TL-2800 AMMONIA & NITRATE ANALYZER

DATA ACQUISITION SYSTEM V.17.12
INSTRUCTION MANUAL

Timberline Instruments, LLC

1880 S. Flatiron Ct., Unit I
Boulder, Colorado 80301

Ph: (303) 440-8779
Fx: (303) 440-8786

Email: info@t-line.com
www.timberlineinstruments.com

Timberline Model TL-2800 Ammonia & Nitrate Analyzer Data Acquisition System Manual

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SECTION 1 - INTRODUCTION

SOFTWARE DESCRIPTION

The Timberline data acquisition software is designed for use with the TL-2800 ammonia analyzer and a Cetac ASX-520, Cetac ASX-260, or Timberline autosampler. This software provides autosampler control and generates quantitative data from the ammonia analyzer's 14-bit analog to digital signal. It also acts as the operations prompt and reports the status of the current analysis.

The software consists of three separate routines: Setup Parameters, Data Acquisition, and Saved Data. The acquisition routine collects data from the ammonia analyzer during the autosampler's timed sequence and analyzes the collected peaks for height and area. All the data from a sample run can be saved and recovered for later viewing and post data processing. Data generated by the software can be reviewed directly in a tabular report form, exported to Microsoft Excel, or saved to HTML files for portability.

SECTION 2 - AUTOSAMPLER INSTALLATION

ELECTRICAL CONNECTIONS

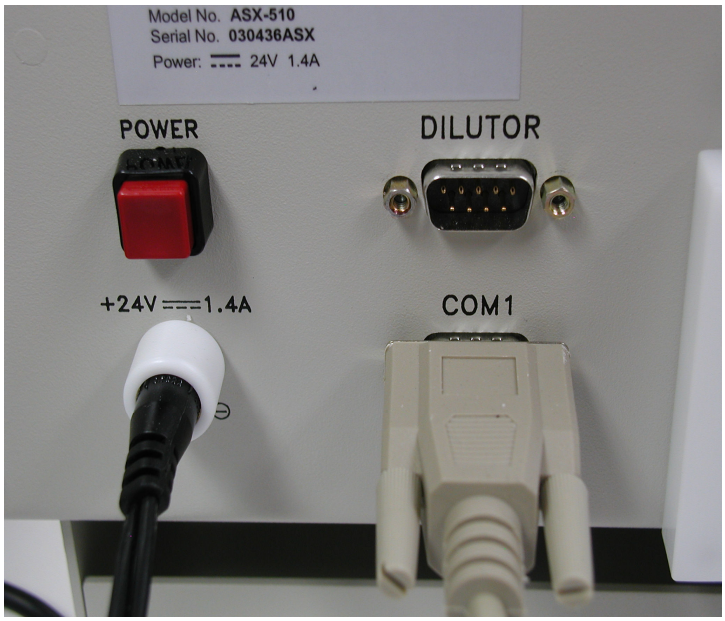

Figure 2-1: Electrical connections on the back of the Cetac autosampler.

1. Connect the 24V supply to the autosampler and plug the other end of the supply into an open receptacle.
2. Connect the serial cable to the port marked COM 1 on the autosampler, connect the other end of the cable to the serial port on the back of the TL-2800. Note: COM 1 is recommended.
3. Press the power button on the back of the autosampler. The autosampler should respond and travel to the home position.

PNEUMATIC CONNECTIONS & SIPPER INSTALLATION

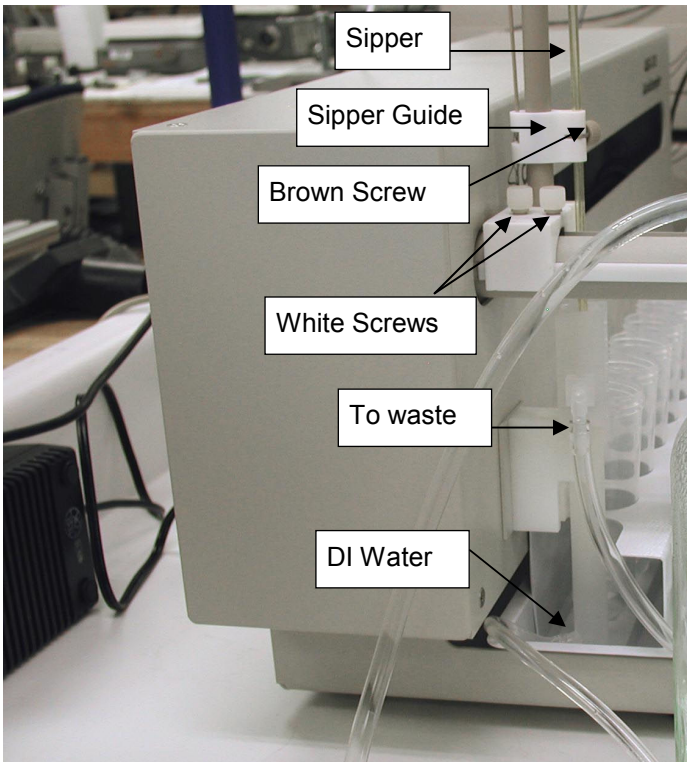

Figure 2-2: Pneumatic connections and sipper installation.

1. Slide the white block with the sipper guide onto the horizontal control arm and secure with the two white plastic screws.

2. Loosen the brown plastic screw and slide the sipper down through the sipper guide until it just touches the bottom of the wash tube. Tighten the brown screw when complete.

3. Connect the bottom port of your DI water bottle to the wash tube (lower connection).

4. Connect the top overflow connection so that it flows into your main waste line.

Note: The above instructions and following autosampler configuration apply only to the Cetac autosamplers. The Timberline autosamplers should come with the pneumatic connections already in place.

CETAC CONFIGURATION

As mentioned earlier, the data acquisition software is designed for use with the Cetac model ASX-510 or ASX-260 autosampler. It is important to understand how the autosampler is configured to ensure proper operation and function.

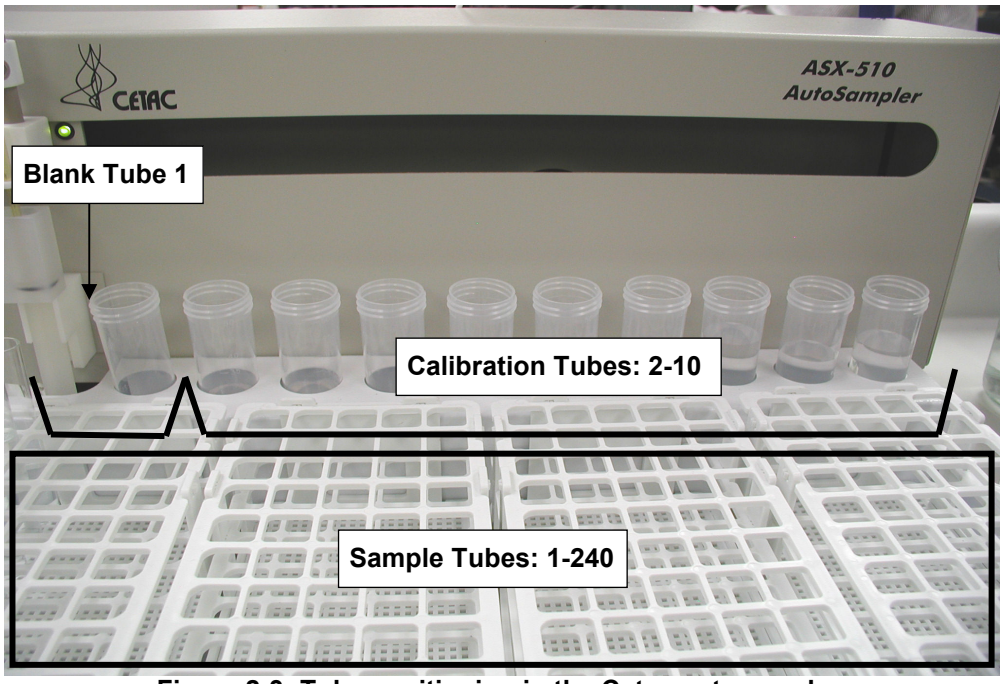

Figure 2-3: Tube positioning in the Cetac autosampler.

