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HEADQUARTERS
OGDEN AIR MATERIEL AREA
UNITED STATES AIR FORCE

12 February 1962

REPLY TO
ATTN OF: OOOYED

SUBJECT: Change Notice to OQAMA Airmunition Test Report OOOY-TR-62-1,
January 1962

TO: See Distribution List

1. The abstract sheets in subject Test Report, Titled:
Report of Hazard Classification Test of Cartridge Engine
Starter, MC-1, MC-2, MXU-4/A (AMOCO) and MXU-4/A (Olin
Mathieson) reflect Storage Compatibility Group C and ICC
Shipping Class B. These classifications are incorrect and
should read Class J and Class C respectively as indicated
on Page 9 of the report.

2. Request the attached corrected abstract sheets be
inserted in place of the incorrect sheets.

FOR THE COMMANDER

Alex D. Peresich

ALEX D. PERESICH
Chief, Engineering and
Test Division
2705th Airmunitions Wing

AD 269 662

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62-1-6

JAN. 1962

OOAMA

AIRMUNITIONS TEST REPORT

REPORT OF HAZARD
CLASSIFICATION TEST OF CARTRIDGE
ENGINE STARTER, MC-1, MC-2, MXU-4/A
(AMOCO) AND MXU-4/A(OLIN MATHIESON)



REPORT OF HAZARD CLASSIFICATION TEST

OF

CARTRIDGE, ENGINE STARTER, MC-1, MC-2, MXU-4/A

(AMGGO) AND MXU-4/A (OLIN MATHIESON)

by

James L. Higgins

PUBLICATION REVIEW

This report has been reviewed and is approved



ALEX D. PERESICH
Chief, Engineering and
Test Division
2705th Airmunitions Wing

JANUARY 1962

2705TH AIRMUNITIONS WING
OGDEN AIR MATERIEL AREA
AIR FORCE LOGISTICS COMMAND
UNITED STATES AIR FORCE
Hill Air Force Base, Utah

ADMINISTRATIVE DATA

PURPOSE OF TEST:

The purpose of this test was to determine the explosive quantity distance classification, storage compatibility group and Interstate Commerce Commission (ICC) explosive classification, for Cartridge, Engine Starter, MC-1, MC-2 and MXU-4/A

MANUFACTURER:

Olin Mathieson Chemical Corporation, Illinois, (MC-1 and MXU-4/A)
Standard Oil Company (AMOCO), Indiana, (MC-2 and MXU-4/A)

DRAWINGS:

Olin-Mathieson Drawing No. 2615-0056-1, MC-1
Standard Oil Drawings Numbers S-120 through S-130, MC-2
Olin-Mathieson Drawing Numbers 300-2 through 300-135, MXU-4/A
Standard Oil Drawing Numbers AS-100 through AG-106, MXU-4/A

SPECIFICATIONS:

MIL-G-25128
Olin-Mathieson Model Specification MS-101 (Conf), MC-1
Standard Oil Model Specification SOI-SC-1 (Conf), MC-2
Olin Mathieson Model Specification MS-102A (Conf), MXU-4A
Standard Oil Model Specification SOI-CS-2 (Conf), MXU-4/A

QUANTITY OF ITEMS TESTED:

36 MC-1 Cartridges, FSN 1375-344-2371-M377
36 MC-2 Cartridges, FSN 1375-528-5978-378
24 MXU-4/A Cartridges, FSN 1375-540-9723-M379 (Olin-Mathieson)
24 MXU-4/A Cartridges, FSN 1375-720-3636-M379 (Standard Oil)

SECURITY CLASSIFICATION

Unclassified

DATE TEST COMPLETED:

15 September 1961

OOY-TR-62-1

TEST CONDUCTED BY:

OCAMA (OOYET) Test Branch, Engineering and Test Division (OOYE)

Test Director: Hoyt O. Brown, Major, USAF

Project Officer: James L. Higgins, Electronic Engineer

DISPOSITION OF SPECIMENS:

All metal parts generated from this operation were inspected, certified inert and turned over to Redistribution and Marketing Division in accordance with Technical Order 11C3-1-3 and HAFBR 136-2.

ABSTRACT

Tests were conducted to determine the explosive quantity distance classification, storage compatibility group and the ICC explosive shipping classification for Cartridge, Engine Starter, MC-1 MC-2 and MXU-4/A. The MXU-4/A Cartridges were manufactured by two different manufacturers and the propellant contains Ammonium Nitrate but in different percentages.

Five detonation tests were conducted on each of the four types of cartridges to determine if a detonation would occur and if so, would the detonation propagate from cartridge to cartridge. One cartridge in a shipping container (cardboard box) was primed with 30 grains of tetryl and initiated with an Engineer Special Blasting Cap. Each type of cartridge was also subject to a cook-off test.

No detonation occurred from any of the tests. The MC-1 and MC-2 primed cartridges were ruptured and threw burning propellant within a ten foot radius. The remains of the cartridge cases also remained in this area. The MXU-4/A cartridges did not ignite as the primer charge could not be placed on the propellant grain. All cartridges cooked-off between ten and fifteen minutes after the scrap lumber was ignited. It was concluded that all of the cartridges tested were Quantity Distance Class 2, Storage Compatibility Group J and ICC Shipping Class C.

