

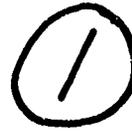
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BIRDS CARE CARTRIDGE QUALIFICATION TEST

JAMES R. WEISS

TECHNICAL REPORT-AD-TR-80-72

AUGUST 1980

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ARMAMENT DIVISION

AIR FORCE SYSTEMS COMMAND • UNITED STATES AIR FORCE

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20 ABSTRACT (Continue on reverse side if necessary and identify by block number) This report contains the results of testing conducted to determine physical and functional characteristics of five types of birdskare devices; three of 12-gauge shotgun shell size and two of 15-mm size. The 12-gauge size birdskare devices were tested in three types of launchers: a 12-gauge, single-barrel, break-open open bore shotgun; a 12-gauge, open bore, pump-action shotgun; and an M1 signal pistol with a metal barrel insert to reduce the inside diameter of the barrel from 47.5-mm to 12-gauge size. The two 15-mm type birdskare devices were tested using a 15-mm signal pistol (Concluded on reverse of this page)		

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furnished with the devices. Physical characteristic measurements were made of representative samples of each birdscare device and its internal components. All birdscare devices were compatible with their respective launchers. A functional performance evaluation consisting of muzzle velocity, chamber pressure, range, drift, and noise level was made of each birdscare device. Of 405 12-gauge birdscare devices tested, 24 were failures: 5 when the pyrotechnic projectile fuze either separated or broke apart on impact with the ground prior to pyrotechnic ignition because of a 0-degree launch angle; 6 when the pyrotechnic projectile fuze failed to ignite; 3 when the over-propellant was stuck in the barrel; 5 when the pyrotechnic projectile case ruptured on ground impact and burned instead of exploding; 1 when the pyrotechnic projectile exploded in the launcher barrel; 3 when the pyrotechnic projectile fuze burned but the projectile fill did not ignite; and 1 when the pyrotechnic projectile did not explode until 13 seconds after ignition of the fuze. Of 120 15-mm size birdscare devices, no failures were encountered. Simulated inbore explosions were made at three different positions in the 12-gauge barrels, and no barrel deformities were noted.

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PREFACE

This test was conducted in response to Air Force Engineering and Services Center (DEVN), Tyndall Air Force Base, Florida, letter, Pyrotechnic Evaluation Program Test Request, 19 September 1979. Testing was started on 1 April and was completed on 31 July 1980.

AD personnel responsible for testing and report preparation were:

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SECTION I
INTRODUCTION

This test was established to determine the performance characteristics of five different types of birdscare devices. Results of previous testing of a birdscare device are contained in H.P. White Laboratory, Incorporated, test report entitled Limited Interior Ballistic Evaluation of the Effects of 12-Gauge Crackershells on the Model 58 (Topper), Harrington Richardson Shot gun, May 1978, which was prepared for the United States Department of the Interior Fish and Wildlife Service.

The specific objectives of this test were:

1. Obtain representative physical characteristics of each manufacturer's scare cartridge and of each type of bird bomb, to include type of cartridge case, primer, propellant charge, fuzing mechanism, and projectile (pyrotechnic) weight and shape.
2. Evaluate the functional performance of each manufacturer's birdscare device, to include firing reliability, chamber pressure, velocity, range, drift, and noise level of the pyrotechnic components of the cartridges.
3. Evaluate the compatibility of scare cartridges with the following delivery mechanisms: (1) 12-gauge, single-barrel, break-open, open bore shotgun; (2) 12-gauge, open bore, pump-action shotgun; and (3) M1 signal pistol with metal barrel insert.
4. Evaluate the compatibility of 15-mm birdscare devices with the 15-mm launcher.
5. Evaluate the functional performance of each 15-mm type birdscare device, to include firing reliability, and range and drift of the pyrotechnic component of the bird bombs.
6. Ascertain the effects of an inbore explosion of 12-gauge scare cartridges on the structural integrity of 12-gauge shotgun barrels.

All objectives were accomplished except for part of Objective 2. Noise levels were obtained in the vicinity of the launcher operator, but noise level of the exploding pyrotechnic projectile was not obtained because available instrumentation had no capability for obtaining this level.

SECTION II
DESCRIPTION

GENERAL

The birdscare devices tested were developed to put into flight birds which roost in areas around runways and create a safety hazard to aircraft during takeoff and landings. Two different types of birdscare devices were tested: 12-gauge shotgun shell size and 15-mm size. The 12-gauge shotgun shell sizes were tested in three different types of launchers: (1) a 12-gauge, open bore, pump-action shotgun (Figure 1); (2) a 12-gauge, break-action, single-shot, open bore shotgun (Figure 2); and (3) an M1 signal pistol with a metal barrel insert which reduced the inside diameter of the pistol barrel from 47.5-mm to 12-gauge (Figures 3 and 4). The 15-mm devices were tested using a signal pistol type launcher which was furnished with the devices (Figure 5).



Figure 1. Pump-action, open bore, 12-gauge shotgun

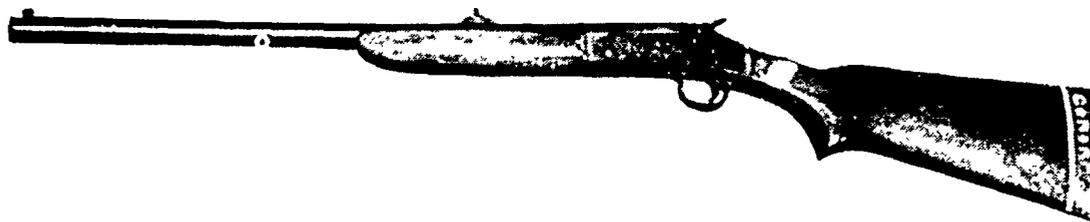


Figure 2. Break-open, open bore, single-shot, 12-gauge shotgun

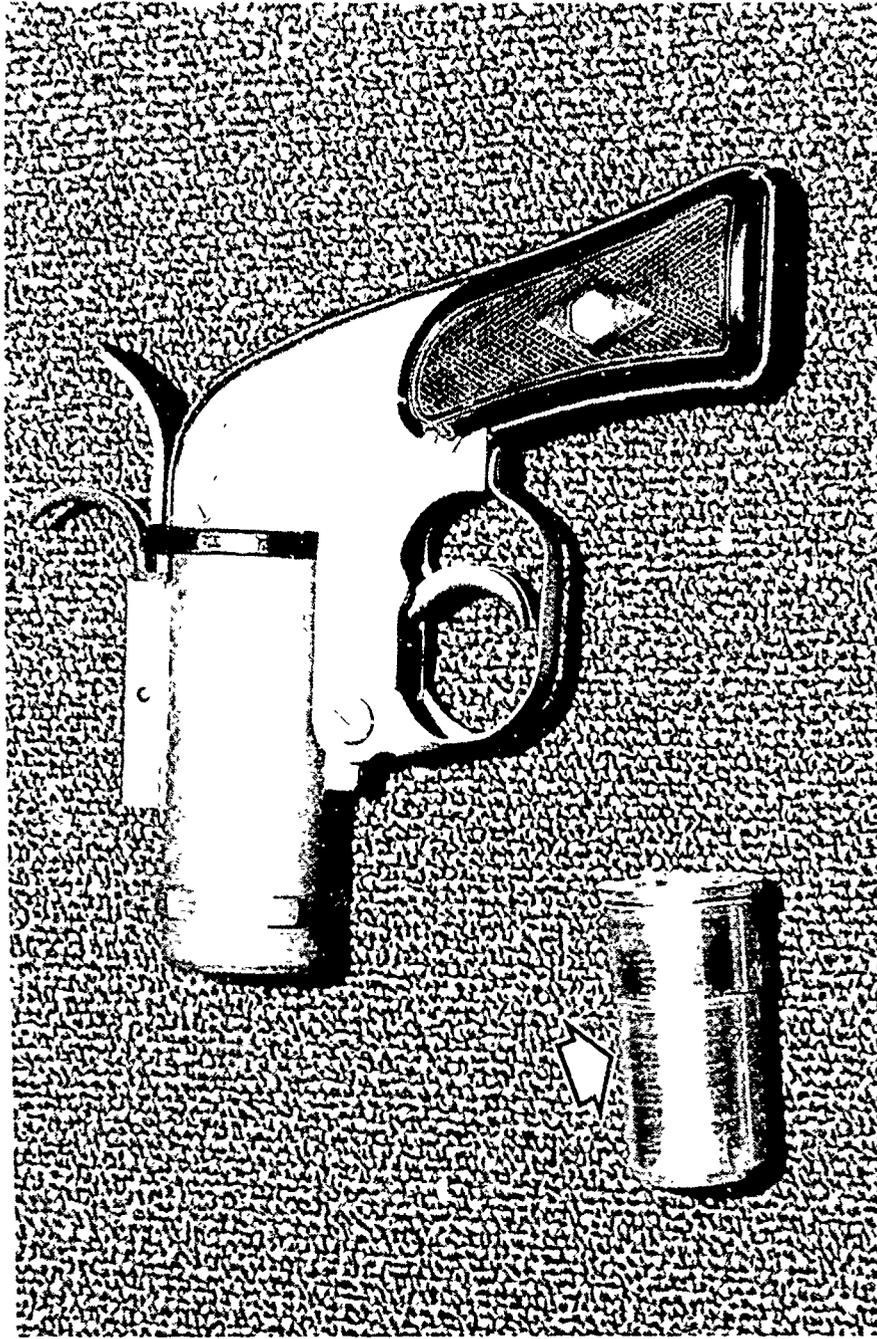


Figure 3. M1 flare pistol and metal barrel insert (arrow)

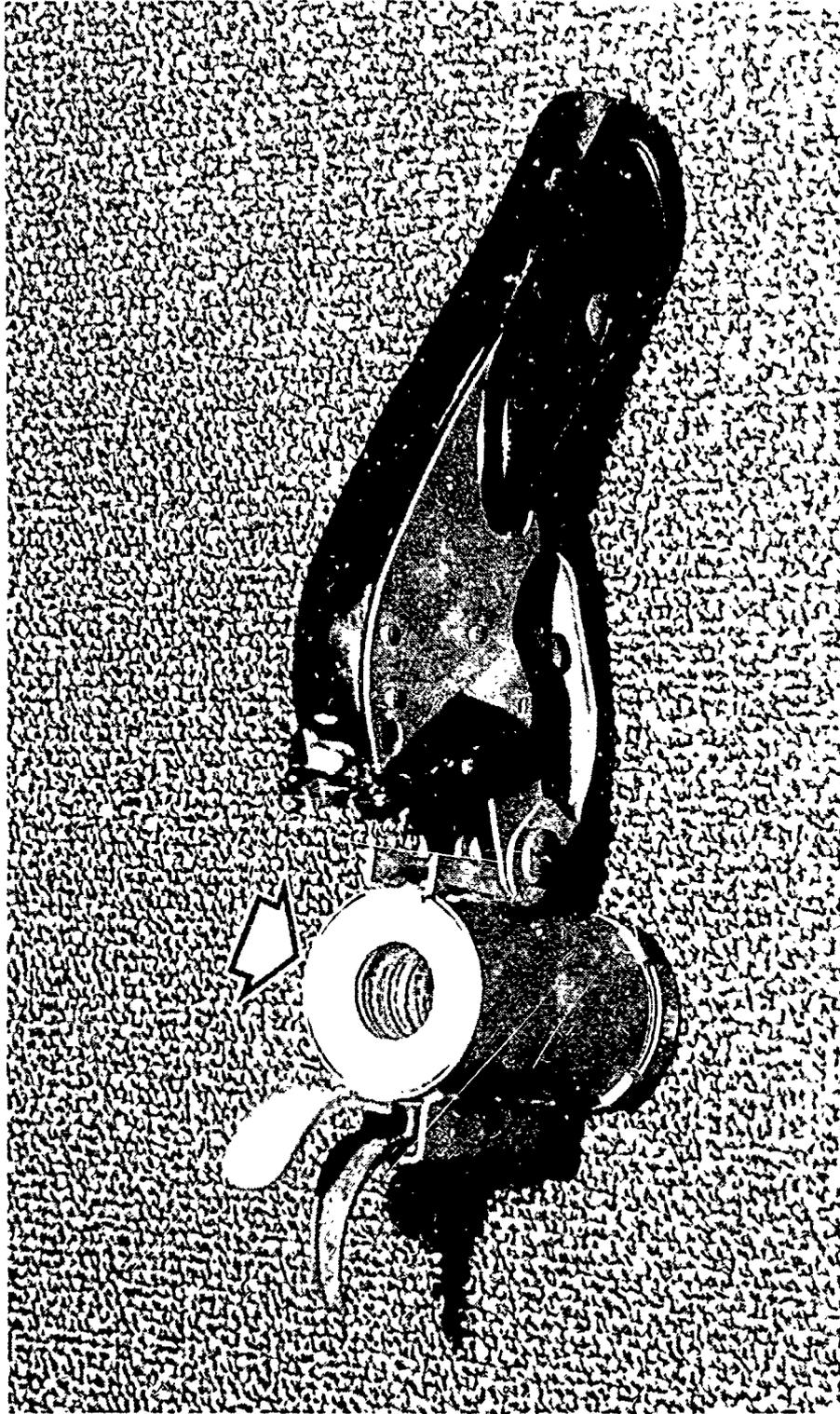


Figure 4. M1 flare pistol with metal barrel insert installed

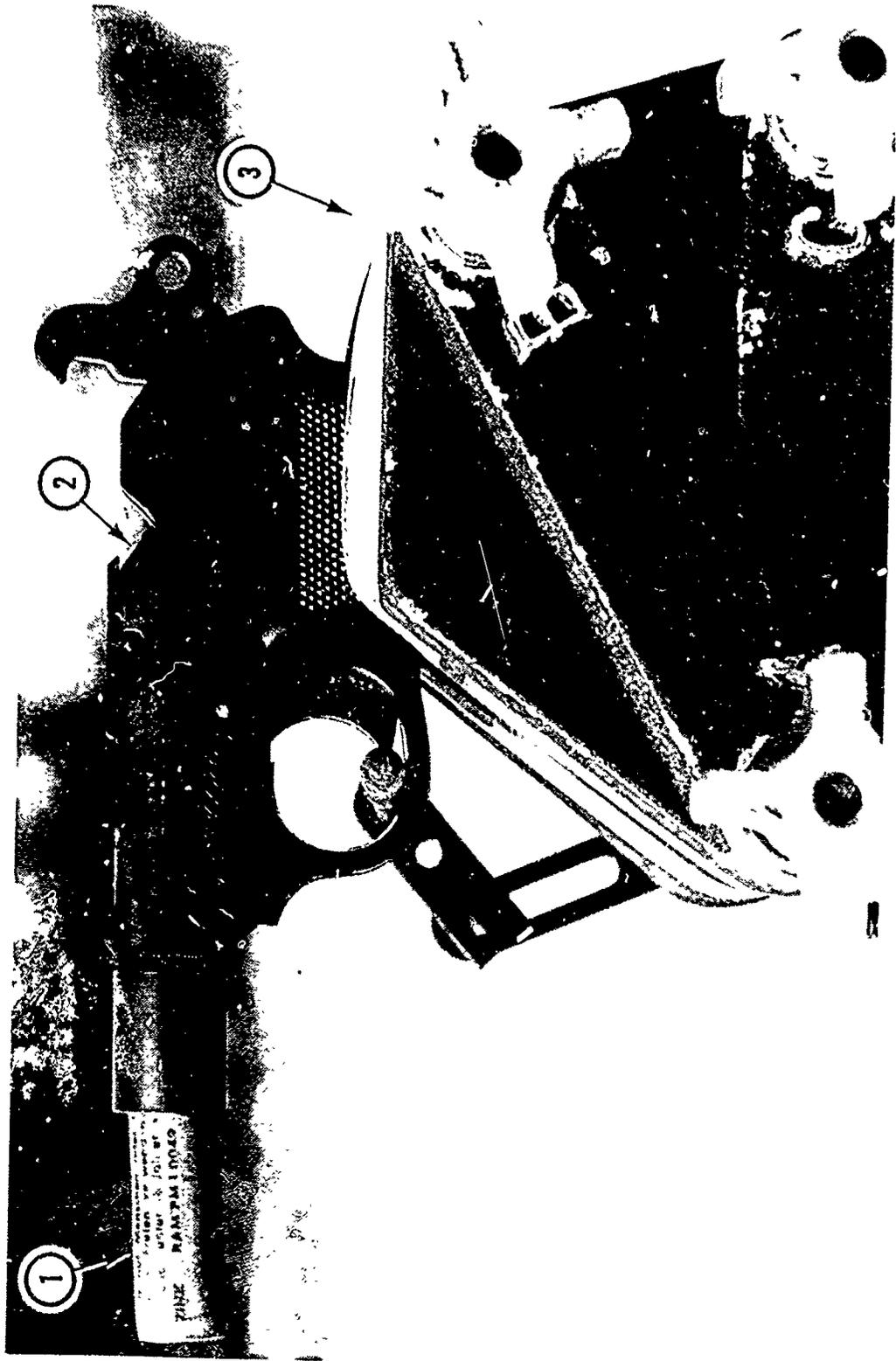


Figure 5. View of 15-mm signal pistol showing (1) type 4 birdscares device, (2) .22 caliber propelling charge, and (3) test fixture

