

AD

SPECIAL PUBLICATION ARCCB-SP-95037

INDEX TO BENET LABORATORIES TECHNICAL REPORTS - 1994

R. D. NEIFELD

AUGUST 1995



**US ARMY ARMAMENT RESEARCH,
DEVELOPMENT AND ENGINEERING CENTER**
CLOSE COMBAT ARMAMENTS CENTER
BENÉT LABORATORIES
WATERVLIET, N.Y. 12189-4050



APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

19960221 084

DTIC QUALITY INSPECTED 1

DISCLAIMER

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

The use of trade name(s) and/or manufacturer(s) does not constitute an official indorsement or approval.

DESTRUCTION NOTICE

For classified documents, follow the procedures in DoD 5200.22-M, Industrial Security Manual, Section II-19 or DoD 5200.1-R, Information Security Program Regulation, Chapter IX.

For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.

For unclassified, unlimited documents, destroy when the report is no longer needed. Do not return it to the originator.

REPORT DOCUMENTATION PAGEForm Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)**2. REPORT DATE**
August 1995**3. REPORT TYPE AND DATES COVERED**
Final**4. TITLE AND SUBTITLE**
INDEX TO BENET LABORATORIES
TECHNICAL REPORTS - 1994**5. FUNDING NUMBERS**
N/A**6. AUTHOR(S)**

R. D. Neifeld

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army ARDEC
Benet Laboratories, AMSTA-AR-CCB-O
Watervliet, NY 12189-4050**8. PERFORMING ORGANIZATION
REPORT NUMBER**
ARCCB-SP-95037**9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
U.S. Army ARDEC
Close Combat Armaments Center
Picatinny Arsenal, NJ 07806-5000**10. SPONSORING / MONITORING
AGENCY REPORT NUMBER****11. SUPPLEMENTARY NOTES****12a. DISTRIBUTION / AVAILABILITY STATEMENT**
Approved for public release; distribution unlimited.**12b. DISTRIBUTION CODE****13. ABSTRACT (Maximum 200 words)**

This is a compilation of technical reports published by Benet Laboratories during 1994.

14. SUBJECT TERMS

Benet Laboratories, Technical Publications, Bibliographies, Abstracts, Document Control Data

15. NUMBER OF PAGES
74**16. PRICE CODE****17. SECURITY CLASSIFICATION
OF REPORT**
UNCLASSIFIED**18. SECURITY CLASSIFICATION
OF THIS PAGE**
UNCLASSIFIED**19. SECURITY CLASSIFICATION
OF ABSTRACT**
UNCLASSIFIED**20. LIMITATION OF ABSTRACT**
UL

TABLE OF CONTENTS

	<u>Page</u>
LIST OF REPORTS	1
AUTHOR INDEX	7
SUBJECT INDEX	11
AD NUMBERS	23
REPORT DOCUMENTATION PAGES	25

TECHNICAL REPORTS 1994

REPORT NUMBER	TITLE	AUTHOR	DATE
ARCCB-TR-94001	Simpler J_{lc} Test and Data Analysis Procedures for High Strength Steels	J.H. Underwood E.J. Troiano R.T. Abbott	Jan 94
ARCCB-TR-94002	Curvature-Induced Motions of 60-mm Guns - Phase II: Modelling	R.G. Gast	Jan 94
ARCCB-TR-94003	A Review of Weldment Failure Modes and Weldability Testing Methods	G. Young	Jan 94
ARCCB-TR-94004	A Review of Radial Forging Technology Including Preform Design for Process Optimization	J.P. Domblesky R. Shivpuri T. Altan C. Calderone (Benet POC)	Feb 94
ARCCB-TR-94005	Determination of Thermal Characteristics of 120-mm Tank Ammunition	K.A.L. Madulka E. Coppola J. Kenna	Feb 94
ARCCB-TR-94006	How the Brain Works	R. Scanlon M. Johnson	Feb 94
ARCCB-TR-94007	A Stress Factor Method for Perforated Muzzle Brake Design	G.C. Carofano M.R. Leach	Feb 94
ARCCB-TR-94008	Evaluation of the "Soft-Ride" Muzzle Reference System Collimators	E. Hyland	Mar 94
ARCCB-TR-94009	Design of a Fatigue-Resistant Press Used to Contain 3,000 Kips of End Load as a Result of High Pressure Cyclic Testing of Open-Ended Cylinders	M.J. Audino J.A. Kapp	Mar 94
ARCCB-TR-94010	Notch-Tip Damage and Translaminar Fracture Toughness Measurements from Carbon/Epoxy Laminates	J.H. Underwood M.T. Kortschot	Mar 94
ARCCB-TR-94011	Chromium/Molybdenum Alloy Plating - Part I: The Electrodeposition of Low Contraction Chromium/Molybdenum Alloys Using Unipolar (On/Off) Pulse Plating	M.D. Miller S. Langston	Mar 94

TECHNICAL REPORTS 1994

ARCCB-TR-94012	Calculations Via Successive Approximations of Stress and Strain Distribution in Thick-Walled Concentric Tubes Due to a Radial Temperature Gradient	B. Avitzur	Mar 94
ARCCB-TR-94013	Qualification of M256 Breechblock Weld Repair	D.A. Porter W.E. Marcoux A.E. Fish	Mar 94
ARCCB-TR-94014	Standards for Ordnance Materials; Dynamic Fracture and Environmental Cracking Applications	J.H. Underwood	Apr 94
ARCCB-TR-94015	Materials Analysis of 155-mm Improved Conventional Armament System (ICAS) Cannon, Tube Serial No. XP-1	K.E. Noll	Apr 94
ARCCB-TR-94016	155-mm Advanced Field Artillery System Liquid Propellant Prototype Cannon: Performance of the Weapon's Recoil system	R.G. Gast	Apr 94
ARCCB-TR-94017	Yield-Before-Break Fracture Mechanics Analysis of High Strength Steel Pressure Vessels	J.H. Underwood R.A. Farrara M.J. Audino	May 94
ARCCB-TR-94018	Experimental Heat Treatment of Beryllium Copper Alloy	K.E. Noll	May 94
ARCCB-TR-94019	Numerical Box-Counting and Correlation Integral Multifractal Analysis	L.V. Meisel M.A. Johnson	May 94
ARCCB-TR-94020	Automated Welding of Rotary Forge Hammers	J.R. Senick, Jr.	May 94
ARCCB-TR-94021	Servo Control Using Switches for Discrete Positional Feedback	R.L. Racicot	May 94
ARCCB-TR-94022	Metallurgical Evaluation of 25-mm M242 Bushmaster Gun Tubes, Serial Nos. 12373 and 12374	K.E. Noll J.R. Senick, Jr.	May 94
ARCCB-TR-94023	The Effects of Fatigue Loading Frequency on Fatigue Life of High-Strength Pressure Vessel Steels	R.R. Fujczak	Jun 94

TECHNICAL REPORTS 1994

ARCCB-TR-94024	Fatigue Life Tests for the Muzzle Reference System Collimator on the 120-mm M256 Cannon Tube	J.H. Underwood E. Troiano D.E. Leighton R.T. Abbott D. Crayon V.J. Olmstead R.A. Farrara	Jun 94
ARCCB-TR-94025	Stress Intensity Factor and Load-Line Displacement Expressions for the Round Bar Bend Specimen	J.H. Underwood	Jun 94
ARCCB-SP-94026	Index to Benet Laboratories Technical Reports - 1993	R.D. Neifeld	Jul 94
ARCCB-TR-94027	Automated Data Base of Mechanical and Physical Properties for Gun Steel	R.R. Fuczak G.L. Spencer J.H. Underwood E. Troiano	Jul 94
ARCCB-TR-94028	Perimeter-Yardstick Technique for Fracture Surface Fractal Analysis	G. Kendall P.J. Cote L.V. Meisel	Aug 94
ARCCB-TR-94029	Exponents in Lifetime and Power Spectral Density in Self-Organized Critical Systems	L.V. Meisel P.J. Cote	Aug 94
ARCCB-TR-94030	Failure Analysis of 120-mm Mortar Bushings and Firing Pins	K.E. Noll	Aug 94
ARCCB-TR-94031	Residual Stress Analysis in Swage Autofrettaged Thick-Walled Cylinders by Position-Sensitive X-ray Diffraction Techniques	S.L. Lee	Aug 94
ARCCB-TR-94032	Fracture Assessment of 155-mm M284 Breech Rings	E. Troiano J.H. Underwood R.T. Abbott	Aug 94
ARCCB-TR-94033	Adaptive Finite Element Method I: Solution Algorithm and Computational Examples	J.M. Coyle J.E. Flaherty	Aug 94
ARCCB-TR-94034	Adaptive Finite Element Method II: Error Estimation	J.M. Coyle J.E. Flaherty	Sep 94
ARCCB-TR-94035	Failure Analysis of 120-mm M256 Gun Tube, Serial No. 2416	K.E. Noll J.R. Senick, Jr.	Sep 94

TECHNICAL REPORTS 1994

ARCCB-TR-94036	Experimental Methods in Residual Stress Measurement Using a Position-Sensitive Single-Exposure Scintillation Detection System	S.L. Lee M. Doxbeck G.P. Capsimalis	Sep 94
ARCCB-TR-94037	Chromium Plating and Electropolishing Solution Analyses by Online X-ray Fluorescence Spectroscopy	S. Sopok	Sep 94
ARCCB-TR-94038	Fatigue Life Analysis and Tests for Thick-Walled Cylinders Including Effects of Overstrain and Axial Grooves	J.H. Underwood A.P. Parker	Sep 94
ARCCB-TR-94039	Monitor for <i>Status Epilepticus</i> Seizures	M. Johnson T. Simkins	Oct 94
ARCCB-MR-94040	Geometric Dimensioning and Tolerancing - 1946 to 1982 - The Differences in the Standards	D.H. Honsinger	Oct 94
ARCCB-TR-94041	A Fracture Mechanics Assessment of the 155-mm M284 Muzzle Brake	R.R. Fujczak J.A. Kapp	Oct 94
ARCCB-TR-94042	Materials Characterization of Hard Chromium and Low Contraction Chromium	K.E. Noll	Nov 94
ARCCB-TR-94043	Parallel Partitioning Strategies for the Adaptive Solution of Conservation Laws	K.D. Devine J.E. Flaherty R.M. Loy S.R. Wheat	Nov 94
ARCCB-TR-94044	Application of a Rapid Quench Thermomagnetic Analyzer to Austempered Ductile Iron	P.J. Cote T. Hickey M.D. Witherell	Nov 94
ARCCB-TR-94045	An HP-Adaptive Method in Space and Time for Parabolic Systems	J.E. Flaherty P.K. Moore	Dec 94
ARCCB-TR-94046	Stress Concentration, Stress Intensity, and Fatigue Crack Growth Along Evacuators of Pressurized, Autofrettaged Tubes	A.P. Parker J.H. Underwood	Dec 94
ARCCB-MR-94047	Report of Visiting Scientist Attachment of Dr. Anthony P. Parker of University of Northumbria, U.K. to Benet Laboratories July - August 1994	J.H. Underwood A.P. Parker	Dec 94

TECHNICAL REPORTS 1994

ARCCB-TR-94048	Spectral Characterization of Pulsed Ultrasound Using Neural Networks	M.A. Johnson M.A. Cipollo R.D. Scanlon	Dec 94
ARCCB-TR-94049	The Electrodeposition of Low Contraction Chromium/Molybdenum Alloys Using Pulse-Reverse Plating	M.D. Miller S. Langston	Dec 94

AUTHOR INDEX 1994

AUTHOR	REPORT NUMBER
Abbott, R.T.	ARCCB-TR-94001 ARCCB-TR-94024 ARCCB-TR-94032
Altan, T.	ARCCB-CR-94004
Audino, M.J.	ARCCB-TR-94009 ARCCB-TR-94017
Avitzur, B.	ARCCB-TR-94012
Calderone, C.	ARCCB-CR-94004
Capsimalis, G.P.	ARCCB-TR-94036
Carofano, G.C.	ARCCB-TR-94007
Cipollo, M.A.	ARCCB-TR-94048
Coppola, E.	ARCCB-TR-94005
Cote, P.J.	ARCCB-TR-94028 ARCCB-TR-94029 ARCCB-TR-94044
Coyle, J.M.	ARCCB-TR-94033 ARCCB-TR-94034
Crayon, D.	ARCCB-TR-94024
Devine, K.D.	ARCCB-TR-94043
Domblesky, J.P.	ARCCB-CR-94004
Doxbeck, M.	ARCCB-TR-94036
Farrara, R.A.	ARCCB-TR-94017 ARCCB-TR-94024
Fish, A.E.	ARCCB-TR-94013

