

AD/A-000 688

INDEX TO WATERVLIET ARSENAL TECHNICAL
REPORTS, 1973

E. Losee, et al

Watervliet Arsenal

Prepared for:

Army Armament Command

September 1973

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER WVT-SP-74044	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) INDEX TO WATERVLIET ARSENAL TECHNICAL REPORTS, 1973		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) E. Losee A. Behn		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Armament Command Rock Island, Illinois 61201		12. REPORT DATE September 1974
		13. NUMBER OF PAGES 64
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This is a compilation of memorandum and technical reports issued during 1973.		

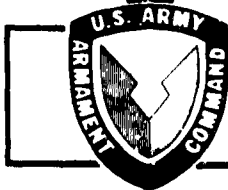
WVT-SP-74044

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E. LOSEE

A. BEHN



BENET WEAPONS LABORATORY
WATERVLIET ARSENAL
WATERVLIET, N.Y. 12189

SEPTEMBER 1973

TECHNICAL REPORT

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R-WV-T-6-20-73
R-WV-T-6-42-73 *

Ultrasonic Tests

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Vibration

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R-WV-T-6-22-73
R-WV-T-6-12-73
R-WV-T-X-4-73
R-WV-T-6-13-73 *
R-WV-T-2-14-73
R-WV-T-X-24-73
R-WV-T-X-28-73
R-WV-T-6-50-73

Warning Systems

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Wave Propagation

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Weibull Distribution

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Whiskers (Crystals)

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Winding

R-WV-S-6-38-73

X Ray Diffraction

R-WV-N-6-30-73

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE THE CORRELATION BETWEEN FIRING AND LABORATORY CYCLING FROM STATISTICAL ANALYSIS OF GUN BARREL FATIGUE DATA			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) R. L. Racicot R. R. Fuczak J. F. Throop T. E. Davidson			
6. REPORT DATE June 1973		7a. TOTAL NO. OF PAGES 70	7b. NO. OF REFS 6
8a. CONTRACT OR GRANT NO. AMCMS No. 61101.11.84400.02		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-1-1-73	
b. PROJECT NO. DA Project No. 1T061101A91A		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-912 916L	
c. Pron No. A1-3-50013-03-M7-M7			
d.			
10. DISTRIBUTION STATEMENT Distribution limited to U.S. Gov't. agencies only; (Test and Evaluation). Requests for this document must be referred to: Watervliet Arsenal, ATTN: SWEWV-RDR-ME, Watervliet, N.Y. 12189			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
13. ABSTRACT Fatigue test results from cannon tubes fired to failure, tubes alternately fired and laboratory cycled to failure, tubes fired and subsequently laboratory cycled to failure and tubes laboratory cycled only to failure are analyzed. Point estimates and confidence intervals on the correlation factor k in the expression $X = \text{Rounds} + k(\text{cycles})$ are determined, assuming a lognormal distribution law for the random variable X, the fatigue life expressed in fired rounds, and using Bayesian methods for obtaining confidence limits.			

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Security Classification

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(Security Classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
3. REPORT TITLE EFFECT OF CARBONACEOUS GAS ENVIRONMENT ON THE CORROSION OF AISI-4330 HIGH STRENGTH STEEL		2b. GROUP	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Fumihiko Saegusa			
6. REPORT DATE January 1973	7a. TOTAL NO. OF PAGES 36	7b. NO. OF REFS 15	
8a. CONTRACT OR GRANT NO. AMCNS No. 502E.11.29400 PROJECT NO DA Project No. 1T062105A328		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-X-02-73	
		9b. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-758 848	
10. DISTRIBUTION STATEMENT Approved for public release; Distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U. S. Army Weapons Command	
13. ABSTRACT Corrosion of high strength steel in gaseous environment is largely divided in two areas, high temperature oxidation and stress corrosion cracking at lower temperatures. High temperature oxidation of the 4330 steel was conducted in CO-CO ₂ mixtures up to 1300°C. The reaction includes decarburization, internal and external oxidation depending on the composition of the gas mixture and temperature. Cracks were observed after the stage of internal oxidation. Stress corrosion test revealed that the 4330 steel is susceptible to stress corrosion cracking in CO-CO ₂ in the presence of moisture. The cracking is transgranular and appears to involve hydrogen embrittlement at the crack tip.			

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
3. REPORT TITLE HI-RATE LOADING OF BARRELS		2b. GROUP	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates, Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) J. D. Vasilakis			
6. REPORT DATE January 1973		7a. TOTAL NO. OF PAGES 76	7b. NO. OF REFS 6
8a. CONTRACT OR GRANT NO. AMGMS No. 5520.11.80700.01.05		8b. ORIGINATOR'S REPORT NUMBER (RIS) R-WV-T-1-3-73	
b. PROJECT NO. DA Project No. 1J562604A607		9. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-758 846	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY AC U.S. Army Weapons Command	
13. ABSTRACT An experimental test facility has been developed to simulate to a certain degree in a laboratory the loading and thermal environment experienced by gun barrels in automatic weapons. The test facility is capable of pressurizing hollow thick-wall cylinders cyclically at a rate of 550-600 cycles per minute and at pressures of 3500 kg/cm ² . The rise time of the pressure pulse is less than 1 millisecond (strain rates of about 3/second) and test temperatures are 260°C, 538°C and 815°C. Temperature is held constant during the test. An automatic air driven hammer is used as the energy source to provide the cyclic loads and a solid loading medium is used to transmit pressures in the specimen. This report discusses the background of the program, the development of the apparatus and the results to date. The facility was initially designed and built to test potential gun barrel materials and configurations. Currently being tested are specimens fabricated from CG27, Udimet 700, and conventional Cr-Mo-V steel.			

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE SIMPLE THICKNESS MODES FOR LAMINATED COMPOSITE MATERIALS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) C. E. Thomas			
6. REPORT DATE January 1975		7a. TOTAL NO. OF PAGES 25	7b. NO. OF REFS 10
8a. CONTRACT OR GRANT NO. DA Project No. 501B-11-55000		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-X-4-73	
9. PROJECT NO. DA Project No. D00-1102A350		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-756 818	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES Reprint from Journal of Sound & Vibration 1973, 25(3)541-561		12. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
13. ABSTRACT The simple thickness modes for laminated media with layering both parallel and perpendicular to the plate free surfaces are studied according to the "effective stiffness" theory and the results obtained are compared to results found from the "effective modulus" theory. The importance and effects of the number of layer pairs for layering parallel to free surfaces and of the ratio of plate thickness to the thickness of a layer pair for layering perpendicular to free surfaces on dimensionless "effective stiffness" frequencies are considered. The various "effective stiffness" and "effective modulus" frequency equations have been solved for a stiff matrix-stiff reinforcing layer material and for a soft matrix-stiff reinforcing layer material; the results are presented in graphs depicting the variation of dimensionless frequency with changes in dimensionless thickness ratio. For a small number of layers parallel to the free surfaces and for small values of thickness ratio, γ , for layering perpendicular to the free surfaces, the microstructure effects included in the "effective stiffness" theory become dominant and the resulting modes differ considerably from the corresponding "effective modulus" theory modes. However, for a large number of layers parallel to the free surfaces and for large values of thickness ratio, γ , for layering perpendicular to the free surfaces, the "effective modulus" theory gives results in excellent agreement with the "effective stiffness" theory.			
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1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2A. REPORT SECURITY CLASSIFICATION Unclassified	
2B. GROUP			
3. REPORT TITLE ARTILLERY PRIMER FOR SEPARATE LOADED CANNON			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Herman J. Reepmeyer			
6. REPORT DATE January 1973		7B. TOTAL NO. OF PAGES 36	7C. NO. OF REFS -
8A. CONTRACT OR GRANT NO. AMCMS No. 552C.11.22300.02 A. PROJECT NO. DA Project No. 1N562603A004 C. D.		9A. ORIGINATOR'S REPORT NUMBER(S) R-WV-S-3-5-73	
		9B. OTHER REPORT NUMBER (Any other numbers that may be assigned this report) AD-909 164L	
10. DISTRIBUTION STATEMENT Distribution limited to U.S. Gov't agencies only; (Test and Evaluation). Requests for this document must be referred to: Watervliet Arsenal, ATTN: SWEWV-RDT-EP, Watervliet, N.Y. 12189			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
13. ABSTRACT A series of tests were conducted to determine the most feasible configuration for an artillery primer that would be suitable for both hand and automatic feeding. Various fillers were also tested to obtain an optimum ignition train. Because of their interrelation, various firing mechanism characteristics were considered, with a more compatible cannon initiator (firing unit) - propellant ignition train interface being achieved.			

