TESTS WITH TWO MODEL MONOPLANES OF THE WOYEVODSKY TYPE.

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Summary.—(*a*) *Introductory* (*reasons for inquiry*).—The object of the present report is to provide data for the Air Ministry relating to a monoplane of the Woyevodsky type. The design embraces certain novel features, and provides for the storage of the landing chassis in the fuselage during flight.

(*b*) *Range of the investigation.*—Two models were used in the experiments of the same general outline, but differing somewhat in detail. One model represented the complete machine and included the landing chassis, engine cowling, two cockpits and gun; in the other these details were omitted.

The tests consisted of the measurements of lift and drag forces at 40 ft./sec. over a range of pitch $-4°$ to $+17°$, and permitted of the calculation of the pitching moment about any axis. The results of these establish a direct comparison between the aerodynamic properties of the two models.

(*c*) *Conclusions.*—The models possess relatively large maximum lifts, occurring at 15° pitch; these are, however, accompanied by somewhat large drag forces, with a result that the maximum value of the ratio L/D is 13·2 for one case, and 10·8 for the more complete model. This latter value is larger than the corresponding ratio for the S.E.5 type of machine. Over a wide range of pitch a constant difference exists between the lift forces on the two models when presented at the same attitude to the wind; but the most important influence of the additional fitting occurs in the neighbourhood of minimum resistance where the drag is increased by 29·2 per cent.

Introductory.—The machine known as the Woyevodsky, Type IV, is a two-seater monoplane, designed as a fast scouting machine. From an aerodynamic standpoint, the design embraces several novel features. Each vertical section of the machine parallel to the median plane of symmetry is of an aerofoil section, the wing section proper being similar to R.A.F.15; the sections of the fuselage are of the form described as Wing Section No. 9 (*see* Eiffel's Nouvelles Recherches, p. 118). An additional feature is the complete suppression of the external bracing wires; this is accomplished by the provision of wings of sufficient thickness to allow of the use of deep spars, braced internally in order to support the maximum loading during flight. Further, arrangements are provided for folding the landing chassis into the fuselage in order to reduce the head resistance to a minimum.

Prior to accepting this design, the Air Ministry requested experiments to be made in a wind channel with models constructed to scale.

Description of the models.—Of the two models used in the experiments one represented the complete machine in some detail; it included the undercarriage with wheels, two cockpits and a gun, as well as the cowling for the engine. The wings were of R.A.F.15 section, and increased in thickness from the tip towards the body, in which neighbourhood the shape was modified to conform with the general profile of the fuselage. Except for the projection formed by the cowling in the front of the body, the shape of each section of the fuselage parallel to the median plane was similar to a special aerofoil section with a flat under surface. In the model the straight edge thus formed by the intersection of the undersurfaces of the two wings in the plane of symmetry proved useful as a datum line of reference, more especially as the wings were arranged with the chords parallel to this line. At the tail end the elevator was set permanently in the neutral position.

