TECHNICAL MEMORANDUM
X-220

FULL-SCALE WIND-TUNNEL INVESTIGATION OF THE LOW-SPEED STATIC AERODYNAMIC CHARACTERISTICS OF A MODEL OF A REENTRY CAPSULE

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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FULL-SCALE WIND-TUNNEL INVESTIGATION OF THE LOW-SPEED STATIC AERODYNAMIC CHARACTERISTICS OF A MODEL OF A REENTRY CAPSULE*

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SUMMARY

An experimental investigation has been made in the Langley full-scale tunnel to determine the low-speed static aerodynamic characteristics of a full-scale model of a reentry capsule. Static data are presented for the space capsule with a 40-inch and a 70-inch canister for an angle-of-attack range from -5° to 88.7°. Also included are the effects of a corrugated canister surface on the static stability characteristics. The test Mach number was 0.10 and the Reynolds number was 4.85×10^{6} based on the maximum body diameter. These data are presented without analysis in order to expedite publication.

INTRODUCTION

The NASA has initiated a wind-tunnel program to investigate the static aerodynamic characteristics of blunt, nonlifting, reentry bodies at high and low speeds. As a part of this program, tests were conducted in the Langley full-scale tunnel to determine the low-speed static aerodynamic characteristics of a full-scale model of a space capsule designed for orbit and reentry. The tests were conducted for an angle-of-attack range of -5° to 88.7° at a Reynolds number, based on the maximum body diameter, of 4.85×10^{6}. The corresponding test Mach number was 0.10. In order to expedite publication, the data are presented without analysis.

SYMBOLS

The data presented herein are referred to the body system of axes with the origin located at the model center of gravity. The positive directions of forces, moments, and angular displacements are shown in figure 1.

*Title, Unclassified. [redacted]

C_A axial-force coefficient, $\frac{\text{Axial force}}{qS}$

C_N normal-force coefficient, $\frac{\text{Normal force}}{qS}$

C_m pitching-moment coefficient, $\frac{\text{Pitching moment}}{qSd}$

S maximum cross-sectional area, sq ft

d maximum body diameter, ft

q free-stream dynamic pressure, lb/sq ft

α angle of attack of model center line, deg

R Reynolds number

MODEL, TESTS, AND ACCURACY

The model was constructed of 1/8-inch boiler plate to the full-size exterior dimensions of the reentry capsule that it represented. Details and principal dimensions of the model are shown in figure 2. The model was mounted for tests on the six-component full-scale tunnel balance system as shown in figure 3.

Forces and moments were measured for an angle-of-attack range of -5° to 49.5° in 5° increments and for angles of attack of 70.3° and 88.7°. The accuracy of the data was estimated to be of the order of ± 0.027, ± 0.01, and ± 0.035 for the normal-force, axial-force, and pitching-moment coefficients, respectively.

PRESENTATION OF RESULTS

The results of the investigation are presented in figures 4 to 6. Figure 4 presents a comparison of the variation of C_N, C_A, and C_m with angle of attack for the model with 40-inch and 70-inch canisters.

The results of tests to determine the effect of a corrugated canister surface on the static stability characteristics of the model with 40-inch and 70-inch canisters are presented in figures 5 and 6, respectively.

Langley Research Center,
National Aeronautics and Space Administration,
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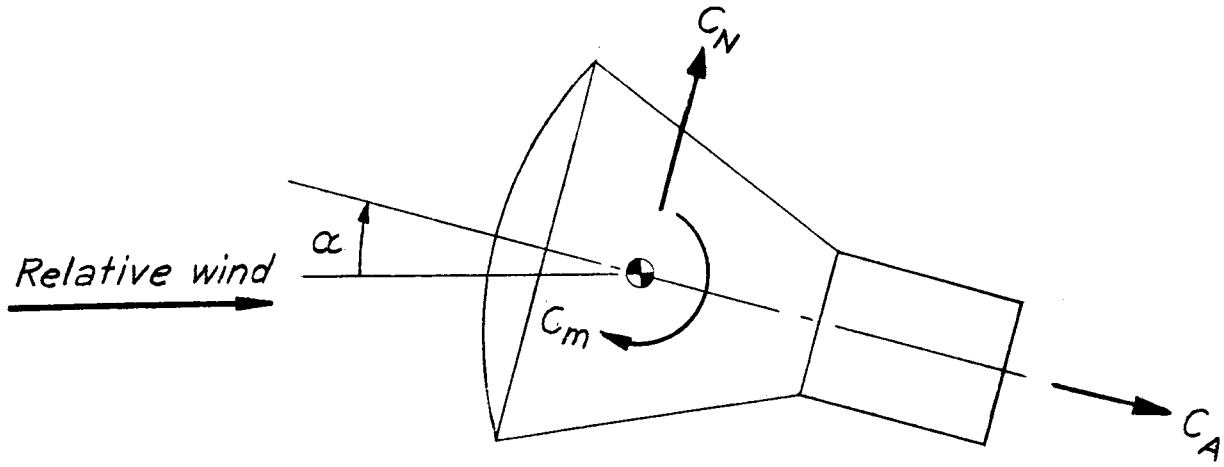