AUTHOR INDEX 1994

Flaherty, J.E.	ARCCB-TR-94033 ARCCB-TR-94034 ARCCB-TR-94043 ARCCB-TR-94045
Fujczak, R.R.	ARCCB-TR-94023 ARCCB-TR-94027 ARCCB-TR-94041
Gast, R.G.	ARCCB-TR-94002 ARCCB-TR-94016
Hickey, T.	ARCCB-TR-94044
Honsinger, D.H.	ARCCB-MR-04040
Hyland, E.	ARCCB-TR-94008
Johnson, M.A.	ARCCB-TR-94006 ARCCB-TR-94019 ARCCB-TR-94039 ARCCB-TR-94048
Kapp, J.A.	ARCCB-TR-94009 ARCCB-TR-94041
Kendall, G.	ARCCB-TR-94028
Kenna, J.	ARCCB-TR-94005
Kortschot, M.T.	ARCCB-TR-94010
Langston, S.	ARCCB-TR-94011 ARCCB-TR-94049
Leach, M.R.	ARCCB-TR-94007
Lee, S.L.	ARCCB-TR-94031 ARCCB-TR-94036
Leighton, D.E.	ARCCB-TR-94024
Loy, R.M.	ARCCB-TR-94043

AUTHOR INDEX 1994

Madulka, K.A.L.	ARCCB-TR-94005
Marcoux, W.E.	ARCCB-TR-94013
Meisel, L.V.	ARCCB-TR-94019 ARCCB-TR-94028 ARCCB-TR-94029
Miller, M.D.	ARCCB-TR-94011 ARCCB-TR-94049
Moore, P.K.	ARCCB-TR-94045
Neifeld, R.D.	ARCCB-SP-94026
Noll, K.E.	ARCCB-TR-94015 ARCCB-TR-94018 ARCCB-TR-94022 ARCCB-TR-94030 ARCCB-TR-94035 ARCCB-TR-94042
Olmstead, V.J.	ARCCB-TR-94024
Parker, A.P.	ARCCB-TR-94038 ARCCB-TR-94046 ARCCB-MR-94047
Porter, D.A.	ARCCB-TR-94013
Racicot, R.L.	ARCCB-TR-94021
Scanlon, R.D.	ARCCB-TR-94006 ARCCB-TR-94048
Senick, J.R., Jr.	ARCCB-TR-94020 ARCCB-TR-94022 ARCCB-TR-94035
Shivpuri, R.	ARCCB-CR-94004
Simkins, T.	ARCCB-TR-94039

AUTHOR INDEX 1994

Sopok, S.	ARCCB-TR-94037
Spencer, G.L.	ARCCB-TR-94027
Troiano, E.J.	ARCCB-TR-94001 ARCCB-TR-94024 ARCCB-TR-94027 ARCCB-TR-94032
Underwood, J.H.	ARCCB-TR-94001 ARCCB-TR-94010 ARCCB-TR-94014 ARCCB-TR-94017 ARCCB-TR-94024 ARCCB-TR-94025 ARCCB-TR-94027 ARCCB-TR-94032 ARCCB-TR-94038 ARCCB-TR-94046 ARCCB-MR-94047
Wheat, S.R.	ARCCB-TR-94043
Witherell, M.D.	ARCCB-TR-94044
Young, G.	ARCCB-TR-94003

SUBJECT INDEX 1994

SUBJECT	REPORT NUMBER
A Posteriori Error Estimation	ARCCB-TR-94045
Abstracts	ARCCB-SP-94026
Adaptive Methods	ARCCB-TR-94033 ARCCB-TR-94034 ARCCB-TR-94043
Adaptive Refinement	ARCCB-TR-94045
Adiabatic Shear Zone	ARCCB-TR-94015
Advanced Field Artillery System	ARCCB-TR-94016
Age Hardening	ARCCB-TR-94018
Algorithms	ARCCB-TR-94019 ARCCB-TR-94021 ARCCB-TR-94033 ARCCB-TR-94043 ARCCB-TR-94045
Anti-Armor Ammunition	ARCCB-TR-94005
Artificial Intelligence	ARCCB-TR-94006
Artillery	ARCCB-TR-94016
Artillery Ammunition	ARCCB-TR-94002
Austempered Ductile Iron	ARCCB-TR-94044
Austenite	ARCCB-TR-94044
Autofrettage	ARCCB-TR-94031 ARCCB-TR-94038 ARCCB-TR-94046
Bauschinger Effect	ARCCB-TR-94031
Bending	ARCCB-TR-94023 ARCCB-TR-94025
Beryllium	ARCCB-TR-94018
Biaxial Stress	ARCCB-TR-94036

SUBJECT INDEX 1994

Bibliographies	ARCCB-SP-94026
Boresighting	ARCCB-TR-94008
Boundary Value Problems	ARCCB-TR-94033 ARCCB-TR-94034
Box-Counting Algorithms	ARCCB-TR-94019
Brain	ARCCB-TR-94006
Breech Mechanisms	ARCCB-TR-94013
Breech Rings	ARCCB-TR-94032
Bushings	ARCCB-TR-94030
Bushmaster	ARCCB-TR-94022
Carbon	ARCCB-TR-94010
Chemical Analysis	ARCCB-TR-94037
Chromium	ARCCB-TR-94011 ARCCB-TR-94017 ARCCB-TR-94037 ARCCB-TR-94042 ARCCB-TR-94049
Collimators	ARCCB-TR-94008 ARCCB-TR-94024
Composite Materials	ARCCB-TR-94010
Conservation	ARCCB-TR-94043
Contraction	ARCCB-TR-94011
Copper Alloys	ARCCB-TR-94018
Correlation Integral Methods	ARCCB-TR-94019
Cracking (Fracturing)	ARCCB-TR-94003 ARCCB-TR-94014
Cracks	ARCCB-TR-94001 ARCCB-TR-94046

SUBJECT INDEX 1994

Curvature	ARCCB-TR-94002
Cylindrical Bodies	ARCCB-TR-94009 ARCCB-TR-94031 ARCCB-TR-94038 ARCCB-TR-94046
Data Bases	ARCCB-TR-94027
Data Reduction	ARCCB-TR-94016
Deformation Zones	ARCCB-CR-94004
Depleted Uranium	ARCCB-TR-94022
Dynamic Strains	ARCCB-TR-94008
Electrodeposition	ARCCB-TR-94011 ARCCB-TR-94049
Electron Beam Welding	ARCCB-TR-94024
Electroplating	ARCCB-TR-94049
Electropolishing Solutions	ARCCB-TR-94037
Engineering Drawings	ARCCB-MR-94040
Environmental Cracking	ARCCB-TR-94014
Epilepsy	ARCCB-TR-94039
Epoxy Laminates	ARCCB-TR-94010
Erosion	ARCCB-TR-94038
Error Estimation	ARCCB-TR-94033 ARCCB-TR-94034
Evacuators	ARCCB-TR-94046
Failure (Mechanics)	ARCCB-TR-94003 ARCCB-TR-94015 ARCCB-TR-94023 ARCCB-TR-94030 ARCCB-TR-94035

SUBJECT INDEX 1994

Fasteners	ARCCB-TR-94024
Fatigue (Mechanics)	ARCCB-TR-94017 ARCCB-TR-94046
Fatigue Life	ARCCB-TR-94009 ARCCB-TR-94023 ARCCB-TR-94024 ARCCB-TR-94032 ARCCB-TR-94038 ARCCB-TR-94041
Feedback	ARCCB-TR-94021
Field Condemnation	ARCCB-TR-94041
Finite Element Analysis	ARCCB-TR-94033 ARCCB-TR-94034 ARCCB-TR-94043 ARCCB-TR-94045
Firing Pins	ARCCB-TR-94030
Firing Tests (Ordnance)	ARCCB-TR-94008
Fluorescence	ARCCB-TR-94037
Forging	ARCCB-CR-94004
Fractals	ARCCB-TR-94019 ARCCB-TR-94028
Fracture (Mechanics)	ARCCB-TR-94001 ARCCB-TR-94010 ARCCB-TR-94014 ARCCB-TR-94017 ARCCB-TR-94025 ARCCB-TR-94028 ARCCB-TR-94032 ARCCB-TR-94035 ARCCB-TR-94038 ARCCB-TR-94041 ARCCB-TR-94046 ARCCB-MR-94047
Fresnel Integrals	ARCCB-TR-94029

SUBJECT INDEX 1994

Galerkin Method	ARCCB-TR-94043
Geometric Dimensioning	ARCCB-MR-94040
Gun Muzzles	ARCCB-TR-94007 ARCCB-TR-94008 ARCCB-TR-94042
Gun Tubes	ARCCB-TR-94002 ARCCB-TR-94009 ARCCB-TR-94012 ARCCB-TR-94014 ARCCB-TR-94015 ARCCB-TR-94017 ARCCB-TR-94022 ARCCB-TR-94024 ARCCB-TR-94035 ARCCB-TR-94038 ARCCB-TR-94042 ARCCB-TR-94046
Guns	ARCCB-SP-94026 ARCCB-TR-94041
<i>h</i> -refinement	ARCCB-TR-94043
Hammers	ARCCB-TR-94020
Heat Treatment	ARCCB-CR-94004 ARCCB-TR-94018
Heat-Affected Zone	ARCCB-TR-94003
High Strength	ARCCB-TR-94001 ARCCB-TR-94009 ARCCB-TR-94017 ARCCB-TR-94023 ARCCB-TR-94028
Hyperbolic Conservation Laws	ARCCB-TR-94043
Hyperbolic Distributions	ARCCB-TR-94029
Improved Conventional Armament System	ARCCB-TR-94015
Indexes	ARCCB-SP-94026

SUBJECT INDEX 1994

Iron Alloys	ARCCB-TR-94044
J-Integrals	ARCCB-TR-94001
Laminates	ARCCB-TR-94010
Liquid Propellant Guns	ARCCB-TR-94016
Load-Line Displacement	ARCCB-TR-94025
Low Contraction	ARCCB-TR-94042 ARCCB-TR-94049
M1A1 Tanks	ARCCB-TR-94008
M242 Guns	ARCCB-TR-94022
M256 Breech Mechanisms	ARCCB-TR-94013
M256 Gun Tubes	ARCCB-TR-94008 ARCCB-TR-94024 ARCCB-TR-94035
M284 Breech Rings	ARCCB-TR-94032
M284 Muzzle Brakes	ARCCB-TR-94041
Malfunction Investigation	ARCCB-TR-94022
Mathematica Programming Language	ARCCB-TR-94029
Mechanical Properties	ARCCB-CR-94004 ARCCB-TR-94015 ARCCB-TR-94022 ARCCB-TR-94027 ARCCB-TR-94030 ARCCB-TR-94032 ARCCB-TR-94035 ARCCB-TR-94042
Mesh Refinement	ARCCB-TR-94033 ARCCB-TR-94034
Metal Fatigue	ARCCB-MR-94047
Metal Inert Gas (MIG)	ARCCB-TR-94020

SUBJECT INDEX 1994

Metallurgy	ARCCB-TR-94022
Metals	ARCCB-TR-94020 ARCCB-TR-94037 ARCCB-TR-94048
Microcracking	ARCCB-TR-94042
Microvoid Coalescence	ARCCB-TR-94035
Modelling	ARCCB-TR-94002
Molybdenum	ARCCB-TR-94011 ARCCB-TR-94017 ARCCB-TR-94049
Monitors	ARCCB-TR-94039
Mortars	ARCCB-TR-94030
Multifractal Measures	ARCCB-TR-94019
Muzzle Brakes	ARCCB-TR-94007 ARCCB-TR-94041
Muzzle Reference Systems	ARCCB-TR-94008 ARCCB-TR-94024
Neural Networks	ARCCB-TR-94006 ARCCB-TR-94039 ARCCB-TR-94048
Nickel	ARCCB-TR-94017
Nitriding	ARCCB-TR-94022
Nondestructive Testing	ARCCB-TR-94036 ARCCB-TR-94048
Notch-Tip Damage	ARCCB-TR-94010
120-mm Mortars	ARCCB-TR-94030
120-mm Tank Ammunition	ARCCB-TR-94005
Online Analysis	ARCCB-TR-94037

SUBJECT INDEX 1994

Optimization	ARCCB-CR-94004
Ordnance Steel	ARCCB-TR-94014 ARCCB-TR-94027
<i>p</i> -refinement	ARCCB-TR-94043
Parallel Computers	ARCCB-TR-94043
Parallel Processing	ARCCB-TR-94048
Partial Differential Equations	ARCCB-TR-94033 ARCCB-TR-94034 ARCCB-TR-94043 ARCCB-TR-94045
Perforated Muzzle Brakes	ARCCB-TR-94007
Perimeter-Yardstick Technique	ARCCB-TR-94028
Physical Properties	ARCCB-TR-94027
Plasma Transferred Arc (PTA)	ARCCB-TR-94020
Plastic Deformation	ARCCB-TR-94017 ARCCB-TR-94031
Plating	ARCCB-TR-94011 ARCCB-TR-94037
Position-Sensitive Scintillation Detection	ARCCB-TR-94031 ARCCB-TR-94036
Power Laws	ARCCB-TR-94029
Preforms	ARCCB-CR-94004
Pressure Vessels	ARCCB-TR-94017 ARCCB-TR-94023 ARCCB-TR-94031 ARCCB-MR-94047
Projectiles	ARCCB-TR-94002
Pulses	ARCCB-TR-94011 ARCCB-TR-94049

