Nonlinear Characterization of the Crack Growth Behavior in a Filled Elastomer

C. T. Liu
AFRL/PRSM
10 E. Saturn Blvd.
Edwards AFB CA 93524-7680, U. S. A.

M. Yen
Materials Technology Center
Southern Illinois University
Carbondale, IL 92601-6603, U. S. A.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JUL 2004		**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Nonlinear Characterization of the Crack Growth Behavior in a Filled Elastomer	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) **C Liu; M Yen**	5d. PROJECT NUMBER **2302**
	5e. TASK NUMBER **0378**
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air Force Research Laboratory (AFMC),AFRL/PRSM,10 E. Saturn Blvd.,Edwards AFB,CA,93524-7680**	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
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
N/A

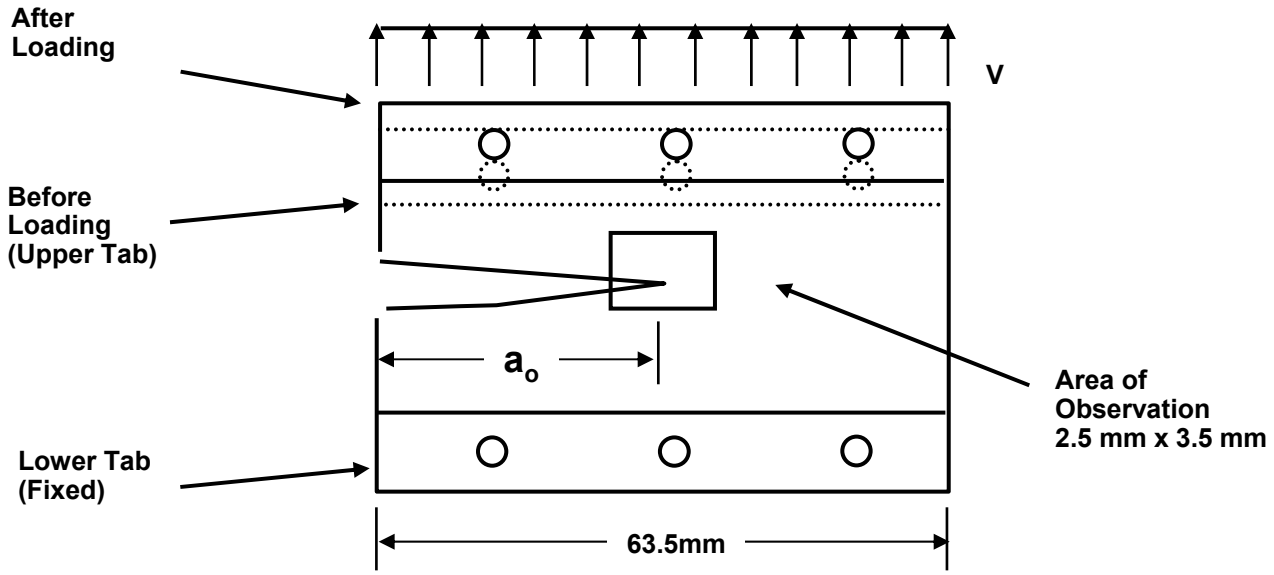
15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**17**	

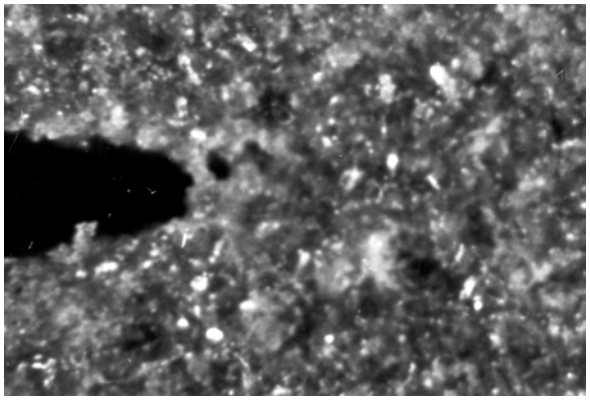
OBJECTIVES

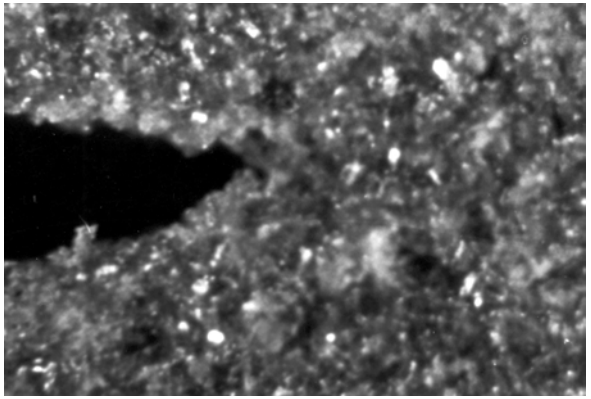
- **Determine J-Integral Using a Hybrid Experimental-Numerical Technique.**
- **Investigate the Effects of Initial Crack Length on the Crack Growth Behavior in the Filled Elastomer.**

