PFEIFFER VACUUM

E2 / VE2 Leak Test Instrument

Operation Manual

Manual Revision 2.3.17 R1

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Conforms to Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements [UL 61010-1:2012 Ed.3+R:19Jul2019]

This product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1 or a later version of the same standard incorporating the same level of testing requirements.

SAFETY CONFORMITY MARKING
THE SAFETY CONFORMITY MARKING IS APPLICABLE ONLY FOR INSTRUMENT PROPERLY MARKED WITH ETL, CE OR SIMILLAR MARKING.

WARNINGS:

ISO 7000 – 0434 is marked on the back panel of the product. Read documentation on why this symbol is marked.

This product deals with gas that will compress under pressure conditions. Pressurized components (reservoirs, hoses, etc.) should be designed with proper protection to avoid any harm to the user.

The instrument is connected to either 115 VAC or 220 VAC single phase power. Use proper care to avoid harm to personnel.

Leak Test Instruments sold to locations outside of North America will include a power cord that is intended for standard use in continental Europe. This cord is manufactured with a 230V IEC 7/7 Type F: “Schuko” plug. It is the responsibility of the end user to ensure that this cord is adequate and appropriate for the intended use and complies with all applicable laws, regulations, codes, and standards of the region where the Leak Test Instrument will be used. If not, the end user will need to source an appropriate power cord that meets their local requirements.

Use this product for the purpose of leak testing or flow measurement and testing in the pressure ranges and temperature ranges specified, only!

Only qualified personnel should install or use this product. Installation must comply with the manual requirements and product specifications. Installation must comply with the manual requirements and product specifications. This product shall be used for leak test applications and/or flow measurement applications only.

Under no circumstances while the test is on should the operator tamper with the “unit under test (UUT).” This may result in bodily injury and/or erroneous results.

When this Leak Test Instrument is part of a leak test system, it is the user's responsibility to assure proper interface and maintenance for this instrument to utilize its measurement capabilities safely and accurately.

This instrument should NOT be operated at a pressure greater than a maximum of 160 psig or full scale of the sensor, whichever is lower.

CAUTIONS:

This Leak Test Instrument measurement reflects the leak flow rate of the unit under test as presented to the instrument at the test conditions and environment used. It is not a guarantee for "leak-free" products over a period or use in different conditions and/or environment.

The user should be familiar with flow, pressure and temperature measurement units before setting up the leak test instrument. It is the user's responsibility to properly define leak flow rates and tolerances for a specific application.

NOTE:

FUSE RATING
Cooper Bussmann GMC-2A (250V, 2A, Time Delay) Fuse should be used for over current protection.

For indoor use only; For use in altitudes up to 2,000m; Maximum relative humidity 80% for temperatures up to 31 degrees decreasing linearly to 50% relative humidity at 40 degrees C; MAINS supply voltage fluctuations up to +/- 10% of the nominal voltage; transient overvoltage is impulse withstand (overvoltage) category 2 of IEC60364-4-443; Pollution degree of device is 2.

1. Introduction

This manual applies to the operation and maintenance of the E2 or VE2 (E2/VE2) leak test instrument incorporating an “Intelligent Gas Leak Sensor” (IGLS). The IGLS is a micro-flow gas sensor operating based on Pfeiffer Vacuum’s accelerated laminar flow design. The IGLS is a microprocessor-based flow controller. The flow program performs on-board volumetric (e.g., cc/min) or mass (e.g., g/min) flow measurements, at actual or “standard” temperature and pressure conditions.

The E2/VE2 controls valves for leak test applications. The touch screen graphic LCD includes a start, stop and test type buttons, measurement reading and flow graph. LeakTek software allows the user to configure desired parameters to meet specific requirements and can be used to download to the IGLS as well as view, save, and analyze test data using a separate PC.

The E2/VE2 includes a female 9-pin D-connector on the rear panel for connecting to a PC using a straight through RS-232 serial extension cable. The IGLS receives commands and data requests and returns data via a bi-directional RS-232 port. Up to nine E2/VE2 units can be connected to a single RS-232 port. The E2/VE2 also includes an RJ45 Ethernet connector on the rear panel for connecting to a PC via a network connection either directly or through a LAN. Selection of the communication method is made via the COMM SELECT toggle switch located between the RS232 and Ethernet ports on the rear panel. Only one communications port may be utilized at any time. The Ethernet connection does not support multiple users access to the E2/VE2. Refer to the Operator Manual for Leak-Tek © program for network setup and instrument configuration when using the Ethernet communications port.

Extensive programming commands allow the user to address any one of the connected sensors to configure the selected sensor, update the calibration data, and establish new test parameters.

An E2/VE2 can access up to four (4) active test types (part recipe holders) locally (without a connected PC) and many part recipes in storage location in the instrument. Active test types can be selected via the front panel display, or remotely via the rear panel connections.

All remote or external controls (input and output) are available at the male 37-pin D connector located on the rear panel of the E2/VE2.

1.1 Principle of Operation

The E2/VE2 Leak Test Instrument and applicable accessories provide a complete solution for leak testing. The leak test concept is based on the mass conservation law. Once the unit under test (UUT) is pressurized and reaches steady state conditions, the amount of mass flow into the UUT equals the amount of mass flow that leaks out. The IGLS in the E2/VE2 measures the makeup flow required to keep the pressure steady in the UUT.

The IGLS is a unique Micro-flow sensor, capable of measuring extremely low flow, utilizing Pfeiffer Vacuum’s accelerated laminar flow design. The IGLS measures volumetric flow and can display many user defined units and conditions based on pressure, temperature and gas type. The sensitivity of the IGLS is enhanced in vacuum conditions, where a given mass flow yields in larger volumetric flow due to the reduced gas density at low pressure. The IGLS operates in the viscous and slip flow regimes, pressure ranges of 13.8 kPa Absolute (~2 psia) to 1140 kPa Abs (165 psia). When

performing tests at low absolute pressure (e.g., under 13.8 KPa absolute pressure) the material transfer mechanism is transitional or molecular flow regimes. For these applications Pfeiffer Vacuum's Mass Extraction Instrumentation with the Intelligent Molecular Flow Sensor (IMFS) should be used.

Micro-flow measurement at steady state conditions is independent of the UUT volume. The reading is a direct flow measurement. Frequent calibration is not required. Typically, annual calibration is applicable (definition by user quality standards). The supplied verification orifice ("calibrated leak") is utilized to verify equipment operation. The Micro-flow technology offers fast and very repeatable leak tests. For short cycle times, a signature concept as described in the LeakTek© software manual may be employed.

2. Function Configuration

The E2/VE2 instrument typically functions as a standalone leak test. It is capable of automated leak testing - with or without automatic pressure control. When functioning as a conventional leak tester, the E2/VE2 controls isolation, quick fill and fill valves to fill and stabilize the unit under test (UUT) prior to measurement.

After fill and equalization steps, fine flow measurement begins. The IGLS will monitor flow readings for a user defined test time and make a pass/fail determination based on defined test criteria. Test pass/fail criteria, test time, fill and equalization time are configurable via the RS-232 port or Ethernet port using the Leak-Tek © program or MS hyper-terminal. Refer to Appendix D for application examples.

3. Interface

3.1 MECHANICAL INTERFACE AND CONNECTION of the E2 / VE2:

WARNINGS:

The E2/VE2 instrument is NOT rated to operate in class 1 or 2 environments. If hazardous conditions and gasses exist, consult Pfeiffer Vacuum.

Fluids used should be gasses compatible with the IGLS wetted material which consists of stainless steel and Viton seals. Gasses currently supported are dry air, nitrogen and carbon dioxide. For other gases, consult Pfeiffer Vacuum.

CAUTIONS:

The E2/VE2 is equipped with a filter. Clean and maintain the filter and supply lines, as excessive contamination will cause distortion of readings.

The operating temperature as well as the gas temperature should be from 10 to 45 °C.

Connections of instrument ports are per the enclosed schematics. Support all bulkhead fittings with proper wrenches to hold those connections steady, and to avoid internal damage to the instrument. Follow Swagelok ® fitting assembly instructions.

CAUTION:

In some configurations, an E2/VE2 instrument should be mounted in level plane (horizontal plane) to operate properly.

NOTE:

Mount and locate the E2/VE2 as close as possible to the UUT to minimize UUT connection tube length and volume. Larger volumes will slow system response to a given leak flow.

The E2/VE2 controls internal Isolation, Fill, Balance and Test valves as well as optional external exhaust valve, clamp/seal valve and/or an electronic pressure controller. A verification valve with connected calibrated leak can be manually actuated from the front panel. The pneumatic connection should be per the enclosed diagram (Figure 3.1.1).

An external expansion reservoir should be 10 times larger than UUT volume. The pressure or vacuum supply to the instrument should be stable. A volume between the pressure regulator/controller and the E2 / VE2 will reduce pressure fluctuations and increase system performance. Air tools connected to the same line may cause a shock wave that will affect pressure stability. If the E2 inlet pressure “drops” momentarily during test, the flow will be reduced and may mask a leak. Pfeiffer Vacuum’s precision pressure regulators are recommended. Pfeiffer Vacuum’s vacuum generation and control packages are recommended for vacuum applications.

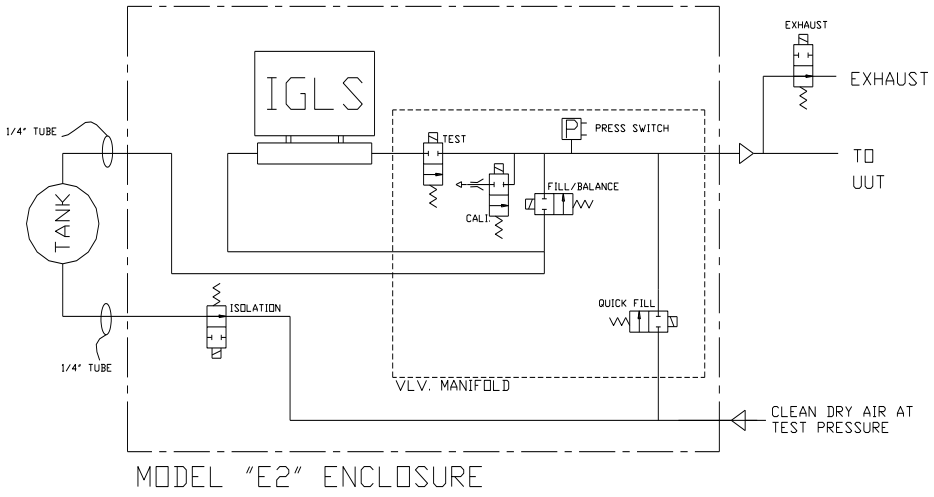


Figure 3.1.1 - Pneumatic Connection

Please see Appendix C for connection and assembly

Ensure that pneumatic interface components are compatible with the gasses and all components comply with appropriate codes for pressure ratings (such as ASME Boiler codes and SAE standards). Tubing, fittings and the associated UUT adaption should meet leak specification of 10 times or better than the rating of the instrument and leak test specification.

Pressure/vacuum regulation: Precision manual regulators or electronic controllers may be utilized. Electronic pressure controllers should be compatible with the electrical output signal of the E2 / VE2.

The UUT Port connection is on the right-hand side of the unit. Support the bulkhead fitting with 5/8" wrench (3/4" for Vacuum) when tightening the tube fitting (1/4" or 3/8" Swagelok ® tube fitting). Do not over-tighten.

Supply pressure and expansion reservoir connections are in the back of the instrument. Support the bulkhead fitting with 5/8" wrench (3/4" for Vacuum) when tightening the tube fitting (1/4" or 3/8" Swagelok ® tube fitting). Do not over-tighten.

3.2 ELECTRICAL INTERFACE AND CONNECTION:

The E2/VE2 is supplied with a power cord for 115-VAC or 220-VAC single-phase power. Connect it to an applicable connector that complies with local electrical codes.

The E2 and VE2 units are rated as shown:

Voltage	Current	Power	Frequency
120 VAC	0.45 A	48W	50/60 Hz
220 VAC	0.24 A	41W	50/60 Hz

WARNING:

Proper grounding and electrical practices should be employed. Power should be disconnected when maintaining or opening the E2/VE2 enclosure.

CAUTION:

Improper power wiring will cause permanent damage to the unit. Always observe hot and neutral polarities when connecting to AC power source. Never connect a 120-VAC unit to a 220-VAC source, or vice versa.

NOTES:

All digital inputs are optically isolated. Use only correctly rated voltage for inputs.

Digital outputs should not drive an inductive load. Use small external relays or optically isolated modules (preferred) to drive valves or large relays.

The E2/VE2 ethernet port does not support Power Over Ethernet (POE).

NOTE: The E2 and VE2 use a 2A fuse for the power module (example: Buss PN: BK/GMC-2-R) and 500mA buss fuse for the E2 RD21 board (example: Buss: PN: BK/GMC-500-R)

The remote I/O connectors located on the rear panel of the E2/VE2 as shown in Figures 3.2.1 & 3.2.2.

Pin	Function	Specifications
Pin 1	Analog Output A	0-5 VDC
Pin 2	Analog Output B	0-5 VDC
Pin 3	Remote Exhaust Valve Output	Switched 12 VDC, 22W max
Pin 4	Remote Exhaust Valve Return	0 VDC
Pin 5	Ground/Common	0 VDC
Pin 6	Verify Input	5-30 VDC, source or sink*, 30 mA max.
Pin 7	Remote Output Common	5-30 VDC, source or sink*, 100 mA max.
Pin 8	Clamp Output	5-30 VDC, source or sink*, 100 mA max.
Pin 9	Pressure/Test Output	5-30 VDC, source or sink*, 100 mA max.
Pin 10	Exhaust Output	5-30 VDC, source or sink*, 100 mA max.
Pin 11	Fill/Balance Output	5-30 VDC, source or sink*, 100 mA max.
Pin 12	Quick Fill Output	5-30 VDC, source or sink*, 100 mA max.
Pin 13	Isolate Output	5-30 VDC, source or sink*, 100 mA max.
Pin 14	Analog Ground	0 VDC
Pin 15	Not used	
Pin 16	Not used	
Pin 17	Not used	
Pin 18	Not used	
Pin 19	Not used	
Pin 20	Not used	
Pin 21	Custom2 Output	5-30 VDC, source or sink*, 100 mA max.
Pin 22	Pass Output	5-30 VDC, source or sink*, 100 mA max.
Pin 23	Fail Output	5-30 VDC, source or sink*, 100 mA max.
Pin 24	PFail Output	5-30 VDC, source or sink*, 100 mA max.
Pin 25	TTA Output	5-30 VDC, source or sink*, 100 mA max.
Pin 26	TTB Output	5-30 VDC, source or sink*, 100 mA max. Test Type1: TTA:1, TTB: 0 Test Type2: TTA:0, TTB: 1 Test Type3: TTA:1, TTB: 1 Test Type4: TTA:0, TTB: 0
Pin 27	Start Input	5-30 VDC, source or sink*, 30 mA max. Pulse to the Start input pin; start test
Pin 28	Stop Input	5-30 VDC, source or sink*, 30 mA max. Pulse to the Stop input pin; stop test
Pin 29	Test Type Input	5-30 VDC, source or sink*, 30 mA max. Pulse to Test Type input pin; switch to next type
Pin 30	Pressure Switch Input	5-30 VDC, source or sink*, 30 mA max.
Pin 31	Remote Input Common	5-30 VDC
Pin 32	Not used	
Pin 33	Not used	
Pin 34	Not used	
Pin 35	Not used	
Pin 36	Not used	
Pin 37	+5 VDC Power (DO NOT use to power external devices! Use only for E2/VE2 digital inputs.)	+5 VDC
* Sinking or Sourcing can be selected for all Inputs or Outputs as a group, i.e., all sinking inputs, all sourcing outputs, etc. Use pins 7 and 31 to select type and voltage of inputs and outputs.		

