

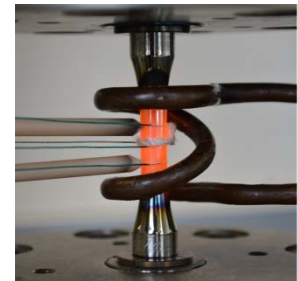
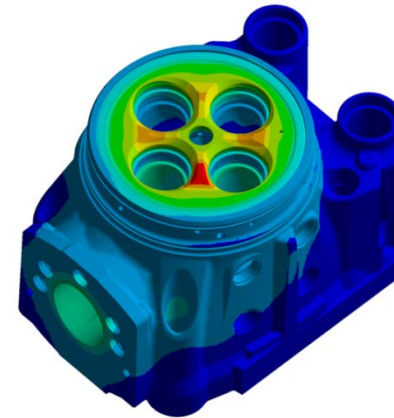
WP4: New Materials for Higher Engine Efficiency

Objectives of Work Package

WP Leader: Dr. Rayk Thumser, MDT -AUG
Deputy: Santiago Uhlenbrock , MDT-AUG

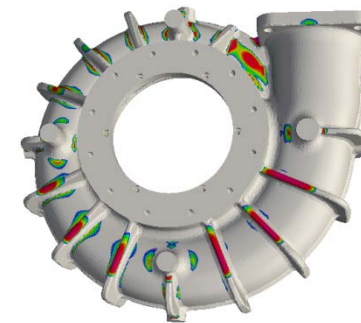
WP 4.1 New materials and design for cylinder heads

- Improvement of thermomechanical cycle resistance of factor 2 under increased temperature of 50 K
- decreased weight of cylinder head of 20%



WP 4.2 New materials for the turbocharger turbine casing

- Typical Load Cycles for Ferry Applications
- Improvement of thermomechanical cycle resistance under increased temperature of 70 K under corrosion environment

