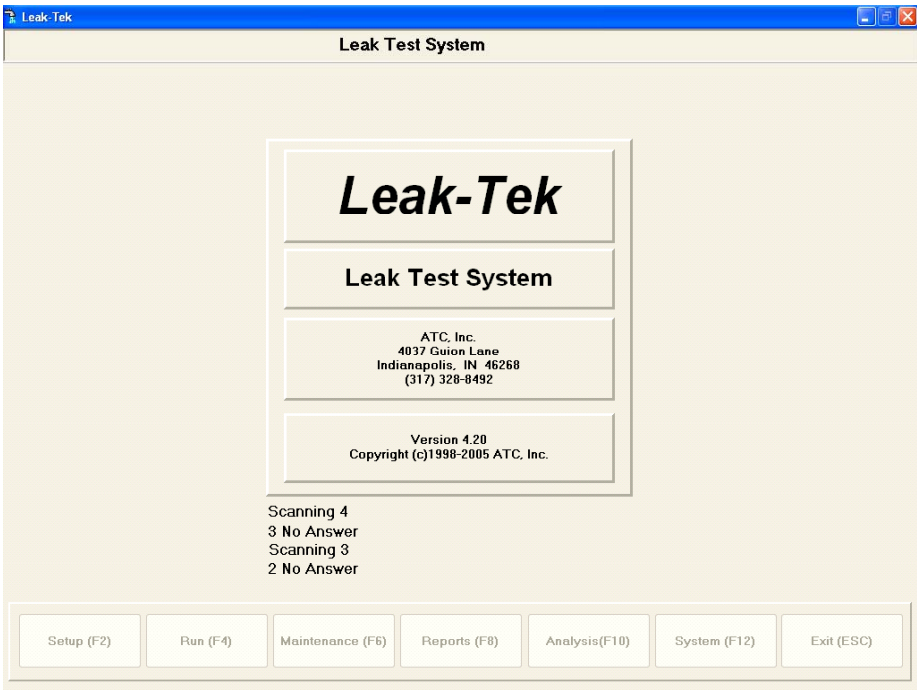
Leak-Tek© and Flo-Tek© Software Manual



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Revision 4.20

Proprietary Note:

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Leak-Tek©, A PC Based Data Acquisition Software

Leak-Tek© is a Windows based data acquisition software package designed for use with ATC's Micro-Flow sensors; The Intelligent Gas Leak Sensor (IGLS) and Intelligent Molecular Flow Sensor (IMFS). The Flo-Tek© program, identical to Leak-Tek© but with different settings, is used for ATC's flow sensors such as the Intelligent Gas Flow System (IGFS), and High Flow Sensors used for flow measurement applications.

Leak-Tek© provides graphical interface for up to ten sensors or Leak Test Instruments. The Leak-Tek© interface allows for downloading test parameters of a given leak test, uploading parameters stored in an Intelligent Sensor, or calibrating a specified sensor. Leak-Tek© also allows storing test data from an Intelligent Sensor into an ASCII comma-separated value (CSV) file. This file can then be printed into a spreadsheet or analyzed by the Leak-Tek© "analysis and reporting features".

Two types of usage are available:

1. Conventional IGLS-Leak Test Cycle:
Conventional Leak Test Cycle includes four steps such as Clamping, Filling, Stability, and Test.

Clamping allows for a "Unit Under Test" (UUT) to be clamped by a pneumatic seal around an entry point into the UUT. Due to the nature of the UUT and the design of the IGLS/IGFS test stand, this part may be omitted.

Filling allows a two-way bypass valve to rapidly fill the UUT and avoid saturating the IGLS/IGFS with high flow. This is necessary because an IGLS unit provides a large restriction to flow. Consequently, reducing the overall cycle time and rapidly filling the UUT are required.

Stability allows a system to "settle down" so that the airflow is not bouncing back and forth through the IGLS. Insufficient stability time may result in unstable flow and pressure readings. Note that unstable air supplies will also result in unstable readings, thereby negating the use of Stability. Designers should take precautions when a test system is designed to use an IGLS/IGFS unit. Isolated expansion tanks are recommended to increase the stability of the supply.

Test is the final part of the test cycle. During the Test time the IGLS/IGFS unit repeatedly checks the UUT to see if it meets the criteria set by Leak-Tek. The moment a failure occurs, the IGLS will indicate failure to both Leak Tek and the systems electrical I/O lines (see IGLS/IGFS manual). If a test is set to NOT deplete pressure at the end of a test, the IGLS will continue to re-test the UUT. If the UUT can meet the test criteria during a re-test, the unit will be flagged as "PASS" on the IGLS.

2. Customized/Advanced IGLS Leak Test Cycle Steps or IGFS Set Up:
Advance features are available for all “second generation” and later sensors. These sensors can be identified by their hardware firmware version (version 2.00.00 or later). The advance features are designed to handle “tougher” applications, including but not limited to larger volume parts, extremely low leak rate, faster cycle time, molecular flow and leak tests in high vacuum. Special calibration features enable the sensor to have two calibration ranges for better turn-down ratio and measurement uncertainty.

The advance features include:
- Step valve configuration and control, customized name and step definition from 4 basic steps up to 14 steps. Details refer to the sensor configuration screen.

- Adaptive Test Concept, which enables faster leak test cycle, times, by identifying very good (low leak) UUT and gross leaks earlier - to shorten average test time and increase test station throughput.

- Relative measurement features
  One step will be configured as a flow base line before test step.

- Dual range features.

WARNING: Setting up Leak Tests or Flow Tests involves using gas pressurized sources, electrical power and sometimes moving systems. Therefore proper safety precautions should be taken while using this package along with ATC’s product as stand alone, or when integrated into a third party system.

Caution: Only trained personnel should use the Leak-Tek© program. Improper use of Leak-Tek© software may cause IGLS/IGFS or Leak Test units to provide improper test results and false readings.

Section 1: Software Versions and Installation

1.0 Leak-Tek Versions

1. ***Leak-Tek Version 2.5*** has had several changes to allow use with IGLS/IGFS units that can perform multiple dual tests, (called “Test Type 1” or “Test Type 2”). Such units can hold two sets of “Setup” parameters. This feature enables users to configure IGLS/IGFS so that two successive leak tests, two successive flow tests, or a combination of a leak and flow test can be performed.

2. ***Leak-Tek Version 3.0*** has had several changes to allow the user to analyze flow vs. time signatures in a new screen named “Signature Analysis “. The new version also has some changes in the INI file to allow going into the “Run” screen immediately and protects the “Setup” screen with a password. The program also provides a grid displaying test results in the report screen. To protect the sensor’s data, the program compares setup’s data with the on-line sensors’ data when going into the “Run” screen. A message box will be prompted if there are any discrepancies, giving the user a message comparing the result and two options; either changing setup’s data or changing sensor’s data to fit each other.

3. ***Leak-Tek Version 3.1*** has had several changes added to simplify the SPC file creation by making this option available in the “Report” screen instead of the “Setup” screen. Also added are the ability to minimize the “Leak Tek” program to access other programs without having to exit the “Leak Tek” program, and the ability to monitor two instances of Leak Tek running at the same time.

4. ***Leak-Tek Version 3.11*** has had several changes added to generate Real Time SPC in Run Screen. A New Variable, “Real SPC,” is added in the Leak.ini “Application” section. When “Real SPC” is set to true, the program will automatically generated SPC files named “yy-mm-dd” in “app.path\data\RTdata” during tests. These files can then be accessed and monitored during test.

5. ***Leak-Tek Version 3.12*** has had several changes added to edit and view the “deplete time” parameter, which is a new feature added in the Model E system. A textbox is added for depleting time in both the “Setup” and ‘Configuration” screen. The depleting stage can be displayed in the “Run” screen during a test. T6 is added for depleting time in IGLS.

6. ***Leak-Tek Version 3.20*** implemented automatic signature created capabilities. The test signatures are automatically saved under user defined test ID names along with the test sequence number if the “Auto signature” checkbox is selected. In the “Analysis” screen, both the auto signature files and the manual signature files can be retrieved separately.

7. ***Leak-Tek Version 4.00*** is compatible with IGLS/IGFS firmware versions 1.0 to 2.0. The program is substantially different and re-written for second generation intelligent micro-flow, and flow sensors with backward compatibility to the earlier firmware version. The sensor "Configuration" screen is different from version 3.20. New adaptive test parameters can be viewed and edited when "adaptive test" is selected. The multiple range features are then enabled. Two level passwords for administrator and general users are available. Window XP Style interface is compatible in window XP operating system.

8. ***Leak-Tek Version 4.01***
- added relative measurement feature..V5 is low flow limit for relative measurement. V6 is high flow limit for relative measurement.

9. ***Leak-Tek Version 4.02***
- added adaptive test function.

10. ***Leak-Tek Version 4.03***
- added a on line sensor auto-detecting feature.
- All parameters on the screen will be downloaded to sensor if "Download All" is selected when download button is clicked
- P-Group is accessible in the sensor configuration screen.
- Added one valve (from 7 to 8) in sensor configuration screen.
- Corrected the unit conversion for the pressure unit "inH_2O" and "inHg".
- Added A5 in the parameter list

11. ***Leak-Tek Version 4.04***
- added large leak check step configuration. Only flow will be checked during large leak check. However, both the pressure and flow will be checked if the "Large Leak Chk-Pres" is selected.

12. ***Leak-Tek version 4.05***
- Added a new field "Signature_ID" in test results database table to identify signature ID.
- Displays the application name in the windows task bar. "ALT" +"Tab" can switch between Leak-Tek application and other windows.
- Added a feature to view the Signature_ID and failure comments in report screen.

13. ***Leak-Tek version 4.06***
- Added a "XC" Parameters to check the Gross-Leak in customer specified test steps.
- Modified the column format of the SPC file.

14. ***Leak-Tek version 4.10***

- Added a new screen “Maintenance” to allow the operator to access some frequently used parameters, which are not accessible from the setup screen.
- Add a master level passwords to access the sensor configuration screen
- Add a password protection when “Download” button is clicked in the Detail screen from the setup.
- This version also is compatible with firmware 1.915 version sensors.

Also Leak-Tek 4.10 will allow users to run software when all sensors are offline and no comm. Port is available.

15. ***Leak-Tek version 4.11***

- Added the prefill time for IGLS version 1.915 to calculate the overall test time for the signature graph in the run screen.
- Checked all available serial ports properties and properly shut down the unusable serial ports;
- Allows for signature files from different folder to be loaded into the select list box
- Resolved the issue of mistakenly dropping one sample of the SPC study.
- Added the driver for Serial to USB to the installation CD
- Changed the following default setting in the leaktek.ini
  a. long format=1
  b. number of sensors=5
  c. multiple sensor test type=1
- Included three default sensors in LeakTek.mdb
  001-----version 1.0
  002-----version 1.915
  003-----version 2.20

16. ***Leak-Tek version 4.20***

- Added saving the flow result of large leak check. Both large flow and final flow records can be displayed and analyzed in report screen. The large flow result is also displayed and recorded in Run Screen if enabled.
- Improved the RS 232 serial communication performance.
-
- Configured not to download buffer size when a file signature starts.
- Corrected U7 LCD lock feature in 1st Generation Sensor.
- Configured “RQ3” command sending rate in system configuration screen.
- Graphs in Analysis, Run and Report Screen are updated.

1.1 System Requirements

Leak-Tek software requires a Pentium based system (IBM compatible system) or higher. This system should have no less than 32 MB of RAM, and have a

minimum of 500 MB of free hard drive space. Leak-Tek software is compatible with Windows 98, Windows NT and Windows XP.

If ATC, Inc provides a USB to Serial convert cable , the driver for this cable is also included in Leak-Tek installation CD. Details about this cable driver installation please refer to the document “Install USB to Serial Cable Driver” in the installation CD.

Note: Leak-Tek is compatible with Windows 98/ NT or above. Windows 95 may cause conflict with Leak-Tek installation on a PC system. It is recommended that Leak-Tek is installed on systems dedicated to Leak-Tek software and have no additional software installed.

1.2 Installation

Leak-Tek installation CD is used to install the Leak-Tek executable and associated files. “Setup.exe” will install the control files (OCX and DLL files) in the System folder of the Windows directory.

Users may access Leak-Tek’s Setup program using Windows Explorer, as shown in Figure 1

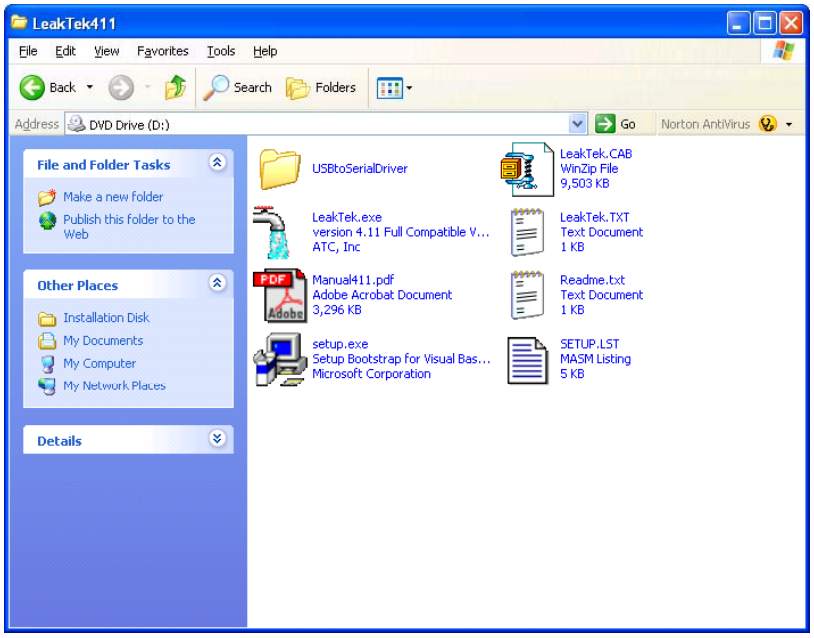


Figure 1 Using Windows' Explorer to locate Setup

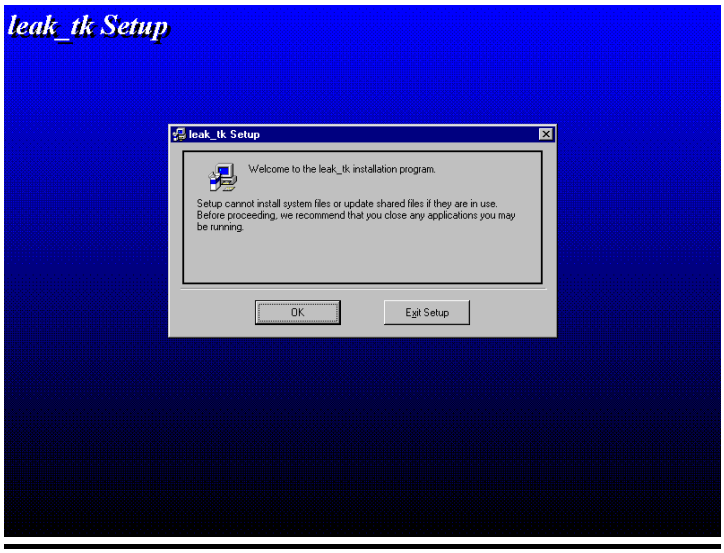


Figure 2 Main Setup Screen

After clicking on “Setup”, the setup screen appears as shown in Figure 2. Upon selecting “OK” in the main setup screen, the user will be prompted to either accept the default installation directory or choose a different directory, as shown in Figure 3. After a directory is selected, Leak-Tek’s setup will start installation.

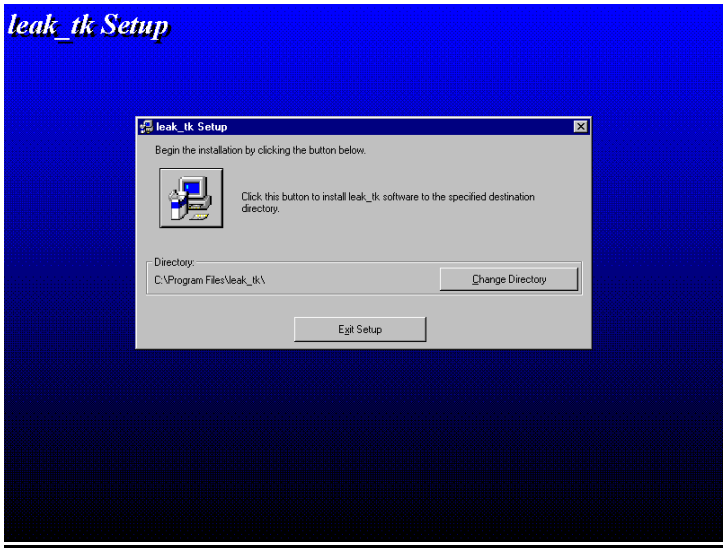


Figure 3 Setup Configuration Screen

The screen shown in Figure 4 will appear after successful installation. Leak-Tek can be used immediately after completed software installation, proper hardware installation and configuration.

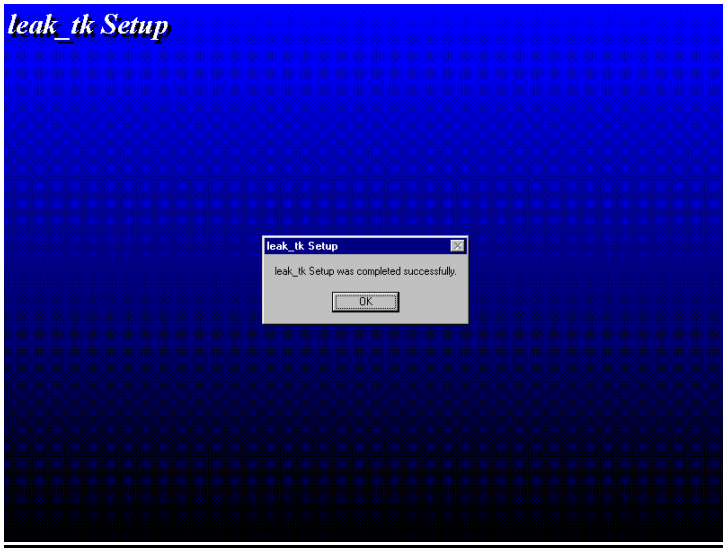


Figure 4 Leak-Tek Setup Successful Installation

Note:
If the default directory is used for installation, Leak-Tek access is available through the start button shown in Figure 5. If a custom directory is used for installation, it is recommended that the user manually install a shortcut in the Start or desktop.
The Leak-Tek application is used to communicate with a serial comport. Please check your PC and set the COM port number match your PC.

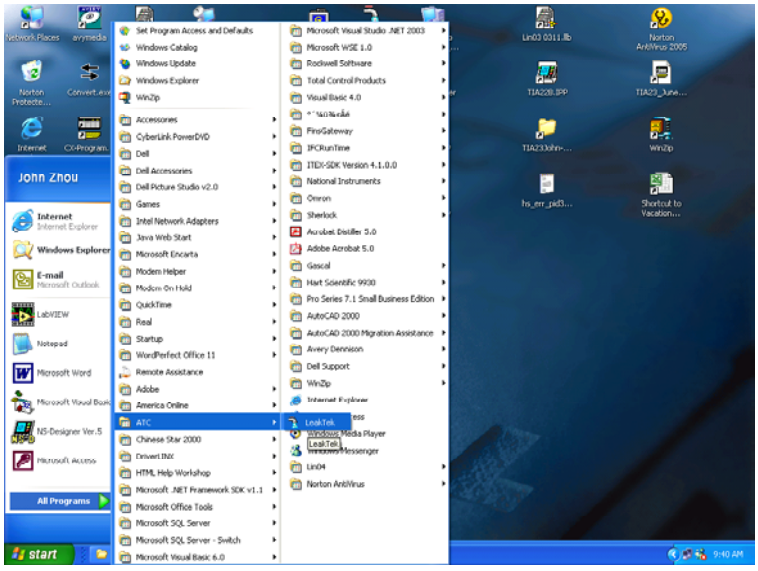


Figure 5 Leak-Tek Location in the Start Menu of Windows XP

Note:
Leak-Tek uses control files and DLL files common to many Microsoft products. Therefore, it is not unusual for an error message to occur during installation, be warned that a DLL or control file is in use on the system. Choose *"Ignore"* to proceed with the installation and allow the Leak-Tek setup to skip writing an existing file to the hard drive. Current Leak-Tek software installation path is set to "C:\Program Files\ATC\LeakTek".

