressure. Also used as a set point for the Electronic Regulator in Charge segment. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Charge Max Press	The value that must not be exceeded at end of Charge segment. If the pressure is measured above the Charge Max Press at end of Charge segment, the testing cycle will end as an Above Charge Malfunction. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST: DDL** icon.

TST Parameter	Description	User Display Mode
Low Limit Leak	Lower set point value used to evaluate test results of parts.	Basic Advanced, Admin
High Limit Leak	Upper set point value used to evaluate test results of parts.	Basic Advanced, Admin
Decay Direction	Defines the method for calculating the part pressure decay during test: Loss – charged part decreasing pressure, Gain – part increasing pressure from external forces.	Admin
Part Volume	Volume of the part under test. This should include the volume of all pressurized cavities of the part, seals, fittings and tubing leading up to the instrument's test port connection.	Basic Advanced, Admin
Leak Rate Offset	Manual compensation value which is added to the final calculated leak rate for the test.	Admin
EDC Enabled	When enabled, Environmental Drift Correction (EDC) monitors and continually corrects final Leak Rate calculations based on the moving average shift of test results within a band about the Master Part calibration curve.	Advanced, Admin
EDC Percentage	Percentage (Plus and Minus) band defined by a percentage of High Limit about the Master Part Curve. EDC continually accumulates and calculates an offset for the test results.	Advanced, Admin
EDC Quantity	Number of test results utilized in calculating the EDC factor.	Advanced, Admin

Chapter 19 – Differential Pressure (DP) Decay-Leak Std

This chapter explains the theory and parameters for conducting a Differential Pressure (DP) Decay Test with Leak Standard. Pressure loss is measured utilizing a Differential Pressure (DP) transducer. The pressure loss is correlated to a leak rate using a leak standard. This test requires a two cycle calibration routine to correlate the pressure loss to a flow rate. The result of this test is presented in units of flow.

This test type utilizes a two-point calibration sequence with a non-leaking master part to record the zero leak pressure loss value and the additional pressure loss value due to the flow rate of the leak standard on the second calibration cycle.

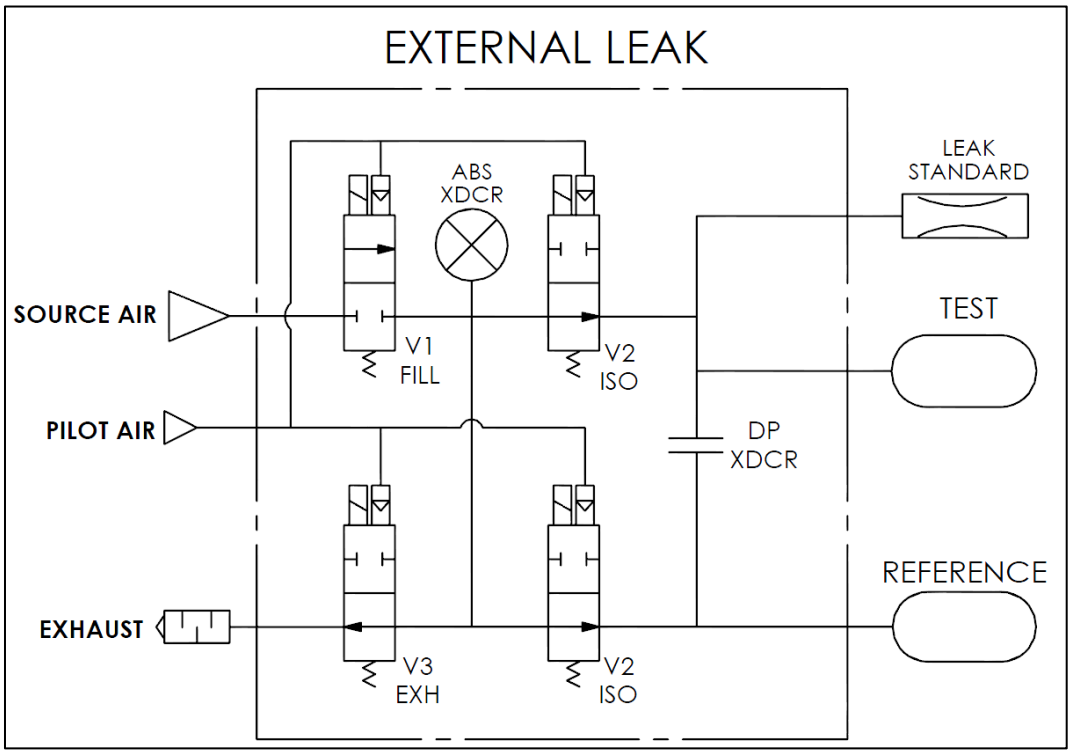
How it works

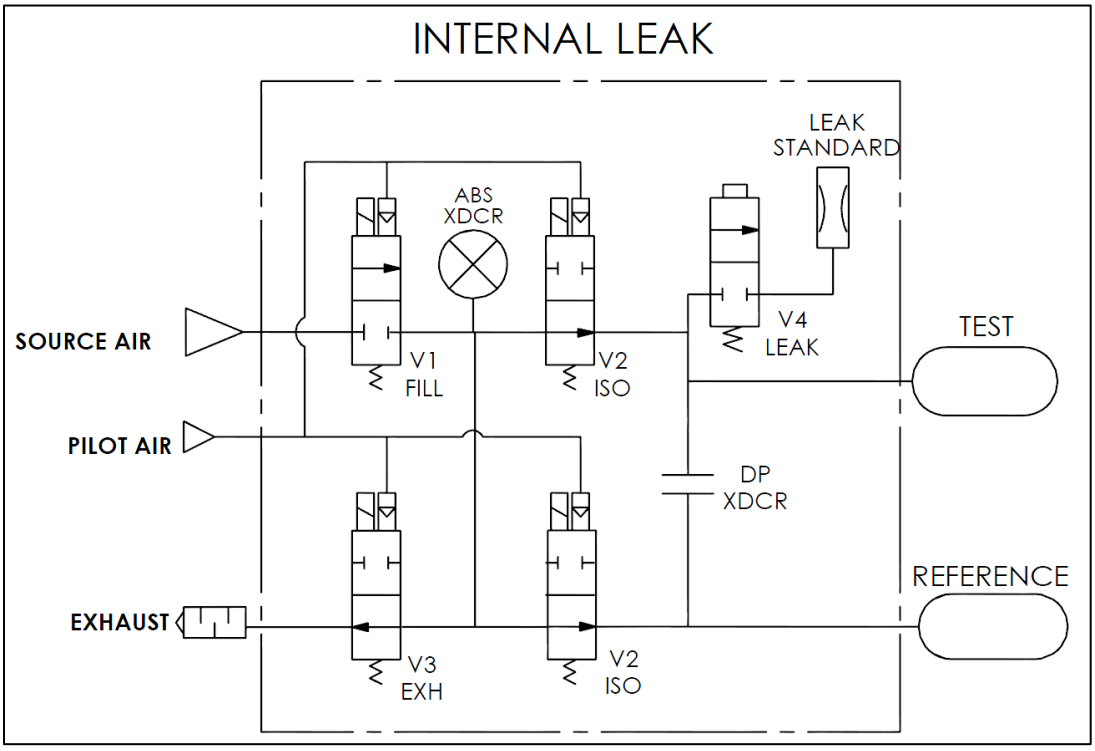
In order to detect leakage in a part, the change in pressure due to temperature and part elasticity must be allowed to settle before taking any pressure readings.

With differential pressure, a reference part volume (should be identical to the nominal test part volume) is pressurized simultaneously with the test part.

Leaks are determined by detecting the rate of pressure loss between the two parts. The instrument can be configured optionally with internal or external leak standards. External leak standards can be driven manually. Internal leak standards are driven by valves (V4) and may be manually forced open during a test to simulate a leak in the test circuit. Open Leak Std is located in **Main Menu > Channel Config > Leak/Cal** icon.

Leak Standard Pneumatic Diagrams





Test Setup

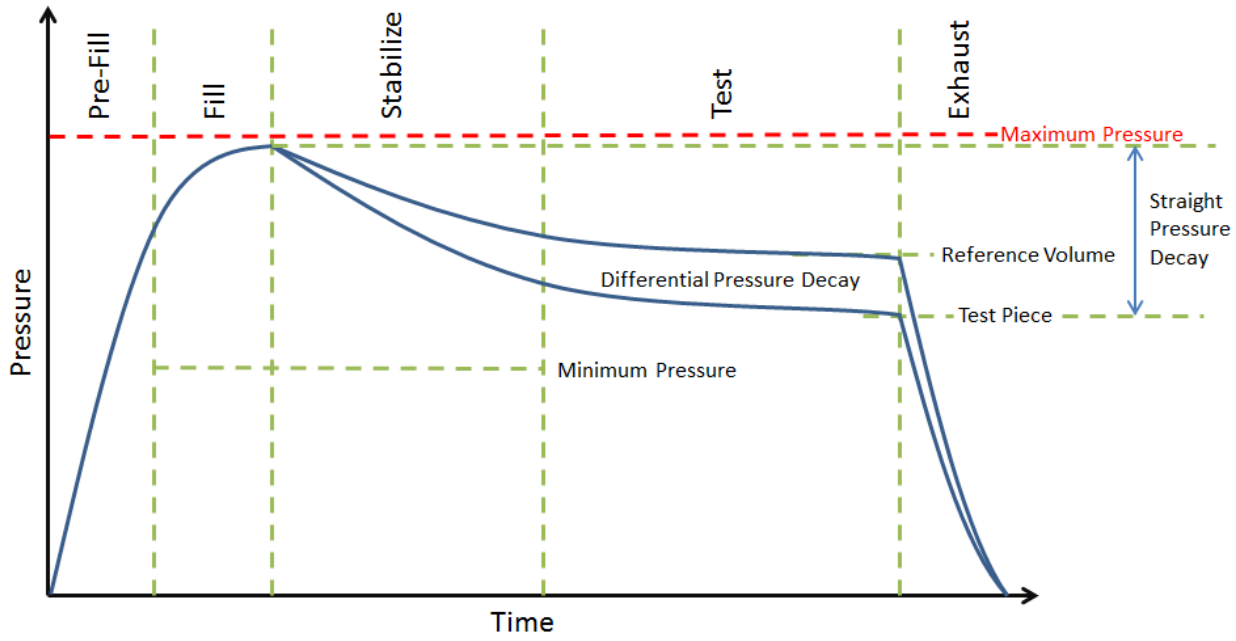
The test part and the reference volume are simultaneously pressurized to a preset pressure. The air in the system is then allowed to stabilize, with the supply valves all closed. After the stabilization time, the Differential Pressure Transducer is automatically zeroed.

During test, the pressure change in the test piece is compared to the pressure change in the reference volume, using the Differential Pressure Transducer. If the test piece is leaking, the difference will increase and be measured; an alarm limit may be set for a pass/fail decision

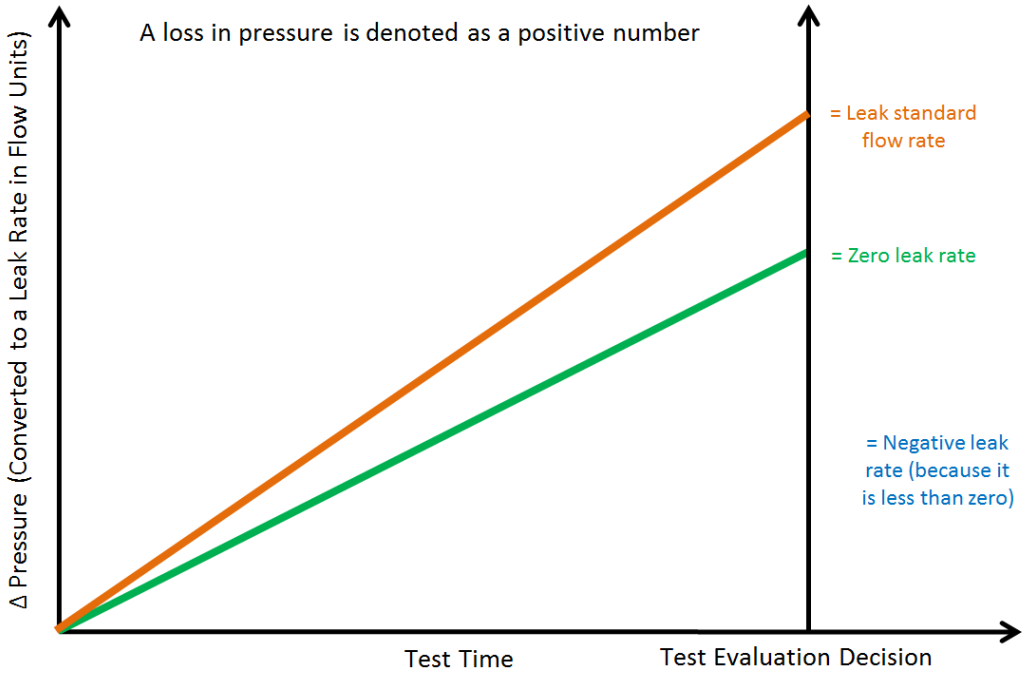
The charts in this chapter give an overview of the parameters used to set up a Pressure Differential Test and correlate the results to a flow rate using a leak standard. The Tables that follow give detailed descriptions of each parameter and also document the Display User Level associated with each parameter.

Note: To change the Display User Level, see Chapter 28 ***– Features***.

Differential Pressure Test



Pressure value gets zeroed at the beginning of test timer



Timer Parameters

The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

Timer	Description	User Display Mode
Tooling Extend 1	When tooling control is specified, there can be one extend timer for one tooling motion.	Basic Advanced, Admin
Prefill	Percentage of the fill timer where the minimum pressure limit is not monitored. This allows time within the fill stage for the instrument to achieve the minimum test pressure.	Advanced, Admin
Charge	Time to enable part to reach the Charge Target Pressure. At the end of this timer, the instrument will read the pressure on the pressure transducer. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Fill	Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air.	Basic Advanced, Admin
Isolation	Amount of stabilization time utilized to isolate the test part and reference volume prior to the test measurement.	Admin
Stabilize	Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test.	Basic Advanced, Admin
Test	At the end of this timer, the instrument will read the pressure on the pressure transducer. This pressure is due to the backpressure created in the pneumatic circuit and part.	Basic Advanced, Admin
Exhaust	Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals.	Basic Advanced, Admin
Tooling Retract 1	When tooling control is specified, there can be up to five retract timers for up to five tooling motions. This is a not to exceed timer when feedback is being utilized.	Advanced, Admin
Relax	Timer used during Program Cal routine as a delay between calibration cycles to allow the master part to recover to repeatable virgin state. (Too short relax times result in decreasing pressure losses/flow results in successive tests.)	Basic Advanced, Admin

Pressure Parameters

The Pressure menu is located in the **Main Menu > Program Config > Pressure** icon.

Pressure	Description	User Display Mode
Minimum Pressure	Minimum test pressure that must be met within the Pre-fill timer and maintained during the Fill and Stabilization timers. This is an early indication of a major leak	Basic Advanced, Admin
Target Pressure	Target test pressure. Also used as a setpoint for the Electronic Regulator.	Basic Advanced, Admin
Maximum Pressure	The value that must not be exceeded at any time to complete a successful test. If the pressure goes above the Maximum Test Pressure, the testing cycle (during Fill and Stabilization) will end as an Over Pressure Malfunction.	Basic Advanced, Admin
Charge Min Press	Minimum charge pressure that must be met within the Charge timer and maintained before the Fill timers. This is an early indication of a major leak. If the pressure is measured below the Charge Min Press at end of Charge segment, the testing cycle will end as a Below Charge Malfunction. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Charge Target Press	Target Charge pressure. Also used as a setpoint for the Electronic Regulator in Charge segment. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin
Charge Max Press	The value that must not be exceeded at end of Charge segment. If the pressure is measured above the Charge Max Press at end of Charge segment, the testing cycle will end as an Above Charge Malfunction. *This parameter is only available if the Prefill Method selected is "Fixed Charge"*	Basic Advanced, Admin

Test Parameters

The Test parameters menu is located in the **Main Menu > Program Config > TST: DPL** icon.

TST Parameter	Description	User Display Mode
Low Limit Leak	Lower set point value used to evaluate test results of parts.	Basic Advanced, Admin
High Limit Leak	Upper set point value used to evaluate test results of parts.	Basic Advanced, Admin
Decay Direction	Defines the method for calculating the part pressure decay during test: Loss – charged part decreasing pressure, Gain – part increasing pressure from external forces.	Basic Advanced, Admin
Min Mstr+Leak Loss	Minimum pressure loss allowable for the master part with Leak Standard during the calibration cycle. Use to prevent calibration to leaking master parts or fixtures.	Basic Advanced, Admin
Max Mstr+Leak Loss	Maximum pressure loss allowable for the master part with Leak Standard during the calibration cycle. Use to prevent calibration to leaking master parts or fixtures.	Basic Advanced, Admin
Min Leak Loss	Minimum pressure loss allowed that represents the pressure loss due to the Leak Standard used to calibrate the instrument.	Basic Advanced, Admin
Max Leak Loss	Maximum pressure loss allowed that represents the pressure loss due to the Leak Standard used to calibrate the instrument.	Basic Advanced, Admin
Min Master Loss	Minimum pressure loss allowable for the Master Part during the calibration cycle. Use to prevent calibration to the Self-Test cap.	Basic Advanced, Admin
Max Master Loss	Maximum pressure loss allowable for the Master Part during the calibration cycle. Use to prevent calibration to the Self-Test cap.	Basic Advanced, Admin
Min Perform Factor	Minimum acceptable value for the Performance Factor compared after the calibration cycle to prevent improper calibration.	Basic Advanced, Admin
EDC Enabled	When enabled, Environmental Drift Correction (EDC) monitors and continually corrects final Leak Rate calculations based on the moving average shift of test results within a band about the Master Part calibration curve.	Advanced, Admin
EDC Percentage	Percentage (Plus and Minus) band defined by a percentage of High Limit about the Master Part Curve. EDC continually accumulates and calculates an offset for the test results.	Advanced, Admin
EDC Quantity	Number of test results utilized in calculating the EDC factor.	Advanced, Admin

Program Calibration

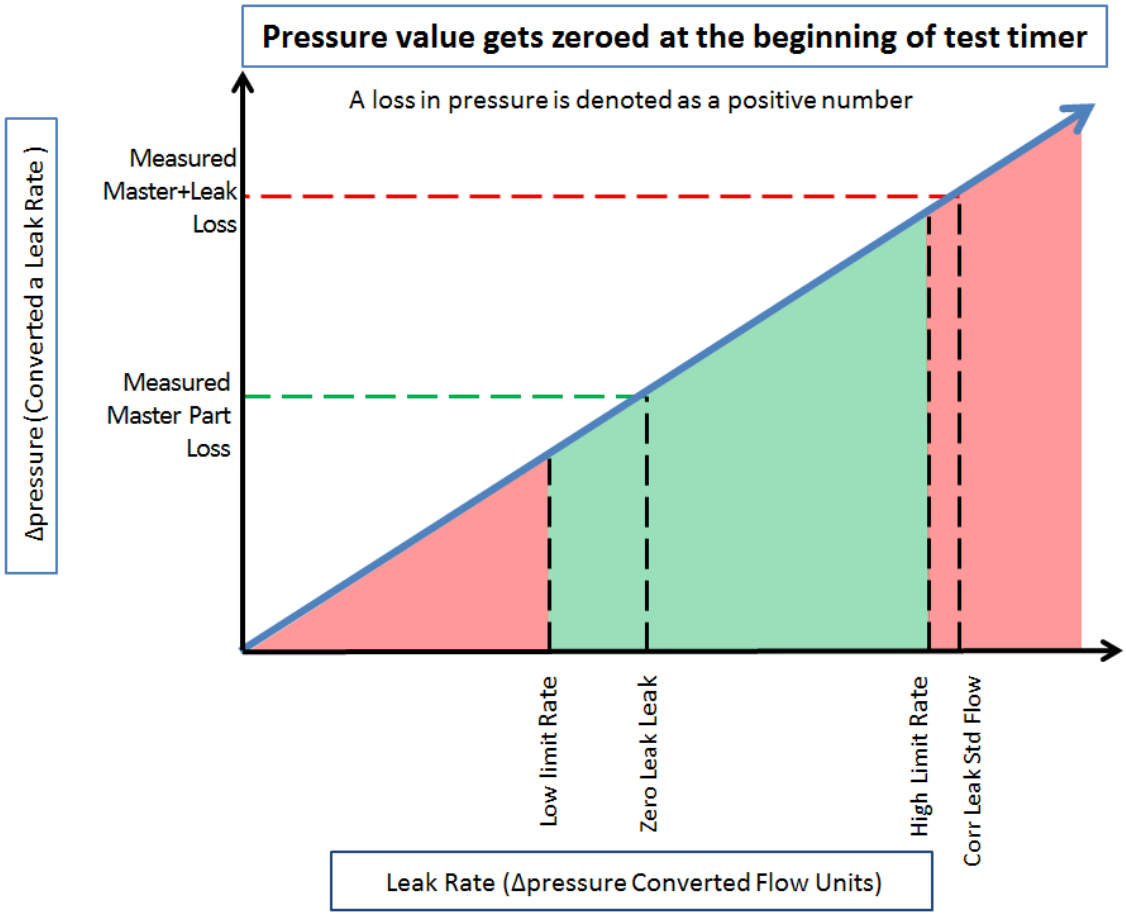
In order to convert the pressure loss measured by the instrument to a leak (flow) rate, the instrument uses a leak standard and needs to run the "Program Cal" routine. This procedure requires at least one known non-leaking part referred to as a "master part". This procedure tests a non-leaking master part connected to the instrument using the timers and pressures established for the program. The procedure automatically tests the non-leaking master part twice with the Relax timer delay between tests. Within each program that uses a leak standard, Program Cal can be configured to use one of four methods. See Setting the Cal Method and Leak Standard Location in Chapter 28 – Features.

Remember: The Leak/Cal menu has a parameter called Leak Std/Cal Define that determines the location for the leak standard settings.

When set to "Channel", leak standard settings are located in the Channel Config menu.

When set to "Program", leak standard settings are located in the Program menu.

Determine how you plan to use your leak test instrument. Review Setting the Leak Standard Values section on page 14. It is critical to make sure the leak standard values are set correctly for proper use. To view the Cal Method parameter, you must be in the Advanced or Admin Display User Level. To change the Display User Level, see Chapter 28 – Features.



Initiating the Program Cal Sequence

To initiate a Program Cal routine, go to **Main Menu > Program Cal** icon, select **OK** and press **Enter**. The Program Cal wizard will tell you to connect a non-leaking master part. Connect the non-leaking master part to the instrument. Push the Start button to initiate the Program Cal routine. The system will conduct an initial test of the non-leaking master part to measure the pressure loss associated with a non-leaking part. This represents the typical offset associated with testing parts within the environment of the test system. The pressure loss value is saved as the Master Part Loss. The system will conduct a second test on a non-leaking master part with a known calibrated leak standard included in the test. The pressure loss value result for this test is saved as the Master+Leak Loss.

Performance Factor

Upon the successful completion of the Program Cal routine, the display will show the calculated Performance Factor for the calibration. The Performance Factor is an estimate of the quality of the calibration. It combines the ratio of the Hi Limit Leak result to the non-leaking master part result, the test pressure, and difference between the Hi Lim result and the non-leaking master part result to scale its anticipated performance. This value ranges from 0 to 100. It is generally desirable to have a Performance Factor of 35 to 100. The actual acceptable Performance Factor can vary depending on the desired Gage R&R performance of the test. Here is the Performance Factor equation:

Performance Factor = **Cal Ratio** x **Pressure Loss Penalty** x **Time Penalty** x **100**

The pressure loss penalty is greater for smaller pressure loss values. The time penalty is greater for shorter Test cycle timer values. Generally, longer stabilize and test cycle timer settings will produce higher Performance Factors and improved Gage R&R performance.

> ***Note: The instrument will require a Program Cal routine if any parameters that affect the calibration are modified.***

Conditions for a Successful Calibration

Several conditions must be met during the Program Calibration routine for the instrument to accept and store the calibration results.
The conditions are based on the following measurements or calculations:

1. DP Master Part Loss
    a. Must be greater than the Min Master Loss limit
    b. Must be less than the Max Master Loss limit
    c. Must be less than the Master+Leak Loss measurement
2. DP Master+Leak Loss
    a. Must be greater than the Min Mstr+Leak Loss limit
    b. Must be less than the Max Mstr+Leak Loss limit
    c. Must be greater than the Master Loss measurement
3. DP Leak Loss
    a. Must be greater than the Min Leak Loss limit
    b. Must be less than the Max Leak Loss limit
4. Performance Factor
    a. Must be greater than the Min Perform Factor limit

If the Program Cal routine is successfully completed, "PROGRAM CALIBRATION PASSED" will be displayed. If there are any problems during the Program Cal sequence an error will be displayed. If there is an error, see Appendix A - Message and Error Codes.

Calibration Parameters

The Calibration parameters menu is located in the **Main Menu > Program Config > CAL: DPL** icon. These calibration parameters are values that are measured or calculated as a result of the Program Cal routine for a Differential Pressure Decay-Leak Std test.

CAL Parameter	Description	User Display Mode
Performance Factor	This is a Performance value generated by the actual calibration cycle to be compared to the Min Perform Factor input as a Test Parameter.	Basic Advanced, Admin
Master Part Press	Actual pressure data generated for the master part during the calibration cycle.	Advanced, Admin
Master+Leak Press	Actual pressure data generated for the master part with Leak Standard during the calibration cycle.	Basic Advanced, Admin
DP Master Part Loss	Differential pressure loss during the calibration cycle of the Master Part and stored to represent normal differential loss at the specified Target Pressure.	* Viewable in Basic & Advanced **Editable in Admin**
DP Master+Leak Loss	Differential pressure loss during the calibration cycle of the Master Part with Leak Standard and stored to represent normal loss + leak standard differential loss at the specified Target Pressure.	* Viewable in Basic & Advanced **Editable in Admin**
DP Leak Loss	Calculated differential pressure loss, based upon measured differential pressure losses during the Program Cal routine. Corresponds to the actual differential pressure loss related to the leak standard.	*Viewable in Basic & Advanced **Editable in Admin**
Master Part Loss	Pressure loss during the calibration cycle of the Master Part and stored to represent normal loss at the specified Target Pressure.	* Viewable in Basic & Advanced **Editable in Admin**
Master+Leak Loss	Pressure loss during the calibration cycle of the Master Part with Leak Standard and stored to represent normal loss + leak standard loss at the specified Target Pressure.	* Viewable in Basic & Advanced **Editable in Admin**
Leak Loss	Calculated pressure loss, based upon measured pressure losses during the Program Cal routine. Corresponds to the actual pressure loss related to the leak standard.	*Viewable in Basic & Advanced **Editable in Admin**
Corr. Leak Std Flow	The calculated leak standard flow rate based on the Program Target Pressure, the leak standard calibrated pressure, and the leak standard calibrated flow rate.	Advanced, Admin

Note: * = These CAL parameters are for those customers who want to do CALS on a series of parts so they can manually input the ideal settings for these parameters to compare again

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Chapter 20 – Tooling Control

This chapter explains the tooling control capability of the instrument. Tooling control is a powerful feature that gives the instrument the ability to control cylinders and seal actuations.

> ***Note: The instrument must be in Advanced or Admin Display User Level to view and modify the tooling functionality. To change the Display User Level, see*** Chapter 28 – *Features.*

The instrument includes user selectable digital inputs and outputs to increase the functionality and simplify the application to various test requirements. The tooling functions are defined within each program. This allows the flexibility to use different tooling functions; permitting the ability to seal unique ports for each program. The tooling functions are located in **Main Menu > Program Config > Tooling** icon.

It is important that all precautions be taken when using the tooling control functions of the instrument. If motions are being controlled, it is important to follow best engineering practices while designing the circuitry. This may include using safety modules in the circuit.

In order to implement the tooling functions, they must be interfaced with the inputs and outputs. See Chapter 21 – Inputs and Outputs.

Menus

Parameter	Description	Display User Level
Tooling Option	The options for this parameter are On, Off, and Disabled. On causes the tooling motion timers to appear on the Timers menu. When On, the instrument will perform these timers in the order they are listed. It will also allow the associated tooling outputs to appear in the selectable list in the Outputs menu. When Disabled, the tooling motion timers still appear but are ignored. It will also allow the associated tooling outputs to appear in the selectable list; however, the outputs are not active in this mode. When Off, the timers will not appear or be active.	Advanced, Admin
Number of Motions	This parameter defines the number of motions intended to be used. You can have up to 5 motions.	Advanced, Admin
Two Inputs to Start	For safety purposes, it may be desired to have 2 independent inputs to activate a test cycle. The 2 inputs are start and cycle.	Advanced, Admin

Parameter	Description	Display User Level
Anti-Tie-Down	For safety purposes, it may be desired to use anti-tie-down inputs to activate a test cycle. The anti-tie-down inputs (Start & Common) require that the inputs go high within 50 to 500 msec. of each other.	Advanced, Admin
Part Present Check	This parameter is not editable. It determines that the part present input is checked when the start input is received. This parameter is active only when one of the Inputs is set to "Part Present".	Advanced, Admin
Retract on Reject	This parameter determines whether or not the tooling will retract automatically after a reject. If it is set to "No", the instrument will wait until a Stop/Reset input is received or the Stop button is pressed before conducting any tooling retract timers or outputs.	Advanced, Admin
Part Mark	The options for this parameter are None, Both, Reject, and Accept. Upon completion of a test an output is available to mark Accept, Reject, or Both for all programs.	Advanced, Admin
Tooling Feedback 1 – 5	Sometimes it is desirable to use proximity sensors or pressure switches on cylinders or seals to determine if and when they reach their intended location. The instrument has the ability to monitor these actions using this parameter. This parameter may be set to "Extend", "Retract", or "Both" to determine which locations are to be monitored.	Advanced, Admin
Part Mark Feedback	The options for this parameter are Yes and No. This is if you want confirmation that a program marking device has completed its response then the test sequence continues on.	Advanced, Admin

Advanced Tooling Control

Advanced Tooling Control is used to control motions or sealing between linked programs; therefore, it is only applicable if Parent Program Linking is being used.

There are applications where it may be required that one or more ports on the test part are blocked or opened between tests to appropriately evaluate multiple chambers of the part. To accomplish this additional part manipulation, tooling motions are required between program executions. Thus far we have covered tooling motions pre-test (Tooling Extend) and post-test (Tooling Retract), this feature adds a method for the instrument to preempt the pre/post-test tooling motions. Again, this feature is only for the Parent Program Linking test type.

On the Program Config menu select the Link icon. The Link Motion parameter defines the Tooling Motion to execute between the Target Program and the next appropriate program number. The options available for this parameter are based on the tooling Number of Motions parameter defined on the Tooling menu under the Part Config menu.

The instrument will automatically manage the pre-test and post-test tooling extend and tooling retract motions. The user only needs to determine:

a) The total number of motions needed (with the Number of Motions parameter on the Tooling menu within the Part Config menu).
b) How many motions may change between each linked Child program (with the Link Motion Preempt parameter on the same Tooling menu).
c) Which motions are to occur between linked Child programs (with the numbered Link Motion parameters on the Link menu under the Program Config menu).

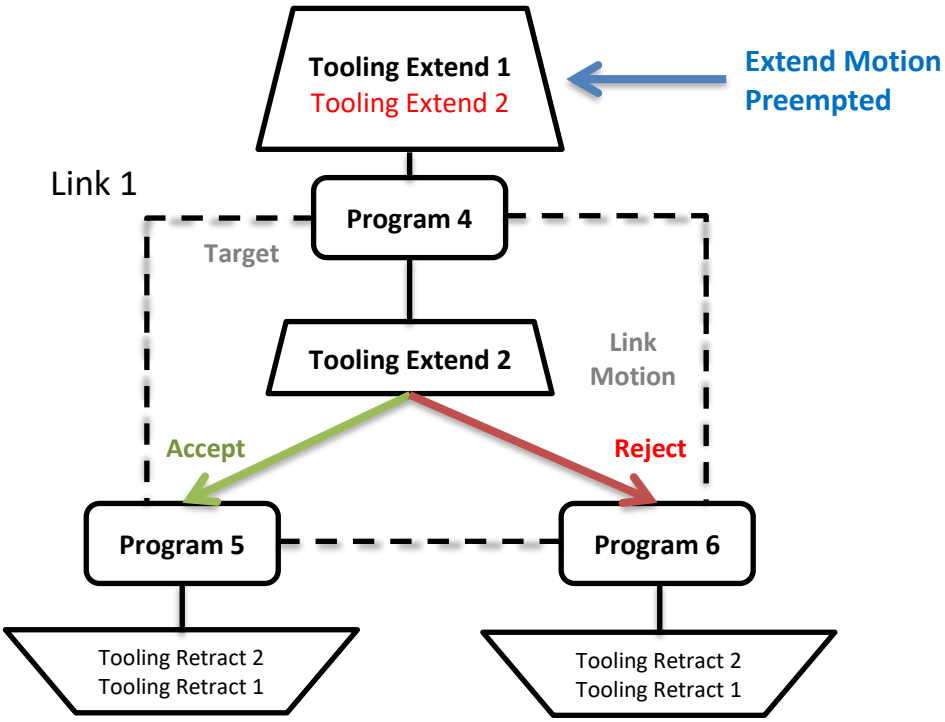
The following rules define this operation:

1. The instrument will place Tooling Extend motions pre-test and Tooling Retract motions post-test up to the number of defined tooling motions.
2. If any path in the decision tree contains a Link Motion configured with a Tooling Extend, with no prior Link Motion configured as a Tooling Retract of the same motion number, the pre-test Tooling Extend motion will not execute.
3. Only those Tooling Extend motions that have been executed either pre-test or using a Link Motion, will have an associated Tooling Retract motion executed post-test.

Advanced Tooling Motion Example 1

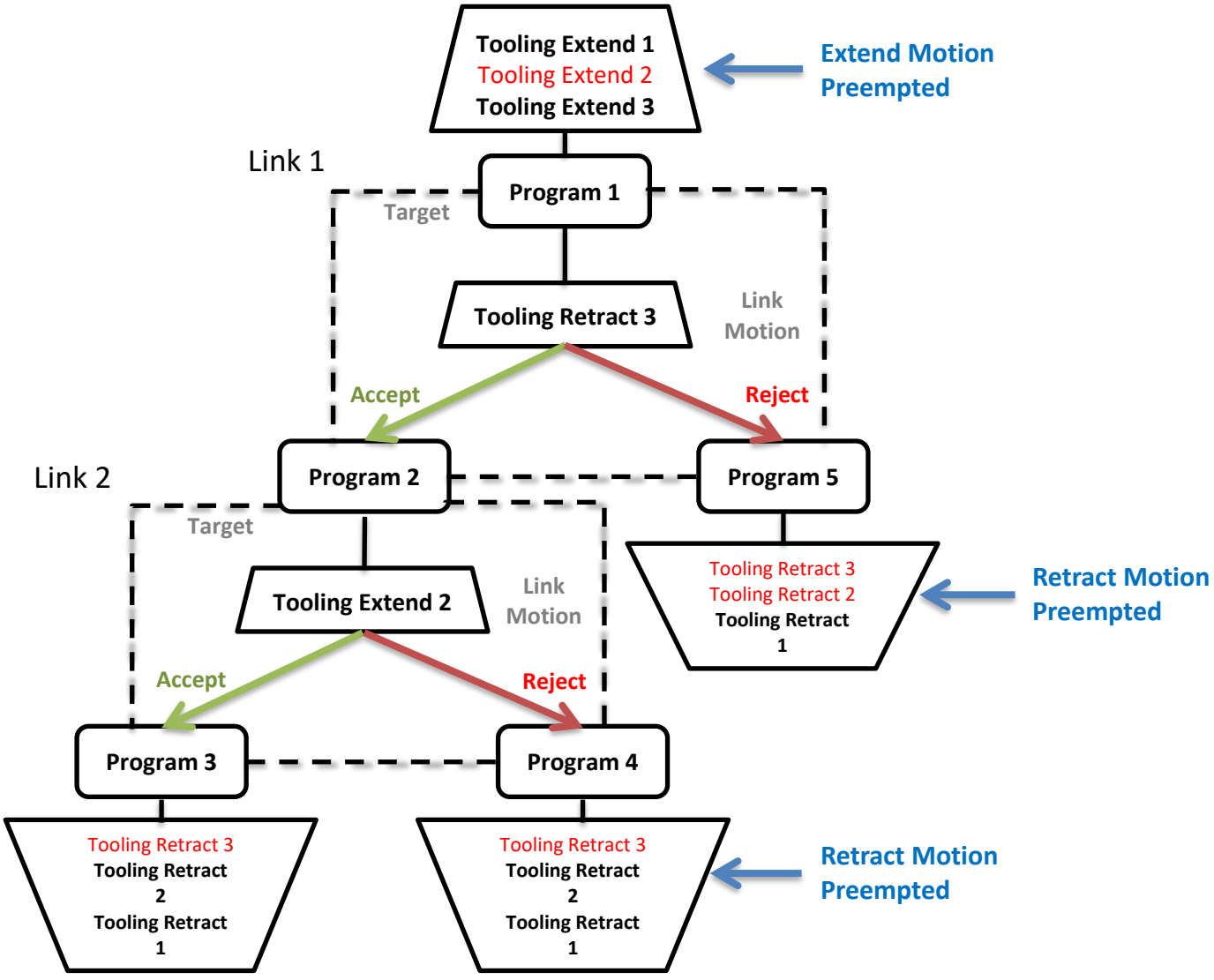
The instrument will attempt to extend all of the tooling motions at the beginning of the test unless there is a matching Link Motion number configured as Extend (obviously there is no reason to extend the same thing twice), thus the pre-test extend is preempted–in defining the link tooling the operator is dictating to the instrument the appropriate tooling sequence. If there is a Link Motion number configured as Retract, then later a Link Motion number configured as Extend of the same motion number, then it appears the operator intended the tooling to be extended at test start (as an operator, if you defined a retract, it is assumed you wanted the tooling to be extended beforehand). At the completion of the test, the instrument is aware of what tooling motions are currently extended, thus only the appropriate retracts will be executed.

The following example of **Parent Program Linking** has two tooling motions, with one link. The instrument automatically places appropriate Tooling Extend motions pre-test and Tooling Retract motions post-test. However, the operator configured a Link Motion as Tooling Extend 2, thus the instrument will not execute the pre-test Tooling Extend 2.



Advanced Tooling Motion Example 2

Another example of a **Parent Program Linking** scenario (shown below) has three tooling motions, with two links. The instrument automatically places appropriate Tooling Extend motions pre-test and Tooling Retract motions post-test. Since the operator configured within Link 2 a Link Motion as Tooling Extend 2, the instrument will not execute the pre-test Tooling Extend 2. The operator configured within Link 1 a Link Motion as Tooling Retract 3, so the instrument will not execute the post-test Tooling Retract 3. Also, following Program 5 the instrument will not execute the post-test Tooling Retract 2, since the Tooling Extend 2 was never executed; however, after Program 3 and Program 4, the Tooling Retract 2 and Tooling Retract 1 will both be executed.



It is helpful when designing a **Parent Program Linking** test to diagram the desired part operation to appropriately define all the link parameters correctly to achieve the correct test sequence.

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Chapter 21 – Inputs and Outputs

This chapter explains the Input and Output (I/O) capabilities of the instrument. The I/O parameters are located in ***Main Menu > Program Config > HW Input*** *and* ***HW Output*** *icons.*

> ***Note: The instrument must be in Advanced or Admin Display User Level to view and modify the Input and Output functionality. To change the Display User Level, see*** Chapter 28 ***– Features.***

The instrument includes user selectable digital inputs and outputs to increase the functionality and simplify the application to various test requirements. The inputs and outputs are divided into two groups – Universal and Program Specific. When a Universal input or output is assigned in a program, it is automatically assigned and available within all programs. When a Program Specific input or output is assigned in a program, that particular input or output is constrained to use only the inputs or outputs within the same Functional Group. When the input or output is set to "Constrained" in a program, it will not function within that program.

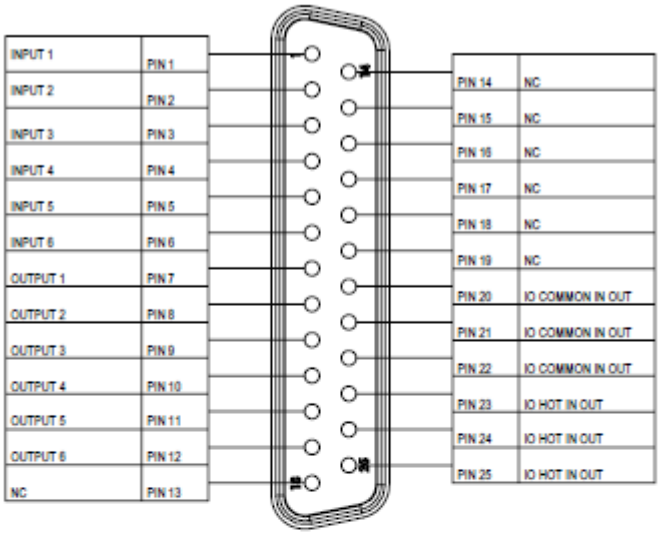
In order to remove the selection of an input or an output, change the parameter to either "Unassign" or "Unassign all Prog". Selecting "Unassign all Prog" will remove the selection of the input or output for all of the programs. Selecting "Unassign" will only remove the selection from the current program. "Unassign" is not available for Universal inputs or outputs.

