TECHNICAL REPORT NO. 71-06

40MM TARGET MARKER (FLOATING), TMF-1

Final Report

By
Joseph A. D'Andrea
Munitions Branch

May 1971

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

U. S. ARMY LAND WARFARE LABORATORY
Aberdeen Proving Ground, Maryland 21005

TECHNICAL REPORT NO. 71-06

40MM TARGET MARKER (FLOATING), TMF-1

Final Report

By

Joseph A. D'Andrea
Munitions Branch

May 1971

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

U. S. ARMY LAND WARFARE LABORATORY
Aberdeen Proving Ground, Maryland 21005

ABSTRACT

This is the Final Report of the 40MM Target Marker (Floating), TMF-1, program. The purpose of this program was to prove the feasibility of and to design, develop and test a floatable target marker in a 40mm configuration that can be fired from either the M79 or the M203 Grenade Launcher.

The TMF-1 is intended to provide a standoff smoke signal for indicating to aircraft observers and others the location of friendly and enemy positions in swampy or water-covered areas. Upon being fired from either the M79 or the M203 Launcher, at a Q.E. between 32^{o} and 35^{o}, the marker will attain a normal range of 300 meters and will emit a smoke signal after impact onto water or mud-covered areas.

The final design attained and tested during this program meets the desired performance and safety requirements for such a marking round. During this program a quantity of the developed TMF-1 was produced for field evaluation in Vietnam.

FOREWORD

This program was conducted by the U. S. Army Land Warfare Laboratory in response to an ENSURE request in accordance with USARV TWX dated July 1967, Subject: Smoke Marking Munitions for Inundated Areas. The 40MM Target Marker (Floating), TMF-1, program was conducted under an LWL task as authorized by DA R&D Project 2X663-701-D718.

TABLE OF CONTENTS

INTRODUCTION

Forces in Vietnam operating in swampy, inundated terrain are often faced with the serious problem of marking for aerial observers the location of friendly and enemy positions. Marking devices currently available become submerged upon water impact, thus reducing or eliminating their marking capability. The basic requirement, therefore, exists for a marker that is small, easily transportable, capable of being fired from existing weapons and with a flotation capability. For operations in the type terrain mentioned above, a marker is required that will:

a. Identify rapidly moving forward units to friendly air.

b. Designate drop zones for rotary wing aircraft.

c. Pinpoint enemy units for aerial attack.

d. Designate friendly assembly areas to unit personnel in the field.

DEVELOPMENT AND TESTING

1. GENERAL

Two design concepts of a 40mm floating target marker were investigated during this program. Feasibility, design, and development on the first concept was pursued under R&D Contract DAADO5-68-C-0235 with Technidyne, Inc., West Chester, Pennsylvania. The basic scope of this contract included the following operational and design requirements:

a. The marker to be capable of being fired from the M79 Grenade Launcher across the temperature range of $+32^{o}F$ to $+130^{o}F$.

b. The marker to be capable of floating and functioning on mud or water of any depth.

c. The marker to have a range of 300 meters (essential) or the same range as the standard 40MM HE round (desired) when fired from the M79 Grenade Launcher.

d. The marker to contain a delay element (fuze) to initiate the signal-emitting pyrotechnic.

e. The marker burn time to be 1-1/2 minutes (minimum) while afloat.

f. The marker colors to be red, yellow, green, and white, identifiable from a one-mile aerial slant range on a clear day.

g. Final marker assembly length not to exceed 6.50 inches.

h. The marker design to incorporate the 40MM XM195 Cartridge Case for the launch system.

i. The marker design not to exceed the structural limitations or produce recoil momentum in excess of 4.00 lb sec when fired from the M79 Grenade Launcher.

j. The marker design to incorporate a means to retard descent prior to impact.

Several technical difficulties were encountered during the development phase of this first design concept. These difficulties primarily involved:

a. Inability to achieve the required range (300 meters).

b. Unsatisfactory and unreliable smoke mix ignition characteristics.

c. Burning of the retardation-flotation bag which directly affected payload flotation upon water impact.

Resolution of these technical problems indicated that a considerably longer development time and cost would be required than originally anticipated or desired. Therefore, consideration was given to a second proprietary design concept, as described in an unsolicited proposal from Northrop Carolina, Inc. (NCI). On the basis of the proposal, LWL procured 25 markers (5 each red, yellow, green, violet, and white) for evaluation. Results of this evaluation indicated that in comparison with the first design concept the NCI design performed more satisfactorily, especially in regard to range, ignition and flotation characteristics. In addition to improved performance over the first design, the nominal over-all length of the NCI design is shorter (5-1/2" vs 5-3/4") which permits its use with the M203 as well as the M79 Launcher.

Based on the satisfactory evaluation results of the NCI design, it was decided to place a contract with them. This contract covered R&D effort to correct minor design deficiencies noted in the above evaluation and to provide quantities of the developed prototype for further in-house and SEA evaluation. Since the red and yellow colors of the NCI design performed the best, these are the final colors decided upon.

During the early phase of the contract effort with NCI, the Naval Ordnance Laboratory, White Oak, Maryland, received a requirement for a 40mm floating target marker. Based on information and the status of the LWL program at that time, NOL decided to fund Technidyne for further development of their design. With this funding, Technidyne was able to correct the deficiencies of their design and to reduce the over-all length to permit use with the M203 Launcher. LWL procured a quantity of the improved Technidyne design for comparative field testing and Engineering Design Tests for Safety Evaluation with the NCI design.

2. DESCRIPTION OF CANDIDATE DESIGNS

A cross section of the Technidyne and NCI designs are shown in Figures 1 and 2, respectively. The internal configurations of both designs are essentially identical (i.e., over-all length and shape of Ogive). The projectile body of the Technidyne round is aluminum with a plastic plug crimped into place in the base end. The NCI projectile body was originally of molded, glass-reinforced plastic. However, this was changed after the Engineering Design Tests to aluminum. The projectile weight (the portion shot from the gun) of each design is comparable with the NCI design weighing 0.37 lbs versus 0.39 lbs for the Technidyne design. Both designs use a pyrotechnic delay column of approximately 5-1/2 seconds to provide the required fuze time from gun launch to function prior to impact.

The most notable difference between the two designs is in the payload. The NCI payload incorporates 55 gms (nominal) of sodium picrate base smoke mix and a retardation-flotation bag known as a ballute. This is so named because this device attaches to the smoke canister such that a portion of the gas from the burning smoke mix is vented into it to effect inflation. With the ballute inflated, it provides payload descent retardation and subsequent

flotation after water impact. In the Technidyne payload 59 gms (nominal) of a chlorate-lactose base smoke mixture is used to produce smoke. A retardation-flotation device in the form of a truncated cone (much like an air-brake) which is spring-loaded deploys umbrella fashion at projectile body-payload separation. When deployed, this device provides flotation after impact.

3. TESTING

Under the previously mentioned contracts, both designs were subjected to developmental test sequences. These development tests were primarily for the purpose of verifying the various design concepts incorporated into the marker. One of the most difficult developmental problems associated with the Technidyne round was to achieve stable flight of the projectile. The difficulty was encountered when the plastic body was made 0.5 inch longer than a previously proven stable plastic body. In order to resolve this problem, an aluminum body was substituted for the plastic. This heavier body provided the required increase in the rotational moment of inertia to again stabilize the projectile flight. However, with this heavier body the achievable range was decreased to an unacceptable level. These problems, along with problems of ignition and poor flotation performance, resulted in dropping the Technidyne design from further consideration. It was not until late in the program that an improved version of this design was retested and reconsidered as a possible candidate.

Most of the developmental testing associated with the NCI round involved correcting the deficiencies noted during the testing of the 25 rounds procured on the basis of an unsolicited proposal from NCI. These deficiencies involved poor burning characteristics of the smoke mix, structural weaknesses in the ballute and canister, and nonuniform inflation of the ballute. All of these deficiencies were corrected and tested under the R&D contract with NCI.

The most meaningful testing occurred during the latter part of this program when comparison performance testing was conducted between the Technidyne and the NCI design. This testing involved field tests to compare range, flotation and aerial visibility between the two rounds with the aim toward selecting the best of the two designs. Both designs were also subjected to EDT for Safety Evaluation as further basis for selection. The EDT for Safety Evaluation was conducted by USATECOM and the test description and results are described in Appendix A. Based on the results of this testing, both designs were given an unqualified Safety Release by USATECOM (Appendix B).

Results of these comparison tests, both field and EDT for Safety Evaluation indicated that both designs would provide the desired performance characteristics for such a marking device. However, since the NCI design results in positive buoyancy, it was selected as the design to be used. This positive buoyancy characteristic will allow the system to function if the round is inadvertently fired at a depressed Q.E. launch angle and results in water impact prior to projectile body-payload separation.

The operational and physical characteristics of the final design are shown in Appendix C.

A small quantity of this final design was manufactured and confirmation tests were run before the evaluation quantity was produced. When the first units of this final design were fired, about half of them failed to separate properly. An investigation indicated that:

a. The manufacturer had "improved" his plastic material (lexan) by making it stronger.

b. The percentage of glass fiber in the original ogive was actually one half of that specified.

c. The dye used to color the ogive changed the physical characteristics of the plastic making it somewhat more brittle.

d. About one half the aluminum bodies had a small burr on the release lip. This burr tended to lock the ogive inside the aluminum body.

