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NWC TP 5529
Part 2

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Conformal Carriage Flight Test Program

Part 2. Weapon Separation

by

R. E. Smith
Weapons Development Department

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Naval Weapons Center
CHINA LAKE, CALIFORNIA ■ JUNE 1973

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ABSTRACT

Conformal carriage represents a new method of carrying stores tangent to the fuselage of an aircraft. Nine to twelve individual bomb racks are housed in an aerodynamically smooth fairing beneath the aircraft fuselage, thus considerably reducing the drag of the installation with or without stores when compared to conventional MER/TER carriage. Supersonic flight with stores was demonstrated in previous tests. Improved separation characteristics were also predicted for this installation because the relatively flat surface should provide smoother air flow over the weapons and the rigid structure should permit higher ejection forces.

Approximately 200 weapons were released at speeds of Mach 0.6 to 1.6 and altitudes of 5,000 to 30,000 ft MSL to test the predictions. Ripple and 30-deg dive releases were also investigated using Mk 82, Rockeye II, NSRDC bluff, and M117-M6 bluff bombs.

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Naval Weapons Center

AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

Paul E. Pugh, RADM, USN .... Commander

Walter B. LaBerge, Ph.D. .... Technical Director

FOREWORD

This report (published in two parts) documents the Conformal Carriage Flight Test Program which was carried out by the Naval Weapons Center (NWC), China Lake. This program was a Joint Service effort with program management provided by the Naval Ship Research and Development Center and Eglin Air Force Base. The Naval Air Systems Command AIR-320 administered the Navy funding and AIR-530141C provided technical assistance. The Flight Test Instrument Pool at the Naval Air Test Center, Patuxent River furnished the aircraft instruments and technical assistance during the initial installation; Edwards Air Force Base supplied calibration facilities for the aircraft airspeed system and instrumented ranges for weapon ballistics. The Boeing Company designed, built, and installed the conformal adapter under contract N00600-71C-1150 and performed an analysis of the performance data, reported in Ref. 1.

The separation tests documented herein were conducted at NWC during the period of February-April 1973. This report was reviewed for technical accuracy by Richard Meeker. It is released at the working level for information only.

Released by
RAY W. VAN AKEN, *Head*
Aeromechanics Division
13 June 1973

Under authority of
F. H. KNEMEYER, *Head*
Weapons Development Department

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INTRODUCTION

In order to test the feasibility of a new weapon carriage concept, the Boeing Company installed a conformal adapter beneath the fuselage of a Navy F-4B aircraft (Bureau No. 148371). The adapter was designed to house nine to twelve Douglas LODE-14 bomb racks in an aerodynamically clean configuration, Fig. 1. Upon completion of a series of subsonic and supersonic performance tests, reported in Ref. 1 and 2, the weapon separation characteristics of the conformal array were investigated.

Two existing conventional bombs and two experimental bluff shapes were selected for the separation tests. Approximately 200 weapons were released from a wide variety of aircraft flight conditions. Prior to the flight tests, both transonic and supersonic wind tunnel separation tests were performed to insure a reasonably safe program. The flight tests were started at Mach 0.6 at 5,000 ft MSL and were incrementally increased in speed and altitude to Mach 1.6 at 30,000 ft MSL. Ripple and 30-deg dive releases were also investigated.

Because of the unique nature of this carriage system and the close bomb spacing maintained for a low-drag profile, the bomb loading and safety procedures are different than those encountered with conventional racks. The procedures and resulting problems are covered in the appendixes (A, B, and C) to this report.

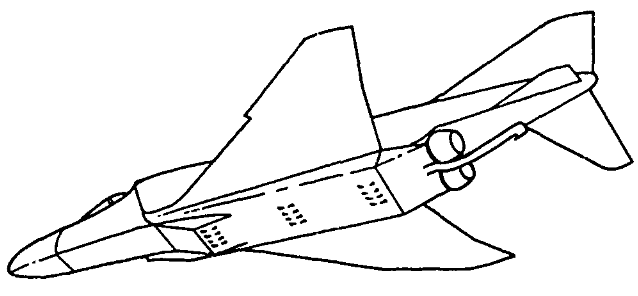

FIG. 1. Conformal Carriage Adapter Installed on an F-4B Aircraft.

DESCRIPTION OF TESTS AND RESULTS

WEAPONS

The weapons used in the separation tests included the Mk 82 low-drag bomb, the Rockeye II cluster weapon, the Air Force M117-M6 bluff bomb, and the NSRDC bluff shape. External weapon dimensions are shown in Fig. 2; the weight and C.G. location for each bomb are provided in Table 1. All weapons were inert ballistic dummies.

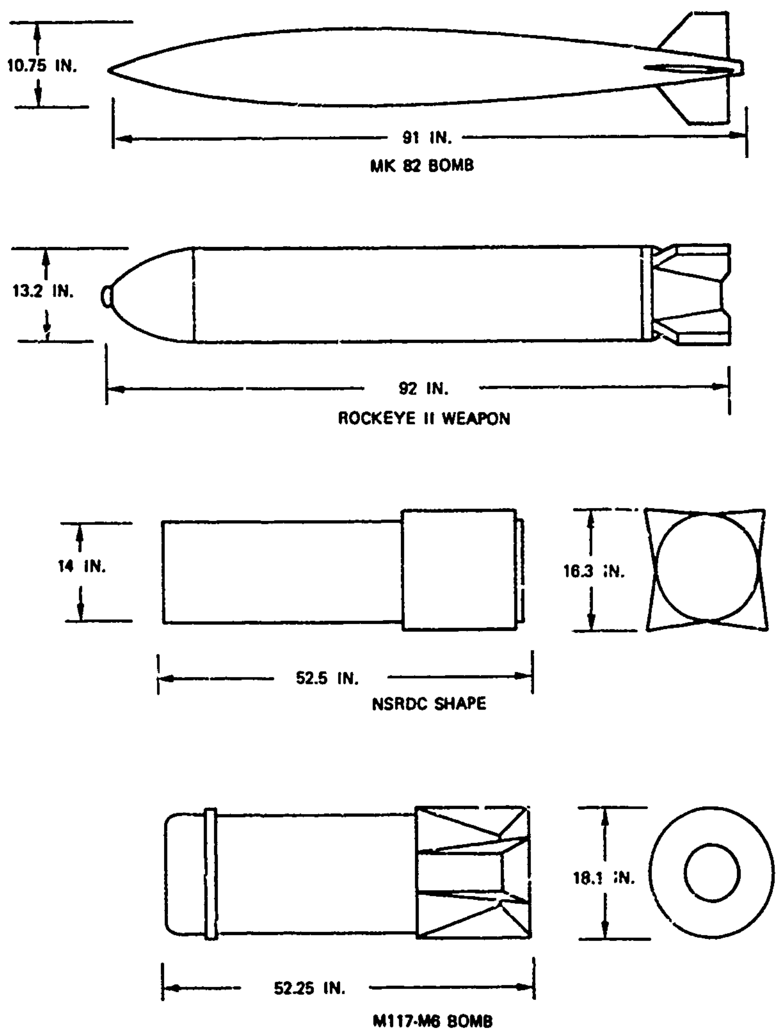

FIG. 2. External Weapon Dimensions.

TABLE 1. Flight Test Sequence.

Mk 82 Low-Drag Bombs

Flight No.	Mach No.	Altitude, ft MSL	Release mode	Station No.	Dive angle, deg	Weight, lb	CG[(1)] inches,	Notes
S-1	0.6	5,000	Single	7	0	510	8.5	From full load
S-2	0.6	5,000	Single	1	0	504	8.8	(2)
S-2	0.8	5,000	Single	2	0	514	8.6	
S-2	0.6	5,000	Single	3	0	508	8.8	
S-2	0.8	5,000	Single	4	0	496	8.6	
S-2	0.8	5,000	Single	5	0	496	8.0	
S-2	0.8	5,000	Single	6	0	500	8.8	
S-2	0.8	5,000	Single	7	0	510	8.4	
S-2	0.8	5,000	Single	8	0	506	8.8	
S-2	0.8	5,000	Single	9	0	514	8.8	
S-2	0.95	7,000	Single	10	0	504	8.9	(3)
S-2	0.8	5,000	Single	11	0	498	8.6	
S-2	0.95	7,000	Single	12	0	504	8.9	(3)
S-4	0.95	5,000	Single	1	0	506	8.4	(2)
S-4	0.95	5,000	Single	2	0	504	8.8	(3)
S-4	0.95	5,000	Single	3	0	504	8.9	
S-4	0.95	5,000	Single	4	0	504	8.8	(3)
S-4	0.95	5,000	Single	5	0	506	8.3	
S-4	0.95	5,000	Single	6	0	504	8.6	(3)
S-4	0.95	5,000	Single	7	0	510	8.3	
S-5	0.95	5,000	Single	8	0	500	8.5	
S-5	0.95	5,000	Single	9	0	503	8.0	
S-5	0.95	7,000	Single	10	30	508	8.1	
S-5	0.95	5,000	Single	11	0	506	8.1	
S-5	0.95	7,000	Single	12	30	498	8.9	
S-6	1.2	13,000	Single	1	0	512	8.2	(2)
S-6	1.2	13,000	Single	2	0	520	8.1	(3)
S-6	1.2	13,000	Single	3	0	504	8.3	
S-7	1.2	13,000	Single	4	0	506	8.3	(3)
S-7	1.2	13,000	Single	5	0	502	8.5	
S-7	1.2	13,000	Single	6	0	520	8.3	(3)
S-7	1.2	13,000	Single	7	0	514	8.5	
S-8	1.2	13,000	Single	8	0	506	8.4	
S-8	1.2	13,000	Single	9	0	500	7.9	
S-9	1.2	13,000	Single	10	0	508	8.3	(3)
S-9	1.2	13,000	Single	11	0	502	8.0	
S-9	1.2	13,000	Single	12	0	518	8.3	(3)
S-10	1.4	25,000	Single	1	0	508	8.0	(2)
S-10	1.4	25,000	Single	2	0	516	8.1	(3)
S-10	1.4	25,000	Single	3	0	514	8.3	
S-11	1.4	25,000	Single	4	0	514	8.3	(3)
S-11	1.4	25,000	Single	5	0	512	8.3	
S-11	1.4	25,000	Single	6	0	---	---	Hung store
S-12	1.4	25,000	Single	7	0	500	8.3	
S-12	1.4	25,000	Single	8	0	490	8.8	
S-12	1.4	25,000	Single	9	0	496	8.4	
S-12	1.4	25,000	Single	10	0	510	8.6	(3)
S-13	1.4	25,000	Single	11	0	505	8.6	
S-13	1.4	25,000	Single	12	0	512	8.3	(3)
S-14	0.8	5,000	0.060 sec ripple	1	0	508	8.2	
S-14	0.8	5,000	0.060 sec ripple	2	0	514	8.4	(3)
S-14	0.8	5,000	0.060 sec ripple	3	0	502	8.5	
S-14	0.8	5,000	0.060 sec ripple	4	0	518	8.3	(3)
S-14	0.8	5,000	0.060 sec ripple	5	0	512	8.3	
S-14	0.8	5,000	0.060 sec ripple	6	0	516	8.4	(3)

TABLE 1. (Contd.)

