GALISO®
INCORPORATED
GASES LIQUIDS SOLIDS

!!!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 4 Water Jacket Cylinder Testing System

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List of Figures

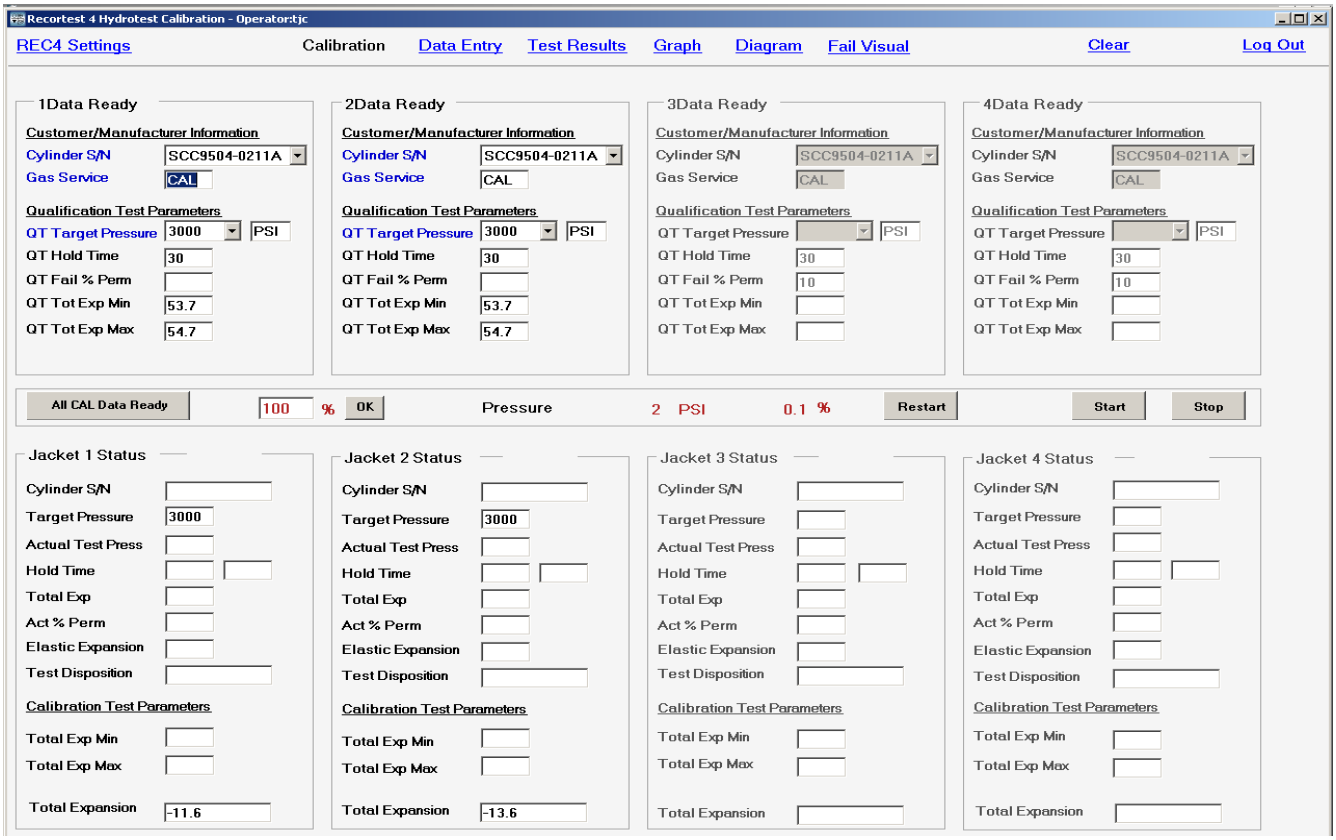
Introduction:

This manual is for the operator to read and study before using the Galiso model Rec4 Steel Jacket System.

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

Operations:

Figure 1: Start-up and Calibration



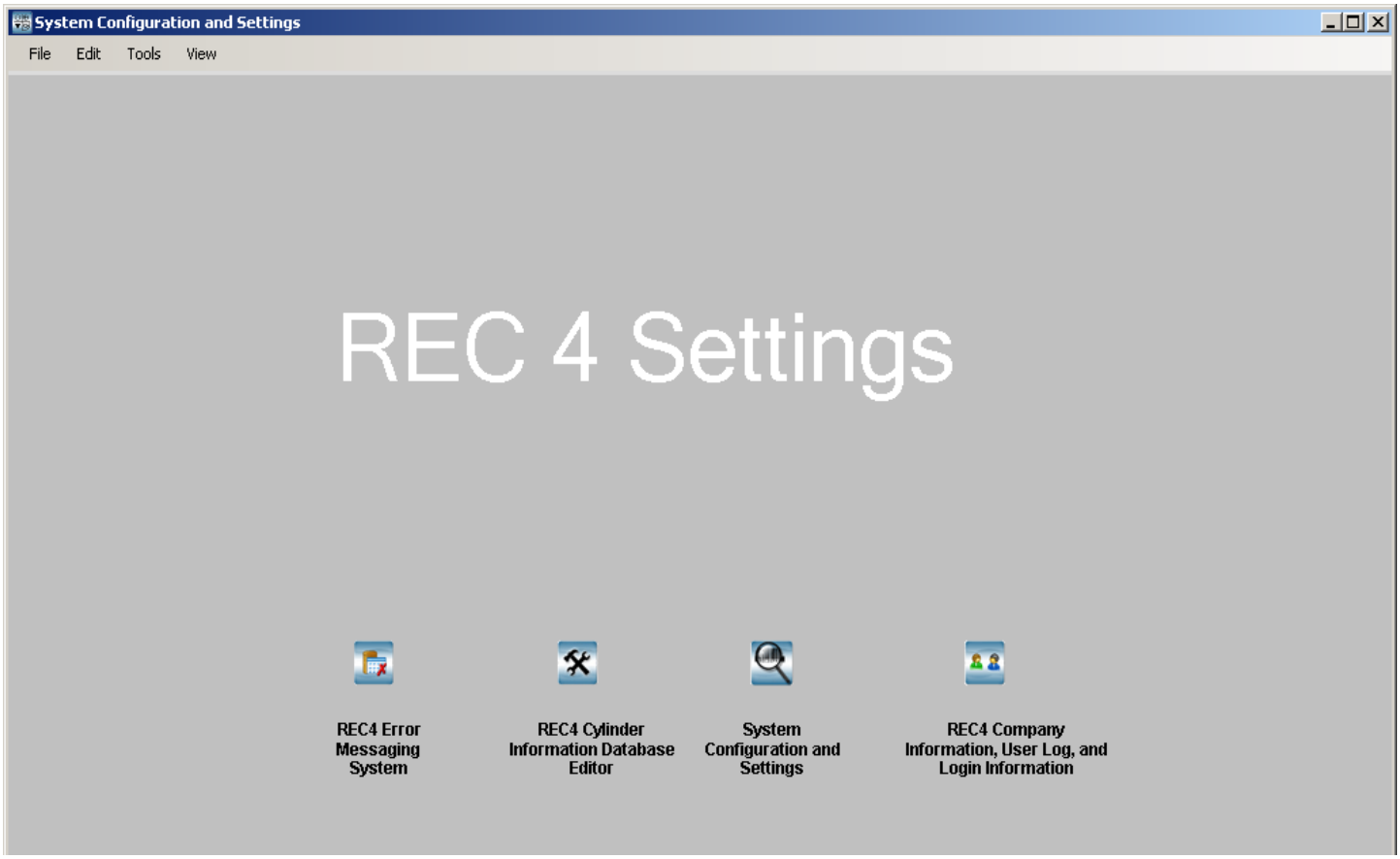
The start-up screen is the calibration screen. Here you can verify the calibration of the expansion and pressure to ensure 24 hours of accurate testing. The computer automatically calculates and adjusts the allowable minimum and maximum expansions for the pressure measured. This makes it much easier for you to verify calibration. You do not have to be perfectly accurate in hitting the pressure point because the computer calculates the allowable +/- 1% min and max expansions from the current pressure reading.

You can only access the settings program from this screen.

You can only log-off and/or close the test program from this screen.

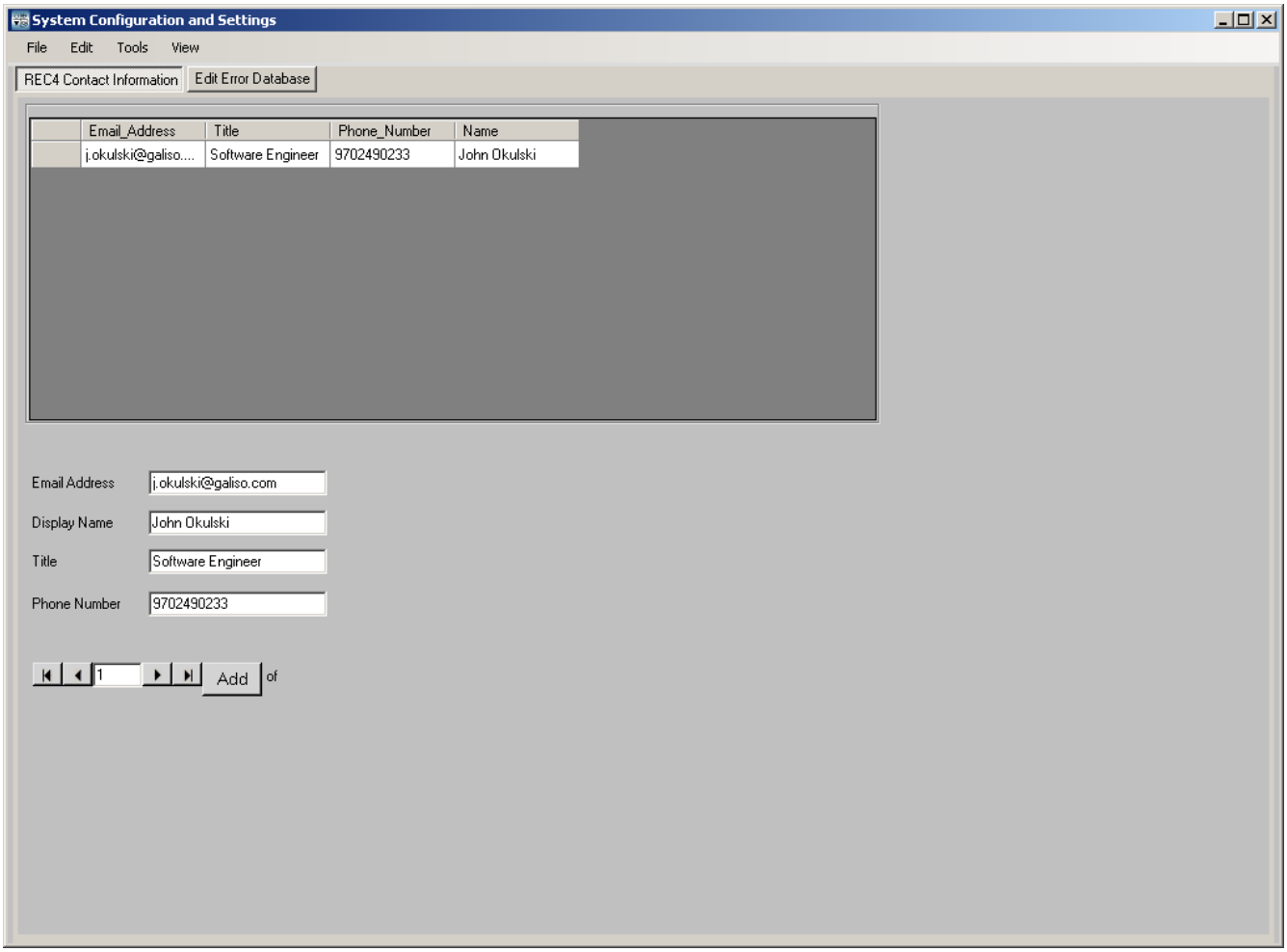
Rec 4 Settings Program

Figure 2: Rec4 Settings Home Screen



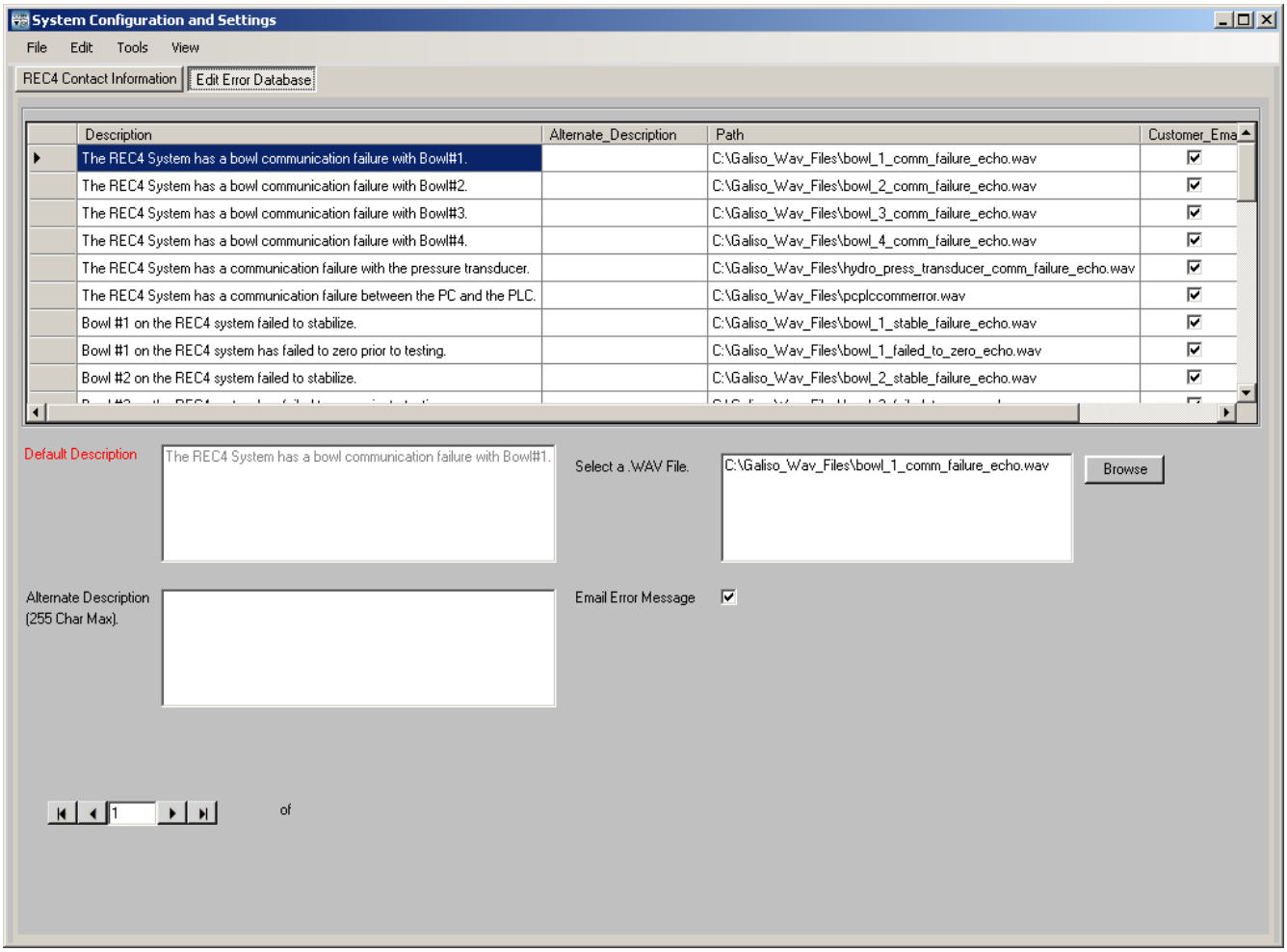
The Rec4 Settings program is where all settings and user defined parameters are made. It can only be accessed through the calibration screen by permitted users. To return to the testing screens, click <Tools>, <Open Test Forms>.

Figure 3: Error Messaging System; REC4 Contact Information Screen



Upon the event of an error, you may inform others via e-mail. Here is where you can input the e-mail addresses. Errors range from operator errors to machine function (system) errors.

Figure 4: Edit Error Database

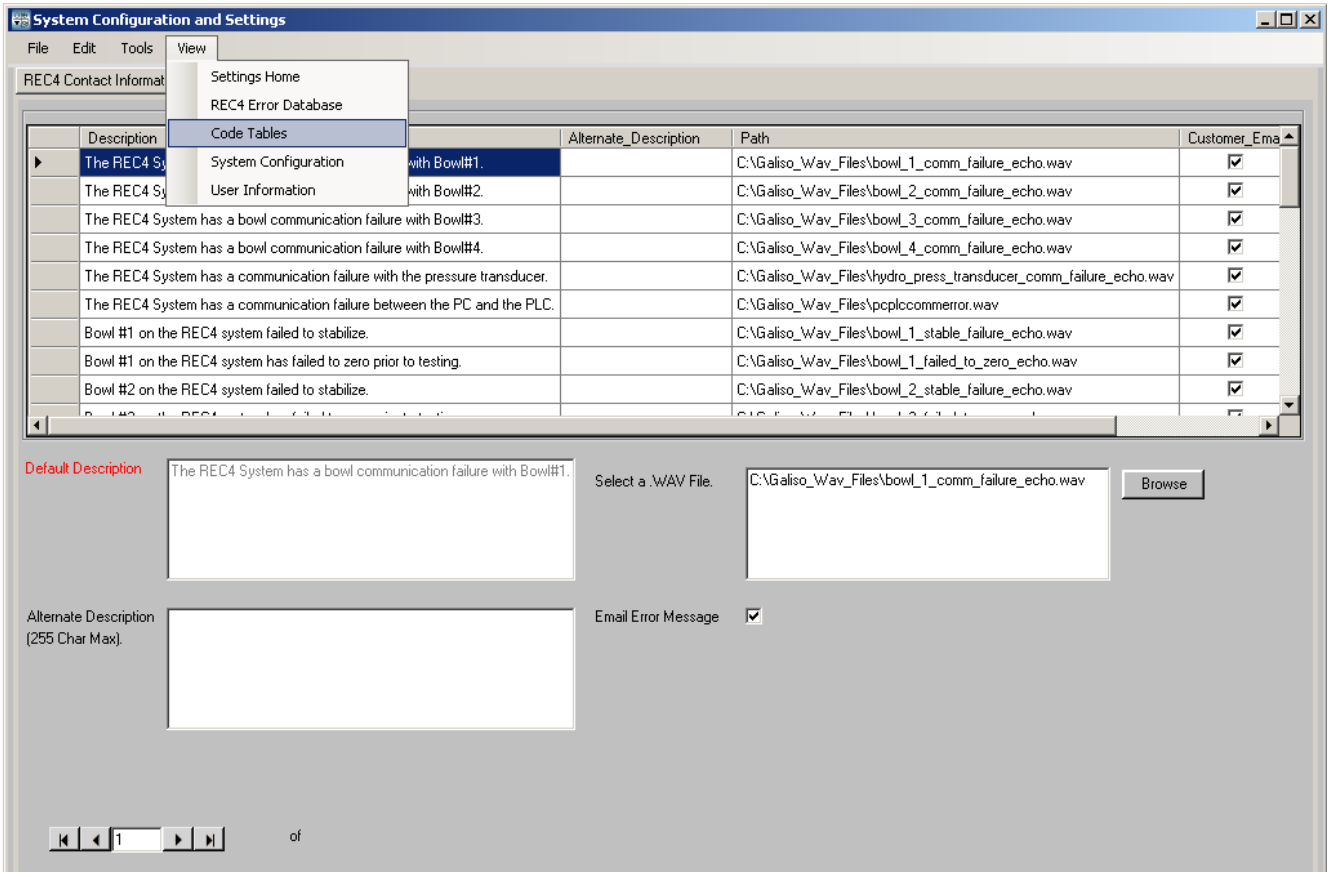


This screen contains the error database list. The default description cannot be changed. However, you can input an alternate description in text. This will appear in a red lettered text error message on screen upon the event of the error.

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. You may also change it 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.