When these problems were corrected or compensated for, the confirmation tests were conducted and all the units functioned properly.

SUMMARY

A final design of a 40MM Floating Target Marker, TMF-1, was established during the program. A sufficient quantity of rounds was tested to develop and verify the finalized design configuration.

CONCLUSIONS

During this program, the U. S. Army Land Warfare Laboratory developed and verified the final design of a 40MM Floating Target Marker, TMF-1, that could be fired from the M79 Grenade Launcher and the M203 mounted on the M16 Rifle. The finalized design of the TMF-1 meets the specified design and performance requirements. In addition, the design is simple, has proven to be safe and reliable in operation, and incorporates standardized components from the family of 40mm smoke and illumination rounds developed by Picatinny Arsenal.

The payload retardation and flotation mechanism is reliable. The general munition ballistic characteristics are satisfactory in that the round is stable in flight and achieves the desired maximum range of 300 meters.

Even though the TMF-1 developed during this program satisfactorily meets the specified design and performance requirements, there are four design areas which should be investigated in the future. They are:

a. Use of fiberglass cloth for the ballute.

b. Use of one smoke mix or a castable smoke mix rather than the three-part mix presently used.

c. A study of ogive locking system and development of optimum cam angle for easier, more reliable separation.

d. Increase the burning time of the delay from 5.5 seconds to 6.0 seconds to increase the range capability.

These improvements could possibly be accomplished in a future product improvement type program.

JDempsey/pad/2155

TEST RECORD NO: TI-T-285	~~REPORT~~/TEST RECORD (Delete one)	DATE OF RECORD: 15 May 1970
DATE(S) OF TEST: 9 Dec 69 to 20 Apr 70	DEVELOPMENT AND PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	AUTHORITY: STE Form 1028, 2 May 1968
TYPE OF TEST: USATECOM PROJECT NO. 8-MU-001-001-002 Engineer Design (Safety Evaluation) Test of 40MM Target Marker (Floating), TMF and TMF-1 LWL Task 01-F-68		REQUESTING AGENCY: US Army Land Warfare Lab CONTRACT NO: WORK ORDER NO: 305-20918-51

OBJECT OF TEST

To provide data for the safety evaluation of the target markers.

TEST ITEM

Target Marker (Floating), TMF (aluminum body)
Target Marker (Floating), TMF-1 (plastic body)

TEST FACILITIES

Bombproof Instruments
Drop Tower and associated equipment
Gaynes Package Tester
Gun Mount
Lumiline Screens with Chronograph
M79 Grenade Launcher, Serial No. 71835
Temperature Conditioning Units
Vibration Facility
Water Immersion Tank
Weighing Scales

TEST RECORD NO: TI-T-285 (Continued) Use additional sheets, if required.

REMARKS

Eight subtests involving 288 rounds were conducted. The round-by-round functioning data are inclosed. A final letter report on this project was forwarded on 7 May 1970.

This is not the final report on this task.

OBSERVERS

1 Incl
Round-by-Round Data

SIGNATURE:

G. A. GUSTAFSON, Chief
Infantry and Aircraft Weapons Division, Materiel Testing Directorate

DISTRIBUTION:	COPIES:	
CO, USALWL, ATTN: CRDLWL-8C	1	This test record signifies that the requested testing has been completed. It does not constitute approval or disapproval of the test item by Aberdeen Proving Ground.
Technical Library	Orig	

STEAP-DS Form 180, 16 Jun 64

FUNCTIONING RESULTS

40MM Target Marker, Water Impacts

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb -Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Remarks
Temperature Storage (7 day, 4 hrs at +155°F and 20 hrs at +125°F)									
1	1	TMF-1	Red	263	3.30	-	-	-	a
2	2		Red	247	3.11	239.5	5.9	59.4	
3	3		Yellow	258	3.25	238.2	5.3	68.5	
4	4		Yellow	252	3.17	258.2	5.2	68.4	
5	5		Violet	264	3.31	-	-	-	a
6	6		Violet	264	3.31	249.0	6.1	33.5	
7	145	TMF	Red	249	3.29	243.3	5.8	86.2	
8	146		Red	245	3.24	217.4	5.9	8.1	b
9	147		Yellow	250	3.30	208.8	6.0	9.0	b
10	148		Yellow	252	3.32	200.9	5.7	56.5	
11	149		Green	245	3.24	252.3	6.1	76.0	
12	150		Violet	243	3.20	221.9	5.8	15.0	b
Transportation-Vibration (+145°F; MTB 4-2-804, 1000 miles trailer and 3 hours aircraft)									
13	7	TMF-1	Red	264	3.31	218.1	5.4	70.0	
14	8		Red	261	3.28	218.1	5.6	66.4	
15	9		Yellow	246	3.10	214.0	5.8	65.7	
16	10		Yellow	264	3.31	143.4	5.1	63.8	
17	11		Violet	263	3.30	143.8	5.2	32.8	
18	12		Violet	265	3.34	187.2	5.6	25.7	
19	151	TMF	Red	248	3.27	227.0	5.7	96.4	
20	152		Red	247	3.26	237.1	6.2	88.2	
21	153		Yellow	252	3.32	262.6	5.8	7.3	c
22	154		Yellow	248	3.27	245.0	5.8	100.2	
23	155		Green	245	3.24	230.8	5.9	91.0	
Transportation-Vibration (-50°F, same as above)									
24	13	TMF-1	Red	258	3.25	187.5	5.6	73.0	
25	14		Red	262	3.29	226.0	5.3	72.5	
26	15		Yellow	268	3.37	224.6	5.7	96.4	
27	16		Yellow	256	3.22	216.4	5.3	60.0	
28	17		Violet	264	3.31	226.4	5.2	37.9	
29	18		Violet	270	3.39	239.9	5.7	37.7	
30	156	TMF	Red	240	3.17	232.4	5.8	93.7	
31	157		Red	247	3.26	248.7	6.0	94.8	
32	158		Yellow	240	3.17	232.2	5.7	96.0	
33	159		Yellow	247	3.26	228.1	5.7	103.0	
34	160		Green	245	3.24	229.8	5.6	95.2	

Incl 1

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb -Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Remarks
Five-Foot Drop (+130°F, MIL-STD-331, Test 111)									
35	19	TMF-1	Red	259	3.26	201.4	5.5	73.0	
36	20		Red	258	3.25	193.5	5.3	70.6	
37	21		Red	261	3.28	212.4	5.3	84.3	
38	22		Red	263	3.30	209.2	5.3	72.0	
39	23		Yellow	264	3.31	220.1	5.4	68.3	
40	24		Yellow	259	3.26	210.5	5.2	69.9	
41	25		Yellow	258	3.25	198.4	5.4	61.0	
42	26		Violet	265	3.34	224.0	5.5	33.0	
43	27		Violet	269	3.38	229.5	5.8	33.3	
44	28		Violet	257	3.23	215.6	5.7	42.1	
45	161	TMF	Red	247	3.26	213.1	5.9	102.6	
46	162		Red	249	3.29	211.3	5.8	102.0	
47	163		Red	242	3.19	216.7	5.8	104.4	
48	164		Red	247	3.26	227.9	5.9	102.4	
49	165		Yellow	239	3.15	205.1	5.7	97.0	
50	166		Yellow	245	3.24	211.9	6.3	105.1	
51	167		Yellow	245	3.24	216.6	5.8	104.0	d
52	168		Yellow	245	3.24	231.4	5.9	105.7	
53	169		Green	244	3.21	199.6	5.8	105.6	
54	170		Violet	251	3.31	221.3	5.7	88.2	
Five-Foot Drop (+60°F, same as above)									
55	29	TMF-1	Red	244	3.06	210.7	5.3	69.7	
56	30		Red	260	3.27	199.4	5.5	66.4	
57	31		Red	261	3.28	193.5	5.2	68.3	
58	32		Yellow	251	3.15	183.5	5.7	64.0	
59	33		Yellow	250	3.14	212.0	4.9	66.8	
60	34		Yellow	260	3.27	203.9	4.9	77.0	
61	35		Yellow	263	3.30	204.7	5.5	40.1	
62	36		Violet	266	3.35	191.1	5.6	37.3	
63	37		Violet	257	3.23	134.9	5.4	34.3	d
64	38		Violet	268	3.37	208.3	5.7	33.0	
65	171	TMF	Red	252	3.32	231.4	6.2	88.8	
66	172		Red	250	3.30	224.6	6.2	85.5	
67	173		Red	248	3.27	187.6	5.7	108.0	
68	174		Red	241	3.18	189.2	5.8	92.1	
69	175		Yellow	251	3.31	217.1	5.8	93.8	
70	176		Yellow	257	3.39	206.4	5.8	99.5	
71	177		Yellow	249	3.29	199.5	5.8	90.0	
72	178		Yellow	250	3.30	209.0	5.8	75.0	
73	179		Green	241	3.18	215.9	5.8	91.3	
74	180		Violet	248	3.27	204.6	6.1	22.4	

