Recortest 4 - Open
Water Jacket Cylinder Testing System

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![GALISO INCORPORATED — GASES (LIQUIDS) SOLIDS logo]

!!!DANGER!!!

DO NOT USE THIS EQUIPMENT TO PURGE TOXIC OR FLAMMABLE GAS

AND

DO NOT USE THIS EQUIPMENT UNDER FLAMMABLE, VOLATILE OR TOXIC ENVIRONMENTAL CONDITIONS

Section 1: Software and Hardware Operations

Introduction:

This manual is for the operator to read and study before using the Galiso model Rec4 Steel Jacket System. Galiso updates the manual with software updates, but there may be subtle differences between your software and this manual. In all cases, it is easy to learn by using the software.

Text items bracketed between these symbols, "<___>" signify a 'clickable' button or tab, or a text field to be entered by the operator.

The word 'dynamically' means the function works or displays the changing values while the changes are occurring.

To open the Galiso testing program, double click the <REC 4 Hydrostatic Testing> icon on the desktop.

****** WARNING *****

'Esc' (Escape) button is used as the keyboard 'Abort' button. Be advised to not attempt to use this for any other reason during testing or the test will abort!

Fig 1: Login window

There are several stages of logins, according to the **type** of password used to log in with.

1. **Supervisor:** This login allows complete access to all levels of settings parameters. This login goes directly to the REC 4 Settings program.
2. **Operator:** This login has several stages or levels to which the operator can be allowed to set up certain test parameters. This is explained further, later in this manual. This login goes directly to the cylinder testing interface.

There is also a 'change database filepath' username and password. This login can only be used when prompted to redirect the database filepath upon the event you choose to do that.
Username: galiso
Password: REC4

Fig 2: REC 4 Settings menu tab options
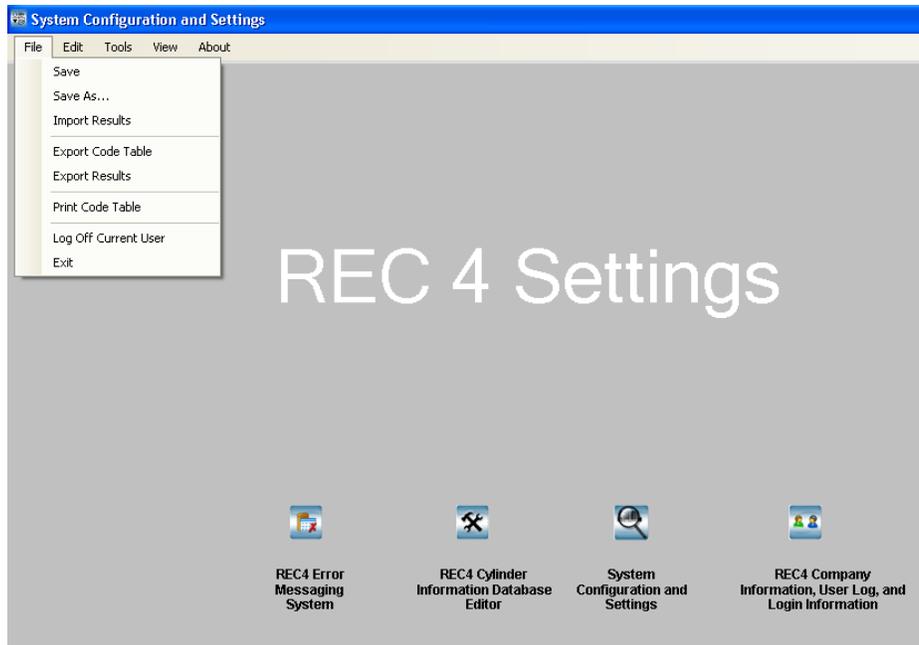
Supervisor logins go directly to this screen.

1. The <Save> or <Save As> function: This must be performed after making any changes to **any** of the REC 4 Settings functions.
   The <Save> function will always save the entire database (all grid/spreadsheet type files) to the **default** file location. The default file location can only be changed by password permission. Please use the <Save> function after making any data changes. This is the testing program database to input the correct data for testing cylinders. It saves the calibration cylinder data, serial number data, customer data, manufacturer data, and cylinder code data, etc….

   The <Save As> function enables you to **back-up** the same database set to another file location on your network. Please back-up the database when changes are made.

2. <Import Results>: After exporting results, you can retrieve them here to view them on the 'Test Results' screen again.

3. <Export Code Table>: This function is to save and print the cylinder code table for the operator to have a hardcopy 'handy' for ready reference. It is also for anyone who needs to view the table in a spreadsheet such as Excel. It may be saved as a text file to use as needed too.

4. <Export Results>: Here is where you can archive your results. You will be asked if you want to keep the results visible on the 'Test Results' screen, or if you want to clear them out to start a new results file. It is recommended to archive the results at least once per month, and clear the 'Test Results' screen grid for faster searching. It is also recommended to duplicate the archived results file to another media too, such as another hard drive on the local area network, or a CD, or flash memory, etc… This will ensure the data survives in the event of a hard drive failure.

5. <Print Code Table>: A hardcopy of the code table can be printed so the operator has a handy reference of all codes when identifying a cylinder for testing.

6. <Log Off Current User>: This is another location where you can simply log out of the test program.
7. <Exit>: Use this function to close the test program entirely.

The Rec4 Settings program is where all settings and user defined parameters are made. It can only be accessed through the calibration screen by permitted users. To navigate to the testing screens, click <Tools>, <Open Test Forms>.

To delete a stored item, click <Edit> <Delete A Record>. Test results cannot be deleted.

Fig 3: Error Messaging System; REC4 Contact Information Screen
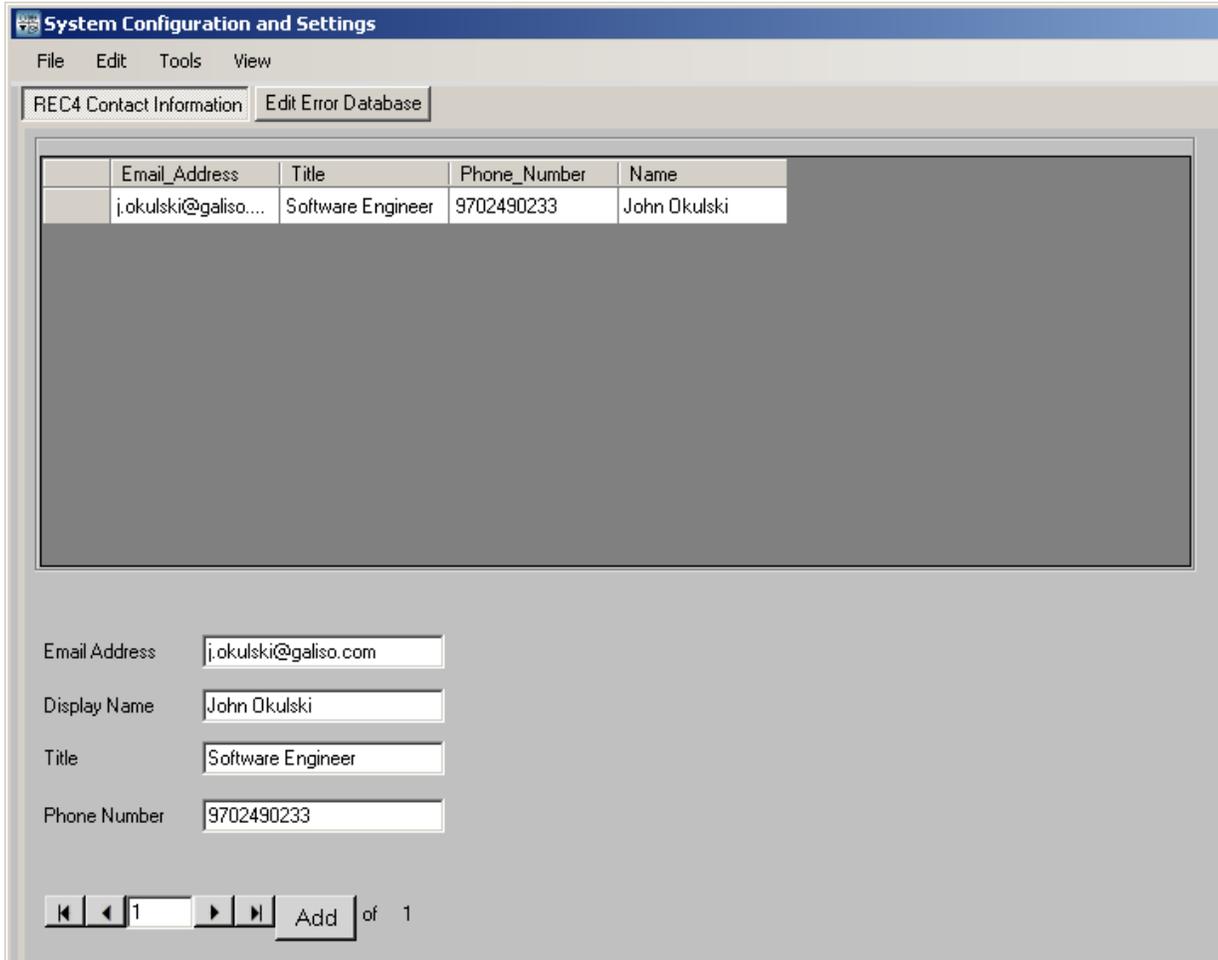
Upon the event of an error, others may be informed via e-mail if you have an internet connection on the machine PC. Here is where you can input the e-mail addresses. Errors range from operator errors to machine function (system) errors. You may input your Galiso customer service representative so Galiso receives an e-mail upon the event of an error.

Fig 4: Edit Error Database
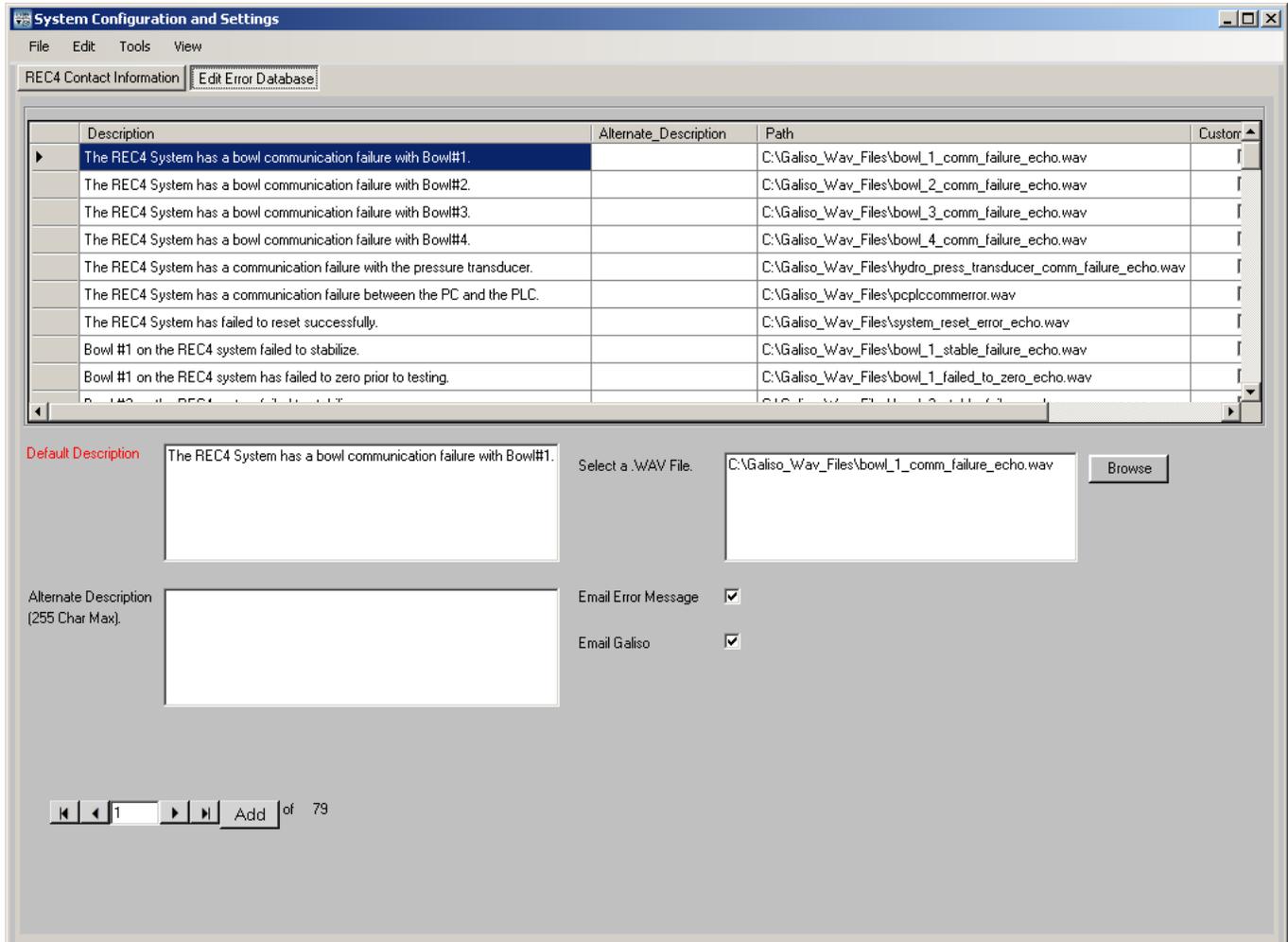
This screen contains the error database list. The default description cannot be changed. However, you can input an alternate description in text. This will appear in a red lettered text error message on screen upon the event of the error.

There is an English speaking audible voice error report that plays in the form of a public address (PA) system, in the event of certain errors. This report may be changed to your language by recording your own .wav file and placing the filepath to it in the 'Select a .WAV file' box. It may also be changed to report the error to the operator differently than the default message. Such as to include procedural steps the operator must take when receiving the particular error. For example, a 'Bowl # 1 communication error' can be customized to say, "The Rec 4 System has a communication failure with bowl #1. Please check that the bowl is powered on". In the example, the blue text was added to the audible error message. Text messages can also reflect added error information in the same manner.

If the 'Email Error Message' box is checked, upon the event of that error, everyone on the list will be notified via e-mail if there is an internet connection present on the machine PC.

If the 'Email Galiso' box is checked, then the Galiso software programming department will receive the error in their e-mail.

Fig 5: Rec 4 Settings navigation
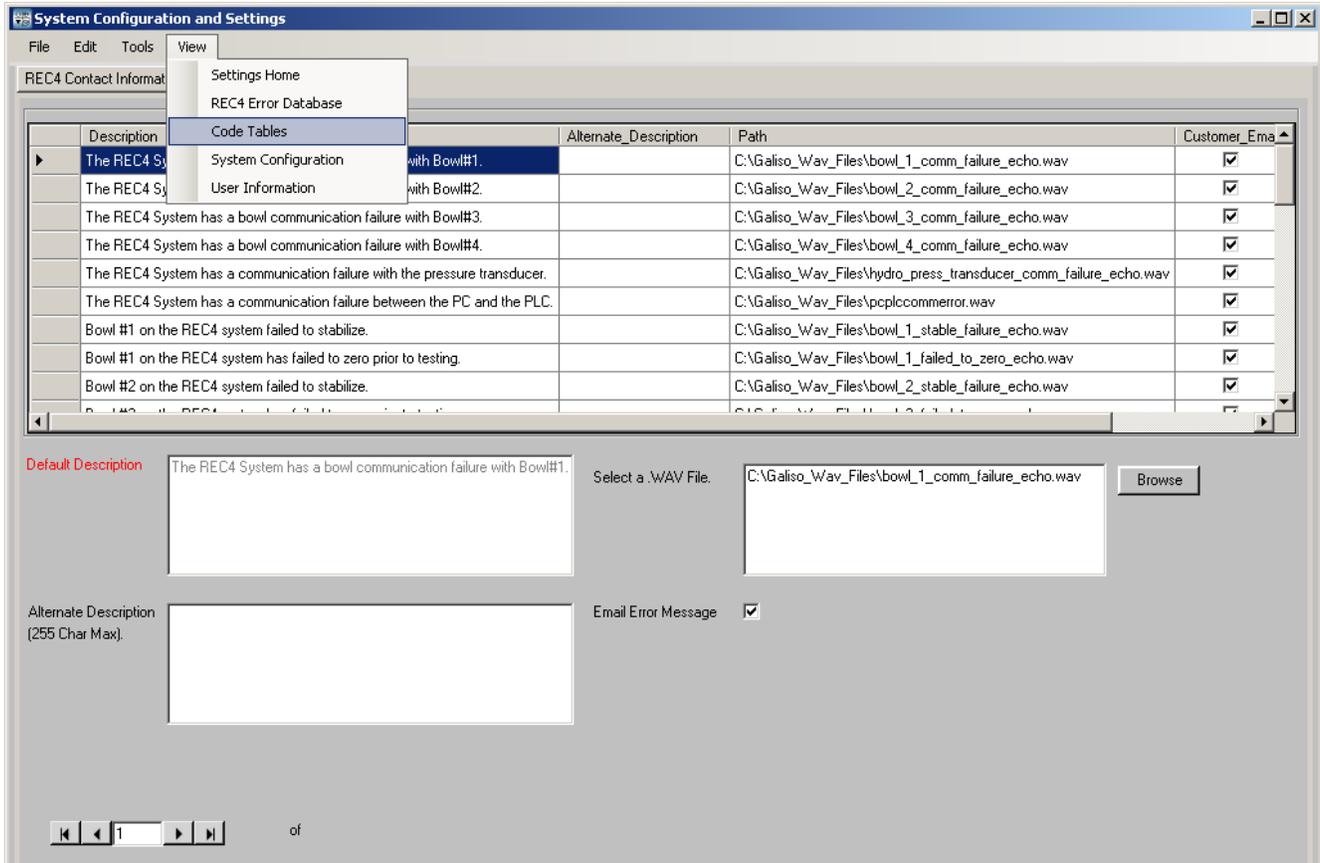
The <view> drop down menu shows the above options. From here, it is possible to navigate to other screens in the R4 settings program.

Fig 6: Add New Calibration Cylinder
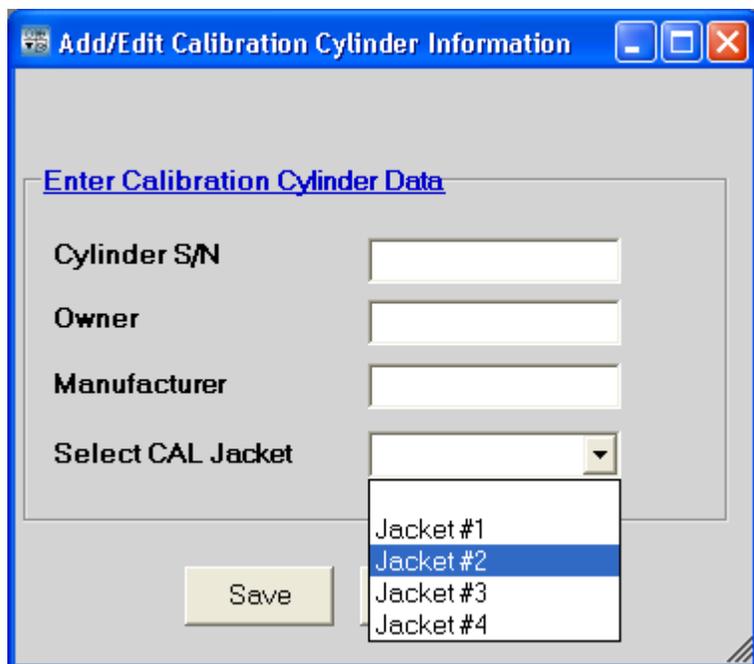
Use the <Add/Edit Calibration Cylinder> button to input the data for a new calibration cylinder.

All of the pertinent test data for the calibrated cylinders can be stored for quick entry as shown above. The cylinder pressure points and expansions are saved for quick data entry of the calibration verification test parameters.

Leaving the 'Select CAL Jacket' box unchecked, allows the cylinder to be used in any jacket. If you have one jacket on your system, you can either check jacket #1, or leave the box open.

Click the <Save> button to save the information entered. The pressure and expansion points are entered later in the 'Calibration Points for Selected Cylinder' grid shown below.

Fig 7: Calibration Cylinder Test Parameters

Target_Pressure	Pressure Unit	Hold_Time	Total_Exp_Min	Total_Exp_Max	Max_Perm_Hold
3000	PSI	30	63.2	64.4	60
4000	PSI	30	83.8	85.4	60
5000	PSI	30	104.5	106.5	60
6000	PSI	30	125.0	127.4	60
7000	PSI	30	145.2	148.0	60
8000	PSI	30	155.2	158.2	60
*					
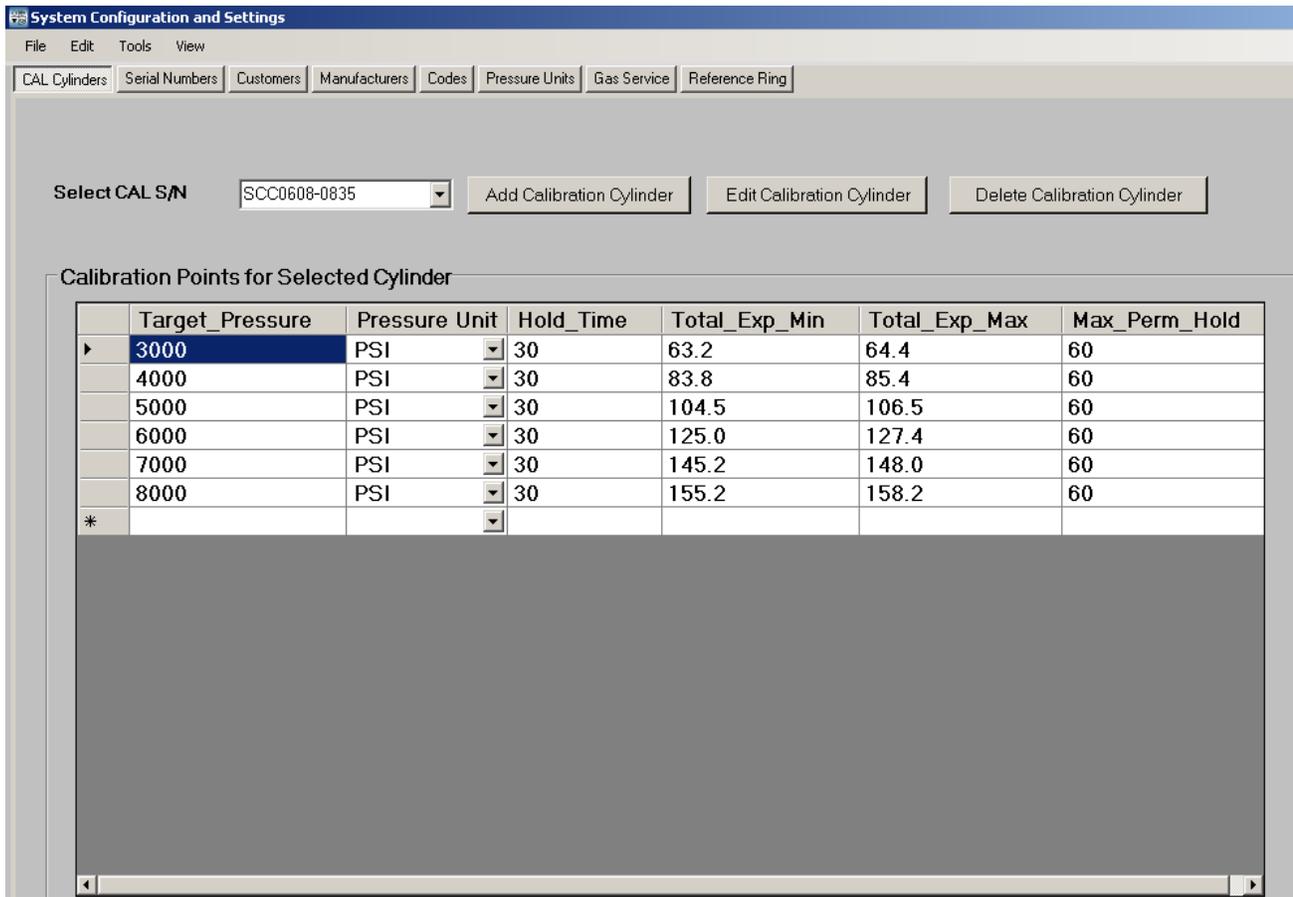
The calibration verification test parameters are entered here. Use the <Select CAL S/N> pull down menu to choose the cylinder.

Use the 'Tab' key on the keyboard after entering the last piece of data, and then remember to click: <File> <Save> to save your work. There should be only one blank line at the bottom showing when <Save> is clicked. If there are two lines, you may receive an error. Delete one of the blank lines, and try saving again.

Fig 8: Edit Calibration Cylinder
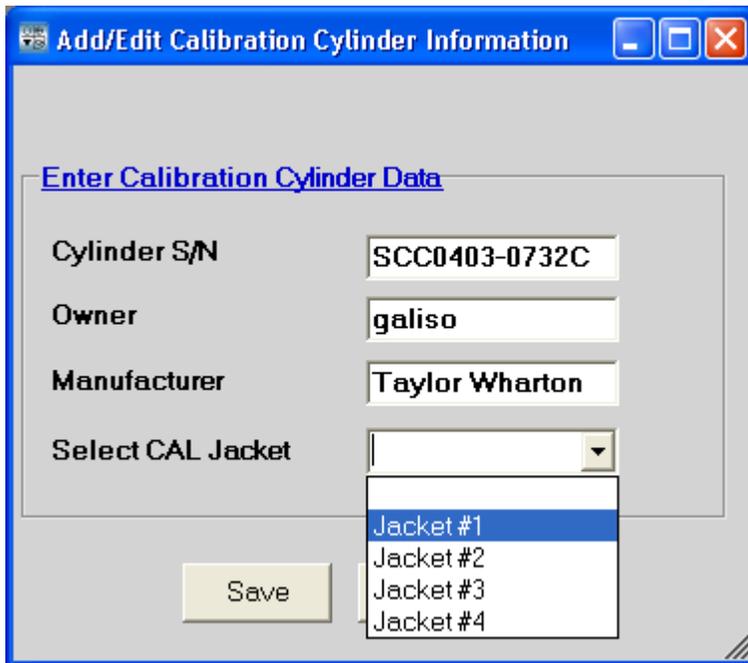
The cal cylinder data shown above can also be edited by clicking the <Add/Edit Calibration Cylinder> button.

