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Technical Memorandum

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114-55-12

CRYSTAL IMPACT FUZING SYSTEM TEST ON THE XW-5/F-101 TYPE C STORE (U)

TM 114-55-12 mc 4/3/04

R. S. Rhodes - 1216

Redacted Version

DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW	
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NAME:	2. CLASSIFICATION CHANGED TO:
2ND REVIEW DATE: 09/11/02	3. CONTAINS NO DOE CLASSIFIED INFO
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AIR FORCE REV. LTR 10/8/02
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ABSTRACT

Tests were performed on the crystal impact system mounted on the nose section of the final configuration of the XW-5/F-101 weapon. Spike type impacts were simulated by using 75 mm projectiles fired at 1000 ft/sec within the expected angle of attack of the weapon.

Case No. 631.0

May 31, 1955

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CRYSTAL IMPACT FUZING SYSTEM TEST ON THE XW-5/F-101 TYPE C STORE

INTRODUCTION

The XW-5/F-101 weapon is designed to be carried externally by the F-101 aircraft at supersonic speeds. The weapon is 32 feet long and contains the XW-5/F-101 warhead, fuzing components, and two fuel cells. The many weapon system delivery capabilities make it possible for weapon impact at angles of 24° to 90° to be obtained. The purpose of this test was to determine the vulnerability of the weapon to spike or corner type impacts back to the major diameter of the weapon.

Figure 1 shows the configuration of the MC-300 crystal system used in the test. The proposed system for the weapon is identical to that tested except that it is planned to mount the two crystals at Station 30.00 diametrically opposite instead of as shown and that it is not planned to use the Channel 3 crystals. Structural interferences in the test nose section prevented the correct orientation at Station 30.00 The Channel 3 crystals mounted at Station 138.28 were so placed to determine the outputs obtainable there should the crystals mounted at Station 98.50 not give sufficient coverage. Although only two crystals were mounted in Channel 3, the network was artificially loaded with capacity to simulate a complete crystal network.

The test nose section was mounted at Station 138.28 to a vertical test stand. The nose was therefore cantilevered toward the gun. This resulted in tension in the upper skin surfaces and compression in the lower skin surfaces. Although the skin stresses should have little effect on the test results, most of the shots were placed on a side of the shape to minimize these effects.

Instrumentation was obtained by connecting two Tektronix oscilloscopes to each network. One scope of each network was set for a fast sweep and one for a slow sweep. Each channel was terminated in a 100 kilohm resistance to simulate the input impedance of the MC-134 X-unit. Capacity of each network was approximately 700 micromicrofarads. Sweep of the oscilloscopes was started by the shorting of two copper screens separated by paper insulation and taped to the skin of the weapon at the target position. Polaroid Land cameras were used to record the output waveform.

RESULTS

Tests were performed April 13, 1955, on the nose section (forward of station 138.28) of the final configuration of the XW-5/F-101 weapon. A total of six shots were placed at different potentially critical areas with the immediate warhead area receiving three of the six. Detailed results of each shot are tabulated in Figure 2.

The first shot was placed directly behind the upper Channel 1 crystal with the projectile starting to enter the skin at about Station 110.00. All three channels produced 30 volts output in less than 0.8 millisecond and 70 volts within 1.2 milliseconds.

The second shot was placed between Channels 1 and 2 at the same station as Shot 1 but through a stiffer part of the structure. All outputs exceeded 45 volts within 0.8 millisecond and 70 volts within 1.0 millisecond.

The third shot was placed directly behind the lower Channel 1 crystal with the projectile starting to enter the skin at about Station 117.00. The outputs of Channels 1 and 2 were greater than 30 volts within 1.3 milliseconds while Channel 3 produced 30 volts at 0.5 millisecond.

The fourth shot was placed directly ahead of the upper Channel 1 crystal at about Station 55.00. The fuel tank was pressurized to 12.5 psi gage prior to the shot to simulate drop conditions. Two distinct outputs were obtained at this shot. As the projectile penetrated the skin, the crystal outputs were greater than 30 volts with less than 1.3 milliseconds penetration time. Then as the projectile passed through the aft fuel tank bulkhead and the Station 98.50 bulkhead, an output of greater than 120 volts was achieved. This is shown in Figure 4.

The fifth shot was placed through the radome directly opposite the Channel 1 crystal. The purpose of the shot was to prove that only one crystal per network was needed at Station 30.00. Outputs in excess of 30 volts were achieved within 0.8 milliseconds from both Channels 1 and 2. As in Shot 4, large outputs were received at about the time the projectile was passing through the aft gas tank bulkhead.