Input and Output Connector Pinout

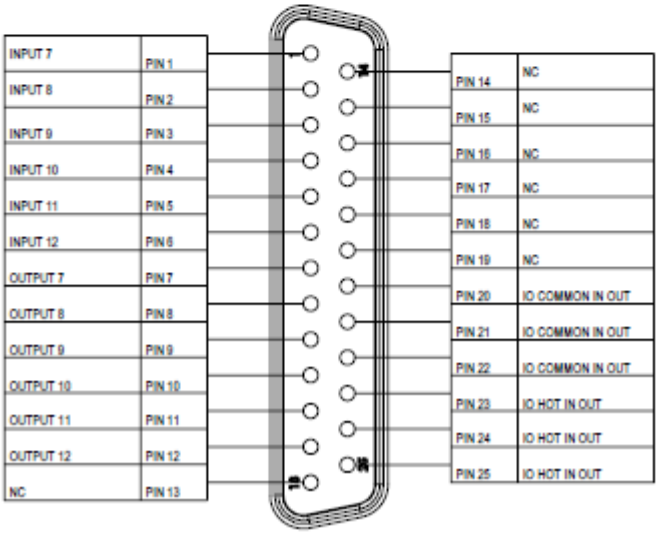
The instrument comes equipped with 12 programmable sinking inputs and 12 programmable sourcing outputs. Both inputs and outputs are 24VDC. See Detail "A" below.

Detail A

DIGITAL INPUT/OUTPUT
1-6 (24VDC NOMINAL)
TOP CONNECTOR LEVEL I/O A



DIGITAL INPUT/OUTPUT
7-12 (24VDC NOMINAL)
BOTTOM CONNECTOR LEVEL I/O B



Detail B

JUMPER FACTORY POSITION FOR EXTERNAL POWER

SWITCH JUMPER POSITION FOR INTERNAL I/O POWER

Digital Outputs Current Draw:

- Maximum current draw for an individual output is 500 mA
- Maximum current draw for all combined outputs is 1A

The instrument is supplied with the option to elect to use the internal power for the I/O supply or an external supply. If an external supply is used, the I/O Factory Jumper is already set to "External I/O Power". See I/O Jumper in "Detail B" above.

Input Pinout and Wiring Table

Input	Function	Wire Color	Connector Location	Instrument Connector	Cable Connector Pin	Wire Color
1	User Selectable	Black	Top (I/O A)	1	1	Black
2	User Selectable	Brown	Top (I/O A)	2	2	Brown
3	User Selectable	Red	Top (I/O A)	3	3	Red
4	User Selectable	Orange	Top (I/O A)	4	4	Orange
5	User Selectable	Yellow	Top (I/O A)	5	5	Yellow
6	User Selectable	Green	Top (I/O A)	6	6	Green
7	User Selectable	Black	Bottom (I/O B)	1	1	Black
8	User Selectable	Brown	Bottom (I/O B)	2	2	Brown
9	User Selectable	Red	Bottom (I/O B)	3	3	Red
10	User Selectable	Orange	Bottom (I/O B)	4	4	Orange
11	User Selectable	Yellow	Bottom (I/O B)	5	5	Yellow
12	User Selectable	Green	Bottom (I/O B)	6	6	Green

User selectable or programmable inputs are listed in a table on the next page.

Output Pinout and Wiring Table

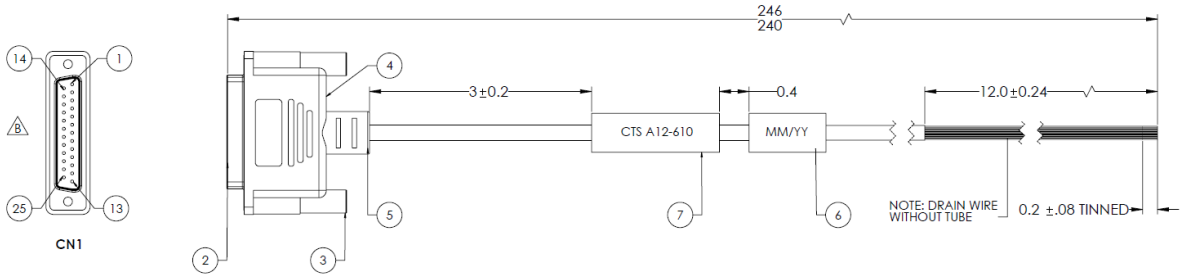
Output	Function	Wire Color	Connector Location	Instrument Connector	Cable Connector Pin	Wire Color
1	User Selectable	Blue	Top (I/O A)	7	7	Blue
2	User Selectable	Violet	Top (I/O A)	8	8	Violet
3	User Selectable	Gray	Top (I/O A)	9	9	Gray
4	User Selectable	White	Top (I/O A)	10	10	White
5	User Selectable	Pink	Top (I/O A)	11	11	Pink
6	User Selectable	Light Green	Top (I/O A)	12	12	Light Green
7	User Selectable	Blue	Bottom (I/O B)	7	7	Blue
8	User Selectable	Violet	Bottom (I/O B)	8	8	Violet
9	User Selectable	Gray	Bottom (I/O B)	9	9	Gray
10	User Selectable	White	Bottom (I/O B)	10	10	White
11	User Selectable	Pink	Bottom (I/O B)	11	11	Pink
12	User Selectable	Light Green	Bottom (I/O B)	12	12	Light Green

User selectable or programmable outputs are listed in a table on page 89.

I/O Power Pinout and Wiring Table

Function	Wire Color	Connector Location	Instrument Connector	Cable Connector Pin	Wire Color
IO Common	Red/Black	Top (I/O A)	20	20	Red/Black
IO Common	Orange/Black	Top (I/O A)	21	21	Orange/Black
IO Common	Yellow/Black	Top (I/O A)	22	22	Yellow/Black
IO Hot	Green/Black	Top (I/O A)	23	23	Green/Black
IO Hot	Gray/Black	Top (I/O A)	24	24	Gray/Black
IO Hot	Pink/Black	Top (I/O A)	25	25	Pink/Black
IO Common	Red/Black	Bottom (I/O B)	20	20	Red/Black
IO Common	Orange/Black	Bottom (I/O B)	21	21	Orange/Black
IO Common	Yellow/Black	Bottom (I/O B)	22	22	Yellow/Black
IO Hot	Green/Black	Bottom (I/O B)	23	23	Green/Black
IO Hot	Gray/Black	Bottom (I/O B)	24	24	Gray/Black
IO Hot	Pink/Black	Bottom (I/O B)	25	25	Pink/Black

25 Pin Digital IO Cable Diagram and Pinout Table



CTS Part Number: **KIT,CTS,A12-770** (includes 2 cables with hardware)

PIN ID	COLOR	FUNCTION	PIN ID	COLOR	FUNCTION
1	BLACK		14	BROWN/WHITE	
2	BROWN		15	RED/WHITE	
3	RED		16	ORANGE/WHITE	
4	ORANGE		17	GREEN/WHITE	
5	YELLOW		18	BLUE/WHITE	
6	GREEN		19	VIOLET/WHITE	
7	BLUE		20	RED/BLACK	
8	VIOLET		21	ORANGE/BLACK	
9	GRAY		22	YELLOW/BACK	
10	WHITE		23	GREEN/BLACK	
11	PINK		24	GRAY/BLACK	
12	LIGHT GREEN		25	PINK/BLACK	
13	BLACK/WHITE		SHELL	DRAIN	

Programmable Inputs and Outputs Menus

Input Options
Start Channel
Start Program
Stop/Reset
Hold
Vent/Halt
Program Cal
Open Leak Std
Part Present
SPC Test Part
Instrument Enable
Program Select B1
Program Select B2
Program Select B3
Program Select B4
Program Select B5
Program Select B6
Program Select B7
Common
Tool Ext Fdbk 1
Tool Ext Fdbk 2
Tool Ext Fdbk 3
Tool Ext Fdbk 4
Tool Ext Fdbk 5
Ext Press Sw
Event Trigger
Tool Ret Fdbk 5
Tool Ret Fdbk 4
Tool Ret Fdbk 3
Tool Ret Fdbk 2
Tool Ret Fdbk 1
Unassign

Output Options
Malfunction
Tool Extend 1
Tool Extend 2
Tool Extend 3
Tool Extend 4
Tool Extend 5
In Relax
Program Cal Mode
Program Cal Master
Program Cal Leak Std
Press Select
Prefill
In Fill
Fill Valve
In Stabilize
Isolation Valve
In Test
Test Passed
Test Failed
Bellow LL
Between Lim
Above HL
In Exhaust
Program Accept
Program Reject
Severe Leak
Part Acc Mark
Part Rej Mark
Tool Retract 5
Tool Retract 4
Tool Retract 3
Tool Retract 2
Tool Retract 1
Unassign

The Inputs and Outputs above are listed in their menu selection order. All of the options may not be available, depending on the test type and the tooling control setting (On or Off and Number of Motions). Descriptions of these menu options are on the following pages are in related groups.

Inputs for Program Control

Input	Description
Start Channel	Starts the active Program
Common	The Start Channel and Common inputs are universal inputs, where each part program can be set individually to use "Two Inputs to Start" or "Anti-Tie-Down" logic.
Vent/Halt	The Vent/Halt input safely ceases the operation of any tooling motion, removes all energy from the part by advancing through the exhaust segment and stops operation. Any programmed tooling motion required to return to the fully retracted positions must be initiated by the Stop/Reset input. While the Vent/Halt input is high, no additional test activity or tooling resets can occur. See description below.
Start Program	Changes the Current Program to the one assigned to this input and Starts the Program.
Stop/Reset	The Stop/Reset input is available to stop tests and retract tooling. When a stop/reset input is received the test cycle goes immediately through a Vent/Halt routine and then advances to retract the tooling. The Malfunction output (if programmed) will go high at the end of the last tooling motion for errors defined as malfunctions. See description below.
Hold	The Hold input halts or suspends the testing sequence as long as this input is high. This can be used to stop the testing while awaiting some other action to occur.
Part Present	Enabled by selecting Part Present as one of the inputs, the Part Present input must be high before a start test input is received. It also must go low between tests (after any tooling motion and before the start of the tooling motion for the next test). If more than one input is set to "Part Present", test will execute only if all inputs are made high.
Ex Press Sw	Enabled by selecting Ext Press Sw as one of the inputs, the External Pressure Switch input must go high before the end of the fill segment. This input is generally used to validate that the test part is properly charged by detecting pressure downstream of a potential blockage point. For Occlusion test type where fill segment is not present, Ext Press Sw input must go high before the end of the test segment. If Ext Press Sw input is not made high during test execution then a malfunction occurs. For more than one input of Ext Press Sw, test will execute only if all inputs are made high before test segment of Occlusion test and fill segment for other test types.
Instrument Enable	Enabled by selecting Instrument Enable as one of the inputs, the Instrument Enable input must be high before a start test input is received. If the input doesn't go high before executing any test, it shows the malfunction message. If the input goes low in between test execution then test aborts and shows malfunction message. For more than one input of Instrument Enable, test will execute only if all inputs are made high and test aborts with malfunction message if any one input is low or made low in between test execution.

Vent/Halt Request

The design of a Vent/Halt request (including initial phase of the Stop/Reset request) is to cease operation of tooling motions, safely remove all energy from the part, and stop operation.

A Vent/Halt request operation has multiple operations depending on the state of the instrument while testing. For better understanding, the test sequence can be broken into three basic groups: Tooling Extend, Part Testing, and Tooling Retract. The Program Evaluation (Accept Program/Reject Program/Malfunction/Severe Leak) is always after the Tooling Retract.
Other than a user generated Vent/Halt input, a number of test errors will generate a Vent/Halt request. Possible scenarios include:

Vent/Halt – Instrument Idle
While the instrument is idle, a high Vent/Halt input will prevent the instrument from performing any test activity or tooling reset. Any type of Start or Stop request will be ignored until the Vent/Halt input is low.

Vent/Halt – Instrument execution during Tooling Extend Group
A Vent/Halt request will cause the output related to an executing Tooling Extend to be turned off. If the extend output is completed, it will remain in its current state. Since the part has not been charged no exhaust is necessary and execution will cease. A Tooling Reset is required.

Vent/Halt – Instrument execution during Part Testing Group
A Vent/Halt request will cause the instrument to exhaust any pressure within the part (if pressure was achieved) and execution will cease. Any output relating to Tooling Extend will remain in its current state. A Tooling Reset is required.

Vent/Halt – Instrument execution during Tooling Retract Group
A Vent/Halt request will cause the output relating to the current executing Tooling Retract to be turned off. Since the part has already been exhausted, execution will cease. A Tooling Reset is required.

Stop/Reset Request

The design of a Stop request is to safely remove all energy from the part, place the tooling into a fully retracted state, and stop operation. Depending on whether the instrument is actively testing or idle, the stop request has two modes of operations.

Stop – Instrument Testing

- If actively testing, a Stop request will cause the instrument to exhaust any pressure within the part (if pressure was achieved), and then execute a tooling reset sequence (only if tooling is enabled). The retract motion will be executed into a known retracted state for the next test.

Stop – Instrument Idle

- If the instrument is idle or in a safe state with the part pressure exhausted, a Stop request will cause the instrument to execute a tooling reset sequence (only if tooling is enabled). The retract motion will be executed into a known retracted state for the next test.

Besides a user generated Stop, a number of test errors will generate a Stop/Reset request that causes a Vent/Halt routine and continues with the tooling reset. The possible scenarios include: Transducer Malfunction (zero or over-range), External Switch Fault (not low or high at appropriate time), Severe Leak, Pressure Low/High, Calculation Faults, Calibration Errors, and General Program Fault (setup errors).

In addition, Stop/Reset input is required:

- After any tooling motion or test malfunction where the instrument completed Vent/Halt to safe state and stopped.
- Tooling must be reset to fully retracted position to start next test.

Inputs for Program Selection

<table>
<tr><th>Input</th><th colspan="2">Description</th></tr>
<tr><td rowspan="9">Binary Program Selection</td><td colspan="2">Programs can be remotely selected using the Binary Program Selection inputs or using one of the communication methods: RS232 or TCP/IP. The number of required inputs for Binary Program Selection depends on the highest program number of the program to which access is required.</td></tr>
<tr><td>Program Numbers</td><td>Binary Program Inputs</td></tr>
<tr><td>1</td><td>B1</td></tr>
<tr><td>2 – 3</td><td>B1 and B2</td></tr>
<tr><td>4 – 7</td><td>B1, B2, and B3</td></tr>
<tr><td>8 – 15</td><td>B1, B2, B3, and B4</td></tr>
<tr><td>16 – 31</td><td>B1, B2, B3, B4 and B5</td></tr>
<tr><td>32 – 63</td><td>B1, B2, B3, B4, B5, and B6</td></tr>
<tr><td>64 – 99</td><td>B1, B2, B3, B4, B5, B6, and B7</td></tr>
</table>

Note: Programs can also be remotely selected using one of the communication methods: RS232 or TCP/IP, see Chapter 24 ***- Communication.***

Inputs for Program Calibration

Input	Description
Program Cal	The Program Cal input prepares the instrument to perform a Program Cal sequence. A Start input initiates the tooling motion and Program Cal sequence.
Open Leak Std	The Open Leak Standard input will open the Leak Standard Calibration valve (if equipped) during the Fill, Stabilization, Test, and Exhaust segments. The valve will only open during the testing cycle when the input is high. If the input goes low during the testing cycle, the Leak Std Calibration valve will close. This input is generally used to automatically verify the calibration of a system by indexing or placing a good part in the test fixture and adding the internal leak standard to measure a part with the leak rate equal to the internal leak standard.
SPC Test Part	The SPC Test Part input identifies the next part to test as an SPC Part (often used when performing a test calibration verification test with a leak standard). This input must be high when receiving the Start input. This will mark the test results in the program result with an "*". Also, the test result output using the communication port will include the "*" to identify these parts for separate analysis.

Inputs for Tooling Motion

Input	Description
Part Marking Feedback	This input must go high as a response to the Part Mark (Accept, Reject, or Both) output within the Part Mark timer that starts at the end of the exhaust timer when the Part Mark output is initiated. The Part Mark Feedback input must be requested. • Part Config/TOOLING – "Part Mark" must be set for "Accept", "Reject", or "Both". • Part Config/TOOLING – "Part Mark Feedback" set to "Yes". • Part Config/INPUT – Part Mark Feedback assigned to a terminal. • Part Config/OUTPUT – "Part Acc Mark" and/or "Part Rej Mark" assigned to terminal(s) • Part Config/TIMER – Part Mark Timer set to a time. Failure to receive this input before the end of the Part Mark Fdbk timer will cause a Malfunction result and an "ERROR: PART MARK FAULT" display.
Tool Ext Fdbk 1 – 5	If enabled by selecting Tool Ext Fdbk #x as one of the inputs, it is required that the Tool Extend Feedback input go high before the associated Tool Ext Timer expires. If the timer expires before the input goes high the instrument will issue a malfunction. A Stop/Reset will need to be initiated to reset the tooling.
Tool Ret Fdbk 1 – 5	If enabled by selecting Tool Ret Fdbk #x as one of the inputs, it is required that the Tool Retract Feedback input go high before the associated Tool Ret Timer expires. If the timer expires before the input goes high the instrument will issue a malfunction. A Stop/Reset will need to be initiated to reset the tooling.

Outputs for Test Cycles

Output	Description
Press Select	Pressure Select goes high during the entire test sequence from start of Prefill or Fill segment to the end of Exhaust segment. ***This output can be used as a Test Active output.***
Prefill	The Prefill output goes high during the Prefill portion of the Fill segment. This output is frequently used to control an external fast-fill valve when testing large volume parts. The external fast-fill valve opens until the instrument reaches the Minimum Pressure.
In Fill	The Fill segment output goes high during the Fill segment.
Fill Valve	This output mimics the Fill Valve functionality in the instrument. It goes high during the Prefill and Fill segments.
In Stabilize	The Stabilization segment output goes high during the Stabilization segment.
Isolation Valve	This output mimics the Isolation Valve functionality in the instrument. It goes high just prior to the fill valve closing and stays energized until the end of the Test segment.
In Test	The Test segment output goes high during the Test segment.
In Exhaust	The Exhaust segment output goes high during the Exhaust segment. This output is frequently used to open an external exhaust valve that vents the test air from the part through a larger valve for fast exhaust or to bypass the instrument and avoid polluting the instrument pneumatics with dirty part air.
In Relax	The relax timer output goes high during the Relax segment between the two tests of the Program Cal sequence. It would go high at the end of the first test Exhaust segment until the start of the second test Prefill or Fill segment. The Relax segment is also functional between tests in the Auto Setup routine.

Outputs for Program Calibration

Output	Description
Program Cal Mode	The Program Cal Mode output goes high whenever the instrument is performing a Program Cal cycle. It goes high at the beginning of the Prefill or Fill timer for the first test of the Program Cal process. It stays high until the end of the Exhaust segment for the second test of the Program Cal Process.
Prog Cal Master	The Program Calibration Master output goes high during the first complete test of the Program Cal process starting at the beginning of the Prefill or Fill segment to the end of the Exhaust segment. This output is used to alert an external process that the instrument is in the first test of calibration.
Prog Cal LS	The Program Calibration Leak Standard output goes high during the second complete test cycle of the Program Cal process when the Leak Standard is added beginning with the Prefill or Fill segment to the end of the Exhaust segment. This output is used to alert an external process that the instrument is in the second test of calibration.

Outputs for Program Results and Test Results

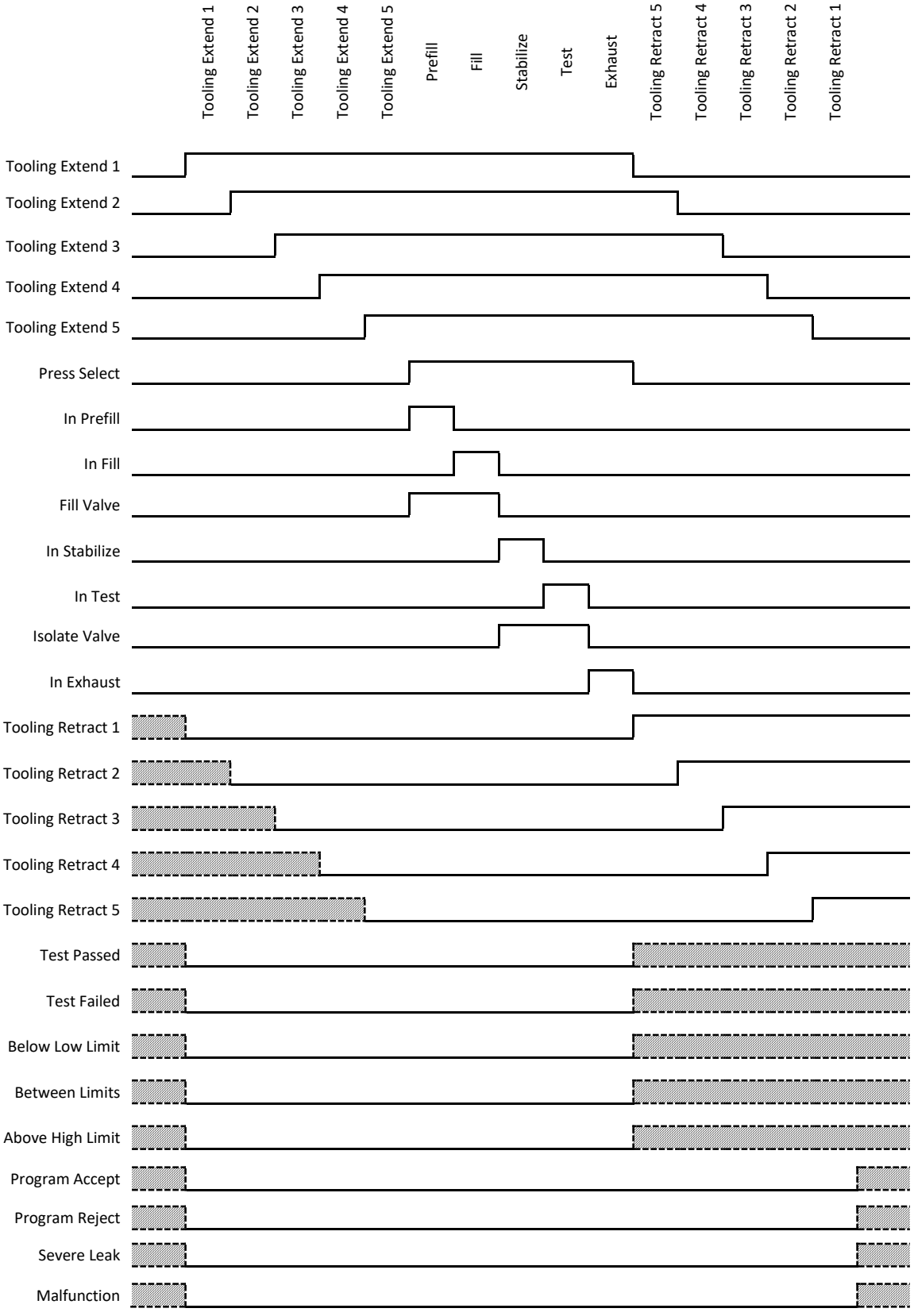
Output	Description
Program Accept	The Program Accept output goes high at the completion of the tooling motion (if tooling is turned on) or at the completion of the Exhaust segment if the test passes.
Program Reject	The Program Reject output goes high at the completion of the tooling motion (if tooling is turned on) if the test fails. Program Rejects also include Severe Leaks when Minimum Pressure is not reached before reaching the Prefill setpoint or maintained during the Fill or Stabilization segments.
Malfunction	If a test has an error or disruption to the normal process and faults out of cycle before the normal completion, a malfunction will occur. With tooling control if the error or disruption occurs during initial tooling action, the tooling will retract. If the error or disruption occurs during the testing cycle, the test will advance immediately to exhaust and the tooling will retract automatically. The Malfunction output goes high at the end of the completion of the last tooling motion.
Severe Leak	If a test fails to reach Minimum Pressure before reaching the Prefill setpoint or fails to maintain at least the Minimum Pressure during the Fill and Stabilization segments, the instrument will exhaust the pressure in the part and output Severe Leak high.
Part Acc Mark	Part Acc Mark output stamps or marks a part as Accept based on the Part Result. This output goes high during the Park Mark Timer immediately at the end of the Exhaust timer.
Part Rej Mark	Part Rej Mark output stamps or marks a part as Reject based on the Part Result. This output goes high during the Park Mark Timer immediately at the end of the Exhaust timer.
Test Passed	Signals the completion of a test that passed at the start of the Exhaust segment. This output stays on until the start of a new test.
Test Failed	Signals the completion of a failed test at the start of the Exhaust segment. This output stays on until the start of a new test.
Below LL	Below Low Limit goes high at the start of Exhaust segment when test results are below the Low Limit setpoint and stays high until the start of the next test.
Between Lim	Between Limits goes high at the start of Exhaust segment when test results are between the Low Limit and High Limit setpoints and stays high until the start of the next test.
Above HL	Above High Limit goes high at the start of Exhaust segment when test results are above the High Limit setpoint and stays high until the start of the next test.

Outputs for Tooling Motion

Output	Description
Tooling Extend 1	This output goes high during the Tooling Extend 1 segment. This option is only available if Tooling is set to "On" or "Disabled".
Tooling Extend 2	This output goes high during the Tooling Extend 2 segment. This option is only available if Tooling is set to "On" or "Disabled" and the Number of Motions is equal to 2 or more.
Tooling Extend 3	This output goes high during the Tooling Extend 3 segment. This option is only available if Tooling is set to "On" or "Disabled" and the Number of Motions is equal to 3 or more.
Tooling Extend 4	This output goes high during the Tooling Extend 4 segment. This option is only available if Tooling is set to "On" or "Disabled" and the Number of Motions is equal to 4 or more.
Tooling Extend 5	This output goes high during the Tooling Extend 5 segment. This option is only available if Tooling is set to "On" or "Disabled" and the Number of Motions is equal to 5 or more.

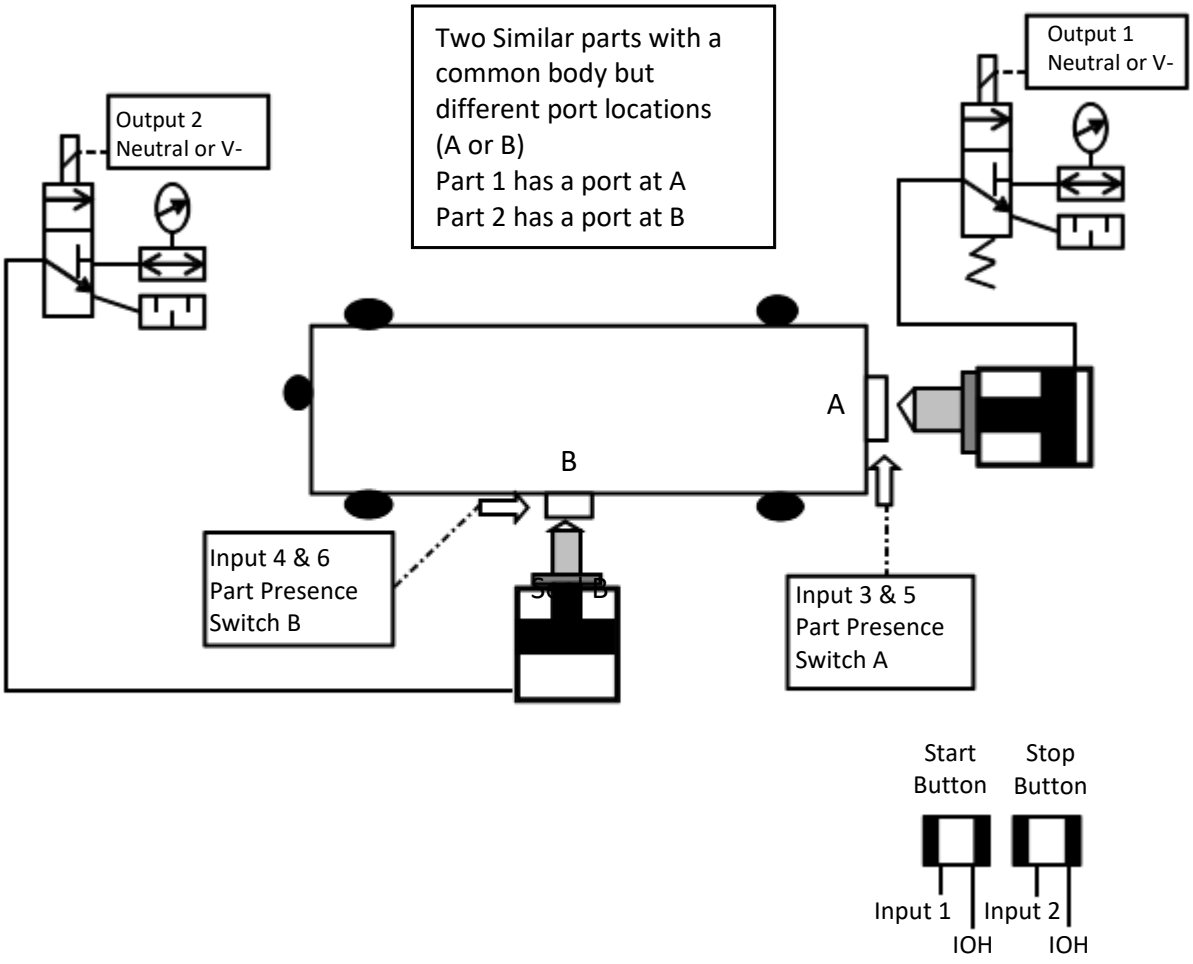
Output	Description
Tooling Retract 5	This output goes high during the Tooling Retract 5 segment. This option is only available if Tooling is set to "On" or "Disabled" and the Number of Motions is equal to 5 or more.
Tooling Retract 4	This output goes high during the Tooling Retract 4 segment. This option is only available if Tooling is set to "On" or "Disabled" and the Number of Motions is equal to 4 or more.
Tooling Retract 3	This output goes high during the Tooling Retract 3 segment. This option is only available if Tooling is set to "On" or "Disabled" and the Number of Motions is equal to 3 or more.
Tooling Retract 2	This output goes high during the Tooling Retract 2 segment. This option is only available if Tooling is set to "On" or "Disabled" and the Number of Motions is equal to 2 or more.
Tooling Retract 1	This output goes high during the Tooling Retract 1 segment. This option is only available if Tooling is set to "On" or "Disabled".

Output Timing Diagram



Tooling Example

The example below shows the power and flexibility of the Input and Output functionality. In this example the inputs and outputs are being used to seal two different types of parts. The two different parts have sealing ports in different locations. The part presence sensors select the program in the instrument that controls the proper hardware based on the current part in the sealing nest.



Parameters	Program #1	Program #2
Tooling Motion	On	On
Number of Motions	1	1
Part Present Check	On Start	On Start
Retract on Reject	No	No

Input	Hardware	Program #1	Program #2
Input 1	Start Button	Start Channel	Start Channel
Input 2	Stop Button	Stop/Reset	Stop/Reset
Input 3	Part Select Switch	Program Select B1	Program Select B1
Input 4	Part Select Switch	Program Select B2	Program Select B2
Input 5	Part Presence Sensor A	Part Presence	Constrained
Input 6	Part Presence Sensor B	Constrained	Part Presence

Output	Hardware	Program #1	Program #2
Output 1	Seal A Extend	Tool Extend 1	Constrained
Output 2	Seal B Extend	Constrained	Tool Extend 1

Chapter 22 – EtherNet/IP

*This chapter explains the control capabilities of the I28 using the **EtherNet/IP™** feature. The instrument is able to communicate over Ethernet via TELNET. **EtherNet/IP** is a registered trademark of ODVA, Inc.*

Instrument EtherNet/IP Functionality

EtherNet/IP is an industrial communication standard which encompasses the Common Industrial Protocol (CIP™) deployed over standard Ethernet technology (IEEE 802.3 with TCP/IP). While EtherNet/IP offers various optional topology methods, our implementation utilizes the conventional star with standard Ethernet infrastructure devices.

Features

EtherNet/IP provides the following capabilities:

- Standard set of I/O functionality for machine control
- Modify the current active Program
- Send/receive ASCII barcode information to be stored with test result (Blackbelt and I28 instruments only)
- User configurable soft I/O functions (16 input, 16 output)
- Test result summary data, and query of full result measurement information
- Latch feature for multi-device communications heartbeat monitoring

EtherNet/IP does **NOT** provide:

- Real-time test data streaming
- Access or modification of instrument settings:
    - Global configuration
    - Channel configuration
    - Program configuration

Compatibility

Provide full communication capabilities over EtherNet/IP™ with any Allen-Bradley ControlLogix® or CompactLogix PLC™.

Standard Fixed, Defined Inputs/Outputs

Enabling EtherNet/IP allows a set of fixed defined I/O points that are preconfigured are already part of EtherNet/IP structure. The following functionality is accessible by these predefined features.

- Start
- Stop
- Vent/Halt
- Reset
- Instrument Ready
- Result Ready
- Result Error
- Result Unique ID
- Program Accept
- Program Reject
- Malfunction
- Current Program Number
- Change Program Number
- Test Evaluation
- Timestamp
- Latch status

Setting EtherNet/IP User Defined Inputs and Outputs

The instrument comes equipped with 16 programmable inputs and 16 programmable outputs. The user can select up to 16 test or program specific I/O that are not in the Standard Fixed, Defined I/O set (described on the first page of this chapter). The following lists of input and output options are the same as the lists of hardware inputs and outputs described in the Programmable I/O Table in the previous chapter titled Chapter 21 – Inputs and Outputs.

Input Options
Start Channel
Start Program
Stop/Reset
Hold
Vent/Halt
Program Cal
Open Leak Std
Part Present
SPC Test Part
Program Select B1
Program Select B2
Program Select B3
Program Select B4
Program Select B5
Program Select B6
Program Select B7
Common
Tool Ext Fdbk 1
Tool Ext Fdbk 2
Tool Ext Fdbk 3
Tool Ext Fdbk 4
Tool Ext Fdbk 5
Ext Press Sw
Event Trigger
Tool Ret Fdbk 5
Tool Ret Fdbk 4
Tool Ret Fdbk 3
Tool Ret Fdbk 2
Tool Ret Fdbk 1
Instrument Enable
Part Mark Fdbk
Unassign

Output Options
Malfunction
Tool Extend 1
Tool Extend 2
Tool Extend 3
Tool Extend 4
Tool Extend 5
In Relax
Program Cal Mode
Program Cal Master
Program Cal Leak Std
Press Select
Prefill
In Fill
Fill Valve
In Stabilize
Isolation Valve
In Test
Test Passed
Test Failed
Bellow LL
Between Lim
Above HL
In Exhaust
Program Accept
Program Reject
Severe Leak
Part Acc Mark
Part Rej Mark
Tool Retract 5
Tool Retract 4
Tool Retract 3
Tool Retract 2
Tool Retract 1
Unassign

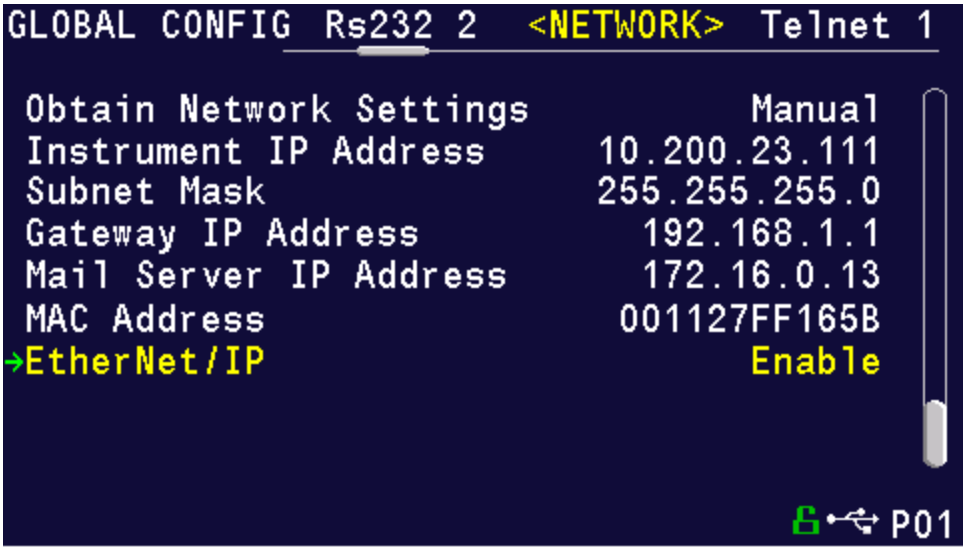
The Inputs and Outputs in the previous table are listed in their menu selection order. All of the options may not be available, depending on the test type and the tooling control setting (On or Off and Number of Motions). Descriptions of these menu options can be found in Chapter 21 – Inputs and Outputs.

Additional Reference Document

For more information on communicating with any Allen-Bradley ControlLogix or CompactLogix PLC, refer to the **EtherNet/IP AOI Integration Manual**. This document file will be located on the USB flash drive that was provided with the CTS instrument. If you cannot locate this file on the USB drive, it can be emailed to you. Contact the Cincinnati Test Systems Service department. See the back cover of this manual for contact information.

Establishing EtherNet/IP Communication

The communication parameters are located in **Main Menu > Global Config > Network** icon menu. The first step in establishing communication with a PLC is to set **EtherNet/IP** to "Enable".



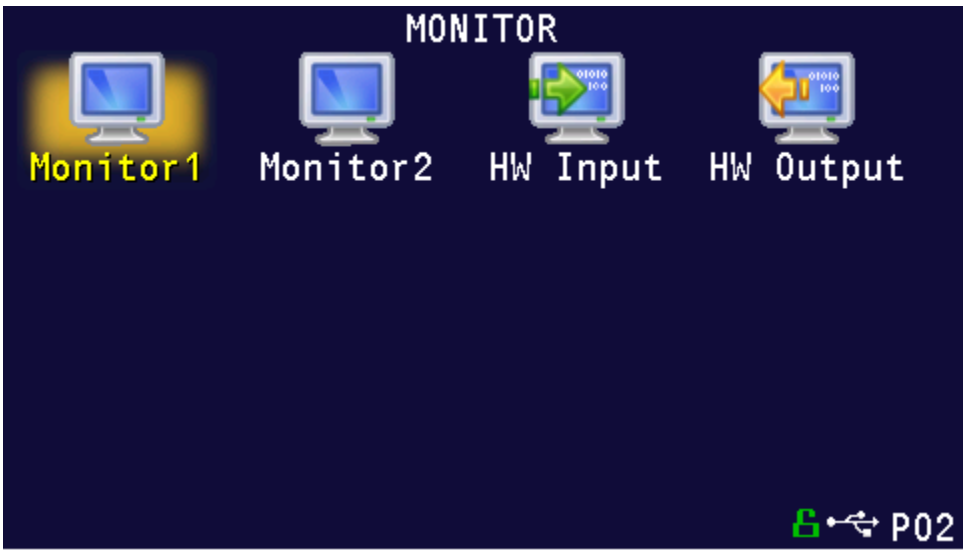
CAUTION: When changing the EtherNet/IP setting from "Enabled" to "Disabled", all of the user assigned IP Inputs and IP Outputs become Unassigned. This is necessary because when EtherNet/IP is no longer functional, any I/O that may cause program faults must be removed. This includes Part Present, External Pressure Switch, etc. This means that all the user assigned IP Inputs and IP Outputs must be set up again.

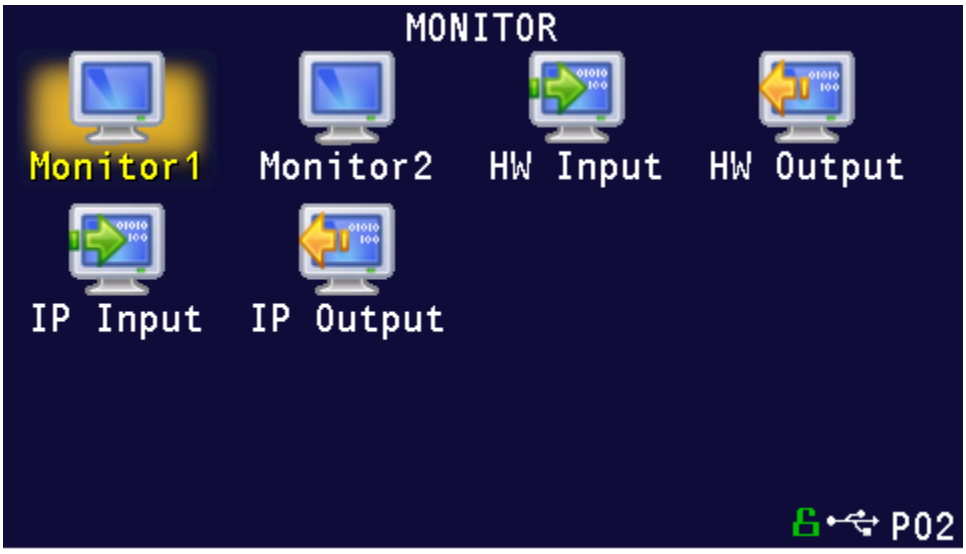
Additional Menus

Turning on this feature will make 2 additional menu icons visible on the Monitor menu screens and 2 additional menu icons visible on the Program Config menu screen.

EtherNet/IP Monitor Screens

Where there were 2 hardware input and output menu icons,
Where there were 2 Monitor menu icons for hardware inputs and outputs., now there are 2 more menu icons to monitor the EtherNet/IP inputs and outputs.

