FINAL REPORT
MAY 2000

REPORT NO. 00-05

CP MANUFACTURING, INC.
AND
BOULDIN & LAWSON

ORDNANCE DEFORMER ENGINEERING TESTS

Prepared for:

Distribution Unlimited

Office of the Deputy Chief of Staff
for Logistics
ATTN: DALO-AMA
Washington, DC 20310-0541

VALIDATION ENGINEERING DIVISION
MCALESTER, OKLAHOMA 74501-9053

REPORT DOCUMENTATION PAGE

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (FROM - TO)
01-05-2000	Final Report	xx-xx-2000 to xx-xx-2000

4. TITLE AND SUBTITLE CP Manufacturing, Inc / Bouldin & Lawson Ordnance Deformer Engineering Tests Unclassified	**5a. CONTRACT NUMBER** **5b. GRANT NUMBER** **5c. PROGRAM ELEMENT NUMBER**
6. AUTHOR(S)	**5d. PROJECT NUMBER** **5e. TASK NUMBER** **5f. WORK UNIT NUMBER**
7. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. ARMY DEFENSE AMMUNITION CENTER VALIDATION ENGINEERING DIVISION MCALESTER , OK 74501-9053	**8. PERFORMING ORGANIZATION REPORT NUMBER** 00-05
9. SPONSORING/MONITORING AGENCY NAME AND ADDRESS Office of the Deputy Chief of Staff for Logistics ATTN: DALO-AMA Washington , DC 20310-0541	**10. SPONSOR/MONITOR'S ACRONYM(S)** **11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

12. DISTRIBUTION/AVAILABILITY STATEMENT
A
PUBLIC RELEASE

Office of the Deputy Chief of Staff for Logistics

ATTN: DALO-AMA

Washington , DC 20310-0541

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SOSAC-DEV), was tasked by Headquarters, Department of the Army, Office of the Deputy Chief of Staff for Logistics (ODCSLOG), to conduct engineering tests on CP Manufacturing, Inc., OD5000 Ordnance Deformers and Bouldin & Lawson, Rotary Drum Ordnance Deformers that are being utilized in the demilitarization of spent ammunition brass cartridges. The objective of this evaluation was to identify any safety hazards that may be present when live ammunition is inadvertently processed using these deformers. As tested, the only direct evidence of any safety hazard was excessively high noise levels when live ammunition was detonated inside the deforming chambers. However, there were numerous potential safety hazards when live ammunition was not detonated and contents accumulated in the exhaust containment vessels. Notably, neither unit was constructed with explosion-proof motors and will potentially be operated in the proximity of explosives materiel, which could result in severe potential safety hazards to operating personnel.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
					Fenster, Lynn lfenster@dtic.mil
a. REPORT Unclassified	**b. ABSTRACT** Unclassified	**c. THIS PAGE** Unclassified	Public Release	24	**19b. TELEPHONE NUMBER** **International Area Code** **Area Code Telephone Number** 703 767-9007 **DSN** 427-9007

AVAILABILTY NOTICE

A copy of this report will be furnished each attendee on automatic distribution. Additional copies or authority for reprinting may be obtained by written request from:

Director
U.S. Army Defense Ammunition Center
ATTN: SOSAC-DEV
1 C Tree Road, Bldg. 35
McAlester, OK 74501-9053

DISTRIBUTION INSTRUCTIONS

Destroy this report when no longer needed. Do not return.

***

Citation of trade names in this report does not constitute an official endorsement.

***

The information contained herein will not be used for advertising purposes.

REPORT NO. 00-05 **April 2000**

CP Manufacturing, Inc / Bouldin & Lawson
Ordnance Deformer Engineering Tests

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SOSAC-DEV), was tasked by Headquarters, Department of the Army, Office of the Deputy Chief of Staff for Logistics (ODCSLOG), to conduct engineering tests on CP Manufacturing, Inc., OD5000 Ordnance Deformers and Bouldin & Lawson, Rotary Drum Ordnance Deformers that are being utilized in the demilitarization of spent ammunition brass cartridges. The objective of this evaluation was to identify any safety hazards that may be present when live ammunition is inadvertently processed using these deformers. As tested, the only direct evidence of any safety hazard was excessively high noise levels when live ammunition was detonated inside the deforming chambers. However, there were numerous potential safety hazards when live ammunition was not detonated and contents accumulated in the exhaust containment vessels. Notably, neither unit was constructed with explosion-proof motors and will potentially be operated in the proximity of explosives materiel, which could result in severe potential safety hazards to operating personnel.

