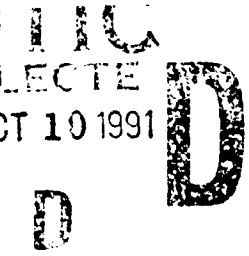

FINAL REPORT

NOVEMBER 1989

DEV 3-90-1

MIL-STD-398 TEST OF PROTOTYPE EXPLOSIVE CONTAINMENT DEVICE (PECD)

DISTRIBUTION UNLIMITED

Prepared for:

Lone Star Army Ammunition Plant
ATTN: SMCLS-SF
Texarkana, TX 75501-9101

EVALUATION DIVISION
SAVANNA, ILLINOIS 61074-9639

US ARMY
ARMAMENT
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The U.S. Army Defense Ammunition Center and School (USADACS) was tasked by Lone Star Army Ammunition Plant (LSAAP), Texarkana, TX to provide instrumentation testing services for MIL-STD-398, Military Standard, Shields, Operational for Ammunition Operation, Criteria for Design of and Tests for Acceptance. The Prototype Explosive Containment Device (PECD) was tested at location XX-17 LSAAP near the test barricade at XX-76. The PECD was instrumented with one blast pressure transducer and one thermal flux gage approximately 12 inches from the opening flange. A 25 percent overcharge of explosive was functioned in the PECD. Blast overpressure was recorded at 9 psi. No recordable thermal flux was observed.

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U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
Evaluation Division
Savanna, IL 61074-9639

REPORT NO. EVT 3-90-1

MIL-STD-398 TEST

OF

PROTOTYPE EXPLOSIVE CONTAINMENT DEVICE (PECD)

TABLE OF CONTENTS

PART 1

INTRODUCTION.

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School was tasked by LSAAP to provide test instrumentation services for the PECD. Instrumentation services consisted of monitoring the blast overpressure and thermal flux radiated from the PECD when a charge of lead azide was functioned within it.

B. AUTHORITY. This test was conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL 61299-6000. Reference is made to Change 4, 4 October 1974, to AR 740-1, 23 April 1971, Storage and Supply Operations. AMCCOMR 10-17, 13 January 1986, Mission and Major Functions of U.S. Army Defense Ammunition Center and School.

C. OBJECTIVE. The objective of this test is to determine if the PECD meets the requirements of MIL-STD-398, Shields, Operational for Ammunition Operations, Criteria for Design of and Tests for Acceptance. To be acceptable, the PECD must pass the Blast Attenuation, Fragment Retention, and Thermal Effects Attenuation tests.

D. CONCLUSION. The PECD did not satisfy the Blast Attenuation (requirements of MIL-STD-398) tests. Peak blast overpressure is limited to 2.5 psi. The measured peak overpressure was 9 psi. The PECD satisfied the requirements of Fragment Retention and Thermal Effects Attenuation tests. No secondary fragments were produced when lead azide was functioned in the PECD. Thermal flux levels were too low to record.

E. RECOMMENDATIONS. As tested, the PECD is unacceptable due to the fact that it does not effectively limit blast overpressure to 2.5 psi. It is recommended that the PECD be redesigned with consideration given to a completely sealed vessel.

PART 2

ATTENDEES

A. C. McIntosh Test Engineer DSN 585-8989 Comm 815-273-8989	Director U.S. Army Defense Ammunition Center and School ATTN: SMCAC-DEV Savanna, IL 61074-9639
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PART 3

TEST PROCEDURES

DETAILED REQUIREMENTS

100 Class- Blast Attenuation Tests

200 Class - Fragment Retention Tests

300 Class - Thermal Effects Attenuation Tests

CLASS-100 BLAST ATTENUATION TESTS

METHOD 101 BLAST OVERPRESSURE MEASUREMENT

A. PURPOSE

1. Measurement of blast overpressure is conducted to ensure that personnel are not exposed to peak positive incident overpressure greater than 2.3 psi when the operational shield is subjected to a maximum credible incident (MCI).

2. An acceptable alternative to measuring peak positive incident overpressure is to measure peak positive normal reflected overpressure. Personnel shall not be exposed to a maximum positive normal reflected overpressure greater than 5.0 psi when the operational shield is subjected to an MCI.

B. DESCRIPTION OF TEST

An MCI is created with the operational shield. Blast pressure gages are used to measure blast overpressure.

C. CRITERIA FOR PASSING TEST

The operational shield shall be considered acceptable if it can be determined from a pressure-distance plot of the data that personnel will not be exposed to a peak positive incident overpressure above 2.3 psi or a peak positive normal reflected overpressure above 5.0 psi.

D. INSTRUMENTATION

Blast Pressure Gages and Electronic Recording System. Based on the equivalent test charge, weight of explosives, and anticipated peak overpressure, the instrumentation system shall have the necessary response time and bandwidth to acquire data. Instrumentation shall be calibrated in accordance with current procedures of TB 43-180, Calibration Requirements for the Maintenance of Army Materiel.

E. TEST PROCEDURE

1. When the shield is tested in a simulated operational bay environment, overpressure readings shall be taken at the following locations:

(a) At the center of probable head locations of each operator. For standing locations, the gages shall be positioned 65 inches above the floor; for sitting locations, it shall be 31.5 inches above the seat.

(b) At representative positions where transient personnel may be located.

