INSTRUCTION MANUAL
TB340A TBRG Calibrator
(TBRG AUTOMATED LABORATORY CALIBRATOR)

QUALITY SYSTEM

ISO: 9001

CERTIFIED

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AMENDMENTS

Issue	Description	By	Date
0.01	Draft version 1.	SG	29-1-16
1	Initial Release	SG	11-7-16
2	Updated Dimensions and Weight in Specifications	SL	11-8-16
3	Section 4.2.4 – Highest rate nozzle should be fitted to position #5	SL	12-12-16
4	Updated transit bracket photos, added Configure PLC section 4.7.4 and expanded the Calibration procedure section 4.9	SL	21-2-17
5	Updated unpacking and installation photos	SL	27-2-17
6	Added sample Certificate of Calibration to Reports section 4.6.3 Changes to PDF & Printing section 4.7.3 Added items to Troubleshooting list	SL	11-4-17
7	Corrected the Dispense Accuracy in the Specification	SL	28-4-17

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1 INTRODUCTION

The TB340A Calibrator is an automated lab-based testing system for tipping bucket rain gauges (TBRGs). Developed using load-cell technology, it is designed to deliver 653 g of water by mass rather than volume with high accuracy and repeatability. It consists of a hardware and software element to provide a solution that can complete multiple tests at a variety of rainfall rates, collect and analyse test data for comparison against specification and generate the resulting report. All this is achieved with almost no required user interaction.

The hardware element consists of a stand that can support simultaneous testing of two tipping bucket rain gauges. All the elements required for testing are managed by a central controller mounted in the cabinet of the stand. 5 solenoid valves can be used interchangeably to provide up to 31 different dispense rates for testing. Through the use of MODBUS over RS-485, multiple stands can be daisy chained together and connected to software running on a PC, which manages the test procedure.

The software element is a PC application that has been developed to support the automation of the TBRG testing process. A high level of flexibility allows for the testing of third party TBRGs and is not limited to HyQuest Solutions products. The application will run a planned test series, collecting and storing the TBRG tip count as it progresses. It will then compare the test data to the specified performance of the TBRG before generating a report on successful completion of a test.

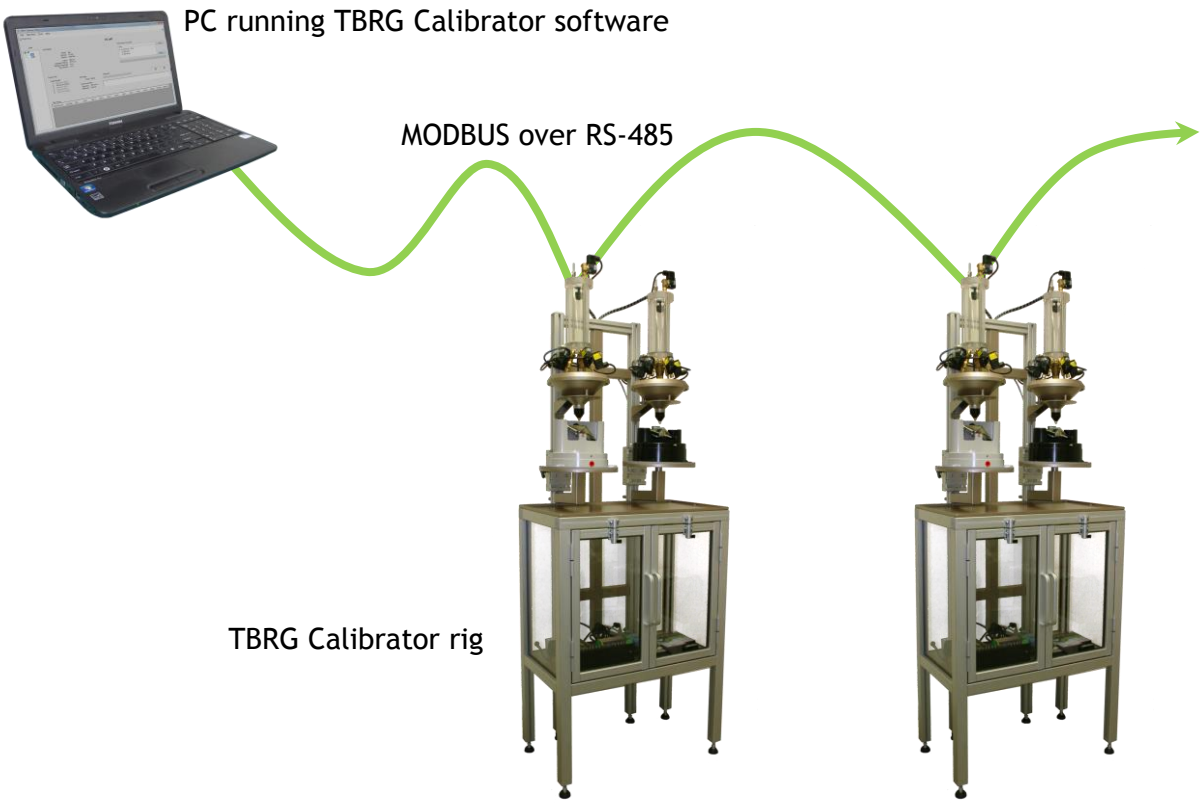


Figure 1-1 TBRG Calibrator overview

2 SPECIFICATIONS

2.1 Mechanical Specifications

• Overall Dimension (1 rig)	1900 mm (H) × 700 mm (W) × 600 mm (D)
• Weight	50 kg
• Packed Dimension in Crate	1840 mm (W) x 900mm (D) x 700 mm (H)
• Packed Weight in Crate	135 kg
• Construction	
• Body	Aluminium
• Solenoid Valves	Brass
• Vessel	Polycarbonate
• Operating Temperature	-25 °C to 50 °C
• Humidity	10 % to 90 %
• IP Rating	IP51
• Load Cell SWL	3 kg (each)
• Max. Input Water Pressure	100 psi
• Max. Dispense Rate	4 × 300 mm/hr 1 × 1000 mm/hr
• Dispensed Mass	653 g
• Dispense Accuracy	±0.3 %F.S. (±2 g)

2.2 Electrical Specifications

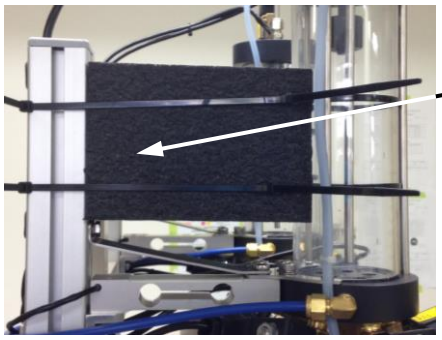
• Input Voltage	110/230 VAC, 50/60 Hz (auto-select) 2.5
• Fuse	Amp (5 × 20 mm, fast blow) MODBUS over
• Communication	RS-485 (2-wire)
• PC Requirements	
• Operating System	Microsoft Windows Vista Microsoft Windows 7 Microsoft Window 8/8.1
• Memory	1 GB (Minimum) 2 GB (Recommended)
• Display	1024 × 768 (Minimum)

3 INSTALLATION

3.1 Setting up the TBRG Calibrator Rig

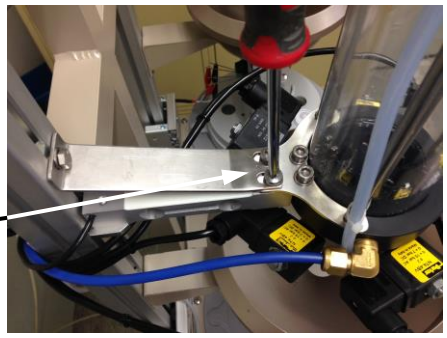
Unpacking

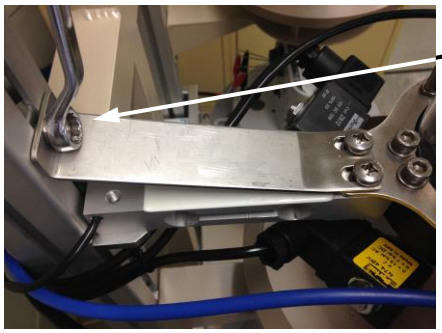
Your Rain Gauge Calibrator has been shipped in a wooden crate for protection during transit, please take extreme care when opening the crate so as not to damage the unit.
Once the Calibrator has been removed from the crate, place upright on a flat level surface, preferably at the final location where the Calibrator will be used.
The Calibrator has been fitted with two transit brackets to help protect the load cells during transit. These can now be moved by undoing the 2 x Philips head screws and 10mm bolt as shown. (Slide the transit bracket up and re-secure for future use.)



1.Remove transit foam.

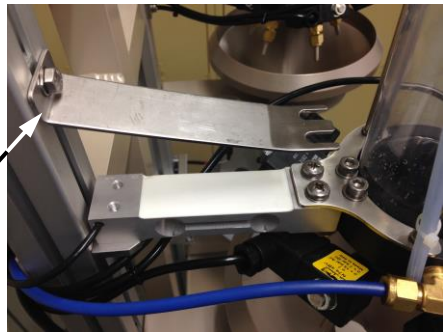
2.Loosen 2 x Philips head screws into load cell.



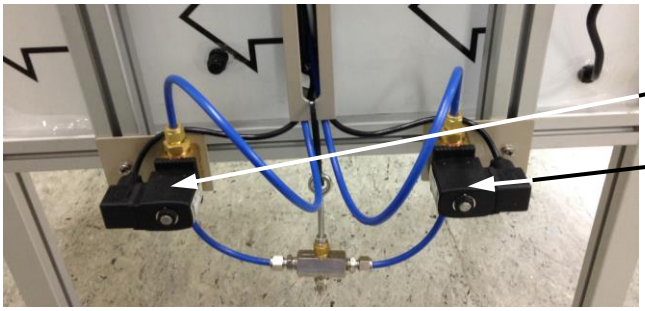


3.Loosen 10mm bolt holding load cell transit bracket.

4.Slide transit bracket up and retighten 2 x Philips head screws and 10mm bolt.



IMPORTANT : Do not apply too much downward pressure to Philips head screws as this may damage the load cells.



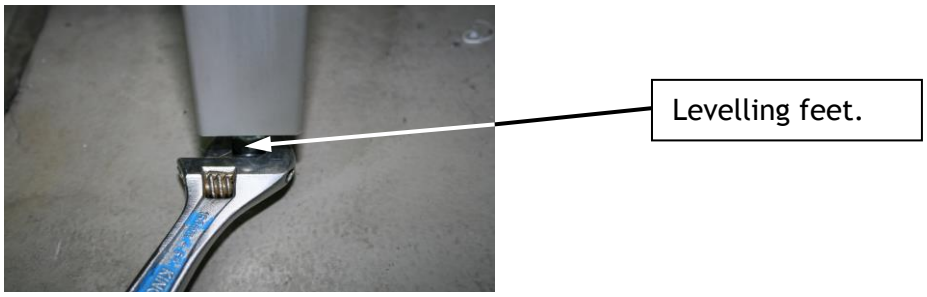
Attach the two 12volt solenoid valves to the back of the calibrator support legs using the supplied brackets, if they are not already fitted.

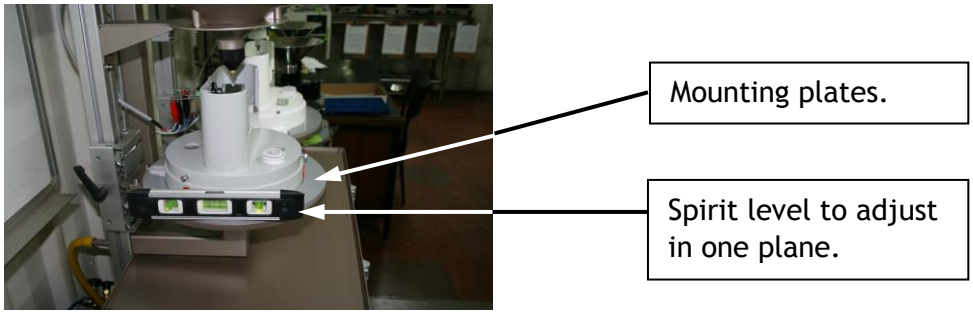
Setup and levelling

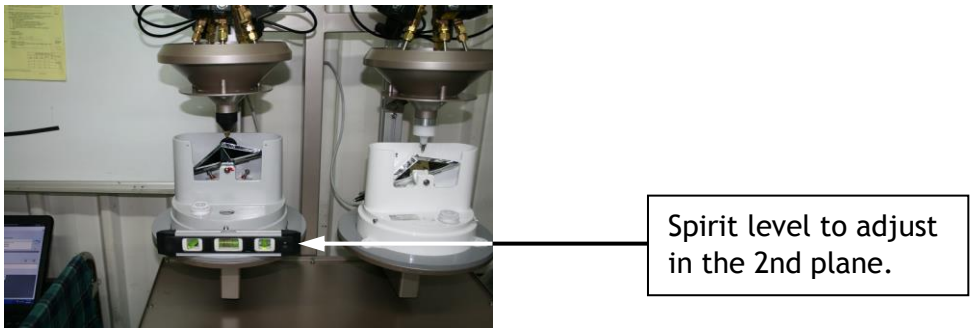
Select a site to install the TB340A taking the following points into consideration.

(A) 110V - 240V AC mains power supply.
(B) Access to a clean filtered water source.
(C) Close to an appropriate water drain.
(D) A flat level surface.

