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PREPRODUCTION TESTING OF THE W. H. OLSEN BDU-8/B PRACTICE BOMB

by

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New Mexico

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Air Force Systems Command
Kirtland Air Force Base
New Mexico

ABSTRACT

Testing of the W. H. Olsen BDU-8/B practice bomb was performed by AFSWC at the request of the Royal Canadian Air Force. The purpose of these tests was to establish the W. H. Olsen Manufacturing Company, Ltd., as a qualified producer of these practice bombs. Testing was performed using two sample bombs produced by this company, numbered WHO-2 and WHO-3. To expedite testing, each of the bombs was subjected to a portion of the specified test requirements. Testing was performed in general accordance with MIL-B-25846A and MIL-B-27000, and included functional testing of the parachute deployment system initiator assembly, static load testing, shock testing, and vibration testing. The results of the test were satisfactory.

PUBLICATION REVIEW

This report has been reviewed and is approved.

ALBERT L. HALEY
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Director, Test Directorate

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1. INTRODUCTION.

a. Purpose.

The purpose of these tests was to determine if the manufacturer has fabricated these preproduction test samples in accordance with required specifications.

b. Authority.

The authority for this test is contained in AFSC Form 111 for Project 921X Task 02150, entitled "Support to RCAF." This authority was issued by Headquarters, Air Force Special Weapons Center, Kirtland Air Force Base, New Mexico, on 21 February 1963.

2. SUMMARY OF TEST.

a. Description of test article.

The BDU-8/B practice bombs used in these tests were manufactured by W. H. Olsen Manufacturing Company, Ltd., Tilbury, Ontario, Canada. The BDU-8/B was designed to provide practice in aircraft maneuverability, cruise control, and bombing. The bomb has provisions for the installation and deployment of a parachute, and consists of a nose section, a center section assembly, an aft section assembly, a parachute assembly, and an MLU-5/B Explosive Kit used to deploy the parachute. The center section is filled with concrete. When filled in accordance with specifications and completely assembled, the bomb should have a weight of 1,969 pounds, a moment of inertia of 1,800,000 lb-in^2 and a center of gravity location 71.7 inches aft of the zero reference (Sta. 71.7). This bomb is 18 inches in diameter and 149.5 inches long. It has been designed to withstand the shock and vibration loads associated with the flight and handling environments encountered during use.

b. List of tests conducted.

These bombs were tested in accordance with MIL-B-25846B, Military Specification Bomb, Practice, Profile BDU-8/B, 14 July 1961, and MIL-B-27000, Military Specification, Bomb, Practice, General Specification for, 1 July 1959. The following tests were conducted:

(1) Assembly and inspection.

(2) Suspension test.

(3) Main ballast and aft section moment test.

(4) Fin test.

(5) Shock test.

(6) Vibration test.

(7) Moment of inertia and center of gravity data test.

c. Description of tests conducted.

(1) Assembly and inspection.

(a) The bombs were filled with concrete in accordance with Para. 3.4.2 of MIL-B-25846A and allowed to cure for approximately 30 days before being subjected to tests.

(b) The bombs were assigned the numbers WHO-2 and WHO-3 for identification purposes.

(2) Suspension tests.

(a) Static loads were applied to BDU-8/B Practice Bomb No. WHO-2 to simulate combined suspension and ejection loads in accordance with Military Specification MIL-B-25846B. These loads were applied for three conditions of loading in accordance with Procedure II of this specification.

(b) For these tests the weapon was suspended from a frame simulating a typical 30-inch suspension system (figure 1). The pylon sway braces were adjustable. The sway brace pads were 1.9 inches in diameter.

Figure 1. Fixture used to impose static loads

The angle of the sway braces was 20.7 from the vertical plane through the longitudinal axis of the bomb. These sway braces were located on 20-inch centers midway between the suspension lugs of the bomb. For the purpose of these tests, the sway braces were torqued to 290 inch-pounds. Before testing, an MLU-5/B Explosive Kit was installed in the bomb.

