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Engineering Evaluation Test of the BLU-40/B Bomb (U)

by

Charles Y. Serikawa, Capt, USAF

JUNE 1968

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DIRECTORATE OF TEST

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SECRET

ENGINEERING EVALUATION TEST OF THE BLU-40/B BOMB (U)

by

Charles Y. Serikawa, Capt, USAF

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FOREWORD

(U) This report contains results of testing conducted by the APGC under Project 2519W2, Engineering Evaluation of the BLU-40/B, in response to Project 2519, dated February 1966, Improved Antimaterial Bomb, and to AFATL letter, dated 20 May 1966, Engineering Evaluation Test Request for the BLU-24/B Bomb with Random Long Delay Fuze, Sea Broom. Active testing was started on 4 October 1966 and completed on 20 March 1968.

(U) This report is classified SECRET because it reveals the maximum and minimum delay intervals of the BLU-40/B bomb. This report contains no classified information extracted from other documents.

(U) The following personnel were associated with the conduct of this test and/or the preparation of this report:

APGC

Project Engineer	Charles Y. Serikawa, Capt, USAF
Test Design Engineers	Earle O. Scott
	A. D. Brinson, Jr.
Mathematician	William T. Ming, Jr.

AFATL

Development Engineer	Omer R. Foley

(U) This technical report has been reviewed and is approved.

A. J. KINNEY, Major General, USAF
Commander

SECRET ABSTRACT

(S) This project was a combined contractor-support and engineering evaluation test of the delayed fuze BLU-40/B bomb. During the contractor-support phase, it was determined that the spin rate of the standard BLU-24/B bomb vane was too fast for the BLU-40/B fuze to operate reliably, i.e., the vanes caused the bombs to reach excess rpm rates resulting in unreliable fuze performance. The BLU-24/B bomb vanes were modified in preparation for the engineering phase of this test. Based on the results of testing the BLU-40/B bomb with modified vanes, 86% functional reliability at 90% confidence level was obtained for bombs released from 500 feet AGL at 500 KTAS. A functional reliability, 85% at 90% confidence level, was obtained for bombs released from 500 feet AGL at 175 KTAS. The BLU-40/B bombs impact at angles ranging from 27.3° to 31.7° from the horizontal, at velocities ranging from 279 to 304 feet per second when they are released from 509 feet AGL at 525 KTAS. Impact angles and velocities were not obtained for BLU-40/B bombs released from 500 feet AGL at 175 KTAS. The fuze was designed to have a delay ranging from 5 minutes to 14 hours. A maximum delay of 21 hours, 53 minutes and a minimum delay of less than 1 minute was recorded for the BLU-40/B bombs. During the period from 1 minute to 14 hours, 12 minutes after impact, the BLU-40/B bombs detonated at a relatively uniform rate. The largest departure from the design function time was 7 hours 53 minutes (14-hour design versus 21-hour, 53-minute function).

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SECTION I

INTRODUCTION

(U) In 1962, a requirement (OSR 237-2) was levied on the Air Force Armament Laboratory (AFATL) to develop a dispenser type of bomb incorporating a random delay fuze. In response to the requirement, AFATL asked the U.S. Army (Picatinny Arsenal) to modify the BLU-3/B bomb. However, the modified fuze was found to be unsafe for handling. Therefore in 1966, AFATL requested Picatinny Arsenal to develop a random delay fuze for the BLU-24/B bomb. Picatinny Arsenal let a contract to Minneapolis Honeywell, Inc., to design and develop a delay fuze that would take the place of the standard BLU-24/B fuze. The BLU-24/B bomb with this random long delay fuze has been designated the BLU-40/B bomb.

(U) During the period from October 1966 through August 1967, the Air Force in cooperation with Minneapolis Honeywell, Inc., conducted a contractor-support test of the proposed random long delay fuze. The engineering-evaluation phase began in August 1967 and ended on 20 March 1968. The specific objectives of the engineering-evaluation phase were to determine:

1. (U) The reliability of the BLU-40/B bomb when delivered from the SUU-7B/A bomb dispenser at 500 KTAS and from the SUU-14A/A dispenser at 175 KTAS, both from 500 feet AGL.

2. (U) The delay interval from impact to bomb function.

3. (U) The bomb impact angle and velocity.

SECTION II

DESCRIPTION

SUU-7B/A BOMB DISPENSER

(U) The SUU-7B/A bomb dispenser (Figure 1) consists of a strongback, five bulkheads, and a thin aluminum skin with a nose and a tail cone. The nose of the dispenser is ogive and the dispenser has an opening with a 4.5-inch diameter in the center of the nose cone. The space inside the nose fairing provides a plenum chamber maintained under pressure by motion of the aircraft. The bomb-carrying portion of the dispenser consists of 19 thin-wall anodized aluminum tubes with their forward ends fixed on the forward bulkhead. The tubes vary in length. They are cut at angles to fit the surface of the tail cone.

(U) The SUU-7B/A dispenser has 19 orifices in the forward bulkhead; they admit ram air needed to eject the bombs from the tubes. The components for loading a tube of bombs are: (1) the helical compression spring, (2) an ejection piston assembly, (3) the adapter, (4) the BLU-40/B bombs, (5) the retaining plug, and (6) an explosive detent assembly. The spring is placed in the tube followed by the ejection piston assembly, the adapter, the bombs, the retaining plug, and the explosive detent assembly. A slot in the side wall of the retaining plug accommodates the explosive detent assembly, which prevents ejection of bombs until the electrical circuit of the dispenser is energized.

(U) The release system consists of a receptacle for connections to the aircraft electrical system, a wiring circuit, a stepper switch assembly, and the explosive detent assemblies. Electrical power is supplied to the dispenser when the pilot depresses the bomb release button. When the detent is ignited, and the retaining plug is removed, the bombs are moved into the airstream under the combined force of the compression spring and ram air pressure. The SUU-7B/A dispenser is designed to provide the options of two, four, or six tubes of bombs released with each application of current.

BLU-40/B FRAGMENTATION BOMB

(U) The BLU-40/B fragmentation bomb (Figure 2) is an area denial munition consisting of a spherical fragmenting case (nodular iron), a plastic impeller type vane, and a random long delay fuze. The bomb weighs 1.6 pounds, and is 3.7 inches high and 2.75 inches in diameter.

(U) The delay fuze is composed of three parts: (1) the standard M-219 spin armed, impact detonating fuze, (2) the delay element, and (3) the rotor half of a M-218 fuze that contains the detonator (Figure 3). The delay element consists of stored CO_2 gas under pressure, a restrictor which passes the CO_2 at a fixed rate, and a snap diaphram with the attached firing pin.

