CINCINNATI TEST SYSTEMS

# Sentinel C20

## *User Manual*


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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 upon 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

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# 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 C20WE precision leak test instrument. The Sentinel C20™ World Edition 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 E with detailed hole to hole dimensions in detailed "full scale" reference to the clearance dimension.***

## Installation

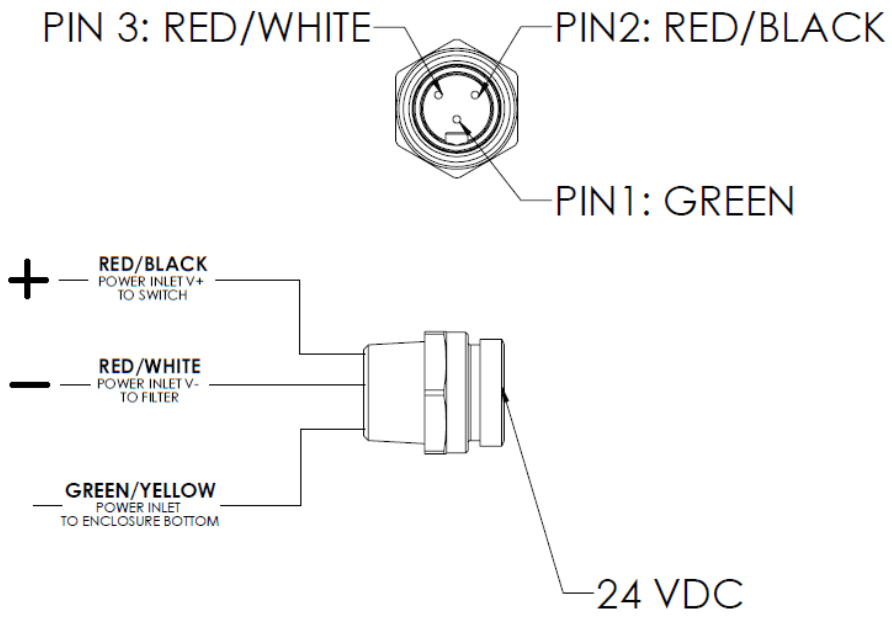
The leak test instrument is a modular, flexible instrument designed to operate in a manufacturing, clean room, or lab environment. To operate trouble-free, it requires:

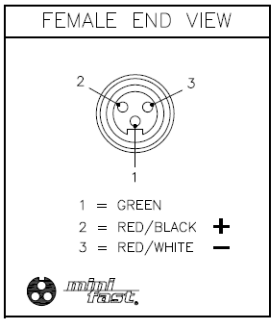
- Clean, dry instrument air for test and pilot air (recommend 0.3 and 5.0-micron coalescing filter)
  - ISO 8573-1, Class 2 filters are recommended, with class 3 being acceptable.
- Vacuum for vacuum test applications
- Supply power: 24 VDC or 100-240 VAC 50/60 Hz auto sensing/switching electrical (based on configuration)

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.

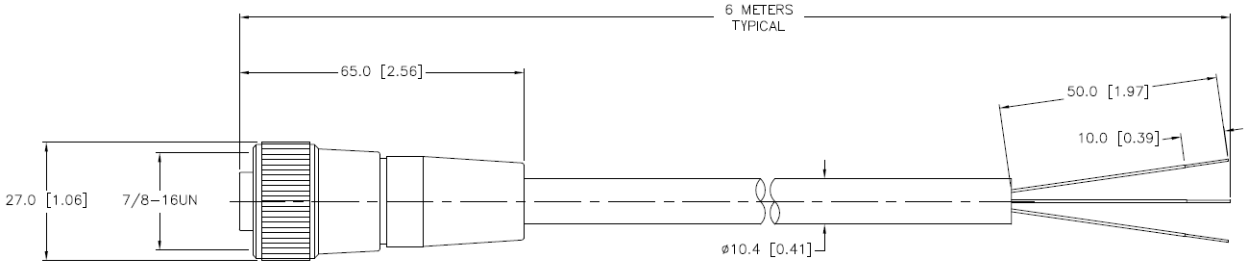
**Note: When supplying power, always be certain that there is nearly zero voltage (< 1 V) difference between the neutral and earth ground wires connected to the instrument.**

## 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 |



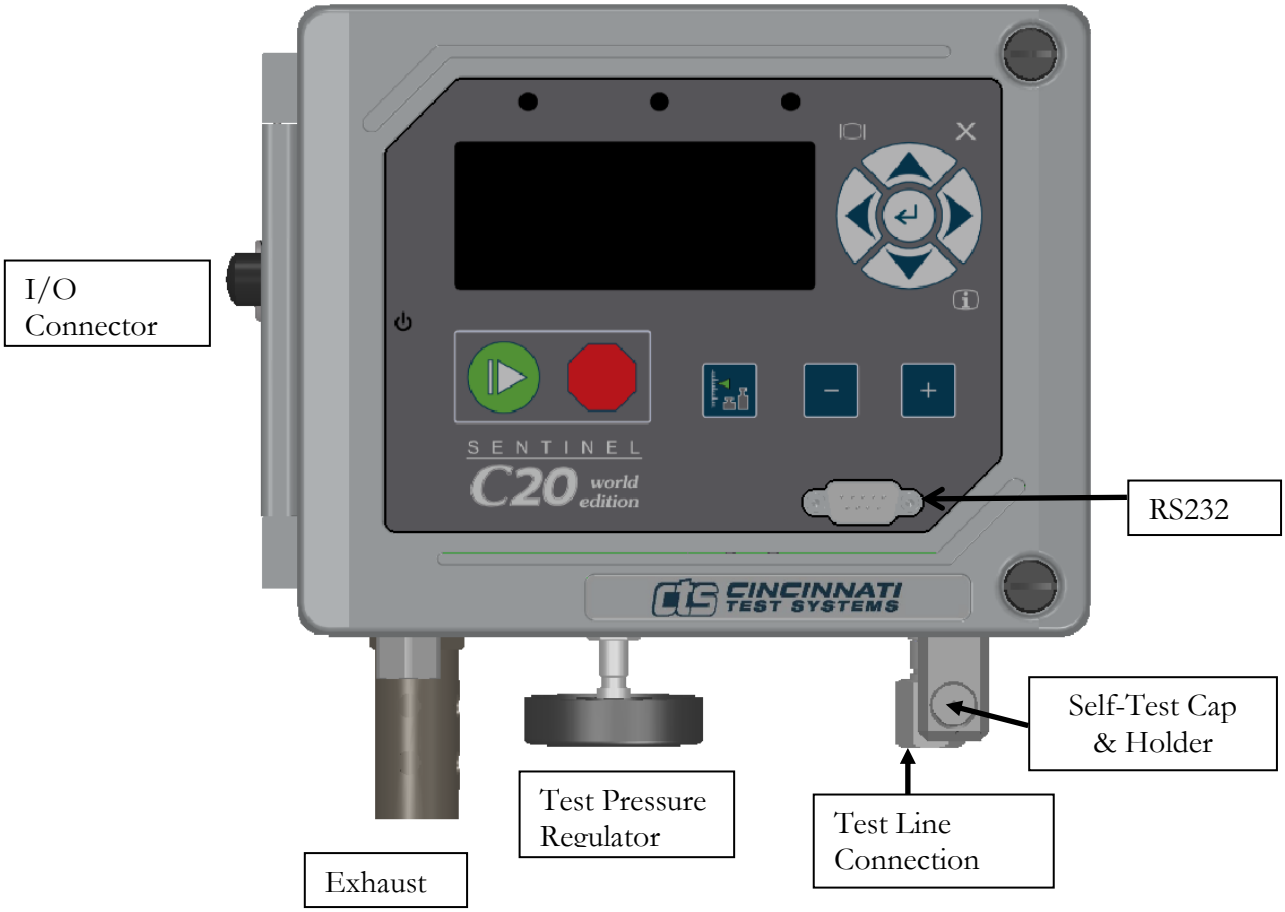

CTS Part Number: **CABLE,TURCK,RKM35D-6M**

## Supply Connections

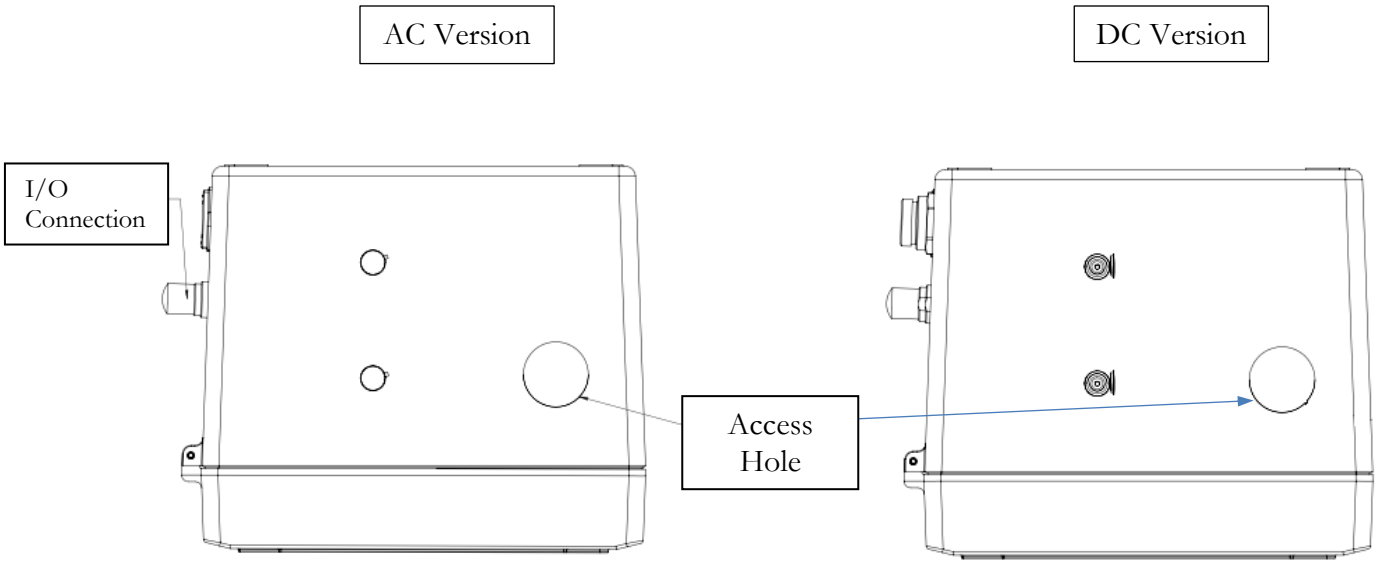
After mounting or locating the instrument, connect the inlet air or vacuum supply to the inlet port shown in the pneumatic diagram supplied with your specific instrument, as this will vary depending on instrument configuration. To reduce future maintenance requirements, install the recommended 0.3 and 5.0-micron coalescing filters in the air supply connected to the instrument. Be certain to replace the filter elements at least quarterly as preventative maintenance.

| Port | Connection Type | Pressure Rating |
|---|---|---|
| Test Supply | 1/4" FNPT | Vacuum OR 0-250 psi |
| Pilot | 1/8" FNPT | 0-90 psi |

