

This workflow will show you how set up the Breuckmann Tripod and SmartScan HE for calibration prior to beginning your scanning project. *Hint: You can click on any image to see a larger version.*

TRIPOD LEGS SETUP

Start with the tripod in the closed position (all three legs together) and check that the legs are the same length, adjusting them if necessary.

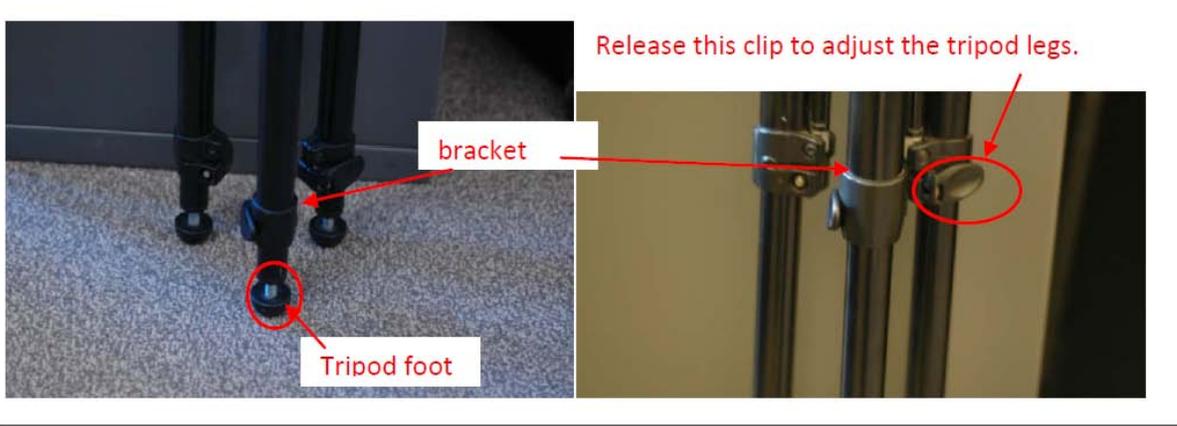


Fig. 1: The brackets at the bottom and center of the tripod legs should be at the same level when the legs are closed, and all the feet should touch the floor at the same time.

Open the tripod legs by loosening the wingnut on the central pole of the tripod and sliding the legs outward. Create a wide triangular base with the tripod legs and tighten the wingnut.

PLACE TRIPOD NEXT TO TABLE

Place the tripod so that two adjacent legs are flush and parallel with the edge of the table or desk on which you have placed (or will place) the calibration chart.



Fig.2: Tripod feet are level and flush with the base of the desk



Fig.3: The lowest bubble level

If you are uncertain about which leg to adjust first, imagine drawing a line down the middle of each leg of the tripod extending through the bubble level. The line that passes closest to the center of the bubble is the leg you should adjust first. In this illustration where A, B and C mark the positions of the legs you should begin by adjusting leg C. To make the bubble move toward the center, level circle, leg C should be lengthened.

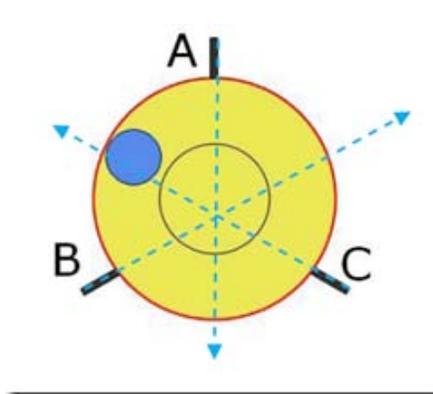


Fig.4: To move the bubble toward you parallel to any leg of the tripod, lengthen that leg. To move the bubble away from you, shorten that leg.

Continue adjusting the length of the legs following this logic until the tripod base is level.

ADJUST TRIPOD HEIGHT

5. Set the height of the tripod head so that it is roughly level with the center of the calibration chart by flipping out and then turning the handle, as shown below.



Fig.5: The central pole height is adjusted by turning this handle.

LEVELING TRIPOD

6. Next, you want to adjust the tripod so that the second lowest level bubble is also within its level circle. This step is a little fiddly. The second level bubble essentially accounts for any deviations from level between the central pole, the bracket which attaches it to the tripod legs, and the tripod head. The goal is for the central pole to be just that – centered in the middle of the tripod base. Begin by checking that the tripod head is seated flat on the central pole. Loosen the two wingnuts that lock the position of the central pole. Shift the position of the central pole until the level bubble is within the circle and tighten the wingnuts. Be sure to check that this bubble is still indicating the tripod head is level after you attach the scanner to the tripod!

