

M I C R O S C O P E

(MICRO-Satellite à traînée Compensée pour l'Observation du Principe d'Equivalence)

Test Mass Fabrication

Challenges & Achievements

**D. Hagedorn, H.-P. Heyne, St. Metschke, U. Langner,
J. Rother, S. Grüner, F. Löffler**

Introducing PTB



Hermann von Helmholtz

PTB:

- National Metrology Institute (NMI)
- Federal Ministry of Economics and Technology (BMWi)
- 1900 staff members
- 125+ million € budget

Metrology:

- Science and application of correct measurement
- Traceability of results to national standards
- Determination of results with verification of uncertainty



Site Braunschweig, Germany



Scientific Instrumentation

WG 5.54 Surface Technology



Mechanics and
Acoustics



Precision Engineering
Mass



Boltzmann-
Constant



Electricity



Ionizing Radiation



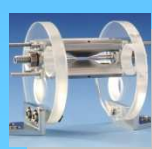
Avogadro-
Constant



Chemical Physics and
Explosion Protection



Temperature and
Synchrotron Radiation



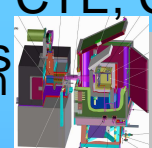
QUEST



Optics



Form & Dimension, CTE, Countersinks,
Medical Physics and
Surface Roughness
Metrological Information
Technology



ESA
ONERA
Metas



Scientific-technical
Cross-sectional Tasks



Administrative
Services
Density Distribution

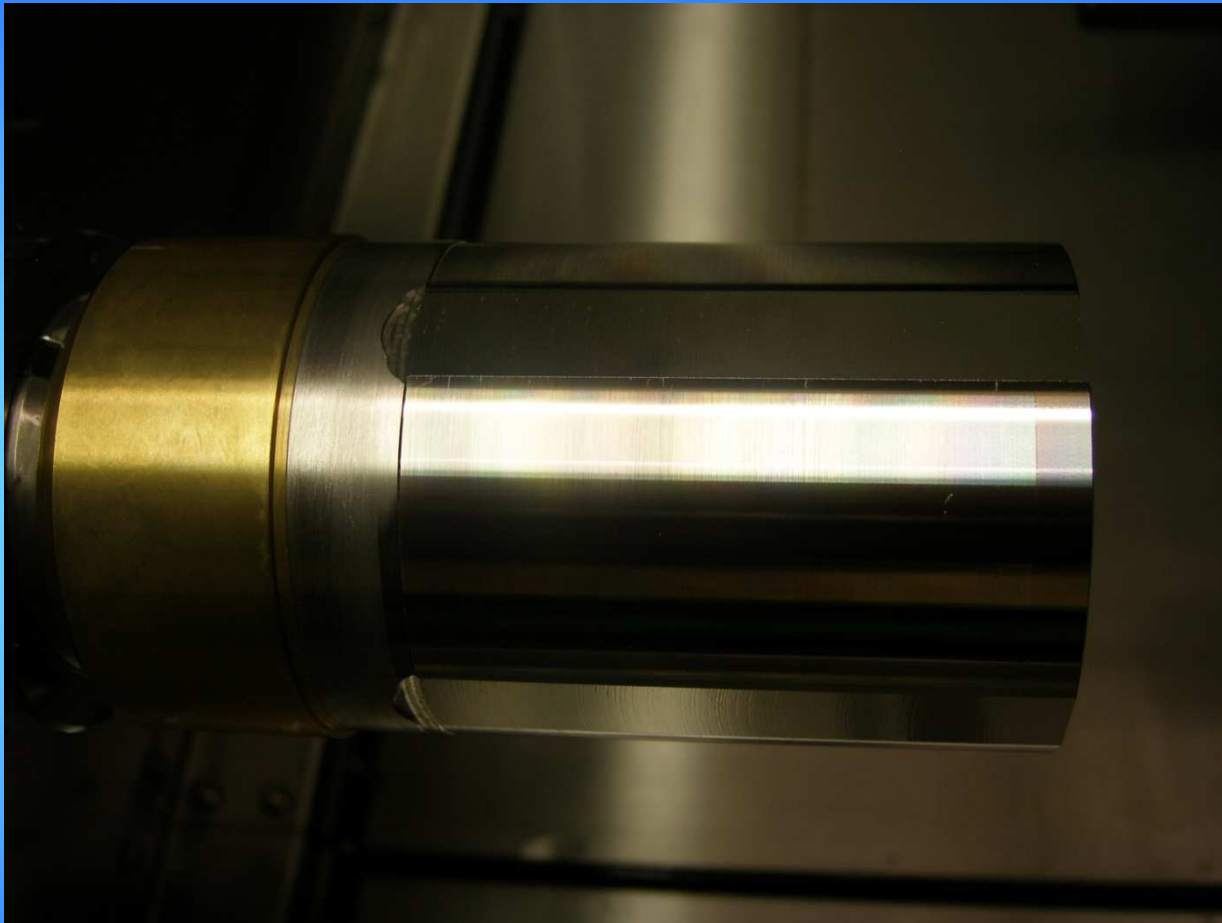
Manufacturing of the MICROSCOPE test mass



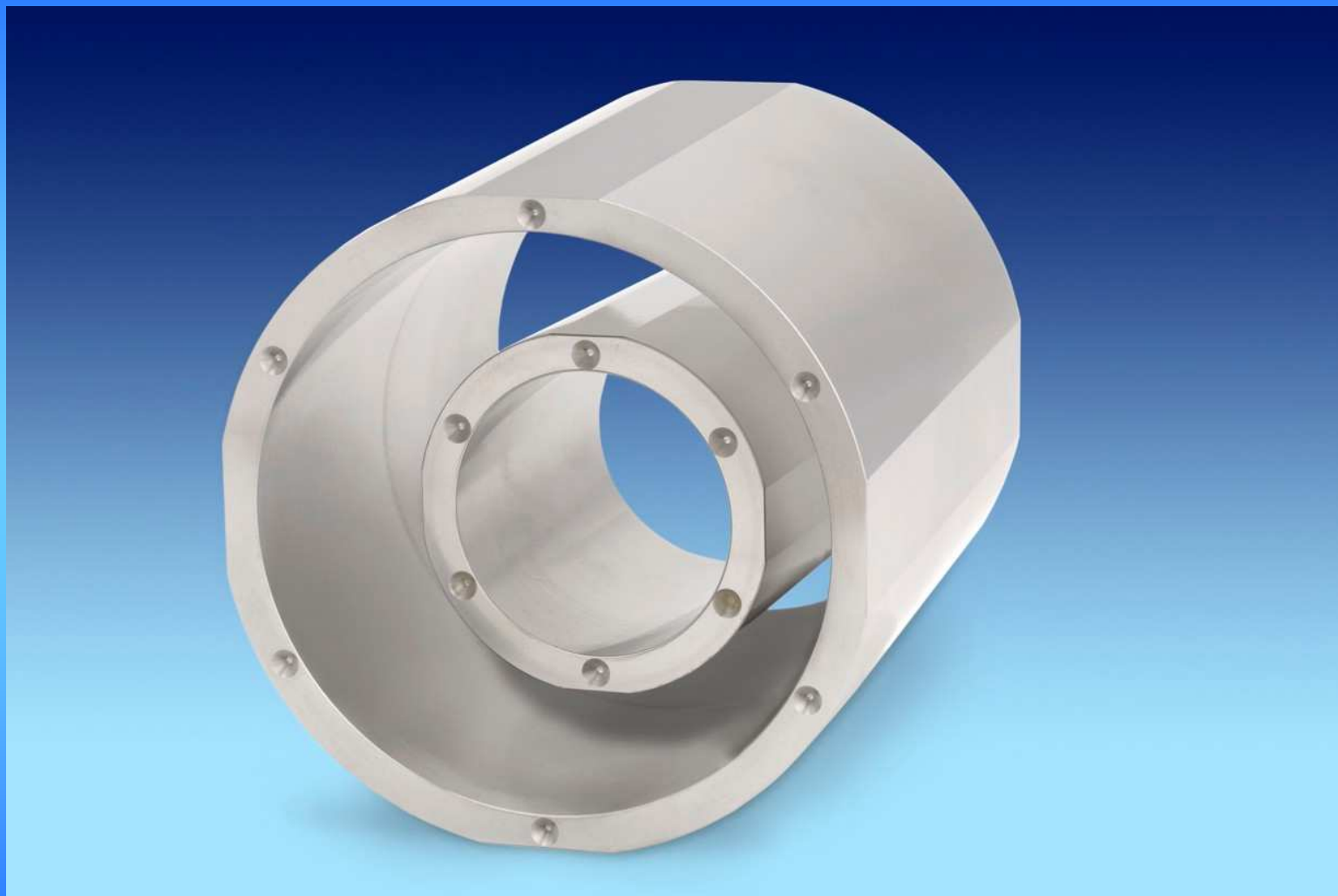
Manufacturing of the MICROSCOPE test mass