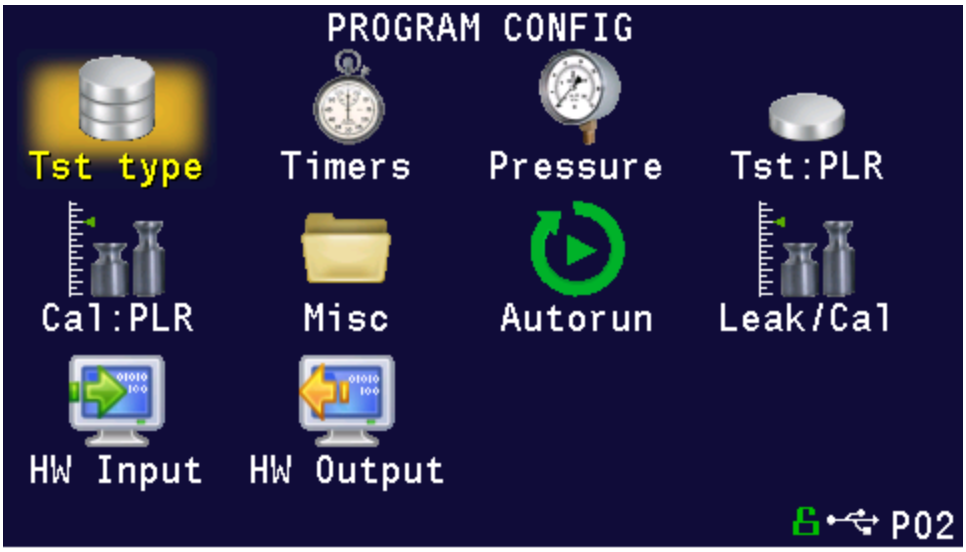


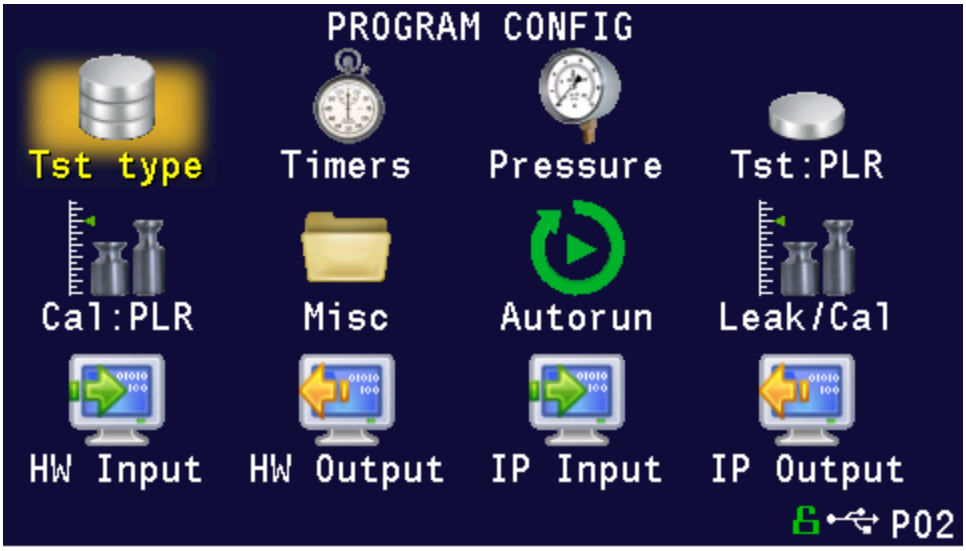


Also see Chapter 30 – Monitor Screen Examples to see how the HW and IP monitor screens appear.

EtherNet/IP Inputs and Outputs

Where there were 2 Program Config menu icons for hardware inputs and outputs, now there will be 2 additional menu icons where the EtherNet/IP inputs and outputs can be set.





Chapter 23 – PROFINET

*This chapter explains the control capabilities of the I28 instrument using the **PROFINET** feature.*

Instrument PROFINET Functionality

PROFINET is an industrial communication standard for data communication over Industrial Ethernet. While PROFINET offers various optional topology methods, our implementation utilizes the conventional star with standard Ethernet infrastructure devices.

Features

PROFINET provides the following capabilities:

- Standard set of I/O functionality for machine control
- Modify the current active Program
- User configurable soft I/O functions (16 input, 16 output)
- Test Result data for the latest test
- Real-time data streaming
- Send/receive ASCII barcode information to be stored with test result

PROFINET does **NOT** provide:

- Access or modification of instrument settings:
  - Global configuration
  - Channel configuration
  - Program configuration
- Test Result Data for a specific Result ID
- Full Result Data

Standard Fixed, Defined Inputs/Outputs

Enabling PROFINET allows a set of fixed defined I/O points that are preconfigured are already part of PROFINET structure. The following functionality is accessible by these predefined features.

- Start
- Stop
- Vent/Halt
- Reset
- Instrument Ready
- Program Accept
- Program Reject
- Malfunction
- Current Program Number
- Change Program Number
- Test Active

Setting PROFINET User Defined Inputs and Outputs

The instrument comes equipped with 16 programmable inputs and 16 programmable outputs. The user can select up to 16 test or program specific I/O that are not in the Standard Fixed, Defined I/O set (described on the first page of this chapter). The following lists of input and output options

are the same as the lists of hardware inputs and hardware outputs described in the Programmable I/O Table in the previous chapter titled Chapter 21 – Inputs and Outputs.

Input Options
Start Channel
Start Program
Stop/Reset
Hold
Vent/Halt
Program Cal
Open Leak Std
Part Present
SPC Test Part
Instrument Enable
Program Select B1
Program Select B2
Program Select B3
Program Select B4
Program Select B5
Program Select B6
Program Select B7
Common
Tool Ext Fdbk 1
Tool Ext Fdbk 2
Tool Ext Fdbk 3
Tool Ext Fdbk 4
Tool Ext Fdbk 5
Part Mark Fdbk
Ext Press Sw
Event Trigger
Tool Ret Fdbk 5
Tool Ret Fdbk 4
Tool Ret Fdbk 3
Tool Ret Fdbk 2
Tool Ret Fdbk 1
Unassign

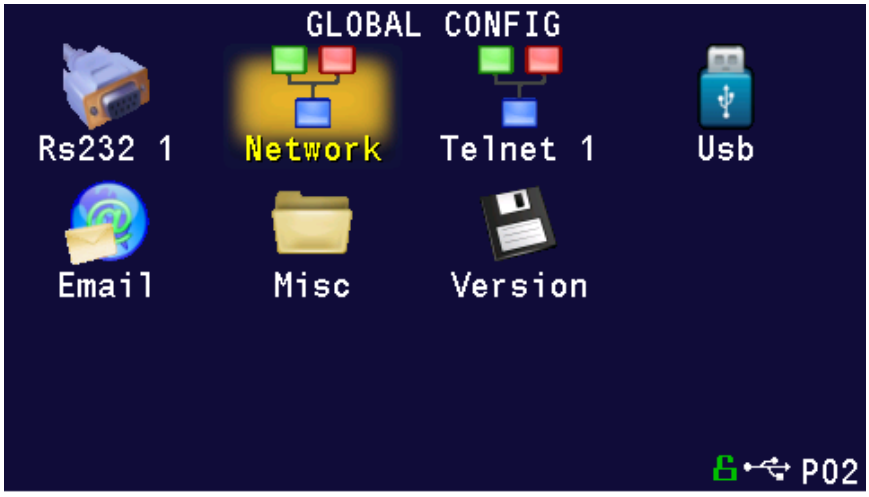
Output Options
Malfunction
Tool Extend 1
Tool Extend 2
Tool Extend 3
Tool Extend 4
Tool Extend 5
In Relax
Program Cal Mode
Program Cal Master
Program Cal Leak Std
Press Select
Prefill
In Fill
Fill Valve
In Stabilize
Isolation Valve
In Test
Test Passed
Test Failed
Bellow LL
Between Lim
Above HL
In Exhaust
Program Accept
Program Reject
Severe Leak
Part Acc Mark
Part Rej Mark
Tool Retract 5
Tool Retract 4
Tool Retract 3
Tool Retract 2
Tool Retract 1
Unassign

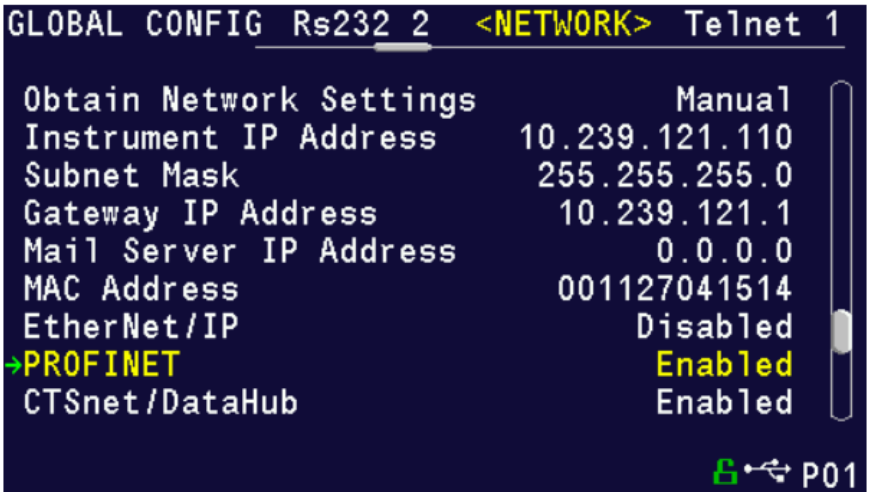
Additional Reference Document

For more information on communicating with the instrument using PROFINET, refer to the **PROFINET Programmers Guide**. This document file will be located on the USB flash drive that was provided with the CTS instrument. If you cannot locate this file on the USB drive, it can be emailed to you. Contact the Cincinnati Test Systems Service department. See the back cover of this manual for contact information.

Establishing PROFINET Communication

The communication parameters are in **Main Menu > Global Config > Network** icon menu. The first step in establishing communication with a PLC is to set **PROFINET** to "Enable". Upon enabling **PROFINET**, the instrument will disable EtherNet/IP, and the instrument will reboot. Upon startup, **PROFINET** will be functional. In addition, disabling PROFINET will also reboot the instrument.





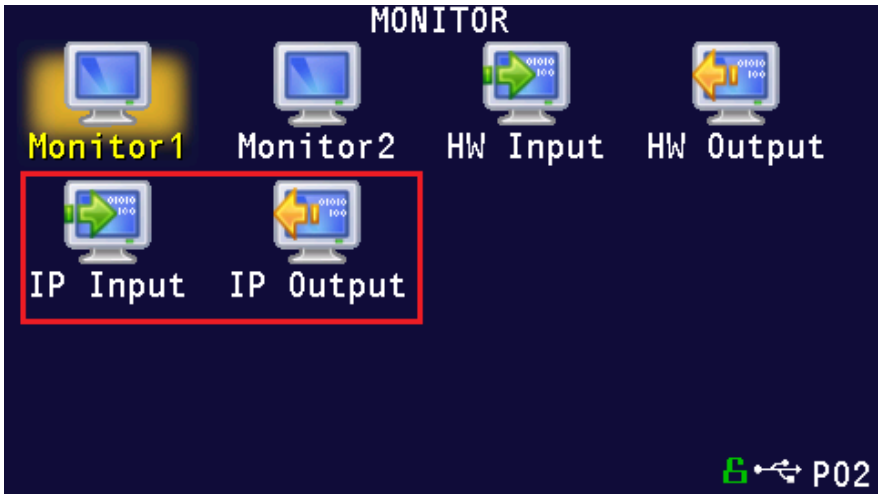
CAUTION: When changing the PROFINET setting from "Enabled" to "Disabled", all of the user assigned IP Inputs and IP Outputs become Unassigned. This is necessary because when PROFINET is no longer functional, any I/O that may cause program faults must be removed. This includes Part Present, External Pressure Switch, etc. This means that all the user assigned IP Inputs and IP Outputs must be set up again.

Additional Menus

Turning on this feature will make 2 additional menu icons visible on the Monitor menu screens and 2 additional menu icons visible on the Program Config menu screen.

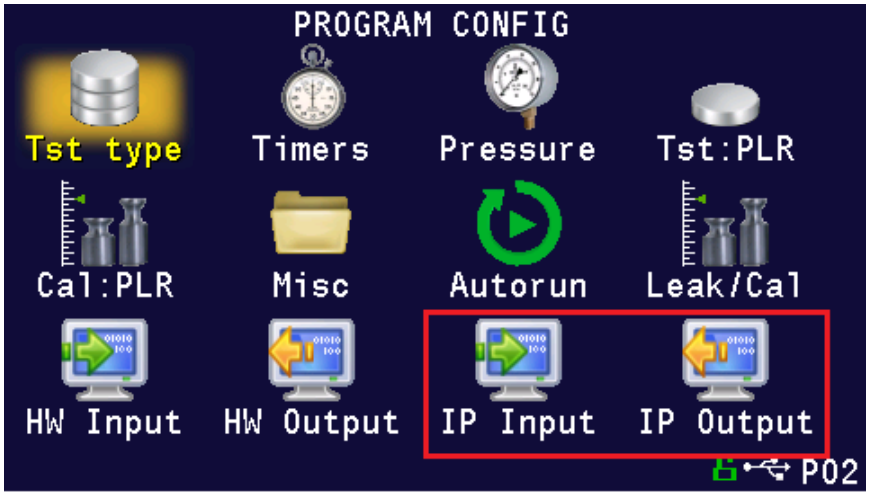
PROFINET Monitor Screens

As highlighted in below screenshot, Monitor screen will have menu icons named “IP Input” and “IP Output” for PROFINET inputs and outputs.



PROFINET Inputs and Outputs

As highlighted in below screenshot, Program Config screen will have menu icons named “IP Input” and “IP Output” for PROFINET inputs and outputs.



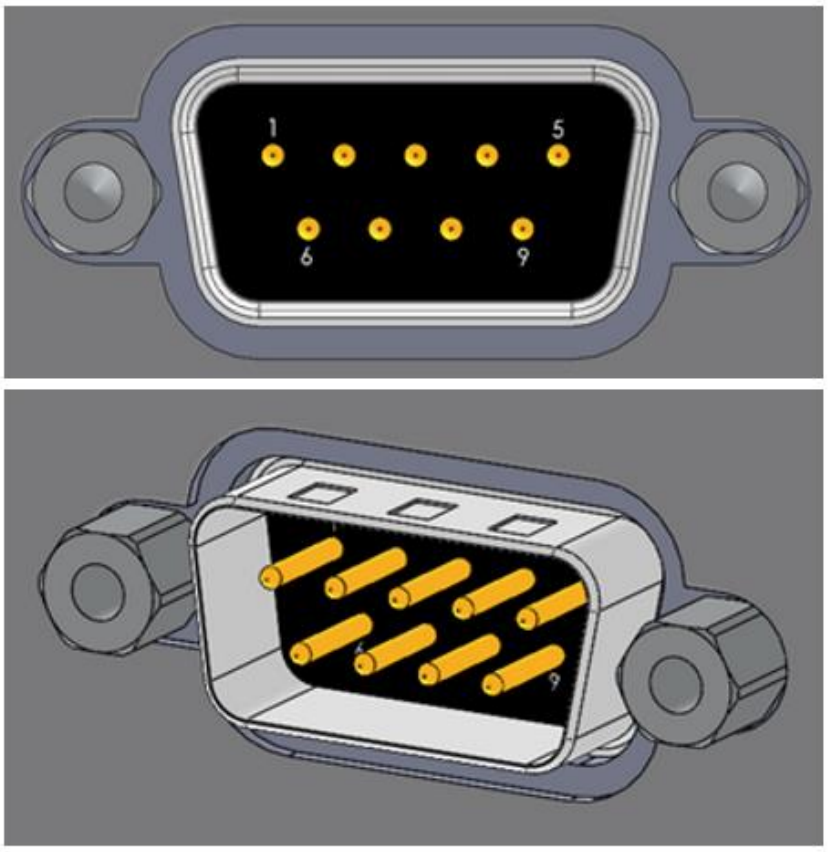
Chapter 24 – Communication

The instrument is able to communicate over RS232 and/or Ethernet via TELNET. This chapter explains how to setup communication with the instrument and how to decode the test results output.

The communication parameters are located in **Main Menu > Global Config** icon.

RS232 Connector Pinout

The pinout for the RS232 connector, located on the side of the I28, is denoted in the diagram below. Pins 1, 4, and 6 are internally connected, but are unused by the instrument.



1	DCD
2	RX
3	TX
4	DTR
5	Ground
6	DSR
7	RTS
8	CTS
9	Not Connected

Establishing RS232 Communication

The RS232 parameters are located in **Main Menu > Global Config > RS232 1** or **RS232 2.** The first step in establishing RS232 communication with the instrument is to set the RS232 1 or RS232 2 Interface parameter to "2-way" communication. Next, set the Baud parameter to match the baud rate of the device that will be communicating with the instrument. The options are: 115200, 57600, 38400, 19200, or 9600 bits per second.

> ***Note: The instrument always uses 8 data bits. The Parity is set to "None". The instrument uses 1 stop bit. The flow control is always set to "None".***

Once you have established communication with the desired device you may select whether you want the instrument to "echo" back each character it receives on the TCP/IP 1 communication port. This setting is located in the **Main Menu > Global Config > RS232 1** icon > **RS232 1 Echo** or **Main Menu > Global Config > RS232 2** icon **> RS232 2 Echo**. If the parameter is set to "ON", the instrument will output an echo for each character it receives. If this parameter is set to "OFF", the instrument will not echo anything.

CTS DataHub

The CTS DataHub interface is a custom interface designed to work with a QualityWorX CTS Datahub setup. When **CTS DataHub** is enabled, the QualityWorX CTS Datahub setup will be able to communicate with the I28 instrument to capture streaming and result data. This data is stored on the QualityWorX CTS Datahub setup and allows for engineers and technicians to analyze and report on a collection of data from your production line.

The CTS DataHub parameter is located in **Main Menu > Global Config > Network**. When CTS DataHub is enabled, a new parameter **Configuration Key** will appear. This parameter is currently unused.

To setup QualityWorx CTS Datahub, please refer to the QualityWorX CTS Datahub Getting Started guide.

Establishing Ethernet (TCP/IP) Communication via TELNET

It is highly recommended that you consult with your company's IT department regarding the configuration of placing the instrument on any network. You should get the proper settings for the following parameters from your company's IT department.

The TCP/IP parameters are located in **Main Menu > Global Config > TCP/IP**. The first step in establishing Ethernet communication with the instrument is to set the Obtain Network Settings parameter to DHCP or Manual (static IP address). If set to "DHCP", the Instrument IP Address becomes a read only parameter. If set to "Manual", then you will need to set the Instrument IP Address manually. You may choose to let the instrument initially get its settings with DHCP and then change the setting to Manual to edit the IP Address of the instrument or lock it so that it will not change.

The Mail Server IP Address parameter should be set to the address of the SMTP mail server.

The Subnet Mask parameter will need to be configured next. The most common configuration for this parameter is "255.255.255.0" unless there is more than one subnet in which case a common configuration is "255.255.0.0".

The Gateway IP Address is the default gateway of the network domain.

The MAC Address is the hardware address of the instrument. This number is read-only.

Once you have established communication with the desired device you may select whether you want the instrument to "echo" back each character it receives on the TCP/IP 1 communication port. This setting is located in the **Main Menu > Global Config > Telnet 1** icon. Select **Telnet 1 Echo**.
If the parameter is set to "On", the instrument will output an echo for each character it receives.
If this parameter is set to "Off", the instrument will not echo anything.

Understanding the Header Information

All of the information that the instrument sends over the communication ports is preempted by header information. This data is sent to help parse specific information. This header information is in the format XXYYZZZ H. The header is followed by a Tab as shown in the table below:

Header	Description
XX	8-Bit CRC in HEX. Used for error checking.
YY	Sequence Code in HEX. The value increments from 01 to FF. This value can be used as a verification that all data has been received and nothing was missed by the receiving device.
ZZZ	Data length in HEX.
	Tab
H	Data Type Code. See Data Type Code Table
	Tab

Note: For the most up to date Data Type codes, type "TABLE HEADER" into the instrument using the communication port. The instrument will return a list of about 8 Data Type Codes and descriptions. The table below is an example of the instrument response.

Data Type Code	Description
V	Variable Edit
L	List
M	Message
Q	Result List
T	Streaming Started
S	Streaming Value
X	Streaming Stopped
R	Result

Test Results via RS232 or Ethernet (TCP/IP) communications

To see the menu settings described below, the communication interface must be set to "2-Way" and not to "Barcode". Depending on which type of communication is being used, these settings are located in:

Main Menu > Global Config > RS232 1 icon > **RS232 1 Results**, or
Main Menu > Global Config > RS232 2 icon > **RS232 2 Results**, or
Main Menu > Global Config > Telnet 1 icon > **TCP/IP 1 Results**.

In order for the instrument to send the test Result Data automatically once the test is complete the parameter is set to "ON". Once this parameter is turned on, the Result Field data parameters show on the screen. Each parameter may be turned on or off depending on the information that is required for to accompany each result. The Test Field parameter may be set to "All Result Information" or "First 2 Test Results". The "First 2 Test Results" will send the two primary results. The table below shows the format of the Test Result Data.

Parameter	Number of Characters	Format	Example Text	Description of Example
Channel #	4	C##	C01	Channel 1
Port #	3	N#	N1	Port 1
Program #	4	P##	P01	Program 1
Link Information	4		R--	No Link
Time	13	HH:MM:SS.XXX	16:15:14.123	16 hrs, 15 mins, 14.123 secs
Date	9	MM/DD/YY	40179	02/01/16
Unique Id	11	##########	0000098353	Unique test number
Program Evaluation	3	#	A	Accept
SPC Flag	2	#	*	SPC Test Data Result
Barcode	41	1…40	12345	Barcode Data
Test Field	**First 2 Test Results**			
Test Type	8	###	PLR	Pressure Decay-Leak Std
Test Evaluation	2	#	P	Pass
Test Data 1	22	TDI Data Unit	LR 0.123456 sccm	Test Data Identifier - Value - Unit
Test Data 2	22	TDI Data Unit	LR 0.123456 sccm	Test Data Identifier - Value - Unit
TAB				Tab
TAB				Tab
CR				Carriage Return
LF				Line Feed

Test Field	All Result Information			
Test Type	8	###	PLR	Pressure Decay-Leak Std
Test Evaluation	2	#	P	Pass
Test Data 1	22	TDI Value Unit	LR 0.123456 sccm	Test Data Identifier - Value - Unit
Test Data 2	22	TDI Value Unit	LR 0.123456 sccm	Test Data Identifier - Value - Unit
|	|	|	|	|
Test Data X	22	TDI Value Unit	LR 0.123456 sccm	Test Data Identifier - Value - Unit
TAB				Tab
TAB				Tab
CR				Carriage Return
LF				Line Feed

Note: For the most up to date Test Data Identifier Codes, type "TABLE VARIABLE" into the instrument using the communication port. The instrument will return a list of about 550 Test Data Identifier Codes and descriptions. See the full list in Appendix E.

Note: For the most up to date Test Evaluation Codes, type "TABLE EVALUATION" into the instrument using the communication port. The instrument will return a list of about 120 Test Evaluation Codes and descriptions. See the full list in Appendix E.

Note: For the most up to date Program Evaluation Codes, type "TABLE RESULT" into the instrument using the communication port. The instrument will return a list of about 12 Data Program Evaluation Codes and descriptions. See the full list in Appendix E.

Streaming Measured Data

The instrument has the ability to stream measured data to *one* of the selected interfaces using RS232, TCP/IP or USB in real time while the test is being conducted. This data may be collected and used for analysis. The data is comma delimited. The table below shows the format of the streaming data.

Parameter		Format	Example Text	Description of Example
Channel #	Comma Delimited	C##	C01	Channel 1
Program #	Comma Delimited	P##	P01	Program 1
Segment	Comma Delimited	XXX	PRF	Prefill Segment
Test Data	Comma Delimited	TDI Value Unit	LR 0.123456 sccm	Test Data Identifier - Value - Unit
TAB				Tab
TAB				Tab
CR				Carriage Return
LF				Line Feed

Note: For the most up to date Segment Codes, type "TABLE SEGMENT" into the instrument using the communication port. The instrument will return a list of about 120 Segment codes and Descriptions. See the full list in Appendix E***.***

Note: For the most up to date Test Data Identifier Codes, type "TABLE VARIABLE" into the instrument using the communication port. The instrument will return a list of about 550 Test Data Identifier codes and Descriptions. See the full list in Appendix E***.***

Note: Only ONE interface at a time can be selected for live streaming measurement data.

Parsing Data Packets

For users who are trying to parse data packets from the instrument, any line beginning with an asterisk "*" should be parsed to be ignored, as these lines will not have header information to be parsed. An example of these types of lines would be the Root menu displayed at instrument boot.

Reports

The instrument is capable of generating a variety of reports through RS232, Ethernet, Email, or USB memory port located on the front of the unit. The reports available are in the table below.

Report	Description
Cur Program Res	Reports all of the test results for the current active program. The current program can be seen in the bottom right hand corner of the display.
All Results	Reports all of the test results in the instrument memory.
Chan Last 1000	Reports the last 1000 test results.
Chan Last 100	Reports the last 100 test results.
Chan Last 20	Reports the last 20 test results.
Chan Last Res	Reports the last test result.
Global Config	Reports all of the parameters and their settings within the Global Config menu.
Channel Config	Reports all of the parameters and their settings within the Channel Config menu.
Cur Program Config	Reports all of the parameters and their settings within the current active program. The current program can be seen in the bottom right hand corner of the display.
Program Config	Reports all of the parameters and their settings within the Program Config menu.
Regulator Cal	Reports the Electronic Regulator Calibration data if the instrument is configured with an electronic regulator.
Transducer Ver	Reports the Transducer Verification data of the last Transducer Verification conducted on the instrument.
Transducer Cal	Reports the Transducer Calibration data of the last Transducer Calibration conducted on the instrument.
Channel Cntrs	Reports all of the counters in the instrument.

Chapter 25 – CTSnet LT

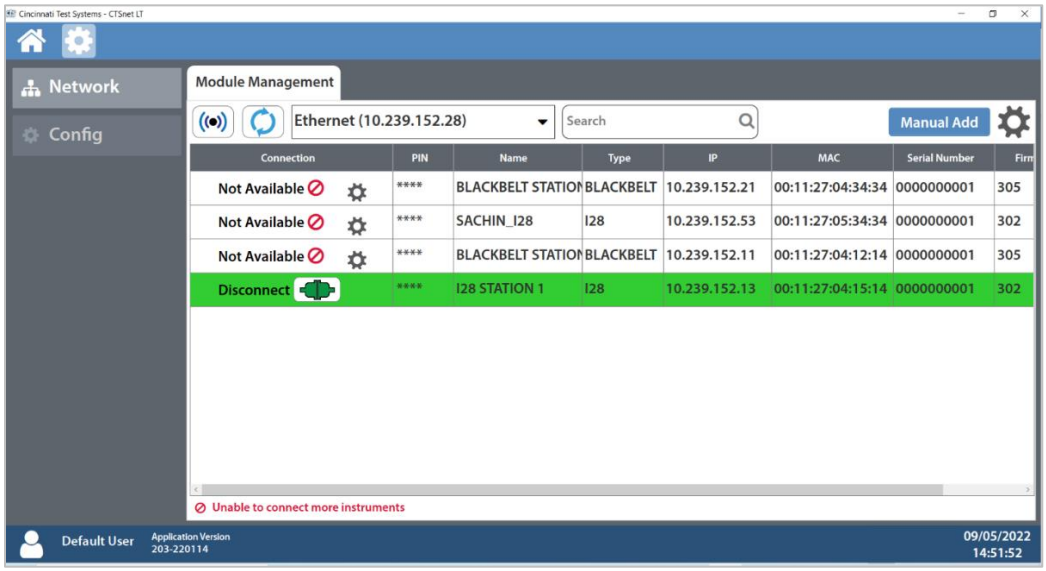
This chapter explores the basic use of CTSnet LT. CTSnet LT is a PC based graphical user interface that allows you to control, configure and monitor your instrument, all from a single, easy-to-use application. Please refer to the quick start guide on the USB drive included with your instrument for instructions on installing the application.

Compatibility

CTSnet LT application will require Win 10 OS installed on PC.

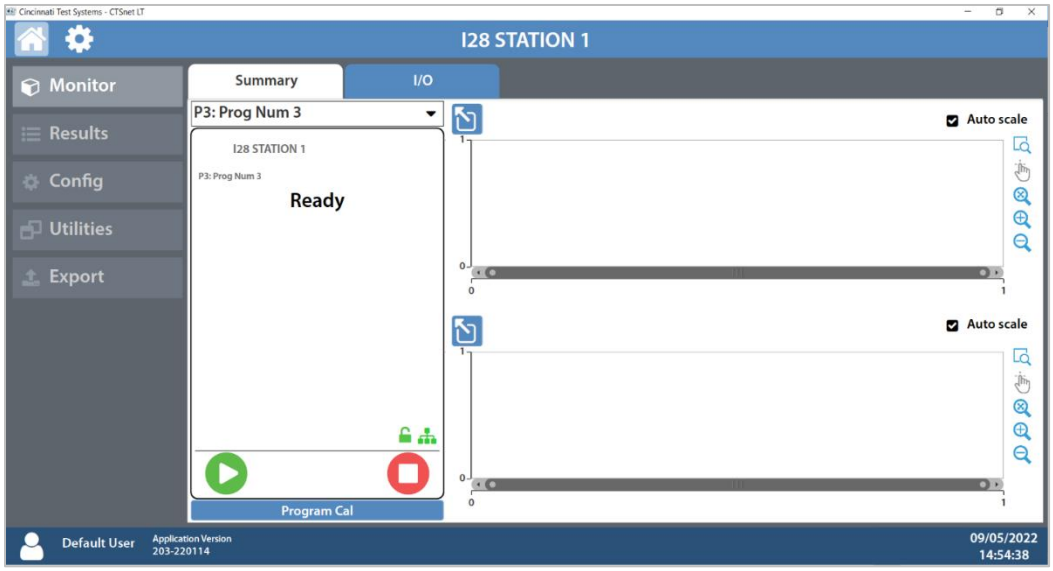
Initial Startup

After Setting up your I28 instrument(s) on the network, launch CTSnet LT. Your instrument(s) will appear on the Module Management screen. You can connect to an I28 by pressing the connect icon on each available instrument. The connected instrument's information will turn green to indicate that it is connected.



Note: The CTSnet LT application can only connect to one I28 instrument at time.

Once an I28 instrument is connected, you will be taken to the home menu. From here you can fully control and configure the I28 instrument to your specifications. This includes running and monitoring tests and calibration.



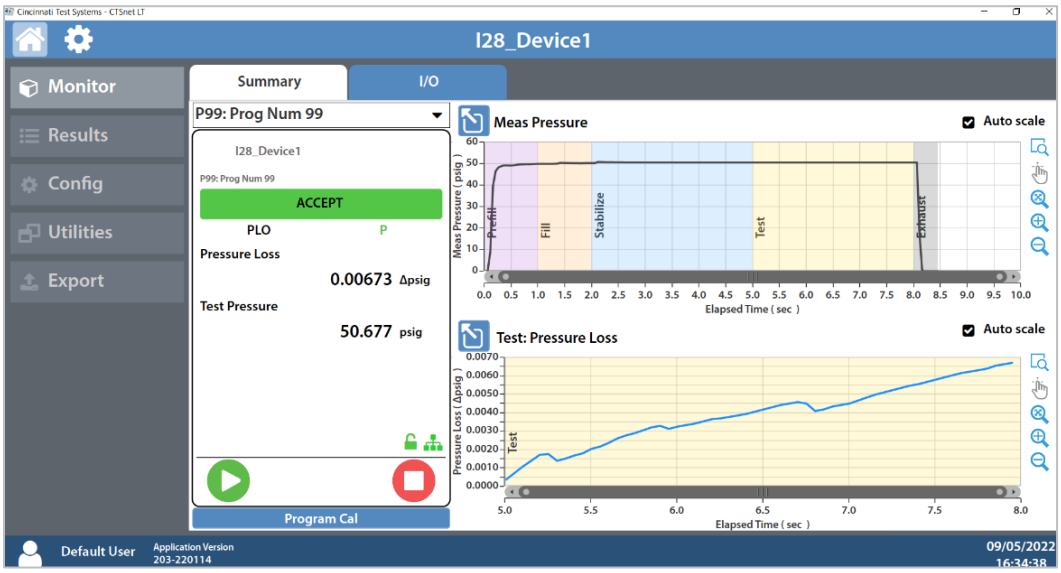
Monitor Screen

Summary Tab

The Summary tab will allow you to start, stop and hold tests. You can select the program being run by using the drop-down selector. Program calibration, if available for the selected program, can be performed from this tab as well.

The test can be visually monitored through its stages on the top plot. This plot displays the value of the primary transducer against elapsed time, as well as marking each phase of the test with color coordination. The bottom plot will display the value of the Secondary Transducer during the test phase.

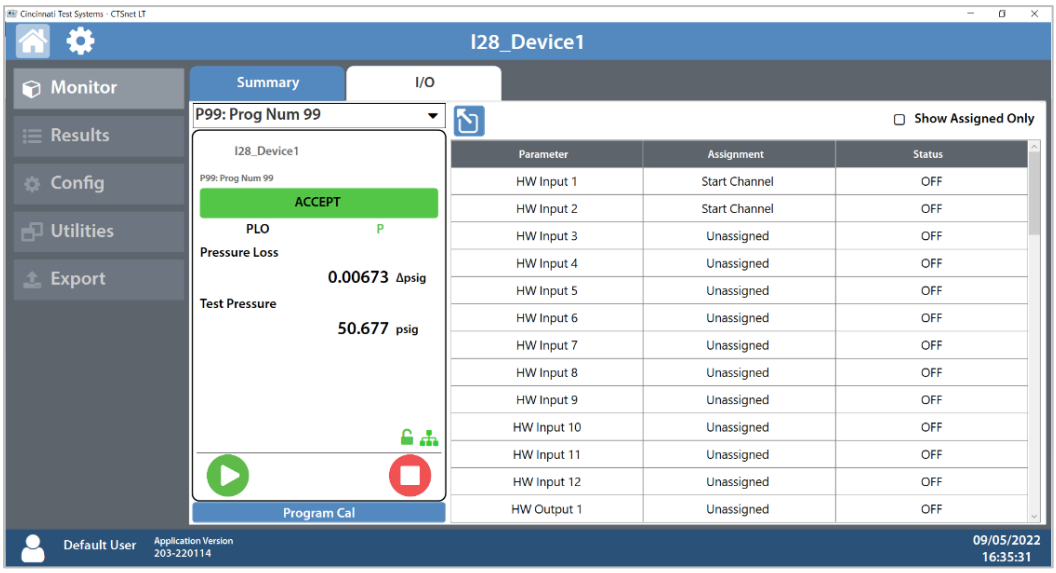
Each plot can be interacted with using the icons to the right of the plot or expanded to fit the screen with the maximize button in the upper left of the plot.



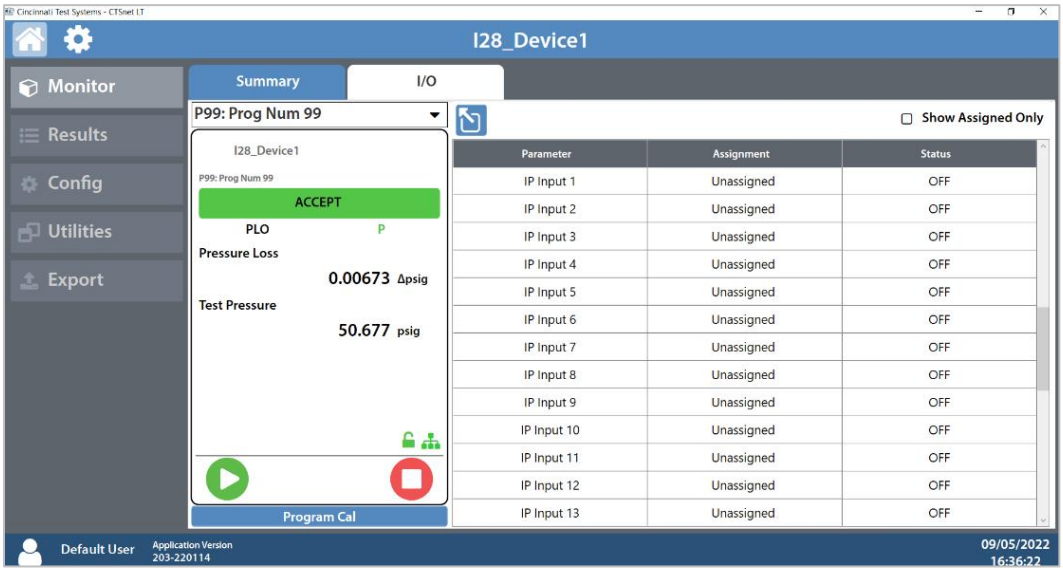
Plots shown are for demonstration, actual view may differ based upon the selected test type.

IO Tab

The I/O tab will allow you to monitor each input and output state in real time. This window can be expanded to fit the full screen by pressing the maximize button on the upper left of the I/O list.



When EtherNet/IP is enabled, the EtherNet/IP IO states will also be displayed here.



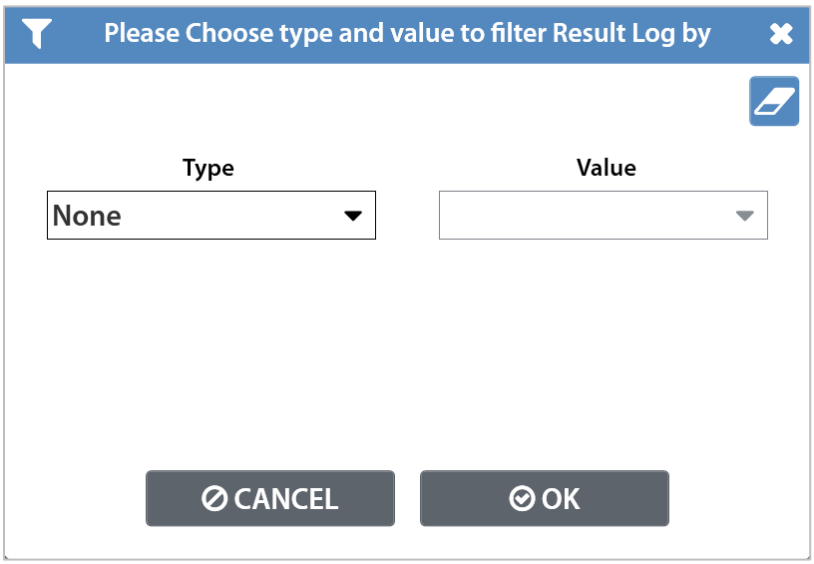
Results Screen

Results Tab

The Results tab displays the allowed number of results and allows for filtering by pressing the filter button. Results can also be cleared by pressing the delete button.

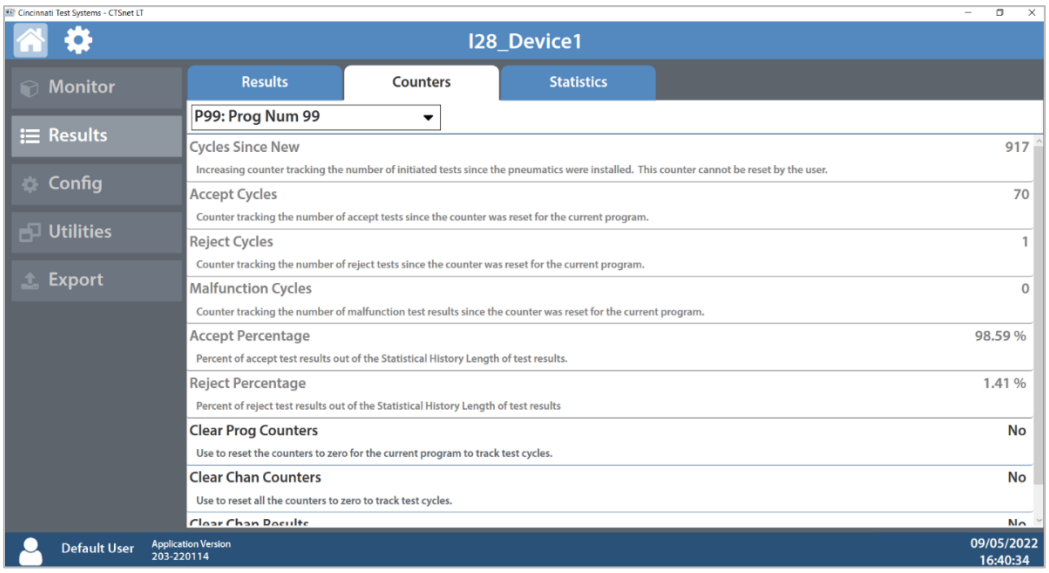
Filtering Results

You can create filters to sort Result logs.



