

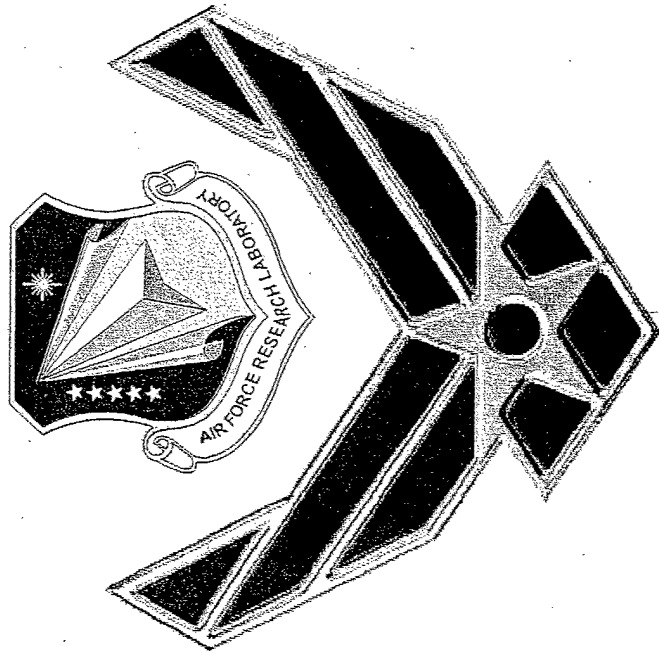
REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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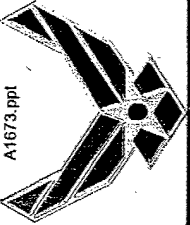
1. REPORT DATE (DD-MM-YYYY) 08-07-2003		2. REPORT TYPE Technical Viewgraph Presentation		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Investigating the Three-Dimensional Effect on Crack Growth Behavior in an Incompressible Material				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) C.T. Liu (AFRL/PRSM); C.W. Smith (VA Polytech)				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 East Saturn Blvd. Edwards AFB CA 93525-7680				8. PERFORMING ORGANIZATION REPORT NUMBER AFRL-PR-ED-VG-2003-186	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory (AFMC) AFRL/PRS 5 Pollux Drive Edwards AFB CA 93524-7048				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S NUMBER(S) AFRL-PR-ED-VG-2003-186	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.					
13. SUPPLEMENTARY NOTES For presentation at the International Conference on Advanced Techniques in Experimental Mechanics in Nagoya, Japan, taking place 12 September 2003.					
14. ABSTRACT					
20030812 217					
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	A	13	Leilani Richardson
					19b. TELEPHONE NUMBER (include area code) (661) 275-5015

Investigating Three- Dimensional Effect on Crack Growth Behavior in an Incomprerial Material



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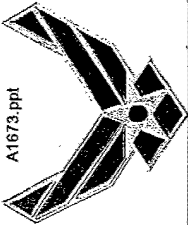
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Virginia Polytechnic Institute & State University
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Objective:



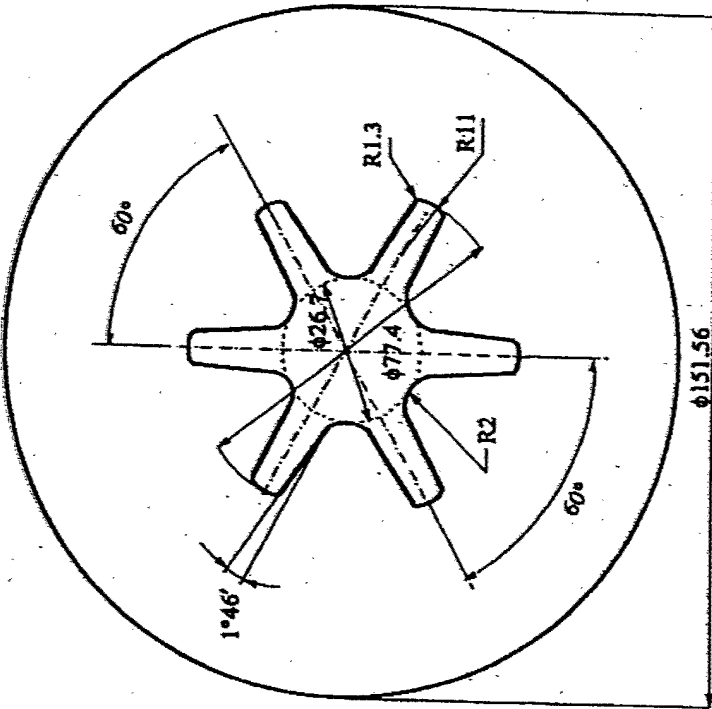
- Investigate the effect of crack location on the crack growth behavior in centrally perforated cylinders under internal pressure.



