

!!!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**

Recortest III to Rec4 Upgrade to Windows
Water Jacket Cylinder Testing System



Galiso Incorporated
22 Ponderosa Ct.
Montrose, CO 81401
800-854-3789
970-249-0233

Table of Contents

<u>Figure</u>	<u>Description</u>
1	Login window
2	REC 4 Settings menu tab options
3	Error Messaging System; REC4 Contact Information Screen
4	Edit Error Database
5	Rec 4 Settings navigation
6	Add New Calibration Cylinder
7	Calibration cylinder test parameters
8	Edit Calibration Cylinder
9	Delete Calibration cylinder
10	Serial Number Entry
10-B	Multiport Test Head Entry
11	'Customer' Entry
12	'Manufacturer' entry
13	Cylinder code entry
14	Test Water Pressure Units Of Measure
15	Gas Service Entry
16	Visual Eddy Reference Ring Number Entry
17	System Configuration and Filepaths Screen
18	System Configuration Window
19	User Information
20	User log
21	Your Company Information
22	Calibration Screen
23	Data Entry Screen
24	Cylinder Serial Number Entry, Add/Edit Cylinders Window
25	Cylinder Properties
26	Command Line; Jacket Status; Retest Options; Test Status
27	Test Results Screen
28	Create Report Function
29	Report Form
30	Export Report Save Option
31	Graph Screen
32	Graph Pressure Bleed
33	Diagram Screen
34	Fail Visual Screen

Introduction:

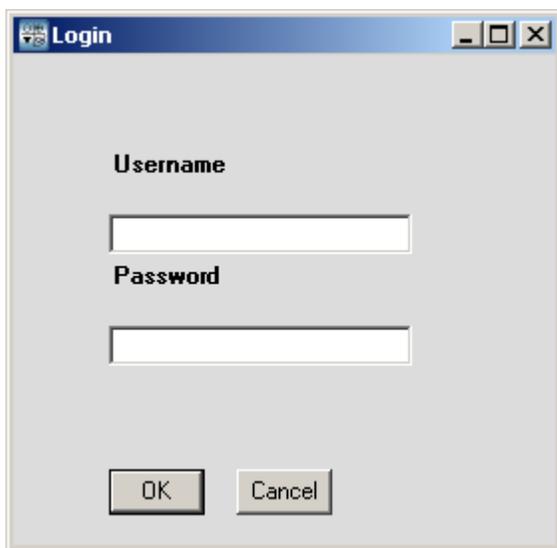
This manual is for the operator to read and study before using the Galiso model Rec4 Steel Jacket System. Galiso updates the manual with software updates, but there may be subtle differences between your software and this manual. In all cases, it is easy to learn by using the software.

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.

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.
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.

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.

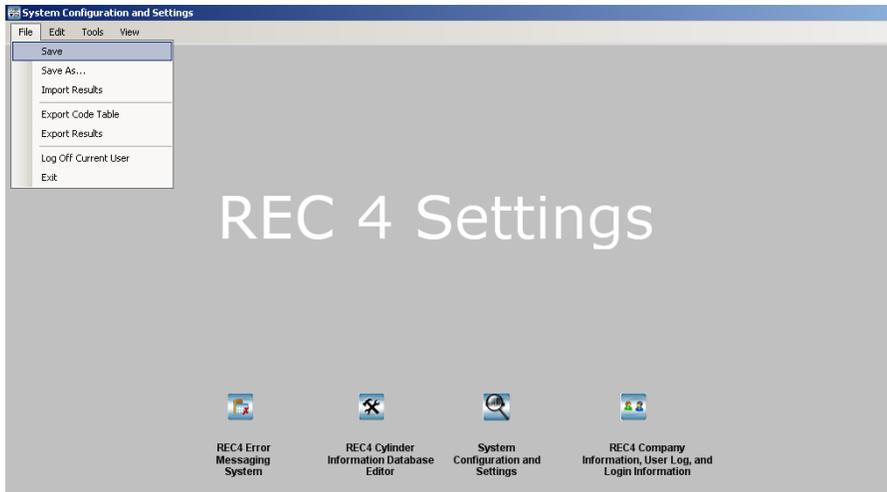
Username: galiso

Password: REC4

*** NOTE ***

Filling out text boxes: After entering information into a text box, you must either click into another text field, or hit the <Tab> button on the keyboard. Otherwise, the information will not be entered.

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....

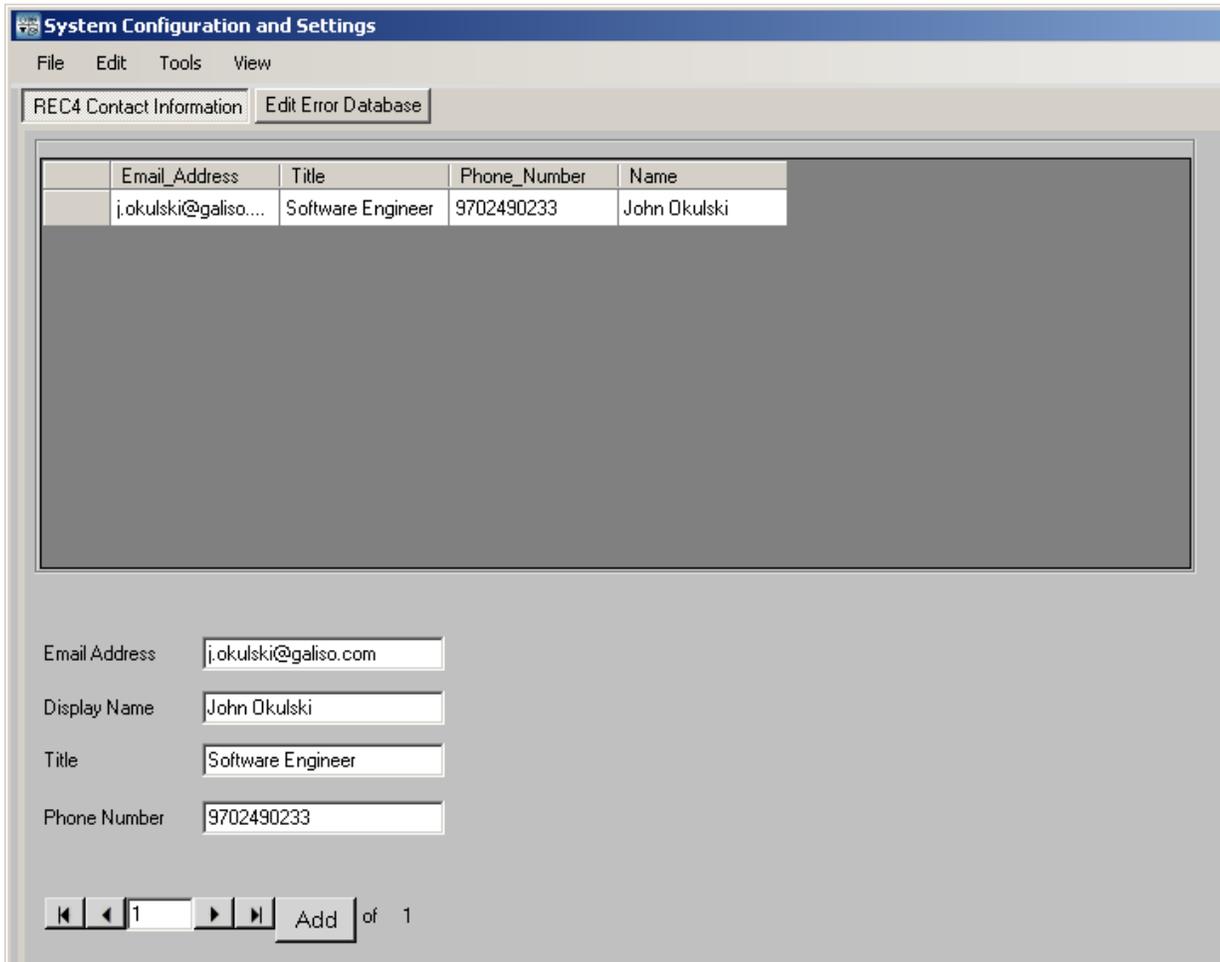
The <Save As> function enables you to **back-up** the same database set to another file location on your network. Please back-up the database when changes are made.

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. <Log Off Current User>: This is another location where you can simply log out of the test program.
6. <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>.

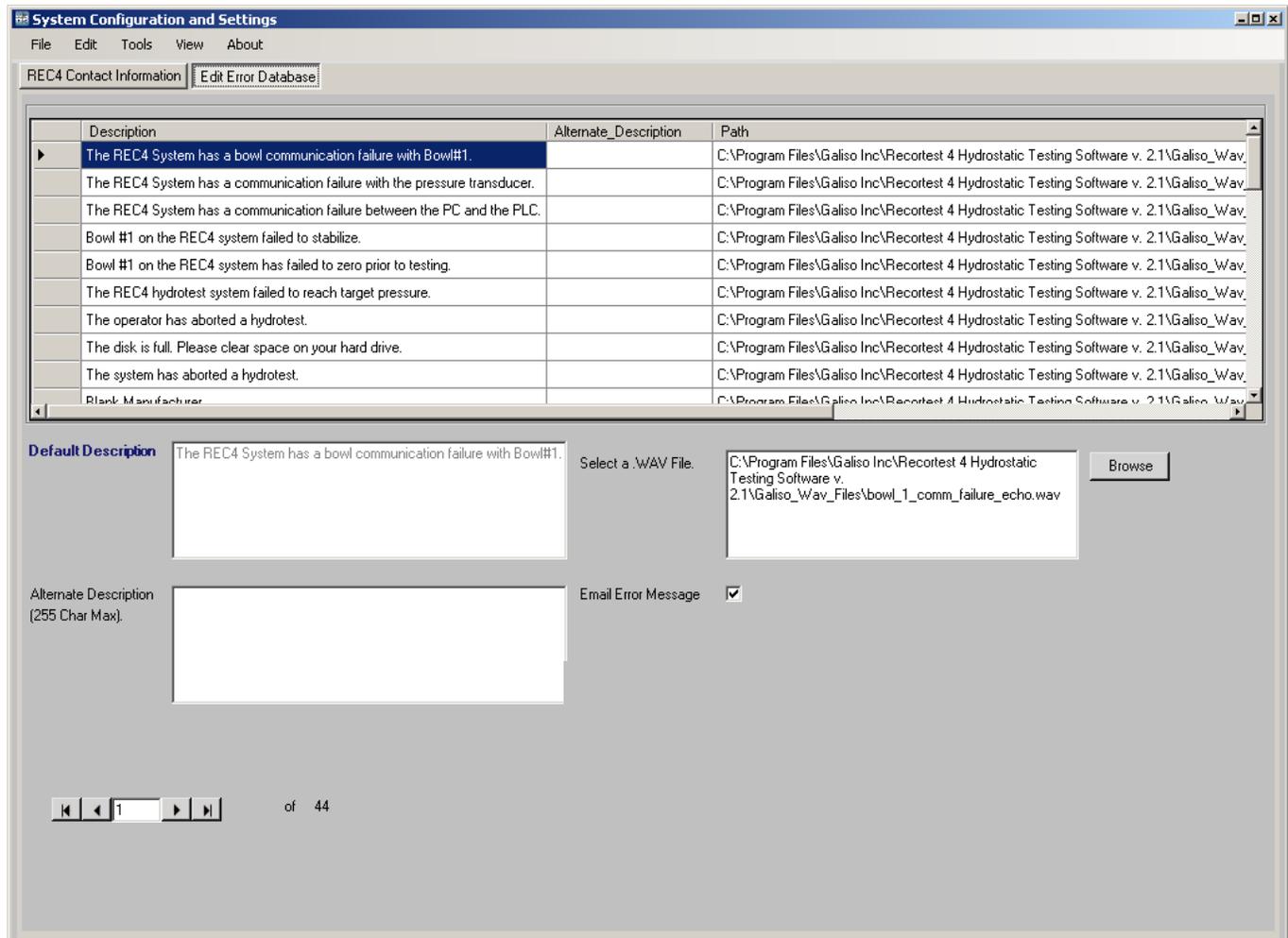
To delete a stored item, click <Edit> <Delete A Record>. Test results cannot be deleted.