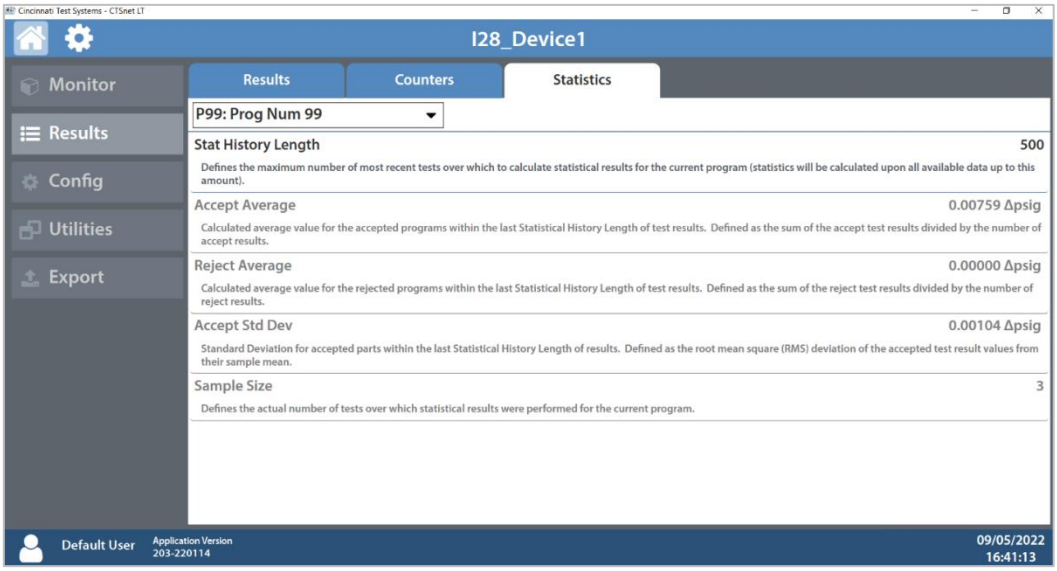
Counters Tab

The Counters tab displays the number of cycles performed on the instrument including the number of accept and reject cycles. These can be cleared to reset statistics.



Statistics Tab

The Statistics tab displays statistical analysis on the results from a selected program. The population of data can be adjusted using the Stat History Length parameter.

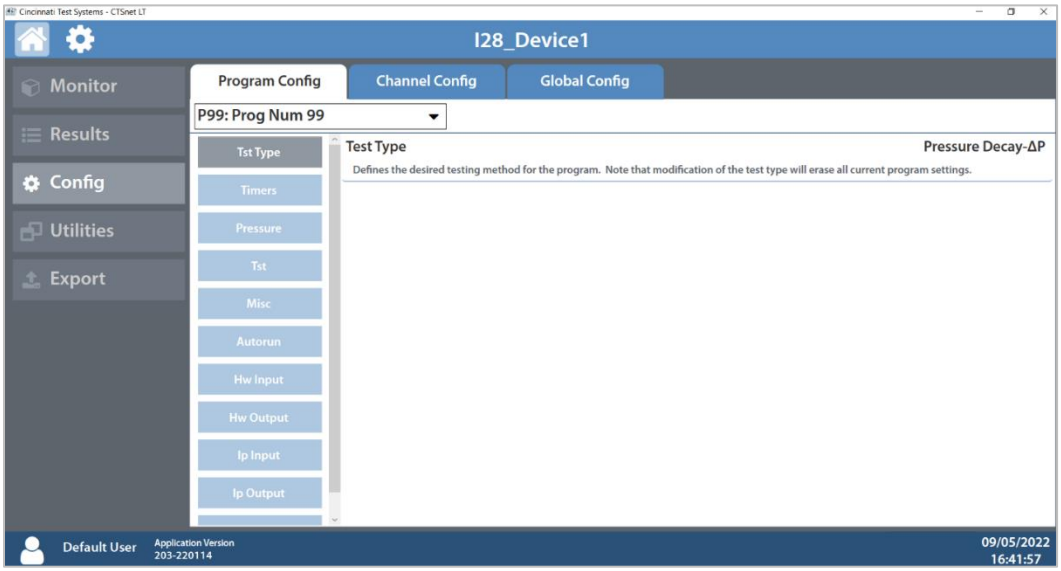


Configuration Screen

Program Configuration Tab

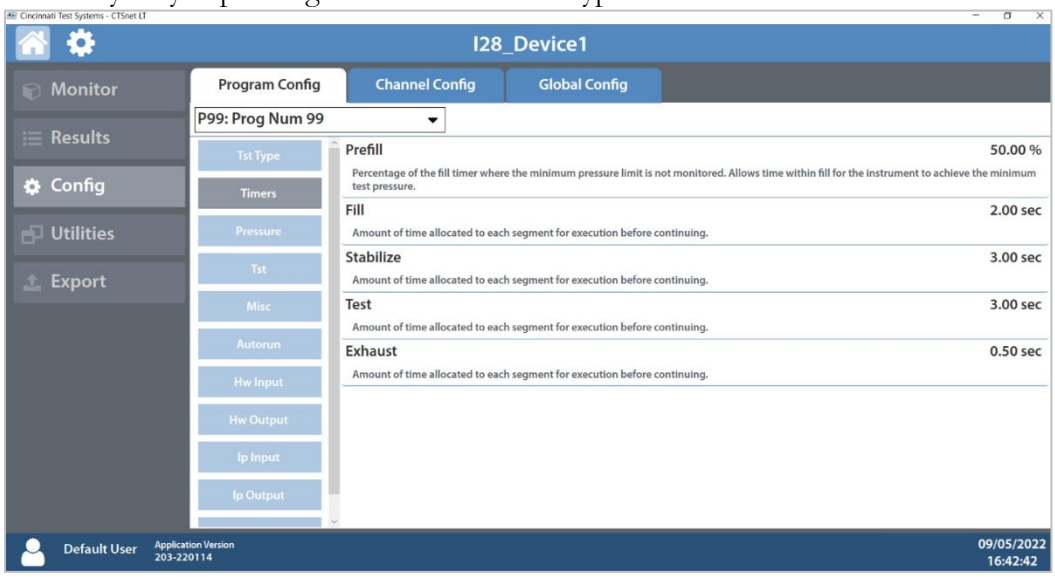
Selecting Test Types

The test type for the current program can be selected under the Tst Type menu. Refer to Chapter 2 – Setup for options. The drop-down menu at the top of the Program Config tab allows for configuration of up to 99 programs.



Setting Timers

Navigating to the Timers menu under the Program Config tab will allow you to set the various stage timers to the desired values. These timers may be preset at CTS for a specific set of test parameters. Please contact CTS to get information on how to set timers for your specific test. Timers are set per program and may vary depending on the selected test type.

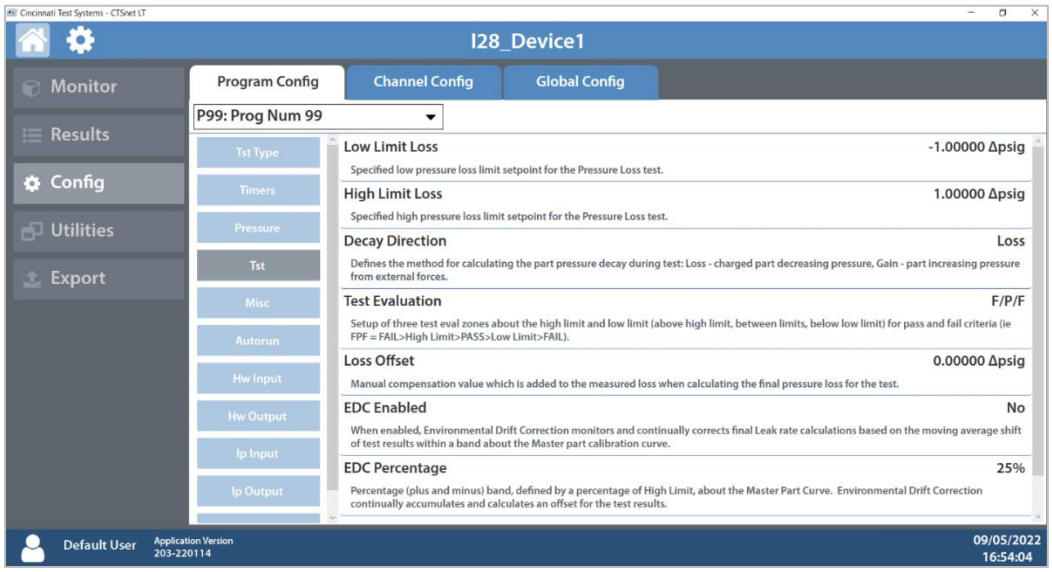


Setting Pressure

Navigating to the Pressure menu under the Program Config tab will allow you to set the target pressure for the selected test, as well as the minimum and maximum constraints for the test to continue.

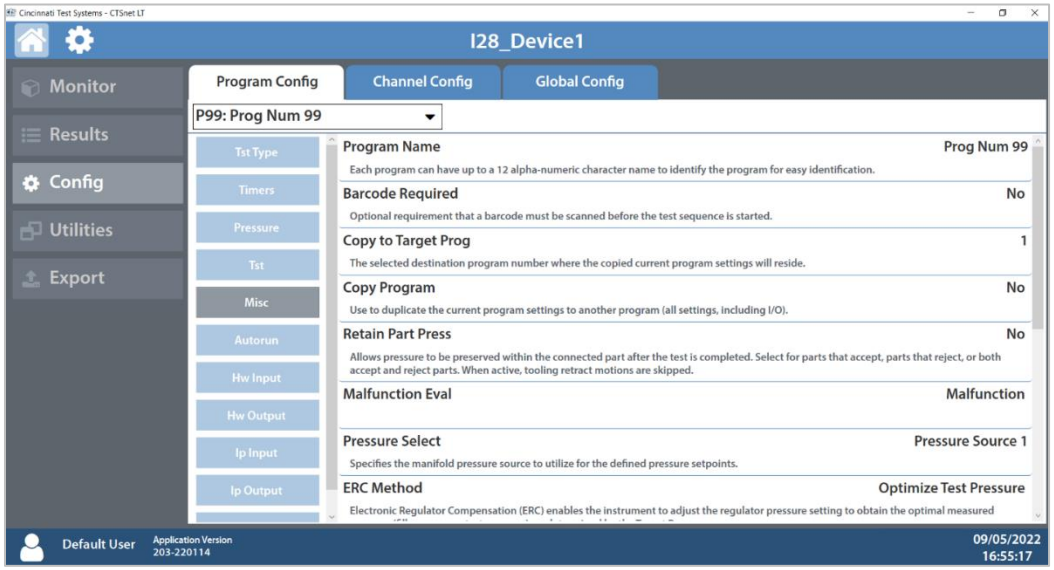
Setting Test Parameters

Navigating to the Tst menu under the Program Config tab will allow you to set the constraints of your test. For example: for a differential pressure decay test, the maximum pressure loss or gain through the test port may be configured here. Refer to the Test Type Table for setting parameters.



Miscellaneous settings

Navigating to the Misc menu under the Program Config tab will allow you to enter in a custom name for the selected program, as well as copy programs from one program to another. Various other settings, such as Electronic Regulator Control Method (if an electronic regulator is available), Prefill Method, Pressure Correction and Exhaust Method. Refer to Chapter 28 for setting parameters.

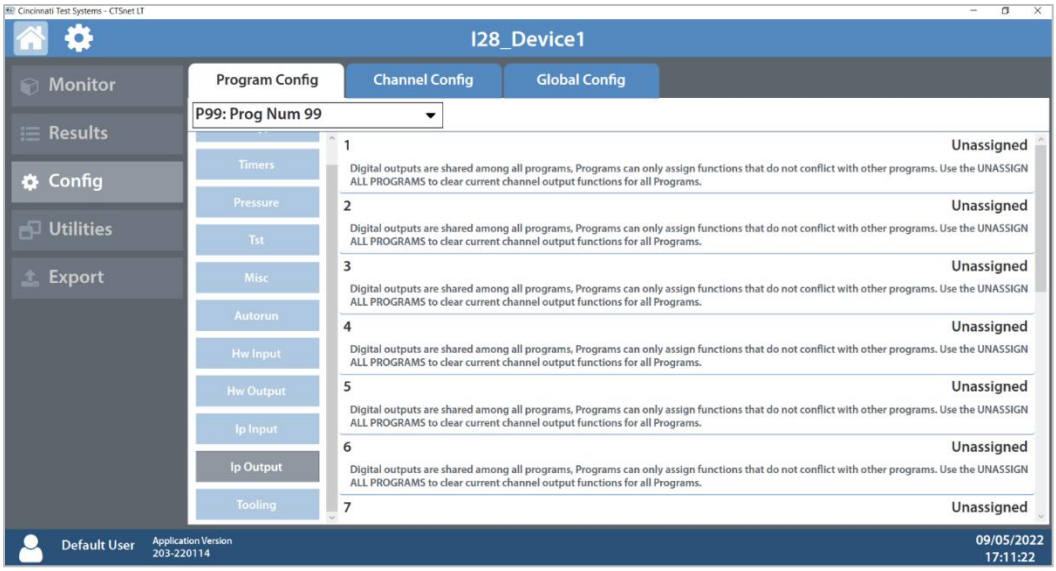


Hardware Input and Output

Navigating to the HW Input / Output menu under the Program Config tab will allow you to configure up to 12 inputs and 12 outputs. Refer to Chapter 21 – Inputs and Outputs for setting parameters.

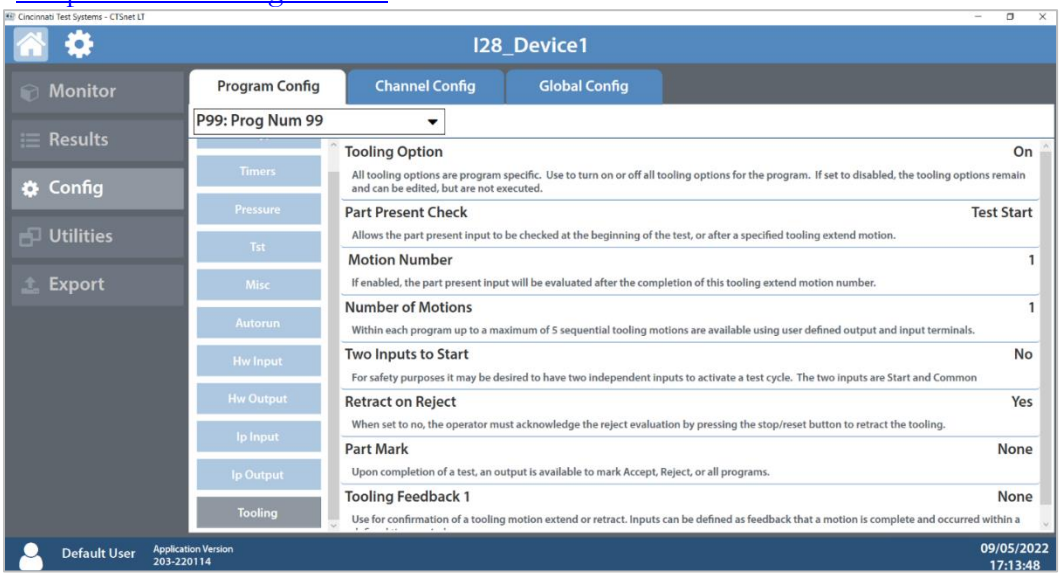
Ip Input and Output

Navigating to the Ip Input / Output menu under the Program Config tab will allow you to configure up to 16 inputs and 16 outputs. Refer to Chapter 21 – Inputs and Outputs for setting parameters.



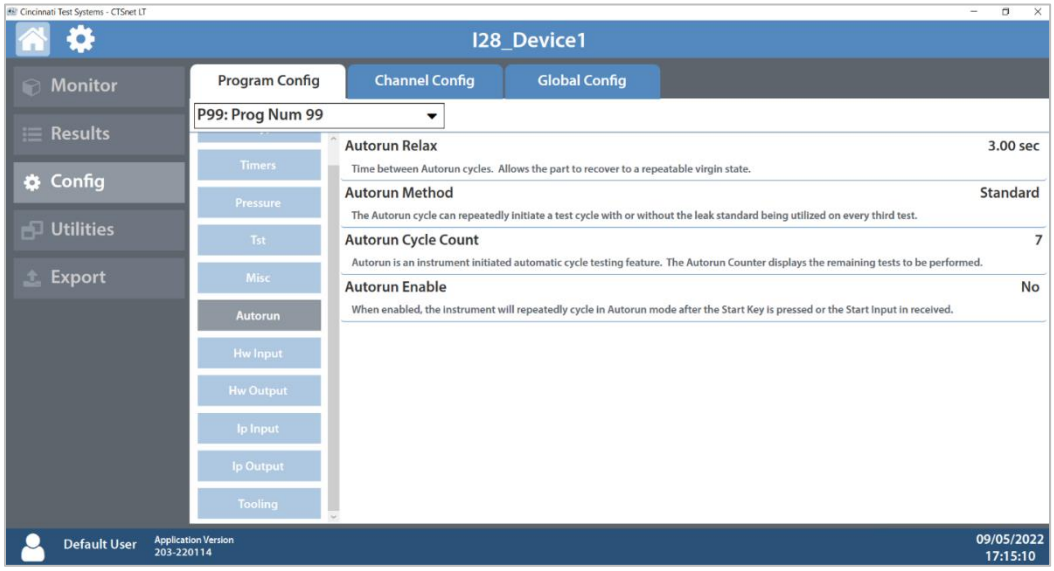
Tooling

Navigating to the Tooling menu under the Program Config tab will allow you to enable or disable tooling motions. The part present check input may be executed before or after tooling motions. Refer to Chapter 20 – Tooling Control



Autorun

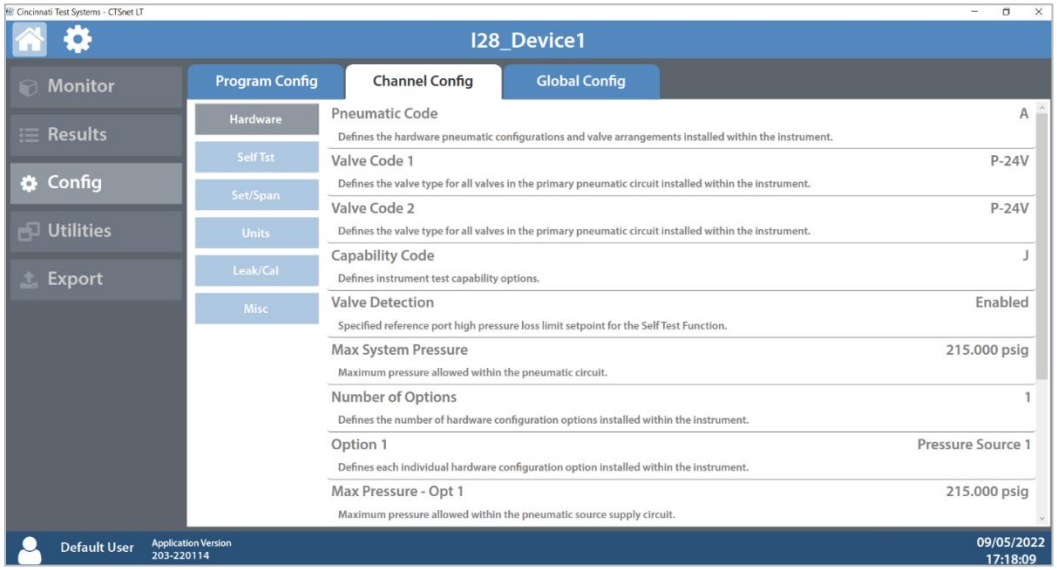
Navigating to the Autorun menu under the Program Config tab will allow you to configure automatic tests, where the selected program will be run a selected number of times.
Refer to Chapter 28 - Autorun for setting parameters.



Channel Configuration Tab

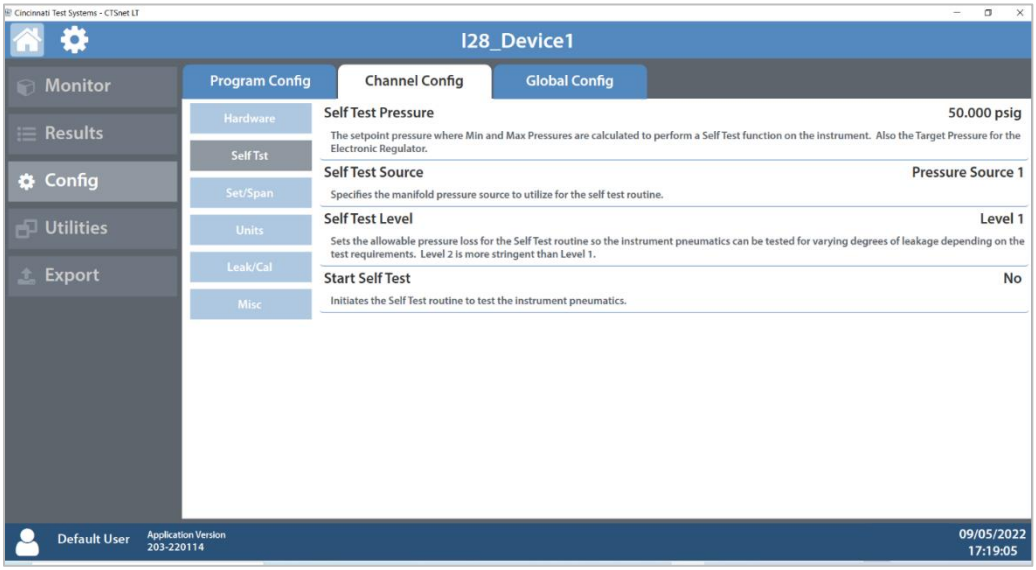
Hardware Configurations

Navigating to the Hardware menu under the Channel Config tab will allow you to view the factory settings of your I28 instrument(s).



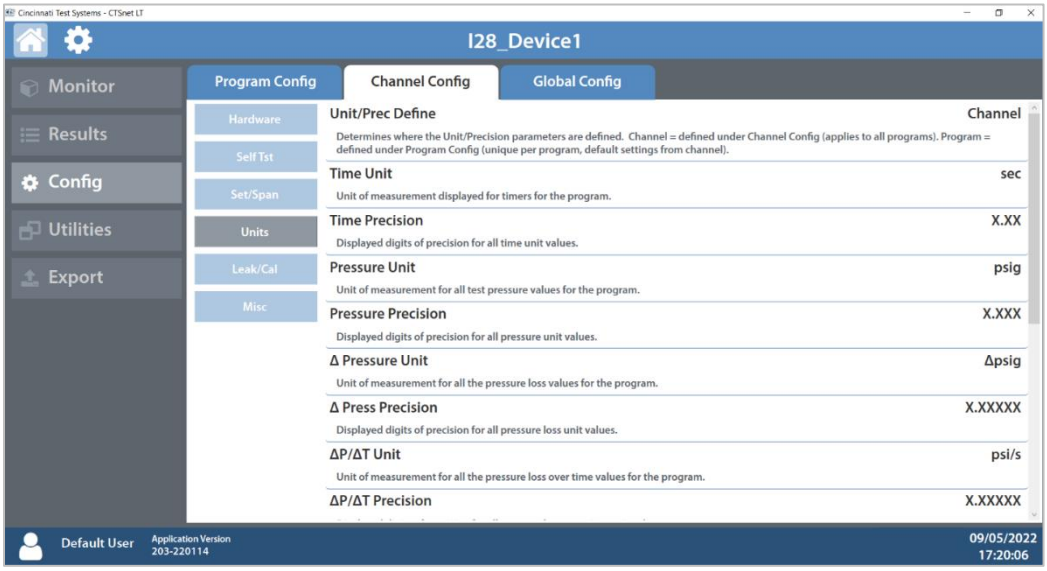
Self-Test

Navigating to the Self Tst menu under the Channel Config tab will allow you to check your I28 instrument(s) for internal leaks at a set pressure. Refer to Chapter 28 - Self-Test for more information.



Setting Units

Navigating to the Units menu under the Channel Config tab will allow you to define units for every program. Refer to Chapter 2- Setting the Units of Measure for more information and for setting parameters.

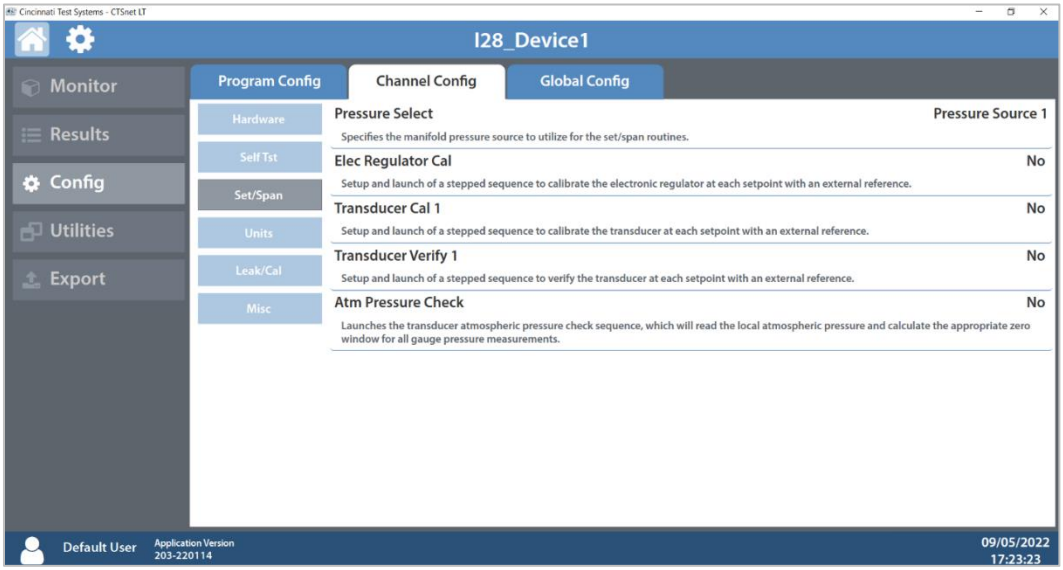


Leak and Calibration

Navigating to the Leak/Cal menu under the Channel Config tab will allow you to set the leak standard parameters for the I28 instrument(s). Refer to Chapter 2- Setting the Leak Standard Values for more information and for setting parameters.

Calibration

Navigating to the Set/Span menu under the Channel Config tab will allow you to run verifications on the transducers available in the I28 instrument as well as an Atmospheric Pressure Check to determine the current atmospheric pressure. Calibrations are done by CTS service. Refer to Chapter 2 - Setup for more information.



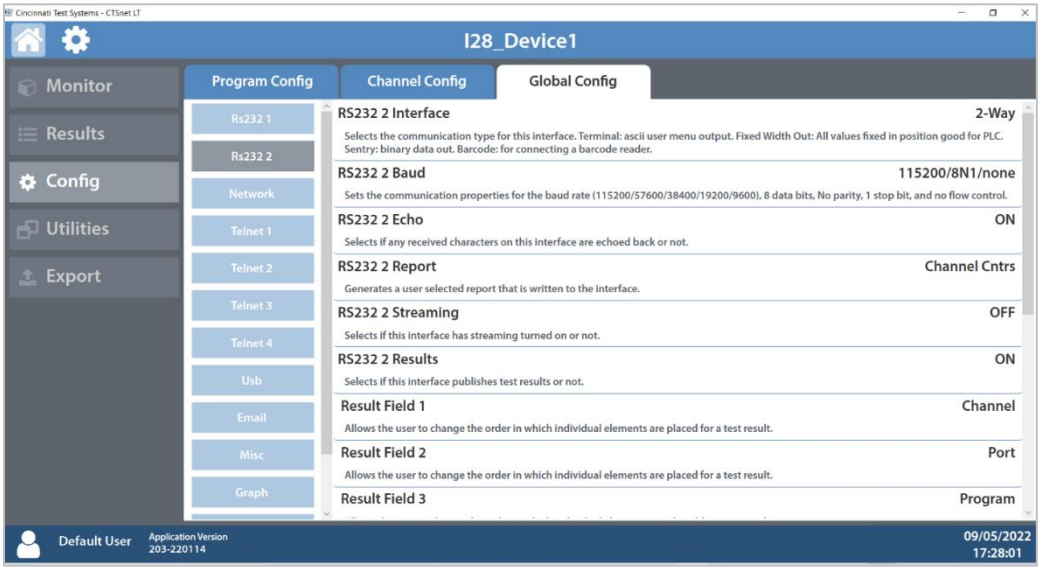
Miscellaneous parameters

Navigating to the Misc menu under the Channel Config tab will allow you to set the maximum allowable programs available up to 99 total.

Global Configuration Tab

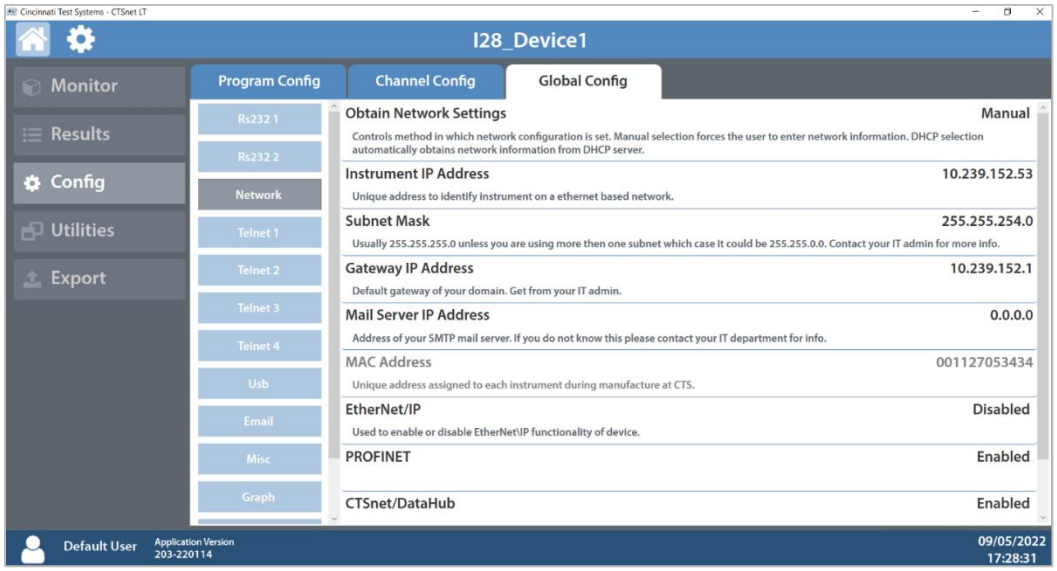
RS232 1 and RS232 2

The instrument can perform direct serial communication. Refer to Chapter 24 – Communication for more information and setting parameters.



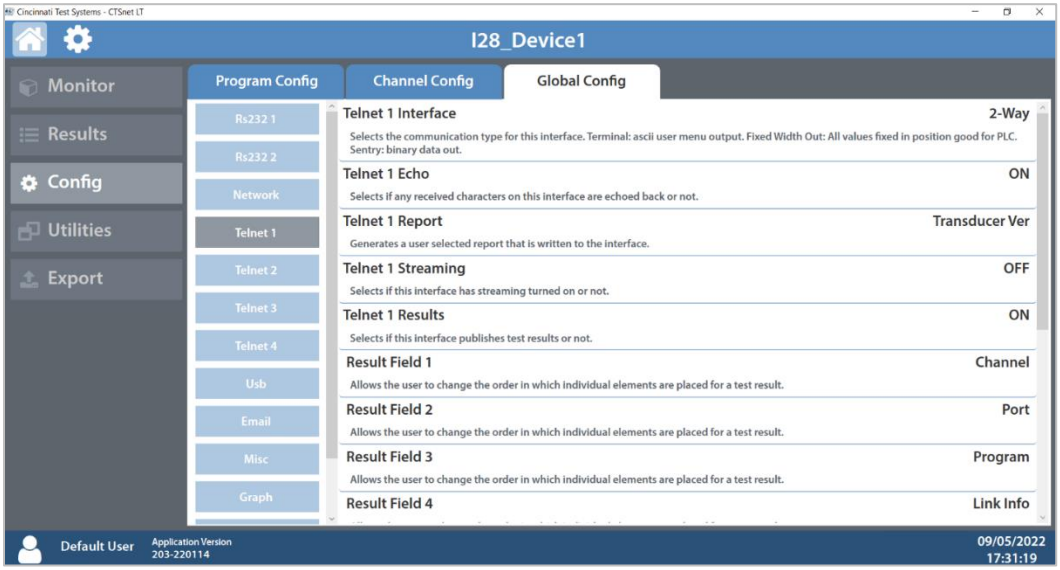
Network

Navigating to the Network menu under the Global Config tab will allow you to change the network parameters for your I28 instrument(s). Please contact your IT department for valid network settings before making changes and refer to Chapter 24– Communication for more information.



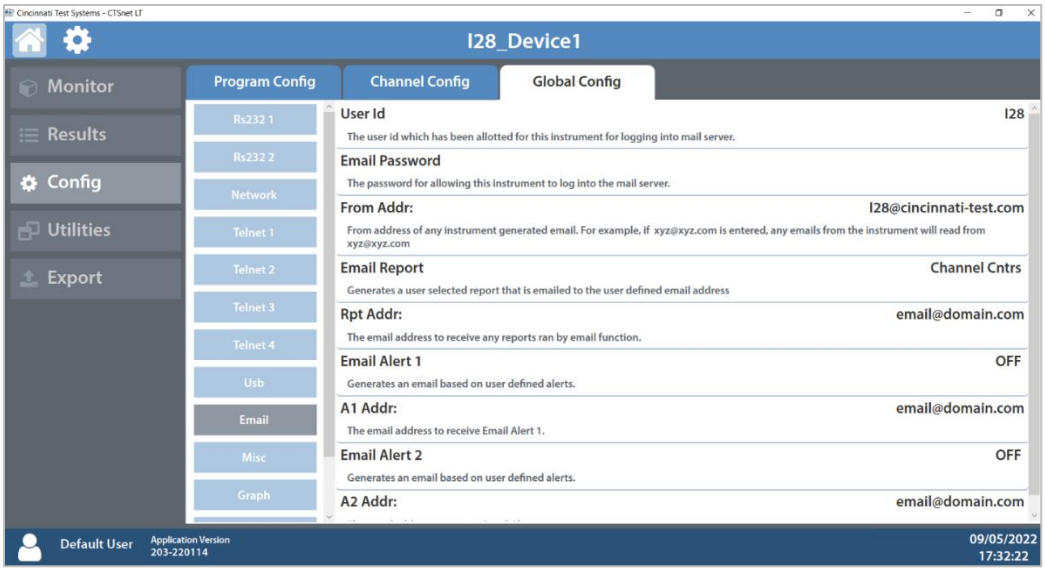
Telnet Communications

Navigating to the Telnet menus under the Global Config tab will allow you set various parameters regarding telnet communications. The I28 instrument can support 4 separate telnet channels at once: Telnet 1, 2, 3 and 4. Refer to Chapter 24 - Communication for more information.



Email Settings

Navigating to the Email menu under the Global Config tab will allow you to create various email reports. Refer to Chapter 24 – Communication for more information.

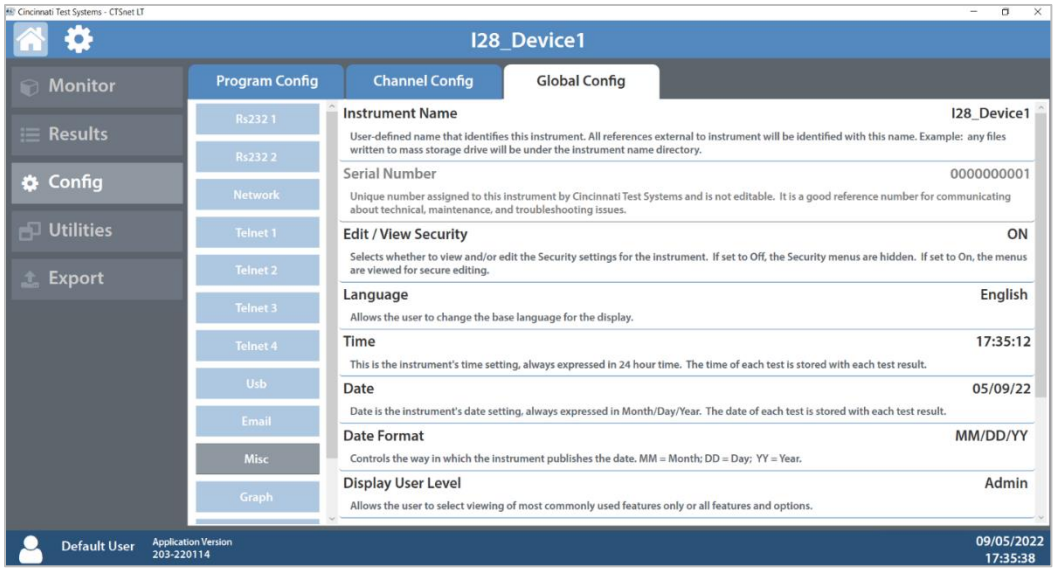


USB settings

Navigating to the USB menu under the Global Config tab will allow you to generate reports onto the USB device by directly connecting the USB device to the instrument.

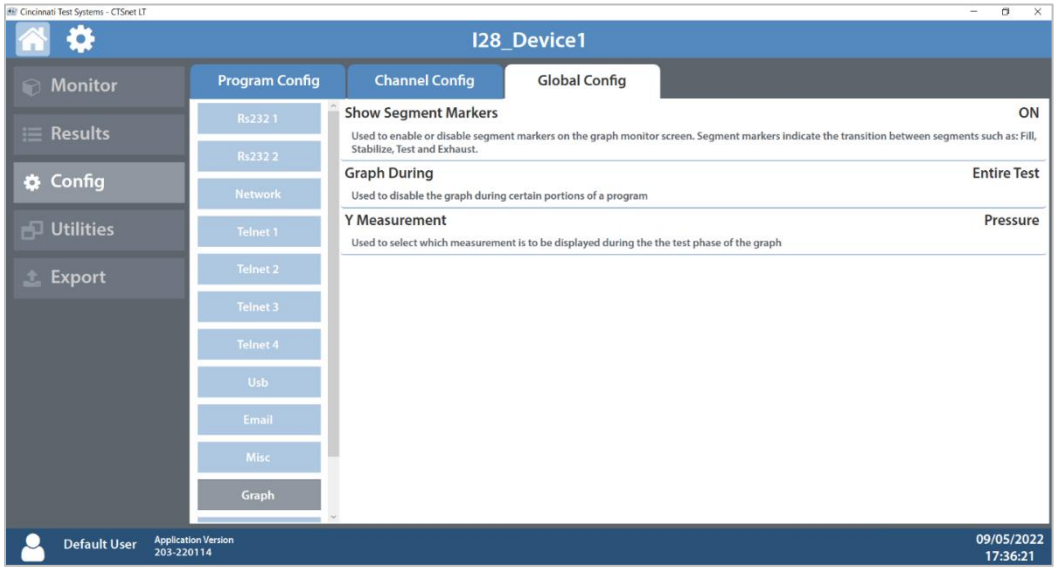
Miscellaneous settings

Navigating to the Misc menu under the Global Config tab will allow you to change your I28 instrument's display name, date, time and user level. Refer to Chapter 28 – Features for more information and to set parameters.



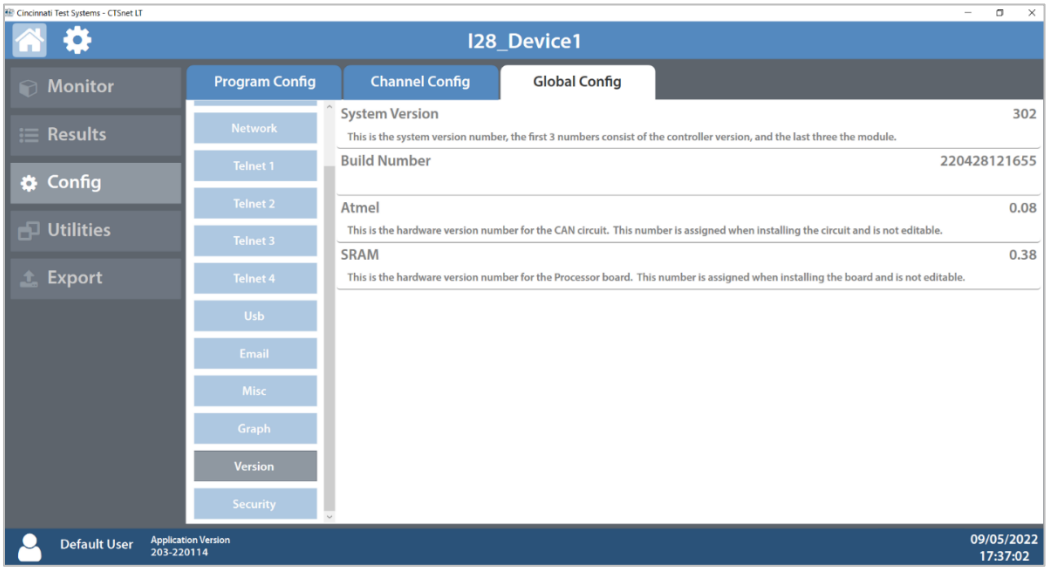
Graph

This menu when selected displays following options as per below screenshot.
Show Segment Markers, Graph During and Y Measurement.