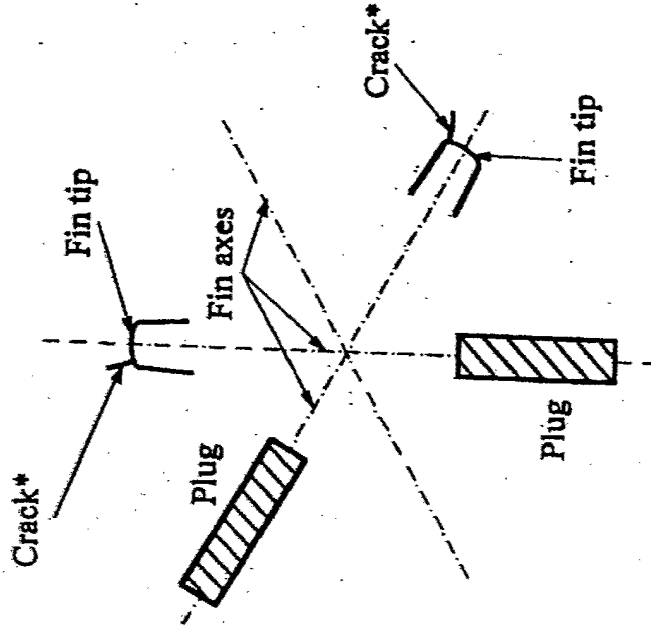
Specimen Dimensions and Crack Locations



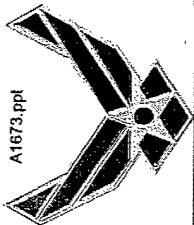
length of cylinder: 376 mm



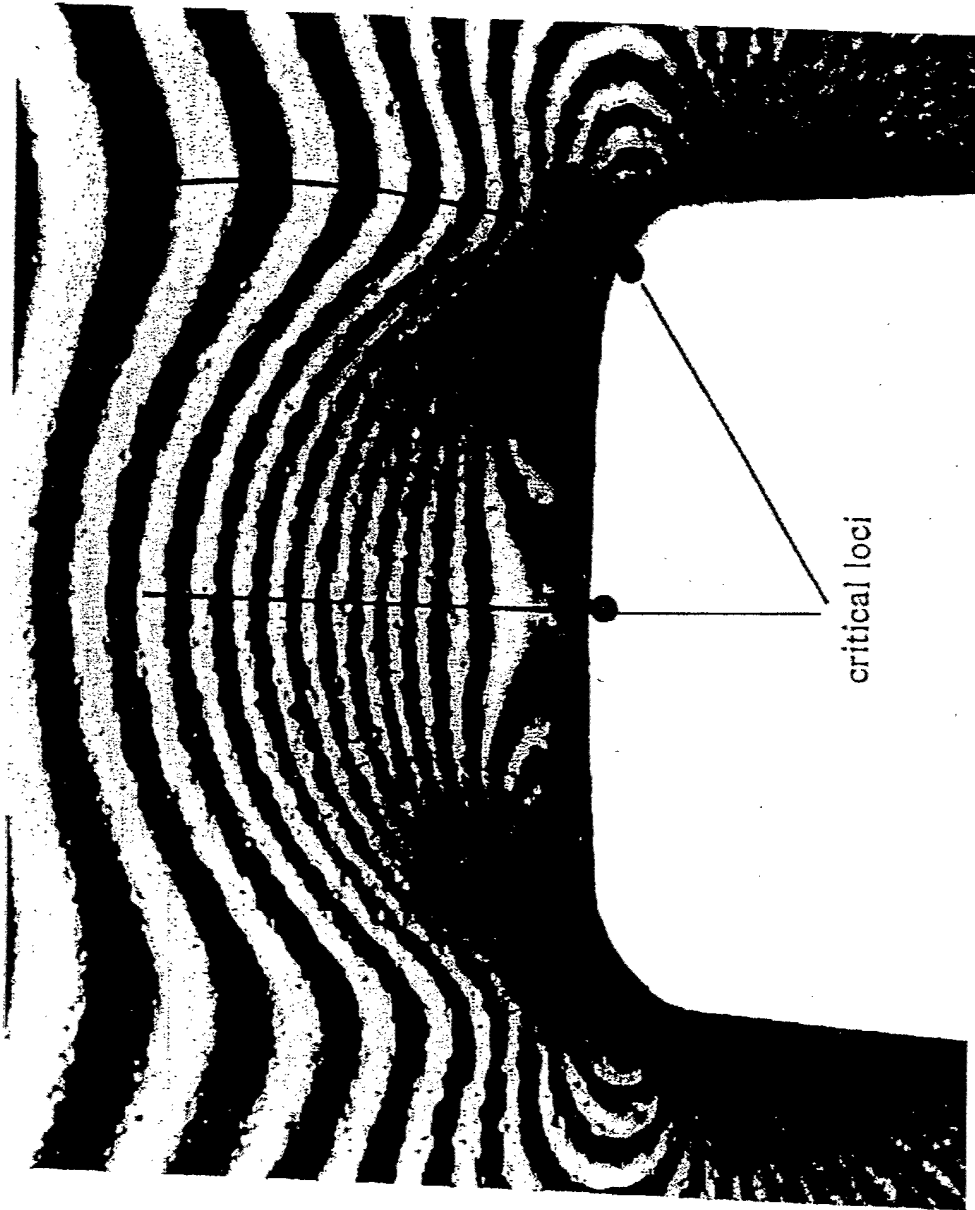
