TECHNICAL NOTES

NATIONAL ADVISORY COMMITEE FOR AERONAUTICS

No. 549

DRAG OF PRESTONE AND OIL RADIATORS ON THE YO-31A AIRPLANE

By S. J. DeFrance
Langley Memorial Aeronautical Laboratory

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SUMMARY

At the request of the Army Air Corps tests were conducted in the full-scale wind tunnel on a mock-up of the YO-31A airplane to determine the drag of the prestone and oil radiators. The drag of the airplane was determined with both radiators exposed on the lower surface of the fuselage; with each radiator exposed; and with no radiators.

The results show that at 120 miles per hour the oil radiator accounted for 2.8 percent of the drag of the complete airplane; the prestone radiator, 8.3 percent; and both radiators together, 11.8 percent.

INTRODUCTION

One of the largest single items contributing to the drag of a modern airplane equipped with a liquid-cooled engine is the radiator installation. At the request of the Army Air Corps, tests were made in the N.A.C.A. full-scale wind tunnel of a YO-31A airplane to determine the drag of the prestone and oil radiators. Drag tests were made with the propeller removed and with both radiators exposed on the lower surface of the fuselage, with each radiator separately exposed, and finally with both radiators removed from the surface of the fuselage and placed inside. In addition, the effect of the slipstream was determined with the propeller operating at four different values of V/nD.

APPARATUS AND TESTS

The airplane used was a mock-up of the YO-31A Army observation plane with a 600-horsepower liquid-cooled engine turning a 9-foot 11-inch propeller at 1,715 r.p.m. The various radiator installations tested are shown in figures 1 to 4; the dimensions of the radiators and of the radiator cowlings are shown in figure 5. The drag of the complete airplane was determined for the four conditions with the propeller removed, and with the propeller operating at values of V/nD of 0.50, 0.70, 0.95, and 1.20. For the tests with power on when the radiators were removed from the surface of the fuselage, cooling was obtained by placing the radiators in a tank within the fuselage and circulating water over them.

RESULTS

The minimum drag coefficient for the complete airplane with each of the radiator installations is given in figure 6 for air speeds varying from approximately 65 to 125 miles per hour. These results are for the propeller-removed condition with a dummy nose installed to represent the spinner.

Figure 6 shows that removal of the oil radiator decreased the drag of the entire airplane at 120 miles per hour 2.8 percent, that removal of the prestone radiator decreased the drag 8.3 percent, and that removal of both radiators decreased the drag 11.8 percent. Since the summation of the decreases in drag with each radiator removed individually was approximately the same as that for both radiators removed, it can be concluded that the flow from one radiator did not greatly affect that over the other or cause any appreciable mutual interference.

Figure 7 shows the difference in drag due to the radiators between the conditions of both radiators removed from the lower surface of the fuselage and with both exposed, for four values of V/nD. At an angle of attack of -1° and a V/nD of 0.95, corresponding to the high-speed-flight condition for the airplane, it is apparent that the slipstream increases the radiator drag by approximately 30 percent. The effect of the radiators on the propulsive efficiency was not measured.

If the top speed of the airplane were originally 188 miles per hour, based on the power-off results the removal of both radiators would increase the speed to approximately 196 miles per hour; if the increase in the radiator drag due to the slipstream were included, the speed would be increased to approximately 199 miles per hour.

CONCLUSION

Even for an airplane with as clean a radiator installation as that of the YO-31A, the radiators may account for 11.8 percent of the total minimum drag of the airplane.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., November 19, 1935.