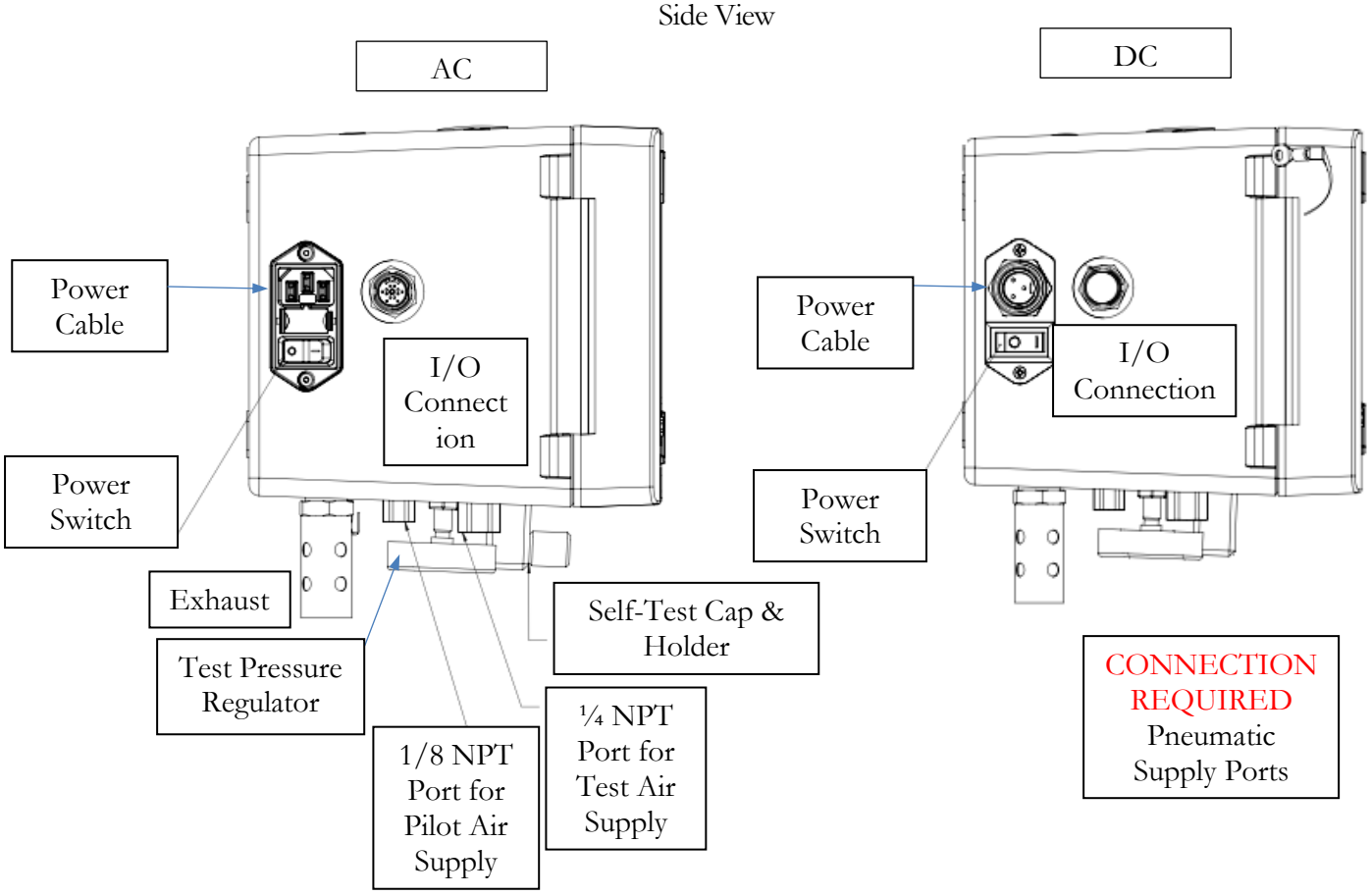
Front View



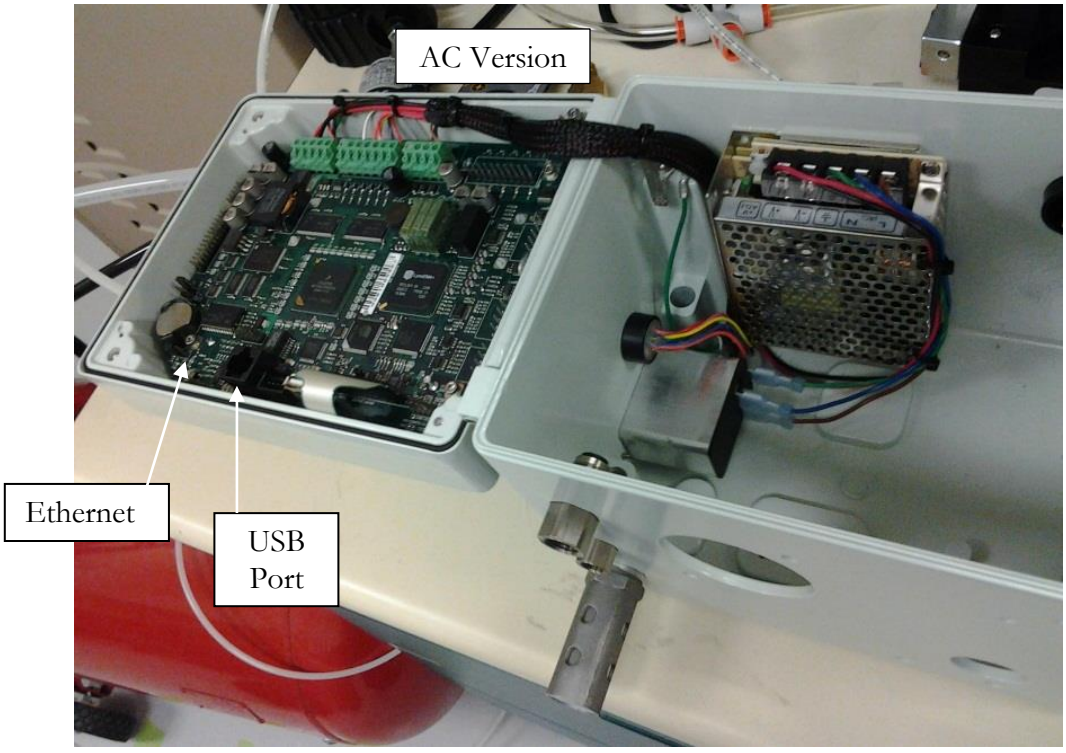
Top View

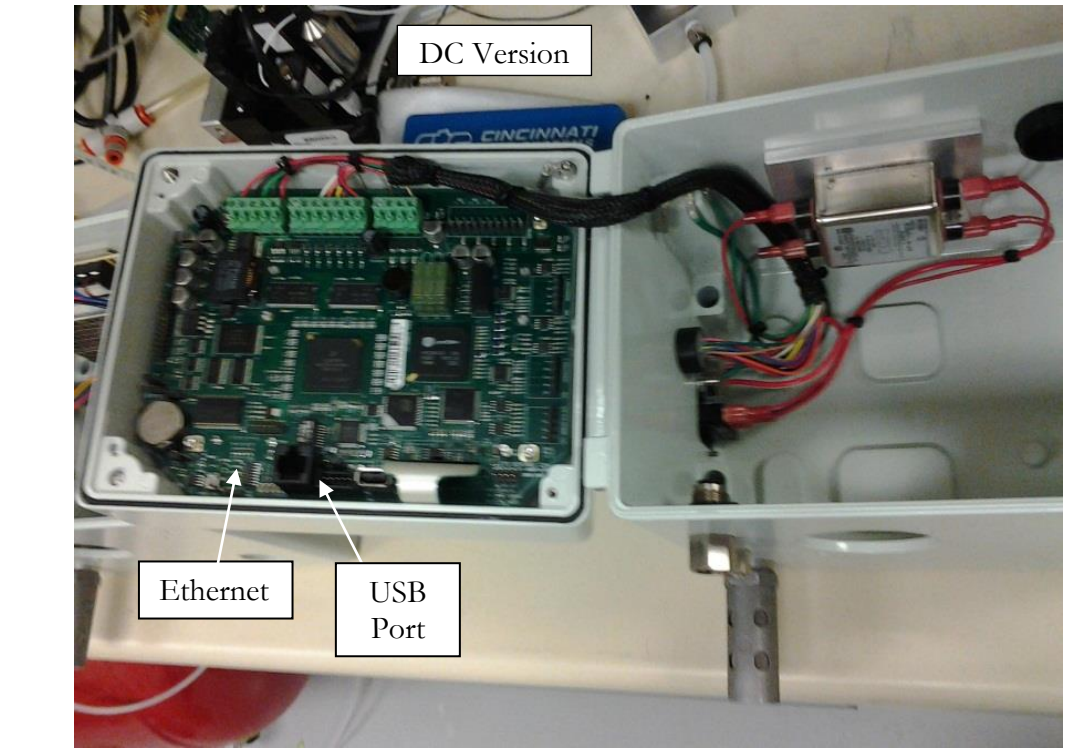



Side View



Open Door View



## 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.

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 the parameter corresponding to where the cursor is located.

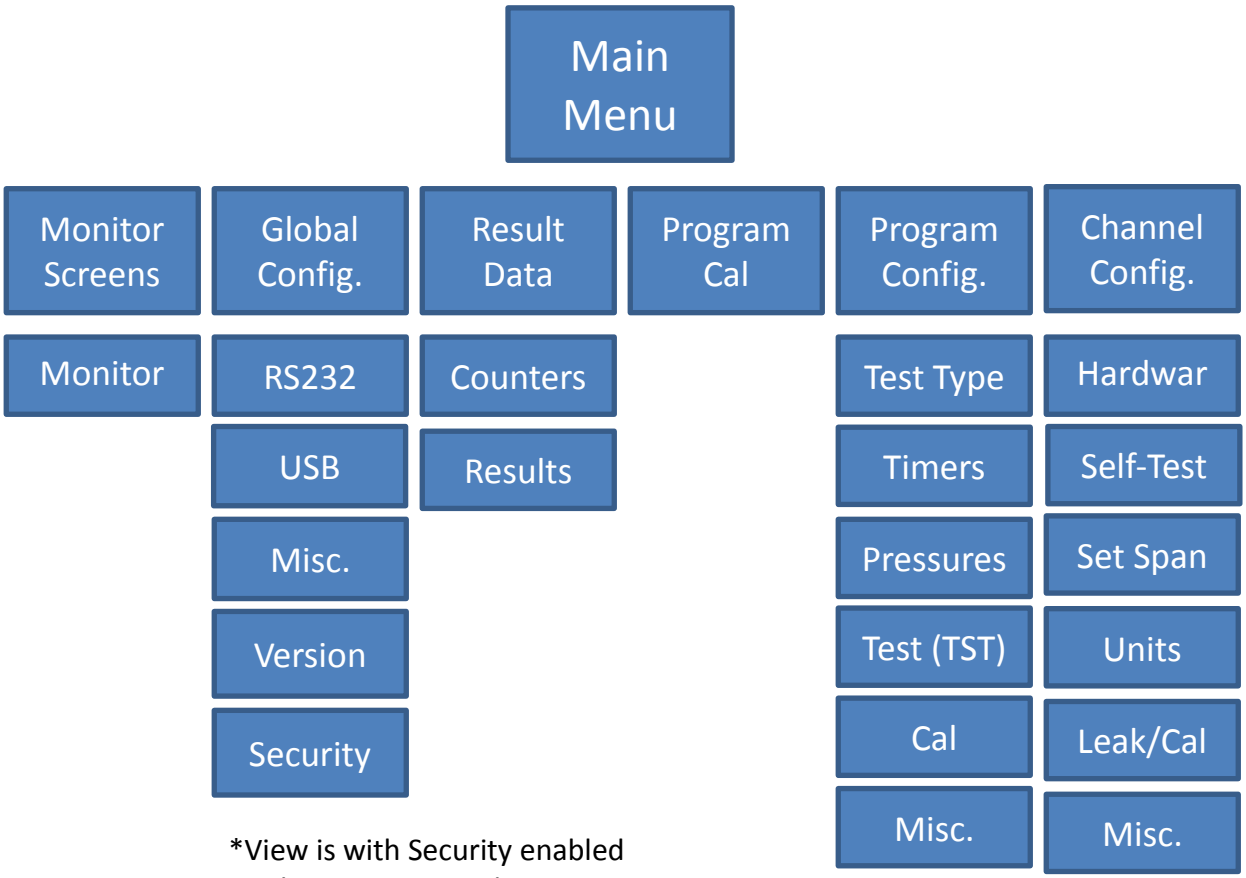
The instrument is capable of storing up to 4 different programs. Switching between these programs is done with the Program Select Buttons on the front of the instrument. The current program is shown in the lower right hand corner of the screen designated by "P" and then a two-digit number corresponding to the current program number.


***Note: The Program may also be changed using Digital I/O (see Chapter 6) or using RS232 Communication methods (see Chapter 7).***

## Menu Structure

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

*Note: Not all of the menus are available for all configurations and Test Types.*




*View is with Security enabled on the Misc. menu above

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# Chapter 2 – Setup

*In this chapter you will be asked how you intend for the instrument to function to conduct the test or sequence of tests for the application.*

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 via individual Programs. Pressure decay leak testing is a volume dependent function. In certain cases, it is possible to group "like parts" together to use the same parameters. In this case we recommend you talk to a CTS applications specialist to assure proper functionality.

## Selection of Test Types

The first step in setting up the instrument is to select the type of test you would like to conduct via the pre-packaged test sequences. Once you set up one type of test repeating this step under a different program will enable you to configure up to 4 different test configurations. The **Test Type Table** on the following page includes the available test types for the Sentinel C20WE instrument. A brief description, and the associated chapter that details the pre-packaged test program. The availability of these test types are based on the 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 Main Menu screen.

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

Select 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 on the previous page 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<br>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<br>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<br>Chapter 5 | Calculates the Leak Rate, based upon 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. |

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

# 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: Please press the Main Menu button. Select the Channel Config Icon. From the Channel Config menu select the Units Icon. Change the Unit/Prec Define parameter to "Channel". Set the desired units on that same screen. These units will apply to every program.**

**No: Please press the Main Menu button. Select the Channel Config Icon. From the Channel Config menu select the Units Icon. Change the Unit/Prec Define parameter to "Program". The Unit 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 now can be changed per program.**

*Note: The units set on the Channel Config screen are also the units used for Self-Test and pressure 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: Please 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 "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: Please 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 whether 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.*

*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 and set the channel level parameters, it is time to set the regulators to the correct test pressure.

## Setting the Pneumatic Regulator

Setting the regulator is done via 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. This may be done with the test port plug, mounted to the bottom of the instrument or with a Self-Test cap, placed in the test port fitting.

## Setting the Test Parameters

It is time to set the test parameters to fit your application. Please refer to the chapter associated with the test type chosen from the Test Type Table located 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 8 – Security.

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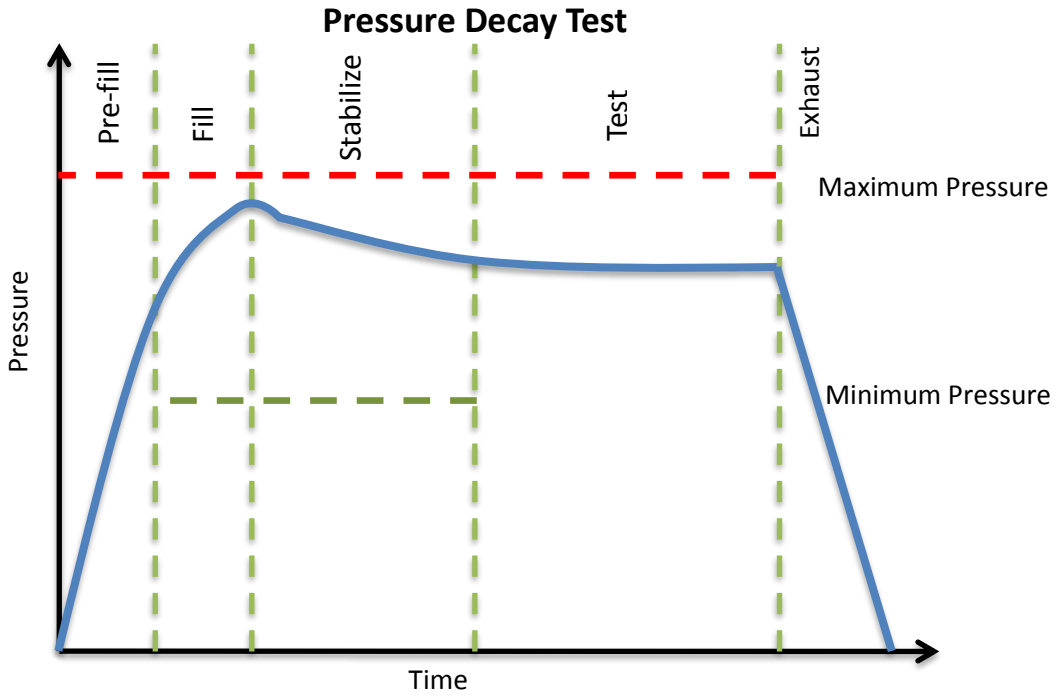
# Chapter 3 – Pressure Decay-ΔP

*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 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 setup a Pressure Decay ΔP Test. The Tables that follow give detailed descriptions of each parameter.