The sixth shot was placed next to the upper Channel 1 crystal on Station 98.50. The purpose of the shot was to see if one channel (Channel 2) could completely cover the Station 98.50 area. Results show that both channels produced over 40 volts output within 1.1 milliseconds of impact. Cables to the Channel 1 crystals were severed at about 1.7 milliseconds, but by this time the channel had produced over 100 volts.

SUMMARY AND CONCLUSIONS

Results of these tests were extremely encouraging in that some of the areas thought previously to have been vulnerable to spikes have now been found to be adequately covered by the proposed crystal system configuration. The accuracy of the test results is felt to be within ±15 per cent.

It is felt that the following conclusions can safely be made as a result of this test:

1. With the proposed crystal system configuration and with one channel operation the weapon is protected from impact on 3-inch diameter or larger spikes back to Station 120.00. With two channel operation, protection extends further aft, but the coverage is irregular and no attempt is being made to define the limits.

2. The Channel 3 crystals are not needed in the system. [redacted] However, since the times obtainable from Station 98.50 crystals are satisfactory, the gains made by mounting crystals on Station 138.28 do not justify the increased complexity of cabling and the decreased sensitivity caused by the added system capacity. The fact that a penetration behind Station 120.00 at 3° toward the weapon axis (the maximum expected angle of attack) would at worst penetrate a half inch into the MC-236 further substantiates this conclusion. DOE b(3)

3. More than adequate coverage is obtained from one crystal per network mounted at Station 30.00.

4. It appears that pressure in the fuel tanks does not significantly affect the crystal outputs at impact.

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Figure 2: Crystal Test Configuration and Shot Location

Shot	Channel	30 Volts	70 Volts	100 Volts
1	1	.55	1.20	1.20
	2	.80	1.50	----
	3	.20	.70	1.90
2	1	.8	1.0	1.0
	2	.8	.9	1.3
	3	.4	.4	.75
3	1	1.3	2.2	----
	2	1.1	----	----
	3	.5	.5	.8
4	1	1.0	3.5	4.0
	2	.7	1.2	4.5
	3	.9	2.5	4.5
5	1	.8	1.6	2.2
	2	.6	1.3	1.3
6	1	1.0	1.3	1.7
	2	1.1	1.6	1.6

Fig. 2 -- Penetration Distance Before Output - Feet

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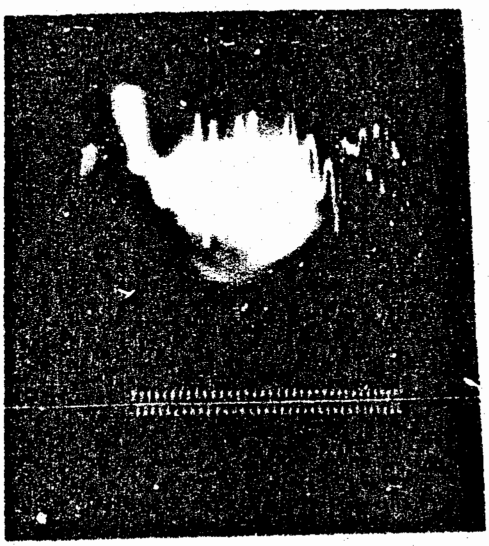
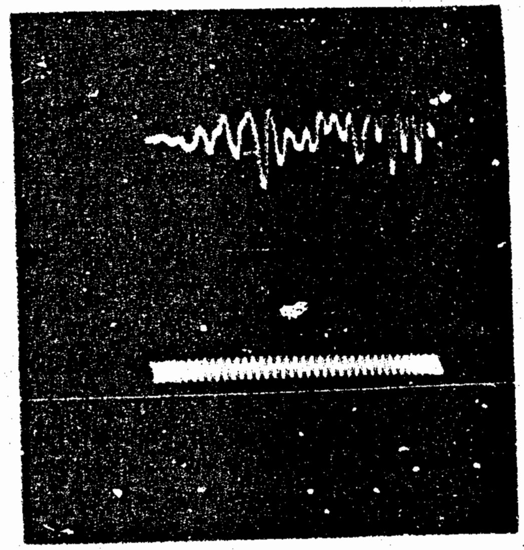


Net 1



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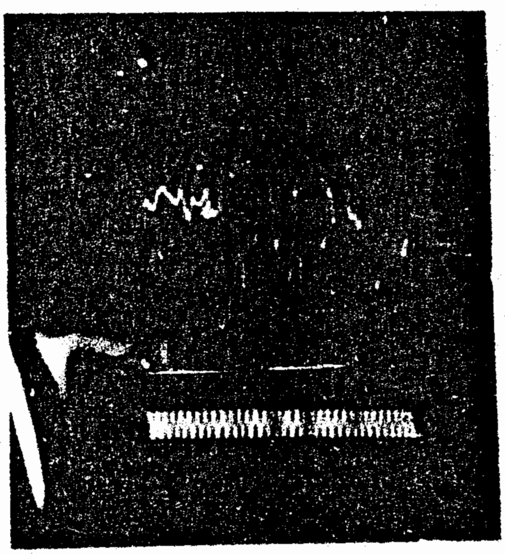

