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Technical Memorandum

Ref. Sym: 1923-(265)

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150-55-12

FINAL REPORT FOR XW-5/F-101 DROPS 96-11 THROUGH 96-16 (U)

E. C. Bauder - 1216

ABSTRACT

This report presents the results of the series of six XW-5/F-101 Preliminary Firing and Fuzing drops (96-11 through 96-16) from a B-47.

Case No. 631.00

July 25, 1955

Redacted Version

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SUMMARY

Six preliminary XW-5/F-101 fuzing and firing drops were made between November 4, 1954 and January 19, 1955, to determine the integrity of the fuze and warhead system as well as the ballistic characteristics of the store. The drops were made from a special wing pylon on a B-47 using prototype models (Type A) of the final weapon configuration. The drop units were numbered 96-11 through 96-16 in keeping with the McDonnell numbering sequence.

The series disclosed several weaknesses in the components used in the system, which are being rectified.

In Drop 96-12 the weapon did not function properly. The indications are that the XMC-505 pull-out switch did not close completely. It is believed that new seals and minor design changes of the switch will prevent the recurrence of this malfunction.

In Drops 96-15 and 96-16 one of the two MC-3's prematurely ranged, firing the weapons. Two possible causes of the prematures are:

1. A signal feedback from the forward tank cavity, which was open to the back of the radar antennae, ranged the radar, or

2. The case of the MC-3's leaked pressure at high altitude causing internal arcing and consequent prematures.

A metal bulkhead is being placed behind the antennae to isolate them from any cavity, and the problem of leaking radar cases was studied by Division 5421. Remedial action for leakage has been initiated in the stockpile.

All other components functioned properly in the weapon system.

The units all fired successfully at impact with adequate time between firing and deformation of the warhead installation.

The vibration during drop was less than one g. During flight and take-off the vibration was somewhat greater, but the data can only be used as a guide since the weapon was flown from the wing of a B-47 instead of the F-101 fighter aircraft.

TEST OBJECTIVES

The objectives of the preliminary XW-5-X1/F-101 firing and fuzing drops, numbered 96-11 through 96-16 were to:

1. Obtain fuzing and firing sequence information from th warhead and fuze installation. That is, to find if the components, as used in the system, operate in a normal manner and produce the desired functions at the proper times and altitudes. This also includes establishing preliminary fuzing sigmas for MC-3 in this application.

2. Evaluate the crystal network and the preliminary (Type A) nose structure to determine suitability for contact fuzing. This only serves as a general guide since the final (Type C) weapon structure will be different from the ones used in the preliminary drop tests.

3. Prove out the radome-antenna-coaxial cable system as it affects firing.

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4. Determine the amount of vibration during take-off, flight and drop. Preliminary vibration data during take-off and flight will only be used as a guide, as the drops from a B-47 were at a much lower release speed and, of course, not from the intended carrier.

5. Obtain ambient pressure data on the fuze and X-unit during drop in Units 96-15 and 96-16.

6. Obtain drag coefficients for release from the B-47 to compare with coefficients obtained from computation and wind tunnel tests. These will be used for evaluation and as an aid in future drops from the F-101.

WEAPON DESCRIPTION

Final Weapon

The XW-5-X1/F-101 bomb is a low-drag, high speed, monocoque assembly containing the XW-5-X1 warhead and a radar-timer-contact fuze. The USAF (McDonnell Aircraft Corporation) is responsible for design of the store, and Sandia Corporation for the warhead and fuze. The weapon is designed to be carried externally on, and delivered by, the McDonnell F-101A aircraft. The store is 394.0 inches in length, with a maximum diameter of 44.0 inches, and is stabilized by three fins spaced 120 degrees apart.

The store also contains two tanks which will carry a total of 849 gallons of JP-4 fuel. The maximum gross weight with fuel is approximately 9,345 pounds.

Test Weapon

The first series of six firing and fuzing drops were conducted with a Type A, McDonnell store, which had the same ballistic characteristics as the final weapon but did not contain fuel system, ejector and associated hardware. The drops were conducted from a special wing pylon on a B-47 by the 4925th Test Group (Atomic). The warhead and fuze were assembled and instrumented by Sandia Corporation.

OPERATIONAL SEQUENCE OF THE FUZING SYSTEM

The following description of the fuzing system gives the sequence of operations as well as describing the circuit used in the drop series. The XW-5/F-101 Fuze Schematic (as used in the tests) is shown in Figure 1.

The T-145E inflight control, which is located in the cockpit, has the following functions:

1. Supplies heater power to fuze components.
2. Supplies AC and DC fuze power.
3. Controls operation of ARM-SAFE switch.
4. Supplies IFI power and control.
5. Controls option-selection.
6. Supplies radar power.

The high-angle and pickle switches are part of the system but not physically located on the T-145 box.

Prior to take-off, heater power is supplied to the space heaters of the MC-73 firing timer, the MC-291 battery boxes and the MC-3 radars, and to the MC-384 ARM-SAFE switch monitor circuit. AC power is used to monitor the option selection

b(3)

- 7 -

circuits which select one of five options: radar-fired with long safe-separation time, radar-fired with short safe-separation time, contact-fired with long safe-separation time, contact-fired with short safe-separation time, and timer-fired with short safe-separation time. Hereafter these will be referred to as RL, RS, CL, CS and TS respectively.

After take-off, fin power is turned on and the fin is operated to the extended position. (The preliminary drop units had fixed fins.)

DoF
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The SA-278 stepping switch, in connection with a relay, forms a voltage-seeking device which will operate to the position chosen by the option-selection switch on the T-145E. Thus, the stepping switch sets in one of the fuzing and electrical arming sequence options previously described. The delivery method determines the option selected.

The A/S switch is operated to arm the MC-384 safety switch just prior to release.

Two other operations may or may not be performed depending upon the maneuver to be used in delivery. The first is the low-angle LABS or pickle operation which allows the pilot to start the MC-73 firing timer running down as he passes some identification point (IP). If the Pickle Button is released, the firing timer will automatically reset putting the fuze in condition for another run. The second is the LABS alternate or high-angle operation. If, for any reason, the pilot misses his IP on the low-angle approach and must use the target itself as an IP, he changes options for this new maneuver. By operating the high-angle switch, the fuzing system will automatically change from TS or RS to RL and from CS to CL.

DoE
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*See pickle operation above.

In this preliminary series, all units were dropped in the RL option from a straight and level release. The pickle and high-angle operations were not performed. The operation of all components was monitored regardless of firing option setting.

DESCRIPTION OF INSTRUMENTATION AND TELEMETRY

The following information was telemetered during each of the six drops:

Standard Telemetering

Pitch, Yaw and Roll
Internal pressure at X-unit; External pressures as requested by McDonnell
Vibration in each plane on the polar cap or cartridge structure
Safety switch position at release
X-charge on each channel
Fire timer clutches (2 each)
Fire timer closure (T_2)
Radars, Arm and Range
Trigger circuit filament voltage
Safe-separation timers, T1 and T2 (2 each)
Fire line ground
Bridge wires (airburst fire)

Mod 6 Telemetering

30 volt crystal output
300 volt crystal output
Contact fire
Deformation (frangible resistor on forward end of IFI)

The telemetering equipment consists of an FM-FM system of two packages each consisting of eight subcarrier, voltage controlled frequency-modulated oscillators which frequency modulate the carrier frequency of the transmitter. The telemetering junction boxes are essentially voltage dividing networks which take the sequence and instrumentation information and convert this to a 0-3 volt signal supplied to the subcarrier channels.

The Mod 6 impact telemetering system operates on a 67 KC subcarrier frequency which is amplitude modulated by two signals for a definite number of cycles, normally 10 and 30 cycles respectively. These two signals are initiated from the impact fuzing system.

One-kilocycle time base signal and a high-speed random synchronization signal are supplied to both the optical and telemetered impact records.

The complete telemetering system is shown in the block diagram of Figure 2.

Other instrumentation consisted of smoke puffs for visual airburst indication and electronic flash tubes for visual and photographic indications of airburst and impact firing.

