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WIND-TUNNEL TESTS OF RADAR REFLECTORS MX-137/A AND MX-138/A

by

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PERSONNEL

The tests described in this report were made by H.B. George. The report is the work of M.J. Bamber.

WIND-TUNNEL TESTS OF RADAR REFLECTORS MX-137/A AND MX-138/A

ABSTRACT

Tests were made in the 8- by 10-foot Wind Tunnel 1 of the David Taylor Model Basin on radar reflectors of two types, MX-137/A and MX-138/A. These reflectors are used on life rafts to facilitate the detection of life rafts by radar from rescue ships.

This report gives the drag and angle of trail of the reflectors at various wind speeds in the free-to-trail condition. The drag of the MX-137/A reflector is also given for the condition with the butt of the supporting mast held perpendicular to the wind direction.

INTRODUCTION

At the request of the Office of Research and Inventions (1),* the drag and the angle of trail of two radar reflectors were measured in the 8- by 10-foot Wind Tunnel 1 of the David Taylor Model Basin.

Radar reflectors are used on life rafts to facilitate the detection of life rafts by radar from rescue ships. When in use, the reflectors are mounted on masts attached to the raft or supported in the air by a small balloon or by a special helicopter.

Tests were conducted to provide data for the design of a supporting helicopter or balloon and to check on the structural soundness of the reflectors under wind loads.

TEST APPARATUS, SETUP, AND PROCEDURE

The radar reflector designated MX-137/A, manufactured by Reed and Barton, is shown in Figures 1, 2, 3, and 4a. The reflector designated MX-138/A, manufactured by Vedo, is shown in Figure 4b. The reflectors are composed of eleven nearly triangular panels of knitted wire mesh. The wire mesh is held taut by six tubular ribs fastened to a central hub. Both types can be stowed in the small containers shown in Figures 4a and 4b. The MX-137/A reflector is equipped with a telescoping tubular steel mast, and the MX-138/A reflector is equipped with a socket for mounting the reflector upright on an oar. The maximum distance from tip to tip of the frame of the MX-137/A is about 49 1/2 inches and of the MX-138/A is about 46 inches.

When suspended from a balloon or helicopter, the MX-137/A reflector is free to trail from the end of the mast whereas the MX-138/A reflector is suspended by a cable.

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* Numbers in parentheses indicate references on page 11 of this report.

