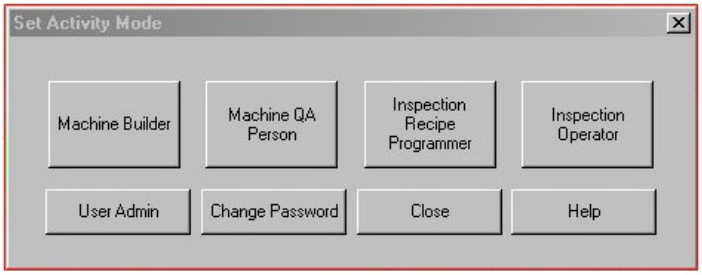
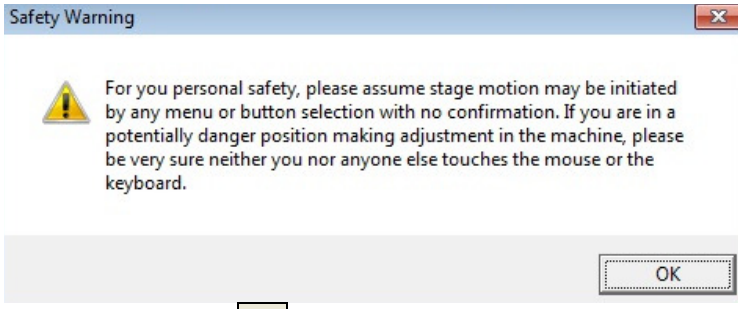
Calibration Procedure
YTV-BX

Running calibration on your YESTech YTV-BX AOI machine will verify that the hardware/software settings meet its specifications. It is recommended that the calibration procedure be run every 6 months. Our YesVision software provides a comprehensive set of guided calibration procedures. There is a series of 15 tests (13 tests if you do not have side angle cameras since the Dewarp Offset and Dewarp Matrix tests will not be performed) that must be run in order for the machine to be completely calibrated.

Initial Setup

1. Make sure that there is no other board currently in the machine.
2. Log into the YesVision software as **Machine Builder Mode**. A safety warning will appear. Click OK to agree and continue.

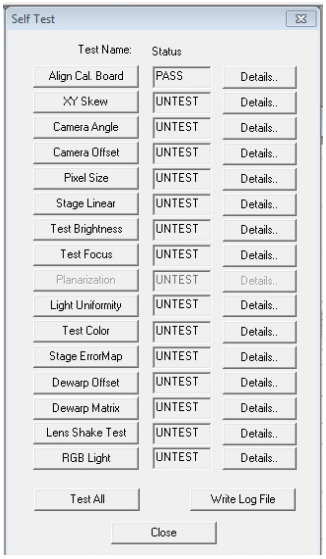




3. Click on the Stage Away icon  . This will bring the stage to the front side of the machine so there is access to place the Calibration Board on the board holder.

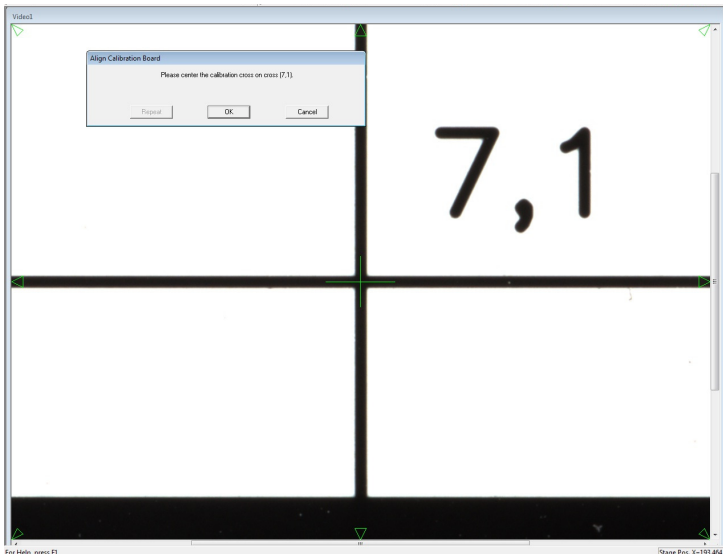
4. Place the Calibration Board (P/N 10876) on the board rails so that the board fits securely. Verify that the board is sitting flat on the conveyor and that the board is up against the board stops.

5. When you log in as **Machine Builder Mode,** there will be a **Self Test** window on the upper right hand corner. These are the 15 tests that will need to be performed in order for calibration to be complete.

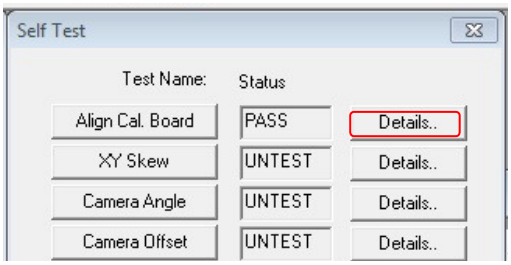


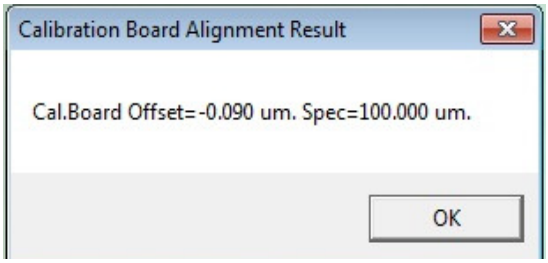
Test 1: Align Calibration Board – this test will verify that the calibration board is perpendicular with the camera stage's Y-axis.

1. Click on **Align Cal. Board** in the **Self Test** window.
2. The software will prompt the user to center the crosshair on (7, 1). Double click on the crosshair on (7, 1) with your mouse and use the arrow keys for precision adjust. Click **OK**.

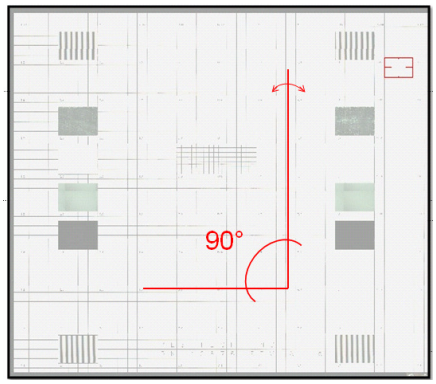


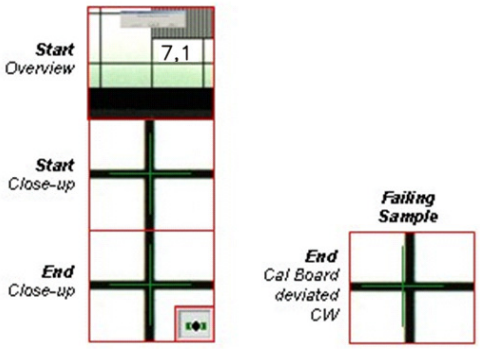
3. The camera will move on the Y-axis to determine if the board is perpendicular with the stage. In the **Self Test** window, the status will show either "FAIL" or "PASS." The scores will be listed under **Details**.