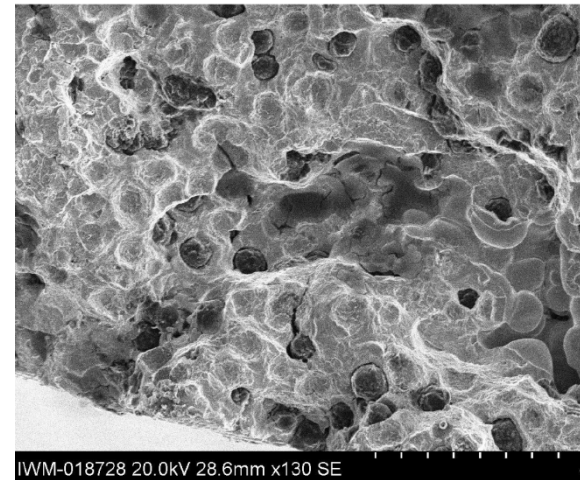
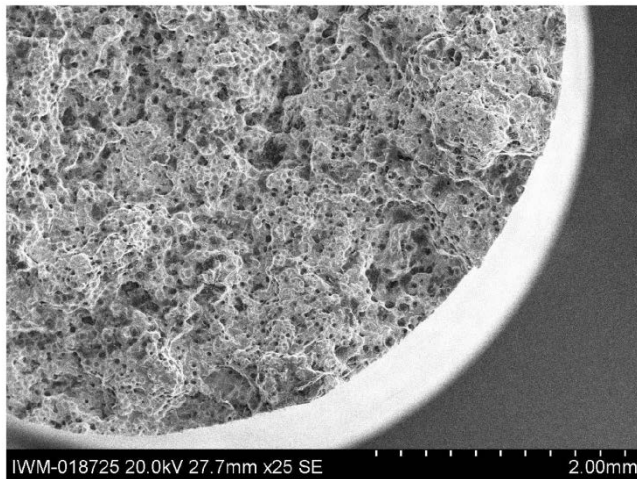
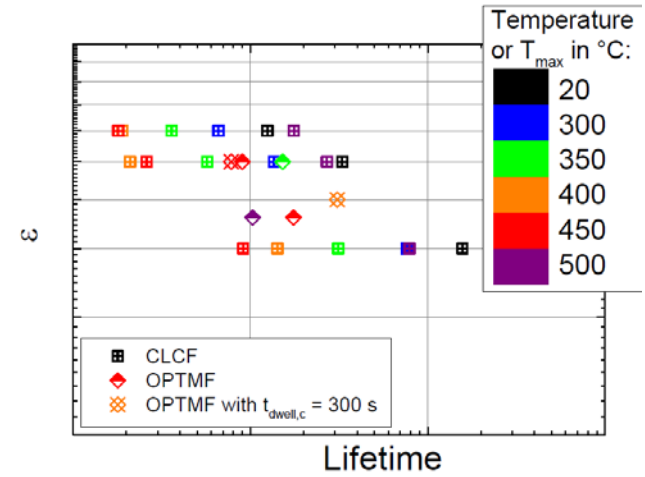
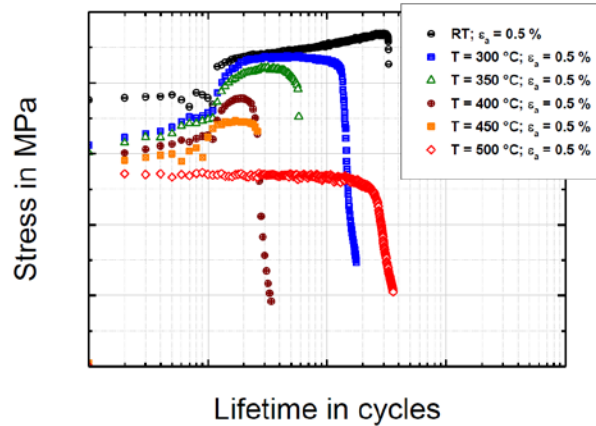
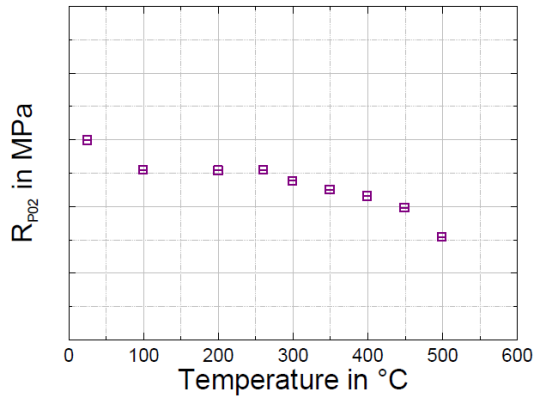


Partners:



New Results within WP4.1

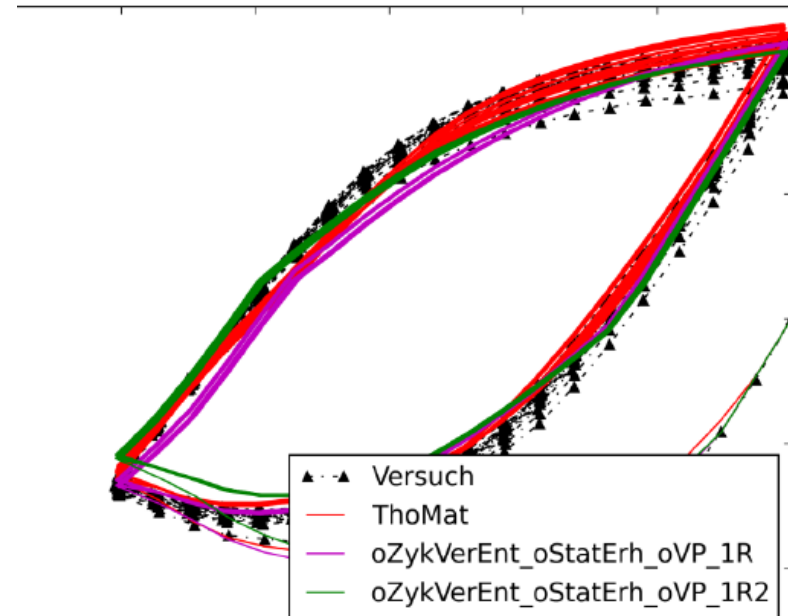
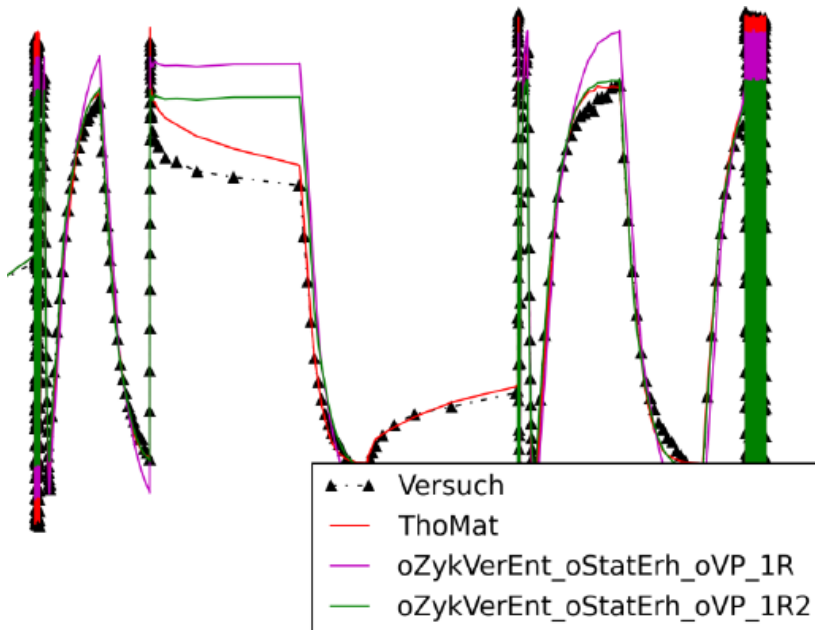
- Intensive evaluation of Material Behaviour for favourite Material



New Results within WP4.1

- Material Modelling

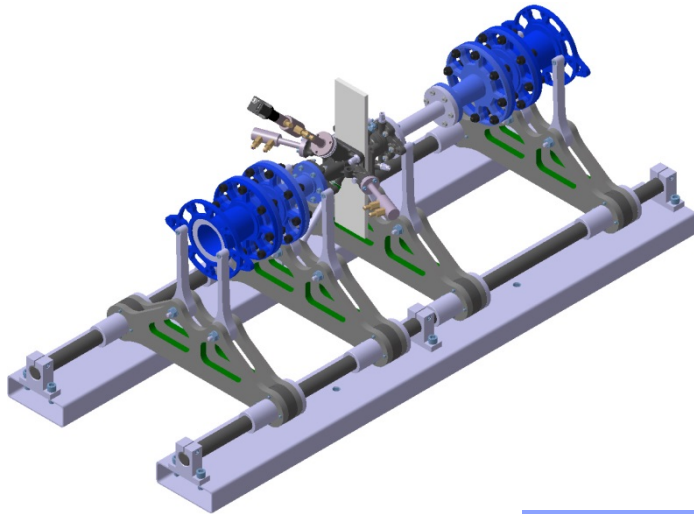
- Chaboche Plasticity Model for time and temperature dependent cyclic plasticity



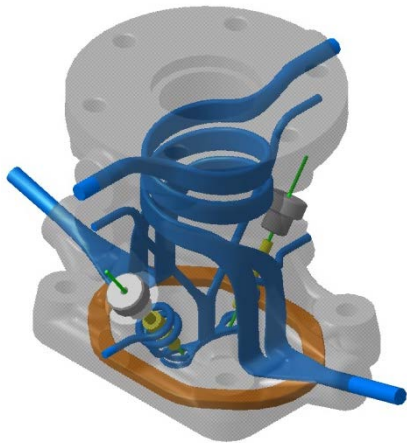
Different Deformation Models in comparison to TMF Tests