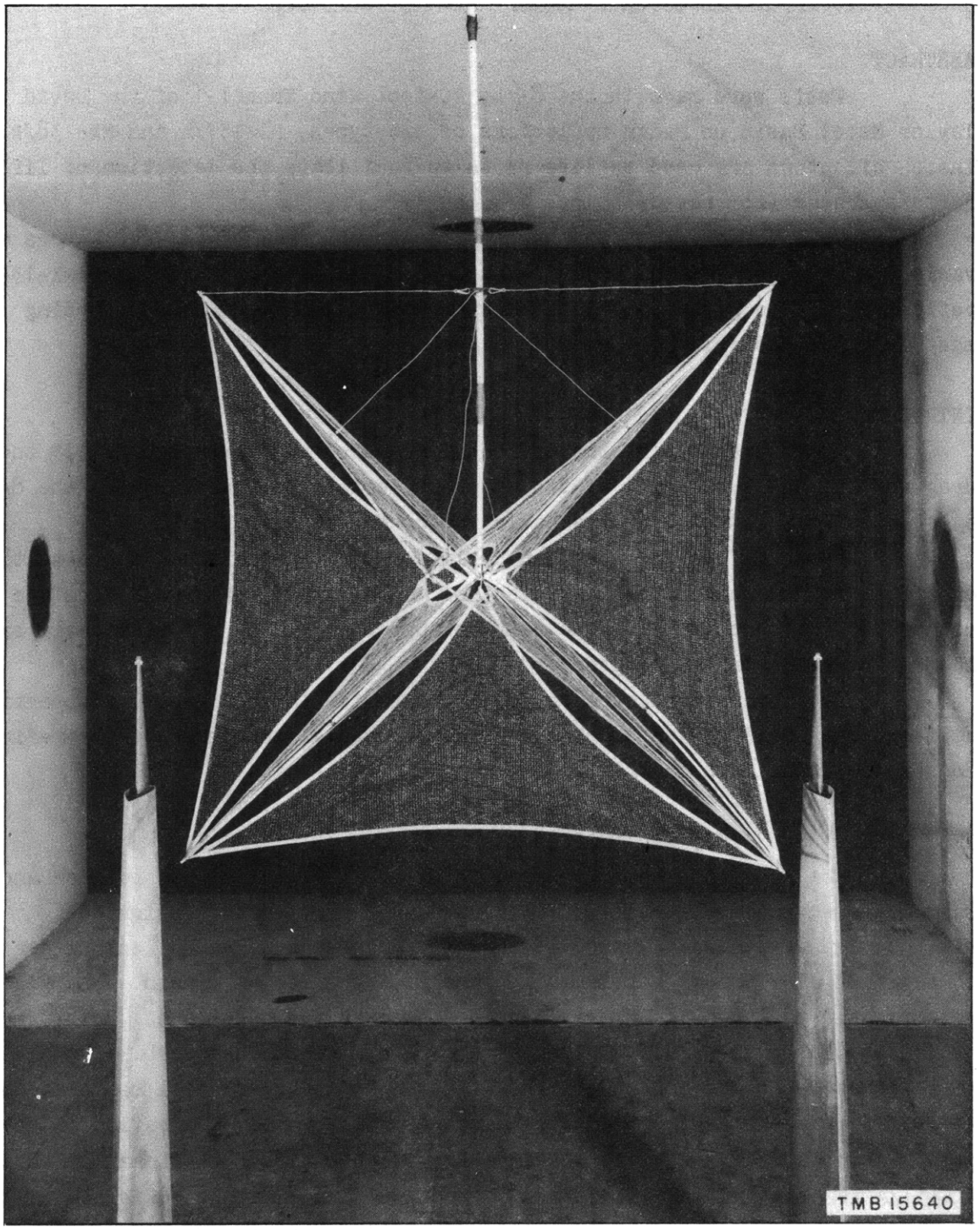

Figure 1 - Reflector MX-137/A Mounted in Wind Tunnel, Looking Upstream with the Reference Axis Parallel to the Wind