all dimensions are in mm



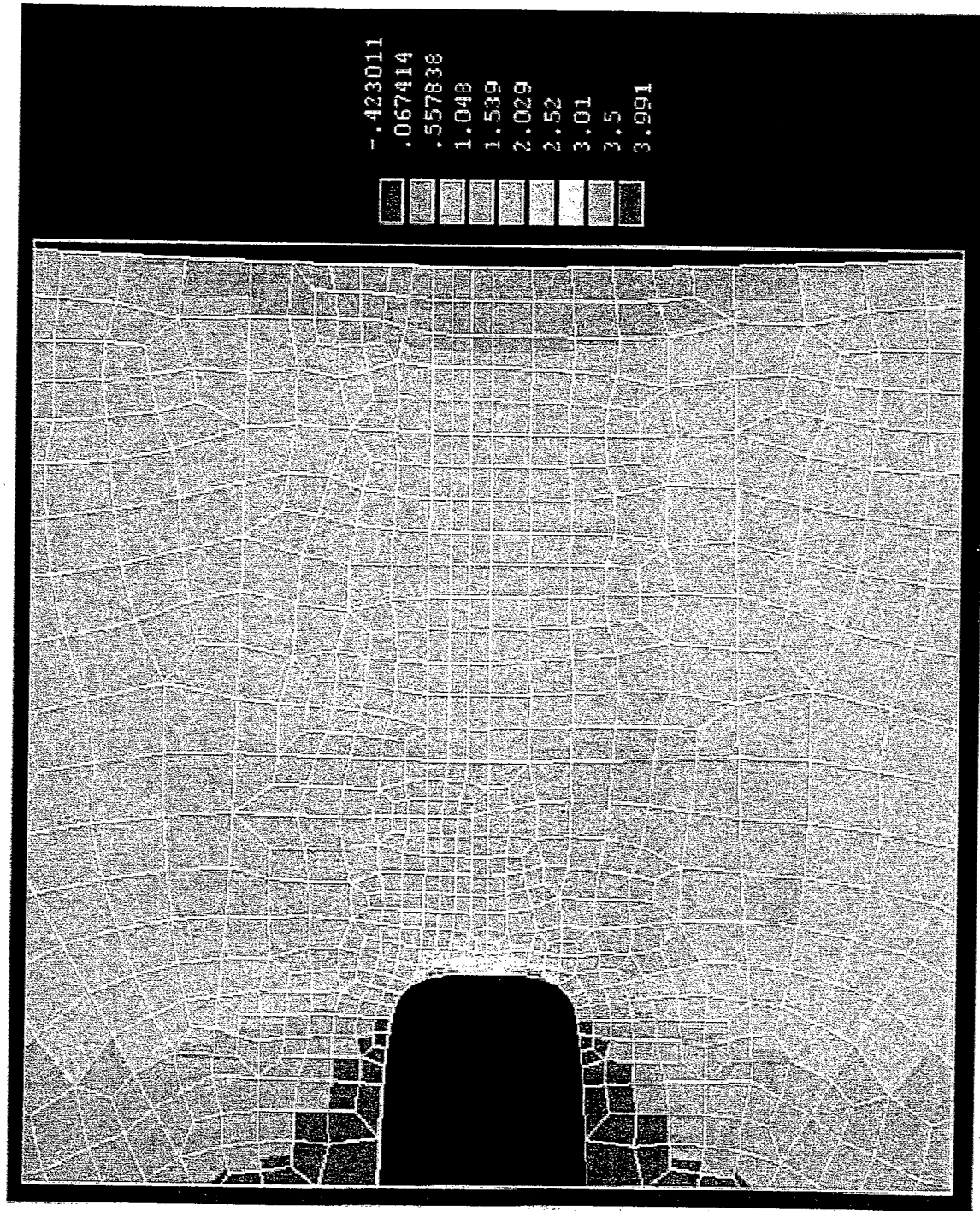
* Path of crack to maximum depth



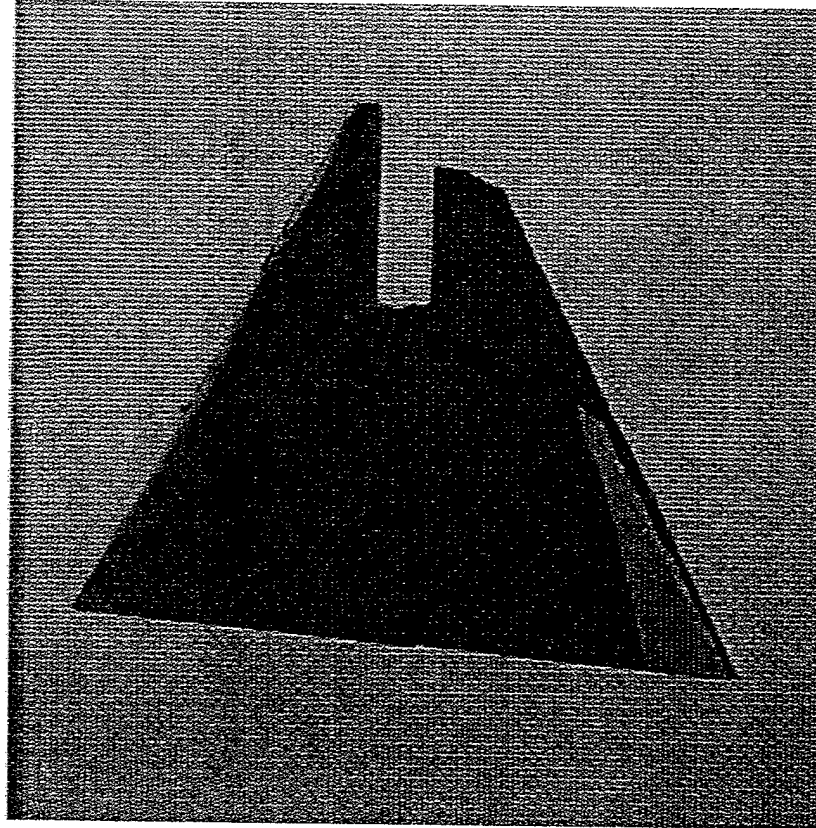
Fringe Patterns Near Critical Loci at Fin Tip



