SCIENCETECH SOLAR SIMULATOR ALIGNMENT PROCEDURE MANUAL

E.M. SYMMETRIC ALIGNMENT METHOD

Specifically designed for the Sciencetech SS150 system

The goal of this report is to document very good and efficient results on uniformity over a specific targeted area, by simply using symmetry. This will be done using step by step procedure, and with the help of diagrams and simple equations to help you understand the process of getting best uniformity to power ratio.

Version 1.0
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1. PRELIMINALY SET-UP

1.1. Mirror positioning

The first step of this process is to make a simple calculation on where we want to install our target based on the target size needed for 2% non-uniformity. Fact: for every size of reflector projection on the target thru one of the mirror segments, one half of the projected segment length will be available for our uniformity test area. For example: If the bisecting length of one segmented mirror projection on the target is *10" (25.4cm),* then the diameter of the area of uniformity will be *5".*

1) $TARGETDISTANCE = (38.42459174 \times \text{Targetsize}) - 41.31844380$
2) $TARG.SIZE = (0.026025 \times TARGETDISTANCE) + 1.0753125$

1.1.1. To calculate the target distance from target size, the equation *(1)* will help you to calculate the target position from the output window based on the target size needed. Or if you want to know the target size from the actual target position, use equation *(2)*

1.1.2. Position the target according to the calculated distance. Measure distances from the output window of the solar simulator to the designated target position.

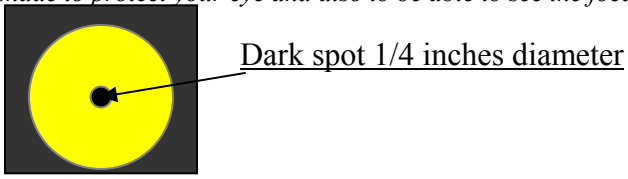
1.2. Lamp housing focusing and alignment

To obtain good results on uniformity, it is important to set the beam of light coming out of the lamp housing so it is iso-concentric, this process will be obvious when measuring the 6 segmented mirrors illuminance on the target. To do so, you will need to get the arc of the lamp perfectly at the reflector's 1st focal distance with the 3 setting screw at the back of the lamp housing. This process should also be in the Solar Simulator instruction manual.

1.2.1. For this you will have to remove the concave mirror holder assembly. By placing a flat black heat resistant shield along the optical axis at approximately *32 inches* from the *lamp housing*, you will have to find the *reflector's image;* you should see a clear donut shape image projected from the lamp when the bulb is at the right position inside the reflector. *See figure (1)*

Note: use dark shade to protect your eye and also to be able to see the focal point easier.

Fig *(1)*



1.2.2. With the help of the *3* alignment screws, consecutively adjust the screws of the lamp until you see the donut shape projection on the black shield. Arrange it so it is perfectly concentric and round with the dark spot having a diameter approximately 1/4 ".This dark center is the anode's shadow and the hole from the back area of the reflector.

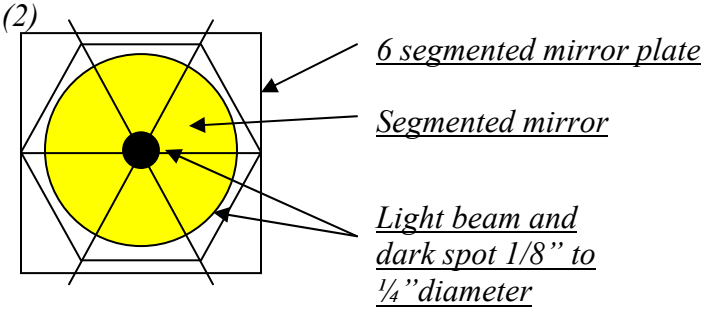
Note: Do not turn the screws more than ¼ turn at a time when adjusting the alignment screws, in doing so, you could allow the lamp and reflector to be damaged if they would ever come in contact while working.

1.2.3. Once you found the right setting for the bulb in the reflector, screw the concave mirror holder at its place and carefully align it to get the beam centered on the segment mirror plate.

1.2.4. The next step for a perfect alignment is to move the shield up to the 6 segmented mirror plate, and while holding it normal to the optic axis, align the 3 screws from the housing to get a perfectly round and concentric dark center inside the light area. This dark spot should be very small, about 1/8-1/4 diameter size; this process will get you the peak power from your solar simulator. You can also install a detector on the center of your target area and move the screws until you detect the higher power settings. *See fig(2)*

1.2.5. Once the focusing is done, it is important to get the light coming out of the lamp housing perfectly centered onto the 6 segmented mirrors plate. To do so, you'll have to use the set screw from the back of the concave mirror and set the light beam perfectly at the center of the segment plate. *See fig(1)*

Fig (2)



1.3. Target alignment

To get the best result on this process, it is very important to have the beam align up to the center of the target.

