

UNCLASSIFIED

AD NUMBER

AD307479

CLASSIFICATION CHANGES

TO: UNCLASSIFIED

FROM: CONFIDENTIAL

LIMITATION CHANGES

TO:  
Approved for public release; distribution is unlimited.

FROM:  
Distribution authorized to U.S. Gov't. agencies and their contractors;  
Administrative/Operational Use; 15 DEC 1958.  
Other requests shall be referred to Naval Ordnance Lab., White Oak, MD.

AUTHORITY

31 Dec 1970, DoDD 5200.10 ; NOL ltr 29 Aug 1974

UNCLASSIFIED

AD \_\_\_\_\_

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION ALEXANDRIA, VIRGINIA

DOWNGRADED AT 3 YEAR INTERVALS:  
DECLASSIFIED AFTER 12 YEARS  
DOD DIR 5200.10



UNCLASSIFIED

~~CONFIDENTIAL~~

**A  
D**

**307479**

# Armed Services Technical Information Agency

ARLINGTON HALL STATION  
ARLINGTON 12 VIRGINIA

FOR  
MICRO CARD  
CONTROL ONLY

**1 OF 1**

NOTICE: WHEN GOVERNMENT OR OTHER DRAWINGS, SPECIFICATIONS OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE U. S. GOVERNMENT THEREBY INCURS NO RESPONSIBILITY, NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OR ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE OR REPRODUCE THE SAME OR ANY INFORMATION THAT MAY IN ANY WAY BE RELATED THERETO.

~~CONFIDENTIAL~~

CONFIDENTIAL

NAVORD REPORT

4464

DRAWING TESTS OF SEVERAL PROPOSED CONFIGURATIONS OF PROJECT HOTPOINT (U)

AD No. **307479**  
ASTIA FILE COPY

FILE COPY

---

Return to

**ASTIA**

ARLINGTON HALL STATION  
ARLINGTON 12, VIRGINIA

Attn: TISS

15 DECEMBER 1958



**FC  
BAC**

**U. S. NAVAL ORDNANCE LABORATORY  
WHITE OAK, MARYLAND**

CONFIDENTIAL

ASTIA

JUN 5 1959

RECEIVED

TIPOR A

This document is the property of the United States Government. It is furnished for the duration of the contract and shall be returned when no longer required, or upon recall by ASTIA to the following address:  
Armed Services Technical Information Agency, Arlington Hall Station,  
Arlington 12, Virginia

**NOTICE: THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTIONS 793 and 794. THE TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.**

**BEST**

**AVAILABLE**

**COPY**

HE

G

LAW.

"This publication is CONFIDENTIAL and shall be safeguarded in accordance with the security provisions of the U. S. Navy Regulations and the provisions of applicable Federal Statutes and Executive Orders for Safeguarding Classified Information. As stated in Article 0906.3 of OPNAVINST 5510.1B, dated 10 March 1958, it is forbidden to make extracts from or to copy this classified document without authorization."

"This material contains information affecting the National Defense of the United States within the meaning of the Espionage Laws, title 18, U.S.C., Sections 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law."

**CONFIDENTIAL**  
**NAVORD Report 4464**

**Aeroballistic Research Report 371**

**DAMPING TESTS OF SEVERAL PROPOSED CONFIGURATIONS  
OF PROJECT HOTPOINT**

**Prepared by:**

**I. Shantz  
F. J. DeMeritte  
R. Groves**

**ABSTRACT:** Results are presented in this report of a wind-tunnel investigation conducted to obtain damping-in-pitch measurements of several proposed configurations of Project Hotpoint. The models were tested at Mach numbers 0.90 and 0.93. The unfaired mine shape indicated no damping below ten degrees angle of attack and the two faired shapes trimmed at ten degrees angle of attack.

**U. S. NAVAL ORDNANCE LABORATORY  
White Oak, Silver Spring, Maryland**

**1  
CONFIDENTIAL**

**CONFIDENTIAL**

NAVORD Report 4464

December 15, 1958

This is a report on an investigation of the damping of three proposed versions of Project Hotpoint. This test was performed at the request of the Underwater Ordnance Department (reference (a)) and was performed under task number 732-566/62001/01.

