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INDEX TO BENET WEAPONS LABORATORY (LCWSL)  
TECHNICAL REPORTS - 1979

R. D. Neifeld  
Technical Publications and Editing Unit

September 1980



US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND  
LARGE CALIBER WEAPON SYSTEMS LABORATORY  
BENÉT WEAPONS LABORATORY  
WATERVLIET, N. Y. 12189

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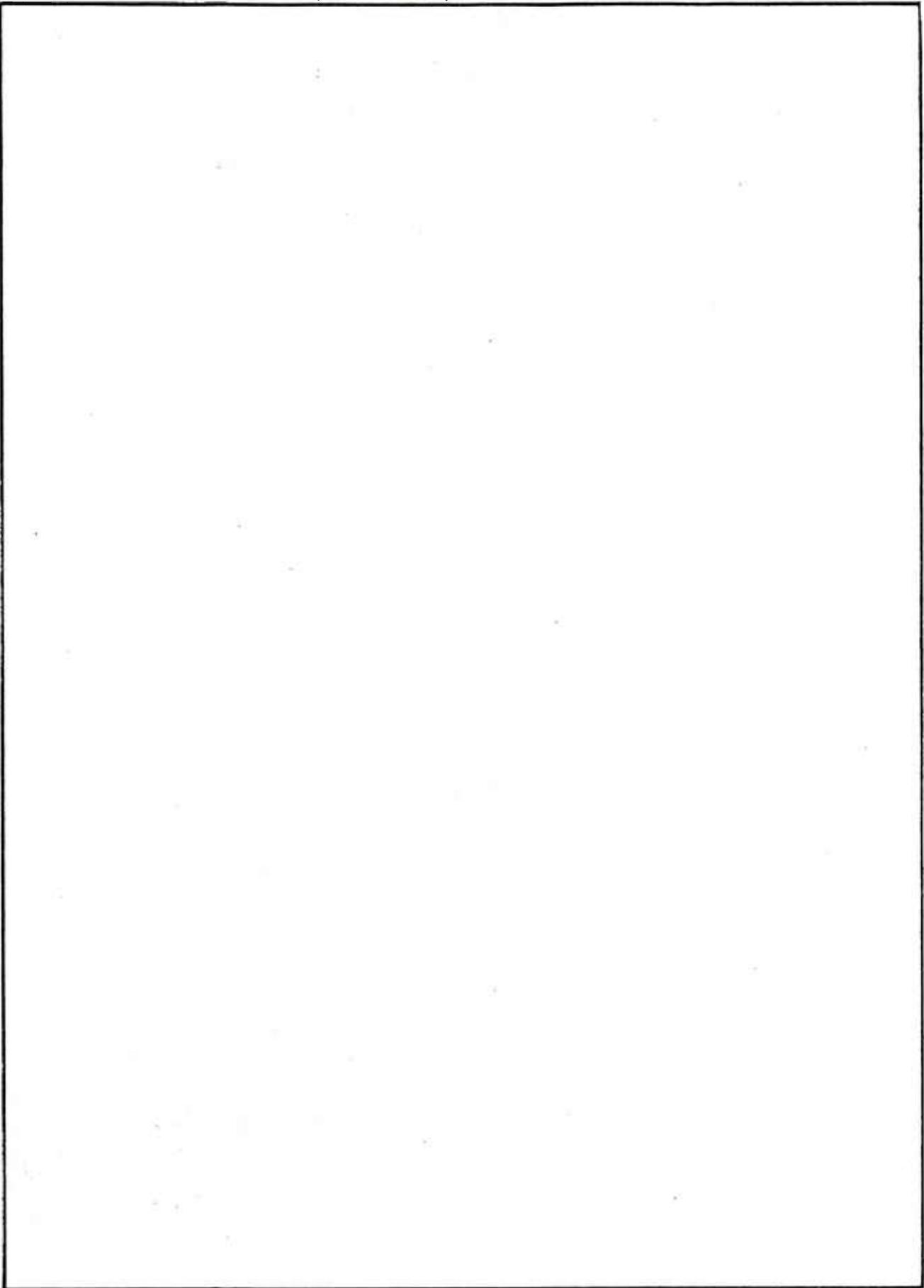
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4. TITLE (and Subtitle)  INDEX TO BENET WEAPONS LABORATORY (LCWSL) TECHNICAL REPORTS - 1979		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  R. D. Neifeld		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TI		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE September 1980
		13. NUMBER OF PAGES 91
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  UNCLASSIFIED
		15e. 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)		
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SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

TABLE OF CONTENTS

	<u>Page</u>
LIST OF REPORTS	1
AUTHOR INDEX	5
SUBJECT INDEX	8
AD NUMBERS	15
ABSTRACTS-REPORT DOCUMENTATION PAGE (DD FORM 1473)	17

TECHNICAL REPORTS 1979

<u>REPORT NUMBER</u>	<u>TITLE</u>	<u>AUTHOR</u>	<u>DATE</u>
ARLCB-TR-79001	Investigation of the Erratic Penetration Performance of the 105MM M735 Round (U)	T.E. Davidson E. Bloore R. Hulbert D.P. Kendall T. Myhre T. DeSisto	May 78
ARLCB-TR-79002	Feasibility Study of 105MM M68 Composite Bore Evacuator	G. D'Andrea R. Cullinan P. Croteau	Apr 79
ARLCB-TR-79003	Automatic Ultrasonic Detection and Measurement of Cracks in Cannon	D.C. Winters	Apr 79
ARLCB-TR-79004	Diamagnetic Anomaly in Pressure Quenched CdS	C.G. Homan D.P. Kendall	May 79
ARLCB-TR-79005	Acoustic Velocity Ratios in Solid Argon at 75 K Up to Static Pressures of 150 Kbar	C.G. Homan J. Frankel D.P. Kendall J.A. Barrett T.E. Davidson	May 79
ARLCB-TR-79006	Magnetic Moment of Pressure Quenched Cadmium Sulfide	C.G. Homan D.P. Kendall R.K. MacCrone	May 79
ARLCB-TR-79007	Cooperative Plane Strain Fracture Toughness Tests with C-Shaped Specimens	J.H. Underwood D.P. Kendall	May 79
ARLCB-TR-79008	The Equivalence of $K_{Ic}$ and $J_{Ic}$ Fracture-Toughness Measurements in NI-CR-MO Steels	J.H. Underwood	May 79
ARLCB-MR-79009	Application of Rapid Heat Treating to Cannon Tubes	P.A. Thornton	Jun 79
ARLCB-MR-79010	Abrasive Machining of Major Components	J. Rodd	May 79
ARLCB-MR-79011	Gun Tube Manufacture by Automation	C. LaRoss	Jun 79

TECHNICAL REPORTS 1979 (CONT.)

<u>REPORT NUMBER</u>	<u>TITLE</u>	<u>AUTHOR</u>	<u>DATE</u>
ARLCB-SP-79012	Index to Benet Weapons Laboratory (LCWSL) Technical Reports - 1978	B. Rahrer	Jun 79
ARLCB-MR-79013	A Short Study of Large Rotary Forged Cylinders	F. Heiser	Jun 79
ARLCB-MR-79014	Application of Electron Beam Welding to Heavy Components	V. Colangelo	Jun 79
ARLCB-MR-79015	Effects of Processing Variables on Erosion of Gun Tubes	J. Passmore	Jun 79
ARLCB-TR-79016	Preliminary Analysis of a Mandrel for 105MM Gun Tube Forgings	M.A. Hussain S.L. Pu J.D. Vasilakis	Jun 79
ARLCB-MR-79017	Corrosion Protection of 416 Stainless Steel Firing Probes	S. Tauscher	Jul 79
ARLCB-TR-79018	Results of the 1978 USAREUR Stargage Survey of 105MM M68 Gun Tubes	R. Campolmi B. Rowekamp	Jun 79
ARLCB-TR-79019	A Computer Program and Approximate Solution Formulation for Gun Motions Analysis	J.J. Wu	Jun 79
ARLCB-MR-79020	The Effect of Wall Thickness Variation of $K_I$ for the Proposed C-Shaped Specimen	J.A. Kapp G.A. Pflagl J.H. Underwood	Aug 79
ARLCB-TR-79021	Calculated Shifts in Electronic States for fcc Hydrogen	D.M. Gray A.M. Gray	Aug 79
ARLCB-TR-79022	Armament Concepts Study for a New Self-Propelled Howitzer (SPH) - 155MM	J.K. Jorczak	Aug 79
ARLCB-TR-79023	Giant Magnetism in Pressure Quenched Cadmium Sulfide	R.K. MacCrone C.G. Homan	Sep 79
ARLCB-TR-79024	A Numerical Comparison Between Two Unconstrained Variational Formulations	J.J. Wu T.E. Simkins	Sep 79

TECHNICAL REPORTS 1979 (CONT.)

<u>REPORT NUMBER</u>	<u>TITLE</u>	<u>AUTHOR</u>	<u>DATE</u>
ARLCB-TR-79025	Thermo-Elastic-Plastic Stresses in Hollow Cylinders Due to Quenching	J.D. Vasilakis P.C.T. Chen	Oct 79
ARLCB-TR-79026	A Numerical Approach to Elastic-Plastic Plane-Strain Problems of Thick-Walled Cylinders	P.C.T. Chen	Oct 79
ARLCB-MR-79027	A Concept for a <u>Minimum Signature Envelope Recoilless Gun (MISER)</u>	M.K. Dale	May 78
ARLCB-TR-79028	Sensitivity Coefficient of Exterior Ballistics with Velocity Square Damping	C.N. Shen	Oct 79
ARLCB-TR-79029	Unconstrained Variational Statements for Initial and Boundary-Value Problems	T.E. Simkins	Oct 79
ARLCB-TR-79030	Dynamic Stability of Columns Subjected to Nonconservative Forces	J.J. Wu J.D. Vasilakis	Oct 79
ARLCB-TR-79031	Some Observations on Liquid Metal Embrittlement	M.H. Kamdar	Nov 79
ARLCB-MR-79032	Comparative Evaluation Test of the Lightweight Company Mortar Auxiliary Baseplate, XM82E2, Modified	J.J. Battaglia	Aug 79
ARLCB-TR-79033	A Breech Technology Program and Technical Review	F.J. John	Aug 79
ARLCB-TR-79034	Implementation of a Trapezoidal Ring Element in NASTRAN for Elastic-Plastic Analysis	P. Chen P. O'Hara	Dec 79
ARLCB-TR-79035	Effect of CVD Tungsten and TaC Coatings on the Mechanical Behavior of SiC(C)	I. Ahmad N. Hill W. Heffernan	Dec 79

TECHNICAL REPORTS 1979 (CONT.)

<u>REPORT NUMBER</u>	<u>TITLE</u>	<u>AUTHOR</u>	<u>DATE</u>
ARLCB-TR-79036	Large Plastic Deformation in a Deep Drawing Process	P.C.T. Chen	Dec 79
ARLCB-TR-79037	Potential Erosion Resistant Refractory Metal (and/or) Alloy Coatings for Gun Tubes	I. Ahmad P. Greco G. D'Andrea J. Barranco	Dec 79

AUTHOR INDEX--1979

<u>AUTHOR</u>	<u>REPORT NUMBER</u>
Ahmad, I.	ARLCB-TR-79035 ARLCB-TR-79037
Barranco, J.	ARLCB-TR-79037
Barrett, J.A.	ARLCB-TR-79005
Battaglia, J.J.	ARLCB-MR-79032
Bloore, E.	ARLCB-TR-79001
Campolmi, R.	ARLCB-TR-79018
Chen, P.C.T.	ARLCB-TR-79025 ARLCB-TR-79026 ARLCB-TR-79034 ARLCB-TR-79036
Colangelo, V.	ARLCB-MR-79014
Croteau, P.	ARLCB-TR-79002
Cullinan, R.	ARLCB-TR-79002
D'Andrea, G.	ARLCB-TR-79002 ARLCB-TR-79037
Dale, M.K.	ARLCB-MR-79027
Davidson, T.E.	ARLCB-TR-79001 ARLCB-TR-79005
DeSisto, T.	ARLCB-TR-79001
Frankel, J.	ARLCB-TR-79005
Gray, A.M.	ARLCB-TR-79021
Gray, D.M.	ARLCB-TR-79021
Greco, P.	ARLCB-TR-79037
Heffernan, W.	ARLCB-TR-79035
Heiser, F.	ARLCB-MR-79013

AUTHOR INDEX--1979 (CONT.)

<u>AUTHOR</u>	<u>REPORT NUMBER</u>
Hill, N.	ARLCB-TR-79035
Homan, C.G.	ARLCB-TR-79004 ARLCB-TR-79005 ARLCB-TR-79006 ARLCB-TR-79023
Hulbert, R.	ARLCB-TR-79001
Hussain, M.A.	ARLCB-TR-79016
John, F.J.	ARLCB-TR-79033
Jorczak, J.K.	ARLCB-TR-79022
Kamdar, M.H.	ARLCB-TR-79031
Kapp, J.A.	ARLCB-MR-79020
Kendall, D.P.	ARLCB-TR-79001 ARLCB-TR-79004 ARLCB-TR-79005 ARLCB-TR-79006 ARLCB-TR-79007
LaRoss, C.	ARLCB-MR-79011
MacCrone, R.K.	ARLCB-TR-79006 ARLCB-TR-79023
Myhre, T.	ARLCB-TR-79001
O'Hara, P.	ARLCB-TR-79034
Passmore, J.	ARLCB-MR-79015
Pflegl, G.A.	ARLCB-MR-79020
Pu, S.L.	ARLCB-TR-79016
Rahrer, B.	ARLCB-SP-79012
Rodd, J.	ARLCB-MR-79010
Rowekamp, B.	ARLCB-TR-79018

AUTHOR INDEX--1979 (CONT.)

<u>AUTHOR</u>	<u>REPORT NUMBER</u>
Shen, C.N.	ARLCB-TR-79028
Simkins, T.E.	ARLCB-TR-79024 ARLCB-TR-79029
Tauscher, S.	ARLCB-MR-79017
Thornton, P.A.	ARLCB-MR-79009
Underwood, J.H.	ARLCB-TR-79007 ARLCB-TR-79008 ARLCB-MR-79020
Vasilakis, J.D.	ARLCB-TR-79016 ARLCB-TR-79025 ARLCB-TR-79030
Winters, D.C.	ARLCB-TR-79003
Wu, J.J.	ARLCB-TR-79019 ARLCB-TR-79024 ARLCB-TR-79030

SUBJECT INDEX--1979

<u>SUBJECT</u>	<u>REPORT NUMBER</u>
Abrasive Machining	ARLCB-MR-79010
Abrasive Surface Finishing	ARLCB-MR-79010
Accelerated Test	ARLCB-MR-79017
Adhesion	ARLCB-TR-79035
Alloy Forgings	ARLCB-MR-79009
Alloy Steels	ARLCB-TR-79008 ARLCB-MR-79014
Anisotropy	ARLCB-TR-79036
Approximation Methods	ARLCB-TR-79024
Argon	ARLCB-TR-79005
Austenite Transformation	ARLCB-MR-79009
Automatic	ARLCB-TR-79003
Ballistics with Drag	ARLCB-TR-79028
Bore Evacuator	ARLCB-TR-79002
Breech Fatigue	ARLCB-TR-79033
Breech Mechanisms	ARLCB-TR-79033
Breech Seals	ARLCB-TR-79033
Breeches, Cannon	ARLCB-TR-79033
Cadmium Sulfide	ARLCB-TR-79006 ARLCB-TR-79023
Calibration	ARLCB-MR-79020
Cannon Auto Loader	ARLCB-TR-79022
Cannon Tube	ARLCB-TR-79008
Chemical Vapor Deposition	ARLCB-TR-79035

SUBJECT INDEX--1979 (CONT.)