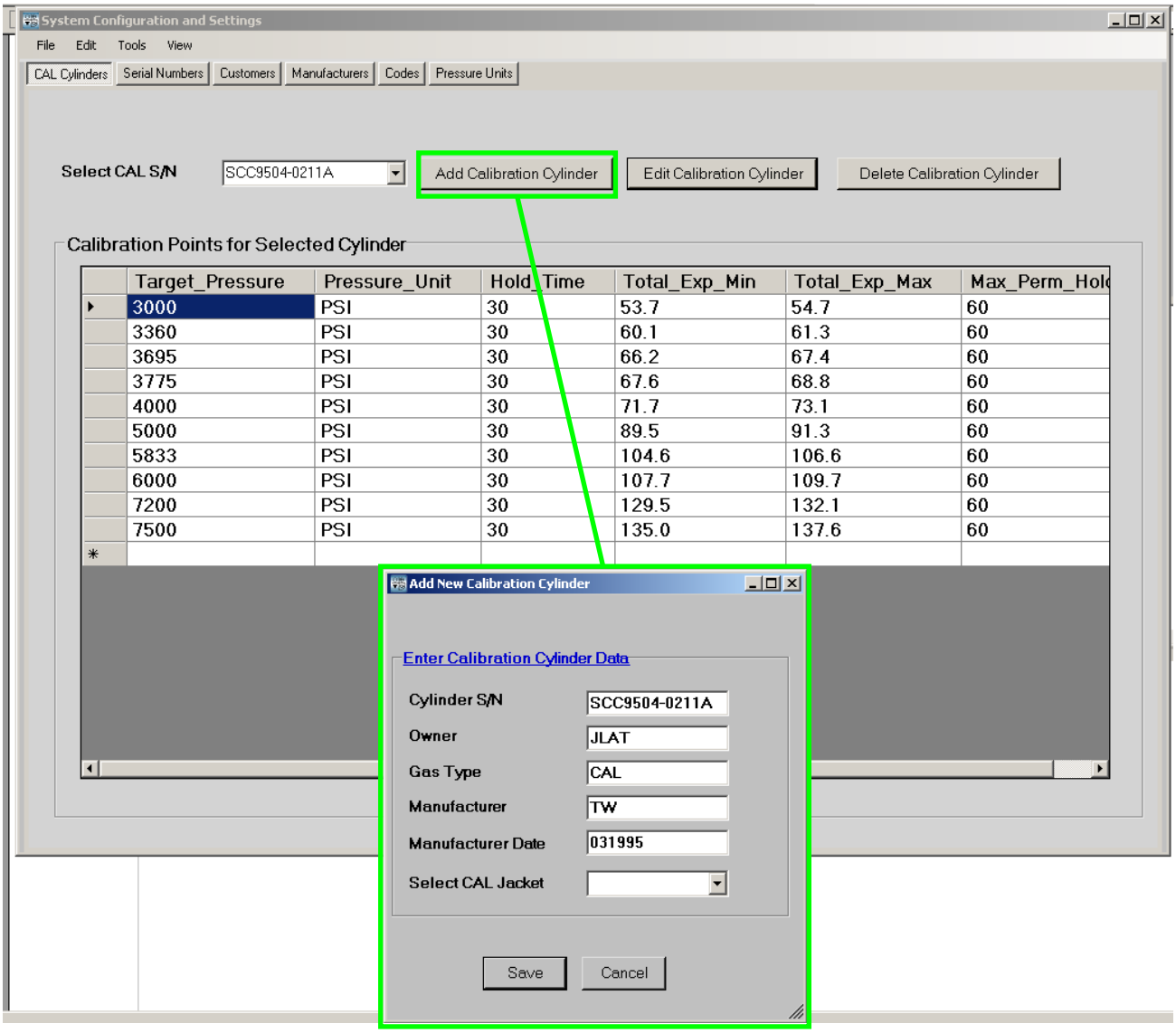
Figure 5: Settings Navigation



The <view> drop down menu shows the above options. From here, you can navigate to other screens in the R4 settings program.

<CAL Cylinders> screen

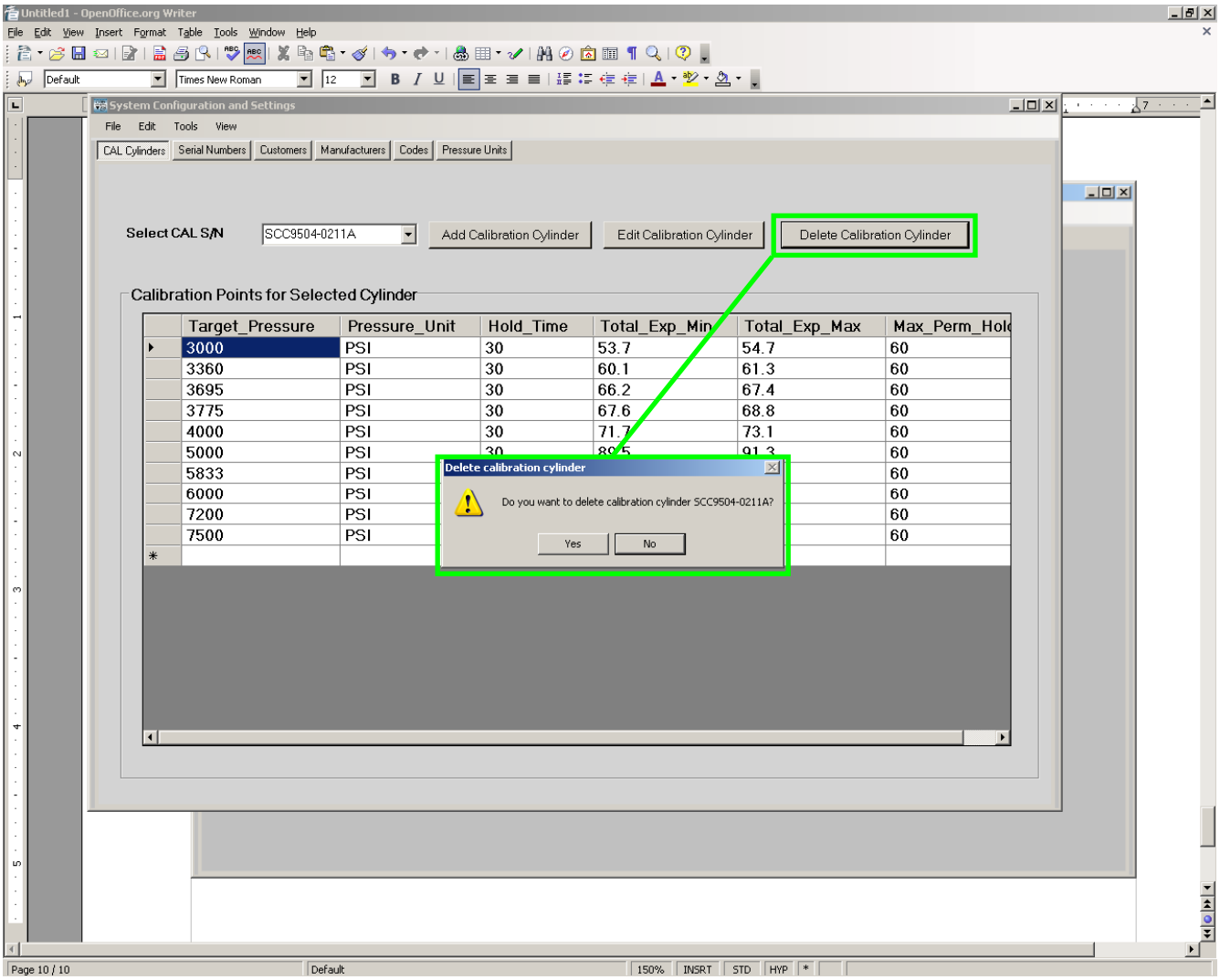
Figure 6: Add and Edit Calibration Cylinders



You can store all of the pertinent test data for the calibrated cylinders as shown above. The cylinder pressure points and expansions are saved for quick report of calibration. Using the <Select CAL Jacket> field you can verify the calibration on both jackets at the same time with 2 calibrated cylinders.

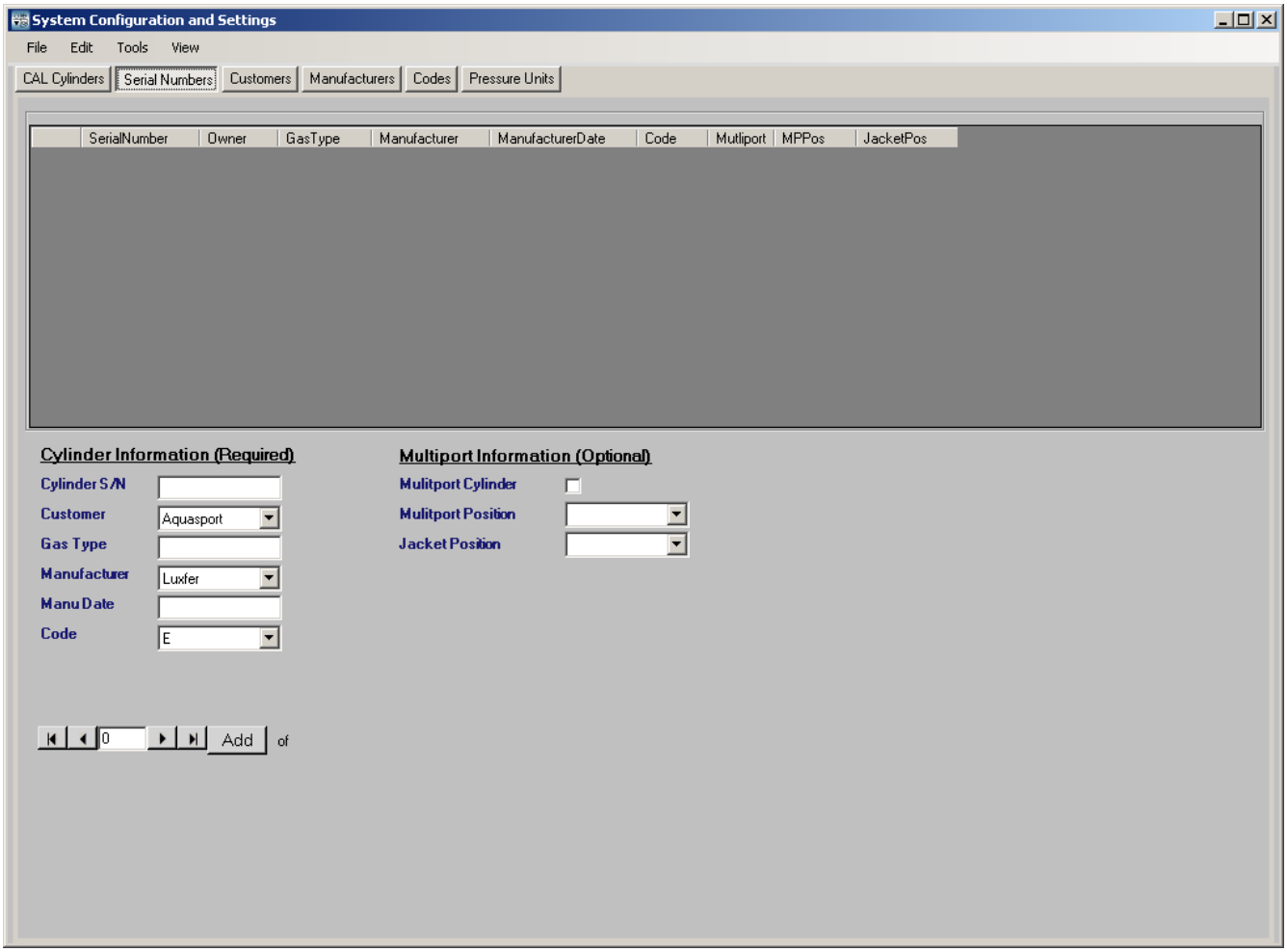
Use the <Save> button to save the cylinder information shown.

Figure 7: <Delete Calibration Cylinder> button



This is self explanatory. You can delete all calibration cylinder data on the selected cylinder.

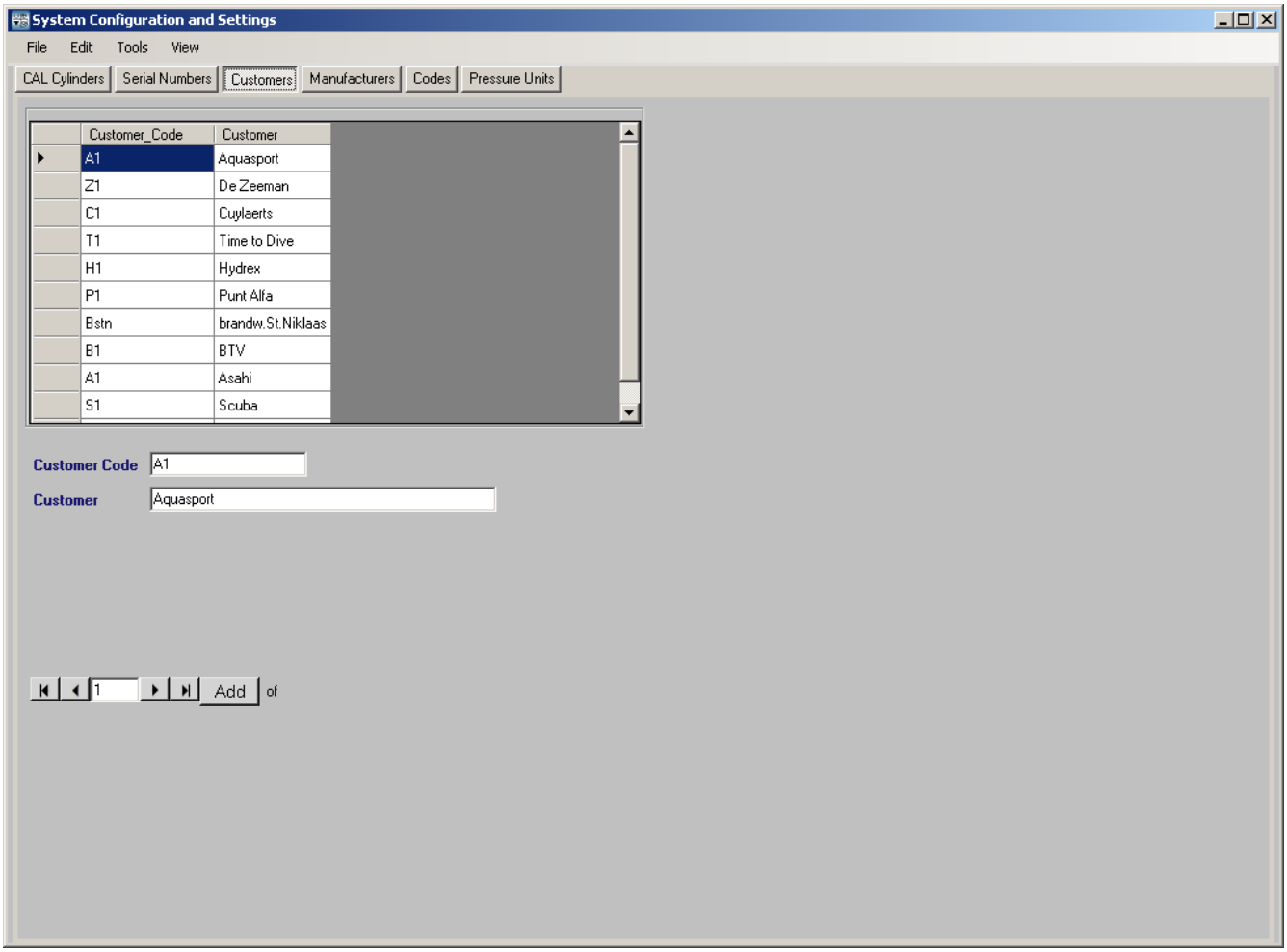
Figure 8: Cylinder <Serial Numbers> pre-entry method



This screen allows you to enter the test criteria for multiple cylinders, pre-test, for efficient data entry during testing. You can line up cylinders during a downtime, or a shop helper can line them up and 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, 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.

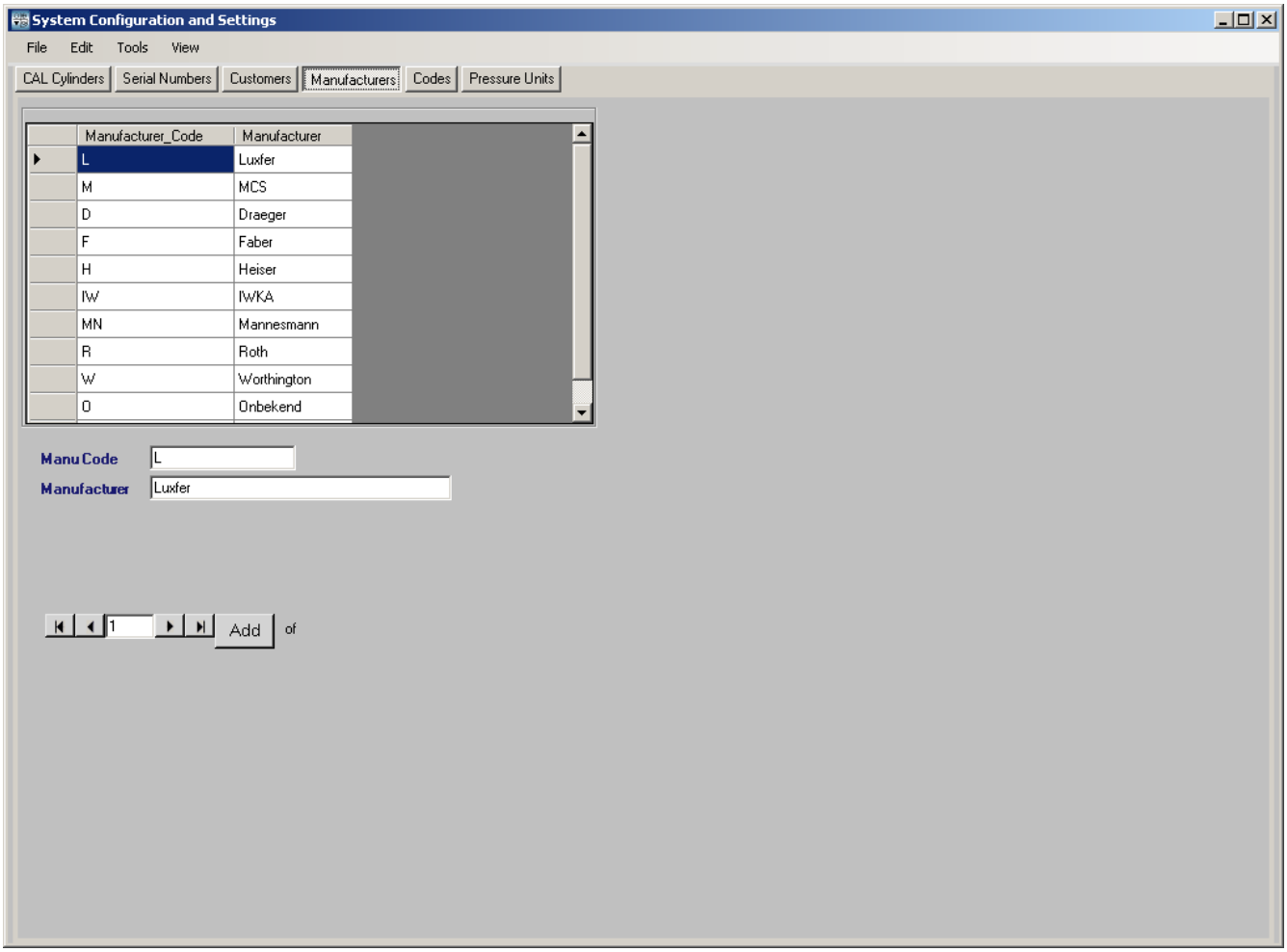
It also makes a provision for using the Galiso multiport head to load multiple (up to 4) cylinders into the jacket at the same time. Just switch the hi-pressure hose from one cylinder to the next. Select the correct <Multiport Position> in the program, and start the test.

Figure 9: <Customers> screen



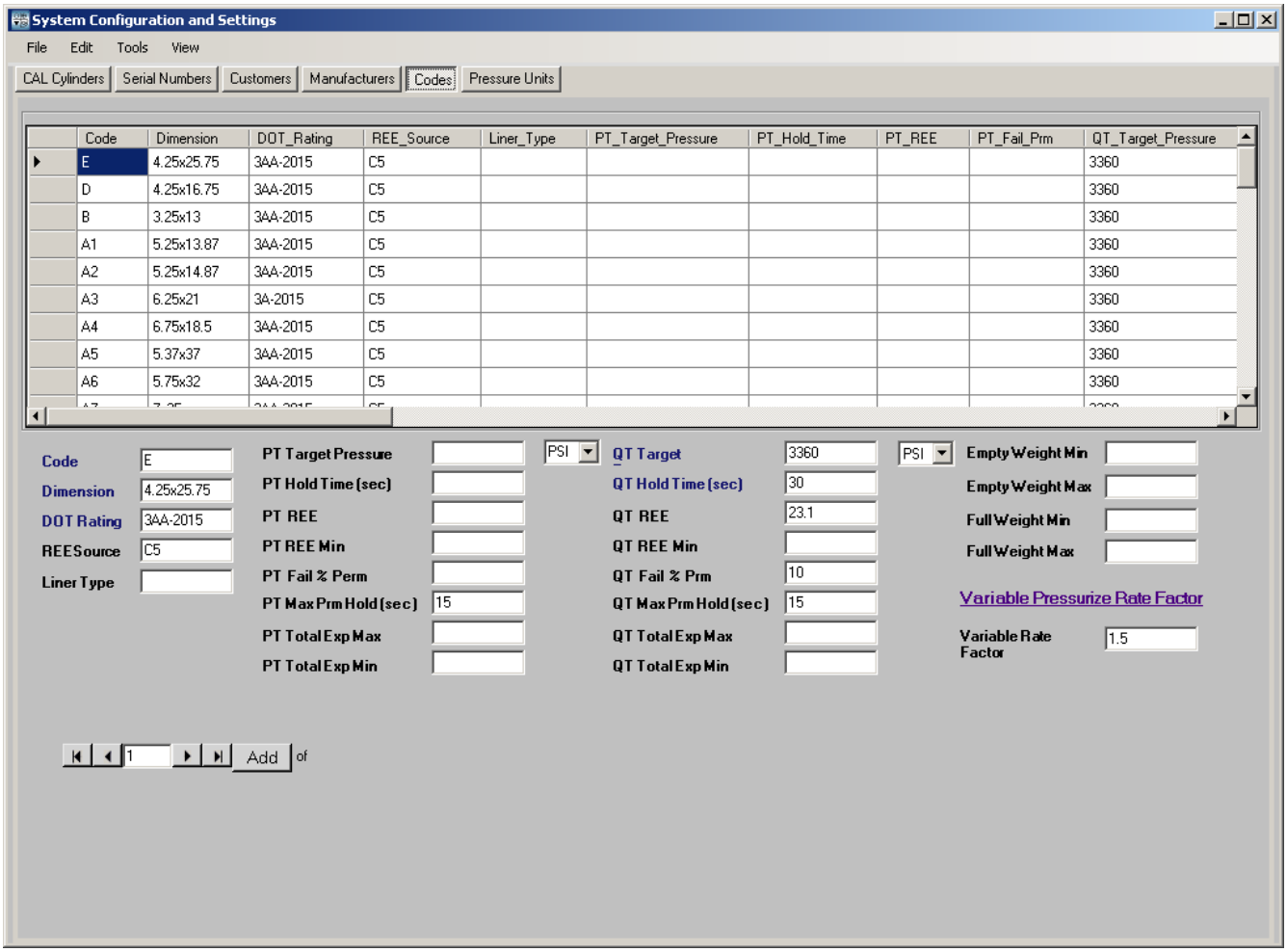
You can make a short code for easy test data entry of all your customers. Enter the short code and the program enters that customer in the <Customers> field on the test screen.