**MELL A. PETERSON**  
Captain, USN  
Commander

**R. KENNETH LOBB**  
By direction

**CONFIDENTIAL**  
**NAVORD Report 4464**

**CONTENTS**

	<b>Page</b>
<b>Introduction</b> .....	<b>1</b>
<b>Symbols</b> .....	<b>1</b>
<b>Description of the Models and Instrumentation</b> .....	<b>1</b>
<b>Data Reduction</b> .....	<b>2</b>
<b>Results</b> .....	<b>2</b>
<b>References</b> .....	<b>3</b>

**ILLUSTRATIONS**

<b>Figure 1</b>	<b>Photograph of Hotpoint Mine Shapes</b>
<b>Figure 2</b>	<b>Photograph of Hotpoint Long-Chord Model</b>
<b>Figure 3</b>	<b>Photograph of Hotpoint Short-Chord Model</b>
<b>Figure 4</b>	<b>Sketch of Hotpoint Mine Shape</b>
<b>Figure 5</b>	<b>Sketch of Hotpoint Long-Chord Model</b>
<b>Figure 6</b>	<b>Sketch of Hotpoint Short-Chord Model</b>

CONFIDENTIAL  
NAVORD Report 4464

DAMPING TESTS OF SEVERAL PROPOSED CONFIGURATIONS  
OF PROJECT HOTPOINT

INTRODUCTION

1. Hotpoint is a bomb that is being developed by the Naval Ordnance Laboratory for the Bureau of Ordnance.
2. Damping-in-pitch data were obtained at Mach numbers 0.90 and 0.93 on three proposed versions of the Hotpoint weapon.

Symbols

$C_{M_q} + C_{M_\alpha}$	damping coefficient ( $= 16/\tau K_H$ )
d	maximum diameter (1.80 inches)
I	transverse moment of inertia about the center of gravity (slugs-ft <sup>2</sup> )
$K_H$	ballistic damping coefficient ( $\mu/\rho V_d^4 = -\tau/16(C_{M_q} + C_{M_\alpha})$ )
q	dynamic pressure (see Table I)
Re	Reynolds number (see Table I)(based on model length)
t	time (seconds)
V	velocity (ft/sec)
$\alpha$	angle of attack (degrees)
$\rho$	air density (slugs/cu. ft.)
$\mu$	damping coefficient ( $= 2 I (\log \alpha/\alpha_0)\Delta t$ )

Description of the Models and Instrumentation

3. The models were dynamically balanced about the scaled full-scale center of gravity. A shaft whose axis was normal to the longitudinal axis of the model was passed through the center of gravity and was attached to the model by means of precision ball bearings of very low frictional torque. The models were thus able to rotate in the pitch plane about a transverse axis which passes through the center of gravity.

CONFIDENTIAL  
NAVORD Report 4464

4. The models tested were an internal store shape and two external store shapes. The external store shapes differed in length of fin chord. Photographs of the models are shown in Figures 1, 2, and 3 and sketches of the models are shown in Figures 4, 5, and 6. All dimensions are in inches.

5. The external store body is similar to the Navy Low-Drag Bomb in appearance. The fins on the external store are swept-wing in planform and are double wedge in cross-section. The test conditions and model physical characteristics are given in Table I. The model dimensions given in Table I are the actual measured dimensions. The dimensions shown in Figures 4, 5, and 6 are the scale dimensions from the full scale hardware.