Flight No.	Mach No.	Altitude, ft MSL	Release mode	Station No.	Dive angle, deg	Weight, lb	CG(1) inches,	Notes
Mk 82 (Contd.)								
S-14	0.8	5,000	0.060 sec ripple	7	0	510	8.3	
S-14	0.8	5,000	0.060 sec ripple	8	0	512	8.2	
S-14	0.8	5,000	0.060 sec ripple	9	0	512	8.3	
S-14	0.8	5,000	0.060 sec ripple	10	0	516	8.4	(3)
S-14	0.8	5,000	0.060 sec ripple	11	0	490	8.8	
S-14	0.8	5,000	0.060 sec ripple	12	0	508	8.3	(3)
S-15	1.2	13,000	Single	1	30	496	8.5	
S-15	1.2	13,000	Single	2	30	504	7.8	
S-15	1.2	13,000	Single	3	30	504	8.1	
S-15	1.2	13,000	Single	4	30	502	8.4	
S-15	1.2	13,000	Single	5	30	490	8.8	
S-15	1.2	13,000	Single	6	30	518	8.5	
S-16	1.2	13,000	Single	7	30	512	8.3	
S-16	1.2	13,000	Single	8	30	514	8.6	
S-16	1.2	13,000	Single	9	30	502	8.8	
S-16	1.2	13,000	Single	10	30	490	8.0	
S-16	1.2	13,000	Single	11	30	496	8.8	
S-16	1.2	13,000	Single	12	30	498	8.4	
S-17	0.95	5,000	0.100 sec ripple	1	0	510	8.5	
S-17	0.95	5,000	0.100 sec ripple	2	0	500	8.3	
S-17	0.95	5,000	0.100 sec ripple	3	0	498	8.5	
S-17	0.95	5,000	0.100 sec ripple	4	0	512	8.3	
S-17	0.95	5,000	0.100 sec ripple	5	0	512	8.0	
S-17	0.95	5,000	0.100 sec ripple	6	0	488	8.8	
S-17	0.95	5,000	0.100 sec ripple	7	0	508	8.4	
S-17	0.95	5,000	0.100 sec ripple	8	0	504	8.9	
S-17	0.95	5,000	0.100 sec ripple	9	0	518	8.6	
S-17	0.95	5,000	0.100 sec ripple	10	0	478	8.5	
S-17	0.95	5,000	0.100 sec ripple	11	0	508	8.4	
S-17	0.95	5,000	0.100 sec ripple	12	0	502	8.4	
S-18	1.2	13,000	0.100 sec ripple	1	0	506	8.4	
S-18	1.2	13,000	0.100 sec ripple	2	0	508	8.2	
S-18	1.2	13,000	0.100 sec ripple	3	0	500	7.9	
S-18	1.2	13,000	0.100 sec ripple	4	0	498	8.3	
S-18	1.2	13,000	0.100 sec ripple	5	0	498	8.5	
S-18	1.2	13,000	0.100 sec ripple	6	0	504	8.3	
S-18	1.2	13,000	0.100 sec ripple	7	0	500	8.5	
S-18	1.2	13,000	0.100 sec ripple	8	0	502	8.3	
S-18	1.2	13,000	0.100 sec ripple	9	0	488	9.0	
S-18	1.2	13,000	0.100 sec ripple	10	0	508	8.5	
S-18	1.2	13,000	0.100 sec ripple	11	0	504	8.5	
S-18	1.2	13,000	0.100 sec ripple	12	0	502	8.6	
S-19	1.6	30,000	Single	1	0	502	8.0	
S-19	1.6	30,000	Single	2	0	508	8.0	
S-19	1.6	30,000	Single	3	0	506	8.3	
S-19	1.6	30,000	Single	4	0	498	8.3	
S-20	1.6	30,000	Single	5	0	502	8.2	
S-20	1.6	30,000	Single	6	0	518	8.1	(3)
S-20	1.6	30,000	Single	7	0	508	8.6	
S-20	1.6	30,000	Single	8	0	518	8.4	
S-20	1.6	30,000	Single	9	0	518	8.4	
S-20	1.6	30,000	Single	10	0	494	8.5	
S-20	1.6	30,000	Single	11	0	503	9.0	
S-20	1.6	30,000	Single	12	0	496	8.6	

TABLE 1. (Contd.)

Flight No.	Mach No.	Altitude, ft MSL	Release mode	Station No.	Dive angle, deg	Weight, lb	CG(1) inches,	Notes
NSRDC Bombs								
S-21	0.6	5,000	Fast ripple	2	0	936	5.9	Inadvertent
S-21	0.6	5,000	Fast ripple	3	0	939	6.0	Inadvertent
S-21	0.6	5,000	Fast ripple	4	0	937	5.9	Inadvertent
S-21	[illegible]	5,000	Fast ripple	5	0	938	5.9	Inadvertent
S-21	0.6	5,000	Fast ripple	6	0	936	6.0	Inadvertent
S-22	0.6	5,000	Single	1	0	936	6.0	(2)
S-22	0.8	5,000	Single	2	0	934	5.8	
S-22	0.8	5,000	Single	3	0	938	5.8	
S-22	0.9	5,000	Single	4	0	930	6.0	
S-22	0.9	5,000	Single	5	0	938	5.9	
S-22	0.9	7,000	Single	6	30	936	6.0	
S-23	0.8	5,000	0.060 sec ripple	1	0	935	5.9	
S-23	0.8	5,000	0.060 sec ripple	2	0	934	5.8	
S-23	0.8	5,000	0.060 sec ripple	3	0	940	6.0	Weapon tumbled
S-23	0.8	5,000	0.060 sec ripple	4	0	936	6.0	
S-23	0.9	[illegible]	0.060 sec ripple	5	0	934	5.8	
S-23	0.8	[illegible]	0.060 sec ripple	6	0	936	6.0	
S-23	0.8	[illegible]	0.060 sec ripple	7	0	940	5.9	
S-23	0.8	[illegible]	0.060 sec ripple	8	0	937	6.0	
S-23	0.8	5,000	0.060 sec ripple	9	0	934	5.9	
M117-[illegible] Bombs								
S-24	0.9	5,000	Single	1	0	812	4.3	(2)
S-24	0.9	5,000	Single	2	0	828	4.3	
S-24	0.9	5,000	Single	3	0	804	4.3	
S-24	0.9	5,000	Single	4	0	802	4.3	
S-24	0.9	5,000	Single	5	0	[illegible]	4.3	
S-24	0.9	5,000	Single	6	0	814	4.3	
S-24	0.9	5,000	Single	7	0	822	4.3	
S-24	0.9	5,000	Single	8	0	798	4.3	
S-25	0.9	5,000	Single	9	0	798	4.3	
S-26	1.15	10,000	Single	1	0	806	4.0	Hung store
S-27	1.15	10,000	Single	2	0	812	4.1	
S-27	1.15	10,000	Single	3	0	802	4.3	(2)
S-27	1.15	10,000	Single	4	0	802	4.3	
S-27	1.15	10,000	Single	5	0	804	4.3	
S-28	1.15	10,000	Single	6	0	804	4.1	
S-28	1.15	10,000	Single	7	0	798	4.1	
S-28	1.15	10,000	Single	8	0	812	4.3	
S-28	1.15	10,000	Single	9	0	816	4.1	
S-29	1.4	25,000	Single	1	0	809	4.1	
S-29	1.4	25,000	Single	2	0	---	---	Hung store
S-29	1.4	25,000	Single	3	0	804	4.6	
S-30	1.4	25,000	Single	4	0	812	4.3	
S-30	1.4	25,000	Single	5	0	814	4.4	
S-30	1.4	25,000	Single	6	0	808	4.3	
S-30	1.4	25,000	Single	7	0	802	4.1	
S-30	1.4	25,000	Single	8	0	808	4.1	
S-30	1.4	25,000	Single	9	0	792	4.4	
S-31	1.4	25,000	0.100 sec ripple	1	0	794	4.6	
S-31	1.4	25,000	0.100 sec ripple	2	0	812	4.3	
S-31	1.4	25,000	0.100 sec ripple	3	0	806	4.1	
S-31	1.4	25,000	0.100 sec ripple	4	0	802	4.4	
S-31	1.4	25,000	0.100 sec ripple	5	0	804	4.2	

TABLE 1. (Contd.)