Figure 3.2.1 – Rear Panel Standard Remote I/O Connections

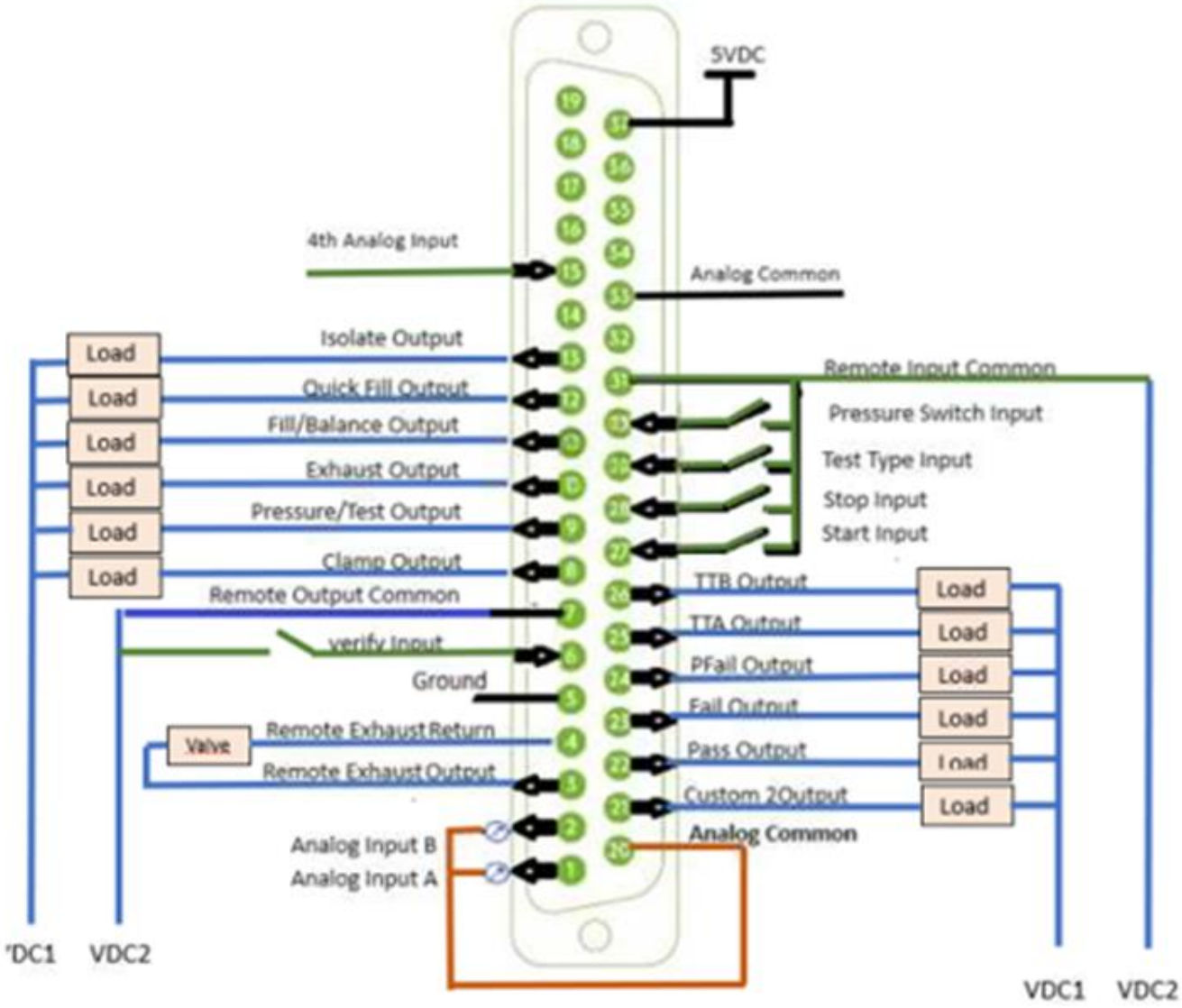


Figure 3.2.2 – Standard Remote I/O Pin Connector

Condition	Description	Pin out
Pass	The test met all criteria set in the set-up screen	Pin 22
Gross leak Fail	Pressure is below the Pressure Min setting in pressure testing	Pin 23
Gross leak vacuum Fail	Pressure is larger than the Pressure Max setting in vacuum testing	Pin 23
No Pres Fail	Pressure switch not turned on in time.	Pin 23
Blockage Fail	Pressure switch not turned off at the end of the test during deplete time, External Pressure is within the limits for Ext Press Off action	Pin 23, Pin 24
Large Leak Fail	The Flow is more than the large leak setting	Pin 23
HiFlow Relative Measurement Fail	Relative Measurement Base Line Flow larger than the set point	Pin 23
Lo Flow Relative Measurement Fail	Relative Measurement Base Line Flow Lower than the set point	Pin 23
Fine Leak Fail	Flow is above the maximum flow limit setting	Pin 23

Low Flow Fail	Flow is below the minimum flow limit setting	Pin 23
Back Flow/Sys pass	The Flow Sensor Detected the Flow in Opposite Direction or System leak check failure	Pin 23
Over pressure	The Pressure Is Larger Than the Pressure Max Setting in pressure testing	Pin 23
Under pressure	The Pressure is below the Pressure Min Setting in vacuum testing	Pin 23
Flow Saturation	Exceeding Flow Sensor Limit	Pin 23
Pressure saturation	Exceeding press Sensor Limit	Pin 23
Temperature saturation	Exceeding temperature Sensor Limit	Pin 23
PresRng-HI	External Pressure higher than set limit	Pin 23, Pin24
PresRng-Lo	External Pressure Lower than set limit	Pin 23, Pin 24

Figure 3.2.3 – List of Pass and Failure Mode with Pin outs

Up to nine E2/VE2 instruments can be connected in a serial loop. A typical serial loop connection with two instruments is shown in Figure 3.2.4.

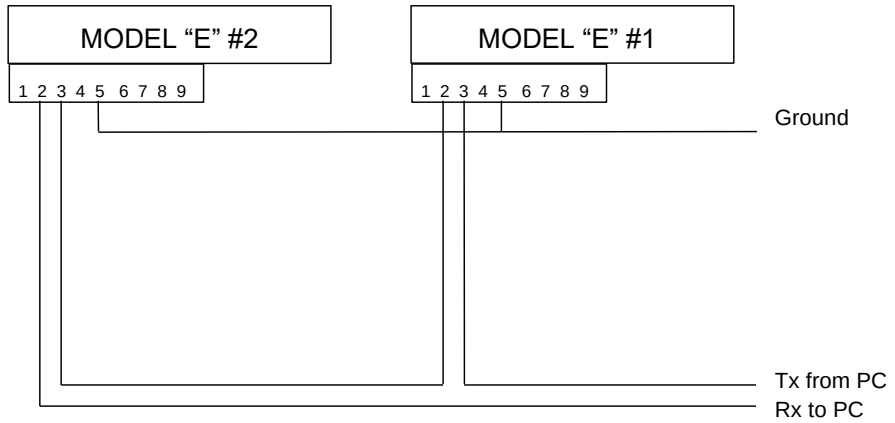


Figure 3.2.4 - Serial Loop Connection of two E2/VE2 Instruments

3.3 Guideline for Pneumatic Interface

A proper pneumatic interface is important to ensure safe, repeatable, and reliable leak test results. Use Pfeiffer Vacuum’s specified pressure components to ensure system performance. Proper connections should be used to minimize system leaks and reduce virtual leaks (leaks that flow into internal hidden cavities).

3.3.1. Common rules for upstream interface:

Upstream pressure fluctuations from pneumatic actuators and/or assembly tools are undesirable and may affect air supply to the actuator solenoid valves.

3.3.2. Compressed dry air (CDA) characteristics:

Composition	≈ 80% N + ≈ 20% O2
Type	Quality 1.3.1. according to standard ISO 8573-1
Pressure	Minimum = 65 psig (4.5 bar relative)
	Maximum = 150 psig (10 bar relative)

3.3.3. Pressure supply requirements:

A high-pressure coarse regulator and reservoir prior to the precision pressure regulator is recommended. The coarse pressure should be set a minimum of 15 psig higher than the test pressure.

3.4 UUT fixture design:

It is the user's responsibility to design the test fixture, test fixture control, electrical system and pneumatic interface for proper leak test operation.

Fixture design and operation should comply with all safety requirements. High forces can be easily generated with low pressure and a large sealing area.

The mechanical fixture should provide stable volume as fixture seal "creep" or movement during leak test will cause volume changes and bias of readings.

Minimize fixture volume or add filler for UUT with large cavities to minimize test volume.

Fixture and sealing mechanism should be designed to minimize virtual leaks.

3.5 Guidelines for setting up E2/VE2 Instrument

1. Unpack the E2/VE2 and make sure the unit is in good condition.
2. Power E2/VE2 and check reading. The temperature should be close to ambient temperature and pressure should be close to zero gauge or the barometric pressure if reading in absolute units.
3. Connect 'expansion' reservoir per schematic.
4. Connect pressure/vacuum source and start pressurizing/evacuating unit to verify test pressure, allowing time to stabilize. Make sure connections are leak free.
5. Run test with the unit capped (brass cap provided). The reading should be close to "zero." If high or low flow is observed, check all upstream and downstream connections for leaks.
6. Run test with the internal calibrated leak open. The reading should be close to the orifice value as indicated on the tag on the calibrated leak.
7. Collect multiple non-leaking parts.
8. Open LeakTek (separate operator's manual) and go to the set-up screen and input the desired pressure setting with +/- 10% on the min/max pressure. Select desired flow units and min/max flow. Make sure the max flow is set high initially and the min flow is about –2% of the sensor full scale. Note the stated full-scale of the sensor is in actual flow units (not "standard", "relative" or "normal" units).
9. Connect and run tests with good parts with the internal calibrated leak open and then run the good parts without the calibrated leak included. Note: immediately repeating tests can have a part interaction. The relax time to allow part to acclimate to original condition may need to be increased.
10. Ensure difference between good parts and the parts at leak specification (i.e., non-leaking parts with calibrated leak) is per user quality requirements. Adjust the timers accordingly.

11. The suggested max flow criteria should initially be set at 20% below the average of the simulated bad parts. The setting can be refined with large data set of test results.

3.6 Verification Procedure

Periodic verification is recommended during the normal operation of the E2 / VE2. Run a test with a known good part and the calibrated leak open. This should fail the test. Run a similar good part without the calibrated leak and this should pass the test. If this sequence does not give the desired results, the instrument and/or parts should be checked and the procedure repeated until the desired result is obtained.

4. Operation Sequence

The E2 / VE2 leak test instrument will run based on the sequence below after the “start” button is pressed on the front panel.

The IGLS has one dedicated analog output to represent the real-time flow measurement. A separate analog output can be used for pressure control (e.g., near barometric conditions).

A typical Test Sequence:

1. **Clamp / Isolate**: Time for clamp/seal motion and isolation of expansion reservoir pressure.
2. **Quick Fill / Pre Evac**: Large Fill/Evacuation of UUT direct from regulated supply source.
3. **Fill / Evac**: All Fill/Test valves and UUT open to regulated supply source.
4. **Pre-Stability**: The ‘expansion’ reservoir becomes the supply source through end of test. UUT and Reservoir balance to same pressure.
5. **Stability (Measurement)**: measured flow develops, flow curve displayed in real time.
6. **Test (Decision)**: Pass/Fail decision.
7. **Deplete / Stop**: time allowed to exhaust/vent before end of test result and unclamp.
8. **Idle / Stand By**: UUT port remains closed. Reservoir is replenished by regulated supply source. IGLS reading is live (some fluctuation is common as the system recovers prior to next test.

To switch to the other test types (i.e., active part recipe), press the “Type” button on LCD Display or pulse the “Remote Type” digital input.

NOTE:

The instrument can run independent of a connection to a PC and LeakTek. If a PC is connected to an E2/VE2 with LeakTek program running, Pass/Fail will be displayed in the Leak-Tek program run screen. The Pass/Fail decision is controlled by the E2/VE2.

CAUTION:

During normal operation if a part fails with failure mode “Flow saturation” or “Gross Leak” the isolation reservoir can be significantly depleted. If this condition happens the reservoir should be allowed to recover back to its original condition and no leak testing should be run during this recovery period. Repeat verification procedure before proceeding.

5. Graphic LCD Display & Touch Screen

The E2 and VE2 has a 7” color touch screen display on the front panel.

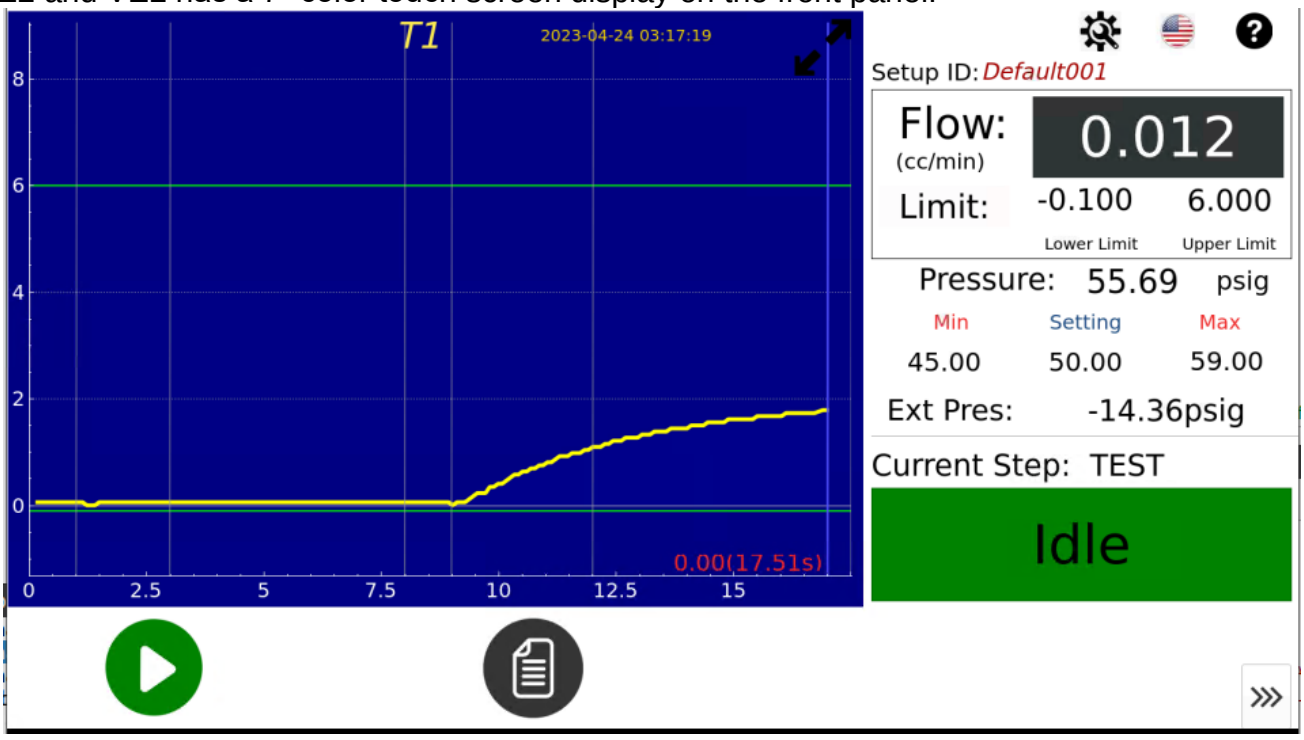


Figure 5.0.1 - E2/VE2 LCD

The display supports the multiple screens. The structure of the screens is shown in Figure 5.0.2. The maintenance screen is protected by a password.