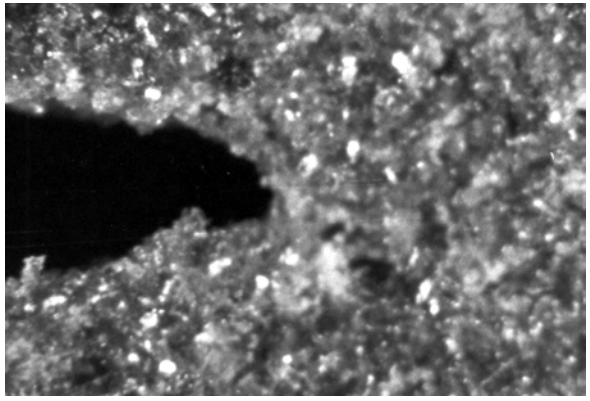
Specimen Geometry



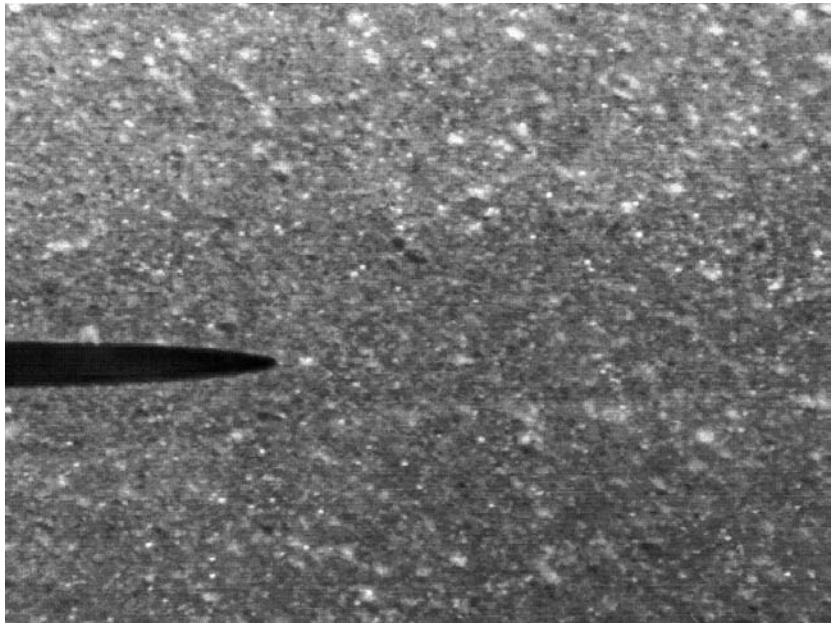
Crack Tip Profiles



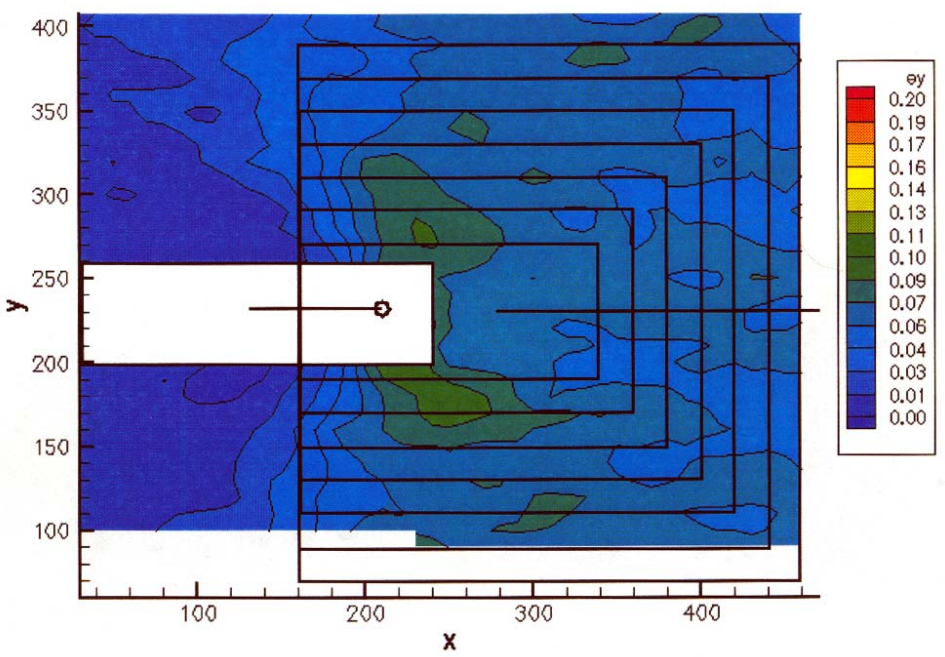




Step 11

