

# Service Manual

## Ultra, UHR Ultra and V3400



# WHEEL ALIGNER

May 2014

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## **IMPORTANT SAFETY INSTRUCTIONS**

**When using this equipment, basic safety precautions should always be followed, including the following:**

- 1. Read all instructions.**
- 2. Do not operate equipment with a damaged power cord or if the equipment has been damaged until it has been examined by a qualified authorized service technician.**
- 3. If an extension cord is used, a cord with a current rating equal to or more than that of the machine should be used. Cords rated for less current than the equipment may overheat. Care should be taken to arrange the cord so that it will not be tripped over or pulled.**
- 4. Always unplug equipment from electrical outlet when not in use. Never use the cord to pull the plug from the outlet. Grasp plug and pull to disconnect.**
- 5. To reduce the risk of fire, do not operate equipment in the vicinity of open containers of flammable liquids (gasoline).**
- 6. Keep hair, loose fitting clothing, fingers and all parts of the body away from moving parts.**
- 7. Adequate ventilation should be provided when working on operating internal combustion engines.**
- 8. To reduce the risk of electric shock, do not use on wet surfaces or expose to rain.**
- 9. Do not allow unauthorized personnel to operate the equipment.**
- 10. Use only as described in this manual. Use only manufacturer's recommended attachments.**
- 11. ALWAYS WEAR Safety Glasses. Everyday eyeglasses only have impact resistant lenses, they are NOT safety glasses.**

## CHAPTER 1


### AC/DC POWER DISTRIBUTION

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#### ELECTRICAL SAFETY PRECAUTIONS

Make sure the aligner is unplugged before disconnecting any wires in preparation for replacing any boards, cables or other items within the unit. Use the “*Lockout and/or Tagout*” procedure.

When working on this aligner, keep three points in mind:

**CAUTION!**

THIS UNIT MUST BE PLUGGED IN TO A PROPER AC OUTLET FOR THE UNIT TO OPERATE CORRECTLY. REFER TO THE UNIT ID PLATE LOCATED ON THE BACK OF THE UNIT. EXTENSION CORDS ARE NOT RECOMMENDED, BUT IF AN EXTENSION CORD MUST BE USED, USE A CORD THAT IS LESS THAN 50 FEET WITH A 16 AWG, OR ABOVE 50 FEET AND LESS THAN 100 WITH A 14 AWG.

1. Aligner voltages refer to the “return” (white) side of the AC line. Yet sometimes outlet wiring is reversed. In that case, electrical neutral connects to the “hot” side of the line. The aligner operates normally, but the PC board floats 110 VAC above safety ground. **Assume that points inside the aligner console are at 110VAC**; observe all safety precautions. If you make measurements with grounded test equipment, use an isolation transformer. An oscilloscope is an example of such test equipment.
2. The aligner is susceptible to power line spikes and noise. **You must connect the equipment to safety ground.** Does your machine do “strange things” or exhibit intermittent problems? Check for a proper ground at the machine and the power outlet. If you’re using an extension cord, check that, too. It must be constructed of at least 16 gauge wire and under 50 feet long.
3. Schematic voltages refer to the “return” side of the line, not safety ground. When measuring AC voltages, use the white wire on the line power terminal block as ground. Don’t use the third, center safety ground terminal. Another place to access ground is at the shield. The black wire in the shielded transducer cables also connects to the ground return.

#### HANDLING STATIC SENSITIVE PCB’S

**Electrostatic discharge can destroy high impedance ICs if uncontrolled. Use the following techniques to avoid damaging ICs:**

- Leave new circuit boards in their antistatic bags until ready for use.
- When replacing boards, proms, etc. be sure to turn off power to the machine first
- Use an anti-static wrist strap. Connect it to chassis ground on the equipment or to an available raw ground.
- Touch the chassis of the equipment to put yourself at the same static potential as the equipment.
- Grasp the PCB from opposite sides using your fingertips. Do not grasp the components on the board.

**WARNING!**

USE STANDARD ANT-STATIC PROCEDURES WHILE PERFORMING THESE INSTRUCTIONS

**When inserting PCB's:**

- Place boards on a grounded static mat after removal.
- Remove the new PCB from the original package onto a grounded static mat. Save packaging to use when returning defective boards.
- Remove power from the machine (un-plug from wall) before installing the PCB.
- Avoid handling components needlessly.
- Do not set PCBs on insulating surfaces such as paper, glass, rubber, or plastic.
- Static is generated by friction. The following actions promote static generation:
  - Wearing silk or nylon clothing.
  - Walking on carpets.
  - Walking with rubber soled shoes.

Static generation is increased when certain environmental conditions exist. Conditions of low humidity combined with wearing silks or nylons, walking on carpets, or walking with rubber soled shoes may create large electrostatic charges on your person, capable of blowing a hole in the substrate of an IC.

**SERVICE GUIDELINES**

1. **BEFORE REPLACING** circuit boards, verify that the main power supply operates within specifications.
2. **VERIFY** that board connectors are fully seated.
3. **NEVER** remove boards or disconnect a connector with the power on!
4. **MAKE SURE** that you completely understand what the aligner does. *(If it works, you can't fix it!)* Refer to the *Aligner Operator's Manual*, application notes, and flow diagrams.
5. **BE CAREFUL** when handling circuit boards! Wear an anti-static wrist strap.
6. **WHEN TRANSPORTING** circuit boards, use anti-static bags.

**NOTE: RELATIVE HUMIDITY HAS A DIRECT EFFECT ON STATIC CHARGE BUILDUP. AS HUMIDITY DECREASES, STATIC BUILDUP USUALLY INCREASES.**

**LOCKOUT AND/OR TAGOUT SYSTEM PROCEDURE**

1. Notify all affected employees that a lockout or tagout system is going to be utilized and the reason thereof. The authorized employee shall know the type and magnitude of energy that the machine or equipment utilized and shall understand the hazards thereof.
2. If the machine or equipment is operating, shut it down by the normal stopping procedure (depress the stop button, open toggle switch, etc.)
3. Operate the switch, valve, or other energy isolating device(s) so that the equipment is isolated from its energy source(s). Stored energy (such as that in springs, elevated machine members, rotating flywheels, hydraulic systems, and air gas, steam or water pressure, etc.) must be dissipated or restrained by methods such as repositioning, blocking, bleeding down, etc.
4. Lockout and/or tagout the energy isolating devices with individual lock(s) or tag(s).
5. After ensuring that no personnel are exposed, and as a check on having disconnected the energy sources, operate the push button or other normal operating controls to make certain the equipment will not operate. **CAUTION: RETURN OPERATING CONTROL(S) TO "NEUTRAL" OR "OFF" POSITION AFTER THE TEST [DE-ENERGIZED STATE].**
6. The equipment is now locked out or tagged out.

## AC THEORY OF OPERATION

Always use “one hand rule” when working with AC voltages by keeping one hand in your pocket or behind your back. Before removing any wires on the equipment, always verify that the equipment is turned “OFF”. Turn off the Main Power switch in the back of the unit and unplug the AC power cord from the AC outlet.



# WARNING!

**DANGEROUS HIGH VOLTAGES  
ARE PRESENT IN THIS EQUIPMENT**

## AC DISTRIBUTION

Alignment Console primary voltage is 110VAC, 60Hz via the hot side (black wire) of the AC power cord. On the Alignment console the power comes to a power strip then is distributed to the Monitor, Printer, and if so equipped the battery charger for voice control module. For the camera power supply box, the power comes via the hot side (black wire) of the AC power cord to an EMI filter to a on/off switch then to the power supplies.

## D.C.THEORY OF OPERATION

### POWER SUPPLY

The power supply is a COSEL LEB100F-0512. The output voltage of the power supply is +5V 5A and +12V 5 (Peak 10) A. The power supply is used to supply the camera with 5 volts to run the wheel indicator LED's and the 12 volts is used to run the strobe LED's. The output connector on the power supply is labeled as V1 and V2. V1 is the 5 volt line and V2 is the 12 volt line. Each output voltage has it's own separate ground. When measuring the output voltage of the power supply the technician must attach the leads of the VOM to the appropriate ground to receive back the correct voltage. Failure to connect the VOM to the correct pins will result in a incorrect voltage reading and may cause the technician to prematurely replace a good power supply.

#### AC Input CN1

- 1 = AC (L) (White)
- 2 = AC (N) (Blu)
- 3 = GND (Blk)

#### DC Output CN2

- V1 = 5VDC (Red)
- G1 = 5VGND (Blk)
- V2 = 12VDC (White)
- G2 = 12VGND (Green)



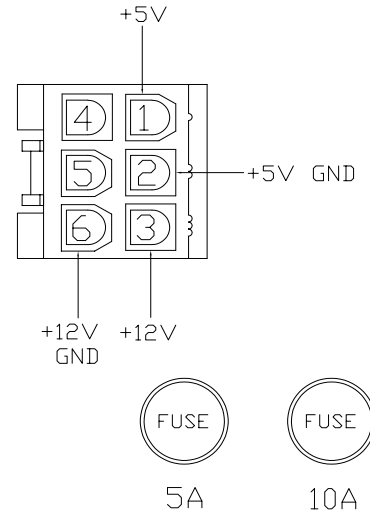
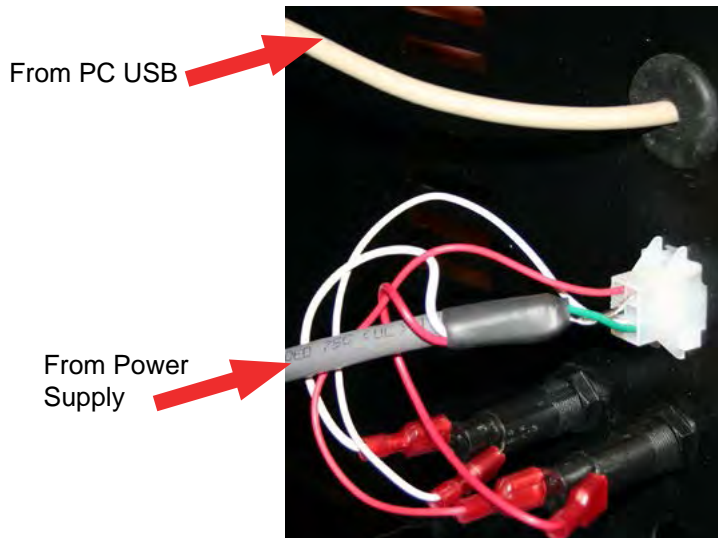
To back of cabinet



## AC/DC POWER DISTRIBUTION

The DC output of the Camera Power supply feeds through a harness on the back of the cabinet. Both the 5V and 12V power is fused at this location. Should a camera stop working checks should be made to both fuses for proper continuity and both the 5V and 12V be checked for proper power using a VOM.

### Inside Cabinet View



## HUB BOARD

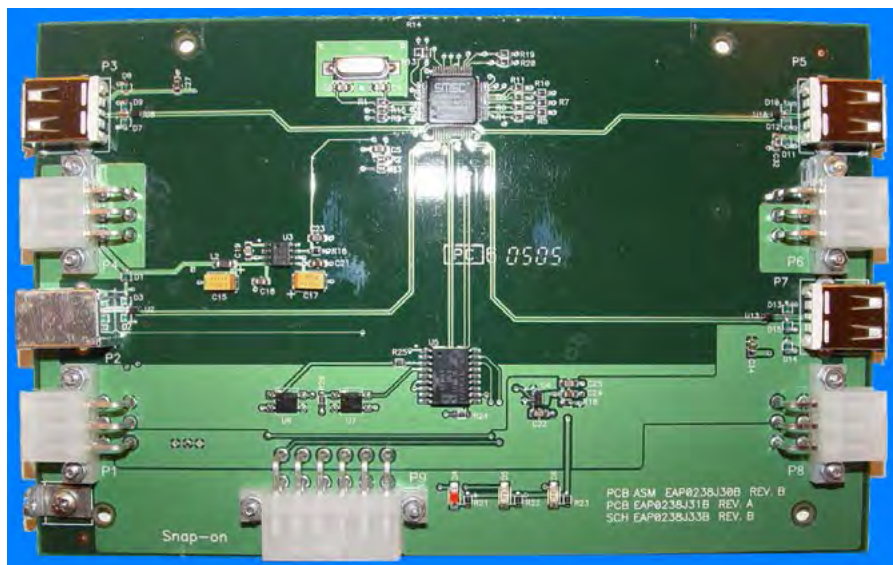
The HUB board is housed inside an aluminum extrusion behind the camera beam. The HUB board's purpose is to pass information to and from each of the camera's directly to one of the USB Ports on the back of the PC. The HUB board has 4 USB connectors for either a two camera system or a three camera system. The Db9 connector at the bottom of the HUB Board is a direct link to the PC, the other 3 connections are equivalent for the camera's, any camera will plug into any of the three camera connections. There is also a Db15 connector on the HUB Board for future motor control.

Camera USB

Camera Pwr.

To PC USB

Incoming  
Camera Pwr.



Camera USB

Camera Pwr.

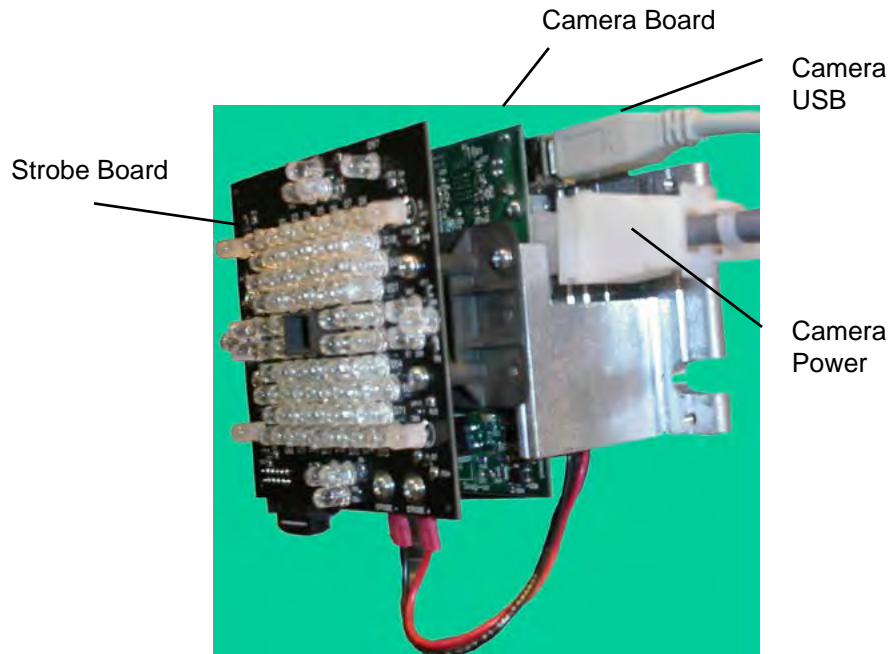
Camera USB

Camera Pwr.

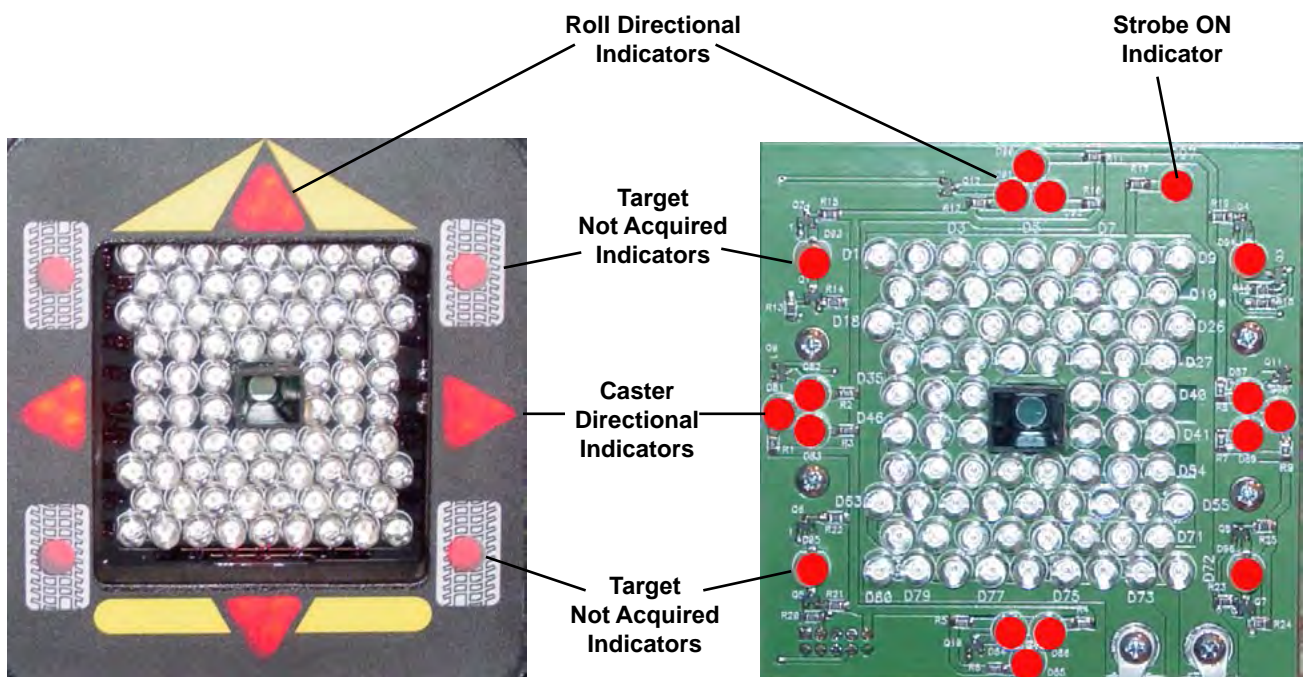
Motor Control

## ULTRA CAMERA POD ASSEMBLY

When ordered the camera pod comes as an assembly however should a strobe board fail it can be ordered and replaced separately. The camera pod is supplied with both 5VDC to power the "Acquired target indicators" and directional LED's and 12VDC to power the strobe.



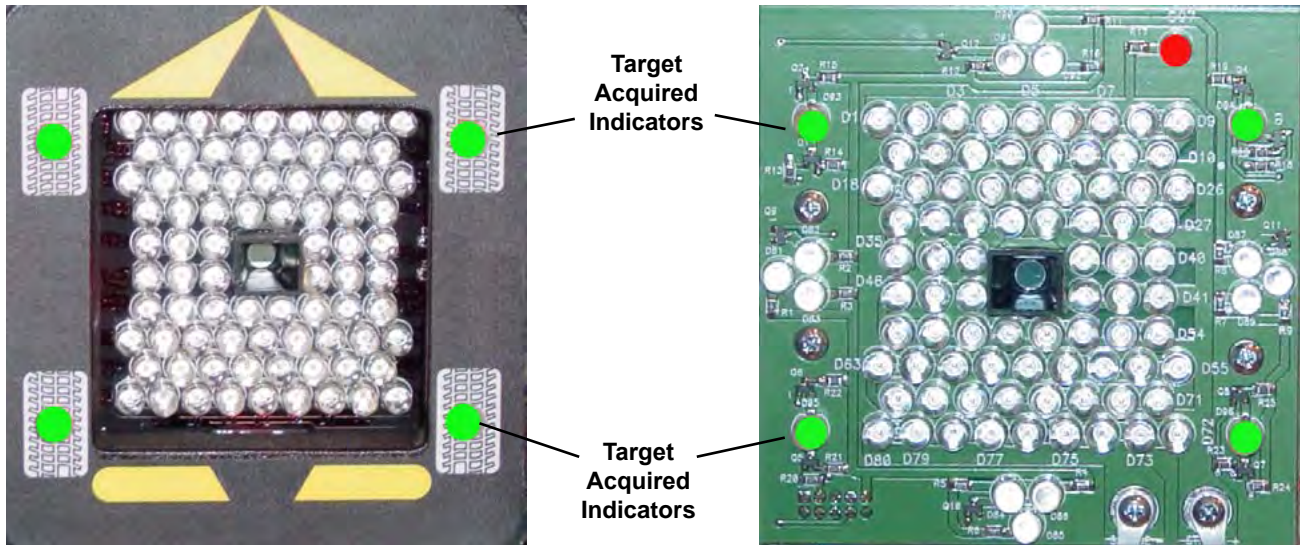
The strobe is held on the camera pod assembly with 4 screws and lockwashers. By viewing the LED's on the strobe board the technician should be able to quickly identify if both the 5VDC and 12VDC are present. There are no test points available. In the figure below all **Target Indicators** and **Directional Indicators** are lit up. Each of these LED's require 5VDC to light these LED's with the exception of the **Strobe ON** indicator it uses 12VDC. The strobe LED's are infrared and appear to be off during the alignment process however this **Strobe ON** LED indicator was added to the strobe board to alert the technician or alignment technician that the strobe LED's are firing. This LED is located behind the intuitive cover and is not visible to the operator however it can be seen by looking closely.





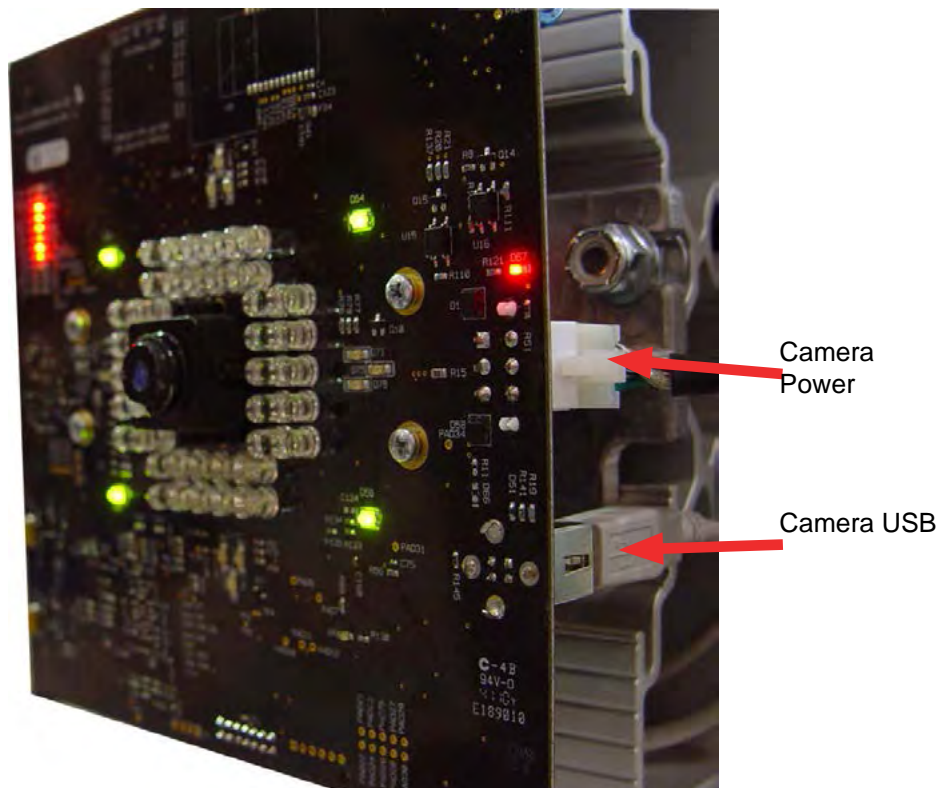
## AC/DC POWER DISTRIBUTION

When the targets have been mounted to the wheel and tire of the vehicle the Target Indicator LED's will illuminate green once the targets have been acquired.



## ULTRA UHR CAMERA / STROBE ASSEMBLY 3D SYSTEM

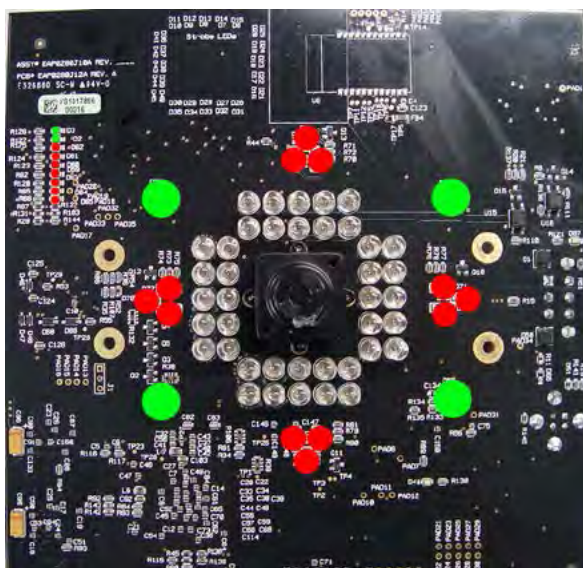
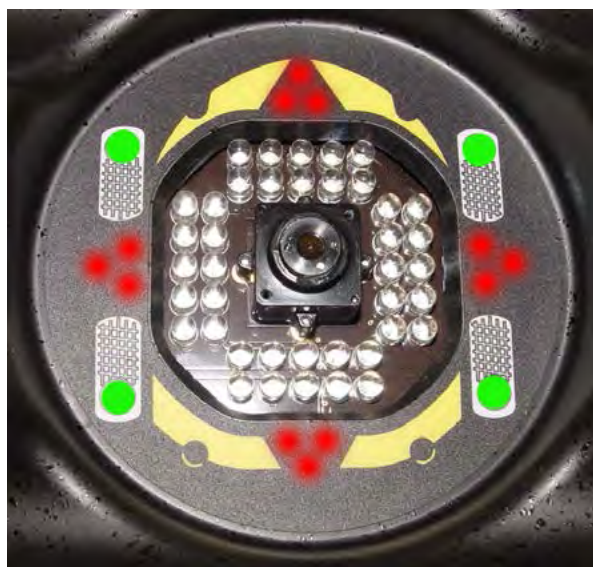
The UHR Camera / Strobe PCB is all integrated onto one PCB. The camera pod is supplied with both 5VDC to power the "Acquired target indicators" and directional LED's and 12VDC to power the strobe.