DISCUSSION OF RESULTS

Fuzing and Firing

The fuze and warhead functions were monitored as listed under Description of Instrumentation and Telemetering. The IFI was not monitored on these drops. It

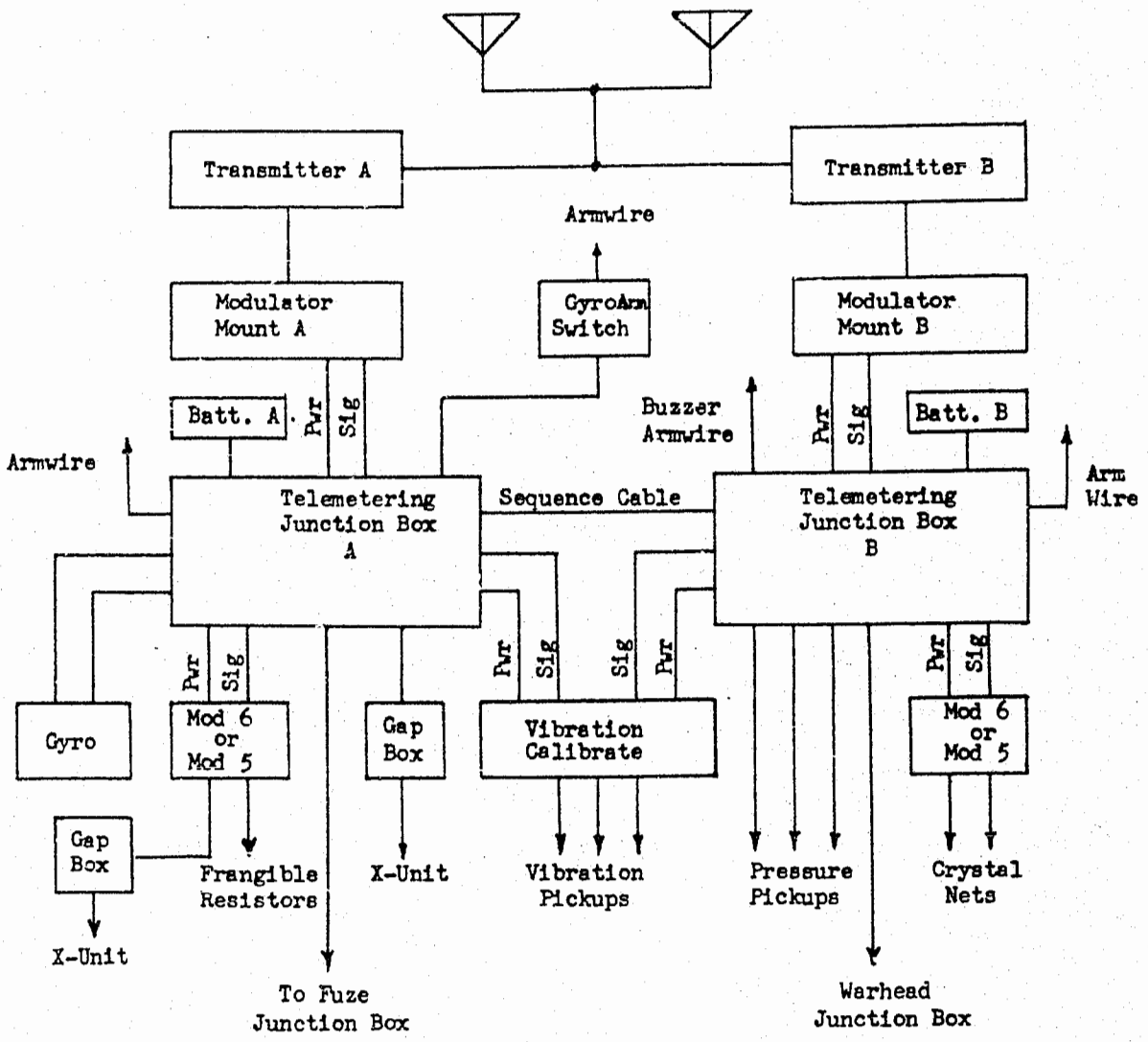

Figure 2 - Telemetering System Used on Drops 96-11 through 96-16

was felt that sufficient information could be obtained from the final F&F drop series and from other weapons which use the same IFI.

Drop 96-11

All information indicates that the fuzing and firing system functioned properly, except one T-1 switch of the safe-separation timer chattered as it was closing.

Drop 96-12

This drop unit failed to fire at air burst but did fire at impact.

The most satisfactory explanation of this malfunction, as obtained from an analysis of the telemetry record is that the pull-out switch failed to close all contacts at pull-out.

The XMC-505 pull-out switch used on this unit was a shop-made prototype which was not moisture sealed as in the final design. It is postulated that the cause of the switch failure was condensation of the moisture in the switch during the first flight to Salton Sea - which was aborted. The next flight froze the moisture causing the switch to fail.

It is believed that with the proper sealing and the design changes incorporated in subsequent switches the cause of this failure will be eliminated.

Drops 96-13 and 96-14

All information indicates that the fuzing and firing system and the warhead functioned as intended in these two drops.

Drops 96-15 and 96-16

All components in these drops functioned as intended except one MC-3 radar, in each drop unit, which ranged prematurely.

The following two causes of these failures have been advanced:

1. That the forward end of the nose section served as a resonant cavity feeding the signal back into the antennae, ranging the radar.

2. That the radar connector seals leaked pressure causing internal arcing which prematured the radar.

Tests have been conducted verifying both the above suggested causes. As a result of the tests, a bulkhead is being placed behind the antennae. The MC-3's are being retrofitted with better connectors, and a leak test is being incorporated for field use.

A summary of all the radar firing information is shown in Table I. An average burst height error ($\bar{X}$) of -67 feet was obtained for the drop series. A standard deviation(s) of 27.2 feet was obtained. The value(s) is only an indication because the errors did not follow a symetrical distribution.

A summary of all timer information is given in Table II for the drop series.

Ref. Sym: 1923-(265)

TABLE I

RADAR SUMMARY, DROPS 96-11 through 96-16

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TABLE II

96-11 Through 96-16 Safe-Separation Timer & Fire Timer Summary

Drop No.	Safe-Sep. Set-Sec T1	T2	Chan.	Safe-Sep. Time Sec T1	T2	Safe-Sep. Time Error-Sec T1	T2	Fire Timer Set-Sec	Fire Timer*** Sec	Fire**** Timer Error-Sec
96-11	17	26	1	16.146	27.262	-0.854	+ 1.262	33.00	33.410	+ 0.410
			2	17.047	28.292	+0.047	+ 2.292			
96-12	17	26	1	17.287	26.162	+0.287	+ 0.162	33.00	*	*
			2	17.664	*	+0.664	*			
96-13	17	26	1	18.15	25.81	+1.15	- 0.19	33.00	33.40	+ 0.40
			2	17.27	27.25	+0.27	+ 1.25			
96-14	17	26	1	**	26.002	**	+ 0.002	33.00	33.283	+ 0.283
			2	17.600	27.307	+0.600	+ 1.307			
96-15	17	26	1	17.138	27.113	+0.138	+ 1.113	33.00	33.467	+ 0.467
			2	17.418	27.401	+0.418	+ 1.401			
96-16	17	26	1	17.510	28.048	+0.510	+ 2.048	33.00	33.422	+ 0.422
			2	17.881	28.057	+0.881	+ 2.057			

Safe-Separation Timer - MC-348
Fire Timer MC-73
All Times from Release
* Pull-out Switch failure caused loss
** Failure of Telemetering Channel caused loss
*** Fire Timer had Channel 1 and 2 tied together in fuze
**** Error attributed to dial of setting equipment

Ref. Sym: 1923-(265)

Impact Firing System

The impact fuzing system functioned properly in all drops.

Impact fuze operation was recorded by Fastax cameras (electronic flash tubes) and Mod 6 or Mod 5 telemetering. Mod 5 is similar to Mod 6 in purpose but larger in size and different in circuitry. However, the value of the records was reduced because the random synchronization or "synch marks", which are supposed to be on the Fastax and Mod 6 films to correlate the time marks, were not the same on the various films for a given drop.