CALIBRATION TUBES

The ten large tubes in the back row of the Cetac autosampler are used for calibration. When filling these tubes, the first tube is always a blank and should contain only DI water. The next five are for your standards. The standards may be placed in any order. However, increasing or decreasing order is recommended. Only two tubes, one blank and one standard, is required for calibration (three or more standards are recommended).

SAMPLE TUBES

The standard tube racks on the Cetac autosampler hold up to 240 14ml sample tubes for model ASX-510 or 120 14ml sample tubes for model ASX-260.

Note: This autosampler configuration applies only to the Cetac autosamplers. The Timberline autosamplers use the same tubes for both calibration and sampling.

SECTION 3 - OPERATION

This section provides a basic overview of the data acquisition software and is intended to get you familiar with the software quickly. You should have standards and samples inserted in the autosampler.

STARTUP

Run the TL-2800 program located in the program start menu or on the desktop. You are presented with the following screen.

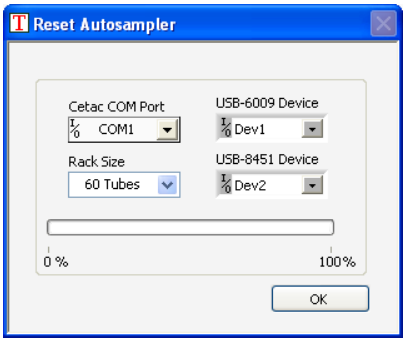

Figure 3-1: Cetac COM Port and Test Tube Rack Size input.

1. Using the drop down box of available COM ports, select which COM port on the computer the Cetac autosampler has been connected to. Usually this is COM1. See figure 3-1.

2. Using the drop down box of available test tube rack sizes, select the size you are using and click 'Ok.' The standard rack size is 60, however different racks to house different size tubes can be ordered. See figure 3-1.

Note: These startup settings will be remembered and will not need to be entered in the future. To change the rack size or COM port select 'Reset Autosampler' from the 'File' menu. This will show that same dialogue box as in figure 3-1.

Note: If you are using a USB to Serial adapter the COM port may be a number 5 or above. You may check this by looking in the device manager (Right Click 'My Computer' ► Properties ► Hardware tab ► Device Manager).

SETTING UP PARAMETERS

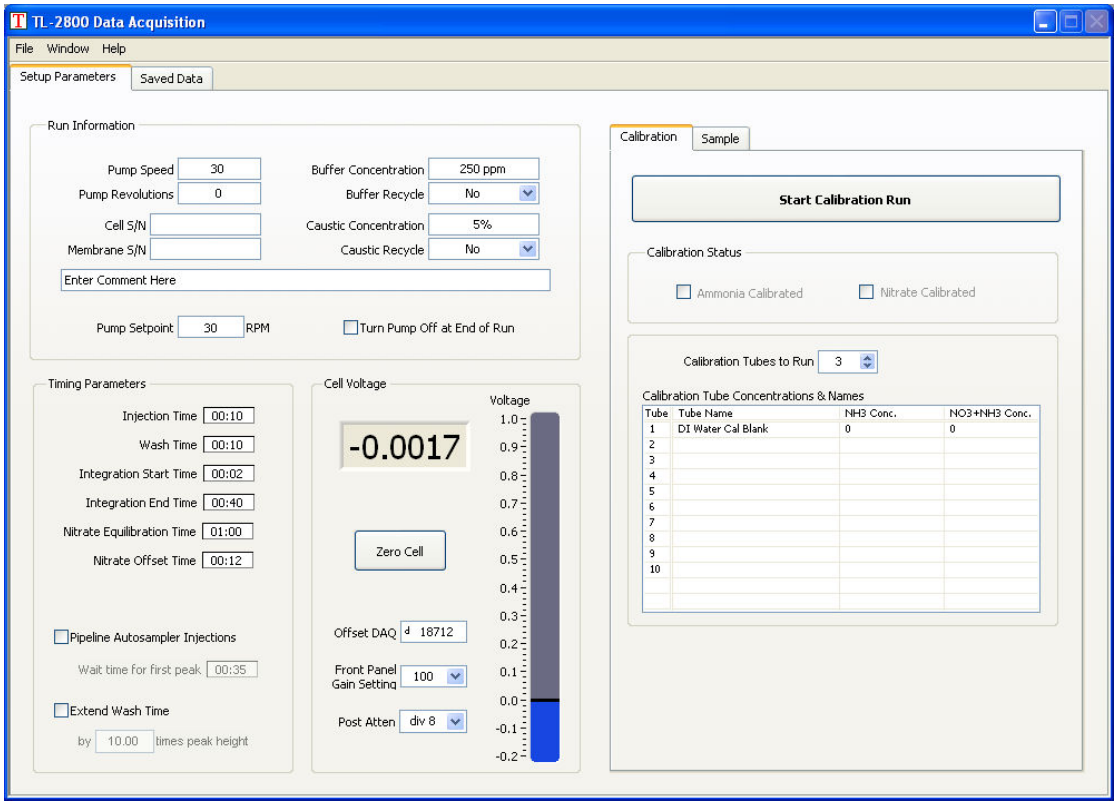

Figure 3-2: Setup Parameters Tab – Calibration.

1. Turn on the pump by entering 30 rpm in the Pump Setpoint field. The Pump Speed field is only for record keeping purposes and does not control the pump.

2. Optionally enter any comments in the run information section.

3. Set the 'Nitrate Control' radio buttons to the appropriate setting.

4. Set the timing parameters and adjust them as necessary. The entire peak should be bracketed by the integration time points.

5. Set the ’Gain’ and 'Post Attenuation' based on the largest calibration concentration. The maximum peak height is 2 volts. The ‘Gain’ and ‘Post Attenuation’ should be set to use the largest range possible without going over 2 volts.

6. In the 'Calibration' sub-tab select the number of calibration tubes you wish to run (including the blank tube) and then enter the known concentrations of each of these tubes. Optionally enter names for the calibration tubes.

7. Click the 'Zero Cell' button or adjust the ‘Offset DAQ’ to zero the cell. See next page for more details.

You are now ready to run your calibration standards. Alternatively, the calibration standards can be run as samples and selected for the calibration in the ‘Saved Data’ tab.

SETTING THE BUFFER ZERO

1. If the pointer on the ‘Cell Voltage’ scale is not centered near 0 volts click the ‘Zero Cell’ button to the left of the scale

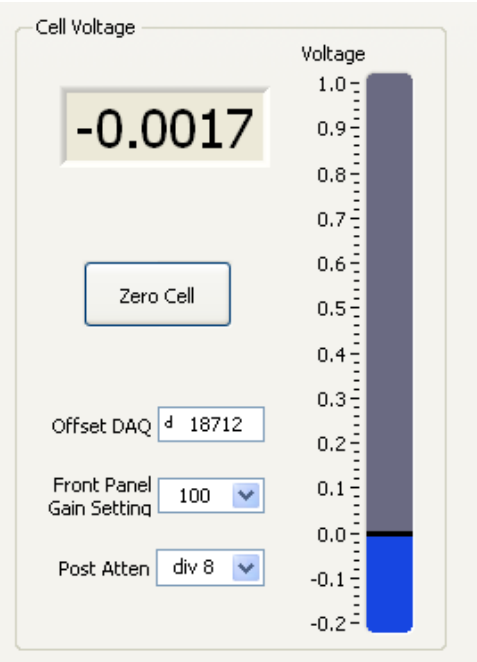

Figure 3-3: Buffer Zero-Output Voltage.