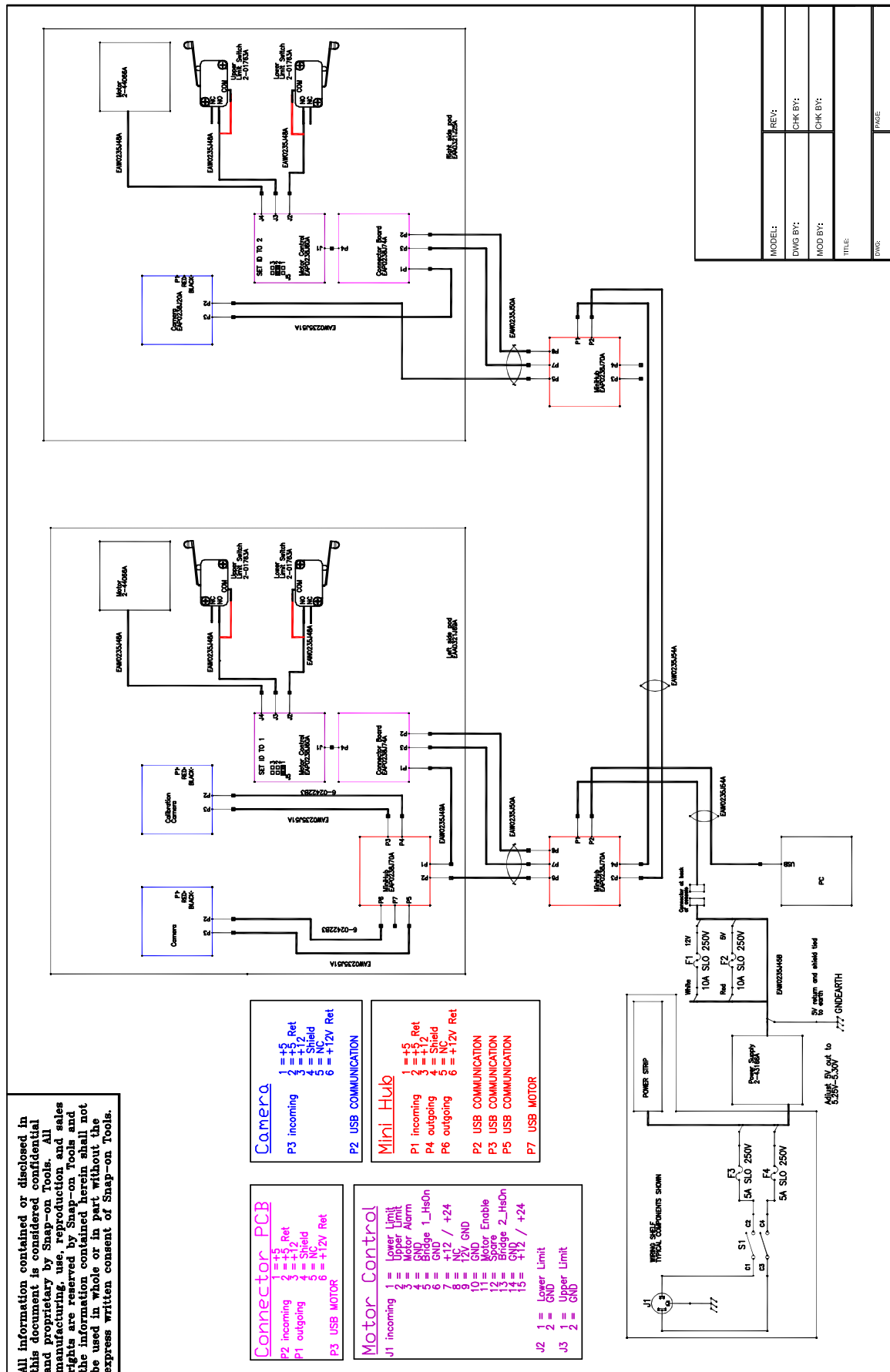


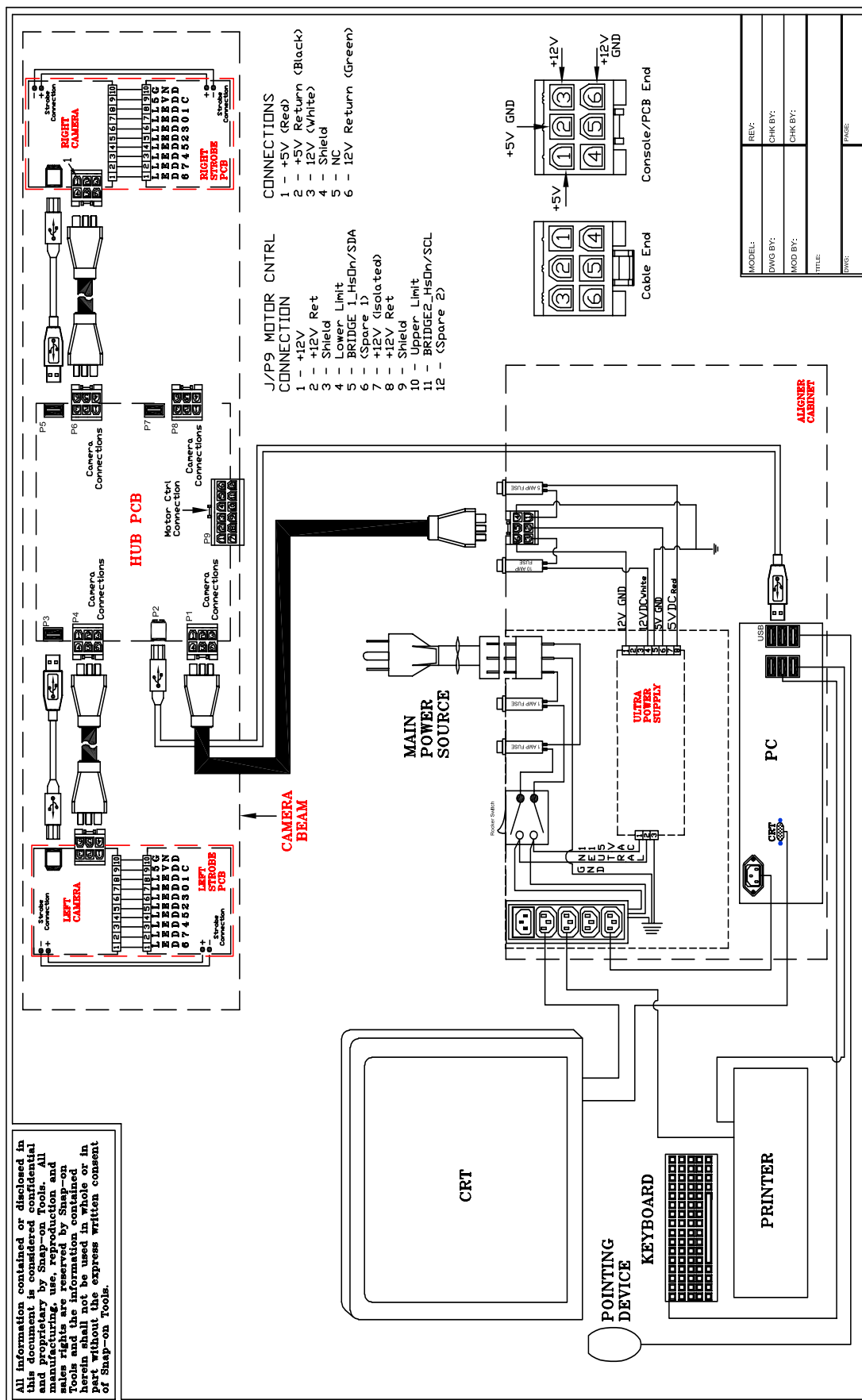
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The assembly is equipped with it's own power supply and DSP processing. All of the image processing is done on the camera directly and sent to the PC as processed information unlike the legacy V3D which used the pc to process all of the images. This new process has improved the speed and accuracy of the system. The new UHR system is equipped with a 5 mega pixel camera compared to a 1.3 mega pixel of the legacy camera. The higher resolution allows us to use a smaller target compared to the past. The LED's used on the UHR camera system are much brighter also than those used in the past. The new system uses the same USB and power cables eliminating the need to have multiple harnesses for troubleshooting. The camera/strobe pcb also uses an improved firmware security system. This new security eliminates possible pirating of the firmware. Relative Target Position (RTP), Security and lens correction is stored on the camera.

**NOTE: IF A CAMERA IS REPLACED ON A UHR SYSTEM IT WILL BE NECESSARY TO PERFORM A TARGET ID AND AN RCP. TARGET ID IS STORED ON THE CAMERA, FAILURE TO PERFORM TARGET ID WILL RESULT IN A TARGET ACQUISITION!**









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## CHAPTER 2

### THEORY OF OPERATION

#### GENERAL

The 3D Image Aligner is a revolutionary concept in performing wheel alignments. The system uses a camera based machine vision technology that provides many benefits to the shop owner and alignment technicians. It is the fastest, most accurate, and easiest to use aligner ever made. One of the benefits to new technologies is the use of state-of-the-art components and computer programming that makes the task of servicing this product easier than previous generations of alignment equipment. One of the most obvious differences is the lack of an electronic measuring head, the source of many of the failures and inaccuracies on conventional products. There is not much about this aligner that is conventional.

Shop owners and alignment technicians easily recognize the many strengths of this system compared to conventional measuring-head systems. As the 3D Aligner was prepared for introduction into other International markets such as Asia and Latin America, it became evident that the tasks of developing language translations and market-specific vehicle specification databases was overwhelming. The decision was made in 1998 to develop a Windows-based user interface for the 3D aligner in parallel with efforts to do the same for the company's conventional wheel alignment system. In the fall of 1998, the Windows environment was introduced. The Windows compliant Pro32 software had a robust set of features, added the familiarity and power of Windows, and had 27 different languages and 13 different specification databases. In addition, Windows offered powerful networking capabilities that gained an importance as the automotive service industry discovers the benefits of information sharing between the front point-of-sale counter and the back shop. In the fall of 2010 Pro42 was introduced. Pro42 added the versatility of added features plus it also opened up the area of using a higher resolution camera system Ultra High Resolution(UHR). The UHR system also incorporates a true 3D target. This target is much smaller and lighter.

#### CAMERAS

The “eyes” of the vision-based 3D Aligner are the two cameras mounted on either end of a camera beam. The cameras are high-resolution CCD video type operating in gray-scale, similar to those used in security and surveillance applications. The proprietary design lens is for this usage, and is permanently mounted to the camera and triple-sealed for protection. The camera also has a band-pass filter, limiting the spectrum of light that can enter the lens. With any camera there is an optical “field of view” that is a characteristic of the lens design. Anyone who has used a camera knows that what you see is what you get no more, no less. The cameras on the 3D Aligner are no different.

The field of view (Figure 1 / 2) is located along each side of the alignment rack and is a cone-shaped “tunnel” that expands in size as it moves further away from the cameras. The tunnel is approximately 2½ feet in diameter near the front turntables. The centerlines of the tunnels are close to vehicle spindle height and about 18 inches outside of the outer wheel surface of an average car. In fact, the cameras are initially aimed at the factory so that the targets, when mounted onto an average vehicle, would be located in the center of that tunnel. This insures that any vehicle placed on the rack in front of the 3D Aligner, from the widest to the narrowest, will have the targets mounted within the cameras’ field of view.

The Strobe Board contains 80 infrared LED's in an array to provide a source of bright light to reflect off the targets when camera images are taken. These LED's are rated for 100,000 hours continuous operation, and up to 50% of the LED's can fail without affecting the cameras ability to see the targets. These infrared LED's are synchronized with the cameras so an image is “captured” every time the lights flash (roughly 2 times per second).

Side Field of View

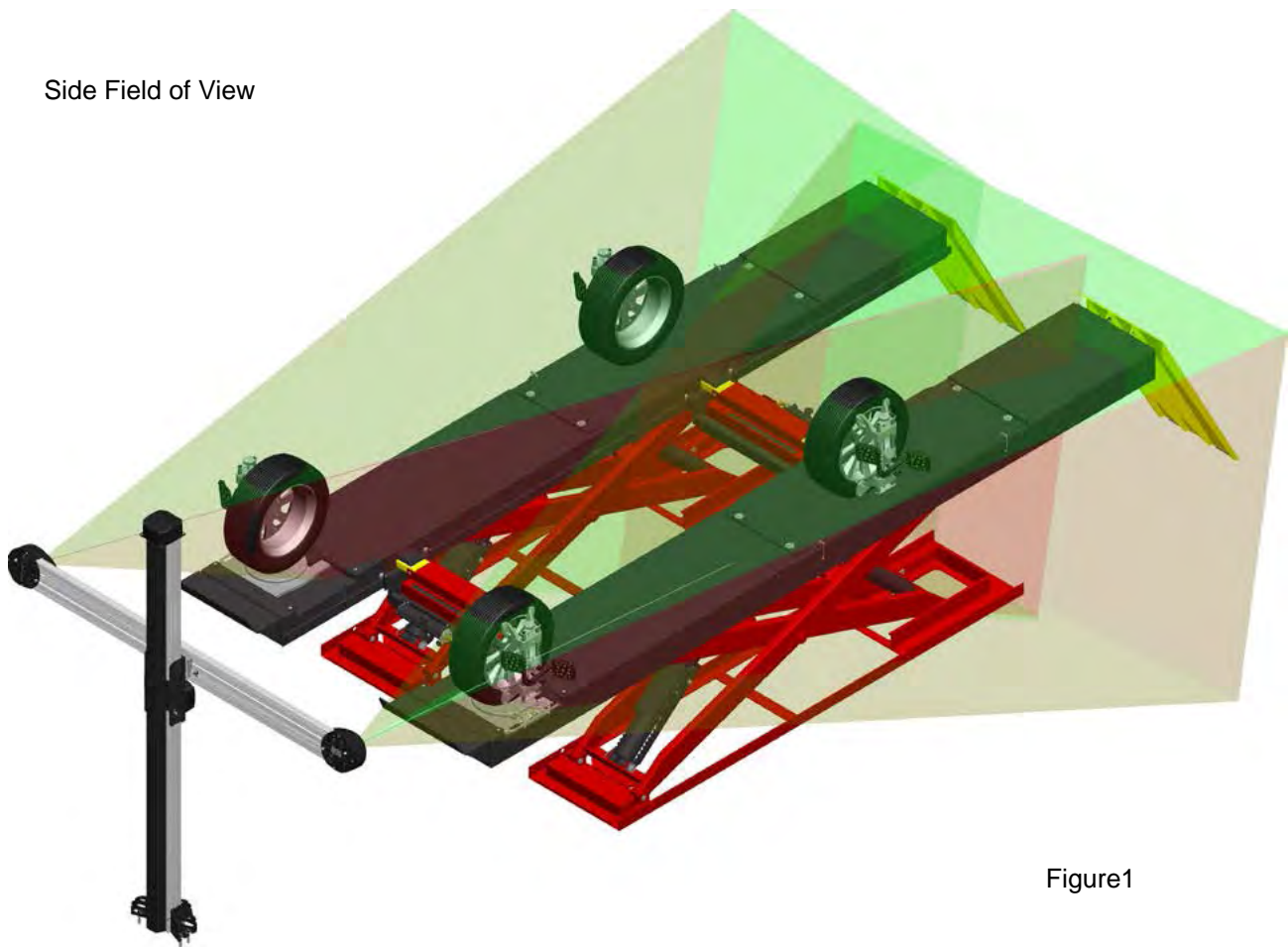


Figure1

Top Field of View

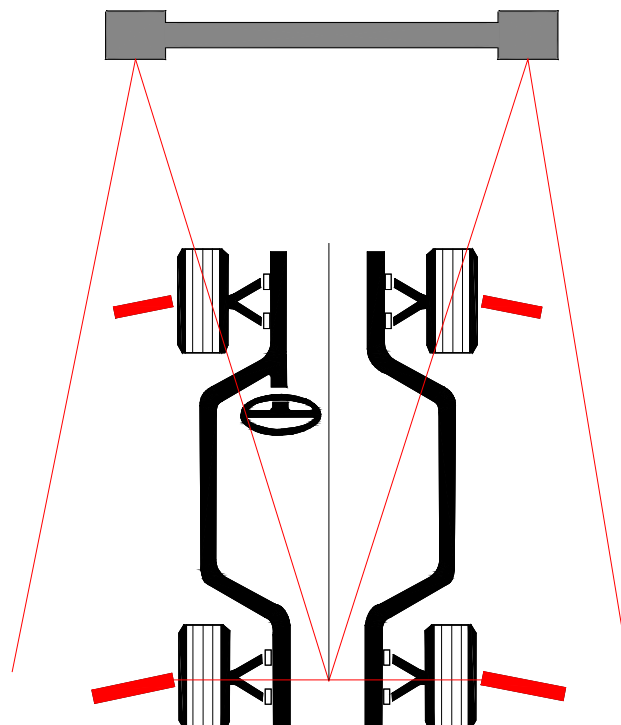
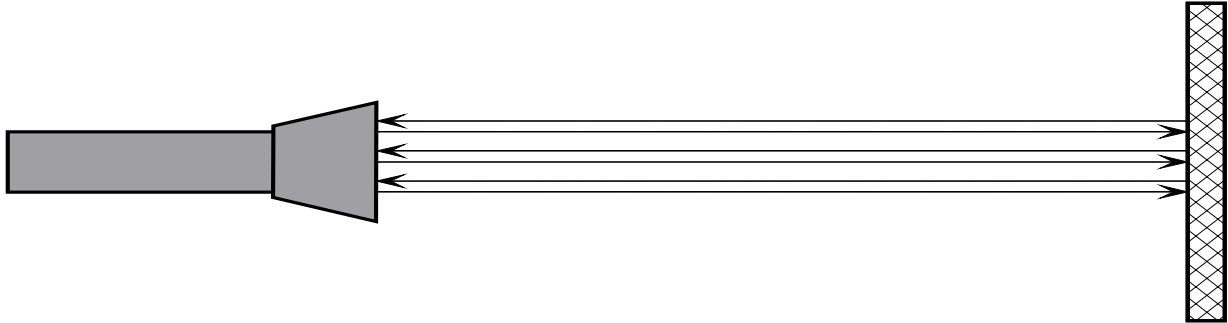


Figure 2



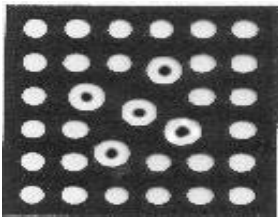
## TARGETS 2D

The target's visual surface is a series of circles or "dots" made of a retroreflective material. This material returns any light that hits its surface at a 180-degree angle directly back towards the source. If we are looking at the reflected light, it is brightest at the center of the light source. As we move away from the source the brightness of the light diminishes rapidly. Street signs have retroreflection material on certain parts of their surface. This material reflects light from a vehicle's headlights back to the motorist's eyes. The portion of the sign that traffic control wants the driver to pay attention to is reflective, while the rest of the sign fades into darkness. Drivers in other cars cannot see the reflected light from the headlights of other cars because the angle of view is too large. In the case of the 3D Aligner, light is generated by the LED's, hits the target, and returns along the same path to the camera when placed in the center of the LED array.



The retroreflection material is placed on an copper backing plate to insure the reflective pattern remains flat. This assembly is then mounted into a hard ABS plastic housing for shock and damage protection. Finally, a special piece of high quality precision exotic plastic is placed on top of the retroreflection material for final protection from damage.

The dot pattern created allows the cameras to see a very unique item that the 3D Aligner recognizes. The various dimensions of this pattern of dots is a known quantity that is stored within the program and is used as a constant, forming the basis of our vision-based measuring system.

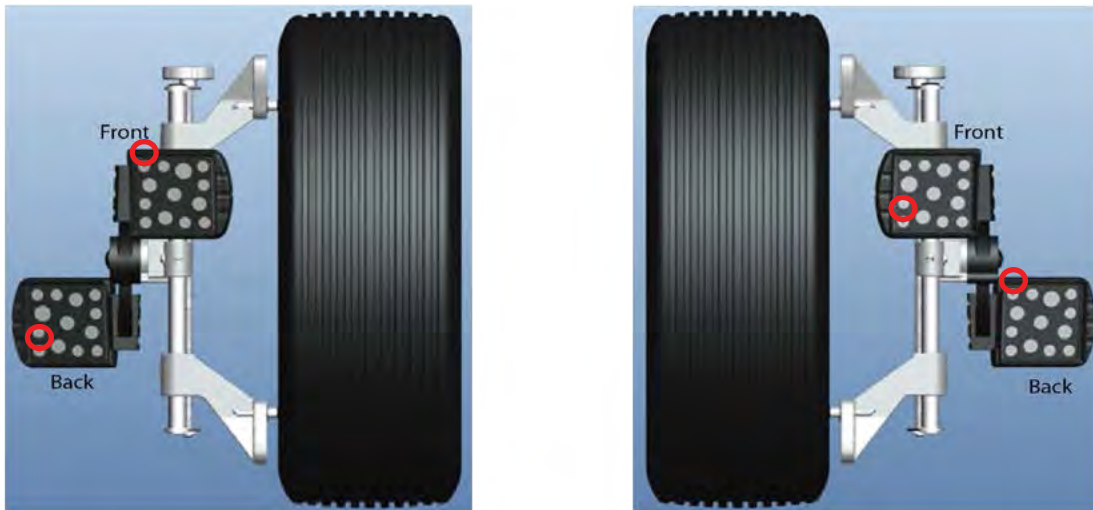


There are 33 dots on each front target and 31 on rear targets laid out in a very distinct manner. A great deal of time and effort was placed on designing this pattern of dots. In some ways the dots appear to be randomly placed, but in other ways appear to have some symmetry. Some of the dots are larger than other dots, and there may also be "donut" circles. It must be noted that these circles we see are geometrically the "roundest" circles we will ever encounter this is necessary for the interpretation of angles, as we will learn later. Note also that the dots on the rear targets are larger than the front targets to allow vision at a further distance.

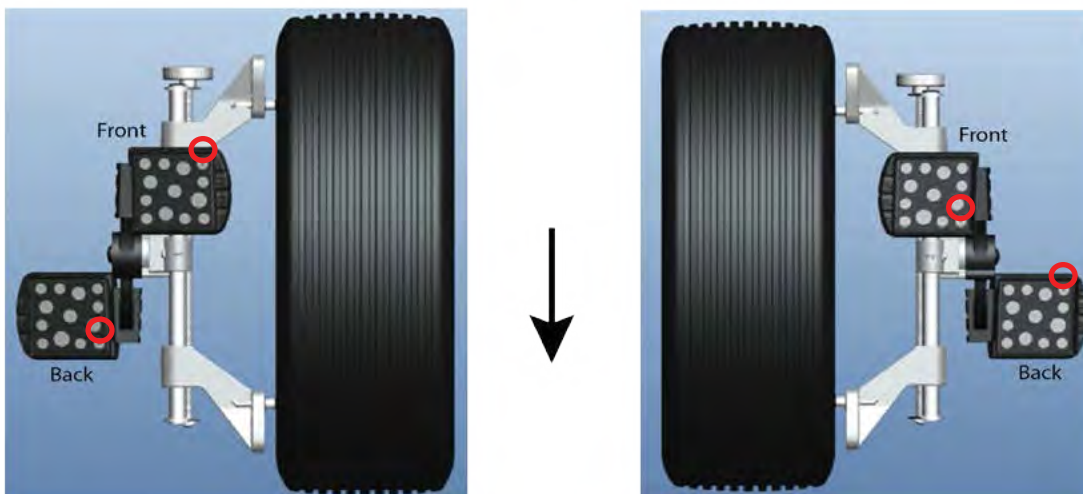
Since the engineers designed the target dot pattern with great precision, they know the exact dimensions of each dot and the distance from any one dot to another. It is possible then to create a computer model of this pattern that the 3D Aligner software could use as it looked at camera images. This would be usable in the program only if we were certain that the target attached to the vehicle matched the computer model. Since it is impractical to have an engineer hand-make each target to the required precision, a detailed manufacturing process was created to make sure each target was an exact duplicate of the original design.

