

# Predicting the Crack Growth Behavior in a Filled Elastomer



**C. T. Liu**

**AFRL/PRSM**

**10 E. Saturn Blvd.**

**Edwards.AFB CA 93524-7680, USA**

**Max. Yen & C-K Ching**

**Materials Technology Center**

**Southern Illinois University**

**Carbondale, IL 62901-6630, USA**

**Approved for public release; distribution unlimited**

## Report Documentation Page

*Form Approved*  
*OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>AUG 2005</b>		2. REPORT TYPE		3. DATES COVERED -	
4. TITLE AND SUBTITLE <b>Predicting the Crack Growth Behavior in a Filled Elastomer (Briefing Charts)</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) <b>C Liu; Max Yen; C-K Ching</b>				5d. PROJECT NUMBER <b>2302</b>	
				5e. TASK NUMBER <b>0378</b>	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Air Force Research Laboratory (AFMC), AFRL/PRSM, 9 Antares Road, Edwards AFB, CA, 93524-7401</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT <b>N/A</b>					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES <b>12</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



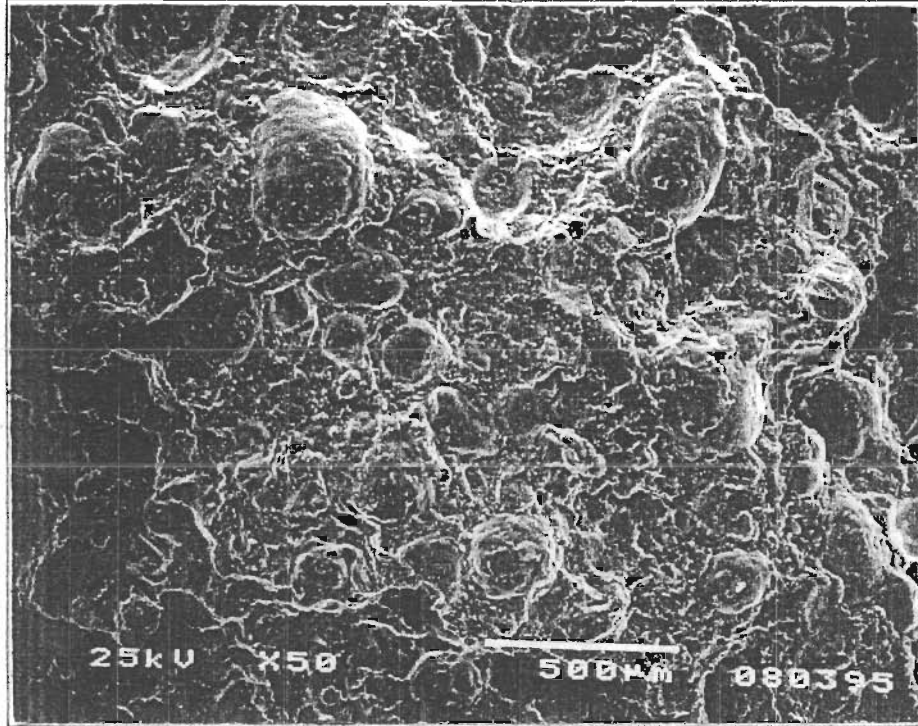
# Objectives



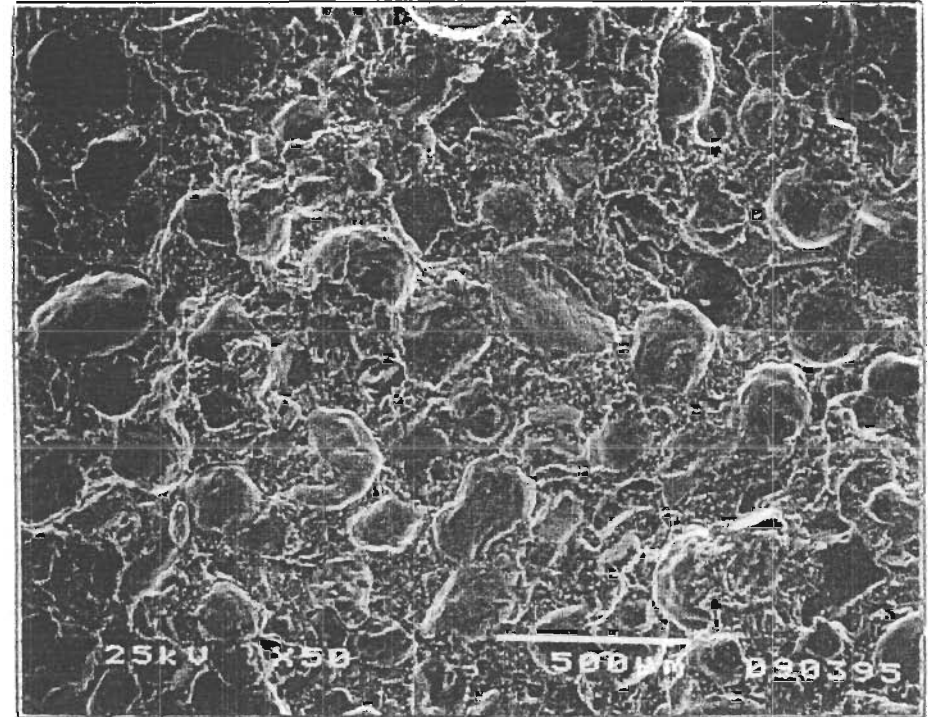
- **Investigate the Effect of Confining Pressure on the Crack Growth Behavior in the Material.**
- **Predict the Crack Growth Behavior in the Material.**