2. The voltage may need to be zeroed manually if the reagents or gain setting has been changed. To do this, click in the ‘Offset DAQ’ field and adjust the offset either by using the up and down arrows on your keyboard or by entering a new offset value. Increasing the offset value will lower the voltage reading and decreasing the offset value will increase the voltage reading. When the output voltage approaches zero, click the zero cell button.

RUNNING A CALIBRATION

1. Check that the 'Cell Voltage' display is near zero. If not, hit 'Zero Cell' and allow the system to be zeroed.
2. In the 'Calibration' sub-tab click the 'Start Calibration Run' button to commence data acquisition. The black data collection screen will appear. See figure 3-4.

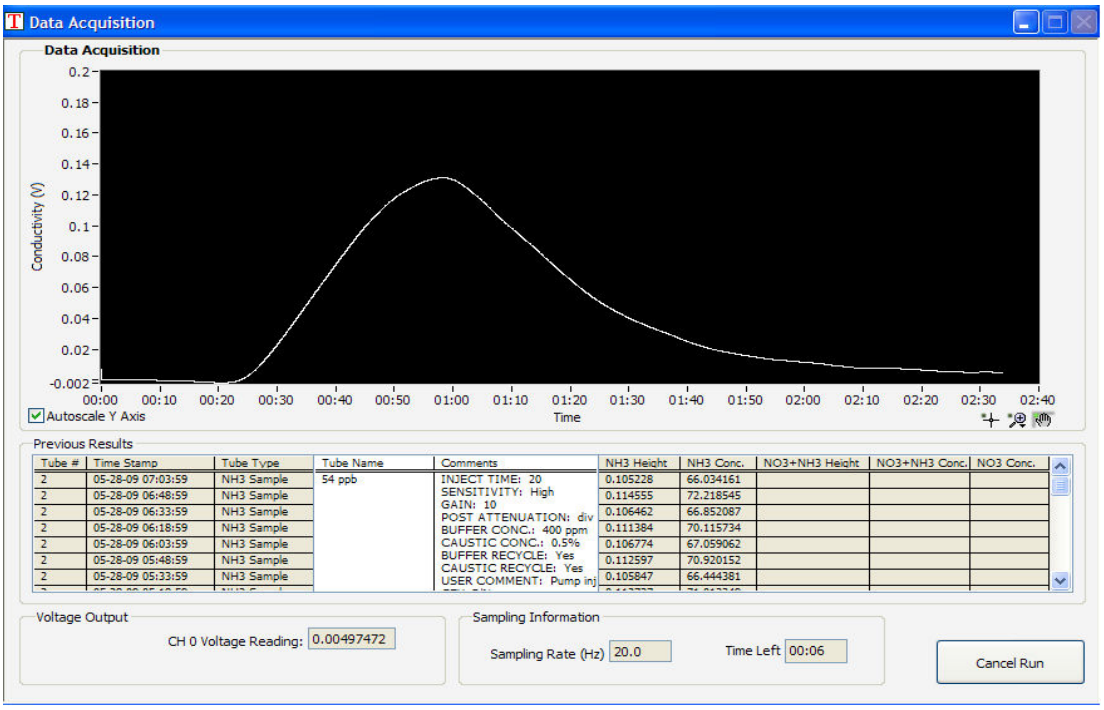

Figure 3-4: Data Collection Screen.

Note: With the Cetac autosamplers, calibration starts with the blank tube in the back row and sequences through the adjacent tubes.

3. Once the data collection has completed, the 'Setup Parameters' tab is again shown. 'Ammonia Calibrated' is now checked, indicating that the system has a valid ammonia calibration curve.

4. To view the data, switch to the 'Saved Data' tab. Here the peaks from all tubes that have been run can be viewed. The red square marker on the peak indicates the maximum height and the red text indicates that height. The blue markers show the integration time points for each peak area and the blue text indicates that area. The same height and area information can be found in the results table. See figure 3-5.

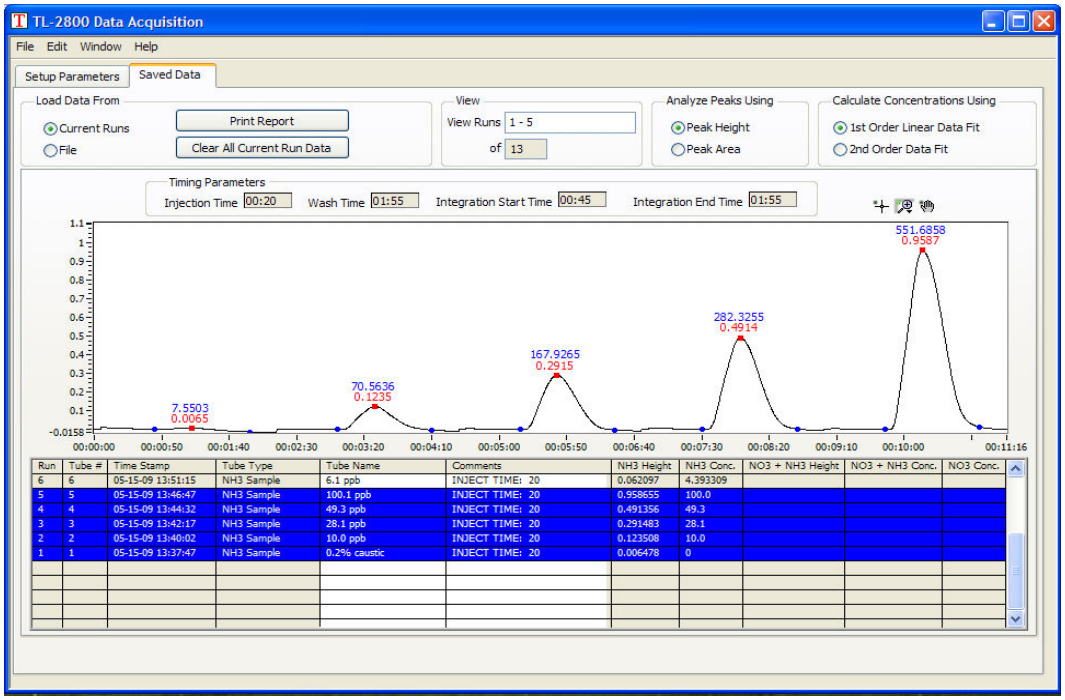

Figure 3-5: Saved Data Tab.

5. To view the calibration curve select 'View Calibration Curve' from the 'Edit' menu.

6. You may toggle between a linear regression data fit or second order polynomial data fit (if three or more calibration points are collected). The equation and R^2 value for the data fit are displayed. Click 'Continue' to return to the Saved Data screen. See figure 3-6.

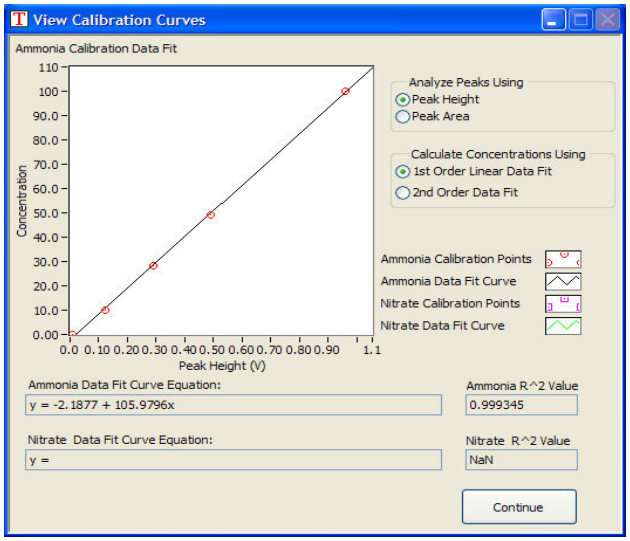

Figure 3-6: Calibration Curve Window.