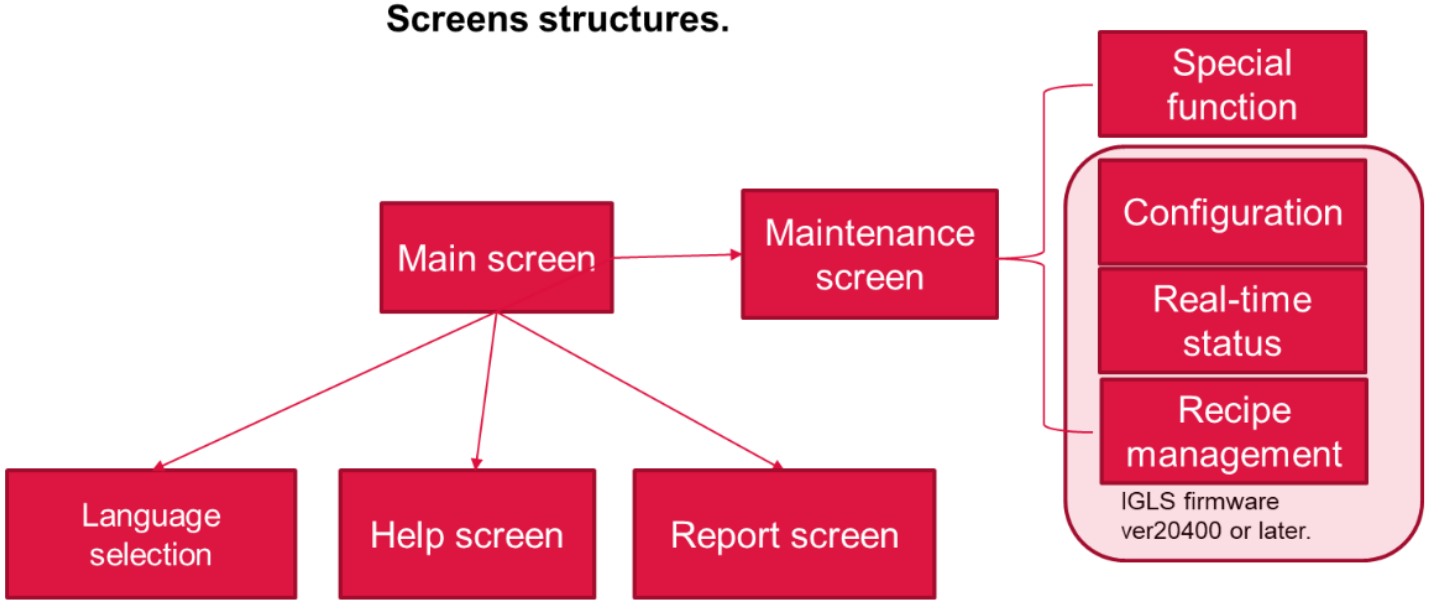


Figure 5.0.2 - Screen software structure

5.1 Main screen

On the top left side of the screen, a graph displays the flow measurement signature for the entire leak test. The two green lines represent the upper and lower limits of the leak test. The yellow line is the flow measurement.

On the top right side of the screen, test information with user defined pressure and flow limits along with current pressure, flow and optional temperature readings are displayed in real time.

At the bottom of the screen, there are two push buttons available. Depending on user preference, each button can either be Enabled or Disabled.

If enabled, then:

Start/Stop will start and stop the test. When the instrument is in “Idle” or “Standby” mode, the button reflects Start mode - clicking the button will start a leak test. During the test, this button will reflect the Stop mode - clicking the button will stop a test in progress.

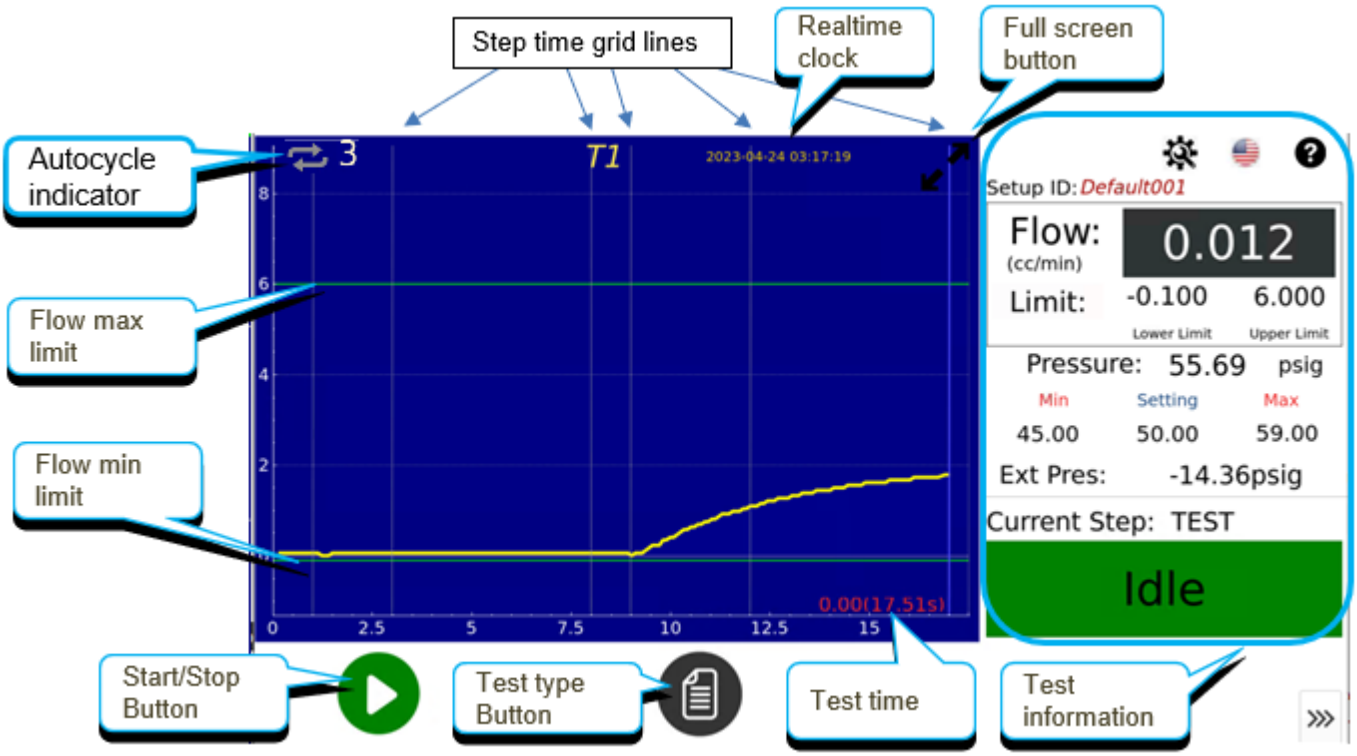
Test Type : The E2/VE2 instrument can have up to four active test setups (recipes). The button can toggle the Test Type to the next test Type (increment by one) or back to Test Type 1 if it has reached the maximum number of enabled test types.

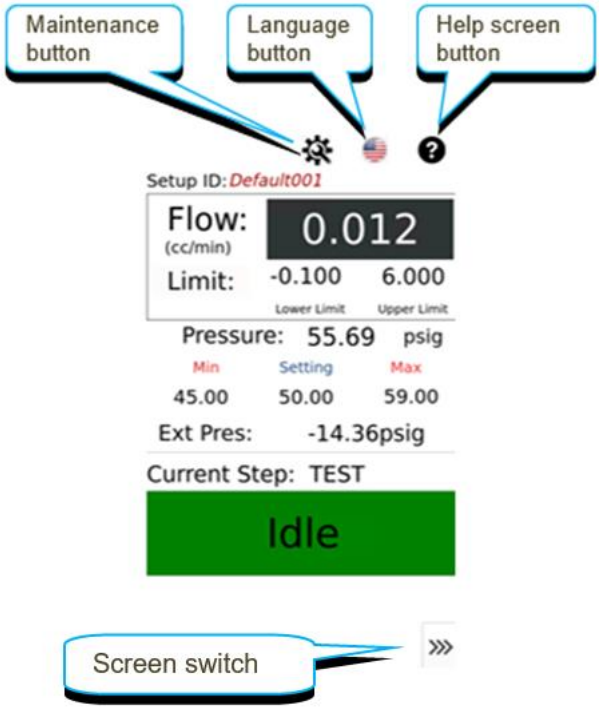
See 5.6.3 “Special function configuration” and 5.6.4 “Recipe management page” for additional button configurations.

Next Page » switches to the next screen. Example: from main screen to report screen or from the report screen to main screen.

On the middle of the graph area, the current test type is displayed - T1 if it is in test Type 1, T2 if it is in test Type 2, T3 if in Test Type 3 and T4 if in Test Type 4. If the sensor is only using one test type and the Type button is hidden, there is no message like “T1” in the Test Type 1.

Further detail of the Main screen follow:





Real Time Flow and Pressure Settings displayed of either the internal or external pressure sensor. User can configure which sensor is “Main Pressure Display” through LeakTek software.

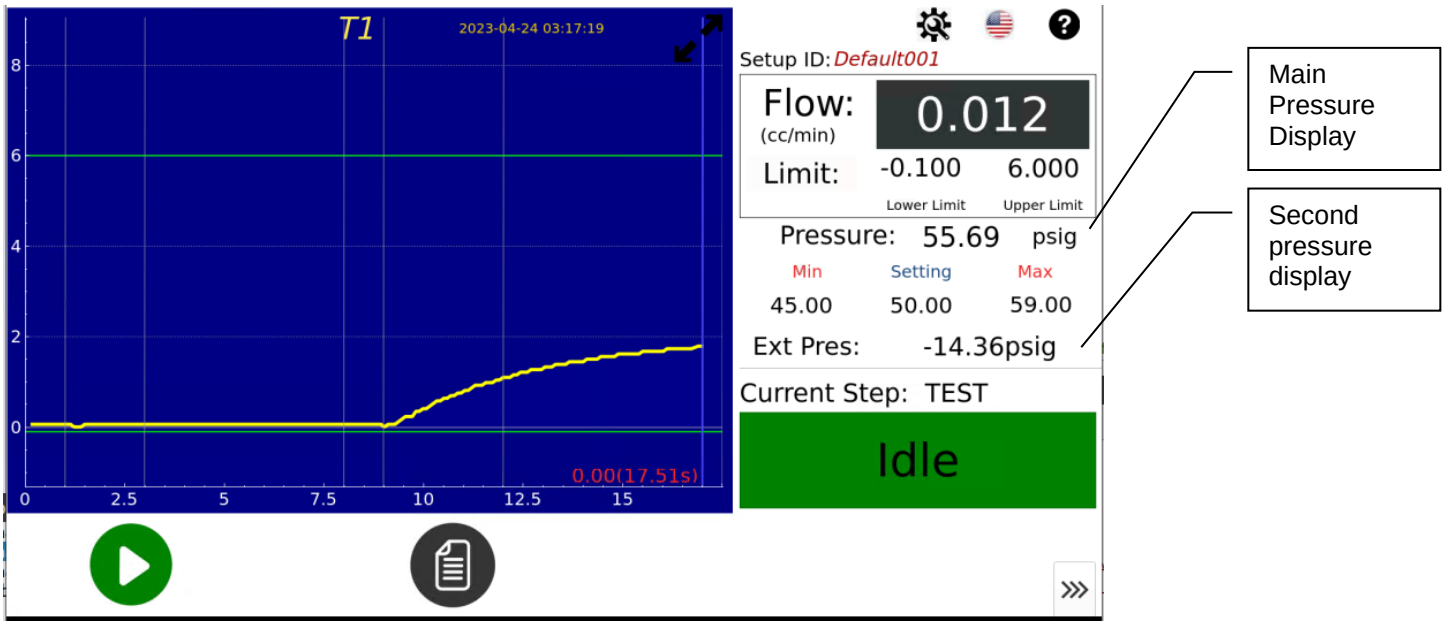


Figure 5.1.1 - External Pressure sensor replacing Internal Pressure sensor displayed.

The user can choose either the internal or external pressure reading on the main pressure display and the other on the secondary pressure display, as shown in Figure 5.3. When the external pressure is configured to be displayed in Main display, the “ExtP” will follow the pressure unit to signify the pressure reading is the external pressure. In the second pressure display, “IntP” or “ExtP” is used to signify the internal or external pressure reading. The second pressure display can also be hidden if user prefers not to show the reading. The Main pressure limit setting is used to display the Min and Max limit of the selected pressure sensor. Please refer to the LeakTek manual to configure the pressure display.

Note: The internal pressure sensor is an absolute pressure sensor; utilized in measurements and unit conversions (ex. volume flow at test pressure to flow at STP; cc/min vs sccm). Many pressure units can be selected by user via LeakTek software. With an absolute pressure sensor, barometric pressure changes can influence flow readings at test pressures between -2 psig (vacuum) and +2 psig. Consult Pfeiffer Vacuum for applicable control that overcome this influence.

The external pressure sensor can be a gage or an absolute pressure sensor. Both sensors must display the same pressure units (i.e., both psia or psig).

- Status messages

Message	Description
Idle	Displays the live pressure and flow reading while unit is in “Idle” or “Standby” mode (reservoir recovers for next test)
Testing	Displays the pressure and flow reading with the step status in the process of the test. The IGLS is in test step.
Pass	Displays the pressure and flow reading with pass message after the test passed.
Stop	Displays the pressure and flow reading with stop message if the test is intentionally stopped manually.
Fail	Displays the pressure and flow reading with failure message if the test fails. The reason for failure is shown on the LCD.

GrossLeak	During test time, pressure is under Pressure Min (K3) setting in pressure testing
GrossLeakV	During test time, pressure exceeds Pressure Max (K2) setting in vacuum testing
No-Pres	Pressure Switch not turned on in time (Version 2.0.0 or later)
OverPres	During test time, pressure exceeds Pressure Max (K2) setting in pressure testing.
UnderPres	During test time, pressure is under Pressure Min setting in vacuum testing
PresSat	Pressure exceeds its full range. Deplete pressure immediately!
FineLeak	During Test, flow is larger than maximum allowed flow (V2), or the accumulated flow during the test period is larger than the allowed leak (V2)
Low Flow	During test, flow is lower than minimum allowed flow (V1).
FlowSat	Flow exceeds maximum sensor flow range.
TempSat	Temperature exceeds maximum limit.
Blockage	Pressure Switch not turned off in deplete time
HiFlow_RM	Relative Measurement –Baseline Flow larger than V6
LoFlow_RM	Relative Measurement –Baseline Flow smaller than V5
LargeLeak	In large leak step, the measured flow is larger than V7
BackFlow	The measured flow in the test step is less than A3
PresRng-Hi	External Pressure higher than set limit (KA)
PresRng-Lo	External Pressure Lower than set limit (K9)
ExtGrossLeak	External Gross Leak Failure (External Pressure Sensor reading Lower than K3) in pressure testing.
ExtOverPres	External Over Pressure Failure (External Pressure sensor reading larger than K2) in pressure testing.
ExtUnderPres	External Under Pressure Failure (External Pressure sensor reading Lower than K3) in vacuum testing.
ExtGrossLeakV	External Gross Leak Vacuum Failure (External Pressure sensor reading larger than K2) in vacuum testing.

Table 5-1 Status message

If the valve control sequence is customized for a particular application, some messages may be worded slightly different.

5.2 Report Screen

The Report Screen can query the test results saved in the storage files of the display screen. It can be accessed from the main screen by clicking the next page » button or swipe from right to left in the empty area (top or bottom) of touch screen.

When the report screen is open, by default all saved test results are loaded (Figure 5.2.1).

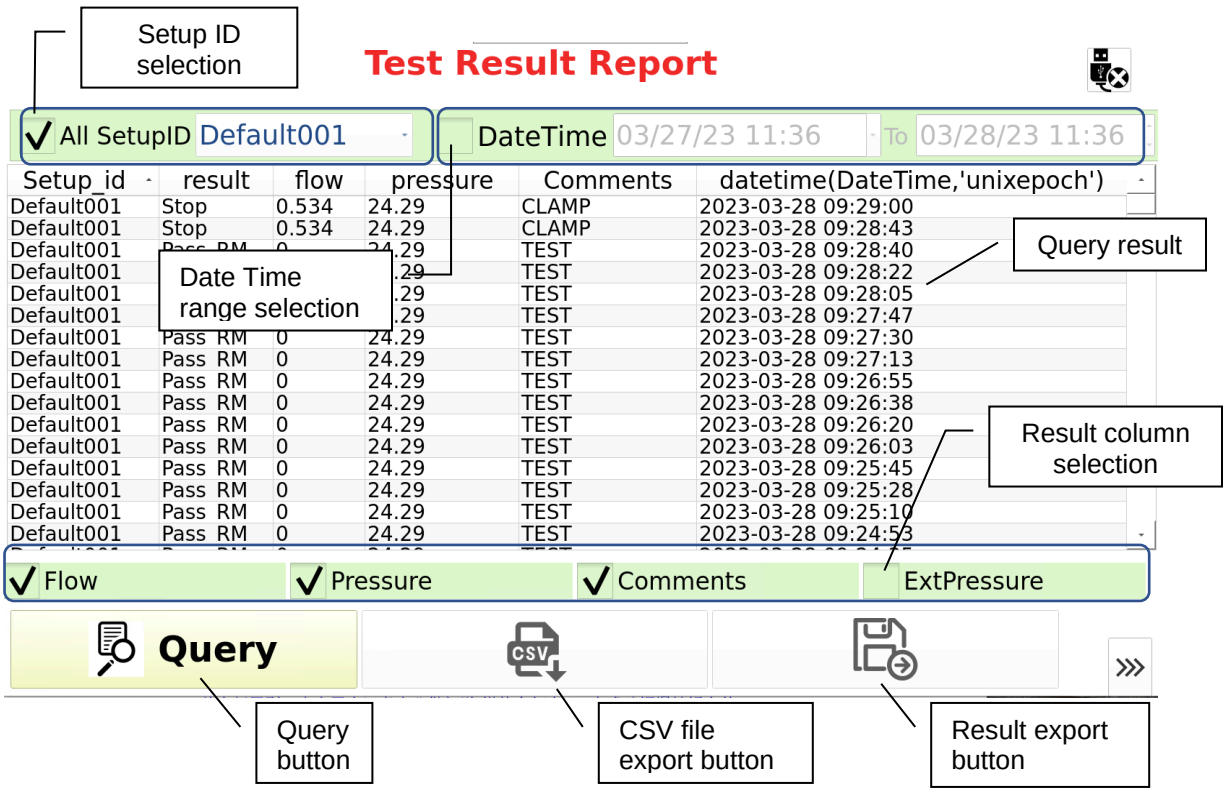


Figure 5.2.1 - Report Screen

- Setup ID selection
  Includes all Setup ID's (recipes) available in the database. When the All SetupID check box is checked, clicking the Query button will list all Setup ID's results. When All Setup ID check box is not checked, the drop-down list will be enabled and allow the user to select one Setup ID from the list, clicking the Query button will only list the selected Setup ID in the results table.
- Date Time range selection
  Sets the time range for the result query. When DateTime check box is checked, clicking the Query button will include all test results. When DateTime check box is not checked, the date time start and end time selection will be enabled and allow the user to pick desired date time range, clicking the Query button will only include test results within the selected date time range in the results table.
- Result column selection
  Includes several selection boxes: Flow, Pressure, Comments, and ExtPressure. Only checked items will be listed in the results table.
- Query Button
  Provides the end test results according to the conditions set by user.
- CSV File Export Button
  Exports the signature file (.csv file) of the results to the external USB flash drive on the front of the instrument.
- Result Export Button
  Exports the selected results to the external USB flash drive with a .csv format.