Fig 9: Delete Calibration Cylinder
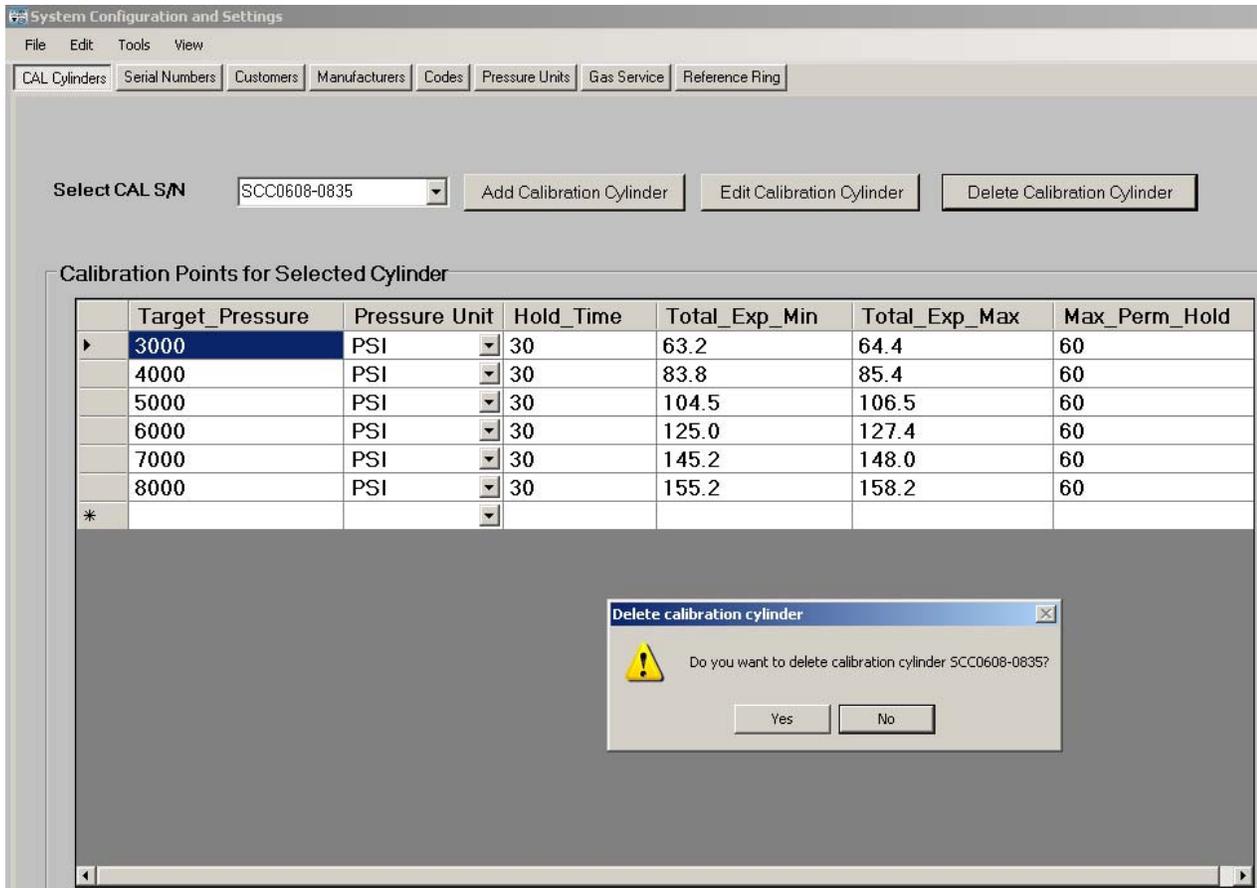
All data for a calibration cylinder can be deleted by clicking the <Delete Calibration Cylinder> button.

Fig 10: Serial Number Entry
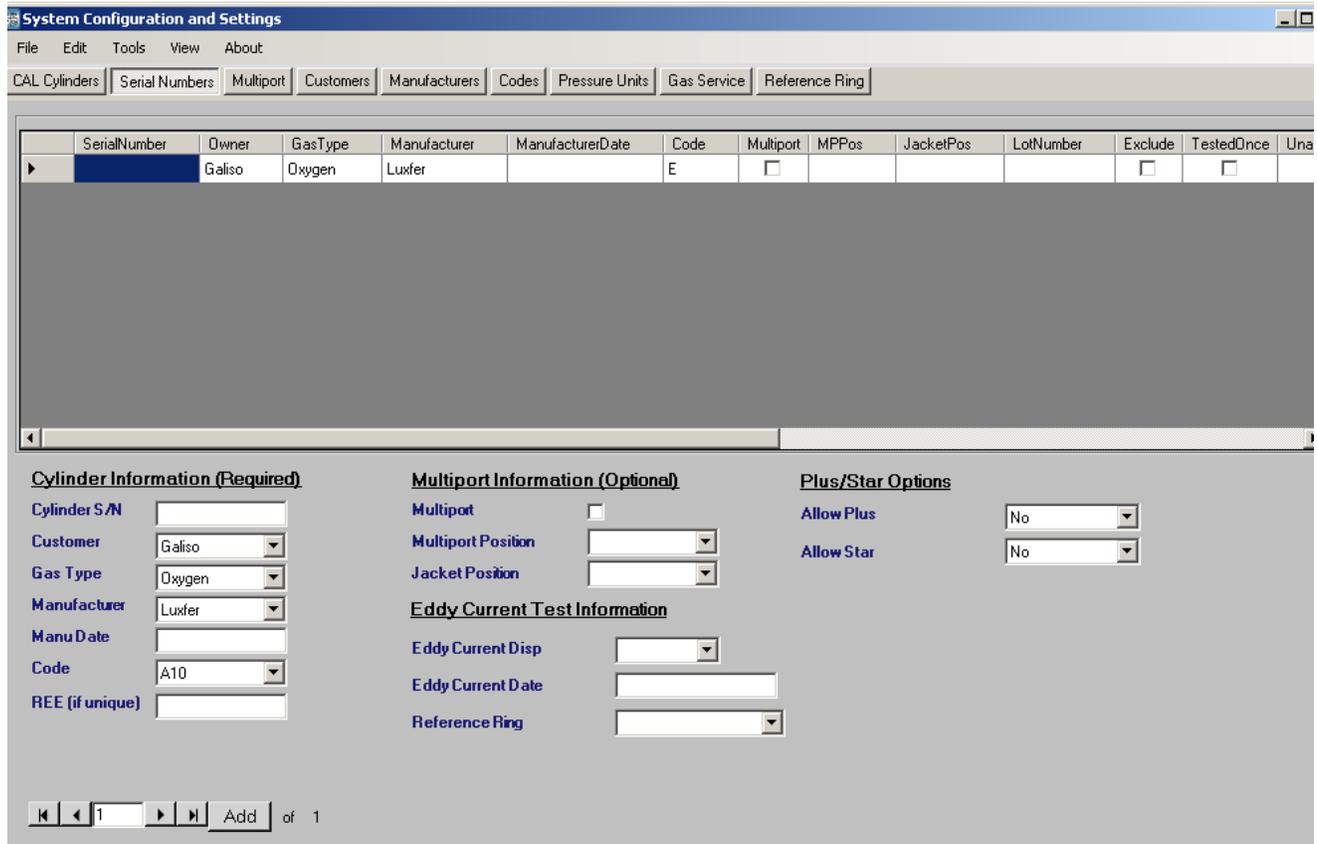
This screen allows the test criteria for multiple cylinders to be entered, pre-test, for efficient data entry during testing. Many times, the bottleneck to re-qualify cylinders is in reading the serial number, manufacturer, and manufacturer date on the cylinder. If it is hard or impossible to read without grinding off the paint, etc.., it causes test machine downtime and decreases test efficiency greatly. With this option, cylinder data can be inputted during a downtime, or a shop helper can input the data at times when the test operator is away from the machine. Then you can load the next cylinder into the jacket, and select the next cylinder serial number on the list while in the 'Data Entry' screen, and start the test, instead of searching for the test criteria for the next cylinder while you are testing other cylinders. Pre-test data entry allows you to find 'problem' cylinders that you cannot read the stamping marks, etc… without slowing you down to do it during testing. Even when the stampings are clear on the cylinder, it is advantageous to have the information loaded on the PC during a downtime of testing.

The screen also makes a provision for using the Galiso multiport head to load multiple (up to 4) cylinders into the jacket at the same time. Just switch the hi-pressure hose from one cylinder to the next. Select the correct <Multiport Position> in the program, and start the test. This function can also be performed dynamically in the 'Data Entry' screen.

Add an REE value if the REE is different from the cylinder code REE.

Fig 11: 'Customer' Entry
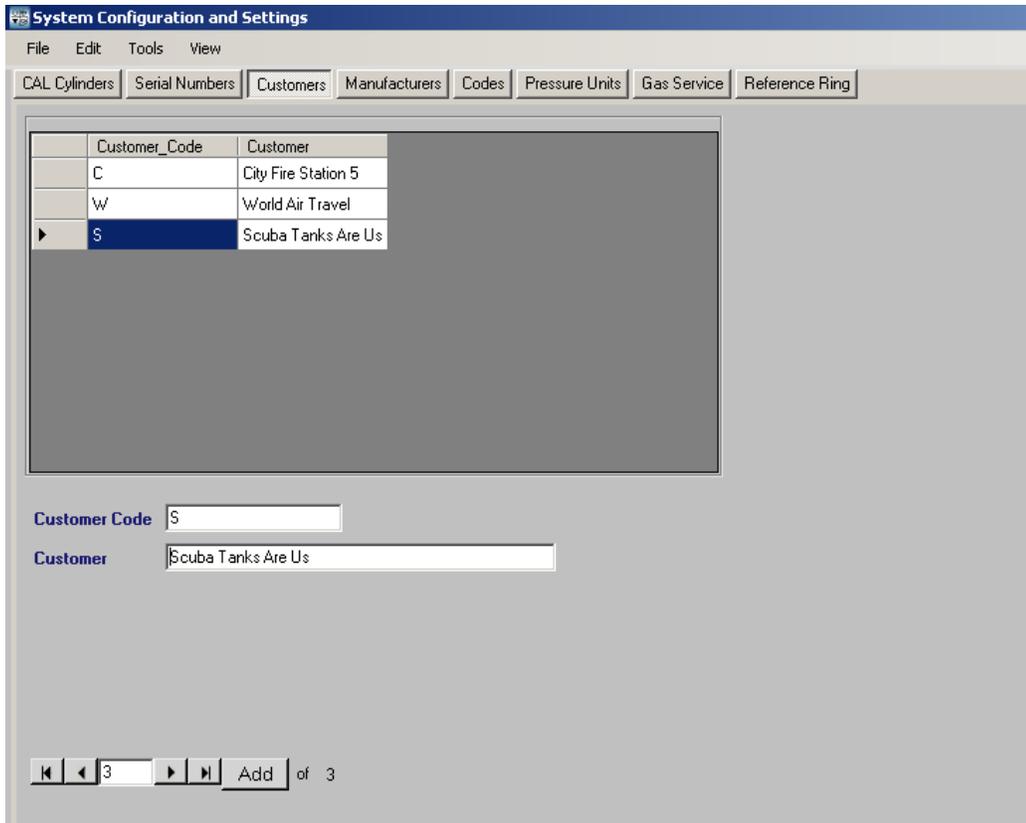
A short 'code' can be created for easy test data entry of all your customers. Enter the short code and the program enters that customer in the <Customers> field on the test screen.

Fig 12: 'Manufacturer' entry
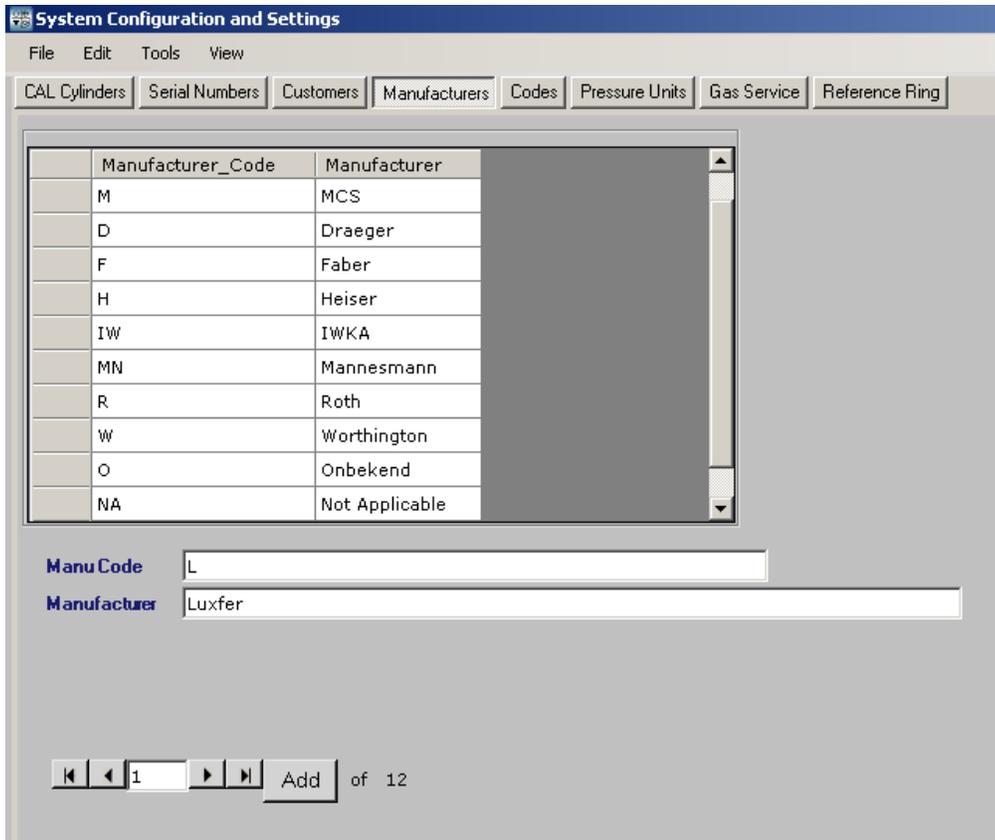
A short 'code' can be created for easy test data entry of all your manufacturers. Enter the short code and the program enters that manufacturer in the <Manufacturers> field on the test screen.

Fig 13: Cylinder code entry

Code	Dimension	DOT_Rating	REE_Source	Liner_Type	PT_Target_Pressure	PT_Hold_Time	PT_REE	PT_Fail_Prm	QT_Target_Pressure
M6A	4.38x7.9	3AL2015							3360
M7	4.38x9.2	3AL2015							3360
M9	4.4x10.6	3AL2015							3360
M11	4.38x10.9	3AL2650							4417
DAL	4.38x16.2	3AL2015							3360
M18	5.25x14.1	3AL2216							3700
M22	5.25 x 17.1	3AL2216							3700
EAL	4.38x25.2	3AL2015							3360
M	NA	3AA-2260	C4						3360

Code	E	
Dimension	4.25x25.75	
DOT Rating	3AA-2015	
REE Source	C5	
Liner Type		
Capacity		

PT Target Pressure		PSI
PT Hold Time (sec)		
PT REE		
PT REE Min		
PT Fail % Perm		
PT Max Prm Hold (sec)	15	
PT Total Exp Max		
PT Total Exp Min		

QT Target	3360	PSI
QT Hold Time (sec)	30	
QT REE	23.1	
QT REE Min		
QT Fail % Prm	10	
QT Max Prm Hold (sec)	15	
QT Total Exp Max		
QT Total Exp Min		

Empty Weight Min	
Empty Weight Max	
Full Weight Min	
Full Weight Max	

Pressurization Parameters

Variable Rate Factor	1.5
Piston Ratio	100

Recirc System Parameters

|	
Fill Time (sec)	90
Drain/Dry Time (sec)	180

1 of 51 Add

A short code can be created for easy test data entry of all cylinder types. Enter the short code and the program enters that cylinder type in the <Cylinder Codes> field on the test screen.

'PT' test parameters are for a 'pre-test' that is performed before the 'QT' or qualification test. This can be used for cylinders that will pass the qualification test more consistently if an 80% pretest is performed first. Pretests on US DOT cylinders must be performed below 90% test pressure, or it is considered a qualification test that demands the result to be documented and the cylinder to be dispositioned accordingly.

The pretest pressure fully bleeds down, and the qualification test begins as soon as the bowl stabilizes and the pressure is under 6 PSI. While the pretest is bleeding down, closely monitor the expansion to see if the reading will go into negative expansion upon the release of pressure. If so, you are then alerted to that, so measures can be taken to prevent it from happening during a qualification test. Remember, all qualification tests will fail if a negative expansion reading is taken into the test result due to the instability shown by a negative expansion value. Refer to the Galiso 'Small Cylinder Hydrostatic Testing Reference Guide' for more help in controlling negative expansion problems.

Fig 14: Test Water Pressure Units Of Measure
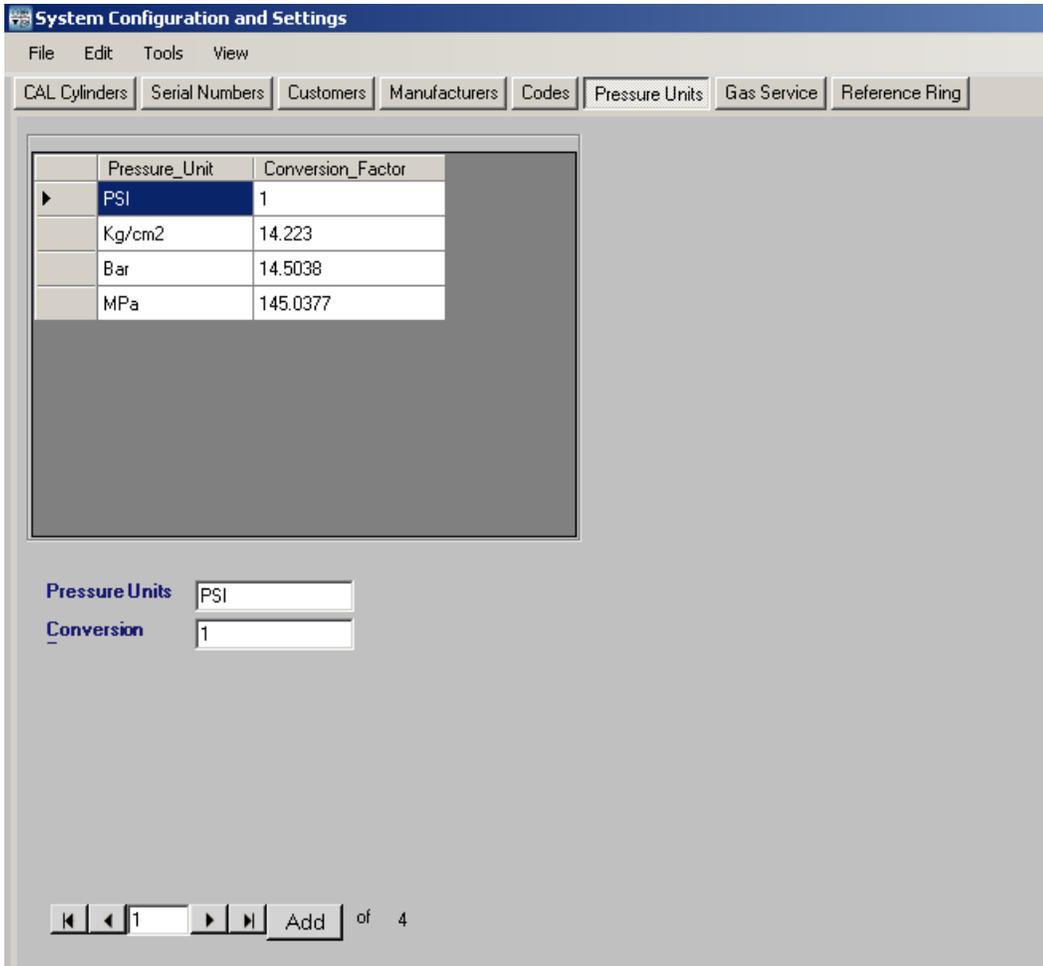
You may select from the pressure units above to display and test with for the test water pressure reading. Another pressure unit may also be created by entering the conversion factor from PSI.

Fig 15: Gas Service Entry
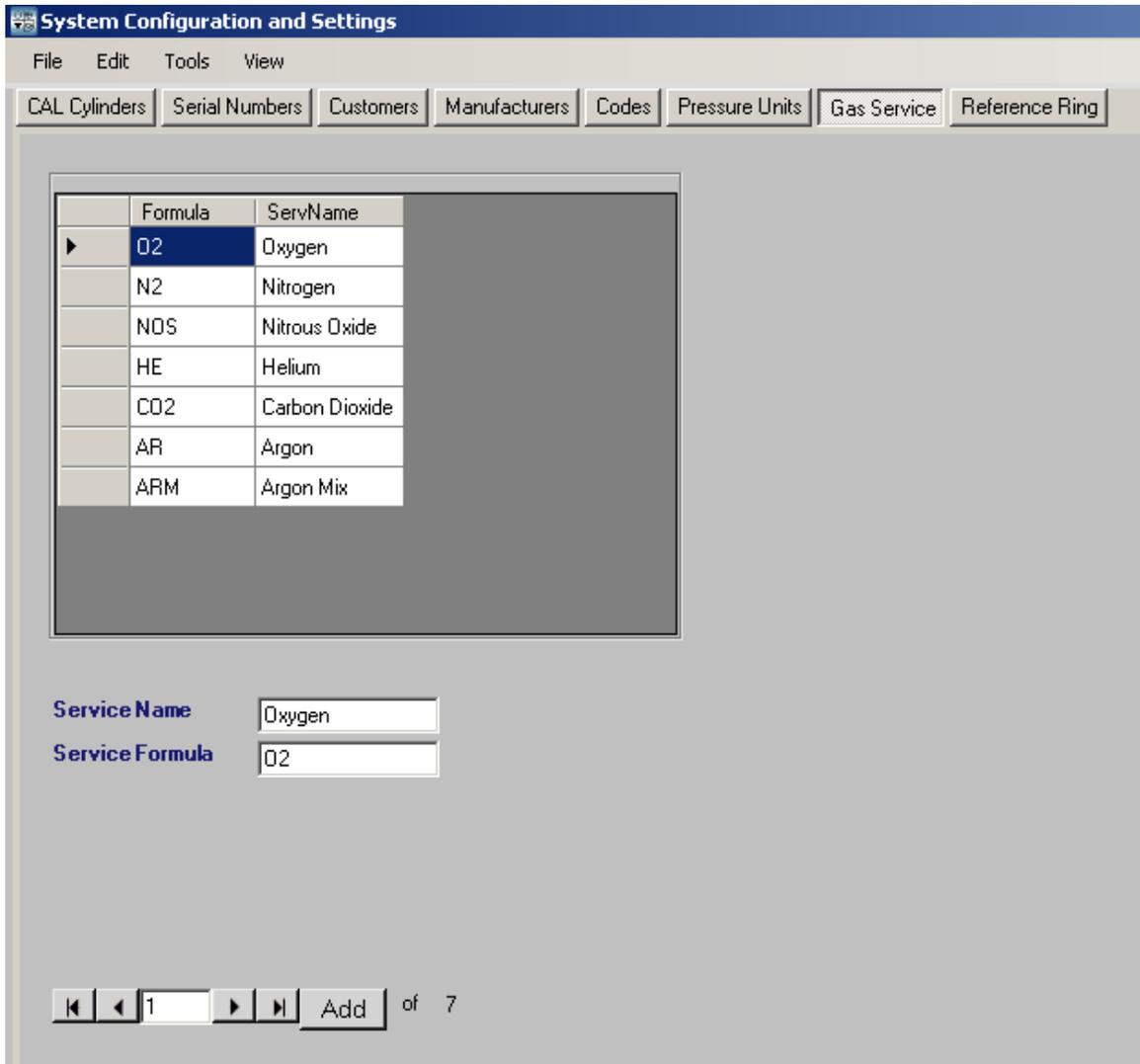
Codes for gas service are entered here. The 'Service Name' can stay the same as the code entry if desired. Such as the code, 'O2' can read 'O2' after the code is entered, instead of reading 'Oxygen'.