RUNNING SAMPLE TUBES

1. Check that the 'Cell Voltage' display is near zero. If not, hit 'Zero Cell' and allow the system to be zeroed.

2. Set the 'Sample Tubes to Run', 'Start at Tube' and 'Runs Per Tube' controls and optionally enter names for the sample tubes. Sample tube names can also be loaded from a CSV file using the File menu. See Figure 3-7.

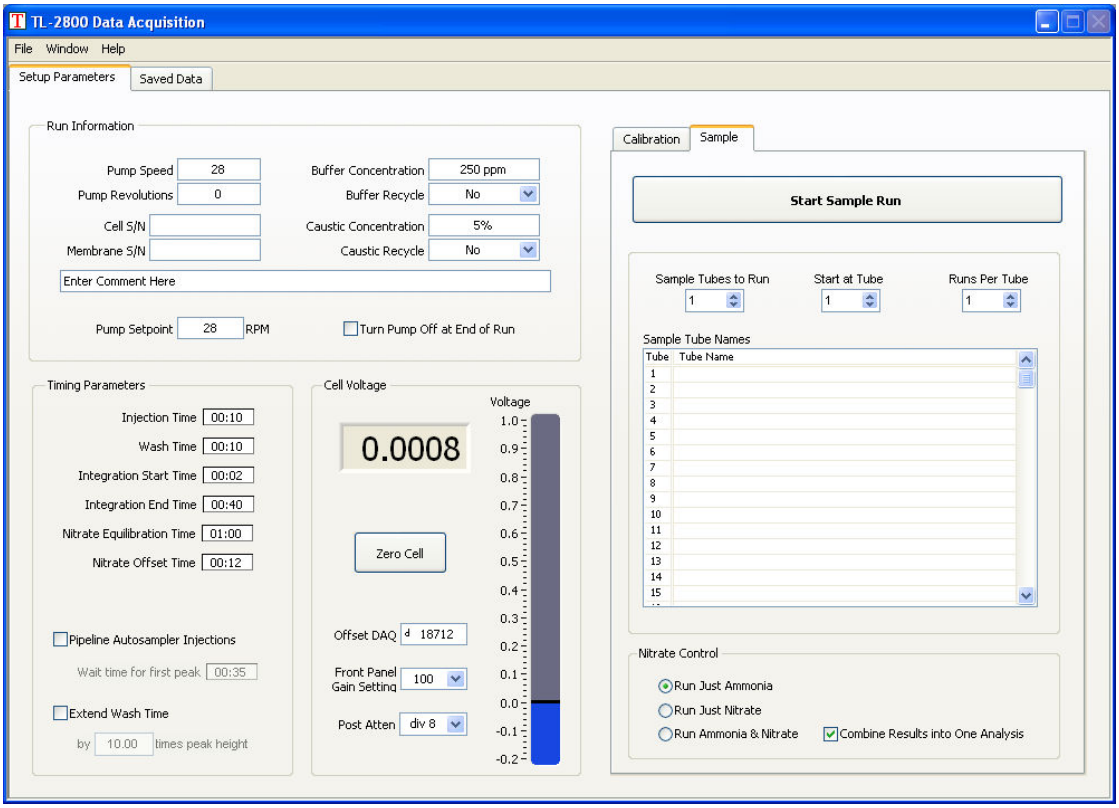

Figure 3-7: Setup Parameters Tab – Sample.

3. Click 'Start Sample Run' to commence data collection. The black data collection screen will appear.

4. When data collection is complete the software returns to the 'Setup Parameters' screen. You can see the data just collected by switching to the 'Saved Data' tab.

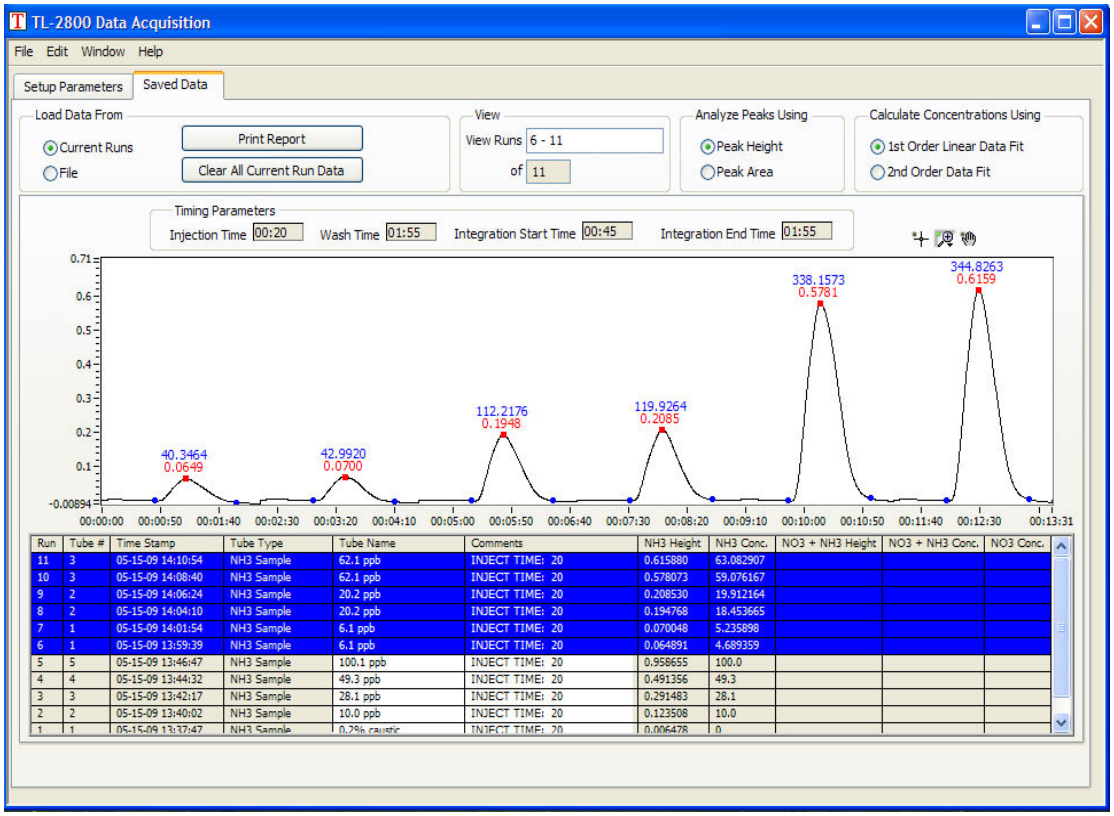

Figure 3-8: Saved Data Tab.

5. The newest peaks are shown on the right of the plot and their information presented at the top of the table. See figure 3-8.

RUNNING SAMPLES FOR NITRATE

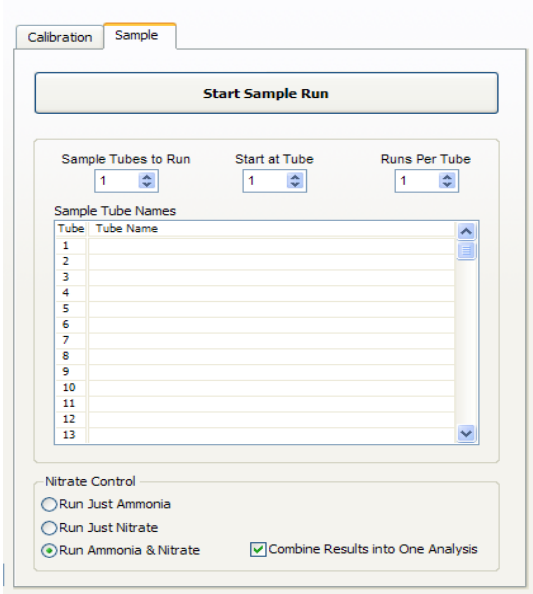

Figure 3-9: Nitrate Runs Setup Parameters.