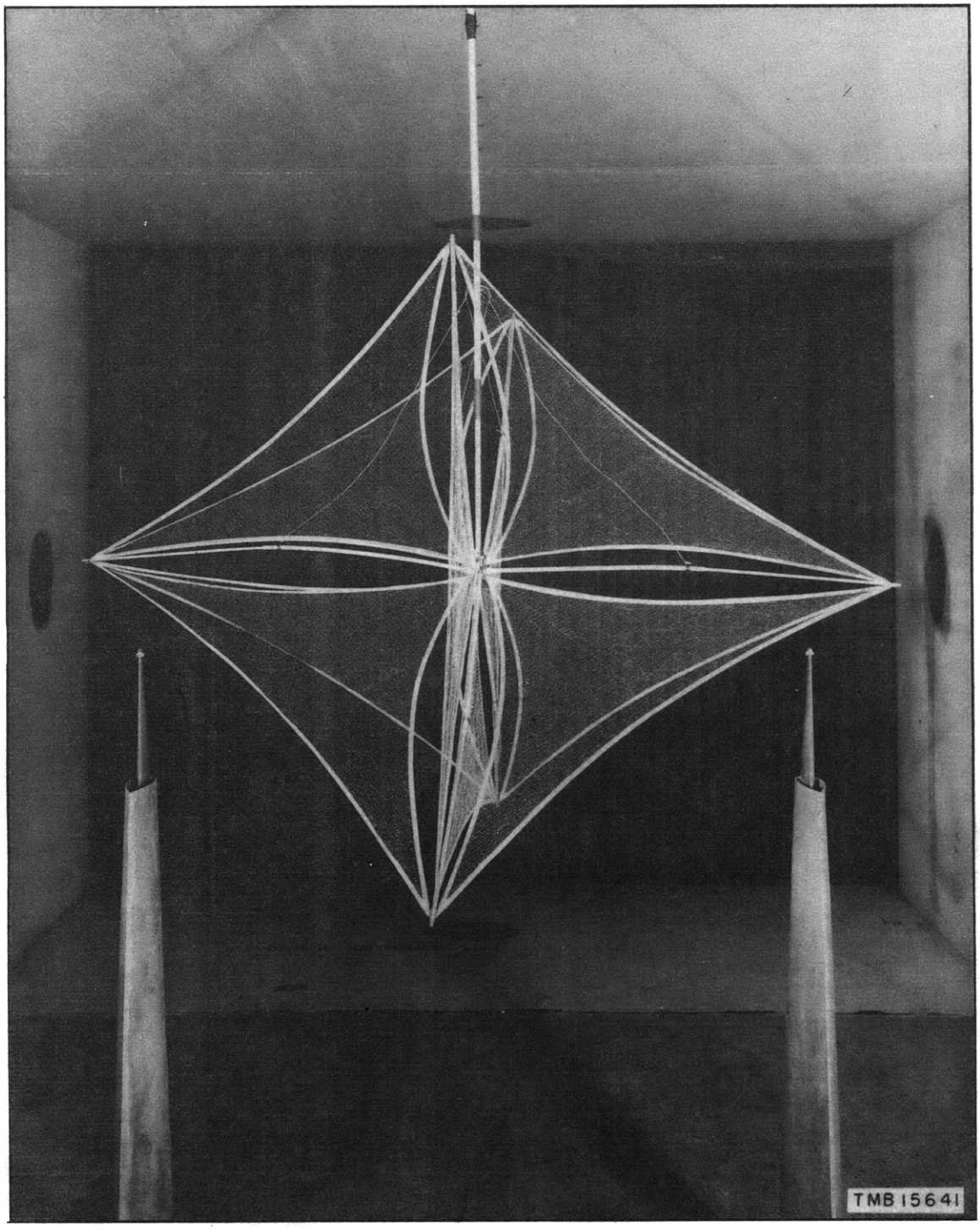

Figure 2 - Reflector MX-137/A Mounted in Wind Tunnel, Looking Upstream with Reference Axis across the Wind

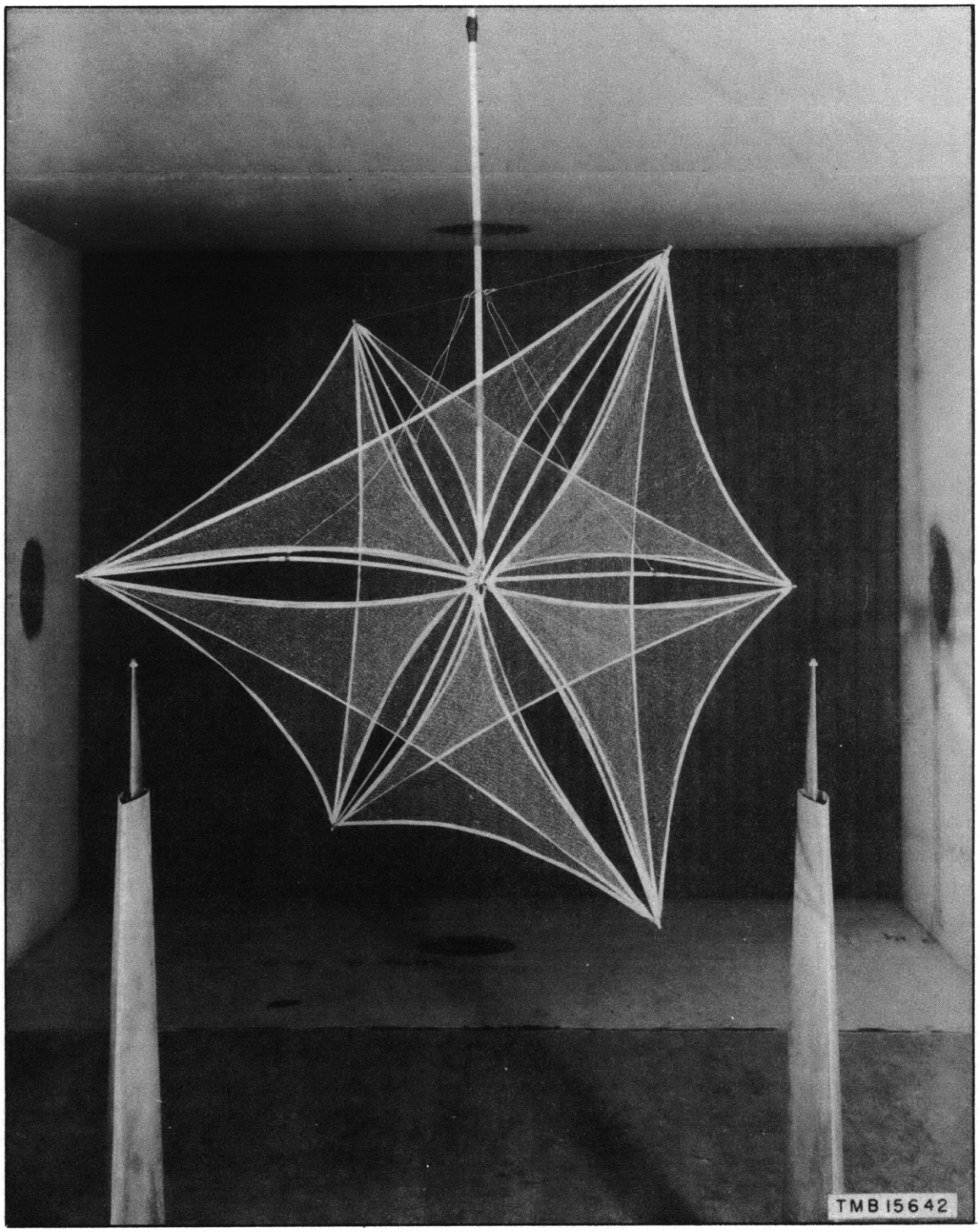

Figure 3 - Reflector MX-137/A Mounted in Wind Tunnel, Looking Upstream with One of the Cups Formed by Three of the Panels Faced into the Wind