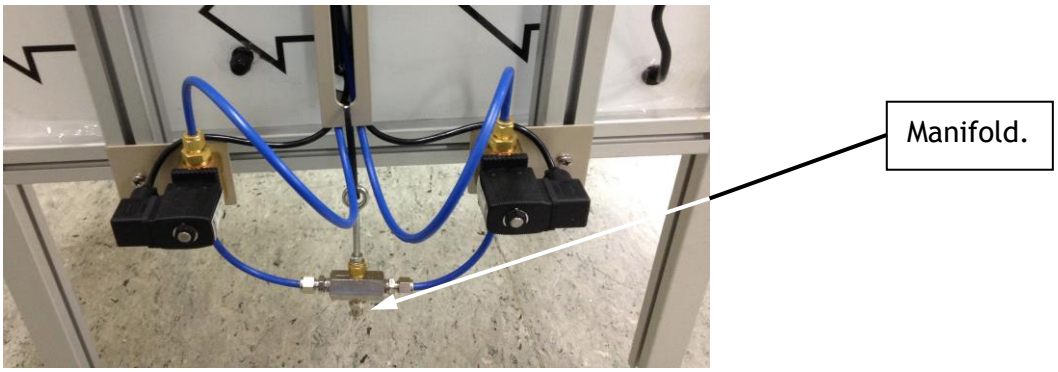
After selecting an appropriate area place the TB340 in position and level using the 6 Adjustable feet to ensure the mounting plates are level in both planes.



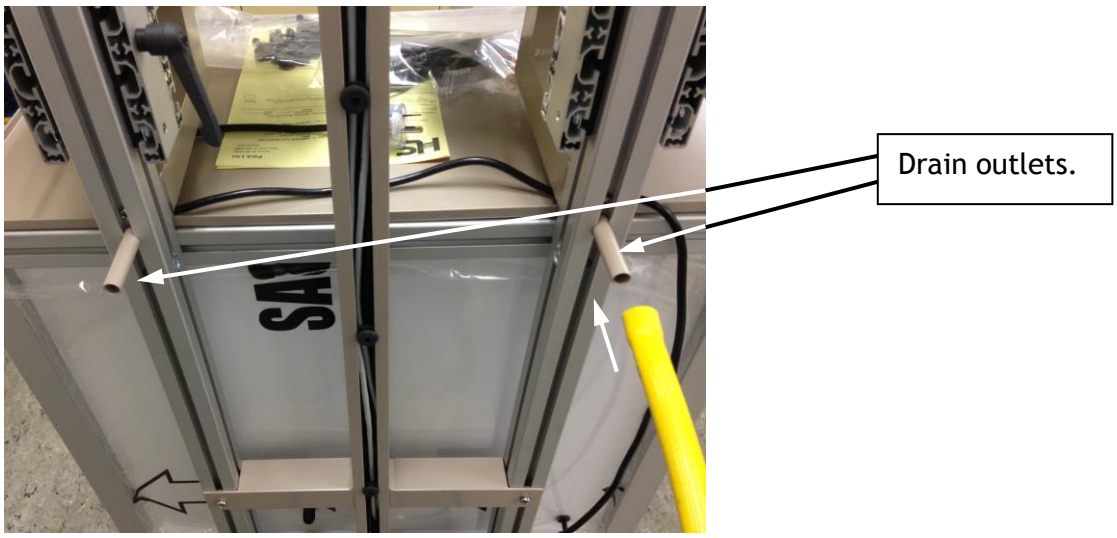




Connect a clean and filtered water supply to the manifold using 1/4'' nylon tube



Connect to appropriate drain outlets.



Pour a small amount of water down the drain holes located in the mounting plates to ensure the water is making its way into the drain before running the system in automatic mode.

3.1.1 Turning the TBRG Calibrator On

In addition to plugging power into the device, there is a switch in the cabinet of the TBRG Calibrator. Switch this to the ON (I) position after the rig is plugged in and power will be applied to the rest of the board.

Figure 3-1 Power switch in cabinet of TBRG Calibrator

When power is applied, the LED on the CR-800 main controller will come on for a short period (about 30 secs) before changing to a flash once every 15 seconds. (Relay #8 will also click on and off the same number of times as the Modbus Address → 1 flash = address 1) The power can also be checked by moving one of the switches on the relay out module (front of cabinet, left side) to the ON position. The LED should come on and a clicking sound should be heard. Return the switch to the AUTO position once testing is complete. **Only do this while water is switched off to the system.**

3.2 Setting up the PC

3.2.1 Install the Software

The software application will be provided either on a medium (CD or USB) supplied with the rig or is available for digital download. If the application has not been provided, please contact HyQuest Solutions to receive a copy.

Installation of the software application will require administrator rights on the PC it will run on. If you do not have administrator rights, please contact your IT administrator for help with installation.

Run the application installer and follow the on-screen prompts. The installer will copy the necessary files to disk to allow it to run. The application does not require administrator rights to run normally.

3.2.2 Connecting the PC to the TBRG Calibrator

A USB to RS-485 adapter is used to connect the PC to the TBRG Calibrators. Only one is required to connect multiple calibrators.

To install the USB to RS-485 adapter, simply plug the USB connector into any available USB port. The device should be automatically detected and the drivers will be installed. (If the drivers cannot be found automatically, we have provided a copy on the HyQuest Solutions website on the TB340A Calibrator page in the Software Upgrades tab.)

To check that it has installed correctly, open the Device Manager from Control Panel on the PC.

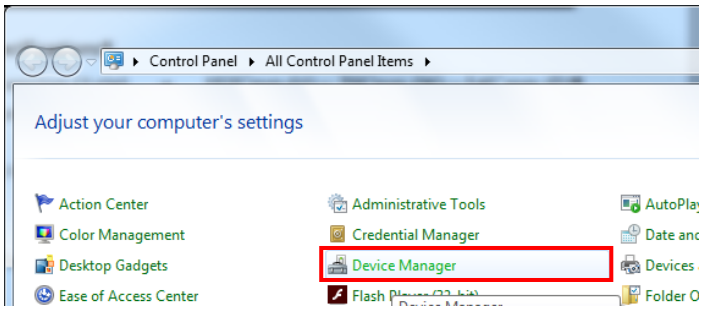


Figure 3-2 Device Manager in Control Panel (Windows 7)

Under **Ports (COM & LPT)**, a device named *USB Serial Port* should be visible in the list. This can be double checked by removing the adapter while the Device Manager is displayed. When disconnected, the list will update and the device should be missing.

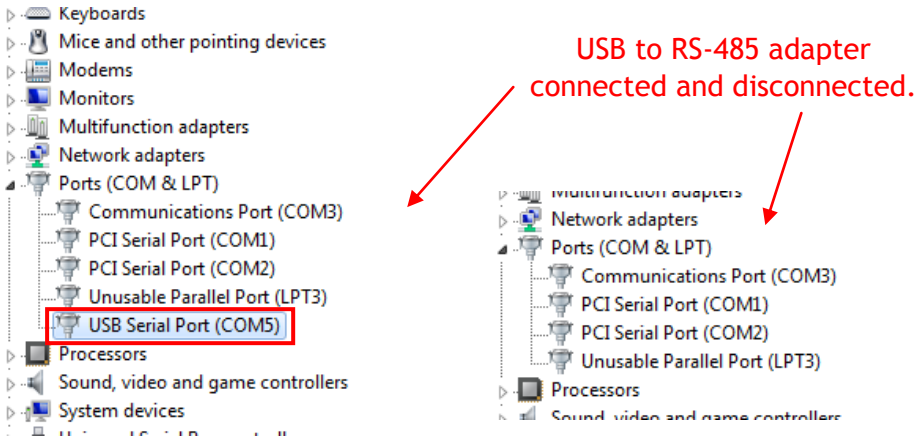


Figure 3-3 USB to RS-485 adapter in Device Manger

Make note of the COM port for the USB adapter (COM5 in *Figure 3-3*). This will be needed to tell the software where the TBRG Calibrator is connected.

If you do not see a device for the USB adapter, please contact your IT administrator for assistance.

3.2.3 Running the Software for the First Time

The first time the application is run, the Program Options (see *4.7 Program Options*) will be displayed automatically. It is recommended that options for reporting (see 4.7.1 Reports), printing and PDFs (see 4.7.3 PDF & Printing) are set up at this time if the details are known.

Select the **Communications** tab (see *4.7.2 Communications*) and set the COM port to that identified in *3.2.2 Connecting the PC to the TBRG Calibrator*. The port status should change to *Open*.

With the Program Options closed, the marker next to the address on the main testing screen (see *4.5 Monitoring a Test Series*, *4.5.1 Units List*) should be green to indicate successful communication to the TBRG Calibrator/s.

Before testing can begin, the load cells need to be calibrated to ensure the required accuracy is delivered. See *4.9 Calibrating a Load Cell* for details on calibrating.

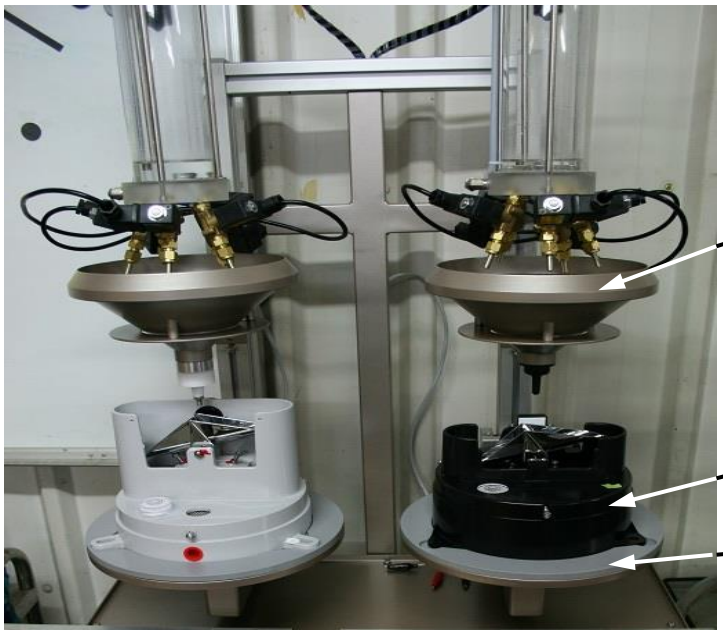
Once calibration is complete, the system is ready to begin testing. See *4.2 Preparing a Test Series*, *4.4 Starting a Test* and *4.5 Monitoring a Test Series* for details on how to run a test.

4 OPERATION

4.1 Preparing a TBRG on a station

Place your Rain Gauge base on the supplied PVC mounting plate. (Please note this calibration rig has been designed to suit HyQuest Solutions model TB3 TB4 TB6 Rain Gauges. A custom adaptor may be necessary to suit other manufacturer's Rain Gauges)

Insert the syphon body into the collector funnel. (Please note this calibration rig has been designed to suit HyQuest Solutions model TB3 TB4 TB6 Rain Gauges. A custom Syphon adaptor may be necessary to suit other manufacturer's Rain Gauges)



Removable funnel assembly.

The supplied funnel assemblies are removable, this allows the Rain Gauge to be calibrated with the standard collector fitted.

Rain Gauge base.

Grey PVC Mounting plate.

Loosen two socket screws to remove funnel assemblies.

4.1.1 Connecting the Reed Switch Inputs

The connection to the tip counter inputs is made up of 4 separate wires. Each pair of wires is identified by colour (blue and white)

One pair of wires is designed to connect to one reed switch so two reed switches can be monitored with two pairs of wires. If only testing one reed switch, only one pair of wires is used, the other pair can be left disconnected. It does not matter which pair is used.

Please refer to the manual of the tipping bucket rain gauge (TBRG) on test to the wiring connections for each reed switch.

Connect the alligator clips either directly to the terminal or with the use of extensions if the terminal is not accessible. Ensure that the clips are not in contact with each other.

Figure 4-1 Reed switch connections

4.2 Preparing a Test Series

Before a test series can begin, it needs to be set up to match the requirements of the tipping bucket rain gauge (TBRG) being tested. The setup is performed in the software to allow for reporting and traceability.

4.2.1 Opening the Setup Window

To begin, when presented with the main testing screen (see *4.5 Monitoring a Test Series*), select Setup to open the setup page for that station. A window will be displayed and will have the station address at the top of the window. In this example, “01 Left”. The following sections will describe how each of the settings affects the test.

Once these setting have been set by the user, they will be remembered from test to test and when the application is closed. Only when a new test has different settings to previous one will a change need to be made. For example, only the serial number would need to be changed when testing two rain gauges of the same model and bucket size.

OK When pressed, the changes that were made in the window are applied to the station and the main screen is updated with the new information.

Cancel When Cancel or the cross in the top right is pressed, the dialog is closed and the changes made are not remembered. The main testing screen will have the setup as it was when the Setup window was opened.