To set the nitrate offset time parameter you must determine the increase in sample time from when the sample passes through the reduction cartridge. This is dependent on flow rate and tubing. Before running any samples for nitrate, check that the reduction cartridge is properly connected to the front of the instrument.

1. Place a standard in the first sample position of the autosampler

2. Set the Nitrate Offset Time to 00:00 and the Nitrate Equilibration Time to 5 minutes. Set the Nitrate Control to 'Run Ammonia & Nitrate' and enable 'Combine Results into One Analysis.'

3. Switch to the Sample tab and set 'Sample Tubes to Run' to 1 and 'Start at Tube' to 1. Click 'Start Sample Run' to begin data acquisition.

4. When data collection has completed, switch to the Save Data tab. The black plot is the ammonia peak and the green plot is the ammonia + nitrate peak.

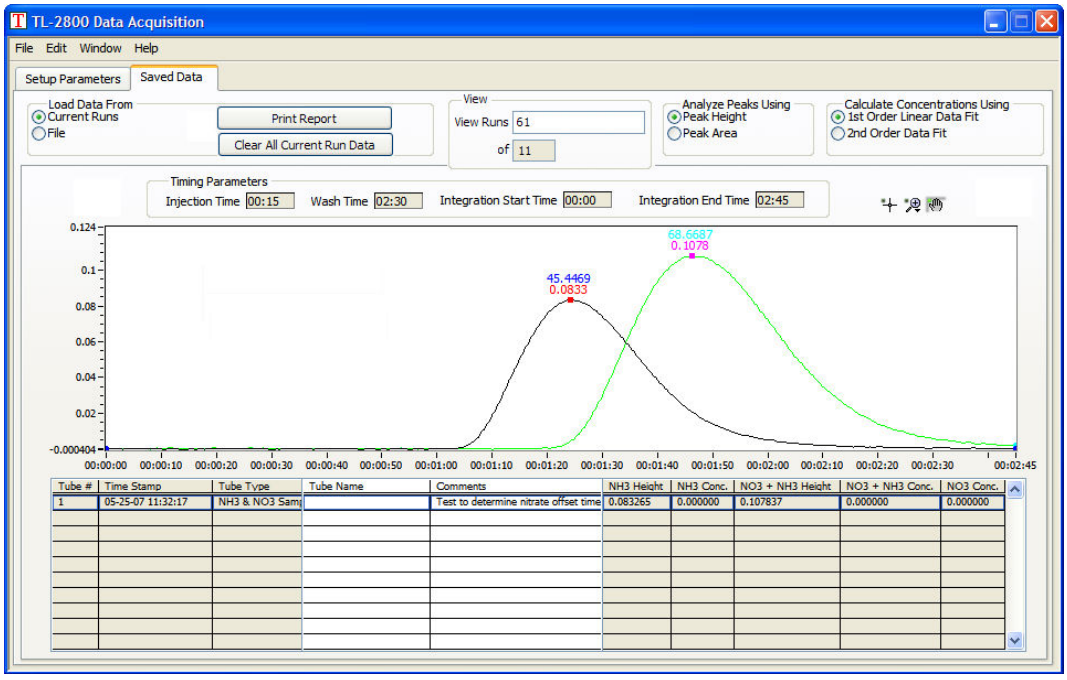

Figure 3-10: Nitrate Run Results.

5. Look at the point where each peak just starts to rise from the baseline. In this example the time is 1:05 for the ammonia peak and 1:20 for the total nitrate peak. See figure 3-10. If you subtract the times, the Nitrate Offset Time is 15 seconds. You can now enter 0:15 into the 'Nitrate Offset Time' field on the setup parameters screen.

6. Now your ammonia + nitrate area calculation will start at the same place as your ammonia peak.

RUNNING SAMPLES WITH PIPELINED INJECTIONS

Running samples with pipelined injections significantly reduces analysis time but also requires a few more parameters.

To set the 'Wait time for first peak' and 'Wash Time' parameters you must find out how long sample takes to reach the conductivity cell, which is dependent on pump speed and tubing. Place a standard in the first sample position of the autosampler.

1. Un-check Pipeline Autosampler Injections. Set the Nitrate Control to 'Run Just Ammonia.'
2. Switch to the Sample tab and set 'Sample Tubes to Run' to 1 and 'Start at Tube' to 1. Click 'Start Sample Run' to begin data acquisition.

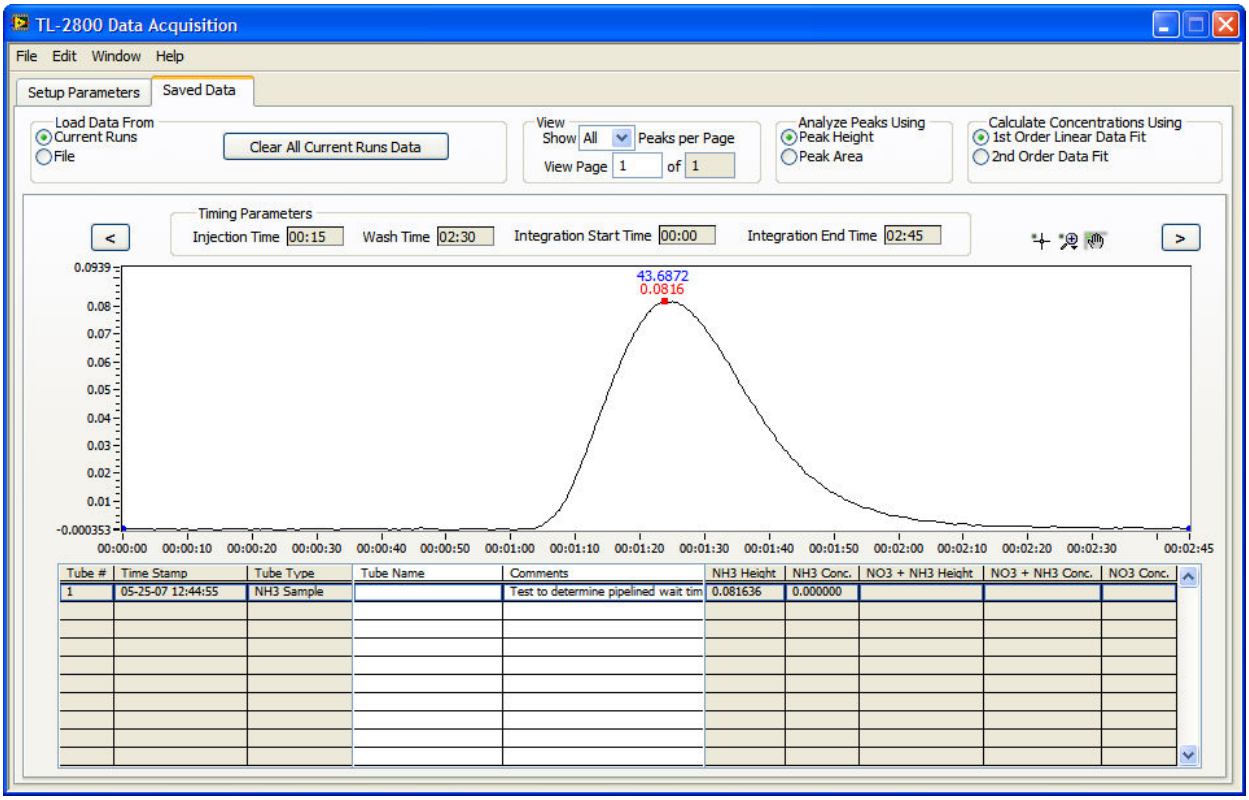

Figure 3-11: Pipelined Injection Runs Setup.