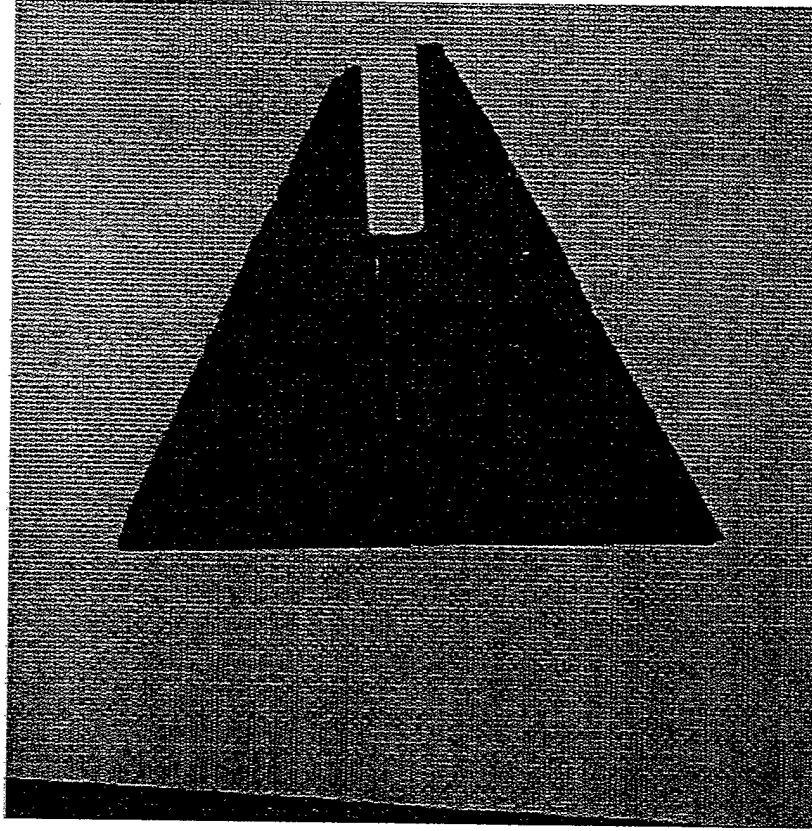
Contour Plot of Stress σ_{yy} (No Crack)



Two-Dimensional Crack Growth Tests

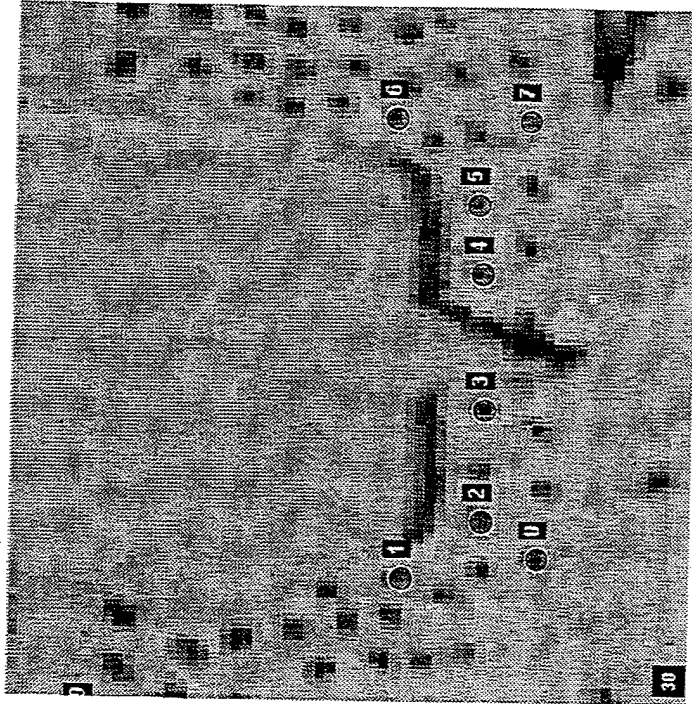
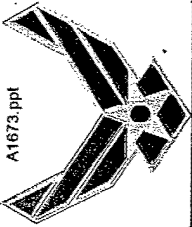