#### Data Reduction

6. The model is rotated about the center of gravity and the wind tunnel is turned on. The motion of the model is photographed with a 16 mm movie camera. The data reduction technique is described in detail in reference (b). Briefly the data reduction consists of two phases: reading the film and fitting an envelope to the data obtained from the film. From the film the angle of the model is obtained for each frame of film using a comparator. The time record is obtained from the camera speed (64 frames per second). The angular deflection plotted against time yields a damped sine motion. The envelope of the motion is faired. In true harmonic damping, this envelope would be of the form  $\alpha = \alpha_0 e^{-\mu t/2I}$ . Damped harmonic motion requires that the restoring moment be linear; this is not always the case. However, by assuming the harmonic condition for small increments along the envelope, the damping coefficient ( $\mu$ ) can be obtained as a function of angular deflection by obtaining an average  $\mu$  for an average angle. The damping coefficient ( $\mu$ ) is related to  $K_H$  by the equation.

$$K_H = \frac{\mu}{\rho V d^4}$$

#### RESULTS

7. The internal store shape exhibited dynamic stability in pitch above angles of attack of 10 degrees but has none at angles below 10 degrees.

8. Both of the external store models were stable but both trimmed at angles of attack of + 10 degrees. There was a large change in frequency with angle of attack which indicates a non-linear restoring moment.

9. The results are tabulated in Table II.

**CONFIDENTIAL**  
**NAVORD Report 4464**

**References**

- (a) Seigel, A., Wind-Tunnel Request (WTR 314) (Conf.) 1955
- (b) Shantz, I., and R. T. Groves, "Subsonic Damping-in Pitch Measurements of the EX-10, EX-30, and 6" Test Vehicle", NAVORD Report 4025, (Conf.)

CONFIDENTIAL  
NAVORD Report 4464

Test Conditions and Model Information

TABLE I\*

Model	Length Cal.	Center of Gravity (calibers from tail)	Mach No.	Re x 10 <sup>-6</sup>
Unfaired	3.59	2.28	0.90	2.5
Faired-short chord	8.15	4.71	0.90	5.5
Faired-long chord	8.15	4.71	0.93	5.5

\* NOTE: Dimensions are measured values and may vary slightly from dimensions given in Figures 4, 5, and 6 which give the design dimensions.

CONFIDENTIAL  
NAVORD Report 4464

Tabulated Data

TABLE II

Model	Mach No.	$\alpha$ Degrees	$C_{M_q} + C_{M_\alpha}$
Unfaired	0.90	32.7	38.5
		25.4	33.4
		20.7	25.2
		17.3	25.9
		14.8	19.6
Faired-Short Chord	0.90	19.5	100.0
		16.7	104.6
		14.5	96.7
Faired-Long Chord	0.93	23.7	173.9
		19.4	121.5
		16.8	95.8