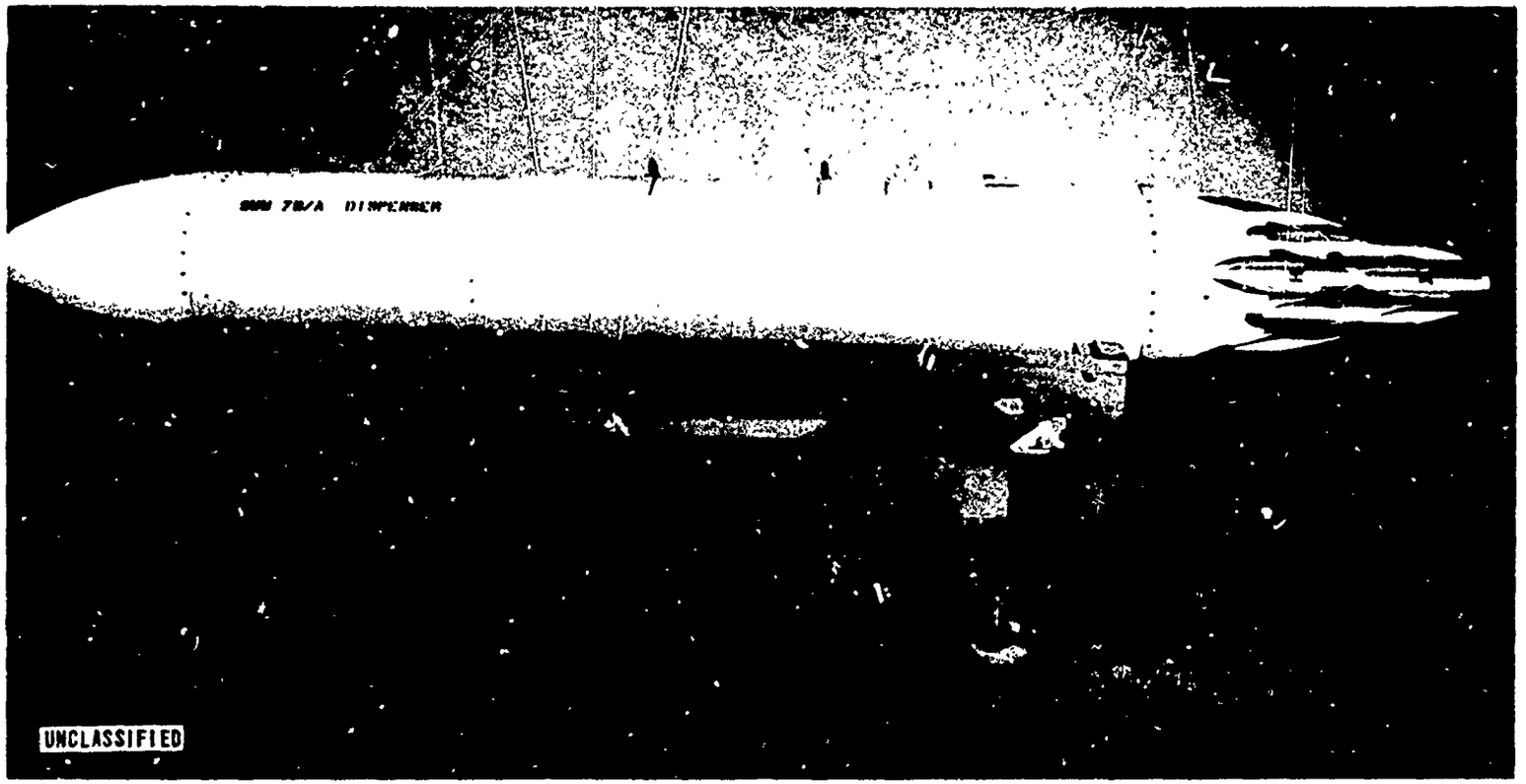
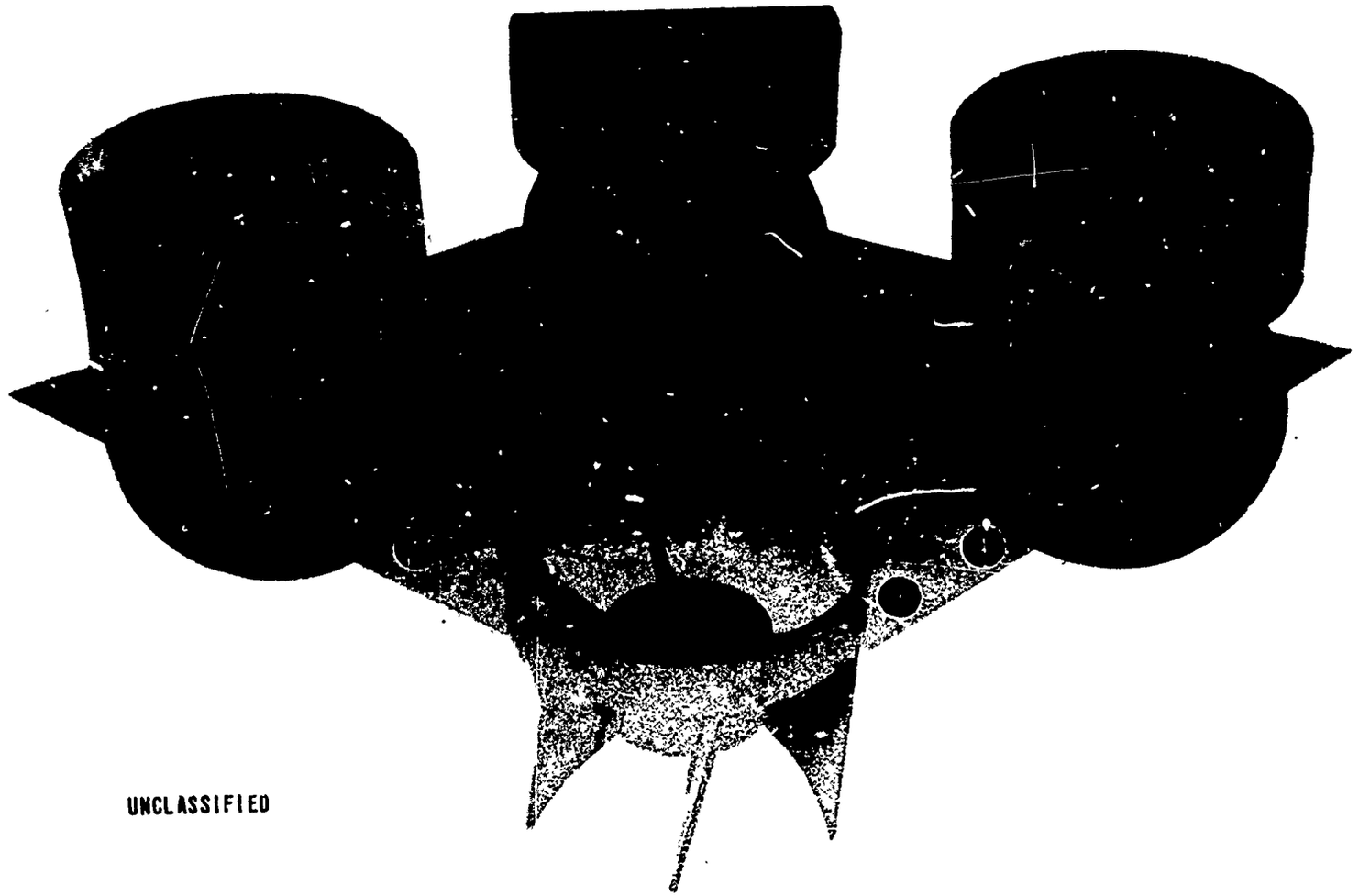


Figure 1. SUU-7B/A Dispenser.