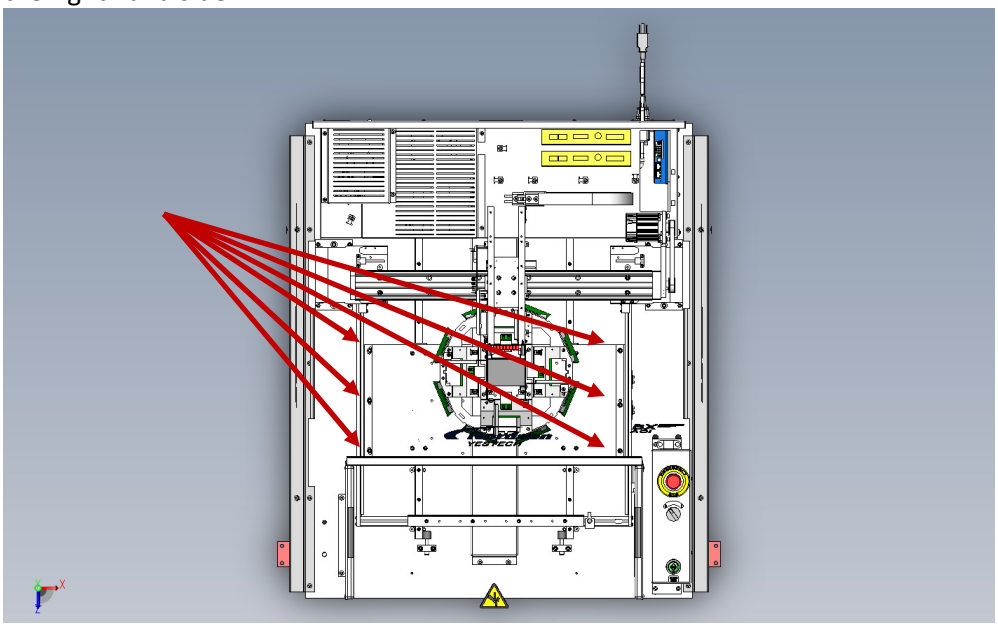


4. If the test fails, click on the "eye" icon (live mode) in the toolbar and make sure the board is seated securely on the rail.
5. If the test is still failing, without moving the stage from the ending test position, click on the ***Live*** toolbar
6. Manually rotate the board slightly to line the crosshair up with the **vertical** line of the calibration board while pinning the bottom right corner of the board down with your hand. The failing sample on the figure shows the calibration board slightly deviated Clockwise (*CW*), the board would need to be rotated Counter-Clockwise (*CCW*)



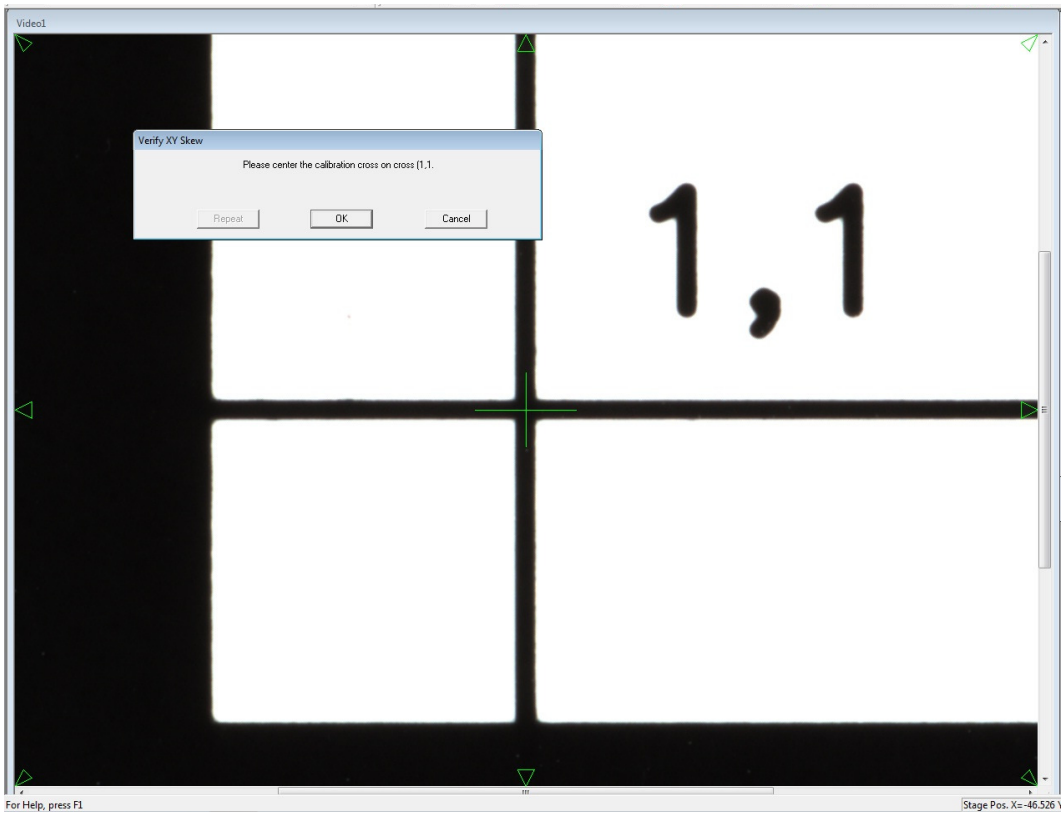


7. Repeat the self test, and re-calibrate if necessary
8. Should the Align Cal Board test result in repeated failure, loosen the six highlighted bolts and pivot the stage in the appropriate direction. This will be a very slight adjustment and should be completed in live mode. The stage will pivot on the pin located in the middle of the right hand side.

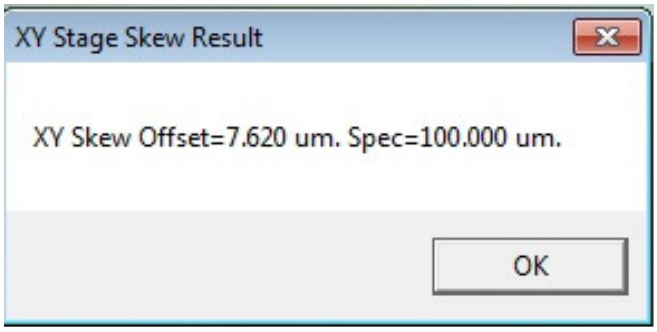


Test 2: XY Skew - this test will verify that the calibration board is perpendicular with the camera stage's X-axis.

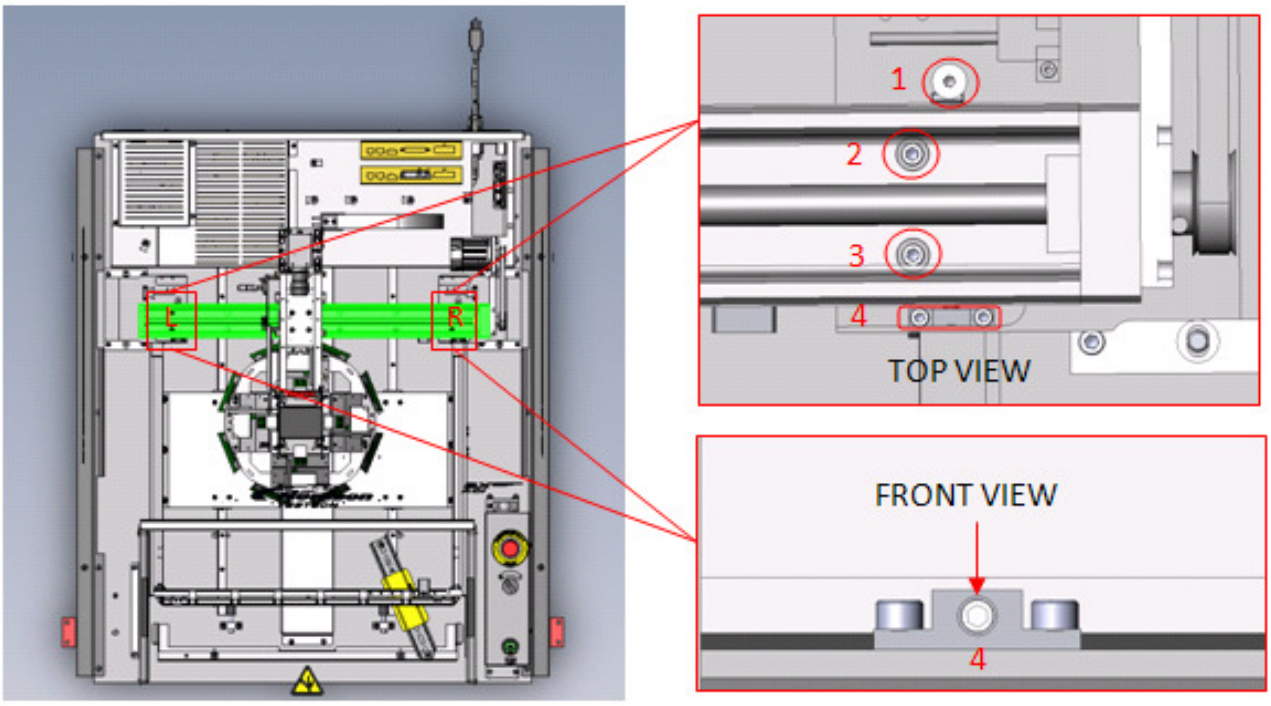
1. Click on **XY Skew** in the **Self Test** window.
2. Software will prompt the user to center the crosshair on (1, 1). Once again, double click on the crosshair on (1, 1) with your mouse and use the arrow keys for precision adjust. Click **OK**.