<u>SUBJECT</u>	<u>REPORT NUMBER</u>
Coatings	ARLCB-TR-79035 ARLCB-TR-79037
Composite Materials	ARLCB-TR-79002
Contour Grinding	ARLCB-MR-79010
Cooperative Tests	ARLCB-TR-79007
Crack Analysis	ARLCB-TR-79016
Crack Propagation	ARLCB-MR-79020
Cracks	ARLCB-TR-79003
Crush Form Grinding	ARLCB-MR-79010
Cryogenic	ARLCB-TR-79005
Cylindrical Surface Generation	ARLCB-MR-79010
Diamagnetism	ARLCB-TR-79004
Elastic-Plastic Analysis	ARLCB-TR-79034
Elastic-Plastic Deformation	ARLCB-TR-79026
Elastic Properties	ARLCB-TR-79036
Electron Beam Welding	ARLCB-MR-79014
Embrittlement Mechanisms	ARLCB-TR-79031
End-On	ARLCB-TR-79003
Energy Shifts	ARLCB-TR-79021
Erosion	ARLCB-MR-79015
Erosion Resistant Materials	ARLCB-TR-79037
ESR Steel	ARLCB-MR-79013
Excitonic Solids	ARLCB-TR-79004

SUBJECT INDEX--1979 (CONT.)

<u>SUBJECT</u>	<u>REPORT NUMBER</u>
Fatigue Analysis	ARLCB-TR-79016
Fatigue Fracture	ARLCB-TR-79031
fcc Hydrogen	ARLCB-TR-79021
Fiberglass	ARLCB-TR-79002
Filament	ARLCB-TR-79035
Filament Winding	ARLCB-TR-79002
Finite-Difference Method	ARLCB-TR-79025 ARLCB-TR-79026
Finite Elements	ARLCB-TR-79019 ARLCB-MR-79020 ARLCB-TR-79024 ARLCB-TR-79029 ARLCB-TR-79030
Follower Forces	ARLCB-TR-79030
416 Stainless Steel	ARLCB-MR-79017
Fracture Mechanics	ARLCB-MR-79020
Fracture Properties	ARLCB-MR-79020
Fracture Toughness	ARLCB-TR-79008
Fractures (Materials)	ARLCB-TR-79007
Gun Barrel Erosion	ARLCB-TR-79037
Gun Barrel Motions	ARLCB-TR-79019
Gun Dynamics	ARLCB-TR-79019
Gun Steel	ARLCB-MR-79015
Gun Tubes	ARLCB-MR-79009 ARLCB-MR-79015 ARLCB-TR-79026 ARLCB-TR-79034

SUBJECT INDEX--1979 (CONT.)

<u>SUBJECT</u>	<u>REPORT NUMBER</u>
Heat Treatment	ARLCB-MR-79009
High Pressure	ARLCB-TR-79004 ARLCB-TR-79006
High Temperature	ARLCB-TR-79035
Hollow Cylinder	ARLCB-TR-79007
Hollow ESR Steel	ARLCB-MR-79013
Hollow Spindle Loading	ARLCB-MR-79011
Hydrostatic Compression	ARLCB-TR-79021
Initial Boundary Problems	ARLCB-TR-79024
Initial/Boundary Value Problems	ARLCB-TR-79029
Initial Elevation Angle Correction	ARLCB-TR-79028
Internal Ballistics	ARLCB-TR-79019
Isotropism	ARLCB-TR-79036
Kinetic Energy Munitions	ARLCB-TR-79001
Lagrange Multipliers	ARLCB-TR-79029
Line Flow	ARLCB-MR-79011
Liquid-Solid Embrittlement	ARLCB-TR-79031
Magnetic Properties	ARLCB-TR-79006
Magnetism	ARLCB-TR-79004
Mechanical Properties	ARLCB-MR-79014
Modified-Plane-Wave Method	ARLCB-TR-79021
Mortar	ARLCB-MR-79032
Mortar Ammunition	ARLCB-MR-79032
Mortar Baseplate	ARLCB-MR-79032

SUBJECT INDEX--1979 (CONT.)

<u>SUBJECT</u>	<u>REPORT NUMBER</u>
Mortar Test Data	ARLCB-MR-79032
NASTRAN Program	ARLCB-TR-79034
Nonconservative Stability	ARLCB-TR-79030
Nonlinear Dynamics	ARLCB-TR-79028
Non-Metallic Coatings	ARLCB-MR-79017
Orthotropic Plasticity	ARLCB-TR-79036
Paramagnetism	ARLCB-TR-79006 ARLCB-TR-79023
Penetrator Materials	ARLCB-TR-79001
Perturbation of Initial Velocity	ARLCB-TR-79028
Perturbation Procedure	ARLCB-TR-79021
Phase Transitions	ARLCB-TR-79004 ARLCB-TR-79006
Pitting Corrosion	ARLCB-MR-79017
Plastic Deformation	ARLCB-TR-79036
Plunge Grinding	ARLCB-MR-79010
Pressure	ARLCB-TR-79005
Pressure Quenched	ARLCB-TR-79023
Radial Forge	ARLCB-TR-79016
Recoilless Guns	ARLCB-MR-79027
Refractory Metals	ARLCB-TR-79037
Ring Element	ARLCB-TR-79034
Rotary Breech Block	ARLCB-TR-79022
Rotary Forge	ARLCB-MR-79013

SUBJECT INDEX--1979 (CONT.)

<u>SUBJECT</u>	<u>REPORT NUMBER</u>
Secondary Wear	ARLCB-TR-79018
Sensitivity Coefficients	ARLCB-TR-79028
Signature	ARLCB-MR-79027
Silicon Carbide	ARLCB-TR-79035
Stargage Survey	ARLCB-TR-79018
Steel Castings	ARLCB-MR-79014
Strains	ARLCB-TR-79007
Stress-to-Rupture	ARLCB-TR-79035
Stresses	ARLCB-TR-79036
Tantalum Carbide	ARLCB-TR-79035
Target Hitting	ARLCB-TR-79028
Telescoped Round	ARLCB-TR-79022
Tensile Strength	ARLCB-TR-79035
Test Methods	ARLCB-TR-79007 ARLCB-TR-79008
Thermal Conductivity	ARLCB-MR-79015
Thermal Stress	ARLCB-TR-79016
Thermo-Elastic Plastic Stresses	ARLCB-TR-79025
Toughness	ARLCB-TR-79007 ARLCB-MR-79020
Transformation Stresses	ARLCB-TR-79025
Transient Temperatures	ARLCB-TR-79025
Tube Face Milling	ARLCB-MR-79011
Tungsten	ARLCB-TR-79035
Ultrasonic	ARLCB-TR-79003

SUBJECT INDEX--1979 (CONT.)

<u>SUBJECT</u>	<u>REPORT NUMBER</u>
Ultrasonic Testing	ARLCB-TR-79008
Ultrasonic Velocities	ARLCB-TR-79005
Unconstrained Variational Formulation	ARLCB-TR-79030
Urban Warfare	ARLCB-MR-79027
Vacuum Degassed Steel	ARLCB-MR-79013
Variation of Integrals	ARLCB-TR-79028
Variational Methods	ARLCB-TR-79024 ARLCB-TR-79029
Wear	ARLCB-MR-79015 ARLCB-TR-79037

## AD NUMBERS--1979

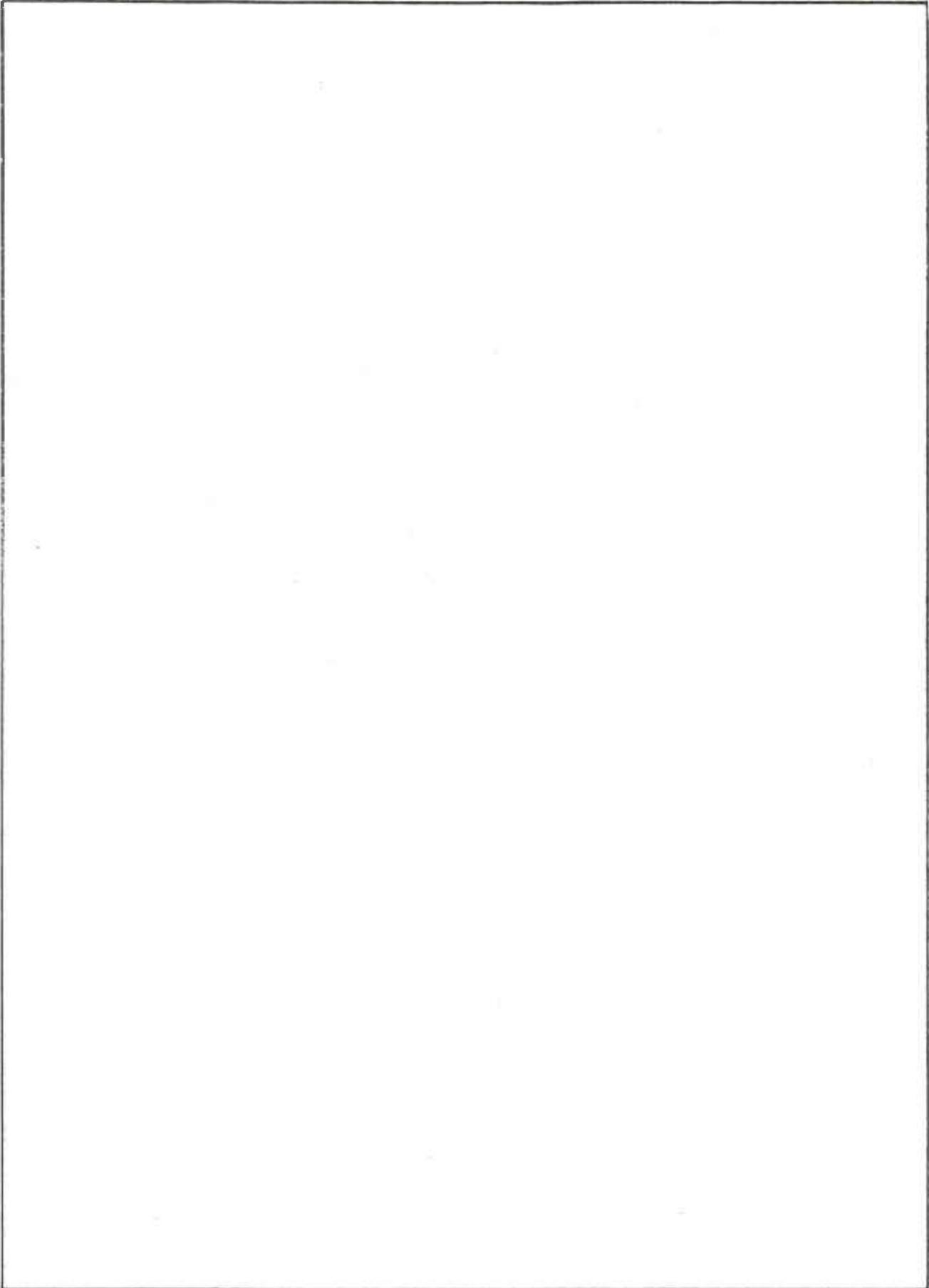
<u>REPORT NUMBER</u>	<u>AD NUMBER</u>
ARLCB-TR-79001	C018509L
ARLCB-TR-79002	A074933
ARLCB-TR-79003	A073759
ARLCB-TR-79004	A069609
ARLCB-TR-79005	A070690
ARLCB-TR-79006	A070533
ARLCB-TR-79007	A072178
ARLCB-TR-79008	A071456
ARLCB-MR-79009	A075341
ARLCB-MR-79010	A071916
ARLCB-MR-79011	A075322
ARLCB-SP-79012	A075364
ARLCB-MR-79013	A075342
ARLCB-MR-79014	A076173
ARLCB-MR-79015	A075343
ARLCB-TR-79016	A072814
ARLCB-MR-79017	A075344
ARLCB-TR-79018	B041494L
ARLCB-TR-79019	A074935
ARLCB-MR-79020	A075558
ARLCB-TR-79021	A075559
ARLCB-TR-79022	--
ARLCB-TR-79023	A076171

AD NUMBERS--1979 (CONT.)

<u>REPORT NUMBER</u>	<u>AD NUMBER</u>
ARLCB-TR-79024	A076176
ARLCB-TR-79025	A077109
ARLCB-TR-79026	A078365
ARLCB-MR-79027	B044321L
ARLCB-TR-79028	A078921
ARLCB-TR-79029	A079407
ARLCB-TR-79030	A078920
ARLCB-TR-79031	B046645L
ARLCB-MR-79032	A082302
ARLCB-TR-79033	B046646L
ARLCB-TR-79034	A083870
ARLCB-TR-79035	A083395
ARLCB-TR-79036	A083456
ARLCB-TR-79037	A083873

