

AD-A274 927



(2)

ARMY RESEARCH LABORATORY



A Review of the V50 Ballistic Limit Requirements of MIL-A-46100

Robert C. Grubinskas

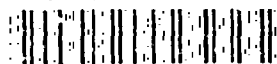
ARL-MR-95

S DTIC
ELECTE
JAN 25 1994
A

December 1993

Sponsored by
U.S. Army Tank-Automotive Command
Program Manager (PM) Survivability
Warren, Michigan 48397-5000

94-02070



Approved for public release; distribution unlimited.

94 1 24 079

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.

Citation of manufacturer's or trade names does not constitute an official endorsement or approval of the use thereof.

Destroy this report when it is no longer needed. Do not return it to the originator.

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 1993		3. REPORT TYPE AND DATES COVERED Final Report
4. TITLE AND SUBTITLE A Review of the V50 Ballistic Limit Requirements of MIL-A-46100			5. FUNDING NUMBERS	
6. AUTHOR(S) Robert C. Grubinskas				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Laboratory Watertown, MA 02172-0001 ATTN: AMSRL-MA-PD			8. PERFORMING ORGANIZATION REPORT NUMBER ARL-MR-95	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Tank-Automotive Command Program Manager (PM) Survivability Warren, Michigan 48397-5000			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 memorandum report is a by-product of that portion of an ongoing project entitled <i>Improved High Hard Armor Steel (MIL-A-46100)</i> which involves the creation of a computerized Armor Steel Database for the storage and analysis of ballistic test data obtained on MIL-A-46100 steel by the U.S. Army Combat Systems Test Activity (CSTA). The CSTA-furnished ballistic test results spanned the following three (3) MIL-A-46100 Revisions: Revision C, Revision C Amendment 2, and Revision D. As the Armor Steel Database was being populated, it was observed that the required ballistic limit velocities (the minimum ballistic acceptance requirements) associated with each of these specification revisions do vary rather significantly. As a consequence of this observation, a complete review of the various revisions and amendments of MIL-A-46100 was undertaken to insure that the specification-revision-dependent results of the ballistic tests being analyzed are, indeed, accurately interpreted and unambiguously compared. This memorandum report presents the salient aspects of this review wherein the differences between the ballistic test requirements of these recent revisions of MIL-A-46100 are appropriately highlighted and documented in a single reference source.				
14. SUBJECT TERMS Military specification, Armor, Ballistics, Ballistic testing			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 UL	

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

Contents

	<u>Page</u>
Objectives.	.1
Introduction.	.1
Discussion.	.1
Acknowledgements.	.5
References.	.5

Tables

1. MIL-A-46100 History	.6
2. MIL-A-46100 Revisions C2 and D Required Armor Plate Thicknesses as a Function of Projectile Diameter.	.6
3. MIL-A-46100 Revision C Required Armor Plate Thickness Ranges	.7
4. MIL-A-46100 Revision C2 Required Armor Plate Thickness Ranges	.7
5. MIL-A-46100 Revision D Required Armor Plate Thickness Ranges	.7
6. MIL-A-46100 V_{50} Protection Limit Velocity Dependencies upon Spec Revisions	.7
7. MIL-A-46100 Revisions, Armor Plate Thickness Ranges, V_{50} Protection Ballistic Limit Velocity Math Models, Security Classifications.	9-10
8. MIL-A-46100 Revision C CSTA AP Math Model Coefficients for Minimum Required V_{50} Ballistic Limit Velocity Equations, Obliquity: 30°. . .	11
9. MIL-A-46100 Revisions C, C2, and D CSTA AP Math Model Coefficients for Minimum Required V_{50} Ballistic Limit Velocity Equations, Obliquities: 30° and 0°.	12
10. MIL-A-46100 Minimum Required V_{50} Protection Limits, BL(P)'s, Projectile P1: 30 CAL AP M2 @ 30° Obliquity. . .	13-14

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

Tables (Continued)

	<u>Page</u>
11. MIL-A-46100 Minimum Required V_{50} Protection Limits, BL(P)'s, Projectile P2: 50 CAL AP M2 @ 30° Obliquity. . .	15-16
12. MIL-A-46100 Minimum Required V_{50} Protection Limits, BL(P)'s, Projectile P3: 14.5 MM API B32 @ 30° Obliquity .	17-18
13. MIL-A-46100 Minimum Required V_{50} Protection Limits, BL(P)'s, Projectile P4: 14.5 MM API BS41 @ 30° Obliquity.	19-20
14. MIL-A-46100 Minimum Required V_{50} Protection Limits, BL(P)'s, Projectile P5: 20 MM API-T M602 @ 0° Obliquity .	21-26
15. MIL-A-46100 Table Sizes for Tables of Minimum Required Ballistic Limits	27

Graphs

1. MIL-A-46100 Rev C and Rev C2 Projectile: 0.30 CAL AP M2 @ 30° Minimum V_{50} Velocity versus Armor Plate Thickness	28
2. MIL-A-46100 Rev C and Rev C2 Projectile: 0.30 CAL AP M2 @ 30° V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (C2-C)	29
3. MIL-A-46100 Rev C and Rev C2 Projectile: 0.30 CAL AP M2 @ 30° Minimum V_{50} Velocity versus Armor Plate Thickness & V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (C2-C)	30
4. MIL-A-46100 Rev C and Rev C2 Projectile: 0.50 CAL AP M2 @ 30° Minimum V_{50} Velocity versus Armor Plate Thickness	31
5. MIL-A-46100 Rev C and Rev C2 Projectile: 0.50 CAL AP M2 @ 30° V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (C2-C)	32

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

Graphs (Continued)

	<u>Page</u>
6. MIL-A-46100 Rev C and Rev C2 Projectile: 0.50 CAL AP M2 @ 30° Minimum V_{50} Velocity versus Armor Plate Thickness & V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (C2-C)	33
7. MIL-A-46100 Rev C and Rev C2 Projectile: 14.5 MM API B32 @ 30° Minimum V_{50} Velocity versus Armor Plate Thickness	34
8. MIL-A-46100 Rev C and Rev C2 Projectile: 14.5 MM API B32 @ 30° V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (C2-C)	35
9. MIL-A-46100 Rev C and Rev C2 Projectile: 14.5 MM API B32 @ 30° Minimum V_{50} Velocity versus Armor Plate Thickness & V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (C2-C)	36
10. MIL-A-46100 Rev C and Rev C2 Projectile: 14.5 MM API BS41 @ 30° Minimum V_{50} Velocity versus Armor Plate Thickness	37
11. MIL-A-46100 Rev C and Rev C2 Projectile: 14.5 MM API BS41 @ 30° V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (C2-C)	38
12. MIL-A-46100 Rev C and Rev C2 Projectile: 14.5 MM API BS41 @ 30° Minimum V_{50} Velocity versus Armor Plate Thickness & V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (D-C2)	39
13. MIL-A-46100 Rev C2 and Rev D Projectile: 20 MM API-T M602 @ 0° Minimum V_{50} Velocity versus Armor Plate Thickness	40
14. MIL-A-46100 Rev C2 and Rev D Projectile: 20 MM API-T M602 @ 0° V_{50} Velocity Difference versus Armor Plate Thickness V_{50} Diff (D-C2)	41

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

Graphs (Continued)

Page

15. MIL-A-46100 Rev C2 and Rev D
 Projectile: 20 MM API-T M602 @ 0°
 Minimum V_{50} Velocity versus Armor Plate Thickness
 &
 V_{50} Velocity Difference versus Armor Plate Thickness
 V_{50} Diff (D-C2) 42

DTIC QUALITY INSPECTED &

Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

Objectives

The objectives of this memorandum report are twofold:

- * To provide the analyst with the various revisions and amendments of the V_{50} ballistic limit requirements of MIL-A-46100 for the purpose of making easier and more accurate analyses and comparisons of V_{50} firing record data.

- * To furnish the reader with useful technical information extracted from the various revisions and amendments of MIL-A-46100 pertaining to its V_{50} ballistic test requirements.

Introduction

MIL-A-46100¹ is a Military Specification which covers quenched and tempered high-hardness wrought steel armor plate of thicknesses up to two (2) inches inclusive for use in lightweight armor applications. This memorandum report is a by-product of that portion of an ongoing project entitled *Improved High Hard Armor Steel (MIL-A-46100)* which involves the creation of a computerized Armor Steel Database for the storage and analysis of ballistic test data obtained on MIL-A-46100 steel by the U.S. Army Combat Systems Test Activity (CSTA).² The CSTA-furnished ballistic test results spanned the following three (3) MIL-A-46100 Revisions: Revision C, Revision C Amendment 2 (hereafter to be denoted as Revision C2), and Revision D. As the Armor Steel Database was being populated, it was observed that the required ballistic limit velocities (the minimum ballistic acceptance requirements) associated with each of these specification revisions do vary rather significantly. As a consequence of this observation, a complete review of the various revisions and amendments of MIL-A-46100 was undertaken to insure that the specification-revision-dependent results of the ballistic tests being analyzed are, indeed, accurately interpreted and unambiguously compared. This memorandum report presents the salient aspects of this review wherein the differences between the ballistic test requirements of these recent revisions of MIL-A-46100 are appropriately highlighted and documented in a single reference source.

Discussion

Military Specification MIL-A-46100 was initiated in 1965 to respond to a then critical need for armor plate in Southeast Asia. Since its implementation on 4 August 1965 - the introductory document being referred to as the **BASE** - this specification has undergone a series of revisions and amendments. The ballistic test requirements were originally classified CONFIDENTIAL and incorporated into a separate classified supplement. Subsequently, as of Revision A, Amendment 2, dated 9 May 1975, the ballistic test

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

requirements were declassified and embodied in an unclassified appendix as an attachment to the specification document. The historical development of this military specification from its inception to present is shown in Table 1.

The overall two (2) inch armor plate thickness range covered by MIL-A-46100 is divided into either four (4) or five (5) subordinate thickness ranges depending upon the applicable specification revision - **four (4) thickness ranges** from the **Base** document through Revision C inclusive, and **five (5) thickness ranges** from Revisions C2 through D1 inclusive. Associated with **each** subordinate thickness range is a specified armor-piercing (AP) **test projectile** and **target obliquity**. This armor plate thickness range partitioning is delineated in Table 2 for MIL-A-46100 Revisions C Amendment 2 and D.

In order to accommodate permissible production-related plate thickness variations in ordered MIL-A-46100 armor plate material, each subordinate thickness range is further subdivided into three (3) component thickness ranges; namely, **UNDERSIZE**, **REQUIRED**, and **OVERSIZE**. The specification's ballistic test requirements **begin** at the **lower boundary** of the **REQUIRED** thickness range and **end** at its **upper boundary**. The **UNDERSIZE** and **OVERSIZE** thickness ranges permit the application of the ballistic test requirements to undersize and oversize plate thicknesses. These three (3) component thickness provisions are included in Tables 3, 4, and 5 for MIL-A-46100 Revisions C, C2, and D respectively. In referring to these tables, it should be noted that Revision C includes only **four (4)** test projectiles. The **fifth** test projectile was added with the issuance of Revision C2 to extend the ballistic test requirements for armor plate to include thicknesses of up to two (2) inches.

The minimum required V_{50} protection ballistic limit, **BL(P)**, velocity values in the MIL-A-46100 Appendix "Armor Plate Thickness - Required BL(P)" Tables are computed using mathematical models developed by the U.S. Army Combat Systems Test Activity. The quantity " V_{50} " will be used synonymously with "**BL(P)**" in this memorandum report to denote the minimum required V_{50} protection ballistic limit velocity expressed in units of [FT/SEC]. In these mathematical models, the dependent variable, V_{50} , is expressed as a function of armor plate thickness expressed in units of [INCHES] and denoted by the symbol t in this memorandum report. Also, the notation P1, P2, P3, P4, and P5 shall be used to represent MIL-A-46100's five (5) test projectiles. A mathematical model exists for each test projectile, target obliquity, and specification revision. See Table 6.

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

The following **implicit** functional notation can be used to mathematically describe this **set** of mathematical models:

$$V_{50}(\text{PROJ}, \text{OBL}, \text{revR})$$

where PROJ = P1: CAL 0.30 AP M2 or
P2: CAL 0.50 AP M2 or
P3: 14.5 MM API B32 or
P4: 14.5 MM API BS 41 or
P5: 20 MM API-T M602;
OBL = target obliquity = 0° or 30° ; and
R = specification revision = C or C2 or D.

This implicit functional notation is employed in Table 6 to illustrate the dependencies of the computed V_{50} Protection Limit Velocities upon MIL-A-46100 Specification Revisions C, C2, and D. In the examination of this Table, it should be noted that a **new** set of five (5) mathematical models were introduced in Revision C2. Consequently, if any reference is to be **unambiguously** made for the satisfaction of the ballistic testing requirements of MIL-A-46100 Revision C, it is important to distinguish Revision C from Revision C2! In contrast, for Revision D, **only** one (1) new mathematical model was introduced for test projectile P5. For Revision D, the current MIL-A-46100 Revision, the mathematical models for the first four (4) test projectiles are the **same** as Revision C2. Prior to Revision D, the same set of four (4) mathematical models had been used from the **BASE** document through Revision C inclusive.

Table 7 shows the ballistic test requirements for each of the five (5) test projectiles in terms of specification revisions, armor plate thickness ranges, mathematical models, and security classifications. The contents of this table provides a compact historical overview of the ballistic test requirements of MIL-A-46100.

Table 8 includes the empirical equations used to compute the minimum required V_{50} ballistic velocities for test projectiles P1 (CAL 0.30 AP M2), P2 (CAL 0.50 AP M2), and P3 (14.5 MM API B32) for MIL-A-46100 Revision C. Similarly, in Table 9, are shown the empirical equations used to compute the remainder of the minimum required V_{50} ballistic velocities for MIL-A-46100 Revisions C, C2, and D.

Tables of the minimum required V_{50} protection ballistic limits (BL(P)'s), as a function of the five (5) test projectiles for MIL-A-46100 Revisions C, C2, and D are given as Tables 10-14 inclusive. In each table, the REQUIRED thickness- V_{50} values are highlighted in **bold face type**. Table 15 contains a listing of the number of individual pages comprising Tables 10-14.

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

Finally, the data contained in Tables 10-14 forms the basis for the generation of a set of three (3) curves for each of the five (5) test projectiles. In these plots, the armor plate thickness range inclusively spans the UNDERSIZE, REQUIRED, and OVERSIZE component thickness ranges. For Projectiles P1, P2, P3, and P4, the three (3) curves are:

1. Minimum V_{50} Velocity versus Armor Plate Thickness for Revision C and Revision C2
 - * (Revision C2 V_{50} 's = Revision D V_{50} 's)
2. V_{50} Velocity Differences versus Armor Plate Thickness
 - * (V_{50} Difference (Revision C2 - Revision C))
 - * (Revision C2 V_{50} 's = Revision D V_{50} 's)
3. Curves 1 & 2 Combined

For Projectile P5, the three (3) curves are:

1. Minimum V_{50} Velocity versus Armor Plate Thickness for Revision C2 and Revision D
2. V_{50} Velocity Differences versus Armor Plate Thickness
 - * (V_{50} Difference (Revision D - Revision C2))
3. Curves 1 & 2 Combined

Regarding the V_{50} Velocity Differences versus Armor Plate Thickness curves (Curve 2), the velocity differences vary non-linearly with armor plate thickness for test projectiles P1 and P2, while the velocity differences are almost constant for test projectiles P3, P4, and P5 over the armor plate thickness range. For the latter case, the curve resembles a scatter plot wherein the data points fall within a narrow velocity difference band.