CONFIDENTIAL  
NAVORD REPORT 4464

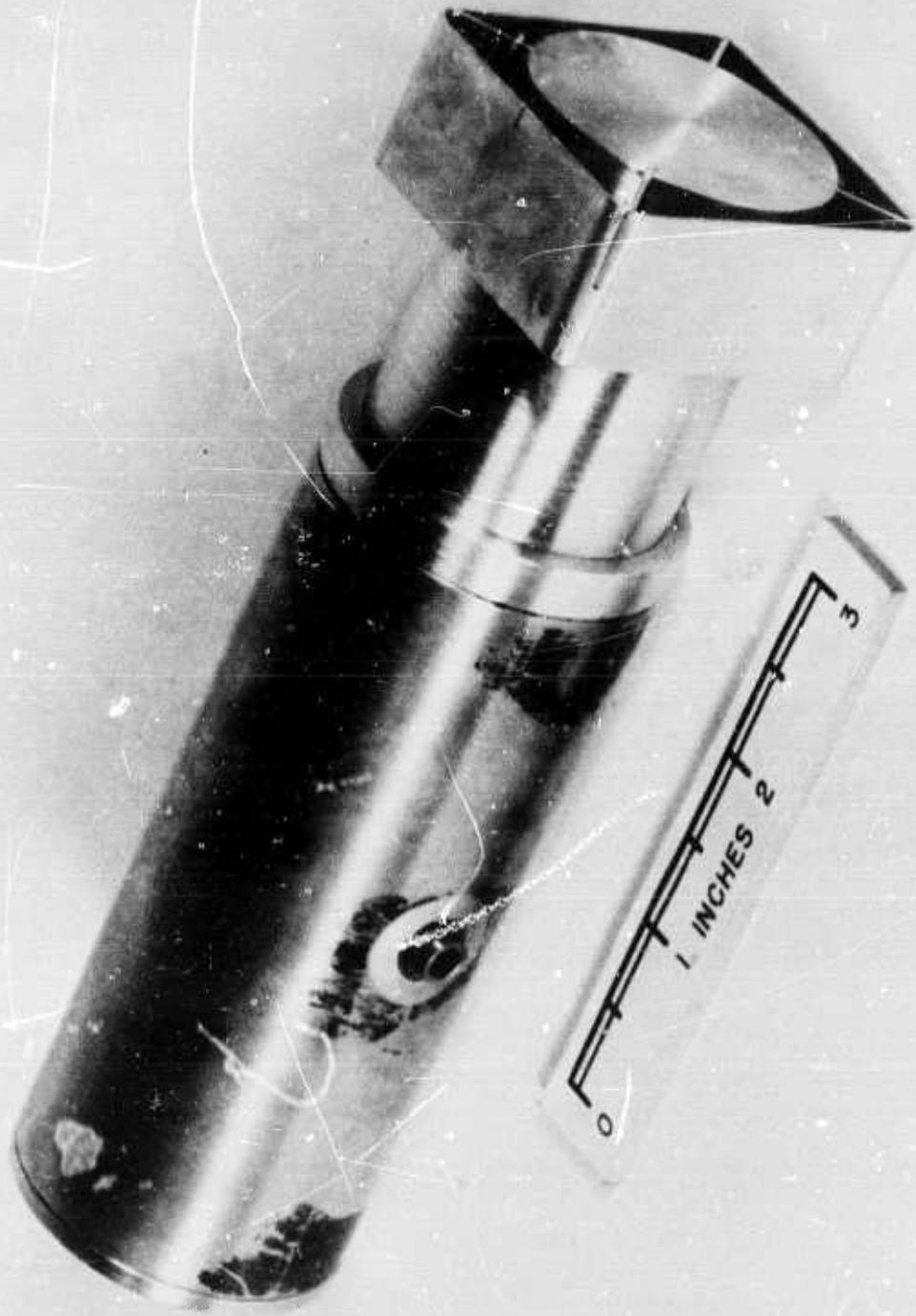


FIG. 1 HOTPOINT MINE SHAPE MODEL

CONFIDENTIAL

CONFIDENTIAL  
NAVORD REPORT 4464

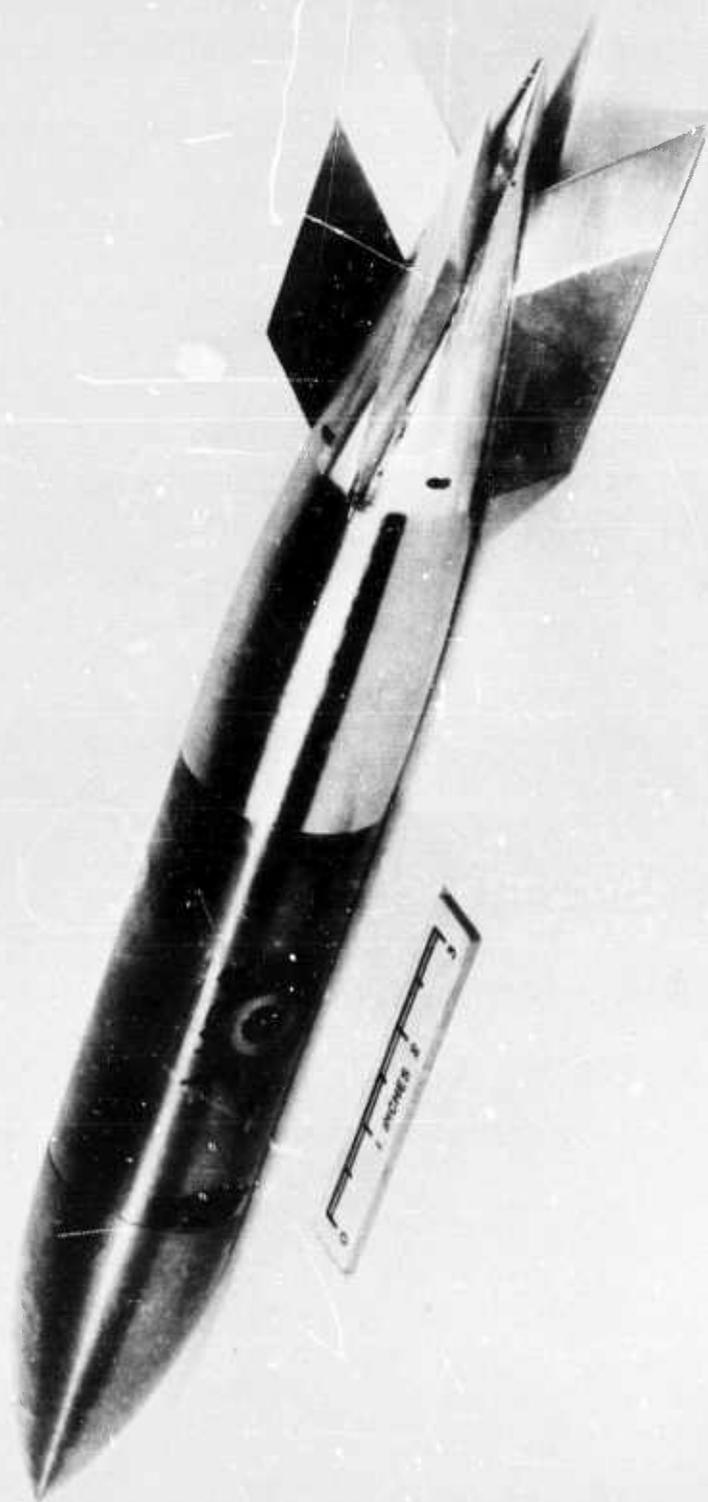


