Development and Validation of Models for Durability Estimation of Exhaust Manifolds under High Temperatures

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Abstract

Air-gap insulated exhaust manifolds are mainly stressed by thermo-mechanical loads (TMF). To calculate the components with regard to their durability, a material model was created using a nonlinear kinematic model of strain hardening based on Low-Cycle-Fatique-(LCF)-tests and multi-level creep tests. On this basis, an energy-based model for life estimation was developed. The simulation of the LCF tests showed a good correlation. The model was validated on the hot gas test rig using a bended pipe. Furthermore, a model was developed to calculate welds. LCF tests with welded specimens were carried out and based on these tests, the material model of the basic material was modified for the welded areas.

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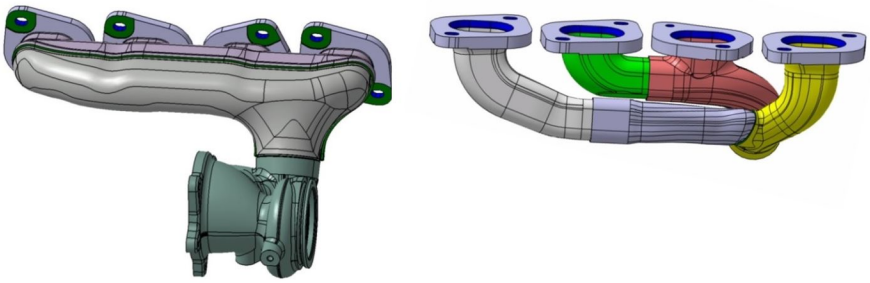