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1 NOV 66

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Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified.

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2b. GROUP			
3. REPORT TITLE A MODIFIED COLLOCATION METHOD FOR C-SHAPED SPECIMENS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) M. A. Hussain S. L. Pu W. E. Lorensen D. P. Kendall			
6. REPORT DATE February 1975		7a. TOTAL NO. OF PAGES 29	7b. NO. OF REFS 11
8a. CONTRACT OR GRANT NO. AMCMs No. 611102.11.55D00.01 8. PROJECT NO. DA Project No. 1F061102A35D		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-X-6-75	
		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-758 849	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
13. ABSTRACT The stress intensity factor for a thick-walled cylindrical section with a straight, radial crack has been obtained by a modified boundary collocation method. The results obtained by this method are in good agreement with previously obtained experimental results. The application of this method to other component configurations can give an accurate K-calibration.			

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Security Classification

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2. REPORT TITLE MINIMUM EFFECTIVE COST DESIGN OF COMPOSITE CYLINDRICAL PRESSURE VESSELS RELATED TO GUN TUBES			
3. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
4. AUTHOR(S) (Last name, middle initial, first name) Lawrence V. Meisel			
5. REPORT DATE February 1973		7a. TOTAL NO. OF PAGES 22	7b. NO. OF REFS 2
6a. CONTRACT OR GRANT NO. AMCMS No. 3297.16.6681		8a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-1-7-73	
6. PROJECT NO.		8b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-758 847	
10. DISTRIBUTION STATEMENT Approved for public release: Distribution Unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U. S. Army Weapons Command	
13. ABSTRACT The dimensions of a composite gun tube consisting of a cylindrical liner and a cylindrical jacket of dissimilar materials necessary to endure given internal pressures are determined theoretically. The dimensions are optimized with respect to effective cost which is defined in terms of both material cost and cost per pound of weight to the external system (penalty factor) within constraints imposed on the stress levels reached in liner and jacket through a yielding criterion. Results are presented for a steel liner - glass epoxy jacket composite tube for a variety of costs per pound to the external system. Comparisons are made with respect to minimum weight design and conventional tube designs.			

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1 NOV 66 1470

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DOCUMENT CONTROL DATA - R & D

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1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION	
Watervliet Arsenal Watervliet, N.Y. 12189		<u>Unclassified</u>	
2b. GROUP			
3. REPORT TITLE			
A COUPLE-STRESS THEORY FOR LAMINATED MEDIA			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
<u>Technical Report</u>			
5. AUTHOR(S) (First name, middle initial, last name)			
Charles R. Thomas			
6. REPORT DATE		7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
February 1973		35	10
8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S)	
AMCMS No. 501B.11.35000		R-WV-T-X-8-73	
b. PROJECT NO.		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
DA Project No. 1F061102A35D		AD-759 333	
10. DISTRIBUTION STATEMENT			
Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
		U. S. Army Weapons Command	
13. ABSTRACT			
A derivation of a couple-stress theory for a laminated medium is developed in detail. Simple thickness modes are used to show the relationship of the theory to a corresponding effective modulus theory. Simple wave propagation problems are used to show when the new theory is dispersive in nature.			

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1 NOV 68

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(Security Classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION	
Watervliet Arsenal Watervliet, N.Y. 12189		Unclassified	
2b. GROUP			
3. REPORT TITLE			
A TECHNIQUE FOR WEIGHING A SINGLE WHISKER			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
Technical Report			
5. AUTHOR(S) (First name, middle initial, last name)			
R. A. Warchak, K. E. Loomis, and I. Ahmad			
6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS	
February 1973	9	3	
8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S)	
AMCMS No. 501B.11.85500.02		R-WV-N-6-9-73	
b. PROJECT NO.		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
DA Project No. 1T061102B32A		AD-756 817	
c.			
d.			
10. DISTRIBUTION STATEMENT			
Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
Reprinted from Chemical Instrumentation, 4(2), pp. 115-120 (1972)		U. S. Army Weapons Command	
13. ABSTRACT			
A simple technique to determine the mass and density of extremely small-sized specimens.			

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1 NOV 65

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM										
1. REPORT NUMBER M-WV-T-1-10-73	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER										
4. TITLE (and Subtitle) SCALING THE NOZZLE BLAST FROM RECOILLESS RIFLE		5. TYPE OF REPORT & PERIOD COVERED										
		6. PERFORMING ORG. REPORT NUMBER										
7. AUTHOR(s) Y.K. Huang	8. CONTRACT OR GRANT NUMBER(s) AM CMS No. 513-I2.05014.02 DA Project No. IFI63206D050											
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS										
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE February 1973										
		13. NUMBER OF PAGES										
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)										
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE										
16. DISTRIBUTION STATEMENT (of this Report) INTERNAL DISTRIBUTION ONLY												
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)												
18. SUPPLEMENTARY NOTES												
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <table><tr><td>Recoilless Guns</td><td>Similarity and Scaling</td></tr><tr><td>Gas Dynamics</td><td>Gun Firing</td></tr><tr><td>Nonsteady Nozzle Flow</td><td>Transition Ballistics</td></tr><tr><td>Shock Waves</td><td>Nozzle Blast</td></tr><tr><td>High Pressure</td><td></td></tr></table>			Recoilless Guns	Similarity and Scaling	Gas Dynamics	Gun Firing	Nonsteady Nozzle Flow	Transition Ballistics	Shock Waves	Nozzle Blast	High Pressure	
Recoilless Guns	Similarity and Scaling											
Gas Dynamics	Gun Firing											
Nonsteady Nozzle Flow	Transition Ballistics											
Shock Waves	Nozzle Blast											
High Pressure												
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <p>This is a summary report of the investigation performed for a recent task concerning recoilless rifle nozzle blast. On the basis of plane and spherical blast waves, scaling formulas are derived for evaluating the distribution of peak pressures along the gun axis and at some slant distances. Basic input data are those as given by the breech pressure, nozzle expansion ratio, and firing duration. Calculations of this investigation are straightforward and self consistent.</p>												

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Security Classification

DOCUMENT CONTROL DATA - R & D

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1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION	
Watervliet Arsenal Watervliet, N.Y. 12189		Unclassified	
2b. GROUP			
3. REPORT TITLE			
AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF THE STRESS FIELD IN AN ANNULAR FINNED HOLLOW TUBE			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
Technical Report			
5. AUTHOR(S) (First name, middle initial, last name)			
G. A. Pflegl G. C. Carofano			
6. REPORT DATE		7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
June 1973		157	9
8a. CONTRACT OR GRANT NO.		8b. ORIGINATOR'S REPORT NUMBER(S)	
AMCMS No. 552C.11.22503.01		R-WV-T-1-11-73	
b. PROJECT NO.		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
DA Project No. 1W562603A00503		AD-914 214L	
c.			
d.			
10. DISTRIBUTION STATEMENT			
Distribution limited to U.S. Gov't agencies only; (Test and Evaluation). Requests for this document must be referred to: Watervliet Arsenal, ATTN: SWEWV-RDR-AMM, Watervliet, N.Y. 12189			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
		U.S. Army Weapons Command	
13. ABSTRACT			
The stress field in a hollow tube with annular fins integrally machined on its outer surface was determined by the finite-element technique (NASTRAN) and an approximate one-dimensional model. Some previously unreported experimental photoelastic results are also presented and good agreement is shown between all three methods. Two FORTRAN program listings are included.			