3. The camera will move on the X-axis, from position (1, 1) to (11, 1), and determine if board is perpendicular with the stage.
4. In the **Self Test** window, the status will show either “FAIL” or “PASS.” The scores will be listed under **Details**.



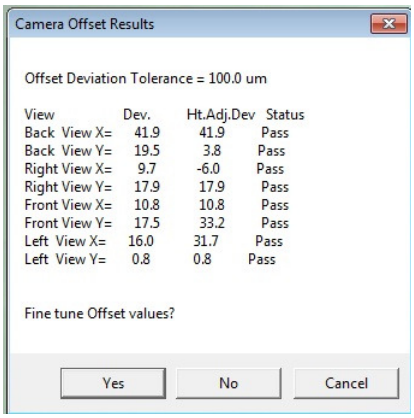
5. If the test fails, loosen screws 1, 2, and 3 on the right (R). Loosen screw 1 and 2 on the left (L). You will only loosen screw 2 on the left (L) just enough so that it becomes your pivot point. side on the X stage block adjusts (Red) and the set screws (Green, opposite to the X stage block adjust) might be needed. Tapping lightly with your hand or a tool on the edge of the X stage, the appropriate adjustments can be made.



6. Again, run this test repeatedly while making adjustments until test passes. If adjustments are made repeat ***Test 1*** and run **Align Cal. Board** again.

Test 3: Camera Offset - Aligns the offset among all cameras to point to the same field of view when switching cameras. This self test performs the searching in a small field of view. If any of the cameras is out of this field of view, the software won't be able to automatically locate it.

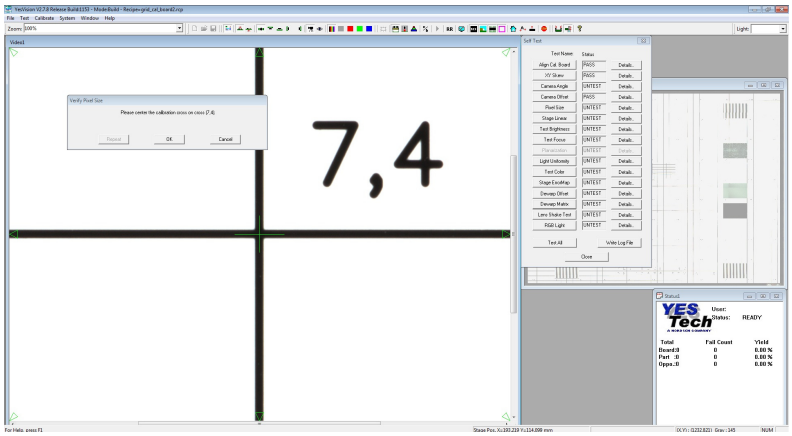
1. Click on ***Camera Offset*** button.
2. Center the crosshair on the **(10, 2)** intersection of the calibration board.
3. Click ***OK***. The system will automatically verify the physical deviation of all the cameras.
4. Click on the ***Details*** button: Despite a *Pass* score having been obtained, repeat the self test until the values are as close to zero as possible. Generally the self test has to be repeated at least three times, in order to have a satisfactory result.
5. If the test fails, click on Details and select Yes to fine tune the Camera Offset values. Re-run the Camera Offset self test.



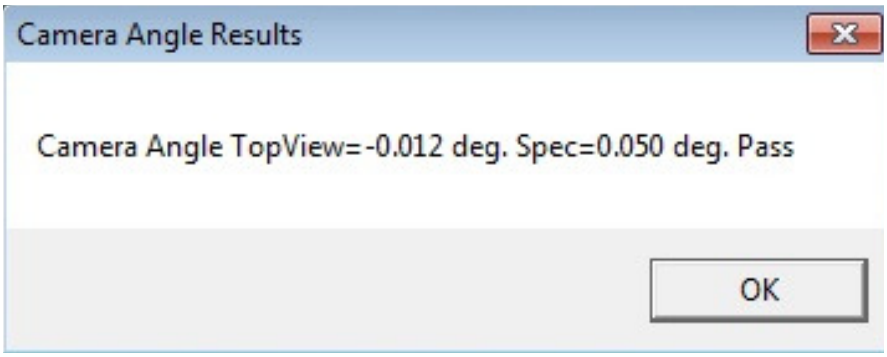
6. If you come across the “Calibration cross cannot be found” error message, it means that the camera’s current offset is higher than the self calibration accepted (out of its field of view) Perform the calibration below. If this happens, go to the pull down menu and choose **Calibrate → Calibrate Camera Offset.**
7. A window will pop up asking to ‘Press YES to zero video offset for all cameras, NO to calibrate offset for each camera individually.’ Press the NO button.
8. The software will then prompt the user to position the crosshair on the edge of the **(10,2)** intersection for each camera. This will allow the camera offsets to be closer to the top down camera.

Test 4: Camera Angle – this test verifies that the camera angle is aligned with the X-Axis.

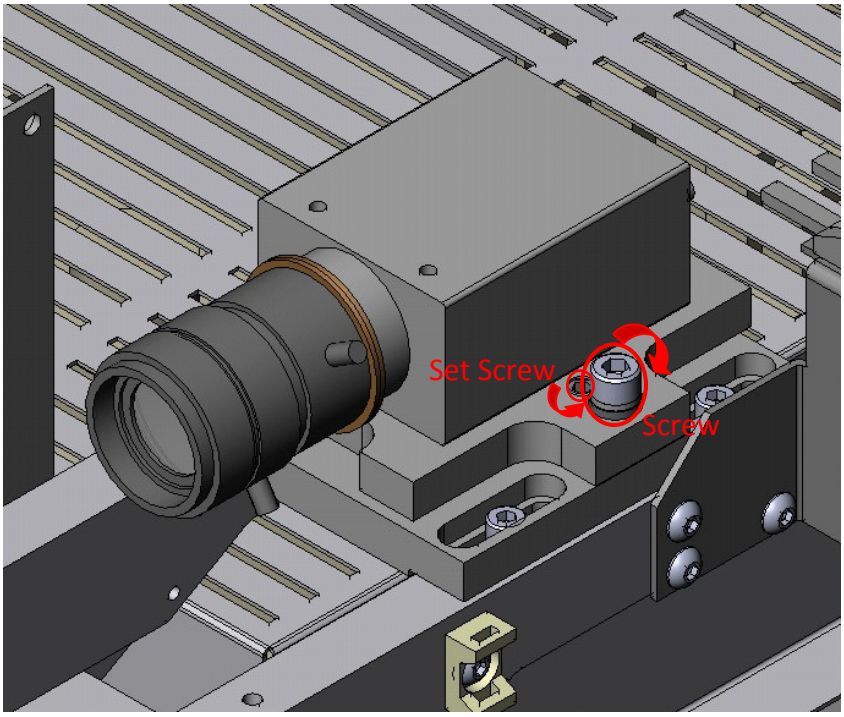
1. Click on **Camera Angle** in the **Self Test** window.
2. The software will prompt the user to place the crosshair on the center of (7, 4).



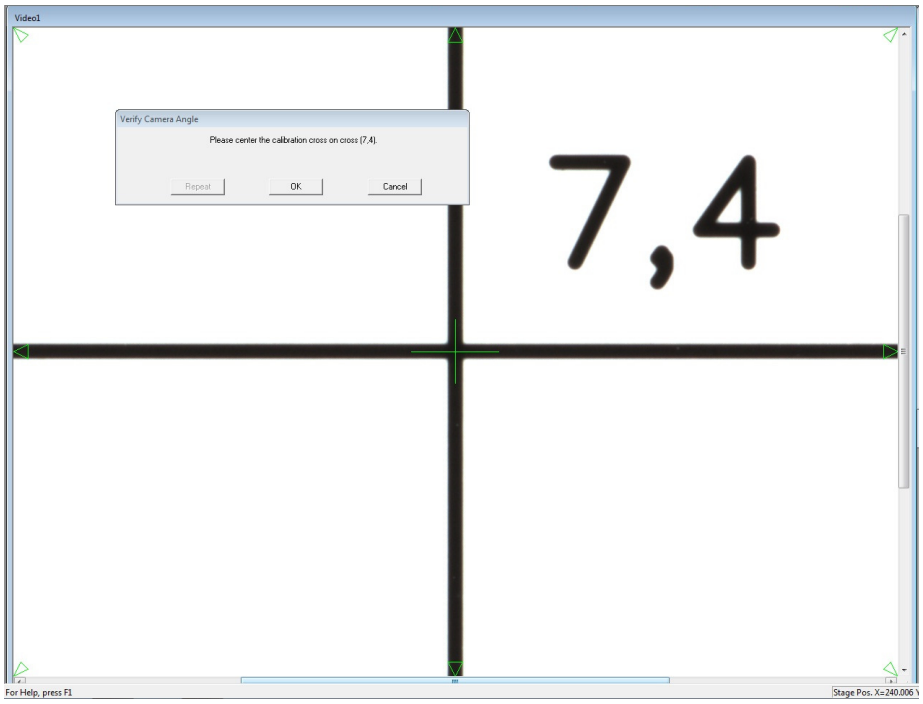
3. The camera will move in the X-axis and the test will either pass or fail. Click on **Details** to see the deviation.