### TARGETS 3D

The new 3D targets are unique for each wheel. The rotation of the sub targets defines the wheel position. A quick glance at the targets the operator may think that both left targets are identical and both right targets are identical. However the illustration below displays the difference of each set of targets to each wheel. Looking at the identification dot on each target you will notice that on each wheel it is in a different location as it is also in a different location on each set of targets. This location tells the camera which of the targets from the set is a back and which is a front target. From the target assembly the back target on each wheel is the Master target. Locate the dot on each master target and you will notice that the dot on the front target is turned either 90° CW or 90° CCW from the Master target. Each target contains a total of 13 fids (5 large and 8 small) this brings the target set to a total of 26 fids. No more than 3 small fids can be blocked on any target before it is lost in the cameras field of view and none of the large fids can be blocked before it is lost in the cameras field of view. Relative Target Position (RTP) is stored on the camera so each target is married to the camera that sees it. The RTP is restored from backup information if used.

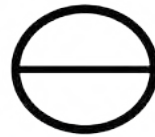


Configuration using conventional wheel clamp





**Configuration using single pole wheel clamp**



## TARGET ACQUISITION

When we begin a new alignment the program has no idea where the targets are located. The software turns on the cameras and goes into a “search mode”, looking throughout the cameras’ field of view for any targets. We see this on the screen in the form of 4 red targets away from the wheels. Since the software knows what a target looks like, when it sees an object that may be a target it applies what is called a “fit algorithm” – how closely does that object match what it knows to be a target. In this way, objects that are not targets (such as reflective lamps on the vehicle) are ignored. As each target is found and fitted (or acquired) it turns blue on the screen and appears attached to the wheel. When a target is acquired the software “hones in” on that region of the camera view ignoring activity in the background. This allows the system to be more responsive to changes in target position.

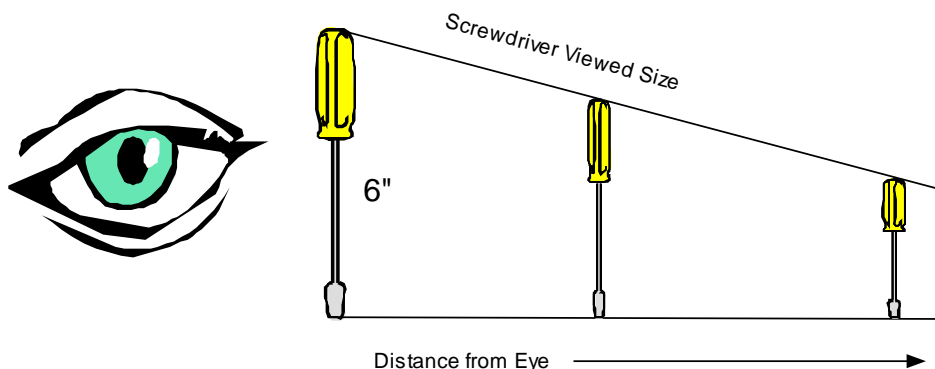
## 3D VISION THEORY

From the previous discussions of the components of the 3D Aligner we have a basic understanding of how the hardware system functions. But how does the software take these camera images of target dots and interpret them as wheel alignment angles?

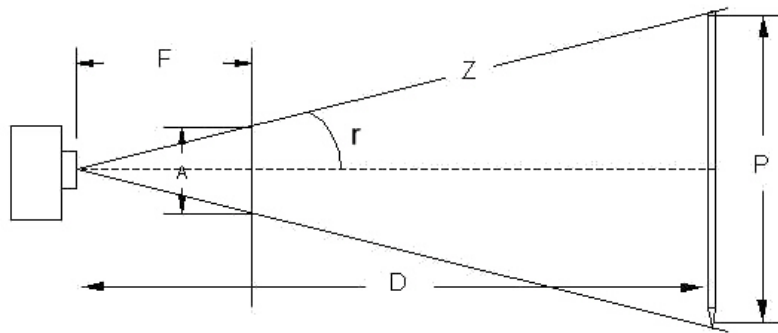
### PERSPECTIVE

One of the things the 3D Aligner must determine is how far away each target is from the cameras at any given moment. As everyone knows, objects appear to get smaller as they move farther away, even though their actual size remains the same. If you look at a screwdriver 2 feet away from you it looks much larger than it does at 20 feet away. This effect is called *perspective*. Artists create the illusion of depth and distance in two-dimensional drawings using this technique.

In the example above, assume that the screwdriver is 6 inches long. If you had a way to “measure” the exact size of the screwdriver your eye sees at some distance away, through the application of high school level mathematics you can determine how far the screwdriver is from your eye. On the following page there is a more detailed explanation of the mathematical principles.



In this example, the camera is at a fixed point in space. All fixed camera lenses have a fixed focal point. The distance from the camera to the focal point is a known value  $F$ , created by the designers of the lens. The size of the pen is a known value  $P$ , created by the designers of the pen. The perceived size of the pen is measured by our “software” at the focal point and becomes a known value  $A$ . The goal of this exercise is to determine the distance  $D$  from the camera to the pen.



First, we must find the angle  $r$  by applying formulas from basic trigonometry:

$$\tan r = \frac{(A/2)}{F} \quad \text{and} \quad Z^2 = (P/2)^2 + D^2$$

Since we know  $A, F, P$  and  $Z$  can be calculated and the angle can be found using trigonometric tables. Once the angle is known, we can use it in another trigonometry formula to find  $D$ :

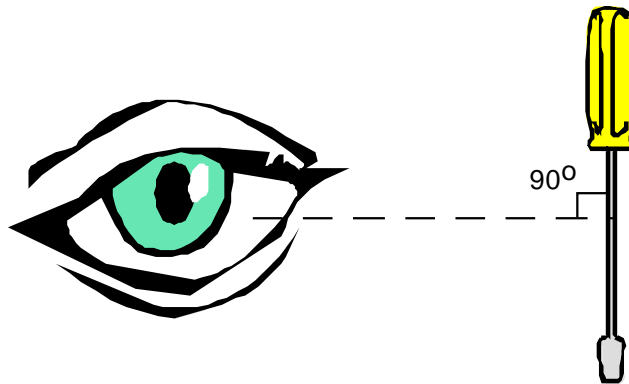
$$D = \frac{(P/2)}{\tan r}$$

Since we know  $P$  and  $r$  we can calculate  $D$  – we now know the distance the pen is from the camera.

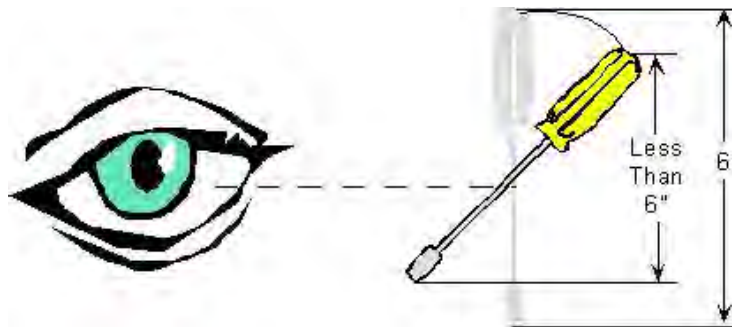
Applying this to the 3D Aligner, the image analysis software takes each image and precisely measures the size of each dot on the photograph – this is the perceived size ( $A$ ). We already discussed the known values of focal length ( $F$ ) and size of the dots ( $P$ ). Thus, using the above math the 3D Aligner can measure the distance from the cameras to any dot on the targets and can do so with a high degree of accuracy – it can measure a target 20 feet away to less than 1 mm accuracy.

## FORESHORTENING

The discussion earlier about perspective and the screwdriver example assumed that the screwdriver (or target) was “normal” to your eye. Normal means the object is being viewed straight on (perpendicular or at 90 degrees), so its full length is observed.



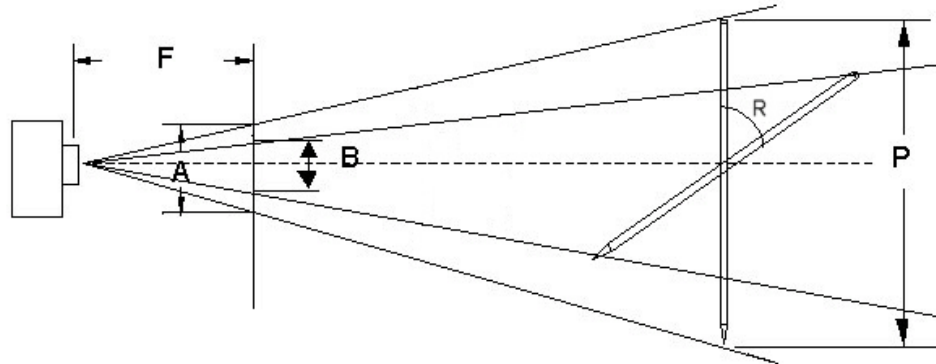
Look what happens to the observed size of the screwdriver when it is rotated away from 90 degrees to your eye— it appears smaller.



The observed size of the screwdriver becomes shorter. The more it is rotated, the smaller it appears to be. This effect is called *foreshortening*. As before, if you know the actual size of the screwdriver is 6 inches, by measuring the observed size and applying mathematics it is possible to determine the screwdriver's angle of orientation with respect to the normal view.

Focal Length (fixed by lens)

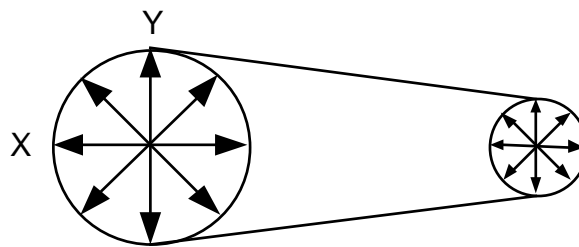
Pen (known length fixed)



In this example, the camera is at a fixed point in space. All fixed camera lenses have a fixed focal point. The distance from the camera to the focal point is a known value  $F$ , created by the designers of the lens. The size of the pen is a known value  $P$ , created by the designers of the pen. The observed size of the pen is measured by our "software" at the focal point and becomes a known value  $B$ . The goal of this exercise is to determine the angle of orientation  $R$  away from the normal position.

### THE CIRCLE

Hopefully by now we have some understanding of how the 3D Aligner can determine how far away the targets are and their angle of orientation. Of course, when placed on a vehicle the dots are likely to be at varying distances from the cameras and at varying angles or orientation at any given moment. An observer to the above may ask, "how can the aligner tell the difference between the effects of perspective and foreshortening? All it knows is the targets images are smaller than their actual size. What about orientation changes in 3 dimensions?". The answer is a powerful geometric shape, the circle. As you will find out, the circle was chosen as the geometric shape for the targets because of its mathematical relationships. For this discussion, assume the aligner targets consist of a single large dot.

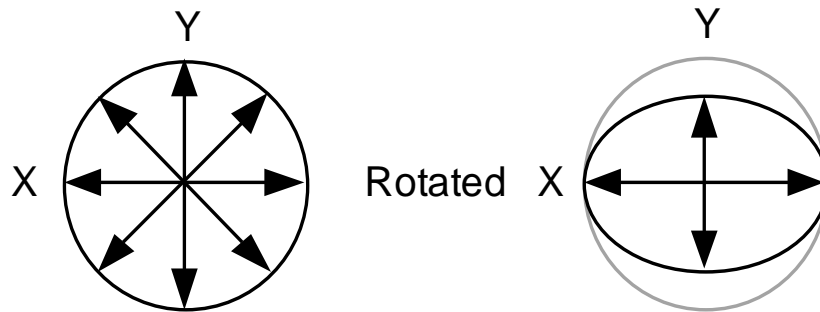


**Normal View of Circle - Moving Away**

The circle has some unique characteristics that make it useful for the 3D Aligner. When you look at a circle from the normal position (straight on, or a 90-degree angle), the diameter across is equal no matter where it is measured. As the circle moves away from you, the diameters appear to get smaller due to the effects of perspective as discussed earlier.



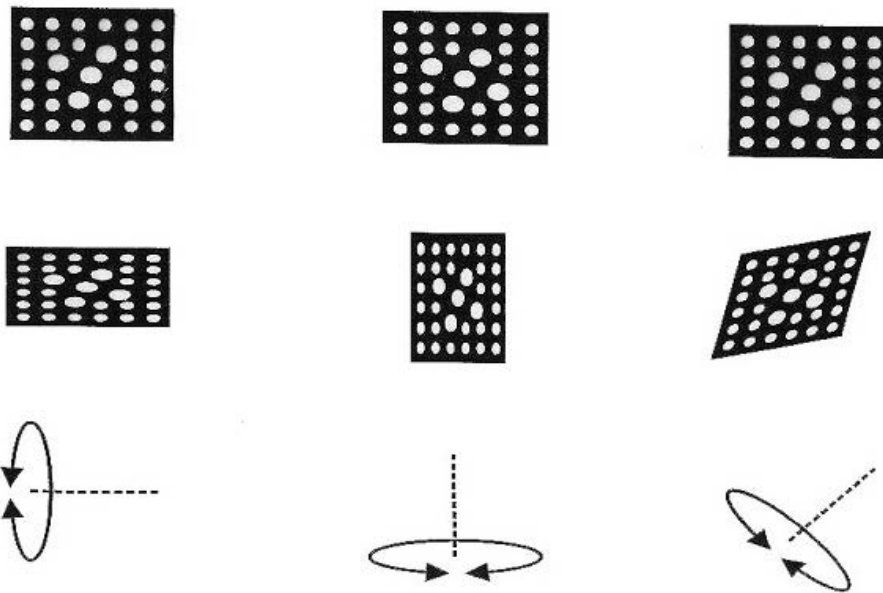
Now look what happens as the circle is rotated about the X-axis – in two dimensions it appears to be an elliptical shape.



The more we rotate the circle about the x-axis, the smaller the y-axis diameter appears. In fact, a mathematical relationship exists that says if you can measure the length of the y-axis line and the length of the x-axis (the circle's true diameter), you can determine the angle of rotation.

To put this all together, no matter how you rotate the circle in any dimension (X, Y, Z), the true diameter axis is always visible. This is called the ellipse's *long axis*. The 3D Aligner measures every diameter on the target dot and uses the long axis it finds as the true diameter to determine how far away the target is through perspective. Then, it looks at the diameters in the other dimensions that are 90 degrees to the true diameter to find the *short axis* and determines the angle of orientation away from normal with foreshortening. Using these methods it determines where the target dot is in three-dimensional space with respect to the camera, both distance and orientation. It is the circle's unique characteristics that allow the aligner to distinguish between the effects of perspective and orientation. Examine below to see an example of a target rotated in different directions.

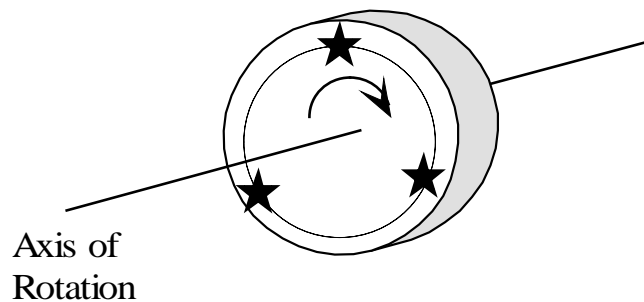
For this discussion we assumed the target has only one dot. In reality, each target has 33 dots (and there are 4 targets), and the 3D Aligner's powerful computer system analyzes each circle simultaneously for incredible accuracy and resolution. We have now seen how the aligner uses the camera images to determine the target's location and orientation in 3-dimensional space. It now has the capability to measure, but how does it use these principles to measure wheel alignment angles?





## POSITIONING SEQUENCE

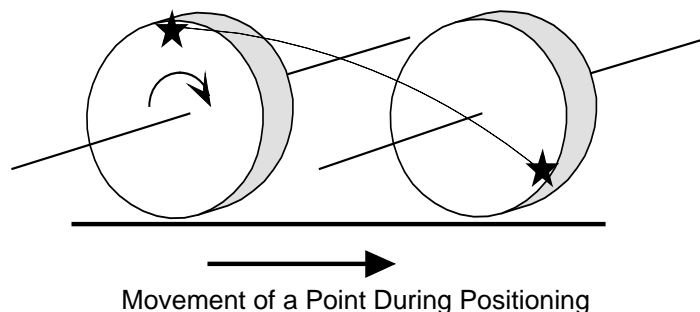
The 3D Aligner knows where the targets are, but it does not yet know where the vehicle is. Of course, the targets are attached to the vehicle's wheels, and this provides the link to the vehicle's alignment angles. The term "wheel alignment" is a bit misleading. We don't adjust the wheels, we adjust the suspension and steering components, resulting in changes at the wheel. It is the vehicle "spindle" that receives the alignment, and the wheels are just along for the ride. All wheel alignment equipment uses the spindle as a starting point, usually by either placing the measuring device directly opposite the spindle or by performing a runout compensation referencing gravity or the rack. The 3D Aligner finds the spindles in a unique way that improves accuracy and speed.



A single point on the wheel/tire is represented by the star. If we rotate the wheel/tire and track the position of the star at various points we would find the star movement forms a circle. If we determine the center of the circle we have defined the axis of rotation of the wheel/tire. In automotive terms, the axis of rotation of the wheel is called the spindle.

The 3D Aligner locates the vehicle spindles directly using a procedure called *positioning*. In positioning, we rotate the wheel/tire/target by rolling the vehicle. As the vehicle moves, the cameras track the location and orientation of the target dots. If the wheel went through a complete 360-degree rotation each dot would scribe a circle as illustrated in the picture below. If we took our scribed circle and determined where the center of that circle was located, we would find the spindle. The dot moves back as well as rotating about the axis, this allows the software to locate the spindle position in 3 dimensions with respect to the camera.

Of course there is more than one point on our targets that the cameras can track, there are 33 reflective dots. As we move the car, each dot is tracked for distance and orientation, with the software using this data to create 33 circles of different sizes. Each circle is then analyzed for the center point, with the results averaged to determine the vehicle's spindle. Since there is a target on each wheel the software finds each of the 4 spindles simultaneously.



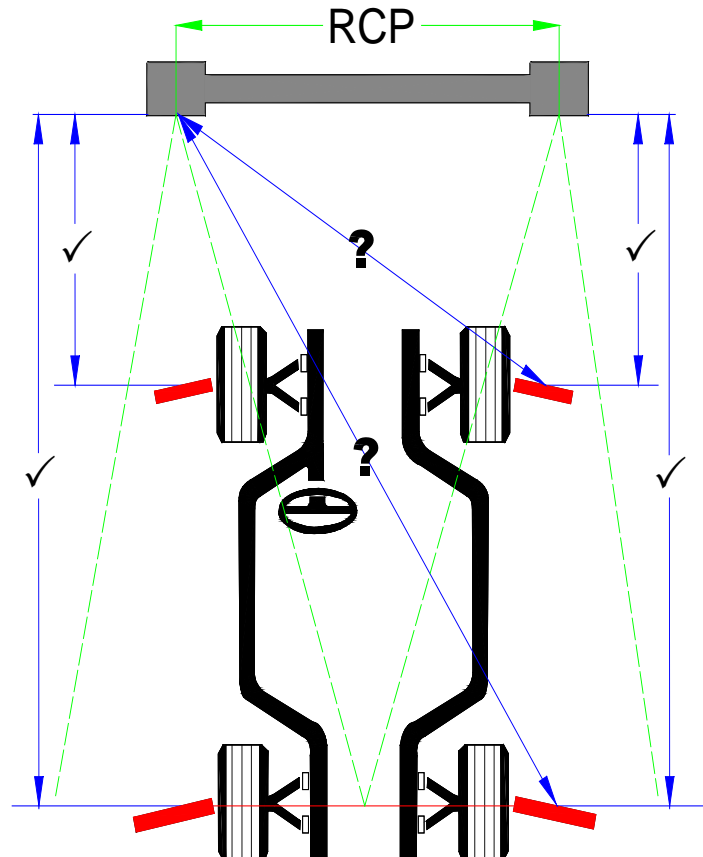
In the last paragraphs the positioning sequence described the targets dots scribing a circle through a 360-degree rotation of the wheel. In reality, this is not practical a full wheel rotation would require a roll back of 5 to 7 feet, depending on the circumference of the tire. Most alignment racks cannot handle this. The engineers were able to shorten the wheel rotation angle to 35-degrees  $\pm 5$ . This works out to 6 to 10 inches of vehicle roll, which is easy to accomplish with most vehicles.

When the vehicle is rolled, the 3D software directly locates the spindles and now knows 4 distinct points in space with respect to the cameras that are part of the vehicle. Since the vehicle is now off the rack turntables, it is necessary to roll it to its start position to perform any corrections. The aligner uses the software when rolling the vehicle as a check of the results of the compensation. As the operator moves the vehicle we repeat the positioning sequence. When the vehicle returns to the turntables we have a new measurement of spindle locations. The software then compares the results of the roll with those earlier; if they agree, the program is satisfied and moves on; if they do not agree an error message appears called "Wheel Wobble" and we are forced to repeat positioning until they agree. This is one of many examples of where the 3D Aligner performs "quality checks" to insure the highest degree of accuracy possible.

### SIDE-TO-SIDE DETERMINATION

The 3D Aligner gathers target images utilizing two cameras mounted on the ends of a beam. This beam is positioned higher than the vehicle's wheels to allow the cameras to see the rear targets (the front targets are smaller, allowing easier viewing of the rear). Each camera can see a front and rear target on its side of the vehicle, and thus determine their locations and orientations, and find the two spindles on that side. However, each camera cannot see the targets on the other side of the vehicle. When determining alignment angles such as thrust angle and setback, it is necessary to "connect" the vehicle sides, to know the relationship of the left side to the right side. To do this, the 3D Aligner must know the positions of each camera with respect to one another.

To get an idea of the type of analysis the 3D Aligner program must do. In the picture there is a vehicle with all targets attached. The program can determine the distance from each camera to the front and rear targets on its side of the vehicle as indicated by the check marks using perspective. What it cannot do directly is determine the distance from the camera to the front and rear targets on the other side (question marks). The way to find the cross-distance is to know the distance between the 2 cameras called "RCP" on the figure. If RCP is known it is straightforward mathematics to determine the cross-distance in question since two sides of a right triangle are known – Pythagorean Theorem:  $a^2 + b^2 = c^2$ . But how does the program know the dimension RCP? We must tell it!



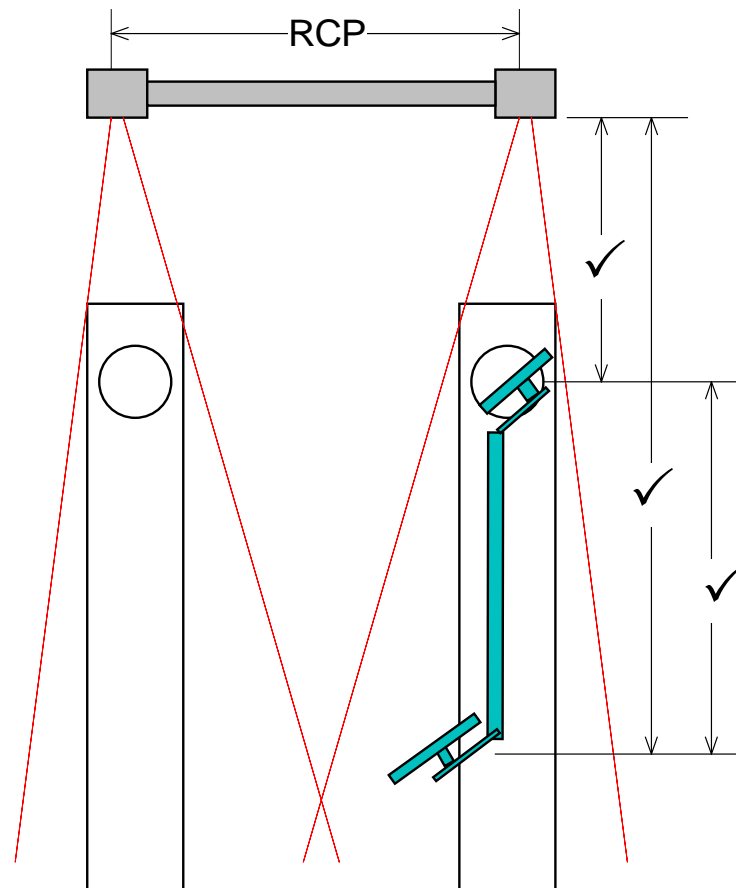
## RELATIVE CAMERA POSITIONING (RCP)

It would be easy to say that we know the distance between the cameras because we designed and manufacture the Camera Beam and cameras. However, the knowledge the aligner must have about the relationship of one camera to another is critical and must be known to high level of precision – manufacturing tolerances in the beam and camera assemblies are too variable to be counted on. When the aligner is installed the technician mounts the cameras onto the beam. Later, the technician performs a camera aim in which he/she alters the position of the cameras. NOTE: The V3400 does not required camera aim. Once all camera movements are completed it is time for us to help the program find out where the cameras are with respect to each other. We must perform Relative Camera Positioning.