Figure 1.- System of axes used. Arrows indicate positive directions of forces, moments, angular displacement, and velocity.

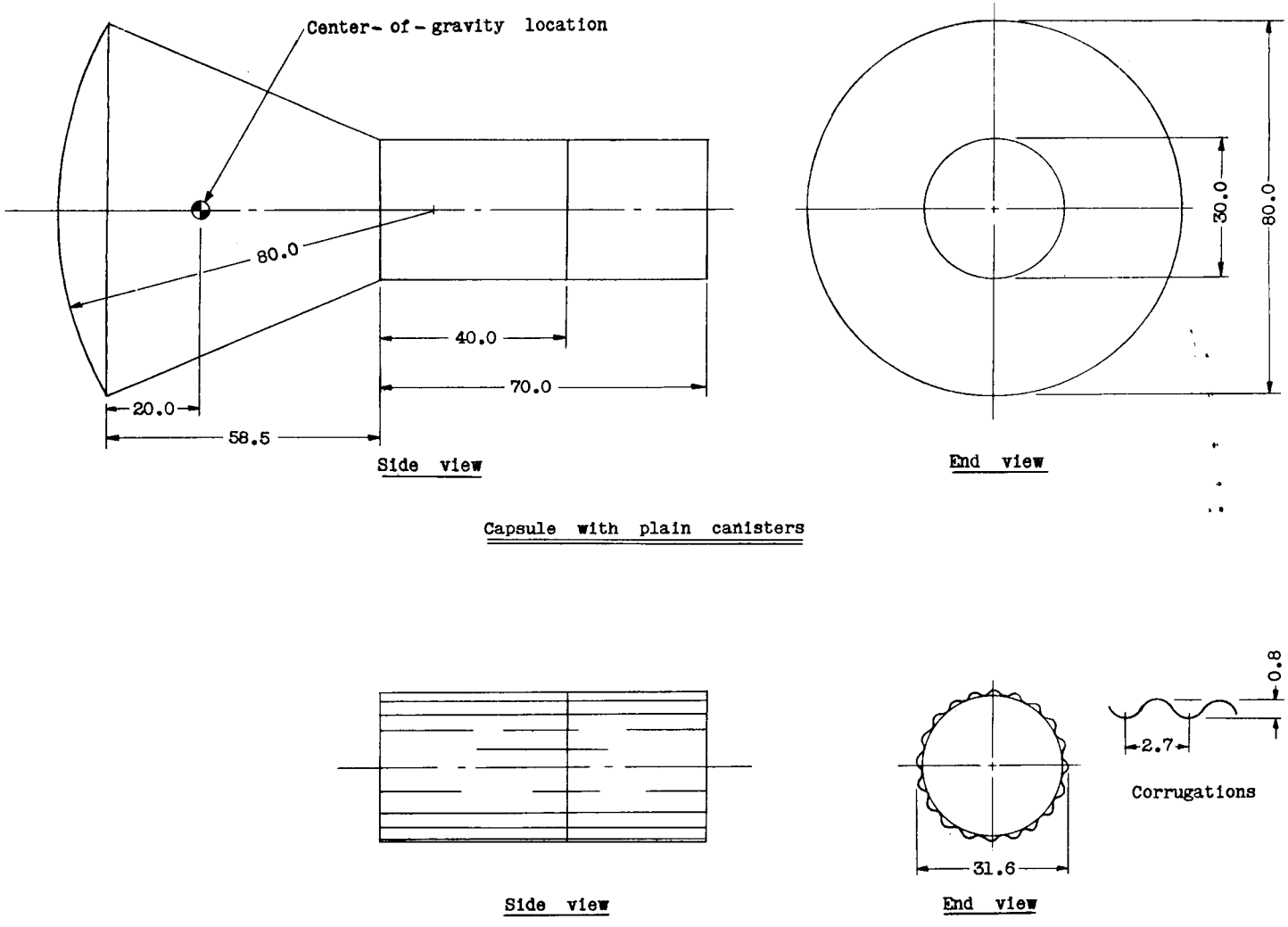

Figure 2.- Two-view drawing of the capsule model. All dimensions are in inches.