Flight No.	Mach No.	Altitude, ft MSL	Release mode	Station No.	Dive angle, deg	Weight, lb	CG(1) inches,	Notes
M117-M6 Bombs (Contd.)								
S-31	1.4	25,000	0.100 sec ripple	6	0	806	4.5	
S-31	1.4	25,000	0.100 sec ripple	7	0	812	4.3	
S-31	1.4	25,000	0.100 sec ripple	8	0	802	4.5	
S-31	1.4	25,000	0.100 sec ripple	9	0	792	4.3	
S-32	0.9	5,000	0.060 sec ripple	1	0	812	4.1	
S-32	0.9	5,000	0.060 sec ripple	2	0	810	4.4	
S-32	0.9	5,000	0.060 sec ripple	3	0	814	4.4	
S-32	0.9	5,000	0.060 sec ripple	4	0	804	4.0	
S-32	0.9	5,000	0.060 sec ripple	5	0	820	4.2	
S-32	0.9	5,000	0.060 sec ripple	6	0	816	4.5	
S-32	0.9	5,000	0.060 sec ripple	7	0	812	4.1	
S-32	0.9	5,000	0.060 sec ripple	8	0	808	4.4	
S-32	0.9	5,000	0.060 sec ripple	9	0	802	4.4	
Rockeye II Weapons								
S-33	0.9	5,000	Single	5	0	494	5.5	
S-33	0.9	5,000	Single	6	0	492	5.4	
S-33	0.9	5,000	Single	7	0	494	5.8	Fins closed
S-33	0.9	5,000	Single	8	0	492	5.6	
S-33	0.9	5,000	Single	9	0	494	5.5	
S-33	0.9	5,000	Single	10	0	492	5.5	
S-33	0.9	5,000	Single	11	0	488	5.5	
S-33	0.9	5,000	Single	12	0	492	5.5	
S-34	0.9	5,000	Single	1	0	492	5.5	
S-34	1.2	13,000	Single	2	0	492	5.5	0.125" orifice aft
S-34	0.9	5,000	Single	3	0	500	5.6	
S-35	1.2	13,000	Single	4	0	496	5.5	0.125" orifice aft
S-35	1.2	13,000	Single	5	0	494	5.5	0.125" orifice aft
S-35	1.2	13,000	Single	6	0	492	5.4	0.125" orifice aft
S-35	1.2	13,000	Single	7	0	492	5.8	0.125" orifice aft
S-35	1.2	13,000	Single	8	0	497	5.5	0.125" orifice aft
S-35	1.2	13,000	Single	9	0	492	5.5	
S-35	1.2	13,000	Single	10	0	494	5.5	
S-35	1.2	13,000	Single	11	0	494	5.8	
S-35	1.2	13,000	Single	12	0	502	5.5	
Mk 82 Low-Drag Bombs								
S-36	1.4	25,000	Single	1	0	508	8.5	0.125" orifice fwd
S-36	1.4	25,000	Single	2	0	508	8.4	0.125" orifice fwd
S-36	1.4	25,000	Single	3	0	494	8.1	0.125" orifice fwd
S-36	1.4	25,000	Single	4	0	510	8.0	0.125" orifice fwd

(1) Measured in inches forward of aft lug CL.
(2) All weapons for this flight condition were released on Edwards AFB ballistic range.
(3) Bombs were painted with photogrametry pattern.

The Mk 82 bomb was a standard low-drag shape which included an ogive nose plug and a MAU-93/B conical tail fin. Both the Mod 2 and Mod 3 Rockeye II weapons were used, and each had a positively armed folding-tail-fin assembly. Positive arming was accomplished by using a small wire clamp and a snap hook to secure the release lanyard to a screw on the bottom of the carriage. A 1.125-inch spacer was installed in each lug well to obtain adequate physical clearance between the bomb and carriage adapter.

The NSRDC bluff shape is a right circular cylinder with a 14-inch diameter and 3.75 fineness ratio. A four-point star-shaped fin has been welded to the tail of the bomb to provide static stability. The shape was designed to provide dense loading of an aerodynamically stable shape on a conformal installation without requiring a folding-fin assembly.

The M117-M6 bomb consists of adding a bluff nose casting and a six-fin tail casting to a standard Air Force M117 warhead. The castings are held in place by the nose and tail fuses, and the warhead is reversed so the nose casting is attached to the aft end. This same method could be used to increase the loading density of other low-drag bombs. The 1.125-inch spacers were also used in each lug well of the M117-M6 bombs.

BOMB RACKS

The Douglas low-drag ejector rack, LODE-14, was used throughout the program. No external sway braces are required with this bomb rack so it presents a low-drag profile when housed inside the conformal adapter. Sway bracing is accomplished by small spring-loaded wedges located inside the rack that react against the top of special T-shaped bomb lugs (Fig. 3). These special T-lugs must be used in place of standard bail lug. A dual-breech assembly was used in the rack along with two ARD 863 cartridges. Each cartridge is fired electrically but if one cartridge fails to ignite, it will be detonated sympathetically by the second cartridge. The pressures are routed to two ejector pistons by way of separate conduits and orifices. Both orifices are removable, and the pistons act independently of one another through the center of the T-lugs so that pitch motion can be imparted in the store by changing the size of the orifice. Reference 3 provides a more detailed description of the racks. During all but the last two tests, a 0.250-inch diameter orifice was used in both ends of each rack. A 0.125-inch orifice was used with the forward piston for the Rockeye II test at Mach 1.2, and the same 0.125-inch orifice was used with the aft piston for the final Mk 82 bomb test at Mach 1.4. Ejection velocity curves provided by Ref. 4 and 5 are shown in Fig. 4 and indicate that this rack provides higher velocities than MER/TER. The arming wire solenoids and store sensing switches were not used.

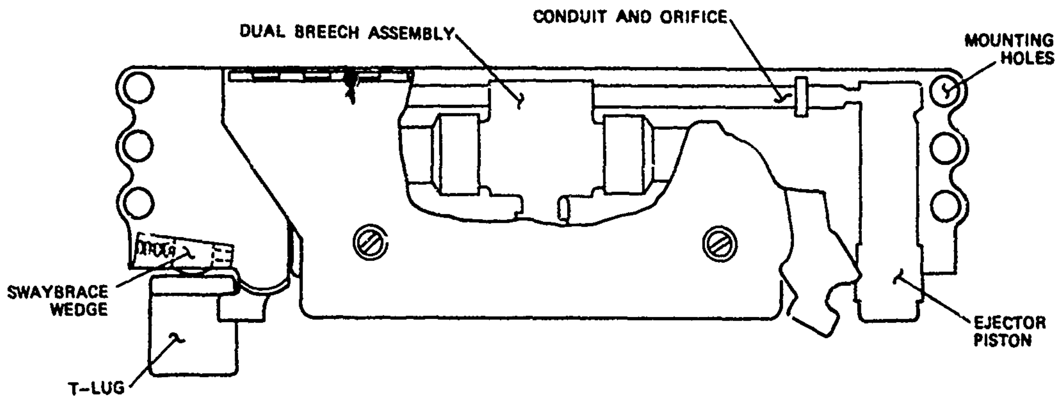

FIG. 3. Douglas Low-Drag Ejector Rack, LODE-14.

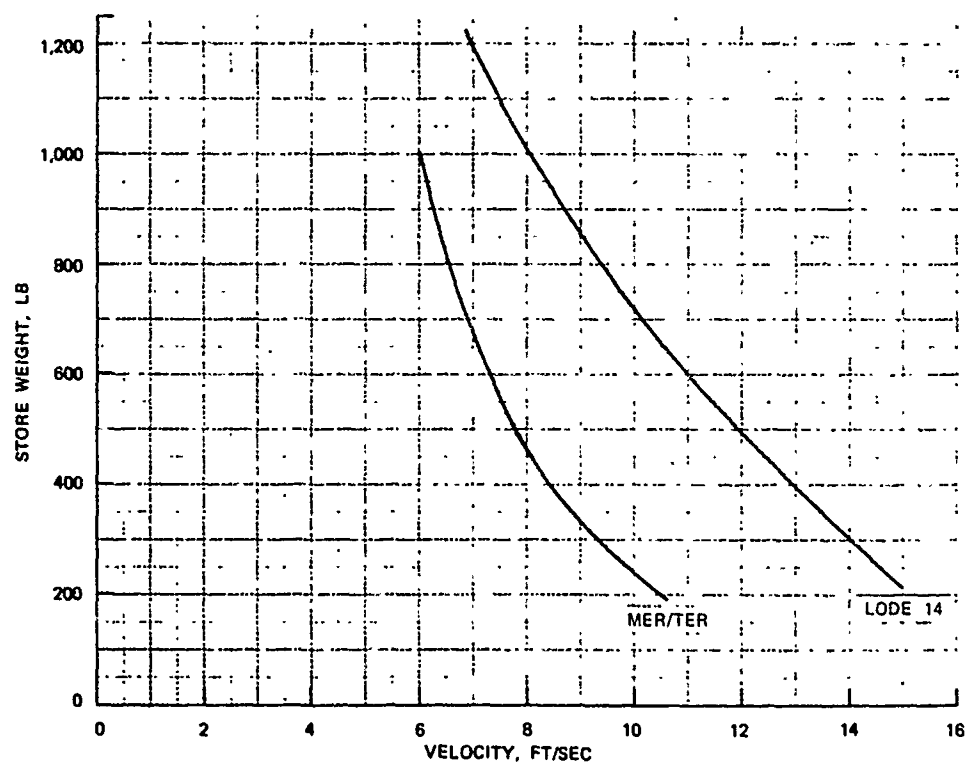

FIG. 4. Ejection Velocity, Two ARD 863 Cartridges.

Selection of the ARD 863 cartridge was based on Douglas information that indicated this cartridge was cleaner burning than either the Mk 125 or Mk 2 equivalent. Also the 863 cartridge exhibits a much more rapid pressure rise which assists in releasing the over-center-bomb latching mechanism (Fig. 5).

Each bomb rack was cleaned after every firing by removing and cleaning the two ejector pistons and the center piston, and using a bottle brush on the cylinders.