## THE FIXTURE

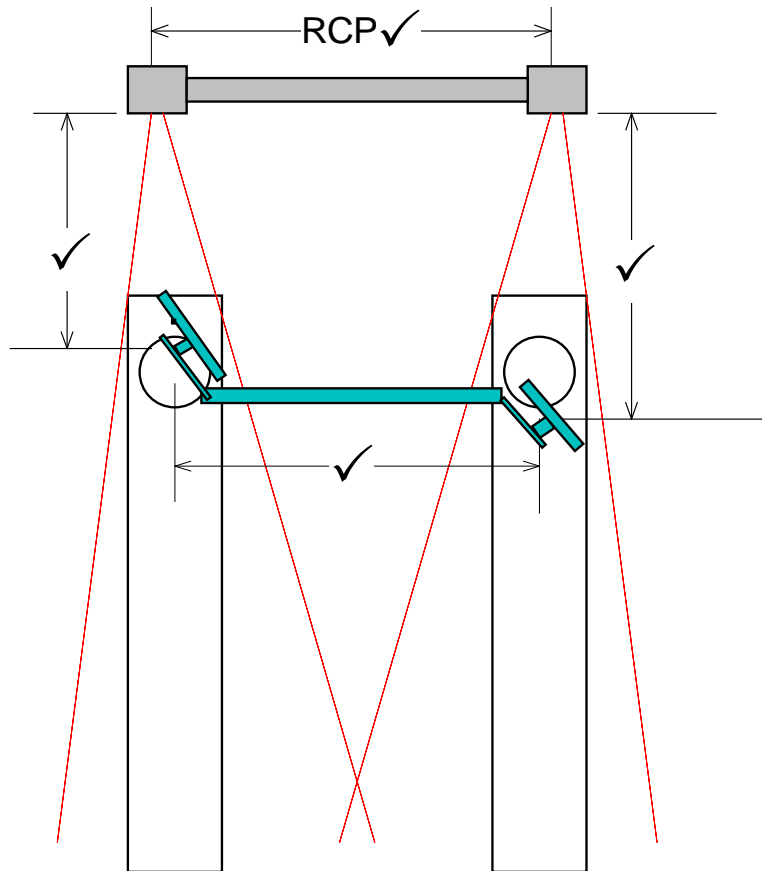
The fixture used to perform RCP and can also used for camera aiming. It is easy to use the clamp and target assemblies placed on the runway to aim cameras. It must be clear that RCP is performed at the factory and is not required unless a camera is replaced or moved.

The fixture consists essentially of a bar about 5.5 feet in length with a target attached on each end (a front and rear). Stands are used to place it on the alignment rack, which should be at alignment height so the targets are visible to the cameras. Due to manufacturing tolerances and transportation of the fixture, we cannot be sure its dimensions are the same as the design. We must measure it each time we perform RCP. Of course, we always have a highly accurate measurement tool at our disposal – the 3D Aligner. To measure the length of the fixture we place the assembly on the right runway of the rack in the view of the right camera.



The right camera measures the distance to the front target and the rear target, and subtracts the two with the difference being the fixture length. This is stored in memory for usage later in the RCP procedure.

To determine Relative Camera Position we need to take the fixture of a length we know and place it across the runways, placing one target in the left camera's vision and one target in the right camera's vision.

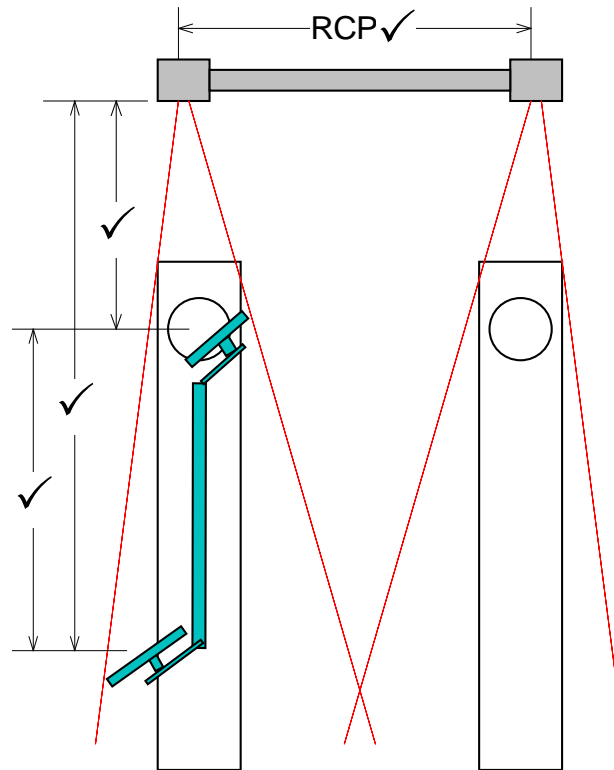


The right camera measures the distance to the right target, the left camera measures the distance to the left target, and the memory has the fixture length. We have 3 of the 4 sides of a trapezoid, and through application of mathematics we can determine the fourth – RCP. We also recheck our calculations several times by placing the fixture back on the runways at different points before proceeding.

The RCP procedure establishes the missing dimension that allows side-to-side determination – each camera's position with respect to each other. The accuracy of this calculation is highly dependent on the fixture being dimensionally stable as we move it from point to point on the rack. The final step is to recheck the fixture to make sure it is the same length. We call this rechecking the fixture length.

We do this by placing the fixture on the left runway so that both targets are in the visual field of the left camera. If we measure with one camera, then measure with a different camera and get the same values we can be sure the fixture has remained stable and our RCP is valid.

If the final check reveals the fixture has changed dimensions during the process we are given notice and must repeat the RCP procedure from the beginning. Because the Camera Beam is rigid, the cameras are hard-mounted to the beam. And the structure is away from the action, the system does not require periodic maintenance calibration. The only way the accuracy of the RCP can be affected is if one camera moves with respect to the other – not likely to happen in every day usage.



### MODELING THE VEHICLE IN 3-DIMENSIONAL SPACE

After Positioning is completed, and the program is able to relate one side of the vehicle to the other, the software knows 4 distinct points that create a plane in space that are part of the vehicle. It takes these points and creates a 3-dimensional model of the vehicle plane. From this model, all alignment angles, caster, SAI, camber, and toe are referenced to the vehicle plane. This is in contrast to conventional measuring-head aligners that use gravity or the rack surface as a reference. For this reason, the 3D Aligner does not rely on a level lift. In reality, the aligner does not require gravity to measure, but our vehicle's physical state will change radically in a weightless environment.

## **MEASURING STEERING ANGLES**

The steering angles caster and SAI are defined by physical components of the vehicle suspension, those that define the steering axis (such as upper and lower ball joints on a short-arm long-arm suspension). Conventional aligners measure these angles using gravity gauges and the toe system by monitoring the affect these angles have on those angles as the wheels turn. Once again the 3D Aligner is unique and superior.

The 3D program locates the steering axis directly in 3- dimensional space in the same way it found the vehicle's spindles. We locate the axis by putting our targets in motion about the axis by turning the wheels. First, we turn one direction 10 to 13 degrees. The software monitors the movement of the target dots, which scribe an arc. The program finds the center of each of the 33 arcs, averages, and knows where the steering axis is located. As with the spindle determination, we check our findings by turning the wheels the other direction. If the two steering axis calculations agree, we pass this along to other parts of the software that convert axis locations to caster and SAI angles referenced to the vehicle plane.

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## CHAPTER 3

### CHECKOUT, CALIBRATION AND MAINTENANCE

#### TROUBLESHOOTING THE SYSTEM

Before using this troubleshooting guide there are some steps that the user must follow. Failure to follow these guidelines will result in longer repair times and repeated callbacks. In using this guide always start with basics regardless of the complaint. Some of the screen captures in this Chapter were taken using a two camera system. Servicing an Ultra Arago or V3400 will only add an additional camera view. The troubleshooting is handled the same.

#### GUIDELINES

- Before beginning any diagnosis verify the customer's complaint and aligner's condition in great detail. In many cases the problem is not the equipment, it's an operator error.
- Never make more than one change at a time on a defective machine. This could result in extended repair times and unnecessary parts replacements.
- If the replacement part did not fix a problem reinstall the original component. (Before trying something else)
- If the replacement part appears to fix the machine take a few minutes to reinstall the defective part and verify the repair and diagnosis. Verification always ensures that the problem has been resolved and usually prevents a return service call.
- When sending a defective part back for repair a detailed description of the failure should be included with it. Failure to follow this procedure may result in a failed part getting returned to the field un-fixed.
- Every Technician should keep a notebook with descriptions of errors, and fixes he has encountered on the aligner. It's easier to repair future problems based on known good experiences instead of guessing what was done the last time this problem was seen.
- Always have current software on-hand.

#### DEFINITIONS

Several types of calibration are discussed or mentioned in the following pages.

- **RCP** is Relative Camera Position. It is the calibration that we do to a 2 camera system to know where the two cameras are with relation to each other. Must be done when you swap out a camera.
- **RTP** is Relative Target Position. We do this for the 3D target to know where one of the sub targets is with relation to the other sub target. We also do this in RCP when we put the cal bar on one side of the rack (the 2 targets are visible in 1 camera).
- **RCTP** is Relative Camera to Target Position. This is the relative position of the calibration target to the wheel camera in the RCTP pod. This needs to be updated any time that pods camera is replaced.
- **RCCP** is Relative Camera to Camera Pod. This is the relative position of the calibration camera to the wheel camera in the RCCP pod. This needs to be updated any time that pods camera is replaced.
- **TID** is Target ID. It is a process in which we measure the relative position of the target to the center of the clamp claw points and save it for later use.

## CALIBRATION UTILITIES

The Calibration Utilities are special utilities designed to calibrate different parts of the alignment system. It also includes a utility used to back up the calibration data and to aid a technician in the proper troubleshooting of the V3D system



### ISO

Utility used for performing ISO calibration. A special fixture is required to perform this procedure. The procedures are included with the fixture. This should only be done by a qualified technician.



### SYSTEM CONFIGURATION

Utilities used to configure the systems camera configuration.



### TID

Utilities used for performing Target Identification for the different types of clamps available to the end-user including Standard Clamps; AC200, AC400, AC900 and others.



### CAMERA VIEW

Live camera view. This utility is very useful for determining proper camera operation.



### RELATIVE CAMERA POSITION (RCP)

Process used to identify the camera's distance from one another.



### RIDE HEIGHT TARGET CALIBRATION

Utility used to calibrate the "Ride Height Target" if available.



### CALIBRATION UTILITIES

Utility used for backing up calibration data.



## SYSTEM CONFIGURATION

After a camera has been installed it will be necessary to train the alignment system which side the new camera has been installed.

**NOTE: FAILURE TO FOLLOW THIS PROCEDURE AFTER A NEW CAMERA INSTALLATION WILL RESULT IN IN-ACCURATE ALIGNMENT RESULTS.**

1. From the calibration menu click on the "System Configuration" icon.
2. Select the proper "Imaging System Type"

- Two Camera System



- Three Camera System



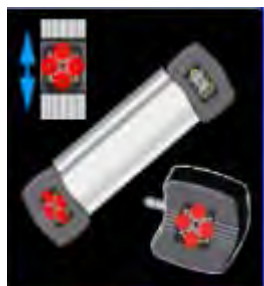
- Two Cameras with remote camera



- Three Cameras with remote camera



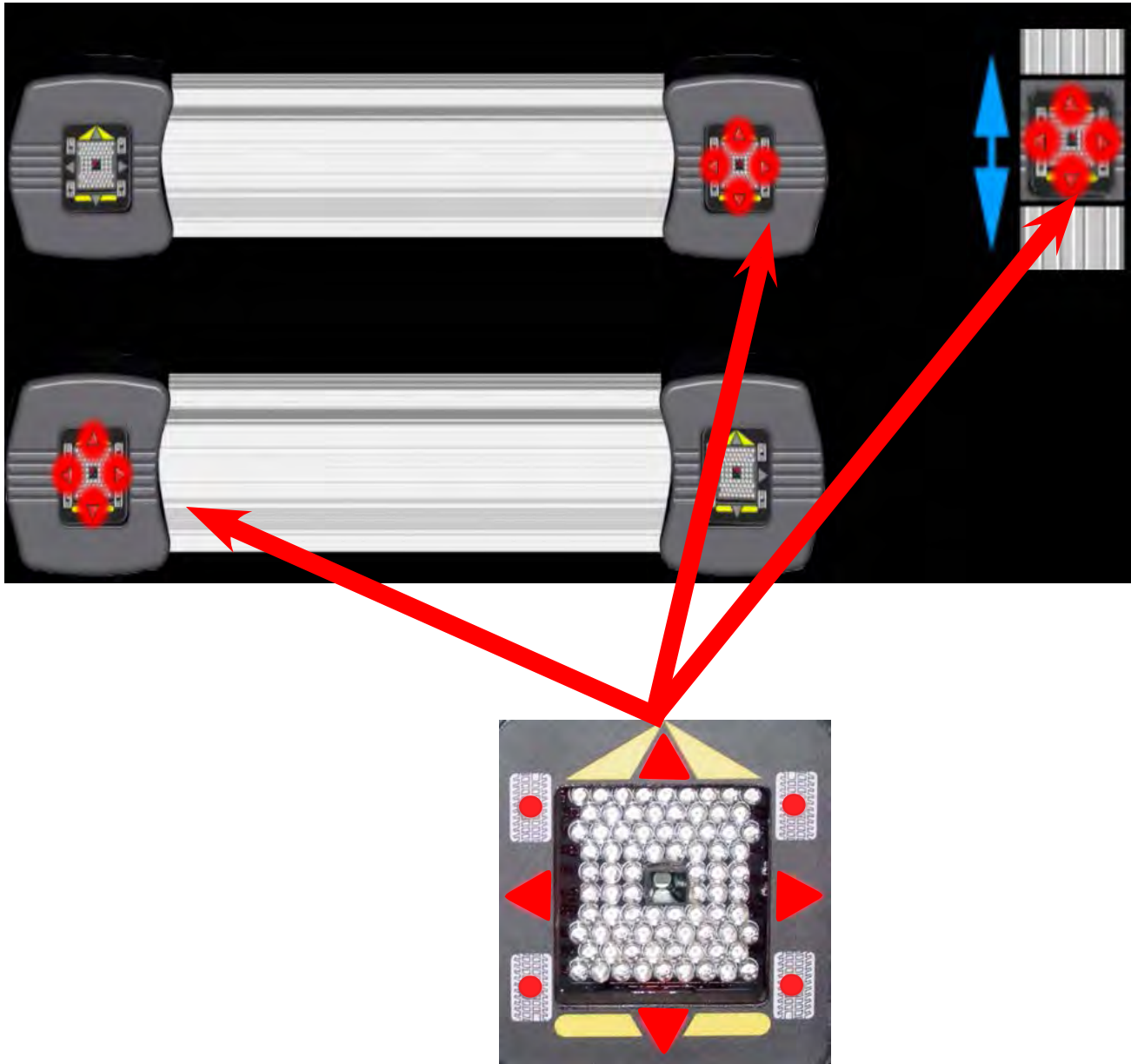
After selecting the correct camera configuration the each of the camera must be identified. By clicking on "Camera Identification" icon a display with a camera beam will appear.



## CALIBRATION

After gaining access to the camera identification, look closely at the illustration of the two camera beams. The upper camera beam illustrates the right (passengers side) directional arrows illuminated and the lower camera beam illustrates the left (drivers side) directional arrows illuminated. If a 3 Camera system was chosen in the previous screen the user will also need to identify the calibration camera or if a remote camera is present it will also need to be identified. Use the pointing device, click on the illustrated camera beam that matches the camera beam that is being serviced. After selecting the correct illustration the illuminated directional arrows should swap from one camera to the other. Again using the pointing device click on the camera beam that matches the beam being worked on. After all cameras have been selected the user is prompted to restart the alignment software.

**NOTE: IF THE INCORRECT CAMERA IDENTIFICATION IS SELECTED THE CAMERA' IMAGES WILL BE SWAPPED FROM LEFT TO RIGHT AND ALL IMAGES WILL APPEAR IN THE CAMERA**



**VIEW AS UPSIDE DOWN**

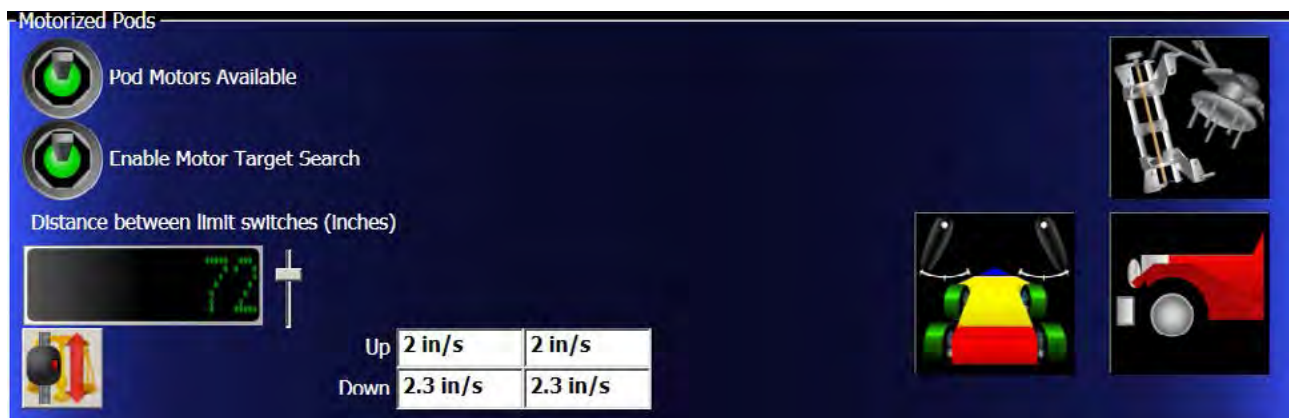


There is also three additional selection buttons available once the Imaging system has been determined.

1. Less than 2.3 Meters (90 Inches)
  - This button should be set to the ON (up) position if the cameras are less than 90 inches from the turnplates. Changes the acceptable range and tolerance of camera based on the the installation baseline.
2. Ride height target in use (calibration explained later)
  - If a ride height target is available this must be turned on the utilize the ride height target capabilities.
3. Front clamps uses 20 degree offset .
  - If 20 degree offsets are used on the front clamps this selection must be turned on.

**Motorized Pods**

If an Arago 3 camera system is selected the user is given additional selection buttons. Each of these buttons should be turned on the utilize the pod motors on the Arago system. If the auto search mode is not working the user should check to ensure of these are on. NOTE: V3400 systems do not required this function.



After enabling the pod motors the user must calibrate them. Using a tape measure, determine the distance from the bottom camera switch on the beam and the top camera switch on the beam. Each side must be identical for proper operation. Move the slider bar until the correct distance is displayed (72.9 used on our system). Make sure the camera pods are free from all obstructions and click on the "calibrate camera motor" button. The system will run the pods from top to bottom or vice versa. After the pods have automatically calibrated the system will auto input the inches per second that the pods are traveling.



## CALIBRATION

In order to maximize the Arago 3™ alignment system, the cameras have been mounted on a swivel pod assembly. This swivel pod allows the right and left cameras to rotate in order to see the targets in all field of views (Narrow, Normal and Wide). The Arago does not require RCP because the third camera maintains constant calibration. NOTE: V3400 systems do not require swivel pod calibration.

1. From the calibration menu single click on the “Pod Rotation” icon.



2. Adjust the camera lever's to the illustrated position shown on the screen and click on **<Next>**.



3. After clicking on “Next” as indicated in step 2, the camera rotation levers change positions. Move the camera levers to the position shown and click on **<Next>**.
4. Continue the process until all camera positions have been checked. After the final rotation lever has been checked click on the **<Next>** button to exit.



**NOTE: IF A MISTAKE IS MADE DURING THE TEACHING PROCESS, THE OPERATOR CAN SIMPLY CLICK ON THE RESET BUTTON TO CLEAR THE LEARNING PROCESS AND START AT THE BEGINNING.**

Wheel Clamp Selection



The customer has several different options of the types of wheel clamps being used. Depending on which market the Aligner is sold in the most common clamp used will be the AC200 and/or AC400 wheel clamp. If additional wheel clamps are used the customer must enable them using the "Wheel Clamp Types". Any wheel clamps that are selected must be ID by the system (Explained below) before they are put into use.



TID

The Pro42 system has several different types of wheel clamps available to the end-

user. Each clamp has a specific use. The "Conventional Clamp" or AC200, comes standard with the Arago aligner. Each target / clamp must be ID'd before using them in the alignment process. Once these targets have been ID'd the customer will then have to choose which clamp assembly he/she will be using for each alignment. The single pole wheel clamp is unique. If it is chosen there are no other options available.

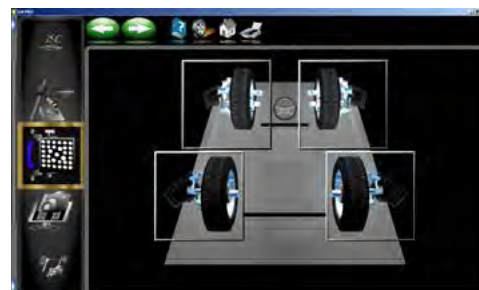
**Conventional Clamp AC200** - Used to perform Target Identification on Conventional Wheel clamps. These clamps and target come standard with the Arago aligner while the AC400 is standard on the Audit aligner and the V3400.

## TARGET ID PROCESS

**NOTE: BEFORE PERFORMING A TID THE OPERATOR MUST CLEAN THE TARGETS WITH GLASS CLEANER AND A LINT FREE CLOTH. THIS IS A VERY CRUCIAL PROCEDURE. ONLY 1 TARGET MUST BE IN THE CAMERA FIELD OF VIEW DURING THIS PROCEDURE.**

1. Click on any of the target ID icons to begin the process. Make sure that the process chosen is for the correct target and wheel clamps. For illustration purposes the Conventional Clamps are used.
2. Move the box around the screen using the arrow keys and click NEXT, or you can double-click on the desired wheel.
3. Once the wheel is selected the screen will instruct the operator to place the target/clamp assembly on the front wheel and lock the steering wheel using the clamp. This step insures the wheels will not move laterally during the Target ID procedure. The next step on this screen is to elevate the front wheels to allow them to rotate as needed. Click OK when ready to proceed.

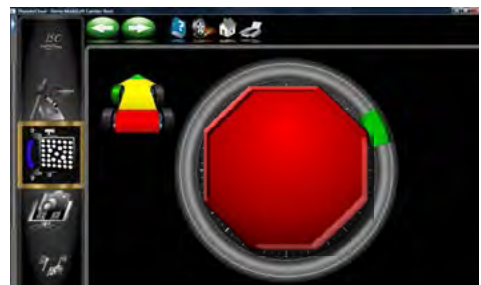
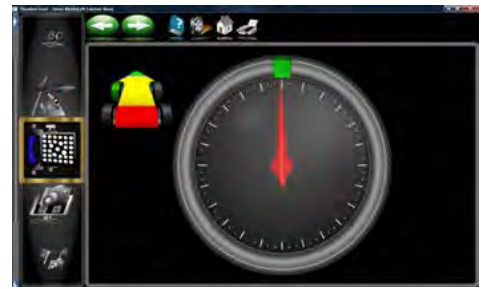
**NOTE: USE RIGID SUPPORTS (JACKS ON LOCKS), ANY DOWN MOVEMENT OF THE WHEELS CAN AND WILL CAUSE INCORRECT MEASUREMENTS WHICH WILL IN TURN CAUSE INACCURATE ALIGNMENT READINGS.**





## CALIBRATION

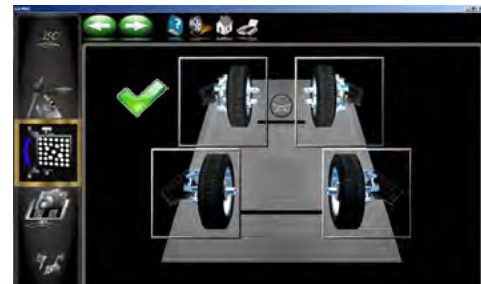
4. Once the system acquires the target an arrow indicates the direction to rotate the target/wheel. The initial rotation is  $25^{\circ}$  forward.
5. If the tire and wheel is rotated past the  $25^{\circ}$  point the meter will change to red letting the operator know to rotate back.
6. Once the wheel has reached the desired location a stop sign will appear in the center of the wheel. Hold the wheel steady as the aligner will take a reading.
7. After the readings have been taken the screen instructs with arrows indicating to rotate the wheel and target back  $90^{\circ}$ . This  $90$  degrees is from the first  $25^{\circ}$  forward, rotate the tire back until a stop sign appears as in step 6 and hold the wheel steady as another reading will be taken.
8. After the readings are taken the arrows indicate to rotate the tire and wheel assembly forward  $90^{\circ}$ . Rotate the wheel until a stop sign appears and hold the wheel steady as a reading will be taken.



9. After the completion of a successful target ID the screen indicates to lower the wheel. This is not necessary if the opposite side target is needing to be ID, click on the **<OK>** button and select the next target. Lower the wheels after all four targets have been ID'd.



10. The program returns to the Target Selection screen to allow additional targets to be ID'd. Repeat this process for all targets. A green check mark appears next to the targets that have been ID'd.