Fig 16: Visual Eddy Reference Ring Number Entry
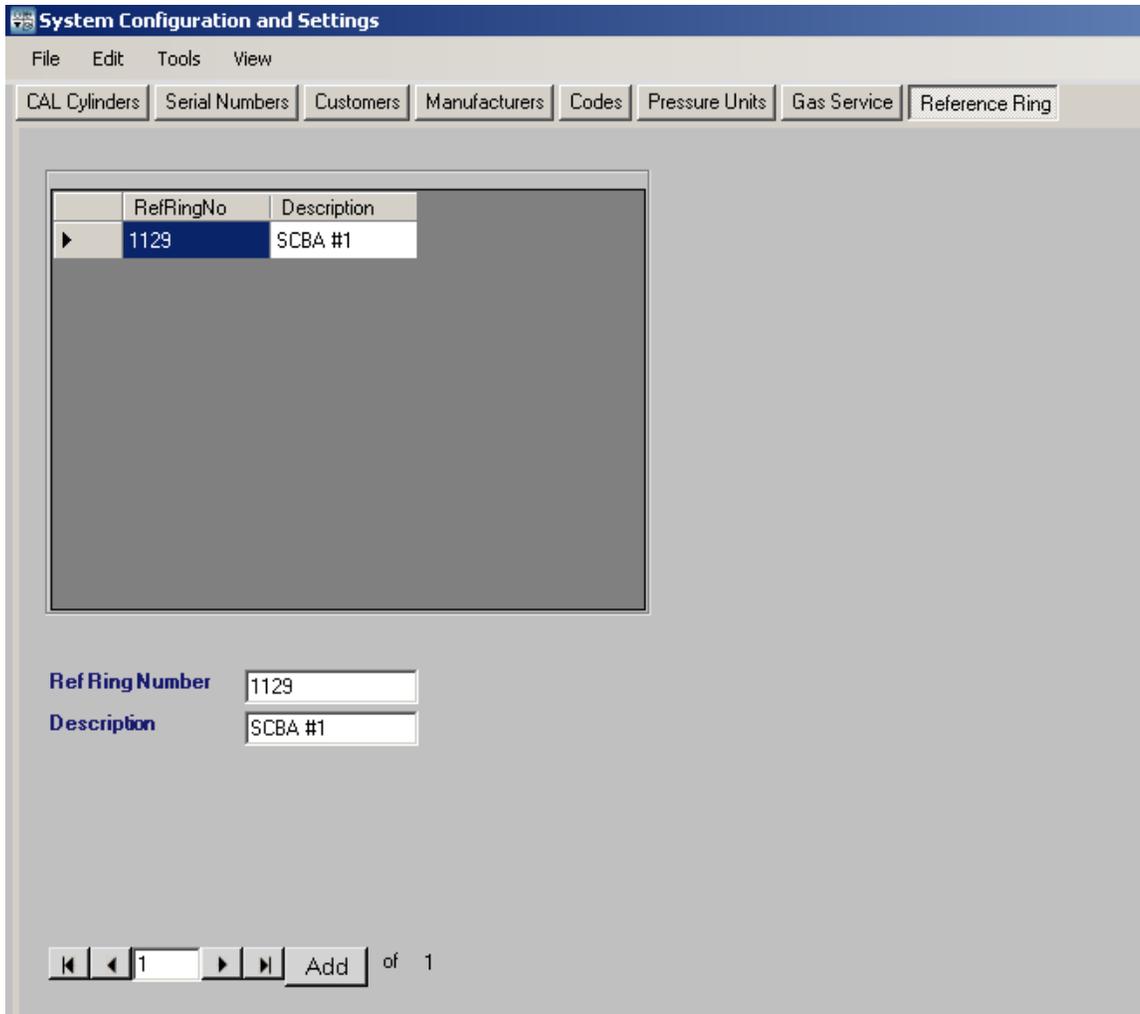
When doing a visual eddy test, the proper reference ring number is documented here for the given cylinder type.

Fig 17: System Configuration and Filepaths Screen
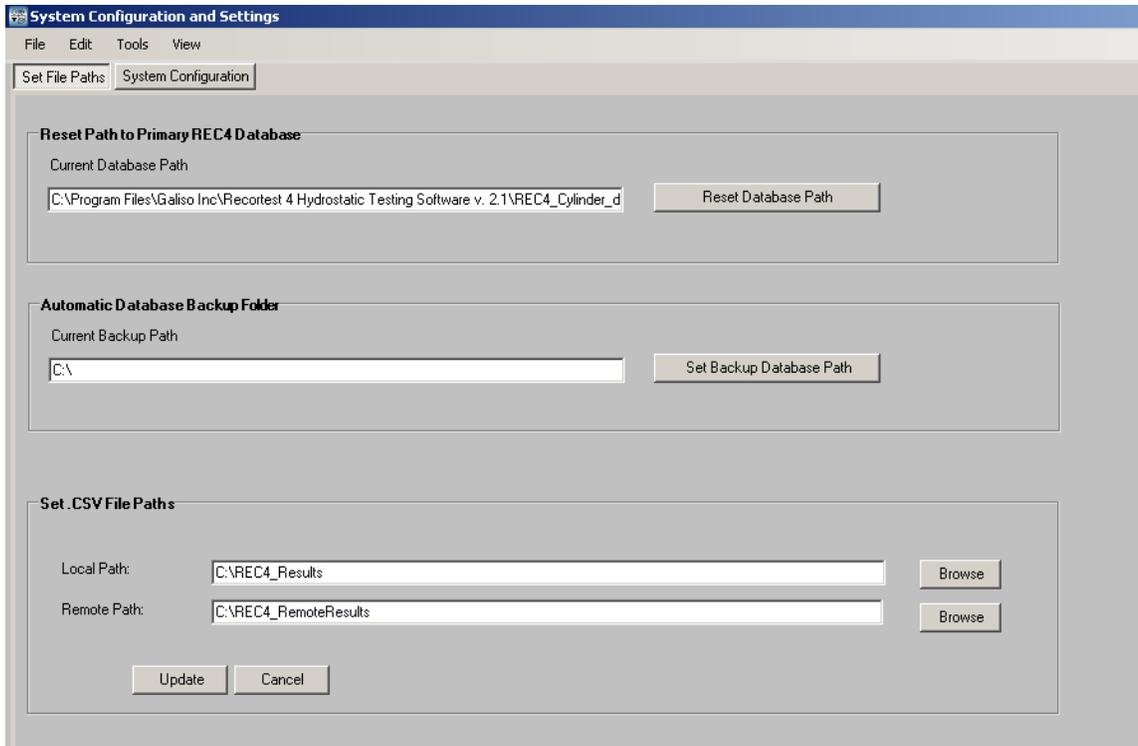
The primary and back-up testing database filepaths are created here. The primary database file is critically important to the testing program. If it is lost, all data for testing is lost too. Do not lose the database file.

To reset the filepath, a password is required.
Username: galiso
Password: REC4

The password is case sensitive, so use all caps.

The local and remote results filepaths are also set here. Galiso recommends the local path be in the shown default location. The remote path should not be on the same drive, so if data is lost due to drive failure, the remote drive will have a safe copy stored for retrieval.

Fig 18: System Configuration Window
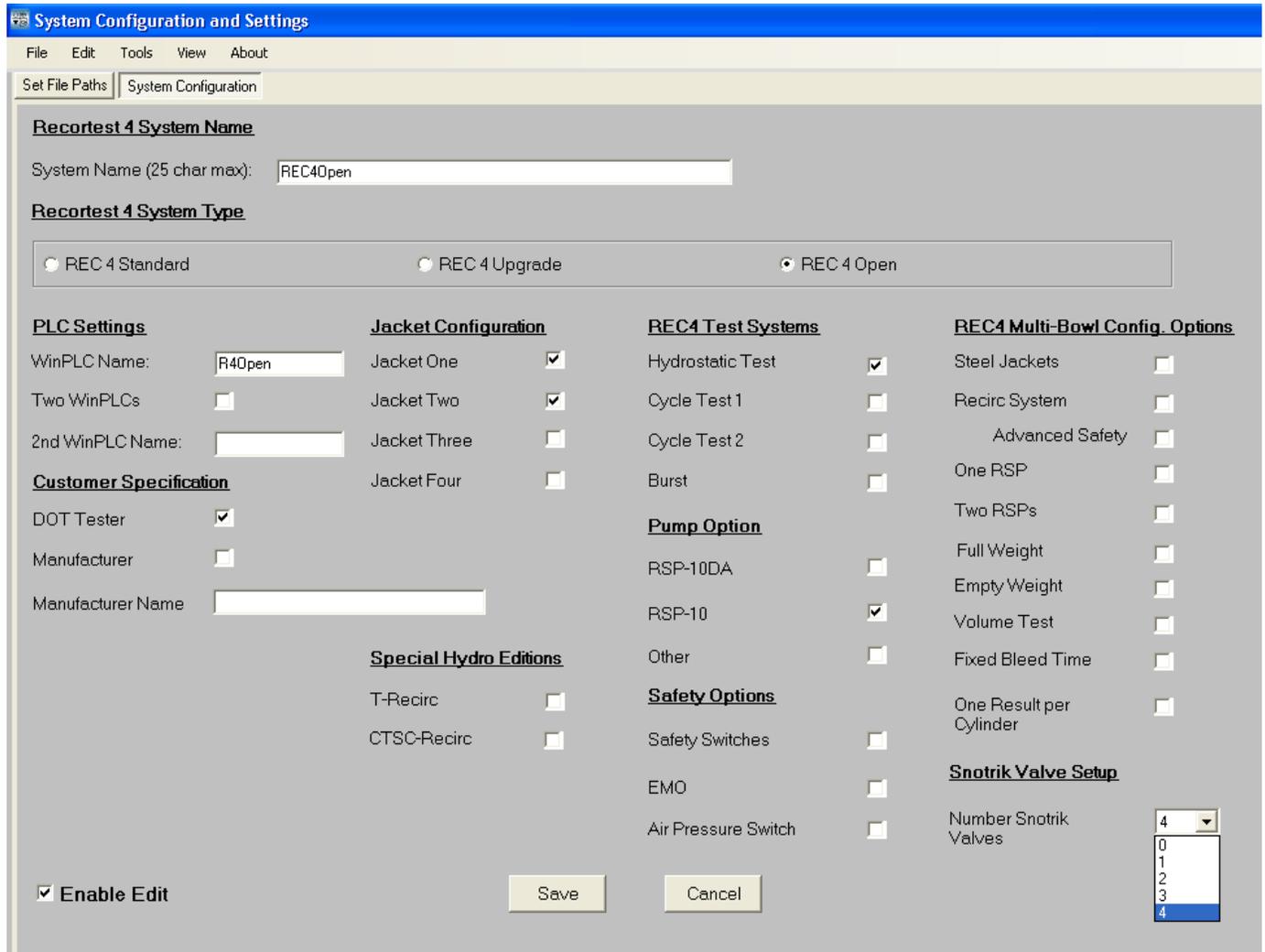
Galiso uses the same basic program to operate different test machine configurations. This also makes it easier for the customer to expand their system with another jacket, etc…

Normally, Galiso customer service will edit this for you over the network. Please contact Galiso if you think changes are required on this screen. We will help you determine what to do.

A supervisor password is required to edit this screen. It is most important to have the proper name of the WinPLC module entered in that box. The program uses the name entered, to find the PLC for controlling the hydrostatic test devices.

The program also uses the configuration for setting up which parts of the program are enabled. Therefore, it must match the hardware configuration exactly, or it may not test properly.

Fig 19: User Information
Edit usernames and passwords:
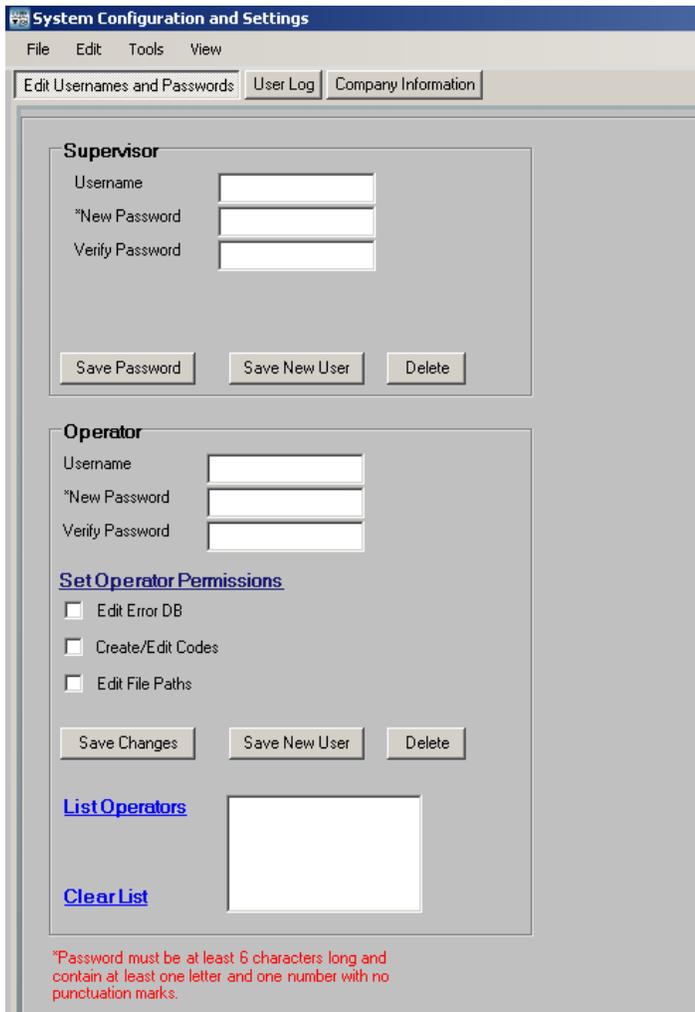
The Galiso install technician must first login as a supervisor, in order to set up a supervisor password for the customer. Supervisors can enter any area except the database filepath edit. Then, the separate password is needed (we already covered that above in this manual).

Only a supervisor login can create any username and password.

A supervisor can delete an operator username and password without knowing the password. Just select the operator from the list and delete it.

When setting up a password, be sure to read and follow the guideline in RED text at the bottom of the window, or it will not accept your new choice of password.

Operator passwords have 4 permission levels:
1. Not allowed to edit any settings.
2. Allowed to edit only 1 of the 3 settings selections.
3. Allowed to only edit 2 of the 3 settings selections.
4. Allowed to edit all 3 of the settings selections.

Just check the box(es) that apply for that operator.

If you are changing username parameters, then click the <Save Changes> button when complete.

If adding a new user, click the <Save New User> button.

Fig 20: User log

This window simply displays who was logged into the program and when.

Fig 21: Your Company Information
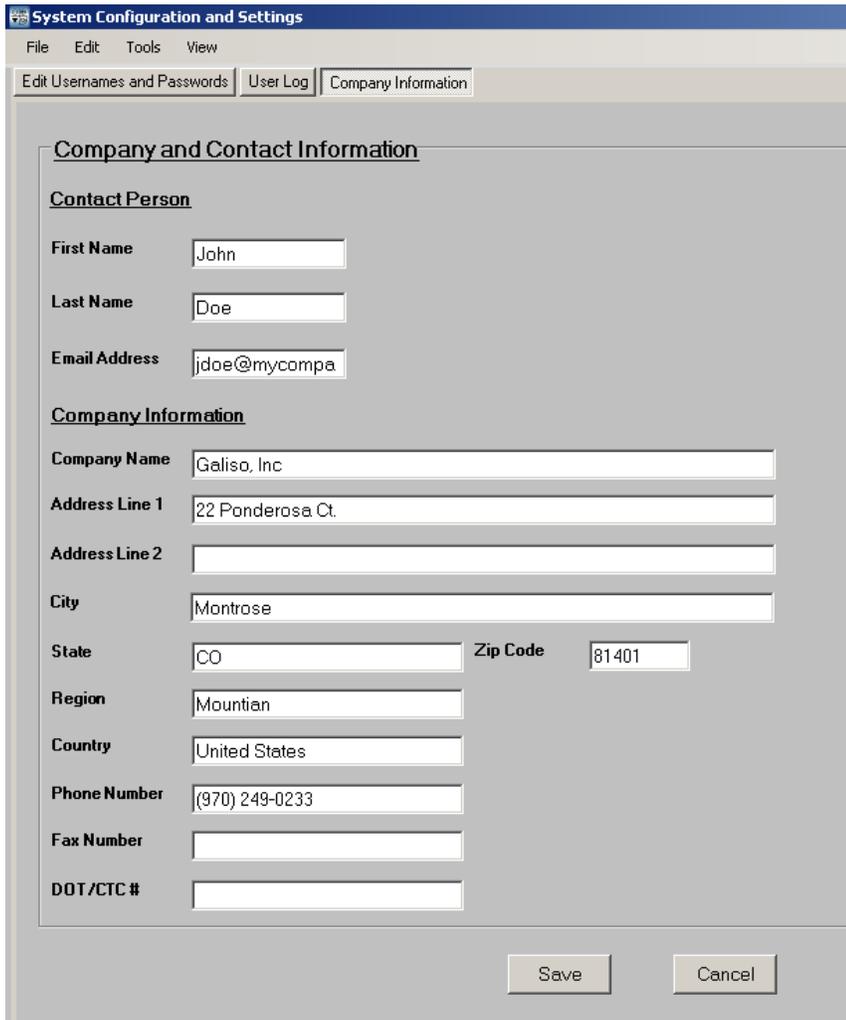
Carefully and correctly, fill out the text fields. This is the information that will display on the test reports.

Fig 22: Calibration Screen
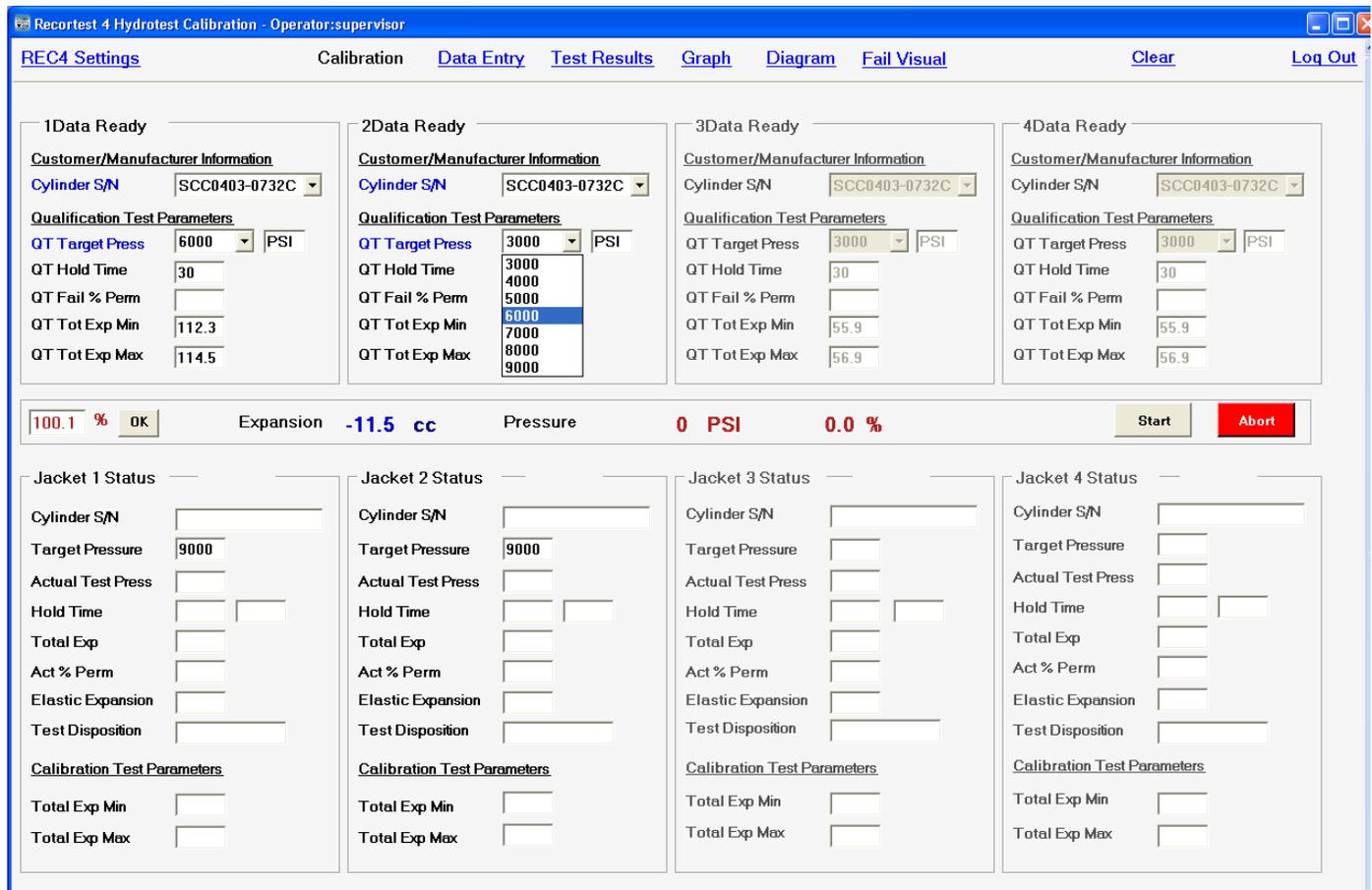
Operator logins go directly to this screen. Access to the Rec4 Settings program is allowed on this screen only. The operator may log out from any screen. To get to the calibration screen from the Rec 4 Settings program, click on the <Tools> menu, and <Open Test Forms> button as shown below.

All screens contain the 'menu' line, which is the top row of screen buttons; the 'Clear' button; and the 'command' line in the center of the screen, which separates the top and bottom portions of all applicable screens.

Here is where the system calibration verification is performed. Remember, nothing is actually calibrated on this screen. The calibration is merely verified by the cylinder expansion points falling within 1% of the expansion point shown on the cylinder, and the cylinder calibration certificate. The pressure itself can be further verified with a master gauge, although the pressure transducer is much more accurate than the master gauge. The gauge at least shows the pressure accuracy to be within acceptable limits. The transducer is typically rated at .1%

accuracy, and the master gauge is typically .25% accurate. This is what your machine has, unless special units were ordered with the machine.

The cylinder is chosen using the Cylinder S/N scroll button (down arrow next to text box).

After choosing the cylinder in jacket #1, all of the calibration test parameters are automatically loaded into that jacket.

Simply click the <1 Data Ready> text at the top of the Jacket 1 test parameter box. If the text turns **Blue** in color, then the program is ready to perform the test. If it does not turn **Blue**, then it will flag an error, and alert you to what parameter is not correct. If you forget to make the 'Data Ready', the test will not start when you click the <Start> button, and the audible error message system will alert you to check that all data is ready. A text error message will also appear on screen in red letters. To 'clear' the message, you can click the <Clear> button, which is in the form of **Blue** text in the top/right portion of the screen.

Click the <Start> button to start the test. During the test, the pressure and expansion will display dynamically on the center 'command' line. The cylinder information will move from the area above the command line, to below it. There, the test timer will display, and all pertinent test information will display.

The computer automatically adjusts the minimum and maximum allowable (within 1%) calibration expansion values for the actual pressure reading taken at the end of the hold time. This means that the values on the cylinder calibration certificate will not necessarily be the values shown on the screen because the actual pressure at the end of the test changes those values in a linear fashion. This linear fashion correction formula is what the computer uses to adjust the allowable minimum and maximum expansion values.

Here is the formula:

Corrected minimum value: Take the minimum value allowed if the exact pressure point is to be reached (value shown on the calibration certificate). Let's use the cylinder information shown above: 63.2cc minimum.

Multiply that by the percent (%) of test pressure at the onset of the bleed function (end of hold time). This figure is displayed to the right of the actual pressure. For our example, let's say it is 100.3% of 3000PSI (3009PSI).

63.2 X 100.3% = 63.4 cc. Or, (63.2 X 100.3) ÷ 100 = 63.4 cc.

Divide by 100

63.4 ÷ 100 = .63

Add .63 to the minimum value shown on the certification sheet, which is 63.2. Since the test will not enter the 'Hold Time' unless the pressure is 100% of target or greater, you will never need to subtract from the cal cylinder cert sheet value. It is always added.

63.2 + .6 = **63.8** is the corrected minimum value for the pressure at bleed. Add only one decimal point since <u>one</u> decimal point is shown on screen for the expansion value.

Use the same formula to calculate the maximum value. Use the max expansion value from the cal cylinder cert sheet. You should calculate 65cc for this example.

Now you can double check the computer correction value to be correct. At the end of the test, the corrected values will display at the bottom of the jacket column.

Cut-Off Pressure: The actual pressure attained can be increased by adjusting the percentage in the % text box at the left of the command line. Click the <OK> button for the value change to take place. For example, since it is imperative that the test pressure is maintained throughout the test, then you need to increase the pressure attained (above target pressure). During the pressure hold time, the pressure will drop. The amount of drop is determined by many factors such as rate of pressurization, cylinder elasticity, etc… Of course, the test should be performed with minimal drop. However, some drop will occur. For example, the percentage can be adjusted to 100.2% so the pressure will not drop below test pressure (100%) during the test.

The actual pressure and the percentage of target pressure are dynamically displayed on the command line in **RED** text at all times. The expansion is displayed in **Blue** text.

Click the <Start> button to start a test when the <Data Ready> buttons are Blue in color. This button starts the pressurization process.

Click the <**Abort**> button to abort the same test. This button stops the pressurization process and bleeds the pressure. It also records the abort in the test results.

Fig 23: Data Entry Screen

The 'Data Entry' screen is where the cylinder qualification tests are performed.

Pretest Parameters: Enter the parameters of target pressure and hold time for a complete test prior to the actual qualification test. Some cylinders require a 'pretest' in order to get a more accurate qualification test. All pretests performed on DOT cylinders must be below 90% of test pressure. If it is above 90%, it is a qualification test attempt that must report the results and the cylinder must be dispositioned accordingly. If it is a newly manufactured cylinder, then the 'pretest' is used for the autofrettage purpose. The pretest parameters can be entered into the cylinder code table, or manually in the 'Data Entry' screen. A pretest on a calibrated cylinder may also be performed to condition it for the calibration verification test. The qualification test will start automatically, directly after the pretest results are recorded.

Qualification Test Parameters: The qualification test parameters are automatically entered by the cylinder code table. They can also be entered manually in the <Set Manual Code> window. The fields can be changed manually on the <Data Entry> screen.

The <Eddy Current>, Pass or Fail selections allow you to document the visual inspection in more detail if needed.