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INTRODUCTION

A hazard classification test on Cartridge, Engine Starters was requested by the Safety and Inspection Division (GOYS), 2705th Airmunitions Wing.

Test Directive S-2-556-Y was prepared by the Explosives Evaluation Branch (GOYEE). The cartridges were subject to detonation and cook-off tests as outlined in Technical Order 11A-1-47 (NAVED Instruction 8020.8 and TB 700-2), Explosives Hazard Classification Procedures. Tests were conducted by the Test Branch (GOYET), Engineering and Test Division (GOYE), 2705th Airmunitions Wing (GOY).

DESCRIPTION

Cartridge, Engine Starter, MC-1, MC-2 and MXU-4/A are gas generating units used to start certain jet aircraft engines. The MC-1 Cartridge contains an Olin-Mathieson AGJ solid propellant charge, weighing approximately four pounds and an electrically fired ignition assembly. The MC-2 Cartridge contains a Standard Oil SOI-LEIP-1 solid propellant charge of approximately the same weight as the MC-1 and is also electrically fired. Both cartridges are approximately seven inches long and six inches wide. Figure 1 shows the exterior of the MC-1 and MC-2 Cartridges. The MXU-4/A Cartridge manufactured by Olin-Mathieson and Standard Oil both contain approximately eight pounds of solid propellant (Ammonium nitrate formulation but different percentage) and are approximately nine inches long and seven inches wide. Figures 2 and 3 show the exterior of these two cartridges.

TEST PROCEDURES

DETONATION TEST ON THE MC-1 CARTRIDGE

The MC-1 Cartridges are packed one per metal container and six containers per cardboard shipping carton (Figure 4). One cartridge was removed from the hermetically sealed metal container and the screen end of the cartridge removed. A 30 gram tetryl pellet was placed in contact with the propellant grain. The tetryl was initiated with a Type II, Special Electric Blasting Cap. The screen end was replaced, and the cartridge placed back in the shipping carton, and the cap was fired.