# Fracture Surface Under Different Confining Pressures

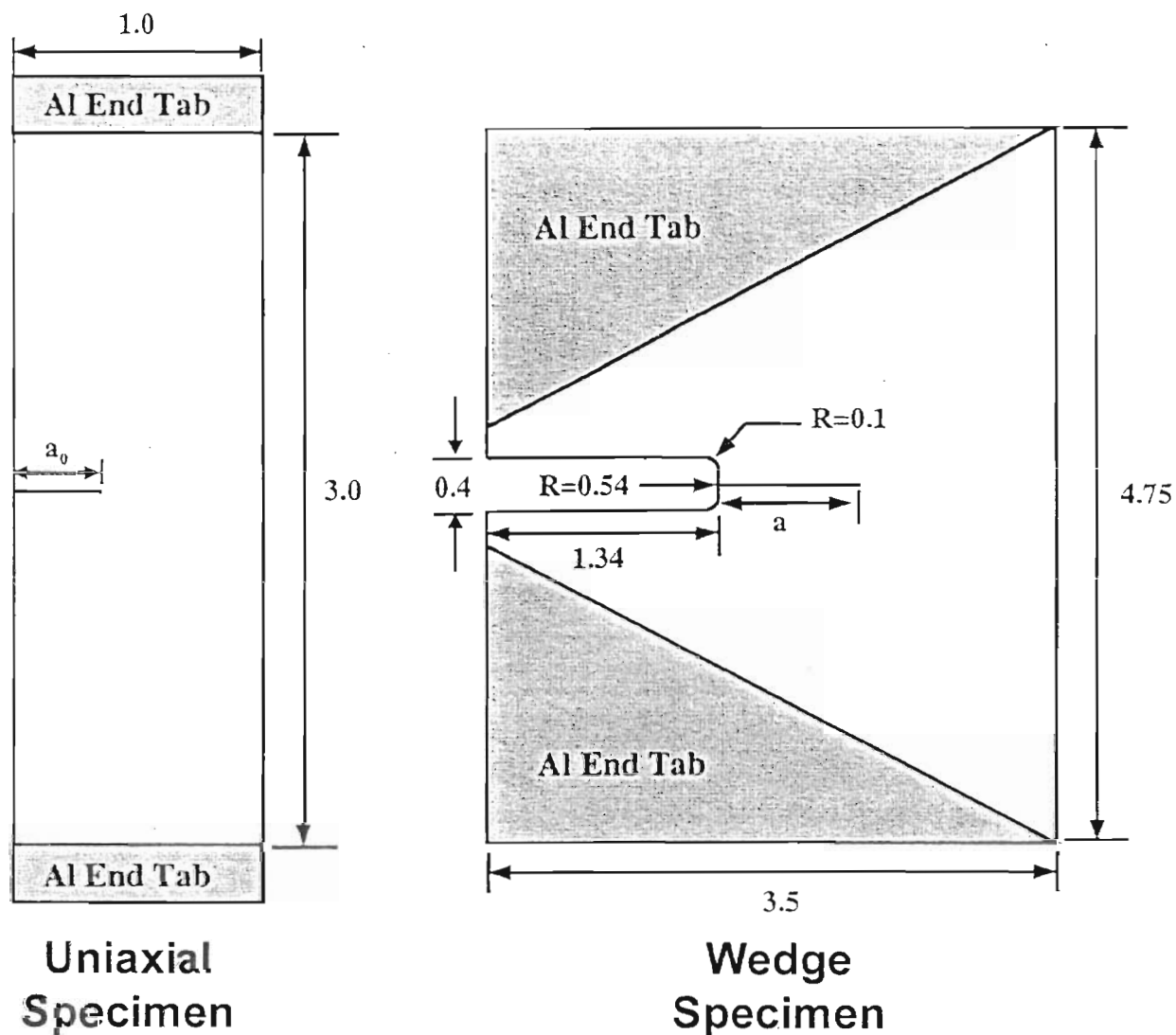


Pressure = 72.7 psi