The <Allow Plus / Star> fields allow you to use those functions for US DOT testing.

<Variable Pressurize Rate>: Adjustable from .1 – 5. This adjusts how fast the pump pumps. Slowing the rate down allows more time for the cylinder to expand during the pressurization which gives a more stable test during the 30 second hold time. If the rate is too high, the more elastic cylinders will continue to expand during the hold time. This can lose pressure below test pressure, and fail the test, or make for a very unstable test that fails.

The <Test Remark> field allows a short reminder note of the test to be entered.

Fig 24: Cylinder Serial Number Entry, Add/Edit Cylinders Window
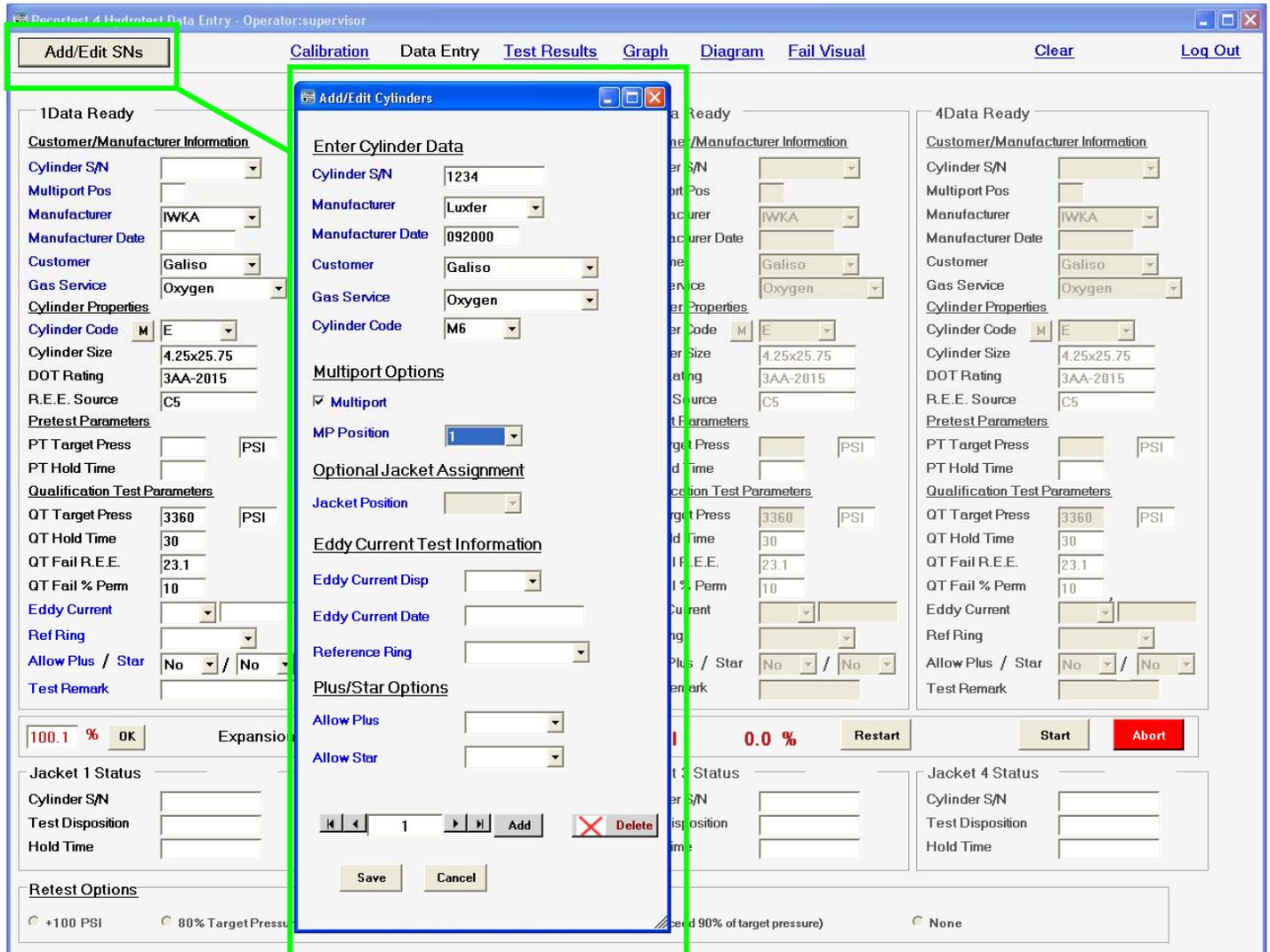
By pressing the <Add/Edit S/Ns> button outlined in **Green** above, you can enter the data for multiple cylinders that are ready for testing. The data can be entered for each cylinder to test that day, etc… This allows the data entry task to be performed first, so you can focus more on the hydrostatic process during testing. Throughput is decreased when you have to stop testing to remove paint, etc… in order to visually see the parameters on the cylinder to be requalified. This option allows you to uncover hard to read serial numbers, dates, etc…., and overcome those obstacles before testing, so your testing time is maximized and cylinder throughput can be increased.

The Multiport Cylinder checkbox, and the MP (multiport) Position field are for use with the Galiso multiport cylinder head which holds up to 4 – 6" diameter cylinders. Input positions 1 through 4 for the corresponding cylinder to head location. Then it is only necessary, to move hose between positions to test all 4 cylinders without removing the test head. Simply choose the cylinder S/N in the pull down text box and run the test.

All test parameters, including cylinder specific ones can be inputted during testing also.

<Cylinder Serial Number> entry field: The S/N is entered here. Upon the successful start of a test, the S/N and cylinder specific information is removed from this database.

<Manufacturer>, <Customer>, and <Cylinder Code> fields: These 3 field entries use the respective database tables to accept the information. They must be chosen from the existing table. If they do not exist in the database, you must go to the R4 Settings program and input the new addition. You can code them for shortcut keystrokes. You can also create an 'N/A' code for cases where the information does not apply.

<Manufacturer Date> field: This is a manually inputted item. The field accepts 2 date formats. This means the date must be entered in one of these formats, or the program will not accept it.

1. MMYY – No spaces or punctuation.

2. MMYYYY – No spaces or punctuation.

<Gas Service> field: This is a manually inputted item. It accepts any input up to 4 digits. The program will display the full name of the gas as entered in the 'Gas Service Entry' screen in the Rec 4 Settings program.

Click <Save> to complete the data entry. The cylinder information can be changed at any time before the test, and click <Save> again to save the change(s). Click <Add> to add another cylinder to the list. The cylinders will come up automatically in the same order entered. You can also open the list and choose one out of order.

Fig 25: Cylinder Properties

<Set Manual Code> window:
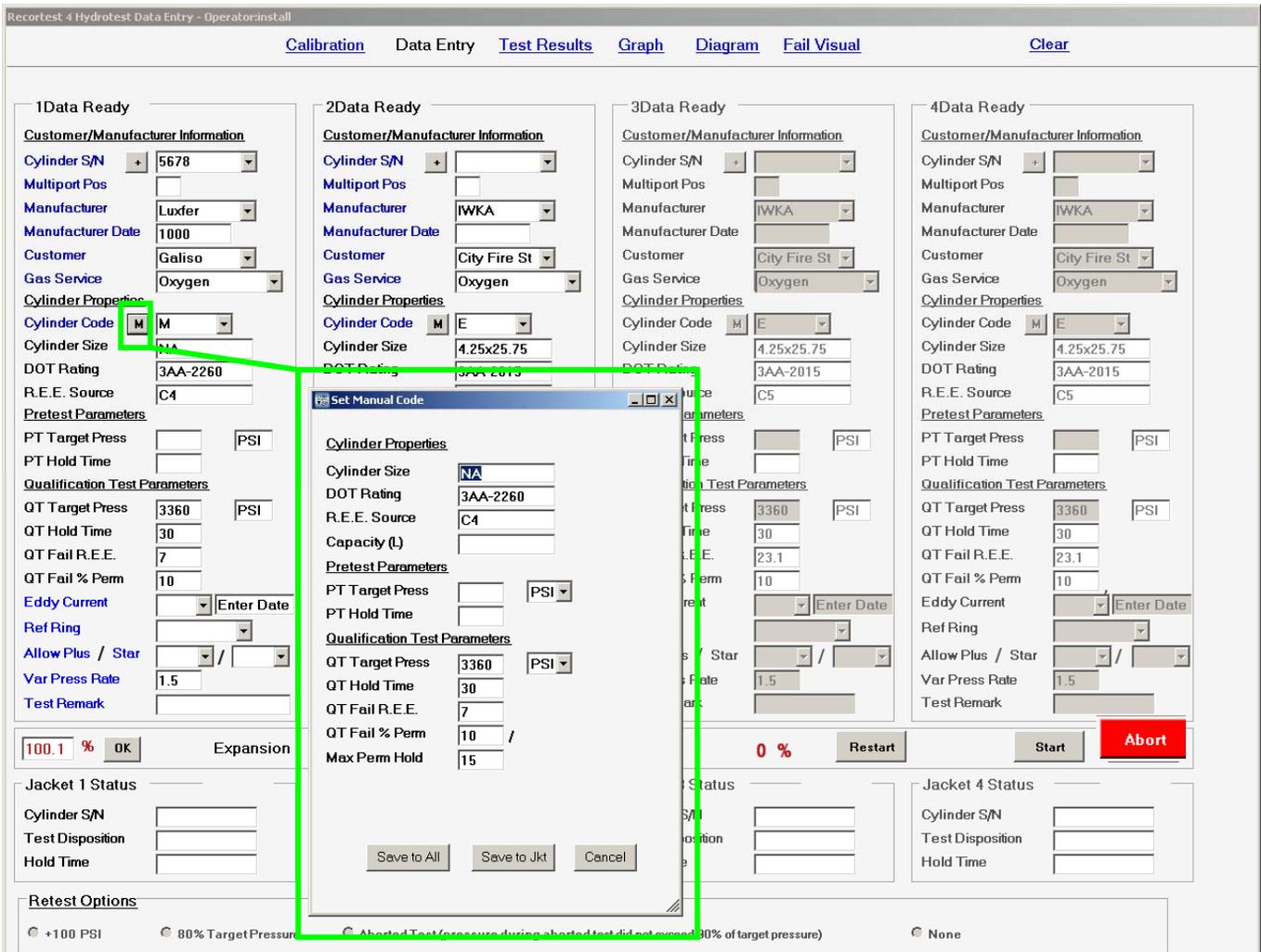
The cylinder properties can be entered automatically by choosing the code from the code table in the <R4 Settings> program. They can also be entered manually by clicking the <M> button as shown in **Green** above.

<Cylinder Size> field: This is for the physical dimensions of the cylinder. The field will accept any text inputted. You may specify inches, millimeters, etc…

<DOT Rating> field: This is to manually input the DOT rating of the cylinder. It accepts any text inputted.

<REE Source> field: If an REE (Reject Elastic Expansion) is used for test criteria, this field is to enter where the REE figure originated from, i.e. manufacturer name, exemption, etc…

<Capacity> field: This is a Liter value to be entered. It is not a mandatory field.
You may use the Pretest Parameters fields if a pretest is needed.
The <Max Perm Hold> value is in seconds of time. This is how long the computer will wait for a passing test result, given the test has not already failed. So, if the cylinder needs to sit longer after bleed, so it has more time for the expansion to stabilize, you can give it more time here.

Fig 26: Command Line; Jacket Status; Retest Options; Test Status

Command Line:

Percent Target Pressure: The % pressure text box on the left side of the command line is the true target pressure. If the target is 3000PSI, you can input 100.3%, and the pump will stop at 3009 PSI. This allows you to overshoot the pressure safely, and ensure the pressure does not drop below test pressure during the test.

Just click in the box and enter the percent you want to go to, and click the <OK> button.

The expansion is displayed dynamically in **Blue** letters.

The actual pressure and the percent of target pressure is displayed dynamically in **Red** letters.

<Restart> button: A retest option must be chosen in order to use the restart button.

<Start> button: When a test has all of the **Data Ready,** and the hardware is ready for the test, click <Start>.

<**Abort**> button: If the test needs stopped for any reason, click the <**Abort**> button. It will show as a test abort in the test results file.

Jacket Status:

When a test is started, all cylinder specific information is moved out of the data entry portion of the screen. The test timer will display dynamically to show how long the test has been in progress. The testing cylinder serial number and hold time will display. At the end of the test, the result will display in the Test Disposition field.

There are 3 digits: 1st = Visual test; 2nd = Percent Permanent Expansion test; 3 = REE (Reject Elastic Expansion) test.

Green = Passed test, Yellow = Failed REE or aborted test, Red = Failed test.

P = Passed; F = Failed; A = Abort.

The disposition codes key is printed on the report form.

Retest Options: Upon the event of a failed or aborted test, you can choose one of the options to perform a retest. Choose the option that applies.

The <+100PSI> option will retest the cylinder at 100PSI over test pressure. This is a US DOT requirement to retest a failed cylinder test. Before selecting this option, you must be confident that it will pass the next test. In other words, you need to remedy the problem that made it fail the first time, such as a test machine problem, or operator error, etc… Operator errors such as setting the <Var Press Rate> too high, can pressurize the cylinder too fast and cause it to continue expanding after reaching the target pressure. This can result in an unstable test that fails.

The <80% Target Pressure> option will take the cylinder to 80% target pressure and perform the test at that pressure. This is good for ensuring the test machine is operational, and the cylinder is not at fault before performing a retest for qualification. If it passes the 80% test, then you can be more confident it will pass a +100 PSI test. However, to perform a +100PSI test after the 80% test, you must manually input the test parameters again, and manually input the target pressure to 100PSI over test pressure to pass the cylinder to US DOT regulation.

The <Aborted Test> option can only be used if the test was aborted before the pressure achieved 90% of test pressure. The retest is then performed at the normal test pressure. Any test that achieves more than 90% and less than 100% (or does not hold 100%+) is a failed test result that requires documenting and the cylinder must be dispositioned accordingly.

Test Status: The status of the test is shown in the lower left corner in **Red letters.** This will help you to know what the computer is doing at any given time. In the example above, you can see the word: ***Done***

Fig 27: Test Results Screen

All of the test results are displayed here. Some fields can be edited to correct data entry mistakes on the part of the operator, or to add comments, etc… Click the <Enable Edit> box to view and edit those fields. The text of the editable fields will be black. Non-editable text will be gray. White text boxes next to grayed out boxes can not be edited.

Fig 28: Create Report Function
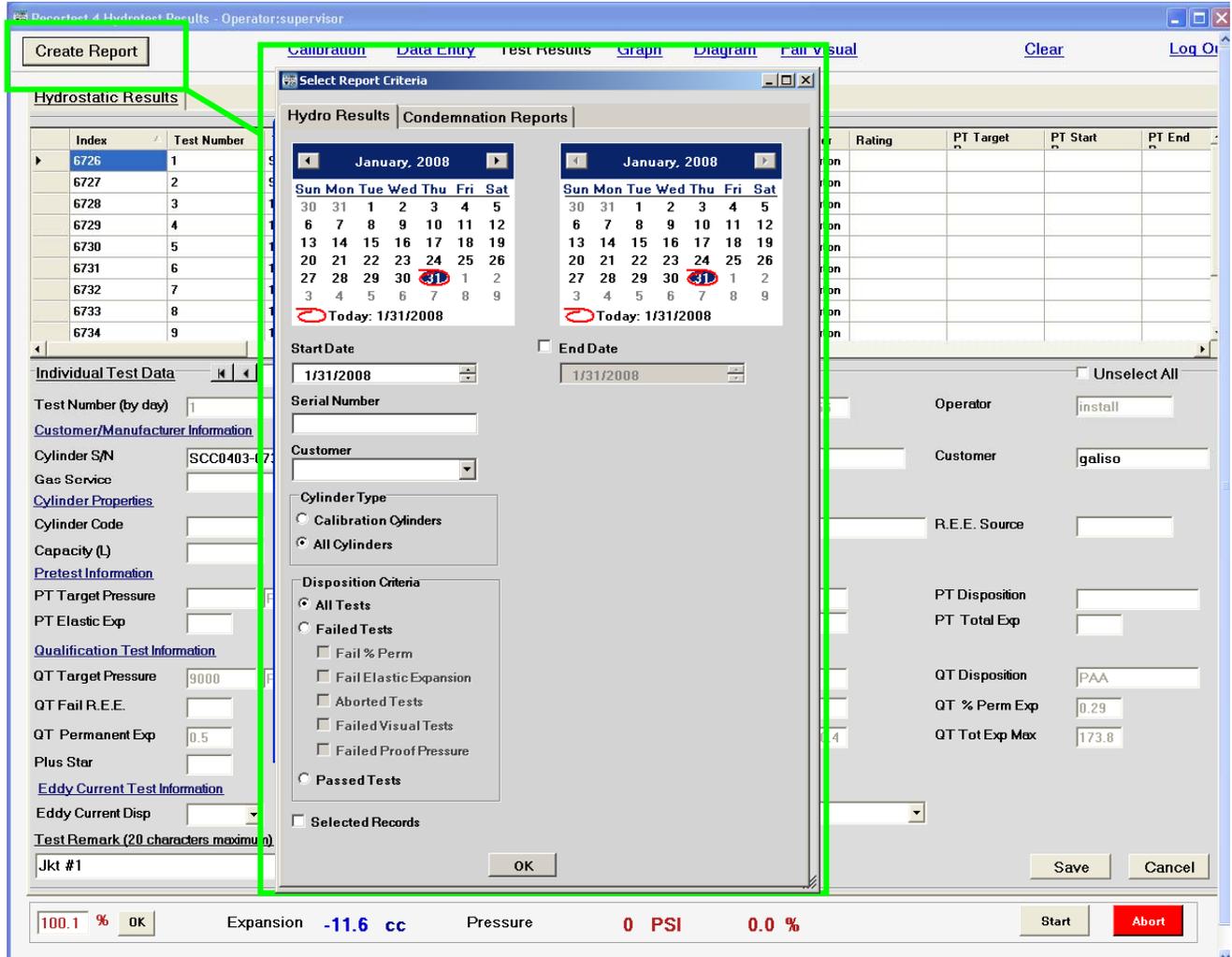
The reports can be sorted and created using the criteria shown above. Click the <Create Report> button to display the <Select Report Criteria> window. Select the desired report criteria and click the <OK> button at the bottom to create the report.

Fig 29: Report Forms

Code Has Three Letters: 1st Letter: Visual Test, 2nd Letter: % Perm Exp Test, 3rd Letter: REE Test
Letter Code: P=Passed, F=Failed, N=Not Applicable, A=Aborted   **Example:** PPP-Passed Visual, Passed % Prm, Passed REE

Operator Signature: _____   Date Signed: _____

I hereby certify that all the following tests were made under my supervision and in accordance with DOT/CTC regulations.

#	Test Date Test Time	Operator	Serial Number Cyl Owner	Size Service	Cyl MFG. MFG. Date	REE Source	Rating Unit	Specified Actual	Test Time	Total Elastic	Perm Percen	+* VE	VE Date Ref Ring	Disposition Remark
1	1/3/2008 9:56	install	SCC0403-0732C galiso		Taylor Wharton		PSI	9000 9017	30	172.3 171.8	0.5 0.2			PAA Jkt #1
2	1/3/2008 9:59	install	SCC0403-0732C galiso		Taylor Wharton		PSI	9000 9015	30	172.1 172.1	0.0 0.0			PCAL Jkt #1
3	1/3/2008 10:02	install	SCC0403-0732C galiso		Taylor Wharton		PSI	8000 8016	30	152.6 152.6	0.0 0.0			PCAL Jkt# 2
4	1/3/2008 10:28	install	SCC0403-0732C galiso		Taylor Wharton		PSI	7000 7019	30	133.6 133.6	0.0 0.0			PCAL Jkt #1
5	1/3/2008 10:47	install	SCC0403-0732C galiso		Taylor Wharton		PSI	6000 6024	30	114.4 114.4	0.0 0.0			PCAL Jkt# 2
6	1/3/2008 10:49	install	SCC0403-0732C galiso		Taylor Wharton		PSI	7000 7021	30	133.5 133.5	0.0 0.0			PCAL Jkt #1
7	1/3/2008 10:57	install	SCC0403-0732C galiso		Taylor Wharton		PSI	4000 4016	30	76.0 76.0	0.0 0.0			PCAL Jkt #1
8	1/3/2008 11:01	install	SCC0403-0732C galiso		Taylor Wharton		PSI	3000 3028	30	57.2 57.2	0.0 0.0			PCAL Jkt #1
9	1/3/2008 11:11	install	SCC0403-0732C galiso		Taylor Wharton		PSI	3000 3025	30	57.2 57.2	0.0 0.0			PCAL Jkt #1
10	1/3/2008 11:24	install	SCC0403-0732C galiso		Taylor Wharton		PSI	9000 9010	30	172.5 171.9	0.6 0.3			FCAL Jkt #1
11	1/3/2008 11:30	install	SCC0403-0732C galiso		Taylor Wharton		PSI	9000 9010	30	172.2 172.2	0.0 0.0			PCAL Jkt #1
12	1/3/2008 11:34	install	SCC0403-0732C galiso		Taylor Wharton		PSI	9000 9014	30	172.2 172.2	0.0 0.0			PCAL Jkt #1

The standard report form is shown above.
The calibration report form is shown below.

Disposition Explanation: PCAL=passed, FCAL=failed, PAA=aborted

Operator Name: _____ Signature: _____ Stamp: _____ Date Signed: _____

Certifying Staff/Inspector Name: _____ Signature: _____ Stamp: _____ Date Signed: _____

I hereby certify that all the following tests were made under my supervision and in accordance with DOT/CTC regulations.

#	Test Date Test Time	Operator	Serial Number	Cyl MFG.	Specified Unit	Actual	Test Time	TE Max TE Min	Total Elastic	Perm Percen	Disposition Remark
1	1/30/2008 12:55	install	SCC0403-0732C		6000 PSI	6010	30	114.6 112.5	113.0 113.0	0.0 0.0	PCAL Jkt #1
2	1/30/2008 12:58	install	SCC0403-0732C		7000 PSI	7010	30	134.1 131.6	131.8 131.8	0.0 0.0	PCAL Jkt #1
3	1/30/2008 13:00	install	SCC0403-0732C		8000 PSI	8010	30	153.8 150.9	150.6 150.6	0.0 0.0	FCAL Jkt #1
4	1/30/2008 13:02	install	SCC0403-0732C		9000 PSI	9010	30	173.6 170.3	169.4 169.4	0.0 0.0	FCAL Jkt #1
5	1/30/2008 13:06	install	SCC0403-0732C		3000 PSI	3010	30	57.0 56.1	56.6 56.6	0.0 0.0	PCAL Jkt #1
7	1/30/2008 14:13	galiso	SCC0403-0732C		3000 PSI	340	30	56.9 55.9	6.4 0.0	0.0 0.0	PAA Jkt #1

Fig 30: Export Report Save Option
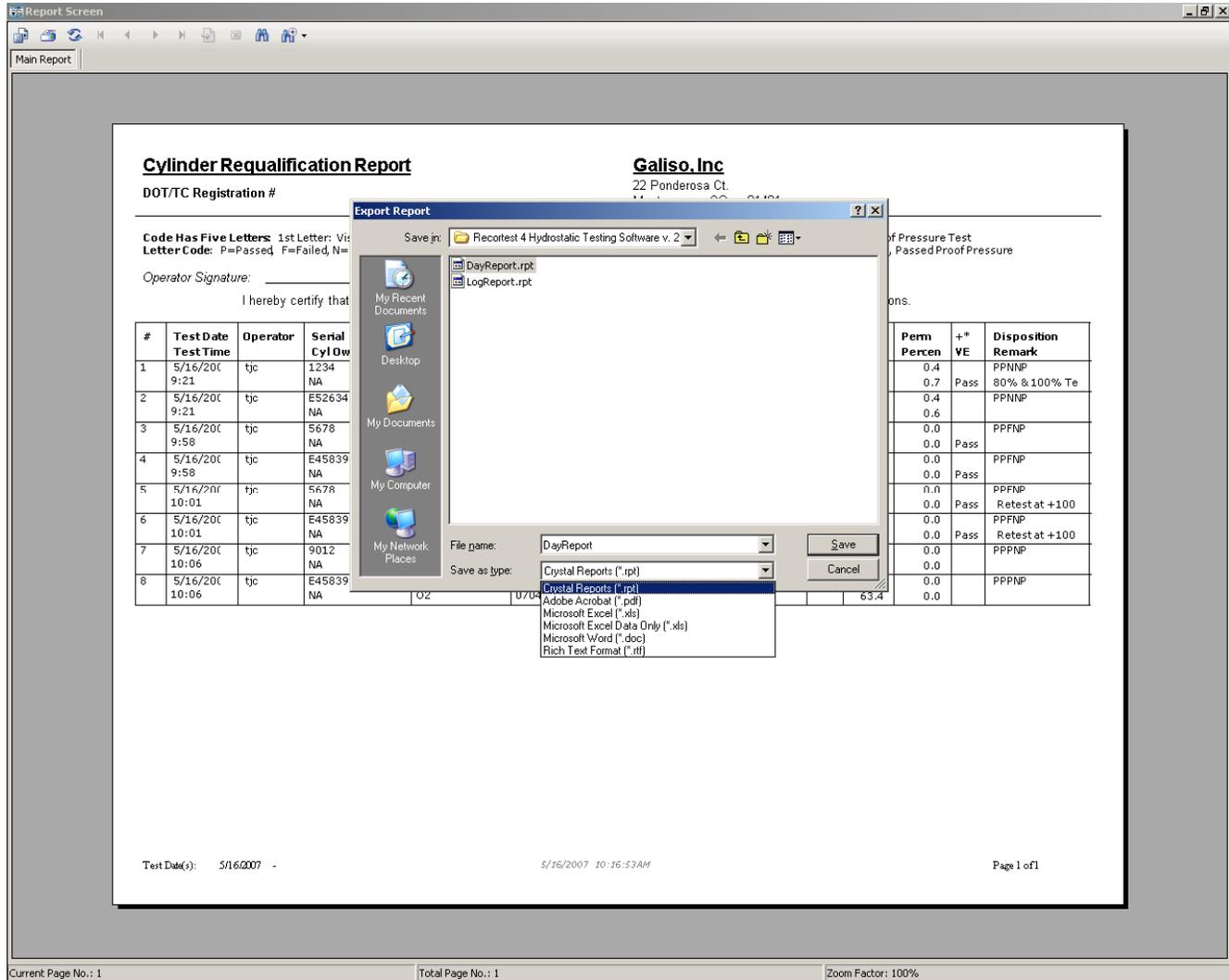
The reports can be exported for further customizing, and or saved for back-up in the file formats shown above.