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DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE INFANTRY SUPPORT WEAPONS SYSTEM TECHNOLOGY (PROJECT DES-VAL) A REVIEW OF MATHEMATICAL MODELS RELEVANT TO AUTOMATIC WEAPONS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Thomas F. Stinkins Maurice A. Scavullo John D. Vasilakis and Garry L. Carofano Ronald L. Racicot			
6. REPORT DATE March 1973		7a. TOTAL NO. OF PAGES 159	7b. NO. OF REFS 55
7a. CONTRACT OR GRANT NO. ANMMS No. 5520.11.22507		8a. PROJECT NO. DA Project No. 1W56.603A005	
		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-12-73	
		8c. OTHER REPORT NO(S) (Any other numbers that may be assigned (this report)) AD-761 103	
9. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
10. SUPPLEMENTARY NOTES		11. SPONSORING MILITARY ACTIVITY U. S. Army Weapons Command	
12. ABSTRACT The principal effort of the math-modeling portion of Project DES-VAL (Design Evaluation of 20-40mm Gun Systems) was in establishing an up-to-date knowledge of existing computer models of automatic weapons. Included in this report is a listing of approximately four hundred documents surveyed for relevance in five separate categories, i.e., Dynamics, Vibration, Stress, Heat Transfer, Reliability, and Math-Modeling. A brief account is given of the general course of math-modeling including recommendations for future work.			

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2. REPORT TITLE DYNAMIC STRESS INTENSITY FACTOR FOR AN UNBOUNDED PLATE HAVING COLLINEAR CRACKS			
3. AUTHOR(S) (First name, middle initial, last name) M. A. Hussain S. L. Pu			
4. REPORT DATE March 1973		7a. TOTAL NO. OF PAGES 15	7b. NO. OF REFS 12
5a. CONTRACT OR GRANT NO. AMCMS No. 611102.11.35D00.01		5b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-13-73	
5. PROJECT NO. DA Project No. 1F061102A35D		5d. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-758 426	
6. PRON NO. EJ-3-ROOO9-EJ-M1			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES Reprinted from Engineering Fracture Mechanics, 1972, Vol. 4, pp. 865-876		12. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
13. ABSTRACT The steady-state vibration of an infinite plate with collinear cracks is considered for low frequency cyclic loading. The formulation of the mixed boundary value problem leads to a dual trigonometric series. The Schwinger's method gives an automatic perturbation scheme. The dynamic stress intensity factor is found to be higher than the corresponding static one. The inertial effect on the stress intensity factor becomes significant only when the frequency of the external load is close to that of the shear wave.			

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1 JUL 68

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified.)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE ON THE STABILITY OF A DEEP BEAM SUBJECTED TO NONCONSERVATIVE AND DISSIPATIVE FORCES			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Gary L. Anderson			
6. REPORT DATE March 1973		7a. TOTAL NO. OF PAGES 48	7b. NO. OF REFS 15
8a. CONTRACT OR GRANT NO. AMCMS No. 611102.11.35D00.01		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-2-14-73	
b. PROJECT NO. DA Project No. 1F06112A35D		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-762 124	
c. Proj No. EJ 5-50040-M7-M7			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
13. ABSTRACT The mode of loss of stability of a hinged-hinged beam subjected to a concentrated, transverse follower force applied at the center of the beam is considered. Due to the nature of the nonconservative applied load, the flexural and torsional deformations of the beam are coupled. The effects of warping rigidity and internal and external damping have been included in the differential equations of motion. The stability problem is solved in an approximate manner by means of an adjoint variational principle. Several graphs are presented to demonstrate the effect of the various damping and rigidity parameters on the value of the flutter load. These results reveal that in the absence of external damping, the value of the flutter load becomes arbitrarily small as the internal damping parameter associated with flexure tends to zero.			

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1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE K CALIBRATION FOR "C" SHAPED FRACTURE TOUGHNESS SPECIMENS OF VARIOUS GEOMETRIES			
4. DESCRIPTIVE NOTES (Type of report and Inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) J. H. Underwood R. D. Scanlon D. P. Kendall			
6. REPORT DATE April 1973		7a. TOTAL NO. OF PAGES 25	7b. NO. OF REFS 8
8a. CONTRACT OR GRANT NO. AMCMS No. S396.OM.6350		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-15-73	
b. PROJECT NO. Pron No. M7-2-P4304		8c. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-761 102	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
13. ABSTRACT Prior collocation results are combined with new collocation data and analyzed using two parameter data approximation methods and fracture mechanics methods. A general K calibration is obtained for "C" shaped specimens which have outer to inner radius ratios, $W = r_2/r_1$, between 1.4 and 1.5. The K calibration for "C" shape specimens is found to depend on the load eccentricity to specimen thickness ratio, x/t , as well as the usual crack depth to specimen thickness ratio, a/t . The K results are presented as tabular and plotted values from a cubic spline surface used to approximate the collocation data and as a polynomial approximation of the collocation data over a more limited range of x/t .			

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1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE A PHENOMENOLOGICAL DESCRIPTION OF CENTRAL BURST FORMATION DURING HYDROSTATIC EXTRUSION			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Joseph Pepe			
6. REPORT DATE May 1973		7a. TOTAL NO. OF PAGES 44	7b. NO. OF REFS 17
8. CONTRACT OR GRANT NO. AMCMS No. 612105.11.29400 PROJECT NO. DA Project No. 1T062105A328 PRON NO. A1-3-PO006-02-AW-M7		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-16-73	
		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-763 201	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U. S. Army Weapons Command	
13. ABSTRACT A detailed metallographic investigation of the phenomenological development of central burst defects during hydrostatic extrusion was conducted. The characteristic extrusion pressure versus billet-displacement curve of extrusions containing center burst defects was periodic; each periodic segment consisted of a constant pressure part during which the extrusion velocity was slow followed by a decreasing pressure part during which the extrusion velocity was rapid. It was established that during the part of the cycle exhibiting slow billet movement, near the billet centerline beyond the end of the die deformation zone, small microcracks formed, linked-up by tensile fracture and formed a rather large cone shaped defect exhibiting little crack opening displacement. During the portion of the periodic cycle exhibiting rapid billet movement, the cone shaped defect developed into a typical central burst defect by shear fracture at the crack tips. It was established that the volume of material immediately behind the rather large cone shaped defect, present in the deforming billet at the end of the slow velocity part of the periodic cycle, behaves as a rigid body thereby forcing the material in the die deformation zone near the die surface to squirt by this rigid body as it moves through the die orifice. The entire central burst defect after the rapid forward billet movement lies beyond the end of the die deformation zone and thus, with further extrusion, the entire cycle can repeat. The squirting action of material past the rigid body was responsible for both the shear fracture near the crack tips and the large crack opening displacement of the central burst defect.			

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1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION <u>Unclassified</u>	
		2b. GROUP	
3. REPORT TITLE FINITE ELEMENT ANALYSIS OF A MUZZLE BRAKE			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle (initial), last name) F. J. John			
6. REPORT DATE May 1973		7a. TOTAL NO. OF PAGES 17	7b. NO. OF REPR
8a. CONTRACT OR GRANT NO. AMCMS No. 662603.11.22300.01 b. PROJECT NO. DA Project No. 1W562603A00401 c. Proj No. A1-3-50002-(02)-M7-M7 d.		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-1-17-73	
		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned (this report)) AD-911 311L	
10. DISTRIBUTION STATEMENT Distribution limited to U.S. Gov't agencies only; (Test and Evaluation). Requests for this document must be referred to: Watervliet Arsenal, ATTN: SWEWV-RDD-SE, Watervliet N.Y. 12189			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
13. ABSTRACT This report describes the stress analysis of a muzzle brake by the finite element method, NASTRAN. The model is described with its constraints and pressure loads, and results given for two different conditions. Results of one analysis are compared with a measured stress to identify the magnitude of pressure loading. Final results include maximum principal and maximum shear stresses with directions of principal stresses.			