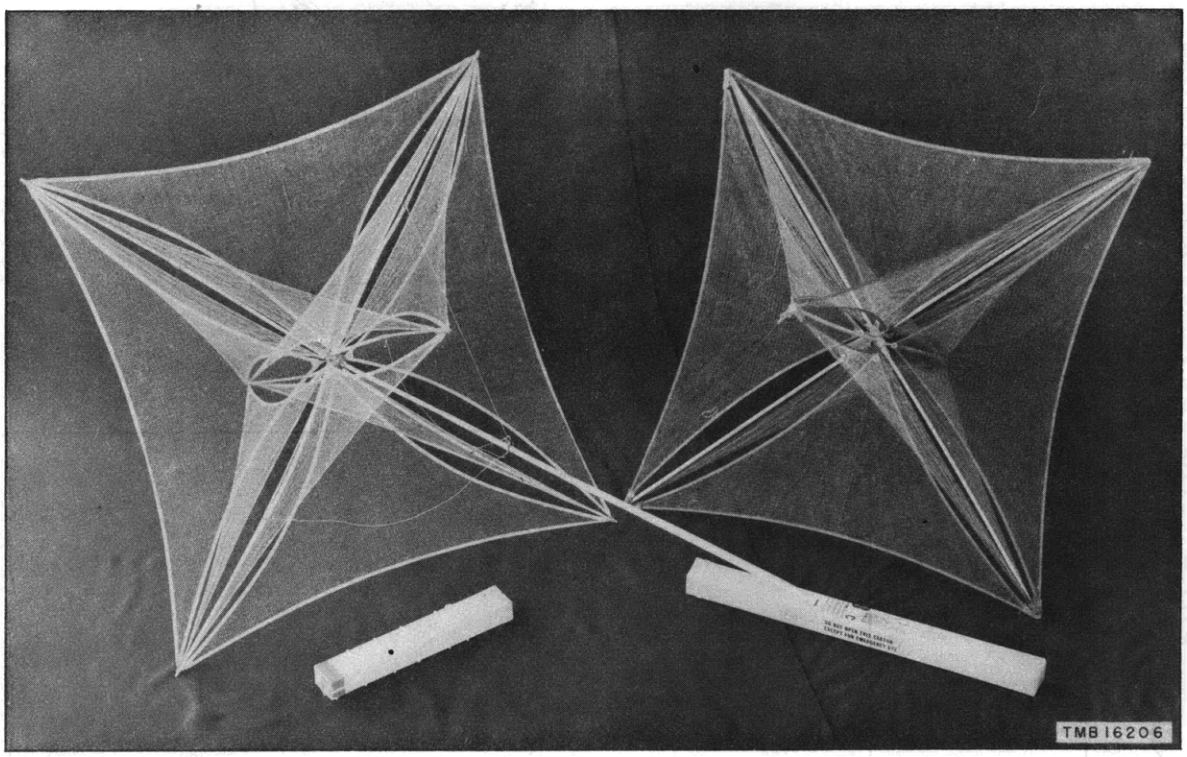

Figure 4a - MX-137/A Reflector Figure 4b - MX-138/A Reflector

Figure 4 - Views of the Reflectors and Their Containers

Both types of reflectors were tested in the 8- by 10-foot Wind Tunnel 1 of the Taylor Model Basin. The tests to simulate the MX-137/A reflector mounted with the mast upright on the life raft were made with the mast stepped into a socket mounted on the balance frame so that the drag of the reflector produced bending in the mast. This test installation is shown in Figures 1, 2, and 3.

The drag force was measured by the tunnel balance, and the deflection of the mast was measured by visually aligning the reflector hub with a scale on the wall of the tunnel. Because the reflector is not symmetrical, it was tested with each of three different faces exposed to the wind.

Both types of reflectors were tested free to trail. The method of mounting the reflectors in the wind tunnel when free to trail is shown in Figure 5. The MX-137/A reflector was pivoted near the butt of the mast to a taut vertical wire which extended between the upper and lower sides of the balance frame.