2. When testing is conducted in open air, position blast gages around the shield in two or three concentric circles at distances where it is expected that overpressures of interest will be found. Stagger the gages so shock waves reaching the outer circles are not distorted by gages in the inner circle. The gages shall be placed at a height of 65 inches.

3. All instrumentation shall be within calibration at time of test.

4. If the shield is designed for use with more than one model or type of ammunition, select the item that would produce the maximum overpressure.

5. Apply an overload equal to 25 percent or more of the filler weight of the ammunition selected for the test, unless otherwise directed in an approved test plan.

6. All major explosive components should be fused separately to ensure simultaneous detonation or deflagration in order to simulate the MCI, unless otherwise directed in an approved test plan.

7. Function explosives and record overpressure readings.

8. Prepare pressure-distance plots from overpressure recordings.

CLASS-200 FRAGMENT RETENTION TESTS

METHOD 201 FRAGMENT RETENTION TEST

A PURPOSE

Fragment testing is conducted to verify that a prototype operational shield will:

1. Contain all fragmentation or direct fragmentation away from areas requiring protection.

2. Prevent generation of secondary fragmentation within areas requiring protection.

3. Prevent movement, overturning, or structural deflections which could result in personal injury.

B. DESCRIPTION OF TEST

An MCI is created to test the operational shield.

C. CRITERIA FOR PASSING TEST

1. Contain all fragmentation or direct fragmentation away from areas requiring protection.

2. Prevent generation of secondary fragmentation within areas requiring protection.

3. Prevent movement, overturning, or structural deflections which could result in personal injury.

D. TEST EQUIPMENT

Still picture camera equipment.

E. TEST PROCEDURE

1. Fragment Retention Test.

(a) If the shield is designed for use with more than one mode or type of ammunition, select that item which will have the greatest potential fragmentation or shape charge effect. Equipment, or reasonable simulation thereof, which shall perform the intended function on the ammunition, shall be

positioned to generate secondary fragments.

(b) Apply an overload equal to 25 percent or more of the filler weight of the ammunition selected for the test, unless otherwise directed in an approved test plan.

(c) All major explosive components should be fused separately to ensure simultaneous detonation or deflagration in order to simulate the MCI, unless otherwise directed in the approved test plan.

(d) Function explosives.

2. Post-Test Procedure.

(a) Examine the interior and exterior for evidence of fragments. Photograph the shield to document test results.

(b) Examine shield for movement, overturning, or structural deflections which could result in personal injury.

(c) Shields designed for intentional detonation shall be examined for damage and an estimate made as to the ability of the shield to remain operational as specified in the design criteria.

CLASS-300 THERMAL EFFECTS MEASUREMENT

METHOD 301 HEAT FLUX MEASUREMENT

A. PURPOSE

Heat flux measurement is a condition of measure that personnel are not exposed to a maximum radiant heat flux determined in the equation given in criteria for passing test of this standard.

B. DESCRIPTION OF TEST

An MCI is created. Heat flux transducers are used to measure radiant heat flux.

C. CRITERIA FOR PASSING TEST

The operational shield shall be considered acceptable if it can be determined from heat flux-distance and heat flux-time plots of test data that personnel will not be exposed to a radiant heat flux rating exceeding the formula: $F=1.0/(0.62t)$ $T=0.7423$ cal/cm2-sec, where F=is the thermal flux, T=time in seconds.

D. INSTRUMENTATION

Heat Flux Transducers and Electronic Recording System. Based on the thermal flux expected at the location of the transducers, the instrumentation system shall have the necessary response time and bandwidth to acquire data. Instrumentation shall be calibrated in accordance with current procedures of TB 43-180, Calibration Requirements for the Maintenance of Army Materiel.

E. TEST PROCEDURE

1. When the shield is tested in a simulated operational bay environment, heat flux readings shall be taken at the following locations:

(a) At the center of probable head locations of each operator. For standing locations the transducers shall be positioned 65 inches above the floor; for sitting locations it shall be 31.5 inches above the seat.

(b) At representative positions where transient personnel may be

located.

2. In a free field test, flux values at various distances from the point of detonation can be estimated by the relationship: $Q1*(d1**2)=Q2*(d2**2)$, where Q=heat flux in btu/in^2-sec d=distance from point of detonation.

3. All instrumentation shall be within calibration at time of test.

4. If the shield is designed for use with more than one model or type of ammunition, select the item for the greatest heat flux.

5. Apply an overload equal to 25 percent or more of the filler weight of the ammunition selected for the test, unless otherwise directed in an approved test plan.

6. All major explosive components should be fuzed separately to ensure simultaneous detonation of deflagration in order to simulate the MCI, unless otherwise directed in an approved test plan.

7. Function explosives and record radiant flux readings.

8. Prepare heat flux-distance and heat flux-time plots from radiant flux recordings.

TECHNICAL PROGRAM LS-318

SUBJECT: Testing of proposed explosive containment device for remote handling of dry initiating explosives in load bay. Drawing EC-11560.

PURPOSE: To determine if the proposed containment device will adequately contain the explosion of .62 ounces of RDX (equivalent ro a normal charge weight plus a 25 percent safety factor.

DISCUSSION:

The proposed ECD will be used to surround the dry lead azide, as well as NOL-130 primer mix, during transfer from the wall barricade to the loading equipment dispense station. Due to the sensitivity of these components, it is desirable to substitute RDX for other components.