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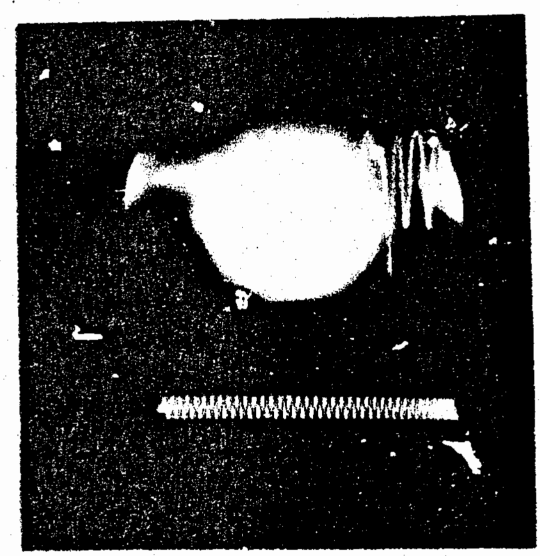

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Shot 2

Fig. 3: Calibration Freq: 10 KC
Calibration Volts: 42.5 Peak to Peak
Positive Voltage Downward

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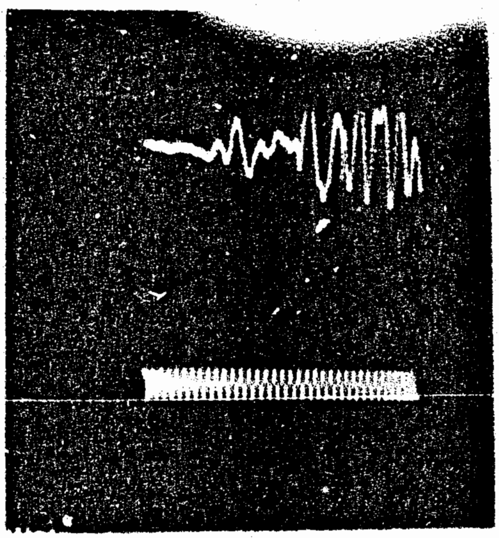

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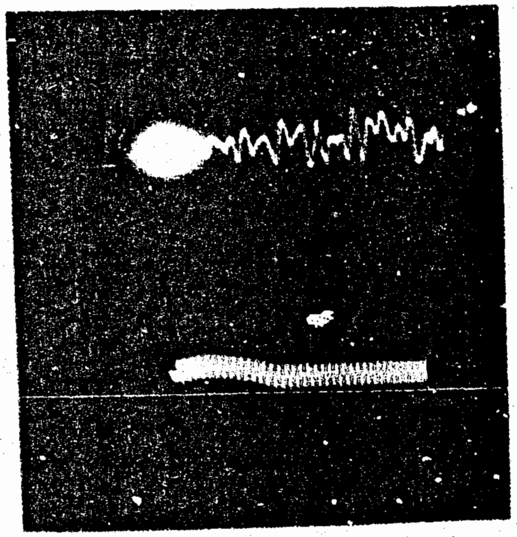

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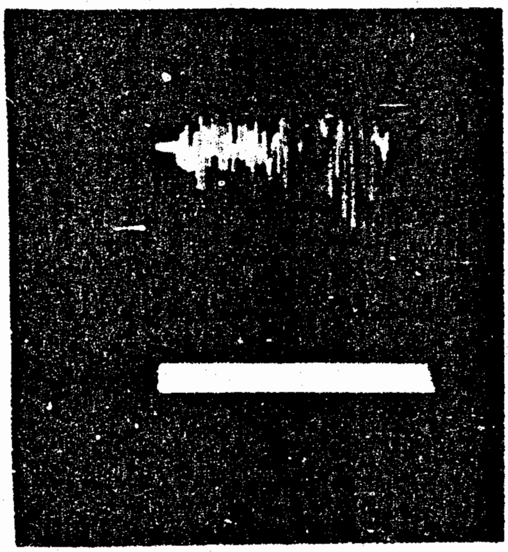
Shot 3



