RECORTEST 4 OPEN

Cylinder Testing Water Jacket System

Instruction Manual

MANUAL NUMBER 21-11-1200
Revision A

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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

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1.0 Introduction

The Galiso Recortest 4 Open is a computer controlled hydrostatic test system which is designed for rapid, accurate testing of compressed gas cylinders at test pressures up to 10,000 PSI. The Recortest 4 Open uses a state-of-the art Control Computer and a patented Electronic Expansion Measuring System to automate the cylinder testing process. After test parameters have been entered into the Recortest 4 Open Control Computer, the system will automatically seal test pressure within the cylinder, perform the test at the required specifications, interpret and record the test results and de-pressurize the cylinder at the end of the test. In addition, the control computer may be used as a personal computer to perform data analysis and processing tasks.

The Recortest 4 Open system automatically controls the entire hydrostatic testing procedure. Each cylinder is tested in accordance with specifications that are entered into the control computer with the keyboard and mouse. Identical test specifications may be repeated many times when a series of identical cylinders are tested, or specifications may be changed to fit the requirements of each individual cylinder. Test specifications include; Cylinder Serial Number, Size, D.O.T./I.C.C Rating, Test Pressure, Maximum Allowable Elastic Expansion, Test Time, Remarks, and Visual Inspection results. Galiso custom software allows a supervisor ultimate ability to customize system parameters and limits an operator to only allowable operations.

The Recortest 4 Open will record specifications and store them along with test results for each cylinder tested. Test results include the test pressure, total expansion, permanent expansion percent expansion and a disposition code which indicates whether the cylinder has passed or failed. All specifications and results are shown on a high resolution, color display monitor. The Recortest 4 Open printer prints a complete test report, which includes all test specifications and results. The test report should be filed to provide a permanent record of the test. Test results can be archived to Thumb or hard drive, emailed, or electronically saved to a back-up system.

Depending on the cylinder sizes, a standard Recortest 4 Open system with one test jacket, and accessory equipment (for filling, draining and drying), can process between 10 and 20 cylinders per hour when manned by two operators.

The Recortest 4 Open system will provide greater accuracy than is possible with other conventional cylinder testing equipment. With this system, documented test results are no longer subject to operator interpretation. The Recortest 4 Open automatically determines if each cylinder meets Department of Transportation specifications, or any other predetermined specification, and will notify the test operator if a cylinder must be retested or rejected. The Recortest 4 Open also monitors the pressurization and expansion circuits for leaks that would invalidate results. Upon detection of leaks the system will notify the operator so that corrective measures may be taken.

The components, and equipment required for a complete Recortest 4 Open installation may be custom configured to meet the specific customer requirements.
Recortest 4 Open systems are also designed to be able to grow with the production requirements of your operation. Options may be added after time of purchase that will allow you to expand the production output of your system. Contact your Galiso®, Inc. representative for additional information regarding cylinder testing and handling equipment and accessories.

1.0 Introduction, continued

1.1 Hydrostatic Testing Overview

In accordance with D.O.T./T.C. regulations, certain cylinders must be periodically requalified and certified safe for use. The re-qualification procedure and regulations are discussed in detail in the Code Of Federal Regulation (CFR), Title 49, Section 180.205. Copies of the CFR may be obtained from Galiso or by writing to the following address:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

The Galiso Recortest 4 Open, will perform water jacket (hydrostatic) testing of compressed gas cylinders. The specifications and procedure for hydrostatic testing are outlined in Compressed Gas Association Pamphlet C-1, "Methods for Hydrostatic Testing of Compressed Gas Cylinders". Copies of Compressed Gas Association pamphlets are available from Galiso®, Inc., online at: https://www.cganet.com/, or by writing to the following address:

Compressed Gas Association
8484 Westpark Drive, Suite 220
McLean, Virginia 22102
PH (703) 788-2700

In general, the water jacket method for hydrostatic testing consists of loading a water filled cylinder into a sealed chamber (Test Jacket), which is also filled with water and is connected to an Electronic Expansion Measuring System. The Expansion Bowl is first zeroed, and the cylinder is then pressurized to 5/3 of its D.O.T. or I.C.C. rating, which is stamped on the shoulder of the cylinder. This test pressure is held for thirty seconds. As pressure is applied to "inflate" the cylinder, the cylinder expands and forces water out of the test jacket and up into the Expansion Bowl. After the thirty second test time has elapsed, the Expansion Bowl is then read to determine the Total Expansion (in cubic centimeters) of the cylinder under test pressure. The test pressure is then released and the cylinder "deflates". As the cylinder shrinks to its approximate original size, water is allowed to drain back into the Test Jacket from the Expansion Bowl. In most cases, the cylinder will not return to its original size, having been slightly stretched by the pressurization process. This stretching is called the Permanent Expansion. The difference between the "Total Expansion" and the "Permanent Expansion" is called the Elastic Expansion. The Percent Expansion of the cylinder is determined by the following formula: Percent Expansion = (Permanent Expansion ÷ Total Expansion) X 100 When the Percent Expansion exceeds the predetermined limits for the cylinder being tested, the cylinder must be condemned and removed from service. A high percent expansion value is an indication that there has been excessive thinning of the cylinder wall and that the cylinder is no longer safe for use.

All test records must be saved and maintained for the life of the test, in the event that there is any future problem with the cylinder. Galiso®, Incorporated has software available for ease of calculation and record keeping, to use, replacing use of the hand written Test Log.

Plus (+) stamped cylinders may be filled to an additional 10 percent beyond the rating which is stamped on the cylinder shoulder. Star (*) stamping makes the cylinder eligible for an extended ten year retest interval. The procedures and requirements for plus stamping and star stamping are discussed in Compressed Gas Association Pamphlet C-5, "Cylinder Service Life, Seamless High Pressure Cylinders". This pamphlet is available from Galiso, or from the Compressed Gas Association at the address indicated previously.

1.0 Introduction, continued

1.1 Hydrostatic Testing Overview, continued

Prior to testing and before the system is turned on, it is important to complete the following:

Ensure that the Cylinders to be tested are free from defects and have been properly, visually inspected according to the appropriate CGA pamphlet.

The Calibrated Cylinder and accompanying certification sheet must be on hand to verify calibration each day of testing. Steps for System Verification in section 4.9 Test System Verification. Digital Pressure Transducer(s) need to be calibrated every six months.

It is the responsibility of the operator of the equipment to run the daily calibration verification of the system using the Calibration Cylinder within the DOT requirements. This means the bowl and pressure readings need to be within the 1% tolerance and the calibration cylinder has been run within 500 psi of the cylinder test pressures of that day, or within 10% at pressures below 3,000 psi.

As each cylinder is finished and the results show the cylinder passes, the empty cylinder may then be removed from the jacket and placed onto a dryer to be dried.

Please call Galiso customer service at 1-(800)-854-3789 for additional information and assistance.

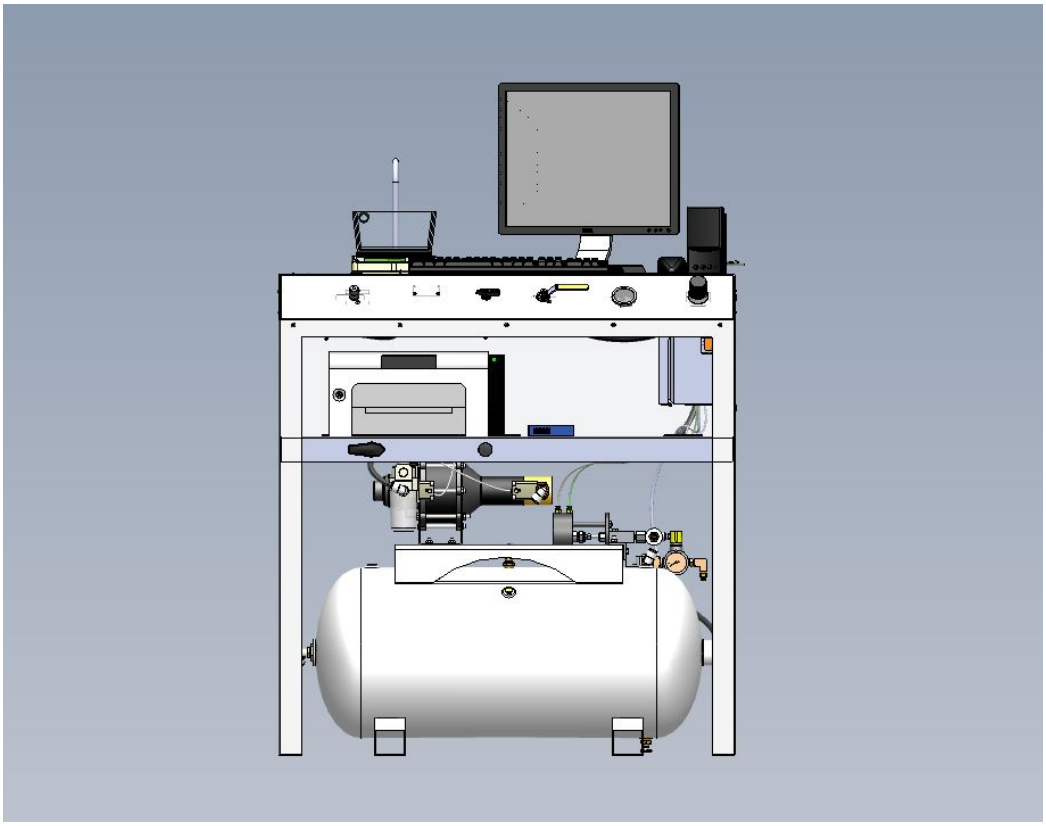

Figure 1, Recortest 4 Open

(See included drawings for specific connection locations)

Foot Print (Table)
26” L x 40” W x 56” H (not including Monitor)

Electrical Connections: 110-220V Single Phase is required for the computer and control electronics

Air Requirements: 10 cfm@ Max 120psi

Water Requirements: City water pressure or 40 psi minimum of supplied water

2.0 Safety

Read all instructions before attempting to install or operate this machine. GALISO, INCORPORATED IS NOT RESPONSIBLE FOR DAMAGE OR INJURY CAUSED BY UNSAFE USE, MAINTENANCE, APPLICATION, MODIFICATION OR IMPROPER INSTALLATION OF THIS MACHINE. Please contact Galiso, Inc. for guidance when you are in doubt as to the proper safety precautions to be taken when installing or operating this machine.

2.1 General Safety

A. Always wear required Personal Protection Equipment (PPE), while operating the RECORTEST 4 OPEN.

B. Although the RECORTEST 4 OPEN is free standing, Galiso, Inc. recommends securing the machine to the shop floor.

C. Galiso, Inc. recommends marking off the area surrounding the RECORTEST 4 OPEN with yellow and black safety tape. The safety area should extend at least 36" around the machine. All personnel should stay clear of the safety area while the machine is operating.

D. Keep the Expansion Scale clean and dry. If water is spilled on to the Scale, immediately unplug the unit and thoroughly dry the unit before plugging the unit back in. After reconnecting the Scale to electrical power, the Scale must be recalibrated as described in Section 5.0, Maintenance and Calibration.

E. Keep the work area around the Recortest 4 Open clean, dry and free of debris to reduce the risk of operator injury due to slips or falls.

F. Keep the Computer, PLC and Electrical components clean and dry. If water is spilled on the any of the components, immediately unplug the unit(s) and thoroughly dry before plugging the unit(s) back in.

G. The Test Adapter must engage the Cylinder Neck Threads with at least four threads for the cylinder to be properly connected. If the Test Hose is not properly attached to the Cylinder Adapter, it could be blown off during pressurization. If there is any question about the test connection **do not test the Cylinder.**

The air pressure regulator must be set at **Minimum -110 psi** to insure proper operation of the equipment.

2.0 Safety, continued

2.2 Equipment Precautions

A. Test Jackets must include a suitable safety relief port, which is equipped with a Galiso crystal glass burst disk.

- The purpose of the relief port and burst disk is to protect the operator in the event of catastrophic failure of the cylinder while it is under pressure. The burst disk is designed to shatter in the event of a sudden release of pressure into the Test Jacket. When the burst disk shatters, excess pressure is released through the relief port, preventing the Hydraclose® Test Head from being forced out of the Test Jacket.

- In the event that you must replace the Test Jacket Burst Disk, make certain that you use a replacement burst disk from Galiso. Never operate the Recortest 4 Open with an improper burst disk in place. The burst disk is designed to fail at a specific pressure to prevent the Test Head from being blown out of the Test Jacket in the event that an improperly mounted cylinder comes off of the test spud while under test pressure, or in the event of a cylinder rupturing.

3.0 Installation

Read all instructions and familiarize yourself with the installation drawings before attempting to install or operate the Recortest 4 Open Test System.

It is recommended that this equipment be installed by, or under the supervision of a certified Galiso technician.

Contact your Galiso representative if you require additional details regarding equipment layout and/or utility requirements.

3.1 Receiving and Placement

Inspect for damage, loose parts or disconnected lines. Contact Galiso®, Inc. immediately, if damaged items are identified.

A. Carefully un-crate the Recortest 4 Open and remove all banding and packing materials. Inspect the unit for any damage. Select an area in which to install the Test System. This location will need to be;

- Close enough, to sufficient drainage to prevent water from accumulating around the test system.
- A location that does not allow direct sunlight to shine on the Control Console Test Jackets, or Cylinders.
- A location that is sheltered from breezes. Breezes can move the expansion bowl and affect the accuracy of test results.
- The location must also be flat and level.
- A location that has relatively stable temperatures.

NOTE:

Even a small (1 - 2 °F) temperature change in the test system / cylinder during testing could affect the test results. Therefore, care must be taken to select a location that is not subject to significant and/or sudden temperature variations.

B. Once an adequate location has been selected, a bubble level should be used to level the equipment. Once level, bolt or clip the Recortest 4 Open Table, to the floor.

C. Place the Expansion Scale on the Table under the Expansion Probe. Center the Expansion Bowl on the Scale Platform with the Expansion Probe inside of the Expansion Bowl.

D. Galiso, Inc. recommends installation of safety tape, which isolates the equipment area to only essential personnel. Non-essential Shop personnel should stay clear of the Test Console and Jackets, while testing is in progress.

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4.0 Operation

4.1 System Login

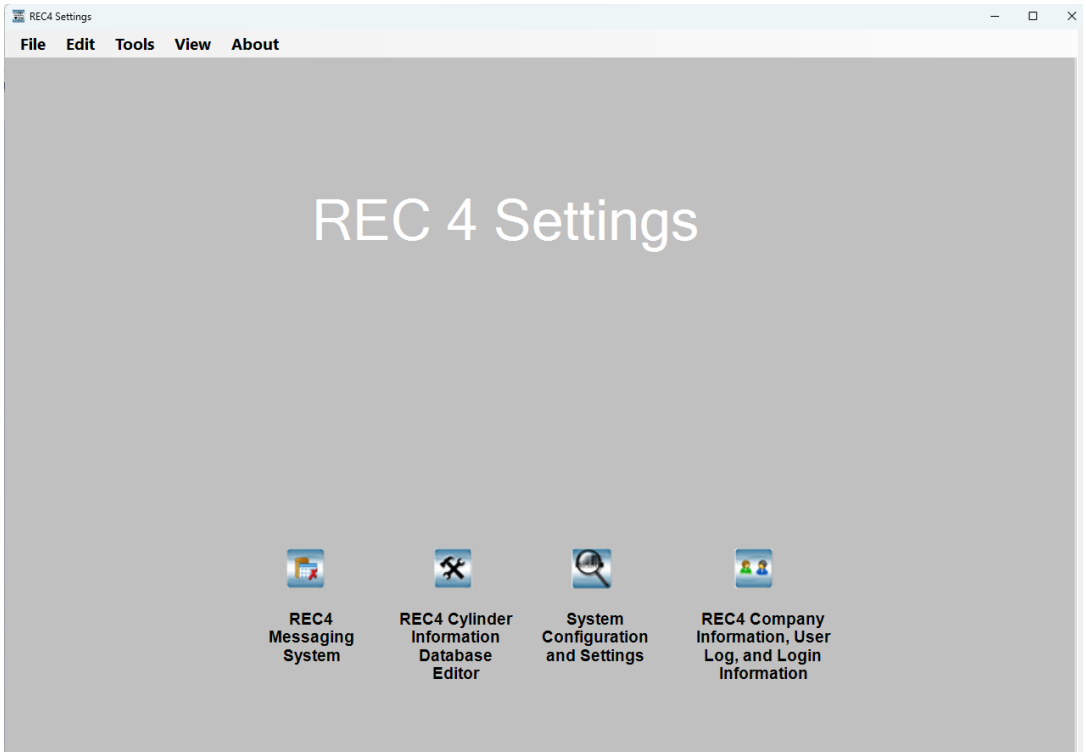
A. Once the computer has been turned on select the REC4 Hydrostatic icon to begin the program. The following instructions have been written describing all of the available options, although, an operator might not have access to all of the options. Supervisors may set up which privileges an operator password will allow.

B. After the program icon has been selected, the following Login screen will appear:

C. Enter the Username and Password and click OK.

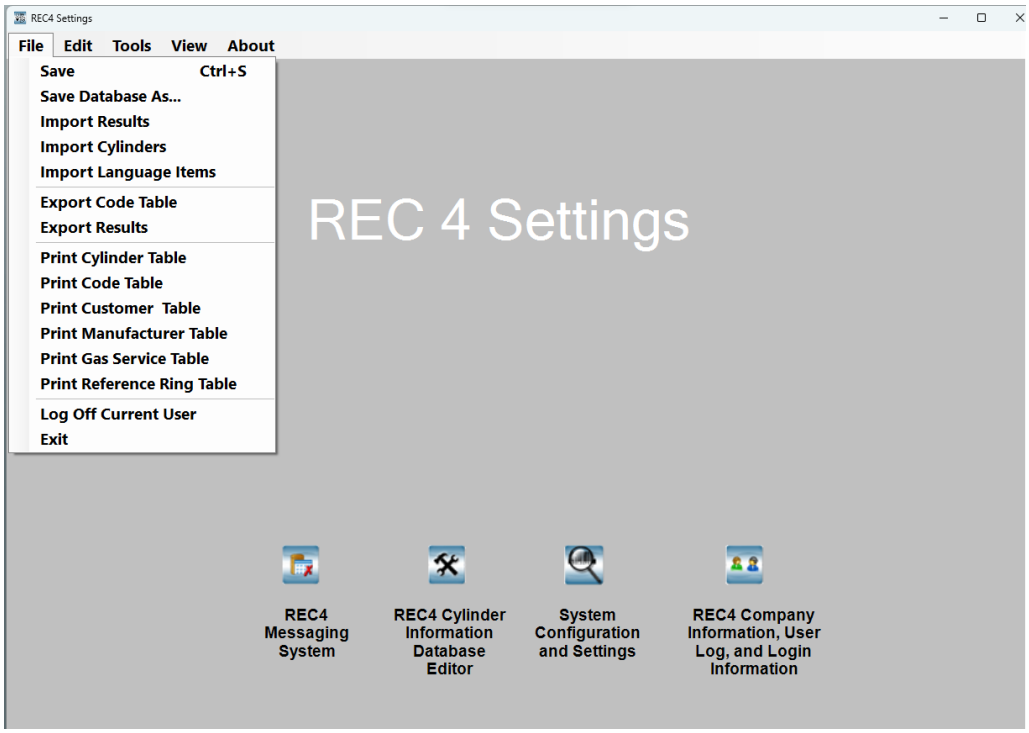
Note: At this point if a Supervisor password has been entered a different screen will open to allow supervisor privileges, for changing the system parameters. If an operator password has been entered, the computer will automatically go to the test screen. Operators may continue to Section 4.7 Test Cylinder Preparation and Test Connection, in this manual.