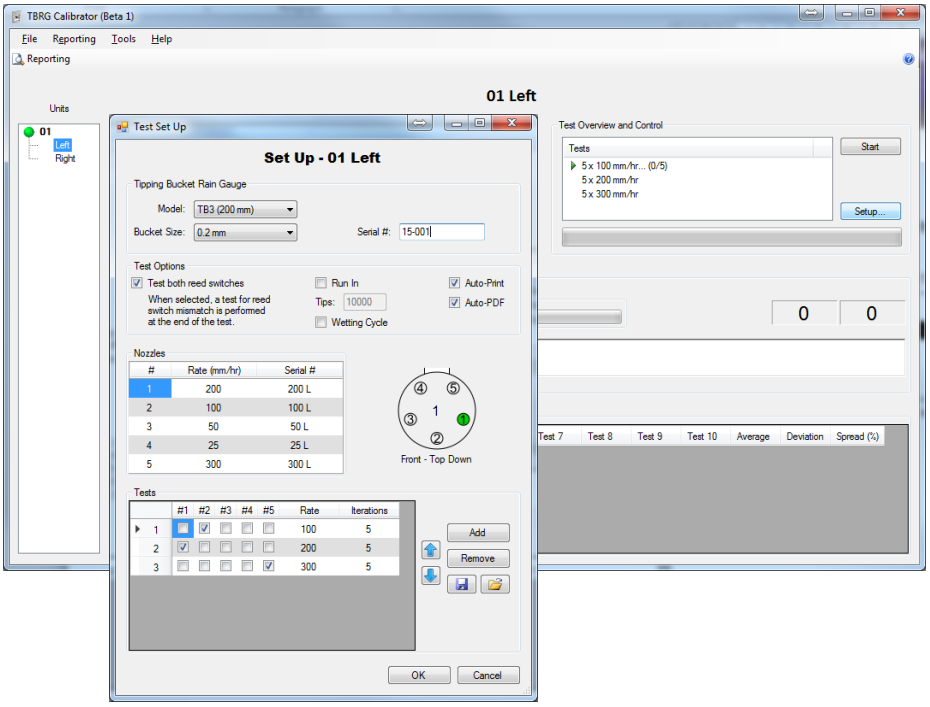


Figure 4-2 Test setup selection

4.2.2 Tipping Bucket Rain Gauge

Correctly selecting the model and bucket size for the TBRG that is going to be tested is critical for the test process to be completed successfully. These two items are used to determine the pass / fail conditions of a test as set up in the model management page (see *4.8 Model Management*). These items, as well as the serial number, are used for result storage and traceability. It is up to the user to ensure these items are correctly entered before the test begins.

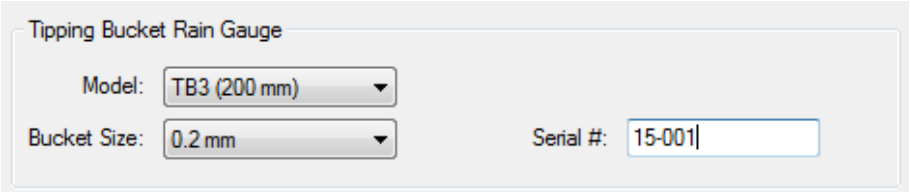


Figure 4-3 Tipping bucket rain gauge options in test setup

Model The manufacturing model of the TBRG that is going to be tested. If the model of the TBRG isn't in the list, it can be added through the model management page (see *4.8 Model Management*, *4.8.1 Model*). This must be selected before the bucket size, the list of appropriate bucket sizes will be loaded for that model.

Bucket Size The bucket size of the TBRG that is going to be tested. If the bucket size for the selected model is not in the list, it can be added through the model management page (see *4.8 Model Management*, *4.8.2 Bucket*).

Serial # The serial number of the TBRG that is going to be tested. This is used, with the model, for reporting (see *4.9 Calibrating a Load Cell*).

4.2.3 Test Options

The test options allow the user to customise the test depending on their requirements. Some of these options can be used together while others can only be used independently.

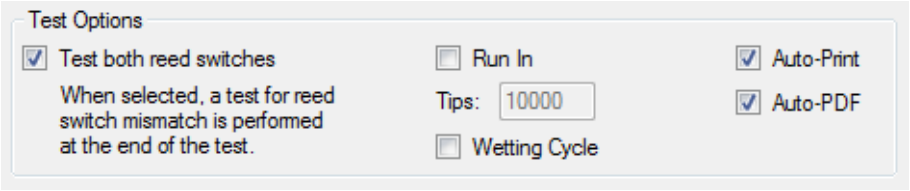


Figure 4-4 Test options in test setup

Test both reed switches In all tests, two reed switch inputs are monitored for tip counts and both values are logged. When checked, a comparison of the two tip counts is made at the end of the test and if they are found to be more than 2 tips apart, the test will fail. When unchecked, no comparison is made between the two tip counts; the count with the highest value is used for determining pass / fail specifications.

Run In When checked, the system will continue to cycle through the test list (see *4.5.3 Test Overview and Control*) until the tip count entered in the corresponding Tips box is exceeded. The current test will complete before finishing. While the test count data is displayed in the test history on the main page (see *4.5.5 Test History*), none of the test data is logged into the database, it is for indication only. The run in feature is an independent feature, and items that can't be used at the same time will be disabled when the run in feature is selected.

Tips (Run In) This becomes available when the Run In feature is selected. The user can then enter the number of tips that need to be counted before the run in test is complete.

Wetting Cycle When checked, a wetting cycle is performed before a test series is started. A wetting cycle is performed by briefly opening each nozzle to remove any air that may be trapped in the nozzle and then running for a random time between 30 and 60 seconds to wet the surfaces of the funnel and bucket. (See also, *4.3 Performing a Wetting Cycle*.)

Auto-Print When checked, a report will be printed upon a completion of a test. The printer that the report will be sent to can be selected in the options page (see *4.7 Program Options*, *4.7.3 PDF & Printing*) and is separate to the operating system default printer. If a test fails, no report will be generated unless the option is selected in the Tools-Options-PDF & Printing section.

Auto-PDF When checked, a PDF report will be generated and saved to a default location as specified in the options page (see *4.7 Program Options*, *4.7.3 PDF & Printing*) upon completion of a test. If a test fails, no report will be generated unless the option is selected in the Tools-Options-PDF & Printing section.

4.2.4 Nozzles

The nozzles table is a representation of the nozzles that are or will be installed into the vessel for the upcoming tests. This information is used primarily in reporting but is also used by the Tests (see *4.2.5 Tests*) below for defining rates.

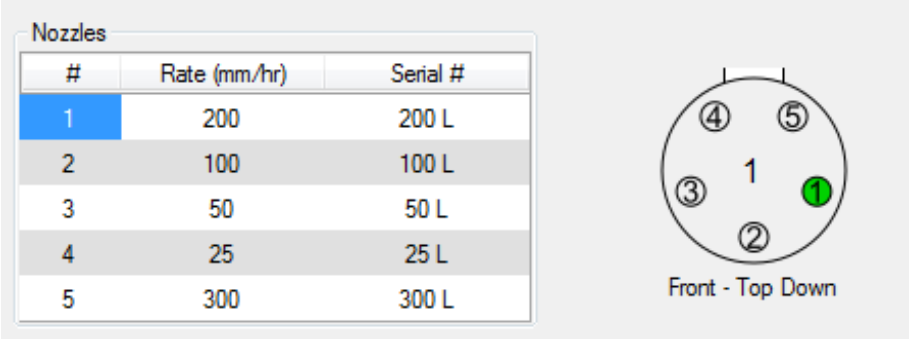


Figure 4-5 Nozzle setup in test setup

The nozzle number is the position of the nozzles as indicated in the image to the right. As changes are made to each nozzle, the image to the right will highlight the nozzle that the changes affect. This field cannot be edited.

IMPORTANT : The highest rate nozzle being used, should **always** be fitted into the Nozzle #5 position (at the right rear) – this position has a larger valve which is capable of handing the higher rates!

Rate (mm/hr) Enter the rate of the nozzle that is installed or is going to be installed at the highlighted location. It may be helpful to enter the data first then install the nozzle as the image will highlight where it needs to be installed.

Serial # Enter the serial number of the nozzle that is installed or is going to be installed at the highlighted location. If no serial number is entered and the nozzle is used in a test, it will be highlighted orange. This does not prevent a test from running but provides an indicator in case it has been forgotten. If no serial number is provided, no serial number will be placed on any reports generated for tests that use that nozzle.

4.2.5 Tests

The tests table represents what nozzles will be used and the number of cycles (iterations) that will be completed to form a test. Each row in the table is an individual test and the table is considered a test series.

Test series can be saved and loaded to disk. This is helpful when a series is used often and can be loaded on to many stations, saving time from entering the list into each station.

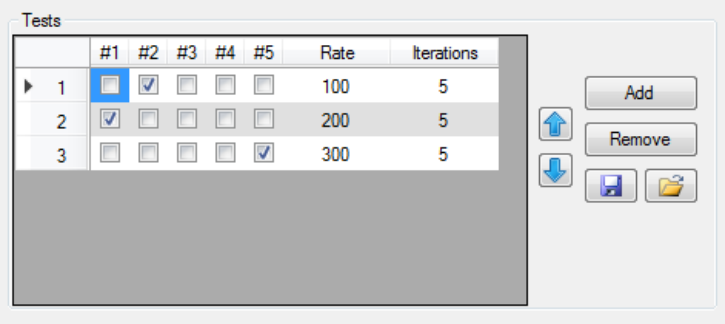


Figure 4-6 Test process setup in test setup

#1, #2, #3, #4, #5 Each column corresponds to the nozzle number in the nozzle table above (see *4.2.4 Nozzles*). For an individual test, a checked box indicates that nozzle will be used in that test (for example, test 1 will use nozzle 2, test 2 will use nozzle 1 and test 3 will use nozzle 5). More than one nozzle can be used in an individual test. The effect is the rates of all the checked nozzles are added together (for example, if test 1 had nozzle 2 and nozzle 5 checked, it would have a rate of 400 mm/hr). In reporting, all the nozzles used in a test are listed.

Rate The rate is calculated from the nozzle table above (see *4.2.4 Nozzles*) and adds all the nozzles used from the boxes that were checked. This field cannot be edited.

Iterations This is the number of times the vessel will complete fill / drain cycle on that test. The iterations of the test are performed consecutively before moving to the next test.

These arrows allow the order of the tests to be changed. A test series will start at the top of the test list and process each test down the list. If a test is in the wrong location, the arrows can be used to move the selected test up or down.

Add/Remove This will add a new test to the bottom of the test list or remove the selected test from the test list.

These will allow the user to save / load a test series to disk. When pressed, a window will open for the user to specify the file they want to save / load.

4.3 Performing a Wetting Cycle

Before a test has begun, or at any time a test is not running, a manual wetting cycle can be run. To do so, press the **Wet Only** button and the system will begin a wetting cycle. You can then abort a cycle by pressing the **Abort** button. Once aborted, starting the cycle will start it from the beginning.

A wetting cycle is performed by briefly opening each nozzle to remove any air that may be trapped in the nozzle and then running for a random time between 30 and 60 seconds to wet the surfaces of the funnel and bucket.

This is also a test option that is run at the start of a test procedure. See *4.2.3 Test Options*.

4.4 Starting a Test

When a test has been set up, the information will be displayed in the main testing screen (see *4.5 Monitoring a Test Series*). Here it can be checked for correctness before the test begins. The user can then press the **Start** button to begin the test series.

Once the test is started, the button will then become an **Abort** button. When pressed, the whole test series will be aborted and will need to be started again.

***** Note** that if a test series is manually aborted before **all** of the tests in a run have completed, the results of the those tests are lost and **ARE NOT** stored in the database.

4.5 Monitoring a Test Series

The main testing screen is where the current state of the test can be viewed. It provides a comprehensive view of the TBRG being tested, the tests that will be carried out, state of the current test and the history of previously run tests. It also provides a status of all the stations that are connected to the software, even when they are not the active station.

The main testing screen is comprised of two main components. The unit list on the left is a list of all the stations that have been setup to be used with the software. On the right is the active station where details of the station can be viewed.

If the current view is not the main testing screen as seen below (*Figure 4-7*), it can be access by selecting **Testing** from the menu bar at the top of the screen.

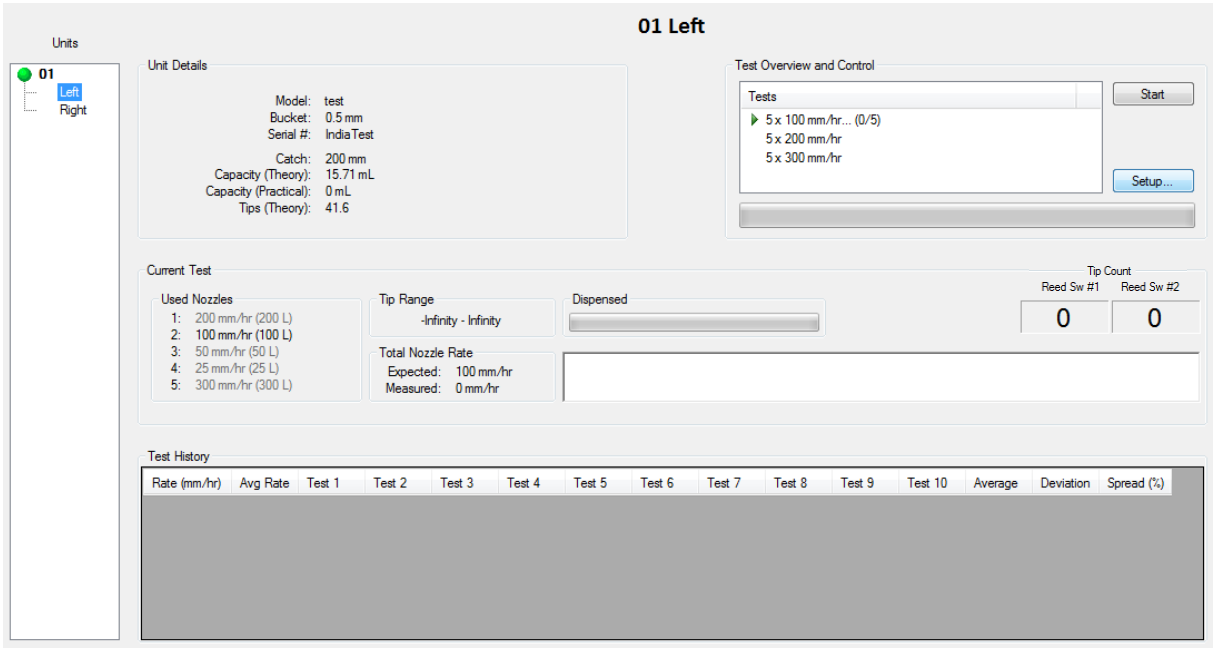


Figure 4-7 Main testing screen

4.5.1 Units List

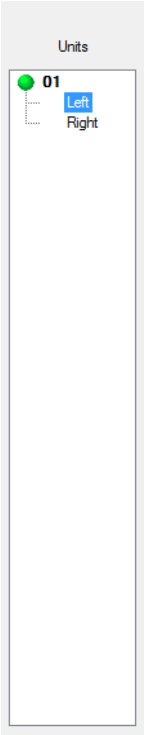


Figure 4-8 Unit list in main testing screen

System Address
The base of the unit list is the collection of all the connected addresses (or complete systems) that have been set up to work with the software. The system address is not a selectable item and is provided as an indicator only.