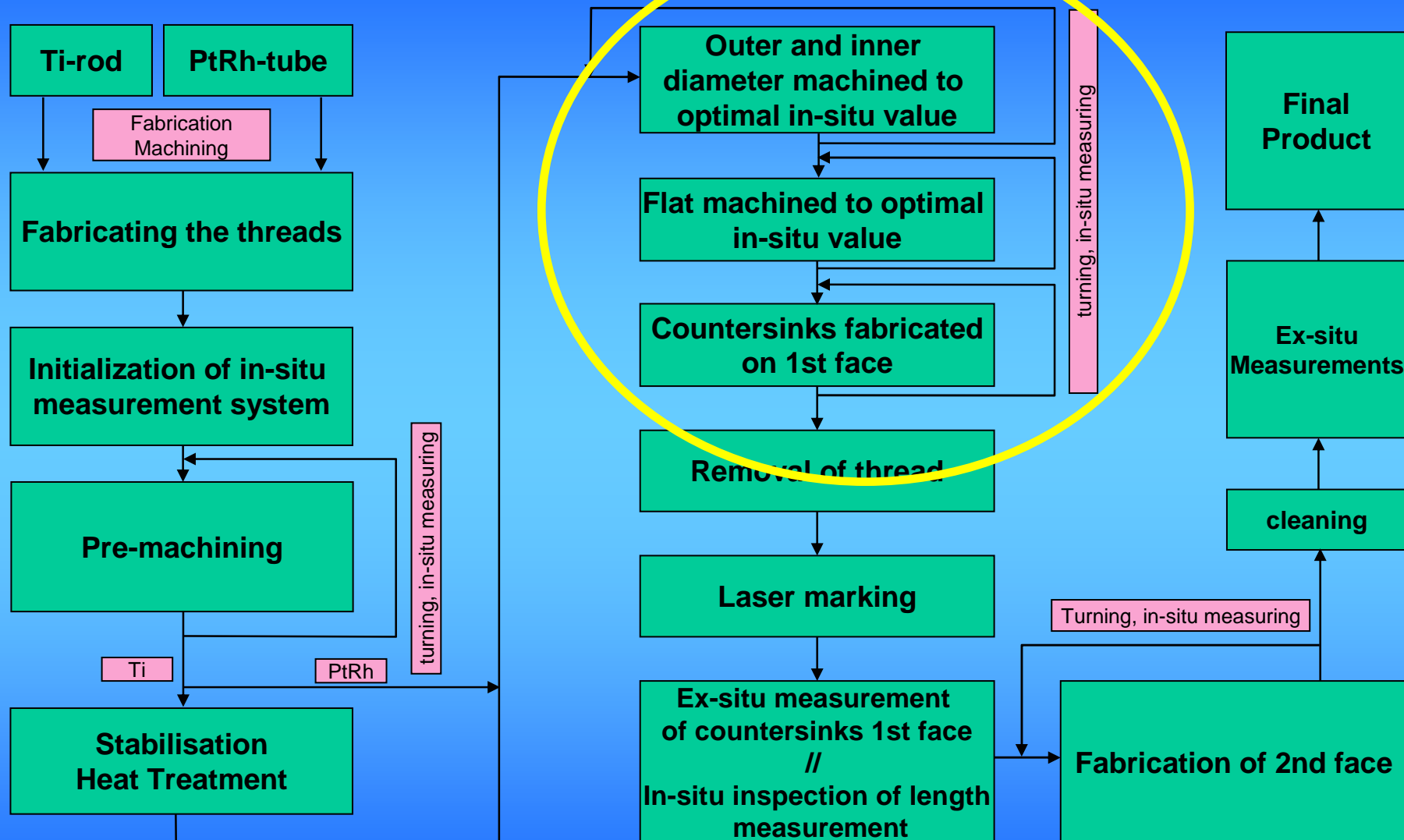
Manufacturing of the MICROSCOPE test mass