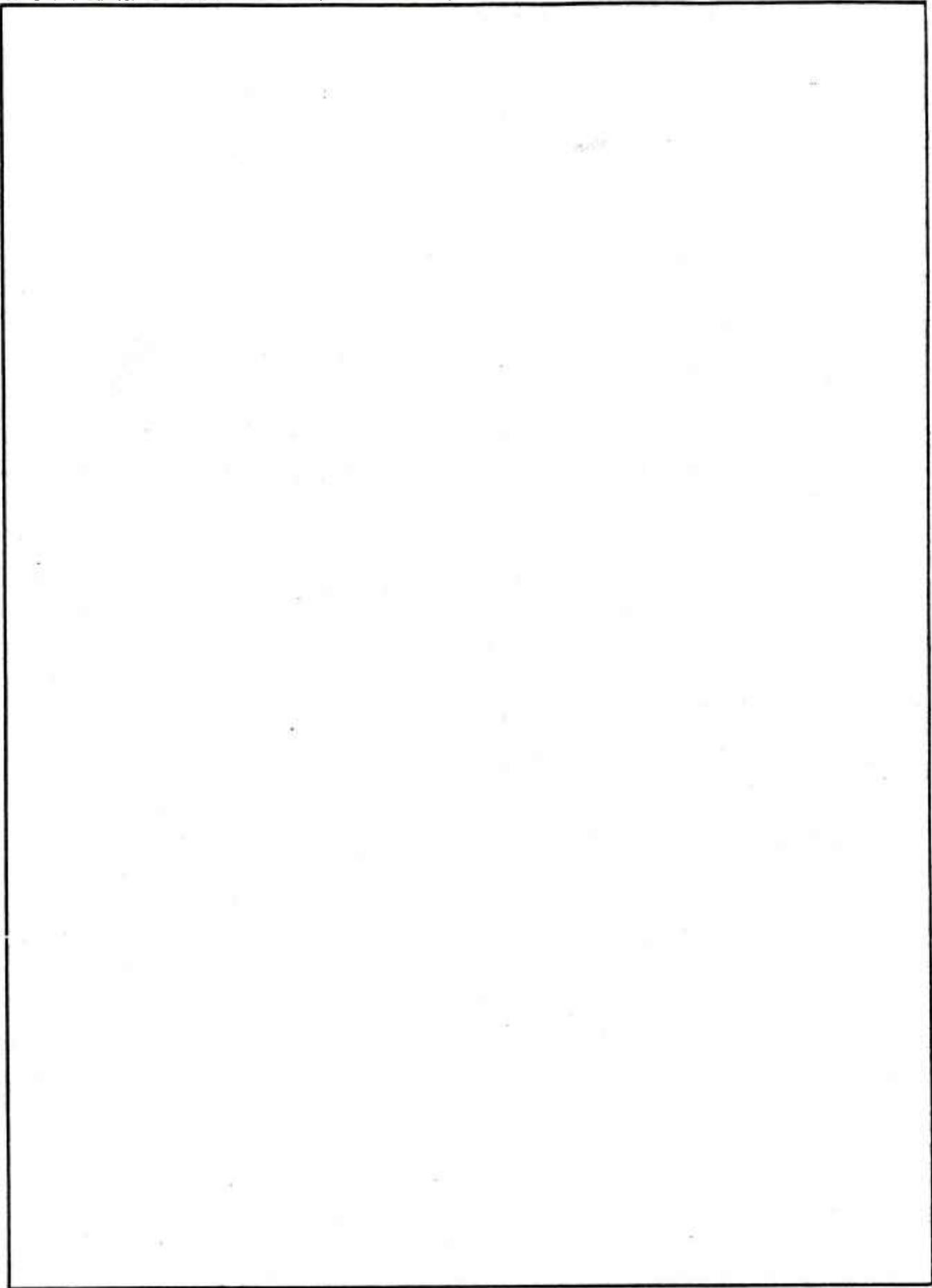
REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79001	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  INVESTIGATION OF THE ERRATIC PENETRATION PERFORMANCE OF THE 105MM M735 ROUND (U)		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) T. E. Davidson                      D. P. Kendall E. Bloore                              T. Myhre R. Hulbert                             T. DeSisto		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Commander, ARRADCOM LCWSL (DRDAR-LC) Dover, NJ 07801		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS  AMCMS No. 4111.16.2978.6 PRON No. A1-7-29167
11. CONTROLLING OFFICE NAME AND ADDRESS Commander, ARRADCOM Benet Weapons Laboratory (DRDAR-LCB-R) Watervliet, NY 12189		12. REPORT DATE May 1978
		13. NUMBER OF PAGES 63
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  CONFIDENTIAL
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE Declassify on 31 May 1984
16. DISTRIBUTION STATEMENT (of this Report)  Distribution limited to U.S. Government Agencies only because of Test and Evaluation, May 1978. Other requests for this document must be referred to the Commander, ARRADCOM, Benet Weapons Laboratory (DRDAR-LCB-R), Watervliet, NY 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)  Kinetic Energy Munitions Penetrator Materials		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  A study by a select committee to investigate the penetration performance of the 105mm M735 round. (U)		

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79002	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  FEASIBILITY STUDY OF 105MM M68 COMPOSITE BORE EVACUATOR		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) G. D'Andrea R. Cullinan P. Croteau		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111019A0011 DA Proj No. 1L161101A91A PRON No. GG825567GGM7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE April 1979
		13. NUMBER OF PAGES 30
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  UNCLASSIFIED
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The feasibility of fabricating a 105 MM M68 composite bore evacuator by the filament winding process has been demonstrated. Design and fabrication procedures for the manufacturing of this type of bore evacuator are presented in this report.		

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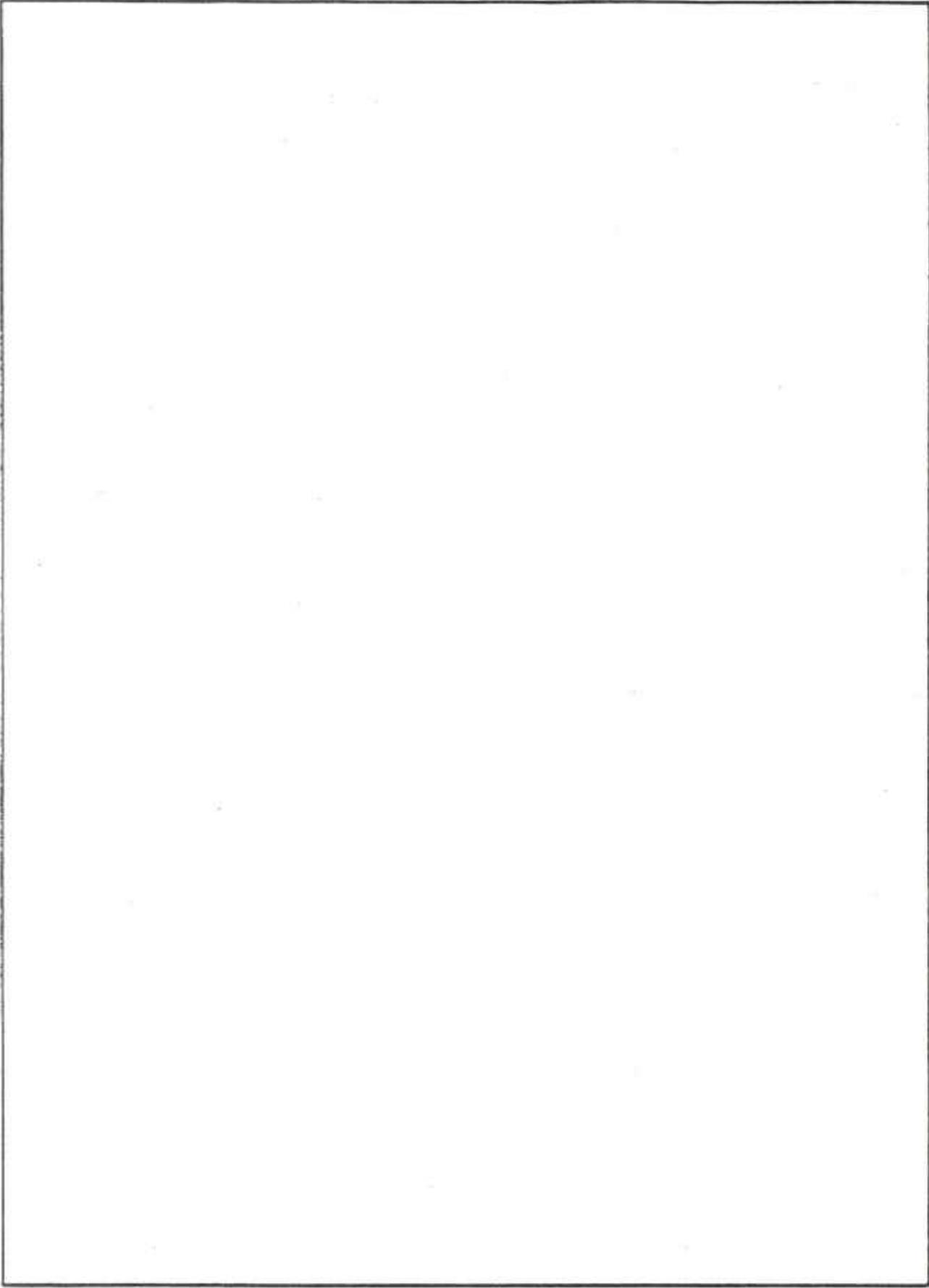


REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79003	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Automatic Ultrasonic Detection and Measurement of Cracks in Cannon		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) D. C. Winters		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 32910673190 DA Project No. 6797319 PRON No. 1A827046GGGG
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapons Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE April 1979
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 18
		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  Presented at the 27th Defense Conference on Nondestructive Testing, Yuma, Arizona, Oct. 1978		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Automatic Cracks End-On Ultrasonic		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  <u>ABSTRACT</u>  The "end-on" ultrasonic crack measurement technique has been refined and perfected to provide reliable automatic sensing and read out of the maximum crack depth and its location for each crack encountered as the probe moves in		

(Block No. 20 continued)

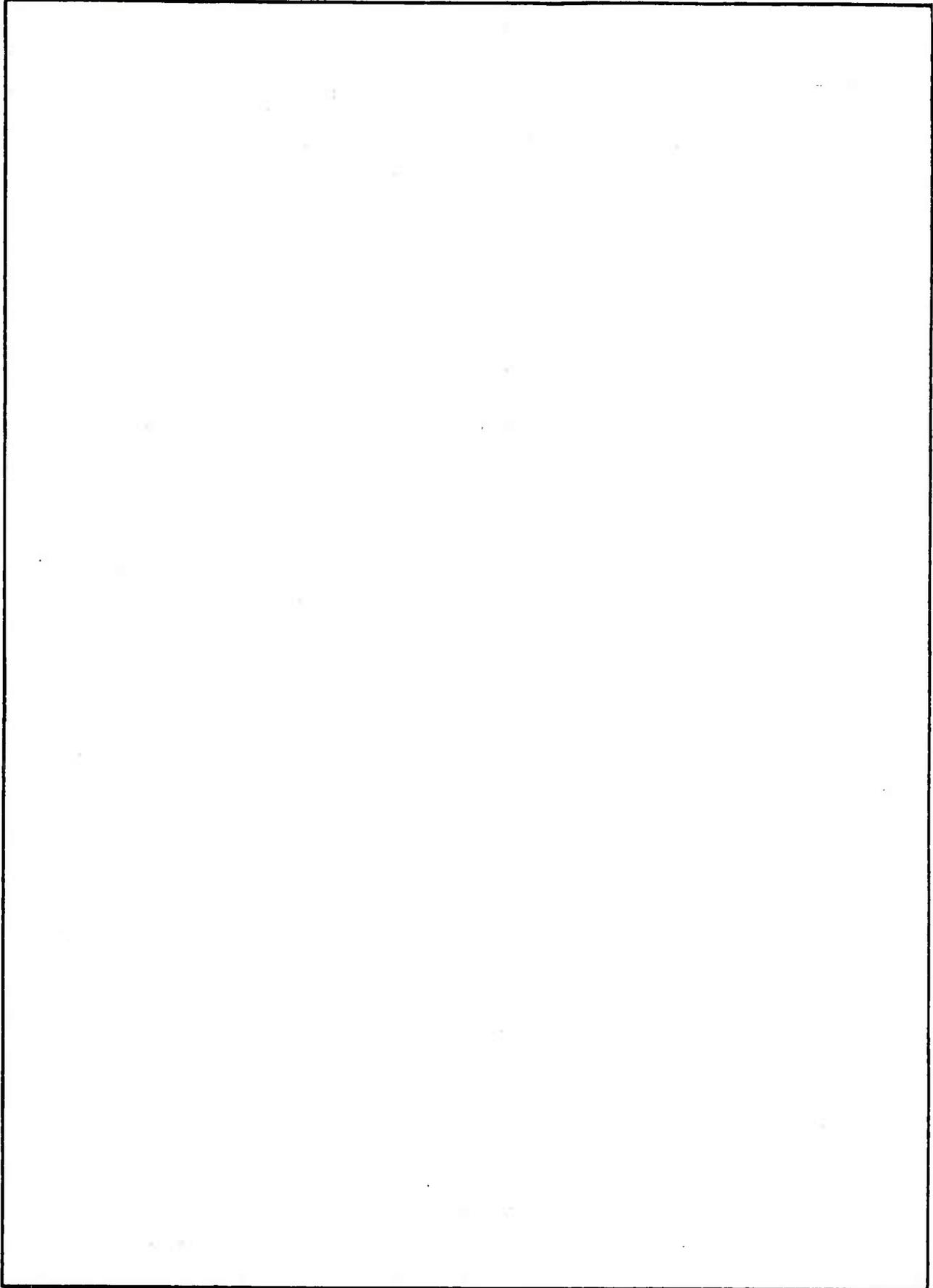
helical path down the cannon tube. A mechanical scanning machine has been constructed and tested which inspects full length 105 millimeter cannon. An ultrasonic flaw detector senses, measures and continuously reads out the distance from the outside surface to the crack tip or bore surface. Digital logic circuits evaluate successive measurements and determine the maximum crack depth reading. Encoders determine the location of each maximum crack depth reading. This data is transferred to a data acquisition system.





REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79005	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ACOUSTIC VELOCITY RATIOS IN SOLID ARGON AT 75 K UP TO STATIC PRESSURES OF 150 KBAR		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. G. Homan                      J. A. Barrett J. Frankel                        T. E. Davidson D. P. Kendall		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 611102.H540011 D.A. Project No. 1L161102AH54 PRON No. M1-7-51700-01-M7-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE May 1979
		13. NUMBER OF PAGES 12
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  Presented at 6th AIRAPT International High Pressure Conference, July '77, Boulder, Colorado. Published in High-Pressure Science and Technology, Vol. 1 (1979).		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Argon Ultrasonic Velocities Pressure Cryogenic		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The ratio of longitudinal to shear ultrasonic velocities in solid Ar has been measured by an interferometric technique in a variably supported Bridgeman anvil device. Pressure was determined by the simultaneous measurement of the polymorphic phase transitions of a Bismuth sample imbedded in the Ar. The 75°K isotherm of the equation of state of Ar was calculated and is compared to earlier experimental results below 20 kbar and the 0°K EOS suggested by Anderson and Swenson to 100 kbar.		

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79006	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) MAGNETIC MOMENT OF PRESSURE QUENCHED CADMIUM SULFIDE		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) C. G. Homan                      R. K. MacCrone D. P. Kendall		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 611102H600211 DA Project No. 1L1161102H60 PRON No. 1A924324GGGG
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE May 1979
		13. NUMBER OF PAGES 16
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  Presented at Physics Colloquium at RPI, 18 April '79, Troy, NY.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Cadmium Sulfide                      Paramagnetism High Pressure                          Phase Transitions Magnetic Properties		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  Magnetic moment measurements of cadmium sulfide (CdS) polycrystalline samples, pressure quenched from above the semi-conducting to conducting transition pressure (40 kbars) at rates approaching $10^6$ bars/sec, have been made in a vibrating sample magnetometer to fields approaching 1000 Oersted. The samples exhibit the complex magnetic behavior of low field diamagnetism ( $\chi_v > -5 \times 10^{-5}$ cgs units) transforming at fields of several hundred Oersted		

Continued from Block 20

to positive magnetism ( $\chi_v > 3 \times 10^4$  cgs units). This magnetic behavior contrasts with unquenched samples which yield the normal diamagnetism of CdS ( $\chi_v = -1.5 \times 10^{-6}$  cgs units). These anomalous magnetic effects are observed at both RT and LN<sub>2</sub> temperatures at atmospheric pressure.