Pressure = 1744 psi

# Specimen Geometry

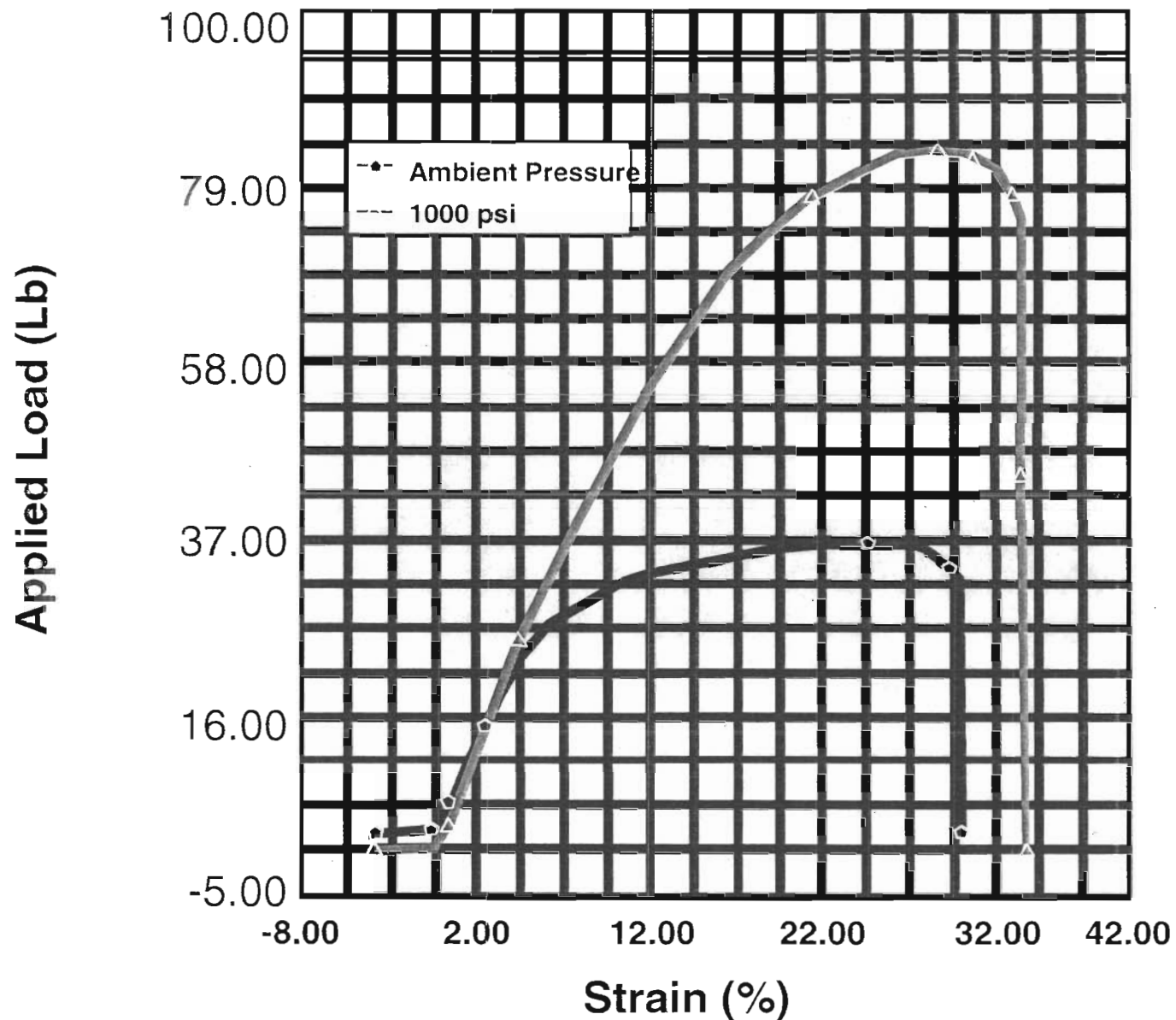


(all dimensions in inches)