PROCEDURE:

The ECD will be positioned at a suitable location in XX-17 near the test barricade at XX-76.

An electric blasting cap will be placed inside the ECD with the lead wires run to the outside. If necessary, a pair of supplemental lead wires will be attached to the wires of the blasting cap and shunted.

An RDX charge weight and blasting cap with total RDX equivelancy of .62 ounces will be placed into the ECD. The blasting cap will be positioned and secured, if necessary, adjacent to the RDX. The ECD will then be lowered and secured.

The field lines will be shunted at the connector box and checked at the ECD end for continuity and extraneous electricity. If the circuit is complete and no extraneous electricity is detected, the lead wires and field line will be connected.

The circuit will be checked at the connector box. If no deficiencies exist in the circuit, the Technical Supervisor will ascertain that all persons are in their proper locations. The blasting machine will then be introduced to the circuit and activated.

SAFETY REQUIREMENTS:

All electrical connections will be taped to insure adequate insulation.

The circuit connector box and the blasting machine will be locked at all times except when firing. The key will be in the possession of the Technical Supervisor.

PERSONNEL LIMITS: Eight (8)

NOTE: Still and Fastex pictures, as well as sound recordings, will be made of the ECD and explosion. Day & Zimmermann and COR Safety Offices will be notified prior to test.

Standing Order #63 will be followed in event of unusual occurance.

COORDINATOR:

HAL FEASEL, DICK KING
Technical Specialists

APPROVED BY:

RONALD E. SINQUEFIELD
Director, Technical
Services Division

CONCURRENCES:

PHILLIP T. HALTOM
Director, Safety &
Industrial Engineering
Division

CARL J. EVANS
Director, Operations Division

JOE B. RAFFAELLI, JR.
General Manager

DON BARCLAY
Chief, Safety Office
Contracting Officer's Representative

12-5-88

PART 4

TEST RESULTS

A. METHOD 101 - BLAST OVERPRESSURE MEASUREMENT

The peak positive normal reflected overpressure recorded by the instrumentation was 9.2 psi. The acceptable peak positive normal reflected overpressure is 2.3 psi.

B. METHOD 201 - FRAGMENT RETENTION TEST

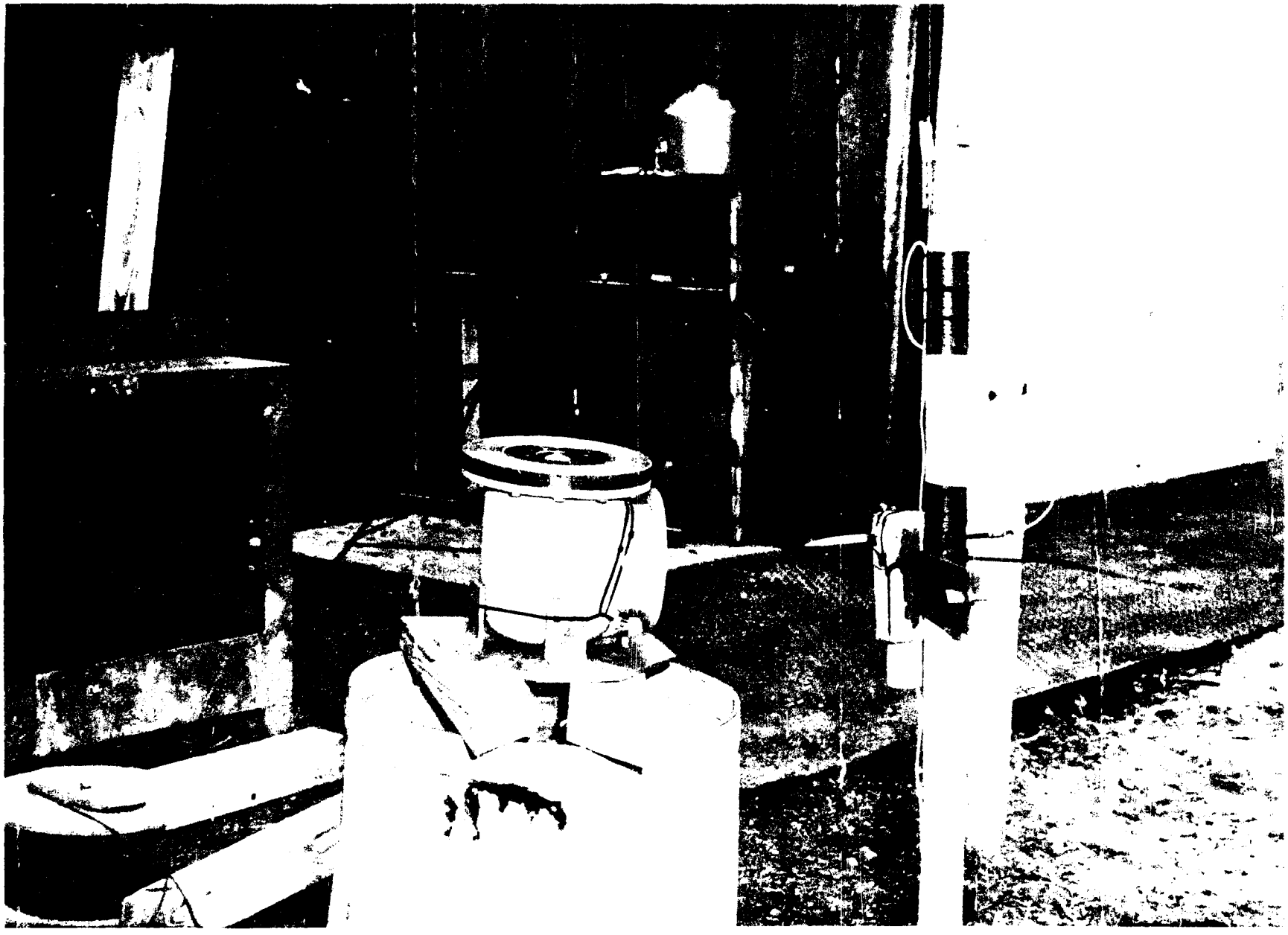
The PECD remained intact after detonating the charge. No fragmentation or secondary fragments were produced.