Prepared by: Reviewed by:

WILLIAM R. MEYER JERRY W. BEAVER
Lead Validation Engineer Chief, Validation Engineering Division

U.S. ARMY DEFENSE AMMUNITION CENTER

VALIDATION ENGINEERING DIVISION
MCALESTER, OK 74501-9053

REPORT NO. 00-05

CP Manufacturing, Inc.
Bouldin & Lawson
Ordnance Deformer Engineering Tests

TABLE OF CONTENTS

PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SOSAC-DEV), was tasked by the Office of the Deputy Chief of Staff for Logistics (ODCSLOG), to conduct engineering tests on the CP Manufacturing, Inc., OD5000 Ordnance Deformer and the Bouldin & Lawson, Rotary Drum Ordnance Deformer, in order to identify any safety hazards that may be present during the operation of these machines if live ammunition is inadvertently processed through the equipment.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Operations Support Command (OSC) (Prov), Rock Island, IL. Reference is made to the following:

1. Change 6, AR 740-1, 18 August 1976, Storage and Supply Activity Operation.

2. IOC-R, 10-23, Mission and Major Functions of USADAC, 7 January 1998.

C. OBJECTIVE. The objective of this evaluation is to determine if any safety hazards may be present when live ammunition is inadvertently processed using these deformers.

D. CONCLUSION. As tested, there was no direct evidence of any safety hazard with the exception of excessively high noise levels when live ammunition is detonated inside the deforming chambers. However, there are numerous potential safety hazards when live ammunition is not detonated, and the contents accumulate in the exhaust containment vessels. Notably, neither unit is constructed with explosion-proof motors and both could be operated in approximate contact with explosives materiel, which could result in severe potential safety hazards to operating personnel.

PART 2 - ATTENDEES

DATES PERFORMED: MARCH 7-31, 2000

ATTENDEES	MAILING ADDRESS
William R. Meyer General Engineer DSN 956-8090 (918) 420-8090	Director U.S. Army Defense Ammunition Center ATTN: SOSAC-DEV 1 C Tree Road, Bldg. 35 McAlester, OK 74501-9053
Wade Sparkman Dir, Ecology Div (800) 443-6398	Bouldin & Lawson 70 Easy Street Box 7177 McMinnville, TN 37111-7177
Tom Judkins Field Technician (619) 477-3175	CP Manufacturing, Inc. 1428 McKinley Avenue National City, CA 91950
Jerry W. Beaver Chief, Validation Engr Div DSN 956-8908 (918) 420-8908	Director U.S. Army Defense Ammunition Center ATTN: SOSAC-DEV 1 C Tree Road, Bldg. 35 McAlester, OK 74501-9053

PART 3 – ENGINEERING TESTS CONDUCTED

The engineering tests were conducted on the CP Manufacturing, Inc., OD5000 Ordnance Deformer, using 5.56mm, .50 caliber, and 20mm ammunition. Identical tests were conducted on the Bouldin & Lawson, Rotary Drum Ordnance Deformer, with the exclusion of the 20mm ammunition. The engineering tests were to determine blast overpressure and decibel noise levels.

During testing, continuous 2-channel data acquisition was taking place utilizing a Pacific Scientific high-speed data acquisition system sampling at 50,000 samples per sec (sps). Upon initiation of a critical event (explosion of the ordnance), data were recorded for graphing. The overpressure tests used directional (pencil-type) pressure transducers, located as close to the explosion site as possible, as well as at the site where the operator would normally be standing. Parallel to and at the same site as the operator's pressure transducer, noise levels were also recorded in decibels (dbs). Data from these sensors were used to determine any safety risks to the operator during the operation of the deformers. To improve the statistical reliability of data, two separate (redundant) tests were conducted per machine. The test ordnance used approximately one (1) cubic foot of spent ammunition cartridges per test cycle contaminated with 1% live ammunition. Following each test, the number of live rounds detonated, not detonated, as well as damaged, was recorded.

Also conducted on both machines were controlled detonation overpressure tests using 5.56mm and .50 caliber ammunition. In addition, 20mm controlled detonations were conducted on the CP Manufacturing, Inc., OD5000 Ordnance Deformer. The purpose of the controlled detonations was to determine maximum overpressure experienced by one round at the location of the operator. This test was conducted using explosive charges attached to the ammunition item.