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1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2. REPORT NUMBER WHILE LAYER DISTRIBUTION IN A 105MM M137 HOWITZER TUBE		2b. GROUP	
3. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
4. AUTHOR(S) (First name, middle initial, last name) A. Imam I. J. Alix			
5. DATES May 1973	7a. TOTAL NO. OF PAGES 89	7b. NO. OF REFS 15	
6. CONTRACT OR GRANT NO. AMRMS No. 4497.06.7026 PROJECT NO. DA Project No. 667026 Derm-MI-1-25028-01-97-M7		8a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-18-73	
		8b. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-911 915L	
9. DISTRIBUTION STATEMENT Distribution limited to U.S. Gov't agencies only; (Test and Evaluation). Requests for this document must be referred to: Watervliet Arsenal, ATTN: SWEWV-RDS-AE, Watervliet, N.Y. 12189			
10. SUPPLEMENTARY NOTES		11. SPONSORING MILITARY ACTIVITY U.S. Army Weapons Command	
12. ABSTRACT To study the distribution of the heat affected zone in the bore surface of gun tubes, a 105mm M137 howitzer fired tube was examined. Twelve sections along the length of the tube were obtained, each section being examined at four positions. The distribution of heat affected zone from origin of rifling to about 30 inches beyond seems to support the temperature profile calculations of Nordheim et al ¹¹ , who calculated a bore surface temperature of 1000°C at the origin of rifling and 800°C at about 25 inches beyond. A heat affected zone was observed near the muzzle. This phenomenon appeared to result from friction between the projectile and the bore surface. The literature pertinent to a study of heat affected zone development is reviewed. An attempt is made to interpret the data in terms of the chemical and thermal history of the bore surface.			

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER M-W-T-3-19-73	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) METAL SEAL SYSTEMS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J.D. Vasilakis	8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 552C.11.22300.02 DA Project No. 1W562603A004 Pron No. M1-2-50022-M1-M7	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE November 1973
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) INTERNAL DISTRIBUTION ONLY		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Gun Barrels Seals Metal Seals		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report will concern itself with a survey of metal seal literature and will attempt to point out various parameters of interest in the design and testing of metal seals for weapon systems. This will include: (1) experimental metal seal programs; (2) contact problems; and (3) surface topography.		

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1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2b. GROUP			
3. REPORT TITLE HYDROSTATIC PRESSURE INDUCED DUCTILITY TRANSITIONS IN PURE BISMUTH AND TIN-BISMUTH ALLOYS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) P. J. Dembowski J. Pepe T. E. Davidson			
6. PERIODIC DATE June 1973	7a. TOTAL NO OF PAGES 46	7b. NO OF REFS 21	
8. CONTRACT OR GRANT NO. AMMS No. 611102.11.85100.01 PROJECT NO. BY Project No. 1F061102B11A08 Prog No. A1-3-50911-M1-M7		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-20-73	
		9b. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-764 241	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U. S. Army Weapons Command	

ABSTRACT

The mechanical behavior of pure (99.999%) bismuth and tin-bismuth alloy of various compositions has been observed over a range of superimposed hydrostatic pressures. Results indicate that maxima in ductility (as measured by percent reduction in area at the fracture surface) in specimens tested at atmospheric pressure occur at compositions bordering pure tin and the eutectic composition. At sufficiently high pressures all compositions failed by rupture, i.e. necking to virtually 100% RA. For pure bismuth, pressure was observed to retard failure due to the formation of cracks at twin-slip boundary intersections; this result was consistent with the hypothesis that the effect of pressure is to shift the mode of crack propagation by decreasing the normal tensile component of stress acting on a crack.

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1. REPORT NUMBER M-WV-T-1-21-73	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A METHOD FOR PREDICTING WEAR IN CANNON TUBES FIRING AMMUNITION WITH TITANIUM DIOXIDE WEAR REDUCING ADDITIVE		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) William F. Rosenberger		8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 662603, 11.22300.01 DA Project No. 1W562603A004
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE June 1973
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		16. DECLASSIFICATION/DOWNGRADING SCHEDULE
18. DISTRIBUTION STATEMENT (of this Report) INTERNAL DISTRIBUTION ONLY		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Gun Barrels Titanium Dioxide Wear Wear Rate Propellants Propellant Additive		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A regression analysis is performed to correlate the wear reducing effect of titanium dioxide propellant additive with other weapon characteristics. The amount of reduction in wear is found to be related to projectile muzzle velocity, and an equation is developed which predicts the effect of TiO ₂ on wear in a cannon tube. An existing method for estimating the average wear rate over the life of a weapon is revised to include the effect of TiO ₂ additive. Wear rates computed with the revised method are compared with observed wear for several artillery systems.		

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(Security Classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION	
Watervliet Arsenal Watervliet, N.Y. 12189		Unclassified	
3. REPORT TITLE		2b. GROUP	
RELIABILITY DATA ANALYSIS MODEL			
4. DESCRIPTIVE NOTES (Type of report and Inclusive dates)			
Technical Report			
5. AUTHOR(S) (First name, middle initial, last name)			
R. Racicot			
6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS	
July 1973	89	20	
8a. CONTRACT OR GRANT NO.	8b. ORIGINATOR'S REPORT NUMBER(S)		
AMCMS No. 611102.11.85300.01	R-WV-T-6-22-73		
9. PROJECT NO.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)		
DA Project No. 1F061102B14A	AD-765 481/7		
10. DISTRIBUTION STATEMENT			
Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
		U. S. Army Weapons Command	
13. ABSTRACT			
<p>A computer model has been prepared to assist in the analysis of reliability test data. Essentially, the model computes point estimates and confidence limits for mission reliability of components, subsystems, and systems from component failure data. The main features of the model are: 1. Performs goodness-of-fit tests to determine the best fit probability distribution of component failure times, 2. Computes maximum likelihood estimates of distribution parameters, 3. Computes point estimates of reliability for the renewal nonconstant failure rate case, and 4. Computes lower confidence limits for component, subsystem, and system reliability for the constant failure rate case.</p>			

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1. REPORT NUMBER M-WV-T-1-23-73	2. JOINT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) STUDY OF FLUTED CHAMBERS FOR 20MM AUTOMATIC GUN, M139		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. Perko D. Costantino		8. CONTRACT OR GRANT NUMBER(s) AMCRS No. 554E-12-283.00.01 DA Project No. 1X654604D258 Fron No. 63-2-92001-(01)-63-H
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE July 1973
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) INTERNAL DISTRIBUTION ONLY		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Gun Barrels Automatic Weapons Cartridge Case Extraction Failure Barrel Chambers Ammunition Lubricators Extraction Automatic Guns (Ordnance)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The tendency of the Automatic Gun, 20mm, M138, to fail to extract the first round of an attempted burst was eliminated by the addition of an automatic ammunition lubricator. However, problems of space limitation arose which were subsequently solved by eliminating the lubricator and using M139 barrels with fluted chambers instead. Tests of three such barrels demonstrated that the use of fluted chambers completely eliminated the failure-to-extract-a-fired-case malfunctions.		

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1. ORIGINATING ACTIVITY (Corporate author): Aeroviet Arsenal Aeroviet, N.Y.		2a. REPORT SECURITY CLASSIFICATION Unclassified	
3. TITLE EFFECTIVE STIFFNESS FLEXURAL VIBRATIONS OF SIMPLY SUPPORTED RECTANGULAR PLATES WITH VELOCITY CORRECTION		2b. GROUP	
4. REPORT TYPE AND DATES COVERED Technical Report			
5. AUTHOR (Last name, first name, middle initial, last name) Charles R. Thomas			
6. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Aeroviet Arsenal Aeroviet, N.Y. 143-3-50040-03-M7-M7	7a. TOTAL NO OF PAGES 64	7b. NO OF REFS 7	
8. CONTRACT OR GRANT NUMBER(S) 611102.11.35D00.01 1F0611102A53D	9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-X-24-73		
9b. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-768 089/5			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U. S. Army Weapons Command	
13. ABSTRACT The previously developed velocity corrected effective stiffness or micro-plate theory is utilized to study the flexural vibrations of simply supported rectangular plates and comparisons are made to an effective modulus plate theory. In each case frequency equations for simply supported edges are developed by passing solutions harmonic in both length and width through the differential equations while automatically satisfying the conditions for simple supports. Careful consideration is given to the variations of dimensionless frequency with such dimensionless parameters as width-to-thickness ratio, number of layer pairs, density ratio, thickness ratio, length-to-length ratio, and elastic ratio and such results are discussed graphically.			

