



The Limousine Project



FATIGUE AT HIGH TEMPERATURE LOADS

1st Workshop

21st – 23rd Sep. 2009

Dept. of Thermal Engg., University of Twente, NL

Monday, 21st Sep. 2009.

9:00 Registration and welcome.

Lectures:

10:00 Talk by Dr. Ton Bor (UT, NL) “Introduction to material science, with application on metals”

Instructors (Basic Material Science):



Ton Bor



Bert Vos



Laura Vargas

Instructors (Combustion/Thermoacoustics):



Jim Kok



Arthur Pozarlik

12:30 Lunch break

13.30 Practical session

A practical experience will be given in the field of material science and vibration. The attendees will be divided into four groups and will go around different lab facilities available at UT. This will include measurement of mechanical properties of materials (e.g. Copper/Aluminium) using various instruments like Vickers hardness tester, tensile testing m/c, Microscopic assessment of surface samples etc. A brief description of various setups is included after this agenda.

Lab locations:

Tensile test	Rolling test	Microscopy	Limousine setup	Presentations
WH221	WH125	WH121	Klienhorst	WH121

Schedule:

	I	II	Break	III	IV	V	VI
Group	13.45 - 14.15	14.15 - 14.45	14.45 - 15.00	15.00 - 15.30	15.30 - 16.00	16.00 - 16.20	16.20 - 17.00
1	Rolling 1	Microscopy		Rolling 2	Limousine setup	Preparation	Presentation
2	Limousine setup	Rolling 1		Microscopy	Rolling 2	Preparation	Presentation
3	Microscopy	Tensile test 1		Limousine setup 1	Tensile test 2	Preparation	Presentation
4	Tensile test 1	Limousine setup		Tensile test 2	Microscopy	Preparation	Presentation

19:00 Workshop banquet.

Tuesday, 22nd Sep. 2009.

Lectures:

9:00 Talk by Dr. Bea Ghys (Electrabel, NL) on “Creep and fatigue in gas turbine materials: superalloys”

10:00 Talk by Prof. Peter Skelton (UK) on “Fracture Mechanics: initiation and growth of fatigue cracks”.

12:30 Lunch break.

13:30 Talk by Dr. Bea Ghys on “Root Cause Analysis of damage in gas turbine components”.

14:30 Practical assignment on Root Cause Analysis.

Assignments will be given for each group on typical gas turbine failure cases. Few specimens/sample pictures of the test cases will be provided. On basis of this, the groups will have to perform a number of Root Cause Analyses.

16:00 Evaluation and discussion of the RCA performed.

17:30 End

Wednesday 23 September 2009.

Lectures:

9:00 Talk by Dr. Stephen Varnam (ANSYS, UK) on “Numerical simulation of vibrations and temperature load, aiming at prediction of failure by fatigue and/or creep”.

11:00 Talk by M.Sc. Artur Pozarlik on “Acoustics induced Vibration in gas turbine combustors”.

12:00 Lunch break

Tensile test (Room No. WH121):

Objective:

- Used for determining the tensile strength of materials like copper, steel and other alloys
- To study the influence of heat treatments
- Determine the deformability of Copper/Aluminium



Rolling test (Room No. WH125):

Objective:

- Determine the relation between deformation and hardness: influence of strain hardening
- To study the influence of heat treatments
- Determine the deformability of Copper and Brass



Microscopy (Room No. WH121):

Objective:

- To study the material characteristics after the tensile/rolling test
- Deformation analysis at microscopic level, like depth of indentation etc.



Limousine model Combustor (Room Labor Kleinhorst):

Objective:

- To produce and measure high pressure oscillations and attain a limit cycle behaviour
- To measure the impedances at the ends
- To study the nonlinear effects and resulting mechanical vibrations and materials fatigue



DESIRE setup (Room Kleinhorst bunker):

Objective:

- To measure the response of the combustor liner subjected to high pressure amplitudes and at elevated pressures (e.g. at 5bar)
- Dynamic characterization of the flame by measuring the flame transfer functions
- Non-intrusive techniques to study the flow field (e.g. LIF, chemiluminescence, LDV)
- Well defined boundary conditions for validating CFD codes