The system will now display four icon options for the supervisor. Descriptions of these options are defined in the following section.



4.2 Pull-down Menus

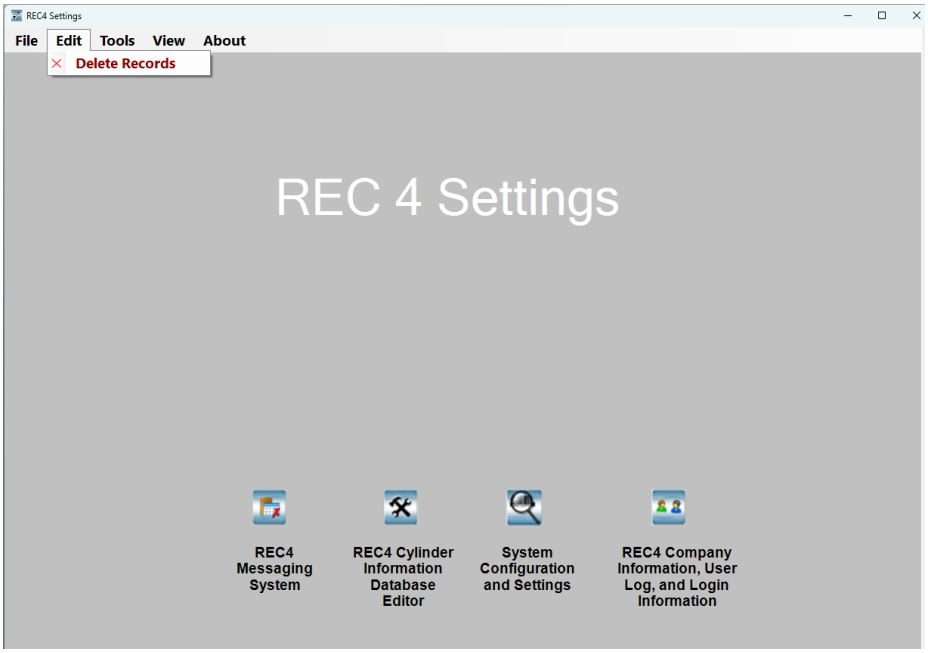
At any time, that the Settings Screen is open, five pull-down menus are available. These menus are; File, Edit, Tools, View and About. Descriptions of each are stated on the following pages. Many of the available options are standard Windows style selections.



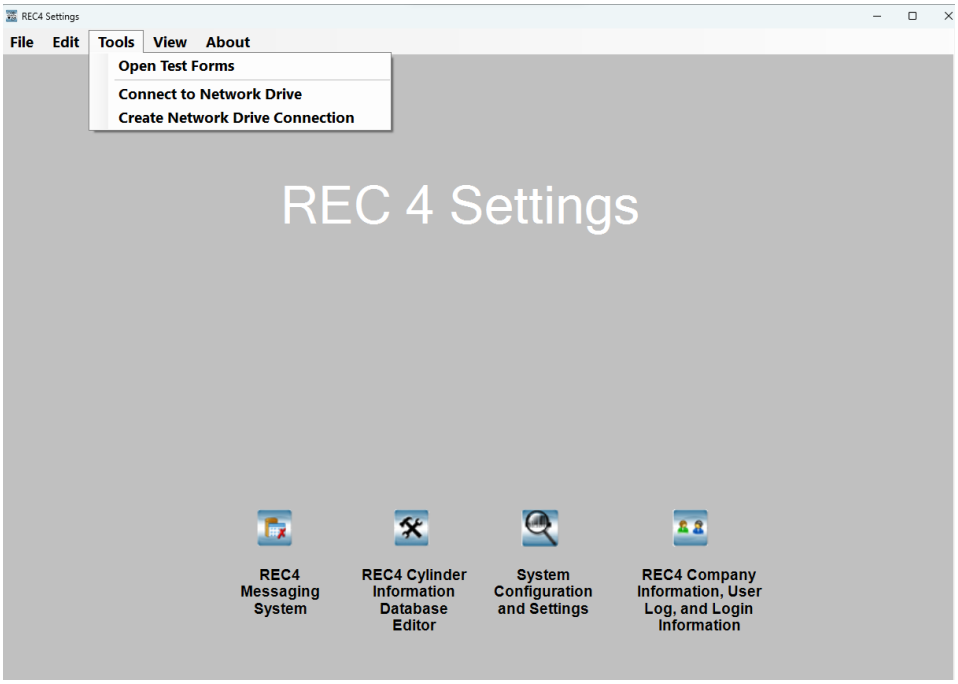
Selecting File: will open a pull-down menu allowing the operator options for saving, importing, exporting and printing files and data. This is also the menu to “Log off” when you are ready to shut down the system or allow for a new operator to “log-in”.

A. Log Off Current User: Use to switch which log-on will be entered (also enables whether a Supervisor or standard log-in will be used, allowing for certain parameters and configurations to be set.)

4.2 Pull-down Menus

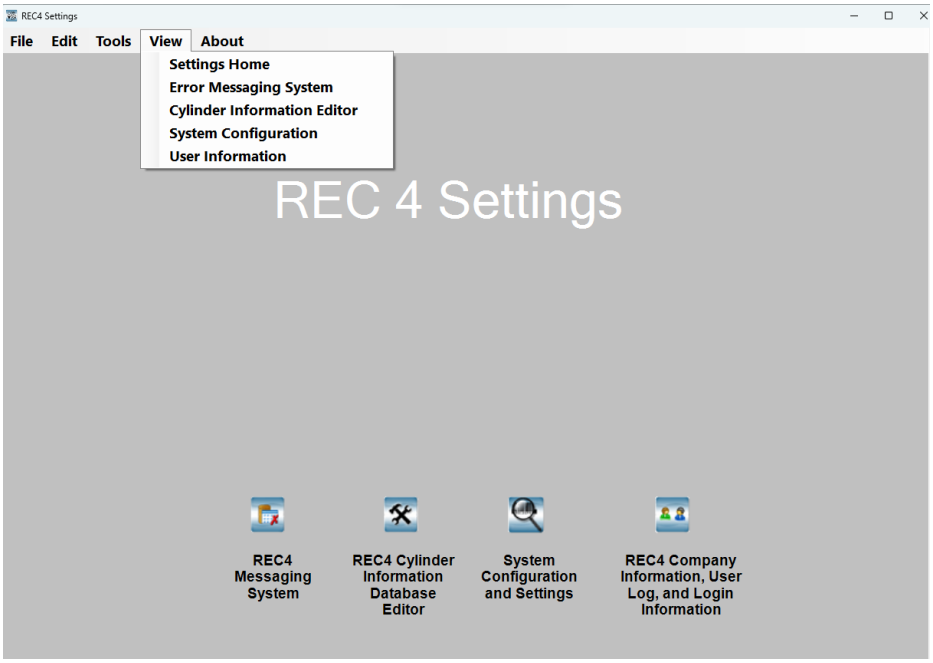


B. Edit Menu: Deleted Records will delete an individual record, or a selected group of records.

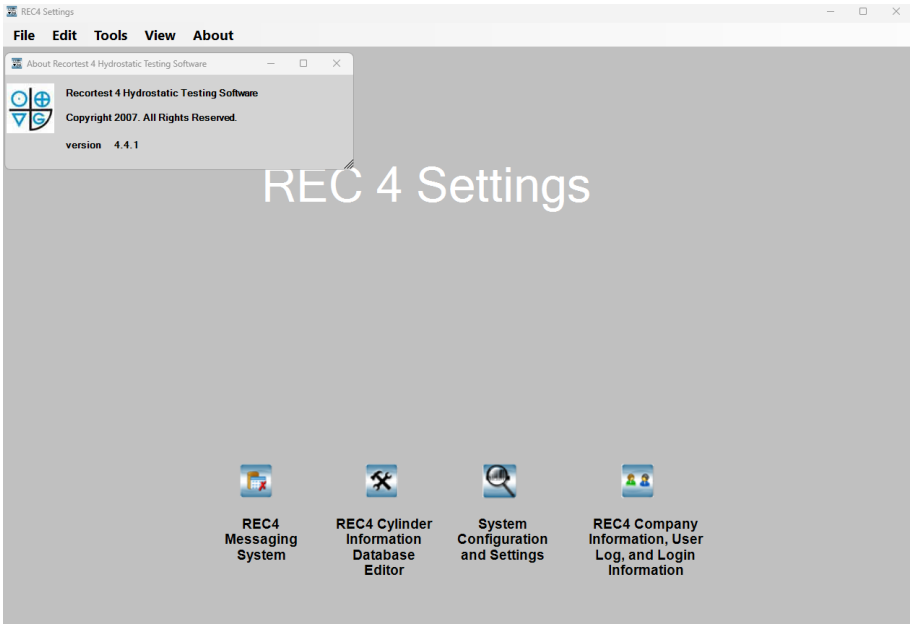


C. Tools Menu: Selecting “Open test forms” will open the test screen. This can also be achieved by selecting the Rec4 Company Information.

4.2 Pull-down Menus, continued



D. View Menu: The selections in the View menu will open the any of the 3 main menus, or return the operator to the home screen.

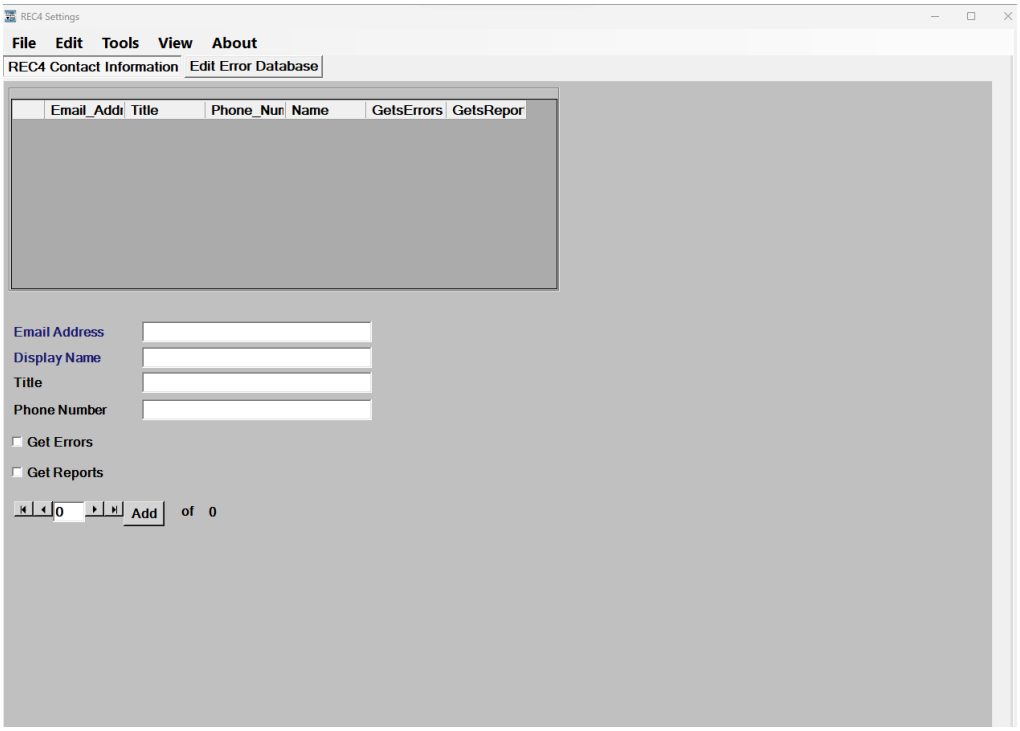


E. About Menu: When About is selected, information on the software and the current version that is loaded, will be shown.

4.3 Rec4 Messaging System:

This menu allows the supervisor to enter an e-mail address for error notification or reports to be received via e-mail. If the Edit Error Database tab is selected a history of errors is shown.

A. Click on REC4 Messaging on the main menu. The following menus will be available.

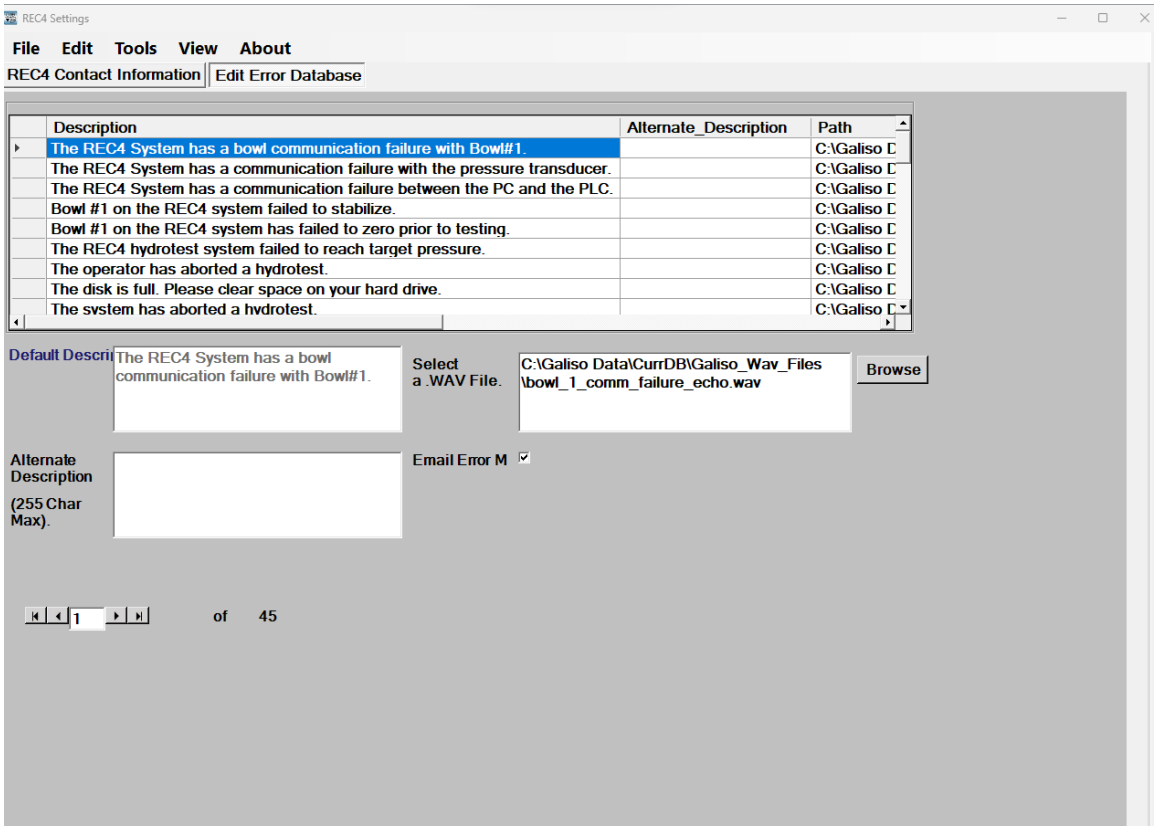


B. REC4 Contact Information: Enter the Email address and Display name in which error messages and reports should be sent. If either “Get Errors” or “Get Reports” is selected, both input areas with blue text must have data entered. Areas with black text are optional.

C. Always select **File** and **Save** or **Cntrl+S** to save any changes made.

4.3 Rec4 Messaging System, continued:

Edit Error Database: This screen will display a record of all system communication errors or system failure notifications. Upon receiving of notifications, a .WAV file will also be heard. The .WAV files may be changed or modified.