A REVIEW OF THE V₅₀ BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

Acknowledgements

The author wishes to acknowledge the following individuals for their invaluable contributions to the success of this memorandum report.

ARL/MD

Richard J. Squillacioti
Patrick D. Woolsey
Anthone Zarkades
Robert A. Muldoon

CSTA

William H. Allison

CONTRACTORS

R. C. Associates - Raymond A. Cellitti

References

1. Military Specification MIL-A-46100.
2. Grubinskas, Robert C. and Squillacioti, Richard J. The Development of an Automated Armor Data Base - Phase 1. U.S. Army Research Laboratory, ARL-TR-218, September 1993.

A REVIEW OF THE V₅₀ BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 1

MIL SPEC MIL-A-46100 HISTORY			
SPEC REVISION	SPEC REVISION DATE	AMENDMENT NUMBER	AMENDMENT NUMBER DATE
BASE	04 AUG 65		
A	09 AUG 72		
A		1	06 NOV 72
A		2	09 MAY 75
B	29 JUL 77		
C	13 JUN 83		
C		1	15 NOV 84
C		2	20 OCT 86
D	16 MAY 88		
D		1	29 JUN 90

TABLE 2

MIL SPEC MIL-A-46100 REVISIONS C AND 2 & D TABLE OF REQUIRED ARMOR PLATE THICKNESS RANGES AS A FUNCTION OF PROJECTILE CALIBER		
PROJECTILE [CALIBER]	OBLIQUITY [DEGREES]	REQUIRED THICKNESS RANGE [INCHES]
CAL 0.30 AP M2	30	0.125-0.315
CAL 0.50 AP M2	30	0.316-0.590
14.5 MM API B32	30	0.591-0.765
14.5 MM API BS41	30	0.766-1.065
20 MM API-T M602	0	1.066-2.100

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLES 3, 4, & 5

MIL SPEC MIL-A-46100 REVISION C			
TABLE OF REQUIRED ARMOR PLATE THICKNESS RANGES [IN]			
PROJECTILE, OBL	UNDERSIZE RANGE	REQUIRED RANGE	OVERSIZE RANGE
0.30 CAL AP M2, 30°	0.102-0.120	0.125-0.300	0.305-0.340
0.50 CAL AP M2, 30°	0.275-0.300	0.301-0.590	0.595-0.625
14.5 MM API B32, 30°	0.575-0.590	0.591-0.765	0.770-0.790
14.5 MM API BS41, 30°	0.740-0.765	0.766-1.065	1.070-1.090

MIL SPEC MIL-A-46100 REVISION C AMENDMENT 2			
TABLE OF REQUIRED ARMOR PLATE THICKNESS RANGES [IN]			
PROJECTILE, OBL	UNDERSIZE RANGE	REQUIRED RANGE	OVERSIZE RANGE
CAL 0.30 AP M2, 30°	0.100-0.120	0.125-0.315	0.320-0.340
CAL 0.50 AP M2, 30°	0.290-0.315	0.316-0.590	0.595-0.625
14.5 MM API B32, 30°	0.575-0.590	0.591-0.765	0.770-0.790
14.5 MM API BS41, 30°	0.740-0.765	0.766-1.065	1.070-1.090
20 MM API-T M602, 0°	1.020-1.065	1.066-2.100	2.105-2.175

MIL SPEC MIL-A-46100 REVISION D			
TABLE OF REQUIRED ARMOR PLATE THICKNESS RANGES [IN]			
PROJECTILE, OBL	UNDERSIZE RANGE	REQUIRED RANGE	OVERSIZE RANGE
CAL 0.30 AP M2, 30°	0.100-0.120	0.125-0.315	0.320-0.340
CAL 0.50 AP M2, 30°	0.290-0.315	0.316-0.590	0.595-0.625
14.5 MM API B32, 30°	0.575-0.590	0.591-0.765	0.770-0.790
14.5 MM API BS41, 30°	0.740-0.765	0.766-1.065	1.070-1.090
20 MM API-T M602, 0°	1.020-1.065	1.066-2.100	2.105-2.175

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 6

MIL SPEC MIL-A-46100 V_{50} PROTECTION BALLISTIC LIMIT VELOCITY DEPENDENCIES UPON SPEC REVISIONS			
PROJECTILE	SPECIFICATION REVISIONS		
	REV C	REV C AMD 2	REV D
P1: CAL 0.30 AP M2	$V_{50}(P1, 30^\circ, \text{revC})$	$V_{50}(P1, 30^\circ, \text{revC2})$	$V_{50}(P1, 30^\circ, \text{revC2})$
P2: CAL 0.50 AP M2	$V_{50}(P2, 30^\circ, \text{revC})$	$V_{50}(P2, 30^\circ, \text{revC2})$	$V_{50}(P2, 30^\circ, \text{revC2})$
P3: 14.5 MM API B32	$V_{50}(P3, 30^\circ, \text{revC})$	$V_{50}(P3, 30^\circ, \text{revC2})$	$V_{50}(P3, 30^\circ, \text{revC2})$
P4: 14.5 MM API BS41	$V_{50}(P4, 30^\circ, \text{revC})$	$V_{50}(P4, 30^\circ, \text{revC2})$	$V_{50}(P4, 30^\circ, \text{revC2})$
P5: 20 MM API-T M602	-	$V_{50}(P5, 0^\circ, \text{revC2})$	$V_{50}(P5, 0^\circ, \text{revD})$

A REVIEW OF THE V₅₀ BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 7

MIL-A-46100 REVISIONS
ARMOR PLATE THICKNESS RANGES [INCHES]
V₅₀ BALLISTIC LIMIT VELOCITY MATH MODELS
SECURITY CLASSIFICATIONS

PROJECTILE P1: CAL 0.30 AP M2 @ 30 DEG OBLIQUITY

SPEC REVISION	UNDERSIZE TH RANGE	REQUIRED TH RANGE	OVERSIZE TH RANGE	MATH MODEL	SEC CLASS
BASE	0.160-0.185	0.1875-0.300	0.305-0.340	V ₅₀ (P1,30°,revC)	C
REV A	0.160-0.185	0.1875-0.300	0.305-0.340	V ₅₀ (P1,30°,revC)	C
REV A1	0.160-0.185	0.1875-0.300	0.305-0.340	V ₅₀ (P1,30°,revC)	C
REV A2	0.160-0.185	0.1875-0.300	0.305-0.340	V ₅₀ (P1,30°,revC)	C
REV B	0.160-0.185	0.1875-0.300	0.305-0.340	V ₅₀ (P1,30°,revC)	U
REV C	0.102-0.120	0.125 -0.300	0.305-0.340	V ₅₀ (P1,30°,revC)	U
REV C1	0.102-0.120	0.125 -0.300	0.305-0.340	V ₅₀ (P1,30°,revC)	U
REV C2	0.100-0.120	0.125 -0.315	0.320-0.340	V ₅₀ (P1,30°,revC2)	U
REV D	0.100-0.120	0.125 -0.315	0.320-0.340	V ₅₀ (P1,30°,revC2)	U
REV D1	0.100-0.120	0.125 -0.300	0.305-0.340	V ₅₀ (P1,30°,revC2)	U

PROJECTILE P2: CAL 0.50 AP M2 @ 30 DEG OBLIQUITY

SPEC REVISION	UNDERSIZE TH RANGE	REQUIRED TH RANGE	OVERSIZE TH RANGE	MATH MODEL	SEC CLASS
BASE	0.275-0.300	0.301-0.590	0.595-0.625	V ₅₀ (P2,30°,revC)	C
REV A	0.275-0.300	0.301-0.590	0.595-0.625	V ₅₀ (P2,30°,revC)	C
REV A1	0.275-0.300	0.301-0.590	0.595-0.625	V ₅₀ (P2,30°,revC)	C
REV A2	0.275-0.300	0.301-0.590	0.595-0.625	V ₅₀ (P2,30°,revC)	U
REV B	0.275-0.300	0.301-0.590	0.595-0.625	V ₅₀ (P2,30°,revC)	U
REV C	0.275-0.300	0.301-0.590	0.595-0.625	V ₅₀ (P2,30°,revC)	U
REV C1	0.275-0.300	0.301-0.590	0.595-0.625	V ₅₀ (P2,30°,revC)	U
REV C2	0.290-0.315	0.316-0.590	0.595-0.625	V ₅₀ (P2,30°,revC2)	U
REV D	0.290-0.315	0.316-0.590	0.595-0.625	V ₅₀ (P2,30°,revC2)	U
REV D1	0.290-0.300	0.301-0.590	0.595-0.625	V ₅₀ (P2,30°,revC2)	U

PROJECTILE P3: 14.5 MM API B32 @ 30 DEG OBLIQUITY

SPEC REVISION	UNDERSIZE TH RANGE	REQUIRED TH RANGE	OVERSIZE TH RANGE	MATH MODEL	SEC CLASS
BASE	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC)	C
REV A	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC)	C
REV A1	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC)	C
REV A2	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC)	U
REV B	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC)	U
REV C	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC)	U
REV C1	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC)	U
REV C2	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC2)	U
REV D	0.575-0.590	0.591-0.765	0.770-0.790	V ₅₀ (P3,30°,revC2)	U

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 7 (CONTINUED)

MIL-A-46100 REVISIONS
 ARMOR PLATE THICKNESS RANGES [INCHES]
 V_{50} BALLISTIC LIMIT VELOCITY MATH MODELS
 SECURITY CLASSIFICATIONS

PROJECTILE P4: 14.5 MM API BS41 @ 30 DEG OBLIQUITY

SPEC REVISION	UNDERSIZE TH RANGE	REQUIRED TH RANGE	OVERSIZE TH RANGE	MATH MODEL	SEC CLASS
REV C	0.740-0.765	0.766-1.065	1.070-1.090	$V_{50}(P4, 30^\circ, \text{revC})$	U
REV C1	0.740-0.765	0.766-1.065	1.070-1.090	$V_{50}(P4, 30^\circ, \text{revC})$	U
REV C2	0.740-0.765	0.766-1.065	1.070-1.090	$V_{50}(P4, 30^\circ, \text{revC2})$	U
REV D	0.740-0.765	0.766-1.065	1.070-1.090	$V_{50}(P4, 30^\circ, \text{revC2})$	U

PROJECTILE P5: 20 MM API-T M602 @ 0 DEG OBLIQUITY

SPEC REVISION	UNDERSIZE TH RANGE	REQUIRED TH RANGE	OVERSIZE TH RANGE	MATH MODEL	SEC CLASS
REV C2	1.020-1.065	1.066-2.100	2.105-2.175	$V_{50}(P5, 0^\circ, \text{revC})$	U
REV D	1.020-1.065	1.066-2.100	2.105-2.175	$V_{50}(P5, 0^\circ, \text{revC2})$	U

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 8

MIL SPEC MIL-A-46100 REVISION C				
CSTA AP MATH MODEL COEFFICIENTS FOR				
MINIMUM REQUIRED V_{50} BALLISTIC LIMIT VELOCITY EQUATIONS				
OBLIQUITY: 30 DEGREES				
$V_{50}(P1, 30^\circ, revC) = \frac{1}{2c} [-b + \sqrt{b^2 - 4c(a-t)}]$				
$V_{50}(P2, 30^\circ, revC) = a + bt + ct^2 + dt^3$				
$V_{50}(P3, 30^\circ, revC) = a - bt + ct^2$				
PROJ	a	b	c	d
P1	8.7458×10^{-2}	1.196828×10^{-5}	2.690298×10^{-8}	
P2	-356.5	8759.2	-8695.4	4366.1
P3	850.2	3388.5	-777.77	

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 9

MIL SPEC MIL-A-46100 REVISIONS C, C2, & D CSTA AP MATH MODEL COEFFICIENTS FOR MINIMUM REQUIRED V_{50} BALLISTIC LIMIT VELOCITY EQUATIONS OBLIQUITIES: 30 & 0 DEGREES						
$V_{50}(PROJ, OBL, revR) = 1000\sqrt{a+bt} - 1.645\hat{\sigma}$						
PROJECTILE	PROJ	OBL	R	a	b	$\hat{\sigma}$
CAL 0.30 AP M2	P1	30	C2,D	-1.617	29.287	91.85
CAL 0.50 AP M2	P2	30	C2,D	-0.388	14.093	85.17
14.5 MM API B32	P3	30	C2,D	-0.260	10.759	76.29
14.5 MM API BS41	P4	30	C2,D	-3.928	12.524	60.36
20 MM API-T M602	P5	0	C2	-3.330	6.849	35.51
20 MM API-T M602	P5	0	D	-3.550	6.790	48.40
14.5 MM API BS41	P4	30	C	-3.927	12.366	36.65

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 10

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P1: 30 AP M2 @ 30 DEG OBLIQUITY

REV C THICKNESS [IN]	REV C REQ BL(P) [FPS]	REV C2 THICKNESS [IN]	REV C2 REQ BL(P) [FPS]	REV D THICKNESS [IN]	REV D REQ BL(P) [FPS]
0.102	545	0.100	994	0.100	994
0.105	615	0.105	1057	0.105	1057
0.110	720	0.110	1116	0.110	1116
0.115	813	0.115	1172	0.115	1172
0.120	900	0.120	1226	0.120	1226
0.125	980	0.125	1279	0.125	1279
0.130	1055	0.130	1329	0.130	1329
0.135	1125	0.135	1378	0.135	1378
0.140	1193	0.140	1425	0.140	1425
0.145	1257	0.145	1471	0.145	1471
0.150	1318	0.150	1515	0.150	1515
0.155	1378	0.155	1558	0.155	1558
0.160	1434	0.160	1601	0.160	1601
0.165	1490	0.165	1642	0.165	1642
0.170	1543	0.170	1682	0.170	1682
0.175	1595	0.175	1722	0.175	1722
0.180	1646	0.180	1761	0.180	1761
0.185	1695	0.185	1799	0.185	1799
0.190	1742	0.190	1836	0.190	1836
0.195	1789	0.195	1872	0.195	1872
0.200	1835	0.200	1908	0.200	1908
0.205	1880	0.205	1943	0.205	1943
0.210	1923	0.210	1978	0.210	1978
0.215	1966	0.215	2012	0.215	2012
0.220	2008	0.220	2046	0.220	2046
0.225	2050	0.225	2079	0.225	2079
0.230	2090	0.230	2111	0.230	2111
0.235	2130	0.235	2144	0.235	2144
0.240	2169	0.240	2175	0.240	2175
0.245	2208	0.245	2207	0.245	2207
0.250	2246	0.250	2237	0.250	2237
0.255	2283	0.255	2268	0.255	2268
0.260	2320	0.260	2298	0.260	2298
0.265	2356	0.265	2328	0.265	2328
0.270	2392	0.270	2357	0.270	2357
0.275	2427	0.275	2386	0.275	2386
0.280	2462	0.280	2415	0.280	2415
0.285	2496	0.285	2443	0.285	2443
0.290	2530	0.290	2471	0.290	2471
0.295	2564	0.295	2499	0.295	2499

