Pathway Services Inc.

AUTOMATED ROAD AND PAVEMENT CONDITION SURVEYS

Block and Bounce Test Guide for Windows 7 Profilers

Rev. 12/30/2016

Measurement Verification

Block Test

The block test verifies the accuracy and precision of the laser measuring equipment. This will ensure the overall quality of the data obtained from the lasers in a static environment. By itself, the block test does not ensure accuracy and precision, but must be combined with a "Bounce Test" and "10-Run verification".

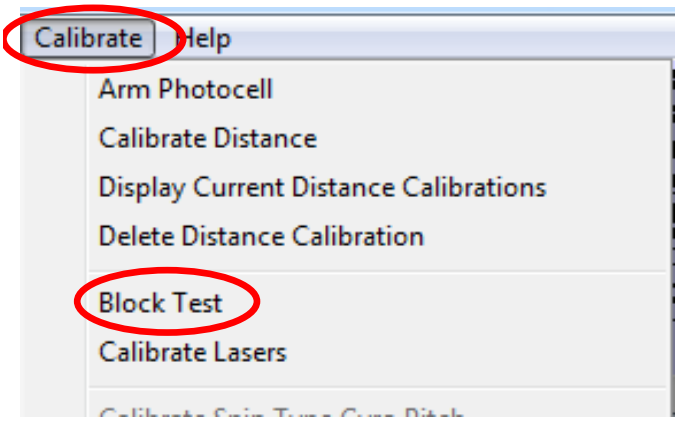
Starting the Block Test

1. Print a copy of the Block Test Data Sheet to capture data.
2. Located the provided set of aluminum calibration blocks from the PathRunner. This set includes a 1/4" x 4" x "6" base plate and four (4) calibrated measuring blocks that are .2500", .5000", 1.000", and 2.000" in height (+/- .001"). The painted side (flat red, grey, or black in color) is the side that will face up.
3. Place the base plate under the laser that is being tested, ensuring that the plate does not rock or move when the corners are pushed. It is important that this plate is stable and does not move during the test.
4. With the vehicle connected to shore power and equipment on, turn on the PathRunner Software.
5. Place the DMI in "TEST" mode and adjust the speed to approximately 40 mph.

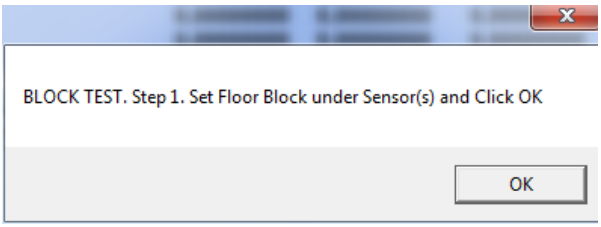
Measurements

The following steps will be repeated several times. In the remainder of this section, it will be referred to as "Take a measurement".

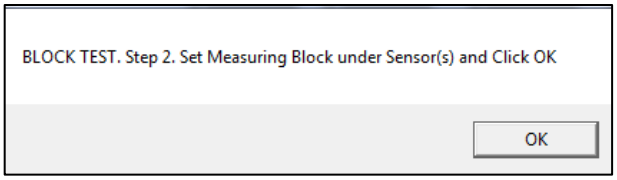
With the baseplate under the laser, from the menu, choose "Calibrate" → "Block Test". This will begin the block test.



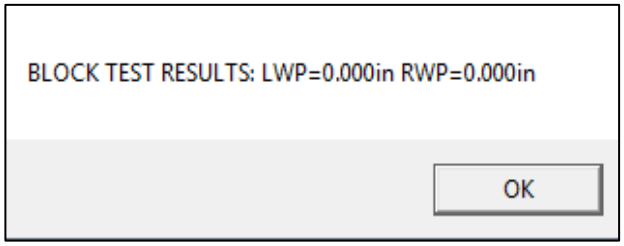
Step 1. A dialogue box will appear instructing the user to set the floor block under the laser sensor(s). At this point, only the baseplate is under the laser. Once this has been completed, click the "OK" button.



Step 2. A dialogue box will appear, instructing the user to place the measurement block under the laser(s). Place the 1.000" calibration block on top of the base plate under the laser being careful not to move the baseplate. Once in place, click the "OK" button.



Step 3. A dialogue box will appear providing the results of the measurement. In this example, the measurement was done with just the baseplate and no calibration block, resulting in a measurement of 0.000 inches.



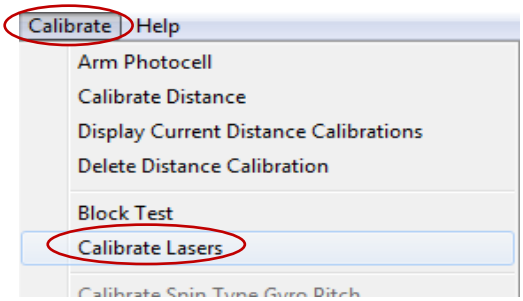
Step 4. Write down the measurement and repeat the process an adequate number of times for each block (base plate, .250", .500", 1.000", and 2.000" blocks)

Documenting the Test

Filling in a data sheet can be used to track the measurements, if needed. All measurement values must be within +/- .01" of the calibrated plate height to be determined valid. If the measurement values fall outside of these tolerances, ensure the plate is stable. If the plate is stable and the values are still out of tolerance, calibrate the lasers. Contact Pathway Services for additional support, if needed.