All birdscare devices and launchers tested were of civilian manufacture. For the purpose of this report, the manufacturers were assigned a type number to identify their birdscare devices and launchers. The birdscare type numbers assigned were as follows: STONECO, Inc., Dacono, Colorado, type 1; Munitions Filling Factory, St Marys, New South Wales, Australia, type 2; and Marshall Hyde, Inc., Port Huron, Michigan, types 3, 4, and 5. The type numbers assigned the launchers were: 12-gauge, open bore, pump-action shotgun, type 1; 12-gauge, break-action, single-shot, open bore shotgun, type 2; M1 signal pistol with metal barrel insert, type 3; and 15-mm signal pistol, type 4.

BIRDSCARE DEVICE TYPES

TYPE 1. The type 1 birdscare device (Figure 6) is 12-gauge size and 2.750 inches in length. The case body is made of green corrugated plastic with a brass-plated steel base, manufactured by Remington Peters Sporting Ammunition Company. The primer is a press-fitted percussion type located in the center of the steel base. The internal components (Figure 7) are the propellant, plastic over propellant wad, and pyrotechnic projectile. The internal components are held in place by means of a six-point star crimp located at the mouth of the case (Figure 8).

The pyrotechnic projectile (Figure 9) is a yellow cardboard cylinder approximately 1.518 inches long and approximately 0.660 inch in diameter. The fuze system consists of an external wick type fuze which extends from the base of the projectile through a hole in the plastic over powder wad, into the propellant charge. When the birdscare device is fired, the burning propellant charge ignites the fuze which, in turn, detonates the pyrotechnic projectile.

TYPE 2. The type 2 birdscare device (Figure 6) is 12-gauge size and 2.750 inches in length. The case body is made of red corrugated plastic with a steel base, manufactured by Eley Sporting Ammunition Company of Great Britain. The primer is a press-fitted percussion type located in the center of the steel base. The internal components are the propellant, felt over propellant wad, and pyrotechnic projectile. The internal components are held in place by means of a eight-point star crimp located at the mouth of the case (Figure 8).

The pyrotechnic projectile (Figure 9) is a grey cardboard cylinder approximately 1.631 inches long and 0.666 inch in diameter. The fuze system consists of an external wick type fuze which extends from the base of the projectile through a hole in the felt over propellant wad, into the propellant charge. When the birdscare device is fired, the burning propellant charge ignites the fuze which, in turn, detonates the pyrotechnic projectile.

TYPE 3. The type 3 birdscare device (Figure 6) is 12-gauge size and 2.750 inches in length. The case body is made of a clear transparent corrugated plastic with a brass-plated steel base, manufactured by an Italian manufacturer for Marshall Hyde, Incorporated. The primer is a press-fitted percussion type located in the center of the steel base. The internal components are the propellant, cardboard over propellant wad, and pyrotechnic projectile. The internal components are held in place by a six-point star crimp located at the mouth of the case (Figure 8).

The pyrotechnic projectile (Figure 9) is a red cardboard cylinder approximately 1.556 inches long and 0.563 inch in diameter. The fuze system consists of a

lead type internal fuze. When loaded, the pyrotechnic projectile rests on a cardboard over propellant wad. This wad has a small hole in the center which aligns with the fuze in the pyrotechnic projectile. Upon firing, the flash from the propellant charge ignites the fuze which, in turn, detonates the pyrotechnic projectile.

TYPE 4. The type 4 birdscare device (Figure 10) is 15-mm in size and approximately 2.134 inches long. The case body is made of a red cardboard cylinder with a lead type internal fuze. The device is launched by placing it in the muzzle of the signal pistol and firing a blank .22 caliber cartridge. The gas from the .22 caliber blank launches the device and also causes the fuze to ignite which, in turn, explodes the device at fuze burnout.

TYPE 5. The type 5 birdscare device (Figure 11) is 15-mm in size and approximately 2.134 inches long. The case body is a green cardboard cylinder with a lead type internal fuze. The device is launched by placing it in the muzzle of the signal pistol and firing a blank .22 caliber cartridge. The gas from the .22 caliber blank launches the device and also causes the fuze to ignite. This device differs from the type 4 in that it makes a loud whistling noise from the moment of launch to burnout and does not explode. The type 4 explodes at fuze burnout.

The 12-gauge devices were packed 25 to a cardboard box, and 20 boxes to a corrugated cardboard case. The 15-mm devices were packed 80 to a cardboard box, and the .22 caliber blank cartridges were packed 100 to a metal can.

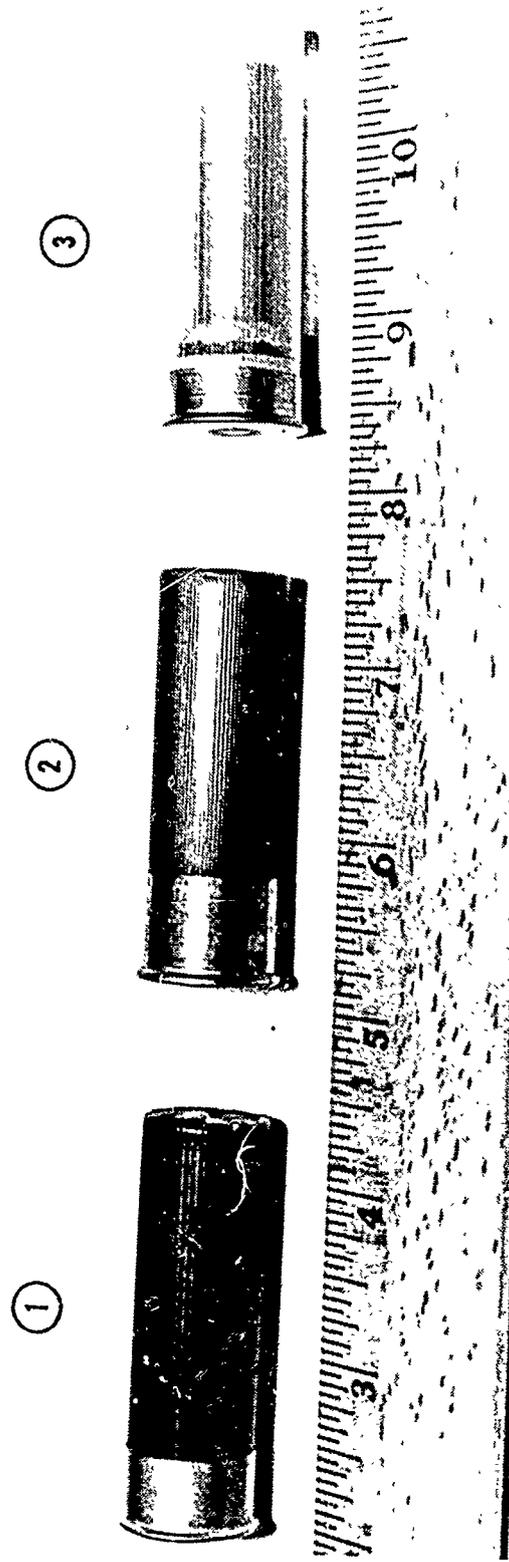


Figure 6. Birdscare devices: (1) type 1, (2) type 2, and (3) type 3

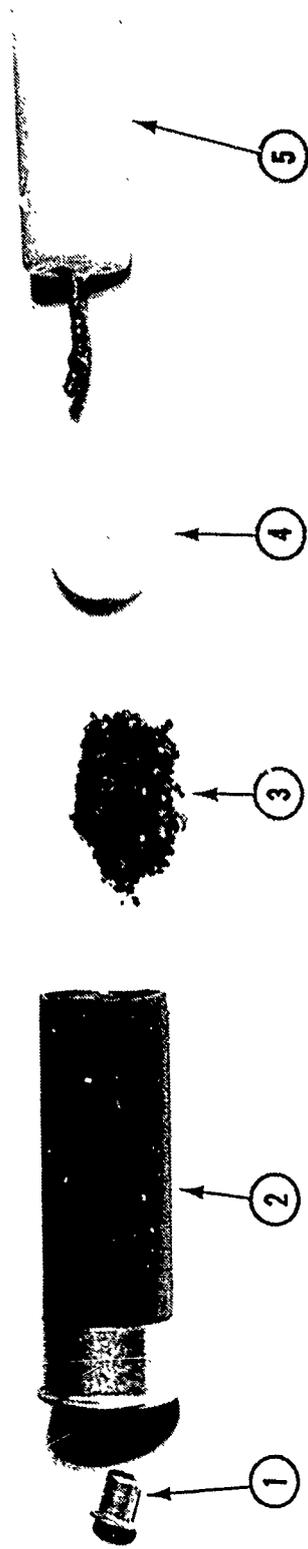


Figure 7. Overall view of disassembled type 1 birdscare device showing (1) primer, (2) plastic case, (3) propellant, (4) plastic over propellant wad, and (5) pyrotechnic projectile

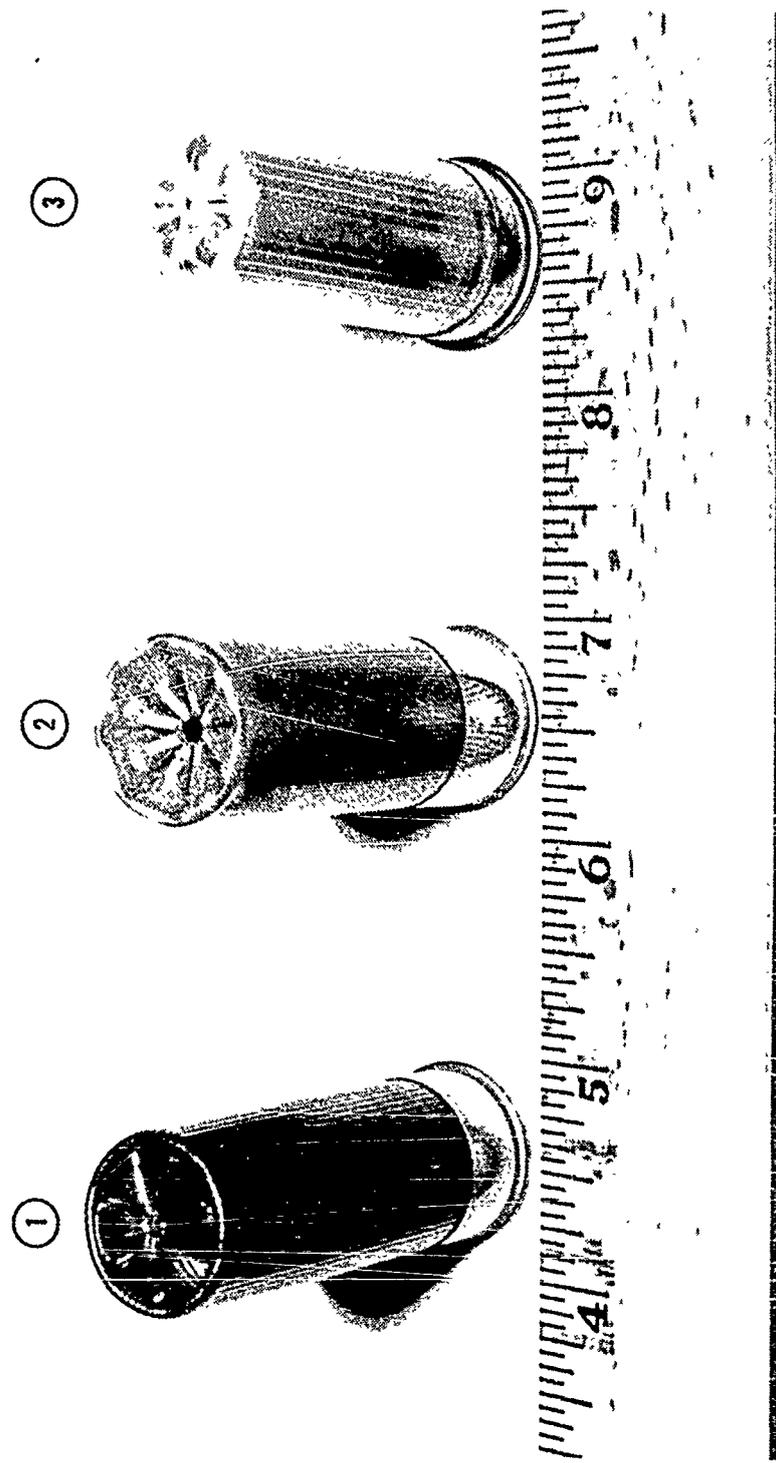


Figure 8. Crimp types of birdscare devices: (1) type 1, (2) type 2, and (3) type 3