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Figure 2. Vane Configurations, BLU-40/B Bombs: (1) Standard Configuration, (2) Modified BLU-24/B Bomb Vane, (3) Picatinny Arsenal Design, and (4) the Final Design.

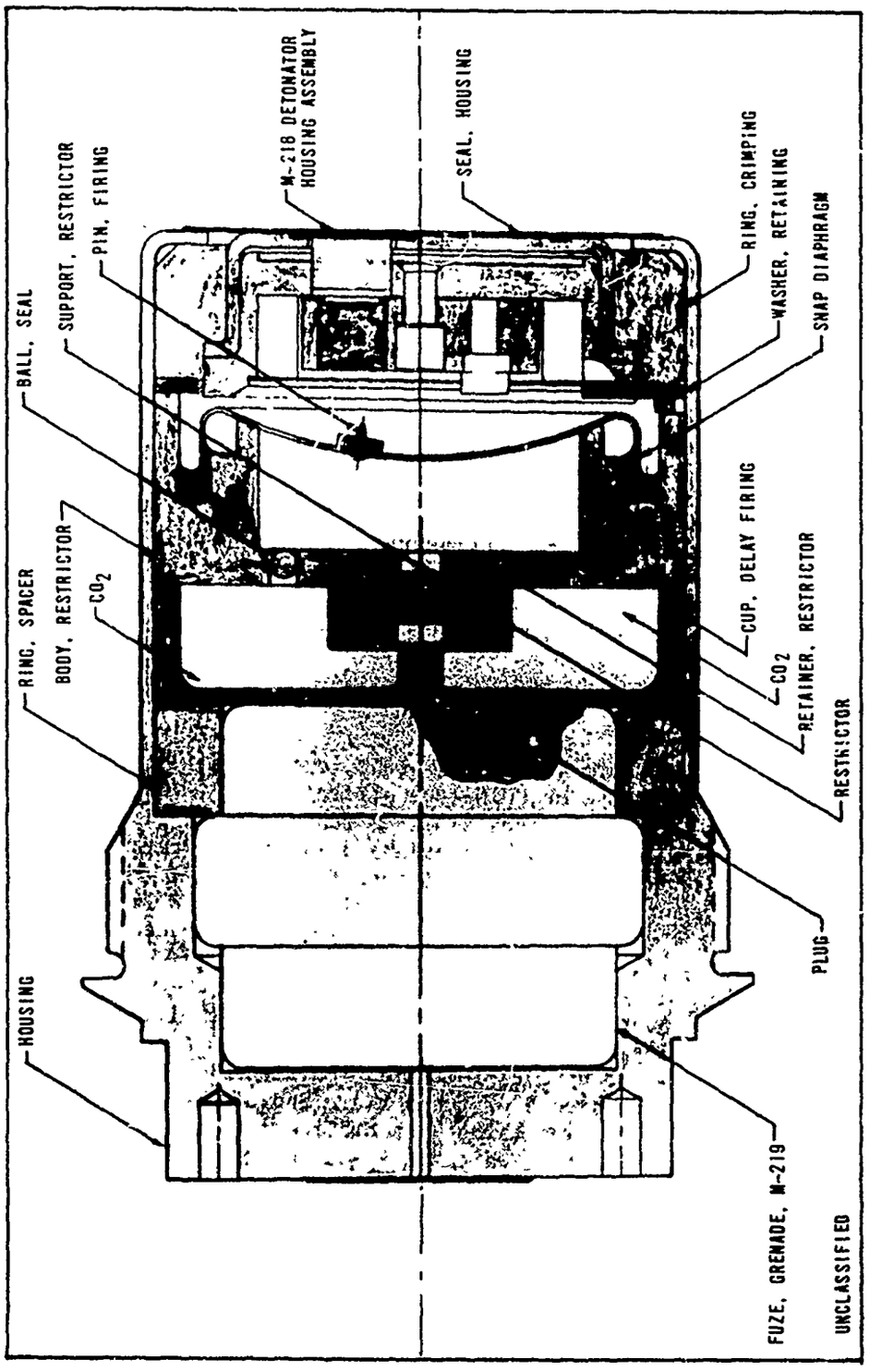


Figure 3. Component Parts of the BLU-40/B Fuze.

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(U) When the bomb is ejected, the airstream acting on the vane assembly causes the bomb to spin. As the rate of spin increases, centrifugal force arms the M-219 fuze and aligns the rotor in the rotor half of the M-218 fuze. Upon impact, the basic M-219 portion of the fuze functions rupturing the restrictor. The restrictor then allows the CO_2 to bleed under pressure into an adjacent chamber containing the snap diaphram. When pressure builds up on the convex surface of the diaphram sufficiently (70 psi), the diaphram snaps, driving the firing pin into an M-55 detonator located in the rotor of the M-218 portion of the fuze, which in turn starts the explosive train that detonates the bomb. The delay is controlled by varying the thicknesses and the diameters of the restrictors and the pressures of the stored CO_2 gas.

(S) Nine combinations of the variables were used to achieve a continuous bomb functioning over a 14-hour period.

(U) For this test, live detonator fuzes with inert-filled bombs were used for the contractor-support phase. Live detonator fuzes with smoke-generating propellant-filled bombs and live detonator fuzes with inert-filled bombs were used for the engineering-evaluation phase. For the remainder of this report, live detonator fuzes with inert-filled bombs are called live det bombs, and live detonator fuzes with smoke-generating propellant-filled bombs are called smoke bombs.

SUU-14A/A BOMB DISPENSER

(U) The SUU-14A/A (Figure 4) is a six-tube, electrically actuated bomb dispenser designed for use on COIN-type aircraft. It is triangular in cross section formed of six 73-inch aluminum tubes. These thin-walled tubes are joined at the forward end by a bulkhead which also furnishes attachment points and support for the blunt nose fairings. The tubes are bound together at the center of gravity with a 21-inch long, 3/16-inch thick strongback. The strongback contains suspension lugs spaced 14 inches apart.

(U) A loaded tube contains a piston and a spring assembly, 22 BLU-40/B bombs, and an end plug which is secured to the tube by three rivets. Bomb ejection is accomplished by the electrical ignition of a gas generating cartridge located in a breech of the forward end of each tube. After ignition, the gas is metered through an orifice into the tube building up pressure on the piston, which relays a shearing force to the rivets via the string of bombs. As soon as the rivets are sheared, the bombs are dispensed.