Figure 3.- Photograph of the model mounted in the Langley full-scale tunnel. L-59-336

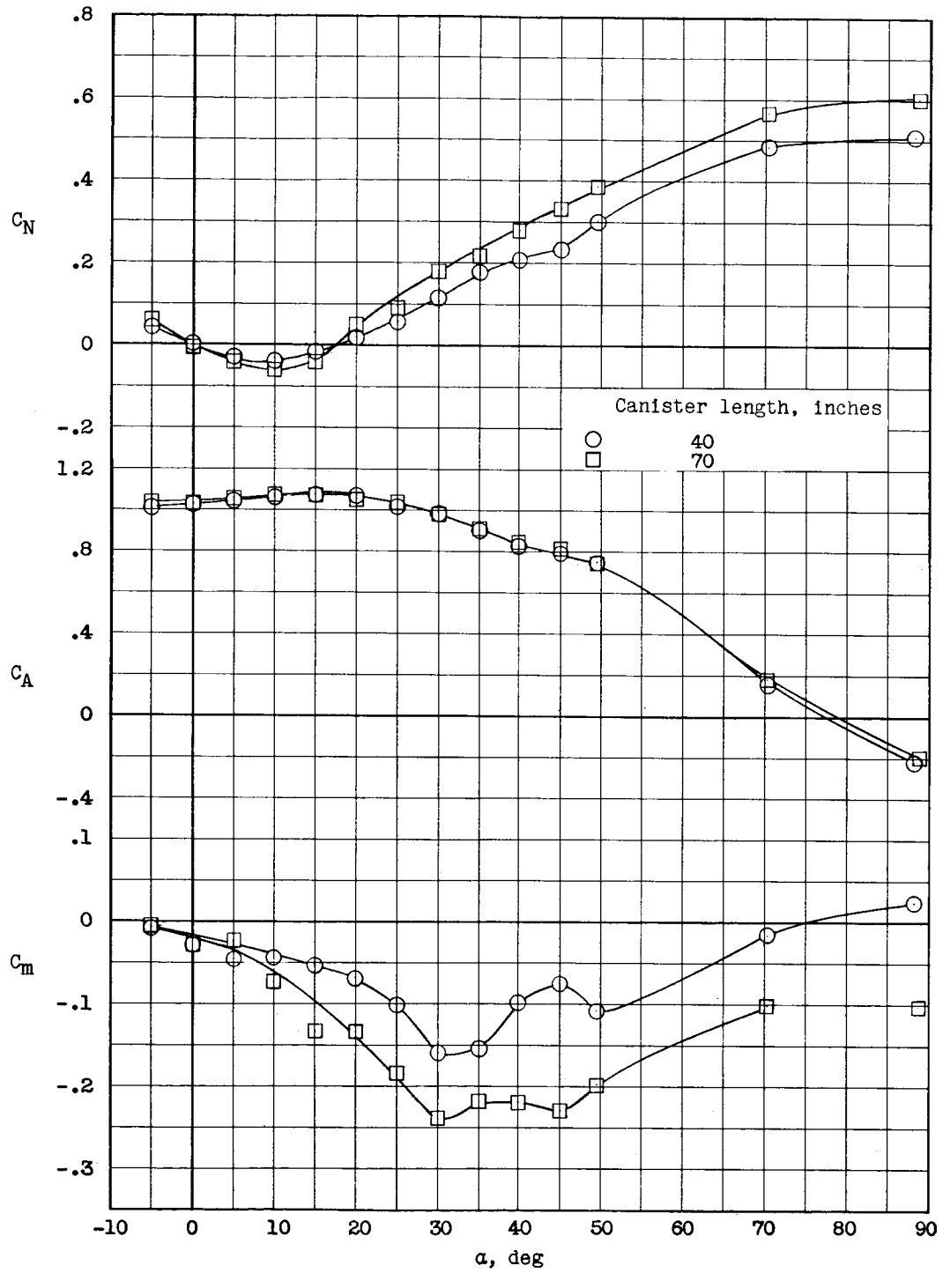

Figure 4.- The effect of canister length on the static aerodynamic characteristics of the model. $R = 4.85 \times 10^6$.