## Timer Parameters

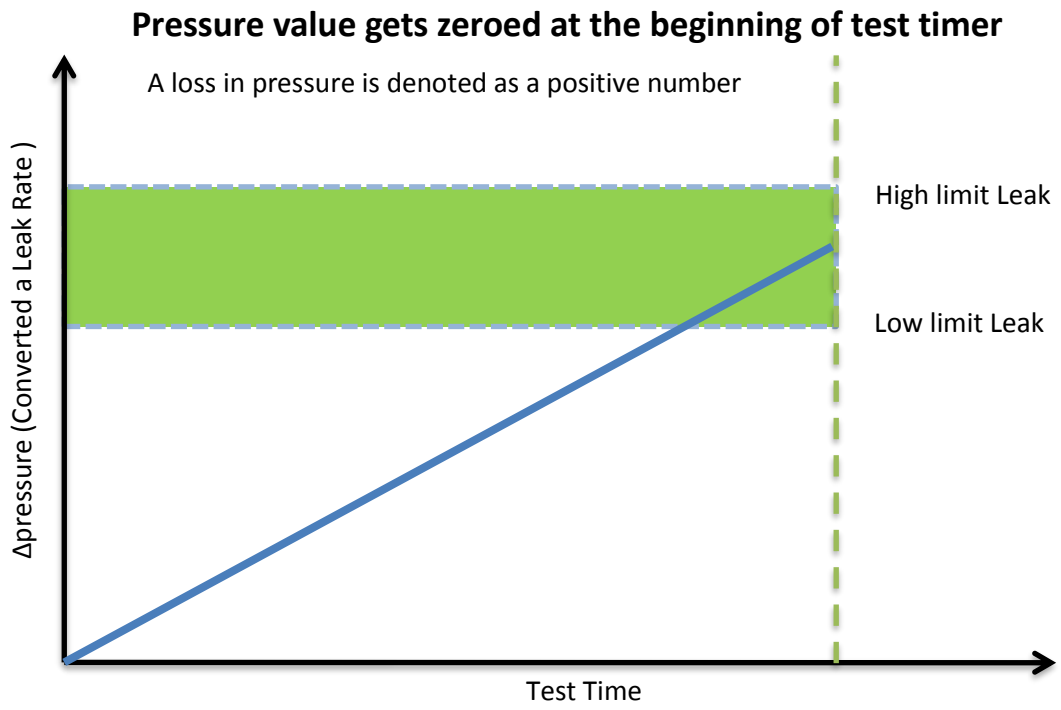
The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

| Timer | Description |
|---|---|
| Prefill | Checks for excessively leaking parts or lack of pressure. May be set as a % of fill time (Default), for fixed fill time tests, or a not to exceed timer. See the Chapter 9 on Features to change the functionality of the Prefill Timer. Maximum time to reach the minimum pressure. If the variable is set to a not to exceed timer, this segment will exit to the next once the Minimum Pressure value is reached. |
| Fill | Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air. |
| Stabilize | Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test. |
| Test | The precise time over which to measure pressure drop or decay or the precise end time to measure pressure rise. |
| Exhaust | Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals. |

## Pressure Parameters

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

| Pressure | Description |
|---|---|
| Minimum Pressure | **This value is not visible.** This value is set automatically to a -20% window with a minimum delta of 0.5 PSI and a max delta of 20.0 PSI. It is the value that must be reached before the Prefill set point is reached and must be maintained through fill and stabilization segments or the testing cycle will end as a Severe Leak. |
| Target Pressure | The specified test pressure for the part. For vacuum test pressures enter as positive values if psiv was selected as the pressure unit. Enter as a negative if psig was selected as the pressure unit. (i.e. A test pressure 9.7 psia would entered as 5 psiv or -5 psig.) Pressure loss is corrected based on the ratio of actual test pressure and the Target Pressure. |
| Maximum Pressure | **This value is not visible.** This value is set automatically to a +20% window with a minimum delta of 0.5 PSI and a max delta of 20.0 PSI. 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. |




## Test Parameters

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

| TST Parameter | Description |
|---|---|
| Low Limit Loss | Lower set point value used to evaluate test results. |
| High Limit Loss | Upper set point value used to evaluate test results |
| EDC Enable | Activates Environmental Drift Correction. See Appendix C |
| EDC Percentage | See Appendix C |
| EDC Quantity | See Appendix C |

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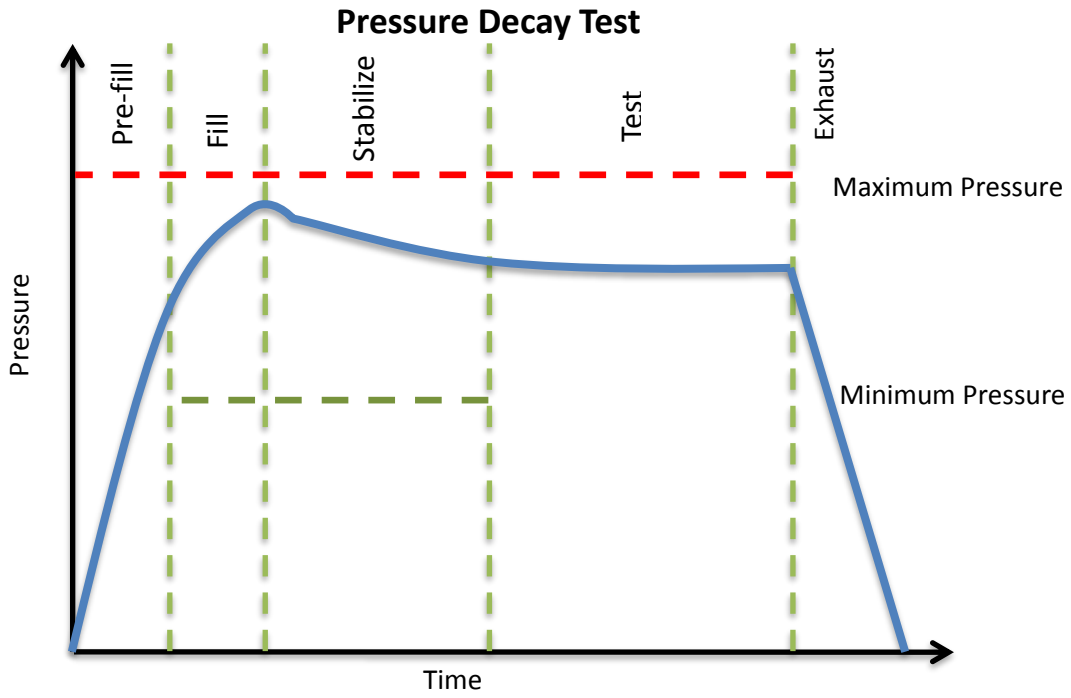
# Chapter 4 – Pressure Decay ΔP/ΔT

*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 setup a Pressure Decay ΔP/ΔT Test. The Tables that follow give detailed descriptions of each parameter.



## Timer Parameters

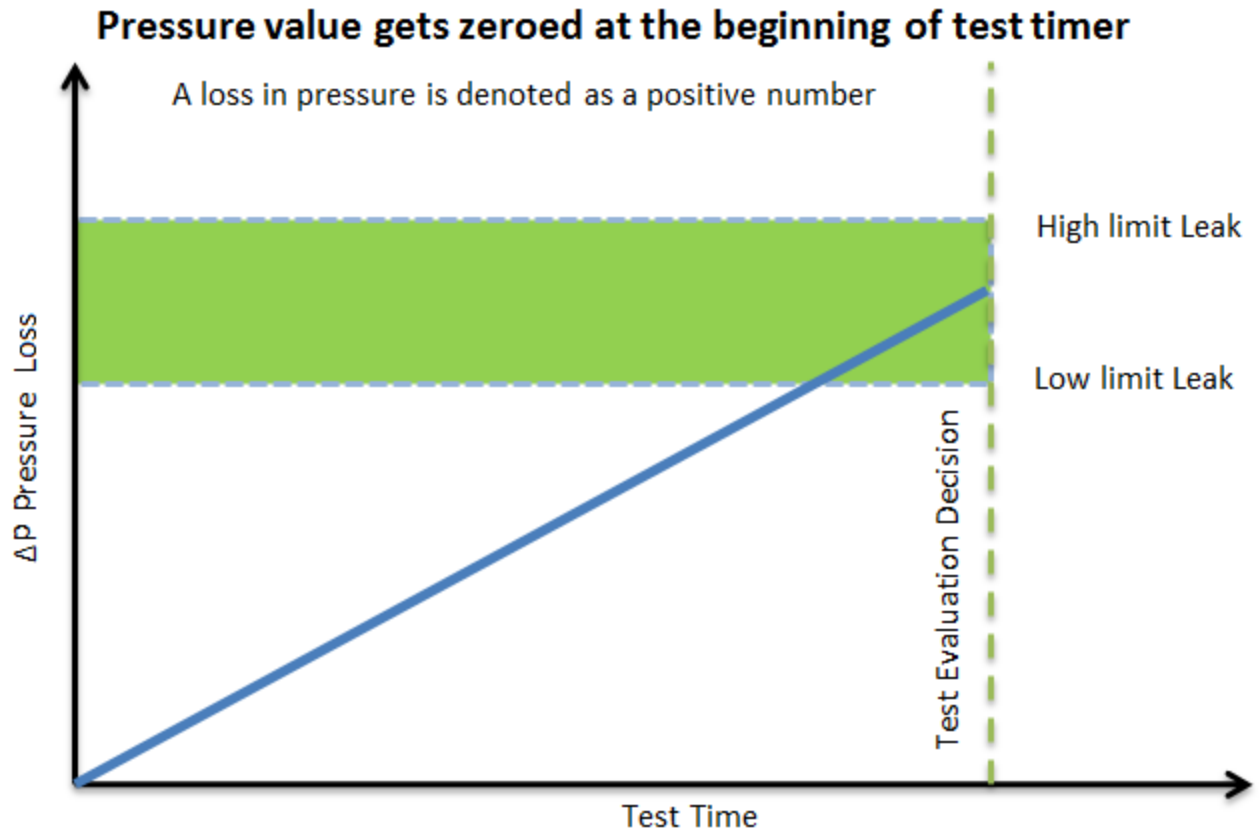
The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

| Timer | Description |
|---|---|
| Prefill | Checks for excessively leaking parts or lack of pressure. May be set as a % of fill time (Default), for fixed fill time tests, or a not to exceed timer. See the Chapter 9 on Features to change the functionality of the Prefill Timer. Maximum time to reach the minimum pressure. If the variable is set to a not to exceed timer, this segment will exit to the next once the Minimum Pressure value is reached. |
| Fill | Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air. |
| Stabilize | Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test. |
| Test | The precise time over which to measure the rate of pressure change. |
| Exhaust | Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals. |

## Pressure Parameters

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

| Pressure | Description |
|---|---|
| Minimum Pressure | **This value is not visible.** This value is set automatically to a -20% window with a minimum delta of 0.5 PSI and a max delta of 20.0 PSI. It is the value that must be reached before the Prefill set point is reached and must be maintained through fill and stabilization segments or the testing cycle will end as a Severe Leak. |
| Target Pressure | The specified test pressure for the part. For vacuum test pressures enter as positive values if psiv was selected as the pressure unit. Enter as a negative if psig was selected as the pressure unit. (i.e. A test pressure 9.7 psia would entered as 5 psiv or -5 psig.) Pressure loss is corrected based on the ratio of actual test pressure and the Target Pressure. |
| Maximum Pressure | **This value is not visible.** This value is set automatically to a +20% window with a minimum delta of 0.5 PSI and a max delta of 20.0 PSI. 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. |




## Test Parameters

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

| TST Parameter | Description |
|---|---|
| Low Limit Rate | Lower set point value used to evaluate test results. |
| High Limit Rate | Upper set point value used to evaluate test results |
| EDC Enable | Activates Environmental Drift Correction. See Appendix C |
| EDC Percentage | See Appendix C |
| EDC Quantity | See Appendix C |

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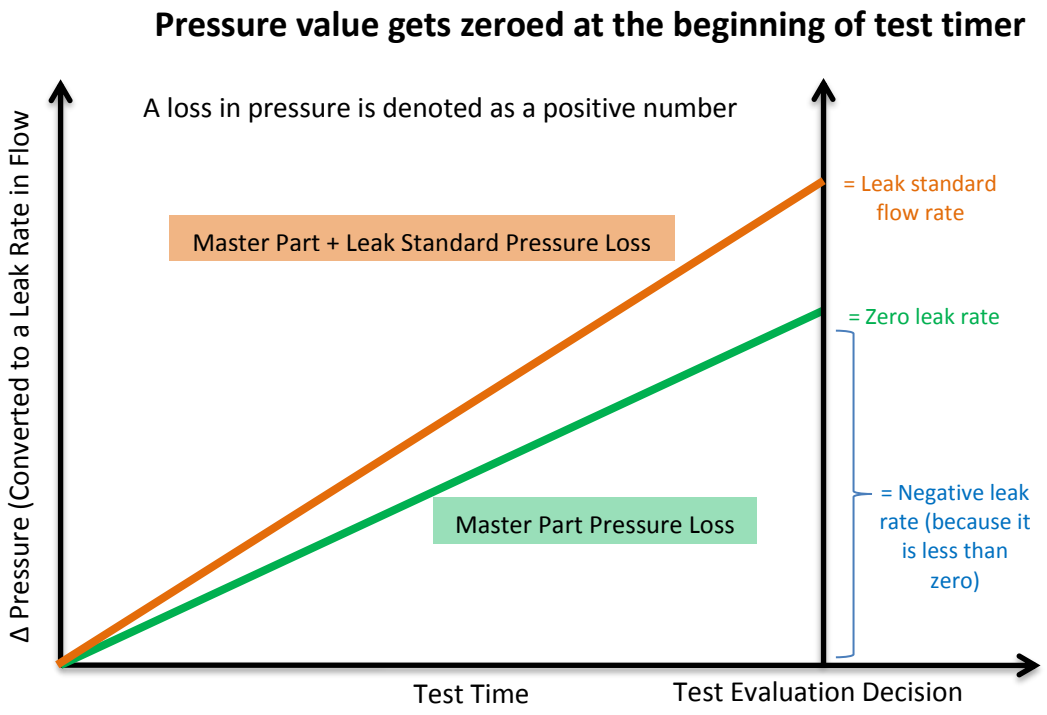
# Chapter 5 – Pressure Decay-Leak Std

*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 below give an overview of the parameters used to setup a Pressure Decay Test and correlating the results to a flow rate using a leak standard. The Tables that follow give detailed descriptions of each parameter.