4. If test fails, switch to “live” mode and align the video crosshair with one of the board crosshairs. Use the green arrows to the right and left of video crosshair as a reference and make sure they are in the same position on both sides. In order to do so, you will need to loosen the screw and turn the set screw (clockwise or counterclockwise) adjacent to the screw as indicated in the image below. Note that if the set screw is turned clockwise, the screw is turned counterclockwise and vice versa.

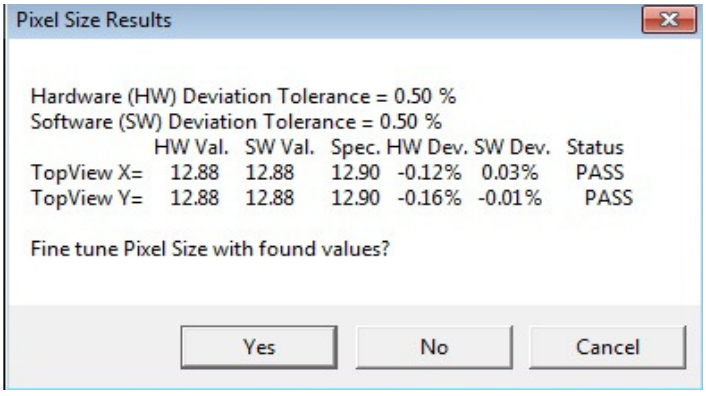


Run the test again and check the **Details**. If the score has gotten worse, turn the set screw the opposite direction. Repeat this procedure until the test passes.

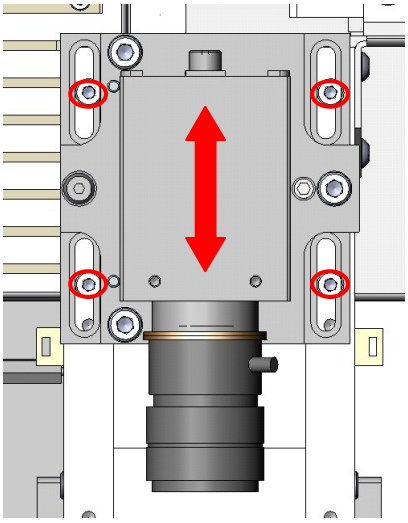


Test 4: Pixel Size – this procedure calibrates the pixel size of the camera. It includes both hardware and software adjustments.

1. Click on **Pixel Size** in the **Self Test** window.
2. The software will prompt the user to center the crosshair on (7, 4). Click **OK**.
3. If the test fails, click on **Details** to see the scores. If the *software* values for pixel size fail, click on **Yes** to Fine tune Pixel Size with found values. This is a software adjustment and you will want to fine tune until software values are within the specifications. Repeat procedure until the test passes.



4. If the test fails on the hardware column, physically adjust the camera distance from the mirror. Loosen the four (4) screws shown in the image below.

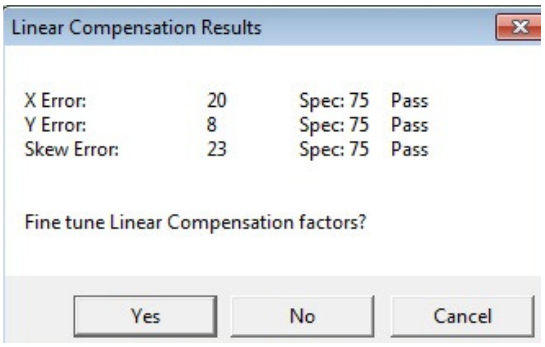


- If the HW Dev. is NEGATIVE:
  Move the camera away from the mirror or in other words, away from the front of the system.
- If the HW Dev. is POSITIVE:
  Move the camera towards the mirror or in other words, towards the front of the system.

5. While the position of the camera is adjusted, observe the angle of the camera on the *Video* window, and keep in mind that since the camera had been physically moved, it will be necessary to re-run the *Camera Offset* and *Camera Angle* self tests
6. Repeat the self test process, and re-calibrate if necessary
7. If self test gives "Cannot locate calibration cross" error, run a manual pixel size adjustment. Choose **Calibrate → Calibrate Camera Pixel Size**. Follow the onscreen prompts to locate calibration cross at the specified coordinates on board. Run self-test again after manual adjustment is complete.

Test 5: Stage Linear – this test will check for any mechanical imperfections of the XY camera transport mechanism. If any imperfections are found, the software will compensate and adjust accordingly.

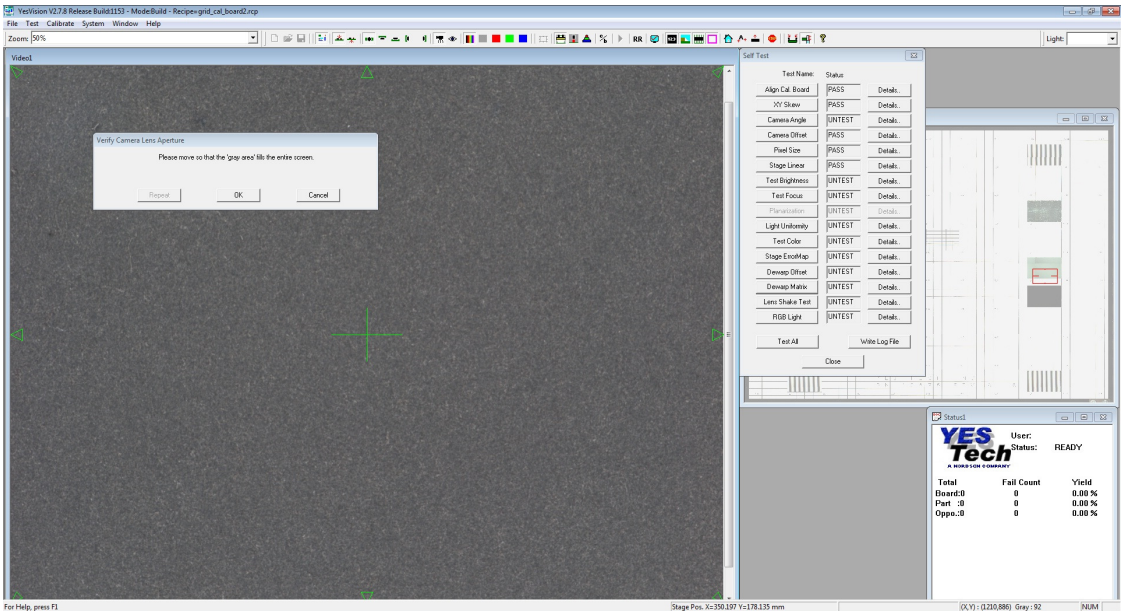
1. Click on **Stage Linear** in the **Self Test** window.
2. The software will prompt the user to center the crosshair on (3, 1). Click **OK**.
3. If test fails, click on **Details**, and when it asks to **Fine Tune Compensation Factors** click **Yes**.



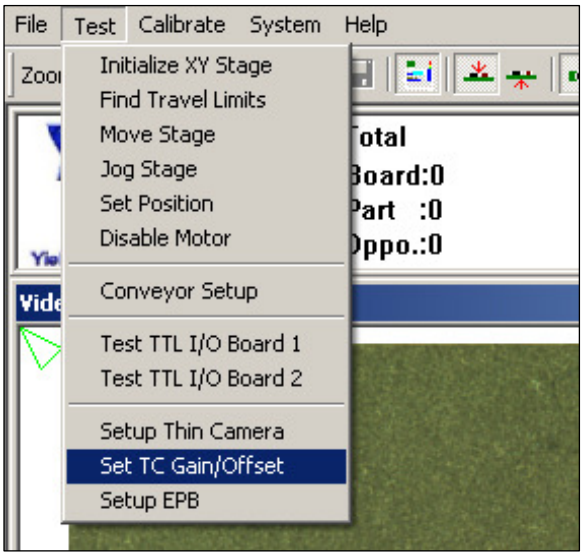
4. Repeat steps 1 – 3 several times until it passes.