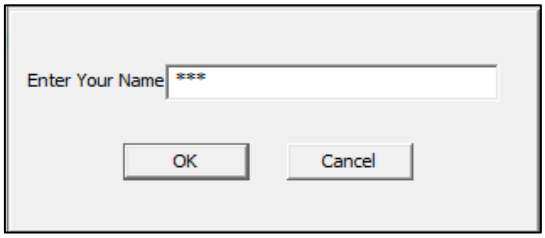
Calibrating the Lasers

If the measurements fall outside of the +/- .01" tolerances, then you must recalibrate the lasers and redo the block test.

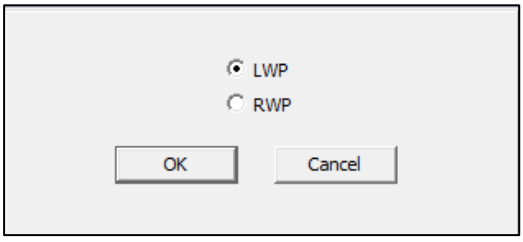


1. To calibrate the lasers, you will need the 1/4" baseplate and the 1" calibrated block. Like the block test, place the base plate under the laser ensuring it does not rock or move.

2. On the menu, choose "Calibrate" → "Calibrate Lasers"



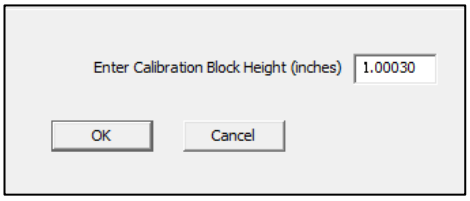
3. A dialogue box with appear instructing the user to enter their name. Enter the appropriate information and click "OK".



4. Next, a dialogue box with appear asking the user to select which laser is to be calibrated:

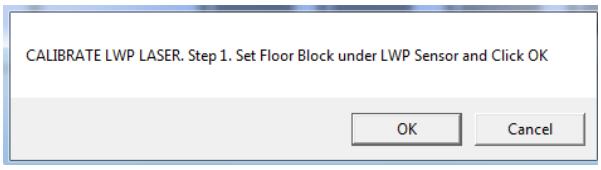
   - LWP = Left Wheel Path
   - RWP = Right Wheel Path

   Make a selection and click "OK".

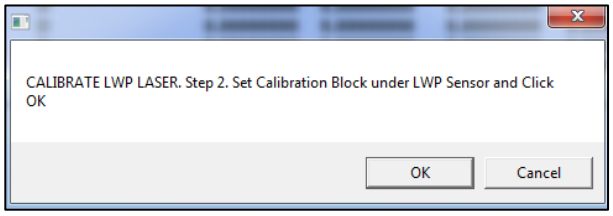


5. A dialogue box with appear requiring the height of the calibration block to be measured. This height can be found on the side of the calibration block. If the block is not marked, contact Pathway Services for assistance.

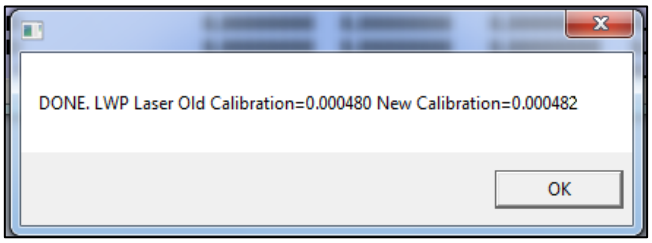
6. A dialogue box will appear instructing the user to place a base plate under the laser. Place only the base plate under the laser and click "OK".



7. A dialogue box will appear instructing the user to place a measurement block under the laser. Carefully place the measurement block on top of the base plate, being careful to not disturb the base plate and making sure the entire laser is on the measurement block. Once in place, click "OK".



8. A dialogue block will open reporting the results of the measurement. In the example provided, the calibration adjusted from .000480 to .000482. Click "OK" to continue.



9. After this step, redo the block test ensuring you stay within tolerances.

***NOTE: If the Block Test was not successful the second time, calibrate the lasers one more time ensuring your baseplates are not moving and then re-perform the block test. If it still does not pass, contact Pathway Services for additional support.**

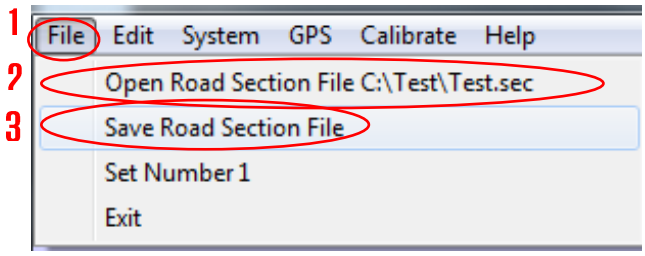
Block Test (Conforms to AASHTO R57 Requirements)

The bounce test will help synchronize and calibrate the accelerometers with the lasers. Anytime a component in the profiler accelerometer system has been replaced or adjusted or a laser calibration has been adjusted, a block test verification and a complete bounce test should be done.

Getting Ready for the Bounce Test

1. Locate the set of calibration blocks provided in the PathRunner. This test needs the 4"X6" baseplate and the .2500" calibration block. The painted side (flat red, grey, or black in color) is the side that will face up.
2. Place the baseplate or the .2500" calibration block under the lasers, ensuring that the laser line stays on the plate when bouncing.
3. With the vehicle connected to shore power and the equipment on, turn on the PathRunner Software.
4. Place the DMI box in "Test" mode and using the knob, adjust the speed to 40 MPH.