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1. REPORT NUMBER M-WV-T-1-25-73	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) 30MM HIGH PRESSURE BARREL STUDY		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. Perko	8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 552C. 11.22507.04.02 DA Project No. 1W562603A005 Pron No. M1-2-67063-02-M2-M7	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARW-RDT		10. PROGRAM ELEMENT PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE August 1973
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) INTERNAL DISTRIBUTION ONLY		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Automatic Weapons Autofrettaged Gun Barrels Fabrication High Temperature Steel Materials Wall Thickness Ratios Gun Barrels		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A study of the feasibility of designing high pressure (70 to 100 ksi) barrels for rapid fire weapons was initiated. Pressure-travel curves for 30mm barrels at 100 ksi and muzzle velocities in the range of 2800 to 4400 fps were plotted. Wall ratios and thicknesses for barrels operating at bulk temperatures of 500°F, 700°F, and 900°F and 100ksi were computed.		

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1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2. REPORT TITLE A RELATIVE OPTIMIZATION OF CANTILEVER FULLER BEAMS WITH EXAMPLE FOR HAUGER'S PROBLEM		2b. GROUP	
3. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
4. AUTHOR (Last name, middle initial, first name) Charles R. Thomas			
6. PERIOD DATE August 1973	7a. TOTAL NO. OF PAGES 50	7b. NO. OF REFS 8	
8a. CONTRACT OR GRANT NO. AMCNR No. 641101.11.84400.02		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-7-6-26-73	
9. PROJECT NO. DTIC Project No. 1T061101A91A		8c. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-768 087/9	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U. S. Army Armament Command	
13. ABSTRACT A relative optimization of a generalized non-dimensional form of the cantilevered fuller beam is accomplished by the application of an adjoint variational principle in conjunction with a generalized Ritz procedure. Considerable weight reductions are shown to be possible within the bounds of imposed constraints for a two term Ritz approximation of Hauger's problem.			

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1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2. REPORT TITLE ADJOINT VARIATIONAL PRINCIPLES FOR COUPLED THERMOMECHANICAL SYSTEMS AND APPLICATION TO DYNAMIC STABILITY PROBLEMS		2b. GROUP	
3. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Julian J. Wu			
6. REPORT DATE August 1973		7a. TOTAL NO. OF PAGES 18	7b. NO. OF REFS 12
8a. CONTRACT OR GRANT NO. AMCMS No. 672703.11. 249.04		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-2-27-73	
b. PROJECT NO. c. Pron No. A1-3-R0014-01-AW-M7		9b. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-767 260/3	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U. S. Army Armament Command	
13. ABSTRACT In conjunction with the differential equations of coupled thermoelasticity with initial stresses, adjoint variational principles have been formulated in this report by introducing a set of adjoint differential equations. The natural and imposed boundary conditions for the original and the adjoint problems are obtained also with respect to each variational principle. These results can be used as basis for the finite element or other Ritz type of approximations to solve dynamic stability problems with nonconservative loads.			

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

3 ORIGINATING ACTIVITY (Corporate auth. nr) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
7 REPORT TITLE EXTENSIONAL VIBRATIONS OF SIMPLY SUPPORTED LAMINATED RECTANGULAR PLATES			
4 DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5 AUTHOR(S) (First name, middle initial, last name) Charles R. Thomas			
8 REPORT DATE August 1973		7a. TOTAL NO. OF PAGES 41	7b. NO. OF REFS 6
9a. CONTRACT OR GRANT NO. AMCMS No. 611102.11.35D00.01 b. PROJECT NO. DA Project No. 1F061102A35D c. Fron No. EJ-3-50040 d.		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-X-28-73 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-768 090/3	
10 DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11 SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U. S. Army Armament Command	
13 ABSTRACT The extensional vibrations of simply supported rectangular plates are considered from the viewpoint of the recently derived "effective stiffness" velocity corrected Sun plate theory by passing solutions harmonic in both plate width and length through the differential equations of motion and boundary conditions such that the boundary conditions for simple supports are automatically satisfied. The results are compared to extensional frequencies for a reduced "effective modulus" velocity corrected Sun plate theory. It is concluded that for extensional vibrations a higher order approximation in going to the plate theory is necessary to bring out the effects of microstructure which are present in the continuum theory.			

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Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified.

1. ORIGINATING ACTIVITY (Corporate author)		7a. REPORT SECURITY CLASSIFICATION	
Watervliet Arsenal Watervliet, N.Y. 12189		Unclassified	
2. TITLE			
STRAIN ENERGY RELEASE RATE FOR A CRACK UNDER COMBINED MODE I AND MODE II			
3. TECHNICAL NOTES (Type of report and inclusive dates)			
Technical Report			
5. AUTHOR(S) (Last name, middle initial, first name)			
M. A. Hussain S. L. Pu		J. H. Underwood	
6. REPORT DATE		7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
August 1975		11	1
8. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S)	
ARMS No. 611102.11.85300.01 PROJECT NO. D. Project No. 1F061102B14A		AD-768 706/4	
9. PERM. STATEMENT		9b. OTHER REPORT NUMBER (Any other numbers that may be assigned this report)	
Approved for public release; distribution unlimited.		AD-768 706/4	
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
		U.S. Army Armament Command	
13. ABSTRACT			
<p>In this paper we have computed the energy release rate for a crack subjected simultaneously to mode I and mode II conditions. The energy was computed using the independent integrals, using the elastic solution of a deflected crack, having a main branch and a propagation branch. The elasticity solution was obtained from the functional integral equations by the process of iterations. This process leads to a point-wise exact solution in the limit as the propagation branch goes to zero. Interestingly enough, the results indicate that the solution in the limit as the propagation branch goes to zero is not the same as the solution with no branch.</p> <p>Using the Griffith-Irwin criterion, incipient paths of propagation of such a crack were obtained from the maximum value of the energy release rate. To check the validity of the results, an experiment, which gives a pure mode II condition at the tip of the crack, was devised. The results were in excellent agreement with the theory. The energy release rate, in parametric form, can be used for any crack subjected to mode I and mode II loading conditions. To the authors' knowledge, such an expression for the energy release rate does not exist in the literature.</p>			

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER M-WV-T-1-30-73	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A COMPARISON OF KRAVITZ'S METHOD FOR PREDICTING MUZZLE VELOCITY AND AN EMPIRICALLY DERIVED REGRESSION EQUATION		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) W. F. Rosenberger		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 663608.12.25600 DA Project No. 1W6636080311 Proj. No. A1-4-R0027-A1-M1
		11. CONTROLLING OFFICE NAME AND ADDRESS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE August 1973
		13. NUMBER OF PAGES
16. DISTRIBUTION STATEMENT (of this Report) INTERNAL DISTRIBUTION ONLY		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Muzzle Velocity Interior Ballistics Cannon Design Gun Barrels		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A study is made of the errors produced when computing muzzle velocity using the Kravitz method of simplified interior ballistics. A regression analysis of existing weapons is also performed to develop an empirically based velocity prediction equation. The errors in estimating muzzle velocity associated with the regression equation are found to be smaller than when using the Kravitz method. The regression equation appears to offer several additional advantages over the Kravitz method.		

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified.)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
3. REPORT TITLE A VARIATIONAL PRINCIPLE FOR SINGULAR INTEGRAL EQUATIONS WITH BOUNDED SOLUTIONS		2b. GROUP	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) M. A. Hissain S. L. Pu			
6. REPORT DATE August 1973		7a. TOTAL NO. OF PAGES 19	7b. NO. OF PAGES 12
8a. CONTRACT OR GRANT NO. AMCMS No. 611102.11.85300.01		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-51-73	
b. PROJECT NO. DA Project No. 1T061102B14A		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-765 944/4	
c. Pron No. A1-4-51702-M1-N7		d.	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES Reprinted from Int. J. Engng Sci, 1973 Vol. 11, pp. 767-781		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT In many boundary value problems involving triple integral equations or triple series relations, it is required to solve a single singular integral equation with constant but unknown limits of integration. In this paper we present a variational method to determine approximately the bounded unknown function, if it exists, together with the unknown limits of integration for a type of such singular integral equations. The method is used to recover the exact solution of an integral equation and is applied to a contact problem in the theory of elasticity which is intractable otherwise.			