## CAMERA VIEW

See the Diagnostic Chapter for details using "Camera View"  
**RCP Fixture Assembly**



## CALIBRATION

---

1. Raise the lift to the alignment working height with no vehicle. Set the lift down on the locks.
2. The RCP fixture must be assembled prior to use. The components consist of:
  - Aluminum bar
  - Large and Small Target
3. Attach the small target to the single leg bracket.
4. Attach the large target to the double leg bracket.
5. Clean the targets using glass cleaner and a soft lint free towel. **DO NOT USE A SHOP TOWEL.**

### RELATIVE CAMERA POSITIONING (RCP)

The purpose of the camera calibration procedure is to measure the cameras' positions relative to each other. This allows the aligner to make accurate measurements between the left and right sides of the vehicle. For this reason the alignment program will not run until a valid RCP has been performed. The unit is shipped from the factory with valid RCP factors and it is not necessary to perform RCP unless a Camera is exchanged or RCP has been lost such as a crashed hard drive with no back up.

Tools needed: Fixed-Length Target Fixture with two targets.

1. Raise the empty lift to working height (no vehicle). Close the garage door to block any stray daylight.
2. Prepare the Calibration Fixture.
3. Clean the two targets on the fixture, according to the user manual. Use a glass cleaning fluid and a soft cloth. Make sure that the glass is free from grease and dirt.
4. Power on the Alignment System.
5. From the calibration menu click on the RCP icon to begin the process.
6. Slide the turntables to the outboard position. Place the calibration bar on the right rack rail, with the small target on the outside of the front turntable, and the large target towards the rear center of the rail.



7. Click on **<NEXT>** when done.

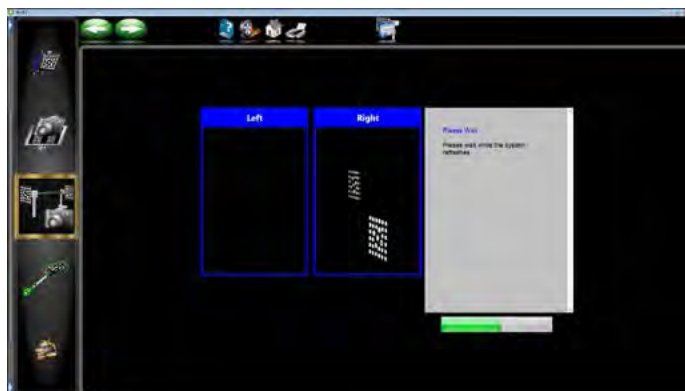




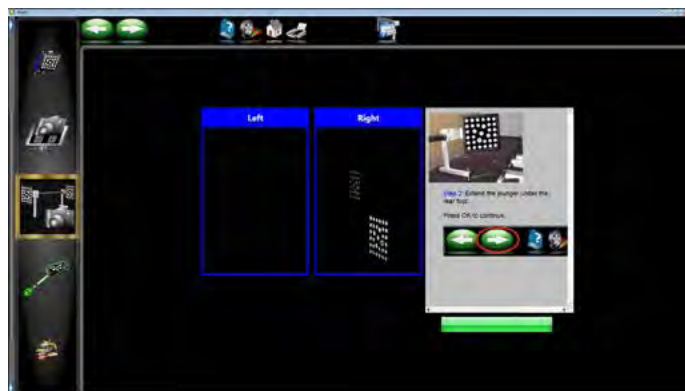
8. Two images should appear in the upper left hand portion of the screen. The aligner will sample the images and will automatically prompt the technician for advancement. Click on the <NEXT> button when prompted.



9. The aligner will sample and process the images. Notice the progress bar in the lower right hand corner.



10. After a period of time a message is displayed to raise the plunger on the double leg bracket. This will cause the images to rotate on the screen. Click on <NEXT> when prompted.

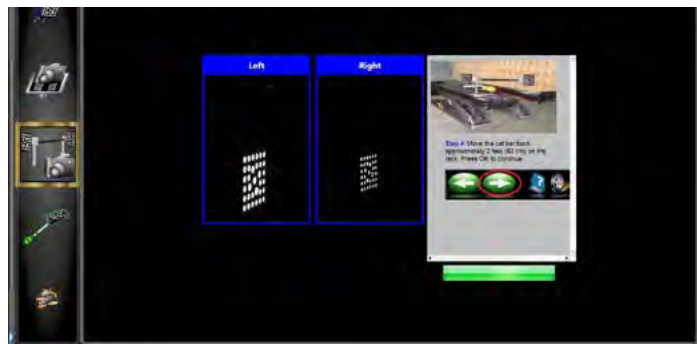


11. Retract the 1.5" plunger. Place the cal bar with the small target on the right rail, the large target on the left rail with the feet centered front to rear on the turntables. Slide the turntables inboard if necessary. Click on <NEXT> when done.

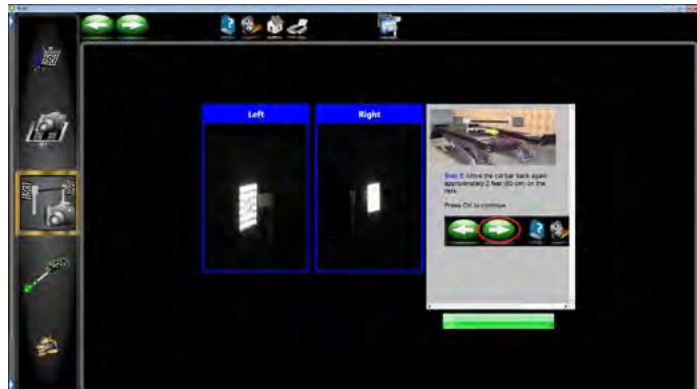


## CALIBRATION

12. Move the cal bar back on the rack approximately 2 feet on the rack. Click on **<NEXT>** when done.



13. Move the cal bar back again approximately 2 feet on the rack. Click on **<NEXT>** when done.



14. Move the cal bar back again to the front turntables. Place the small target on the right rail and the large target on the left rail. Center the feet front to rear. Click on **<NEXT>** when done.

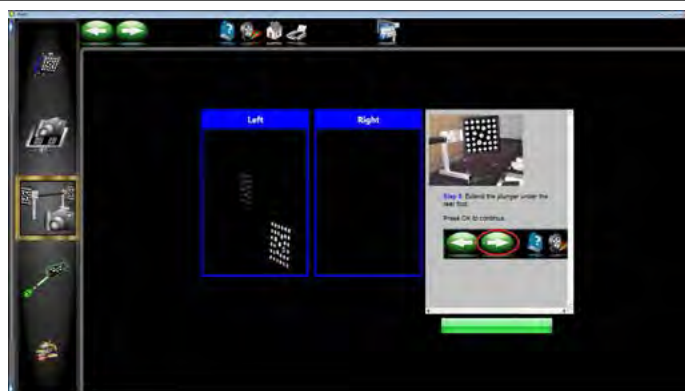


15. Place the cal bar on the left rail with the small target in the center of the front table and the large towards the rear outside of the rail. Click on **<NEXT>** when done.



16. Extend the plunger under the rear foot. Click on **<NEXT>** when done.

**Congratulations!** You have successfully completed calibration.



## ACTIVATE AND CALIBRATE THE RIDE HEIGHT MEASURING DEVICE

From the **Calibration Menu**, click on the **System Configuration** icon and click on **Ride Height Target** switch to activate the Ride Height Target feature.



## CALIBRATE

1. From the **Calibration Menu**, click on **Ride Height Target Calibration** icon to begin the calibration process.
2. Locate the Ride Height Calibration fixture and place the fixture on one of the lift runways so the straight edge is toward the camera.
3. Select the side of the rack you are to calibrate from.
4. Place the tip of the target pointer into the hole in the base of the calibration fixture.



**NOTE: THE POINTER TIP MUST REMAIN IN THE HOLE DURING ALL STEPS OF CALIBRATION.**

5. Tilt the target to the first position. The reflective surface of the target should be facing the camera. The target should be steady during each step.



## CALIBRATION

6. The <NEXT> button will illuminate once the target has been acquired. Click on the <NEXT> button, a check mark will appear prompting the user to proceed to step 2.



7. Proceed with calibration, until all three steps have been completed.
8. Should calibration of the ride height target fail, a warning dialogue box will pop up and the user must begin the process from the beginning. After the process completes the 3rd step the software auto advance to the main menu.



## CALIBRATION BACKUP / RESTORE

Calibration and Preference backup offers the user or technician a way of backing up all customized options and alignment calibration to a flash drive. Should an alignment machine require a hard drive replacement the user or technician can simply restore all data from a saved flash drive back on to the newly installed hard drive. From the **Calibration Menu** click on the **Backup** icon.

**NOTE: Calibration Data Backup must be activated or checked in Preferences, Features. If not activated the system only backs up preferences and custom specs**

**Backup** - It is recommended after every calibration that the user backup the new data in case of a PC or Hard Drive failure. This enables the user to quickly restore the alignment system's calibration after the operating system has been restored. It is recommended that each time the system is backed up the user date the flash drive. This ensures that the most current data backup be restored. Insert the flash drive into one of the open USB ports on the PC. Click on the <FIND> button to point to the flash drive and click on <OK>. After the selection is made click on the backup button. The user is prompted to confirm the location.



**Restore** - Should a hard drive failure occur or a PC replaced, simply install the last known alignment calibration and preference data disk and restore the aligner back to the user's preferred preferences.



**NOTE: IF THE OPERATOR IS NOT SURE IF THE SAVED DATA ON THE FLASH DRIVE IS NOT CURRENT IT IS RECOMMENDED THAT A CALIBRATION BE PERFORMED. FAILURE TO HAVE ACCURATE CALIBRATION DATA CAN AND WILL CAUSE EXCESSIVE TIRE WEAR.**



## NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

## CHAPTER 4 DIAGNOSTICS

The Diagnostics menu offers the technicians tools to troubleshoot and diagnose problems with the aligner only. These diagnostic routines will not diagnose all problems that could arise. The technician should also become familiar with the proper hookup and voltage that is supplied to this unit.



Before troubleshooting the V3D Pro42 UHR system it is very important that you check to make sure the correct wheel clamps are selected in the Preference Menu. It is possible that a user could inadvertently change the wheel clamp type not knowing the consequences. This could cause the service technician to improperly troubleshoot and diagnose a problem. Having the incorrect wheel clamp may be the problem.

1. From the Main Menu select the Preference Icon.



2. Select the System Configuration Icon.



3. Click on the "Clamp Selection" Icon.



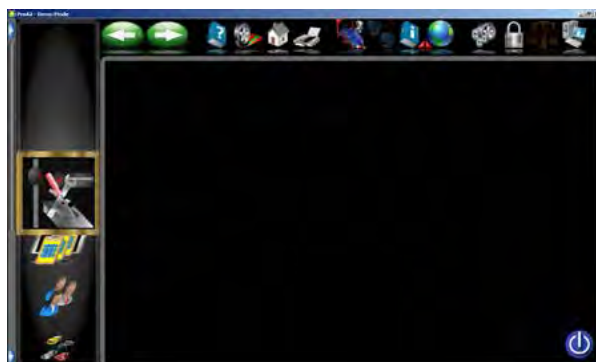
4. If the AC200 wheel clamp is selected no other wheel clamp is available.

There are several types of wheel clamps.





From the Main Menu select the Diagnostic Icon at the top of the Carousel.



### STORED IMAGE ANALYSIS

Allows the user to view and zoom into stored images (stored using Ctrl Alt P). This feature is available any time that the system has target view on the screen. The system is set to acquire images for every 2 seconds for a known time after which it will switch to 4 seconds and then 20 seconds and then 1 minute. The system will automatically stop the process when the user goes to the home screen to begin a new alignment. This feature is helpful if a system is experiencing problems randomly.

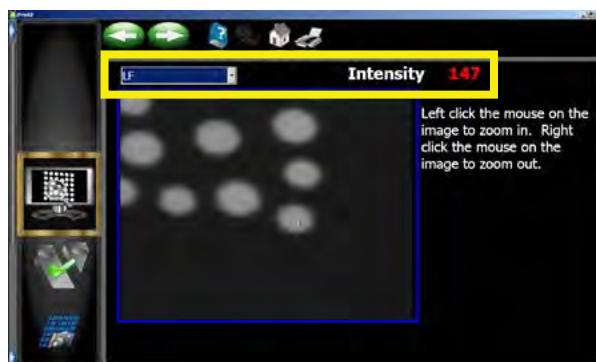


**NOTE: EACH TIME "CTRL ALT P" IS PRESSED IT WILL OVERWRITE THE PREVIOUS STORED IMAGES. IF TARGETS ARE NOT AVAILABLE IN THE CAMERA VIEW THERE WILL BE NO IMAGES TO LOOK AT USING THIS FUNCTION.**

- Allows you to view individual pixel intensity levels.

Moving the cursor over the image display, the pixel value (intensity) of the cursor location is displayed in red. The brighter the cursor location the higher the intensity value. Left clicking on the image using the mouse zooms in on that location. The user must remember to view the correct intensity of a particular target he/she must select it. The system will sample both the front and rear targets, alternating between the two. The user must select the target during its sampling process to obtain the correct values.

Click on "OK" or "Cancel" to exit this test.



## RACK CHECK

This test checks how coplanar (parallel) the rack is. Even though we are very resistant to rack problems, non coplanar racks can introduce some error to our system.

The image aligner is designed to perform a perfect alignment every time. The levelness of the rack “side-to-side” or “front-to-rear” is irrelevant to performing this perfect alignment, however a rack that is non coplanar (parallel) will induce erroneous readings because the suspension of the vehicle is under stress.



**NOTE: This test is not available when aligner is equipped with 3d or XD targets.**

A Non Coplanar rack is evident when one runway is tipped up or down relative to the opposite runway.

- This test checks how coplanar (parallel) the rack is. Even though we are very resistant to rack problems, non coplanar racks can introduce some error to our system.
- If the lag between rails is less than 0.02 inches (0.5 mm), the rack is considered to be coplanar.
- If the lag is greater than 0.02 inches and less than 0.3 inches we display the value but leave it up to the individual shop to decide what to do. Although this will not cause a great deal of problems it will affect the alignment readings a small amount.
- If the lag is over 0.3 (7.5 mm) inches we tell the user to adjust the rack to the manufacturers specifications as this will affect alignment accuracy.

This test requires the use of the RCP fixture. The technician must have this fixture to check the rack rails for a coplanar (parallel) condition.

5. Place the RCP fixture across the rack with the small target on the RF turntable and the large target on the LF turntable and press “OK”.
6. Move the RCP fixture towards the rear of the rack just FORWARD of the rear slip plates.
7. Read the results.

Click on “**OK**” or “Cancel” to exit this test.

## DATA EXAMINATION

- This mode allows the operator to look at raw plane generation data as it arrives. This information depends on the camera being used (Ultra or Ultra UHR or V3400)
- Displays the number of proto-blobs (dot like object in the cameras FOV. Could be a reflector on a car or a dot on a target) as well as measured blobs.
- Translates error codes into text explanations that may aid in diagnostics.

The data examination mode displays a myriad of information. The information is updated on-going and can be used by the operator if a failure in the alignment mode occurs. This test has two pages of information. By clicking on the small respective target identification in the upper left hand corner the operator receives the second page of information. This is only available when you access this screen from the Menu mode and not from the camera view toolbar button.



**RMS** - Background noise, should be .05 or less, .10 is maximum.

**Target Blobs (Dots)** - Number of Blobs identified. The number in parenthesis is the number of potential dots.

**Distance (")** - Distance from the camera to the respective target in inches.

**Target Angle (°)** - Angle of target

**Intensity** - The amount of light sent back from the target. Minimum = 100 Goal = 160 Maximum = 220

**Error RTP/Vector/Flag** - Status of the V3D target and wheel clamp (Vector reflects type of clamp being used)

- Error RTP (Relative Target Position)**

9 = Good RTP

0 = No RTP

? = RTP is bad

- Vector** - This data is use for the **wheel diameter** indicators on the single pole wheel clamp. This data is VERY useful when acquiring targets and wheel clamps during rollback.

0 = Good

20 = Can't find indicators or distorted indicators

65480 = Upper Grabber is mounted upside down on single pole.

21 = Not looking for marks. (The wheel diameter indicators are only used at the beginning of a rollback.

- Flag** - Target(s) information

<9 = Bad target

9 = Good target

10 = Front Sub target blocked

11 = Back target blocked

12 = Found a front target but has issues (Camera sees front target on another wheel) but cannot locate front target on respective wheel.

13 = Found a rear target but has issues (Camera sees rear target on another wheel) but cannot locate rear target on respective wheel.



Retrieve additional data by clicking on the target identification icon. The information displayed depends on the type of camera being used (Ultra or Ultra UHR)



| LF                            | RF                            | CAL                           |
|-------------------------------|-------------------------------|-------------------------------|
| Good target measurement       | Good target measurement       | Good target measurement       |
| RMS: 05                       | RMS: 04                       | RMS: 05                       |
| Target Blobs (Blobs): 32(33)  | Target Blobs (Blobs): 32(33)  | Target Blobs (Blobs): 32(33)  |
| Distance (*): 80.0            | Distance (*): 84.3            | Distance (*): 114.8           |
| Target Angle (*): 16.3        | Target Angle (*): 15.8        | Target Angle (*): 27.3        |
| Stroke: 125                   | Stroke: 150                   | Stroke: 1975                  |
| Error RTP/Vactor/Flag: 0/20/0 | Error RTP/Vactor/Flag: 0/20/0 | Error RTP/Vactor/Flag: 0/20/0 |
| Number of Planes: 262         | Number of Planes: 264         | Number of Planes: 289         |
| Number of Images: 264         | Number of Images: 276         | Number of Images: 760         |
| LR                            | RR                            |                               |
| Good target measurement       | Good target measurement       |                               |
| RMS: 03                       | RMS: 07                       |                               |
| Target Blobs (Blobs): 3(01)   | Target Blobs (Blobs): 3(01)   |                               |
| Distance (*): 163.7           | Distance (*): 161.4           |                               |
| Target Angle (*): 17          | Target Angle (*): 20          |                               |
| Stroke: 360                   | Stroke: 400                   |                               |
| Error RTP/Vactor/Flag: 0/20/0 | Error RTP/Vactor/Flag: 0/20/0 |                               |
| Number of Planes: 275         | Number of Planes: 270         |                               |
| Number of Images: 262         | Number of Images: 276         |                               |

**Threshold** - All pixels received by the cameras have a brightness level of 0 to 255. Threshold tells the cameras to ignore any pixel with a brightness level below a certain number. Threshold levels are software controlled and are primarily for engineering use.

**Acquire Count** - How many images it takes to acquire a target.

**Number of Planes** - Number of target planes that the camera has acquired.

**Number of Images** - Number of raw images that the camera has acquired.

| LF                            |
|-------------------------------|
| Good target measurement       |
| RMS: .06                      |
| Target Blobs (Blobs): 26(52)  |
| Distance (*): 130.3           |
| Target Angle (*): 20.7        |
| Intensity: 187                |
| Error RTP/Vactor/Flag: 9/20/9 |
| Threshold: 70                 |
| Acquire Count: 1              |
| Number of Planes: 14296       |
| Number of Images: 14337       |



The user can quickly jump to each targets information by clicking on the target identification icon. This screen will display warning indications if any of the following criteria have been exceeded or if a target is not visible.

- Target angle greater than 48 degrees.
- Distance to front target greater than 160 inches (4.064 meters).
- Distance to rear target greater than 240 inches (6.096 meters).
- Target RMS greater than 0.10.
- Number of target blobs is specific to the type of target being used.
- Number of images is 0 for a particular camera.
- Number of planes is 0 for a particular wheel..

NOTE: CLICK ON "BACK" BUTTON TO EXIT ALL TESTS!

The Data Examination Screen offers a few more diagnostic tools to troubleshoot the UHR cameras. Most of this information is used by engineering in development.



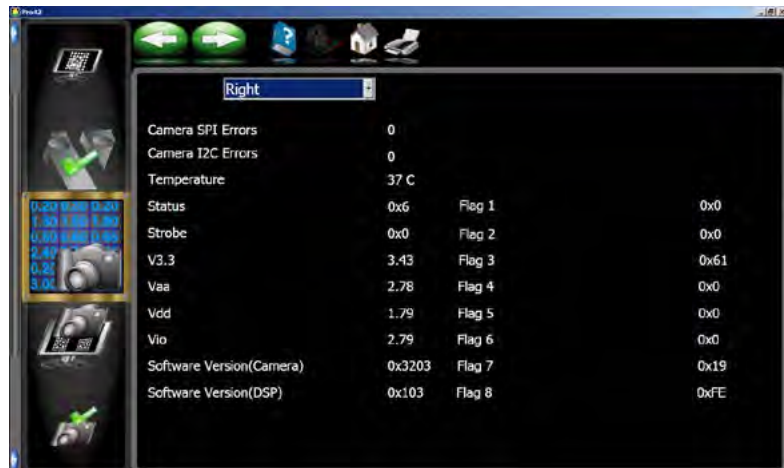
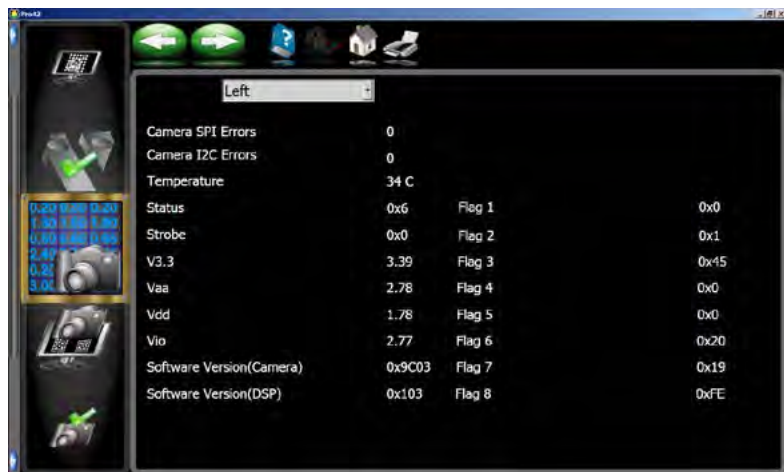
| LF                            | RF                            | CAL                           |
|-------------------------------|-------------------------------|-------------------------------|
| Good target measurement       | Good target measurement       | Good target measurement       |
| RMS: 05                       | RMS: 04                       | RMS: 05                       |
| Target Blobs (Blobs): 32(33)  | Target Blobs (Blobs): 32(33)  | Target Blobs (Blobs): 32(33)  |
| Distance (*): 80.0            | Distance (*): 84.3            | Distance (*): 114.8           |
| Target Angle (*): 16.3        | Target Angle (*): 15.8        | Target Angle (*): 27.3        |
| Stroke: 125                   | Stroke: 150                   | Stroke: 1975                  |
| Error RTP/Vactor/Flag: 0/20/0 | Error RTP/Vactor/Flag: 0/20/0 | Error RTP/Vactor/Flag: 0/20/0 |
| Number of Planes: 262         | Number of Planes: 264         | Number of Planes: 289         |
| Number of Images: 264         | Number of Images: 276         | Number of Images: 760         |
| LR                            | RR                            |                               |
| Good target measurement       | Good target measurement       |                               |
| RMS: 03                       | RMS: 07                       |                               |
| Target Blobs (Blobs): 3(01)   | Target Blobs (Blobs): 3(01)   |                               |
| Distance (*): 163.7           | Distance (*): 161.4           |                               |
| Target Angle (*): 17          | Target Angle (*): 20          |                               |
| Stroke: 360                   | Stroke: 400                   |                               |
| Error RTP/Vactor/Flag: 0/20/0 | Error RTP/Vactor/Flag: 0/20/0 |                               |
| Number of Planes: 275         | Number of Planes: 270         |                               |
| Number of Images: 262         | Number of Images: 276         |                               |



## CAMERA DIAGNOSTIC

By switching from Left to Right the technician can compare camera characteristics. Both the Left and the Right camera should run parallel information.

- Temperature
- V3.3
- Vaa
- Vdd
- Vio
- Software Version (Camera)
- Software Version (DSP)



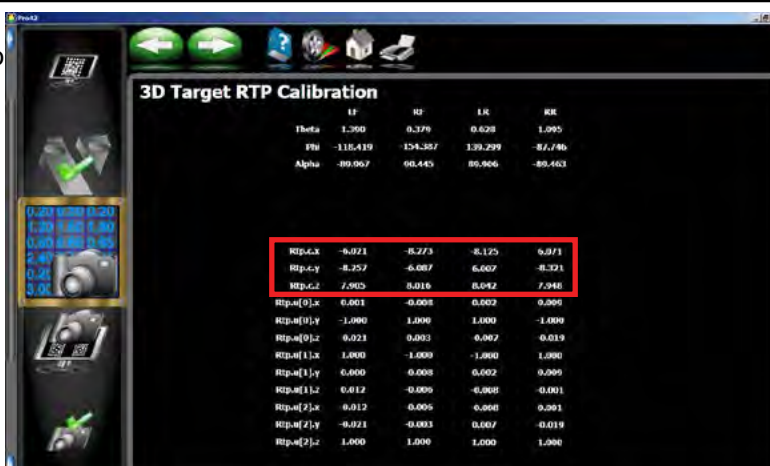
Clicking the Back button will exit this test. 3D Target Calibration.