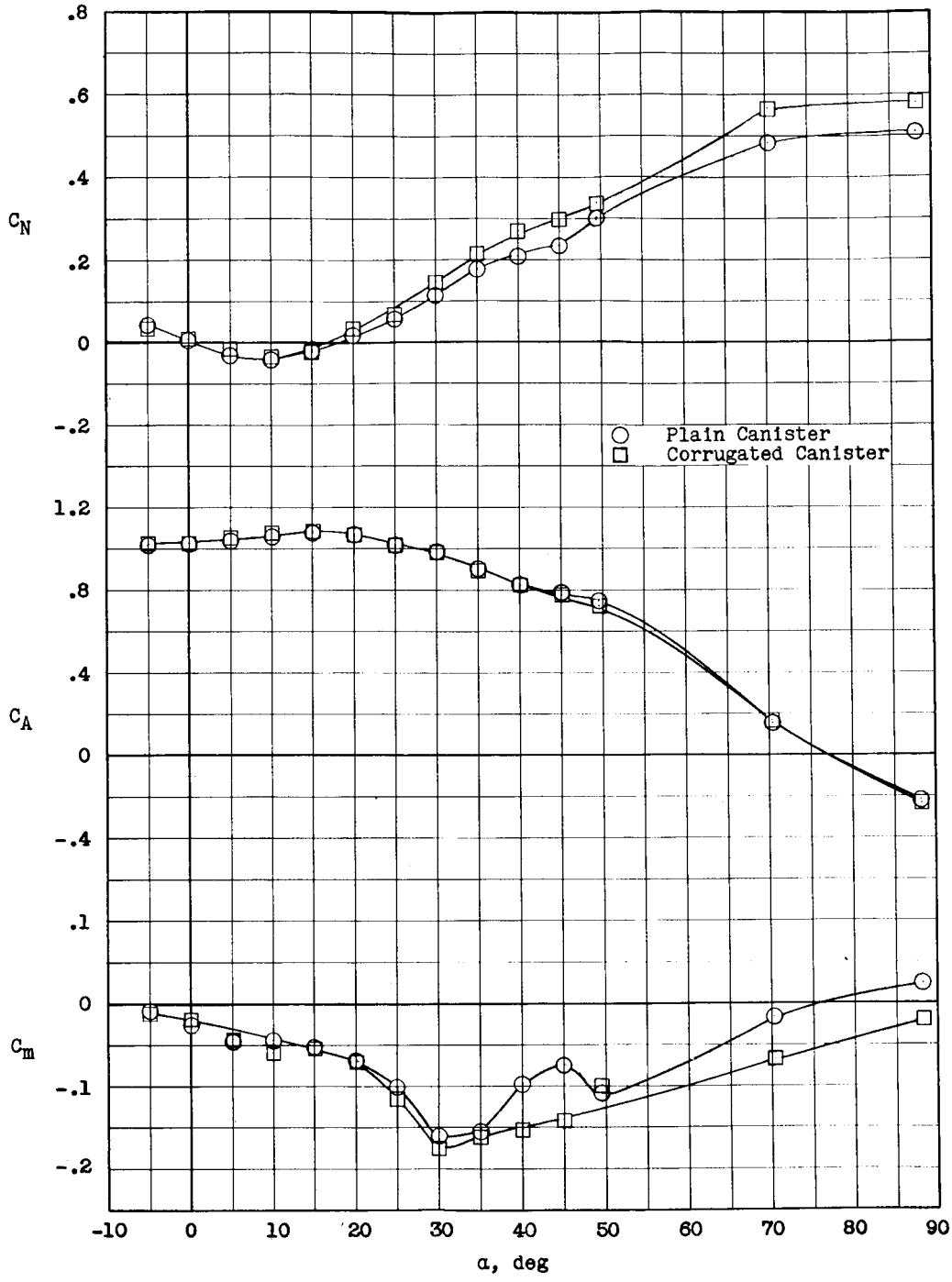

Figure 5.- The effect of a corrugated canister surface on the aerodynamic characteristics of the model with the 40-inch canister. $R = 4.85 \times 10^6$.