Section 2: Getting Started-First Time

2.1 Leak-Tek INI File

The Leak-Tek software creates an INI file, “LEAKTEK.INI”, when the software is loaded at the first time. This file may require editing if Leak-Tek needs to work with a COM port other than COM 1. For example, if the default COM port is 4, set “Port” equal to 4 (*Port=4).* Modify this file by using Window’s notepad, as shown in Figure 6.

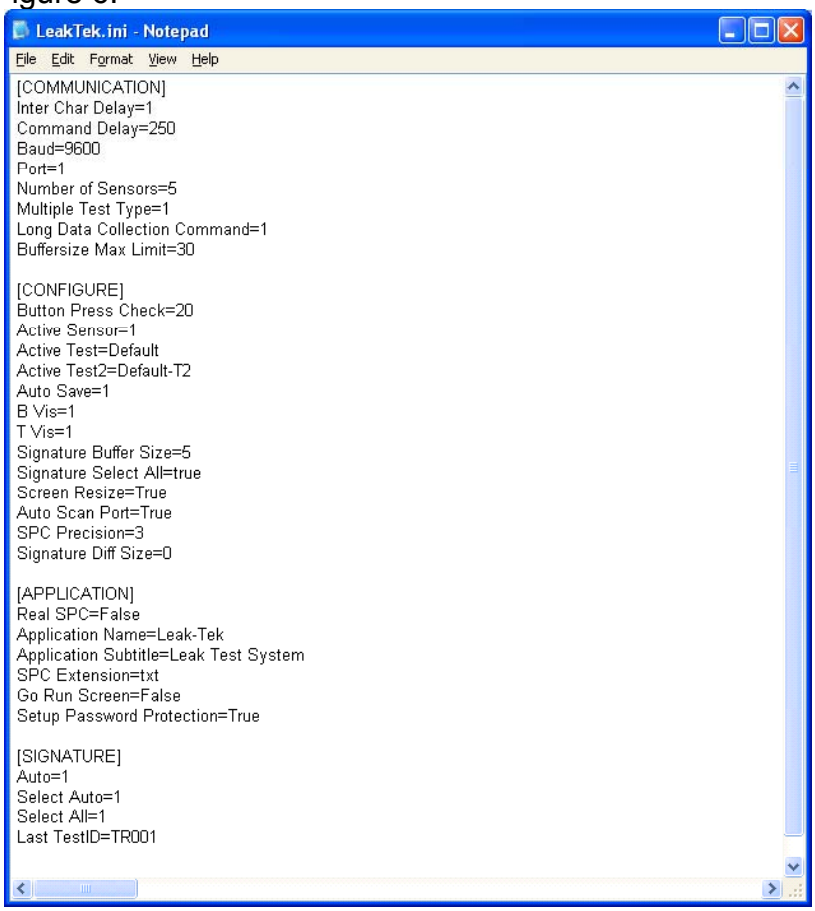


Figure 6 Using Notepad To Edit LeakTek.ini

If only one IGLS is in use, change the “***Number of Sensors***” setting to 2.The standard IGLS/IGFS units are set to a Baud rate of 9600. Therefore, it is recommended to leave the “***Baud***” parameter at 9600.

The ***Baud rate*** in LeakTek.ini should be the same as those in IGLS/IGFS sensor. Please refer to sensor configuration for downloading IGLS/IGFS baud rate.

The parameters *“**Inter Char Delay***” and “***Command Delay***” are parameters that affect communications between the IGLS/IGFS unit and Leak-Tek. ATC

personnel and ATC customer support does not recommend changing these parameters. The comm. Delay should be set to “250”.

The settings “***Button Press Check***”, “***B Vis***” and”***T Vis***” affect software performance and should not be altered without consultation with ATC.

The parameter “***Active Sensor***” indicates the last sensor for which Leak-Tek had communications. The parameters “***Active Test***”, (the last “Type 1” test configured by a user), “***Active Test 2***”, (the last “Type 2” test configured by a user), and “***Auto Save***”, are set from the “Setup” and “Run” screens, respectively. These screens are referenced later in this manual. The “***Multiple Test Type***” parameter must be set to 1 if the IGLS communicating with Leak-Tek is capable of dual testing. “***Multiple Test Type***” should be set to 0 if the IGLS unit is only capable of a single test. “***Signature Buffer Size***” sets the resolution on the Signature graph in the Run screen.

The Parameter “***SPC Extension***” is used to define the SPC file’s extension. When parameter “***Go run screen***” is set to *true*, the program will go into the Run screen immediately after starting the Main screen. When parameter “***Setup Password Protection***” is set to *true*, the user will need to type in the password that is same as the “System” screen’s whenever the user wishes to enter the “Setup” screen.

The parameter “Screen Full Size “is used to select default size or full screen size.

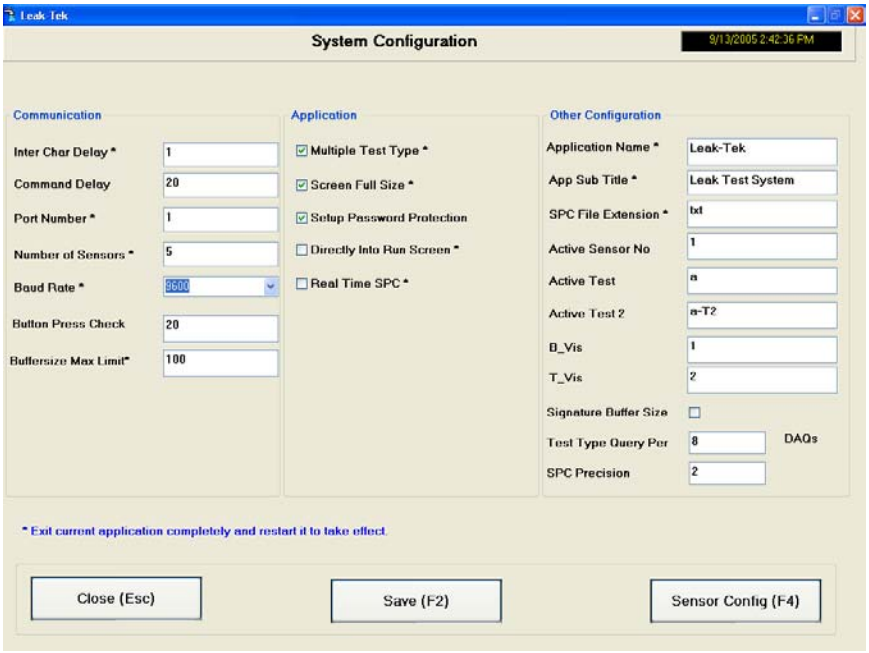


Figure 7 Using System Configuration Screen to Edit Leak-Tek.ini

The parameters in LeakTek.ini can be edited in system configuration screen (4.00 versions later). The parameters with symbol “*” will take effect after the application has been fully closed and re-opened.

2.2 Auto Scan Sensors

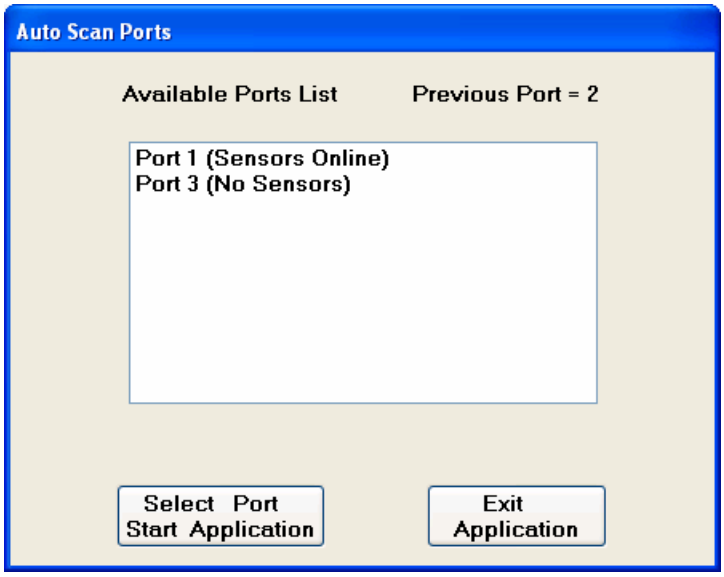


Figure 8 Auto Scan Sensors

1. When the previous port setting in INI file does not exist or no sensors are connected to this COM port, auto scanning ports from 1 to 8 will be performed. Available ports with sensors online information will be displayed in the list box as shown in figure 8. (This feature exists in LeakTek version 4.03 or after)

2. To continue the application, please select one port from the list and click the left command button or double-click the selected item in the list.

3. If system does not have comm. Port, the left button caption will be “Run as Demo”.

4. If the previous port setting in INI exists and have sensors linked, the communication between sensor and PC will be established and the main operation screen will automatically show up as shown in figure 9.

2.3 Operation Screen

The “Operation” screen, as shown in Figure 9, has one of the following screens to be chosen:

- Setup — Allows a user to enter test parameters and create named IGLS/IGFS tests
- System — Allows a user to either configure the software and the test unit or allows users to calibrate test units. (Note: This screen is password protected)

- Reports — Allows a user to load and analyze previous tests' data files using SPC. Data files are stored in CSV format. This screen also allows Users to load and print any appropriate test results.
- Exit Program — Allows a user to exit the application.
- Run Test — Allows a user to run a leak test. This function will present the user with the Run Test Screen.
- Analysis — Allows a user to analyze and print Multiple signature processes (as many as five in the Analysis screen).

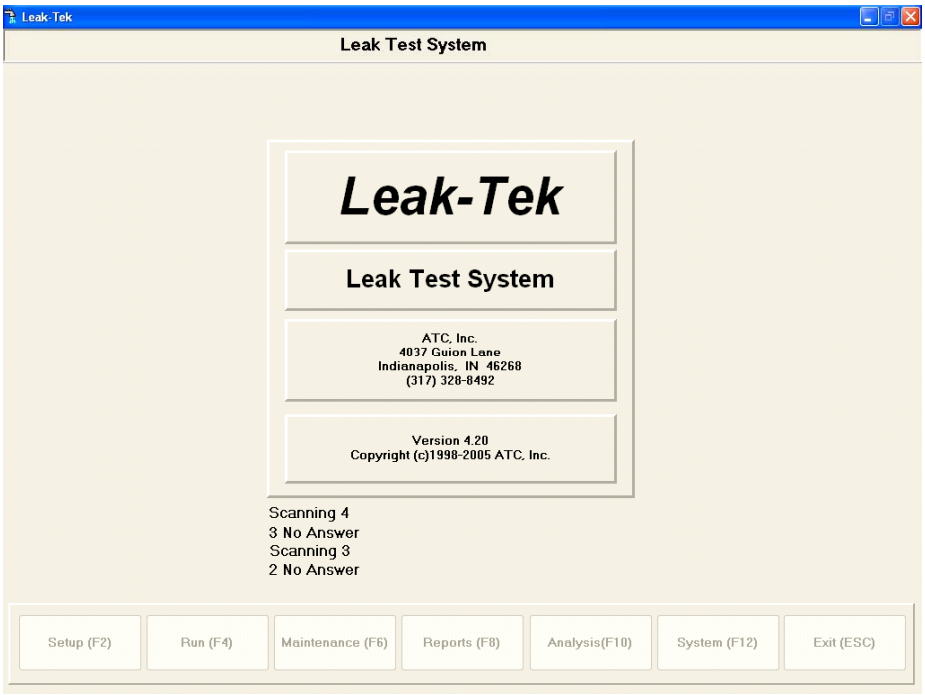


Figure 9 Leak-Tek Main Screen

(The text shown near the bottom of the screen occurs when IGLS/IGFS communication has been established.)

When the Leak-Tek program opens, it will attempt to establish communication with IGLS units attached to the communications port defined in the INI file. As shown in Figure 7, Leak-Tek will display text in the lower part of the Operations screen as it attempts to find IGLS/IGFS units. IGLS/IGFS units that are “seen” by Leak-Tek for the first time are assigned a Sensor Name, (see section 2.3). Leak-Tek automatically enters sensor information to “Leak Tek.mdb” file. The online IGLS/IGFS sensor version will be automatically detected by Leak-Tek (4.00

version later) as shown in Figure 10. This information will be saved in the same database.

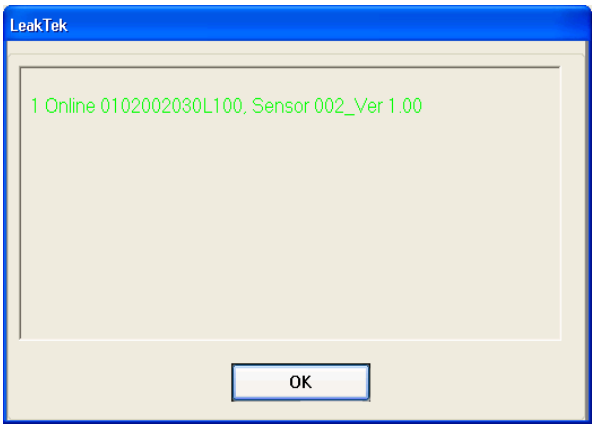


Figure 10 Sensors Scanning Information

2.4 Setup Screen

The Setup Screen, as shown in Figure 11, allows setup of test parameters, creating named tests, and assigning sensors. The following describes these parameters;

- Test ID — The name for a given test. This must be a unique name in the database. Tests with a "-T2" suffix are downloaded to the IGLS as the "second" test type.
- Part ID — The identification of the part. This item's only purpose is to allow a user to make a note in a test setup referencing a part number to a test. This item does not represent any parameter downloaded to IGLS/IGFS units.
- Sensor Name — Allows a user to choose a sensor for a test. The Leak-Tek software assigns a name to a sensor the first time the sensor is "detected" by Leak-Tek.
- Units — Allows users to choose from a pre-defined list of units for temperature, pressure, and flow units. The units chosen will affect the unit displayed in the RUN screen, the IGLS display, and the test

time settings in the Setup screen. (Note: Available temperature units are **Celsius** and **Fahrenheit**. Available pressure units are **kPa**, **kg/cm^2**, **psia**, **inHg**, **inH$_2$O**, and **psig**. Available volume units are **cc**, **L**, **cf**, and **gallon**. Available Mass units are **g**, **mg**, and **µg**. Available time units are **sec**, **min**, and **hour**. Users can also select **sccm**, **slm**, and **scfm** from the time unit's menu. Users should verify that the correct gas type is in use when mass flow is used.)

- Flow/Leak — Allows setting the minimum and maximum flows/Leaks allowable for a test. Due to the internal algorithm of IGLS/IGFS units, minimum flow should be set to -0.1 for flows that are 0. If the mass extraction method is used, all the flow settings are in total leak during the test time.

- Gas Information — Allows a user to select from a list of pre-defined gases and selects the appropriate gas viscosity and universal constant for use in mass flow testing.

- Pressure Settings — Defines a set pressure at which to perform the test. The user can also set high and low pressure limits at which the system will indicate a test failure. Checking the "Deplete Pressure" box will cause pressure to be depleted at the end of a test. The default is to hold pressure.

- Time — The "Time" group enables setting the times used for clamping and filling a unit under test (UUT), as well as time for flow stability and the time used to actually test the UUT.

- Add Setup — Creates a test record for a part. Supply a new test name in order to complete the new record. Other parameters will default to the previously displayed settings. If test "type 2" is chose, Leak-Tek will add the "-T2" suffix to the Test ID.

- Save — Saves Setup Screen parameters to a data file.
- Download to Sensor — Downloads Setup screen parameters to an IGLS unit.
- Upload from Sensor — Uploads setup parameters from a sensor in the test unit.
- Done — Exits the Setup Screen to the Main Screen.
- Print — Prints the current setup information.
- Delete Record — Deletes the current record.
- Previous and Next — “Scrolls” through the test setup database.
- Create SPC — Creates a SPC CSV file, from test data collected from test runs, for a given test. This file will have a SPC file extension, and will be stored in the DATA folder, located in the application folder. This file must be generated from the test history in order to analyze this data in the SPC screen (Referenced in Section 5).

There are two different interfaces in setup screen. Sensor version below 2.0 is as shown below in figure 11. Sensor version above 2.0 is as shown in Figure 12.

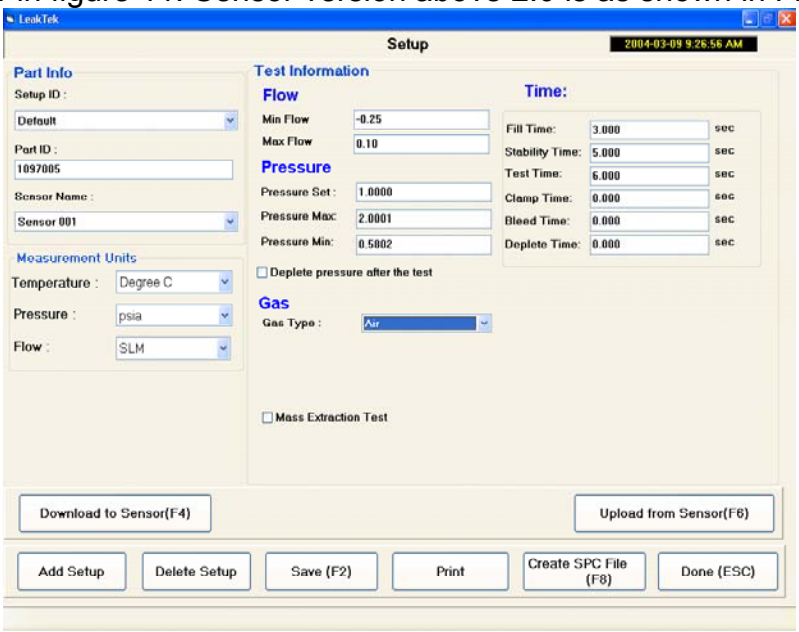


Figure 11 Setup Screen for Sensor Version 1.0

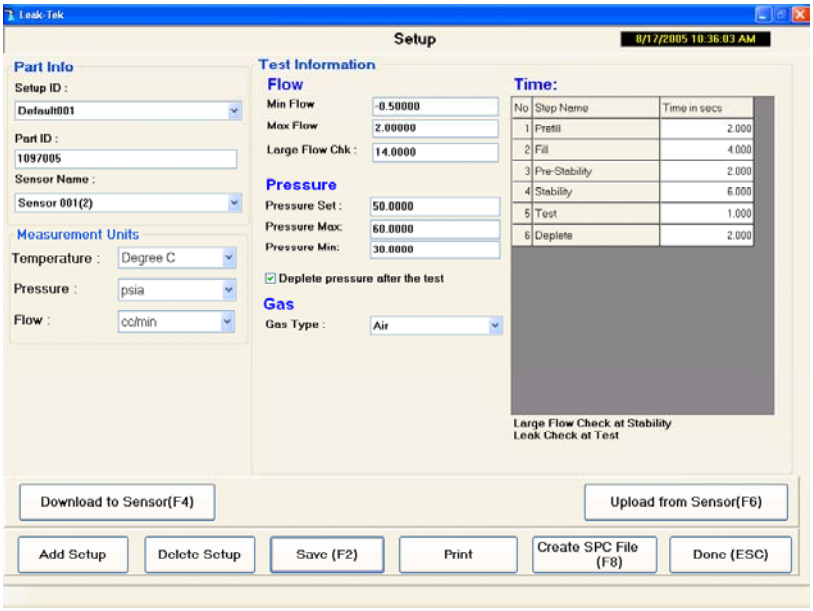


Figure 12 Setup Screen for Sensor Version 2.0 Later

2.5 Changing Settings

To change the current test setup in an IGLS, download the new parameters to the unit using the DOWNLOAD TO SENSOR button. (Note: Change the Sensor setting to match the unit being configured.) Multiple tests may have the same Part ID; however, each test must have a unique name. Unique sensor names must be defined in the configuration screen (Note: Leak-Tek will assign a name to the sensor automatically, as the sensor is “detected” by Leak-Tek). Sensor names that have not been defined will be inaccessible from the setup screen.