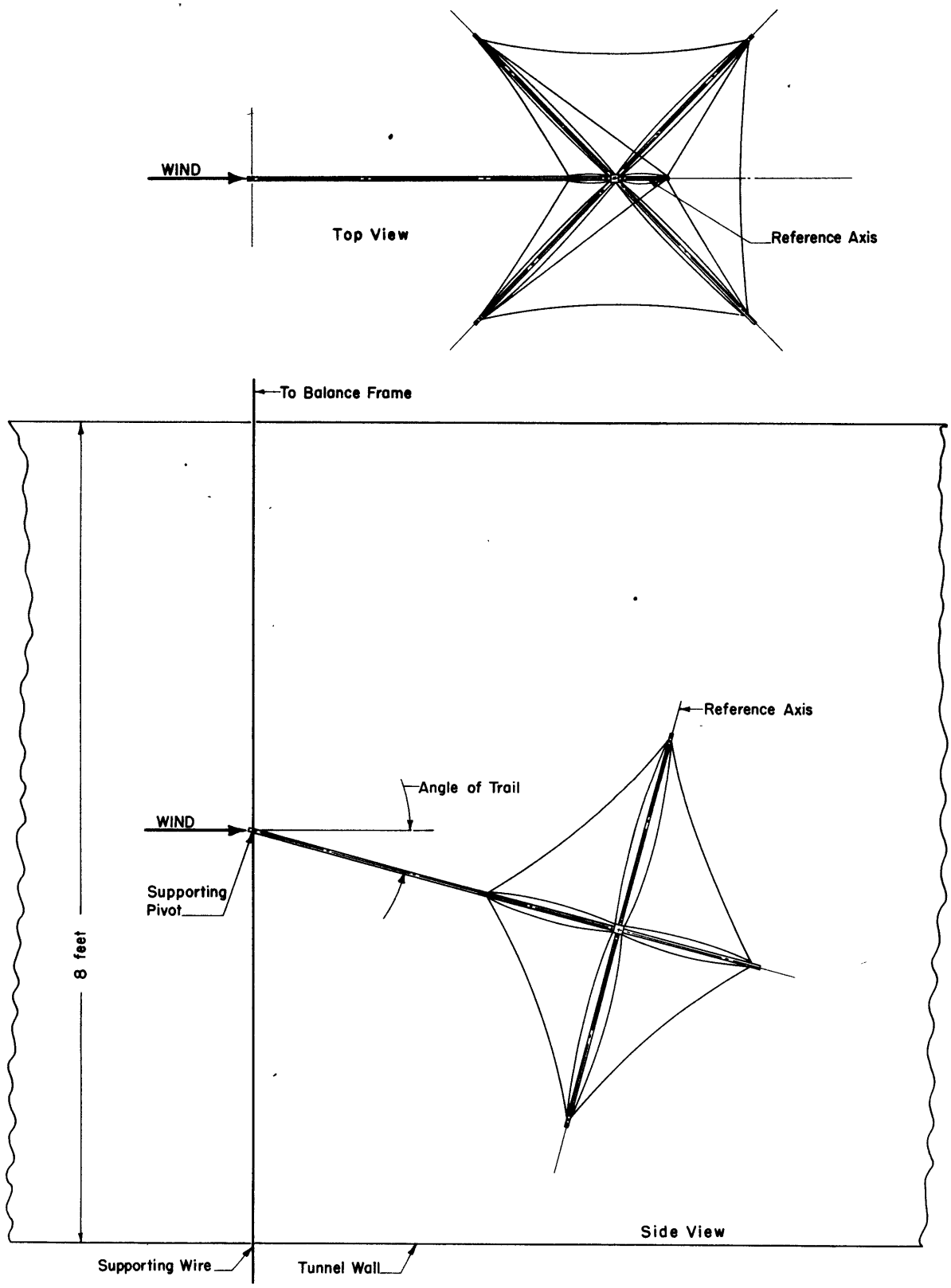

Figure 5 - Sketch of Radar Reflector MX-137/A Showing Reference Axis and Method of Mounting in Wind Tunnel in the Free-to-Trail Condition

With this installation, the mast was free to rotate about the pivot. The drag force was measured by the wind-tunnel balance, and the angle of trail was measured by visually aligning a straightedge along the mast and measuring the angle of the straightedge with respect to the horizontal.

The MX-138/A reflector was attached by two lines from the central hub of the reflector to the struts which may be seen in Figure 1. The lines formed a V-bridle in the horizontal plane when the angle of trail was zero. The drag forces and trail angles were measured in a manner similar to that for the MX-137/A reflector.