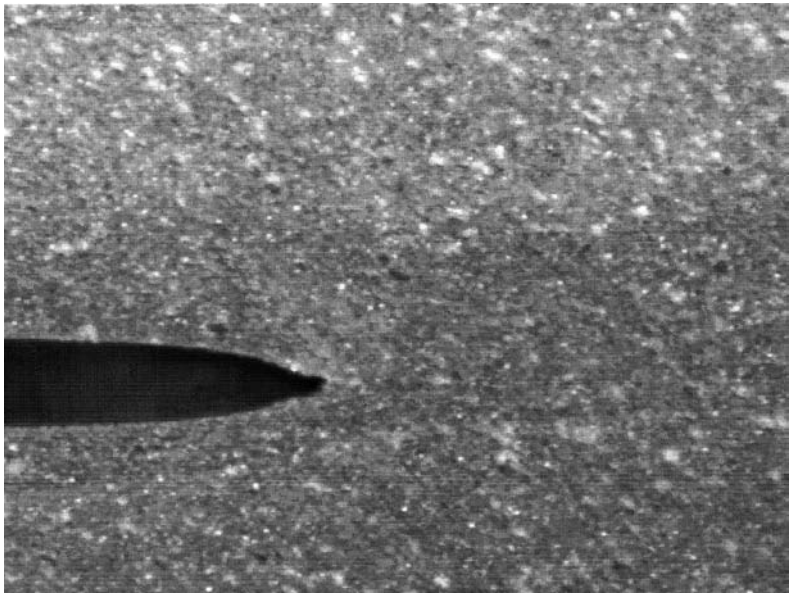


Deformed Image

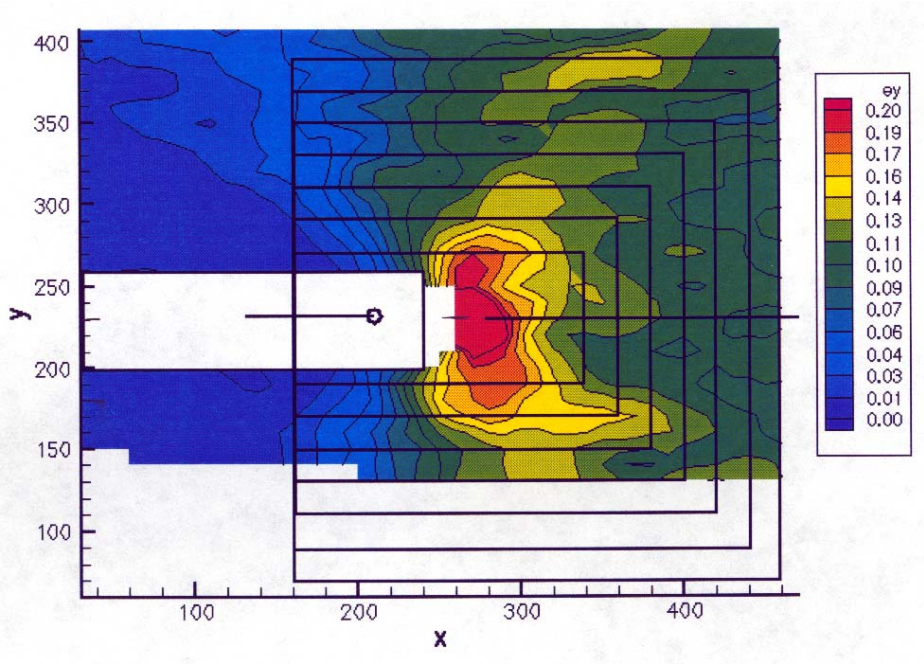


Strain Distributions and Integration Paths

Step 19

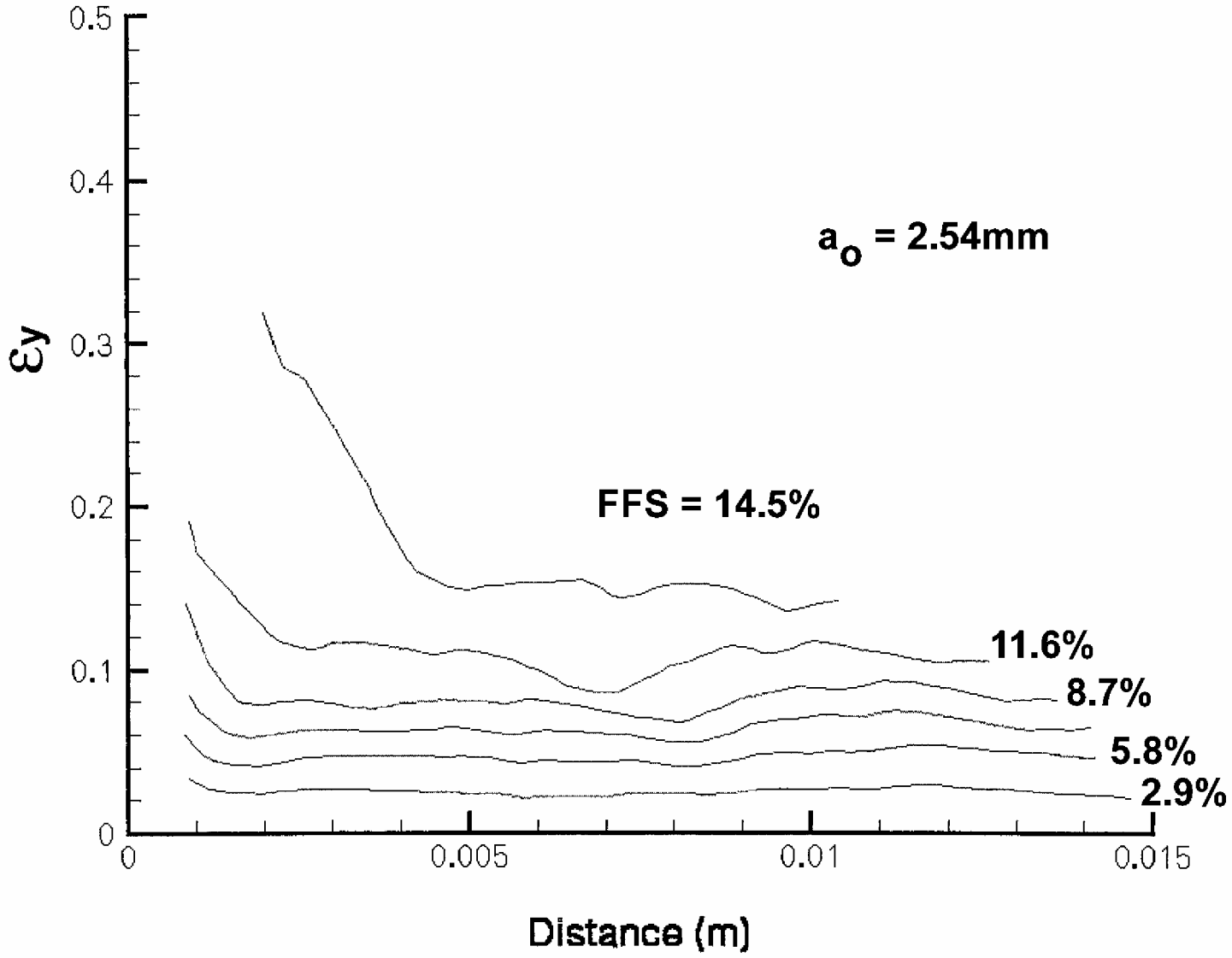