The instrumentation was set up to monitor crystal network output on one Mod 6, and X-unit fire and deformation on another Mod 6. Since the times between the two Mod 6 records could not be correlated with synch marks, the assumption was made that the telemetering packages would go off the air at about the same time. In reducing the data, the times of the various functions were then measured from the signal-off time. This method is not accurate but is the best that could be done under these circumstances. The times for all drops are tabulated in Table III. The times between 30 volt and 300 volt crystal signals are accurate in the order of 15 to 30 microseconds, since they were recorded on the same Mod 6 record. The same time accuracies are true of the interval between X-unit fire and deformation because they were on the same Mod 6.

DOE
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The Fastax film records did not have synch marks so could only be used as backup information. In all cases where the impact flash showed on the film, the bomb hood penetrated from 18 to 30 inches in to the water.

In the future drops the instrumentation procedure will be changed to increase the accuracy of the resultant data. The synch marks from the radome synch generator will not be used. Instead, one of the impact signals (preferably X-unit fire) will be fed into all Mod 6 units as a common reference on all records. The time between the various functions will then be measured using the 67 KC carrier instead of the 1 KC time marks as the scale.

Vibration

The vibration recorded in all drops was slight (less than one g) during flight and lower during drop. The greatest vibration was during take-off and reached a maximum of 3.4 g's at 400-500 cps on the forward flange of the MC-400. On Drops 96-11 and 12, the vibration pickups were mounted on the forward polar flange as shown in Figure 8. The vibration pickups were mounted on the lower forward flange of the MC-400 on Drops 96-13 through 16 as shown in Figure 9.

Pressure

On this series of drops (96-11 through 96-16) the internal pressure was measured near the X-unit. The pressure data was lost on Drops 96-11, 96-14 and 96-16. On Drops 96-12 and 96-13 the internal pressure was not of much value since the nose was open to ram air pressure. On Drops 96-15 and 96-16 a bulkhead was placed across the forward-end of the warhead compartment as in the final weapon. The

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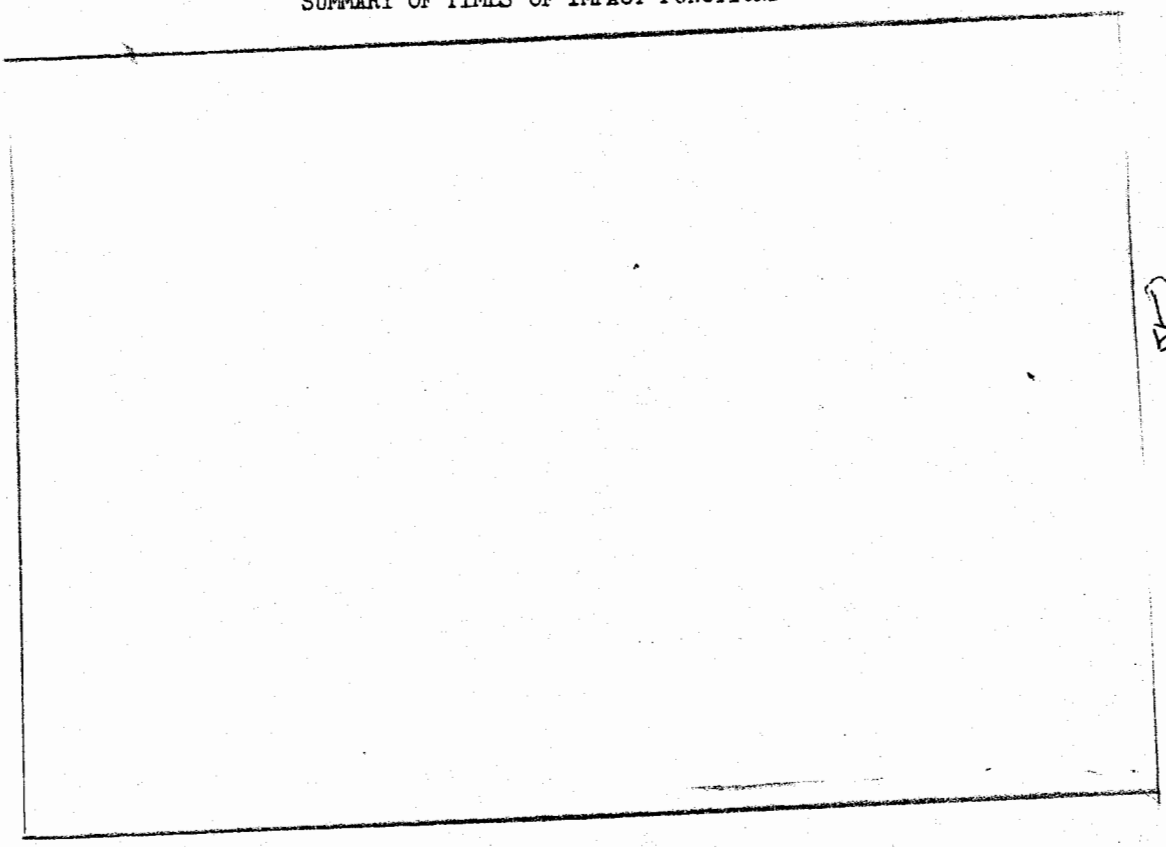
TABLE III

SUMMARY OF TIMES OF IMPACT FUNCTIONS



pressure seen near the X-unit on Drop 96-15 lagged only about 1000 feet at the arming altitude of 28,677 feet msl. The final store will have much tighter seals than those of the "A" stores. However, the final configuration units will be purposely vented.

Four body stations have been selected as being the most feasible for accurate pressure-sensing: 33, 69, 75 and 90.2 percent of the body length. The 69 and 75 percent stations have indicated the best repeatability from flight-to-flight, but both have a considerable transonic "jump". The 33 and 90.2 percent stations, while not having an appreciable transonic "jump", are not as repeatable as is desirable. Comparatively little data exists on these two stations; however, in future flights more data will be obtained on all of these stations.

E. C. BAUDER - 1216

Case No. 631.00
July 25, 1955

APPENDIX A

Individual Drop Results	Page
96-11	18
96-12	22
96-13	26
96-14	30
96-15	34
96-16	38

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Ref. Sym: 1923-(265)
Drop Date: Nov. 4, 1954
Salton Sea Test Base

Drop No. 96-11

PHYSICAL CHARACTERISTICS

Weight	3750 pounds
Center of Gravity	163.8 inches
Moment of Inertia	12,596,000 lb in^2

Fin Settings

Fin	Actual	Requested
Staggered (Top)	+ 15 min 22 sec	+ 12 min 0 sec
Left	+ 24 min 53 sec	+ 29 min 0 sec
Right	- 3 min 0 sec	- 5 min 0 sec
Algebraic Sum	+ 37 min 15 sec	+ 36 min 0 sec

RELEASE CONDITIONS	Actual	Scheduled
Aircraft	B-47 No. 12222	B-47 No. 12222
Bombing System	K-4	
Altitude MSL	39,644 ft	40,000 ft
Attitude	Level	Level
True Air Speed	414 K	Mach 0.75 (425 K)
Ground Speed	421 K	
Vertical Velocity	+ 4.222 fps	
Wind at Altitude	10 K @ 14°	
Plane True Course		

FUZE SETTINGS

Safe-Separation Timer T_1	17 sec
Safe-Separation Timer T_2	26 sec
Fire Timer Set	33 sec
Radar Set	Range 6

DROP DATA

Estimated Time of Fall	53.99 sec
Askania Time of Fall	54.928 sec
Telemetered Time of Fall	54.928 sec
Range	33,656 ft
Maximum Mach No.	1.109
Minimum Mach No.	0.726
Impact Velocity	1189 fps
Impact Angle	71°
Circular Error	325 ft, 325 ft over .4 ft left on 150° 36'

GROUND CAMERAS

6 - Askania Phototheodolites
4 - Mitchell Cameras
6 - Fastax Frame Cameras
3 - Faxtax Ribbon Cameras
1 - 16mm B&H Color Camera

PLANE CAMERAS

Due to circuit failure, none of the aircraft cameras operated.