- USB drive status indicator
  Shows if a USB flash drive is connected.
  -  USB flash drive connected.
  -  USB flash drive disconnected.

5.3 Multilanguage

On the top right of the screen, a flag button shows the language selected for the display. There are five instrument display languages available.

Language	*Flag icon*
English	
Chinese	
French	
Spanish	
German	

To change the language of the system, user can touch the flag icon to open the language selection as shown.

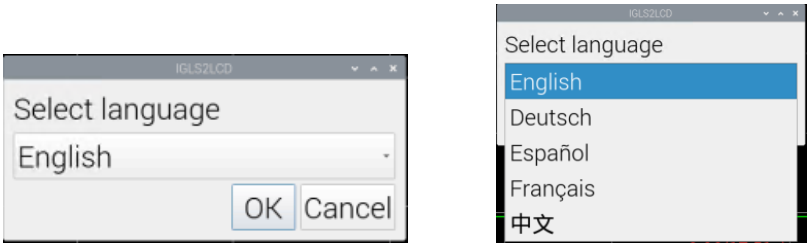


Figure 5.3.1- Language selection dialog

After selecting a new language and clicking the OK button, the language will switch to the selected language.

5.4 Help Screen

A “Help” screen can be accessed by clicking the Question icon from the main screen. The help screen provides the contact information about the sensor, IGLS SN, Ethernet address, LCD firmware version and IGLS firmware version as shown in Figure 5.4.1. In the middle of the screen, there is the video widget to show how to connect the instrument to the system, and there are four control buttons under the video widget which are described in table 5-2.

Figure 5.4.1- Help screen

Button	Description
	Play button. User can click this button to play or replay the video
	Pause button. Pause during playing of the video.
	Stop button. Stop the play of video. After Stop, the video will play from the beginning.
	Full screen button. Clicking it will zoom the video to full screen. To exit the full screen mode, user can touch anywhere on the screen.
I/O	Instrument I/O interface description dialog button.
	Manual button. Clicking it will open the E2 manual.

Table 5-2 - Control buttons for video widget

5.4 IO quick View dialog

The “IO quick View” dialog can be accessed by clicking the I/O button from the help screen. This dialog provides the explanation of the pins of the 37pin connector. To exit the dialog, click the return button .

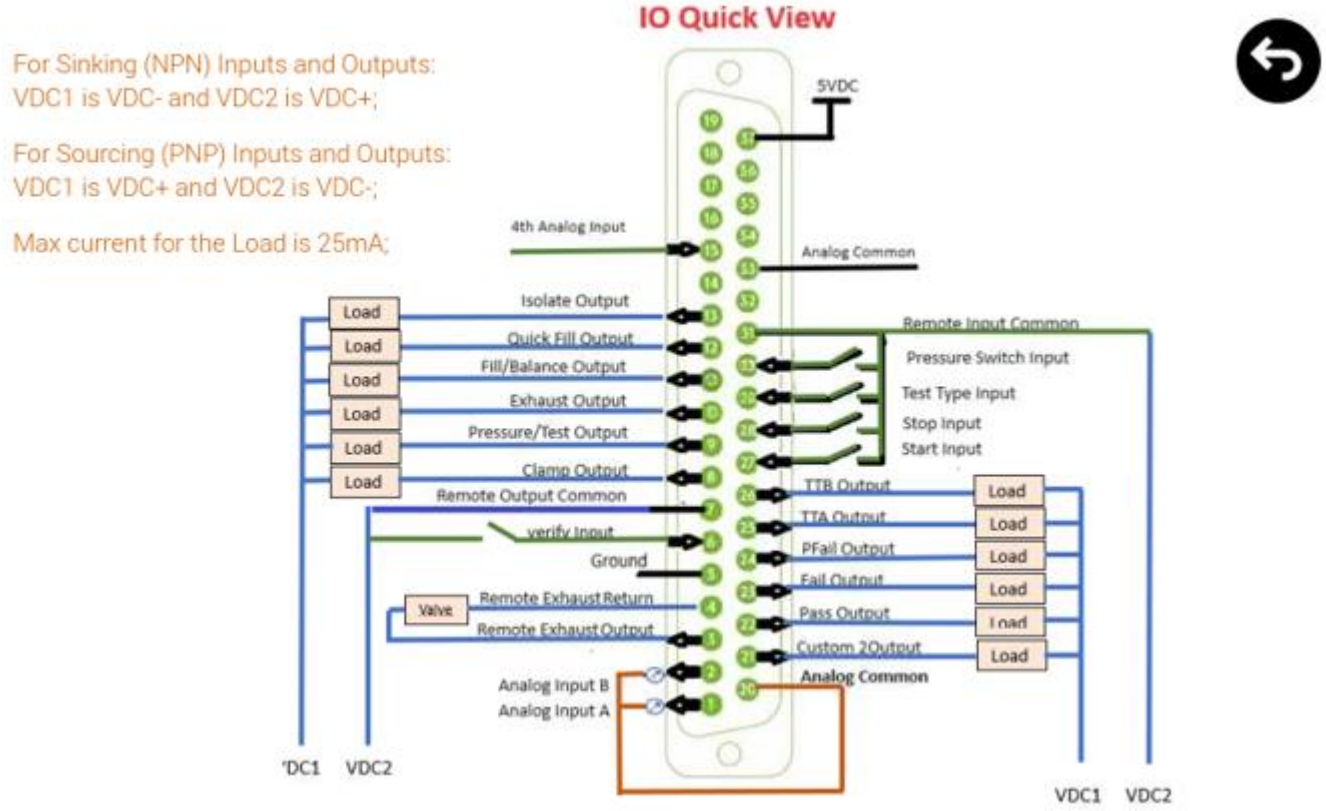


Figure 5.4.2- Help screen

5.5 Maintenance login screen

When Maintenance screen is available, it can be accessed by clicking the maintenance button on the top right corner of main screen. The screen is password protected and the user must input the correct password in the login dialog (Figure 5.5.1).

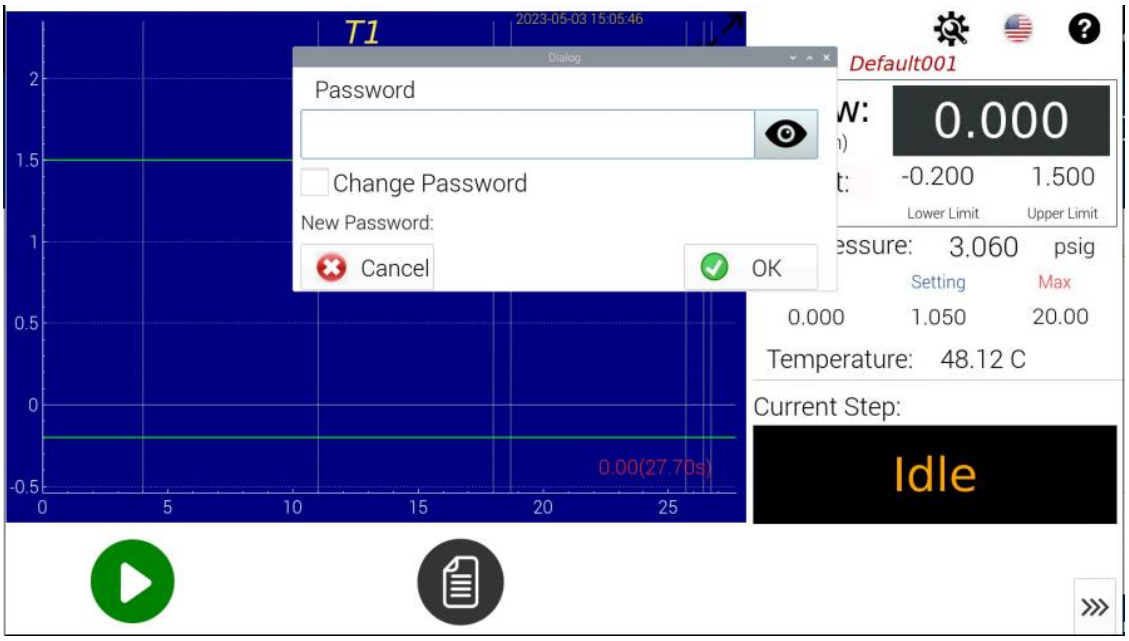


Figure 5.5.1 - Maintenance login dialog

When the maintenance login dialog is shown, touching the password text input will open the virtual keyboard to allow the user to input a password (Figure 5.5.2). There is no length requirement on the password and can be combination of letters, numbers, and special characters. When the user inputs the password, he can choose the password display mode by clicking the eye icon on the right side of the password input edit (Figure 5.5.3 and 5.5.4). When the icon is an eye with the slash, the password is masked to dots to prevent others from obtaining the password. When the icon is an eye without slash, the password is visible to ensure the correct password is input. If the correct password is input, clicking the OK button will switch the screen to the maintenance screen, otherwise the wrong password warning message box will pop up (Figure 5.5.5). Clicking the OK button will close the message box and go back to the login password input dialog.

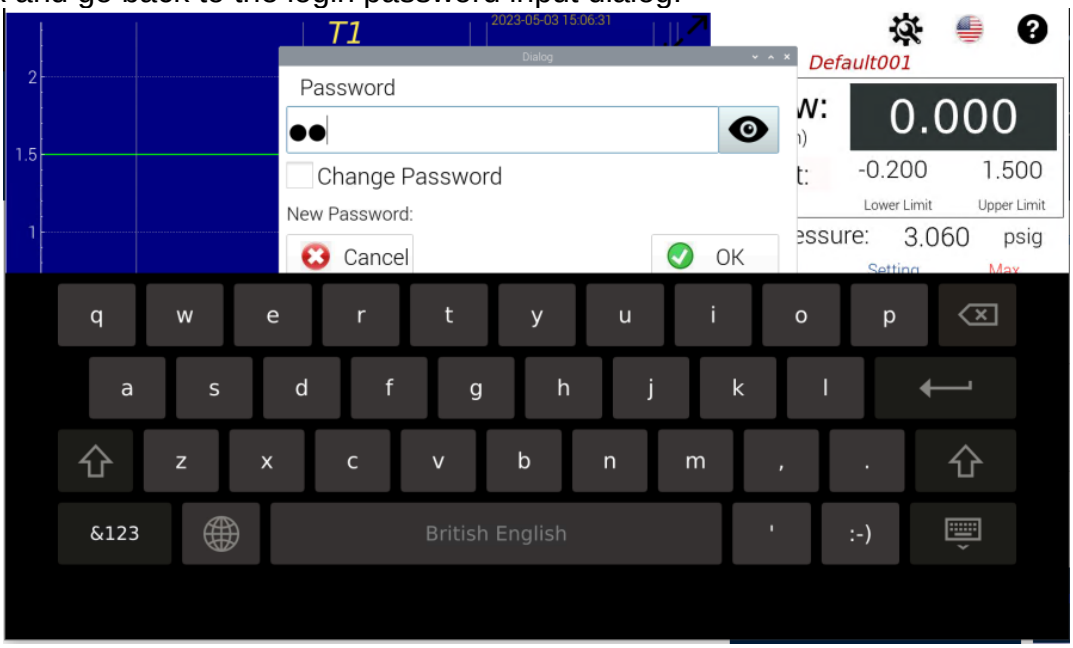


Figure 5.5.2 - Password input with virtual keyboard

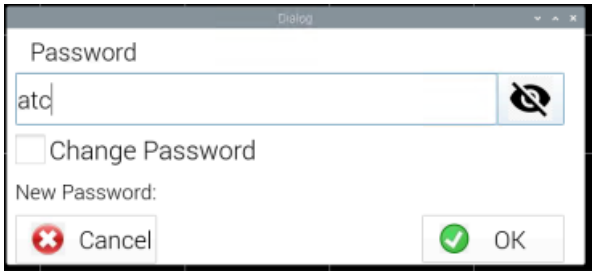


Figure 5.5.3 - Visible password dialog

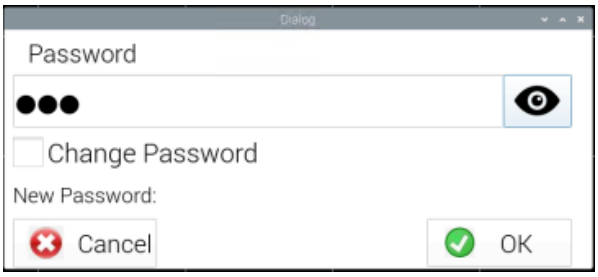


Figure 5.5.4 - Masked password dialog

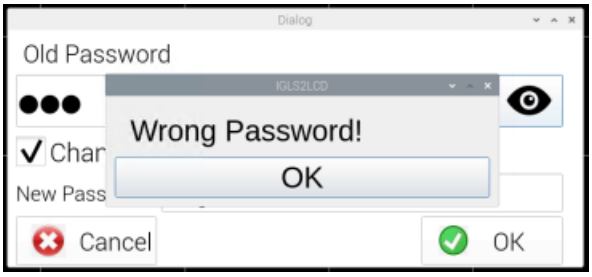


Figure 5.5.5 - Wrong password rejection dialog

The password input dialog also provides the password modification function. If user wants to change the password, input the correct password and check the Change Password check box. After change password is checked, the “New Password” input edit is available to allow user to input a new password (Figure 5.5.6). If the correct Old Password is entered, the password will be modified and Password Change Success! Message will be displayed (Figure 5.5.7).

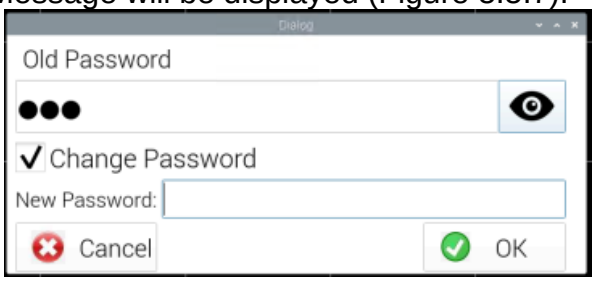


Figure 5.5.6 - Password change dialog

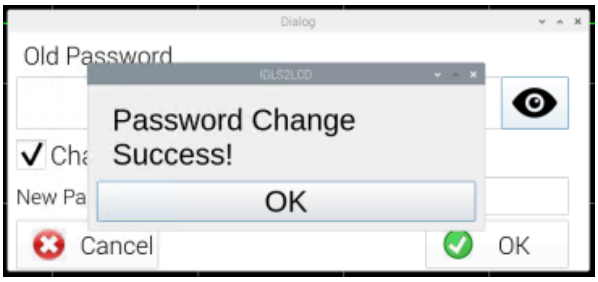


Figure 5.5.7 - Password change success dialog

5.6 Maintenance Screen

Maintenance screen is composed of four pages: special function page (Figure 5.6.7), v alve setup configuration page (Figure 5.6.1), the real-time status page (Figure 5.6.5) and Recipe management page (Figure 5.6.4).

