Chapter 5

Testing

This chapter details the ***Test*** functions available to **Normal** users — and describes them here separately from all other functions. **Chapter 3** summarized ***Test*** functions, only indicating how they were activated from menus. However, here they are described in their fullest detail.

5.1 Introduction to Testing Functions

Several *test programs* currently exist for **Normal** users.

- the **Leak Test** (for all pressure scanner/standard modules or groups)
- the **Pressure Accuracy Test** (for all pressure scanner/standard modules or groups)
- the **Leak & Pressure Set Accuracy Test** (for pressure calibrator modules only)
- the **Compensation Accuracy Test** (for pressure scanner modules)
- the **Noise Test**.(for all modules)
- the **Memory Test** (for all modules with "user memory" EEPROMs).

The first two tests operate for *single* connected *pressure scanner/standard* modules or for a *coordinated group* of connected *pressure scanner/standard* modules. These tests look and act like to the ***Calibration Adjustment*** function detailed in **Chapter 4**. Also, since they utilize pressure calibrators (assigned via an LRN) they test only a module's channels that are associate with each LRN. The last four tests operate for *single modules only*, thus are found only on the *context* menus of individual *connected* modules. Since they do not utilize pressure calibrators, they ignore the LRN mechanism. These tests are similar to those used at the PSI factory to test final production units of NetScanner modules, though some have been "adapted" to match the limited test-equipment support that Normal users are expected to have — thus they require many more "prompted" manual operations than do the more automated Factory versions. The last test checks "user memory" EEPROMs in modules that have such memory installed.

Additional tests are found on the ***Test*** menus for **Advanced** users of NUSS. However, such *advanced* (or *factory)* tests usually require special *attached test equipment* that is *real* (i.e, interfaced via the **GPIB** bus in factory user version) or *external* (user supplied) or *virtual* (NUSS simulated). When such equipment is *external* or *virtual* the test prompts the user to make settings to (and make readings from) the equipment using manual prompts. See **Chapter 5** in the **User's Manual Addendum for Advanced Users** if you have requirements for additional tests or more rigorous testing (and also you have the necessary test equipment to support more automated testing).

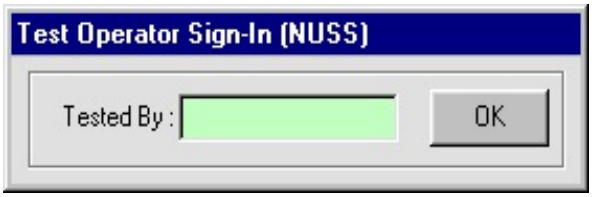
The various test descriptions below concentrate on using the interactive *point-and-click* features of Windows to accomplish all testing functions — instead of having to create scripts of low-level commands. Mouse clicks, drags, and drops, are used to operate all the forms, and their menus and explicit controls. Alternate keyboard functions (e.g., <*Tab*>, <*Space*>, and <*Arrow*> keys) may be preferred by a frequent user of a ***Test*** program, and such functions are described in **Appendix K**.

CAUTION: The tests, described in the following sections, allow a user to test many basic features of NetScanner modules and their individual transducers. Although there is nothing in NUSS to prevent these tests from proceeding *concurrently* and independently on several different modules, such operation is neither specifically recommended nor prohibited. However, if you attempt to run multiple tests *concurrently* (on different modules) and get bad results, we suggest that you retest each module *separately* and compare the results.

The ***Test Group*** menu item on the home-base menu leads to the following submenu:

Test Group submenu

Notice that in addition to the two Group tests available, there is an overall NUSS function to perform a central Operator Sign-in. Selecting that menu item pops-up the following form:



Operator Sign-In form

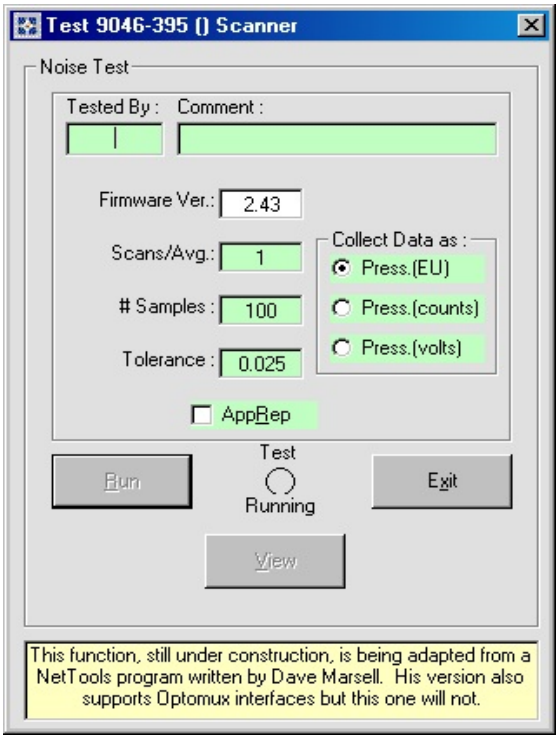
By entering the test operator's name once, on this form, you can avoid entering it on each of many individual Test forms later. Such a central sign-in lasts until you exit NUSS. See the text box labeled IMPORTANT on the following page for more information.

5.1.1 Elements Common to All Tests

Since all these tests have *similar* user interfaces, any common elements are described here — to avoid having to repeat the details in each individual test's descriptive section.

IMPORTANT: Most tests begin with the **[Run]** button *disabled* (dim). It is not *enabled* until a ***non-blank "operator name"*** is entered into the "**Tested by:**" *text box* on the form. To complete this entry you must ***move the entry cursor somewhere outside this text box*** (e.g., click the mouse outside the box — *or* end your name entry with a ***<Tab>*** key). To assist you in remembering this required task, the entry cursor blinks in that *text box* when the test form initially appears. To avoid repetitive entry of this name for individual tests, use the central ***'Test | Operator Sign-In (NUSS)'*** menu item on the home-base menu.

Each ***Test*** program displays a form (see typical example below). It always appears on the screen *just below* the *home-base* strip, and to the *right* of the **Nodes Map** pane of the **Network Status** form.



Typical ***Test*** program form (single module)

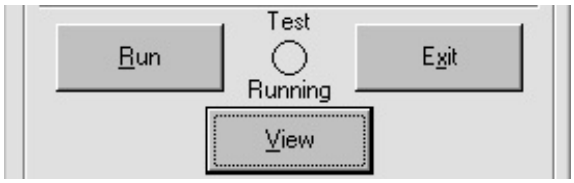
The test form has a *title bar* indicating which module (or group of modules) is being tested, and an *outer frame* whose label describes the particular test being performed (**Noise Test** in

example above). One or more *inner frames*, often unlabeled, may contain *options* selected with *radio buttons* (each related option grouping is in its own frame) and several *text boxes* or other controls. Those with *light green* backgrounds or labels *may be changed (edited)* by the user. Other text fields with *white* backgrounds contain *fixed information* for display purposes only, that may not be changed. A *text box* labeled "**Tested By:**" receives the initial Windows *keyboard focus* when the program is started, and requires the *Operator Name* be entered there before the **[Run]** button is enabled — except when an *Operator Sign-in* has been done outside the test form (see **IMPORTANT** note in box above). Most tests also have a larger *text box* labeled **Comment:** which is the next control in the <*Tab*> *order sequence* of the form after the *Operator Name* field. Entry of a comment (which ultimately appears in test's report) is optional. An unlabeled option frame, with several *radio button* choices, may be selected by mouse click or by keyboard ***<Arrow>*** and <***Space***> keys.

One (or two) *Status Box(es),* with *light-yellow* and/or *light-orange* background(s), at the bottom of the form, informs you of any notable events or error conditions. Such messages may be accompanied by a "beep" (if your sound card and speakers are on) and "blinking text" if the need is urgent or your attention is otherwise required (e.g., prompting messages). If operator prompts are required by the ***Test*** program a **[Resume]** button also appears above the status box for clearing each prompt.

Clicking the **[Run]** button starts the test. Then, a "light" illuminates (*yellow*) to indicate the test is in progress (on some forms), and the **[Run]** button is dimmed while the test is running.

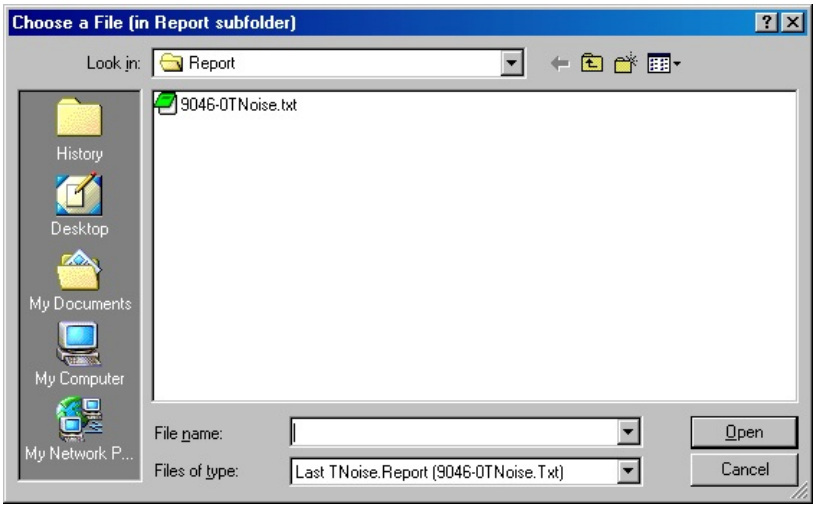
You may click the **[Exit]** or **[Cancel]** button, at any time, to *abort* the test in progress. When the test ends, any "light" goes out (turns *gray*) to indicate that the test is no longer in progress, and a **[View]** button (dim during the test) is enabled and has the keyboard focus (i.e., has a dotted cursor visible).



NOTE: Often a test program sets the *keyboard focus* (dotted cursor) on the button most likely "pushed" next. The keyboard <*Space*> bar "pushes" this button without having to reach for the mouse. Users who run tests frequently may prefer using the keyboard exclusively to operate the test. In such cases the <*Tab*> and <*Shift*>+<*Tab*> keys move through all the controls on the form forward and backward..

You may click the **[View]** button to locate and then examine (and optionally *print* and *save*) the *Test Report* text file created for the most recent "run". This button is also visible *before* you start the test, to allow you "one more chance" to view (and optionally *print* and *save*) the report from the most recent *previous "run"* for that module or group. By default, any old reports are overwritten by any new reports (of the same name) — unless you check a *check box* on the form labeled **AppRep** (append new report to old report). You may also examine any *partial report* that may result — in the event the test session ends early (due to errors) or you forcefully abort it. One or more examples of *test reports* are shown for each of the tests, at the end of its section.

Clicking **[View]** pops-up a standard Windows dialog box, with a default (first) *filter* set to show only the *most recent single-module* or *coordinated group* test report.

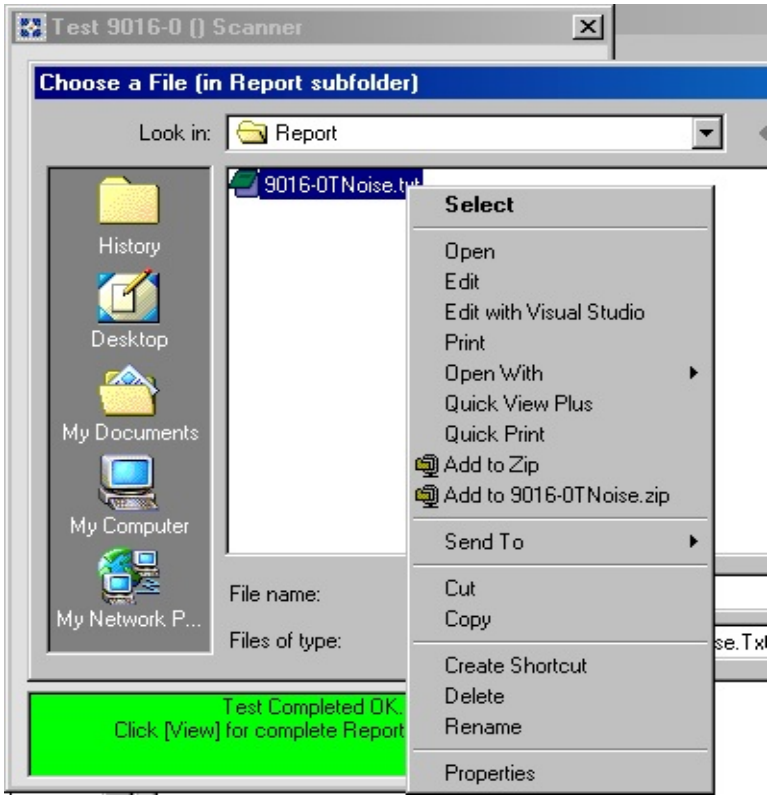


See example below with default filter selected and *latest test report* shown only.

Click that report name to highlight it, then press **[Open]** (on dialog form) to view it. You may also *double-click* the *selected report name* to skip clicking the **[Open]** button. An instance of NUSS's *text editor* form pops-up in a separate window showing the simple text contents of that report file for you to view (not shown).

Any report file is named ***<modid><testid>.txt*** (or **.csv**) for a single module test (**9046-0TNoise.txt** in example above), or ***CG<grpid><testid>.txt*** (or **.csv**) for a Coordinated Group test. All report files are located in the **Report** subfolder of the *NUSS Install Path*. The field <***testid***> varies with the particular test you execute (in example above it is '**TNoise**' which is short for the 'Test Noise'). After Nuss version 1.2.17, the *individual reports* generated for group-tested modules (per the *SepRep* option) were simplified by dropping their **"CG<*grpid*>-M"** prefix. These names became ***<modid><testid>.txt*** (or **.csv**) , making them look just like files tested as single modules – except for their first header lines.