Fig 31: Graph Screen

Shown above are the graphed curves of the pressure, and cylinder expansion.

The scale of the graph can be changed for different viewing if needed.

Fig 32: Graph Pressure Bleed
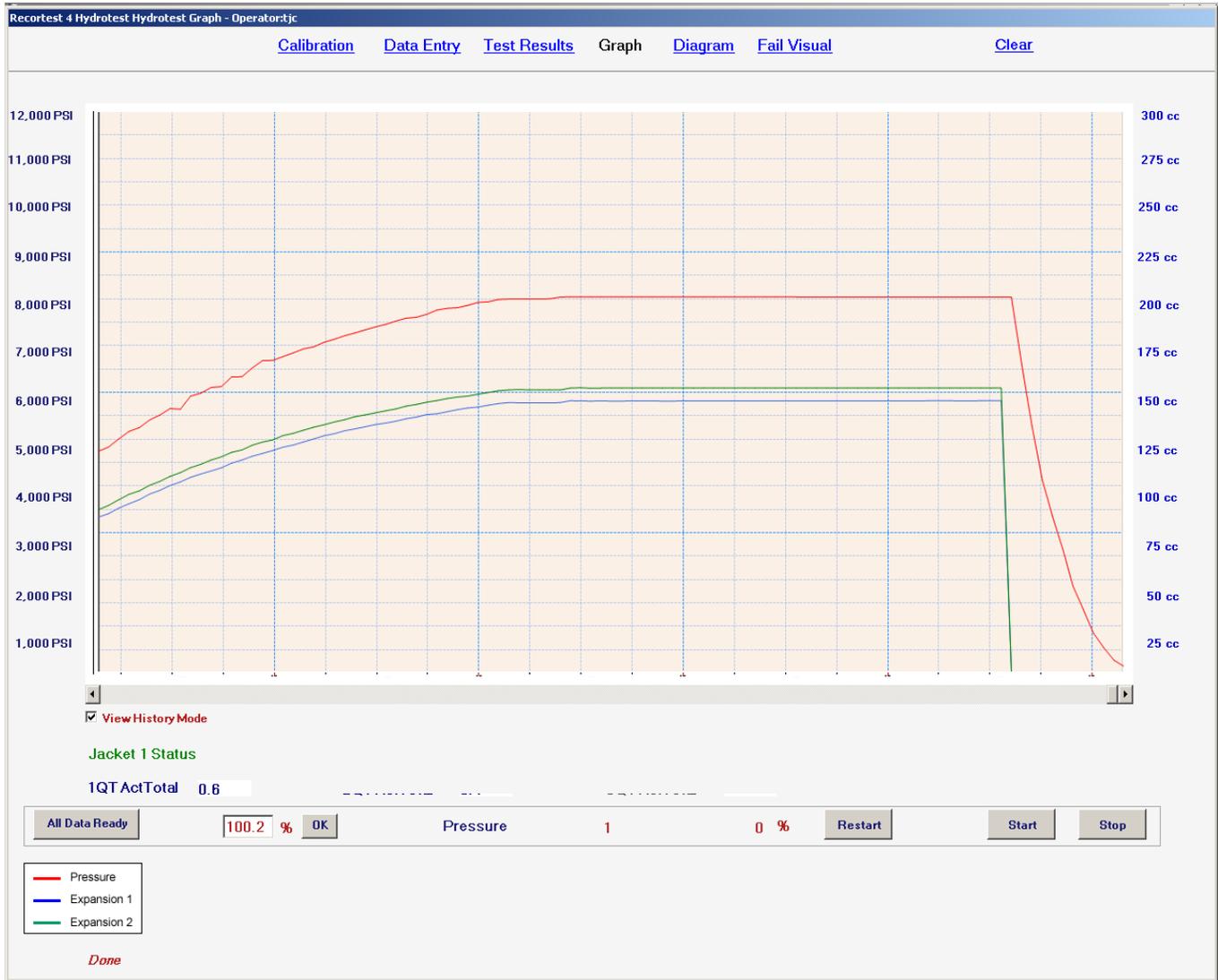
The <Graph> screen continuously moves on a timeline to show the entire test, including the release or 'bleed' of pressure. You can click on the <View History Mode> check box to view up to 15 minutes previously.

Fig 33: Diagram Screen
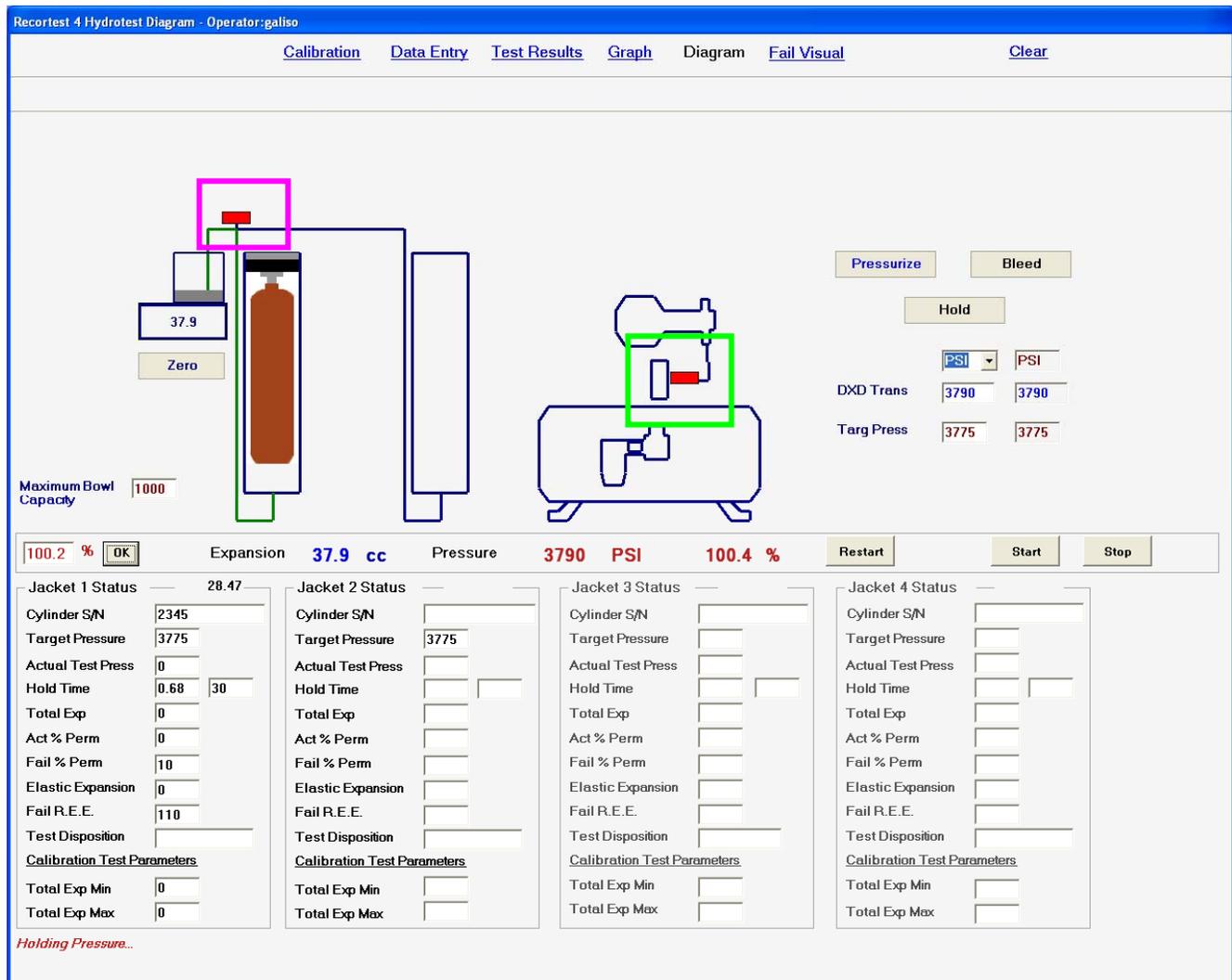
This screen is a manual mode used for manually operated tests. All test functions can be performed manually here.

After starting a test from the 'Data Entry' screen, you can switch to the diagram screen to view the progression of the test in more detail. You can also start a test from the <Diagram> screen.

You can run troubleshooting tests that are not documented. You can also use this screen to pressurize the calibration cylinder to exercise it before the calibration test. You can manually operate the test by opening the expansion valve, and clicking on the <Pressurize> button. To release the pressure, click the <Bleed> button. When the button text is **Blue**, the function is activated. Also, the **Red** text in the lower left corner depicts the test status.

The rectangle inside of the **Green** outline above represents the bleed valve. When the valve is a **Red** color, it is <u>closed</u>. When it is **Green**, it is <u>open</u>.

The rectangle inside of the **Pink** outline represents the manually operated jacket selection valve. When it is **Red**, the jacket #1 test parameters are testing in progress. When it is **Green**, the jacket #2 test parameters are testing in progress. This is basically just a reminder to switch

the valve to the corresponding jacket. The expansion line depiction to the testing jacket will also turn **Green**.

<Zero> button: This button tares the scale/bowl to zero expansion. At the same time, it 'zeros' the pressure valve. Both of these functions are performed automatically during a test that starts with the <Start> button. The computer program waits for the bowl reading to be stable, before taring to zero. It will go to zero immediately when you click the button in manual mode. The scale itself displays the same value as the screen at all times.

<PSI> field: Displays the current unit of measure. It is also adjustable to Bar, MPa, KG/CM^2, or PSI.

DXD Trans: Displays the current pressure. This field is not adjustable. Digital DXD serial transducer is addressed to 01. It is accurate to .1%. The acceptable deviation from zero as displayed on the test software screen is +/-10 PSI. The reading must be steady. If reading is unstable, check PLC ground to transducer ground (transducer case) connection.

<Target Press>: Displays the current target pressure. It can be manually adjusted too.

<Maximum Bowl Capacity> This field value should equal the capacity of the bowl being used.

Fig 34: Fail Visual Screen

A failed cylinder can be documented from failing the visual inspection. The reason for the failure can show on the test report. Many known reasons are listed for you to check if it failed for that reason. Otherwise, you can enter the reason in the comments, along with any other comment needed.

Fig 35: Scale Calibration Procedure

1. AND scale model: EK-1200I; part# 37-11-8019
2. Use an NIST standard 1KG weight for calibration.

7. CALIBRATION

This function adjusts the balance for accurate weighing. Perform a calibration in the following cases.

- ☐ When the balance is first used.
- ☐ When the balance has been moved.
- ☐ When the ambient environment has changed.
- ☐ For regular calibration.

Press and lower down the calibration switch cover
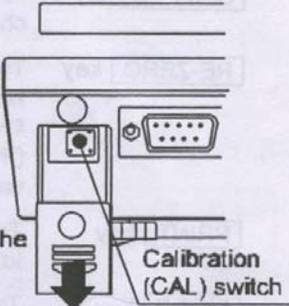
Calibration (CAL) switch

7-1. Calibration using a weight

1. Warm up the balance for at least half an hour with nothing on the pan.

   Press and hold the CAL switch.

2. Press and hold the calibration (CAL) switch until `Cal` appears, and release the switch.

   `Cal`

3. The balance displays `Cal 0`.

   Release the CAL switch.

   To change the calibration weight value, proceed to step 4.

   `Cal 0`

   To use the calibration weight value in the balance memory, proceed to step 5.

4. Press the `SAMPLE` key. The display shows the calibration weight value in "gram" that is stored in the balance. Use the following keys to change the value.

   `0 1 2000`

   Set the weight using the relevant keys.

`SAMPLE` key	To select the digit blinking to change.
`RE-ZERO` key	To set the value of the digit selected.
`PRINT` key	To store the value and return to step 3.
`MODE` key	To cancel the value and return to step 3.

   `Cal 0`
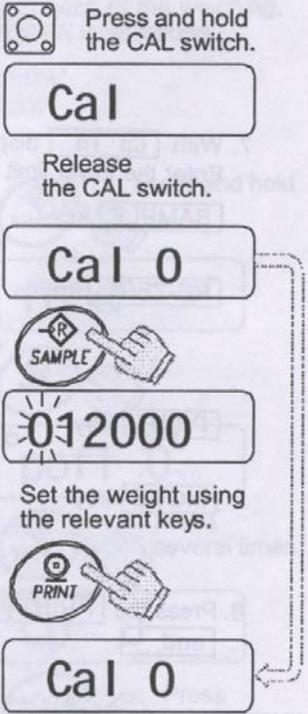
Fig 36: Scale Calibration Procedure (continued)

5. At step 3, pressing the PRINT key weighs the zero-point value. Do not touch the pan during weighing.

Weighing pan

With nothing on the pan

To store

Cal 0

10000
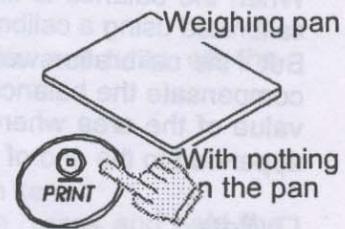
6. Place the calibration weight with the same value as displayed on the pan. Press the PRINT key to weigh it. Do not touch the pan during weighing.

Calibration weight

To store

10000
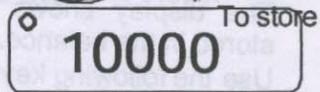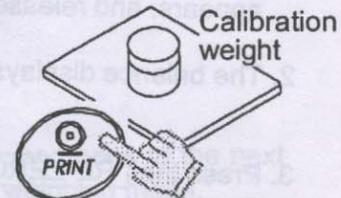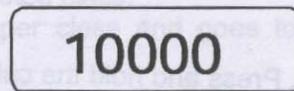
7. end appears.
   Remove the weight from the pan, and press the CAL switch or MODE key to return to the weighing mode.

end
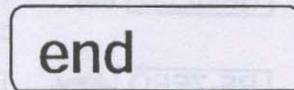
❏ *Note*

The value set in step 4 is stored in memory even after the power is switched off.

If the balance is to be moved to other places, set the gravity acceleration value of the area where the calibration using a weight is to be done, and calibrate the balance according to the procedure above. See the next section to set the value.

Section 2: Step By Step Quick Start Guide

<u>**Rec 4 – Open; Step By Step Quick Start Guide**</u>

Introduction: This guide is a quick reference for preparing the system for testing. Some detail is omitted.

Any words bracketed by <_____>, are items on screen that are 'clickable' with the mouse or a text field that allows keyboard text entry.

<u>Prior to testing:</u>

Before the system is turned on, it is important to complete the following:

- Ensure the cylinders to be tested are free from visual defects and have been properly inspected according to corresponding CGA pamphlets.
- Completely fill the cylinders with clean water and allow them to achieve room temperature.
- Master Gauge, test weights, and Calibrated Cylinder must be on hand each day, to verify calibration of system.
- Read all instructions before attempting to operate the Recortest 4 Open test system.

1. <u>Powering on the system:</u>
   a) Ensure the air and water are off, and that the battery back-up supply is on.
   b) Turn on the PC, and type in the <Username> and <Password> if there is one.
   c) Open the testing program by clicking on the <Galiso test software icon> on the desktop.
   d) Turn on the air supply to the test system first, and then the water and you should now be ready for testing.
   e) Verify the air pressure on the control air regulator (right end of pump air manifold) is set to 90 PSI.
   f) Check the oil level in the lubricator on the left end of the pump air manifold.
2. <u>Bleed air from the water lines.</u>
   2.1. Jacket water fill Line:
   a) Ensure the blue air hose to the test head is disconnected.
   b) Turn the 'Drain/Hold/Expansion' control valve to 'hold'.
   c) Open the 'Bowl/Jacket Fill' valve for 15 – 20 seconds.
   2.2 Bowl Expansion Line:
   a) Properly load the calibrated cylinder into the test jacket, and connect the low pressure blue hose to pressurize the test head with air. Always verify water comes out from top of jacket when attaching blue hose.
   b) Ensure the 'Drain/Hold/Expansion' valve is on 'Expansion'.
   c) Barely crack open the 'Bowl/Jacket Fill' valve, and watch the water level in the bowl increase.
   d) Allow the bowl water level to get to about ¾ of the way full, and <u>close</u> the 'Bowl/Jacket Fill' valve.
   e) Turn the 'Drain/Hold/Expansion' valve to drain, and watch the water level in the bowl decrease. Allow the water level to descend to between 200 – 300cc water level as indicated on the side of the bowl and turn the valve to 'Expansion'. Do not allow the water level to go below the end of the expansion probe in bowl or air will

enter the expansion line. Repeat above steps if water level ever falls below the end of the probe in the bowl.

f)   Repeat this 2 – 3 times, or until no air bubbles are seen to enter the bowl when you increase the water level.

g)   Leave the water level in the bowl between 200 – 300cc.

3. <u>System Calibration and Verification.</u>

3.1 Expansion calibration verification steps:

a) Navigate to the <Diagram> screen on the computer monitor.

b) Verify the system is stable by clicking the <Zero> button and ensuring it holds a 0.0 reading for 2 minutes before proceeding.
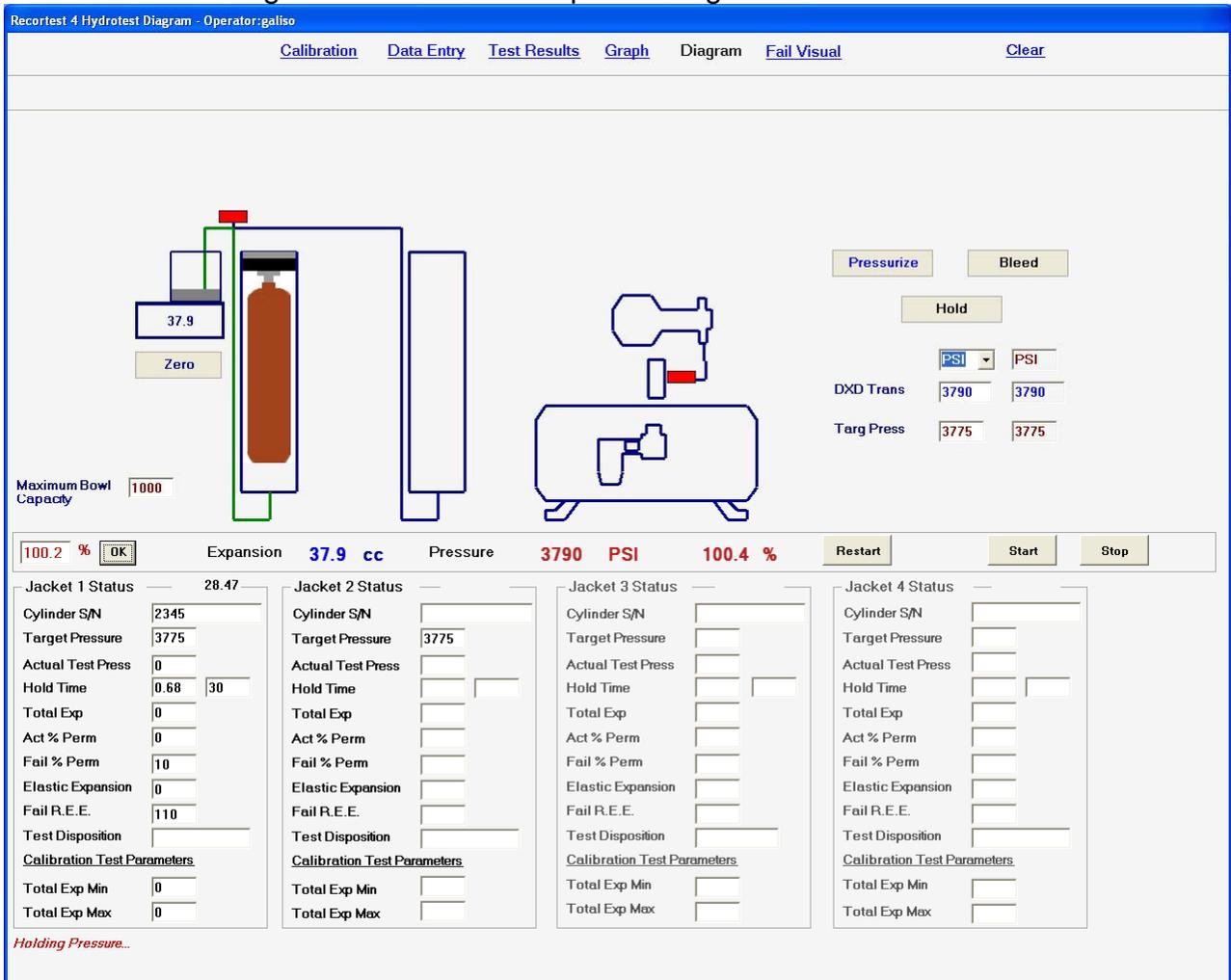
c) Carefully remove the cover from over the weigh bowl, zero the scale (use either the <Zero> button on screen, or the **RED** '**RE-ZERO**' button on the scale), and place the two 50 gram weights onto the scale platform.

d) Ensure the scale reading is between 99.7 – 100.3 grams (100 +/- .3 grams). If it is not in that tolerance, recalibrate the scale according to the scale instruction manual or the R4 Open Operations manual.

3.2 Pressure transducer calibration verification steps:

a) Ensure the low-pressure blue hose is still connected to the test head, with the calibration cylinder still in the jacket.

b) Connect the master gauge to the test head, and connect the hi-pressure black hose to the master gauge. The master gauge must have a current calibration date marking within one year of calibration.

c) Navigate to the <Diagram> screen and enter a mid-range (middle of caly cylinder range points) calibration pressure point into the <Targ Press> (target pressure) text box. Press the <Tab> key or click into another text box for your entry to stay entered.

d) Ensure the expansion/hold valve is on 'Expansion'.

e) Set the 'Air to Pump' regulator according to the chart below to achieve the test pressure. Use the 'Pump Fast Speed Control' ball valve, and the 'Pump Slow Speed Control' fine adjustment valve to reach the pressure at the desired rate.

f) Click the <Pressurize> button on screen to manually pressurize the calibration cylinder to the target pressure. Be sure to use the master gauge calibration sheet to know the true pressure value of the reading on the gauge. Example: Gauge will read 5980PSI when the actual pressure is 6000PSI.

g) After the pump stops at the mid-range pressure, verify the transducer reading on screen is within 1% of the gauge reading.

h) Click the <Bleed> button to release the pressure and verify the scale/bowl reading returns to a maximum of .4 before proceeding to the calibration screen. If the scale returns to .3 - .4 within 20 seconds, then the next test performed directly after, should return all the way to zero.

3.3 Pressure and expansion calibration <u>verification</u>: This must be done every day a cylinder is tested; usually the first test of the day is calibration verification. You must verify the equipment calibration within 500PSI of every cylinder to be tested within 24 hours. These instructions start from the beginning, so if you already achieved .3 - .4 scale reading within 20 seconds of bleeding the pressure, please proceed to step 4.1.

a) Ensure the low-pressure blue hose is connected to the test head, with the calibration cylinder still in the jacket.

b) Navigate to the <Diagram> screen. This process will verify the expansion amount, and the pressure for each pressure point on the calibrated cylinder.

c) Enter the highest pressure point to verify that day into the <Targ Press> text box.

d) Set the 'Air to Pump' regulator according to the chart again.

Pump Hydraulic Pressure VS Air Regulator Pressure
For High Pressure (140:1) Pump
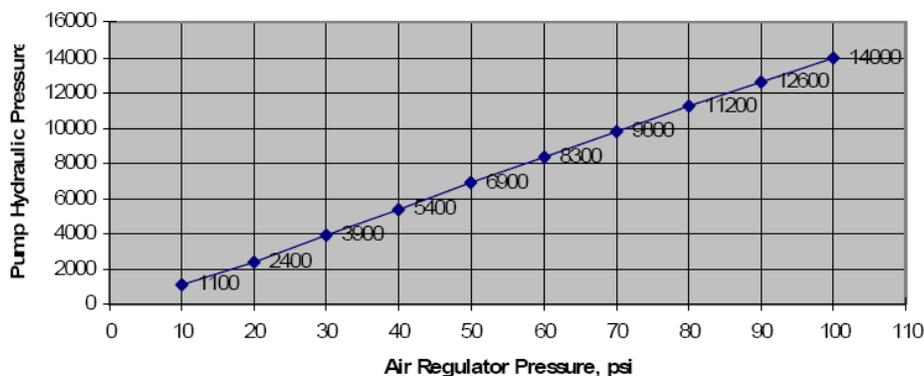
e) When the system achieves the selected pressure, and stops pressurizing, verify that the master gauge reading is within 1% of the shown value on the monitor screen, as

per DOT requirement. Some valve adjustments may be required to reach the pressure. Check the air to pump regulator pressure, and ensure the pump fast and pump slow valves are opened enough to achieve the desired test pressure.

      f) <Bleed> the pressure and verify the bowl reading returns to .3 - .4 within 20 seconds. If the bowl reading does not reach .3 - .4, repeat the steps above until it does. It is important to re-pressurize immediately. Do not let it sit more than 30 seconds between pressurizations.