FIG. 2 HOTPOINT - LONG-- CHORD MODEL

CONFIDENTIAL

CONFIDENTIAL  
NAVORD REPORT 4464

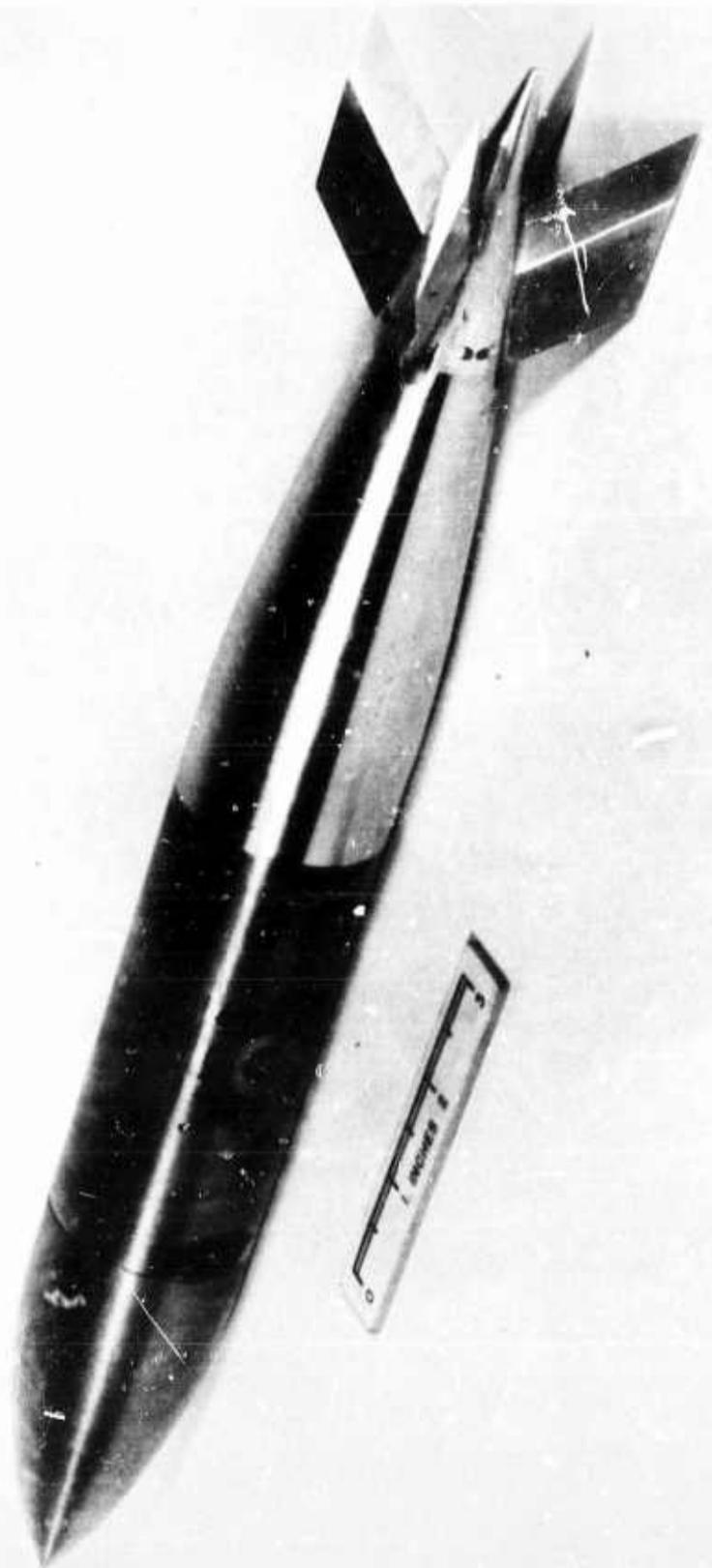


FIG. 3 HOTPOINT - SHORT-CHORD MODEL

CONFIDENTIAL

CONFIDENTIAL  