A



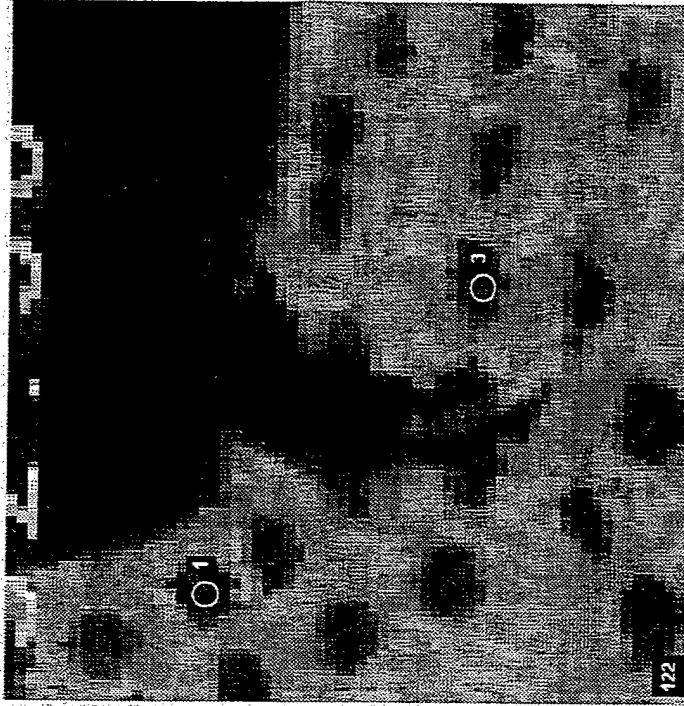
B

Two-Dimensional Crack Growth Tests



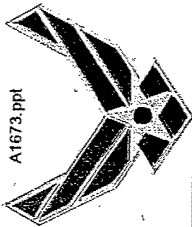
A

Crack initiated at the center of the fin



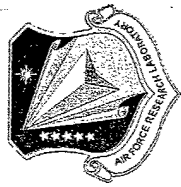
B

Crack initiated at the corner of the fin



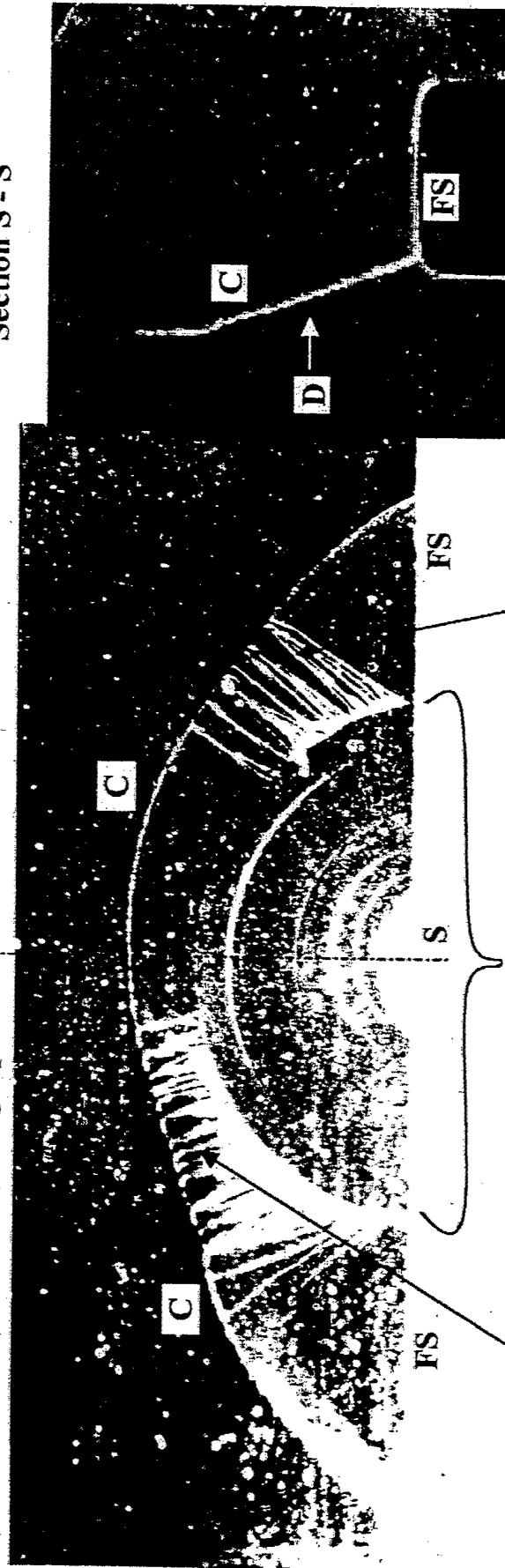
A1673.ppt

Typical Off-Axis Inclined Crack Which is Perpendicular to the Fin Surface



D - camera view of the photograph

S