Continued from Block 20

$K_{IC}$  values obtained with standard compact specimens. Results show that both versions of the C-shaped specimen yield accurate values of measured  $K_{IC}$ . Normal geometric variations, as would be expected from machining of the specimen from an existing hollow cylinder, have no significant effect on the measured  $K_{IC}$ .



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test procedures are suggested for use with Ni-Cr-Mo steels within certain ranges of yield stress and specimen geometry.

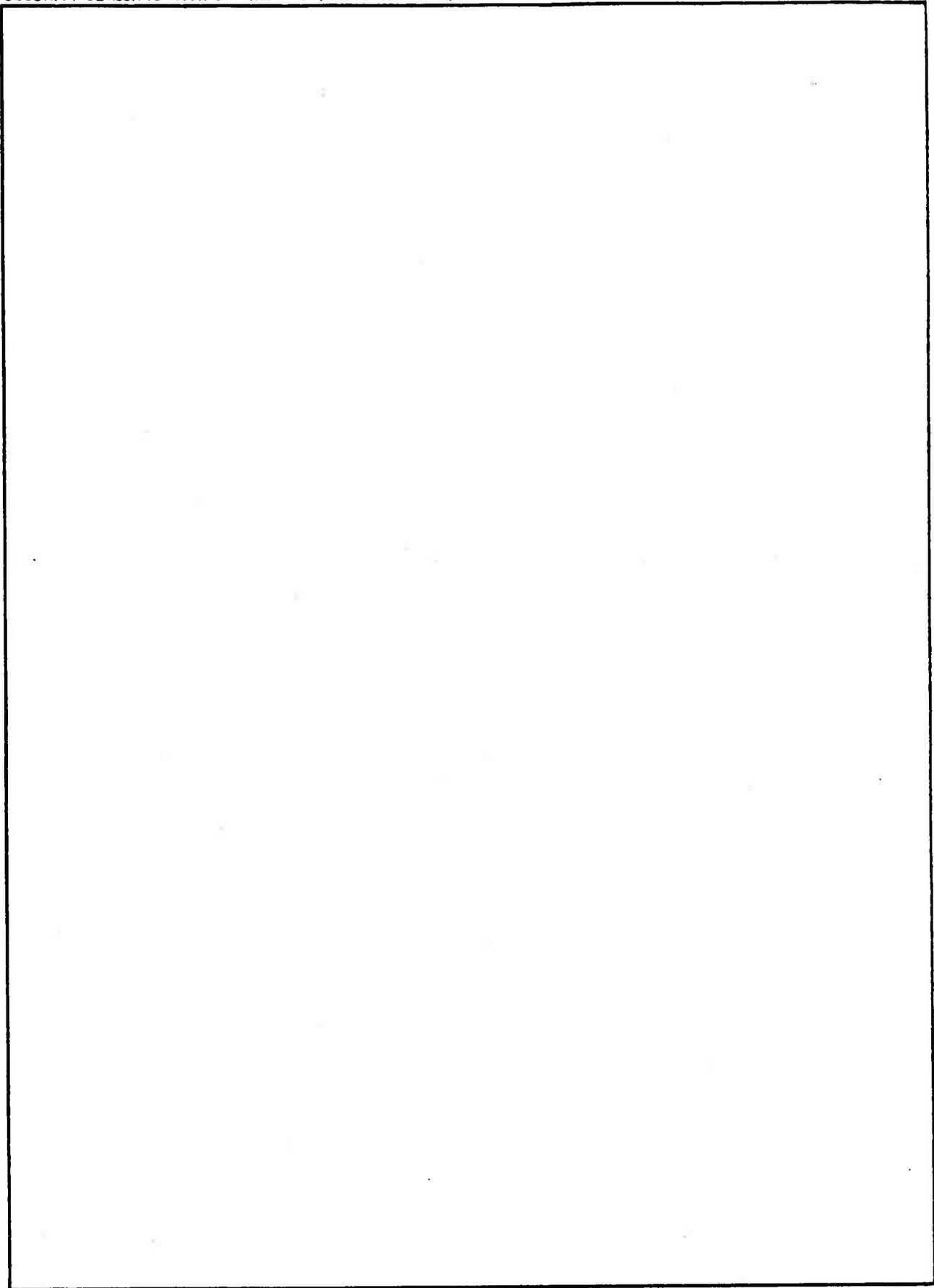
REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-79009	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  APPLICATION OF RAPID HEAT TREATING TO CANNON TUBES		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  P. A. Thornton		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS  AMCMS No. 3297.06.7236 PRON No. M1-6-A1735-01-M7-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon System Laboratory Dover, New Jersey 07801		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 30
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  Originally submitted as an MM&T project to U.S. Army Armament Materiel Readiness Command in June 1978.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Heat Treatment Austenite Transformation Gun Tubes Alloy Forgings		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  In order to demonstrate the feasibility of shortened heat treatment cycles for gun tubes, eight forgings (four 105mm M68 and four 155mm M185) were subjected to reduced austenitizing and tempering times. Austenitizing time was held to 30 minutes at temperature as measured by thermocouples. Quenching was accomplished by either vertical immersion, horizontal immersion or horizontal spray. The results showed that accepted mechanical properties		

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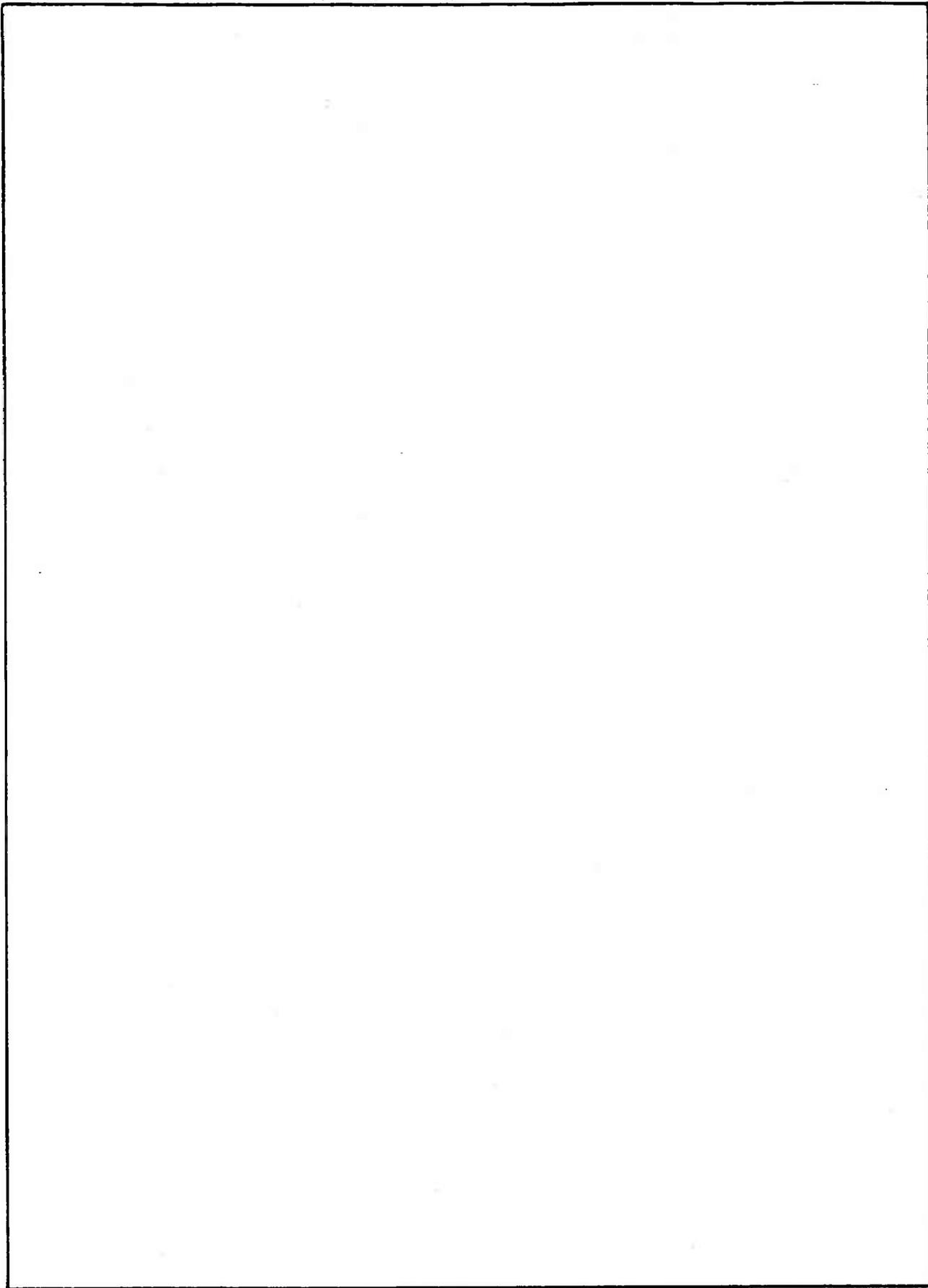
could be attained with these shortened cycles. However, the shortened cycles must be established for a particular component with consideration for material variation, especially chemical segregation, which seriously affects transformation behavior. Nevertheless, in view of the present and future costs of firing heat treat furnaces and the potential increases in production capacity, reduced heating times can be highly significant.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-79010	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  ABRASIVE MACHINING OF MAJOR COMPONENTS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  John Rood		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.7408 PRON No. M1-4-A1530-M7-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE May 1979
		13. NUMBER OF PAGES 65
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  UNCLASSIFIED
		15e. 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  Originally submitted as an MM&T project to US Army Armament Materiel Readiness Command on 7 December 1977.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Abrasive Machining Abrasive Surface Finishing Contour Grinding Crush Form Grinding Cylindrical Surface Generation Plunge Grinding		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The term "abrasive machining" has been expressed in many ways. It is generally used to denote stock removal operations that are more economically performed by abrasive grinding methods than the more conventional means of turning or milling. The two largest fields for abrasive machining are the production of flat surfaces and form grinding from the solid. This report is concerned with the latter; grinding various complex external shapes from the solid forging, bar stock or hollow cylindrical items.		

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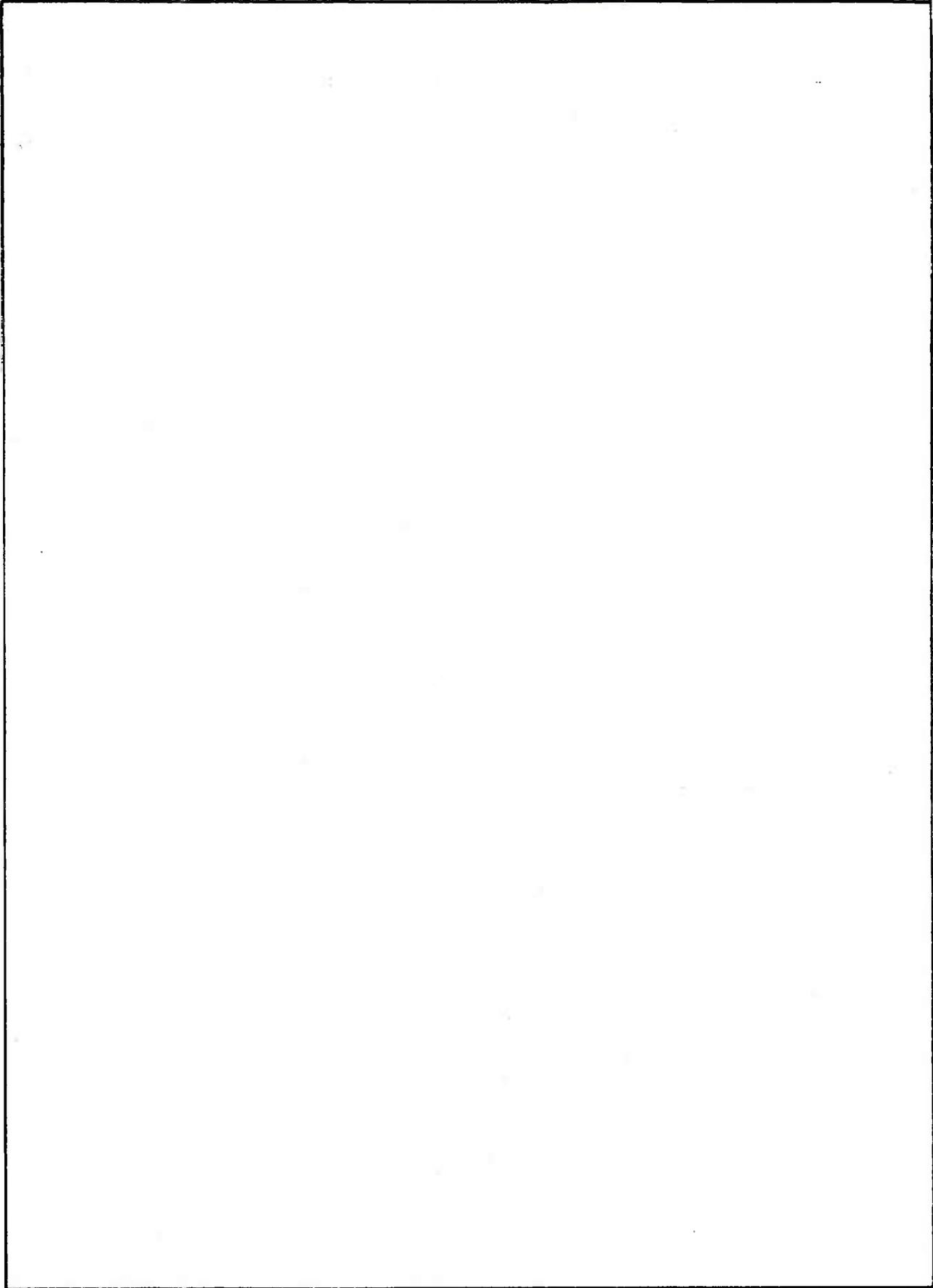


REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-79011	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  GUN TUBE MANUFACTURE BY AUTOMATION		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  C. LaRoss		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.7242 DA Project No. 6737242 PRON No. M1-3-23022-M7-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 24
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  UNCLASSIFIED
		15e. 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  Originally submitted as an MM&T report to the US Army Armament Materiel Readiness Command on 6 January 1978.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Line Flow Tube Face Milling Hollow Spindle Loading		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This report describes three areas of the production line in manufacture of gun tubes that, with improvement, would be beneficial to gun tube manufacture by automation. The purpose of the project was to highlight and improve these areas to result in an improved gun tube manufacturing facility.		



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-SP-79012	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  INDEX TO BENET WEAPONS LABORATORY (LCWSL) TECHNICAL REPORTS - 1978		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  B. Rahrer	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801	12. REPORT DATE June 1979	
	13. NUMBER OF PAGES 60	
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 technical reports published during 1978.		