## Timer Parameters

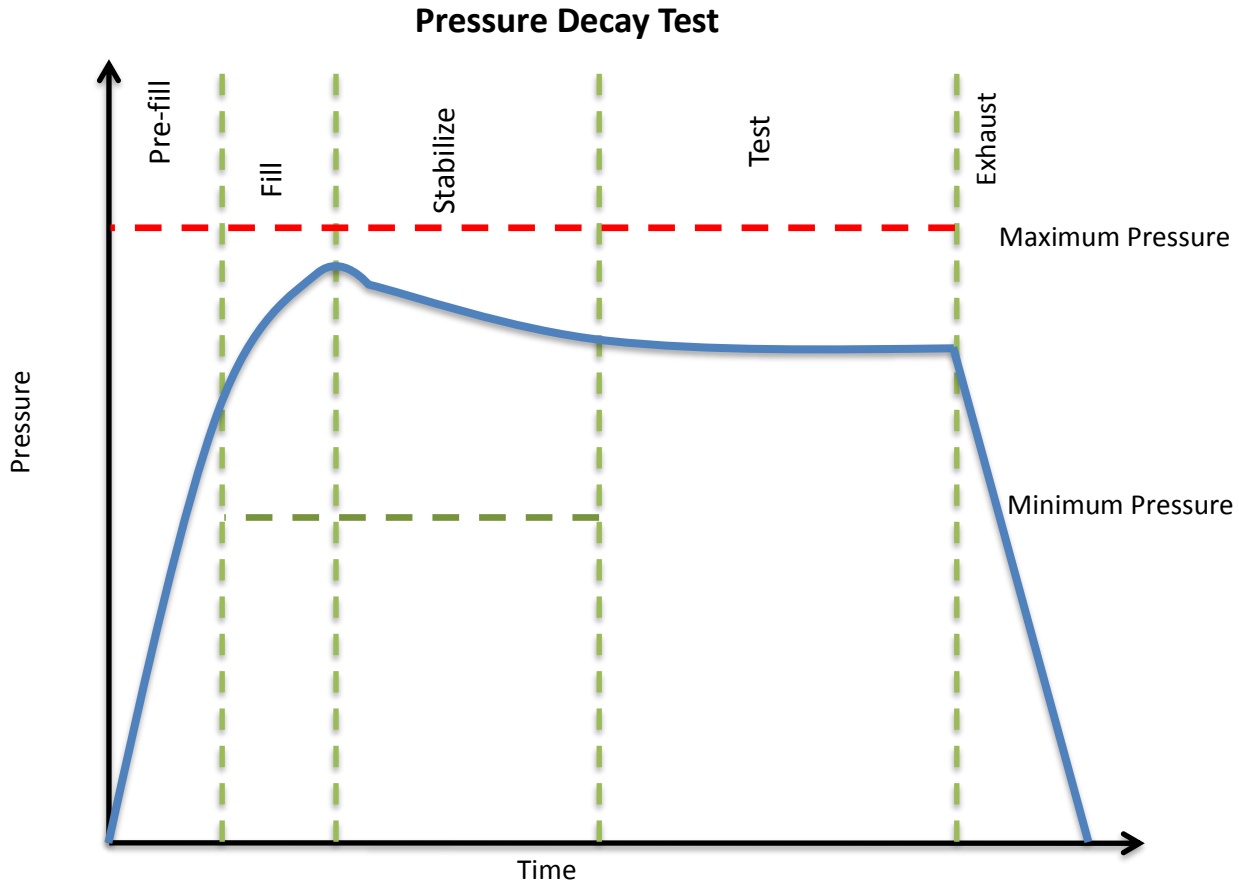
The Timers menu is located in the **Main Menu > Program Config > Timers** icon.

| Timer | Description |
|---|---|
| Prefill | Checks for excessively leaking parts or lack of pressure. May be set as a % of fill time (Default), for fixed fill time tests, or a not to exceed timer. See the Chapter 9 on Features to change the functionality of the Prefill Timer. Maximum time to reach the minimum pressure. If the variable is set to a not to exceed timer, this segment will exit to the next once the Minimum Pressure value is reached. |
| Fill | Time to enable part to reach the Target Pressure. It may also be used as time to stabilize part pressure with additional air. |
| Stabilize | Time to stabilize part pressure while isolated from the pressure regulator. This time directly affects the repeatability of the test. |
| Test | The precise time over which to measure pressure drop or decay or the precise end time to measure pressure rise. |
| Exhaust | Time to relieve or vent part pressure before signaling the end of test. Need time to prevent blowing out debris or fixture seals. |
| Relax | Timer used during Program Cal sequence as a delay between tests to allow the part to recover to repeatable virgin state. Usually short relax times result in decreasing pressure losses (flows) in successive tests. |

## Pressure Parameters

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

| Pressure | Description |
|---|---|
| Minimum Pressure | **This value is not visible.** This value is set automatically to a -20% window with a minimum delta of 0.5 PSI and a max delta of 20.0 PSI. It is the value that must be reached before the Prefill set point is reached and must be maintained through fill and stabilization segments or the testing cycle will end as a Severe Leak. |
| Target Pressure | The specified test pressure for the part. For vacuum test pressures enter as positive values if psiv was selected as the pressure unit. Enter as a negative if psig was selected as the pressure unit. (i.e. A test pressure 9.7 psia would entered as 5 psiv or -5 psig.) Pressure loss is corrected based on the ratio of actual test pressure and the Target Pressure. |
| Maximum Pressure | **This value is not visible.** This value is set automatically to a +20% window with a minimum delta of 0.5 PSI and a max delta of 20.0 PSI. 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. |



## Test Parameters

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

| TST Parameter | Description |
|---|---|
| Low Limit Rate | Lower set point value used to evaluate test results. |
| High Limit Rate | Upper set point value used to evaluate test results |
| Min Master Loss | Minimum pressure loss or flow allowed during either test in Program Cal routine. Prevents the acceptance of a calibration of a blocked part or test line. |
| 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. |
| 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. |
| Max Mstr+Leak Loss | Maximum pressure loss allowed during either 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. |
| 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. |
| 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". |
| 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". |
| Quik Test Enable | Activates Quik Test. See Appendix B |
| Quik Test Timer | Options include 10%, 25%, 50%, 75%, or 90%<br>See Appendix B. |
| Quik Test LL Band | See Appendix B |

| TST Parameter | Description |
|---|---|
| Quik Test HL Band | See Appendix B |
| EDC Enable | Activates Environmental Drift Correction. See Appendix C |
| EDC Percentage | See Appendix C |
| EDC Quantity | See Appendix C |

## Program Calibration

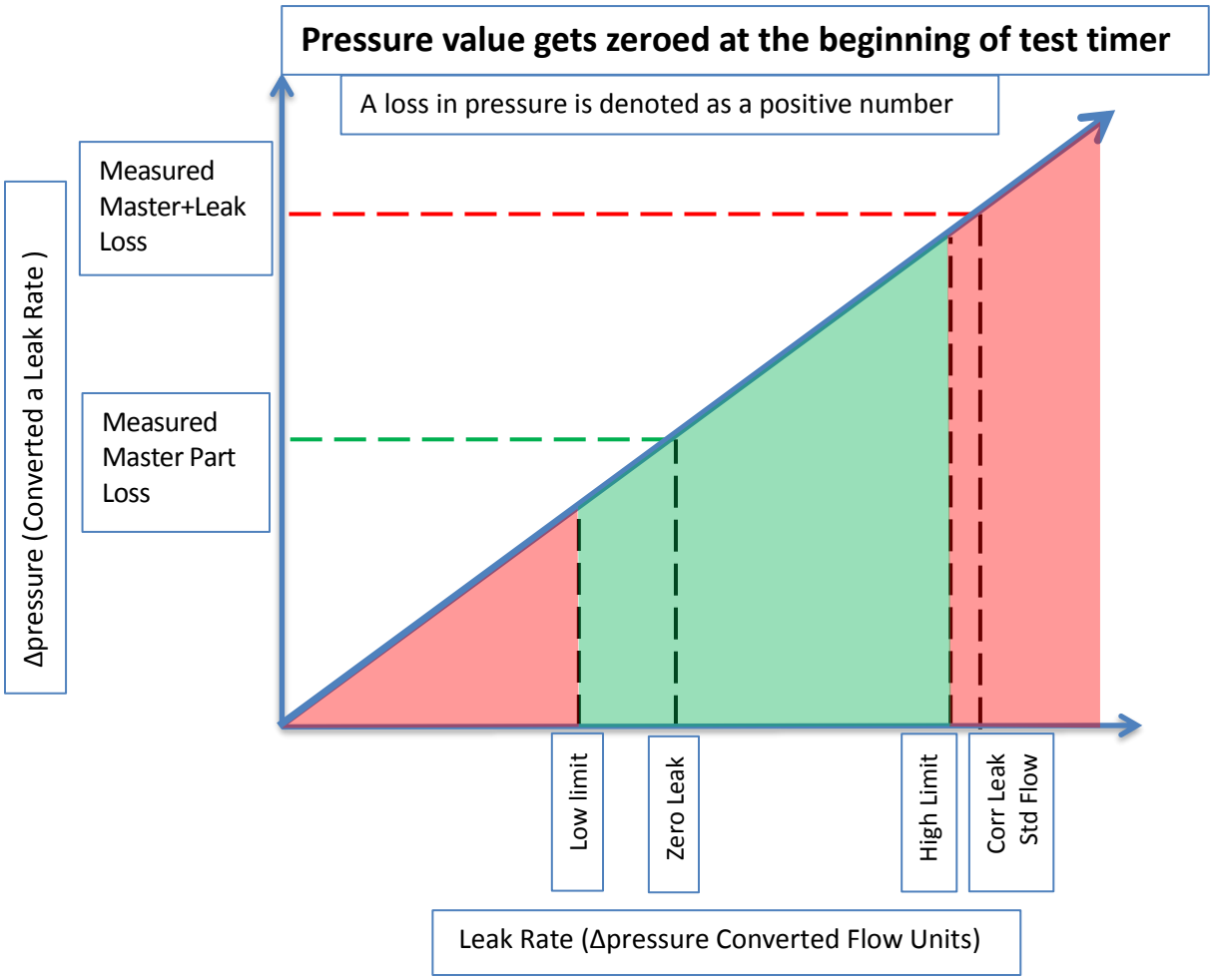
In order to convert the pressure loss measured by the instrument to a leak (flow) rate, the instrument uses a leak standard and needs to run the "Program Cal" procedure. This procedure requires at least one known non-leaking part referred to as a "master part." This procedure tests a non-leaking master 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 9 – 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 16. It is critical to make sure the leak standard values are set correctly for proper use.***



## Initiating the Program Cal Sequence

To initiate a Program Cal sequence, press the shortcut key on the front of the instrument or go to Main Menu and select the Program Cal Icon. 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. 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. The table below describes the parameters.

| Parameter | Description |
|---|---|
| Performance Factor | Resultant evaluation of ratio of Master Part Loss to Master+Leak loss, Test Pressure, and loss due to Leak Std |
| Master Part Press | Measured pressure at the beginning of the test segment during the first test of the Program Cal routine for the non-leaking master part. |
| Master+Leak Press | Measured pressure at the beginning of the test cycle of second test during Program Cal routine for the non-leaking master part with the leak standard introduced to the pneumatic test circuit. |
| Master Part Loss | Measured pressure loss for the non-leaking master part during the first test of Program Cal routine |
| 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. |
| 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. |

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# Chapter 6 – Inputs and Outputs

*This chapter explains the Input and Output (I/O) capabilities of the instrument.*

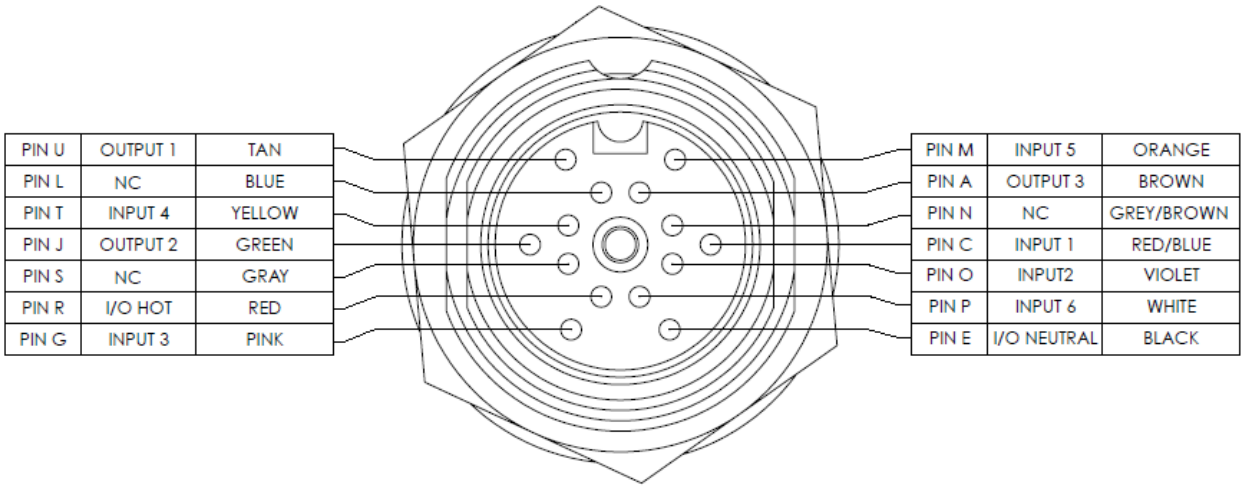
The I/O parameters are located in **Main Menu > Program Config > Misc** icon.