5.6.1 Valve Setup Configuration

The valve setup configuration page displays valve configuration for each test type. The configuration includes the step names, step time and the valve open/close status for each step.

Valve Setup Configuration Test Type: **T1**

	Name	Time(s)	Clamp	Test	Exhaust	Fill	QFill	ISO	CUST1	CUST2
Step1	CLAMP	1.00	Open			Open		Open		
Step2	PREFILL	5.00	Open			Open	Open	Open		
Step3	FILL	5.00	Open	Open		Open	Open	Open		
Step4	PRESTAB	5.00	Open	Open		Open				
Step5	STABILITY	5.00	Open	Open						
Step6	TEST	5.00	Open	Open						
Step7	DEPLETE	5.00	Open		Open	Open				
Step8	STOP	0.50			Open			Open		

Figure 5.6.1 - Valve Setup Configuration.

> **Note**: In the valve configuration table, **ON** means the valve is in open position. Previous manuals reflected energized coil state.

The button and indicator of the valve setup screen are described Table 5-3.

Indicator and button	Description
Test Type: T1	Test type indicator to show the active test type
	Download button. Clicking the button will download the step time from the table to the active test type
	Test type switch button. Clicking the button will switch to the next test type.

Table 5-3 Button and indicator description

- Step time modification

The step time modification is available in the maintenance screen. To edit a step time, the user can double click the cell to be changed. The cell will change to the edit mode and a virtual keyboard will pop up to allow the user to input the new time value (Figure 5.6.6).

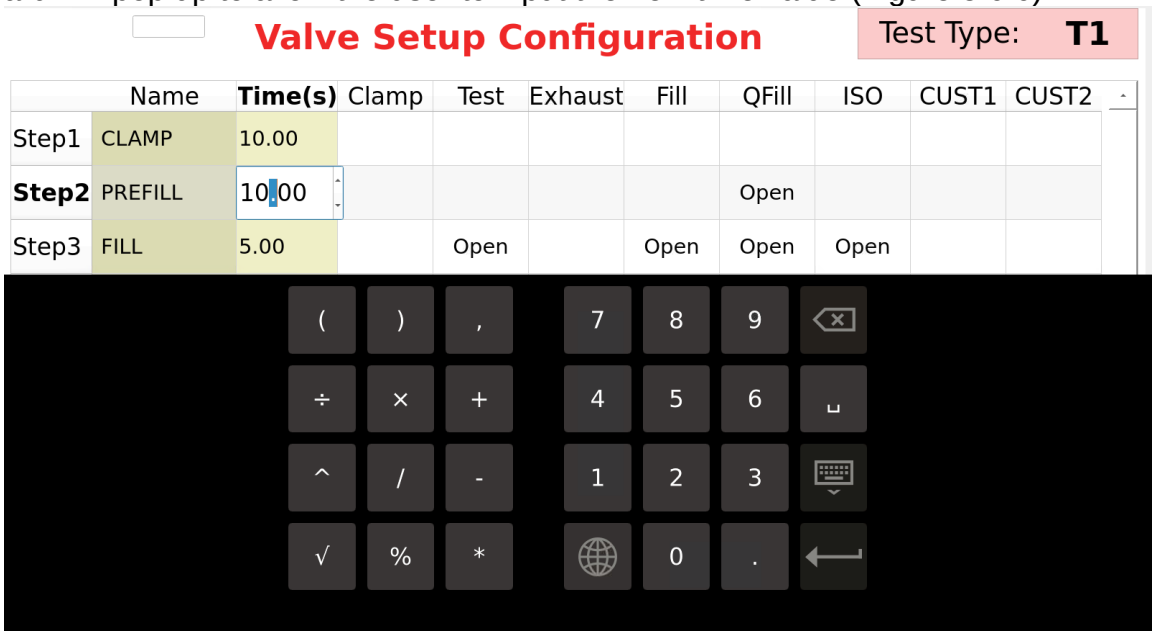


Figure 5.6.3 - Step time modification.

After finishing editing the step time, the user must click the download button to download any changes to the sensor. During download, on the side of the download button, a downloading message is available to show the download command (Figure 5.6.4).

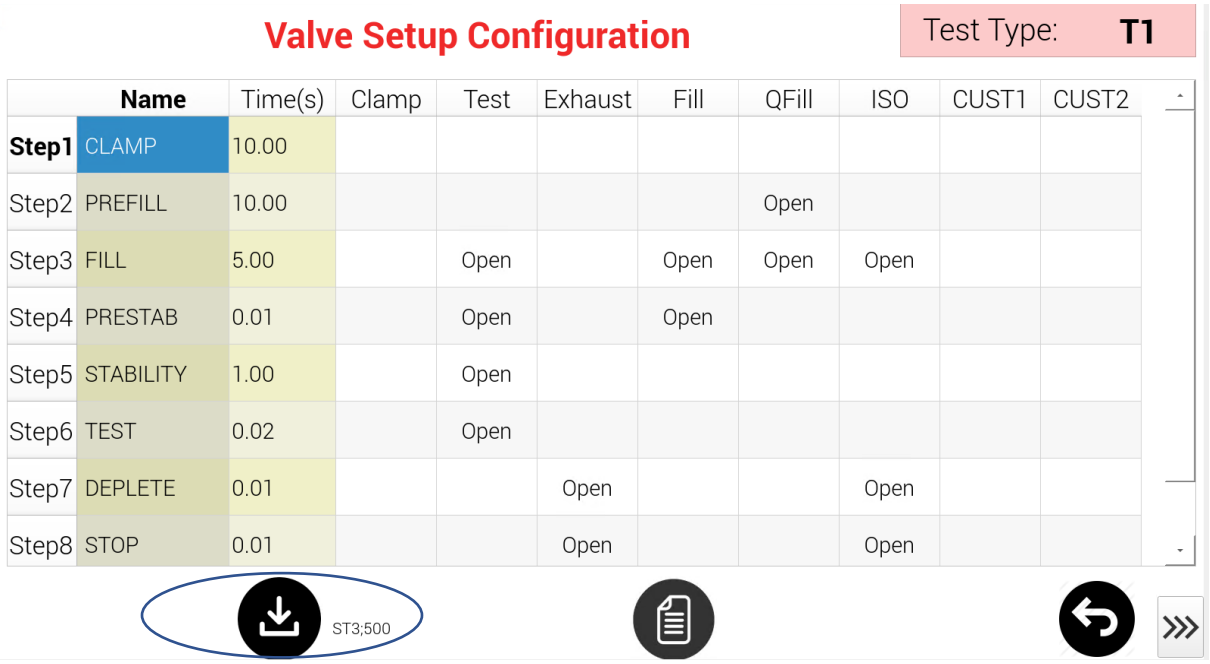


Figure 5.6.4 - Step time download

5.6.2 Real-time status

The real-time status page (Figure 5.6.5) shows the real-time sensor reading and the valve status. The top of the screen is the real-time sensor values that includes raw data (A/D count from the sensor) and “Engineering” reading after calculation. The displayed “Units” is the same as the main screen and can be configured in LeakTek.

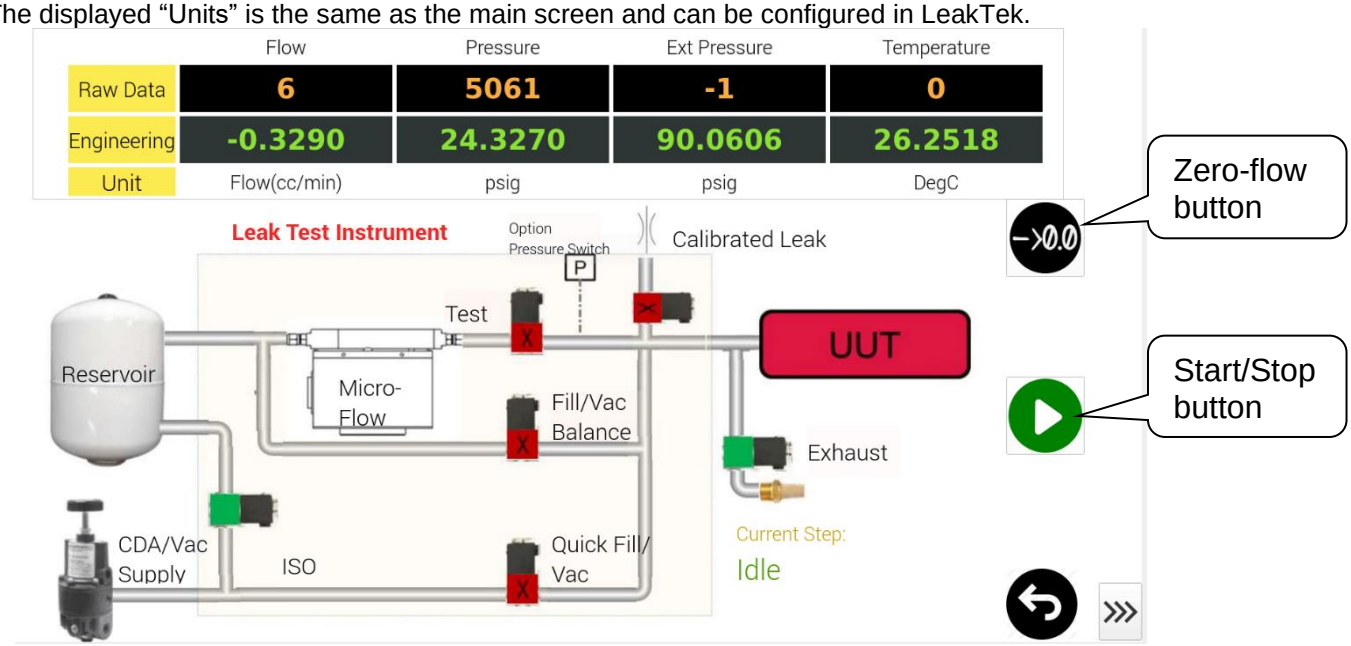


Figure 5.6.5 Real-time status

Below the table is the real-time pneumatics of the Micro-Flow sensor and valve status. For each valve, green means the valve is open and red means the valve is closed.

Start/Stop button 
The Start/Stop button is on the right side and allows the user to start a test and monitor the real-time status of the sensor readings and the valve open/close status. The current step indicator shows the running step name during the test.

Zero-flow button 
The zero-flow button is used to change the C1 parameter to force the current flow reading to zero. This button is only enabled under the idle step and the flow reading is stable. When it is clicked, a confirmation message “Zero flow will change C1. Continue?” is displayed to let the user confirm the zero-flow operation (Figure 5.6.6).

Figure 5.6.6 - Zero-flow confirmation

5.6.3 Special function configuration page

The special function page is used to edit LCD configurations (Figure 5.6.7).

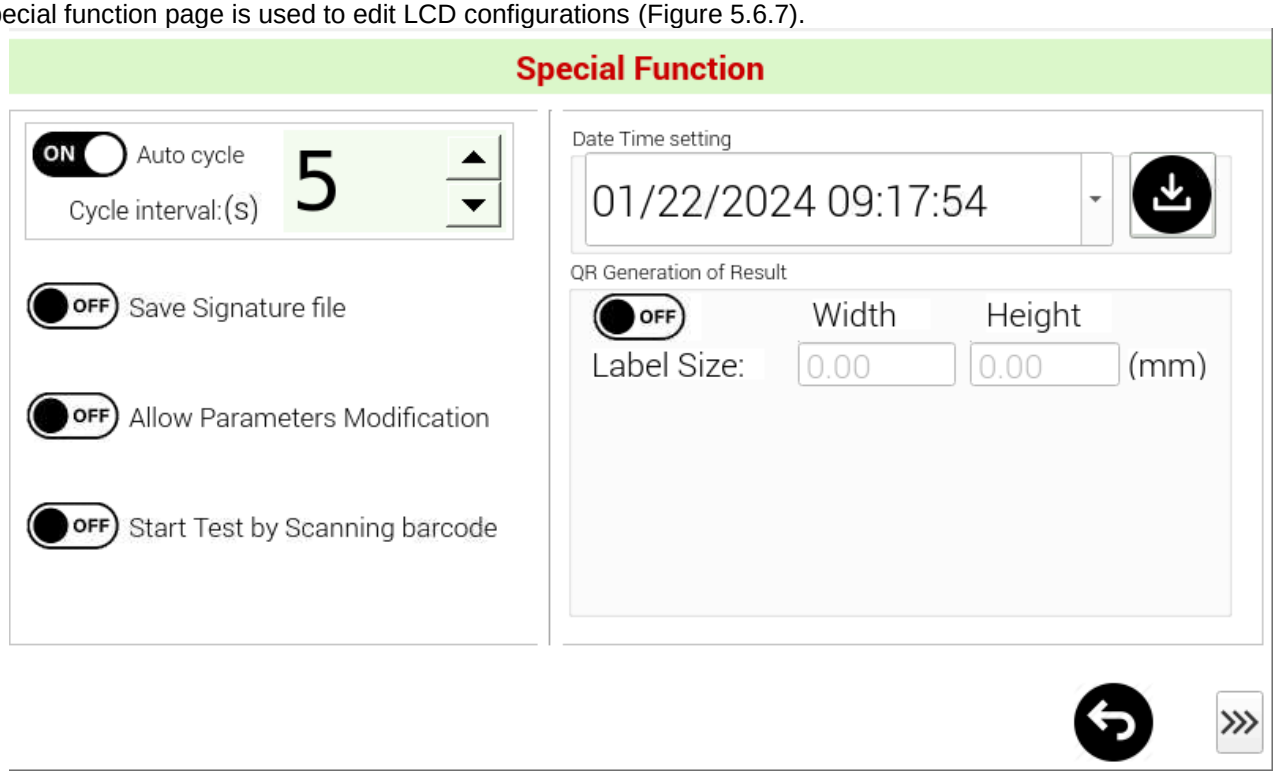


Figure 5.6.7 - Special function configuration

- Auto cycle

  When auto cycle is on, after the user start the first test the instrument will automatically start subsequent test(s) after the set cycle interval time. Clicking the stop button during test will stop the automatically cycle as well as the current test.

- Save (Flow) Signature file

  If the Save signature file option is on, the flow and pressure reading will be saved to a signature file within 0.5 sec interval. The User can export the files to an external USB drive from the report screen.

- Allow Parameter Modification

  If “Allow Flow Edit” is enabled, the “Flow Edit” button and the “Download” button will be available to allow the user to edit the flow limit from the main screen.

- Start test by scanning the barcode

  If “Start test by scanning the barcode” is turned on and a barcode reader is connected to the screen, scanning a barcode will automatically start a test.

- Date Time setting

  The date time setting is used to set the date and time of the LCD. If LCD is connected to internet via ethernet connection, the date and time will be automatically synchronized.

- QR generation of Result

  If “QR generation of Result” is enabled and a label printer*1 is connected, at the end of each test, the test result (including pass/fail, final flow, final pressure and SetupID) will be printed on the label in QR format.

  *1：Current supported label printer is Zebra ZD410.

5.6.4 Recipe management page

The Recipe Management Page is shown in Figure 5.*6.8.*

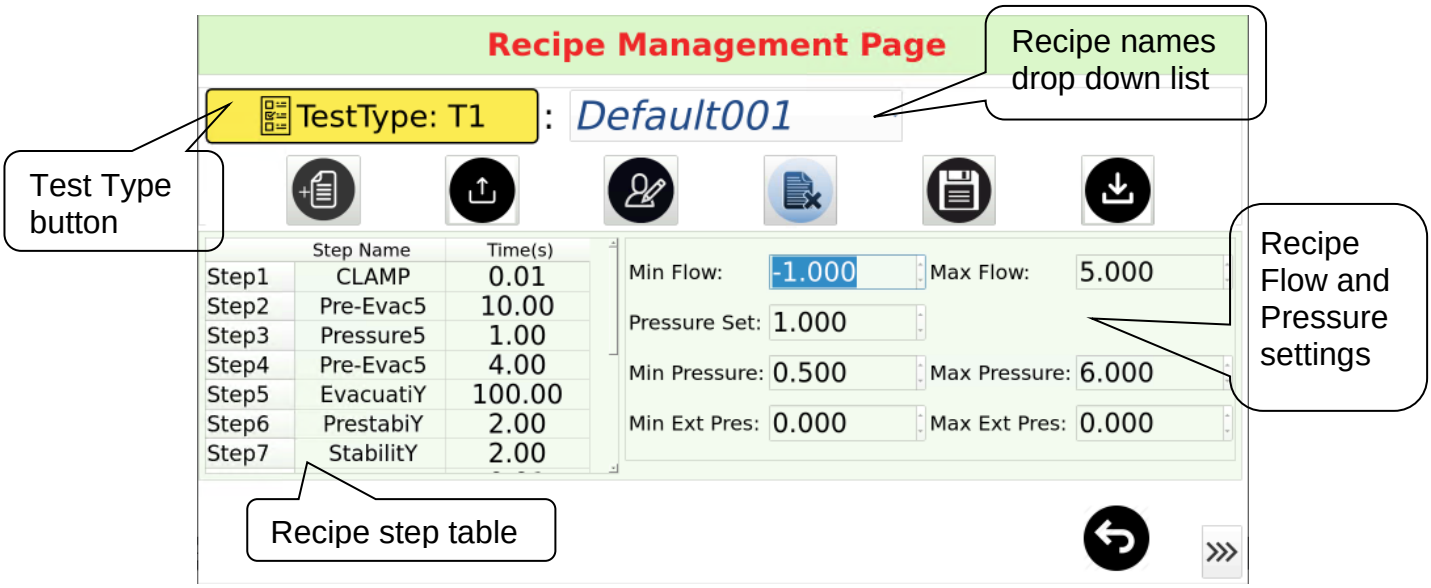


Figure 5.6.8 - Recipe Management

Each Test type allows multiple recipes.