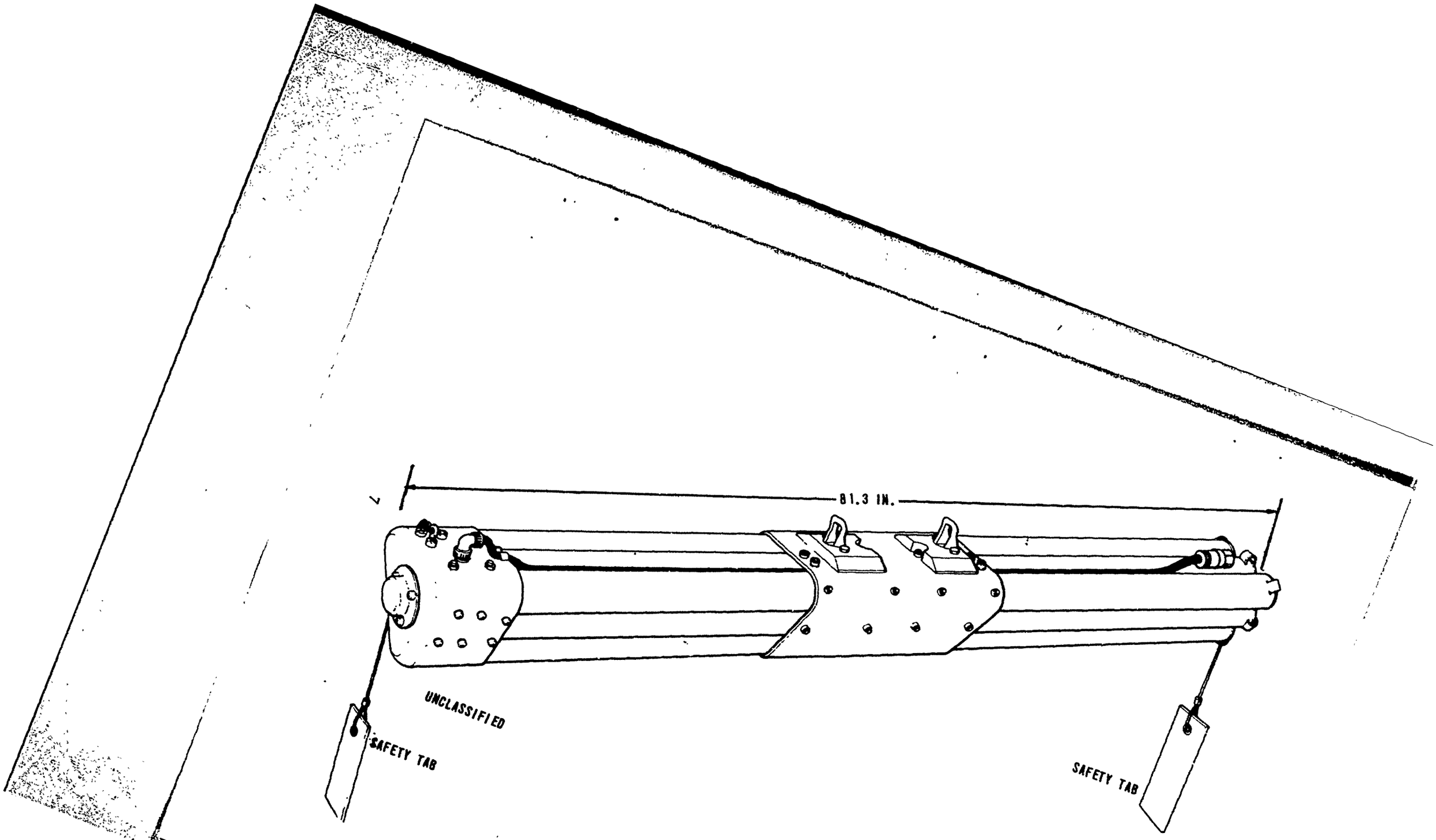


Figure 4. SUU-14A/A Bomb Dispenser.

SECTION III

INSTRUMENTATION

(U) Four Contraves cinetheodolites were used to determine the time-space-position information of the aircraft at release, i.e., the altitude and the airspeed of the aircraft from 5 seconds before release to 5 seconds after release. These cameras operated at 30 frames per second.

(U) Release and fallaway information were obtained from Mitchell 35mm ground tracking cameras operating at 90 frames per second.

(U) The striking angle and the velocity of the bomb were determined using 10 CZR ballistics cameras operating at 90 frames per second.

(U) Data gathered were accurate within the following limits:

1. TSPI, Contraves cinetheodolites, ±5 feet altitude and ±12 feet per second airspeed.

2. Impact data, CZR cameras, ±5 feet per second velocity and ±2° angle.

SECTION IV

TEST PROCEDURES, RESULTS, AND DISCUSSION

CONTRACTOR-SUPPORT PHASE

(U) During this phase, five missions were conducted, and 528 BLU-40/B live det bombs were tested. These bombs were released from 500 feet AGL at 175 to 500 KTAS. After each mission the inert-filled bombs were taken to the Eglin AFB Fuze Test Facility for analysis by the contractor. The contractor monitored the functioning of the bombs and recorded the lapsed time required for each bomb to function. On all five missions, vane configurations 1 and 2 (Figure 2) were tested. During high speed missions (400-500 KTAS), the bombs with configuration 1 had a higher dud rate than those with configuration 2. Low speed (175 KTAS) deliveries did not affect the function rate of bombs with configuration 1. It was determined that the spin rate of the standard BLU-24/B vane (configuration 1) was too fast at high speed delivery conditions. It was estimated that the BLU-40/B bomb with vane configuration 1, released at 500 KTAS, was spinning at rates ranging up to 15,000 rpm. These extremely high rates caused the M-219 fuze to jam in an out-of-line position and dud. As a result of findings from the contractor-support phase of this test, two additional vane configurations (Figure 2) were designed for testing in the engineering-evaluation phase of the test. Configuration 1 was used for slow speed delivery only. Configurations 2, 3, and 4 were used for high speed delivery. These vanes were designed to moderate the rpm of the bomb when it is released at higher airspeeds. Configurations 3 and 4 were introduced in the latter portion of the test, and only 250 bombs with configuration 3 and 105 bombs with configuration 4 were tested.

ENGINEERING EVALUATION PHASE

(U) Seven missions were conducted during the engineering evaluation phase of the test. A total of 1,442 BLU-40/B smoke bombs were released on missions 1 through 6. One-hundred and five BLU-40/B live det bombs were released on Mission 7. All bombs contained fuzes with either the short, medium, or long delay elements. After release, the function times of the bombs were monitored and recorded by test personnel. The delay times for each bomb that functioned are listed by mission number in the Appendix tables. A summary of the flight testing conducted during this phase is contained in Table I. Each mission is further summarized as follows:

(S) MISSION 1. Two hundred and seventy-three BLU-40/B smoke bombs with short delay fuzes were dropped on APGC Test Area 71. The bombs were dispensed from a SUU-7B/A bomb dispenser at 510 KTAS and 530 feet AGL. These bombs had configuration 2 (Figure 2) and were programmed to begin to detonate 5 minutes after impact and finish detonating 165 minutes after impact.