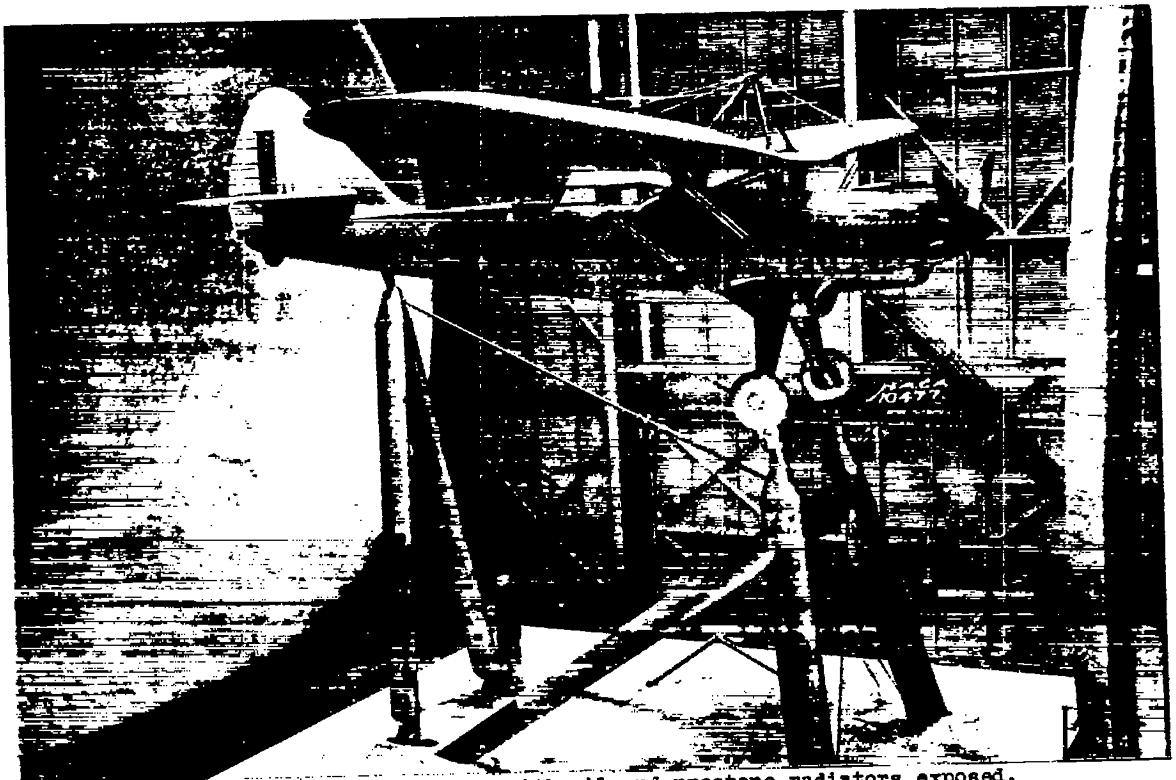


Figure 1.- YO-31A airplane with oil and prestone radiators exposed.