1.3.1. To do so, you will need to align your target perfectly with the output window of the solar simulator at the calculated distance, with the help of a ruler or any safe measuring device. Make sure that the target is exactly aligned with the horizontal and vertical axis.

1.3.2. Once all alignments are done you won't be able to reposition the target in any way before all tests are done under the specific uniformity area and target size obtained. So make sure that the target is properly positioned during alignment and testing. In any case of target movement, you will have to redo uniformity measurements again.

2. E.M SYMMETRIC METHOD OF ALIGNMENT

2.1. Six segmented mirror

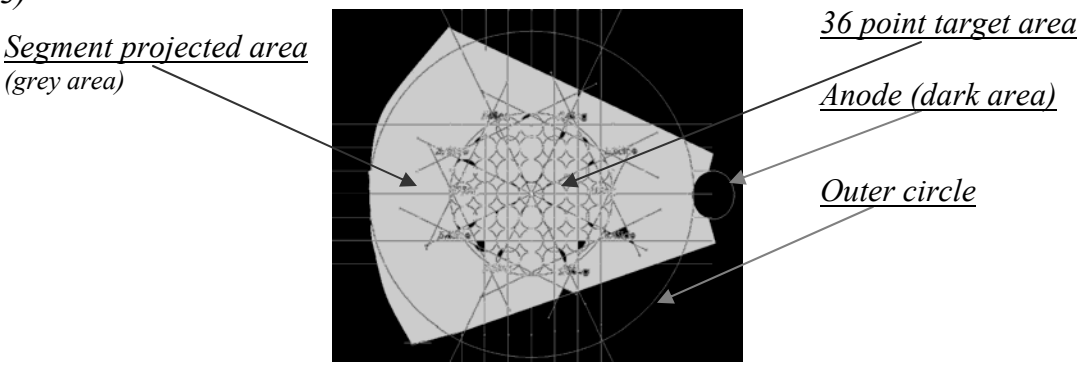
This is Sciencetech's solar simulator unique alignment method developed by our engineers especially for the light folding solar simulator system. The tools required for this process should be included in the complete solar simulator alignment package. *(Available soon*) List: two aperture segment mask, one aperture segment mask, laser pen, swiveling laser holder, adjustable laser stand, 36 measurements position target template, Sciencetech's silicon detector, Sciencetech's voltmeter, measuring tool, E.M alignment manual.

2.1.1. Turn on the solar simulator, and let it warm up for at least 10 minutes.

2.1.2. Place the two aperture segment mask with the aperture directed vertically on the segmented mirror plate, and place the other with one aperture segment mask on top of it so it obstructs one aperture *(bottom one)*. To start you should always use the position *#1(usually the top one)* corresponding the anode's position labeled *#1* specifically marked on the Sciencetech target.

2.1.3. Using the *3* adjustment screws on the back of each segment, place the projected segment inside and centered in the outer circle placing the anode part on the outside border. *See figure (3)*

Fig (3)

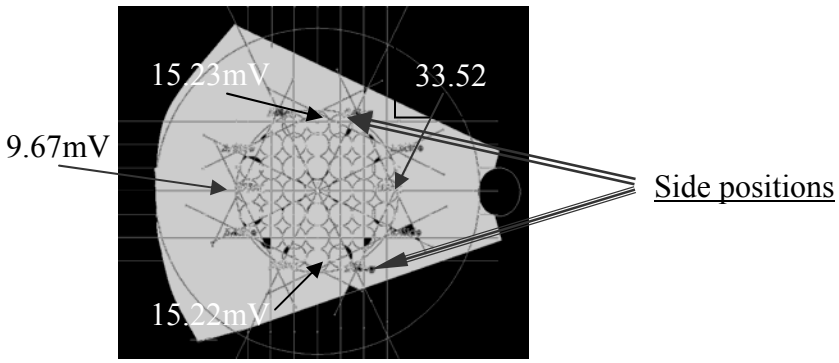


2.1.4. Using the special Sciencetech's detector or any *ASTM* class detector for specific *36* point measuring target area, measure the power on the corresponding *4* corners of the target measuring map. That would be the upper center (most powerful), bottom center (weaker) and center sides (equal power). This detector is equipped with a reticule that enables easy and accurate spotting of the measuring position on the uniformity target. Always align the reticule line with the one corresponding to the target's position to be measured. This will allow for repetitiveness and better accuracy and results.