PART 4 - TEST EQUIPMENT

A. DATA ACQUISITION SYSTEM

Manufacturer: Pacific Scientific

Sampling Rate: 50,000 sps

B. PRESSURE TRANSDUCERS

Manufacturer: PCB Piezotronics

Sensitivity: 108.3mv

C. NOISE LEVELS

Manufacturer: Quest M28D

Accuracy: +/-1.5 dbs

PART 5 - TEST RESULTS

A. CP MANUFACTURING, INC., ENGINEERING TESTS

A.1. The CP Manufacturing, Inc., OD5000 Ordnance Deformer, is designed to process 5,000 pounds of ordnance (up to 20mm) per hour. The unit consists of a holding bin with a control chute opening that limits the amount of material that will be vibrated onto the stepped conveyor belt. The conveyor belt will transport the material up and will dispense the material into the deformer drum. The deformer drum is assembled with two sets of rotor blades that perform the demilitarization operation. After the demilitarization is complete, the material will be discharged through the exit chute into the receiving container to be provided (see photos 1-3).

Photo 1. CP Manufacturing, Inc., OD5000 Ordnance Deformer, Showing Holding Bin, Conveyor, and Deformer Drum

Photo 2. CP Manufacturing, Inc., OD5000 Ordnance Deformer, Showing the Deformer Drum and the Exit Chute

Photo 3. CP Manufacturing, Inc., OD5000 Ordnance Deformer, Showing the Deformer Drum Interior

A.2. Cartridge, 5.56mm, Blank, M20 Ammunition. The 1% live 5.56mm ammunition test was conducted on 8 March 2000. During the first test containing fifty-six (56) live rounds, one (1) round fired, two (2) rounds were undamaged, and fifty-three (53) rounds were damaged but did not detonate. During the second test, again using 1% live ammunition, similar results were noted. Namely, one (1) round fired, three (3) rounds were not damaged, and fifty-two (52) were damaged but did not detonate. When using the CP Manufacturing, Inc., OD5000 Ordnance Deformer, with 5.56mm ammunition, it can be expected that about 2% of the live rounds will detonate, 5% will be undamaged and serviceable, and 93% will be damaged but not detonated. This latter group poses the greatest safety hazard due to the damaged live rounds which still have the potential for initiation, as well as the live propellant remaining in the deforming chamber, or being expelled and accumulating in the receiving receptacle (see Photo 4).

Photo 4. 1% Live Test With 5.56mm Blank Ammunition Processed Through the CP Manufacturing, Inc., OD5000 Ordnance Deformer

The maximum overpressure of the 5.56mm, under the controlled blast test, was .07 psi at the position the operator would normally be standing. Therefore, there appears to be no safety risks to the operator due to overpressure. The maximum noise level that was noted during this test was 139 dbs, and is well above the upper limits for hearing protection requirements.

A.3. Cartridge, .50 Caliber, Ball Ammunition. The 1% live .50 caliber ammunition test was conducted on 9 March 2000. During the first test which contained six (6) live rounds, no live detonations occurred with all six (6) rounds damaged, five (5) of which had the projectile and propellant separated from the cartridges. During the second test using 1% live ammunition, similar results were noted. There were no live initiations with all six (6) rounds having the projectile separated and propellant spilling from the cartridge. From this test, it can be expected when using the CP Manufacturing, Inc., OD5000 Ordnance Deformer, on .50 caliber ammunition, that live detonations will be less prevalent than for 5.56mm ammunition. Also, up to 8% of the live rounds will be damaged and 92% of the rounds will have the projectile and propellant separated from the cartridges. The non-detonated cartridges expose the greatest safety risk as they remain intact and live with contained projectile and primer. The non-detonated (exposed) propellant poses the second greatest safety risk as it remains in the deforming chamber or expelled and accumulates in the receiving receptacle (see Photo 5).

Photo 5. 1% Live Mixture of .50 Caliber Ammunition With Loose Propellant Processed Through CP Manufacturing, Inc., OD5000 Ordnance Deformer

During the controlled blast, the maximum over pressure with the .50 caliber ammunition was .14 psi at the operator's position, with a maximum noise level of 142dbs. As was noted with the 5.56mm test, only the noise level is a safety hazard.

A.4. 20MM Ammunition. The 1% live ammunition was not processed through the CP Manufacturing, Inc., OD5000 Ordnance Deformer; however, a controlled live fire detonation was conducted. This test was to ascertain the maximum noise, overpressure conditions, and containment capability that exist during the detonation. To simulate a live round, an empty 20mm projectile was packed with C-4 and detonated using a blasting cap. During this simulation, the maximum noise level was 139 dbs with an overpressure at the operator position of .12 psi. Again, noise level is the safety hazard, not the overpressure. The

chamber contained all of the fragments resulting from the blast. Empty (spent) cartridges were processed through the deformer to determine the degree of demilitarization (see Photo 6).