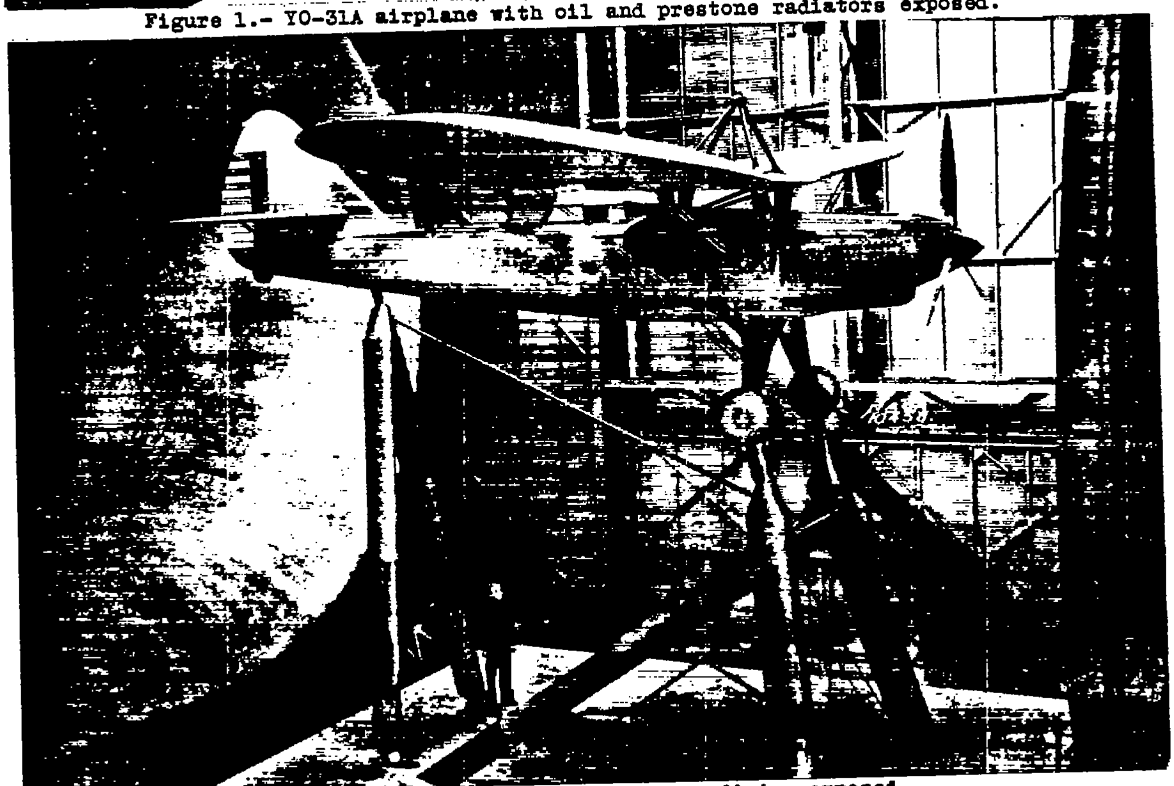


Figure 2.- YO-31A airplane with oil radiator exposed.

