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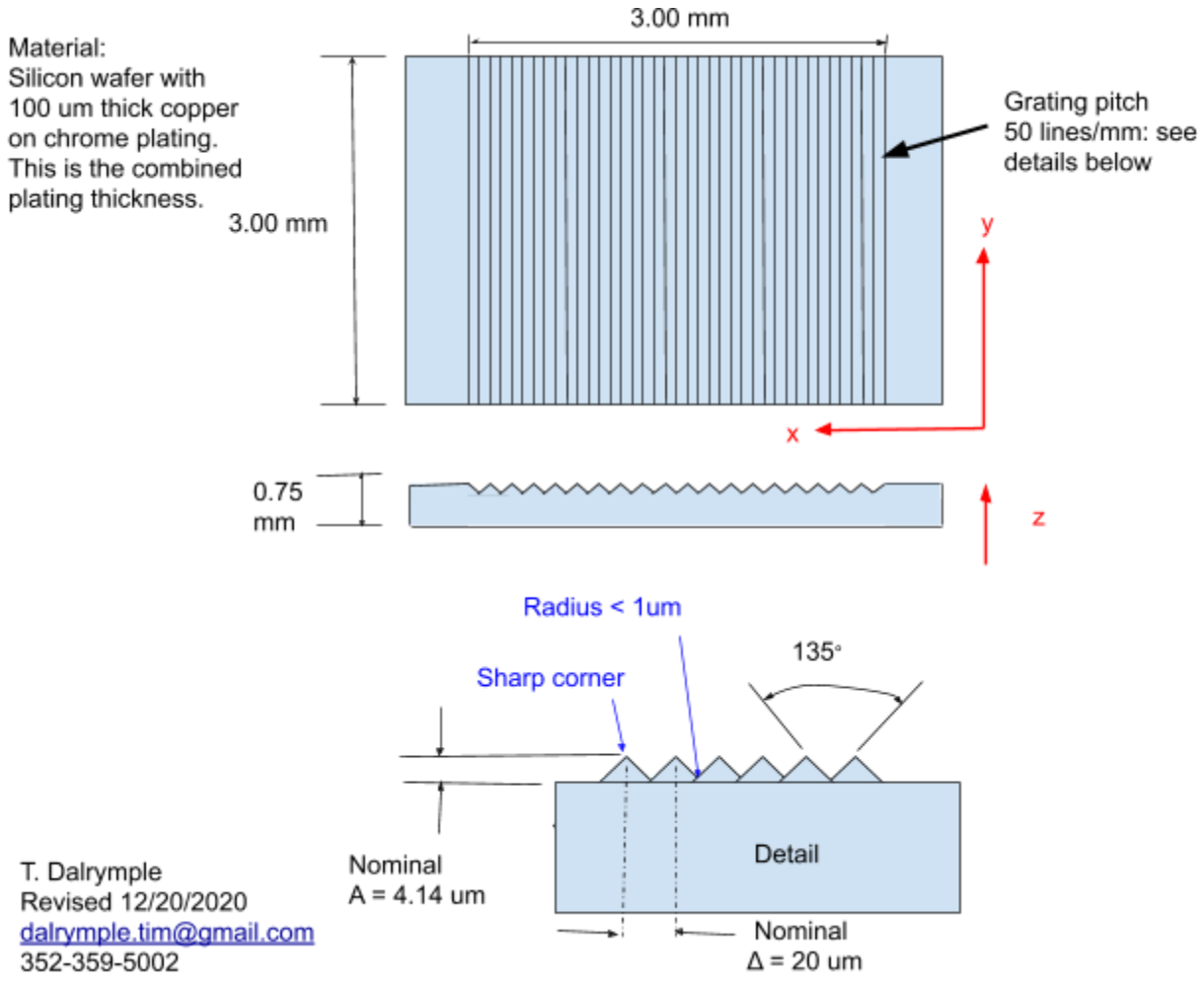
Date: 20 December 2020
Purpose: Illustrate Nominal Grating Geometry and Deliberate Manufacturing Errors to Validate Metrology and System Performance

This is a request for grating samples manufactured by the committee to evaluate and compare the metrology at Zeiss (Paul Brackma) and functional metrology using laser illumination of the grating and a high quality camera to analyze the diffraction pattern in Matlab using the approach by Goodman.[1]



[1] https://docs.google.com/document/d/1n6pp1N77Ltw1z6cv_Xrl_f6IG5NeOH52JhCRWR3x1zA/edit?usp=sharing

Table of Diffraction Grating Samples to Evaluate Process and Metrology

Diffraction grating	Test Coupon 1 Nominal Diffraction Grating	Test Coupon 2 with depth bias	Test Coupon 3 with pitch bias	Test Coupon 4 without bias but with random dept variation on a groove by groove basis (i.e. no deliberate variations within a groove)
Pitch (μm)	20	20	18	20
Depth (μm)	4.14	3.0	4.14	4.14 ∓ 3 σ 3.09-5.19 σ = 350 nm

Where σ is the standard deviation of a normally distributed random variable (depth). For the test gratings, I suggest σ = 350 nm.