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb - Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Remarks
Five-Foot Drop (+32°F, MIL-STD-331, Test 111)									
75	39	TMF-1	Red	266	3.35	220.2	5.4	64.5	
76	40		Red	260	3.27	219.5	5.5	66.6	
77	41		Red	265	3.34	178.2	5.2	72.6	
78	42		Red	259	3.26	201.7	5.4	70.8	
79	43		Yellow	256	3.22	207.9	5.2	67.1	
80	44		Yellow	257	3.23	218.7	5.5	63.1	
81	45		Yellow	259	3.26	209.0	5.1	70.6	
82	46		Violet	261	3.28	204.4	5.3	35.1	
83	47		Violet	261	3.28	198.1	5.4	27.6	
84	48		Violet	263	3.30	197.6	5.3	30.7	
85	181	TMF	Red	249	3.29	216.7	5.6	102.7	
86	182		Red	254	3.35	215.8	6.0	90.6	
87	183		Red	244	3.21	228.1	5.9	16.3	c,e
88	184		Red	255	3.37	228.1	6.4	81.5	
89	185		Yellow	250	3.30	186.9	5.8	99.6	
90	186		Yellow	246	3.25	214.4	5.8	46.1	c,e
91	187		Yellow	253	3.33	235.7	5.7	103.0	
92	188		Yellow	252	3.32	225.2	5.8	13.3	c,e
93	189		Green	251	3.31	204.1	5.9	97.8	
94	190		Violet	254	3.35	205.1	6.0	50.5	
Forty-Foot Drop #1 (MTP 4-2-601)									
95	49	TMF-1	Red	253	3.18	223.8	5.5	71.5	
96	50		Red	254	3.19	232.1	5.8	78.8	f
97	51		Red	258	3.25	222.8	5.6	71.7	
98	52		Red	261	3.28	234.6	5.1	92.3	
99	59		Yellow	260	3.27	230.7	5.1	57.7	
100	60		Yellow	256	3.22	224.4	5.6	65.0	
101	61		Yellow	258	3.25	228.2	5.4	69.3	
102	69		Violet	194	2.32	195.3	5.6	35.7	f
103	70		Violet	240	3.02	217.1	5.3	35.1	
104	71		Violet	261	3.28	234.7	5.8	36.7	
105	191	TMF	Red	240	3.17	230.6	5.7	105.0	
106	192		Red	234	3.08	231.1	5.7	78.0	f
107	193		Red	237	3.13	239.8	5.8	Lost	
108	200		Yellow	245	3.24	257.9	5.8	90.5	
109	201		Yellow	244	3.21	216.7	5.3	108.6	g
110	202		Yellow	243	3.20	227.2	5.7	98.4	g
111	209		Green	246	3.25	225.9	5.8	99.0	h
112	210		Green	242	3.19	230.3	5.7	98.3	
113	211		Green	250	3.30	239.5	6.0	97.6	d
114	218		Violet	266	3.51	237.0	5.8	73.0	

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb -Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Remarks
Forty-Foot Drop #2, MTP 4-2-601; fired at 50° elevation.									
115	53	TMF-1	Red	261	3.28	107.1	5.8	78.1	
116	54		Red	260	3.27	128.0	5.7	67.7	
117	55		Red	262	3.29	104.4	5.5	67.8	
118	62		Yellow	252	3.17	-	-	-	a,f
119	63		Yellow	251	3.15	102.3	5.8	66.5	
120	64		Yellow	256	3.22	105.4	5.8	62.0	g
121	65		Yellow	256	3.22	114.7	5.6	66.3	
122	72		Violet	258	3.25	125.3	5.5	39.9	
123	73		Violet	266	3.35	-	-	-	a
124	74		Violet	258	3.25	133.6	5.6	36.4	
125	194	TMF	Red	237	3.13	144.5	6.2	107.4	
126	195		Red	244	3.21	130.5	6.0	105.0	
127	196		Red	234	3.08	149.8	5.8	85.5	
128	203		Yellow	239	3.15	151.2	5.6	107.5	
129	204		Yellow	239	3.15	144.1	5.6	83.9	
130	205		Yellow	244	3.21	147.2	6.1	109.5	
131	212		Green	243	3.20	144.1	6.3	80.5	
132	213		Green	227	3.00	139.8	5.8	96.4	f
133	214		Green	242	3.19	140.6	5.7	97.2	g
134	219		Violet	224	2.95	134.7	5.8	88.3	f
Forty-Foot Drop #3, same as above; fired at 60° elevation									
135	56	TMF-1	Red	262	3.29	65.5	5.1	72.4	
136	57		Red	259	3.26	102.9	5.4	72.0	
137	58		Red	267	3.36	89.7	5.3	72.1	
138	66		Yellow	258	3.25	71.7	5.1	67.0	f
139	67		Yellow	258	3.25	105.3	5.0	71.0	
140	68		Yellow	266	3.35	94.1	5.8	67.7	
141	75		Violet	256	3.22	112.2	5.7	37.8	
142	76		Violet	271	3.41	113.1	5.3	39.9	
143	77		Violet	264	3.31	112.3	5.4	31.9	
144	78		Violet	264	3.31	97.4	5.1	35.8	
145	197	TMF	Red	236	3.12	103.1	6.0	81.0	h
146	198		Red	236	3.12	103.2	5.8	88.7	f
147	199		Red	237	3.13	91.6	5.3	114.5	
148	206		Yellow	252	3.32	108.5	5.6	98.7	
149	207		Yellow	241	3.18	104.4	5.9	102.8	
150	208		Yellow	251	3.31	96.4	5.9	99.5	
151	215		Green	247	3.26	91.3	5.3	91.4	
152	216		Green	248	3.27	99.4	6.1	91.7	g
153	217		Green	246	3.25	102.0	5.8	93.6	
154	220		Violet	251	3.31	92.3	6.1	88.3	g

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb -Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Remarks
Humidity (MTP 4-2-820, par 4.2)									
155	79	TMF-1	Red	263	3.30	224.0	6.1	105.5	
156	80		Red	261	3.28	183.1	5.5	77.2	
157	81		Red	257	3.23	217.9	5.4	69.1	
158	82		Red	254	3.19	227.1	5.6	69.7	
159	83		Yellow	256	3.22	227.6	5.6	70.3	
160	84		Yellow	262	3.29	241.3	5.3	69.0	
161	85		Yellow	259	3.26	170.2	5.3	71.0	
162	86		Yellow	249	3.13	210.4	5.6	75.1	
163	87		Violet	263	3.30	252.6	5.8	43.5	
164	88		Violet	256	3.22	230.6	5.8	39.7	
165	221	TMF	Red	240	3.17	229.8	5.7	66.2	
166	222		Red	237	3.13	231.0	6.2	70.1	
167	223		Red	239	3.15	220.9	6.1	90.4	
168	224		Yellow	256	3.38	222.1	5.6	49.5	
169	225		Yellow	246	3.25	218.9	5.7	80.3	
170	226		Yellow	237	3.13	237.7	6.0	106.8	
171	227		Green	248	3.27	196.6	5.3	107.7	
172	228		Green	243	3.20	209.4	6.1	104.6	d
173	229		Green	247	3.26	232.5	6.1	110.0	
174	230		Violet	245	3.24	204.1	5.7	90.9	
Waterproof (1 hour immersion in 70°F "wet" water)									
175	89	TMF-1	Red	258	3.25	198.1	5.3	68.8	
176	90		Red	257	3.23	198.6	5.4	55.1	
177	91		Red	269	3.38	203.0	5.4	67.1	
178	92		Yellow	259	3.26	197.0	5.5	59.8	
179	93		Yellow	270	3.39	195.8	5.1	66.3	
180	94		Yellow	262	3.29	206.9	5.0	59.4	
181	95		Violet	265	3.34	213.1	5.2	38.1	
182	96		Violet	261	3.28	201.3	5.6	34.2	
183	231	TMF	Red	226	2.99	192.0	5.6	68.8	
184	232		Red	234	3.08	197.7	5.9	99.0	
185	233		Yellow	235	3.09	198.9	5.8	97.3	
186	234		Yellow	237	3.13	196.8	5.9	101.5	
187	235		Green	242	3.19	180.2	5.4	85.3	
188	236		Green	249	3.29	204.9	5.8	79.8	
189	237		Violet	234	3.08	197.0	5.8	24.6	
190	238		Violet	246	3.25	202.1	6.1	89.2	

