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Pressure Distributions at High Speed on EC 1250 (Data Report)

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J. A. BEAVAN, M.A., and G. A. M. HYDE,
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Pressure Distributions at High Speed on EC 1250 (Data Report)

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This report puts on record, as data, pressure distributions measured on a 5-in. chord aerofoil of EC 1250 section in the 20 × 8 in. Rectangular High-Speed Tunnel, at the National Physical Laboratory.

The pressure distributions given here were obtained some years ago, and give detailed results on an aerofoil which has some interesting properties but differs in shape from those now used for aircraft wings. Some discussion of the results has been made elsewhere, for example in R. & M.'s 2560[5] and 2222[6]. The curves show the now well-known phenomenon of the backward movement of shock waves and spread of the supersonic region ahead of them at a fairly constant limiting local Mach number along the surface, for a symmetrical aerofoil at moderate incidences. The changes of lift, pitching moment, etc., with Mach number can be estimated from the pressure distributions. The results resemble those obtained from German tests[7] at higher Reynold's number, but smaller incidence range.

The technique and general conditions of test, and reduction of the observations, is described in R. & M. 2065[1] and will not be repeated here. The present aerofoil was the first to be pressure plotted in this tunnel and preliminary results were reported in R. & M. 2056[2]. The following figures*, however, cover a much wider range of incidence and take advantage of improvements of tunnel and technique that followed. The further change, made much more recently, in reducing the humid conditions in the tunnel by installation of return ducts, is not likely to have altered the pressure results much, though it is known[3,4] that the effect on drag rise is marked.

The range covered is as follows, being limited at high incidence by aerofoil strength considerations:

Incidence	0 deg	2 deg	4 deg	6 deg	8 deg	10 deg	12 deg
Highest M							
Streamline Walls	0·882	0·86	0·85	0·84			
Straight Walls	0·85		0·825	0·73	0·58	0·58	0·58

* In Figs. 1, 5, 6, 8 dotted lines are shown on the higher pressure distributions. The smooth curves at even values of M are obtained from the experimental observations by cross plotting at constant stations along the aerofoil. But abrupt rises in pressure, corresponding possibly to definite shock-wave discontinuities, can sometimes (though not always) be drawn in the original pressure distributions. From plottings of their range of possible position and amplitude against M, these discontinuities can be inserted as shown dotted. They probably correspond to conditions outside the boundary layer.

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At the time it was not thought necessary to perform the high incidence tests with streamline walls, which involve a considerable amount of preliminary work and resetting of the walls for different speeds. Comparison of the straight and streamline wall tests at 0, 4 and 6 deg suggest however, that the error on Mach number due to using straight walls is less than 0·01 (at $M=0{\cdot}58$), and the shape of the pressure distribution curves is negligibly different.

Lift results obtained by integration of the original curves are given in Fig. 19.

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No.	Author	Title, etc.
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2	J. A. Beavan and G. A. M. Hyde	Examples of Pressure Distributions at Compressibility Speeds on EC 1250. R. & M. 2056. September, 1942.
3	H. H. Pearcey	The Effect of Condensation of Atmospheric Water Vapor on Total Head and Other Measurements in the N.P.L. High-Speed Tunnel. R. & M. 2249. February, 1944.
4	H. H. Pearcey and J. A. Beavan	Force and Pressure Coefficients up to Mach Number 0.87 on the Goldstein Roof Top Section 1442/1547. R. & M. 2346. April, 1946.
5	D. W. Holder	The N.P.L. High-Speed Laboratory. R. & M. 2560.
6	W. A. Mair (editor)	Research on High-Speed Aerodynamics at the Royal Aircraft Establishment from 1942 to 1945. R. & M. 2222.
7	K. W. Mangler & H. B. Squire .. .	D.V.L. High-Speed Wind Tunnel Tests on NACA-00012-0.55 50. A.R.C. 11103. August, 1947. (unpublished).

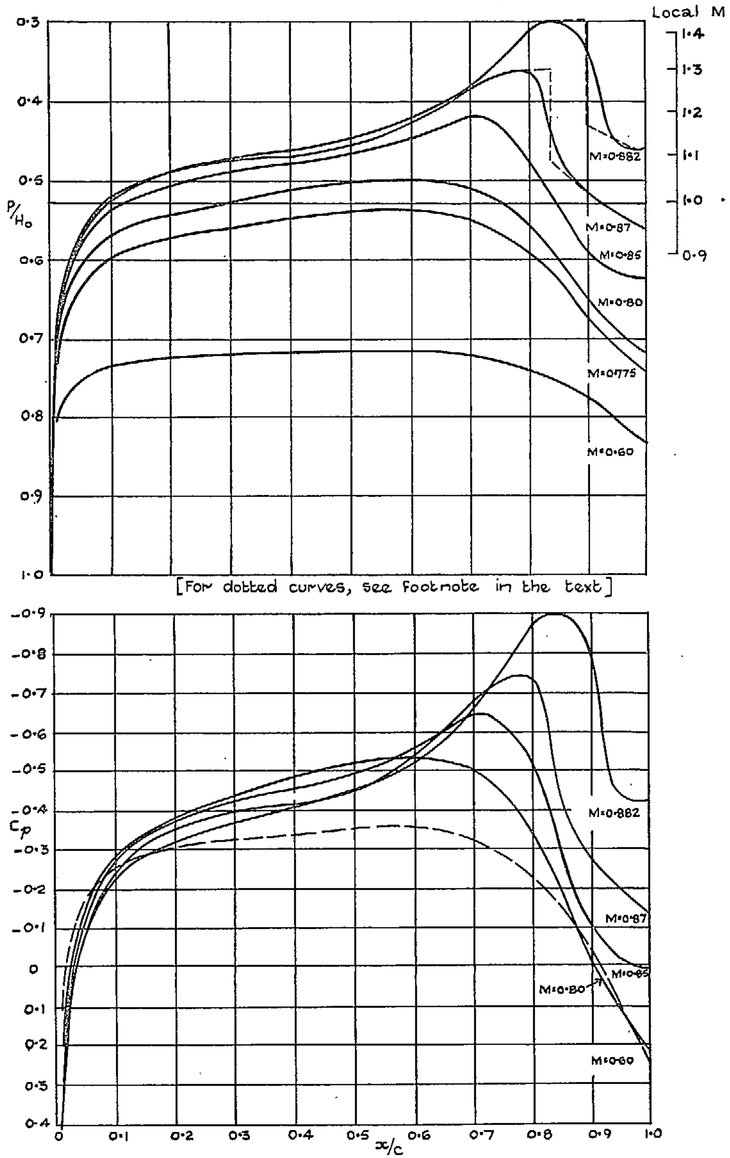


FIG. 1. EC 1250 $\alpha = 0$ deg. Streamline walls.