2.1.5. Measure the illuminance of the *2* side position, and then get them at the same value using the *3* alignment screws, once it is set, make notes of all your measurements along the way. To get best results, it is imperative that you acquire very accurate values when adjusting the power on the side positions, and to make sure that the beam is always centered inside the outer circle when adjusting the mirrors. *See figure (4)*

**An example worksheet and Sciencetech uniformity target is provided with this manual*

Fig *(4)* A measurement:



2.1.6. Remove the single aperture mask from the segment plate and turn it around so it obstructs the other segment mirror. The anode part should now be on the area labeled *#2* on the target. Follow the same procedure of alignment noted in section *2.1.5.*

2.1.7. Follow the same procedure for the other segmented mirrors with respect to the labeled order on the Sciencetech's uniformity target.

2.1.8. To get good uniformity, all 6 segments should match its mate's side's power value.

2.1.9. Once all alignment is done, you are ready to do a complete area measurement of uniformity using the *36* points specified on the target that is in compliance with *ASTM* requirements.

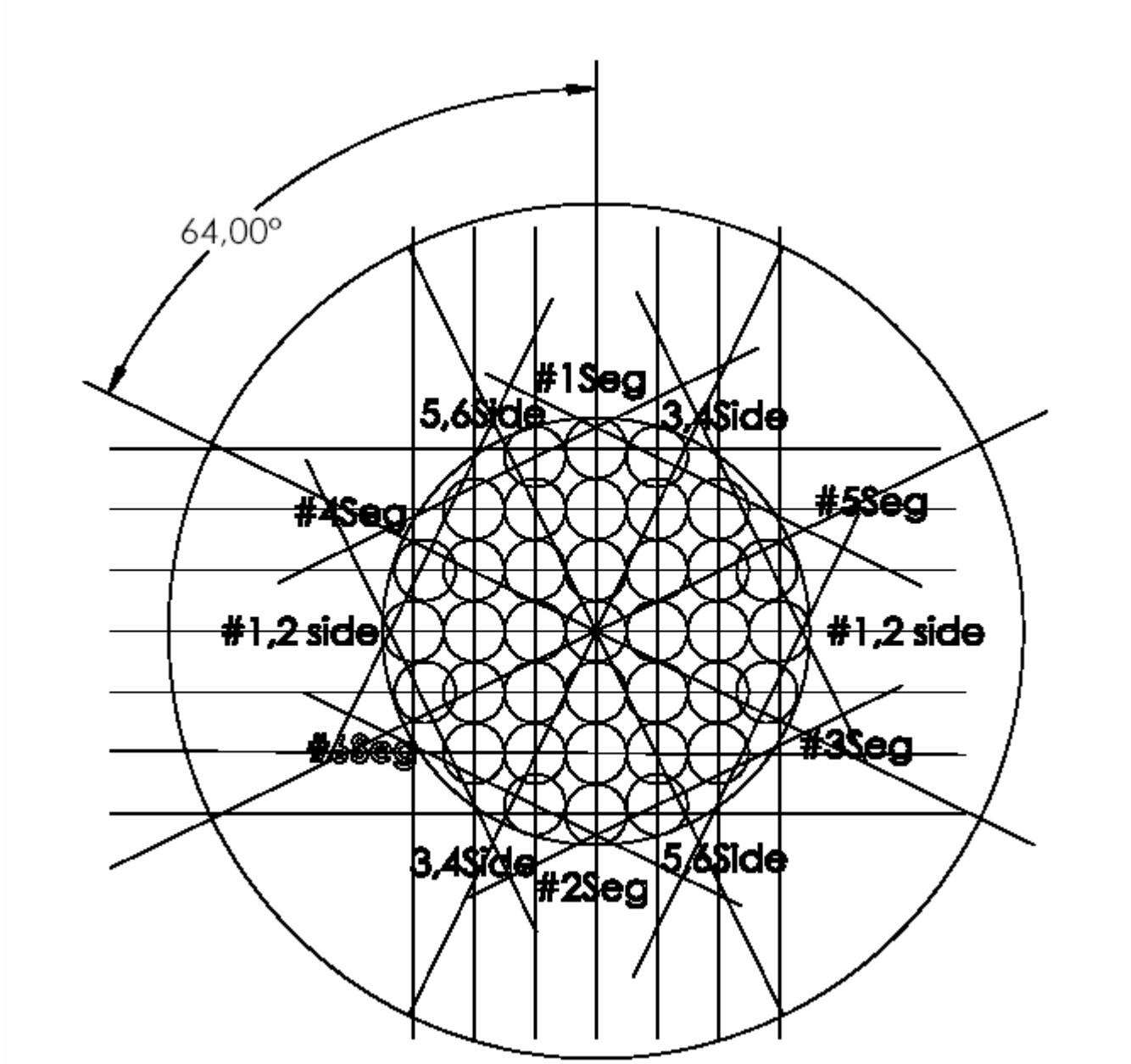
2.1.10. Use the equation *(3)* for spatial non- uniformity from the maximum and minimum illuminance value obtained within the *36* measurements, to document what is your results on uniformity.