Note: I specify modulating the depth rather than the pitch in Grating #3. I choose the pitch since we discussed that the depth is to be the controller variable most dependent on the design of the team.

The variation in pitch is also a 1st order effect on the diffraction pattern. However, I expect this to be more related to the quality of the xy stage and also--to some degree--dependent on the executed motion profile.

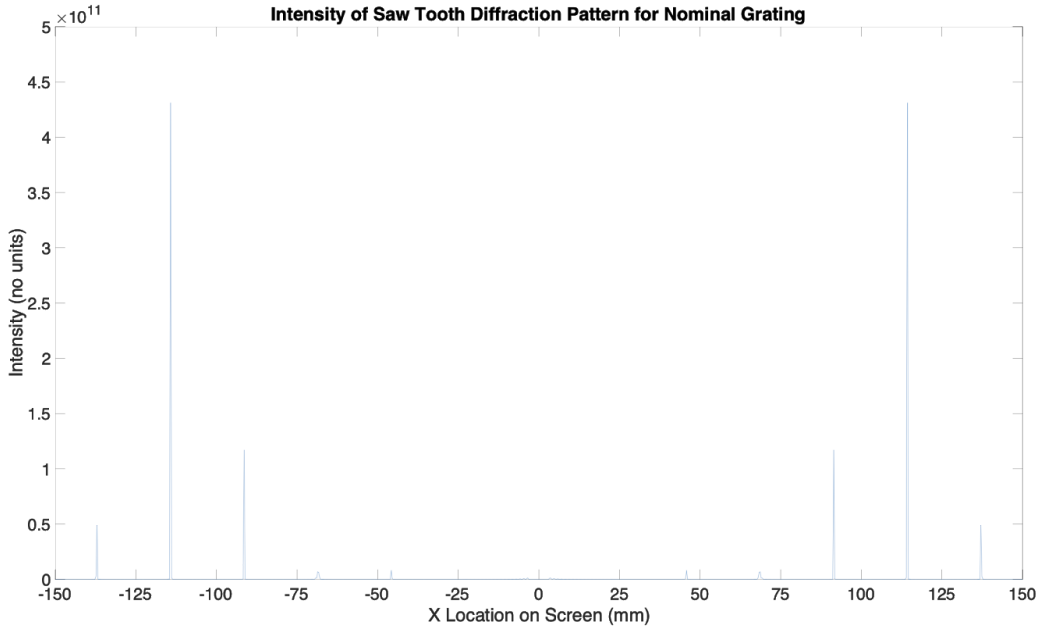


Figure 1: Test Coupon 1-Nominal Diffraction Grating

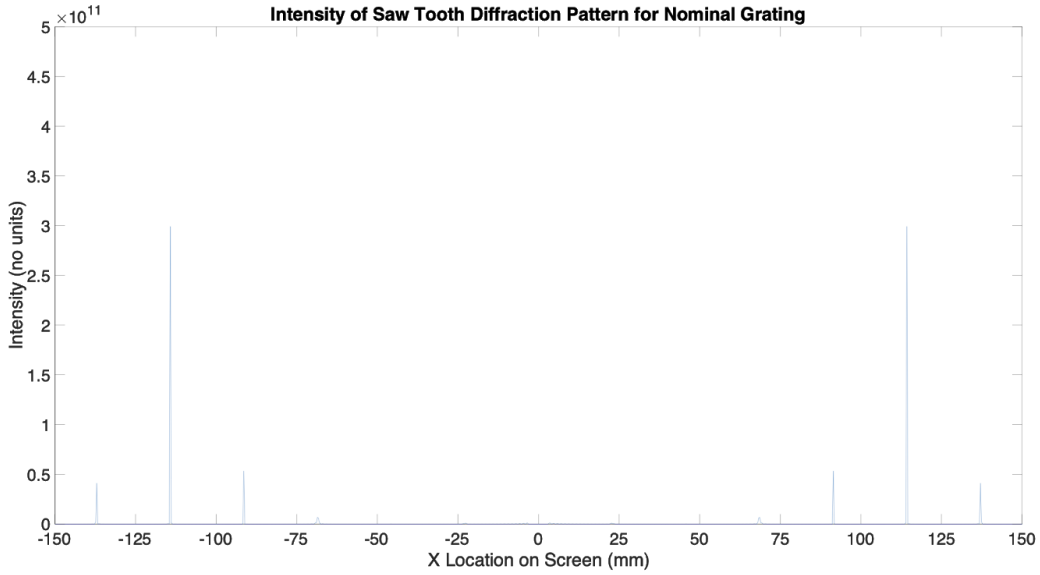


Figure 2: Test Coupon 2 Theoretical Diffraction Pattern depth bias