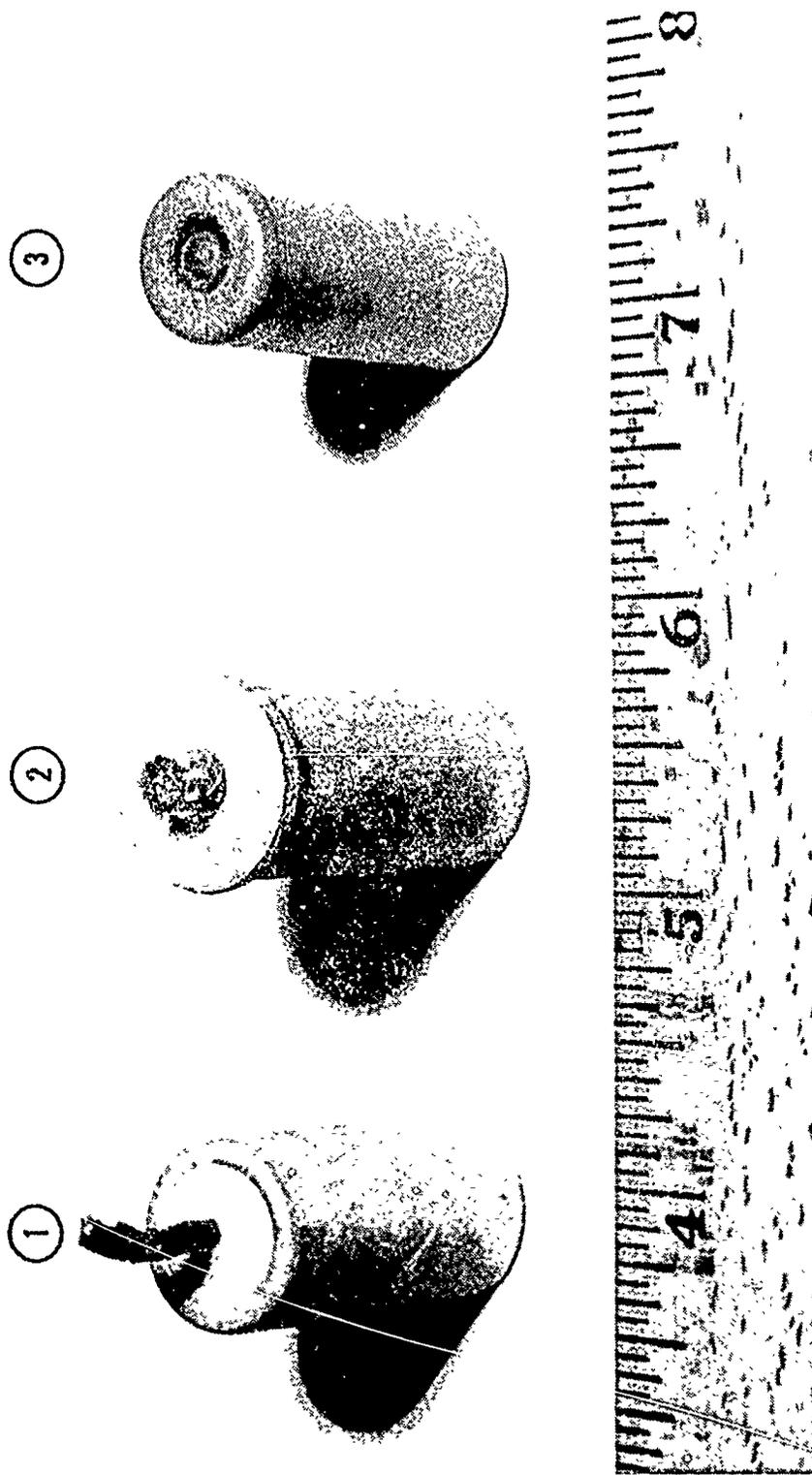


Figure 9. Pyrotechnic projectiles showing fuzing systems; (1) type 1, (2) type 2, and (3) type 3

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Figure 10. Type 4 15-mm birdscare device (1) and .22 caliber propelling charge (2)



Figure 11. Type 5 15-mm birdscare device (1) and .22 caliber propelling charge (2)

SECTION III
INSTRUMENTATION AND TEST PROCEDURES

GENERAL

This test consisted of two parts: a physical characteristics investigation of each manufacturer's birdscare device, which was performed at the AD Fuze Test Facility (Test Area A-24)¹ and a functional performance evaluation of each manufacturer's birdscare device, which was performed at the AD Ground Aircraft Gun Test Area (Test Area 22)².

PHYSICAL CHARACTERISTICS INVESTIGATION

ASSEMBLED BIRDSCARE DEVICES. The 12-gauge and 15-mm size birdscare devices were randomly selected from each manufacturer's sample and inspected for physical condition; manufacturer's lot number and markings; type and color of case material; total weight; case measurements consisting of length, diameter, flange diameter (at case head); and case head material.

DISASSEMBLED BIRDSCARE DEVICES. The 12-gauge birdscare devices were randomly selected from each manufacturer's sample and disassembled to obtain case volume, propellant type and weight, primer type and method of fit, number of wads and their location, and pyrotechnic composition. The 15-mm size birdscare devices were randomly selected from the manufacturer's sample and disassembled to obtain the propellant type and weight, pyrotechnic composition type, weight, and fuzing.

FUNCTIONAL PERFORMANCE EVALUATION

The functional performance evaluation consisted of three different tests: in-bore explosion assessments, chamber pressure and muzzle velocity measurements, and compatibility and firing reliability assessments of birdscare devices in their respective launchers. In-bore explosions and chamber pressure measurements were not made in the type 3 gun because of the short length of the barrel.

INBORE EXPLOSION ASSESSMENTS. In-bore explosions were performed in two different 12-gauge shotguns: a single-shot, open bore, break-action shotgun; and a 12-gauge, pump-action, open-bore shotgun. Three pyrotechnic projectiles from each of the three manufacturers were modified and fired in each shotgun. The modifications were made by interfacing a pyrotechnic projectile with a length of safety fuze which was mated with a safety fuze lighter (Figure 12). The pyrotechnic projectile was placed in the barrel of the shotgun at three different positions: 2 inches forward of the chamber, the middle of the barrel, and at the muzzle of the

¹ ADTC Technical Facilities, Vol I, Range Instrumentation Systems and Technical Support Facilities, November 1975, ADB011362L.

² ADTC Technical Facilities, Vol II, Land Test Areas, March 1976, ADB034286L.

barrel. Micrometer readings were made at the outside of the barrels at these three positions before and after each explosion to determine if there was any barrel damage.

CHAMBER PRESSURE AND MUZZLE VELOCITY MEASUREMENTS. Modified type 1 and type 2 shotgun barrels were used to obtain chamber pressure measurements. The modifications consisted of drilling a hole 1/16 inch in diameter on top of the barrel in the chamber area and silver soldering a collar over the hole in which a pressure transducer was mounted (Figure 13). The pressure transducer was connected to a computer system to record the chamber pressures in the barrel as each birdscare device was fired. The barrels were attached to the guns for all pressure tests, and the guns were mounted in a test fixture and fired remotely.

Muzzle velocity measurements were obtained by mounting the gun in a test fixture at 0 degrees elevation and firing through a blast stripper 3 feet from the muzzle of the gun and through velocity screens mounted 1.134 feet apart, 9 feet from the muzzle of the gun (Figure 14). The velocity screens were connected to a computer system to reduce and record the data. A representative sample of each manufacturer's birdscare device was fired from both shotguns and the M1 signal pistol during this test.

COMPATIBILITY AND FIRING RELIABILITY ASSESSMENTS. Representative samples of each manufacturer's birdscare device were first fired from each gun which was mounted in a test fixture at 0- and 45-degree angles. The guns were also fired hand-held by an operator, with the guns elevated to approximately a 45-degree angle. Range, drift, and height of burst were estimated visually by an observer located to the side of the gun and an observer located to the rear of the gun. Fuze burn time was obtained by using a stopwatch. To measure the range and drift, four poles 10 feet high were set up in line with the gun barrel. The first pole was set up 150 feet from the gun, and the remaining poles were set 30 feet apart. Two 10-foot poles were set 45 feet to the right and left in line with the last range marker to measure drift. A portable hand-held noise level meter was available to measure noise levels at the operator's ear at the time of firing and at the functioning height of the birdscare devices.

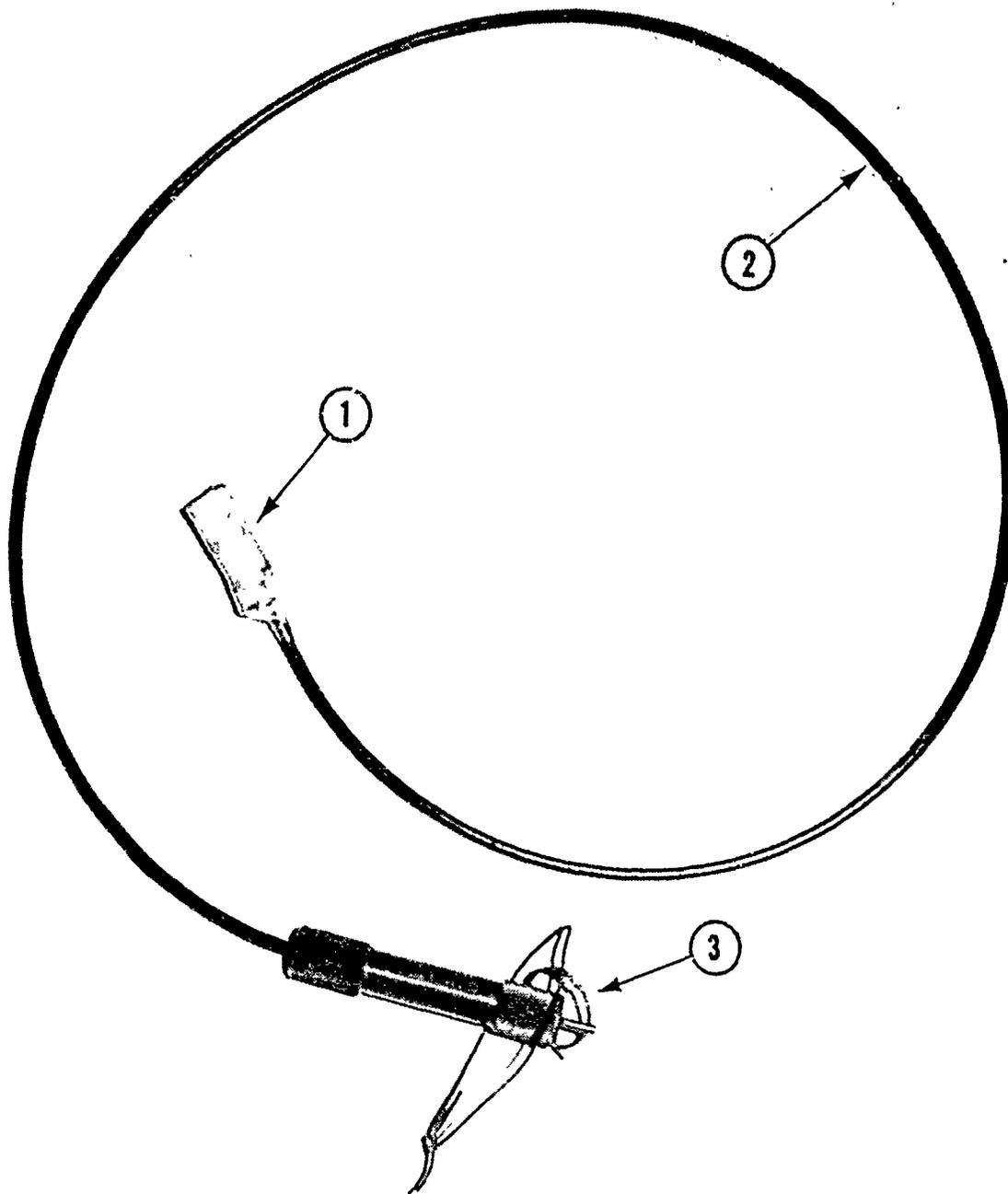


Figure 12. Device used to perform in-bore explosions showing (1) pyrotechnic projectile, (2) safety fuze, and (3) safety fuze lighter

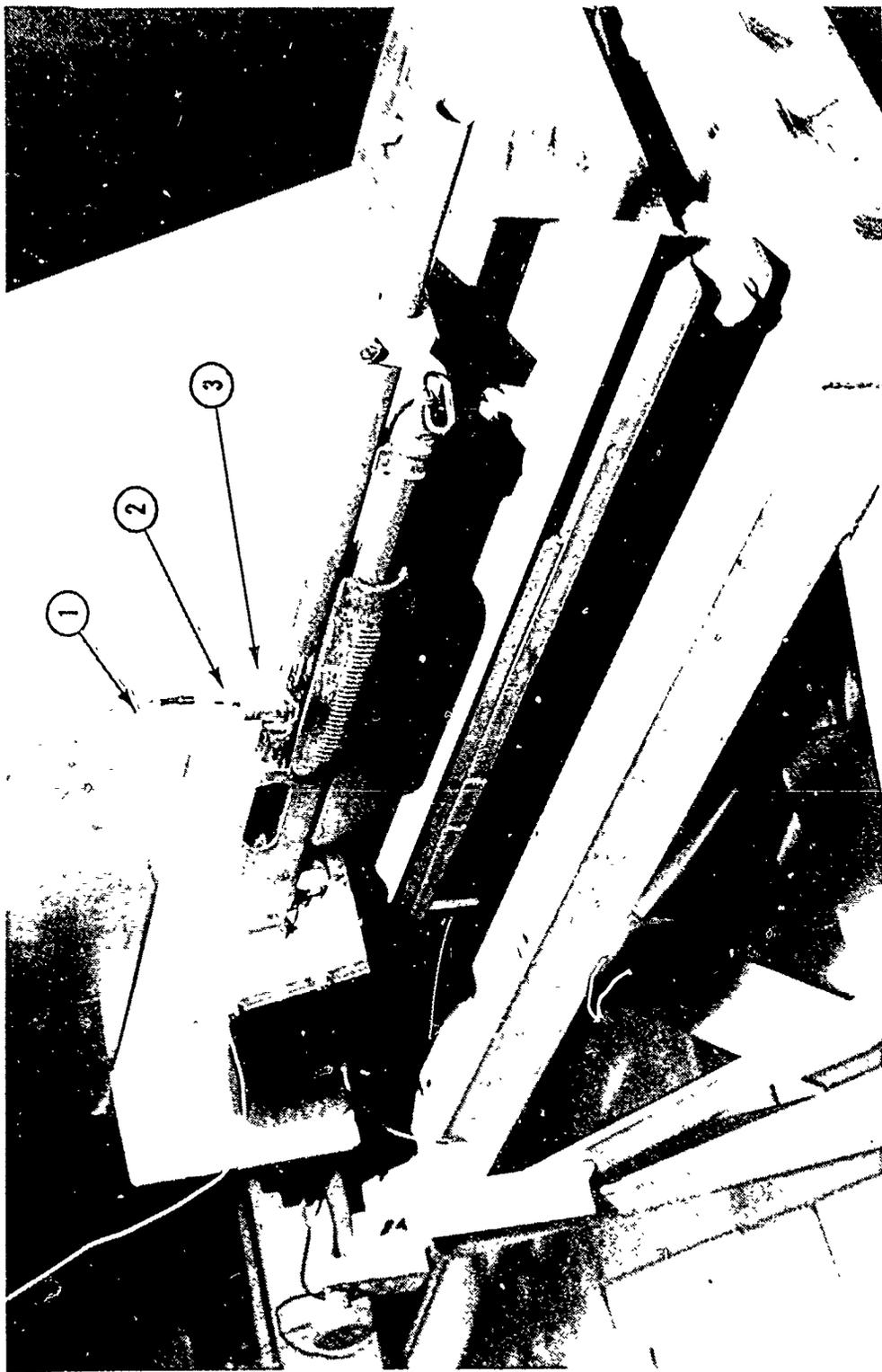


Figure 13. Type 1 shotgun modified to measure chamber pressures, showing (1) instrumentation lead, (2) pressure transducer, and (3) adapter collar