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Drop No. 96-11

Ref. Sym: 1923-(265)

TELEMETERING RECORD

Good

SEQUENCE INFORMATION

[redacted]

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Drop No. 96-11

Ref. Sym: 1923-(265)

CONTACT INFORMATION

DoE b(3)

[redacted]

** Mod 6 did not receive fire signal due to discontinuity in the telemetering system. The Fastax film shows the photo flash from contact fire at about 18 inches penetration.

F&F CONCLUSIONS

DoE b(3)

[redacted]

VIBRATION

The vibration pickups were mounted in a cluster on the right hand side of the forward warhead mounting flange. All vibration channels appear to have operated properly.

Since the amount of vibration recorded was slight during flight and drop and less than the accuracy of the system, it was not reduced. The vibration during fall was less than during flight prior to release.

The vibration data during take-off was not reduceable because the record was not calibrated.

PITCH, YAW AND ROLL SUMMARY

Pitch

The unit showed its characteristic upward pitch on release. This was about five degrees with a period of about two seconds. Initial pitch was damped out completely by six seconds.

From about 28 seconds to impact, the unit had angle of attack of about one degree. Pitch, yaw and roll were coupled from that time to impact.

Yaw

The unit yawed to the right about two degrees on release. After this initial yaw of one half cycle, no measurable yaw was recorded until 28 seconds, as indicated above.

Roll

Roll rates were as follows in the clockwise rotation:

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Drop No. 96-11 Ref. Sym: 1923-(265)

Time from Release (Sec)	Roll Rate rev/sec
3.8	(First 1/8 rev completed)
10.0	0.10
20.0	0.13
30.0	0.20
40.0	0.21
50.0	0.24
53.0	0.26

PRESSURE INFORMATION

Pressure information was lost. The subcommutating switch was rotating properly, but it appears that the pickup contacts were grounded. This may have been due to excessive wear on the switch contacts by the time of drop.

UNIT COMPONENT INVENTORY

Drop Unit 96-11

QUANTITY	COMPONENT	SERIAL NUMBER
1	MC-115	CO 167 F4
1	MC-134	Not Available
2	MC-251	AF 5783 C4 AF 6113 C4
1	MC-384	SC-0055 A4
1	MC-401	None
1	MC-73	CO 1284 E3
1	MC-348	GB 072 A4
1	MC-474	#6
1	MC-505	None
8	MC-300	None
2	MC-72	AA 3782 F2 AA 2911 D2
2	MC-3	R-1 AA1192 C3 R-2 AA1977 J3
2	MC-291	AK 7703 I3 AK 11714 K3
2	MC-193A	DG 17790 L3 DG 17616 L3

Ref. Sym: 1923-(265)
Drop Date: Nov. 19, 1954
Salton Sea Test Base

Drop No. 96-12

PHYSICAL CHARACTERISTICS

Weight	3750 pounds
Center of Gravity	163.15 inches
Moment of Inertia	12,623,000 lb in^2

Fin Settings

Fin	Actual	Requested
Staggered (Top)	+ 39 min 15 sec	+ 35 min 0 sec
Left	+ 49 min 15 sec	+ 47 min 0 sec
Right	+ 24 min 0 sec	+ 23 min 0 sec
Algebraic Sum	+112 min 30 sec	+105 min 0 sec

RELEASE CONDITIONS	Actual	Scheduled
Aircraft	B-47 No. 12222	
Bombing System	K-4	
Altitude MSL	39,552 ft	40,000 ft
Attitude	Level	Level
True Air Speed	400 K	414 K
Ground Speed	409 K	
Vertical Velocity	- 2.286 fps	
Wind at Altitude	17 K @ 252°	
Plane True Course	160°	

FUZE SETTINGS

Safe-Separation Timer T_1	17 sec
Safe-Separation Timer T_2	26 sec
Fire Timer Set	33 sec
Radar Set	Range 6

DROP DATA

Estimated Time of Fall	53.99 sec
Askania Time of Fall	54.493 sec
Telemetered Time of Fall	54.501 sec
Range	32,124 ft
Maximum Mach No.	1.102
Minimum Mach No.	0.697
Impact Velocity	1201 fps
Impact Angle	72°
Circular Error	1377 ft, 1123 over and 795 right based on 146° 39'

GROUND CAMERAS

6 - Askania Phototheodolites
4 - Mitchell Cameras
6 - Fastax Frame Cameras
2 - Fastax Ribbon Cameras

One Mitchell and one Fastax Ribbon Camera failed during last half of drop.

PLANE CAMERAS

Good camera coverage showing clean separation.

Drop No. 96-12 Ref. Sym: 1923-(265)

TELEMETERING RECORD

Telemetering reception was very good and records clear.

SEQUENCE INFORMATION

[redacted]

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Drop No. 96-12 Ref. Sym: 1923-(265)

F&F CONCLUSIONS

Reference: Hollingsworth to Distribution, Failure Analysis XW-5/F-101 Fuzing and Firing Drop 96-12; Ref. Sym: 1242 (814)

The above Reference concludes that one bank (S-1 through S-6) of the MC-505 pull-out switch failed to close at pull-out. The MC-505 used in the drop was a shop-made prototype which did not have the seals as in the final design. The exact cause of the switch failure is unknown and no evidence is available, but it is postulated that the cause was condensation of moisture in the switch during the first flight to Salton Sea - which was aborted. The next flight froze the moisture causing the switch to fail. It is felt that with design changes of subsequent switches this failure will not be repeated. The drop was partially successful in that the X-unit charged and the weapon fired properly on impact.

VIBRATION

Recorded vibration was of such a low level that the vibration channels will not be reduced. Vibration while the weapon was aboard the aircraft, while also at a very low level (less than 1 g), was greater than during free-fall. The vibration pickups were mounted on the sphere poker cap flange as in Drop 96-11. See Figure 8 and 9.

PITCH, YAW AND ROLL SUMMARY

Pitch

The unit pitched up about six degrees on release as usual. Initial pitch had damped out by five seconds. By 10 seconds the unit had taken a constant angle of attack of about 1-1/2 degrees with coupled yaw and roll to impact.

Roll

Roll rate as follows (clockwise throughout):

Time From Release (Sec)	Roll Rate rev/sec
1.75	(First 1/8 rev completed)
10.00	0.48
20.00	0.61
30.00	0.82
40.00	1.00
50.00	1.01
Impact	0.99

Yaw

Yaw was about 1-1/2 degrees as described above.

PRESSURE INFORMATION

The subcommutated pressure information was good. The internal pressure followed the external pressure closely. This was because of four ram holes in the nose aft of the radome to maintain internal pressure. The data is not of great value, since the warhead compartment will be enclosed and of different structure on the final weapon.

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Ref. Sym: 1923-(265)

UNIT COMPONENT INVENTORY

Drop Unit 96-12

QUANTITY	COMPONENT	SERIAL NUMBER
1	MC-115	#59
1	MC-134	None Available
2	MC-251	AF 6119 C4 AF 5705 C4
1	MC-384	SC-0053 A4
1	MC-401	None
1	MC-73	CO 2215 H3
1	MC-348	GB 052 A4
1	MC-474	#2
1	MC-505	None
8	MC-300	None
2	MC-72	AA 11368 A2 AA 11324 A2
2	MC-3	R-1 AA 3415 E4 R-2 AA 3367 E4
2	MC-291	None None
2	MC-193A	None None

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Ref. Sym: 1923-(265)
Drop Date: Dec. 7, 1954
Salton Sea Test Base

Drop No. 96-13

PHYSICAL CHARACTERISTICS

Weight	3825 pounds
Center of Gravity	162.88 inches
Moment of Inertia	12,540,000 lb in^2

Fin Settings

Fin	Actual	Requested
Staggered (Top)	+ 5 min 0 sec	+ 5 min 0 sec
Left	+ 46 min 25 sec	+ 50 min 0 sec
Right	- 11 min 25 sec	- 10 min 0 sec
Algebraic Sum	+ 40 min 50 sec	+ 45 min 0 sec

RELEASE CONDITIONS	Actual	Scheduled
Aircraft	B-47 No. 222	B-47 No. 222
Bombing System	K-4	
Altitude MSL	24,499 ft	25,000 ft
Attitude	Level	Level
True Air Speed	308 K	315 K
Ground Speed	313 K	
Vertical Velocity	- 0.93175 fps	
Wind at Altitude	63 K @ 263°	
Plane True Course	163°	

FUZE SETTINGS

Safe-Separation Timer T_1	17 sec
Safe-Separation Timer T_2	26 sec
Fire Timer Set	33 sec
Radar Set	Range 6

DROP DATA

Estimated Time of Fall	41.25 sec
Askania Time of Fall	40.878 sec
Telemetered Time of Fall	40.884 sec
Range	20,092 ft
Maximum Mach No.	1.022
Minimum Mach No.	0.500
Impact Velocity	1159 fps
Impact Angle	69°
Circular Error	408 ft, over 148 left 380 on 162° 36'

GROUND CAMERAS

5 - Askania Phototheodolites
2 - Mitchell Cameras
5 - Fastax Frame Cameras
2 - Fastax Ribbon Cameras

One Fastax Ribbon Camera failed, all others reported good operation.