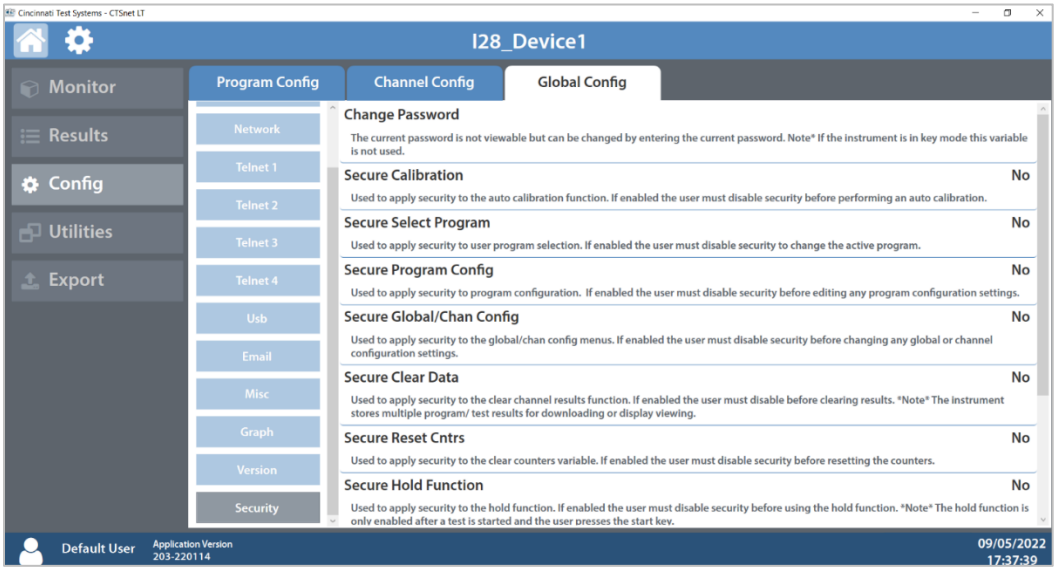
Version

Navigating to the Version menu under the Global Config tab will allow will display version information about your I28 instrument(s).

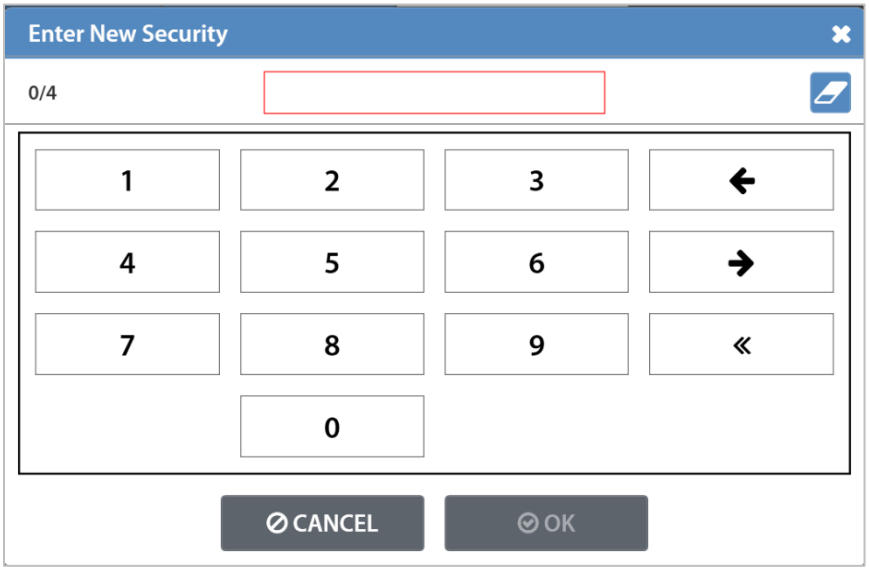


Security

Navigating to the Security menu under the Global Config tab will allow you to set a password for your I28 instrument(s) as well as secure various features and functions of the instrument(s).



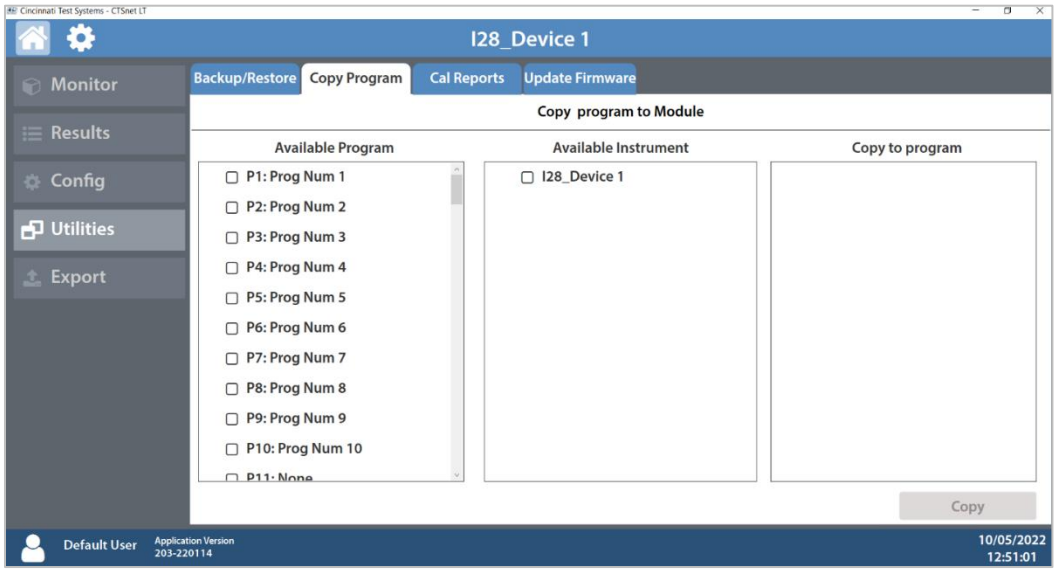
Whenever a secured feature or function is accessed, the user will be prompted to enter the security password.



Utilities Screen
Copy Program Tab

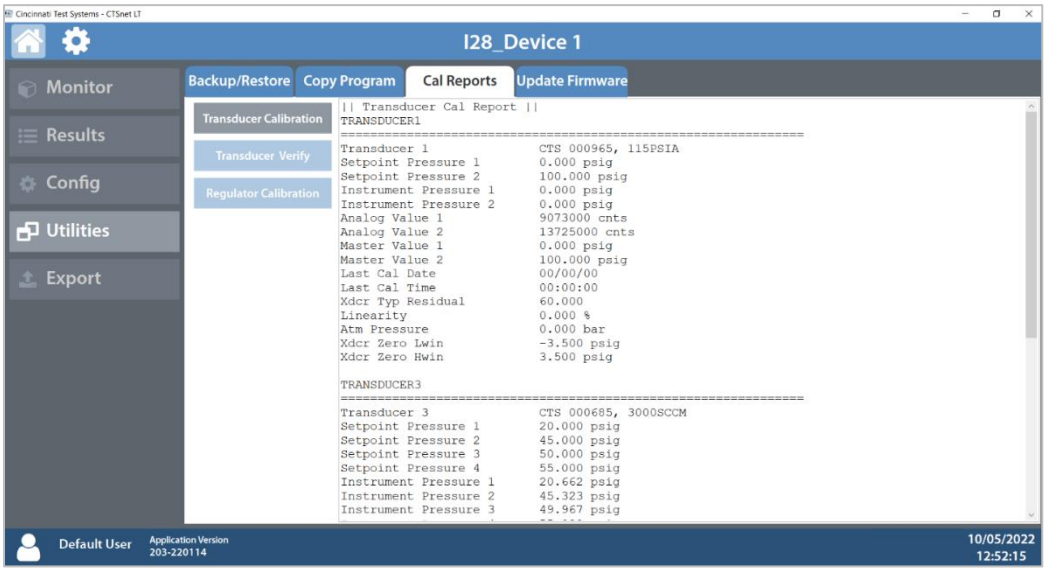
The Copy Program tab will allow you to copy any available program to one or more instruments.

1) Select the program you wish to copy from the list of available programs.
2) Select the instruments you wish to copy them to.
3) Select the program you wish to overwrite with the copied program and press Copy



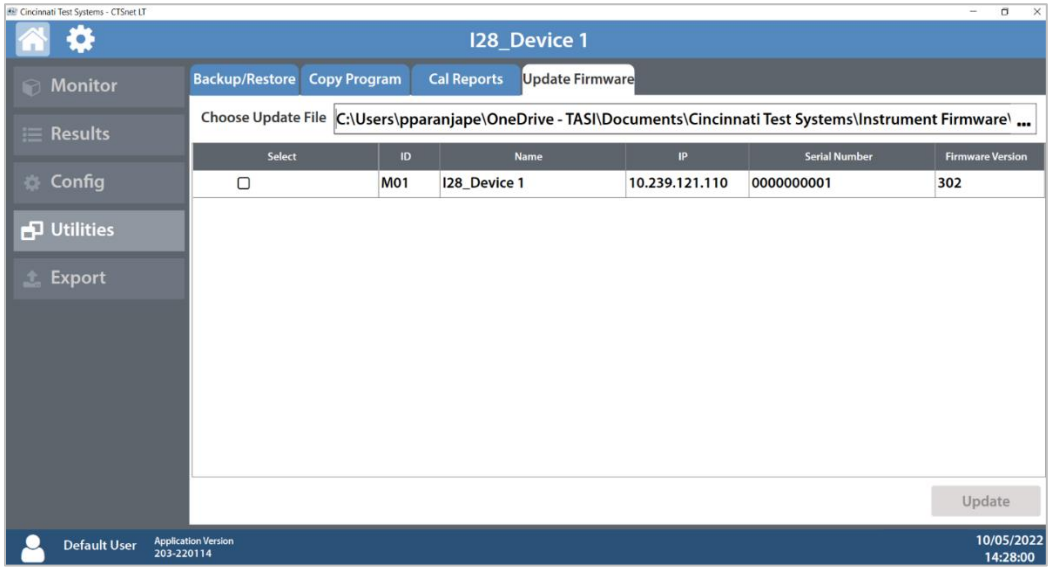
Cal Reports Tab

Navigating to the Transducer Calibration menu under the Cal Reports tab will allow you to view the Transducer calibration/Verification and Electronic regulator Calibration results for all available transducers.



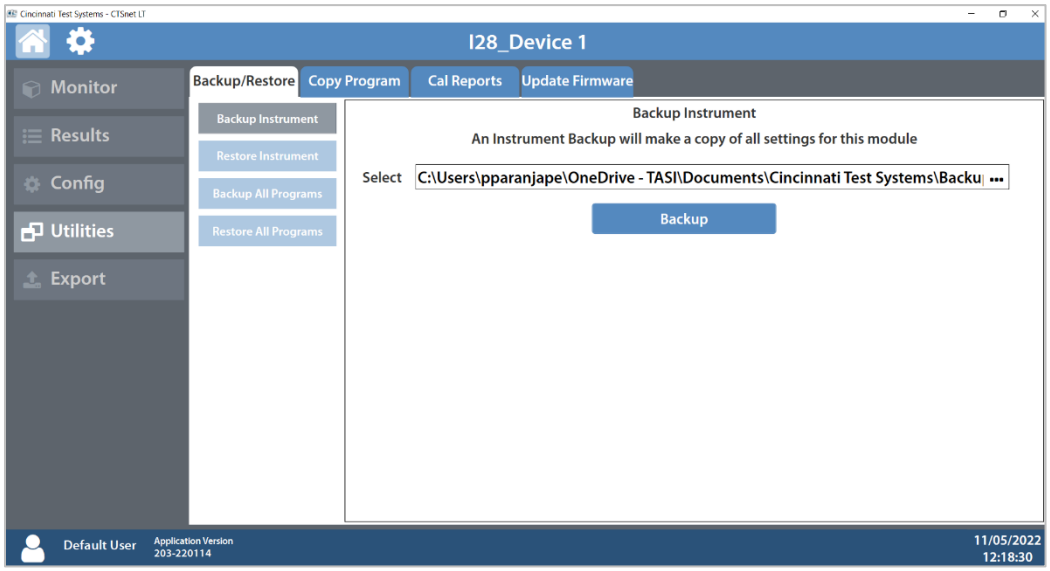
Update Firmware Tab

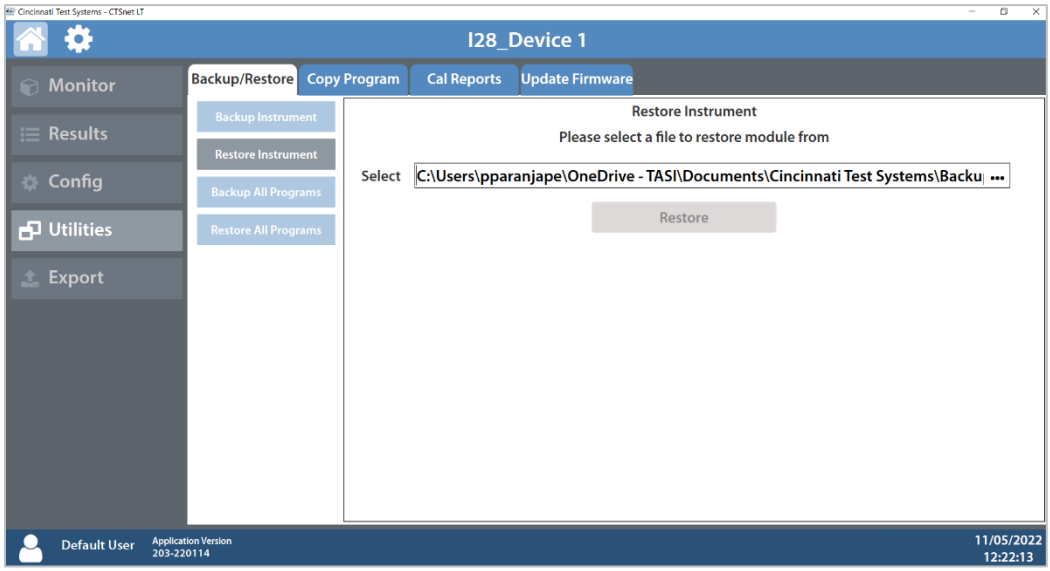
This tab will allow you to update instrument firmware. Browse for and choose the firmware file and select the device in which an update needs to be performed. Click on the Update button. The instrument firmware will get updated and device will reboot. Please contact CTS to get more information on this.

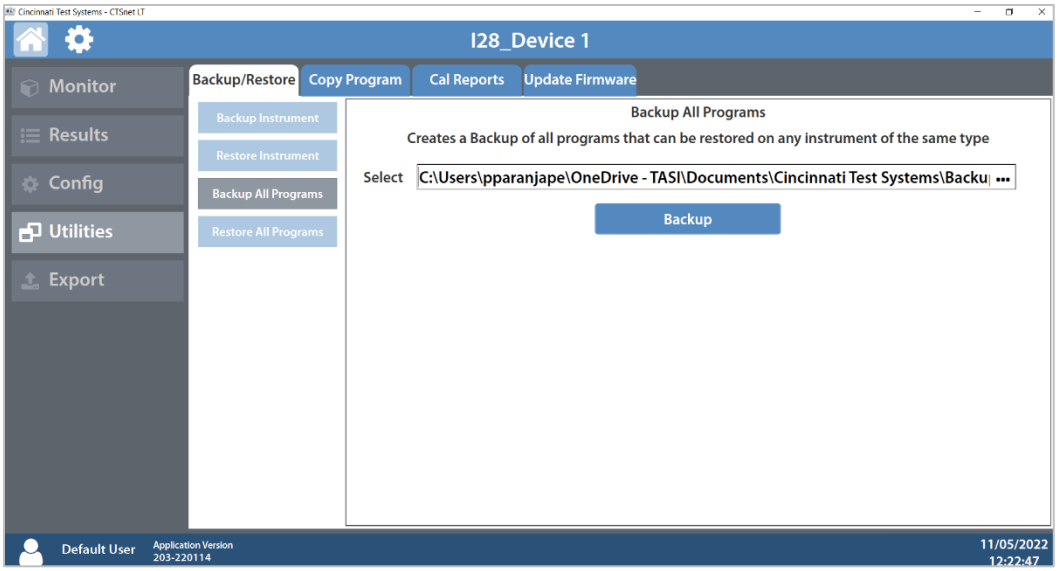


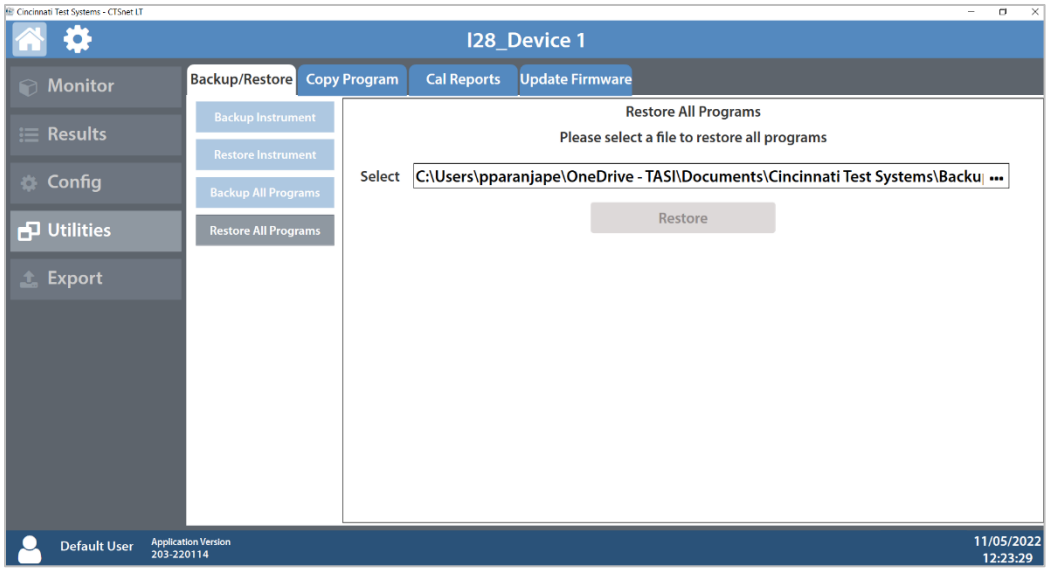
Backup/Restore Tab

This tab will allow you to create instrument backup of all settings, restore an instrument back up file, create a backup file of all programs, restore a backup file of all programs as shown in below screenshots.



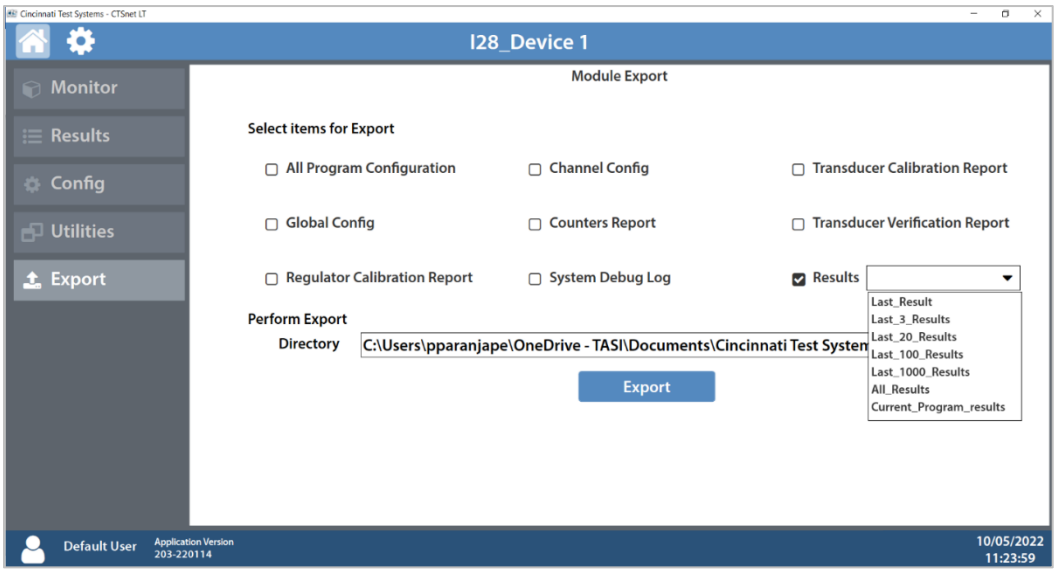



Cincinnati Test Systems - CTSnet LT
I28_Device 1
Monitor
Results
Config
Utilities
Export
Backup/Restore
Copy Program
Cal Reports
Update Firmware
Backup Instrument
Restore Instrument
Backup All Programs
Restore All Programs
Backup All Programs
Creates a Backup of all programs that can be restored on any instrument of the same type
Select
C:\Users\pparanjape\OneDrive - TASI\Documents\Cincinnati Test Systems\Backu
Backup
Default User
Application Version
203-220114
11/05/2022
12:22:47


Cincinnati Test Systems - CTSnet LT
I28_Device 1
Monitor
Results
Config
Utilities
Export
Backup/Restore
Copy Program
Cal Reports
Update Firmware
Backup Instrument
Restore Instrument
Backup All Programs
Restore All Programs
Restore All Programs
Please select a file to restore all programs
Select
C:\Users\pparanjape\OneDrive - TASI\Documents\Cincinnati Test Systems\Backu
Restore
Default User
Application Version
203-220114
11/05/2022
12:23:29

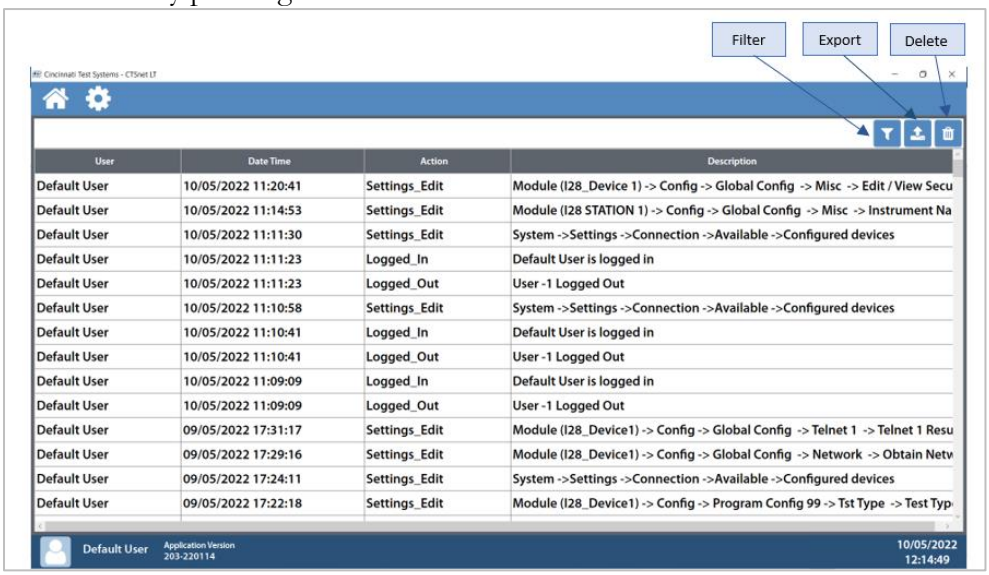
Export Screen

The Export section will allow you to export a various results as .txt files.
You can also export System Debug Log to send to CTS for service needs.



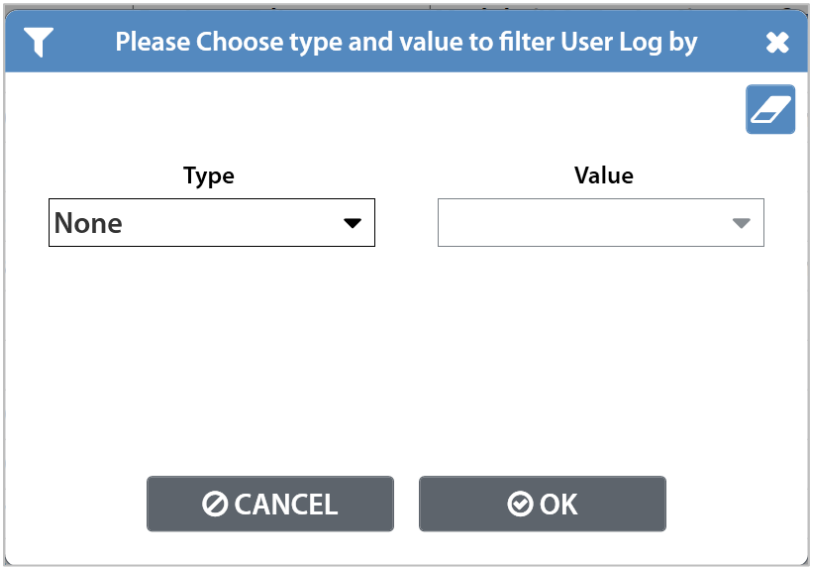
Users Screen

Pressing the user icon on the bottom left of the screen will display a log of user actions along with a description of the action. This log can be filtered by pressing the filter icon, exported by pressing the export icon or deleted by pressing the delete icon.



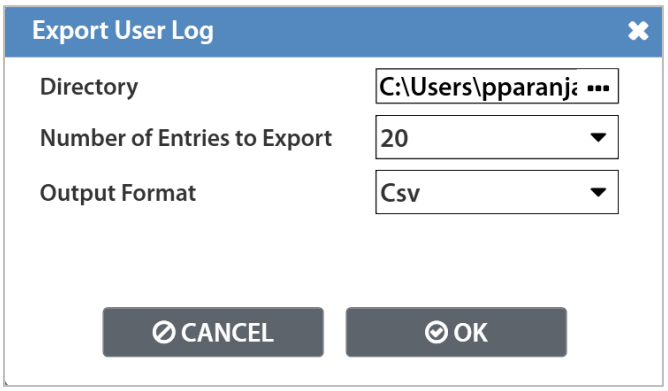
Filtering User Log

You can create filters to sort user logs.

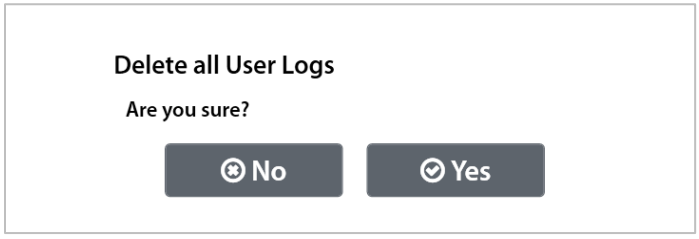


Exporting User Log

When exporting the user log, select a folder to export to, the number of entries and the output format.



Deleting User Log



Chapter 26 – Webserver

The instrument provides a rich web server to control and configure the instrument. The Web Server can be used to display and update configuration, backup/restore instrument configurations, upgrade instrument firmware, and navigate remotely.

System Requirements

To use the Web Server, you must have the following:

- a TCP/IP-based network
- a web browser installed on your computer, preferably either Google Chrome 60.0X or Microsoft Internet Explorer 11.0X and above

Note: The web server can be accessed from any operating system that supports the TCP/IP protocol and a web browser. You cannot view the embedded web server pages from outside a firewall.

Viewing the Web Server

Launch your web browser. In the Address or Go to field, type the IP address assigned to the instrument (for example: http://192.168.1.1). For more details on setting up the IP address on the instrument, refer to Chapter 24 - Communication.

Home Page

The top section will always display the Identity information (Instrument name, Firmware Version, Serial number, and MAC address) of the instrument. The Home page is shown in Figure 1.

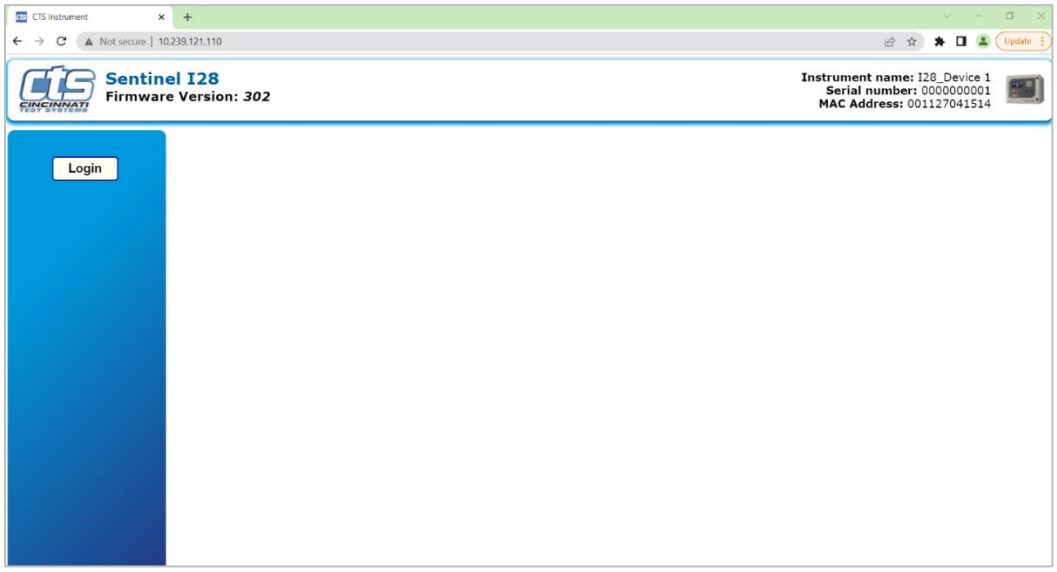


Figure 1 Web page - Login Page

Web Server Login

Once you click **Login**, the web server will prompt you for a User Name and Password. You must login with the appropriate username and password to access the webserver features. For more details on security, please refer to Chapter 27 - Security.

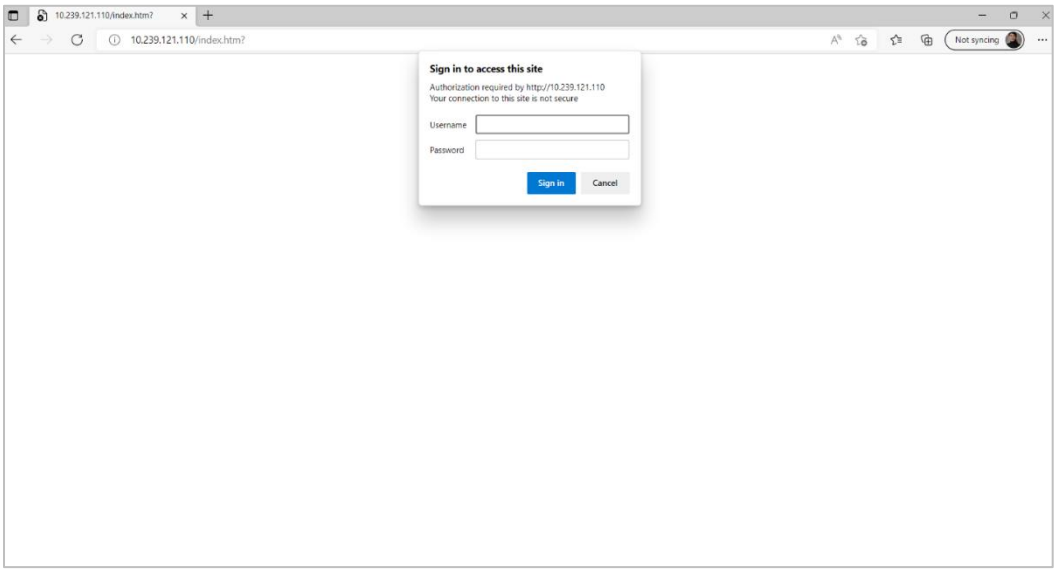


Figure 2 Security login

Navigation - Web Server

The left section lists all available menus. Clicking a menu in the left section will update the right section with content for the selected menu.

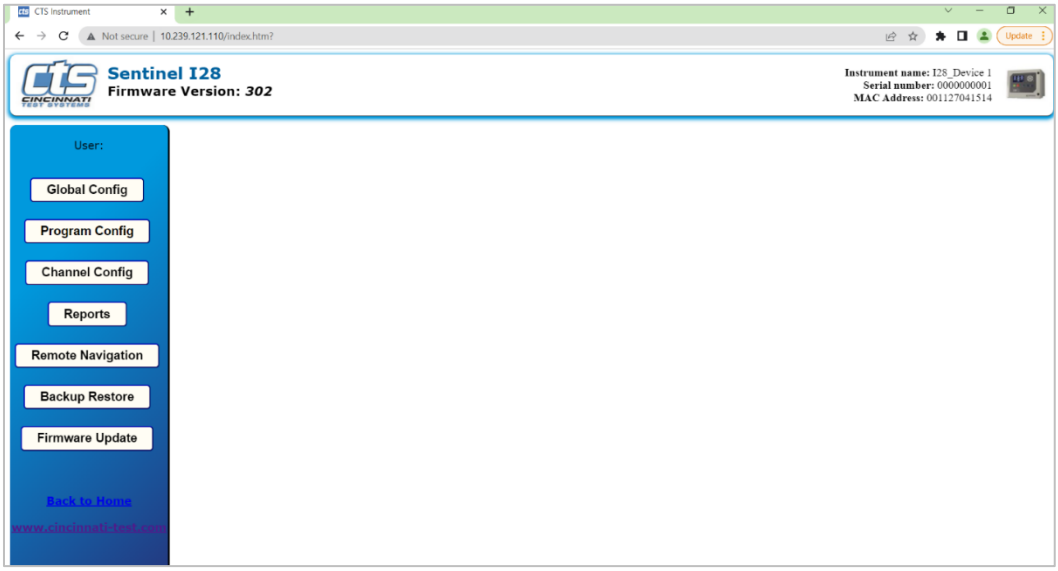


Figure 3 Web Page - Main Page

The **Channel config** page allows you to configure Channel Config parameters for the instrument.

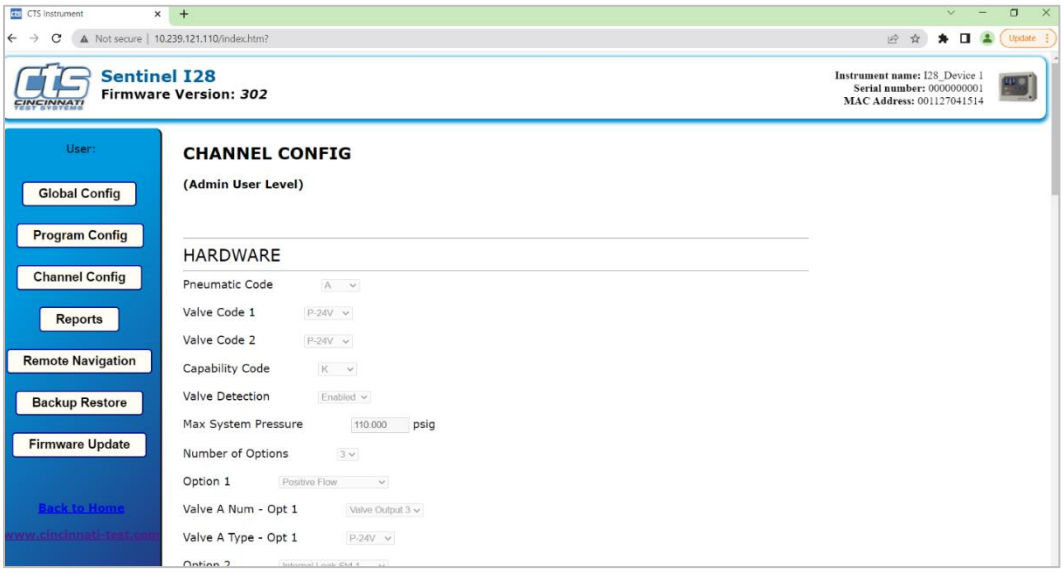


Figure 4 Web Page - Channel Config

The **Global config** page allows you to configure Global Config parameters for the instrument.

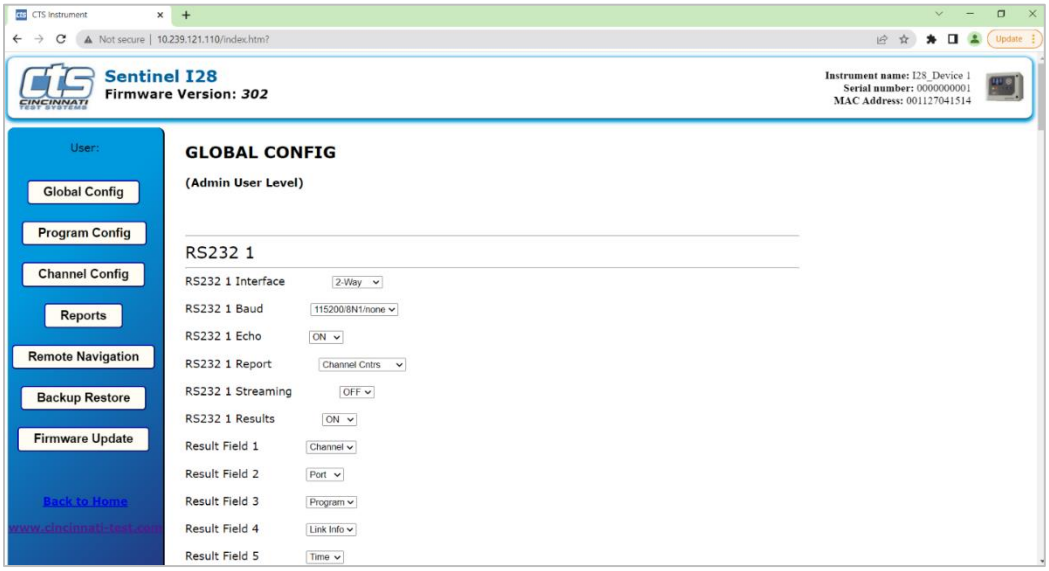


Figure 5 Web Page - Global Config

The **Program config** page allows user to configure Program Config parameters for the selected program. To select a program, move the cursor onto "**Program Config**" menu. This will display available slots in the instrument i.e. 1-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99. Hold the cursor on 1-9 slot to display list of programs under it. Select the required program. Information for this program will be displayed. This same technique can be used to select and configure any other available program.

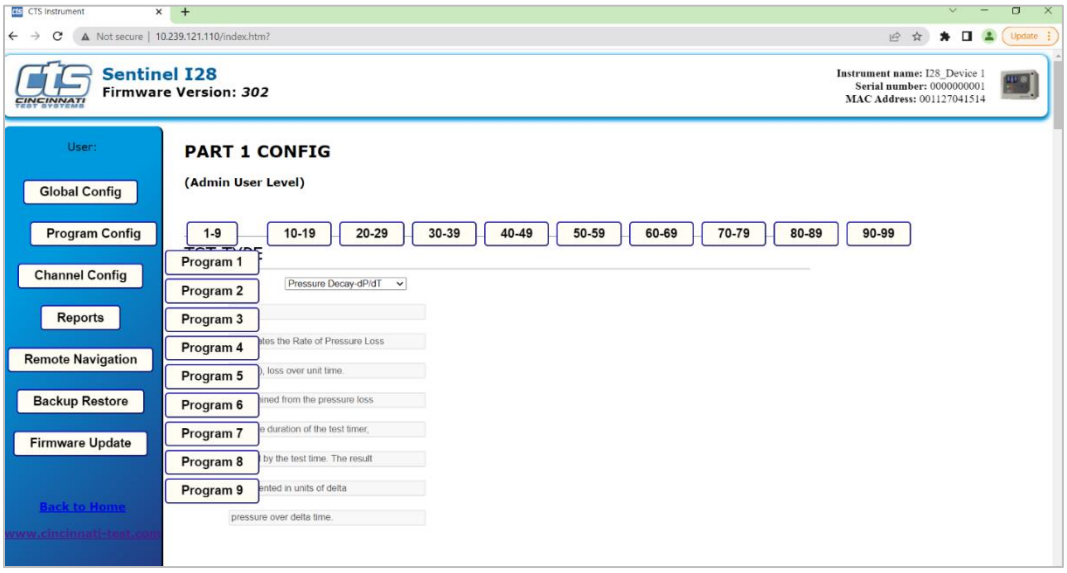
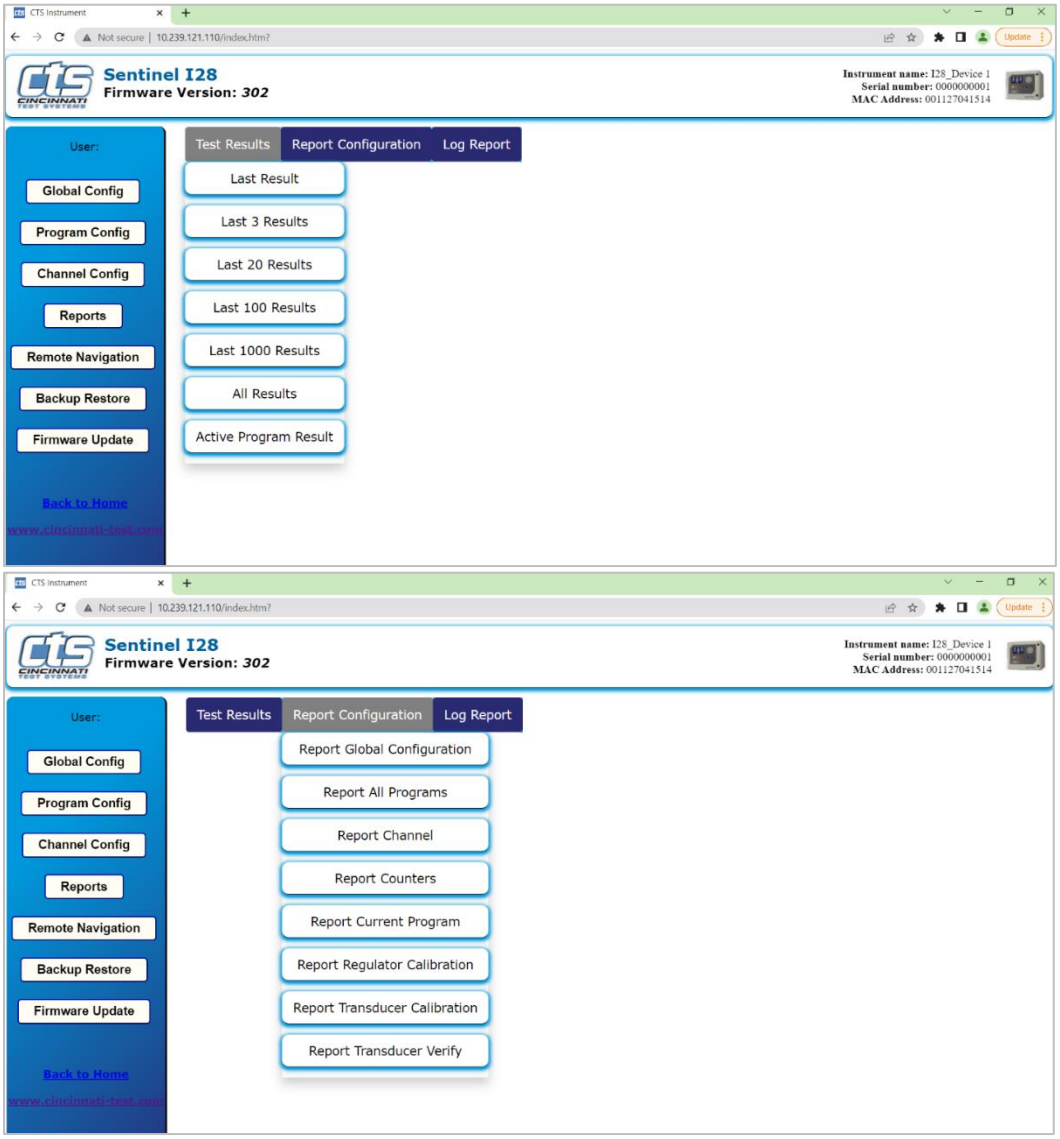


Figure 6 Web Page - Program Config

The **Reports** menu allows user to generate a various Reports for the instrument. Click Reports menu so display Test Results, Report Configuration and Log Reports tab. As per below screenshots, expand individual tabs to display available report selections. User can choose any report and view information as required.