4. <u>Document the calibration verification of the system as per DOT requirement.</u>

    4.1 Verify the highest pressure range of cylinders to be tested that day.
- a. Navigate the computer to the <Calibration> Screen.
- b. Choose the calibration cylinder <Serial Number> from the list.
- c. Choose the highest pressure point needed for the cylinders to be tested during the next 24 hours (within 500PSI of cylinder test pressure).
- d. Click the <1 Data Ready> text line and then click <Start>.
- e. Run the test, and verify the cylinder passes within the 1% expansion tolerance.

    NOTE: As a general rule, Galiso recommends the actual pressure of a calibration test does not exceed 1% or 50 PSI (whichever is less) of the target pressure. Your 3rd party inspector may require a more stringent test performed than Galiso. Please be sure to adhere to your 3rd party inspector's parameters when performing a calibration test.

- f. **'PCAL'** should display in the 'Test Disposition' field. If it fails calibration, run the test again immediately unless a problem is found that needs fixed. You can also set up the calibration to run a pre-test first to exercise the cylinder one more time before the qualification test. After the pre-test, the program will automatically start the calibration qual test.
- g. Repeat the steps for each pressure to be tested. Calibration finishes faster by verifying the highest point first, and working down to the lowest point. This is due to the cylinder being greater exercised first, so subsequent tests of less pressures return to zero faster.

    NOTE: Calibrated cylinder must show NO permanent expansion to pass the calibration verification test.

    4.2 Verify each additional pressure range of cylinders to be tested that day.
- a) Remain in the <Calibration> screen.
- b) Keep the calibration cylinder serial number entered in the <serial number> field.
- c) Choose the desired <pressure point> from the list.
- d) Click the <1 Data Ready> text line (for jacket #1) and then click <Start>.
- e) Repeat these steps for each pressure to be tested.
- f) Once all test pressure ranges have been verified, you can now start testing production cylinders in those ranges for one 24hour period. The test head adapter spud may need changed to fit the cylinders to be tested.

5. <u>Powering off the system.</u>
- a) Turn off the water supply to the test system first, and then turn off the air supply.
- b) <Close> the test software program.
- c) <Close> any other open programs, and <Shut-Down> the PC. Galiso recommends turning off the PC and the PLC every day, especially in hot environments.
- d) The scale can be left on.

Section 3: Instrument Detail

<u>**Instrument Detail for the**</u>
<u>**Recortest 4 – Open; Cylinder Water Jacket Test System**</u>

The water jacket cylinder test system mainly consists of the following components:

1. Pressure system
2. Expansion system
3. Water filtering system
4. Software control interface

1. **Pressure system:** This system contains the water pump with high pressure/bleed valve; high pressure tubing with fittings; test heads; and calibrated cylinders. Its main function is to pressurize the cylinders for hydrostatic testing.

    a) **Water pump:** It is an air driven, 140:1 ratio, single action intensifier pump. 1 PSI of air to the pump, = 100PSI of water pressure. This ratio is a hardware constant value in the theoretical world. Actual pump performance may vary. There are 2 check valves 1 for low pressure water inlet, and 1 for high pressure water outlet. There is a reservoir support package to provide more air volume to feed the pump drive. To operate the pump, set the regulator according to the chart below, and open the 'Air to Pump' ball valve to a sufficient amount for attaining the desired cylinder test pressure. Faster pumping and test times can be achieved by opening the valve more than what is required to achieve test pressure. Each pump varies slightly in its operation. This variance may require slightly different settings. The 'Pump Fast Speed Control' ball valve and the 'Pump Slow Speed Control' fine adjustment valve also need adjusted to achieve test pressure at the desired rate.

    b) **High pressure bleed valve:** Upon initial start of cylinder pressurization, the bleed valve closes (electro-pneumatic control valve light on). It stays closed during the test 'hold time'. To release the test pressure, the bleed valve opens (lights off)at the end of the hold time duration. Watch the control valve lights on the electro pneumatic valves under the table top for correct valve signal operation. Watch the valve stem movement to ensure the valve is properly moving with signal. This observation (as is with all test function observations) will help you understand what is happening and when. This will help you choose the correct course of action for later maintenance and troubleshooting. The monitor screen and the software manual show a visual depiction of the valve operation too.

    c) **Transducer:** Digital DXD serial transducer is addressed to 01. It is accurate to .1%. The acceptable deviation from zero as displayed on the test software screen is +/-10 PSI. The reading must be steady. If reading is unstable, check PLC ground to transducer ground (transducer case) connection.

d) Air to pump pressure regulator: Adjust this according to the chart below for the proper pump air pressure required to reach the cylinder target pressure. Pumps vary in operation, but this chart is a good starting point to know where to set the regulator before starting the test.

Pump Hydraulic Pressure VS Air Regulator Pressure For High Pressure (140:1) Pump

Data points (Air Regulator Pressure, psi → Pump Hydraulic Pressure):
- 10 → 1100
- 20 → 2400
- 30 → 3900
- 40 → 5400
- 50 → 6900
- 60 → 8300
- 70 → 9800
- 80 → 11200
- 90 → 12600
- 100 → 14000
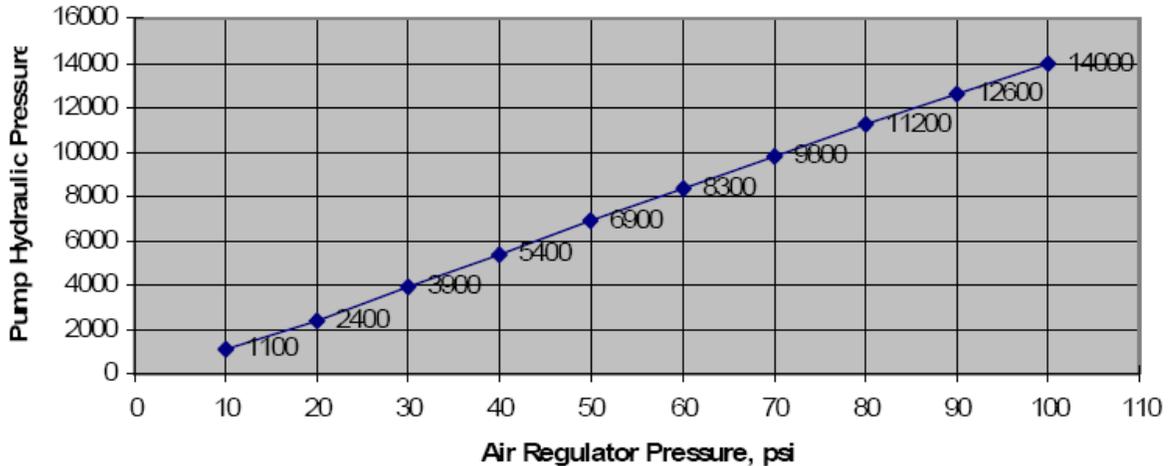
d) Pump air exhaust: The pump exhaust has a muffler attached that must be kept clean and open.

e) Reservoir safety valve: The RSP has a 175PSI safety valve. Please keep incoming air pressure at 150 or less.

f) Reservoir relief valve: This is a manually operated valve at the bottom-right side of the tank when facing the front of console.

g) High pressure tubing, fittings, test heads, & quick couplers: Stainless tube with compression fittings to the stainless test heads, and master gauge locations. Quick couplers are utilized for the master gauge connection. The fittings must not be over-tightened. Care must be made during maintenance to ensure fittings are not damaged during reassembly. The coupler seals require periodic replacement.

h) Calibrated cylinders: The final piece of the pressure system. Verifies predetermined pressure to expansion measurements to ensure the system is in calibration before testing production cylinders. The correct cylinder serial number must be placed in the jacket for proper calibration. Each cylinder has a predetermined, calibrated point certification sheet to show the nominal expansion cc at the given pressure point. To properly calibrate, a pre-pressurization should be done on the cylinders, immediately before the qualification calibration test is performed. Do not allow more than 30 seconds to expire between the pre-test bleed to zero PSI, and qualification calibration test. Generally, the next pressurization should be started as soon as the bleed pressure from the previous test comes to zero and the scale is stable enough for the program to zero it and start the next test. When the calibrated cylinder ages over time, the parameters of the pre-test may need changed to better accommodate exercising the cylinder as it gets older. Again, the pre-test is basically to exercise the cylinders so they will expand and contract properly for the calibration verification test.

Adapter usage: It is important to not remove and reinstall the test adapters for daily calibration verification tests. Leave the adapters on the calibrated cylinders. The cylinders should not be dried. They should be set aside full of water, ready for the next day's calibration test. If water stagnation is a concern, you may drain and dry them every 2 months.

2. **Expansion system:** This system contains the water jacket; test head to jacket seal boot; expansion tubing; expansion weigh scale; and weigh bowl.
   a) **Water jackets:** Must be full of water, and sealed with the test head and cylinder in place. Made of steel. Has an 8" glass pressure relief port (burst disc) in the event of a loss of cylinder integrity under pressure. Upon pressurization, the cylinder physically expands, pushing water from the sealed jacket, through the expansion line, and to the weigh bowl on the scale for measuring in cc (cubic centimeter). The amount of water pushed to the bowl is measured under pressure. After pressure is released and the cylinder stabilizes, the expansion is measured again. This method of measurement accurately displays the integrity of the pressure vessel or cylinder as the case may be.
   b) **Test head:** Seals the head to the jacket with air applied to the air fitting. It is to be kept clean and free of dirt or water slime. The main seal is the head boot that encircles the top inside perimeter of the jacket. Keep the boot rubber clean, and do not allow rust barnacles to build up on it.
   c) **Expansion tubing:** Flexible nylon tubing, connected via push in style fittings. The nylon tube must not have any kinks or blockages in it. The tube carries the expansion water from the jacket, to the stainless weigh bowl probe, which is the last extension of the expansion tube. The probe typically sits at a level within ¼" of the bottom of the weigh bowl. An air free siphon must be established between jacket and weigh bowl for the system to properly function.

d) Expansion weigh scale: The scale measures the weight in grams. 1 gram of weight = 1cc of water. The scale must simply be powered on, and the control software does the tare and measure functions. Scales should be kept level by adjusting the feet so the air bubble stays centered in the circle. Do not allow the scale to be immersed in or covered with water. **<u>Do not</u>** manually 'zero' the scale with the scale 'zero' button.

e) Weigh bowl: The bowl is a 1000cc bowl. It is sufficient in size to test up to 800cc expansion cylinders. It must be completely on the scale platform, and not touching <u>anything else</u>.

3) Test water cartridge filtering: There is one large cartridge filter for incoming facility water that filters particles to 5 µm. This filter needs changed once per year.

4) Software control interface: Controls the test parameters for all testing. Measures the test information and calculates pass or fail.

a) There are 2 programs essential to performing tests on the water jacket system. Both programs are started with the same <Galiso Testing> icon.

      1) **Rec4 Settings program:** This program allows for test parameters to be set according to the cylinders being tested. Please read the Rec4 Settings section of the software operations manual for complete training on its functions.

      2) **Rec4 Testing Software:** This program is the user interface to control the machine. Please read the software operations manual for complete instructions.

b) Programmable Logic Controller (PLC): Direct Logic sub-base with 3 modules. 1. WinPLC module to control all main processing. 2. Serial module to communicate with digital devices. 3. Output module sends commands to operate devices.

c) Data storage and analysis: Galiso saves all of the raw test data in text (.csv) files. One set of all test data is saved to the machine PC hard drive. Another set is saved remotely to a LAN file location chosen by the customer in the Rec4 Settings program. The remote file may also be another drive on the machine PC, such as a CD write drive, or a removable drive, etc….

Section 4: Installation and General Maintenance

<u>Installation and General Maintenance of the</u>
<u>Rec 4 Open - Water Jacket Cylinder Test System</u>

<u>**Pressure system:**</u>

1. **Water pump:**

    A) Change the inlet water supply filter to the pressure pump at least once per year.

    B) Periodically check the muffler to ensure it allows air to escape freely, and is not clogged.

    C) Pressure/bleed valve: Check for leaks once per month or if leak is suspected. If valve is leaking through the weep hole, tighten the large nut 1/8 of a turn. **<u>Do not over-tighten!</u>** Remove the lock ring with allen wrench and discard. Carefully tighten the nut, and get a feel for its tightness. The valve pintel tightens against graphite packing rings. These rings can break very easily if over-tightened. Try 1/8th of a turn to see if leak stops. Try another 1/8 of a turn if leak does not stop. Ensure the Festo electro-pneumatic pressure and bleed control valve lights are functioning at least once per month. Upon initial start of cylinder pressurization, the bleed valve closes (electro-pneumatic control valve light on). Upon achieving the target pressure, the bleed valve stays closed. To bleed off the test pressure, the bleed valve opens (lights off). Observe the valve movement itself to ensure a clean crisp on and off/in and out movement of the valve hardware.

    D) Keep the air tank and all assemblies clean, and free of excessive shop dust.

2. **Hi Pressure Tubing:** Keep all fittings tight, and visually check for leaks once per month.

    Quick couplers: Upon the event of a quick coupler leak, replace the coupler if the machine needs to test cylinders immediately. The old coupler housing is probably still good. Replace the seals in it, and put it back in the rotation of used replacement parts. If new seals don't work to fix the leak on the old coupler, then discard the coupler. Changing the seals on the old coupler is much easier to do when it is not connected. Then, you can change them on a workbench at a more convenient time, or with a more convenient laborer.

3. **Calibrated cylinders:**

Neck threads: Do not remove the test adapters from the calibrated cylinders unless it is absolutely necessary. Frequent removal and reinstallation of the test adapters will wear out the threads, and void the warranty of the cylinders. Galiso does not warranty excessively worn cylinder neck threads. The cylinders can be drained and dried every 2 months, without ruining the neck threads; however it is not required to drain and dry them at all.

Expansion system:

1. **Water jacket:**
A) **Head seal to jacket:** Keep the head seal boot clean. Keep the jacket clean, and do not polish the top area where the head seal engages. That area should be about 80-grit rough.
B) **Burst disc port:** The glass should be kept clean. Do not allow rust to build up around the rubber seal.
C) **Jacket water:** Completely drain and replace the jacket water once per month.

2. **Expansion tubing and fittings:**
A) **Tube condition:** Do not allow the tubing to become clogged, compressed, kinked or deteriorated. Tubing must look to be perfectly intact. Replace tubing if it becomes worn or damaged. Purge all air from the lines. Check for leaks once a month, or if leak is suspected. Cut worn tube ends off, and reinstall new end of tube and new ferrule into fitting. If that does not fix the leak, replace the tube and the fitting.
B) **Placement:** If you replace tubing, keep its length to a minimum. Point the tubing in the direction of destination. Do not make full circle loops with the tubing. Circle loops will develop air pockets that grow larger as more testing is performed. Keep the expansion probe from touching the bowl sides or bottom.
C) **Purging air from the lines:** The entire expansion line from jacket to bowl must not have any air in it.
1. Properly load the calibrated cylinder into the test jacket, and connect the low pressure blue hose to pressurize the test head with air.
2. Ensure the 'Drain/Hold/Expansion' valve is on 'Expansion'.
3. Barely crack open the 'Bowl/Jacket Fill' valve, and watch the water level in the bowl increase.
4. Allow the bowl water level to get to about ¾ of the way full, and <u>close</u> the 'Bowl/Jacket Fill' valve.
5. Turn the 'Drain/Hold/Expansion' valve to drain, and watch the water level in the bowl decrease. Allow the water level to descend to between 200 – 300cc water level as indicated on the side of the bowl.
6. Turn the valve to 'Hold'. Do not allow the water level to go below the end of the expansion tube.
7. Repeat this 2 – 3 times, or until no air bubbles are seen to enter the bowl when you increase the water level.
8. Leave the water level in the bowl between 200 – 300cc.

3. Expansion weigh scale and bowl:
   A) **Powering on:** Carefully remove the scale cover and lift the weigh bowl off of the scale platform and press the on button. Wait for scale to register 0.0, and carefully replace the bowl onto the scale platform. <u>Be sure the bowl does not touch anything</u>, including the expansion probe, and scale cover. <u>Be sure the bowl is on the scale platform as much as possible, without touching anything else</u>. Ensure the Galiso signal wire connection is in place at the rear of the scale. Carefully place the cover back over the scale.
   B) **Taring:** There is no need to tare the scale, as the Galiso program performs that function automatically. Please do not tare the scale.

Section 5: General Diagnostics and Troubleshooting

<u>General Diagnostics and Troubleshooting of the</u>
<u>Recortest 4 Open Water Jacket Cylinder Test System</u>

<u>General Troubleshooting Guidelines:</u>

Study what is happening, and when. Gather clear and precise information before calling Galiso Customer Service. 1-800-854-3789 or 970-249-0233.

Keep all schematics and drawings accessible so Galiso Customer Service can use them to help you fix the machine. Please study the drawings and become familiar with them.

1. <u>**Water Jacket System:**</u>

   a) **Pressure system:**
   1) **Hi pressure pump:**
      A. If loss of line pressure is experienced, and there is no leak anywhere in the lines, then fix according to the instruction in the 'Installation and General Maintenance' manual.
      B. Rebuild or replace the outlet check valves on the pump. The pressure could be going back into the pump through a check valve that is not functioning properly.
   2) **Negative expansion problem:** The real problem is temperature, but if the temperature problem is not severe, you can try this: If negative expansion occurs during water jacket test, slow down the bleed speed with a manual bleed valve. Turn it off, and then open it about 1/16th of a turn. That will help keep the cylinder from bleeding down the pressure too fast, and going negative on the expansion scale.
   3) **Expansion rise during hold:** If expansion cc reading increases during the pressure hold time of the water jacket test, then it is highly likely that there is a test connection leak. The test connection is sealed by the speed seal connection from head to cylinder. If it leaks into the jacket, the bowl reading will rise. The pressure will also decrease.
   4) **Pressure loss:** A loss of pressure during the hold time with no increase in expansion, after the pressure stabilizes, greater than 1PSI per every 2 seconds, can be an external leak somewhere in the pressure line system. This is usually visible, so look for the leak. You need to give the pressure time to stabilize after pressurizing, before being concerned about a pressure leak, unless it cannot stabilize due to a large leak. It is also caused by a very rapid pressurization on a more elastic cylinder. The cylinder pressurizes very fast, and then expands during the hold time. The expansion allows the cc's to drop rapidly during hold. In such cases, slow down the rate of pressurization so all expansion takes place during pressurization.
   5) **Pump pressure / bleed valve leaking through weep hole:** Fix according to instruction in the 'Installation and General Maintenance' manual.
   6) **Calibrated cylinders:** You must pressurize the calibrated cylinders manually in the <Diagram> screen to the pressure to calibrate or more (not to exceed the highest point on the cylinder), 2 to 3 times to exercise the cylinders so they will meet the points, and come back to zero expansion correctly during the calibration test. You can pressurize using the <Pressurize> button on the on the diagram screen. Hold it for at least 20 seconds, and bleed using the <Bleed> button.

b) Expansion system:

1) **Water jacket:** The bowl level should stabilize within 10 seconds after the expansion valve is opened.

2) **Expansion weigh scale:** <u>If the expansion does not go high enough</u> compared to other cylinder tests, then the placement of the bowl on the scale is suspected to be the problem first. Check the bowl placement according the 'Installation and General Maintenance' manual. <u>Do the same if the expansion does not come to zero/shows to much permanent expansion.</u> **Check the bowl placement and ensure the cover is not touching the bowl or scale platform.**

<u>Reference Guide For Common Occurrences:</u> Please refer to the operations manual for more detailed descriptions.

1. **Software is not responding properly:**
   a) Close the program completely, and open it up again.
      If that doesn't fix it, close down all programs, and reboot the PC.
   b) Cycle the power on the PLC by removing the PLC power connector on the back of it. Wait 10 seconds, and reconnect it. The PLC can run out of memory if it is run for too long without cycling the power. This should be performed once a week at a minimum.

2. **PC <> PLC COM FAILURE:**
   a) Check the power to the PLC to be on.
   b) Ensure the 'Link' light is on, on the WinPLC module. This is the module with the single ethernet cable hooked to it on the PLC sub-base.

3. **Device communication failure:** If the testing program flags a communication error with the scale or the transducer, it is most likely a cable connection problem. The problem is usually not visible. The phone cord (RJ11) type connector can lose it's grip on the 26 Gauge wires. Normally, the connector only needs re-crimped with the proper crimpers. Or, you can replace it with a simple phone cord.

4. **Pump won't pressurize:**
   a. Open the manual ball valve on the pump air supply line.
   b. Cycle the power to the PLC by removing the PLC power connector on the back of the PLC. Wait 10 seconds, and reconnect it. Try pressurizing again. You may also need to exit the test program, and re-open it.
   c. Ensure that the 'Power' and 'Run' green lights are on, on the WinPLC Module.

5. **Cylinder test result fails <u>negative</u> expansion mostly on cylinders 10L or less:**
The proper adjustments should be documented so the operator can set them for testing small cylinders. More accurate adjustments may be needed for 3.5 L and smaller cylinders. You may also find that some cylinders larger than 10L will benefit by giving a faster test result, with the proper adjustments described below. These will also help the test to not fail '% Perm'. You can do initial set-up tests at 80% of test pressure. Any test under 90% is not considered a valid test that requires a written result, so it is safe to do set-up tests at 80%. Be careful to not allow the pressure to exceed 90% during your set-up test unless it is on a shop 'test set-up' cylinder that is not in service. Also, refer to the 'Cylinder Testing Reference Guide' manual in this set.

   a. **<u>Control the temperature:</u>** Negative expansion bowl readings are always partly due to a temperature problem of some kind. The room temperature, the full cylinder (water) temperature, the full jacket temp, and the pump test water temp must all be the same. If you are having problems with small cylinders, make all of these temps the same (+/-4°F) and 99% of the problems will go away. Use a mixing valve on the water filter assembly to mix hot and cold water to match room temperature, or better yet, use water from a water storage tank in the same room. Make all other items the same temperature as the room. i.e. test jacket water, test pumping water, and cylinder fill water. Air cannot be moving around the jacket outer steel. Insulate the jackets. Do not blow AC on or near the jackets. All AC ducting must be diverted away from the jacket area. Do not blow large fans on or near the jackets.
   <u>Control the rate of pressurization</u>: This needs to be a very slow steady increase to the target. The rate of increase should be about 500 PSI every 3 seconds or slower. Use the ball valve and the slow pump valve to restrict the air flow to the pump and slow down the rate of pressurization.

   b. **<u>Control the rate of depressurization or 'Bleed':</u>** Use a manual bleed restrictor valve and attach it to the air operated bleed valve on the reservoir tank. <u>More bleed restriction</u> will affect the bowl cc's to go <u>less into negative expansion</u>. Less bleed restriction (faster bleed flow) will allow the bowl cc's to go further into negative expansion. Make small adjustments to determine the proper setting. Large adjustments or extreme settings can cause erratic results.

6. **Low Bowl Level:** Care must be taken to not allow the water level to fall below the end of the expansion probe. This will cause air to get into the expansion line, so be sure to keep the water level above the end of the probe during manual testing in the diagram screen.

7. **Fail To Reach Target Pressure:** Galiso has overcome this problem that can sometimes happen when the variables (such as incoming air supply, water pressure, and pump stroke position) keep the pump from attaining target pressure. If the pump stalls below the target for 6 seconds, it will bleed for 2 seconds, and start pumping again to achieve the target. It should achieve the target the second time, and start the 30 second timer at that point.

8. **Pressure drop below 100% target pressure:** Should the pressure fall below 100% of target pressure the pump will activate again to gain the percentage of target shown in the cut-off pressure text box. It will start the 30 second hold timer again too.

Section 6 - REC4 Open Step By Step Software Recovery Procedure:

1. Insert the Entivity Data Pack v7.0 disk that ships with your system. This software was created by a third party vendor and enables the software running on your PC to communicate with the software running on the PLC.
2. Follow the default procedures.
3. If, during the installation of the software, the system prompts you to insert your operating system disk, then please do so. DO NOT take any action with the operating system setup upon inserting the disk. The software will recognize the files it needs and take the actions it needs.
4. After completion of the Entivity Data Pack v.7.0 procedure, the system will prompt you to restart the computer. Please do so.
5. After logging back onto Windows, please double click on the desktop icon for the Entivity Data Pack, as shown below.