NAVORD REPORT 4464

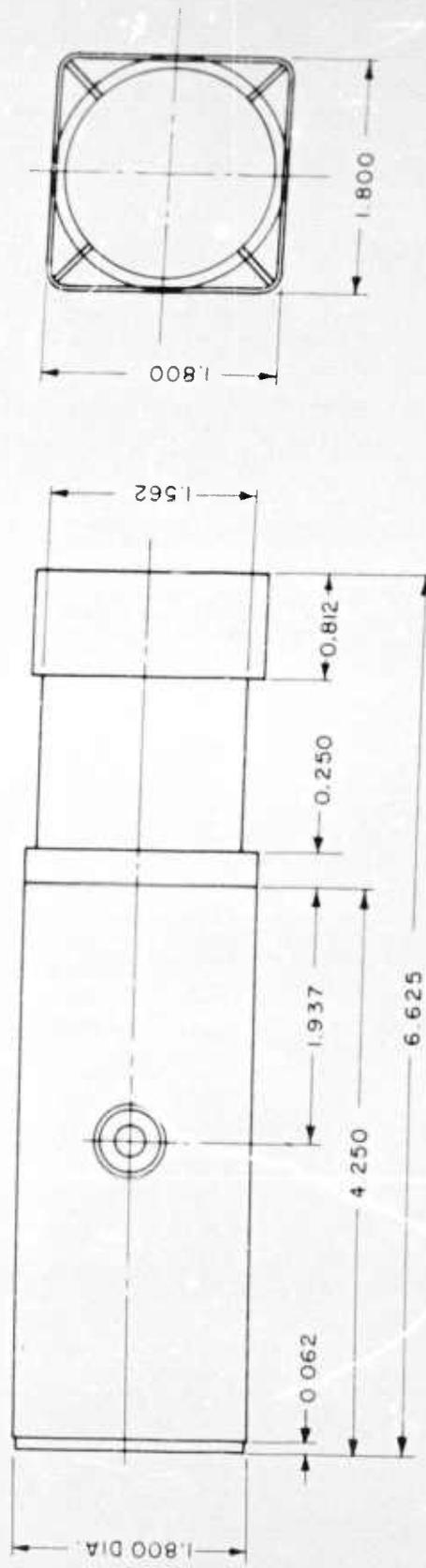


FIG. 4 HOTPOINT INTERNAL STORE

CONFIDENTIAL

CONFIDENTIAL  
NAVORD REPORT 4464

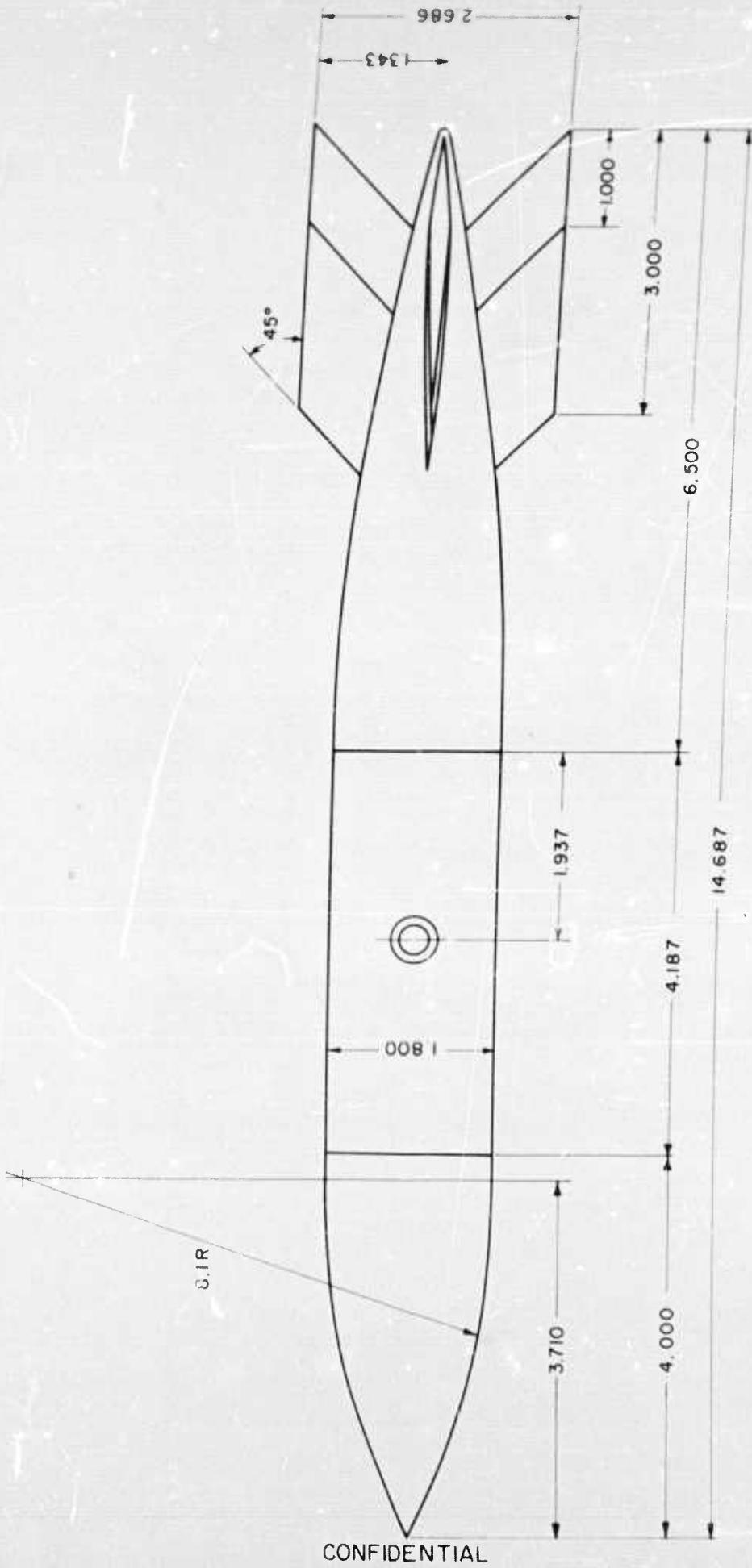