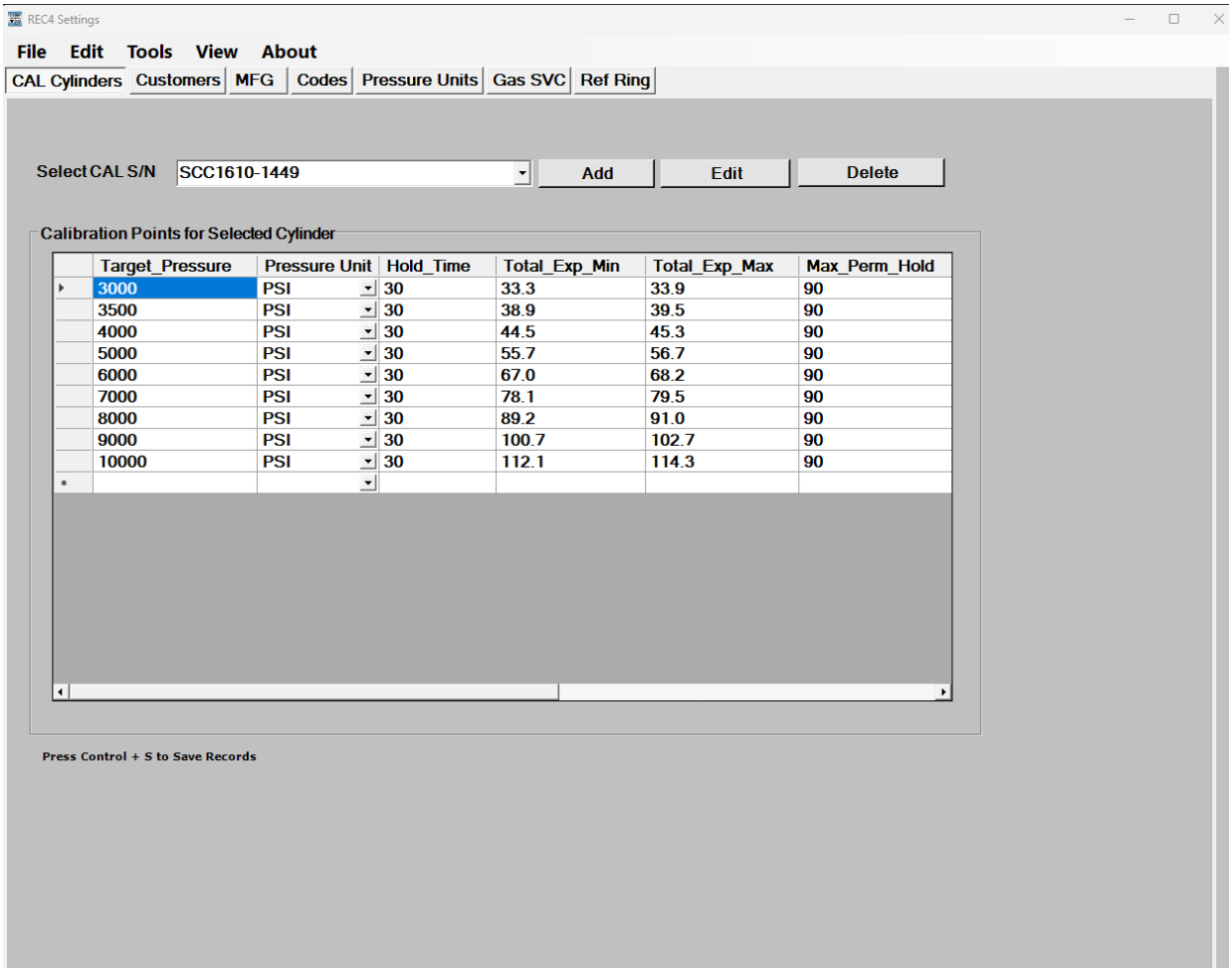


D. Select the file to be edited and select the check mark box to receive an email of a particular error.

E. Select File and Save (or Cntrl + S) when finished to save any changes.

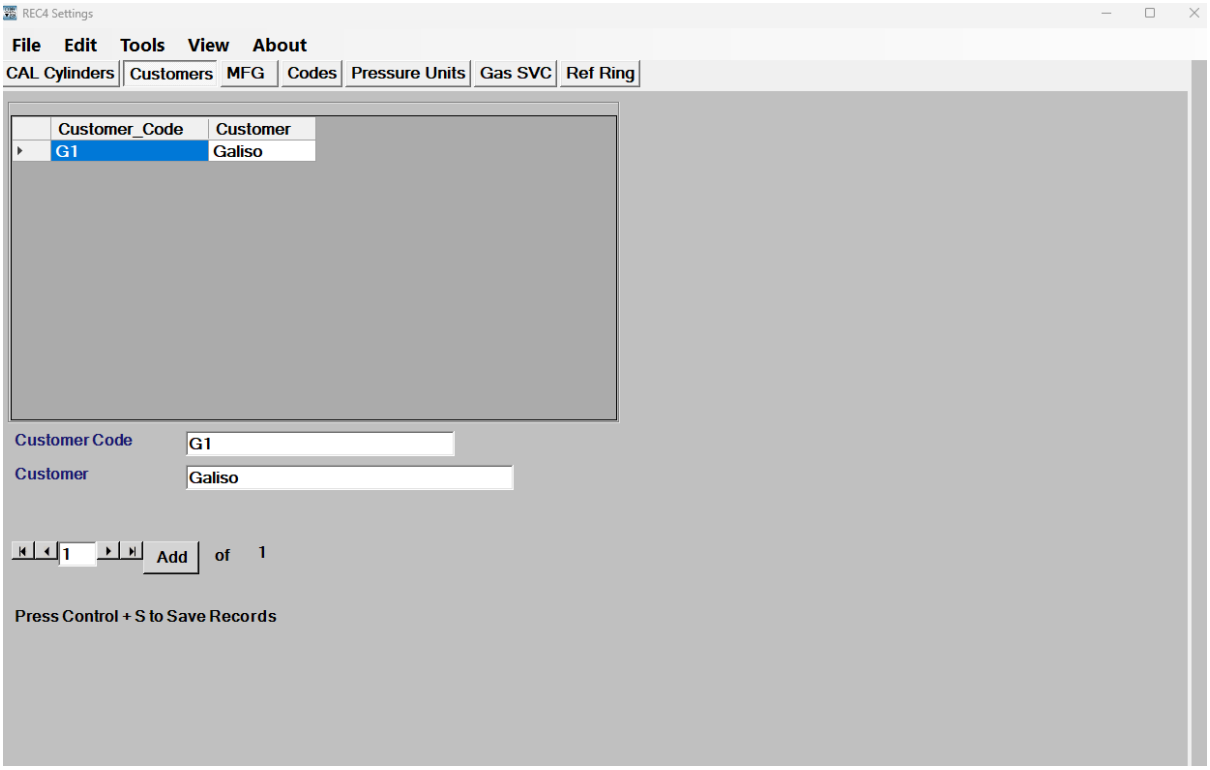
4.4 Rec4 Cylinder Information Database Editor

This menu allows the supervisor to enter information and change parameters for Calibrated and Test Cylinders.



A. Cal Cylinders: Select the Calibrated Cylinder serial number to change the parameters, add or delete a Calibrated Cylinder or Edit the Calibrated Cylinder information. Pressures can be edited here by selecting the Target Pressure and entering the value of pressure desired. After changes have been made, press Enter or Tab to set the information into a particular cell. With the cursor in a blank cell, select File and Save or Ctrl +S to save the changed information.

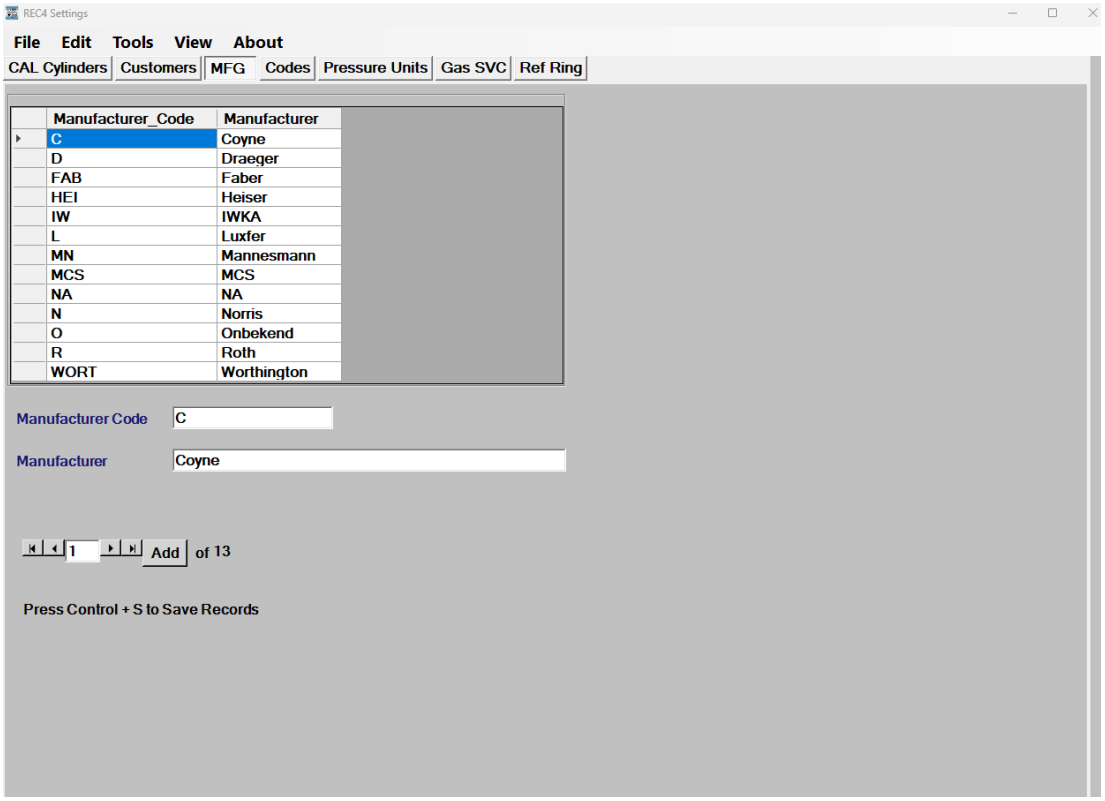
4.4 Rec4 Cylinder Information Database Editor, continued:



B. Customers: This menu allows a code to be created for each customer allowing for quick selection and input of preset data. To add a new customer, click on ADD and place cursor in data field next to Customer Code. Type the desired code name i.e. G1 in this field and the customer name i.e Galiso in the proper field. More customer codes can be added now or at any time when not in test mode. Always select File and Save, or Ctrl + S to keep any changed or added data.

4.0 Operation, continued

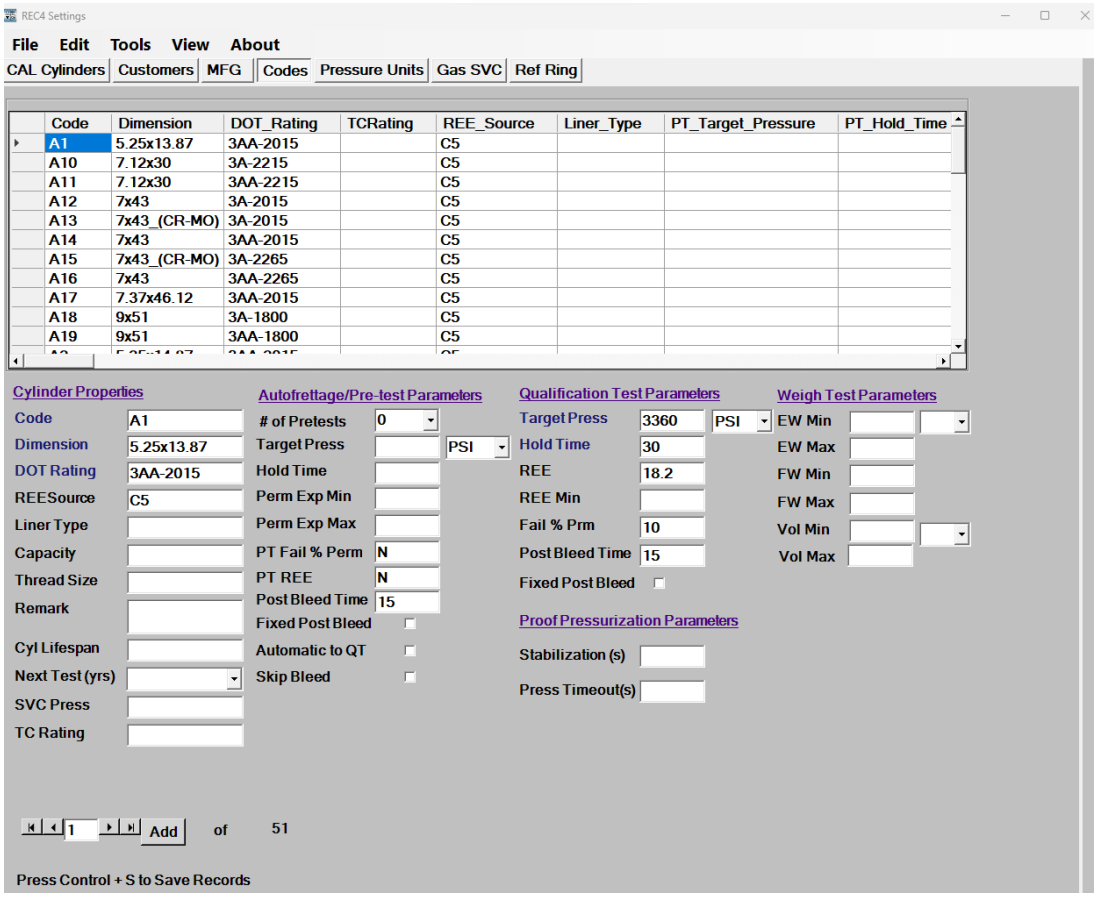
4.4 Rec4 Cylinder Information Database Editor, continued:



C. MFG: This menu allows a code to be created for each cylinder manufacturer allowing for quick selection and input of preset data. To add a new manufacturer, click on ADD and place cursor in data field next to Manufacturer Code. Type the desired code name i.e. L in this field and the customer name i.e. Luxfer in the proper field. More Manufacturer Codes can be added now or at any time when not in test mode. Always select File and Save, or Ctrl + S to keep any changed or added data.

4.0 Operation, continued

4.4 Rec4 Cylinder Information Database Editor, continued:

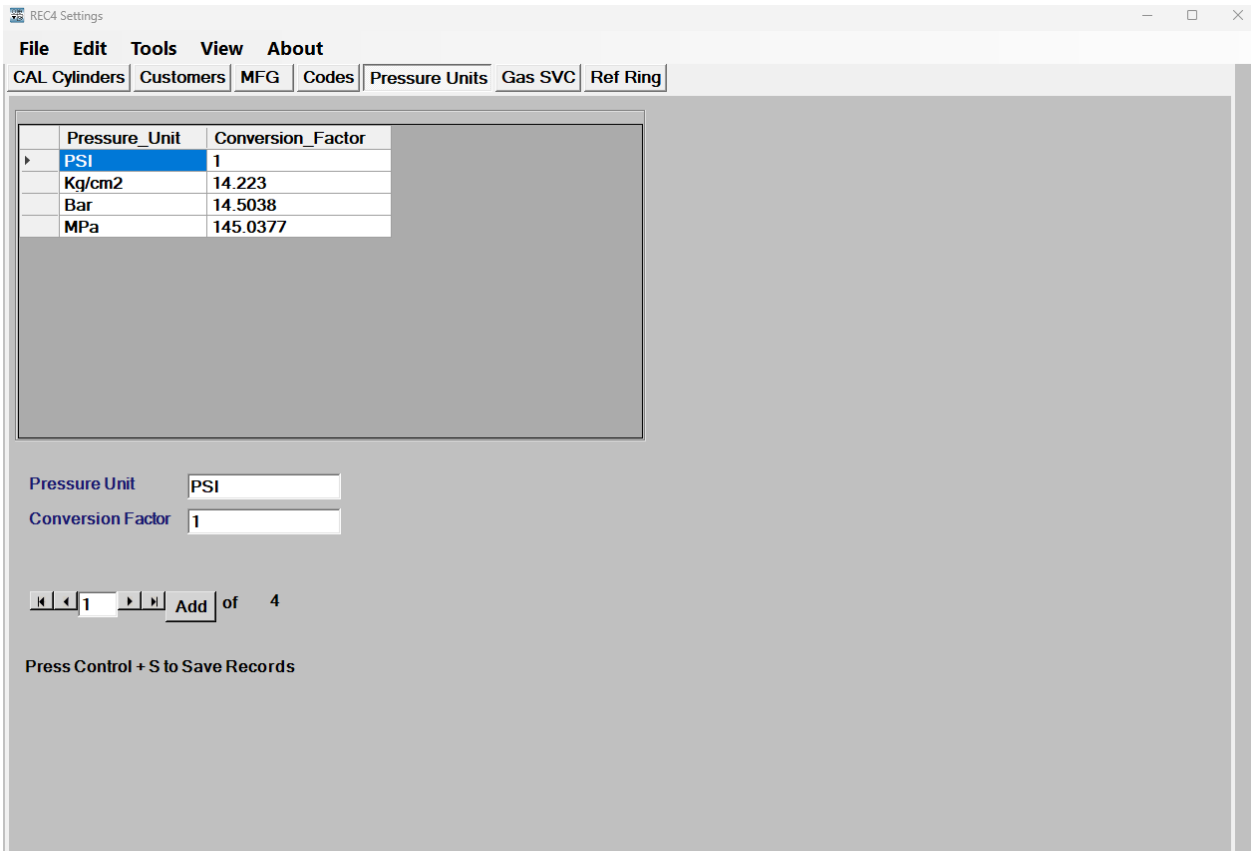


D. Codes: This menu allows codes to be created for cylinder properties and test parameters that are repetitive, allowing for one code to be entered and certain test data to be automatically input. This code enables the operator to spend less time on data entry.

Note: The items on this screen in Blue text, are required by DOT. The items in black are optional, but maybe required by your specific company. Click on ADD to add a new code. If desired code is shown, simply select the row to select a previously entered code.

'PT' test parameters are for a 'pre-test' that is performed before the 'QT' or qualification test. This will be used for cylinders that will pass the qualification test more consistently if an 85%-90% pretest is performed first. This is required for Autofrettage processes. 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.

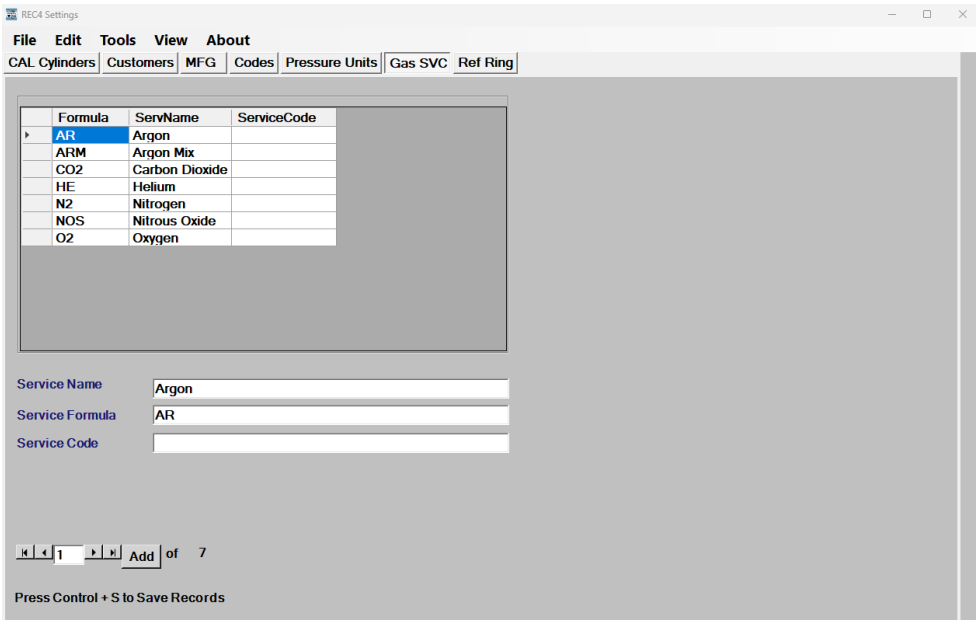
4.4 Rec4 Cylinder Information Database Editor, continued:



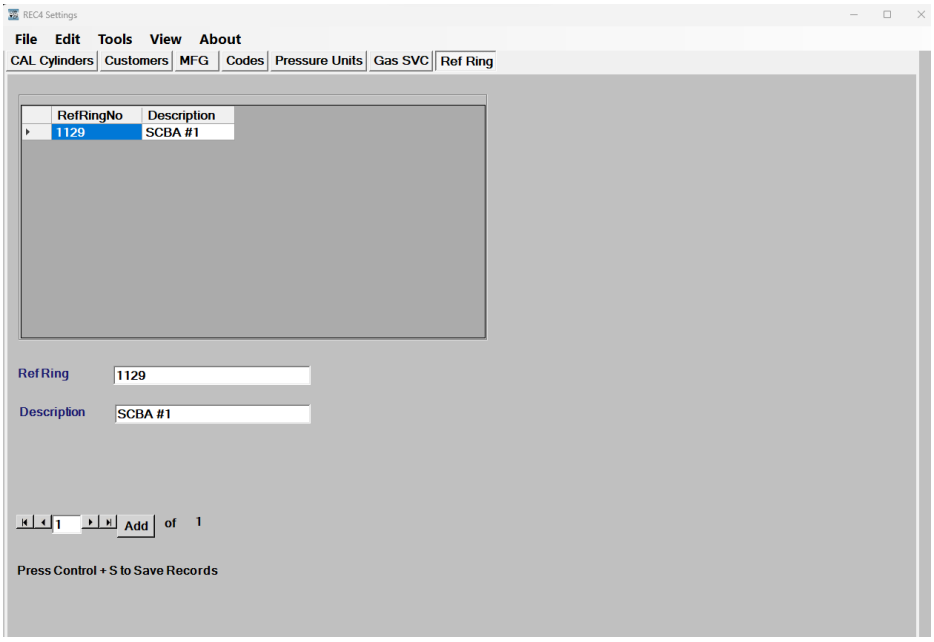
E. Pressure Units: This tab will allow the operator to change the Unit of Measure. The units can be changed from PSI, Kg/cm^2, BAR, MPa. The operator can also add a new choice for the units of measure, but will need to input the conversion factor from PSI. Always select File and Save or Cntrl +S after making a selection or after adding to ensure that the changes have been recorded.

4.0 Operation, continued

4.4 Rec4 Cylinder Information Database Editor, continued:



F. Gas SVC: This tab will allow the operator to save a code for any type of gas service in which the cylinder will use. The operator can select the row indicating the type of gas service the cylinder held or will hold. Select add if the appropriate gas is not listed.