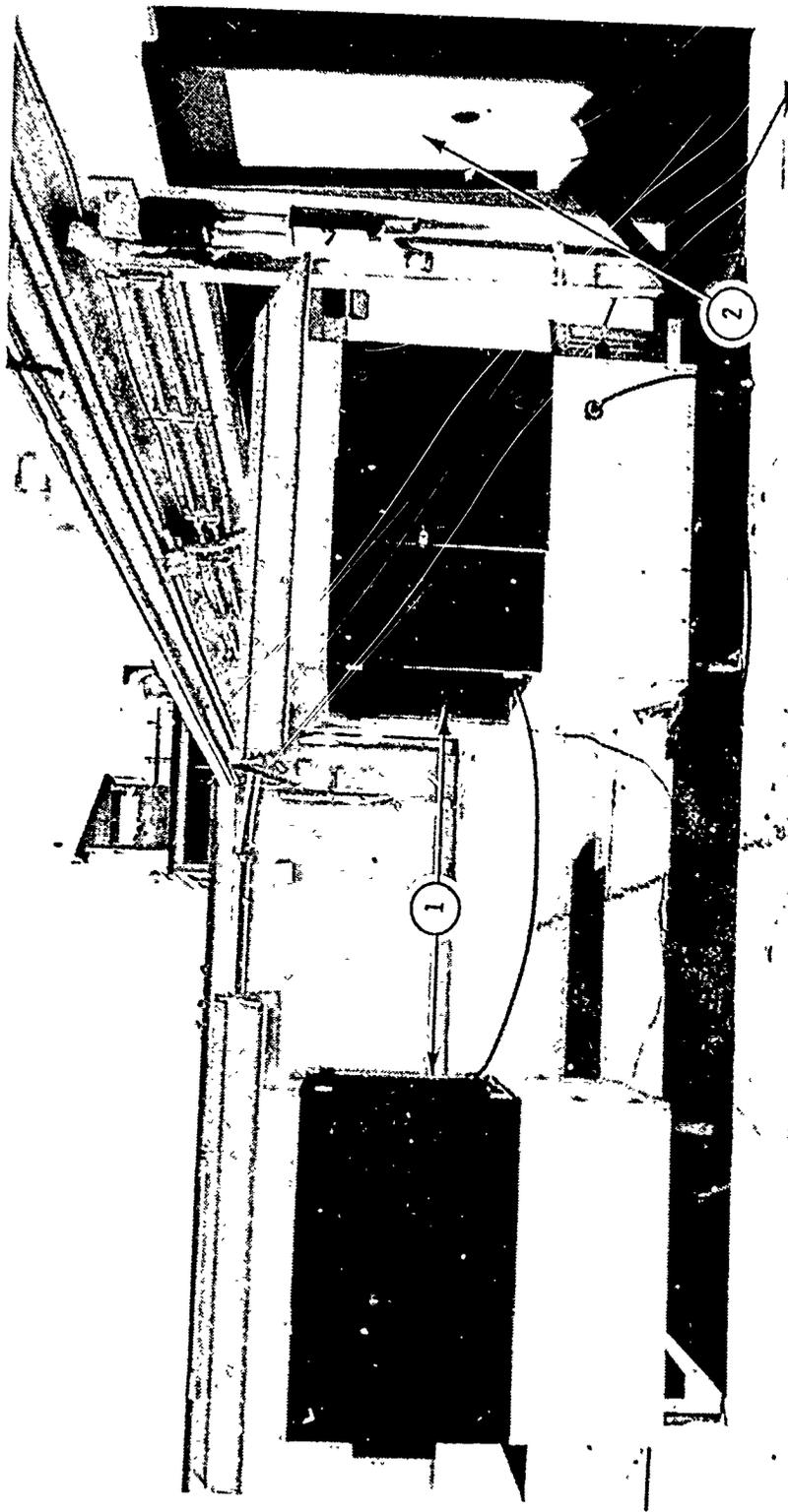


Figure 14. Test setup used to measure muzzle velocities showing (1) velocity screen is and (2) blast stripper

SECTION IV

TEST RESULTS AND DISCUSSION

GENERAL

Testing of the birdscare devices was accomplished in two areas. A physical characteristics investigation (on both assembled and disassembled devices) was accomplished to determine the physical condition, explosive and component weights, composition, and overall dimensions of each birdscare device. The functional performance evaluation of each birdscare device with its respective launcher included inbore explosion assessments, chamber pressure and muzzle velocity measurements, and compatibility and firing reliability assessments.

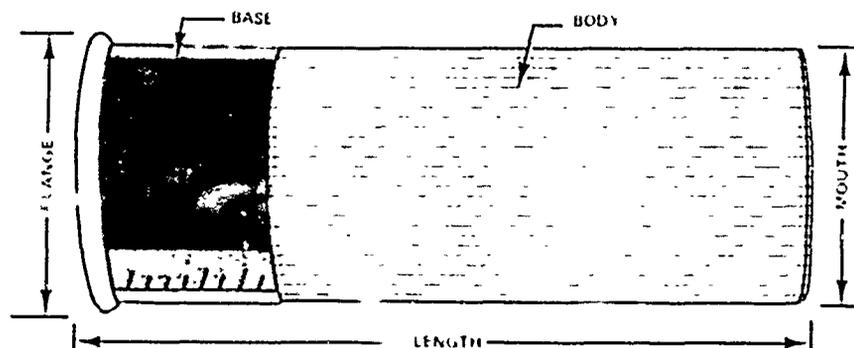
Operators of the launchers were experienced in handling small arms and were dressed in protective equipment consisting of face protectors, gloves, and ear protectors during hand-held firings of the launchers.

PHYSICAL CHARACTERISTICS INVESTIGATION

ASSEMBLED BIRDSKARE DEVICES. The objective of this investigation was accomplished by visually inspecting and measuring 85 of each manufacturer's 12-gauge birdscare devices and 20 of each manufacturer's 15-mm size birdscare devices. All 12-gauge birdscare device measurements are provided in Appendix A. The mean and standard deviation of these measurements are shown in Table 1.

Table 1. Assembled birdscare device measurements

Type	Length (in.)		Diameter (in.)							
			Base		Body		Mouth		Flange	
	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev
1	2.3968	0.0080	0.8016	0.0007	0.7817	0.0051	0.7864	0.0037	0.8765	0.0028
2	2.3623	0.0061	0.8007	0.0017	0.7805	0.0043	0.7949	0.0034	0.8790	0.0003
3	2.2988	0.0031	0.8015	0.0031	0.7724	0.0053	0.7850	0.0030	0.8808	0.0017



Visual inspection of all 12-gauge birdscare devices showed no abnormalities, with the exception of the area in which the crimp points met. All 12-gauge birdscare devices contained a hole approximately 1/8 inch in diameter at the center of the crimp. This hole could allow moisture inside the casing. No abnormalities were noted on any 15-mm birdscare devices.

DISASSEMBLED BIRDSKARE DEVICES. The objective of this investigation was accomplished by disassembling 10 of each manufacturer's 12-gauge birdscare devices and 20 of each manufacturer's 15-mm birdscare devices. The 12-gauge birdscare devices were inspected for type and quantity of propellant charge; primer type and method of fit; wad location and material; pyrotechnic projectile size, weight, and type of fill; and method of pyrotechnic projectile fuzing. The 15-mm birdscare devices were inspected for length, diameter, overall weight, and fill weight of the pyrotechnic projectile. All measurements taken on the disassembled birdscare devices are provided in Tables 2 through 6. No abnormalities were noted on any of the 15-mm birdscare devices. On one 12-gauge birdscare device (type 1), the propellant charge was missing. Analysis of the propellant fill in the 12-gauge devices revealed that the type 1 device had a double-based propellant, the type 2 device had a black powder propellant, and the type 3 device had a black powder substitute. The projectile weight for the 12-gauge devices ranged from 5.8 to 6.9 grams.

Ten of each of the type 1, 2, and 3 birdscare devices were fired from a type 2 launcher (shotgun). On one type 1 birdscare device, the pyrotechnic projectile fuze stopped burning before the projectile fill material was ignited. On one type 2 and one type 3 device, the projectile fill material burned out, but the projectile did not explode. On one type 2 device, the pyrotechnic projectile fuze separated at ground impact prior to pyrotechnic ignition. All failures encountered during this part of the test were attributed to firing the devices at 0 degrees elevation, which did not allow sufficient time for ignition of the pyrotechnic projectile before ground impact. The chamber pressure and muzzle velocity obtained using the type 2 launcher with the type 1 birdscare device varied respectively from 827 to 2,010 pounds-force per square inch and from 264 to 656 feet per second; with the type 2 device, the pressure varied from 165 to 827 pounds-force per square inch, and the velocity varied from 493 to 590 feet per second; with the type 3 device, the pressure varied from 189 to 603 pounds-force per square inch and the velocity from 241 to 474 feet per second.

Thirteen type 1, 10 type 2, and 13 type 3 birdscare devices were fired in a type 3 launcher. Muzzle velocities on shots 4, 5, 8, 12, and 13 of the type 1 birdscare device were not recorded due to instrumentation malfunction. No test item malfunction was encountered. The muzzle velocity obtained using a type 3 launcher with a type 1 birdscare device varied from 298 to 467 feet per second; with the type 2 device, the velocity varied from 310 to 361 feet per second; and with the type 3 device, the velocity varied from 135 to 293 feet per second.

Table 2. Results of ammunition characterization investigation; type 1 birdscare devices

Item no. ^a	Weight (g)	Length (in.)	Case diameter (in.)		Base flange diameter (in.)	Propellant weight (g)	Pyrotechnic projectile		
			Max	Min			Length (in.)	Diameter (in.)	Weight (g)
1	17.6	2.385	0.804	0.783	0.876	0.5	1.518	0.660	6.5
2	17.2	2.385	0.802	0.785	0.871	0.5	1.510	0.660	6.5
3	17.7	2.386	0.802	0.785	0.879	0.5	1.500	0.653	6.4
4	17.7	2.393	0.802	0.788	0.878	0.5	1.518	0.658	6.6
5	17.1	2.388	0.803	0.783	0.871	0.5	1.530	0.661	6.2
6	17.1	2.390	0.802	0.779	0.874	0.0 ^b	1.504	0.659	6.3
7	18.0	2.406	0.802	0.776	0.877	0.5	1.538	0.657	6.6
8	17.8	2.403	0.802	0.777	0.877	0.5	1.528	0.662	6.5
9	17.5	2.399	0.803	0.772	0.880	0.5	1.498	0.657	6.9
10	18.2	2.405	0.803	0.780	0.881	0.5	1.530	0.663	6.6

^a The following apply to all items:

1. Condition - good
2. Color - green
3. Type crimp - six-point star
4. Volume - 13 milliliters
5. Case material - base, plated steel; body, plastic
6. Propellant - double-based, consisting of:
Nitrocellulose, 77.75%
Nitroquadine, 20.00%
Diphenylamine (stabilizer), 0.75%
Barium nitrate (flash suppressant), 1.5%
Graphite glaze (added after mix), 0.3%
7. Fill - Fotoflash powder, consisting of:
Potassium perchlorate, 86.8%
Aluminum (metallic), 9.6%
Sulfur, 3.6%

^b Propellant missing.

Table 3. Results of ammunition characterization investigation; type 2 birdscare devices

Item no. ^a	Weight (g)	Length (in.)	Case diameter (in.)		Base flange diameter (in.)	Propellant weight (g)	Pyrotechnic projectile		
			Max	Min			Length (in.)	Diameter (in.)	Weight (g)
1	16.5	2.358	0.800	0.788	0.878	0.4	1.598	0.642	6.4
2	16.5	2.367	0.800	0.776	0.878	0.5	1.582	0.643	6.4
3	16.7	2.378	0.803	0.784	0.878	0.5	1.592	0.639	6.3
4	16.6	2.357	0.800	0.788	0.878	0.5	1.590	0.657	6.5
5	16.4	2.358	0.788	0.777	0.879	0.5	1.592	0.666	6.2
6	17.1	2.376	0.801	0.786	0.878	0.5	1.637	0.662	6.7
7	16.5	2.360	0.800	0.785	0.879	0.5	1.576	0.653	6.4
8	16.9	2.361	0.801	0.786	0.879	0.5	1.595	0.664	6.7
9	16.4	2.356	0.802	0.772	0.880	0.4	1.572	0.653	6.4
10	16.7	2.371	0.800	0.777	0.880	0.5	1.631	0.652	6.4

^a The following apply to all items:

1. Condition - Good
2. Color - red
3. Type crimp - eight-point star
4. Volume - 13.7 milliliters
5. Case material - base, steel; body, plastic
6. Propellant - No chemical analysis performed; opinion of test personnel is that propellant charge was ordinary black powder.
7. Fill - No chemical analysis performed; composition unknown.