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-79013	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  A SHORT STUDY OF LARGE ROTARY FORGED CYLINDERS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  F. Heiser		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 612603H181011 DA Proj No. 1L1626603AH18 PRON No. 1A924362GGGG
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 35
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)  ESR Steel Hollow ESR Steel Rotary Forge Vacuum Degassed Steel		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The Integrated Forging Line was used to produce steel for the Advanced Breech Technology program. Cylinders were rotary forged from cast hollow ESR and from vacuum degassed steel. Anomalies in the data prompted a more detailed metallurgical study. The results are presented. Satisfactory properties were produced from the vacuum degassed steel. However, the very light forging reduction coupled with the very rapid and short austenitizing inherent in the Selas heat treatment system were inadequate to develop satisfactory properties		

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in the cast ESR steel.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-79014	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  APPLICATION OF ELECTRON BEAM WELDING TO HEAVY COMPONENTS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  V. Colangelo		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N. Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.7480 DA Project No. 6747480 PRON No. M1-4-A1561-M7-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 28
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  Originally submitted as an MM&T report to the US Army Armament Materiel Readiness Command on 6 January 1978.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Alloy Steels Electron Beam Welding Mechanical Properties Steel Castings		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The current investigation evaluates the mechanical properties and weld soundness of an electron beam welded casting which was substituted for a complex forging. The mechanical properties obtained were adequate, however, radiographic studies indicated considerable porosity in the welds which was not tolerable. This porosity was the result of the agglomeration of porosity on forged specimens of the same alloy and configuration. The study showed		

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that weldments made from forged sub-sections could meet the mechanical property and soundness requirements.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-79015	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  EFFECTS OF PROCESSING VARIABLES ON EROSION OF GUN TUBES		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  J. Passmore		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3297.06.7026 DA Project No. 6747026 PRON No. M1-4-A1532-M7-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 16
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  Originally submitted as an MM&T report to the US Army Armament Materiel Readiness Command on 31 January 1978.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Erosion Wear Gun Steel Thermal Conductivity Gun Tubes		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  A reduction in silicon with an associate increase in molybdenum is known to increase the wear life of gun steel when fired under subscale firing con- ditions. However, when this same material is employed in a full scale firing test utilizing the 105mm M68 gun tube, the wear life of the tube, as measured at the origin of rifling (i.e. OR), remains the same regardless of silicon and molybdenum content. A few inches beyond the OR (27 inches from the rear face of the tube and beyond), the results of the full scale firing test agree with		

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the results of the subscale firing tests, in that the low silicon steel exhibits a lower erosion rate than for a normal gun steel composition. {

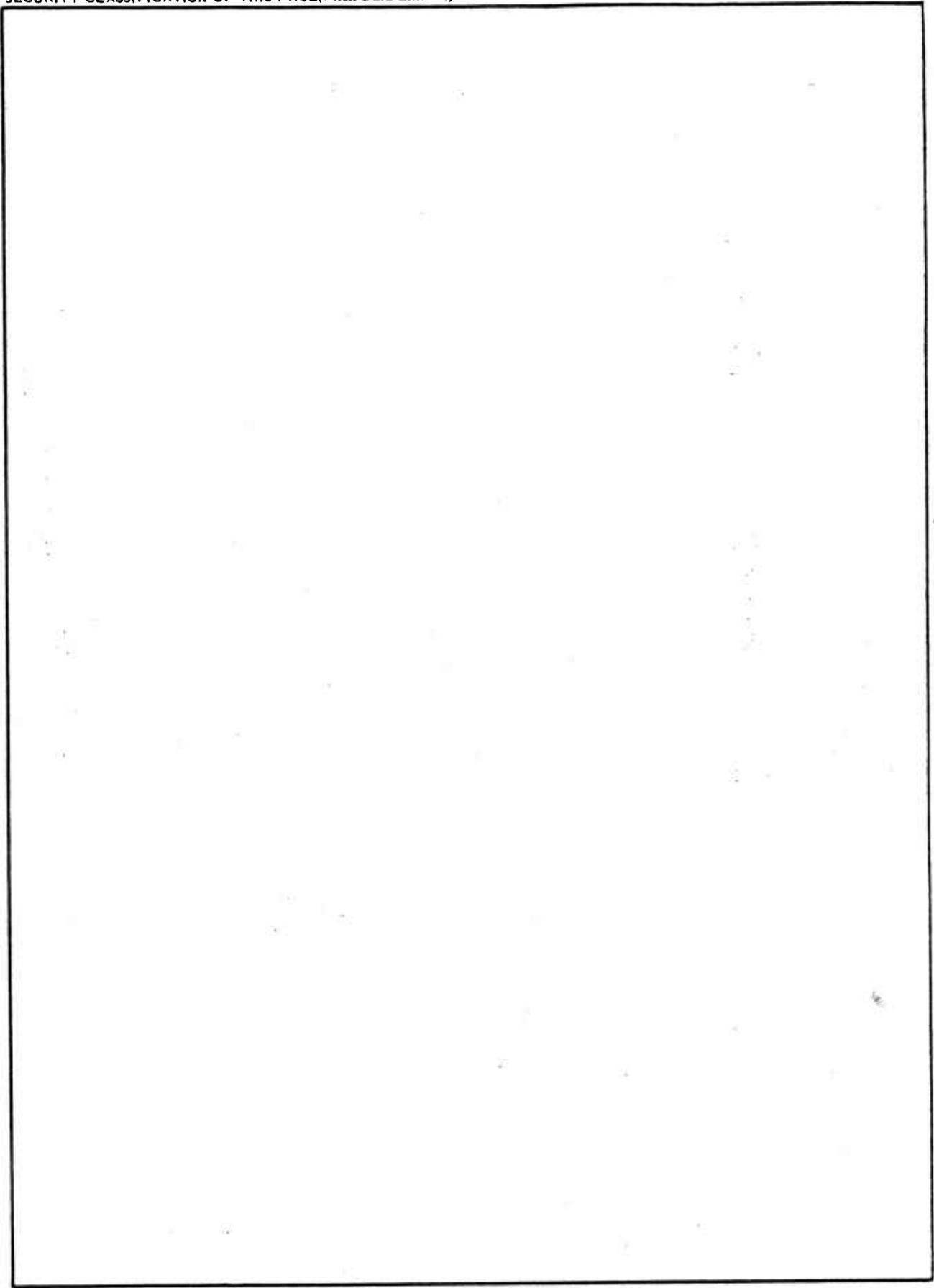
REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79016	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  PRELIMINARY ANALYSIS OF A MANDREL FOR 105MM GUN TUBE FORGINGS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) M. A. Hussain S. L. Pu J. D. Vasilakis		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 3110.15.0003 PRON No. 32-6-P4941-01-M7-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon System Laboratory Dover, New Jersey 07801		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 36
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)  Crack Analysis Fatigue Analysis Radial Forge Thermal Stress		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  A simplified stress analysis of a mandrel used in rotary forging of 105mm M68 gun tube forgings is presented. High tensile stress occurs at the inner bore during a fraction of a forging cycle when two hammers are engaged with the billet. The combination of the tensile stresses due to mechanical and thermal loading is responsible for the fracture of the mandrel. Assuming a semi-circular crack initiated at the inner bore of the mandrel and propagated in the radial direction, the stress intensity factors are		

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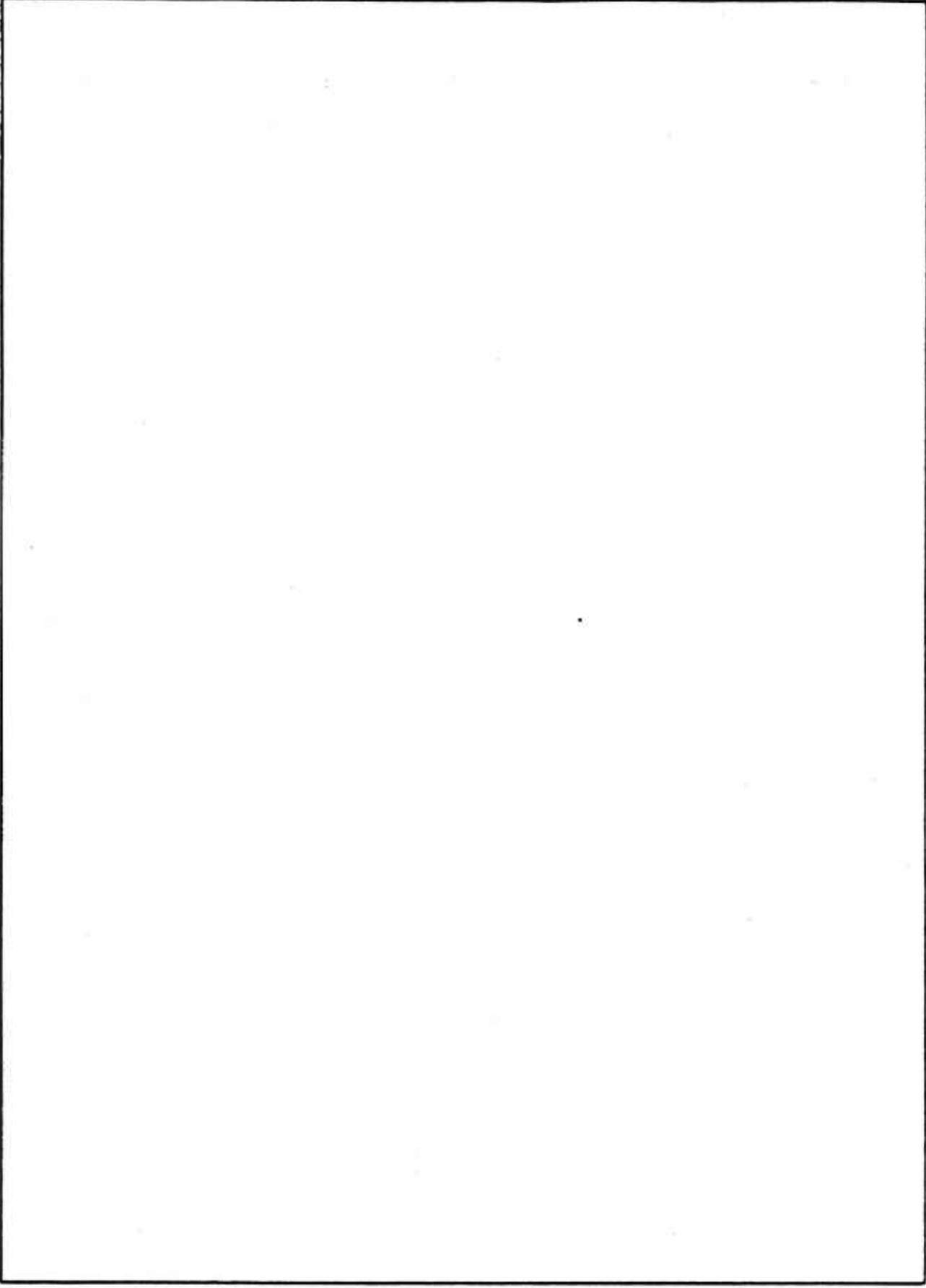
computed based on the penny shaped crack under arbitrary loading. The remaining life of a mandrel having a semi-circular crack of 0.003 inch is predicted based on the most severe loading conditions and using the propagation equation for gun steel.

The effect of the reduction of the inner diameter of the mandrel on the mandrel life is studied. A four-fold life increase is predicted if the bore diameter is reduced from 1.969 to 1.4 inches. The effect of autofrettage is also studied. The mandrel life can be increased as much as 48 times if the mandrel is overstrained 50 percent.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-79017	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  CORROSION PROTECTION OF 416 STAINLESS STEEL FIRING PROBES		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  S. Tauscher		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS  AMCMS No. 728012.12000 PRON No. M7-79F-1726-M7-1A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE July 1979
		13. NUMBER OF PAGES 18
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)  Accelerated Test 416 Stainless Steel Non-Metallic Coatings Pitting Corrosion		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The effectiveness of several protective coatings in resisting pitting corrosion on 416 stainless steel 152mm firing probes was investigated using an accelerated corrosion test. Test specimens with selected metallic and non-metallic coatings were immersed in ferric chloride and examined periodically for damage. This report concludes that on the basis of these tests, the non-metallic coatings investigated generally provided better resistance to corrosive attack than the metallic coatings investigated.		



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79018	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  RESULTS OF THE 1978 USAREUR STARGAGE SURVEY OF 105MM M68 GUN TUBES		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R. Campolmi B. Rowekamp		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, NY 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 41111699896 PRON No. 1A-7-28319-GG-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Cover, New Jersey 07801		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 25
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) Distribution limited to US Government Agencies only because of test and evaluation; June 1979. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-DP, Watervliet Arsenal, Watervliet, NY 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)  Stargage Survey Secondary Wear		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  Description of procedures, results and conclusions for secondary wear survey of 105mm M68 gun tubes (M60 Tank) with active US Army units in Germany.		



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79019	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A COMPUTER PROGRAM AND APPROXIMATE SOLUTION FORMULATION FOR GUN MOTIONS ANALYSIS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. J. Wu		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111-01-91A0011 PRON No. 1A92ZA01NMLC
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE June 1979
		13. NUMBER OF PAGES 31
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  To be published in an open literature journal.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Finite Element Gun Barrel Motions Gun Dynamics Internal Ballistics		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The purpose of this paper is to describe some of the features associated with a finite element computer program for approximate solutions of a gun dynamics problem. The lateral motion of a gun tube is modeled by an Euler-Bernoulli beam. The difficulties of the problem are due to various complicated loadings and support conditions which can be nonconservative, highly discontinuous and time dependent. The solution formulation for this generally non-self-adjoint problem has been presented in an earlier paper. In		

Continued from Block 20

terms of finite element discretization, the two-dimensional shape function of spatial and time coordinates is chosen as a product of two one-dimensional shape functions; each for its respective coordinate and both being Hermitian polynomials. The generalized coordinates are then the displacement, slope, velocity and time derivatives of the slope at each node point. The correspondence between local and global generalized coordinates is described. The "stiffness matrices" of spatial and time-effect, contributed by the recoil force, pressure and curvature induced force and the moving mass of a projectile are derived. It is interesting to observe that the strong discontinuities associated with these forces disappear as a result of the smoothing effect of integration in spatial as well as in time coordinates. The present approach to deal with the moving support problem efficiently is also pointed out in this paper. Numerical results of a demonstrative problem are presented.