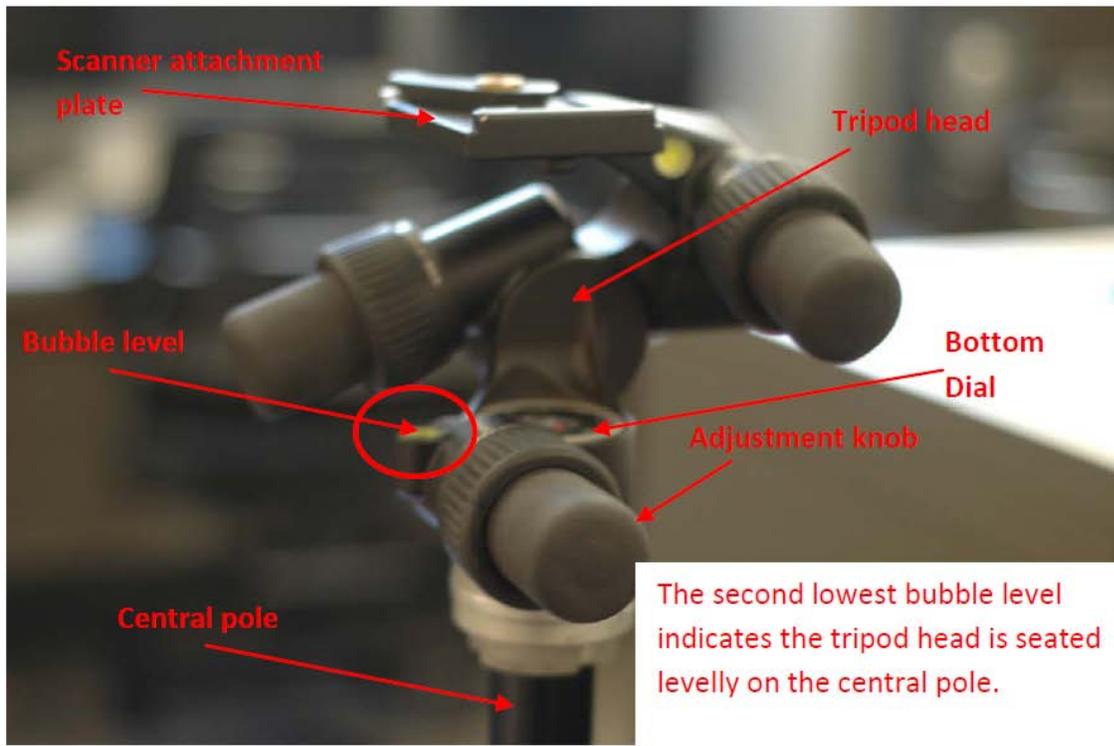


Fig.6: The tripod head.

LEVEL TRIPOD 2- LOWEST ADJUSTMENT KNOB

7. Use the lowest adjustment knob to align the front edge of the scanner attachment plate parallel to the edge of the desk or table. On the CAST tripod, this should be approximately at the 30° mark on the bottom dial.
8. Finally, adjust the tripod head so that the top bubble is centered in the inner circle of the bubble level. The highest adjustment knob moves the scanner attachment plate along its long axis, the second highest adjustment knob moves the scanner attachment plate along its short axis.

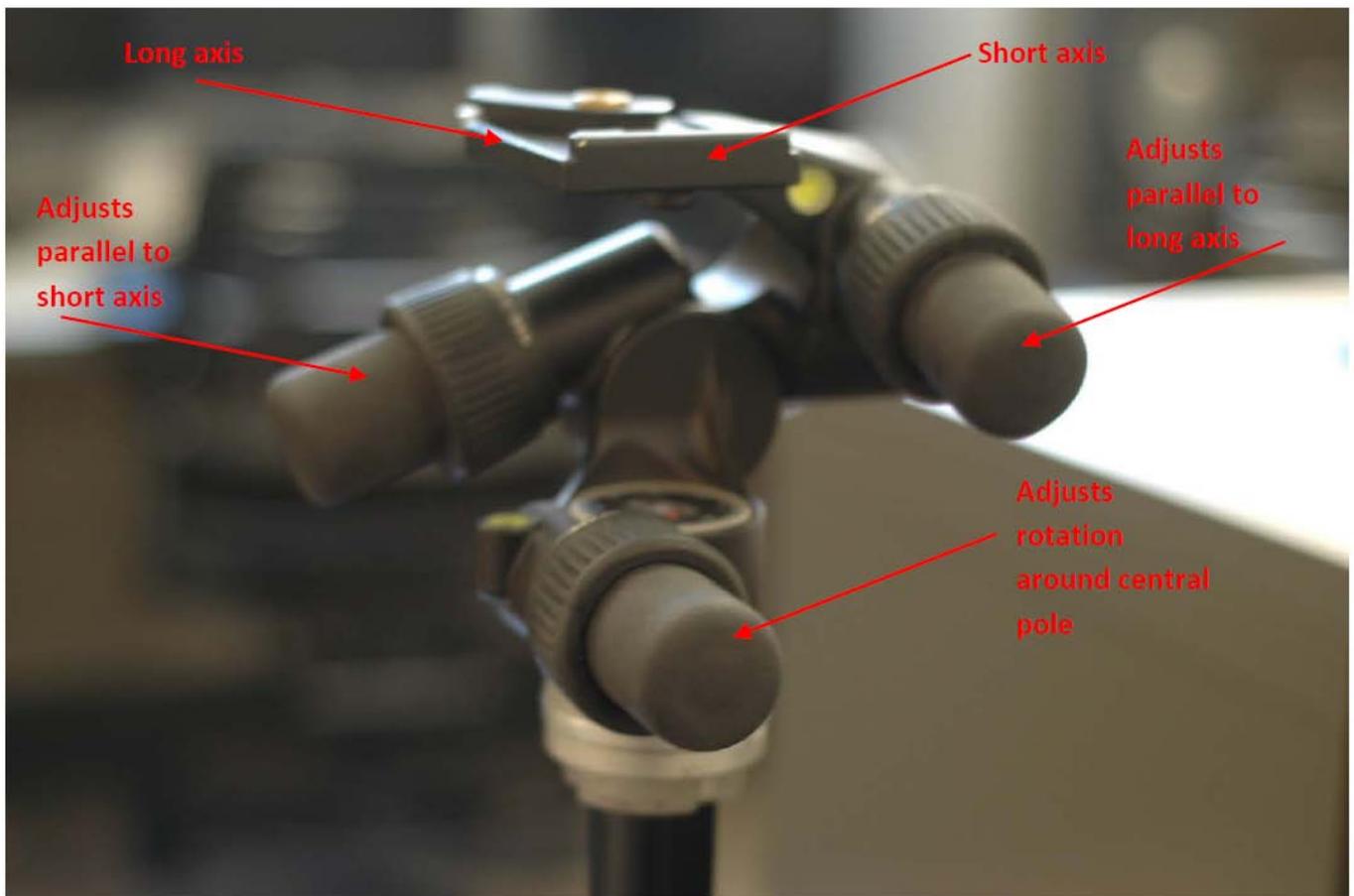


Fig. 7: Tripod head adjustment guide.