Deformed Image

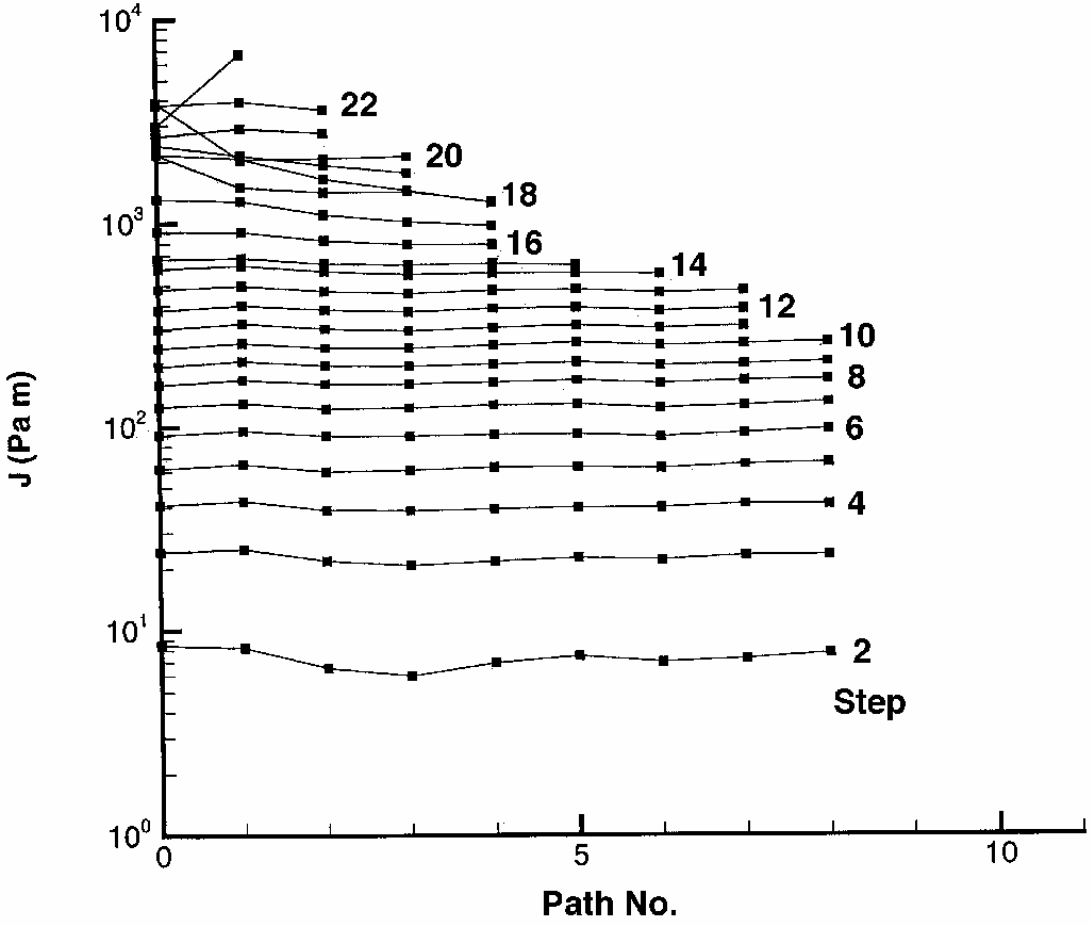


Strain Distributions and Integration Paths

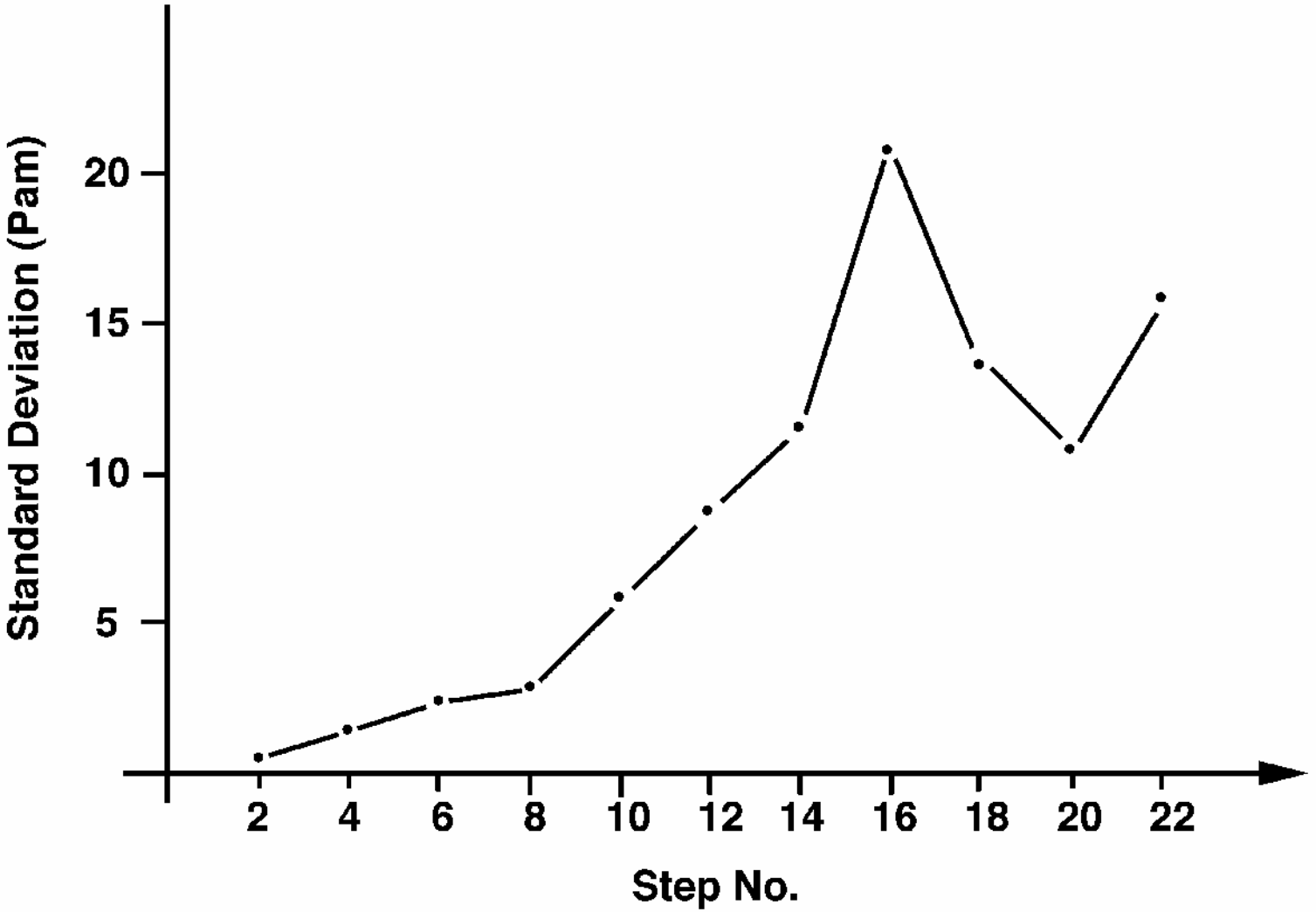
Normal Strain Vs. Distance from Crack Tip