Table 4. Results of ammunition characterization investigation; type 3 birdscare devices

Item no. ^a	Weight (g)	Length (in.)	Case diameter (in.)		Base flange diameter (in.)	Propellant weight (g)	Pyrotechnic projectile		
			Max	Min			Length (in.)	Diameter (in.)	Weight (g)
1	14.4	2.301	0.803	0.777	0.878	1.0	1.589	0.563	6.0
2	13.9	2.300	0.802	0.782	0.883	0.6	1.587	0.562	6.0
3	14.1	2.297	0.800	0.777	0.880	1.0	1.568	0.557	5.8
4	14.6	2.298	0.801	0.766	0.882	1.0	1.594	0.570	6.2
5	14.2	2.297	0.800	0.774	0.882	1.0	1.563	0.558	5.7
6	14.0	2.297	0.803	0.769	0.878	1.0	1.562	0.566	5.7
7	14.2	2.300	0.802	0.782	0.882	1.0	1.566	0.567	5.9
8	14.2	2.298	0.800	0.772	0.882	1.0	1.555	0.563	5.8
9	14.2	2.300	0.797	0.774	0.880	1.0	1.547	0.563	5.6
10	14.3	2.302	0.803	0.788	0.882	1.0	1.574	0.563	5.8

^a The following apply to all items

1. Condition - good
2. Color - clear
3. Type crimp - six-point star
4. Volume - 13.1 milliliters
5. Case material - base, plated steel; body, plastic
6. Propellant. No chemical analysis performed. Contractor supplied following information:
Oxidizer (potassium nitrate and potassium perchlorate), 60%
Fuel (charcoal and sulfur), 13%
The remaining 27% contains an additional fuel, a binder, and a modifier.
7. Fill - Fotoflash powder, consisting of:
Potassium perchlorate, 61%
Aluminum, 30%
Sulfur, 9%

Table 5. Results of ammunition characterization investigation; type 4 birdscare devices

Item no. ^a	Pyrotechnic projectile			
	Length (in.)	Diameter (in.)	Weight (g)	Fill weight (g)
1	2.134	0.564	6.7	1.0
2	2.129	0.564	6.7	1.0
3	2.120	0.572	6.9	1.0
4	2.135	0.562	6.6	1.0
5	2.130	0.562	6.6	1.0
6	2.128	0.561	6.7	1.0
7	2.123	0.563	6.9	1.0
8	2.132	0.567	6.6	1.0
9	2.124	0.565	6.8	1.0
10	2.127	0.572	6.7	1.0
11	2.128	0.574	6.9	1.0
12	2.130	0.559	6.6	1.1
13	2.134	0.566	6.9	1.0
14	2.122	0.562	6.7	1.0
15	2.124	0.560	6.8	1.0
16	2.126	0.569	6.8	1.0
17	2.123	0.562	6.9	1.0
18	2.134	0.560	6.4	0.9
19	2.122	0.567	6.8	1.0
20	2.133	0.565	6.5	1.0

^a The following apply to all items:

1. Condition - good
2. Color - red
3. Cardboard body
4. Fill - Fotoflash powder, consisting of:
 - Potassium perchlorate, 61%
 - Aluminum, 30%
 - Sulfur, 9%

Table 6. Results of ammunition characterization investigation; type 5 birdscare devices

Item no. ^a	Length (in.)	Diameter (in.)	Weight (g)	Fill weight (g)
1	2.066	0.549	5.4	3.6
2	2.056	0.549	5.3	3.7
3	2.061	0.549	5.2	3.6
4	2.065	0.549	5.4	3.8
5	2.063	0.551	5.5	3.8
6	2.053	0.554	5.4	3.6
7	2.068	0.548	5.4	3.7
8	2.071	0.546	5.3	3.5
9	2.069	0.547	5.2	3.7
10	2.073	0.549	5.3	3.7
11	2.071	0.547	5.5	3.8
12	2.060	0.552	5.4	3.8
13	2.070	0.551	5.4	3.8
14	2.075	0.553	5.4	3.7
15	2.059	0.552	5.4	3.8
16	2.074	0.551	5.2	3.6
17	2.052	0.547	5.4	3.8
18	2.073	0.547	5.4	3.8
19	2.067	0.551	5.3	3.7
20	2.062	0.554	5.3	3.7

^a The following apply to all items:

1. Condition - good
2. Color - green
3. Cardboard body
4. Fill - No chemical analysis performed; composition unknown.

FUNCTIONAL PERFORMANCE EVALUATION

This evaluation was divided into three parts: inbore explosion assessment, chamber pressure and muzzle velocity measurements, and compatibility and firing reliability assessments.

INBORE EXPLOSION ASSESSMENT. Three of each type of the 12-gauge birdscare devices were fired at 2 inches forward of the chamber, the middle of the barrel, and at the muzzle of the barrel in types 1 and 2 shotguns. Upon completion of each simulated inbore explosion the barrels were measured, and no deformation was noted.

CHAMBER PRESSURE AND MUZZLE VELOCITY MEASUREMENTS. Chamber pressure and muzzle velocity measurements were taken on the three types of 12-gauge birdscare devices (types 1, 2, and 3) when fired from the 12-gauge shotguns (types 1 and 2). Only muzzle velocity measurements were taken on the three types of 12-gauge birdscare devices when fired from the M1 signal pistol as its barrel was too short to accommodate chamber pressure instrumentation. All measurements were taken with the guns at a 0-degree elevation. Chamber pressures and muzzle velocities along with the mean and standard deviation are provided in Tables 7 through 9.

Twelve type 1, 10 type 2, and 10 type 3 birdscare devices were fired from a type 1 shotgun. Muzzle velocity of the third type 1 birdscare device was not recorded due to instrumentation malfunction. Two type 1, three type 2, and two type 3 birdscare devices had the pyrotechnic projectile fuze either separate or break apart on impact with the ground prior to pyrotechnic ignition. This was attributed to firing the devices at 0-degree elevation, which did not allow sufficient time for ignition of the pyrotechnic projectile before ground impact. The chamber pressure and muzzle velocity obtained using the type 1 launcher with the type 1 birdscare device varied respectively from 243 to 1,680 pounds-force per square inch and from 310 to 676 feet per second; with the type 2 device the pressure varied from 173 to 794 pounds-force per square inch and the velocity from 451 to 577 feet per second; with the type 3 device, the pressure varied from 4 to 1,747 pounds-force per square inch and the velocity from 297 to 533 feet per second.

Ten of each of the type 1, 2, and 3 birdscare devices were fired from a type 2 launcher (shotgun). On one type 1 birdscare device, the pyrotechnic projectile fuze stopped burning before the projectile fill material was ignited. On one type 2 and one type 3 device, the projectile fill material burned out, but the projectile did not explode. On one type 2 device, the pyrotechnic projectile fuze separated at ground impact prior to pyrotechnic ignition. All failures encountered during this part of the test were attributed to firing the devices at 0 degrees elevation, which did not allow sufficient time for ignition of the pyrotechnic projectile before ground impact. The chamber pressure and muzzle velocity obtained using the type 2 launcher with the type 1 birdscare device varied respectively from 827 to 2,010 pounds-force per square inch and from 264 to 656 feet per second; with the type 2 device, the pressure varied from 165 to 827 pounds-force per square inch and the velocity varied from 493 to 590 feet per second; with the type 3 device the pressure varied from 189 to 603 pounds-force per square inch and the velocity from 241 to 474 feet per second.

Thirteen type 1, 10 type 2, and 13 type 3 birdscares were fired in a type 3 launcher. Muzzle velocities on shots 4, 5, 8, 12, and 13 of the type 1 birdscares were not recorded due to instrumentation malfunction. No test item malfunction was encountered. The muzzle velocity obtained using a type 3 launcher with a type 1 birdscares device varied from 298 to 467 per second; with the type 2 device, the velocity varied from 310 to 361 feet per second; and with the type 3 device, the velocity varied from 135 to 293 feet per second.

COMPATIBILITY AND FIRING RELIABILITY. Height of burst, range, drift, fuze burn time, and sound measurements were taken as each birdscares device was fired from its respective gun. Data from each birdscares device and gun combination were collected with the gun in three positions: a 0-degree elevation, a 45-degree elevation, and hand-held at approximately 45 degrees elevation. These data are provided in Tables 10 through 21. Ten devices were fired at the 0-degree and hand-held positions, while 25 devices were fired at the 45-degree position. Sound level measurements were not taken on gun type 4, or any of the guns in the hand-held position. All 12-gauge and 15-mm devices were compatible with the launchers during this test.

TYPE 1 SHOTGUN FIRINGS. Of the 10 type 1 birdscares devices fired at a 0-degree elevation in the type 1 shotgun, one malfunction occurred due to the fuze separating from the pyrotechnic projectile on impact with the ground. This was attributed to firing the device at 0 degrees, which did not allow sufficient time for the fuze to explode before ground impact. Another type 1 birdscares device fired at a 0-degree elevation in the type 1 shotgun had a long burn time of 13 seconds before explosion. Ten of each of the type 2 and 3 birdscares devices were fired from the type 1 shotgun at a 0-degree elevation with no malfunctions.

Twenty-five of each of the type 1, 2 and 3 birdscares devices were fired from the type 1 shotgun at the 45-degree elevation with no malfunctions.

Of the 10 type 1 birdscares devices fired from the type 1 shotgun in the hand-held position (approximately 45 degrees), the over propellant wad of one device remained in the barrel after the firing. The barrel was cleared of the wad and firing continued. Ten of each of the type 2 and 3 birdscares devices were fired from the type 1 shotgun in the hand-held position with no malfunctions.

TYPE 2 SHOTGUN FIRINGS. Of the 10 type 1 birdscares devices fired at the 0-degree elevation in the type 2 shotgun, five malfunctions occurred. On three devices the pyrotechnic projectiles failed to explode. Two of these failures were due to the fuze separating from the projectile upon ground impact. The third failure was due to the fuze not igniting. On two other type 1 devices, the pyrotechnic fill burned but did not explode. Ten type 2 birdscares devices were fired from the type 2 shotgun at 0 degree with no malfunctions encountered. Of the 10 type 3 birdscares devices fired in the type 2 shotgun at the 0-degree elevation, two malfunctions occurred. On these two devices, the pyrotechnic fill burned but did not explode, because the casing ruptured upon ground impact.

Of the 25 type 1 birdscares devices fired from the type 2 shotgun at 45-degree elevation, one malfunction occurred due to the fuze failing to ignite. Twenty-five of each of the types 2 and 3 birdscares devices were fired from the type 2 shotgun

at a 45-degree elevation with no malfunctions encountered. Sound level measurements were only taken on the first 12 type 1 birdscares fired. Instrumentation failure prevented sound measurements from being taken on the remaining 13 type 1 devices and on any type 2 or type 3 devices.

Of the 10 type 1 birdscares fired in a type 2 shotgun in the hand-held position (approximately 45 degrees), one firing resulted in an inbore explosion. No damage to the barrel was noted, and the operator was not injured. Ten type 2 birdscares were fired from the type 2 shotgun in the hand-held position with no malfunctions encountered. Of the 10 type 3 birdscares fired in the type 2 shotgun in the hand-held position, the over propellant wad of two devices remained in the barrel. The barrels were cleared and firing continued.

TYPE 3 GUN FIRINGS. Of the 10 type 1 birdscares fired from the type 3 guns at 0-degree elevation, two malfunctions occurred. One malfunction occurred due to the casing of the device rupturing upon ground impact. The other malfunction was due to the fuze separating from the projectile upon ground impact. Of the 10 type 2 birdscares fired from the type 3 gun at 0 degree elevation, one malfunction occurred, due to the fuze separating from the pyrotechnic projectile upon ground impact. The type 3 birdscares were fired from the type 3 gun at the 0-degree elevation with no malfunctions.

Of the 25 type 1 birdscares fired from the type 3 gun at a 45-degree elevation, three malfunctions occurred. On two of these malfunctions the fuze burned, but the projectiles did not explode. On the third malfunction, the fuze did not ignite. Of the 25 type 2 birdscares fired from the type 3 gun at a 45-degree elevation, one malfunction occurred due to the failure of the fuze to ignite. Twenty-five type 3 birdscares were fired from the type 3 gun at a 45-degree elevation with no malfunctions. Of 10 type 1 birdscares fired in the type 3 gun in the hand-held position, two malfunctions occurred. On one of these malfunctions the fuze burned, but the projectile did not explode. The other malfunction was due to the failure of the fuze to ignite. Of the 10 type 2 birdscares fired from the type 3 gun in the hand-held position, one malfunction occurred because the fuze failed to ignite. Ten type 3 birdscares were fired from the type 3 gun in the hand-held position with no malfunctions.

TYPE 4 GUN FIRINGS. Ten of each of type 4 and 5 birdscares were fired from the type 4 gun at a 0-degree elevation with no malfunctions.

Twenty-five of each of the type 4 and 5 birdscares were fired from a type 4 gun at a 45-degree elevation with no malfunctions.

Twenty-five of each of the type 4 and 5 birdscares were fired from a type 4 launcher in the hand-held position with no malfunctions.

Table 7. Chamber pressure and muzzle velocity measurements; birdscare devices fired from a type 1 gun

Shot no.	Chamber pressure (lb/in. ²)			Muzzle velocity (ft/s)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	1,434	551	1,256	471	541	343
2	243	431 ^a	588	310	577 ^a	522
3	1,680	493	383	---	567	312
4	334 ^a	343	4	358 ^a	558	297
5	626	455	399	520	495	488
6	1,096 ^a	210 ^a	338	676 ^a	512 ^a	352
7	564	589	1,747 ^a	413	532	352 ^a
8	486	794 ^a	884	450	451 ^a	374
9	393	309	1,094 ^a	419	485	390 ^a
10	642	173	490	507	511	451
11	693			521		
12	756			526		
Max	1,680	794	1,747	676	577	522
Min	243	173	4	310	451	297
Avg	746	435	718	470	533	388
^a Fuze separated from the pyrotechnic projectile on impact with the ground.						

Table 8. Chamber pressure and muzzle velocity measurements; birdscore devices fired from a type 2 gun

Shot no.	Chamber pressure (lbf/in. ²)			Muzzle velocity (ft/s)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	437	433	312	451	493	312
2	357	212	314	430	537	390
3	294	247 ^a	189	359	542 ^a	474
4	266 ^a	201	323	264 ^a	510	313
5	1,085	251	280	444	518	488
6	2,006	231	361 ^a	656	544	453 ^a
7	2,010	165 ^a	536	549	514 ^a	463
8	1,120	298	603	511	590	241
9	378	827	437	345	567	440
10	688	241	313	575	523	345
Max	2,010	827	603	656	590	474
Min	266	165	189	264	493	241
Avg	864	311	367	458	534	392
^a Fuze separated from pyrotechnic projectile on impact with ground.						

Table 9. Muzzle velocity measurements; birdscares fired from a type 3 gun

Shot no.	Muzzle velocity (ft/s)		
	Type 1	Type 2	Type 3
1	465	310	281
2	343	342	267
3	298	326	247
4	---	343	222
5	---	328	285
6	385	332	290
7	365	361	265
8	---	336	293
9	410	349	178
10	398	314	216
11	375	---	135
12	---	---	280
13	---	---	248
Max	465	361	293
Min	298	310	135
Avg	380	334	247
NOTE: Chamber pressure was not measured; barrel too short.			

Table 10. Performance data; type 1, 2, and 3 birdscares devices fired from a type 3 gun at a 0-degree elevation

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft) ^a			Fuze burn time (sec)			Noise level (dBA)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	0	0	0	165	160	250	0	35L	0	2.5	4.0	2.0	110.5	116.3	125.0
2	0	0	0	140	175	175	20L	0	0	2.5	4.0	2.0	116.5	119.1	124.5
3	3	0	0	145	190	180	20L	15R	10L	2.5	3.5	2.0	112.9	116.7	122.9
4	0	0	0	225	180	150	30L	15L	0	5.0	4.0	1.5	107.6	119.0	122.9
5	0	0	0	200	160	145	30L	0	0	5.0	4.0	2.0	109.0	188.1	124.1
6	0	0	0	---	150	160	0	25L	0	b	4.0	2.0	109.5	119.7	124.4
7	0	0	0	170	165	180	15L	20L	0	13.0 ^c	4.0	2.0	109.9	119.9	120.3
8	0	0	0	190	150	175	0	20L	0	5.0	4.0	2.0	106.4	126.3	123.7
9	0	0	0	175	160	180	10R	0	0	4.0	4.0	2.0	102.6	120.3	123.3
10	0	0	0	160	145	50	15R	20L	0	3.0	4.0	1.5	108.9	117.4	124.6
Max	3	0	0	225	190	250	30L/15R	35L/15R	10L	13.0	4.0	2.0	116.5	120.3	125.0
Min	0	0	0	140	145	50	0	0	0	2.5	3.5	1.5	102.6	116.3	120.3
Avg	0	0	0	174	164	165	9L	12L	1L	4.7	4.0	1.9	110.3	118.7	123.6

^a L - left; R - right

^b Fuze separated from pyrotechnic projectile on impact with ground.