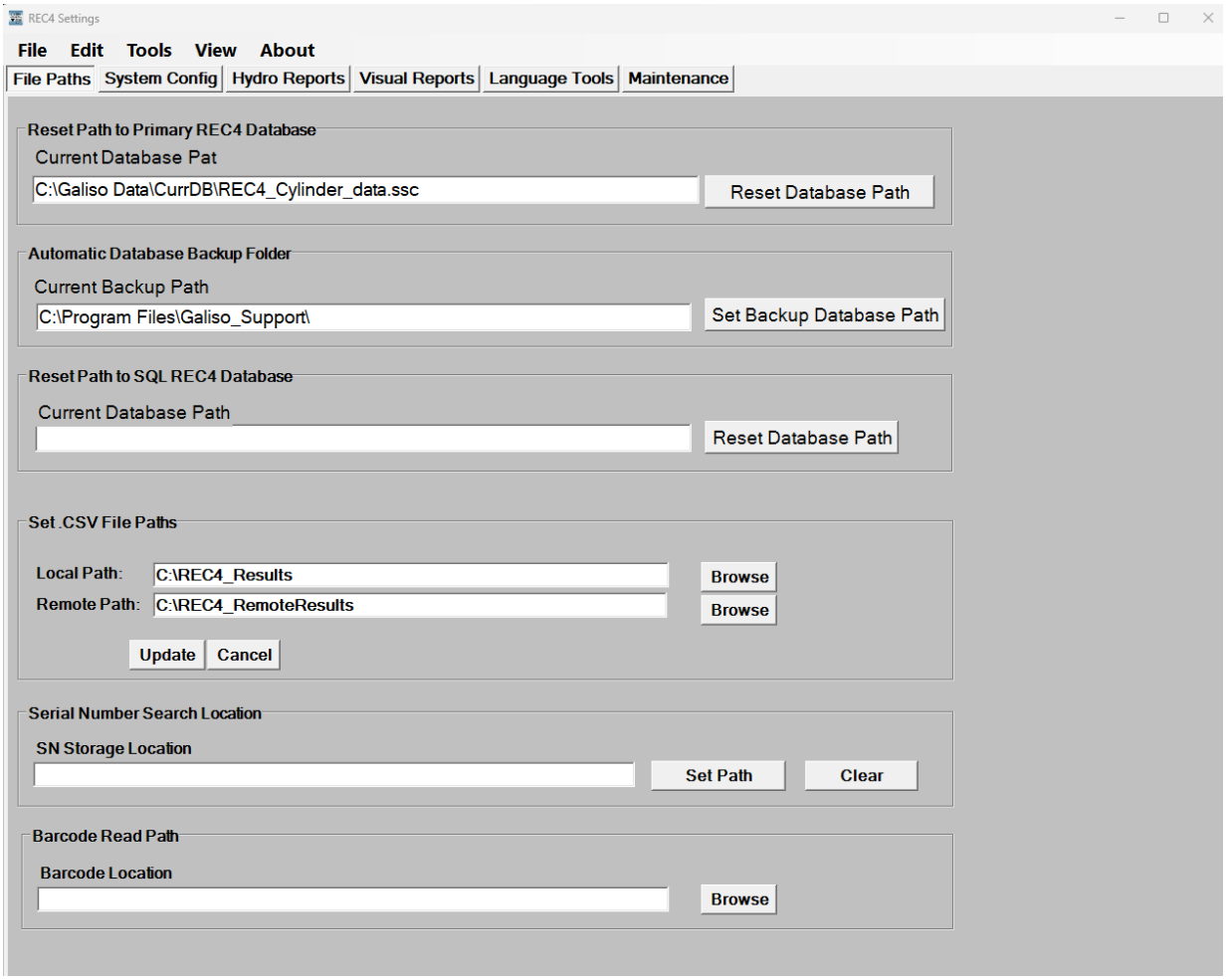


G. Ref Ring: This tab will not be used for general testing. This is only used for the specific number of the calibration ring, used with Eddy Current Visual inspection.

4.0 Operation, continued

4.5 System Configuration and Settings

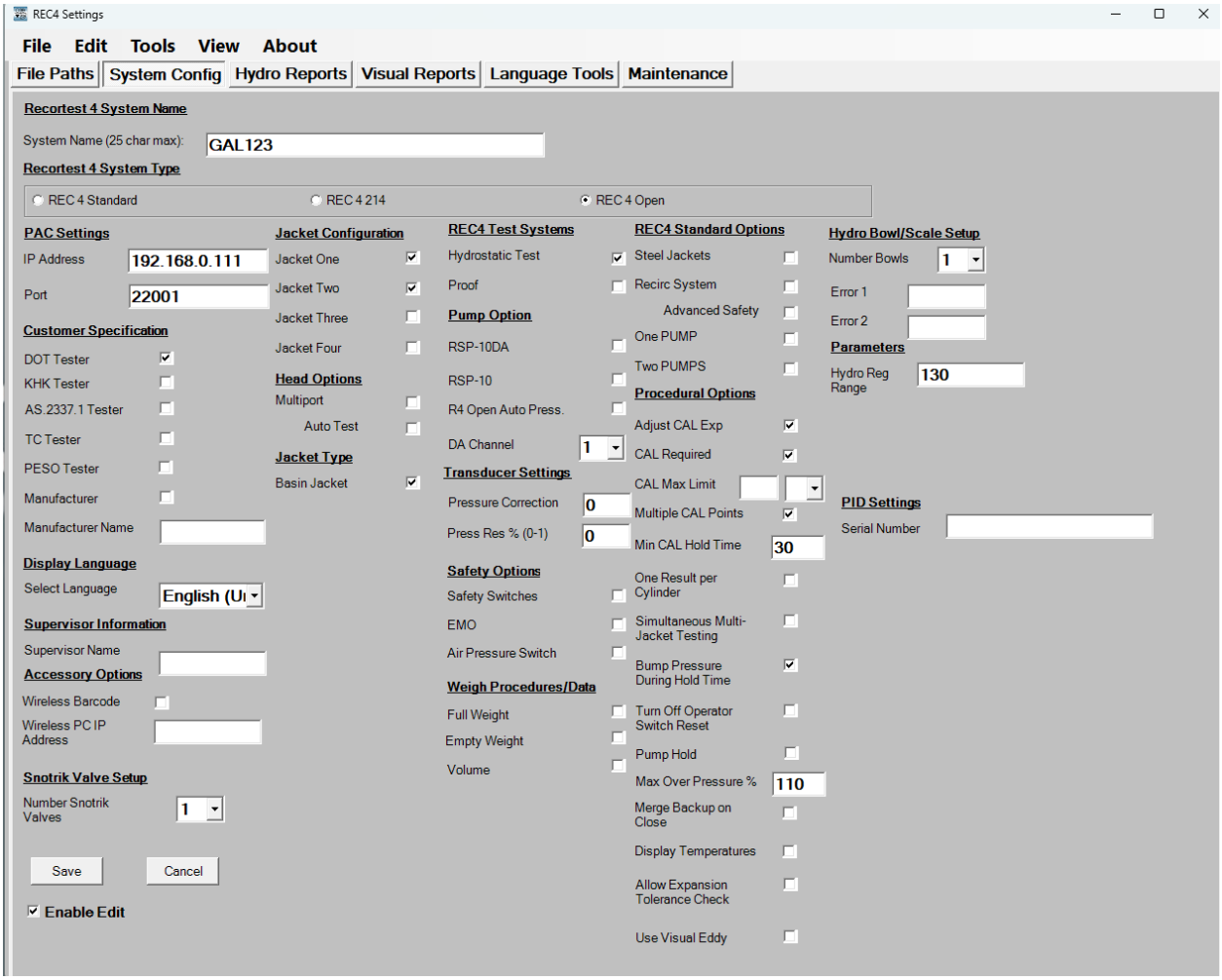
This menu allows the supervisor program choices for the locations for storage of reports and some specifications.



A. File Paths: This menu allows changes to where the current and backup files will be stored. All files and reports can be saved to the local hard drive or to offsite locations.

4.0 Operation, continued

4.5 System Configuration and Settings, continued

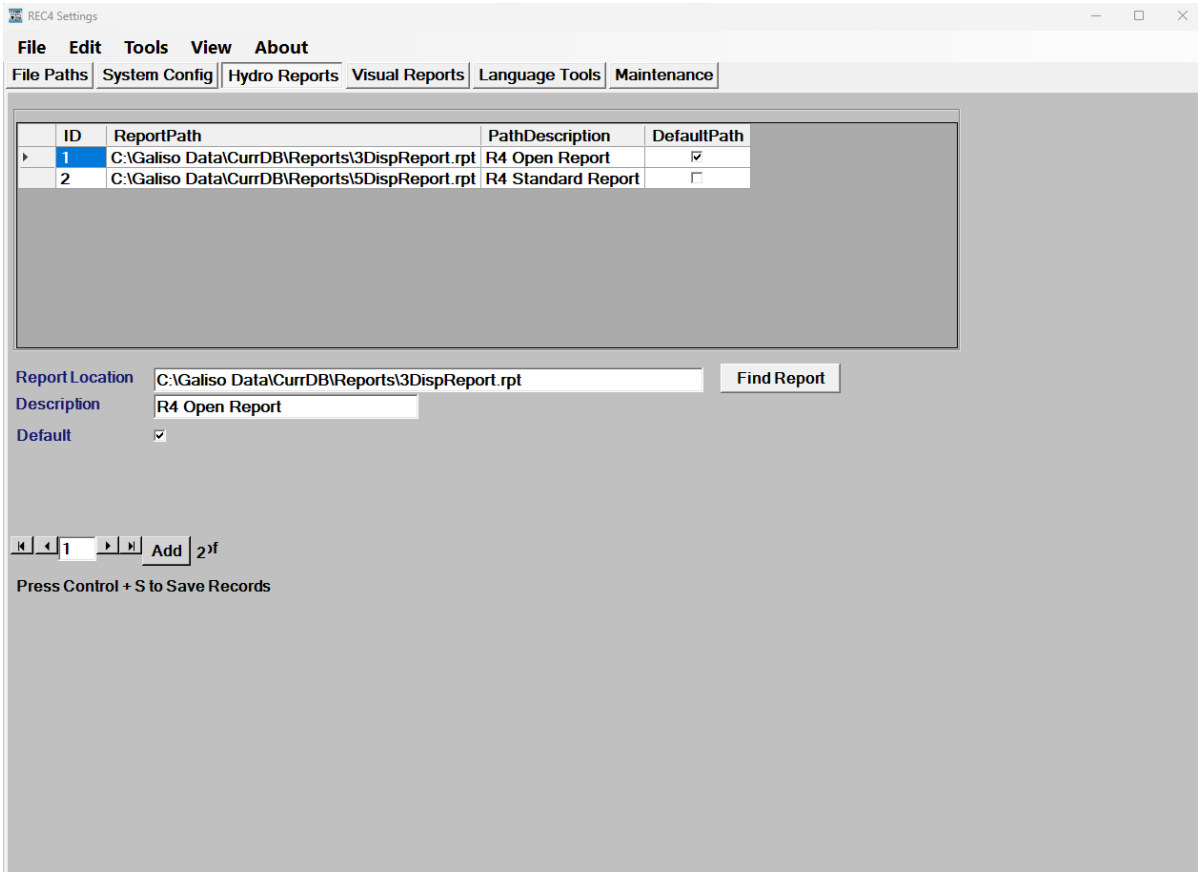


B. System Config: These functions are available for a Supervisor to make changes to various parameters such as; Language, Position or Jacket selection, Pump Options and some procedural options.

Always select File and Save or Cntrl+S to save any changes made.

4.0 Operation, continued

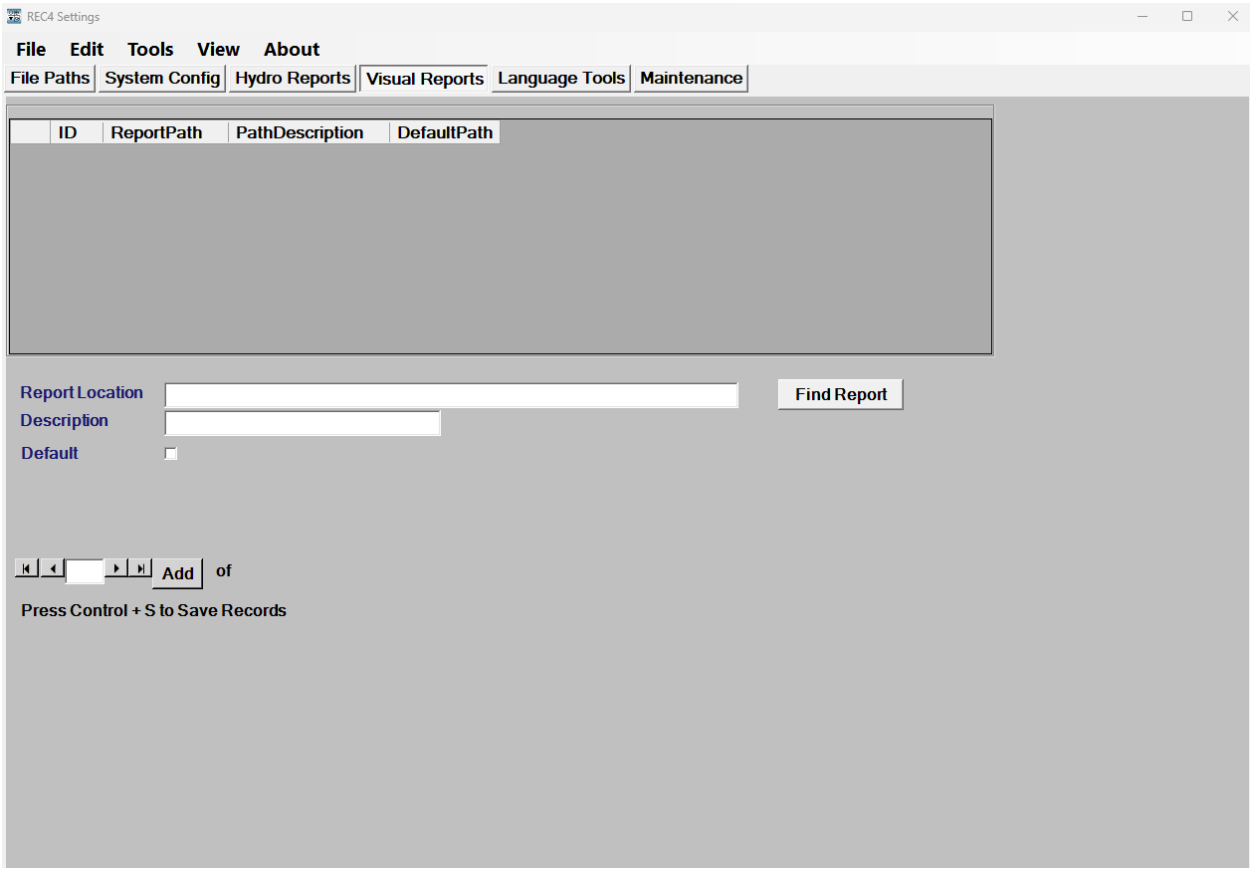
4.5 System Configuration and Settings, continued



C. Hydro Reports: This menu will be used to select which style of report to use, determining what the report will look like.

4.0 Operation, continued

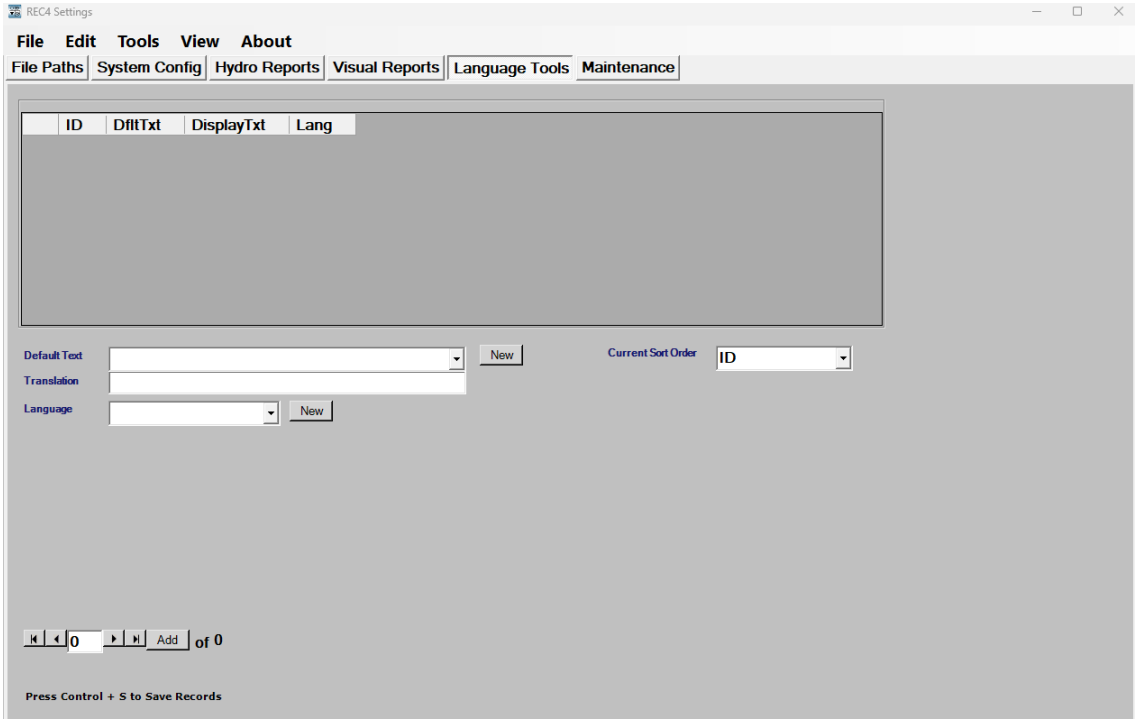
4.5 System Configuration and Settings, continued



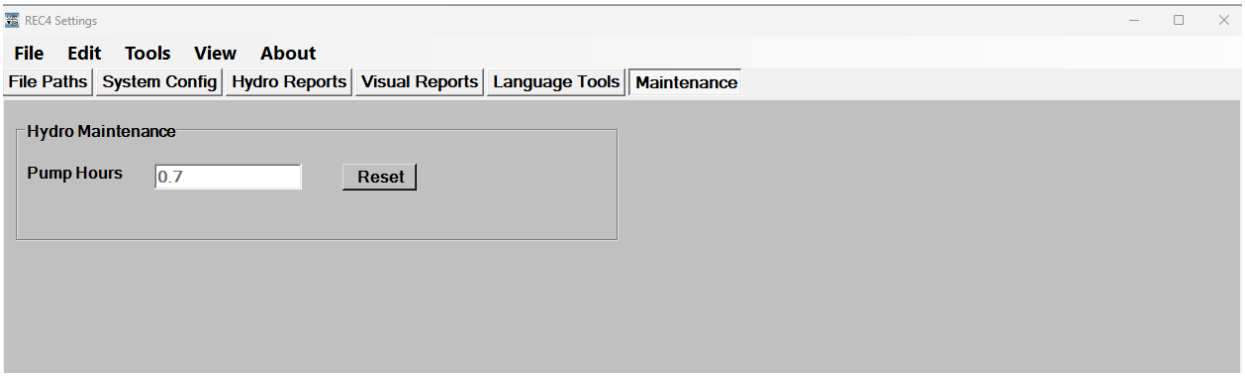
D. Visual Reports: This menu will be used for the report style, for Visual Inspection Reports.