Attempts to provide test criteria beyond the ability of the IGLS assigned to that sensor name will result in an error message.

2.6 Test Settings

2.6.1 Sensor version below 2.0 Test

a. Conventional Leak Test Steps
A Conventional IGLS/IGFS test cycle has four steps. The first, CLAMP, is used to allow enough time for a pneumatic clamp to seal around an entry point into a UUT. If the test system does not use a clamp, the time of this step may be set to zero. The second, FILL, allows a bypass valve to rapidly fill a UUT and avoid saturating the IGLS with high flow. The third step is STABILITY. The stability time allows a system to “settle down” so airflow is not bouncing back and forth through the IGLS. The fourth step of the test cycle is TEST. During the TEST time the IGLS/IGFS unit

repeatability checks the UUT to see that it meets the criteria set in the Flow and Pressure settings (V1, V2, K1, and K2). If at any moment there is failure, the IGLS will indicate failure to both the Leak-Tek software and the IGLS electrical I/O lines (see IGLS/IGFS manual). If a test is set to NOT deplete pressure at the end of a test, then the IGLS will continue to re-test the UUT. If the UUT can meet the test criteria during a re-test, the unit is flagged as “PASS” by the IGLS.

b. Mass extraction Test
When the mass extraction method is used, the stability time is usually set as short as possible (such as 0.025 sec). The depleting time should be set to zero for mass extraction test.

c. Bleed Step Feature
Bleed valve feature has been added since Leak-Tek 2.9 with the IGLS firmware 1.60. The bleed valve will be kept at close position throughout the test if it is set to 0. If the bleed valve is set to a number other than zero, it will open at the beginning of the test and remain in this position until the timer setting after filling is finished.

d. Pressure Switch Test
Pressure switch (specification such as 150 psig) feature has been added since Leak-Tek 3.12. This pressure switch should be detected “on” before test during the filling stage, and be detected “off” after test during the depleting stage. If the pressure switch is not in right position, gross leak or blockage fail will be displayed, and the test will fail. Depleting time should be set to zero for mass extraction test. If the deplete time is set to zero, pressure switch check will be bypassed. If the depleting time is longer than filling time, the pressure switch check during the filling stage will be bypassed.

e. Pre-fill Step
For sensor version 1.915, pre-fill step is added in to check Gross leak.

2.6.2 Sensor version above 2.0 Test

When IGLS/IGFS above version 2.0 is selected, up to 14 test steps can be added, with seven different valves available in the system. Each step valve combination can be configured by an administrator. Tests will follow the setup sequence and “open” or “close” specified valves at certain times.

For Mass extraction, “adaptive test” and “flow auto zero” methods can be disabled or enabled when appropriate sensor types are configured.

When “adaptive test sensor” is selected, adaptive test parameters can be viewed and edited as shown in Figure 13 and Figure 14.

When “ Auto zero/Relative Measurement” is checked, then Relative Measurement parameters “ High flow relative measurement” and “ Low flow relative measurement “ can be viewed and edited as show as in Figure 13 and 14.

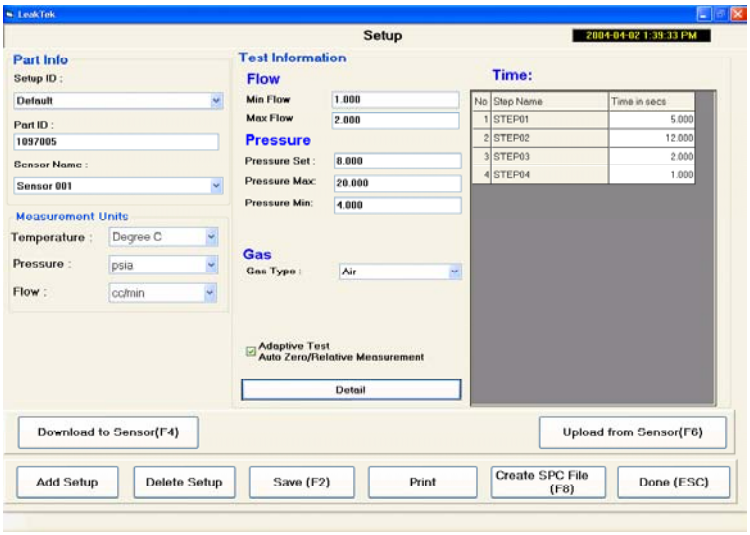


Figure 13 Special Features Enabled in Setup Screen

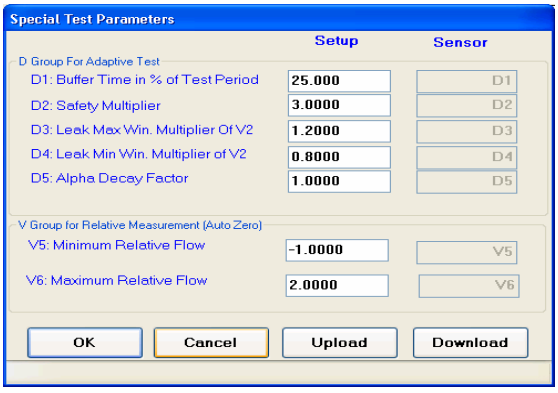


Figure 14 Adaptive Test and Relative Test Parameters Screen

Adaptive Test is not a fixed length test. Based on a sensor general behavior to flow, the sensor will determine the “leak unit” or “non-leak unit” by the D group parameters in sensor. Early detection will shorten the test time.

D1 Buffer time in %, usually about 1/5 or 1/10 of the test step duration. This time is used as a FIFO buffer length to collect data.

D2 Safety multiplier indicates how stable flow is in the buffer (This is usually set between 2 to 6).

D3 Test Start Leak Max Window multiplier of V2 (1.2)

D4 Test Start Leak Min Window in multiplier of V2 (0.8)

D5 Alpha curve decay factor is for the adaptive calculation (This is usually set between 0.6 to1).

Note:
To setup D group parameters, please refer to manual *IGLS Adaptive Test Analysis Utility*

Warning:
For IGLS version before 2.2.0, D3 shall be set to 1.0 all the time.

If Mass Extraction or Adaptive Test is enabled, the “depleting pressure after test” parameter in the setup screen has no impact on the sensor.

If Relative Measurement feature is enabled, V5 and V6 parameters are shown up as Figure 14.

Note: the download button in adaptive screen is locked by system password.

Warning:
The test time for each step shall not be zero. If any step test time is equal to zero, it will be changed to “0.01” (version 2.00.00 or later) or “0.025” (version before 2.00.00) by program for downloading to IGLS/IGFS. An “upload from sensor” & “save” need to be performed after downloading to sensor.

Section 3: Run Test Screen

3.1 Run Screen

The Run Test Screen, as shown in Figure 16, allows the user to choose one of the following functions,

- Sensor Select — Allows a user to choose a sensor for a test. This feature is disabled in single unit systems.
- Save — Saves test data to a file for SPC analysis.
- Auto Save — Automatically saves test data into a data file for SPC analysis upon each test conducted.
- Signature — Allows a user to view and/or print a graph of a tests' flow and pressure in real-time. Note: Only one sensor should be “on-line” when using this function. Leak-Tek will warn a user to only have one IGLS on-line at a time. Failure to comply with this prompt will lower the number of data points available to the graph. When a graph is displayed to the screen a CSV file, as shown in Figure 11, is created in the DATA folder of Leak-Tek. The file name will be defined by the user. A Message-box is prompted to input name. When there exist a file with the same name, the program gives an option to overwrite or not. The new file will contain all data points for the signature. The file can also be used as spreadsheet for analysis. This feature is disabled for IGLS units that do not match the IGLS name stored in the Test record.
- Done — Allow a user to exit the Run Test Screen and return to the Main Screen.

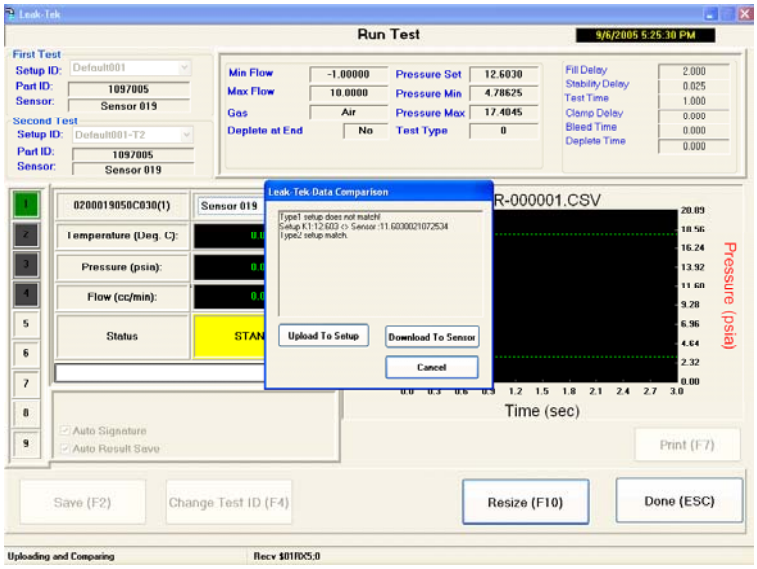


Figure 15 Message Window for Data in Setup and Sensor Comparison

Leak-Tek gives two options to make data in setup and sensor fit each other. The user can either “Upload data from sensor to setup” or “Download data from setup to sensor”. The program could be running continually but the data in sensor may be different from setup. If the data in the setup and sensor match each other, the following message box does not appear.

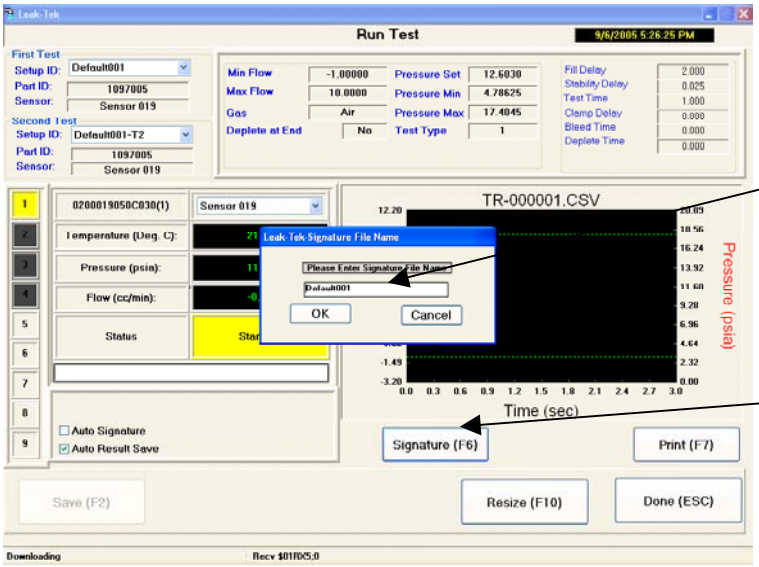


Figure 16 Message Box for Signature

There are two options in signature. If the “Auto Signature” checkbox is not selected, the user can define the name of the file, which is used to store signature data. The default name is current setup Id followed by “.CSV”. When there is a file with the same name, a yellow message will appear to give the user an option of whether the previous file will be overwritten or not.

Figure 17 Auto Signature Enabled

If the “Auto Signature” is checked, all the test signatures will be automatically saved under user defined test ID name together with the test sequence number as shown in Figure17. If the user prefers to change the test ID, the user may simply click the button “Change Test ID”, a screen similar to Figure 18 will appear to allow the user to either select the pre-existing test ID or enter a new one.

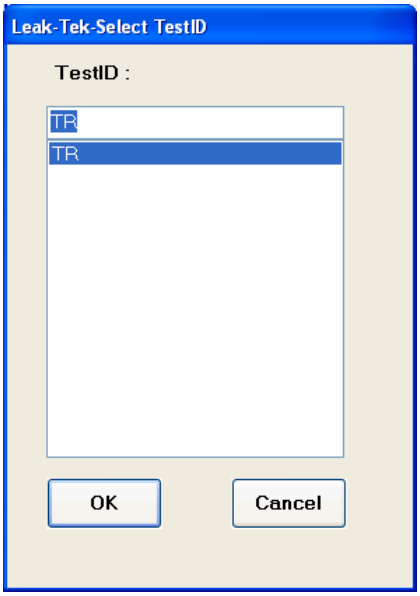


Figure 18 Change Test ID-Auto Signature

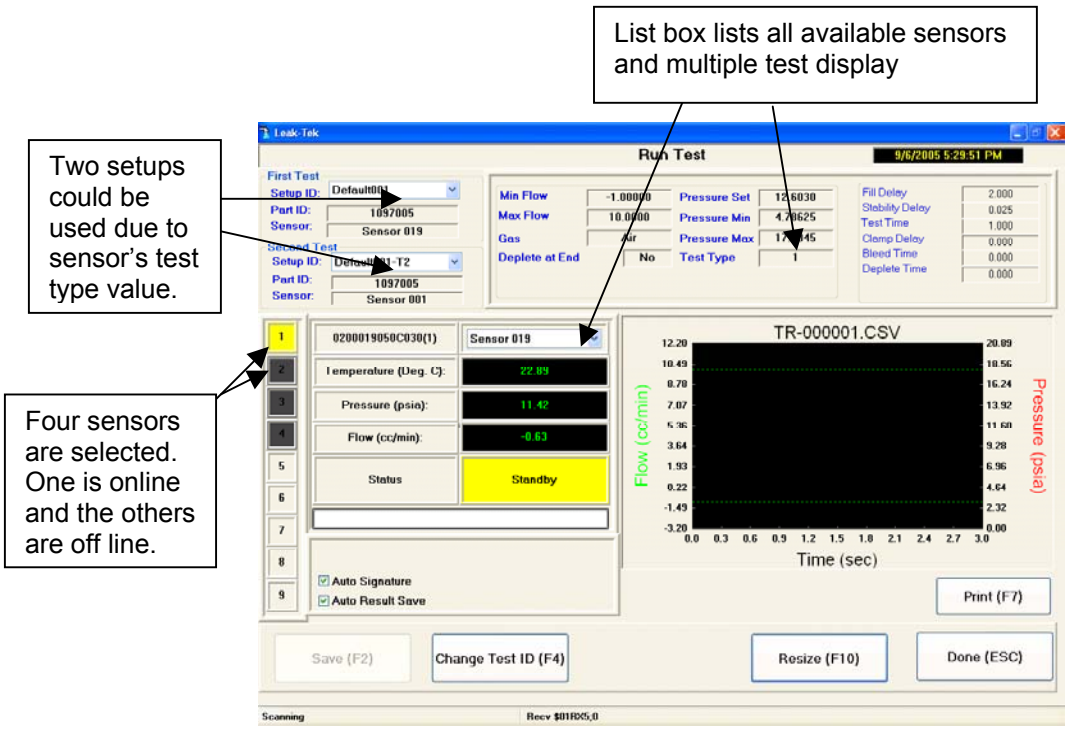


Figure 19 Run Screen with Multiple Test Setup

When the "Multiple Test Type" in INI file is set to "1", Run Screen will display two setups as shown in Figure 18. When the "Number of Sensor" in INI file is set to a value more than 2, the "Run" screen will display appropriate sensor status as shown is Figure19 (If the Number of Sensor" is set to "3", the program will connect to two IGLS Sensors at same time. The color "yellow" symbolizes that the sensor is on–line, while the color "black" means that the sensor is not on-line. No "1" to "9" is the addresses of connected sensors.)

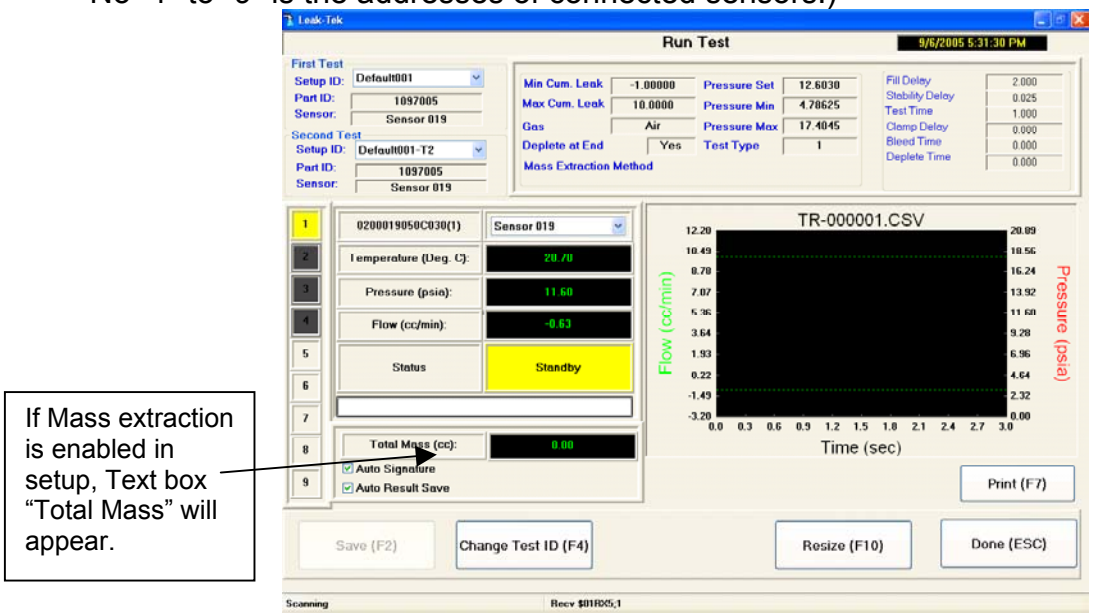


Figure 20 Run Screen with Mass Extraction Method Enabled

Run Test

a. Display and Data Saving.
The Run screen displays a colored message stating the step of a test that is in progress, and the final test result. If the results fail, the reason for failure is displayed at the time of the failure. If the results pass, "PASS" is displayed at the time the test passes. Select the “Save” button in order to store test results in the LeakTek.MDB file. This information can be extracted later from the Setup Screen so the SPC feature of Leak-Tek can be used. Check the “***Auto Save***” in the “Run” screen to automatically save test results. The “Signature” function can only be used for one test at a time. Step time information can be watched in a table by using scroll bar on the top left side with IGLS/IGFS sensor versions 2.0 or later.

b. Test Type
The “Test Type” label, as shown in Figure 18, indicates the current IGLS test. IGLS/IGFS units can perform dual tests and their current test type can be changed with an external switch. Leak-Tek checks the current test type every 1.5 second. As a result, Leak-Tek may take a few seconds before the “Run” screen is aware of the current test type.