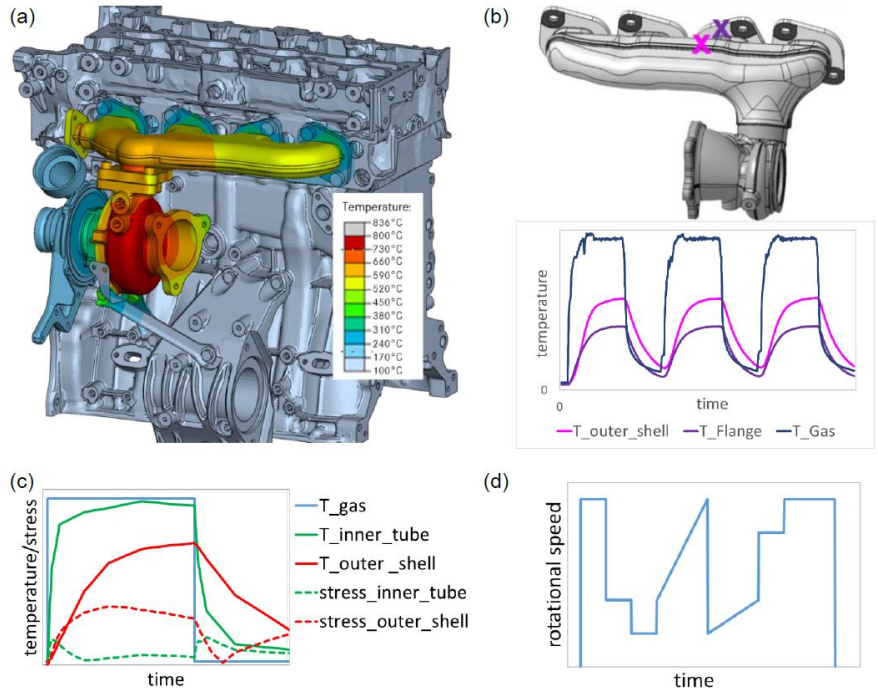

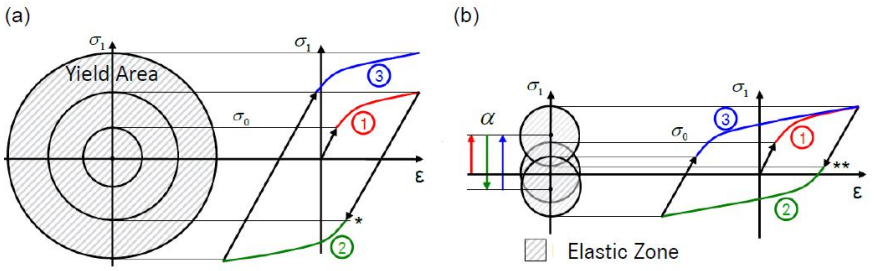

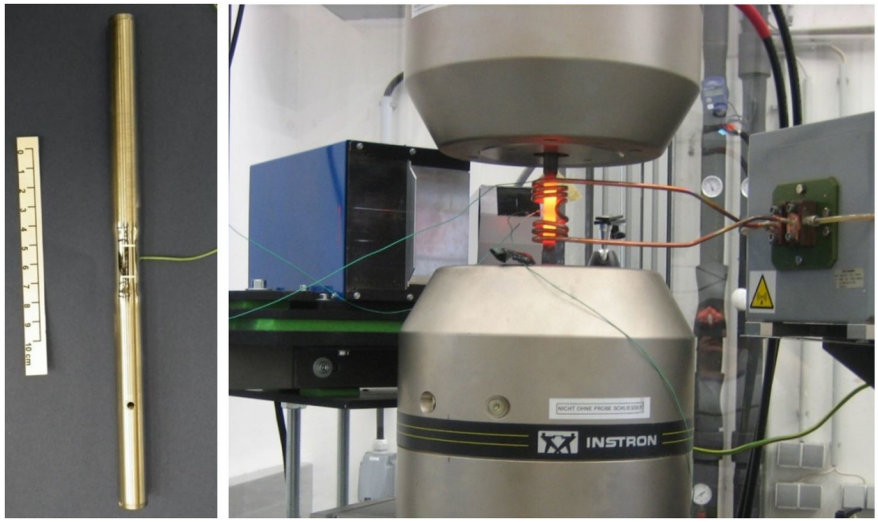

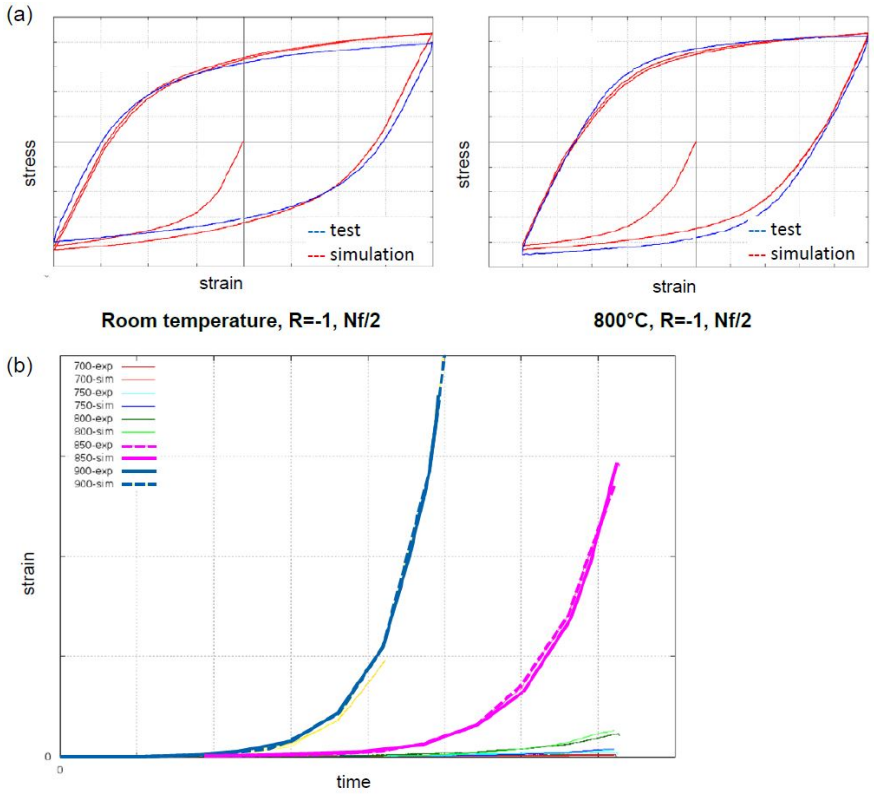

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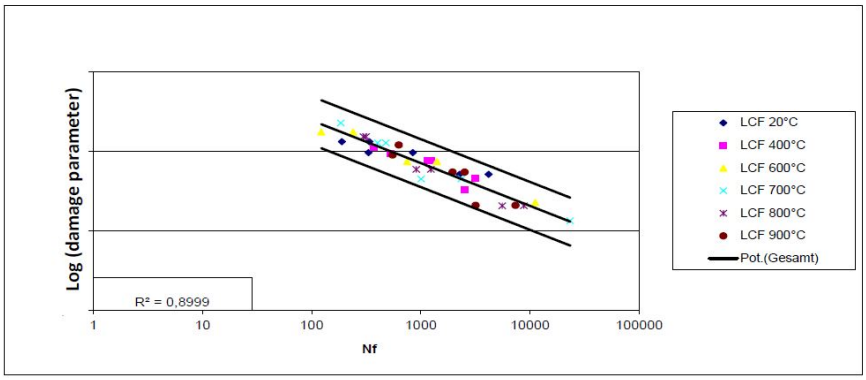