Starting the Bounce Test



1. Create a new SEC file for the block test. From the menu, choose "File" → "Save Road Section File". Save a file named "MM_DD_YY_Bounce.sec" to the "Test" Folder, where MM_DD_YY is today's date.
2. Open the file created: Choose "File" → "Open Section File" and then select the file you just saved.
3. Select the Set number for the file to collect to. Do not use a SET number that has already been used. In our example, we will use "Set 1".

Performing the "Bounce"

NOTE: Read this section completely before performing the bounce test, as there are several steps that should be completed together. If you are unsure how to perform any task, refer to the operator's manual for assistance.

The bounce will cover a minimum of a simulated 1,584-feet. This will be 528-feet of no bouncing, 528-feet of bouncing, and 528-feet of no bouncing. At 40-MPH, 528-feet is approximately ten (10) seconds.

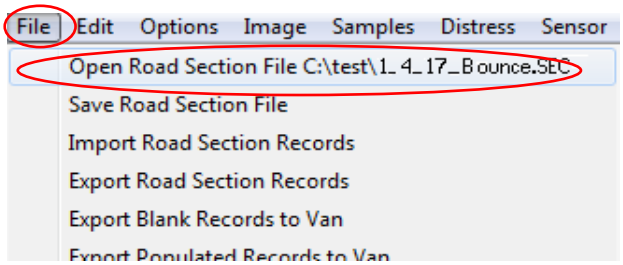
1. Activate the system ("Ctrl "+ "A")
2. Start the collection ("S" or "Collect Button"
3. Wait approximately ten (10) seconds. Longer is acceptable.
4. After 10 seconds, stand on the rear bumper and smoothly bounce for approximately ten (10) seconds.
    a. Try to be as close to ten (10) seconds as possible, which will equate to approximately ten (10) solid bounces.
    b. Each bounce should move the rear bumper more than an inch and up to several inches. ASHTO specifies 1" of travel.
    c. Be sure not to try and jolt or stop in between each bounce.
    d. After ten (10) seconds of bouncing, step off of the bumper
    NOTE: The series of "bounces" should be equal in magnitude, creating a somewhat "rhythmic" motion.

5. Wait approximately ten (10) seconds. Longer is acceptable.
6. End collection ("E" or "Collect Button"
7. Deactivate the system ("Ctrl" + "D")
8. Close the PathRunner software.

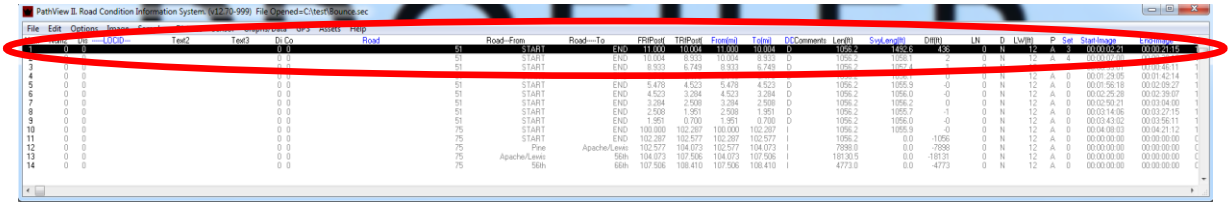
Creating the ERD files

After the physical bounce test has been conducted, create the ERD files.

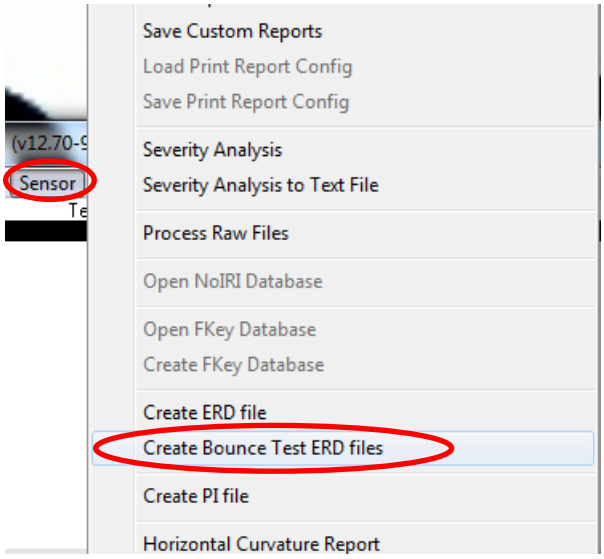
1. Open PathView II. A dialogue box will ask to open a previous database, select "No"
2. From the menu, choose "File" → "Open Road Section File". Select the road section file (*.sec) created in the bounce test.



3. The database will open. Select the record used to perform the bounce test (it will become highlighted black). In this case, record 1.

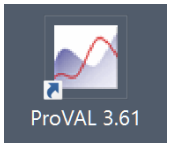


4. Create the Bounce Test ERD file: From the menu, choose "Sensor" → "Create Bounce Test ERD files". This will save four (4) files to the folder the road section file is in. In this example, the files were saved to the "C:\Test\" folder. The four files created/modified are: "BounceL.ERD", "BounceR.ERD", "ProfileL.ERD", and "ProfileR.ERD". An activity window and activity curser may appear briefly.
5. Close PathViewII.