Figure 10: <Manufacturers> tab



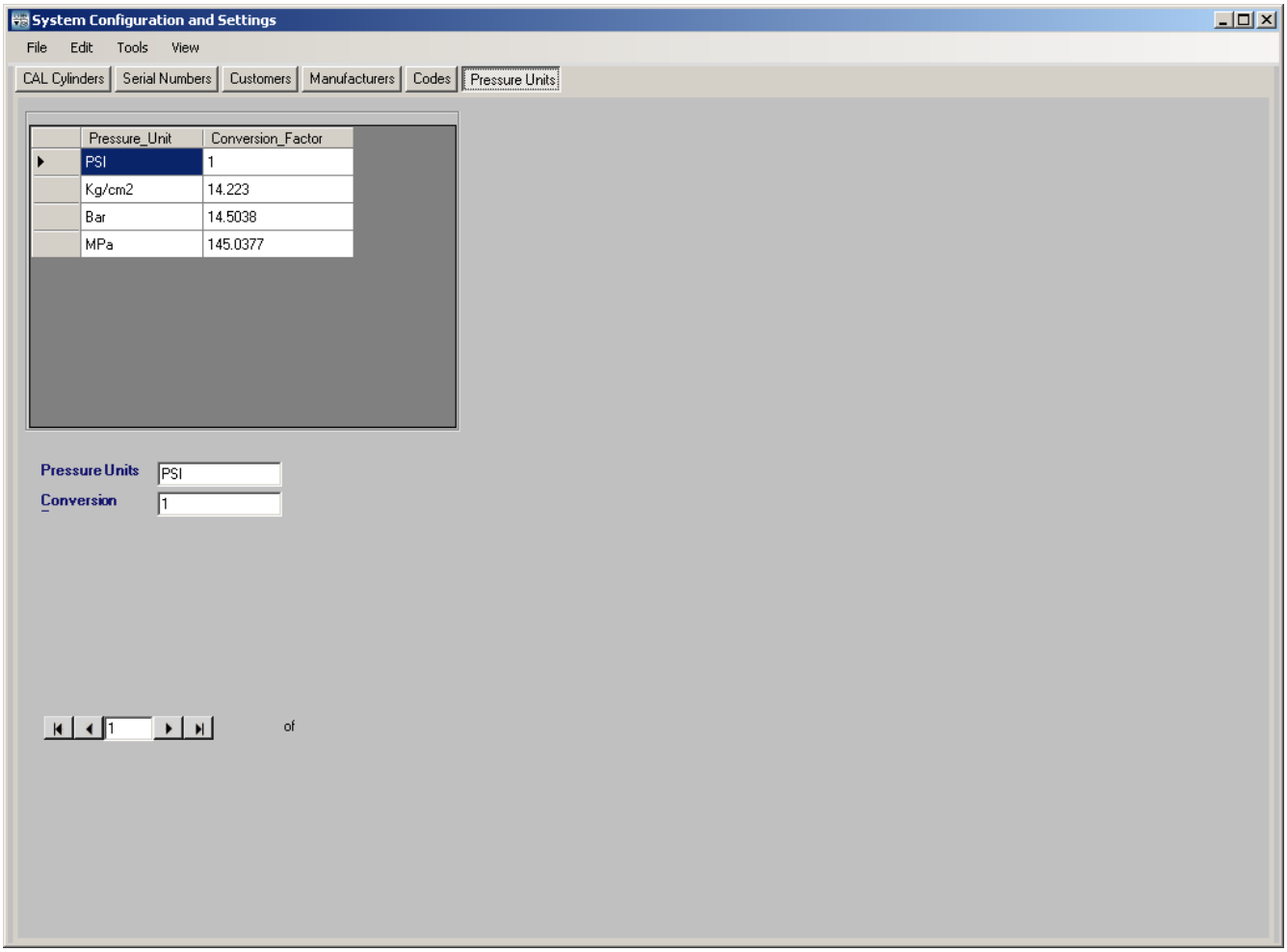
You can make a short code for easy test data entry of all your manufacturers. Enter the short code and the program enters that manufacturer in the <Manufacturers> field on the test screen.

Figure 11: <Codes> screen



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

Figure 12: <Pressure Units> screen

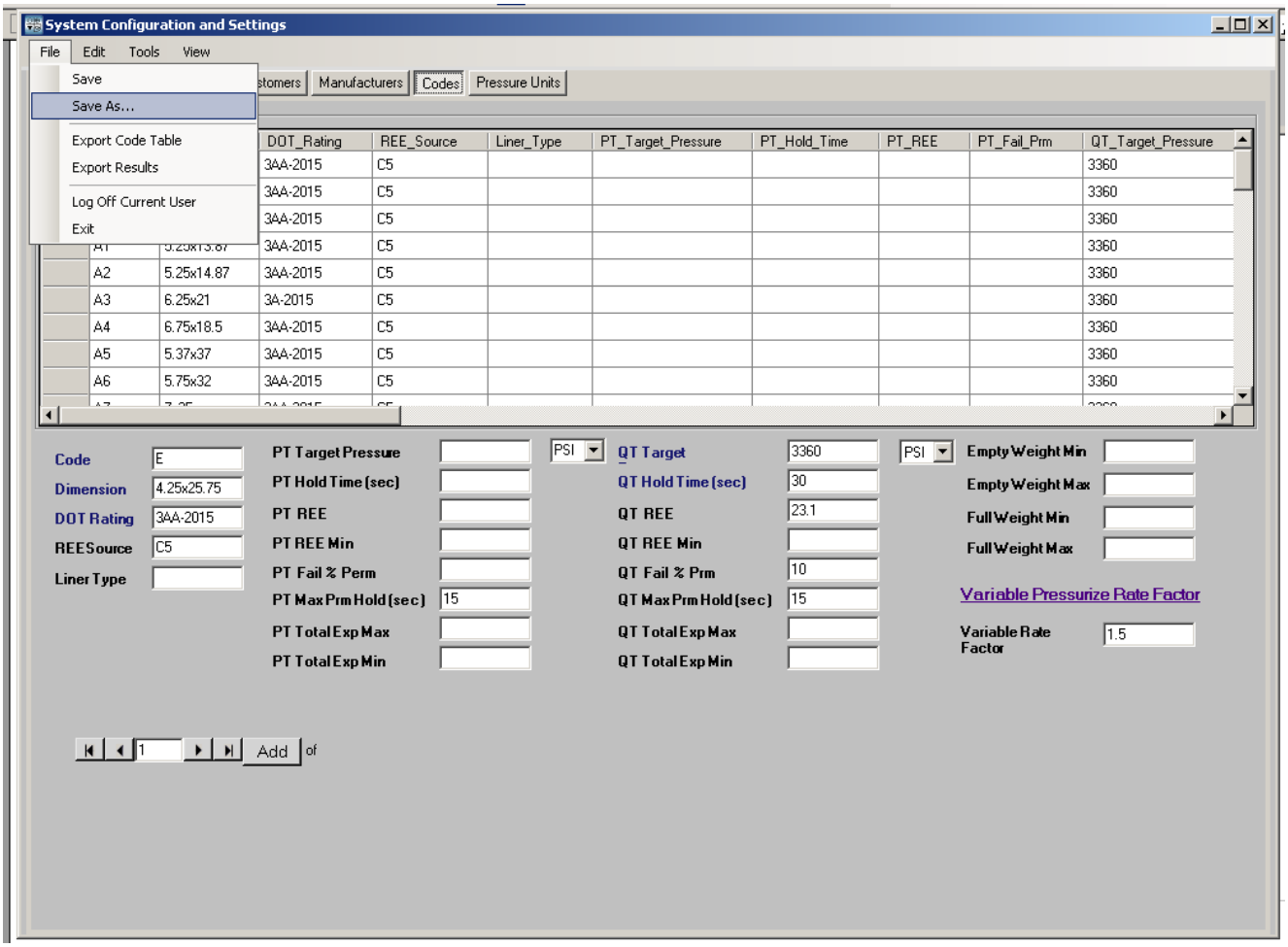


You may select from the pressure units above to display and test with for the test water pressure reading. Another pressure unit may also be created by entering the conversion factor from PSI.

Any changes made to 'Grid Lines', must be saved by going to the <File> menu, and clicking <Save> or <Save As>.

System and configuration settings drop down menus.

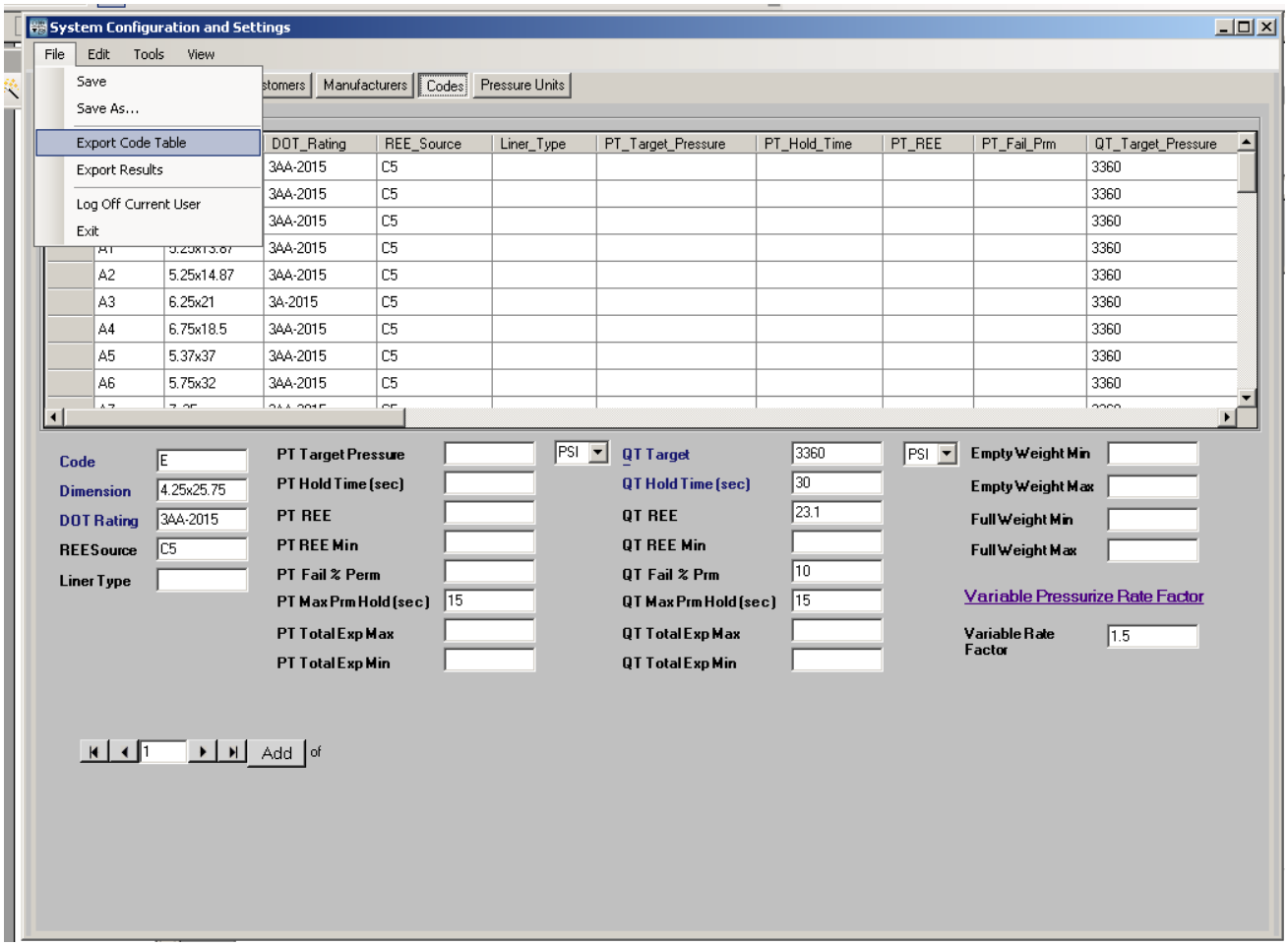
Figure 13: <Save> and <Save As> function



The <Save> function will always save the entire database (all grid/spreadsheet type files) to the **default** file location. The default file location cannot be changed. Please use the <Save> function after making any 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.

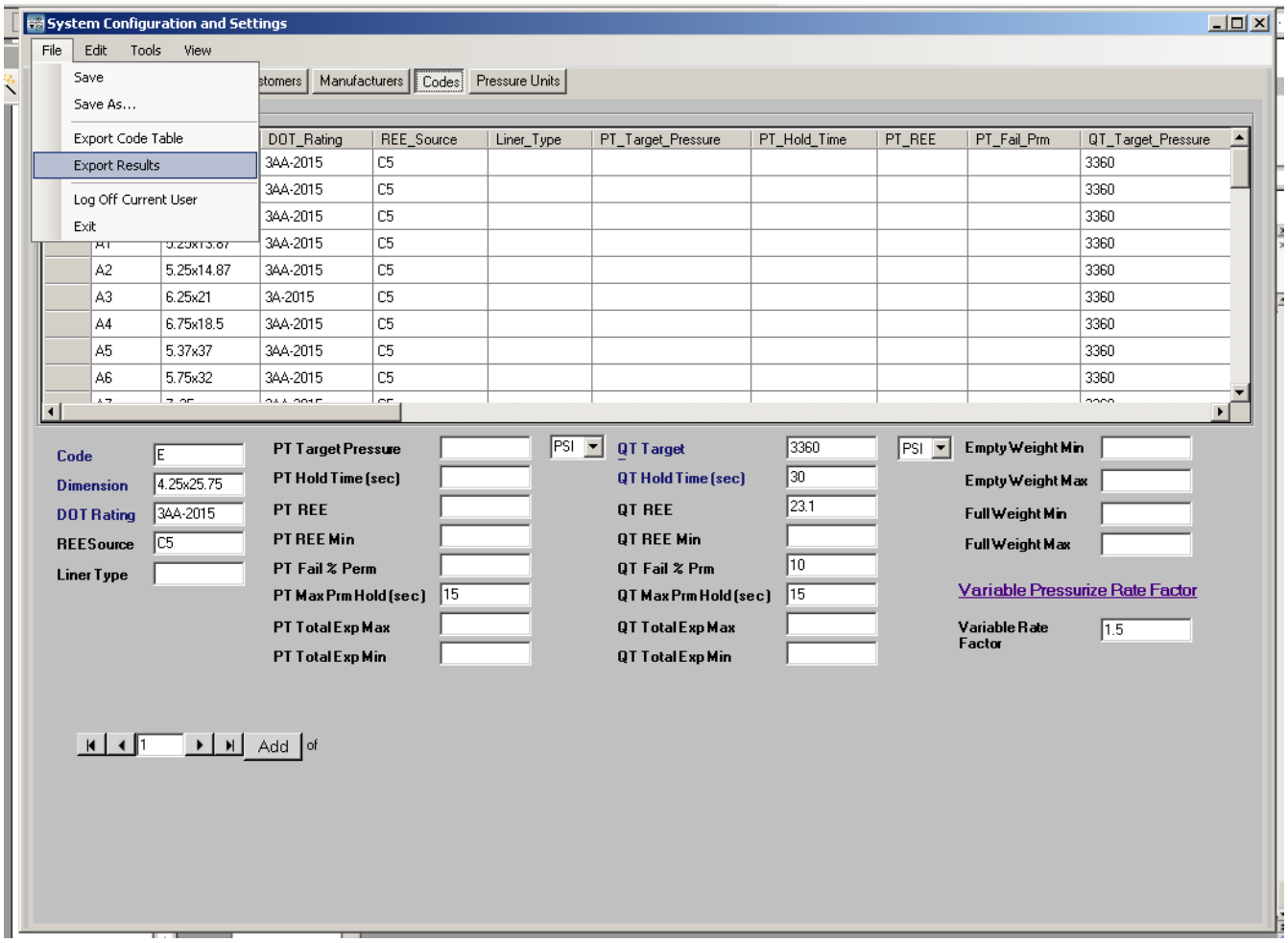
The <Save As> function enables you to **back-up** the same database set to another file location on your network. Please back-up the database when changes are made.

Figure 14: <Export Code Table>



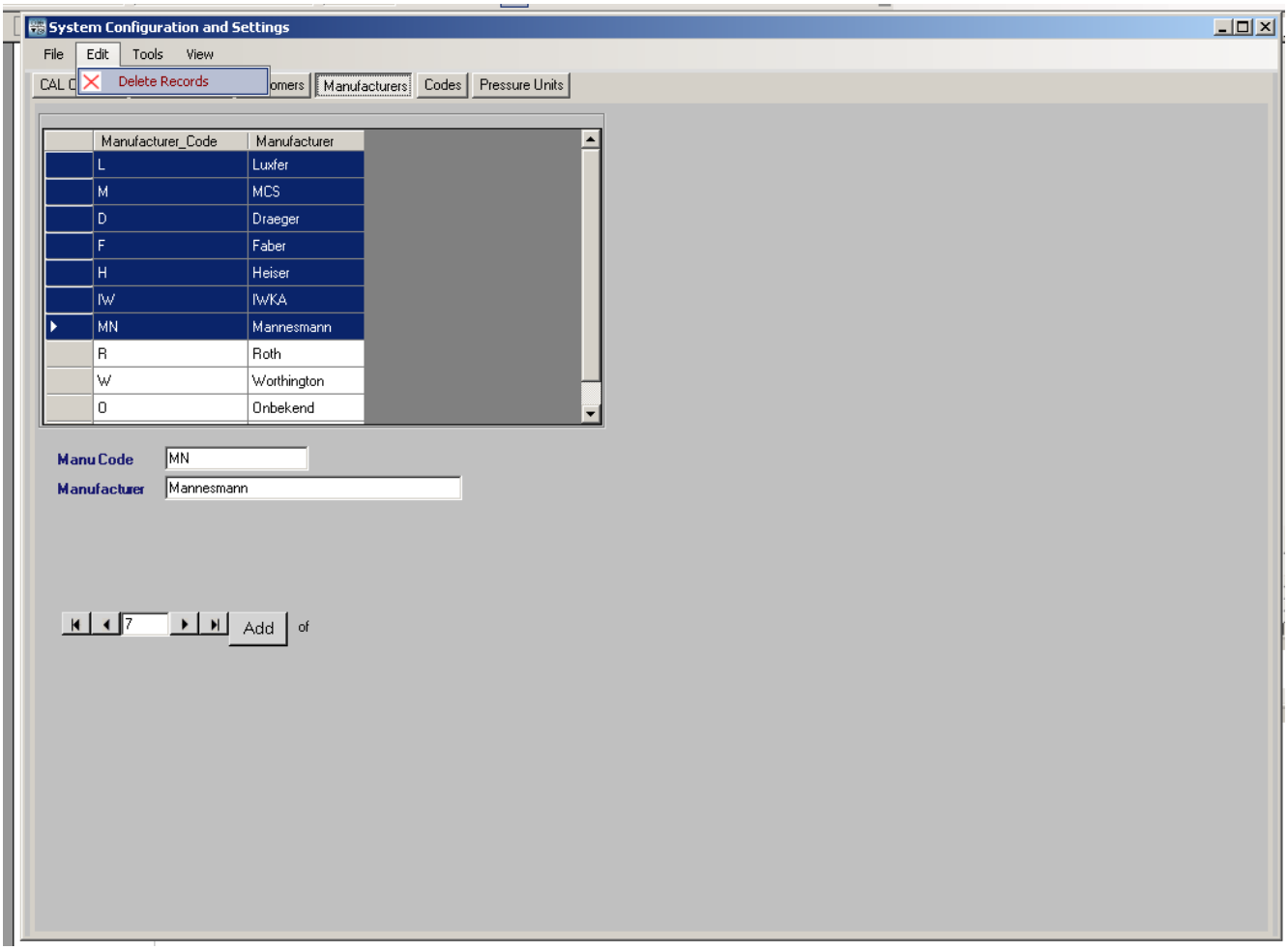
This function is to save and print the cylinder code table for the operator to have a hardcopy handy for ready reference. It is also for anyone who needs to view the table. It may be saved as a text file to use as needed.