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb -Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Remarks
Control Firing (+130°F)									
191	97	TMF-1	Red	271	3.41	178.2	5.2	62.4	
192	98		Red	266	3.35	201.7	5.3	59.0	
193	107		Yellow	257	3.23	191.3	5.6	57.8	
194	108		Yellow	264	3.31	196.6	5.2	48.7	
195	117		Violet	257	3.23	129.2	5.2	33.5	
196	239	TMF	Red	242	3.19	194.0	6.1	105.5	
197	240		Red	244	3.21	201.6	5.9	98.8	
198	249		Yellow	250	3.30	184.0	5.6	21.0	c,e
199	250		Yellow	248	3.27	208.5	6.3	5.8	c,e
200	259		Green	247	3.26	223.8	6.1	95.1	d
Control Firing (+32°F)									
201	101	TMF-1	Red	250	3.14	232.4	5.8	82.9	
202	110		Yellow	262	3.29	227.7	5.8	58.9	
203	111		Yellow	266	3.35	222.7	5.9	70.2	
204	120		Violet	265	3.34	239.5	5.7	33.9	
205	121		Violet	252	3.17	226.0	5.8	36.5	
206	243	TMF	Red	244	3.21	228.6	5.7	70.6	
207	252		Yellow	244	3.21	227.4	5.9	106.0	
208	253		Yellow	252	3.32	230.5	5.7	14.0	c
209	262		Green	243	3.20	205.4	5.4	105.6	j
210	263		Green	242	3.19	213.0	5.7	108.7	k
Control Firing (+60°F)									
211	99	TMF-1	Red	264	3.31	232.0	5.4	70.6	
212	100		Red	265	3.34	160.4	5.4	68.7	
213	109		Yellow	254	3.19	225.3	5.6	66.0	
214	118		Violet	254	3.19	231.7	5.5	35.7	
215	119		Violet	256	3.22	217.9	5.6	39.6	
216	241	TMF	Red	231	3.05	215.4	5.8	98.4	
217	242		Red	237	3.13	235.8	6.0	107.4	
218	251		Yellow	244	3.21	211.5	5.9	105.0	
219	260		Green	246	3.25	209.9	5.9	83.3	
220	261		Green	235	3.11	216.7	5.8	88.1	

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb -Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Remarks
Bounce (MTP 4-2-602, 30 minutes)									
221	139	TMF-1	Red	262	3.29	219.3	5.8	69.2	
222	140		Red	260	3.27	192.7	5.4	71.4	
223	141		Yellow	255	3.21	171.0	5.3	60.4	
224	142		Yellow	255	3.21	218.7	5.1	66.6	
225	143		Violet	265	3.34	123.5	5.4	31.7	
226	144		Violet	263	3.30	217.0	5.3	33.2	
227	282	TMF.	Red	240	3.17	223.3	6.2	106.3	
228	283		Red	243	3.20	222.2	5.8	105.0	
229	284		Yellow	244	3.21	210.8	5.7	108.6	
230	285		Yellow	245	3.24	216.5	5.9	108.5	
231	286		Green	240	3.17	216.4	5.4	94.9	d
232	287		Green	243	3.20	219.6	5.9	99.0	
233	288		Violet	245	3.24	243.5	5.9	75.6	

TMF-1
22 less than 200 M
INCL 5 less than 150 M

TMF
19 less than 200 M

less 60 sec burn time

TMF-1 3 Red, 6 yellow, 34 violet - (43)
TMF 2 Red 9 yellow 4 violet - (15)

results
TMF smoke time vs TMF-1
red - at least 24.8% more
yellow 26.8%
Violet 77.8%

Ave Burn time

7

TMF-1		% design goal 90 sec	TMF		% design goal 90 sec
red	71.53	84	red	89.37	99.3
yellow	65.71	73	yellow	83.16	92.5
			green	94.99	102.5
violet	33.35	39.2	violet	62.83	69.8

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb -Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Alt of Funct, M	Funct to Gnd, Sec	Rate of Descent M per Sec	Remarks
Control (+130°F)												
234	102	TMF-1	Red	255	3.21	138.1	5.4	58.4	37.5	2.55	14.70	
235	103		Red	264	3.31	182.2	4.9	59.0	62.8	5.75	10.92	
236	112		Yellow	269	3.38	131.2	5.0	50.8	56.1	4.59	12.22	
237	113		Yellow	269	3.38	198.8	4.9	47.2	70.6	6.14	11.49	
238	122		Violet	258	3.26	204.2	5.2	37.7	66.0	7.45	8.85	
239	244	TMF	Red	236	3.12	193.6	5.7	92.6	43.1	4.12	10.46	
240	245		Red	238	3.14	202.7	5.6	101.7	51.8	5.50	9.41	
241	254		Yellow	244	3.21	216.0	5.6	98.6	Lost	4.70	----	
242	255		Yellow	249	3.29	221.8	5.6	108.0	48.7	3.95	12.32	
243	264		Green	234	3.08	199.1	5.7	107.2	53.3	4.48	11.89	
Control (+32°F)												
244	106	TMF-1	Red	266	3.35	222.1	5.3	74.8	74.8	6.20	12.06	
245	115		Yellow	268	3.37	147.7	5.0	56.2	58.9	4.44	13.26	
246	116		Yellow	263	3.30	197.1	5.1	54.8	75.9	5.83	13.01	
247	125		Violet	272	3.42	151.9	5.4	38.8	85.4	6.76	12.63	
248	126		Violet	271	3.41	175.1	5.3	35.4	76.9	5.80	13.25	
249	248	TMF	Red	266	3.51	232.3	5.9	90.0	74.3	7.40	10.04	
250	257		Yellow	272	3.58	212.5	5.9	90.6	41.8	4.60	9.08	
251	258		Yellow	257	3.39	203.4	5.5	93.4	71.8	7.45	9.63	
252	267		Green	253	3.33	211.1	6.0	81.8	40.5	4.10	9.87	
253	268		Green	251	3.31	217.0	5.9	94.9	38.8	4.49	8.64	
Control (+60°F)												
254	104	TMF-1	Red	268	3.37	193.7	5.2	86.2	69.4	5.45	12.73	
255	105		Red	267	3.36	166.3	5.8	73.0	77.8	6.90	11.27	
256	114		Yellow	269	3.38	185.0	5.1	48.3	77.1	5.81	13.27	
257	123		Violet	270	3.39	216.2	5.3	34.5	65.8	6.31	10.42	
258	124		Violet	266	3.35	192.5	5.6	32.4	67.7	5.20	13.01	

Rd. No.	Signal No.	Type	Color	MV fps	Impulse lb -Sec	Hor. Range Meters	Fuze Delay Sec.	Smoke Duration Sec.	Alt of Funct, M	Funct to Gnd, Sec	Rate of Descent M per sec	Remarks
259	246	TMF	Red	256	3.38	203.7	6.0	101.2	53.7	4.99	10.76	
260	247		Red	254	3.35	190.4	5.4	104.4	73.2	6.39	11.45	
261	256		Yellow	257	3.39	214.2	5.9	96.6	60.0	4.70	12.76	e
262	265		Green	258	3.41	232.0	5.9	85.2	54.4	5.79	9.39	
263	266		Green	250	3.30	210.7	5.9	88.9	58.2	4.64	12.54	
Control (-65°F)												
264	127	TMF-1	Red	276	3.47	234.1	5.7	94.6	74.6	5.58	13.36	1
265	128		Red	280	3.52	143.6	5.8	126.6	49.4	3.66	13.49	1
266	129		Yellow	275	3.46	173.6	5.7	71.8	31.0	2.40	12.91	1
267	130		Yellow	274	3.44	149.7	5.5	66.8	47.7	3.39	14.07	1
268	131		Violet	263	3.30	149.7	5.8	37.1	32.5	2.42	13.42	
269	132		Violet	274	3.44	249.8	5.7	39.0	58.7	4.50	13.04	
270	269	TMF	Red	255	3.37	Lost	-	-	-	-	-	m
271	270		Red	247	3.26	217.7	5.9	71.0	53.5	4.45	12.02	1
272	271		Yellow	263	3.47	234.0	5.9	93.8	48.9	3.22	15.18	1
273	272		Yellow	269	3.55	228.6	5.9	Lost	64.7	5.10	12.68	1
274	273		Green	249	3.29	215.2	5.9	-	58.1	4.89	11.88	b
275	274		Green	247	3.26	227.2	5.8	57.3	59.9	4.80	12.47	1
276	275		Violet	254	3.35	258.1	5.9	Lost	46.6	3.80	12.26	1
Shoulder Fired at +70°F												
277	133		Red	256	3.22	227.8	5.3	72.4	67.1	5.38	12.47	
278	134		Red	267	3.36	225.1	5.6	69.2	Lost	5.90	-	
279	135		Yellow	264	3.31	223.7	5.8	51.1	58.4	4.62	12.64	
280	136		Yellow	262	3.29	224.8	5.6	42.2	61.0	4.80	12.70	
281	137		Violet	266	3.35	203.6	5.8	35.3	68.0	5.25	12.95	
282	138		Violet	265	3.34	227.0	5.6	45.1	39.2	2.97	13.19	
283	276		Red	250	3.30	215.0	6.0	95.6	60.3	4.74	12.72	
284	277		Red	250	3.30	235.8	5.7	93.3	76.3	6.95	10.97	
285	278		Yellow	262	3.45	147.6	5.8	-	57.9	5.42	10.68	b
286	279		Yellow	258	3.41	219.3	5.9	110.0	69.5	6.52	10.65	
287	280		Green	252	3.32	207.2	5.2	100.2	65.6	5.50	11.92	
288	281		Green	254	3.35	229.4	5.8	79.7	67.5	6.24	10.81	

Notes

a. Marker broken in flight.

b. Signal out upon impact.

c. Submerged.

d. Signal smoked, flamed, smoked again.

e. Signal had slight flame at ignition.

f. Projectile loose in cartridge case.

g. Cartridge hard to chamber, slight dent in shoulder of cartridge case (result of 40-foot drop).

h. Ogive loose in projectile (result of 40-foot drop).

i. Projectile broke up upon functioning.

j. Signal smoked, flamed 5.4 seconds, smoked, flamed 16.0 seconds, smoked to completion.

k. Signal smoked, flamed 12.0 seconds, smoked to completion.

l. Signal smoke density very light.

m. Signal failed to ignite.