TEST RESULTS

The drag force in pounds and the angle of trail in degrees of both reflectors when free to trail are plotted against wind speed in Figure 6. The drag in pounds and the mast deflection in inches for the MX-137/A reflector with the butt of the mast held perpendicular to the wind are plotted against wind speed in Figures 7 and 8. The reflector was tested in three different attitudes with respect to the wind. These attitudes are defined as follows:

a. Reference axis parallel to wind, as shown in Figure 1. The reference axis is defined as a line coinciding with the reflector rib which is perpendicular to the mast, as shown in Figure 5.

b. The reference axis across wind, as shown in Figure 2.

c. One of the cups formed by three of the panels faced into the wind, as shown in Figure 3.

All drag values are corrected for tares due to the supports. The wind speeds are given in knots for air under standard conditions. The maximum error in the values for drag is probably within plus or minus 0.20 pound, for the angle, within plus or minus 0.5 degree, and for the deflection of the mast, within plus or minus 0.5 inch.

DISCUSSION OF RESULTS

Although the MX-137/A reflector is larger than the MX-138/A reflector, the results indicate that the drag is about the same for both in the free-to-trail condition; see Figure 6. This unusual circumstance is probably due to the difference in trail angle for the two reflectors. The MX-137/A reflector has a larger trail angle than the MX-138/A reflector, probably because of the weight of its mast. The maximum wind speed that the ribs will withstand without a permanent set is about 60 knots.

With the butt of the mast held perpendicular to the wind direction, the telescopic mast of the MX-137/A reflector took a small permanent set at