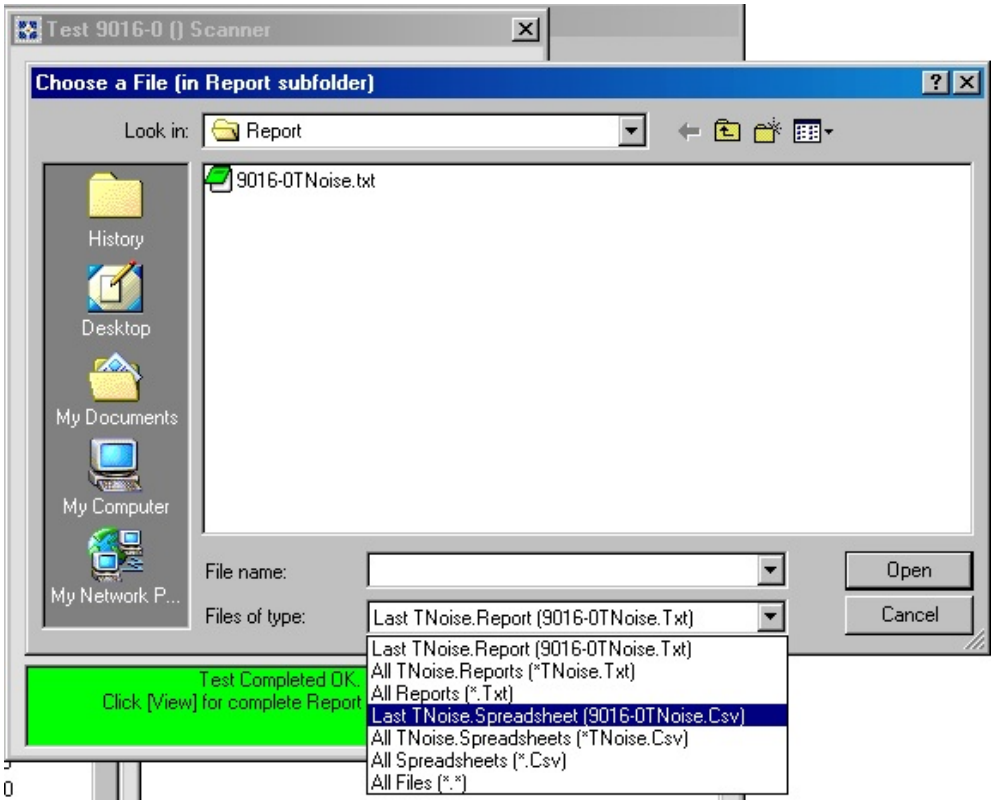
Alternately, you may also right-click the highlighted report name to obtain a module's *context menu*, which allows you not only the ability to open it, but to do other file maintenance functions (delete, copy, edit, move, print, etc.) as well. When you use the context menu, the dialog stays on the screen to allow you to do more than one thing to the highlighted file.



Using *Context Menu* to view and do other things to reports

Sometimes the default **<name>.txt** filter does not show the file you wish to view. Optionally, most tests can also generate a second spreadsheet like file (***.csv**), or comma-separated-variable file, meant to be viewed directly by Microsoft Excel instead of the

NUSS text editor. In this case the **Open** selection on the *Context Menu* opens the file in Excel directly. Such test-wide options, like generating the optional **.csv** file, are found in a frame titled **Common Options**, at the bottom of the form obtained by the ***'Configure | Calibrators (NUSS)'*** menu function. Another *filter* must be selected to find the latest such **.csv** file or all such files. Clicking the arrow button at the right-end of the list box labeled **Files of type:** reveals all available filters. See example below with all *filters* exposed.



View Report Dialog with all filters exposed

Notice that there are filters available to show only the *latest current report* (**.txt** and **.csv**), *all reports of the current test* (**.txt** and **.csv**), *all reports of all tests* (**.txt** and **.csv**), and *all files* (*.*), within the **Report** folder. You can change the list box labeled **Look in:** to navigate, thus extend the viewing to other folders and/or drives. Other controls to the right of this list box allow you to view full details (and sort) file names listed in the files window. If the filter you need is not provided, you may create your own (with ? and * wildcards) by typing it directly into the list box labeled **File name:**. For example, typing **9?16*.*** shows all Report files for Model 9x16 pressure scanner modules.

When you use the Windows context menu, you must dismiss the dialog box manually (press **Cancel**) when you are through with it.

Behind the scenes, and for certain tests only, other *separate report files* for a "single module" or "single-transducer", may have been created as special abstracts of the *main session* report file. These generally have **Summary Data** only (no **Detailed Events**). Such extra files also do not have a spreadsheet format (**.csv**) equivalent. In such cases, there is usually a *check box* labeled **SepRep** somewhere on the form (checked by default) that can be unchecked if you do not wish to write these extra files. Other *filters* on the **[View]** dialog box (the second one labeled *TNoise.Txt in above example) aid in finding these *separate report files*.

If you immediately start another test session, any *similarly named* old report file is normally overwritten, and thus lost for that *group* or *single-module*, since only a single "latest" report is retained *with a particular name*. You can avoid this automatic overwrite by checking a *check box* labeled **AppRep** somewhere on the form (normally unchecked by default). Once checked, this option causes any new report file(s) generated thereafter to be appended to any old file of same name — instead of overwriting it. A Page Break is added unconditionally between each such appended report in the file. This is useful if you want to run the same test over several times and have the results of such repeated tests concatenated together is one text report. Since this *check box* is unchecked by default, each time you start the test program, you must always remember to check it — if you wish to continue appending similarly named files generated by that form.

To save a report file indefinitely for a particular module or group, you must rename it (via context menu) else it is overwritten by any new "run" of that same module or group. Alternately, the **'File | Save-As'** menu function of NUSS's text editor form or the NUSS ***Archive*** form may also assist in moving the file to another location than the Report folder.

Some Test forms, that generate long reports, may utilize a feature called ***Add Page Breaks*** that can be pre-specified by and option of the ***'Configure | Calibrators (NUSS)'*** function. This home-base menu form pre-specifies *Common Options* used by both Calibration functions and some explicit Test functions. There is no *check box* for enabling or disabling this feature on the Test form itself. See the TEXT EDITOR NOTE (on next page) for information on how to insure that such Page Breaks are actually printed by the NUSS Text Editor.

In the **Common Options** box of the ***'Configure | Calibrators (NUSS)'*** home-base menu function, a *Show Run Forms* option appears. Its default setting (checked or unchecked) is inherited by all calibration and test forms, and a check box labeled **ShowRun** also appears on a few test forms, allowing the default to be over-ridden at time of test. When checked, this option causes the running of each test to also pop-up the applicable ***Run*** form(s) of any modules actually being tested — during the test itself. Such ***Run*** forms appear to the right

of the test form, and are cascaded (overlapped but offset) and initially shown in their minimum (Less) size. Such forms always run in Run State 0.

TEXT EDITOR NOTE: If the ***Add Page Brks.*** Common Option for reports is selected, such page breaks are generated as *Form-Feed* codes (ASCII code 12 or 0xC) embedded in the report's text file at the point where each page break is needed. Unfortunately, most Windows standard text editors (WordPad or NotePad) ignore such codes, simply showing them as a *tiny box character* in the printed or viewed text file. If you really need to print your reports with proper page breaks, you must assign a more adept Text Editor to NUSS (with ***'Configure | General Options (NUSS)'***) for report viewing and printing.

In the Text Report examples shown at the end of each of the following sections, the viewing form is the **WordPad** text editor of Windows (usually located in the path C:\Windows\Accessories). **NotePad** is used, instead, if no editor is ever configured, though that simpler editor has file length limitations. However, NUSS may be configured to use *any favorite* text editor installed on your PC (see ***'Configure | General Options (NUSS)'***) on the home-base menu).

Whether a test ends normally, or it fails due to some unrecoverable error it detects, or it is aborted forcefully by the operator, its form's *main status box* (with a *light yellow* background color during the test) changes to an appropriate *bright background color* that indicates the quality of the data in the test Report file waiting to be viewed. This *bright background color* can be seen, from across the room, once the test has ended. It provides a simple *success*, or *caution*, or *failure* indication, in visible form, as follows:

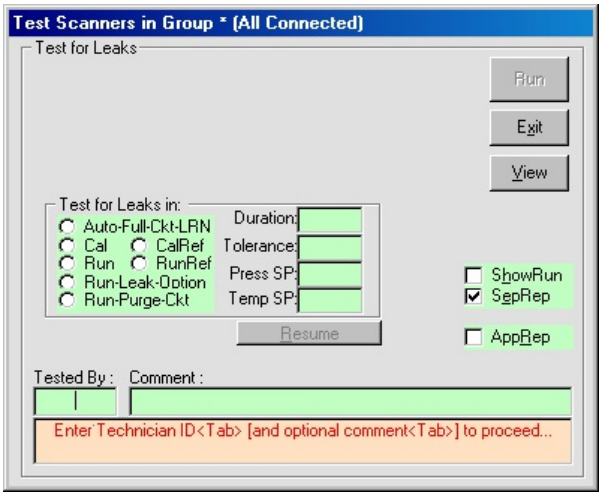
- If the test is *aborted* by the operator or *terminates itself* due to a detected error, this status box's background color may initially change to *bright orange* — during the time it takes for all test operations to cease. However, the color eventually changes to *bright red* to indicate that the test *failed* and an *incomplete* report file now awaits viewing.

- If the test and its report file are *complete*, but one or more *out-of-tolerance data items (or ignored errors)* are flagged somewhere in the report (i.e., marked with two or more *asterisks*), the background color is *bright yellow* to indicate that the report must be scanned to find the flagged items. The color is *bright green* if *no datum is flagged and no ignored error has occurred* anywhere in the complete report .

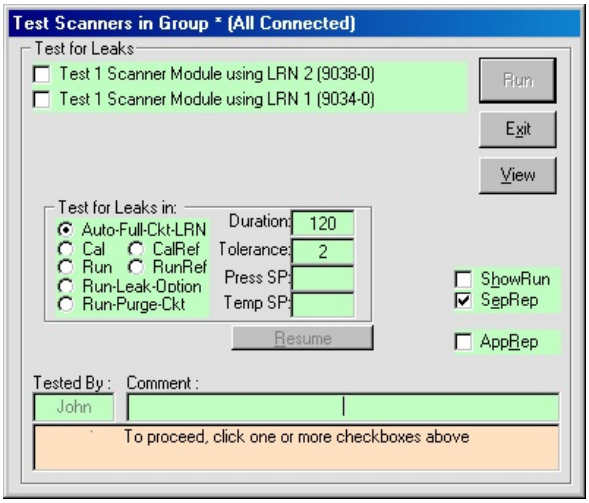
Ignore the actual text in the status box examples above, as they were generated by a special ***Auto Gain Adjust*** *aid* (available in Advanced and Factory user versions of NUSS). However, true ***Test*** programs all have similar error and success status box color indications. This special *aid* also operates almost identically to other ***Test*** forms, thus all the general information in this section also applies to it. In fact, it looks and acts just like the ***Voltage Accuracy Test*** (for 902x and 9x46 modules) except that it has an extra **[Save]** button, and only sets and reads *one* full-scale voltage set-point instead of *two* (for the **RTD/Volts** test) or *nine* (for all other **Volts** tests).

5.2 Leak Test (Press. Scanners/Standards)

Select this test (‘***Test | Leak’***) from the *context* menu of a *single connected* module or from the home-base menu (‘***Test | Leak (Group’s Scanners)’***) for a *group* of *connected* modules. The following examples illustrate the *group* case where Group “*” (or Star) is shown, which is the dynamically-configured group containing all “connected” modules. The *single module* case looks the same except that the title bar shows the model#-serial# (and optional name) of the single scanner module instead of the group ID (and description).



Initial ***Leak Test*** form before operator sign-in



Initial ***Leak Test*** form after operator sign-in

The first example (above left) shows the empty form that appears before any operator ID is entered in the **Tested By:** text box. After operator sign-in (or immediately if operator sign-in was accomplished ahead of time via the home base ***‘Test | Operator Sign In’*** menu), the second example (above right) additionally shows two selectable LRN choices for all the pressure scanner/standard modules it finds in the *current group*. Each LRN is assigned to a pressure calibrator module (whose name is shown in parentheses after the LRN number). The equivalent single-module ***Leak Test*** form would look the same, except for its Title Bar, but would only show LRN choice(s) for that single module (yes, a single module with dissimilar transducers (at least two different ranges) could have multiple LRNs). Review **Section 4.1** in **Chapter 4** if you need a refresher course in the purpose and value of LRNs, and the ways you configure them. Also see the common introduction to tests in **Section 5.1** above for a complete description of the basic test form layout and how one conducts the test and views results.

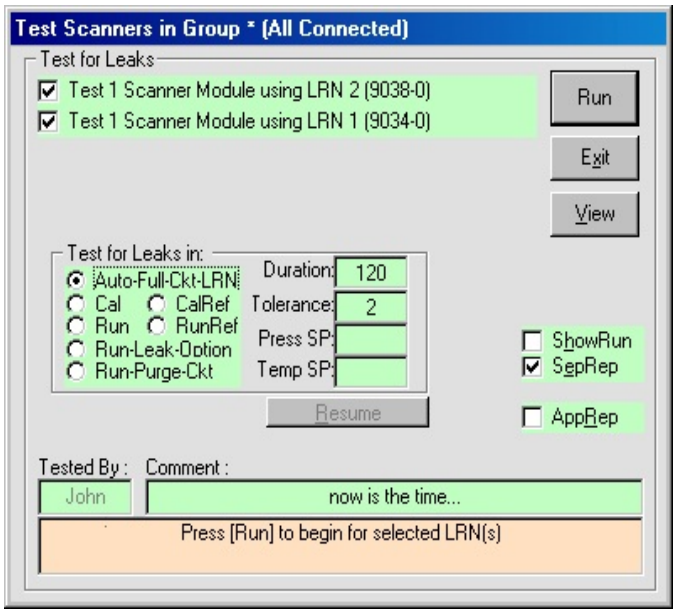
As you may have noticed (if you read **Chapter 4**) this *test* function operates in a fashion very similar to the way the ***Calibration Adjustment*** functions operate. The LRN choices offered are exactly the same, and you can decide to *include* any or all of the LRN choices

displayed – by checking the ones you want to include in this test's current session report. Up to eight LRN choices may be displayed. If only one LRN is displayed it is selected (checked) for you. The **[Run]** button is enabled after any LRN is selected.

The next example (below) shows the ***Leak Test*** form after both displayed LRN choices have been selected (checked). These are tested together, in sequence (from top to bottom: LRN #2 then LRN #1) when the **[Run]** button is clicked. The final test report contains separate sections for each LRN tested..

Before you click **[Run]** you still have time to *view* (and *save* or *print*) the *previous* test report file – that is about to be overwritten. To avoid overwrite you may also check the **AppRep** option check-box first. That option simply appends the new test report to any existing one.