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 10 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P1: 30 AP M2 @ 30 DEG OBLIQUITY

REV C	REV C	REV C2	REV C2	REV D	REV D
THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)
[IN]	[FPS]	[IN]	[FPS]	[IN]	[FPS]
0.300	2597	0.300	2526	0.300	2526
0.305	2630	0.305	2554	0.305	2554
0.310	2662	0.310	2581	0.310	2581
0.315	2694	0.315	2607	0.315	2607
0.320	2726	0.320	2634	0.320	2634
0.325	2758	0.325	2660	0.325	2660
0.330	2788	0.330	2686	0.330	2686
0.335	2819	0.335	2711	0.335	2711
0.340	2850	0.340	2737	0.340	2737

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 11

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S
PROJECTILE P2: 50 AP M2 @ 30 DEG OBLIQUITY

REV C THICKNESS [IN]	REV C REQ BL(P) [FPS]	REV C2 THICKNESS [IN]	REV C2 REQ BL(P) [FPS]	REV D THICKNESS [IN]	REV D REQ BL(P) [FPS]
0.275	1482	0.290	1783	0.290	1783
0.280	1507	0.295	1801	0.295	1801
0.285	1532	0.300	1820	0.300	1820
0.290	1557	0.305	1837	0.305	1837
0.295	1582	0.310	1855	0.310	1855
0.300	1606	0.315	1873	0.315	1873
0.301	1611	0.316	1876	0.316	1876
0.305	1630	0.320	1890	0.320	1890
0.310	1653	0.325	1907	0.325	1907
0.315	1676	0.330	1925	0.330	1925
0.320	1699	0.335	1942	0.335	1942
0.325	1722	0.340	1958	0.340	1958
0.330	1744	0.345	1975	0.345	1975
0.335	1767	0.350	1992	0.350	1992
0.340	1789	0.355	2008	0.355	2008
0.345	1810	0.360	2025	0.360	2025
0.350	1832	0.365	2041	0.365	2041
0.355	1853	0.370	2057	0.370	2057
0.360	1874	0.375	2073	0.375	2073
0.365	1895	0.380	2089	0.380	2089
0.370	1916	0.385	2104	0.385	2104
0.375	1936	0.390	2120	0.390	2120
0.380	1956	0.395	2136	0.395	2136
0.385	1976	0.400	2151	0.400	2151
0.390	1996	0.405	2166	0.405	2166
0.395	2016	0.410	2182	0.410	2182
0.400	2035	0.415	2197	0.415	2197
0.405	2055	0.420	2212	0.420	2212
0.410	2074	0.425	2227	0.425	2227
0.415	2093	0.430	2242	0.430	2242
0.420	2112	0.435	2256	0.435	2256
0.425	2130	0.440	2271	0.440	2271
0.430	2149	0.445	2286	0.445	2286
0.435	2167	0.450	2300	0.450	2300
0.440	2186	0.455	2314	0.455	2314
0.445	2204	0.460	2329	0.460	2329
0.450	2222	0.465	2343	0.465	2343
0.455	2240	0.470	2357	0.470	2357
0.460	2257	0.475	2371	0.475	2371
0.465	2275	0.480	2385	0.480	2385

A REVIEW OF THE V₅₀ BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 11 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V₅₀ PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P2: 50 AP M2 @ 30 DEG OBLIQUITY

REV C THICKNESS [IN]	REV C REQ BL(P) [FPS]	REV C2 THICKNESS [IN]	REV C2 REQ BL(P) [FPS]	REV D THICKNESS [IN]	REV D REQ BL(P) [FPS]
0.470	2292	0.485	2399	0.485	2399
0.475	2310	0.490	2413	0.490	2413
0.480	2327	0.495	2427	0.495	2427
0.485	2344	0.500	2440	0.500	2440
0.490	2361	0.505	2454	0.505	2454
0.495	2378	0.510	2468	0.510	2468
0.500	2395	0.515	2481	0.515	2481
0.505	2412	0.520	2494	0.520	2494
0.510	2428	0.525	2508	0.525	2508
0.515	2445	0.530	2521	0.530	2521
0.520	2461	0.535	2534	0.535	2534
0.525	2478	0.540	2547	0.540	2547
0.530	2494	0.545	2560	0.545	2560
0.535	2510	0.550	2573	0.550	2573
0.540	2526	0.555	2586	0.555	2586
0.545	2542	0.560	2599	0.560	2599
0.550	2558	0.565	2612	0.565	2612
0.555	2573	0.570	2625	0.570	2625
0.560	2589	0.575	2638	0.575	2638
0.565	2604	0.580	2650	0.580	2650
0.570	2620	0.585	2663	0.585	2663
0.575	2635	0.590	2675	0.590	2675
0.580	2651	0.595	2688	0.595	2688
0.585	2666	0.600	2700	0.600	2700
0.590	2681	0.605	2713	0.605	2713
0.595	2696	0.610	2725	0.610	2725
0.600	2711	0.615	2737	0.615	2737
0.605	2726	0.620	2750	0.620	2750
0.610	2741	0.625	2762	0.625	2762
0.615	2756				
0.620	2770				
0.625	2785				

A REVIEW OF THE V₅₀ BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 12

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V₅₀ PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P3: 14.5 MM API B32 @ 30 DEG OBLIQUITY

REV C THICKNESS [IN]	REV C REQ BL(P) [FPS]	REV C2 THICKNESS [IN]	REV C2 REQ BL(P) [FPS]	REV D THICKNESS [IN]	REV D REQ BL(P) [FPS]
0.575	2369	0.575	2320	0.575	2320
0.580	2380	0.580	2331	0.580	2331
0.585	2391	0.585	2342	0.585	2342
0.590	2402	0.590	2353	0.590	2353
0.591	2404	0.591	2355	0.591	2355
0.595	2412	0.595	2364	0.595	2364
0.600	2423	0.600	2374	0.600	2374
0.605	2434	0.605	2385	0.605	2385
0.610	2445	0.610	2396	0.610	2396
0.615	2456	0.615	2407	0.615	2407
0.620	2466	0.620	2417	0.620	2417
0.625	2477	0.625	2428	0.625	2428
0.630	2487	0.630	2438	0.630	2438
0.635	2498	0.635	2449	0.635	2449
0.640	2508	0.640	2459	0.640	2459
0.645	2519	0.645	2469	0.645	2469
0.650	2529	0.650	2480	0.650	2480
0.655	2540	0.655	2490	0.655	2490
0.660	2550	0.660	2500	0.660	2500
0.665	2560	0.665	2511	0.665	2511
0.670	2570	0.670	2521	0.670	2521
0.675	2580	0.675	2531	0.675	2531
0.680	2591	0.680	2541	0.680	2541
0.685	2601	0.685	2551	0.685	2551
0.690	2611	0.690	2561	0.690	2561
0.695	2621	0.695	2571	0.695	2571
0.700	2631	0.700	2581	0.700	2581
0.705	2641	0.705	2591	0.705	2591
0.710	2651	0.710	2601	0.710	2601
0.715	2661	0.715	2611	0.715	2611
0.720	2670	0.720	2621	0.720	2621
0.725	2680	0.725	2630	0.725	2630
0.730	2690	0.730	2640	0.730	2640
0.735	2700	0.735	2650	0.735	2650
0.740	2710	0.740	2659	0.740	2659
0.745	2719	0.745	2669	0.745	2659
0.750	2729	0.750	2679	0.750	2679
0.755	2739	0.755	2688	0.755	2688
0.760	2748	0.760	2698	0.760	2698
0.765	2758	0.765	2707	0.765	2707

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 12 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P3: 14.5 MM API B32 @ 30 DEG OBLIQUITY

REV C	REV C	REV C2	REV C2	REV D	REV D
THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)
[IN]	[FPS]	[IN]	[FPS]	[IN]	[FPS]
0.770	2767	0.770	2717	0.770	2717
0.775	2777	0.775	2726	0.775	2726
0.780	2786	0.780	2736	0.780	2736
0.785	2796	0.785	2745	0.785	2745
0.790	2805	0.790	2754	0.790	2754

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 13

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S
PROJECTILE P4: 14.5 MM API BS41 @ 30 DEG OBLIQUITY

REV C THICKNESS [IN]	REV C REQ BL(P) [FPS]	REV C2 THICKNESS [IN]	REV C2 REQ BL(P) [FPS]	REV D THICKNESS [IN]	REV D REQ BL(P) [FPS]
0.740	2225	0.740	2212	0.740	2212
0.745	2239	0.745	2225	0.745	2225
0.750	2252	0.750	2239	0.750	2239
0.755	2265	0.755	2252	0.755	2252
0.760	2279	0.760	2265	0.760	2265
0.765	2292	0.765	2278	0.765	2278
0.766	2295	0.766	2281	0.766	2281
0.770	2305	0.770	2292	0.770	2292
0.775	2318	0.775	2305	0.775	2305
0.780	2331	0.780	2318	0.780	2318
0.785	2344	0.785	2331	0.785	2331
0.790	2357	0.790	2343	0.790	2343
0.795	2369	0.795	2356	0.795	2356
0.800	2382	0.800	2369	0.800	2369
0.805	2395	0.805	2382	0.805	2382
0.810	2407	0.810	2394	0.810	2394
0.815	2420	0.815	2407	0.815	2407
0.820	2432	0.820	2419	0.820	2419
0.825	2445	0.825	2431	0.825	2431
0.830	2457	0.830	2444	0.830	2444
0.835	2469	0.835	2456	0.835	2456
0.840	2481	0.840	2468	0.840	2468
0.845	2494	0.845	2481	0.845	2481
0.850	2506	0.850	2493	0.850	2493
0.855	2518	0.855	2505	0.855	2505
0.860	2530	0.860	2517	0.860	2517
0.865	2542	0.865	2529	0.865	2529
0.870	2553	0.870	2540	0.870	2540
0.875	2565	0.875	2552	0.875	2552
0.880	2577	0.880	2564	0.880	2564
0.885	2589	0.885	2576	0.885	2576
0.890	2600	0.890	2588	0.890	2588
0.895	2612	0.895	2599	0.895	2599
0.900	2623	0.900	2611	0.900	2611
0.905	2635	0.905	2622	0.905	2622
0.910	2646	0.910	2634	0.910	2634
0.915	2658	0.915	2645	0.915	2645
0.920	2669	0.920	2657	0.920	2657
0.925	2680	0.925	2668	0.925	2668
0.930	2692	0.930	2679	0.930	2679

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 13 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P4: 14.5 MM API BS41 @ 30 DEG OBLIQUITY

REV C THICKNESS [IN]	REV C REQ BL(P) [FPS]	REV C2 THICKNESS [IN]	REV C2 REQ BL(P) [FPS]	REV D THICKNESS [IN]	REV D REQ BL(P) [FPS]
0.935	2703	0.935	2690	0.935	2690
0.940	2714	0.940	2702	0.940	2702
0.945	2725	0.945	2713	0.945	2713
0.950	2736	0.950	2724	0.950	2724
0.955	2747	0.955	2735	0.955	2735
0.960	2758	0.960	2746	0.960	2746
0.965	2769	0.965	2757	0.965	2757
0.975	2791	0.975	2779	0.975	2779
0.980	2802	0.980	2790	0.980	2790
0.985	2813	0.985	2800	0.985	2800
0.990	2823	0.990	2811	0.990	2811
0.995	2834	0.995	2822	0.995	2822
1.000	2845	1.000	2832	1.000	2832
1.005	2855	1.005	2843	1.005	2843
1.010	2866	1.010	2854	1.010	2854
1.015	2876	1.015	2865	1.015	2865
1.020	2887	1.020	2875	1.020	2875
1.025	2897	1.025	2886	1.025	2886
1.030	2908	1.030	2896	1.030	2896
1.035	2918	1.035	2907	1.035	2907
1.040	2929	1.040	2917	1.040	2917
1.045	2939	1.045	2927	1.045	2927
1.050	2949	1.050	2938	1.050	2938
1.055	2959	1.055	2948	1.055	2948
1.060	2970	1.060	2958	1.060	2958
1.065	2980	1.065	2968	1.065	2968
1.070	2990	1.070	2979	1.070	2979
1.075	3000	1.075	2989	1.075	2989
1.080	3010	1.080	2999	1.080	2999
1.085	3020	1.085	3009	1.085	3009
1.090	3030	1.090	3019	1.090	3019

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 14

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S
PROJECTILE P5: 20 MM API-T M602 @ 30 DEG OBLIQUITY

REV C	REV C	REV C2	REV C2	REV D	REV D
THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)
[IN]	[FPS]	[IN]	[FPS]	[IN]	[FPS]
		1.020	1801	1.020	1758
		1.025	1810	1.025	1767
		1.030	1819	1.030	1776
		1.035	1828	1.035	1785
		1.040	1837	1.040	1794
		1.045	1846	1.045	1804
		1.050	1855	1.050	1813
		1.055	1864	1.055	1821
		1.060	1873	1.060	1830
		1.065	1882	1.065	1839
		1.066	1884	1.066	1841
		1.070	1891	1.070	1848
		1.075	1899	1.075	1857
		1.080	1908	1.080	1866
		1.085	1917	1.085	1874
		1.090	1925	1.090	1883
		1.095	1934	1.095	1892
		1.100	1943	1.100	1900
		1.105	1951	1.105	1909
		1.110	1960	1.110	1917
		1.115	1968	1.115	1926
		1.120	1977	1.120	1934
		1.125	1985	1.125	1943
		1.130	1993	1.130	1951
		1.135	2002	1.135	1959
		1.140	2010	1.140	1968
		1.145	2018	1.145	1976
		1.150	2026	1.150	1984
		1.155	2035	1.155	1992
		1.160	2043	1.160	2001
		1.165	2051	1.165	2009
		1.170	2059	1.170	2017
		1.175	2067	1.175	2025
		1.180	2075	1.180	2033
		1.185	2083	1.185	2041
		1.190	2091	1.190	2049
		1.195	2099	1.195	2057
		1.200	2107	1.200	2065
		1.205	2115	1.205	2073
		1.210	2123	1.210	2081

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 14 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S
PROJECTILE P5: 20 MM API-T M602 @ 30 DEG OBLIQUITY