Photo 6. Spent 20MM Cases Processed Through CP Manufacturing, Inc., OD5000 Ordnance Deformer

B. BOULDIN & LAWSON ENGINEERING TESTS

B.1. The Bouldin & Lawson Rotary Drum Ordnance Deformer is designed with the purpose of deforming the cartridge casings of expended ordnance, .50 caliber and smaller, and to prevent them from being reloaded as usable ammunition. This equipment consists of a hopper bin which inclines onto a rubber cleated Infeed Conveyor that raises the ordnance up to the drum. As the ordnance falls into the drum, hammers/cutters rotating at high speeds deform the brass material. The expended ordnance is carried away by an Outfeed Conveyor (see Photo 7-8).

Photo 7. Bouldin & Lawson Rotary Drum Ordnance Deformer with Hopper, Infeed Conveyor, Rotary Drum, and Outfeed Conveyor

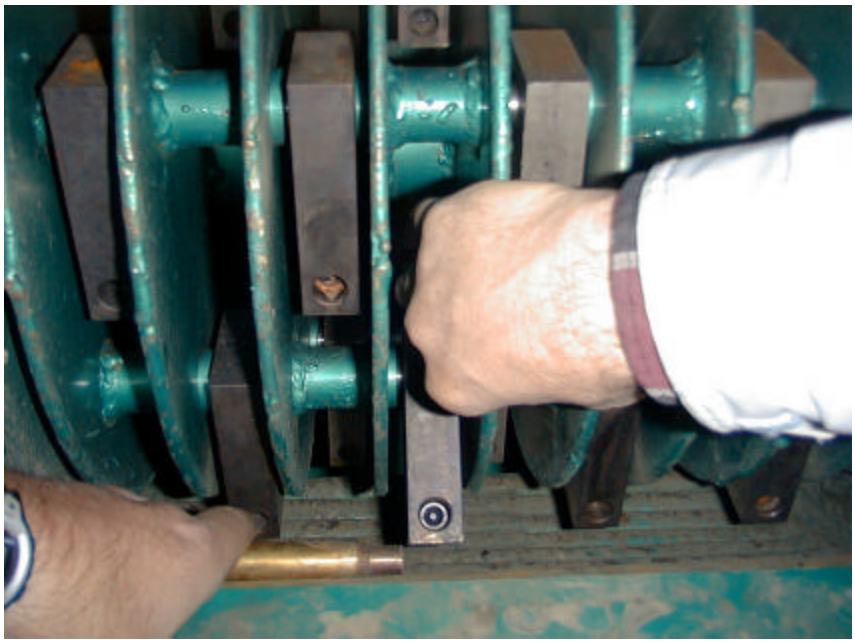


Photo 8. Bouldin & Lawson Rotary Drum Ordnance Deformer Showing the Drum's Cutters/Hammers

B.2. Cartridge, 5.56mm, Blank, M20 Ammunition. The 1% live 5.56mm ammunition test was conducted on 21 March 2000. During the first test containing fifty-six (56) live rounds, two (2) rounds initiated, four (4) rounds were undamaged, and fifty (50) rounds were damaged but did not detonate. During the second test, again using 1% live ammunition, there were no rounds detonated, six (6) rounds were not damaged, and fifty (50) rounds were damaged but not detonated. It can be expected when using the Bouldin & Lawson Rotary Drum Ordnance Deformer with 5.56mm ammunition, that about 2% of the live rounds will be detonated, 9% will be undamaged and serviceable, and 89% will be damaged but not detonated. This latter group poses the greatest safety hazard due to the damaged live rounds which still have the potential for initiation as well as the live propellant remaining in the deforming chamber or being expelled and accumulating in the receiving receptacle (see Photo 9).

Photo 9. 1% Live Test with 5.56mm Blank Ammunition in Bouldin & Lawson Rotary Drum Ordnance Deformer

During the controlled detonation, the maximum overpressure with the 5.56mm under live fire conditions was .07 psi at the position of the operator. The maximum noise level during the live initiations was 131 dbs; again, well above the upper limits for hearing protection requirements.

B.3. Cartridge, .50 Caliber, Ball Ammunition. The 1% live .50 caliber ammunition test was conducted on 22 March 2000. During the first test containing six (6) live rounds, one (1) round initiated with the remaining rounds having the projectile and propellant separated from the cartridge. During the second test of 1% live ammunition, no detonations took place with 100% of the rounds having the projectile and propellant separate from the casing. It can be expected with the Bouldin & Lawson Rotary Drum Ordnance Deformer that about 8% of the live .50 caliber ammunition will detonate, with the balance having the projectile and propellant separated from the cartridge. As pointed out earlier, the

possibility of non-detonated cartridges poses the greatest safety hazard, as they remain intact and live. The non-detonated (exposed) propellant poses the second greatest safety hazard as it remains in the deforming chamber or expelled and accumulates in the receiving receptacle along with the cases with intact primers (see Photo 10).