To the left of each address (e.g. 01) is a small indicator showing the state of communication with that system. When the indicator is green, communications are working properly and the information on the screen is up to date. When the indicator is red, there has been a recent problem with communications and the information in the software may not be up to date. In most cases, a problem with communications will correct itself, however if the indicator stays red, there may be further problems that need to be investigated.

Station
Connected to each system is two stations (left and right side). When any of these is selected, that station becomes the active station and is loaded into the main display. The system address and station will be visible at the top of the display.

If problem occurs during a test, a yellow indicator will flash to left of the station that has had a problem. The user can then view that station and identify the cause of the failure. When a station is loaded, the indicator will be cleared.

4.5.2 Unit Details

The unit details display the specifics that have been set up for that station when the test setup was last applied (see *4.2.2 Tipping Bucket Rain Gauge*). This informatio does not change during a test but allows the user to identify what is being tested.

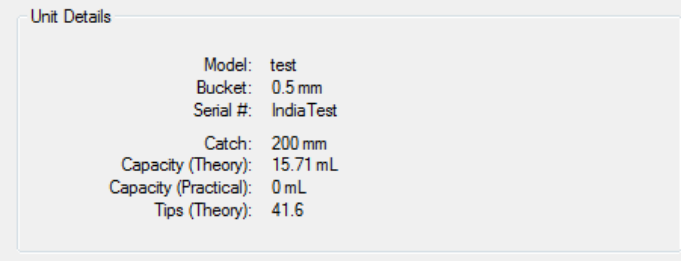


Figure 4-9 Unit details in main testing screen

Model, Bucket, Serial #
These are the details entered directly by the user into the test setup page (see *4.2.2 Tipping Bucket Rain Gauge*). When the test setup is applied, the changes are shown here.

Catch, Capacity (Theory), Capacity (Practical), Tips (Theory)
These details are loaded based on the model and bucket that was selected in the test setup. This information can be modified but any changes affect all units of the same model and bucket. The changes can be made in the model management page (see *4.8 Model Management*).

4.5.3 Test Overview and Control

The test overview and control shows the currently planned or running test series.

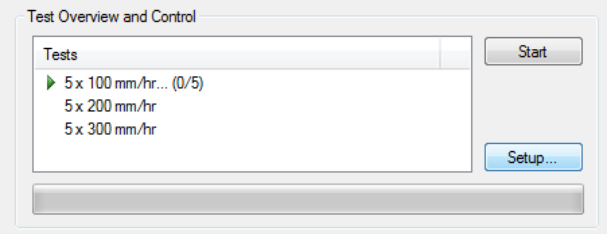


Figure 4-10 Test overview and control in main testing screen

Tests
Each test in the test list displays the information that was set in the test table during test setup (see *4.2.5 Tests*). This test is displayed in the form of…

Iterations x *Rate* mm/hr

A test is shown as the current test with an arrow next to the test. On the current test, the current iteration is shown in parentheses (e.g. "(1/5)").

A completed test is marked with a ✓ next to the test. The test history for a completed test can be viewed in the test history table (see *4.5.5 Test History*)

Start When pressed, this starts the test series. See *4.4 Starting a Test*.

Wet Only When pressed, this starts a wetting cycle. See *4.3 Performing a Wetting Cycle*.

Setup When pressed, this opens the test setup window. See *4.2* Preparing a Test Series.

Progress Bar
The progress bar underneath the test list indicates the progress of the total test series. When the progress bar is full, the test series is complete. This is updated at the end of every iteration.

4.5.4 Current Test

The current test shows the status of the actively running test from the test series.

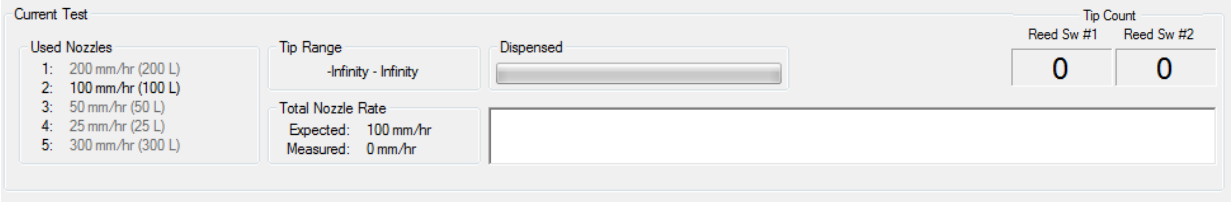


Figure 4-11 Current test in main testing screen

Used Nozzles
The list of installed nozzles, as defined in *4.2.4 Nozzles*, is shown. For each nozzle position, the user entered rate and serial number are shown.

Greyed Text — Nozzles greyed out are listed as installed but are not being used for the current test.

Normal Text — Nozzles, where the text is not greyed out, will be / are being used the current test.

Green Back — Nozzles that are highlighted with a green background are should be open and water draining from them. This allows the user to verify that a nozzle is operating properly.

Tip Range
Indicates the upper and lower limits of the tip count for the current test that are deemed a pass condition. This is calculated based on the theoretical tips (see *4.8.4 Theoretical and Practical Values*) and the tolerance for the current test rate (see *4.8.5 Tolerances*).

If there is no tolerance set, infinity will be dislpay in place of a number, indicating no limit for that range at the current test rate. This is specified in the *4.8.5 Tolerances*.

Total Nozzle Rate

Expected — The expected total rainfall rate being dispensed by all the nozzle being used in the test. This is the addition of all the selected nozzle rates entered by the user for this test.

Measured — The dispense rate as measured by the system. This is used purely as an indicator to verify that the test rate is approximately what is actually being dispensed.

Dispensed — This progress bar indicates how much of the vessel has been dispensed and how close the test is to finishing. This is for indication purposes only.

Tip Counts — These two numbers indicate the current tip counts of the TBRG. If the TBRG contains two reed switches, both values are shown for comparison.

Status — This status box provides information on the test iteration, rate, fail conditions and error.

4.5.5 Test History

The test history shows historical data from the previously run tests. It will continue to update as tests are completed.

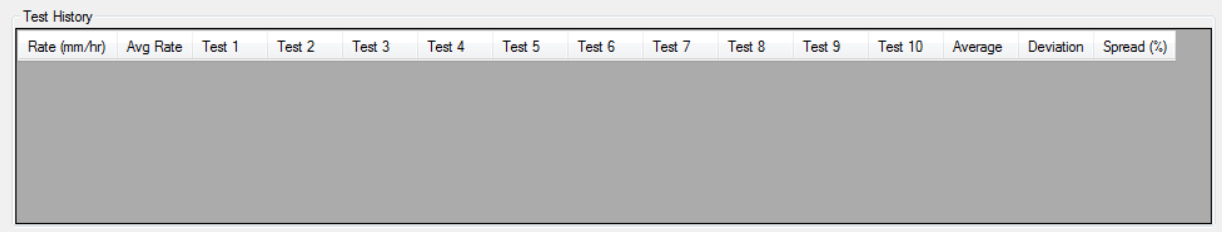


Figure 4-12 Test history in main testing screen

Rate The rate (mm/hr) as entered by the user in *4.2.4 Nozzles*.

Avg Rate The average rate (mm/hr) over each of the completed tests as measured by the system. This is for indication only.

Test 1 – 10 The tip count for that test. If the test was measuring both reed switches (see *4.2.3 Test Options – Test Both Reed Switches*), then both counts will be displayed, separated by a '/'.

Average The average tip count from the completed for that rate. If the test was testing both reed switches and the reed switch count is different, then the greater of the two values is used to determine the average.

Deviation The deviation of the calculated average from the theoretical tip value (see *4.8.4 Theoretical and Practical Values*). The deviation determines the pass/fail criteria of a TBRG.

Spread The difference between the highest and lowest test value, shown as a percentage of the theoretical tip value (see *4.8.4 Theoretical and Practical Values*).

4.6 Reporting

The reporting screen allows for the review and report generation of historical tests. From here, reports can be manually printed or a PDF generated.

To access the reporting page from the main testing screen, simply press Reporting on the toolbar or in the main menu. When selected, the buttons will change to Testing. This will return the user to the main testing screen.

The reporting screen is comprised of four main elements. On the left is the unit list containing the units that have been tested for the current calendar year. In the center is all the test data for the selected unit (top) and test data for the selected unit that has been staged to be included in a report (bottom). On the right is the test details for the selected test.

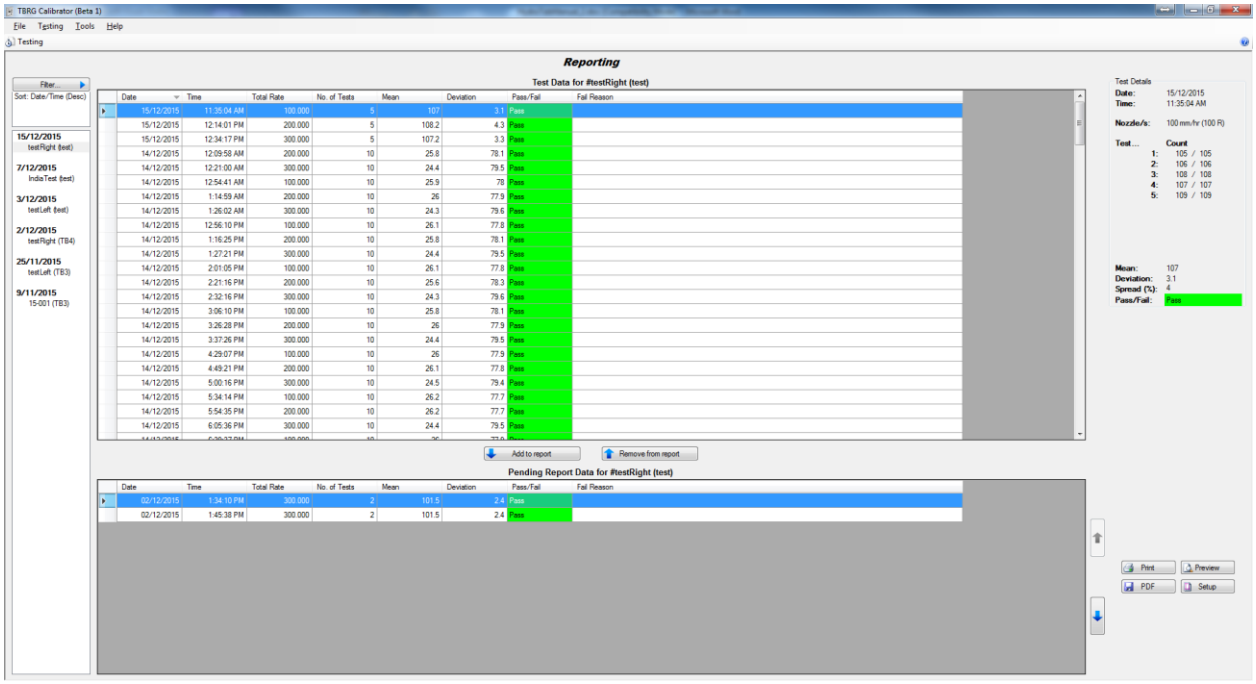


Figure 4-13 Reporting screen

4.6.1 Unit List

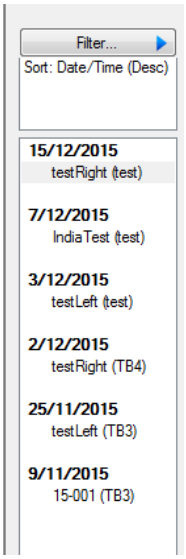


Figure 4-14 Unit list in reporting

The unit list is the units that have been tested in that year. When a unit is selected from the list, all the historical data for that year is loaded into the test data table (see *4.6.2 Test Data Table*).