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



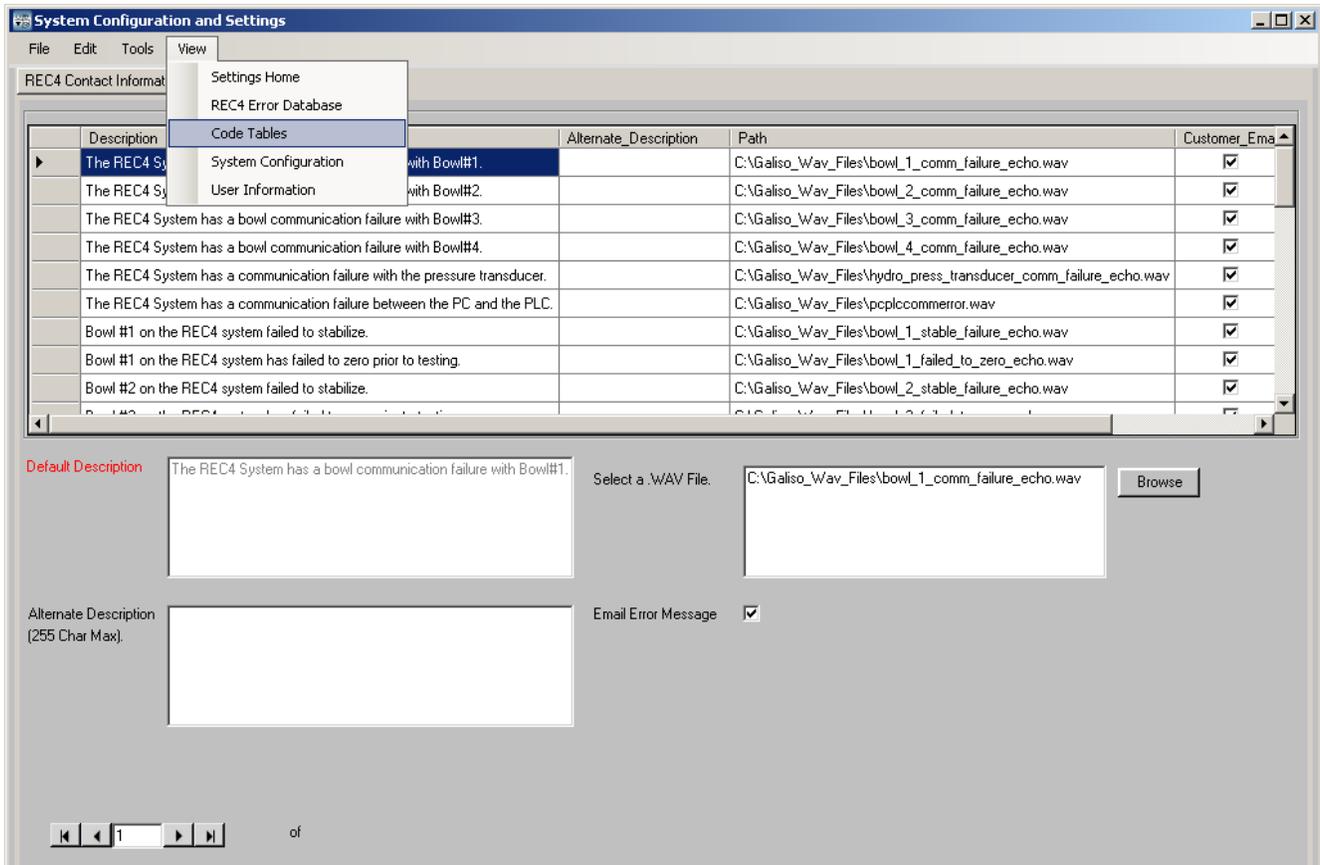
This screen contains the error database list. The default description cannot be changed. However, you can input an alternate description in text. This will appear in a red lettered text error message on screen upon the event of the error.

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.

Galiso automatically receives e-mails from errors of interest.

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

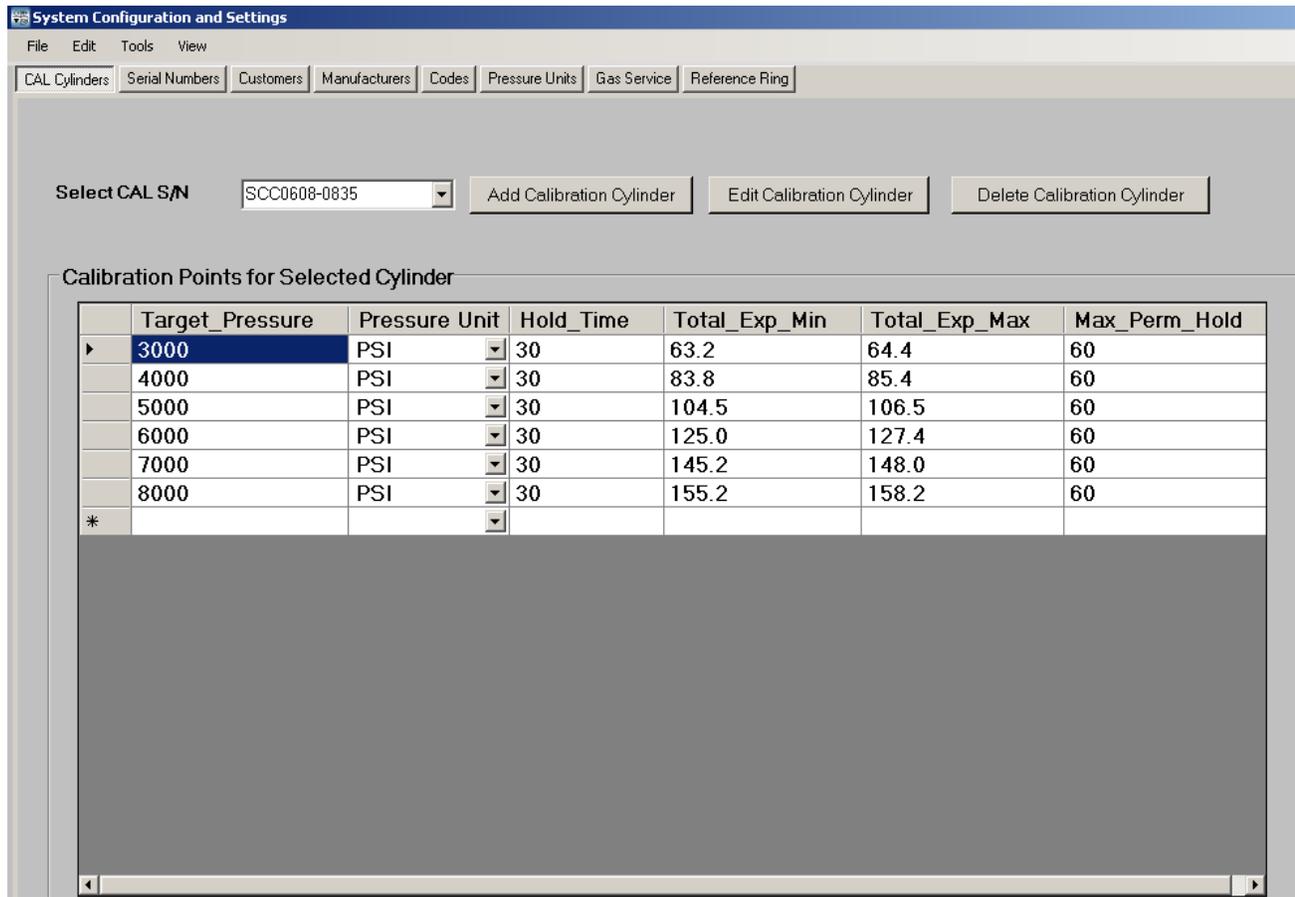
The screenshot shows a software window titled "Add New Calibration Cylinder". Inside the window, there is a section titled "Enter Calibration Cylinder Data". This section contains four input fields: "Cylinder S/N" with the value "SCC0608-0836", "Owner" with "Galiso", "Manufacturer" with "MCS", and "Select CAL Jacket" which is a dropdown menu currently showing "Jacket #1". Below these fields is a "Save" button.

Use the <Add 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



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

Add New Calibration Cylinder

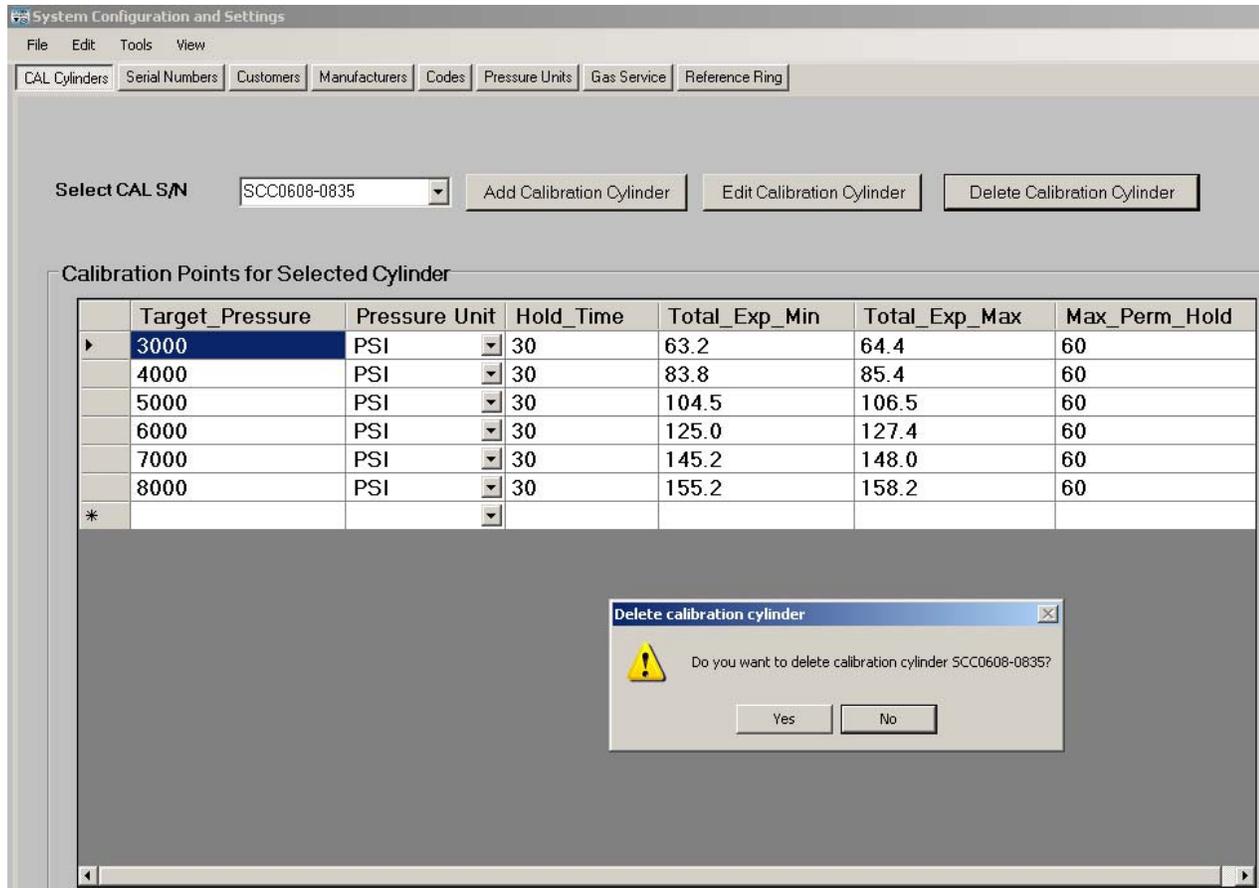
Enter Calibration Cylinder Data

Cylinder S/N	SCC0608-0836
Owner	Galiso
Manufacturer	MCS
Select CAL Jacket	

Save Cancel

The cal cylinder data shown above can be edited by clicking the <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.

You can also record the 'Eddy Current' test result for the cylinder here.

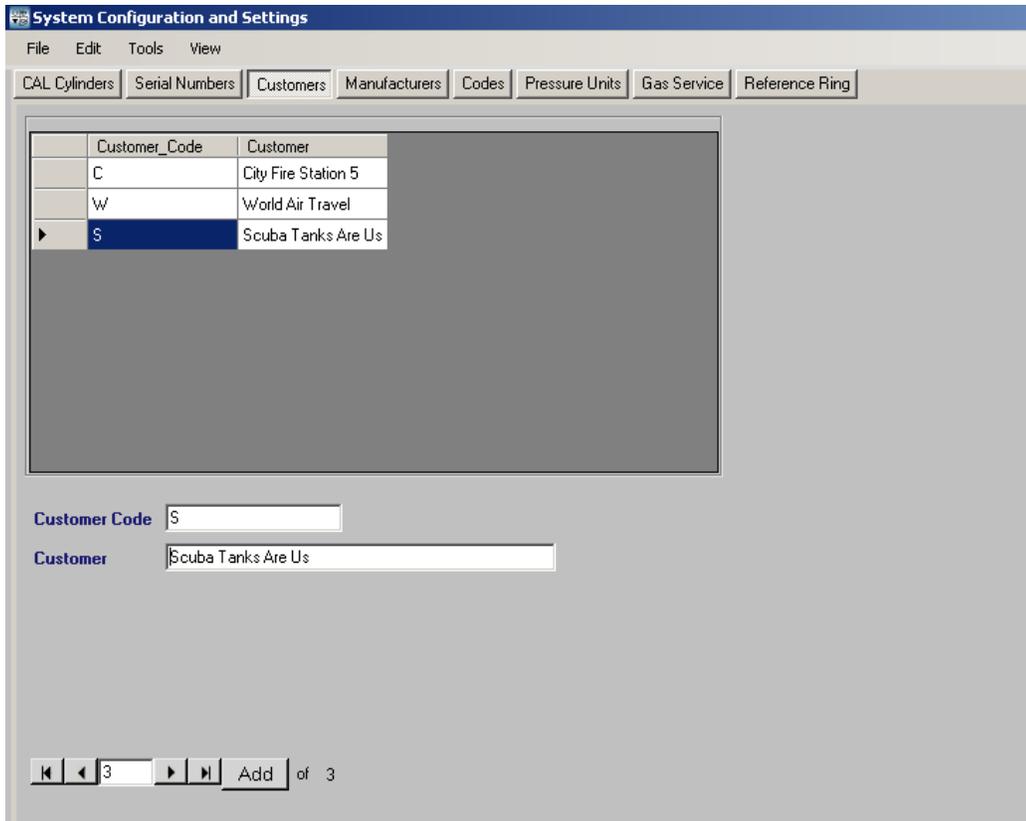
If you allow the 'Plus/Star' test, then the software will give you a pass or fail for those too.