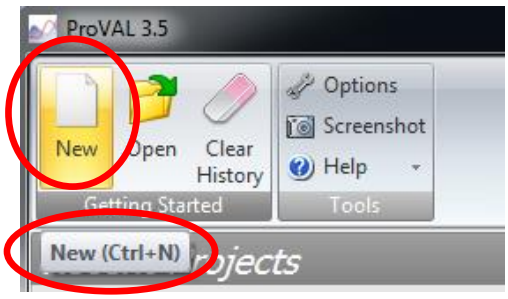


Opening ERD files in ProVal 3.0 or higher

1. ProVal from the Profiler Desk Top.

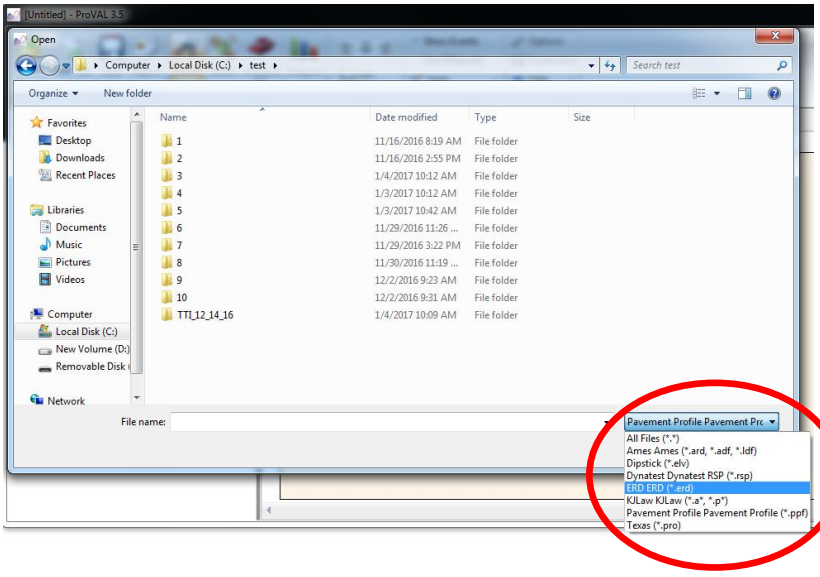


2. Start a New project. Press "Ctrl" + "N" or click the" New" icon (circled).

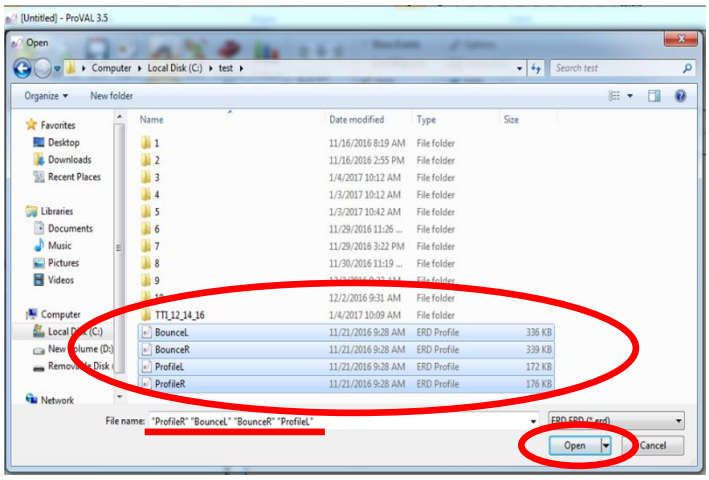


3. Click the "Add Files" icon

4. A file explorer box will open. Navigate to the "C:\Test\" folder. If *.erd files do not appear in this folder, change the file type the computer is looking for to ERD (*.erd) using the pull-down menu below.



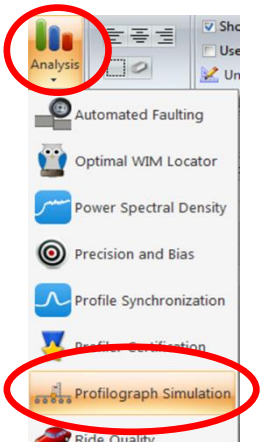
5. Once the ERD files are available, select "BounceL.erd", "BounceR.erd", "ProfileL.erd", and "ProfileR.erd".
    a. Either select one file at a time and repeat this step four times until all the files are added or select multiple files at once and add them.
    b. To select multiple files, click on the top file (BounceL.erd), then press and hold "Shift", and then click on the bottom file (ProfileR.erd)



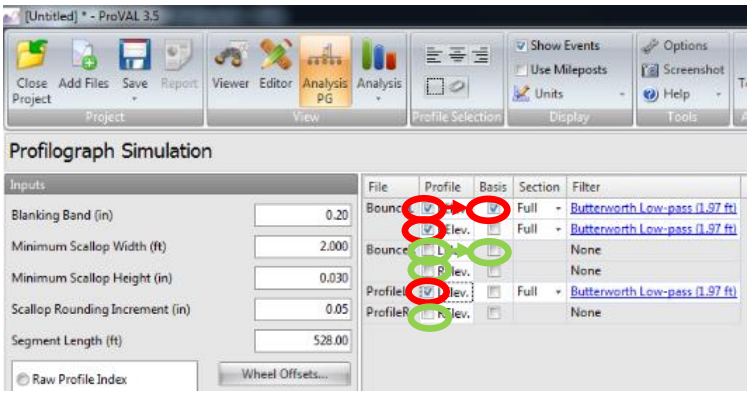
Using ProVal to Analyze Laser and Accelerometer Synchronization

The first analysis to perform in ProVal is Laser and Accelerometer Synchronization. To do this, utilize the Profilograph Simulation function.