Section S - S

Eliminating shear mode

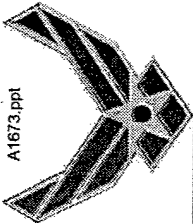
Starter crack

Eliminating shear mode

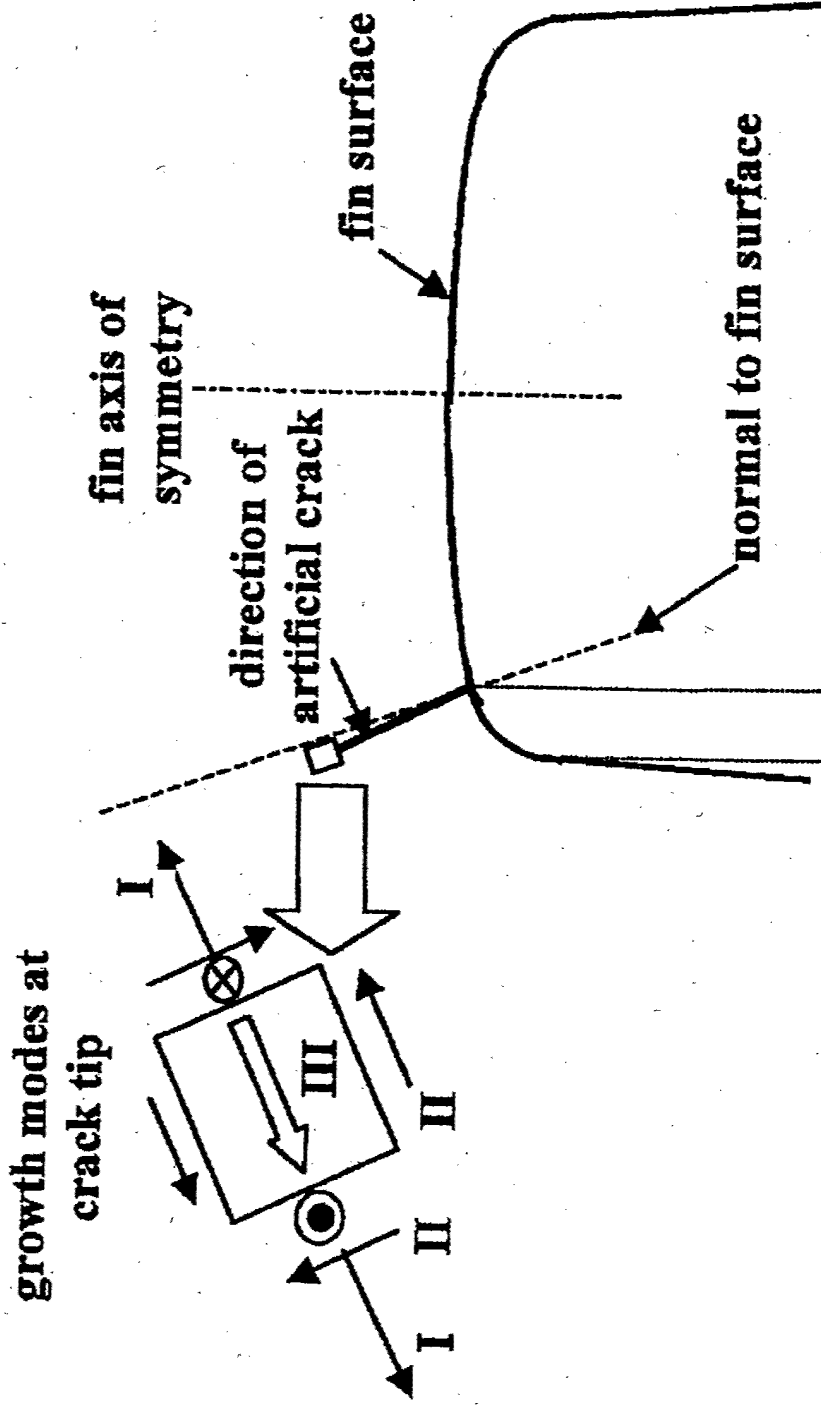
FS - fin surface

C - crack front

magnification factor 3.68



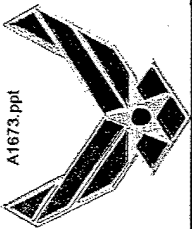
Stress Distribution at Crack Tip



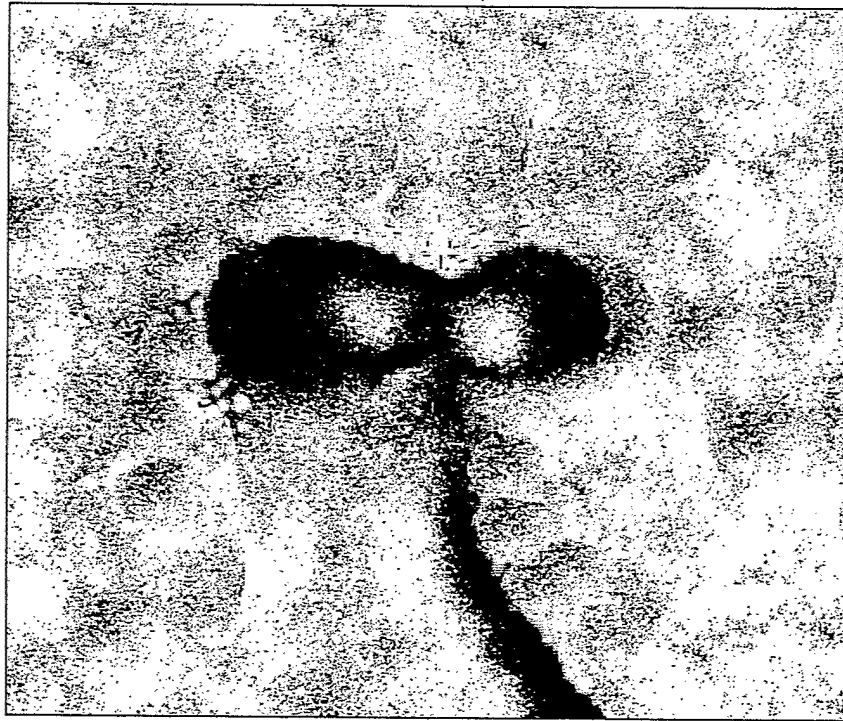
I = Normal Stress (Mode I)

II = In-Plane Shear (Mode II)

III = Out-of-Plane Shear (Mode III)