UNCLASSIFIED

Drop No. 96-13 Ref. Sym: 1923-(265)

PLANE CAMERAS

Two Fastax (
One Bell & Howell (Cameras showed clean separation.

TELEMETERING RECORD

Telemetering "A" package was noisy but readable; "B" package was good.

SEQUENCE INFORMATION

[redacted]

DoE b(3)

F&F CONCLUSION

All information indicates that the fuzing and firing system functioned as desired.

Drop No. 96-13 Ref. Sym: 1923-(265)

VIBRATION

The vibration pickups were mounted in a cluster on the bottom-front of the forward flange of the MC-400 structure, measuring vertical, transverse and longitudinal vibration. See Figure 8.

The level of vibration measured was greatest during take-off. The level was too low to reduce during flight and drop. However, the flight vibration was of a higher value than during drop but still less than one g. The take-off vibration data is shown in the following table for maximum reading which occurred just before the plane was air borne.

Maximum Vibration on MC-400 Forward End During Take-off

Frequency CPS	Vertical g	Transverse g	Longitudinal g
0-20	0.8	too low	0.7
20-40	0.9	to	0.8
40-80	1.4	measure	1.1
80-120	1.1		0.9
120-180	1.7	0.6	1.0
180-240	1.8	1.0	1.1
290-320	0.7	1.0	1.0
320-400	0.8	1.9	1.3
400-500	0.8	3.4	1.1

PITCH, YAW AND ROLL SUMMARY

Pitch

This unit showed its characteristic upward pitch of about seven degrees on release. Period was about two and one half seconds and damped out in four seconds after which there was no appreciable oscillation.

Yaw

There was one yaw oscillation to the right of about three degrees on release and no appreciable yaw oscillation thereafter.

Roll

The roll was clockwise throughout at the following rates:

Time From Release (Sec)	Roll Rate rev/sec
3.9	(First 1/8 rev completed)
15.0	0.10
25.0	0.14
35.0	0.18

PRESSURE

The subcommutated pressure records were clear. The internal pressure followed the external pressure closely. This was because four ram holes were cut in the nose aft of the radome to maintain internal pressure. The data is not of great value since the warhead compartment will be enclosed and of different structure on the final weapon.

UNCLASSIFIED

Ref. Sym: 1923-(265)

UNIT COMPONENT INVENTORY

Drop Unit 96-13

QUANTITY	COMPONENT	SERIAL NUMBER
1	MC-115	#48
1	MC-134	AS 1119 C4
2	MC-251	AF 4329 A4 AF 1066 J3
1	MC-384	SC-0065 A4
1	MC-401	None
1	MC-73	EV 4944 C4
1	MC-348	GB 033 L3
1	MC-474	None
1	MC-505	None
8	MC-300	None
2	MC-72	AA 11353 L2 AA 11355 L2
2	MC-3	R-1 AA 1267 D3 R-2 AA 934 J3
2	MC-291	None None
2	MC-193A	None None

UNCLASSIFIED

UNCLASSIFIED

Ref. Sym: 1923-(265)
Drop Date: Dec. 14, 1954
Salton Sea Test Base

Drop No. 96-14

PHYSICAL CHARACTERISTICS

Weight	3880 pounds
Center of Gravity	162.53 inches
Moment of Inertia	12,611,419 lb in^2

Fin Settings

Fin	Actual	Requested
Staggered (Top)	+ 12 min 30 sec	+ 12 min 0 sec
Left	+ 30 min 49 sec	+ 29 min 0 sec
Right	- 2 min 0 sec	- 5 min 0 sec
Algebraic Sum	+ 41 min 19 sec	+ 36 min 0 sec

RELEASE CONDITIONS	Actual	Scheduled
Aircraft	B-47 No. 12222	B-47 No. 12222
Bombing System	K-4	K-4
Altitude MSL	29,558 ft	30,000 ft
Attitude	Level	Level
True Air Speed	429 K	440 K
Ground Speed	451 K	
Vertical Velocity	- 1.036 fps	
Wind at Altitude	41 K @ 279°	
Plane True Course	155° 19'	

FUZE SETTINGS

Safe-Separation Timer T_1	17 sec
Safe-Separation Timer T_2	26 sec
Fire Timer Set	33 sec
Radar Set	Range 6

DROP DATA

Estimated Time of Fall	46.72 sec
Askania Time of Fall	46.166 sec
Telemetered Time of Fall	46.168 sec
Range	31,177 ft
Maximum Mach No.	1.060
Minimum Mach No.	0.712
Impact Velocity	1169 fps
Impact Angle	66°
Circular Error	1013 ft, 1013 over 25 left on 155° 19'

GROUND CAMERAS

5 - Askania Phototheodolites
3 - Mitchell Cameras
6 - Fastax Frame Cameras
2 - Fastax Ribbon Cameras
1 - B&H 16mm Color Camera

All Camera Stations reported good operation.

UNCLASSIFIED

Drop No. 96-14 Ref. Sym: 1923-(265)

PLANE CAMERAS

Two Fastax (
One Bell & Howell (Cameras showed clean separation.

TELEMETERING RECORD

Telemetering reception was good with a clear record. Channel 4 of "A" pack did not operate; losing indication of Fire Timer 1 clutch, T-1 of Safe-Separation Timer 1 and Radar 1 range. However, other channels indicate that Fire Timer 1 and Safe-Separation Timer 1 operated properly and the unit fired at the proper altitude by Radar 1 ranging.

SEQUENCE INFORMATION

DOE b(3)

Drop No. 96-14 Ref. Sym: 1923-(265)

F&F CONCLUSIONS

All information indicates that the fuzing and firing system functioned properly at both airburst and contact fire.

VIBRATION

As in previous drops the vibration recorded prior to drop was greater than during free-fall. In both cases the level of amplitude was slight and less than the error of the instrumentation system.

PITCH, YAW AND ROLL SUMMARY

Pitch and Yaw

This unit showed its characteristic upward pitch of about seven degrees on release. The period of the oscillation was about two seconds. The initial pitch had damped out in five seconds and, by this time, the unit had assumed a constant angle of attack of about three degrees (pitch, yaw coupled with roll) which remained until impact.

Roll

The roll was clockwise at the following rates:

Time from Release (Sec)	Roll Rate rev/sec
1.95	(First 1/8 rev completed)
10.0	0.25
20.0	0.31
30.0	0.37
40.0	0.44
45.0	0.45

PRESSURE INFORMATION

Wear of the subcommutating switch caused its terminals to become tied together. Playbacks were made in an attempt to salvage the data but it was impossible to determine segment changes. No data was published.