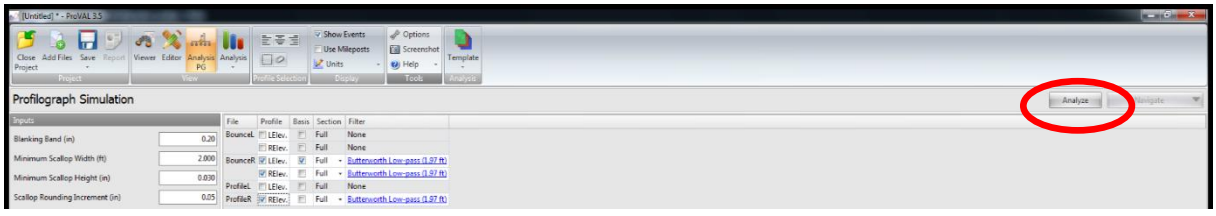
1. To select the Profilograph Simulation function, click on the Analysis button to pull-down the menu and then click on Profilograph Simulation.



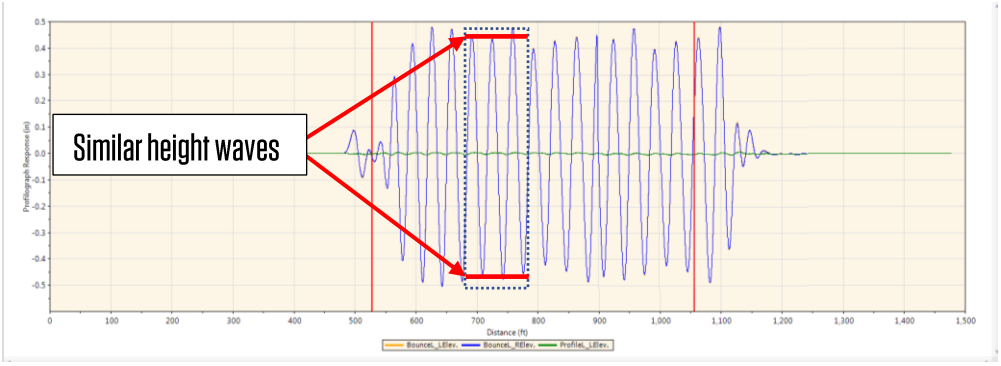
2. Once the Profilograph Simulation has launched, select four boxes.
    a. For Left Wheel Path, click the boxes in the four red circles
    b. For Right Wheel path, click the boxes in the three green circles.



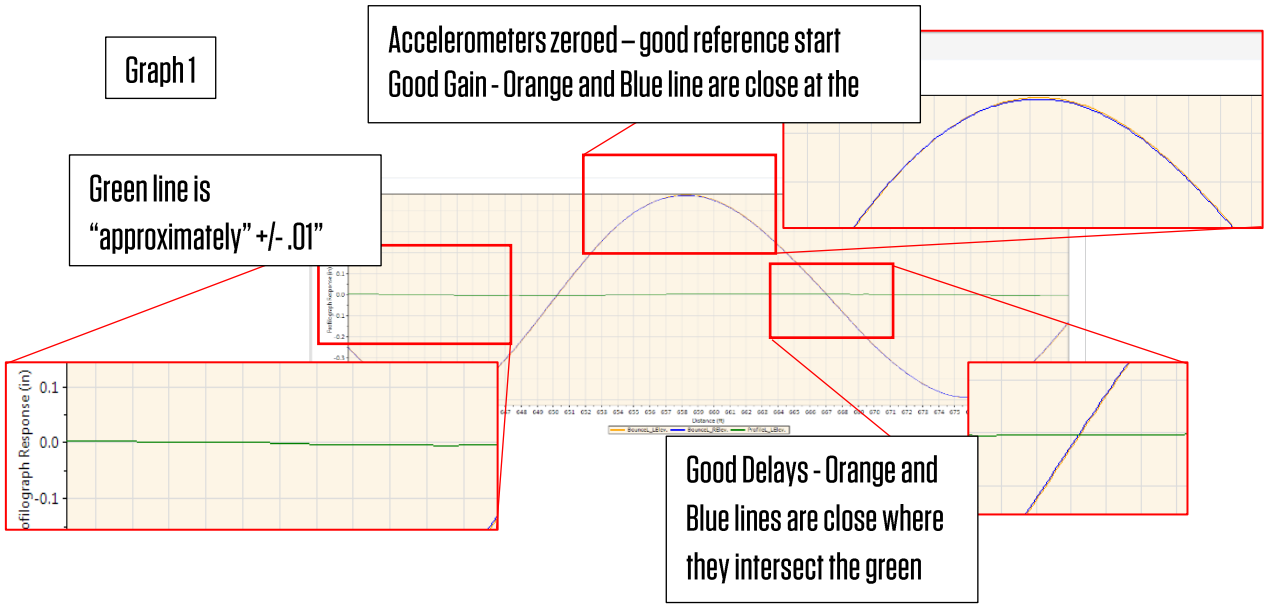
3. Click the "Analyze" button



4. A graph similar to the one shown, below, will appear. Select a couple of waves to analyze by left left-clicking on the graph and dragging the window down and to the right. Look for waves where the peaks are similar in height.

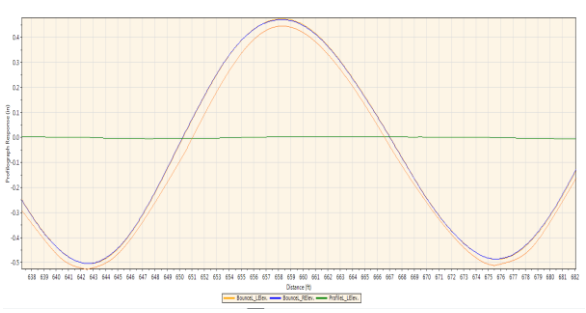


5. Analyze the graph.
   a. The orange line represents the accelerometer. In a well calibrated system, you will not see the orange line.
   b. The blue line represents the laser profile.
   c. The green line represents the overall profile after the accelerometers have eliminated the motion of the lasers.
6. Graph interpretation
   a. Graph 1 represents a well synchronized system. We interpret the graph in the following order: 1) Accelerometer Zero, 2) Laser Delays, and 3) Accelerometer Gain. Adjusting these in this order will shift the Blue and Orange lines to line up near perfect at the peaks and the green "Profile" line is flat. While there is precise measurement, it is best to achieve +/- .01" variation in the green line from peak to peak. You can zoom in for better clarity. Not having good synchronization will affect the "Ride Quality Analysis Test".