FIGURE 1. MC-2 (Metal Case) and MC-1 (Rubber Case) Starter Cartridges

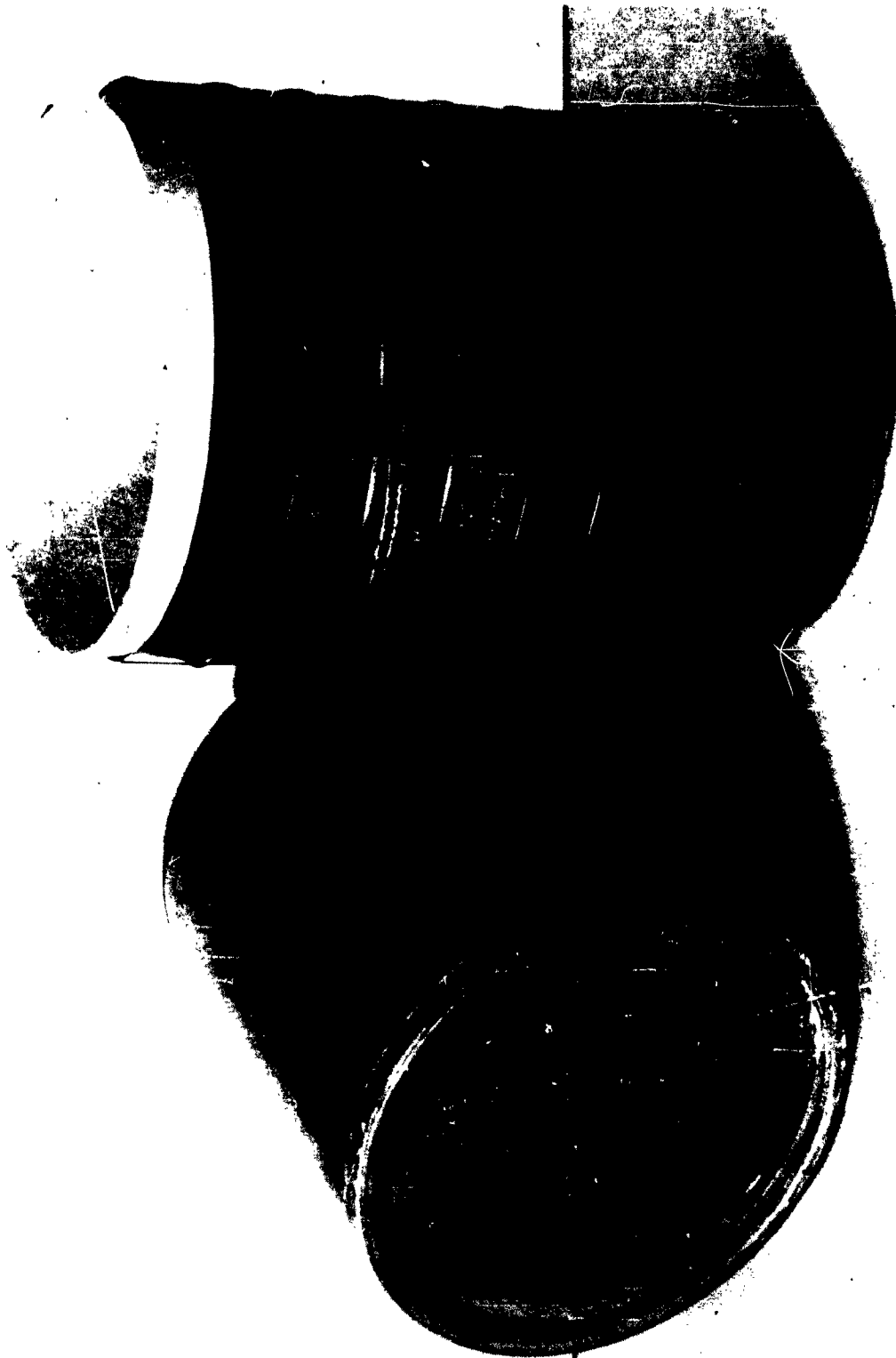


FIGURE 2. NXU 4/A Starter Cartridge (Olin Mathieson)

FIGURE 3. MXU 4/A Starter Cartridge (Standard Oil Co) (AMOCO)



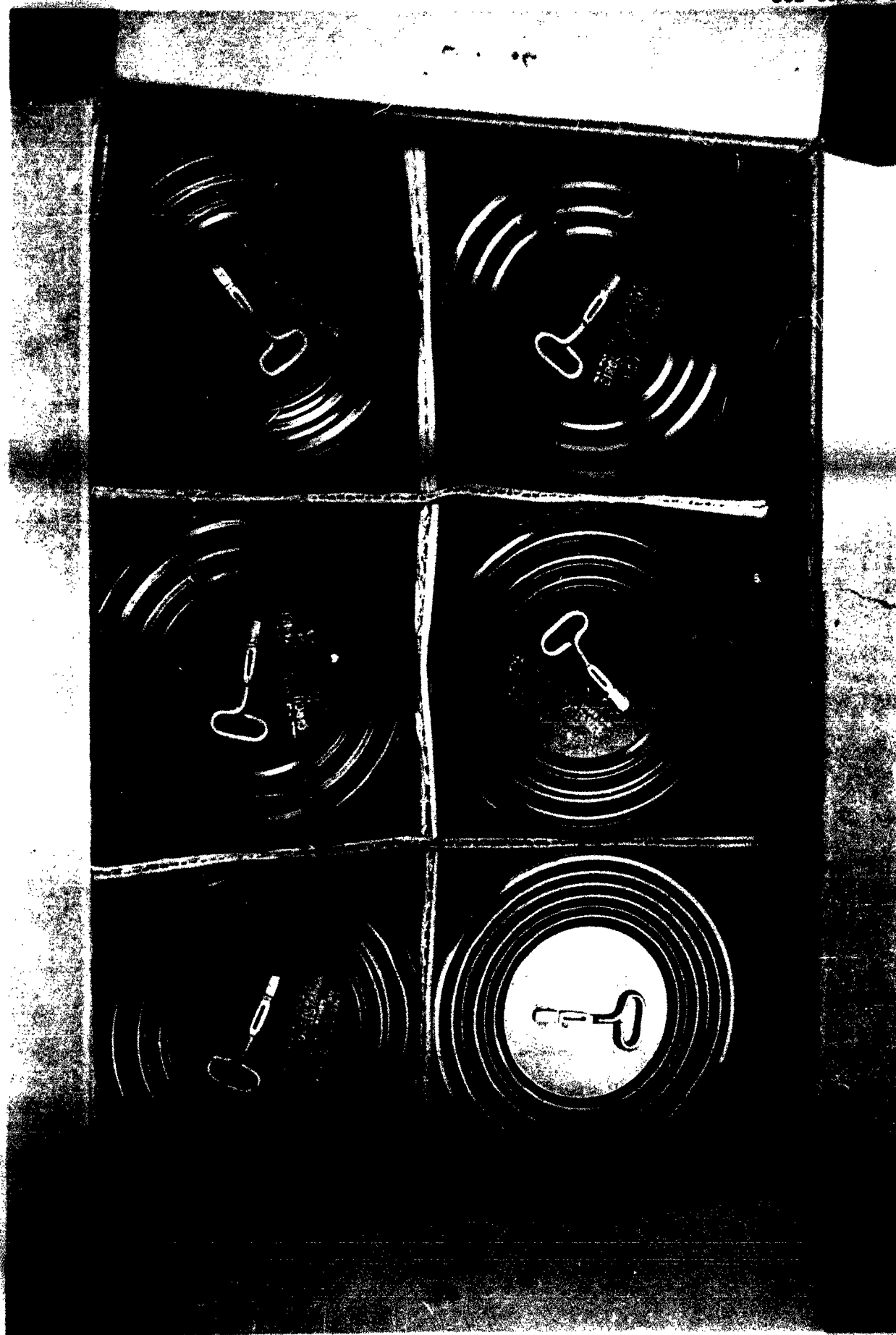


FIGURE 4. Packing and Shipping Container for the MC-1 Cartridges

TEST RESULTS OF DETONATION TEST ON THE MC-1 CARTRIDGE

The tetryl charge did not detonate the propellant, however, the cartridge case was blown into small pieces, with most of the propellant burning. The fragments were within 10 feet of the test area. The remaining five cartridges did not detonate or ignite (Figure 5) but were thrown from 15 to 50 feet from the test site. The detonation test was conducted five times with similar results.