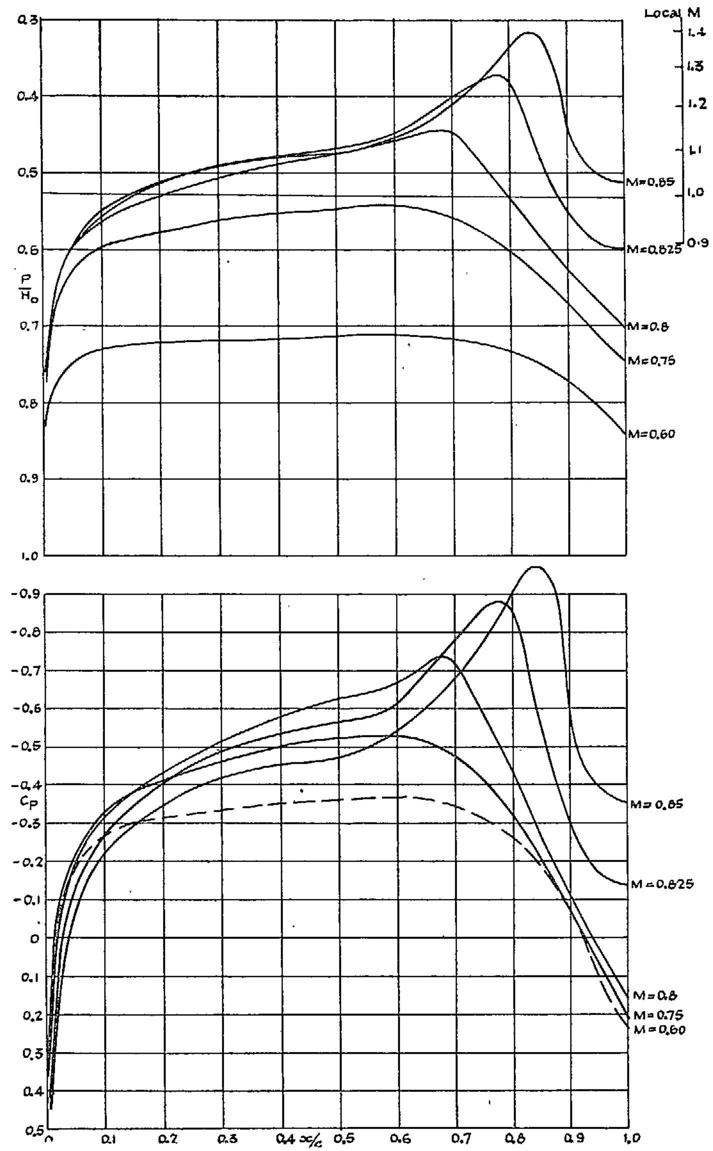


FIG. 2. EC 1250 $\alpha = 0$ deg. Straight walls.

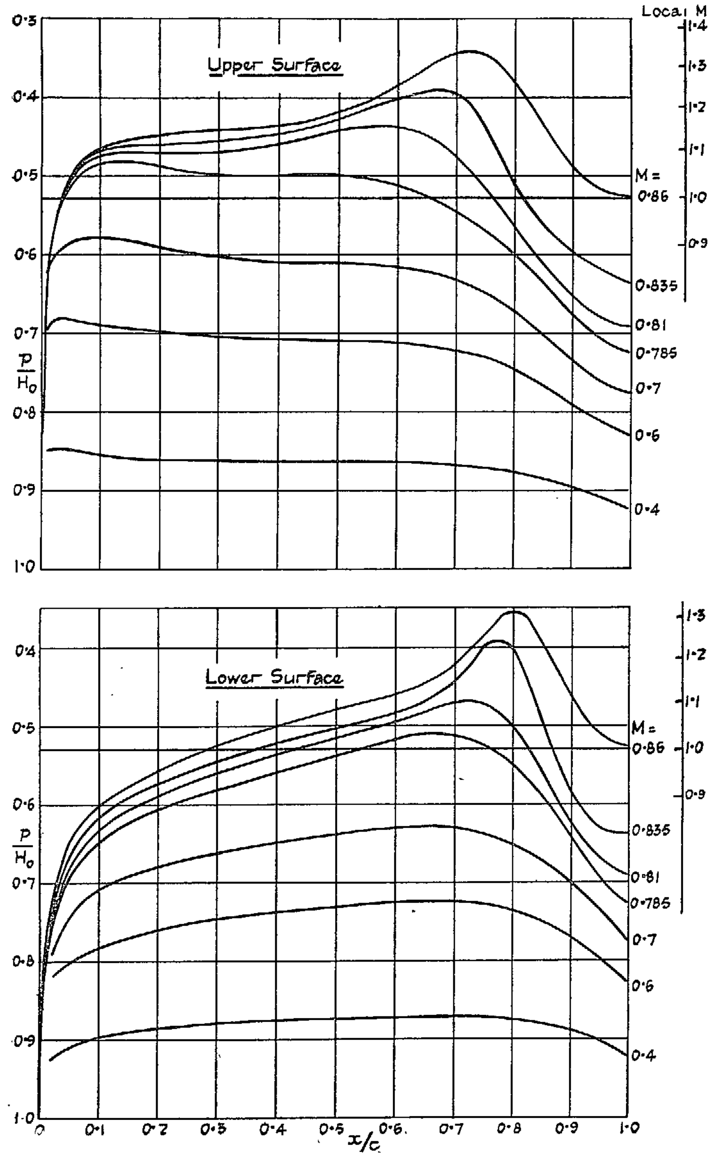


FIG. 3. EC 1250 $\alpha = 2$ deg. Streamline walls.

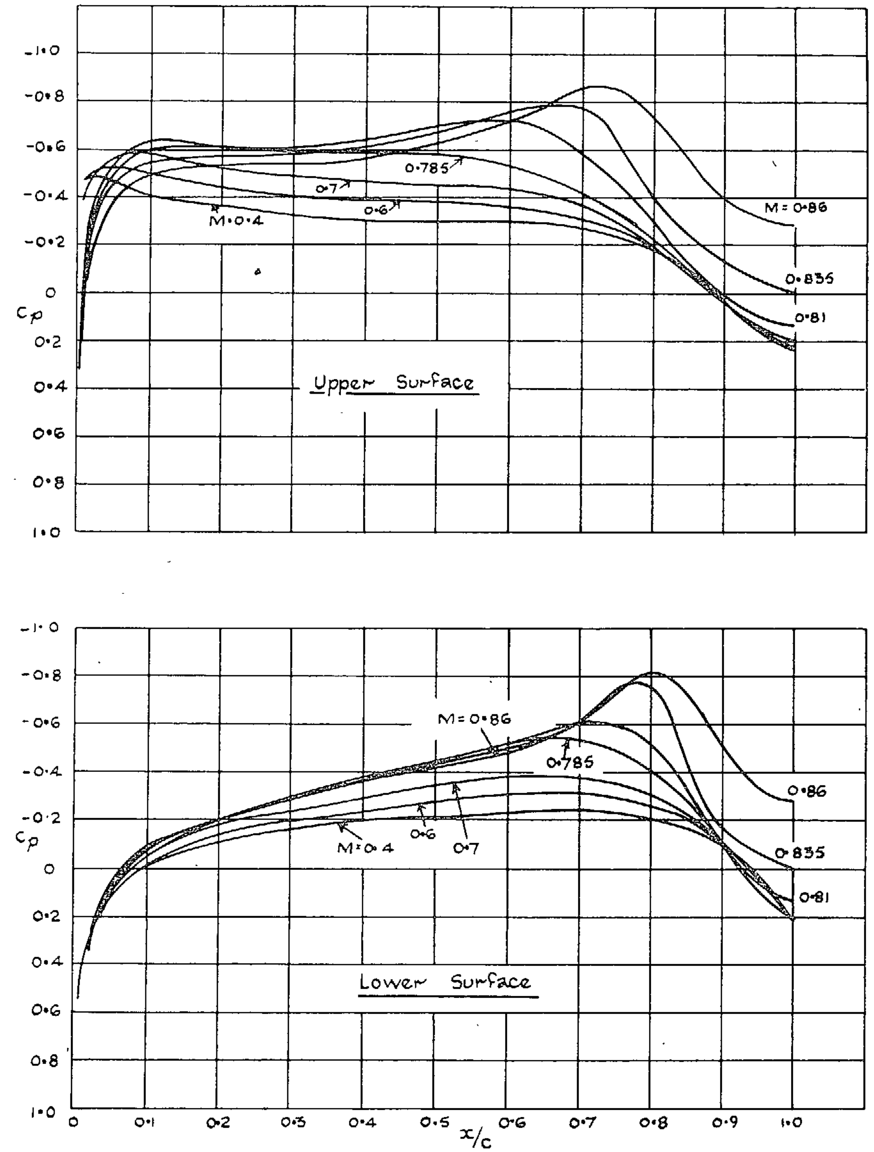


FIG. 4. EC 1250 $\alpha = 2$ deg. Streamline walls.