TABLE I. SUMMARY OF FLIGHT TESTS OF BLU-40/B BOMB, ENGINEERING-EVALUATION PHASE.

Mission No.	No. and Type Bomb	Vane Configuration*	Dispenser	Aircraft	Release Mode	Altitude (ft AGL)	Airspeed (KTAS)	No. of Duds	Function Rate (%)
1	273 smoke	2	SUU-7B/A	F-100D	Ripple	530	570	42	84.6
2	272 smoke	2	SUU-7B/A	F-100D	Ripple	535	466	33	87.9
3	294 smoke	2	SUU-7B/A	F-100D	Ripple	525	509	34	88.4
4	110 smoke	1	SUU-14A/A	A-1E	Ripple	540	177	12	89.1
5	132 smoke	2	SUU-14A/A	A-1E	Ripple	460	175	19	85.6
6	250 smoke 111 smoke	3 2	SUU-7B/A	F-105D	Ripple	580	510	34 19	86.0 82.9
7	105 live det	4	SUU-7B/A	F-105F	Ripple	510	520	9	91.4

*See Figure 2.

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Table I-1 of the Appendix shows that 10 bombs detonated in less than 2 minutes after impact, and one bomb detonated 247 minutes after impact. However, all of the bombs with the exception of the last one detonated within a period of 156 minutes after impact. Of the 273 bombs dropped, 42 were duds, an 85% function rate.

(S) MISSION 2. A total of 272 BLU-40/B smoke bombs with medium delay elements were released from a SUU-7B/A bomb dispenser at 535 KTAS and 446 feet AGL. These bombs also had configuration 2 (Figure 2) and were programmed to start detonating 2 hours after impact and finish detonating 8 hours after impact. Table I-2 of the Appendix lists the functioning times of the bombs. The 230 bombs detonated during a period beginning 1 hour, 44 minutes and ending 5 hours, 4 minutes after impact. Of the 272 bombs dropped, 33 were duds, an 88% function rate.

(S) MISSION 3. Mission 3 was conducted on 13 September 1967. Two hundred and ninety-four BLU-40/B smoke bombs with long delay fuzes were dropped. They were released at 525 KTAS and 509 feet AGL. The bombs were programmed to start detonating 4 hours after impact and to finish 14 hours after impact. These bombs had vane configuration 2. Table I-3 lists the detonating times of the bombs. Of the 294 bombs dropped, 34 were duds, an 88.4% function rate.

(S) MISSION 4. Mission 4 was conducted on 29 January 1968. One hundred and ten BLU-40/B smoke bombs with vane configuration 1 were released from a SUU-14A/A dispenser at 177 KTAS and 540 feet AGL. The A-1E aircraft was used for the delivery. The smoke bombs contained short delay fuzes. The minimum delay was 5 minutes and the maximum was 165 minutes. Table I-4 lists the function times of the bombs and notes that four bombs detonated on impact, that the last bomb detonated 6 hours, 4 minutes after impact. However the majority detonated within the programmed time. Of the 110 bombs dropped, 12 were duds, an 89.1% function rate.

(S) MISSION 5. A total of 132 smoke bombs were released from a SUU-14A/A dispenser at 175 KTAS and 460 feet AGL. The items dropped on this mission had the long delay fuzes and vane configuration 2. The function times were recorded and are listed in Table I-5. Note again that the majority of the items detonated within the programmed time period of 6 to 14 hours after impact. Of the 132 bombs dropped, 19 were duds, an 85.6% function rate.

(S) MISSION 6. On this mission, 361 BLU-40/B smoke bombs were released from a SUU-7B/A dispenser at 510 KTAS and 580 feet AGL. Of the 361 bombs, 250 had configuration 3 and the remaining 111 had configuration 2. These bombs were programmed to start functioning 1 hour after impact and stop 14 hours after impact. Table I-6 of the Appendix lists the function times of the bombs. Of the 250 bombs with vane configuration 3, 34 were duds, an 86.0% function rate, and of the 111 bombs with vane configuration 2, 19 were duds, an 82.9% function rate. Therefore, individual function rates of 86.0% and 82.9%, respectively, were obtained for the two vane configurations, and the function rate of 85.3% was obtained for the combined lot.

(S) MISSION 7. The final mission was conducted on 20 March 1968. On this mission, 105 BLU-40/B live det bombs with vane configuration 4 were released from a SUU-7B/A dispenser at 520 KTAS and 510 feet AGL. These bombs had the short to medium delay elements, i.e., the bombs were programmed to detonate from 5 minutes to 14 hours after impact. A total of nine bombs were duds. Note in Table I-7 of the Appendix, that only 82 function times were recorded. These items were not smoke bombs but live det bombs; therefore, the functions could not be visually recorded. Observers had to detect the detonations by listening. Twenty-three functions were not detected. These are thought to have occurred in transit to the main base where the bombs were placed in a closed room so that observers could hear the detonations. Visual inspections of the 105 items dropped disclosed 9 duds, a 91.4% function rate.

IMPACT ANGLES AND VELOCITIES

(U) On Mission 3, CZR ballistics cameras were used to obtain the impact angles and velocities of the BLU-40/B bombs. On this mission, the bombs were released from 509 feet AGL at 525 KTAS. The impact angles ranged from 27.3° to 31.7° with the horizontal, and the impact velocities. ranged from 279 feet to 304 feet per second. This was the only mission on which CZR cameras were used.

CAUSES OF DUDS

(U) On Missions 3 and 6, the dud BLU-40/B fuzes were removed from the BLU-40/B smoke bomb body by the Eglin EOD personnel and transported to the Eglin Fuze Test Facility for X-raying. The X-ray data showed that the duds resulted from failure of the diaphrams either to invert or to invert uniformly. The consequent misalignment of the firing pin did not allow it to strike the detonator. Another reason for duds found by X-raying was the failure of the top M-219 fuze to arm and/or fire initiating the delay sequence. A third type of dud was caused by the failure of the rotor half of the M-218 fuze to arm. In the 70 X-rays taken, 46 duds were found to be due to the failure of the basic M-219 portion of the fuze to arm and fire, 28 to the diaphram not inverting or inverting improperly, and 6 to the rotor half of the M-218 fuze not arming.

SECTION V

SUMMARY OF FINDINGS

1. (C) The BLU-40/B bomb with vane configuration 1 demonstrated a function rate of 89.1% (12 were duds out of a total of 110).

2. (C) The BLU-40/B bomb with vane configuration 2 demonstrated a function rate of 86.5% (147 were duds out of a total of 1,082).

3. (C) The BLU-40/B bomb with vane configuration 3 demonstrated a function rate of 86.0% (34 were duds out of a total of 250).

4. (C) The BLU-40/B bomb with vane configuration 4 demonstrated a function rate of 91.5% (9 were duds out of a total of 105).

