

Miller, Debra

From: Kyle Allred <k.allred@rr-optics.com>
Sent: Tuesday, July 18, 2017 4:47 PM
To: Xu, Shirley
Subject: [External_Sender] Last two action items
Attachments: Process to Validate less than 10 percent Thorium.docx

Follow Up Flag: Follow up
Flag Status: Flagged

Hello Shirley,

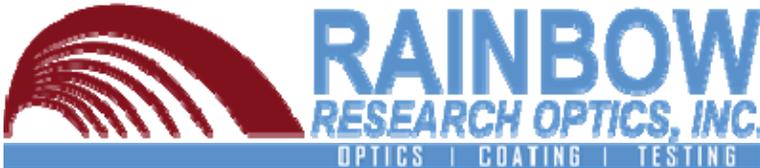
Action Item #1: Attached is the processes we use to validate that the Thorium on the lenses is less than 10%. It is less than .002%, I have pictures of all the equipment.

Action Item #2: New License from the State of Colorado. We had to come up with \$37,000 for the State bond so it took a little while. That is complete and I am just waiting for my license number. I will send that over once it arrives. Should be very soon.

Kind Regards,

Kyle Allred

Test Engineer



Small Disadvantaged Business (SDB) / Minority Owned Business

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How to Validate Less Than 10% Composition of Thorium on a Coated Lens

1. A job tag is created and the lens is polished down to a defined center thickness. The center thickness can vary by .01mm which is 0.002% tolerance variation.



