WIND-TUNNEL TESTS OF THE NAVY LOW-DRA G BOMB AT ANGLES OF
ATTACK UP TO 70 DEGREES (U)

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WIND-TUNNEL TESTS OF THE NAVY LOW-DRAG BOMB AT ANGLES OF ATTACK UP TO 70 DEGREES

Prepared by
V. L. Schermerhorn
F. J. LeMeritte

ABSTRACT: This report presents the results of an investigation in the NOL Supersonic Tunnel No. 1 to measure the static stability and drag of the Navy low-drag bomb at angles of attack up to 70 degrees. These data were obtained at Mach numbers of 0.40, 0.60, 0.80, 1.53, 1.76, and 2.03.

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The purpose of this investigation was to obtain stability and drag data at high angles of attack on the Navy low-drag bomb for trajectory calculations. The wind-tunnel test was performed at the request of the Naval Weapons Laboratory (reference (a)), under Task Number 526. Other reports on the low-drag bomb shape are given in references (b) through (m).

W. D. COLEMAN
Captain, USN
Commander

R. KENNETH LOBB
By direction
UNCLASSIFIED
NAVWEPS REPORT 7291

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INTRODUCTION

1. The low-drag bomb is a standard Navy external store carried by high speed aircraft. The MK 81, 82, 83, and 84 bombs use the low-drag bomb shape as tested in this investigation.

2. This report gives the results of a wind-tunnel investigation to determine the stability and drag coefficients at high angles of attack (up to 70 degrees). The coefficients are necessary for trajectory calculations. The data were obtained at Mach numbers of 0.40, 0.60, 0.80, 1.53, 1.76, and 2.03.

AERODYNAMIC SYMBOLS

- $A$ reference area (based on maximum body diameter)
- $c.g.$ center of gravity, 3.64 calibers forward from the base
- $C_A$ axial force coefficient ($F_A/qA$)
- $C_\theta$ pitching moment coefficient ($M_\theta/qAd$)
- $C_N$ normal force coefficient ($F_N/qA$)
- $C_Y$ side force coefficient ($F_Y/qA$)
- $C_\phi$ rolling moment coefficient ($M_\phi/qAd$)
- $C_\psi$ yawing moment coefficient ($M_\psi/qAd$)
- $d$ reference diameter (maximum body diameter - caliber) (1.5 in)
- $F_A$ axial force (lbs)
- $F_N$ normal force (lbs)
- $F_Y$ side force (lbs)
- $M_\theta$ pitching moment (in-lbs)
- $M_\phi$ rolling moment (in-lbs)
- $M_\psi$ yawing moment (in-lbs)
- $q$ dynamic pressure (psi)
MODEL, TEST TECHNIQUES, AND DATA REDUCTION

3. A sketch of the model is shown as Figure 1. The data were obtained using a six-component internal strain-gage balance (reference (n)). These data were recorded on IBM cards using the automatic data recording system explained in reference (o). The IBM 704 machine was used to reduce the wind-tunnel data to coefficient form. A correction was made to the data for the elastic deflection of the sting due to the aerodynamic loading.

DISCUSSION

4. Six-component data were desired over a Mach number range from 0.40 to 2.03 at angles of attack up to 70 degrees. At the supersonic Mach numbers the model size restricted the maximum angle of attack. At a Mach number of 1.53, the maximum angle of attack was 10 degrees, Mach number 1.76 the maximum angle of attack, 12 degrees, and at Mach number 2.03 the maximum angle of attack, 30 degrees.

5. The data are plotted in coefficient form versus angle of attack in Figures 2 through 37. An index of the plotted data is presented in Table I.
REFERENCES

(a) Wind-tunnel request (WTR 592) (1960)


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(d) Long, J. E., "Low-Yaw Data on the Low Drag Bomb (EX-010) at Transonic Speeds (0.7 ≤ M ≤ 1.4)," NAVORD Report 4227, Confidential, (1956)

(e) Long, J. E., "Roll Coefficients for the Low Drag Bomb (EX-10) in the Transonic Velocity Region (0.65 ≤ M ≤ 1.31)," NAVORD Report 4389, Confidential, (1956)


(g) Greene, J. E., "Static Stability and Magnus Characteristics of a Low Drag Bomb at Low Subsonic Speeds," NAVORD Report 4112, Confidential, (1956)


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LOW DRAG BOMB

$\phi = -45$

$M = 1.53$

**FIG. 2** $C_N$, $C_D$, $C_Y$, $C_{\phi}$ vs. $\alpha$
LOW DRAG BOMB

\[ \theta = -0.45 \]

\[ \kappa = 1.53 \]

FIG. 3 \( C_g, C_A \) vs. \( \alpha \)
LOW TRAC BOMB

\[ \beta = 22.5 \]
\[ \mu = 1.53 \]

**FIG. 4** $C_N$, $C_Q$, $C_Y$, $C_P$ vs. $\alpha$
LOW DRAG BOMB

$\theta = 0$

$M = 1.53$

FIG. 6 $C_N$, $C_D$, $C_Y$, $C_\psi$ vs. $a$
LOW DRAG BOMB

\[ \theta = 0 \]
\[ M = 1.53 \]

\[ C_g \]
\[ C_A \]

**FIG. 7** $C_g$, $C_A$ vs. $\alpha$
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LOW DRAG BOMB

$\theta = -45$
$M = 1.78$

FIG. 8 $C_N$, $C_D$, $C_Y$, $C_\psi$ vs. $\alpha$
LOW DRAG BOMB

\[ \alpha = -45^\circ \]
\[ M = 1.76 \]

**Figure 9:** \( C_\phi, C_A \) vs. \( \alpha \)
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LOW DRAG BOMB

\[ \alpha = -22.5 \]
\[ M = 1.76 \]

\[ C_N, C_D, C_Y, C_\psi \text{ vs. } \alpha \]

FIG. 10
LOW DRAG BOMB

\( \theta = -22.5 \)

\( M = 1.76 \)

FIG. 11: \( C_y, C_A \) vs. \( \alpha \)
FIG. 12  $C_N$, $C_D$, $C_Y$, $C_{\psi}$ vs. $\alpha$
FIG. 13  $C_y, C_A$ vs. $\alpha$
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Naval Ordnance Laboratory, White Oak, Md.
(NAVORD report 7291)

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Abstract card is unclassified!