Fig 10-B: Multiport Test Head

This screen is for use with the galiso multi-port test head. The head will load 4 medical aluminums or equivalent sizes at one time. Then you simply switch the hose from one cylinder to the next between tests. Test all 4, then reload another 4 cylinders. You can also test 2 jackets at the same time to test 8 cylinders with 4 pressurizations. This is faster when using the multiport heads. Alternating jackets is faster when testing with a standard single cylinder test head.

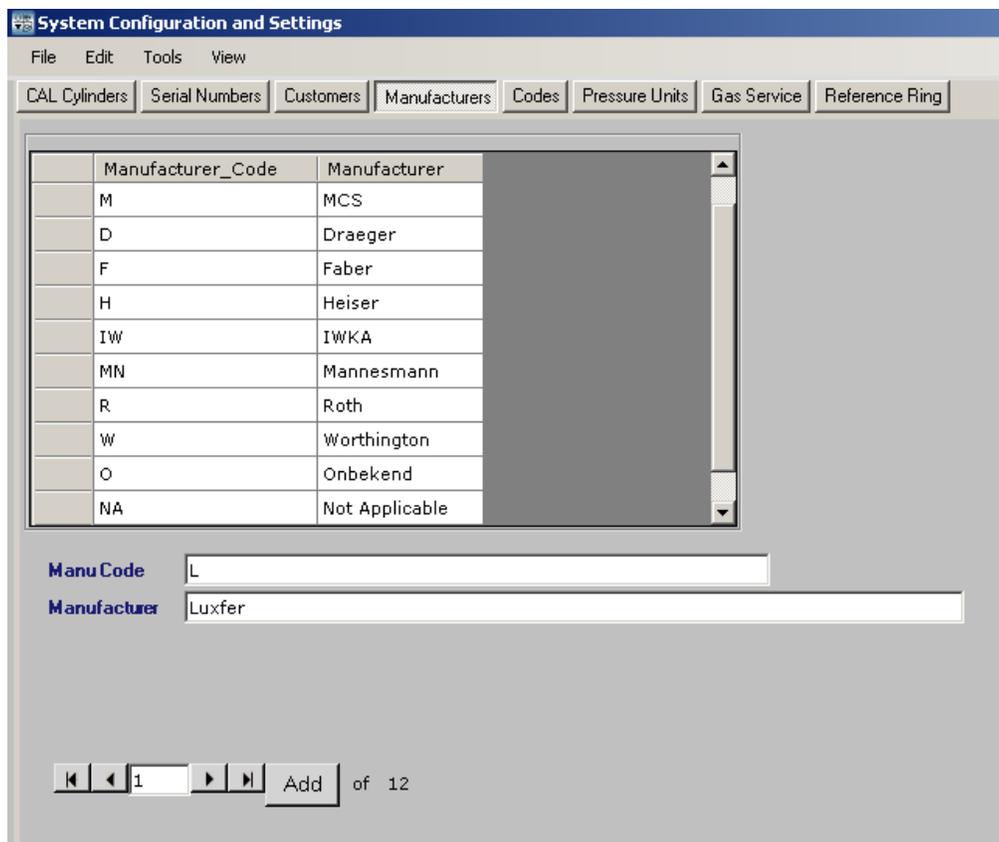
You can create groups by pre-entering the cylinder info for each cylinder, and keeping them in order to place on the test head in the correct position. You can also mark each cylinder for the corresponding jacket and test head position.

Fig 11: 'Customer' Entry



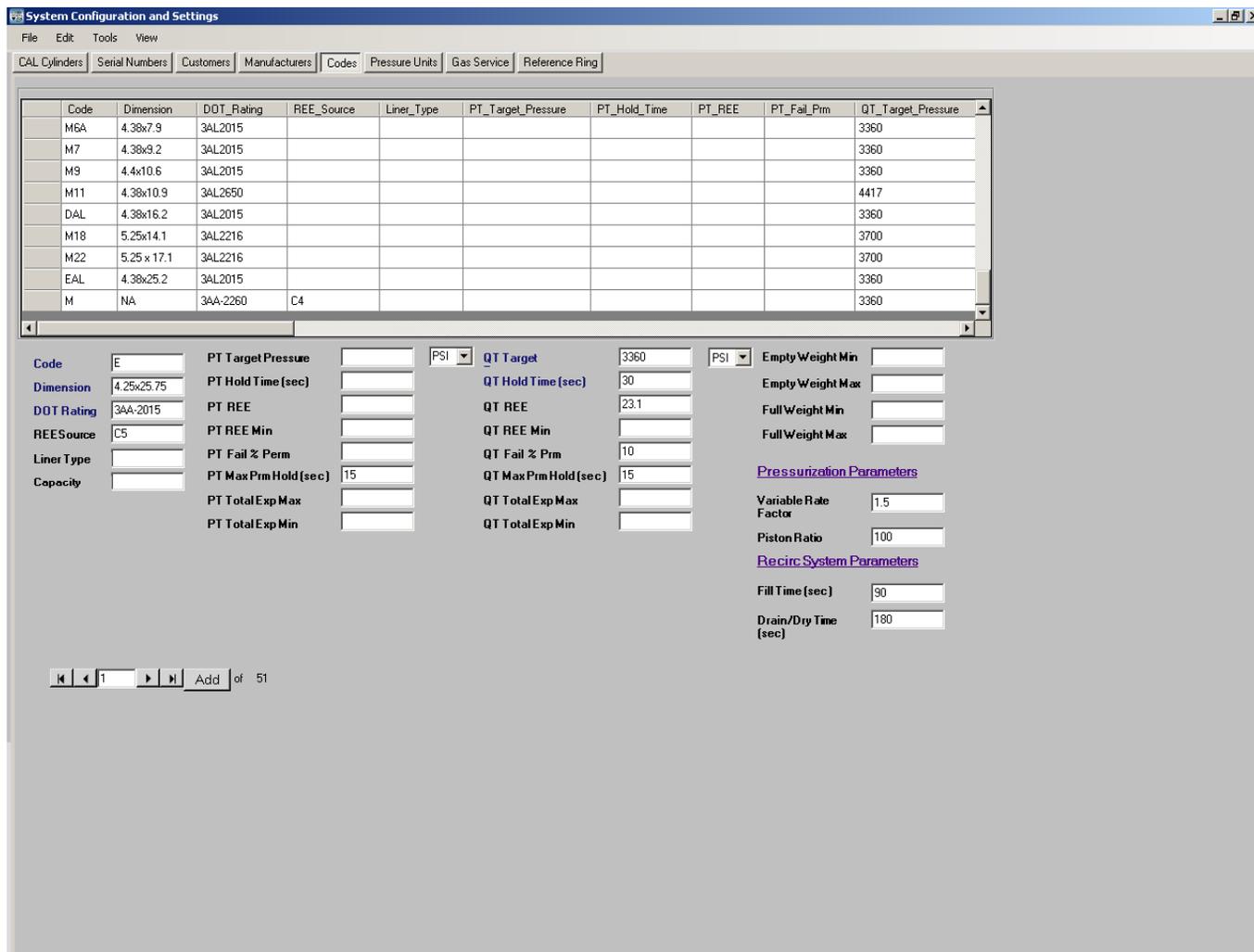
A short 'code' can be created for easy test data entry of all your customers. Enter the short code and the program enters that customer in the <Customers> field on the test screen.

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

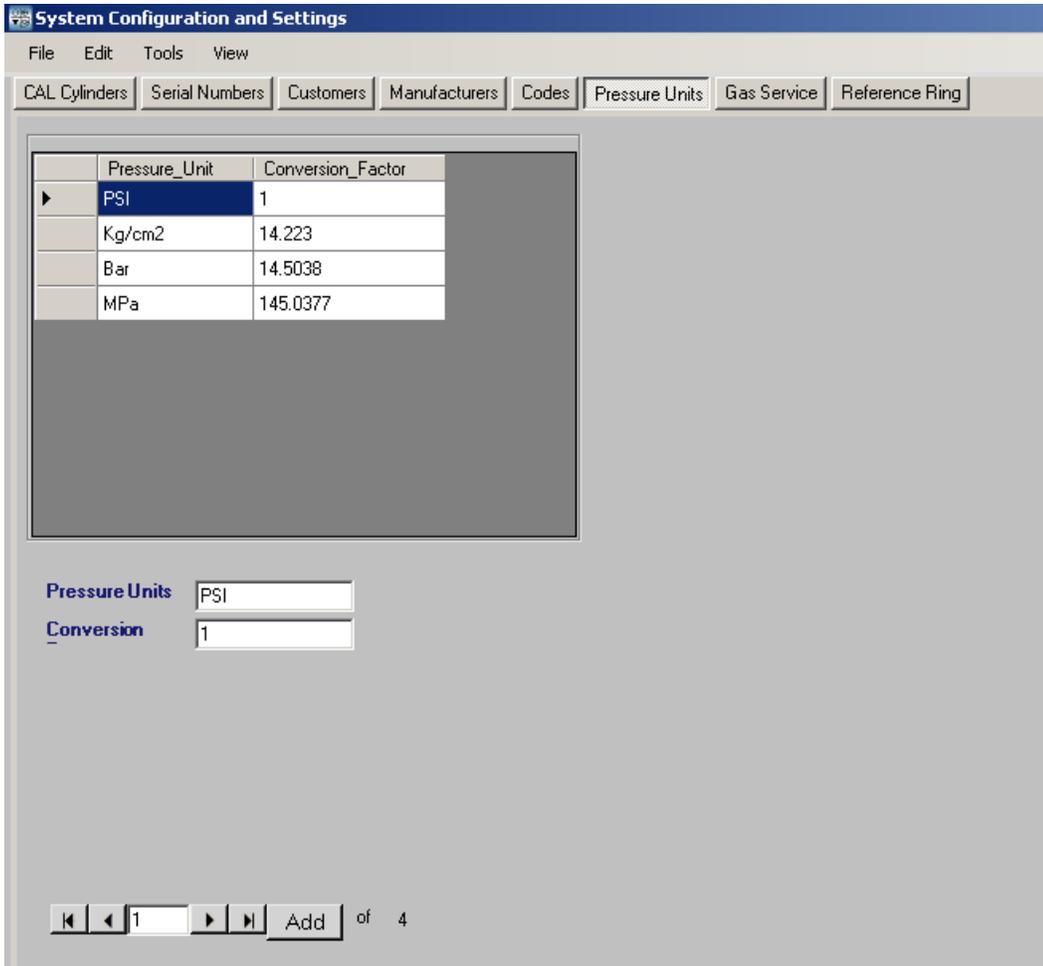


A short code can be created for easy test data entry of all cylinder types. Enter the short code and the program enters that cylinder type in the <Cylinder Codes> field on the test screen.

'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.