The bottom of the rack was mounted flush with the underside of the carriage adapter with removable panels filling in the spaces between racks. Since access to the breech assembly is through the side of the rack, numerous panels had to be removed from the adapter each time the cartridges were changed. This also made it necessary to load weapons after the cartridges were installed. Mechanical safety pins consisted of three long rods which were inserted through the side of the carriage adapter, and each rod engaged a complete row of three or four bomb racks. The special loading instructions are included as Appendix B.

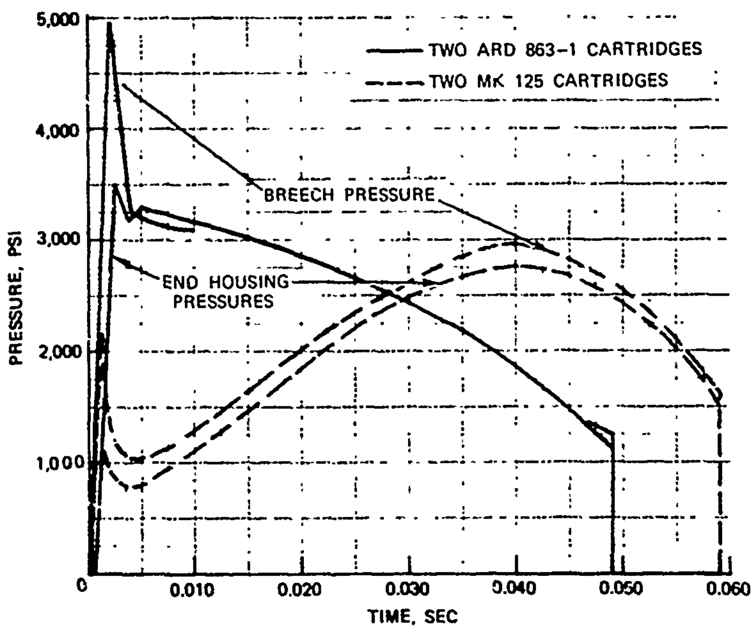

FIG. 5. LODE-14A Rack, 970.5-Lb Store, Two 0.250-Inch-Diameter Orifices.

INSTRUMENTATION

Separation photographs were recorded by five cameras on board the conformal carriage aircraft and a photo chase airplane. Photo pods were installed on outboard wing stations 1 and 9; each pod contained two Milliken cameras running at 200 frames per second. A GSAP camera was installed inside the nose radome and looked aft through a small externally mounted prism. The GSAP camera was running at 64 frames per second. Aircraft flight conditions at release were recorded by a photo panel mounted in the rear seat, providing airspeed, altitude, Mach number, normal acceleration, free air temperature, and an attitude gyro for aircraft pitch and roll angles. An event light on the photo panel and inside each camera was activated by the bomb release pulse for correlation of the data. Instrument calibrations and aircraft airspeed calibrations were available from the previous performance tests so that airspeed, altitude, and Mach number were corrected to true values. Measurements were not made of the pressure lag in the airspeed system, therefore dive release conditions were not corrected.

Table 2 provides the corrected photo panel data for all level flight releases except two of the Mk 82 missions during which the camera did not work (the Mach 0.8 at 5,000 ft, 0.060-sec ripple, and Mach 1.4 at 25,000 ft, singles). The altitude, airspeed, and Mach number are indicated values for all of the dive releases. The static pressure compensator of the air data computer was not used during any of the tests, so the supersonic corrections are large.

Eglin Air Force Base uses a photogrametric method of reducing the photo pod film to get weapon attitude and displacement during separation. Information from the separation films and geometric data on the location of the cameras and weapons are used as inputs into a computer which solves the equations and provides the separation data. A special paint pattern is required on both the aircraft and weapons for best accuracy, but time and money did not permit putting this pattern on all the weapons. Table 1, Note 3, indicates which Mk 82 and M117-M6 bombs had the pattern. The dimensions required for the computer inputs are provided in Fig. 6 through 8.

Several of the flights were flown over the ballistics ranges at Edwards Air Force Base as indicated by Note 3 of Table 1. The ballistics data were sent directly from Edwards Air Force Base to Eglin Air Force Base and are not available for this report.

TABLE 2. Aircraft Flight Conditions.

Weapon	Bomb No.	Airspeed, knots	Altitude, ft	Mach No.	*g*	Dive angle	Bank angle, deg right
Mk 82	1	379	4,840	0.59	1.05	0	1
	2	503	4,830	0.78	1.20	0	3
	3	384	4,890	0.59	1.05	0	3
	4	489	4,900	0.75	1.35	0	3
	5	495	4,880	0.76	1.20	0	3
	6	500	4,730	0.77	1.20	0	0
	7	500	4,740	0.77	1.25	0	1
	8	507	4,710	0.78	1.20	0	0
	9	490	4,750	0.76	1.05	0	2
	10	612	5,350	0.95	1.30	0	3
	11	504	4,780	0.78	1.25	0	1
	12	617	5,630	0.96	1.30	0	1
Mk 82	1	602	4,790	0.94	1.10	3 deg climb	5
	2	604	4,810	0.94	1.20	0	7
	3	606	4,850	0.94	1.10	1 deg climb	5
	4	607	4,830	0.94	1.05	1 deg climb	3
	5	605	4,680	0.93	1.20	0	3
	6	606	4,760	0.94	1.20	1 deg climb	7
	7	605	4,850	0.93	1.25	0	6
	8	605	4,810	0.93	1.20	0	6
	9	608	4,830	0.94	1.10	0	2
	10[a]	545	8,920	0.94	1.50	37 deg dive	5
	11	610	5,000	0.94	1.40	0	5
	12[a]	570	7,080	0.95	2.00	38 deg dive	5
Mk 82	1	724	13,360	1.14	---	---	---
	2	724	13,360	1.14	1.05	1 deg climb	1
	3	717	13,330	1.13	1.10	1 deg climb	0
	4	721	13,400	1.13	1.10	0	18
	5	689	13,430	1.08	1.20	0	10
	6	699	13,580	1.10	1.15	0	10
	7	738	14,020	1.17	1.10	0	1
	8	687	12,880	1.09	1.20	0	10
	9	743	13,900	1.18	1.20	1 deg climb	1
	10	702	13,940	1.12	1.15	0	10
	11	675	13,120	1.07	1.35	0	0
	12	684	12,900	1.08	1.25	5 deg dive	1
Mk 82	1[a]	678	14,840	1.29	1.45	28 deg	18
	2[a]	685	14,090	1.28	1.75	28 deg	18
	3[a]	658	17,410	1.30	1.50	31 deg	8
	4[a]	669	16,820	1.32	1.95	31 deg	10
	5[a]	650	18,040	1.30	1.10	33 deg	10
	6[a]	664	17,350	1.32	1.40	32 deg	10
	7[a]	642	17,880	1.28	1.60	38 deg	10
	8[a]	656	16,990	1.29	1.50	36 deg	14
	9[a]	620	20,100	1.28	1.00	44 deg	20
	10[a]	637	19,160	1.30	1.05	43 deg	20
	11[a]	637	18,980	1.30	1.80	50 deg	12
	12[a]	658	18,030	1.32	1.80	48 deg	15
Mk 82 Ripple	1-12	600	4,710	0.93	1.10	0	5
Mk 82 Ripple	1-12	713	14,360	1.14	1.20	0	5
Mk 82	1	893	28,550	1.51	1.00	0	3
	2	895	28,610	1.51	1.00	0	5
	3	895	28,630	1.51	1.10	0	5
	4	896	28,650	1.51	1.20	0	5
	5	896	28,640	1.52	1.05	0	5
	6	897	28,630	1.52	1.00	0	8

TABLE 2. (Contd.)

Weapon	Bomb No.	Airspeed, knots	Altitude, ft	Mach No.	g	Dive angle	Bank angle, deg right
Mk 82	7	896	28,600	1.51	1.10	0	5
	8	897	28,610	1.52	1.05	0	2
	9	885	29,790	1.50	1.40	0	2
	10	885	29,800	1.50	1.00	0	1
	11	885	29,830	1.51	1.20	1 deg climb	3
	12	887	29,860	1.51	1.00	2 deg climb	5
NSRDC	1	380	4,740	0.58	1.15	0	0
	2	500	4,710	0.77	1.20	0	10
	3	492	4,800	0.75	1.20	2 deg dive	10
	4	575	4,620	0.88	1.10	2 deg dive	10
	5	582	4,610	0.89	1.05	3 deg dive	5
	6[a]	482	4,770	0.79	1.40	25 deg dive	8
NSRDC Ripple	1-9	512	4,410	0.78	1.25	0	8
M117-M6	1	572	4,720	0.87	1.30	0	8
	2	576	4,560	0.87	1.20	0	8
	3	580	4,610	0.88	1.15	0	10
	4	580	4,600	0.88	1.05	0	10
	5	582	4,590	0.88	1.15	0	10
	6	580	4,670	0.88	1.00	2 deg dive	10
	7	580	4,560	0.88	1.30	3 deg dive	6
	8	583	4,630	0.89	1.20	0	3
	9	574	4,170	0.87	1.20	0	3
M117-M6	1	654	10,060	1.01	1.35	3 deg climb	10
	2	654	10,440	1.01	1.25	0	0
	3	655	10,270	1.01	1.25	0	2
	4	656	10,490	1.02	1.10	2 deg climb	8
	5	656	10,490	1.02	1.25	2 deg climb	8
	6	658	10,200	1.02	1.60	0	10
	7	659	10,330	1.02	1.40	1 deg climb	5
	8	659	10,100	1.02	1.40	2 deg climb	12
	9	659	9,990	1.02	1.60	2 deg climb	10
M117-M6	1	701	24,530	1.16	1.20	0	5
	2	701	24,530	1.16	1.25	0	5
	3	701	24,530	1.16	1.25	0	5
	4	718	24,780	1.19	1.35	0	3
	5	717	24,760	1.19	1.15	0	0
	6	719	24,760	1.19	1.15	0	0
	7	---	---	---	---	---	---
	8	---	---	---	---	---	---
	9	---	---	---	---	---	---
M117-M6 Ripple	1-9	678	23,820	1.12	1.20	0	2
M117-M6 Ripple	1-9	605	4,310	0.91	1.20	5 deg climb	13
Rockeye II	1	569	4,500	0.87	1.30	5 deg climb	18
	2	572	4,470	0.88	1.25	7 deg climb	18
	3	574	4,460	0.88	1.20	7 deg climb	17
	4	573	4,460	0.88	1.25	5 deg climb	8
	5	581	4,430	0.89	1.40	0	10
	6	583	4,460	0.89	1.25	2 deg dive	12
	7	584	4,530	0.89	1.20	2 deg dive	10
	8	587	4,630	0.90	1.15	2 deg dive	10

TABLE 2. (Contd.)