The wind velocity at the time of firing was as follows:

16 March 1970 (Rds 1 thru 12) 17 - 30 mph.
17 March 1970 (Rds 13 thru 233) 4 - 15 mph.
9 April 1970 (Rds 234 thru 276) 13 - 21 mph.
10 April 1970 (Rds 277 thru 288) 11 - 20 mph.

All markers were fired from an M79 grenade launcher. Rounds 1 through 176 were fired with the launcher held in a rigid mount; rounds 1 through 144 and 155 through 276 at an elevation of 40°, rds 115 through 134 at 50° elevation and rds 155 through 276 at 60° elevation. Rounds 277 through 288 were shoulder fired at 40° elevation.

DEPARTMENT OF THE ARMY
U. S. ARMY LIMITED WAR LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21005

CRDLWL-8C

18 APR 1968

SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68

Commanding General
U. S. Army Test and Evaluation Command
ATTN: AMSTE-PO-O
Aberdeen Proving Ground, Maryland 21005

1. Reference: Engineering Design Test and Safety Release of 40MM Position Marker (PM-3), LWL Task 04-F-67, USATECOM Project No. 8-7-2310-07.

2. The U. S. Army Limited War Laboratory is developing a 40MM Target Marker to mark positions in swampy or water-covered areas such as those found in South Vietnam. (Marking devices currently available are not useful in inundated areas because they become submerged, thus reducing and/or eliminating their marking capability.) The subject device is fired from existing weapons and has a flotation capability.

3. The 40MM TMF-1 consists of the XM195 cartridge case (modified M118), pyrotechnic delay element (fuze), projectile body, smoke canister, ogive and a combination retardation/flotation device. The marker can be shoulder-fired from the M79 grenade launcher, has an approximate length of 5-1/4" and a minimum range of 300 meters (based on a muzzle velocity of 250 ft/sec). The delay element (fuze) provides simultaneous ignition and separation of the smoke canister from the projectile body upon descent followed by deployment of the retardation/flotation device. This device will provide flotation after impact onto water. The smoke duration is approximately 1-1/2 minutes. Smoke colors of red, yellow, green or white are identifiable from an aerial slant line distance of one mile on a clear day. The TMF-1 is similar to the 40MM Position Marker (PM-3), which has undergone Engineering Design and Safety Release testing under USATECOM Project No. 8-7-2310-07 (Ref 1).

4. It is requested that an Engineering Design Test be conducted on the TMF-1 in accordance with Inclosure 1; and if proven acceptable, request the item be given a Safety Release. If additional testing is necessary to obtain a Safety Release, please

Incl 1

CRDLWL-8C 18 APR 1968
SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68

advise this Laboratory of its nature. This project is unclassified and carries an 02 SEA priority in accordance with Memorandum, CRD/X, dtd 11 Oct 65, subj: Status of U. S. Army Limited War Laboratory Expansion (copy available upon request).

5. One hundred and twenty-four (124) markers and five (5) shipping containers will be available for test on or about 1 Sept 68. It is requested that all testing be completed six (6) weeks after receipt of test items and that all test data be incorporated in a Final Report. It is further requested that the Safety Release, in letter form, be provided two (2) weeks after completion of testing.

6. In order that funds may be transferred, a cost estimate should be forwarded to this Laboratory.

7. If any technical information is required, contact Mr. J. A. D'Andrea, Task Officer, LWL, Ext 5693. For information other than of a technical nature, contact Mr. David C. Adams, Test Liaison Officer, LWL, Ext 3370.

FOR THE COMMANDER:

1 Incl
Test Plan

PETER B. FERRARA
Chief, Technical Support Division

TEST PLAN

Engineering Design and Safety Release Test of
40MM Target Marker (Floating) TMF-1
LWL Task -1-F-68

1. Temperature Storage

Five (5) Position Markers will undergo a +155°F high temperature storage in accordance with Paragraph 7. 1. a, AR 705-15, Change 1. After storage, the markers will be examined for damage. The markers will be fired for performance rating at ambient temperature (+50°F to +90°F). The following marker colors shall be used for this test:

2	Red
1	Yellow
1	Green
1	White

2. Transportation

Two (2) shipping containers, each containing six (6) markers, will be vibrated in accordance with TECP 700-700, Interim Pamphlet 70-73 currently being revised. One (1) container shall be preconditioned and vibrated at +155°F; the other, at -65°F. The criteria for passing this test is that the markers remain safe and operable at ambient temperature (+50°F to +90°F). Marker colors for this test shall be as follows:

at +155°F		at -65°F	
3	Red	1	Red
1	Yellow	3	Yellow
1	Green	1	Green
1	White	1	White

3. Five (5) Foot Drop

Six (6) five (5) round groups will be tested in accordance with Mil-Std-358; two (2) groups each at temperatures of +130°F, +60°F and +32°F. The criteria for passing this test is that the markers remain safe and operable at ambient temperature (+50°F to +90°F). Marker colors for this test shall be as follows:

at +130°F	at +60°F	at +32°F
5 Red	5 Green	5 Red
5 Yellow	5 Yellow	5 White

4. Forty (40) Foot Drop

Three (3) shipping containers, each containing six (6) markers, will be dropped one time from a height of forty (40) feet, at ambient temperature (+50°F to +90°F), to impact on steel plate. The drop orientations for the three containers shall be bottom down, top down and top corner down, respectively. The criteria for passing the test is that the markers neither burn nor detonate on impact and that they be safe to handle for disposal purposes. Each shipping container shall contain the following marker colors:

2 Red
2 Yellow
1 Green
1 White

The remaining spaces in each shipping container shall be filled with dummy weights to simulate the actual gross weight of the container.

5. Humidity

a. Five (5) markers will be subjected to the test outlined in Mil-Std-810, USAF, Method 507.

b. At the end of the test, the markers will be examined for evidence of leakage and damage. After examination, they will be fired for performance rating at ambient temperature (+50°F to +90°F). The following marker colors shall be used for this test:

1 Red
2 Yellow
1 Green
1 White

6. Waterproof

Eight (8) previously untested markers, two (2) each of colors red, yellow, green and white, shall be subjected to a waterproof test consisting of immersion in water

of $70^{o}F \pm 5^{o}F$ for one (1) hour. Immediately after removal from the water, the marker shall be fired for performance rating at ambient temperature ($+50^{o}F$ to $+90^{o}F$).

7. Control Firing

a. Thirty (30) previously untested rounds will be fired, ten (10) each at temperatures of $+130^{o}F$, $+60^{o}F$, and $+32^{o}F$. All rounds will be fixture fired from the M79 Grenade Launcher at the Q.E. angle for the maximum range (this Q.E. angle shall be furnished at a later date). Fifteen (15) rounds will be fired to impact on hard ground and the balance will be fired to impact on water. Each group of fifteen (15) shall include rounds at each of the specified temperature conditions. The flotation capability of the rounds in the water impact group shall be determined and recorded. The criterion for passing this test is that all markers prove safe to fire. The marker colors for each of the three (3) groups of ten (10) shall be as follows:

4 Red
4 Yellow
1 Green
1 White

b. Eight (8) previously untested rounds, two (2) each of color red, yellow, green and white, will be fixture fired from the M79 Grenade Launcher for maximum range at $-65^{o}F$ for information purposes only. These shall impact on hard ground.

c. The eighteen (18) rounds from the forty (40) foot drop test of paragraph 4 will be fixture fired from the M79 Grenade Launcher for maximum range at ambient temperature ($+50^{o}F$ to $+90^{o}F$) for information purposes only. These shall impact on hard ground.

d. The following parameters from firings of a, b, and c above will be obtained for engineer design purposes for comparison with the preconditioned items from paragraphs 1, 2, 3, 5b, and 6 above:

(1) Impulse
(2) Muzzle Velocity
(3) Altitude at Function
(4) Delay Time (From Launch to Function)
(5) Altitude at Smoke Ignition
(6) Smoke Signal Duration
(7) Horizontal Range
(8) Rate of Descent

24.

8. Shoulder Firing

Eight (8) previously untested markers, two (2) each of colors red, yellow, green and white, will be shoulder fired from the M79 Grenade Launcher, for maximum range, at ambient temperature (+50°F to +90°F).

COPY/pad

PKertis/pad/895-3350-2369

STEAP-DS-TI 15 May 1968

SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-8-2310-12

Commanding Officer
US Army Limited War Laboratory
ATTN: CRDLWL-8C

1. References:

a. Letter, CRDLWL-8C, 18 Apr 68, Subject: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68.

b. AMC Regulation No. 385-12, 29 Dec 67, Verification of Safety of Materiel from Development Through Testing, Production, and Supply to Disposition.

2. The test plan provided by reference 1a has been reviewed and is acceptable with the addition of one test, the clarification of the details of several other tests, and the reallotment of the quantity and color of munitions. Detailed comments are inclosed.

3. Suggest your office reconsider the request for safety release (paragraph 4, reference 1a). As specified in AMCR 385-12 (reference 1b), a safety release will allow only subsequent testing at a service board; this item would most likely be assigned to the Infantry Board at Fort Benning, Georgia. A safety evaluation, as defined in the regulation, is more appropriate.

4. The preliminary estimated programming required to evaluate the subject item is $20,000. The required test completion within six weeks is reasonable, assuming no significant test delays.