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1 NOV 65

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DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
3. REPORT TITLE A COMPARISON OF FLOW AND DEFORMATION THEORIES IN A RADIALLY STRESSED ANNULAR PLATE			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) P. C. T. Chen			
6. REPORT DATE August 1973		7a. TOTAL NO. OF PAGES 9	7b. NO. OF REFS 15
8a. CONTRACT OR GRANT NO. WCMMS 611101.11.84400.02		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-32-73	
9. PROJECT NO. DA Project No. 1T061101A91A Fron No. AI-3-50013-01-M7-M7		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-766 001/2	
10. DISTRIBUTION STATEMENT Approved for public release, distribution unlimited.			
11. SUPPLEMENTARY NOTES Reprinted from Journal of Applied Mechanics March 1973, pp. 283-287		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT Two mathematically consistent solutions to the strains and displacement in a partly plastic, annular plate stressed by internal pressure are obtained according to the deformation theory of Hencky and to the flow theory of Prandtl-Reuss. In both cases, the material is assumed to be elastic, perfectly plastic and obeying the Mises yield condition. It is shown that one solution is expressed in closed form and the other, in terms of simple integrals. A quantitative comparison of two theories is given and the effect of compressibility is discussed.			

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DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE FORBIDDEN Si (442) STRUCTURE FACTOR			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) A. Marcus Gray			
6. REPORT DATE September 1973		7b. TOTAL NO. OF PAGES 14	7c. NO. OF REFS 3
8a. CONTRACT OR GRANT NO. AMCMS No. 611101.11.84400.02		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-N-6-33-75	
b. PROJECT NO. DA Project No. 1T061101A91A		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-768 088/7	
c. Pron No. AI-3-50013-M1-M7			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT A recent measurement by Trucano and Batterman of the forbidden Si (442) x ray structure factor prompted us to calculate this value by using a simple model, previously developed by us, for the electronic charge distribution with parameters determined from a given set of allowed formfactors. For the allowed formfactor experimental values of Raccach et al were used. For $T = 0^\circ\text{K}$ we found $ F(442) = 0.082 + 0.010$, compared to Trucano and Batterman's bond value of $0.089 + 0.007$ converted to $T = 0^\circ\text{K}$.			

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER M-WV-T-1-35-73	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) 105MM M2A1 GUN SN 62203, TUBE SN 60664, MALFUNCTION INVESTIGATION	5. TYPE OF REPORT & PERIOD COVERED	
	6. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) H. Powis	8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 0700.01 Prn No. M1-132002-01-M7-M7	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE September 1973	13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report)	
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report) Distribution limited to U.S. Government Agencies only (Test and Evaluation) September 1973 to September 1978. Other requests for this document must be referred to: Watervliet Arsenal, ATTN: SARWV-RDS-AE, Watervliet, N.Y. 12189		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Gun Barrels Failure Ammunition Damage		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) On 21 June 1972 at 1415 hours a malfunction of 105mm M1A1 tube, SN 60664, Gun SN 62203 occurred at Fort Bragg, N.C. involving "I" Battery, 3rd Battalion, 10th Marines, 2nd Marine Division, FMF, Camp Lejeune, N.C. This report summarizes the investigation performed on the tube and concludes that failure was caused by an in-bore detonation of the projectile.		

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER M-WV-T-1-36-73	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) 175MM GUN M113A1, TUBE SN7101, MALFUNCTION INVESTIGATION		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) H. Powis	8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 4440.15.2226.2.02 Pron No. M7-9-P4095-06-M7-M7	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE September 1973
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Distribution limited to U.S. Government Agencies only (Test and Evaluation) September 1973 to September 1978. Other requests for this document must be referred to: Watervliet Arsenal, ATTN: SARWV-RDS-AE, Watervliet, N.Y. 12189		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary; and identify by block number) Gun Barrels Failure Ammunition Damage		
20. ABSTRACT (Continue on reverse side if necessary; and identify by block number) On 6 February 1972, 175mm Gun M113A1, Tube SN 7101, Breech SN 4970, was involved in a malfunction on the fourth round of a fifty-two round mission in Viet Nam. This report summarizes the investigation and concludes that the failure was due to a premature in-bore explosion of the projectile.		

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER M-WV-T-1-37-73	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) 155MM GUN TUBES, TUBES SN 12537, SN 20919, SN 11965, MALFUNCTION INVESTIGATION		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) H. Powis	8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 0700.1 Peacetime Pron No. M1-1-32002-M7-M7	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SARW-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE September 1973
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Distribution limited to U.S. Government agencies only; (Test and Evaluation); September 1973 to September 1978. Other requests for this document must be referred to: Watervliet Arsenal, ATTN: SARW-RDS-AE, Watervliet, N.Y. 12189		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Gun Barrels Failure Ammunition Damage		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report covers the malfunction investigations of three gun tubes: M1A1 Tube SN 12537, M1A1 Tube SN 11965, and M126E1 Tube SN 20919. The three malfunctions occurred in Viet Nam during May and June of 1970. The report summarizes these investigations and concludes that the tube failures were caused by premature detonation of the projectiles.		

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE STABLE GEODESICS ON SURFACES OF REVOLUTION			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Royce W. Soanes			
6. REPORT DATE October 1973		7a. TOTAL NO. OF PAGES 46	7b. NO. OF REFS 2
8a. CONTRACT OR GRANT NO. AMCMS No. 611101.11.84400.02		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-S-6-38-73	
b. PROJECT NO. DA Project No. 1T061101A91A		9b. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned (to report)) AD-914 682L	
c. Pron No. A1-3-50013-M1-M7		d.	
10. DISTRIBUTION STATEMENT Distribution limited to U.S. Gov't agencies only; (Test and Evaluation). Requests for this document must be referred to: Watervliet Arsenal, ATTN: SARWV-RDR-C, Watervliet, N.Y. 12189.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT A computational scheme is derived for describing stable geodesic curves on surfaces of revolution, where "stable" refers to the particular geodesics along which a flexible filament may be wrapped without lifting from the surface or slipping.			

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1 NOV 65

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47

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Security Classification

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DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE FRACTURE TOUGHNESS AND CRACK GROWTH MEASUREMENTS WITH "C" SHAPED SPECIMENS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) D. P. Kendall J. H. Underwood D. C. Winters			
6. REPORT DATE October 1973		7a. TOTAL NO. OF PAGES 39	7b. NO. OF REFS 9
8a. CONTRACT OR GRANT NO. AMCMS No. 5396.OM.6350		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-39-73	
9. PRONOS. a. M7-2-P4304 c. M7-3-P4539 d.		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-769 605/7	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT A series of "C" shaped fracture toughness specimens from 4330 steel forged cylinders have been tested using the general test procedure recommended by ASTM-E399. A wide range of specimen sizes were tested and no significant size effect on the fracture toughness, as measured by this specimen, was found. Crack growth during fracture toughness tests was measured using an ultrasonic technique. Based on these results and on a compliance analysis, the use of a 5 percent secant offset fracture criterion is recommended for this specimen. Standardized specimen dimensions for utilization of the "C" shaped specimen for testing a variety of thick-walled cylinders are recommended.			

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Unclassified
Security Classification

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE FAILURE PHENOMENA OF SOME FIBER-REINFORCED COMPOSITE STRIPS WITH A HOLE			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
5. AUTHOR(S) (First name, middle initial, last name) Technical Report Y. F. Cheng			
6. REPORT DATE October 1973		7a. TOTAL NO. OF PAGES 25	7b. NO. OF REFS 2
8a. CONTRACT OR GRANT NO. AMCMS No. 612105.11.29900		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-40-73	
b. PROJECT NO. DA Project No. 1T062105A349		8d. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-771 060/1GI	
c.			
d. Pron No. A1-3-R0011-01-AW-M7			
10. DISTRIBUTION STATEMENT Approved for public release, distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT Ten composite strips with a hole (D/W=3/4) were loaded to failure under tension. Failure stresses and strains were compared with the composite ultimate strengths. The results showed that while the hole reduced the composite strength, the effect on strain however depends on the properties of composite components. The strain was reduced in boron-aluminum, but increased in boron-epoxy and in fiberglass-epoxy.			