Weapon	Bomb No.	Airspeed, knots	Altitude, ft	Mach No.	g	Dive angle	Bank angle, deg right
Rockeye II	1	546	4,550	0.83	1.45	0	2
	2	662	11,960	1.05	1.00	2 deg dive	12
	3	554	5,280	0.85	1.20	2 deg dive	3
	4	553	12,770	1.02	1.40	0	2
	5	654	12,740	1.02	1.10	2 deg dive	0
	6	661	12,860	1.03	1.20	2 deg dive	1
	7	664	12,820	1.03	1.20	2 deg dive	1
	8	671	13,020	1.04	1.25	3 deg dive	1
	9	672	13,030	1.05	1.40	3 deg dive	0
	10	667	12,930	1.04	1.00	3 deg dive	0
	11	671	13,000	1.04	1.40	2 deg dive	0
	12	666	12,940	1.04	1.50	1 deg dive	0
Mk 82	1	735	24,550	1.21	1.20	1 deg dive	2
	2	735	24,560	1.21	1.20	0	2
	3	736	24,560	1.21	1.20	0	2
	4	737	24,570	1.22	1.20	0	2

[a] Altitude, airspeed, and Mach number are indicated values.

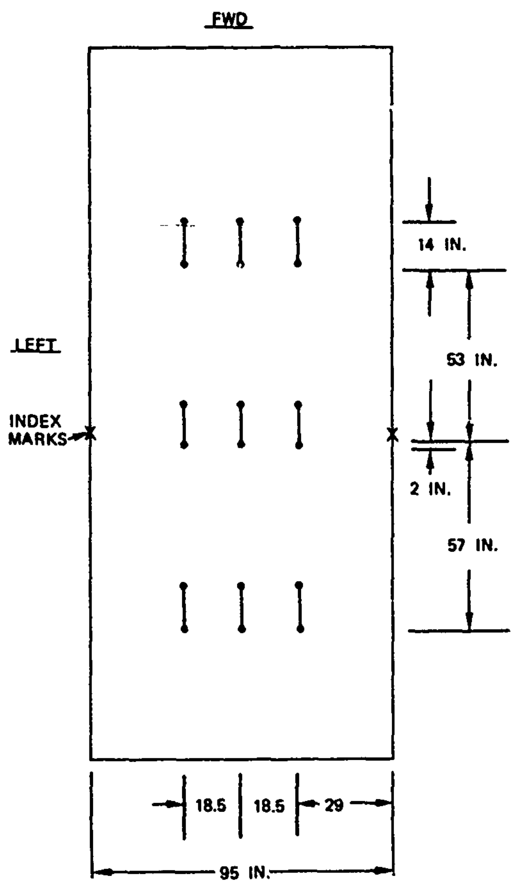

FIG. 6. M117-M6 Configuration.

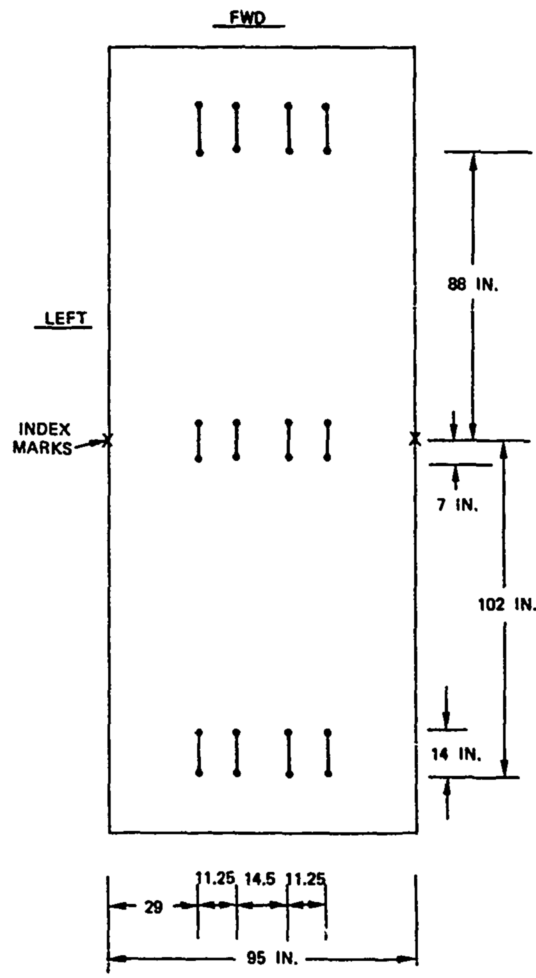

FIG. 7. Mk 82 Configuration.

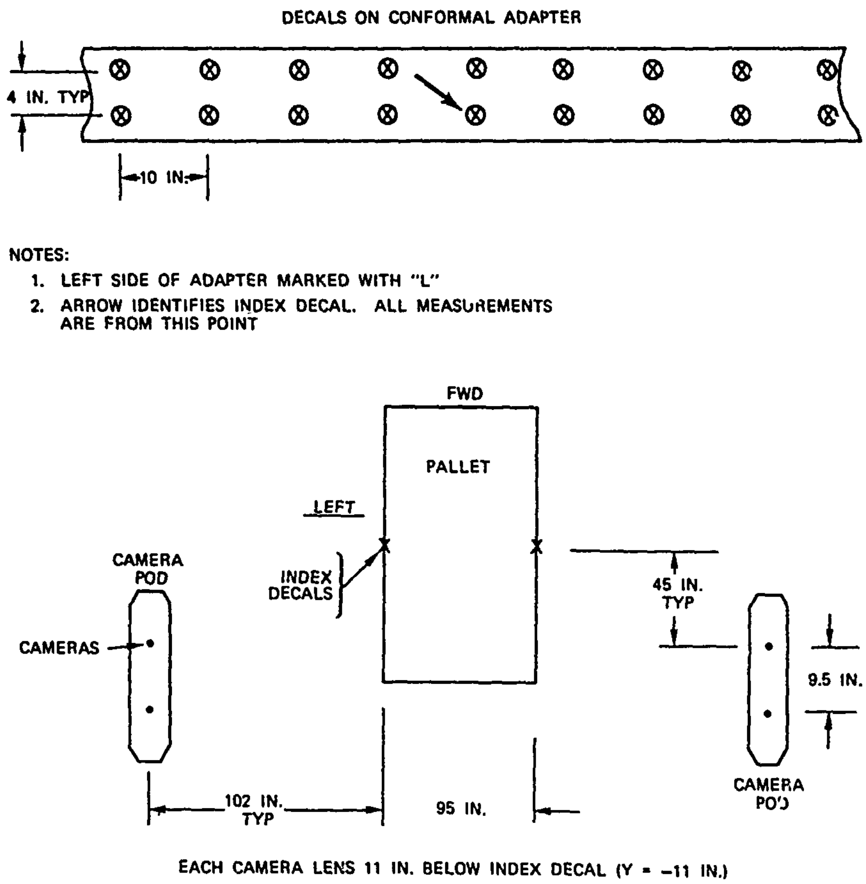

FIG. 8. Aircraft Markings and Dimensions.

FLIGHT TESTS

Thirty-six flights were made during the separation test program, and Table 1 ties the flight numbers to nominal release conditions and weapon physical characteristics. Release sequences for both the nine- and twelve-bomb arrays are shown in Fig. 9 and 10. These sequences were chosen in an effort to minimize weapon-to-weapon collisions during short-interval ripple releases. Although the sequences were used exclusively in the tests, several hung stores resulted in a straight left-to-right sequence with no apparent change in separation characteristics. On the first flight, one Mk 82 bomb was inadvertently released from the middle of the array and it also separated safely and cleanly.

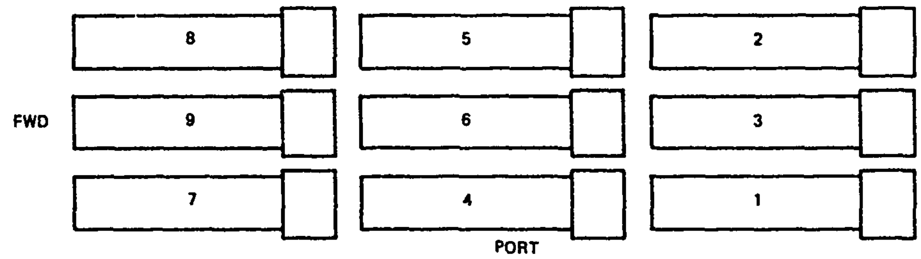

FIG. 9. Nine Weapon Release Sequence, M117-M6 and NSRDC Bluff.

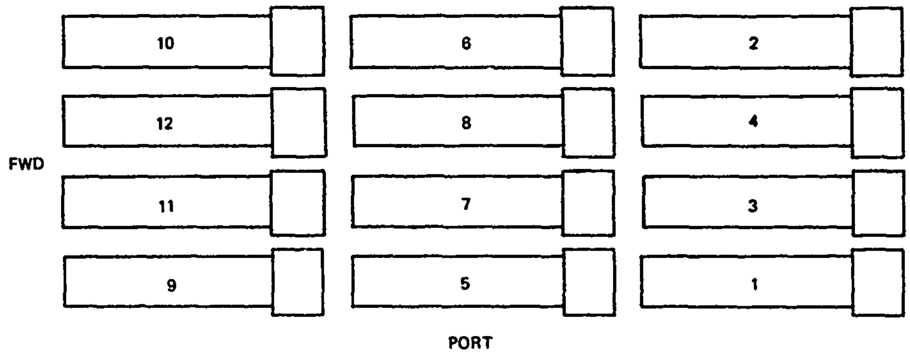

FIG. 10. Twelve Weapon Release Sequence, Mk 82 and Rockeye II.