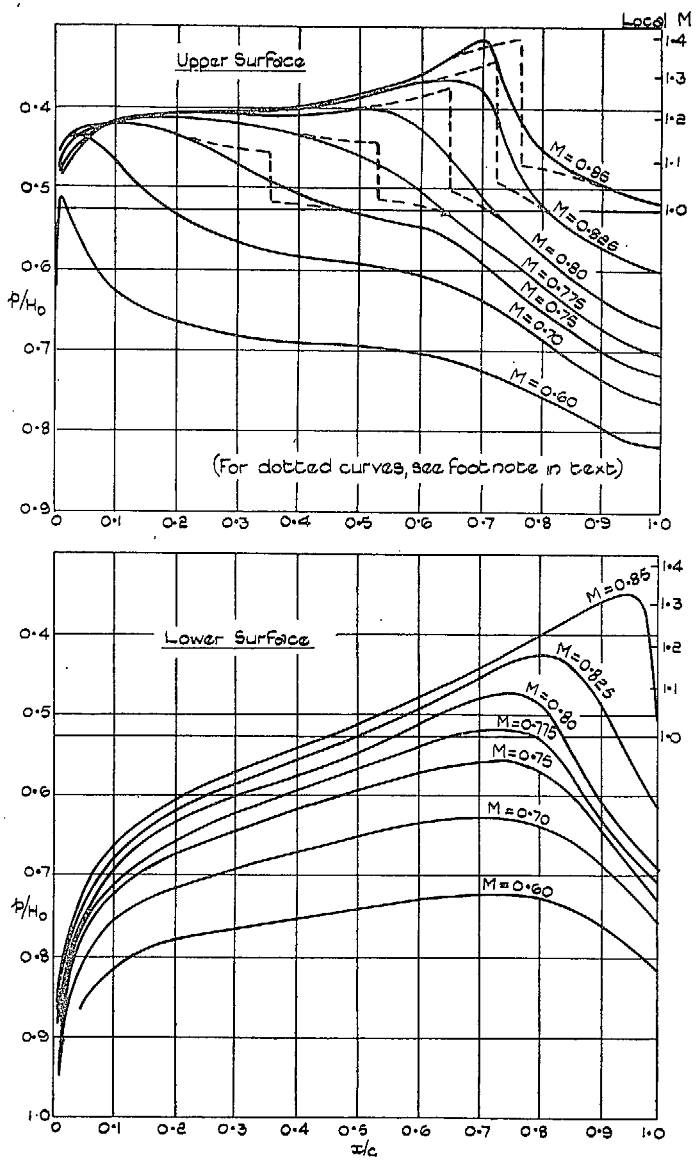


FIG. 5. EC 1250 $\alpha = 4$ deg. Streamline walls.

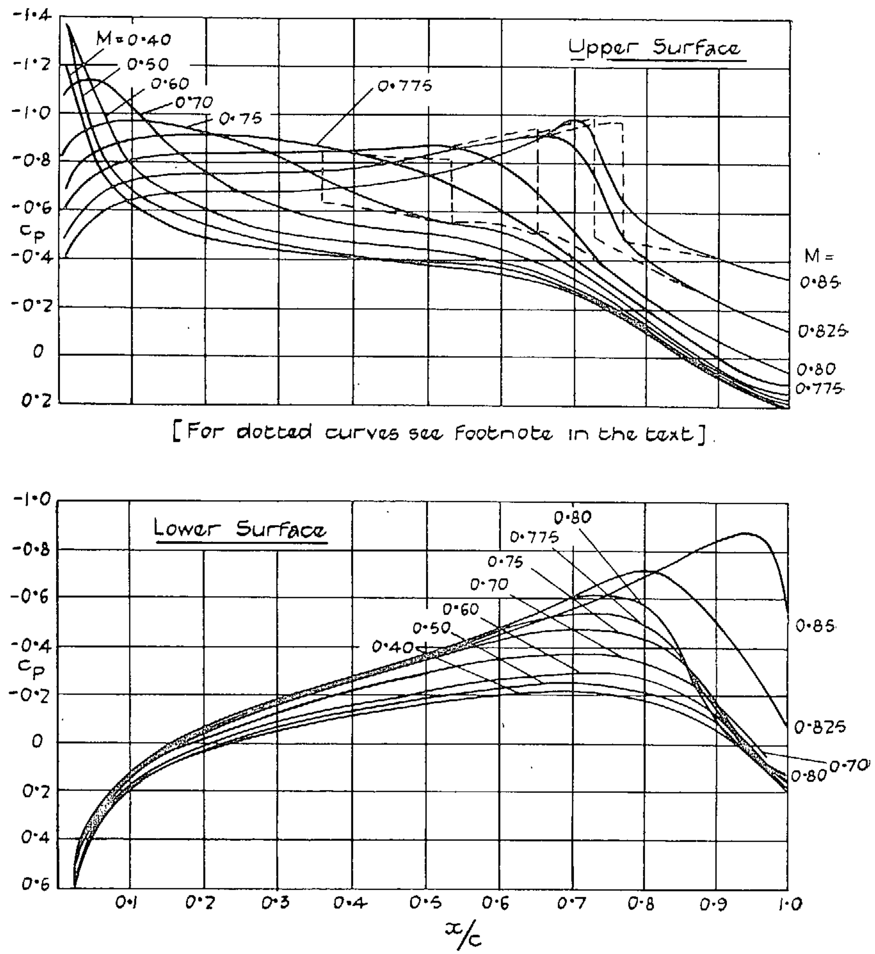


FIG. 6. EC 1250 $\alpha = 4$ deg. Streamline walls.

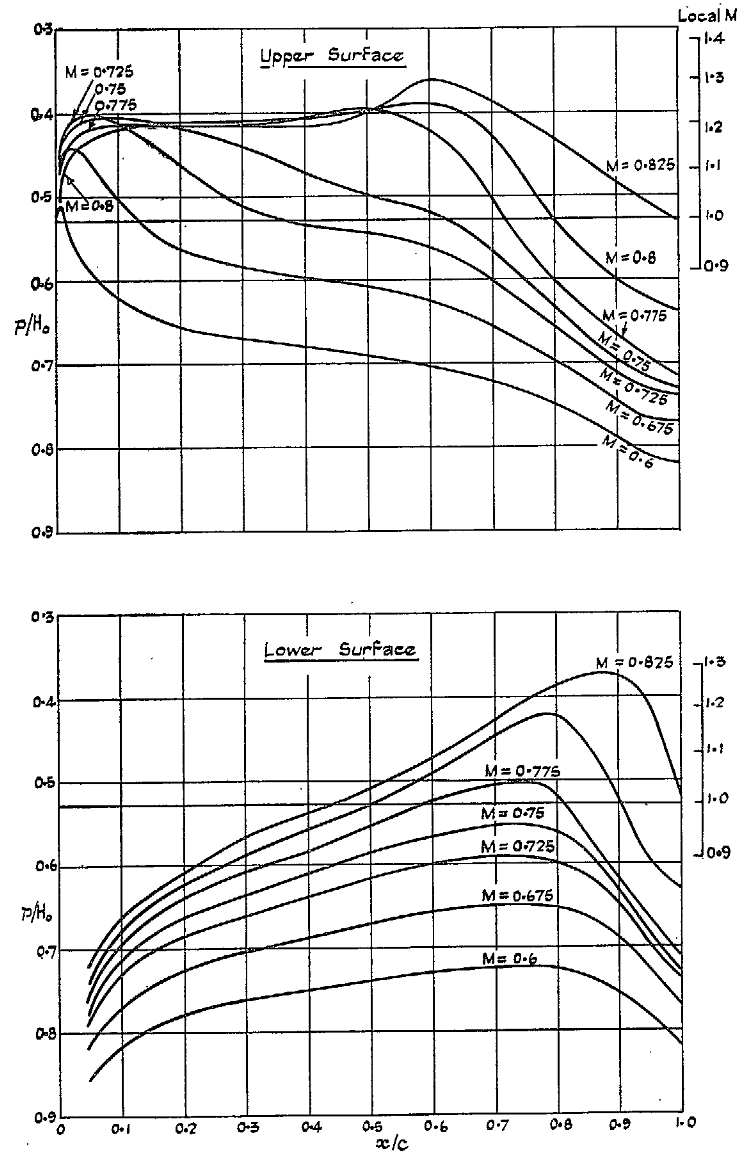


FIG. 7. EC 1250 α = 4 deg. Straight walls.