The instrument is equipped with 6 digital inputs and 3 digital outputs. The instrument includes one user selectable digital input and one user selectable digital output to increase the functionality and simplify the application of various test requirements.

## Input and Output Wiring

The instrument comes equipped with 6 sinking inputs and 3 sourcing outputs. Both inputs and outputs are 24VDC. The user selectable input (#6) and user selectable output (#3) may be defined .

### Input and Output Connector Pinout




Digital Inputs 1-6 (24VDC NOMINAL)

Digital Outputs 1-3 (24VDC NOMINAL)
Maximum current draw for an individual output is 500 mA
Maximum current draw for all combined outputs are 1A

## Input and Output Table

| Input | Function | Wire Color | Instrument Connector Pin | Cable Connector Pin | Wire Color |
|---|---|---|---|---|---|
| 1 | Start | Red/Blue | C | C | Red/Blue |
| 2 | Stop | Violet | O | O | Violet |
| 3 | Binary Program Select 1 | Pink | G | G | Pink |
| 4 | Binary Program Select 2 | Yellow | T | T | Yellow |
| 5 | Binary Program Select 3 | Orange | M | M | Orange |
| 6 | **Program Cal, Part Present, or None** | White | P | P | White |

| Output | Function | Wire Color | Instrument Connector Pin | Cable Connector Pin | Wire Color |
|---|---|---|---|---|---|
| 1 | Accept | Tan | U | U | Tan |
| 2 | Reject | Green | J | J | Green |
| 3 | **Malfunction, Seal Extend, In Cycle, Exhaust, or None** | Brown | A | A | Brown |

| I/O Power | Function | Wire Color | Instrument Connector Pin | Cable Connector Pin | Wire Color |
|---|---|---|---|---|---|
| 1 | Hot | Red | R | R | Red |
| 2 | Common | Black | E | E | Black |

## Inputs

<table>
<tr><th>Input</th><th>Description</th></tr>
<tr><td>Start</td><td>Starts the active Program</td></tr>
<tr><td>Stop/Reset</td><td>Stop test/Reset input is available to stop tests and reset the seal output (if programmed)</td></tr>
<tr><td>Program Cal</td><td>The Program Cal input prepares the instrument to perform a Program Cal sequence. A Start input initiates the tooling motion and Program Cal sequence</td></tr>
<tr><td>Part Present</td><td>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 one meeting the criteria fulfills the requirements of this feature.</td></tr>
<tr><td>Binary Program Selection</td><td>Programs can be remotely selected using the Binary Program Selection inputs or using one of the communication methods like RS232. The number of required inputs for Binary Program Selection depends on the highest program number of the program to which access is required.
<table>
<tr><th>Program Numbers</th><th>Binary Program Inputs</th></tr>
<tr><td>1</td><td>B1</td></tr>
<tr><td>2</td><td>B2</td></tr>
<tr><td>3</td><td>B1 & B2</td></tr>
<tr><td>4</td><td>B3</td></tr>
</table>
</td></tr>
</table>

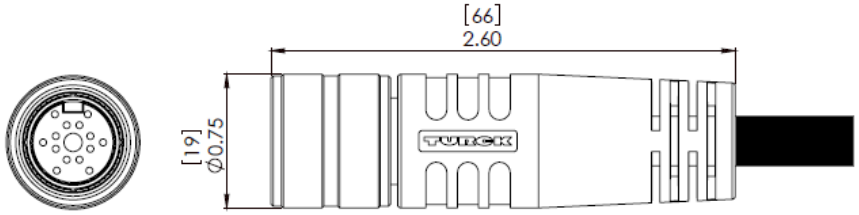
***Note: Programmable Inputs in the table above have bold font.***

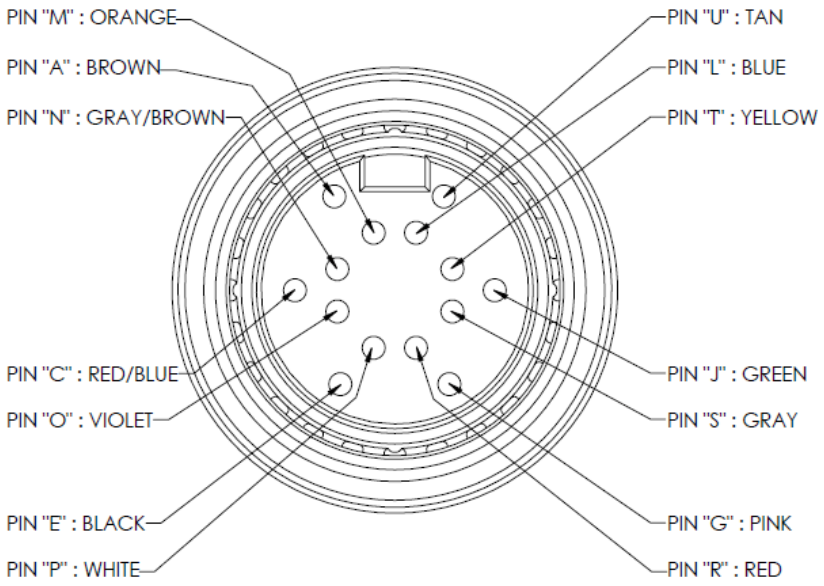
## Outputs

| Output | Description |
|---|---|
| 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. |
| 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 set point 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. If the error or disruption occurs during the testing cycle, the test will advance immediately to exhaust and the seal output will return low after exhaust. The Malfunction output goes high once the cycle is complete. |
| **Seal Extend** | This output goes high 0.5 seconds before the Prefill segment begins and goes low 0.5 seconds after the Exhaust segment is complete. This option is intended to activate a seal such as a CTS Connect. |
| **In Cycle** | This output goes high when the start signal is received and remains high until the entire cycle is complete. |
| **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. |

***Note: Programmable Outputs in the table above have bold font.***

# 14 Pin Digital I/O Cable Diagram and Pinout Table

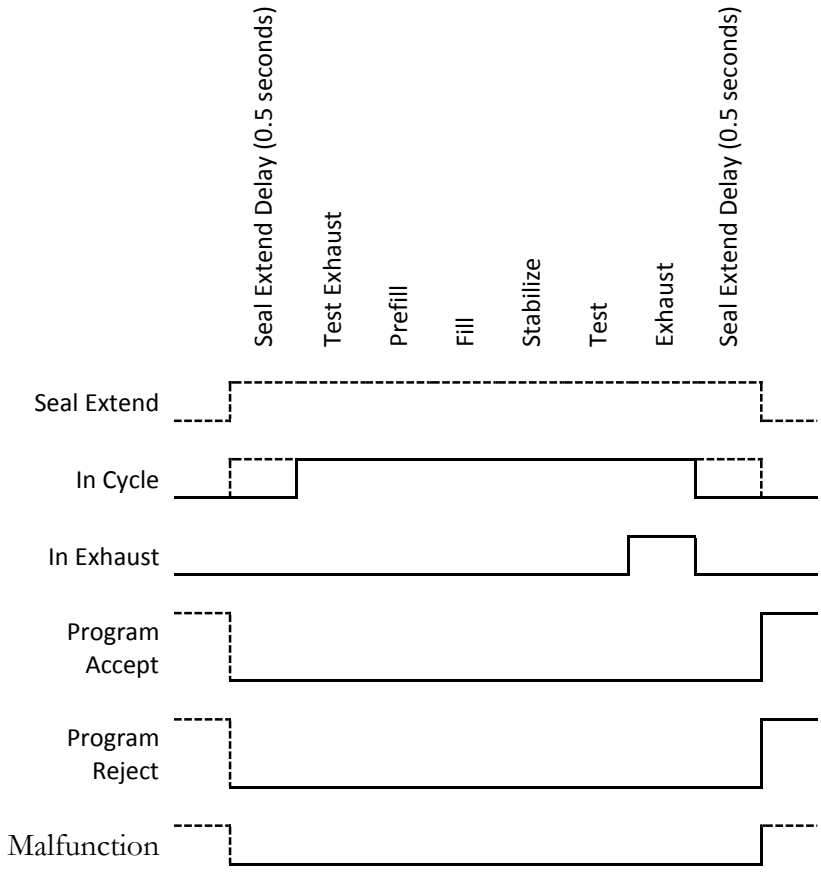



CTS Part Number: **CABLE,TURCK,BKM14-002-6**

| PIN ID & COLOR | OUTPUTS | INPUTS | POWER |
|---|---|---|---|
| A = BROWN | OUTPUT 3 | | |
| C = RED/BLUE | | INPUT 1 | |
| E = BLACK | | | I/O COMMON |
| G = PINK | | INPUT 3 | |
| J = GREEN | OUTPUT 2 | | |
| L = BLUE | | | |
| M = ORANGE | | INPUT 5 | |
| N = GRAY/BROWN | | | |
| O = VIOLET | | INPUT 2 | |
| P = WHITE | | INPUT 6 | |
| R = RED | | | I/O HOT |
| S = GRAY | | | |
| T = YELLOW | | INPUT 4 | |
| U = TAN | OUTPUT 1 | | |

# Output Timing Diagram



# Chapter 7 – Communication

*The instrument is able to communicate over RS232. 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.

## Establishing RS232 Communication

The RS232 parameters are located in **Main Menu > Global Config > RS232 1.** The first step in establishing RS232 communication with the instrument is to set the RS232 1 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.

In order to set the RS232 parameters, select the RS232 1 icon on the Global Config screen. The first step in establishing RS232 communication with the instrument is to set the RS232 1 Interface parameter to "2-way" communication. Next, select the baud rate that matches the baud rate of the device that will be communicating with the instrument. This is done via the RS232 1 Baud parameter. 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**. 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 via the communication port. The instrument will return a list of Data Type Codes and descriptions.***

| 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 communication

These settings are located in: **Main Menu > Global Config > RS232 1** icon > **RS232 1 Results**. To command the instrument to send the test result data automatically once the test is complete, set the parameter **RS232 1 Results** is set to "ON." 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 |
| Program # | 4 | P## | P01 | Program 1 |
| Time | 13 | HH:MM:SS.XXX | 16:15:14.123 | 16 hrs, 15 mins, 14.123 secs |
| Date | 9 | MM/DD/YY | 40179 | 02/03/2016 |
| Unique Id | 11 | ########## | 0000098353 | Unique test number |
| Program Evaluation | 3 | # | A | Accept |
| **Test Field** | **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 |

***Note:*** ***For the most up to date Test Data Identifier Codes type "TABLE VARIABLE" into the instrument via the communication port. The instrument will return a list of Data Type Codes and descriptions.***

***Note:*** ***For the most up to date Test Evaluation Codes type "TABLE EVALUATION" into the instrument via the communication port. The instrument will return a list of Data Type Codes and descriptions.***

***Note:*** ***For the most up to date Program Evaluation Codes type "TABLE RESULT" into the instrument via the communication port. The instrument will return a list of Data Type Codes and descriptions.***

## Streaming Measured Data

The instrument has the ability to stream measured data via the RS232 communication port 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 via the communication port. The instrument will return a list of Data Type Codes and descriptions.***

***Note: For the most up to date Test Data Identifier Codes type "TABLE VARIABLE" into the instrument via the communication port. The instrument will return a list of Data Type Codes and descriptions.***

## 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. 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 |

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# Chapter 8 – 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." It is important that this be changed upon configuring the password. Remember to write down the new password. If the new password is forgotten, Cincinnati Test Systems can provide a back door password that changes every hour.

The table below describes the all of the security settings available in the C20WE menu.

| Parameter | Description |
|---|---|
| Secure Calibration | Applies security to performing a program calibration. |
| Secure Instrument | Applies security to changing any parameters within the instrument. |
| Secure Monitor Screen | Applies security to the monitor screen If set to Yes the user will not be able to view any other screens other than the last monitor screen viewed before being secured |

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# Chapter 9 – Features

*This chapter explains essential features of the instrument.*

## 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.

## 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, the instrument automatically introduces the leak standard during the appropriate segments of a Program Cal routine.***

## 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 |
|---|---|
| Self-Test Pressure | Enter the pressure setting of the pressure source chosen to use for the Self-Test diagnostic routine. |
| Self-Test Source | Specifies the pressure source to utilize for the Self-Test diagnostic routine. |
| 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. |
| Start Self-Test | Starts the diagnostic routine. |

***Note: It is important that the test port is plugged with the Self-Test cap during a Self-Test.***

## Update Firmware

The instrument is able to update the firmware via the USB port. The file can be sent by email or a USB memory stick. If the file is sent by email, it will be in a zip file that will create the folder structure on the USB memory stick that the instrument needs to locate the file. Once the file is on a USB memory stick, insert the stick into the USB port. Go to the Global Config menu and select the USB Icon. Change the parameter Update Firmware to "Yes" in order to start the update process. The instrument will list all of the firmware version files on the screen. Select which file you would like 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. Please see the firmware documentation to determine if the firmware version you are upgrading from will cause the settings to be cleared.***

## Changing the Functionality of the Prefill Timer

When the Prefill Timer is set to a 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 a 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.