3. When data collection has completed switch to the Save Data tab. You want to look at where the peak just starts to rise above the baseline and where it returns back to 90% of baseline. In this example this is at 1:05 and 1:55.
4. From this you get a 'Wait time for first peak' value of 1:05. If you subtract the two times we get a 'Wash Time' of 0:50. You can now enter 1:05 into the 'Wait time for first peak' field on the setup parameters screen once you have enabled 'Pipeline Autosampler Injections' and entered 0:50 into the 'Wash Time' field.

MANAGING YOUR SAVED RESULTS

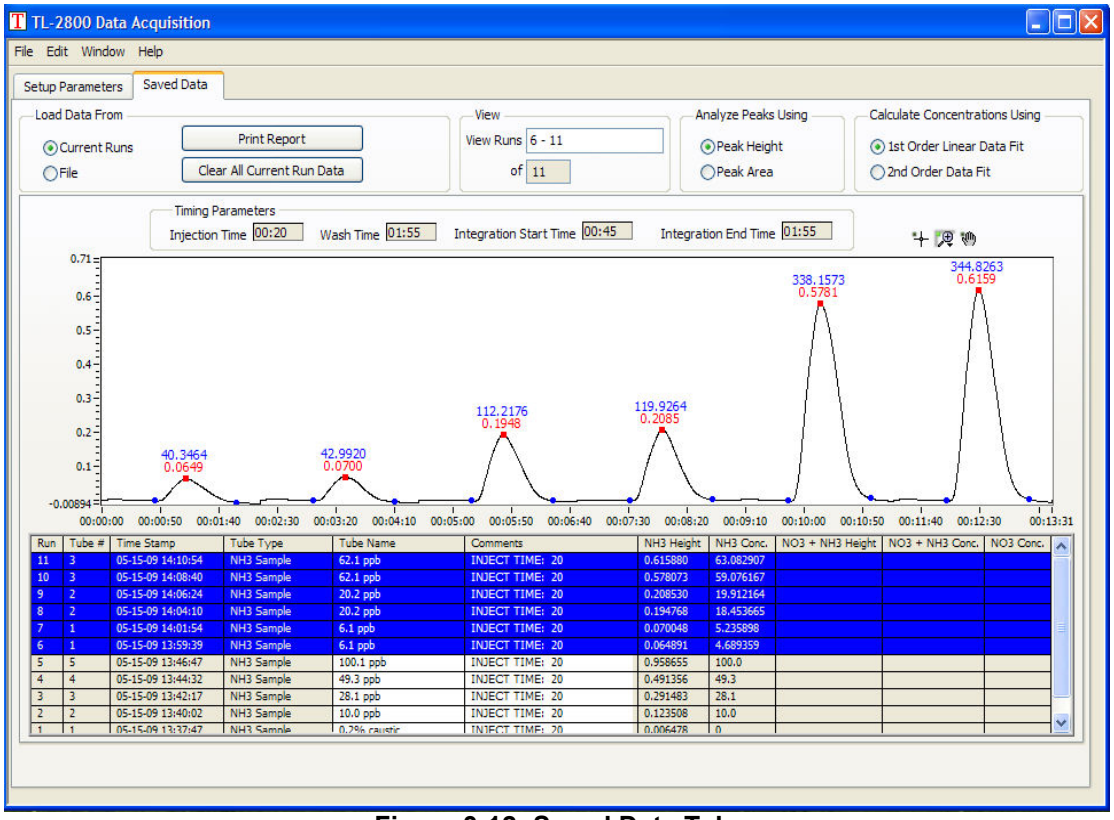

Figure 3-12: Saved Data Tab.

VIEW AND ANALYSIS OPTIONS

1. The number of peaks shown on the graph can be changed using the "View Runs' box at the top of the screen. To display a single peak, enter the run number in the box next to 'View Runs'. To view multiple, consecutive peaks, enter the lowest run number and the highest run number you want to see and separate the two numbers by a hyphen (i.e. 6-11). To display multiple, non-consecutive peaks, enter the run numbers into the box and separate each run number by a comma.

2. Peaks can be analyzed using peak height or peak area which you can toggle between using the 'Analyze Peaks Using' radio buttons. Peak height finds the highest point on the peak from the first integration marker. Peak area finds the area of the peak between the start and stop integration markers.

3. The concentrations of sample tubes can be calculated using either a linear data curve fit or a 2nd order polynomial data fit (if three or more calibration tubes were used to calibrate the instrument). You can toggle between the data fit options using the 'Calculate Concentrations Using' radio buttons.

REMOVING UNWANTED RUNS

Unwanted tube data can be removed using the 'Delete Selected Row' item in the 'Edit' menu. First, click the row in the results table you want to remove from memory. Select 'Delete Selected Row.' The row is removed from the table and its corresponding peak is also removed from the graph.

Note: Once a row is removed it cannot be recovered, so be careful to remove the correct row.

SUMMARY REPORTS

Summary reports combine all the run information shown on the 'Saved Data' screen into an easy to read format. These reports are ideal for emailing and printing. The summary reports include the following:

- Timing information for the runs
- Calibration curves, equations, and R^2 values
- A combined peak plot showing all peaks together
- Individual peak plot pages broken up as defined by the user
- Results tables for each peak plot page

1. Select either 'Print...' or 'Save as HTML...' from the 'File' menu.
2. Configure the report pages and analysis options and click 'Ok.'
3. Either a print or save dialog is displayed to complete the operation.
4. A report can also be printed directly from the 'Saved Data' screen by hitting the 'Print Report' button in the 'Load Data From' box.
5. Configure the report pages and analysis options and hit 'Print'.

SAVING RUN DATA

All stored run data can be saved to a Timberline Data File (*.tdf) for later viewing and creation of summary reports.

1. Remove any runs you do not want to be stored in the file.
2. Select 'Save...' from the 'File' menu.
3. A save file dialog box appears. Type in a file name, select a location to save to, and click 'Save.'

LOADING RUN DATA

Previously saved data files can be loaded again for viewing.

1. Click the 'Load Data From File' radio button. A file path indicator and open file button appears.
2. Click the open file button. An open file dialog box appears.
3. Locate the file you wish to open and click ‘Open’.
4. The current run data is replaced by the stored information. Summary reports can be printed and saved, unwanted runs can be removed as before, tube name and comments can be changed, and the modified data can be saved again to a data file.
5. When you are done viewing, modifying, and creating new data files click the 'Load Data From Current Runs' radio button and the current runs are restored to the screen.

SAVING YOUR SETTINGS (CREATING A METHOD)

Note: Methods can only be created and loaded from the 'Setup Parameters' tab only.

If you are satisfied with the settings, save them as a method by selecting the 'Save Setup Parameters to Method File' in the 'File' menu in the setup parameters tab. You can now shutdown and restart the program and easily load all your settings. For a further description of managing methods see section 4.

SECTION 4 - OPERATING MODES

GENERAL SETUP PARAMETERS

The setup parameters screen is where all parameters are defined to control the data acquisition. This screen includes sections to name your runs, set up timing parameters, select the number of tubes to run, and create unique sample IDs.

RUN INFORMATION

Field	Description
Pump Speed	Allows you to record the pump speed.
Pump Revolutions	Allows you to record the number of revolutions this pump has made, a good way to check for wear of tubing.
Cell S/N	Allows you to record the cell serial number.
Membrane S/N	Allows you to record the membrane serial number.
Buffer Concentration	Allows you to record the buffer concentration.
Buffer Recycle	A drop-down box to record whether the buffer is recycled or put to waste.
Caustic Concentration	Allows you to record the caustic concentration.
Caustic Recycle	A drop-down box to record whether the caustic is recycled or put to waste.
Comment Box	Allows for any other comments.
Pump Setpoint	Setting this field to 30 rpm turns the pump on; 0 rpm turns the pump off.