Ref. Sym: 1923-(265)

UNIT COMPONENT INVENTORY

Drop Unit 96-14

QUANTITY	COMPONENT	SERIAL NUMBER
1	MC-115	#30
1	MC-134	AS 1116 G4
2	MC-251	AF 0006 K3 AF 0296 I3
1	MC-384	SC-0047 A4
1	MC-401	None
1	MC-73	EY 5404 D4
1	MC-348	GB 042 L3
1	MC-474	None
1	MC-505	None
—	MC-300	None
2	MC-72	AA 3872 F2 AA 4878 I2
2	MC-3	R-1 AA 3468 E4 R-2 AA 1984 J3
2	MC-291	AK 8254 I3 AK 224
2	MC-193A	DG 14,542 A4 DG 19,872 A4

UNCLASSIFIED

Ref. Sym: 1925-(265)
Drop Date: Jan. 19, 1955
Salton Sea Test Base

Drop No. 96-15

PHYSICAL CHARACTERISTICS

Weight	3735 pounds
Center of Gravity	162.061 inches
Moment of Inertia	12,358,656 lb in^2

Fin Settings

Fin	Actual	Requested
Staggered (Top)	+ 7 min 10 sec	+ 20 min ± 15 sec
Left	+ 20 min 57 sec	+ 35 min ± 15 sec
Right	- 12 min 30 sec	+ 5 min ± 15 sec
Algebraic Sum	+ 40 min 37 sec	+ 60 min ± 45 sec

RELEASE CONDITIONS	Actual	Scheduled
Aircraft	B-47 No. 12222	
Bombing System	K-4	
Altitude MSL	39,835 ft	40,000 ft
Attitude	Level	Level
True Air Speed	411 K	414 K
Ground Speed	408 K	
Vertical Velocity	+ 13.316 fps	
Wind at Altitude	73 K @ 247°	
Plane True Course		

FUZE SETTINGS

Safe-Separation Timer T_1	17 sec
Safe-Separation Timer T_2	26 sec
Fire Timer Set	33 sec
Radar Set	R-1, Range 6
	R-2, Range 12

DROP DATA

Estimated Time of Fall	53.99 sec
Askania Time of Fall	55.449 sec
Telemetered Time of Fall	55.450 sec
Range	32,666 ft
Maximum Mach No.	1.116
Minimum Mach No.	0.702
Impact Velocity	1176 fps
Impact Angle	72°
Circular Error	3333 ft, 1893 over 2743 left on 153° 39'

GROUND CAMERAS

6 - Askania Phototheodolites
3 - Mitchell Cameras
1 - 16mm B&H Camera
5 - Fastax Frame Cameras
2 - Fastax Ribbon Cameras

All Cameras reported good operation.

UNCLASSIFIED

UNCLASSIFIED

Drop No. ~~95~~-15

Ref. Sym: 1923-(265)

PLANE CAMERAS

Good camera coverage showing clean separation.

TELEMETERING RECORD

Telemetering record was clear and reception good.

SEQUENCE INFORMATION

DOE
b(3)

UNCLASSIFIED

Drop No. 96-15 Ref. Sym: 1923-(265)

[redacted]

DoE b(3)

F&F CONCLUSIONS

All components in the system except Radar 1 (MC-3 Serial Number AA-1902-J-3) operated properly and as expected. Radar 1 ranged in at arming and remained in with three brief openings until near ranging altitude where it ranged out for 6.53 seconds (long record time) before ranging in correctly.

The conclusions and recommendations for Drops 96-15 and 96-16 are given in Appendix B.

VIBRATION

As in previous drops the vibration recorded prior to drop was greater than during free-fall. In both cases the level of amplitude was slight and less than the error of the instrumentation system.

PITCH, YAW AND ROLL SUMMARY

Pitch and Yaw

Upon release the unit showed an upward pitch of about seven degrees with a period of 1.8 seconds. Angle of attack reached about 1.25 degrees maximum.

Roll

The roll rates were as follows and clockwise throughout drop:

Time from Release (Sec)	Roll Rate rev/sec
2.98	(First 1/8 rev completed)
10.0	0.179
20.0	0.238
30.0	0.348
40.0	0.391
50.0	0.385

Drop No. 96-15

Ref. Sym: 1923-(265)

PRESSURE INFORMATION

The pressure record was clear and subcommutation clean.

The pressure around the X-unit followed the actual pressure around the weapon very closely. This weapon had a bulkhead across the front of the warhead section and was sealed with aircraft sealing compound around the connectors and other surface fixtures. The only leakage which was not inhibited was around the plates of the skin which simulates the final weapon. Further tests with the final-type store will be made to determine the pressure in the X-unit during drop.

UNIT COMPONENT INVENTORY

Drop Unit 96-15

QUANTITY	COMPONENT	SERIAL NUMBER
1	MC-115	GM 885-168
1	MC-134	A9 1182 H4
2	MC-251	AF 2400 G3 AF 2360 G3
1	MC-384	SC-0069 A4
1	MC-401	None
1	MC-73	EY 5396 D4
1	MC-348	AH 40020 I4
1	MC-474	None
1	MC-505	None
8	MC-300	None
2	MC-72	AA 11342 L2 AA 11367 L2
2	MC-3	R-1 AA 1133 C3 R-2 AA 1892 J3
2	MC-291	AK 3489 F3 XAK 0581 G3
2	MC-193A	DG 19682 A4 DG 19549 A4

UNCLASSIFIED

Ref. Sym: 1923-(265)
Drop Date: Jan. 13, 1955
Yucca Lake Range
Nevada Proving Grounds

Drop No. 96-16

PHYSICAL CHARACTERISTICS

Weight	3635 pounds
Center of Gravity	163.250 inches
Moment of Inertia	12,289,536 lb in^2

Fin Settings

Fin	Actual	Requested
Staggered (Top)	3 min	20 min ± 15 sec
Left	30 min	35 min ± 15 sec
Right	10 min 45 sec	5 min ± 15 sec
Algebraic Sum	43 min 45 sec	60 min ± 45 sec

RELEASE CONDITIONS	Actual	Scheduled
Aircraft	B-47 No. 12222	
Bombing System	K-4	
Altitude MSL	35,950 ft above Tgt. (Radar)	40,000
Attitude	Level	Level
True Air Speed	414 K	414 K
Ground Speed	410 K (Radar)	
Local Velocity	Not available	
Wind at Altitude	Not available	
Plane True Course	130°	

FUZE SETTINGS

Safe-Separation Timer T_1	17 sec
Safe-Separation Timer T_2	26 sec
Fire Timer Set	33.00 sec
Radar Set	Range 6

DROP DATA

Estimated Time of Fall	50.83
Askania Time of Fall	51.184
Telemetered Time of Fall	51.190
Maximum Mach No.	1.111
Minimum Mach No.	0.803
Impact Velocity	1199 fps
Impact Angle	70°
Circular Error	785 ft, 219 over 753 left on 130°

GROUND CAMERAS

4 - Askania Phototheodolites - Two stations did not track to impact
1 - Mitchell Camera 40" lens
1 - Bell & Howell 16mm documentary

PLANE CAMERAS

Good camera coverage showing clean separation.

UNCLASSIFIED

Ref. Syr: 1923-(265)

Drop No. 96-16
TELEMETERING RECORD
Good
SEQUENCE INFORMATION

DoE
b(3)

Drop No. 96-16 Ref. Sym: 1923-(265)

F&F CONCLUSIONS

The reading accuracy of the data reduction on this drop was ± 0.003 seconds, at best, due to very poor time base on the record. The altitudes are not accurate because of poor triangulation of the two Askania phototheodolites (out of four possible) which tracked to impact.

All indications show that the fuzing and firing system operated properly, except Radar 2 which prematurely ranged in for 0.157 seconds firing the unit. This premature occurred at an altitude of 17,479 feet msl. The failure of Radar 2 in this drop is similar to the failure of Radar 1 in Drop 96-15. The analysis and conclusions of both failures are considered in Appendix B.

VIBRATION

As in previous drops the vibration recorded prior to drop was greater than during drop. In both cases the level of amplitude was lower than the error of the system and consequently was not reduced. The transverse vibration channel was out of channel prior to and during drop. This information was waived before drop.

PITCH, YAW AND ROLL SUMMARY

Pitch

Upon release the unit showed an upward pitch of about five degrees with a period of two seconds. Angle of attack reached about two degrees and remained constant to impact (from pitch record).

Yaw

The yaw gyro tumbled and data was disregarded.

Roll

The following roll rates were obtained with roll in clockwise direction throughout drop.

Time from Release (Sec)	Roll Rate rev/sec
2.06	(First 1/8 rev completed)
10.0	0.153
20.0	0.25
30.0	0.32
40.0	0.41
50.0	0.37

PRESSURE INFORMATION

The pressure information was published, but reliability is low due to poor Askania data.