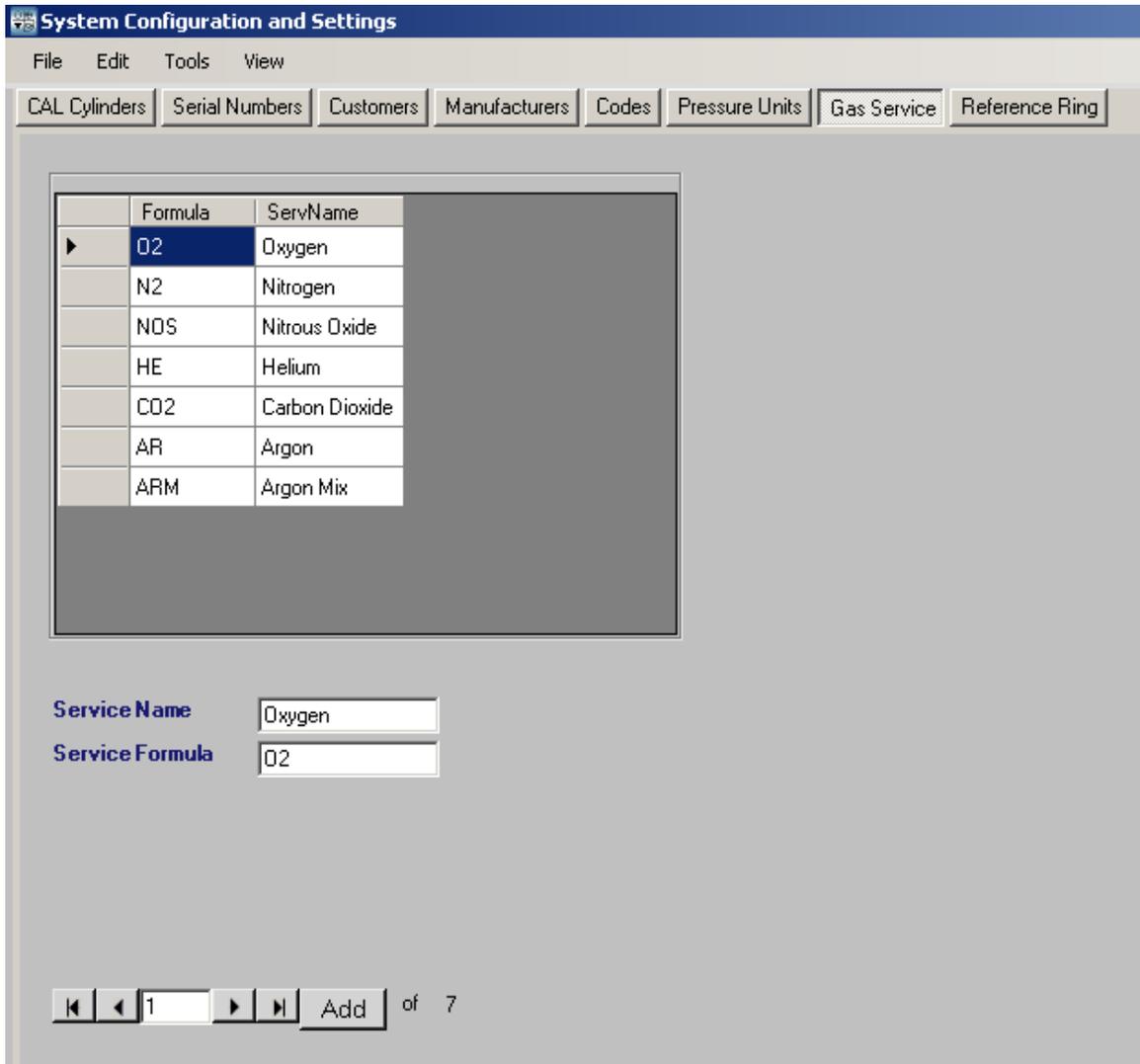
The pretest pressure fully bleeds down, and the qualification test begins as soon as the bowl stabilizes and the pressure is under 6 PSI. While the pretest is bleeding down, closely monitor the expansion to see if the reading will go into negative expansion upon the release of pressure. If so, you are 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



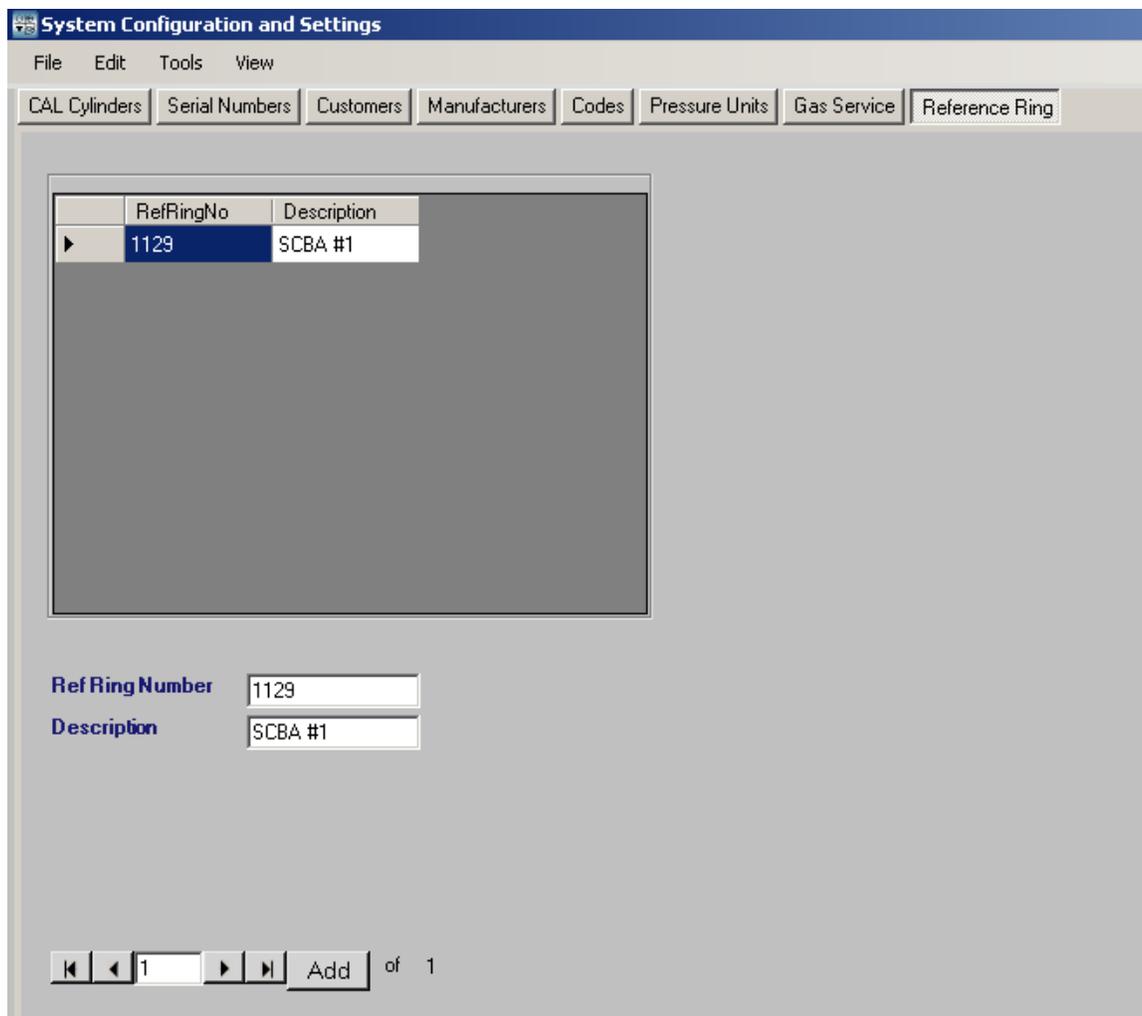
You may select from the pressure units above to display and test with for the test water pressure reading. Another pressure unit may also be created by entering the conversion factor from PSI.

Fig 15: Gas Service Entry



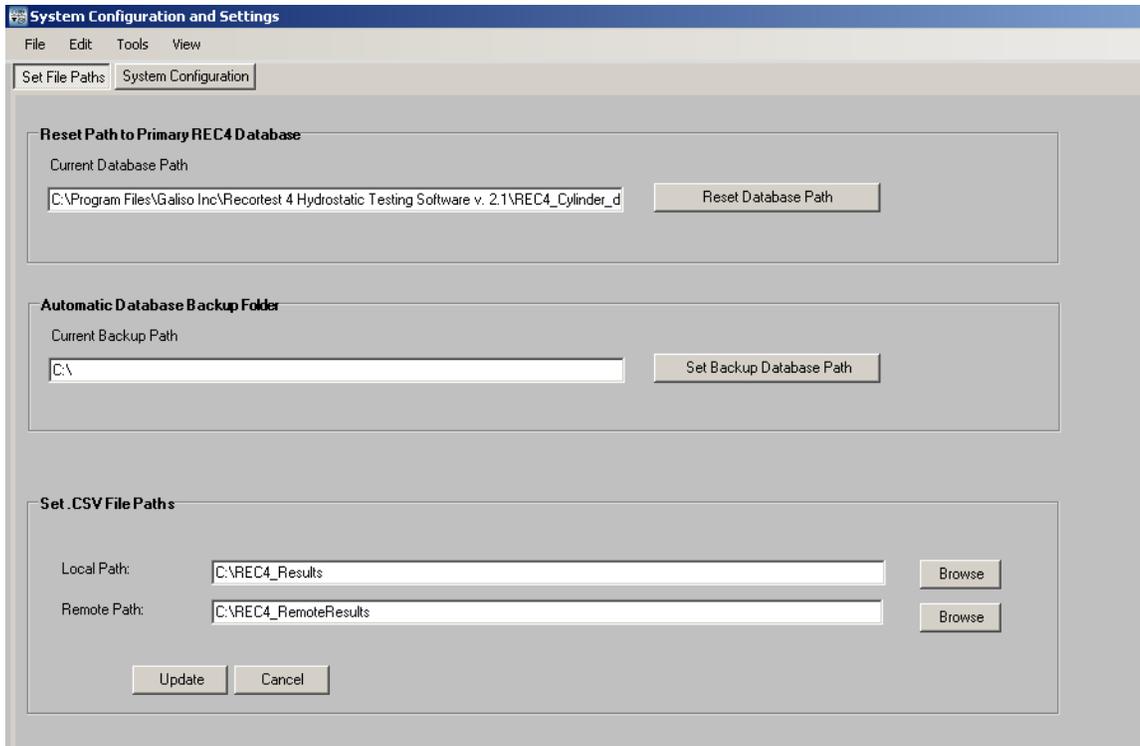
Codes for gas service are entered here. The 'Service Name' can stay the same as the code entry if desired. Such as the code, 'O2' can read 'O2' after the code is entered, instead of reading 'Oxygen'.

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

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 screen 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 screenshot shows a software interface titled "System Configuration and Settings" with a menu bar (File, Edit, Tools, View) and a tabbed interface. The active tab is "Edit Usernames and Passwords".

Supervisor Section:

- Username: [Text Input]
- *New Password: [Text Input]
- Verify Password: [Text Input]
- Buttons: Save Password, Save New User, Delete

Operator Section:

- Username: [Text Input]
- *New Password: [Text Input]
- Verify Password: [Text Input]
- Set Operator Permissions:**
 - Edit Error DB
 - Create/Edit Codes
 - Edit File Paths
- Buttons: Save Changes, Save New User, Delete
- List Operators:** [Empty List Box]
- Clear List:** [Text Link]

*Password must be at least 6 characters long and contain at least one letter and one number with no punctuation marks.

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

ID	Username	Date
2442		4/19/2007 3:4
2443		4/19/2007 3:5
2444		4/19/2007 3:5
2445		4/19/2007 3:5
2446		4/19/2007 3:5
2447		4/19/2007 4:0
2448		4/19/2007 4:0
2449		4/19/2007 4:0
2450		4/19/2007 4:0
2451	GALISO	4/19/2007 4:1
2452	GALISO	4/19/2007 4:2
2453	GALISO	4/20/2007 6:4
2454	GALISO	4/20/2007 7:0
2455	GALISO	4/20/2007 7:4
2456	GALISO	4/20/2007 7:5
2457	GALISO	4/20/2007 8:5
2458	GALISO	4/20/2007 9:0
2459		4/20/2007 9:0
2460		4/20/2007 9:0
2461	GALISO	4/20/2007 9:0
2462	GALISO	4/20/2007 9:3
2463	GALISO	4/20/2007 9:4
2464	GALISO	4/20/2007 10:
2465		4/20/2007 11:
2466		4/20/2007 11:
2467	GALISO	4/20/2007 11:
2468	GALISO	4/20/2007 12:
2469		4/20/2007 12:
2470		4/20/2007 12:
2471	GALISO	4/20/2007 12:
2472	GALISO	4/23/2007 7:0
2473	GALISO	4/23/2007 7:3
2474	GALISO	4/23/2007 8:0
2475	GALISO	4/23/2007 8:1
2476	GALISO	4/23/2007 8:2

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

Fig 21: Your Company Information

The screenshot shows a software window titled "System Configuration and Settings" with a menu bar (File, Edit, Tools, View) and three tabs: "Edit Usernames and Passwords", "User Log", and "Company Information". The "Company Information" tab is active, displaying a form with two sections: "Contact Person" and "Company Information".