REV C	REV C	REV C2	REV C2	REV D	REV D
THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)
[IN]	[FPS]	[IN]	[FPS]	[IN]	[FPS]
		1.215	2131	1.215	2088
		1.220	2138	1.220	2096
		1.225	2146	1.225	2104
		1.230	2154	1.230	2112
		1.235	2162	1.235	2120
		1.240	2169	1.240	2127
		1.245	2177	1.245	2135
		1.250	2185	1.250	2143
		1.255	2192	1.255	2150
		1.260	2200	1.260	2158
		1.265	2207	1.265	2165
		1.270	2215	1.270	2173
		1.275	2223	1.275	2180
		1.280	2230	1.280	2188
		1.285	2237	1.285	2195
		1.290	2245	1.290	2203
		1.295	2252	1.295	2210
		1.300	2260	1.300	2218
		1.305	2267	1.305	2225
		1.310	2274	1.310	2232
		1.315	2282	1.315	2240
		1.320	2289	1.320	2247
		1.325	2296	1.325	2254
		1.330	2304	1.330	2262
		1.335	2311	1.335	2269
		1.340	2318	1.340	2276
		1.345	2325	1.345	2283
		1.350	2332	1.350	2290
		1.355	2340	1.355	2298
		1.360	2347	1.360	2305
		1.365	2354	1.365	2312
		1.370	2361	1.370	2319
		1.375	2368	1.375	2326
		1.380	2375	1.380	2333
		1.385	2382	1.385	2340
		1.390	2389	1.390	2347
		1.395	2396	1.395	2354
		1.400	2403	1.400	2361
		1.405	2410	1.405	2368
		1.410	2417	1.410	2375

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 14 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P5: 20 MM API-T M602 @ 30 DEG OBLIQUITY

REV C THICKNESS [IN]	REV C REQ BL(P) [FPS]	REV C2 THICKNESS [IN]	REV C2 REQ BL(P) [FPS]	REV D THICKNESS [IN]	REV D REQ BL(P) [FPS]
		1.415	2424	1.415	2382
		1.420	2431	1.420	2389
		1.425	2438	1.425	2396
		1.430	2444	1.430	2402
		1.435	2451	1.435	2409
		1.440	2458	1.440	2416
		1.445	2465	1.445	2423
		1.450	2472	1.450	2430
		1.455	2478	1.455	2436
		1.460	2485	1.460	2443
		1.465	2492	1.465	2450
		1.470	2499	1.470	2457
		1.475	2505	1.475	2463
		1.480	2512	1.480	2470
		1.485	2519	1.485	2477
		1.490	2525	1.490	2483
		1.495	2532	1.495	2490
		1.500	2538	1.500	2496
		1.505	2545	1.505	2503
		1.510	2552	1.510	2510
		1.515	2558	1.515	2516
		1.520	2565	1.520	2523
		1.525	2571	1.525	2529
		1.530	2578	1.530	2536
		1.535	2584	1.535	2542
		1.540	2591	1.540	2549
		1.545	2597	1.545	2555
		1.550	2604	1.550	2561
		1.555	2610	1.555	2568
		1.560	2616	1.560	2574
		1.565	2623	1.565	2581
		1.570	2629	1.570	2587
		1.575	2636	1.575	2593
		1.580	2642	1.580	2600
		1.585	2648	1.585	2606
		1.590	2655	1.590	2612
		1.595	2661	1.595	2619
		1.600	2667	1.600	2625
		1.605	2673	1.605	2631
		1.610	2680	1.610	2637

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 14 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P5: 20 MM API-T M602 @ 30 DEG OBLIQUITY

REV C	REV C	REV C2	REV C2	REV D	REV D
THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)
[IN]	[FPS]	[IN]	[FPS]	[IN]	[FPS]
		1.615	2686	1.615	2644
		1.620	2692	1.620	2650
		1.625	2698	1.625	2656
		1.630	2705	1.630	2662
		1.635	2711	1.635	2669
		1.640	2717	1.640	2675
		1.645	2723	1.645	2681
		1.650	2729	1.650	2687
		1.655	2735	1.655	2693
		1.660	2742	1.660	2699
		1.665	2748	1.665	2705
		1.670	2754	1.670	2711
		1.675	2760	1.675	2718
		1.680	2766	1.680	2724
		1.685	2772	1.685	2730
		1.690	2778	1.690	2736
		1.695	2784	1.695	2742
		1.700	2790	1.700	2748
		1.705	2796	1.705	2754
		1.710	2802	1.710	2760
		1.715	2808	1.715	2766
		1.720	2814	1.720	2772
		1.725	2820	1.725	2778
		1.730	2826	1.730	2784
		1.735	2832	1.735	2789
		1.740	2838	1.740	2795
		1.745	2844	1.745	2801
		1.750	2850	1.750	2807
		1.755	2855	1.755	2813
		1.760	2861	1.760	2819
		1.765	2867	1.765	2825
		1.770	2873	1.770	2831
		1.775	2879	1.775	2836
		1.780	2885	1.780	2842
		1.785	2890	1.785	2848
		1.790	2896	1.790	2854
		1.795	2902	1.795	2860
		1.800	2908	1.800	2865
		1.805	2914	1.805	2871
		1.810	2919	1.810	2877

A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 14 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V_{50} PROTECTION BALLISTIC LIMITS, BL(P)'S

PROJECTILE P5: 20 MM API-T M602 @ 30 DEG OBLIQUITY

REV C	REV C	REV C2	REV C2	REV D	REV D
THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)
[IN]	[FPS]	[IN]	[FPS]	[IN]	[FPS]
		1.815	2925	1.815	2883
		1.820	2931	1.820	2888
		1.825	2937	1.825	2894
		1.830	2942	1.830	2900
		1.835	2948	1.835	2905
		1.840	2954	1.840	2911
		1.845	2959	1.845	2917
		1.850	2965	1.850	2922
		1.855	2971	1.855	2928
		1.860	2976	1.860	2934
		1.865	2982	1.865	2939
		1.870	2988	1.870	2945
		1.875	2993	1.875	2951
		1.880	2999	1.880	2956
		1.885	3004	1.885	2962
		1.890	3010	1.890	2967
		1.895	3016	1.895	2973
		1.900	3021	1.900	2978
		1.905	3027	1.905	2984
		1.910	3032	1.910	2990
		1.915	3038	1.915	2995
		1.920	3043	1.920	3001
		1.925	3049	1.925	3006
		1.930	3054	1.930	3012
		1.935	3060	1.935	3017
		1.940	3065	1.940	3023
		1.945	3071	1.945	3028
		1.950	3076	1.950	3033
		1.955	3082	1.955	3039
		1.960	3087	1.960	3044
		1.965	3093	1.965	3050
		1.970	3098	1.970	3055
		1.975	3103	1.975	3061
		1.980	3109	1.980	3066
		1.985	3114	1.985	3071
		1.990	3120	1.990	3077
		1.995	3125	1.995	3082
		2.000	3130	2.000	3088
		2.005	3136	2.005	3093
		2.010	3141	2.010	3098

A REVIEW OF THE V₅₀ BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 14 (CONTINUED)

MIL SPEC MIL-A-46100

MINIMUM REQUIRED V₅₀ PROTECTION BALLISTIC LIMITS, BL(P)'S
PROJECTILE P5: 20 MM API-T M602 @ 30 DEG OBLIQUITY

REV C	REV C	REV C2	REV C2	REV D	REV D
THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)	THICKNESS	REQ BL(P)
[IN]	[FPS]	[IN]	[FPS]	[IN]	[FPS]
		2.015	3146	2.015	3104
		2.020	3152	2.020	3109
		2.025	3157	2.025	3114
		2.030	3162	2.030	3120
		2.035	3168	2.035	3125
		2.040	3173	2.040	3130
		2.045	3178	2.045	3135
		2.050	3184	2.050	3141
		2.055	3189	2.055	3146
		2.060	3194	2.060	3151
		2.065	3199	2.065	3156
		2.070	3205	2.070	3162
		2.075	3210	2.075	3167
		2.080	3215	2.080	3172
		2.085	3220	2.085	3177
		2.090	3226	2.090	3183
		2.095	3231	2.095	3188
		2.100	3236	2.100	3193
		2.105	3241	2.105	3198
		2.110	3246	2.110	3203
		2.115	3252	2.115	3208
		2.120	3257	2.120	3214
		2.125	3262	2.125	3219
		2.130	3267	2.130	3224
		2.135	3272	2.135	3229
		2.140	3277	2.140	3234
		2.145	3282	2.145	3239
		2.150	3288	2.150	3244
		2.155	3293	2.155	3250
		2.160	3298	2.160	3255
		2.165	3303	2.165	3260
		2.170	3308	2.170	3265
		2.175	3313	2.175	3270

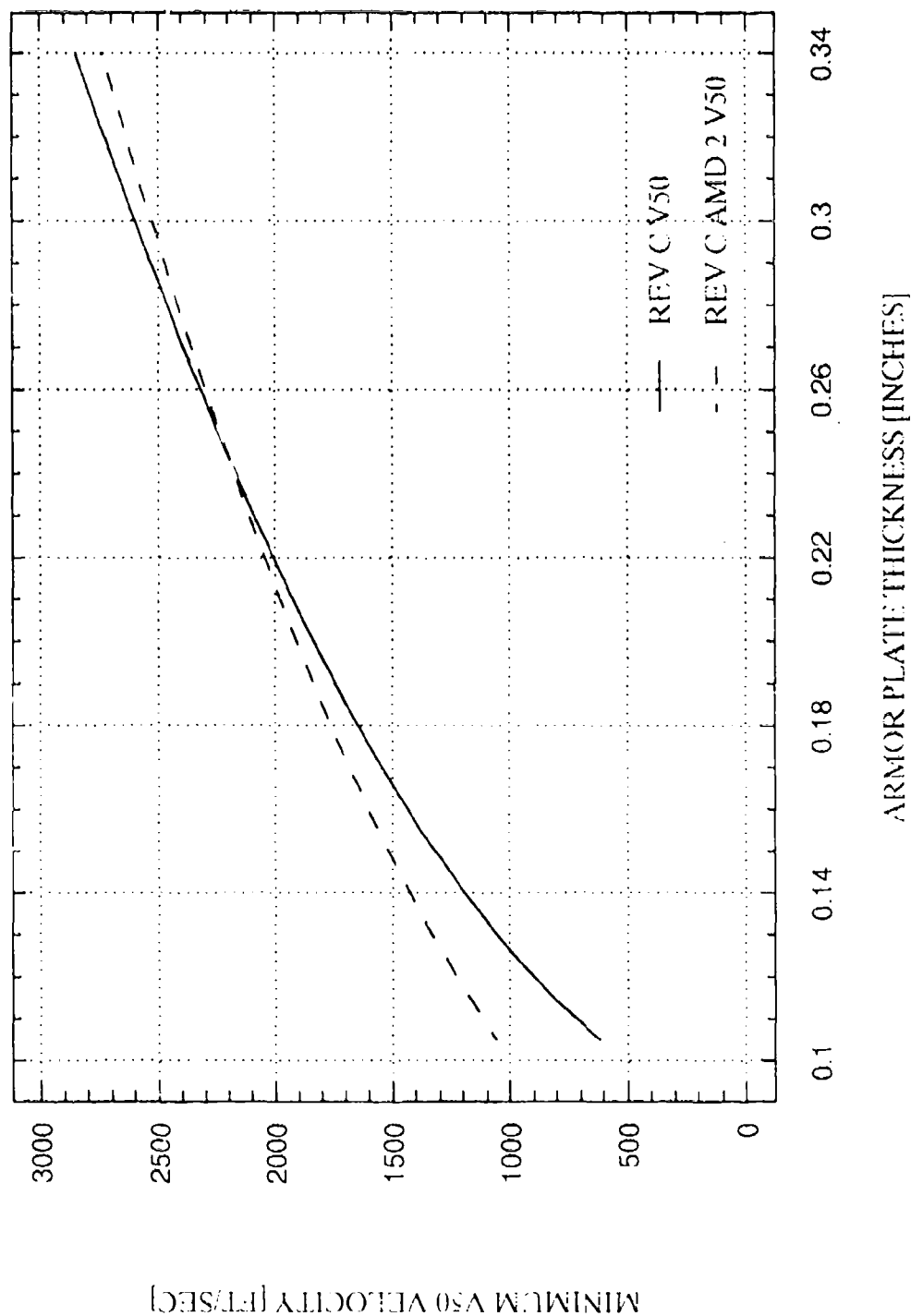
A REVIEW OF THE V_{50} BALLISTIC TEST REQUIREMENTS OF MIL-A-46100

TABLE 15

MIL-A-46100 TABLE SIZES FOR TABLES OF MINIMUM REQUIRED BALLISTIC LIMITS		
PROJECTILE	TABLE	PAGES
CAL 0.30 AP M2	10	2
CAL 0.50 AP M2	11	2
14.5 MM API B32	12	2
14.5 MM API BS41	13	2
20 MM API-T M602	14	6