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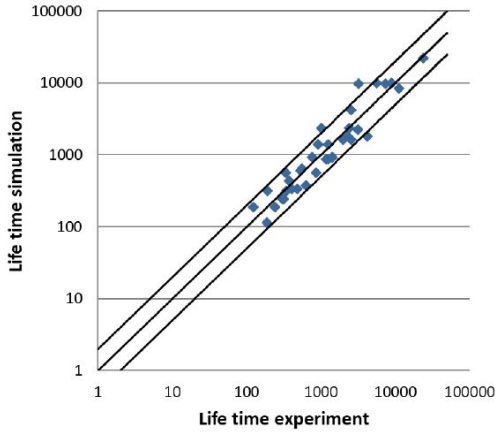

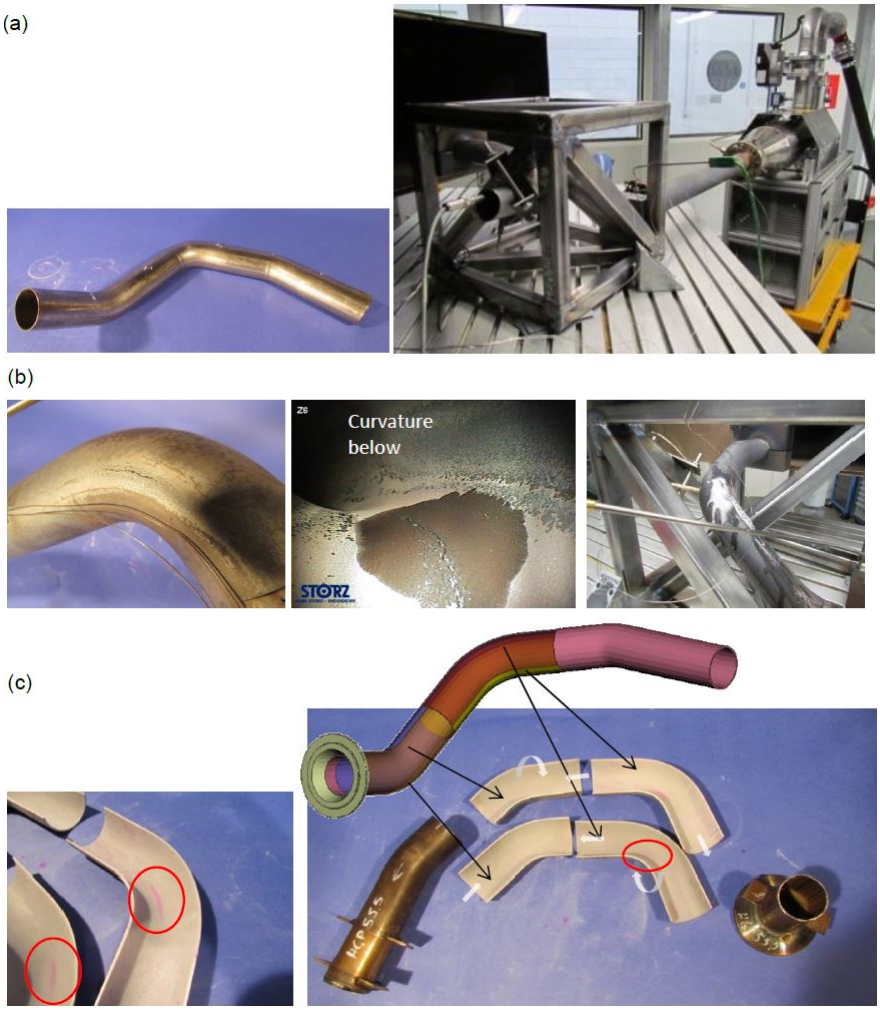

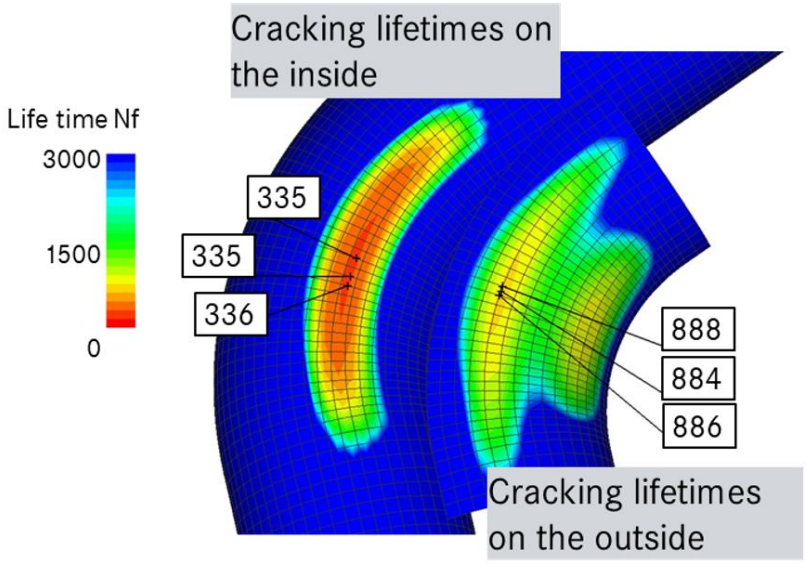

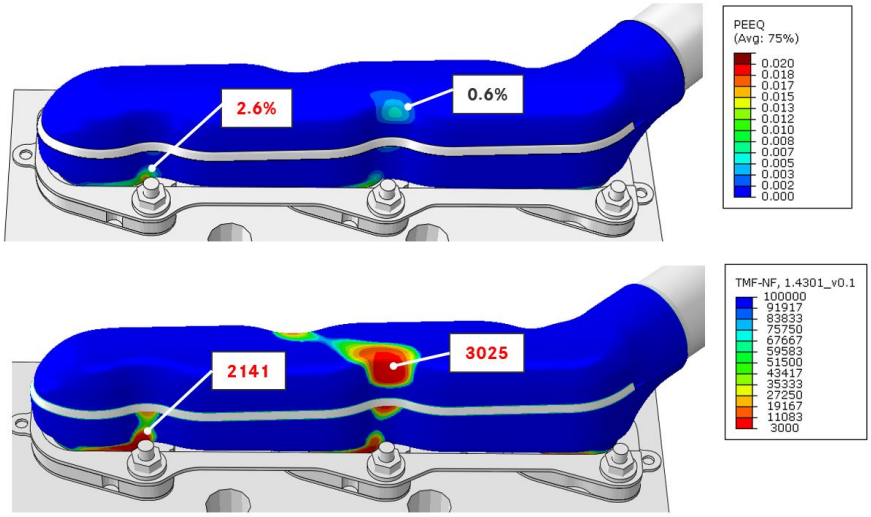