If the “Multiple Test Type” parameter in the INI file is set to “0”, the Test Type label will not show and the ability to select a “2nd Test” Test ID from the “Run” screen is disabled. However, if “Multiple Test Type” is set to “0”, any test ID ending with “-T2” will be selected from the "1st Test" feature on the “Run” screen. Such test setups will be downloaded as a "1st test" type.

b. Mass Extraction & Adaptive Test
When Mass Extraction Methods is enabled in the setup, the run screen will display a statement “Mass Extraction Methods is used”. The total leak during the test will be displayed whenever the data is available.

When “Adaptive Test” is enabled in setup, the run screen will display a statement “Adaptive Test”. The predicted flow during the test will be displayed when test step is started.

When “Relative Measurement” is enabled, the run screen will display “Relative measurement” statement. When the “Test step” is greater than the “Zero Flow” step, relative flow measurement will be displayed. During flow base line step, if flow is greater than high flow relative limit, then show high flow relative measurement error and stop the test. If flow is lower than low flow relative limit, then show low flow measurement error and stop the test. If test result is “pass”, “relative measurement pass” will show on the run screen.

Figure 21 Run Screen with Large Flow Display

For IGFS/IGLS version 2.2.0 later, the large flow test result will be displayed in run screen if large leak check enabled.

Figure 22 Run Screen with Two Y Scale Graph Normal Display

Two different scales are used for flow and pressure.

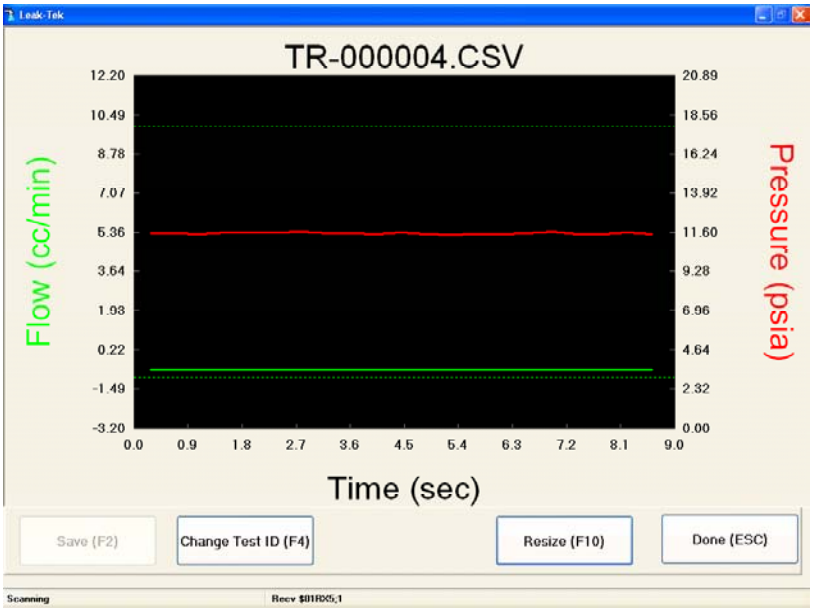


Figure 23 Run Screen with Full Screen Display

The Graph can be resized to full screen by double-clicking it or click resize button.

Note:

When users select different setup in both the “First test “ and the “Second Test” list boxes in the “Run” screen, the data in setup will download to sensor (if the sensor named in setup is the same as the sensor online). Likewise, when users click the “signature” button to start test, the data in setup will download to sensor (if the sensor named in setup is the same as the sensor online).

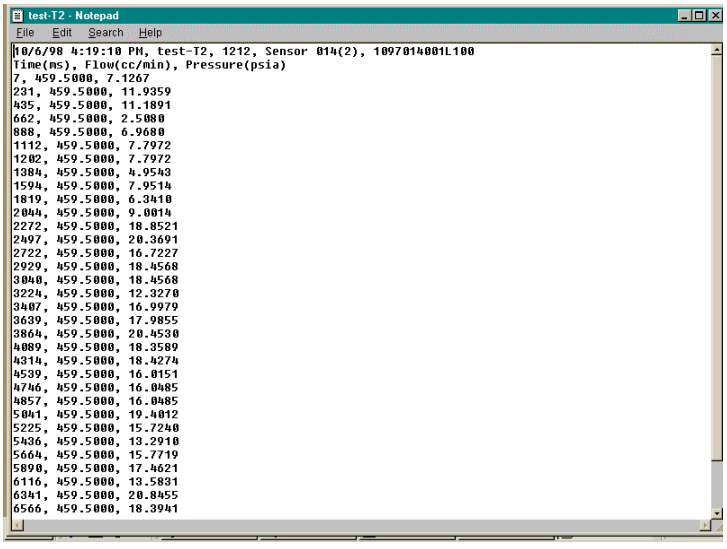


Figure 24 Viewing a Signature File using Notepad

The format of CSV is determined by the program automatically, do not change the format in order to display and analyze the signature process normally.

3.2 Signature and Dynamic Testing

Leak-Tek's Signature feature is designed to assist in determining the best times for filling and stability. The preference for any test is to minimize the overall test time for productivity's sake. Therefore, a user can create preliminary tests that provide signature data outlining the characteristics of a UUT. Figure 25 shows a typical signature for a UUT that does not leak, and has had sufficient time to fill.

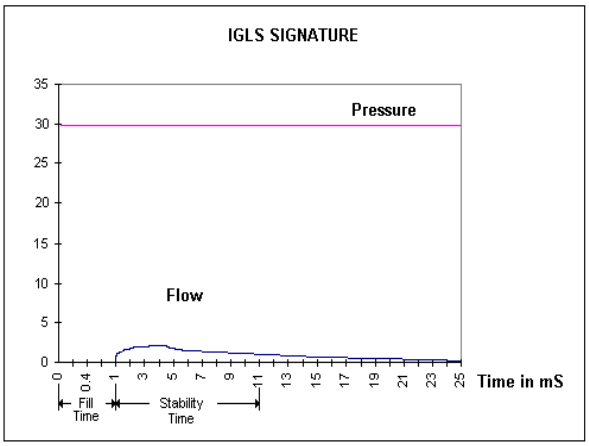


Figure 25 Signature Graph of a Typical UUT with Sufficient Fill Time

UUTs that are not leaking should have flows that approach zero and pressures that reach a stable reading during the Stability time. Insufficient fill times produce signatures similar to Figure 25.

Note: When dealing with large volume and UUT that do not leak, flow reading may be negative due to possible back flow condition and mass exchange between the system volume and the UUT volume.

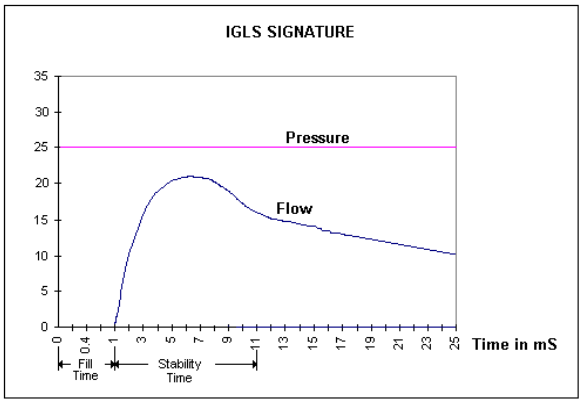


Figure 26 Signature Graph of a typical UUT with Insufficient Fill Time

UUTs that leak typically produce a signature like Figure 27. Such components never completely pressurize and never have a zero-flow.

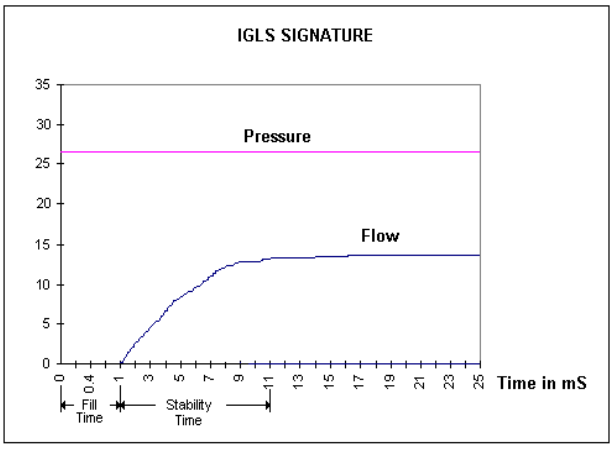


Figure 27 Signature Graph of a Typical UUT with a Leak

Users may wish to perform tests that require times that are too short for a normal fill and stability. Users can perform multiple tests on products with “normal” versus “abnormal” behavior. In such cases a user can generate several signatures. The purpose of such data is to compare the characteristic curves of each tested item.

Section 4: System and Sensor Configuration Screens

4.1 Passwords in Leak-Tek

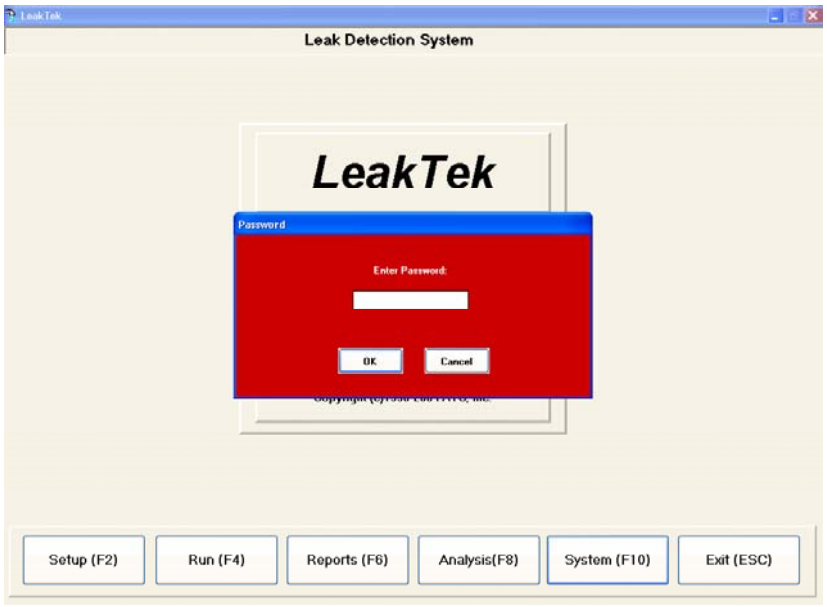


Figure 28 Password Input Screen

System, setup and sensor configuration screen are password protected. There are two level passwords in Leak-Tek 4.00 later. A General password can go through system and setup screen. A System password can go through system, setup and sensor configuration. Those two level passwords can be modified in the sensor configuration screen. Once the password is confirmed, the system configuration screen will be displayed.

If the system level password is typed in when “system” button or “F10” is clicked, the sensor configuration screen can be accessed without typing in password.

4.2 System Configuration

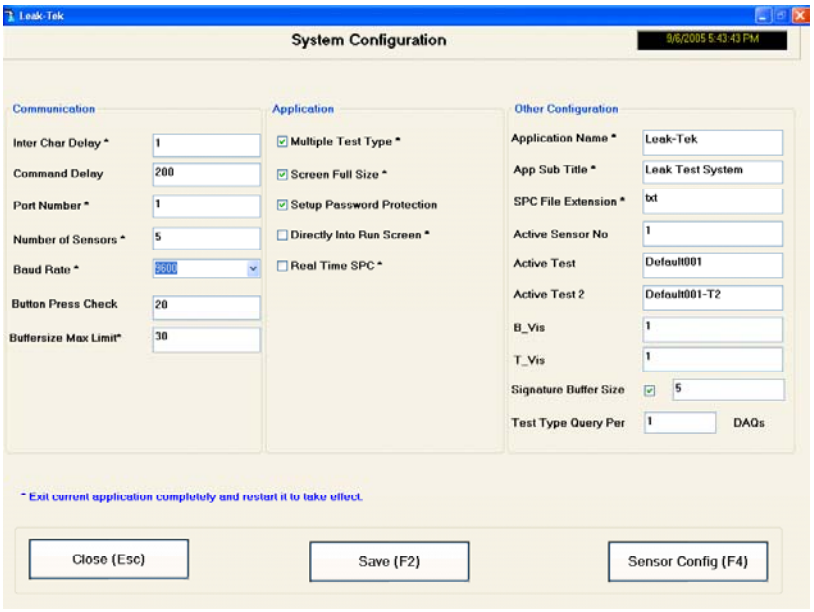


Figure 29 System Configuration Screen

The system configuration screen protected by system password, as shown in Figure 29, allows the user to choose one of the following functions:

- Save — Save system parameters shown on the current screen.
- Sensor Config — Prompts system level password input screen. If the password is verified, sensor configuration screen will show up. If system level password already verified before system configuration screen, sensor configuration screen can be accessed directly.
- Close — Exits the System Configuration screen and return to the Main Screen.

Caution: Only qualified persons should attempt to use this screen. Inappropriate use of this screen may result in slow down program performance and losing communication with IGLS/IGFS.

4.3 Sensor Configuration Screen

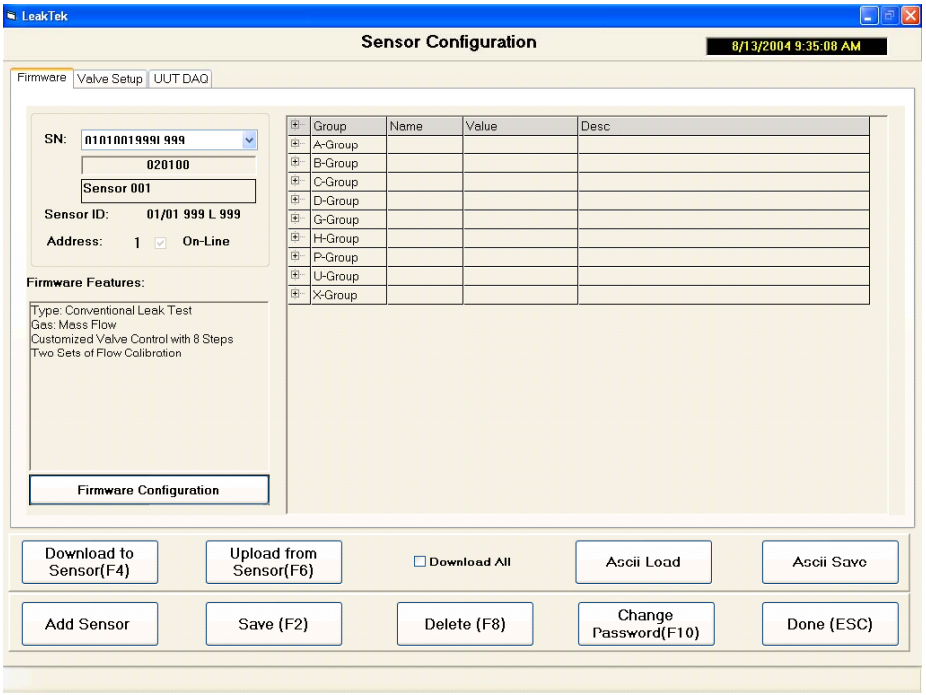


Figure 30 Sensor Configuration Screen

In order to protect sensor parameters integrity, Sensor configuration screen can be only accessed with top level password provided. The Configuration Screen, as shown in Figure 28, allows the user to choose one of the following functions:

(Note: This screen is system password protected)

- Save — Save sensor configuration parameters to “leaktek.mdb” database file.
- Download to Sensor — Download configuration parameters to IGLS sensor in the test unit.
- Upload from Sensor — Upload configuration parameters from a sensor in the test unit.
- Done — Exits the “Configuration” Screen and returns to the Main Screen. Password protection is reset.
- Calibration Functions — There are three calibration buttons on the configuration screen for future design. However, the button selected determines

	the actual sensor calibration to be performed in the “Calibration” screen.
• Auto Zero Flow	Allows setting the zero point for flow.
• ASCII Save	Allows saving Configuration data to an ASCII file.
• Change Password	Allows changing the password to the “Configuration” screen.
• Configuration Selection	Tab selection from Firmware, valve setup and UUT DAQ.
• ASCII Load	Allows loading of previously saved ASCII configuration data from a file.
• Deleted	Allows for deleting sensor information in a database file.
• Firmware Configuration	Allows for configuring the sensor type.

Also included in the “Configuration” screen are the parameter settings of the IGLS/IGFS. These parameters are set by group, as indicated in the IGLS manual and the following tables.

Note that IGLS/IGFS units that have dual testing abilities have two sets of V, T, and K parameters. Those parameters are accessible from the “Configuration” screen for convenience purposes when multiple test type is enabled.

Caution: Only qualified persons should attempt to use this screen. Inappropriate use of this screen may result in IGLS/IGFS calibration corruption, corrupted pressure control, and IGLS/IGFS serial number corruption.

4.3.1 Firmware Configuration

The Sensor of choice can be selected from a pull-down combination list. The sensors name, address and version information will be displayed in the top left of "Sensor Configuration" screen. The software will detect if the selected sensor is on-line or off-line.

The version number format is "XXXXXX" (For example, if "020100" is display in version label on the screen). The first two bits are the main version number and the remaining digits are the modified version number (The version number of the previous example is 2.01).

When the selected sensor's version number is more 2.0 or larger, the "Firmware Configuration" button is enabled. The "Firmware Option" screen will be prompted as shown in Figure 28 by clicking the "Firmware Configuration" button.

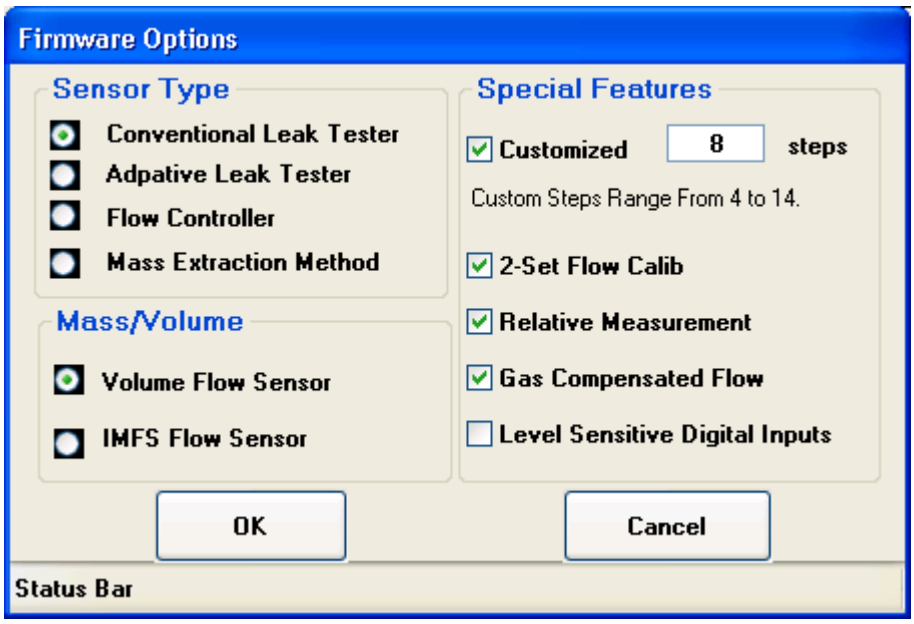


Figure 31 Firmware Option Screen

As shown in Figure 29, three main information sections can be configured in the "Firmware Option" screen.

a. Sensor Type Main Usage of the Sensor (single selection).

- Conventional Leak Tester
  The senor is used to detect leaks by the current specified reading. If the current reading is in the specified range, the UUT will pass the test.

- Adaptive Leak Tester
  Based on the sensor' general flow behavior, the senor can detect leak early in the test step.