To change the function of the Prefill timer go to the Program Config menu and select the Misc Icon. The parameter called Prefill Method changes the Prefill functionality.

## Pressure Correction

In several test types the instrument uses pressure correction to enhance the performance of the instrument. If the actual test pressure is different than the Target Pressure, the pressure loss value is corrected. **Pressure Correction** is always on and cannot be turned off.

## 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 via the user interface or remotely using programmed start test logic to initiate the second test after changing non-leaking master parts. |
| **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 via the user interface or remotely using programmed start test logic to initiate the second test after changing non-leaking master part with leak standard. |

## 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 10 – Instrument Calibration

*This chapter explains the Set/Span parameters for the pressure transducer.*

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 7 ***- 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.

## Pressure Transducer Cal 1 (Pressure)

| Parameter | Description |
|---|---|
| Number of Points | The number of setpoints to be used for the transducer calibration procedure. Value must be 2 to 32. |
| 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. |
| Linearity Limit | The maximum allowed linearity variance for a successful calibration. |
| Start Calibration | Commences the calibration procedure. A wizard will walk you through the calibration process. |

> ***Note: A Transducer Calibration Report may be downloaded from the instrument if desired. See the Reports section on the last page of*** Chapter 7 ***- Communication.***

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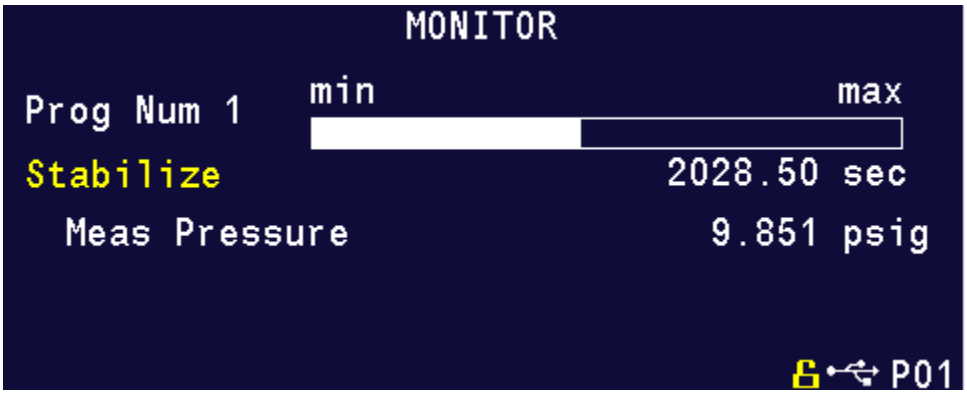
# Chapter 11 – Monitor Screen Examples

*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

**The Monitor Screen provides a visual indication of test execution. During test operation the program name, phase of execution, remaining execution time, measurement data, and a bar graph with appropriate limits are all displayed.**



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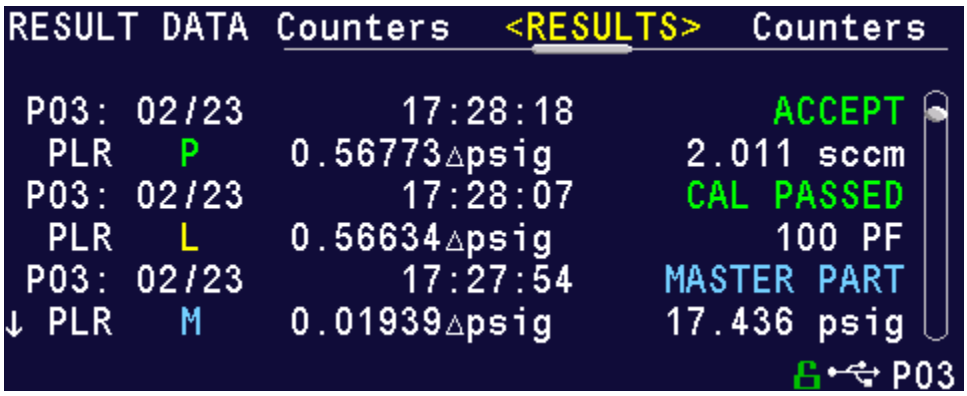
# Chapter 12 – Results Screen Examples

*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:**



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# Appendix A – Messages & Error Codes

*This chapter is a quick reference for the messages and error codes that appear 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 via the communication port. The instrument will return a list of Data Type Codes and descriptions.***

| Message | Code | Description | Corrective Actions |
|---|---|---|---|
| Program Accept | A | Program evaluation was successful, for multiple tests – all tests passed | |
| Auto Setup Seq Complete | AC | Not Used | |
| 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 | Not Used | |
| Error: Barcode Req to Start | BR | The instrument was expecting a barcode value to be received over the RS232 port. The configuration was set to require this action before a start command is enabled. | Check barcode reader wiring and functionality. Make sure the Baud Rates are set properly within the instrument. |
| 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. |

| Message | Code | Description | Corrective Actions |
|---|---|---|---|
| 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 set point. 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 set point. 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 set point. 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 plug. |
| 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 set point. 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 set point. 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 Max Master Flow set point. 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 set point. 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 | |
| DP Transducer Over Range | DO | Not Used | |
| DP Transducer Zero Bad | DZ | Not Used | |
| Elec Regulator Cal Complete | EC | Not Used | |

| Message | Code | Description | Corrective Actions |
|---|---|---|---|
| Elec Regulator Cal Error | EE | Not Used | 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 factory. | |
| System Error - Service Req | ER | There was an error with the instrument. Please contact the factory. | |
| Flow Transducer Over Range | FO | Not Used | |
| 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 | Not Used | 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 | |
| Invalid Program Selected | IP | The program selected does not exist or has not been configured. | Check BCD Input programming |
| Error: Duplicate Target Link | LD | Not Used. | |
| 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. | |

| Message | Code | Description | Corrective Actions |
|---|---|---|---|
| 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 Std Select Config Error | LE | Configuration Error. The instrument was not configured properly. | |
| Error: Link Execution Loop | LL | Not Used | Check programming of the Parent/Child Structures |
| 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 | Not Used | |
| Error: Link Prog Undefined | LU | Not Used | |
| Error: Part Mark Fault | MF | Not Used | 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 |

| Message | Code | Description | Corrective Actions |
|---|---|---|---|
| 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. | |
| 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 |
| Test Pressure Low | PL | Test pressure was below Minimum Pressure during fill cycle. This results in a severe leak. | |
| 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 | |

| Message | Code | Description | Corrective Actions |
|---|---|---|---|
| Start Common Input Low | SC | Not Used | |
| Pressure Select Config Error | SE | Configuration Error. The instrument was not configured properly. | |
| Self-Test Failed | SF | The Self-Test failed | Make sure that the test line was removed and the test port was plugged before the test was conducted. One of the internal valves may be leaking. |
| Error: Stop Input Height | 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 set point 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 | Not Used | |
| Error: Two- Input Req to Start | TI | Not Used | |
| Test Port Select Config Error | TP | The instrument configuration is not correct. | |
| Error: Tooling not Retracted | TR | Not Used | |
| Tooling Reset | TS | Not Used | |
| Error: Tooling not Extended | TX | Not Used | |
| Vent Part Reset Tooling | VR | Not Used | |
| Transducer Cal Complete | XC | The transducer calibration is complete and was successful. | |

| Message | Code | Description | Corrective Actions |
|---|---|---|---|
| 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 |

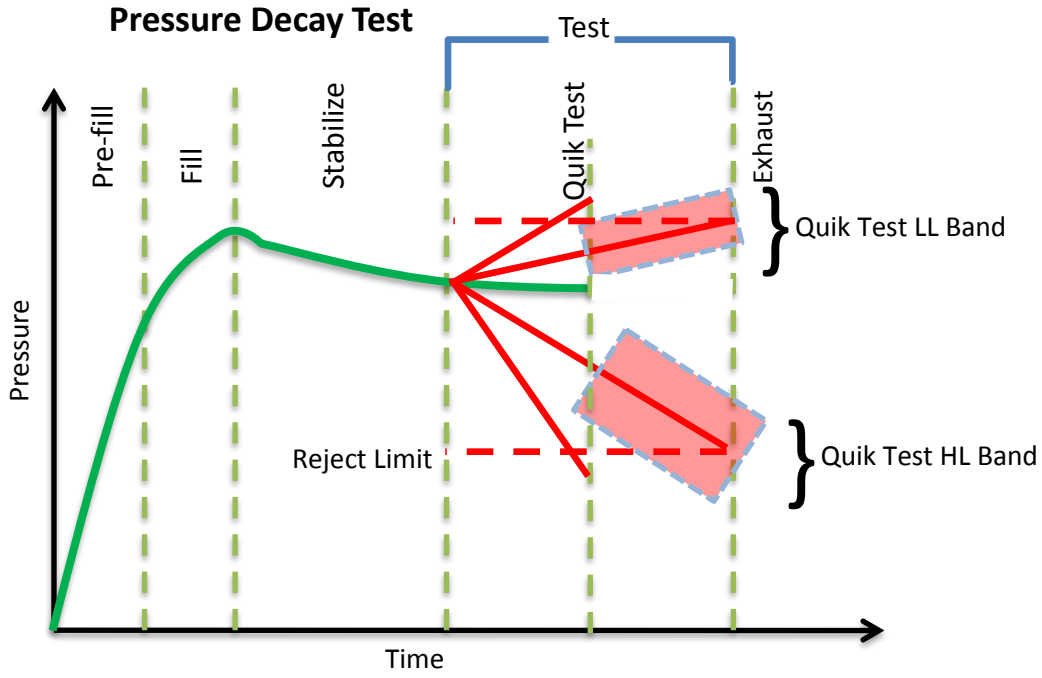
# Appendix B – Quik Test

*In this Appendix you will understand the theory and parameters for reducing the test time for obviously good and obviously bad products without sacrificing the accuracy for marginal parts. This capability is referred to as Quik Test in the instrument. This functionality is available in any test type that is capable of conducting 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 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 Quik Test LL band limit, and the High Limit with its Quik Test HL band limit. If the pressure loss is within either the Quik Test LL band or Quik Test HL 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 Test parameters for the program may be viewed and modified by going to the Program Config menu and selecting the TST:*** Icon.

| TST Parameter | Description |
|---|---|
| Quik Test Enable | Activates Quik Test. |
| Quik Test Timer | Defines the time as a percent of the Test sequence when the Quik Test function result is calculated. |
| 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 will be -4.5 to -5.5scc/m. |
| 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 will be 9.0 to 11.0 scc/m. |

# Appendix C – Environmental Drift Correction

*In this Appendix you will understand 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 like 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, 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.

| TST Parameter | Description |
|---|---|
| EDC Enable | Enables Environmental Drift Correction |
| 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. |
| EDC Quantity | Defines the number of test results within the EDC band used to calculate drift. |

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 – Communication Code Tables

*This appendix lists the codes that are referenced in the notes of Chapter13 – Communication.*

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

## Data Type Codes 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 | CM | MIN PERF FACTOR ERROR |
| 22 | CP | CAL REQUIRED - PARAM CHANGED |
| 23 | CR | CAL PROGRAM REJECT |
| 24 | CX | CHAMBER EVACUATION FAULT |
| 25 | DF | DP TRANSDUCER FAULT |
| 26 | DO | DP TRANSDUCER OVER-RANGE |
| 27 | DZ | DP TRANSDUCER ZERO BAD |
| 28 | EC | ELEC REGULATOR CAL COMPLETE |
| 29 | EE | ELEC REGULATOR CAL ERROR |
| 30 | EF | PART EVAC FAULT |

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

*type "TABLE EVALUATION"*

| | Test Evaluation Code | Description |
|---|---|---|
| 61 | LU | ERROR: LINK PROG UNDEFINED |
| 62 | MC | MASS SPEC CONTAMINATION |
| 63 | MF | ERROR: PART MARK FAULT |
| 64 | MS | MAN FILL SWITCH |
| 65 | NE | NO EVENT OCCURRED |
| 66 | OC | ATMOSPHERIC PRESSURE COMPLETE |
| 67 | OE | ATMOSPHERIC PRESSURE ERROR |
| 68 | PA | ABOVE TARGET PRESSURE |
| 69 | PB | BELOW TARGET PRESSURE |
| 70 | PC | ERROR: PART NOT CHANGED |
| 71 | PE | PROGRAM CONFIGURATION ERROR |
| 72 | PF | PART NOT FULL |
| 73 | PH | TEST PRESSURE HIGH |
| 74 | PL | TEST PRESSURE LOW |
| 75 | PP | ERROR: PART NOT PRESENT |
| 76 | PR | POWER RESET |
| 77 | PS | PART NOT STABILIZED |
| 78 | PV | PROCESS FAULT |
| 79 | PX | PART NOT EXHAUSTED |
| 80 | QC | SEQUENCE COMPLETE |
| 81 | R | PROGRAM REJECT |
| 82 | R1 | PART REJECT - LEVEL 1 |
| 83 | R2 | PART REJECT - LEVEL 2 |
| 84 | R3 | PART REJECT - LEVEL 3 |
| 85 | RF | CHAMBER RISE FAULT |
| 86 | RH | PRE-PRESSURE HIGH |
| 87 | RL | PRE-PRESSURE LOW |
| 88 | RX | SOURCE PRESSURE EXCEEDED |
| 89 | S1 | LD ZERO < MIN |
| 90 | S2 | LD ZERO > MAX |

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

# 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 | DLY | Delay |
| 25 | DPD | Differential Pressure Decay Test |
| 26 | DPL | Differential Pressure Decay - Leak Standard Test |
| 27 | DPS | Setup - DP Transducer Setpoint |
| 28 | DPT | Rate of Pressure Loss Test |
| 29 | DTV | Setup - DP Transducer Verification |
| 30 | DTZ | Setup - DP Transducer Zero |