The supersonic release altitudes were selected to provide a wide range of Mach numbers while maintaining a 650-knot calibrated airspeed limit. Previous performance tests indicated most of these conditions should be attainable, but it soon became apparent that the added drag of the camera pods made it impossible to reach the desired Mach numbers. All supersonic tests were flown with maximum afterburner power, and the Mach 1.6 tests were flown without the camera pods. The reasons for the hung stores and other problems encountered are discussed in Appendix A.

During the supersonic Mk 82 bomb releases, it became apparent that the aft row of weapons underwent a large nose-down pitch motion. An additional test was flown at Mach 1.4 to determine the effect of changing the bomb rack orifices on correcting this pitch motion. The aft row of weapons was released with the 0.125-inch orifice in the forward piston conduit and the 0.250-inch orifice in the aft piston conduit. Accurate data reduction will be accomplished by Eglin Air Force Base, but an approximate pitch angle-versus-time curve is shown in Fig. 11 for bomb position 2, with and without the orifice change. The data indicates a slight decrease in the initial pitch rate but little or no change in first maximum pitch amplitude. It is possible to decrease the diameter of the forward orifice further but time did not permit additional tests.

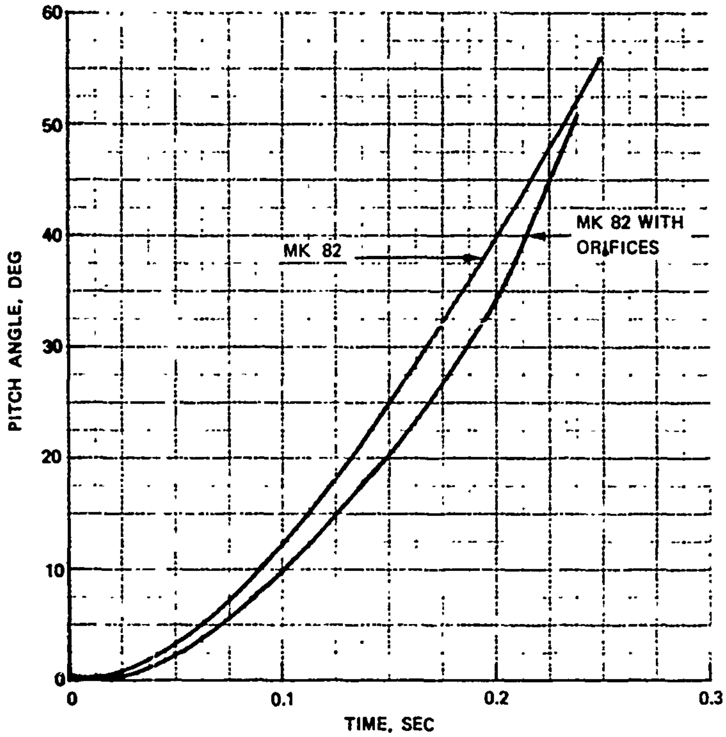

FIG. 11. Pitch Angle Versus Time, Bomb Position 2, M = 1.4 at 25,000 ft.

Only twenty Rockeye II weapons were available, therefore the first test included single releases of eight weapons from the forward two rows of the adapter. As stated previously all tail fins were positively armed, but the method was not completely effective as bomb No. 7 was released at Mach 0.9 with the fins folded. The separation was very safe and clean as the weapon underwent a slow nose-down pitch motion. The second test consisted of releasing weapons No. 1 and 3 at Mach 0.9 and the other ten weapons at Mach 1.2. Wind tunnel separation films indicated the aft and middle rows of Rockeyes had an unsafe tendency to pitch nose-up at supersonic speeds. To counter this, a 0.250-inch diameter orifice in the forward conduit and a 0.125-inch diameter orifice aft was incorporated for the six weapons released at Mach 1.2 from the aft two rows of the adapter. All separations were safe with a mild nose-down pitch motion.

Subsonic ripple releases of a full load of Mk 82, M117-M6, and NSRDC bluff bombs and supersonic ripple releases of Mk 82 and M117-M6 bombs were successfully completed at the flight conditions shown in Table 2. The only intervals available in the aircraft system were 0.060, 0.100, and 0.140 seconds with the one exception noted below. Ground impact patterns obtained for each ripple are shown in Fig. 12 through 17. The supersonic Mk 82 pattern shows the effect of the rapid nose-down pitch of the aft row in the large space between the first four and last eight impacts. In no case was it possible to trace the individual impact points back to weapon carriage position. The weapons either skipped wildly or were buried, and no films were obtained that tracked the entire flight from the aircraft to the ground. A straight line with very little lateral dispersion seems to characterize all the ripple patterns. All the multiple releases were in level flight so the pattern length could be reduced by using dive releases.

In one instance, five NSRDC bluff shapes were inadvertently rippled when the rack was *Homed* (return the rack to the No. 1 position) by the pilot (stations 2 through 6). Although this occurred on the Edwards range, no films were recorded. Personnel familiar with the MER/TER stepper switches used in the tests estimate that there was an interval of 0.015 to 0.018 sec between bombs. Release was at Mach 0.6 at 5,000 ft MSL, and the chase plane pilot reported all bombs separated safely and cleanly.

For the Mk 82 bombs, the lateral space between the inboard and outboard weapons was not the same--approximately 0.6 inch between the outboard and inboard stores, and 3.75 inches between the two inboard stores. When releasing Mk 82 bombs from the forward row, the fins on the outboard weapons consistently struck the fins on the inboard weapons. While there was no apparent fin damage, the contact did increase the pitch, yaw, and roll motion of the outboard stores. When releasing the Rockeye II weapons, there were several occasions when the upper fins were delayed in reaching the full open position due to contact with adjacent unreleased stores. A longer delay before opening the fins would prevent this contact, but no adverse effects were observed because of the contact.

In three instances, Rockeye weapons lost one fin blade immediately after fin opening. These were bombs No. 5 and 6 from the first flight and bomb No. 3 from the second flight, at Mach 0.9. Close observation of the on-board film indicates the fins were broken prior to fin opening so this problem would not be attributed to any aspect of the conformal carriage.

A sharp buffet condition was reported during the separation tests of the M117-M6 bombs. It occurred at all Mach numbers above 0.94 IMN, and the frequency and amplitude appeared to be independent of altitude and Mach number above onset. The pilot described it as similar to riding a high-speed boat through choppy water. Buffet intensity was decreased as the aft, middle, and front row of weapons were released, and was not present with just the forward fairing installed. This problem was not found during the performance tests at the same flight conditions, which suggests the Nellis camera pods contributed to its onset. The Mk 82 and Rockeye II weapons did not encounter this problem, and the NSRDC bluff shape was not tested above Mach 0.9. The comments of the pilot are included as Appendix C.

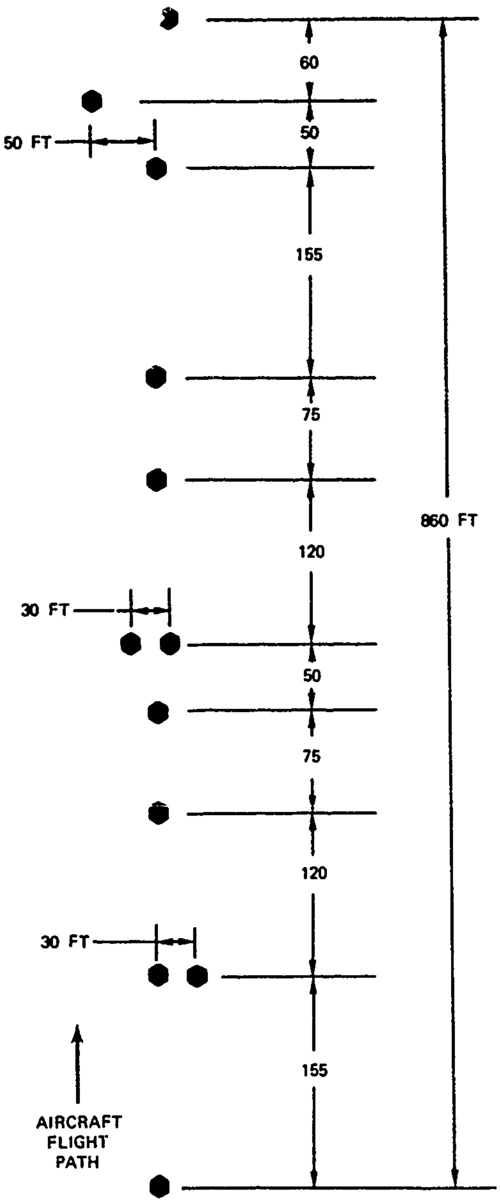

FIG. 12. Flight S-14, Mach 0.8 at 5,000 ft MSL, 0.060-sec Ripple, Twelve Mk 82 Bombs; Target Altitude 3,100 ft.