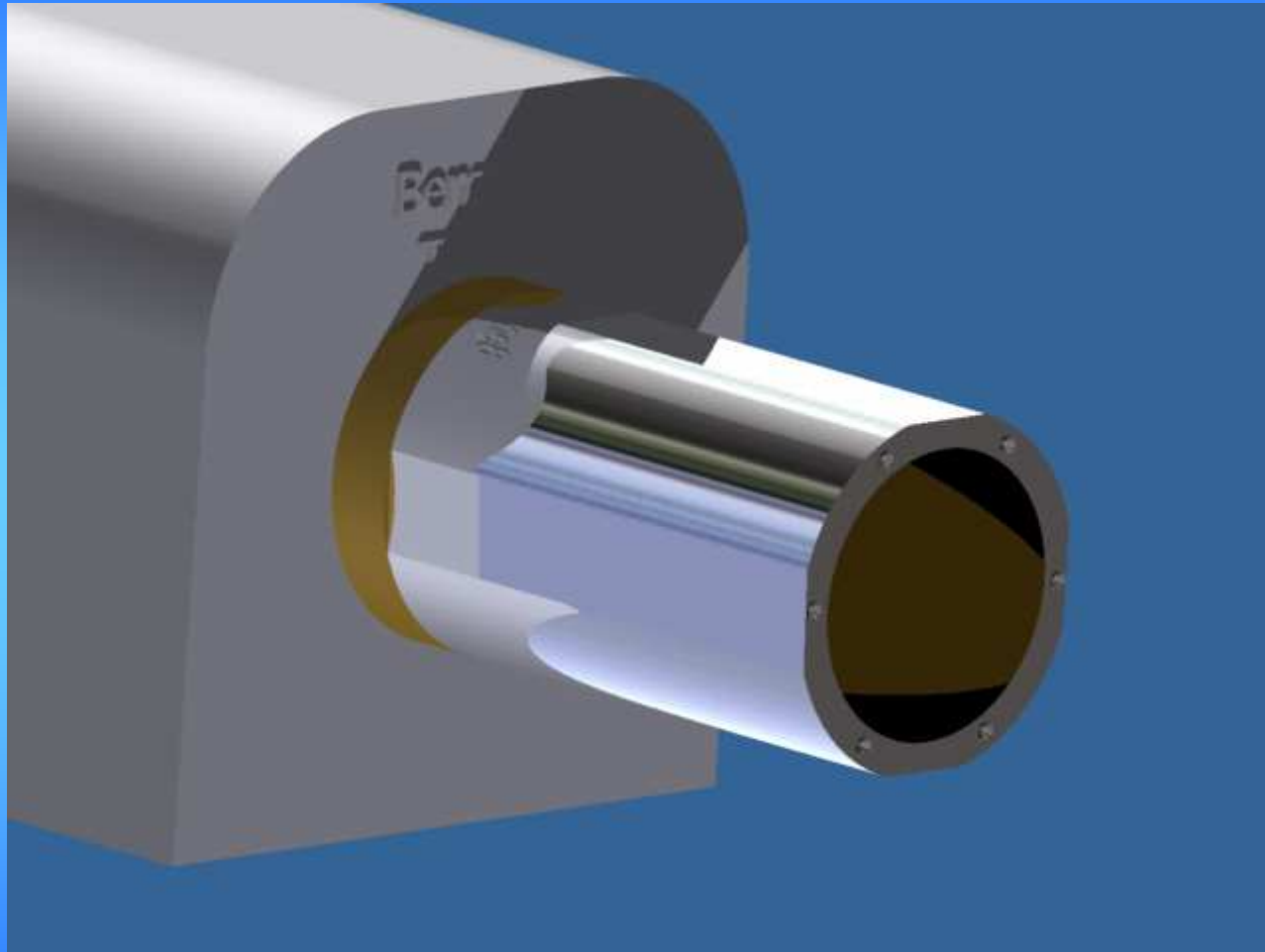


Manufacturing of the MICROSCOPE test mass

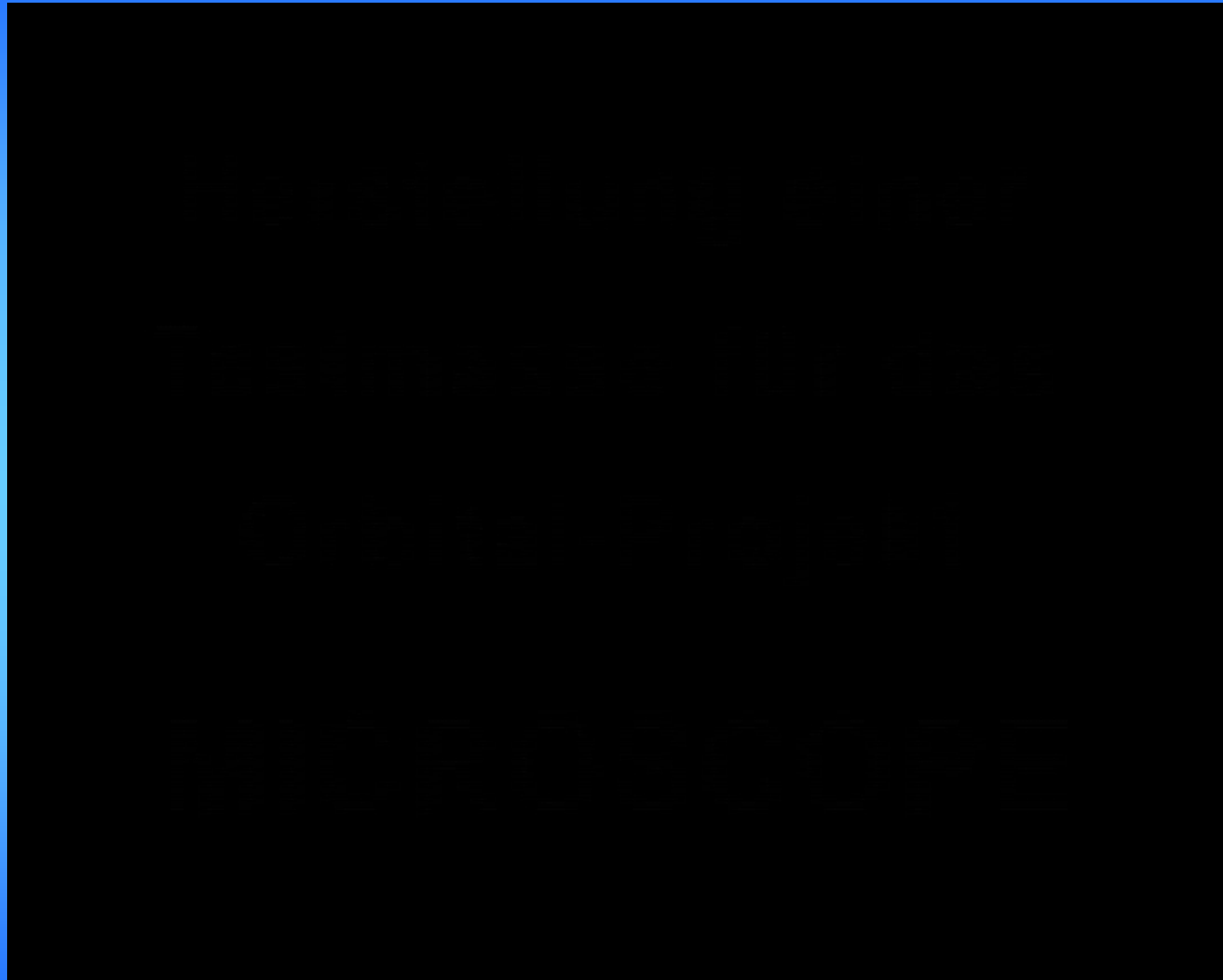


Fabrication Workflow

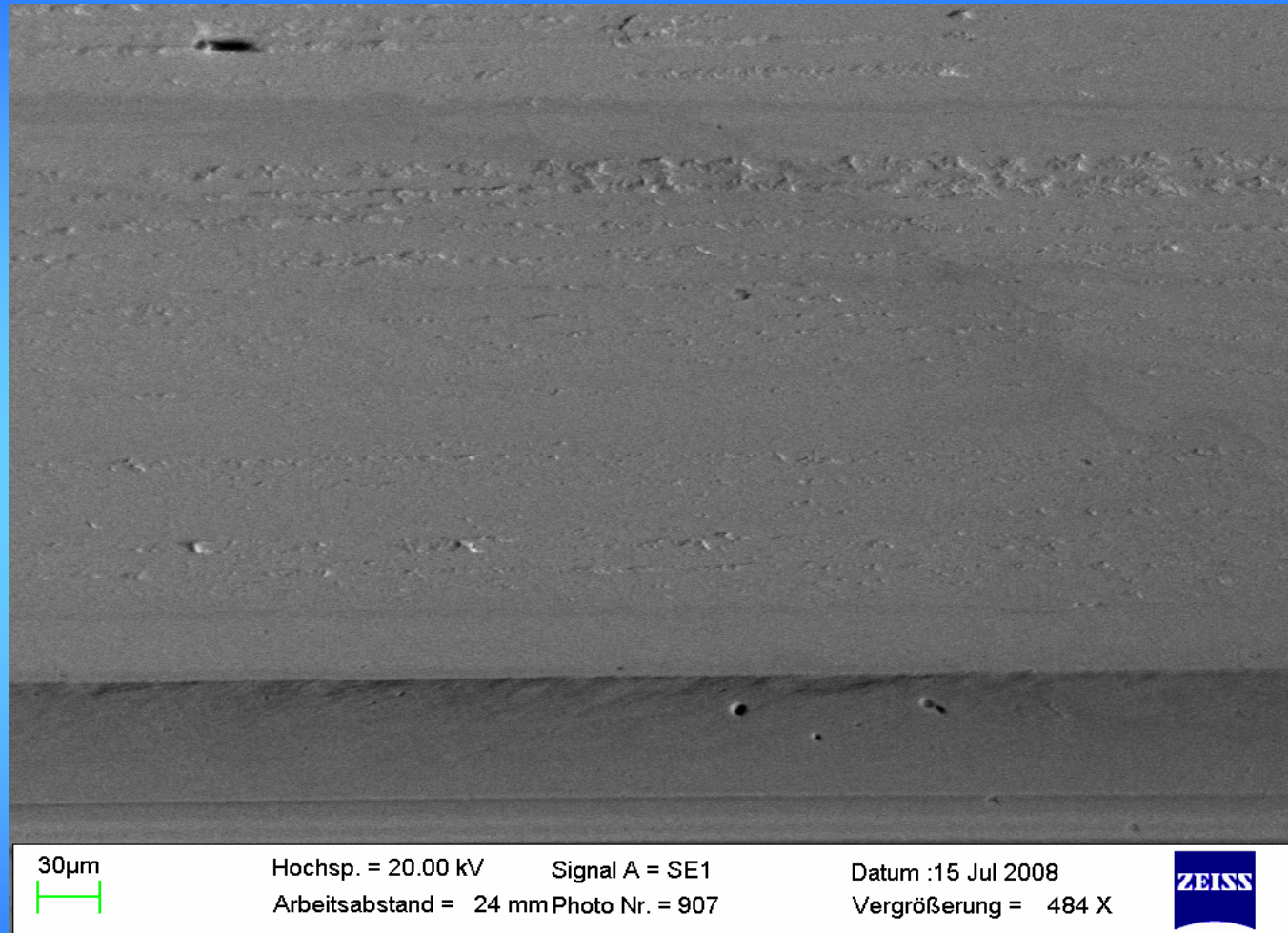




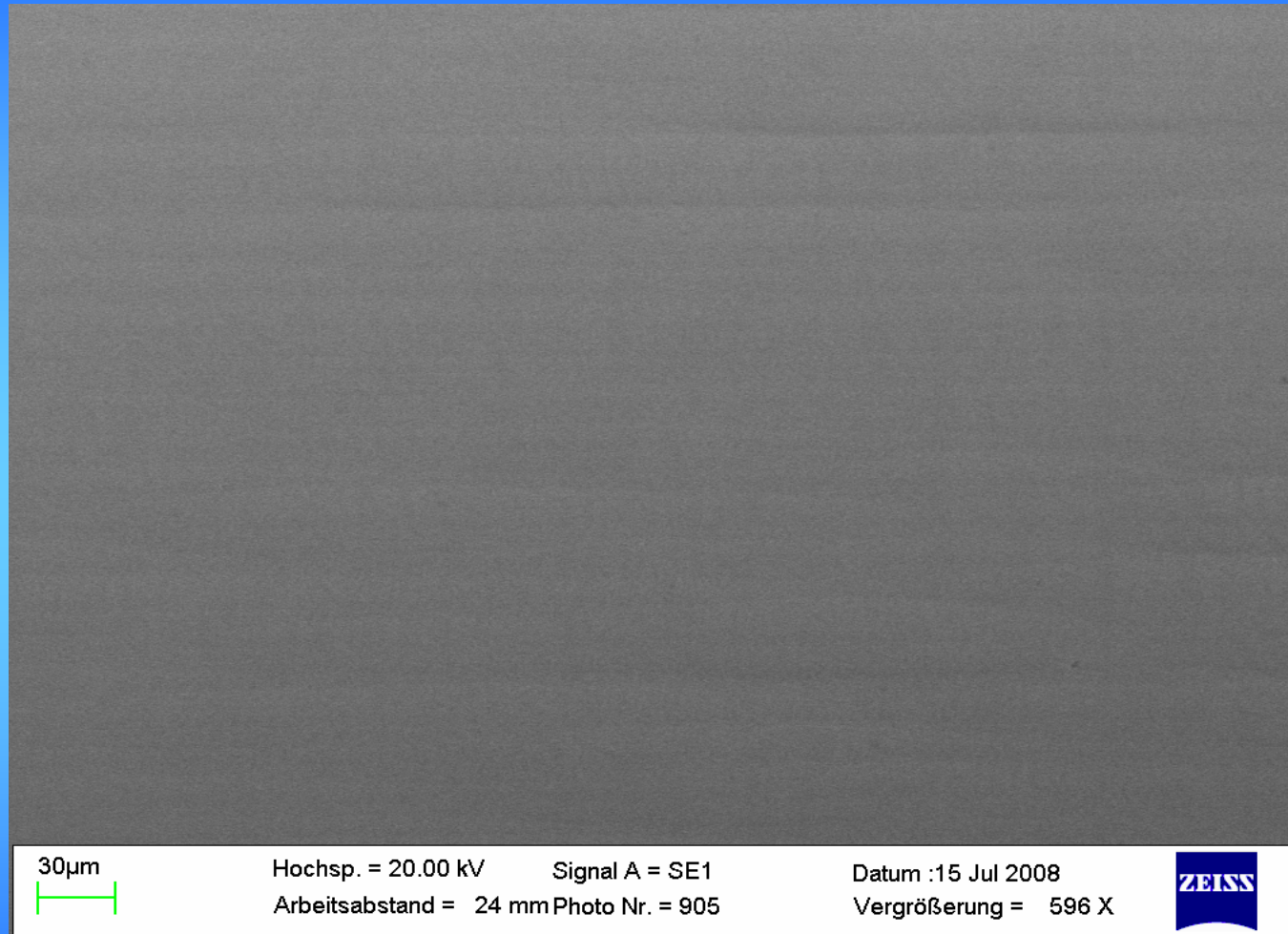
Live Action

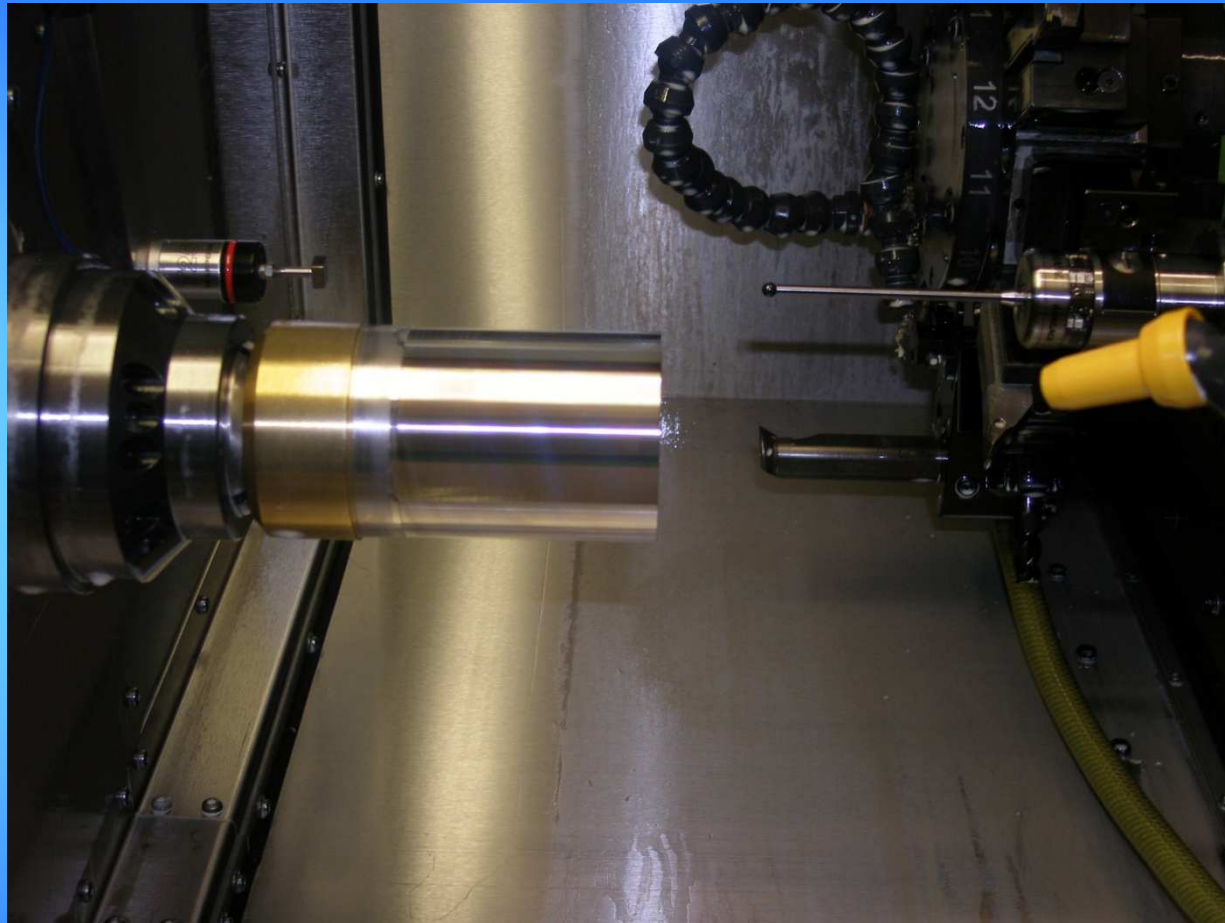


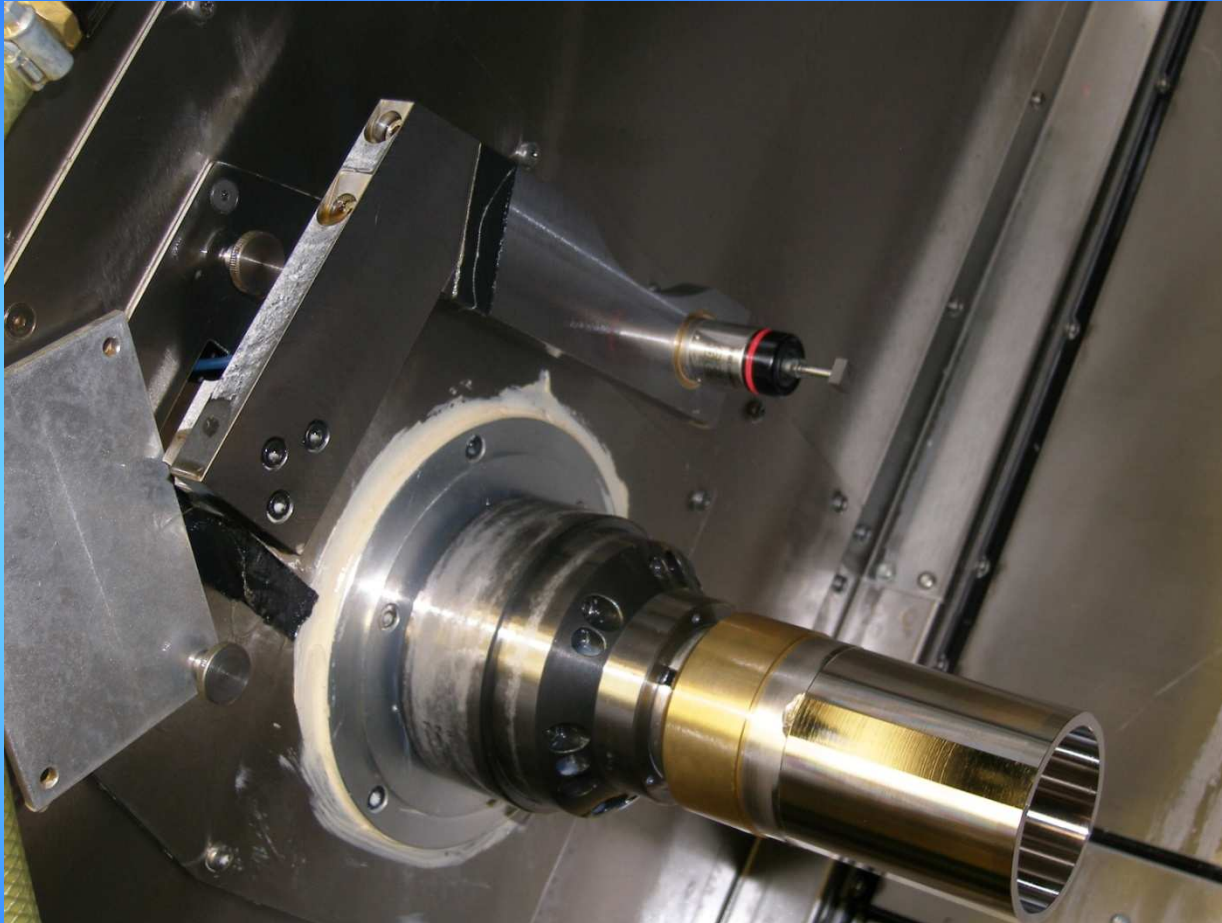
