Precitech

Global Manufacturer of Innovative Ultra Precision Machining Solutions

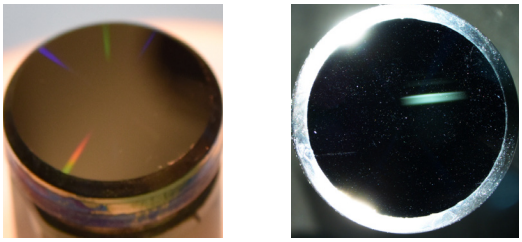
APPNOTE

No-color molds for mobile phone camera lenses

Nanoform® X

With TMC/Precitech QUIET-Base™

Part photos



Left: Mold cut on competitor's machine with standard cutting conditions.

Right: Mold cut with Nanoform X on TMC QUIET-Base with Precitech's exclusive no color cutting conditions.

Goal:

Demonstrate the capability to diamond turn mobile phone and smart device camera lens molds with no diffractive color or tool marks and also minimize surface roughness.

Process:

Two axis or XZC diamond turning on a Nanoform® X with TMC/Precitech QUIET-Base™. Process conditions optimized to minimize surface roughness and eliminate diffractive color and tool marks.

Part Details:

Material: Electroless nickel plated steel
Diameter: 3.25 mm, optical zone

Machine Details:

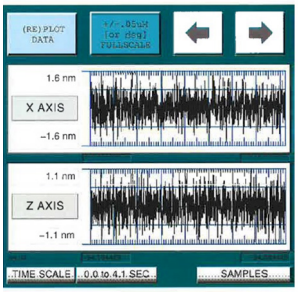
Slide type: dovetail, for dynamic stillness
Bearing type: hydraulic oil, for damping
Oil temperature control: water cooled
X axis following error: 1.6 nm
Z axis following error: 1.1 nm

Process Details:

Feed rate: 1.8 mm/min
Coolant: OMS

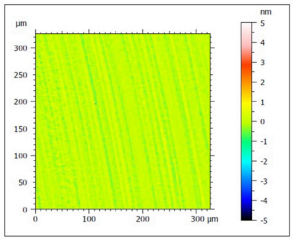
Results:

- **Surface finish:** 0.15 nm Sa
- **No diffractive color**
- **No tool marks**



POSITION_ERROR_PLOT 2017-06-06 01:22:53
SAMPLED AT 2 kHz WITH NO FILTERING OVER 4 SECONDS

Surface Finish Metrology



Roughness (Gaussian filter, 25 µm)

ISO 25178		
Height Parameters		
Sa	0.15035	nm
Sq	0.18782	nm

Precitech's No-Color Specification

- No color test part = 12.7 mm dia., 254 mm convex spherical radius, nickel plated steel test part
- Surface finish < 0.4 nm Sa (measured halfway between the center and the edge and on the outer diameter on a Zygo Zegage with a 10x objective. A 25 µm filter will be used with form error removed using a 12th order polynomial)
- No diffractive color visible when observed with a 50x stereo microscope when the part is illuminated with a fiber optic light source
- Tool radius < 100 µm
- Feed rate > 0.6 mm/min
- Z-axis following error < ± 2 nm

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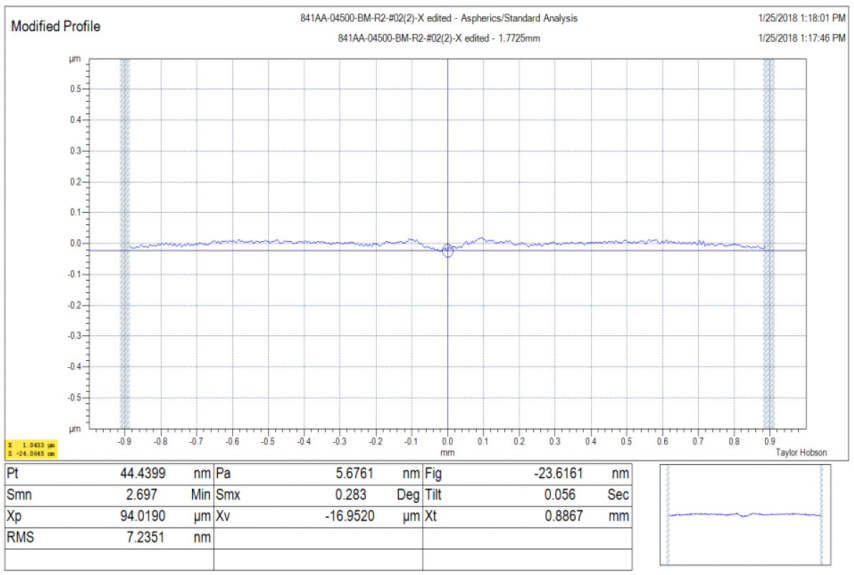
Gullwing sample repeatability test results: (µm)

Sample #	Design Fit RMS	Best Fit RMS	Design Fit P-V	Best Fit P-V
1	0.0230	0.0072	0.0990	0.0444
2	0.0323	0.0064	0.1190	0.0512
3	0.0294	0.0081	0.1169	0.0583
4	0.0238	0.0087	0.1053	0.0583
5	0.0264	0.0067	0.1068	0.0495
6	0.0209	0.0078	0.0944	0.0536
7	0.0218	0.0074	0.0940	0.0589
8	0.0324	0.0061	0.1141	0.0468
Max	0.0324	0.0087	0.1190	0.0589
Min	0.0209	0.0061	0.0940	0.0444
St. dev. (2 σ)	0.0086	**0.0017**	0.0185	0.0104

1.7 nm RMS form repeatability over 8 samples

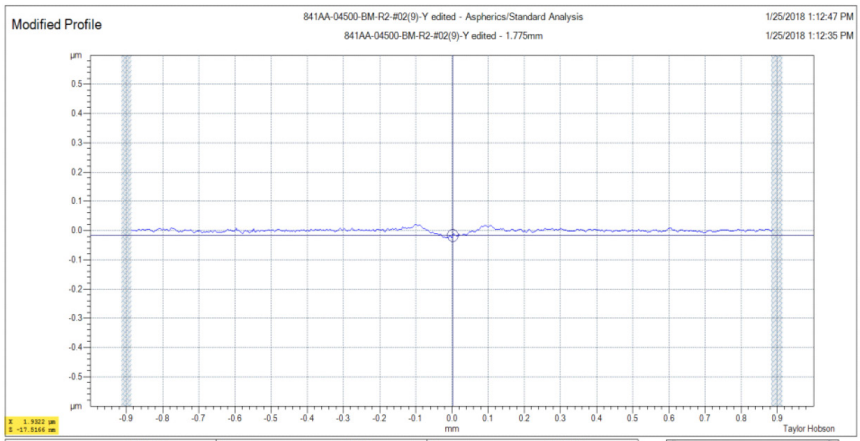
NOTE: Temperature control of ± 0.1 °C recommended for maximum form repeatability

Sample 1



Pt	44.4399	nm	Pa	5.6761	nm	Fig	-23.6161	nm
Smn	2.697	Min	Smx	0.283	Deg	Tilt	0.056	Sec
Xp	94.0190	µm	Xv	-16.9520	µm	Xt	0.8867	mm
RMS	7.2351	nm						

Sample 8



Pt	46.7625	nm	Pa	4.0481	nm	Fig	-22.6280	nm
Smn	2.369	Min	Smx	0.228	Deg	Tilt	0.066	Sec
Xp	-99.8380	µm	Xv	-1.0611	µm	Xt	0.8871	mm
RMS	6.0782	nm						

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