Figure 15:<Export Results>



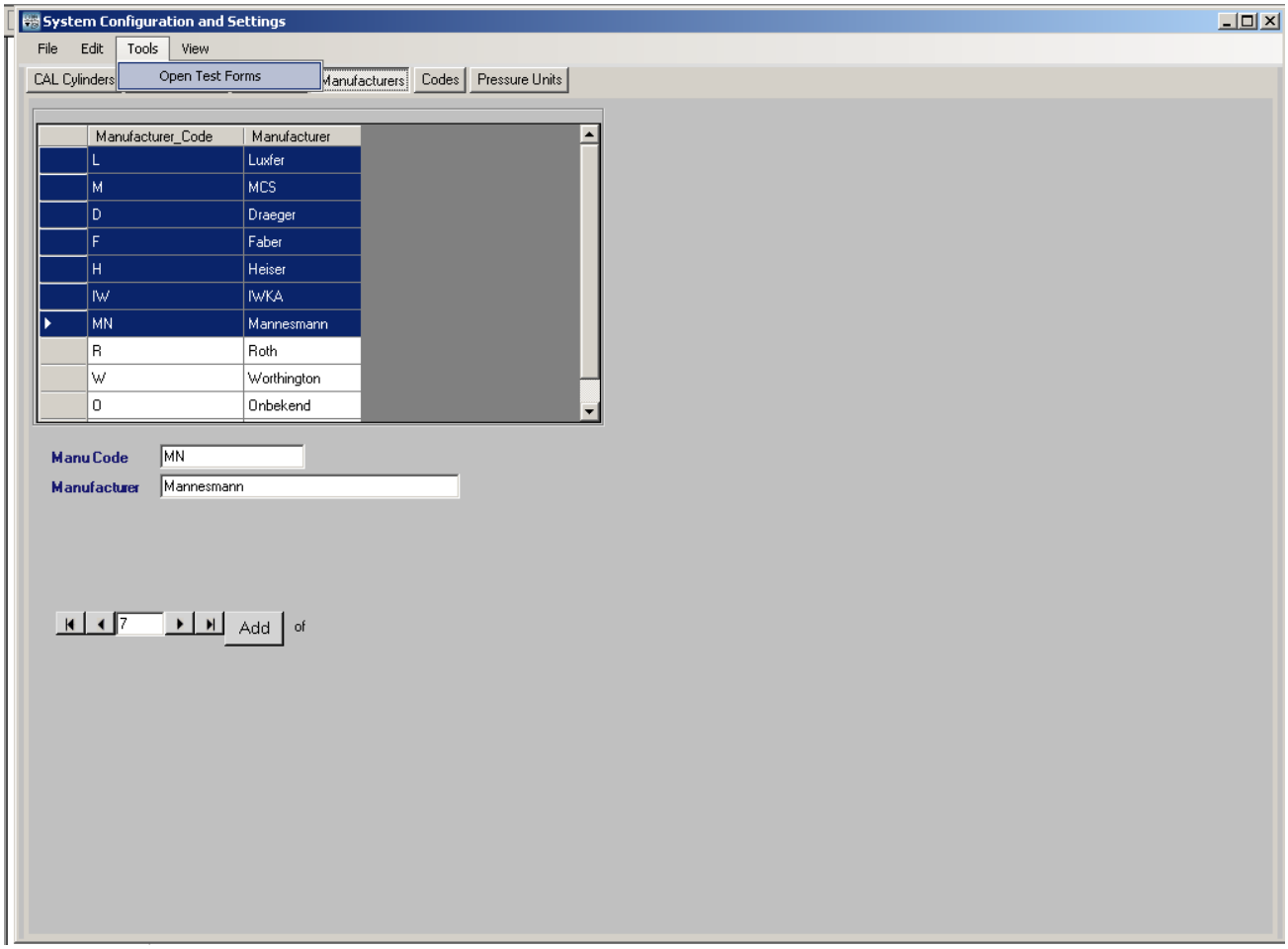
This function allows you to back-up the test results file for remote or duplicate storage. Upon execution of exporting the results, it will ask you if you want to remove the results from the current data base. Galiso recommends backing up the results and removing them from the current data base once per month, or periodically at your convenience.

Figure 16: <Delete Records>



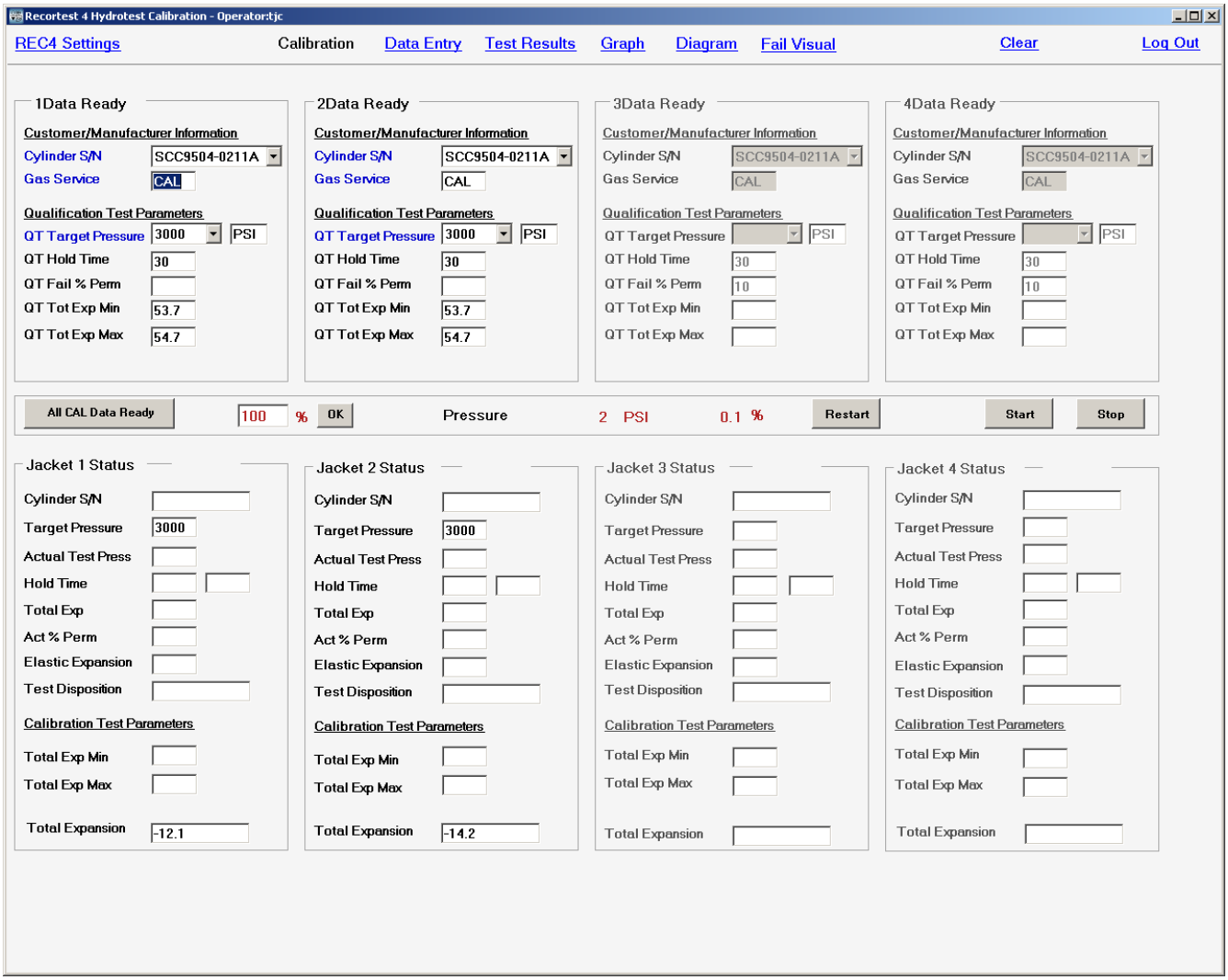
Unused, or unwanted data base items can be deleted here. Simply go to the desired data base (customer, manufacturer, etc…), make the desired record/item selections, and use the <Delete Records> button.

Figure 17: Go to test screens:



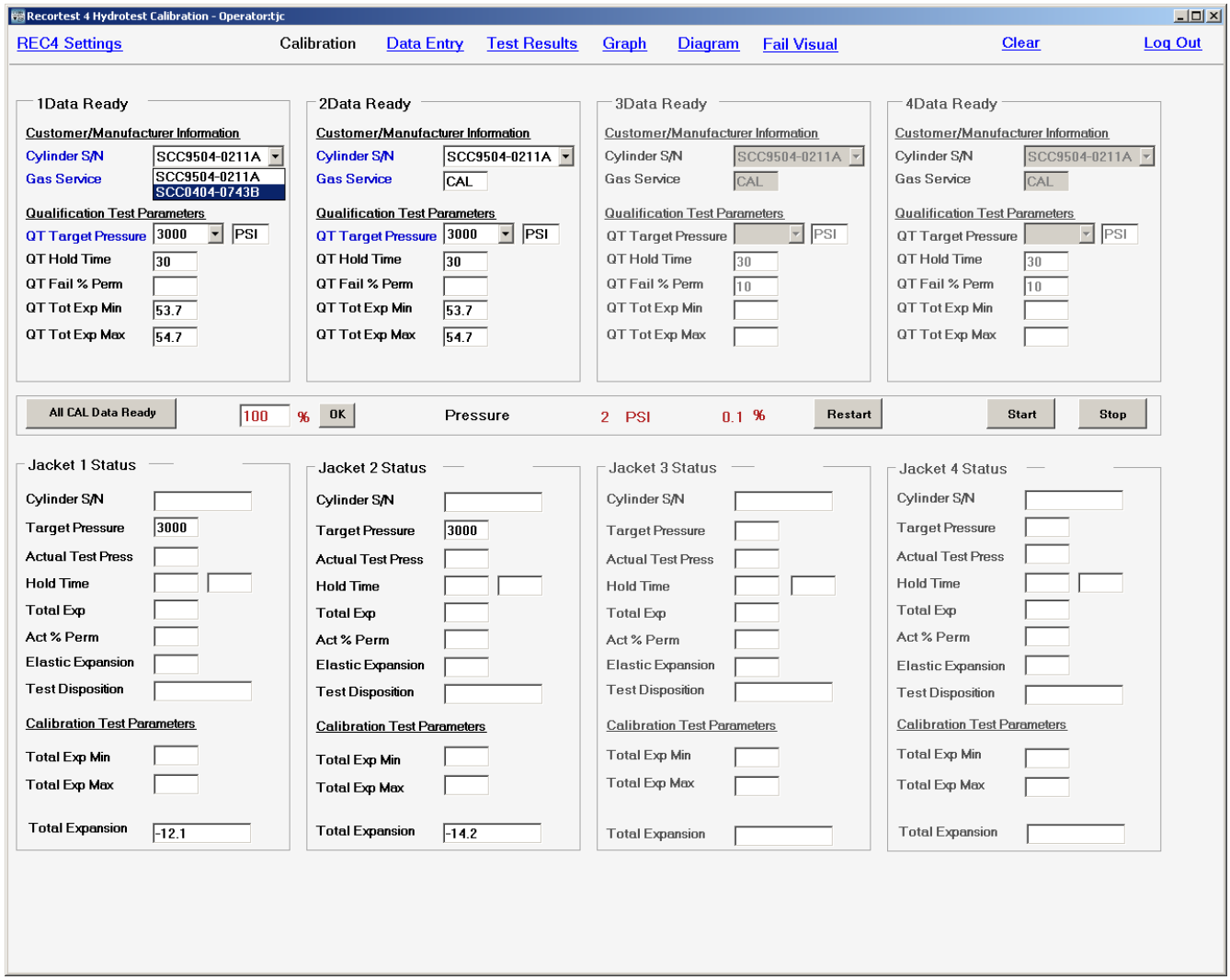
To navigate back to the test screens, use the <Tools> menu, and click the <Open Test Forums> button.

Figure 18: Start-up screen from R4 Settings:



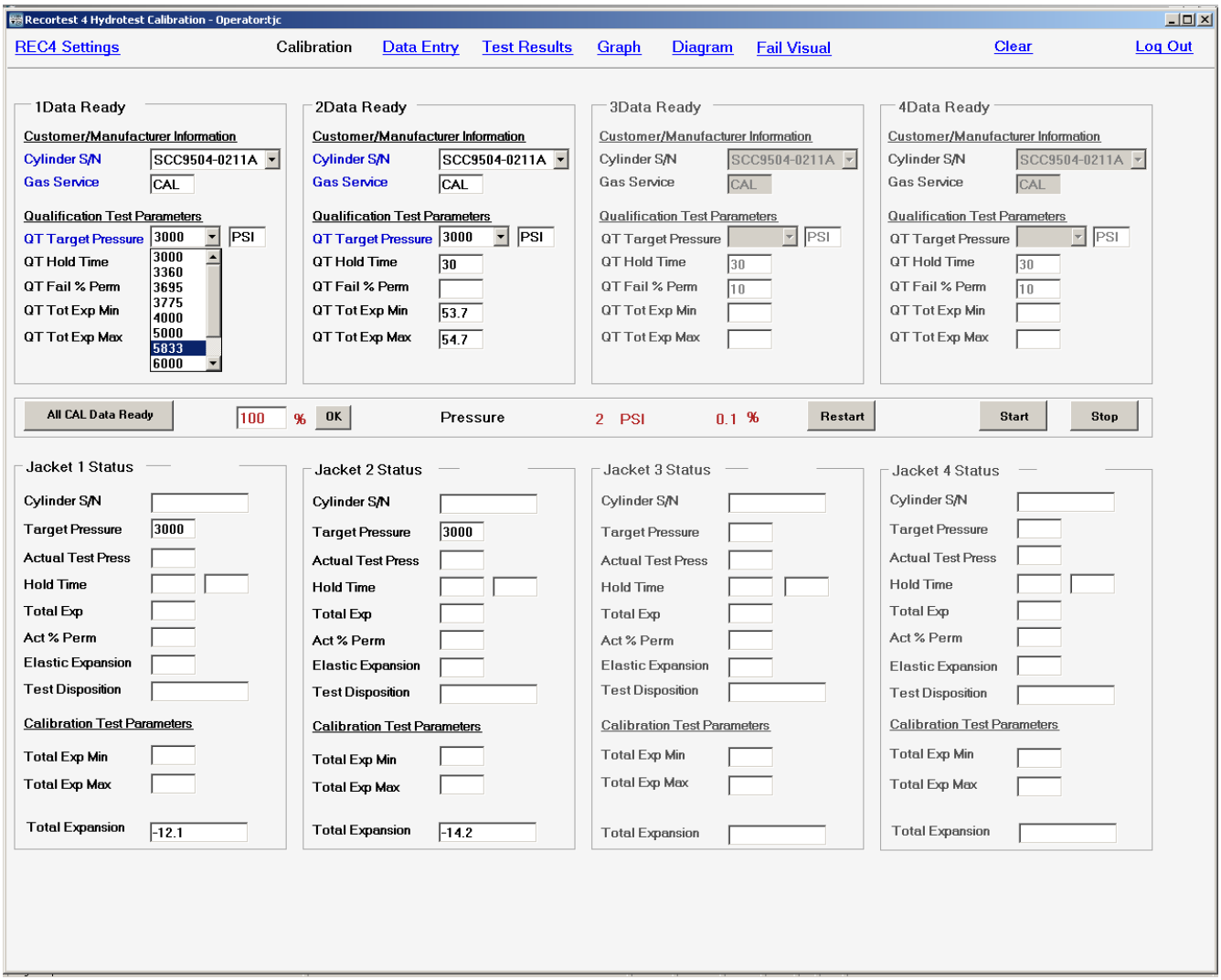
The calibration screen displays when first navigating to the test screens. This is the screen used when performing your daily calibration verification tests. Galiso recommends you adhere to the testing authority calibration verification regulations for the cylinders being tested.

Figure 19: Choosing a calibrated cylinder:



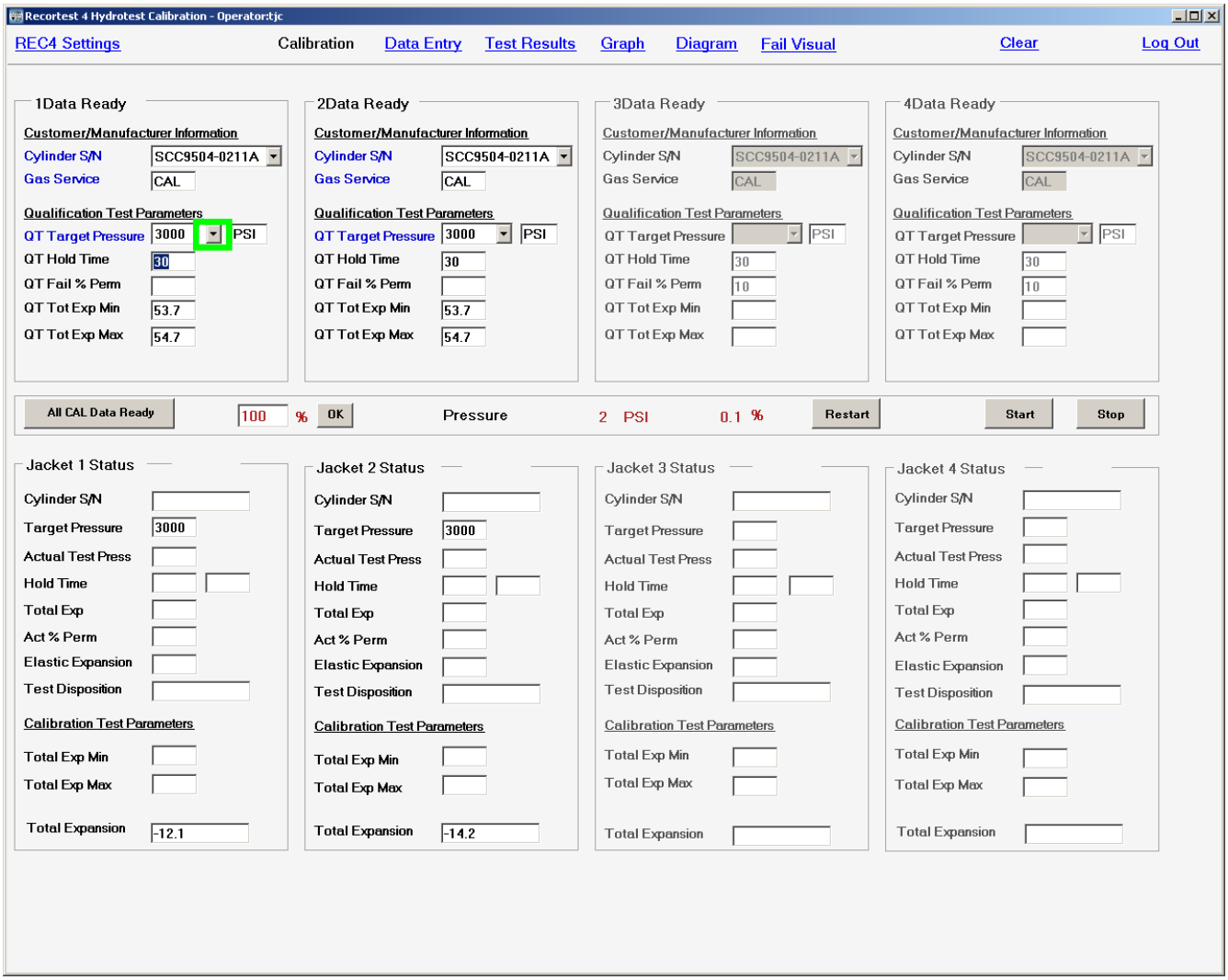
Here you may choose the calibrated cylinder for the jacket to be verified.

Figure 20: Calibration target pressure:



You can select the pressure for calibration verification. Galiso recommends verifying within 500 PSI of the test pressure for every cylinder to be tested that day.

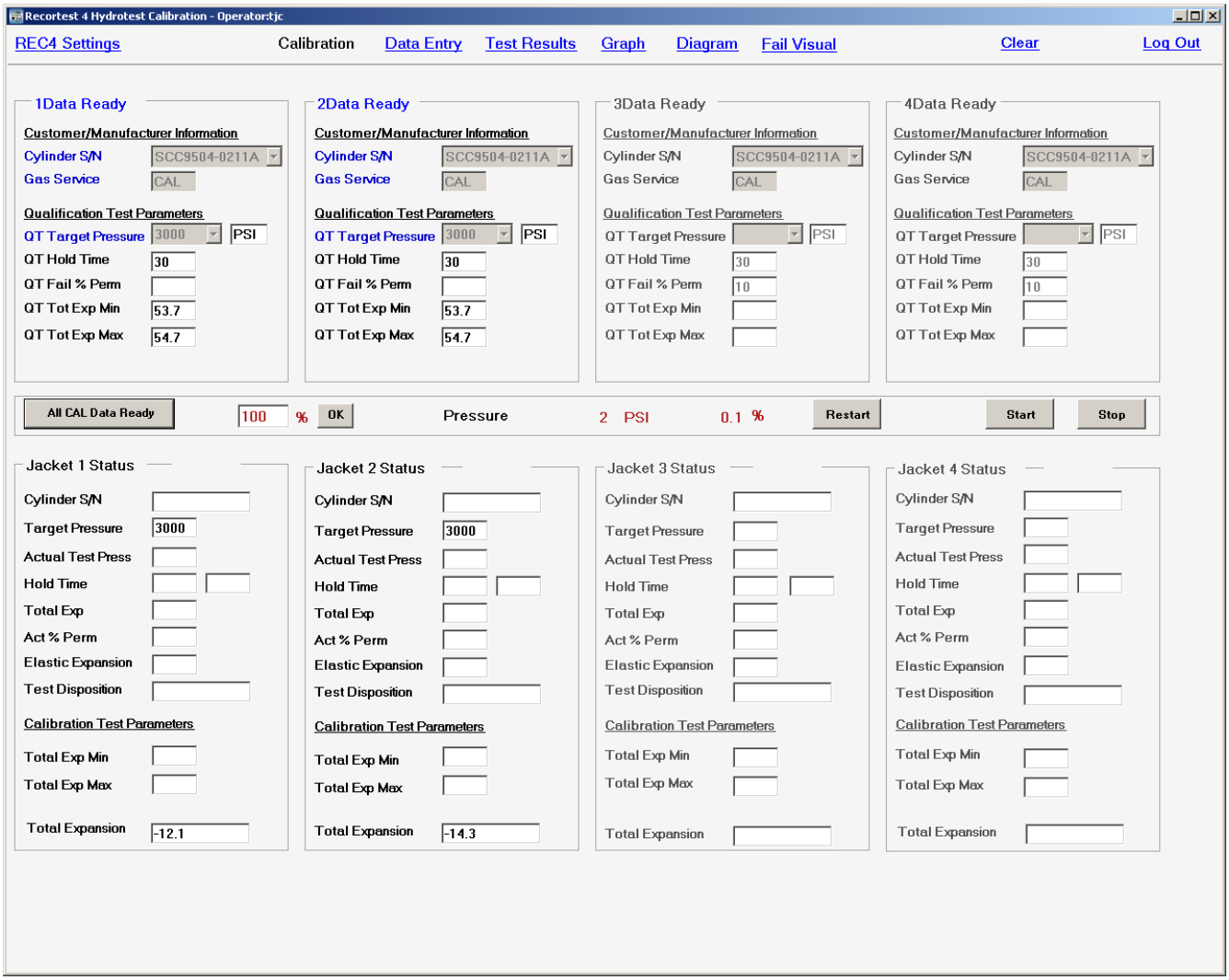
Figure 21: Other qualification test parameters:



All test parameters for the cal cylinder serial number are entered automatically from the code table data base. You can manually change the parameters in each field before testing if needed. The target pressure can be selected by clicking the <down arrow> as outlined in Green above. The default pressure is already selected to 3000PSI.