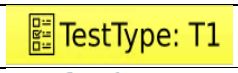
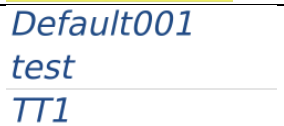
Item	Screenshot	Description
Test Type button/indicator		Show the current selected Test type. Clicking it will switch to next test type.
Recipe name drop list		Holds all the recipe names for the selected test type. Clicking it will show all the recipe names in the list and a recipe can be selected by clicking on the recipe name. Selecting recipe name will update all the parameters in the page to the selected recipe.
Recipe step table		Display the step names and the step times for the selected recipe.
Recipe flow and pressure settnig group		Display the Flow and Pressure settings for the selected recipe.
New Recipe button		Used to add a new recipe. Clicking this button will open a recipe name dialog to allow the user input the recipe name.
Upload recipe button		Upload the setting from sensor to the selected recipe.
Edit recipe button		Enable the recipe edit mode, to allow the user change the step time, flow range and pressure setting.
Delete recipe button		Delete the selected recipe from the recipe name list. The current used recipe is unable to be deleted.
Save recipe button		Save the step time, flow range and pressure setting to the database for the selected recipe.
Download recipe button		Download the recipe name, step times and the flow/pressure settings of the selected recipe to the sensor.

Table 5-4 *Buttons and indicators in recipe management*

6. Communication Protocol

NOTE:

All commands and responses should terminate with <lf><cr>

6.1 Conventional Commands for Sensor Parameters

Read Command Format:

"!0" + ADDRESS + "R" + COMMAND

Response Format:

"$0" + ADDRESS + "R" + COMMAND; DATA

Save Command Format:

"!0" + ADDRESS + "S" + COMMAND; DATA

Response Format:

"$0" + ADDRESS + "S" + COMMAND; DATA

Where:

ADDRESS is valid from 0 to 9. (The first sensor will respond to 0)

DATA is the number to saved or read.

COMMAND, see Appendix B.

For example, to change G1 to 287(Air) in IGLS addressed as 2, the command string will be as follows:

!02SG1;287.0<lf><cr>

Note:

For commands such as U2, U3, U4, U5, the returned DATA is in Hex format of "0xFFFFFFFF" in version 2.0.0 or later, however, the data in the command will be treated as a decimal value unless there is a prefix "0x". For example, either of the following command will change IGLS addressed as 1 to flow unit mg/min.

!01SU5;91 <lf><cr>

!01SU5;0x51<lf><cr>

6.2 DAQ Commands

The DAQ string response is in the form of !01SQ5; Data1;Data2;Data3;Data4;Data5;StepNo

Where:

Data1: temperature reading

Data2: pressure reading

Data3: flow reading

Data4: external pressure reading

StepNo: interpreted as Hex value (see Section 6.3).

SQ1;1	Command: !01SQ1;1 Response: $01SQ1;Data1;Data2;Data3;StepNo If (X6<>0) Then: Data1 refers to temperature in Degree C Data2 refers to pressure in kPa Data3 refers to flow in cc/min or μg/min Otherwise:

	Data1 refers to temperature in the selected temperature unit. Data2 refers to pressure in the selected pressure unit. Data3 refers to flow in the selected flow unit.
SQ1;2	Command: !01SQ1;2 Response: $01SQ2;Data1;Data2;Data3;StepNo Data1 refers to temperature in digital count. Data2 refers to pressure in digital count. Data3 refers to flow in digital count.
SQ1;3	Command: !01SQ1;3 Response: $01SQ3;Data1;Data2;Data3;StepNo Data1 refers to temperature in Degree C Data2 refers to pressure in kPa. Data3 refers to flow in cc/ or μg/min
SQ1;4	Command: !01SQ1;4 Response: $01SQ4;Data1;Data2;Data3;StepNo Data1 refers to temperature in the selected temperature unit. Data2 refers to pressure in the selected pressure unit. Data3 refers to flow in the selected flow unit.
SQ1;5	Command: !01SQ1;5 Response: $01SQ5;Data1;Data2;Data3;Data4;Data5;StepNo Data1 refers to temperature in Degree C Data2 refers to pressure in kPa Data3 refers to flow in cc/min or μg/min Data4 refers to external pressure (4th analog input) in kPa Data5 refers to Adaptive flow or steady state flow in cc/min orμg/min
SQ1;6	Command: !01SQ1;6 Response: $01SQ6;Data1;Data2;Data3;Data4;Data5;StepNo Data1 refers to temperature in digital count. Data2 refers to pressure in digital count. Data3 refers to flow in digital count. Date4 refers to external pressure (4th analog input) in digital count
SQ1;7	Command: !01SQ1;7 Response: $01SQ7;Data1;Data2;Data3;Data4;Data5;StepNo Data1 refers to temperature in Degree C. Data2 refers to pressure in kPa. Data3 refers to flow in cc/min or μg/min. Date4 refers to external pressure (4th analog input) in kPa Data5 refers to adaptive flow in cc/min or μg/min
SQ1;8	Command: !01SQ1;8 Response: $01SQ8;Data1;Data2;Data3;Data4;Data5;StepNo Data1 refers to temperature in selected temperature unit Data2 refers to pressure in selected pressure unit Data3 refers to flow in selected flow unit Date4 refers to external pressure (4th analog input) in selected pressure unit Data5 refers to adaptive flow in selected flow unit

SQ1;9	Command: !01SQ1;9 Response: $01SQ9;Data1;Data2;Data3;StepNo;TimeStamp Where: If (X6<>0) Then: Data1 refers to temperature in Degree C Data2 refers to pressure in kPa Data3 refers to flow in cc/min or μg/min Otherwise: Data1 refers to temperature in the selected temperature unit. Data2 refers to pressure in the selected pressure unit. Data3 refers to flow in the selected flow unit.
SQ1;A	Command: !01SQ1;A Response: $01SQA;Data1;Data2;Data3;Data4;Data5;StepNo;TimeStamp Data1 refers to temperature in Degree C Data2 refers to pressure in kPa Data3 refers to flow in cc/min or μg/min Data4 refers to external pressure (4th analog input) in kPa Data5 refers to Adaptive flow in cc/min or μg/min
SQ1;B	Command: !01SQ1;B Response: $01SQB;Data1;Data2;Data3;Data4;Data5;StepNo;TimeStamp Engineering Display Unit Value and Step Data1 refers to temperature in selected temperature unit Data2 refers to pressure in selected pressure unit Data3 refers to flow in selected flow unit Date4 refers to external pressure (4th analog input) in selected pressure units Data5 refers to adaptive flow in selected flow unit
SQ2;1	Command: !01SQ2;1 Response: $01SQ2;1 Auto Zero to update C1
SQ2;2	Command: !01SQ2:2 Response: $01SQ2;2 Auto Zero to update C5
SQ2;3	Command: !01SQ2;3 Response: $01SQ2;3 Auto Zero to update C1 and C5
SQ3; 0-3	Command: !01SQ3;0 to Set the Parameter to Type 1 Command: !01SQ3;1 to Set the Parameter to Type 2 Command: !01SQ3;2 to Set the Parameter to Type 3 Command: !01SQ3;3 to Set the Parameter to Type 4 Response: Does not matter Note: After the command is sent, all following commands related to T, V, and K groups are corresponding to that test type regardless of what the current test type is.
RQ3	Command: !01RQ3 Response: $01RQ3;0: Currently in Test Type 1 Response: $01RQ3;1: Currently in Test Type 2 Response: $01RQ3;2: Currently in Test Type 3 Response: $01RQ3;3: Currently in Test Type 4 Note: This command returns the test type currently active, which is driven by the test type digital, independent of SQ3 command result.

NOTE:
If the sensor is configured as mass extraction mode, Data1 carries the accumulated mass or volume instead of temperature during the test step.

SQ1;1 Command ONLY
When the mass extraction method is selected, Data1 will refer to the temperature in °C or in the selected temperature unit in all sensor steps except in the test step. In the test step, Data1 represents the real-time accumulated leak in the selected mass or volume unit.

For example, mg if mg/min is selected as flow unit.
Liter if liter/hr is selected as flow unit.

6.3 Step Number

Typical Step Number Table (Hex System)

Step	Built-in Sequence	Customized Sequence/Description
0, 100	Standby	Standby
1	Open Clamp Valve	Customized
2	Open Pressure and Fill Valve	Customized
3	Fill	Customized
4	Stability	Customized
5	Test	Customized
6,7	Close all valves	Customized
8	Stop	Customized
9	Customized	Customized
A		Customized
B		Customized
C		Customized
D		Customized
E		Customized
F		Stop*
16	Pass	Pass
17	Pass-RM	Pass – Relative Measurement
18	Pass-RF	Pass – Reference Flow Measurement (The reference flow test must be enabled and activated in the current test type. Please refer the Leak-Tek manual (version 6.06 or later) section 6.3.3 and 5.3.3.1).
21	PresSat	Pressure Sensor Saturated Failure
22	FlowSat	Flow Sensor Saturated Failure
23	TempSat	Temperature Sensor Saturated Failure
24	GrossLeak	Gross Leak Failure (Pressure Lower than K3) in pressure testing
25	FineLeak	Fine Leak Failure (Flow larger than V2)
26	Low Flow	Low Flow Failure (Flow Lower than V1)
27	OverPres	Over Pressure Failure (Pressure larger than K2) in pressure testing
28	BackFlow	Backflow Failure (Flow sensor smaller than A3)
29	Blockage	Blockage Failure –Pressure Switch does not turn off in deplete time (T6)
2A	No-Pres	No Pressure Failure (Pressure Switch not turned on in time)
2B	HiFlow_RM	Relative Measurement Baseline Flow Too High
2C	LoFlow_RM	Relative Measurement Baseline Flow Too Low
2D	LargeLeak	Large Leak Check Failure (Flow larger than V7 at Large Leak check Step)
2E	UnderPres	Under Pressure Failure (Pressure Lower than K3) in vacuum testing
2F	GrossLeakV	Gross Leak Vacuum Failure (Pressure larger than K2) in vacuum testing
30	PresRng-Hi	External Pressure higher than set limit (KA)

31	PresRng-Lo	External Pressure Lower than set limit (K9)
32	ExtGrossLeak	External Gross Leak Failure (External Pressure Sensor reading Lower than K3) in pressure testing.
33	ExtOverPres	External Over Pressure Failure (External Pressure sensor reading larger than K2) in pressure testing.
34	ExtUnderPres	External Under Pressure Failure (External Pressure sensor reading Lower than K3) in vacuum testing.
35	ExtGrossLeakV	External Gross Leak Vacuum Failure (External Pressure sensor reading larger than K2) in vacuum testing.

Table 6-1 *Step Number Interpretation*

The Step number in the DAQ response string reflects a Hex Value although there is no hex prefix such as “0x”. Any step numbers between 1 to E could be valid step numbers depending on the customized valve sequence. For example, if the sensor is configured to have 12 steps in the test, the customized step number shall be C (12) steps. D (13) will be reflected in the DAQ response string as the stop step if the user pushes the stop button during the test. Step numbers between 10 and 100 will be interpreted the same among all sensor versions and all configurations.

7. Maintenance and Troubleshooting

7.1 Periodic Maintenance and Calibration

WARNINGS:

Only qualified and trained personnel should maintain the E2/VE2 Instrument.

The calibrated leak is an integral part of the E2/VE2. The calibrated leak should not be tampered with.

The E2/VE2 contains pressure or vacuum. Make sure to deplete internal pressure before doing any maintenance work that requires opening any internal components.

The E2/VE2 contains 115 VAC or 220 VAC, single phase wires, power supply and valves. Disconnect the power cord from the power outlet before removing the E2/VE2 cover and during any electrical work.

The E2/VE2 should only be serviced by trained and authorized personnel.

7.1.1 Filter

The IGLS inside an E2/VE2 includes an in-line filter. The filter is at the inlet of the IGLS or the UUT port. Periodically clean or replace the filter, as necessary. Consult Pfeiffer Vacuum.

7.1.2 Periodic Calibration

The IGLS in an E2/VE2 is a measuring device. Periodic calibration, typically annually, by authorized personnel and standards is recommended. Consult Pfeiffer Vacuum.

7.1.3 System performance Verification

The IGLS, E2/VE2 may include an optional calibrated leak or equivalent channel(“orifice”). Depending on version specified, they are certified at either a specified pressure and flow or a defined geometry. A verification valve can be manually opened/closed by the verification switch on the front panel. The

calibrated leak should be used for system performance, verification and diagnosis. It should not be used for instrument calibration. Use the following procedure to verify the E2/VE2 performance:

- Set the system pressure and allow it to stabilize.
- Open the calibration valve and allow the flow to stabilize.
- Record the IGLS readings and compare them to calibrated leak flow calibration at that pressure.
- With a new unit, (during initial installation) set up one test and make a sample test (same test parameters). Establish the system verification flow tolerance. Recommended tolerance is +/- 3 times the standard deviation of the initial sample.
- Periodic readings should be taken at the same test setup and compared to the flow verification tolerance. If readings (at same pressure range) are higher, after a few tests look for a leak downstream from the IGLS. If the readings are too low, look for a leaking fill valve, upstream leak or clogged inlet filter or lines. In each case, the cause of the problem (readings out of the verification tolerance) must be resolved prior to continuing a test.

7.2 Troubleshooting

The following table summarizes common problems that may occur, and repair recommendations.