Approved for public release; distribution unlimited



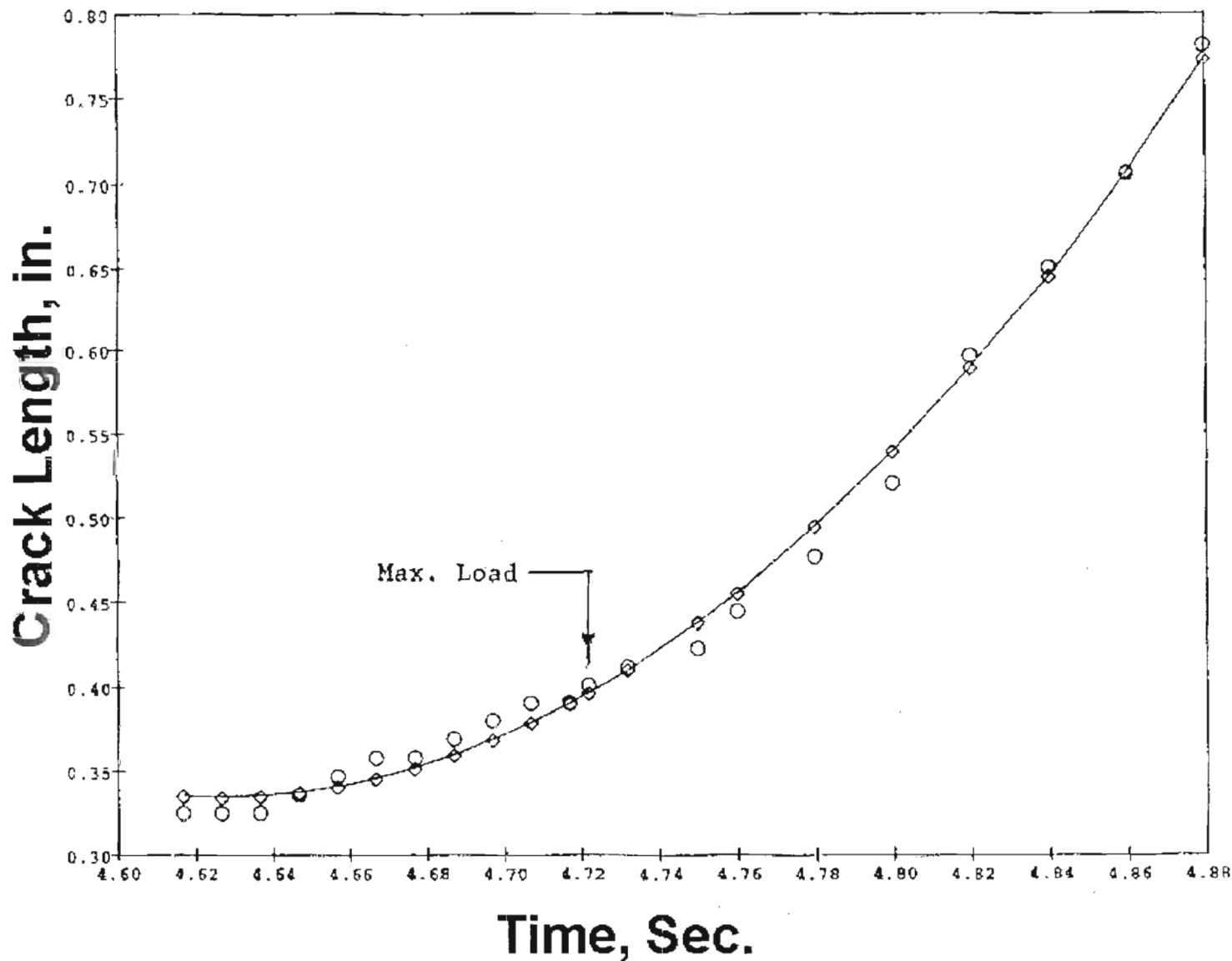
# Applied Load Vs. Strain



Approved for public release; distribution unlimited

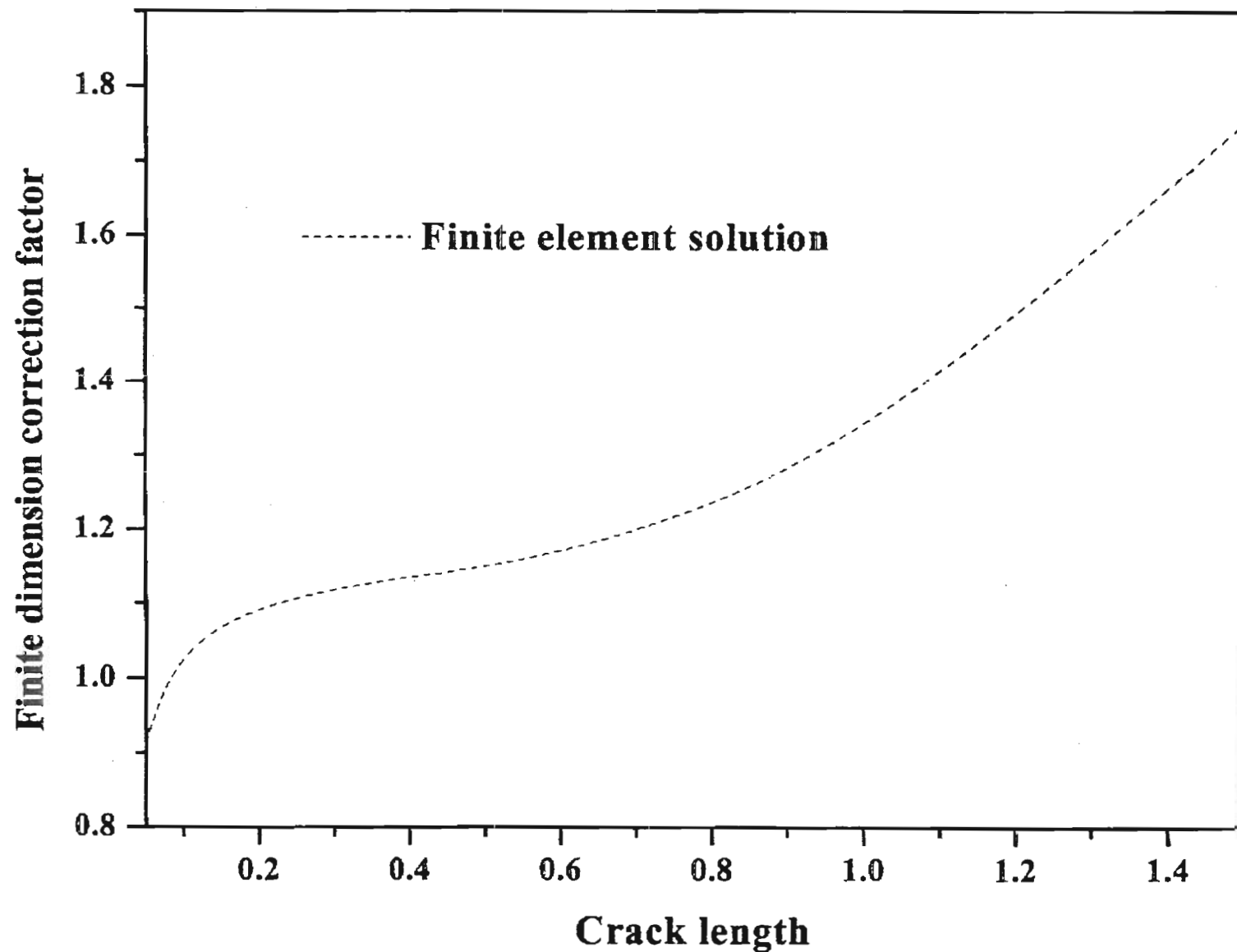