New Results within WP4.1

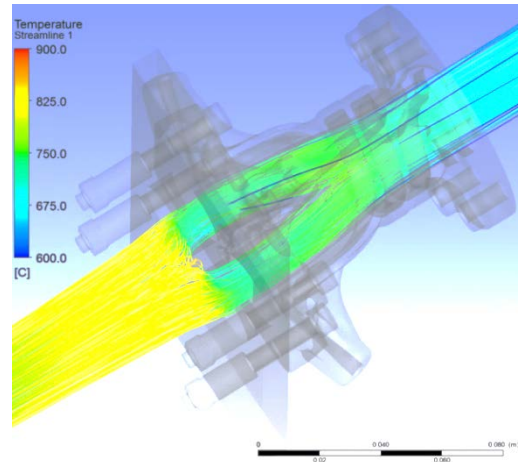
- Test Rig



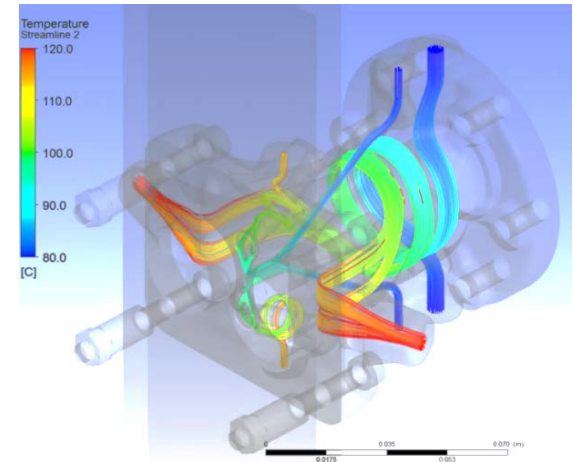
- Flow-optimised hot gas path
- Cooling of specimen with cooling adapter
- Design of test rig compensates thermal expansion