CTS Instrument
Not secure | 10.239.121.110/index.htm?
Update
Sentinel I28
Firmware Version: 302
Instrument name: I28_Device 1
Serial number: 0000000001
MAC Address: 001127041514
User:
Global Config
Program Config
Channel Config
Reports
Remote Navigation
Backup Restore
Firmware Update
Back to Home
www.cincinnati-test.com
Test Results
Report Configuration
Log Report
Last Result
Last 3 Results
Last 20 Results
Last 100 Results
Last 1000 Results
All Results
Active Program Result
CTS Instrument
Not secure | 10.239.121.110/index.htm?
Update
Sentinel I28
Firmware Version: 302
Instrument name: I28_Device 1
Serial number: 0000000001
MAC Address: 001127041514
User:
Global Config
Program Config
Channel Config
Reports
Remote Navigation
Backup Restore
Firmware Update
Back to Home
www.cincinnati-test.com
Test Results
Report Configuration
Log Report
Report Global Configuration
Report All Programs
Report Channel
Report Counters
Report Current Program
Report Regulator Calibration
Report Transducer Calibration
Report Transducer Verify

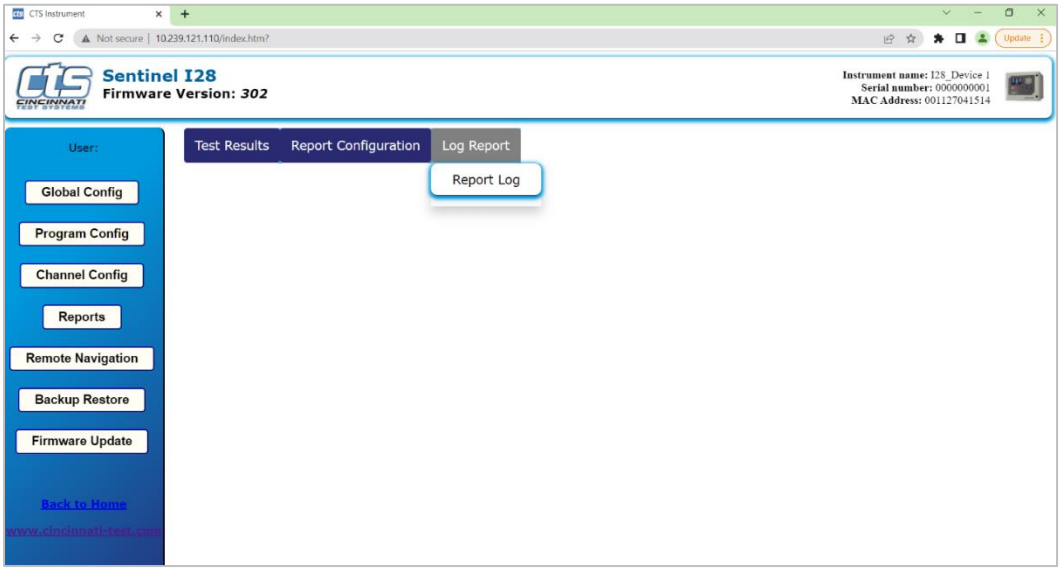


Figure 7 Web Page - Reports

The **Navigation** page gives user a similar user interface to the one available on the front display of the instrument.

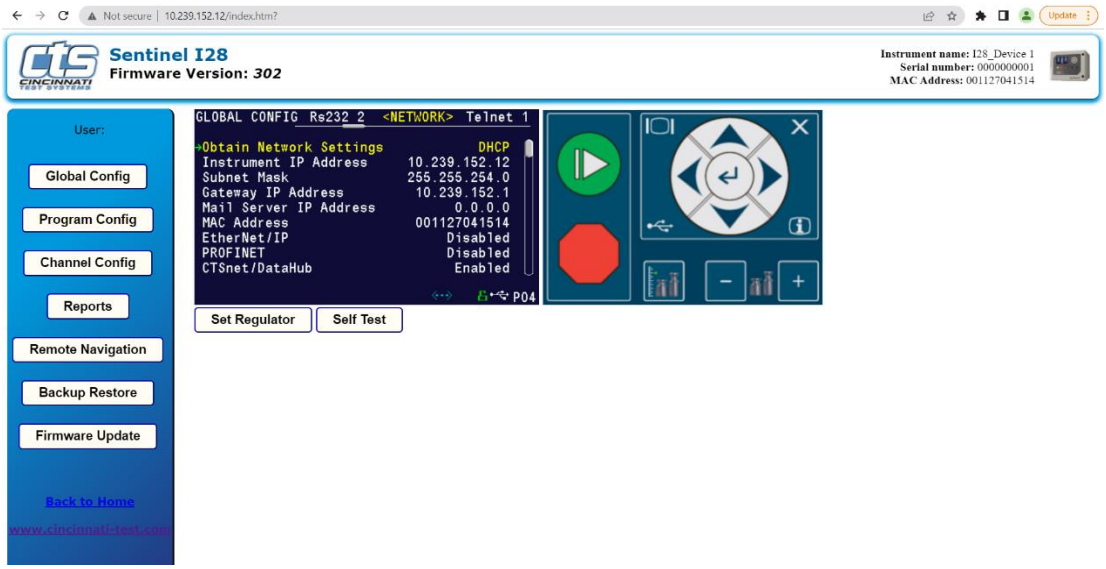


Figure 8 Web Page - Navigation

The **Backup Restore** page allows user to generate a backup file of all the Program Configuration settings and Restore any previously generated backup file.

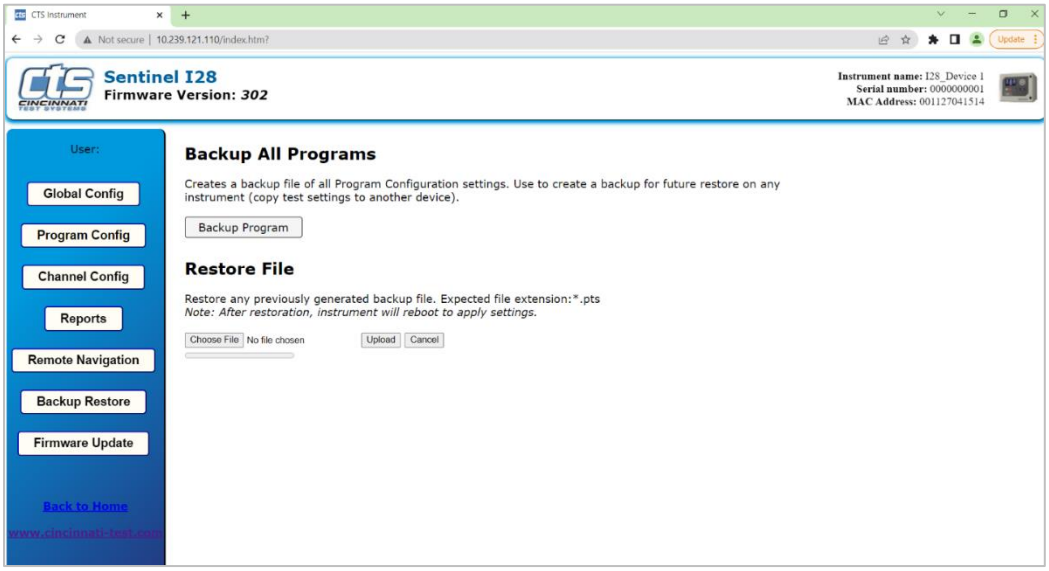


Figure 9 Web Page - Backup/Restore

The **Firmware Update** page allows user to update the instrument's main controller firmware, co-processor firmware, IO-Board firmware.

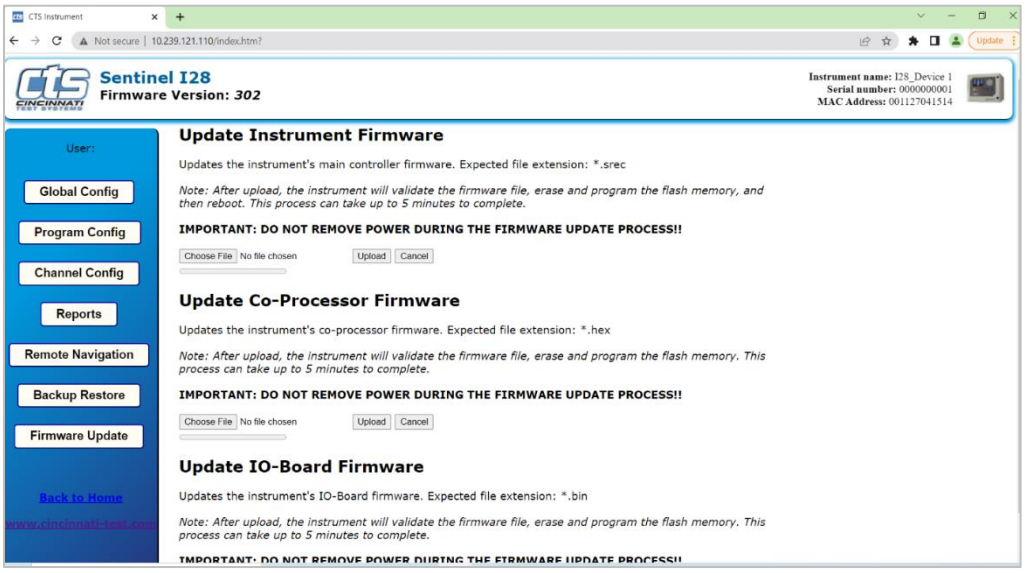


Figure 10 Web Page - Firmware Update

Parameter Configuration via Web Server

User can edit parameters listed on the right section of webpage. Once the value of any editable parameter is changed, the updated value gets displayed with background color "Yellow." "**Edit in progress, Please wait…"** message is displayed to the user.. After some time the message disappears and the changed parameter is displayed with white background.

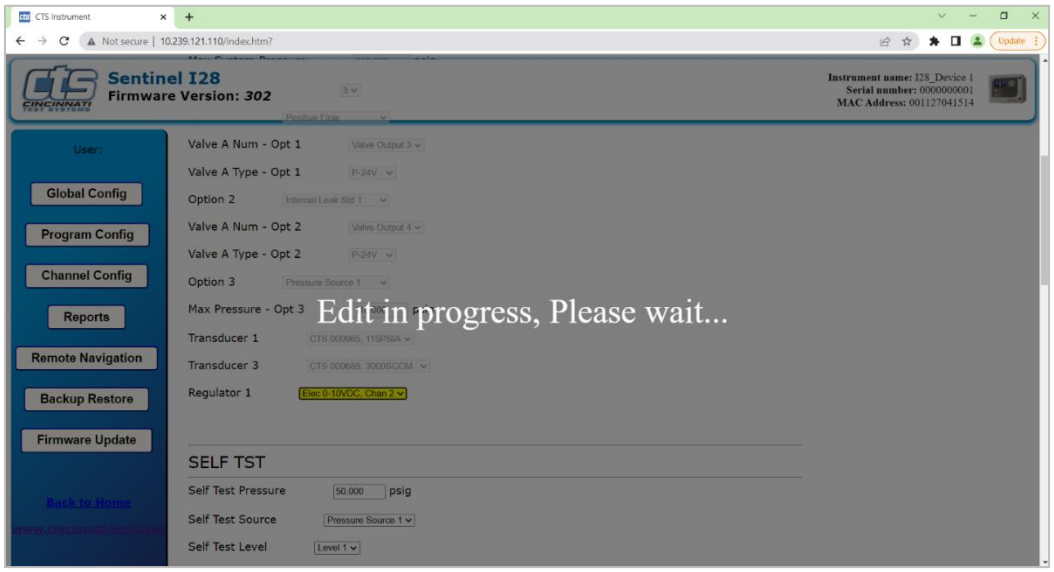


Figure 11 Web page - Editing parameters

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Chapter 27 – Security

This chapter explains the instrument security parameters. The Security menu allows flexibility in allowing access or locking functions with a password.

It is located in **Main Menu > Global Config** menu. The **Security** icon may be hidden. To make the Security icon visible, the setting is located in **Main Menu > Global Config > Misc** icon. Select **Edit/View Security**, press **Enter**, use arrows to select "On", and press **Enter**. You will be taken to the Security menu. The Security icon is now visible at the bottom of the Global Config screen.

When the instrument is secured with any of the settings in the Security menu, a password is required to unlock that function of the instrument. The default password is "5555". Anyone with access to this manual will know the default password. To secure the instrument, the password must be changed. Remember to write down the new password. If the new password is forgotten, Cincinnati Test Systems Service department can provide a temporary password to unlock the instrument.

The table below describes all of the settings in the Security menu.

Parameter	Description	Display User Level
Change Password	Edit allows setting a new password after entering the old password.	Basic Advanced, Admin
Secure Calibration	Applies security to performing a program calibration.	Basic Advanced, Admin
Secure Select Program	Applies security to changing test programs by pressing Change Program buttons.	Basic Advanced, Admin
Secure Program Config	Applies security to changing test part parameters.	Basic Advanced, Admin
Secure Global/Chan Config	Applies security to changing instrument configuration parameters.	Basic Advanced, Admin
Secure Clear Data	Applies security to clearing test Result Data from instrument.	Basic Advanced, Admin
Secure Reset Cntrs	Applies security to clearing the counter registers from instrument.	Basic Advanced, Admin
Secure Hold Function	Applies security to hold function.	Basic Advanced, Admin
Secure Reject Release	Applies security to protect releasing the part on a reject. This security option only works if Retract on Reject is set to "No" in the program Tooling menu.	Basic Advanced, Admin
Secure Monitor Screen	Applies security to the Monitor screen. If set to "Yes", the user will be unable to view any other screens other than the last Monitor screen viewed before being secured.	Basic Advanced, Admin
Backup/Restore	Allows the user to save a backup and/or restore various instrument settings. ***Note: The manifold code must match to restore channel settings.***	Basic Advanced, Admin

Note: The security feature is not applicable to commands over Serial, Telnet, EtherNet/IP and Digital I/O.

Chapter 28 – Features

This chapter explains essential features of the instrument.

Selecting the Display User Level

There are three user levels in the instrument. This is done to minimize the number of items shown on the screen for basic users. More advanced users requiring more features may view these by changing this parameter to the appropriate setting. Throughout the manual the parameter tables have denoted the Display User Level required for viewing and editing access. The **Display User Level** is located in **Main Menu > Global Config > Misc** icon. The three levels are "Basic", "Advanced", and "Admin".

> ***Suggestion: Set the Display User Level to the most basic level for your requirements. Parameters may be locked from editing using Security, see*** Chapter 27 ***– Security.***

Setting the Date & Time

The Date and Time parameters are located in **Main Menu > Global Config > Misc** icon. The date and time are set at the factory. If you are in a different time zone, it may be desirable to change the date and time on the instrument. The date format can be modified with the Date Format parameter. The time format is 24 hour and cannot be changed.

Changing the Instrument Language

The instrument is a multi-language instrument and may be modified. The language setting is located in **Main Menu > Global Config > Misc** icon.

> ***Note: The instrument must be in Advanced or Admin Display User Level to view and modify the instrument Language. To change the Display User Level, see*** Chapter 28***– Features.***

Copy & Paste Programs

To simplify the setup, the instrument comes with the ability to copy all of the parameters from one program to another program. Copy Program is located in the **Main Menu > Program Config > Misc** icon of the program you want to copy. Select the **Copy to Target Prog** parameter and press **Enter**. Increment or decrement the target program number where you want to "paste" the program and press **Enter**. Then, change the **Copy Program** parameter to "Yes" and press **Enter**.

> ***Note: The copied program will overwrite all parameters in the target program. Make sure you want to overwrite this program before executing. If a program exists in the target program number, the instrument will prompt to confirm that you want to continue.***

Instrument Backup & Restore

The Backup and Restore function of the instrument is a feature that allows the instrument to create a backup file on a (FAT32) USB memory stick. This can be used to restore the instrument back to its current state. There is no limit to the number of backup files you can have for an instrument. The files are named using the following format: YYMMDD_I28_SERIALNUMBER_NUMBER. Backup files are stored in a subfolder named Backup-Restore.

> ***Note: The NUMBER at the end of the backup filename will increment for each backup of the instrument saved on the same day.***

To execute this function, press the USB button on the user interface of the instrument (or press **Main Menu > Global Config > USB** icon). Move the cursor down to the **Backup/Restore** parameter. Make sure a USB memory stick is placed in the USB port on the front of the instrument. Press **Enter** to activate the edit function and select "Backup Instrument". When it is complete a pop-up window will tell you it was successful.

Instrument Cloning

This function should only be executed under the advice of CTS personnel. This feature is used for service and support of our products. It enables a technician to replicate the exact instrument within our facility to help with any questions or concerns. To execute this function, press the USB button on the user interface of the instrument (or press **Main Menu > Global Config > USB** icon). Move the cursor down to the "Backup/Restore" parameter. Make sure a USB memory stick is placed in the USB port on the front of the instrument. Press **Enter** to activate the edit function and select "Instr Clone". When it is complete a pop-up window will tell you it was successful.

Adjusting the Light Bar Control

Light Feature Control is located in **Main Menu > Global Config > Misc** icon. The LED Light Bar on the front of the instrument has four options. It can be set to "Always On", "Always Off", "3 Seconds On" or "3 Sec ACC/REJ". The "3 Seconds On" setting refers to all lights, including the white light during the test cycle (if the test cycle is longer than 3 seconds). The "3 Sec ACC/REJ" refers to just the green/red Accept/Reject light after a test is completed.

The Light Feature Brightness parameter, on the same menu, may be adjusted to 20%, 40%, 60%, 80%, or 100% of maximum brightness.

Open Internal Leak Standard

The instrument may be configured with one or more internal leak standards. Internal leak standard valves may be manually forced open during a test to simulate a leak in the test circuit. Open Leak Std is located in **Main Menu > Channel Config > Leak/Cal** icon.

> ***Note: If the instrument is configured with an internal leak standard(s), the instrument automatically introduces the leak standard during the appropriate segments of a Program Cal routine.***

Selecting the Proper Internal Leak Standard

If the instrument is configured multiple internal leak standards the user must select which leak standard is to be used in the Program. Leak Std Select is located in **Main Menu > Program Config > Misc** icon. The **Leak Std Select** parameter defines which leak standard is used. This must be set for each program utilized.

Self-Test

The Self-Test diagnostic provides a way to check the integrity of the instrument's pneumatic circuit. This is a great way to isolate a potential leak by allowing the user to verify the instrument is working correctly. By isolating the instrument from the test part and the external tooling and plumbing, this special test will verify that the instrument is performing properly and leak free.

The Self-Test diagnostic is located in **Main Menu > Channel Config > Self-Test** icon.

Parameter	Description	Display User Level
Self-Test Pressure	Enter the pressure setting of the pressure source chosen to use for the Self-Test diagnostic routine.	Basic Advanced, Admin
Self-Test Source	Specifies the pressure source to utilize for the Self-Test diagnostic routine.	Basic Advanced, Admin
Self-Test Level	The instrument performs two levels of Self-Test. Level 1 is a general integrity test of the pneumatic circuit. Level 2 is more stringent and should be used when testing for low leak or flow rates.	Basic Advanced, Admin
Start Self-Test	Starts the diagnostic routine.	Basic Advanced, Admin

Note: It is important that all test ports are plugged during a Self-Test. The instrument will multiplex through the test ports to verify all circuits are operating leak free.

Update Firmware

The instrument is able to update the firmware using the USB port on the front of the instrument. Upon a proper Service request, a firmware update can be sent by an authorized CTS person by email for transfer to a (FAT32) USB memory stick. The file sent will be saved as a ZIP file. Extract the ZIP file to the root directory of the USB memory stick. This step creates the proper folder structure on a USB memory stick. Safely remove the USB memory stick from your computer and insert the stick into the USB port on the front of the instrument. Press the USB button on the user interface. Change the parameter "Update Firmware" to "Yes" to start the update process. The instrument will list all of the firmware version files on the screen. Select which file you want to use. This will start the update process.

> ***Note: If the firmware version is a minor revision all of the parameter settings will be kept the same. However, if the firmware version is a major revision all of the settings will be cleared. See the firmware documentation to determine if the firmware version you are upgrading from will cause the settings to be cleared. To be safe, always perform a Backup Instrument and Instr Clone before updating firmware.***

Changing the Functionality of the Prefill Timer

The Prefill timer function is located in **Main Menu > Program Config > Misc** icon. The parameter is called **Prefill Method**. It can be set to "Percent of Fill Time", "Not to Exceed Time", "Controlled Fill" or "Fixed Charge".

When the Prefill Method is set to "Percent of the Fill Timer", which is the default value, the Minimum Pressure must be met before the value in the Prefill is exhausted. For example, if the Fill Timer is set to 10 seconds and the Prefill Timer is set to 80% then the part must reach Minimum Pressure within 8 seconds. This allows for fixed fill times to be utilized.

When the Prefill Timer is set to "Not to Exceed Timer", the instrument will begin the cycle in the Prefill segment. Once the pressure reaches the Minimum Pressure, the instrument will exit the Prefill segment, regardless of any time remaining, and enter the Fill segment.

When the Prefill Method is set to "Controlled Fill", the instrument will begin the cycle in the Prefill Segment and will ramp up the pressure from 0 to the target pressure within the specified Prefill timer. When instrument enters the Fill segment the instrument is at target pressure.

> ***Note: "Controlled Fill" method is available only when Electronic regulator is present in the instrument.***

When the Prefill Method is set to "Fixed Charge", the instrument begins the cycle in the Charge Segment and charge the pneumatic with desired "Charge Target Press". At the end of charge timer pressure must reach "Charge Min Press" and below "Charge Max Press". Once successfully exited from the charge segment, the instrument will start to fill the part with the charged pneumatic volume.

Exhaust Method

The **Exhaust Method** parameter is located in **Main Menu > Program Config > Misc** icon. It can be set to "Dump" or "Controlled Exhaust".

When the Exhaust method is set to "Dump", which is the default value, the instrument will open the Exhaust valve and dump the pressure immediately after entering the Exhaust segment.

When the Exhaust Method is set to "Controlled Exhaust", when the instrument enters the Exhaust segment, the instrument will start ramping down the pressure from the last noted instrument pressure to 0 within the specified Exhaust timer. At the end of the Exhaust timer, the instrument will open the Exhaust valve and dump any remaining pressure.

Note: "Controlled Exhaust" method is available only when an Electronic regulator is present in the instrument.

Saving a Barcode with Results

Note: The instrument must be in Advanced or Admin Display User Level to view and modify the communication port functionality. To change the Display User Level, see Chapter 28***– Features.***

The instrument has the capability to store barcode data with each test result. The instrument will work with any RS232 barcode scanner that has the ability to supply a barcode in an ASCII string (no longer than 40 characters) followed by a carriage return. To store the barcode information, it must be received before a Start command is received by the instrument. There is an option to require the barcode data in order for the Start command to be acknowledged.

The Barcode function is located in **Main Menu > Global Config > RS232 1** icon **> RS232 1 Interface** or **Main Menu > Global Config > RS232 2** icon **> RS232 2 Interface**. Set the parameter to "Barcode". In the same menu, set the RS232 1 or RS232 2 Baud parameter to match the baud rate of the barcode scanner communication.

Note: The data bits are always configured to 8. The parity is always set to None. The number of stop bits is always set to 1. The flow control is always set to None.

If a barcode is required before a start signal is acknowledged, this parameter is located in **Main Menu > Program Config > Misc** icon. Set the **Barcode Required** parameter to "Yes".

Holding Pressure in the Part after Test (No Exhaust)

In some applications, it is desirable to keep the pressure in the part after the test sequence is complete. Retain Part Press is located in **Main Menu > Program Config > Misc** icon. Set the **Retain Part Press** parameter to "Yes". The instrument will retain the pressure until either the part is removed from the sealing fixture or a Stop signal is initiated.

Note: The instrument must be in Advanced or Admin Display User Level to view and modify this functionality. To change the Display User Level, see Chapter 28***– Features.***

Changing the Functionality of the Prefill Timer

The Prefill timer function is located in **Main Menu > Program Config > Misc** icon. The parameter is called **Prefill Method**. It can be set to "Percent of Fill Time" or "Not to Exceed Time".

When the Prefill Timer is set to "Percent of the Fill Timer", which is the default value, the Minimum Pressure must be met before the value in the Prefill is exhausted. For example, if the Fill Timer is set to 10 seconds and the Prefill Timer is set to 80% then the part must reach Minimum Pressure within 8 seconds. This allows for fixed fill times to be utilized.

When the Prefill Timer is set to "Not to Exceed Timer", the instrument will begin the cycle in the Prefill segment. Once the pressure reaches the Minimum Pressure, the instrument will exit the Prefill segment, regardless of any time remaining, and enter the Fill segment.

Turning On/Off Pressure Correction

In several test types the instrument uses pressure correction to enhance the performance of the instrument. There are times where pressure correction may not be desirable. For these cases, the instrument has the ability to select whether or not pressure correction is used. This is located in the **Main Menu > Program Config > Misc** icon on the. Change the **Pressure Correction** parameter to the desired setting.

Setting the Cal Method and Leak Standard Location

The **Cal Method** parameter is located in the **Main Menu > Channel Config > Leak/Cal** icon when the **Leak Standard** is set to "Channel". The **Cal Method** parameter is located in the **Main Menu > Program Config > Misc** icon when the **Leak Standard** is set to "Program".

Select Parameter	Description	Explanation
One Part – Int. LS	Automatic test cycling using Leak Standard located inside the instrument	Automatically tests same non-leaking master part twice; the second time using a calibrated leak standard mounted on the internal manifold. .
One Part - Ext LS	Manual testing of same part using Leak Standard provided outside the instrument	Tests same non-leaking master part twice; the second time using calibrated leak standard provided externally from the instrument. The instrument will prompt the operator to attach the leak standard when it is time.
Multi-Part – Int. LS	Manual testing of two parts using a Leak Standard located inside the instrument	Tests two different non-leaking master parts using the calibrated leak standard mounted on the internal manifold. Any tooling must retract between tests to change parts. A Start signal is required either by the user interface or remotely using programmed start test logic to initiate the second test after changing non-leaking master parts.

This table is continued on the next page.

Select Parameter	Description	Explanation
Multi-Part – Ext LS	Manual testing of two parts using Leak Standard provided outside instrument	Tests two different non-leaking master parts using the calibrated leak standard provided externally from the instrument. Any tooling must retract between tests to change parts. A Start signal is required either by the user interface or remotely using programmed start test logic to initiate the second test after changing non-leaking master part with leak standard.

Autorun

Sometimes it is desired to have the instrument cycle automatically without any need for a person to press the Start button or send a start signal using the digital inputs. The Autorun feature is designed to accomplish this. **Autorun** is located in **Main Menu > Program Config > Autorun** icon. The following menu will display on the screen.

Parameter	Description	Display User Level
Autorun Relax	The amount of time the instrument pauses in between cycles.	Advanced, Admin
Autorun Method	There are two options for this parameter. "Standard" which runs a normal leak test every cycle or "LS on 3rd" which opens the internal leak standard (if supplied) every 3rd cycle.	Advanced, Admin
Autorun Cycle Count	The number of cycles left in the Autorun sequence. This parameter is used to determine how many cycles are conducted in an Autorun.	Advanced, Admin
Autorun Enable	When this parameter is set to "Yes" a start command will initiate the Autorun sequence.	Advanced, Admin

Malfunction evaluation as Reject

Malfunction Eval is located in **Main Menu > Program Config > Misc** icon with the options of **Malfunction** and **Reject**. Malfunction evaluation options allow the user to configure all the malfunction messages, including all program calibration malfunctions messages either as Malfunction (Yellow color) or as Reject (Red color) per setting. The digital outputs operation changes as follows: "Malfunction" and "Program Reject", both outputs will go high if Malfunction Eval is set as **Reject.**

Batch Calibration

The Batch Calibration feature allows multiple calibration sequences to be performed. Results are averaged to calculate the final calibration values. The **Batch Calibration** parameter is located in the **Main Menu > Program Config > Leak/Cal** icon and allows for enabling or disabling of batch program calibration mode. When enabled, three more parameters "Batch Layout", "Batch Quantity" & "Average Quantity" are visible to user.

Parameter	Description	Display User Level
Batch Layout	Defines the layout of batch calibration. When Batch Layout is set to "Alternating", which is the default value, the instrument performs the first 'Master' calibration, then the first 'Master+Leak' calibration, then alternates between the two for the remaining batch quantity. When Batch Layout is set to "Grouped", the instrument first performs all 'Master' calibrations, then all 'Master+Leak' calibrations.	Advanced, Admin
Batch Quantity	Defines the number of calibration sequences in the batch. Minimum value is 2 and maximum value is 25.	Advanced, Admin
Average Quantity	Defines the number of calibration sequences utilized to average calibration data out of Batch quantity. The value must be less than or equal to Batch Quantity.	Advanced, Admin

Prefill Pressure Check

Prefill Pressure Check is located in **Main Menu > Program Config > Misc** icon with the options of **Enabled** and **Disabled.** Prefill pressure check determines the prefill pressure monitoring. When enabled, the instrument monitors the pressure during Prefill time. When disabled, the instrument skips the pressure monitoring during Prefill time.

> ***Note:*** ***This parameter is only available if the*** **Prefill** ***Method selected is "*****Percent of Fill Time*****" or "Pre-Pressure Time".**

Valve Detection

Valve Detection is located in **Main Menu > Channel Config > Hardware icon** with the options of **Enabled** and **Disabled.** This feature, when enabled, allows the instrument to monitor for the presence of pneumatic valves via electronic load detection.

> ***Note:*** **This parameter is only available for viewing, and the user cannot change the settings.**

Chapter 29 – Instrument Calibration

This chapter explains the Set/Span parameters for the pressure transducer, flow transducer, and electronic regulator.

Note: Your instrument may not have a flow transducer or an electronic regulator.

These parameters are located in **Main Menu > Channel Configuration > Set/Span** icon.

Verifying a Transducer

The transducer verification process is very similar to the calibration process. You must enter the external master gauge value at each point to step through the sequence. You will be prompted to input values so the ***Transducer Verification Report*** has this data for later review. This feature does not affect the calibration of the instrument.

Note: A Transducer Verification Report may be downloaded from the instrument if desired. See the Reports section on the last page of Chapter 24 ***- Communication.***

Calibrating a Transducer

The transducers have been calibrated at the factory. A calibration of the transducer should be done periodically according to the quality standards at your facility. The instrument is capable of doing a multiple point calibration. The number of points is determined by the user. You may select up to 32 points for calibration. You will need a calibrated master pressure gauge to calibrate the transducer on the instrument. On the Set/Span menu select which transducer you want to calibrate. Press Enter to enable the edit function. Change the value to "Yes". The following menu will display on the screen.

Transducer 1 Cal Menu (Pressure)

Parameter	Description	Display User Level
Number of Points	The number of setpoints to be used for the transducer calibration procedure. Value must be 2 to 32.	Basic Advanced, Admin
Setpoints 2 – 32	The user is able to define the setpoints at which the calibration occurs. The number of setpoints shown is based on the number of points selected in the parameter above.	Basic Advanced, Admin
Linearity Limit	The maximum allowed linearity variance for a successful calibration.	Basic Advanced, Admin
Start Calibration	Commences the calibration procedure. A wizard will walk you through the calibration process.	Basic Advanced, Admin

Note: A Transducer Calibration Report may be downloaded from the instrument if desired. See the Reports section on the last page of Chapter 24 ***- Communication.***

Transducer 3 Cal Menu (Flow)

Parameter	Description	Display User Level
Number of Points	The number of setpoints to be used for the transducer calibration procedure. Value must be 2 to 32.	Basic Advanced, Admin
Pressure Mode	Determines whether one pressure value is utilized for all setpoints or if individual pressure values are used for each setpoint when calibrating or verifying the transducer.	Basic Advanced, Admin
Setpoints 2 – 32	This parameter is only visible if Pressure Mode is set to "Multi Pressure". The user is able to define the setpoints at which the calibration occurs. The number of setpoints shown is based on the number of points selected in the parameter above.	Basic Advanced, Admin
Cal Pressure	This parameter is only visible if Pressure Mode is set to "Single Pressure". It is the desired pressure for all setpoints when calibrating or verifying the transducer.	Basic Advanced, Admin
Pressure Correction	Allows the instrument to perform measurement corrections when calibrating or verifying the transducer based on the relationship between the setpoint pressure and the actual measured pressure.	Basic Advanced, Admin
Linearity Limit	The maximum allowed linearity variance for a successful calibration.	Basic Advanced, Admin
Start Calibration	Commences the calibration procedure. A wizard will walk you through the calibration process.	Basic Advanced, Admin

Note: A Transducer Calibration Report may be downloaded from the instrument if desired. See the Reports section on the last page of Chapter 24 ***- Communication.***

Calibrating an Electronic Regulator

The electronic regulator has been calibrated at the factory. The instrument is capable of doing a multiple point calibration. The number of points is determined by the user. You may select up to 20 points for calibration. You will need a calibrated master pressure gauge to calibrate the electronic regulator on the instrument. On the Set/Span menu select which electronic regulator you want to calibrate. Press Enter to enable the edit function. Change the value to "Yes". The following menu will display on the screen.

Parameter	Description	Display User Level
Number of Points	The number of setpoints to be used for the electronic regulator calibration procedure. Value must be 2 to 20.	Basic Advanced, Admin
Low Limit Voltage	The user is able to define the low voltage for the calibration process.	Admin
High Limit Voltage	The user is able to define the high voltage for the calibration process.	Admin
Start Calibration	Commences the calibration procedure. A wizard will walk you through the calibration process.	Basic Advanced, Admin

Note: The Low Limit Voltage and High Limit Voltage values are disregarded if both are set to "0" (zero is the default setting). You should only change these values if the instrument is not able to automatically analyze the electronic regulator range and perform a proper calibration.

Note: The electronic regulator can remain active in between instrument test cycles or it can be set to "Idle". This parameter is edited by going to Channel Config and selecting the Hardware icon. The parameter is called "E-Regulator Rest" and is available in Basic Display User Level. To change the Display User Level, see Chapter 28 ***– Features.***

Note: An Electronic Regulator Calibration Report may be downloaded from the instrument if desired. See the Reports section on the last page of Chapter 24 ***- Communication.***

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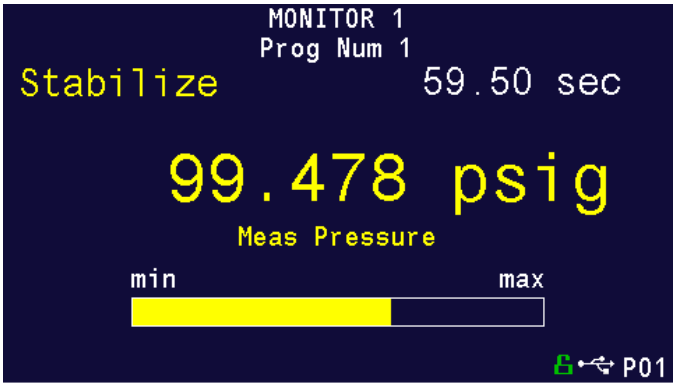
Chapter 30 – Monitor Screen Examples

This chapter is a quick reference for the screens that display at power on and when running the various tests established for your requirements.

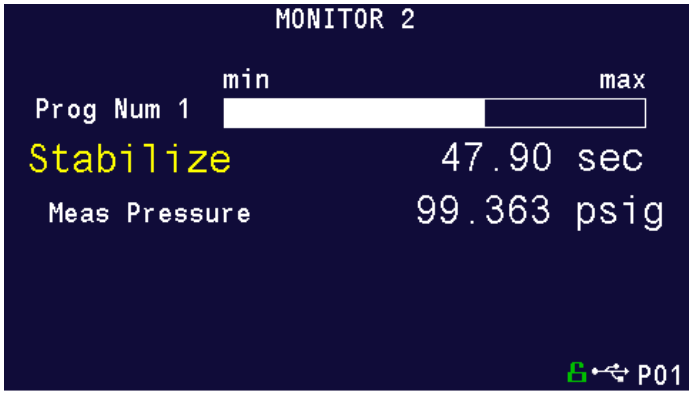
Monitor Screen Examples

These screens are available by using the right arrow on the Arrow/Enter Navigation buttons.

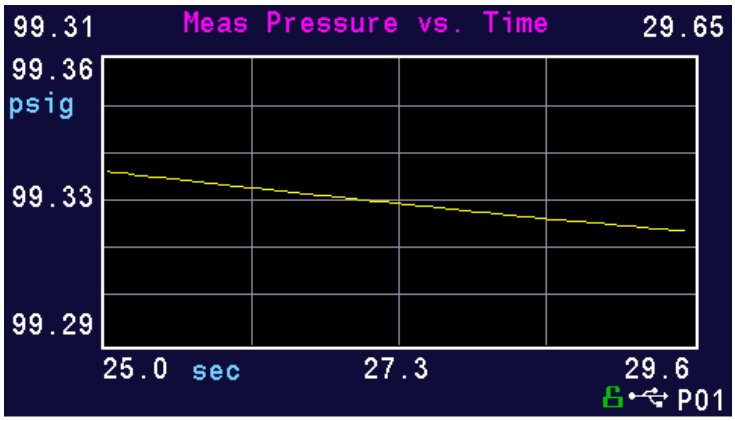
Screen 1: Monitor 1 highlights the numerical pressure reading:



Screen 2: Monitor 2 highlights the location of the reading from the Min to the Max allowable pressure:

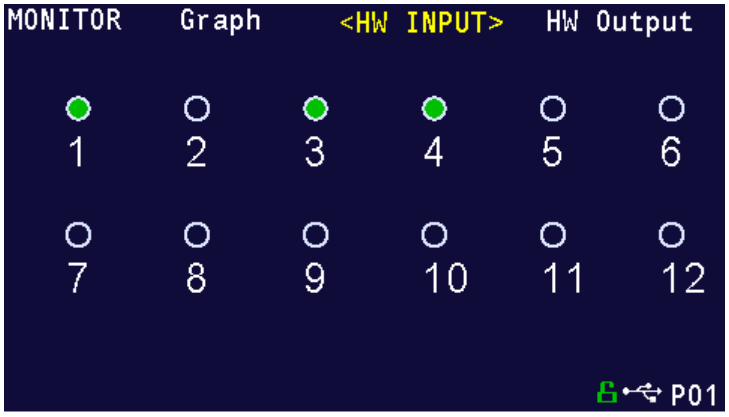


Screen 3: Graph highlights the pressure as it relates to time:

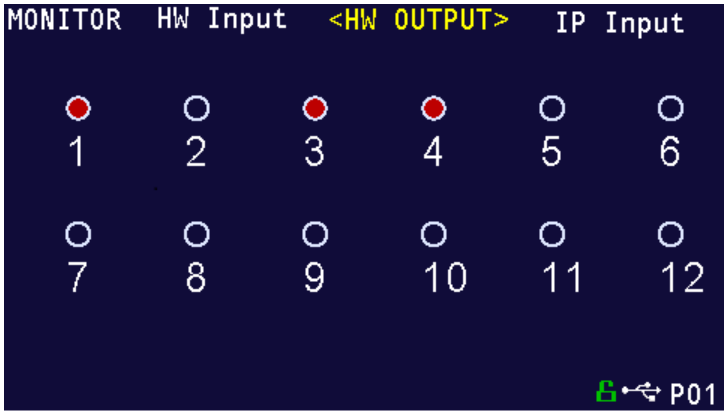


Note: You can zoom/adjust the graph by pressing the Enter button. A menu will display on the right side of the screen. Additional graph screen parameters are located in Main Menu > Global Config > Graph icon.