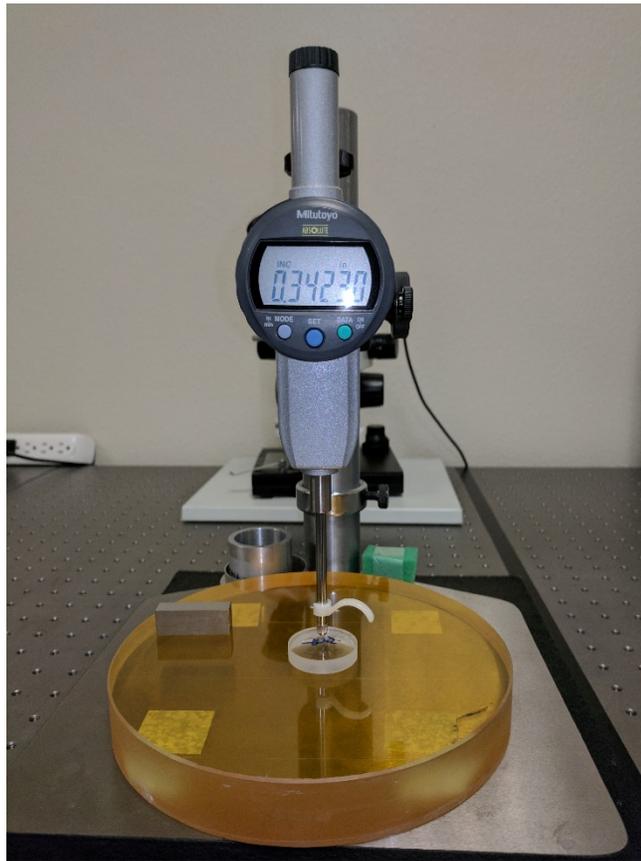
Rainbow Research

Inspection Report

CUSTOMER:	JOB#:	ITEM#:
MATERIAL:	PO#:	P/N:
LOT QTY:	INS. QTY:	LOT#:
INSPECTOR:	INSPECTION DATE:	QA APPROV

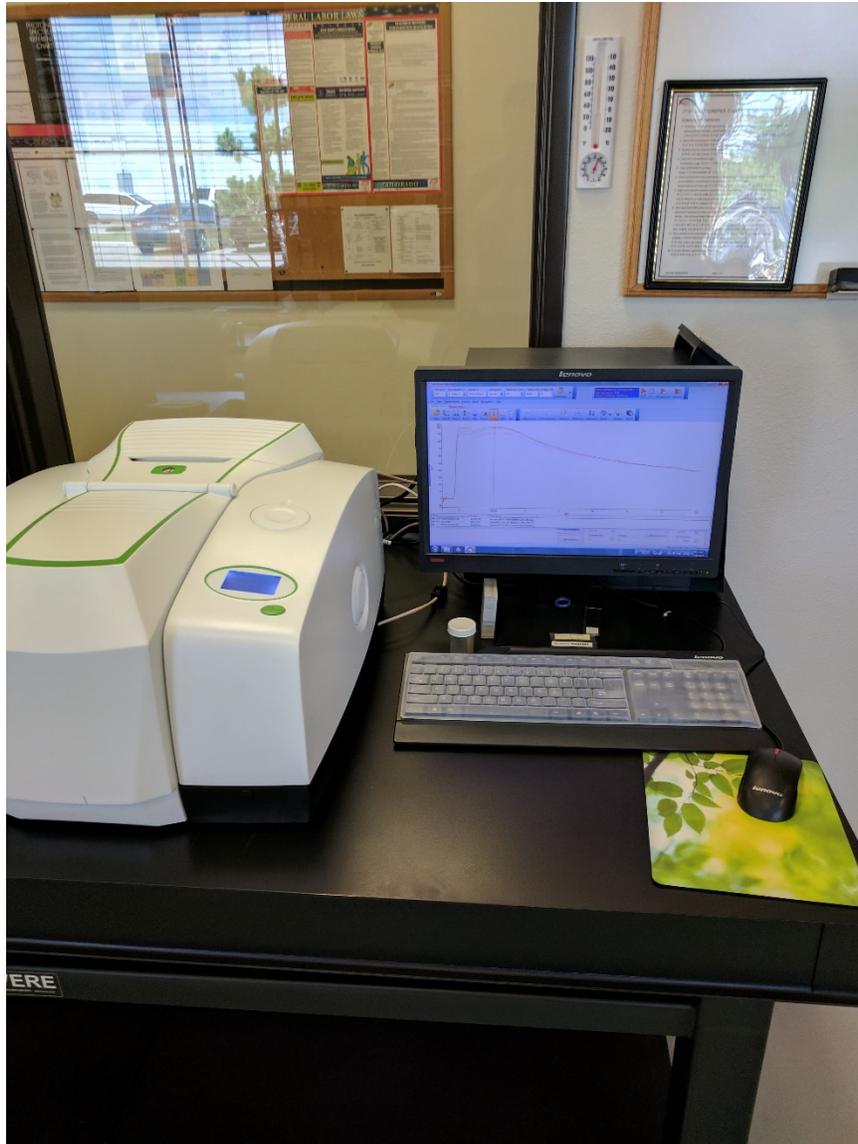
SPECIFICATIONS	Min	Nominal	Max	1	2	3
DIAMETER(mm)	47.950	48.000	48.000			
CT(mm)	4.950	5.000	5.050			
WEDGE	< 3° 30'					
CHAMFER(mm)	0.2mm @ 45deg					
SURFACE 1	CX(ASP)					
ROC(mm)	460.043	460.243	460.443			
SQ	80	/	50			
IRREG. @633 nm	Lambda / 2					
CA(mm)	44.000					
SURFACE 2	CX					
ROC(mm)	166.940	167.140	167.340			
SQ	80	/	50			
IRREG. @633 nm	Lambda / 4					
CA(mm)	44.000					
1) Roughness : ≤ 5.0nm rms						
2) Figure Error : "S1" ≤ 50nm rms (after coating), "S2" ≤ 30nm rms (after coating)						