Test 6: Test Brightness – this test (along with the ***Test Color*** test) verifies that the camera produces an image of consistent brightness and color.

1. Click on **Test Brightness** in the **Self Test** window.
2. The software will prompt the user to place the crosshair on the center of a uniform gray area. It is recommended to put the camera to 50% view to verify that the camera only captures the gray image in its field of view. If it does not, move camera accordingly. Click **OK**.



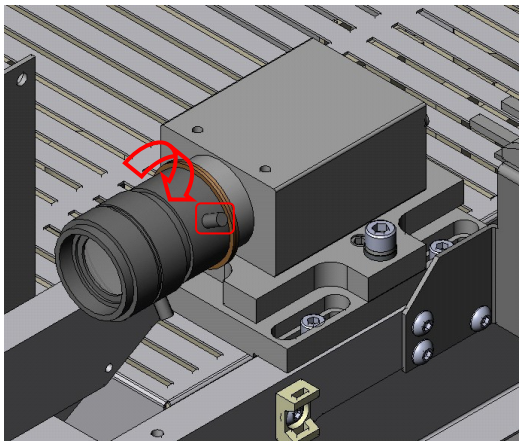
8. If the test fails for the top camera, select the top camera from the icon toolbar and then go to the pull down menu and select **Test → Set Gain/Offset.**



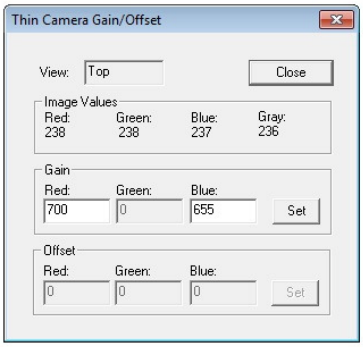
4. In the section labeled *Image Values,* our desired values are:

100 (Red), 100 (Green), 100 (Blue), and 100 (Gray)

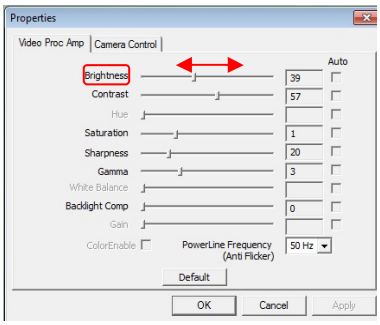
Change the numbers under *Gain* for Red, Green, and Blue in order to achieve our desired *Image Values*. The **Set** button will refresh the image values. Note: Changing the Red Gain value will affect the Red Image Value and changing the Blue Gain value will affect the Blue Image Value. Note that the Green Gain value is grayed out and it is for that reason that it is adjusted through the aperture of the camera lens. Please note that to unlock the aperture from its current position you will need to loosen the set screw as indicated in the image below.



Sometimes, it can be difficult to reach the desired values exactly. Try to be as close as possible, but keep in mind that the specification is +/-10 for each color.

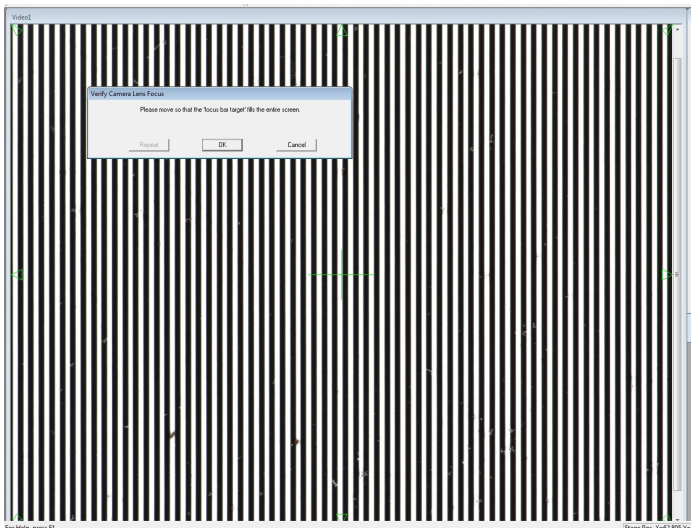


If you are getting a FAIL on one of the side angle views, you will first need to select the camera that is giving you a FAIL from the icon toolbar and then proceed to Test → Set Gain/Offset. This will open the properties for the selected side camera. In order to modify the brightness of the camera you will need to adjust the brightness slide bar as indicated in the image below. Slide the brightness to the right if the camera brightness is too low and slide it to the left if the camera brightness is too high.

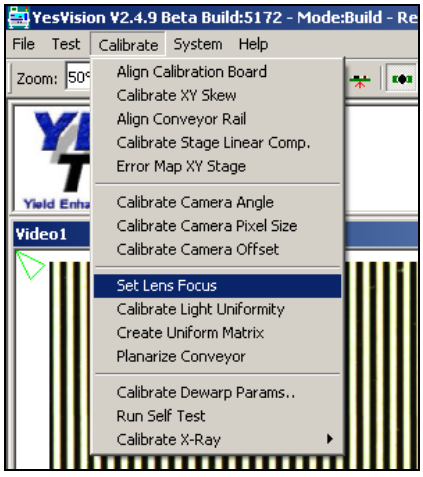


Test 7: Test Focus – this test checks to see if the camera is in focus based on image contrast.

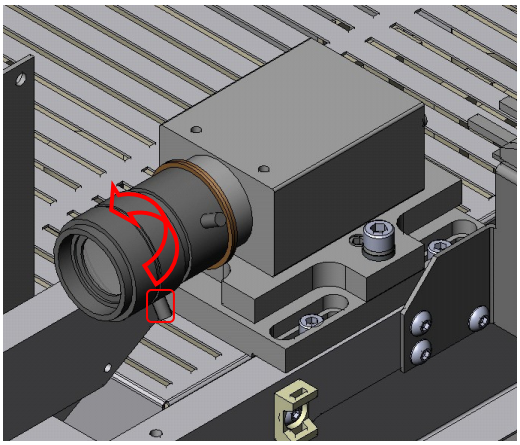
1. Click on **Test Focus** in the **Self Test** window.
2. The software will prompt the user to place the crosshair on the center of the focus bar (vertical lines). Click **OK**.



9. If this test fails for the top camera, go to the pull down menu and click on **Calibrate → Set Lens Focus**.



10. Verify that the camera is in “live” mode . Remove the cover, loosen the locking screw on the camera lens and adjust the focus ring as indicated in the image below.

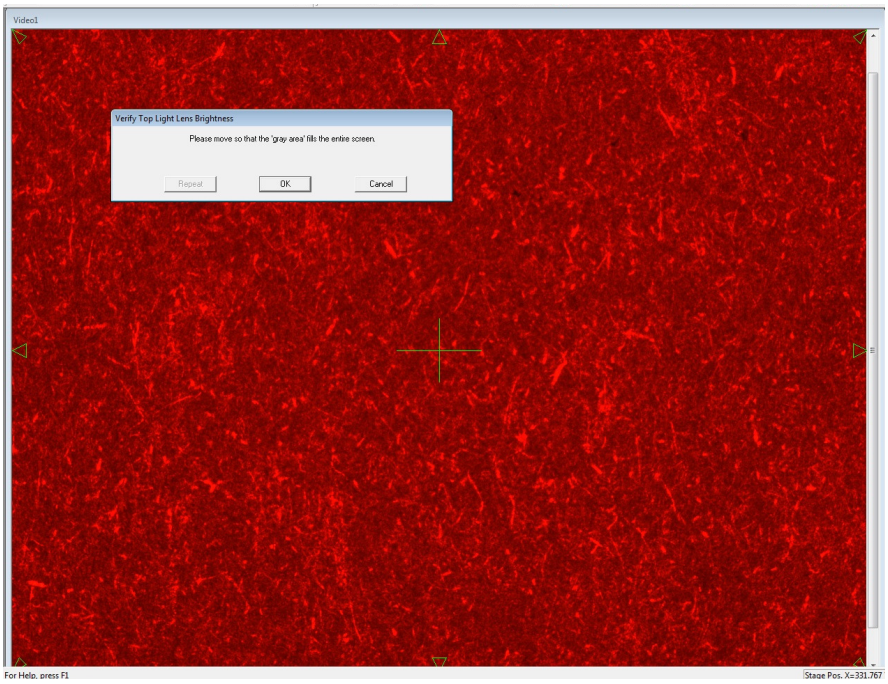


The software produces a “focus quality number,” where the larger the number means the better the focus. Tighten the set screw once a maximum reading is achieved.