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

*type "TABLE SEGMENT"*

| | Segment Code | Description |
|---|---|---|
| 61 | PRF | Prefill until Pressure |
| 62 | PRF | Proof Test |
| 63 | PRI | Internal - Pre-Seq |
| 64 | PRI | Internal - Evaluate Part Result |
| 65 | PRP | Prefill Pre-Pressure |
| 66 | PRS | Step Proof |
| 67 | PSI | Internal - Post-Seq |
| 68 | PTS | Setup - Pressure Transducer Setpoint |
| 69 | PTV | Setup - Pressure Transducer Verification |
| 70 | PTZ | Setup - Pressure Transducer Zero |
| 71 | PVF | Pressure Verify |
| 72 | RCF | Refrigerant Iso Off |
| 73 | RCX | Refrigerant CS Isolation |
| 74 | REC | Exhaust - T-Gas |
| 75 | REF | Refrigerant Fill |
| 76 | RET | Tooling Motion Retract |
| 77 | REV | Exhaust - Re-Evacuate |
| 78 | RFE | Refrigerant Evac |
| 79 | RFM | Refrigerant Manual Fill |
| 80 | RFS | Stabilize Scale |
| 81 | RFT | Refrigerant Fill |
| 82 | RFX | Refrigerant Stabilize |
| 83 | RL | Calibration Relax |
| 84 | RPS | Refrigerant Part Switch |
| 85 | RTE | Ramp to Pressure Event Test |
| 86 | RTF | Ramp to Flow Event Test |
| 87 | RTI | Ramp to Digital Input Event Test |
| 88 | RVN | Refrigerant Vent |
| 89 | SCI | Setup - Scale Init |
| 90 | SD1 | Setup - Sniffer idle |

| | Segment Code | Description |
|---|---|---|
| 91 | SDP | Stabilize for DP |
| 92 | SFS | Stabilize Tracer |
| 93 | SGL | Fill Tracer Gross |
| 94 | SGS | Stabilize Tracer Gross |
| 95 | SI1 | Setup - Sniffer Init |
| 96 | SI2 | Setup - Sniffer Init 2 |
| 97 | SLE | Tooling Seal Extend |
| 98 | SLR | Tooling Seal Retract |
| 99 | SME | Setup - Manifold Exhaust |
| 100 | SMF | Setup - Manifold Fill |
| 101 | SMI | Setup - Manifold Isolate |
| 102 | SNF | Sniffer Test |
| 103 | SNG | Sniffer Gross Test |
| 104 | SNW | Stabilize Tracer Wait |
| 105 | SPF | Fill Step |
| 106 | SPL | Setup - Pressure Select |
| 107 | SPR | Setup - Pre-Seq |
| 108 | SPS | Setup - Post-Seq |
| 109 | SSD | Stabilize Step Dwell |
| 110 | SSR | Setup - Set Regulator |
| 111 | STE | Stabilize Evac |
| 112 | STF | Stabilize for Flow |
| 113 | STG | General Stabilize |
| 114 | STR | Setup - Transducer Residual |
| 115 | STR | Stabilize Reference Volume |
| 116 | STS | Stabilize until Slope |
| 117 | SVD | Evac Test |
| 118 | SXT | Stabilize for Xdcr Test |
| 119 | TMC | Tooling Motion Control |
| 120 | XDR | Transducer Test |

# Test Data 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-Cyle Test 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 | CMX | Maximum Pressure |
| 57 | COF | Continue on Fail |
| 58 | COL | Cutoff Limit |
| 59 | CP | Current Precision |
| 60 | CPP | Copy Program |
| 61 | CPS | TLR Change/Sec |
| 62 | CPT | Consecutive Points |
| 63 | CPT | Consecutive Points |
| 64 | CR | Reject Cycles |
| 65 | CRA | Clean Part Source |
| 66 | CRF | Pre-Purge |
| 67 | CRS | Chmbr Crossover |
| 68 | CSC | Cycles Since Cal |
| 69 | CSN | Clear Since New Ctr |
| 70 | CSN | Cycles Since New |
| 71 | CST | Custom Self Test |
| 72 | CT | Total Cycles |
| 73 | CTE | Continue to Evac |
| 74 | CTF | Continue to Fill |
| 75 | CTG | Target Pressure |
| 76 | CTP | Copy to Target Prog |
| 77 | CTR | Clean Part Timer |
| 78 | CTX | Continue T-Gas Exh |
| 79 | DA | Analog D/A |
| 80 | DD | Decay Direction |
| 81 | DFL | Direct Flow |
| 82 | DKL | DP Leak Loss |
| 83 | DL | Diff Press Loss |
| 84 | DLL | DP Master+Leak Loss |
| 85 | DLR | Diff Press Loss Rd |
| 86 | DLT | Delay Timer |
| 87 | DML | DP Master Part Loss |
| 88 | DMR | DP Mstr Part Lss Rd |
| 89 | DP | Diff Pressure |
| 90 | DPI | DP iso Percent |

*type "TABLE VARIABLE"*

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

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

*type "TABLE VARIABLE"*

| | Test Data Identifier Code | Description |
|---|---|---|
| 181 | LCD | Leak Std Cal Date |
| 182 | LCF | Correction Factor |
| 183 | LDP | Leak Det Precision |
| 184 | LDT | Dev Zero Delay |
| 185 | LDU | Leak Det Unit |
| 186 | LDZ | Device Zero |
| 187 | LF | Master+Leak Flow |
| 188 | LFC | Leak Std Cal Flow |
| 189 | LFR | Master+Leak Flow Rd |
| 190 | LIN | Linearity |
| 191 | LKF | Leak Flow |
| 192 | LKL | Leak Loss |
| 193 | LKM | Link Motion |
| 194 | LL | Master+Leak Loss |
| 195 | LLE | Low Limit Event |
| 196 | LLF | Low Limit Flow |
| 197 | LLL | Low Limit Loss |
| 198 | LLP | Low Limit Pressure |
| 199 | LLQ | Low Limit Leak |
| 200 | LLR | Master+Leak Loss Rd |
| 201 | LLR | Low Limit Rate |
| 202 | LLV | Low Limit %Vref |
| 203 | LMP | Link Motion Preempt |
| 204 | LNL | Linearity Limit |
| 205 | LOF | Loss Offset |
| 206 | LQ | Master+Leak QL |
| 207 | LQD | DP Mstr+Lk QL Rd |
| 208 | LQD | DP Master+Leak QL |
| 209 | LQF | Master+Leak QF Rd |
| 210 | LQF | Master+Leak QF |
| 211 | LQR | Master+Leak QL Rd |
| 212 | LR | Leak Rate |
| 213 | LRC | Leak Std Recert |
| 214 | LSC | Leak Std Chk |
| 215 | LSP | Leak Std Pressure |
| 216 | LSS | Leak Std Select |
| 217 | LSV | Leak Std Value |
| 218 | LV | Launch Validation |
| 219 | ME | Malfunction Eval |
| 220 | MF | Master Part Flow |
| 221 | MFO | Manual Fill |
| 222 | MFR | Master Part Flow Rd |
| 223 | MFT | Manual Fill |
| 224 | ML | Master Part Loss |
| 225 | MLF | Min Mstr+Leak Flow |

| | Test Data Identifier Code | Description |
|---|---|---|
| 226 | MLF | Min Leak Flow |
| 227 | MLL | Min Leak Loss |
| 228 | MLR | Master Part Loss Rd |
| 229 | MMF | Min Master Flow |
| 230 | MMF | Min Master Flow |
| 231 | MML | Max Master Loss |
| 232 | MML | Min Mstr+Leak Loss |
| 233 | MML | Min Master Loss |
| 234 | MNT | Min Tare Weight |
| 235 | MO | Master Flow Offset |
| 236 | MOR | Master Flow Offset |
| 237 | MPC | Malfunction Percent |
| 238 | MPF | Min Perform Factor |
| 239 | MPP | Max System Pressure |
| 240 | MQ | Master Part QL |
| 241 | MQD | DP Mstr Part QL Rd |
| 242 | MQD | DP Master Part QL |
| 243 | MQF | Master Part QF Rd |
| 244 | MQF | Master Part QF |
| 245 | MQR | Master Part QL Rd |
| 246 | MSL | Reject Rate |
| 247 | MSO | MS Iso Open Delay |
| 248 | MSP | Max Pressure - Opt |
| 249 | MSR | Mark Severe Lk Rej |
| 250 | MST | Mass Spec Purge |
| 251 | MTM | Min T-Gas Mode |
| 252 | MTS | T-Gas Source |
| 253 | MV | T-Gas Mix Verify |
| 254 | MVF | T-Gas Tgt Press |
| 255 | MVH | Leakrate High Limit |
| 256 | MVL | Leakrate Low Limit |
| 257 | MVM | T-Gas Leak Rate |
| 258 | MVS | Start Mix Verify |
| 259 | MVT | T-Gas Fill Timer |
| 260 | MXT | Max Tare Weight |
| 261 | Mot | Motion Number |
| 262 | Mot | Number of Motions |
| 263 | NAM | Program Name |
| 264 | NBC | Number of Barcodes |
| 265 | NLK | Number of Links |
| 266 | NOP | Number of Options |
| 267 | NPP | Next Program |
| 268 | NPS | Number of Steps |
| 269 | NTP | Sample Points |
| 270 | NUM | Number of Programs |

*type "TABLE VARIABLE"*

| | Test Data Identifier Code | Description |
|---|---|---|
| 271 | OLS | Open Leak Std |
| 272 | OPT | Option |
| 273 | OTL | Open T-Gas Leak Std |
| 274 | P | Master Gauge Press |
| 275 | P | Instrument Pressure |
| 276 | P | Meas Pressure |
| 277 | P%V | Part %Vref |
| 278 | PC | Pneumatic Code |
| 279 | PCL | Leak Std Cal Press |
| 280 | PCR | Pressure Correction |
| 281 | PCT | Chmbr Post-Purge |
| 282 | PDL | Press Delta Limit |
| 283 | PET | Part Evac Limit |
| 284 | PEV | Part Evacuation |
| 285 | PEX | Partial Exhaust |
| 286 | PF | Performance Factor |
| 287 | PFL | Part Flow |
| 288 | PFM | Prefill Method |
| 289 | PG | Target Pressure |
| 290 | PKP | Peak Pressure |
| 291 | PL | Pressure Loss |
| 292 | PLP | Predicted Loss |
| 293 | PLQ | Master+Leak Q-Press |
| 294 | PLR | Pressure Loss Rd |
| 295 | PLR | DP Mstr+Lk Loss Rd |
| 296 | PM | Master Part Press |
| 297 | PM | Part Mark |
| 298 | PMF | Part Mark Feedback |
| 299 | PML | Master+Leak Press |
| 300 | PMN | Minimum Pressure |
| 301 | PMQ | Master Part Q-Press |
| 302 | PMX | Maximum Pressure |
| 303 | PNM | Sniffer Test Point |
| 304 | PP | Pressure Precision |
| 305 | PP | Proof Pressure |
| 306 | PPC | Part Present Check |
| 307 | PPE | Pre-Press Enable |
| 308 | PPR | Pre-Pressure |
| 309 | PPS | Pre-Press Select |
| 310 | PPW | Pre-Pressure Window |
| 311 | PQ | Predicted Leak |
| 312 | PRF | Prefill |
| 313 | PRI | Programmable Input |
| 314 | PRO | Programmable Output |
| 315 | PRR | Pressure Restrict |

| | Test Data Identifier Code | Description |
|---|---|---|
| 316 | PSL | Pressure Select |
| 317 | PSL | Pressure Select |
| 318 | PSL | Pressure Select |
| 319 | PSP | Setpoint Pressure |
| 320 | PST | Self Test Pressure |
| 321 | PSV | Part Sniffer Type |
| 322 | PT | Target Pressure |
| 323 | PTF | Prefill |
| 324 | PTG | Gross Prefill |
| 325 | PTP | ¤P/¤T Precision |
| 326 | PTS | Port Select |
| 327 | PTS | Part Seal |
| 328 | PTU | ¤P/¤T Unit |
| 329 | PTX | Test Passed Text |
| 330 | PW | Weight Precision |
| 331 | Pp | Part Pressure |
| 332 | Pr | Ref Pressure |
| 333 | Pt | Test Pressure |
| 334 | Pt | Target Pressure |
| 335 | Pt | Apply to Program # |
| 336 | Pt | Program Number |
| 337 | Pv | Estimated Part Size |
| 338 | QF | Quik Flow |
| 339 | QHL | Quik Test HL Band |
| 340 | QL | Quik Loss |
| 341 | QLL | Quik Test LL Band |
| 342 | QP | Quik Test Pressure |
| 343 | QPT | Quantity Points |
| 344 | QTE | Quik Test Enable |
| 345 | RAN | Number of Points |
| 346 | RAP | Analysis Pressure |
| 347 | RAS | Analysis Voltage |
| 348 | RAT | Analysis Percent |
| 349 | RAV | Reject Average |
| 350 | RC | Elec Regulator Cal |
| 351 | RC1 | EReg Zero DA Cal |
| 352 | RC2 | EReg Span DA Cal |
| 353 | RC3 | EReg Zero Base Cal |
| 354 | RC4 | EReg Span Base Cal |
| 355 | RCA | Analog Value |
| 356 | RCD | Last Cal Date |
| 357 | RCI | Instrument Pressure |
| 358 | RCP | Retention Cutoff |
| 359 | RCS | Setpoint Voltage |
| 360 | RCT | Last Cal Time |