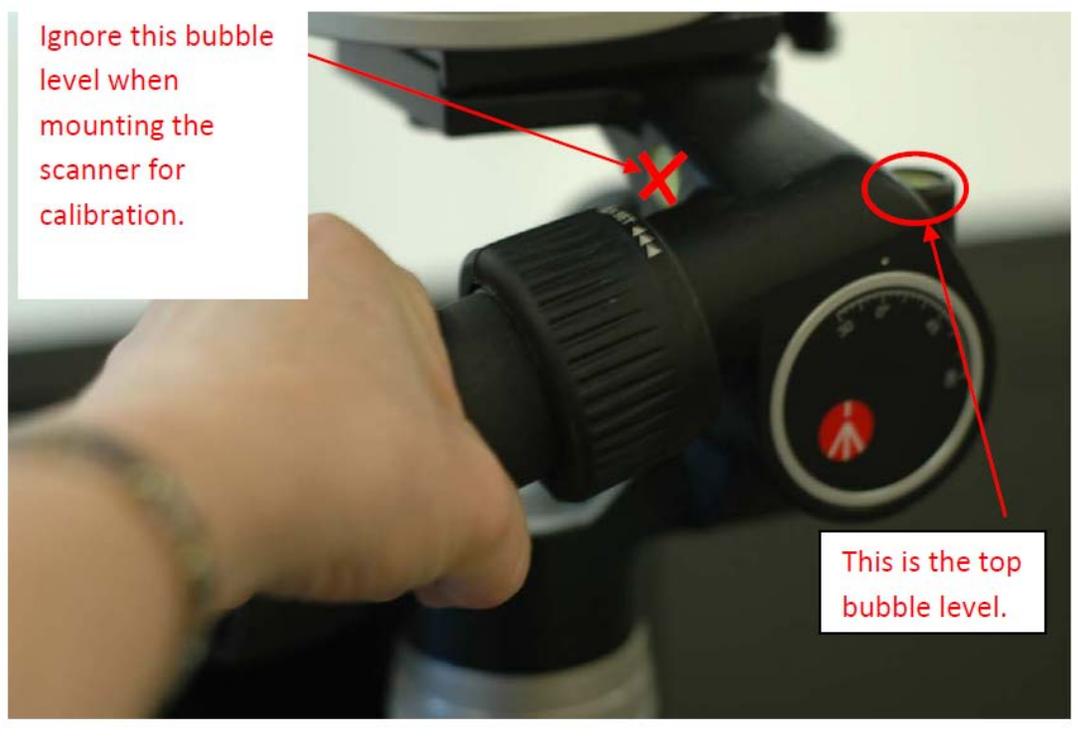


Fig. 8: The top bubble level.

LEVEL TRIPOD 3- SIDE DIALS

In addition to the top level bubble, you can use the two side dials as guides for setting the level of the tripod head. On flat ground both these dials should read approximately 0°. There is a small silver dot above each dial marking the 0° position.

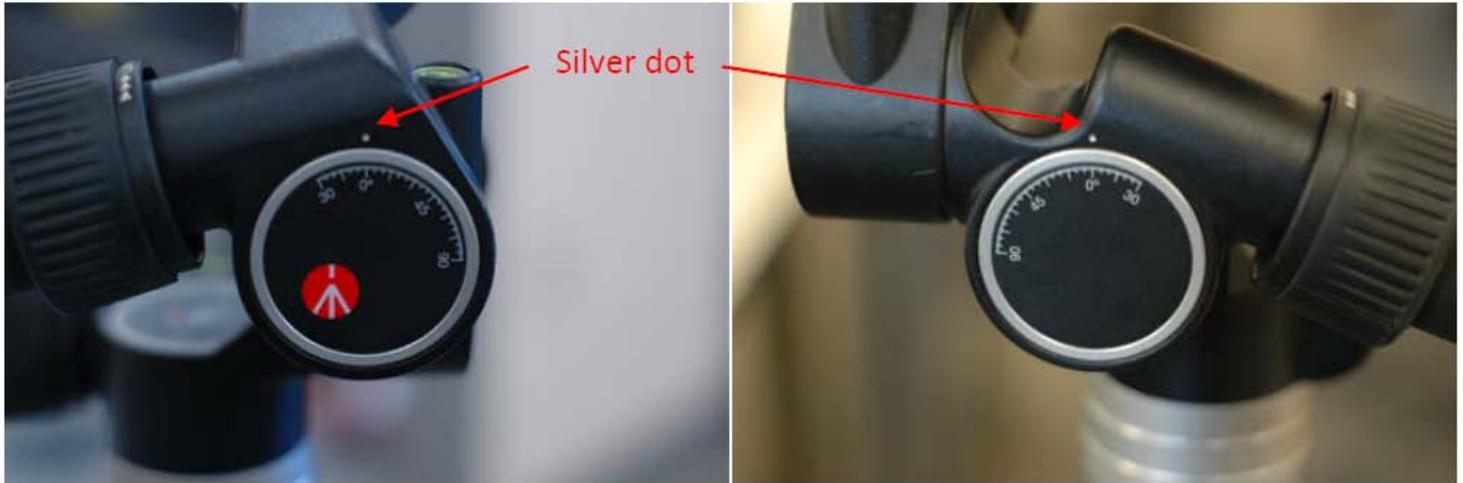


Fig.9: Side dials on the tripod head.

