Temperature robust structure of a coordinate measuring machine

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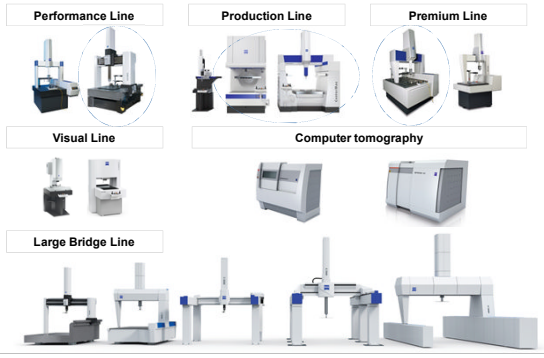
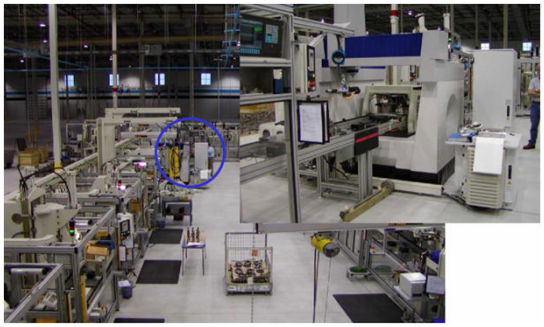
20.03.2014 euspen Special Interest Group Meeting

Agenda

Zeiss Industrial Metrology Product portfolio Systems



From climate room to a shopfloor inline installation



Material mix

Combinations

Long-term-stability, weight, modulus of elasticity ,
thermal capacity , heat conduction, coefficient of thermal expansion (CTE)

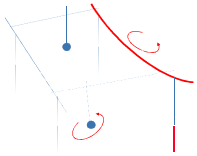
- granit
- steel
- aluminium
- carbon fiber
- ceramic
- invar
- polymer concrete
- glass
- zerodur

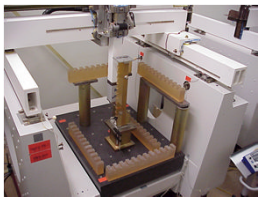
The "right" combination and decoupling is important

Temperature stability

Environmental temperature change

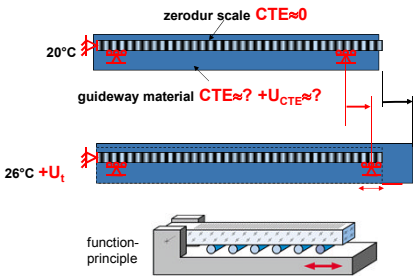
Guideway stability at thermal gradients
per hour, per day, per meter





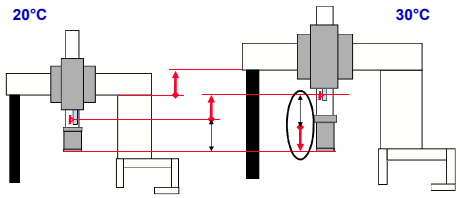
all guideway changes are visible

“Swimming” zerodur scale



Minimized uncertainty for coefficient of thermal expansion U_{CTE} and avoid temperature sensor uncertainty U_t

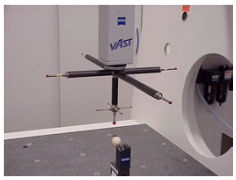
Temperature robust structure



Thermal extension of the Z-shaft is compensated by the portal

Temperature stability

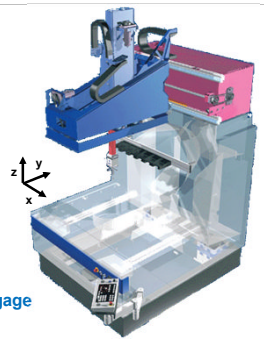
Zero point drift



Repeatable errors are correctable

Temperature robust design

- polymer concrete base
- steel 3D-box
- steel linear guideway
- zerodur scale
- carbon fiber Z-shaft
- environment shroud

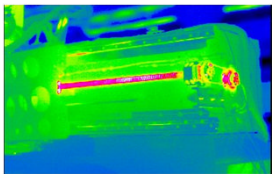


GageMax = flexible process gage

Temperature optimizing

Self heating

- thermal drive decoupling
- motor exhauster
- motorinsulation

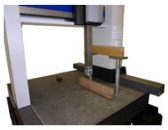


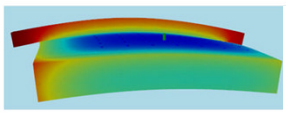
Endurance stability

Temperature simulation

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Environmental temperature change
and thermal gradients





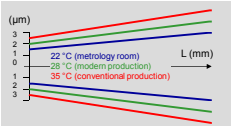
Simulation of the thermodynamic behavior to increase development efficiency

Temperature specification

- TVA MPEe $_{[\mu m]}$ =1.2 + L/(280- 5•$\Delta\vartheta$) ($\Delta\vartheta$ = deviation to 20 °C)

- allowed gradients
  2K/hour
  8K/ day
  2K/meter

- Temperature range
  15 bis 40°C



TVA Temperature Variable Accuracy

ZEISS

We make it visible.