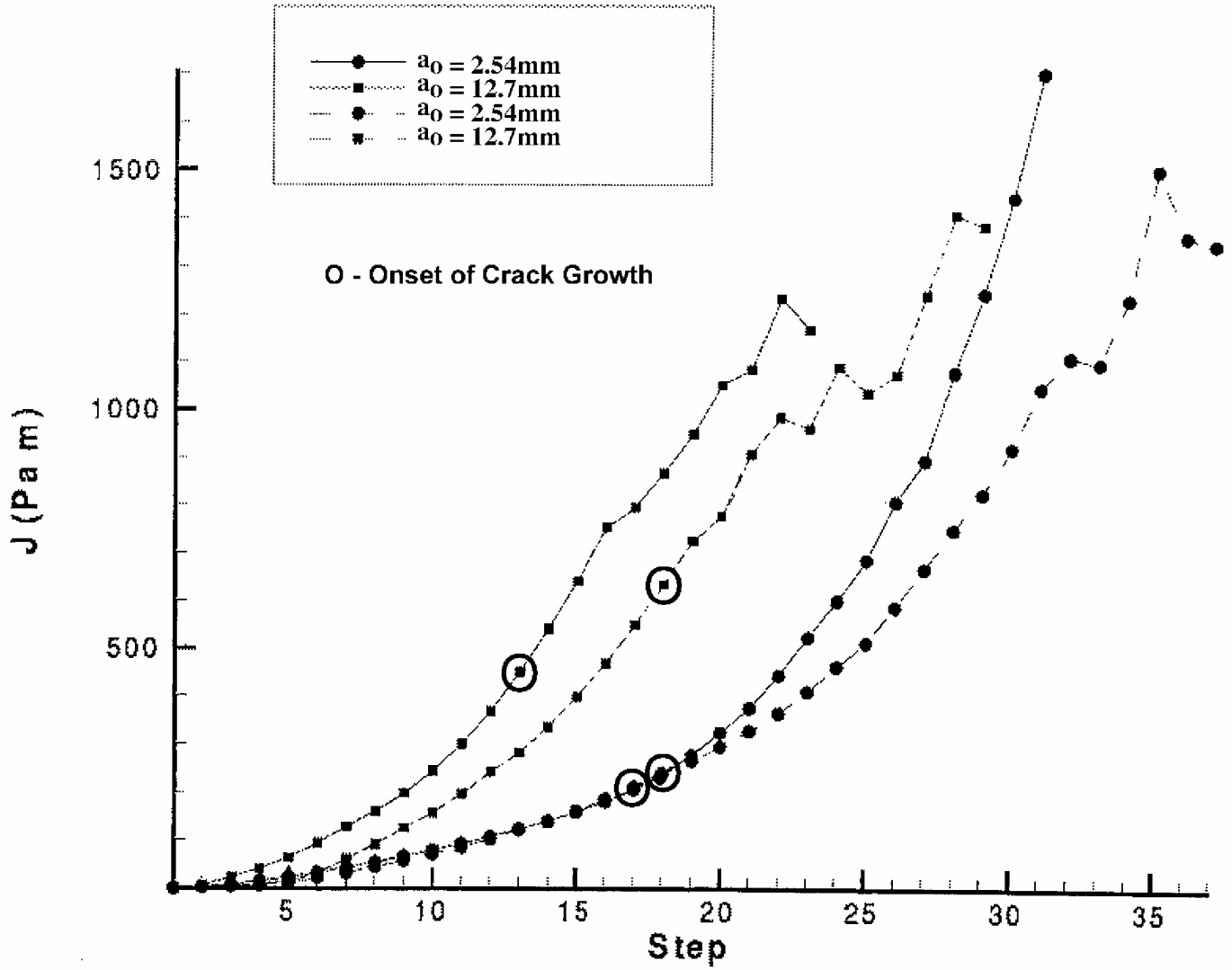
J-Integral Versus Path Number as a Function of Step Number (Applied Strain)