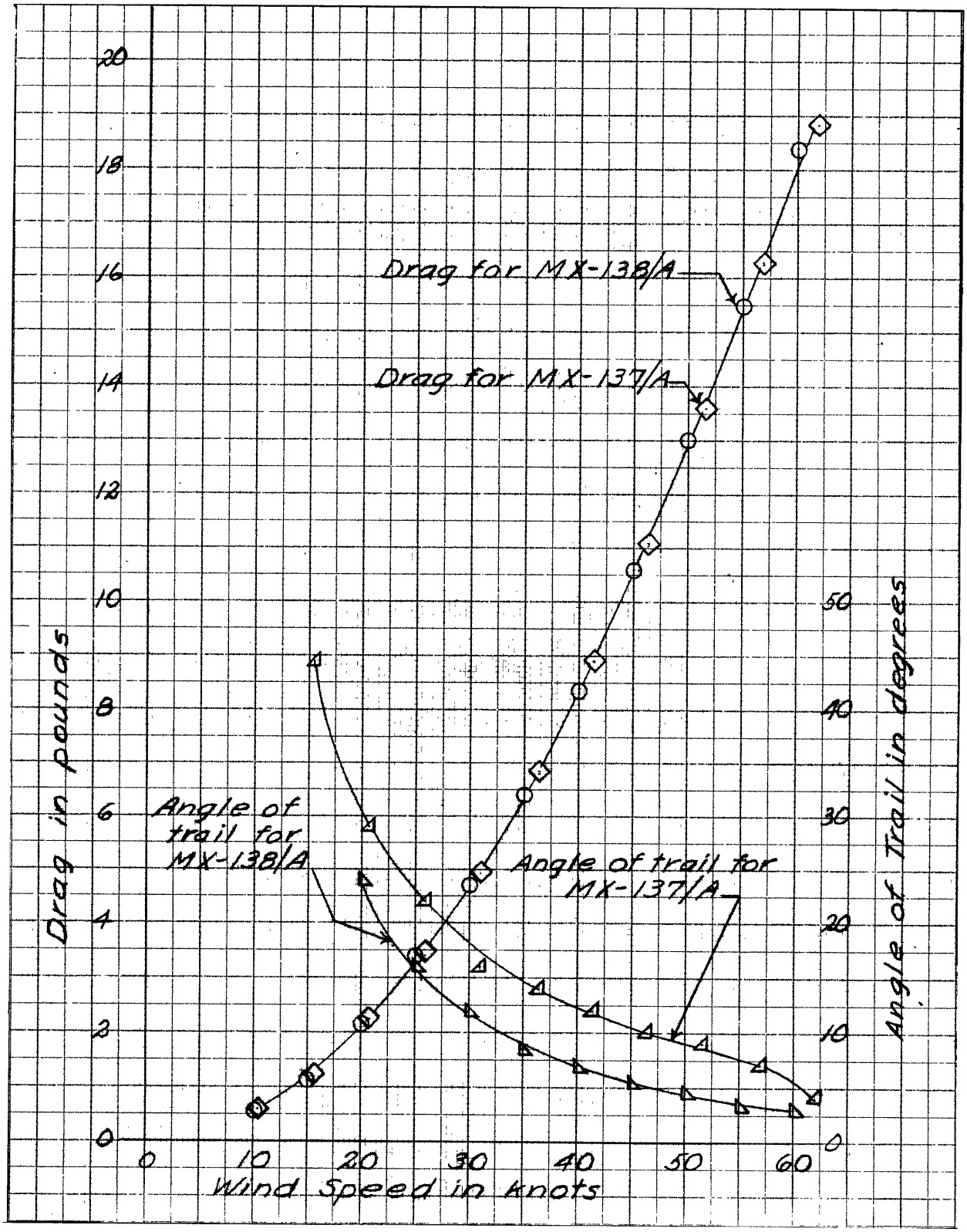

Figure 6 - Variation of Drag and Angle of Trail with Wind Speed for Radar Reflectors MX-137/A and MX-138/A in the Free-to-Trail Condition

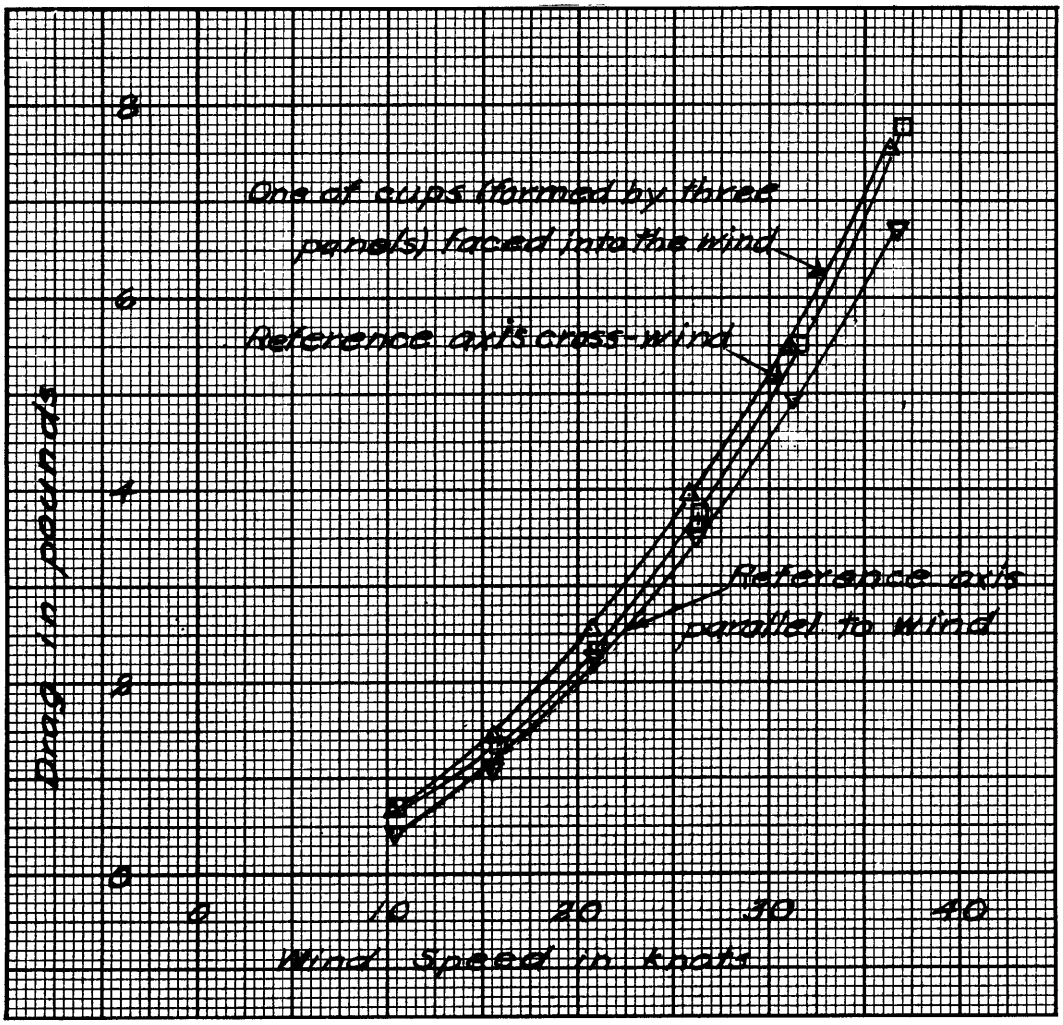

Figure 7 - Variation of Drag with Wind Speed for Radar Reflector MX-137/A with Butt of Mast Held Perpendicular to Wind Stream