^c Long burn time.

Table 11. Performance data; type 1, 2, and 3 birdscore devices fired from type 1 gun at a 45-degree elevation

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft) ^a			Fuze burn time (sec)			Noise level (dBA)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	120	135	135	100	95	140	0	30L	45L	3.0	3.5	2.0	108.9	118.6	123.7
2	105	105	105	140	110	125	20L	30L	15L	4.0	4.0	2.0	111.0	118.5	121.2
3	135	135	135	130	130	90	20L	30L	0	4.0	4.0	1.5	112.6	118.1	123.4
4	45	120	120	150	130	90	20L	20L	10L	6.0	4.0	1.5	112.6	118.8	122.6
5	120	60	60	90	150	100	20L	40L	30L	2.5	4.0	1.5	112.2	117.7	121.7
6	0	90	90	135	150	75	50L	25L	30L	6.0	4.0	1.5	108.8	118.4	123.0
7	60	90	90	150	135	140	50L	25L	0	4.0	4.0	2.0	109.5	118.7	119.5
8	135	120	120	80	140	155	0	30L	20L	2.0	4.0	2.0	110.7	118.3	121.9
9	120	75	75	100	140	80	0	30L	30L	3.0	4.0	2.0	110.2	119.1	121.8
10	30	105	105	135	75	145	20L	30L	30L	5.0	4.0	1.5	114.8	118.3	123.2
11	150	150	150	100	100	175	0	30L	0	3.0	4.0	1.5	114.3	119.1	121.1
12	135	90	90	90	125	60	0	0	10L	3.0	3.5	1.5	115.5	119.9	123.0
13	120	120	120	90	100	75	0	60L	10L	4.0	4.0	1.5	115.6	119.9	121.5
14	95	135	135	135	150	100	15R	100L	10L	5.0	4.0	2.0	115.4	119.6	123.1
15	95	75	75	100	140	90	20L	75L	0	3.5	4.0	1.5	109.3	118.1	122.7
16	150	135	135	100	135	125	0	0	10L	3.0	4.0	1.5	114.6	118.3	119.3
17	120	120	120	130	50	115	0	30L	20L	3.5	4.0	2.0	109.6	118.9	123.0
18	150	120	120	125	90	140	0	40L	10L	3.0	3.0	1.5	111.4	119.1	123.7
19	150	75	75	90	90	120	0	75L	20L	2.5	3.5	1.5	110.3	---	121.3
20	135	90	90	100	100	125	20L	0	0	3.0	3.5	2.0	110.5	---	119.1
21	150	90	90	75	140	50	10L	0	10L	2.5	4.0	1.5	112.2	---	119.3
22	45	75	75	130	110	75	50L	80L	0	5.0	3.5	2.0	111.3	---	123.6
23	165	60	60	115	80	40	0	90L	20L	4.0	3.5	1.0	114.0	---	117.8
24	135	75	75	120	90	25	0	80L	10R	3.5	3.5	1.5	112.5	---	120.3
25	120	90	90	75	100	90	10L	80L	10L	3.0	4.0	1.5	110.8	---	120.3
Max	165	150	150	150	150	175	50L/15R	100L	45L/10R	6.0	4.0	2.0	115.5	119.9	123.7
Min	0	60	60	75	50	25	0	0	0	2.0	3.0	1.0	108.8	117.7	117.8
AVG	111	101	101	111	114	102	12L	41L	13L	3.6	3.8	1.7	111.9	118.7	121.6

^a L - left; R - right

Table 12. Performance data: type 1, 2, and 3 birdscare devices fired from type 1 gun in hand-held mode (approximately 45 degrees elevation)

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft) ^a			Fuze burn time (sec)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	0	15	20	200	250	180	20L	25L	10L	2.5	4.0	2.0
2	0	9	20	240	260	165	20L	20L	10L	4.0	4.0	2.0
3	0	6	20	130	260	200	15L	15L	5L	4.0 ^b	4.0	2.0
4	25	12	20	250	250	180	25L	15L	10L	3.5	4.0	2.0
5	15	12	35	250	250	200	20L	10L	15L	4.0	4.0	2.0
6	10	15	20	240	275	165	15L	15L	15L	3.5	4.0	2.0
7	40	0	15	240	260	130	15L	15L	15L	2.0	4.5	2.0
8	30	3	25	240	250	180	25L	10L	20L	2.5	4.0	2.0
9	15	30	15	250	275	180	25L	20L	15L	3.0	4.0	2.0
10	0	30	30	275	275	180	10L	20L	15L	7.0	4.0	1.5
Max	40	30	35	275	275	200	25L	25L	20L	7.0	4.5	2.0
Min	0	0	15	130	250	130	10L	10L	5L	2.0	4.0	1.5
Avg	14	13	22	232	261	176	19L	17L	13L	3.6	4.1	2.0

^a L - left.

^b Wad stuck in barrel.

Table 13. Performance data; type 1, 2, and 3 birdscare devices fired from type 2 gun at a 0-degree elevation

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft) ^a			Fuze burn time (sec)			Noise level (dBA)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	0	0	0	182	180	210	5L	10L	5L	12.0 ^b	4.0	2.0	111.2	117.6	124.1
2	0	0	0	162	182	182	10L	10L	10L	3.5	4.0	2.0	110.9	115.1	123.3
3	0	0	0	180	182	152	10L	15L	5L	12.0 ^b	4.0	2.0	112.7	122.4	125.4
4	0	0	0	162	165	132	10L	15L	5L	4.0	4.0	2.0	111.5	119.4	120.0
5	0	0	0	200	152	75	15L	10L	5L	4.5	4.0	5.0 ^b	114.0	117.6	119.5
6	0	0	0	172	180	75	5L	10L	10L	5.0	4.0	2.0	110.1	119.6	116.7
7	0	0	0	150	252	70	10L	5L	5L	c	4.0	2.0	110.0	119.6	123.2
8	0	0	0	162	152	212	10L	5L	5L	c	4.0	2.0	112.1	119.8	122.0
9	0	0	0	200	250	152	10L	10L	5L	c	4.0	2.0	112.8	117.0	123.6
10	0	0	0	182	182	75	5L	10L	15L	4.0	3.0	8.0 ^b	111.6	118.0	118.1
Max	0	0	0	200	252	212	15L	15L	15L	12.0	4.0	8.0	114.0	122.4	125.4
Min	0	0	0	150	152	70	5L	5L	5L	3.5	3.0	2.0	110.0	115.1	116.7
AVG	0	0	0	175	188	134	9L	10L	7L	6.4	3.9	2.9	111.7	118.6	121.6

^a L - left.

^b Pyrotechnic projectile ruptured on impact with the ground and burned.

^c Fuze separated from pyrotechnic projectile on impact with ground.

Table 14. Performance data; type 1, 2, and 3 birdscare devices fired from type 2 gun at a 45-degree elevation

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft) ^a			Fuze burn time (sec)			Noise level (dBA) ^b
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1
1	195	75	135	250	180	200	30L	10L	45L	4.0	4.0	2.0	113.8
2	105	60	150	250	220	180	25L	40L	30L	4.0	4.0	2.0	110.9
3	0	75	150	0	230	200	50L	15L	30L	c	3.5	2.0	113.4
4	135	75	150	220	200	200	75L	20L	25L	4.0	3.5	2.0	113.2
5	135	75	150	220	230	180	25L	20L	40L	3.5	4.0	2.0	112.3
6	150	120	165	220	230	180	70L	40L	40L	3.0	3.5	1.5	110.5
7	135	135	160	210	250	180	45L	35L	10L	5.0	4.0	2.0	110.3
8	120	90	135	250	230	220	0	10L	15L	4.0	3.5	3.0	110.9
9	150	90	135	230	210	150	20L	25L	15L	3.0	4.0	2.0	111.7
10	120	90	165	210	200	180	10L	25L	10L	3.0	4.0	2.0	109.6
11	0	90	120	200	200	150	10L	30L	15L	5.0	3.0	2.5	113.3
12	150	105	135	250	180	185	75L	40L	25L	1.0	4.0	2.0	111.4
13	120	175	150	180	180	200	70L	45L	40L	3.5	4.0	2.0	---
14	135	75	150	200	210	185	65L	60L	30L	4.0	4.0	2.0	---
15	125	75	135	200	185	165	35L	30L	25L	4.0	3.5	2.0	---
16	90	90	150	220	185	165	0	30L	25L	0.5	4.0	2.0	---
17	150	60	165	130	200	165	40L	15L	10L	3.5	3.5	2.0	---
18	120	90	150	230	185	180	25L	10L	10L	3.0	3.5	2.0	---
19	155	90	150	180	185	200	15L	10L	30L	2.5	4.0	2.0	---
20	30	105	135	200	185	210	30L	25L	20L	6.0	3.0	1.5	---
21	120	175	135	250	180	150	30L	40L	20L	3.5	4.0	2.0	---
22	135	60	150	185	185	200	100L	20L	25L	3.0	3.0	2.0	---
23	135	90	150	200	200	200	80L	15L	40L	3.0	4.0	2.5	---
24	105	60	150	180	200	210	80L	15L	35L	4.0	4.0	2.0	---
25	135	90	165	250	175	185	60L	25L	45L	3.5	3.5	2.0	---
Max	195	175	165	250	250	220	100L	60L	45L	6.0	4.0	3.0	113.8
Min	0	60	120	0	175	150	0	10L	10L	0.5	3.0	1.5	109.6
Avg	118	93	147	205	201	185	43L	26L	26L	3.4	3.7	2.0	111.8

^a L - left.

^b Type 1 only. Noise level for types 2 and 3 not measured due to instrumentation malfunction.

^c Fuze separated from pyrotechnic projectile on impact with ground.

Table 15. Performance data; type 1, 2, and 3 birdscare devices fired from type 2 gun in hand-held mode (approximately 45 degrees elevation)

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft)			Fuze burn time (sec)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	25	0	20	230	250	185	10L	15L	10L	3.0	3.0	2.0
2	0	15	30	275	250	165	15L	20L	10L ^b	4.5	4.0	2.0
3	a	3	20 ^b	c	250	140	c	20L	15L ^b	c	4.0	2.0 ^b
4	0	5	30	300	250	220	20L	25L	20L	5.0	4.0	2.0
5	20	5	40	250	250	200	20L	40L	20L	3.0	3.5	2.0
6	15	10	20 ^b	275	230	150 ^b	25L	20L	15L ^b	2.0	3.0	2.0 ^b
7	0	20	20	275	250	165	30L	20L	10L	5.0	3.0	1.5
8	20	2	25	185	250	185	20L	25L	15L	2.0	4.0	2.0
9	15	1	30	250	275	185	25L	35L	15L	4.0	4.0	2.0
10	35	15	30	200	275	200	20L	30L	25L	2.0	3.5	2.0
Max	35	20	40	300	275	220	30L	40L	25L	5.0	4.0	2.0
Min	0	0	20	185	230	140	10L	15L	10L	2.0	3.0	1.5
AVG	13	8	27	224	253	180	21L	25L	16L	3.6	3.6	2.0

^a L - left.

^b Over propellant wad stuck in the barrel.

^c Pyrotechnic projectile exploded in the bore of the gun.

Table 16. Performance data; type 1, 2, and 3 birdscare devices fired from type 3 gun at a 0-degree elevation

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft) ^a			Fuze burn time (sec)			Noise level (dBA)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	0	0	0	165	175	125	5L	5L	10L	4.0	4.0	2.0	120.2	123.3	120.5
2	0	0	0	200	145	135	5L	5L	10L	10.0 ^b	4.0	2.0	125.2	121.4	123.7
3	0	0	0	165	130	130	10L	10L	10L	c	4.0	2.0	120.2	121.2	120.7
4	0	0	0	210	165	125	10L	5L	5L	2.0	4.0	2.5	122.1	119.9	123.4
5	0	0	0	150	150	145	15L	5L	10L	2.5	4.0	2.0	122.9	120.9	124.2
6	0	0	0	130	135	135	15L	10L	15L	6.0	0	1.0	121.6	119.9	125.2
7	0	0	0	210	130	130	15L	10L	10L	4.0	4.0	2.0	124.5	120.4	124.7
8	0	0	0	180	180	125	10L	5L	10L	1.5	4.0	1.5	126.0	118.2	117.9
9	0	0	0	180	130	180	10L	5L	10L	5.0	4.0	2.0	120.0	121.8	121.8
10	0	0	0	175	165	125	15L	10L	15L	4.5	4.0	1.5	122.3	121.5	118.0
Max	0	0	0	210	180	180	15L	10L	15L	10.0	4.0	2.0	126.0	123.3	125.2
Min	0	0	0	130	130	125	5L	5L	5L	1.5	4.0	1.5	120.0	118.2	117.9
Ave	0	0	0	177	151	136	11L	7L	11L	4.4	4.0	1.9	122.5	120.9	122.0

^a L - left.

^b Pyrotechnic projectile ruptured on impact with ground.

^c Fuze separated from the pyrotechnic projectile on impact with ground.