*type "TABLE VARIABLE"*

| | Test Data Identifier Code | Description |
|---|---|---|
| 361 | RCV | Master Value |
| 362 | RDI | Restore Default I/O |
| 363 | RDT | Reg Dwell Timer |
| 364 | RED | Refrgnt Vent Close |
| 365 | REG | Regulator |
| 366 | REO | Refrigerant Vent |
| 367 | REX | Refrigerant Vent |
| 368 | RFC | Fill Close Delay |
| 369 | RFL | Reference Loss |
| 370 | RL | Loss Rate |
| 371 | RLC | Run Leak Calibrate |
| 372 | RLR | Loss Rate Rd |
| 373 | RLV | T-Gas LeakStd Value |
| 374 | RMX | EReg Span DA Cal |
| 375 | RNP | Number of Points |
| 376 | ROS | Reject on Slope |
| 377 | RPC | Reject Percentage |
| 378 | RPM | Ramp Method |
| 379 | RPP | Retain Part Press |
| 380 | RPP | Reject Program |
| 381 | RR | Ramp Rate |
| 382 | RR | Retract on Reject |
| 383 | RRT | Reject Rate Total |
| 384 | RSI | Result Information |
| 385 | RSP | Slope Window |
| 386 | RSR | Slope Change/Sec |
| 387 | RST | Stabilize |
| 388 | RVH | High Limit Voltage |
| 389 | RVH | High Limit Voltage |
| 390 | RVL | Low Limit Voltage |
| 391 | RVL | Low Limit Voltage |
| 392 | RVP | Retain Volume Press |
| 393 | RXM | Pre-Evac Exhaust |
| 394 | SAM | Sample Size |
| 395 | SAS | Start AutoSetup |
| 396 | SCF | Cal Coefficient |
| 397 | SCL | T-Gas LeakStd Value |
| 398 | SCO | Cal Offset |
| 399 | SCP | Start Clean Part |
| 400 | SCR | Reject Rate Percent |
| 401 | SCT | Scale Type |
| 402 | SEV | Leak Rate Window |
| 403 | SF | Standard Flow |
| 404 | SGN | Sample Gas Number |
| 405 | SIO | Sniffer Init |

| | Test Data Identifier Code | Description |
|---|---|---|
| 406 | SMP | Sample Time |
| 407 | SN | Step Number |
| 408 | SNR | SNR |
| 409 | SOD | Shut Off Delay |
| 410 | SP | Starting Pressure |
| 411 | SP | Standard Pressure |
| 412 | SPM | Fine Wait |
| 413 | SPT | Gross Wait |
| 414 | SR | Set Regulator |
| 415 | SRC | Start Calibration |
| 416 | SRH | LD Leak Val Max |
| 417 | SRL | LD Leak Val Min |
| 418 | SSW | Starting Src Weight |
| 419 | STL | Self Test Level |
| 420 | STM | Self Test Method |
| 421 | STN | Self Test Program |
| 422 | STP | Target Press |
| 423 | STS | Self Test Source |
| 424 | STS | Start Self Test |
| 425 | STT | Self Test Limit |
| 426 | STV | Step Target Press |
| 427 | STW | Target Window |
| 428 | SXC | Start Calibration |
| 429 | SXT | Start Xdcr Test |
| 430 | SXV | Start Verification |
| 431 | SZH | LD Zero Val Max |
| 432 | SZL | LD Zero Val Min |
| 433 | Ser | Serial Number |
| 434 | Stn | Channel Number |
| 435 | T | Timer |
| 436 | T | Timer |
| 437 | TBF | LD Background Limit |
| 438 | TEP | T-Gas Exh Press |
| 439 | TI | Iso Delay Timer |
| 440 | TL | Tooling Option |
| 441 | TLK | Test Leak Rate |
| 442 | TLP | Leak Rate Precision |
| 443 | TLR | T-Gas Leak Rate |
| 444 | TLU | Leak Rate Unit |
| 445 | TML | LD Min T-Gas Setpt |
| 446 | TMN | Fine T-Gas Min |
| 447 | TMP | Temp Precision |
| 448 | TMX | Fine T-Gas Max |
| 449 | TP | Time Precision |
| 450 | TPP | Target Program |

*type "TABLE VARIABLE"*

| | Test Data Identifier Code | Description |
|---|---|---|
| 451 | TPW | Target Press Window |
| 452 | TQ | Quik Test Timer |
| 453 | TR1 | Trigger 1 |
| 454 | TRA | T-Gas Source |
| 455 | TRM | T-Gas Recovery |
| 456 | TSM | T-Gas Sampling |
| 457 | TT | Test Sel Timer |
| 458 | TT | Test Execution Time |
| 459 | TTF | TracerMate Flags |
| 460 | TTY | Test Type |
| 461 | TTY | Test Type |
| 462 | TV | Valve Delay Timer |
| 463 | TW | Target Weight |
| 464 | TWN | Min Fill Weight |
| 465 | TWX | Max Fill Weight |
| 466 | Tcy | Desired Cycle Time |
| 467 | Tm | Time |
| 468 | Tm | Timer Mode |
| 469 | UC | Current Unit |
| 470 | UDP | ¤ Pressure Unit |
| 471 | UF | Flow Unit |
| 472 | UP | Pressure Unit |
| 473 | UP | Percent Unit |
| 474 | UPD | Unit/Prec Define |
| 475 | UT | Time Unit |
| 476 | UTM | Temperature Unit |
| 477 | UV | Voltage Unit |
| 478 | UV | Volume Unit |
| 479 | UW | Weight Unit |
| 480 | V | V |
| 481 | VAN | Valve A Num - Opt |
| 482 | VAP | Valve A PWM - Opt |
| 483 | VAT | Valve A Type - Opt |
| 484 | VBN | Valve B Num - Opt |
| 485 | VBP | Valve B PWM - Opt |
| 486 | VBT | Valve B Type - Opt |
| 487 | VC | Valve Code |
| 488 | VCN | Valve C Num - Opt |
| 489 | VCP | Valve C PWM - Opt |
| 490 | VCT | Valve C Type - Opt |
| 491 | VDN | Valve D Num - Opt |
| 492 | VDP | Valve D PWM - Opt |
| 493 | VDT | Valve D Type - Opt |
| 494 | VFL | Virtual Flow |
| 495 | VHT | Vent/Halt Tooling |

| | Test Data Identifier Code | Description |
|---|---|---|
| 496 | VLP | Volume Precision |
| 497 | VLV | Valve Number |
| 498 | VNP | Number of Points |
| 499 | VP | Voltage Precision |
| 500 | VPS | Setpoint Pressure |
| 501 | VPW | Valve PWM |
| 502 | VSP | Setpoint Voltage |
| 503 | VWO | Residual Offset |
| 504 | WGT | Refrigerant Weight |
| 505 | WHL | High Limit |
| 506 | WIN | Stat History Length |
| 507 | WLL | Low Limit |
| 508 | XAN | Xdcr Zero LL |
| 509 | XAX | Xdcr Base Max |
| 510 | XBH | Xdcr Zero Hwin |
| 511 | XBL | Xdcr Zero Lwin |
| 512 | XC | Transducer Cal |
| 513 | XC1 | Xdcr Zero AD Cal |
| 514 | XC2 | Xdcr Span AD Cal |
| 515 | XC3 | Xdcr Zero Base Cal |
| 516 | XC4 | Xdcr Span Base Cal |
| 517 | XCA | Analog Value |
| 518 | XCB | Atm Pressure |
| 519 | XCD | Last Cal Date |
| 520 | XCF | Instrument Flow |
| 521 | XCI | Instrument Pressure |
| 522 | XCL | Xdcr Curr Limit |
| 523 | XCM | Master Reading |
| 524 | XCP | Cal Pressure |
| 525 | XCS | Setpoint Pressure |
| 526 | XCT | Last Cal Time |
| 527 | XCV | Master Value |
| 528 | XCX | Xdcr Cal X Array |
| 529 | XCY | Xdcr Cal Y Array |
| 530 | XFC | Xdcr Filter Code |
| 531 | XFP | Flow Precision |
| 532 | XID | Xdcr Iso Delay |
| 533 | XIS | Xdcr Span Inter Cal |
| 534 | XIZ | Xdcr Zero Inter Cal |
| 535 | XLF | Max Mstr+Leak Flow |
| 536 | XLF | Max Leak Flow |
| 537 | XLL | Max Leak Loss |
| 538 | XMF | Max Master Flow |
| 539 | XML | Max Mstr+Leak Loss |
| 540 | XMN | Xdcr Base Min |

*type "TABLE VARIABLE"*

| | Test Data Identifier Code | Description |
|---|---|---|
| 541 | XMX | Xdcr Base Max |
| 542 | XNP | Number of Points |
| 543 | XOP | Crossover Pressure |
| 544 | XPC | Pressure Correction |
| 545 | XPM | Pressure Mode |
| 546 | XPP | Pressure Precision |
| 547 | XPR | Pressure Reference |
| 548 | XRL | Xdcr Risidual Limit |
| 549 | XRW | Xdcr Risidual Warn |
| 550 | XSP | Setpoint Pressure |
| 551 | XT | Transducer |
| 552 | XT | Xdcr Tare |
| 553 | XTG | Xdcr Tare Range |
| 554 | XTR | Xdcr Typ Residual |
| 555 | XUF | Flow Unit |
| 556 | XUP | Pressure Unit |
| 557 | XV | Transducer Verify |
| 558 | XVD | Verify Date |
| 559 | XVF | Instrument Flow |
| 560 | XVI | Instrument Pressure |
| 561 | XVM | Master Reading |
| 562 | XVS | Setpoint Pressure |
| 563 | XVT | Verify Time |
| 564 | XVV | Master Value |
| 565 | XZC | Xdcr Zero Check |
| 566 | XZH | Xdcr Zero HL |
| 567 | XZL | Xdcr Zero LL |
| 568 | XZW | Xdcr Zero Window |

# Appendix E - Setup & Instrument Configuration Sheets

*In this Appendix you will find an aid in documenting the various setup configurations for your C20 Instrument. The following page will hold up to 4 setups.*

## Instrument and Part Parameter Setup Menu

| Instrument Configuration | Factory setting | Changes |
|---|---|---|
| **Orifice** {Orificio} (value on calibration certificate) | _(per calibration)_ | _____ |
| **Display format** {Formate de Pantalla} | ____Flow_____ | _____ |
| **Cal Method** {Metodo de Calibracion} | ____Auto_____ | _____ |
| **Test Evaluation** {Evaluacion de Pruebas} | ___Acc/Rej_____ | _____ |
| **Trans Range** {Rango del Transductor}) | _(set per order)__ | _____ |
| **Range Adj** (Ajus do Rango) | _____0.0_____ | _____ |
| **Serial Port** {Porto serial} | _____Off_____ | _____ |
| **Program Input** {Programa de Dentro} | ___Calibrate_____ | _____ |
| **Program Output** {Program de Fuera} | ___Exhaust_____ | _____ |
| **Password** {Clave de Acceso} (1 - 99) | _____0.0_____ | _____ |
| **Enable Security?** {Opcion de Seguridad?} | _____N_____ | _____ |
| **Language** {Eli dionna} (Eng or Spn) | _____Eng_____ | _____ |

| Part Parameters | Factory setting | Changes |
|---|---|---|
| **Prefill time** {Tiempo de Pre-llenado}- max. time to each 90% of test pressure before starting fill timer | _____2.0_____ | _____ |
| **Fill time** {Tiempo de llenado}- additional time to fill part with regulated air | _____2.0_____ | _____ |
| **Stabilization time** {Tiempo de estabilizacion}- Time for pressure to stabilize in part before measuring pressure loss | _____3.0_____ | _____ |
| **Test time** {Tiempo de Prueba}- time when pressure loss is precisely measured. | _____4.0_____ | _____ |
| **Exhaust time** {Tiempo de escape}- time delay after test to vent part before releasing optional seal output | _____1.0_____ | _____ |
| **Relax time** {Tiempo de Descanso}- time between tests during automatic calibration sequence | _____20.0_____ | _____ |
| **Test pressure** {Presion de Prueba}- specified pressure for leak test | (based on range) | _____ |
| **Reject Rate** {Rango de Rechazo}- Specified leak value to reject parts | _____5.0_____ | _____ |
| **Max Neg Leak** {Neg Fugo Max} - negative leak value below which will reject tests due to process variations | _____-0.1_____ | _____ |
| **Min Cal Ratio** (Cal Relac Min) - lower limit of acceptable calibration | _____0.5_____ | _____ |
| **No Leak Loss** {Rango de No-Fuga}- pressure loss measured for master good part during calibration cycle. | (based on instrument) | _____ |
| **Reject Loss** {Fuga de rechazo}- pressure loss calculated for reject leak rate. | (based on instrument) | _____ |
| **Quik Testing** (Pruebe rapido)- %band for Quik test | _____Off_____ | _____ |
| **Quik Test Time** (Tiempo rapido) - time into test to check | _____0.0_____ | _____ |
| **Process Drift Correction** {Correccion de tendencia del Proceso}- percentage variation allowed around "No Leak Loss" for zero shift due to process drift. (Off, 10,25,50,90%) | _____Off_____ | _____ |

# Instrument Configuration Table

| Part Name | | | | |
|---|---|---|---|---|
| **Part Parameters** | | | | |
| Prefill time | | | | |
| Fill time | | | | |
| Stabilization time | | | | |
| Test time | | | | |
| Exhaust time | | | | |
| Relax time | | | | |
| Test Pressure | | | | |
| Reject rate | | | | |
| Max Neg Leak | | | | |
| Min Cal Ratio | | | | |
| No leak loss | | | | |
| Reject loss | | | | |
| Quik Testing | | | | |
| Quik Test Time | | | | |
| Process drift correction | | | | |
| **Instrument Parameters** | | | | |
| Orifice value | | | | |
| Display format | | | | |
| Calibration method | | | | |
| Test evaluation | | | | |
| Transducer range | | | | |
| Range Adj. (%) | | | | |
| Serial port | | | | |
| Programmable output | | | | |
| Programmable input | | | | |
| Password | | | | |
| Language | | | | |

# 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) .25-28X 3.5 INCH LONG SHCS.**
4) **RECOMMENDED 4 INCH CLEARANCE UNDER INSTRUMENT FOR TEST PORT, PNEUMATIC CONNECTIONS, AND HAND CLEARANCE.**

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# Index

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# Sentinel C20WE Technical Specifications

**Outside Physical Dimensions**

Wall mount model (W x H x D): 229 x 165 x 184 (mm) 9 x 6.5 x 7.25 (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 Customer 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