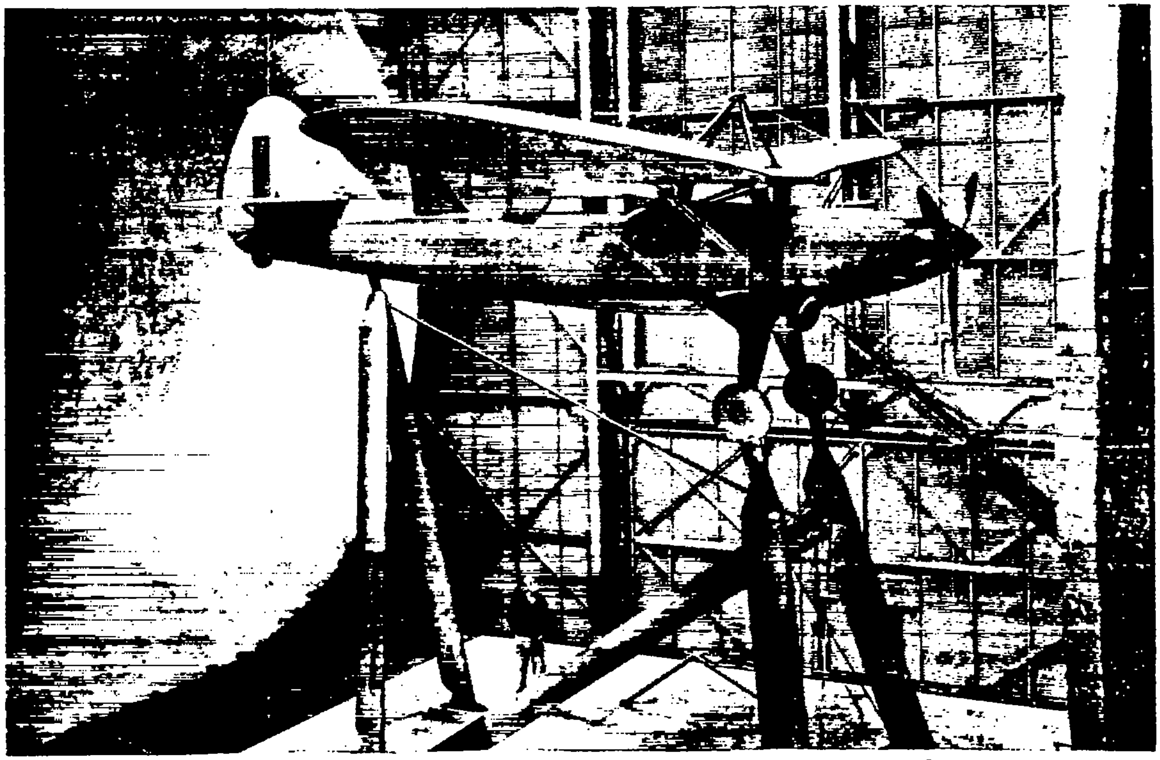


Figure 3.- YO-31A airplane with prestone radiator exposed.