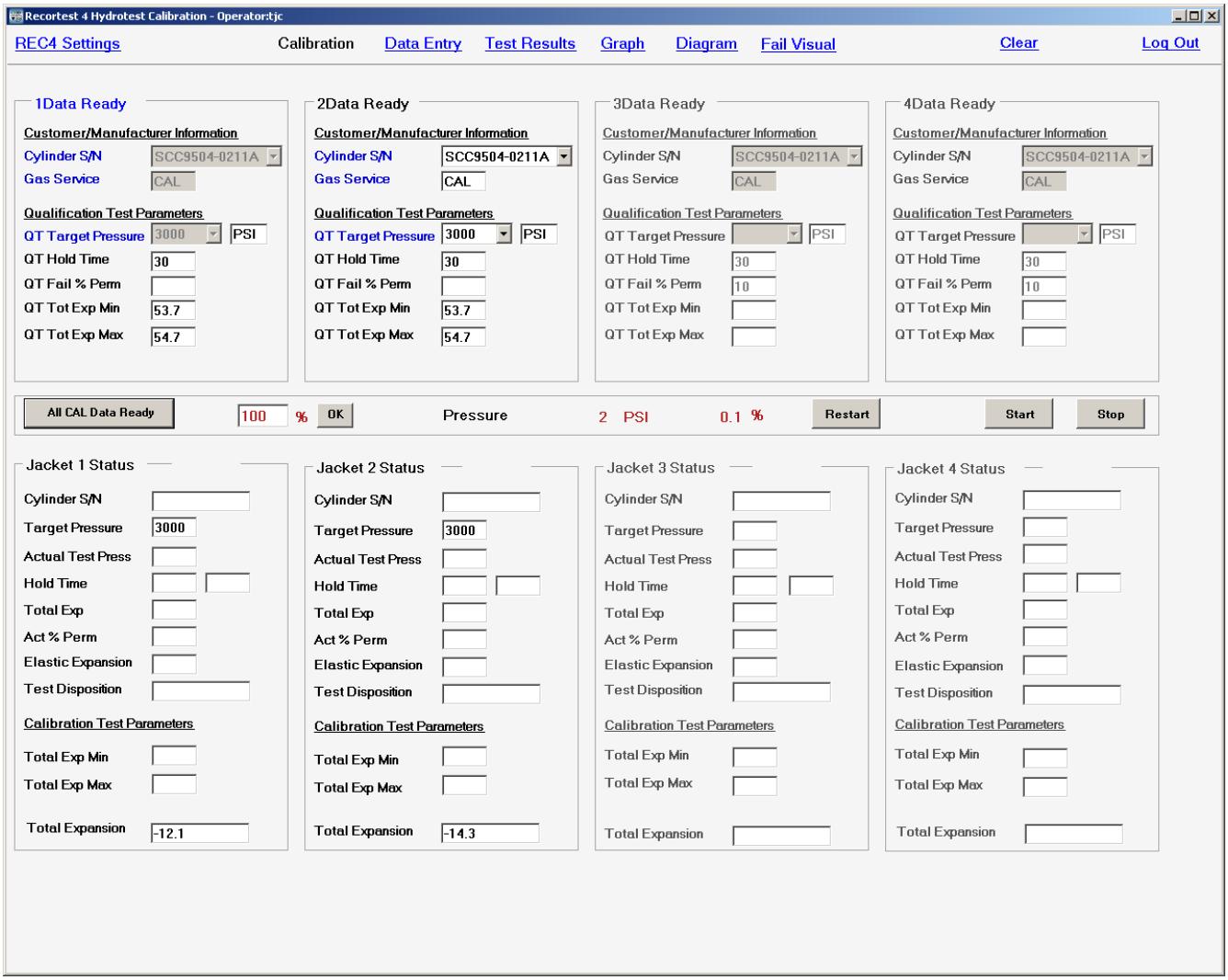
Command line options:

Figure 22: <All Cal Data Ready> button:



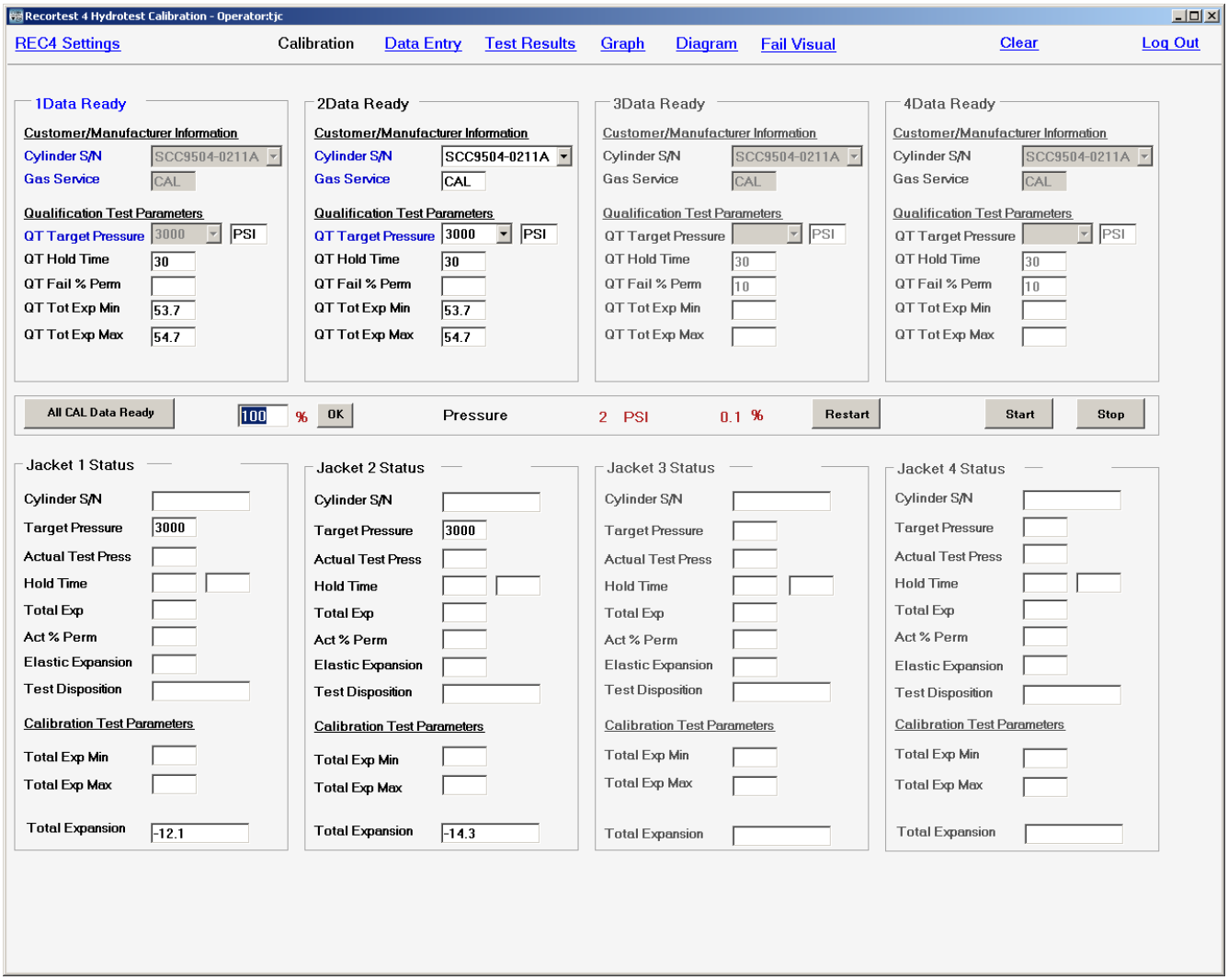
You must inform the testing program that all of the test data is entered correctly. If both jackets have cal cylinders in place, and are testing the same pressure, you may use this button. The <1 Data Ready> and <2 Data Ready> text lines will turn Blue on both jackets when the program accepts the inputted data.

Figure 23: Single Jacket Data Ready:



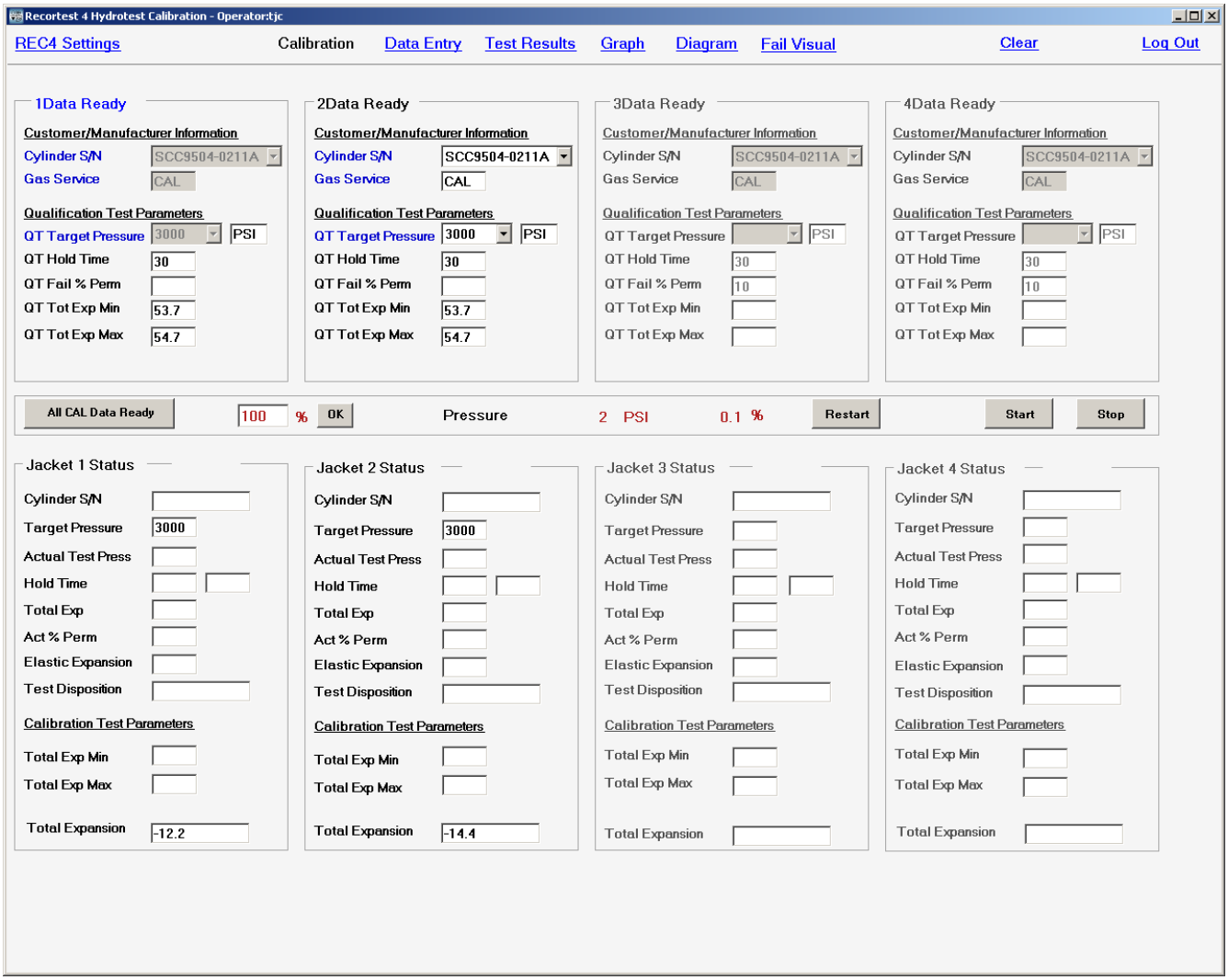
If only one jacket is ready for calibration verification, you may select only that jacket by clicking on the <1 Data Ready> or <2 Data Ready> lines of text (the text lines are also buttons) individually. The text will turn Blue, on the jacket to be tested.

Figure 24: Calibration target cut-off percentage:



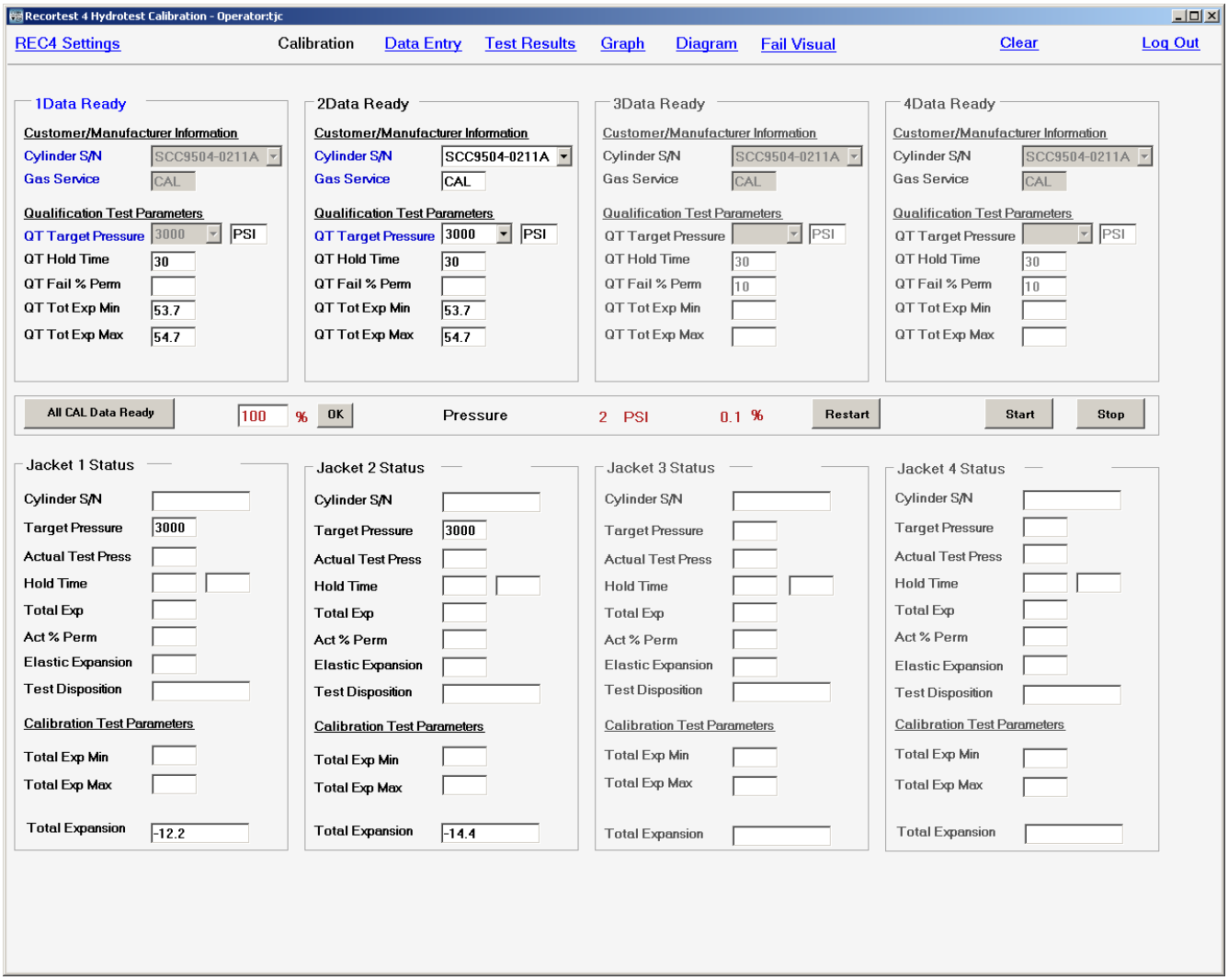
The actual pressure attained can be increased by adjusting the percentage. For example, if it is imperative that the test pressure is maintained throughout the test, you need to increase the pressure attained (target pressure). During the pressure hold time, the pressure will drop. The amount of drop 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, you can adjust the percentage to 100.2% so the pressure will not drop below test pressure during the test.

Figure 25: Actual pressure and target percentage displays:



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

Figure 26: <Restart>; <Start> and <Stop> buttons:

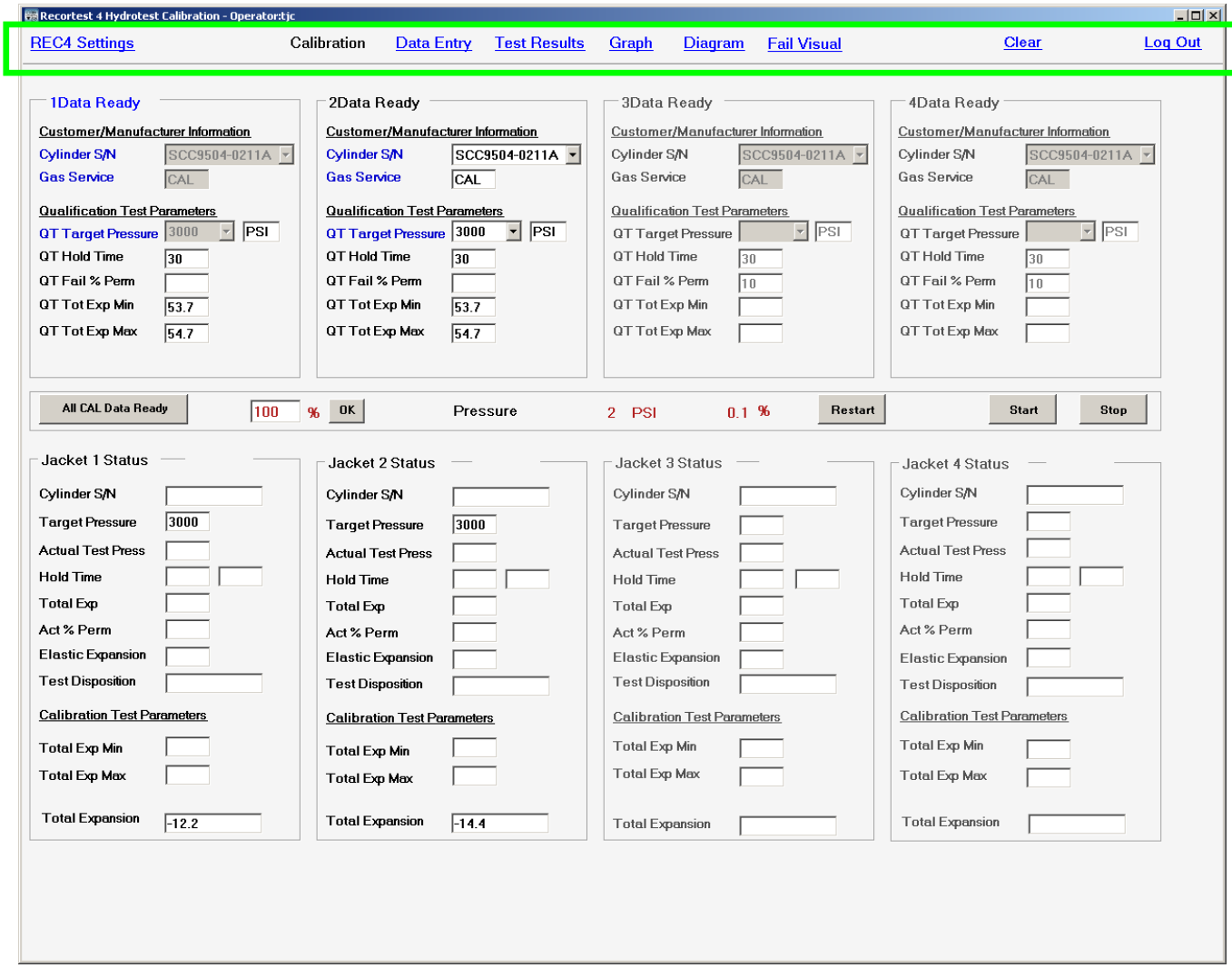


Click the <Start> button to start a test when the <Data Ready> buttons are Blue in color. This button starts the pressurization process.

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.