Cooling adapter



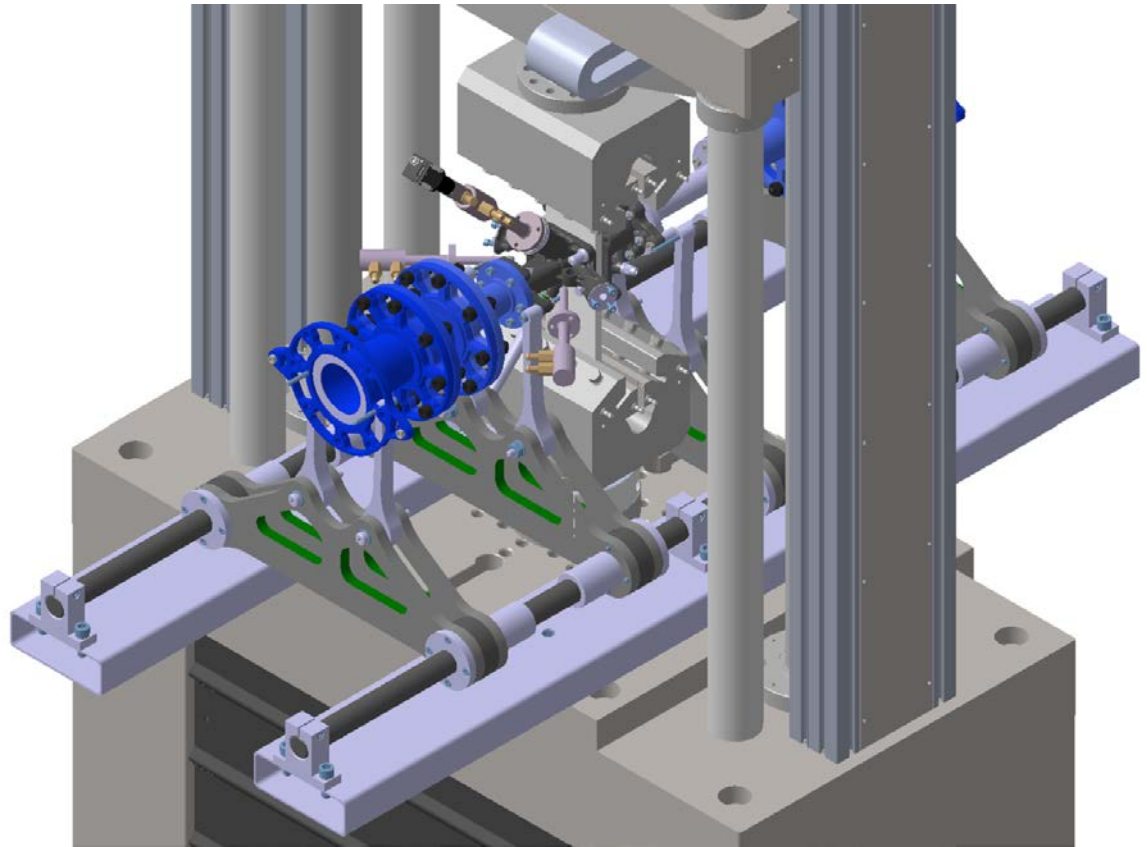
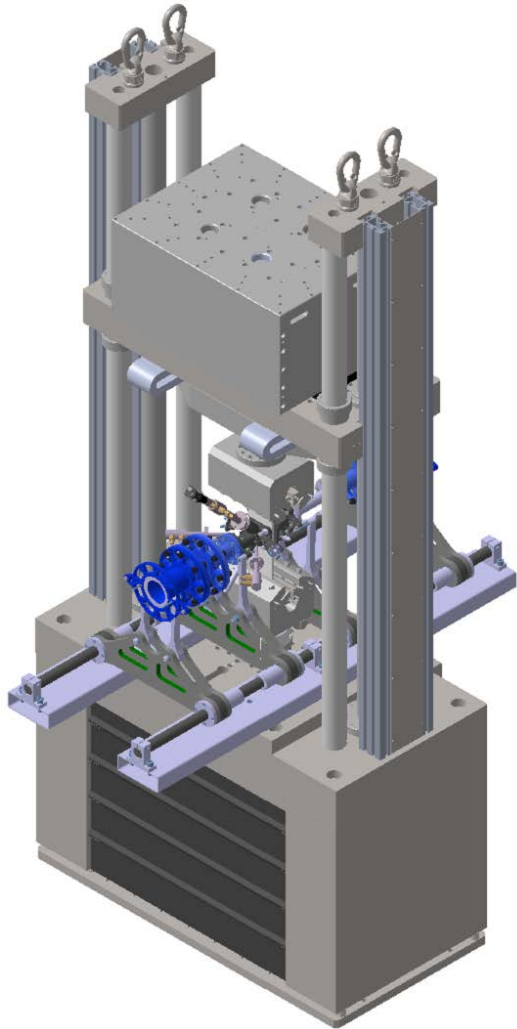
Hot gas temperature