SUBJECT INDEX 1994

Quenching	ARCCB-TR-94044
Recoil Mechanisms	ARCCB-TR-94016
Reports	ARCCB-SP-94026 ARCCB-MR-94047
Residual Stress	ARCCB-TR-94031 ARCCB-TR-94036 ARCCB-TR-94038 ARCCB-TR-94046
Rotary Forging	ARCCB-CR-94004 ARCCB-TR-94020
Round Bar	ARCCB-TR-94025
Safe Service Life	ARCCB-TR-94009
Scientists	ARCCB-MR-94047
Self-Organized Phenomena	ARCCB-TR-94029
Servomechanisms	ARCCB-TR-94021
Shock	ARCCB-TR-94013
Shock Absorbers	ARCCB-TR-94016
Signal Analysis	ARCCB-TR-94048
Sine Integrals	ARCCB-TR-94029
Single-Exposure Technique	ARCCB-TR-94036
60-mm Guns	ARCCB-TR-94002
Slit-Island Method	ARCCB-TR-94028
Soderberg Criteria	ARCCB-TR-94009
<i>Status Epilepticus</i>	ARCCB-TR-94039

SUBJECT INDEX 1994

Steel	ARCCB-TR-94001 ARCCB-TR-94017 ARCCB-TR-94023 ARCCB-TR-94027 ARCCB-TR-94028 ARCCB-TR-94036 ARCCB-TR-94044
Strain Rates	ARCCB-CR-94004
Stress Analysis	ARCCB-TR-94007
Stress Analysis	ARCCB-TR-94009 ARCCB-TR-94031 ARCCB-TR-94036 ARCCB-TR-94038 ARCCB-MR-94047
Stress Intensity Factor	ARCCB-TR-94025 ARCCB-TR-94046
Stress Strain Relations	ARCCB-TR-94012
Superconvergence	ARCCB-TR-94033 ARCCB-TR-94034
Switches	ARCCB-TR-94021
Tank Guns	ARCCB-TR-94002 ARCCB-TR-94005 ARCCB-TR-94008
Technical Publications	ARCCB-SP-94026
Temperature	ARCCB-TR-94005
Temperature Gradients	ARCCB-TR-94012
Thermal Expansion	ARCCB-TR-94012
Thermal Properties	ARCCB-TR-94005
Thermomagnetic Analysis	ARCCB-TR-94044
Thick Walls	ARCCB-TR-94012 ARCCB-TR-94031 ARCCB-TR-94038

SUBJECT INDEX 1994

Three-Point Bending	ARCCB-TR-94001 ARCCB-TR-94025
Tolerancing	ARCCB-MR-94040
Toughness	ARCCB-TR-94010
Transputers	ARCCB-TR-94048
Ultrasonic Tests	ARCCB-TR-94048
Unloading Compliance	ARCCB-TR-94001
Vents	ARCCB-TR-94007
Vertebrates	ARCCB-TR-94006
Vessel Plating	ARCCB-TR-94042
Vibration	ARCCB-TR-94002 ARCCB-TR-94013
Von Mises Stress	ARCCB-TR-94007
Welding	ARCCB-TR-94003 ARCCB-TR-94013 ARCCB-TR-94020
Wire Electrical Discharge Machining	ARCCB-TR-94030
X-Ray Diffraction	ARCCB-TR-94031 ARCCB-TR-94036
X-Ray Spectroscopy	ARCCB-TR-94037

AD NUMBERS 1994

REPORT NUMBER	AD NUMBER
ARCCB-TR-94001	A277 731
ARCCB-TR-94002	B182 554L
ARCCB-TR-94003	A278 096
ARCCB-CR-94004	A278 770
ARCCB-TR-94005	B183 887L
ARCCB-TR-94006	A279 138
ARCCB-TR-94007	A279 238
ARCCB-TR-94008	B184 834L
ARCCB-TR-94009	A279 921
ARCCB-TR-94010	A280 101
ARCCB-TR-94011	A280 236
ARCCB-TR-94012	A280 409
ARCCB-TR-94013	A280 508
ARCCB-TR-94014	A281 217
ARCCB-TR-94015	B186 717L
ARCCB-TR-94016	B186 607L
ARCCB-TR-94017	A282 518
ARCCB-TR-94018	A282 714
ARCCB-TR-94019	A282 902
ARCCB-TR-94020	A283 985
ARCCB-TR-94021	A284 747
ARCCB-TR-94022	B189 827L
ARCCB-TR-94023	A285 301
ARCCB-TR-94024	B190 269L
ARCCB-TR-94025	A285 669
ARCCB-SP-94026	B191 082L
ARCCB-TR-94027	B191 872L
ARCCB-TR-94028	A286 240
ARCCB-TR-94029	A286 242
ARCCB-TR-94030	A286 391
ARCCB-TR-94031	A286 383

AD NUMBERS 1994

ARCCB-TR-94032	A194 977L
ARCCB-TR-94033	A288 979
ARCCB-TR-94034	A288 358
ARCCB-TR-94035	B195 530L
ARCCB-TR-94036	A289 803
ARCCB-TR-94037	A290 023
ARCCB-TR-94038	A290 931
ARCCB-TR-94039	A290 885
ARCCB-MR-94040	A290 909
ARCCB-TR-94041	B200 266L
ARCCB-TR-94042	B196 808L
ARCCB-TR-94043	A290 458
ARCCB-TR-94044	A292 261
ARCCB-TR-94045	A292 262
ARCCB-TR-94046	A291 920
ARCCB-MR-94047	A292 299
ARCCB-TR-94048	A292 440
ARCCB-TR-94049	A292 727