Ref. Sym: 1923-(265)

UNIT COMPONENT INVENTORY

Drop Unit 96-16

QUANTITY	COMPONENT	SERIAL NUMBER
1	MC-115	None
1	MC-134	AF 1179 I4
2	MC-251	AF 00091 I3 AF 2404 G3
1	MC-384	SC-0061 A4
1	MC-401	None
1	MC-73	EY 5586 D4
1	MC-348	AH 40018 I4
1	MC-474	None
1	MC-505	None
8	MC-300	None
2	MC-72	AA 11303 L2 AA 3868 F2
2	MC-3	R-1 Not Available R-2 AA 1902 J3
2	MC-291	Not Available Not Available
2	MC-193A	Not Available Not Available

Ref. Sym: 1923-(265)

APPENDIX B

Conclusions and Recommendations on MC-3 Prematures on Drops 96-15 and 96-16

The following is an extract from a: Memo, J. R. Park to Distribution, Ref. Sym: 1216 (92), Re: Summary of the Meeting on the XW-5/F-1C1, MC-3, Prematures held in Room 33, Building 880 on February 28, 1955:

"Radar two of Drop 96-16 at NPG ranged in for 0.15 seconds at approximately 10.7 seconds after arming. It then operated normally. Radar one of Drop 96-15 at Salton Sea ranged in at arming and remained in with three brief openings until near ranging altitude where it ranged out for 6.79 seconds before ranging in correctly.

Two causes for the failures have been advanced. The members of Division 5421 have run tests on the cavity effect produced by leaving the forward end of the weapon nose section open. This produces a large cavity behind the antennae. Tests show that radio energy fringes past the rim of the antenna into the cavity. Energy is then fed back from the cavity into the antennae and appears as strong close targets. The cavity energy then could ring the radars. It was noted in tests performed on the roof of Building 802 that the three units tested range in nearly continuously, although Mr. Bachand says their loop sensitivity is below that of 98 percent of the units received by the Corporation.

The second possible cause for the prematures is pressure leakage from the MC-3 cans. Of six units tested in the 1216 laboratory it was found that all prematured if the pressure equivalent altitude withir the cans was between 21,000 and 29,000 feet approximately. It was also found that out of six units tested, three leaked at an excessive rate. However, the unit with the lowest leak rate did not show bubbles when pressurized and immersed in water. The other units leaked through the AN connector.

The units tested by Division 1216 - although allotted to the drop program - were not the latest production units and in all probability did not have the AN connectors sealed with Thiokol nor circuitry changes designed to reduce internal arcing.

The units used in the drops did not have the seal ring tightening bolt checked for proper torque, and although four of the units tested by 1216 were in the same condition and did not leak through the O-Ring, under flight conditions O-ring leakage may have occurred.

In conclusion, it was decided to recommend to McDonnell Aircraft Corporation that a ground-plane bulkhead be incorporated in the weapon directly behind the antennae. It was also decided - dependent upon the leakage tests being made by Division 5421 on some 50 or 60 units - that it may be necessary to incorporate a seal test into the testing procedures of MC-3's."

Since the publishing of the above memo, McDonnell Aircraft Corporation has incorporated a bulkhead behind the antennae and a leak test for field use has been called out for the MC-3 seals. The MC-3 AN connectors are being retrofitted to prevent leaking.

APPENDIX C

Photographs of Typical XW-5/F-101 Drop Units

Ref. Sym: 1523-(265)

691

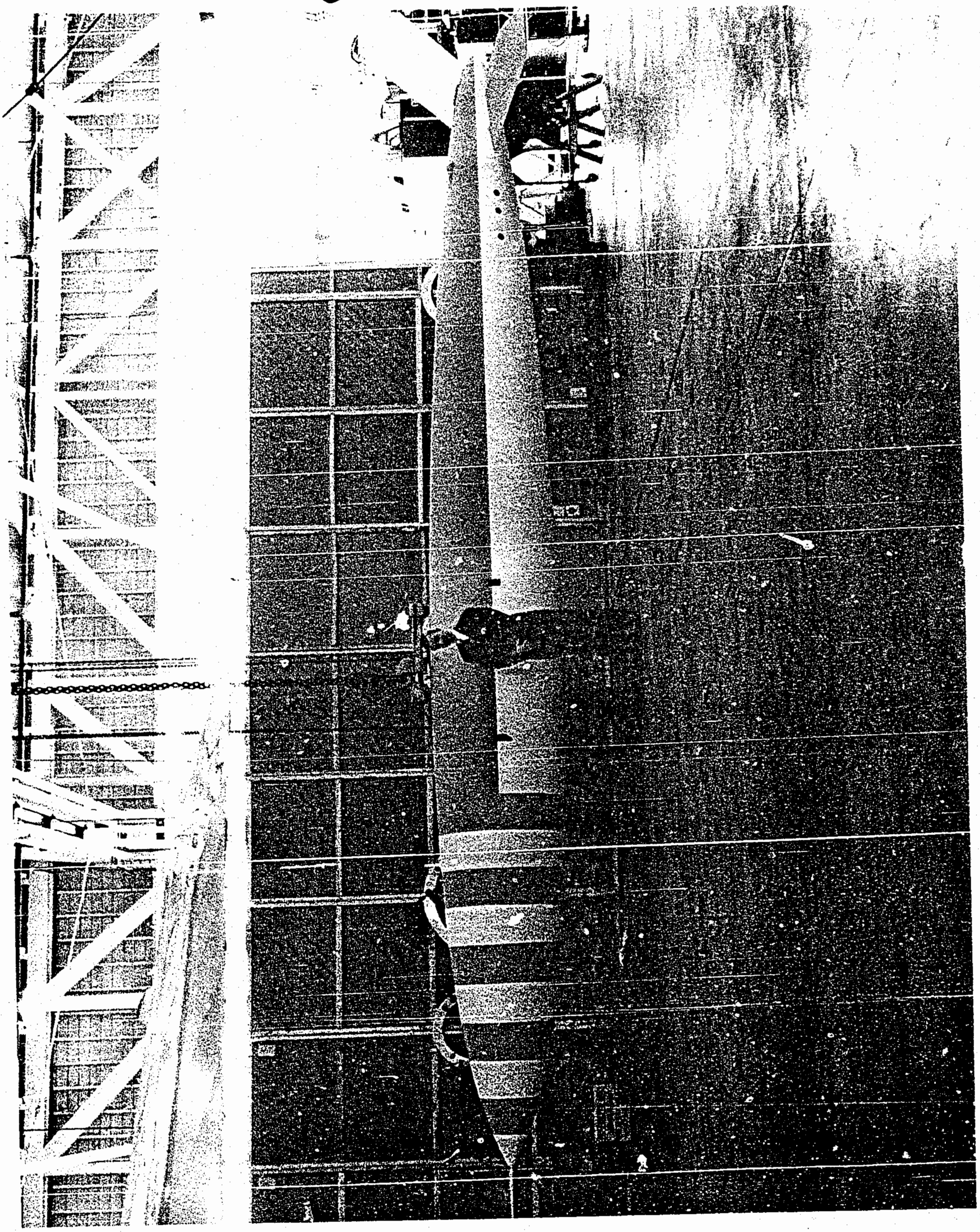

Fig. 3 -- Model 96 Conf. A Drop Test Unit (with nose boom and metal nose instead of radome)

DOE (513)

Fig. 4 -- View of XW-5/F-101 Warhead and Fuze (Aft Quarter)

Fig. 5 -- General View (From Forward Quarter) of XW-5/F-101 Fuze and Warhead

Ref. Sym: 1923-(265)

694

Fig. 6 - Looking at Forward End of XW-5/F-101 Fuze and Warhead (Typical Drop Unit) with Radars and Batteries Installed

DOE 43)

695

Fig. 7 -- Looking at Forward End of XW-5/F-101 Fuze and Warhead (Typical Drop Unit) Without Radars

Fig. 8 - Vibration Pickups, Typical of Drops 96-11 and 12
(Looking Forward)