Filter

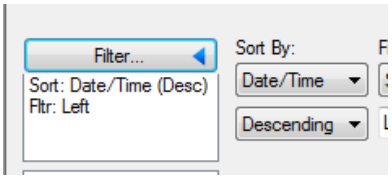
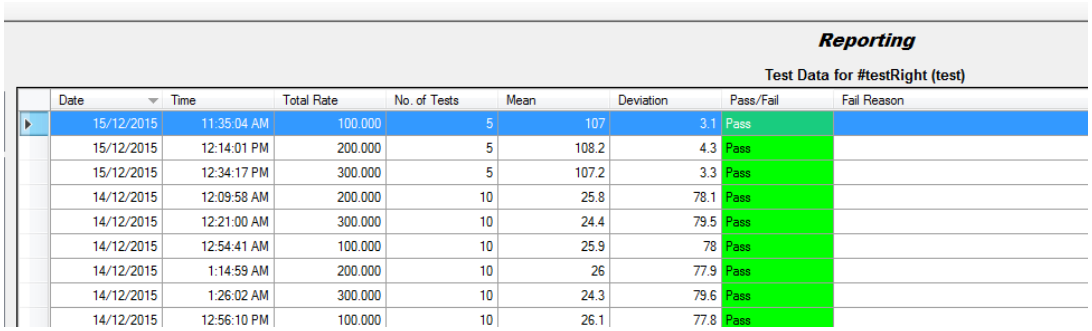


Figure 4-15 Filter for unit list in reporting

When this is selected, a list of options are provided for how the unit list is organised. The unit list can be sorted in ascending or descending order by date/time of last test on the unit, unit model or unit serial number.

4.6.2 Test Data Table

The test data table is loaded with the test data from the unit as selected by the unit list (see *4.6.1 Unit List*). It contains summary data for each test. Selecting a specific test will load the test details for that test (see *4.6.4 Test Details*).



Reporting

Test Data for #testRight (test)

Date	Time	Total Rate	No. of Tests	Mean	Deviation	Pass/Fail	Fail Reason
15/12/2015	11:35:04 AM	100.000	5	107	3.1	Pass	
15/12/2015	12:14:01 PM	200.000	5	108.2	4.3	Pass	
15/12/2015	12:34:17 PM	300.000	5	107.2	3.3	Pass	
14/12/2015	12:09:58 AM	200.000	10	25.8	78.1	Pass	
14/12/2015	12:21:00 AM	300.000	10	24.4	79.5	Pass	
14/12/2015	12:54:41 AM	100.000	10	25.9	78	Pass	
14/12/2015	1:14:59 AM	200.000	10	26	77.9	Pass	
14/12/2015	1:26:02 AM	300.000	10	24.3	79.6	Pass	
14/12/2015	12:56:10 PM	100.000	10	26.1	77.8	Pass	

Figure 4-16 Test data table in reporting

Date Date the test was completed.

Time Time the test was completed.

Total Rate The rate (mm/hr) as entered by the user in the set up (see *4.2.5 Tests*). This determines that pass / fail conditions as per the model tolerance (see *4.8.5 Tolerances*).

No. of Tests The number of iterations that was performed for that test.

Mean The average tip count across the number of iteration that were performed for that test.

Deviation The difference that the mean for that test was from theoretical tip value (see *4.8.4 Theoretical and Practical Values*).

Pass/Fail Whether the test was within tolerance (see *4.8.5 Tolerances*) and passed or was outside tolerance and failed.

Fail Reason A textual representation of the why the test was given a fail representation. For example…

Tip average outside of specification. Average: 101.5. Tip Range: 101.8-106.0.

4.6.3 Staged Test Data for Report

This table includes the tests that will be included in a report if the Print, PDF or Preview buttons are clicked. This is used for generating a manual report. The data format for this table is identical to *4.6.2 Test Data Table*.

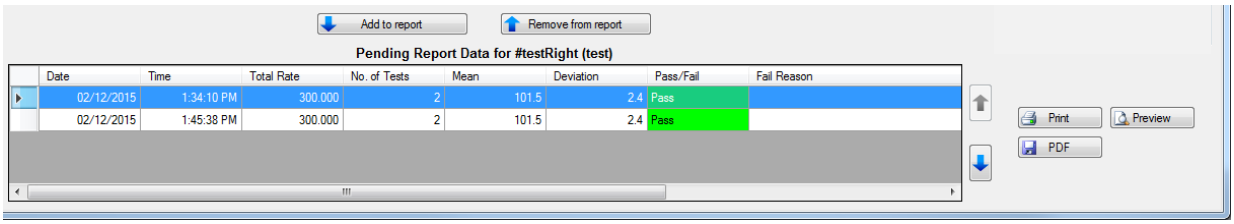


Figure 4-17 Staged test data in reporting

Add to report When clicked, the selected test from the test data table (see *4.6.2 Test Data Table*) is moved to the staged test data, to be included in a manually generated report.

Remove to report When clicked, the selected test in the staged test data is removed and returned to the test data table. Once removed it won't be included in a manually generated report but can be added again later.

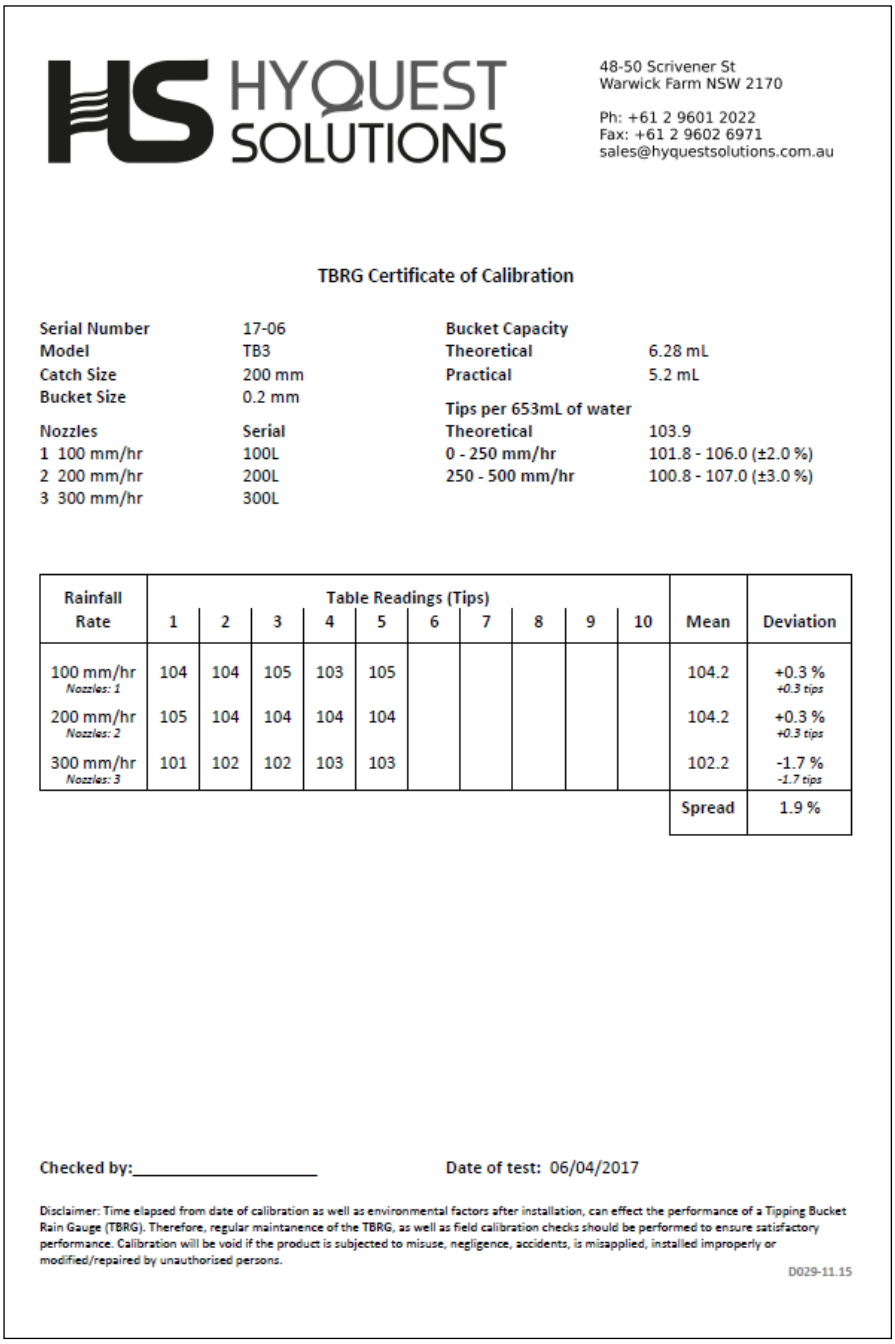
Print Prints a manually generated report with the test data contained in the staged test data table. A print dialog will be displayed to allow printing to a printer other than that set for printing auto-print reports as configured in *4.7.3 PDF & Printing*.

Preview Generates a dialog with a print preview of the report as it would appear by printing or generating a PDF. From here, a report can be printed.

PDF Creates a manually generated report as a PDF using the data in the staged test data table. A dialog will be displayed to allow saving of the file to a location other than the default location for auto-PDFs as configured in *4.7.3 PDF & Printing*.

A sample test report is shown on the following page.

A typical test report - note the features :



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TBRG Certificate of Calibration

Serial Number	17-06	Bucket Capacity	
Model	TB3	Theoretical	6.28 mL
Catch Size	200 mm	Practical	5.2 mL
Bucket Size	0.2 mm	Tips per 653mL of water	
Nozzles	Serial	Theoretical	103.9
1 100 mm/hr	100L	0 - 250 mm/hr	101.8 - 106.0 (±2.0 %)
2 200 mm/hr	200L	250 - 500 mm/hr	100.8 - 107.0 (±3.0 %)
3 300 mm/hr	300L		

Rainfall Rate	Table Readings (Tips) 1	2	3	4	5	6	7	8	9	10	Mean	Deviation
100 mm/hr *Nozzles: 1*	104	104	105	103	105						104.2	+0.3 % *+0.3 tips*
200 mm/hr *Nozzles: 2*	105	104	104	104	104						104.2	+0.3 % *+0.3 tips*
300 mm/hr *Nozzles: 3*	101	102	102	103	103						102.2	-1.7 % *-1.7 tips*
											Spread	1.9 %

Checked by:_____ Date of test: 06/04/2017

Disclaimer: Time elapsed from date of calibration as well as environmental factors after installation, can effect the performance of a Tipping Bucket Rain Gauge (TBRG). Therefore, regular maintanence of the TBRG, as well as field calibration checks should be performed to ensure satisfactory performance. Calibration will be void if the product is subjected to misuse, negligence, accidents, is misapplied, installed improperly or modified/repaired by unauthorised persons.

D029-11.15

Custom header can be created by the user.

Details of the TBRG being tested – and the tolerances used at the different rainfall rates.

Bucket tip counts of each test at each rate.

The Mean (or average number of tips) for each group of tests.

The Deviation is the difference between the Mean and the Theoretical number of tips.

The Spread is the max minus the min percentage deviation.

Date of test and area to sign.

This report can be <u>either</u> automatically generated at the end of each series of tests – <u>OR</u> it can be manually created by selecting test results from the database – the format is the same in both cases.

4.6.4 Test Details

The test details show specific information for each iteration of the test selected in the test data table (see *4.6.2 Test Data Table*) or the staged test data (see *4.6.3 Staged Test Data for Report*).

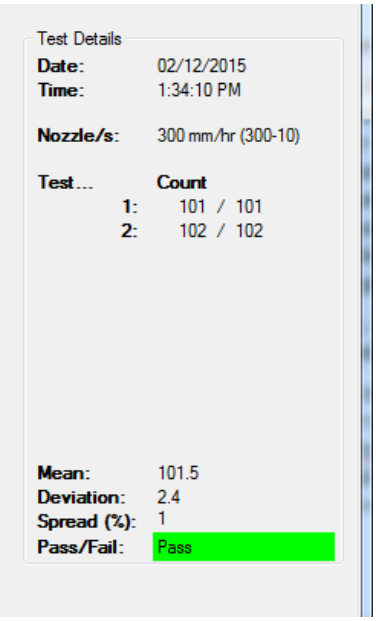


Figure 4-18 Test details in reporting

Date The date that the test was completed.

Time The time that the test was completed.

Nozzles A list of the nozzles that were used during the test as set during set up (see *4.2.4 Nozzles*, *4.2.5 Tests*).

Test… For each iteration that was completed, the count for each side of the reed switch assembly for that iteration is listed (if testing both reed switches, see 4.2.3 Test Options).

Mean The average tip count across the number of iteration that were performed for that test.

Deviation The difference that the mean for that test was from theoretical tip value (see *4.8.4 Theoretical and Practical Values*).

Spread The difference between the highest count value and the lowest count value, shown as a percentage of the theoretical value (see *4.8.4 Theoretical and Practical Values*).

Pass/Fail Whether the test was within tolerance (see *4.8.5 Tolerances*) and passed or was outside tolerance and failed.

4.7 Program Options

The program options are options that affect all stations and all tests. This includes options for reporting and communication to stations.

It can be accessed by selecting *Tools* → *Options* from the main menu. It is also displayed the first time the application is run to allow review and set up before running any tests.

It is important that these options are correct as some features will not work properly if not correctly set up.