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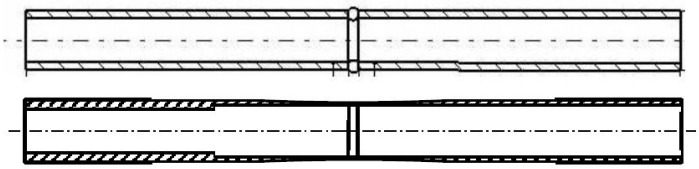

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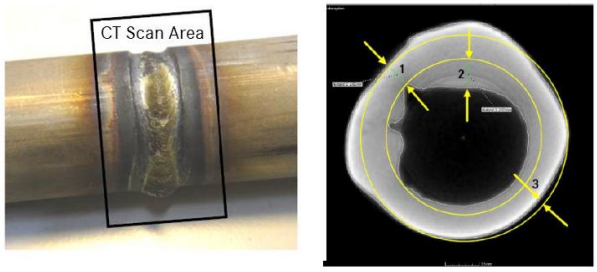
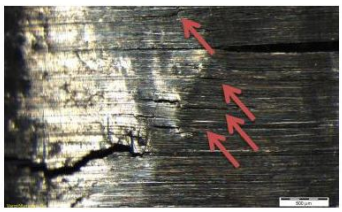


(c)

(a)