COARSE ADJUSTMENTS

(left) Quick, coarse adjustments are made by twisting the 'quick grip' and then pivoting the tripod head. Be careful using the 'quick grip' if the scanner is already mounted on the tripod head, as the uneven weight of the scanner can cause it to pivot faster than you might expect. (right) Fine adjustments are made by twisting the knob below the 'quick grip'.



Fig.10: Quick grip and fine adjustment positions on the adjustment handles of the tripod head.

FINAL CHECK

9. After you have leveled the tripod, attach the scanner and check and adjust the level if needed. At this point you should only need to make fine adjustments.



Fig. 11: The scanner mounted on the level tripod.

SCANNER SHEET IN SCANNER CASE

10. Once the scanner is positioned, put the chart placement guide on the table. Position the guide so its short edge is parallel to the edge of the table, and the side reading "SENSOR" is pointed toward the scanner. Check the datasheet for the correct distance between the scanner and the center of the chart placement guide (approximately one meter). The datasheet and chart placement guide are stored in the lid of the scanner's case.

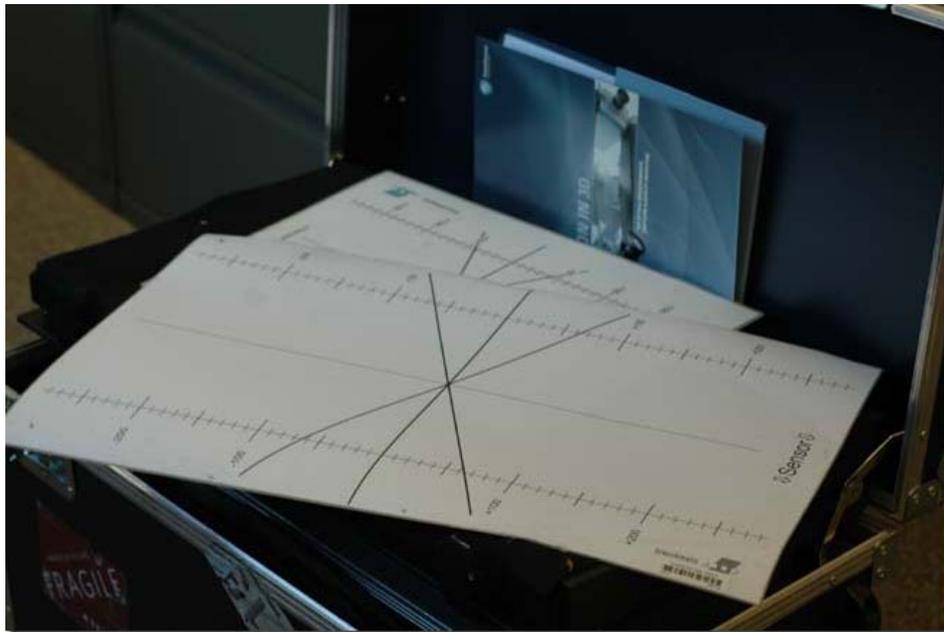
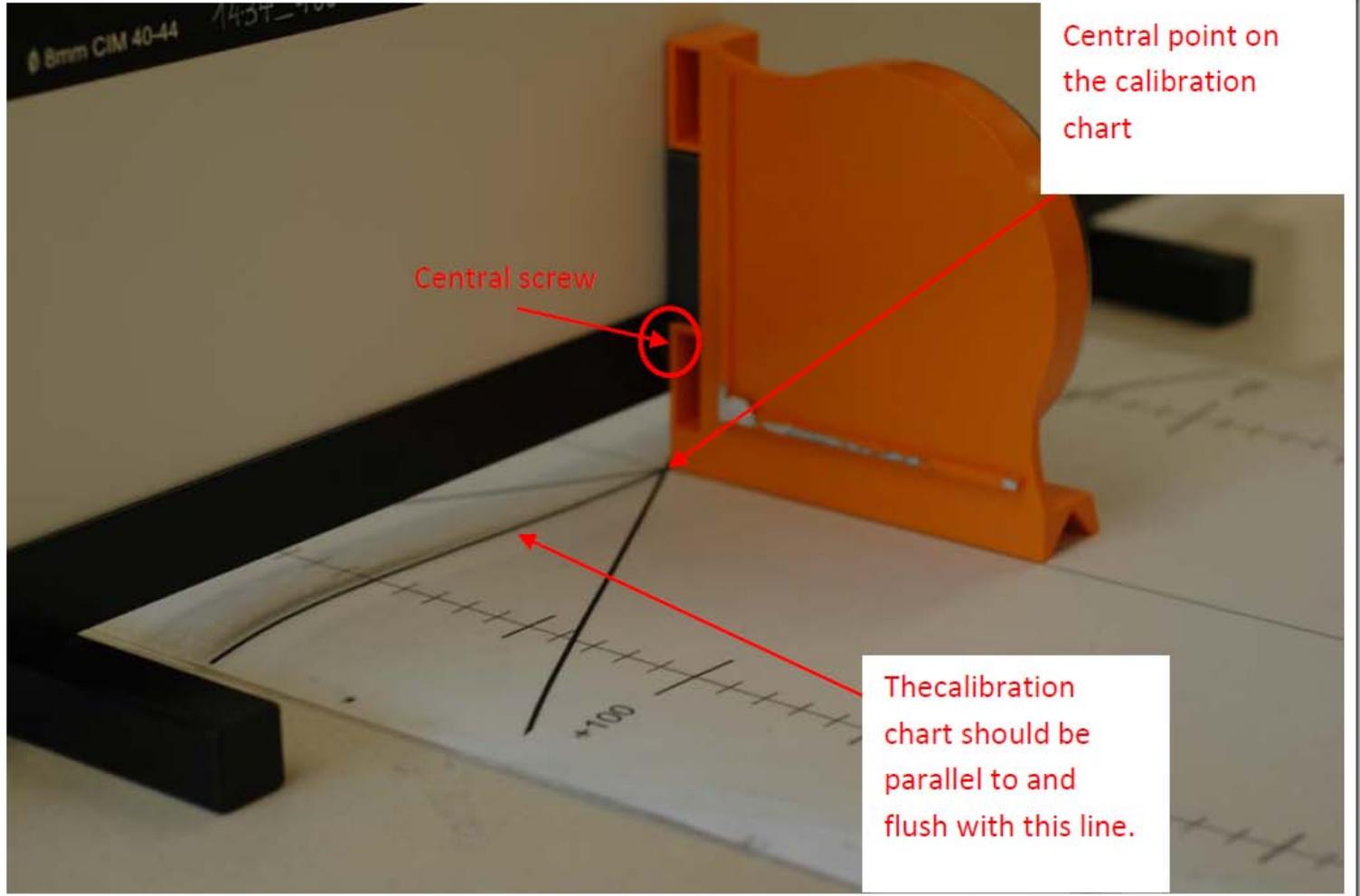


