

Name.....Student I.D.....

**Department of Mining and Materials Engineering**  
**Faculty of Engineering**  
**Prince of Songkla University**

Final Examination for Semester: 2

Academic Year: 2004

Date: February 22, 2005

Time: 13.30-16.30

Subject: 237-508 Structures and Mechanical Properties of Materials

Room: R300

Instruction

1. There are 3 problem sets in total. Please do all of them and write your answers on the space provided after each problem set. If you need more space, you can write the answer on the back of the problem set.
2. Only two (2) pieces of A4-size note are allowed. You may write on both sides of them. Please return them with your answers.
3. Dictionary, calculator, and stationery are also allowed.
4. Text books and other studying materials are not allowed.
5. This final exam is accounted for 30% of the total grade point.

Dr. Thawatchai Plookphol

Problem No.	Full Score (points)	Student's Score (points)
1.	30	
2.	40	
3.	20	
Total	90	

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1. Suppose you are planning to do creep experiment on polycrystalline rock salt (i.e. sodium chloride, NaCl) and you are interested in the power-law creep behavior of this material.

1.1 By using the information given below, please design the experimental conditions for creep tests, e.g. what are temperature and stress ranges in which creep experiments will be performed? Show your calculations and explain the reasons to support your answer. (20 points)

1.2 What creep parameters do you want to know from your experiments? (10 points)

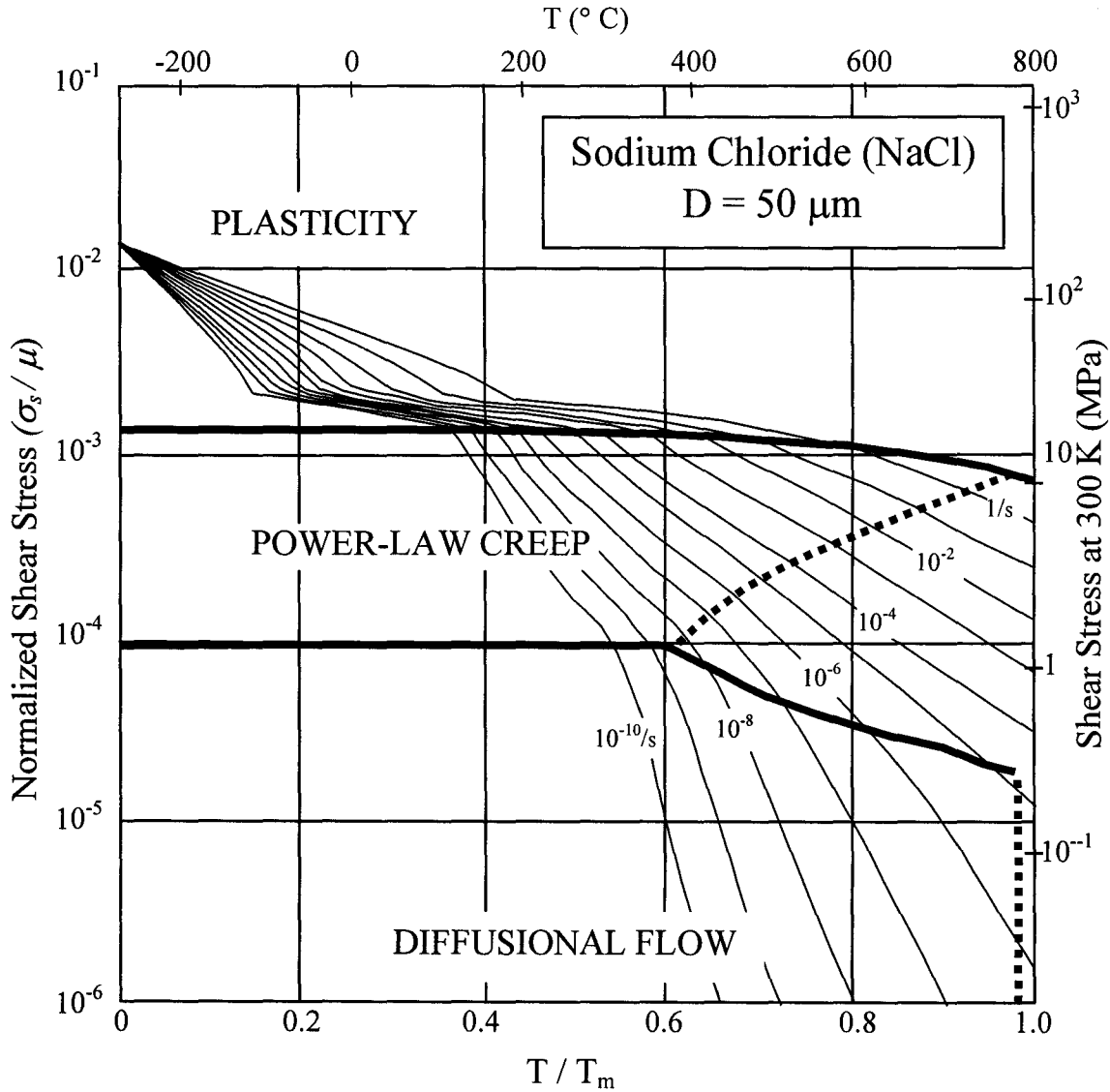


Figure 1 Deformation-mechanism map for sodium chloride (NaCl) of grain size 50 μm. [Redrawn from Frost and Ashby, 1982]

Given:

$$\sigma_s = \frac{\sigma_1}{\sqrt{3}}$$

where  $\sigma_s$  is shear stress, and  $\sigma_1$  is normal stress.

$$T_m = 797 \text{ }^\circ\text{C}$$

$$\mu \cong 10,000 \text{ MPa}$$



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3. The fatigue crack growth rates for A533B-1 steel used for making pressure vessel is shown in Figure 3 below.

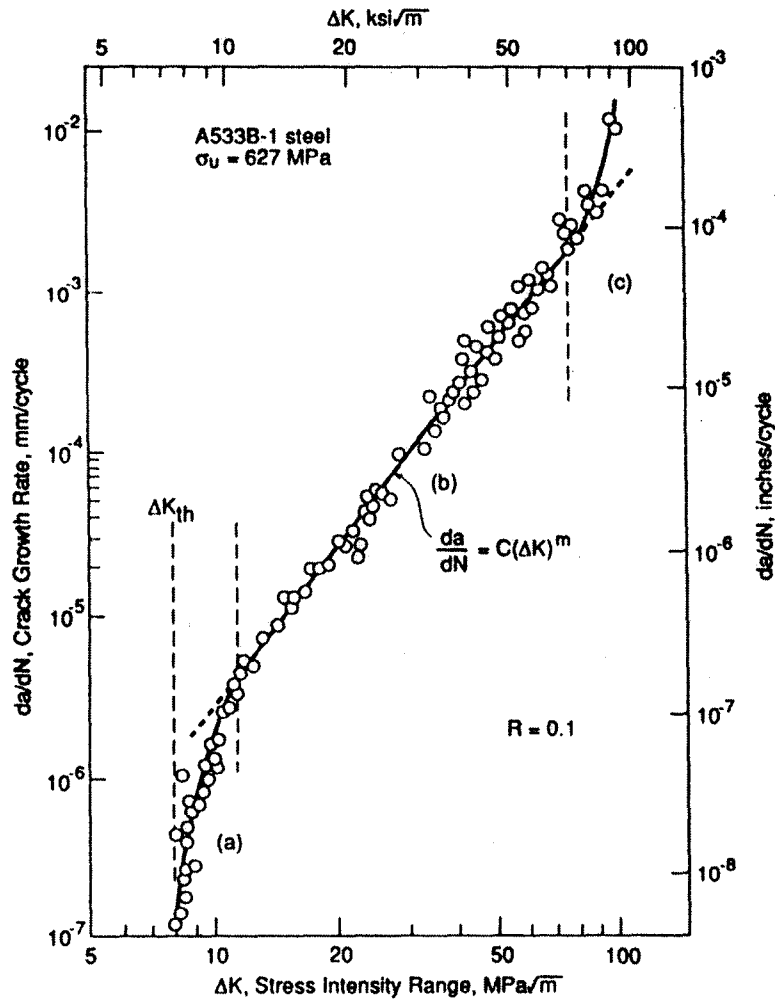


Figure 3 Fatigue crack growth rates over a wide range of stress intensities for a ductile pressure vessel steel.

If you are doing your research on a high strength aluminum alloy, e.g. 7075-T651, and you are assigned to set up an experiment to achieve fatigue crack growth rates data similar to that is shown in Figure 3.

Please suggest the experiment procedure you may use to get the data. (20 points)

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