PtRh10 Surface – First fabrication tests



PtRh10 Surface - optimised








Measurement – Calibrated Gauges



Fabrication – In-situ Measurements

Measurement

Job: FM2-00002 

Properties

Date (YYYY-MM-DD): 2011-03-08
Time (HH:MM): 14:45:00 bis 14:55:00
Person: -

Environment

Room temperature [°C]: 21
Temperature 1 [°C]: 21
Temperature 2 [°C]: 21

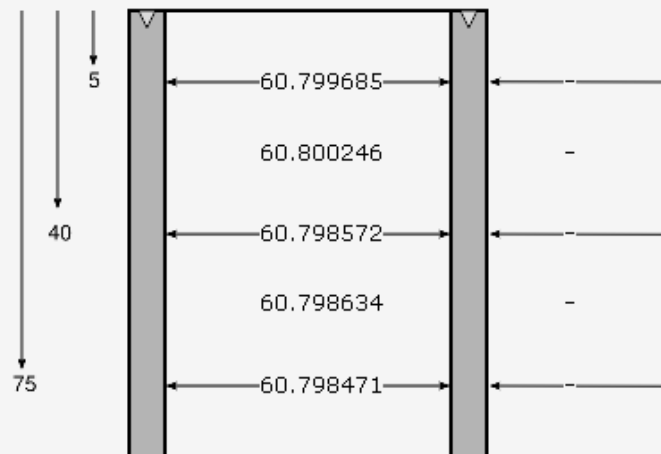
Workpiece

Workpiece: FM2
Taken from: -
Brought to: -

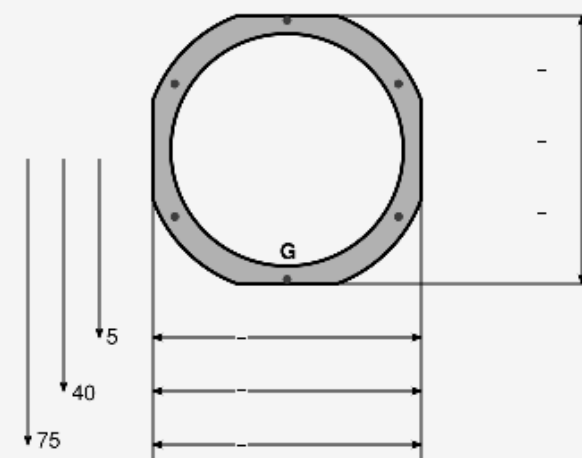
Instruments

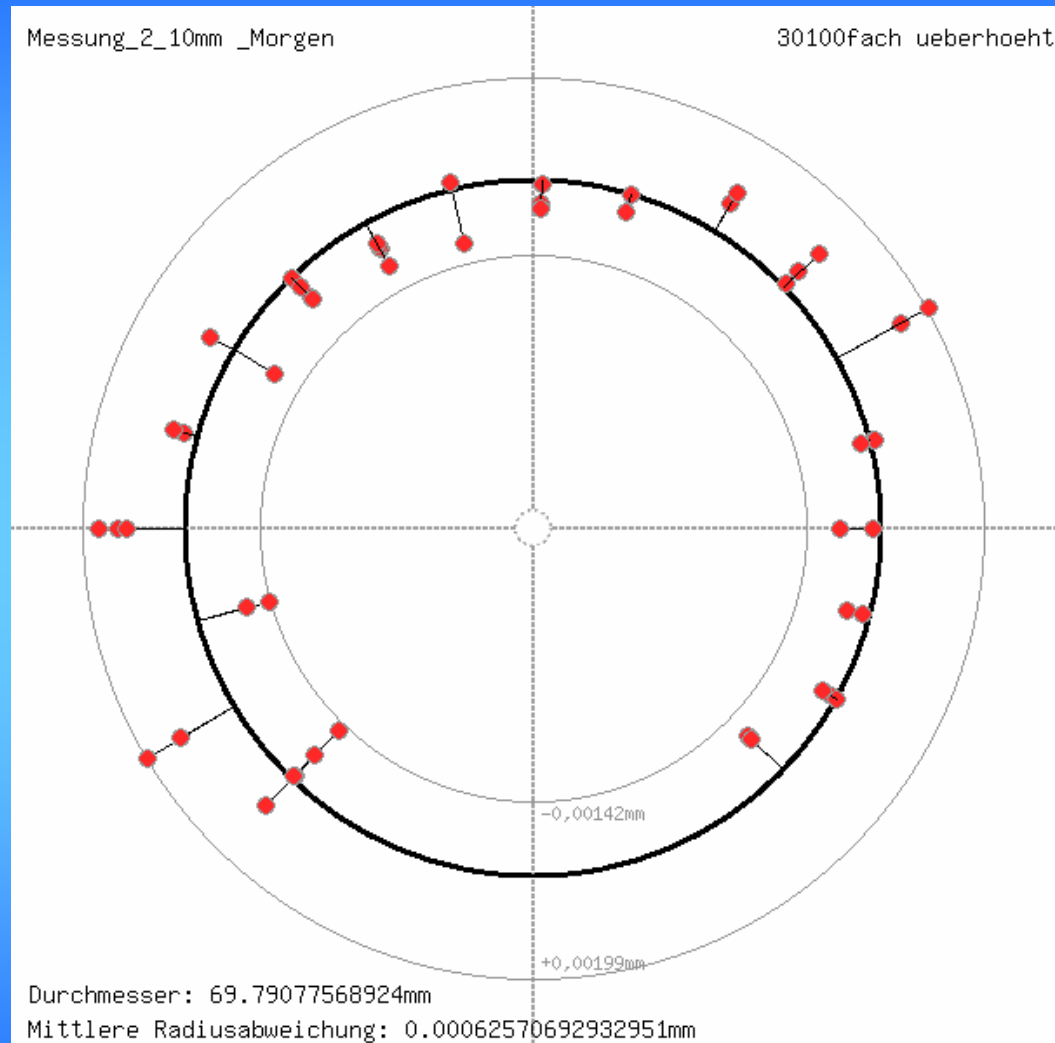
outer gauge: -
inner gauge: Renishaw OMP400 Messtaster
flat gauge: -
Place: -