- Flow Controller

- Mass Extraction Method
  The senor is used to detect leak by accumulated mass.

b. Mass/Volume Molecular/Volume Sensor (single selection)
   - Volume Flow Sensor
     Base unit cc / min

   - IMFS Flow Sensor
     Base unit ug / min

c. Special Features (multiple selections)
   - Customized Steps
     If the IGLS/IGFS uses only internal valves to do the test, the standard IGLS/IGFS should be used.
     If the required valves are more than just the internal valves, then customized steps can be configured (from 4 -14 steps). For details, refer to the valve configuration section.

   - 2-Set Flow Calibration
     If the flow sensor has different flow behavior in two sections, 2 set flow calibration could be used. One is for low flow range and the other for high flow range.

   - Relative Measurement
     If this feature is selected, X9 is enabled to set a step as a flow base line. "Flow Auto Zero" will be in the X9 step. For details refer to the valve configuration section.

   - Gas Compensated Flow
     Flow is compensated by gas and viscosity.

   - Level Sensitive Digital Inputs
     If the start signal is used as the level sensitive digital inputs, the test will be repeated after the previous test is finished.

After the firmware options are selected, all changes will be downloaded to the sensor once "OK" is clicked. The selected firmware features will be displayed in the screen. Then Leak-Tek will automatically upload all information from the

sensor to the display screen. It is recommended to save this information to a database.

Caution: Only qualified persons should attempt to use this screen. Inappropriate use of this screen may result in destruction of the IGLS/IGFS Sensor.

4.3.2 General Group Configuration (A-X)

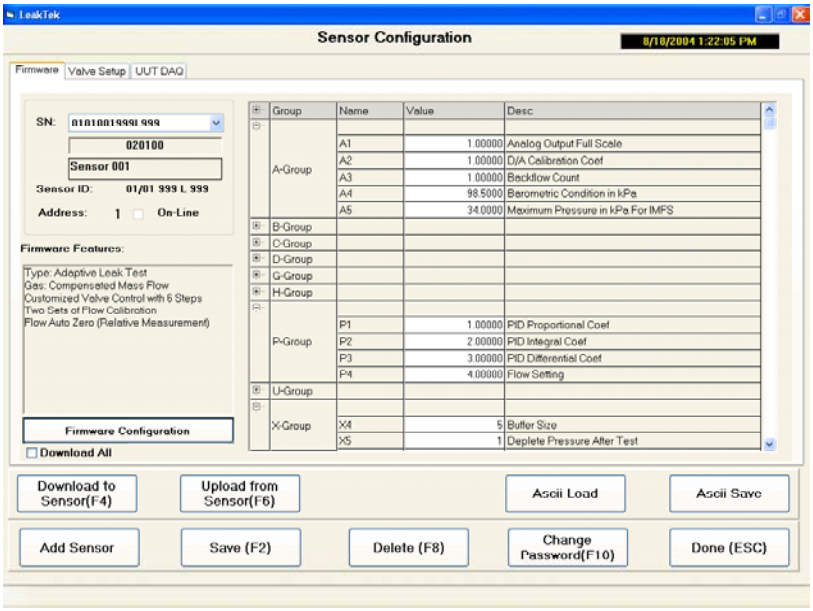


Figure 32 Parameter Groups in Sensor Configuration

General sensor parameters can be viewed and edited in the firmware selection. A Group can be displayed by clicking the “Plus” symbol and hidden by clicking the “Minus” symbol on the left side of the group table as shown in Figure 30.

If IGLS/IGFS baud rate (U7) is changed, IGLS/IGFS will need to be powered on once more to take effect. The baud rate in Leak-Tek should be the same as that of IGLS/IGFS.

Only the parameters related to the “Firmware Configuration” can be accessed. For all details, refer to group parameter description and the IGLS/IGFS manual.

4.3.3 Valve Configuration (L, O, X)

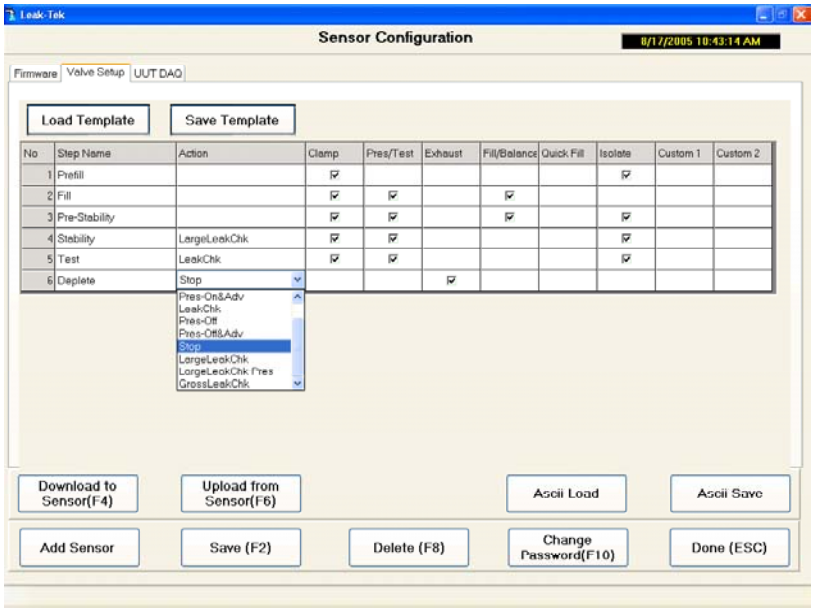


Figure 33 Customized Valve Configuration

In this section, the administrator can configure steps 4 to 14. It is also important to realize that the number of steps is configured in the “Firmware Configuration”. The customized step names are linked to the “L” group in the IGLS/IGFS sensor, while the valve combinations are linked to “O” Group.

The Pull-down combination box in the “Action” column, lists 6 options for the current step action as shown in Figure 32.

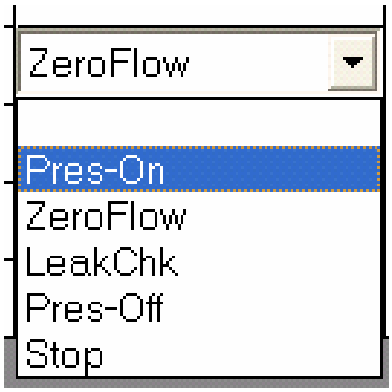


Figure 34 Step Action List

Action List Descriptions

Action	Description	Version
“LeakChk”	Configured as the test step (X3)	2.0.0 or later
“Stop”	Staring step of the depletion	2.0.0 or later
“ZeroFlow”	If the “relative measurement” feature in firmware configuration is selected, one step must be configured as a flow baseline step. This step number is downloaded to IGLS/IGFS’s X9 parameter.	2.0.1 or later
“Pres-On”	If the pressure switch ON State is detected at any time in the step, it will satisfies the check	2.1.1 or later
“Pres-Off”	If the pressure switch OFF State is detected at any time in the step, it will satisfies the check	2.1.1 or later
“Pres-On&Adv”	Once the pressure switch ON sate is detected, it will move on to next step immediately	2.1.1 or later
“Pres-Off&Adv”	Once the pressure switch OFF sate is detected, it will move on to next step immediately	2.1.1 or later
LargeLeakChk or LargeLeakChk-Pres	If “LargeLeakChk” is selected, large leak check will be performed at that step. Large Leak flow check criteria are “V7”, If “LargeLeakChk-Pres” is selected, large leak pressure setting criteria are “K5”,”K6” and “K7” as well as Large Leak flow check criteria are “V7”.	2.1.2 or later
GrossLeakChk	basic check such as sensors’ checking and pressure checking will be performed at the end of this step.	2.2.0 or later

Pressure Check step must follow a sequence.
“Pres-On” or “Pres-On&Adv”
“LeakChk
“Stop”
“Pres-Off”

Note: Loading and Saving Valve configuration template are available for users to configure sensor easily for future usage. In order to load a template valve configuration template file, the customize step number in the firmware must be

configured the same as that in the template file. It is recommended that the user save the changes before editing the UUT DAQ parameters.

4.3.4 UUT DAQ (K, V, T, Units)

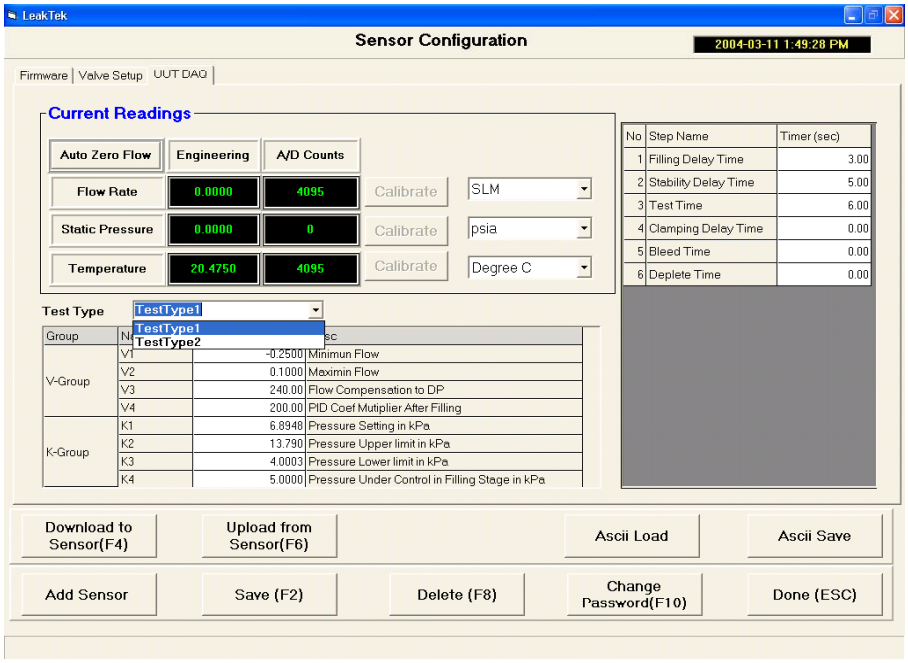


Figure 35 UUT DAQ Configuration

The Test type related parameters are; K for pressure, V for flow and T for Test time, and can be viewed and edited in the “Sensor Configuration” screen.

If multiple test type is enabled in the “System Configuration”, the parameters can be switched from one test type to another test type by clicking the “Test Type” pull-down list box on the screen.

Displayed units of flow, pressure and temperature are selected from the unit combination pull-down box.

Another way to configure the current sensor is loading the parameters from an ASCII file. After loaded, a download operation needs to be performed so that the parameters can be downloaded to the sensor. The firm configuration and valve configuration can only be downloaded when the senor version is 2.0 later.

4.3.5 Parameters Description

Here is a reference for sensor configuration.

A-Group

Group	Description
A1	Analog Output Full scale corresponding flow in cc/min
A2	Coefficient of D/A calibration, depending on the reference voltage as well

	as the max. Pressure of the proportional air valve.
A3	Backflow if count reading in DP is less than A3
A4	Barometric condition of the pressure in kPa
A5	IGFS version 2.x only **For Volume Sensor, Minimum Pressure** **For IFMS, Maximum Pressure**

B-Group

Command	Description
B1	Temperature Calibration Slope(C/Count)
B2	Temperature Calibration Offset(C)
B3	Temperature Compensation Flow Coef, 2nd Order
B4	Temperature Compensation Flow Coef, 3rd Order
B5	IGFS version 2.x only **Calibrated Temperature in Deg C** **Used for flow compensation when calibration temperature is much different from working temperature**

C-Group

Command	Description
C1	Offset Flow Coef(cc/min or µg/min)
C2	First-order Flow Coef (cc/min/count or µg/min/count)
C3	Second-order Flow Coef (cc/min/ $count^2$ or µg/min/ $count^2$)
C4	Third-order Flow Coef (cc/min/$count^3$ or µg/min/ $count^3$)
C5	**Offset Flow Coef for Low Flow (cc/min or µg/min)**
C6	**First-order Flow for Low Flow (cc/min/count or µg/min/count)**
C7	**Third-order Flow for Low Flow (cc/min/ $count^2$ or µg/min/ $count^2$)**
C8	**Third-order Flow for Low Flow (cc/min/$count^3$ or µg/min/ $count^3$)**
C9	**Percent Divider (such as 10)** Counts in full scale which is low than that value belong to Low Flow Section
CA	**Smooth % (such as 1%)** Range window for two calibration lines link together.
CB	**Calibrated Gas Constant** If Gas compensated method and IFMS is selected, this value should be set for flow calculation.
CC	**Calibrated Gas Viscosity** If Gas compensated method and Volume sensor is selected, this value should be set for flow calculation.

D-Group

Command	Description
D1	**Buffer In % of the Test Period**
D2	**Safety Multiplier =2 to 6**
D3	**Start Leak Window Max in Multiplier of V2**
D4	**Start Leak Window Min in Multiplier of V2**
D5	**Alpha Decay Factor (0-1)**

G-Group (Gas Information)

Command	Description
G1	Universal Constant of the Gas: necessary if mass flow unit is selected
G2	Viscosity at 0 degree C. currently not implemented
G3	Viscosity change per degree C. currently not implemented
G4	Density of the gas at standard barometric condition in mg/cc

H-Group

Command	Description
H1	Pressure Calibration Slope(kPa/count)
H2	Pressure Calibration Offset(kPa)
H3	Pressure Compensation Flow Coef, (2^{nd} order)
H4	Pressure Compensation Flow Coef, (3^{rd} order)
H5	**Calibrated Pressure in kPa** Used for flow compensation when calibration pressure is much different from working pressure.

K-Group

Command	Description
K1	Pressure Setting for Leak Test mode (kPa)
K2	Pressure Upper Limit(kPa)
K3	Pressure Lower Limit(kPa)
K4	*IGFS Version 1.x Only* Used to provide the Pressure Setting Value during Filling, (Psvf). This value is computed as Psvf=K1-K4.
K5	**Pressure Setting for Large Leak Check (kPa)**
K6	**Pressure Upper Limit for Large Leak Check (kPa)**
K7	**Pressure Lower Limit for Large Leak Check (kPa)**

L-Group

	New
L1…LE	**Phase Label for Customized Step** (if customized steps are configured from 4 to 14)

O-Group

	Description
O1…LE	**Phase Valve Configuration for Customized Step** (if customized steps are configured from 4 to 14)

P-Group

	Description
P1	PID Proportional Coef
P2	PID Integral Coef
P3	PID Differential Coef
P4	Flow Setting for flow control mode in cc/min

S-Group

	Description
S1	Serial Number XX XX XXX XXX X XXX 1 2 3 4 5 6 1 = Release of month. i.e. 06=June 2 = Release of year i.e. 04=2004 3 = 3digit serial No i.e. 022 4 = Maximum Flow i.e. 090=90 ,120=120, 12H=1200, 12K=12000 5 = Flow Unit i.e. C=CCM, L=LPM 6 = Maximum Pres in psia i.e. 500=500, 12H=1200, 12K=12000
S2	**Version No. Format "000000" i.e "020000"=2.0** Version 1.x will return SN string

T-Group

Command	Description
T1	Filling delay time in 10 ms or Step Timer, *ver 1.x timer is in 25 ms*
T2	Stability delay time in 10 ms or Step Timer , *ver 1.x timer is in 25 ms*
T3	Test time in 10 ms or Step Timer, *ver 1.x timer is in 25 ms*
T4	Clamping delay time in 10 ms or Step Timer, *ver 1.x timer is in 25 ms*
T5	Step Timer in 10 ms or *Bleed time in 25ms for ver 1.x after filling is done*
T6	Step Timer in 10 ms or *Deplete time in 25ms for ver 1.x after test is done*
T7-TE	**Step timer in 10ms**

U-Group

Command	Description

U1	Address from 0-1
U2	Sensor Firmware Configuration , Format “0xFFFFFFFF” 4th Byte Sensor Type Conventional Leak Tester =0 Adaptive Leak Tester=1 Flow Controller=2 Mass Extraction Method=3 3 rd Byte 2 nd Byte 0x 1 1 1 1 1 1 1 1 4 3 2 1 1: Valve Control Standard 0x0 Customized 0x1-0xF 2: Flow Calibration 0: one set calibration 1: two set calibration 3: Relative Measurement set to 1 to enable X9 4: Digital Input Pulse/Level 1st Byte Bit 0 : Measurement Sensor 0: Volume Flow Sensor cc/min as Base Unit 1: IFMS Sensor µg/min as Base Unit Bit 1 : Gas Compensation 1: Gas Compensation Enabled Universal R Adjustment for Mass Flow Base G1 and CB are enabled Viscosity Adjustment for Volume Flow Base G2, G3 and CC are enabled 0: No Compensation Only G1 , G4 are enabled *For version 1.x Mode:* *0 Manual Test Mode* *1 Auto Test Mode* *2 Flow Control Mode* *3 Measurement Mode* *4 Calibration*
U3	Temperature Unit 0: Degree C 1: Degree F
U4	Pressure Unit 0: kPa 1: kg/cm2

	2: psia 3: inHg 4: inH2O 5: psig 6: Torr
U5	Flow Unit High Nibble 0- cc 1- cf 2- liter 3- gal 4- gram 5- mg 6- ug Low Nibble 0- sec 1- min. 2- hour 3- SCCM etc. 16 * High Nibble + Low Nibble Besides: 7*16+3 for SCCM 8*16+3 for SLM 9*16+3 for SCFM 10 *16+3 for SCCSe-6
U6	0 : Short format (One string of response to SQ1 command) 1: Long format (Two string of response to SQ1 command)
U7	**Baud rate:** **0: 9600** **2:19200** **4: 38400** **12: 115200** Version 1.x *Test result will hold if set to other than zero* *The LCD will be disabled If U7=2 and measurement mode is selected*.
U8	**Hold Results Time in U8 *10ms** Version 1.x *The number of cycle to hold after the test (1-100)*
U9	**Mass extraction, adaptive test or relative measurement is enabled if set to other than zero.** Version 1.x *Mass extraction method is enabled if set to other than zero*

V-Group

	Description
V1	Min flow alarm for leak test mode in cc/min, ug/min or selected unit based on X6
V2	Max flow alarm for leak test mode in cc/min, ug/min or selected unit based on X6 For mass extraction method, Max. leak alarm for leak test mode in cc, ug or selected unit based on X6
V3	Flow compensation to DP in kPa/(cc/min) or kPa/(ug/min)
V4	*used only for version 1.x* *PID Coef. Multiplier after filling is done*
V5	**Min flow for relative measurement**
V6	**Max flow for relative measurement**
V7	**Large Leak Check Flow Criteria**

X-Group

Command	Description
X1	**Pressure Switch On Check Step No.** Version 1.x *Enable flag for Clamp valve*
X2	**Pressure Switch Off Check Step No.** Version 1.x *Enable flag for filling valve*
X3	**Leak Check Step No**. Version 1.x *Enable flag for pressure valve*
X4	Buffer Size : Valid from 4 to 100
X5	Enable Flag: Deplete the pressure after the test failure
X6	Default unit is used if set to other than zero Flow in cc/min or ug/min, pressure in kPa and temperature in Degree C
X9	**Flow baseline Step No. for relative flow measurement** Version 1.x *Enable flag: of the initialize the DAC pressure output based on the pressure setting.*
XA	**Stop Test step No.** (this step also used for idle stage valve configuration)
XB	**Large Leak Check Step No. for large leak check** Version 2.12
XC	**Gross Leak Check Step No. for Gross Leak Check** Version 2.20

Section 5: SPC

The SPC Screen, shown in Figure 35, displays an X-Bar chart and R-Chart for data collected from a test, as defined in the “Setup” screen. Such test history is automatically stored in the “leaktek.mdb” file from the “Run” screen after selecting “Save”, or “Auto Save”.
The "Create SPC" function in the “Report” screen or the “Setup” screen must be chosen so that SPC data can be converted to a CSV file and analyzed in the “SPC” screen. When the “create SPC” function is selected in the “Reports” screen, the program will default to the current running Setup. If other Setup is required for this selection, select the correct Setup from the “Setup” screen.