You may also select one of seven test *modes* and edit other *text boxes* (in the frame labeled **Test for Leaks in:**). The leak test *mode* named **Auto-Full-Ckt-LRN** (automatic full-circuit leak test per pre-specified LRN) is normally selected by default. The other six *manual* modes are described later below.



Ready-to-Run ***Leak Test*** Form

The default value of the **Duration** parameter was inherited from the ***'Configure | Calibrators (NUSS)'*** form on the home-base menu – where it may be specified in advance (see frame titled **Leak Test Options** in example form on next page). The default value for the **Tolerance** parameter came from a system configuration file. For a *standard* ***Leak Test*** these two values should not be changed by the user.

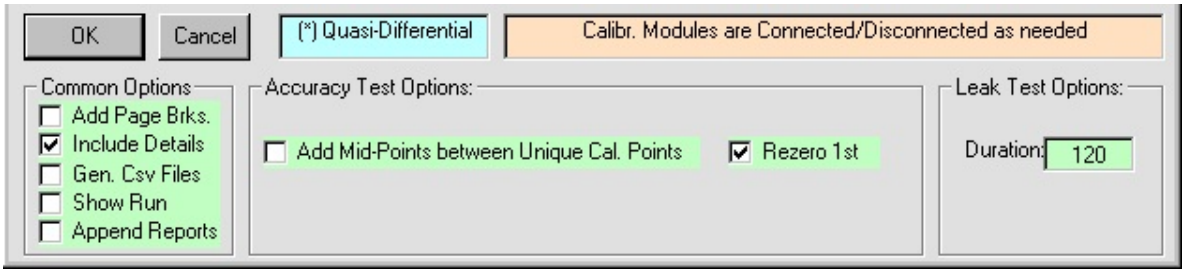
The **Press SP** (pressure set-point) text box value (shown blank above) is not filled in until the test is underway for a particular LRN, at which time it defaults to the **Span-Only** pressure set-point of that particular LRN. This is the pressure that is applied to the scanner module(s) assigned to that LRN for the specified **Duration** (in seconds) during the ***Leak Test***. If you enter a pressure value manually into this text box *early* (while it is blank as shown) this new value is retained, and used instead of the particular LRN's default set-

point. However, if the final set-point could drive any pressure channels of the LRN's assigned pressure scanner(s) over-scale, the test is aborted early.

The **Temp SP** (temperature set-point) text box is normally blank, but can be set to a temperature value (degC) if an Oven is available for testing (more on this capability later).

Of the ***Leak Test*** *mode* choices, only the first (***Auto-Full-Ckt-LRN***) leads to an *automatic* test. The remaining *modes* are *manual* tests that *require* the operator to *physically change* the pneumatic plumbing to the test module(s) – thus they are normally used only to test production models being assembled at the factory. When the test is started in these *manual* modes the operator is prompted to make the necessary plumbing connections to specific ports of the module(s), and a **[Resume]** button appears. Then, the test pauses until the operator clicks this button — indicating that he/she has successfully accomplished the task — as directed by the prompting message in the (*light-orange*) status box. Each test you run, in any *mode,* generates a report file with a unique *mode-specific* name.

The ***Leak Test*** form also has three checkbox options on the right side of the form (see inset right). The ***Show Run*** *option* is the same as for *Calibration Adjustment*. It inherits its default setting from the *Common Options* frame of the ***'Configure | Calibrators (NUSS)'*** form, which is selected from the home-base menu (see example below). When checked, this option causes *simple* ***Run*** forms to pop-up (during the ***Leak Test***) adjacent to the right edge of the test form. These cascaded ***Run*** forms show the scanner modules affected by the current LRN being tested during the session. See description in **Chapter 4** for more information about how to utilize them and their limitations.



Pre-specified options of ***'Configure | Calibrators (NUSS)'*** that affect ***Leak Test***

The two outer frames (of partial form example above) have options that affect the ***Leak Test***. The *Common Options* frame contains the **Show Run** option just described above – and the **AppRep** (append report) option to be described below. It shares these options with several other test programs (thus the name Common Options). The *Leak Test Options* frame contains a value used explicitly by the ***Leak Test*** program (the default value of the **Duration** text box).

Now, let's continue our description of the option check boxes on the ***Leak Test*** form (see inset right). The ***SepRep*** *check box* appears on the Leak Test form only when the test is activated for a *Group* of modules. When present, that option is always *checked* by default, and must be *unchecked explicitly* if you do not want its effects. When *checked*, it causes *separate reports* to be written in the **Report** subfolder *for each individual module* in the group — after the normal Coordinated Group's Report file (containing data from all LRNs tested for all modules in the group) has been written and closed — after the test has ended. These individual *separate reports*, contain only *Summary* data (no *Detailed Events*) and only a **.txt** version of the file is created (no **.csv** version even if optioned). The main session report file is named **CG<*grpid*>TLk<*mid*>.txt** (and **.csv**). In Nuss version 1.2.16 and earlier the individual files were named **CG<*grpid*>-M<*modid*>TLk<*mid*>.txt** (e.g., **CGStar-M9016-0TLk<*mid*>.txt**). Starting with NUSS version 1.2.17 these separate report names were simplified to **<*modid*>TLk<*mid*>.txt** to make them easier to archive. Use the *third* filter on the **[View]** button's dialog (*TLk*.txt) to find both the session reports and the newer version of separate reports.

Since each separate *mode* of the ***Leak Test*** that you run has its own uniquely named report file, the **<*mid*>** (*mode id*) field in each of the file names shown above is required. This *mode* sub-name field has the characters '**Auto**' for the first *automatic* mode, and '**C**', '**CR**', '**R**', '**RR**', '**RLO**', and '**Prg**', respectively, for the other six *manual* modes.

Click (check) the **AppRep** (append new report to last report) option check box if you would like to record several different data runs of the same mode to the same file. You can even use it across several separate loads of the ***Leak Test*** form. Just like the **ShowRun** option already described, it inherits its default setting from the *Common Options* frame of the ***'Configure | Calibrators (NUSS)'*** form, which is selected from the home-base menu (see example previous page).

Now, lets continue our description of the ***Leak Test*** automatic and manual test modes (see inset right). The *automatic* mode (labeled ***Auto-Full-Ckt-LRN***) tests the full pneumatic circuit – that is also used by the *Multipoint* ***Calibration Adjustment*** function to calibrate the module(s) affected by each LRN. It is successfully automatic **only** if the module(s) are currently pneumatically-plumbed as they should be (via appropriate ***Run*** or ***Cal*** valve connections as specified by the ***LRN-to-Transducer*** configuration function for each tested LRN (see ***'Calibrate | Associate LRNs'*** menu selection on each affected module's *context* menu). This *mode* starts and finishes the test without any prompt messages requiring operator response. The base report file name for tests run in this mode is ***TLkAuto.*** (e.g., **9816-123TLkAuto.txt**).

The specific manual ***Cal*** mode tests the explicit pneumatic circuit in which the *calibrator output* is plumbed directly to only the *Cal port* of the affected scanner module(s) of each LRN. This may or may not be the same as the ***Auto*** mode. The operator is prompted with a message to connect this pneumatic circuit, and then press **[Resume]**. The base report file name for tests run in this mode is ***TLkC.***(e.g., **CGStarTLkC.txt**).

The specific manual ***CalRef*** mode tests the explicit pneumatic circuit in which the *calibrator output* is plumbed directly to only the *Cal-Reference port* of the affected scanner module(s) of each LRN. The operator is prompted with a message to connect this pneumatic circuit, and then press **[Resume]**. The test program expects the pressures, that the calibrator sets, to *read* negative because they are directed to a reference port. The base report file name for tests run in this mode is ***TLkCR.***(e.g., **9016-913TLkCR.txt**).

The specific manual ***Run*** mode tests the explicit pneumatic circuit in which the *calibrator output* is plumbed directly to all the affected *Run ports* of the affected scanner module(s) of each LRN. This may or may not be the same as the ***Full*** mode. The operator is prompted with a message to connect this pneumatic circuit, and then press **[Resume]**. The base report file name for tests run in this mode is ***TLkR.*** (e.g., **CGATLkR.txt**).

The specific manual ***RunRef*** mode tests the explicit pneumatic circuit in which the *calibrator output* is plumbed directly to only the *Run-Reference port* of the affected scanner module(s) of each LRN. The operator is prompted with a message to connect this pneumatic circuit, and then press **[Resume]**. The test program expects the pressures that the calibrator sets to *read* negative because they are directed to a reference port. The base report file name for tests run in this mode is ***TLkRR.*** (e.g., **9022-163TLkRR.txt**).

The specific manual ***Run-Leak-Option*** mode tests the explicit pneumatic circuit in which the *calibrator output* is plumbed directly to only the ***Cal*** *port* of the affected scanner module(s) of each LRN while all the affected Run ports of each scanner are connected together via any external manifold that has been dead-headed. The operator is prompted (with two separate messages) to connect this pneumatic circuit, and then press **[Resume]**. The base report file name for tests run in this mode is ***TLkRLO.*** (e.g., **CGStarTLkRLO.txt**).

The specific manual **Run-Purge-Ckt** mode operates somewhat like the ***Run-Leak-Option*** mode. It tests a special pneumatic circuit in which the calibrator output is plumbed directly to only the ***Purge*** *port* of the affected scanner module(s) of each LRN while all the affected *Run ports* of each scanner are connected together via an external manifold that has been dead-headed. It is also somewhat different from other modes in that it has different default parameters for **Duration** and **Tolerance**. Also (before this mode of Leak Test form is started) each affected DH transducer channel must be **manually changed** to utilize a

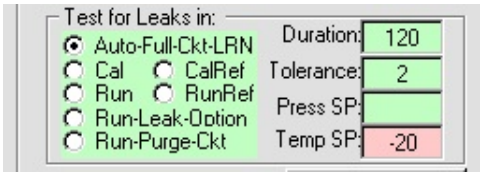
different (than normal) LRN: one whose calibrator "Span" set point **is set to a fixed Purge Pressure of 300 psi (or equivalent other native units)**. When the test starts it selects the Purge valve, which isolates the scanner module's DH transducers of each channel from the pneumatic circuit being tested for leaks – before this pressure is applied. Thus, the output reports for this test mode show only the Calibrator's reading instead of a reading of each DH channel. Also, when this test mode is over, the affected channels must be **manually changed** back to their correct LRN (whose full-scale Span is suitable for a Span-Only Calibration Adjustment of the affected channels). The base report file name for leak tests run in this "Purge" mode is ***TLkPrg.***(e.g., **9016-913TLkPrg.txt**).

The *first text box*, labeled **Duration**, is normally set by default to 120 seconds (2 minutes) but is increased to 180 seconds (3 minutes) for the ***Run-Purge-Ckt*** mode. These tolerances come from a factory tolerance file or the Leak Test Options frame at the bottom right of the ***'Configure | Calibrators (NUSS)'*** form. You should not normally change it on the Leak Test form, but if you do its text box turns bright red. However, the final report is non-standard (not according to PSI Standard Operating Procedures).

The *second text box*, labeled **Tolerance**, is normally set by default to 2% of Full Scale "Span" value assigned to the LRN. However, for the ***Run-Purge-Ckt*** mode, this tolerance is increased to 5% of Full Scale "Span" value (300 psi, or equivalent other native units) assigned to the special Purge LRN. These tolerances comes from a factory tolerance file, and should not normally be changed by the user. You can, however, change this value just before you click **[Run]** to start the test. However, the value entered is scaled up or down appropriately inside the test if you also manually change the **Duration** box. The final test report reflects this scaled tolerance value.

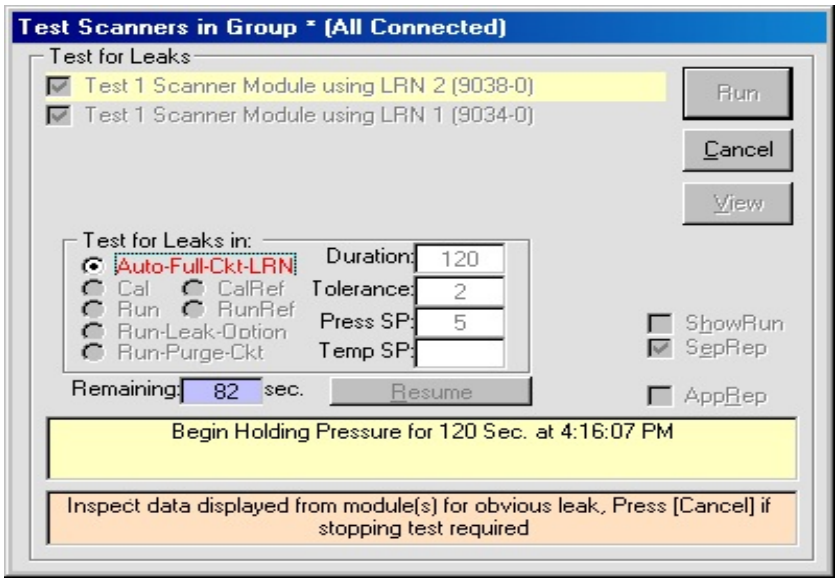
The *third text box*, labeled **Press SP**, is normally set automatically to the Full-Scale range of the particular transducers being tested in the module(s) affected, which is assumed to be the value specified by the *Span-Only* set point of the pre-defined LRN. This value is automatically limited (to 400 psi or equivalent other native units) for certain high-pressure scanners, and (in some cases) for the reference port modes of the test. You can change the value if you like, but that is not recommended. For manual modes only, you can simply click the text box to make the change just before you clear the first operator prompt with the **[Resume]** button. For the Auto mode you can set it early, before you start the test, and the new entry overrides the *Span-Only* set-point normally used by each LRN.

The *fourth text box*, labeled **TempSP**, in normally blank, as the ***Leak Test*** is normally conducted without any Oven usage. However, if a temperature value (in degC) is entered into this text box (see inset right) then some external Oven (containing the tested



modules) is assumed to be set (manually by the user) to this temperature before the ***Leak Test*** starts. When such a temperature value is specified the final ***Leak Test*** report format is also modified to include each pressure scanner's initial *temperature* data (per channel) in addition to its initial and final *pressure* data. These data are flagged (****) if any channel's *temperature* deviates ±7 degC or more from the specified **Temp SP**. This feature improves for a Factory User as the specified Oven temperature is automatically set if the oven is interfaced to the PC running NUSS. In that case, these data are flagged for any ±7 degC deviation from the Oven's *temperature reading*.