Fig.12: The datasheet and chart placement guide in the scanner case.

CHART PLACEMENT

11. Place the Chart over the placement guide and center it. There is a screw in the center of the chart's frame. This screw should be directly over the center line of the chart. You will probably want to use a straight edge to ensure the calibration chart is parallel and flush with the center line on the placement guide.



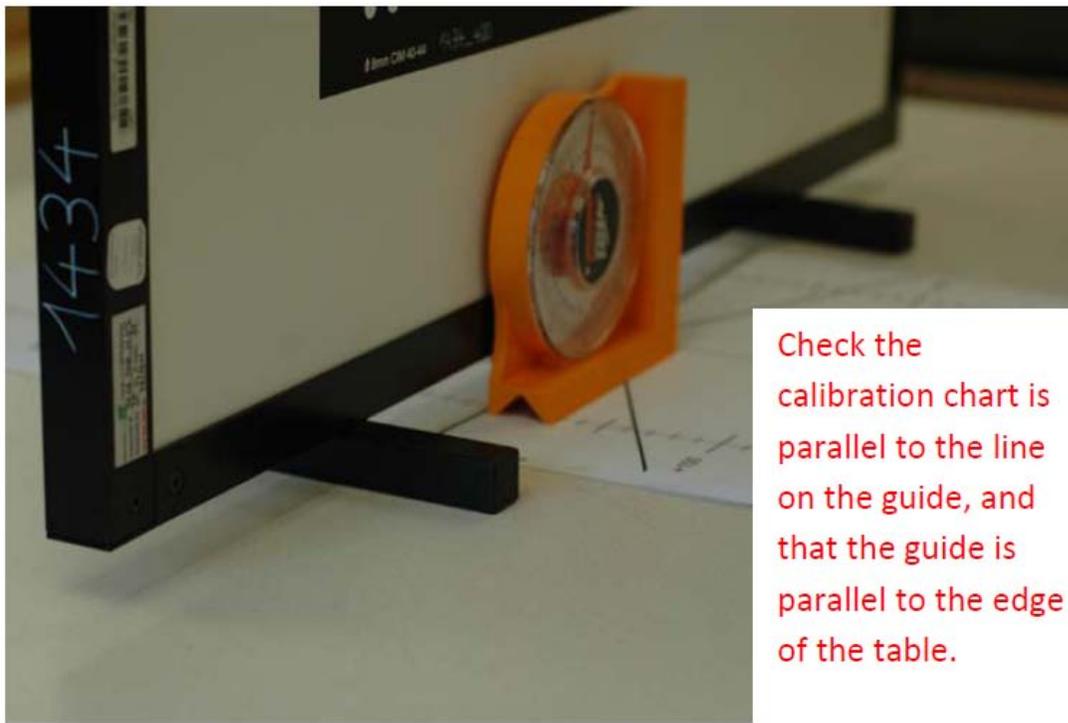


Fig. 13: Aligning the calibration chart to the chart placement guide.

When everything is aligned, tape the chart placement guide to the table so it won't move as you shift the calibration chart.

12. Alignment and leveling is complete!

13. You may now proceed with the calibration. (You may make some further fine adjustments to the height of the scanner and position of the chart once you have activated the lasers and live screen in the calibration.)

CONTINUE TO...

Continue to Section XXXXXX

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This workflow will show you how set up the Breuckmann SmartScan HE prior to beginning your scanning project.
Hint: You can click on any image to see a larger version.

FOV

The SmartSCAN HE is a dual camera white light scanner that uses fringe projection to measure precise 3D coordinates. The unit owned by CAST is a 5 MP(megapixel) system that captures color and includes three lenses or fields of view (FOV): 125mm, 475mm, and 825mm. The field of view measure is the length along the diagonal of the scan-able area (shown in Figure 1 below).