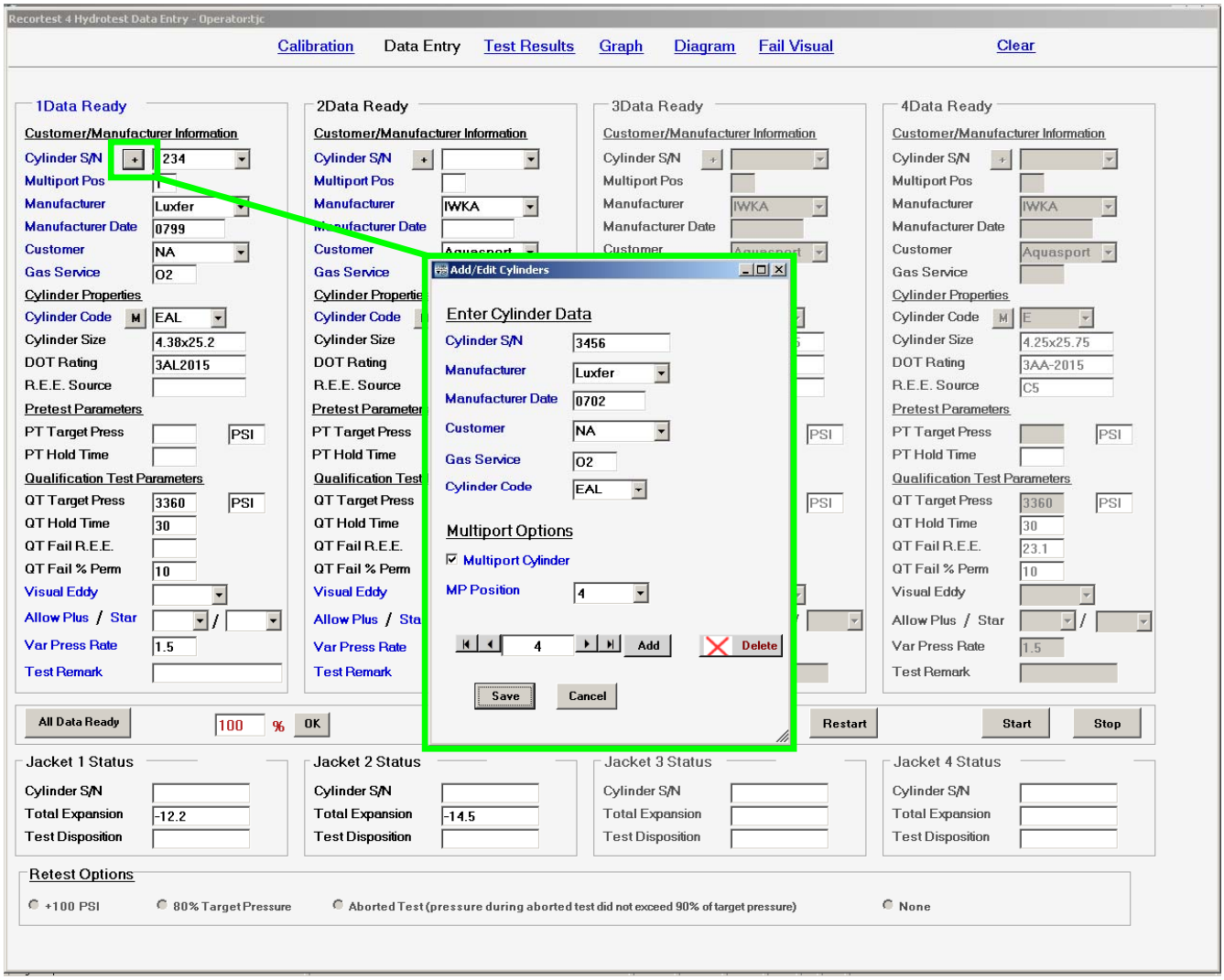
Click the <Restart> button to retest a failed or aborted test. If, for any reason, the calibrated cylinder fails the test, you can immediately run another calibration test. The operator should determine another test should pass before performing the retest.

Figure 27: Menu Line:



The menu line is outlined above in Green. Each item on this line will be explained further, later in the manual.

Figure 28: <Data Entry> screen; Add/Edit Cylinders window:



The <Data Entry> screen is where the recorded cylinder tests are performed.

By pressing the <+> button outlined in Green above, you can enter the data for multiple cylinders that are ready for testing. You can input the data for each cylinder in the same order the cylinders are physically lined up in the shop. This allows the data entry task to be performed first, so you can concentrate only on testing later. 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. You can input positions 1 through 4 for the corresponding cylinder to head location. Then, only moving the hose between positions is necessary to test all 4 cylinders without removing the test head.

Of course, all test parameters can be inputted manually during testing too.

<Cylinder Serial Number> entry field: The S/N must be entered here for pre-test data entry. Upon the successful start of a test, the S/N and cylinder 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’ for cases where the information does not apply.

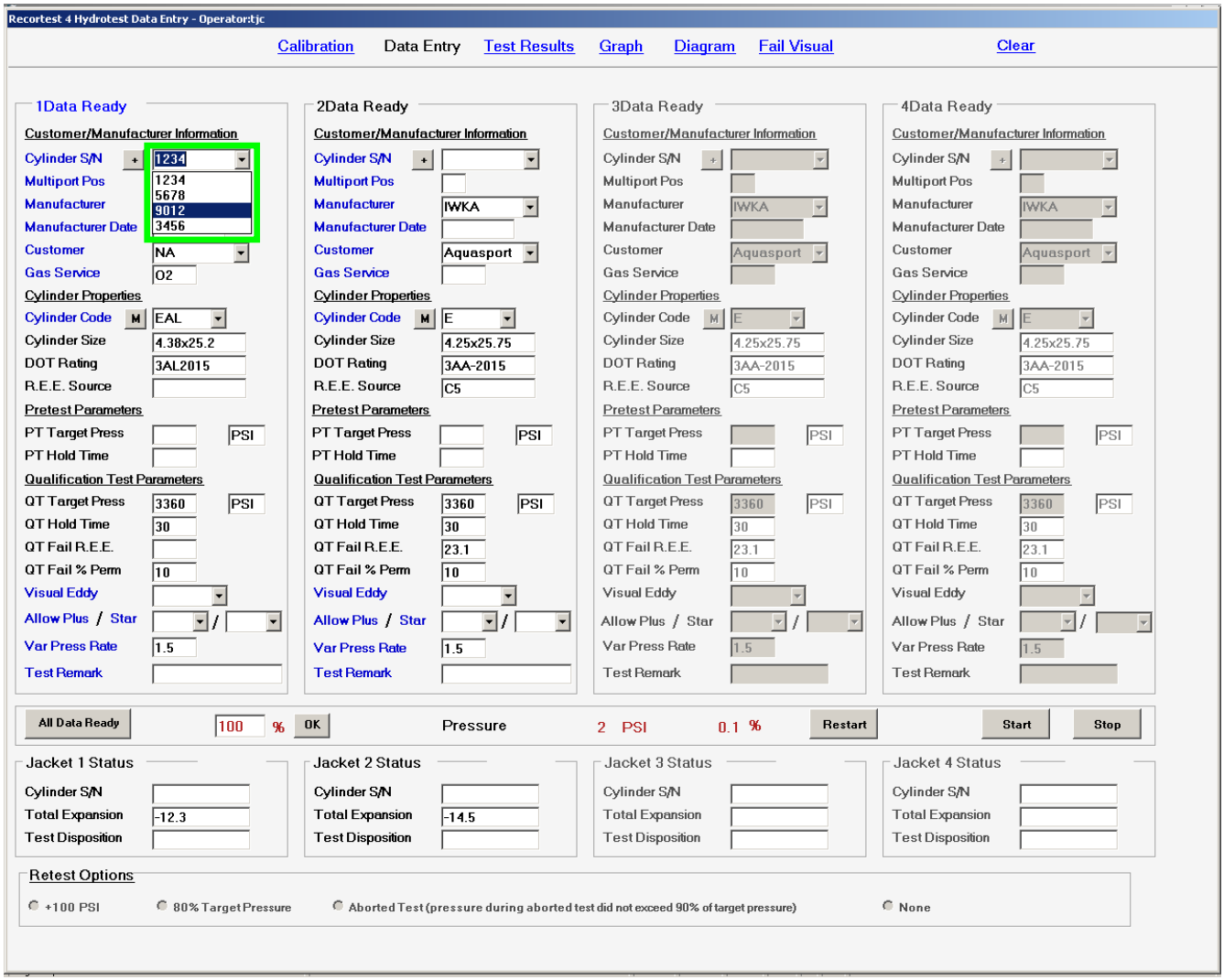
<Manufacturer Date> field: This is a manually inputted item. The field accepts 2 date formats.

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.

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

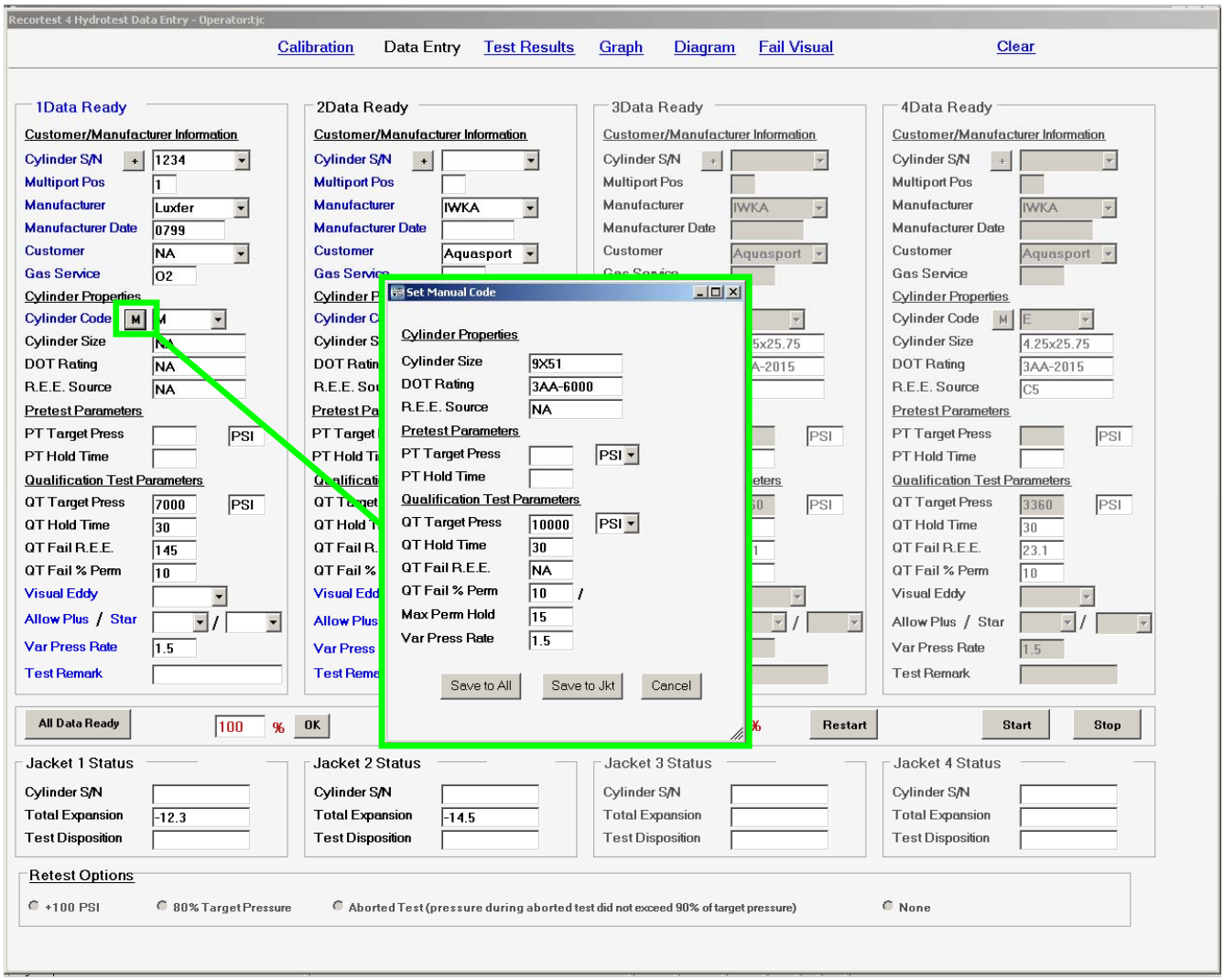
Figure 29: Choosing a pre-entered cylinder:



As stated above, you can choose a cylinder out of order here.

Cylinder properties:

Figure 30: <Set Manual Code> window:



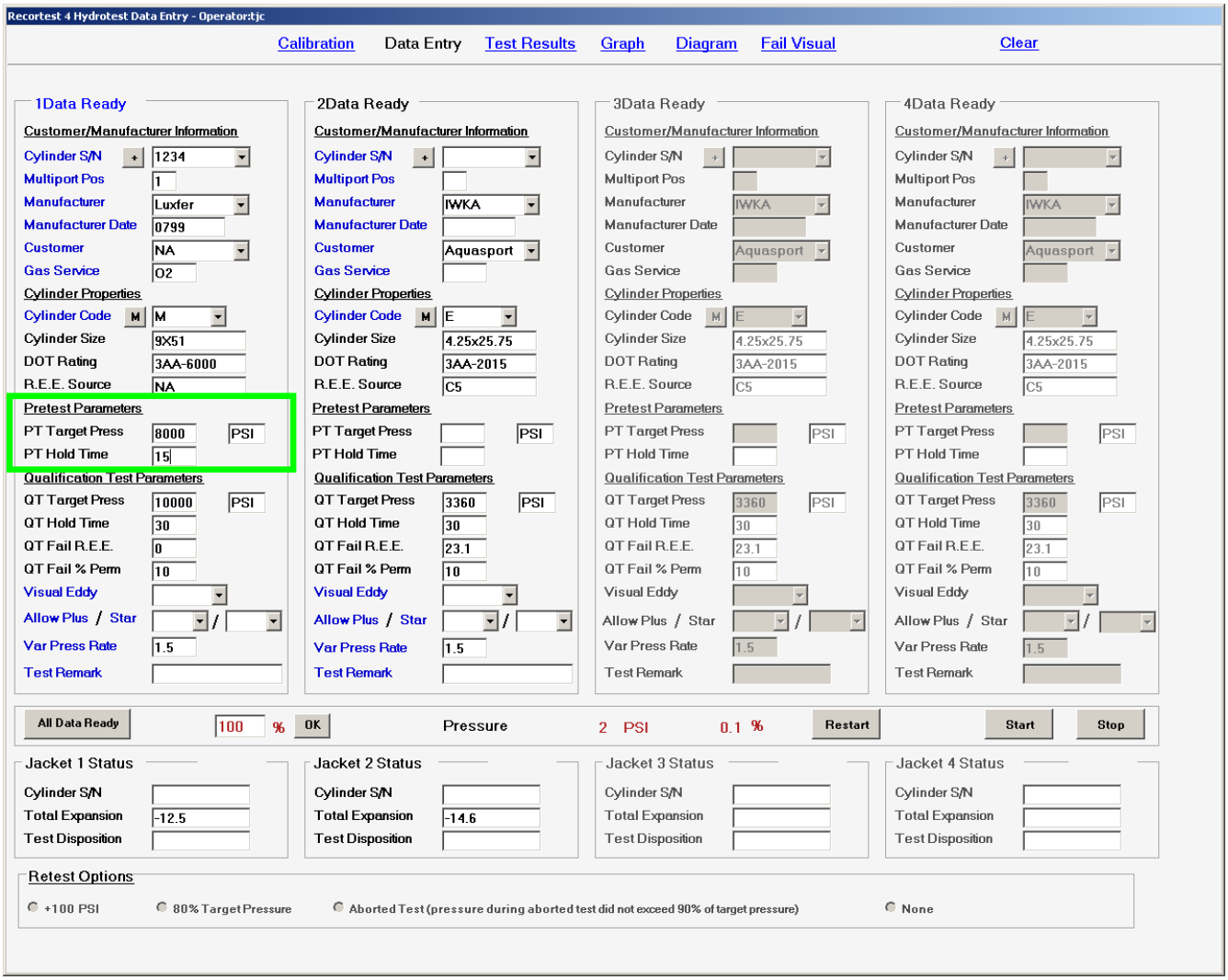
The cylinder properties can be entered automatically by choosing the code from the code table in the <R4 Settings> program. They can also be entered manually by clicking the <M> button as shown in Green above.

<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.

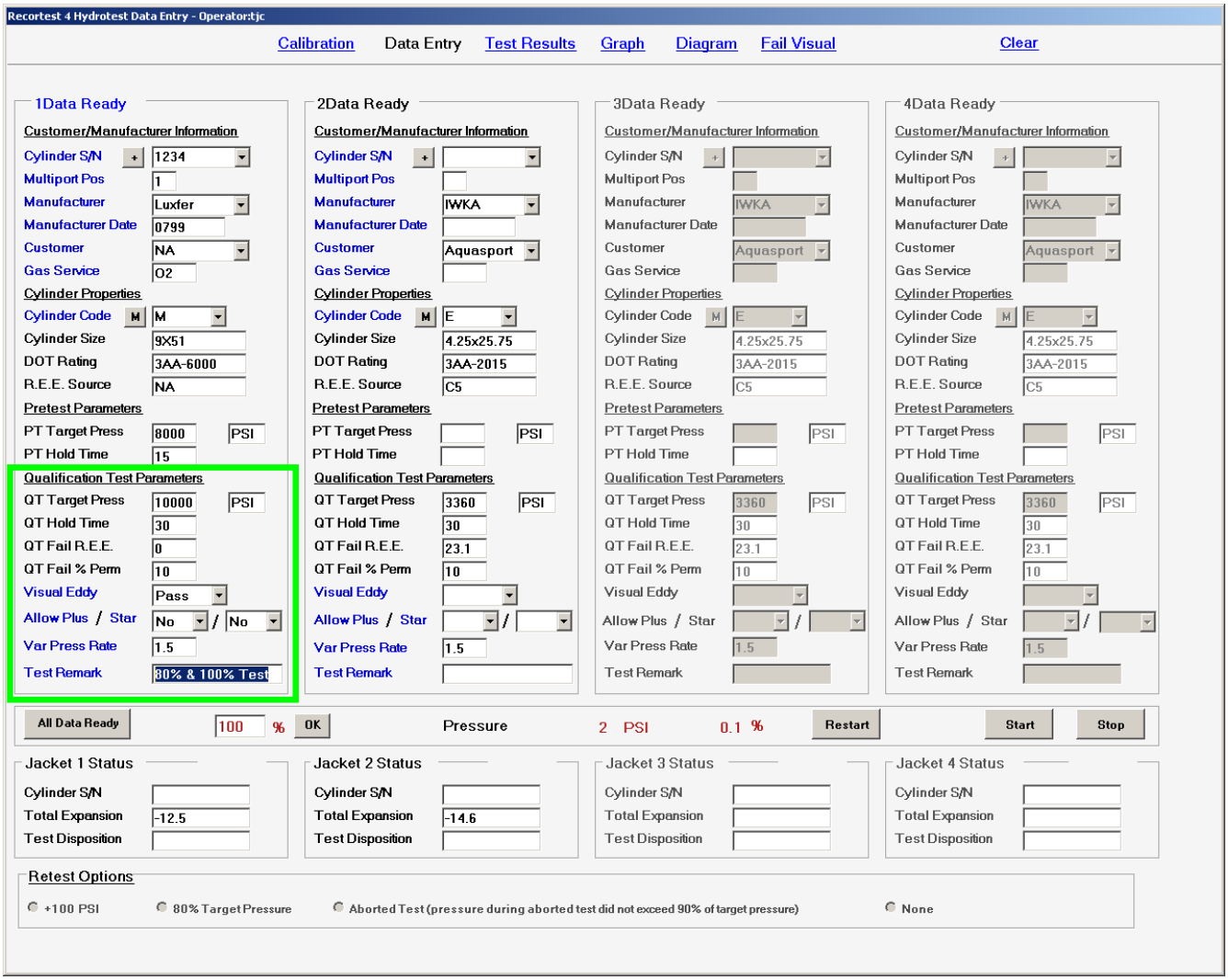
<REE Source> field: If an REE (Reject Elastic Expansion) is used for test criteria, this field is to enter where the REE figure originated from, i.e. manufacturer name, exemption, etc…

Figure 31: Pretest parameters:



You can enter 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, or it is a qualification test attempt that must report the results and be dispositioned accordingly. If it is a newly manufactured cylinder, then the ‘pretest’ is used for autofrettage purposes. The pretest parameters can be entered into the cylinder code table, or manually in the ‘Data Entry’ screen. You can also perform a pretest on a calibrated cylinder to condition it for the calibration verification test. The qualification test will start automatically, directly after the pretest results are recorded.

Figure 32: 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 also be changed manually on the <Data Entry> screen.

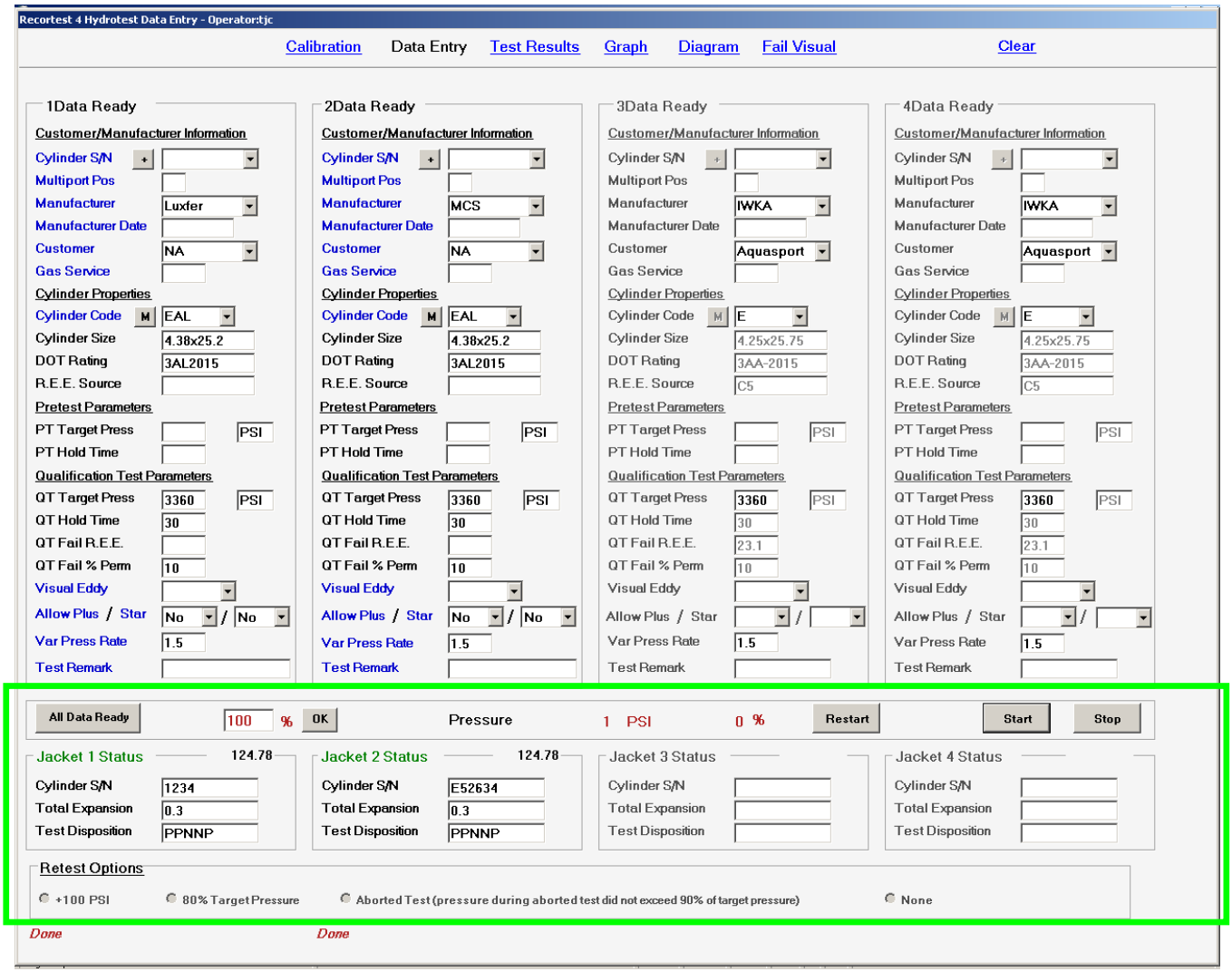
The <Visual Eddy>, Pass or Fail selections allow you to document the visual inspection in more detail if needed.