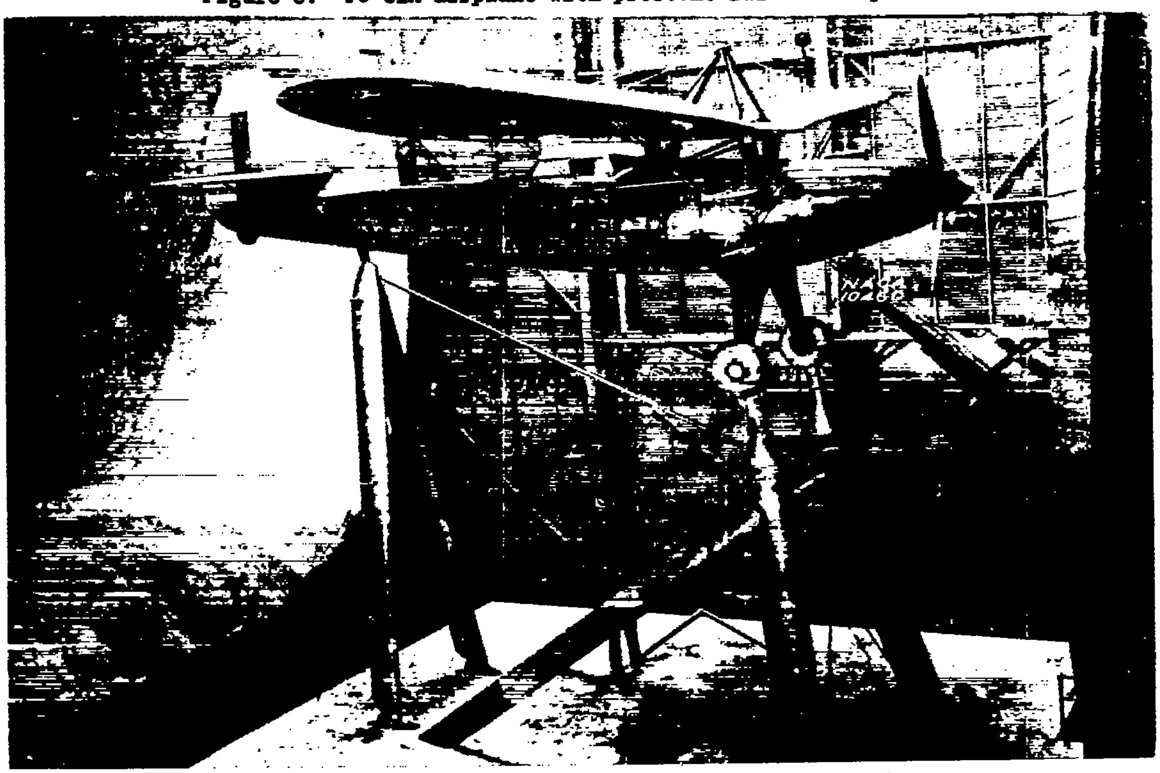
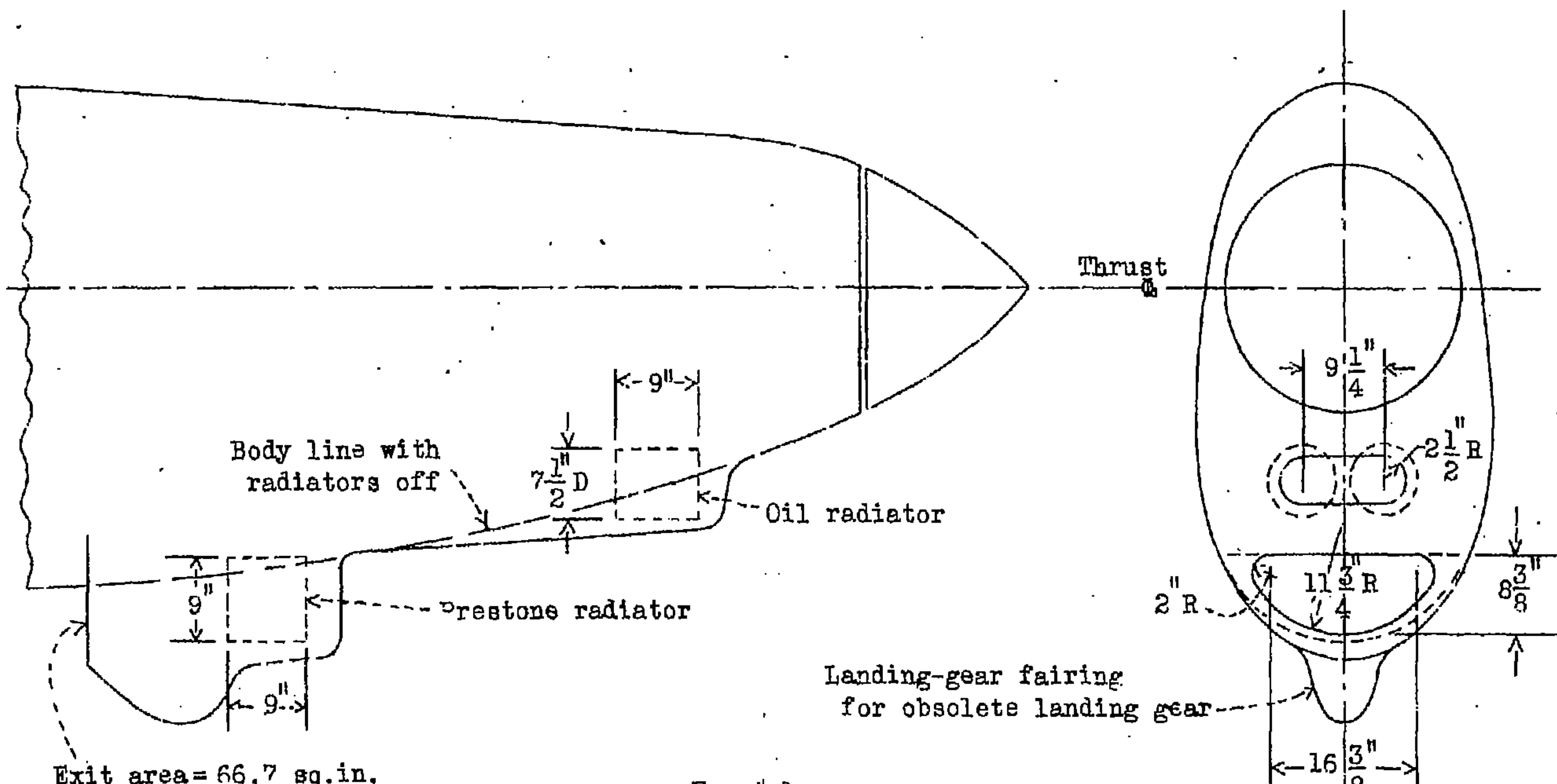


Figure 4.- YO-31A airplane with no radiators exposed.



Frontal area
Oil radiator 88.4 sq.in.
Prestone radiator 172.9 "

Core tubes
Oil radiator 065948 inside Dia. = 0.257 in.
Prestone radiator AN4011 " " = 0.257 "

Figure 5.- The YO-31A oil and prestone radiators.