# Crack Length Vs. Time Curve



Approved for public release; distribution unlimited

# Finite Dimension Correction Factor versus Crack Length (Poisson's Ratio = 0.49)

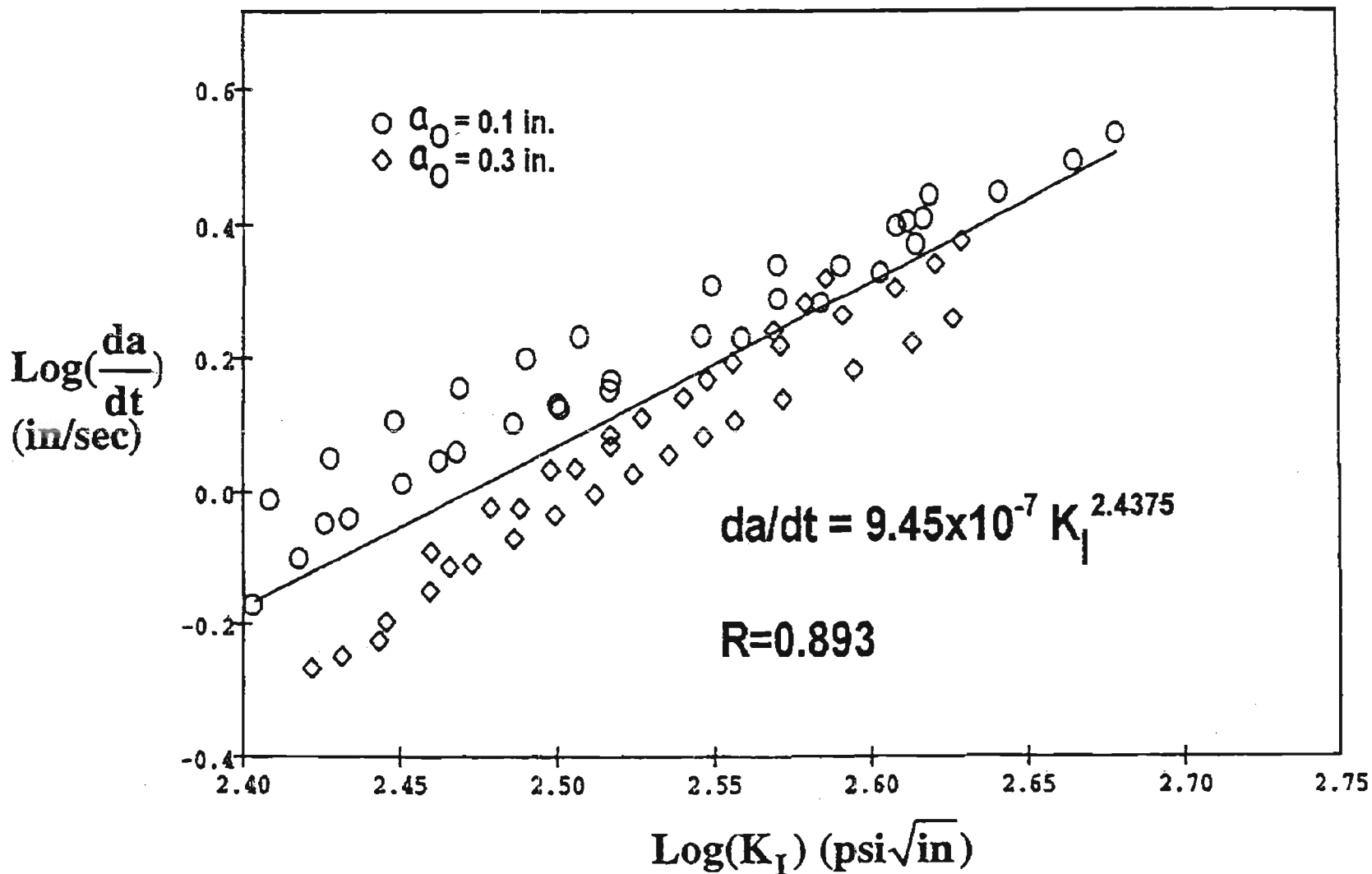


Approved for public release; distribution unlimited