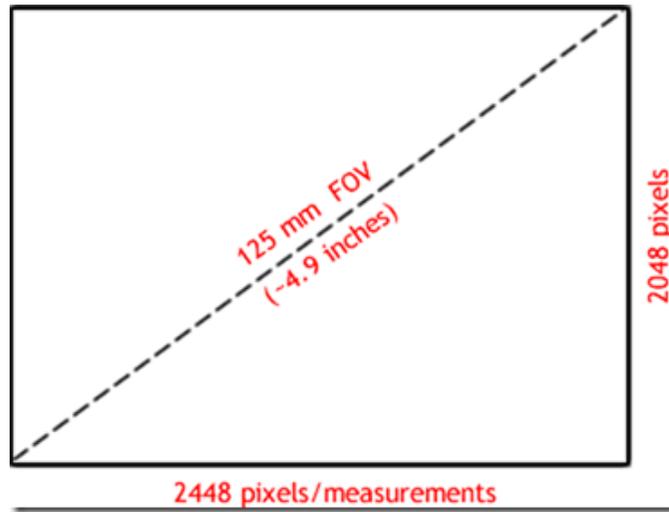


Figure 1: Approximate scan area using 125mm FOV with Breuckmann scanner

A good way to remember the different lens sizes is:

- 125mm: baseball/softball size scan area
- 475mm: basketball size
- 825mm: two basketballs or yogaball size

SIZE OF ARRAY

The size of the array – 5MP (2448×2048) is static for each of the fields of view. Scanning with the 125mm lens will provide 5,013,504 measurements across the area the size of a softball while scanning with the 475mm lens provide the same number of measurements across the area the size of a basketball. Therefore, a smaller FOV = higher data resolution. The approximate resolution for each of the lenses is provided in the table below:

Breuckmann Lens/FOV	Estimated Data Resolution (in microns)
125	60
475	280
825	500

It is important to choose an appropriate lens for your scan project. The size of the object, the desired resolution, the final product for the project, and the amount of time available to scan are all important factors to consider.

SETTING UP THE BREUCKMANN

The Breuckmann setup includes three items: the scanner case(1), the calibration chart case(2), and the tripod(3).



Figure 2: (1) Case containing scanner, optolink, and all necessary cables, (2) Case containing large calibration chart, (3) System tripod

At minimum the scanner case and tripod are necessary for every scan project. It is recommended to calibrate the scanner every time the lenses are changed on the scanner. If you are using the mid (475mm) or large (825mm) FOV's, then you will need to calibrate the system using the large calibration chart in case #2. The calibration chart for the small (125mm) FOV is in the main scanner case. Please see the workflow on Calibrating the Breuckmann for more information on system calibration.

TRIPOD SETUP

When setting up the Breuckmann, first setup the system tripod. While it is not required for the tripod to be level for scanning objects, it should be level when performing a system calibration. The tripod that is used has four levels on it (shown below). When leveling the tripod, it is best to first level the very base of the tripod (level#1) and then to level the tripod mount using the very top level (level #2). The other levels are not used.



Figure 2: Tripod levels. Only use levels 1 and 2 when leveling the tripod.

CONTENTS OF CASE

Next open the Breuckmann case, and remove the large piece of t-shaped foam. The case components are shown in the image below.

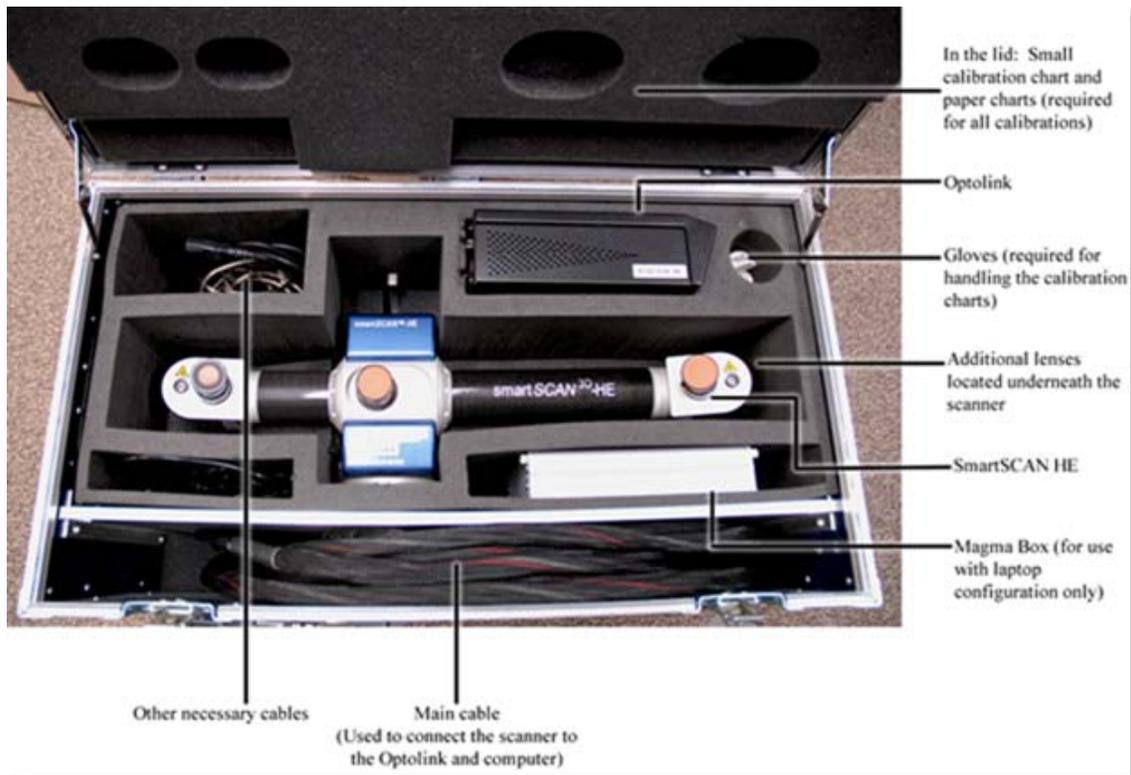


Figure 3: Scanner components

in main scanner case

PLACING ON TRIPOD

Next, remove the scanner from the case and place on the tripod.

IMPORTANT: The lever on the tripod will click into place once the scanner is secured. Do NOT LET GO of the scanner until you have heard the tripod mount click. Also, always use the silver handle located on top of the scanner when moving the scanner from the box to the tripod or vice versa.