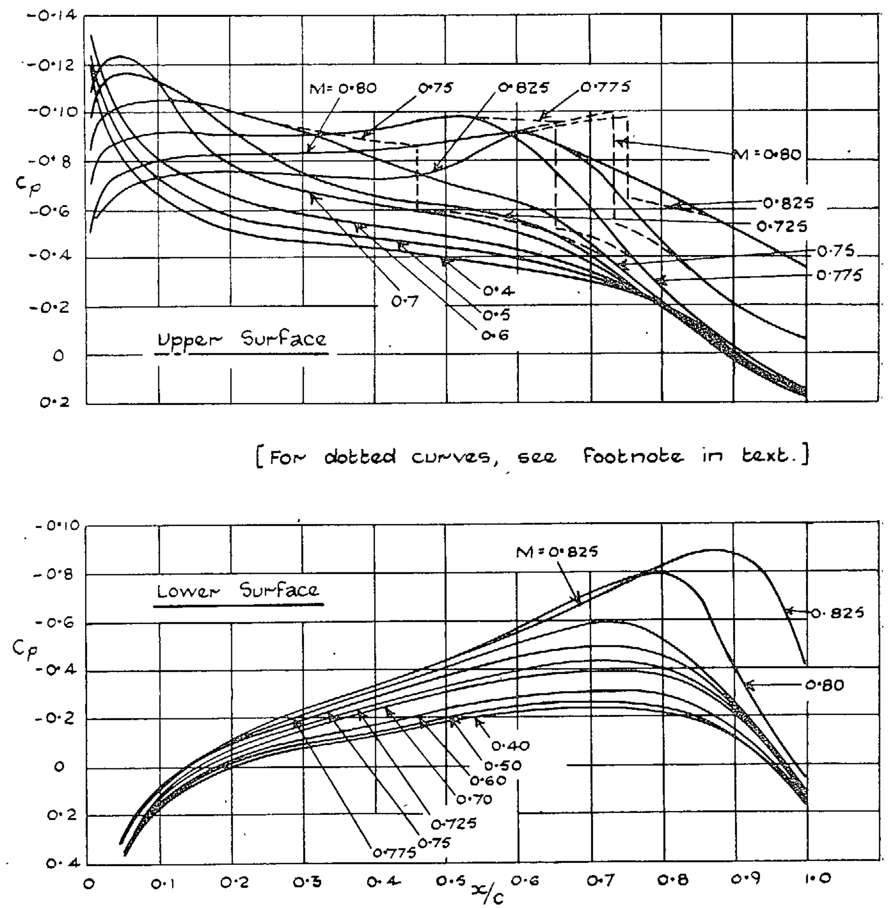


FIG. 8. EC 1250 α = 4 deg. Straight walls.

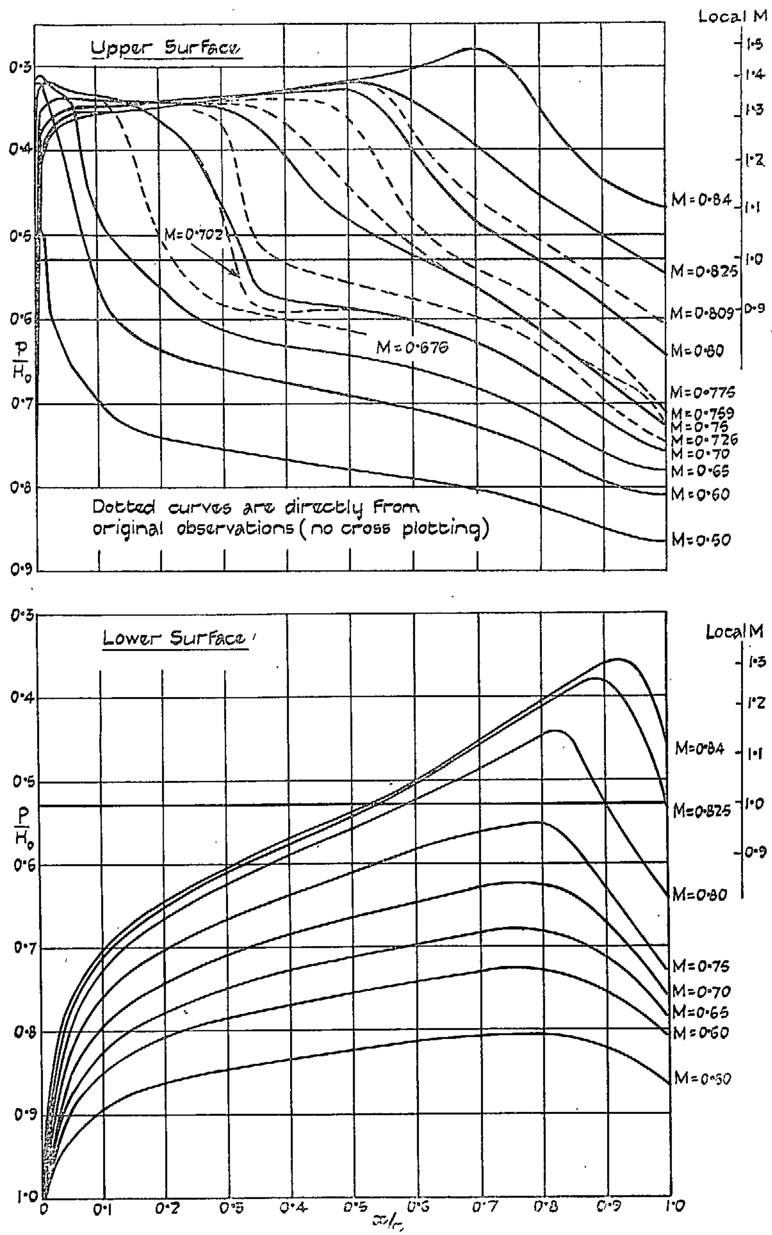


FIG. 9. EC 1250 $\alpha = 6$ deg. Streamline walls.