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

The <Variable Pressurize Rate> field allows you to adjust the pump speed faster or slower.

The <Test Remark> field allows you to put a short reminder note of the test if needed.

Figure 33: <Data Entry> screen command line and jacket status information:



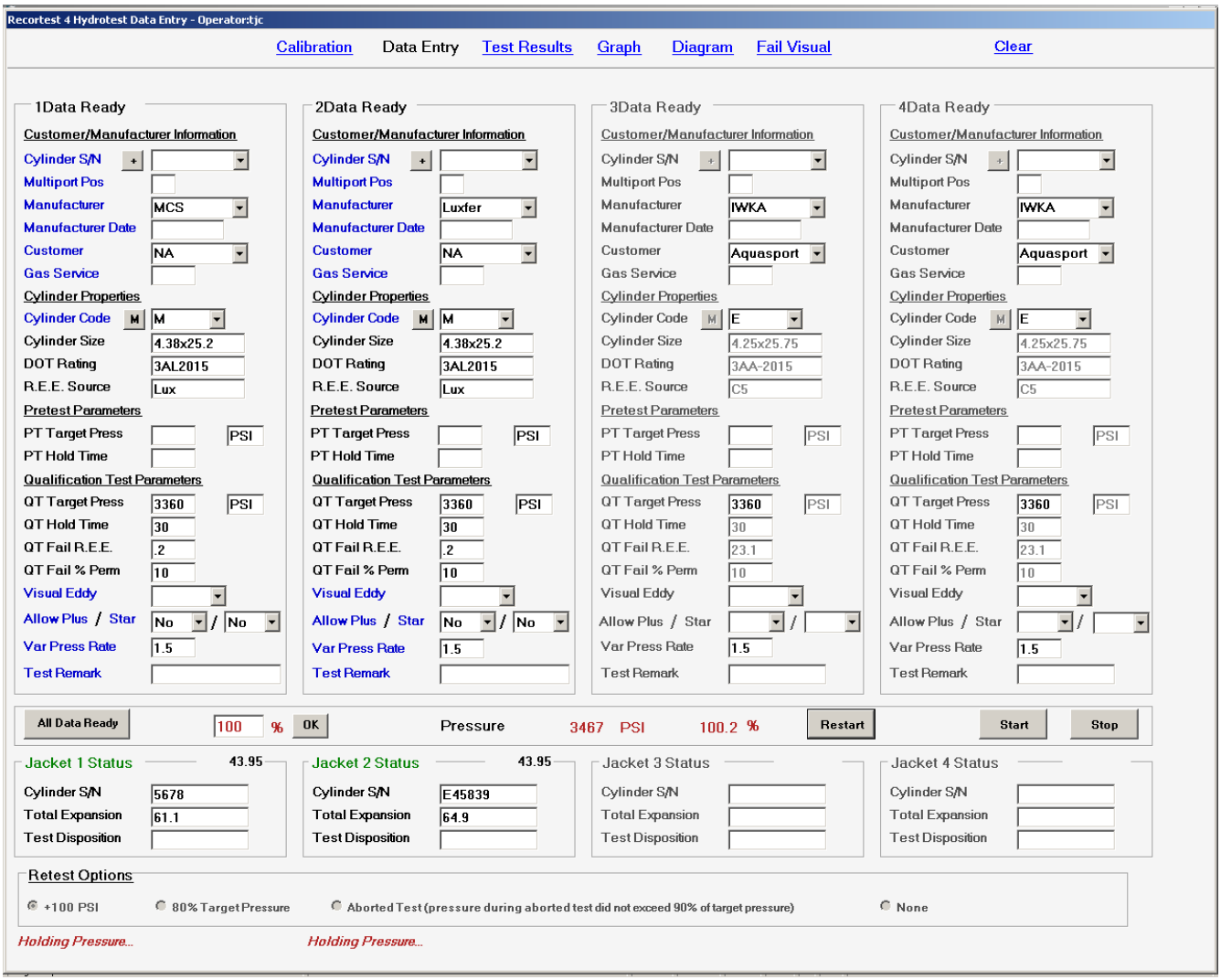
The <All Data Ready> button is to make the data ready on all jackets at the same time. This is so the testing program knows the data is ready for testing. Before starting a test, be sure the cylinder is in the jacket, and the high and low pressure hoses are attached.

The <% Target Pressure> field text is in Red letters. Here you can enter in a % value of the target pressure and click the <OK> button to finalize the entry. The system will stop pressurizing at that pressure. Less than 100% of target pressure, and you can restart the pump by entering in another value greater than the current value. At pressures greater than 100% target pressure, the test will start the hold time.

The actual pressure and percent of target pressure are dynamically displayed in Red letters on the command line.

The <Start> button starts the test. The <Stop> button aborts the test. It will stop pressurizing and bleed off the pressure.

Figure 34: Retesting a failed cylinder:



In the example above, the <Restart> button has been clicked. But, before clicking it, you must choose a <Retest Option> from the selections shown.

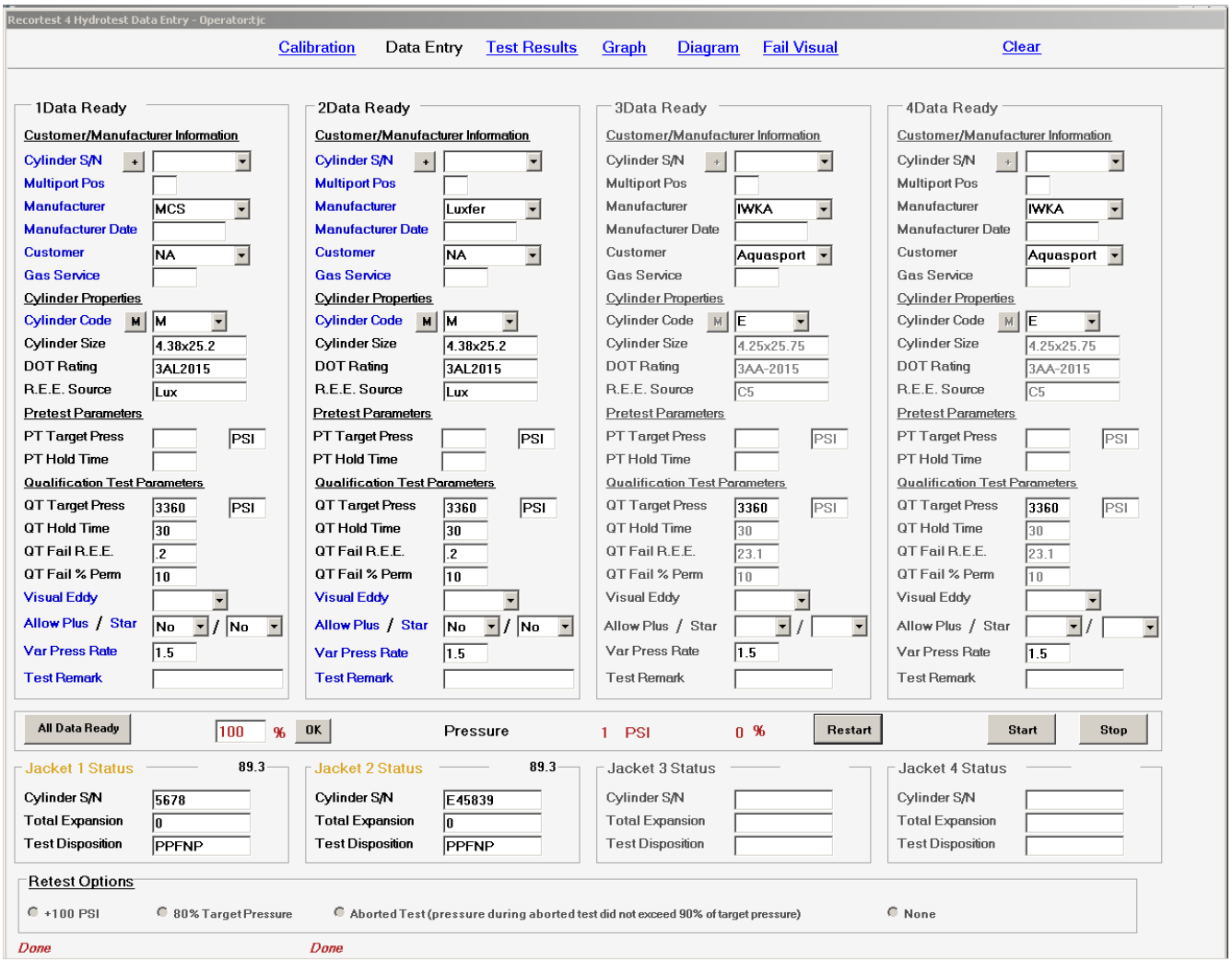
The <+100PSI> option will retest the cylinder at 100PSI over test pressure. This is a US DOT requirement to retest a failed cylinder test. Before selecting this option, you must be confident that it will pass the next test. In other words, you need to remedy the problem that made it fail the first time, such as a 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.

Figure 35: Failed tests:



Upon the event of a failed test, the jacket status text will change color. Yellow = failed REE. Red = failed % permanent expansion.

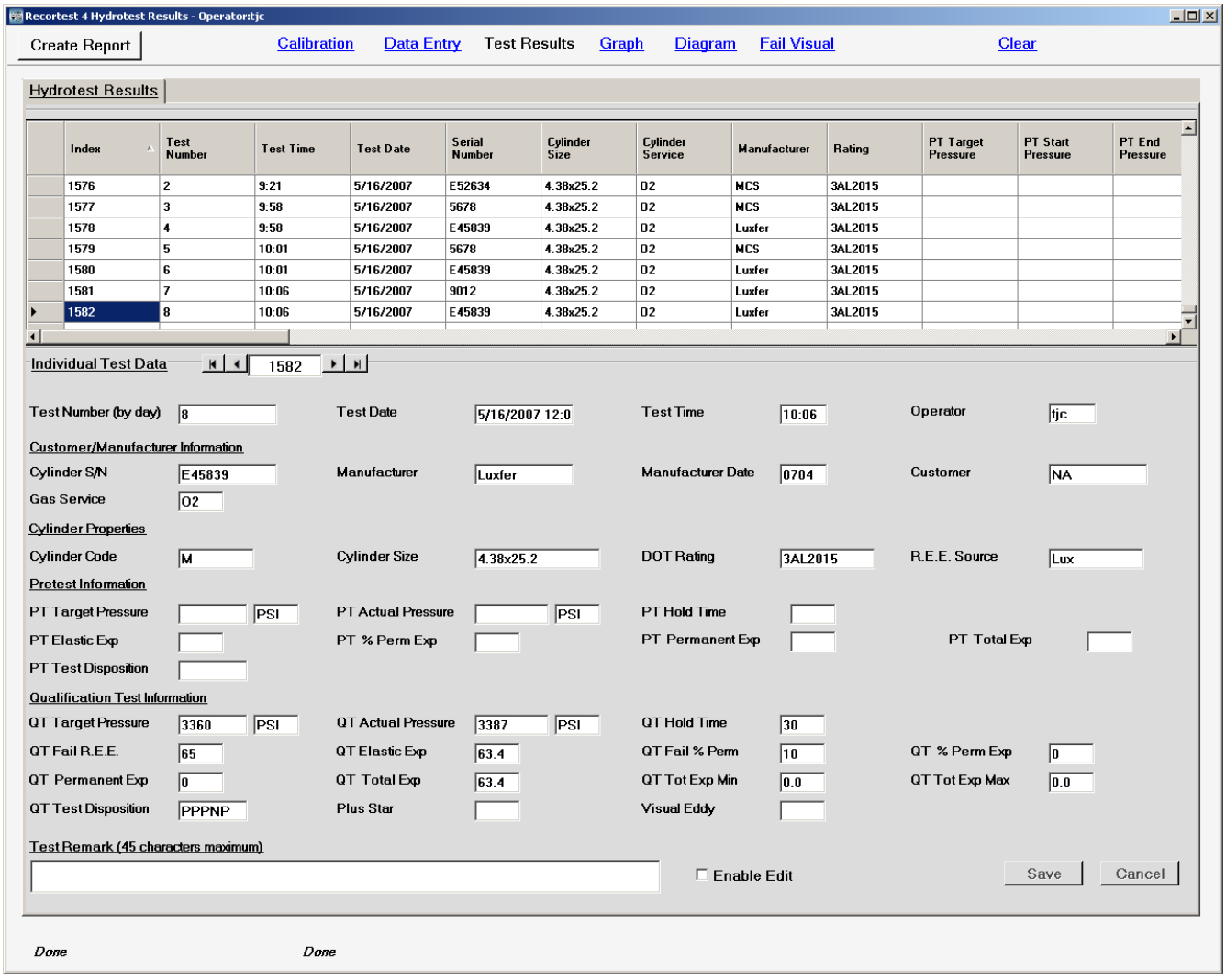
<Test Disposition> field: The letters in the disposition will also change color according to pass = green; fail = red for % perm and yellow for REE; abort = yellow; or black = not applicable. The disposition codes key is printed on the report form.

Test status display line. This is on the very bottom of each screen in Red letters.

Figure 36: Disposition codes key:

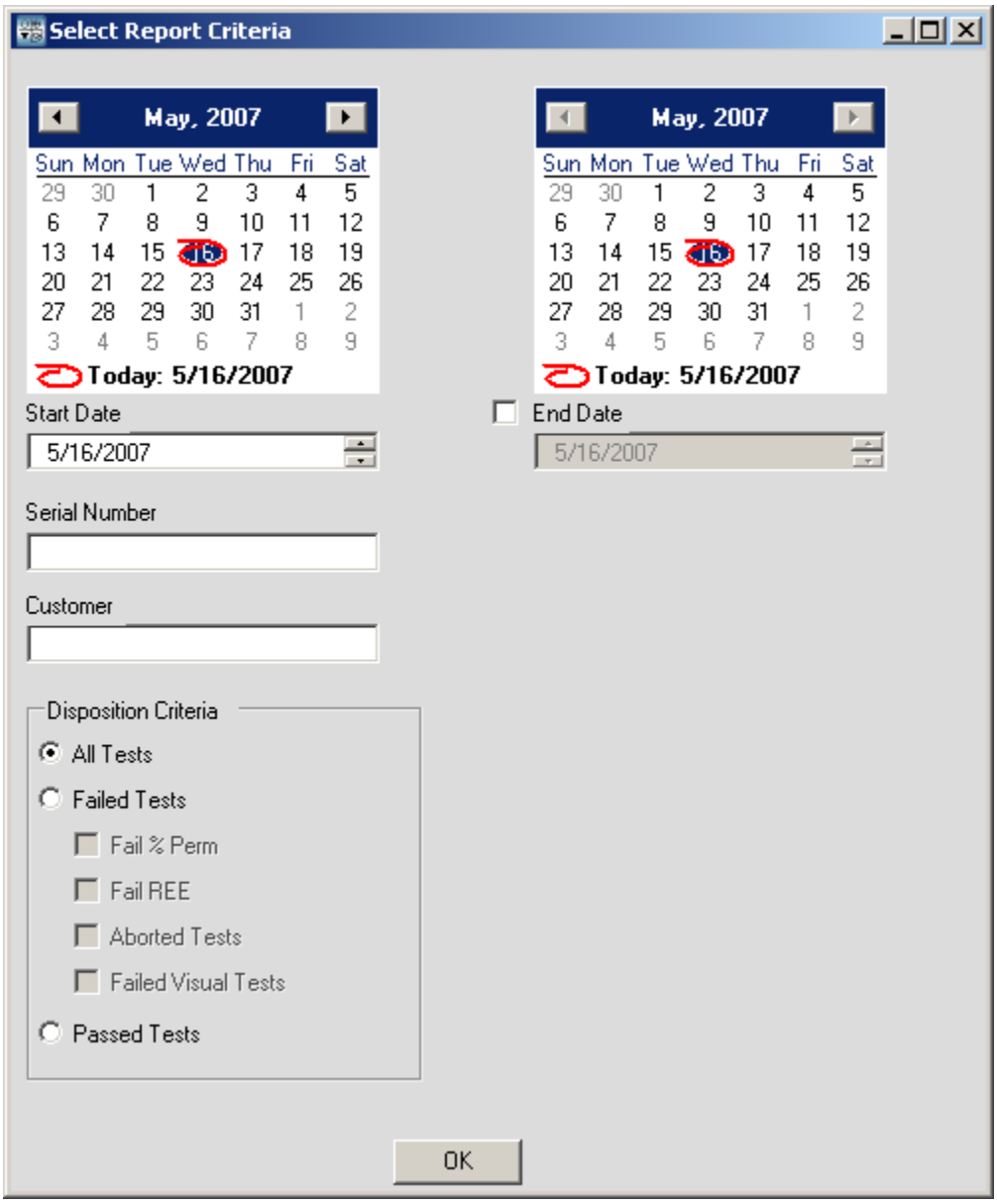
Disposition Codes Key		
Code Has Five Letters:	**Letter Code:**	**Examples:**
1st Letter: Visual Test	**P= Passed**	**PPPNP - Passed Visual, Passed % Perm, Passed REE, Total Exp Not Applicable, Passed Proof Pressure**
2nd Letter: % Perm Exp Test	**F= Failed**	
3rd Letter: REE Test	**N=Not Applicable**	**PFFNP - Passed Visual, Failed % Perm, Failed REE, Total Exp Not Applicable, Passed Proof Pressure**
4th Letter: Total Exp Test	**A=Aborted**	
5th Letter: Proof Pressure Test		

Figure 37: <Test Results> screen:



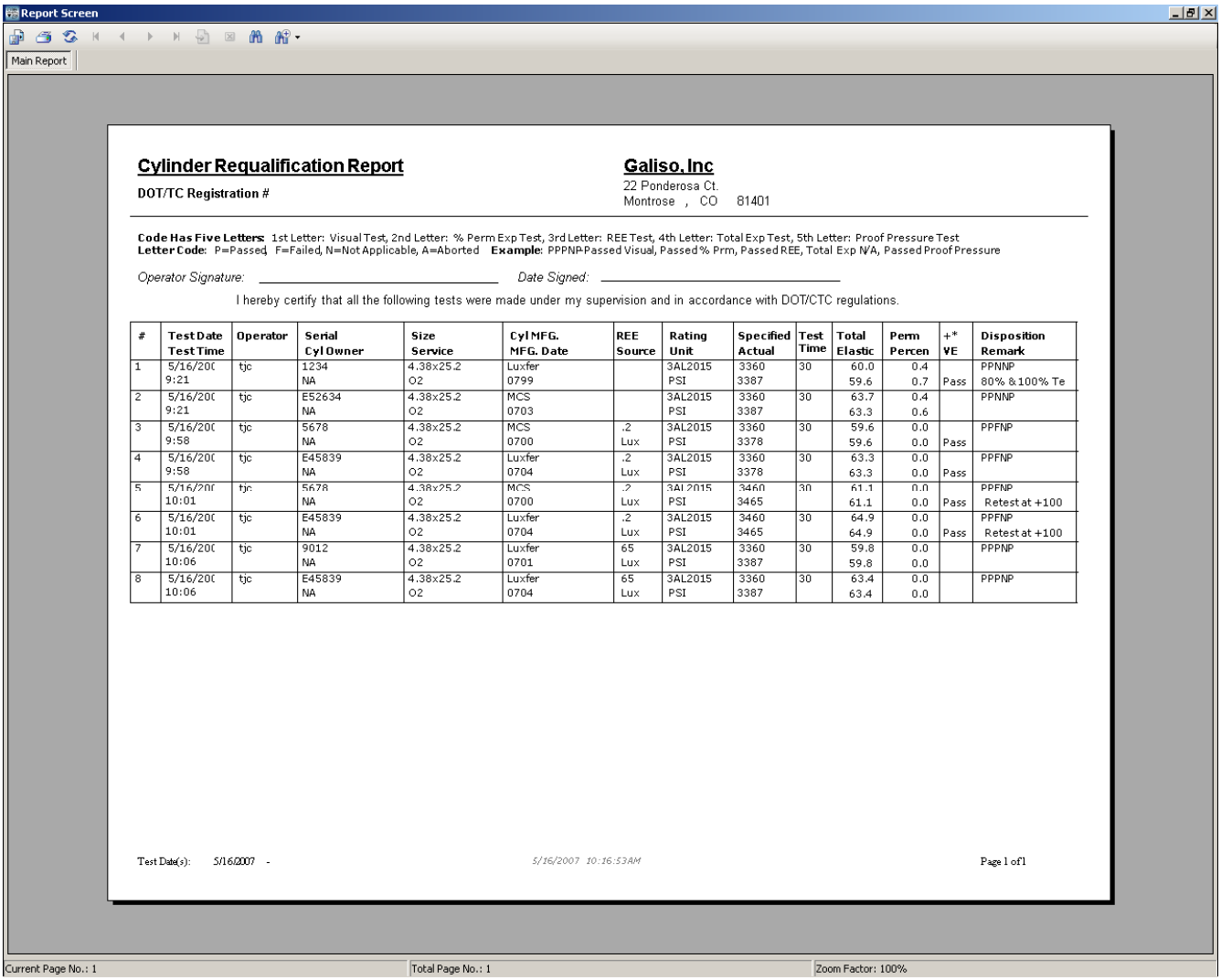
All of the test results are displayed here. Some fields can be edited to correct data entry mistakes on the part of the operator, or to add comments, etc… Click the <Enable Edit> box to view and edit those fields.