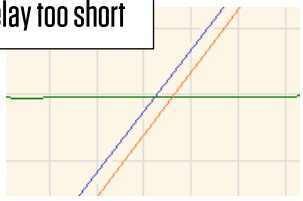
b. Graph 2 represents accelerometers that need to be zeroed. It is good practice to zero delays prior to starting the bounce test. However, sometimes they may need to be zeroed a couple of times to achieve good results and it can be difficult to determine prior to doing some of the other adjustments. A good indicator of accelerometers that need to be adjusted is where the orange line is constantly above or below the blue line the duration of the test.

Graph 2 – Accelerometers need zeroed



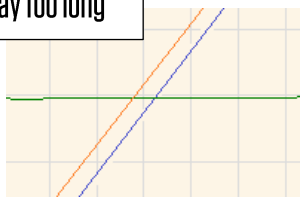
c. Graph 3 represents a system where the Laser Delay is too short, allowing the accelerometer to lead the laser. Laser delay adjustments should not be needed; however, if you think adjustments need to be made, contact Pathway Services for support.

Graph 3 – Delay too short



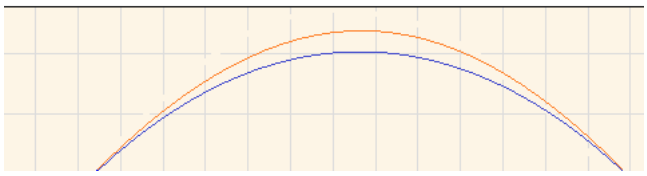
d. Graph 4 represents a system where the Laser Delay is too long, causing the laser to lead the accelerometer. Laser delay adjustments should not be needed; however, if you think adjustments need to be made, contact Pathway Services for support.

Graph 4 – Delay too long



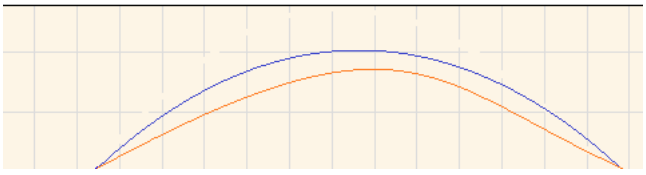
e. Graph 5 represents a system where the Accelerometer Gain is too high. The orange line is the Accelerometer line and the gain will need to be lowered. In this case the adjustment knob will need to be turned counter-clockwise as described in "Adjusting Accelerometer Gain" Section.

Graph 5 – High Gain



f. Graph 6 represents a system where the Accelerometer Gain is too low. The orange line is the Accelerometer line and the gain will need to be raised. In this case the adjustment knob will need to be turned clockwise as described in "Adjusting Accelerometer Gain" Section.