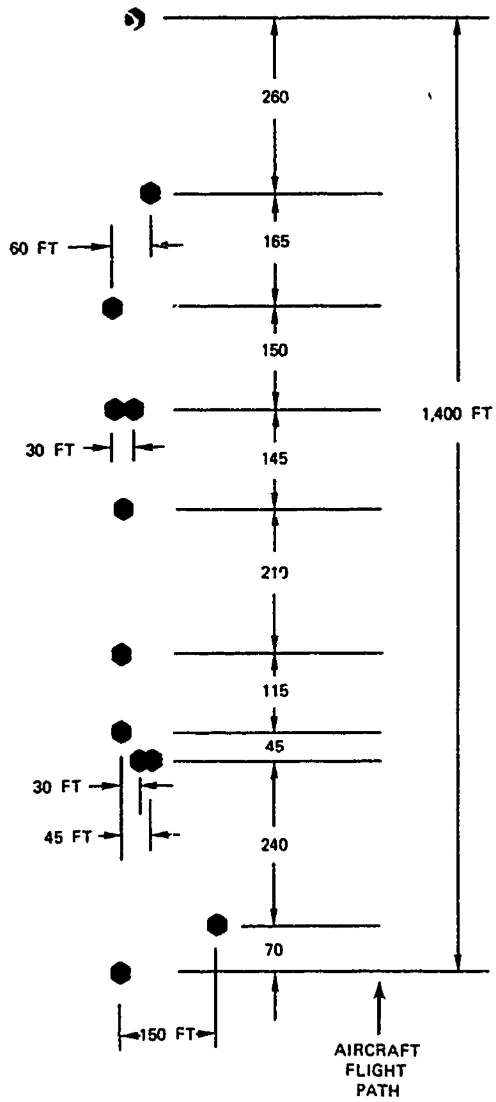

FIG. 13. Flight S-17, Mach 0.95 at 5,000 ft MSL, 0.100-sec Ripple, Twelve Mk 82 Bombs; Target Altitude 3,100 ft.

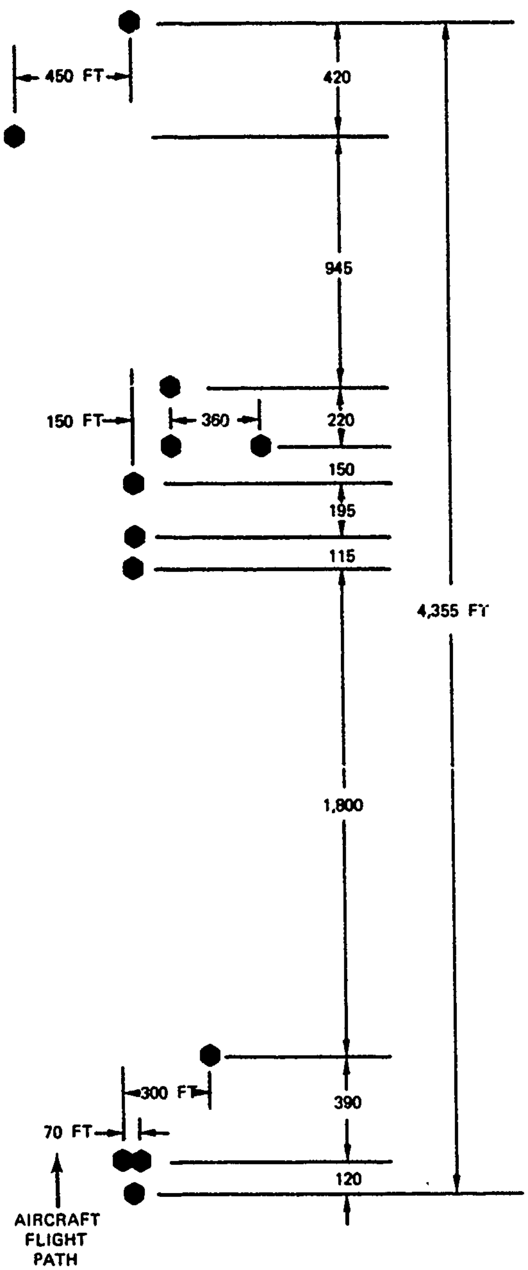

FIG. 14. Flight S-18, Mach 1.2 at 13,000 ft MSL, 0.100-sec Ripple, Twelve Mk 82 Bombs; Target Altitude 3,100 ft.

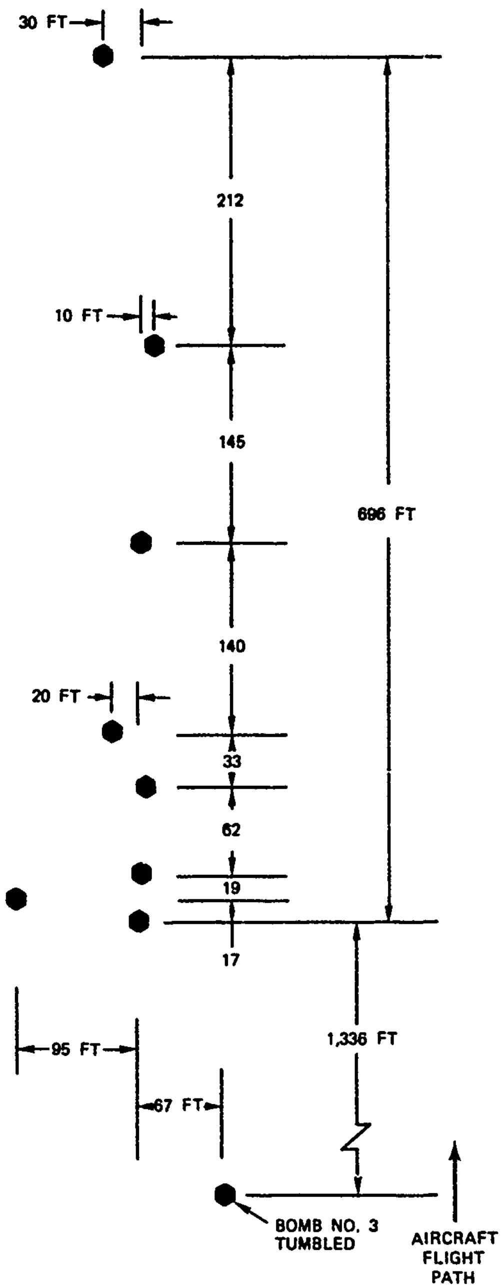

FIG. 15. Flight S-23, Mach 0.8 at 5,000 ft MSL, 0.060-sec Ripple, Nine NSRDC Bluff Bombs; Target Altitude 3,100 ft.

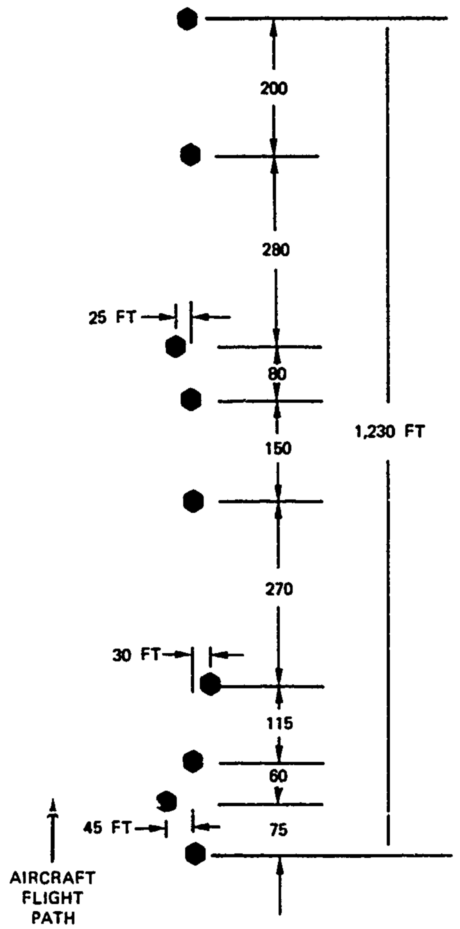

FIG. 16. Flight S-32, Mach 0.9 at 5,000 ft MSL, 0.060-sec Ripple, Nine M117-M6 Bombs; Target Altitude 3,100 ft.

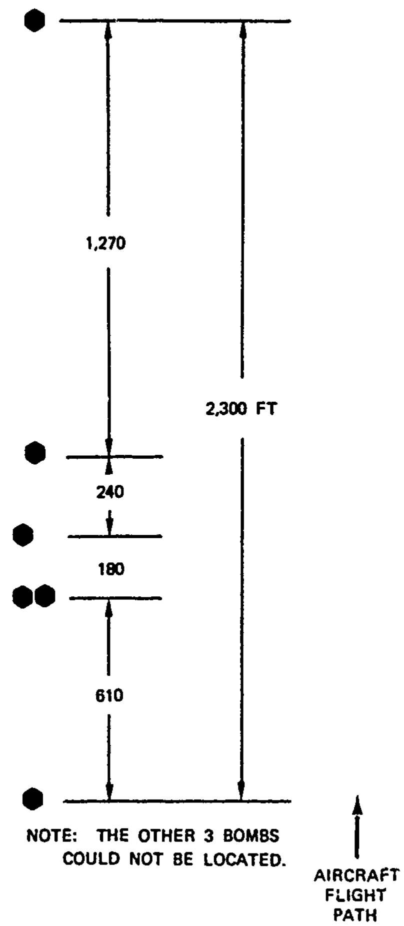

FIG. 17. Flight S-31, Mach 1.4 at 25,000 ft MSL, 0.100-sec Interval, Nine M117-M6 Bombs; Target Altitude 3,100 ft.

CONCLUSIONS AND RECOMMENDATIONS

As a result of the weapon separation studies on the conformal carriage adapter, the following conclusions and recommendations have been made.

CONCLUSIONS

1. Safe separation was achieved for all weapons and release conditions tested, amply demonstrating a supersonic release capability.

2. Supersonically, the Mk 82 bombs undergo a large nose-down pitch motion when released from the aft row, adversely affecting ground impact patterns during ripple releases.

3. Both the M117-M6 and NSRDC bluff weapons separate uniformly well from all carriage stations.

4. The orifice change for reducing the nose-down pitch motion of the aft row of Mk 82 bombs had no significant effect.

5. Ripple releases exhibited a straight line pattern with very little lateral dispersion.

6. A shock hammer/buffet problem exists when carrying M117-M6 bombs in conjunction with wing-mounted stores at speeds above Mach 0.94.

7. A significant amount of aircraft vibration was indicated by the loosening of panel screws, bomb rack breech caps and bomb rack attachment bolts. No structural damage was found.