Figure 38: <Create Report> criteria options:



The reports can be sorted and created using the criteria shown above.

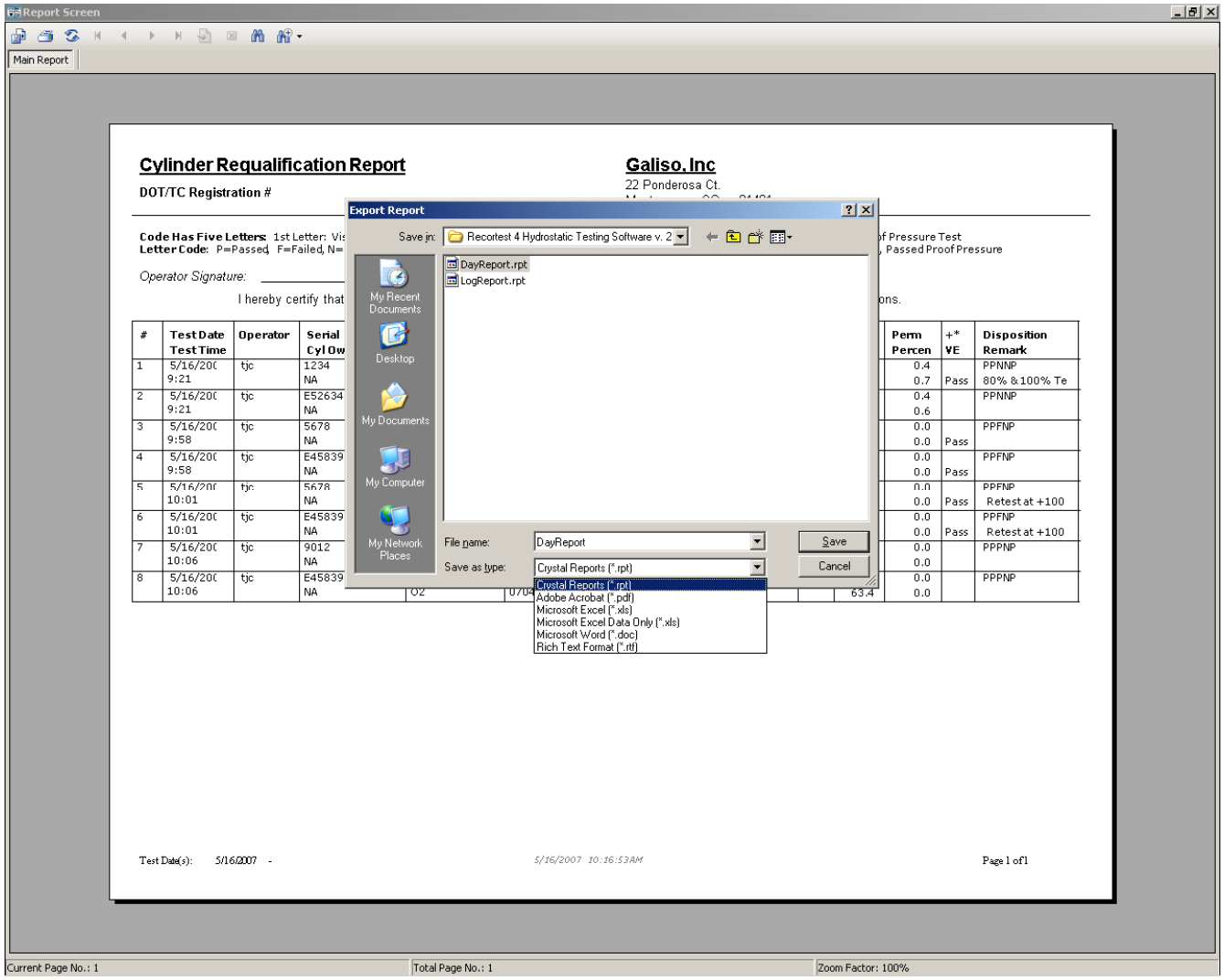
Figure 39: Report form:



#	Test Date Test Time	Operator	Serial Cyl Owner	Size Service	Cyl MFG. MFG. Date	REE Source	Rating Unit	Specified Actual	Test Time	Total Elastic	Perm Percen	+* YE	Disposition Remark
1	5/16/200 9:21	tjc	1234 NA	4.38x25.2 O2	Luxfer 0799		3AL2015 PSI	3360 3387	30	60.0 59.6	0.4 0.7	 Pass	PPNNP 80% &100% Te
2	5/16/200 9:21	tjc	E52634 NA	4.38x25.2 O2	MCS 0703		3AL2015 PSI	3360 3387	30	63.7 63.3	0.4 0.6		PPNNP
3	5/16/200 9:58	tjc	5678 NA	4.38x25.2 O2	MCS 0700	.2 Lux	3AL2015 PSI	3360 3378	30	59.6 59.6	0.0 0.0	 Pass	PPFNP
4	5/16/200 9:58	tjc	E45839 NA	4.38x25.2 O2	Luxfer 0704	.2 Lux	3AL2015 PSI	3360 3378	30	63.3 63.3	0.0 0.0	 Pass	PPFNP
5	5/16/200 10:01	tjc	5678 NA	4.38x25.2 O2	MCS 0700	.2 Lux	3AL2015 PSI	3460 3465	30	61.1 61.1	0.0 0.0	 Pass	PPFNP Retest at +100
6	5/16/200 10:01	tjc	E45839 NA	4.38x25.2 O2	Luxfer 0704	.2 Lux	3AL2015 PSI	3460 3465	30	64.9 64.9	0.0 0.0	 Pass	PPFNP Retest at +100
7	5/16/200 10:06	tjc	9012 NA	4.38x25.2 O2	Luxfer 0701	65 Lux	3AL2015 PSI	3360 3387	30	59.8 59.8	0.0 0.0		PPPNP
8	5/16/200 10:06	tjc	E45839 NA	4.38x25.2 O2	Luxfer 0704	65 Lux	3AL2015 PSI	3360 3387	30	63.4 63.4	0.0 0.0		PPPNP

The standard report form displays the items shown above.

Figure 40: <Export Report> save option:



The reports can be exported for further customizing, and or saved for back-up in the file formats shown above.

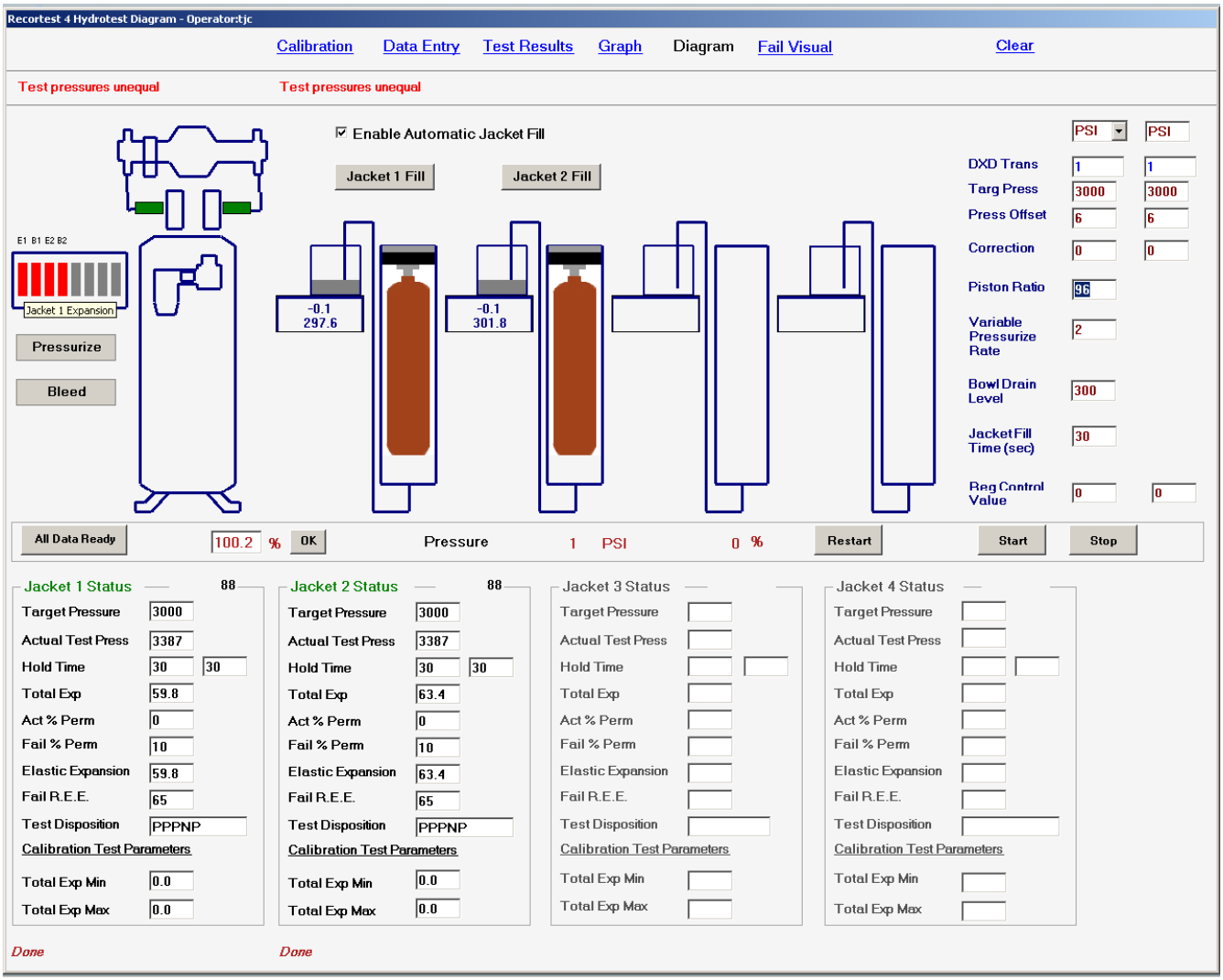
Figure 41: <Graph> Screen:

Shown above are the graphed curves of the pressure, and cylinder expansions. 2 cylinders are shown to be pressurizing at the same time. The scale of the graph can be changed for different viewing if needed.

Figure 42: Pressure Bleed:

The <Graph> screen continuously moves on a timeline to show the release or ‘bleed’ of pressure. You can click on the <View History Mode> check box to view up to 15 minutes previously.

Figure 43: <Diagram> screen:



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.

The red text toward the top is the error message line. Click on the ‘Clear’ text (upper right corner of screen) to clear the message out of memory. This enables another message to appear if and when another error occurs. It displays operator and system errors.

The ‘Diagram’ screen is mainly for learning and troubleshooting. Here, you can set the various control parameters to test the cylinder more precisely if needed. To learn those parameters, you may need to experiment with changing them to see the effect they have on the test. For example: Test a cylinder at 80% test pressure. If it does not pass the test (% Perm, or REE), then you may need to do a full pretest on that type of cylinder, before doing a 100% pressure test. Pretests can be used to exercise the cylinder before the qualification test, so the next test is more stable. There are simply many things you can learn about the cylinder type, by

using the diagram screen.

You can run troubleshooting tests that are not documented. You can also use the screen to pressurize the calibration cylinder to exercise it before the calibration test. You can manually operate the test by opening each expansion valve, and clicking on the <Pressurize> button. To release the pressure, click the <Bleed> button.

To learn the control parameters, use the calibration cylinder or a shop cylinder that stays in the shop. The adjustable fields should be set correctly before the start of the test, but can be adjusted dynamically during a test. Here is an explanation of the different fields on the screen:

<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.

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

<Press Offset>: Adjusts to make the pressure start from zero.

<Correction>: This can be adjusted up in value to theoretically increase the target by that amount.

<Piston Ratio>: For higher targets, start with the adjustment higher. To re-adjust during a test, decrease the value for more pressure.

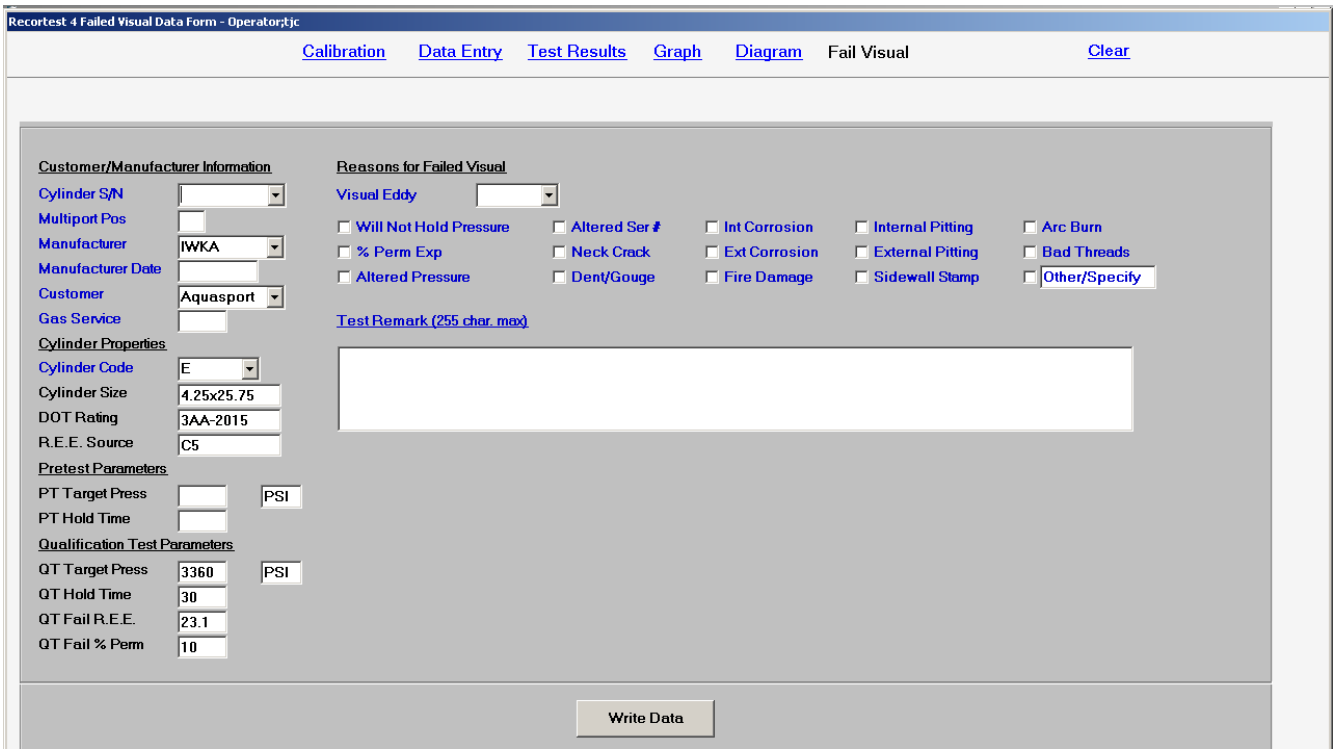
<Variable Pressurize Rate>: Adjustable from .1 – 5. It allows you to give time if needed, for the cylinder to expand during the pressurization which gives a more stable test during the 30 second hold time.

<Bowl Drain Level>: The program will achieve this amount of water in the bowl before starting a documented test. You can adjust it for more stability, or for the amount of expansion you are measuring, etc… It is basically an operator preference, but Galiso like to put it between 150 – 250.

<Jacket Fill Time>: This value is in seconds. The adjustment will fill the jacket for that amount of time, starting from when the head safety switch is disengaged to remove the tested cylinder.

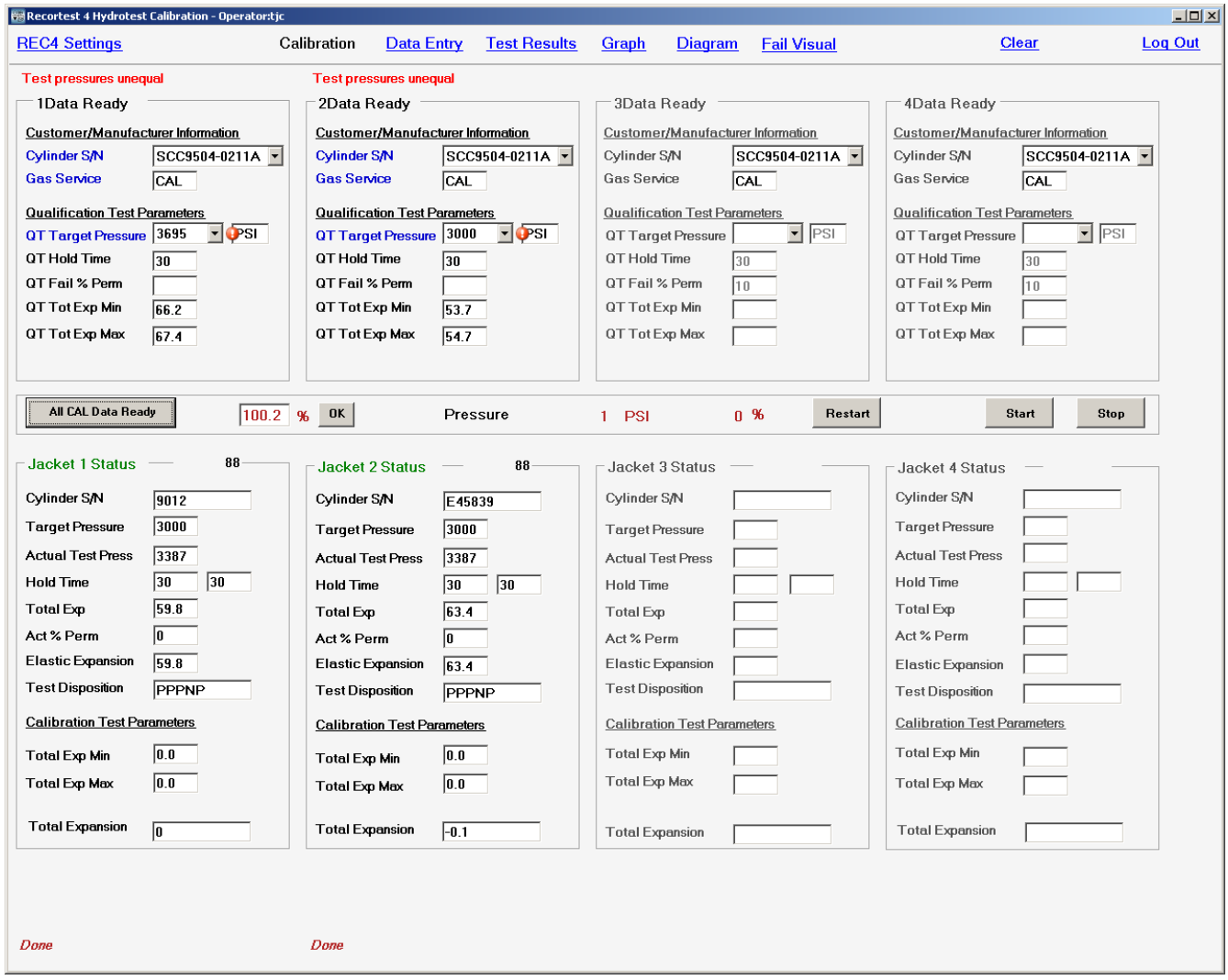
Reg Control Value: Displays the amount of PSI the regulator is allowing to flow through. It is not adjustable.

Figure 44: <Fail Visual> screen:



You can document a failed cylinder due to failing the visual inspection. Your customer can clearly see the reason for the failure. 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 you desire.

Figure 45: Error messages:



Error messages are shown in red text above the corresponding jacket that the error is affecting, if it is jacket specific. Jacket specific errors will overwrite non-jacket specific errors. So, if there are both errors present, you may not see the non-jacket specific error.

In the example above, note the red colored blurb next to the field that is incorrectly entered. In this case, one or the other must be changed to match each other. Since both jackets will pressurize simultaneously (if 'Data Ready' light is on for both), then both test pressures must be equal.

Section 2: **Quick Start and Reference Guide**

REC 4 Steel Jacket Quick Start and Reference Guide

Powering on the system:

1. Ensure the air and water are off, and that the battery back-up supply is on.
2. Turn on the PC, and type in the username and password.
3. Open the testing program by clicking on the Galiso test software icon on the desktop.
4. Turn on the air supply to the test system first, and then the water and you should now be ready for testing. The reason the air is turned on first, is to get air to all air operated valves so they are properly working before water is applied.
5. If you get a PLC Bowl Communication failure, then check the scales and turn them on. When that error occurs, always check the scale power first.

Powering off the system:

1. Turn off the water supply to the test system first, and then turn off the air supply.
2. Close the test software program.
3. Close any other open programs, and <Shut-Down> the PC.
4. You may leave the scales on.

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:** 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.

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:** There is 1 for each jacket. 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 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.**