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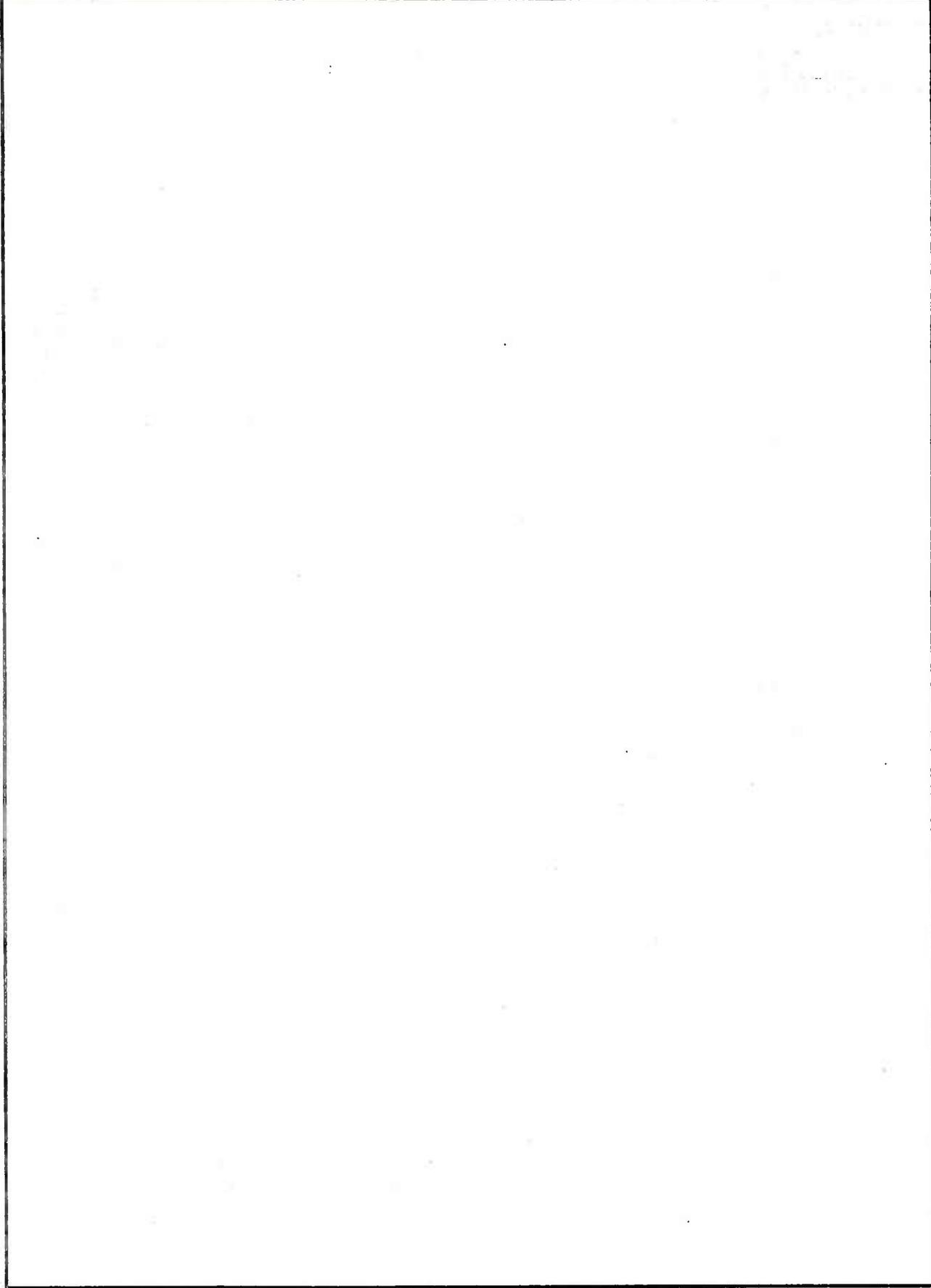
Three basic specimen geometries were studied: 1. A symmetric specimen; 2. A specimen with  $\pm 5\%$  wall thickness variation; and, 3. A  $\pm 10\%$  wall thickness variation specimen. Each case was studied at three different crack depths for a total of nine solutions. All specimens have a radius ratio  $R_1/R_2$  of .5; and a loading position of  $X/W$  of .5. The results show that there is virtually no difference between  $K_I$  for a nonsymmetric specimen compared with a symmetric specimen and that only negligible amounts of Mode II sliding develop with non-symmetry due to wall thickness variation.



Continued from Block 20

requirements where tested. For comparable strain parameter  $\epsilon$  the shifts at  $E_F$  under shear are considerably larger than in the hydrostatic case.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79022	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ARMAMENT CONCEPTS STUDY FOR A NEW SELF-PROPELLED HOWITZER (SPH) - 155MM		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. K. Jorczak		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 612603.H1.80011 DA Project No. (SPEF) TA-10 PRON No. GG-8-25538-GG-M7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE August 1979
		13. NUMBER OF PAGES 35
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)  Distribution limited to US Government Agencies only because of test and evaluation; August 1979. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-DS, Watervliet Arsenal, 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)  Cannon Auto Loader Rotary Breech Block Telescoped Round		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  Various ammunition and integral automatic loading cannon concepts for a new Self-Propelled Howitzer are described and discussed in this report. The intent of this preliminary report is to document various concepts which may be useful in future development of artillery test beds.		



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79023	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  GIANT MAGNETISM IN PRESSURE QUENCHED CADMIUM SULFIDE		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R. K. MacCrone C. G. Homan		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 611102H600211 DA Project No. 1L1161102H60 PRON No. 1A932A03NMLC
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE Sept 1979
		13. NUMBER OF PAGES 14
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  Presented at International Conference on Amorphous Materials, Aug 79, RPI. To be published in Solid State Communication.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Cadmium Sulfide Paramagnetism Pressure Quenched		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  Large positive magnetism (paramagnetism) is reported in poly-crystalline CdS samples pressure quenched from above the semiconducting-conducting phase transition. This positive magnetism reaches a maximum magnetization approaching four gauss at fields between five and twelve KOe.		



REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79024	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  A NUMERICAL COMPARISON BETWEEN TWO UNCONSTRAINED VARIATIONAL FORMULATIONS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  J. J. Wu T. E. Simkins		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS  AMCMS No. 6111.0191A011 PRON No. 1A924225GGGG
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon System Laboratory Dover, New Jersey 07801		12. REPORT DATE Sept 1979
		13. NUMBER OF PAGES 30
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  Presented at 25th (Silver Jubilee) Conference of Army Mathematicians, 6-8 June 79, Johns Hopkins Univ. Baltimore, Maryland. To be published in Journal of Applied Mechanics.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Approximation Methods Finite Element Initial Boundary Problems Variational Methods		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  In an effort to relieve the often cumbersome burden of meeting the require- ments on the end conditions and to unify the solution formulation for bound- ary- and initial-value problems, unconstrained variational statements have been introduced in conjunction with some approximate methods. In the case of a boundary value problem, it is shown in this paper that two different vari- ational statements can be established: one is arrived at by the use of the		

Cont. from Block 20

LaGrange multipliers, the other by energy considerations. The numerical convergence of the solutions associated with finite element schemes using one of these two different variational statements is compared with that of the other. In the case of an initial value problem, both formulations can again be established when the adjoint field variable and the adjoint variational statement are introduced. The numerical data presented here indicate that while both methods generate excellent convergent results for the boundary value problem, the method of stiff springs yields results which show much better convergence for the initial value problem than those achieved by LaGrange multipliers.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79025	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  THERMO-ELASTIC-PLASTIC STRESSES IN HOLLOW CYLINDERS DUE TO QUENCHING		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. D. Vasilakis P. C. T. Chen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, NY 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.01.91A0.0 DA Project No. 1L161101A91A PRON No. 1A-9-27A01-Y
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE October 1979
		13. NUMBER OF PAGES 20
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  Presented at the 25th (Silver Jubilee) Conf of Army Mathematicians, 6-8 Jun 79, Johns Hopkins Univ, Baltimore, MD. To be published in the proceedings of the 25th Conf of Army Mathematicians.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Finite Difference Method Transient Temperatures Thermo-Elastic Plastic Stresses Transformation Stresses		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  A hollow cylindrical tube rapidly quenched for the purpose of developing a high strength material structure is analyzed. The quenching creates severe thermal stresses early in the quenching cycle while later the material transformation by virtue of a volume change in the transformed material causes large transformation stresses. The transient temperature distributions and the elastic treatment of the stresses has been treated previously. The present work is an attempt to consider the thermo-elastic-plastic aspects of the		

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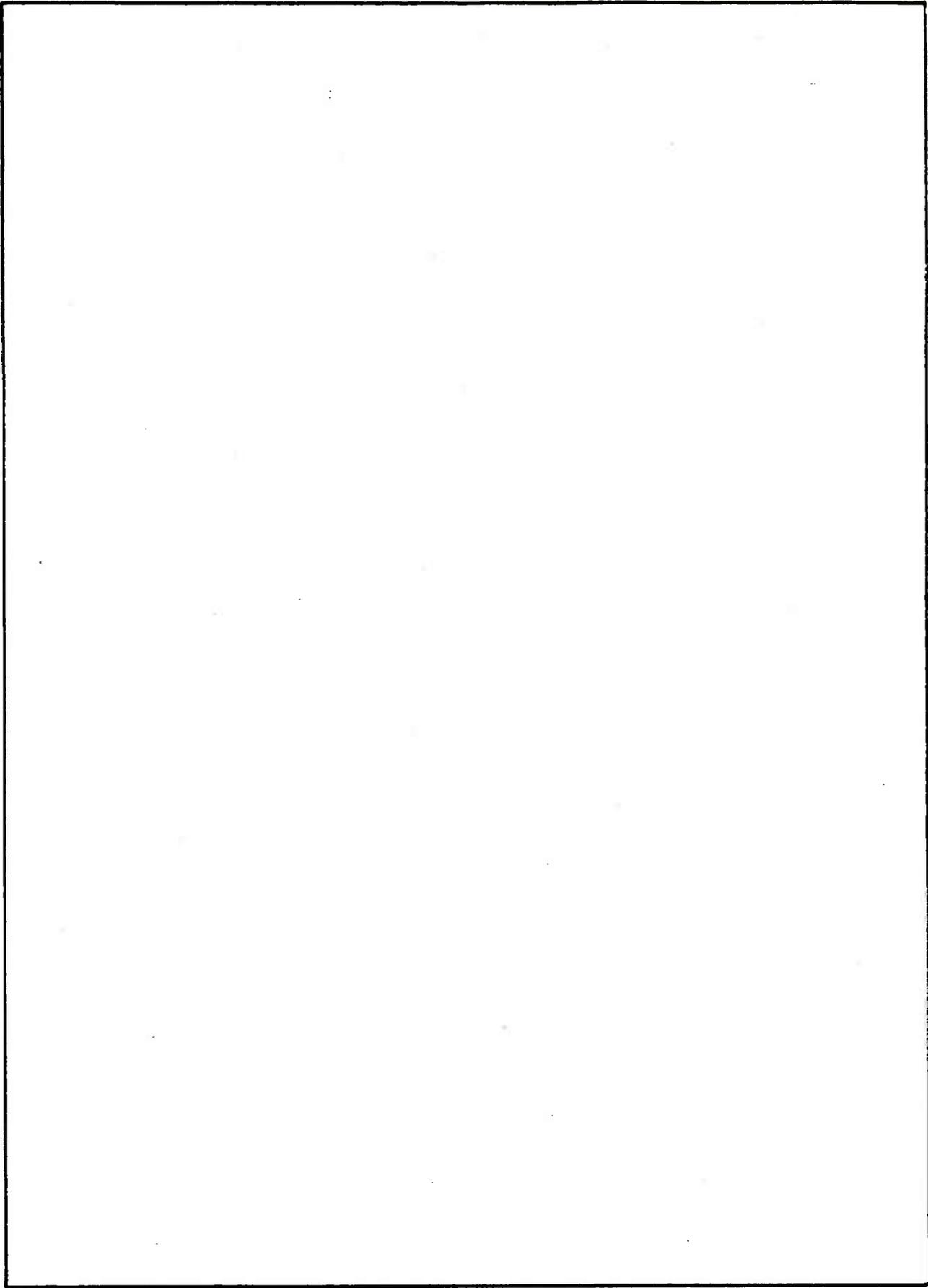
problem. The von Mises' yield criterion and the Prandtl-Reuss stress strain relations are used. Results are calculated based on a new finite difference approach.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79026	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  A NUMERICAL APPROACH TO ELASTIC-PLASTIC PLANE-STRAIN PROBLEMS OF THICK-WALLED CYLINDERS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  P. C. T. Chen		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, NY 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.01.91A0.0 DA Project No. 1L161101A91A PRON No. 1A-9-2Za01-Y
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE October 1979
		13. NUMBER OF PAGES 17
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  Presented at Tenth Southeastern Conf on Theoretical & Applied Mechanics, 17-18 Apr 80, Univ of Tennessee, Knoxville, Tennessee. To be published in an open literature journal.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Elastic-Plastic Deformation Finite-Difference Method Gun Tube		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  A new finite-difference approach has been developed for solving the elastic-plastic plane-strain problems of thick-walled cylinders subjected to internal or external pressure. The material is assumed to obey the von Mises' yield criterion, the Prandtl-Reuss flow theory and the isotropic hardening rule. The numerical scheme is stable for ideally-plastic as well as straining-hardening materials. The approach is simpler than others, and very accurate solutions can be obtained by reducing the grid sizes and load increments. The results		

Cont from Block 20

for the stresses and strains in all principal directions have been computed as functions of loading history.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-MR-79027	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A CONCEPT FOR A <u>MINIMUM SIGNATURE ENVELOPE</u> <u>RECOILLESS GUN (MISER)</u>		5. TYPE OF REPORT & PERIOD COVERED FINAL 1 Oct 76 - 1 Oct 77
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) MALCOLM K. DALE		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory US Army Armament Research & Development Command Watervliet Arsenal, Watervliet, NY 12189		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS PE-61101A Proj - 1T161101A91A WU - 167
11. CONTROLLING OFFICE NAME AND ADDRESS Large Caliber Weapon Systems Laboratory US Army Armament Research & Development Command Dover, NJ 07801		12. REPORT DATE May 1978
		13. NUMBER OF PAGES 28
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  UNCLASSIFIED
		15e. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Distribution limited to US Government Agencies only because of test and evaluation; NOV 1979. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-DM, Watervliet Arsenal, 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)  Recoilless Guns Urban Warfare Signature		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This report introduces a concept for a low signature recoilless gun applicable to Urban conflict, i.e., the Military Operations in Urban Terrain (MOUT) application, and proposes a small test program to establish concept feasibility. This is a launch or delivery system concept, and no warhead effort is included.		