C. METHOD 301 - HEAT FLUX MEASUREMENT

Thermal flux produced from detonating lead Azide in the PECD was not of sufficient amplitude to register on the thermal flux transducer.

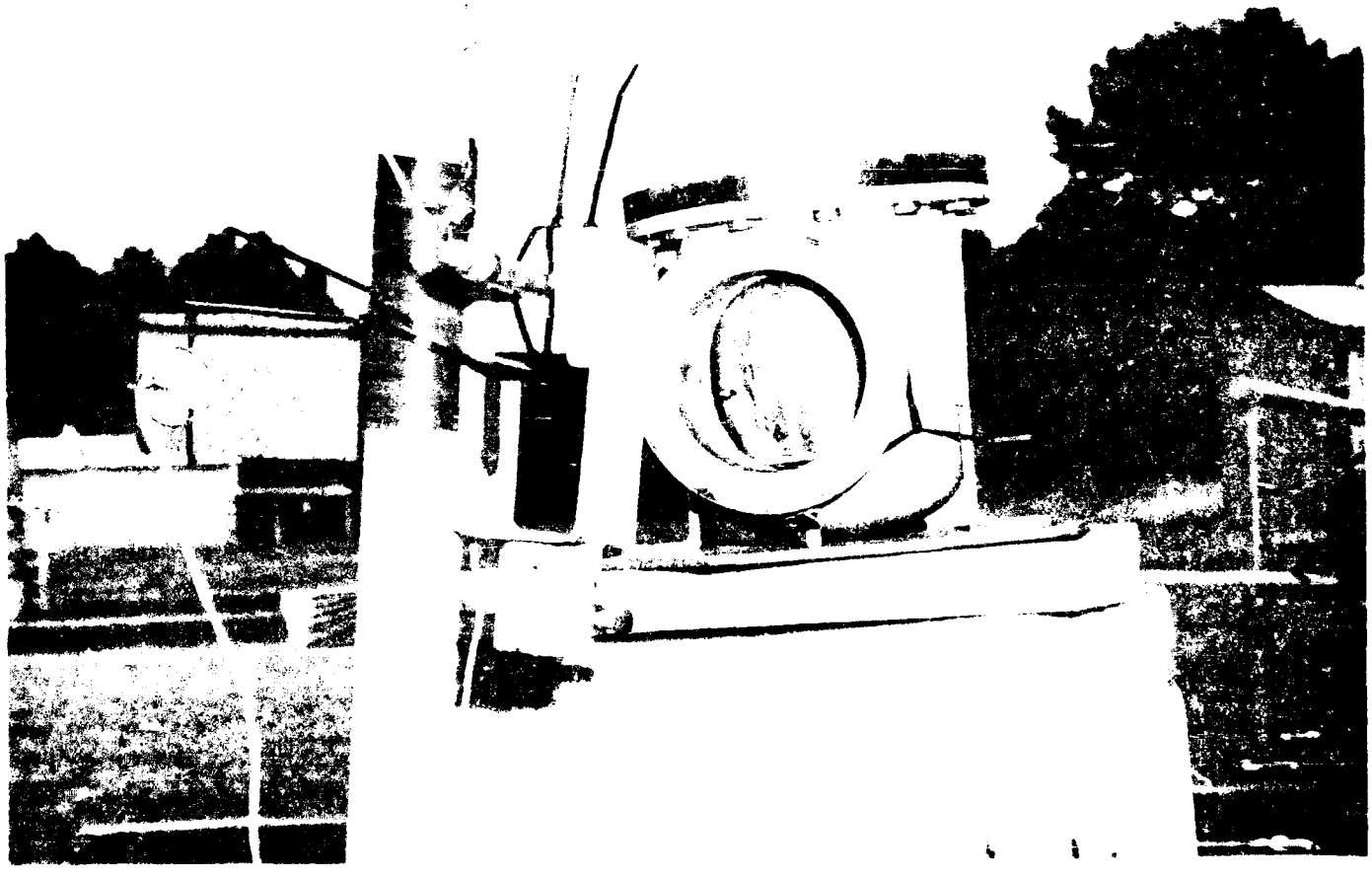
PART 5

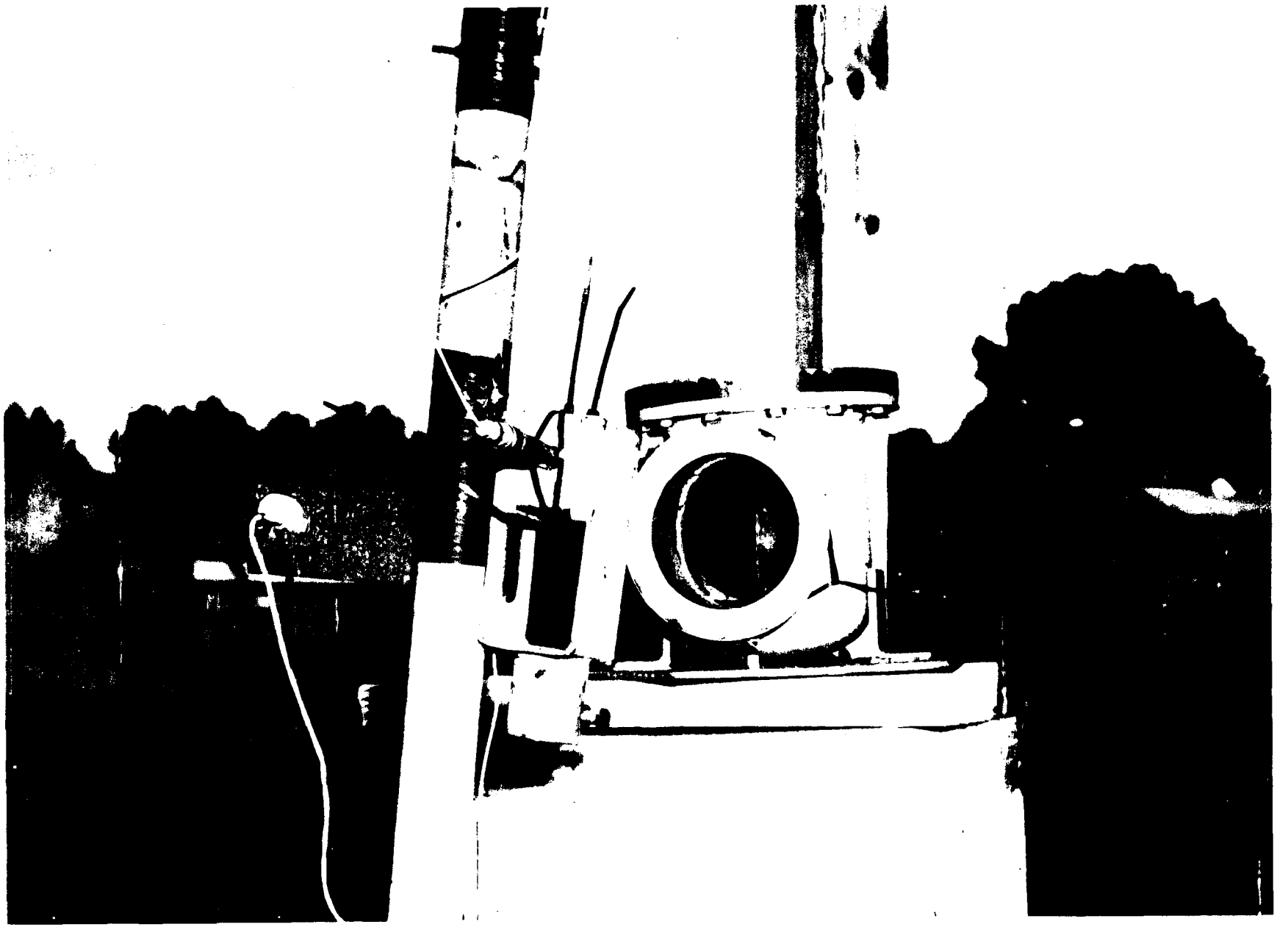
PHOTOGRAPHS



11-173-447 AMC 89	DEFENSE AMMUNITION CENTER AND SCHOOL SAVANNA, IL	

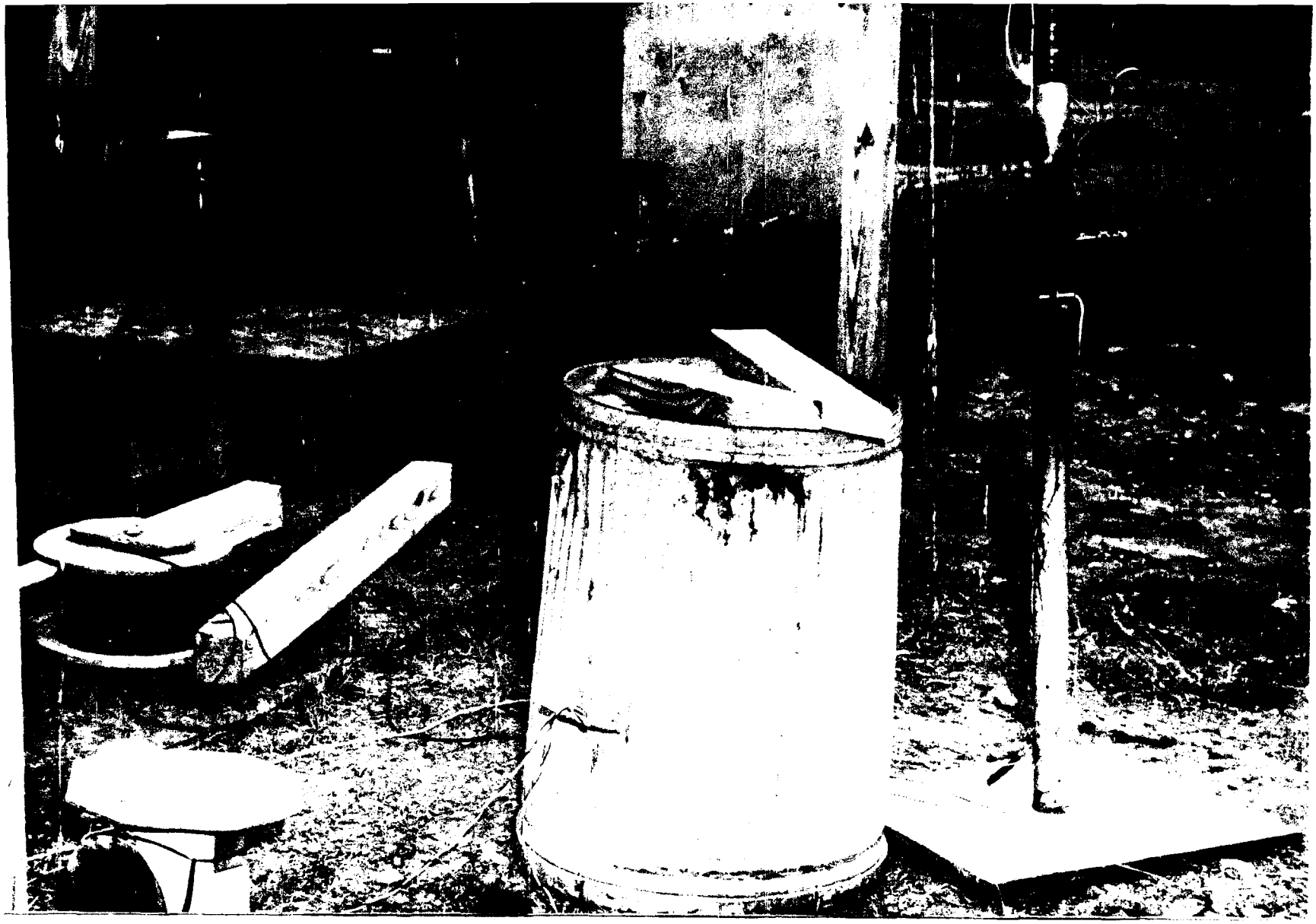
Photo No. 1 This photo shows the ECD positioned on a temporary test stand. In normal use, the test stand is replaced by a cart. Blast pressure and thermal flux transducer are directed normally to blast front





11-173-447A AMC 89	DEFENSE AMMUNITION CENTER AND SCHOOL SAVANNA, IL	

Photo No. 3 This photo shows the ECD with the inner barricade in the open position for loading or unloading explosive material.