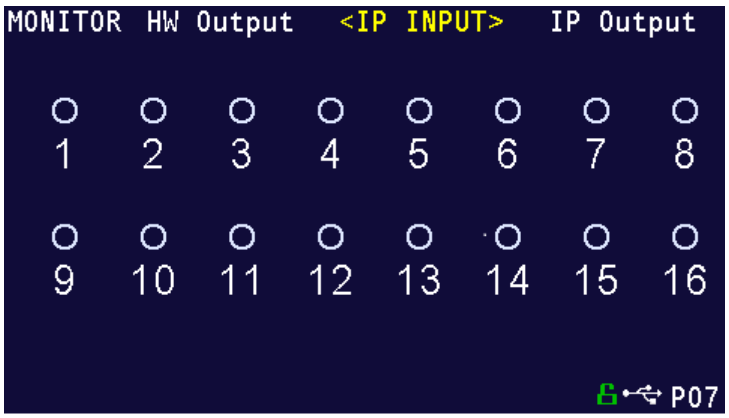
Screen 4: Hardware Input highlights which of the possible 12 inputs are engaged:



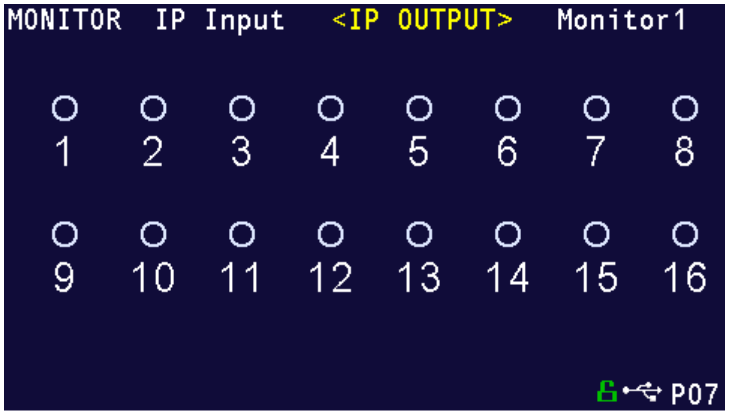
Screen 5: Hardware Output highlights which of the possible 12 outputs are engaged:



Screen 6: IP Input highlights which of the possible 16 inputs are engaged:



Screen 7: IP Output highlights which of the possible 16 outputs are engaged:



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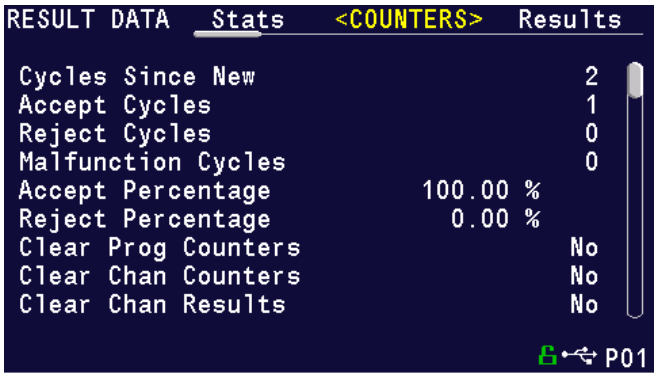
Chapter 31 – Results Screen Examples

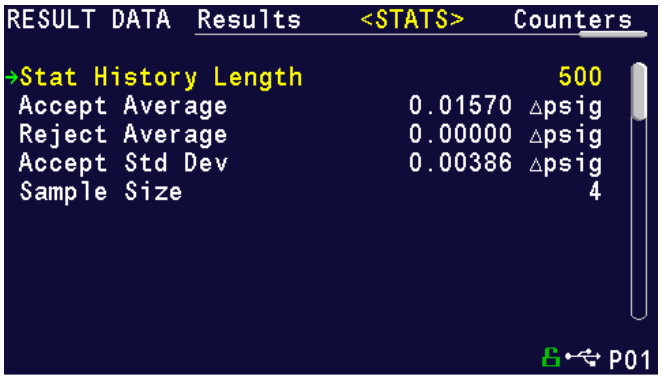
This chapter is a quick reference for the screens that display when running the various tests established for your requirements. These are examples; your screens will display similar but different data.

Result Data Screens

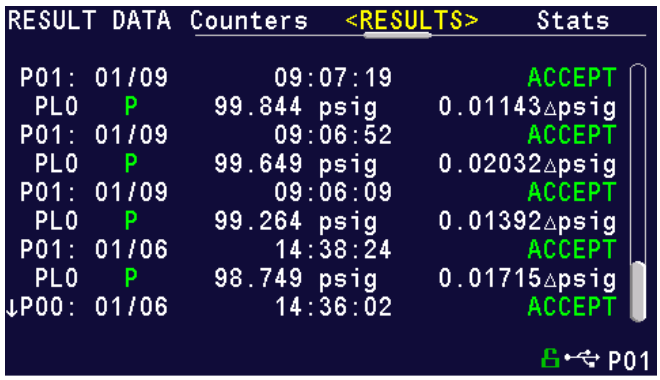
Counters Screen



Results screen



Stats Screen



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Appendix A – Messages & Error Codes

This appendix is a quick reference for the messages and error codes that display on the screen and through the communication ports.

Test Messages & Errors

Note: For the most up to date Test Message and Error Codes type "TABLE EVALUATION" into the instrument using the communication port. The instrument will return a list of Data Type Codes and descriptions. (This table contains the same list of codes found in the 3rd table of Appendix E.)

Message	Code	Description	Corrective Actions
Program Accept	A	Program evaluation was successful, for multiple tests – all tests passed.	
Auto Setup Seq Complete	AC	The Auto Setup Sequence is complete.	
Program Calibration Failed	AF	The test type is one that is capable of conducting a program calibration and this sequence was not successful.	
Master Part Complete	AM	The test type is one that is capable of conducting a program calibration. The first phase of the sequence is complete.	
Program Calibration Passed	AP	The test type is one that is capable of conducting a program calibration and this sequence was successful.	
Error: Anti-Tie-Down	AT	The two inputs (Start and Common) are not held high during all of the "extend" tooling motions. There is no resultant output.	The two inputs must go high within 0.05 seconds and be held high until the end of all extend tooling motions.
Error: Barcode Req to Start	BR	The instrument was expecting a barcode value to be received over the RS232 port. The Barcode Required parameter was set to "Yes", which requires a barcode before a start command is enabled.	Check barcode reader wiring and functionality. Make sure the Baud Rates are set properly within the instrument.

Message	Code	Description	Corrective Actions
Master+Leak Loss<Master Loss	C1	During the Program Cal routine, the instrument measured a greater pressure loss for the master part by itself than for the master part with the leak in the second test. This results in a Malfunction.	Increase the stabilization and possibly test time. Verify the leak standard.
Master Part Loss>Max Mstr+Leak Loss	C2	The pressure loss during the first test of Program Cal on the master part exceeded the Max Mstr+Leak Loss setpoint. This results in a Malfunction.	Check the seals and master part for leaks, or extend stabilization timer. Check that Max Mstr+Leak Loss was correctly set.
Master +Leak Loss>Max Mstr+Leak Loss	C3	The pressure loss during the second test of Program Cal on the master part exceeded the Max Mstr+Leak Loss setpoint. This results in a Malfunction.	Check the seals and master part for leaks, or extend stabilization timer. Check to leaks about leak standard. Check that Max Mstr+Leak Loss was correctly set.
Master Flow>Max M+L Flow	C4	The flow value during the first sequence of Program Cal on the master part exceeded the Max Mstr+Leak Flow setpoint. This results in a Malfunction.	Check the seals and master part for leaks, or extend fill or test timers. Check that Max Mstr+Leak Flow was correctly set.
Master Flow<Min Master Flow	C5	The master flow value was less than the Min Master Flow setpoint.	Check that the Min Master Flow setpoint was set correctly. Verify the test line is connected to the test port and not the Self-Test cap.
Master+Leak Flow>Max M+L Flow	C6	The flow value during the second sequence of Program Cal on the master part exceeded the Max Mstr+Leak Flow setpoint. This results in a Malfunction.	Check the seals and master part for leaks, or extend fill or test timers. Check the leak standard. Check that Max Mstr+Leak Flow was correctly set.
Master Flow>Max Master Flow	C7	The flow value during the first sequence of Program Cal on the master part exceeded the Max Master Flow setpoint. This results in a Malfunction.	Check the seals and master part for leaks, or extend fill or test timers. Check that Max Master Flow was correctly set.

Message	Code	Description	Corrective Actions
Master+Leak Flow<Master Flow	C8	The flow value during the second sequence of Program Cal on the master part was less than the measured Master Flow value. This results in a Malfunction.	Check the seals and master part for leaks, or extend fill or test timers. Check the leak standard. Check that Max Master Flow was correctly set.
Master Loss<Min Master Loss	C9	The pressure loss reading during the first test of Program Cal cycle for a pressure decay test was less than the Min Master Loss setpoint. This results in a Malfunction.	Check for blockage in the test line of part.
Cal Program Accept	CA	The Program Calibration was successful.	
Calculation Error	CE	This result occurs from illegal program configurations, calculation errors when trying to convert vacuum pressures to positive pressure readings, and other occurrences.	
Cal Required - Limit Exceeded	CF	Not Used.	
Min Perf Factor Error	CM	The Performance Factor calculated at the end of Program Cal exceeds the Minimum Performance Factor set in the Test Factors.	Check that the Minimum Performance Factor was correctly set. Increase stabilize and test timers.
Calibration Required- Parameters Changed	CP	The stabilization or test timers, target pressure, Leak Std Flow, or Leak Std Pressure have been changed since the last calibration and therefore the part needs to be recalibrated. There is no output resultant.	Recalibrate the instrument for this program.
Cal Program Reject	CR	The Program Calibration was not successful.	
DP Transducer Fault	DF	Not Used.	

Message	Code	Description	Corrective Actions
DP Transducer Over Range	DO	Not Used.	
DP Transducer Zero Bad	DZ	Not Used.	
Elec Regulator Cal Complete	EC	The Electronic Regulator Calibration was successful.	
Elec Regulator Cal Error	EE	The Electronic Regulator Calibration was not successful.	Check the wiring of the electronic regulator. Check that the entry of each pressure calibration point was correct.
Part Evac Fault	EF	Not Used.	
Prog Error	EP	There was an error with the program. Please contact the CTS Service department.	
System Error - Service Req	ER	There was an error with the instrument. Please contact the CTS Service department.	
Flow Transducer Over Range	FO	The flow transducer measured a value out of its range. The instrument stopped the test sequence to prevent damage to the sensor.	
Error: Excessive Flow	FX	The flow sensor measured a value out of its range. The instrument stopped the test sequence to prevent damage to the sensor.	
Flow Transducer Zero Bad	FZ	The flow transducer was not sending the proper voltage. The instrument checks to make sure that the flow transducer is within range before the test sequence begins.	Check the flow sensor wiring. If this happens multiple times, replace the flow sensor.
Helium Background Fault	HF	Not Used.	
Invalid Calibration Data	ID	The calibration data has been corrupted or not properly entered. Please calibrate the unit again.	
I/O Fault	IF	Not Used.	
Invalid I/O Configuration	IO	Not Used.	

Message	Code	Description	Corrective Actions
Invalid Program Selected	IP	The program selected does not exist or has not been configured.	Check BCD Input programming.
Error: Duplicate Target Link	LD	The same child program cannot be in the same link structure. If it is desired to conduct the same test twice you will need to copy the program.	
Master Loss>Max Master Loss	L0	The pressure loss reading during the first test of Program Cal cycle was greater than the Max Master Loss setpoint. This results in a Malfunction.	
Master+Leak Loss<Min Master+Leak Loss	L1	The pressure loss value during the second sequence of Program Cal on the master part was less than the Min Master +Leak Loss setpoint. This results in a Malfunction	
Leak Loss<Min Leak Loss	L2	Measured Leak Loss of Program Cal was less than Min Leak Loss setpoint. This results in a Malfunction.	
Leak Loss >Max Leak Loss	L3	Measured Leak Loss of Program Cal was greater than Max Leak Loss setpoint. This results in a Malfunction	
Master+L Flow <Min Master+L Flow	L4	The flow value during the second sequence of Program Cal on the master part was less than the Min Master+Leak Flow setpoint. This results in a Malfunction.	
Leak Flow<Min Leak Flow	L5	Measured Leak Flow of Program Cal was less than Min Leak Flow setpoint. This results in a Malfunction.	
Leak Flow>Max Leak Flow	L6	Measured Leak Flow of Program Cal was greater than Max Leak Flow setpoint. This results in a Malfunction	
Leak Std Select Config Error	LE	Configuration Error. The instrument was not configured properly.	
Error: Link Execution Loop	LL	There was an error in the Linking Execution.	Check programming of the Parent/Child Structures.

Message	Code	Description	Corrective Actions
Error: No Links Defined	LN	The instrument was expecting a link that did not exist.	
Error: Dissimilar Link Order	LO	When the instrument conducts a Program Calibration sequence on linked programs, the links must execute in the same order for both the first and second sequences for Program Calibration.	
Error: Link Program is Parent	LP	A Parent Program may not be a link target.	
Error: Link Prog Undefined	LU	The linked program is undefined.	
Error: Part Mark Fault	MF	The part mark feedback input did not receive the input in time.	Check operation of the part marker. Check wiring of the feedback input. Check wiring of the valve to fire the part marker.
No Event Occurred	NE	In a test that is looking for an event, this is the result when one does not occur.	
Above Target Pressure	PA	The instrument will stop conducting a test if the pressure rises above the target pressure window setting.	Check pressure regulator setting, cut seals, bad parts, or tooling control pressure by testing with master part.
Below Target Pressure	PA	The instrument will stop conducting a test if the pressure drops below the target pressure window setting.	Check pressure regulator setting, cut seals, bad parts, or tooling control pressure by testing with master part.
Part Not Changed	PC	The present input signal did not go low between tests to indicate that the part was removed from the fixture after the last test. This results in a Malfunction.	Remove the part after each test.
Part Configuration Error	PE	There was an error in the way the program was configured.	
Part Not Full	PF	This is an error in the Auto Setup Sequence that can occur if the instrument fails to fill the part to the desired pressure.	

Message	Code	Description	Corrective Actions
Test Pressure Low	PL	Test pressure was below Minimum Pressure during fill cycle. This results in a severe leak.	
Test Pressure High	PH	Test pressure was above the Maximum Pressure during fill or stabilization cycles resulting in a Malfunction.	Check pressure regulator setting and tooling control pressures
Error: Part Not Present	PP	The part present input is set for the active program and the input was not received.	Check the part presence sensor and input wiring
Part Not Stabilized	PS	This is an error in the Auto Setup Sequence that can occur if the instrument fails to stabilize the part.	
Part Not Exhausted	PX	This is an error in the Auto Setup Sequence that can occur if the instrument fails to exhaust the part.	
Sequence Complete	QC	Sequence Complete	
Program Reject	R	Program evaluation was not successful, for multiple tests – if any test fails, the part is rejected	
Part Reject - Level 1	R1	Not Used.	
Part Reject - Level 2	R2	Not Used.	
Part Reject - Level 3	R3	Not Used.	
Source Pressure Exceeded	RX	The source pressure set by the factory on the hardware configuration menu was exceeded.	
Stop Button Pressed	SB	The stop button or input was received.	
Start Common Input Low	SC	Not Used.	
Pressure Select Config Error	SE	Configuration Error. The instrument was not configured properly.	

Message	Code	Description	Corrective Actions
Self-Test Failed	SF	The Self-Test failed.	Make sure the test line was removed and the test port plugged before the test was conducted. One of the internal valves may be leaking.
Error: Stop Input High	SH	The instrument cannot start a test if the Stop input is high.	
Stop Input Received	SI	Stop Input Received.	
Severe Leak	SL	Severe Leak indicates the test process did not achieve Minimum Pressure before reaching the Prefill setpoint or failed to maintain Minimum Pressure during fill or Stabilization timers. This results in a Program Reject.	Check pressure regulator setting, cut seals, bad parts, or tooling control pressure by testing with master part
Self-Test Passed	SP	Self-Test process indicates no internal leak.	
System Pressure Exceeded	SX	The system pressure of the unit was exceeded.	Check the pressure source and regulators
Tooling Not Reset	TE	If a tooling error occurs involving any motions, there will be a tooling error. Before the start of the next test, the tooling needs to be reset by the Stop/Reset input. This results in a Malfunction.	Push the Stop/Reset Input and possibly Common to return the tooling to the Start position.
Error: Two-Input Req to Start	TI	Both Start Test and Common must go high to start a test.	
Test Port Select Config Error	TP	The instrument configuration is not correct.	
Error: Tooling not Retracted	TR	The instrument may not start a sequence if all of the tooling is not retracted.	
Tooling Reset	TS	Most tooling errors or some test errors may require a tooling reset with the Stop/Reset input. After completion of the reset, this confirmation message is displayed.	
Error: Tooling not Extended	TX	If the instrument is configured for tooling feedback this error will occur if the tooling feedback input is not received within the time allocated.	Check feedback sensor and input wiring. Make sure the tooling motion feedback timer is set properly.

Message	Code	Description	Corrective Actions
Vent Part Reset Tooling	VR	Message sent when retain part pressure and tooling are both configured to be used. This message is sent upon a reset.	
Transducer Cal Complete	XC	The transducer calibration is complete and was successful.	
Transducer Cal Error	XE	There was an error when trying to calibrate the transducer.	Check transducer wiring
Pressure Transducer Fault	XF	Not used.	
External Switch did not go high	XH	The External Pressure Switch input did not go high before the end of the fill timer. This results in a Malfunction.	Check the pressure switch. Make sure that the path to the pressure switch is not blocked.
External Switch did not go low	XL	The External Pressure Switch input did not go low between tests. This results in a Malfunction.	Check pressure switch to make sure it is functioning.
Transducer Over Range	XO	During the testing process the pressure exceeded the range of the transducer. This results in a Malfunction.	Check the pressure regulator setting
Transducer Verify Complete	XV	The transducer verification sequence is complete.	
Transducer Zero Bad	XZ	The pressure transducer's atmospheric pressure reading at the beginning of the testing cycle is outside of tolerance. This results in a Malfunction.	Perform transducer calibration routine in Self-Test

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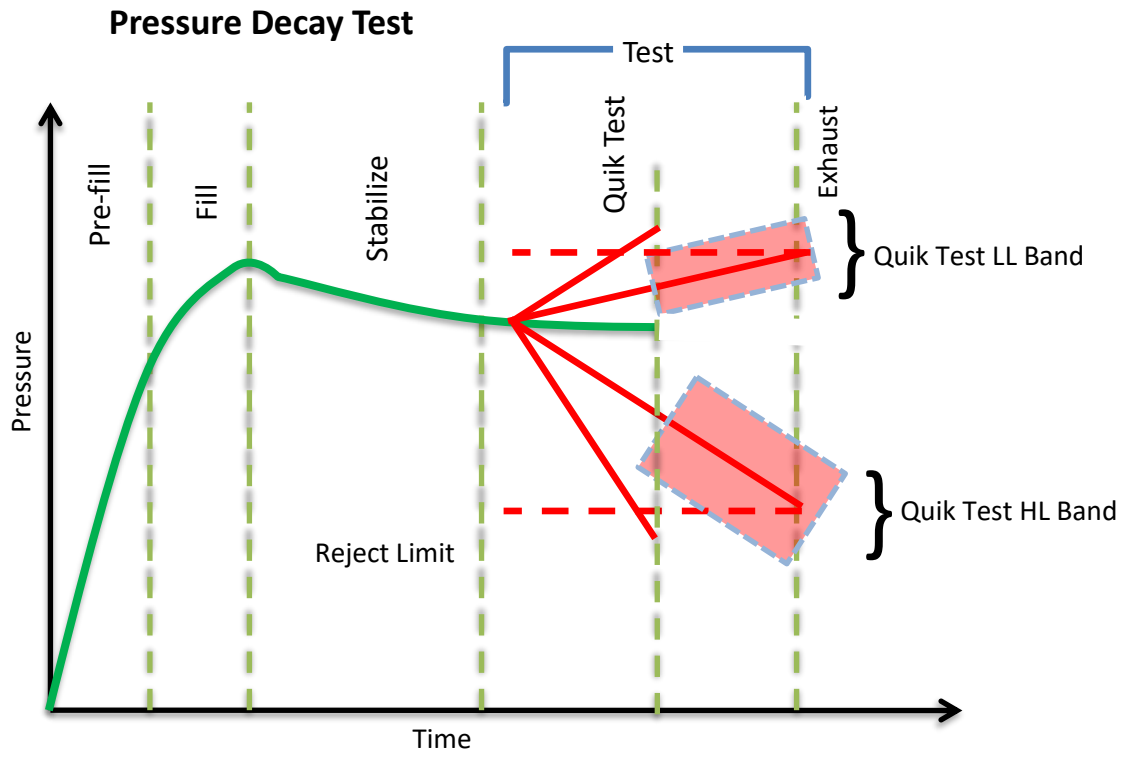
Appendix B – Quik Test

This appendix explains the theory and parameters for reducing the test time for obviously good and obviously bad parts, without sacrificing the accuracy for marginal parts. This capability is called Quik Test in the instrument. Quik Test is available in the Pressure Decay-Leak Std test type that conducts a Program Calibration using a leak standard.

How it works

Most manufacturing processes produce the desired quality of product a high majority of the time. These parts easily pass the leak test being performed on them. Conversely, most defective parts reject by a wide margin. Quik Test monitors the pressure or flow signal during the test and ends the test early for parts that easily pass or easily reject. Any marginal parts that are within the parameters set by the Quik Test HL (High Limit) Band and Quik Test LL (Low Limit) Band will utilize the entire Test time to ensure the accuracy of the result.

At the desired time in the Test sequence determined by the Quik Test Percent parameter the instrument calculates the projected leak rate and compares it with the Quik Test Low Limit and High Limit Bands. If the projected leak rate is within either of these two bands, the test continues to the end of the test timer. If the instrument's projected leak rate is outside of these bands, it will stop the test, output the results according to the Test Evaluation criteria, and display the projected leak rate.



The prior chart shows the master part curve, the Low Limit with its LL Quik Test band limit, and the High Limit with its HL Quik Test band limit. If the pressure loss is within either the LL Quik Test band or HL Quik test band at the QT% of Test Timer, the test will continue and complete the entire test cycle. If the results are outside the limit bands at the QT% of Test Timer, the test will stop and the test result will reflect the Test Evaluation criteria. Setting narrow bands about the Low Limit and High Limit is a very aggressive approach that will greatly limit the number of tests that run to the end of the test timer. Set wider bands as a more conservative approach to Quik Test.

An initial analysis of Quik Test should be performed before actually implementing this feature by establishing the "QT Test Timer" at 10, 25, 50, 75, or 90% and setting "Quik Test" to OFF. A Program Cal must be performed after setting the "Quik Test Timer" to measure the typical leak response curve for the test. Test production parts over a reasonable time (up to 1000 parts in various production conditions). The instrument projects a leak rate at the Quik Test Timer and then completes the full test cycle and calculates the leak rate for the complete test. The instrument stores the test results that include both the actual complete test result and a projected test result based on the Quik Test measurement. By comparing the two leak rate results, a percent of error for the Quik Test feature can be calculated. If the results are satisfactory, the Quik Test feature can be implemented by setting appropriate High Limit and Low Limit Bands based on the test comparison and enabling Quik Test. This feature will save the time difference between a full test time and the Quik Test Time for almost all of the accepted parts and most of the rejected parts. If the results are not consistent to each other, test further by increasing the Quik Test Timer, re-calibrate the instrument, and compare the results again.

Test Parameters

The Quik Test parameters menu is located in **Main Menu > Program Config > TST:***** icon.

TST Parameter	Description	Display User Level
Quik Test Enable	Activates Quik Test.	Advanced, Admin
Quik Test Timer	Defines the time as a percent of the Test sequence when the Quik Test function result is calculated.	Advanced, Admin
Quik Test LL Band	The leak (flow) rate band around the Low Limit within which the tests will continue to completion. This value is the amount above and below the nominal. For example, if this value is set to 0.5 scc/m and the Low limit is set to -5.0 scc/m, the entire Quik Test LL Band is -4.5 to -5.5 scc/m.	Advanced, Admin
Quik Test HL Band	The leak (flow) rate band around the High Limit within which the tests will continue to completion. This value is the amount above and below the nominal. For example, if this value is set to 1.0 scc/m and the High limit is set to 10.0 scc/m, the entire Quik Test LL Band is 9.0 to 11.0 scc/m.	Advanced, Admin

Appendix C – Environmental Drift Correction

This appendix explains the theory and parameters for implementing the Environmental Drift Correction feature.

How it works

The environmental drift correction routine helps to maintain the calibration of the system by continuously monitoring and calculating a correction factor for changes in the test conditions. This routine dynamically compensates for slow changes in the test environment such as room temperature changes, part temperature changes, test air temperature changes, part elasticity changes, part absorption characteristics, etc. These factors influence the dynamics of how the test part reacts to the testing process and the determination of the leak rate. "Environmental Drift Correction" defines how wide of a band around the Master Part Loss or Master Part Flow value will be considered as normal variations in flow rate for a non-leaking part. The "Environmental Drift Correction" (+EDC %) is based on High Limit. The instrument continuously calculates a running average of test results that fall within the band (EDC %) about the original non-leaking master part curve. It corrects each future result by the calculated drift determined from previous test results. The drift value is calculated as shown.

$$\text{Environmental Drift Correction} = \frac{\Sigma n \text{ Flow}}{n} - \text{"Master Part Flow"}$$

Typical settings for "Environmental Drift Correction" are 10%, 25%, 50%, 75%, and 90%. The sample size is set as EDC quantity (3 or greater). Flexible parts require a greater "Environmental drift correction" than rigid parts.

The "Environmental Drift Correction" effectively defines how much shift can occur. This limits the routine from continuing to compensate for possible growing leaks in the seal or test pneumatics.

The EDC parameters menu is located in **Main Menu > Program Config > TST:***** icon.

TST:*** Parameter	Description	Display User Level
EDC Enable	Enables Environmental Drift Correction	Advanced, Admin
EDC Percentage	Defines the band about the master part curve where test values are saved to calculate EDC drift. Set as a percentage of the High Limit parameter. Options include 10%, 25%, 50%, 75%, and 90%.	Advanced, Admin
EDC Quantity	Defines the number of test results within the EDC band used to calculate drift.	Advanced, Admin

Environmental Drift Correction (EDC) will reset based on any of the following conditions:

1. Instrument power-cycle (due to limitations in instrument non-volatile storage)
2. Change of any variables that affect EDC calculations:
    a. EDC Configuration change (modification the variables: *EDC Enabled*, *EDC Percentage*, or *EDC Quantity*)
    b. Test Limit change (modification of the variable: *High Limit [Loss/Leak/Rate]*)
3. Program idle time-out: 1 hour elapsed since last test on matching program number

Note: The act of changing the selected active program does not reset the Environmental Drift Correction feature. A user can switch between multiple programs (EDC data is stored per program), as long as the amount of time from the last time the similar program number was run does not exceed the 1-hour time-out.

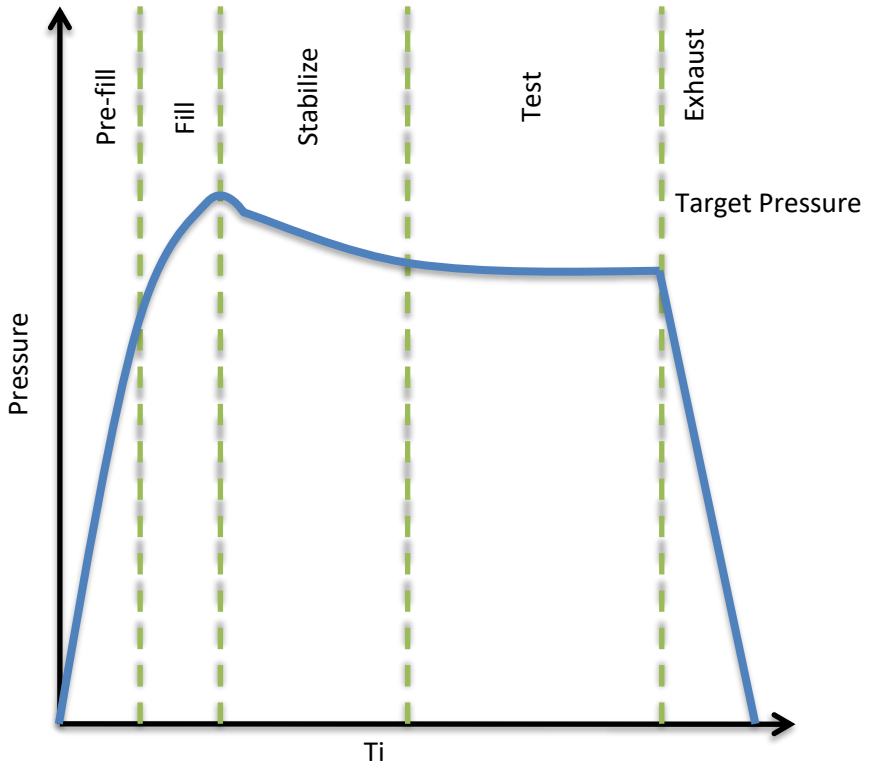
Appendix D – Electronic Regulator Compensation

This appendix explains the theory and parameters for implementing the Electronic Regulator Compensation (ERC) feature.

How it works

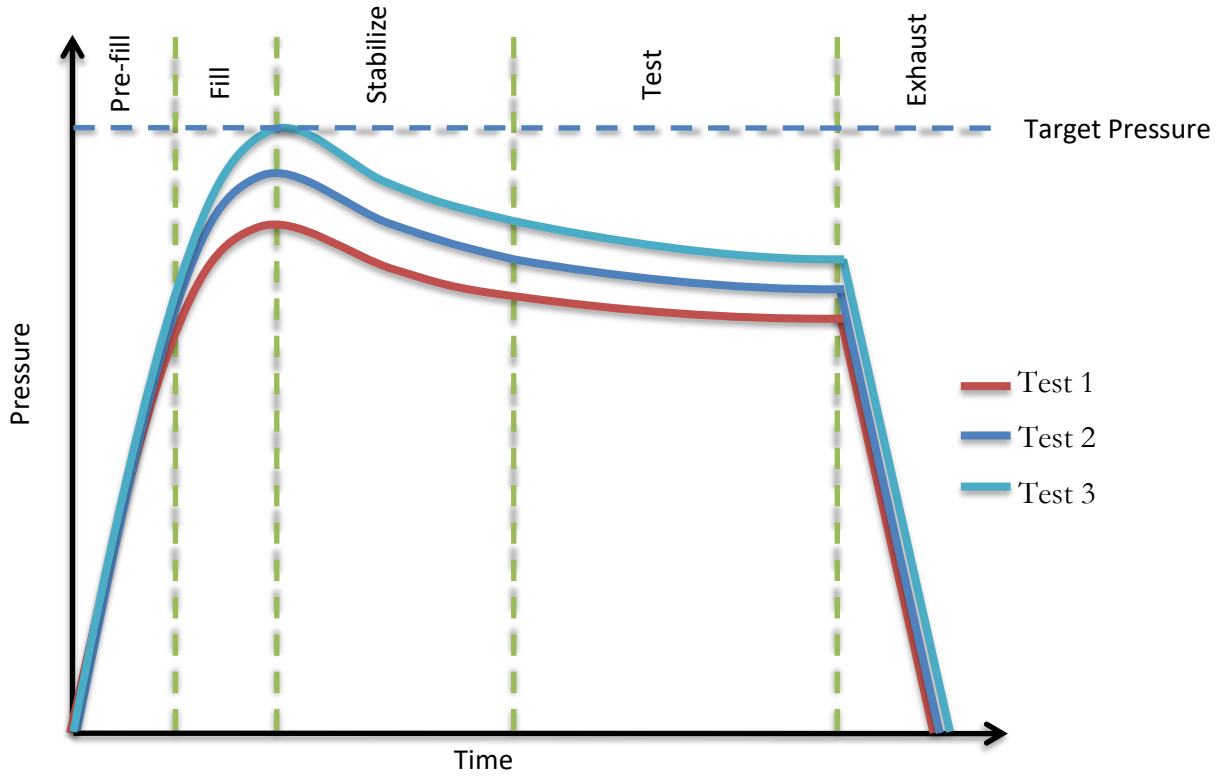
The Electronic Regulator Compensation (ERC) routine helps the instrument to compensate for electronic regulator calibration error (drift from calibrated setpoint). This allows the instrument to reach the desired target pressure. The ERC method can be set to "*Optimize* Fill *Pressure*", "*Optimize* Test *Pressure*", or "*Optimize Source Pressure*".

The below graph represents a test with ERC disabled. In this example, the electronic regulator is not calibrated for Target Pressure, so the pressure set during the test has deviated.



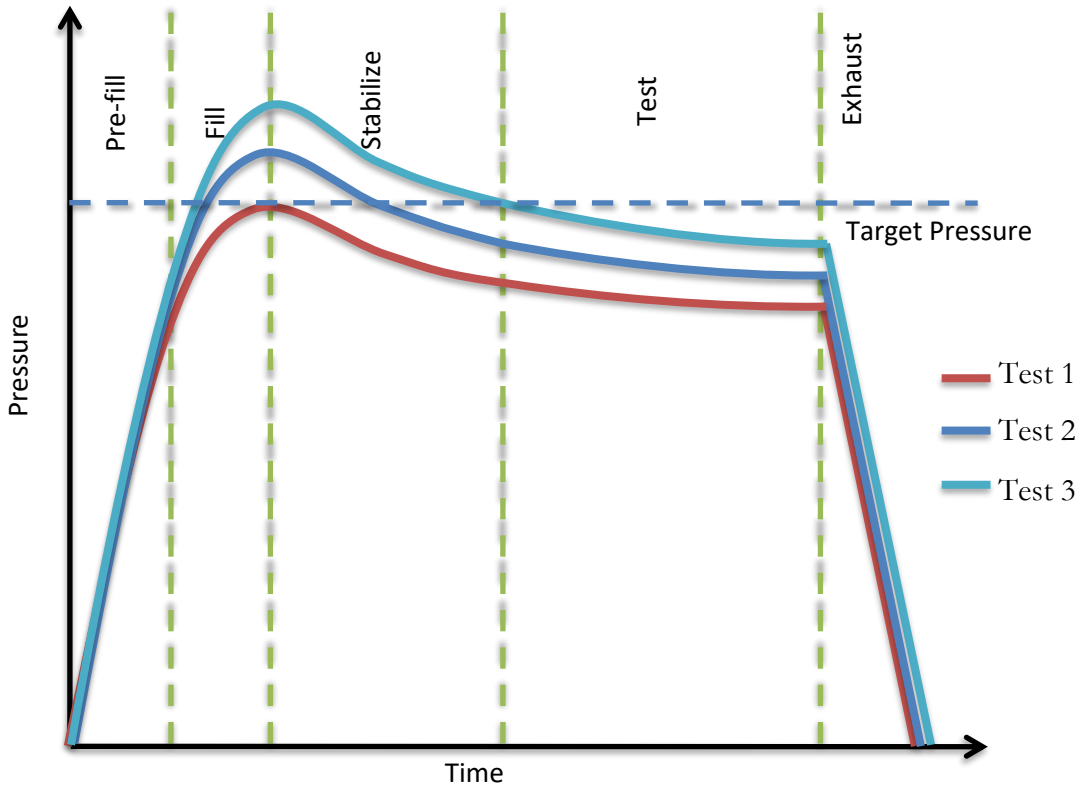
In the "Optimize Fill Pressure" method, ERC enables the instrument to adjust the regulator pressure setting to obtain the **optimal measured fill pressure**, as determined by the Target pressure.

In this method, the electronic regulator setpoint is adjusted on subsequent tests to force the measured fill pressure to match the target pressure, based upon the stored result history of previous passed tests.

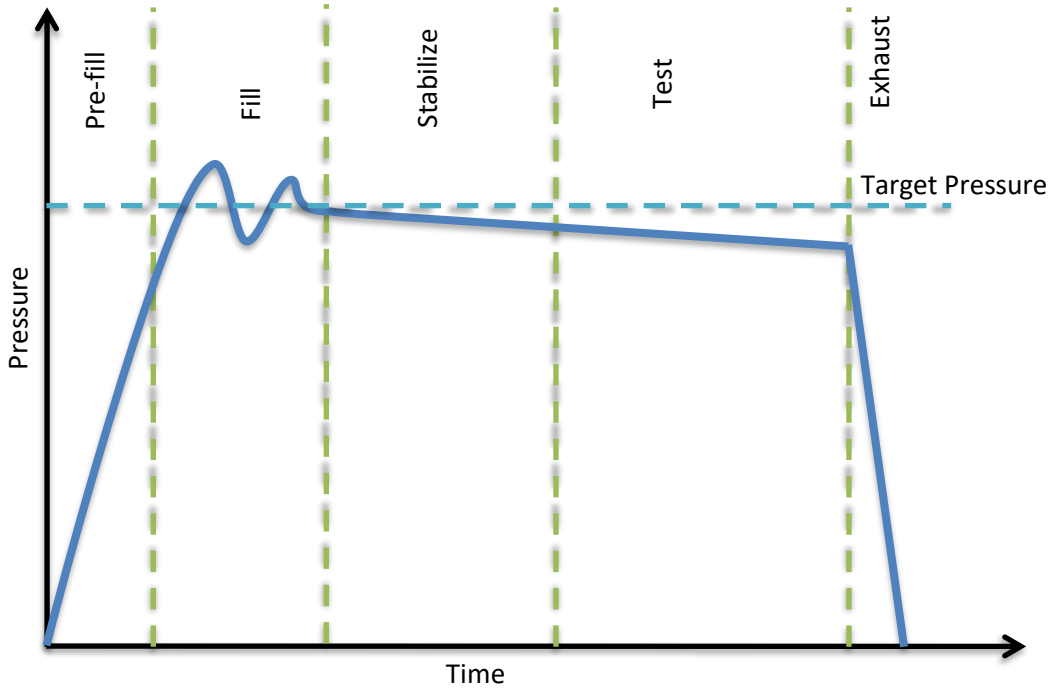


In the "Optimize Test Pressure" method, ERC enables the instrument to adjust the regulator pressure setting to obtain the **optimal measured test pressure**, as determined by the Target pressure.

In this method, the electronic regulator setpoint is adjusted on subsequent tests to force the measured test pressure to match the target pressure, based upon the stored result history of previous passed tests.



In the "Optimize Source Pressure" method, the electronic regulator will be continuously adjusted during the fill segment to force the measured fill pressure to match the desired target pressure for the test.



Note:

1. ***The performance of "Optimize Test Pressure" or "Optimize Fill Pressure" methods depends on multiple iterations since it is based on the history of previous Accept tests. For these ERC methods, only tests that pass with the measured pressure that is inside the ERC target window will be added to the history.***
2. ***The "Optimize Source Pressure" method does not depend on the history of previous Accept tests. Every time you run this test, the instrument will regulate pressure to the desired target pressure for that test only.***

ERC will reset based on any of the following conditions:

1. Instrument power-cycle (due to limitations in instrument non-volatile storage)
2. Change of any variable that affect ERC calculation
    a. ERC Method
    b. ERC Target Window
    c. ERC Offset Limit
    d. ERC Quantity

Test Parameters

The ERC Test parameters menu is located in **Main Menu > Program Config > MISC** icon.

TST Parameter	Description	Display User Level
ERC Method	ERC method enables the instrument to adjust the regulator pressure setting to obtain the optimal measured pressure (fill pressure or test pressure), as determined by the Target Pressure.	Advanced, Admin
ERC Target Window	Percentage (plus and minus) window about the target pressure, defining the maximum allowable test pressure to be utilized in the calculation for the ERC routine. *This parameter is only available if the ERC Method selected is "Optimize Test Pressure" or "Optimize Fill Pressure"*	Admin
ERC Offset Limit	Maximum correction value, defined as a percentage of the target pressure, allowed for the ERC routine. *This parameter is only available if the ERC Method selected is "Optimize Test Pressure" or "Optimize Fill Pressure"*	Admin
ERC Quantity	Maximum number of test results within the ERC target window used to calculate the ERC pressure offset. *This parameter is only available if the ERC Method selected is "Optimize Test Pressure" or "Optimize Fill Pressure"*	Admin
ERC Increment Limit	Limits the maximum electronic regulator incremental adjustment for the ERC routine, Defined as the percentage of the window between the target pressure and the min/max pressure. *This parameter is only available if ERC Method selected is "Optimize Source Pressure"*	Admin
ERC Crossover Limit	Defines the number of times the pressure must crossover the desired target pressure when determining the period response rate of the electronics regulator. *This parameter is only available if ERC Method selected is "Optimize Source Pressure"*	Admin
ERC Rate/Period	Percentage of the electronic regulator response period used to determine the ERC routine response rate *This parameter is only available if ERC Method selected is "Optimize Source Pressure"*	Admin

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Appendix E – Communication Code Tables

This appendix lists the codes that are referenced in the notes of Chapter 24 Communication.

Each table can be generated within the communications interface by providing the associated command denoted.