After you click the **[Run]** button to start the test, most of the other controls (except the **[Exit]** button, now renamed **[Cancel]**) are dimmed and unresponsive (see example form below). Notice that the selected mode is highlighted with blinking red text.



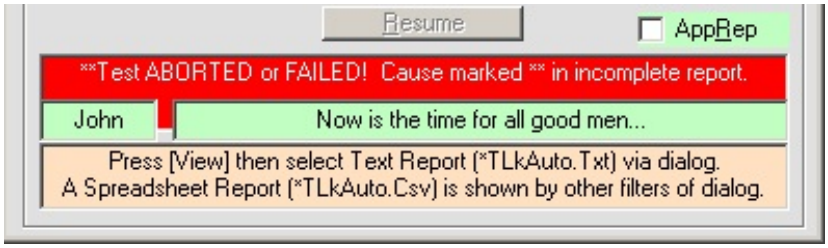
Leak Test form after test starts

During the running of the test a new Status Box (with *light-yellow* background) appears (in place of the **Tested by:** and **Comment:** text boxes), and just above the other permanent (*light-orange*) Status Box. Its purpose is to describe the main mode of the test currently in progress (e.g., which selected LRN is currently being tested, and which calibrator module (and which scanner modules) are associated with that LRN). The "current" LRN selected for testing is also indicated by highlighting (*light-yellow*) that LRN's *check box label* near the top of the screen. The bottom Status Box holds other status messages and prompt messages for the attention of the operator, which are cleared by clicking the **[Resume]** button that is enabled (and turns bright yellow) when a prompt is waiting for the operator to acknowledge (clear). A bell (or beep) sounds (if you have a sound card) when prompting messages appear. Such high-priority messages also blink (alternately, red then black text).

Since this test requires numerous delays (to wait for pneumatic pressure to settle, etc.) a small text box (*light-blue*) appears when any delay is in progress. It indicates how many seconds are remaining in the current delay.

You may use the **[Cancel]** button to abort the test at any time. The test may also self-abort if the errors it detects are serious enough. In all such cases the actual cause if shown in the final incomplete report (that you view by clicking the **[View]** button).

In either case, a cancelled or self-aborted test may not stop immediately, but does so as soon as the next "breakpoint" is reached. During such a wait, the upper status box's background turns *bright-orange*, and the message in it indicates the impending abort of the test. If the test finishes successfully, then its background turn's *bright-green* if no data items are flagged out-of-tolerance, and *bright yellow* if any items are flagged. and the box also contains a suitable message. If the test is aborted or ends with an incomplete report its background eventually turn's *bright-red*, and contains a suitable error/failure message (see example below).



The bottom Status box reminds the operator of the complete or partial reports available to be viewed. The specific reason(s) for the failure are recorded on error lines (marked **) in the incomplete test report. The **Tested by:** and **Comment:** text boxes are restored (overlaid on the top Status box). The **[Cancel]** button is renamed **[Exit]**. At this point the operator may choose to start a new test session, with the same (previously checked) LRN's or with others selected instead. You should, of course, save the various mode reports (from the **]View] button's File Open** form's context menu) if you cannot afford to lose their data. Similarly named reports are overwritten if you rerun the same test mode(s) for the same modules and/or group (without the **AppRep** option being checked).

After a test ends normally, or is aborted, you can press **[View]** to see the complete or partial report file. See file naming conventions above for identifying which files belong to which test modes. The following example shows an *individual* module's *separate report* abstracted from the testing of a larger group of more than one module. The report for a **Run-Purge-Ckt** mode (e.g., **9016-913TLkPrg.txt**) leak test would look similar, except that each Scanner would have only a single data line (instead of a data line per channel) and

that data would be the *calibrator's reading* in the isolated pneumatic circuit instead of the channel's DH *transducer reading*.

CGStar-M9016-669TLeak.txt - Notepad

File Edit Search Help

```
--- NUSS 'Leak Test Summary Report' for Group * but including only data for module:
----  9016-669 () associated with LRN 1
--- Session includes Auto 'Full-circuit' cycle only
--- Report generated: 05-29-2001 at 17:18:08
--- Contents includes Summary Results only
--- Test conducted by: q  Comment: q

------------------------------------------------------------------------------
  Auto Leak Test Cycle in 'Full-Circuit' Mode
------------------------------------------------------------------------------

   Measured Leaks: LRN 1 for Cycle Full-Circuit
     Calibr. PCUg-373      Set to: 1.0
      :       :            Reads:  0.999963
                                 Initial       Final        Leak(-)  *out*
     Scanner 9016-669      Ch      Press(psi)    Press(psi)   Err(%FS)  >2%
      :         :          1       1.000294      0.998709    -0.158495
      :         :          2       1.000288      0.998733    -0.155503
      :         :          3       1.000444      0.998887    -0.155705
      :         :          5       1.000223      0.998503    -0.172001
      :         :          6       1.001467      1.001292    -0.0175
      :         :          7       1.00039       0.998782    -0.160807
      :         :          9       1.000398      0.998886    -0.151205
      :         :          10      1.000484      0.998894    -0.159001
      :         :          11      1.000464      0.998948    -0.151599
      :         :          12      1.000511      0.998847    -0.166404
      :         :          13      1.000474      0.998888    -0.158596
      :         :          14      1.000418      0.99891     -0.150794
      :         :          16      1.001287      1.000035    -0.125194
```

Separate Report of an *Individual* Module after a Group Leak Test

In this test report example, only the ***Auto-Full-Ckt-LRN*** mode was tested. This is for a real module (9016-669). Though no leaks were detected outside of the tolerance (no **** in last column), you can see some minor leaks are indicated by comparing the Initial Pressure and Final Pressure data.

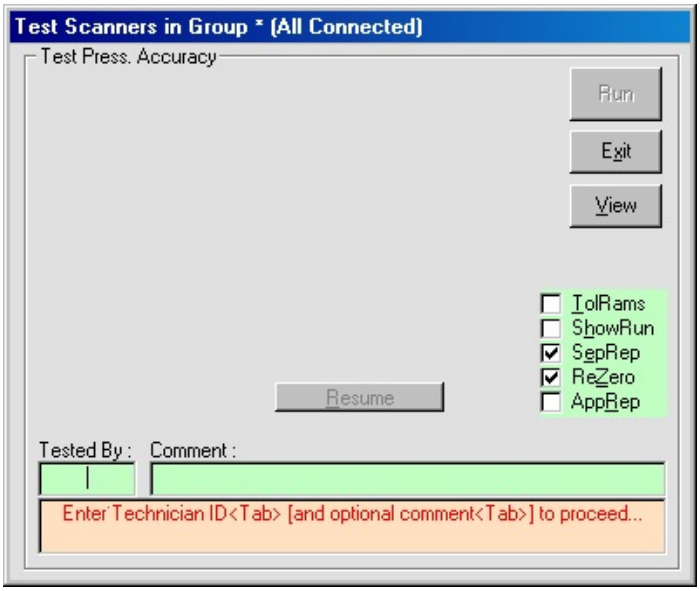
The **Leak(-)** column always shows a true leak as a *negative number*, regardless of the sign of the **Initial** and **Final** columns (which are both negative for "Ref." mode tests). The ***out*** column is flagged with "********" if the **Leak(-)** column is *negative* and larger (in absolute magnitude) than 2% of FS. If the **Leak(-)** column is *positive* and larger (in absolute magnitude) than 2% of FS, it contains the word "**rise**", which is not considered an error. Such rises often result from tube clamping of low pressure units.

If the ***Run-Purge-Ckt*** mode was used to run the test, the status report is similar to the example above, but there is no DH transducer reading for each channel of each module. Instead, there is a single data line showing the Calibrator Reading during the test for each module. This is because this mode isolates the DH transducers from the trapped pneumatic circuit being leak tested, thus only the calibrator reading is meaningful. The ***out*** column is flagged with "********" if the **Leak(-)** column is *negative* and larger (in absolute magnitude) than 5% of the FS 300 psi (15 psi) or equivalent other native units.

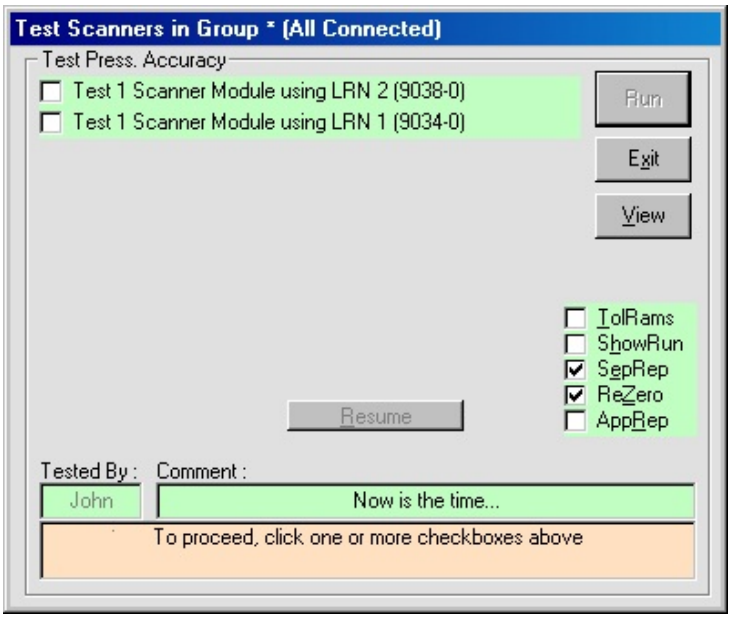
Two complete Report file examples a Leak Test (that was once included in this chapter) can be found in Section F.5 of Appendix F (File Formats).

5.3 Pressure Accuracy Test (Press. Scanners/Standards)

Select this test (‘***Test | Pressure Accuracy’***) from the *context* menu of a single *connected pressure scanner/standard* module – or from the home-base menu (‘***Test | Pressure Accuracy (Group’s Scanners)’*** for a group of *connected pressure* scanners/standards (see example inset right). No LRN choice *check boxes* appear until you have first entered the operator’s name (Technician ID) in the **Tested-By** text box (or have entered it ahead of time on the “main” form).



Initial ***Pressure Accuracy Test*** form for Group *



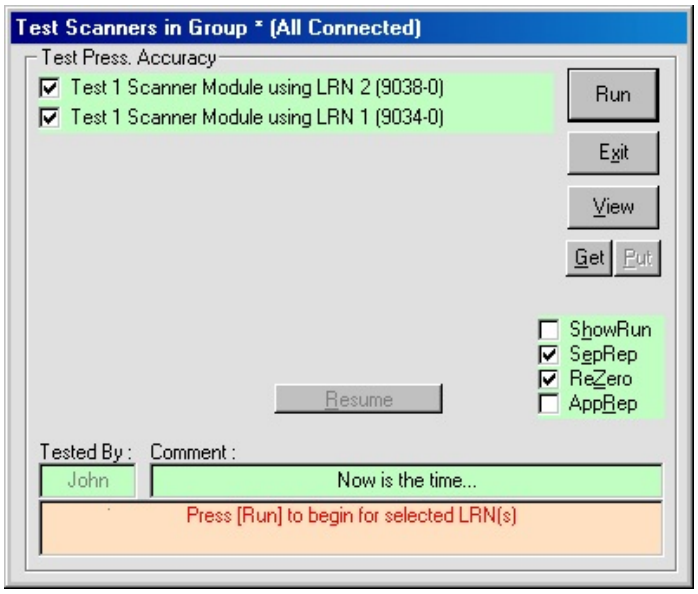
Pressure Accuracy Test form after operator sign-in

Once LRN choices are visible (see example inset left) you may select any or all of them by checking one or more of their *check boxes*. When only a single LRN is displayed, it’s *check box* is checked for you. This example shows two available LRN choices (currently unchecked) for the scanner modules it finds in the current group (“*” or Star). Both LRNs show a different calibrator module (9038-0 and 9034-0) in this case. The equivalent single-module ***Pressure Accuracy Test*** forms would look the same as the group examples above, except the title bar would indicate a single module instead of a group, and it would only show LRN choice(s) for that single module.

Review **Section 4.1** in **Chapter 4** if you need a refresher course in the purpose and value of LRNs, and ways to configure them. Also see the common introduction to tests in **Section**

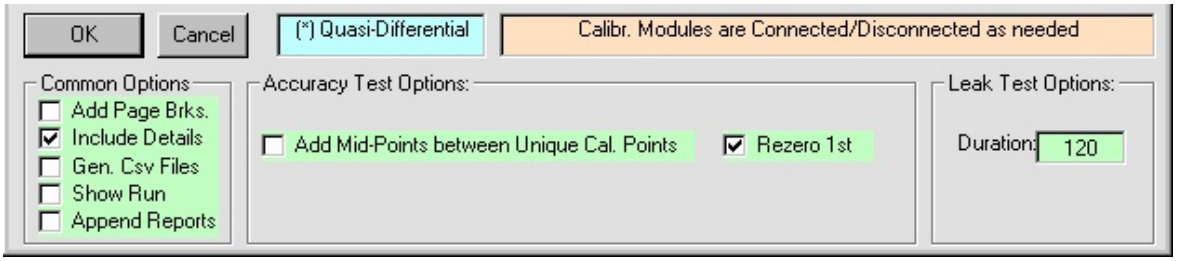
5.1 above for a complete description of the basic test form layout and how one conducts the test and views results.

The next example (inset right) shows the same form after the operator's name and optional comment have been entered, and both LRN choices have been selected (checked). Notice that the **[Run]** button has now been enabled. At this point, you still have time to *view* (and *save* or *print*) the *last* test report file — that is about to be overwritten (if you press **[Run]**). At this time you should also look at the unique test options (see the four *check boxes* below the buttons), and decide if you want to change their default selections when you run the test.