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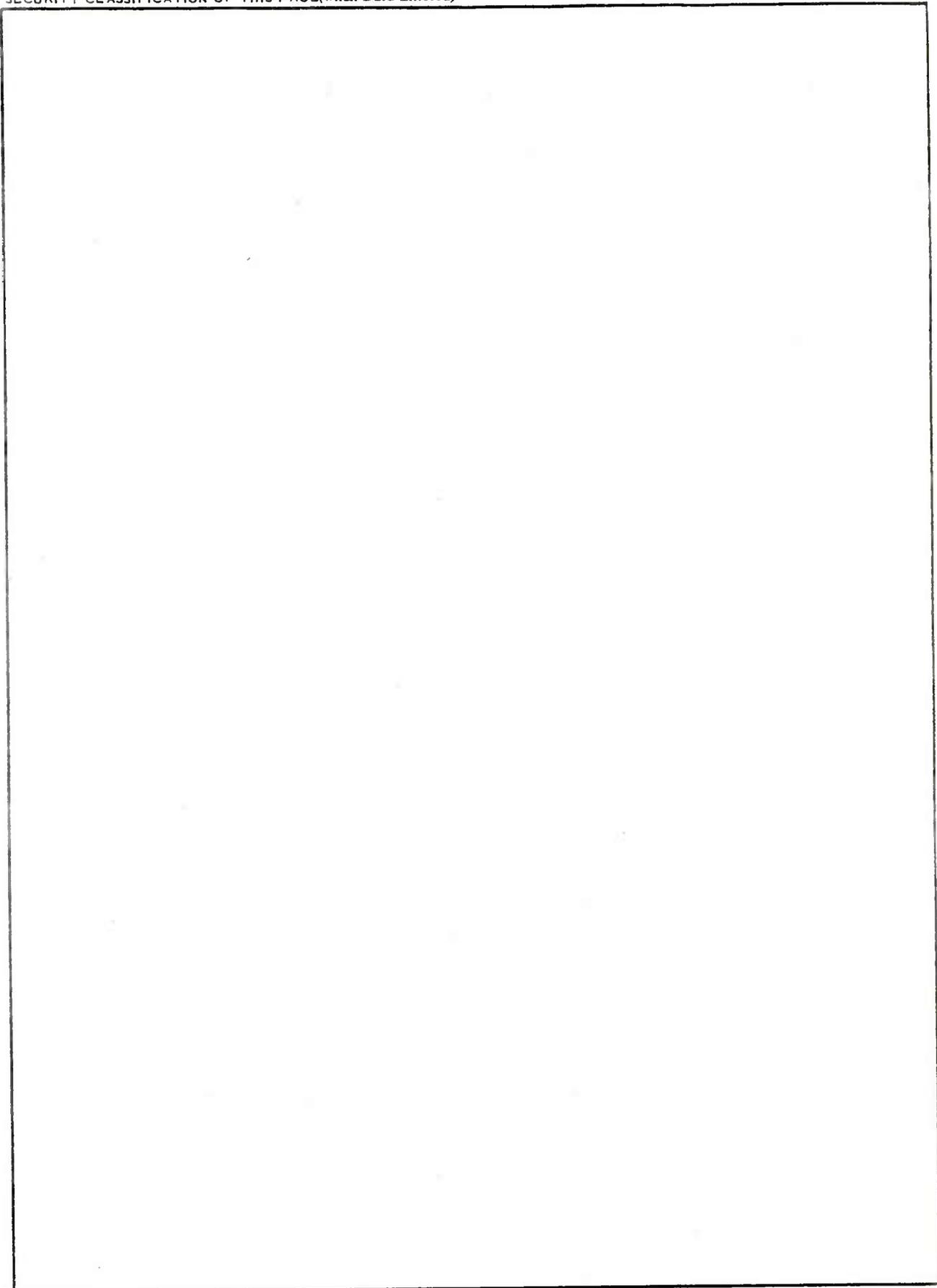
cipal equation is integrated analytically in obtaining the solution for tangential velocity in terms of the elevation angle, together with all the necessary initial conditions. The horizontal range and the vertical range are also expressed as integrals of certain function of the elevation angles. In order to obtain the sensitivity coefficient it is necessary to find the perturbations of the horizontal and vertical ranges. This procedure is similar to that of evaluating differentiation under the integral sign. The perturbation of the ranges is the sum of the perturbations due to the initial velocity, the initial elevation angle, and the impact elevation angle. By setting to zeroes the range perturbations we can group the coefficients of the perturbations into two separate equations. The ratio of the perturbations for initial elevation angle to that for initial velocity is the sensitivity coefficient for exterior ballistics that we are seeking.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79029	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) UNCONSTRAINED VARIATIONAL STATEMENTS FOR INITIAL AND BOUNDARY-VALUE PROBLEMS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) T. E. Simkins		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, NY 12189 LRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS ANCMS No. 611102H600211 DA Project No. 1L1161102H60 PRON No. 1A924324GGGG
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE October 1979
		13. NUMBER OF PAGES 20
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  Presented at the 25th (Silver Jubilee) Conf of Army Mathematicians, 6-8 Jun 79, Johns Hopkins Univ, Baltimore, MD. To be published in the proceedings of the 25th Conf of Army Mathematicians.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Variational Methods Initial/Boundary Value Problems Finite Elements Lagrange Multipliers		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  A procedure is developed for generating variational statements suitable for obtaining approximate solutions to boundary-initial value problems. The es- sence of the procedure is to introduce all boundary and initial conditions in- to the variational statement as natural boundary conditions. This is accom- plished through the use of Lagrange multipliers in which all initial condition terms as well as boundary terms are determined analytically. The result is a variational statement in which completely unconstrained trial functions may be assumed as a basis for an approximate solution. Several applications are		

Cont from Block 20

given, including the response of a beam subject to a moving concentrated mass loading.

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79030	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  DYNAMIC STABILITY OF COLUMNS SUBJECTED TO NONCONSERVATIVE FORCES		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) J. J. Wu J. D. Vasilakis		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, NY 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS PRON No. 1A-9-2ZA01-y AMCMS No. 6111.01.91A0.0 DA PRO.No. 1L161101A91A
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE October 1979
		13. NUMBER OF PAGES 21
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  Presented at the 25th (Silver Jubilee) Conf of Army Mathematicians, 6-8 Jun 79, Johns Hopkins Univ, Baltimore, MD. To be published in the Journal of Sound and Vibration.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Nonconservative Stability Follower Forces Unconstrained Variational Formulation Finite Element		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The numerical results of a class of problems of linear elastic stability problems subjected to nonconservative forces and under various support con- ditions are presented here. A single solution formulation by which these results have been obtained is described. Accuracy of these results compared with those reported in the literature is discussed.		

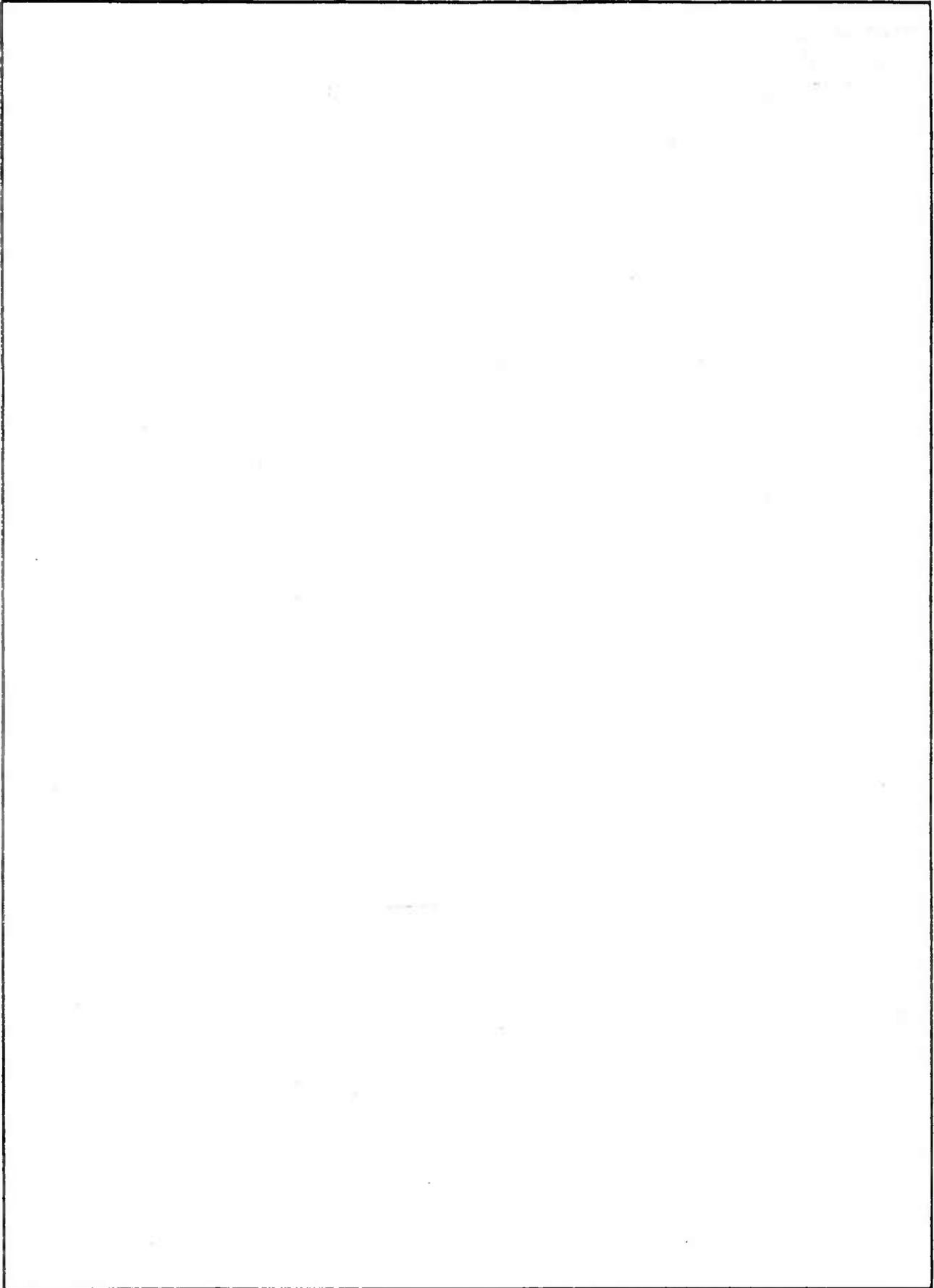


REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ARLCB-TR-79031	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  SOME OBSERVATIONS ON LIQUID METAL EMBRITTELEMENT		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  M. H. Kamdar		8. CONTRACT OR GRANT NUMBER(e)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, NY 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 611102H600211 DA Project No. 1L1161102H60 PRON No. 1A924324GGGG
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE November 1979
		13. NUMBER OF PAGES 39
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)  Distribution limited to US Government Agencies only because of test and evaluation; October 1979. Other requests for this document must be referred to Commander, ARRADCOM, ATTN: Benet Weapons Laboratory, DRDAR-LCB-RA, Watervliet Arsenal, Watervliet, New York 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) Liquid-Solid Embrittlement Embrittlement Mechanisms Fatigue Fracture		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  In this paper the phenomena of liquid and solid metal induced embrittlement of metals are described. It is shown that liquid metal embrittlement is a special case of brittle fracture. A mechanism of liquid metal embrittlement is proposed which involves liquid metal chemisorption-induced reduction in cohesive strength of bonds at the crack tip. An alternative possibility is discussed when chemisorption-induced reduction in shear strength of atomic bonds may lead to embrittlement via ductile failure mode. A new phenomenon is		

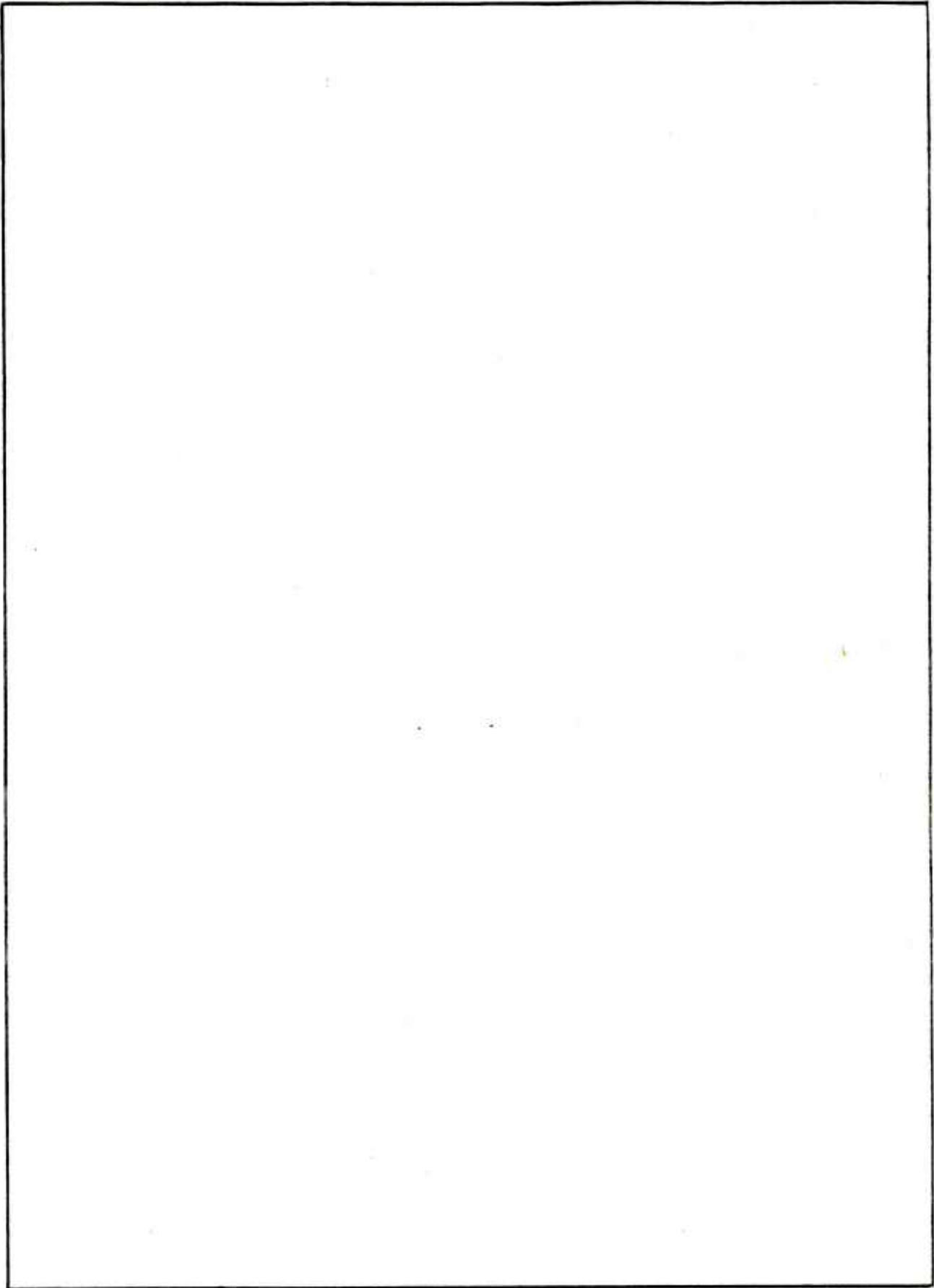
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described where a solid metal induces embrittlement in a ductile metal. A mechanism is described which may be responsible for the solid metal induced embrittlement.