TIMING PARAMETERS

Field	Description
Injection Time	Determines the amount of time (in min:sec format) sample is drawn from each tube.
Wash Time	Determines the amount of time (in min:sec format) DI Water is drawn from the wash station before advancing to the next sample tube.
Integration Start Time	Defines when the peak height/area calculation begins.
Integration End Time	Defines when the peak area calculation ends.
Nitrate Equilibration Time	The amount of time to wait after switching on the reduction cartridge before a nitrate run to allow the system to equilibrate.
Nitrate Offset Time	Since it takes longer for the sample to travel through the nitrate reduction cartridge, this control allows the height or area integration calculation to be delayed by the specified amount of time.

OPTIONS

Field	Description
Turn Pump Off at End of Run	When enabled, the system automatically turns off the peristaltic pump at the end of the analysis.
Pipeline Autosampler Injections	When enabled, the system injects the next sample ahead of time to significantly reduce analysis time. See Pipelined Runs Section for further description of this run mode.
Extend Wash Time	When enabled, the system automatically extends the wash time based on peak height and the value *n* you enter into the box. Extending the wash time 1 second for every 1 * *n* unit of conductivity. The value entered typically ranges from 10 to 200. Not available when running in pipelined injection mode.
Zero Cell	Zeros the cell when depressed.
Offset DAQ	Displays the amount of offset voltage required to zero the cell.
Front Panel Gain Setting	Allows you to record the gain setting selected on the front panel.
Post Attenuation	Signal is attenuated by a factor of 8, 4, 2, or 1. User selectable
Cell Voltage	Displays the cell voltage for the user.

Example of how Sensitivity, Gain and Post Attenuation affect the output signal:

Highest Sensitivity: Gain=1000, Attenuation=1, the output signal is amplified by a factor of 1000
Lowest Sensitivity: Gain=1, Attenuation=8, the output signal is amplified by a factor of 0.125

CALIBRATION AND SAMPLE TABS

Field	Description
Start Calibration / Sample Run	Once you are satisfied with your Setup Parameters click this button to launch data acquisition on the selected tubes.
Calibration / Sample Tubes to Run	The total number of tubes to be included in the run.
Start at Tube	Starts the run beginning with the tube indicated in this field. Only available for sample runs. Calibration runs always begin with blank cal tube number 1.
Runs Per Tube	Allows multiple samples of each tube to be injected. Only available for sample runs.
Calibration Status	Displays a check mark if the system has a valid ammonia and/or total nitrate calibration curve in memory.
Calibration Tube Concentrations and Names	This table is for entering the known concentrations for each of the calibration tubes to be run and optionally the names for the tubes. If you are running just an ammonia calibration, concentrations need only be entered for the 'NH3 conc.' column. If running just a nitrate calibration, concentrations need only be entered for the 'NO3 + NH3 conc.' column. If running both an ammonia and a total nitrate calibration, concentrations must be entered in both columns.
Nitrate Control	Controls the type of analysis to be run. 'Run Just Ammonia' is the default type of run, which does not use the nitrate reduction cartridge. When the 'Run Just Nitrate' radio button is selected the nitrate reduction cartridge is switched on and the system displays a 'Waiting to equilibrate...' message. When the equilibration time has completed you may run your samples for total nitrate. When 'Run Both Ammonia and Nitrate' radio button is selected the system will first run all samples specified for ammonia, switch on the nitrate reduction cartridge and wait for it to equilibrate, and finally run all samples for total nitrate.
Combine Results into One Analysis	When enabled and running samples for both ammonia and total nitrate, the results for each tube are displayed in the same row, the peaks are displayed in an overlapping fashion, and the nitrate concentration is calculated as the difference between ammonia and total nitrate concentrations.

MENU ITEMS

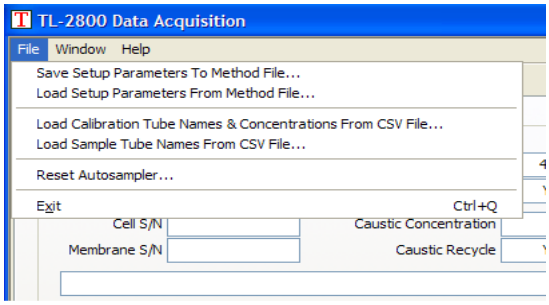

Figure 4-1: Setup Parameters Tab – File Menu

File	Description
Save Setup Parameters To Method File	Brings up a save file dialog which allows you to save all parameters on the 'Setup Parameters' tab to a method file.
Load Setup Parameters From Method File	Brings up a load file dialog which allows you to load all parameters on the 'Setup Parameters' tab with values from a method file.
Load Calibration Tube Names & Concentrations From CSV File	Brings up a load file dialog which allows you to load the calibration tube names, ammonia, and total nitrate concentrations from a stored CSV file. See the next section on creating tube name CSV files.
Load Sample Tube Names From CSV File	Brings up a load file dialog which allows you to load the sample tube names from a stored CSV file.
Reset Autosampler	Resets the autosampler to home.
Exit	Exits the program.

TUBE NAME CSV FILES

Tube names give an identifier to each sample for easy recognition. Tube names and concentrations for calibration tubes can be loaded from an external CSV file or entered directly into the table.

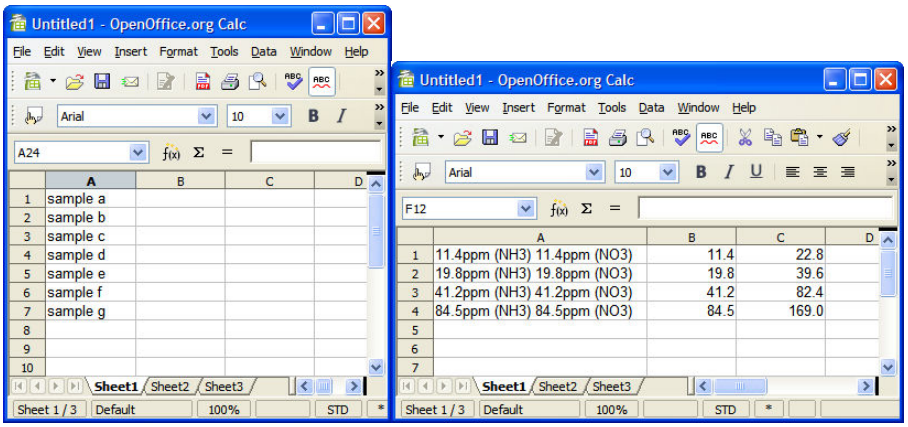

Figure 4-2: Creating Tube Name CSV files for Samples (left) Calibration (right).

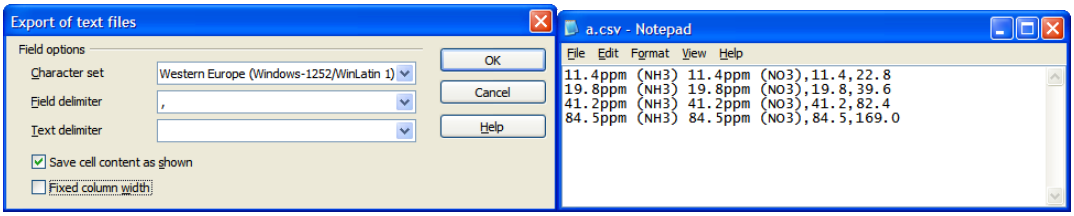

Figure 4-3: Calc Export of text files (left) and resulting CSV File (right).

1. Open a blank spreadsheet and enter the sample tube numbers in Column A, rows 1 up to 9 for calibration tubes and rows 1 up to 120 or 240 for sample tubes.

2. For Calibration tubes enter the known ammonia concentrations in Column B, and total nitrate concentrations in Column C.

3. Save this file as a 'Text CSV (.csv)' file. Answer yes to the format warning to save as a Text CSV file. Make sure the Field delimiter is a comma and there is no text delimiter. See figure 4-4.