(c) The aborted ejection tests of the practice bomb consisted of applying suspension loads with the simultaneous imposition of ejection forces to conditions enumerated below:

1. Condition I. Application of three cases of design loads and the application of a downward force of 26,000 pounds at Station 77.5. These conditions simulate the loads imposed in aborted ejections using a single-ejector-type bomb rack.

2. Condition II. Application of three cases of design suspension loads with the application of two downward forces of 19,000 pounds each at Stations 56.5 and 92.5. These conditions simulate the loads imposed in aborted ejections using a double-ejector-type bomb rack.

3. For these tests the following loads were applied:

a. Condition I.

(Case 1)

Vertical plane

Station 54.5 down	5,803 pounds
Station 77.5 down	26,000 pounds
Station 91.0 down	6,660 pounds
Station 142.38 down	1,645 pounds

Horizontal plane

Station 37.0 left	1,389 pounds
Station 61.25 right	5,192 pounds
Station 85.25 right	5,192 pounds
Station 100.00 right	1,017 pounds
Handling lugs forward	808 pounds

(Case 2)

Vertical plane

Station 54.5 down	5,803 pounds
Station 77.5 down	26,000 pounds
Station 91.0 down	6,660 pounds
Station 141.375 up	3,250 pounds

Horizontal plane

Station 27.725 right	1,693 pounds
Station 61.25 right	5,192 pounds
Station 85.25 right	5,192 pounds
Handling lugs aft	3,354 pounds

(Case 3)

Vertical plane

Station 54.5 down	5,803 pounds
Station 77.5 down	26,000 pounds
Station 91.0 down	6,660 pounds
Station 141.375 up	1,500 pounds

Horizontal plane

Station 61.25 right	5,192 pounds
Station 85.25 right	5,192 pounds
Station 99.0 right	4,000 pounds
Handling lugs aft	3,354 pounds

b. Condition II.

(Case 1)

Vertical plane

Station 55 down	23,803 pounds
Station 92 down	24,660 pounds
Station 142.38 down	1,645 pounds

Horizontal plane

Station 37.0 left	1,389 pounds
Station 61.25 right	5,192 pounds
Station 85.25 right	5,192 pounds
Station 100.00 right	1,017 pounds
Handling lugs forward	808 pounds

(Case 2)

Vertical plane

Station 55 down	23,803 pounds
Station 92 down	24,660 pounds
Station 141.375 up	3,250 pounds

Horizontal plane

Station 27.725 right	1,693 pounds
Station 61.25 right	5,192 pounds
Station 85.25 right	5,192 pounds
Handling lugs aft	3,354 pounds

(Case 3)

Vertical plane

Station 55 down	23,803 pounds
Station 92 down	24,660 pounds
Station 141.375 up	15,800 pounds

Horizontal plane

Station 61.25 right	5,192 pounds
Station 85.25 right	5,192 pounds
Station 99.0 right	4,000 pounds
Handling lugs aft	3,354 pounds

4. The load combinations noted in the preceding paragraphs were imposed simultaneously in steps of 50, 66.7, 75, 85, 90, 95, and 100 percent of the loads. At each of these steps, the applied load was maintained for a period of 3 minutes before increased loads were applied. No deformation or damage to any part of the bomb was noted. After the bomb was subjected to the combination of 100 percent of the design limit loads and ejection loads, the loadings were increased to 150 percent of design limit loads combined with the ejection loads. No permanent deformation or damage occurred.

(3) Main ballast and aft section moment test.

(a) For this test the bomb was supported by cradles under the bomb at Stations 57.00 and 91.50 (figure 2).