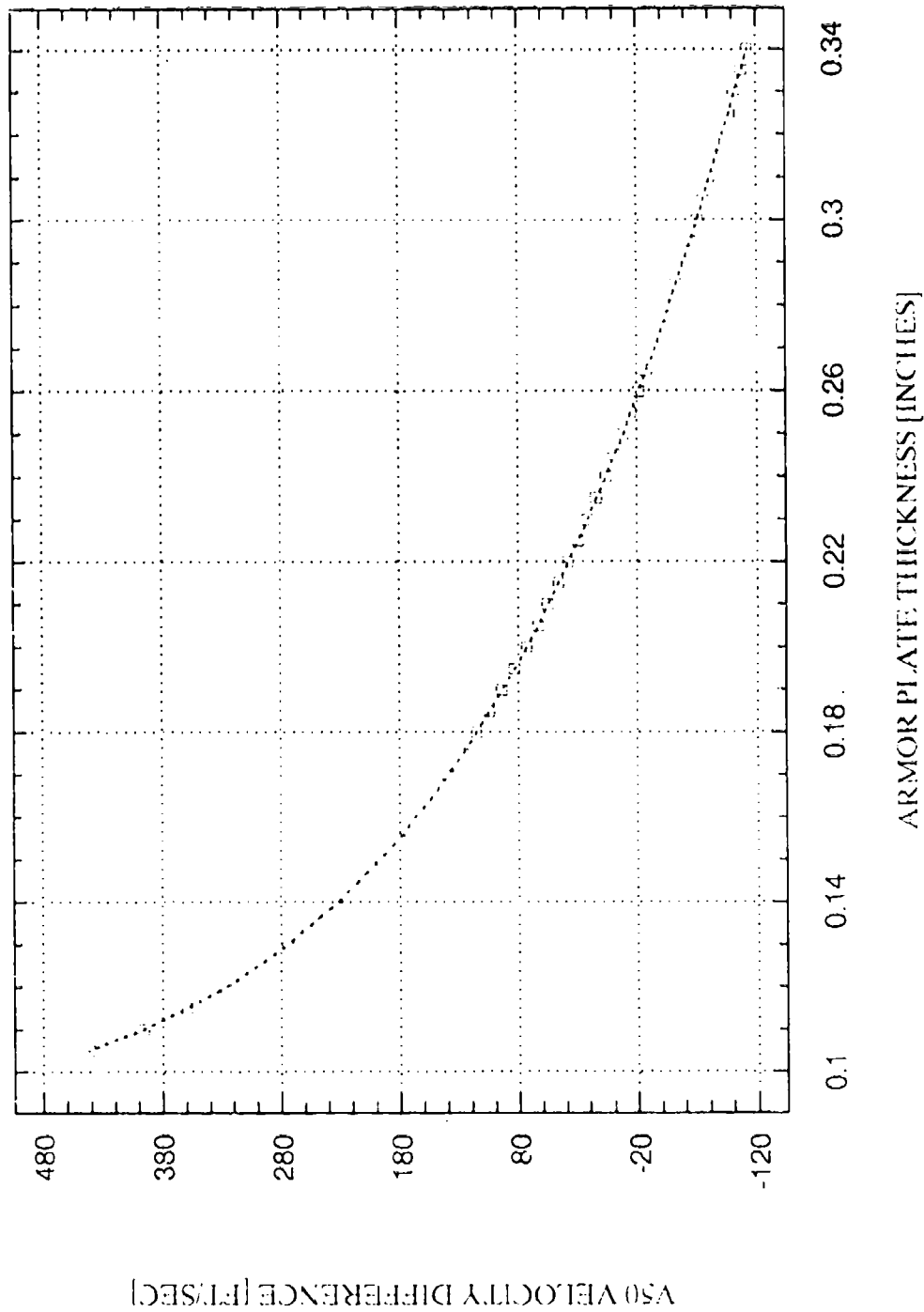
MIL-A-46100 REV C & REV C AMD 2

PROJECTILE: 0.30 CAL AP M2 @ 30 DEG



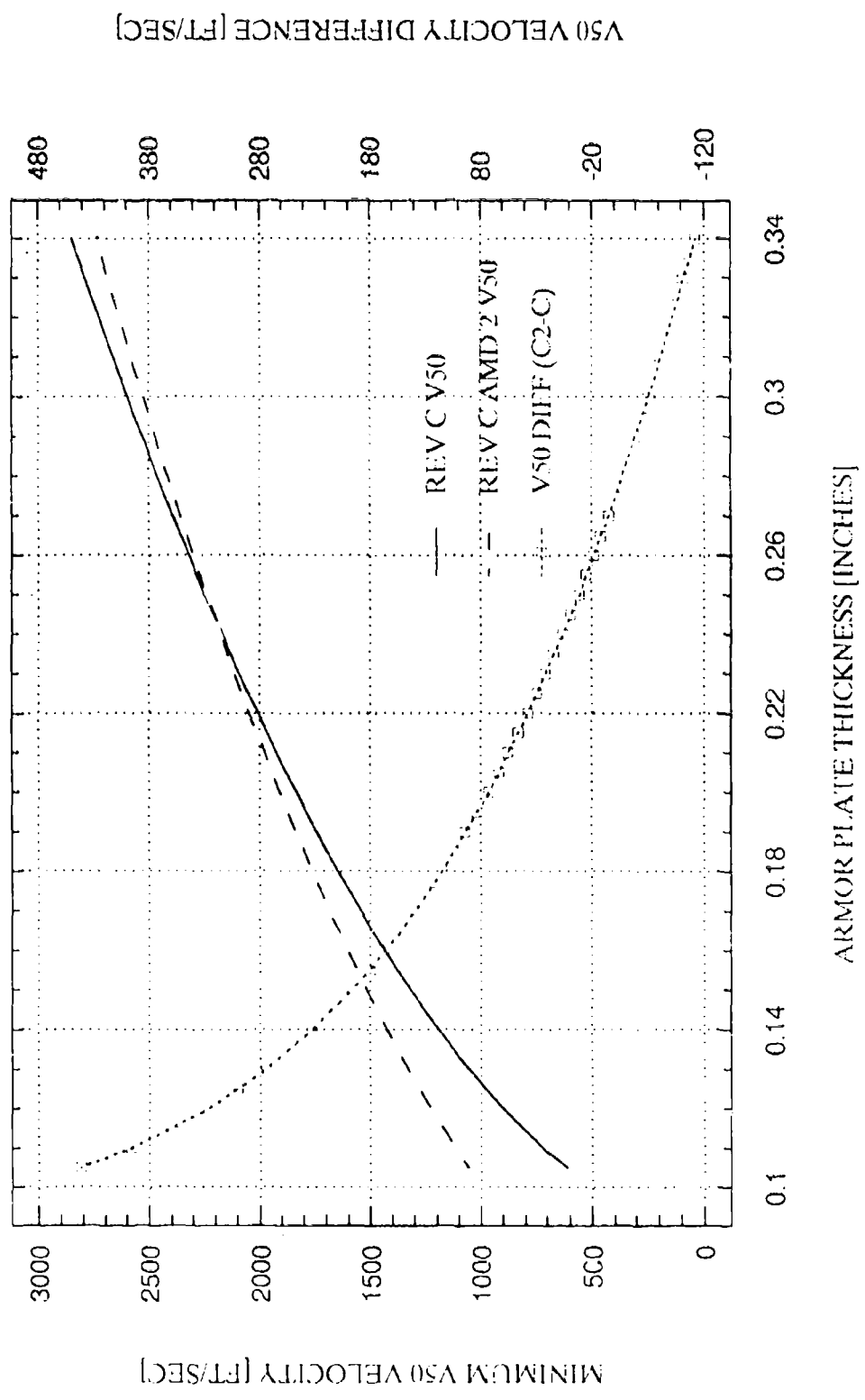
MIL-A-46100 REV C & REV C AMD2

PROJECTILE: 0.30 CAL AP M2 @ 30 DEG



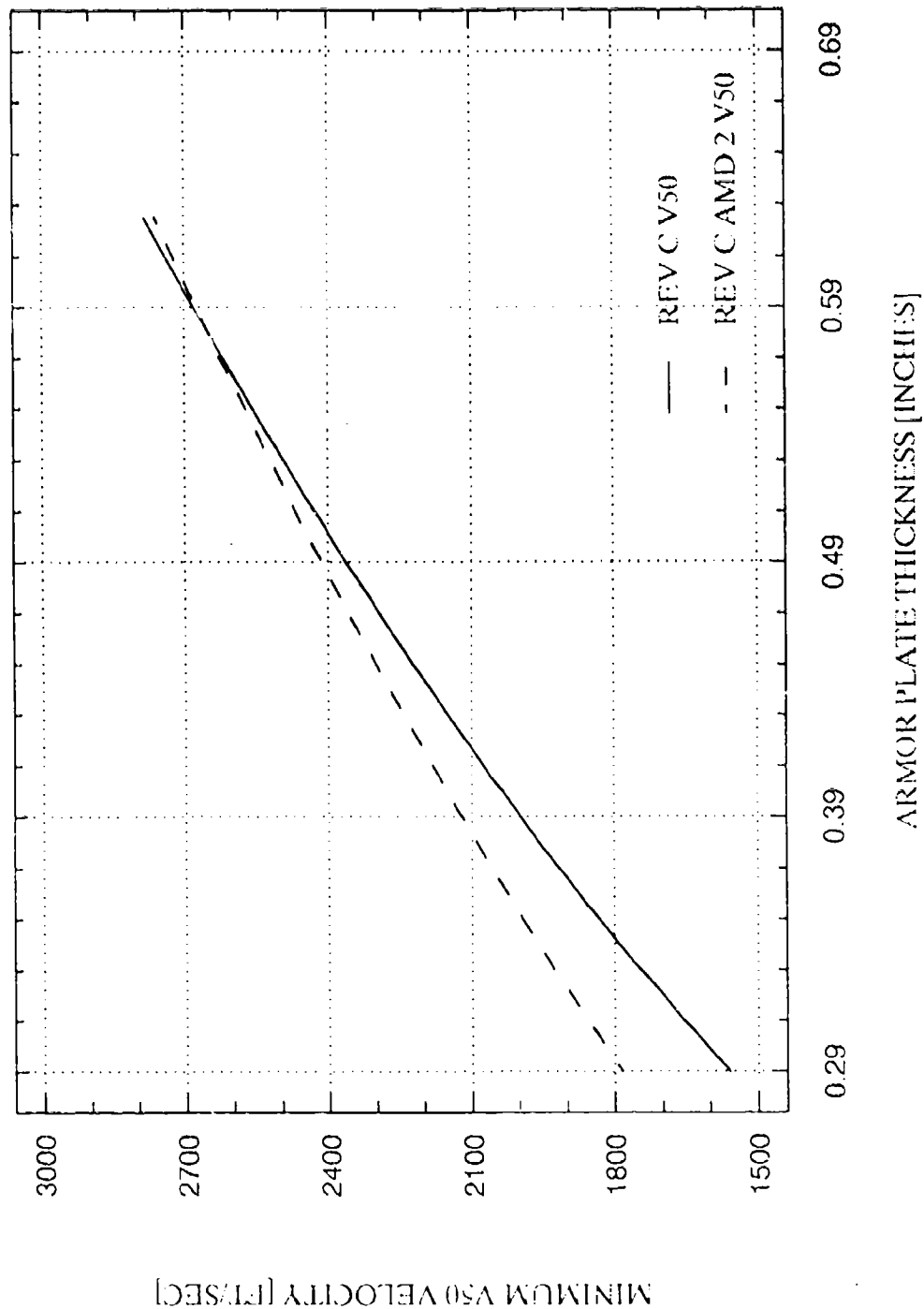
MIL-A-46100 REV C & REV C AMD2

PROJECTILE: 0.30 CAL AP M2 @ 30 DEG



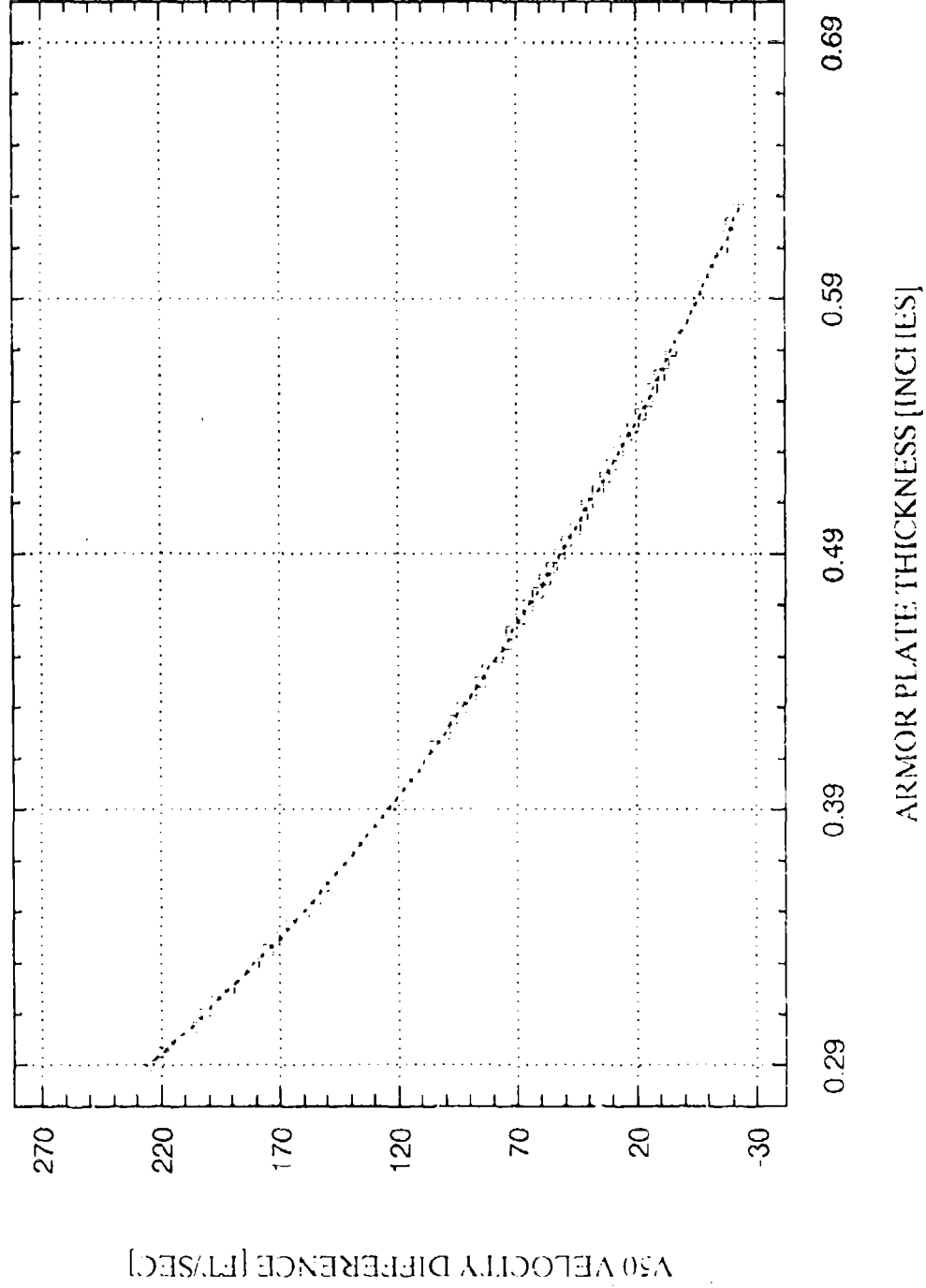
MIL-A-46100 REV C & REV C AMD 2

PROJECTILE: 0.50 CAL AP M2 @ 30 DEG



MIL-A-46100 REV C & REV C AMD2

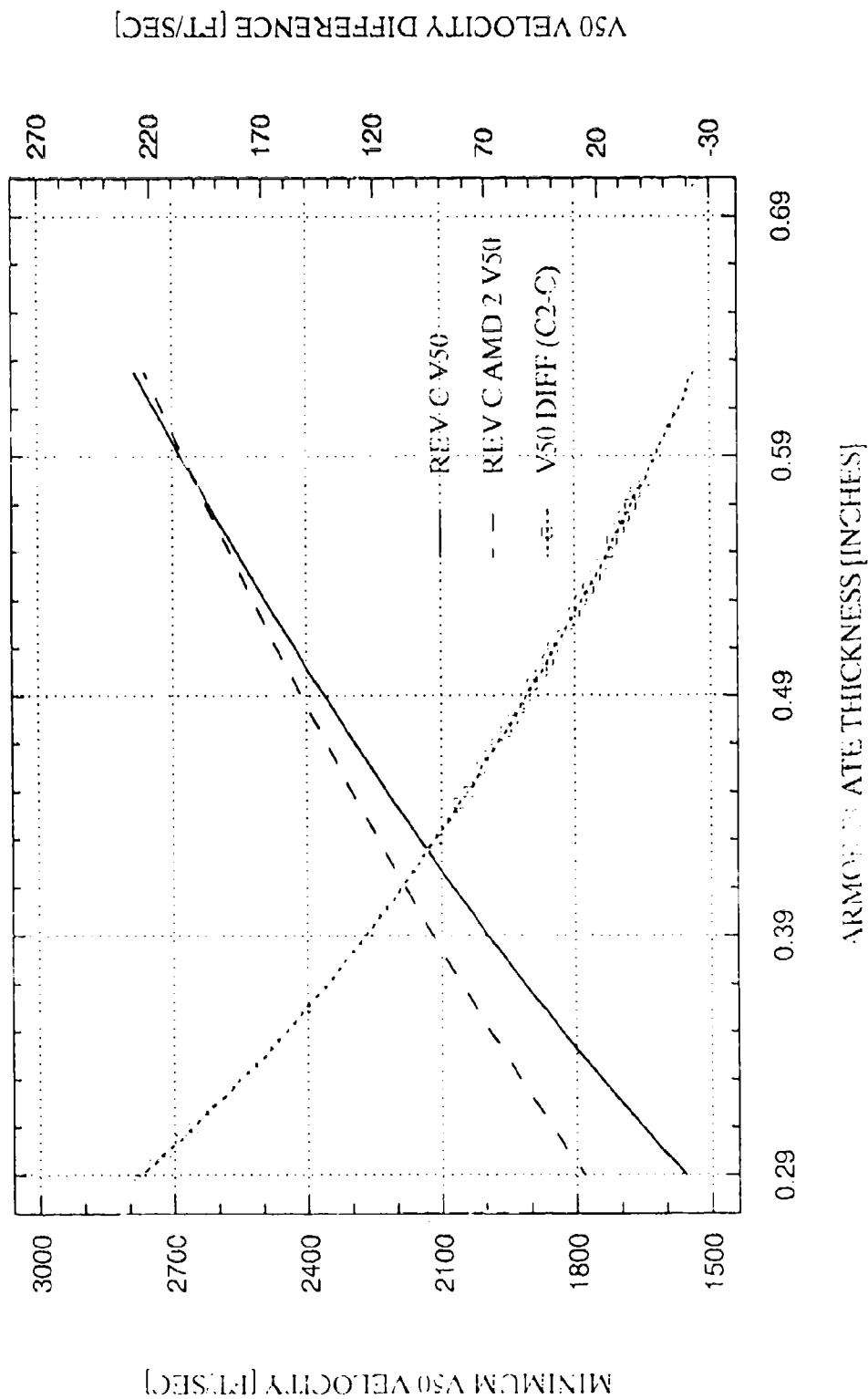
PROJECTILE: 0.50 CAL AP M2 @ 30 DEG



V50 DIFF (C2-C)