4. This file can now be loaded in the program.

METHODS

Methods are a quick way to save and load all your settings as well as your tube names. Individual methods for various analytical techniques can be created and saved for future use.

CREATING

All of the parameters shown in the setup screen are saved in a method. Once you are satisfied with your settings you may create the method by selecting 'Save Setup Parameters To Method File' in the file menu. Enter a new file name for the method and click 'Save'.

LOADING

To load a previously created method, select 'Load Setup Parameters From Method File' in the File menu. Then in the load file dialog, select a method file, and click 'Open'.

UPDATING

To save any changes you have made to the current method. Select 'Save Setup Parameters To Method File' in the file menu.

Note: Tube names are saved in methods. However, changes to the tube names are not saved back to the CSV file.

DATA ACQUISITION MODE

This screen displays peak data as it is being collected. The fields below show the status of the current analysis. The data acquisition process can be canceled any time after autozeroing.

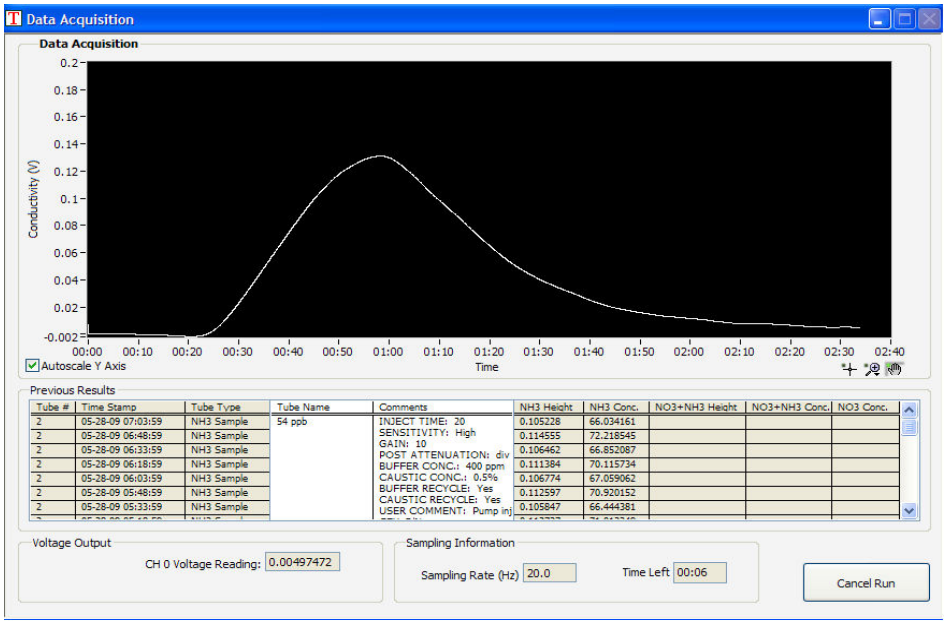

Figure 4-4: Acquisition Mode screen.

FIELD DESCRIPTIONS

Field	Description
Conductivity Plot	Displays the conductivity of the fluid passing through the cell in real-time.
Autoscale Y Axis	Enabling this option will automatically set the Y scale to -0.001 to 0.05 at the beginning of each tube to show the stability of the baseline. As the sample peak rises, the scale increases to adjust for the peak height. Disable this option if you want to fix the Y scale at your own range.
Graph Tools (Hand, Magnifying glass, Cross-hairs)	These tools allow you to manipulate the conductivity plot. The hand tool pans the graph when you click and drag. The magnifying glass contains different zoom options: Zoom to Rectangle, X-zoom, Y-zoom, Zoom In about Point, Zoom Out about Point, and Zoom to Fit. The final cross-hair tool is unused here.
Previous Results	Data from completed tubes is displayed here. You may edit tube names and comments here and any changes will be carried through to the Saved Data tab.
CH 0 Voltage Reading	The actual voltage from the acquisition hardware.
Sample Rate	The actual rate at which conductivity measurements are taken. If this value is fluctuating you may have too many programs open or insufficient computer speed to run the Timberline Data Acquisition Software.
Time Left	Displays how much time is left on the current tube.
Cancel Run	Stops the Data Acquisition process. The data from the current tube is not saved.

CANCELING A RUN

To cancel a run click the 'Cancel Run' button. The autosampler will immediately return to the home position and the Setup Parameters screen will be displayed. All data from tubes finished before the run was canceled is saved. You may need to wait for the TL-2800 output to return to the baseline before running additional samples.

SAVED DATA

The saved data tab allows you to view saved run information. Here information can be printed or saved as a summary report.

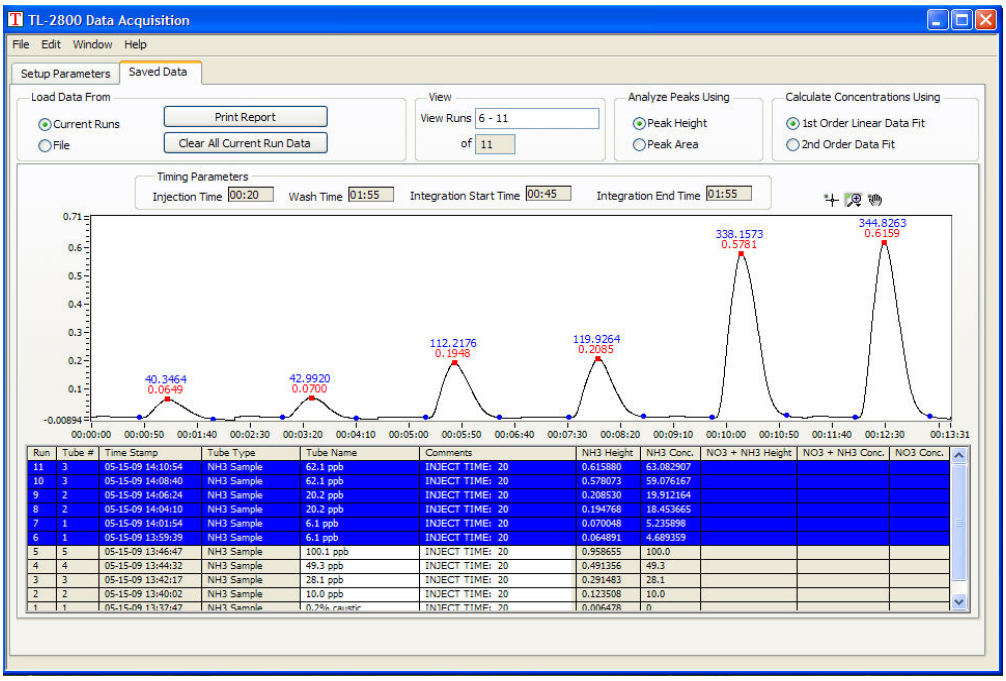

Figure 4-5: Report Preview Window.

Field	Description
Load Data From	Allows you to switch between displaying data from the current set of runs and runs in a stored data file. When loading from a data file, click the 'File' radio button, click the open file button that appears, select the file you wish to load from the open file dialog and click 'Open.'
Clear All Current Runs Data	Clears all the current runs from memory, leaving the calibration curve intact. Make sure you save your data to a data file before using this control because data cannot be recovered once it is cleared.
Print Report	Allows you to print a report straight from the Saved Data page.
View Runs	Shows the run numbers of the peaks that are being displayed in the window out of the total number of runs.
Analyze Peaks Using	Allows you to switch the type of peak analysis between peak height and peak area.
Calculate Concentrations Using	Allows you to switch the calibration curve used to calculate concentration between a linear data fit and a second order polynomial data fit.
Timing Parameters	Shows the timing parameters on the currently selected row.
Results Table	Displays analysis information on all samples run. You can edit tube names and comments here as well. Clicking a row allows you to change what sample(s) are shown in the plot.