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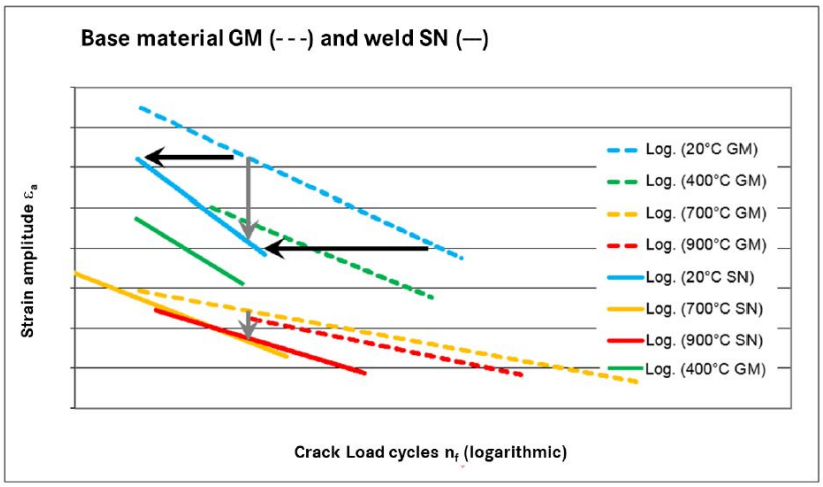

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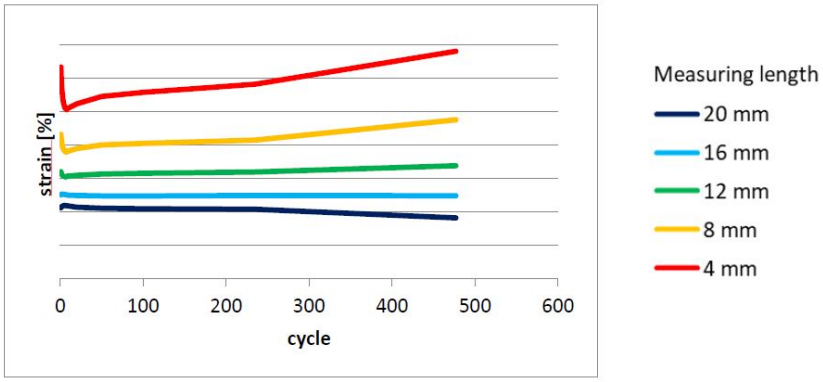