Contact Person

First Name	<input type="text" value="John"/>
Last Name	<input type="text" value="Doe"/>
Email Address	<input type="text" value="jdoe@mycompa"/>

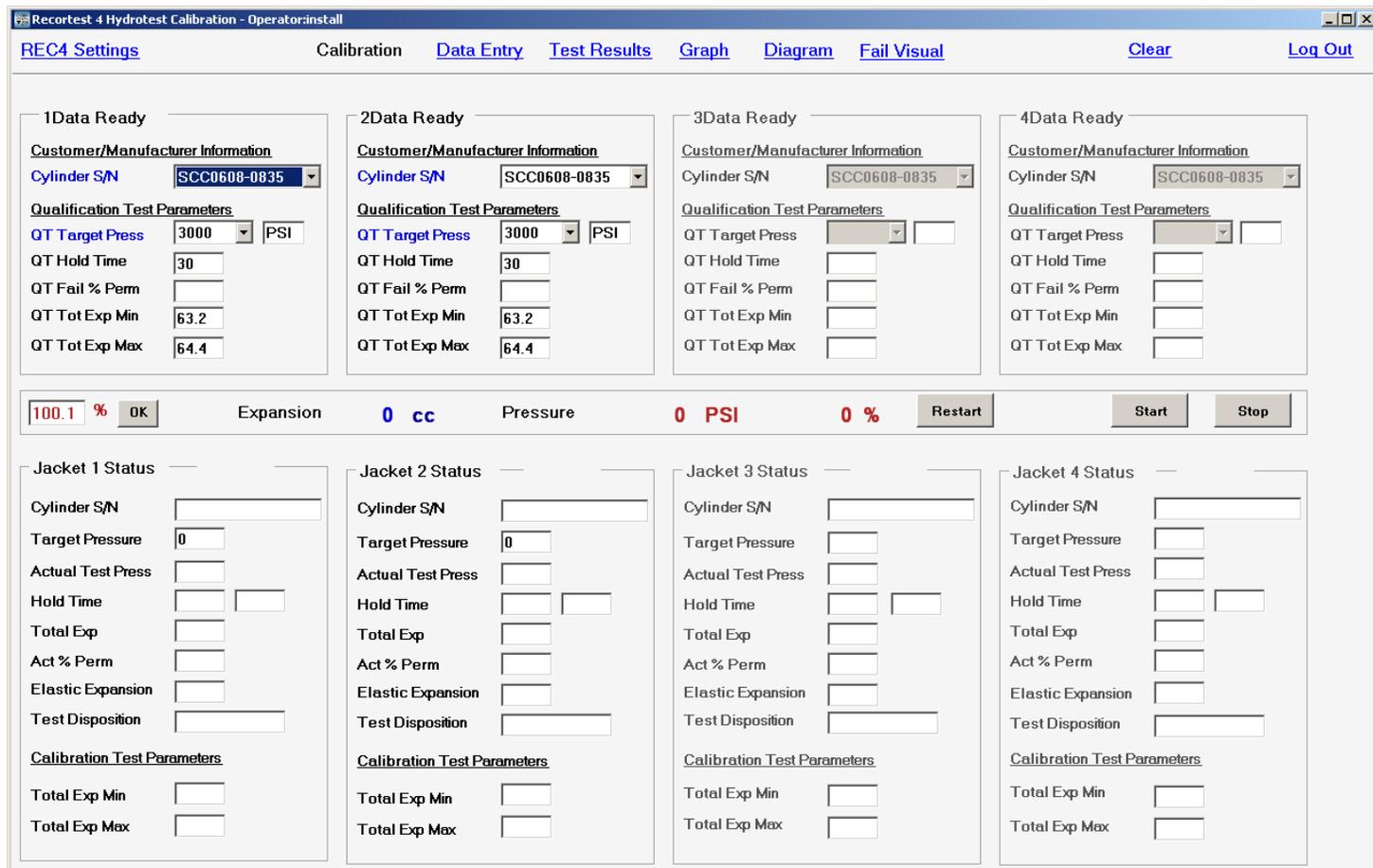
Company Information

Company Name	<input type="text" value="Galiso, Inc"/>	
Address Line 1	<input type="text" value="22 Ponderosa Ct"/>	
Address Line 2	<input type="text"/>	
City	<input type="text" value="Montrose"/>	
State	<input type="text" value="CO"/>	Zip Code <input type="text" value="81401"/>
Region	<input type="text" value="Mountian"/>	
Country	<input type="text" value="United States"/>	
Phone Number	<input type="text" value="(970) 249-0233"/>	
Fax Number	<input type="text"/>	
DOT/CTC #	<input type="text"/>	

At the bottom right of the form are two buttons: "Save" and "Cancel".

Be sure to 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.

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 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).

$$63.2 \times 100.3\% = 63.4 \text{ cc}$$

Divide by 100

$$63.4 \div 100 = .63$$

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 one 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 <Stop> 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.

Click the <Restart> button to retest a failed or aborted test. If, for any reason, the calibrated cylinder fails the test, you can immediately run another calibration test. The operator should determine another test should pass before performing the retest.

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.

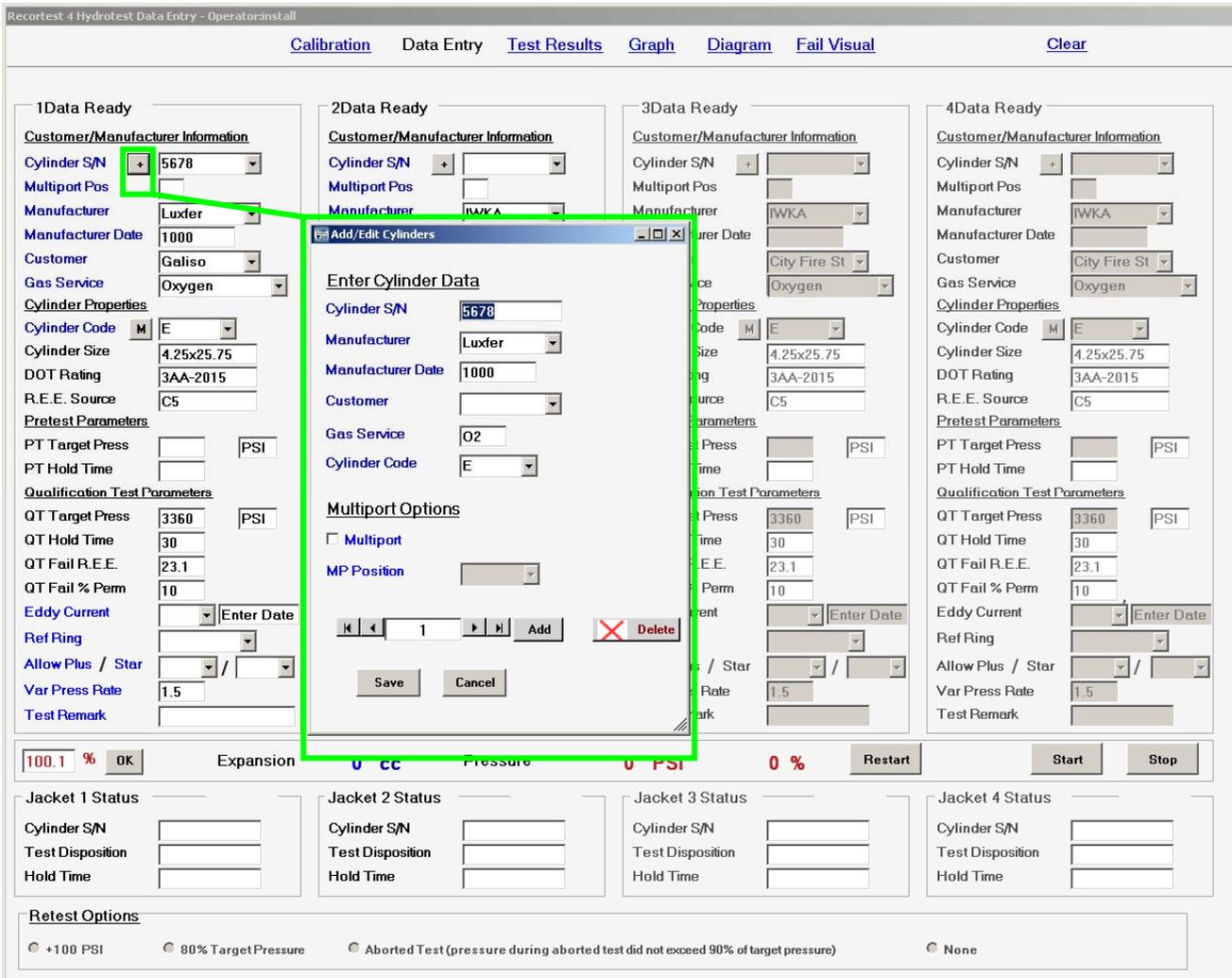
The <Eddy Current>, Pass or Fail selections allow you to document the visual inspection in more detail if needed.

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 <+> 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.

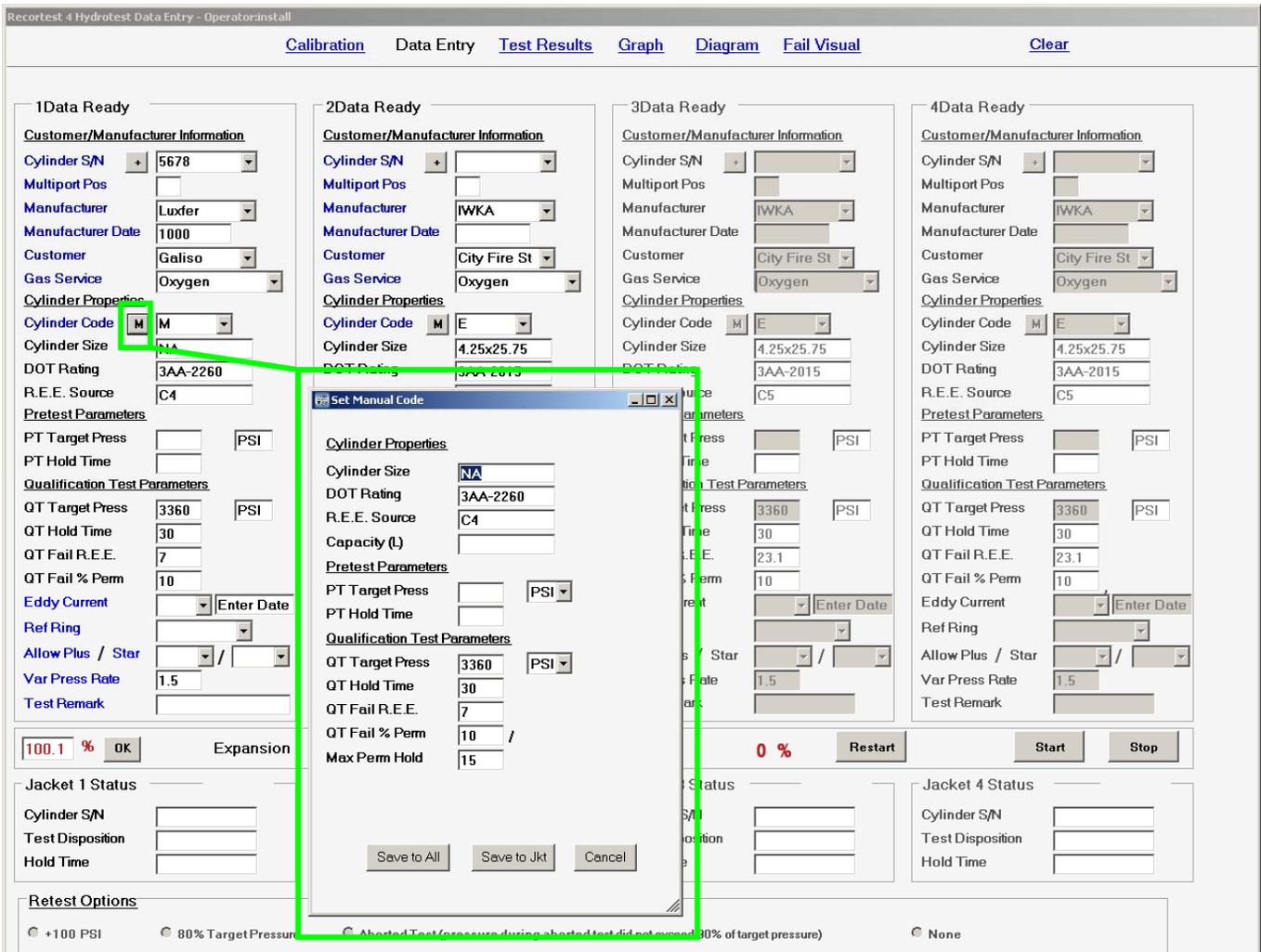
<Manufacturer Date> field: This is a manually inputted item. The field accepts 2 date formats. This means the date must be entered in one of these formats, or the program will not accept it.

1. MMY – 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>.

<Stop> button: If the test needs stopped for any reason, click the <Stop> 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 the function being performed at any given time. In the example above, you can see the word: **Done**

Fig 27: Test Results Screen

Recordtest 4 Hydrotest Results - Operator:install

Create Report Calibration Data Entry Test Results Graph Diagram Fail Visual Clear

Hydrotest Results

Test Number	Test Time	Test Date	Serial Number	Cylinder Size	Cylinder	Manufacturer	Rating	PT Target	PT Start	PT End	PT Hold Time
88	13:03	5/23/2007	23235	7x43_(CR-MO)	02	IWKA	3A-2265				
88	13:06	5/23/2007	12345	7x43_(CR-MO)	02	IWKA	3A-2265				
89	13:06	5/23/2007	2345	7x43_(CR-MO)	02	IWKA	3A-2265				
90	13:59	5/23/2007	12545	7x43_(CR-MO)	02	IWKA	3A-2265				
91	14:04	5/23/2007	1234	7x43_(CR-MO)	02	IWKA	3A-2265				
92	14:06	5/23/2007	1234	7x43_(CR-MO)	02	IWKA	3A-2265				
93	14:08	5/23/2007	1234	7x43_(CR-MO)	02	IWKA	3A-2265				
94	14:12	5/23/2007	22345	7x43_(CR-MO)	02	IWKA	3A-2265	2800	2810	2810	30
95	14:19	5/23/2007	1234	9.25x51	02	IWKA	3AA-3600	4800	4810	4810	

Individual Test Data 421 of 421

Test Number (by day) 101 Test Date 5/23/2007 12:00 Test Time 14:35 Operator galiso

Customer/Manufacturer Information

Cylinder S/N 1425 Manufacturer IWKA Manufacturer Date 092000 Customer Aquasport

Gas Service 02

Cylinder Properties

Cylinder Code A33 Cylinder Size 9.37x51 DOT Rating 3AA-4500 R.E.E. Source C5

Capacity (L)

Pretest Information

PT Target Pressure PSI PT Actual Pressure PSI PT Hold Time

PT Elastic Exp PT % Perm Exp PT Permanent Exp PT Total Exp

PT Test Disposition

Qualification Test Information

QT Target Pressure 7600 PSI QT Actual Pressure 7610 PSI QT Hold Time 30

QT Fail R.E.E. 226 QT Elastic Exp 266.4 QT Fail % Perm 10 QT % Perm Exp 0

QT Permanent Exp 0 QT Total Exp 266.4 QT Tot Exp Min 0.0 QT Tot Exp Max 0.0

QT Test Disposition PPFNP Plus Star

Eddy Current Test Information

Eddy Current Disp Eddy Current Date Reference Ring

Test Remark (45 characters maximum)

Retest at +100 Enable Edit Save Cancel

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.