No.	Description	Possible Cause	Repair Action
1	LCD does not light	Power supply 5 VDC not available Bad LCD or internal component	Check power supply Check D connector Measure 5 VDC and common Consult Pfeiffer Vacuum
2	LCD Only Display Partial Screen	The LCD momentarily lost power	Turn off and turn on the power supply. Click the two buttons Deactivate and Activate in LeakTek Run Screen.
3	No communication with PC and data saving	Communication problem	Check 9-pin RS232 cable between E2/VE2 and PC Check PC COM port settings Check E2/VE2 address Power down the unit, wait 2 minutes before power up
4	Test will not start	Damaged wiring Bad control panel component Bad remote I/O connection.	Check for damage to internal wiring Consult Pfeiffer Vacuum Remove remote I/O cable and start test from the button on the front panel
5	Valves not working	Valves not enabled Damaged wiring Bad valves Bad control panel components Bad remote I/O connection.	Checked valve matrix and make sure they are enabled. Check for damage to internal wiring Check valves; Consult Pfeiffer Vacuum for replacement parts Remove remote I/O cable and start test from the button on the front panel Consult Pfeiffer Vacuum
6	Pressure controller does not get to zero, no control	No analog voltage output 12 VDC not available Defective pressure control	Check analog output voltage on rear panel connector Check for damage to internal wiring Power down the unit, wait 2 minutes before power up; Analog voltage output should be 0. If not, consult Pfeiffer Vacuum. Check 12 VDC supply Check for defective pressure/flow controller Check P group variables, set to 0 (disable PID) as required.
7	Pressure Sensor readings are incorrect	Measurement units are not set properly Pressure sensor has large offset-sensor	Verify measurement units using Leak-Tek program. Check pressure sensor calibration and verify proper calibration coefficients. Check for 12 VDC power supply

		was over pressurized. Pressure sensor calibration coefficients corrupted Loose connection No power supply	In case of large reading offset, typically pressure sensor was over-pressurized. Contact Pfeiffer Vacuum.
8	IGLS shift of flow	Wrong units of measurement Temperature variation IGLS tilted	Check set up and units Go to configuration screen and check A/D counts of Flow sensor. Tilt sensor to see if “zero” returns. See Auto zero procedure Press must be stable in standby mode. Consult Pfeiffer Vacuum.
9	IGLS flow reading High all the time, and in standby mode.	Leakage downstream to the IGLS Fill valve not opening Pressure valve leakage IGLS zero shift or unit has moved	Isolate IGLS (E2/VE2) by plugging the UUT outlet, check downstream fittings and tubing to the IGLS. Go through initial setup procedure Check/replace pressure, verification and/or exhaust valves. Check / replace fill valve If high readings persist, plug the IGLS outlet, check A/D counts and compare to original calibration. Auto zero the sensor if A/D counts are below 200.
10	IGLS flow reading too low (A/D counts is “0”).	Leakage through the fill line Leaking fill valve External leakage through the expansion reservoir or isolation valve. Unstable supply pressure-pressure drops down. Unit clogged	Check/replace inlet filter Check supply pressure Isolate and check fill/by-pass lines Check leakage through fill valve. Check for expansion reservoir or isolation valve leak. Verify calibration coefficients Check for leaks at the IGLS outlet plugs and fittings Consult Pfeiffer Vacuum for internal cleaning instructions. DO NOT AUTO ZERO the flow sensor if flow or any A/D counts are “0”
11	IGLS Flow, pressure and temperature readings do not make sense	Calibration scrambled Power supply damaged	Verify power supply outputs Verify calibration data with original cal. sheet. Check/increase buffer size (Less than 30) Check that unit reacts normally (pressure flow readings varies with flow) Recalibrate the unit
12	Cannot pass verification test with the calibrated leak	Upstream leak to leak instrument Bad Pressure regulator Equivalent Channel or calibrated leak is plugged. Leaking Fill valve Isolation valve is not closing during stability and test time IGLS measurement is incorrect.	Check test criteria and flow reading Check flow calibration coefficients. Check for upstream and expansion tank connections. Replace pressure regulator. Cap the instrument out port and repeat the test. Connect a separate Calibrated Leak to verify that calibrated leak is not plugged. If plugged, replace the calibrated leak. See line (4) Consult Pfeiffer Vacuum to replace defective valves. See lines 8,9,10.
13	Test Starts/stops by itself when connected to a remote PLC or PC control system	Current leakage into the opto-isolated inputs of the IGLS	Verify that start and stop signals are through dry contact relay. Install one if missing!

14	IGLS Pressure or Flow readings unstable	Upstream pressure fluctuation Incorrect remote I/O connections. Unstable Power Supply Bad connections	Check E2 / VE2 / IGLS connections. Disconnect I/O connector, to isolate for test machine for common-ground issues. Check power supply Check internal IGLS connection Check upstream pressure supply, add or increase reservoir volume between regulators, add an isolation valve if required. Check precision regulator.
15	LCD screen is distorted	Power Spike or rough handling of the instrument may cause the LCD	Touch the right-hand side of the LCD screen to refresh the screen.

Table 7-1 Troubleshooting

8. Appendix A - Calculations

1. Density Calculation

$$D = \frac{P+Q*V_3}{G_1*(T+273.15)}$$

Where:

D: Density of the gas in mg/cc
G_1: Gas Constant (For example, Air = 287)
P: Pressure Measurement in Pa
T: Temperature of the gas in degree C
Q: Flow Measurement in cc/min.
V_3: Flow compensated Pressure Coefficient (See Appendix B)

2. Volumetric Flow Calculation

If the Two Sets of Calibration is disabled, then One Set Calibration is utilized.

Flow is calculated as follows:

$$F = C_1 + C_2 * x + C_3 * x^2 + C_4 * x^3$$

Where:

x: The average count of flow sensor
F: Base Unit flow in cc/min or μg/min

When Two Sets of Calibration is enabled,
All C Group (C1-CA) are Enabled.

Count	α	Range
<65536*(C9-CA)/100	1	Low Range
>65536*(C9+CA)/100	0	Normal Range
65536*(C9-CA)/100<65536*(C9+CA)/100	α=(65536*(C9+CA)/100-x)/(65536*2*CA)/100)	Transient Area Between Low and Normal range

Flow is calculated as follows:

$$F = (1-\alpha)*(C_1 + C_2 * x + C_3 * x^2 + C_4 * x^3) + \alpha*(C_5 + C_6 * x + C_7 * x^2 + C_8 * x^3)$$

Where:

x: The average count of flow sensor
F: Base Unit flow in cc/min or μg/min

If any of H3, H4, B3, H4 is non-zero, then:

$$F_{comp} = F*\left[\ (1 + H_4*(P-H_5) + H_3*(P-H_5)^2\ \right]*\left[\ (1 + B_4*(T-B_5) + B_3*(T-B_5)^2\ \right]$$

Where:

F_{comp}: Compensated flow
P: Pressure sensor reading
T: Temperature Sensor Reading

Note:
If gas compensation is enabled, then a multiplier needs to be included before the base unit flow is obtained. See the IGLS manual for details.

3. Mass Flow

The mass flow calculation is based on the following formula:

$$dM/dt = Q * \rho$$

Where:
dM/dt: mass flow in mg/cc
Q: volumetric flow in cc/min.
ρ: density in mg/cc.

3.a Mass Extracted:

$$M = \int_{t_0}^{t_{test}} \frac{dM}{dt} \bullet dt$$

Where:
dM/dt: mass flow in mg/cc
t_0: starting time of the test step.
t_{test}: ending time of the test step.

4. Temperature Calculation

$$T = B_2 + B_1 x$$

Where:
x: count reading from the temperature sensor.
T: temperature in Degrees C.
B_1, B_2: Temperature Coefficients. (See Appendix B)

5. Pressure Calculation

$$P = H_2 + H_1 x$$

Where:
x: count reading from the pressure sensor.
P: pressure in kPa.
H_1, H_2: Pressure Coefficients. (See Appendix B)

6. PID Pressure control Calculation (when this function is set and used)

$$u(t) = P1 * e(t) + P2 * \int_{t0}^{t} e(\tau) \bullet d\tau + P3 * \frac{de(t)}{dt}$$

Where:
$P1, P2, P3$: PID coefficients (See Appendix B).
$e(t)$: error between the setting and reading.

9. APPENDIX B - Command List

Notes:

1. All calibration coefficients are units of °C, flow base units or kPa as applicable.
2. Density units of mg/cc.
3. Time unit of 10 ms (Ex. 500 * 10ms = 5 sec)
4. All configuration coefficients are selected flow units or kPa as applicable, except for item 5.
5. If X6 is set to 0, RS232 data acquisition response is in the selected unit.
   If X6 is set to other than 0, RS232 data acquisition response is in the °C, base flow unit or kPa.

B.1 A Group

Command	Type	Note
A1	float	Analog Output Full scale corresponding flow in selected flow unit.
A2	float	D/A calibration, Count/kPa
A3	float	Back Flow if count reading in DP is less than A3
A4	float	Barometric condition of the pressure in kPa
A5	float	Min Pressure for Volume Flow sensor or Max Pressure for Mass Flow Sensor

B.2 B Group

Command	Type	Note
B1	float	Temperature Calibration Slope(C/Count)
B2	float	Temperature Calibration Offset(C)
B3	float	Temperature Compensation Flow Coef (2nd order)
B4	float	Temperature Compensation Flow Coef (Linear)
B5	float	Calibrated Temperature in Deg. C

B.3 C-Group

Command	Type	Note
C1	float	Offset Flow Coef (cc/min or μg/min)
C2	float	First-order Flow Coef (cc/min/count or μg/min/count)
C3	float	Second-order Flow Coef (cc/min/count2 or μg/min/count2)
C4	float	Third-order Flow Coef (cc/min/count3 count2 or μg/min/count2)
C5	float	Lo Offset Flow Coef (cc/min or μg/min)
C6	float	Lo First-order Flow Coef (cc/min/count or μg/min/count)
C7	float	Lo Second-order Flow Coef (cc/min/count2 or μg/min/count2)
C8	float	Lo Third-order Flow Coef (cc/min/count3 or μg/min/count3)
C9	float	Percent Divider % (such as 10)
CA	float	Smooth % (such as 1)
CB	float	Calibrated Gas Constant
CC	float	Calibrated Gas Viscosity

B.4 D Group

For Adaptive Flow test:

Command	Type	Note
D1	float	Buffer Time in % of the test period
D2	float	Safety Multiplier = 2 to 6
D3	float	Test Start Leak Window Max in multiplier of V2 (1.2)
D4	float	Test Start Leak Window Min in multiplier of V2 (0.8)
D5	float	Alpha (Curve) (0-1)

B.5 G Group

Command	Type	Note
G1	float	Universal Constant of the Gas (287 for air) is necessary if density is required in calculation.
G2	float	Viscosity at 0 °C
G3	float	Viscosity change per °C.
G4	float	Density of the gas at standard barometric condition in mg/cc.
G5	Float	Sensor Alpha (kPa/(cc/min)). G5 = (DP range)/(Sensor full scale)*0.24884

B.6 H Group

Command	Type	Note
H1	float	Pressure Calibration Slope(kPa/count)
H2	float	Pressure Calibration Offset(kPa)
H3	float	Pressure Compensation Flow Coef (2nd order)
H4	float	Pressure Compensation Flow Coef (Linear)
H5	float	Calibrated Pressure in kPa
H6	float	Pressure Calibration Slope (kPa/Count)
H7	float	Pressure Calibration Offset (kpa)

B.7 K Group

Command	Type	Note
K1	float	Pressure Setting for Leak Test mode (kPa)
K2	float	Pressure Upper Limit(kPa)
K3	float	Pressure Lower Limit(kPa)
K5	float	Pressure Setting for Leak Test mode (kPa) for large leak check with dual pressure settings
K6	float	Pressure Upper Limit(kPa) for large leak check with dual pressure settings
K7	float	Pressure Lower Limit(kPa) for large leak check with dual pressure settings
K9	float	Pressure Lower Limit (kPa) for external pressure switch
KA	float	Pressure Higher Limit (kPa) for external pressure switch

B.8 L Group

Command	Type	Phase Label
L1…LE	String	Up to 15 characters per Label

B.9 M Group

Command	Type	Phase Valve Configuration
M1	long	Not saved in the memory. M1;1 to Calibrate the LCD M1;2 to Activate the LCD M1;3 to Deactivate the LCD M1;6 to change the test typeM1;8 to start test M1;9 TO STOP TEST
M2	long	Pass Sound Period (x 10ms), Set 0 to disable
M3	long	Fail Sound Period (x 10ms), Set 0 to disable
M4	long	Stop Sound Period (x 10ms), Set 0 to disable
M5	long	Automatically Deactivate to Screen Saver The timer setting after Idle Condition (x 10ms), Set to 0 to disable
M6	long	The setting is based on the combination of the following: Display/Hide the second pressure 0x400. Switch the internal Pressure and External Pressure 0x200 Alternative Location 0x100; Temperature Reading 0x08; Enable remote command to start/stop 0x20; 0:Disable, 1:Enable Enable DIO to start/stop 0x10; 0:Enable, 1:Disable Start Button 0x04 Type Button 0x02 Stop Button 0x01
M7	Long	Brightness (1-255)

B10 O Group

Command	Type	Phase Valve Configuration
O1…OE	Integer	The last byte is configured as follows: Clamp 0x80 Pres/Test 40 Exhaust 0x20 Fill/Balance 0x10 QuickFill 0x08 Isolate 0x04 Customer1 0x02 Customer2 0x01

B.11 P Group

Command	Type	Note
P1	float	PID Proportional Coef
P2	float	PID Integral Coef
P3	float	PID Differential Coef
P4	float	Flow Setting for flow control mode in selected flow unit.
P5	float	PID External Pressure Sensor usable criteria (%)

B.12 S Group

Command	Type	Note
S1	String	Serial Number: Up to fourteen characters are allowed. For example: XX XXX XXX X XXX 1 2 3 4 5 6

		1 = Release of month, i.e., 06 = June 2 = Release of year, example 23 = 2023 3 = Serial No. – valid from 001 to 999 4 = Maximum Flow, i.e., 090=90, 120=120, 12H=1,200, 12K=12,000 5 = Flow Unit- C = CCM, L = LPM, U=ug/min, M=mm3/min 6 = Maximum Pressure in psia, i.e., 500=500 psia, 12H=1,200 psia, 12K=12,000 psia
S2	String	Read Only Return Version Number such as 020000 for version 2.0.0

B.13 T Group

Command	Type	Built-in Timers	Customized Timers
T1	Integer	Filling delay time in 10 ms	Step timer in 10ms
T2	Integer	Stability delay time in 10 ms	Step timer in 10ms
T3	Integer	Test time in 10 ms	Step timer in 10ms
T4	Integer	Clamping delay time in 10 ms	Step timer in 10ms
T5	Integer	N/A	Step timer in 10ms
T6	Integer	N/A	Step timer in 10ms
T7	Integer	N/A	Step timer in 10ms
T8-TE	Integer	N/A	Step timer in 10ms

Note: all T group settings are defined as long integer (32 Bit).

B.14 U-Group

Command	Type	Note
U1	Integer	Address 1-9
U2	Integer	Mode: 4th Byte Sensor Type Conventional Leak Tester 0 Adaptive Leak Tester 1 Flow Controller 2 Mass Extraction Method 3 Steady state Predictor 4 3rd Byte 0x0 0 1 1 0 0 1 1 Bit 0: When ‘1’, Sensor is configured as XE Bit 1: Reference Flow function BIT 2: QUICK REFERENCE FLOW FUNCTION Bit 4: When ‘1’, Sensor is configured for 4th analog input Bit5: PID Pressure sensor selection, 0=Internal Pressure sensor, 1= External pressure sensor 2nd Byte 0x 1 1 1 1 1 1 1 1 5 4 3 2 1 1: Valve Control Standard 0x0 (Disable C1, X2, X3, XA) Customized 0x1- 0xF 2: Flow Calibration One Set of Calibration 0 Two Set of Calibration 1 3: Relative Measurement

		4: Digital Input Pulse/Level Set to 1 if Level detection is desirable 5: Vacuum Testing Message 1—Vacuum 1st Byte Bit 0: Measurement Unit Mass Flow Base 1 μg/min as Base Unit Volume Flow Base 0 cc/min as Base Unit Bit 1: Gas Compensation Gas Compensation 1 No Coef Compensation 0 Bit 2: 3rd Test Type On Bit 3: 3rd and 4th Test Type On Example: 0x00(1st byte) 27(2nd byte) 00(3rd byte) 02(4th byte)
U3	Integer	Temperature Unit: 0-Degree C 1-Degree F
U4	Integer	Pressure Unit: Pressure Unit: 0- kPa 1-kg/cm2 2-psia 3-inHg 4-inH2O 5-psig 6-Torr 7- KPA-G 8- Bar-a
U5	Integer	Flow Unit: High Nibble 0 - cc 1 – mm3 2 -liter 3-gal 4 -gram 5 -mg 6- μg Lower Nibble 0 -sec 1 -min. 2 -hour 3-SCCM etc. 16*HighNibble+LowNibble Besides: 7*16+3-SCCM

<table>
<tr><td></td><td></td><td>8*16+3-SLM
9*16+3-SCFM

7*16+4 SCCSe-6</td></tr>
<tr><td>U6</td><td>Integer</td><td>0: One string of response to SQ1 command
1: two strings of response to SQ1 command</td></tr>
<tr><td>U7</td><td>Integer</td><td>Baud Rate:
0, and else: 9600
2:19200
4:38400
12:115200
The Parameter will take effect after the power reset of the sensor</td></tr>
<tr><td>U8</td><td>Integer</td><td>Hold Value Time in U8*10 ms</td></tr>
<tr><td>U9</td><td>Integer</td><td>Set U9 = 0 to disable special features.
1) Disable Relative Measurement
2) Disable Mass Extraction Test
3) Disable Early Detection for Adaptive Test</td></tr>
<tr><td>UA</td><td>Integer</td><td>Start Cycle Counter. Cycle number can be shown on system and maintenance screens.</td></tr>
<tr><td>UB</td><td>Integer</td><td>Reference flow function flag. 1 Byte
Within each byte of the above value the bit positions are numbered as shown:
<table>
<tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
</table>
<table>
<tr><th>Bit #</th><th>Description</th></tr>
<tr><td>0</td><td>Reference Flow Activate:
0 = Reference Flow disabled from setup
1 = Reference Flow Enabled from setup</td></tr>
<tr><td>4</td><td>0 = TT1 Reference Flow activated if it is enabled
1 = TT1 Reference Flow deactivated</td></tr>
<tr><td>5</td><td>0 = TT2 Reference Flow activated if it is enabled
1 = TT2 Reference Flow deactivated</td></tr>
<tr><td>6</td><td>0 = TT3 Reference Flow activated if it is enabled
1 = TT3 Reference Flow deactivated</td></tr>
<tr><td>7</td><td>0 = TT4 Reference Flow activated if it is enabled
1 = TT4 Reference Flow deactivated</td></tr>
</table></td></tr>
</table>

B.15 V Group

Command	Type	Note
V1	float	Min. Flow Alarm for leak test mode in cc/min, μg/min or selected unit based on X6.
V2	float	Max. Flow Alarm for leak test mode in cc/min. or selected unit based on X6. For mass extraction method, Max. Leak Alarm for leak test mode in cc, μg, or selected unit based on X6
V3	float	Flow compensation to DP in kPa/(cc/min) or kPa/(μg/min)
V5	float	Min. Flow Alarm for Relative Measurement Baseline Flow in cc/min, μg/min or selected unit based on X6.
V6	float	Max. Flow Alarm for Relative Measurement Baseline Flow in cc/min. or selected unit based on X6.
V7	float	Large Leak Flow Alarm Flow in cc/min. or selected unit based on X6.