4.0 Operation, continued

4.5 System Configuration and Settings, continued



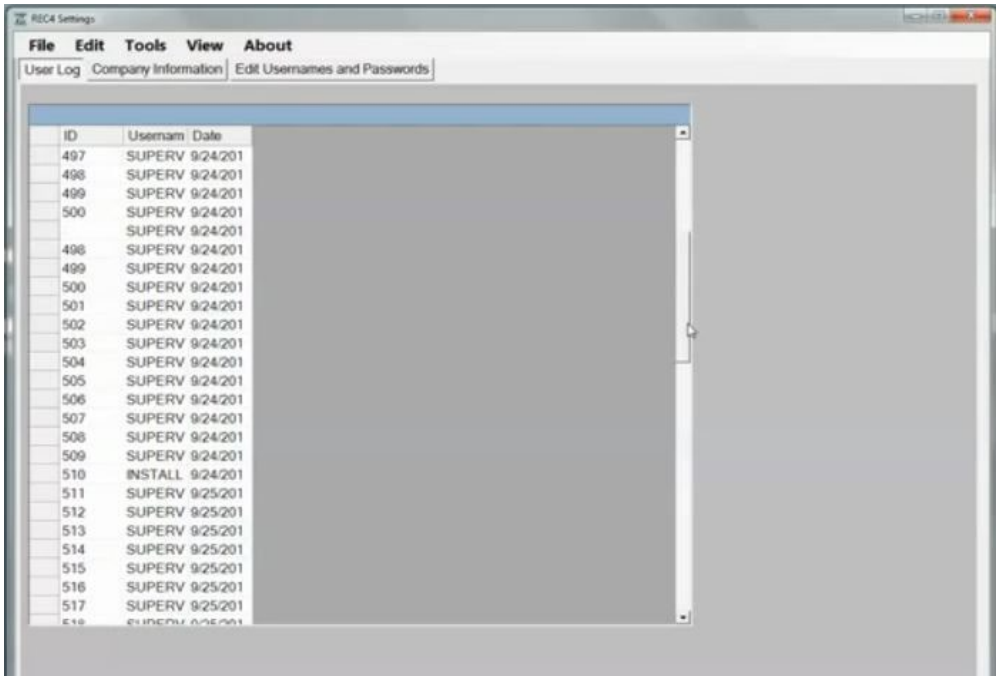
E. Language Tools: To change specific wording or terminology in the testing software and for any reports. For instance, if the word “Calibrate” is to be changed to “Verify”, place the cursor in the Default Text box and type (or select) “Calibrate”. Select the Language to be used, Spanish, French or German and the word that will replace it (Verify). After this is performed, the word Calibrate will be replaced by the word verify on the screens.



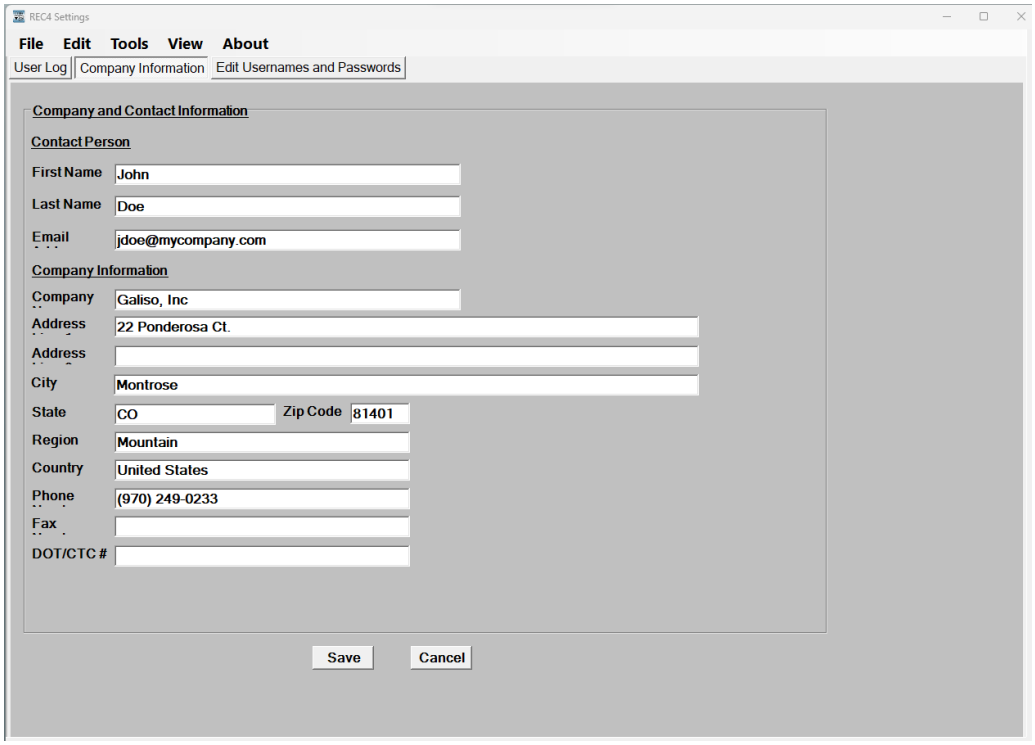
F. Maintenance: The Maintenance Menu shows the actual machine run-time (in hours) for reference to assist with maintenance. The Pump should be checked for oil weekly. A Reset button is available for use if the pump is replaced or rebuilt.

4.0 Operation, continued

4.6 REC4 Company Information, User Log and Login Information



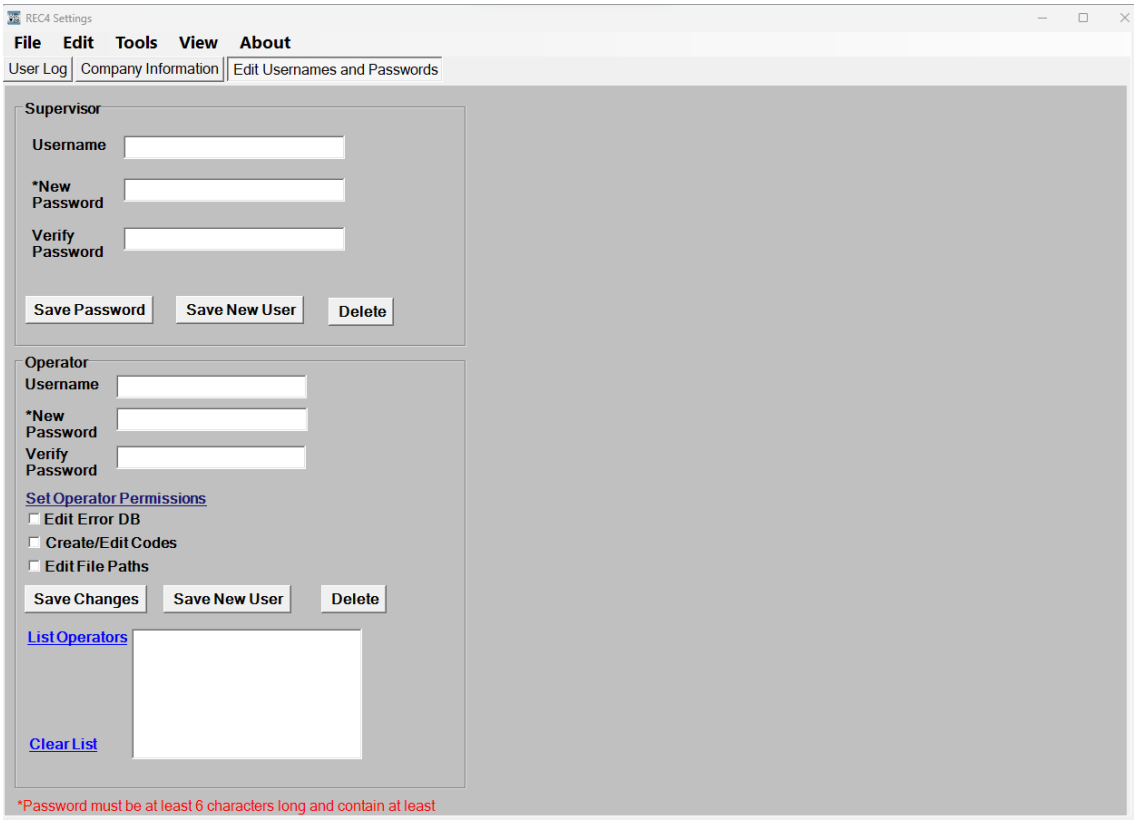
A. User Log: This tab allows Supervisors to view a record of all instances of dates and times of personnel login.



B. Company Information: This tab sets the record of the testing company and contact information.

4.0 Operation, continued

4.6 REC4 Company Information, User Log and Login Information, continued



C. Edit Usernames and Passwords: Supervisors can use this screen to enter new, or edit older Usernames and Passwords. This is location to select the permissions an operator may have.

Always remember to save any changes, or the changes will not be retained.

4.0 Operation, continued

4.7 Test Cylinder Preparation and Test Connections

A. Visually inspect the cylinder and verify that the cylinder will safely contain the test pressure. Always check the recommended pressure rating for the cylinder and make certain that you are using the appropriate test pressure for the pressure rating of the cylinder. If there is any question regarding cylinder integrity, DO NOT pressurize the cylinder.

B. Check the Air and Water Supply Lines to the Test Console for proper flow and pressure.

C. Completely fill the cylinder with water, taking care to eliminate any trapped pockets of air.

D. Verify that you are using a Galiso Test Connection that is appropriate for the neck threads of the cylinder that is being tested. If you have any questions concerning the appropriate Test Connection to be used with a particular type of cylinder, contact Galiso, Inc. at 1 (800) 854-3789.

E. All cylinders should be inspected before testing to ensure that the neck threads are not excessively worn or damaged. Cylinders with inadequate or damaged neck threads should be handled in accordance with 49 CFR.

NOTE: Do not lean on the Control Console or Table while a test is in progress. Weight applied against the side of the Table can cause the Expansion Bowl to sway and affect the accuracy of expansion readings.

4.7.1 Test Connections

A. Before connecting a cylinder for testing, inspect the cylinder neck threads. Cylinders with excessively worn or damaged neck threads must be dispositioned in accordance with CGA Pamphlets C-6, 6.1 or 6.2 as appropriate. Also, check the test pressure hose and fittings to ensure they are in proper working order.

4.0 Operation, continued

4.7 Test Cylinder Preparation and Test Connection, continued

B. The test spud (see figure 3) must engage the cylinder neck threads with at least four threads for the cylinder to be safely tested. If the test connection is not properly attached to the cylinder, it could be blown off during pressurization. If there is any question about the test connection **do not test the cylinder**.

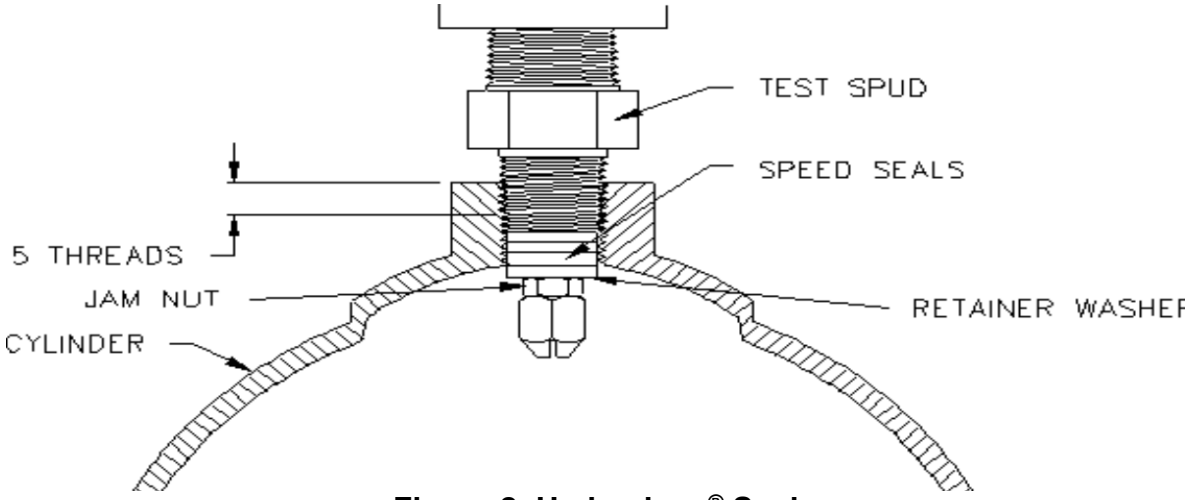


Figure 2, Hydraclose® Seal

C. Make certain that you are using a test spud that is appropriate for the neck threads of the cylinder that is being tested (see figure 3-2 below). When an incorrect test spud is screwed on to certain types of cylinders such as a cylinder with oversize neck threads, or some cylinders with double tapered neck threads. When connecting these types of cylinders, they will appear firmly attached, but they do not properly engage the threads of the test spud. If you have any questions concerning the appropriate test spud to be used with a particular type of cylinder, contact Galiso® Incorporated.

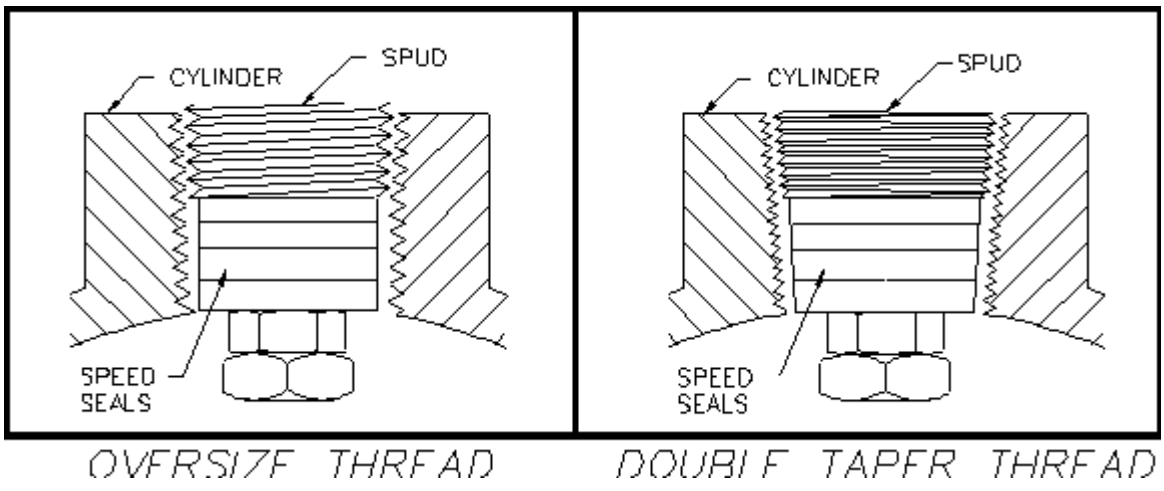


Figure 3 Cylinder Neck Thread Detail

4.0 Operation, continued
4.8 Operator Testing

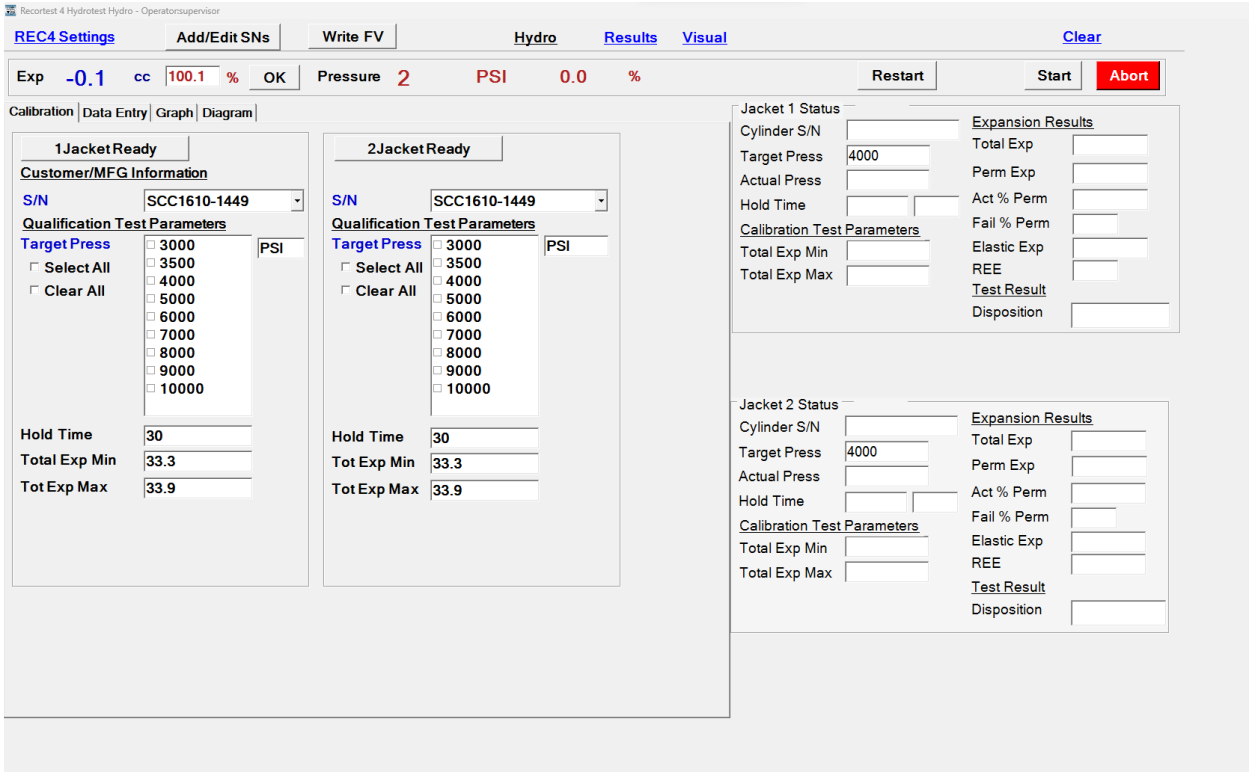
Prior to any testing, turn on the power to the Scale and let it warm up for at least 30 minutes. Ensure that the Scale is properly calibrated prior to initiating a test.

The water, in the cylinder to be tested, must be clean. Any contamination in the water will be passed through the pump and greatly reduce the life of the pump seals. Dirty or contaminated cylinders may need to be washed prior to testing. It is recommended the water temperature in the cylinder and Test Jacket be within 4°F to the air (ambient) temperature.

All personnel responsible for testing should be thoroughly familiar with test components, functions and controls prior to initiating any testing.

Prior to initiating testing, verify that all required connections are installed, the equipment is functioning properly and the Calibration Verification has been performed (see Section 4.9).

After an Operator has “Logged In”, the following screen will show:



This screen will also be used to verify calibration of the system. This is a verification process, nothing will be “calibrated”. Calibration verification is performed by points showing within 1% of the expansion points stamped on the Cylinder and showing on the Cylinder Calibration Certificate. System accuracy can further be verified, using a Master Gauge or Transducer. (See Section 5.3)

4.0 Operation, continued
4.8 Operator Testing, continued

A. Using a Hoist, lower the Cylinder and Test Head into a water-filled Galiso Test Jacket and lock into place using the Locking bars.