COOK-OFF TEST, MC-1 CARTRIDGE

One shipping container (6 cartridges) was banded with one-half inch steel banding, and placed on a pile of scrap lumber. The entire mass was saturated with kerosene and ignited (Figure 6).

RESULTS OF COOK-OFF TEST, MC-1 CARTRIDGE

All cartridges functioned within seven to ten minutes after igniting the scrap lumber. When a cartridge functioned the pressure generated would burst the hermetically sealed metal container, throwing the screen closures and portions of the metal container within a five foot radius of the test site (Figure 7).

DETONATION TEST ON THE MC-2 CARTRIDGE

These cartridges were prepared for the test in the same manner as the MC-1 cartridges and the test conducted five times.

RESULTS OF DETONATION TEST ON THE MC-2 CARTRIDGE

The results of these tests (Figure 8) were similar to those experienced on the MC-1 cartridges.

COOK-OFF TEST AND RESULTS , MC-2 CARTRIDGES

The preparation and results of this test were the same as for the MC-1 Cartridges (Figure 9).

DETONATION TEST ON THE MXU 4/A (AMOCA)

The MXU 4/A Cartridges are packed one per metal container and four containers per cardboard shipping carton. One cartridge was removed from the hermetical container and primed by taping 30 grams of tetryl (two 15 grain charges) and a Type II Electric Blasting Cap to the side of the cartridge. It was not possible to place the tetryl on the propellant grain because the screened end could not be removed safely (Figure 10).

RESULTS OF DETONATION TEST ON THE MXU 4/A (AMOGA)

The primed cartridge did not detonate or ignite, but the metal casing was dented. The cardboard shipping container, however, was ignited by the booster charge, which in turn caused the primed cartridge to cook-off in approximately eleven minutes. The heat generated from the ignited cartridge caused two of the remaining three cartridges to cook-off. The fourth cartridge did not ignite, but was moved about six feet from the test site (Figure 11). This test was conducted five times, however, the first test was the only one in which the cartridge functioned. During the remaining four tests some of the cartridges were thrown up to twelve feet from the test site, but none of the cartridges functioned.

COOK-OFF TEST, MXU-4/A (AMOGO)

Four MXU-4/A Cartridges contained in a shipping container were banded together and placed in a crib of scrap lumber as in Figure 6. The entire mass was saturated with kerosene and ignited.

RESULTS OF COOK-OFF TEST, MXU-4/A (AMOGO)

All of the cartridges functioned between five and twelve minutes after the scrap lumber was ignited. The pressure generated by the burning cartridges caused the metal storage cans to burst. As a result of these pressure bursts various parts of the cartridges and storage cans were propelled up to 15 feet from the test site (Figure 12).

DETONATION TEST ON THE MXU 4/A CARTRIDGE (OLIN MATHIESON)

These tests were conducted in the same manner as for the MXU 4/A Cartridges manufactured by Standard Oil, except one 30 gram charged was used rather than two 15 grams charges. The charge was taped to the side of the rubber case as shown in Figure 13.

RESULTS OF DETONATION TEST ON THE MXU 4/A CARTRIDGE (OLIN MATHIESON)

The detonation of the booster charge removed part of the outside rubber casing of the primed cartridge, however, the cartridge did not function. The cardboard box was torn apart and the remaining three cartridges came to rest about two feet from the test site. The metal storage cans containing the individual cartridges were not damaged in any way. This test was conducted a total of five times with the same results each time. Figure 14 is typical of the results obtained.

COOK-OFF TEST, MXU 4/A CARTRIDGE (OLIN MATHIESON)

Four cartridges were banded together in one shipping container and placed in a crib of scrap lumber in the manner shown in Figure 6. The entire mass was saturated with kerosene and ignited.

RESULTS OF COOK-OFF TEST, MXU 4/A CARTRIDGE (OLIN MATHIESON)

All cartridges cooked off between 11 and 15 minutes from the time the scrap lumber was ignited. The igniters in the individual cartridges were cooked-off by the fire and ignited the propellant. The pressure generated by the igniter and burning propellant caused a pressure burst of the hermetically sealed containers. One of the four cartridges rolled out of the fire and did not function. All projectiles came to rest within 15 feet of the test site. Figure 15 shows the results of this test.

CONCLUSIONS

None of the Cartridge, Engine Starter, MC-1, MC-2, MXU 4/A (AMOCO) and MXU 4/A (Olin Mathieson) detonated when subjected to detonation and cook-off tests.