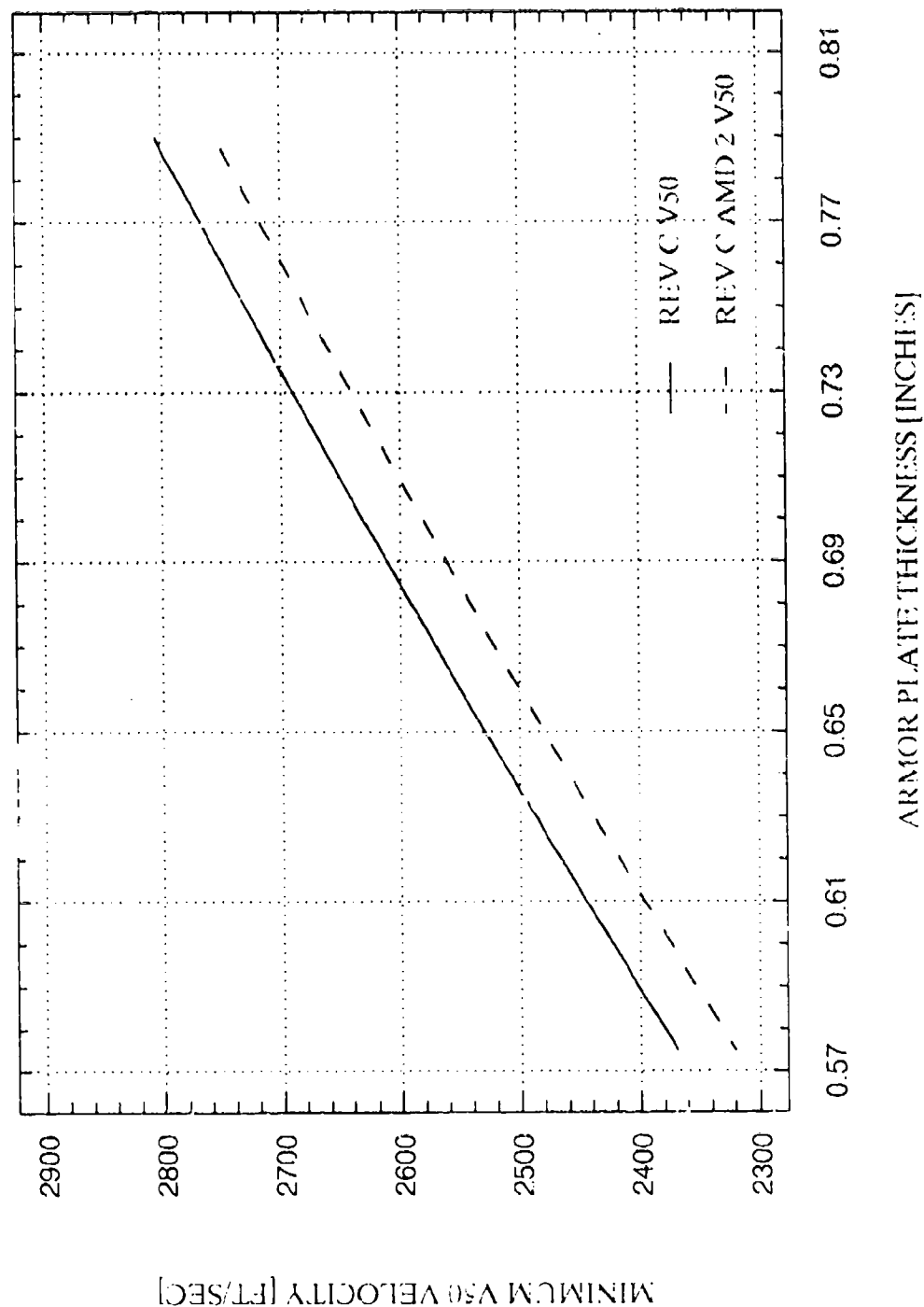
MIL-A-46100 REV C & REV C AMD2

PROJECTILE: 0.50 CAL AP M2 @ 30 DEG



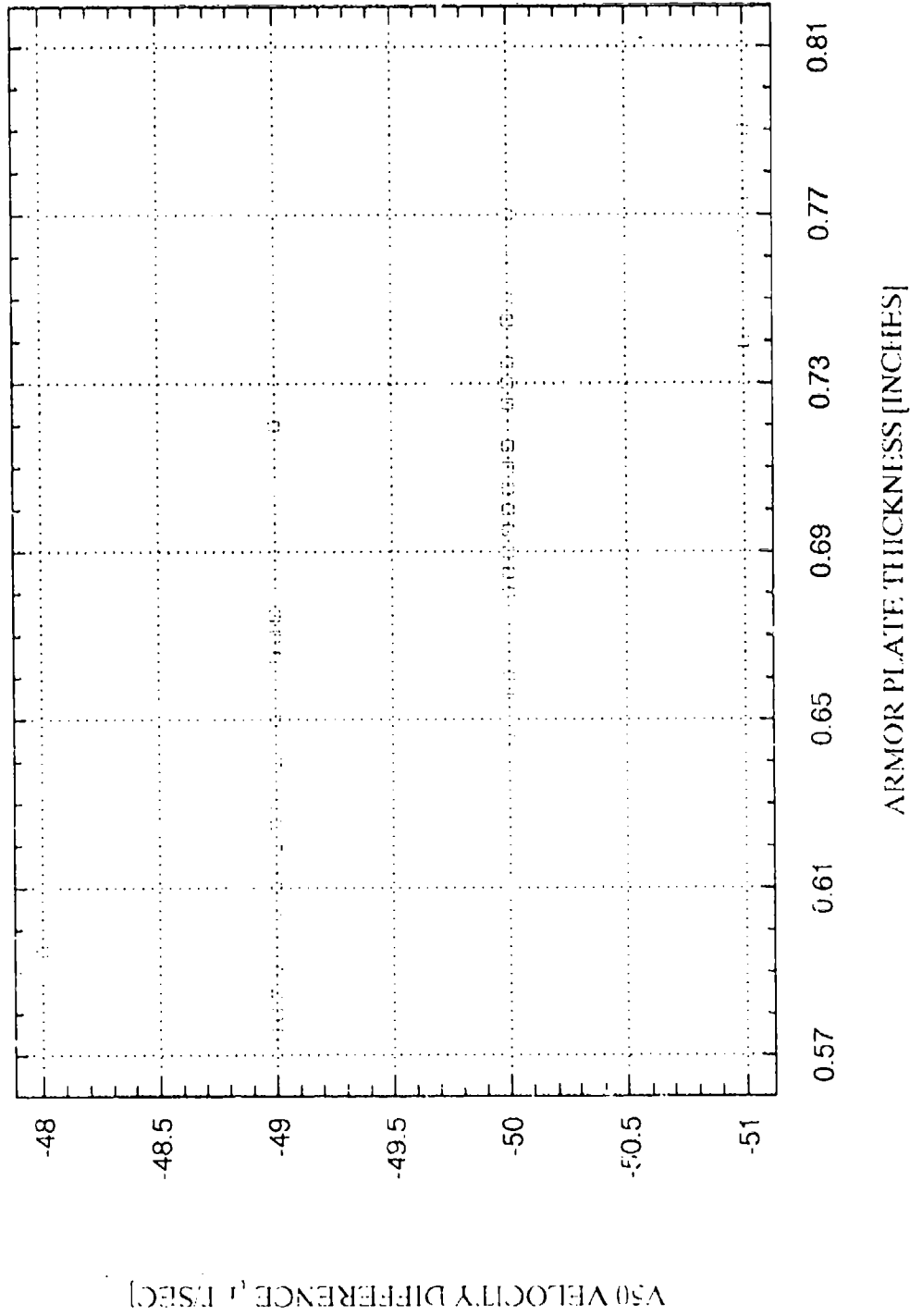
MIL-A-46100 REV C & REV C AMD 2

PROJECTILE: 14.5 MM API B32 @ 30 DEG



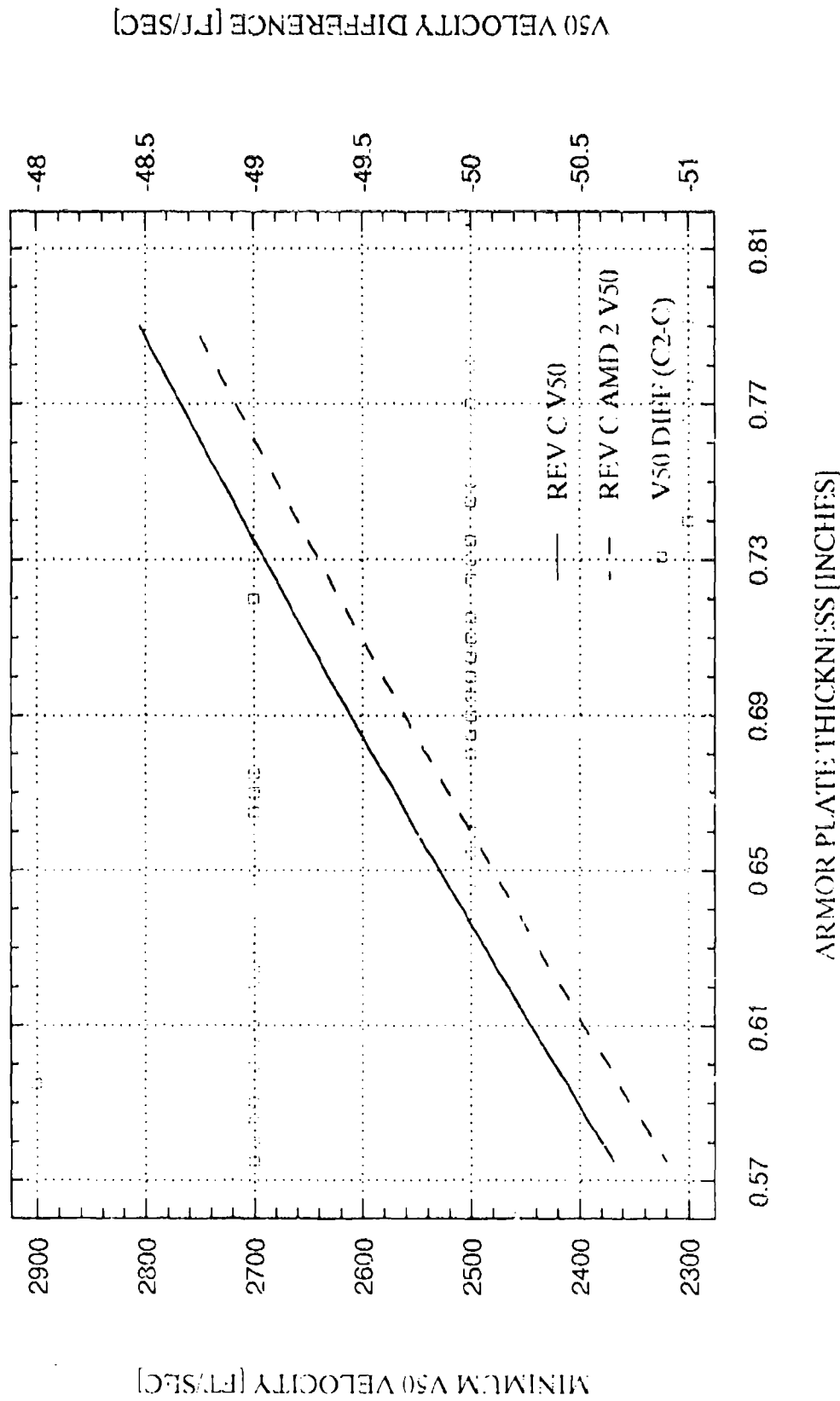
MIL-A-46100 REV C & REV C AMD 2

PROJECTILE: 14.5 MM API B32 @ 30 DEG



MIL-A-46100 REV C & REV C AMD 2

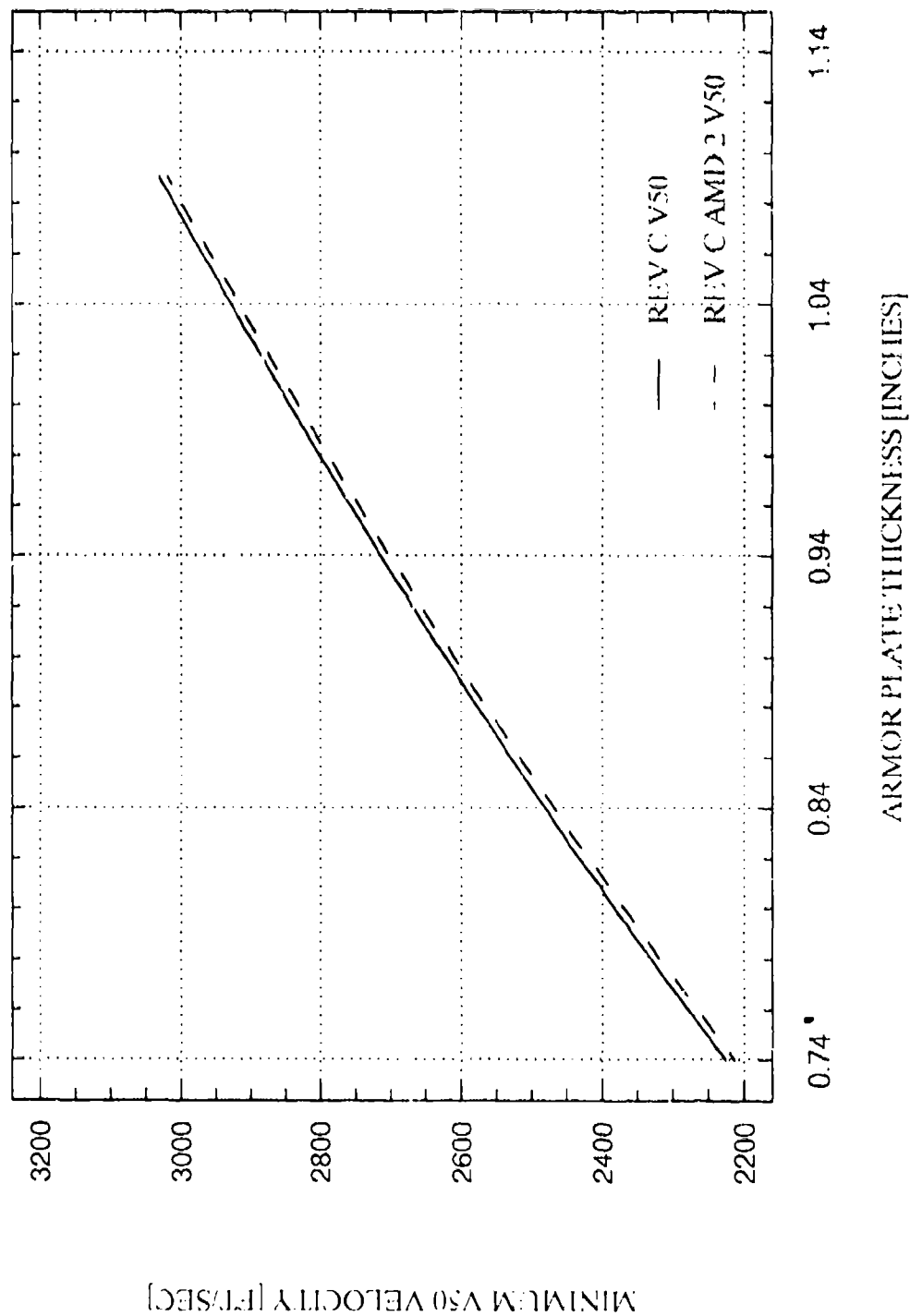
PROJECTILE: 14.5 MM API B32 @ 30 DEG