B. Connect the Blue Hose (Head Seal pressure, “Air In”) to the Test Head.

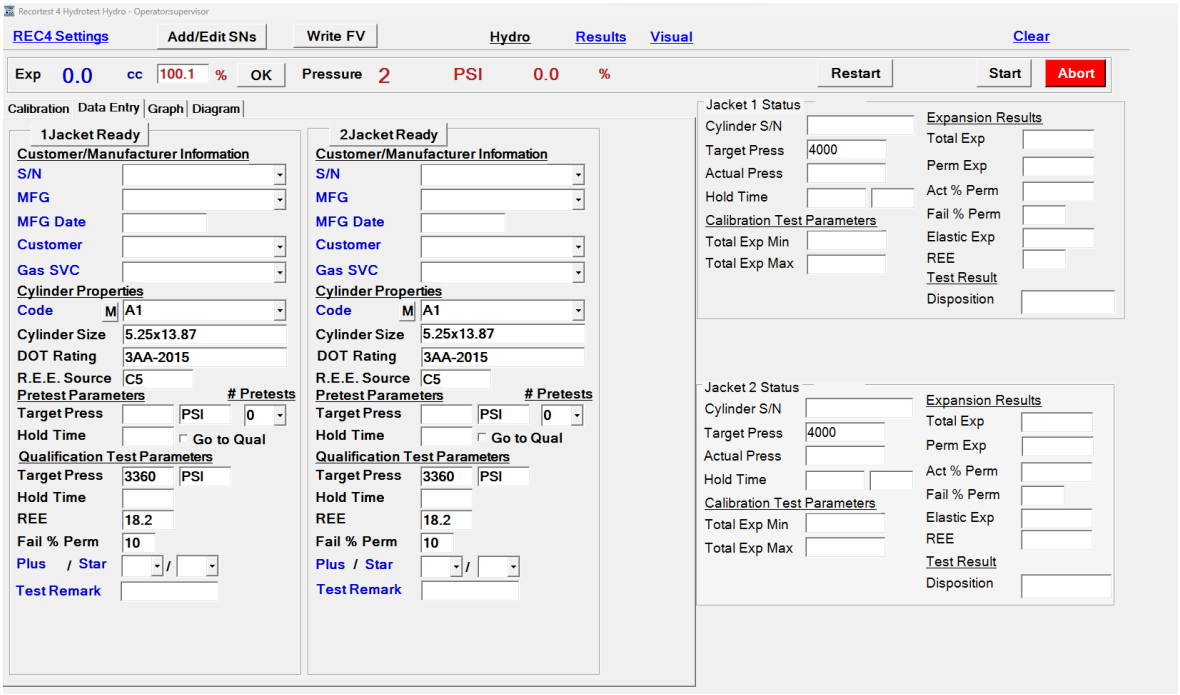
C. Turn the Expansion Valve on the front of the Console Table to **Expansion.**

NOTE: If the manual Expansion valve is in the Hold position when testing is started, pressurization will occur and the Burst Disk in the Jacket may, possibly rupture.

D. Connect the Black Hose (Expansion pressure) to the Test Head. (“Water In” quick connect).

4.0 Operation, continued
4.8 Operator Testing, continued

E. After the system has been verified for daily testing, insert a Galiso Test Head into the first (water-filled) Cylinder to be tested. Using the Test Head, hoist the Cylinder into the Test Jacket, and lock in place.



F. Select the Data Entry Tab. Enter the required data. Required data is in blue text. Information is to be entered for the corresponding Test Jacket. Enter the Cylinder serial number, manufacturer and date, gas service (type of gas cylinder holds), code (codes can be used for quicker data propagation), plus / star rating, test remark, eddy current and reference ring, into the appropriate data entry box for each corresponding jacket. If a Code is selected, certain information will auto-populate, such as; cylinder size, DOT rating, REE source, Pretest Parameters and Qualification Test Parameters.

G. After entering the data and verifying the accuracy, select 1JacktReady and 2JacketReady (these are “clickable” buttons) to ready the system. (Processes will not begin until Start is pressed). Select Start.

Once Target Pressure has been achieved, that pressure will be held for 30 seconds. If the pressure is not steady during that time frame, the cylinder will not pass the test.

4.0 Operation, continued
4.8 Operator Testing, continued

Pretest Parameters: If a Pretest is to be performed, 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, if the "Go To Qual" box is checked. If the "Go To Qual" box is not checked, the Start Button will need to be clicked upon after the pretest is complete.

Qualification Test Parameters: The qualification test parameters are automatically entered by the cylinder code table. They can also be entered manually in 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.

H. Once Start has been selected and testing has begun, a full test process will be performed starting in Jacket 1 and then continuing on and pressurizing in Jacket 2 (if the system is a two jacket system).

At completion of a test, the final test values for each cylinder tested are displayed on the right side of the screen.

I. Once the testing process is complete, disconnect the Black Hose (Expansion pressure) to the Test Head. ("Water In" quick connect).

J. Disconnect the Blue Hose (Head Seal pressure, "Air In") to the Test Head and Cylinder may now be removed.

K. Turn the Test Head to "Unlock" the Test Head from the Jacket and lift with the Hoist.

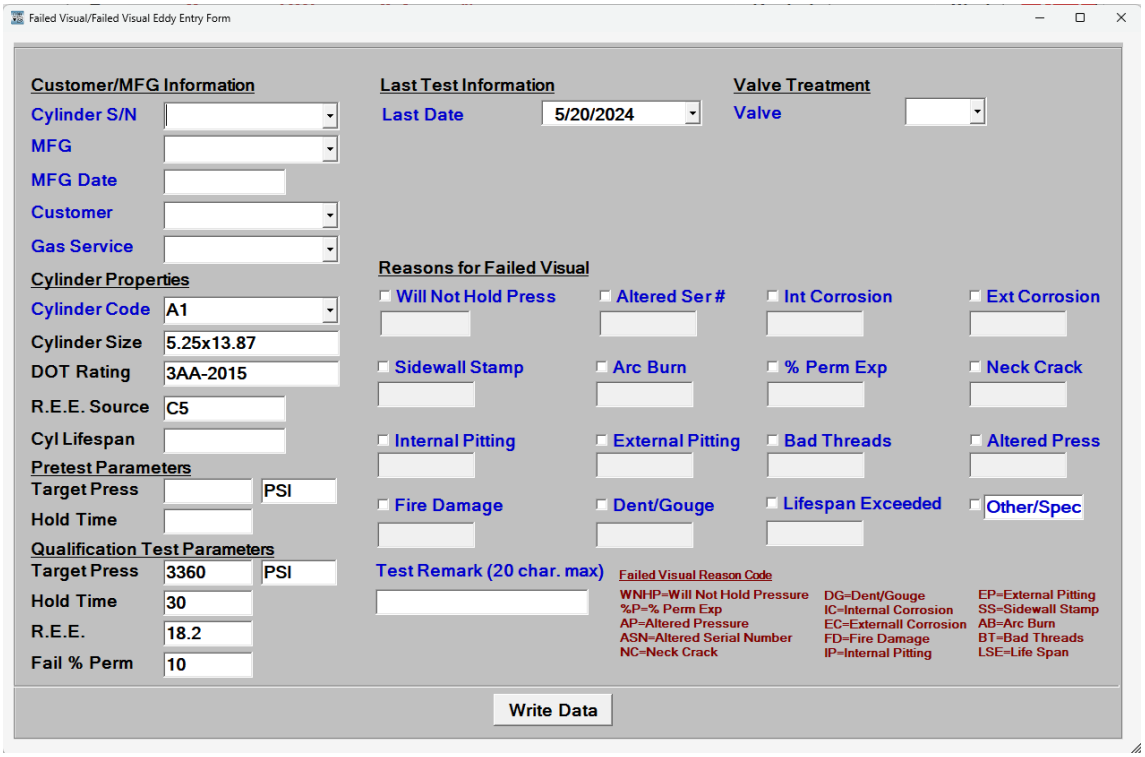
L. The system will now be ready for the next Cylinder(s) to be loaded. Verify all of the parameters are correct and enter any required data for the next test.

4.0 Operation, continued
4.8 Operator Testing, continued

After a test is complete, the result for each Cylinder will be displayed in the Test Result 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.
A PPP code is a passed cylinder. The key of disposition codes is printed on the report form.

4.8.1 Failed Cylinders:

For Cylinders that have failed select Write FV. The following menu is provided to record the reason for failure. After data entry, click “Write Data” to enter the information to the database.



After selecting “Write Data”, a confirmation pop-up will show. Click “OK” and proceed to further testing.

4.0 Operation Continued
4.8 Operator Testing, continued

4.8.2 Manual Pump Speed Adjustment

Slight adjustments to the pump speed will assist with increasing the quantity of cylinders tested.

Both Fast and Slow speeds will vary, dependent upon cylinder size. Fast and slow speed refers to how quickly the pump will pressurize a cylinder. Once pressure is within approximately 200 psi of Test Pressure, the Slow Pump will occur, slowing the pump pressurization, as to not over-pressurize the cylinder.

Once testing has begun, the control Valves on the front of the Console Table will be used. Opening the fast pump speed control to roughly 200 psi per second is sufficient for larger cylinders. “Pump Slow” will engage when a predetermined Psi value is achieved. By switching to a slower pumping rate, it is less likely to “over-shoot” the Target Pressure.

4.0 Operation Continued

4.9 Test System Verification

Prior to initiating system verification, make sure that all required connections are installed, the equipment is functioning properly and the Scale has been properly calibrated. For Scale calibration, see Section 5.2, Scale Calibration.

This test system verification procedure must be used to verify system accuracy every day in accordance with 49 CFR and all applicable CGA pamphlets.

SYSTEM START-UP:

Air and Water should be off at this time.

1. Press the ON button for the computer.
2. Enter Login and password.

SYSTEM VERIFICATION:

Scale:

1. Remove cover, slide Bowl to the side.
2. Press ZERO and when the scale reads 0.0, place a 1 Kg weight on the platform. The scale should read between 999.7 - 1000.3 grams. (If using two 50g weights, scale should read between 99.7 – 100.3.)
3. Return the bowl and cover to testing position.
   NOTE: Air flow and temperature changes can affect this reading, therefore, air cooling or fans may need to be shut off for an accurate reading.

Turn on shop AIR to the system. Verify that control air pressure gauge reads 90-100 psi. Turn on the WATER to the system.

Bleed Air from Lines:

1. Load the calibrated cylinder into the test jacket and lock the Test Head in place. The Hoses should NOT be connected at this time. Make sure the Jacket is full; if necessary, using the Jacket/Bowl Fill Valve for filling
2. Connect Master Gauge to the Test Head and the Black Hose to the Master Gauge. Connect the Blue Hose to the Test Head.
3. Turn the Drain/Hold/Expansion Valve to EXPANSION.
4. Turn the Bowl/Jacket Fill Valve for approximately 15 – 20 seconds, filling the bowl approximately 2/3 full, thus eliminating air from the Jacket lines. Return the valve to the neutral position.
5. Turn the Drain/Hold/Expansion Valve to Drain, allowing the water level to return to approximately 1/2” above the bottom of the probe.
6. Turn the Drain/Hold/Expansion Valve to EXPANSION.
7. Repeat steps 4-6, two or three times to allow trapped air to escape the lines.

4.0 Operation, continued
4.9 Test System Verification, continued

PRESSURE VERIFICATION

1. Confirm that both Hoses and the Master Gauge are still connected.
   NOTE: The Master Gauge must have a current calibration date marking within one year of calibration.

2. After starting the testing program, enter the Diagram screen. Enter maximum pressure of calibrated cylinder into the “Target Pressure” text box.

3. The Drain/Hold/Expansion Valve should be in the **EXPANSION** position.

4. Click “Pressurize” on the screen to manually pressurize the cylinder. Use the Pump Fast Speed Control and the Pump Slow Speed Control for adjustments to the speed of the pump.

5. After the pump stops at the target pressure check the Master Gauge reading, making sure to lightly tap with finger 2-3 times for an accurate reading. This reading should be compared to the Master Gauge Calibration sheet. The transducer reading on the screen should match within 1% of the gauge reading. Click “Bleed” to release the system pressure.

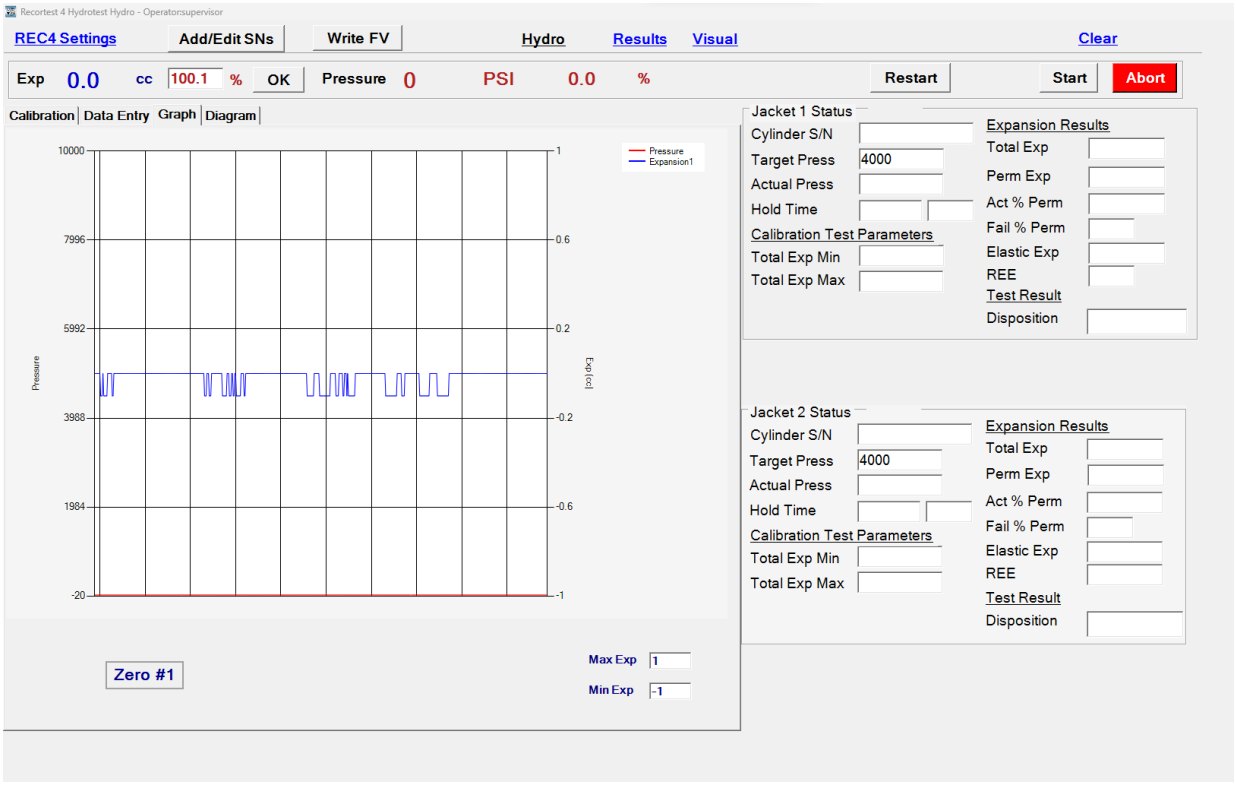
6. After pressing “Bleed”, the scale should read 0.0. If 0.0 is not achieved, repeat steps 4-5. Do not let it sit more than 30 seconds between pressurizations.
   If all pressures have read accurately proceed to the Calibration Screen to record Calibration Verification data per DOT requirements.

CALIBRATION VERIFICATION

NOTE: This **MUST** be performed DAILY to comply with DOT regulations!

1. Verify the highest pressure point for the cylinders to be tested that day.
2. Select “Calibration” on the computer screen.
3. Select the Calibrated Cylinder serial number from the list.
4. Choose the highest pressure point for the cylinders to be tested that day. This should be within 500 psi at test pressures greater than 3,000psi or within 10% of pressures below 3,000psi. These requirements are stated in CGA pamphlet C-1.
5. Click the “1 Jacket Ready” on the text line, next click on “Start”. Run the test and verify that the cylinder passes within the 1% expansion and pressure tolerances. The Test Disposition field should read PCAL. If a reading of FCAL (or red text) appears the test can be immediately run again, unless a problem has been found.
6. Repeat steps 4-5, for each calibration point on the calibrated cylinder.

4.0 Operation, continued
4.10 Graph Screen



A. The Graph Screen is a Pressure vs Expansion curve shown in graph format to enable the operator to see the pressure being applied to the cylinder vs the amount the cylinder is expanding. Once the system has been started, and at any time during testing, Graph can be selected to observe the Pressure vs Expansion.

The Graph Screen can also be used to check for Expansion Stability issues including temperature. See troubleshooting for mor details on leak and temperature problems.

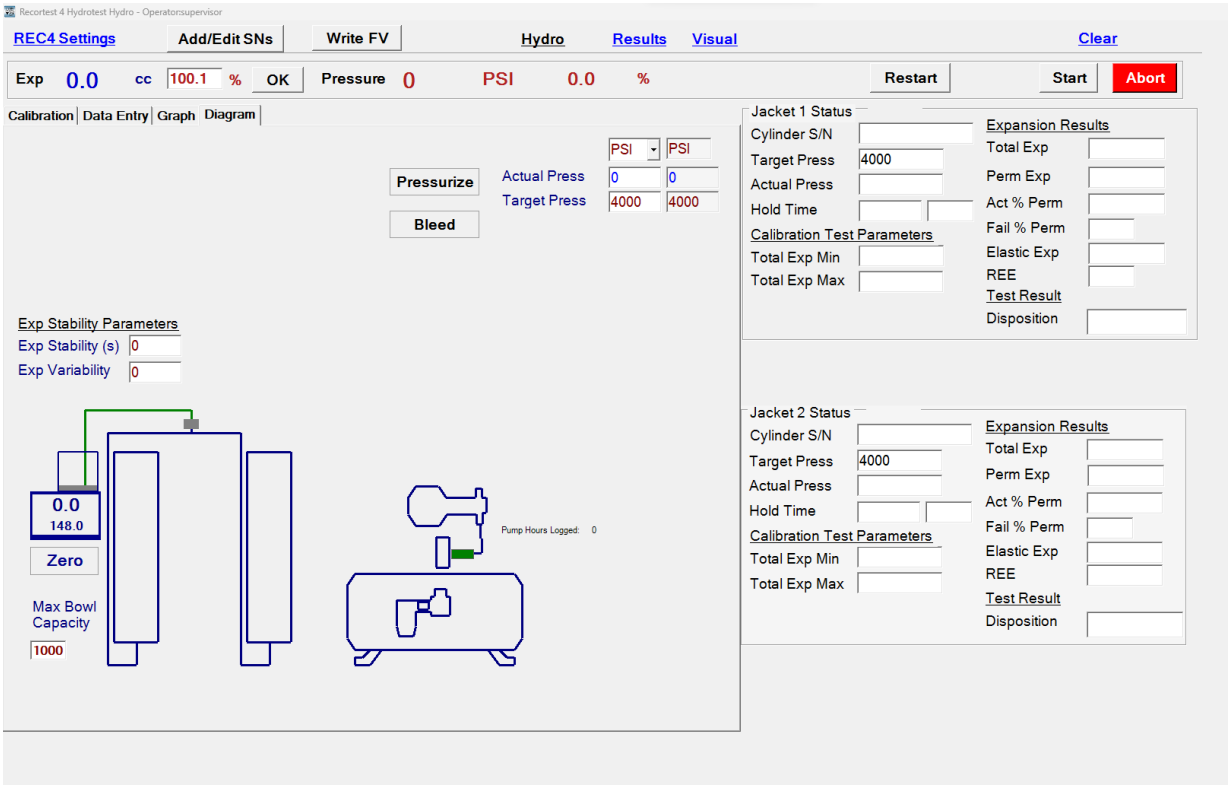
B. Pressure is shown as a red line on the graph and Expansion is indicated with a blue line.