Fig 28: Create Report Function

Select Report Criteria

Hydro Results | **Condemnation Reports**

March, 2008

Sun	Mon	Tue	Wed	Thu	Fri	Sat
24	25	26	27	28	29	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

Today: 3/19/2008

Start Date
3/19/2008

End Date
3/19/2008

Serial Number
[Empty text box]

Customer
[Empty dropdown menu]

Cylinder Type

- Calibration Cylinders
- All Cylinders

Disposition Criteria

- All Tests
 - Failed Tests
 - Fail % Perm
 - Fail Elastic Expansion
 - Aborted Tests
 - Failed Visual Tests
 - Failed Proof Pressure
 - Passed Tests

Selected Records

OK

The reports can be sorted and created using the criteria shown above. A report to condemn a cylinder can also be created.

Fig 29: Report Form

Report Screen

Main Report

Cylinder Regualification Report

Galiso, Inc
22 Ponderosa Ct.
Montrose, CO 81401

DOT/TC Registration # _____

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: _____

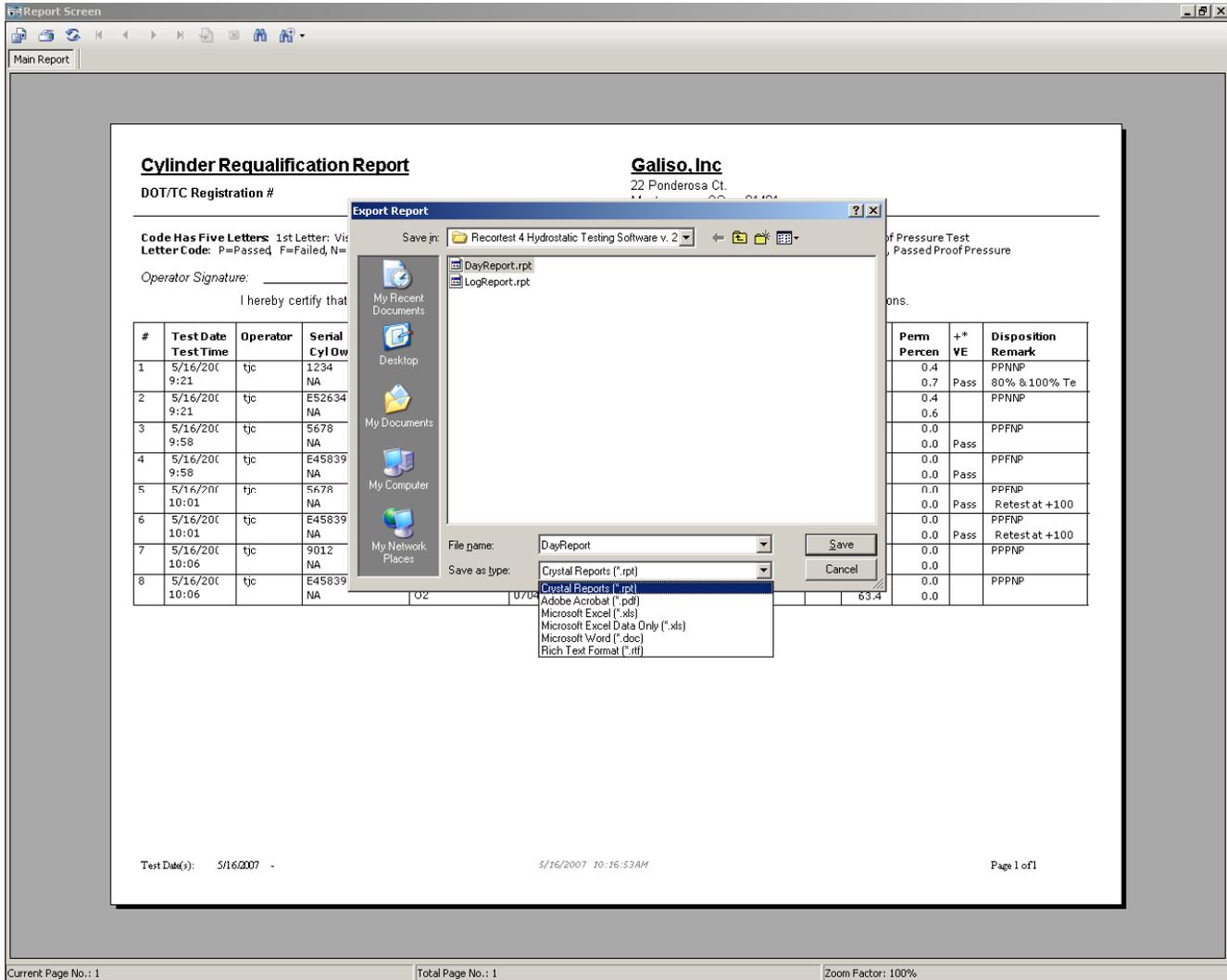
I hereby certify that all the following tests were made under my supervision and in accordance with DOT/CTC regulations

#	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 Date Ref Ring	Disposition Remark
1	7/18/2007 9:17	superviso	5832 Galiso	4.38x25.2 O2	IWKA 022001		3AL2015 PSI	3360 3367	30	61.4 61.4	0.0 0.0			PPN Ops Manual Test
2	7/18/2007 9:52	superviso	SCC0608-0837 Galiso		MCS		PSI	7000 7028	30	128.3 128.3	0.0 0.0			FCAL
3	7/18/2007 9:54	superviso	SCC0608-0837 Galiso		MCS		PSI	7000 7028	30	128.3 128.3	0.0 0.0			FCAL
4	7/18/2007 10:03	superviso	8362 Galiso	9X21" O2	Luxfer 012002	148 Lux	E10915-4500 PSI	7500 7530	30	137.4 137.4	0.0 0.0			PPP
5	7/18/2007 10:06	superviso	8573 Galiso	9X21" O2	Luxfer 012001	148 Lux	E10915-4500 PSI	7500 7530	30	137.4 137.4	0.0 0.0			PPP
6	7/18/2007 10:07	superviso	8674 Galiso	9X21" O2	Luxfer 012001	148 Lux	E10915-4500 PSI	7500 7530	30	137.4 137.4	0.0 0.0			PPP
7	7/18/2007 10:09	superviso	8784 Galiso	9X21" Breathing Air	Luxfer 022001	148 Lux	E10915-4500 PSI	7500 7530	30	137.4 137.4	0.0 0.0			PPP
8	7/18/2007 10:10	superviso	8742 Galiso	9X21" O2	Luxfer 012001	148 Lux	E10915-4500 PSI	7500 7530	30	137.4 137.4	0.0 0.0			PPP
9	7/18/2007 10:12	superviso	8732 Galiso	9X21" Breathing Air	Luxfer 012001	148 Lux	E10915-4500 PSI	7500 7515	30	137.1 137.1	0.0 0.0			PPP Screen Test

Current Page No.: 1 Total Page No.: 1 Zoom Factor: 100%

The standard report form displays the items shown above.
 Calibration verification test results will display the jacket that ran the test.

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.

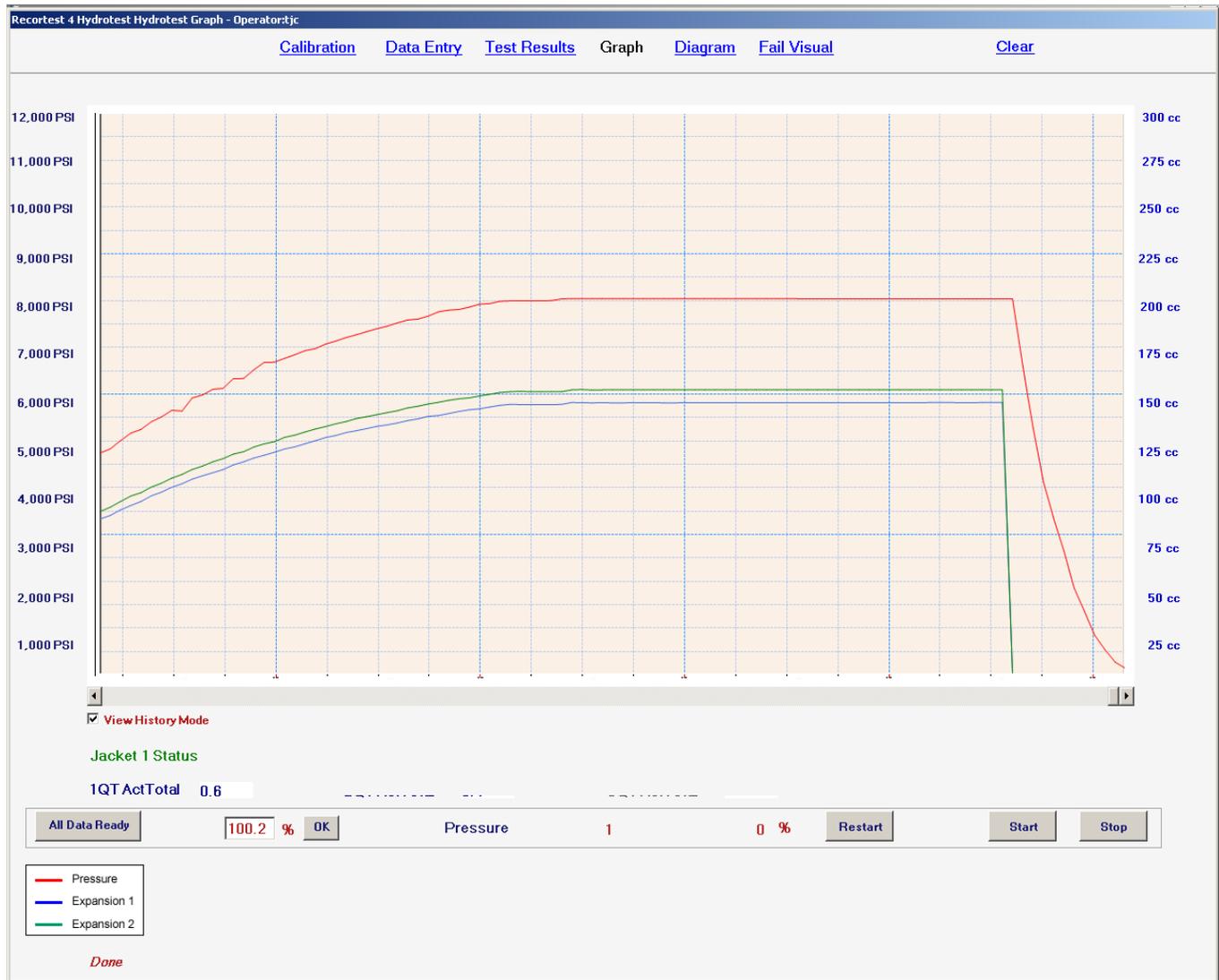
You should save each month's report to its own file. It will ask you if you wish to delete the files from the database. Answer yes to clear out the tests from the <Test Results> screen. Then no tests will show there, so there is no need to scroll through a lot of tests to see the last test. It basically cleans up the test results screen for a more user friendly search when needed.