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE January 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE SIMPLER J_{Ic} TEST AND DATA ANALYSIS PROCEDURES FOR HIGH STRENGTH STEELS				5. FUNDING NUMBERS AMCMS No. 6111.02.H610.011 PRON No. 1A11Z1CANMBJ	
6. AUTHOR(S) J.H. Underwood, E.J. Troiano, and R.T. Abbott					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94001	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Presented at the 24th National Symposium on Fracture Mechanics, Gatlinburg, TN, 30 June-2 July 1992. Published in Proceedings of the Symposium.					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Tests of five medium and high strength steels were used to investigate some prospective simplifications in J_{Ic} test and data analysis procedures. Three-point bend specimens with material strengths of 500 to 1500 MPa and nominal thickness of 10 mm were tested at room temperature. The investigation included (1) J_{Ic} tests using measured crack-mouth displacement to calculate load-line displacement based on an expression that relates the two displacements; (2) a simple zero-point adjustment for J versus Δa curves, whereby certain intermediate Δa values are shifted to the blunting line to correct for errors at low values of Δa ; and (3) a comparison of Δa and J_{Ic} results from the load-drop method, which gives a simple measure of crack growth after maximum load, with results from the usual unloading compliance method. The various results and comparisons are discussed in relation to their usefulness as a general J_{Ic} test procedure for a variety of materials, or a limited use test for certain materials. Two specific test and data analysis procedures are proposed for general use in J_{Ic} testing, as follows: (1) A new expression is described that calculates load-line displacement for the bend specimen from measured crack-mouth displacement, for a range of a/W values and strain-hardening exponents. The expression makes possible a single-displacement unloading compliance J_{Ic} test for the bend specimen, using a single, standard, crack-mouth clip gage. (2) A simple zero-shift procedure is proposed for general use with J_{Ic} tests and for addition to ASTM Method E-813. The procedure adjusts the zero point of Δa so that on average the Δa values lie on the blunting line over the J-range of 20 to 60 percent of the provisional fracture toughness, J_{Q} . The adjustment calculations can be done with a calculator or a few lines of computer code.					
14. SUBJECT TERMS J-Integral Fracture Toughness, Fracture Mechanics, High Strength Steel, Crack-Mouth Displacement, Unloading Compliance, Three-point Bend Specimen				15. NUMBER OF PAGES 21	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE January 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE CURVATURE-INDUCED MOTIONS OF 60-MM GUNS PHASE II: MODELLING			5. FUNDING NUMBERS PRON: M139Q199M11A AMCMS: 61262411180000	
6. AUTHOR(S) Ronald G. Gast				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94002	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Distribution limited to DoD and DoD contractors only because of critical technology; January 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benét Laboratories, SMCAR-CCB-DC, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) In recent years, great strides have been made regarding the identification of the dominant loads that cause beam-type vibrations in tank cannons during ballistic operation. These motions infringe upon shot accuracy because at projectile disengagement the muzzle's kinematic state may compromise the projectile's intended flight path. A more subtle point involves the sources of loading the bore profile of the gun tube itself. While curvature-induced loads due to gravity droop are known to have little effect on gun motions, a similar claim in regard to center line profile produced by other conditions (manufacturing, thermal flexure, etc.) cannot be made. Very little testing or modelling has been conducted to establish the severity of this condition. This lack of data was the driving force behind the development of a set of controlled laboratory tests and the modelling simulations to study these relationships. Tests conducted on two 60-mm gun tubes with different profiles have been reported previously. In the current phase of this investigation, the modelling aspects are addressed. The mathematical relationships regarding load functions for beam vibration and the statistical aspects of curvature estimations are presented. These simulations mimic test results very well, thus establishing the worth of Benét Laboratories' Uniform Segments Gun Vibration Model. It is apparent that the tubes modelled are not dynamically similar with regard to their transverse motions during operation. The muzzle motion of the tube processing the most curvature is greater than and more sensitive to orientation than the straighter tube. The data indicates their effect and the modelling results confirm that shape and orientation have a significant effect upon gun motion and quite presumably accuracy.				
14. SUBJECT TERMS Gun Vibration, Vibration Modelling, Modal Analysis, 60-mm Guns, Gun Accuracy, Bore Curvature Sensitivity, Non-uniform Beam Vibration Modelling			15. NUMBER OF PAGES 32	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE January 1994		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE A REVIEW OF WELDMENT FAILURE MODES AND WELDABILITY TESTING METHODS			5. FUNDING NUMBERS AMCMS No. 6126.24.H180.000 PRON No. 1A12ZW22NMBJ	
6. AUTHOR(S) George Young				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94003	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) An engineering study was conducted that reviewed typical weldment failure modes and the types of weldability test procedures currently used to predict behavioral response of a material that is to be welded. In comparing the design effectiveness of these tests, each has certain inherent technical advantages/disadvantages associated with it. The tests, if used appropriately, can save untold time and costs associated with poorly welded structures/components that fail in service prematurely. They are divided into two major categories, direct and indirect, related to the test methodology or procedure used to generate results. Specifically, direct tests make use of actual weldments, while indirect tests utilize basic metallurgical principles to predict weld behavior. From this study, it should be apparent that determining what the most appropriate weldability test procedure is for obtaining useful results for a given situation is critical to the success of that test.				
14. SUBJECT TERMS Weldability, Hot Cracking, Cold Cracking, Heat-Affected Zone			15. NUMBER OF PAGES 23	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE February 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE A REVIEW OF RADIAL FORGING TECHNOLOGY INCLUDING PREFORM DESIGN FOR PROCESS OPTIMIZATION			5. FUNDING NUMBERS Contract DAAA22-89-M-0081	
6. AUTHOR(S) Joseph P. Domblesky, Rajiv Shivpuri, and Taylan Altan				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NSF Engineering Research Center for Net Shape Manufacturing The Ohio State University Columbus, Ohio 43210			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			10. SPONSORING / MONITORING AGENCY REPORT NUMBER ARCCB-CR-94004	
11. SUPPLEMENTARY NOTES Charles Calderone - Benet Laboratories Project Engineer				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The Engineering Research Center for Net Shape Manufacturing (located at Ohio State University, Columbus, Ohio) was contracted by Benet Laboratories to investigate the rotary forging operation at Watervliet Arsenal. They were asked to make recommendations on how to optimize the shape and size of the starting material (preform) prior to forging which would reduce or eliminate variations in mechanical properties along the length of the resulting forging. Based on the data supplied by Benet Laboratories, the study resulted in recommendation of a two-step preform design. This was a preliminary recommendation and further testing was suggested to separate the effects of forging reduction from post-forging heat treatment.				
14. SUBJECT TERMS Deformation Zones, Forging Reduction, Heat Treatment, Mechanical Properties, Optimization, Preform, Rotary Forging, Strain Rates			15. NUMBER OF PAGES 106	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGEForm Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE February 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE DETERMINATION OF THERMAL CHARACTERISTICS OF 120-MM TANK AMMUNITION			5. FUNDING NUMBERS AMCMS No. 6126.24.H180.000	
6. AUTHOR(S) Karol Anne Liu Madulka, Eugene Coppola, and John Kenna				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94005	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Distribution limited to U.S. Government Agencies only because of proprietary information and specific authority; February 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benet Laboratories, SMCAR-CCB-DC, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A program has been completed in which the thermal properties of 12 instrumented 120-mm tank rounds were measured as a function of varying ambient temperature. This report describes the test procedure, results of the test, and preliminary conclusions. The primary technical objective of the program was to determine the thermal responsiveness (in terms of time) of 120-mm tank rounds to varying ambient temperature conditions. The overall purpose of this report is to document program efforts. This report provides a reference for future work on the thermal characteristics of 120-mm M256 cannon tank ammunition.				
14. SUBJECT TERMS Thermal Emulator, 120-mm Tank Ammunition, Thermal Responsiveness, Instrumented Rounds, M1A1 Tank			15. NUMBER OF PAGES 89	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGEForm Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE February 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE HOW THE BRAIN WORKS			5. FUNDING NUMBERS AMCMS: 6111.01.91A0.0 PRON: 1A1AZ11BNMBJ	
6. AUTHOR(S) Raymond Scanlon and Mark Johnson				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94006	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The vertebrate brain is explained as an assemblage of neurons, each responsive only to those afferent upon it. Thought is shown to proceed without a homunculus.				
14. SUBJECT TERMS Brain, Vertebrate, Homeostat, Thinking			15. NUMBER OF PAGES 25	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE February 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE A STRESS FACTOR METHOD FOR PERFORATED MUZZLE BRAKE DESIGN				5. FUNDING NUMBERS AMCMS: 611.02.H611.100	
6. AUTHOR(S) Garry C. Carofano and Martin R. Leach					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94007	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Accepted for presentation at the 1994 ASME Pressure Vessel and Piping Conference, 19-23 June 1994, Minneapolis, MN. Accepted for publication in the Conference Proceedings.					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A perforated muzzle brake consists of a set of vents drilled through the wall of a cannon near the muzzle to reduce the impulse transmitted to the mount. The vented structure must support both the tube pressure and the pressure acting on the vent surfaces that produces the braking force. This report presents a method for estimating the maximum Von Mises stress within the structure. The results agree to within 10 percent of those from a more detailed finite element calculation.					
14. SUBJECT TERMS Gun, Muzzle Brake, Cylinder With Multiple Holes, Stress Factors				15. NUMBER OF PAGES 15	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE March 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE EVALUATION OF THE "SOFT-RIDE" MUZZLE REFERENCE SYSTEM COLLIMATORS			5. FUNDING NUMBERS AMCMS: 6126.24.H180.0	
6. AUTHOR(S) Edward Hyland				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94008	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07801-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Distribution limited to U.S. Government Agencies only because of test and evaluation; March 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benét Laboratories, SMCAR-CCB-DA, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This report presents the results of a series of tests used to evaluate two experimental "Soft-Ride" Muzzle Reference System Collimators (MRSCs). These MRSCs were designed as potential replacements for the MRSC used on the M1A1 Abrams tank. They would be used in the event that the firing shock of future ammunition became too severe for the M1A1 MRSC. Testing consisted of non-firing environmental tests, as well as hardstand and vehicle firing tests. The MRSCs were evaluated based upon their boresight retention accuracy and their ability to attenuate the firing load experienced by the MRSC optics. Results indicate that both "Soft-Ride" MRSC configurations can significantly attenuate the firing loads seen by the MRSC optics, however, only the banded configuration provides accuracy comparable to the M1A1 MRSC.				
14. SUBJECT TERMS Muzzle Reference Systems, Collimators, M1A1 Abrams Tank, Boresight, 120-mm M256 Tube, Cannon Tubes, Muzzle Boresight Device, Dynamic Strain, Dynamic Strain Waves			15. NUMBER OF PAGES 47	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE March 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE DESIGN OF A FATIGUE-RESISTANT PRESS USED TO CONTAIN 3,000 KIPS OF END LOAD AS A RESULT OF HIGH PRESSURE CYCLIC TESTING OF OPEN-ENDED CYLINDERS				5. FUNDING NUMBERS AMCMS No. 6126.24.H180.0 PRON No. 1A12ZWGBNMBJ	
6. AUTHOR(S) Michael J. Audino and Joseph A. Kapp					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94009	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Presented at the ASTM Pressure Vessel Conference, New Orleans, LA, May 1992. Published in Proceedings of the Conference.					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) To determine the safe service life of cannon tubes, several samples must be cyclically tested to failure. Since testing these large diameter, open-ended cylinders requires pressures as high as 100 Ksi, the fatigue-loading conditions on the testing equipment are very demanding. One method for reacting the very high-end loads associated with testing these open-ended cylinders is through the use of an external press. The press design discussed in this report deals with the design procedures involved in developing an infinite life press that can react end loads as high as 3000 kips. This press design involves the use of two low deflection platens connected by two high strength posts. To design an infinite life threaded post, several methods of fatigue life enhancement can be applied. The most effective method of life extension is to preload the threaded post producing a high mean stress, but reducing the alternating stress or stress amplitude. This avenue of enhancement became the method of choice. Producing sufficient preload on a post with a diameter of 7 inches and a length of 115 inches by mechanical means requires torque-producing equipment presently available. By using electric heating elements inserted at the center of the posts, the posts can be expanded and the preload applied.					
14. SUBJECT TERMS Safe Service Life, Soderberg Criteria, Stress Amplitude, Alternating Press				15. NUMBER OF PAGES 21	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE March 1994	3. REPORT TYPE AND DATES COVERED Final		
4. TITLE AND SUBTITLE NOTCH-TIP DAMAGE AND TRANSLAMINAR FRACTURE TOUGHNESS MEASUREMENTS FROM CARBON/EPOXY LAMINATES		5. FUNDING NUMBERS AMCMS: 6111.02.H611.1 PRON: 1A11Z1CANMBJ		
6. AUTHOR(S) J.H. Underwood and M.T. Kortschot (University of Toronto)				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050		8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94010		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07801-5000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Presented at the 2nd International Conference on Deformation and Fracture of Composites, Manchester, U.K., 29-31 March 1993. Published in the Conference Proceedings.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) Notched [0/+45/90/-45] carbon/epoxy laminates were used to study translamellar fracture, where through-thickness cracking propagates across fibers and laminae. Radiographs of damage were compared with crack growth determined from load-versus-deflection plots using elastic fracture mechanics. Comparison of damage at the notch tip with fracture mechanics evaluations identified some material/test conditions for which a critical value of fracture toughness is a useful concept. For other conditions, the extent of damage in the specimen showed that the concept of fracture toughness is not directly applicable.				
14. SUBJECT TERMS Carbon/Epoxy, Laminates, Composite Materials, Notch Damage, Radiography, Fracture Mechanics, Fracture Toughness			15. NUMBER OF PAGES 13	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE March 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE CHROMIUM/MOLYBDENUM ALLOY PLATING PART I: THE ELECTRODEPOSITION OF LOW CONTRACTION CHROMIUM/ MOLYBDENUM ALLOYS USING UNIPOLAR (ON/OFF) PULSE PLATING			5. FUNDING NUMBERS AMCMS: 6111.02.H611.1	
6. AUTHOR(S) Mark D. Miller and Stephen Langston				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94011	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07801-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The microstructure and mechanical properties of a pulse-plated low contraction (LC) chromium/molybdenum (Cr/Mo) alloy deposit were evaluated and compared to both pulse-plated LC chromium and direct (dc)-plated LC chromium. Molybdenum concentrations as high as approximately 2.4 percent were obtained at a pulsing frequency of 5 Hz (100 ms on-time/100 ms off-time). This represents nearly a 300 percent increase over the percent molybdenum obtained in a dc-plated LC Cr/Mo alloy deposit. However, pulse-plated LC Cr/Mo deposits were generally poor in quality with deposits that were frequently cracked and nodular in appearance. Hardness values as high as 900 KHN (50 gm load) were obtained for the pulse-plated LC Cr/Mo alloy deposits. This hardness represents an 18 percent increase over the maximum reported hardness obtained in a dc-plated LC chromium deposit. The maximum cathode current efficiency (CCE) obtained while pulse plating an LC Cr/Mo alloy was 7.3 percent. This is nearly 52 percent less than the reported CCE obtained when dc plating LC chromium.				
14. SUBJECT TERMS Chromium/Molybdenum Alloy, Aqueous, Pulse, Electrodeposition			15. NUMBER OF PAGES 13	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE March 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE CALCULATIONS VIA SUCCESSIVE APPROXIMATIONS OF STRESS AND STRAIN DISTRIBUTION IN THICK-WALLED CONCENTRIC TUBES DUE TO A RADIAL TEMPERATURE GRADIENT			5. FUNDING NUMBERS AMCMS: 612624H180.000 PRON: M721F221M71A	
6. AUTHOR(S) Boaz Avitzur				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94012	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) When thick-walled tubes are subjected to radial temperature gradients, cooler portions of the tubes impose constraints on the thermal expansion of hotter segments. (For example, in an internally heated tube, outer portions of the tube contain the expansion of the inner layer.) Constraint of the thermal expansion results in triaxial stress and strain distributions. A sequence of successive approximations has been used to calculate such stress and strain fields, while accounting for the mutual effect between the stress and strain fields, as described by the constitutive equations. Equilibrium is satisfied in all three mutually orthogonal coordinate directions, and compatibility (or conservation and continuity of matter) requirements are being complied with. Temperature dependence of the modulus of elasticity of the material is accounted for. The Mises' numbers field is computed to detect potential yielding. The total strain (thermal and elastic), which at the boundaries (inner and outer diameter surfaces and the axial ends of the tube) represents the dilation of the tubes, is also calculated.				
14. SUBJECT TERMS Thick-Walled Tubes, Thermal Dilation, Temperature Gradient			15. NUMBER OF PAGES 18	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE March 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE QUALIFICATION OF M256 BREECHBLOCK WELD REPAIR			5. FUNDING NUMBERS AMCMS No. 6126.24.H180.0 PRON No. 1A12ZTP9NMSC	
6. AUTHOR(S) David A. Porter, William E. Marcoux, and Alice E. Fish				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94013	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A more engineered approach was taken to qualify an M256 breechblock weld repair procedure. The approach consisted of (1) identifying the principal areas requiring weld repair, (2) identifying a weld procedure and material, (3) preparing weld repair specimens, and (4) accumulating a shock and vibration history similar to that expected in service.				
14. SUBJECT TERMS M256, Breechblock, Welding, Repair			15. NUMBER OF PAGES 20	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE April 1994		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE STANDARDS FOR ORDNANCE MATERIALS; DYNAMIC FRACTURE AND ENVIRONMENTAL CRACKING APPLICATIONS			5. FUNDING NUMBERS AMCMS No. 6111.02.H611.1 PRON No. 1A11Z1CANMBJ	
6. AUTHOR(S) John H. Underwood				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army, ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94014	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Submitted to <i>ASTM Standardization News</i>				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Two difficult and very different service conditions for Army ordnance, dynamic fracture and environmentally-assisted cracking, result in surprisingly similar approaches for fracture testing standards.				
14. SUBJECT TERMS Ordnance Materials, Dynamic Fracture, Crack Arrest Environmental Cracking, Fracture Mechanics			15. NUMBER OF PAGES 10	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE April 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE MATERIALS ANALYSIS OF 155-MM IMPROVED CONVENTIONAL ARMAMENT SYSTEM (ICAS) CANNON, TUBE SERIAL NO. XP-1			5. FUNDING NUMBERS AMCMS No. 6126.24.H180.0	
6. AUTHOR(S) Kathryn E. Noll				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94015	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Distribution limited to Department of Defense only because of premature dissemination; April 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benet Laboratories, SMCAR-CCB-SE, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A materials analysis was performed on an experimental 155-mm Improved Conventional Armament System (ICAS) Cannon, Serial No. XP-1. The cannon experienced a malfunction during test firing at Aberdeen Proving Ground (MD), Range 18. The analysis included visual examination, chemical composition determination, metallographic examination, and mechanical property determination. It was determined that the tube material did not contribute to the malfunction. An adiabatic shear zone was observed indicating the tube was subjected to a localized, excessively high, rapidly applied load that was beyond the strength capabilities of the tube material.				
14. SUBJECT TERMS Gun Tube, Adiabatic Shear Zone, Failure Analysis			15. NUMBER OF PAGES 14	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE April 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE 155-MM ADVANCED FIELD ARTILLERY SYSTEM LIQUID PROPELLANT PROTOTYPE CANNON: PERFORMANCE OF THE WEAPON'S RECOIL SYSTEM			5. FUNDING NUMBERS AMCMS: 612624H1800 PRON: 470TEV64471A	
6. AUTHOR(S) Ronald G. Gast				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94016	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Distribution limited to U.S. Government Agencies only because of test and evaluation; April 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benét Laboratories, SMCAR-CCB-DC, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The liquid propellant version of the Advanced Field Artillery System, which incorporated a tank-style mount and recoil system, was tested at the Wright-Malta Test Center (Malta, NY) and Yuma Proving Ground (Yuma, AZ) in late 1992. This report details the performance of the recoil system and compares the results to Benét Laboratories' recoil system modelling code.				
14. SUBJECT TERMS Advanced Field Artillery System, Recoil Brake Analysis, Recoil Brake Performance, Liquid Propellant Artillery Gun, Data Reduction, Shock Absorbers			15. NUMBER OF PAGES 24	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE May 1994	3. REPORT TYPE AND DATES COVERED Final		
4. TITLE AND SUBTITLE YIELD-BEFORE-BREAK FRACTURE MECHANICS ANALYSIS OF HIGH STRENGTH STEEL PRESSURE VESSELS		5. FUNDING NUMBERS AMCMS: 611102H61111		
6. AUTHOR(S) John H. Underwood, Richard A. Farrara, and Michael J. Audino				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050		8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94017		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000		10. SPONSORING / MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Presented at the ASME Pressure Vessels and Piping Conference, Denver, Colorado, 26-29 July 1993. Published in the Conference Proceedings.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Case study examples of fracture mechanics testing and analysis of Ni-Cr-Mo high strength steel cannon tubes are presented. The testing and analysis include significant plastic deformation accompanying fracture, which often occurs when high pressure is applied to high toughness steel pressure vessels. The analysis is based on a comparison of the size of the Irwin crack-tip plastic zone with the remaining ligament of the tube in the critical fatigue crack area that causes final failure. The results of the study show that the type of final failure can be predicted as either a relatively safe yield-before-break failure or a less safe running-crack type of failure for a variety of material, configuration, and loading conditions.				
14. SUBJECT TERMS Pressure Vessels, Fracture Mechanics, High Strength Steel, Plastic Yielding, Fatigue Failure			15. NUMBER OF PAGES 19	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE