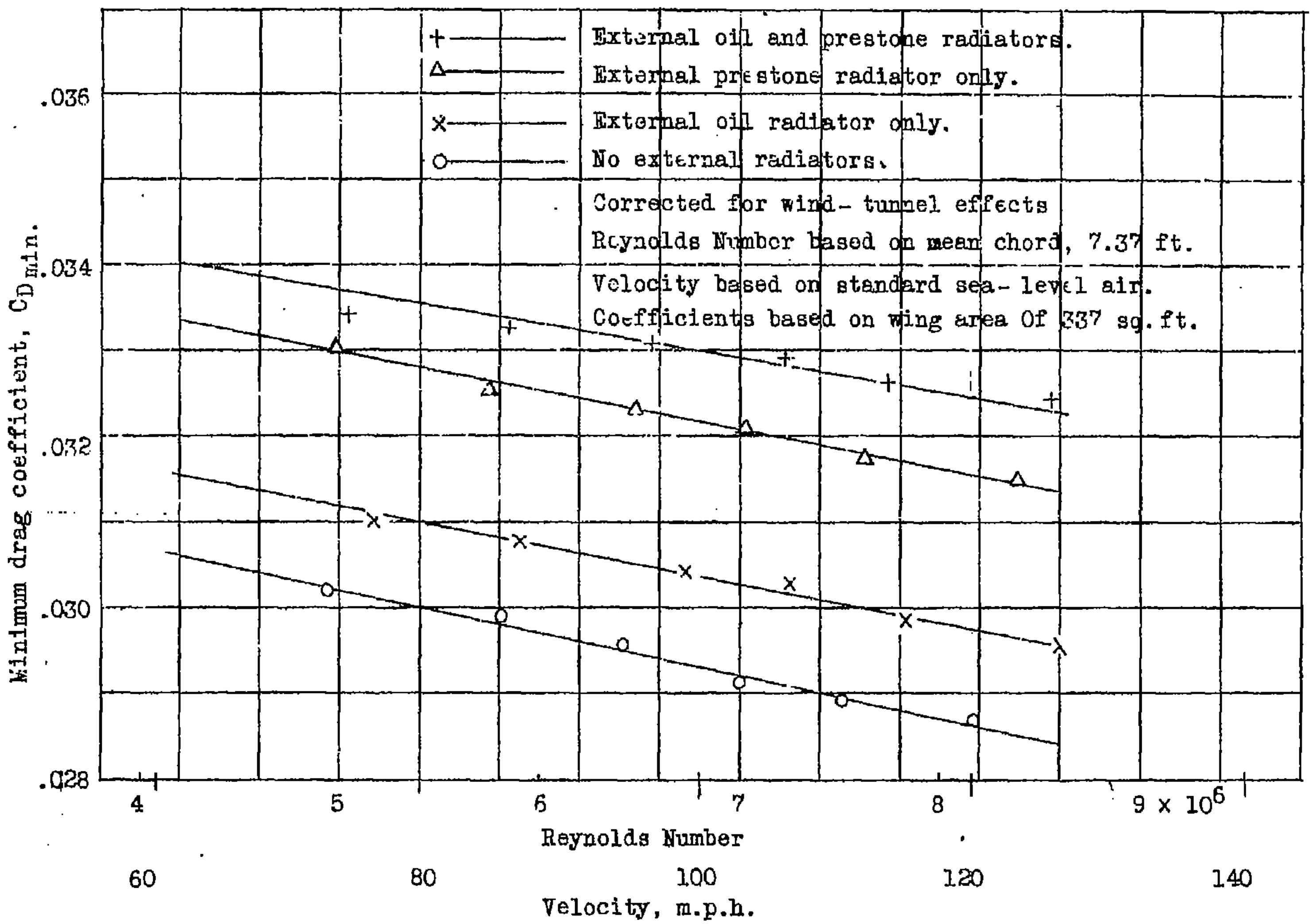


Figure 6.- The YO-31A mock-up, propeller removed.