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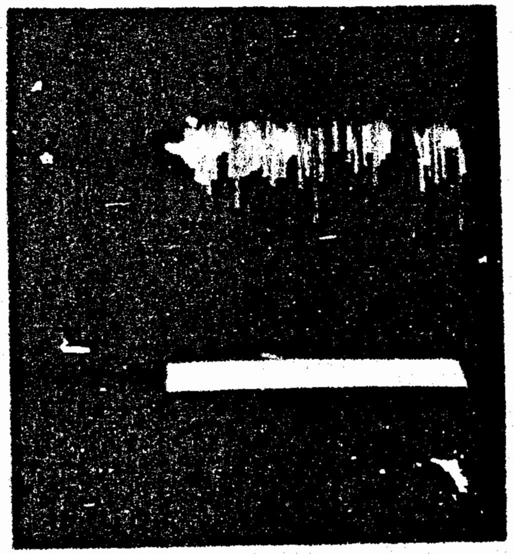
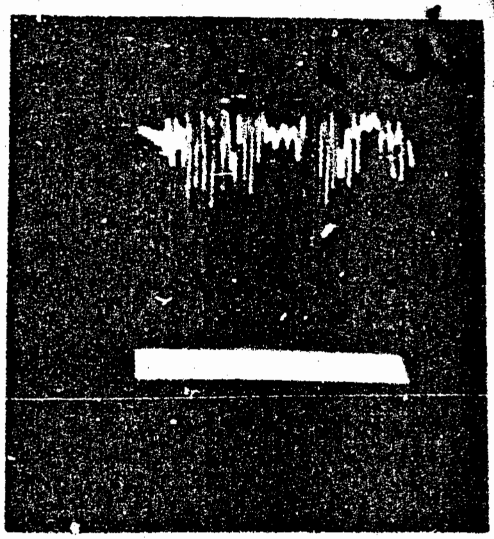


Net 2

Shot [illegible]

F[illegible]. 4: Calibration Freq: [illegible] KC
Calibration Volts: 42.5 Peak to Peak
Positive Voltage Downward



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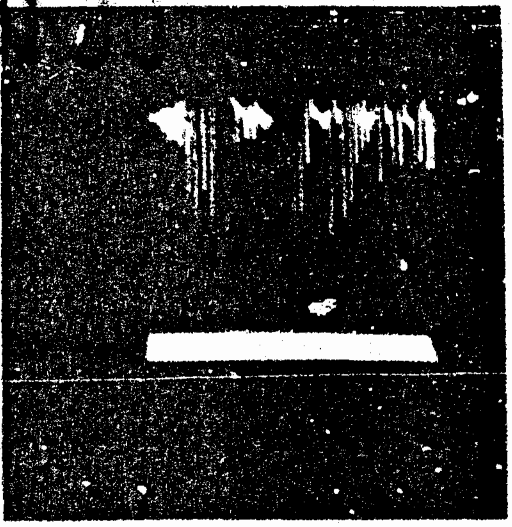

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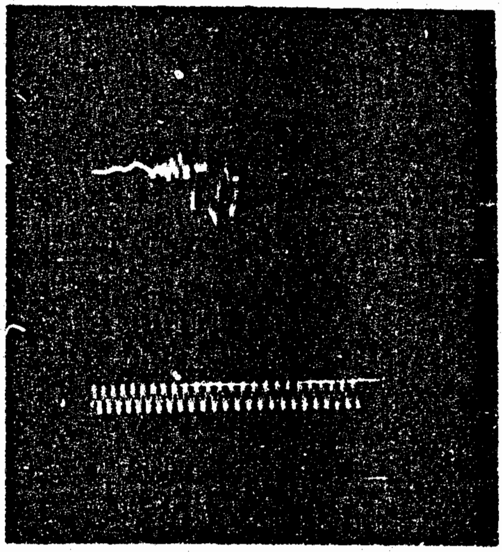
Shot 5



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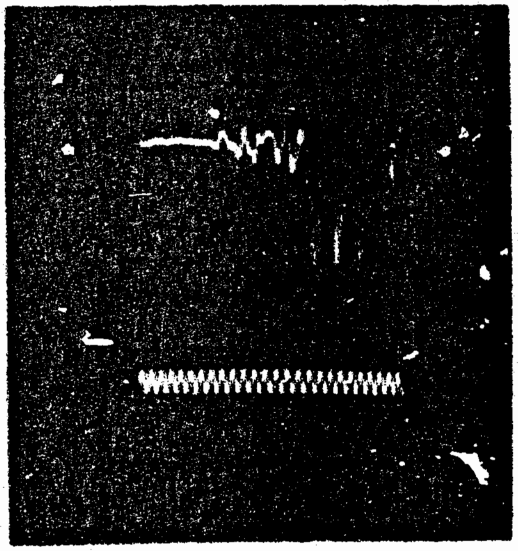

Net 2

Shot 6

Fig. 5: Calibration Freq: [illegible] KC
Calibration Volts: [illegible] peak to peak
Positive [illegible] Downward