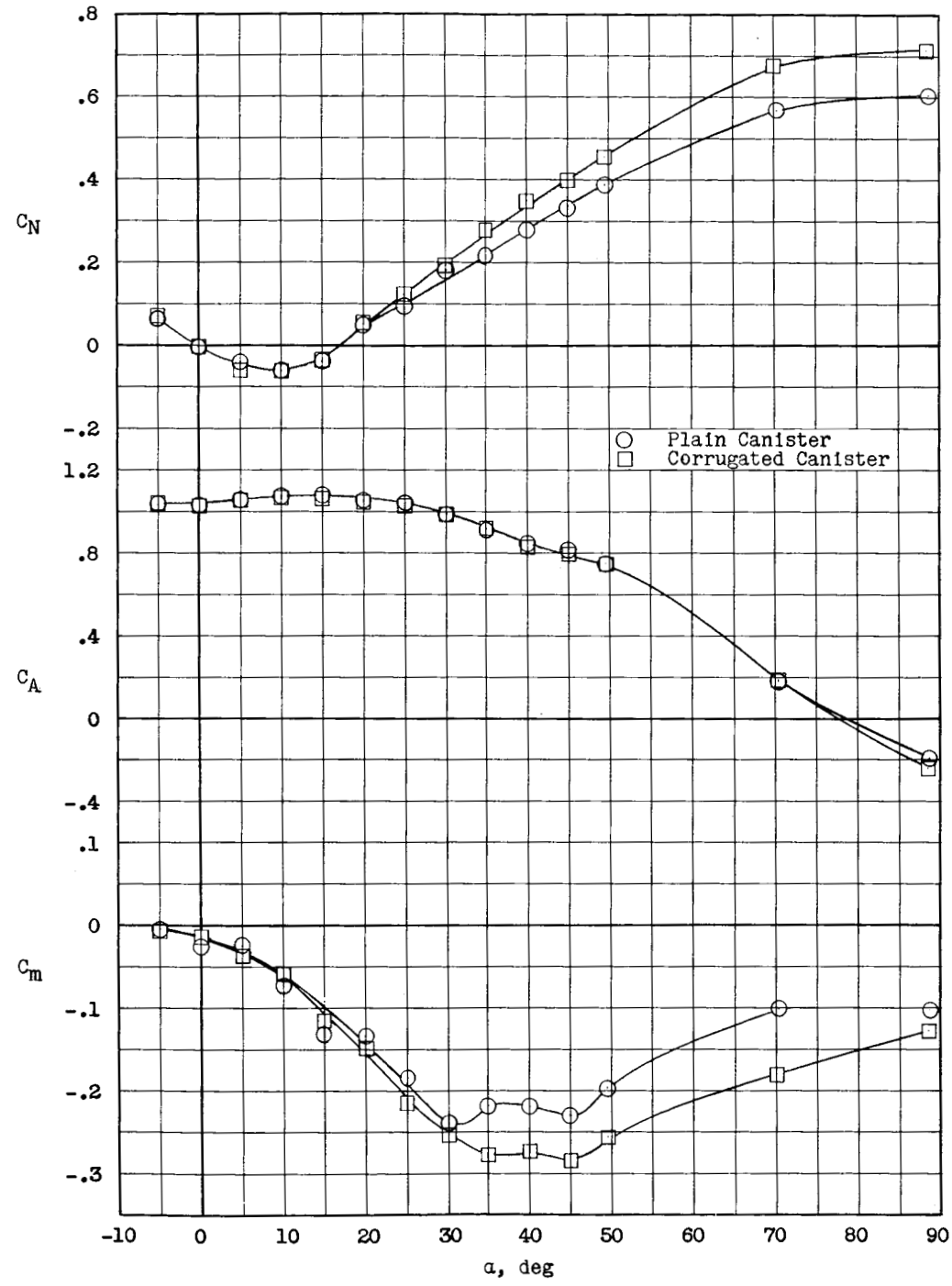

Figure 6.- The effect of a corrugated canister surface on the aerodynamic characteristics of the model with the 70-inch canister. $R = 4.85 \times 10^6$.

[redacted]