4.0 Operation Continued

4.11 Diagram Screen

The Diagram Screen is available to manually operate Bowl options and Valve functions. Manual pressurizations can be controlled from this screen.

Note: Be certain to not exceed 80% of specified test pressure.

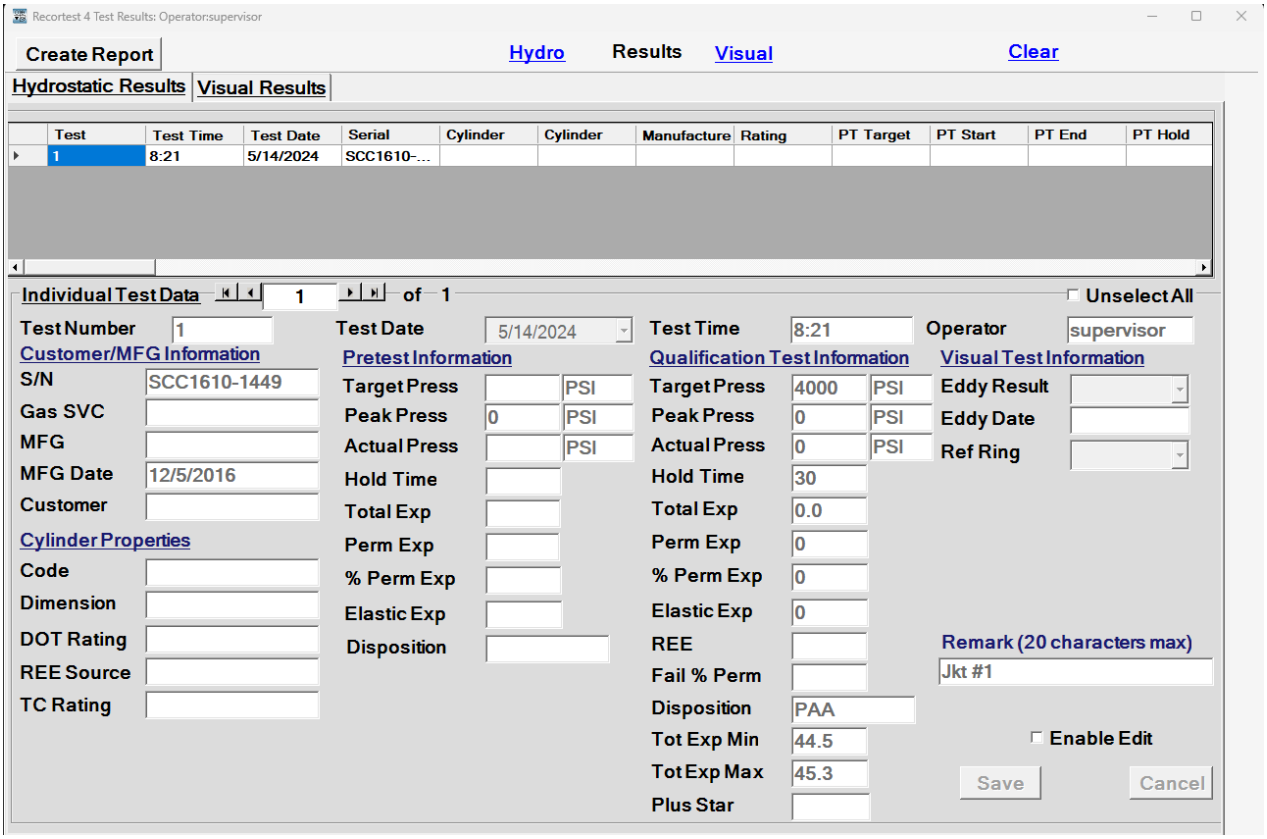


Testing and selecting Abort can also be performed on this screen. When selecting Start on this screen, Jackets must be “readied” on the Data Entry screen. 1 or 2 JacketReady must be selected before Start can be selected.

4.0 Operation, continued

4.12 Hydrostatic and Visual Results

A. To view or print a single report or print a batch of reports, click on Results at the top of the screen. The following menu will be available:



B. To select a single record, Click to the left of the test you wish to view or print. When the desired Test Number is displayed, click on Create Report. An option to print or select a date range (or other criteria) is now shown.

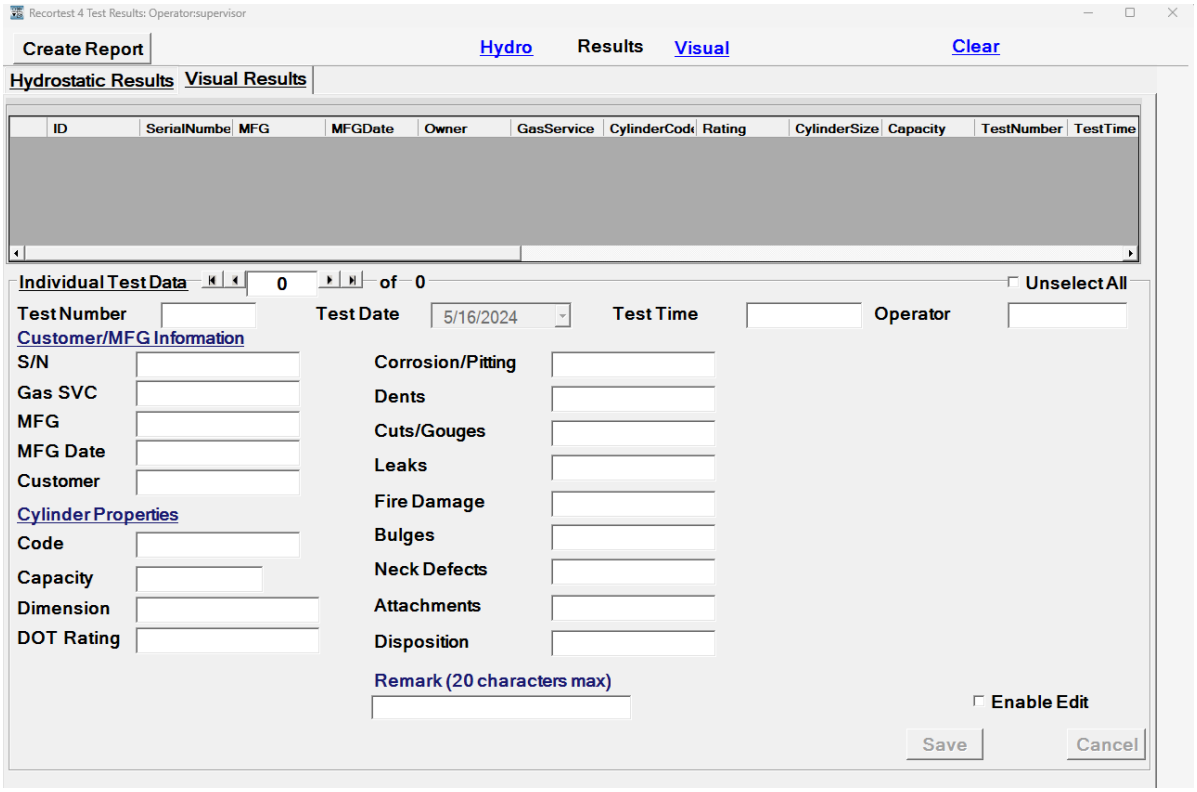
To select multiple records, click to the left of the starting record. Click and hold the Shift key and select the last record to be placed on a report. Multiple individual test records can be selected by “clicking” next to the test number. Highlighted test records will be incorporated into the report.

4.0 Operation, continued

4.12 Hydrostatic and Visual Results, continued

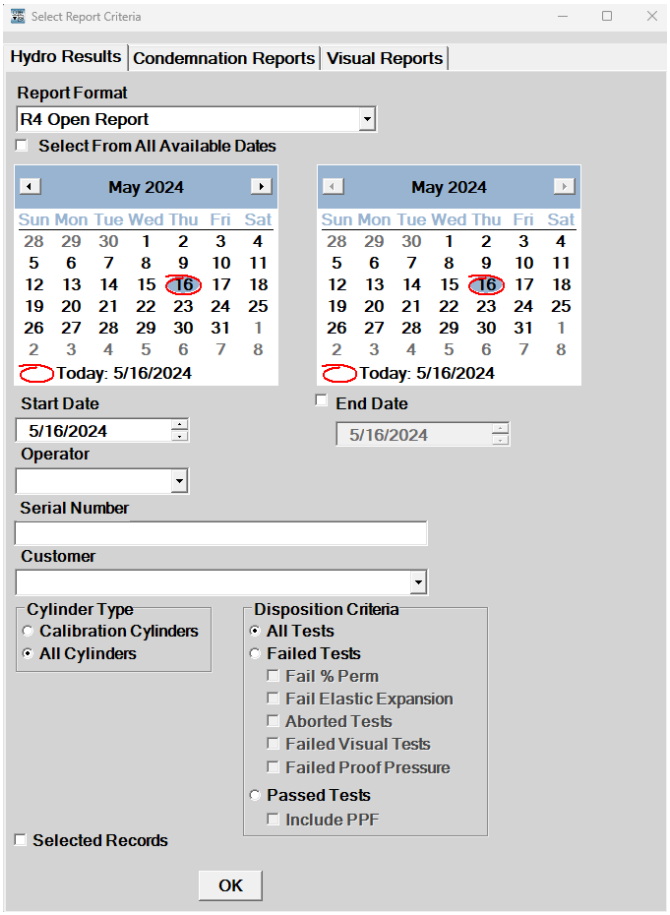
The Visual Results tab is available to record visual statistics and have that information be placed on hydrostatic reports.

Note: This section is not for Visual Eddy Testing. The blue, underlined Visual next to the word Results (in the upper-center of the screen) is to be used for Visual Testing.



4.13 Creating Reports

To Create a report, Click-on the Create Report Button in the upper left-hand of the screen. Report Format menu will become available.

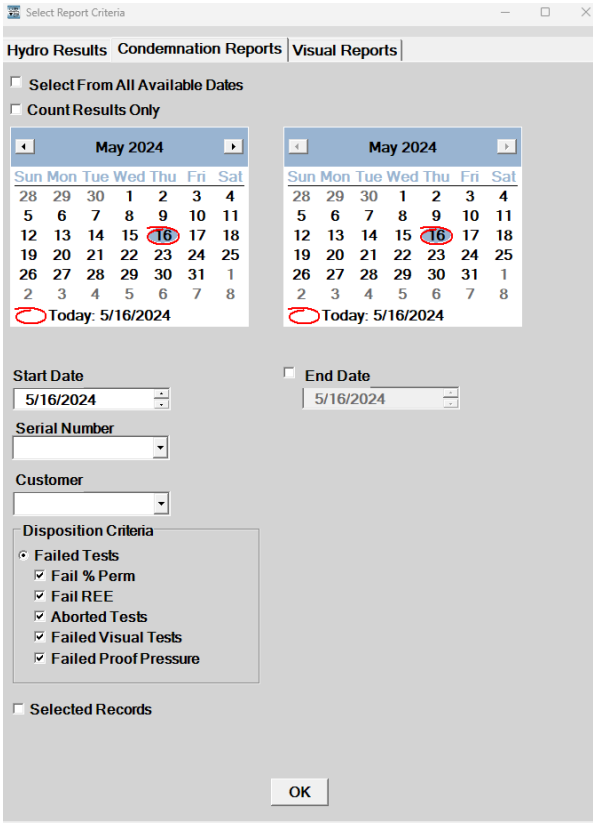


C. To print a single Hydro record, click OK.

D. To print all reports for a specific date range, select a start date, an end date and click OK.

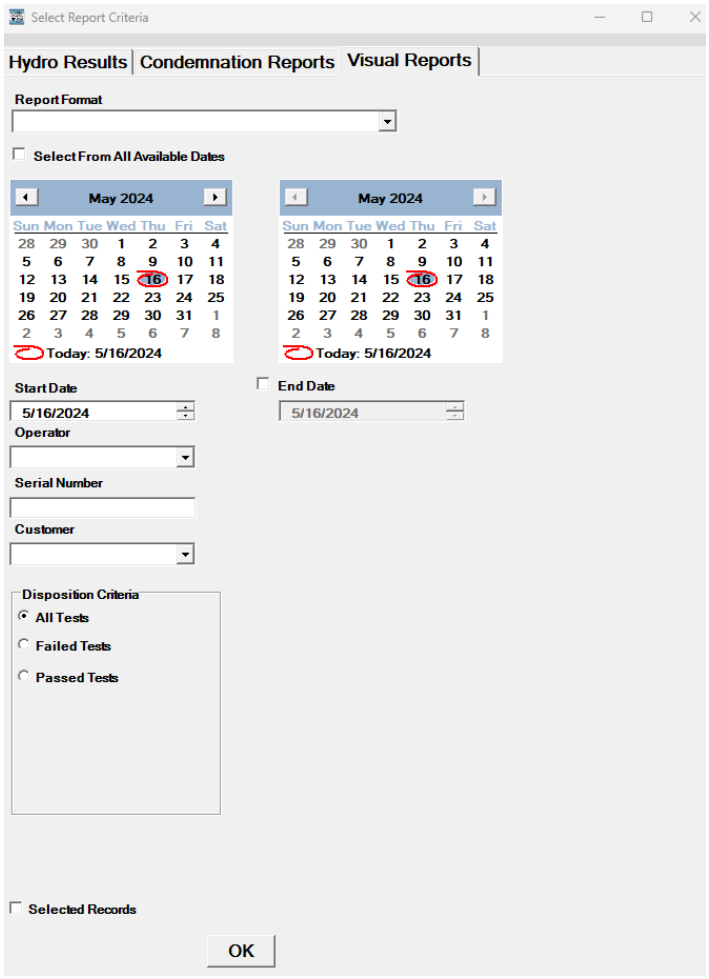
4.0 Operation, continued

4.13 Creating Reports, continued



A. To print a single Condemnation record, click OK.

B. To print all reports for a specific date range, select a start date, an end date and click OK.



A. To print a single Visual record, click OK.

B. To print all reports for a specific date range, select a start date, an end date and click OK.

4.0 Operation, continued

4.13 Creating Reports, continued

This is an example of a report for a test date range. Once the test result is shown on the screen, options to print or print to email are available at the top left of the screen.

Cylinder Requalification Report

DOT/TC Registration #

Galiso, Inc
22 Ponderosa Ct.
Montrose, CO 81401

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
PCAL, FCAL used for passed, failed calibration verification test, respectively; **PASS/FAIL** used proof tests-no REE, no % perm criteria

Operator Signature: _____ *Date Signed:* _____

Supervisor Signature: _____ *Date Signed:* _____

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

#	Test Date Test Time	Operator	Serial Number Cyl Owner	Size Service	Cyl MFG. MFG. Date	REE Source	Rating Unit	Specified Actual	Test Time	Total Elastic	Perm Percen	+* VE	VE Date Ref Ring	Disposition Remark
1	1/16/2024 13:09	supervisor	SCC1610-1449		12/5/2016		PSI	10000 10007	30	112.9 112.9	0.0 0.0			PCAL Jkt #1
1	1/19/2024 12:33	supervisor	test test	5.25x13.87 test	test test	18.2 C5	3AA-2015 PSI	3360 1315	30	0.0 0.0	0.0 0.0			PAA Operator Abort
3	1/19/2024 12:34	supervisor	test test	5.25x13.87 test	test test	18.2 C5	3AA-2015 PSI	3479 3183	30	35.7 0.0	0.0 0.0			PAA Operator Abort
1	1/24/2024 8:14	supervisor	SCC1610-1449		12/5/2016		PSI	3000 3034	30	33.9 0.0	0.0 0.0			PAA Jkt #1

Test Date(s): 1/16/2024 - 1/24/2024 1/24/2024 9:08:44AM Page 1 of 1

5.0 Maintenance and Verification (Scale and Gauge)

5.1 Maintenance

This section provides instructions for maintenance of the System components and calibration of instrumentation.

A. Keep the Control Table clean and dry and free of dirt and debris. Regularly inspect the plumbing components for leaks.

B. Regularly inspect the Expansion Bowl Assembly, if dirt and residue have accumulated in the Expansion Bowl, carefully drain and remove the Bowl. Clean the Expansion Bowl and reinstall it on the Scale Platform.

C. All metal surfaces including the Test Connections should be kept clean and free of rust and corrosion.

D. Test Hoses, and connections, should be periodically inspected for wear and replaced as needed.

E. “O-Rings” and Speed Seals should be inspected regularly, and replaced if necessary.

5.0 Maintenance and Verification (Scale and Gauge), continued

5.2 Scale Calibration Verification

The purpose of this procedure is to check and, if necessary, adjust the expansion readings provided by the electronic measuring Scale. Ensure that the Scale has been plugged in and turned on for at least 30 minutes before checking the Scale calibration.

In accordance with D.O.T. regulations, the calibration of the expansion reading and pressure reading must be checked at the beginning of each work day or shift. Also, in accordance with D.O.T. regulations, the expansion reading must be within plus or minus 1% of the total expansion. Normally the calibration check procedure will show that the system is reading accurately and that the system will not need to be adjusted. However, if the calibration check indicates that the expansion readings are not accurate, the Scale may be adjusted as described in below, and in the Scale vendor OEM literature included in the back of this manual.

A precision Calibration Weight (laboratory weight) is required to calibrate the Scale. Check the calibration of the expansion scale as follows;

A. Turn the Drain Valve to the “Drain” position to empty the water from the Expansion Bowl. When the Bowl has finished draining, turn the Drain/Fill/Hold Valve to the “Hold” position. Note that the Expansion Bowl will not drain completely, some water will be left in the bottom of the expansion bowl.

B. With the Expansion Bowl in place, press the ZERO / On - Off Button to zero the weight reading.

C. Place the Calibration Weight into the Expansion Bowl and wait for the indicator on the Scale to display a steady reading.

D. Check the LCD display. The display should read within .5 % of the weight.

   If the LCD display does not read within .5%, check that the device is level, and that the unit was re-zeroed before placing the calibration weight on the measuring platform. Recalibrate the scale as necessary.

E. If calibration is necessary, calibrate in accordance with the manufacturers’ instructions included with this manual.

5.0 Maintenance and Verification (Scale and Gauge), continued

5.3 Pressure Gauge Calibration Check

A. Calibration requirement per 49 CFR for the system pressure gauges are as follows:

High Pressure: Calibration of the Pressure Indicating Device must be verified within 500 psi of any pressure at or above 3000 psi to be tested each day.

Low Pressure: Calibration of the Pressure Indicating Device must be verified within 10% of any pressure below 3000 psi to be tested each day.