6. The following screen will appear. Click on the Studio Station tab when it does:
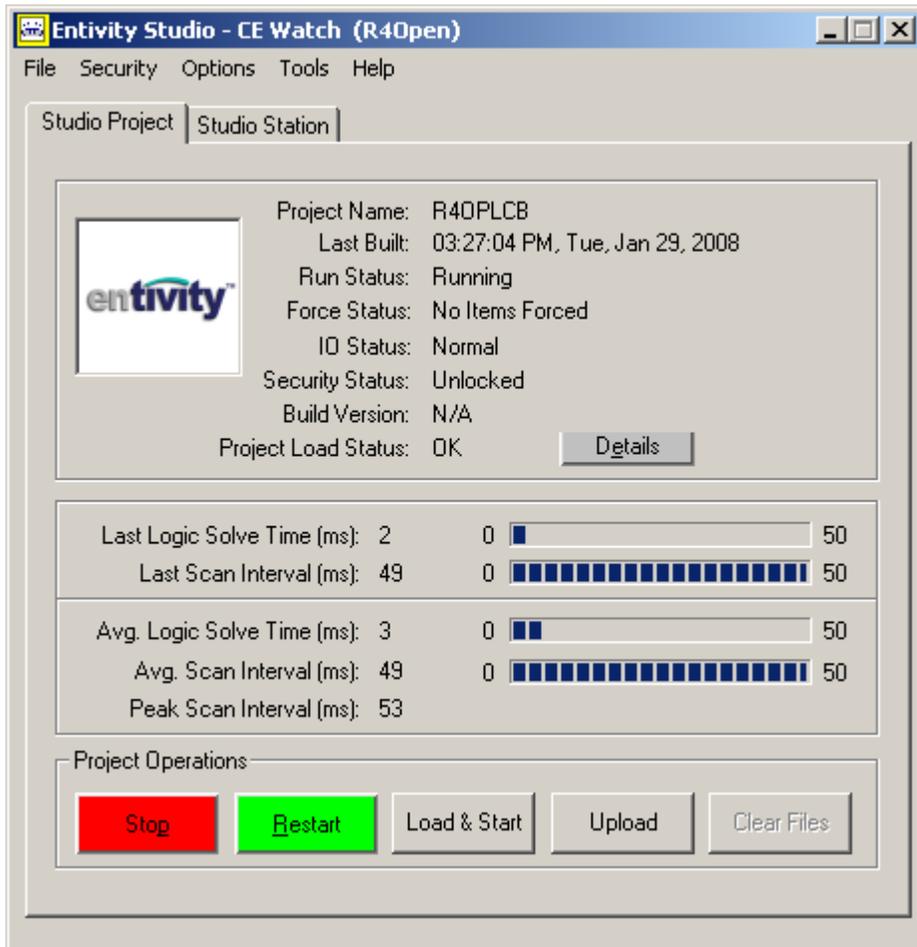
7. From the Studio Station tab, click on the Select CE Station button
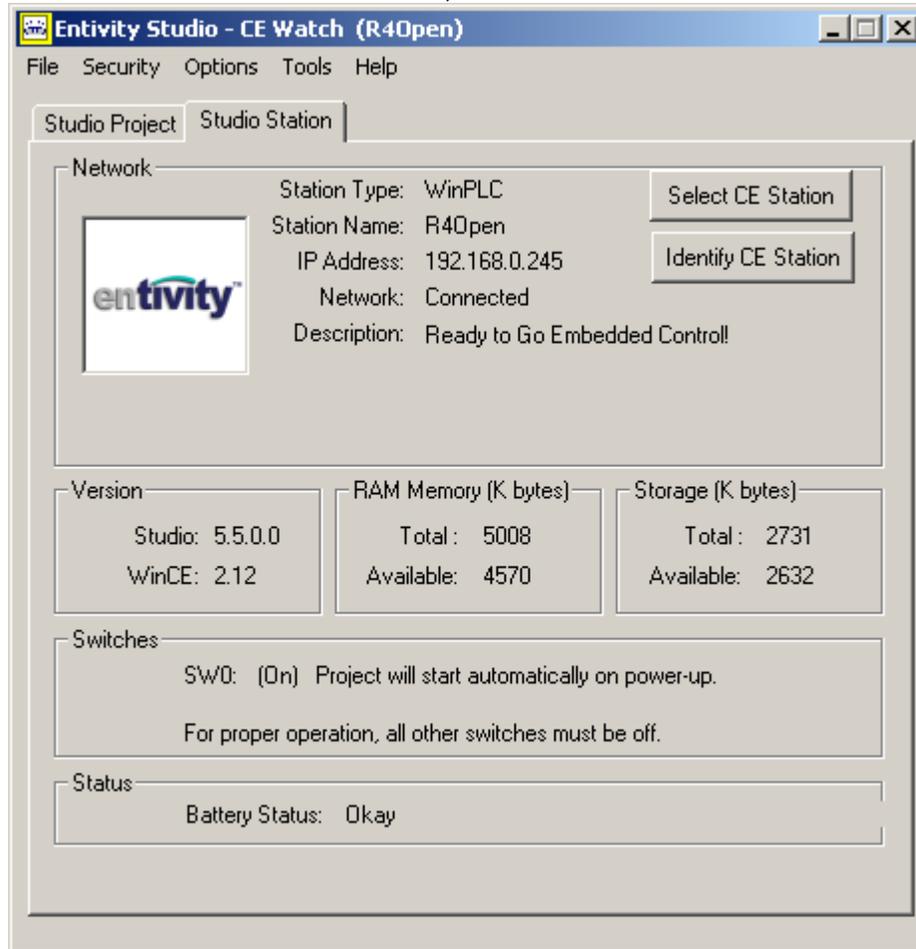
8. After clicking on the Select CE Station, you will see a screen like the following. The PLC shown on the screen below may not be visible yet. If it is not, click on the Reset Using IPX button (requires that the IPX Protocol-a Windows supplied protocol-has been installed) shown on the screen below.

Entivity Studio - CE Watch - CE Station Selection

Following is a list of "Entivity Studio CE Runtime(s)" currently available on the network.

| Re-scan | Reset using IPX... |

	Mac Address	IP Address	Name	Description
1	00 E0 62 80 19 B4	192.168.0.245	R4Open	Ready to Go Embedded Control!

| Configure... | Select | Exit | Help |
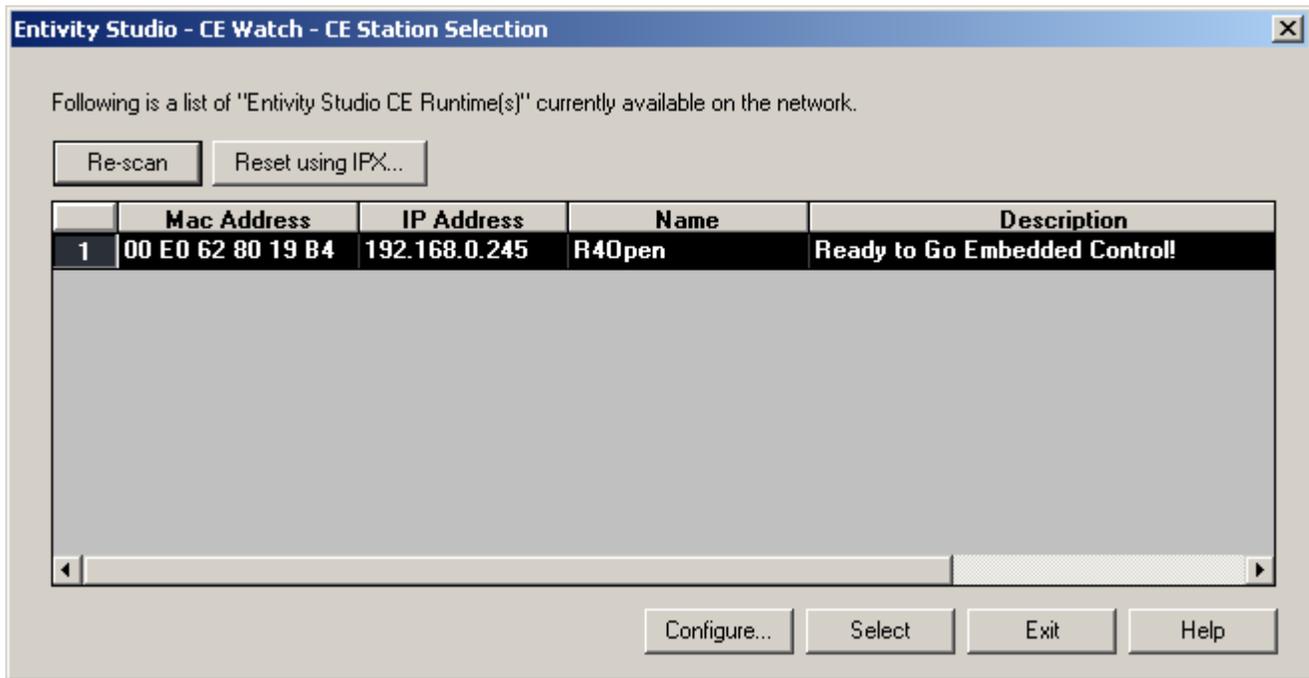
9. The Reset Using IPX button will display the following screen. You will need to enter the MAC Address for your PLC. This information is supplied with your system and may also be found on the inside of your WinPLC module:

Reset WinPLC using IPX

Enter the Mac address of the WinPLC that you want to reset.

| 0 . 0 . 0 . 0 . 0 . 0 |

Note

Mac address for a WinPLC is printed on the back of the module.

Only WinPLC's can be reset. Other Windows CE Runtimes cannot be reset using this dialog.

| OK | Cancel | Help |
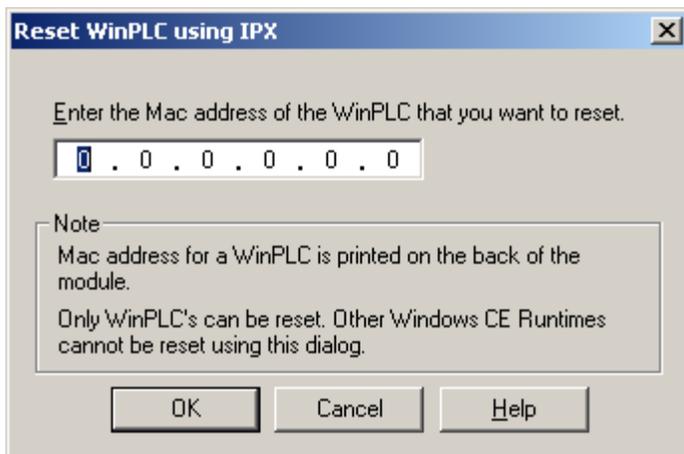
10. After entering the MAC address, click OK. You will then be prompted to cycle the power on your PLC. Unplug the power supply to the PLC, wait a few seconds, then plug it back in. The system should recognize the PLC and display the following screen.
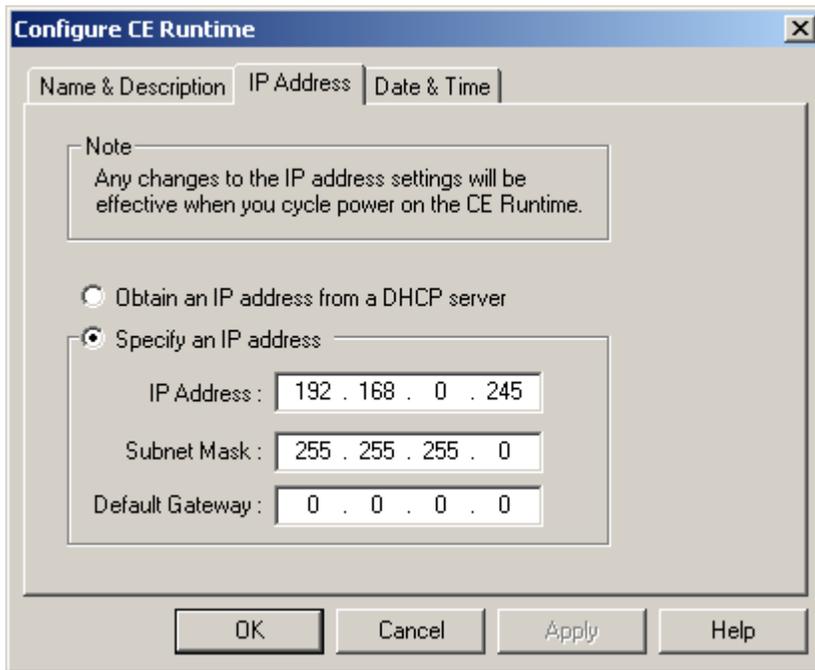
11. Switch to the IP Address tab, as shown above and configure the system in a way similar to that shown above. You will need to have the 'Specify an IP address' option selected, and supply an IP Address (and Subnet Mask) that will work for your system. You may also need to alter the PLC name through the Name & Description tab. We recommend that you name it R4Open unless you have multiple R4 Open systems and need distinct names for each PLC.

12. When you are finished, click OK. You will be prompted to cycle the power to the PLC again. When you have done that, the system will display the screen shown below step #8. If the PLC is not immediately visible on the screen, click Rescan to display your newly configured PLC.

13. When the newly configured PLC appears, click Select and close all Entivity Data Pack screens.

14. The next step you need to perform is to configure your local area connection to communicate with the WinPLC. Go to Start > Settings > Network Connections > Local Area Connection > Properties to display the following screen:
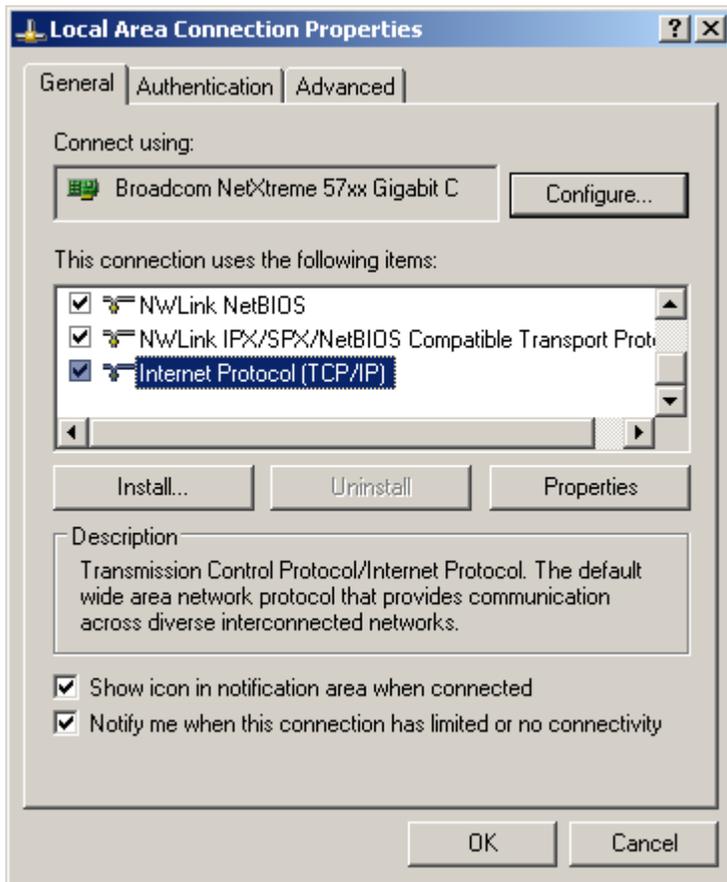
15. Select the Internet Protocol(TCP/IP) as shown above and click Properties to show the screen below:
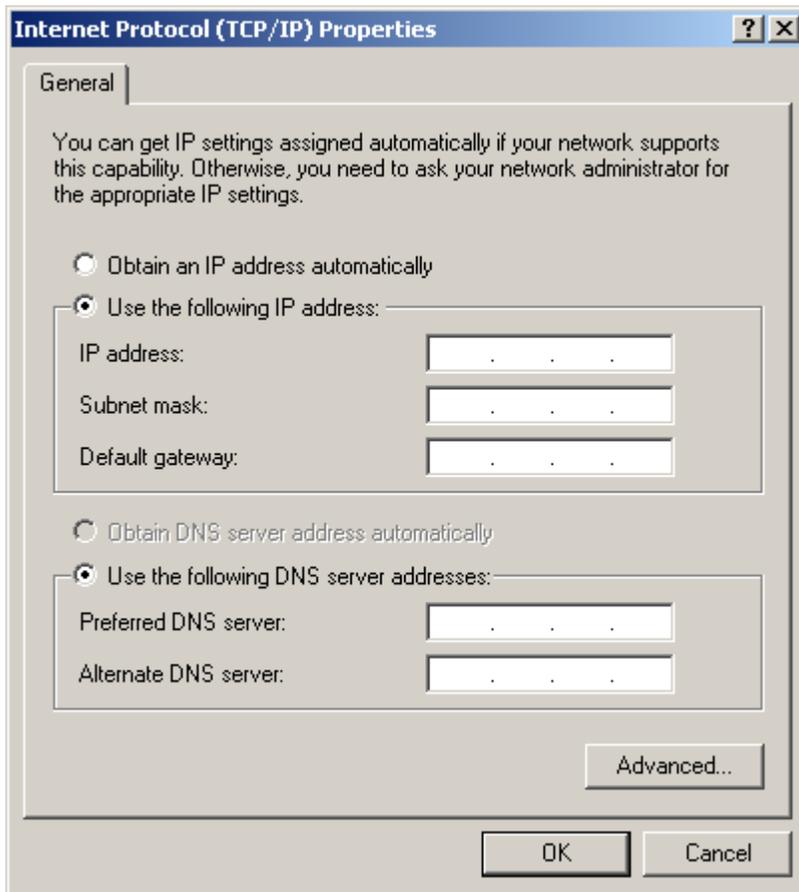
16. Select the 'Use the following IP address option' and specify and IP address, subnet mask, and default gateway that will work with your system. The first three numbers in the IP Address must match the first 3 numbers of the PLC IP Address that you specified previously. E.g., PLC IP Address: xxx.xx.x.yy; PC Address: xxx.xx.x.zz. Click OK when finished.

17. Next, you may need to load the PLC software. You may check the need for this by opening the Entivity Data Pack application. If the Studio Project tab shows a project running as shown below, you will not need to reload the PLC software onto the WinPLC. If a project is running, the Project Name will show R4OPLCB, the Run Status will be 'Running', and the Project Load Status will show 'OK'.
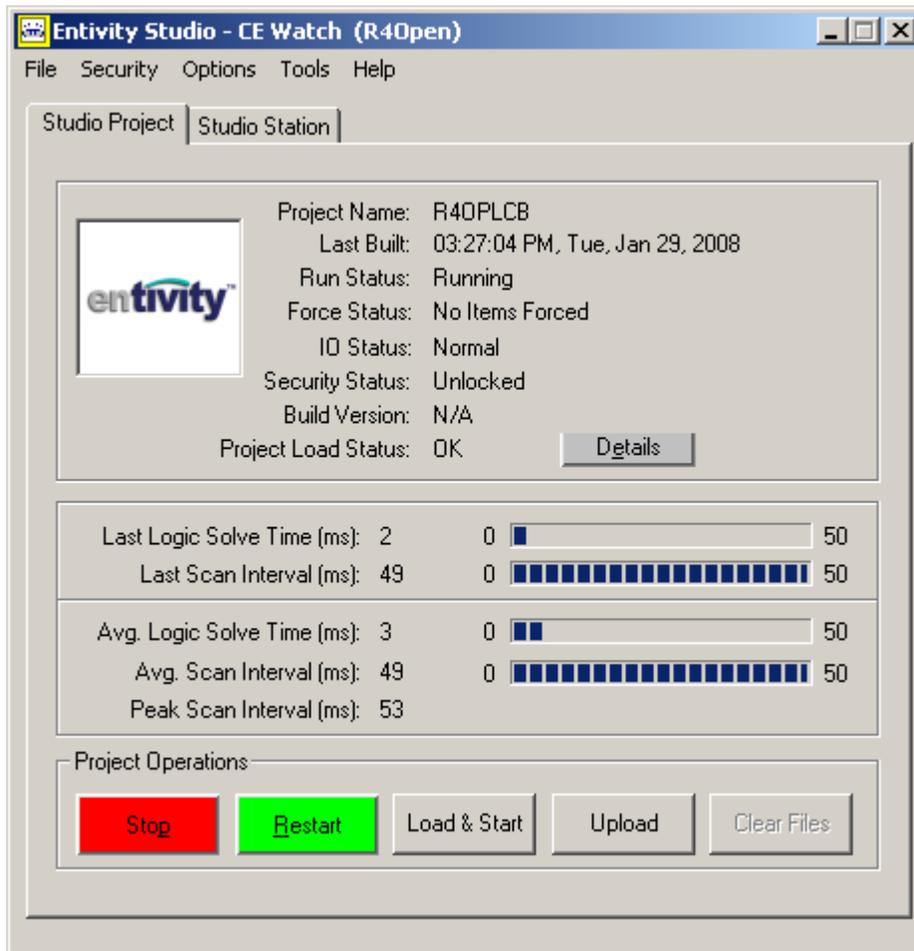
18. If the project is not running, you may click 'Restart' if the 'Restart' button is enabled to restart the program previously loaded on the PLC or you may reload the software from the R4OPLCB disk that shipped with your system.

19. Insert the CD mentioned above into the CD Drive and click the Load & Start button to open up a Windows navigation window. Navigate to the CD Drive, open the main folder on the drive and double click the file displayed in that folder to load it.

20. To restore the PC Software, take the Recortest 4 Hydrostatic Testing Software disk and load it into the CD Drive. The installation will start automatically. If the computer has been re-formatted, then you will need to click Accept to accept the licensing agreement for Crystal Reports and the .NET 2.0 Framework that are installed with the REC4 software. When those pre-requisite applications have completed their installation the following screen will appear.
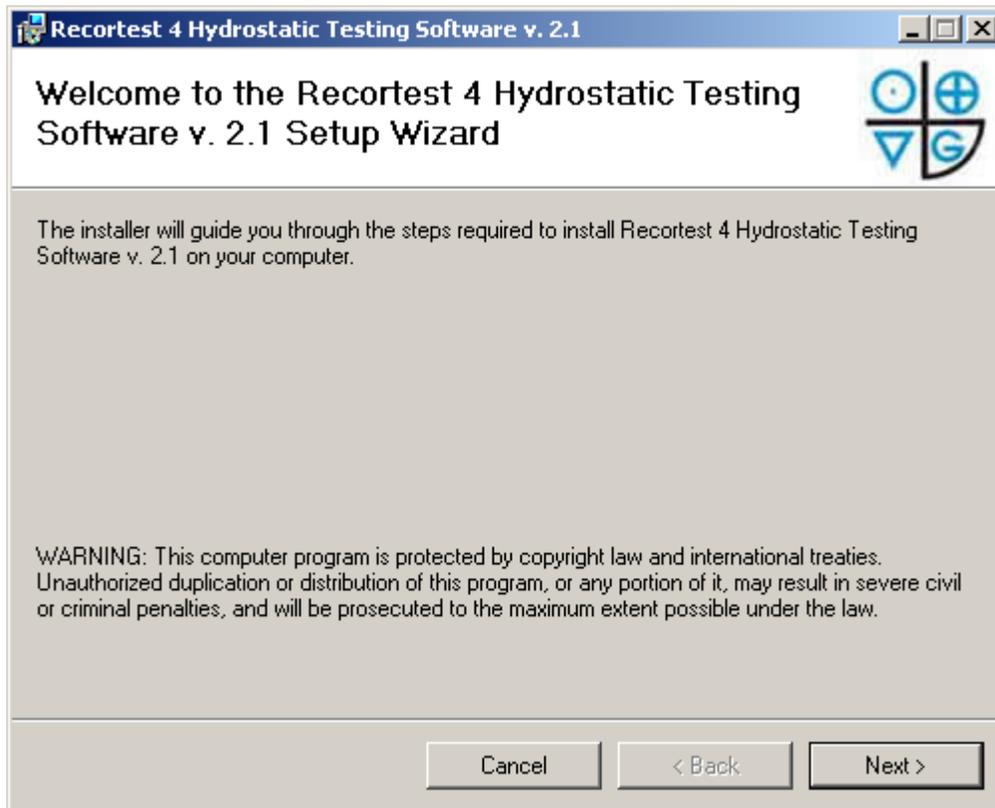
21. Click Next to load the program using the default installation options. You will need to click Next two more times to complete the installation.
22. Open the REC4 Software application by double clicking on the Recortest4 Desktop icon. You will receive a message, "Creating default usernames and passwords" to inform you that any usernames and passwords that the system is restarting with the default usernames and passwords supplied with the software. Log in using the following ID/password combination:

    username: supervisor
    Password: supervisor1

23. When you have successfully logged in you will receive a message informing you that the path to the database has been set as the application installation location by default. After you click OK to that message, the following screen will appear to enable you to configure your system.