Cooling water temperature

New Results within WP4.1

- Test Rig



New Results within WP4.1

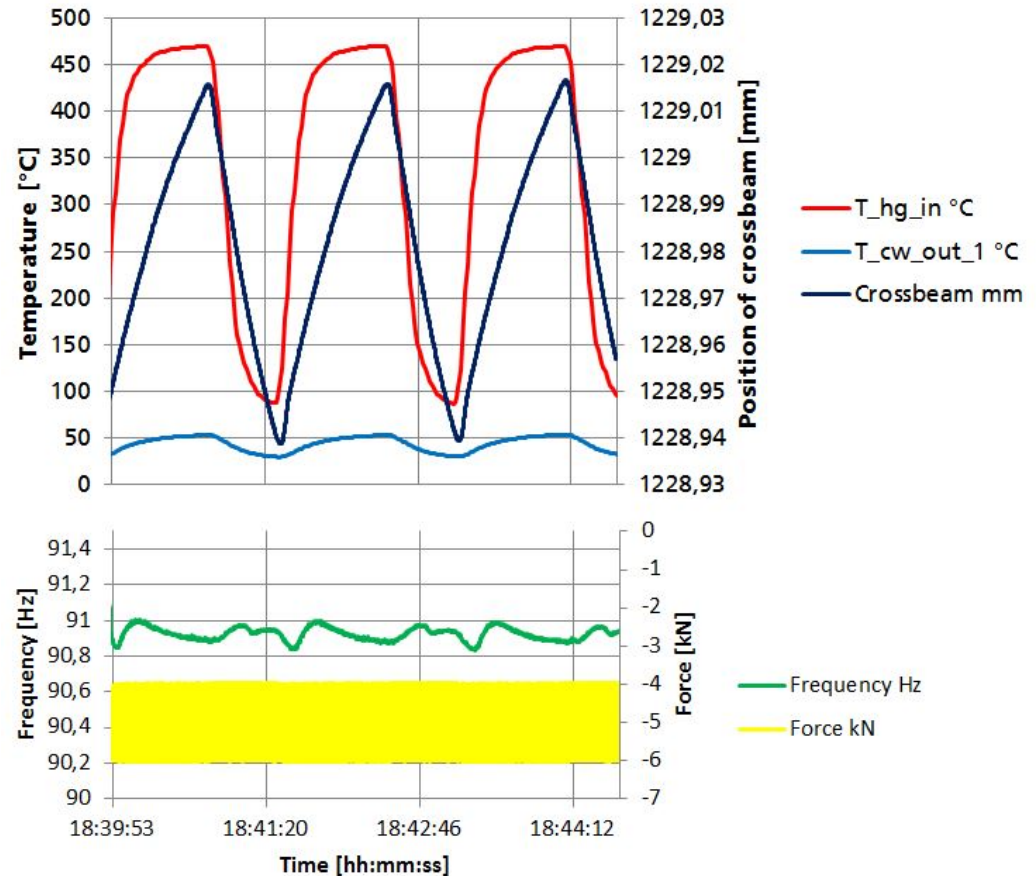
- PreTest



New Results within WP4.1

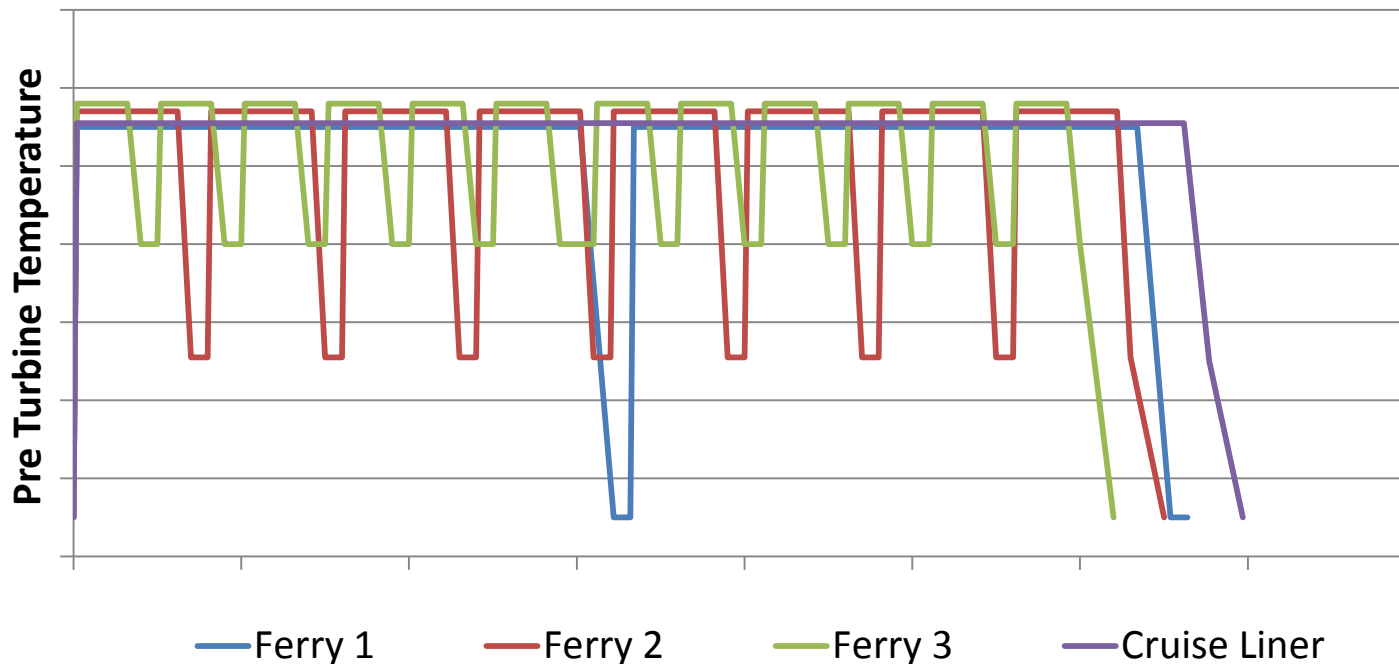
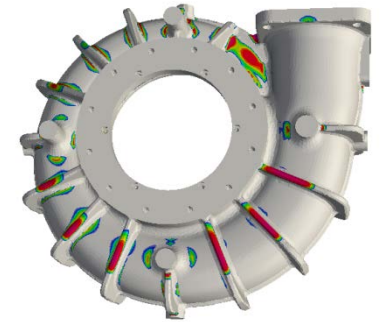
- TMF/HCF:
 - Pulsing continuously
 - Hot gas temperatures: 470°C / 87°C
 - Mass flow: 0,3 kg/s
 - $F_m = -5$ kN, $F_a = 1$ kN