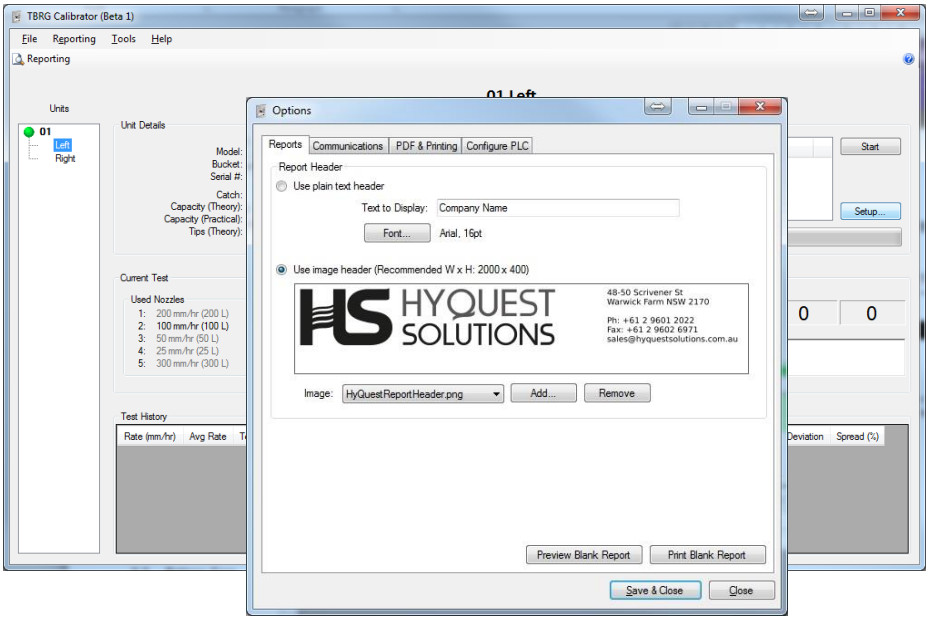


Figure 4-19 Program options dialog

4.7.1 Reports

This specifies the type of header that is applied to all reports generated by the software. The user can choose between a plain text string to display at the center of the header area or an image.

Plain Text Header

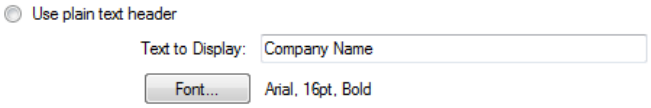


Figure 4-20 Report plain text header in program options

To use a plain text string as the header, select the radio button next to **Use plain text header**. Enter the text string in **Text to Display** and set the desired font settings by clicking **Font…**.

Image Header

Figure 4-21 Report image header in program options

To use an image as a header, it first needs to be added to the image list. Click **Add…** and navigate to the location of the image. When it is selected, it will be copied to the application directory and added to the list. The image to be used can then be selected from the drop down list.

To remove an image from the list (and application directory), select the image from the drop down list and click **Remove**. This action cannot be undone.

As the image is copied to the application directory, changes made to the original image will **not** be reflected in the report image. To update an image, remove the current image and add the new, updated image.

The image that is to be used on the report should have a width:height ratio of approximately 5:1 and be of high enough resolution to avoid grainy or blocky images – the recommended image size is 2000 x 400.

Preview and Blank Reports

A screen preview of a blank report can be seen by clicking **Preview Blank Report**.

A blank report can be printed (provided a printer is setup, see *4.7.3 PDF & Printing*) by clicking **Print Blank Report**.

4.7.2 Communications

This specifies the settings for communicating to the TBRG stations that are connected to the software.

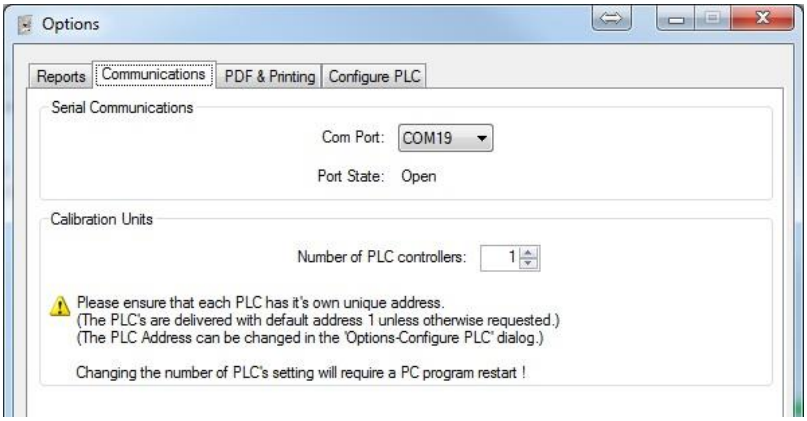


Figure 4-22 Communications in program options

Serial Communications
This specifies options for communicating with the TBRG stations.

COM Port Set this to the COM port that connects to the TBRG stations. Selecting Close will close the port and communication will not be possible.

Port State This is an indicator of the state of the selected COM port (open / close) and not whether there is successful communication with the stations (for that, see *4.5.1 Units List*)

Calibration Units

Number of PLC controllers This number indicates the total number of systems (2 TBRG stations per system) connected to the software. Changing this value to support more systems will require and application restart and will terminate any currently running tests.

4.7.3 PDF & Printing

This specifies the options for printing and generating PDFs automatically at the end of tests when specified (see *4.2.3 Test Options*).

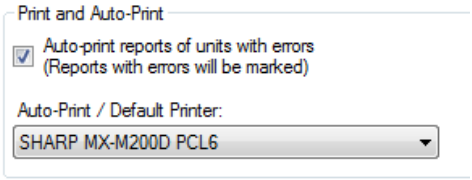


Figure 4-23 Print and auto-print in program options

Auto-Print / Default Printer
This specifies the printer to be used when automatically printing reports at the completion of the test. The drop down list contains all printers installed on the computer the software is running on. This means that the printer needs to be successfully installed before selecting it in this software. A failed test will **only** be printed if the above checkbox is ticked **and** the Printing option is **also** selected in *4.2.3 Test Options*.

For help with installing printers, visit…
http://windows.microsoft.com/en-au/windows/install-printer (Windows 7, 8, 10)
http://windows.microsoft.com/en-au/windows-vista/add-or-remove-a-printer (Windows Vista)

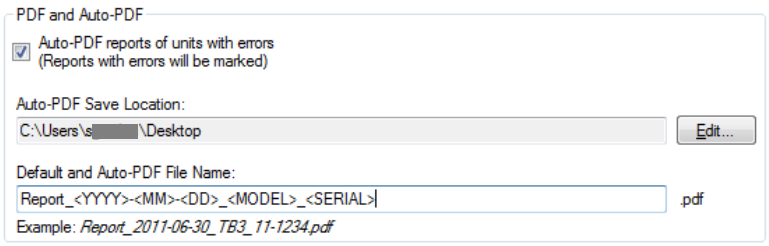


Figure 4-24 PDF and auto-PDF in program options

Auto-PDF Save Location
This is the directory where automatically generated PDFs will be saved to. To change the directory, click the **Edit…** button and navigate to the location where PDFs should be saved.

Default and Auto-PDF File Name
This is the file name that is given to PDF reports by default, whether generated automatically after the completion of a test or manually (it can be changed at save time). A failed test will **only** be saved as a PDF if the above checkbox is ticked **and** the PDF option is **also** selected in *4.2.3 Test Options*.

A number of wildcard entries are available to the user that will substitute test data into the file name. These options are shown on the lower part of the screen.

An example file name is displayed below with the wildcards implemented to check that the template will generate the expected file name.

4.7.4 Configure PLC

This allows the address of the PLC in each TBRG rig to be changed, and also viewing of the Serial numbers programmed into the PLC. The range of PLC addresses selectable depends on the number of PLC Controllers that have been programmed into this system. (see 4.7.2 Communications).

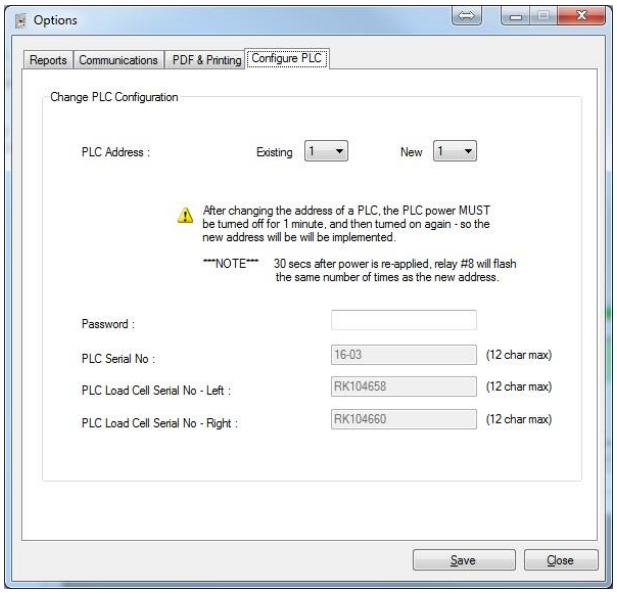


Figure 4-25 Configure PLC in program Options

When TBRG rigs are supplied by HS they are configured to Modbus address 1 (unless otherwise requested). Multiple TBRG rigs can be controlled by the one PC. Each TBRG rig is connected via a multidrop RS485 bus.

NOTE : Each TBRG rig must be set to a unique MODBUS address.

To change the address of a TBRG rig :

1. Set the number of PLC Controller that will be used in this system. (See 4.7.2 Communications) Please note that if this number is changed, the PC software will need to be restarted before the changes will take affect.
2. Disconnect the RS485 communications to all TBRG rigs except the one you want to change.
3. Use the dialog above to connect to the 'Existing' PLC Address 1. Then select the 'New' address that you want it to become – and press 'Save'.
4. The new address will not be activated in the TBRG rig until the rig is powered down for 1 minute and then powered up again. Note that 30 seconds after the TBRG rig power is applied, Relay #8 will click on and off the same number of times as the newly configured Modbus Address → 2 flashes = address 2.
5. Connect all of the TBRG rigs and check communications to all addresses is successful.

The serial numbers within each rig are setup at the factory as the units are manufactured and can only be changed once a password is entered.

4.8 Model Management

The Tipping Bucket Calibrator is designed to be highly flexible and is not restricted to testing just HyQuest Solutions TBRGs. To allow users to test non-HS TBRGs, they will need to go to the Model Management dialog and create their custom model. Once entered here, the model can be used on any station connected to the Tipping Bucket Calibrator software.

To access the Model Management dialog, select *Tools → Manage Models and Buckets…* from the main menu.

When changes to Model Management are made, they are only applied when the **Save** or **Save & Close** buttons are clicked.

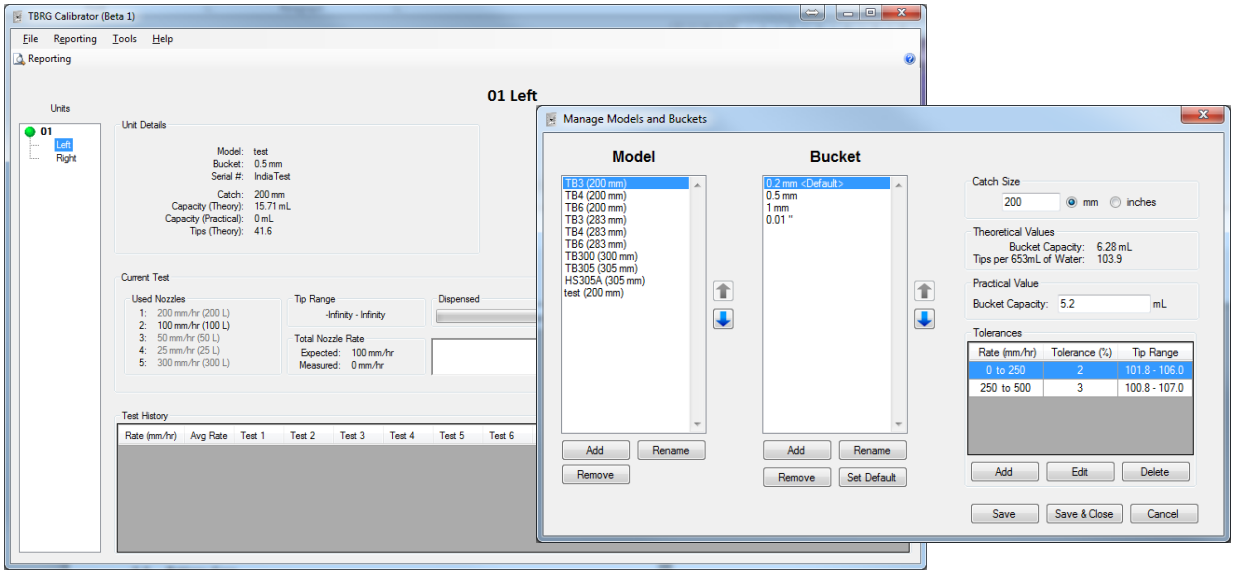


Figure 4-26 Model management dialog

4.8.1 Model

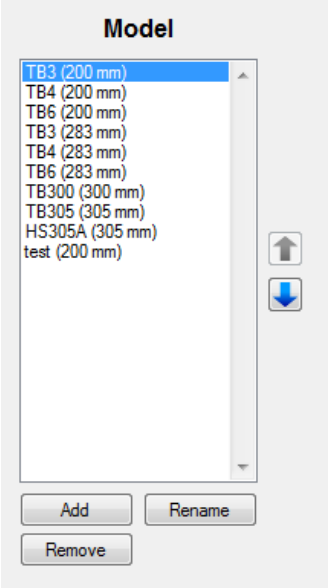


Figure 4-27 Model list in model management

This contains a list of all the models that can be tested. Each model has its own list of buckets (see *4.8.2 Bucket*), catch size (see *4.8.3 Catch Size*) and tolerances (see *4.8.5 Tolerances*). The remaining details on the dialog (buckets, catch size and tolerances) are displayed for the selected model in the model list. As a new selection is made, these details are updated.

The name as displayed in the list is the model name as entered by the user followed by the catch size in parentheses. This is to help identify the difference between models with different catch sizes.

To add a new model, press **Add** and enter the name of the model. Press enter to complete creation of the model. The bucket, catch size and tolerance information can now be entered for the newly created model.

When a model is selected, it can be renamed or removed by selecting the **Rename** and **Remove** buttons respectively. Once removed, the model will be deleted forever from the list. Renaming or removing will not affect units that had previously been tested with that model.