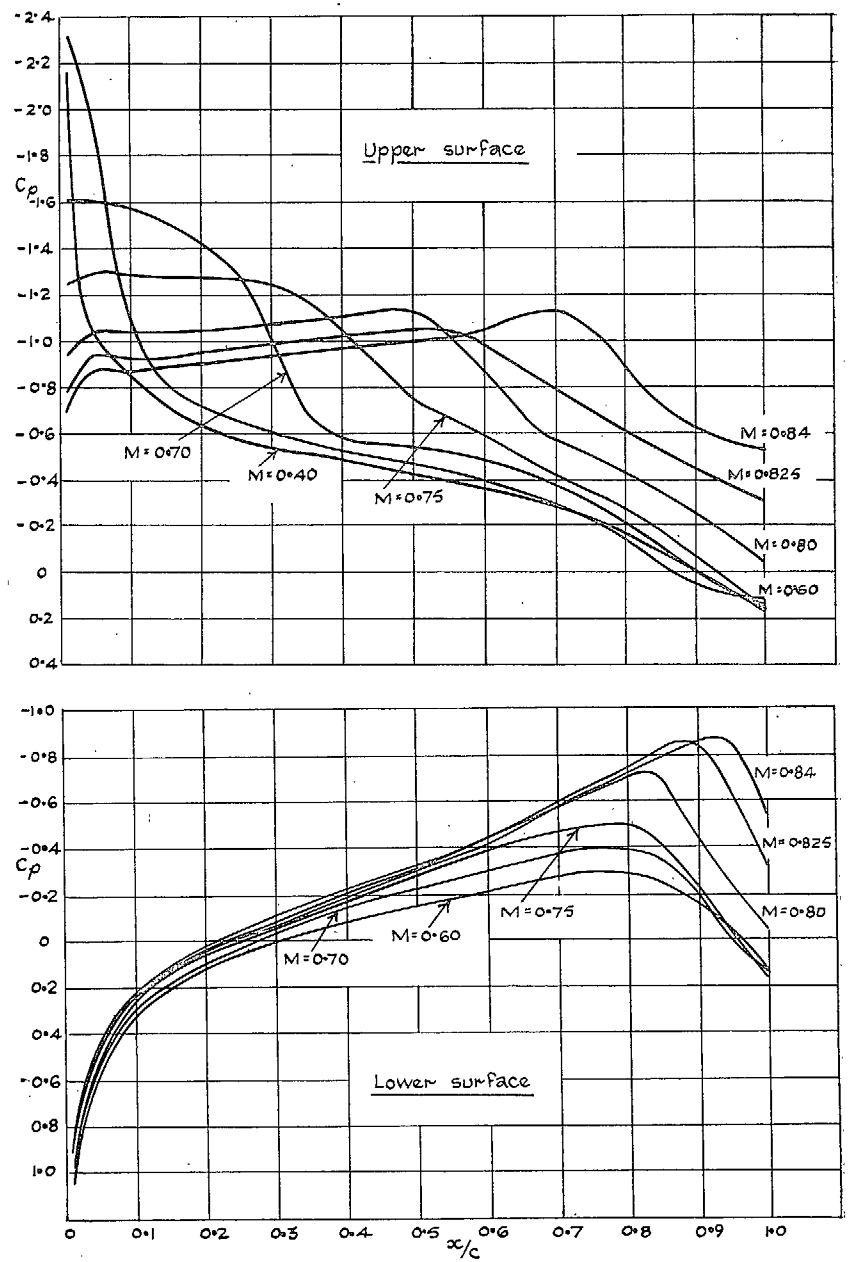


FIG. 10. EC 1250 $\alpha = 6$ deg. Streamline walls.

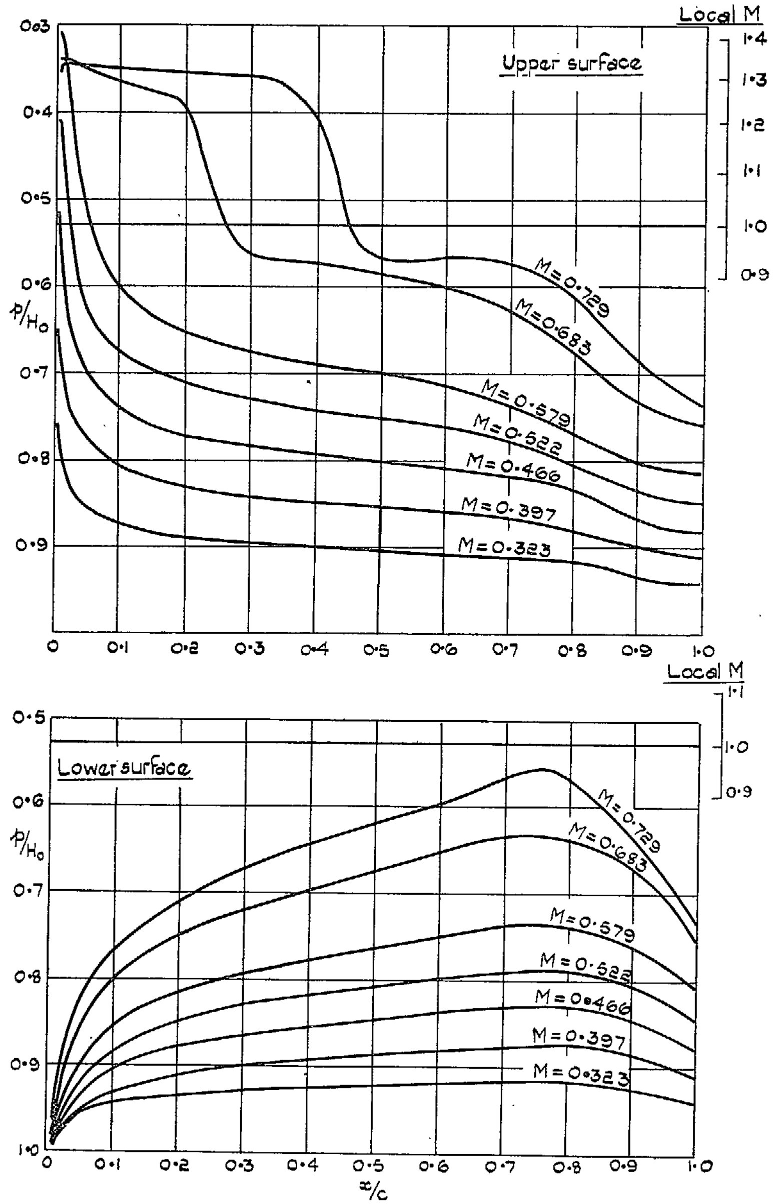


FIG. 11. EC 1250 $\alpha = 6$ deg. Straight walls.

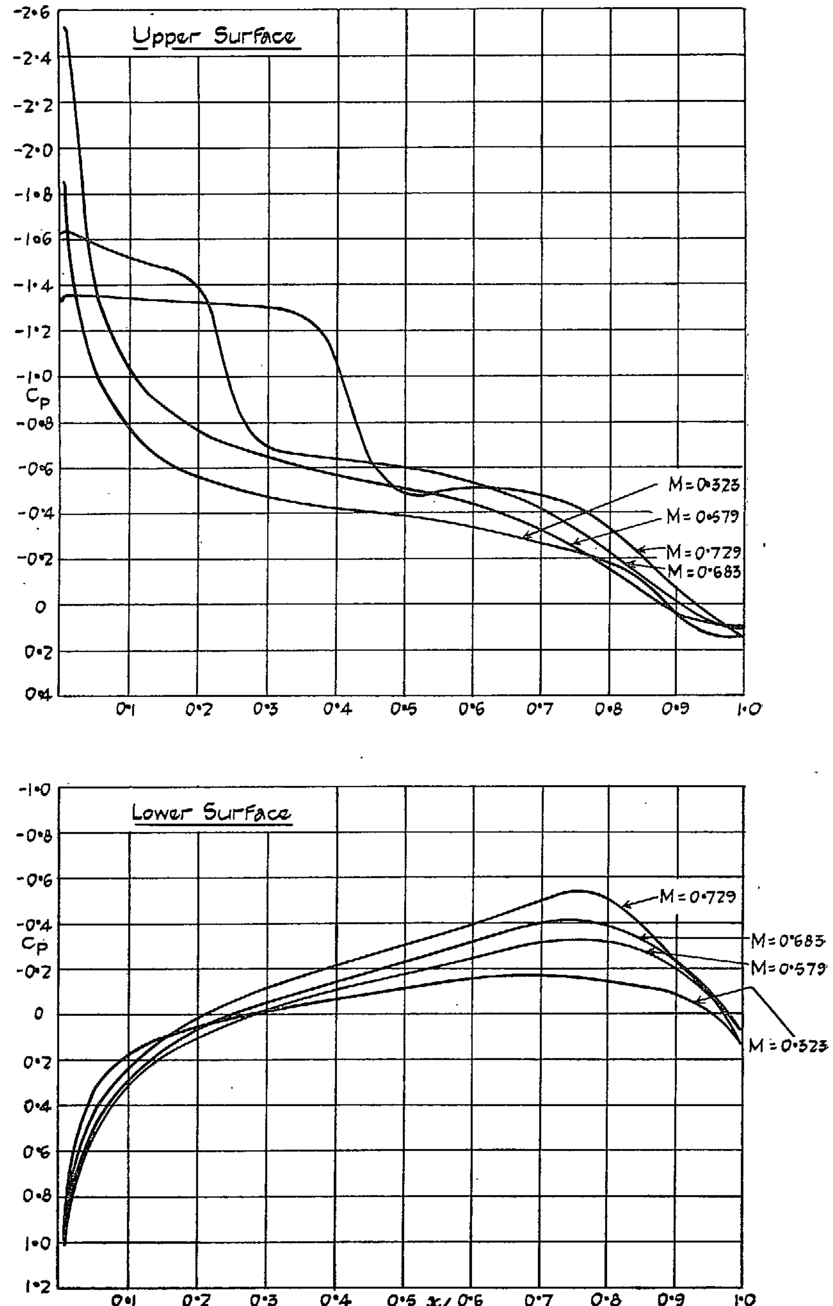


FIG. 12. EC 1250 $\alpha = 6$ deg. Straight walls.