The cartridges will cook-off by open fire in approximately fifteen minutes of exposure. The igniter in the cartridge will cook-off first, thereby, igniting the propellant grain. The pressures generated from the propellant will burst the hermetically sealed container, usually at the seams, and the cartridge will burn in place. The screen end of the cartridge can be thrown up to fifteen feet.

Thirty grams of tetryl primed with a Cap Blasting, Type II, placed on the propellant grain of an MC-1 or MC-2 Cartridge will destroy the cartridge, with most of the propellant being burned. Other cartridges, in their containers will be dented and propelled or rolled a distance of fifty feet.

For safety reasons the MXU 4/A Cartridges were not disassembled, therefore, the explosive charge could be placed on the propellant grain. Had the explosive charge been placed on the propellant grain, rather than taped to the case, it is believed that the primed cartridge would have been blown apart, with most of the propellant burning, in the manner of the MC-1 and MC-2 cartridges. This conclusion is based on the composition of the propellant grain, which is practical the same as the MC-2 Cartridge.

RECOMMENDATIONS

It is recommended that the following explosive hazard classifications be assigned to Cartridge, Engine Starter, MC-1, MC-2 and MXU 4/A:

Quantity Distance	Class 2
Storage Compatibility	Group 3
ICC Shipping	Class 1C

FIGURE 5. Results of MC-1 Starter Cartridge Detonation Test



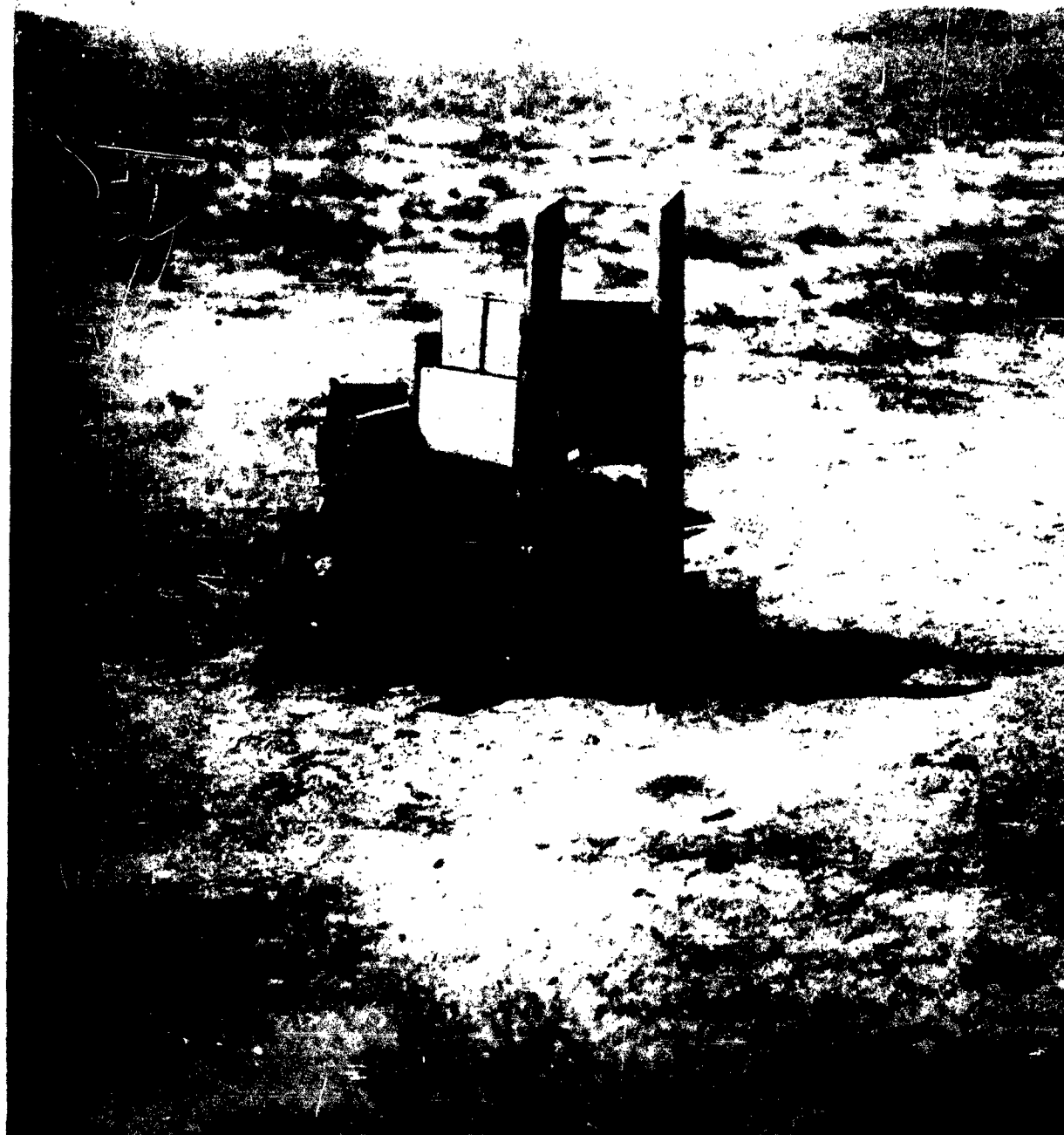


FIGURE 6. Typical Cook-off Test Set-up



FIGURE 7. Results of MC-1 Cartridge Cook-off Test.