Fig 31: Graph Screen



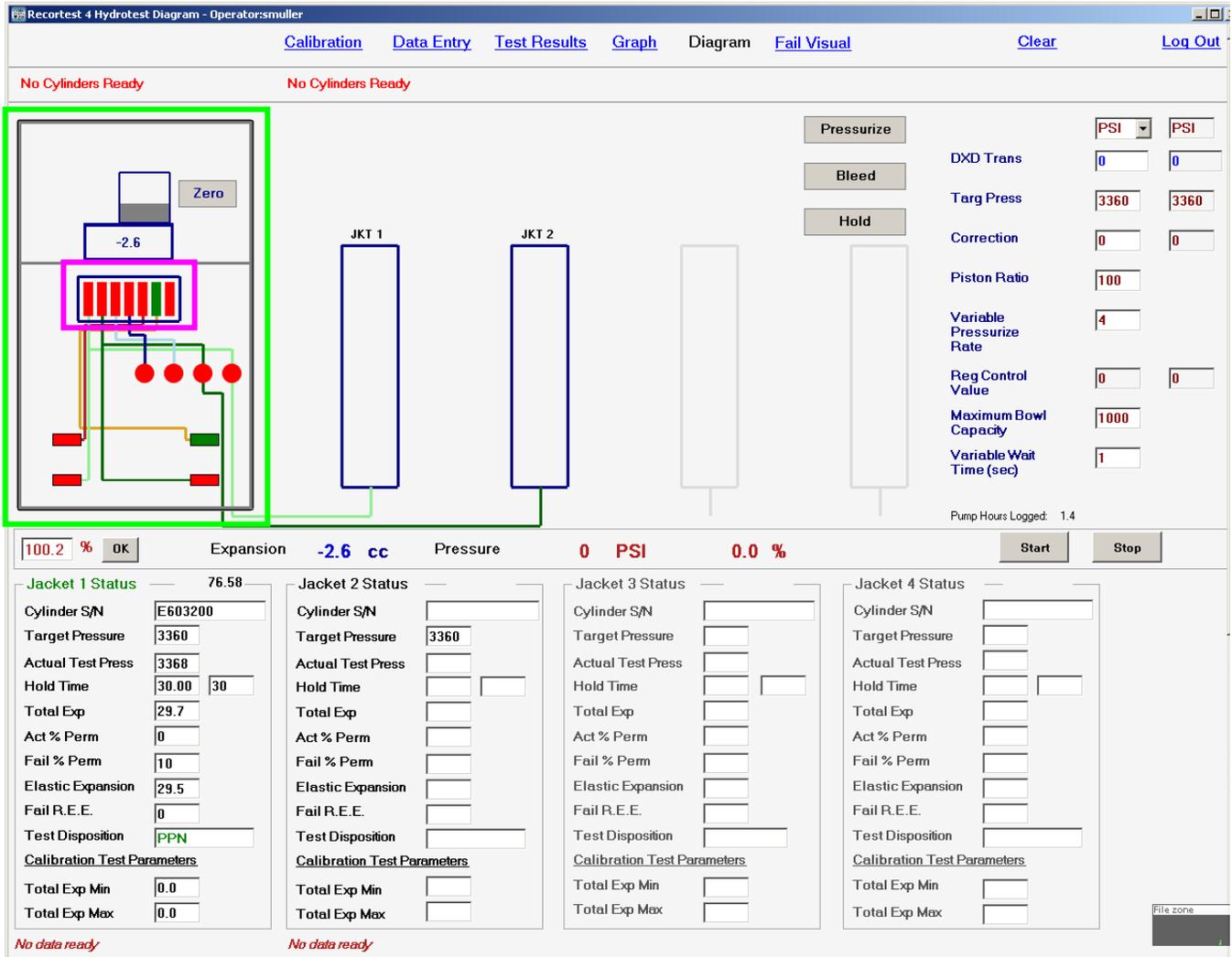
Shown above are the graphed curves of the pressure, and cylinder expansion. The scale of the graph can be changed for different viewing if needed.

Fig 32: Graph Pressure Bleed



The <Graph> screen continuously moves on a timeline to show the entire test, including pressurization curve, hold time, and 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 qualification 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 drawing inside of the **Green** outline above represents the side cabinet door area inside of the control console. From top to bottom is the scale, the Aro valve stack, the Nupro valves (jacket 1 expansion, jacket 2 expansion, bowl fill and bowl drain valves), and the Sno-Trik valves (pressure, bleed, jacket 1 high pressure, jacket 2 high pressure).

Clicking the <Zero> button will 'zero' the expansion and pressure readings, provided a test is not in progress.

The bar graph inside of the **Pink** outline represents the manually operated Aro valve stack under the scale in the left side of the cabinet. The bars are the actual switches. Clicking on them will toggle the corresponding switch on or off. Hovering over the switch with the mouse will make a flag pop up, describing the switch function. When the bar switch is **Red**, the valve is closed. When it is **Green**, the valve is open.

<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 from clicking 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/CM², or PSI.

DXD Trans: Displays the current pressure. This field is not adjustable.

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

<Correction>: A value in PSI can be entered here during pressurization to give the pump an extra push to achieve target pressure. If you are doing experimentation on where to set the test parameters, sometimes your first guess at where to set the piston ratio can be a little weak, and not achieve the test pressure. Increase the correction to give it that much more of a boost to get there. Normally, you should not enter a value more than 50. 20 is usually enough to get it to test pressure. If the first value is not enough, you can enter in another one. Entering in too high of a value initially, can cause the pressure to increase too far beyond test pressure, and potentially damage the cylinder. If the pressure was not reached without adjusting the correction value, then the next test on the same type of cylinder should be performed with a lower piston ratio value. Decrease the piston ratio by a value of 1.

<Piston Ratio>: This represents the 100:1 ratio of water pressure, to the amount of air pressure inlet the pumps receives. 1 PSI of air = 100 PSI of water pressure the pump will increase to. Decreasing the value makes the pump push harder. If Necessary, change the pump values in very low increments such as 1. So, if the last test did not reach target pressure, and the same cylinder type is being tested again, decrease the piston ratio by 1, and try it again.

<Variable Pressurize Rate>: The range is from .5 – 10. A value of 4 or 5 should be sufficient for most normal testing. Faster pressurization is achieved by increasing the value.

<Regulator Control Value>: The field on the left should show flashing numbers when the pressure is increasing. If the numbers stop flashing, and test pressure has not been achieved, you can enter in a PSI value into the correction value field to get the regulator to open up and move the pump some more.

The field on the right should always be the same as what is displayed in red digital figures on the automatic air pressure regulator on the RSP.

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

<Variable Wait Time>: This is the amount of time the testing program will wait before starting the next test automatically, after the previous test is completed. If the data is not ready for the next test, it will not start it.

Fig 34: Fail Visual Screen

Recortest 4 Failed Visual Data Form - Operator:install

Calibration Data Entry Test Results Graph Diagram Fail Visual Clear

Customer/Manufacturer Information

Cylinder S/N

Multiport Pos

Manufacturer IWKA

Manufacturer Date

Customer Galiso

Gas Service Oxygen

Cylinder Properties

Cylinder Code E

Cylinder Size 4.25x25.75

DOT Rating 3AA-2015

R.E.E. Source C5

Pretest Parameters

PT Target Press PSI

PT Hold Time

Qualification Test Parameters

QT Target Press 3360 PSI

QT Hold Time 30

QT Fail R.E.E. 23.1

QT Fail % Perm 10

Eddy Current Results

Eddy Current Disp Eddy Current Date Reference Ring

Reasons for Failed Visual

Will Not Hold Pressure Altered Ser # Int Corrosion Internal Pitting Arc Burn

% Perm Exp Neck Crack Ext Corrosion External Pitting Bad Threads

Altered Pressure Dent/Gouge Fire Damage Sidewall Stamp Other/Specify

Test Remark (255 char. max)

Failed Visual Reason Code

WNHP=Will Not Hold Pressure DG=Dent/Gouge EP=External Pitting

%P=% Perm Exp IC=Internal Corrosion SS=Sidewall Stamp

AP=Altered Pressure EC=External Corrosion AB=Arc Burn

ASN=Altered Serial Number FD=Fire Damage BT=Bad Threads

NC=Neck Crack IP=Internal Pitting

Write Data

You can document a cylinder that failed the visual test here. 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. This is most often used to give the failed report to the customer.

Clicking on the <Write Data> button will write the data to the test results screen for archiving, printing, etc...

Section 2: Step By Step Quick Start Guide

Rec 4 – Steel Jacket System; Step By Step Quick Start Guide

Introduction: This guide is a basic guide 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.

1. Powering on the system:

- 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>.
- c) Open the testing program by clicking on the <Galiso test software icon> on the desktop. Type/enter in the Galiso program username and password.
- d) Turn on the air supply to the test system first, and then the water and you should now be ready for testing.
- e) If you get a PLC Bowl Communication failure, then check the scale(s) to ensure the power is on. When that error occurs, always check the scale power first. The scale needs to be powered on for 30 minutes before use.

2. Ensure the bowls are properly placed on the scales and touching only the scale platform.

- a) Ensure the bowl is sitting on the scale platform as much as possible.
- b) Place the bowls so the drain stick/tube does not touch anything (mainly the scale bracket on the left side), and the bowl does not touch the expansion probe.

3. Bleed air from the expansion lines. This may need performed a couple of times to completely remove the air in the lines. (This step may not need performed every day! Only purge air from the lines if bowl water level falls below the probe, or if air is suspected to be in the lines.)

3.1 Fill the weigh bowl with water:

- a) Ensure the blue air hoses to the test heads are connected with the calibration cylinders in the jackets.
- b) On the <Diagram> screen, open the expansion lines manually by clicking on the <E1> & <E2> bars to the left of the screen so they become green in color. Green = Open, red = closed.
- c) Click on the <B1> & <B2> bars to the left of the screen so they are green in color. Green = Open, red = closed. The buttons only operate when the jacket safety valve is engaged. Whenever the safety valve is engaged, the program assumes the blue and black hoses are hooked up to the test head.

That will fill the bowls, and the computer will automatically close the valves when the bowl level gets near the top.

3.2 Lower the bowl water level:

- a) Disconnect the blue air hose from the test head and turn the head in the jacket to deactivate the head safety switch.

-
- b) Open the expansion lines manually by clicking on the <E1> & <E2> bars to the left of the screen so they are green in color. This should allow the water in the bowl to go down.
 - c) If the water level of the jacket is too high, compared to the bowl water level, you may need to lift the cylinder out of the jacket a few inches to allow the bowl water to siphon back into the jacket.
 - d) Allow the water level to get to roughly 350cc/grams and quickly click the <E1> & or <E2> bar(s) to manually close the expansion valves.
Performing the steps above once or twice should get all of the air out of the expansion lines.

4. System calibration verification.

4.1 Expansion calibration verification steps: (This step may not need performed every day. Only perform it if system will not calibrate, or if a problem with the bowl reading is suspected!)

- a) Navigate to the <Diagram> screen in the testing program.
- b) 'Zero' the bowls by clicking on the rectangle below the bowl depiction. (When hovering over the rectangle, you should see a finger that is showing you a clickable function) Place the two, 50 gram weights onto the corresponding (#1 or #2) scale platform.
- c) Ensure the scale reading is between 99.7 – 100.3 grams/cc to be within the 1% tolerance required by DOT.
- d) Perform the same function for both scales.

4.2 Pressure calibration verification steps:

Usually, the cylinder needs exercised first with one or two pressurizations before it is ready to run a documented calibration verification test. (Disregard the master gauge operation unless it is suspected that the machine is out of pressure calibration.)

- a) Ensure the low-pressure blue hose is connected to the test head, with the correct calibration cylinder still in the jacket (Cal Cyl#1 in Jkt#1, etc..).
- b) Connect the master gauge to one of the test heads, 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 calibration pressure point into the <Targ Press> (target pressure) text box (upper right portion of diagram screen). Be sure to hit the <Tab> key to enter any data in any text box in the program.
- d) Open the <E1> & or <E2> bar(s) (depending on which jacket, or both jackets) and click the <Pressurize> button.
- e) After the pump stops at the pressure, verify the transducer reading on screen is within 1% of the master gauge reading. Be sure to tap the master gauge with your fingers to ensure the needle is not stuck.
- f) After the pressure is reached and you have verified the 'on-screen' reading of the transducer is within 1% of the gauge reading, click the <Bleed> button.
- g) Carefully watch the scale cc reading shown on screen under the scale depiction as it is bleeding the pressure down. If value comes down to .5 or less, then the cylinder is ready to run a calibration verification test. If not, then perform the pressurize steps again until the scale reading comes down to .5 directly after bleeding. Do not wait between pressurizations. The reading will come closer to zero after each pressurization. The goal is to continue to exercise the cylinder so it becomes conditioned to come to zero cc when

bleeding down. The documented calibration cylinder test must show no permanent expansion of the calibration cylinder.

4.3 Pressure and expansion calibration verification: This must be done every day a cylinder is tested; usually the first documented test of the day is calibration verification. You must verify the equipment calibration within 500PSI of each cylinder test pressure to be tested that day.

- a) Ensure the low-pressure blue hose and hi-pressure black hose is connected to the test head, with the calibration cylinder still in the jacket.
- b) Navigate to the <Calibration> screen. This process will verify the expansion amount, and the pressure for each pressure point on the calibrated cylinder.
- c) From the pull-down menu for the serial number, select the correct calibrated cylinder that is in the test jacket.
- d) Enter the highest pressure point to verify that day into the <Targ Press> text box for each jacket. You should select it from the list by clicking the arrow to the right of the text box.
- e) Ensure the data is correct, and click on the <All Cal Data Ready> button if calibrating both jackets simultaneously, or click the <Jkt1 Data Ready> text line (it is actually a button) at the top of the jacket column on screen. The computer should give a blue light on the box on top of the console, for each jacket to calibrate. The blue light verifies the data is correct enough to run a test.
- f) Click the <Start> button. The computer will automatically perform the calibration test and document the results as per DOT requirements, except you need to print the results. Perform the test for each pressure to be verified that day. The calibration verification test results can be printed by themselves, or at the end of the day to show on the same print as all tests performed that day.
- g) You should now be ready for production cylinder testing for one 24 hour period.

5. Powering off the system.

- 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. The PC does not need turned off every day. Please restart the PC at least once per week if it is left on all the time.
- d) The scales can be left on at all times.