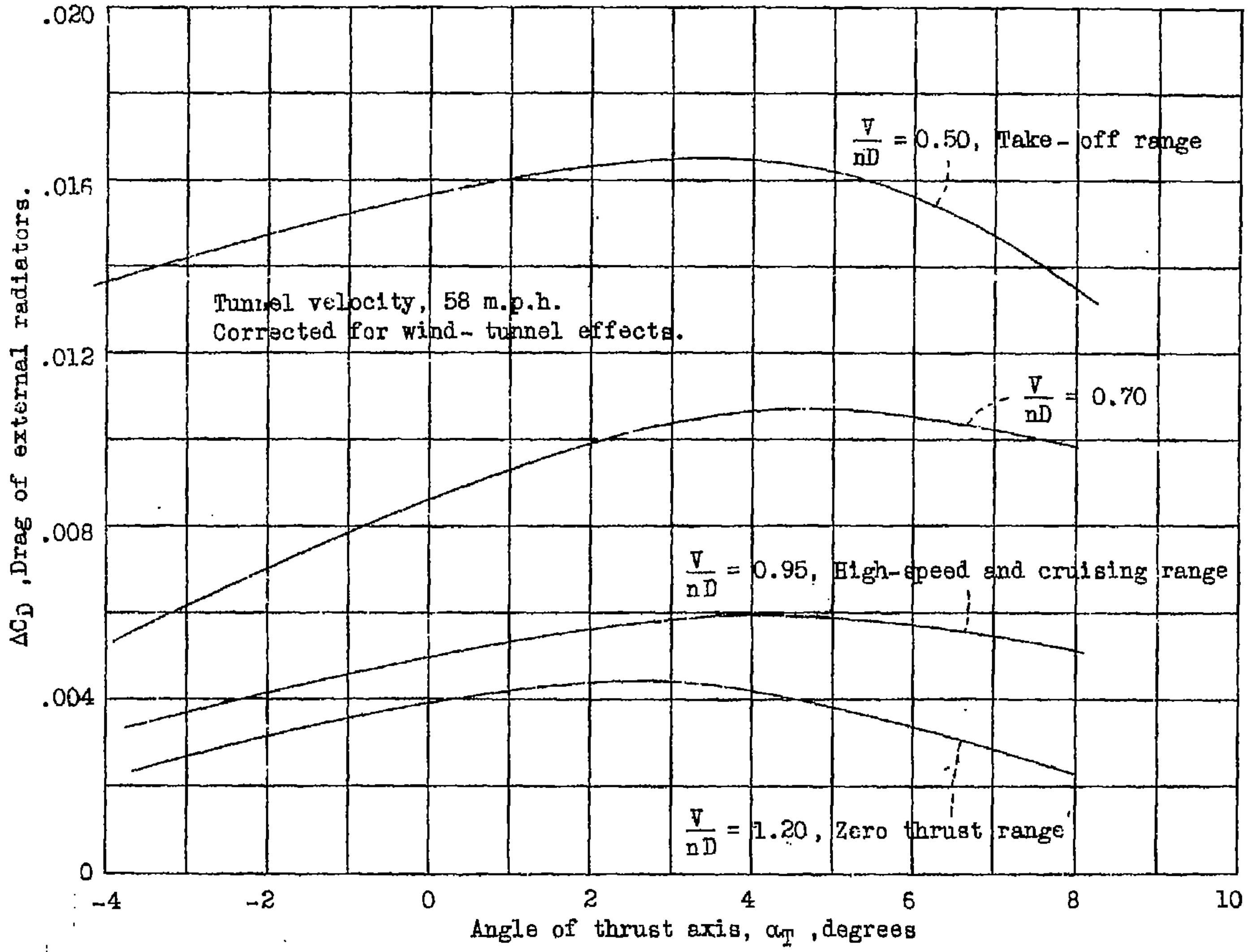


Figure 7.- The Y O-31 A mock-up, power on.