FIGURE 8. Results of MC-2 Cartridge Detonation Test

FIGURE 9. Results of MC-2 Cartridge Cook-off Test

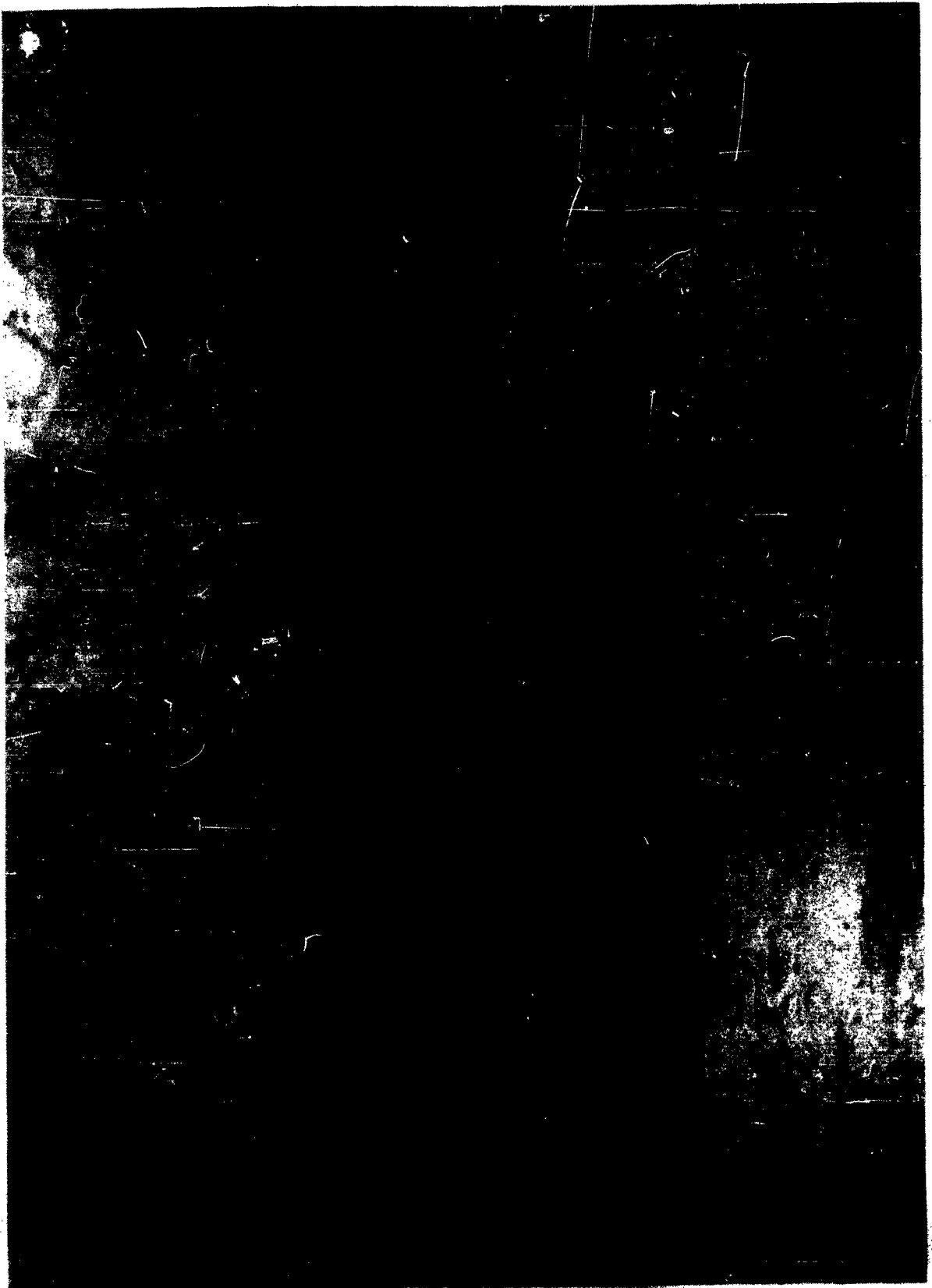




FIGURE 10. NXU 4/A Cartridge (AlOCO) Primed with 30 Grams of Teteryl

FIGURE 11. Results of MXU 4/A Cartridge (MOCO) Detonation Test





FIGURE 12. Results of EXU 4/A Cartridge (AMOCO) Cook-off Test

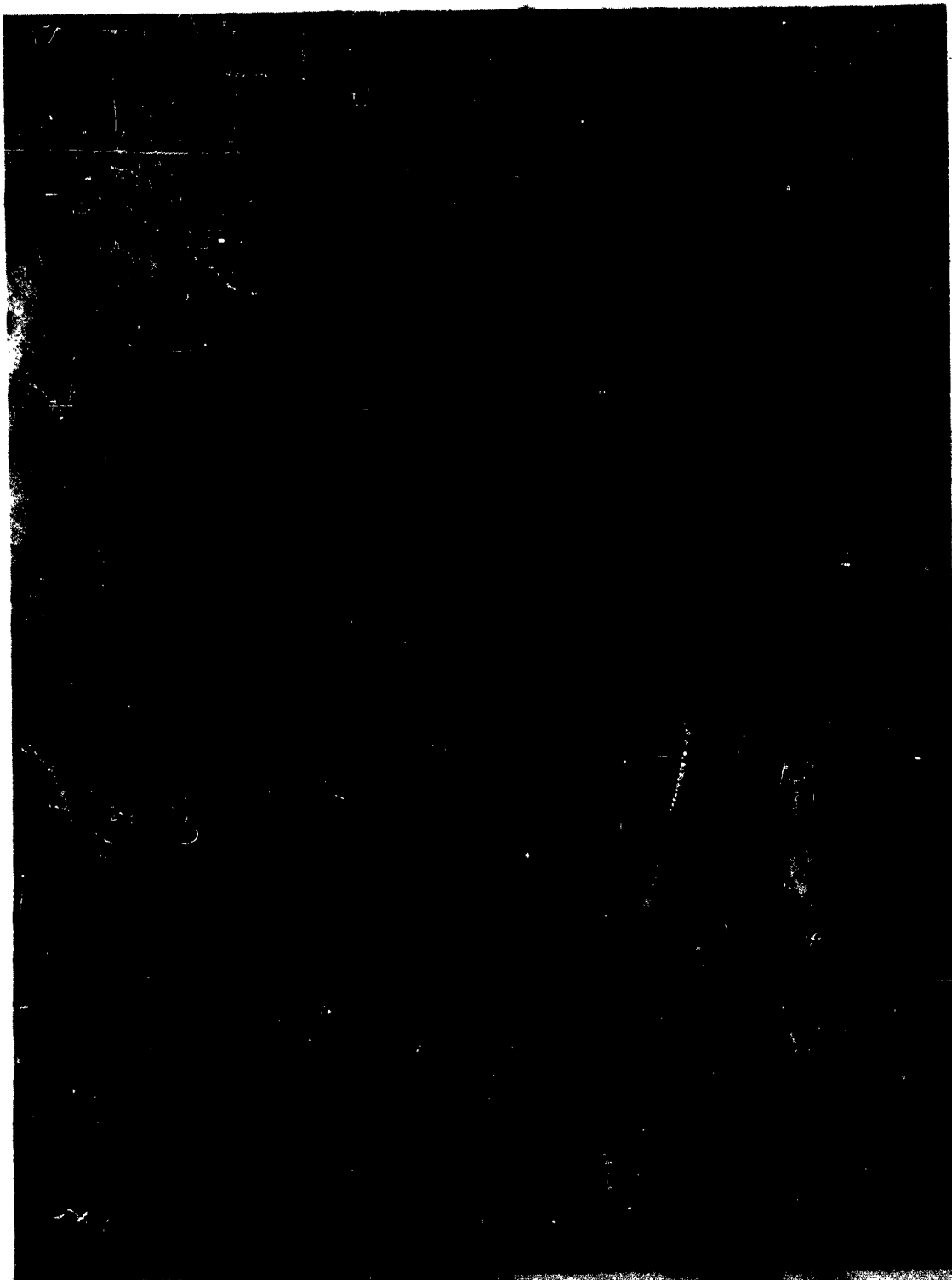
FIGURE 13. MXU 4/A Cartridge (Olin Mathieson) Primed with 30 Grams of Tetrvl