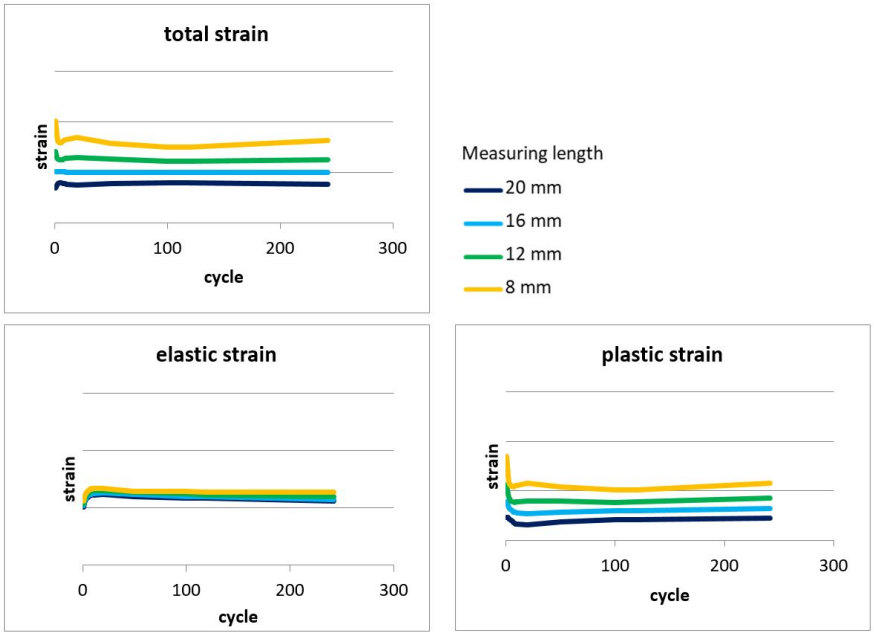

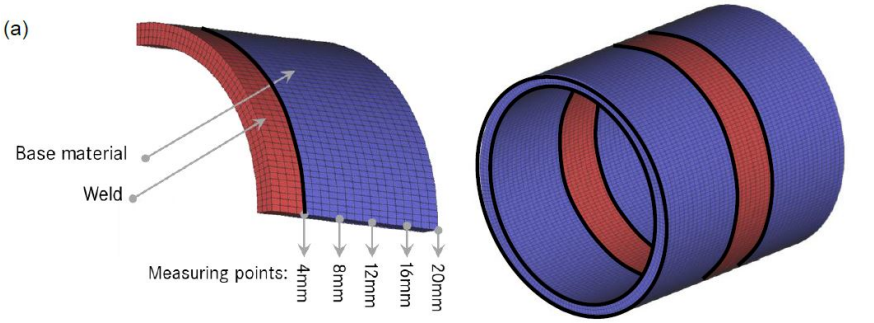

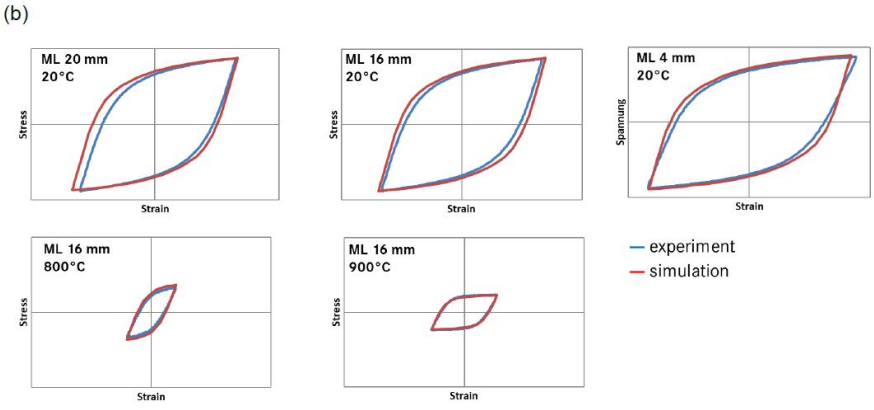

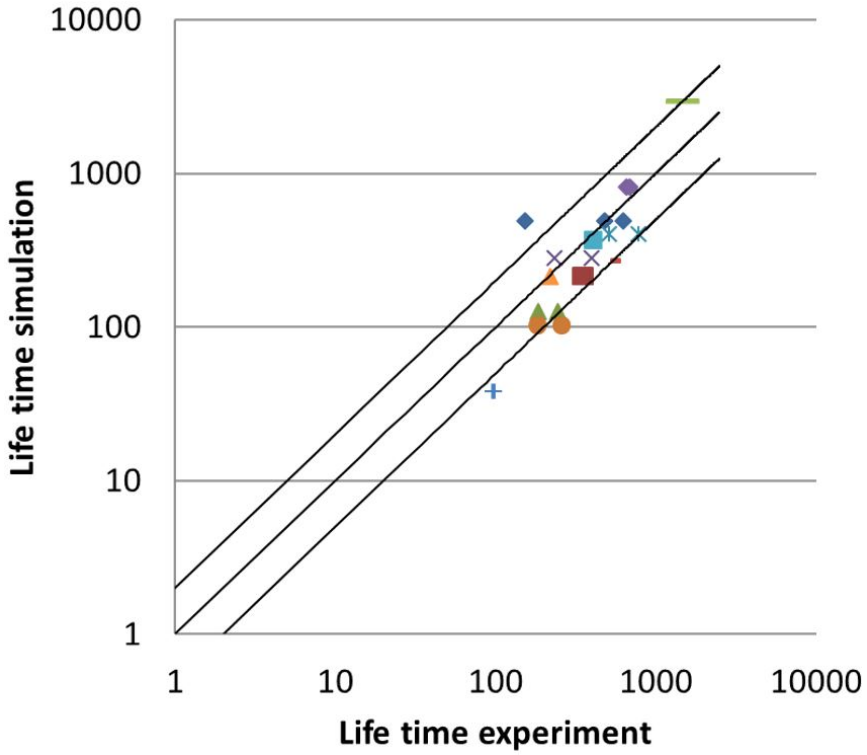

	C	Si	Mn	P	S	Cr	Ni	N
min.	-	-	-	-	-	17,5	8	-
max.	0,07	1	2	0,045	0,03	19,5	10,5	0,1

HB Hardness	E [Gpa] Modulus of Elasticity	Rp0,2 [Mpa] 0.2%-Yield Strength	Rm [Mpa] Tensile Strength	As [%] Elongation
< 215	200	> 190	> 500	> 45