FIG. 5 LONG CHORD EXTERNAL STORE

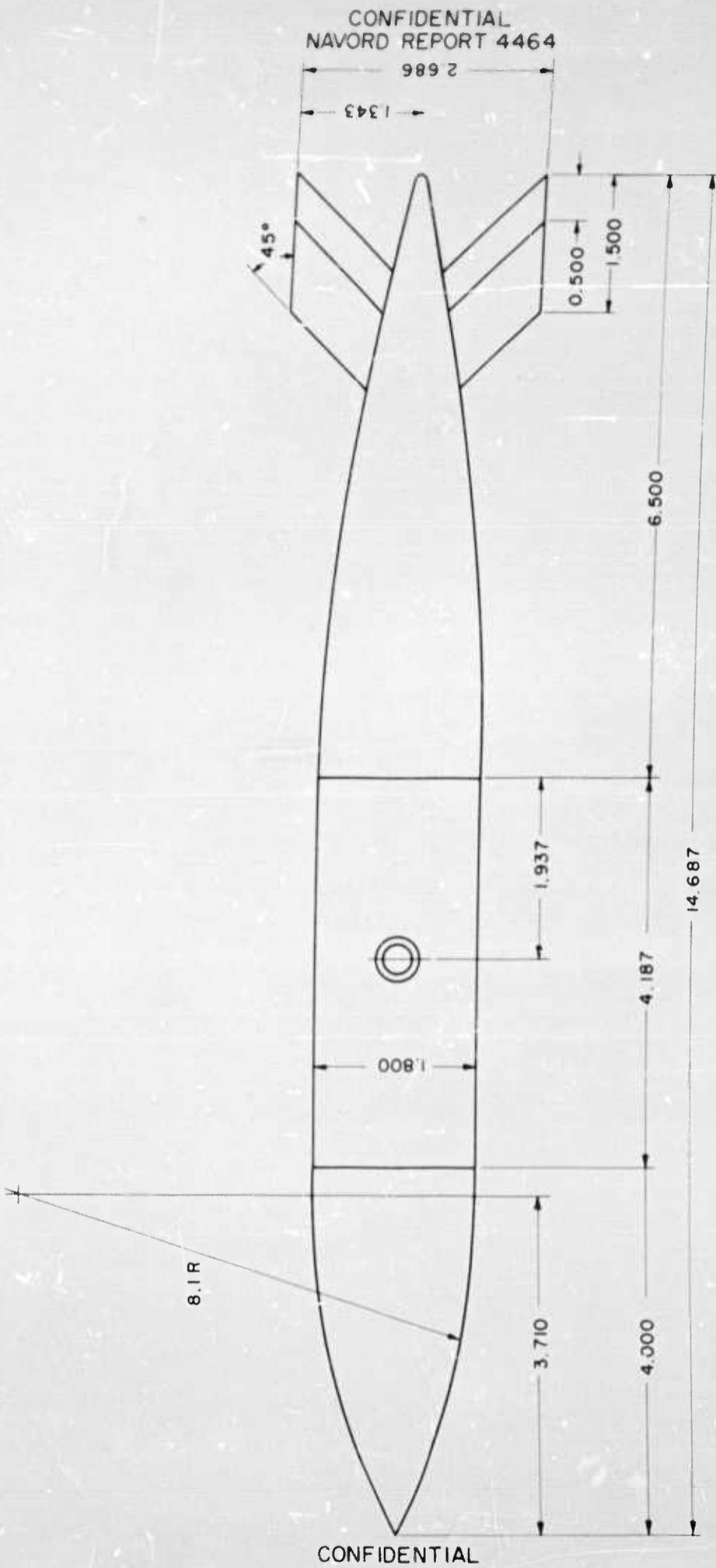


FIG. 6 SHORT CHORD EXTERNAL STORE

**CONFIDENTIAL**  
NAVORD Report 4464

**EXTERNAL DISTRIBUTION**

Chief, Bureau of Ordnance  
Navy Department  
Washington 25, D. C.  
Attn: ReW4-d

No. of  
Copies

ASTIA  
Attn: TIPDR  
Arlington Hall Station  
Arlington 12, Virginia

1

5

**CONFIDENTIAL**

**UNCLASSIFIED**

**UNCLASSIFIED**