May 1994

3. REPORT TYPE AND DATES COVERED

Final

4. TITLE AND SUBTITLE

EXPERIMENTAL HEAT TREATMENT OF BERYLLIUM COPPER ALLOY

5. FUNDING NUMBERS

AMCMS No. 6126.24.H180.0
PRON No. 1A12ZRLQNMSC

6. AUTHOR(S)

Kathryn E. Noll

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army ARDEC
Benet Laboratories, SMCAR-CCB-TL
Watervliet, NY 12189-4050

8. PERFORMING ORGANIZATION
REPORT NUMBER

ARCCB-TR-94018

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army ARDEC
Close Combat Armaments Center
Picatinny Arsenal, NJ 07806-5000

10. SPONSORING/MONITORING
AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

A cold-rolled beryllium copper alloy, in bar form, was experiencing deformation (bowing) during machining. Several experimental heat treatments were performed in order to develop a procedure that would alleviate this condition. These treatments consisted of (1) an age-hardening (overaging) and (2) a solution treatment and age-hardening. The minimum desired ultimate tensile strength (UTS) value was achieved in both heat-treating experiments conducted. For the age-hardening experiment, any aging time between one-half hour and two hours would obtain the desired UTS. For the solution treatment and age-hardening experiment, aging for one-half hour or greater at 500°F would fulfill the UTS requirement. Our recommendation for the remaining beryllium copper bars was a one hour age-hardening at 900°F.

