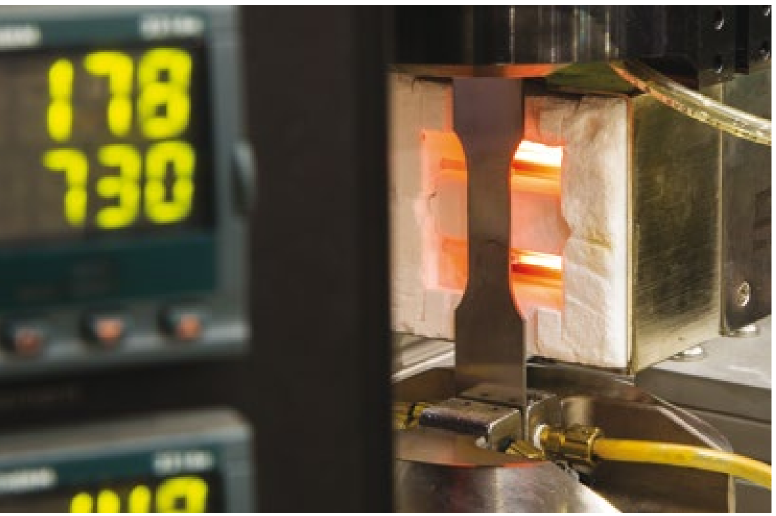
## Your Benefits

- Uses established method for TMF-LCF fatigue analysis
- Different damage effects can be accounted for and are available for results interpretation
- Finite Element code independent solution
- Advanced consulting available for material model definition and test program setup




## Interface

- ABAQUS
- MEDINA
- PERMAS
- ANSYS
- NASTRAN

# FEMFAT heat

FINITE ELEMENT METHOD FATIGUE

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# FEMFAT heat

BY MAGNA POWERTRAIN

# Thermo-Mechanical Low Cycle Fatigue

Method for hot engine parts, according to Professor Sehitoglu

femfat.magna.com

## Thermo-Mechanical Low Cycle Fatigue

**The objective of the FEMFAT heat module is to facilitate low-cycle fatigue analysis of components where a combined thermal and mechanical load occurs. Typical components are engine parts such as cylinder heads, pistons, exhaust manifolds or turbine blades which must satisfy design criteria with regards to economy and fatigue resistance.**

FEMFAT heat combines temperature-dependent material behavior with component related properties such as geometry for each combination of thermal and mechanical loads. The aim of computation is primarily to identify a damage distribution for each of the component‘s finite element nodes.

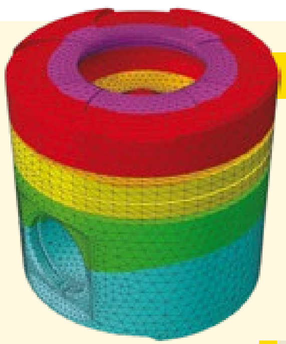
## Method Sehitoglu

This established method according to Professor Sehitoglu of the University of Illinois is provided as an option to FEMFAT max. The aim is to compute damage results for components subject to very high temperatures, e.g. turbochargers or cylinder heads.

This method facilitates time-dependent elasto-plastic stress, strain and temperature distributions, which must be analyzed using FEM, into account and uses them for FEMFAT heat Sehitoglu.
The main advantage of this method is that it takes three relevant damage mechanisms into account:

- Mechanical damage
- Environmental damage (e.g. oxidation, elevated temperature)
- Creep damage

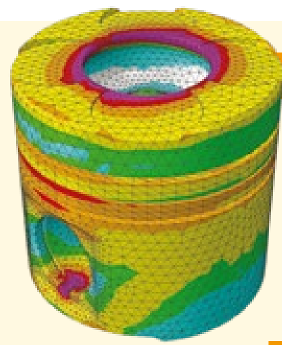
The FEMFAT material database has been extended by all necessary material parameters for a limited number of frequently used materials.
Additionally a Maple tool was developed to generate new material data for such analyses. This tool computes the required material data based on isothermal and thermo-mechanical tests results.
Our specialists have good experience for the required specimen tests and can offer to perform the tests together with a renowned test institute.



**Transient heat transfer analysis**

**INPUT**
- FEA model
- Boundary conditions from CFD: temperatures / connectivity‘s
- Material behavior depending on temperature

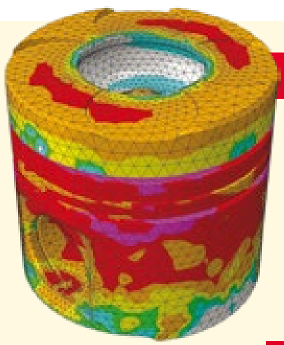
**OUTPUT**
Structural temperature in time domain



**Transient stress-strain analysis**

**INPUT**
- FEA model
- Boundary conditions
- Material behavior depending on temperature
- Temperature field

**OUTPUT**
- Stress
- Strain
- Temperature



**TMF damage analysis**

**INPUT**
- Temperature history
- Strain history
- Stress history
- TMF material parameters

**OUTPUT**
- Oxidation damage
- Mechanical damage
- Creep damage