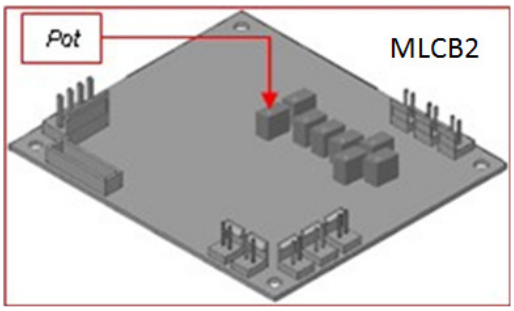
Test 8: Light Uniformity – this test verifies that the top red LED lights have light uniformity.

1. Click on **Light Uniformity** in the **Self Test** window.

2. The top light (red LED's) will turn on and the software will prompt you to place the crosshair on the center of a uniform gray area. Be sure the camera only covers that gray area and not the white board. Click **OK**.



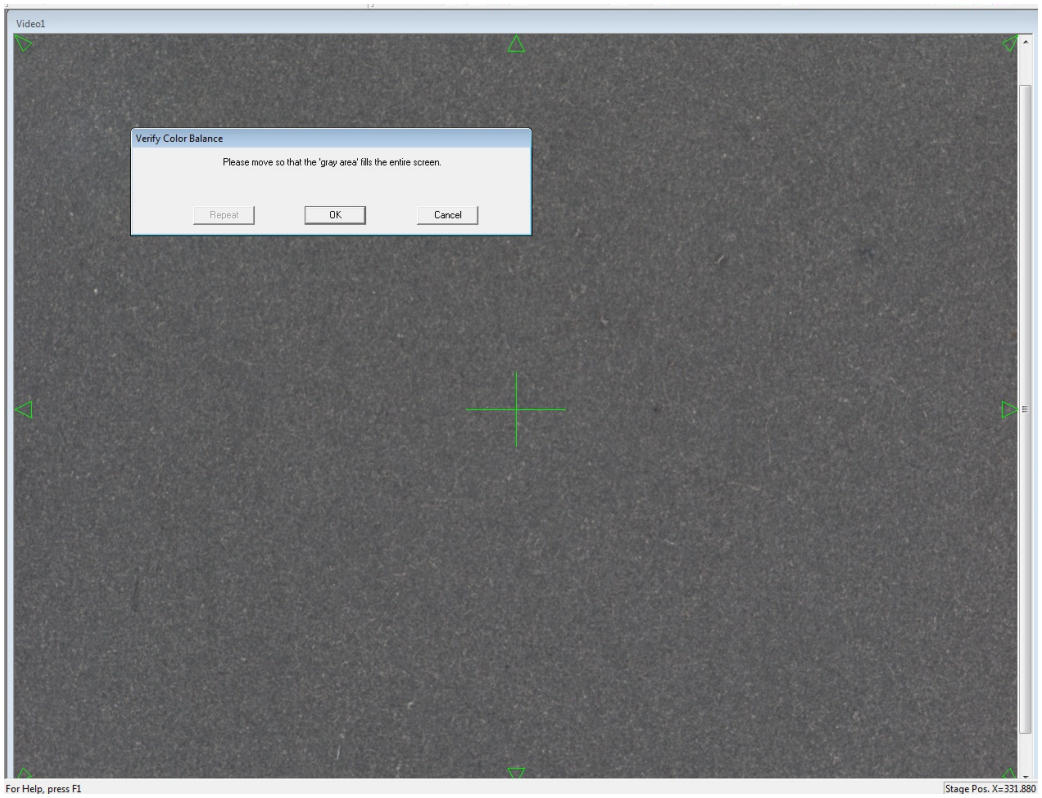
3. If the test fails, go to the pull down menu and choose Calibrate → Calibrate Light Uniformity and adjust the corresponding trim potentiometer as indicated in the image below. If the light uniformity value falls below the spec, adjust the potentiometer clockwise. If the light uniformity value falls above spec, adjust the trim potentiometer (as indicated in the image below) counter-clockwise.



4. Repeat steps 1 - 3 until the test passes.

Test 9: Test Color - this test (along with the ***Test Brightness*** test) verifies that the camera produces an image of consistent brightness and color.

1. Click on **Test Color** in the **Self Test** window.
2. The software will prompt the user to place the crosshair on the center of a uniform gray area similar to ***Test 7***. Click **OK**.

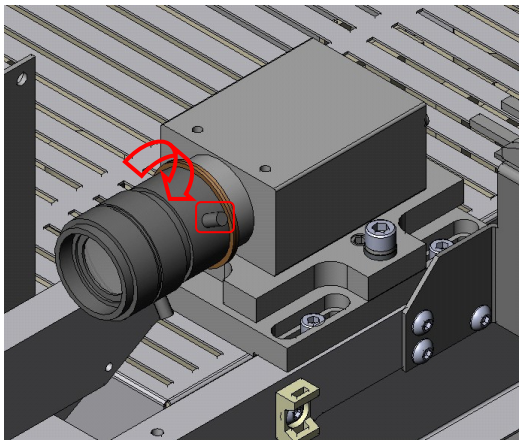


3. If the test fails for the top camera, select the top camera from the icon toolbar and then go to the pull down menu and select on **Test → Set Gain/Offset.**

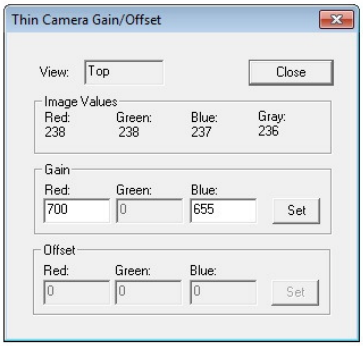
4. In the section labeled *Image Values,* our desired values are:

   100 (Red), 100 (Green), 100 (Blue), and 100 (Gray)

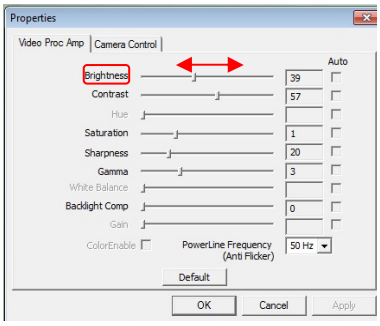
   Change the numbers under *Gain* for Red, Green, and Blue in order to achieve our desired *Image Values*. The **Set** button will refresh the image values. Note: Changing the Red Gain value will affect the Red Image Value and changing the Blue Gain value will affect the Blue Image Value. Note that the Green Gain value is grayed out and it is for that reason that it is adjusted through the aperture of the camera lens. Please note that to unlock the aperture from its current position you will need to loosen the set screw as indicated in the image below.



Sometimes, it can be difficult to reach the desired values exactly. Try to be as close as possible, but keep in mind that the specification is +/-10 for each color.