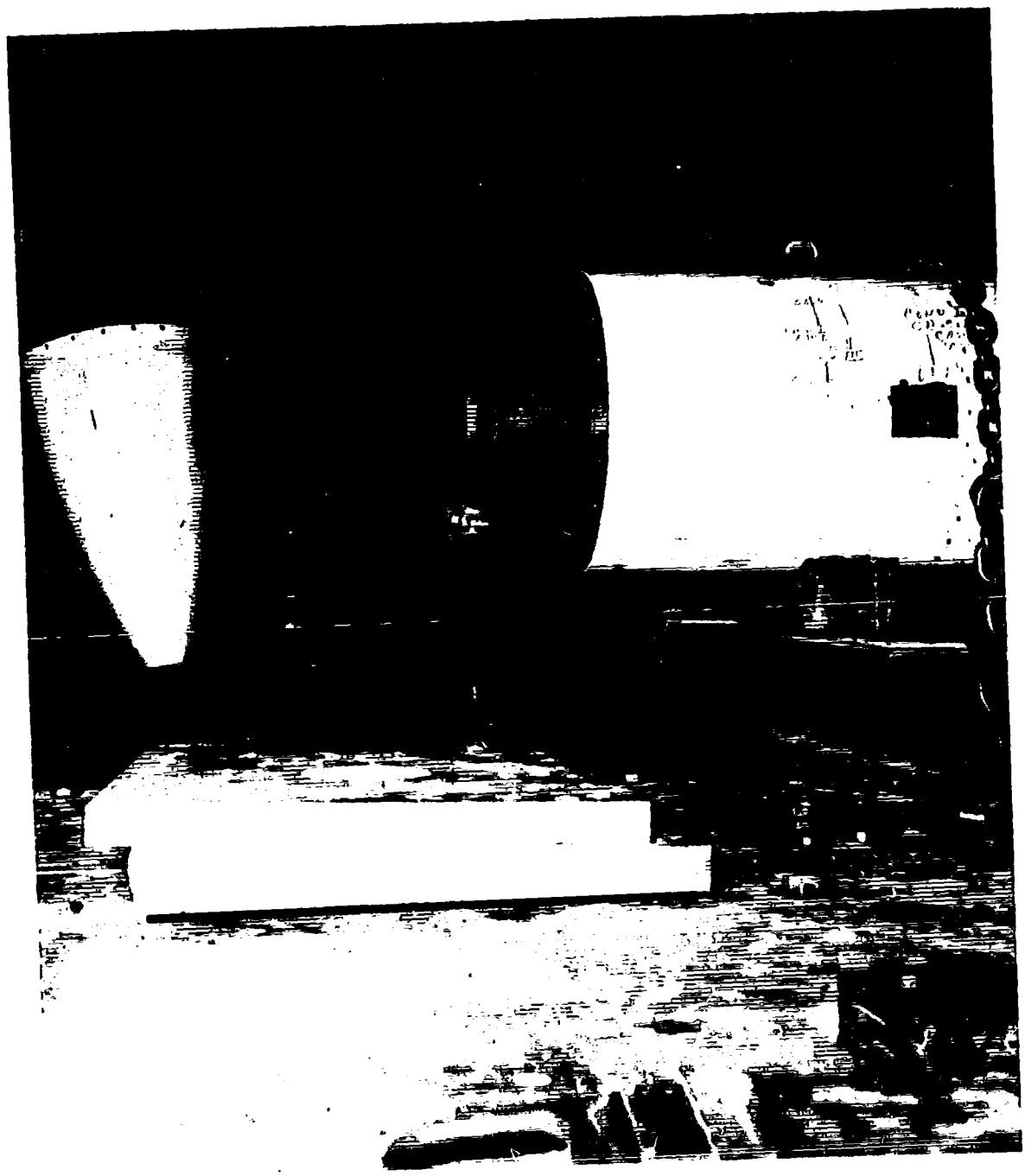

Figure 2. Test setup for main ballast test

(b) The main ballast test consisted of applying a downward load of 12,205 pounds at Station 37.37. This load was applied in increments of 0, 50, 66.7, 75, 85, 90, 95, and 100 percent of the full load.

(c) The aft section test consisted of applying a downward load of 8,423 pounds at Station 137.30. This force was applied in increments of 0, 50, 66.7, 75, 85, 90, and 100 percent of full load.

(d) No permanent deformation or damage occurred during any portion of these tests.

(4) Fin test.