DOE
631

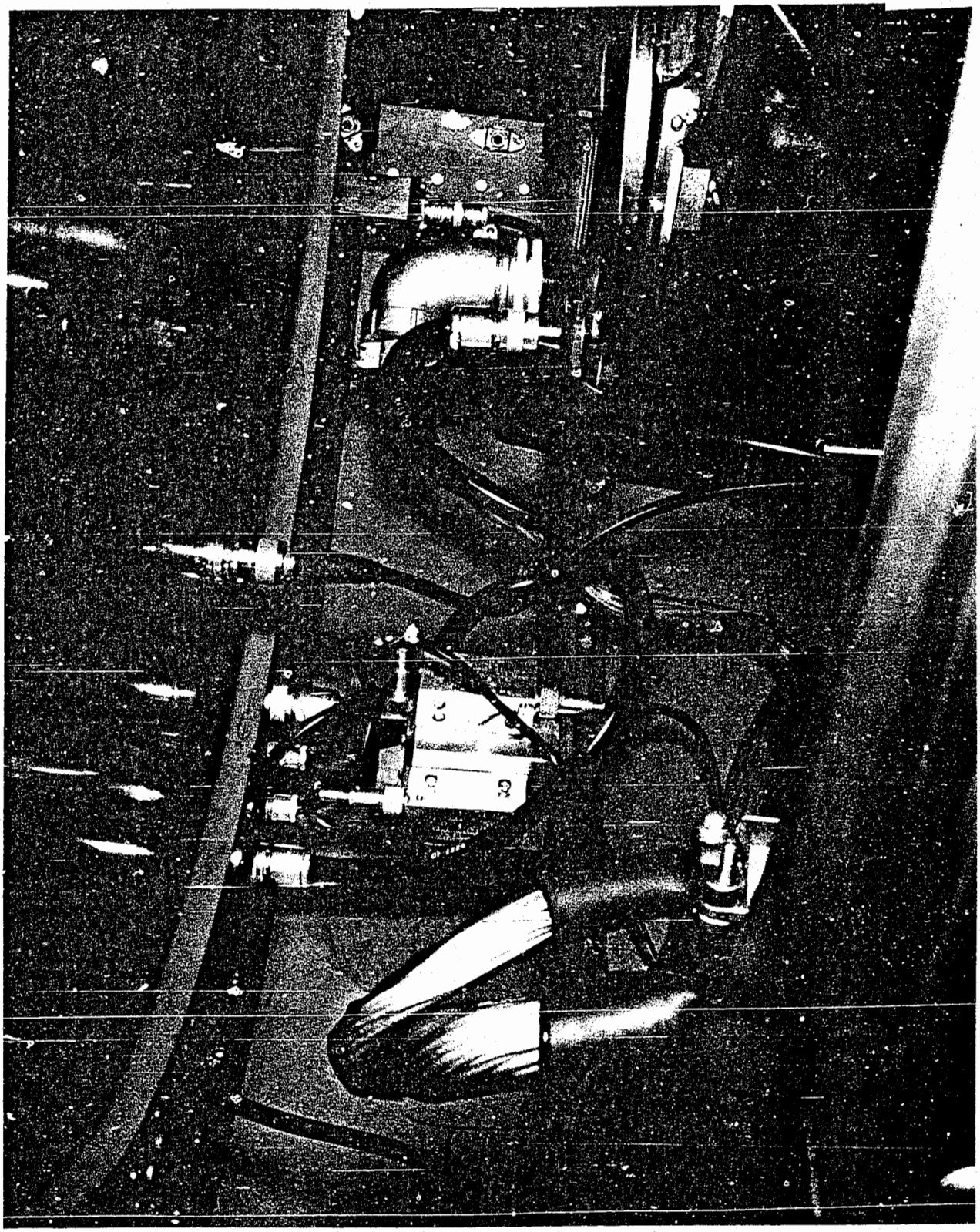

Fig. 9 -- Vibration Pickups Typical of Drops 96-13, 14, 15 and 16.
The Bulkhead on Left Typical of Drops 96-16

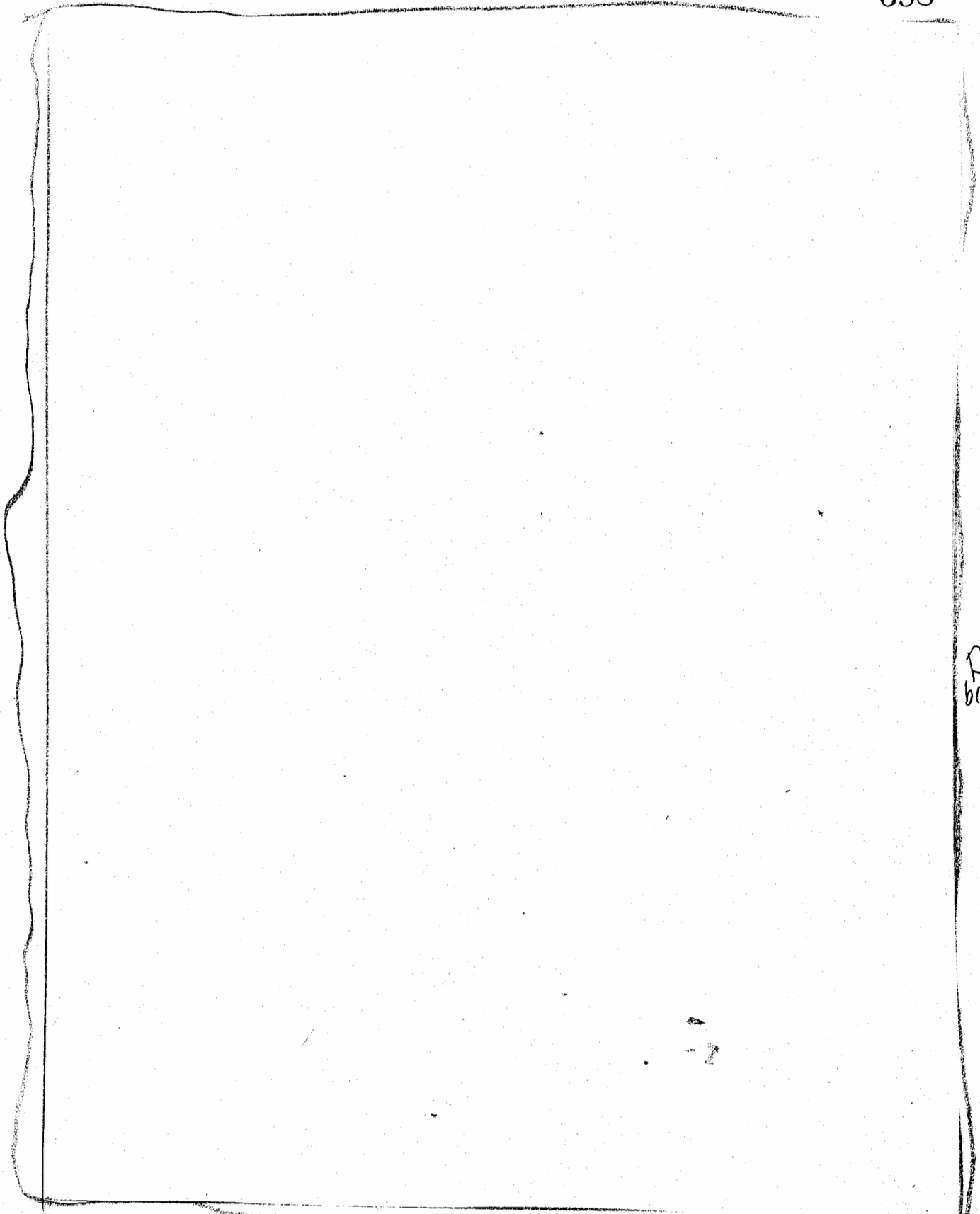

Fig. 10 -- Frangible Resistors on Forward End of IFI Typical of all Six Preliminary Drops (96-11 through 16)

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Ref. Sym: 1923-(265)

699

Fig. 11 Left Side Telemetering Compartment, Typical of Drops 96-11 through 16

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53455 DOE 6131

Fig. 12 -- Right Side Telemetering Compartment, Typical of Drops 96-11 through 16