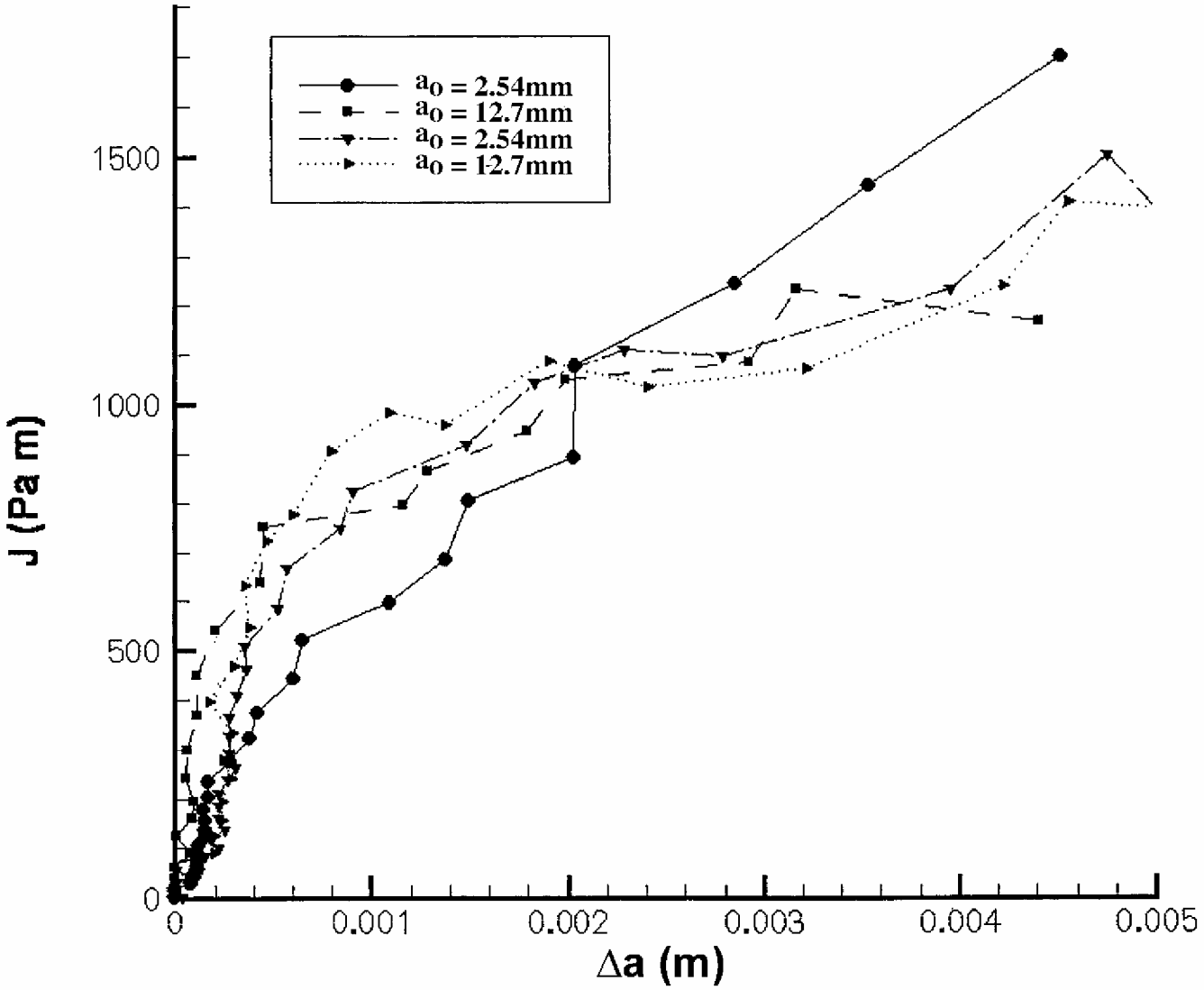
Standard Deviation of J-Integral Versus Step Number (Applied Strain)



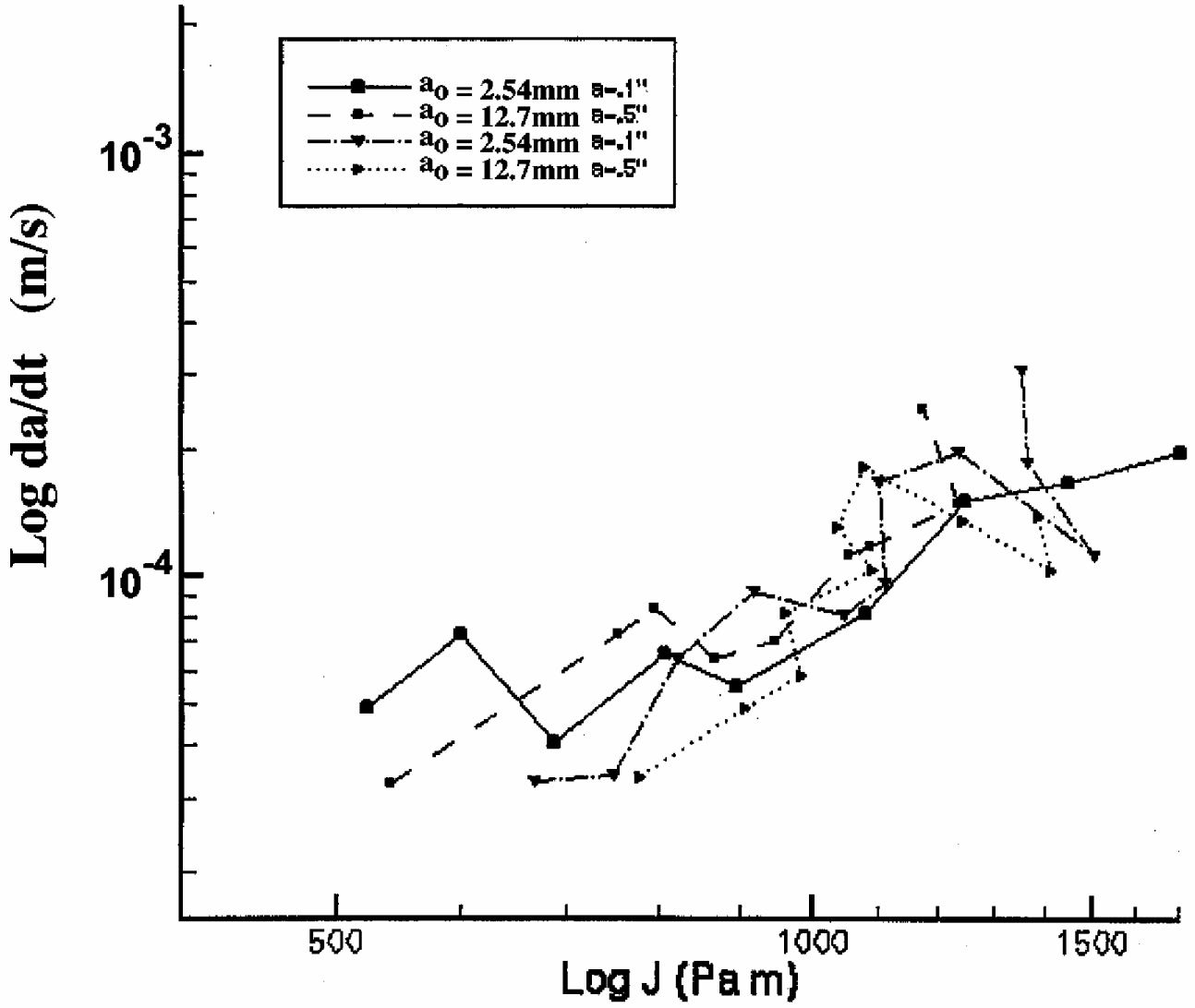
J-Integral Vs. Step Number (Applied Strain)