Set Up New Recortest 4 System

Recortest 4 System Name

System Name (25 char max): [   ]

Recortest 4 System Tye

○ REC 4 Standard   ○ REC 4 Upgrade   ○ REC 4 Open

PLC Settings	**Jacket Configuration**	**REC4 Test Systems**	**REC4 Standard Options**
WinPLC Name: [ ]	Jacket One ☐	Hydrostatic Test ☐	Steel Jackets ☐
Two WinPLCs ☐	Jacket Two ☐	Cycle Test 1 ☐	Recirc System ☐
2nd WinPLC Name: [ ]	Jacket Three ☐	Cycle Test 2 ☐	Advanced Safety ☐
Customer Specification	Jacket Four ☐	Burst ☐	One RSP ☐
DOT Tester ☐		**Pump Option**	Two RSPs ☐
Manufacturer ☐		RSP-10DA ☐	Full Weight ☐
Manufacturer Name [ ]		RSP-10 ☐	Empty Weight ☐
Galiso Options	**Special Hydro Editions**	Other ☐	Volume Test ☐
Allow Simulation ☐	T-Recirc ☐	R4 Open Auto Press. ☐	Fixed Post Bleed Time ☐
Demo Mode ☐	CTSC-Recirc ☐	**Safety Options**	One Result per Cylinder ☐
Allow REC4 Email ☐		Safety Switches ☐	**Snotrik Valve Setup**
		EMO ☐	No. Snotrik Valves [▾]
		Air Pressure Switch ☐	

Save   Cancel

24. If your system is a Recortest 4 Open, you would fill out the system configuration form like this:

Set Up New Recortest 4 System

Recortest 4 System Name

System Name (25 char max): REC4Open

Recortest 4 System Tye

○ REC 4 Standard   ○ REC 4 Upgrade   ● REC 4 Open

PLC Settings
WinPLC Name: R4Open
Two WinPLCs ☐
2nd WinPLC Name:

Customer Specification
DOT Tester ☑
Manufacturer ☐
Manufacturer Name

Galiso Options
Allow Simulation ☐
Demo Mode ☐
Allow REC4 Email ☑

Jacket Configuration
Jacket One ☑
Jacket Two ☑
Jacket Three ☐
Jacket Four ☐

Special Hydro Editions
T-Recirc ☐
CTSC-Recirc ☐

REC4 Test Systems
Hydrostatic Test ☑
Cycle Test 1 ☐
Cycle Test 2 ☐
Burst ☐
Pump Option
RSP-10DA ☐
RSP-10 ☐
Other ☑
R4 Open Auto Press. ☐
Safety Options
Safety Switches ☐
EMO ☐
Air Pressure Switch ☐

REC4 Standard Options
Steel Jackets ☐
Recirc System ☐
  Advanced Safety ☐
One RSP ☐
Two RSPs ☐
  Full Weight ☐
Empty Weight ☐
Volume Test ☐
Fixed Post Bleed Time ☐
One Result per Cylinder ☐
Snotrik Valve Setup
No. Snotrik Valves 1 ▾

Save   Cancel

25. If you prefer to run a fixed post bleed time, click the Fixed Post Bleed Time checkbox to have the software run a fixed timer after the test prior to taking a result. Click 'Save' to accept the configuration options.
26. You will receive another two messages regarding default settings immediately prior to loading the REC4 Settings portion of the application. Click 'OK' to accept these defaults.
27. The next step is highly recommended to ensure that all data written to the system database is saved and retained reliably. Click on the System Configuration and Settings icon. Click File > Save As to save a backup of the database. Create or select a folder location in which to save the database and change the default database name (REC4_Backup) as needed.
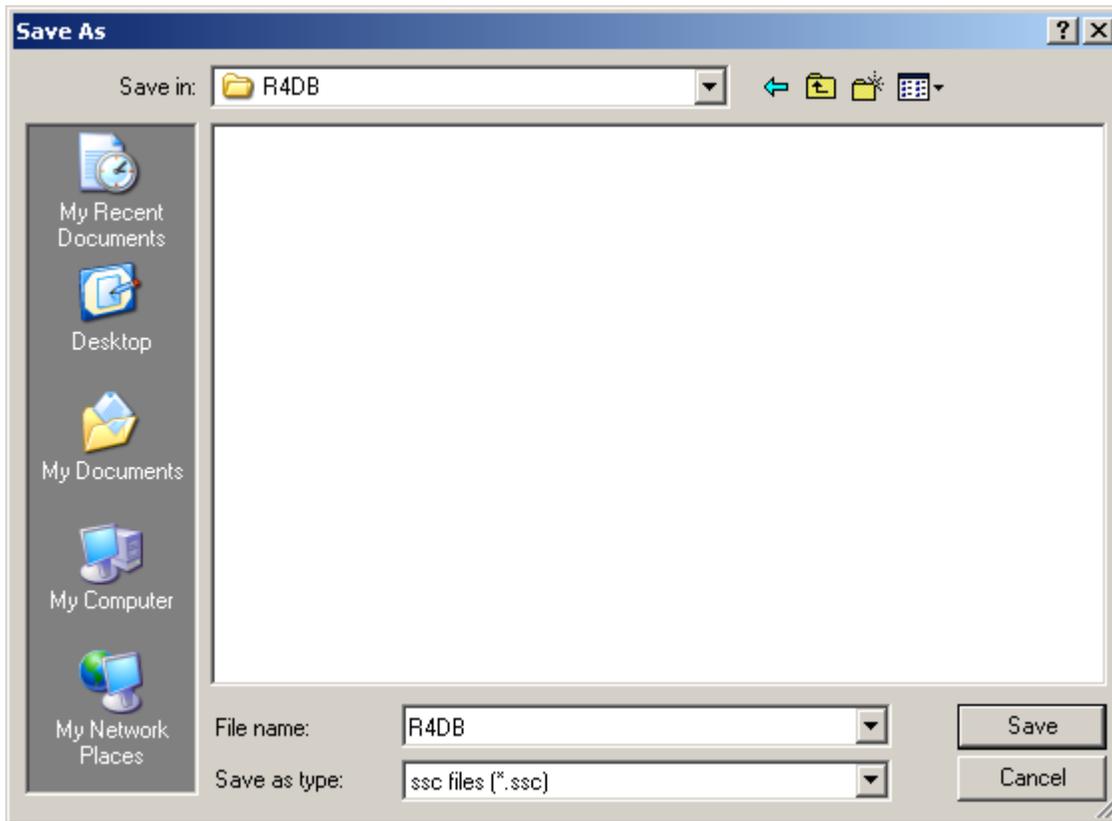
28. Click Reset Database Path on the Set File Paths of the System Configuration and Settings module to direct the software to the database you just created. The Windows dialog box that appears will then open in the same folder where you just saved the database. Click on the file you saved and then click Open. You will see a 'Database Verification' window that will prompt you for a username and password. This username and password simply verifies that the database you have selected is a REC4 database. The correct, case sensitive, username and password combination is as follows:

    Username: galiso
    Password: REC4

29. After clicking OK, you will see that your database path has been reset. You will also see a long message that is primarily relevant if you are resetting the database path to a REC4 database that is being used by other systems. Click 'Yes' to accept the conditions and then click OK on any messages that follow.

30. Close the application and restart it to begin using the REC4 software.

Section 7: RF Bar Code Scanner Procedure

The bar code option is best used when all of the cylinder specific data is entered before the cylinder is physically moved to the hydrostatic testing area. This method facilitates more efficient throughput of cylinders through the hydrostatic testing station. A remote computer can input the data for the cylinder. The bar code printer is then used to print the serial number of the cylinder so the cylinder database can be used to load that information into the test parameters by simply scanning the bar code.
The remote PC must be connected to the cylinder test PC so both PC's can read the same database. The test PC can also be used to input the cylinder information directly into it.

1. Use the <Recortest 4 Remote> program to input all cylinder specific data into the cylinder database from a remote PC. Or, use the <R4 Settings> program to input the data directly into the cylinder testing PC.
2. Use the bar code printer to print a bar code label of the cylinder serial number.
   a) Power on the bar code printer.
   b) Press the <BCODE> button while holding down the <Function> button.
   c) Make sure <Code 128> is selected and press the <ENTER> button. The barcode contains the cylinder serial number and does not permit characters other than 'a-z', '0-9', and '-'. The maximum number of characters is 20.
   d) Input the serial number of the cylinder and press <ENTER>.
   e) Press the <PRINT> button.
   f) Cut the label with the thumb cutter on the top right side of the printer.
3. Place the serial number par code label onto the cylinder. The label must be placed vertically.
4. Scan the label with the scanner gun to input the cylinder testing parameters onto the <Data Entry> screen. The software will recognize the serial number and automatically make the data ready to test that cylinder. If the barcode is not a valid serial number, or the barcode format is not valid, an 'Invalid Serial Number' message will appear at the top of the REC4 test forms.
5. Perform the hydrostatic test on the cylinder.

Section 8 - PLC, Electrical, Air and Water Diagrams:

ITEM	QTY.	PART NO.	DESCRIPTION
1	1	37-11-8262 S	TRANSDUCER, D&D, 10K PSI
2	1	86-11-9192	COMPUTER, DELL, REC4-OPEN
3	1	37-11-8019	SCALE ELECTRONIC, 1200 G
4	3	81-11-0283	VALVE, MICRO, 24V
5	1	81-11-0504	MANIFOLD, SUB BASE
6	1	94-11-0035	PRINTER, HP LAZERJET
7	1	86-11-9199	MONITOR, 17"
8	1	92-11-7087	BARRIER STRIP, 4 POS. DUAL ROW
9	1	86-11-6590	ETHERNET SWITCH, NETGEAR
10	1	86-41-9490	POWER ARRAY BOARD
11	1	86-41-9149	PLC ASSY
11a	1	86-11-9466	SUBBASE, DL205, 4 POS.
11b	1	86-11-9449	MODULE, DL205 H2-WPLC1-LV
11c	1	86-11-9487	MODULE, SERIAL I/O 3 PORT
11d	1	86-11-9454	MODULE, DL205, 8 CHANNEL RELAY OUTPUT
11e	1	86-11-9448	PLASTIC COVER, DL205 "D2-FLL"

*1 TRANDUCER
2 KEY BOARD COMPUTER
*3 SCALE
4 VALVE #1 / VALVE #2 / VALVE #3
5 VALVE STACK
6 PRINTER
7 MONITOR
8 BARRIER STRIP 4 POS.
*9 ETHERNET SWITCH
*10 POWER ARRAY BD.
11 PLC

AIR IN
EXHAUST

BLK / RED / RED / RED
BLK / WHT / GRN / RED

NOTE:
1. * INDICATES POWER SUPPLIED BY POWER ARRAY BOARD ON 220V SYSTEMS.

ELECTRICAL DIAGRAM
REC4 OPEN

TITLE:

DRAWING #: 02-95-0200
REV.: F
BUILD #
AUTHORITY: REC4 OPEN RELEASE
DATE: 02/01/08
BY: DM

DRAWN BY: DON MORTON

SHEET 1 OF 1
EXT. SLDDRW

GALISO
GAS TECHNOLOGIES & SOLUTIONS
MONTROSE, CO
(970) 249-0255 PHONE
(970) 249-0607 FAX

Direct 205
LOGIC

H2-FILL

RELAY
D2-08TR
OUT

H2-SERIO

H2-WPLC1

SCALE

TRANSDUCER

100-240V ~
50-60Hz 40mA
— GND
— LG
+ [ ] —

BRN
BLU
GRY
GRN
RED
BLK

POWER IN

GND LUG
ON CHASSIE

BARRIER STRIP
TERM 4

SCANNER
OPTION

NETGEAR
ETHERNET

BLK CABLE SHIELD
TERM 4
(WHI) TERM 3
(GRN) TERM 2
(RED) TERM 1
(RED) TERM C
TO BARRIER STRIP

GALISO® INCORPORATED

02-91-0200

Legend:
- AIR
- WATER
- HIGH PRESSURE
- AIR PILOT SIGNAL

6 AIR OPERATED VALVE ASSY.

MICRO VALVE ASSY.

3 FILTER/REGULATOR ASSY. AIR

2 FILTER/REGULATOR ASSY. WATER

WATER IN

8 PUMP ASSY.

1 AIR TANK ASSY.

AIR IN

DRAIN TO TEST PIT

9 BOWL/SCALE ASSY.

10 EXP/DRAIN VALVE ASSY.

TEST JACKET

ITEM	QTY	PART NO.	DESCRIPTION
1	1	57-00-3004	TANK, AIR HORZ. 20 GAL.
2	1	02-41-0123A	FILTER/REGULATOR ASSY. WATER
2a	1	36-41-0090	GAUGE, 0-60 PSI, BACK CONNECT
2b	1	37-11-3055	REGULATOR, WATER 3-50 PSI 1/2"
2c	1	81-11-0009	VALVE, BALL 1/2"
2d	1	80-754-008	FILTER HOUSING WITH 3/4"
3	1	02-41-0223A	FILTER/REGULATOR ASSY. AIR
3a	1	80-01-0029	LUBRICATOR, AIR
3b	1	81-11-1204	VALVE, FLOW CONT. W/CHECK
3c	1	81-11-1403	VALVE, AIR OPERATED, BRASS
3d	1	81-11-0009	VALVE, BALL 1/2"
3e	1	37-11-3076	REGULATOR, 1/2"
3f	1	80-01-0066	FILTER, AIR 1/2"
3g	1	37-11-3058	REGULATOR, MINI 1/4"
3h	1	83-31-0047	VALVE, SAFETY 1/4"NPT 125PSI
3i	1	83-31-0047	VALVE, RELIEF 1/4"NPT 125PSI
3j	1	81-11-1203	VALVE, SLOW PUMP, 1/4" MINIBALL
4	3	81-11-0904	VALVE, MICRO, 24V / MANIFOLD, SUB BASE
5	1	02-41-0124A	AIR OPERATED VALVE ASSY.
6	1	37-11-2525	TRANSDUCER DXD, 40KPSI
7	1	81-11-307B	PUMP ASSY.
8	1	02-41-0121A	PUMP, WATER, 14KPSI PNEUMATIC
8a	1	81-11-1403	VALVE, AIR OPERATED
8b	1	01-31-8866A	VALVE, AIR OPERATED, BRASS
8c	1		CHECK VALVE
9	1	83-11-5011	SCALE, ELECTRONIC 1200 GRAM
10	1	37-11-3079	VALVE, BALL 3 WAY, 3/8"
	1	81-11-0288	

GALISO®
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MONTROSE, CO
(970) 249-0233 PHONE
(970) 249-0607 FAX

TITLE: WATER & AIR SCHEMATIC
REC4-OPEN

DESIGN BY: DON MORTON   DATE: 02/06/08

DRAWING #: 02-91-0200   REV. D   BUILD F

EXT. SLDDRW   SHEET 1 OF 1

Section 9 - Spare Parts list:
REC4/Open - 02-51-0296

Part Number	Description
01-41-1982	Cable, PLC-DXD
01-41-1983	Cable, Scale
01-41-1984	Cable,PLC-Valve
02-31-0114G	Expansion Cover Rec Open
09-76-0006	Weigh Bowl, 1000 ml
36-11-0010	Gauge, 0-60, 1/4"NPT
36-11-0508	2" Gauge, 160#,
36-11-0523	Gauge, 2", 160#, 1/8" BkCn,
37-11-3055	Regulator, Water, 3-50 psi, 1/2" NPT
37-11-3058	Regulator, Mini, 1/4"
37-11-3076	Regulator, 1/2", w/ panel mount and bracket
37-11-8019	Scale, Electronic, 1200 Gram Capacity
37-11-8252S	Transducer, Serial, DXD, 10,000 psi .1% Acc., Switchcraft
37-11-8255	Accessory Kit, RS232, DXD Transducer
38-11-3078	Pump, Water, Pneumatic, 14,000 psi
.38-11-3028	Pilot Valve Assembly
.38-11-3084	Repair Kit for Pump AZ-1-140CF
.38-11-5526	Piston, Air
.38-11-5528	Cylinder, Air, 11-5004A000
.38-11-5565	Spring Cage, Inlet for Hydraulic Head
.40-11-3033	Seal Kit, Pump Piston for AZ-1-140CF
.40-87-6429	FT, O-Ring, 70 Shore Buna N, 2-429
54-11-0003	Oil, non-detergent, 10 Weight, 1qt
.83-11-5009	Valve, Check, Inlet, 30,000 psi
.83-11-5010	Check Valve, Check, Outlet, 30,000 psi
57-00-3004	Tank, Air, Horizontal, 20 Gal. ASME
73-38-0673C	Ferrule, 1/4", SST CPI
73-38-0688C	Nut, 1/4", SST, CPI
73-51-0677C	Ferrule, 1/2", CPI
73-51-0691C	Nut, 1/2", Brass, CPI
80-11-0108	Air Moisture Filter, 1/2", Auto-Drain, 150 psi max
80-11-0110	Filter element, AF40 SMC
80-11-4009	Water Filter Element, 5 micron (main system water filter)
80-11-4029	Lubricator, 1/2", SMC
80-11-7001	Muffler, 3/4"NPT,
80-75-4008	Housing, Filter, Keystone
81-11-0009	Valve, Ball, 1/2" NPT, Parker
81-11-0130	Valve, Air Operated: 10,000 psi, SnoTrik
.81-41-0263	Repair Kit, Sno-Trik Valve
..81-11-0131	Stem, Valve, SnoTrik
..81-11-0132	Seal, Stem, SnoTrik
..81-11-0133	Seat, Replaceable, SnoTrik
81-11-0210	Valve, Herion, 1/2", 3-Way, Air Pilot
81-11-0283	Valve, Micro, MZH-5/2-1.5-L-LED 24V
81-11-0288	Valve, Ball, 3-Way, 3/8", Whitey
81-11-0504	Manifold, Sub Base, PRMZ-5-M5-3
81-11-1201	Valve, Drain Cock, 1/4" NPT Brass
81-11-1203	Valve, Slow Pump, 1/4" Mini Ball
81-11-1204	Valve, Flow Control w/Check, 1/4" NPTF, 5GPM, 2KPSI
81-11-1403	Valve, Air Operated, 1/2 NPT, Brass
83-11-0031	Valve, Check, 1/4"

83-11-0047	Valve, Safety, 1/4" - 125 psi
83-11-2503	Relief Valve, 1/4" NPT, 175 psi
83-11-5011	Valve, Check, 10,000 psi, 1/4" NPT, SST
86-11-6583	Mouse Pad, Rec4
86-11-6584	USB Powered Speakers System,3W
86-11-6590	Switch, 5 Port Workgroup SW, Netgear
86-11-9192	Computer, Dell, Rec 4-Open
86-11-9199	Monitor, 17" Flat Panel, Dell
86-42-9149	PLC Assy, Rec4 Open
86-11-9449	Module, DL205, Window CE, "H2-WPLC1-LV"
86-11-9454	Module, DL205, 8-Channel Relay Output, "D2-08TR"
86-11-9466	Subbase, DL205, 4-Position, 85-264VAC-50-60Hz, "D2-04B"
86-11-9487	Module, Serial I/O, RS-232, 3 Port H2-SERIO
86-41-8161	C Sharp REC4 Software
86-41-8200	PLC App, REC4/Open
86-41-9204	REC4, Entivity Data Pack
86-41-9490	Regulator Array Board, Assembly
93-11-1064	UPS, 400VA, 220V 50/60 Hz, IEC320 P/R

MGA 01-43-1113C

36-11-2500	Gauge, 0-11000 psi, 6"D
69-38-0007	Coupler, QC, 1/4"NPT Female, Stainless Steel
69-38-0014	Nipple, QC, 1/4" NPT Male, Stainless Steel
74-33-7161	Tee,Female,1/4" Service
76-33-7261	Nipple, Hex, 1/4", 1.87"L, SST
69-41-0022	Coupler Seal, 2 Part, Teflon-Buna

12" Stainless Jacket 01-41-3247

01-31-3100B	Cover, 12" Dia. Jacket, w/Logo
01-41-3235	6" Burst Disk Assembly with Gasket
.01-32-2493B	Burst Disk Etched, 6", w/Labels
.01-32-2510B	Gasket, Burst Disk, 6" Diameter
01-32-3035B	Plate, Burst Disk, SST
(01-11-2964)	Hose - 250 psi, 36"L, 3/8" NPT
41-11-3009	Hose, 10,000 psi, 36"L
69-38-0007	Coupler, QC, 1/4"NPT Female, Stainless Steel
69-41-0022	Coupler Seal, 2 Part, Teflon-Buna
69-51-0047	Socket, QC, 3/8" FPT, Hansen
69-83-0048	Nipple, Quick Connect, Male, 3/8", Zinc
74-33-6420	Bushing, Hex, 1/4" x 1/8", SST,
81-11-0001	Ball Valve, 1"NPT, Parker
83-11-0047	Valve, Safety, 1/4" - 125 psi

12" G-Style SST Head 01-54-4618

01-41-2840

.01-32-2520A	Diaphragm, GTH, G & H
.40-87-6118	FT, O-Ring, 70 Shore Buna N, 2-118
.54-99-7001	Compound, Duct Sealing,
01-32-2534	Speed Seal, 3/4"
01-32-2535B	Washer, Spud, 3/4"

01-32-2545	Nut, Protector, Brass
01-32-2752A	Spring, Pressurization Adapter
01-32-2824F	Spud, G-Style QC, GTS-750-G
01-32-2829D	Sleeve, Coupling, G Head
01-32-4611B	Backing, Plate, Heads, SST
01-32-4613B	Spanner, Ring, Heads, SST
01-33-4531M	Head Boot, Hydraclose, 12"
01-41-2819C	Spud Protector, 3/4", Steel, GHH
01-41-4660B	Spud Plate, G Style, Weldment, SST
01-41-4690	Pressurization Adap/Spud Stem
.01-31-4691D	Spud, Stem, G & H Style
.01-32-2843K	Test Pressurization Adapter, G & H
.73-32-0001	Collar, 3/8" O.D. Tubing
.73-32-0002	Gland, 3/8" O.D. Tubing
69-38-0076	Nipple, QC, 1/4" NPT Female
69-83-0048	Nipple, QC, Male, 3/8", Zinc
92-11-0003	Plug, Blow Out, 3/4", Black
01-32-2635D	Adapter, ¾" NPT, ¾" NPT
62-33-6862	Nut, Jam, 3/8"-24, SST

1/2 Ton Hoist 47-11-0002

47-11-0028	Grease Kit, JDNeuhaus, 250 ml, 1600 Hours of Use
47-11-0029	Trolley, for Mini 500/1000
47-11-0039	Maintenance Unit, ½", Filter/Regulator/Lubricator

Opti-Lite 85-11-0055

85-11-0028	Bulb, Halogen, Opti-Lite, MR16 Quartz
85-11-0087	Lamp Base Support
85-11-0091	Receptacle, Fiber, Opti-Lite
85-11-0092	Knob, Knurled, Opti-Lite
85-11-0093	Foot for Opti-Lite
85-11-0094	Knob, Control, Opti-Lite,
85-11-0098	Opti-Lite Strain Relief,Heyco,1/2" Hole
85-11-0101	Holder, Fuse, Opti-Lite
85-11-0102	Switch, Light Dimmer, Opti-Lite
85-11-0113	Button, Fuse Holder, Opti-Lite
85-11-0117	Ceramic Bulb Connector, Opti-Lite
85-11-0119	Circuit Breaker, 3 Amp, Opti-Lite
85-11-0066	Light Guide, 1/8 x 5, Hypo Tube End, w/Sil. cover

Black Light Assembly 85-41-0074

85-11-0072	Longwave Pencil Lamp (Black Lite)
93-11-1072	Power Supply, 100v-240v
39-11-0035	Safety Glasses, w/UV (100%)

Belt Vise 47-11-1000

47-11-1007	Belt, Vise, Standard
	Backpad, Belt Vise

RCSG 01-51-2335

01-51-1972	Nozzle Assembly, RCSG
37-11-3072	Regulator, Flow, 25 psi
04-51-0023	Fitting, Garden Hose, Male x 3/8
41-11-2522	Hose, 250 psi, Red or Blue, 120"L

Bar Code Reader 86-41-9250

86-11-9250	PSC PowerScan RF Base Station
86-11-9251	PSC PowerScan RF Barcode Scanner

GCD4, SST 25-51-3186

25-41-3015	Thermostat Control, GCD
25-41-3185	Blwr/Fltr/Htr Assy,GCD-4,220V,SST
25-41-3188	Blower/Filter Assembly, GCD-4, 220
.46-11-5013	Blower w/RFI Filter, 2HP 220V
..46-11-5028	Motor Brushes, Pair, for 46-11-5012, 5013
..46-11-5029	Housing, Top, for 46-11-5012,5013
..46-11-5030	Housing, Bottom for 46-11-5012,5013
..46-11-5031	Foam Insert, Ultra 2000
88-11-0012	Fuse, 1 Amp
01-31-8010	GCD Option, dryer probe assembly for large cylinder

Stamp Sets

68-11-0242	Stamp, ¼" Number Set, Low Stress
Special	Stamp Set, Low Stress, 1/8" character, alpha/numeric
68-11-0235	Stamp Holder

Misc Inspection tools

85-11-0077	Optical Plus neck thread inspection tool
Special	10X Magnifying Lens

Galiso Product Warranty

1. DURATION: Galiso provides a one-year warranty from date of purchase, to the original purchaser, for standard products, unless otherwise specified. For all spare parts purchases, Galiso provides a 90-day warranty unless otherwise specified. Soft goods such as our speed seals and O-rings, which are Subject to wear in the normal course of operation, are not covered under this warranty.

2. COVERAGE: Galiso manufactured equipment is warranted against defective materials or workmanship.
 THIS WARRANTY IS VOID IF:

     A) THE EQUIPMENT HAS BEEN DAMAGED BY ACCIDENT OR UNREASONABLE USE, IMPROPER SERVICE/MAINTENANCE, IMPROPER INSTALLTION,ABNORMAL OPERATING CONDITIONS,NEGLECT, REPAIR BY ANY PERSON NOT AUTHORIZED BY GALISO, INC. OR OTHER CAUSE NOT RELATED TO MATERIAL DEFECTS OR WORKMANSHIP.

     B) THE SERIAL NUMBER HAS BEEN ALTERED OR DEFACED.

3. PERFORMANCE: Galiso reserves the right to make the warranty determination only after inspecting the item at the Galiso manufacturing facility. If the warranty determination indicates that the defective item is covered under warranty, the item will be repaired or replaced with same parts/items, or parts/item of equivalent quality, at the option of Galiso. If warranty replacement is necessary, the replacement unit will continue under the original equipment warranty or carry a 90-day warranty whichever is longer. No charge will be made for warranty repairs, and/or replacement. All freight is the responsibility of the customer requesting warranty service.

4. CLAIMS: In the case of equipment malfunction, notify Galiso (1-800-854-3789) and provide the Model Name, Model Number, Serial Number and a description of the problem. A Return Authorization number will be issued.

5. SERVICE EQUIPMENT: Galiso attempts to make available, whenever possible, a limited amount of service Equipment at a minimal use charge, plus freight expense, for those customers wishing to avoid downtime during repair of their equipment. Such items are available on a first come, first served basis and are billable at the specific service charge applying with a one-month minimum.

6. MODEL CHANGES: Galiso reserves the right to make changes in materials and specifications, without notice. Galiso may offer, for a stipulated fee, the opportunity to upgrade your equipment to the latest configuration.

7. DISCLAIMERS: Galiso provides technical data assistance to aid customers in the selection and use of our products. There are no implied warranties of merchantability nor suitability for a particular purpose associated with the transmittal of technical data and/or customer assistance.

Galiso does not assume liability for any consequential or special damages. Liability under this warranty is limited to repairing, or replacing Galiso equipment items returned to the factory or an authorized facility.

8. PC VIRUS PROTECTION: For Systems with Internet access, Galiso equips the PC with competitive virus protection software. Current virus subscriptions are mandatory, and are the responsibility of the equipment owner. Periodic updating may be required. Galiso does not assume liability for damages incurred due to any internet or network attacks.