## TARGET RTP



The information in target RTP is the “X” “Y” and “Z” coordinates of the targets relative to the axis of rotation (Spindle). As described in the Theory of Operation chapter all the targets are identical however each target is rotated differently to properly identify the location (LF, RF, LR, RR). All relative data outlined in red should be consistent with each other based on the target location. Because each target is the same however rotated generates either a positive or negative number.

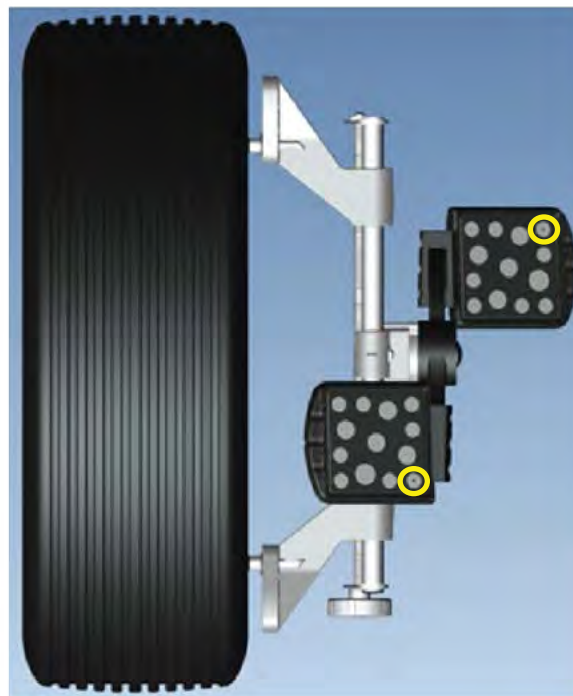


|            | LF       | RF      | LR      | RR      |
|------------|----------|---------|---------|---------|
| Theta      | 1.360    | 0.379   | 0.628   | 1.995   |
| Phi        | -118.419 | 124.387 | 139.299 | -87.796 |
| Alpha      | -89.067  | 60.445  | 80.966  | -89.463 |
| Rtp.c.x    | -0.021   | -0.273  | -0.125  | 0.071   |
| Rtp.c.y    | -0.257   | -0.087  | 0.007   | -0.321  |
| Rtp.c.z    | 7.905    | 8.016   | 8.042   | 7.948   |
| Rtp.a[0].x | 0.001    | -0.008  | 0.002   | 0.000   |
| Rtp.a[0].y | -1.000   | 1.000   | 1.000   | -1.000  |
| Rtp.a[0].z | 0.021    | 0.003   | 0.002   | -0.019  |
| Rtp.a[1].x | 1.000    | -1.000  | -1.000  | 1.000   |
| Rtp.a[1].y | 0.000    | 0.008   | 0.002   | 0.000   |
| Rtp.a[1].z | 0.012    | -0.009  | -0.008  | -0.001  |
| Rtp.a[2].x | 0.012    | 0.006   | 0.000   | 0.001   |
| Rtp.a[2].y | -0.021   | -0.003  | 0.007   | -0.019  |
| Rtp.a[2].z | 1.000    | 1.000   | 1.000   | 1.000   |

The graphic below shows a LF target next to a RR target. If you were to look at the ID dots you will see that they are in the same location on both the targets however since the entire (RR) target assembly has been rotated 180° the system assumes that the target has been placed on the wheel upside down. If TID had been done with the target upside down the numbers displayed on this screen above will be way different than the other targets. This is useful to know so that when a user is performing a TID on a set of targets and there happens to be a 2nd alignment system next to the unit being calibrated it is possible that the RR target of a 2nd alignment system could be in the field of view of system 1 when calibrating the LF target. The camera could possibly think the target is turned upside down, thus generating erroneous values. The same would happen if you were to rotate the LR target and place it next to the RF.



Left Front target



Right Rear target upside down

## ALIGNER DIAGNOSTIC

The information from this screen is used for both field service and engineering.



## CAMERA VIEW

This screen shows the view as seen by the camera. This is a good tool to use to verify live images. The user can also use the <CTRL-ALT-P> function to capture images and live data for export purposes.

This screen displays a count of the received images over each sides display. If one camera is sending a lot less images than another  $\pm 15\%$ , this may be an indication of a camera problem. However in V3400 systems the cameras can be turned on individually.



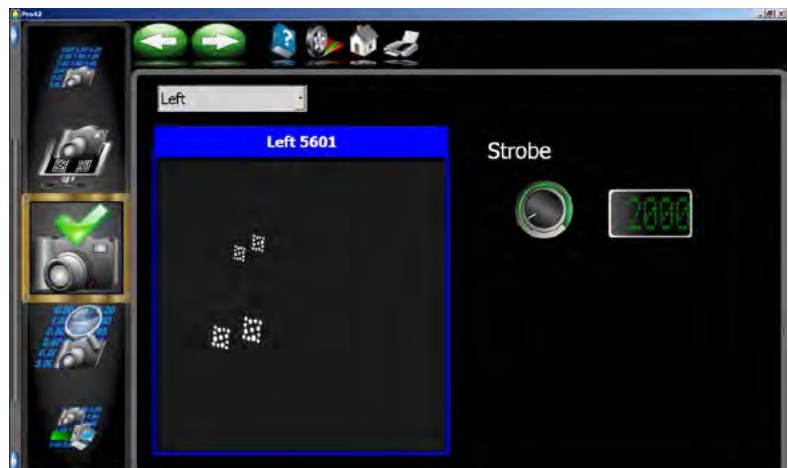
By clicking on the camera diagnostic icon on the toolbar the user can manually control camera functions.





## CAMERA TEST

Test both the strobe and the gain of the camera and it's ability to recognize images with gain and strobe changes. All adjustment from this location are manual adjustments, when exiting this test the camera assembly will return to auto function.



Running the Strobe to full strength should over expose the targets in the field of view. The user can easily switch from left to right.



## STORED DIAGNOSTIC FILE ANALYSIS

This allows the operator to examine a stored hmain.diag file (stored using Ctrl Alt P) without having to search the hard drive. This information can be used to troubleshoot a



possible problem at a later time. If a unit is experiencing problems, the customer can simply press <CNTRL-ALT-P>. The software will record the information to the hard drive. When arriving on site the technician can review the information using this function. The diagnostic data being collected will abort when starting a new alignment. Any data collected will over write previously collected data.



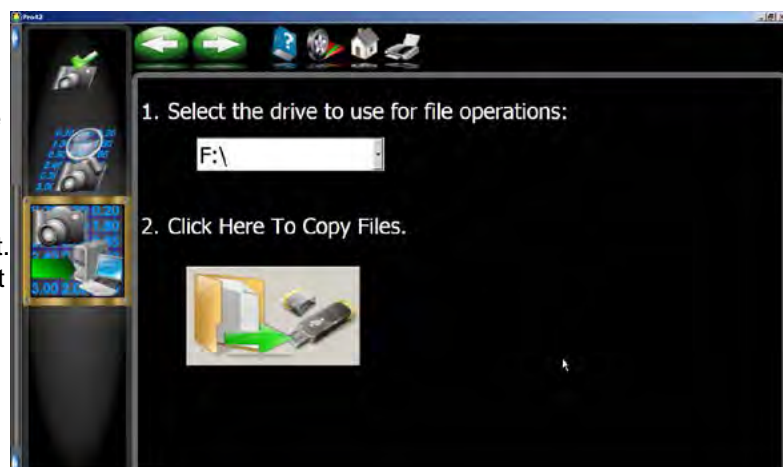
## EXPORT DIAGNOSTIC FILES

The diagnostic file export icon allows the technician to easily export all potential diagnostic information to a jump drive. The original location for this information is located in the root directory of Thundercloud.

Insert the jump drive into an open USB port. Click on the drive location and or folder that you would like to export the information to and click on the export icon. The information is written to the jump drive so that the technician can view it later or email the information for a more in-depth analysis.

The files are:

- Wheel0.raw
- Wheel3.raw
- Wheel1.raw
- Wheel2.raw
- App\_hMain.sav
- App\_hMain.txt



---

## COVERING THE BASICS

These procedures must be followed before placing a call to tech support. Failure to have these answers when asked result in longer customer down time and additional calls to TECHNICAL SUPPORT.

1. Verify complaint. (Remember, operator error requires proper training, no service tools or service parts are needed.)
2. Note the conditions in great detail (I.E.)
  - Weather,
  - Temperature,
  - Time of day,
  - Sun position,
  - Heater locations,
  - CRT under the camera,
  - CPU speed and type,
  - Motherboard type,
  - Installed memory,
  - Printer type,
  - Software revision #,
  - Machine serial #,
  - Modification Status,
  - Hardware configuration,
  - Is the machine using the latest files? (I.E. software version level)
  - Additional software that has been added
  - Additional Hardware that may have been added.
3. Is the condition repeatable? If yes, .... what sequence makes the condition occur?
4. Where is the machine located in the shop?
5. Distance from cameras to Turn plate centerline and distance between the camera pods (Is the unit within the proscribed installation parameter?)
6. What type of equipment is used near it? (Possible interference)
7. Check camera view.
  - Ensure Cal Target is visible, and un-obscured. (Arago and V3400 only)
  - Clean the targets.
  - Clean the camera lens. (To clean camera use canned air don't touch lens with fingers)
8. Verify Power and ground to unit is acceptable. (115 volts  $\pm$  10%)
  - Is this a dedicated circuit?
  - Verify polarity.( correct orientation of hot neutral, and ground)
  - Verify ground. Aligner must be properly grounded. (Resistance from Aligner to earth ground should be less 0.5 Ohms.)
9. Check for mechanical issues. (Clamps, cables, damage to unit)

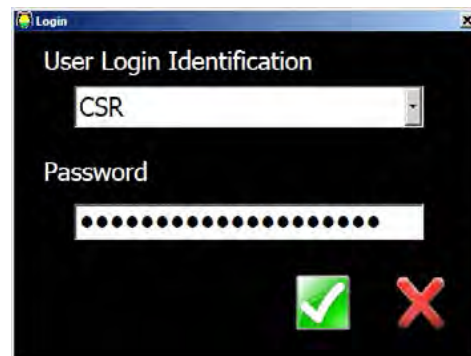
## CSR PREFERENCES

There should be no reason for the preferences of the aligner to be changed. Changes made in the preferences can ultimately affect the aligners accuracy. Listed are the preferences and a brief explanation of it's use. This feature should be used with extreme caution.



## STEPS FOR CHANGING PARAMETERS

1. From the Main Menu click on the Preference tab and then click on the "Log In / Out button"
2. Log in as CSR using the 20 digit code given from technical support.
3. Click on the CSR Preferences icon in the Preference menu.



4. The **Main Preference** screen has 3 option tabs, CSR Preferences, TID Preferences and Parameters. Radio buttons are provided for changing from factory defaults.

**Parameter Group**

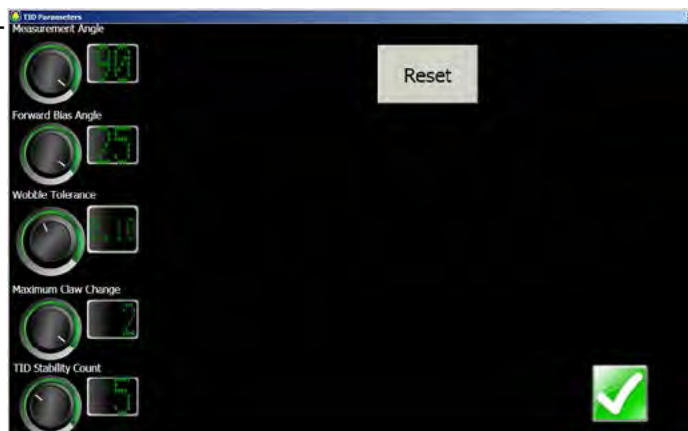
- Standard
- OEM
- Show
- CSR Edited
- **Allow Positioning Wobble** (Default checked) - Allows the operator to by pass "Wheel Wobble" if box is unchecked the operator must redo and pass wheel positioning on all 4 wheels.
- **Allow Caster Roll** (Default checked) - Allows the operator to by pass "Wheel Roll" during caster sweep. If the box is unchecked the operator must redo and pass a successful caster sweep without wheel roll.
- **Allow Individual Toe Editing** (Default unchecked) - This allows for individual toe specification edit during specification editing procedures.



## TID PARAMETERS

These values are used when performing a Target ID (TID). These preferences are found in the CSR Preferences by clicking on the TID Preferences tab.

- Measurement Angle (Default 90) - Total rotation of the target from the forward position back.
- Forward Bias Angle (Default 25) - Maximum amount of forward rotation for TID.
- Wobble tolerance (Default 10) - The maximum amount of wobble during TID.
- Maximum Claw Change (Default 2.0) - Maximum amount of claw change before software flags errors during TID.
- TID Stability Count (Default 5) - Minimum amount of consecutive snapshots of the target before the unit identifies it as a valid target.
- Reset Tolerances - Resets the unit back to manufacture defaults.



## COMMAND PARAMETERS

Click on the Parameters Preferences tab to access and view Command Preferences. The “CSR Edited” radio button must be selected to view and edit these parameters. Click on <OK> to save changes and exit.

- Positioning Stability Count (Default 5) - How many planes the unit must acquire in sequence before measurements are displayed.
  - Caster Stability Count (Default 5) - How many planes the unit must acquire in sequence during caster sweeps to display the measurement. Note: The more it is, the more repeatable the measurements.
  - Linear Stability Tolerance (Default .10) - Distance Measurement. Measures the height of the target and must be constant to acquire a target.
  - Angular Stability Tolerance (Default .05) - Angle of the target. Measures the width of the target and must be constant to acquire a target.
  - Positioning Angle (Default 40) - How many degrees the target must rollback before acquiring a reading.
  - Positioning Angle Tolerance (Default 10) - Minimum / Maximum for “Positioning Angle”.
  - Centering Tolerance (Default .25) - The maximum a target can be turned before the unit will ask the operator to steer the wheels straight ahead. Steering angle during centering.
  - Positioning Wobble Tolerance (Default .10) - Maximum angle that a target can move during positioning before wheel wobble occurs.
  - Caster Roll Tolerance (Default .30) - Maximum angle that a target can roll during caster sweep before wheel roll occurs.
  - Smoothing Factor (Default .7) - Smooths out display meters. Note: Keeps meters from jumping.
  - Dropout ( 10ms units) (Default 350) - Amount of time it takes to drop a target when a target is blocked.
  - Front First Threshold (Default 1.3°) - sets the value at which the Adjust Front First Indicator Icon appears on any of the rear reading screens. (See operator manual for details)
  - AC400 Runout Angle Tolerance (0.5 - 5.0) How much the arms vary from the axis of rotation.
  - AC400 Unequal Arm Tolerance (0.1 - 0.5) How much difference in length the clamps are to each other.
- NOTE: RUNNING IN THE EXTREME WEATHER MODE CHANGES DEFAULTS.





## TROUBLESHOOTING THE SYSTEM

The Ultra Aligner can be easily broken down into these major components -

- PC (usb & drivers)
- Power Supply
- Hub PCB (3 on Arago)
- Camera's (3 on Arago)
- Cables
- USB Motors (Moveable Beam & Arago)

Each of these components need to be working to acquire images for the PC processor to display the images on the screen for the operator. Should any of these components fail the result could be no images or erratic images.

**NOTE: WHEN USING A TEST CAMERA AS A TROUBLE SHOOTING TOOL ALWAYS UNPLUG BOTH CAMERAS. THIS WILL ENABLE YOU TO TEST THE SYSTEM WITHOUT HAVING TO TRANSFER SECURITY CODES TO THE NEW CAMERA.**

USB devices normally require an array of hardware settings that can create conflicts. Debugging becomes a different process, since USB takes Plug and Play to a new level by allowing multiple devices to share a single path into the PC such as pointing devices, printers, remote readers and now Ultra Cameras. Troubleshooting USB requires a bit more effort than other connection methods because the entire bus could be malfunctioning. Examine the troubleshooting scenarios below until you find one that applies to your situation. These scenarios provide general descriptions of possible errors, along with steps you can use to resolve the problem. You'll also find tips for troubleshooting common causes of USB failures. Become familiar with using the **"Device Manager"** as a troubleshooting tool. Use the following sequence to open the "Device Manager". Hold down both the Windows Key and the Pause/Break Key on the keyboard. The user can also click on the **<START>** button and right click on **<My Computer>** and select **<Properties>**.

After opening the "System Properties" click on the **<Hardware>** tab to open the hardware menu.

After opening the Hardware Menu click on the **"Device Manager"** button to open the device manager.

Locate the "Universal Serial Bus Controller" at the bottom and click on the "+" to view all of the active devices.

### USB BASICS

USB controllers are known as root hubs. They're integrated on the motherboard in most computers. Current motherboards typically have between two and six root hubs, each with at least two headers for connecting ports. Older computers may only have one hub on the motherboard, or a PC may have an add-on PCI or EISA controller card that provides USB service. The Ultra Aligner has a Hub PCB that relays information to and from the cameras to the PC and passes power from the power supply to the cameras. The aligner loads a "Generic USB HUB at startup and must be present in order to operate the cameras and pass information. The Ultra Arago uses 3 Generic Hubs and each must be present. Also the camera device drivers must be loaded and will also show up in the device manager. The conventional will show 2 cameras and the Arago will show either 3 or 4 depending on whether the unit is equipped with a remote camera. The Ultra Cameras will not show up in the device manager if the Generic USB Hub is not present. The Ultra Arago will also show 2 USB motors used to drive the camera pods up and down the towers.

| <b>Check</b>   | <b>the</b> | <b>Obvious</b> |
|--|------------|----------------|
| Before you start troubleshooting a USB problem, double-check your fundamentals. Check to make sure that the Generic USB hub is loaded, check to ensure that the two Ultra Cameras are loaded, check to ensure USB cables are physically connected. Confirm that any USB hubs are properly connected and plugged in to powered electrical outlets. Many failures can be traced to unplugged equipment or devices that are plugged into outlets that aren't receiving power. The Ultra Aligner has a dedicated Power Supply for the cameras. |            |                |

For troubleshooting, you should have an extra Ultra Camera that has tested OK on another computer. You can try using the device on the PC experiencing the problems to verify that the USB port, not a faulty device or cord, is causing the trouble. This can be easily accomplished by plugging an extra Ultra Camera directly into the PC's USB port on the back of the PC.



## CAMERA TROUBLESHOOTING

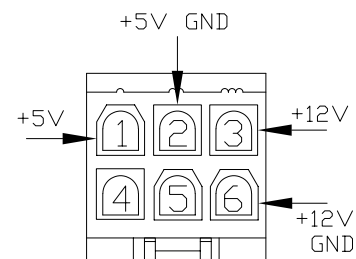
**Scenario 1: One camera never works**

Check the device manager to make sure that it recognizes two cameras. If it does you can assume that the PC, Camera Power Supply, Cable from the console to the Hub and ½ of the Hub is good. Unplug both cameras from the Hub and plug a spare camera into the Hub location of the camera that is not working. If the spare camera is working the problem is either the camera or the cable. If the spare camera does not come on the problem is in the hub.

**Scenario 2: Both cameras stop working**

Plug a spare power/usb cable and camera into the back of the console and check to see if the Device manager recognizes an Ultra camera. If so we can assume that the PC and USB root hub and Universal host controller and power supply are working correctly. If the Ultra Camera does not show up in the device manager remove the power connection and check for the proper voltage at the back of the console.

Looking at the connector on the back of the cabinet check for both the +5V and +12V, remembering that each voltages utilizes separate ground (see connector pinout). Should any of the two voltages be absent or not within range replace the camera power supply and retest.



## OTHER USB DEVICE TROUBLESHOOTING PROCEDURES

**Scenario: One device occasionally stops working**

**Possible causes:** Device drivers, power management, bandwidth.

It's important to isolate the particular event that's common to all failures. Move the device to another root hub to see if the problem is in a particular root hub or in the device itself. Remove external hubs from the equation to confirm they are not the problem. Also, try using the device when no other USB peripherals are connected. More than likely you have a driver problem, but it could be a power or bandwidth issue.

**Controller/hub compatibility**

USB computers manufactured before 2002 are limited to USB 1.1 devices. USB 2.0 is much faster and is usually backward compatible with the older 1.1, but it's possible that a USB 2.0 device could refuse to work on a USB 1.1 controller or external hub, so check to see if there's a compatibility issue. Assuming a firmware update is available, you may need access to a USB 2.0-equipped computer to apply it.

**Configurations for add-on USB controllers**

Check the Windows Device Manager, to see if the USB controller is recognized or is experiencing a conflict. In Windows, click Start | Control Panel, select the Systems applet, click the Hardware tab, and then click the Device Manager button. The Device Manager will likely refer to the USB controller as a USB Root Hub, USB Controller, or USB Bridge. The usual suspects of IRQ addresses and memory address conflicts are the first things to check. PCI devices shouldn't have many problems, being Plug and Play, but EISA cards may require more adjustment. If the hardware appears to work, reinstall the drivers.

**Integrated USB controller settings**

If you suspect the trouble is with your USB controller settings, check the Device Manager for a conflict. Depending upon how well integrated the controller is with Windows, you may be able to adjust the IRQ or memory address settings from the Device Manager.

Try rebooting the PC and entering the BIOS configuration. USB settings are usually listed in the Peripherals section. You'll need to check for an entry marked USB Controller that is off or inactive. If this entry is already active, check the IRQ and memory addresses. Use the Device Manager to ensure that no other device is using those settings. You may need to reboot a few times to find a valid IRQ/memory address combination that won't conflict with other devices. If the hardware settings are fine, reinstall the drivers.

## **USB Keyboards**

When editing the BIOS, enable DOS USB Keyboard Support. Enabling this option will allow you to use a USB keyboard when booting a system with a boot disk.

## **Controller drivers**

Many motherboard suppliers release driver combinations that include a number of hardware drivers. Confirm that you have the latest driver installed. Some operating systems also provide drivers, so make sure you have the latest available software patch as well.

### ***Scenario: No device ever works***

**Possible causes:** Operating system compatibility, controller/hub compatibility, configurations for USB controllers, controller drivers.

If a system is experiencing constant controller failure, make sure the OS in use supports USB; verify that the devices are supported by the controller; and check the controller's settings and drivers. The Ultra cameras use a generic controller. Integrated controllers will likely require you to enter the BIOS to make changes, while add-on cards will require traditional troubleshooting according to the manufacturer's directions.

You can identify integrated USB controllers by the location of the ports—if they are adjacent to the PS/2 ports, the USB service is likely provided by an integrated controller. If the USB ports are located anywhere else on the back of the computer, you're probably dealing with a USB add-on card. Front-mounted USB ports can be either type. You may have to open the PC case and visually inspect the USB ports to see whether they connect directly to the motherboard or to an add-on card.

### ***Scenario: All devices occasionally stop working at the same time***

**Possible causes:** Power management, configurations for USB controllers, controller drivers, bandwidth

If the system experiences sporadic controller failure, the primary suspect on the PC/OS side is power management, although it could be either an intermittent conflict or a problem with the USB controller. Try to isolate a particular event common to all the failures, just as you would with any other sporadic hardware conflict. This could lead you back to a power issue if you have bus-powered scanners or hard drives that might be drawing more power than the PC can provide. If the system requires more power, try replacing the PC's power supply with one that provides more watts.

Bandwidth can also be an issue if several active devices are transferring large amounts of data. Potential peripheral bandwidth hogs include printers, scanners, hard drives, and CD, DVD, or CDR/W drives. Eliminating bandwidth problems might mean replacing a demanding USB device with an integrated replacement or dividing the USB devices between different USB root hubs. See below for more on bandwidth issues.

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**Scenario: Several devices never work, but others are fine**

**Possible causes:** Controller/hub compatibility, configurations for USB controllers, power management, controller drivers, device drivers, bandwidth

Should you experience this issue, move the working devices to another root hub to see if the problem is in a particular root hub or with the devices themselves. If an Ultra camera is moved to a hub that has not loaded the device drivers the Operating system will prompt the user to load these drivers. This procedure is automatic. Remove external hubs from the equation to see if they are the problem. Try the problematic devices individually on the computer; if they work, it's either a device driver or power issue. If they never work, it's a controller compatibility issue, a device driver problem, or a lack of bandwidth. Solving compatibility issues and driver errors requires updating drivers or obtaining appropriate patches.

**Scenario: Several devices occasionally stop working at the same time, while others are fine**

**Possible causes:** Power management, device drivers, bandwidth

As you would with any other sporadic hardware conflict, try to isolate the particular event that's common to all failures. The system may be experiencing a sporadic controller failure if your devices are split across root hubs. Try moving the devices to another root hub to see if the problem is in a particular root hub or in the devices themselves. Remove external hubs from the equation to see if they are the problem. Try the problematic devices individually on the computer; if they work it's a device driver, power issue, or bandwidth pinch.