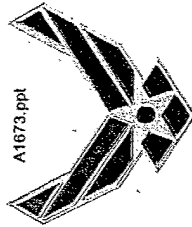
Photoelastic Fringe Patterns



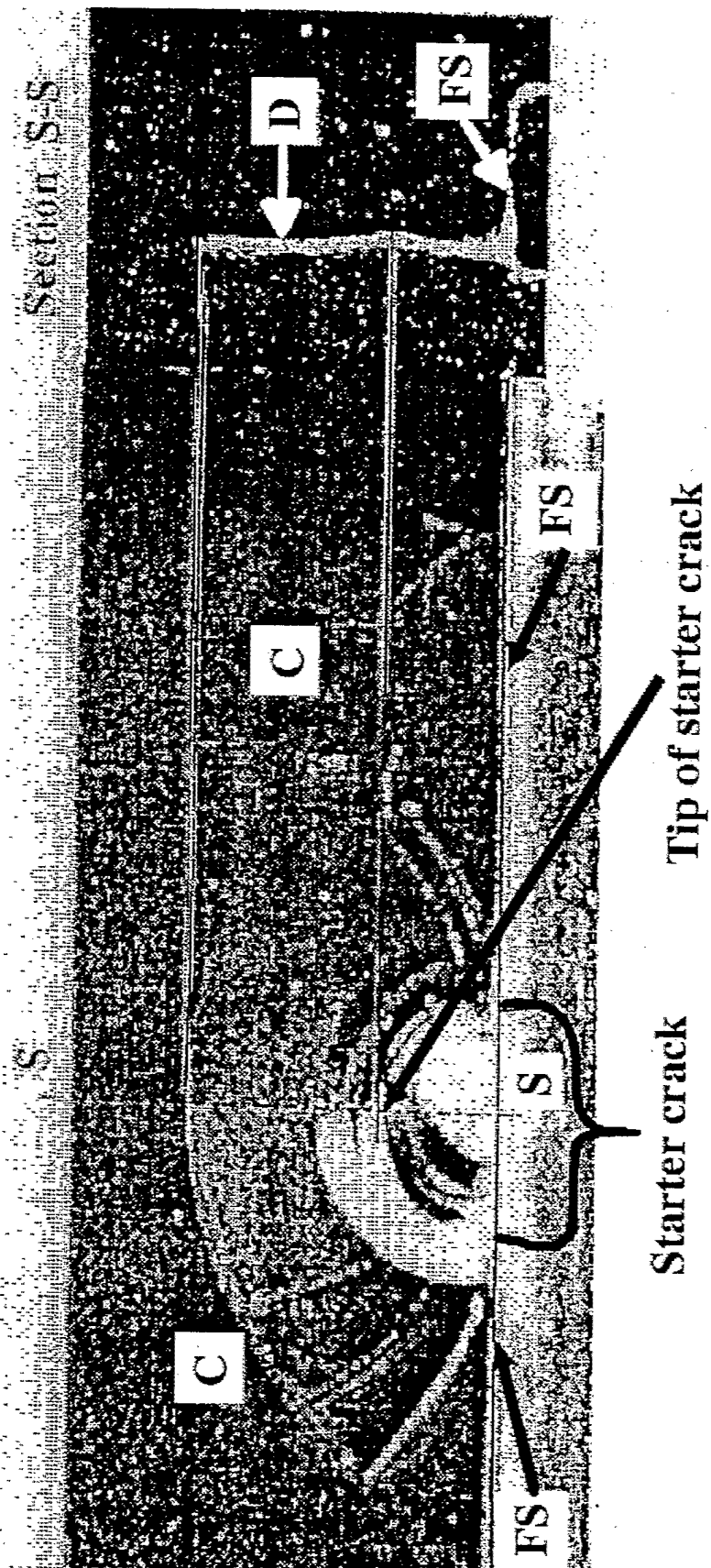
**Crack Turning
Completed**



**Crack Turning
Incomplete**



Typical Off-Axis Straight Crack Which is Parallel to the Fin Axis

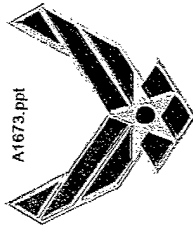


Fin surface

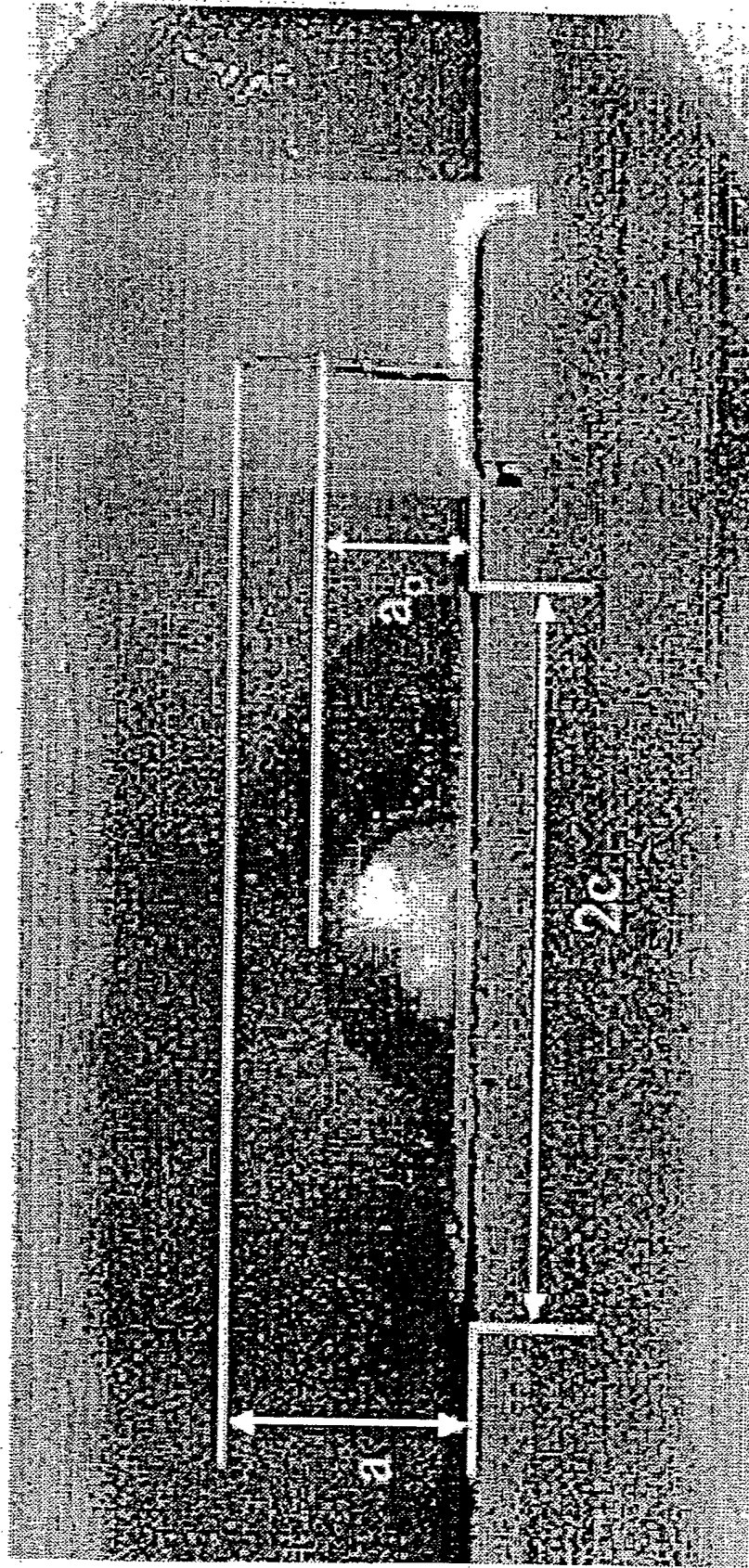
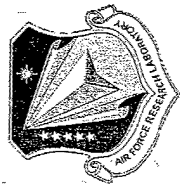
C - crack front

D - camera view of the photograph

Magnification factor: 1.73

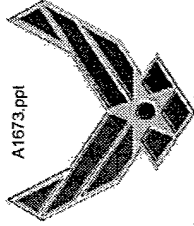


Typical Symmetric Crack Which is Near the Fin Axis



a_0 - initial crack
 a - final crack

M.F. 2.52



Conclusions:



- When the crack is perpendicular to the fin surface, a significant three-dimensional effect occurs during crack turning.
- During crack turning, normal mode (Mode I) and shear modes (Mode II and Mode III) are developed at the crack tip.
- After the crack turning process is completed, the crack grows under normal mode (Mode I loading).
- When the crack is parallel to the fin axis, there is no crack turning observed and the crack grows under normal mode only.
- Crack turning induces a significant reduction in crack growth rate.