14. SUBJECT TERMS

Beryllium Copper, Heat Treatment, Age-Hardening, Overaging

15. NUMBER OF PAGES

14

16. PRICE CODE

17. SECURITY CLASSIFICATION
OF REPORT

UNCLASSIFIED

18. SECURITY CLASSIFICATION
OF THIS PAGE

UNCLASSIFIED

19. SECURITY CLASSIFICATION
OF ABSTRACT

UNCLASSIFIED

20. LIMITATION OF ABSTRACT

UL

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE May 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE NUMERICAL BOX-COUNTING AND CORRELATION INTEGRAL MULTIFRACTAL ANALYSIS			5. FUNDING NUMBERS AMCMS: 6126.24.H180 PRON: 470TEV64471A	
6. AUTHOR(S) L.V. Meisel and M.A. Johnson				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94019	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Submitted to: <i>Journal of Computational Physics</i>				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A systematic study of the rate of convergence, cpu time, and accuracy of a numerical box-counting and a numerical correlation integral algorithm to Euclidean point sets, Koch constructions, and a symmetric chaotic mapping is described.				
14. SUBJECT TERMS Fractals, Multifractal Measures, Box-Counting Algorithms, Correlation Integral Methods, Numerical Multifractal Analysis			15. NUMBER OF PAGES 38	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE May 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE AUTOMATED WELDING OF ROTARY FORGE HAMMERS				5. FUNDING NUMBERS Operations Order No. 8430	
6. AUTHOR(S) John R. Senick, Jr.					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94020	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The process development and implementation of an automated welding system used for repairing rotary forge hammers was performed by Benet Laboratories under a Manufacturing Methods and Technology project at Watervliet Arsenal. Two welding technologies were evaluated in the project, automated flux-cored wire-feed welding by the metal inert gas (MIG) process and powdered metal feed welding by the plasma transferred arc (PTA) process. Initially, two development contracts were established and executed to determine the feasibility of and welding parameters necessary for hammer repair. Both contracts involved welding representative test samples to determine the optimum parameters for deposition rate and quality, and finally utilizing these parameters to weld-overlay actual rotary forge hammers. The hammers were then returned to Watervliet Arsenal for testing in production runs. Based on encouraging results generated during the project, the flux-cored wire-feed welding method has been implemented at the Arsenal and is the current production welding method used for hammer repair and restoration.					
14. SUBJECT TERMS Plasma Transferred Arc (PTA) Welding, Metal Inert Gas (MIG) Welding, Metal Powder, Rotary Forge Hammers, Hardfacing				15. NUMBER OF PAGES 34	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED		20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE May 1994	3. REPORT TYPE AND DATES COVERED Final		
4. TITLE AND SUBTITLE SERVO CONTROL USING SWITCHES FOR DISCRETE POSITIONAL FEEDBACK		5. FUNDING NUMBERS AMCMS: 612624H191.1		
6. AUTHOR(S) Ronald L. Racicot				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050		8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94021		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07801-5000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Published in: <i>IEEE Transactions on Control Systems Technology</i>				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) This report describes an approach for providing and/or assisting in the positional control of a one degree-of-freedom servo-mechanism <i>using switches</i> . The switches, positioned along the path of a moving mechanism, can also be simulated using continuous feedback sensors for certain applications. Real time feedback of the discrete time at which each switch is tripped during motion is provided to the controller. Based on this time-position information, <i>constant motor forces to be applied between switches</i> are determined to sustain and complete the required repositioning task. A definitive control procedure is not presented here, but rather a promising one that may have important applications as we have found in our work. Also, the method is not intended to compete with more sophisticated and complicated approaches using higher component quality and quantity and computer power. On the contrary, one of the intended goals is to go somewhat the other way to make use of existing or even less expensive components. The main contribution that we make to this overall control technique is to introduce and use <i>probability and statistical concepts in determining the switch locations and the required real time motor forces</i> . A probabilistic approach is needed because of the uncertainty in the actual position and velocities of the mechanism as it travels between switches. These uncertainties in turn are derived from uncertainties in the disturbing forces that are encountered during any given motion cycle. In this report, we develop the theory for a statistically-based approach for control using switches. We then verify the results using simulation and experimentation. In our experimental work, we applied our techniques to the ramming mechanism of a large caliber tank autoloader with excellent results. From our experimental work, we also developed some modifications to the theoretically-derived control procedure to improve the overall response.				
14. SUBJECT TERMS Servo Control, Positional Feedback, Switches		15. NUMBER OF PAGES 25		
		16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE May 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE METALLURGICAL EVALUATION OF 25-MM M242 BUSHMASTER GUN TUBES, SERIAL NOS. 12373 AND 12374			5. FUNDING NUMBERS AMCMS No. 6126.24.H180.0 PRON No. F11XB066M1A1	
6. AUTHOR(S) Kathryn E. Noll and John R. Senick, Jr.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94022	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Distribution limited to Department of Defense and Department of Defense contractors because of premature dissemination; May 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benet Laboratories, SMCAR-CCB-SE, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A metallurgical evaluation of two 25-mm M242 Bushmaster gun tubes, Serial Nos. 12373 and 12374, was performed. The evaluation included visual examination, mechanical property determination, scanning electron microscopy, metallographic examination, and chemical composition determination. Based on the hardness values, chemical composition, and microstructure observed, the two gun tubes appeared to have been processed correctly. An area toward the muzzle end of Serial No. 12373 displayed a lower hardness and an altered microstructure that was likely due to overheating during firing. Uranium, aluminum, iron, and zinc were deposited throughout both gun tube bores.				
14. SUBJECT TERMS Malfunction Investigation, Bushmaster, 25-mm Gun Tubes, Nitriding, Depleted Uranium			15. NUMBER OF PAGES 36	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE June 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE THE EFFECTS OF FATIGUE LOADING FREQUENCY ON FATIGUE LIFE OF HIGH-STRENGTH PRESSURE VESSEL STEELS			5. FUNDING NUMBERS AMCMS No. 6111.02.H611.1 PRON No. 1A11Z1CANMBJ	
6. AUTHOR(S) Robert R. Fuczak				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94023	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Bend specimens of high-strength pressure vessel steel were tested in bending fatigue to failure at 1.5, 15, 30, and 75 Hz fatigue loading frequencies. In the 1.5 to 15 Hz range, there was no discernible difference in the frequency effect on fatigue life. However, in the 30 to 75 Hz range, there was a definite increase in fatigue life compared to the lower range of frequency. The average increase in fatigue life over the stress range was a factor of 10 greater than the life at the lower frequency range. This factor increased at lower stresses and decreased at higher stresses, but even at the highest stresses tested, the increase was significant, about 5 to 1. This indicates that the frequency effect is more effective at high-cycle fatigue and diminishes with low-cycle fatigue. A model for fatigue life deterioration caused by superimposition of loads under different frequencies is introduced.				
14. SUBJECT TERMS Fatigue Life, High Strength, Pressure Vessels, Steel, Frequency			15. NUMBER OF PAGES 17	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE June 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE FATIGUE LIFE TESTS FOR THE MUZZLE REFERENCE SYSTEM COLLIMATOR ON THE 120-MM M256 CANNON TUBE			5. FUNDING NUMBERS AMCMS: 612624H180 PRON: 472GEV16471A	
6. AUTHOR(S) J.H. Underwood, E. Troiano, D.E. Leighton, R.T. Abbott, D. Crayon, V.J. Olmstead, and R.A. Farrara				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94024	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Distribution limited to U.S. Government agencies only because of contractor performance evaluator, June 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benét Laboratories, SMCAR-CCB-RM, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A laboratory fatigue life test system was developed to obtain comparative life data for the muzzle reference system collimator on the 120-mm M256 cannon tube. A fatigue load was established which, although only indirectly shown to correspond to the service loading, is believed to provide valuable comparative life data for different means of fastening key components of the collimator. Fatigue lives were measured for various means of fastening, including different configurations of electron-beam welding and different sizes and types of high strength screws. Using the S-N fatigue life approach, consistent descriptions of the fatigue life of the muzzle reference system collimator could be made.				
14. SUBJECT TERMS Fatigue Life, Electron-Beam Weld, Fasteners, Cannon Tube, S-N Curve, Muzzle Reference System			15. NUMBER OF PAGES 17	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE June 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE STRESS INTENSITY FACTOR AND LOAD-LINE DISPLACEMENT EXPRESSIONS FOR THE ROUND BAR BEND SPECIMEN			5. FUNDING NUMBERS AMCMS No. 6111.02.H611.1 PRON No. 1A11Z1CANMBJ	
6. AUTHOR(S) John H. Underwood				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94025	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Submitted to <i>International Journal of Fracture</i> .				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) New wide-range expressions for stress intensity factor and load-line displacement for three-point bend fracture tests with the round bar specimen are described.				
14. SUBJECT TERMS Fracture Mechanics, Round Bar, Stress Intensity Factor, Load-Line Displacement, Fracture Toughness, Three-Point Bending			15. NUMBER OF PAGES 9	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE July 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE INDEX TO BENET LABORATORIES TECHNICAL REPORTS - 1993				5. FUNDING NUMBERS N/A	
6. AUTHOR(S) R. D. Neifeld					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-SP-94026	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Distribution limited to Department of Defense only because of critical technology and specific authority; July 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benet Laboratories, SMCAR-CCB-TL, Watervliet, NY 12189-4050.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This is a compilation of technical reports published by Benet Laboratories during 1993.					
14. SUBJECT TERMS Benet Laboratories, Technical Publications, Bibliographies, Abstracts, Document Control Data				15. NUMBER OF PAGES 64	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGEForm Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE July 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE AUTOMATED DATA BASE OF MECHANICAL AND PHYSICAL PROPERTIES FOR GUN STEEL			5. FUNDING NUMBERS AMCMS No. 6111.02.H611.1 PRON No. 1A11Z1CANMBJ	
6. AUTHOR(S) Robert R. Fajczak, Gerald L. Spencer, John H. Underwood, and Edward Troiano				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94027	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Distribution limited to Department of Defense and Department of Defense contractors because of critical technology; July 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benet Laboratories, SMCAR-CCB-RM, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) An automated data base of mechanical and physical properties for gun steel has been developed. The initial data base contains information for several gun systems and components with the available information including strength, fracture toughness, chemistry, and other mechanical properties. The data contents are available for publishing periodic summaries of the data-base results.				
14. SUBJECT TERMS Data Base, Gun Steel, Mechanical Properties, Physical Properties			15. NUMBER OF PAGES 13	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 1994		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE PERIMETER-YARDSTICK TECHNIQUE FOR FRACTURE SURFACE FRACTAL ANALYSIS				5. FUNDING NUMBERS AMCMS: 6111.02.H611.1 PRON: 1A1321CANMBJ
6. AUTHOR(S) Gay Kendall, P.J. Cote, L.V. Meisel				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94028
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING / MONITORING AGENCY REPORT NUMBER
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited				12b. DISTRIBUTION CODE
13. ABSTRACT (Maximum 200 words) Local fractal dimensions $\alpha(x, \epsilon)$, which are closely related to "crowding indices" of individual islands and lakes formed by sectioning of fracture surfaces produced in Charpy impact testing of a high-strength and high-toughness steel (ASTM A723) alloy, have been determined by perimeter-yardstick analysis. In this type of analysis, the perimeter of an island or lake on a fracture surface section is measured at several different magnifications, and Richardson's equation is employed to determine the fractal dimension of the island or lake. Perimeter-yardstick analysis, which had not previously been applied to fracture surface analysis, yielded $\alpha(x, \epsilon)$-values ranging from 1.17 to 1.40 (mean: 1.28, standard deviation: 0.08) for Charpy fracture islands and lakes in ASTM A723 steel for ϵ-values near $1.3 \cdot 10^{-4}$ cm. The mean $\alpha(x, \epsilon)$-value is consistent with the (global) fractal dimension of 1.25 obtained by slit-island analysis of the same fracture surface sections--a value typical of high-strength steel alloys previously studied. The island-to-island and lake-to-lake variations of the local fractal dimensions reflect real variations analogous to differences in the fractal dimensions of the coastlines of Norway and England. Either the fracture surfaces are fractally inhomogeneous or the range of $\alpha(x, \epsilon)$-values determines limits on the variation of the global multifractal dimensions $D(q)$ and $a(q)$.				
14. SUBJECT TERMS Fractals, Fracture, Crowding Indices, Slit-Island Method				15. NUMBER OF PAGES 9
				16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNCLASSIFIED	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE EXPONENTS IN LIFETIME AND POWER SPECTRAL DENSITY IN SELF-ORGANIZED CRITICAL SYSTEMS				5. FUNDING NUMBERS AMCMS: 6111.02.H611.1 PRON: 1A13Z1CANMBJ	
6. AUTHOR(S) L.V. Meisel and P.J. Cote					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94029	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Submitted to: <i>Computers in Physics</i>					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Bak, Tang, and Weisenfeld (BTW) established that power-law frequency dependencies in the power spectral density (PSD) and size-effect modified power-law distributions of lifetimes are the fingerprints of self-organized critical systems. Jensen, Christensen, and Fogedby (JCF) clarified the ideas introduced by BTW and established the connection between the distribution of lifetimes and the PSD for the case of exponentially cutoff ("size-effect" modified) distributions of lifetimes. Here the (JCF) connection between the PSD and the distribution of lifetimes is established for sharp cutoff distributions, which supports the idea that the JCF connection holds for quite general "size-effect" modified lifetime distributions. The PSD may be expressed in terms of generalized hypergeometric functions in this case. A detailed discussion of the JCF connections is presented for a subset of values of the lifetime distribution exponent for which the generalized hypergeometric functions reduce to Fresnel integrals and sine and cosine integrals, which were the subject of a recent "Numerical Recipes" column. All calculations were performed in Mathematica.					
14. SUBJECT TERMS Self-Organized Phenomena, Hyperbolic Distributions, Power Laws, Fresnel Integrals, Sine Integrals, Mathematica				15. NUMBER OF PAGES 12	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE FAILURE ANALYSIS OF 120-MM MORTAR BUSHINGS AND FIRING PINS			5. FUNDING NUMBERS AMCMS No. 6126.24.H180.0 PRON No. W161F125M71A	
6. AUTHOR(S) Kathryn E. Noll				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94030	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A failure analysis was performed on several 120-mm mortar bushings and firing pins. The analysis entailed examining (1) the failed firing pins and bushings for conformance to drawing requirements, and (2) the material differences between the U.S.-made and the Israeli-made components. The evaluation included visual examination, metallographic examination, microhardness determination, chemical composition determination, and scanning electron microscopy. The firing pins essentially met the required material specifications. However, it could not be determined whether the bushings met the requirements due to the vagueness of the drawing specifications. There were no observable material differences between the U.S.-made and the Israeli-made firing pins. The U.S.-made bushings did have a larger grain size, and the inner diameter of the bushing showed a slight surface degradation and rougher topography than the Israeli-made bushing. This difference in the inner diameter was due to the machining process, wire electrical discharge machining, that was used to produce the U.S.-made bushings.				
14. SUBJECT TERMS Failure Analysis, 120-mm Mortar, Wire Electrical Discharge Machining, Remelt			15. NUMBER OF PAGES 36	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE RESIDUAL STRESS ANALYSIS IN SWAGE AUTOFRETTAGED THICK-WALLED CYLINDERS BY POSITION-SENSITIVE X-RAY DIFFRACTION TECHNIQUES			5. FUNDING NUMBERS AMCMS: 6111.02.H611.1	
6. AUTHOR(S) S.L. Lee				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94031	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Presented at the ASME International Conference on Pressure Vessels & Piping, Denver, Colorado, 25-29 July 1993. Published in the Proceedings of the Conference.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Experimental and theoretical investigations were made for swage autofrettaged partially plastic ASTM A723 steel cylinders with an outside diameter (OD) to inside diameter (ID) ratio of 2.75 and 74 percent overstrain. Residual stress radial distribution and angular stress distribution around the bore were analyzed using two position-sensitive x-ray diffraction stress analyzers. Theoretical calculation was made by implementing an interactive, iterative Lotus Works spreadsheet residual stress model on an IBM PC. The model was based on the classical solution to the elastic-plastic deformation problem of a symmetric thick-walled cylinder under internal pressure, including reverse yielding effect. Angular stress distribution data at the ID and OD indicated that non-axisymmetric deformation had occurred during yielding of the cylinders. Excellent agreement was obtained between experimental results and theoretical predictions, including the Bauschinger effect near the bore. By comparing experimental data with theoretical calculations for the 74 percent overstrained cylinders, the Bauschinger factor for the A723 steel was determined to be close to 0.5. Residual stress analysis for the entire cylinder is suggested in the future.				
14. SUBJECT TERMS Residual Stress, Swage Autofrettage, Bauschinger's Effect, Position-Sensitive Stress Analyzer, X-Ray Diffraction, Pressure Vessel, Reverse Yielding, Plastic Deformation			15. NUMBER OF PAGES 15	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE FRACTURE ASSESSMENT OF 155-MM M284 BREECH RINGS			5. FUNDING NUMBERS AMCMS No. 6111.02.H611.1 PRON No. 1A11Z1CANMBJ	
6. AUTHOR(S) E. Troiano, J.H. Underwood, and R.T. Abbott				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94032	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Distribution limited to U.S. Government Agencies and their contractors because of critical technology; August 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center ATTN: Benet Laboratories, SMCAR-CCB-RM, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A 155-mm M284 breech ring assembly was being laboratory fatigue tested when an earlier-than-expected malfunction incident occurred. The subject breech ring, Serial No. 1659, was the sixth to be tested out of a population of six. The previous five breech rings tested possessed fatigue lives ranging from 4444 to 6214 cycles-to-failure (N _f). This particular ring, tested under the same conditions as the previous five rings, failed in a brittle fashion after only 109 cycles. Mechanical and fracture toughness testing of Serial No. 1659 revealed that the ring had undergone an inadequate heat treatment, which resulted in extremely low values of fracture toughness.				
14. SUBJECT TERMS Fatigue Life, Breech Ring, Fracture Toughness			15. NUMBER OF PAGES 7	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE August 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE ADAPTIVE FINITE ELEMENT METHOD I: SOLUTION ALGORITHM AND COMPUTATIONAL EXAMPLES			5. FUNDING NUMBERS PRON: 1A323F2TA11A AMCMS: 612624H181100	
6. AUTHOR(S) J.M. Coyle and J.E. Flaherty				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94033	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) An adaptive finite element method is developed to solve initial boundary value problems for vector systems of parabolic partial differential equations in one space dimension and time. The differential equations are discretized in space using piecewise linear finite element approximations. Superconvergence properties and quadratic polynomials are used to derive a computationally inexpensive approximation to the spatial component of the error. This technique is coupled with time integration schemes of successively higher orders to obtain an approximation of the temporal and total discretization errors. These approximate errors are used to control an adaptive mesh refinement strategy. Refinement is performed in space, time, or both space and time depending on the dominant component of the error estimate. A computer code coupling this refinement strategy and stable mesh movement has been written and applied to a number of problems. These computations confirm that proper mesh movement can reduce the computational efforts associated with mesh refinement.				
14. SUBJECT TERMS Parabolic Differential Equations, Adaptive Finite Elements, Superconvergence, Error Estimation, Mesh Refinement, Mesh Movement			15. NUMBER OF PAGES 51	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT U	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 1994		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE ADAPTIVE FINITE ELEMENT METHOD II: ERROR ESTIMATION			5. FUNDING NUMBERS AMCMS: 612624H191.0	
6. AUTHOR(S) J.M. Coyle and J.E. Flaherty				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94034	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) An adaptive finite element method is developed to solve initial boundary value problems for vector systems of parabolic partial differential equations in one space dimension and time. The differential equations are discretized in space using piecewise linear finite element approximations. Superconvergence properties and quadratic polynomials are used to derive a computationally inexpensive approximation to the spatial component of the error. This technique is coupled with time integration schemes of successively higher orders to obtain an approximation of the temporal and total discretization errors. Computational results indicate that these approximations converge to the exact discretization errors as the mesh is refined.				
14. SUBJECT TERMS Parabolic Differential Equations, Adaptive Finite Elements, Finite Differences, Superconvergence, Error Estimation, Error Decomposition			15. NUMBER OF PAGES 25	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGEForm Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE FAILURE ANALYSIS OF 120-MM M256 GUN TUBE, SERIAL NO. 2416			5. FUNDING NUMBERS AMCMS No. 6126.24.H180.0	
6. AUTHOR(S) Kathryn E. Noll and John R. Senick, Jr.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94035	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Distribution limited to Department of Defense only because of premature dissemination; September 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benet Laboratories, SMCAR-CCB-SE, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A failure analysis was performed on a 120-mm M256 gun tube, Serial No. 2416. The gun tube experienced a muzzle end failure while firing kinetic energy training ammunition. The analysis included visual examination, mechanical property determination, scanning electron microscopy, metallographic examination, and chemical composition determination. Based on the analysis, the gun tube material met or exceeded all drawing requirements. No evidence of pre-existing flaws was found on the fracture surface. The most probable cause for the failure was a bore obstruction that was present during firing.				
14. SUBJECT TERMS Gun Tube Failure, Shear Fracture, Microvoid Coalescence, 120-mm M256 Gun Tube			15. NUMBER OF PAGES 25	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 1994		3. REPORT TYPE AND DATES COVERED Final
4. TITLE AND SUBTITLE EXPERIMENTAL METHODS IN RESIDUAL STRESS MEASUREMENT USING A POSITION-SENSITIVE SINGLE-EXPOSURE SCINTILLATION DETECTION SYSTEM			5. FUNDING NUMBERS AMCMS: 6111.02.H611.1 PRON: 1A12Z1CANMBJ	
6. AUTHOR(S) S.L. Lee, M. Doxbeck, and G.P. Capsimalis				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94036	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) In the Denver D-1000-A single-exposure position-sensitive scintillation detection (PSSD) system, surface residual stress measurement in any chosen direction is based on crystalline plane spacings determined in two directions normal to the surface made simultaneously in a single psi tilt. This technical allows fast, noncontacting, and nondestructive biaxial stress analysis. In this report, system performance is characterized by studying the noise, gain, and diffraction peak profiles as a function of diode array element. A four-point bend experiment was performed to determine the elastic constant of the 211 plane of body-centered cubic martensitic steel. Residual stress measurements were performed in several steel specimens and compared to measurements made on a similar system at Pennsylvania State University. Local software development allowed the single-exposure PSSD to run in a multiple-exposure mode for improved accuracy in biaxial stress analysis.				
14. SUBJECT TERMS Residual Stress, Biaxial Stress, X-Ray Diffraction, Position-Sensitive Scintillation Detector, Single-Exposure Technique			15. NUMBER OF PAGES 27	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE CHROMIUM PLATING AND ELECTROPOLISHING SOLUTION ANALYSES BY ONLINE X-RAY FLUORESCENCE SPECTROSCOPY			5. FUNDING NUMBERS AMCMS No. 6126.24.H181.1	
6. AUTHOR(S) Samuel Sopok				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94037	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Two increasingly important issues for the chemical processing industry are product quality and productivity. Traditionally, offline chemical analysis has been used to monitor both. The main disadvantage of offline analysis is the loss of time due to sampling, bringing samples to a lab, and waiting for results. Obvious efficiencies can be realized by continuous online chemical monitoring. The initial investment is high, but the return on investment can be very efficient process performance. X-ray fluorescence spectroscopy (online and offline) is investigated and evaluated as a means to quantitatively analyze metal finishing solutions such as actual chromium plating and electroplating solutions for chromium, sulfur, phosphorus, and iron. The identical experiment was conducted at three different manufacturers of this type of instrument, and included calibration, standardization, and analysis. Although this work has a specific objective related to chromium plating and electropolishing liquid samples, much information is related to and provided for other types of samples. Chemical analysis by x-ray fluorescence spectroscopy is nondestructive, applicable to multiple process streams (liquid or solid), and requires no dilutions. In addition, calibration, standardization, and maintenance are minimal. For the specific metal finishing applications discussed, the resultant data do not suggest that this online monitoring technique is useful at this time, but future work may show this technique to be practical.				
14. SUBJECT TERMS Chemical Analysis, X-Ray Fluorescence, Online Analysis, Liquid Samples, Solid Samples, Chromium Plating Solutions, Electropolishing Solutions, Chromium Analysis, Sulfur Analysis, Iron Analysis, Phosphorus Analysis			15. NUMBER OF PAGES 26	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE FATIGUE LIFE ANALYSIS AND TESTS FOR THICK-WALLED CYLINDERS INCLUDING EFFECTS OF OVERSTRAIN AND AXIAL GROOVES			5. FUNDING NUMBERS AMCMS: 6111.02.H611.1 PRON: 1A11Z1CANMBJ	
6. AUTHOR(S) J.H. Underwood and A.P. Parker (University of Northumbria at Newcastle, UK)				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, SMCAR-CCB-TL Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94038	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Presented at the ASME Pressure Vessel Conference, Minneapolis, MN, 19-23 June 1994. Published in the <i>ASME Journal of Pressure Vessel Technology</i>				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A fracture mechanics-based fatigue life analysis was developed for pressurized thick-walled cylinders autofrettaged by overstrain and with one or several semi-elliptical-shaped axial grooves at the inner diameter. The fatigue life for a crack initiating at the root of the groove was calculated for various cylinder, groove, and crack configurations and for different material yielding conditions. Comparisons were made with fatigue crack growth and laboratory life results from A723 thick-walled cylinders in which cannon firing tests were first performed to produce axial erosion grooves, followed by cyclic hydraulic pressurization to failure in the laboratory. The life analysis, with an initial crack size based on the expected pre-existing defects, gave a good description of the crack growth and fatigue life of the tests for cylinders with and without grooves. General fatigue life calculations summarized important and configurational effects on the fatigue life design of overstrained cylinders, including effects of material yield strength, cylinder diameter ratio, stress concentration factor, and initial crack size.				
14. SUBJECT TERMS Fatigue Life Analysis, Thick-Walled Cylinders, Stress Concentration, Fatigue Tests, Erosion, Autofrettage, Residual Stress			15. NUMBER OF PAGES 17	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE October 1994	3. REPORT TYPE AND DATES COVERED Final		
4. TITLE AND SUBTITLE MONITOR FOR STATUS EPILEPTICUS SEIZURES		5. FUNDING NUMBERS AMCMS No. 6111.02.H611.1 PRON No. 1A13Z1CANMBJ		
6. AUTHOR(S) Mark Johnson and Thomas Simkins				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050		8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94039		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000		10. SPONSORING / MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Presented at Technology 2003, Fourth National Technology Transfer Conference and Exposition, Anaheim, CA, 7-9 December 1993. Published in Proceedings of Technology 2003.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This report describes the sensor technology and associated electronics of a monitor designed to detect the onset of a seizure disorder called <i>status epilepticus</i> . It is a condition that affects approximately 3 to 5 percent of those individuals suffering from epilepsy. This form of epilepsy does not follow the typical cycle of start-peak-end. The convulsions continue until medically interrupted and are life-threatening. The mortality rate is high without prompt medical treatment at a suitable facility. The report describes the details of a monitor design that provides an inexpensive solution to the needs of those responsible for the care of individuals afflicted with this disorder. The monitor has been designed as a cooperative research and development effort involving the United States Army Armament Research, Development, and Engineering Center's Benet Laboratories (Benet) and the Cerebral Palsy Center for the Disabled (Center), in association with the Department of Neurology at Albany Medical College (AMC). Benet has delivered a working prototype of the device for field testing, in collaboration with AMC. The Center has identified several children in need of special monitoring and has agreed to pursue commercialization of the device.				
14. SUBJECT TERMS Neuronetworks, Epilepsy, Status Epilepticus, Monitors			15. NUMBER OF PAGES 9	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE October 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE GEOMETRIC DIMENSIONING AND TOLERANCING - 1946 TO 1982 THE DIFFERENCES IN THE STANDARDS				5. FUNDING NUMBERS AMCMS No. 6126.24.H180.0 PRON No. W16H1F308	
6. AUTHOR(S) David H. Honsinger					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-MR-94040	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) An analysis is made of the meaning of the symbolically represented characteristics defined in certain dimensioning and tolerancing standards, authorized for use by the Department of Defense and the U.S. Army in the preparation of engineering drawings. The analysis is based on a comparison of the defined meaning in each of these standards as it relates to the defined meaning in the most current standard. The results show that the meaning and the associated tolerance has, in some cases, changed significantly as the standards evolved. These differences are identified and described.					
14. SUBJECT TERMS Geometric, Dimensioning, Tolerancing				15. NUMBER OF PAGES 29	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE October 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE A FRACTURE MECHANICS ASSESSMENT OF THE 155-MM M284 MUZZLE BRAKE				5. FUNDING NUMBERS AMCMS No. 6111.02.H611.1 PRON No. 1A11Z1CANMBJ	
6. AUTHOR(S) Robert R. Fuczak and Joseph A. Kapp					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94041	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Distribution limited to Department of Defense and Department of Defense contractors because of critical technology; October 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benet Laboratories, AMSTA-AR-CCB-TB, Watervliet, NY 12189-4050.				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A fracture mechanics analysis was conducted to determine the condemnation life assessment of the 155-mm M284 muzzle brake. The original assessment was found to be too conservative for a proper evaluation of fatigue life, based on a low estimate of fracture toughness derived from previous muzzle brake material. The updated analysis proved to be very accurate in predicting safe fatigue life and replacement of the muzzle brake after every second gun tube change, thereby saving considerably on muzzle brake replacement.					
14. SUBJECT TERMS Muzzle Brake, Fracture Toughness, Fatigue Life, In-House Inspection, Field Condemnation				15. NUMBER OF PAGES 26	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE November 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE MATERIALS CHARACTERIZATION OF HARD CHROMIUM AND LOW CONTRACTION CHROMIUM			5. FUNDING NUMBERS AMCMS No. 6126.24.H180.0 PRON No. 470TEV64471A	
6. AUTHOR(S) Kathryn E. Noll				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94042	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Distribution limited to U.S. Government Agencies only because of test and evaluation; November 1994. Other requests for this document must be referred to Commander, U.S. Army Armament Research, Development, and Engineering Center, ATTN: Benet Laboratories, AMSTA-AR-CCB-EA, Watervliet, NY 12189-4050.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A materials characterization was performed on hard chromium (HC) and low contraction (LC) chromium. The samples utilized in our analysis were sectioned from gun tubes electroplated in the vessel plating and production facilities at Watervliet Arsenal. The characterization compared chromium plate morphology and properties for (1) breech versus muzzle end of an LC chromium plated tube, (2) HC versus LC chromium, and (3) HC plated in the vessel plating versus production facilities. The analysis consisted of visual examination, metallographic examination, microhardness evaluation, x-ray diffraction, chemical composition determination, and scanning electron microscopy. Muzzle versus breech and hardness values were found to vary significantly within the LC chromium plated tube, while a slight variation was observed in the microstructure. The HC and LC chromium also displayed large differences in hardness and morphology. There were no observable differences in the HC plated in the two plating facilities.				
14. SUBJECT TERMS Hard Chromium, Low Contraction Chromium, Vessel Plating, Microcracking			15. NUMBER OF PAGES 21	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved

OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE

November 1994

3. REPORT TYPE AND DATES COVERED

Final

4. TITLE AND SUBTITLE
PARALLEL PARTITIONING STRATEGIES FOR THE
ADAPTIVE SOLUTION OF CONSERVATION LAWS

5. FUNDING NUMBERS

PRON No. 6111.02.H611.1

6. AUTHOR(S)

Karen D. Devine (RPI, Troy, NY), Joseph E. Flaherty (RPI and Benet),
Raymond M. Loy (RPI), and Stephen R. Wheat (Sandia National
Laboratories, Albuquerque, NM)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army ARDEC
Benet Laboratories, AMSTA-AR-CCB-O
Watervliet, NY 12189-4050

8. PERFORMING ORGANIZATION
REPORT NUMBER

ARCCB-TR-94043

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army ARDEC
Close Combat Armaments Center
Picatinny Arsenal, NJ 07806-5000

10. SPONSORING / MONITORING
AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

We describe and examine the performance of adaptive methods for solving hyperbolic systems of conservation laws on massively parallel computers. The differential system is approximated by a discontinuous Galerkin finite element method with a hierarchical Legendre piecewise polynomial basis for the spatial discretization. Fluxes at element boundaries are computed by solving an approximate Riemann problem; a projection limiter is applied to keep the average solution monotone; time discretization is performed by Runge-Kutta integration; and a p -refinement-based error estimate is used as an enrichment indicator. Adaptive order (p -) and mesh (h -) refinement algorithms are presented and demonstrated. Using an element-based dynamic load balancing algorithm called tiling and adaptive p -refinement, parallel efficiencies of over 60% are achieved on a 1024-processor nCUBE/2 hypercube. We also demonstrate a fast, tree-based parallel partitioning strategy for three-dimensional octree-structured meshes. This method produces partition quality comparable to recursive spectral bisection at a greatly reduced cost.