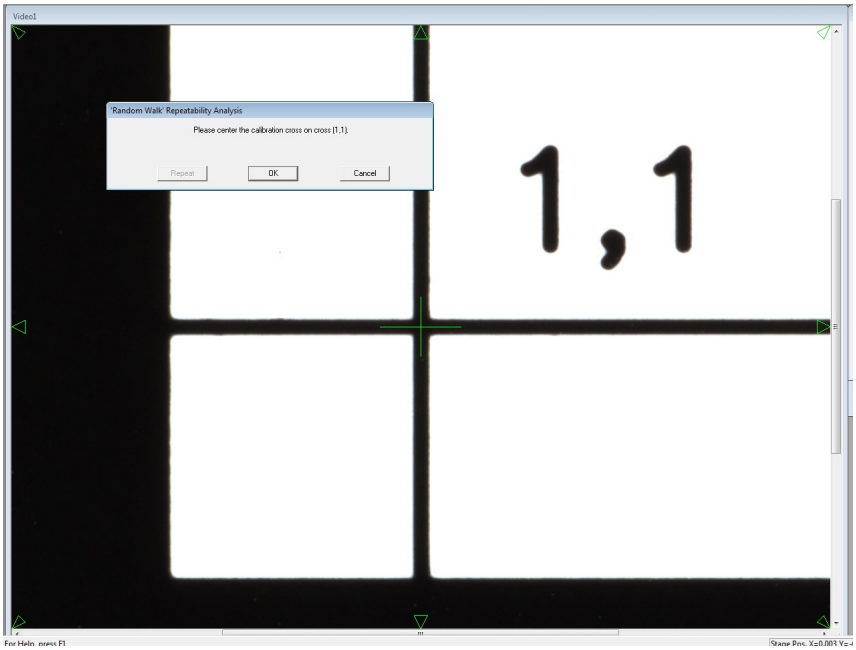
If you are getting a FAIL on one of the side angle views, you will first need to select the camera that is giving you a FAIL from the icon toolbar and then proceed to Test → Set Gain/Offset. This will open the properties for the selected side camera. In order to modify the brightness of the camera you will need to adjust the brightness slide bar as indicated in the image below. Slide the brightness to the right if the camera color balance is too low and slide it to the left if the camera color balance is too high.



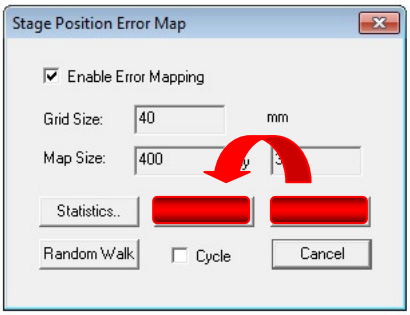
5. Repeat steps 1 – 4 until the test passes.

Test 10: Stage ErrorMap – This test extends the error compensation feature by compensating for non-linear distortion of the XY stage

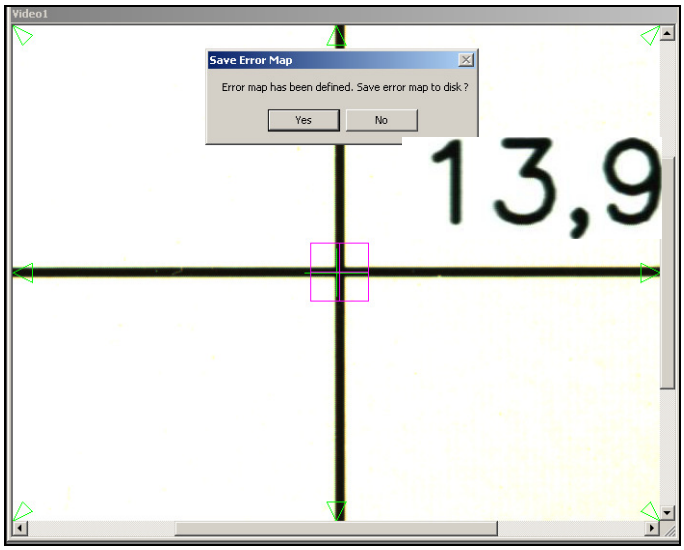
1. Click on **ErrorMap** in the **Self Test** window.
2. The software will prompt the user to place the crosshair on the center (1, 1). Click **OK.**



3. If test fails, click on **Calibrate → ErrorMap XY Stage.** Click on **Clear Map** followed by **Calibrate.** This will create a new Error Map.



4. The software will prompt you to place the crosshair on the center (1, 1). Click **OK.**
5. The stage will proceed to move incrementally across the board. Once complete, click **Yes** to save define ErrorMap.



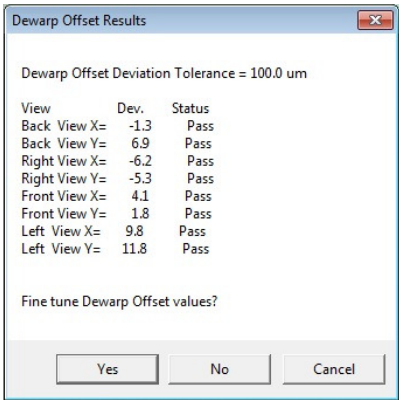
5. Repeat steps 1 - 2 and verify that the test passes.

Test 11: Dewarp Offset - Auto calibration compensates for the distortion by warping the images captured by the side angle cameras only, and aligns the offsets among them to maintain the same field of view when switching to side views.

1. Click on the **Dewarp Offset** Button
2. Center the crosshair on the **(10,2)** intersection of the calibration board

Image

3. Click ***OK***. The system will automatically compensate any distortion of the side angle cameras
4. Click on ***Details*** button: Despite a *Pass* score has been obtained, repeat the self test until the values are as close to zero as possible. Typically, the self test has to be repeated at least three times, in order to have a satisfactory result
5. If the test fails, click on Details and select Yes to fine tune Dewarp Offset values.

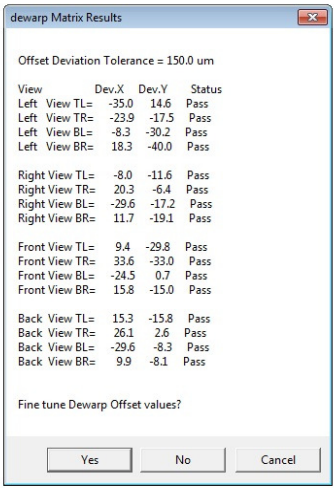


6. If *"Cannot locate calibration cross"* error comes up, run a manual Dewarp Offset adjustment. Under *Calibrate* Menu click on *Calibrate Dewarp Offset*. Follow the onscreen prompts to locate

the calibration cross at (10, 2) for all cameras. After manual calibration is done, run self test again

Test 11: Dewarp Matrix - Calibration compensates for the distortion by warping the images captured by the side angle cameras only

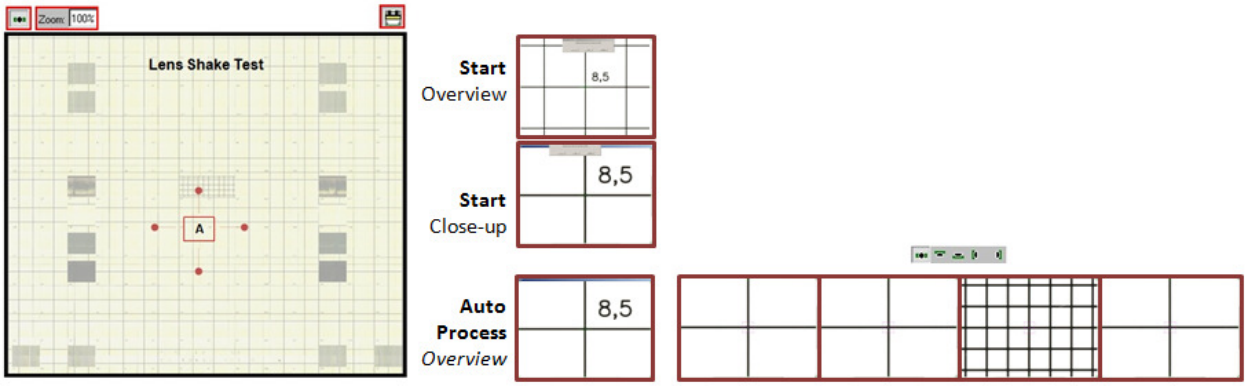
1. Click on ***Dewarp Matrix*** button.
2. Center the crosshair on the **(10,2)** intersection of the calibration board
3. Click ***OK***. The system will automatically compensate any distortion of the side angle cameras by creating a matrix.
4. Click on ***Details*** button: Despite a *Pass* score has been obtained, repeat the self test until the values are as close to zero as possible. Typically, the self test has to be repeated at least three times, in order to have a satisfactory result.
5. If the test fails, click on ***Details*** and select Yes to fine tune Dewarp Offset Values. Re-run the Dewarp Matrix test found in the self test window.