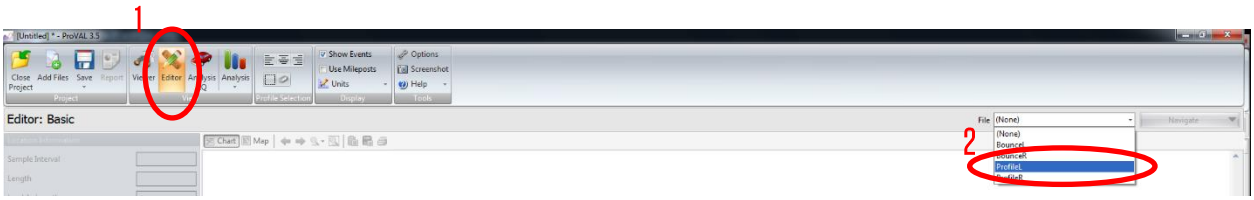
Graph 6 – Low Gain



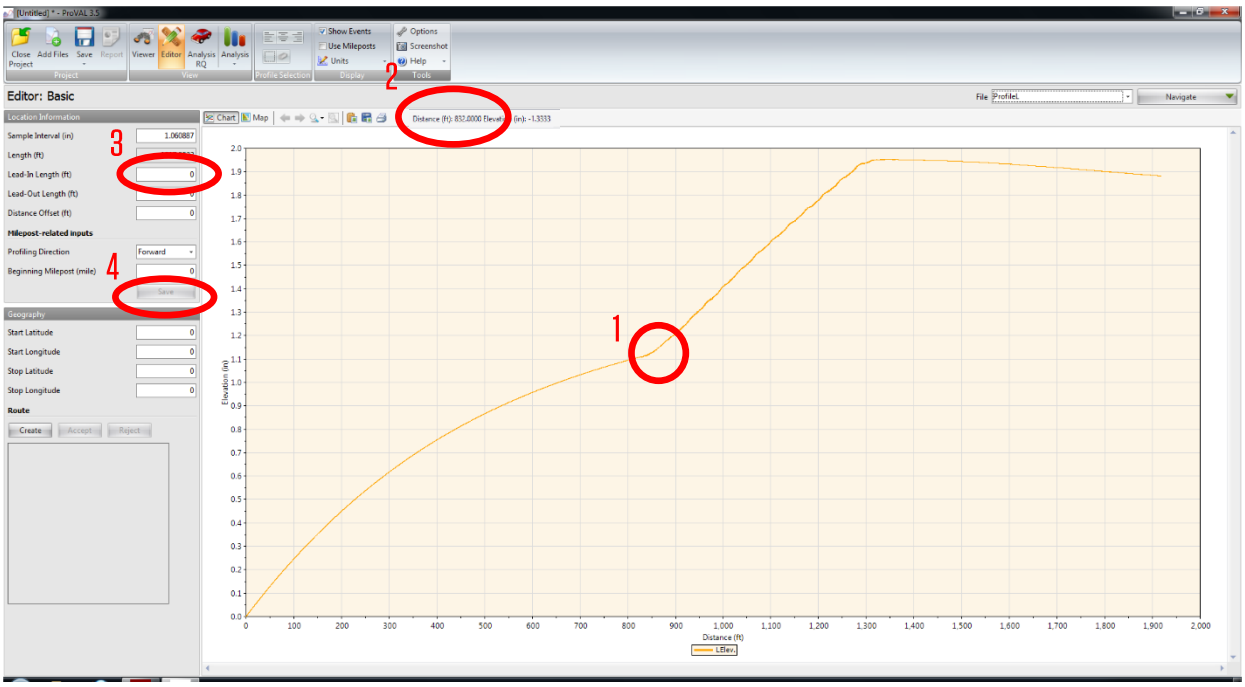
Adjusting Test Section Length

Because the overall test section needs to be 1,584-feet in length, the file may need to be trimmed to give us the most accurate results. The main purpose of this is to get the "bouncing" section in the middle 528-feet.

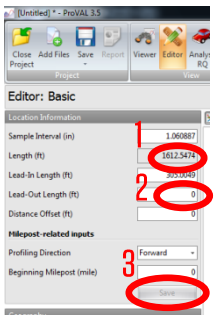
1) Click on the "editor" button and then select the profile to be tested. In this example, the Left Wheel Path is tested. (Choose "ProfileL").



2) Determine the Lead-in value to use to trim excess distance off the front of the file. To do this, find where the "bounce" starts. The line can be going upwards or downwards. Move the cursor to the point where the line deviates (circle 1) and then look at circle 2 -- This is the distance to the start of the bounce (in feet).
   a. In this example it is 832-feet.
   b. Subtract 528-feet to find the lead in trim point (832 – 528 = 304).
   c. Insert the result in the lead in box (circle 3)
   d. Then click "Save" (circle 4)



3) Next, trim the lead-out excess.



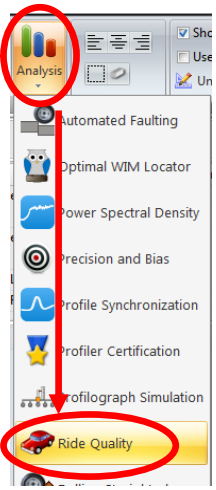
a. In circle 1, find the length of the file after it has been trimmed—in this example it is 1612-feet.
b. Subtract 1584 from this number. The lead out trim point (1612 – 1584 = 29 feet)
c. Enter the result in the lead out box (circle 2)
d. Click "Save" (circle 3)

4) If both wheel paths are to be tested/calibrated, repeat the process for ProfileR for the Right Wheel Path.

Reviewing the Ride Quality Test Data

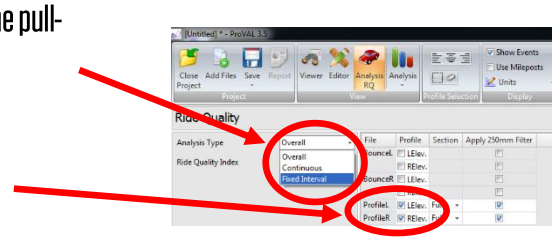
At this point, the test data is ready to be reviewed to see if it passed the bounce test. To do this, choose Ride Quality Analysis.

1) Click on the analysis button and select "Ride Quality" from the buttons.



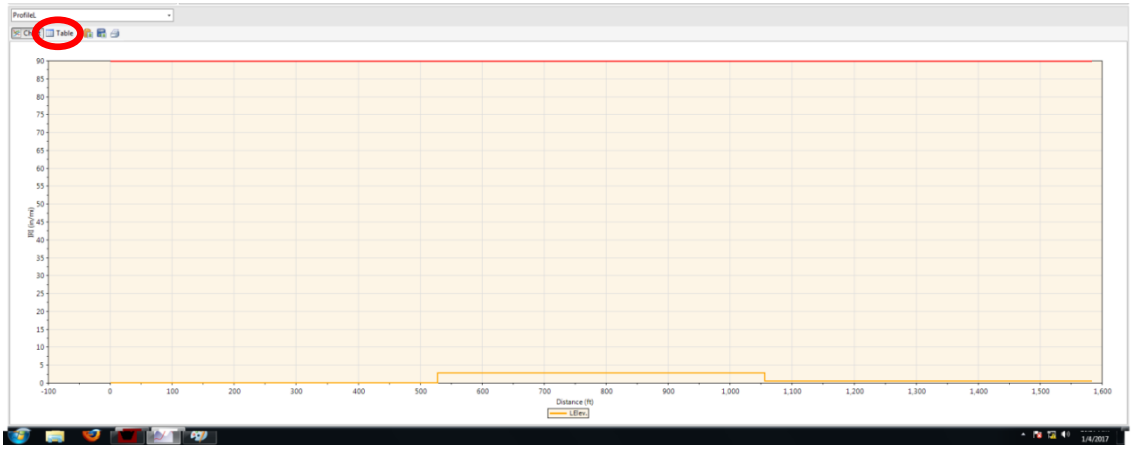
2) Choose "Analysis Type", use the pull-down to select "Fixed Interval"

3) Select the two boxes next to ProfileL and ProfileR.