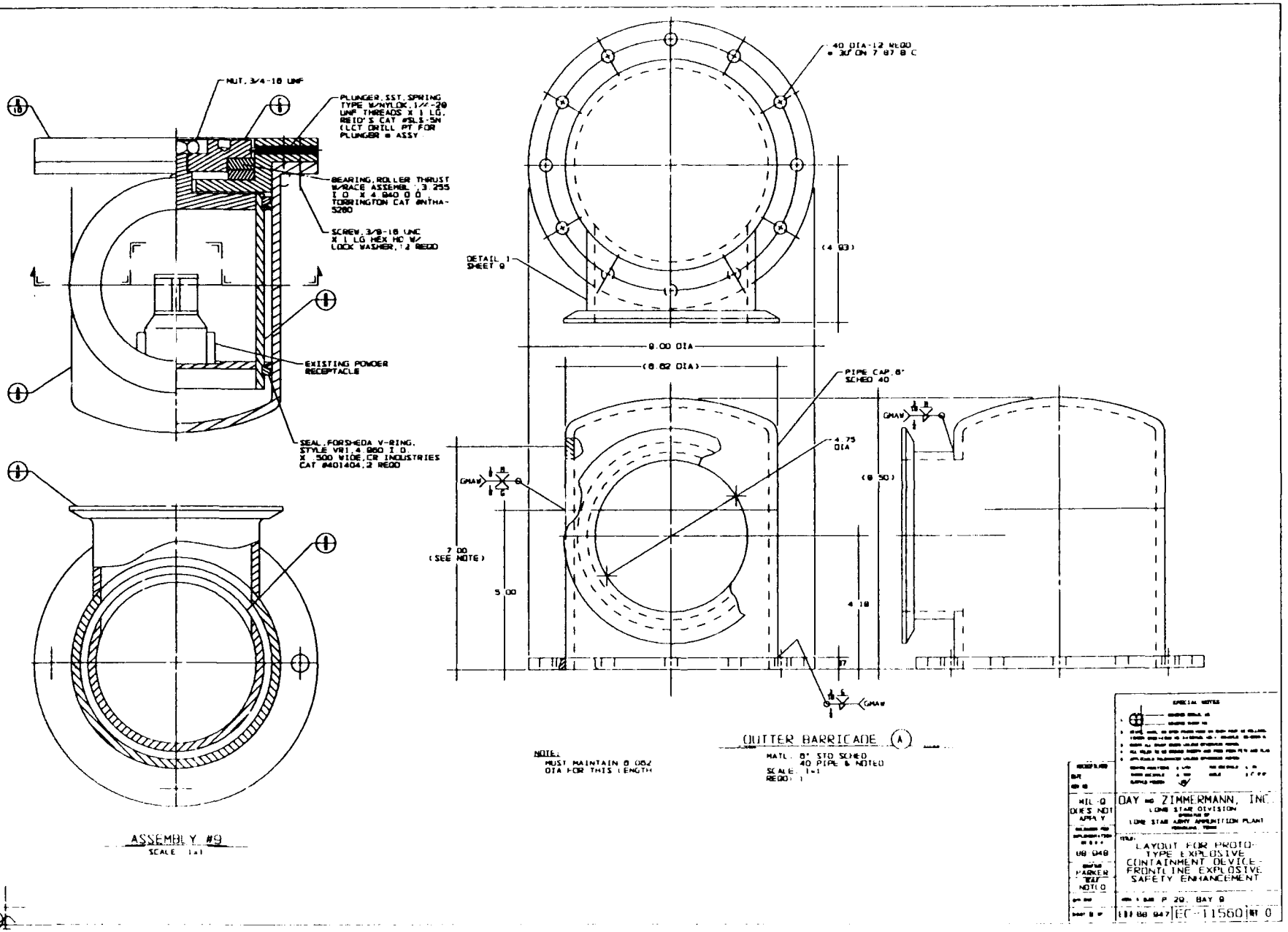


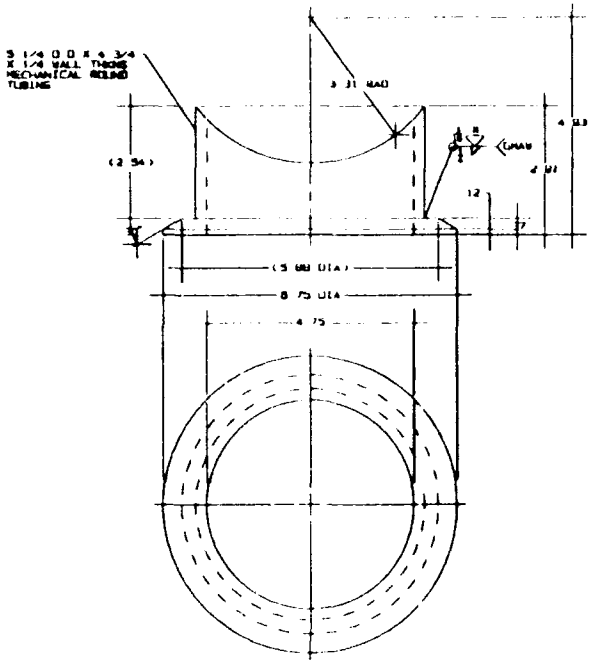
11-173-447C AMC 89	DEFENSE AMMUNITION CENTER AND SCHOOL SAVANNA, IL	

Photo No. 4 This photo shows the ECD after functioning the explosive charge. The inner barricade remained closed during the test. The black coating on the transducers and inner barricade are by products from the explosive material.

PART 6

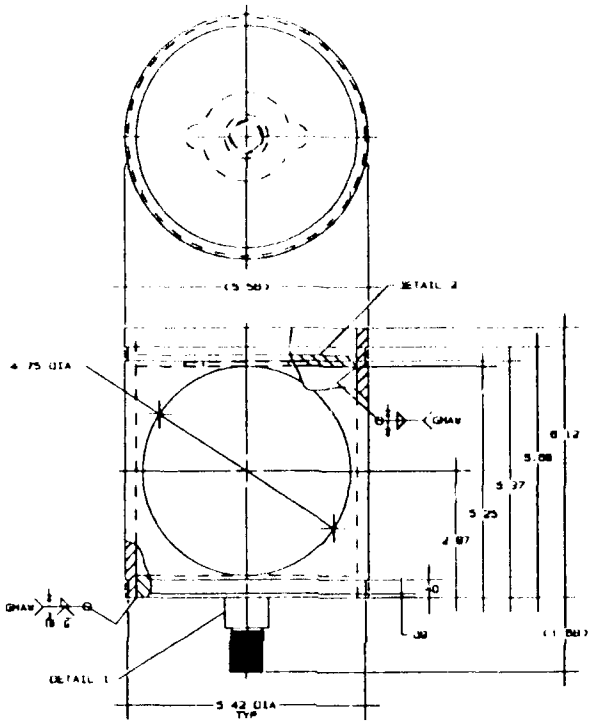
DRAWINGS


NUT, 3/4-16 UNF
PLUNGER, SST, SPRING TYPE W/NYLOK, 1/4"-20 UNF THREADS X 1 LG, REID'S CAT #SLS-SN (LCT DRILL PT FOR PLUNGER @ ASSY
BEARING, ROLLER THRUST W/RACE ASSEMBL, 3.255 I.D. X 4.940 O.D. TORRINGTON CAT #NTHA-5200
SCREW, 3/8-16 UNC X 1 LG HEX HD W/ LOCK WASHER, 12 REQD
EXISTING POWDER RECEPTACLE
SEAL, FORSHEDA V-RING, STYLE V81, 4.880 I.D. X .500 WIDE, CR INDUSTRIES CAT #401404, 2 REQD
.40 DIA-12 REQD @ 30° ON 7.87 B.C.
DETAIL 1 SHEET 9
(4.93)
9.00 DIA
(8.62 DIA)
PIPE CAP, 8" SCHED 40
4.75 DIA
GMAW
(8.50)
7.00 (SEE NOTE)
5.00
4.18
NOTE: MUST MAINTAIN 8.062 DIA FOR THIS LENGTH
ASSEMBLY #9
SCALE 1:1
CUTTER BARRICADE (A)
MATL: 8" STD SCHED 40 PIPE & NOTED
SCALE: 1:1
REQD: 1
DAY & ZIMMERMANN, INC.
LONE STAR DIVISION
LONE STAR ARMY AMMUNITION PLANT
LAYOUT FOR PROTOTYPE EXPLOSIVE CONTAINMENT DEVICE FRONTLINE EXPLOSIVE SAFETY ENHANCEMENT
EC T1560
REV 0