B. Examine the Gauge Calibration Certificate which is included with this manual. The Gauge Calibration Sheet is supplied by the gauge manufacturer to provide a record of the accuracy of the gauge at selected pressures. The Gauge Calibration Certificate shows two columns, one called “Applied (or Actual) Pressure”, and the other called “Indicated Pressure”. When the manufacturer or repair shop performs the gauge calibration, a Dead Weight Tester is used to apply a series of exact pressures to the gauge. Each of these pressures is recorded in the “Applied” column. The gauge is then read to see where the needle sits at each of these applied pressures. The pressure, in which the needle sits, is the pressure that is recorded into the “Indicated” column. The “Difference” column displays the discrepancy between the gauge reading and the true, applied pressure. Each of these points must be within 0.5% of the full range of the gauge, in accordance with 49 CFR. It may be necessary to take this deviation into account when verifying the system with the Calibrated Cylinder. For example, if the Gauge Calibration Certificate indicates that the gauge displays a value of 3020 psi when a true pressure of 3000 psi is applied, the gauge would need to be pressurized until a reading of 3020 psi is displayed in order for a true pressure of 3000 psi to be in the Calibrated Cylinder. If the gauge were only pressurized until it read 3000 psi, the cylinder would actually only be pressurized to 2980 psi and it may be difficult to achieve the proper expansion readings.

C. Connect the Master Gauge to the Calibrated Cylinder. Connect the Test Pressure Hose to the Master Gauge.

D. Select Start #1 to pressurize start the pressurization.

E. After the system has completed the pressurization, the Value reading on the Gauge should match the value indicated on the Gauge Calibration Certificate.

5.0 Maintenance and Calibration, continued

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6.0 Spare Parts

6.1 Recommended Spare Parts

The following Table identifies the recommended spare parts for the Rec4 Open Test System. Shown, are parts specific to a standard REC4/Open, Test Console 10,000 psi model. Parts indicated with*** vary, dependent upon unit pressures and special builds. Please verify your specific model and serial number for accuracy. Please call Galiso, Inc., for any questions or parts needs at 1(800) 854-3789.

Galiso Part No.	Description	Qty
37-11-3055	Regulator, Water, 3-50 psi, 1/2" NPT	1
37-11-8019	Scale, Electronic, 1200 Gram Capacity	1
37-11-8252S	Transducer, Serial, DXD, 10,000 psi .1% Acc. ***	1
37-11-8255	Accessory Kit, RS232, DXD Transducer	1
38-11-3078	Pump, Water, Pneumatic, 14,000 psi***	1
38-11-3084	Repair Kit for Water Pump 38-11-3078***	1
40-11-3033	Seal Kit, Pump Piston for 38-11-3078***	1
83-11-5009	Valve, Check, Inlet, 30,000 psi ***	1
38-11-5405	Rebuild Kit for 83-11-5009, Fluid Inlet Check Valve, 3/8" NPT***	1
83-11-5010	Check Valve, Check, Outlet, 30,000 psi ***	1
38-11-5406	Rebuild Kit for 83-11-5010, Fluid Outlet Check Valve***	1
54-11-0003	Oil, non-detergent, 10 Weight, 1qt	1
80-11-0110	Filter element, AF40 SMC	1
80-11-4008	Filter Element, 5 Micron, 2 1/2 X 9 7/8	1
81-11-0130	Valve, Air Operated: 10,000 psi	1
81-41-0263	Rebuild Kit, for Valve 81-11-0130	1
81-11-0288	Valve, Ball, 3-Way, 3/8", Whitey	1
81-41-1416	Valve, Piston, Assy, 1/2" W/Control Air Fitting & Silencer	1

Recommended Spare Parts

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PRODUCT WARRANTY

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

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

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

   B) THE SERIAL NUMBER HAS BEEN ALTERED OR DEFACED.

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

   If the warranty determination indicates that the item is **not** covered by warranty, a repair/replacement cost estimate will be submitted to the customer/purchaser for approval prior to initiating any repair work.

4. **CLAIMS:** In the case of equipment malfunction, notify Galiso (1-800-854-3789) and provide the Model Name, Model Number, Serial Number and a description of the problem. Return Authorization Number, shipping and/or service information will be provided on receipt of the required information.

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

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

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

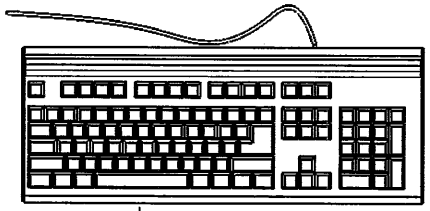
   Galiso does not assume liability for any consequential, incidental, or special damages. Liability under this warranty is limited to repairing, or replacing Galiso equipment items returned to the factory or an authorized facility.

8. **COMPUTER AND NETWORK VIRUS PROTECTION:** Galiso Inc. equipment, which utilizes internet access, comes equipped with a subscription to virus protection software. It is the responsibility of the equipment owner to maintain this virus protection subscription or other virus protection at their cost. Current virus subscriptions are mandatory to maintain the benefits of this warranty. Galiso does not assume liability for any or all damages related to or are the result of internet or network failure or malware or computer viruses or any other type of internet or network malfunction or attack.

DRAWING #	02-95-0200	BUILD #	

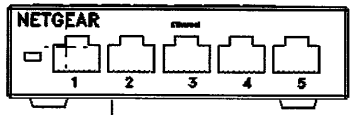
REV	AUTHORITY	DATE	BY
F	REC4 OPEN RELEASE	02/01/08	DM
G	UPDATE PARTS	01/11/2024	PL

ITEM	QTY.	PART NO.	DESCRIPTION
1	1	37-11-8252S	Transducer,DXD,Serial,10K Psi.1% Acc,(ADD 8255
2	1	86-11-9192	Computer, Dell, Rec4/R4O Add USB
3	1	37-11-8019	Scale, Electronic, 1200 Gram, Configured
4	1	94-11-0035	Printer, Laserjet
5	1	86-11-9027	Monitor, 22" Dell, LCD, Anti-Glare, 1920 x 1080 Full HD
6	1	86-11-6590	Switch, Gigabit, 5 Port Workgroup
7	1	86-42-9114	PLC Assy, REC4 OPEN (OPTO 22)
8	1	02-41-0235	Valve Manifold Assy,

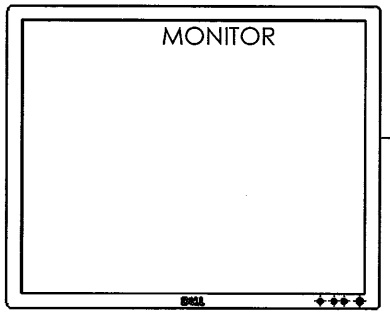


KEY BOARD
COMPUTER

6 ETHERNET SWITCH

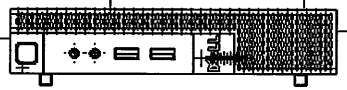


5 MONITOR



PRINTER NOT SUPPLIED
WITH 220 VOLT

2



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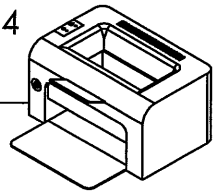

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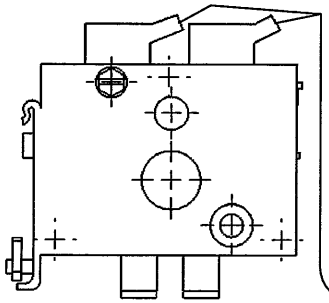

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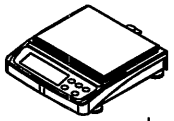
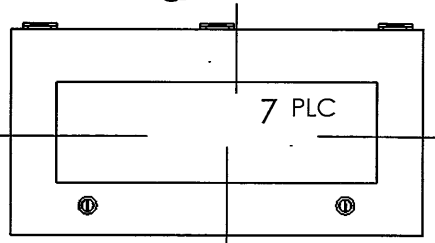


1 TRANDUCER

7 PLC



GALISO
GAS LIQUIDS SOLIDS
MONTROSE, CO
(970) 249-0233 PHONE
(970) 249-0607 FAX

INTERPRET THIS DRAWING IN ACCORDANCE WITH ANSI Y14.5

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.
TOLERANCES:
.X ± .1
.XX ± .03
.XXX ± .015
ANGLES ± 1°
SURFACE ROUGHNESS √

APPROVAL	SIGNATURE	DATE
DRAWN BY:	DON MORTON	02/01/08
PRODUCTION		2/8/24
ENGINEERING		2/8/24
QUAL. ASSURANCE		2-8-2024

TITLE:

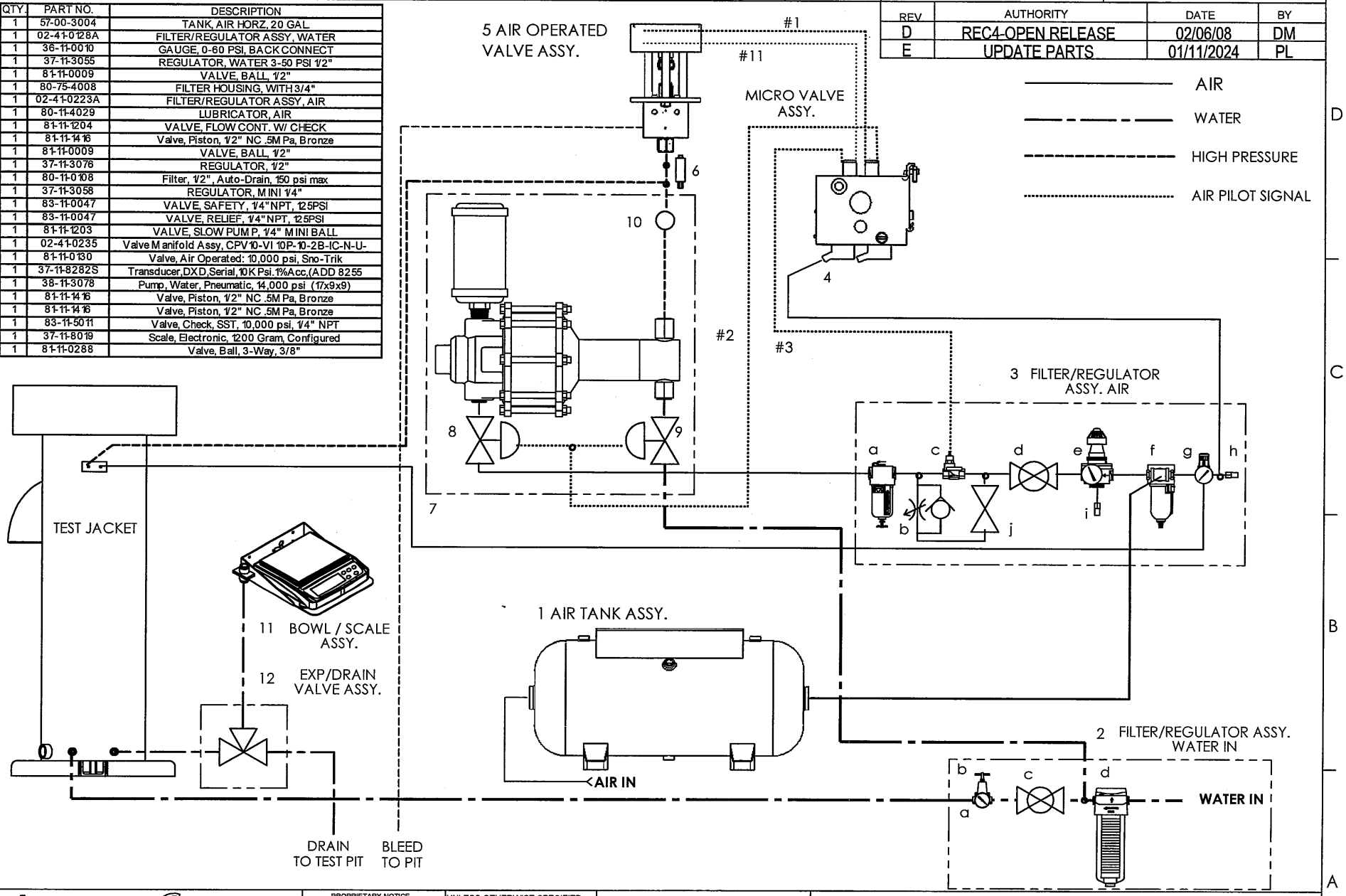
ELECTRICAL DIAGRAM
REC4 OPEN

DRAWING #	BUILD #	REV.	EXT.	SHEET
02-95-0200		G	SLDDRW	1 OF 1

DRAWING #	02-91-0200	BUILD #	

REV	AUTHORITY	DATE	BY
D	REC4-OPEN RELEASE	02/06/08	DM
E	UPDATE PARTS	01/11/2024	PL

ITEM	QTY.	PART NO.	DESCRIPTION
1	1	57-00-3004	TANK, AIR HORZ, 20 GAL
2	1	02-41-0128A	FILTER/REGULATOR ASSY, WATER
2a	1	36-11-0010	GAUGE, 0-60 PSI, BACK CONNECT
2b	1	37-11-3055	REGULATOR, WATER 3-50 PSI 1/2"
2c	1	81-11-0009	VALVE, BALL, 1/2"
2d	1	80-75-4008	FILTER HOUSING, WITH 3/4"
3	1	02-41-0223A	FILTER/REGULATOR ASSY, AIR
3a	1	80-11-4029	LUBRICATOR, AIR
3b	1	81-11-1204	VALVE, FLOW CONT. W/ CHECK
3c	1	81-11-1416	Valve, Piston, 1/2" NC .5M Pa, Bronze
3d	1	81-11-0009	VALVE, BALL, 1/2"
3e	1	37-11-3076	REGULATOR, 1/2"
3f	1	80-11-0108	Filter, 1/2", Auto-Drain, 150 psi max
3g	1	37-11-3058	REGULATOR, MINI 1/4"
3h	1	83-11-0047	VALVE, SAFETY, 1/4" NPT, 125PSI
3i	1	83-11-0047	VALVE, RELIEF, 1/4" NPT, 125PSI
3j	1	81-11-1203	VALVE, SLOW PUMP, 1/4" MINI BALL
4	1	02-41-0235	Valve Manifold Assy, CPV10-VI 10P-10-2B-IC-N-U-
5	1	81-11-0130	Valve, Air Operated: 10,000 psi, Sno-Trik
6	1	37-11-8282S	Transducer,DXD,Serial,10K Psi.1%Acc,(ADD 8255
7	1	38-11-3078	Pump, Water, Pneumatic, 14,000 psi (17x9x9)
8	1	81-11-1416	Valve, Piston, 1/2" NC .5M Pa, Bronze
9	1	81-11-1416	Valve, Piston, 1/2" NC .5M Pa, Bronze
10	1	83-11-5011	Valve, Check, SST, 10,000 psi, 1/4" NPT
11	1	37-11-8019	Scale, Electronic, 1200 Gram, Configured
12	1	81-11-0288	Valve, Ball, 3-Way, 3/8"



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UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.
TOLERANCES:
.X ± .1
.XX ± .03
.XXX ± .015
ANGLES ± 1°
SURFACE ROUGHNESS √

APPROVAL	SIGNATURE	DATE
DRAWN BY:	DON MORTON	02/06/08
PRODUCTION	M. Sahn	2/21/24
ENGINEERING		2/22/24
QUALITY ASSURANCE		2/22/24

TITLE:

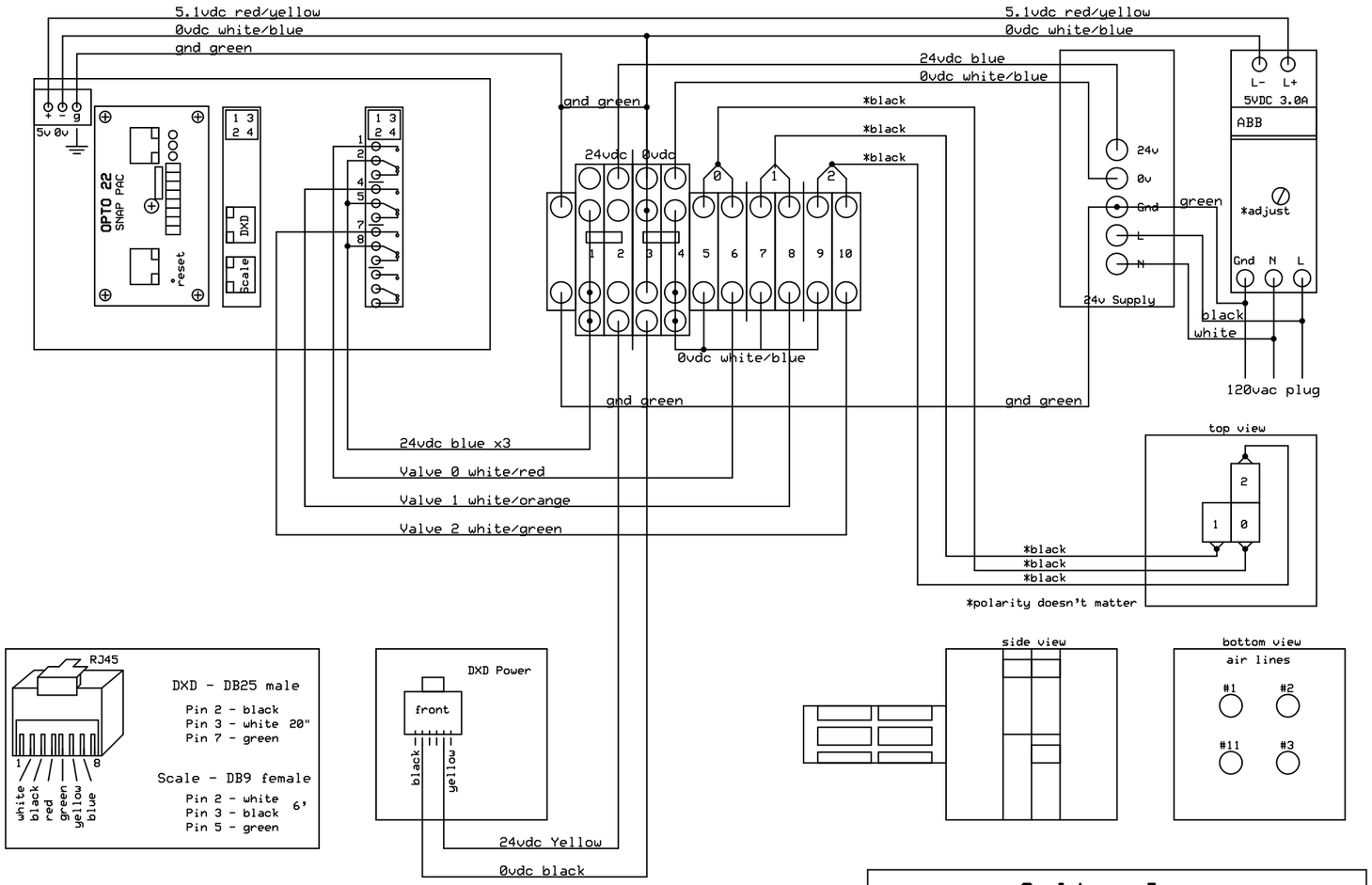
WATER & AIR SCHEMATIC

REC4-OPEN

DRAWING #	BUILD #	REV.	EXT.	SHEET
02-91-0200		E	SLDDRW	1 OF 1

PAC Control Basic program: Engineering:\OPTO22\Releases\R40\OPT-R40-1.0
DXD: 19200 7/E/1
Scale: 9600 8/N/1

*Adjust 5v power supply to output ~5.1v



Galiso Inc.		
OPTO22 Rec4 Open Wiring Diagram		
David Lutz	Rev 1.1 12/29/2017	Page 1 of 1