Diameters



Flats





Outer Diameter:

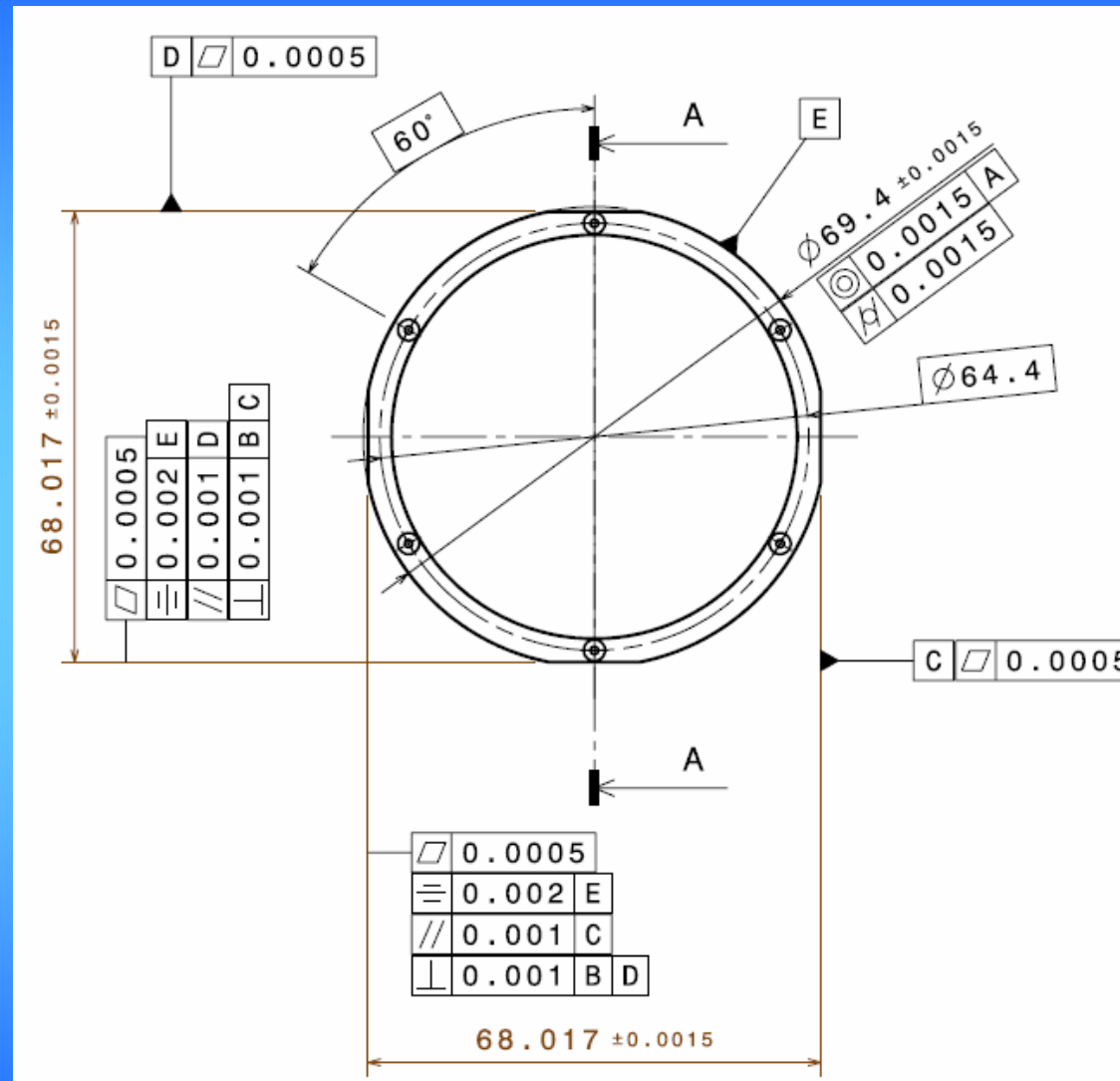
69,790(8) mm

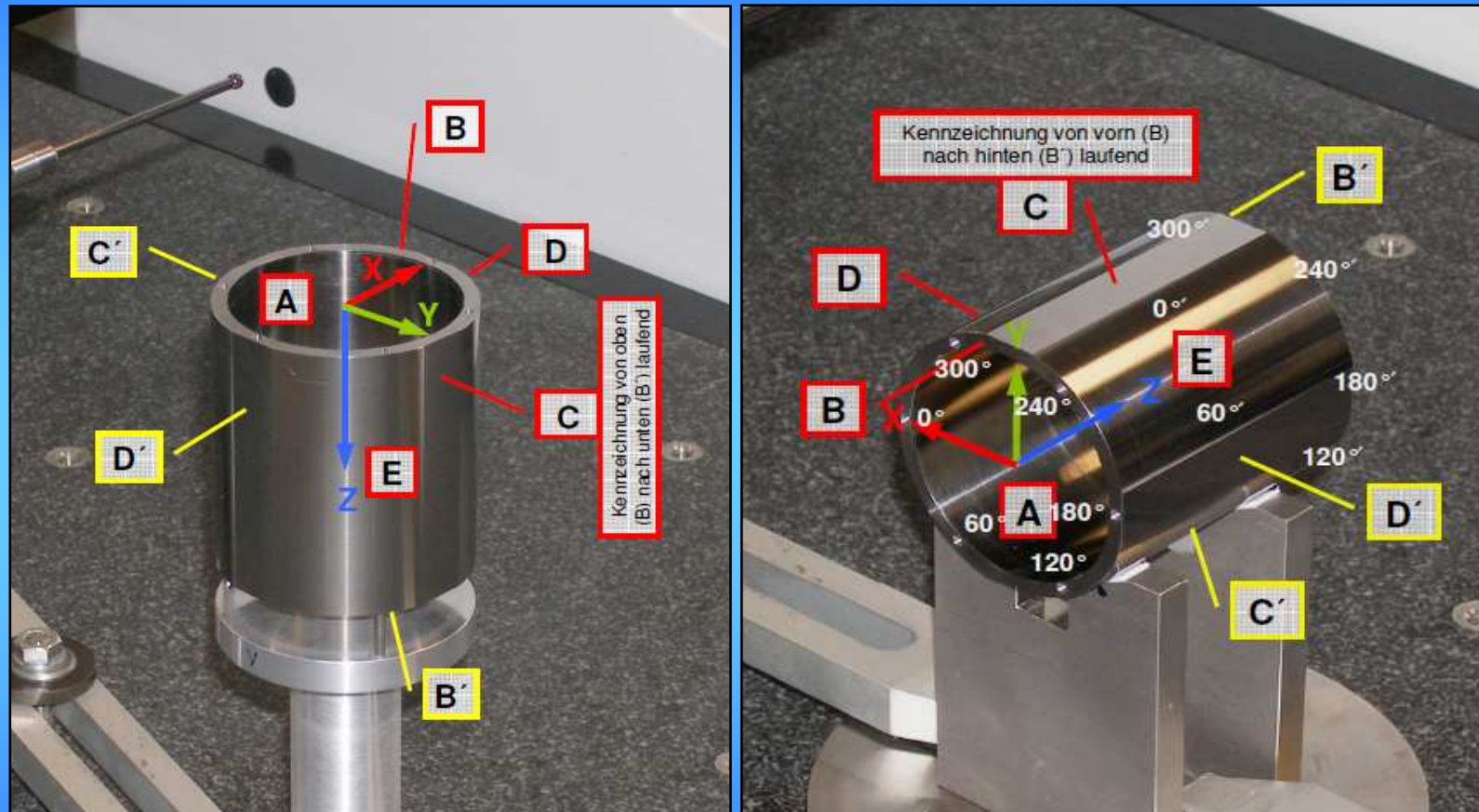
Mean Radius Deviation:

0,0006(3) mm

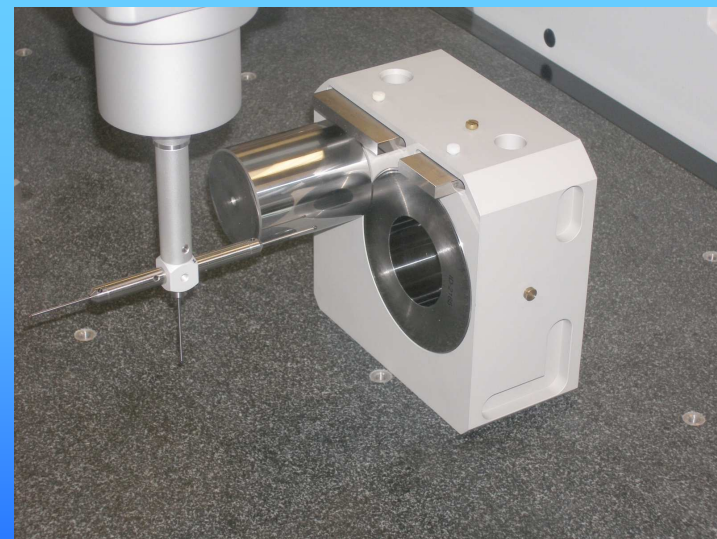
Magnification:

30100x





Leitz Reference 600 Co-ordinate Measuring Machine CMM



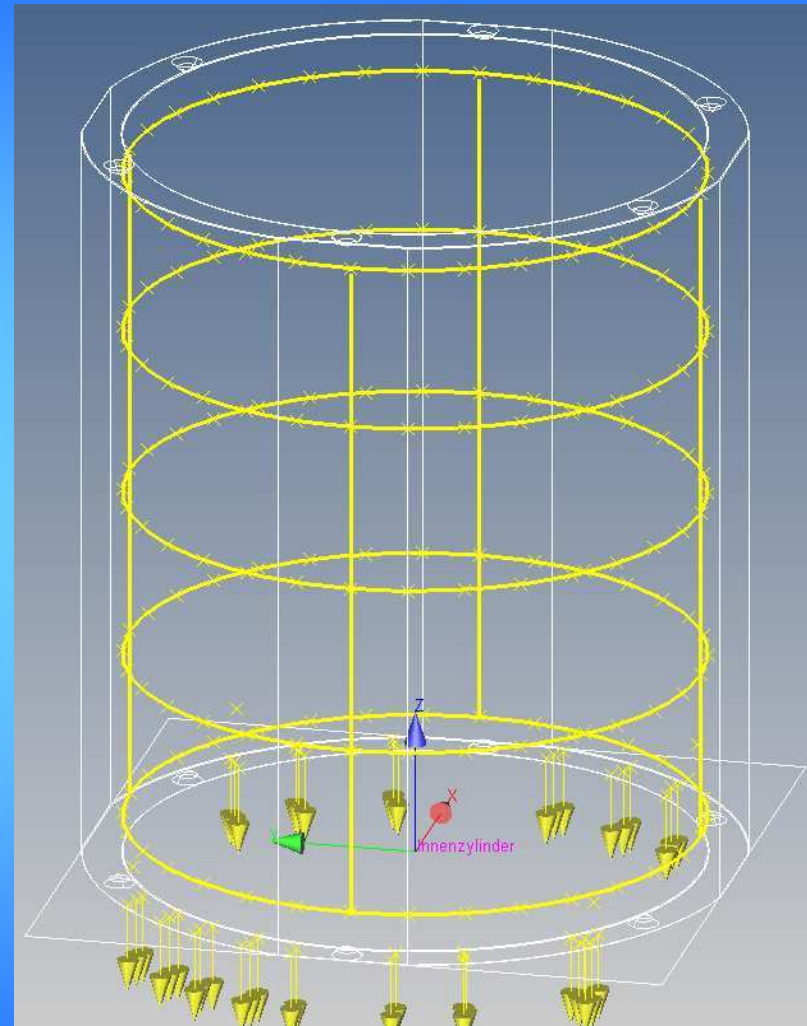
Orthogonality B - A

Measurement of face B and calculation of orthogonality w/respect to inner cylinder A