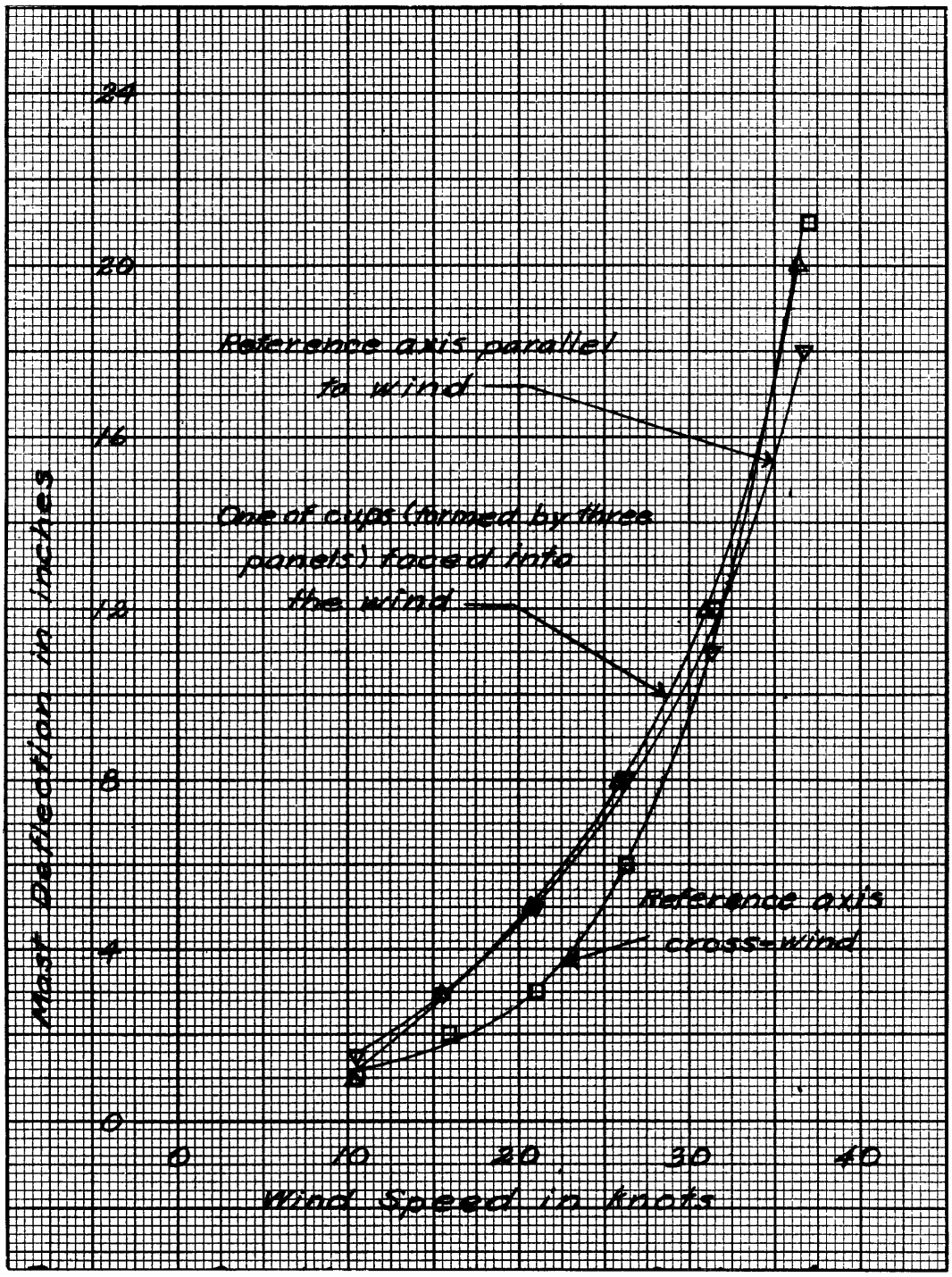

Figure 8 - Variation of Mast Deflection with Wind Speed for Radar Reflector MX-137/A with Butt of Mast Held Perpendicular to Wind Stream

low wind speeds. Tests, therefore, were not made at a wind speed higher than 35 knots.

CONCLUSIONS

1. Both the MX-137/A and the MX-138/A radar reflectors will withstand wind speeds up to at least 60 knots in the free-to-trail condition.

2. When the butt of the mast of the MX-137/A reflector is held perpendicular to a 35-knot wind, the mast receives a serious permanent set.

3. The drag of either reflector in the free-to-trail condition is 13 pounds at a wind speed of 50 knots. The drag varies approximately as the square of the wind speed.

REFERENCE

(1) ORI letter EXOS:ORI:SD:2:CPA, 0466SD of 18 July 1945 to TMB.