AVG V50 DIFF = -50 FT/SEC

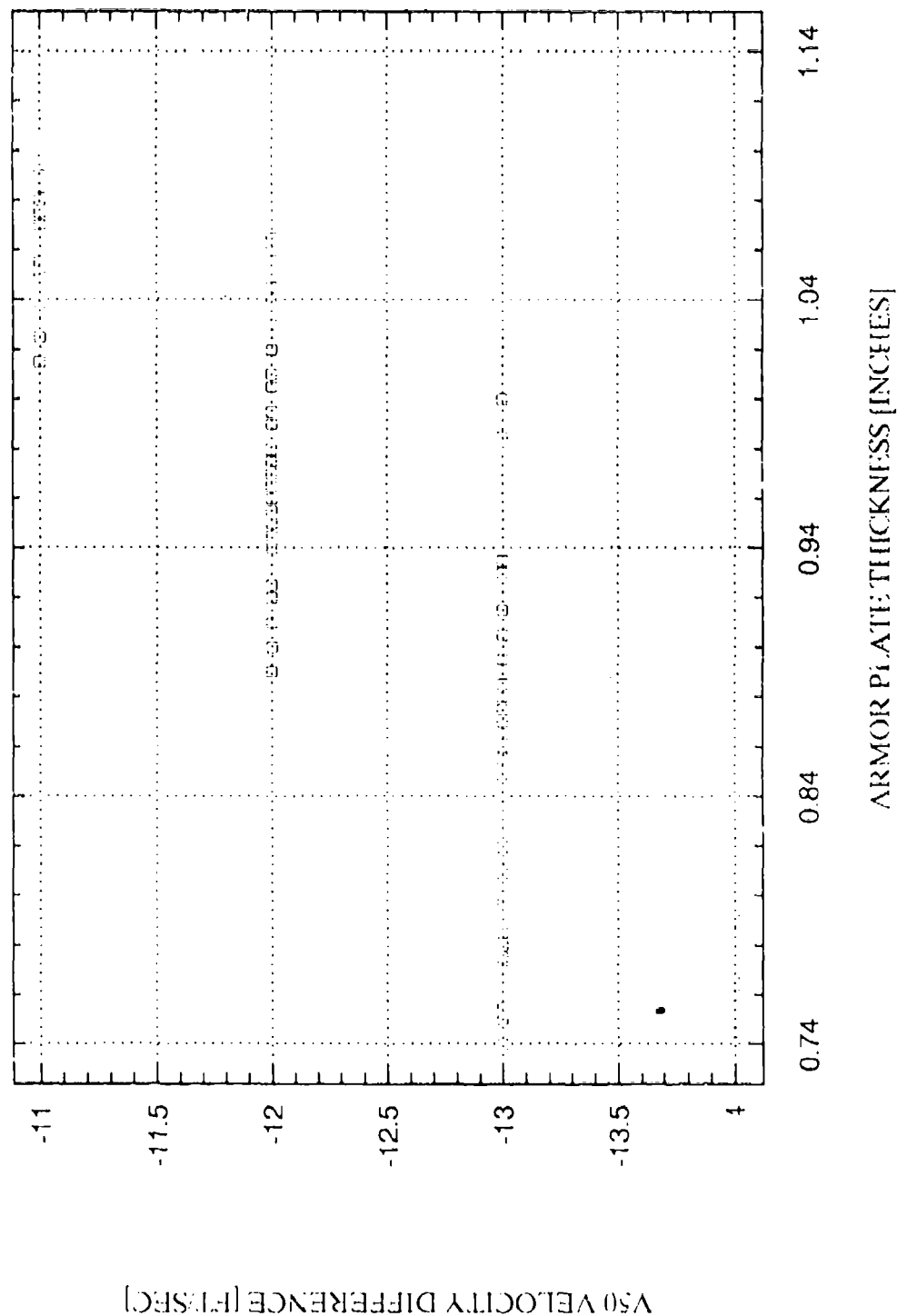
MIL-A-46100 REV C & REV C AMD 2

PROJECTILE: 14.5 MM API BS41 @ 30 DEG



MIL-A-46100 REV C & REV C AMD 2

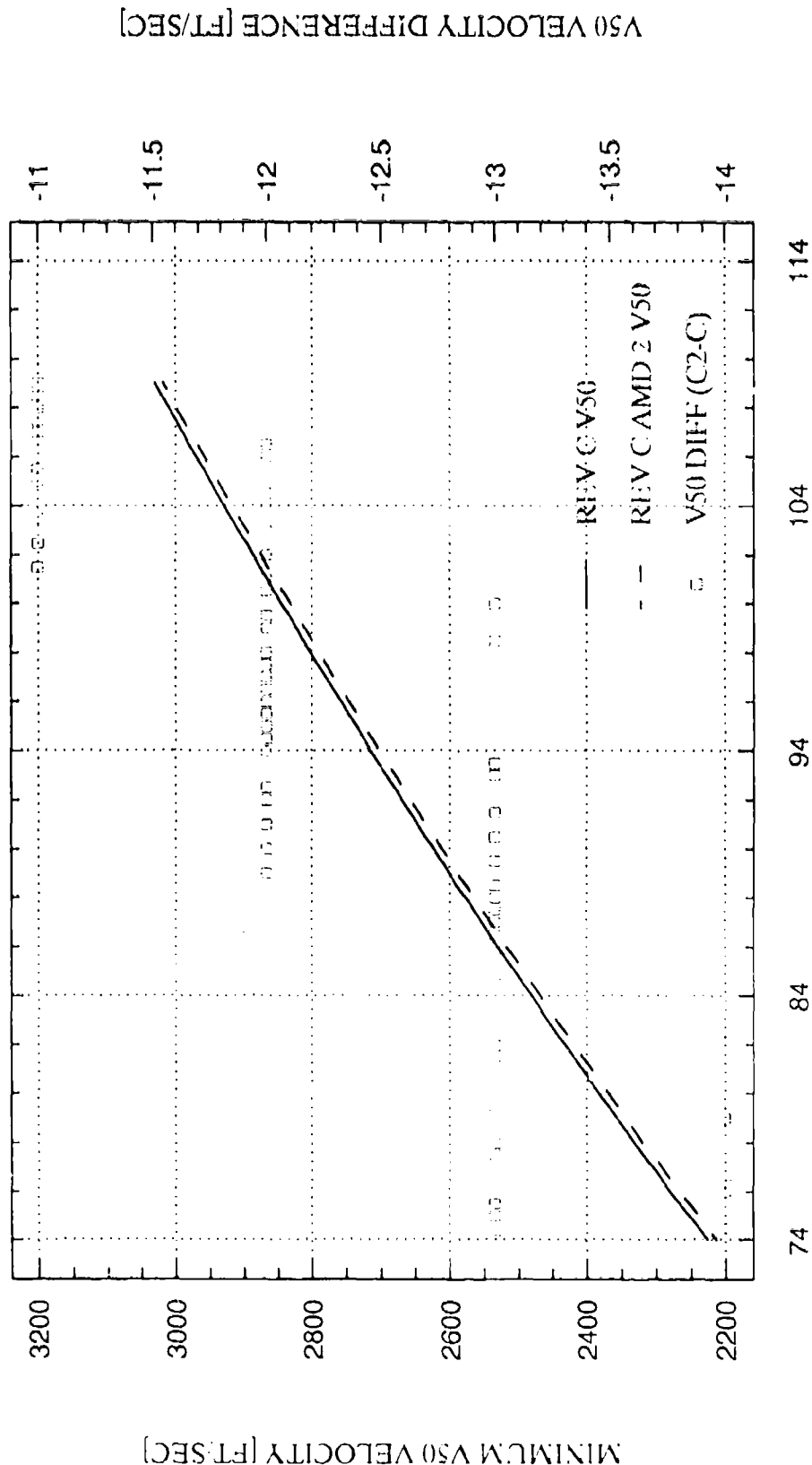
PROJECTILE: 14.5 MM API BS41 @ 30 DEG



V50 DIFF (C2-C): AVG V50 DIFF = -12 FT/SEC

MIL-A-46100 REV C & REV C AMD 2

PROJECTILE: 14.5 MM API BS41 @ 30 DEG

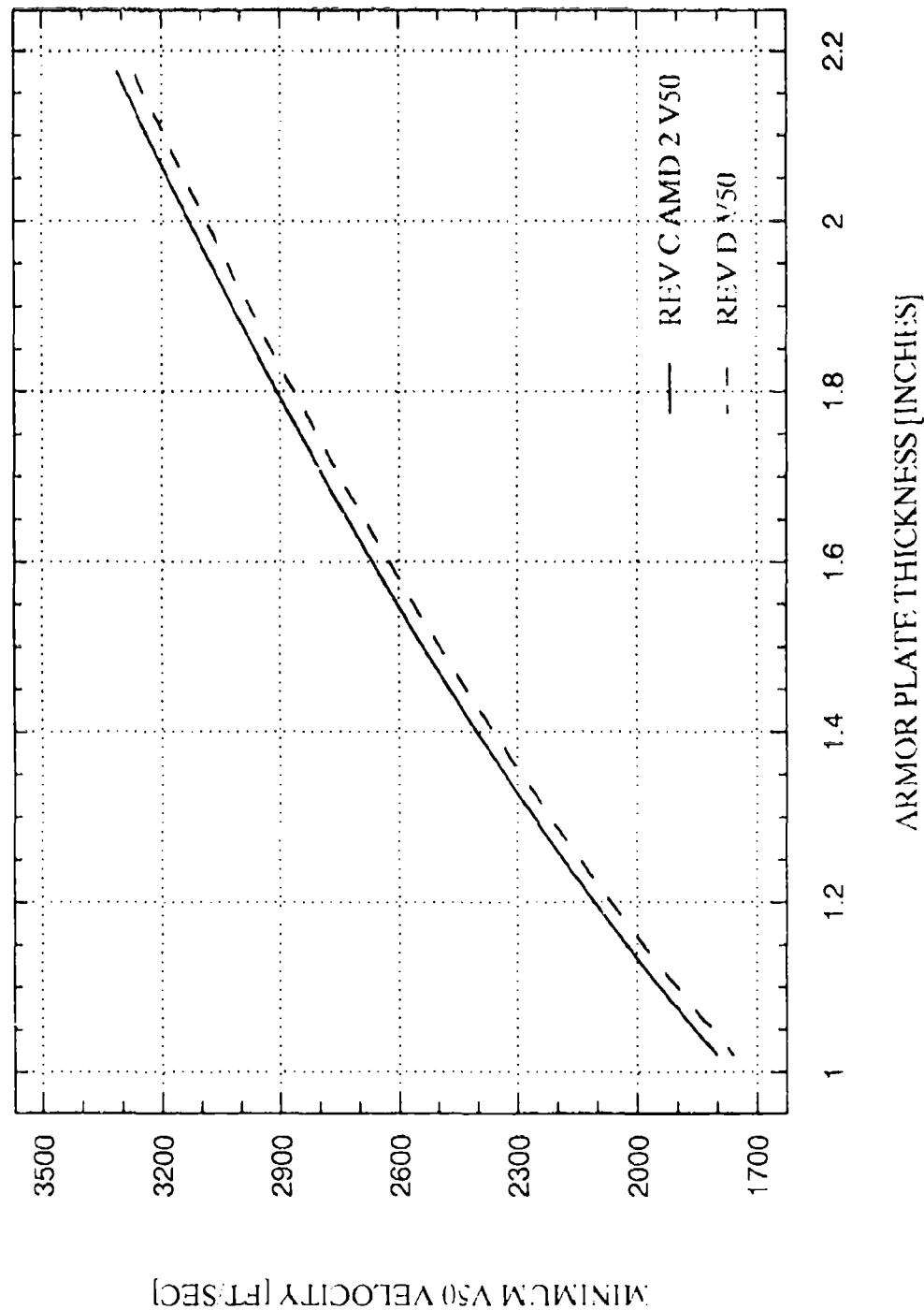


ARMOR PLATE THICKNESS [INCHES] (X 0.01)