Table 17. Performance data; type 1, 2, and 3 birdscare devices fired from type 3 gun at a 45-degree elevation

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft) ^a			Fuze burn time (sec)			Noise level (dBA)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	90	3	105	185	200	180	45L	40L	15L	3.0	4.0	2.0	122.7	122.8	121.3
2	75	30	120	230	220	150	30L	25L	20L	3.0	4.0	2.0	123.9	122.2	118.9
3	0	45	120	250	230	150	40L	20L	10L	4.5	4.0	2.0	122.6	120.4	115.6
4	75	0	120	210	---	165	35L	---	15L	3.0	b	2.0	124.3	119.4	121.8
5	105	0	135	700	220	180	50L	50L	20L	3.0	3.5	2.0	123.9	122.3	121.5
6	0	15	120	250	220	180	20L	40L	25L	4.5	4.0	2.0	123.5	120.8	122.2
7	0	30	120	---	240	175	30L	30L	40L	b	4.0	2.0	124.0	123.3	121.6
8	0	15	120	200	220	175	45L	40L	15L	4.0	4.0	2.0	113.8	122.5	122.8
9	0	6	135	220	230	175	40L	45L	15L	4.0	4.0	2.0	123.9	120.3	121.6
10	20	0	120	210	240	180	50L	40L	30L	3.0	4.0	2.0	121.4	121.4	122.2
11	30	6	105	210	230	180	25L	25L	30L	3.0	4.0	2.0	117.1	120.5	122.0
12	0	9	135	250	220	150	15L	30L	25L	4.0	4.0	2.0	123.2	121.1	120.6
13	0	6	105	---	240	165	---	25L	20L	b	4.0	2.0	123.2	121.0	121.3
14	0	9	120	150	240	150	40L	40L	15L	s.5	4.0	2.0	107.4	120.5	122.8
15	90	15	120	150	250	150	60L	45L	15L	2.0	4.0	2.0	120.9	121.4	119.8
16	0	6	90	185	230	165	35L	45L	10L	4.5	4.0	2.0	115.6	121.4	121.3
17	15	45	105	250	210	165	40L	20L	30L	4.0	4.0	2.0	124.4	120.9	122.2
18	0	45	105	165	250	165	75L	20L	25L	5.5	4.0	2.0	110.4	125.6	122.8
19	45	9	120	220	220	210	35L	30L	25L	3.5	4.0	2.0	120.8	122.6	126.0
20	0	0	120	155	220	180	60L	40L	35L	5.0	4.0	2.0	103.5	121.8	122.7
21	0	15	135	---	210	150	---	25L	10L	b	4.0	1.5	119.4	122.9	123.6
22	45	60	105	230	210	180	35L	15L	40L	3.5	3.5	2.0	121.5	122.9	122.2
23	0	15	120	220	230	180	35L	30L	20L	5.0	4.0	2.0	124.2	120.3	121.5
24	60	15	120	230	250	200	40L	25L	20L	4.0	4.0	2.0	123.5	122.8	123.9
25	15	60	90	210	260	150	40L	15L	10L	4.0	4.0	2.0	121.3	122.0	121.9
Max	105	60	135	250	260	210	75L	50L	40L	5.5	4.0	2.0	124.4	125.6	126.0
Min	0	0	90	150	200	150	15L	15L	10L	2.0	3.5	1.5	103.5	119.4	115.6
AVG	27	18	116	208	229	170	40L	32L	21L	3.8	4.0	2.0	120.0	121.7	121.8

^a L - left.

^b Fuze separated from the pyrotechnic projectile on impact with ground.

Table 18. Performance data; type 1, 2, and 3 birdscare devices fired from type 3 gun in hand-held mode (approximately 45 degrees elevation)

Shot no.	Height of burst (ft)			Range (ft)			Drift (ft)			Fuze burn time (sec)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
1	0	20	25	250	150	185	15L	15L	20L	5.0	2.0	3.5
2	15	5	35	275	240	165	15L	25L	10L	4.0	4.0	2.0
3	30	4	40	250	250	150	15L	20L	10L	3.0	4.0	2.0
4	0	5	25	275	210	150	20L	15L	15L	4.0	4.0	2.0
5	0	10	30	---	210	150	---	15L	15L	b	4.0	2.0
6	0	0	40	---	---	165	---	---	20L	b	b	2.0
7	3	15	30	250	230	135	20L	15L	15L	4.0	4.0	2.0
8	20	10	35	250	200	140	15L	10L	10L	4.0	4.0	2.0
9	3	10	25	200	220	150	10L	20L	15L	4.0	4.0	2.0
10	6	10	40	250	220	160	20L	20L	20L	4.0	4.0	2.0
Max	30	20	40	275	250	185	20L	25L	20L	5.0	4.0	3.5
Min	0	0	25	200	150	135	10L	10L	10L	3.0	2.0	2.0
AVG	8	9	33	250	214	155	14L	17L	15L	4.0	3.8	2.2

^a L - left.

^b Fuze burned but pyrotechnic projectile did not explode.

Table 19. Performance data; type 4 and 5 15-mm birdscore devices fired from type 4 gun at a 0-degree elevation

Shot no.	Height of burst (ft)		Range (ft)		Drift (ft) ^a		Fuze burn time (sec)	
	Type 4	Type 5	Type 4	Type 5	Type 4	Type 5	Type 4	Type 5
1	0	---	75	300	0	0	1.5	2.0
2	0	---	75	150	0	0	2.0	1.5
3	0	---	75	100	0	0	2.0	1.0
4	0	---	75	100	0	45L	2.0	1.0
5	0	---	75	100	0	0	2.0	1.0
6	0	---	75	150	0	0	2.0	1.5
7	0	---	75	100	0	0	1.5	1.0
8	0	---	75	150	0	50L	2.0	1.5
9	0	---	75	300	0	0	2.0	2.0
10	0	---	75	75	0	0	2.0	1.0
Max	0	---	75	300	0	50L	2.0	2.0
Min	0	---	75	75	0	45L	1.5	1.0
Avg	0	---	75	153	0	10L	1.9	1.5
^a L - left.								

Table 20. Performance data; type 4 and 5 15-mm birdscare devices fired from type 4 gun at a 45-degree elevation

Shot no.	Height of burst (ft)		Range (ft)		Drift (ft)		Fuze burn time (sec)	
	Type 4	Type 5	Type 4	Type 5	Type 4	Type 5	Type 4	Type 5
1	60	---	150	300	0	0	1.5	2.0
2	75	---	120	300	0	0	2.0	2.0
3	60	---	75	300	0	0	2.0	2.0
4	90	---	60	300	0	0	2.0	2.0
5	90	---	60	300	0	0	2.0	2.0
6	105	---	60	300	0	0	2.0	2.0
7	105	---	60	250	0	0	2.0	1.5
8	75	---	75	250	0	0	1.5	2.0
9	75	---	75	250	0	0	1.5	2.5
10	105	---	60	250	0	0	2.0	2.0
11	105	---	60	250	0	0	2.0	2.0
12	75	---	75	300	0	0	2.0	2.5
13	105	---	60	300	0	0	2.0	2.0
14	120	---	60	300	0	0	2.0	2.0
15	75	---	75	300	0	0	1.5	2.0
16	75	---	75	300	0	0	1.5	2.0
17	90	---	60	300	0	0	2.0	2.0
18	90	---	60	300	0	0	2.0	2.0
19	75	---	75	300	0	0	2.0	2.0
20	75	---	60	300	0	0	1.5	1.5
21	90	---	60	300	0	0	1.5	2.0
22	90	---	60	300	0	0	2.0	2.0
23	105	---	75	300	0	0	2.0	2.0
24	75	---	75	300	0	0	2.0	2.0
25	105	---	60	300	0	0	2.0	2.0
Max	120	---	150	300	0	0	2.0	2.5
Min	60	---	60	250	0	0	1.5	1.5
Avg	88	---	71	290	0	0	1.9	2.0

Table 21. Performance data; type 4 and 5 15-mm birdscare devices fired from type 4 gun in hand-held mode (approximately 45-degrees elevation)

Shot no.	Height of burst (ft)		Range (ft)		Drift (ft) ^a		Fuze burn time (sec)	
	Type 4	Type 5	Type 4	Type 5	Type 4	Type 5	Type 4	Type 5
1	60	---	60	300	0	0	1.5	2.0
2	90	---	45	200	0	0	2.0	1.5
3	75	---	45	200	0	0	2.0	2.0
4	75	---	30	200	0	0	2.0	2.0
5	75	---	60	200	0	0	2.0	2.0
6	60	---	60	300	0	0	1.5	2.0
7	60	---	45	300	0	0	1.5	2.0
8	75	---	60	300	0	0	1.5	1.5
9	90	---	45	300	0	0	2.0	2.0
10	105	---	30	300	0	0	2.0	2.0
11	105	---	30	300	0	0	2.0	2.0
12	90	---	30	300	30R	0	2.0	2.0
13	90	---	45	300	30R	0	2.0	1.5
14	105	---	45	300	0	0	2.0	2.0
15	75	---	60	300	0	0	2.0	2.0
16	75	---	45	300	0	0	2.0	2.0
17	90	---	45	300	0	0	2.0	2.0
18	90	---	45	200	0	0	2.0	2.0
19	60	---	45	200	0	0	2.0	2.0
20	60	---	30	300	0	0	2.0	2.0
21	75	---	40	300	0	0	2.0	2.0
22	75	---	60	300	0	0	2.0	2.0
23	60	---	60	300	0	0	2.0	2.0
24	60	---	45	300	0	0	1.5	2.0
25	75	---	45	300	0	0	2.0	2.0
Max	105	---	60	300	30R	0	2.0	2.0
Min	60	---	30	200	30R	0	1.5	1.5
Avg	78	---	46	276	2.4R	0	1.9	1.9

^a R - right.

SECTION V

SUMMARY OF FINDINGS

1. Results of the physical characteristics investigation were as follows:
 - a. Type 1, 2, and 3 birdscares had star-crimped, plastic cartridge cases with a steel base and percussion type primers.
 - b. Type 1 birdscares had a double-based propellant; type 2 had black powder propellant; and type 3 had a black powder substitute.
 - c. Type 1 and 2 birdscares had a wick type pyrotechnic projectile fuze; type 3 had an internal lead type fuze.
 - d. Type 1, 2 and 3 birdscares had cylindrical shaped pyrotechnic projectiles with cardboard case. The projectile weight ranged from 5.8 to 6.9 grams.
 - e. No physical abnormalities with the type 1, 2 and 3 devices were discovered with the exception of an unsealed hole at the center of the star crimp and one type 1 device was found without a propellant charge.
2. Results of the functional performance evaluation were as follows:
 - a. Of the 135 type 1 birdscares tested, 17 failures occurred. Four devices failed due to the fuze separating from the projectile; four failures occurred due to the fuze not igniting; three failures were due to the projectile casing rupturing upon ground impact and burning; three devices failed due to the fuze burning but not detonating; one device failed due to the over propellant wad sticking in the gun barrel; one failure occurred due to a long fuze burn time; and one failure was due to an in bore explosion. Of the 135 type 2 birdscares tested, three failures occurred. One failure was due to the fuze separating from the projectile, and two failures occurred due to the fuze not igniting. Of the 135 type 3 birdscares tested, four failures occurred. Two of the devices failed due to the projectile casing rupturing upon ground impact and burning, and two failures were due to the wad over propellant sticking in the gun barrel.
 - b. The chamber pressure and muzzle velocity obtained using the type 1 launcher with type 1 birdscares varied respectively from 243 to 1,680 pounds force per square inch and from 310 to 676 feet per second. With the type 2 device, the pressure varied from 173 to 794 pounds-force per square inch and the velocity from 451 to 577 feet per second. With type 3 device, the pressure varied from 4 to 1,747 pounds-force per square inch and the velocity from 297 to 533 feet per second.
 - c. The chamber pressure and muzzle velocity obtained using the type 2 launcher with type 1 birdscares varied respectively from 266 to 2,010 pounds-force per square inch and from 264 to 656 feet per second. With the type 2 device, the pressure varied from 165 to 827 pounds-force per square inch and the velocity from 493 to 590 feet per second. With the type 3 device, the pressure varied from 189 to 603 pounds-force per square inch and the velocity from 241 to 474 feet per second.

d. The muzzle velocity obtained using a type 3 launcher with type 1 birdscare device varied from 298 to 465 feet per second. With the type 2 device, the velocity varied from 310 to 361 feet per second. With the type 3 device, the velocity varied from 135 to 293 feet per second.

e. Range, drift, and noise data for the birdscare pyrotechnic projectiles are contained in Tables 10 through 18.

3. Type 1, 2, and 3 birdscare devices were compatible with the type 1, 2, and 3 launchers used during this test.

4. Type 4 and 5 birdscare devices were compatible with the type 4 launcher used during this test.

5. Sixty of each of the type 4 and 5 birdscare devices were tested with no failures. Range and drift for the type 4 and 5 pyrotechnic projectiles are contained in Tables 19 through 21.

6. Three of each of the type 1, 2, and 3 birdscare pyrotechnic projectiles were exploded at 2 inches forward of the chamber, at mid-point, and just aft of the muzzle in type 1 and 2 launcher barrels to simulate inbore explosions. The barrels were measured before and after each explosion with no barrel deformation detected.

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APPENDIX A
 BIRDSCARE DEVICE PHYSICAL CHARACTERISTICS

Item no.	Length (in.)	Diameter (in.)			
		Base	Body	Mouth	Flange
Type 1 birdscare device					
1	2.393	0.801	0.785	0.790	0.877
2	2.387	0.801	0.778	0.784	0.876
3	2.404	0.801	0.783	0.788	0.881
4	2.407	0.801	0.778	0.789	0.876
5	2.392	0.801	0.783	0.788	0.876
6	2.386	0.801	0.797	0.789	0.874
7	2.384	0.801	0.786	0.791	0.876
8	2.385	0.801	0.771	0.783	0.872
9	2.406	0.803	0.788	0.791	0.881
10	2.408	0.802	0.782	0.787	0.887
11	2.397	0.802	0.779	0.783	0.877
12	2.418	0.802	0.776	0.783	0.876
13	2.395	0.801	0.788	0.790	0.878
14	2.410	0.801	0.787	0.787	0.875
15	2.389	0.802	0.776	0.783	0.880
16	2.396	0.801	0.787	0.790	0.878
17	2.396	0.802	0.789	0.793	0.872
18	2.393	0.801	0.784	0.794	0.877
19	2.392	0.801	0.780	0.792	0.880
20	2.387	0.802	0.791	0.787	0.873
21	2.394	0.801	0.783	0.787	0.876
22	2.393	0.801	0.781	0.785	0.873
23	2.398	0.802	0.783	0.784	0.879
24	2.401	0.801	0.783	0.787	0.876
25	2.389	0.801	0.780	0.782	0.877
26	2.394	0.802	0.780	0.783	0.871
27	2.397	0.801	0.774	0.780	0.878
28	2.392	0.802	0.787	0.788	0.874
29	2.407	0.802	0.782	0.784	0.877
30	2.396	0.801	0.785	0.787	0.876
31	2.401	0.801	0.780	0.784	0.876
32	2.403	0.801	0.787	0.793	0.879
33	2.402	0.802	0.787	0.788	0.874
34	2.390	0.802	0.773	0.783	0.874
35	2.384	0.802	0.779	0.784	0.874
36	2.413	0.802	0.792	0.793	0.875
37	2.395	0.801	0.782	0.787	0.874
38	2.392	0.801	0.779	0.782	0.875
39	2.410	0.802	0.774	0.782	0.876
40	2.397	0.801	0.791	0.787	0.874