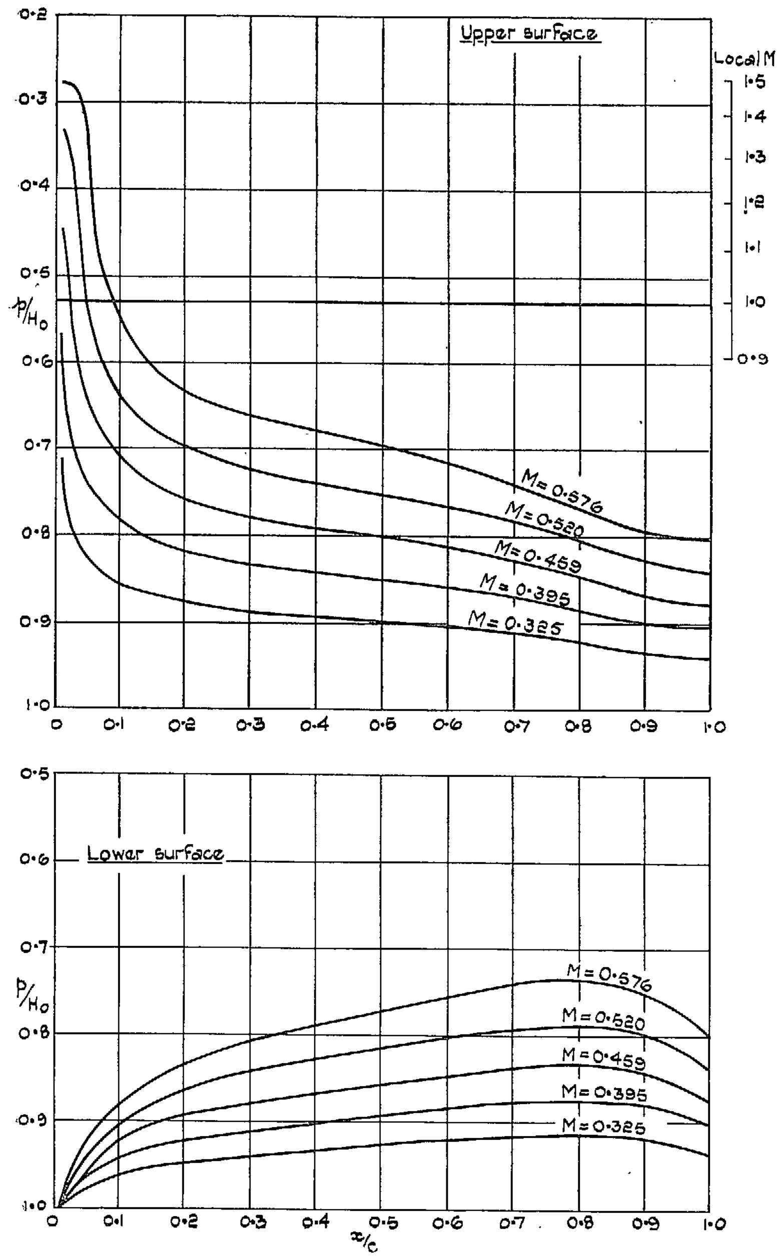


FIG. 13. EC 1250 $\alpha = 8$ deg. Straight walls.

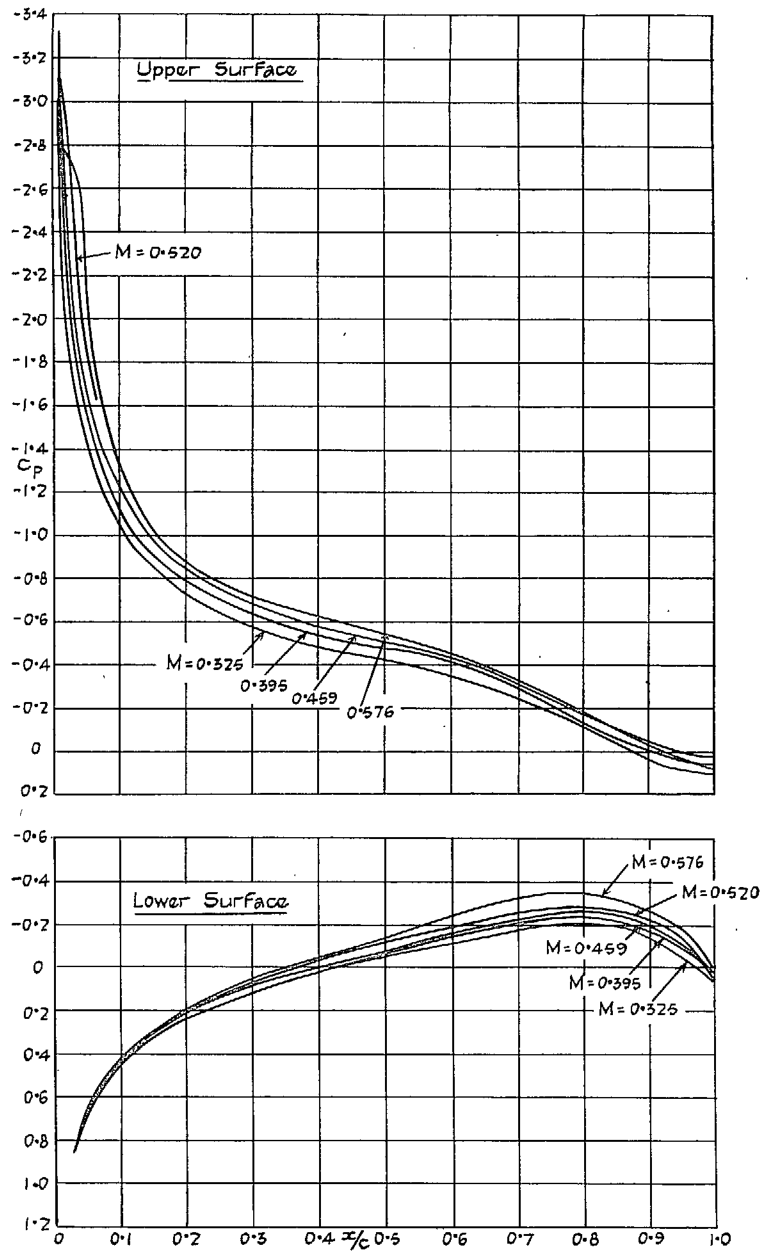


FIG. 14. EC 1250 $\alpha = 8$ deg. Straight walls.