RECOMMENDATIONS

1. Additional wind tunnel or flight testing should be accomplished to investigate the extent of the shock hammer/buffet problem with wing-mounted stores, such as fuel tanks, missiles, and rocket pods.

2. Adapter modifications should be investigated to reduce the pitch motion of Mk 82 bombs from the aft row.

3. Spacing between the outside and inside rows of Mk 82 bombs should be increased to allow adequate fin clearance. Spacing between the Mk 82 and M117-M6 tails and the bottom of the adapter should be increased to prevent chafing.

4. A significant improvement in accessibility of aircraft components for maintenance and servicing is required.

5. The electrical firing system should be redesigned so that failure to provide power to the control relay will route the normal firing pulse to the first six store stations instead of the last six stations. Also, the firing pulse should be prevented from reaching the bomb racks during the *Home* function.

Appendix A
SEPARATION PROBLEMS

Most of the difficulties encountered in service and maintenance of the aircraft were discussed in Part 1, *Performance*, of this document (Ref. 2). This appendix is concerned with unusual loading procedures and problems related to store separation. The adapter installation represented an experimental test bed, and time and money did not permit optimizing the serviceability of the installation. However, outlining the problems that were encountered will serve to focus attention on areas requiring improvement on future installations.

Two problems were encountered with the adapter system that controls the firing signal to the bomb racks. The first problem resulted in releasing bomb No. 7 from a full load of Mk 82 stores. Two MER/TER stepper switches are used to sequentially provide a firing pulse to all twelve bomb racks. One stepper switch controls the first six store positions, and the second switch controls store positions 7 through 12. A relay was used to control which stepper switch was functioning. When the relay was activated, the firing pulse went to the first six positions; and when no power was supplied to the relay, the firing pulse was routed to the last six store positions. Failure of the relay then results in releasing bombs No. 7 through 12 with the first six still unreleased.

Each stepper switch has eleven positions, only six of which are used. A *Home* switch is located in the cockpit which allows the pilot to return the stepper to the No. 1 position. If either stepper switch is in the No. 1 position, it will not move when the *Home* switch is activated; but, if it is in any other position, it will rapidly cycle through each position until it returns to No. 1. Normal procedure was to *home* the system immediately after each flight. On the first flight with NSRDC bluff weapons, the pilot attempted to release the first store and nothing happened because the bomb rack electrical connector had been left unplugged. He immediately thought the system had not been *homed* prior to the flight and the stepper switch was on the unused positions. When he activated the cockpit *Home* switch, bombs No. 2 through 6 were ripple-released. A check of the system revealed that as the stepper switch cycles through the store positions, a firing pulse is sent to each rack. Because of the unsuccessful release attempt, the first stepper was on position No. 2 and cycled through position No. 6, but the second stepper was on its No. 1 position (station 7) and was not activated by the *home* circuit.

The camera pod film from Flight 18 clearly shows the No. 2 store hanging by the aft lug only. Bomb release and separation were good although the weapon was initially in approximately a 5-deg nose-down attitude. Loading procedures include thoroughly shaking each store after latching it to the rack and prior to installing the mechanical safety pin. An inspection of the rack indicated all adjustments were within tolerance and the problem did not reoccur on later flights.

Bomb rack cleaning procedures required the removal of both ejector pistons and the center breech piston after each firing. On Flight 26, the No. 2 bomb did not release; a post flight inspection revealed the center breech piston was missing. This piston is not visible after the bomb is installed and could not have come out of the rack with the bomb in place. Therefore, it must not have been replaced after the cleaning operation. Both cartridges had fired and both breech caps were in place.

The No. 2 bomb on Flight 29 did not release. Both breech caps were in place, and the forward cartridge fired but the aft cartridge did not. Inspection showed the aft ejector piston had been pushed up inside the cylinder until it was unseated from the sealing rings. This provided a vent that did not allow sufficient pressure to build up to release the store. Poor electrical contact caused the aft cartridge to fail to ignite, and the vent prevented sympathetic detonation. The aft ejector piston assembly was shorter in length than the forward piston, therefore it did not seat against the bottom of the housing. NWC had purchased a very early version of the LODE-14 rack, MER-101, whereas the racks used in the conformal adapter were a later version of the Air Force BRU-3. The short piston had originally been installed in the NWC racks and was used to replace a damaged part in the BRU-3 rack.

Appendix B

SPECIAL SAFE OPERATING PROCEDURES

Special safe operating procedures for loading the conformal carriage aircraft with inert Mk 82 low-drag bombs, NSRDC bluff bombs, M117-M6 bombs, and Mk 20 (Rockeye II) bombs are as follows:

Operation	Details	Safety factors
I. Weapon Assembly:		
1. Mk 82 Low-Drag Bomb	a. Install ogive nose plug.	Lock in place with set screw.
	b. Install tail fin assembly.	Insure tail fin assembly is secure.
	c. Install T-lugs.	Bottom lugs then back each out 3 turns.
2. NSRDC Bluff Bomb	a. Install T-lugs.	---
3. M117-M6	a. Remove tail fuze plug.	---
	b. Install nose casting and secure in place with fuze plug or inert fuze.	---
	c. Secure the locking set screw.	---
	d. Remove nose fuze plug.	---
	e. Install tail casting.	---
	f. Install align bolt.	---
	g. Secure tail casting with fuze plug or inert fuze.	---
	h. Install lug spacers and T-lugs.	Make sure there is no play in the fin casting.
4. Rockeye II (Mk 20)	a. Install lug spacers and T-lugs.	---

Operation	Details	Safety factors
II. Pre-Loading:		
1. All weapons	a. Install electrical safety pin.	---
	b. Disconnect external electrical power.	---
	c. Open bomb hooks.	---
	d. Retract sway brace wedges.	---
	e. Install ARD 863 cartridge and replace aircraft panels.	Stay clear of ejector pistons when attaching the electrical connectors (breech caps) to the cartridges.
2. Rockeye II (Mk 20)	a. Install arming wire pickup (clamp and swivel snap hook).	---
III. Loading:		
1. All weapons	a. Use bomb trailer to position bomb and engage hooks.	Do not hand load weapons as racks are armed. In each row, load weapon stations from right to left.
	b. Slack off tension on hoisting equipment and check to see that hooks are fully engaged.	---
	c. Install safety pin.	Do not lower or remove bomb trailer until safety pin is installed.
	d. Unlatch sway brace wedges.	---
2. Rockeye II (Mk 20)	a. Connect tail-fin arming wire to snap hook on the aircraft.	Stay well clear of the tail assembly. Do not put tension on the arming wire.

Operation	Details	Safety factors
IV. Down-Loading:		
1. All weapons	a. Install the mechanical and electrical safety pins.	---
	b. Disconnect external power from the aircraft.	---
	c. Position the bomb trailer beneath the L/H bomb.	Unload each row of bombs starting with port weapon.
	d. Slide the safety pin out until the bomb rack being unloaded is clear.	Be sure the safety pin is still engaged with all of the bomb racks to the right of the one being down-loaded.
	e. Raise the bomb cradle until part of the bomb weight is on the cradle.	---
	f. Unlatch the bomb rack hooks.	Use the special tool provided for manual release of bomb rack hooks.
	g. Lower the bomb cradle and remove the bomb trailer.	---
2. Rockeye II (Mk 20)	a. Same as above except prior to unlatching the hooks disconnect the arming wire from the aircraft.	Stay well clear of the tail fins while disconnecting the arming wire.

Appendix C

HAMMER SHOCK PROBLEM
CONFORMAL CARRIAGE SEPARATION TESTS
F-4B AIRCRAFT 148371, APRIL 1973

by

LCDR R. C. Good, USN

In the Mk 82 configuration with twelve Mk 82 bombs and Nellis AFB photo pods, no basic flight quality differences were noted. However, that configuration limits the F-4 aircraft maximum speed significantly. Maximum speed with the camera pods installed was approximately 590 knots IAS, limiting speed to 1.3 IMN at 25,000 ft MSL.

The NSRDC bluff shapes were all carried and dropped subsonic (≤0.9 IMN) and no differences with or without camera pods were noted.

With nine M117-M6 bombs loaded and camera pods on board, a significant amount of *shock hammering* was noted throughout the drops at or above 0.94 IMN at altitudes between 5,000 and 25,000 ft MSL that was not noted during previous flight testing without the camera pods on board. This *hammer shock* can best be described as being similar to the pounding that a ski boat takes at 30 knots while planing on choppy water. The hammering is not frequency-dependent and occurs at about 2 cps. The amplitude of the hammering does not vary with Mach number after onset, but does vary with the configuration. With no M117-M6 bombs aboard, there is no hammering. With the forward row (three bombs) aboard, the hammering is light; with the forward two rows aboard, the hammering is moderate; and with a full load (three rows), the hammering is heavy. During heavy hammering, a slight pitch oscillation was noted, suggesting that the hammering is caused by disturbed airflow/shock-wave interaction between the Nellis AFB photo pods and the M117-M6 shapes.

It is recommended that flight quality testing be performed with external wing tanks and/or missile pylons installed in any future similar test programs to check for and measure the above described phenomena.

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13. ABSTRACT

Conformal carriage represents a new method of carrying stores tangent to the fuselage of an aircraft. Nine to twelve individual bomb racks are housed in an aerodynamically smooth fairing beneath the aircraft fuselage, thus considerably reducing the drag of the installation with or without stores when compared to conventional MER/TER carriage. Supersonic flight with stores was demonstrated in previous tests. Improved separation characteristics were also predicted for this installation because the relatively flat surface should provide smoother air flow over the weapons and the rigid structure should permit higher ejection forces.

Approximately 200 weapons were released at speeds of Mach 0.6 to 1.6 and altitudes of 5,000 to 30,000 ft MSL to test the predictions. Ripple and 30-deg dive releases were also investigated using Mk 82, Rockeye II, NSRDC bluff, and M117-M6 bluff bombs.

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