2. The measurement is taken with a dial test indicator micrometer that is calibrated quarterly.

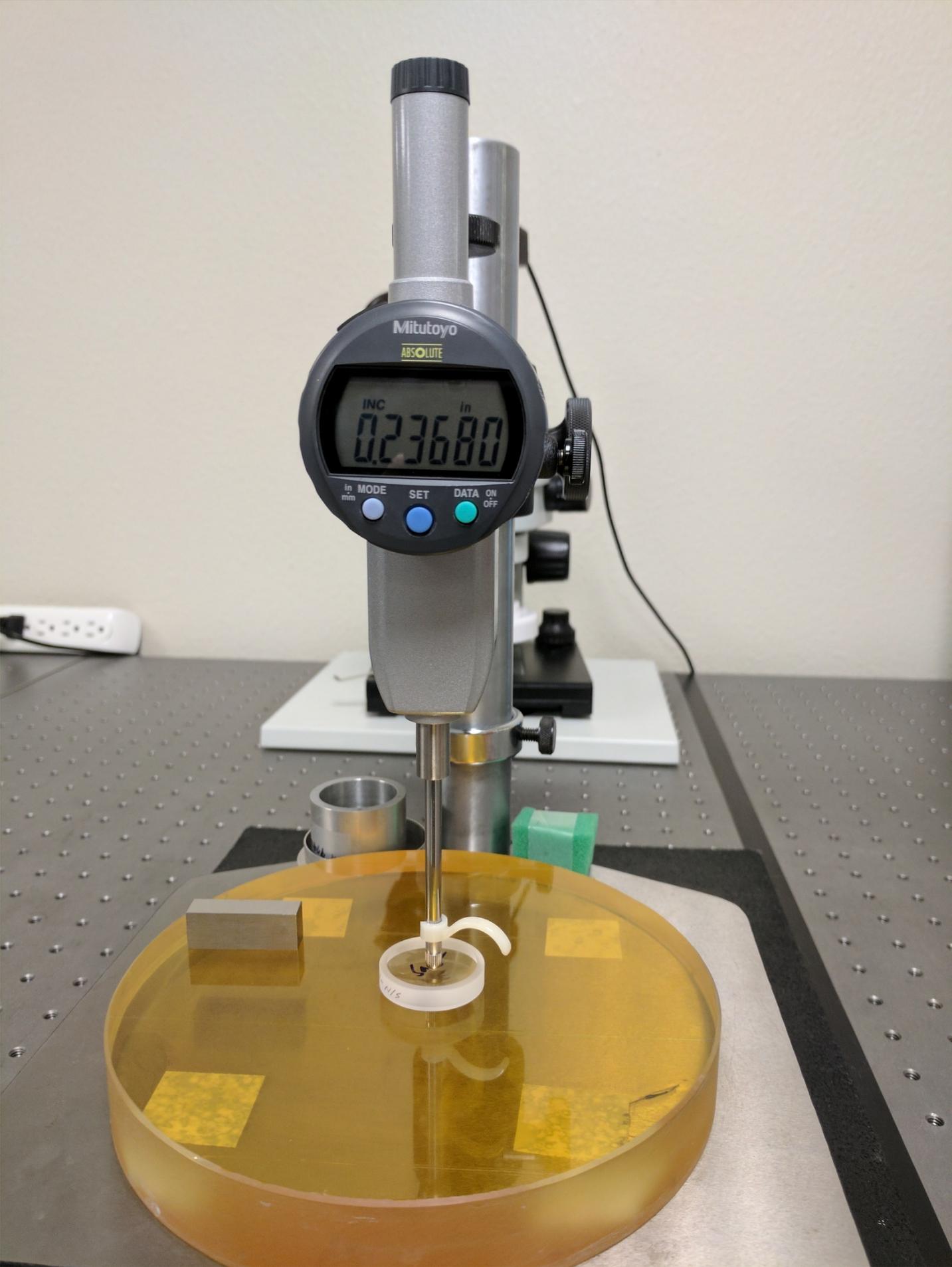


3. The lens after passing the center thickness measurement is passed on to apply the thin film coating. (Thorium) The thickness is controlled by the Inficon XTC3 thin film deposition controller. We set the Angstroms per second and then check that the layers are done correctly. We then add layers of magnesium to protect the Thorium layer.

4. After the thin coating is applied to the lens. A transmission test is done to check that light going through the lens is within specifications. Too thin or too thick of a coating will show up exponentially in this test. We can determine the thickness down to the micron. The thin coating will be less than .002% of the total composition at the most dense state. Perkin Elmer Spectroscope (Calibration Valid)



5. The center thickness is measured once more in Final QA. The final QA will test the center thickness, check for any chips or damage, and go through all the environmental testing steps to ensure the thin film will not lift under the conditions presented.



Mitutoyo

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