Photo 10. 1% Live Test With .50 Caliber Ammunition Processed Through Bouldin & Lawson Rotary Drum Ordnance Deformer

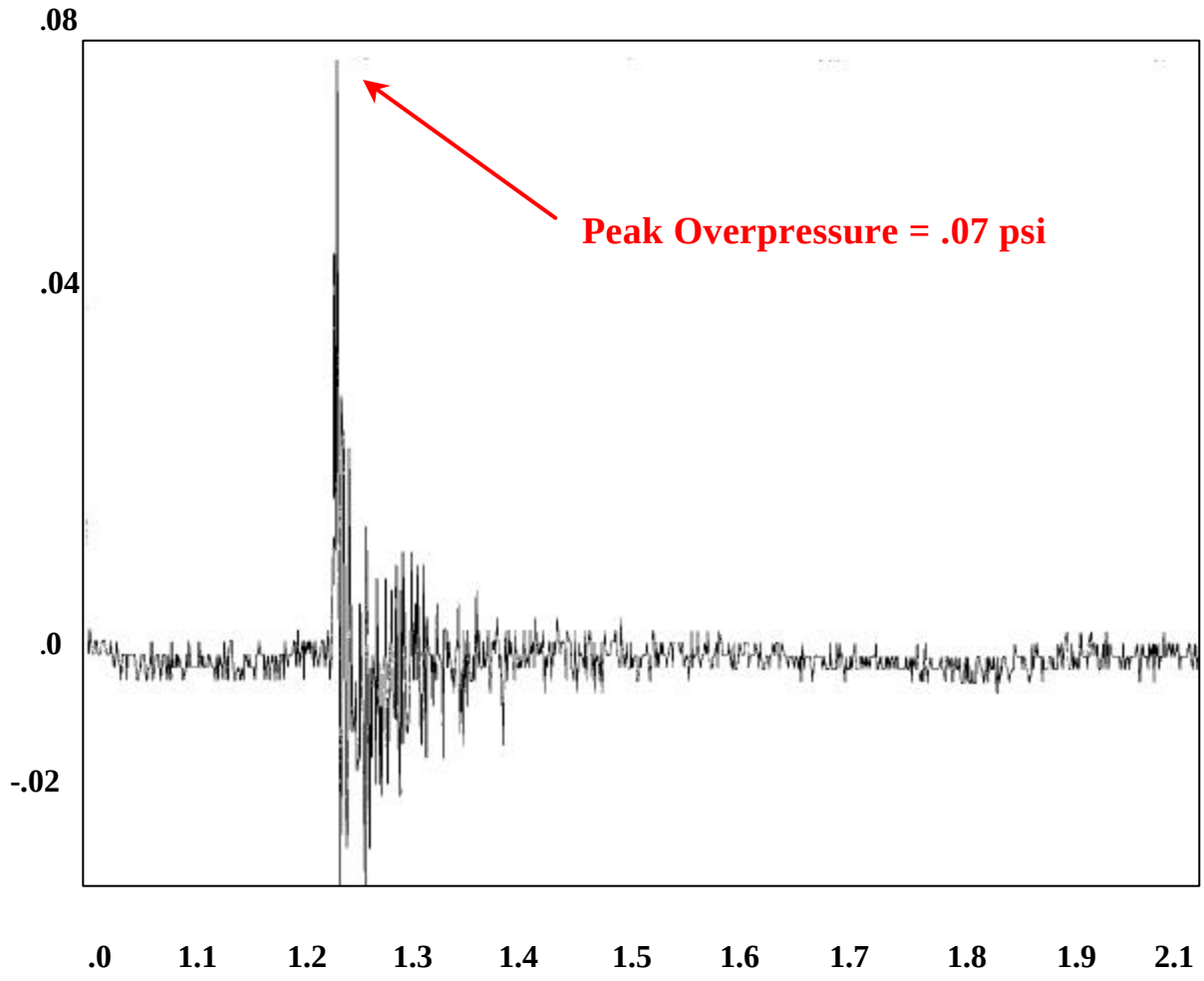
During the controlled detonations, the maximum overpressure during the .50 caliber test was .08 psi for the operator, at a maximum noise level of 130 dbs. As noted above, the noise level is the safety hazard while the overpressure does not pose a risk.