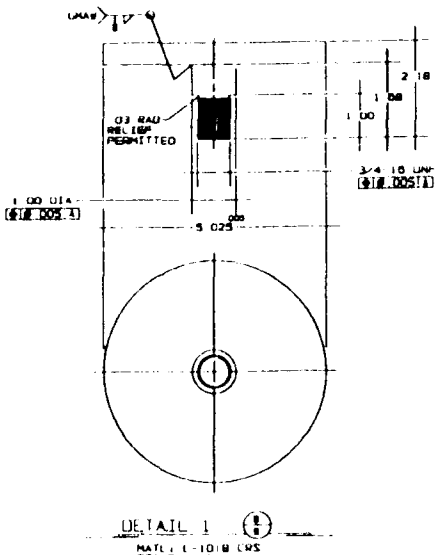
DETAIL 1 (A/B)

MATL: C 1018 CRS & NOTED
SCALE: 1=1
REQD: 1



INNER BARRICADE (B)

MATL: 5" STD SCHED 40 PIPE & NOTED
SCALE: 1=1
REQD: 1



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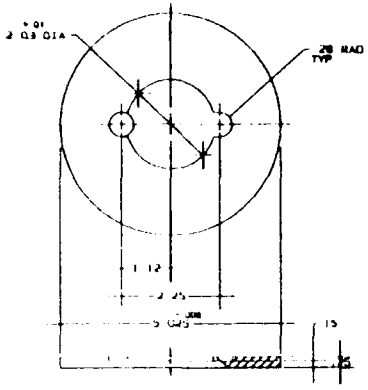
MATL: C-1018 CRS
SCALE: 1=1
REQD: 1



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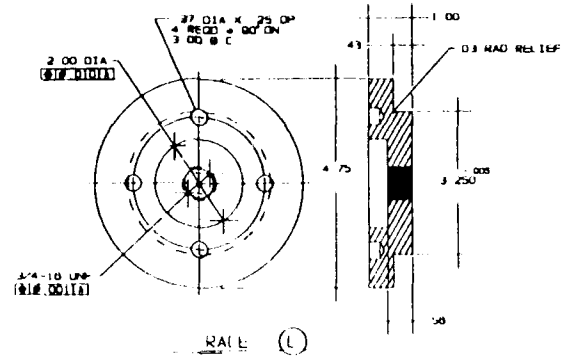


RACE (L)

MATL: AISI-01 IS RH-C-58-62
SCALE: 1=1
REQD: 1

MIL Q DOES NOT APPLY

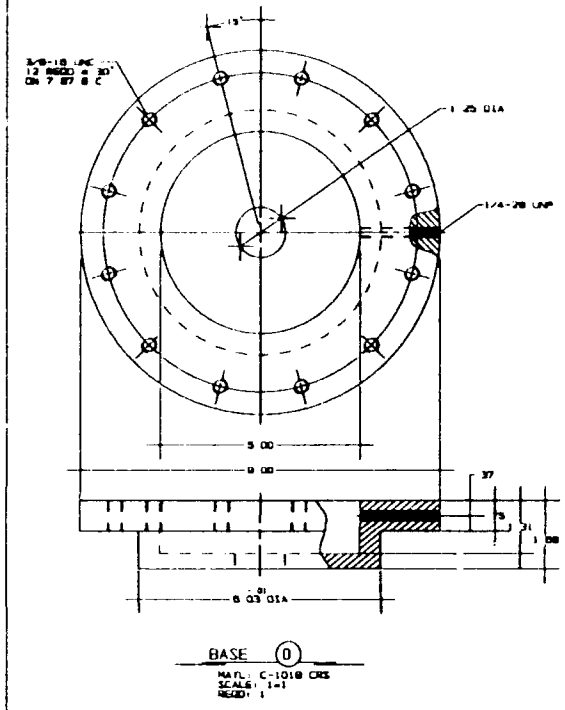
DAY & ZIMMERMANN INC
LONE STAR DIVISION
OPERATED BY
LONE STAR ARMY AMMUNITION PLANT

LAYOUT FOR PROTOTYPE EXPLOSIVE CONTAINMENT DEVICE FRONTLINE EXPLOSIVE SAFETY ENHANCEMENT

FARREN PART NOTED

P 20 BAY B

EC 115560 REV 0



MIL-Q DOES NOT APPLY	DAY & ZIMMERMANN, INC. LONE STAR DIVISION
PARKER NOTED	LAYOUT FOR PROTO-TYPE EXPLOSIVE CONTAINMENT DEVICE - FRONTLINE EXPLOSIVE SAFETY ENHANCEMENT
	EC-11560 | 0