Ready-to-Run ***Pressure Accuracy Test*** form

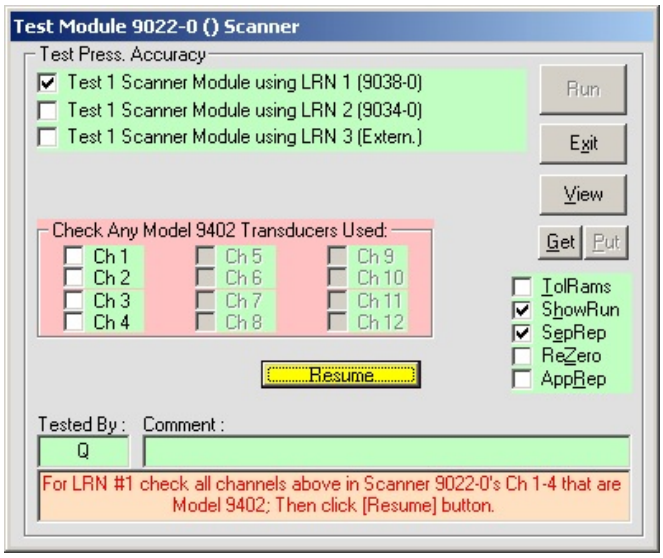
Some of these options are pre-specified and inherited from the special LRN configuration form selected by the ***'Configure | Calibrators (NUSS)'*** menu item on the home-base menu, as described in **Section 4.1.1.3** of **Chapter 4** (see just the bottom of that form in example below).



Pre-specified options for ***Pressure Accuracy Test*** plus options common to other tests

Other options pop-up only when certain scanner module(s) are tested. All NetScanner Model **902x** modules have *external* transducers, and any combination of transducer ranges may be mixed and matched. Any of three models of **KPSI Model 940x** transducer may be plugged into any channel (1-12) of a **902x** module. These include:

- **Model 9400** *Gage* types (with ranges from 5 to 10000 psig)
- **Model 9401** *Absolute* types (with ranges from 15 to 10000 psia)
- **Model 9402** *Differential* types (with ranges from 5 to 750 psig)

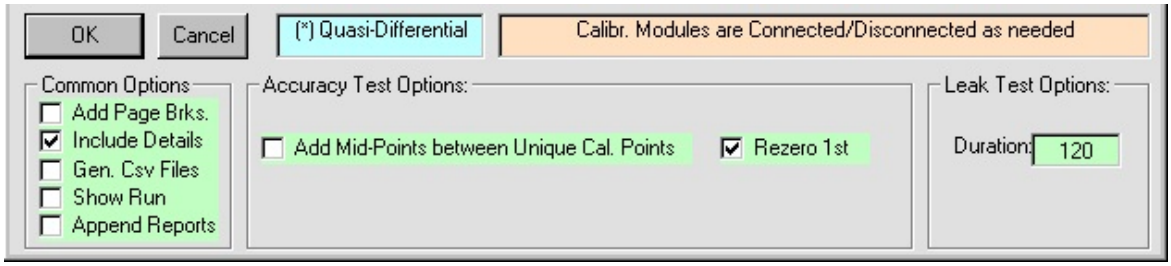


Choosing Model 9402 Transducer Tolerances

The **Model 9402** is a *special transducer with a much lower published accuracy of 0.5 % of full scale* over all ranges 5 to 750 psig. The *other* **940x** models all have 0.05 % full-scale accuracies for the same ranges. **Since there was no provision for automatically reading the transducer *model number* it must be specified manually by the user of this test program.** The example (see inset right) shows the test form at the moment you check any LRN check-box (at the top of the form) **that has any Model 902x type scanner module assigned to it**. A *pink* dialog frame and a *yellow* **[Resume]** button appears on the form. Only the check boxes of channels you have associated with that LRN for one module is enabled (the others are dim). Only Ch 1-4 are selectable in the example above. The blinking prompt message at the bottom of the form identifies the module by its serial number. You must MANUALLY check those channels of this module that have **9402** models plugged into them, and leave the others unchecked. Then, click the **[Resume]** button to continue (i.e., to **[Run]** the test with just that LRN checked, or to check another LRN checkbox first). If other LRNs have any associated **Model 902x** channels, the above dialog reappears for those channels, and you must again check any **9402** models that apply.

As you may have noticed (if you read **Chapter 4**) this *test* function operates in a fashion very similar to the way the ***Calibration Adjustment*** functions operate — except as already noted above. It also has other operational similarities to the ***Leak Test*** (**Section 5.2**). The LRN choices offered are exactly the same, and you can decide to *include* any or all of the LRN choices — by checking the ones you want to include in this test's current session report.

Actually, a ***Pressure Accuracy*** test is no more than a re-run of a *Multi-Point calibration adjustment*, without any actual adjusting of coefficients being done, and with an added report showing how close the module(s) still track the latest calibration results. The same basic pre-specified *Multi-Point* calibration *set points* are used, but others (half way between) may be optionally added to test how good the coefficients "fit" the real data at other than at the calibration points. These extra *half-way* set points are selected (or not) on the special LRN configuration form selected by the ***'Configure | Calibrators (NUSS)'*** menu item on the home-base menu, as described in **Section 4.1.1.3** of **Chapter 4** (see example repeated below).



Pre-specified options of ***'Configure | Calibrators (NUSS)'*** affecting ***Pressure Accuracy Test***

This bottom middle of that form has a special **Accuracy Test Options:** frame of controls the has two basic *check-box* options. These options directly affect only the running of this **Pressure Accuracy Test** and have the following meanings:

- The first check box (labeled **Add Mid-points between Unique Cal. Points:**) causes the test program to add extra mid-points as described above (when *checked*). This option is not visible on the **Pressure Accuracy Test** form itself when the test runs.
- The second check box (labeled **ReZero 1st:**) causes an actual *Zero-Only calibration adjustment* to be performed (when *checked*) — before starting each selected LRN's accuracy test cycle. This is always elected at the PSI factory, and recommended for your testing. The results of this fine *adjustment* appears in the final test report for each LRN included in the session.

Now, let us continue the description of the ***Pressure Accuracy Test*** program's form.

The ***ShowRun*** *check box* (see 1st option in inset example) is the same used by *calibration adjustment* and *leak test*. It inherits its default setting from the ***LRN-to-Calibrator*** configuration form (i.e., ***'Configure | Calibrators'*** on the home-base menu). When *checked*, it causes *simple* ***Run*** forms to pop-up (during the test) adjacent to the right edge of this test form. These cascaded ***Run*** forms only show the scanner modules affected by the current LRN being tested during the session. See their complete description in **Chapter 4** for more information.

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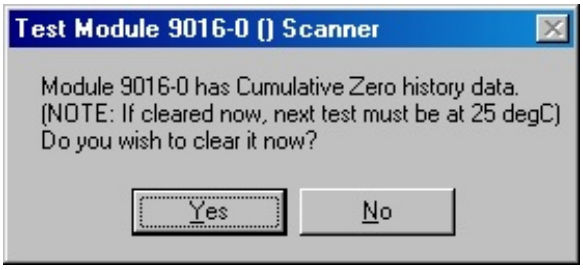
The ***SepRep*** *check box* (see 2nd option in inset example) appears only when the test is activated for a *Group* of modules — or when the test is activated for a single 9021 or 9022 scanner module. When present, the option's *check-box* is always *checked* by default, and must be *unchecked explicitly* if you do not want its effects. When *checked*, it causes ***Separate Reports*** to be written in the Report subfolder for each individual module in the group — or for each individual 9400 transducer attached to the single Model 902x module. These separate reports are written after the normal full report file has been written and closed — after the test session has ended. These separate *individual module* (or *individual transducer)* reports, contain only *Summary*

data (no *Detailed Events*) and only a **.txt** version is created. Though the main report files are named **CG<*grpid*>TAcc.txt** (and **.csv**). In Nuss version 1.2.16 and earlier, the *individual module files* were named **CG**<*grpid*>**-M**<***modid***>**TAcc.txt** (e.g., **CGStar-M9016-0TAcc.txt**). Starting with version 1.2.17 these separate report names were simplified to **<*modid*>TAcc.txt** to make them easier to archive. Likewise, the *individual transducer files* created for each 9400 transducer of a 902x module are named: **<*modid*>-X9400<*xdcr#*>TAcc.txt** .(where <***xdcr#***> is Transducer Number 1-12) Use any of numerous filters on the ***View*** dialog to locate these individual module files or individual transducer files.

A **ReZero** *check box* (see 3rd option in inset example) appears only on this test form. It inherits its default setting from **ReZero 1st:** option setting in the **Accuracy Test Options** frame on the LRN configuration form (see ***'Configure | Calibrators'*** on the home-base menu). See example of this form on the previous page. When checked, the **ReZero** option causes a *Zero-Only* calibration adjustment to be performed before each LRN's test cycle. If appears on this form just so you can optionally override the default option specified at a higher configuration level.

Click (check) the **AppRep** (append new report to last report) option check box (see 4th option in inset example) if you would like to record several different data runs of the same mode to the same file. You can even use it across several separate loads of the ***Pressure Accuracy Test*** form. Just like the **ShowRun** option already described, it inherits its default setting from the *Common Options* frame of the ***'Configure | Calibrators (NUSS)'*** form, which is selected from the home-base menu (see example previous page).

The **Pressure Accuracy Test** originally had (in **NUSS versions 2.0.9** and below) **[Get]** and **[Put]** buttons on the form whose use was optional. Manual use of these two buttons allowed you to extend the default *historical cumulative zero/offset* data, normally "accumulated" by this program across all *test runs* only encompassing one load of the form, to multiple loads of the form. The **[Put]** button simply saved any module-specific *cumulative zero/offset* "history" data before you exited the form. The **[Get]** button simply restored these data any time after the form was reloaded – and you needed to continue the "accumulation" that you had saved. When these buttons were not used such "history" data were simply "reset" (cleared) when the form was reloaded, and forgotten (i.e., not written to a file) when you exited the form.



Starting with **NUSS version 2.0.10** and above, the **[Get]** and **[Put]** buttons are **removed**, and the process of saving and

restoring *cumulative zero/offset "history"* data is **partially automated**. Now, any *exit* of this test form *automatically saves* any existing *cumulative zero/offset "history"* data in a file for each module that was tested. When the test form is reloaded later, and such history files *exist* for *any module now being tested*, the user is prompted with a pop-up dialog form (see inset right) for each module. Click the **[Yes]** button on the dialog to clear it (thus starting a new accumulation as indicated below). Be sure to heed the NOTE shown on the 2nd line of the dialog in this case. Click the **[No]** button to not clear these data, and historical data continues to be accumulated for that module for each new Re-zero.

Such *historical cumulative zero/offset* data files are named ***<modid>*TAcc.ini** where <*modid*> is a particular pressure scanner module's ID (e.g., 9016-0 in prompt example above). Read the end of **Appendix F** for a description of the format of such files. To view the contents of these files use the **.ini** file *filter* on the *dialog* form that pops-up when you select the menu item ***"File |View Files (NUSS)"*** from the *home base* form. Modification of these files is not recommended – though deleting them (when this test is not running) is equivalent to clicking the **[Cancel]** button in the prompt when the test is starting.

When no historical data files exist for any of the participating modules (or you click **[Yes]** in above dialog when such data do exist), those modules' *cumulative offset error* data are **reset** to the **base offset**. This is the *offset* coefficient obtained after the *first successful* Re-Zero adjustment of a session (for the applicable channels of module's current LRN). After each such Re-Zero operation during a session the *cumulative offset change* is recalculated as follows (per channel):

<Cumulative Offset Change> = <Base Offset> - <New Offset of This Re-Zero>

This value appears, when the *ReZero* check box is checked during the test, in the column labeled "Cumul.Ofst.Chg." in each Re-Zero report section that precedes each Accuracy Test data section of each test run (see example below). Also notice the column labeled "Cumul.Cnt" which contains a simple integer count of how many Re-Zero operations have been performed since the historical data accumulation was started.

```
Adjustment Summary: LRN 1 Offset     Offset     Current    Cumul.     Cumul.   *out* Cumul. Range
  Scanner 9016-0      Ch  (orig.)    (final)    Zero Rdg.  Ofst.Chg.  Err%FS  >0.05% Cnt    (F.S.)
   :       :          1   0.0001     0.0012     0.001     -0.0011    -0.003235       12     34 kPa
   :       :          2   0.0002     0.0013     0.002     -0.0011    -0.600006 ****  12     34 kPa
   :       :          3   0.0003     0.0014     0.003     -0.0011    -0.003235       12     34 kPa
   :       :          4   0.0004     0.0015     0.004     -0.0011     0.60006  ****  12     34 kPa
   :       :          5   0.0005     0.0016     0.005     -0.0011    -0.003235       12     34 kPa
   :       :          6   0.0006     0.0017     0.006     -0.0011     0.6      ****  12     34 kPa
   :       :          7   0.0007     0.0018     0.007     -0.0011    -0.003235       12     34 kPa
   :       :          8   0.0008     0.0019     0.008     -0.0011    -0.003235       12     34 kPa
   :       :          9   0.0009     0.002      0.009     -0.0011    -0.003235       12     34 kPa
   :       :          10  0.001      0.0021     0.01      -0.0011    -0.003235       12     34 kPa
   :       :          11  0.0011     0.0022     0.011     -0.0011    -0.003235       12     34 kPa
   :       :          12  0.0012     0.0023     0.012     -0.0011    -0.003235       12     34 kPa
```

The principal data appearing in each test run's report (after any optional Re-Zero section) are multiple sections showing the result of setting each pressure set point defined for the test.