5. (C) There is no significant difference at the .25 significance level in the functioning rates experienced in high speed delivery and low speed delivery of the BLU-40/B bombs with vane configuration 2.

6. (C) There is no significant difference at the .25 significance level in the functioning rates experienced in high speed delivery between the BLU-40/B bomb with vane configuration 1 and with vane configuration 2.

7. (C) There is no significant difference at the .25 significance level in the functioning rates experienced in low speed delivery between the BLU-40/B bomb with vane configuration 1 and with vane configuration 2.

8. (C) At the .25 significance level, the BLU-40/B bomb with vane configuration 4 (Figure 2) has a functioning rate higher than the BLU-40/B bomb with vane configurations 2 and 3 when delivered at high speed.

9. (S) A maximum delay of 21 hours, 53 minutes and a minimum delay of less than 1 minute were recorded for the BLU-40/B bombs.

10. (S) During the period from 1 minute after impact to 14 hours, 12 minutes after impact, the BLU-40/B bombs detonated at a relatively uniform rate.

11. (S) The largest departure from the design function time was 7 hours, 53 minutes (14-hour design, maximum time, versus 21-hour, 53-minute actual function time).

12. (U) When BLU-40/B bombs were released at 525 KTAS and 509 feet AGL, they impacted at angles ranging from 27.3° to 31.7° from the horizontal and at velocities ranging from 279 to 304 feet per second.

SECTION VI

CONCLUSIONS

1. (C) The BLU-40/B bomb with vane configurations 2, 3, and 4 has an overall functional reliability of 85.6% at a 90% confidence level when it is released at 500 KTAS and 500 feet AGL.

2. (C) The BLU-40/B bomb with vane configurations 1 and 2 has an overall bomb functional reliability of 84% at a 90% confidence level when it is released at 175 KTAS and 500 feet AGL.

3. (S) The delay interval from impact to function of the BLU-40/B bomb will range from 1 minute to 21 hours and 53 minutes with detonations at a relatively uniform rate during the period 1 minute after release to 14 hours, 12 minutes after release.

4. (C) When BLU-40/B bombs are released at 525 KTAS and 509 feet AGL, the impact angles will range from 27.3^{o} to 31.7^{o} from the horizontal and velocities will range from 279 to 304 feet per second.

APPENDIX

BLU-40/B DELAYED FUNCTION TIMES

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TABLE I-1. BLU-40/B DELAYED FUNCTION TIMES, MISSION 1 (DESIGN DELAY INTERVAL 5-165 MIN).

Delay (min)	No. of Items	Delay (min)	No. of Items	Delay (min)	No. of Items	Delay (min)	No. of Items
2	10	47	2	73	1	104.5	1
3	1	48	1	73.5	1	105	2
4	1	49	1	74	1	105.5	1
4.5	1	49.5	2	74.5	1	106	1
7	1	50.5	1	76	1	107	1
7.5	1	51	2	77	1	108	2
8	2	51.5	1	78	1	108.5	1
9	1	52	1	80.5	1	109	1
10	1	52.5	1	81	1	110	2
11	2	53.5	1	82	1	110.5	1
11.5	2	54.5	1	82.5	2	112	1
13.5	2	55.5	1	83	2	112.5	4
14	2	56	2	83.5	1	114	2
14.5	3	56.5	1	84	2	114.5	3
15	1	57	2	85	1	115.5	1
15.5	3	57.5	1	85.5	2	116	1
18	1	58	2	86.5	2	117	1
22	1	59	3	87	2	118	2
23.5	1	60.5	1	88.5	2	118.5	2
24	1	61	1	89	2	120	1
24.5	1	61.5	1	90.5	2	122	1
26.5	1	62	3	91	2	123	2
29.5	2	62.5	1	92	1	124	2
30	1	63	4	92.5	1	124.5	3
30.5	1	64	2	93	1	125.5	3
32	1	64.5	1	93.5	2	129	3
32.5	2	65	1	94	3	129.5	2
35	1	65.5	4	96	1	131	1
38	1	66.5	1	97	1	132	1
39.5	2	67	2	97.5	1	133	3
41	1	67.5	1	98	1	134	1
42.5	1	68	1	99	3	145	1
45	2	69	1	100	1	147.5	1
45.5	1	69.5	2	100.5	1	150	2
46.5	2	72	1	102	2	156	1
SECRET						247	1

TABLE I-2. BLU-40/B DELAYED FUNCTION TIMES, MISSION 2 (DESIGN DELAY INTERVAL 2-8 HR).

Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items
Impact	2	2:30	1	3:00	1	3:27.5	2	4:05	1
:17	2	2:31.5	2	3:00.5	1	3:28	1	4:06	1
:46	1	2:32.5	2	3:01	1	3:28.5	3	4:07	1
1:44	1	2:33	1	3:01.5	4	3:29	1	4:08	1
1:47	1	2:33.5	2	3:02	1	3:29.5	2	4:08.5	1
1:50	1	2:34	1	3:02.5	3	3:30	1	4:11	1
1:51	1	2:34.5	1	3:03	1	3:31	1	4:12	1
1:58	1	2:37	1	3:03.5	2	3:32	1	4:13	1
2:00	1	2:37.5	1	3:06	2	3:32.5	2	4:14	1
2:01	2	2:38.5	1	3:06.5	1	3:33.5	1	4:19	1
2:02	1	2:40	1	3:07	1	3:36	1	4:22	1
2:02.5	1	2:40.5	2	3:08	2	3:36.5	1	4:27	1
2:03	1	2:41	1	3:09	1	3:37	1	4:32	1
2:03.5	2	2:41.5	1	3:09.5	1	3:38	1	4:35	1
2:06	1	2:42	2	3:10	2	3:38.5	1	4:48	1
2:06.5	1	2:42.5	2	3:10.5	2	3:40	1	4:48.5	1
2:07	1	2:44	1	3:11	1	3:41	1	4:50	1
2:09	2	2:45	1	3:12	1	3:42	1	4:54	1
2:10	3	2:46	1	3:13	2	3:42.5	3	5:03	1
2:11	1	2:47	1	3:13.5	2	3:43	1	5:04	1
2:11.5	1	2:47.5	1	3:14	1	3:44	1	6:52	1
2:12	1	2:48	1	3:14.5	2	3:45	1	7:04	1
2:12.5	1	2:48.5	1	3:15	1	3:46	1	8:04	1
2:13	1	2:49	1	3:16	1	3:46.5	2	8:52	1
2:14	1	2:50	1	3:17	1	3:47	2		
2:14.5	1	2:50.5	1	3:18	1	3:47.5	2		
2:16	2	2:51	2	3:19	2	3:48.5	1		
2:17	1	2:51.5	1	3:19.5	2	3:50	1		
2:18	2	2:52	2	3:20	1	3:51.5	1		
2:18.5	1	2:53	1	3:21	1	3:54	1		
2:19	1	2:54	2	3:21.5	1	3:55	1		
2:20	1	2:54.5	1	3:22	2	3:55.5	1		
2:21	1	2:55	1	3:23	3	3:56.5	1		
2:22	2	2:55.5	1	3:23.5	1	3:58	1		
2:24	1	2:56	2	3:24	2	3:59	1		
2:24.5	2	2:57	1	3:24.5	2	4:00	1		
2:25	2	2:57.5	3	3:25	1	4:00.5	1		
2:25.5	2	2:58	1	3:25.5	1	4:01	1		
2:27	1	2:59	1	3:26	1	4:01.5	1		
2:29	1	2:59.5	1	3:27	1	4:02	1		

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TABLE I-3. BLU-40/B DELAYED FUNCTION TIMES, MISSION 3 (DESIGN DELAY INTERVAL 4-14 HR).

Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items
4:05	1	5:32	1	6:39	2	7:38	1	8:55	2	11:38	1
4:25	1	5:34	1	6:40	1	7:39	1	8:56	1	11:51	1
4:26	1	5:35	1	6:43	1	7:40	1	8:56.5	1	12:00	1
4:33	1	5:37	1	6:45	1	7:41	1	8:57	1	12:09	1
4:39	1	5:38	2	6:46	1	7:45	2	8:59.5	1	12:22	1
4:43	2	5:39	2	6:48	1	7:46	1	9:02	1	12:36	1
4:46	1	5:40	3	6:50	2	7:48	1	9:04.5	1	12:39	1
4:50	1	5:43	1	6:52	1	7:49	3	9:05	1	12:41	1
4:51	1	5:45	1	6:55	1	7:50	2	9:07	1	12:46	1
4:52	1	5:46	1	6:56	2	7:51	1	9:10	1	13:11	1
4:56	1	5:50	1	6:57	1	7:54	1	9:12	1	13:24	1
4:57	1	5:52	2	6:59	2	7:56	1	9:14	1	13:25	1
4:58	2	5:53	2	7:02	2	8:00	1	9:16	1	13:42	1
4:59	2	5:55	2	7:03	2	8:03	2	9:20	1	13:46	1
5:00	2	5:58	2	7:04	2	8:05	1	9:27	1	13:48	1
5:01	1	5:59	2	7:05	2	8:09	1	9:28	1	13:48.5	1
5:02	1	6:02	1	7:06	2	8:11	1	9:35	1	14:07	1
5:03	2	6:03	1	7:08	1	8:14	2	9:39	1	14:38	1
5:05	2	6:04	1	7:09	2	8:15	1	9:40	1	15:07	1
5:06	1	6:10	1	7:10	4	8:15.5	2	9:42	1	15:13	1
5:07	1	6:11	1	7:11	1	8:20	1	9:58	1	15:30	1
5:08	1	6:12	1	7:12	2	8:23	2	10.09	1	15:45	1
5:09	2	6:14	2	7:13	1	8:24	1	10:15	1	16:45	1
5:10	1	6:18	1	7:17	1	8:25	1	10:17	1	17:10	1
5:12	1	6:19	1	7:18	2	8:29	1	10:18	1	17:15	1
5:16	1	6:22	2	7:20	1	8:30	1	10:40	1	17:41	1
5:17	1	6:23	2	7:21	1	8:34	1	10:49	1	18:15	1
5:22	2	6:28	1	7:24	2	8:37	1	11:05	1	18:35	1
5:23	1	6:30	1	7:26	1	8:38	1	11:12	1	19:25	1
5:25	2	6:31	1	7:29	1	8:42	1	11:14	1	20.15	1
5:26	2	6:32	1	7:30	2	8:43	1	11:23	1	21:53	1
5:27	1	6:35	2	7:32	1	8:45	1	11:26	1		
5:29	1	6:36	1	7:34	1	8:48	1	11:29	1		
5:30	2	6:37	2	7:35	1	8:52	1	11:35	1		
5:31	1	6:38	2	7:36	3	8:53	1	11:36	1		

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TABLE I-4. BLU-40/B DELAYED FUNCTION TIMES, MISSION 4
(DESIGN DELAY INTERVAL 5-165 MIN).

Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items
Impact	4	1:04	1	1:26	1	2:00	1
:03	2	1:05	1	1:28	1	2:02	2
:06	1	1:06	2	1:29	1	2:03	1
:14	1	1:07.5	1	1:32	1	2:03.5	1
:19	1	1:08	2	1:34	1	2:04	1
:24	1	1:08.5	1	1:37	1	2:12	1
:26	1	1:09	2	1:38	1	2:13	1
:33	1	1:09.5	1	1:39	2	2:14	1
:35	1	1:10	1	1:40	2	2:14.5	1
:39	1	1:11	2	1:42	1	2:17	1
:47	1	1:12	1	1:44	2	2:18	2
:48	1	1:14	1	1:45	1	2:29	1
:52	1	1:16	1	1:45.5	1	2.34	1
:53	2	1:17	1	1:46	1	2:39	1
:54	1	1:18	2	1:47	1	2:44	2
:55	2	1:19	1	1:50	1	6:04	1
:56	1	1:20	2	1:52	1		
:56.5	1	1:21	1	1:53	1		
1:02	2	1:23	2	1:56	1		
1:03	1	1:25	2	1:58	1		
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TABLE I-5. BLU-40/B DELAYED FUNCTION TIMES, MISSION 5 (DESIGN DELAY INTERVAL 6-14 HR).

Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items
2:55	1	6:45	2	9:10	2
3:43	1	6:46	1	9:15	1
5:00	1	6:48	2	9:24	1
5:40	1	6:50	1	9:35	2
5:45	1	6:51	1	10:05	1
5:49	1	6:55	4	10:07	1
5:51	1	7:02	1	10:08	1
5:53	1	7:05	1	10:14	1
5:54	2	7:10	1	10:35	2
5:55	1	7:13	2	10:40	1
5:56	1	7:15	1	10:47	1
5:57	2	7:23	1	10:50	2
6:00	3	7:30	2	11:10	1
6:04	2	7:36	1	11:12	1
6:05	2	7:37	1	11:45	1
6:07	1	7:41	2	11:49	1
6:08	2	7:51	1	13:10	2
6:09	1	8:00	1	13:25	1
6:11	1	8:02	2	13:27	1
6:14	2	8:10	1	13:50	1
6:15	1	8:17	1	13:55	1
6:16	2	8:18	3	14:00	1
6:20	1	8:24	1	14:12	1
6:21	2	8:38	1	14:27	1
6:25	1	8:50	2	14:45	1
6:28	1	8:55	1	16:06	1
6:29	1	8:58	1		
6:33	1	9:00	1		
6:34	1	9:01	1		
6:38	1	9:02	1		

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TABLE I-6. BLU-40/B DELAYED FUNCTION TIMES, MISSION 6
(DESIGN DELAY INTERVAL 1-14 HR).

Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items
Impact	1	3:24	1	4:03.5	1	6:50	1	8:51.5	1	11:11	1
1:16	1	3:24.5	1	4:04	1	7:07	1	8:52	1	11:17	1
1:55	1	3:25	1	4:05	1	7:09	2	8:58	1	11:19	1
2:02	1	3:26	2	4:07.5	1	7:17	2	9:02	1	11:26	1
2:02.5	1	3:26.5	1	4:08	1	7:19	1	9:03.5	1	11:42	1
2:03	1	3:27	1	4:09	1	7:19.5	2	9:04.5	1	11:42.5	1
2:03.5	1	3:28	1	4:10	1	7:20	1	9:05	1	11:44.5	1
2:04	1	3:29	1	4:12	1	7:23	1	9:05.5	1	11:46	1
2:04.5	1	3:31	1	4:15	1	7:25.5	1	9:06.5	1	11:46.5	1
2:05	1	3:32	1	4:16	2	7:27	1	9:12	2	11:50	1
2:07	1	3:35.5	1	4:21	2	7:28	1	9:27	1	11:51	1
2:08.5	1	3:36	1	4:22.5	1	7:28.5	1	9:32.5	1	11:52	1
2:09	1	3:36.5	1	4:23	1	7:29.5	1	9:34	1	11:53	1
2:10	1	3:37.5	1	4:32	1	7:30	1	9:35	1	12:03	1
2:17	1	3:38	1	4:33.5	1	7:31.5	1	9:35.5	1	12:11	1
2:18	1	3:39	1	4:35	1	7:33	1	9:38	1	12:24	1
2:18.5	1	3:39.5	2	4:37.5	1	7:34.5	1	9:40.5	1	12:36	1
2:20	1	3:40	2	4:57	1	7:35	1	9:44.5	2	12:49	2
2:20.5	2	3:40.5	1	4:58.5	1	7:36	1	9:45	2	12:55	2
2:21	2	3:41	1	5:13	1	7:36.5	1	9:48.5	1	13:08	1
2:22	1	3:41.5	1	5:14.5	1	7:38	1	9:49.5	1	13:23	1
2:36	1	3:42	1	5:15	1	7:47	1	9:50	1	13:23.5	1
2:37	1	3:42.5	1	5:15.5	1	7:49.5	1	9:57	1	13:24.5	1
2:37.5	2	3:43	1	5:50	1	7:53	1	9:57.5	1	13:29	1
2:38	4	3:44.5	2	6:00	2	7:54.5	1	10:00	4	13:45	1
2:38.5	1	3:45	3	6:00.5	1	7:56	1	10:15	1	14:07	1
2:39	2	3:45.5	1	6:02	1	7:57.5	1	10:15.5	1	14:29	2
2:50	1	3:46	2	6:07	1	7:58	1	10:17	1	16:02	1
2:52	2	3:46.5	1	6:08.5	2	7:59.5	1	10:18.5	1		
2:52.5	1	3:47	1	6:09	1	8:00	1	10:20	1		
2:56	2	3:48	2	6:09.5	2	8:01.5	1	10:27	1		
2:56.5	1	3:49	1	6:10.5	1	8:11	1	10:29.5	1		
2:58.5	1	3:50	2	6:11	2	8:11.5	1	10:30	1		
3:02	1	3:50.5	1	6:11.5	2	8:13.5	1	10:32.5	1		
3:04	1	3:51	2	6:12	2	8:17	1	10:36	1		
3:08	1	3:51.5	2	6:25	2	8:20	1	10:36.5	1		
3:08.5	1	3:52	1	6:27.5	1	8:25	3	10:37	1		
3:09	3	3:54.5	2	6:28	1	8:26.5	1	10:38	1		
3:12	1	3:55	1	6:29.5	1	8:27	1	10:38.5	1		
3:13	1	3:55.5	2	6:30.5	1	8:27.5	1	10:53	1		
3:15	1	3:57	1	6:33	2	8:29	1	11:01	1		
3:17.5	1	3:57.5	1	6:34.5	1	8:29.5	1	11:01.5	1		
3:19	1	3:58	2	6:35	2	8:34	1	11:08	1		
3:22	1	3:59.5	3	6:36.5	1	8:42	1	11:09.5	1		
3:23.5	1	4:00	2	6:39	1	8:48	1	11:10.5	1		

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TABLE I-7. BLU-40/B DELAYED FUNCTION TIMES, MISSION 7 (DESIGN DELAY INTERVAL 5 MIN TO 4 HR).

Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items	Delay (hr:min)	No. of Items
:15	4	:51	1	2:05	1
:16	1	:51.5	1	2:07	1
:17	2	:52	2	2:09	1
:18	1	:53.5	2	2:10	1
:20	2	:54	2	2:15	1
:23	3	:55	1	2:21	1
:23.5	1	:57	1	2:25	1
:24	1	:58	1	2:28	1
:25	1	:59	1	2:50	1
:26	1	1:00.5	2	2:53	1
:27	1	1:02	1	3:05	1
:28	1	1:05	1	3:17	1
:29	1	1:06	1	3:24	1
:29.5	1	1:08	1	3:30	1
:30	1	1:08.5	1	4:05	1
:31	1	1:09	1	4:35	1
:35	1	1:10	2	5:27	1
:35.5	1	1:18	1		
:36.5	1	1:18.5	1		
:40	1	1:26.5	1		
:43	1	1:27	1		
:46	2	1:27.5	1		
:47	1	1:28	2		
:47.5	1	1:40	1		
:48	1	1:55	1		
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

(S) This project was a combined contractor-support and engineering evaluation test of the delayed fuze BLU-40/B bomb. During the contractor-support phase, it was determined that the spin rate of the standard BLU-24/B bomb vane was too fast for the BLU-40/B fuze to operate reliably, i.e., the vanes caused the bombs to reach excess rpm rates resulting in unreliable fuze performance. The BLU-24/B bomb vanes were modified in preparation for the engineering phase of this test. Based on the results of testing the BLU-40/B bomb with modified vanes, 86% functional reliability at 90% confidence level, was obtained for bombs released from 500 feet AGL at 500 KTAS. A functional reliability, 85% at 90% confidence level, was obtained for bombs released from 500 feet AGL at 175 KTAS. The BLU-40/B bombs impact at angles ranging from 27.3° to 31.7° above the horizontal, at velocities ranging from 279 to 304 feet per second when they are released from 509 feet AGL at 525 KTAS. Impact angles and velocities were not obtained for BLU-40/B bombs released from 500 feet AGL at 175 KTAS. The fuze was designed to have a delay ranging from 5 minutes to 14 hours. A maximum delay of 21 hours, 53 minutes and a minimum delay of less than 1 minute was recorded for the BLU-40/B bombs. During the period from 1 minute to 14 hours, 12 minutes after impact, the BLU-40/B bombs detonated at a relatively uniform rate. The largest departure from the design function time was 7 hours 53 minutes (14-hour design versus 21-hour, 53-minute function).

DD FORM 1 NOV 65 1473

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Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Cluster bomb						
Delay element						
Area denial munition						
Impact fuze						
Time delay fuze						

UNCLASSIFIED

AD 391072

CLASSIFICATION CHANGED
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