- Constant pulsing load during temperature cycles



Introduction WP4.2

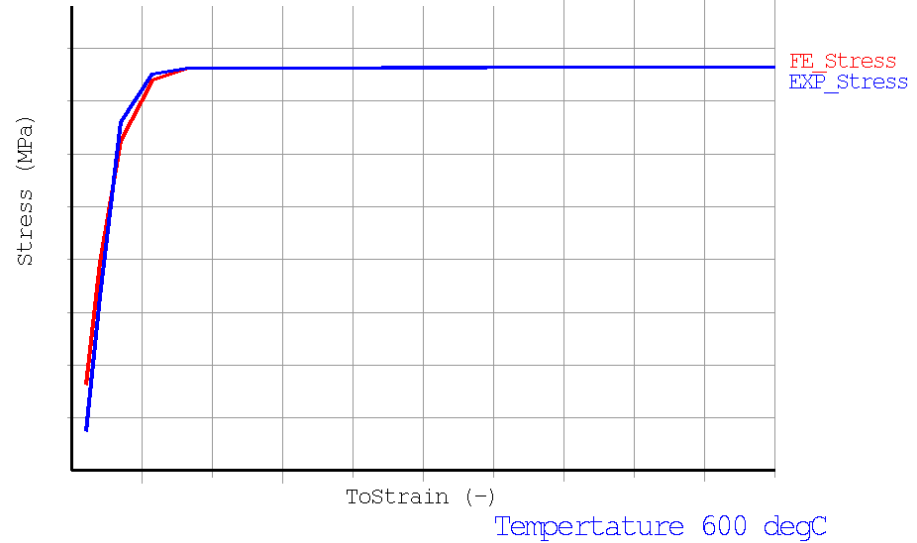
- Ferry applications are very cyclic marine applications. Thermo-mechanic fatigue damage is dominant compared to creep damage.
- Cruise liner applications are stationary applications with large dwell times at elevated temperature. Creep damage is dominant compared to thermo-mechanic fatigue damage.