**Power management**

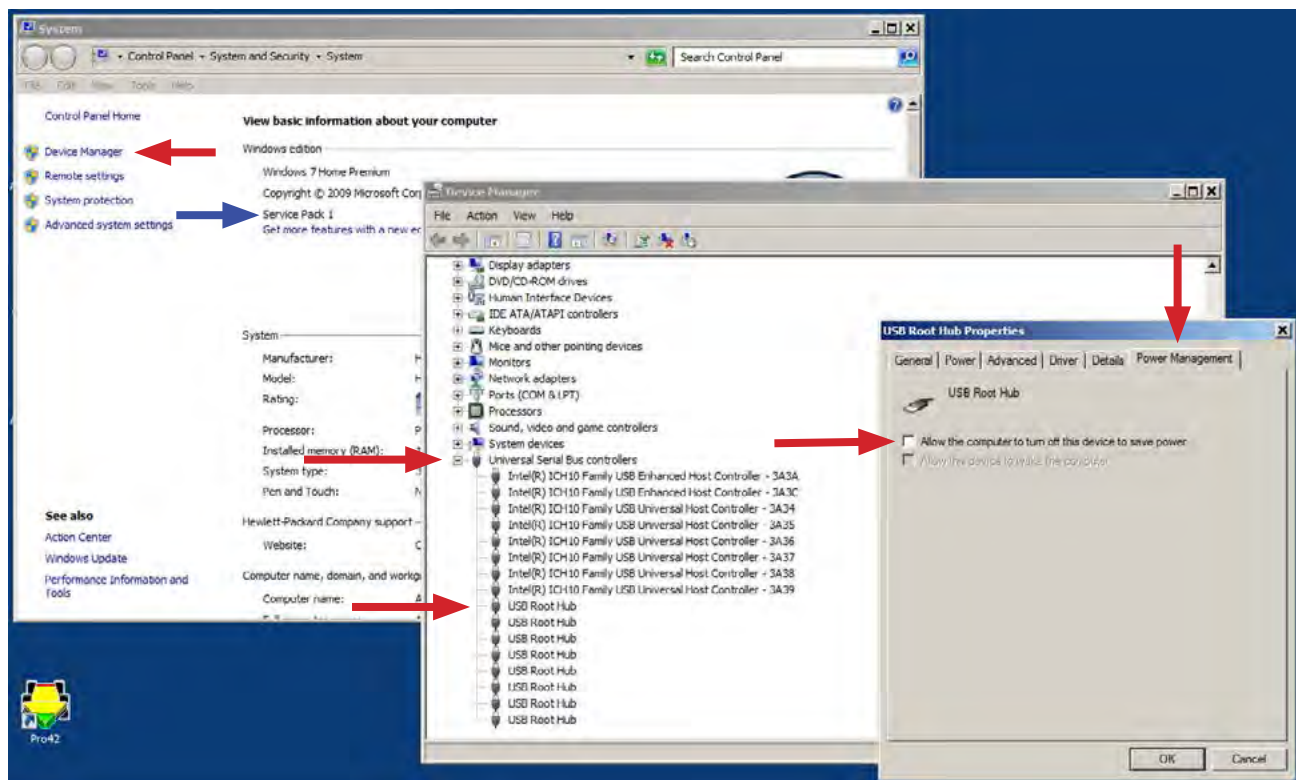
Most computers have some form of sleep mode connected with the screensaver. A controller is not harmed when an energy setting kicks and eliminates its power. However, the OS may fail to power up the controller again. You can eliminate this error by opening Power Options and disabling System Standby,

Excessive loads on the bus can also cause power problems. The USB controller can power USB devices. Small devices like mice and keyboards aren't a significant drain, but larger devices—such as scanners, hard drives, Web cams, and speakers—can draw considerable power. You might be able to eliminate the problem by spreading the power-hungry devices across multiple root hubs. Otherwise, acquire a good self-powered external USB hub.

### Managing the USB Hubs

Change USB Root Hub settings as follows:

1. Click START.
2. Right click on COMPUTER.
3. Click PROPERTIES.
4. Verify Windows Service Pack 1 (Blue Arrow) is installed. If not this update can be found on Microsoft's website.
5. Click DEVICE MANAGER.
6. Double-click to expand the UNIVERSAL SERIAL BUS CONTROLLERS branch.
7. Right-click USB ROOT HUB.
8. Click PROPERTIES.
9. Click POWER MANAGEMENT.
10. De-select the ALLOW THE COMPUTER TO TURN OFF THIS DEVICE TO SAVE POWER check box. Repeat Steps 5 – 8 for each USB ROOT HUB.
11. Click OK.
12. Close DEVICE MANAGER.



**USB Device Drivers**

The ability to hot swap USB devices is a great feature, but it relies on a somewhat oversimplified set of general-purpose drivers. Some devices may appear to be general-purpose devices when in fact they are not. This means that you must install the drivers before you connect the device to the PC. Sometimes you need to reboot to give the new drivers priority over the general-purpose drivers. This means that skipping the reboot will break the whole process.

If you think the new drivers aren't receiving priority, completely uninstall the device in question. You may have to leave the device connected to uninstall it properly. At other times, you may be able to remove a device's drivers using Control Panel's Add/Remove Programs applet, just as you would with other software.

Sometimes it's necessary to upgrade a device's firmware, which is basically a driver that runs on the peripheral. The more advanced the device, the more likely it is that the firmware can be upgraded. Mice, being simple devices, don't require firmware upgrades. Scanners, hard disks, printers, optical disks, and other sophisticated peripherals likely have upgradeable firmware. Check the manufacturer's site to ensure you've loaded the most recent update.

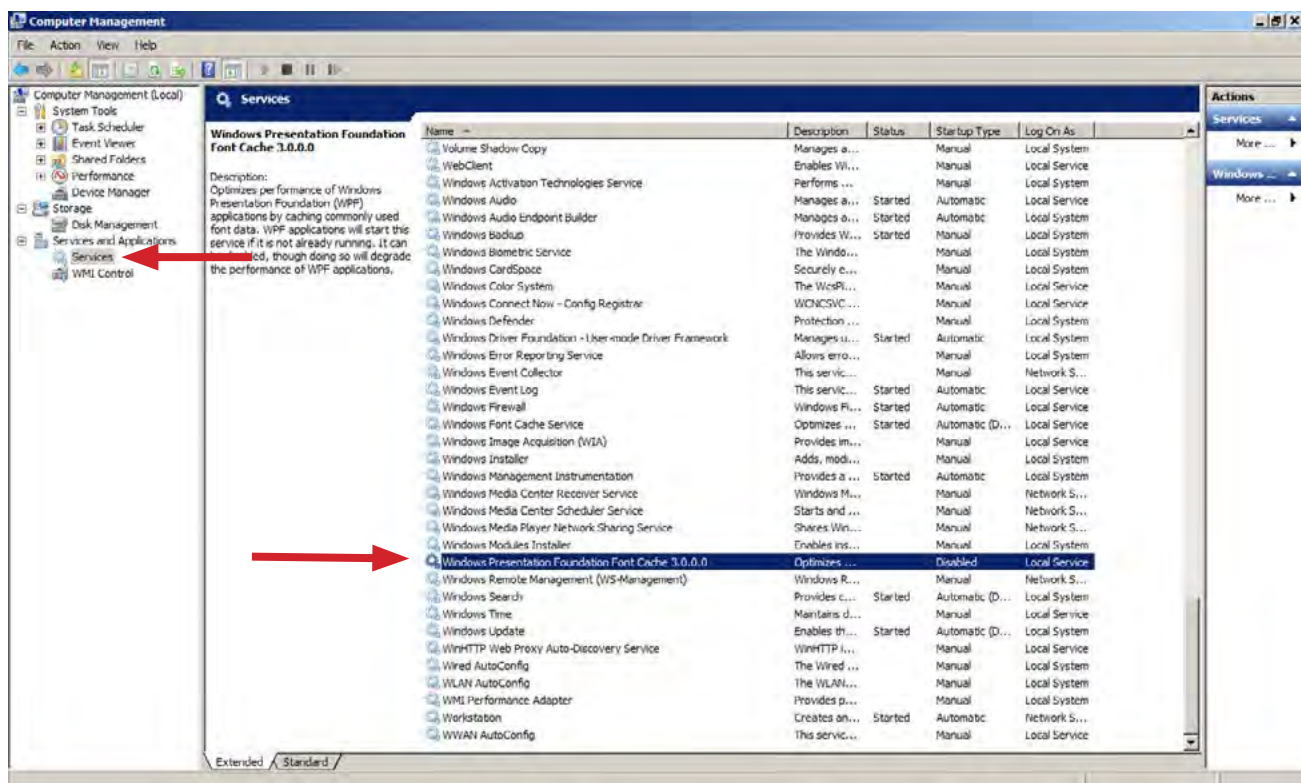
**Bandwidth**

USB root hubs can each support up to 128 devices, but they can run out of bandwidth, depending on consumption rates. USB 1.1 is limited to 12 Mbps, not counting the bus management overhead. USB 2.0 has 480 Mbps with about 420 Mbps available, so it can support more devices. Combine an Ethernet adapter, a printer, and an external CD-ROM or hard drive on a single USB controller, though, and the PC can quickly exhaust its capacity.

The only solution for bandwidth problems is to either stop using all the devices simultaneously or to distribute the load. Make sure you put devices that will always see use, like Ethernet adapters and USB speakers, on different root hubs. You may need to get additional USB controllers, which are inexpensive.

**Disabling “Windows Presentation Foundation Font Cache 3.0.0.0”:**

1. Click Start
2. Right Click Computer
3. Left Click Manage
4. Left Click Services and Applications
5. Double Click Services
6. Double Click “Windows Presentation Foundation Font Cache 3.0.0.0”
7. Change “Startup Type” to Disabled
8. Click Apply
9. Click Ok
10. Exit Services and reboot system.







## NOTES

[illegible]



**Snap-on V3400/Geo 790**

## INTRODUCTION

The Snap-on V3400 Aligner Platform is similar to the legacy imaging aligner with some unique features we need to point out. There are three main differences to focus service and operation issues:

1. The use of Blue Tooth for cameras to PC communications.
2. The “XD” Targets are unique from the V3400.
3. The cameras used are different than the previous imaging systems and feature improved tracking.

## NEW FOR V3400

We will discuss the important areas that set this aligner apart from previous models.

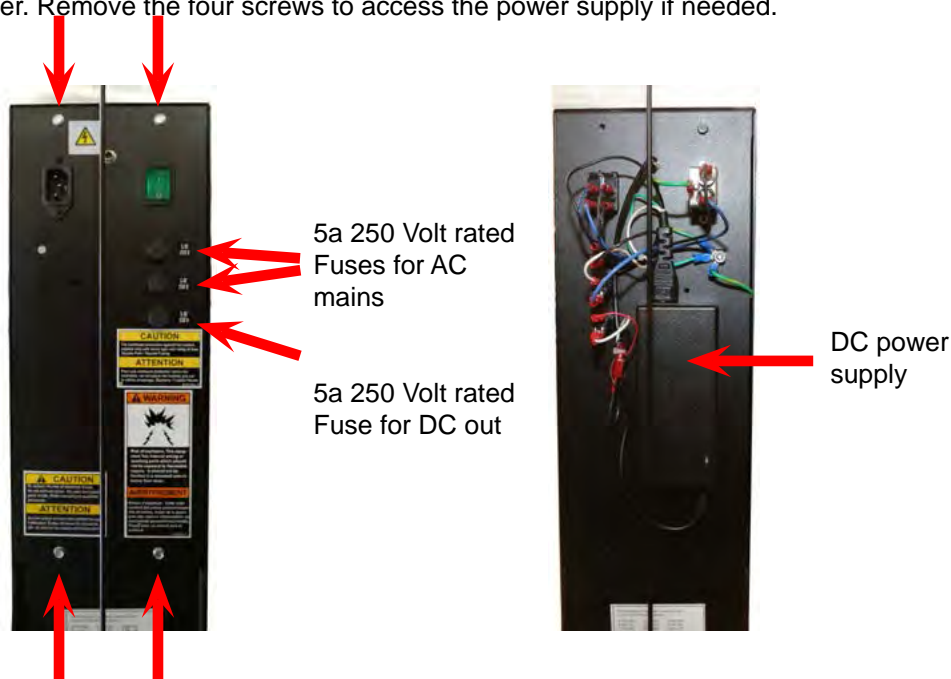
The boot-up sequence of the new Pro42 software for V3400 is much faster. Only the very first occurrence of boot up will take any time at all and that will be roughly 5 minutes for loading of all the required files. After that boot-up will only take a few seconds. Pods may take several minutes to connect but navigation is possible.

## SERVICING THE V3400

### POWER DISTRIBUTION

Power for the camera tower is 115~230 volts AC, 50/60hz 15 amp service. A Fused AC receptacle is supplied at the rear of each tower base. A universal DC power supply is located inside the box which supplies each camera assembly with 19-32 volts DC. Camera boards further regulate the required voltages inside the pod. Access to the power supply is by the removal of four screws on lower support base. All electrical components are mounted on the inner cover. Remove the four screws to access the power supply if needed.

There are two fuses for the AC power mains, and one fuse for the DC output to the cameras. Power can be removed from the cameras or restored at anytime and the cameras will automatically restore communication with the PC.



## ESTABLISHING COMMUNICATIONS WITH THE CAMERAS

When the camera towers are first powered up you will note one green LED that indicates DC power supplied to the pods. Once the pods boot up you will note a slow “rotating strobe”. The “rotating strobe” are the LEDs in each camera board that flash in a circle indicating the level of connection. When the camera makes communication contact with the PC radio, the rotating strobe go to a fast mode. The fast mode will be maintained on home screen only until the cameras are required to “see” a target and relay information to the PC. At this time the lights that are relevant to the target condition are shown steadily. When the pods are receiving a firmware update the “rotating strobe” are in the superfast mode.

When all three cameras make communication contact with the PC, both pods go to the bottom most position or home where they establish a reference point for left camera pod to right camera pod position. As soon as the software invokes a command that requires the cameras to see a target the pods go to the search mode. This search mode is much faster and smoother than past models and will not stop and go as much.

As in all other Pro42 variants, the operation of the software is pretty much the same and little has changed. However with the new cameras and targets we must properly set the system up for the hardware.

Select the camera system



From the “Preferences” screen select “System Configuration”. Select “Three Cameras”.

**Note:** *Ride Height targets are shipped standard with the V3400 Aligner Systems.*



Activate all clamp types to be used in the system. If only one clamp type is selected you will not be asked which clamp is being used before performing compensation. If more than one clamp is selected you will choose which clamp will be used for the procedures.

The V3400 can utilize either the AT600 targets or standard AT700 targets. Only one target type can be selected for each system. Multiple clamp types can be selected. The system will have a separate TID called for each clamp-target assembly.

## IDENTIFICATION OF THE CAMERAS

If the cameras are not identified or when replacing a camera, you must perform the identification process.



There are two ways to identify the cameras, automatic and manual.



The manual entry requires the camera ID be known. When shipped from the factory there is a label that identifies the camera on the face of the camera board and on the bottom of each pod. Record this number for each of the three cameras in the appropriate spaces. If one camera has to be replaced, then RCP will be required. If more than one camera is replaced then order a complete set of pods. Save the camera ID labels or numbers in a secure location, such as inside the aligner console.



Automatic camera ID invokes the Blue Tooth to search all available devices that are in range. If a camera is connected to another system, the camera search feature will ignore that camera. If a camera is turned on and not currently connected to a system then its ID number will be displayed.



Once all available devices are discovered, they will be displayed and you are asked if any lights are turned on solid. Look at each of the three cameras, if any are solid lit select Yes, else say No. Click on the appropriate camera indicator to marry to the ID selected.

If more than one camera requires identification continue until all are identified. If no further cameras require identification, exit to the home screen to complete the procedure.

If replacing a target, or clamp, TID or single bar calibration will be required. It is recommended that single bar be performed, however if a customer is doing the work TID will suffice.

**NOTE: NEVER PERFORM TID AFTER DOING A SINGLE BAR CALIBRATION. DOING SO WILL DELETE THE OFFSETS FOR TOTAL TOE AND CAMBER.**

Motor calibration is not used with the V3400, the upper and lower limit switches have been removed. The end of travel is sensed by current change detection. Also when the pods are not engaged, there is an electric brake that prevents the pods from moving freely. However if you need to move a pod for some reason, press downward firmly for a few seconds and the software determines that the user wants to move them and releases the brake. Motors will not move for 30 seconds after manual movement. The brake will re-engage after 30 seconds. Pod lever calibration has also been removed.

## CHECKING THE FIRMWARE

From the home screen select “Diagnostics” from the left carousel bar. Then select “Check Firmware” located at the bottom of the carousel.



When invoked the system checks the revision level of the cameras and controller firmware and compares to the currently loaded Pro42 version. If there are updates available it will be indicated by a green arrow. The green check mark indicates version is good. A red X indicated a loss of communications.

Note: Multiple updates can be performed simultaneously. The load process takes about 8 minutes.

## CAMERA DIAGNOSTICS

The various Camera Diagnostics screens have not changed much from previous versions of Pro42. A few added features assist the technician with diagnosing problem areas.



Camera View - The camera view may be noticeably grainier than previous versions of Pro42. This is normal and not a result of the camera resolution. We are only displaying what is necessary to verify target position and ensure targets are in the optimal position.

Notice the radio signal strength indicator bars at the bottom of each camera view. Also displayed is the camera ID number.

**NOTE: WITH THIS CAMERA VIEW, THE DRIVE-ON ASSIST CANNOT BE USED UNLESS AN AFTER-MARKET WEB-CAM IS ADDED TO THE SYSTEM.**



| LP Good target measurement |       | BP Good target measurement |       | CAL Good target measurement |       |
|----------------------------|-------|----------------------------|-------|-----------------------------|-------|
| RMS                        | 10    | RMS                        | 14    | RMS                         | 10    |
| Target Skew (Rads)         | 0.000 | Target Skew (Rads)         | 0.000 | Target Skew (Rads)          | 0.000 |
| Distance (ft)              | 81.6  | Distance (ft)              | 84.3  | Distance (ft)               | 114.9 |
| Target Angle (°)           | 16.3  | Target Angle (°)           | 15.8  | Target Angle (°)            | 27.3  |
| Skew                       | 120   | Skew                       | 150   | Skew                        | 1875  |
| Error (1/1000 inch)        | 0.000 | Error (1/1000 inch)        | 0.000 | Error (1/1000 inch)         | 0.000 |
| Number of Planes           | 252   | Number of Planes           | 254   | Number of Planes            | 209   |
| Number of Images           | 264   | Number of Images           | 270   | Number of Images            | 700   |

Also the measurement data screen indicates the relative signal strength and ID of the cameras as well.

## DISCONNECTED CAMERA

In the event a camera loses communication with the PC during a live screen such as rollback, readings or adjust. A new pop-up screen appears that indicates which camera has been dropped.



The screen alerts the operator to check the power and see if the LEDs are working on the camera(s) displayed.

If both cameras on the left side disconnected, the power would be suspect, however if only one camera is shown to be disconnected then look for an obstruction or other issues. The power source indicator will be displayed with a green check if any one of the two are connected.

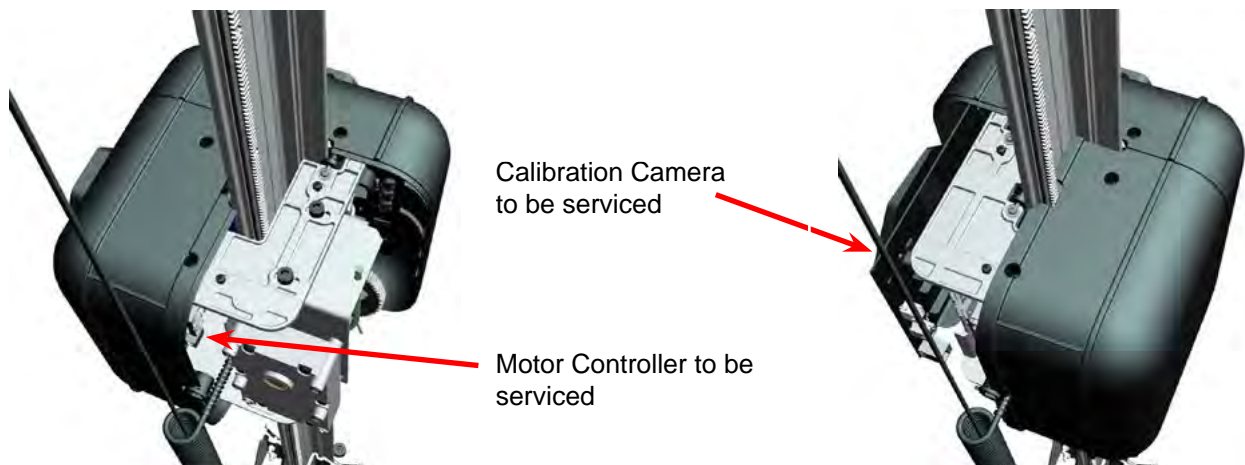
If the pods are not level it is possible to force a calibration of pod level by going into "Camera View" and sending the pods to the bottom manually for 10 seconds. This should happen during normal operation. Make sure the Cal Target is visible when the pods are at the bottom of the supports.

## SERVICING POD COMPONENTS

Pod covers are constructed in three pieces allowing the technician to only remove the section covering the component to be serviced. Each pod cover section is secured with two phillips screws on the top and two on the bottom.



This illustration shows the cam-cam pod with two covers removed. The outside pod cover is removed to allow access to the motor controller board.



The cover to the inside or facing the cam-targ pod is removed to allow access to the calibration camera.

The front cover is removed for serving the measurement camera. Removal of the front camera cover is eased a small amount if one of the side covers is removed first.

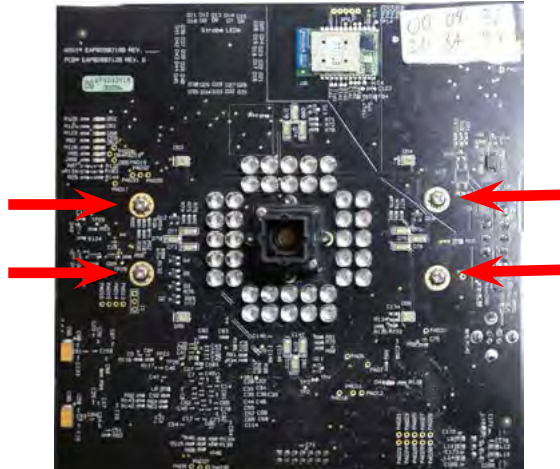
If pod covers are removed, make sure the coiled cable strain relief is properly placed between the pod covers.

## REPLACEMENT OF POD COMPONENTS

### CAMERA REPLACEMENT

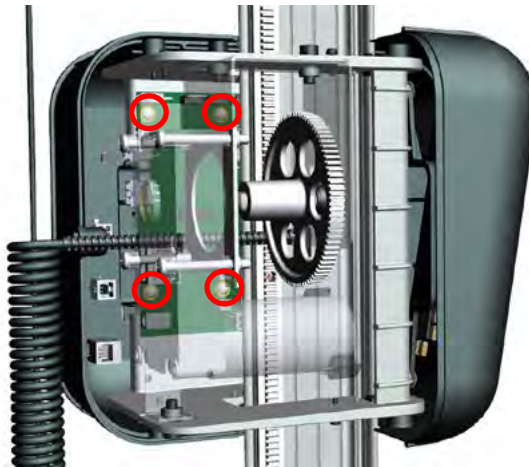
To remove pod components, first identify the part in question and remove that section of pod cover. To remove a camera board, first disconnect the power and control cables. Only the measurement cameras will have motor control cables, the calibration camera has only a power cable connected. Next remove the four phillips screws near the center of the board. Replace with service board in the reverse order followed by performing RCP.

**NOTE:** If the left side camera is replaced the security key will be required to be used to activate the camera and load security to the camera before use. Reference instructions TEAK0277J97C.



### REPLACING THE MOTOR CONTROLLER

Remove the outside pod cover. Disconnect control and power cables from the board. To remove the Motor Controller Board, use a long shank phillips screwdriver to access the four screws securing the board to the pod chassis. Re-install service board in the reverse order.



# SINGLE BAR CALIBRATION

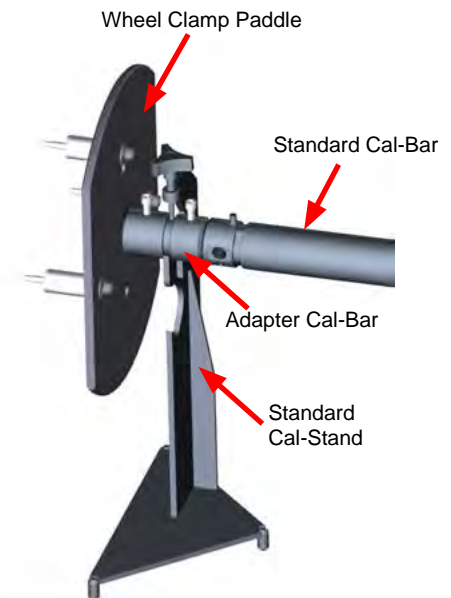
## Introduction

With the release of 7.4 Pro42 software, a new Single Bar calibration feature is now available. This new Calibration procedure will execute TID, RTP, and apply Total Toe and Camber offsets to maximize accuracy. This single bar calibration is applicable to all X-CEL (UHR) Imaging Aligners with 7.4 and up software. Technicians are encouraged to use this new Calibration procedure any time Targets and/or Wheel Clamps are replaced or dropped in the field. Before, when a TID calibration was performed, the factory offset calibration for Total Toe and Camber would be lost. Now with this new procedure you can calibrate in these valuable offsets to maximize accuracy.