DD FORM 1473
NOV 68

REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

49

Unclassified
Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
3. REPORT TITLE STRESS CONCENTRATION FACTORS OF SOME FIBER-REINFORCED COMPOSITE STRIPS CONTAINING A HOLE UNDER TENSION OR BENDING		2b. GROUP	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Y. F. Cheng			
6. REPORT DATE October 1973		7a. TOTAL NO. OF PAGES 47	7b. NO. OF PAGES 12
8a. CONTRACT OR GRANT NO. AMCMS No. 612105.11.29900		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-41-73	
b. PROJECT NO. DA Project No. 1T062105A349		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-771 055/1GI	
c. Fron No. A1-3-RO011-01-AW-M7			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT Factors of stress concentration were determined, experimentally and analytically, for boron-aluminum, boron-epoxy and fiberglass-epoxy composite material strips containing a hole under tension or bending. In total, ten combinations of constituent modulus ratio, lamina orientation and fiber volume fraction, and three values of hole diameter to strip width ratio were investigated. Experimental values were obtained by means of electric resistance foil strain gages, and analytical results from the NASTRAN finite element analysis. It appears that stress concentration could be minimized by employing angle ply instead of uniaxial or cross-ply, by reducing constituent modulus ratio, and by adjusting fiber volume fraction. Further work is necessary in order to optimize these parameters.			

DD FORM 1473

REPLACES DD FORM 1473, 1 JAN 66, WHICH IS OBSOLETE FOR ARMY USE.

50

Unclassified

Security Classification

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2. REPORT TITLE NEW TECHNIQUES IN MEASURING PLASTIC STRAIN IN A MEMORY MATERIAL		2b. GROUP	
3. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
4. AUTHOR(S) (First name, middle initial, last name) R. V. Milligan			
5. REPORT DATE October 1973	7a. TOTAL NO. OF PAGES 9	7b. NO. OF REFS 2	
6a. CONTRACT OR GRANT NO. 6b. PROJECT NO. DA Project No. 1F061101A91A 6c. Deron No. A1350013	8a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-42-73		
7. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.		8b. OTHER REPORT NUM (Any other numbers that may be assigned this report) AD-768 497/0	
11. SUPPLEMENTARY NOTES Reprinted from Instrument Society of America, ASI 73239 (187-192), 1973		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT A Nickel-Titanium memory material was studied for the purpose of characterizing its stress-strain behavior, energy absorption capacity, and cyclic response. Instrumentation problems encountered in the testing of this unique material are discussed from the standpoint of thermal recovery effects on strain readings from strain gages and LVDT-type extensometers. Nickel foil type temperature sensors were used to measure surface temperatures from heat generated in the course of plastically straining the material. In addition, the sensors also monitored the heat applied to the specimen to effect thermal recovery from the plastic strain. Temperature-time curves using a strip chart recorder exhibited possible phase changes occurring in the material during thermal recovery after the half cycle of straining.			

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
3. REPORT TITLE ORGANIC MATRIX TOUGHENING ADDITIVES FOR COMPOSITE MATERIALS		2b. GROUP	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Martin S. Ferguson			
6. REPORT DATE November 1973		7a. TOTAL NO. OF PAGES 33	7b. NO. OF REFS 5
8a. CONTRACT OR GRANT NO. AMCMS No. 612105.11.297 XXXXXXXXXX Pron No. A1-3-R0010-02-AW-M7 c.		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-43-73	
d.		8c. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AT-774 373/5GI	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT Toughening of organic matrix material has been shown feasible using precipitated rubber particles as the discontinuous phase in epoxy resins. Physical tests consisted of recording the work required (as a measure of toughness) to separate a cantilevered cleavage specimen of epoxy matrix with and without these particles. Data is also presented from ASTM tensile tests to assess the extent of sacrifice in elastic modulus and ultimate tensile strength caused by the additions. Results are presented for three related epoxy resin systems and three hardeners while holding rubber additions at 0 or 10 ppm resin. Several resins used in filament winding or casting of composites show beneficial increases in toughness.			

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DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION <u>Unclassified</u>	
		2b. GROUP	
3. REPORT TITLE RELATIVE OPTIMIZATION OF HAUGER'S PROBLEM WITH CIRCULAR CROSS-SECTION			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Charles R. Thomas			
6. REPORT DATE October 1973		7a. TOTAL NO. OF PAGES 40	7b. NO. OF REFS 8
8a. CONTRACT OR GRANT NO. AMCMS No. 611101.11.84400.02		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-44-73	
8c. PROJECT NO. DA Project No. 1T061101A91A		8d. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-771 173/361	
8e. PRON NO. Pron No. A1-3-50013-M1-M7			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT A relative optimization of Hauger's problem with a circular cross-section is accomplished by the application of an adjoint variational principle in conjunction with a generalized Ritz procedure. Considerable weight reductions are shown to be possible within the bounds of imposed constraints for a two term Ritz approximation of Hauger's problem. The circular cross-section optimization is shown to yield a relatively lower mass than a corresponding procedure for a rectangular cross-section.			

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2b. GROUP			
3 REPORT TITLE FLEXURE EQUATIONS OF MOTION FOR LAMINATED COMPOSITE BEAMS			
4 DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5 AUTHOR(S) (First name, middle initial, last name) Charles R. Thomas			
6 REPORT DATE October 1973		7a. TOTAL NO. OF PAGES 23	7b. NO. OF REFS 8
8a. CONTRACT OR GRANT NO. AMCMS No. 611102.11.35D00.01		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-45-73	
b. PROJECT NO. DA Project No. 1F061102A35D		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-770 394/5GI	
c. Pron No. EJ-3-50040		d.	
10 DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11 SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13 ABSTRACT With little actual effort and no recourse to new derivations, a flexural theory for laminated composite beams is obtained directly from a reduction of existing flexure equations for composite plates. Results previously developed for plate strips are shown to be directly applicable to beam problems if slight changes are made in the elastic constants.			

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

Watervliet Arsenal
Watervliet, N.Y. 12180

2a. REPORT SECURITY CLASSIFICATION

Unclassified

2b. GROUP

3. REPORT TITLE

DYNAMICS OF ROTATING DEFORMABLE SOLIDS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Technical Report

5. AUTHOR(S) (First name, middle initial, last name)

C. L. Anderson

6. PERIOD DATE

November 1973

7a. TOTAL NO. OF PAGES

98

7b. NO. OF REFS

46

8. CONTRACT OR GRANT NO.

DAAG 29-11-611102.11.35D00.01

9. SUBJECT NO.

Project No. 1F061102A35D

Order No. 1J-3-50040-M1-M7

10. ORIGINATOR'S REPORT NUMBER(S)

R-W-T-2-46-73

11. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

AD-772 943/7GI

12. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

14. SPONSORING MILITARY ACTIVITY

U.S. Army Armament Command

15. ABSTRACT

The kinematics of rotating deformable solids are developed, and a conservation law is postulated. The general equations of motion for a deformable solid rotating about a fixed axis are obtained from this conservation law, which then serves as the theoretical basis for the derivation of suitable beam theories for rotating beams and shafts subjected to conservative and non-conservative loads. The effects of internal and external damping as well as gyroscopic inertial forces are included in the formulation.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER M-WV-T-3-47-73	2. GOVT ACCESSION NO. AD-770 368/9GI	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) CAM PATH DRAWING, AN AUTOMATIC DRAFTING MACHINE APPLICATION		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) V.H. Montuori		8. CONTRACT OR GRANT NUMBER(s) AMCMS No. 4932.06.6824
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 SAEWV-RDT		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE November 1973
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) INTERNAL DISTRIBUTION ONLY		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Automatic Drafting Machine Cam path Drafting FORTRAN		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <p>This is a report on a practical and simple application of an automatic drafting machine. Cam paths normally drawn by hand are now computerized and drawn in less than two hours. A FORTRAN program has been written to cover all types of cam paths drawings.</p>		