C. Summary

The CP Manufacturing, Inc., OD5000 Ordnance Deformer, and the Bouldin & Lawson Rotary Drum Ordnance Deformer, demilitarize the brass casings to approximately the same level of deformation. During these tests, both units had some rounds that went through the deforming process without being deformed. In the case of live ammunition, these items were still serviceable. Both units had live ammunition that was damaged to a point where live propellant was found loose in the deforming chambers as well as the receiving receptacle, most notably with the .50 caliber ammunition. Though both deformers were adequately designed for detonation containment, neither unit was designed to operate with live ammunition. As examples, one unit used non-explosion proof electric motors and controls that could generate sparks. The other unit used an internal combustion engine for propulsion along with a petroleum source for power, which generates heat and spark potential along with a fuel supply for propagation of a fire. Also, both units used non-conductive rubber belts for the transmission of the ammunition to and from the deforming chambers. These could generate static electricity that is a potential for ignition of the loose propellant. Due to the poor ignition of the loose propellant during these engineering tests, there is potential for substantial accumulation of propellant if these units are used for demilitarizing large quantities of spent brass cartridges that have small percentages of mixtures of live rounds. The deformation process develops a dust cloud that will contain propellant particles. Over a period of time, this propellant dust will entirely contaminate the deformer units.

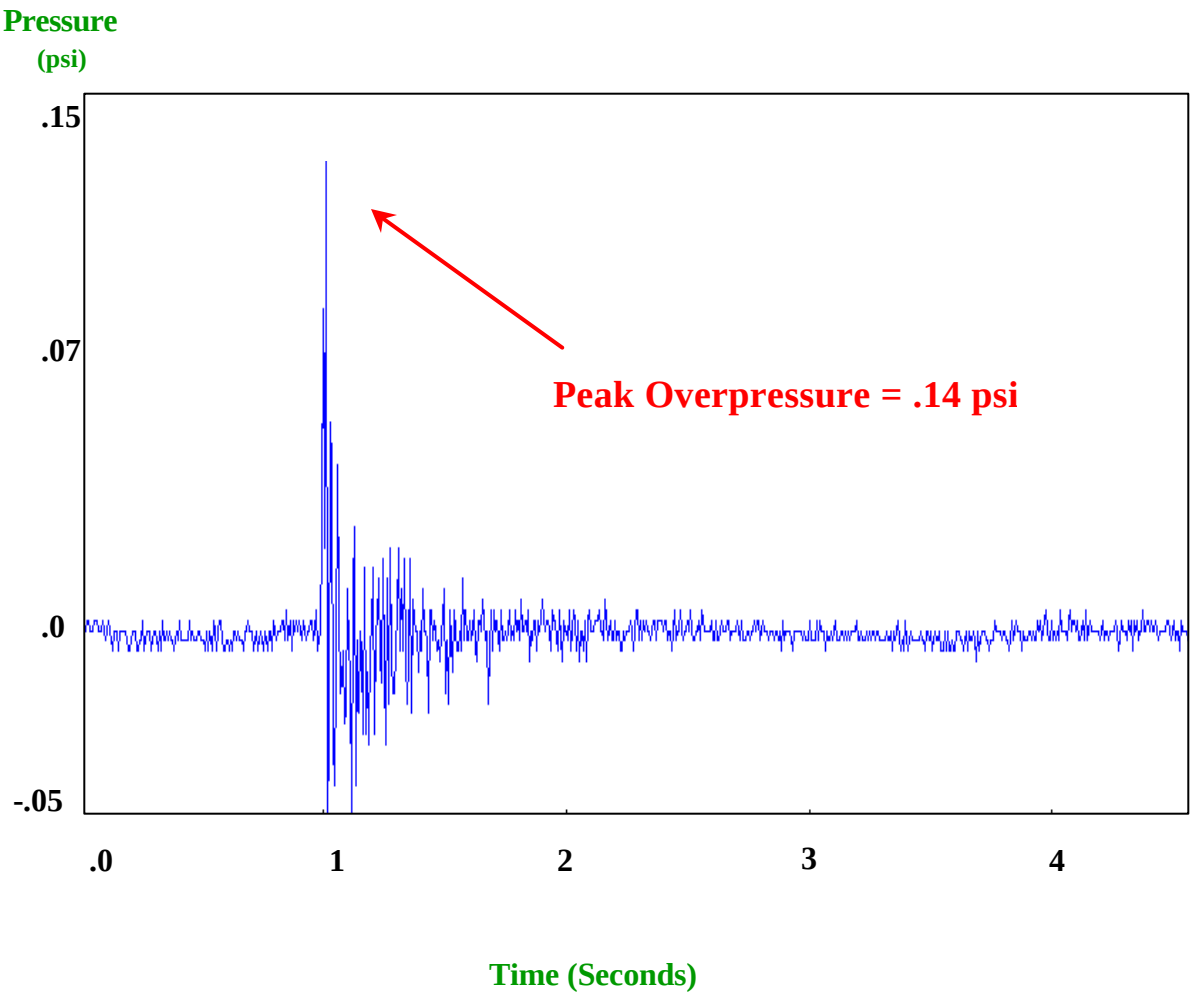
Validation Engineering Division

GRAPH 1
Results of Controlled 5.56mm Blast on CP Manufacturing, Inc. OD5000 Ordnance Deformer



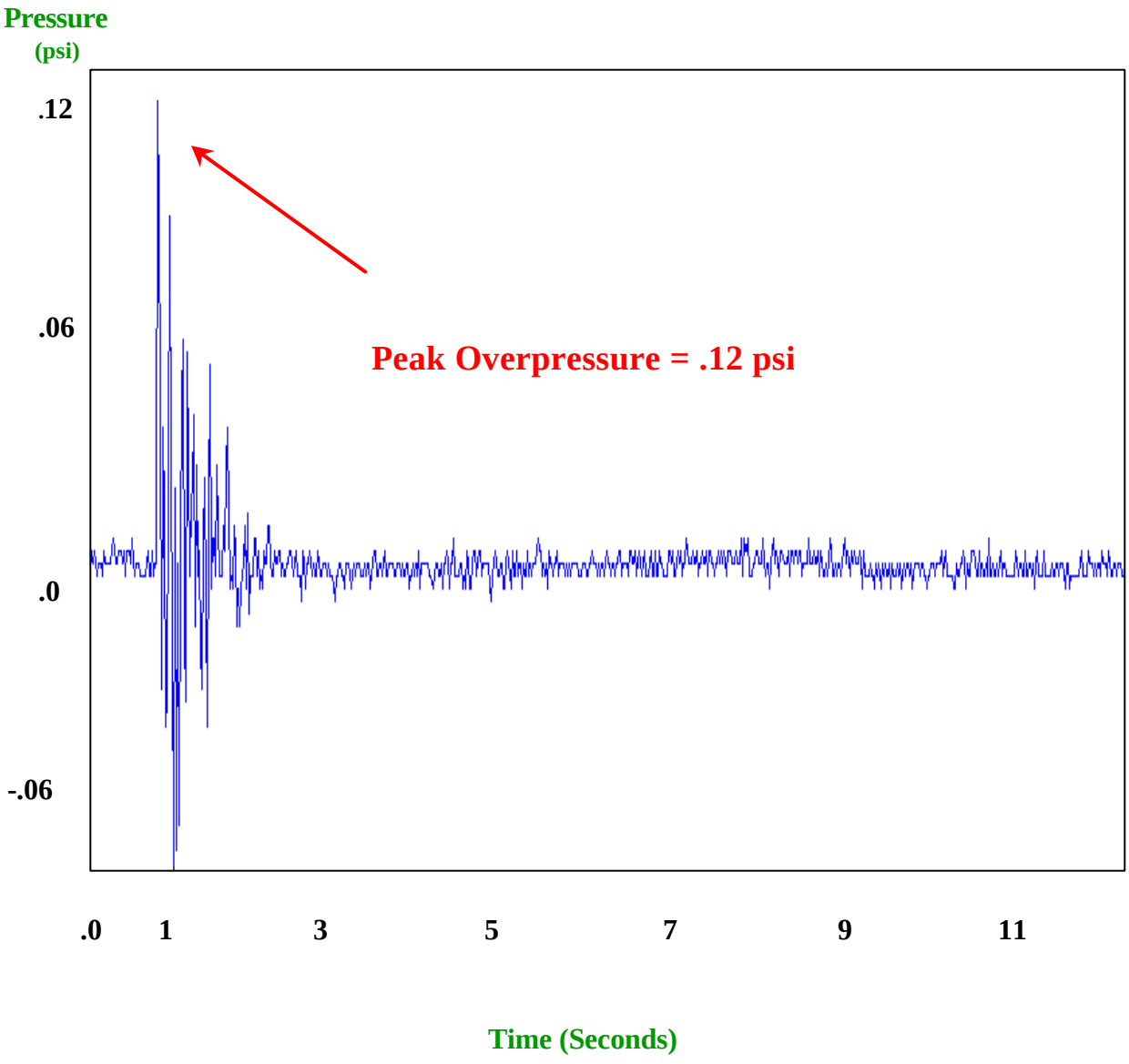
Validation Engineering Division

GRAPH 2
Results of Controlled .50 Caliber Blast on CP Manufacturing, Inc. OD5000 Ordnance Deformer