Customers can still execute a TID calibration using a “Jacked Vehicle” if needed, however if a technician is called to perform a TID procedure on an older unit it is recommended he/she use the cal bar and paddles to perform TID instead of a vehicle’s tire and wheel assembly. Never at any time would a technician want to perform this new Single Bar Calibration, and then follow it with the TID calibration using a “Jacked Vehicle”. Doing so will delete the offsets for Total Toe and Camber. The alignment system must have a valid RCP calibration prior to performing Single Bar calibration. If you have reason to believe the RCP is wrong, do an RCP calibration before the Single Bar Calibration. The RCP procedure has not changed and will still require the previous RCP fixture. Always backup any calibration data to a flash drive prior to replacing calibration data.

Select “Preferences” from the main carousel, then “System configuration” and insure correct clamps and targets are selected. The calibration bar and Adapter is the standard Calibration Bar and Stands that have been used on past aligners. A new Paddle kit must be secured to the existing Calibration bar (see illustration below).

1. Clean all targets with soft lint free rag and glass cleaner.
2. Place the Calibration bar and stands on the rack **in front of the turnplates**. The bar and stands CAN NOT move during this procedure.
3. Place the Calibration paddles on the calibration bar and mount the selected targets.
4. Using the Camera View rotate the calibration bar with the targets in view of the camera to ensure that the targets can be seen at all times during the rotation process. You do not want to move the camera beam up or down during this process to acquire target images. Do this before beginning the single bar calibration process. This bar and target assembly will be moved to the rear of the rack during the calibration process, make note that the targets must be in the camera field of view at the rear also before beginning.



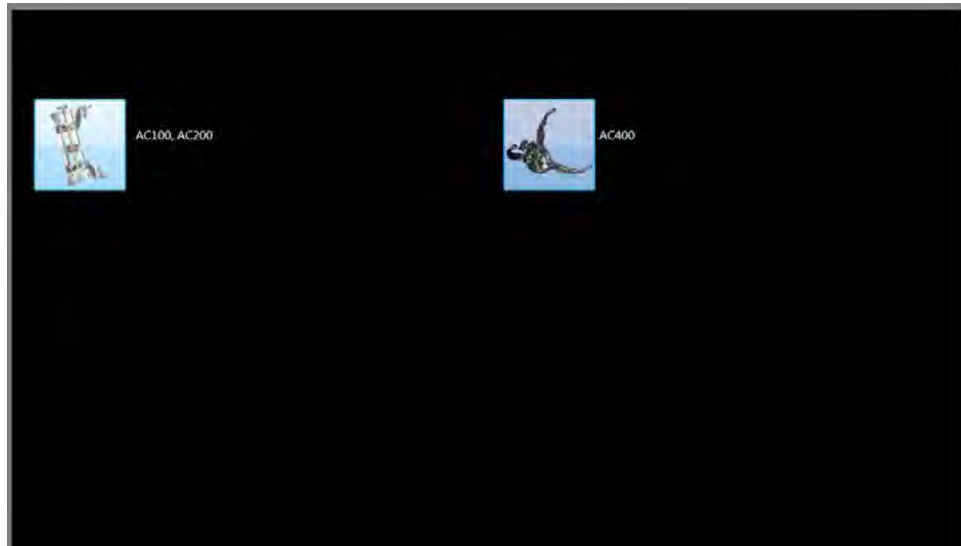
5. From the Main Menu select the “Calibration” option.



6. From the Calibration Menu select the “Single Bar Calibration”

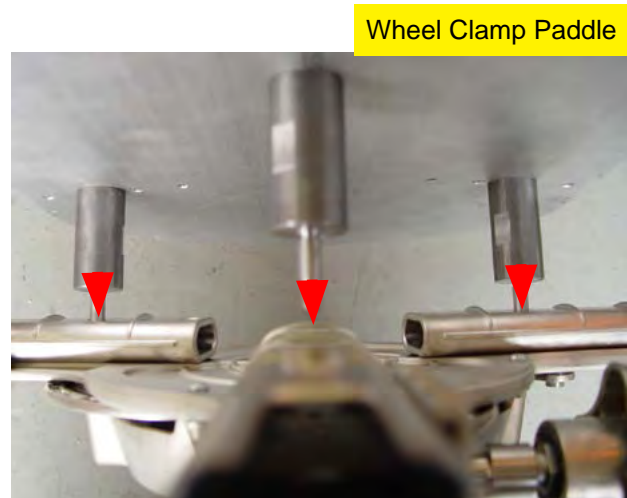
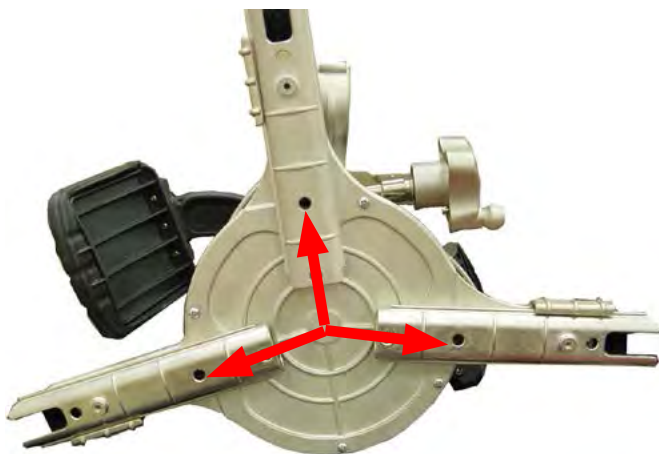


7. Select the wheel clamp(s) being used. The procedure used is the same for all wheel clamps with the exception of the degree rotations and the mounting of the AC400 wheel clamps. (See Below). ***This procedure must be done using all wheel clamps on site as each set of clamps has it's own calibration factors.***



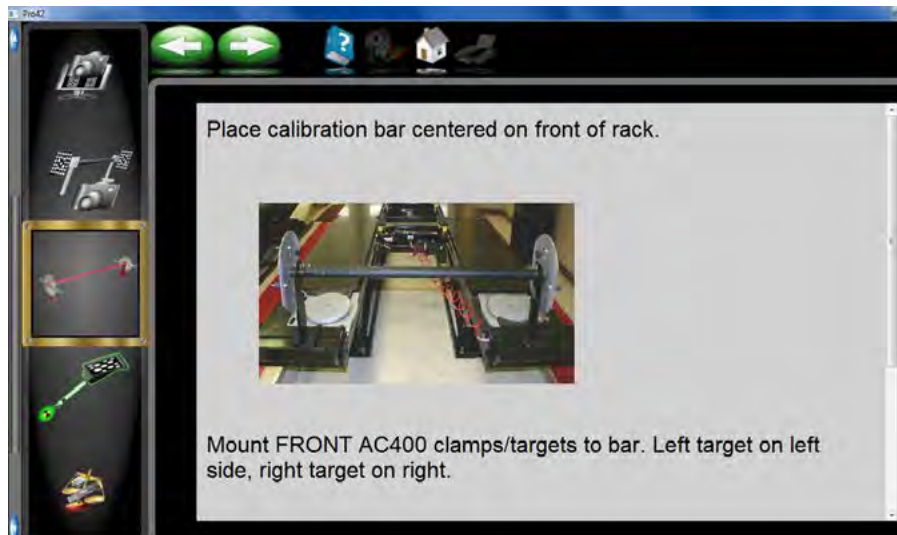
- AC100 / 200 / 700      AC400

***NOTE: IF THE AC400 WHEEL CLAMPS ARE BEING USED IT WILL BE NECESSARY TO REMOVE THE CLAMP ARMS FROM THE WHEEL CLAMP ASSEMBLY. THE CENTER LOCKING LOCATION HOLE WILL BE USED TO MOUNT THE WHEEL CLAMP AND TARGET ASSEMBLY TO THE CALIBRATION PADDLE.***





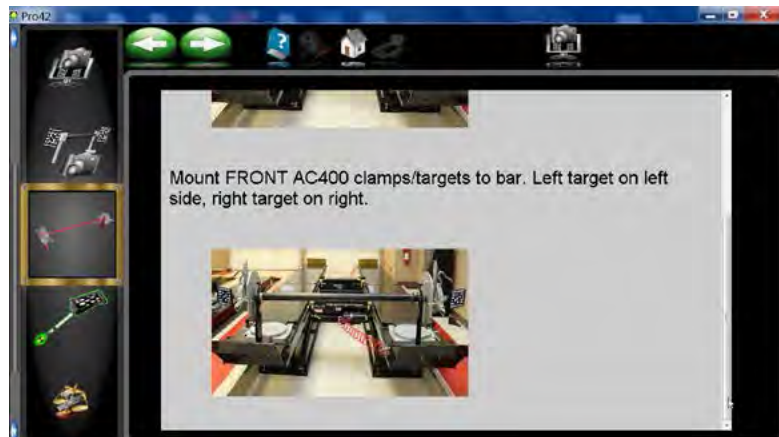
- Place the calibration bar and stands **in front of the turnplates** if possible and mount the paddle assembly to the bar.



- Mount the front selected wheel clamps and target assembly to the calibration paddles.

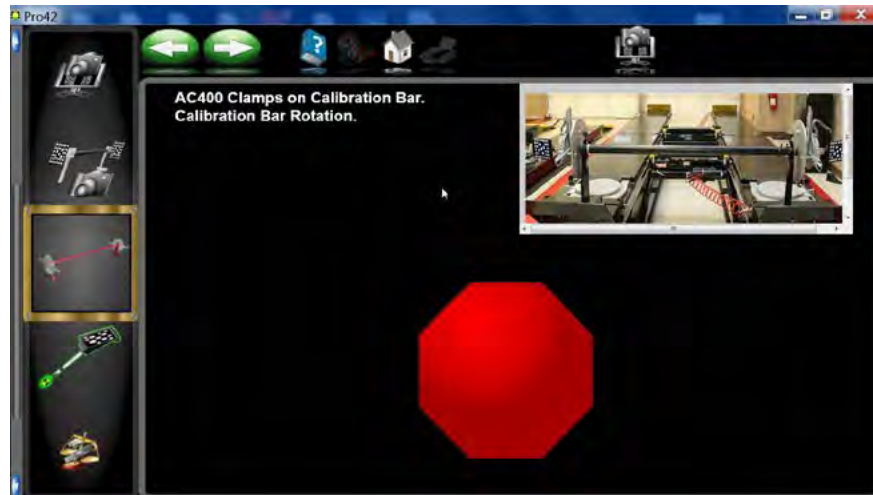
**NOTE: The wheel clamp and target assembly must be mounted vertical before continuing. This initial reading is recording the RTP data and marks vertical for all alignments.**

- Press the "Next" icon to continue.



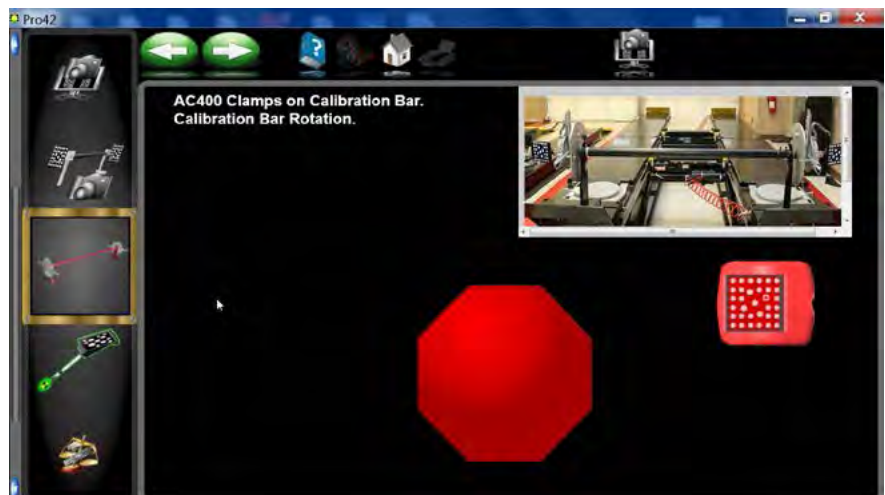


11. With the front clamps and targets mounted vertical, a stop sign will appear. Be patient as the system is recording data and may take several minutes to complete. This is the wheel clamp and targets initial position (Vertical) for the entire single bar calibration procedure. **NOTE: THE CAMERA TO TARGET DISTANCE MUST BE 120" OR LESS TO PROCEED.**

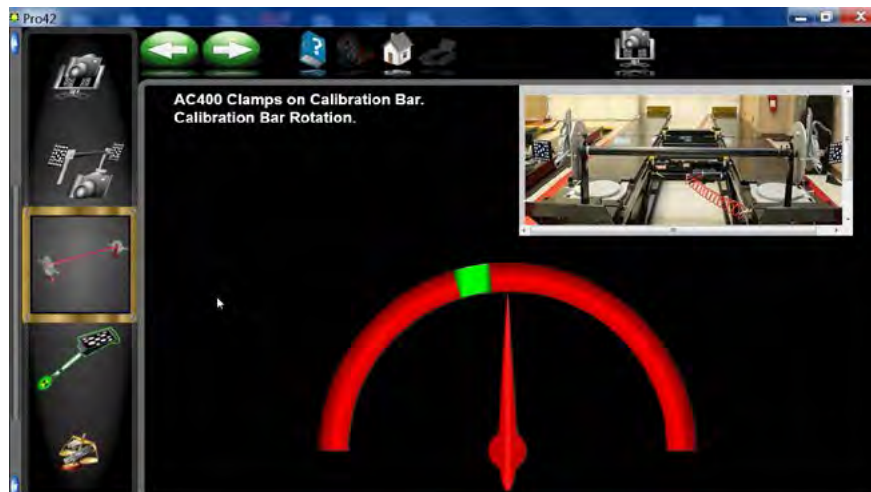


12. Rotate the calibration bar back and lock it using one of the locking knobs on the stands until the stop sign appears.

**NOTE: If a target is blocked at anytime during the single bar calibration procedure a blocked target sign will appear as shown in the illustration. Also note that if a wheel wobble occurs the system will automatically restart the previous step. A "Wheel Wobble" is flagged when the ending position is different than the beginning position.**

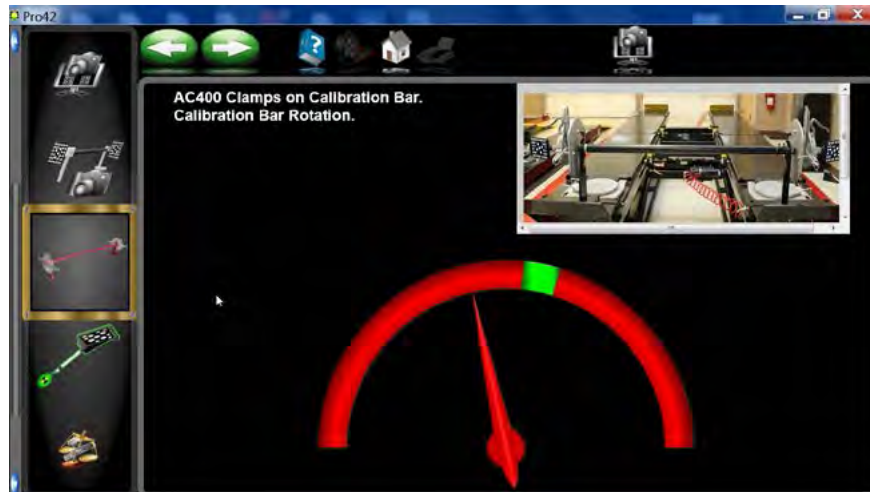


13. Rotate the calibration bar forward and lock it using one of the locking knobs on the stands until a stop sign appears.

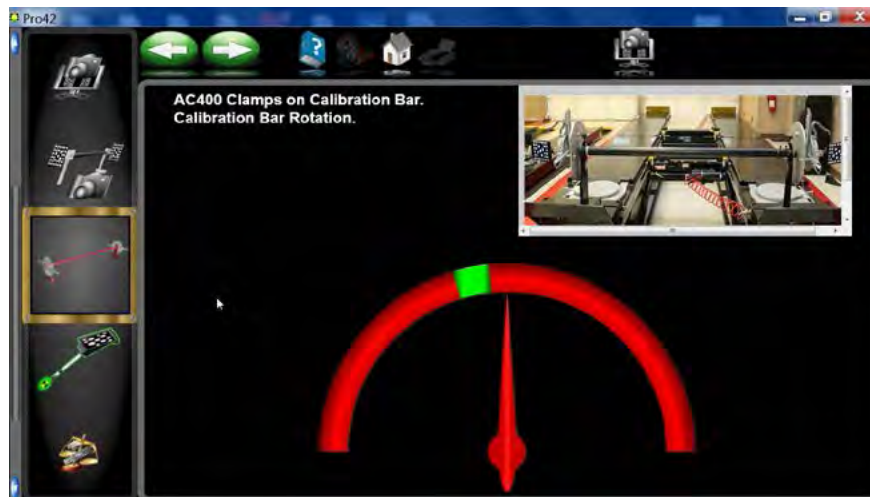


## Single Bar Calibration

14. Rotate the bar rearward and lock it using one of the locking knobs on the stands until a stop sign appears.



15. Rotate the bar forward and lock it using one of the locking knobs on the stands until a stop sign appears.



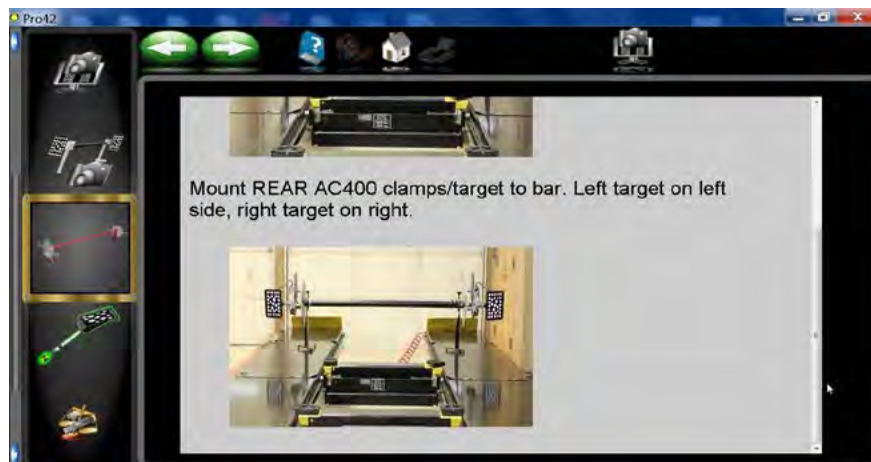
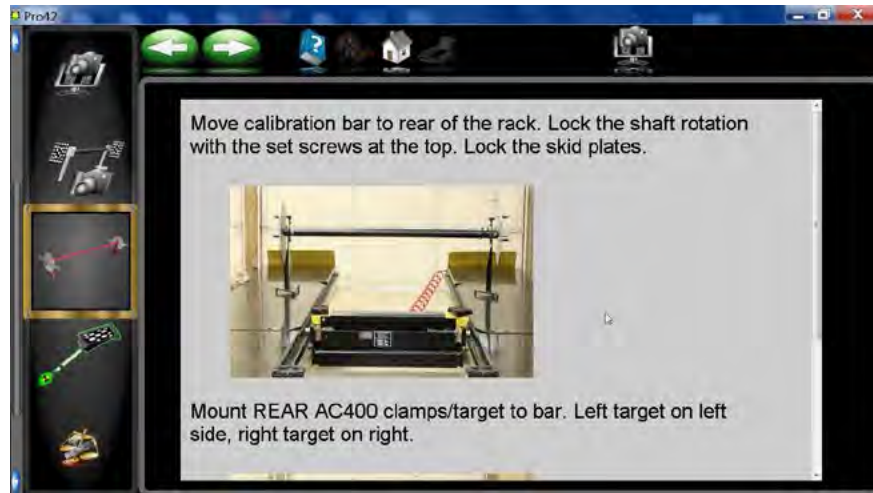
16. Rotate the bar back and lock it using one of the locking knobs on the stands until a stop sign appears.



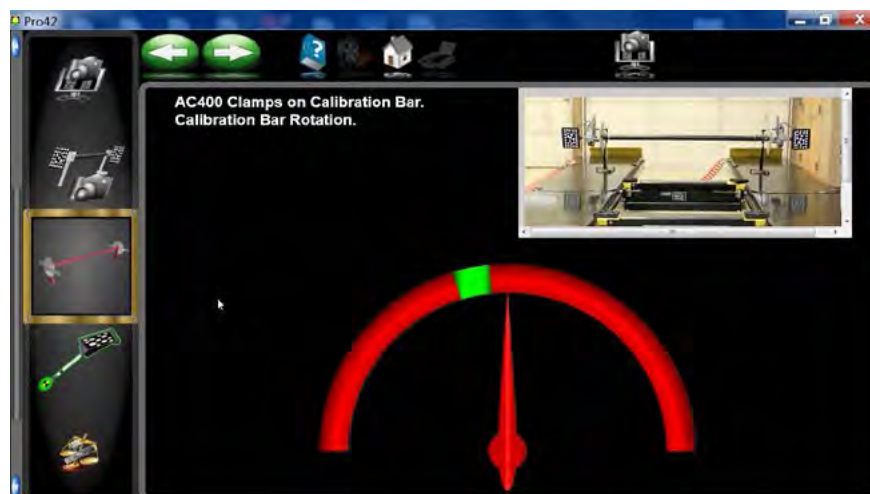
17. Continue each rotation process to complete the front target calibration.
18. Repeat steps 11 through 15 with the rear targets mounted on the bar in front of the turnplates.

## Single Bar Calibration

19. After the rear target assembly has been measured on the front of the rack the software will prompt the user to move the bar and stand assembly to the rear of the alignment rack. Again make sure that the bar and stands are on a solid surface. The rear slip plates must be pinned. Press the “Next” button to continue.



20. Rotate the bar forward and lock it using one of the locking knobs on the stands until a stop sign appears.

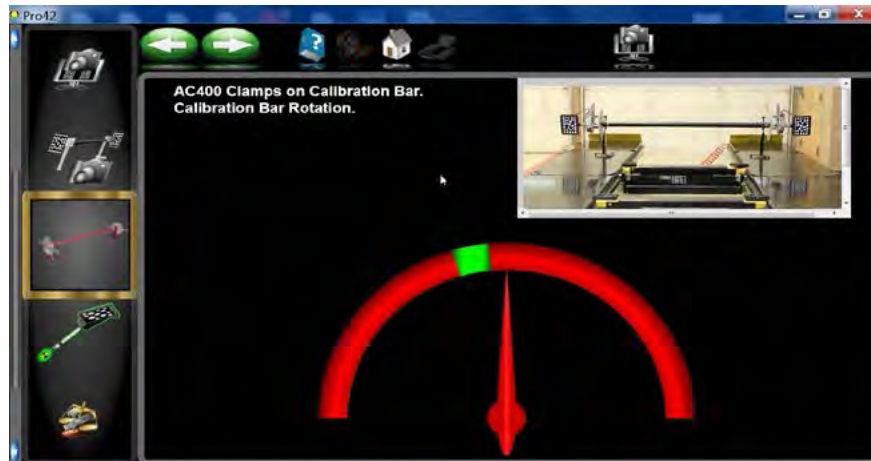




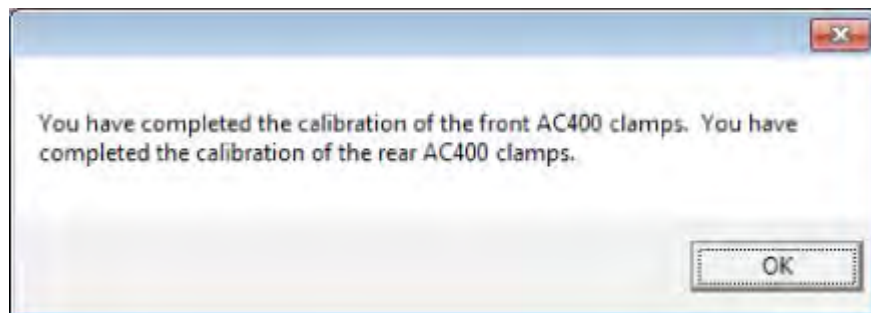
21. Rotate the calibration bar rearward and lock it using one of the locking knobs on the stands until a stop sign appears.



22. Rotate the bar forward and lock it using one of the locking knobs on the stands until a stop sign appears.



23. Repeat steps 20 thru 21.
24. After a successful calibration a completion flag should appear.



25. Depending on the wheel clamp and target being calibrated the necessary calibration files will be updated with the new values.
26. Using a vehicle with known alignment angles verify the alignment system before returning it to service.
27. Calibration Complete.



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