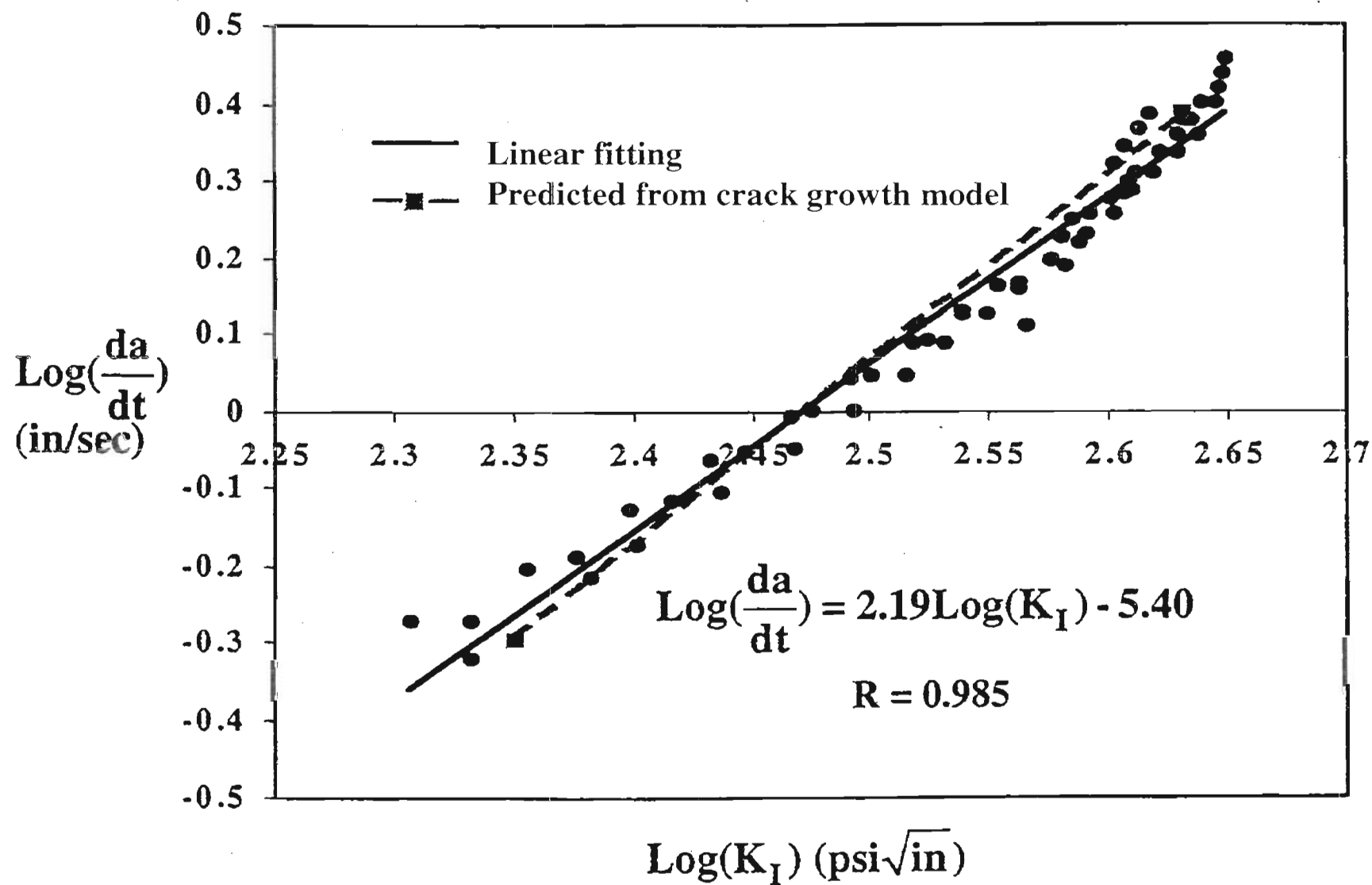




# Crack Growth Rate versus Mode I Stress Intensity Factor (Uniaxial Specimen)

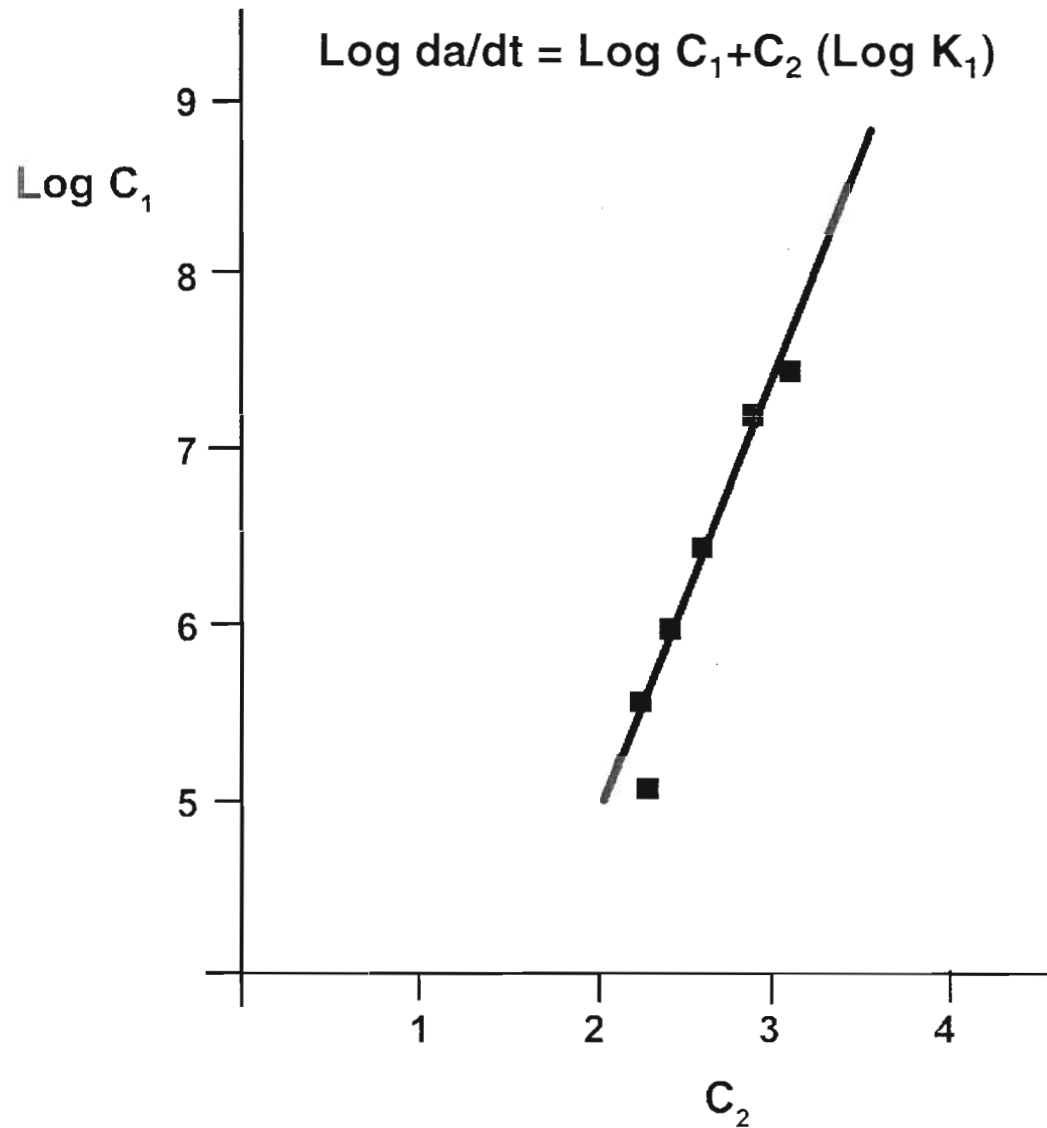


# Crack Growth Rate versus Mode I Stress Intensity Factor (Wedge-Shaped Specimen)



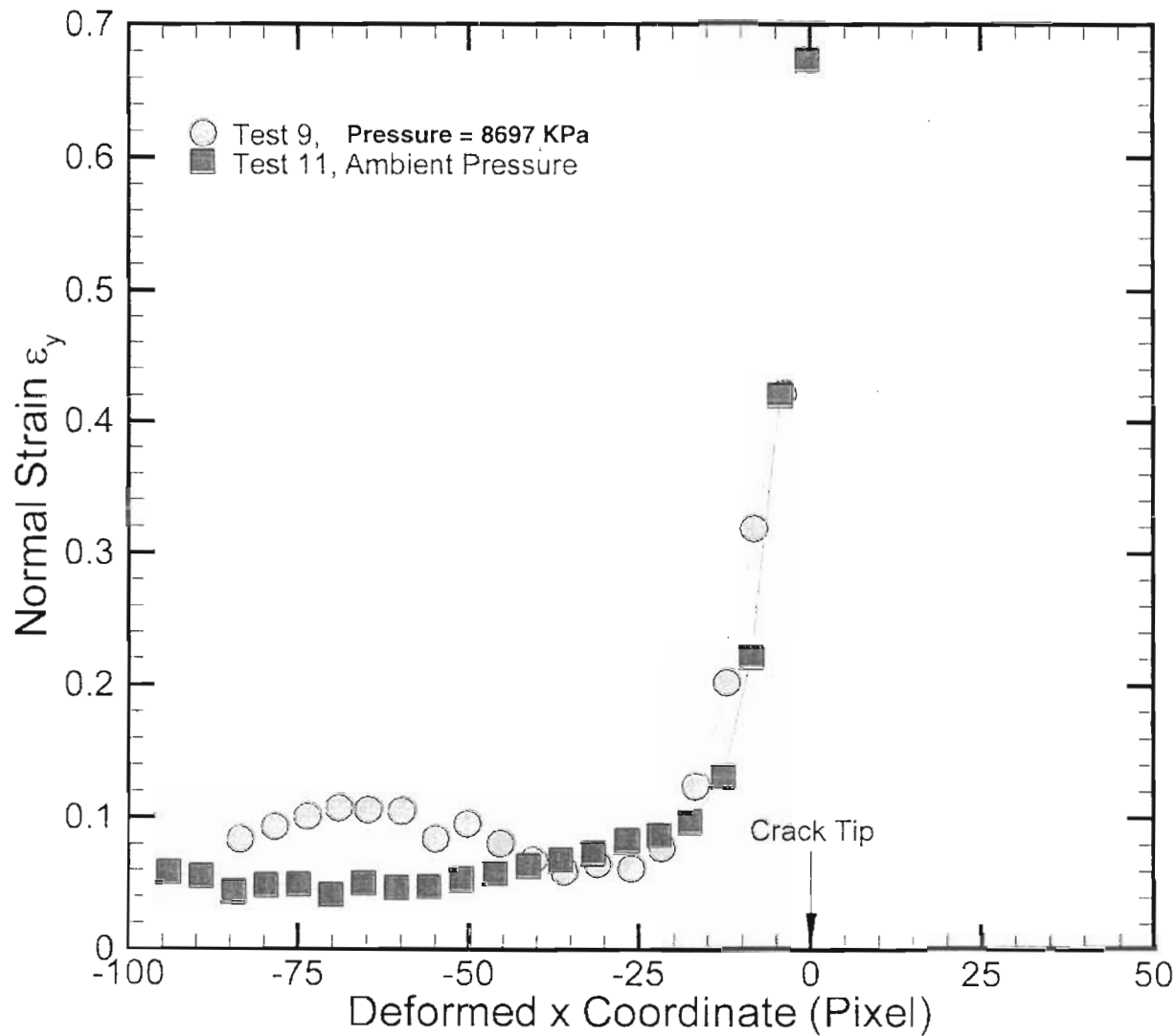


# Log $C_1$ versus $C_2$



Approved for public release; distribution unlimited

# Normal Strain Distribution Ahead of the Crack Tip at the Onset of Crack Growth





# Conclusions



- **Under the confining pressure, the crack grows stably until the specimen fractured.**
- **A Power law relationship exists between the crack growth rate and the Mode I stress intensity factor.**
- **A good correlation exists between the predicted and the measured crack growth rate.**