AVG V50 DIFF = -12 FT/SEC

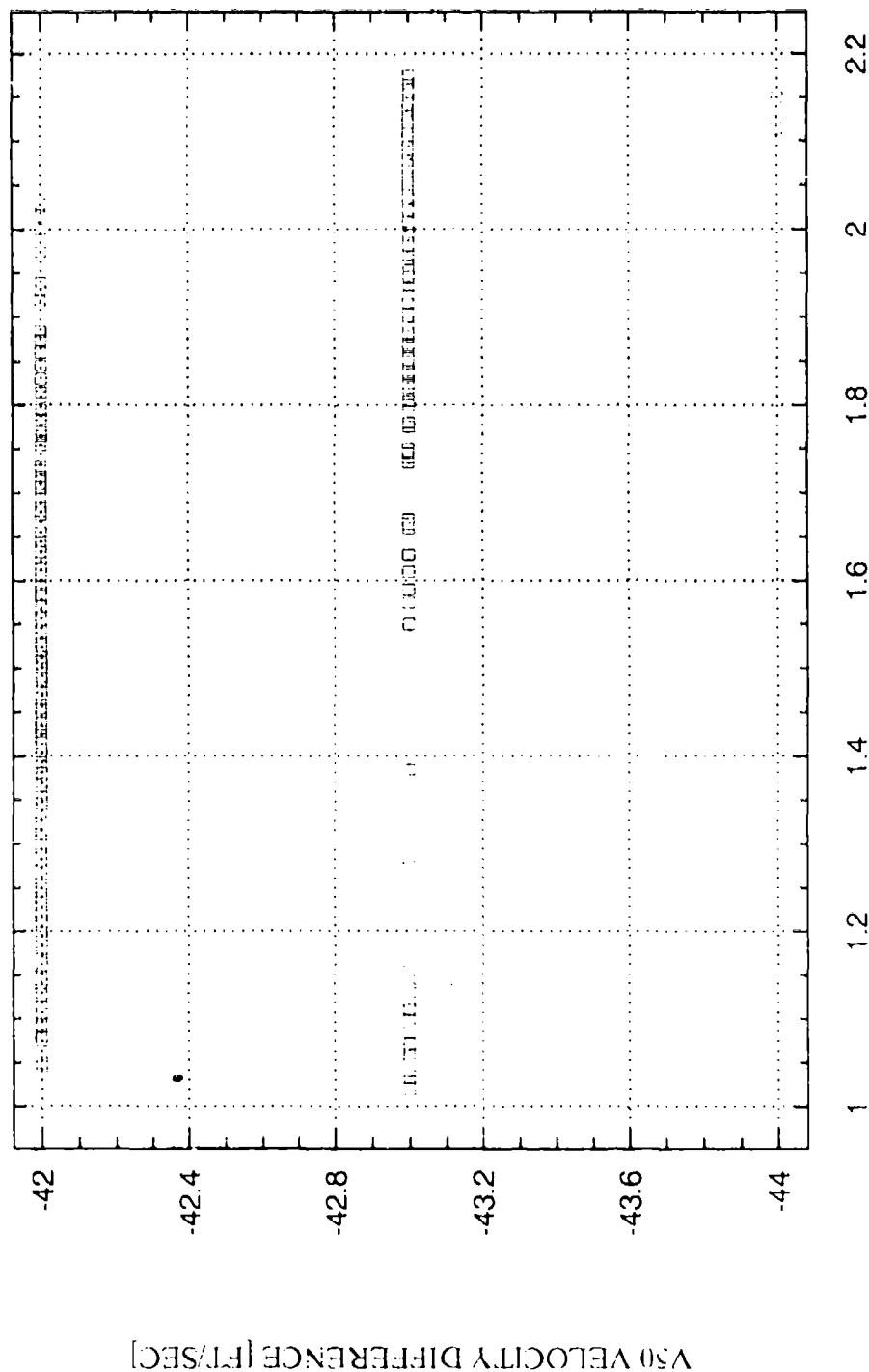
MIL-A-46100 REV C AMD 2 & REV D

PROJECTILE: 20 MM API-T M602 @ 0 DEG



MIL-A-46100 REV C AMD 2 & REV D

PROJECTILE: 20 MM API-T M602 @ 30 DEG

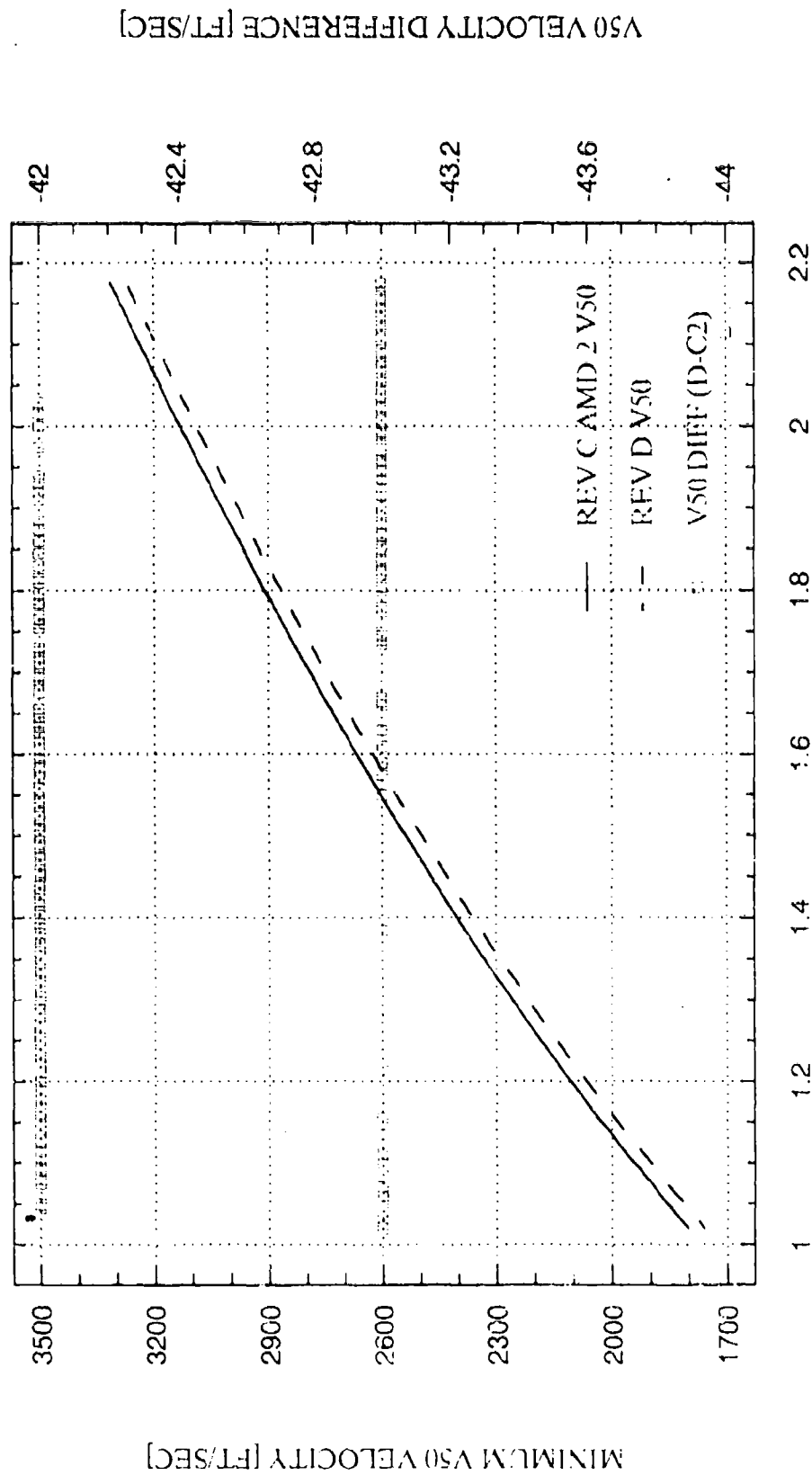


ARMOR PLATE THICKNESS [INCHES]

V50 DIFF (D-C2); AVG V50 DIFF = -42 FT/SEC

MIL-A-46100 REV C AMD 2 & REV D

PROJECTILE: 20 MM API-T M602 @ 30 DEG



ARMOR PLATE THICKNESS [INCHES]

AVG V50 DIFF = -42 FT/SEC

DISTRIBUTION LIST

No. of Copies	To
1	Office of the Under Secretary of Defense for Research and Engineering, The Pentagon, Washington, DC 20301
	Director, U.S. Army Research Laboratory, 2800 Powder Mill Road, Adelphi, MD 20783-1197
1	ATTN: AMSRL-OP-SD-TP, Technical Publishing Branch
1	AMSRL-OP-SD-TM, Records Management Administrator
	Commander, Defense Technical Information Center, Cameron Station, Building 5, 5010 Duke Street, Alexandria, VA 22304-6145
2	ATTN: DTIC-FDAC
1	MIA/CINDAS, Purdue University, 2595 Yeager Road, West Lafayette, IN 47905
	Commander, Army Research Office, P.O. Box 12211, Research Triangle Park, NC 27709-2211
1	ATTN: Information Processing Office
	Commander, U.S. Army Materiel Command, 5001 Eisenhower Avenue, Alexandria, VA 22333
1	ATTN: AMCSCI
	Commander, U.S. Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, MD 21005
1	ATTN: AMXSX-MP, H. Cohen
	Commander, U.S. Army Missile Command, Redstone Arsenal, AL 35809
1	ATTN: AMSMI-RD-CS-R/Doc
	Commander, U.S. Army Armament, Munitions and Chemical Command, Dover, NJ 07801
2	ATTN: Technical Library
	Commander, U.S. Army Natick Research, Development and Engineering Center, Natick, MA 01760-5010
1	ATTN: Technical Library
	Commander, U.S. Army Satellite Communications Agency, Fort Monmouth, NJ 07703
1	ATTN: Technical Document Center
	Commander, U.S. Army Tank-Automotive Command, Warren, MI 48397-5000
1	ATTN: AMSTA-ZSK
1	AMSTA-TSL, Technical Library
	Commander, White Sands Missile Range, NM 88002
1	ATTN: STEWS-WS-VT
	President, Airborne, Electronics and Special Warfare Board, Fort Bragg, NC 28307
1	ATTN: Library
	Director, U.S. Army Research Laboratory, Weapons Technology, Aberdeen Proving Ground, MD 21005-5066
1	ATTN: AMSRL-WT

No. of Copies	To
1	Commander, Dugway Proving Ground, UT. 84022 ATTN: Technical Library, Technical Information Division
1	Commander, U.S. Army Research Laboratory, 2800 Powder Mill Road, Adelphi, MD 20783 ATTN: AMSRL-SS
1	Director, Benet Weapons Laboratory, LCWSL, USA AMCCOM, Watervliet, NY 12189 ATTN: AMSMC-LCB-TL
1	AMSMC-LCB-R
1	AMSMC-LCB-RM
1	AMSMC-LCB-RP
3	Commander, U.S. Army Foreign Science and Technology Center, 220 7th Street, N.E., Charlottesville, VA 22901-5396 ATTN: AIFRTC, Applied Technologies Branch, Gerald Schlesinger
1	Commander, U.S. Army Aeromedical Research Unit, P.O. Box 577, Fort Rucker, AL 36360 ATTN: Technical Library
1	U.S. Army Aviation Training Library, Fort Rucker, AL 36360 ATTN: Building 5906-5907
1	Commander, U.S. Army Agency for Aviation Safety, Fort Rucker, AL 36362 ATTN: Technical Library
1	Commander, Clarke Engineer School Library, 3202 Nebraska Ave., N, Fort Leonard Wood, MO 65473-5000 ATTN: Library
1	Commander, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 39180 ATTN: Research Center Library
1	Commandant, U.S. Army Quartermaster School, Fort Lee, VA 23801 ATTN: Quartermaster School Library
2	Naval Research Laboratory, Washington, DC 20375 ATTN: Dr. G. R. Yoder - Code 6384
1	Chief of Naval Research, Arlington, VA 22217 ATTN: Code 471
1	Commander, U.S. Air Force Wright Research & Development Center, Wright-Patterson Air Force Base, OH 45433-6523 ATTN: WRDC/MLLP, M. Forney, Jr.
1	WRDC/MLBC, Mr. Stanley Schulman
1	U.S. Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD 20899 ATTN: Stephen M. Hsu, Chief, Ceramics Division, Institute for Materials Science and Engineering

No. of Copies	To
1	Committee on Marine Structures, Marine Board, National Research Council, 2101 Constitution Avenue, N.W., Washington, DC 20418
1	Materials Sciences Corporation, Suite 250, 500 Office Center Drive, Fort Washington, PA 19034
1	Charles Stark Draper Laboratory, 555 Technology Square, Cambridge, MA 02139
	Wyman-Gordon Company, Worcester, MA 01601
1	ATTN: Technical Library
	General Dynamics, Convair Aerospace Division, P.O. Box 748, Fort Worth, TX 76101
1	ATTN: Mfg. Engineering Technical Library
	Plastics Technical Evaluation Center, PLASTEC, ARDEC, Bldg. 355N, Picatinny Arsenal, NJ 07806-5000
1	ATTN: Harry Pebly
1	Department of the Army, Aerostructures Directorate, MS-266, U.S. Army Aviation R&T Activity - AVSCOM, Langley Research Center, Hampton, VA 23665-5225
1	NASA - Langley Research Center, Hampton, VA 23665-5225
	U.S. Army Vehicle Propulsion Directorate, NASA Lewis Research Center, 2100 Brookpark Road, Cleveland, OH 44135-3191
1	ATTN: AMSRL-VP
	Director, Defense Intelligence Agency, Washington, DC 20340-5053
1	ATTN: ODT-5A (Mr. Frank Jaeger)
	U.S. Army Communications and Electronics Command, Fort Monmouth, NJ 07703
1	ATTN: Technical Library
	U.S. Army Research Laboratory, Electronic Power Sources Directorate, Fort Monmouth, NJ 07703
1	ATTN: Technical Library
	Director, U.S. Army Research Laboratory, Watertown, MA 02172-0001
2	ATTN: AMSRL-OP-WT-IS Technical Library
10	Authors