The arrows on the right side of the list allow the selected model's location to be moved up and down. The displayed order of the model list is the order presented to the user in the test setup dialog (see *4.2 Preparing a Test Series*).

4.8.2 Bucket

Figure 4-28 Bucket list in model management

This contains a list of buckets that can be used with the currently selected model. The bucket marked with a <*default*>, is the bucket size that comes up automatically when a model is selected in the test setup dialog (see *4.2 Preparing a Test Series*).

To add a bucket to the list, click **Add**. Enter the value and select the units for the bucket. Press Enter to confirm the addition. If the catch size has already been entered, the theoretical bucket capacity and theoretical tips will be updated for that bucket.

When a bucket is selected, it can be renamed or removed by selecting the **Rename** and **Remove** buttons respectively. Once removed, the bucket will be deleted forever from the list. Renaming or removing will not affect units that had previously been tested with that bucket

The default bucket that is displayed when a model is loaded can be changed by click **Set Default** when the desired bucket is selected.

The arrows on the right side of the list allow the selected bucket's location to be moved up and down. The displayed order of the bucket list is the order presented to the user in the test setup dialog (see *4.2 Preparing a Test Series*).

4.8.3 Catch Size

Figure 4-29 Catch size in model management

The catch size is specific to the selected model in the model list (see *4.8.1 Model*) and is the diameter of the catch on the TBRG. As the selection in the model list is changed, this value is updated for that model. The catch size is also displayed in the model list, next to the model name, in parentheses for easy viewing.

4.8.4 Theoretical and Practical Values

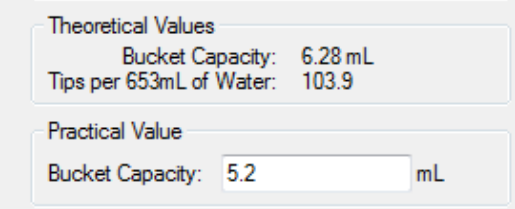


Figure 4-30 Theoretical and practical values in model management

The theoretical values are updated based on the model list (see *4.8.1 Model*) and bucket list (see *4.8.2 Bucket*) selections. It uses the catch size and bucket size to determine the volume of water that the TBRG would theoretically tip and the number of tips expected when 653 mL of water is passed through the TBRG.

The practical bucket capacity is the volume of water the bucket is set to start tipping at. This is not used in any element of testing. It is only used for reference and is visible in the reports.

4.8.5 Tolerances

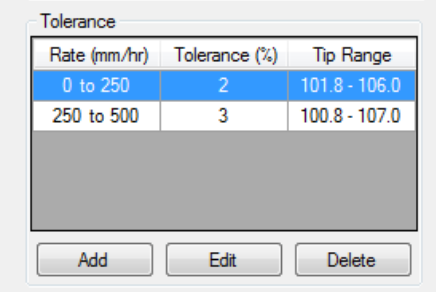


Figure 4-31 Tolerances in model management

The tolerances for a model are the specified allowable ranges, of the average tip count, that would place a TBRG "in specification" or is the pass conditions of the test. It is defined as a percentage of the theoretical tip count and is applied to a specific range of rainfall rate. The tolerance is applied to the model that is selected in the model list (see *4.8.1 Model*).

A tolerance table is made up of any number of tolerance points. The tolerance point at the lowest rate should start at 0 mm/hr. The tolerance point at the highest rate can be any value that is the highest specified rate for the selected TBRG model.

At the boundary of two tolerance points (e.g. 250 mm/hr in *Figure 4-31*), the upper rate of the lower range (0 to 250) and the lower rate of the upper range (250 to 500) should be the same value. At the time of testing, the tighter tolerance (e.g. 2 %) is applied to any test that occurs at the boundary rate. That is, in the example of *Figure 4-31*, a test specified at 250 mm/hr would use a 2 % tolerance to determine the pass / fail conditions of that model.

In the event that a test is performed where no tolerance has been specified, the test will pass by default. **** NOTE **** This can be useful for completing a full test on a gauge without it stopping on a test failure.

Tolerances displayed in the tolerance table are displayed in order of rainfall rate (by lower range then upper range). This is to help identify any gaps or overlaps in the table where data may be missing.

Adding a Tolerance

To add a new tolerance, click the **Add** button. A small dialog will be displayed as shown in *Figure 4-32*.

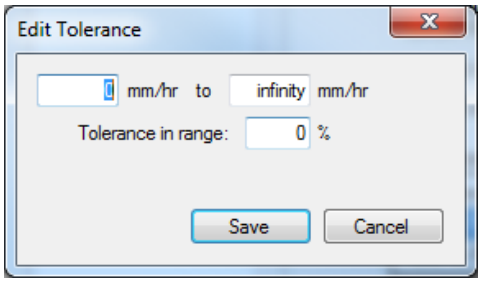


Figure 4-32 Adding a new tolerance in model management

Enter the lower rainfall rate (mm/hr) for this tolerance in the first text box (e.g. 0 mm/hr in *Figure 4-32*). This value should be greater than or equal to zero.

Enter the upper rainfall rate (mm/hr) for this tolerance in the second text box (e.g. infinity mm/hr in *Figure 4-32*). This value should be greater than the lower rainfall rate.

Enter the tolerance, as a percentage of the theoretical value (see *4.8.4 Theoretical and Practical Values*) in the third text box (e.g. 0 % in *Figure 4-32*).

To apply the new tolerance, click the **Save** button and the dialog will close, adding the tolerance to the table for review. To cancel the addition of the new tolerance, click the **Cancel** button and the dialog will close without adding the tolerance to the table.

Editing a Tolerance

To modify an existing tolerance, select the row in the table to be edited and click Edit. A small dialog, as shown in *Figure 4-33*, will be displayed with the selected row data loaded into the text boxes.

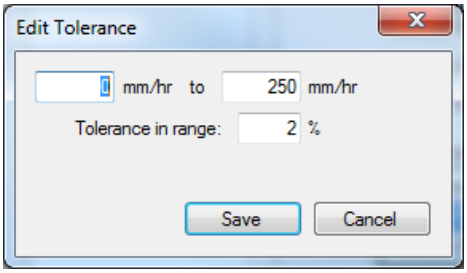


Figure 4-33 Editing a tolerance in model management

To modify the lower rainfall rate that the tolerance applies to, edit the first text box (e.g. 0 mm/hr in *Figure 4-33*).

To modify the upper rainfall rate that the tolerance applies to, edit the value in the second text box (e.g. 250 mm/hr in *Figure 4-33*).

To modify the tolerance at the specified rainfall rate range, edit the value in the third text box (e.g. 2 % in *Figure 4-33*).

To apply the modified tolerance, click the **Save** button and the dialog will close, updating the tolerance table with the changes. To leave the tolerance unchanged, click the **Cancel** button and the dialog will close without making changes.

Deleting a Tolerance

If a tolerance point needs to be removed, select the row to be removed and click the **Delete** button (see *Figure 4-31*). This will remove the tolerance from the table and cannot be undone.

4.9 Calibrating a Load Cell

To deliver the required specification, the load cells on the left and right of each station must be calibrated periodically by the user. This involves dispensing the expected 653ml of water, measuring the weight, entering the weight – repeating this 5 times – and the system will then make the appropriate corrections. A test run can then be performed to verify that 653ml is indeed being dispensed. (A 'Check Only' run can be performed to simply verify that the correct amount of water is being dispensed.)

HyQuest Solutions recommends that calibration is completed at least every 12 months.

Additional items required to complete a calibration or a check include…

- A set of calibrated scales with at least a 1 kg range to be used as a reference.
- A jug or vessel with a capacity of at least 750 mL for collecting the water for each test.

To begin a check or a calibration, navigate to *Tools → Calibrate or Check…* from the main menu. From here, the on screen prompts will guide the user through the calibration process.

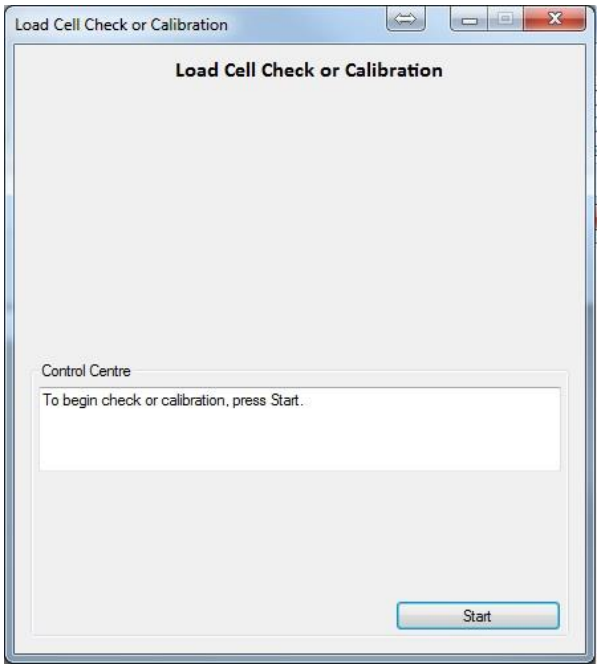


Figure 4-34 Load cell calibration dialog

A calibration is not applied to the system until the end of calibration so if a calibration process is aborted at any point, it will not be applied to the station.

When calibration is complete, and the user is satisfied with the results, then that station is ready for testing TBRGs.

The following screen shots show the steps involved in performing a Calibration.