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EDITION OF 1 NOV 68 IS OBSOLETE

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE STRESS SINGULARITIES ASSOCIATED WITH A CRACK INCLINED TO A BI-MATERIAL INTERFACE			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) S. L. Pu R. D. Scanlon M. A. Hussain			
6. REPORT DATE November 1973	7a. TOTAL NO. OF PAGES 19	7b. NO. OF REFS 21	
8a. CONTRACT OR GRANT NO. AMRMS No. 501A.11.84400.02		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-18-73	
8c. PROJECT NO. DA Project No. 1T061101a91A		8d. OTHER REPORT NUMBER(S) (Any other numbers that may be assigned this report) AD-770 303/6GI	
9. DISTRIBUTION STATEMENT Approved for public release, distribution unlimited.			
11. SUPPLEMENTARY NOTES Reprinted from Developments in Mechanics, Vol. 7, pp 349-364, Proceedings of the 13th Midwestern Mechanics Conference: 26.		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT In this paper we have investigated the nature of stress singularities associated with a crack inclined to a bimaterial interface, under general loading conditions. The stress singularities were obtained from the eigenvalues of a characteristic equation. Careful study of these results indicated a physical paradox. We could find no angle of inclination of the crack tip to the interface for which the singularity had the same order as that of a crack tip lying in either of the individual materials. The problem was then reformulated incorporating boundary layer effects via couple stress theory. The most dramatic result found was that there are only two possible angles of inclination of a crack to the interface for which the singular stress field of a crack in a homogeneous material could be preserved. This suggests that there are only two possible paths of propagation of a crack as it approaches an interface.			

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DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
2b. GROUP			
3. REPORT TITLE HOW MICROSTRUCTURE INFLUENCES MECHANICAL PROPERTIES OF FORGINGS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) C. J. Nolan T. V. Brassard R. S. DeFries			
6. REPORT DATE November 1973		7a. TOTAL NO. OF PAGES 9	7b. NO. OF REFS 5
8a. CONTRACT OR GRANT NO. AMCMS No. 552D.11.80700.01.03		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-49-73	
b. PROJECT NO. DA Project No. 1J562604A607		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-770 248/3GI	
c. Fron No. B9-2-67030-M2-M7		d.	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES Reprinted from Metals Engineering Quarterly, May 1973		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT A series of laboratory isothermal heat treatments was employed to develop and characterize the low-temperature transformation products or microstructures in large cylindrical forgings for pressure vessels. Tensile properties, hardness, and impact energy transition curves were determined for the various microstructures produced. Of the three microstructures investigated, tempered martensite provided the optimum combination of strength and toughness. The tempered bainite structure developed during isothermal transformation, produced both low yield and impact strengths.			

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DOCUMENT CONTROL DATA - R & D

<i>(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)</i>		
1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified
		2b. GROUP
3. REPORT TITLE A NON-LINEAR FORMULATION OF THE EQUATIONS OF MOTION OF A ROTATING BAR		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report		
5. AUTHOR(S) (First name, middle initial, last name) Gary L. Anderson		
6. REPORT DATE November 1973	7a. TOTAL NO. OF PAGES 30	7b. NO. OF REFS 6
8a. CONTRACT OR GRANT NO. AMCMS No. 611102.11.35D00.01	8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-50-73	
8. PROJECT NO. DA Project No. 1F061102A3SD	8d. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-771 057/3GI	
c. Pron No. EJ-3-50040		
d.		
10. DISTRIBUTION STATEMENT Approved for Public Release; distribution unlimited.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT The non-linear equations of motion of a slender beam rotating at constant angular velocity about a transverse axis are formulated. The state of stress in the bar is assumed to consist of two parts: (i) the initial state of stress associated with the undisturbed "equilibrium" configuration of the rotating bar and (ii) the state of stress associated with the disturbed motion about the configuration of undisturbed "equilibrium." The equations for the equilibrium state and the disturbed motion are separated and linearized, neglecting non-linear terms as well as gradients of initial displacements. As examples of the theory developed, the equations of motion for the longitudinal and flexural deformations of a rotating bar carrying a tip mass are derived. The longitudinal displacement and stress are shown to become unbounded at certain rotational velocities.		

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1 NOV 65

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DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION	
Watervliet Arsenal Watervliet, N.Y. 12189		Unclassified	
3. REPORT TITLE		2b. GROUP	
BAYESIAN INFERENCE ON FUNCTIONS OF THE PARAMETERS OF UNIVARIATE DISTRIBUTIONS USING ESTIMATOR DISTRIBUTION			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
Technical Report			
5. AUTHOR(S) (First name, middle initial, last name)			
Ronald L. Racicot			
6. REPORT DATE		7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
November 1973		25	5
2a. CONTRACT OR GRANT NO.		2a. ORIGINATOR'S REPORT NUMBER(S)	
AMCMS No. 611102.11.85300.01		R-WV-T-6-51-73	
b. PROJECT NO.		2b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
DA Project No. 1T061102B14A		AD-771 953/7GI	
c.			
Pron No. A1-3-50014			
d.			
10. DISTRIBUTION STATEMENT			
Approved for Public Release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
		U.S. Army Armament Command	
13. ABSTRACT			
<p>In the Bayesian approach to determining inferencing information, the likelihood function is often used as the conditional distribution of sample outcome given the population parameters. For the more difficult problems involving quantities which are functions of more than one population parameter, use of the likelihood function can lead to very tedious computations. Computational efficiency can be improved in many instances if the distribution of estimators is used rather than the likelihood function. The use of the estimator distribution in determining Bayesian intervals is discussed with application being made to the Weibull mean. Exactness from a classical frequency viewpoint of the Bayesian intervals assuming uniform priors was also studied.</p>			

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		3a. REPORT SECURITY CLASSIFICATION <u>Unclassified</u>	
		3b. GROUP	
2. REPORT TITLE PHOTOELASTIC STRESS ANALYSIS OF TWO SLIDE BLOCK BREECH DESIGNS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) <u>Technical Report</u>			
5. AUTHOR(S) (First name, middle initial, last name) G. Peter O'Hara			
6. REPORT DATE November 1973		7a. TOTAL NO. OF PAGES 26	7b. NO. OF REFS 3
8a. CONTRACT OR GRANT NO. AMCMS No. 662603.11.22300.01		8b. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-6-52-73	
a. PROJECT NO. DA Project No. 1W562603A004		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-772 942/9GI	
c. Pron No. A1-3-50002-(04)-M7-M7		d.	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT The work presented is an extension of the Watervliet Arsenal Report "Photoelastic Stress Analysis of Conventional and Serrated Slide Block Breech Designs", WVT-6830 by T. F. MacLaughlin. The current work is an analysis of two more possible designs for slide block breeches. The "Open Jaw" design is a possible lightweight configuration and the "90° U" would be useful in some cases where space is limited. The variation of fillet stress along the fillet is reported for all the block cavity fillets along with stresses at other points of interest. The lateral deflection of the sides of the breech ring is also reported.			

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Watervliet Arsenal Watervliet, N.Y. 12189		2a. REPORT SECURITY CLASSIFICATION Unclassified	
3. REPORT TITLE TEMPERATURE MEASUREMENT AND WARNING SYSTEMS		2b. GROUP	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report			
5. AUTHOR(S) (First name, middle initial, last name) Herbert Frankel			
6. REPORT DATE December 1973		7a. TOTAL NO. OF PAGES 23	7b. NO. OF REFS 5
8a. CONTRACT OR GRANT NO. -		9a. ORIGINATOR'S REPORT NUMBER(S) R-WV-T-1-53-73	
b. PROJECT NO. -		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD-772 941/1GI	
c. -		-	
d. -		-	
10. DISTRIBUTION STATEMENT Approved for Public Release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Army Armament Command	
13. ABSTRACT A thermistor varies the frequency of a tiny oscillator mounted on a gun tube. The temperature signal is received 6 inches away. This avoids the breakage of thermocouple wires because of recoil. A thermistor causes a circuit to oscillate when a gun tube reaches 350°F. One wire, fastened to the gun mount instead of the tube, allows a small receiver to warn personnel when the critical temperature is reached.			

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1 NOV 65

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