The SPC screen is accessed from the Operations screen through the “Reports” button. Other functions of this screen are as follows;

- Load File — Allows loading an SPC to analyze. Load the same SPC to display in a grid. Displays X-Bar and R charts from ASCII CSV, (Comma Separated Value), files generated from the test screen.
- SPC — Enables examining the SPC analysis of a currently loaded CSV file.
- Print — Allows Printing a leak-test-results report Including “teststatus”;”flow”;”pressure”; “time”;”comment” based on the SPC file
- Create SPC — Creates an SPC CSV file, from test data collected for the current test. This file will have an SPC file extension, and will be stored in the DATA folder, located in the Leak-Tek application folder. The file must be generated from the test history in order to analyze this data in the SPC screen.
- Done — Exits the SPC Screen to the Main Screen.

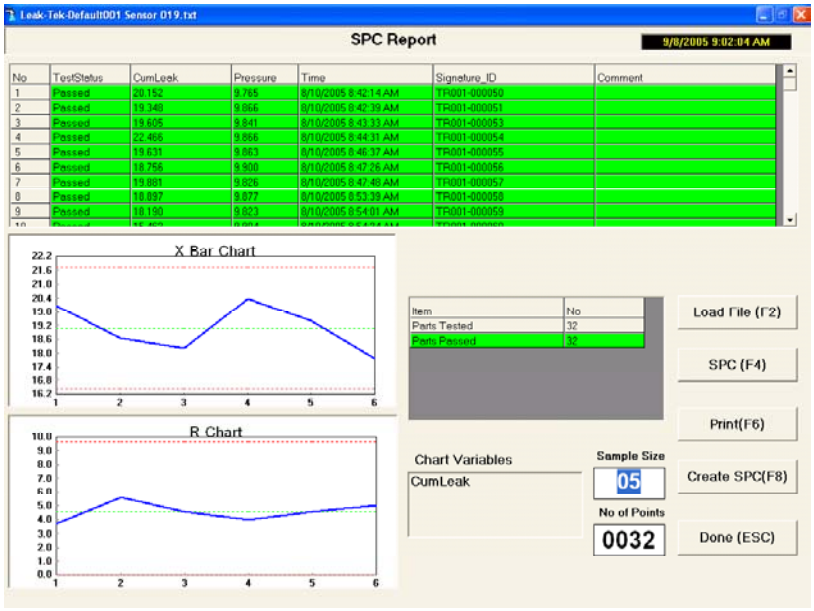


Figure 36 SPC Screen without Large Flow

The X-Bar chart displays a "Moving Average" for a given set of data. The user may set a "Sample Size" of N, as shown in Figure 35. This feature, (minimum size of 2 for N, the maximum is 10), calculates a point on the X-Bar chart, which is the average of N number of data points. (Note: NUMBER OF POINTS will indicate the number of available data points. If a user attempts to set the Sample Size to a value greater than the number of points available, Leak-Tek will indicate an error.) The R-Chart will show the Variance of the data. The Grid on the left side displays the result. When the program is loading a file or display data, a yellow message will appear.

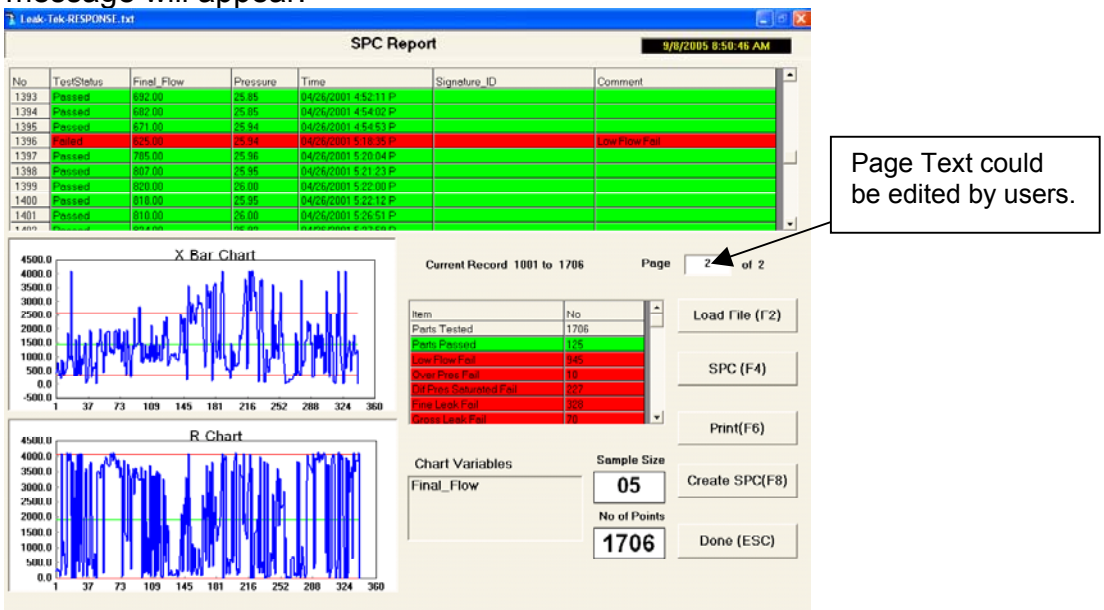


Figure 37 SPC Records More Than 1000

When SPC records are more than 1000, user can select data to display. Please type in the page number, click the “Tab” to display. The label under the table displays the current record range. If the file is very large, the program may need more time to load records.

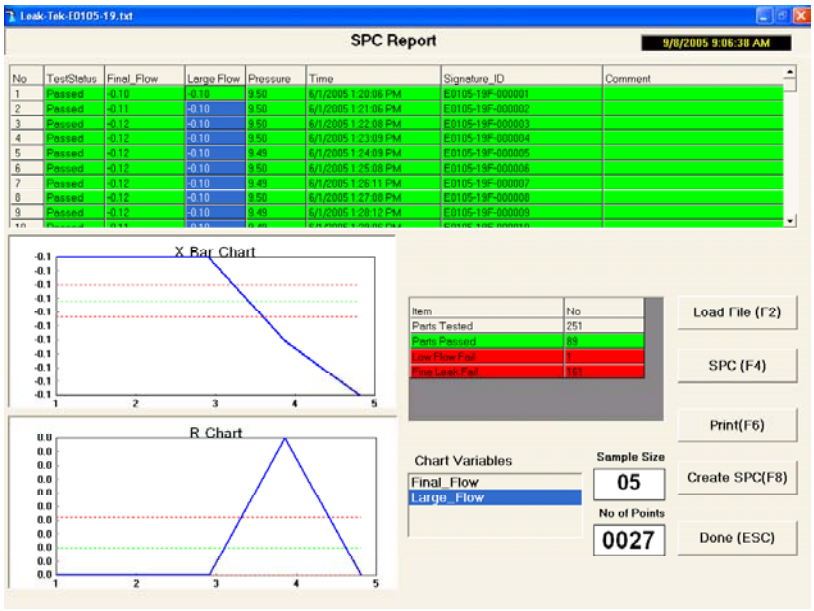


Figure 38 SPC Records with Large Flow

If the sensor of current setup ID has large flow feature, the test results table will include large flow table as figure 37 when the SPC file of current Setup ID is loaded. The test status is shown in the table of middle screen. The chart variables table is used to select the variable to perform SPC analysis.

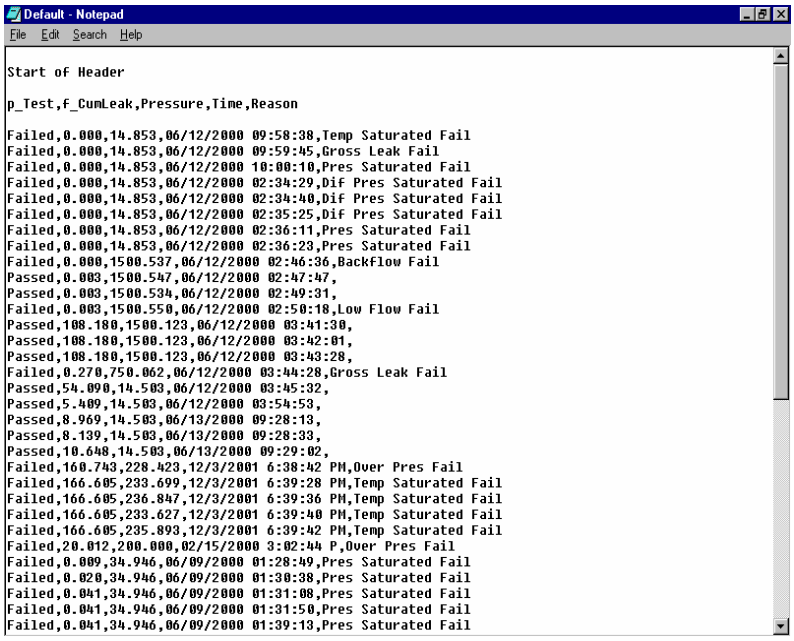


Figure 39 View a SPC Data File Using Notepad

Note: The program designs the format of SPC automatically, do not change the format in order to display and analyze the test results normally. SPC extension can be edited in INI file.

The SPC record columns are changed to “test result, flow, pressure, temperature, time, test comment, signature ID”, large flow.

Section 6: Signature Analysis Screen

The Signature Analysis screen, as shown in Figure 38, displays a chart to show Flow vs. time data. Two list-boxes are used to select files. The user can select from 1 to 5 files to display separately and simultaneously. The “Select All” check box will list all file sources when it is checked. If this box is not checked, the search function will be active and the source file will be selected per the search criteria. The user can also change the axis scales to analyze the signature process.

- Display — Click this button to display the signature files which are selected in left list box. If no files are selected, a message will appear to remind the user to select files.
- Print — Click this button to print a report of the current graph.
- Save Graph — Clicking this button will prompt an input dialogue box to create a file with extension “BMP” or “JPG” to save the display graph.
- Change Scale — Allows the user to change the graph axis scales by using an input box to input appropriate scales.
- Change Mode — Allows the user to change the graph color and add markers.
- Done — Allows the user to exit the Signature Analysis Screen and return to the Main Screen.

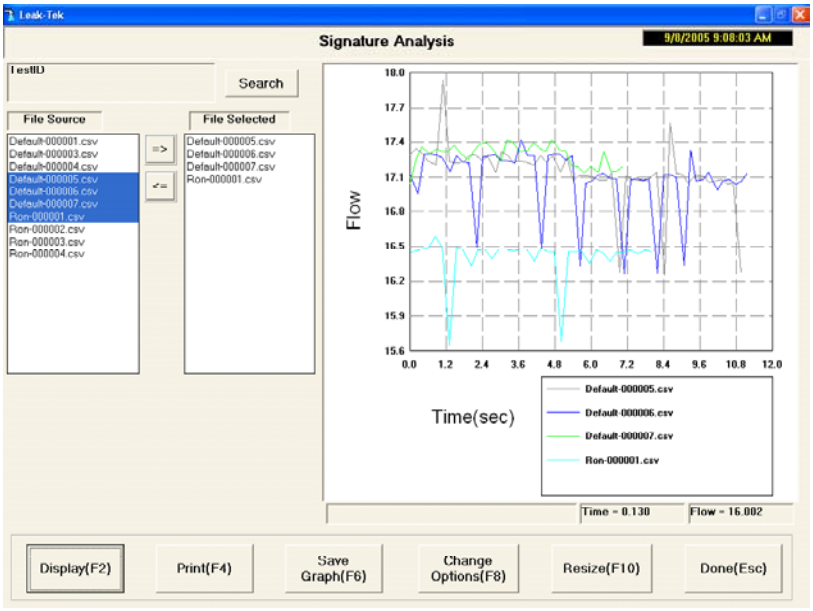


Figure 40 Display a Color and Normal Auto-scaled Graph

Note: The data in signature files the user selected must be in the same unit group (for example flow unit, mass unit or standard mass unit) in order that they are able to display in same graph. The user can select the displayed files by double-clicking the item in the left/right list-box or highlighting the item then clicking the arrow button between two list-boxes.

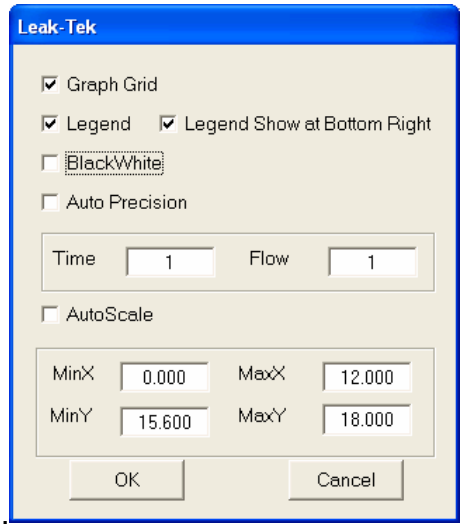


Figure 41 Display a Black & White and Scaling-changed Graph.

By clicking the button “Change Options”, a dialog box will be prompted as shown in Figure 41.

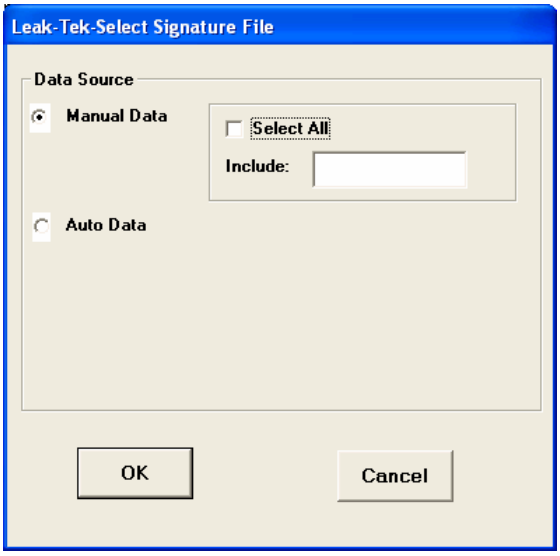


Figure 42 Signature Search – Manual Data

The manual data refers to the signature files generated every time the ‘Signature” button is clicked while the auto data refers to the file automatically generated when the “Auto Signature” checkbox is checked.

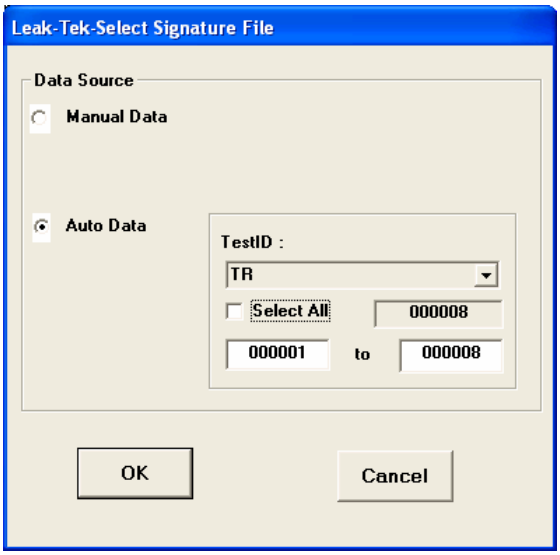


Figure 43 Signature Search – Auto Data

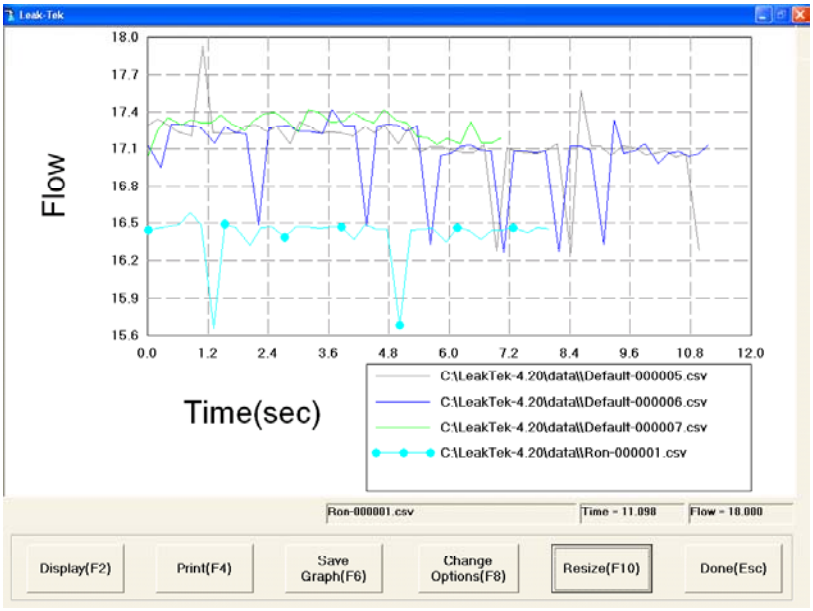


Figure 44 Resize Signature Graph to Full Screen

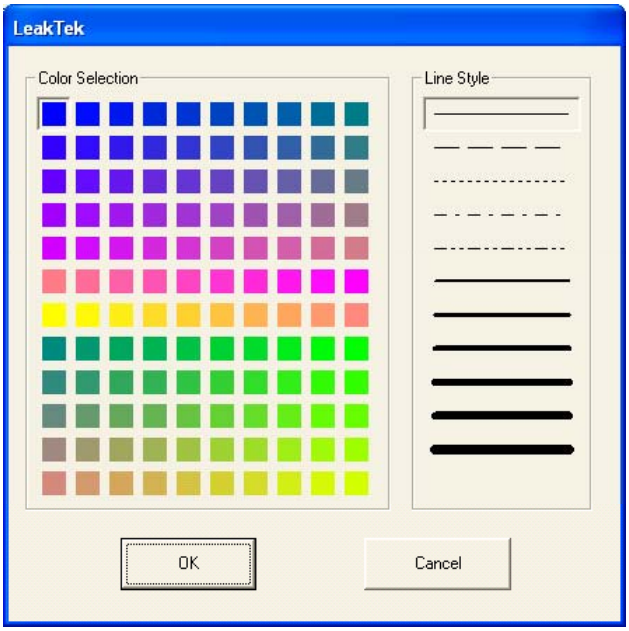


Figure 45 Select Signature Legend style

Double clicking legend in the graph will prompt up the message as Figure 45.

Section 7: Maintenance Screen

The Maintenance screen, as shown in Figure 42, provides a place to check the sensor's base function. In this screen, customers upload and download those basic parameters, check sensor's count display, view selected sensor's firmware configuration and hardware version etc. this screen is protected by operator level password.

- Upload — Allows the user to upload sensor all parameters and only those selected parameters will be displayed on the screen.
- Download — Allows the user to save these parameters on this screen to "Leaktek.mdb" database file.
- Save — Allows the user to exit the Maintenance Screen and return to the Main Screen
- Done — Allows the user to exit the Maintenance Screen and return to the Main Screen.