FIGURE 14. Results of MXU 4/A Cartridge (Olin Mathieson) Detonation Test

FIGURE 15. Results of MXU 4/h Cartridge (Olin Iethieson) Cook-off Test



DISTRIBUTION LIST

1 Dep IG for Safety, Hq USAF (AFIGS-B), Norton AFB, Calif
1 Hq USAF (AFMSS-AE) Wash 25, DC
1 AFLC (MCMTC) Wright-Patterson AFB, Ohio
1 Det 4, ASD (ACR), Eglin AFB, Fla
2 AU Lib, Maxwell AFB, Ala
1 USAFA, Colorado Springs, Colo
10 ASTIA, Arlington Hall Stn, Arlington 12, Va
1 ASESE, DOD, Wash 25, DC
1 Bureau of Naval Wpn (Mtal Div), Dep of the Navy, Wash 25, DC
1 CO, US Army Ord Safety Agcy, Charleston, Ind
1 Ofc of the Ch of Ord, Dept of the Army (ORDGU-SA), Wash 25, DC
1 Ord Ammo Comd (ORDLY-Q), Joliet, Ill
1 Picatinny Arsenal (Tech Lib), Dover, NJ
2 Hq AFSC (1-RDSMSC, 1-SCMMS-3), Andrews AFB, Md
1 CO, US Naval Torpedo Stn (QEL Tech Lib), Keyport, Wash
15 OOAMA, Hill AFB, Utah (1-OOY, 1-OOYIT, 1-OOYS, 1-OOYET, 5-OOYEE, 1-OOYID, 1-OOYI, 1-OOYO, 1-OOK, 2-OOAEP)
1 Bureau of Explo (T.C.George), 63 Vesey St, New York 7, NY
1 Comdt (OPL8-2), U.S. Coast Guard Hq, Wash 25, DC
1 ICC, Bureau of Safety and Svc (V.E. Haninger), Wash 25, DC
1 NASA, 1520 H Street NW, Wash 25, DC
1 Fed Aviation Agcy (Code FS40), Wash 25, DC
1 Tech Tng Cn (Code TOT-3), Amarillo AFB, Tex
1 AFFTC, Directorate of Rkt Prpln (Code DGSM), Edwards AFB, Calif
1 ASD, Wright-Patterson AFB, Ohio
1 TAC (Dir of Requirements), Langley AFB, Va
1 ADC (ADMME-DE), Ent AFB, Colo
1 ATC, Randolph AFB, Tex
1 USAFE, APO 633, New York, NY
1 PACAF, APO 953, San Francisco, Calif
1 AMFEA, APO 10, New York, NY
1 AAC, APO 942, Seattle, Wash
1 NGB (NG-AFMS), Wash 25, DC
1 QeLAB, Naval Ammo & Net Depot, Seal Beach, Calif
1 QeLAB, Naval Ammo Dept, Concord, Calif
1 R-1, Naval Propellant Plant, Indian Head, Md
1 Chief of Transportation, Dept of Army, (TCRAC-A), Wash 25, DC
3 INAPD, 2355 S Tibbs Ave, Indianapolis 41, Ind, with
1 for Standard Oil Co (Ind) Research Dept, Whiting, Ind
1 for Olin Mathieson Chem Corp, East Alton Plant, East Alton, Ind

AD 2705th Airammunitions Wing (COMMA), Hill Air Force Base, Utah REPORT OF HAZARD CLASSIFICATION TEST OF CARTRIDGE, ENGINE STARTER, MC-1, MC-2, MU-4/A (MCOO) AND MU-4/A (OLIN MATTHEWS), by James L. Higgins, January 1962, 21p incl. figures. (OUT-78-62-1) Unclassified Report Tests were conducted to determine the explosive quantity distance classification, storage compatibility group and the IOC explosive shipping classification for Cartridge, Engine Starter, MC-1, MC-2 and MU-4/A. The MU-4/A Cartridges were manufactured by two different manufacturers and the propellant contains Ammonium Nitrate but in different percentages. Five detonation tests were conducted on each of the four types of cartridges to determine if a detonation would occur and if so, would the detonation propagate from cartridge to cartridge. One cartridge in a shipping container (cardboard box) was primed with 30 grains of tetryl and initiated with an Engineer Special Blasting Cap. Each type of cartridge was also subject to a cook-off test. No detonation occurred from any of the tests. The MC-1 and MC-2 primed cartridges were ruptured and threw burning propellant within a ten foot radius. The remains of the cartridge cases also remained in this area. The MU-4/A cartridges did not ignite as the primer charge could not be placed on the propellant grain. All cartridges cooked-off between ten and fifteen minutes after the scrap lumber was ignited. It was concluded that all of the cartridges tested were Quantity Distance Class 2, Storage Compatibility Group C and IOC Shipping Class B.	UNCLASSIFIED 1. Engine Starter Cartridges I. James L. Higgins	AD 2705th Airammunitions Wing (COMMA), Hill Air Force Base, Utah REPORT OF HAZARD CLASSIFICATION TEST OF CARTRIDGE, ENGINE STARTER, MC-1, MC-2, MU-4/A (MCOO) AND MU-4/A (OLIN MATTHEWS), by James L. Higgins, January 1962, 21p incl. figures. (OUT-78-62-1) Unclassified Report Tests were conducted to determine the explosive quantity distance classification, storage compatibility group and the IOC explosive shipping classification for Cartridge, Engine Starter, MC-1, MC-2 and MU-4/A. The MU-4/A Cartridges were manufactured by two different manufacturers and the propellant contains Ammonium Nitrate but in different percentages. Five detonation tests were conducted on each of the four types of cartridges to determine if a detonation would occur and if so, would the detonation propagate from cartridge to cartridge. One cartridge in a shipping container (cardboard box) was primed with 30 grains of tetryl and initiated with an Engineer Special Blasting Cap. Each type of cartridge was also subject to a cook-off test. No detonation occurred from any of the tests. The MC-1 and MC-2 primed cartridges were ruptured and threw burning propellant within a ten foot radius. The remains of the cartridge cases also remained in this area. The MU-4/A cartridges did not ignite as the primer charge could not be placed on the propellant grain. All cartridges cooked-off between ten and fifteen minutes after the scrap lumber was ignited. It was concluded that all of the cartridges tested were Quantity Distance Class 2, Storage Compatibility Group C and IOC Shipping Class B.	UNCLASSIFIED 1. Engine Starter Cartridges I. James L. Higgins
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