6. If self test still doesn't pass, manually calibrate the Dewarp Matrix
    a. Move the camera stage so that the top down camera is looking at the grid array in the center of the calibration board
    b. Select a side angle camera to start with
    c. Click on Calibrate from the pull down menu, and select *Calibrate Dewarp Params*
    d. Double click on an intersection in order to move the align the two grids on one another
    e. In the new window that appears, manipulate the X and Y axes in corners of the grid in order to line up the intersecting lines with the green grid
    f. Select the next side angle camera and follow step *d*
7. Repeat the self test process and calibrate again if necessary

Test 12: Lens Shake Test – Calibration is performed to check if alignment errors are caused by loose lens issues

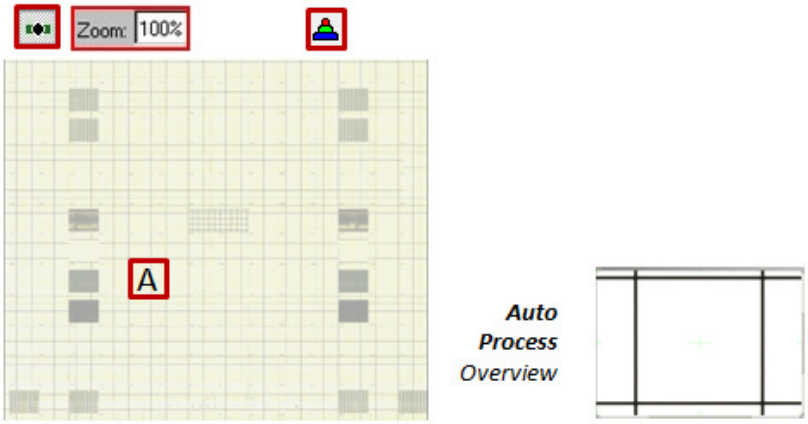
1. Click on **Lens Shake Test** button
2. Align the crosshairs with the intersection at (8,5)
3. Click **OK** to have the system test if the lens is loose



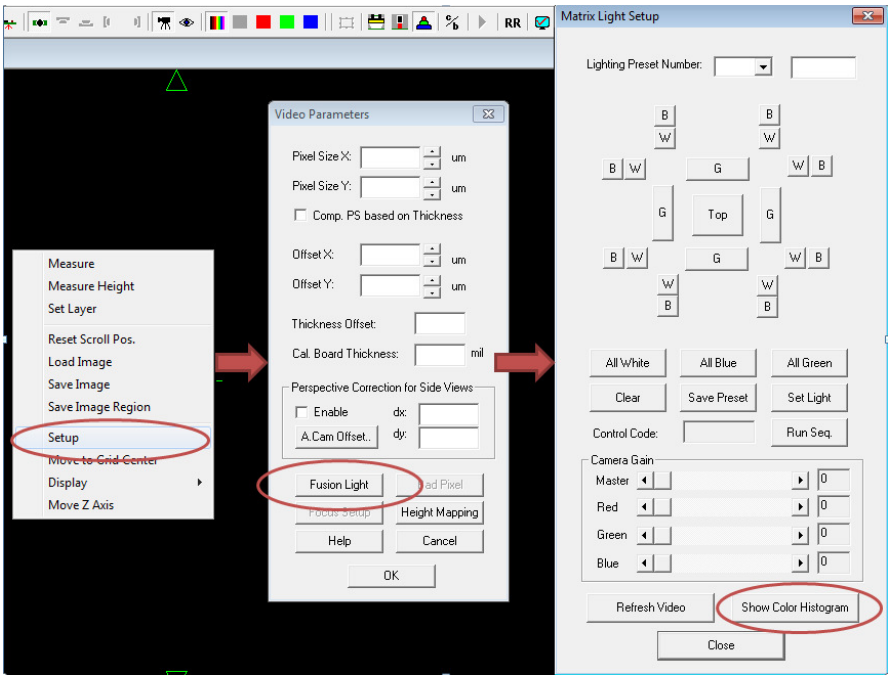
4. Having the top camera selected, center the crosshair on the border of any intersection of the center area of the calibration board
5. Click three times on the left arrow, placed on the *Video* window. The stage will move on X-Axis only
6. Then, click three times on the right arrow. Verify that the crosshair is placed on the previous intersection's border afterward
7. If lens if found to be loose, remove it from the body assembly of the camera (top or side) and apply a small amount of Locktite 242 to the threads connecting the camera lens to the body
8. Before tightening lens, check to see if lens is found to have free-moving components inside, replace lens
9. Tighten the lens back in
10. Repeat the self test process, and attempt another solution if necessary

Test 13: RGB Light Calibration – this test verifies that the color LED's are calibrated correctly.

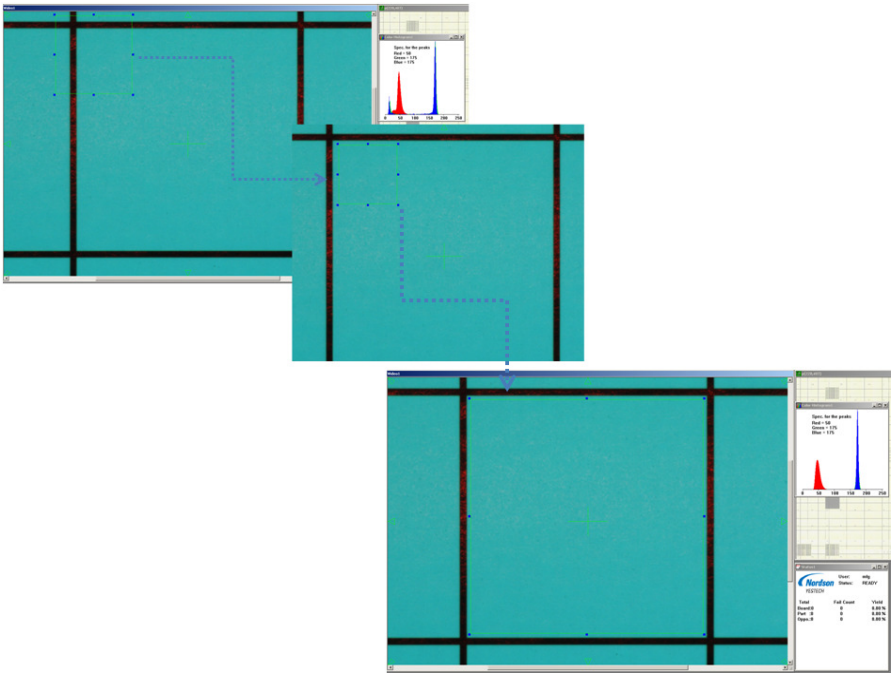
1. Click on **RGB Light** button
2. Align the crosshairs in the center of a white are of the calibration board
    a. If the white box is damaged, or has some discoloration/marks on it, move the camera to the center of another white box
3. Click **OK** to have the system perform the RGB Light Test



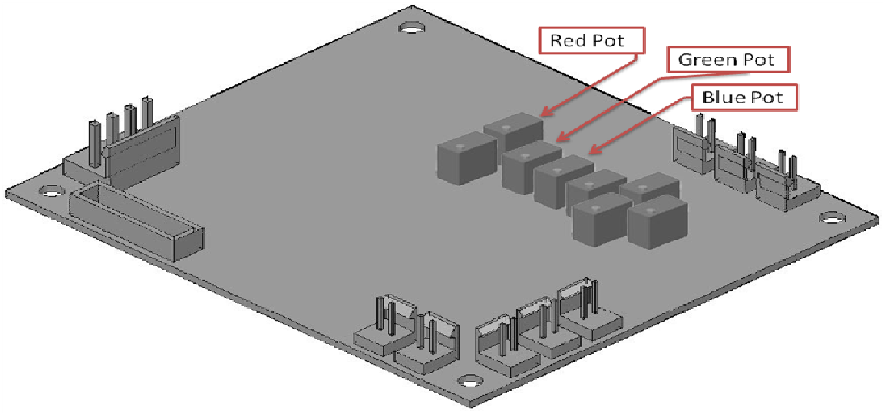
4. If calibration fails, set machine to live mode and place the crosshairs over the center of the white box
5. Right click on the Video1 screen and select **SETUP**
6. In the Video Parameters window, select the **Fusion Light** button
7. In the Matrix Light Setup window, select the **Show Color Histogram** button



8. Close out of the Matrix Light Setup and Video Parameters windows
9. Move the green box and expand it so that it is enclosed by one of the white squares, without going over the black lines



10. Adjust the Red, Green, and Blue potentiometers on the light control board so that they register values of approximately 54, 177, and 171 respectively



11. Repeat the self test process and calibrate again if necessary
12. Upon successful completion of the calibration, exit the *YesVision* software in order to save the changes.