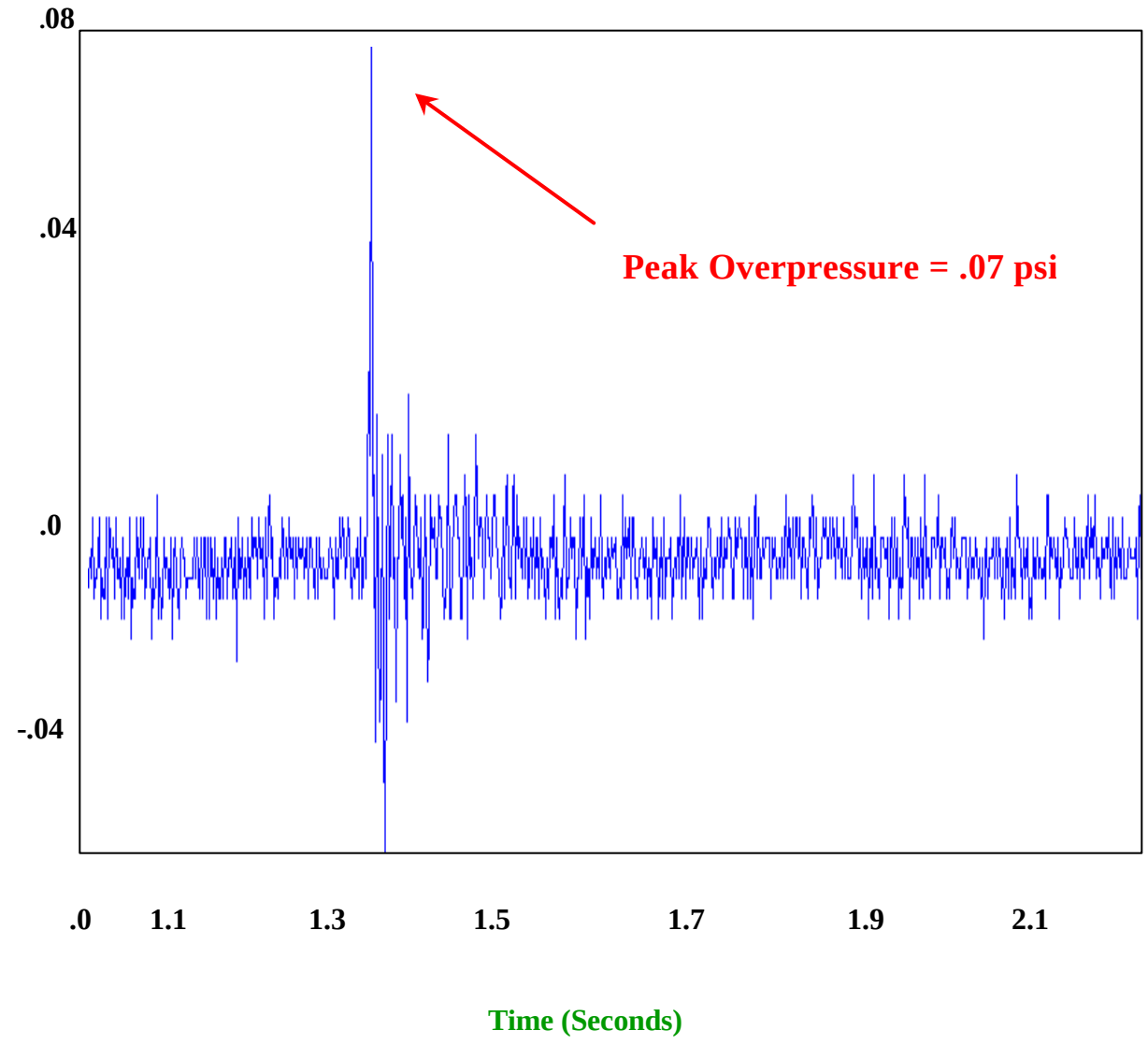
Validation Engineering Division

GRAPH 3
Results of Controlled 20mm Blast on
CP Manufacturing, Inc. OD5000 Ordnance Deformer



Validation Engineering Division

GRAPH 4
Results of Controlled 5.56mm Blast on
Bouldin & Lawson Rotary Drum Ordnance Deformer



Validation Engineering Division

GRAPH 5
Results of Controlled .50 Caliber Blast on Bouldin & Lawson Rotary Drum Ordnance Deformer