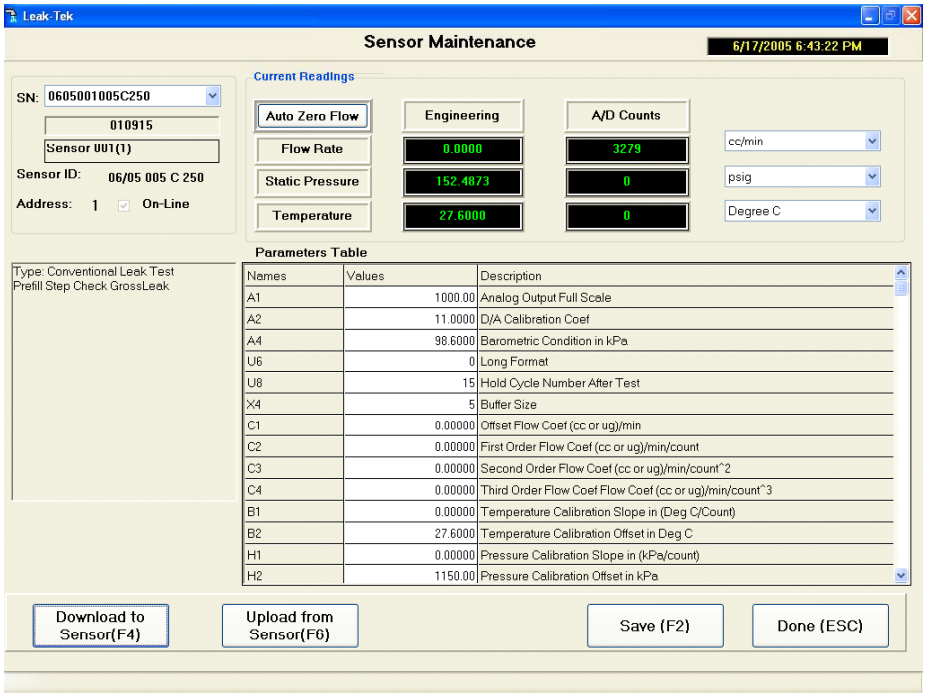
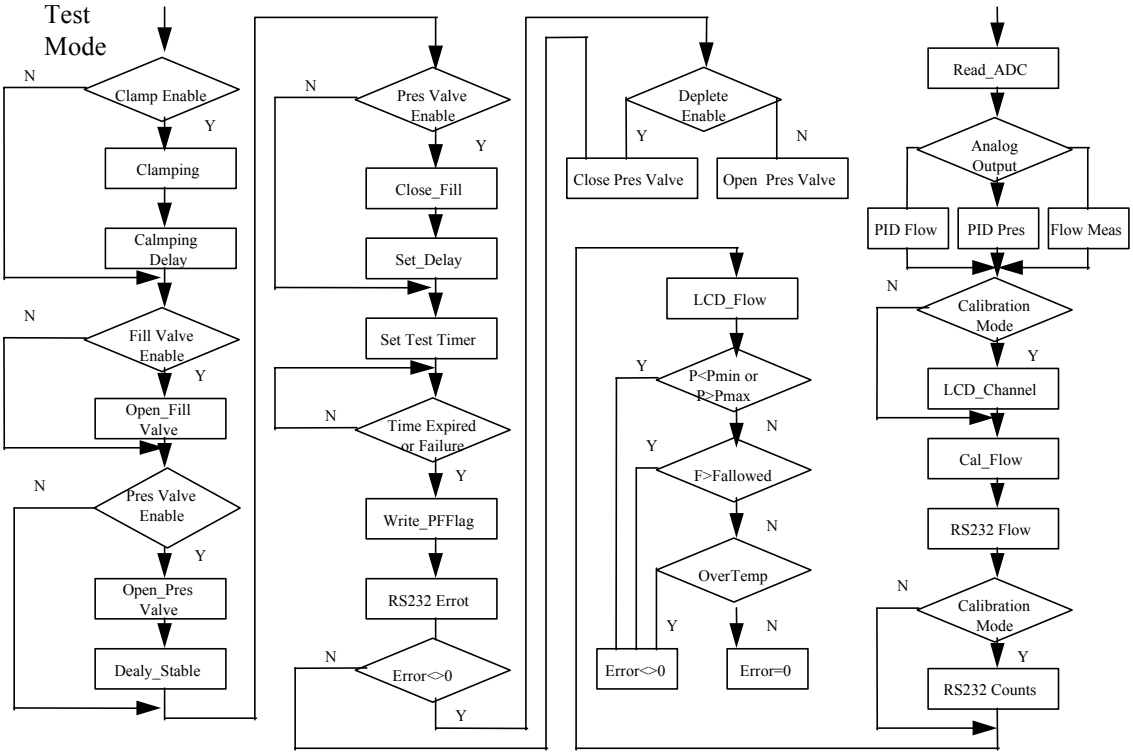


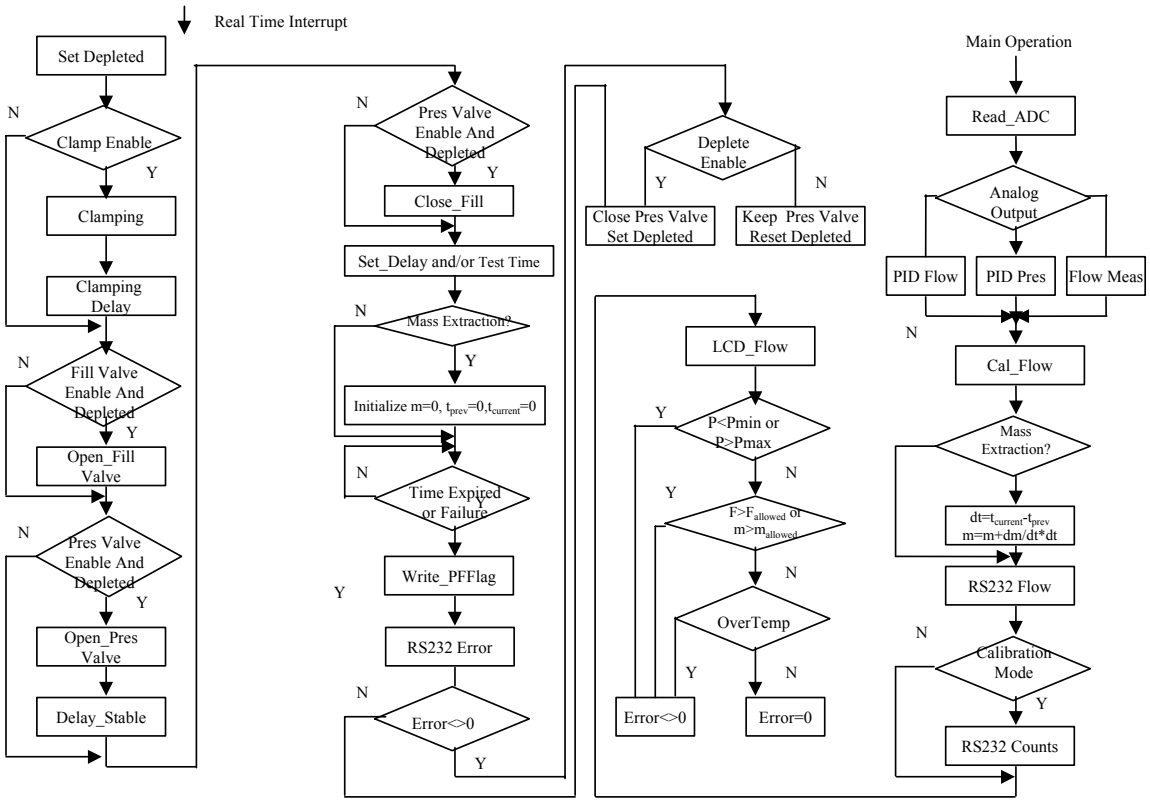
Figure 46 Sensor Maintenance Screen

Appendix A: Leak Test Control Algorithm

The leak test control algorithm is as follows:



The mass extraction test control algorithm is as follows:



APPENDIX B: SPC

B.1 Terminology

Statistical Process Control (SPC): Statistical methods for analyzing and controlling the variation of a process.

Control Chart: a plot of some parameter of the process performance, usually determined by regular sampling of the product, as a function (usually) of time or unit number or other chronological variables. The control limits are also plotted for comparison.

X-Chart: A control chart of mean value as the parameter of a particular measurement for a product sample of specified size.

R-Chart: A control chart of range of variation as the parameter among the individual elements in the sample.

$\overline{R}$: Average range value displayed on R-Chart

$\overline{\overline{X}}$: Average value displayed on X-Chart

$\delta_{\overline{x}}$: Estimated standard deviation of $\overline{\overline{X}}$ value

Lower Control Limit of $\overline{\overline{X}}$ value (LCLx): determined by ±3.00 sigma ($\delta_{\overline{x}}$) limit as following formula LCLx = $\overline{\overline{X}}$ - 3* $\delta_{\overline{x}}$ or LCLx = $\overline{\overline{X}}$ - A_2* $\overline{R}$

Upper Control Limit of $\overline{\overline{X}}$ value (UCLx): determined by ±3.00 sigma ($\delta_{\overline{x}}$) limit as following formula UCLx = $\overline{\overline{X}}$ + 3* $\delta_{\overline{x}}$ or UCLx = $\overline{\overline{X}}$ + A_2* $\overline{R}$

Lower Control Limit of $\overline{R}$ value (LCLx): determined by ±3.00 sigma ($\delta_{\overline{x}}$) limit as following formula LCLr = D_3* $\overline{R}$

Lower Control Limit of $\overline{R}$ value (LCLx): determined by ±3.00 sigma ($\delta_{\overline{x}}$) limit as following formula UCLr = D_4* $\overline{R}$

Table 1 Constant for Calculating SPC

Observations in Sample n	Chart for Average Factor A_2	Chart for Range Factor D_3	Chart for Range Factor D_4
2	1.880	0	3.267
3	1.023	0	2.574
4	0.729	0	2.282
5	0.577	0	2.114
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

B.2 Analysis of SPC

1. The Control limit (from Upper limit to lower limit) within the product of a process is expected (or required) to remain. If the process leaves the limits, it is said to be out of control. This is a signal that action should be taken to identify the cause and eliminate it if possible.
Note: control Limits are not the same as the tolerance limits

2. The sample size shall be between 2 to 10. The larger the size of the sample is, the smoother the curve will look like because individual test result has been "smoothed" by average. At the same time, the R value tend to be larger.

3. Selecting sample size less than 7 will result in lower limit of the R value as zero.

The characteristics can be summarized as follows:

Most points are center the centerline
Some points are spread out and approach the limits
No points are beyond the control limit.

Typical pattern of the SPC chart is similar to the following Figure B-1.

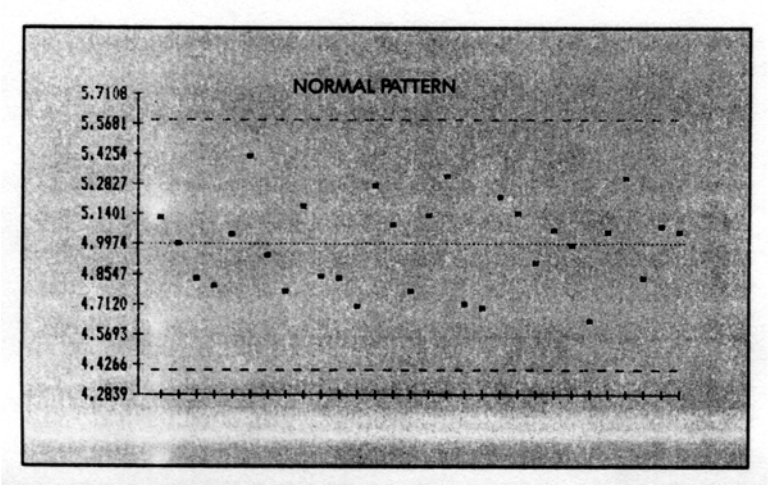


Figure B-1 Normal Pattern

Any abnormal observations in the SPC chart shall be carefully studied. And the following
are the typical situation indicating the problems.

1. One or more points are outside the control lines is the indication of a lack of stability as Figure B-2.

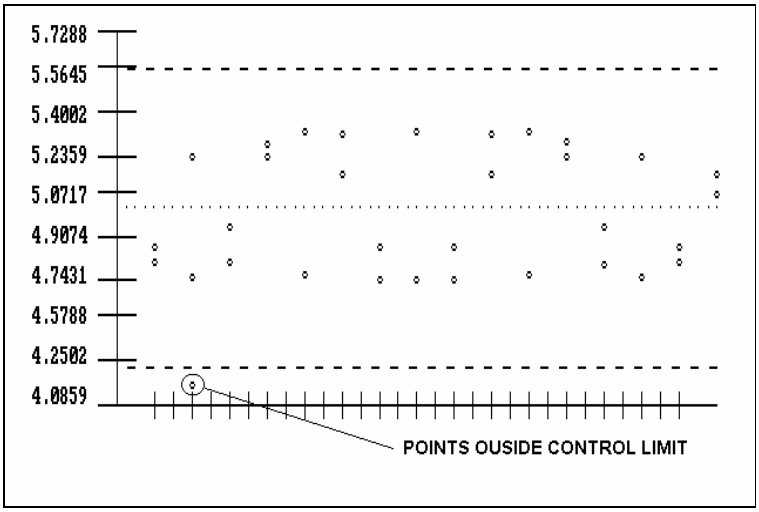


Figure B-2 Out of Control Limit

2. There are a run of 7 or more points above the centerline as Figure B-3.

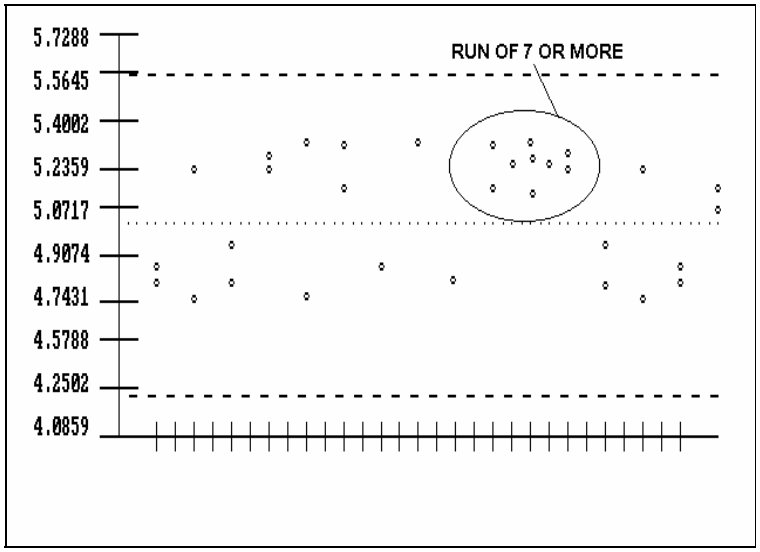


Figure B-3 Run Of 7 Or More Points

3. There is a trend, downward or upward, of 7 or more successive points as Figure B-4.

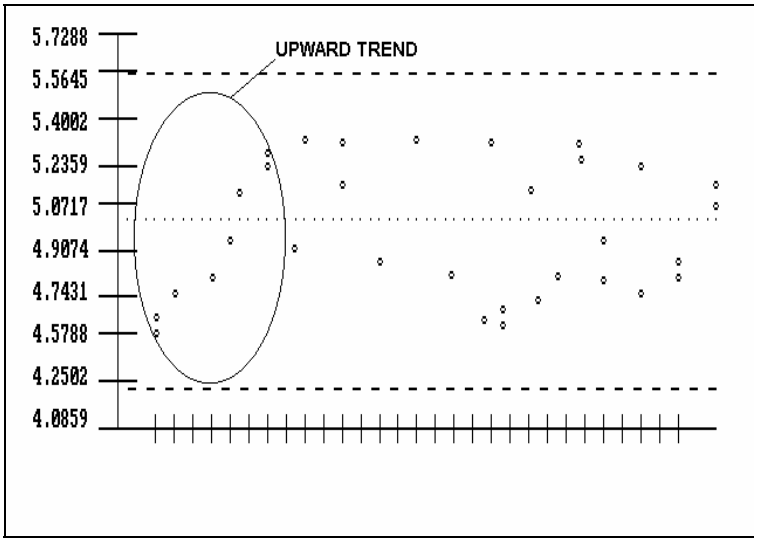


Figure B-4 Upward Or Downward Trend

4. There is a cycle, a pattern that repeats itself is an early indication of instability might indicate the result of overadjustment by the machine operator as Figure B-

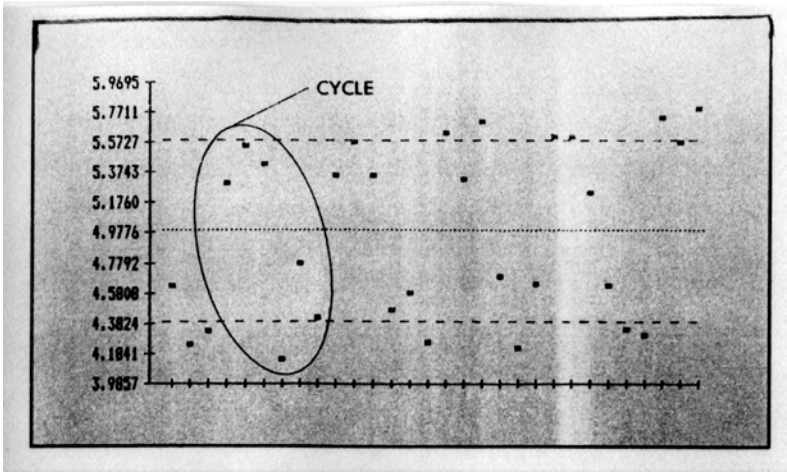


Figure B-5 Cycle Pattern

5. There are almost no points are located near the centerline indicate two group of parts are processed at different level as Figure B-6.

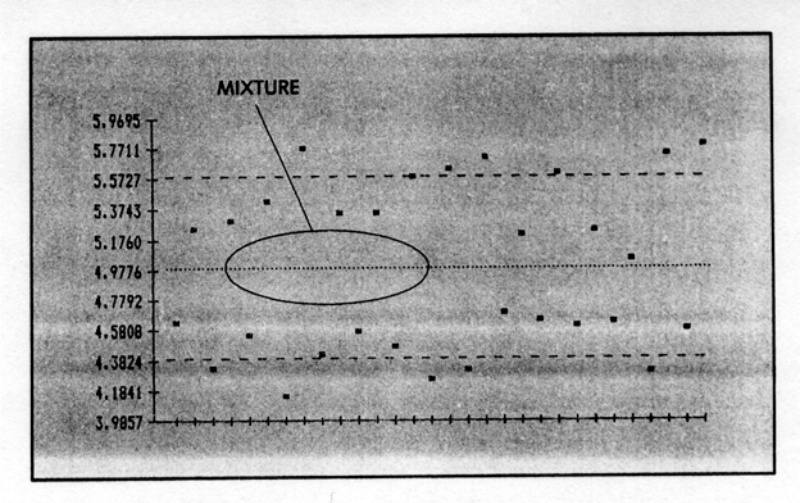


Figure B-6 Mixture Pattern

6. 15 or more points consistently hugging the centerline, indicate the samples are consistently offset each other. or improper calculation as Figure B-7

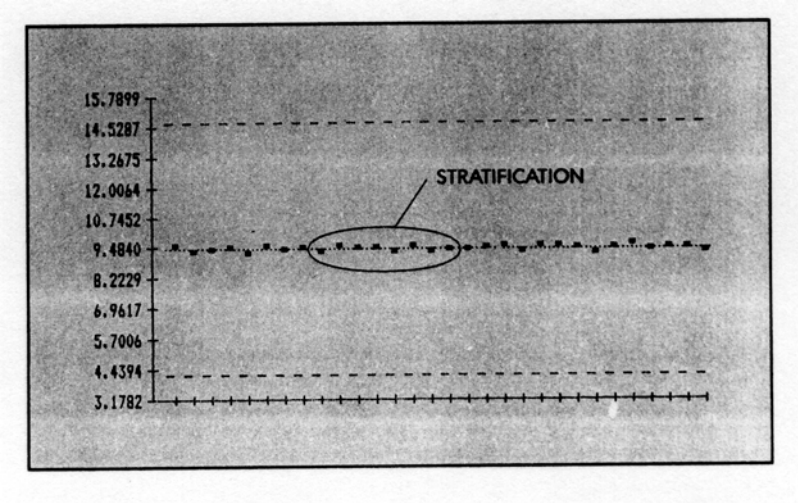


Figure B-7 Stratification Pattern

7. Cluster. The grouping of the points in one area of the chart is an indication of short duration, assignable cause, such as measurement problem, or accidentally sampling for bad group of part as Figure B-8.