B.16 X Group

Command	Type	Note
X1	Integer	Pressure Switch On Check Step No Lowest Byte=Step No 2nd Lowest<>0, Advance to the next step once the PS is on (ver 2.1.1)
X2	Integer	Pressure Switch Off Check Step No Lowest Byte=Step No 2nd Lowest<>0, Advance to the next step once the PS is off (Ver 2.1.1)
X3	Integer	Leak Check Step
X4	Integer	Buffer Size: Valid from 4 to 100
X5	Integer	Enable Flag: Deplete the pressure after the test failure
X6	Integer	Default unit is used if X6 <>0 Flow in cc/min or μg/min. pressure in kPa and temperature in Degree C
X9	Integer	Flow baseline Step No
XA	Integer	Stop Test Step No
XB	Integer	LargeLeak Test Step No (ver 2.1.2) Lowest Byte=Step No 2nd Lowest<>0, The steps before and on LargeLeak will be set based on K5 and check against K6 and K7 3rd Lowest<>0, the step on LargeLeak will check against V7 as Minimum Large Flow (Version 2.37)
XC	Integer	Basic Check (ver2.2.0) Each bit of the integer representing the step in which the basic check shall be enforced. The Basic Check verifies the sensor is not saturated and pressure is not out of settings (PHi and PLo). “XC” Note: 1. If XC was set such as 0xFF, the gross leak check will be disabled. 2. Any basic step check after leak check step will be ignored! Example of setting: XC=0x06 In step 2 and step 3 the basic check will be enforced.
XD	Integer	External Pressure On Step No Lowest Byte=Step No 2nd Lowest<>0, Advance to the next step once the external pressure is in range
XE	Integer	External Pressure Off Step No Lowest Byte=Step No 2nd Lowest<>0, Advance to the next step once the external pressure is out of range

Note:
The following condition must be met for the IGLS to function properly:

- X1<X3<XA<X2
- XB<X9<X3
- 1<X3
- 1<XB

B.17 Y-Group

Command	Type	Note
Y1	float	Reference Flow the first point time parameters.
Y2	float	Reference Flow the second point time parameters.
Y3	float	Reference Flow the third point time parameters.
Y4	float	Reference Flow the fourth point time parameters.
Y5	float	Reference Flow the fifth point time parameters.

B.18 Z-Group

Command	Type	Note
Z1	float	Reference Flow the first point flow parameters.
Z2	float	Reference Flow the second point flow parameters.
Z3	float	Reference Flow the third point flow parameters.
Z4	float	Reference Flow the fourth point flow parameters.
Z5	float	Reference Flow the fifth point flow parameters.

10. APPENDIX C - E2 / VE2 ASSEMBLY

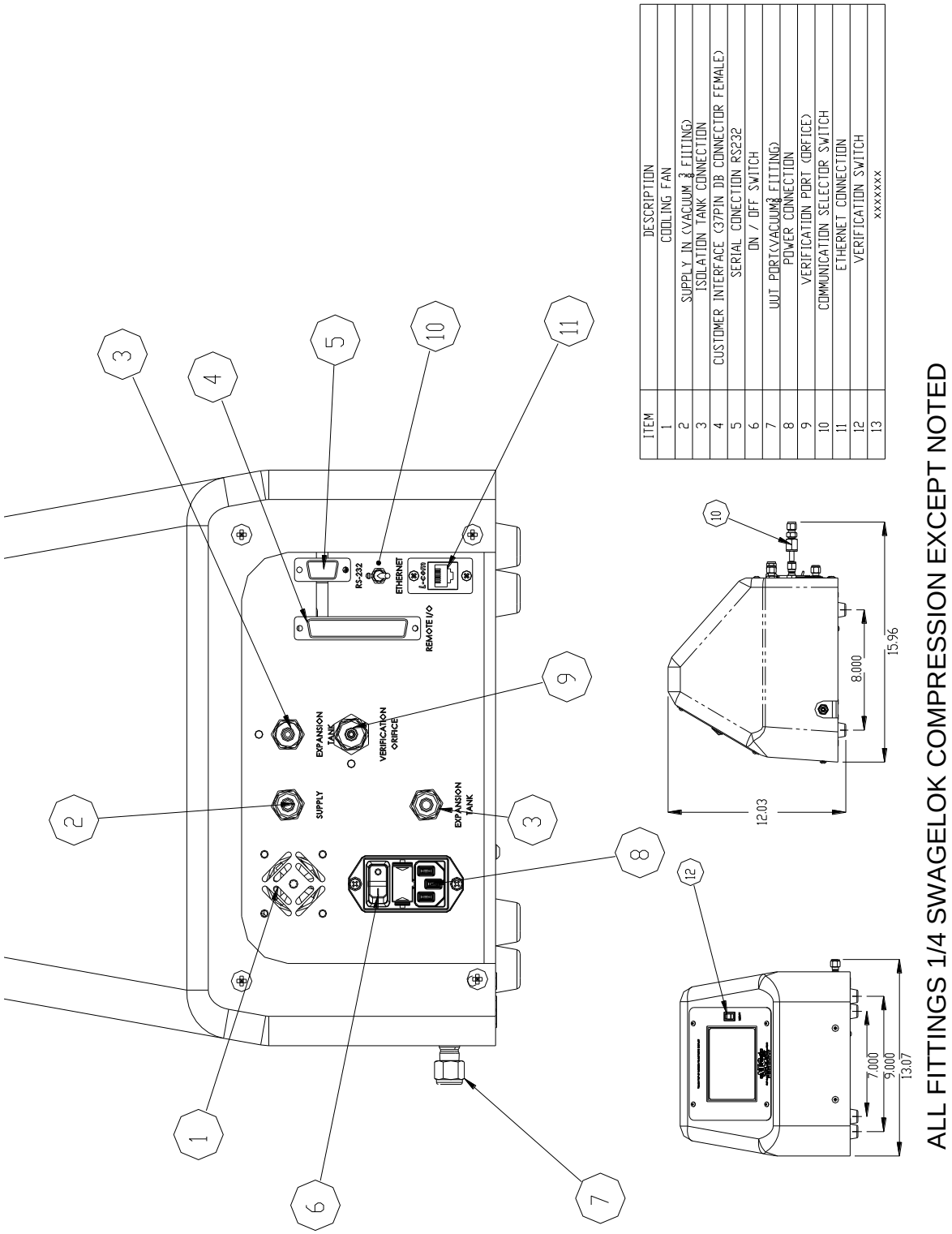


Figure C.1 – E2 Installation Example

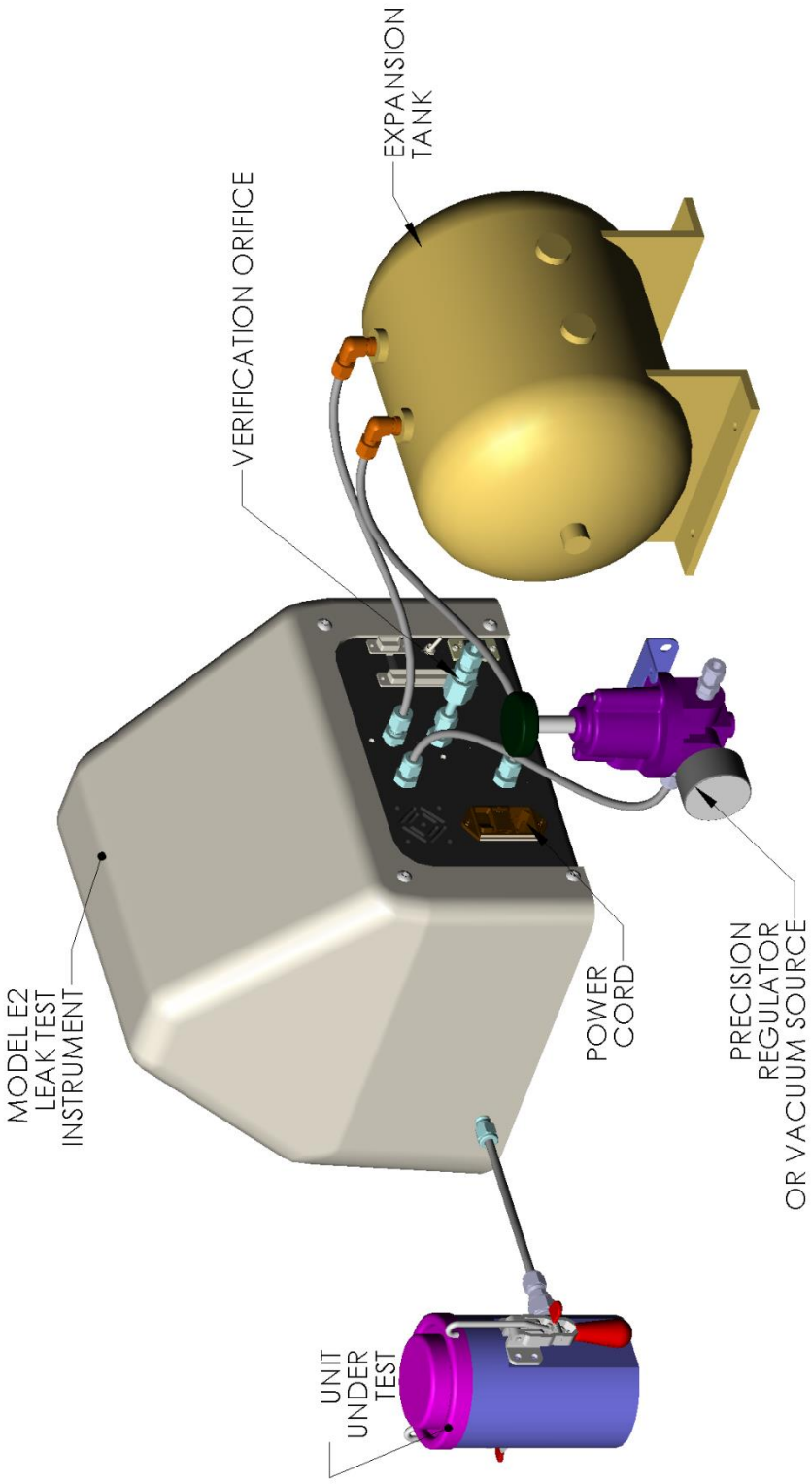
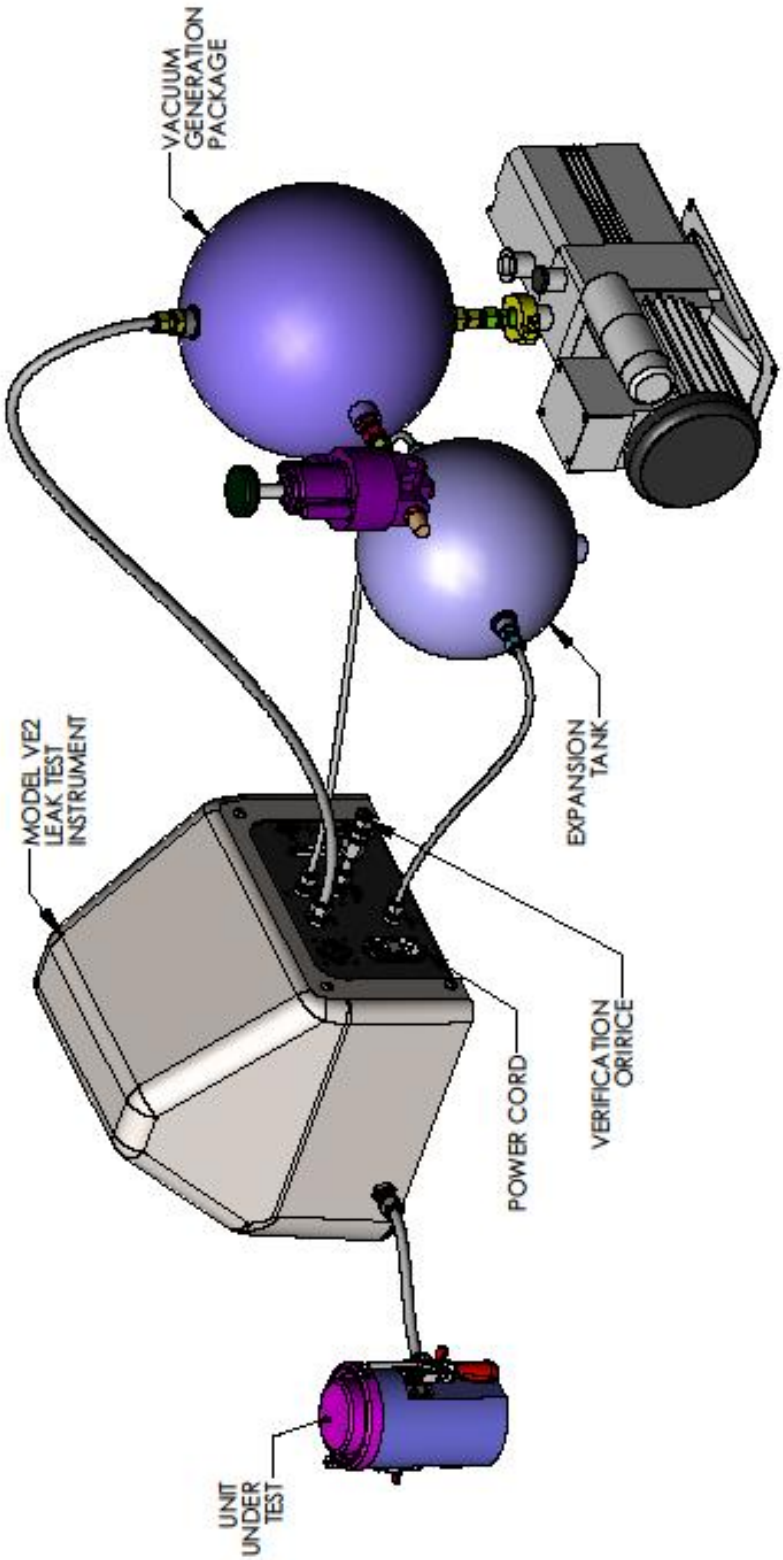


Figure C.2 – VE2 Installation Example



11. APPENDIX D – EC DECLARATION

EC Declaration of conformity

This declaration of conformity has been issued under the sole responsibility of the manufacturer.

Declaration for product(s) of the type:

Model E2 and V2 leak test instruments including associated variants/options

We hereby declare that the listed product satisfies all relevant provisions of the following **European Directives**.

Low-voltage 2014/35/EU
Machinery 2006/42/EC (Annex II, No. 1 A)
Electromagnetic Compatibility 2014/30/EU
Restriction of Hazardous Substances 2011/65/EU

Harmonized standards and national standards and specifications which have been applied:

EN-61010-1 : 2010
EN-61010-1 : 2010/AMD1 :2016
EN-61010-1 : 2010/A1
UL 61010A-1 : (3rd Ed.)
Am.1
CAN/CSA-C22.2 Nr 61010-1 + Amd 1
ANSI C63.4:2014
IEC 61326-1:2012

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