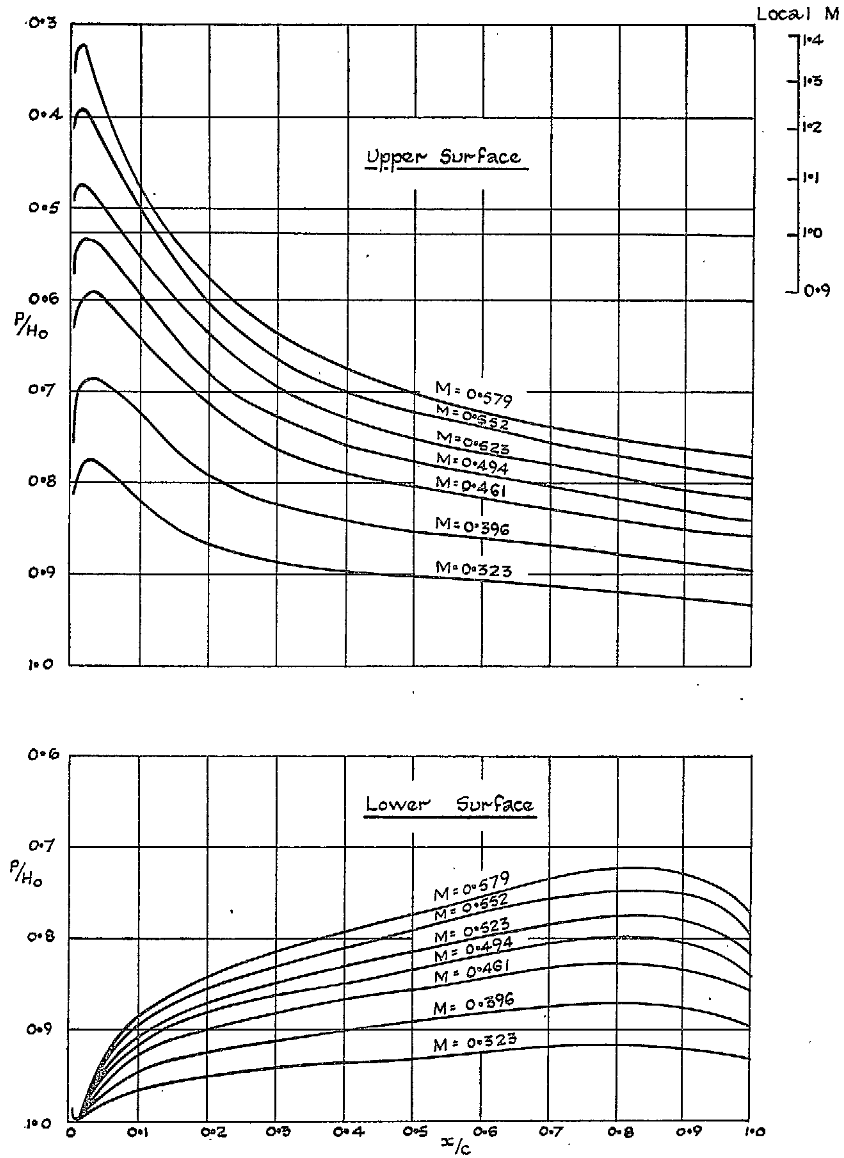


FIG. 15. EC 1250 $\alpha = 10$ deg. Straight walls.

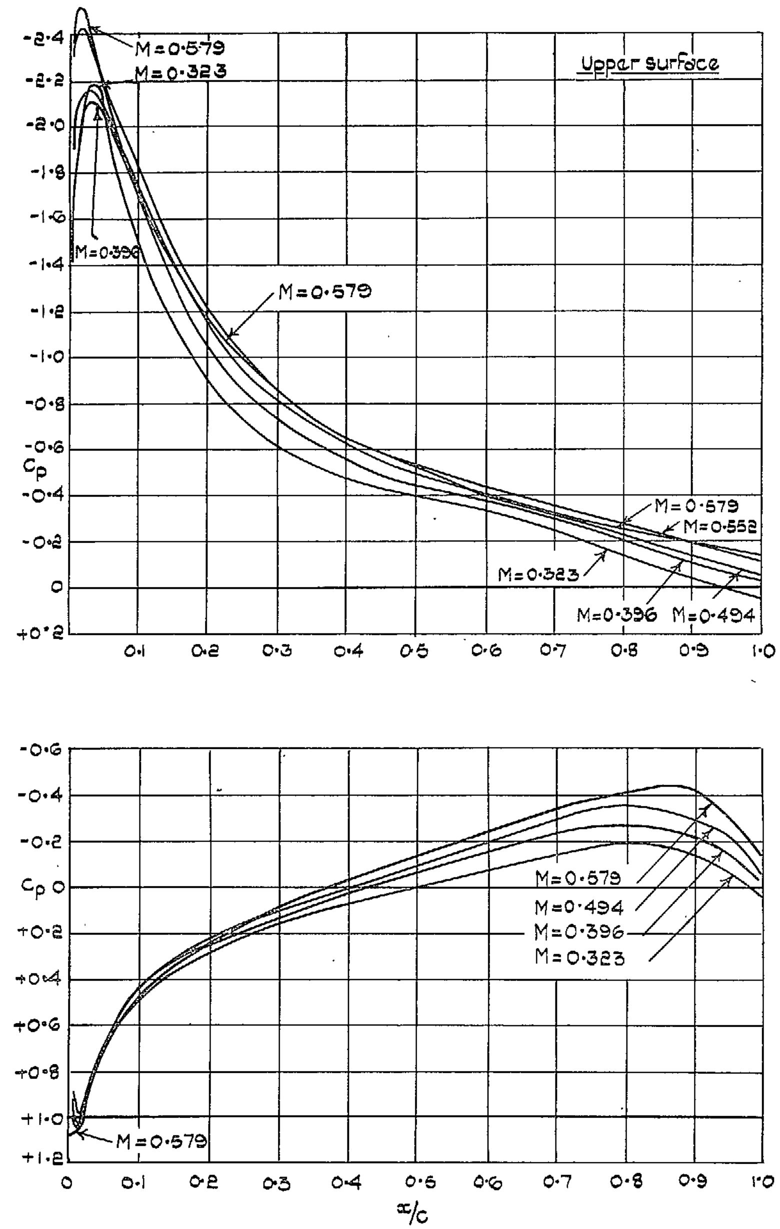


FIG. 16. EC 1250 $\alpha = 10$ deg. Straight walls.