Section 3: Principles and Structure

Principles and Structure with Component Function Detail of the Recortest 4 Water Jacket Test Console

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

Basic overview of the water jacket test system components:

1. **Pressure system:** This system contains the water pump with high pressure valve, 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, 100:1 ratio, dual action intensifier pump. 1 PSI of air to the pump, = 100PSI of water pressure in the pressure line. Those are the design figures in the theoretical world/best case scenario. There are 4 check valves on the pump: 1 for low pressure water inlet, and 1 for high pressure water outlet for each of the 2 pump pistons. There is a reservoir support package to provide more air volume to feed the pump drive.
 - b) **High pressure and bleed valves:** Upon initial start of cylinder pressurization, the bleed valve closes (electro-pneumatic control valve light on). Upon achieving the target pressure, during the hold time, the pressure valve also closes (electro-pneumatic control valve light on). To bleed off the test pressure, both valves open (lights off).
 - c) **High pressure tubing, fittings, test head stems, & quick couplers:** Stainless tube with compression fittings to the stainless test heads, and master gauge locations. A quick coupler is utilized for the master gauge connection.
 - d) **Calibrated cylinder:** The final piece of the pressure system. Verifies predetermined pressure to expansion measurements to ensure the system is in calibration before testing production cylinders.
2. **Expansion system:** This system contains the water jacket (1 for each cylinder to test), test head to jacket seal boot, expansion tubing, expansion weigh scale, and weigh bowl.
 - a) **Water Jacket:** 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.
 - b) **Test head to jacket seal boot:** Seals the head to the jacket with air applied to the air fitting.
 - c) **Expansion tubing:** Blue colored flexible nylon tubing, connected via push in style fittings. 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. **Do not** manually 'zero' the scale with the scale 'zero' button.
 - e) **Weigh bowl:** The weigh bowl holds enough water to enable a stable measurement of the cylinder expansion. It is a simple plastic bowl, with a metal drain stick, should the level accidentally overflow.

3. **Test water cartridge filtering:** There is one large cartridge filter for incoming facility water. 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. There are 2 programs that effect water jacket system testing control. One is the Rec4 Settings program, and the other is the main testing interface. In the Rec4 Settings program, you can input many of the test parameters such as cylinder code information. Sends test result files to the network location of your choice, and to the machine PC local hard drive.

Section 4: Instrument Detail

Instrument Detail Operations and Technologies for the Rec4 Cylinder Water Jacket Test System

1. Water Jacket Testing:

a) Pressure system:

1) **Water pump:** A minimum of 100PSI of facility shop air is required to properly operate and control the pump functions. It is an air driven, 100:1 ratio, dual action intensifier pump. 1 PSI of air to the pump, = 100PSI of water pressure. This ratio is a hardware constant value. However, the pump piston ratio value can be changed in the control interface to achieve cylinder test target pressure more efficiently. There are 4 check valves 1 for low pressure water inlet, and 1 for high pressure water outlet for each of the 2 pump pistons. There is a reservoir support package to provide more air volume to feed the pump drive. To operate the pump, open the ball valve (adjacent to the automatic regulator) 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. Galiso controls the rate of pressurization with several software parameters. These are adjustable in the diagram screen. You can also adjust the rate value, and the piston ratio value for more accurate pressure points. Each pump varies slightly in its operation. This variance may require slightly different settings. The cylinder also has many features that require certain changes in the test parameter values in order to achieve test pressure.

A) **High pressure and bleed valves:** Upon initial start of cylinder pressurization, the bleed valve closes (electro-pneumatic control valve light on). Upon achieving the target pressure, the pressure valve also closes (electro-pneumatic control valve light on). To bleed off the test pressure, both valves open (lights off). Watch the control valve lights on the SMC electro pneumatic valves 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.

B) **Manual pressure regulator:** Adjust this to 115PSI control air pressure as displayed on the digital pressure switch. It will go down as cylinders are pressurized, according to the volume of air supplied by the facility compressor. It should not drop below 70PSI.

C) **Automatic pressure regulator:** Receives signal from control software, to provide adequate air volume to the pump for pressurizing. There is a regulator correction value in the control software if a change is needed to achieve test pressure more efficiently. Normally, this value should not be changed after installation, except for extreme volume and elasticity differences in the cylinders being tested, compared to the cylinders the settings were adjusted with.

D) **Pump air exhaust:** The pump must have an open exhaust line,

similar to the tail pipe of an automobile. This should remain open. Galiso equips the reservoir support package with a 1" exhaust tube, to be extended and routed by the customer to their exhaust dump location. If you must, it is permissible to place a muffler at the end of the exhaust tube. Preferably at least 5 meters of exhaust tube should be in front of the muffler.

E) **Reservoir safety valve:** The RSP has a 150PSI safety valve. Please keep incoming air pressure at 130 or less.

F) **Reservoir relief valve:** This is a manually operated valve for fast air evacuation from the tank. It will relieve the air in the tank, and shut-off incoming air simultaneously.

2) **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.

3) **Calibrated cylinders:** The correct cylinder serial number must be placed in the correct jacket for proper calibration. Each cylinder has a predetermined, calibrated point list 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 done. Do not allow more than 10 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. With 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.

A) **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, and should be set aside with water still in them, ready for the next day's calibration test. If water stagnation is a concern, you may drain and dry them once every 2 months.

b) Expansion system:

1) **Water jackets:** 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, and then the amount is also measured after the pressure is released, and the cylinder stabilizes. This method of measurement accurately displays the integrity of the pressure vessel or cylinder as the case may be.

2) **Test head:** This unit is what seals the test head to the jacket. 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.

-
- 3) **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.
 - 4) **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.
 - 5) **Weigh bowl:** The bowl is a 1000cc bowl. It is sufficient in size to test up to 800cc expansion cylinders.
- c) **Test water cartridge filtering:** The inlet water is filtered down to 5µm.
- d) **Software control interface:**
- 1) There are 2 programs essential to performing tests on the water jacket system.
 - A) **Rec4 Settings program:** This program allows for test parameters to be set according to the cylinders being tested. Please read the Rec4 Settings manual for complete training on its functions.
 - B) **Rec4 Testing Software:** This program is the user interface to control the machine. Please read its manual for complete operations instructions.
- e) **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 5: Installation and General Maintenance

Installation and General Hardware Maintenance of the Rec4 Water Jacket Cylinder Test System

1. Water Jacket System:

a) Pressure system:

1. Water pump:

- A) Change the inlet water supply filter to the pressure pump at least once per year.
- B) Ensure pump exhaust pipe is kept clear and unobstructed at all times. Check the end of the pipe at least once per month to ensure pump exhaust is freely escaping out of the end of the pipe. If you use a muffler, check it to ensure it is not clogged.
- C) Pressure and bleed valves: 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. **Do not over-tighten!** 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 SMC 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 pressure valve also closes (electro-pneumatic control valve light on). To bleed off the test pressure, both valves open (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 RSP and pump 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.

b) 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 80grit rough.

B) **Burst disc port:** The glass should be kept clean. Do not allow rust to build up around the rubber seal.

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. If leak is found, cut the worn tube end off, and reinstall new end of tube 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 the more testing is done. Keep the expansion probe from touching the bowl sides or bottom.

C) **Fitting operation:** The fittings are a press and fit type. To install the tubing, simply push it into the fitting all the way. To remove the tubing, use a ½" wrench or equivalent, place it around the tube, and over the flange, and depress the tube flange with the wrench, while pulling out the tube. You can use your fingers to depress the flange, but some places may require a wrench to assist in pushing the flange down.

D) **Purging air from the lines:** The entire expansion line from jacket to bowl must not have any air in it.

1. Insert the calibrated cylinder into the jacket, and seal the test head with the blue low pressure hose.
2. Fill the bowl with water. Go to about 800 on the cc lines on the bowl itself. To do this, you must click on the bowl fill valve button on the diagram screen as shown below as B1 = bowl #1, and B2 = bowl #2.
3. Disconnect the blue low pressure hose on the test head, and move the head safety bar away from the head safety switch.
4. Watch the bowl level go down, and click the bowl fill button when the level is between 200 and 250. You can go lower or higher, but this is a good working level. Just make sure the level never goes below the end of the probe. If it does, then purge the line again.

3. Expansion weigh scale and bowl:

- A) **Powering on:** Carefully lift the weigh bowl off of the scale platform (leave the expansion probe intact) and press the on button. Wait for scale to register 0.0, and carefully replace the bowl onto the scale platform. Be sure the bowl and overflow stick do not touch anything, including the expansion probe, and scale mounting bracket. Be sure the bowl is on the scale platform as much as possible, without touching anything else, including expansion probe. Ensure the Galiso signal wire connection is in place at the rear of 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 6: Hardware Diagnostics and Troubleshooting

Hardware General Diagnostics and Troubleshooting of the Recortest 4 Water Jacket Cylinder Test System

General Troubleshooting Guidelines:

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. Water Jacket System:

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:** If negative expansion occurs during water jacket test, slow down the bleed speed with the manual bleed valve. Turn it off, and then back it off about 1/16th of a turn. That will keep the cylinder from bleeding down the pressure too fast, and going negative on the expansion scale.
- 3) **Pressure 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.
- 4) **Pressure loss:** A loss of pressure during the hold time, and after the pressure stabilizes, greater than 1PSI per every 2 seconds, is probably 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 or 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 7800PSI), 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 on the diagram screen.

b) Expansion system:

- 1) **Water jacket:** The bowl level should stabilize within 10 seconds after the expansion valve opens.
- 2) **Expansion weigh scale:** If the expansion does not go high enough 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. Do the same if the expansion does not come to zero/shows to much permanent expansion. **Check the bowl placement.**

Section 7: Reference Guide for Common Occurrences

REC 4 Steel Jacket Reference Guide for Common Occurrences

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 the PLC. 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:** check the power to the PLC to be on, and ensure that the red EMO button is in the 'OUT' position.
3. **Pump won't pressurize:**
 - a) Open the manual override ball valve on the pump air supply line located on the tubing between the automatic E/P regulator, and the water pump.
 - 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 cylinder testing again. You may also need to exit the test program, and re-open it. Ensure that the 'Power' and 'Run' green lights are on, on the WinPLC Module. This is the module with the single ethernet cable hooked to it in the PLC.
4. **Bleed activation does not work:** Open the manual override bleed valve on the RSP bleed line. Sometimes a person will close the valve and forget to open it back up.
5. **Cylinder test result fails negative 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 the 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 tests unless it is on a shop 'test set-up' cylinder that is not in service.

 - a) **Control the temperature:** 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.
 - b) **Control the rate of pressurization:** This needs to be a very slow steady increase to the target. The rate of increase should be about 500 PSI every 3 seconds. Use

the ball valve on the electronic regulator to restrict the air flow to the pump to control the rate of pressurization. You may also change the 'Reg Cont Corr' value on the diagram screen. A good range to stay in is 200 - 300. Going up in value will increase the rate of pressurization. You may also change the 'Piston Ratio' value. Going down in value number will increase rate of pressurization. The pump is rated at 100:1 piston ratio. Normally it should not be necessary to go below 98 or above 102.

Another way is to decrease the piston ratio value to 95, and manually restrict the air feed to the pump with the ball valve between E/P reg and pump. Set this where it works, and leave it for all small cylinder testing.

- c) **Control the rate of depressurization or 'Bleed'**: Use the manual bleed restrictor valve attached to the air operated bleed valve on the RSP. More bleed restriction will affect the bowl cc's to go less into negative expansion. Less bleed restriction (faster bleed flow) will allow the bowl cc's to go further into negative expansion. There is a point where too much adjustment either way, can greatly affect the bowl reading either way to not make sense and confuse the operator. Make small adjustments to determine the proper setting.
6. **Low Bowl Level**: The program automatically adds water, and sets the bowl to zero. It also gets the air out of the line by adding water to the minimum bowl level adjustment in the diagram screen. The program limits the water level in the scale so that water cannot overflow and damage the scale during normal use. Care must also 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. **'Restart' Button**: Automatically restarts a test at **80%** target pressure. If the full target pressure is desired, click the 'Restart' button, and then click the 80% button. This will uncheck the 80% feature, and run a full target pressure test.
 8. **'+100PSI' Retest**: If you choose to retest a failed cylinder at 100PSI over the rated target pressure, then you must click on the '+100PSI' button, and click the 'Restart' button. The software will only allow 1 "retest" at +100PSI over the rated target pressure for that cylinder serial number. The +100PSI text will turn red after the start of the test. It is best to run a failed cylinder at 80% test pressure first, for an equipment check. After passing at 80%, then test at 100 PSI, or 10% over test pressure, whichever is less.
 9. **Fail to Reach Target Pressure**: Failing to reach target usually only happens upon the first test of a certain cylinder type. Variables such as incoming air supply, water pressure, and pump stroke position (among others) can changeover time too. This change may keep the pump from attaining target pressure. If the pump stalls below the target, some adjustment may be necessary. Refer to the diagram screen instructions to learn what adjustments can help to reach target pressure. You can then incorporate the adjustments into the cylinder code so no further adjustments will be needed when testing that type of cylinder.

Section 8: Safety

*****Notice***:**

Galiso, Inc. is not responsible for damage or injury caused by unsafe use; improper maintenance; or misapplication of this equipment. Please contact Galiso, Inc. if you are in doubt as to the proper safety precautions to be taken with this equipment!

Always double check the cylinder pressure rating before testing. Do not over-pressurize it!

Always use proper lock-out/tag-out procedures before performing any maintenance.