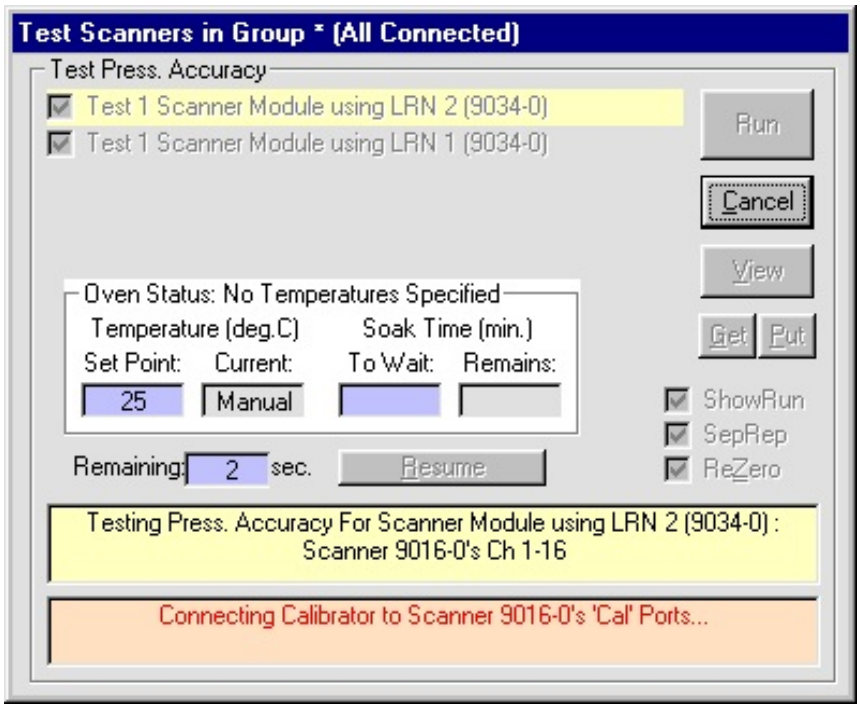
```
Indicated Readings: LRN 1 @ Pt. 1
  Calibr. 9034-373    Set to: 0.0
   :       :          Reads:  0.000009     Deviation    Deviation *out*
  Scanner 9016-669    Ch      Pr(psid)     Err(psid)    Err(%FS)  >Tol  Tol%
   :       :          1      -0.00001     -0.000019    -0.001895        0.15%
   :       :          2       0.000038     0.000029     0.002905        0.15%
   :       :          3      -0.00001     -0.000019    -0.001895        0.15%
   :       :          5       0.000087     0.000078     0.007805        0.15%
   :       :          6      -0.00001     -0.000019    -0.001895        0.15%
   :       :          7      -0.000057    -0.000066    -0.006595        0.15%
   :       :          9       0.000034     0.000025     0.002505        0.15%
   :       :          10     -0.00001     -0.000019    -0.001895        0.15%
   :       :          11     -0.000061    -0.00007     -0.006995        0.15%
   :       :          12     -0.00001     -0.000019    -0.001895        0.15%

  :       :       :       :       other sections deleted here for brevity

Indicated Readings: LRN 1 @ Pt. 5
  Calibr. 9034-373    Set to: 1.0
   :       :          Reads:  0.999923     Deviation    Deviation *out*
  Scanner 9016-669    Ch      Pr(psid)     Err(psid)    Err(%FS)  >Tol  Tol%
   :       :          1       0.999934     0.000011     0.001103        0.15%
   :       :          2       0.999922    -0.000001    -0.000101        0.15%
   :       :          3       0.999761    -0.000162    -0.016201        0.15%
   :       :          5       0.999735    -0.000188    -0.018799        0.15%
   :       :          6       0.999285    -0.000638    -0.063801        0.15%
   :       :          7       0.99984     -0.000083    -0.008297        0.15%
   :       :          9       0.999866    -0.000057    -0.005698        0.15%
   :       :          10      0.999835    -0.000088    -0.008798        0.15%
   :       :          11      0.999934     0.000011     0.001103        0.15%
   :       :          12      1.000022     0.000099     0.009906        0.15%
```

The current LRN's *Multi-Point* pressure *calibration set points* are normally chosen to stimulate the module(s) being tested for pressure accuracy — but with the optional addition of mid-points specified by an option chosen on the ***LRN-to-Calibrator*** configuration function (see ***'Calibrate | Calibrators'*** form as described above and selected from the *home-base* menu). These pressures are automatically applied using the same valves specified by this ***LRN-to-Transducer*** configuration function (see ***'Calibrate | Associate LRNs'*** on the single-module context menu).

After you click the **[Run]** button to start the test, most of the other controls (except the **[Exit]** button now renamed **[Cancel]**) are dimmed and unresponsive. An example of this form is shown on the following page.
During the test a second Status Box (with *light-yellow* background) appears (in place of the **Tested by:** and **Comment:** text boxes) just above the other (*light-orange*) Status Box. Its purpose is to describe the main mode of the test currently in progress (e.g., which selected LRN is currently being tested, and which calibrator module (and which scanner modules) are associated with that LRN). The "current" LRN selected for testing is also indicated by highlighting (*light-yellow*) that LRN's check box label near the top of the screen. The bottom Status Box holds other status messages and prompt messages for the attention of the operator.



Pressure Accuracy Test form after test starts

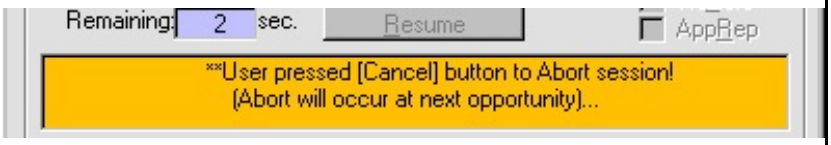
Since this test has numerous delays a small text box (*light-blue*) appears when any delay is in progress, and indicates how many seconds are remaining. It is updated every ½ second.

Also, during the running of this test, an entirely new frame (with white background, and several *light-blue* and *light-gray* text boxes) appears. The main purpose of this frame is to show the status of various *set points (temperatures)* that may be optionally set by a ***computer-controlled oven*** — across a wide range of temperatures — and used to actually heat up (or cool) all the modules being tested. Such an oven may be used only by ***Factory*** users of NUSS. This optional feature can also specify *Soak Times* for the modules at each temperature set point.

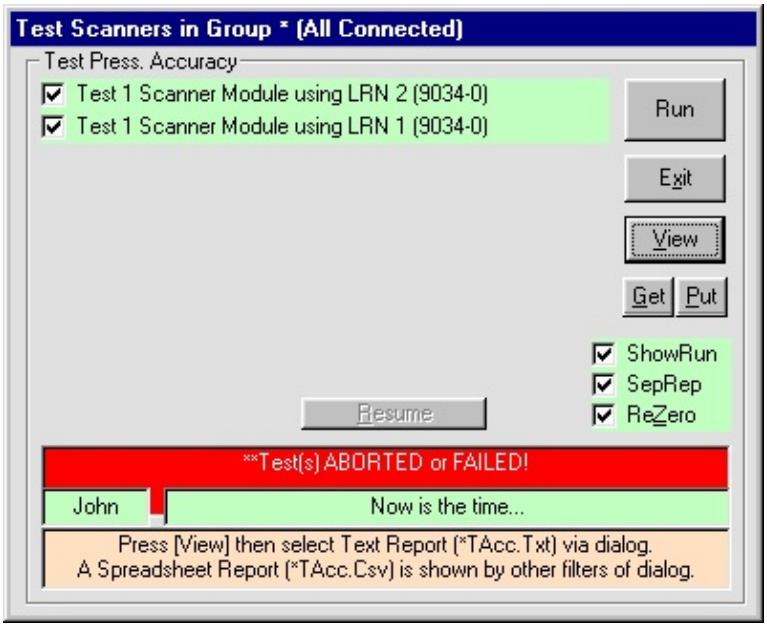
However, since you are a ***Normal*** user (now), you are not expected to have such advanced equipment, and thus cannot use this feature. Because of this, your test sessions run at an assumed fixed (module) temperature of 25 Degrees C (i.e., nominal room temperature).

Thus, this *white* status frame has no particular usage that needs to be described here (except that there are "no oven temperatures specified" for the test). See **Chapter 5** of the **Factory Addendum of the User's Manual** for more information on this feature.

You may use the **[Cancel]** button to abort the test at any time. However, it may not stop immediately, but does so as soon as the next "breakpoint" is reached. During such a wait, the top Status Box's background turns *bright-orange* (see example inset right), and the message in it indicates the impending abort of the test. If the test finishes successfully, then its background turn's *bright-green* if no data items are flagged out-of-tolerance, and *bright yellow* if any items are flagged. and the box also contains a suitable message. If the test is aborted or ends with an incomplete report its background eventually turn's *bright-red* (see example below), and contains a suitable error/failure message. You may need to examine the report file with the **[View]** button to find the true reason for the failure.



The bottom Status box reminds the operator of the complete or partial reports available for him/her to view. The specific reason(s) for any failure are recorded on error lines (marked **) in the report. The **Tested by:** and **Comment:** text boxes are restored (overlaid on the top Status box). The **[Cancel]** button is renamed **[Exit]**. At this point the operator may choose to start a new test session, with the same (previously checked) LRN's or with others selected instead. You should, of course, save the report (from the **NUSS** *text editor* form's menu) if you cannot afford to lose its data. It (and any separate *individual* module/transducer reports) is (are) overwritten if you rerun the same test for the same modules and/or group (without the **AppRep** option being checked).



Pressure Accuracy Test form after test aborted or failed

After test ends normally, or is aborted, click the **[View]** button to see the complete or partial report file. The *main report files* are named <***modid***>**TAcc.txt** (and **.csv**) for single-module tests and **CG<*grpid*>TAcc.txt** (and **.csv**) for group tests. Any *separate* report files per the *SepRep* option for *individual modules tested as group* are named **CG<*grpid*>-M<*modid*>TAcc.txt** in Nuss version 1.2.16 and earlier. Starting with version 1.2.17 these separate report names were simplified to **<*modid*>TAcc.txt** to make them easier to archive. For *individual external transducers (9400 types) tested together on a single 902x module* with the *SepRep* option, the individual files are named **<*modid*>-X9400-<*xdcr#*>TAcc.txt**.

The following example shows an individual transducer's *separate* test report abstracted from the testing of all the transducers of a single 9022 module. In this test, only a single fixed "oven" temperature is assumed. This file (named **9022-0-X9400-12TAcc.txt**) is for a simulated 12th transducer of a *simulated* module (9022-0). This accounts for the poor "out of tolerance" data, which is indicated by **** in next-to-last column of each data row.

```
--- NUSS 'Pressure Accuracy Test Summary Report' for a Single Transducer Tested on Module:
----  9022-0 () Scanner associated with LRN 2
--- The Model 9400 Transducer (Ser# 12) was tested on Module's Channel 12
--- Session includes setting NO temperatures
--- Session includes Rezero Cal. before ea.LRN tested
--- Report generated: 09-25-2001 at 15:56:34
--- Contents include Summary Results only
--- Test conducted by: q  Comment:

------------------------------------------------------------------------------
  Temperature Set to 25 deg.C for Following Accuracy Test Results
------------------------------------------------------------------------------

  Testing Press. Accuracy For Scanner Module using LRN 2 (9038-0) :

    Adjustment Summary: LRN 2   Offset     Offset     Current    Cumul.     Cumul. *out*
      Scanner 9022-0        Ch  (orig.)    (final)    Zero Rdg.  Ofst.Chg.  Err%FS >0.05%
        :       :           12  0.0        0.0        0.012      0.0        0.0

    Indicated Readings: LRN 2 for Model 9400 Transducer Ser# 12 tested on..
      Scanner 9022-0 Ch=12          Calib.Rdg    Scnr.Rdg     Deviation    Deviation *out*
      Calibr. 9038-0        Pt.     Pr(psid)     Pr(psid)     Err(psid)    Err(%FS)  >Tol  Tol(%)
        :         :         1      -5.0         -4.988        0.012        0.240002  ****  0.1
        :         :         2      -2.5         -2.488        0.012        0.240002  ****  0.1
        :         :         3       0.0          0.012        0.012        0.24      ****  0.1
        :         :         4       2.5          2.512        0.012        0.240002  ****  0.1
        :         :         5       5.0          5.012        0.012        0.240002  ****  0.1
```

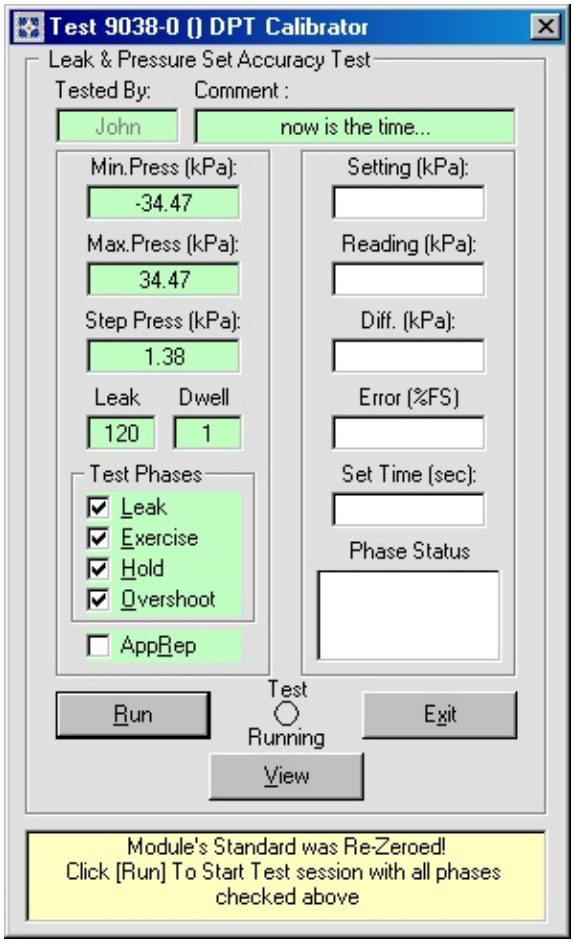
EXTRA ZERO DIFFERENTIAL SETPOINTS:

For high-pressure Absolute Quartz calibrators (with range > 100 psia) that are operated in the quasi-differential mode, extra zero (0.0 psig) set points as set by the Pressure Accuracy Test preceding the setting of any non-zero differential set points specified for the subject LRN. These extra zero settings appear in messages in the status box at the end of the form. They are used only to improve the setting accuracy of the specified set points. The final status report has only a single header message indicating the use of these extra zero points, but no data are collected for them.

The complete example of a **Pressure Accuracy Test** report (that was once included in this chapter) can now be found in Section F.5 of Appendix F (File Formats).

5.4 Leak & Pressure Set Accuracy Test (Calibrators)

Select this test (‘***Test | Leak & Press. Set Accuracy’***) from the *context* menu of any Model 903x *connected* module that can generate pressure (i.e., a *calibrator* Model 9034 or 9038) .



There is no Group version of this test, thus each calibrator module must be tested separately. See the common introduction to tests in **Section 5.1** above for a complete description of the basic test form layout and how one conducts the test and views results.