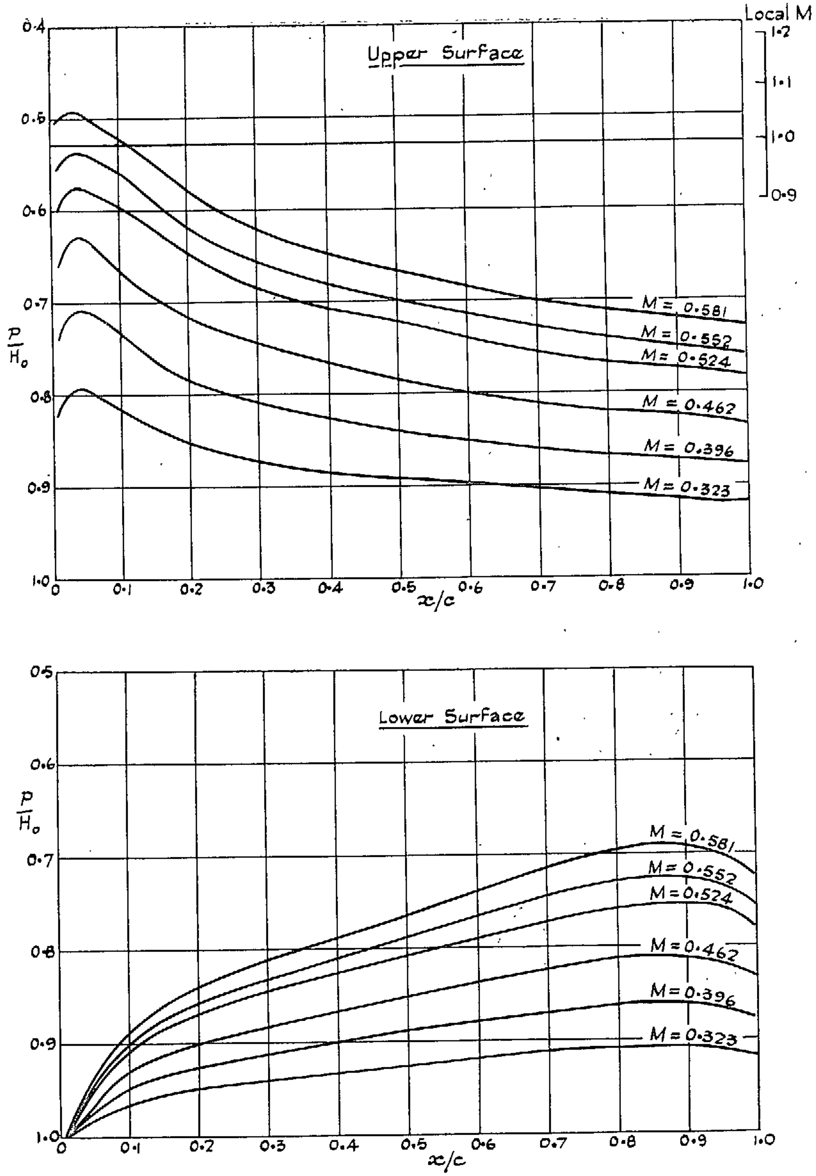


FIG. 17. EC 1250 $\alpha = 12$ deg. Straight walls.

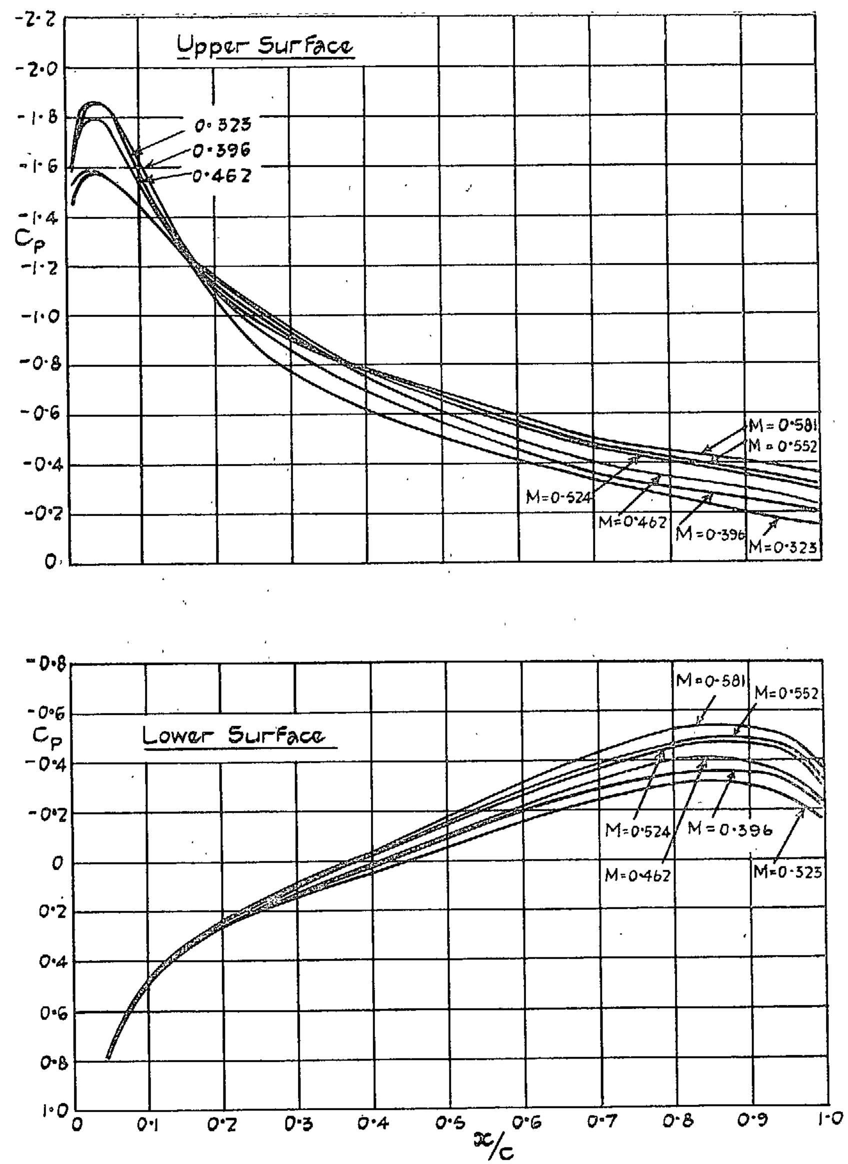
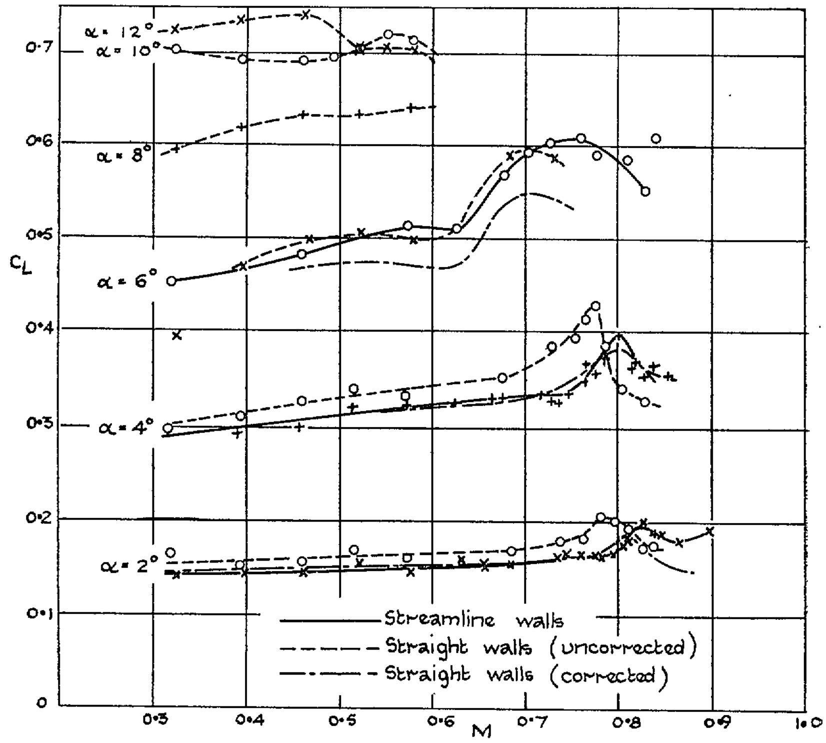


FIG. 18. EC 1250 $\alpha = 12$ deg. Straight walls.



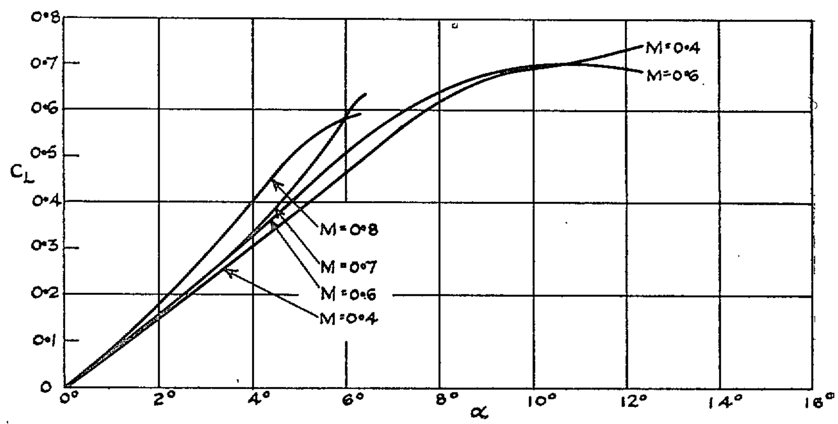


FIG. 19. EC 1250 Lift variation with incidence and Mach number.

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