Figure 4: Placing the scanner onto the tripod

LENSES

Once the scanner is on the tripod, next choose the appropriate lenses for your project. Each set of lenses include one

lens for the left camera, one lens for the right camera, and one lens for the projector. When looking at the lenses, the first set of letters indicate whether the lens is for the left camera (CL), the right camera (CR) or the project (P) and the last set of numbers indicate the FOV (12 = 125mm, 47 = 475mm, and 82 = 825mm). Notice the labels on the set of lenses below for the 825mm FOV.



Figure 5: Set of lenses for the 825mm FOV (CR = Camera Right, P=Projector, and CL = Camera Left)

One set of lenses will already be in place on the scanner. If you have to change the lenses, the additional lens sets are located under the pieces of foam directly under the scanner in the case. Before removing the lenses from the scanner, make sure the orange lens caps are in place and locate the black lens caps in the case that are used for the other side of each lens. Unscrew a lens from the scanner and **IMMEDIATELY** place the black lens cap on the other side of the lens. Repeat for all lenses and place each lens in the individual pieces of bubble wrap provided in the case. **BABY THE LENSES** as they are a crucial part of the system and can easily be scratched.

When standing behind the scanner, the projector is the center lens the left camera is to left (and farthest from the projector) and the right camera is to the right (closest to the projector). When installing new lenses it is critical to get the correct lens in the correct location. All lenses should be tightly screwed in.



Figure 6: Camera and projector locations on the SmartSCAN

INTERFACING SCANNER WITH A DESKTOP COMPUTER (IN LAB)

Once the scanner is setup, remove the Optolink (black box) and all necessary cables. The large black cable connects the scanner to the Optolink (via the main connector) and the computer (via two firewire connections). The Optolink has its own power cable and is also connected to the computer (via USB).

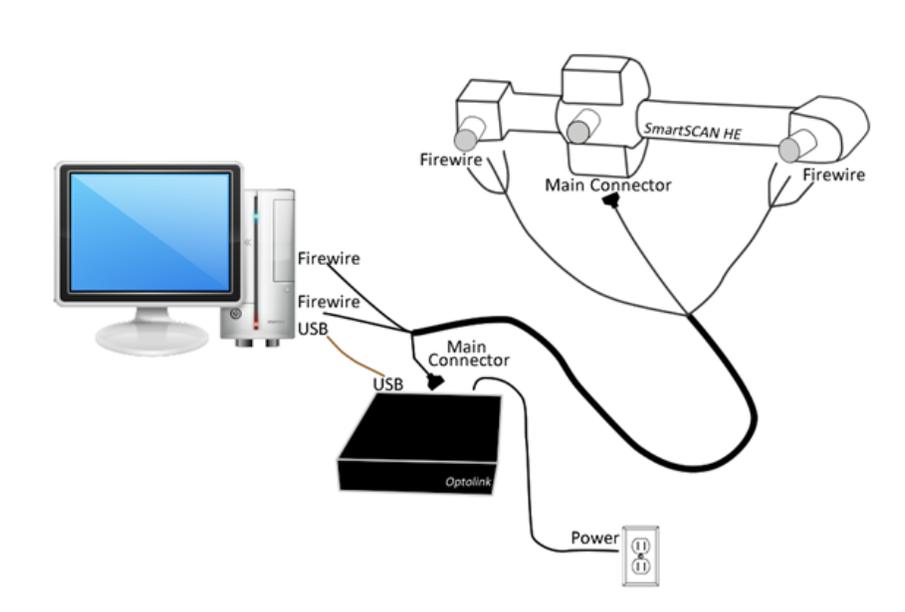


Figure 7: Diagram showing connectivity between SmartSCAN, Optolink box, and desktop computer

Connect the main connector to the scanner. Make sure the connection is square and screw in to secure (*Note: Screws should go in easily. If not, you might be cross-threading the connection*). Each camera has three cables. Be sure and line up the dots on the smallest round connection (1). Plug the remaining cables in accordingly and *be sure* to screw in the firewire connections using the screwdriver provided in the case. **DO NOT FORCE ANY CONNECTIONS!!!**



Figure 8: Three camera cables and their associated connections

When plugging cables into the scanner, it is *essential* to lift the cable slightly and attach it to the scanner handle using the attached Velcro strap. This prevents the weight of the cable from straining the connections.

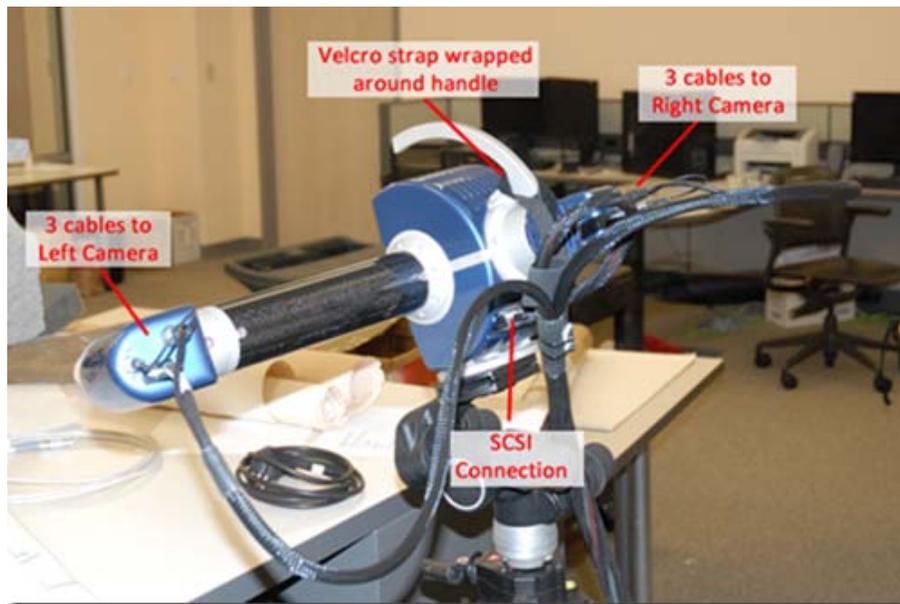


Figure 9: Completed scanner setup with Velcro strapped secured around handle for support