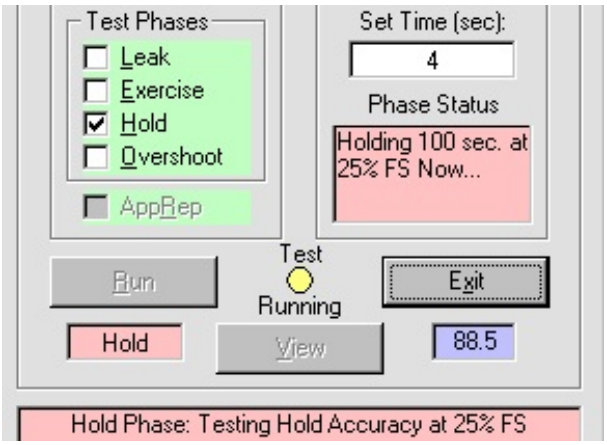
This form has three major control frames. The *right frame* contains only white fields that cannot be edited, but do show various pressure *setting* and *reading* status which are updated continuously during a test session. The top and left *frames* contain light green fields you are allowed to edit. The top frame has the **Tested By:** text box that requires you enter the operator’s name before you can start the test (unless you entered it from the NUSS main Test menu earlier). It also has a **Comment:** text box where you can enter an optional comment that appears in this test’s report. The left frame’s fields are normally filled with default values appropriate to either selecting or omitting any of the four (4) *test phases* of each test session.

You may change any of these left-frame test parameters *before* you start the test – though a *non-standard* test session results if you do so. The top three parameters (**Min. Press**, **Max. Press**, and **Step Press**), alter the *Exercise* phase when edited. However, the second parameter (**Max. Press**) applies to all phases when edited – and is displayed against a *bright-red* background in order to emphasize its change resulting in a non-standard test (see example inset right).

Similarly, the **Leak** *hold* time delay parameter (normally set to 120 sec. by default) may also be edited if a non-standard *Leak* phase is to be tested in a session (see example inset left). The **Dwell** time delay (normally set to 1 sec. by default) may be set to larger values if the calibrator’s pressure output is being used to drive another pressure measuring device or scanner (e.g., a 9032 or 9033 Pressure Standard

module) – and the time after each pressure is set is to be extended longer, so that ***Run*** form *recording* feature can capture several samples reliably. When edited, its value is displayed against a *yellow* background (see inset right) since the only consequences of changing it are lengthening the duration of the test session. This **Dwell** time parameter is used by both the *Exercise* and *Hold* phases. During a test session some or all of the left frame's parameters are updated to show progress. They remain blank during any phases for which they do not apply.

When the test is started, by clicking the **[Run]** button, all *checked* **Test Phases** are included as part of that test session. The results of each phase appears in its own section of the final test report. The checked phases are performed in the order shown (from top to bottom). A phase may be *aborted* prematurely by un-checking its check box while that phase is in progress – though its report subsection indicates its incomplete nature. However, you **cannot** *add* a phase to a session by checking it after the session starts.



In the example (inset above right) only the *Hold* phase was selected and is shown in progress. Additional controls may appear when a phase is in progress. A small status box (with a *light-pink* background in this example) appears below the **[Run]** button. It shows the name of the test "phase" currently in progress. Another small text box (with a *light purple* background) may appear intermittently *below* the **[Exit]** button. It shows the number of seconds still remaining in any significant timed delays. When it is visible, a larger status box above the **[Exit]** button labeled **Phase Status** may contain a message indicating the length and purpose of that delay. When the *seconds remaining* box is not visible, other status messages may appear in the **Phase Status** box indicating what test condition currently exists (e.g. currently setting a particular pressure set point) The color of three of the *status boxes* is unique to the test phase currently in progress. It is *light-pink* in the *Hold* phase example shown above, but is *light-yellow* for the *Leak* phase, *light-orange* for the *Exercise* phase, and *light-blue* for *the Overshoot* phase.

During the *Leak* phase the program sets the **Max Pressure** (normally Full-Scale except when edited) of the calibrator under test, waits for the pressure to stabilize, and then records the first pressure reading. Then a longer **Leak** *hold period* begins (normally 120 sec. except when edited) after which a second (final) pressure reading is made. If the second

reading is **significantly** lower than the first a "leak" is declared, and **the test ends early** (skipping all other phases of the test session that were checked at the beginning).

During the *Exercise* phase the program alternately sets one *high* value (beginning with **Max. Pressure**) and then one *low* value (beginning with **Min. Pressure**), repetitively. It then subtracts the **Step Pressure** from the *high* value and adds it to the *low* value to calculated the next two test points. This continues until both *high* and *low* reach the *other end* of its range. Normally this process completes after 100 set points have been exercised. For each set point the program records how long it takes the module to set that pressure to within a reasonable "coarse" tolerance. Next, a "fine" setting is verified by reading the "Pressure Is Set" status from the calibrator module. Sixty seconds is the limit for any point reaching both its coarse and fine setting, after which that point is "flagged" in the final report. If you watch this process occurring on the *right* frame of the form (a bit boring), only the **Reading** field has anything worth watching. That field turns *bright-green* (for the specified **Dwell** time delay period) when the set point is declared "set" successfully. It may turn *bright-yellow* if the "coarse" setting is achieved but the "fine" setting (via status) is not achieved within the 60 second limit. Any reading that reaches the "coarse" setting but not the "fine"setting, or which exceeds the 60 second limit, is flagged in the final report. If any error occurs while waiting for the pressure to be set, the reading field turns *bright red*.

During the *Hold* phase four different pressure set points are set (25%, 50%, 75%, and 100% of **Max. Press** for a Model 9034 *absolute* calibrator, or -100%, -50%, +50%, and +100% of **Max. Press** for a Model 9038 *differential* calibrator. These values are all fractions of Full-Scale (FS) if **Max. Press** is not edited. Some of these "low pressure" set point values may be substituted with other "set-able" ones if the stated points cannot actually be set with the vacuum pump. Once each set point is set and stabilized, 100 readings are recorded (at 1 second intervals). These readings are all verified as to whether they continue to *hold* the pressure setting within a fixed tolerance. Any readings that fail to hold the tolerance are flagged .

During the *Overshoot* phase many pressure readings are recorded at a shorter (0.2 second) interval. The recording begins with the calibrator set to zero (or minimum absolute) pressure. After the 2nd reading **Max. Pressure** (normally Full-Scale except when edited) is set. Starting with the 4th reading all the values are checked for +overshoot. Any readings that shows a positive overshoot by more than some fixed tolerance are flagged in the final report. Once the pressure is declared set (by checking status) another 100 readings are recorded and also checked for +overshoot.

You can abort the test by pressing the **[Exit]** button after the test starts. Similarly, you may abort just the *current phase* "early" by un-checking that phase's checkbox. Whether you abort the entire test or just the current phase, it may not stop immediately, but does so as

soon as the next "breakpoint" is reached. During any wait for the entire test to stop, the Status Box at the bottom of the form has it background turns *bright-orange*, and the message in it indicates the impending abort of the test.

If the test finishes successfully, then the *bottom* status box's background color turn's *bright-green* if no data items are flagged out-of-tolerance (and no test phases were aborted prematurely), and *bright yellow* if any items are flagged (or any test phase was aborted prematurely). This *bottom* status box also contains a suitable message. If the test is aborted (by operator or due to a serious error being detected) its background eventually turn's *bright-red*, and contains a suitable error/failure message.

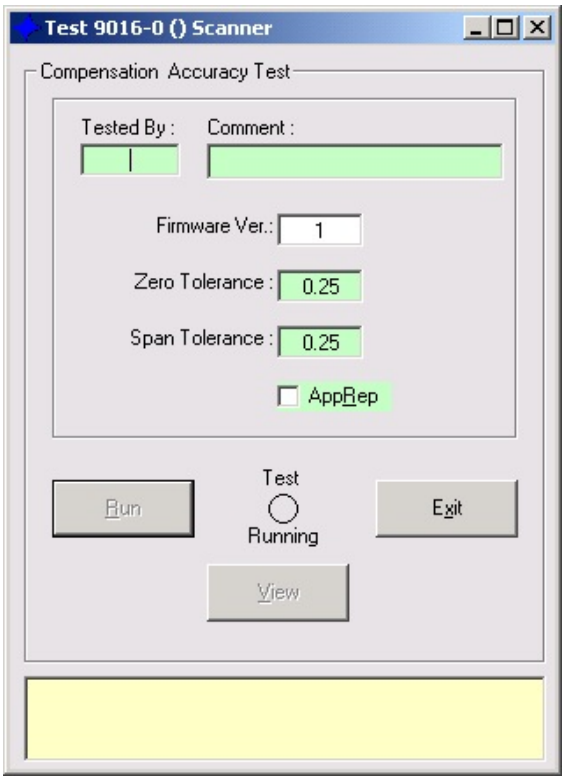
After a test session ends normally, or is aborted, you can press **[View]** to see the complete or partial report file. Each phase included (or skipped) during the test session has its own section in the session's report. The main report files are named <***modid***>**TPrSet.txt** (and **.csv**). The bottom Status box reminds the operator of the complete or partial reports available for him/her to view. The specific reason(s) for any failure are recorded on error lines (preceded by ** characters) in the report.

You may choose to start a new test session after one is completed. You should, of course, save the previous session's report (from the **NUSS** *text editor* form's menu) if you cannot afford to lose its data. The file is overwritten if you rerun the test (unless the **AppRep** option is checked). Click (check) the normally-unchecked **AppRep** check box if you would like to record (append) several different data runs to the same file. You may also change the default setting (check or un-checked) of this check box at the bottom of the **'Configure | Calibrators'** form. This form can also change the 120 sec. default *hold time* for the Leak phase.

The complete example of a **Leak & Pressure Setting Accuracy Test** report (that was once included in this chapter) can be found Section F.5 of Appendix F (File Formats).

5.5 Compensation Accuracy Test (Pressure Scanners)

Select this test (‘***Test | Compensation Accuracy’***) from the *context* menu of a *connected* scanner module. No “Group” version of the test exists on the home-base ***Test*** menu. The following form appears (in this example the operator has already entered his name and comment, and a test has already been Run):



There is no Group version of this test, thus each module must be tested separately.
See the common introduction to tests in **Section 5.1** above for a complete description of the basic test form layout and how one conducts the test and views results.

Unique to this *Comp. Accuracy* test, are two *tolerance* text boxes that initially display default tolerances (% of full-scale) for the *Zero* and *Span* coefficients that are displayed in the test’s report. These data are *flagged* for each *out-of-tolerance* channel. You may change these defaults just before running the test, and they remain for all other test sessions that you run — until you press **[Exit]**. Starting a new copy of the test restores default values. After test ends normally, or is aborted, you can press **[View]** to see the complete or partial report file. The main report files are named <***modid***>**TComp.txt** (and **.csv**), and example of which follows.

```
--- NUSS 'Compensation Accuracy Test Report' File for All Channels of Module:
---- 9016-1349 () Scanner (Scans/Avg=8 Sfw.Ver.=2.35)
--- Report generated: 01-09-2003 at 11:25:28.
--- Specified Tolerances (%FS) are Zero = 0.25  Span = 0.25
--- Test conducted by: bl  Comment:

Chan Range D.O.C. Serial#   Zero-Coef.*Out*   %FS       Span-Coef.*Out*  %FS
 1    30   020716  120696    0.02346          0.078      0.999177         0.082
 2    30   020716  120692    0.027978         0.093      0.999305         0.069
 3    30   020716  120694    0.027949         0.093      0.999303         0.070
 4    30   020716  120691    0.00609          0.020      0.999341         0.066
 5    30   020716  120689    0.01948          0.065      0.999453         0.055
 6    30   020716  120690    0.008461         0.028      0.999485         0.051
 7    30   020716  120693    0.021511         0.072      0.999506         0.049
 8    30   020716  120755    0.022393         0.075      0.999551         0.045
 9    30   020716  120687    0.026116         0.087      0.999377         0.062
 10   30   020716  120698    0.002551         0.009      0.999453         0.055
 11   30   020716  120717    0.011929         0.040      0.999478         0.052
 12   30   020716  120701    0.021249         0.071      0.999356         0.064
 13   30   020716  120699    0.007679         0.026      0.999413         0.059
 14   30   020716  120688    0.013316         0.044      0.999619         0.038
 15   30   020716  120695    0.002966         0.010      0.999317         0.068
 16   30   020716  120697    0.010039         0.033      0.999446         0.055

Test Completed OK.
```

This report shows (for each transducer/channel of the module) its *Range Code*, *Date-of-(Factory) Calibration*, *Serial #* (of *transducer*, not *module*), and the current *calibration adjustment* coefficients (*Zero* and *Span*). The values of both are shown, as a *simple value* and as a *percent of full scale (%FS)*. Any of these coefficients whose values are *out-of-tolerance* are flagged (******).

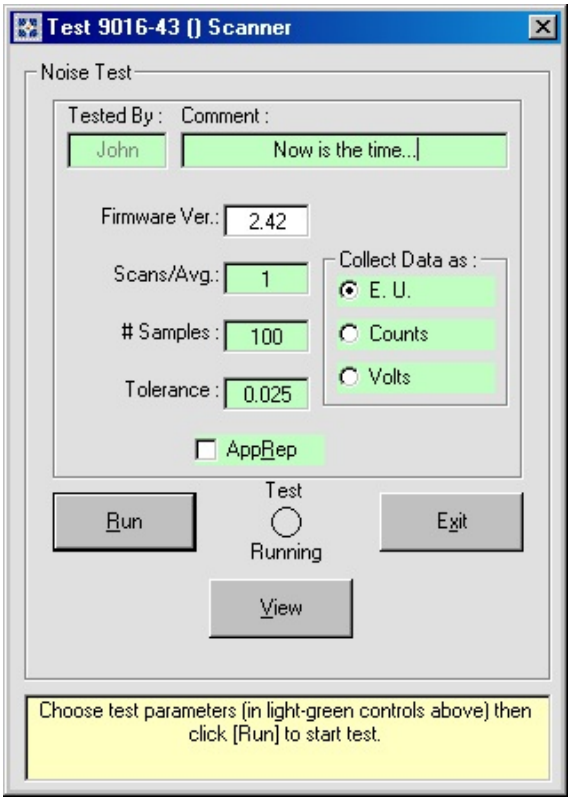
The report's header indicates the *Module ID* (model-serial#) and module's *Firmware Version*, the *Date* and *Time* test was conducted, and other conditions of the test (e.g., the tolerances). Finally, the *Test Conductor* (or Technician ID) and any *Comment* he/she entered are listed. If the test is incomplete for any reason, the "Test Completed OK" message at end of report is replaced with a suitable error message.