Data Type or Header Codes

Type "TABLE HEADER"

	Data Type Code	Description
1	V	Variable Edit
2	L	List
3	M	Message
4	Q	Result List
5	T	Streaming Started
6	S	Streaming Value
7	X	Streaming Stopped
8	R	Result Value

Program Evaluation Codes

Type "TABLE RESULT"

	Program Evaluation Code	Description
1	P	TEST PASSED
2	F	TEST FAILED
3	E	TEST ERROR
4	S	TEST SKIPPED
5	X	TEST FAILED - LEVEL 1
6	Y	TEST FAILED - LEVEL 2
7	Z	TEST FAILED - LEVEL 3
8	M	AUTO-CAL MASTER PART
9	L	AUTO-CAL LEAK STANDARD PART
10	N	TEST FAILED - NO EVENT
11	C	TEST COMPLETE

Test Evaluation Codes

type "TABLE EVALUATION"

	Test Evaluation Code	Description
1	A	PROGRAM ACCEPT
2	AC	AUTOSETUP SEQ COMPLETE
3	AF	PROGRAM CALIBRATION FAILED
4	AL	MASTER+LEAK PART COMPLETE
5	AM	MASTER PART COMPLETE
6	AP	PROGRAM CALIBRATION PASSED
7	AT	ERROR: ANTI-TIE DOWN
8	BR	ERROR: BARCODE REQ TO START
9	C1	MASTER+LEAK LOSS<MASTER LOSS
10	C2	MASTER LOSS>MAX M+L LOSS
11	C3	MASTER+LEAK LOSS>MAX M+L LOSS
12	C4	MASTER FLOW>MAX M+L FLOW
13	C5	MASTER FLOW<MIN MASTER FLOW
14	C6	MASTER+LEAK FLOW>MAX M+L FLOW
15	C7	MASTER FLOW>MAX MASTER FLOW
16	C8	MASTER+LEAK FLOW<MASTER FLOW
17	C9	MASTER LOSS<MIN MASTER LOSS
18	CA	CAL PROGRAM ACCEPT
19	CE	CALCULATION ERROR
20	CF	CAL REQUIRED - LIMIT EXCEEDED
21	CH	CHARGE PRESSURE HIGH
22	CL	CHARGE PRESSURE LOW
23	CM	MIN PERF FACTOR ERROR
24	CP	CAL REQUIRED - PARAM CHANGED
25	CR	CAL PROGRAM REJECT
26	CX	CHAMBER EVACUATION FAULT
27	DF	DP TRANSDUCER FAULT
28	DO	DP TRANSDUCER OVER-RANGE
29	DZ	DP TRANSDUCER ZERO BAD
30	EC	ELEC REGULATOR CAL COMPLETE

	Test Evaluation Code	Description
31	EE	ELEC REGULATOR CAL ERROR
32	EF	PART EVAC FAULT
33	EI	ERROR: INSTRUMENT NOT ENABLED
34	EP	PROG ERROR
35	ER	SYSTEM ERROR - SERVICE REQ
36	FC	CHAMBER PRESSURE HIGH
37	FO	FLOW TRANSDUCER OVER-RANGE
38	FX	ERROR: EXCESSIVE FLOW
39	FZ	FLOW TRANSDUCER ZERO BAD
40	HF	HELIUM BACKGROUND FAULT
41	IC	INVALID INPUT CONFIGURATION
42	ID	INVALID CALIBRATION DATA
43	IE	INPUT INITIAL STATE ERROR
44	IF	I/O FAULT
45	IO	INVALID I/O CONFIGURATION
46	IP	INVALID PROGRAM SELECTED
47	IR	CHAMBER RISE INPUT FAULT
48	IS	ISOLATION FAILURE
49	IX	CHAMBER CROSSOVER INPUT FAULT
50	L0	MASTER LOSS>MAX MASTER LOSS
51	L1	MASTER+LEAK LOSS<MIN M+L LOSS
52	L2	LEAK LOSS<MIN LEAK LOSS
53	L3	LEAK LOSS>MAX LEAK LOSS
54	L4	MASTER+LEAK FLOW<MIN M+L FLOW
55	L5	LEAK FLOW<MIN LEAK FLOW
56	L6	LEAK FLOW > MAX LEAK FLOW
57	LD	ERROR: DUPLICATE TARGET LINK
58	LE	LEAK STD SELECT CONFIG ERROR
59	LL	ERROR: LINK EXECUTION LOOP
60	LN	ERROR: NO LINKS DEFINED

type "TABLE EVALUATION"

	Test Evaluation Code	Description
61	LO	ERROR: DISSIMILAR LINK ORDER
62	LP	ERROR: LINK PROG IS PARENT
63	LU	ERROR: LINK PROG UNDEFINED
64	MC	MASS SPEC CONTAMINATION
65	MF	ERROR: PART MARK FAULT
66	MS	MAN FILL SWITCH
67	NE	NO EVENT OCCURRED
68	OC	ATMOSPHERIC PRESSURE COMPLETE
69	OE	ATMOSPHERIC PRESSURE ERROR
70	PA	ABOVE TARGET PRESSURE
71	PB	BELOW TARGET PRESSURE
72	PC	ERROR: PART NOT CHANGED
73	PE	PROGRAM CONFIGURATION ERROR
74	PF	PART NOT FULL
75	PH	TEST PRESSURE HIGH
76	PL	TEST PRESSURE LOW
77	PP	ERROR: PART NOT PRESENT
78	PR	POWER RESET
79	PS	PART NOT STABILIZED
80	PV	PROCESS FAULT
81	PX	PART NOT EXHAUSTED
82	QC	SEQUENCE COMPLETE
83	R	PROGRAM REJECT
84	R1	PART REJECT - LEVEL 1
85	R2	PART REJECT - LEVEL 2
86	R3	PART REJECT - LEVEL 3
87	RF	CHAMBER RISE FAULT
88	RH	PRE-PRESSURE HIGH
89	RL	PRE-PRESSURE LOW
90	RX	SOURCE PRESSURE EXCEEDED

	Test Evaluation Code	Description
91	S1	LD ZERO < MIN
92	S2	LD ZERO > MAX
93	S3	LD LEAK < MIN
94	S4	LD LEAK > MAX
95	SB	STOP BUTTON PRESSED
96	SC	START COMMON INPUT LOW
97	SE	PRESSURE SELECT CONFIG ERROR
98	SF	SELF-TEST FAILED
99	SH	ERROR: STOP INPUT HIGH
100	SI	STOP INPUT RECEIVED
101	SL	SEVERE LEAK
102	SM	SNIFFER MODE MISMATCH
103	SN	ERROR: SNIFFER NOT READY
104	SP	SELF-TEST PASSED
105	SR	SNIFFER READY INPUT FAULT
106	ST	SNIFFER TYPE MISMATCH
107	SU	SNIFFER UNITS MISMATCH
108	SX	SYSTEM PRESSURE EXCEEDED
109	TB	T-GAS BACKGROUND FAULT
110	TC	T-GAS CHAMBER CLEANUP FAULT
111	TE	ERROR: TOOLING NOT RESET
112	TF	T-GAS PART FILL FAULT
113	TI	ERROR: TWO-INPUT REQ TO START
114	TL	T-GAS LEAK STD FAULT
115	TM	T-GAS MIN LEAK RATE FAULT
116	TP	TEST PORT SELECT CONFIG ERROR
117	TR	ERROR: TOOLING NOT RETRACTED
118	TS	TOOLING RESET
119	TX	ERROR: TOOLING NOT EXTENDED
120	VF	VALVE LOAD FAULT

type "TABLE EVALUATION"

	Test Evaluation Code	Description
121	VR	VENT PART RESET TOOLING
122	WA	WEIGHT ABOVE MAX
123	WB	WEIGHT BELOW MIN
124	WC	SCALE CONFIG ERROR
125	WH	SCALE WEIGHT HIGH
126	WL	SCALE WEIGHT LOW
127	WR	SCALE NOT READY
128	WS	SCALE NOT STABLE
129	XC	TRANSDUCER CAL COMPLETE
130	XE	TRANSDUCER CAL ERROR
131	XF	PRESSURE TRANSDUCER FAULT
132	XH	EXT SWITCH DID NOT GO HIGH
133	XL	EXT SWITCH DID NOT GO LOW
134	XO	TRANSDUCER OVER-RANGE
135	XP	EXTERNAL XDCR PRESS
136	XV	TRANSDUCER VERIFY COMPLETE
137	XZ	TRANSDUCER ZERO BAD

Segment Codes

type "TABLE SEGMENT"

	Segment Code	Description
1	%VR	Percent of Reference Volume Test
2	APC	Setup - Atmospheric Pressure Check
3	AR	Autorun Relax
4	BAL	Stabilize DP Xdcr Balance
5	CBC	Chamber - blower control
6	CC0	Chamber - circulation off
7	CC1	Chamber - circulation on
8	CCX	Chamber - accumulation rest
9	CE0	Chamber - evacuate off
10	CE1	Chamber - evacuate on
11	CHA	Exhaust - Chamber Output Rest
12	CIF	Chamber - inlet blower off
13	CIO	Chamber - inlet blower on
14	CLN	Stabilize Chamber Cleanup
15	CO0	Chamber - outlet blower off
16	CO1	Chamber - outlet blower on
17	CP0	Chamber - pre-purge
18	CPC	Chamber - clamshell purge rings control
19	CPG	Chamber - Exh/Purge
20	CPO	Chamber - clamshell purge rings option
21	CPR	Chamber - clamshell purge rings rest
22	CST	Fill Clean
23	CV0	Chamber - vent off
24	DDL	Differential Pressure Decay - Leak Rate (volume calculated)
25	DLY	Delay
26	DPD	Differential Pressure Decay Test
27	DPD	Differential Pressure Decay Test (no abs pressure)
28	DPL	Differential Pressure Decay - Leak Standard Test (no abs pressure)
29	DPL	Differential Pressure Decay - Leak Standard Test
30	DPS	Setup - DP Transducer Setpoint

	Segment Code	Description
31	DPT	Rate of Pressure Loss Test
32	DTV	Setup - DP Transducer Verification
33	DTZ	Setup - DP Transducer Zero
34	ERA	Setup - Electronic Regulator Analyze
35	ERS	Setup - Electronic Regulator Setpoint
36	ERZ	Setup - Electronic Regulator Zero
37	ESI	Internal - Empty-Seq
38	EST	Fill Evac
39	EXE	Exhaust until Empty
40	EXH	Exhaust
41	EXP	Exhaust until Pressure
42	EXT	Tooling Motion Extend
43	FFL	Fill until Full
44	FGN	General Fill
45	FLC	Mass Flow - Leak Rate Test
46	FLL	Fill (without pressure monitoring)
47	FLR	Precise Mass Flow Test (Differential Flow)
48	FLW	Mass Flow Test
49	FRF	Fill Reference
50	FRP	Fill Ramp
51	FST	Fill Tracer
52	FTS	Setup - Flow Transducer Setpoint
53	FTV	Setup - Flow Transducer Verification
54	FTZ	Setup - Flow Transducer Zero
55	HVC	Chamber - hardvac control
56	LKC	Link Control
57	LNK	Link Decision
58	MVX	Setup - Mix Verification
59	OCC	Occlusion Test (Backpressure)
60	PLO	Pressure Loss Test

type "TABLE SEGMENT"

	Segment Code	Description
61	PLR	Pressure Decay - Leak Standard Test
62	PMK	Tooling Part Mark
63	PRC	Prefill - Charge Volume
64	PRF	Prefill/Fill
65	PRF	Prefill until Pressure
66	PRF	Proof Test
67	PRI	Internal - Pre-Seq
68	PRI	Internal - Evaluate Part Result
69	PRP	Prefill Pre-Pressure
70	PRS	Step Proof
71	PSI	Internal - Post-Seq
72	PTS	Setup - Pressure Transducer Setpoint
73	PTV	Setup - Pressure Transducer Verification
74	PTZ	Setup - Pressure Transducer Zero
75	PVF	Pressure Verify
76	RCF	Refrigerant Iso Off
77	RCX	Refrigerant CS Isolation
78	REC	Exhaust - T-Gas
79	REF	Refrigerant Fill
80	RET	Tooling Motion Retract
81	REV	Exhaust - Re-Evacuate
82	RFE	Refrigerant Evac
83	RFM	Refrigerant Manual Fill
84	RFS	Stabilize Scale
85	RFT	Refrigerant Fill
86	RFX	Refrigerant Stabilize
87	RL	Calibration Relax
88	RPS	Refrigerant Part Switch
89	RTE	Ramp to Pressure Event Test
90	RTF	Ramp to Flow Event Test

	Segment Code	Description
91	RTI	Ramp to Digital Input Event Test
92	RVN	Refrigerant Vent
93	SCI	Setup - Scale Init
94	SD1	Setup - Sniffer idle
95	SDP	Stabilize for DP
96	SDP	Stabilize Balance DP
97	SFS	Stabilize Tracer
98	SGL	Fill Tracer Gross
99	SGS	Stabilize Tracer Gross
100	SI1	Setup - Sniffer Init
101	SI2	Setup - Sniffer Init 2
102	SLE	Tooling Seal Extend
103	SLR	Tooling Seal Retract
104	SME	Setup - Manifold Exhaust
105	SMF	Setup - Manifold Fill
106	SMI	Setup - Manifold Isolate
107	SNF	Sniffer Test
108	SNG	Sniffer Gross Test
109	SNW	Stabilize Tracer Wait
110	SPF	Fill Step
111	SPL	Setup - Pressure Select
112	SPR	Setup - Pre-Seq
113	SPS	Setup - Post-Seq
114	SSD	Stabilize Step Dwell
115	SSR	Setup - Set Regulator
116	STE	Stabilize Evac
117	STF	Stabilize for Flow
118	STG	General Stabilize
119	STR	Setup - Transducer Residual
120	STR	Stabilize Reference Volume

type "TABLE SEGMENT"

	Segment Code	Description
121	STS	Stabilize until Slope
122	SVD	Evac Test
123	SXT	Stabilize for Xdcr Test
124	TMC	Tooling Motion Control
125	XDR	Transducer Test

Test Data or Variable Identifier Codes

type "TABLE VARIABLE"

	Test Data Identifier Code	Description
1	%P	Percent Precision
2	2in	Two Inputs to Start
3	AAA	Accum Autozero
4	AAV	Accept Average
5	ACT	Auto-Cycle Tst Mode
6	AD	Analog A/D
7	AER	Permit Early Reject
8	ALR	Alt Leak Rate
9	APC	Accept Percentage
10	APC	Atm Pressure Check
11	APP	Accept Program
12	AQ	Average Quantity
13	ARC	Autorun Cycle Count
14	ARE	Autorun Enable
15	ARM	Autorun Method
16	ARR	Autorun Relax
17	ASA	Short Autozero
18	ASD	Accept Std Dev
19	ASM	AutoSetup Method
20	ASP	Accept SPC Std Dev
21	ATD	Anti-Tie-Down
22	AZD	Autozero Delay
23	AZE	Autozero Enable
24	Ain	Analog Input
25	Aot	Analog Output
26	BC	Batch Calibration
27	BCM	Barcode Method
28	BL	Batch Layout
29	BQ	Batch Quantity
30	BR	Barcode Required
31	CA	Accept Cycles
32	CAP	Calibrate Percent
33	CC	Capability Code
34	CCD	Ch Evac Valve Dly
35	CCP	Clear Prog Counters
36	CCR	Clear Chan Results
37	CCS	Clear Chan Counters
38	CEF	Chmbr Evac Limit
39	CEV	Chmbr Evac Close
40	CFS	Cleanup Setpoint
41	CGP	Chmbr Pre-Purge
42	CGT	Chmbr Pre-Purge
43	CHM	Post-Purge Method
44	CHO	Chmbr Post-Purge
45	CHP	Chamber Pressure

	Test Data Identifier Code	Description
46	CHV	Chamber Volume
47	CID	CS Iso Delay
48	CLF	Corr. Leak Std Flow
49	CLM	Clamshell
50	CLP	Check Limit Percent
51	CLR	Cal Required
52	CLR	Cumulative Leak
53	CM	Malfunction Cycles
54	CM	Cal Method
55	CMN	Clean Min Pressure
56	CMP	Charge Min Press
57	CMX	Maximum Pressure
58	COF	Continue on Fail
59	COL	Cutoff Limit
60	CP	Current Precision
61	CPP	Copy Program
62	CPR	Charge Pressure
63	CPS	TLR Change/Sec
64	CPT	Consecutive Points
65	CPT	Consecutive Points
66	CR	Reject Cycles
67	CRA	Clean Part Source
68	CRF	Pre-Purge
69	CRS	Chmbr Crossover
70	CSC	Cycles Since Cal
71	CSN	Clear Since New Ctr
72	CSN	Cycles Since New
73	CST	Custom Self Test
74	CT	Total Cycles
75	CTE	Continue to Evac
76	CTF	Continue to Fill
77	CTG	Target Pressure
78	CTP	Copy to Target Prog
79	CTP	Charge Target Press
80	CTR	Clean Part Timer
81	CTX	Continue T-Gas Exh
82	CXP	Charge Max Press
83	DA	Analog D/A
84	DD	Decay Direction
85	DFL	Direct Flow
86	DKL	DP Leak Loss
87	DL	Diff Press Loss
88	DLL	DP Master+Leak Loss
89	DLR	Diff Press Loss Rd
90	DLT	Delay Timer

type "TABLE VARIABLE"

	Test Data Identifier Code	Description
91	DML	DP Master Part Loss
92	DMR	DP Mstr Part Lss Rd
93	DP	Diff Pressure
94	DPI	DP iso Percent
95	DPP	¤ Press Precision
96	DVF	Vent During Fill
97	DVM	Test Mode
98	DVO	Device Mode
99	Dt	Date
100	ECL	ERC Crossover Limit
101	EDC	EDC Offset
102	EDE	EDC Enabled
103	EDP	Event ¤P
104	EDP	EDC Percentage
105	EDQ	EDC Quantity
106	EDT	Event ¤T
107	EIL	ERC Increment Limit
108	EM	Exhaust Method
109	EMP	Ext Xdcr Pressure
110	ENB	E-NOB
111	ENC	Enable Calibration
112	ENT	Enable Tooling I/O
113	EOL	ERC Offset Limit
114	EPP	Pressure Precision
115	EPR	Pressure Reference
116	EPV	Estimated Part Size
117	ERA	Atm Pressure
118	ERC	ERC Method
119	ERE	ERC Enabled
120	ERP	ERC Rate/Period
121	ERQ	ERC Quantity
122	ERR	E-Regulator Rest
123	ERV	Re-Evac After Test
124	ESC	Ext Switch Low Chk
125	ESN	External Sniffer
126	ESP	Exhaust Setpoint
127	ET	Elapsed Time
128	ETP	Evacuation Setpoint
129	ETP	Fine T-Gas Target
130	ETW	ERC Target Window
131	ETW	ERC Target Window
132	ETY	Edge Type
133	EUP	Pressure Unit
134	EVA	Evacuation Source
135	EVC	Eval Condition

	Test Data Identifier Code	Description
136	EVD	Vacuum Decay
137	EVL	Test Evaluation
138	EVM	Allow Evac Limit
139	EVP	Event Pressure
140	EVT	Event Type
141	EXD	Evacuation Xdcr
142	EXP	Execution Pause
143	FC	Feature Code
144	FCC	Force Cal Cycles
145	FCD	FCal Date Limit
146	FCL	FCal Cyc Limit
147	FCM	Force Cal Mode
148	FCT	FCal Time Limit
149	FCT	Force Cal Time
150	FEL	Flow Event Limit
151	FL	Flow
152	FLD	Fine T-Gas Decay
153	FLF	Fine T-Gas Fill
154	FMV	Finish Mix Verify
155	FNB	FF-NOB
156	FP	Flow Precision
157	FPR	Fill Pressure
158	FPS	Fine Sample
159	FSW	Final Src Weight
160	FTA	Fill
161	FTA	Dwell
162	FTX	Test Failed Text
163	Fdb	Tooling Feedback
164	GLD	Gross T-Gas Decay
165	GLF	Gross T-Gas Fill
166	GLN	Gross T-Gas Min
167	GLT	Gross T-Gas Target
168	GLX	Gross T-Gas Max
169	GPS	Gross Sample
170	GPT	Gross Fill Pulse
171	HLE	High Limit Event
172	HLF	High Limit Flow
173	HLL	High Limit Loss
174	HLP	High Limit Pressure
175	HLQ	High Limit Leak
176	HLR	High Limit Rate
177	HLV	High Limit %Vref
178	I/O	I/O ID
179	IET	Event Type
180	IF	Instrument Flow

type "TABLE VARIABLE"

	Test Data Identifier Code	Description
181	IIS	Input Initial State
182	ILS	Level State
183	ILT	Level Time
184	IPR	Close Inner Purge
185	IS	Input State
186	ISO	Isolation
187	LAV	Leak Alarm Volume
188	LCD	Leak Std/Cal Define
189	LCD	Leak Std Cal Date
190	LCF	Correction Factor
191	LDP	Leak Det Precision
192	LDT	Dev Zero Delay
193	LDU	Leak Det Unit
194	LDZ	Device Zero
195	LF	Master+Leak Flow
196	LFC	Leak Std Cal Flow
197	LFR	Master+Leak Flow Rd
198	LIN	Linearity
199	LKF	Leak Flow
200	LKL	Leak Loss
201	LKM	Link Motion
202	LL	Master+Leak Loss
203	LLE	Low Limit Event
204	LLF	Low Limit Flow
205	LLL	Low Limit Loss
206	LLP	Low Limit Pressure
207	LLQ	Low Limit Leak
208	LLR	Master+Leak Loss Rd
209	LLR	Low Limit Rate
210	LLV	Low Limit %Vref
211	LMP	Link Motion Preempt
212	LNL	Linearity Limit
213	LOF	Loss Offset
214	LQ	Master+Leak QL
215	LQD	DP Mstr+Lk QL Rd
216	LQD	DP Master+Leak QL
217	LQF	Master+Leak QF Rd
218	LQF	Master+Leak QF
219	LQR	Master+Leak QL Rd
220	LR	Leak Rate
221	LRC	Leak Std Recert
222	LRO	Leak Rate Offset
223	LRO	Leak Rate Offset
224	LSC	Leak Std Chk
225	LSP	Leak Std Pressure

	Test Data Identifier Code	Description
226	LSS	Leak Std Select
227	LSV	Leak Std Value
228	LV	Launch Validation
229	ME	Malfunction Eval
230	MF	Master Part Flow
231	MFO	Manual Fill
232	MFR	Master Part Flow Rd
233	MFT	Manual Fill
234	ML	Master Part Loss
235	MLF	Min Mstr+Leak Flow
236	MLF	Min Leak Flow
237	MLL	Min Leak Loss
238	MLR	Master Part Loss Rd
239	MMF	Min Master Flow
240	MMF	Min Master Flow
241	MML	Max Master Loss
242	MML	Min Mstr+Leak Loss
243	MML	Min Master Loss
244	MNT	Min Tare Weight
245	MO	Master Flow Offset
246	MOR	Master Flow Offset
247	MPC	Malfunction Percent
248	MPF	Min Perform Factor
249	MPP	Max System Pressure
250	MQ	Master Part QL
251	MQD	DP Mstr Part QL Rd
252	MQD	DP Master Part QL
253	MQF	Master Part QF Rd
254	MQF	Master Part QF
255	MQR	Master Part QL Rd
256	MSL	Reject Rate
257	MSO	MS Iso Open Delay
258	MSP	Max Pressure - Opt
259	MSR	Mark Severe Lk Rej
260	MST	Mass Spec Purge
261	MTM	Min T-Gas Mode
262	MTS	T-Gas Source
263	MV	T-Gas Mix Verify
264	MVF	T-Gas Tgt Press
265	MVH	Leakrate High Limit
266	MVL	Leakrate Low Limit
267	MVM	T-Gas Leak Rate
268	MVS	Start Mix Verify
269	MVT	T-Gas Fill Timer
270	MXT	Max Tare Weight

type "TABLE VARIABLE"

	Test Data Identifier Code	Description
271	Mot	Motion Number
272	Mot	Number of Motions
273	NAM	Program Name
274	NBC	Number of Barcodes
275	NLK	Number of Links
276	NOP	Number of Options
277	NPP	Next Program
278	NPS	Number of Steps
279	NTP	Sample Points
280	NUM	Number of Programs
281	OLS	Open Leak Std
282	OPT	Option
283	OTL	Open T-Gas Leak Std
284	P	Master Gauge Press
285	P	Instrument Pressure
286	P	Meas Pressure
287	P%V	Part %Vref
288	PC	Pneumatic Code
289	PCL	Leak Std Cal Press
290	PCR	Pressure Correction
291	PCT	Chmbr Post-Purge
292	PDL	Press Delta Limit
293	PET	Part Evac Limit
294	PEV	Part Evacuation
295	PEX	Partial Exhaust
296	PF	Performance Factor
297	PFL	Part Flow
298	PFM	Prefill Method
299	PG	Target Pressure
300	PKP	Peak Pressure
301	PL	Pressure Loss
302	PLP	Predicted Loss
303	PLQ	Master+Leak Q-Press
304	PLR	Pressure Loss Rd
305	PLR	DP Mstr+Lk Loss Rd
306	PM	Master Part Press
307	PM	Part Mark
308	PMF	Part Mark Feedback
309	PML	Master+Leak Press
310	PMN	Minimum Pressure
311	PMQ	Master Part Q-Press
312	PMX	Maximum Pressure
313	PNM	Sniffer Test Point
314	PP	Pressure Precision
315	PP	Proof Pressure

	Test Data Identifier Code	Description
316	PPC	Part Present Check
317	PPC	Prefill Press Check
318	PPE	Pre-Press Enable
319	PPR	Pre-Pressure
320	PPS	Pre-Press Select
321	PPW	Pre-Pressure Window
322	PQ	Predicted Leak
323	PRF	Prefill
324	PRI	Programmable Input
325	PRO	Programmable Output
326	PRR	Pressure Restrict
327	PSL	Pressure Select
328	PSL	Pressure Select
329	PSL	Pressure Select
330	PSP	Setpoint Pressure
331	PST	Self Test Pressure
332	PSV	Part Sniffer Type
333	PT	Target Pressure
334	PTF	Prefill
335	PTG	Gross Prefill
336	PTP	¤P/¤T Precision
337	PTS	Port Select
338	PTS	Part Seal
339	PTU	¤P/¤T Unit
340	PTX	Test Passed Text
341	PW	Weight Precision
342	Pp	Part Pressure
343	Pr	Ref Pressure
344	Ps	Standard Pressure
345	Pt	Program Number
346	Pt	Apply to Program #
347	Pt	Target Pressure
348	Pt	Test Pressure
349	QF	Quik Flow
350	QHL	Quik Test HL Band
351	QL	Quik Loss
352	QLL	Quik Test LL Band
353	QP	Quik Test Pressure
354	QPT	Quantity Points
355	QTE	Quik Test Enable
356	RAN	Number of Points
357	RAP	Analysis Pressure
358	RAS	Analysis Voltage
359	RAT	Analysis Percent
360	RAV	Reject Average

type "TABLE VARIABLE"

	Test Data Identifier Code	Description
361	RC	Elec Regulator Cal
362	RC1	EReg Zero DA Cal
363	RC2	EReg Span DA Cal
364	RC3	EReg Zero Base Cal
365	RC4	EReg Span Base Cal
366	RCA	Analog Value
367	RCD	Last Cal Date
368	RCI	Instrument Pressure
369	RCP	Retention Cutoff
370	RCS	Setpoint Voltage
371	RCT	Last Cal Time
372	RCV	Master Value
373	RDI	Restore Default I/O
374	RDT	Reg Dwell Timer
375	RED	Refrgnt Vent Close
376	REG	Regulator
377	REO	Refrigerant Vent
378	REX	Refrigerant Vent
379	RFC	Fill Close Delay
380	RFL	Reference Loss
381	RL	Loss Rate
382	RLC	Run Leak Calibrate
383	RLR	Loss Rate Rd
384	RLV	T-Gas LeakStd Value
385	RMX	EReg Span DA Cal
386	RNP	Number of Points
387	ROS	Reject on Slope
388	RPC	Reject Percentage
389	RPM	Ramp Method
390	RPP	Retain Part Press
391	RPP	Reject Program
392	RR	Retract on Reject
393	RR	Ramp Rate
394	RRT	Reject Rate Total
395	RSI	Result Information
396	RSP	Slope Window
397	RSR	Slope Change/Sec
398	RST	Stabilize
399	RVH	High Limit Voltage
400	RVH	High Limit Voltage
401	RVL	Low Limit Voltage
402	RVL	Low Limit Voltage
403	RVP	Retain Volume Press
404	RXM	Pre-Evac Exhaust
405	SAM	Sample Size
406	SAS	Start AutoSetup

	Test Data Identifier Code	Description
407	SCF	Cal Coefficient
408	SCL	T-Gas LeakStd Value
409	SCO	Cal Offset
410	SCP	Start Clean Part
411	SCR	Reject Rate Percent
412	SCT	Scale Type
413	SDH	ST DP High Limit
414	SDL	ST DP Low Limit
415	SEV	Leak Rate Window
416	SF	Standard Flow
417	SGN	Sample Gas Number
418	SIO	Sniffer Init
419	SMP	Sample Time
420	SN	Step Number
421	SNR	SNR
422	SOD	Shut Off Delay
423	SP	Standard Pressure
424	SP	Starting Pressure
425	SPM	Fine Wait
426	SPT	Gross Wait
427	SR	Set Regulator
428	SRC	Start Calibration
429	SRH	ST RPL High Limit
430	SRH	LD Leak Val Max
431	SRL	LD Leak Val Min
432	SRL	ST RPL Low Limit
433	SSW	Starting Src Weight
434	STH	ST TPL High Limit
435	STL	ST TPL Low Limit
436	STL	Self Test Level
437	STM	Self Test Method
438	STN	Self Test Program
439	STP	Target Press
440	STS	Self Test Source
441	STS	Start Self Test
442	STT	Self Test Limit
443	STV	Step Target Press
444	STW	Target Window
445	SXC	Start Calibration
446	SXT	Start Xdcr Test
447	SXV	Start Verification
448	SZH	LD Zero Val Max
449	SZL	LD Zero Val Min
450	Ser	Serial Number
451	Stn	Channel Number
452	T	Timer

type "TABLE VARIABLE"

	Test Data Identifier Code	Description
453	T	Timer
454	TBF	LD Background Limit
455	TEP	T-Gas Exh Press
456	TI	Iso Delay Timer
457	TL	Tooling Option
458	TLK	Test Leak Rate
459	TLP	Leak Rate Precision
460	TLR	T-Gas Leak Rate
461	TLU	Leak Rate Unit
462	TML	LD Min T-Gas Setpt
463	TMN	Fine T-Gas Min
464	TMP	Temp Precision
465	TMX	Fine T-Gas Max
466	TP	Time Precision
467	TPP	Target Program
468	TPW	Target Press Window
469	TQ	Quik Test Timer
470	TR1	Trigger 1
471	TRA	T-Gas Source
472	TRM	T-Gas Recovery
473	TSM	T-Gas Sampling
474	TT	Test Sel Timer
475	TT	Test Execution Time
476	TTF	TracerMate Flags
477	TTY	Test Type
478	TTY	Test Type
479	TV	Valve Delay Timer
480	TW	Target Weight
481	TWN	Min Fill Weight
482	TWX	Max Fill Weight
483	Tcy	Desired Cycle Time
484	Tm	Timer Mode
485	Tm	Time
486	UC	Current Unit
487	UDP	¤ Pressure Unit
488	UF	Flow Unit
489	UP	Pressure Unit
490	UP	Percent Unit
491	UPD	Unit/Prec Define
492	UT	Time Unit
493	UTM	Temperature Unit
494	UV	Voltage Unit
495	UV	Volume Unit
496	UW	Weight Unit
497	V	V
498	VAN	Valve A Num - Opt

	Test Data Identifier Code	Description
499	VAP	Valve A PWM - Opt
500	VAT	Valve A Type - Opt
501	VBN	Valve B Num - Opt
502	VBP	Valve B PWM - Opt
503	VBT	Valve B Type - Opt
504	VC	Valve Code
505	VCN	Valve C Num - Opt
506	VCP	Valve C PWM - Opt
507	VCT	Valve C Type - Opt
508	VDN	Valve D Num - Opt
509	VDP	Valve D PWM - Opt
510	VDT	Valve D Type - Opt
511	VFL	Virtual Flow
512	VHT	Vent/Halt Tooling
513	VLD	Valve Detection
514	VLP	Volume Precision
515	VLV	Valve Number
516	VNP	Number of Points
517	VP	Voltage Precision
518	VPS	Setpoint Pressure
519	VPW	Valve PWM
520	VSP	Setpoint Voltage
521	VWO	Residual Offset
522	Vi	Instrument Volume
523	Vp	Part Volume
524	WGT	Refrigerant Weight
525	WHL	High Limit
526	WIN	Stat History Length
527	WLL	Low Limit
528	XAN	Xdcr Zero LL
529	XAX	Xdcr Base Max
530	XBH	Xdcr Zero Hwin
531	XBL	Xdcr Zero Lwin
532	XC	Transducer Cal
533	XC1	Xdcr Zero AD Cal
534	XC2	Xdcr Span AD Cal
535	XC3	Xdcr Zero Base Cal
536	XC4	Xdcr Span Base Cal
537	XCA	Analog Value
538	XCB	Atm Pressure
539	XCD	Last Cal Date
540	XCF	Instrument Flow
541	XCI	Instrument Pressure
542	XCL	Xdcr Curr Limit
543	XCM	Master Reading
544	XCP	Cal Pressure

type "TABLE VARIABLE"

	Test Data Identifier Code	Description
545	XCS	Setpoint Pressure
546	XCT	Last Cal Time
547	XCV	Master Value
548	XCX	Xdcr Cal X Array
549	XCY	Xdcr Cal Y Array
550	XFC	Xdcr Filter Code
551	XFP	Flow Precision
552	XID	Xdcr Iso Delay
553	XIS	Xdcr Span Inter Cal
554	XIZ	Xdcr Zero Inter Cal
555	XLF	Max Mstr+Leak Flow
556	XLF	Max Leak Flow
557	XLL	Max Leak Loss
558	XMF	Max Master Flow
559	XML	Max Mstr+Leak Loss
560	XMN	Xdcr Base Min
561	XMX	Xdcr Base Max
562	XNP	Number of Points
563	XOP	Crossover Pressure
564	XPC	Pressure Correction
565	XPM	Pressure Mode
566	XPP	Pressure Precision

	Test Data Identifier Code	Description
567	XPR	Pressure Reference
568	XRL	Xdcr Residual Limit
569	XRW	Xdcr Residual Warn
570	XSP	Setpoint Pressure
571	XT	Transducer
572	XT	Xdcr Tare
573	XTG	Xdcr Tare Range
574	XTR	Xdcr Typ Residual
575	XUF	Flow Unit
576	XUP	Pressure Unit
577	XV	Transducer Verify
578	XVD	Verify Date
579	XVF	Instrument Flow
580	XVI	Instrument Pressure
581	XVM	Master Reading
582	XVS	Setpoint Pressure
583	XVT	Verify Time
584	XVV	Master Value
585	XZC	Xdcr Zero Check
586	XZH	Xdcr Zero HL
587	XZL	Xdcr Zero LL
588	XZW	Xdcr Zero Window
589	t	Test Time

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Appendix F – Instrument Attachment and Clearance

NOTES:

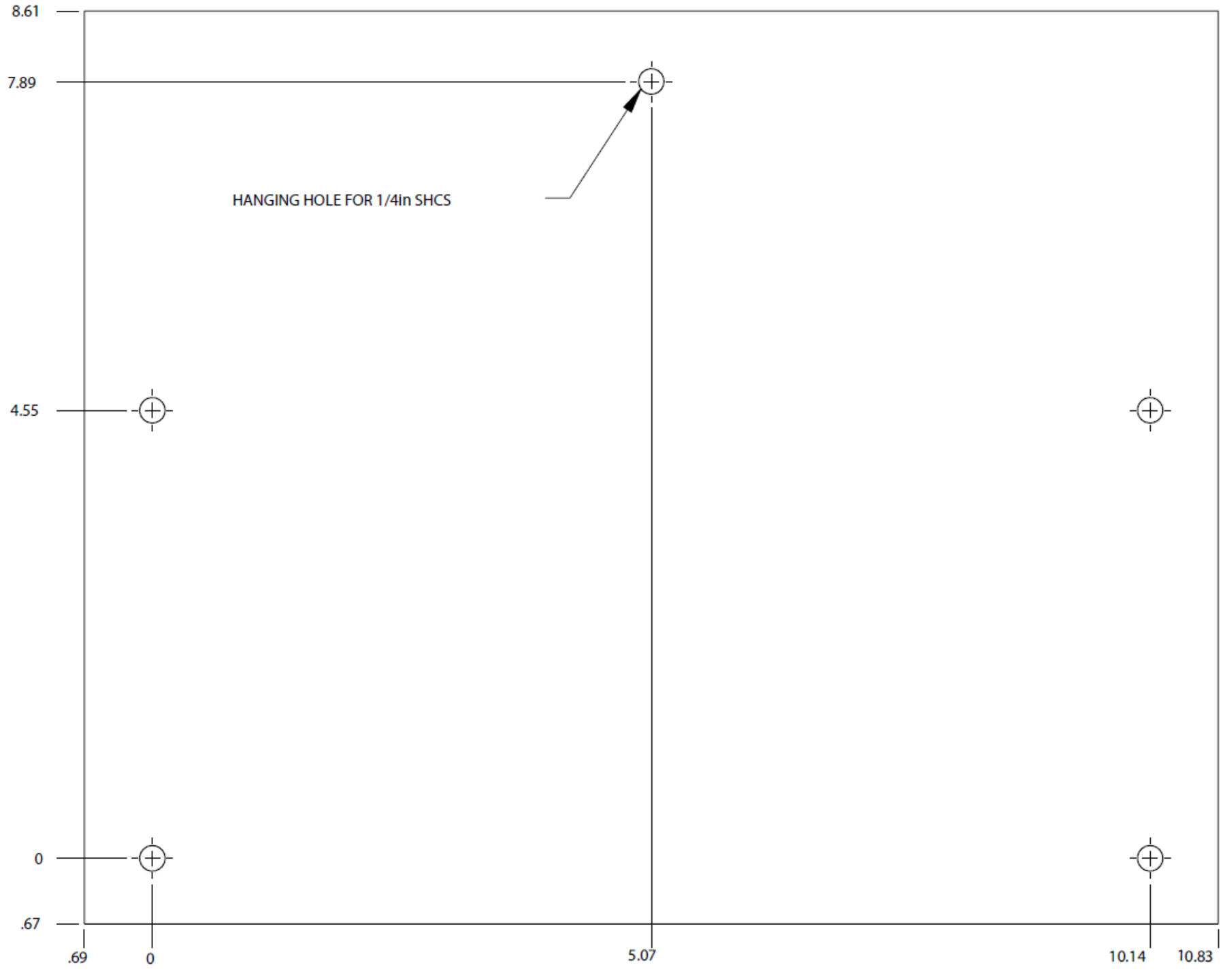
1) THIS DRAWING IS NOT TO SCALE.

2) ALL MEASUREMENTS ON THIS PAGE ARE IN INCHS.

3) ALL INSTRUMENTS ARE SHIPPED WITH (4) .25-28 X 3.5 INCH LONG SHCS.

4) RECOMMENDED 4 INCH CLEARANCE UNDER INSTRUMENT FOR TEST PORT, PNEUMATIC CONNECTIONS AND HAND CLEARANCE.

5) THE HANGING HOLE USED TO STABILIZE INSTRUMENT FOR INSTALLATION, IS NOT INTENDED TO SOLELY SUPPORT INSTRUMENTATION.



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Sentinel I28 Technical Specifications

Outside Physical Dimensions

Wall mount model (W x H x D): 305 x 235 x 222 (mm) 12 x 9.25 x 8.75 (inches)

Electrical Specifications

Supply power: 100-240 VAC 50-60 Hz auto sensing/switching

Input power fuse: 3 Amp 250VAC, slow, 5X20MM, glass

I/O driver fuse: 1 Amp 250VAC, fast, 5X20MM, glass

Board fuse: 3.125 Amp 250VAC, fast, radial leads, plastic can, vertical plug in fuse

Output current limit for each output: 0.5 amp max

Output current limit for all outputs combined: 1 amp max

Instrument may operate at ± 10% of nominal voltage

Environmental Factors

Operating temperature Range: 5°C to 40° C (41°F to 104°F)

Maximum humidity 90% relative humidity, non-condensing

Maximum operating altitude 2,500 meters (8,200 feet)

Indoor use only, IP20

Inlet Ports & Connection Type	**Connection Type & Max Pressure Rating**
P1 1/4-18 FNPT or 1/4-19 BSPT fitting	Vacuum to 200 psi (1380 kPa) *
P2 1/4-18 FNPT or 1/4-19 BSPT fitting	Vacuum to 200 psi (1380 kPa) *
Pilot 1/8 FNPT or 1/8 BSPT fitting	65 to 105 psi (540 kPa to 725 kPa)
Hi Press 1/4-18 FNPT or 1/4-19 BSPT fitting	0 to 500 psi (3450 kPa)

* See label on instrument enclosure to determine whether port is for pressure or vacuum

Air Cleanliness Specifications

Max Particulate Size: 0.3 micron

Max Dew Point: -30°C

Max Oil: 0.1mg/m3

Recommended Filter Sets (available separately)

Small filter (includes 5.0 micron and 0.3 micron filters) for parts less than 300 ml

Medium filter (includes 5.0 micron and 0.3 micron filters) for parts from 300 ml to 13,000 ml

Large filter (includes 5.0 micron and 0.3 micron filters) for parts larger than 13,000 ml

Contact Cincinnati Test Systems Service Department

By phone 513-202-5108 or by email service@cincinnati-test.com 8am-5pm eastern US

For after-hours, 24/7 emergency phone support, call 513-202-5174