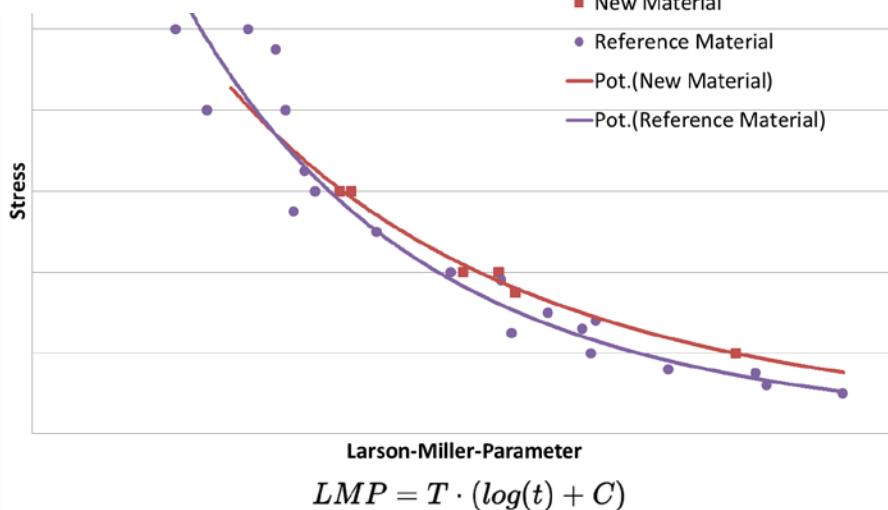
New Results within WP4.2

- Material Model
 - > Deformation Model
 - > Damage Model (TMF + Creep)

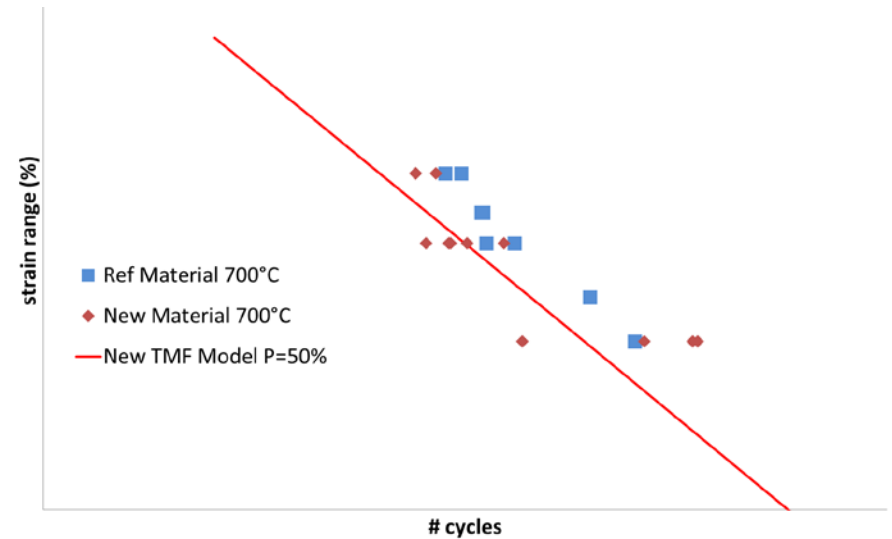
Deformation Model



Creep Resistance



TMF Resistance



Future Work

WP4.1

- Numerical studies material modeling, advanced plasticity model, simplified plasticity models, multiaxial TMF life prediction model
- TMF loaded component like specimen – final tests
- Optimization of cylinder head regarding TMF resistance and weight

WP 4.2

- Validation -> FE-Analysis with new defined material model.