Circular measurements on face B

Diameter [mm]	# of points (evenly distributed)
33	32
35	32
37	32

Tolerance: 0.003 mm

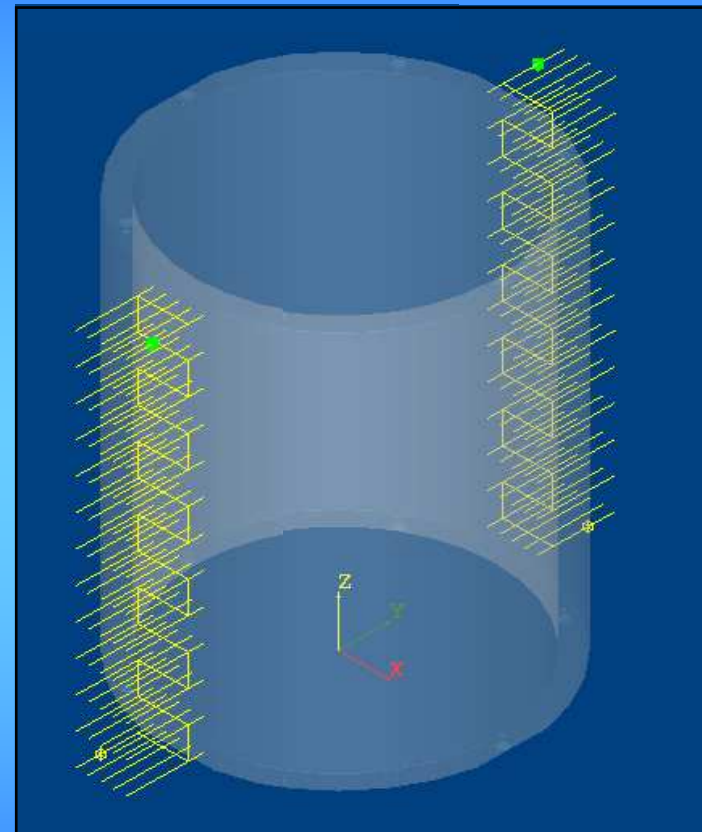


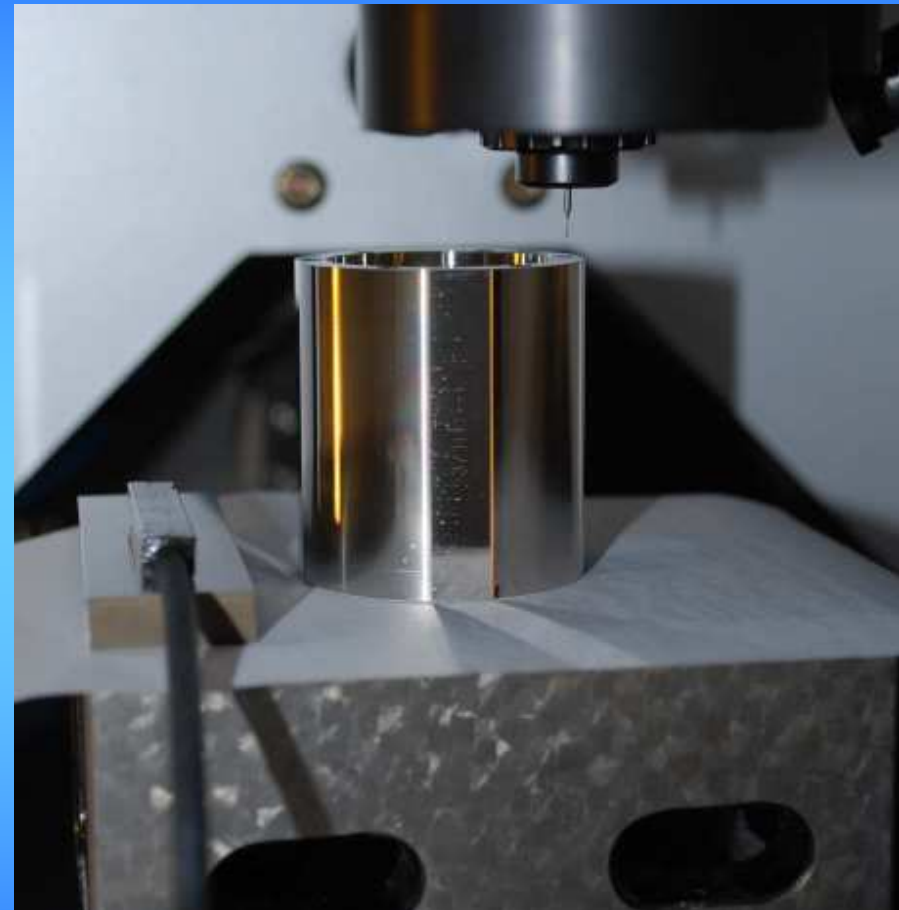
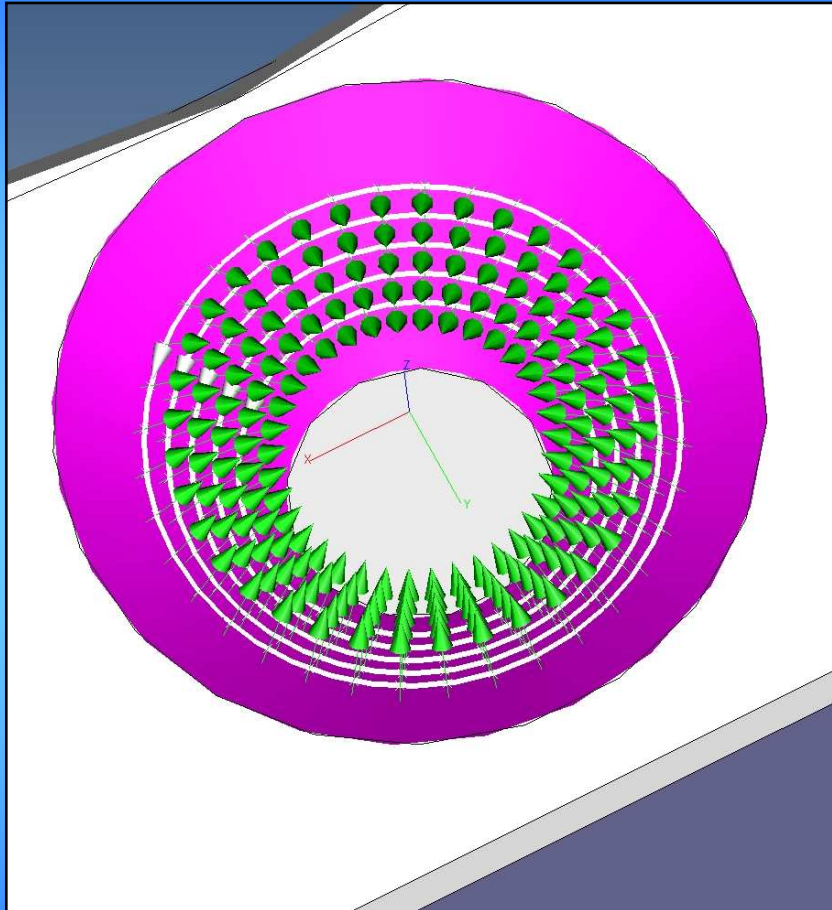
Parallelism of C and C'

(opposing flats)

The parallelism of the flats is determined by creating the respective planes (C, C' as well as D und D') from a multitude of measuring points and referencing these w/respect to the test mass co-ordinate system.

Tolerance 0.01 mm

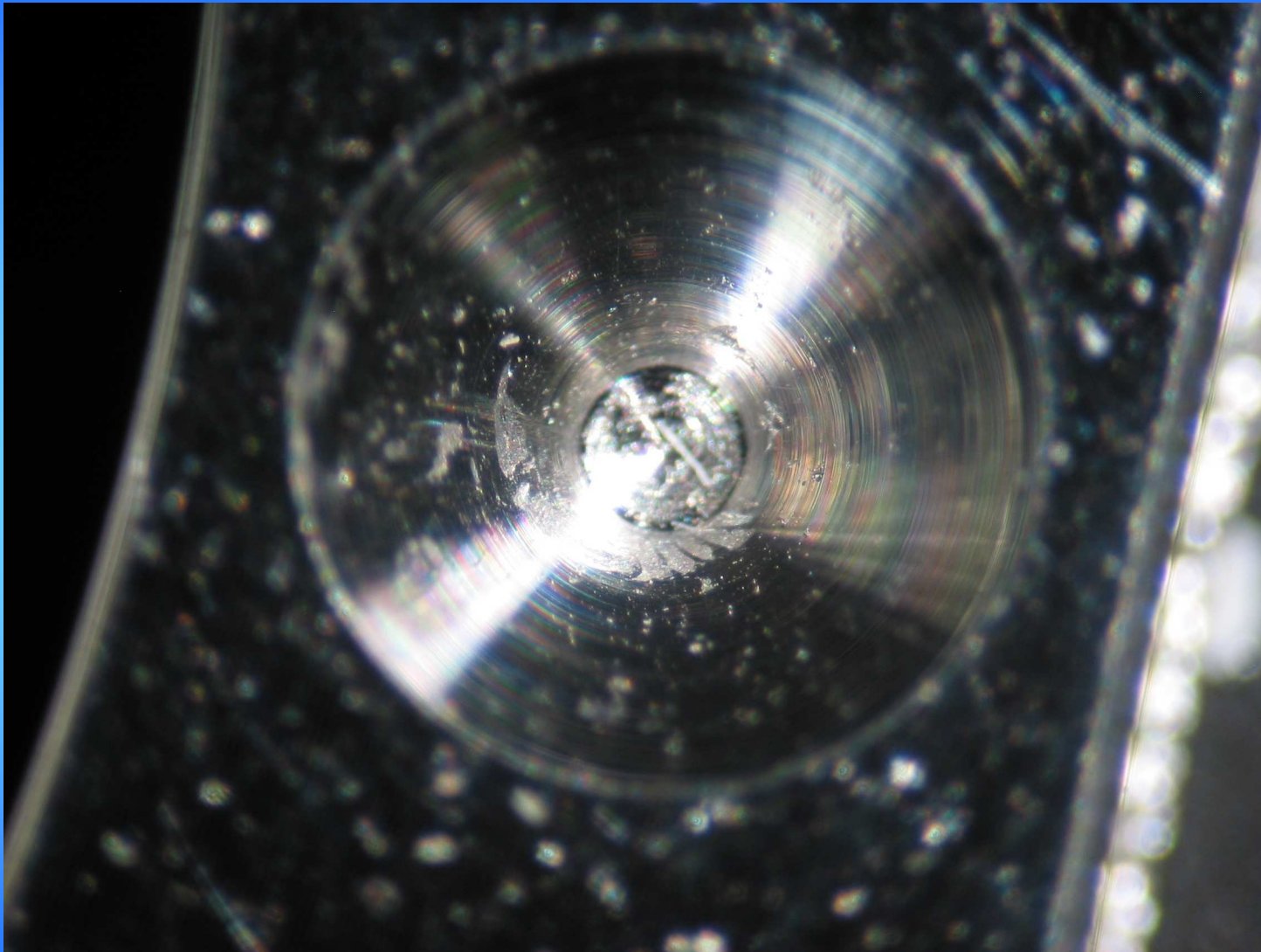




Measurement of Countersinks



Measurement of Countersinks



The special capabilities of PTB allow

- precision manufacturing
- metrology based development of in-situ measuring techniques
- traceable high precision measurement based on national standards

Only the combination of those capabilities
guarantees a successful fabrication of the MICROSCOPE test masses.

Thank you for your attention !