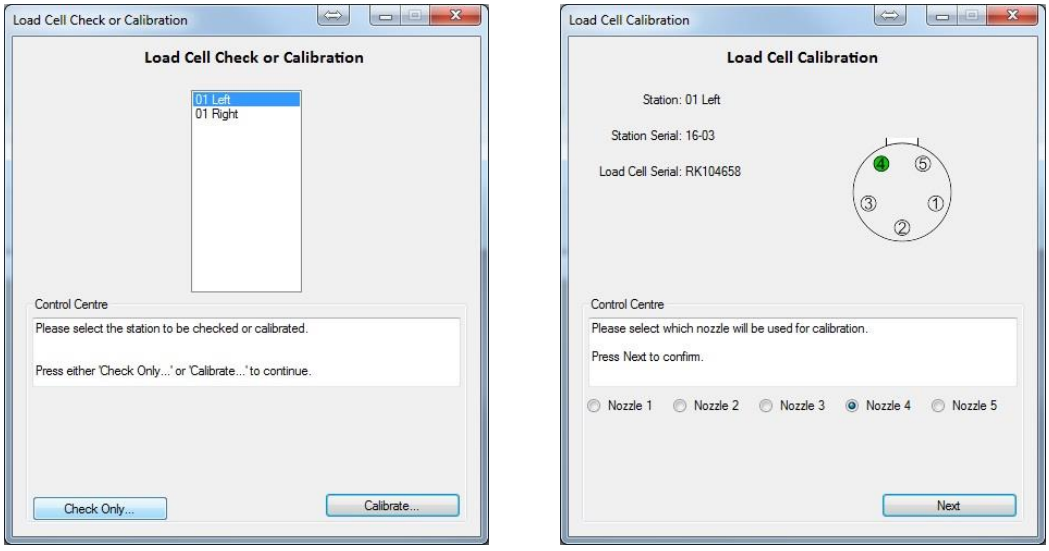


Figure 4-35 Load cell calibration dialog 2 and 3 - Selecting Station and Nozzle

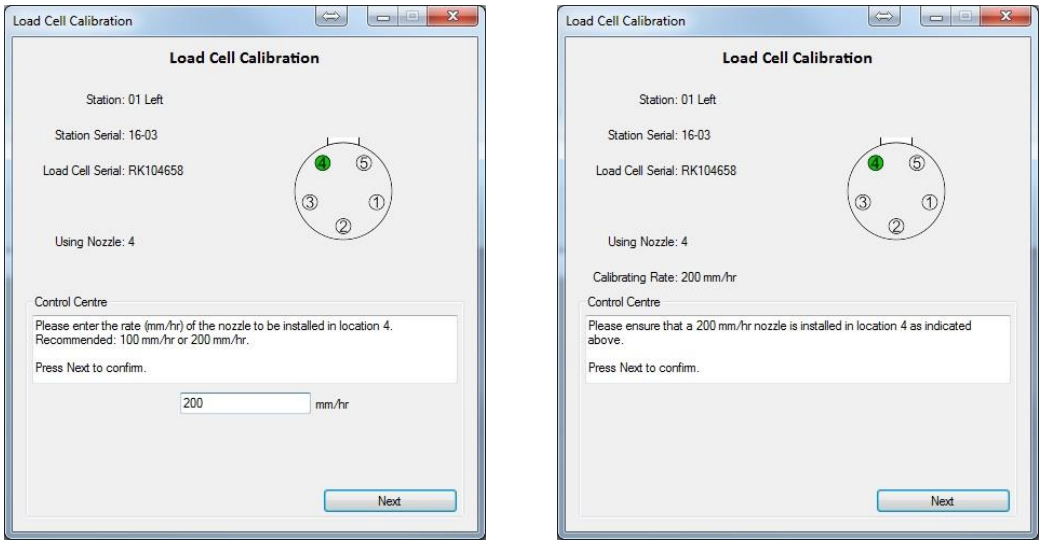


Figure 4-36 Load cell calibration dialog 4 and 5 - Nozzle Rate

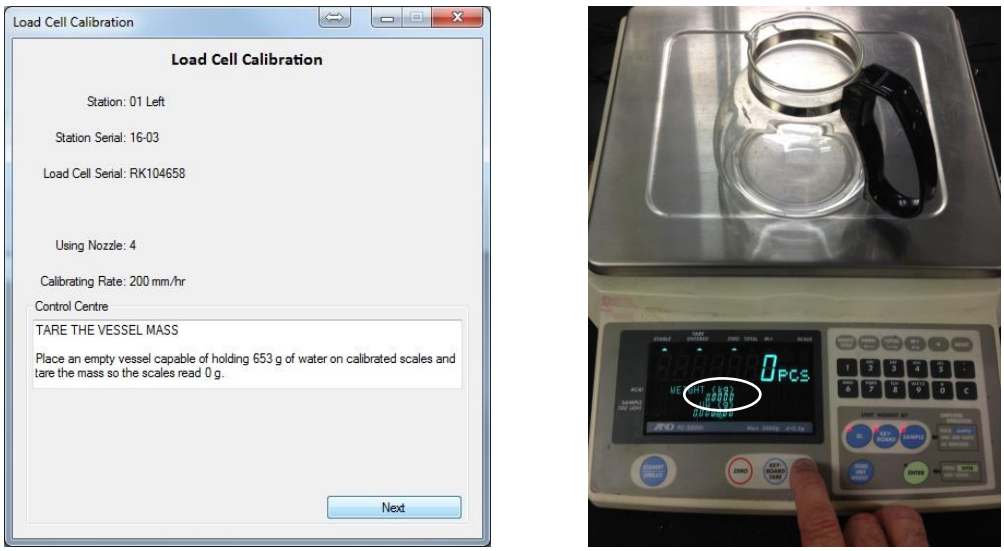


Figure 4-37 Load cell calibration dialog 6 - Taring container

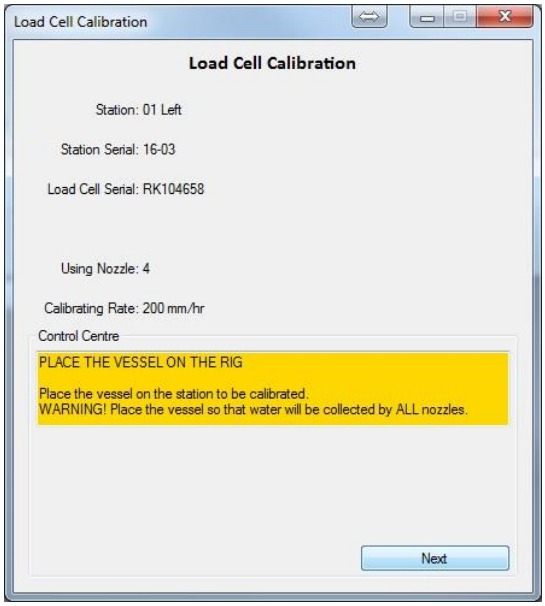
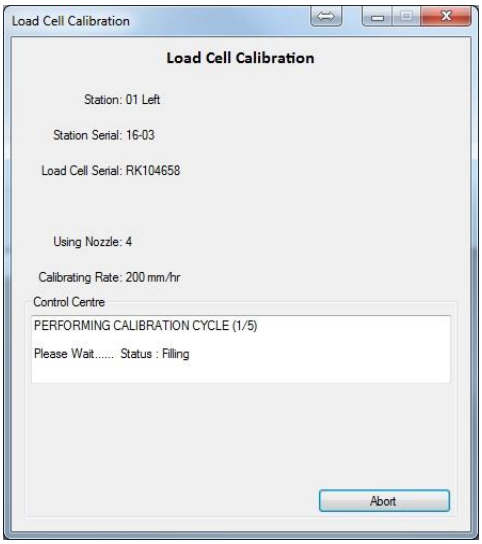


Figure 4-38 Load cell calibration dialog 7 - Container to collect water



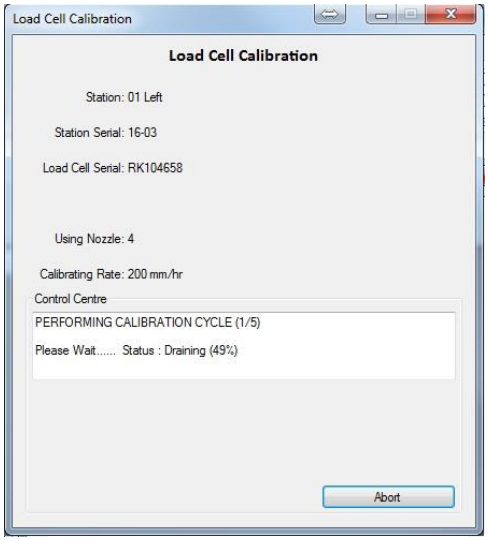
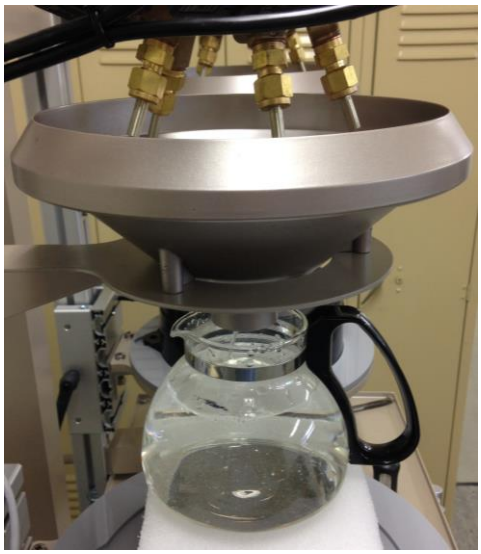


Figure 4-39 Load cell calibration dialog 8 and 9 - Filling and Draining



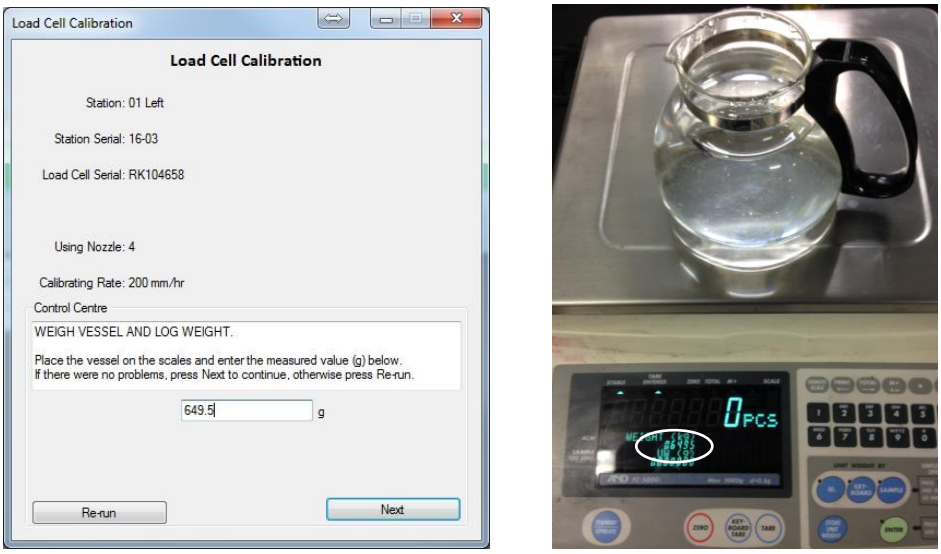


Figure 4-40 Load cell calibration dialog 10 – Weigh the water collected

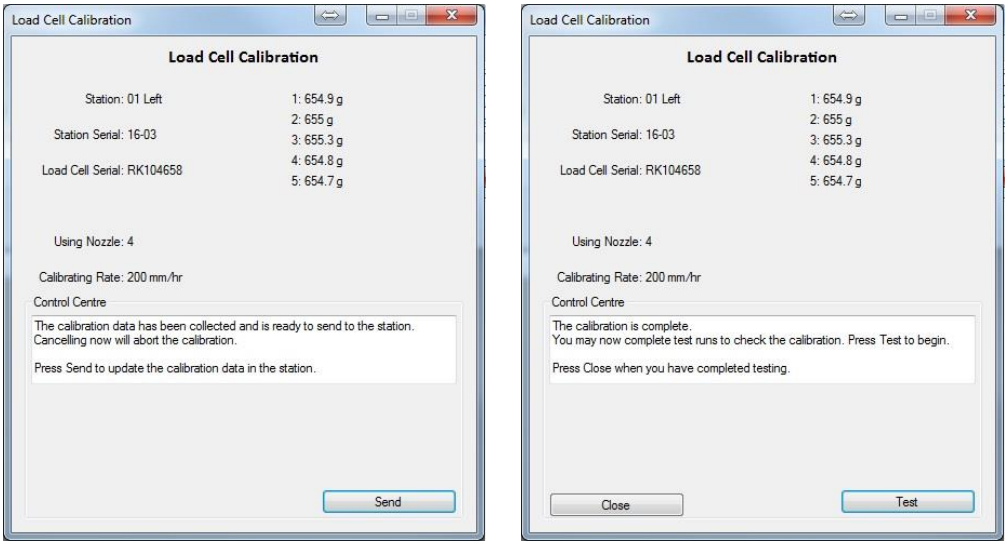


Figure 4-41 Load cell calibration dialog 11 – Repeated process 5 times – then test

Each step of filling and emptying the container takes about 4 minutes.
So repeating 5 times with an extra test cycle takes about 30 mins.

If the amount of water dispensed during the test cycle does not meet your expectations (653g ±2g) then try repeating the calibration procedure.

This process calibrates one side of the rig – it **must** be repeated for the other side.

5 TROUBLESHOOTING / FAQ

Please have a look through this list to solve possible problems before contacting the factory.

The marker next to the unit address is red. What does it mean?
The marker next to the unit address indicates that is cannot communicate with the TBRG Calibrator at that address.

- Check there is power to the TBRG calibrator. There is a switch in the cabinet that also needs to be on (see *3.1.1 Turning the TBRG Calibrator On*).
- Check that the USB to RS-485 adapter is installed correctly (see *3.2.2 Connecting the PC to the TBRG Calibrator*).
- Check the COM port is open (see *4.7.2 Communications*).

The tip count isn't increasing but the TBRG is tipping.

- Check that one pair of tip inputs (paired by colour) is connected to one reed switch (see *4.1.1 Connecting the Reed Switch Inputs*).
- Check the reed switch is functioning properly when not on the TBRG calibrator. Refer to the manual for the TBRG on the wiring connections for the reed switch.

The application says a nozzle should be open but it isn't.

- Check the switches on the relay module are set to the AUTO position (towards the back of the cabinet).

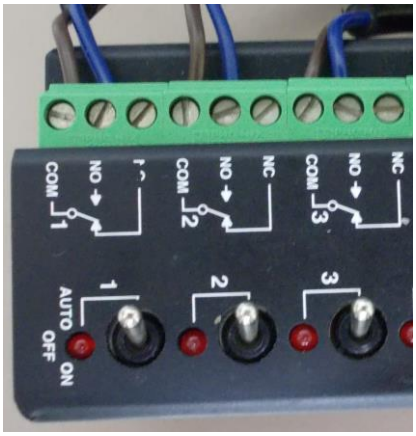


Figure 5-1 Switches on the relay module

- The switches can be used to manually open nozzles in the event that a solenoid valve becomes stuck. Please contact HyQuest Solutions for further assistance in this case.

The station did not complete all the tests and has stopped.

- Check the status bar on the main testing screen for the station in question (see *4.5.4 Current Test*). It may have information regarding an aborted test, including test failure.
- Check the marker next to the TBRG Calibrator rig in question is green. The application may be waiting for communication to be resumed to continue testing. See *"The marker next to the unit address is red. What does it mean?"* steps for more information.

Where did last year's data go?

- Data from testing is organised into separate database files, organised by year. While data from previous years is not displayed, the data can be accessed through the database file stored in the Application Data directory.

Is there a chance that water could spill out of the system?

- A number of safe guards have been put in place to prevent the spill of water, even when the system is not being monitored (e.g. outside office hours). This includes a final safety of a limit on the fill time. Water that may spill will be of a small quantity and should end up in the splash pan. However, it is recommended that electrical equipment is not left on the floor around the TBRG Calibrator.

Will the application run on Windows XP?

- It is quite possible that the application will run on some Windows XP machine. However, as Microsoft no longer supports Windows XP as an operating system, there is no guarantee that the application will work now or with future releases. If you wish to try the application on a Windows XP machine, please contact HyQuest Solutions and we will attempt to help you.

Can a gravity fed water supply be used?

- Yes, a gravity fed water supply should be able to operate with the TBRG Calibrator. If you are unsure, contact HyQuest Solutions to confirm details.

A part of the TBRG Calibrator is broken. Does it have to be returned to the factory for repair?

- No. Many of the components of a TBRG Calibrator are designed to be replaced with minimal fuss. When the broken component is identified, HyQuest Solutions can send you a replacement part with instructions on replacing it.

I have just installed the system and no reports are created after a TBRG has finished calibration + there are no tests shown in the Reporting section?

- At the end of a test run, the data is stored in a Microsoft Access Database. If your PC does not have Microsoft Access installed, then the application cannot read or write to the database file! This problem can be solved by going to the HyQuest Solutions website, on the TB340A Calibrator page and selecting the Software Upgrades tab – here you will find a download called "Microsoft Access Database Engine". (This is a free download provided by Microsoft and placed here for your convenience.) Download and install this software and the TBRG Calibration application will be able to read and write to the database file.

The first run of a test series always seem to have a lower tip count?

- Try performing a "Wetting Cycle" which ensures there is water in each valve and nozzle – and the syphon and bucket has a random amount of water in them which is what happens in between the other test runs.