Next, take the opposite end of the black cable and plug the main connector into the Optolink and the two firewires into the back of the desktop. Again, use the provided screwdriver to secure the firewire connections. Finally, connect the Optolink to the desktop using the brown, reflective USB cable and plug the power cord for the Optolink into an outlet. The scanner and associated hardware are now ready to use. Power the Optolink first and then the computer. You are now ready to open the Optocat software and begin your scan project.

INTERFACING THE SCANNER WITH A LAPTOP (IN FIELD)

The Dell M4500 laptop is the currently the only CAST laptop that is configured to interface with the Breuckmann. The Magma box (silver box) is an additional piece of hardware that is required to connect the laptop with the scanner. Remove the Magma box, Optolink, and all associated cables from the scanner case. The difference between the laptop configuration and desktop configuration is that the two receiving firewire cables plug into the Magma box and the Magma box connects to the laptop using a express card adapter.

The large black cable connects the scanner to the Optolink (via main connector) and the magma box (via two firewire connections). The Optolink has its own power cable and is connected to the computer (via USB). The Magma box also has its own power cable and it connected to the computer via an express card adapter that fits into the express slot on the left side of the laptop.

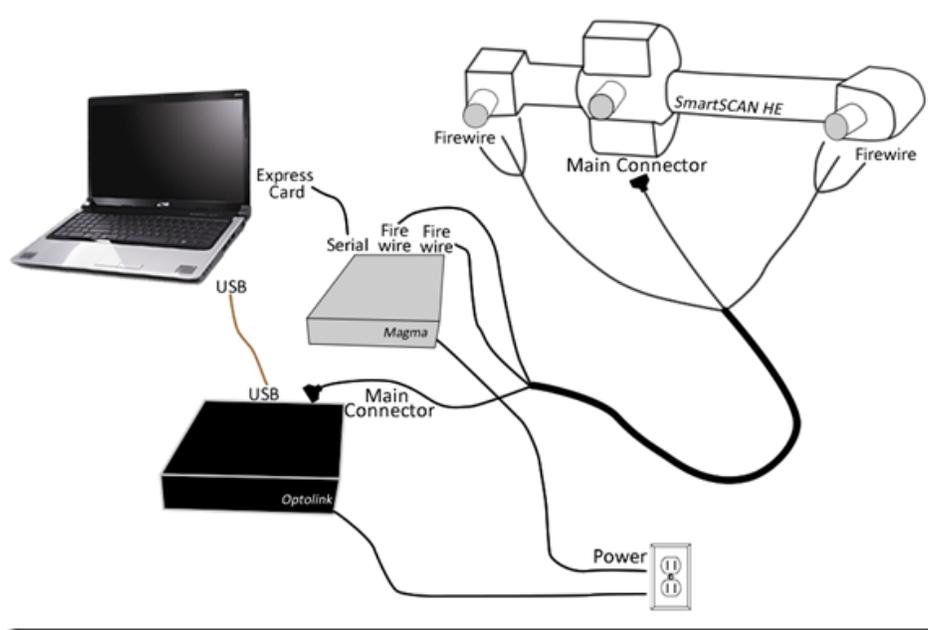


Figure 10: Diagram showing connectivity between SmartSCAN, Optolink, Magma box, and laptop

Connect the main connector to the scanner. Make sure the connection is square and screw in to secure (Note: screws should go in easily. If not, you might be cross-threading the connection.) Be sure and line up the dots on the smallest round connection (1). Plug the remaining cables in accordingly and *be sure* to screw in the firewire connections using the screwdriver provided in the case. **DO NOT FORCE ANY CONNECTIONS!!!**

When plugging cables into the scanner, it is *essential* to lift the cable slightly and attach it to the scanner handle using the attached Velcro strap. This prevents the weight of the cable from straining the connections. The finished setup for the scanner can be seen in the Figure 9 above.

Next, take the opposite end of the black cable and plug the main connector into the Optolink and the two firewires into the Magma box. Again, use the provided screwdriver to secure the firewire connections. Next, connect the Optolink to the desktop using the brown, reflective USB cable and plug in the power cord for the Optolink. Finally, connect the Magma box to the computer using the serial cable and Express Card adapter and plug in the power cord for the Magma box.



Figure 11: Express card adapter that fits the Express card slot on the laptop

The scanner and associated hardware are now ready to use. Power the Optolink and then turn on the computer. You are now ready to open the Optocat software and begin your scan project.

BREUCKMANN DISASSEMBLY

Disassembling the scanner is fairly straight forward with a few notable points. All screwed-in connections including the main connector and all firewires should be unscrewed completely and then pulled. Of the three camera cables, the smallest round connection (1) can be disconnected simply by pulling firmly on metal grips. The large round connection (2) is push-pull connector, so first slide the metal grips forward and then pull to disconnect.



Figure 12: Image showing three cables/connections for each camera

To remove the scanner from the tripod, pull the silver lever on the tripod mount back to disengage the connection and to remove the scanner. Always carry the scanner by the silver handle.



Figure 13: Pull silver lever towards the back of the scanner to remove the scanner from the tripod

Once everything is in the case, double check that all cables/connections are tucked securely in the case before closing the lid.



Figure 14: Successful pack up! (Minus the Magma box)

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