(a) A test of the tail fins was performed on BDU-8/B No. WHO-2 in accordance with the procedures prescribed in MIL-B-25846B. For the purpose of this test, the bomb was supported on cradles under the bomb at Stations 57.00 and 91.50 (figure 3). The two horizontal fins for the bomb were drilled at the center of pressure and rods were attached which were used to apply the fin deflection loads.

(b) The fins were each preloaded to 400 pounds and a zero deflection reference was established with this load applied. This load was then increased to 600 pounds and deflection measurements taken. The load on each fin was subsequently increased in increments of 75 pounds to a total of 1,500 pounds. At each 75-pound increment, deflection measurements were made. The loads were then decreased to 400 pounds on each fin and deflection measurements made. The residual deflection on the fins was less than 0.005 inch. The load was then increased to 1,690 pounds on each fin and deflection measurements made. The deflection was 0.017 inch. The load was then increased in increments of 50 pounds to a total load of 2,190 pounds on each fin. Fin deflection measurements were made at each 50-pound increment. The fin loads were then reduced to 400 pounds. The permanent set measured was less than 0.004 inch.

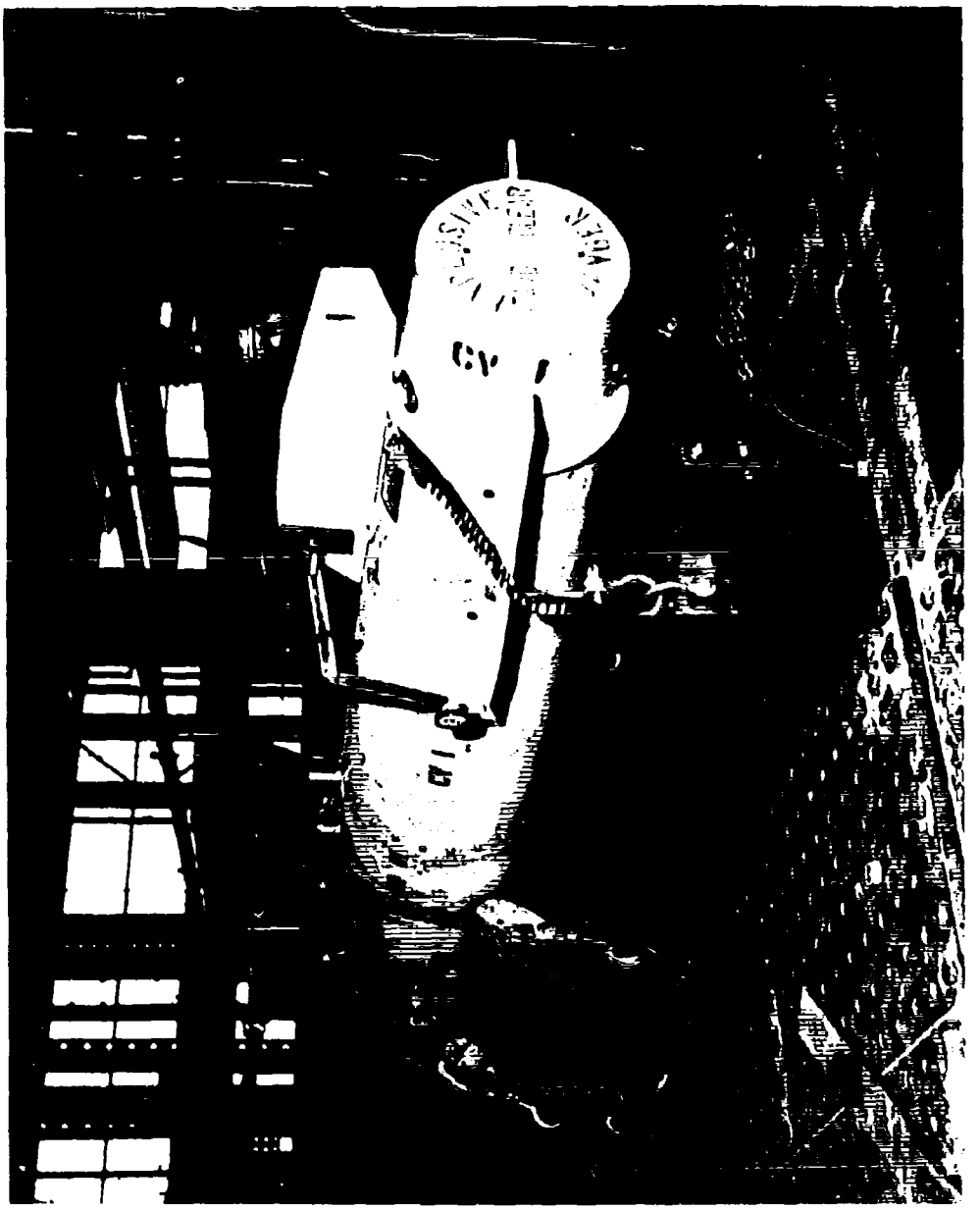

Figure 3. Test setup for fin test

(5) Shock test.

(a) Before testing, an MLU-5/B explosive kit was installed in the bomb. The bomb was suspended from a mockup which simulated a 30-inch aircraft suspension system. This mockup incorporated two sway braces on each side of the practice bomb. These sway braces were on 