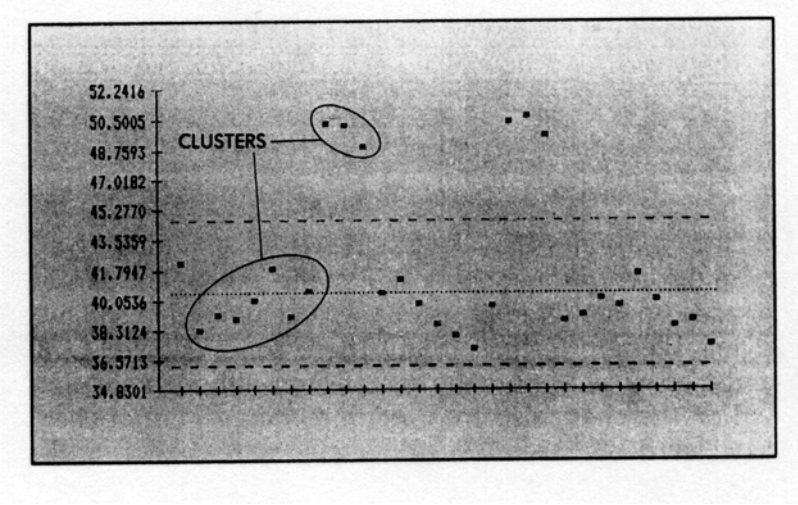


Figure B-8 Cluster Pattern

APPENDIX C: Unit Conversion

C.1 Mass Density at Standard Condition

Density at standard condition is based on 14.695 psia pressure and at 529.69°R

C.2 Unit Conversion Table

Parameter	Primary Unit	Converted Unit	
Temperature	1°C×1.8	=°F-32	
Time	1 min	=6.0 E+01 =1.0/6.0 E+01	sec hr
Pressure	1 kPa	=10.0/9.80665 E-02 =1/ 6.894757 =(1-101.325)/ 6.894757 =1/ 0.1333224 =1/ 0.24884	kgf/cm2 psia psig Torr inH2O
Flow	1 cc	=1/ 1000 =1/ 3785.412 =1000	Liter gallon mm3
Mass Flow	1 gram	=1000 =1000000	mg ug
Standard Flow	1 SCCM	= 1 / (2.54 * 12) ^ 3 = 1 / 1000 = 60 / 1000000	SCFM SLM SCCse6

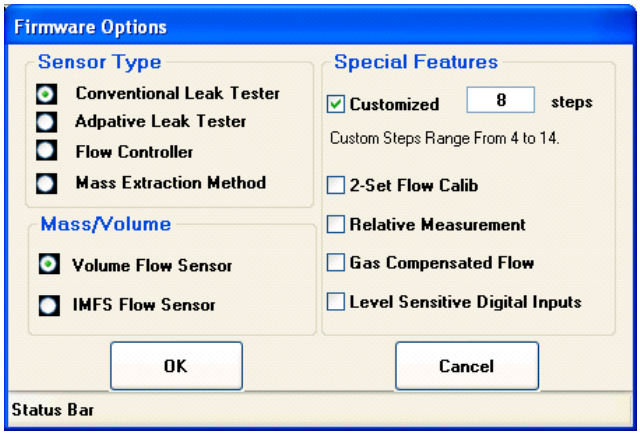
Note: Std. Flow(SCCM)=Volume Flow(cc/min) ×Actual Density/Std. Density

Reference:
Guide for the Use of the International System of Units(SI)
NIST Special Publication 811 1995 Edition

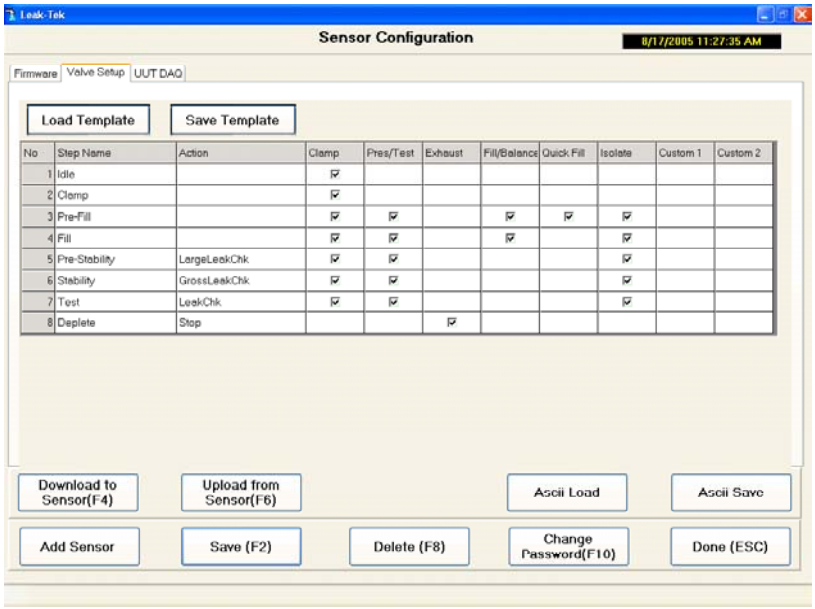
APPENDIX D: Sensor Configuration Examples

Only qualified persons should attempt to use those examples. Inappropriate use of those examples may result in destruction of the IGLS/IGFS Sensor.

D.1 Customized 8 Steps Conventional Leak Test



Step1: Go to Sensor configuration, open firmware configuration screen by clicking 'firmware configuration' in sensor configuration screen. Select related feature as figure shown above. Then click 'OK'.



Step2: After firmware settings are downloaded and uploading is finished, go to valve configuration by clicking the "Valve Setup" in current screen.

8 steps name can be edited and those step names will be displayed on the IGLS/IGFS LCD and the leakTek Run screen during test.

The “LeakChk” step is the main test step. One step has to be configured as “LeakChk”.

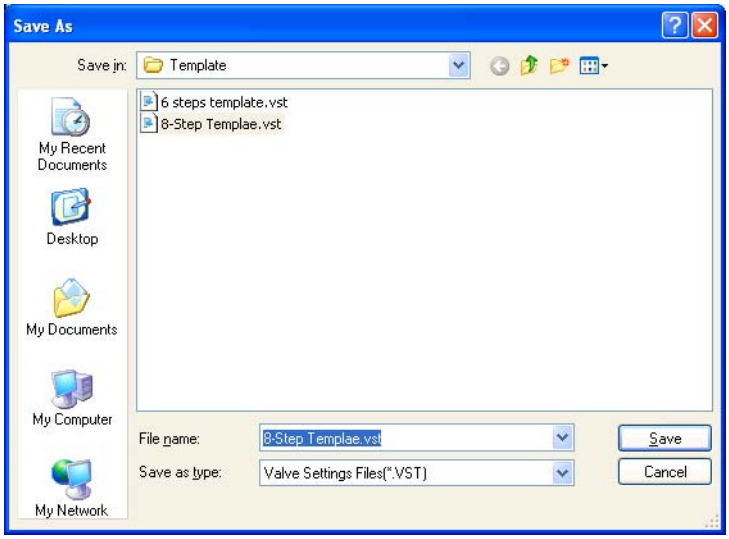
When the IGLS/IGFS receives “stop” command, test step will go to “Stop” step. One step has to be configured as “Stop”.

The “idle” or “standby” step will follow the last step valve configuration.

Step 3: Configure the valves in the test step.

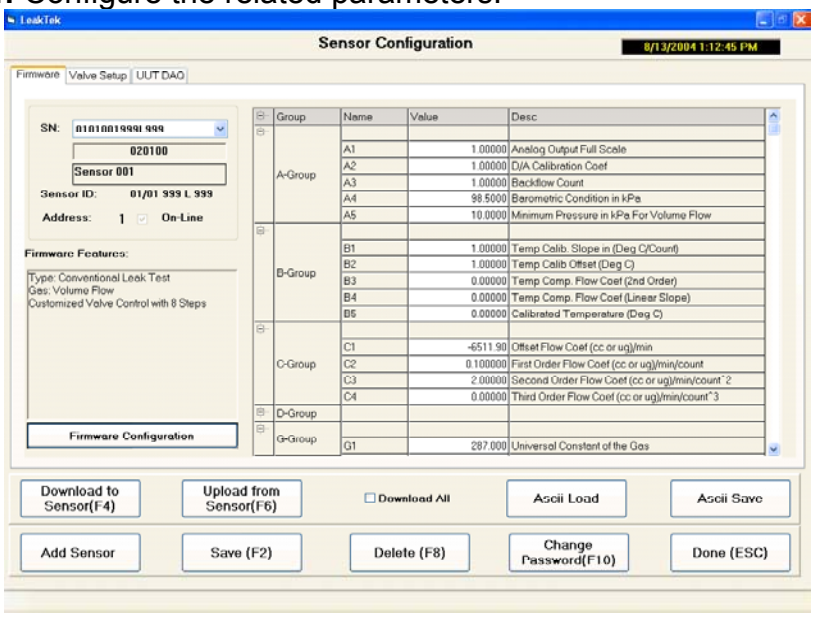
8 valves can be configured. The checked valves will be opened and unchecked valves will be closed during each test step. “custom 1” and “custom 2” valves are used for customized IGLS/IGFS design.

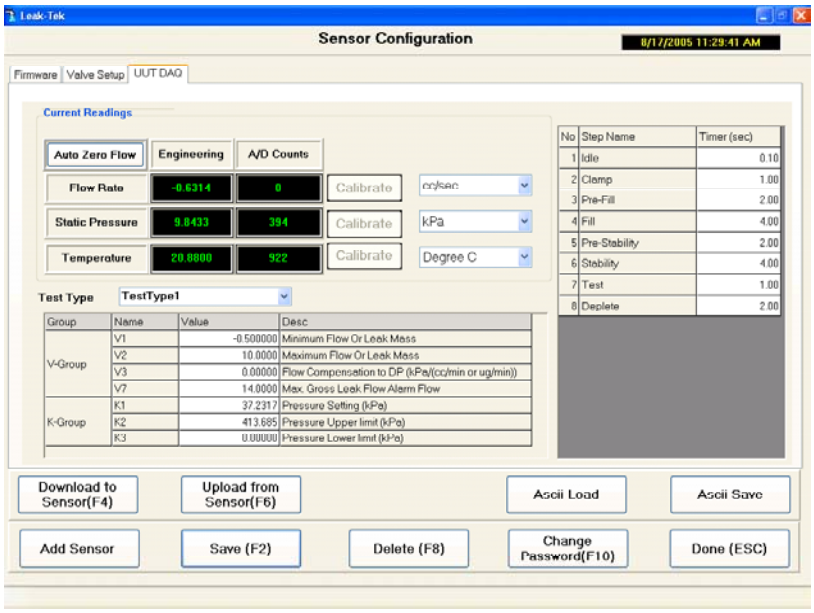
When all valves configuration is finished, click ‘Save’ to save in database and click “Download to Sensor” or “F4” to apply the configuration.



This configuration can be saved as a template for the next valve configuration by clicking “Save Template” on the top of the valve configuration.

Step 4: Configure the related parameters.

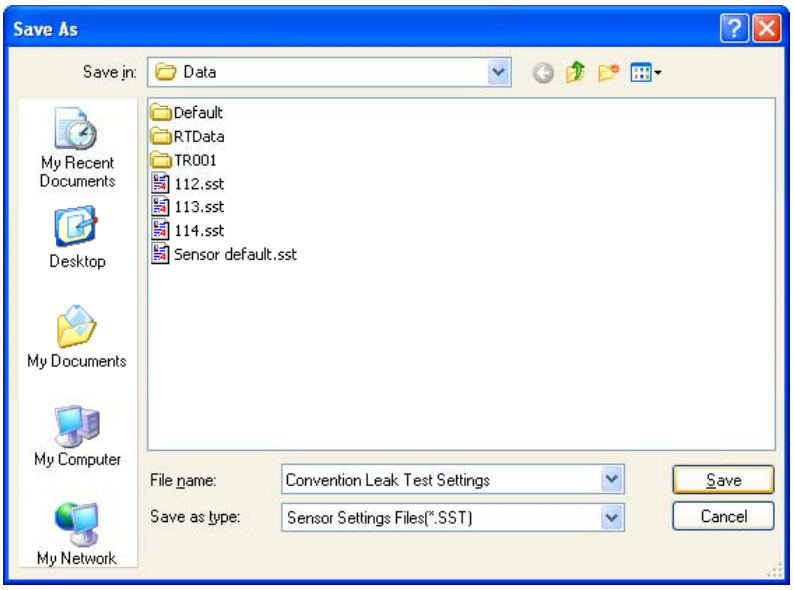




Perform an uploading by clicking “Upload from Sensor” or “F6”. Then open all the parameters as figure shown above. Check and edit each parameter based on the parameters description (reference to 4.3.5).

When all parameters editing are finished, check “Download All”, click “Save “or “F2”, then perform a downloading by clicking “Download to Sensor” or “F4” to take effect.

Step 5: Save this sensor information for the next same sensor configuration by clicking “ASCII Save”.



D.2 2-Set Flow Calibration Feature

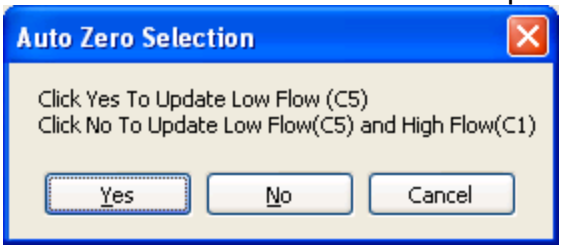
Please enable the 2-set flow calibration feature in sensor firmware configuration.

B-Group			
C-Group	C1	-6511.90	Offset Flow Coef (cc or ug)/min
	C2	0.100000	First Order Flow Coef (cc or ug)/min/count
	C3	2.00000	Second Order Flow Coef (cc or ug)/min/count^2
	C4	0.00000	Third Order Flow Coef (cc or ug)/min/count^3
	C5	0.00000	Lo Offset Flow Coef (cc or ug)/min
	C6	0.00000	Lo First Order Flow Coef (cc or ug)/min/count
	C7	0.00000	Lo Second Order Flow Coef cc or ug)/min/count^2
	C8	0.00000	Lo Third Order Flow Coef (cc or ug)/min/count^3
	C9	10.0000	Percent Divider in % (10)
	CA	1.00000	Smooth Range in % (1)
D-Group			

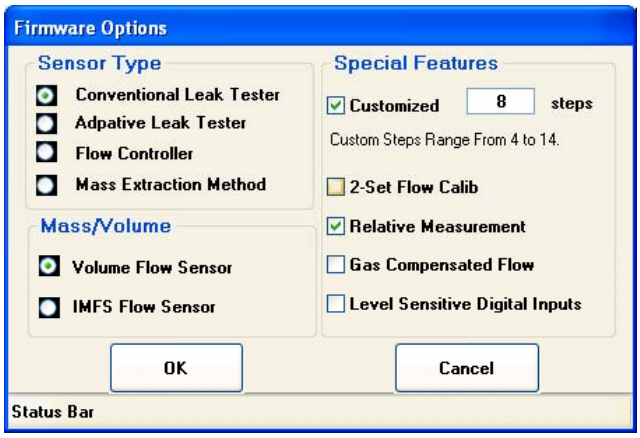
The C9 value is used to distinguish high and low flow range. Flow counts from IGLS/IGFS more than 10% of total IGLS/IGFS counts as configured above are in high flow range and C1-C4 are used. Flow counts less than 10% of total IGLS/IGFS counts are in low flow range and C5-C8 are used.

The CA value is a window range for smooth calculation from low range to high range.

“Auto Zero” function has two choices to compensate the appropriate values.

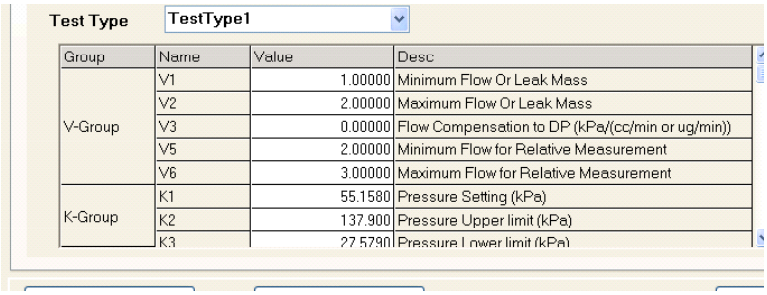


D.3 Relative Flow Measurement Feature



The test steps should be customized for Relative Flow measurement feature to be enabled.

The “Zero Flow” Step shall be configured as before the “LeakChk” step.



V5 and V6 are used to set a relative measurement (Zero Flow) window. When the sensor is at the end of “Zero Flow”, real time flow should be in this range. Otherwise an failure will be detected and test will be stopped.

D.4 Gas Compensation Feature

	A2	1.00000	D/A Calibration Coef
A-Group	A3	1.00000	Backflow Count
	A4	98.5000	Barometric Condition in kPa
	A5	150.000	Minimum Pressure in kPa For Volume Flow
B-Group			
	C1	-6511.90	Offset Flow Coef (cc or ug)/min
	C2	0.100000	First Order Flow Coef (cc or ug)/min/count
C-Group	C3	2.00000	Second Order Flow Coef (cc or ug)/min/count^2
	C4	0.00000	Third Order Flow Coef (cc or ug)/min/count^3
	CB	287.000	Calibrated Gas Constant
	CC	0.00000	Calibrated Gas Viscosity
D-Group			
	G1	287.000	Universal Constant of the Gas
G-Group	G2	0.00000	Viscosity at 0 Deg C (lbm*sec)
	G3	1.00000	Viscosity Change per Deg C(lbm*sec/c)
	G4	1.27000	Density at Standard Condition (mg/cc)
H-Group			

A5 value is used for checking current pressure condition. A5 specifies the minimum pressure for IGLS/IGFS operation while A5 specifies the maximum pressure condition if the sensor is configured as IMFS. A questions mark will be displayed on the right side of LCD if the condition is not met.

CB, CC, G1-G4 are related to gas compensation feature. CC and G2 shall be in used same units and CB and G1 shall be in the same units.

For gas compensation calculation algorithm, please refer to IGLS/IGFS manual.

D.5 Adaptive Leak Tester

Please select “Adaptive Leak Tester “in sensor firmware configuration.

	CC	0.00000	Calibrated Gas Viscosity
	D1	5.00000	Buffer Time in % of Test Time
	D2	3.00000	Safety Multiplier
D-Group	D3	1.20000	Start Leak Window Max Multiplier of V2 (1.2)
	D4	0.800000	Start Leak Window Min Multiplier of V2 (0.8)
	D5	0.600000	Alpha Decay Factor (0-1)
	G1	287.000	Universal Constant of the Gas

D group parameters are related to adaptive test. For Adaptive test parameter setup, please refer to adaptive test and IGLS/IGFS manual.