The tolerance specification used by this test are kept in a user-modifiable text file, named **TComp.ini**, which is located in the **Ini** folder of the *NUSS Install Path*. The Zero tolerance is a single number on the first line of the file, and the Span tolerance is a single number on the second line of the file.

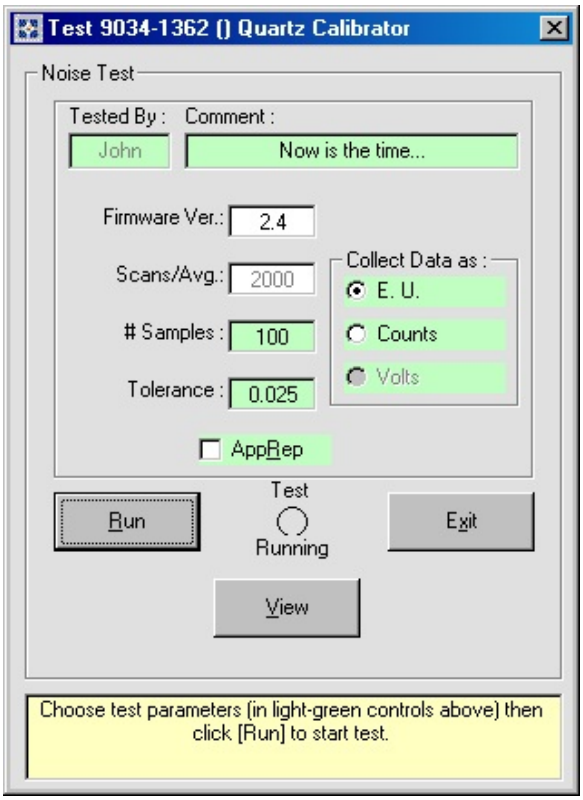
Click (check) the normally-unchecked **AppRep** check box (after the first run is completed) if you would like to record several different data runs to the same file. A ***SepRep*** check box may appear, but only for Model 9021 or 9022 modules and causes (if checked) individual Model 9400 transducer reports to be generated in addition to the main report shown above.

5.6 Noise Test (All Modules)

Select this test (‘***Test | Noise’***) from the *context* menu of a *connected* module. No “Group” version of the test exists on the home-base ***Test*** menu. The following form appears (this example shows form after the operator’s ID and comment have been entered, and the **[Run]** button is ready to be pressed):



Noise Test form for Scanner module



Noise Test form for Model 903x module

There is no Group version of this test, thus each module must be tested separately.
See the common introduction to tests in **Section 5.1** above for a complete description of the basic test form layout and how one conducts the test and views results.

The **Scans/Avg** text box and the **Collect Data as:** frame (see left example above) are similar for all *pressure scanner* modules (Models 9x16, 9012, 9022) and *temperature/ resistance scanner* modules (Model 9x46). However, for *pressure calibrator* or *standard* modules (Model 903x) some features are limited (see right example above). For example, the **Scans/Avg** field cannot be changed, and for Quartz sensor models the value may be a large number (e.g., 2000) actually in *frequency (Hz)* rather than a true *Scans/Avg* as shown. The **Collect Data as:** frame has the *Volts* option dimmed, because no command to read

voltage data exists in such modules. For all module types the default data collection type is *E. U.* data, though you may select another available option before you start the test. Unique to this *Noise* test is a **Tolerance** text box that initially displays a default tolerance (% of full-scale) for a datum that is displayed in the test report. The datum is *flagged* for each *out-of-tolerance* channel in the test report. You may change this default just before running the test, and it remains for all other sessions of the test you run — until you press **[Exit]**. Loading a new copy of the test restores the default tolerance value.

The main test report files are named **<***modid***>TNoise.txt** (and **.csv**). If you click the **[View]** button you are prompted to select the latest report generated by the program – which can then be viewed with a your favorite text editor.

Check the **AppRep** check box (after the first run is completed) if you would like to record several different test sessions in the same report file. If you uncheck this box, the next session **over-writes** any previous test report with the same name. To keep reports indefinitely you must rename them. The default state of this check box is inherited from the setup form obtained by selecting the ***'Configure | Calibrators'*** menu on the NUSS home-base form.

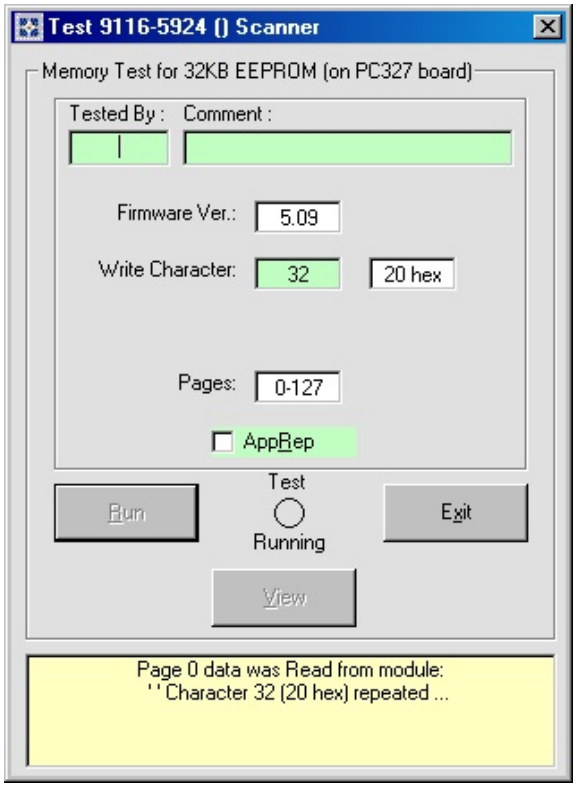
To start the test simply click the **[Run]** button. The test results appear in the final report when the test is over. A message summarizing the test result appears in the *status box* at the bottom of the form, which turns *bright green* if successful, *bright-yellow* if some errors were found, and *bright-red* if the test failed or was aborted for some reason (including the user clicking **[Exit]** before the test ends naturally).

Three complete examples of **Noise Test** reports (that were once included in this chapter) are found in Section F.5 of Appendix F (File Formats).

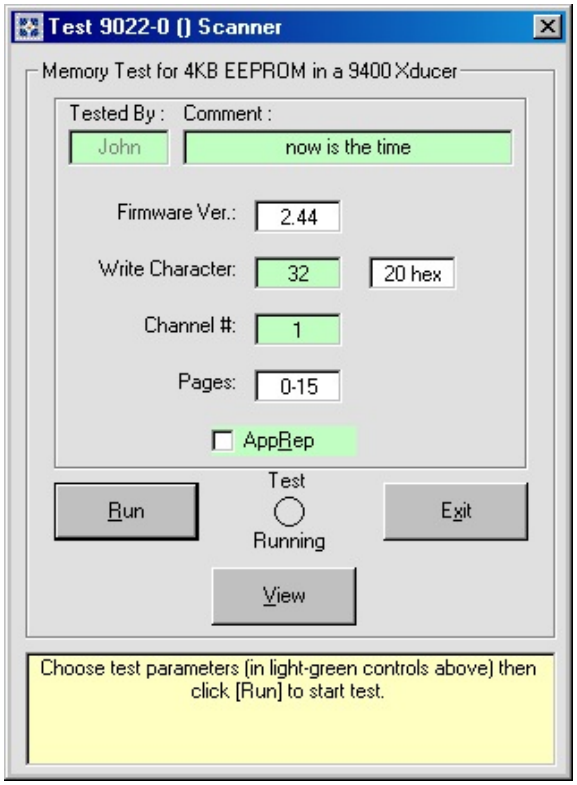
5.7 Memory Test (All Modules With EEPROMs)

Select this test (‘***Test | Memory’***) from the *context* menu of a *connected* module. No “Group” version of test exists on the home-base ***Test*** menu. Modules types which have no “user” EEPROM capability do not see this test on their menu. Modules having a PC327 board (or older PC206 board) can run this test – if their firmware version is recent enough to have the necessary support to read/write the board’s 32K byte EEPROM. This includes Model 9046 and 9146 temperature/resistance modules, plus the 9116 pressure scanner modules. This test also runs on Model 9022 modules with externally-attached Model 9400 pressure transducers. In this case a smaller 4K byte EEPROM can be tested inside the transducer itself – when connected to a particular channel you specify (1-12). These 902x modules may also have a 32K EEPROM inside the module itself. This can be tested by selecting “non-existent” channel 0. Model 9816 scanners **cannot** run this test.

One of the following two forms appear, depending on the model number of the module. Notice that each form’s title and 1st frame description line differ, and the right form has a **Channel #** text box that the left form lacks. Other differences are described below



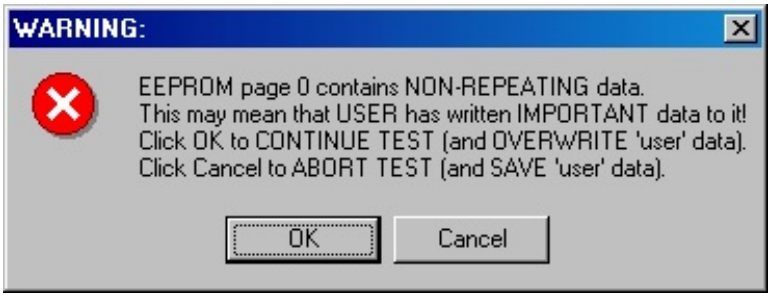
Test form for 32K EEPROM inside module



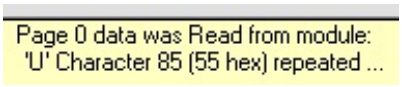
Test form for 4K EEPROM in transducer

About ½ second after the test program starts it attempts to read Page Zero (0) from its EEPROM. If the module returns an *error code* (N07 in this case), this pop-up WARNING message appears (see inset right) . The test exits after you click **[OK]**.

The left example (on previous page) is for a Model 9116 scanner, and it shows the form before the operator's (**Tested By:**) ID field is entered. Thus, it still displays the contents read from Page Zero (0) in the *status box* at the bottom of form. This is a valid "repeating data pattern" in this case. However, if it contains any non-repeating "user" data (that may have already been written to the EEPROM in a previous session), this pop-up WARNING message appears (see inset left). You may choose to continue with the test (by clicking **[OK]**) or you may abort the test and preserve these data (by clicking **[Cancel]**). Please notice that this "warning" feature checks **only** EEPROM Page 0.



If neither pop-up WARNING message appears, you should still examine the initial Page Zero (0) read data that is still displayed in the status box (see inset right). This should normally be a repeating pattern of some single ASCII character – which is a Space ' ' or ASCII 32 or hex 20, by default – if you run this program without making any changes to its options. However, this character may be changed (as in example above) before starting each test session -- by clicking the text box labeled *Write Character* and entering a different character code: which can be printable (ASCII 32-126) or non-printable control characters (0-31, or 127-255). A *decimal* ASCII code must be entered, but its hexadecimal equivalent is also displayed beside it (if you enter <*Tab*> after making the numerical entry).



The right example (on first page of this section) is for a Model 9022 scanner, and it shows the form after operator's ID and (optional) *Comment* have already been entered (and status box displays simple instructions on how to start the test). Notice that this example has a second modifiable (*light-green*) text box labeled **Channel #**, that the left example does not have. This text box highlights the default *channel number* (1) of where a 9400 external

transducer (whose 4KB EEPROM is to be tested) is expected to be connected on the host 9022 scanner. You can run other tests in a single session – for other external 9400 transducers – just by changing this channel # before clicking the **Run** button. You can also test the larger 32K EEPROM inside the 9022 module itself – by setting the channel # to zero (a non-existent channel #). This changes to *test title line* just below the *title bar* of the form – to reflect this different EEPROM test for the Model 9022.

The left example (on first page of this section) does not have the extra text box labeled **Channel #**, since there is only the single 32KB EEPROM in all other scanner models. If a model with the PC327 board is selected (9116 and 9146) instead of one with the PC206 board (9046, 9016) this fact is reflected in the *test title line* that lists the size of the EEPROM and the board type.

Check the **AppRep** check box (after the first run is completed) if you would like to record several subsequent test sessions in the same report file. If you uncheck this box, the next session **over-writes** any previous test report with the same name. To keep older reports with the same name indefinitely you must rename their default names. The default state of this check box is inherited from the setup form obtained by selecting the ***'Configure | Calibrators'*** menu on the NUSS home-base form.

To start a test session simply click the **[Run]** button. The *status box* at the bottom of the form shows each *write operation* to the module (that takes about 5 seconds per page). After the EEPROM pages are all written, this status box also shows each *read operation* (that takes about 1 second per page). Each read operation is followed by a *comparison check* to see if all the data read was as written. The test results appear in the final report when the test session is over. A message summarizing the test result appears in the *status box*, which turns *bright green* if session was successful, *bright-yellow* if some errors were found, and *bright-red* if the session failed or was aborted for some reason (including the user clicking **[Exit]** before the test's read/check loop ends naturally).

The main *report* file for this test is named **<***modid***>TMemory.txt** (and **.csv**). If you click the **[View]** button you are prompted to select the latest report generated by the program – which can then be viewed with your favorite text editor.

There is another feature of this test you can try – should you desire to write data patterns other than the normal ones (that repeat the same character to all parts of all pages). If you enter the code value **-1** in the text box labeled **Write Character:** the test will write whatever text string you have previously entered into the **Comment** box to the start of each page. If this comment does not completely fill each page, trailing *space* characters fill the rest. The *read check* insures that this pattern repeats in every page. However, please note that when you start the program again, after having written this comment text pattern, you

will be warned (via the second pop-up warning box shown on second page of this section) that "user" data pre-exists in the EEPROM. To get rid of this warning you must write a repeating character pattern in a subsequent test (for at least Page 0).

There is one more feature not obvious from the controls displayed on the form. However, this feature is somewhat evident if you monitor the *ToolTip* displayed when you hover the mouse over the **Exit** button during a test. The feature is the ability to shorten a test session to a smaller subset of pages checked than all the pages in the EEPROM. If you click the **Exit** button while the test is *writing* patterns to each page, the writing will stop short of writing all pages. Then, only those pages that were written are read back and checked for correctness. However, the session report does indicate that the entire EEPROM was not tested.

Examples of **Memory Test** reports are found in **Section F.5** of **Appendix F** (File Formats).