COPY/pad

STEAP-DS-TI 15 May 1970
SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-8-2310-12

5. Your letter (reference 1a) requested a final report. We propose to furnish a letter report; this to contain all data collected plus observations as appropriate. Request D&PS be furnished a distribution list for this report.

FOR THE COMMANDER:

1 Incl
as

/t/R. P. WITT
Acting Associate Director
Development and Proof Services

CF:
CG, USATECOM
ATTN: AMSTE-BC

COPY/pad

COMMENTS ON TEST PLAN

(The first eight paragraphs correspond to the eight sub-tests in the test plan)

1. The AR specifies only the daily duration; suggest 5 or 7 days with a daily cycle of 4 hours at +155°F and 20 hours at +125°F.

2. The TECP has been revised (8 March 1967) and one pertinent change is reduction of the upper temperature to +145°F. The test will simulate transport for 1000 miles by two-wheeled trailer plus 3 hours of aircraft flight. Only two directions of vibration will be used, longitudinal and transverse.

3. MIL-STD 358 (17 Nov 58) has been absorbed in MIL-STD 331 (10 January 1966) and is identified as Test 111; the basic procedure was not changed.

4. Satisfactory as written.

5. MIL-STD 810 (USAF) (14 June 62) has been twice superseded. The most recent MIL-STD 810B (15 June 1967) contains five different humidity test procedures. LWL must specify the procedure or, preferably, use the procedure contained in TECP 700-700, Interim Pamphlet 70-84, paragraph 4.2 (20 May 1966).

6. Suggest precise weighings before and after immersion and a time lapse between immersion and functioning.

7. No strenuous objection as written, but is all this data necessary? It would seem appropriate to fire more water than ground impacts and to vary the range. It would be most practical to measure altitudes and rates of descent on ground firings only.

8. Satisfactory as written.

9. The proposed addition is an unpackaged "bounce" test, conducted in accordance with TECP 700-700, Interim Pamphlet 70-96, "Rough Handling of Items Carried by Military Personnel", 6 June 1966.

10. The following table presents the original, and proposed revised allotment of munitions by color.

Incl 1

SUBTEST:	ORIGINAL ALLOTMENT RED	YELLOW	GREEN	WHITE	TOTAL	PROPOSED REVISION RED	YELLOW	GREEN	WHITE	TOTAL
Storage	2	1	1	1	5	2	1	1	1	5
TV (Hot)	3	1	1	1	6	1	2	1	1	5
TV (Cold)	1	3	1	1	6	1	1	2	1	5
5' Drop (Hot)	5	5	-	-	10	4	4	1	1	10
5' Drop (Amb)	-	5	5	-	10	4	4	1	1	10
5' Drop (Cold)	5	-	-	5	10	4	4	1	1	10
40' Drop	6	6	3	3	18	6	6	3	3	18
Humidity	1	2	1	1	5	1	1	1	2	5
Waterproof	2	2	2	2	8	2	2	2	2	8
Control (a)	12	12	3	3	30	10	10	5	5	30
Control (b)	2	2	2	2	8	2	2	1	1	6
Shoulder Fire	2	2	2	2	8	2	2	1	1	6
Bounce	-	-	-	-	-	2	2	1	1	6
TOTALS:	41	41	21	21	124	41	41	21	21	124

DEPARTMENT OF THE ARMY
U. S. ARMY LIMITED WAR LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21005

CRDLWL-8C

6 JUN 1968

SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-8-2310-12

Commanding General
U. S. Army Test and Evaluation Command
ATTN: AMSTE-BC
Aberdeen Proving Ground, Maryland 21005

CO, APG, ATTN: STEAP-DS-TI, D&PS

1. References:

a. Letter, STEAP-DS-TI, D&PS, dtd 15 May 68, subj: Same as above.

b. Meeting, 22 May 68, between Mr. P. Kertis, D&PS and Messrs. J. D'Andrea and D. C. Adams, USALWL.

2. During the meeting, Ref 1b, the following items from Inclosure 1 of Ref 1a were mutually agreed upon by D&PS and the Limited War Laboratory:

a. Item 1 - LWL concurs.

b. Item 2 - LWL concurs except that simulated two-wheeled trailer transport will be 1,000 miles instead of 2,000 miles.

c. Item 3 - LWL concurs with the use of MIL-STD-331, Test III instead of MIL-STD-358 for the five-foot drop test.

d. Item 5 - LWL concurs with the use of the TECP instead of MIL-STD-810.

e. Item 6 - LWL concurs with the suggested precise weighings before and after immersion for the waterproof test. The time lapse between removal from immersion and function shall be 24 hours (min).

CRDLWL-8C 8 JUN 1968
SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-8-2310-12

f. Item 7 - This item corresponds with Item 7, "Control Firing," of the LWL test plan which is revised as follows:

(1) Para 7a - Unchanged.

(2) Para 7b - The quantity is changed from eight (8) to six (6) markers.

(3) Para 7c - "Ground impact" is changed to "water impact."

(4) Para 7d - This paragraph is changed as follows:

"The following parameters from firings of a, b and c above will be obtained for engineer design purposes for comparison with the preconditioned items from paragraphs 1, 2, 3, 5b, 6 and 9:

Ground Impact	Water Impact
(1) Impulse	(1) Impulse
(2) Muzzle Velocity	(2) Muzzle Velocity
(3) Altitude at Function	(3) Delay Time (Fm Launch to Function)
(4) Delay Time (Fm launch to Function)	(4) Smoke Signal Duration
(5) Altitude at Smoke Ignition	(5) Horizontal Range
(6) Smoke Signal Duration	
(7) Horizontal Range	
(8) Rate of Descent	

The preconditioned rounds shall be fired to impact on water. In addition, this quantity, plus the quantity from para 7c, shall be divided as evenly as possible into three (3) groups. Each group shall be fired at the QE for maximum range, a QE of 60° and a QE of 75° respectively."

g. Item 9 - LWL concurs with the D&PS proposed addition of the unpackaged "bounce" test. Therefore, the following is added as Item 9 to the LWL test plan:

CRDLWL-8C 6 JUN 1966

SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-8-2310-12

"9. "Bounce" Test

Six (6) markers will be subjected to an unpackaged "bounce" test in accordance with TECP 700-700, Interim Pamphlet 70-96, Rough Handling of Items Carried by Military Personnel, dated 6 June 1966. The criteria for passing this test is that the markers remain safe and operable at ambient temperature (+50°F to +90°F). Marker colors for this test shall be as follows:

2 Red
2 Yellow
1 Green
1 White"

h. Item 10 - LWL concurs with the proposed revised allotment of munitions, by color, for the over-all test program.

3. LWL concurs that a "safety evaluation" in accordance with AMCR 385-12, instead of a "safety release," is more appropriate for the TMF-1 (see para 3, Ref 1a).

4. LWL concurs with the letter report, as described in para 5 of Ref 1b, instead of a final report to be furnished by D&PS at the conclusion of the test program. The distribution of this report is as follows:

Commanding General U. S. Army Test and Evaluation Command ATTN: AMSTE-BC APG, Md. 21005	1 copy
Commanding Officer U. S. Army Limited War Laboratory ATTN: CRDLWL-8C APG, Md. 21005	6 copies
Technical Library Aberdeen Proving Ground APG, Md. 21005	1 Reference Original

CRDLWL-8C 6 JUN 1968

SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-8-2310-12

5. After incorporating the changes to the test plan, it is requested that another cost estimate be forwarded this Laboratory.

6. If any technical information is required, contact Mr. J. A. D'Andrea, Task Officer, LWL, Ext 4693. For information other than of a technical nature, contact Mr. David C. Adams, Test Liaison Officer, LWL, Ext 3370.

FOR THE COMMANDER:

David C. Adams

PETER B. FERRARA
Chief, Technical Support Division

DEPARTMENT OF THE ARMY
U. S. ARMY LIMITED WAR LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21005

CRDLWL 3 NOV 1969

SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-MU-001-001-002 (8-8-2310-12)

Commanding General
U. S. Army Test and Evaluation Command
ATTN: AMSTE-BC
Aberdeen Proving Ground, Maryland 21005

1. Reference: Letter, USALWL, CRDLWL-8C, dtd 6 June 68, subject as above.

2. It is requested that the test plan outlined in the referenced letter be further modified as below:

a. Increase the quantity of TMF-1 rounds from 124 to 144 and subject an additional quantity of 144 rounds, identified as TMF, to the identical test program. The subtest distribution of each quantity of 144 rounds shall be in accordance with the inclosed Test Matrix. It will be noted that the TMF-1 shall be identified as the "Plastic Body" round and the TMF identified as the "Aluminum Body" round.

b. Where applicable, the Operational, and Storage and Transit hot and cold temperature conditions be changed to Category 3 (Hot-Humid) and Category 7 (Cold Temperature), respectively, in accordance with AR 70-38. (This AR supersedes AR 705-15 in its entirety.)

3. The test items will be available about 17 November 1969. In order that funds may be transferred, a revised cost estimate should be forwarded this Laboratory.

3 NOV 1969

CRDLWL-8C
SUBJECT: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68,
USATECOM Project No. 8-MU-001-001-002 (8-8-2310-12)

4. Technical information can be obtained by contacting Mr. J. A. D'Andrea, Task Officer, LWL, Ext 3267. For other information, contact Mr. David C. Adams, Test Liaison Officer, LWL, Ext 3370.