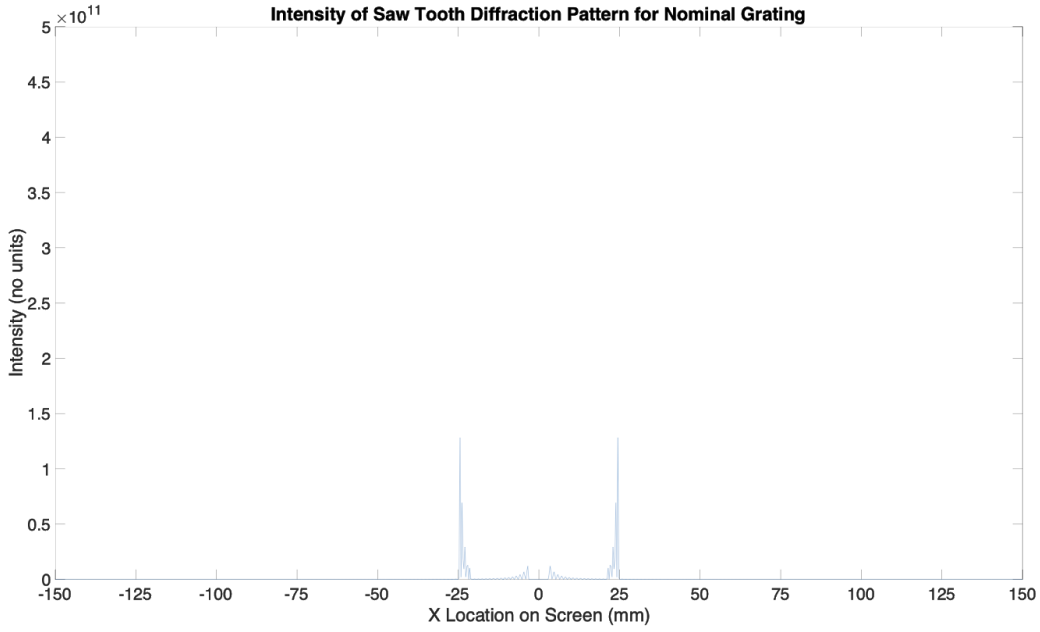
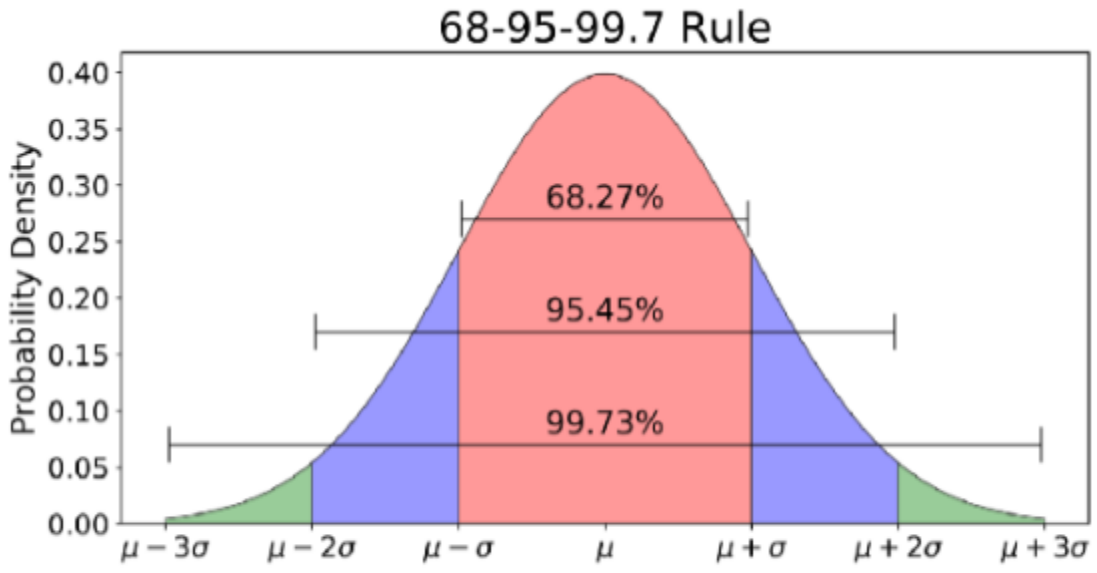


Figure 3: Test Coupon 3 Theoretical Diffraction Pattern pitch bias

Figure 4: Test Coupon 4: Theoretical Diffraction Pattern random depth variation

Procedure: Zeiss inspects three coupons. Inspect three coupons with laser illumination and SLR camera. Compare results to evaluate methods.

So, over the area, the distribution of grating depts is random and is distributed as shown below.



u - 3 sigma = 3.09 um u = 4.14 um u + 3 sigma = 5.19 um

Illustration of the midpoint and ∓ 3 σ points for the target distribution of the grating depth