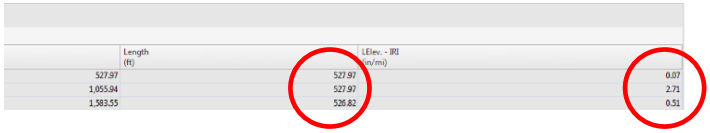
4) Verify that the "Segment Length Ft" says 528.0 ft.

5) The following graph will appear. Select "Table"

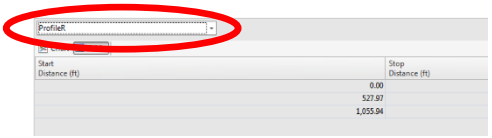


6) A Table will appear with several numbers. Verify several things:
   a. The Length for all three (3) sections is approximately 528-feet.
   b. The IRI for the sections meets the following criteria:
      i. Section 1 (lead-in) - less than 3.00
      ii. Section 2 (bounce) - less than 10.00
      iii. Section 3 (lead-out) - less than 3.00

c. If any of these sections are out of tolerances, the system will need to be adjusted and another bounce test will need to be completed after adjustments are made.

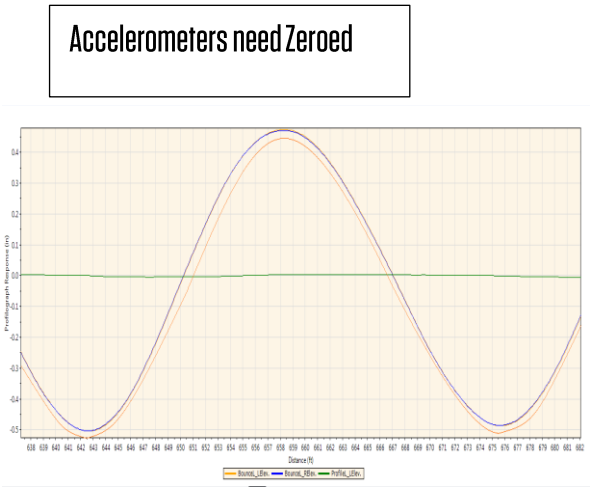


7) Move between the two profiles by using the pull-down to select ProfileL or ProfileR.



Adjusting Laser and Accelerometer Synchronization

Zeroing Accelerometers



It is a good practice to zero delays before any bounce test. This may need to be completed a couple of times. The vehicle will need to be vehicle perfectly still for the adjustment.

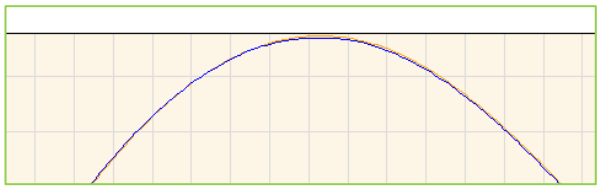
1) In the PathRunner Software, on the "menu" bar, click "Calibrate" and then click "Zero Accelerometers.
2) A dialogue box will appear, directing the user to make sure the vehicle is still. Once the vehicle is still, click "OK".
3) The adjustment is now complete. Conduct a bounce test to verify they are better aligned and make additional adjustments. If the accelerometers will not "zero", contact Pathway Services for more information.

Adjusting Accelerometer Gain

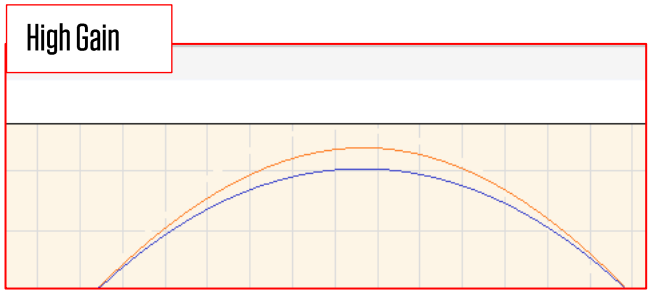
The last adjustment in Laser and Accelerometer Synchronization is the Accelerometer Gain. There is no "exact" amount to make adjustments, so the recommended starting point is approximately 1/8th of a turn at a time until the system is in alignment. After each adjustment, a complete "Bounce Test" will need to be performed.

1) Locate the accelerometer boxes in the computer rack. The accelerometer box should be labeled, but it can be identified by having an adjustment screw hole on one side or the other.
    a. If they are not labeled, the cable with the "Blue" zip-tie is the Left Wheel Path Accelerometer. The cable with the "Red" zip-tie is the Right Wheel Path Accelerometer.

2) Analyze the graph by zooming in on a peak to analyze and determine needed adjustments.
   a. Gain is correct – Orange and blue lines to be right on top of each other. No adjustments necessary.



   b. Too much gain – the adjustment knob will need to be turned counter-clockwise.



   c. Too little gain – the adjustment knob will need to be turned clockwise.

3) After adjustments have been made, redo the bounce test and re-analyze the graphs.
   NOTE: Make certain to look at both graphs and ensure the appropriate wheel path is being adjusted.

Laser Delay

Laser delay adjustments should not be needed, but if there is difficulty achieving a good bounce test, then zoom to where the blue and orange line intersects the green line. If there are indications of a short delay or a long delay, contact Pathway Services for support. Copies of all the ERD files from the bounce test will be needed.