20-inch centers located midway between the suspension lugs and at an angle of 20.7 from the vertical plane passing through the bomb longitudinal axis. The mockup was suspended from a hinged frame capable of being dropped to impose the desired shock intensity and duration (figure 4).

(b) Three test shocks were applied to the bomb along each of the major axes. The shock signatures measured from these tests had amplitudes up to 18 g's and durations of approximately 11 milliseconds.

(c) At no time during the test did the MLU-5/B explosive kit fire. Examination of the item after the test revealed no failures.

(6) Vibration test.

(a) A vibration test was performed on Bomb No. WHO-2 as required by Military Specification, MIL-B-25846B. The bomb was mounted on a mockup of a 30-inch suspension system. The mockup incorporated two sway braces on each side of the practice bomb on 20-inch centers located midway between the suspension lugs and at an angle of 20.7 from the vertical plane passing through the bomb longitudinal axis. The bomb and test fixture were mounted in the inverted position on a 25,000-pound Ling-Temco vibration exciter (see figure 5). An accelerometer was mounted on the bomb in the vicinity of the aft suspension lug. An MLU-5/B explosive kit was installed in the bomb prior to testing.

(b) The bomb was subjected to a resonance survey with ½ g input as measured at the aft lug of the bomb. This survey was performed between 10 and 34 cycles per second. One resonant point was found at 24 cycles per second. The bomb was then vibrated continuously at 24 cycles per second for 15 minutes with input of 4 g's. No failures were observed