FOR THE COMMANDER:

PETER B. FERRARA
Chief, Technical Support Division

1 Incl
Test Matrix

Cy Furn
CG, USATECOM, AMSTE-PO-O
CO, APG, STEAP-MT-DW,
STEAP-MT-TI and STEAP-CO

TEST MATRIX

Subtest	40MM Target Marker, Floating, TMF-1 Plastic Body				40MM Target Marker, Floating, TMF Aluminum Body				
	Red	Yellow	Violet	Total	Red	Yellow	Green	Violet	Total
Storage	2	2	2	6	2	2	1	1	6
TV (Hot)	2	2	2	6	2	2	1	-	5
TV (Cold)	2	2	2	6	2	2	1	-	5
5' Drop (Hot)	4	3	3	10	4	4	1	1	10
5' Drop (Amb)	3	3	4	10	4	4	1	1	10
5' Drop (Cold)	4	3	3	10	4	4	1	1	10
40' Drop	10	10	10	30	9	9	9	3	30
Humidity	4	4	2	10	3	3	3	1	10
Waterproof	3	3	2	8	2	2	2	2	8
Control (a)	10	10	10	30	10	10	10	-	30
Control (b)	2	2	2	6	2	2	2	1	7
Shoulder Fire	2	2	2	6	2	2	2	-	6
Bounce	2	2	2	6	2	2	2	1	7
Totals	50	48	46	144	48	48	36	12	144

APPENDIX B

DEPARTMENT OF THE ARMY JDempsey/pad/234-3350-2935
ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND 21005

STEAP-MT-TI

7 MAY 1970

SUBJECT: Final Letter Report of Engineer Design (Safety Evaluation) Test of 40-mm Target Marker (Floating), TMF and TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-MU-001-001-002

Commanding Officer
US Army Land Warfare Laboratory
ATTN: CRDLWL-8C

1. REFERENCES:

a. Letter, CRDLWL-8C, 18 Apr 68, Subject: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68.

b. STE Form 1028, AMSTE-BC, 2 May 68, Test Directive.

c. Letter, STEAP-DS-TI, 15 May 68, Subject: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-8-2310-12.

d. Letter, CRDLWL-8C, 6 Jun 68, Subject: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-8-2310-12.

e. Letter, CRDLWL, 3 Nov 69, Subject: 40MM Target Marker (Floating), TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-MU-001-001-002 (8-8-2310-12), with 1st Ind, AMSTE-BC, 13 Nov 69.

f. APG Test Record No. TI-T-285, 15 May 1970, Subject: Engineer Design (Safety Evaluation) of 40-mm Target Marker (Floating), TMF and TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-MU-001-001-002.

2. BACKGROUND:

a. Land Warfare Laboratory has developed a 40-mm target marker to mark positions in swampy or water-covered areas. Markers currently available become submerged in inundated areas thus reducing their marking capability. Two versions of floating markers have been developed and are designated as TMF (aluminum body) and TMF-1 (plastic body).

STEAP-MT-TI 7 MAY 1970

SUBJECT: Final Letter Report of Engineer Design (Safety Evaluation) Test of 40-mm Target Marker (Floating), TMF and TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-MU-001-001-002

b. The markers consist of an XM195 cartridge case (modified M118 case), a pyrotechnic delay element, the projectile body of either aluminum or plastic, a smoke canister, an ogive and a combination retardation/flotation device. The delay element provides simultaneous ignition and separation of the smoke canister from the projectile body after 5 to 6 seconds followed by deployment of the retardation-flotation device. This device will provide flotation after impact onto water. The smoke duration of the red, yellow, green, or violet markers ranges from 30 to 100 seconds. The markers are designed to be fired from an M79 grenade launcher. A round weighs approximately 0.5 lb and measures 5.25 inches long.

c. The purpose of this test was to evaluate the safety aspects of the TMF (aluminum body) and the TMF-1 (plastic body) target markers after they had been subjected to series of subtests. This report covers the environmental, safety, and functioning tests that were conducted at Aberdeen Proving Ground from 9 December 1969 through 20 April 1970.

3. OBJECTIVE:

To determine if the TMF and TMF-1 40-mm Target Markers are safe to handle, store, transport, and fire.

4. SUMMARY OF RESULTS:

Test results relative to the test objective are provided below. Detailed, round-by-round data are available in Test Record TI-T-285 (reference 1f).

a. Temperature Storage. Six rounds of each type marker (TMF and TMF-1) were subjected to a 7-day storage test; each day consisted of 4 hours at +155°F and 20 hours at +125°F. No exudation or damage occurred; all rounds were safe to handle and fire. Five rounds did not operate properly.

b. Transportation-Vibration. Eleven rounds of each type (packaged) were subjected to 1000 miles of simulated 2-wheel trailer operation plus 3 hours of simulated air transport in accordance with MTP 4-2-804. No damage occurred; all rounds were safe to handle and operable. One round sank after water impact.

STEAP-MT-TI 7 MAY 1970
SUBJECT: Final Letter Report of Engineer Design (Safety Evaluation) Test of 40-mm Target Marker (Floating), TMF and TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-MU-001-001-002

c. Five-Foot Drop. Sixty rounds, 10 of each type at +130°F, +60°F and +32°F were tested in accordance with MIL-STD-331, Test 111. All were safe to handle and operable although three signals sank.

d. Forty-Foot Drop. Three shipping containers, each containing 10 rounds each TMF and TMF-1 were dropped individually from a height of 40 feet. Although some markers of both types suffered slight damage, (dents in cartridge case, projectile loose in case, ogives loose or cocked) all rounds were safe to handle and were subsequently fired.

e. Humidity. Ten rounds each type were subjected to the 10-day humidity cycle defined in paragraph 4.2 of MTP 4-2-820. All rounds were safe to handle and operable.

f. Waterproof. Eight rounds of each type were immersed in water at +70°F for one hour; the water contained a wetting agent. Each round was weighed before and after immersion; no change in weight was noted. All markers were safe and operable.

g. Bounce. Thirteen unpackaged markers (7 TMF and 6 TMF-1) were bounced at 300 RPM for 30 minutes in accordance with MTP 4-2-602. All markers were safe and operable.

h. Control Firing. Seventy-three markers were conditioned and fired, 10 each of each type at +130°F, +60°F and +32°F; 7 TMF and 6 TMF-1 at -65°F. All markers were safe to handle and fire. At the plus temperatures, three rounds sank. At -65°F, one round failed to ignite, one round ignited but went out on impact, and 9 rounds produced light-density smoke.

i. Shoulder-Firing. Six markers of each type were shoulder fired at ambient temperature. All were fired safely. Qualitatively, the recoil approximated that of a 16-gage shotgun.

5. CONCLUSIONS:

It is concluded that the 40-mm target markers TMF and TMF-1 are safe to handle, transport, store, and use.

STEAP-MT-TI 7 MAY 1970

SUBJECT: Final Letter Report of Engineer Design (Safety Evaluation) Test of 40-mm Target Marker (Floating), TMF and TMF-1, LWL Task 01-F-68, USATECOM Project No. 8-MU-001-001-002

6. RECOMMENDATIONS:

Not applicable.

FOR THE COMMANDER:

R. P. WITT
Associate Director
Materiel Testing Directorate

1 Incl
Correspondence

CF:
CG, USATECOM, ATTN: AMSTE-BC

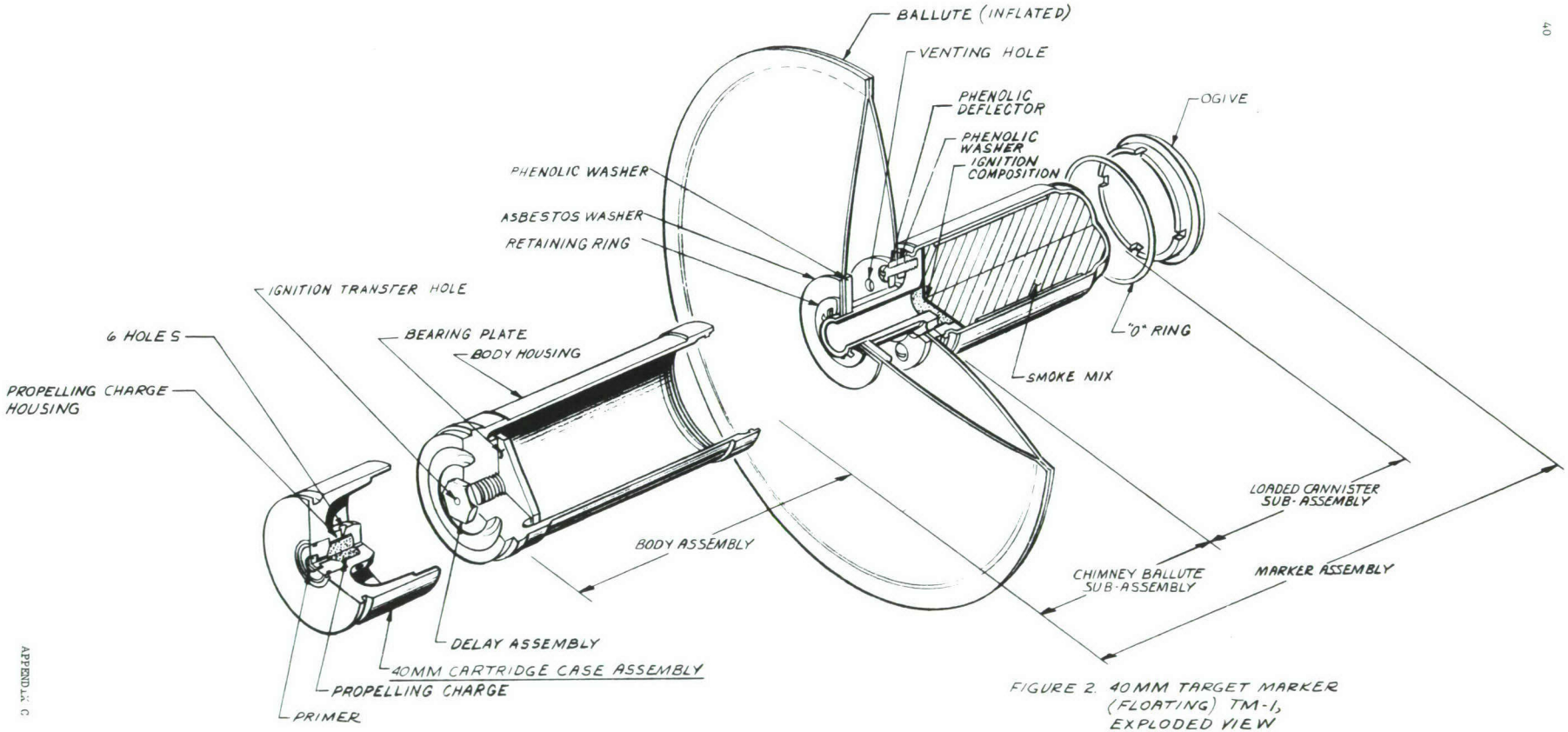

FIGURE 2. 40MM TARGET MARKER (FLOATING) TM-1, EXPLODED VIEW

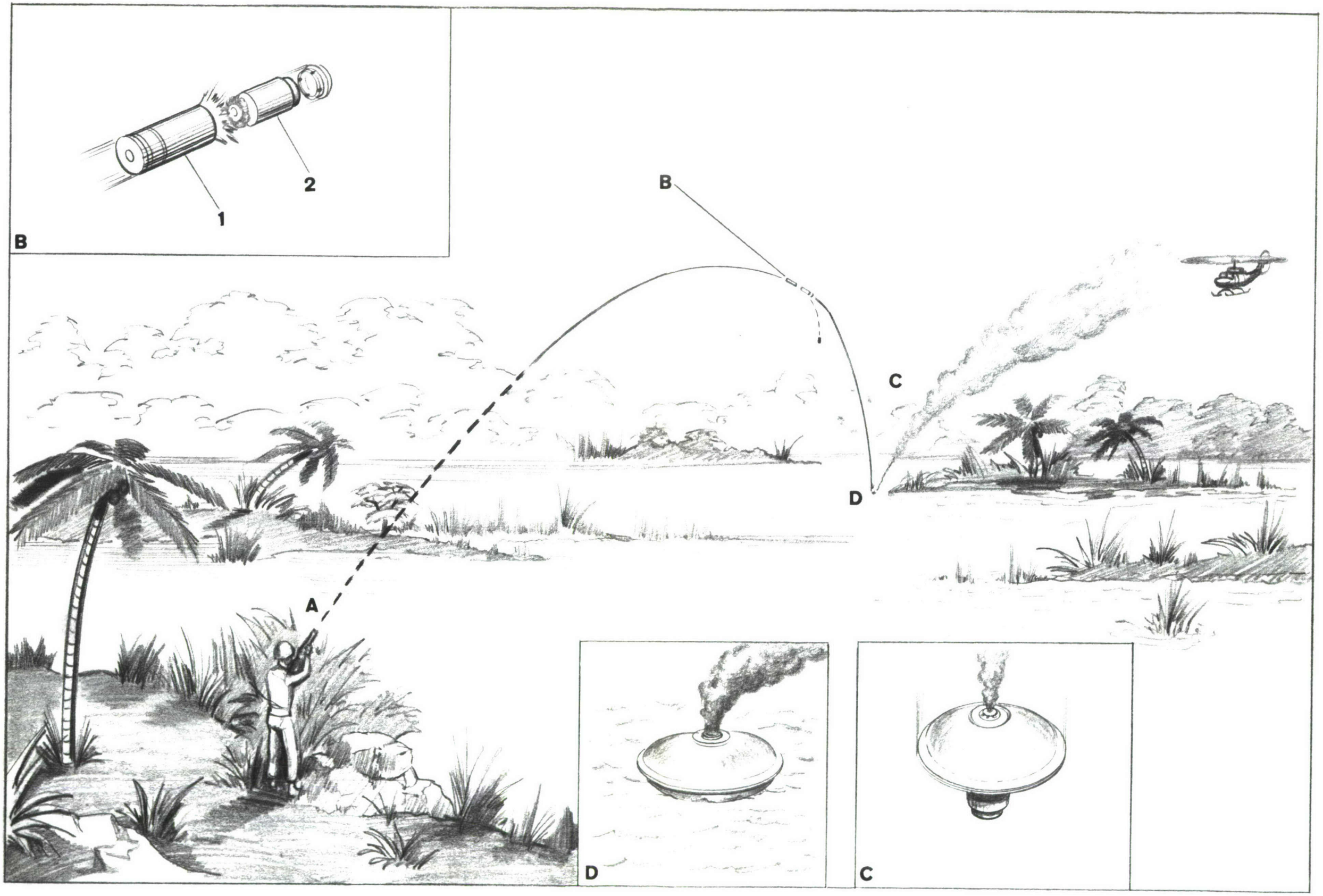

Figure 3. 40MM Target Marker (Floating) Firing Sequence

DISTRIBUTION LIST

	Copies
Director Advanced Research Projects Agency Office Director of Defense Research & Engineering ATTN: Assistant Director, Remote Area Conflict Washington, D. C. 20310	3
Chief of Research and Development ATTN: CRDSTN Department of the Army Washington, D. C. 20310	4
Chief of Research and Development ATTN: Army Research Office Department of the Army Washington, D. C. 20310	1
Assistant Chief of Staff for Force Development ATTN: Director for Materiel Requirements Department of the Army Washington, D. C. 20310	1
Assistant Chief of Staff for Force Development ATTN: Liaison Officer, ACTIV Department of the Army Washington, D. C. 20310	2
Commanding General U. S. Army Materiel Command ATTN: Director of Research and Laboratories Washington, D. C. 20315	1
Commanding General U. S. Army Materiel Command ATTN: Director of Developments Washington, D. C. 20315	3
Commanding General U. S. Army Materiel Command ATTN: AMCRD-PT Washington, D. C. 20315	1
U. S. Army Combat Developments Command Liaison Officer Aberdeen Proving Ground, Maryland 21005	1

	Copies
Commanding General U. S. Army Combat Developments Command Combat Support Group Fort Belvoir, Virginia 22060	1
Commanding General U. S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	1
Commanding Officer U. S. Army Combat Developments Command Institute of Strategic and Stability Operations Fort Bragg, North Carolina 28307	1
Commanding General U. S. Army John F. Kennedy Center for Special Warfare Fort Bragg, North Carolina 28307	1
Commanding Officer U. S. Army Concept Team in Vietnam APO San Francisco 96384	2
Senior Representative U. S. Army Standardization Group, Australia c/o American Embassy Canberra, A.C.T., Australia	1
Director Air University Library ATTN: AUL3t-64-572 Maxwell Air Force Base, Alabama 36112	1
Director OSD/ARPA Research & Development Field Unit APO San Francisco 96243	1
Director OSD/ARPA Research & Development Center APO San Francisco 96346	1
Director of Defense Research & Engineering ATTN: Deputy Director for SEA Matters Department of Defense Washington, D. C. 20310	1

	Copies
Battelle Memorial Institute Remote Area Conflict Information Center Columbus Laboratories 505 King Avenue Columbus, Ohio 43201	1
Defense Documentation Center (ASTIA) Cameron Station Alexandria, Virginia 22314	12
Commanding Officer U. S. Army Land Warfare Laboratory ATTN: Technical Library Aberdeen Proving Ground, Maryland 21005	4
Commanding Officer U. S. Army Edgewood Arsenal ATTN: SMUEA-TSTI-L Edgewood Arsenal, Maryland 21010	1
USALWL Liaison Officer U. S. Army Concept Team in Vietnam APO San Francisco 96384	1
Assistant Chief of Staff for Intelligence ATTN: ACSI-DDG Department of the Army Washington, D. C. 20310	1
U. S. Marine Corp Liaison Officer Aberdeen Proving Ground, Maryland 21005	1
Deputy Chief of Staff for Military Operations ATTN: War Plans Division Department of the Army Washington, D. C. 20310	1
Deputy Chief of Staff for Military Operations ATTN: Special Operations Division Department of the Army Washington, D. C. 20310	1

E-R-R-A-T-A

Delete from Section 2. "Description of Candidate Designs" the whole first sentence.