$$(3) \quad \%Non-uniformity = \frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}} \times 100$$

** *For further information please contact Sciencetech inc. engineering.*

Mission Statement: "To serve the New Product Development market in the field of Optical Spectroscopy with dedication, integrity and excellence"

SCIENCETECH'S UNIFORMITY TARGET PATHERN



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ILLUMINANCE DATA COLLECTED FROM EACH SEGMENTS
ON ALL CARDINAL POINTS IN THE CIRCLE

Segment#	Top *(mV)*	Sides *(mV)*	Bottom *(mV)*
Segment 1			
Segment 2			
Segment 3			
Segment 4			
Segment 5			
Segment 6			

FULL MAP DOCUMENT FOR UNIFORMITY MEASUREMENT

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Line 1							
Line 2							
Line 3							
Line 4							
Line 5							
Line 6							
Line 7							

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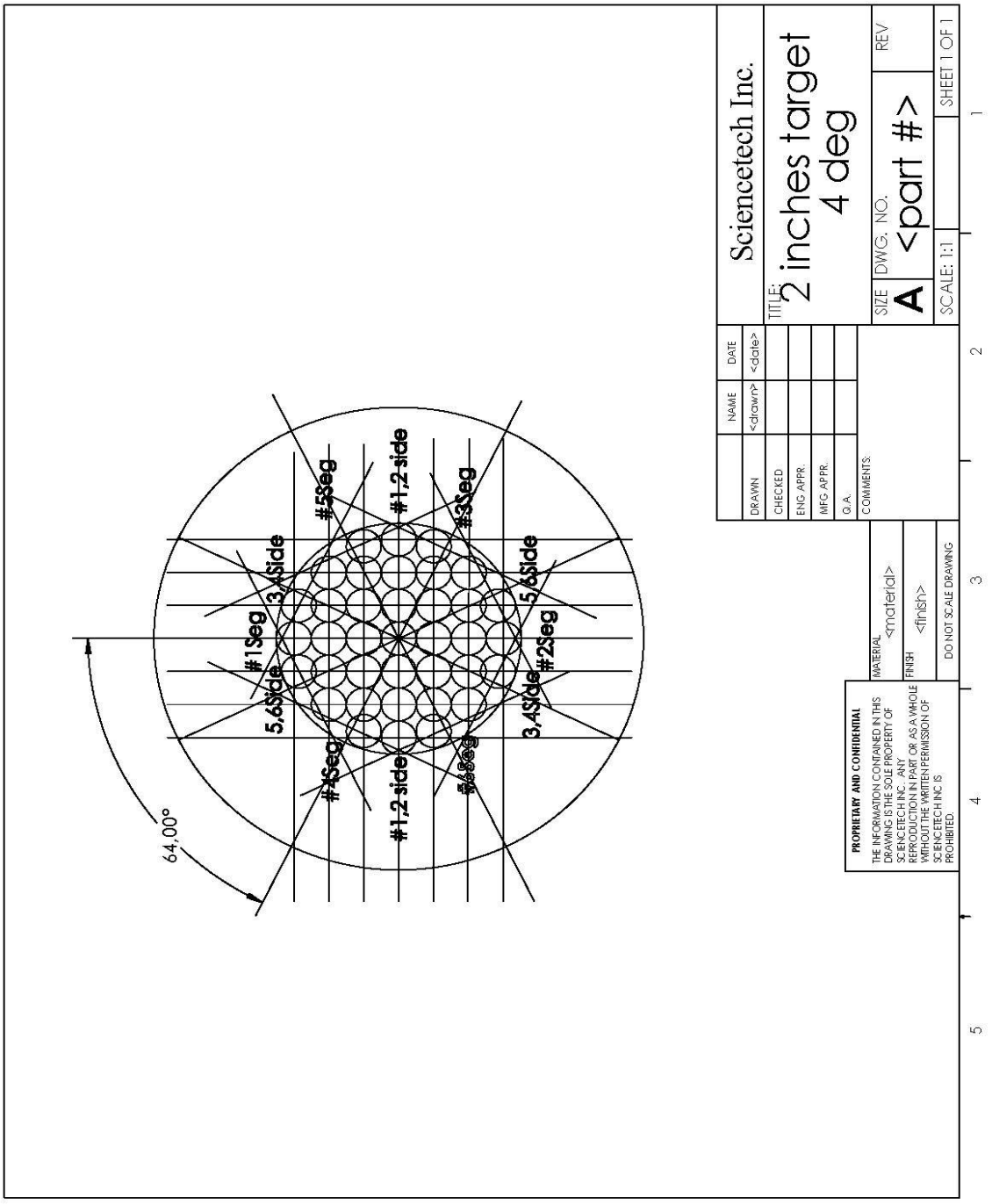

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