CONTINUED

Item no.	Length (in.)	Diameter (in.)			
		Base	Body	Mouth	Flange
41	2.389	0.801	0.789	0.784	0.877
42	2.402	0.802	0.780	0.793	0.876
43	2.395	0.801	0.777	0.786	0.877
44	2.403	0.802	0.779	0.785	0.874
45	2.388	0.801	0.783	0.785	0.878
46	2.391	0.801	0.780	0.783	0.874
47	2.382	0.801	0.785	0.788	0.875
48	2.410	0.802	0.777	0.784	0.877
49	2.406	0.801	0.776	0.785	0.873
50	2.412	0.802	0.775	0.787	0.875
51	2.403	0.802	0.785	0.792	0.880
52	2.402	0.801	0.780	0.789	0.880
53	2.403	0.802	0.782	0.785	0.877
54	2.404	0.802	0.784	0.789	0.873
55	2.395	0.801	0.776	0.792	0.873
56	2.394	0.802	0.782	0.785	0.877
57	2.401	0.802	0.786	0.781	0.876
58	2.404	0.801	0.786	0.787	0.879
59	2.396	0.801	0.783	0.786	0.880
60	2.401	0.801	0.780	0.789	0.880
61	2.403	0.801	0.776	0.783	0.880
62	2.392	0.802	0.773	0.786	0.876
63	2.402	0.802	0.787	0.792	0.873
64	2.394	0.801	0.780	0.785	0.878
65	2.404	0.801	0.779	0.787	0.877
66	2.407	0.803	0.774	0.783	0.881
67	2.395	0.801	0.782	0.787	0.874
68	2.395	0.802	0.783	0.786	0.877
69	2.399	0.802	0.790	0.791	0.878
70	2.383	0.801	0.780	0.785	0.877
71	2.390	0.803	0.774	0.783	0.880
72	2.399	0.802	0.783	0.788	0.877
73	2.396	0.801	0.779	0.788	0.877
74	2.387	0.801	0.782	0.782	0.881
75	2.386	0.801	0.780	0.784	0.877
76	2.385	0.804	0.783	0.783	0.876
77	2.385	0.802	0.785	0.785	0.871
78	2.386	0.802	0.785	0.792	0.879
79	2.393	0.802	0.788	0.788	0.878
80	2.388	0.802	0.783	0.793	0.871
81	2.390	0.802	0.779	0.779	0.874
82	2.406	0.802	0.776	0.779	0.877
83	2.403	0.802	0.777	0.775	0.877
84	2.399	0.803	0.772	0.784	0.880
85	2.405	0.803	0.780	0.785	0.881

CONTINUED

Item no.	Length (in.)	Diameter (in.)			
		Base	Body	Mouth	Flange
Type 2 birdscare device					
1	2.362	0.802	0.786	0.798	0.879
2	2.366	0.801	0.781	0.793	0.879
3	2.363	0.801	0.778	0.797	0.879
4	2.352	0.802	0.776	0.793	0.879
5	2.360	0.800	0.773	0.796	0.878
6	2.363	0.800	0.781	0.794	0.879
7	2.369	0.802	0.779	0.790	0.879
8	2.363	0.802	0.789	0.800	0.878
9	2.363	0.802	0.784	0.798	0.879
10	2.362	0.802	0.783	0.802	0.879
11	2.365	0.802	0.778	0.794	0.879
12	2.365	0.801	0.786	0.798	0.879
13	2.364	0.802	0.776	0.795	0.879
14	2.370	0.800	0.784	0.801	0.879
15	2.367	0.800	0.788	0.799	0.879
16	2.361	0.801	0.777	0.793	0.879
17	2.369	0.802	0.785	0.797	0.879
18	2.366	0.801	0.775	0.792	0.879
19	2.354	0.802	0.781	0.798	0.879
20	2.357	0.801	0.777	0.795	0.879
21	2.370	0.802	0.784	0.801	0.879
22	2.352	0.801	0.781	0.797	0.879
23	2.362	0.800	0.782	0.792	0.879
24	2.370	0.801	0.782	0.794	0.879
25	2.361	0.801	0.775	0.792	0.879
26	2.362	0.800	0.783	0.797	0.879
27	2.361	0.803	0.777	0.792	0.879
28	2.362	0.800	0.781	0.796	0.879
29	2.369	0.801	0.781	0.796	0.879
30	2.352	0.801	0.780	0.795	0.879
31	2.360	0.800	0.780	0.797	0.879
32	2.361	0.801	0.780	0.797	0.879
33	2.361	0.800	0.784	0.798	0.879
34	2.361	0.801	0.783	0.800	0.879
35	2.364	0.800	0.777	0.795	0.879
36	2.359	0.801	0.780	0.796	0.879
37	2.353	0.802	0.780	0.792	0.879
38	2.362	0.800	0.789	0.793	0.879
39	2.358	0.801	0.783	0.794	0.879
40	2.350	0.801	0.777	0.792	0.879
41	2.365	0.800	0.776	0.797	0.879
42	2.365	0.802	0.774	0.793	0.879
43	2.357	0.801	0.781	0.794	0.879
44	2.352	0.800	0.783	0.792	0.879
45	2.359	0.800	0.781	0.792	0.879

CONTINUED

Item no.	Length (in.)	Diameter (in.)			
		Base	Body	Mouth	Flange
46	2.370	0.800	0.780	0.797	0.879
47	2.352	0.800	0.785	0.793	0.879
48	2.363	0.800	0.782	0.794	0.879
49	2.364	0.801	0.788	0.797	0.879
50	2.360	0.801	0.785	0.794	0.879
51	2.366	0.801	0.781	0.797	0.879
52	2.363	0.803	0.783	0.794	0.879
53	2.359	0.800	0.778	0.795	0.879
54	2.364	0.801	0.771	0.795	0.879
55	2.375	0.801	0.786	0.796	0.879
56	2.371	0.801	0.780	0.793	0.879
57	2.358	0.802	0.783	0.793	0.879
58	2.359	0.802	0.783	0.793	0.879
59	2.375	0.802	0.781	0.795	0.879
60	2.370	0.801	0.778	0.799	0.879
61	2.350	0.800	0.777	0.790	0.879
62	2.357	0.800	0.780	0.795	0.879
63	2.359	0.799	0.784	0.788	0.879
64	2.355	0.800	0.784	0.795	0.879
65	2.361	0.801	0.774	0.796	0.879
66	2.360	0.801	0.767	0.793	0.879
67	2.363	0.802	0.777	0.795	0.879
68	2.365	0.799	0.776	0.797	0.879
69	2.355	0.799	0.780	0.789	0.879
70	2.373	0.800	0.781	0.794	0.879
71	2.362	0.800	0.775	0.792	0.879
72	2.367	0.801	0.777	0.801	0.879
73	2.364	0.800	0.778	0.793	0.879
74	2.358	0.802	0.781	0.796	0.879
75	2.362	0.801	0.778	0.799	0.879
76	2.358	0.800	0.788	0.791	0.878
77	2.367	0.800	0.776	0.797	0.879
78	2.378	0.803	0.784	0.793	0.878
79	2.357	0.800	0.788	0.793	0.879
80	2.358	0.788	0.777	0.800	0.879
81	2.376	0.801	0.786	0.798	0.878
82	2.360	0.800	0.785	0.797	0.879
83	2.361	0.801	0.786	0.792	0.879
84	2.356	0.802	0.772	0.792	0.880
85	2.371	0.800	0.777	0.793	0.880
Type 3 birdscore device					
1	2.302	0.803	0.777	0.784	0.880
2	2.298	0.804	0.772	0.784	0.877
3	2.301	0.801	0.774	0.784	0.880
4	2.300	0.803	0.773	0.781	0.880
5	2.300	0.801	0.779	0.782	0.883

CONTINUED

Item no.	Length (in.)	Diameter (in.)			
		Base	Body	Mouth	Flange
6	2.296	0.804	0.775	0.783	0.881
7	2.302	0.801	0.768	0.782	0.880
8	2.303	0.803	0.777	0.792	0.882
9	2.300	0.802	0.772	0.782	0.881
10	2.300	0.803	0.779	0.784	0.878
11	2.306	0.803	0.784	0.782	0.877
12	2.298	0.805	0.769	0.785	0.882
13	2.299	0.802	0.777	0.792	0.881
14	2.302	0.801	0.771	0.789	0.877
15	2.299	0.803	0.776	0.785	0.881
16	2.299	0.804	0.778	0.789	0.880
17	2.300	0.802	0.772	0.788	0.881
18	2.296	0.804	0.779	0.789	0.879
19	2.302	0.778	0.769	0.788	0.877
20	2.302	0.804	0.773	0.785	0.882
21	2.297	0.802	0.776	0.783	0.880
22	2.299	0.800	0.771	0.778	0.881
23	2.293	0.792	0.770	0.782	0.882
24	2.297	0.801	0.772	0.785	0.881
25	2.300	0.805	0.766	0.785	0.877
26	2.304	0.802	0.769	0.787	0.877
27	2.303	0.802	0.772	0.791	0.883
28	2.298	0.800	0.782	0.784	0.879
29	2.303	0.802	0.772	0.791	0.883
30	2.290	0.803	0.770	0.784	0.881
31	2.293	0.800	0.772	0.787	0.879
32	2.303	0.801	0.767	0.793	0.879
33	2.298	0.801	0.763	0.786	0.884
34	2.301	0.801	0.773	0.786	0.881
35	2.293	0.803	0.772	0.789	0.881
36	2.302	0.800	0.773	0.785	0.881
37	2.293	0.801	0.767	0.786	0.882
38	2.298	0.802	0.777	0.785	0.880
39	2.295	0.803	0.765	0.784	0.879
40	2.298	0.798	0.769	0.784	0.881
41	2.298	0.802	0.766	0.786	0.882
42	2.293	0.800	0.777	0.784	0.880
43	2.299	0.802	0.769	0.782	0.882
44	2.298	0.801	0.771	0.787	0.882
45	2.294	0.802	0.773	0.789	0.882
46	2.298	0.802	0.778	0.790	0.883
47	2.300	0.803	0.764	0.786	0.882
48	2.293	0.801	0.762	0.784	0.879
49	2.300	0.802	0.778	0.791	0.881
50	2.303	0.802	0.762	0.780	0.882

CONTINUED

Item no.	Length (in.)	Diameter (in.)			
		Base	Body	Mouth	Flange
51	2.296	0.803	0.774	0.784	0.883
52	2.299	0.802	0.764	0.784	0.882
53	2.298	0.803	0.769	0.785	0.879
54	2.298	0.803	0.775	0.783	0.881
55	2.301	0.802	0.772	0.785	0.881
56	2.302	0.800	0.770	0.781	0.881
57	2.297	0.801	0.769	0.786	0.881
58	2.302	0.802	0.770	0.786	0.883
59	2.304	0.802	0.764	0.785	0.881
60	2.295	0.800	0.775	0.787	0.881
61	2.296	0.802	0.777	0.787	0.882
62	2.299	0.803	0.774	0.785	0.882
63	2.302	0.803	0.777	0.784	0.881
64	2.300	0.802	0.778	0.788	0.879
65	2.296	0.801	0.769	0.787	0.881
66	2.297	0.804	0.770	0.785	0.883
67	2.299	0.804	0.773	0.789	0.881
68	2.298	0.803	0.772	0.785	0.882
69	2.296	0.800	0.761	0.778	0.881
70	2.295	0.800	0.771	0.785	0.882
71	2.298	0.803	0.772	0.780	0.880
72	2.295	0.801	0.771	0.783	0.883
73	2.301	0.800	0.775	0.784	0.882
74	2.301	0.801	0.763	0.785	0.880
75	2.303	0.804	0.779	0.787	0.882
76	2.301	0.803	0.777	0.788	0.878
77	2.300	0.802	0.782	0.783	0.883
78	2.297	0.800	0.777	0.780	0.880
79	2.298	0.801	0.766	0.779	0.882
80	2.297	0.800	0.774	0.783	0.882
81	2.296	0.803	0.769	0.776	0.878
82	2.300	0.802	0.782	0.782	0.882
83	2.298	0.800	0.772	0.780	0.882
84	2.300	0.797	0.774	0.784	0.880
85	2.302	0.803	0.788	0.786	0.882

Note: See Table 1 for mean and standard deviation.

APPENDIX B
METRIC CONVERSION FACTORS

This appendix presents conversion factors to convert from units customarily used in the United States to metric units. This information was extracted from Pamphlet E380-76, American Society for Testing and Materials (ASTM), 19 January 1976, which was approved 19 January 1976 for use within the Department of Defense.

<u>To convert from</u>	<u>To</u>	<u>Multiply by</u>
Foot (ft)	Meter (m)	3.048 000 E-01
Inch (in.)	Meter (m)	2.540 000 E-02
Degree (angle) (deg)	Radian (rad)	1.745 329 E-02
Pound-force per square inch (lbf/in. ²)	Pascal (pa)	6.894 757 E+03

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DISTRIBUTION LIST

Hq USAF		TAC	
Wash DC 20330		Langley AFB VA 23365	
LEYW	1	DRW	1
SAMI	1	LGW	1
XOORE	1	DRA	1
XOORI		INAT	1
AFIS/INTA	1	SM-ALC(MMSR)	1
Wash DC 20330		McClellan AFB CA 95652	
AFSC		AFEWC/EST	2
Andrews		San Antonio TX 78243	
TEV	1		
SDW	1	SA-ALC/MMSREF	1
SDZ	1	San Antonio TX 78243	
AFLC		AFISC/SEW	1
Wright-Patterson AFB OH 45433		Norton AFB CA 92409	
LOWM	1		
LOEA	1	AUL/LSE-70-375	1
		Maxwell AFB AL 36112	
FTD/SDNW	1		
Wright-Patterson AFB OH 45433		57 TTW/DT	1
		Nellis AFB NEV 89191	
ASD		Warner Robins ALC	
Wright-Patterson AFB OH 45433		Robins AFB GA 31098	
ENESH	1		
AEWA	1	MMRR	1
		MMIRBD	1
AFWAL/LOEA	1	MMIRDB	1
Wright-Patterson AFB OH 45433			
		Ogden ALC	
SAC		Hill AFB Utah 84406	
Offutt AFB NE 68113		MMSR	1
INTQ	1	MMWRAS	1
LGWC	1		
SPHN	1	23 TFW/DOW	1
DOOV	1	England AFB LA 71301	
DIA/DB-4C3	1	453 FTS/DOI	1
Wash DC 20301		Stop #19	
		Mather AFB CA 95655	
6510 ABG/SSD, Stop 238	1		
Tech Lib FL 2806		US Army Armament Research &	1
Edwards AFB CA 93523		Development	
		Attn: DRDAR-TSS #59	
Intelligence Ctr Pacific	1	Dover NJ 07801	
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OC-ALC/MMSRG Tinker AFB Okala 73145	1		
LTTTC/TTGXR Lowry AFB CO 80230	2	DTIC Cameron Station Alexandria VA 22314	2
57 TTW/DOSV Nellis AFB NEV 89191	1	Hq PACAF/OA Hickam AFB HI 96853	1
35 TTS/CC George AFB CA 92392	1	314 AD/INT APO SF 96301	1
ADCOM/DOOV Peterson AFB CO 80914	1	Hq 13 AF/LGW APO SF CA 96274	1
AFWL/SUL Tech Lib Kirtland AFB NM 87117	1	366 TFW/DOW Mt Home ID 83648	1
475 Test Sq/TEJ Tyndall AFB FL 32401	1	ASD/ENAD Wright-Patterson AFB OH 45433	1
AFESC/DEVN Tyndall AFB FL 32401	25	Eglin AFB FL 32542 AD	
1st Special Operations Wing/DOW Hurlburt FLD FL 32544	1	DLODL 3201 ABG/HO 3246 TESTW/DO 3246 TESTW/TE 4484FWS/CC	2 1 1 2 1
USAF AGOS/EDO Hurlburt FLD FL 32544	1	TAWC ERW TXA	1 1
8TFW/DO4 APO SF 96264	1		
5 AF/LGW APO SF 96398	1		
USAF/DOOW APO NY 09012	1		