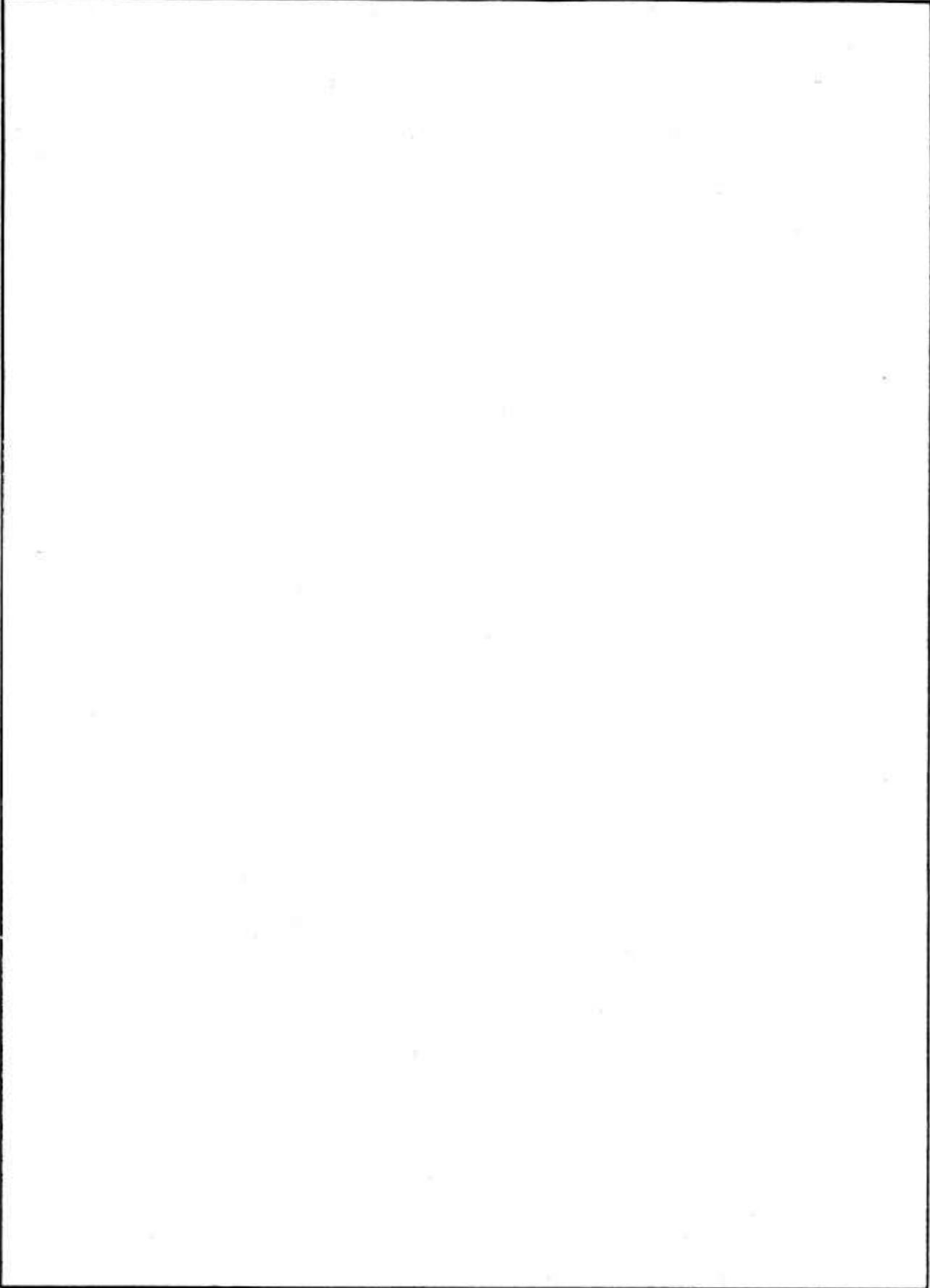
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1. REPORT NUMBER ARLCB-MR-79032	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Comparative Evaluation Test of the Lightweight Company Mortar Auxiliary Baseplate, XM82E2, Modified		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  J. J. Battaglia		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 4111.16.2050.6 PRON NO. 1A-9-29346-0 NMAE
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE August 1979
		13. NUMBER OF PAGES 17
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  UNCLASSIFIED
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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) Mortar Mortar Baseplate Mortar Ammunition Mortar Test Data		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  A test was conducted to evaluate a proposed design change for the Lightweight Company Mortar, XM82E2 baseplate. The mortar was test fired with the standard XM82E2 baseplate and a modified baseplate representing the design change. The performance of the modified baseplate appeared equal to that of the standard baseplate.		



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1. REPORT NUMBER ARLCB-TR-79033	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  A Breech Technology Program and Technical Review		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  F. J. John		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-ICB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 612603H181011 PRON. No. 1A-9-AZA07-Y-NMLC
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE August 1979
		13. NUMBER OF PAGES 45
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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) Breeches, Cannon Breech Fatigue Breech Seals Breech Mechanisms		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This is an interim review of the breech technology program being con- ducted on slide block breeches. These breeches are planned for high pressure, large caliber applications in 120mm and 155mm cannon.  The technology encompasses three principal areas: means of increasing strength, means of self sealing combustible charges and development of mechanisms to operate seals and primer loaders. Innovations to accomplish all of these are described and test results are presented where available.		



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4. TITLE (and Subtitle)  IMPLEMENTATION OF A TRAPEZOIDAL RING ELEMENT IN NASTRAN FOR ELASTIC-PLASTIC ANALYSIS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)  P. Chen P. O'Hara		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS  Benet Weapons Laboratory Watervliet Arsenal, Watervliet, NY 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No. 6111.01.91A0.0 DA Project No. 1L161101A91A PRON No. 1A-9-2ZA01-Y
11. CONTROLLING OFFICE NAME AND ADDRESS  US Army Armament Research and Development Command Large Caliber Weapon Systems Laboratory Dover, New Jersey 07801		12. REPORT DATE December 1979
		13. NUMBER OF PAGES 20
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  Unclassified
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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  Presented at the 8th NASTRAN Users' Colloquium, Goddard Space Flight Center, Oct 79. To be published in the proceedings of the 8th NASTRAN Users' Colloquium.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Elastic-Plastic Analysis NASTRAN Program Gun Tube Ring Element		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  The explicit expressions for an elastic-plastic trapezoidal ring element are presented and implemented in NASTRAN computer program. The material is assumed to obey the von Mises' yield criterion, isotropic hardening rule, and the Prandtl-Reuss flow relations. For the purpose of demonstration, two elastic-plastic problems are solved and compared with previous results. The first is a plane-strain tube under uniform internal pressure and the second a finite-length tube loaded over part of its inner surface. A very good agree- ment has been found in both test problems.		





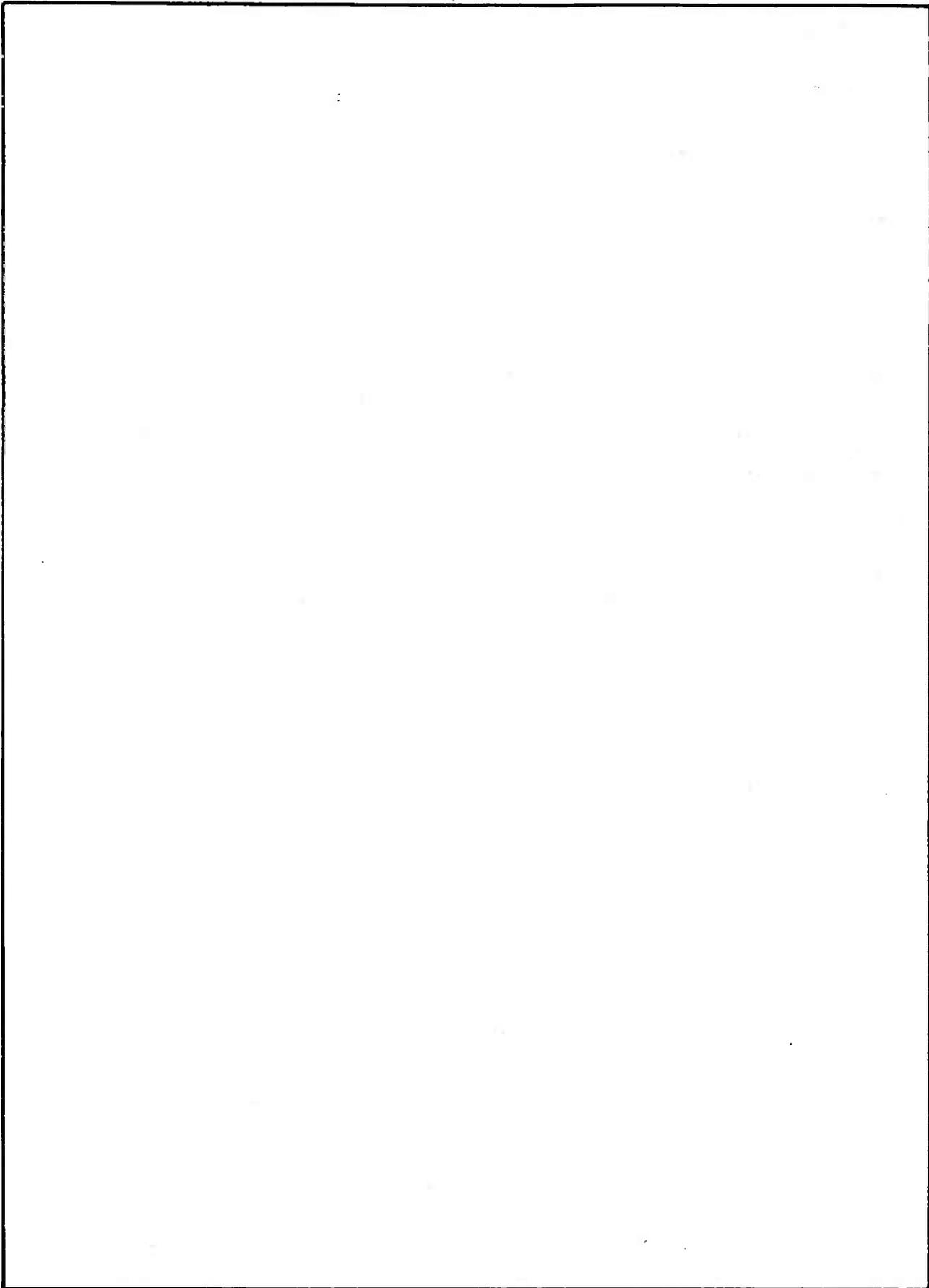
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Stress-to-rupture  
High temperature

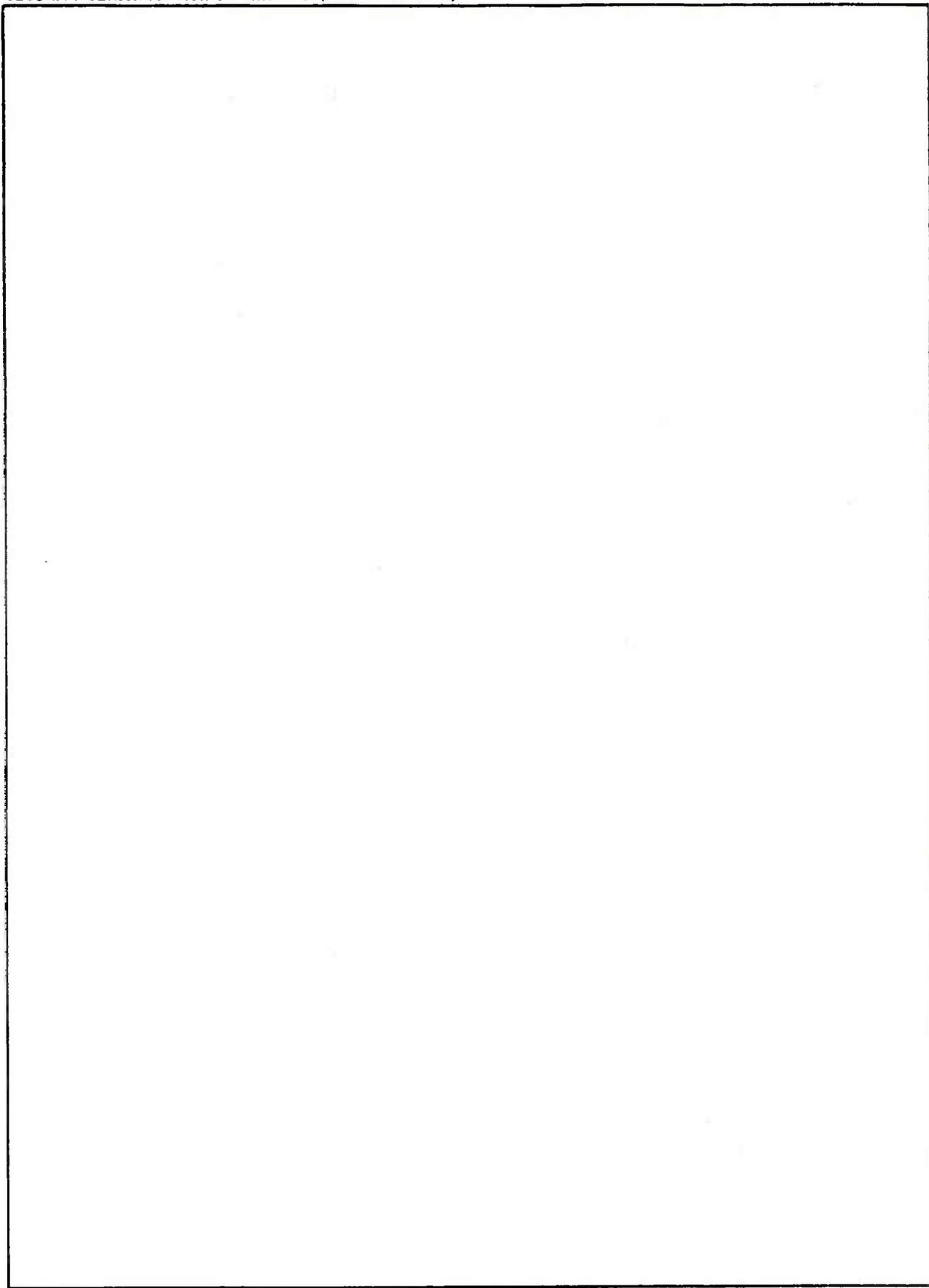
20. Cont'd

nucleation of tungsten by adjusting the temperature, the direction of flow of reactants and filament speed, the degradation effect of the coating can be minimized. TaC coating did not decrease the strength of the filament, because it did not react with the filament and had fine grain structure. Coatings of tungsten and TaC decreased the 100 hr 2000°F, rupture strength of the filament from 1.9 GN/M<sup>2</sup> (280 Ksi) to respectively 1.05 GN/M<sup>2</sup> (150 Ksi) and 1.6 GN/M<sup>2</sup> (240 Ksi). The tensile strength of the W coated filament was superior to that coated with TaC in the temperature range 1000 - 1500°C. Thermal cycling (room temperature - 1600°C) induced cracks in the TaC coating while W coating remained unaffected.





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4. TITLE (and Subtitle) Potential Erosion Resistant Refractory Metal (and/or) Alloy Coatings for Gun Tubes		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) I. Ahmad                      G. D'Andrea P. Greco                        J. Barranco		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Benet Weapons Laboratory Watervliet Arsenal, Watervliet, N.Y. 12189 DRDAR-LCB-TL		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AMCMS No 611102H 600011 DA Project NO. 1L161102AH60 Pron No. GG825497GGM7
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research and Development Command Large Caliber Weapon System Laboratory Dover, New Jersey 07801		12. REPORT DATE Dec 1979
		13. NUMBER OF PAGES 14
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)  UNCLASSIFIED
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18. SUPPLEMENTARY NOTES Presented at Tri-Service Conference on Corrosion, New Orleans, La., Oct. 1978.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Erosion Resistant Materials                      Refractory Metals Coatings    Wear Gun Barrel Erosion		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report addresses the problem of erosion in gun tubes and the need to develop superior materials and techniques for its control in gun barrels.		



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