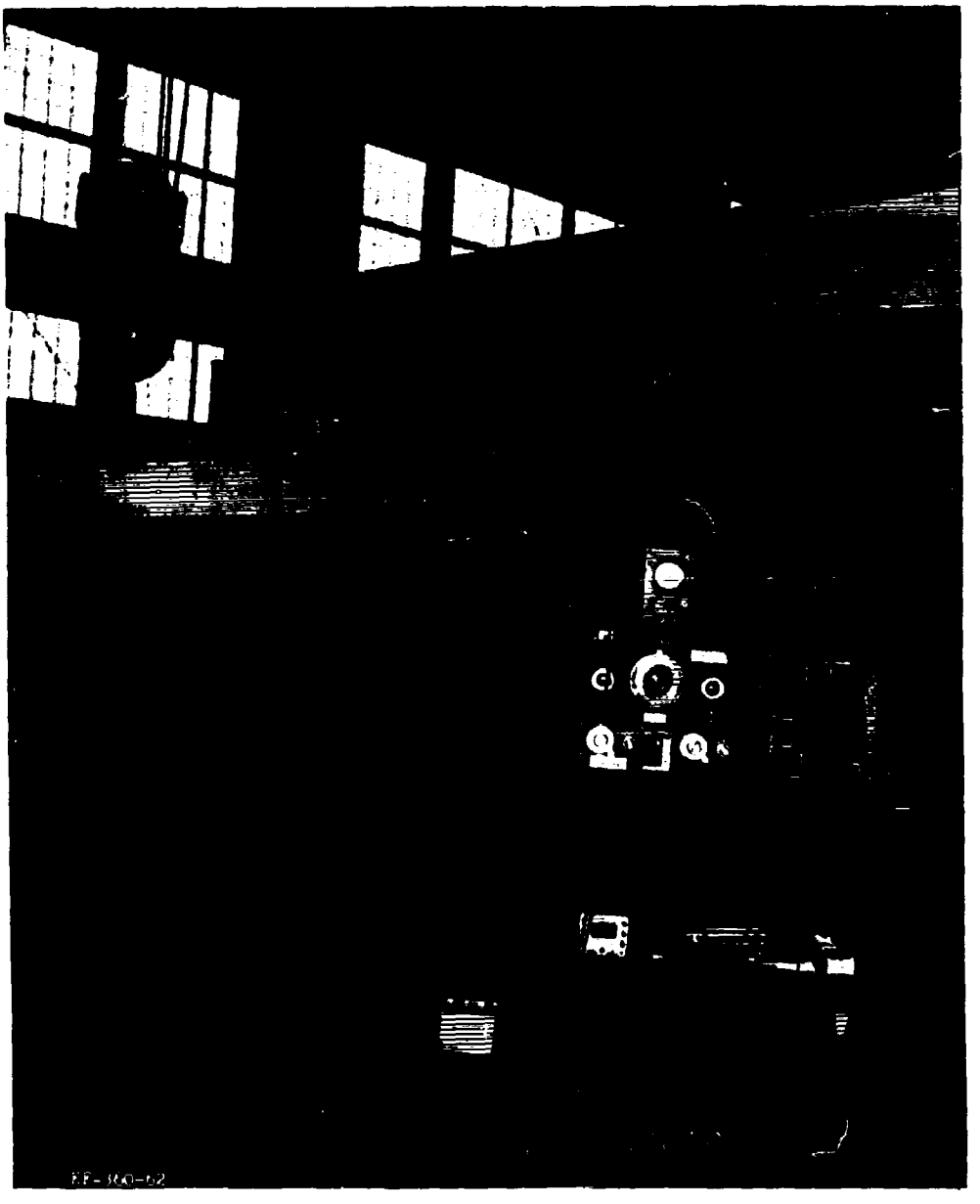

Figure 4. Apparatus used for shock test

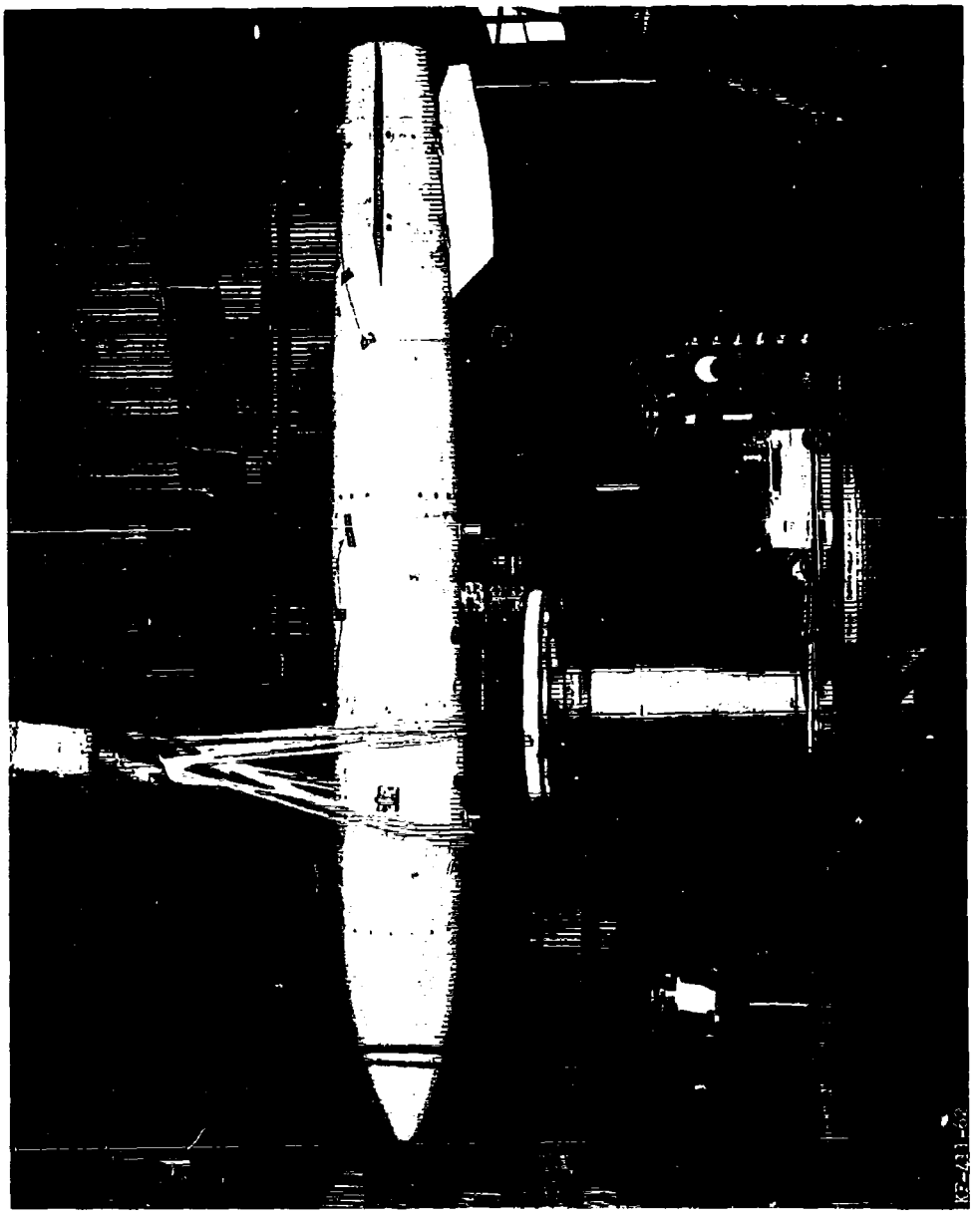

Figure 5. Vibration test setup

during the vibration or as a result of the test.

(7) Moment of inertia and center of gravity data test.

(a) Moment of inertia, weight, and center of gravity tests were performed on two samples of the bomb manufactured by W. H. Olsen Manufacturing Company, Ltd.

(b) Weight and center of gravity locations were determined on a Hoover Electronic-scale. These values are tabulated below:

Bomb No.	Weight -- lbs	Center of gravity location
WHO-2	2,090	60 inches from nose
WHO-3	2,090	59 7/8 inches from nose

(c) Moment of inertia was determined by mounting the bomb on a torsional pendulum (see figure 6).

(d) The bombs were oscillated on the pendulum and an average period established from 100 oscillations. The moment of inertia was then calculated from the formula

$$I = KT^2 - I \text{ of the fixture}$$

where

I = moment of inertia, lb in^2

T = average period, seconds

K = 102,650 (determined empirically with precisely measured billets).

$I_{fixture}$ = moment of inertia of the fixture (determined empirically).

(e) The moments of inertia as determined by this method are as follows:

Bomb No.	Moment of inertia (lb in^2)
WHO-2	1,904,800
WHO-3	1,930,154

3. CONCLUSION.

The BDU-8/B practice bombs as submitted for testing successfully

Figure 6. Mounted on torsional pendulum

withstood exposure to all the mechanical and climatic environments to which they were subjected.

4. RECOMMENDATION:

It is recommended that W. H. Olsen Manufacturing Company, Ltd., Tilbury, Ontario, Canada, be recognized as a technically qualified manufacturer of the BDU-8/B practice bomb.

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