Crack Growth Resistance Curves

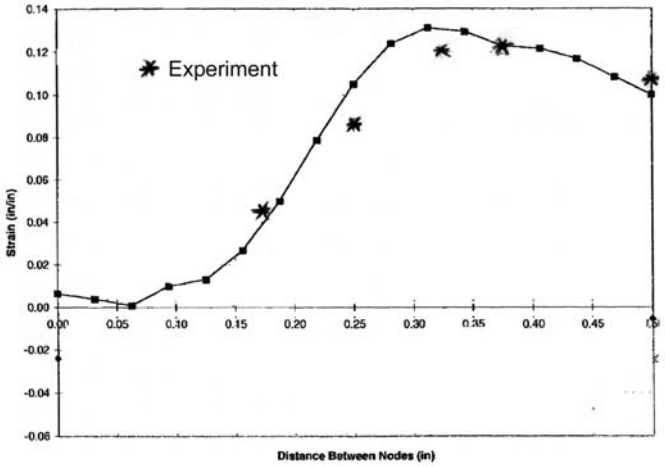


Crack Growth Rate Vs. J-Integral

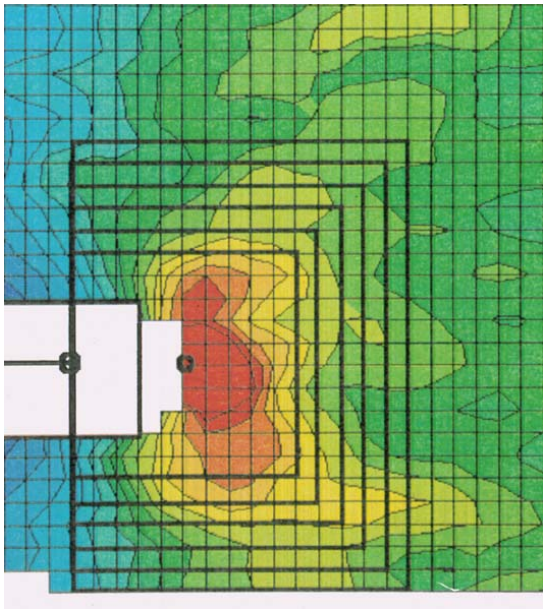


CONCLUSIONS

- On the macroscopic scale, the J-integral is independent of the integration path.
- The initial crack length has no significant effect on the crack growth behavior.
- A considerable amount of stable crack growth takes place before unstable crack growth occurs.
- A power law relationship exists between the crack growth rate and the J-integral