14. SUBJECT TERMS

Adaptive Methods, Hyperbolic Systems of Conservation Laws, Massively Parallel
Computation, Galerkin Finite Element Method, h -refinement, p -refinement,
Load Balancing, Tiling, Domain Decomposition, Octree-Derived Meshes

15. NUMBER OF PAGES

30

16. PRICE CODE

17. SECURITY CLASSIFICATION
OF REPORT

UNCLASSIFIED

18. SECURITY CLASSIFICATION
OF THIS PAGE

UNCLASSIFIED

19. SECURITY CLASSIFICATION
OF ABSTRACT

UNCLASSIFIED

20. LIMITATION OF ABSTRACT

UL

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE November 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE APPLICATION OF A RAPID QUENCH THERMOMAGNETIC ANALYZER TO AUSTEMPERED DUCTILE IRON				5. FUNDING NUMBERS AMCMS: 6126.24.H180.0 PRON: M02B2FR21ABJ	
6. AUTHOR(S) P.J. Cote, T. Hickey, and M.D. Witherell					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94044	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A thermomagnetic analyzer was fabricated to provide in-situ monitoring of isothermal decompositions of austenite in steels and related alloys. The analyzer provides a convenient and rapid means for establishing time-temperature-transformation characteristics of a ferrous alloy by cycling a given specimen through a series of thermal treatments and monitoring the transformations magnetically. The present report describes the apparatus and gives results on the transformation characteristics of austempered ductile iron (ADI). This analyzer was also used to investigate alternative processing procedures; the results indicate that an improved heat treatment is available for large ADI components.					
14. SUBJECT TERMS Thermomagnetic Analysis, Austempered Ductile Iron, Transformations, Austenite, Ferrite, Bainite				15. NUMBER OF PAGES 14	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE December 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE AN HP-ADAPTIVE METHOD IN SPACE AND TIME FOR PARABOLIC SYSTEMS				5. FUNDING NUMBERS AMCMS: 611.02.H611.1	
6. AUTHOR(S) Joseph E. Flaherty (Rensselaer Polytechnic Institute, Troy, NY and Benét Laboratories) and Peter K. Moore (Tulane University, New Orleans, LA)					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94045	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07805-5000				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Submitted to: <i>SIAM Journal of Scientific Computations</i>					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) We describe an adaptive method-of-lines <i>hp</i> -refinement algorithm in space and time for one-dimensional vector systems of parabolic partial differential equations. Solutions are calculated using Galerkin's method with a piecewise-polynomial hierarchical basis in space and singly-implicit Runge-Kutta (SIRK) methods in time. A posteriori estimates of the local spatial and temporal discretization error are used with a priori error estimates to control spatial and temporal enrichment. Computational results are used to compare and verify the utility of several variants of the basic <i>hp</i> -refinement procedure.					
14. SUBJECT TERMS Adaptive Refinement, Finite-Element Methods, A Posteriori Error Estimation				15. NUMBER OF PAGES 37	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE December 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE STRESS CONCENTRATION, STRESS INTENSITY, AND FATIGUE CRACK GROWTH ALONG EVACUATORS OF PRESSURIZED, AUTOFRETTAGED TUBES				5. FUNDING NUMBERS AMCMS: 6111.02.H611.1 PRON: 1A11Z1CANMBJ	
6. AUTHOR(S) A.P. Parker (University of Northumbria at Newcastle, Newcastle, England) and J.H. Underwood					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94046	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A stress analysis has been conducted on a pressurized, fully or partially autofrettaged cylinder with a small diameter evacuator hole penetrating radially through the wall. Pressure was applied on the inside diameter (ID) of the tube, and all or part of this pressure was applied on the evacuator hole surfaces. Total hoop stress concentrations have been determined for a range of radial locations along the evacuator and stress intensity factors have been determined along a crack emanating from the evacuator hole. Fatigue crack growth rates, and hence crack profiles, were predicted at each of the radial locations. These predictions indicate that the critical location for the crack in a non-autofrettaged tube is at the ID, whereas in a fully autofrettaged tube, it is located approximately halfway through the wall thickness. Stress ratio $\sigma_{min}/\sigma_{max}$ has a significant influence on crack shape in autofrettaged tubes, however, it has a limited effect upon lifetime. The effect of axial residual stresses upon fatigue lifetime due to the autofrettage process has been described and an insignificant reduction in lifetime was a result of such stresses. Finally, the predicted profiles are compared with experimental observations of fatigue crack evacuators, and a limited comparison of predicted and actual lifetimes is presented. Good agreement has been observed in both comparisons.					
14. SUBJECT TERMS Crack Growth, Fatigue Cracks, Cylinders, Evacuators, Cross-Bore, Fracture (Materials), Fracture Mechanics, Residual Stress, Stress Intensity Factor, Stress Ratio				15. NUMBER OF PAGES 24	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT U1		

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE December 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE REPORT OF VISITING SCIENTIST ATTACHMENT OF DR. ANTHONY P. PARKER OF UNIVERSITY OF NORTHUMBRIA, U.K. TO BENÉT LABORATORIES JULY - AUGUST 1994			5. FUNDING NUMBERS AMCMS: 6126.24.H180.0 PRON: 470TEV64471A	
6. AUTHOR(S) J.H. Underwood and A.P. Parker (University of Northumbria at Newcastle, United Kingdom)				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-MR-94047	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The results of a two-month visiting scientist attachment of Dr. Anthony P. Parker from the University of Northumbria at Newcastle, United Kingdom to the U.S. Army Armament Research, Development, and Engineering Center, Benét Laboratories are reported. A description is given of the arrangements for the visit, the technical topics addressed during the visit, and the status of the technical reports that give details of the results of the visit.				
14. SUBJECT TERMS Visiting Scientist, Fracture Mechanics, Metal Fatigue, Stress Analysis, Pressure Vessels			15. NUMBER OF PAGES 10	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE December 1994	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE SPECTRAL CHARACTERIZATION OF PULSED ULTRASOUND USING NEURAL NETWORKS			5. FUNDING NUMBERS AMCMS No. 6111.02.H611.1	
6. AUTHOR(S) Mark A. Johnson, Michael A. Cipollo, and R.D. Scanlon				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050			8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94048	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) A novel nondestructive evaluation technique that uses the spectral signature of a pulsed ultrasound signal to identify metals had recently been abandoned because of the difficulty in interpreting the results. Traditional analysis is inconvenient to apply to this type of problem because of the complicated, noisy, and incomplete nature of the data. Neural networks provide a radically different approach to computation. These massively parallel systems provide a mechanism to extract pertinent information from input data while maintaining a high degree of fault tolerance. This report discusses design of a neural network system capable of accepting data from nondestructive test equipment and producing output relative to the quality of the sample being tested.				
14. SUBJECT TERMS Neural Networks, Nondestructive Testing, Ultrasonics, Signal Analysis, Parallel Processing, Transputers, Metals, Impurities			15. NUMBER OF PAGES 11	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE December 1994		3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE THE ELECTRODEPOSITION OF LOW CONTRACTION CHROMIUM/MOLYBDENUM ALLOYS USING PULSE-REVERSE PLATING				5. FUNDING NUMBERS AMCMS: 6111.02.H611.1	
6. AUTHOR(S) Mark D. Miller and Stephen Langston					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benét Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050				8. PERFORMING ORGANIZATION REPORT NUMBER ARCCB-TR-94049	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The use of modulated pulse periodic reverse (pulse-reverse) current to electrodeposit a low contraction (LC) chromium/molybdenum alloy has been evaluated. When using one full pulse-reverse plating cycle, the percent molybdenum in the deposit increased almost 400 percent (from 1 to 4 percent) as the current in the reverse cycle was increased from 0 to 10 amps. However, when the pulse-reverse current was carried to six full plating cycles, the percent molybdenum in the deposit was not dependent upon the current and remained constant at about 1 percent. This is about the same percent molybdenum that could be expected in direct current-plated LC chromium/molybdenum alloy and about half the percent molybdenum that could be expected in an on/off pulse-plated LC chromium/molybdenum alloy.					
14. SUBJECT TERMS Molybdenum, Chromium, Electroplating, Electrodeposition, Pulse, Pulse-Reverse				15. NUMBER OF PAGES 12	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL		

TECHNICAL REPORT INTERNAL DISTRIBUTION LIST

	<u>NO. OF COPIES</u>
CHIEF, DEVELOPMENT ENGINEERING DIVISION	
ATTN: AMSTA-AR-CCB-DA	1
-DB	1
-DC	1
-DD	1
-DE	1
CHIEF, ENGINEERING DIVISION	
ATTN: AMSTA-AR-CCB-E	1
-EA	1
-EB	1
-EC	
CHIEF, TECHNOLOGY DIVISION	
ATTN: AMSTA-AR-CCB-T	2
-TA	1
-TB	1
-TC	1
TECHNICAL LIBRARY	
ATTN: AMSTA-AR-CCB-O	5
TECHNICAL PUBLICATIONS & EDITING SECTION	
ATTN: AMSTA-AR-CCB-O	3
OPERATIONS DIRECTORATE	
ATTN: SMCWV-ODP-P	1
DIRECTOR, PROCUREMENT & CONTRACTING DIRECTORATE	
ATTN: SMCWV-PP	1
DIRECTOR, PRODUCT ASSURANCE & TEST DIRECTORATE	
ATTN: SMCWV-QA	1

NOTE: PLEASE NOTIFY DIRECTOR, BENÉT LABORATORIES, ATTN: AMSTA-AR-CCB-O OF ADDRESS CHANGES.

TECHNICAL REPORT EXTERNAL DISTRIBUTION LIST

	<u>NO. OF COPIES</u>		<u>NO. OF COPIES</u>
ASST SEC OF THE ARMY RESEARCH AND DEVELOPMENT ATTN: DEPT FOR SCI AND TECH THE PENTAGON WASHINGTON, D.C. 20310-0103	1	COMMANDER ROCK ISLAND ARSENAL ATTN: SMCRI-ENM ROCK ISLAND, IL 61299-5000	1
ADMINISTRATOR DEFENSE TECHNICAL INFO CENTER ATTN: DTIC-OCP (ACQUISITION GROUP) BLDG. 5, CAMERON STATION ALEXANDRIA, VA 22304-6145	2	MIAC/CINDAS PURDUE UNIVERSITY P.O. BOX 2634 WEST LAFAYETTE, IN 47906	1
COMMANDER U.S. ARMY ARDEC ATTN: SMCAR-AEE	1	COMMANDER U.S. ARMY TANK-AUTMV R&D COMMAND ATTN: AMSTA-DDL (TECH LIBRARY) WARREN, MI 48397-5000	1
SMCAR-AES, BLDG. 321	1	COMMANDER U.S. MILITARY ACADEMY ATTN: DEPARTMENT OF MECHANICS WEST POINT, NY 10966-1792	1
SMCAR-AET-O, BLDG. 351N	1		
SMCAR-FSA	1		
SMCAR-FSM-E	1		
SMCAR-FSS-D, BLDG. 94	1		
SMCAR-IMI-I, (STINFO) BLDG. 59	2	U.S. ARMY MISSILE COMMAND REDSTONE SCIENTIFIC INFO CENTER ATTN: DOCUMENTS SECTION, BLDG. 4484 REDSTONE ARSENAL, AL 35898-5241	2
PICATINNY ARSENAL, NJ 07806-5000			
DIRECTOR U.S. ARMY RESEARCH LABORATORY ATTN: AMSRL-DD-T, BLDG. 305 ABERDEEN PROVING GROUND, MD 21005-5066	1	COMMANDER U.S. ARMY FOREIGN SCI & TECH CENTER ATTN: DRXST-SD 220 7TH STREET, N.E. CHARLOTTESVILLE, VA 22901	1
DIRECTOR U.S. ARMY RESEARCH LABORATORY ATTN: AMSRL-WT-PD (DR. B. BURNS) ABERDEEN PROVING GROUND, MD 21005-5066	1	COMMANDER U.S. ARMY LABCOM MATERIALS TECHNOLOGY LABORATORY ATTN: SLCMT-IML (TECH LIBRARY) WATERTOWN, MA 02172-0001	2
DIRECTOR U.S. MATERIEL SYSTEMS ANALYSIS ACTV ATTN: AMXSY-MP ABERDEEN PROVING GROUND, MD 21005-5071	1	COMMANDER U.S. ARMY LABCOM, ISA ATTN: SLCIS-IM-TL 2800 POWER MILL ROAD ADELPHI, MD 20783-1145	1

NOTE: PLEASE NOTIFY COMMANDER, ARMAMENT RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER, BENÉT LABORATORIES, CCAC, U.S. ARMY TANK-AUTOMOTIVE AND ARMAMENTS COMMAND, AMSTA-AR-CCB-O, WATERVLIET, NY 12189-4050 OF ADDRESS CHANGES.

TECHNICAL REPORT EXTERNAL DISTRIBUTION LIST (CONT'D)

	<u>NO. OF COPIES</u>		<u>NO. OF COPIES</u>
COMMANDER		WRIGHT LABORATORY	
U.S. ARMY RESEARCH OFFICE		ARMAMENT DIRECTORATE	
ATTN: CHIEF, IPO	1	ATTN: WL/MNM	1
P.O. BOX 12211		EGLIN AFB, FL 32542-6810	
RESEARCH TRIANGLE PARK, NC 27709-2211			
DIRECTOR		WRIGHT LABORATORY	
U.S. NAVAL RESEARCH LABORATORY		ARMAMENT DIRECTORATE	
ATTN: MATERIALS SCI & TECH DIV	1	ATTN: WL/MNMF	1
CODE 26-27 (DOC LIBRARY)	1	EGLIN AFB, FL 32542-6810	
WASHINGTON, D.C. 20375			

NOTE: PLEASE NOTIFY COMMANDER, ARMAMENT RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER,
BENÉT LABORATORIES, CCAC, U.S. ARMY TANK-AUTOMOTIVE AND ARMAMENTS COMMAND,
AMSTA-AR-CCB-O, WATERVLIET, NY 12189-4050 OF ADDRESS CHANGES.