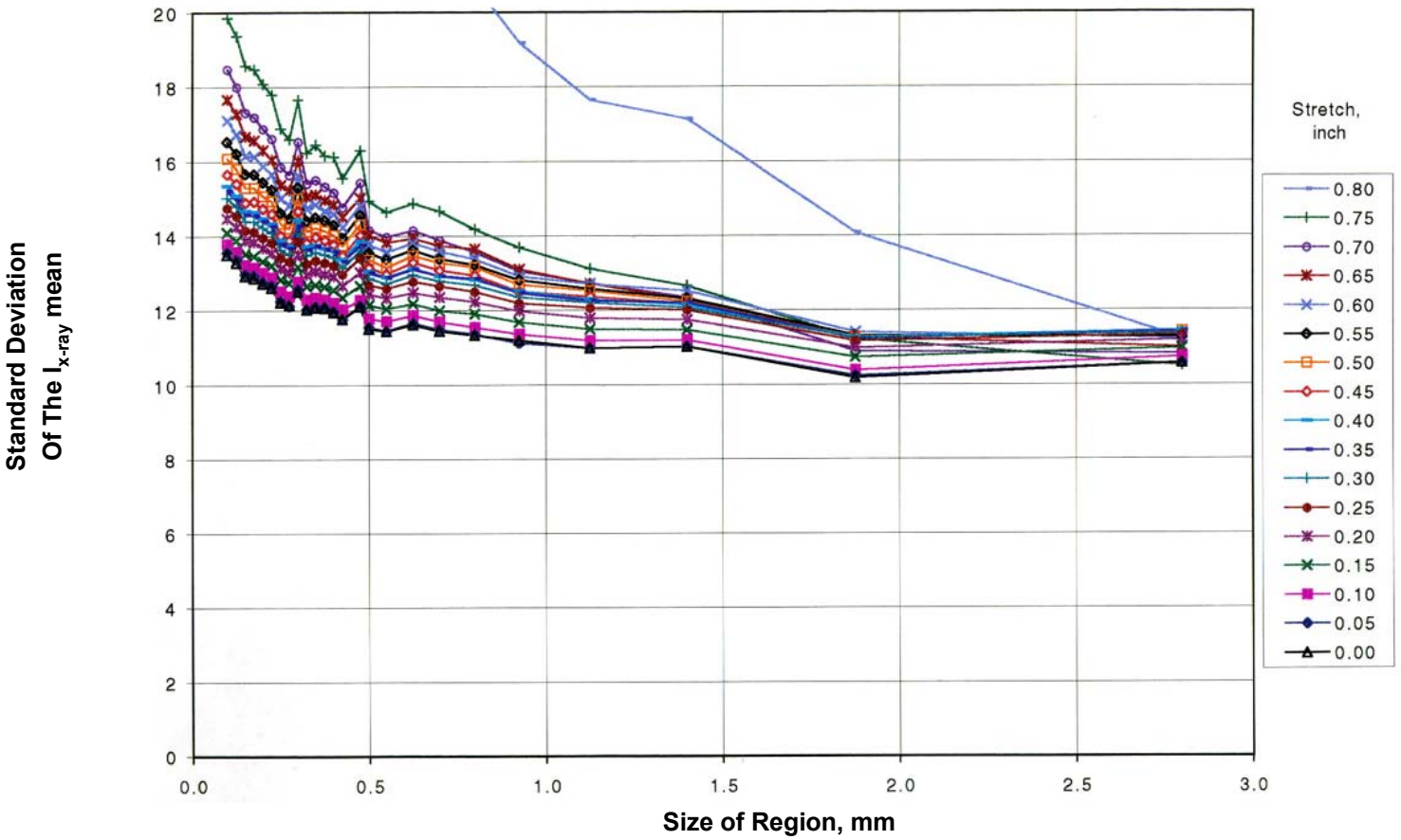


Normal Strain Along an Integration Path

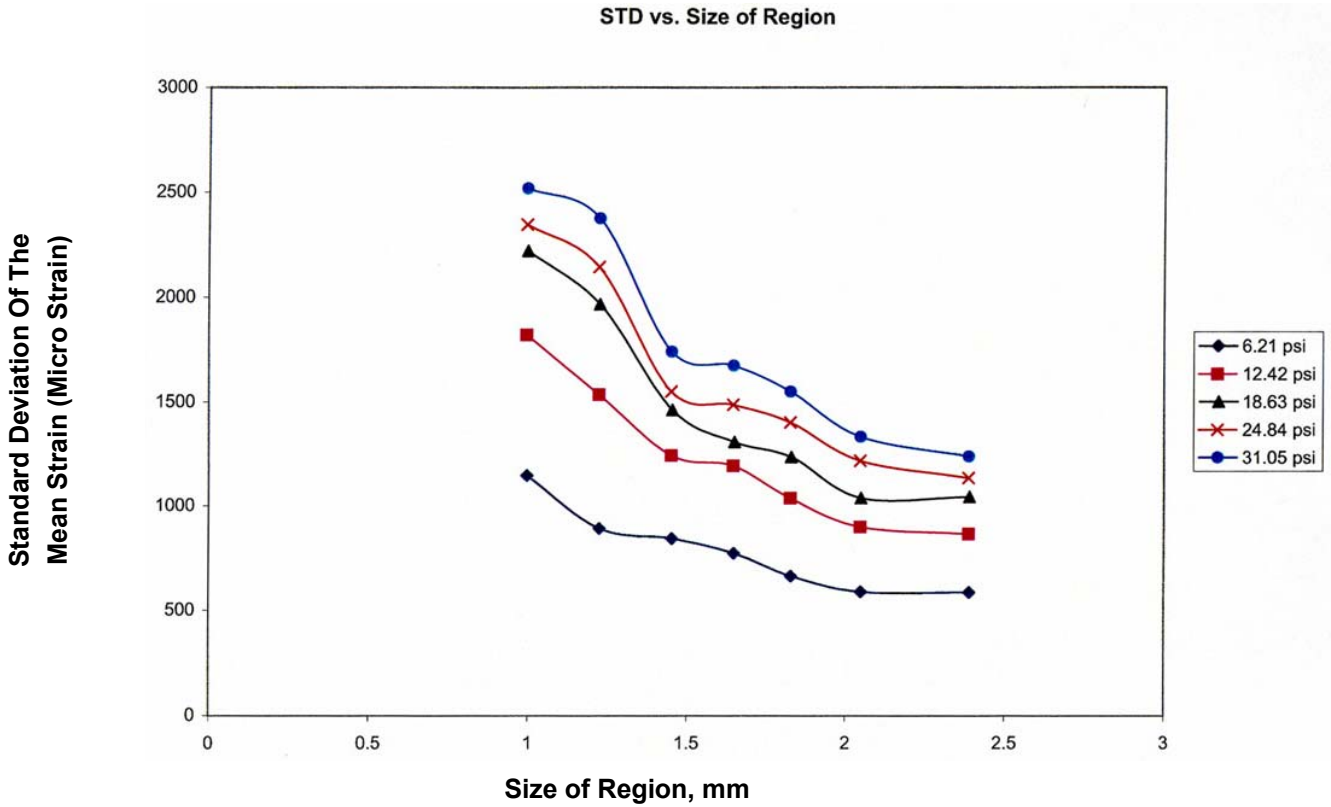


Strain Distributions and Integration Paths

Standard Deviation of X-Ray Intensity Versus Size of Region as a Function of Applied Deformation



Standard Deviation of Strain Versus Size of Region as a Function of Applied Stress



Maximum Principal Distribution at 6% Applied Strain