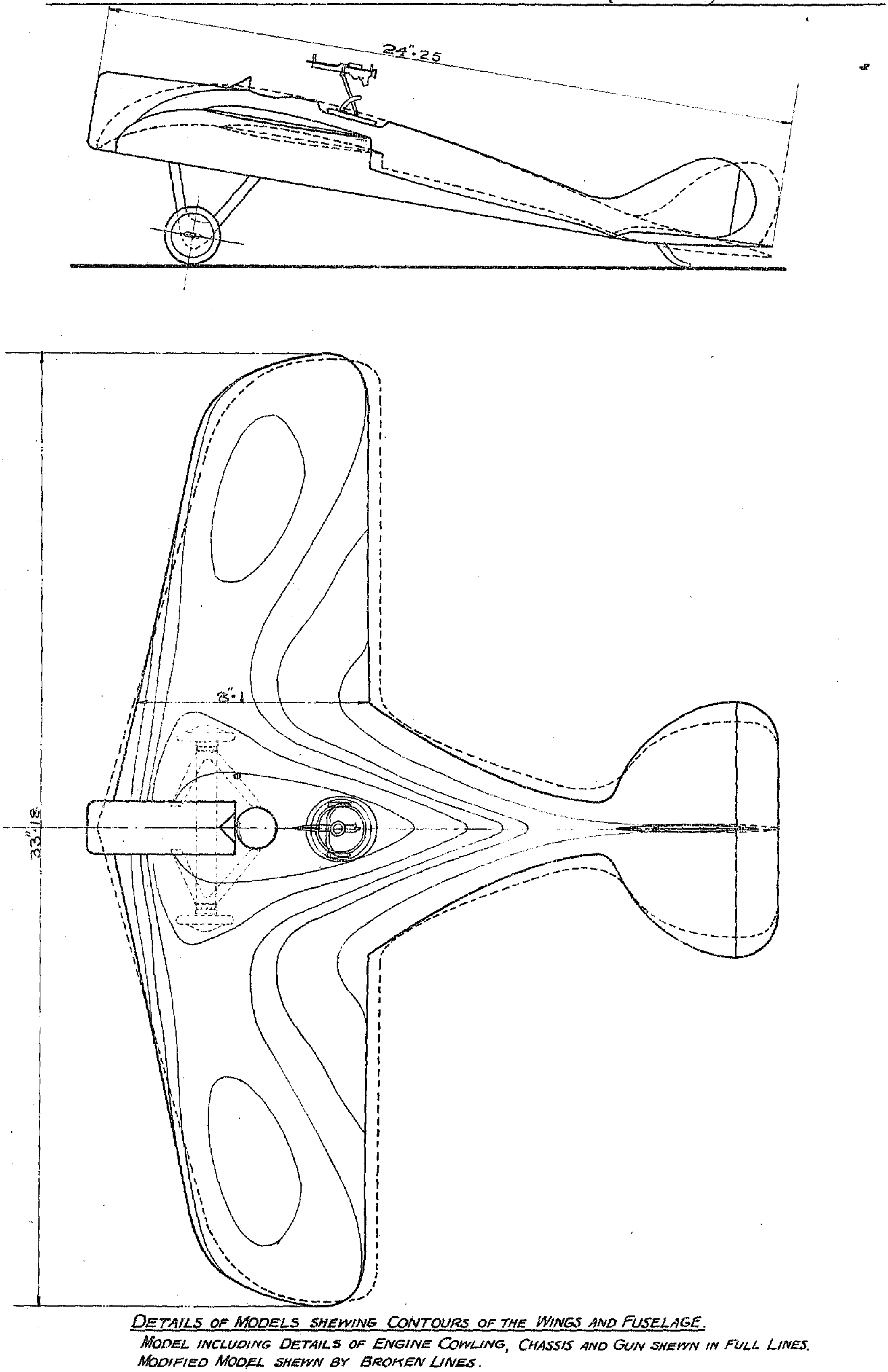
From the second model the undercarriage, cowling, guns and cockpits were omitted for the express purpose of providing comparative tests with one more or less similar in shape to the first, but lacking in special details. Other slight differences were noticeable, particularly in the shape of the rear part of the fuselage, and in the inclination of the tail plane which was set at $-4{\cdot}1^\circ$ instead of $-6{\cdot}25^\circ$ as in the more complete model. For details reference should be made to Fig. 1.

Description of tests.—Both models were made 1/15·5 full size. During the tests the model in each case was suspended at two points on the wings from a balance fixed on top of the wind channel, with the aid of fine steel wires; and at a point near the tail it was also supported by a streamline spindle connected to a lower balance. The reactions measured by the two balances represented the separate components of the total lift, and these, taken in conjunction with the drag force, measured by the lower balance, provided the requisite data for the purpose of calculating the pitching moment of the wind forces about any given axis.

Results of the tests.—The results of the tests are given in Tables 1 and 2 and Figs. 2—4. No definite information being available of the effective wing area as separate from the total supporting area, which, in fact, comprises the fuselage as well as the wings proper, the results are presented as lift and drag forces on the models. In consequence of this, and in view of the absence of definite information relating to the engine and propeller, no detailed comparison of the model with existing types is attempted. It may be remarked, however, that the results with the complete model compare favourably with those of a biplane of the S.E.5, chosen as a representative type of fast scouting machine, taking as a basis the L/D ratio at different flying speeds; but this method is deficient in many respects, so that before a true estimate of the relative merits of the two designs can be formed a more complete knowledge of the separate performances is essential.

It is shown that the effect of the chassis and the additional fittings is more pronounced at the higher speeds, resulting in a decrease of the ratio L/D from 7·32 to 5·48, in the neighbourhood of the maximum flying speed (assumed to occur at an angle of pitch corresponding with a lift of 0·8 lbs.). Moreover, a reduction of the maximum lift coefficient by 3 per cent. is effected, which is due in a measure to the extra parts, but is more directly ascribable to the alteration of the tail setting, in view of the disposition of the lift forces in the two models. Finally, the tests confirm the influence of the additional fittings on the drag, which results in a change from 0·1110 to 0·1435 lbs. corresponding with an increase of resistance of 29·2 per cent. in neighbourhood of the minimum drag.

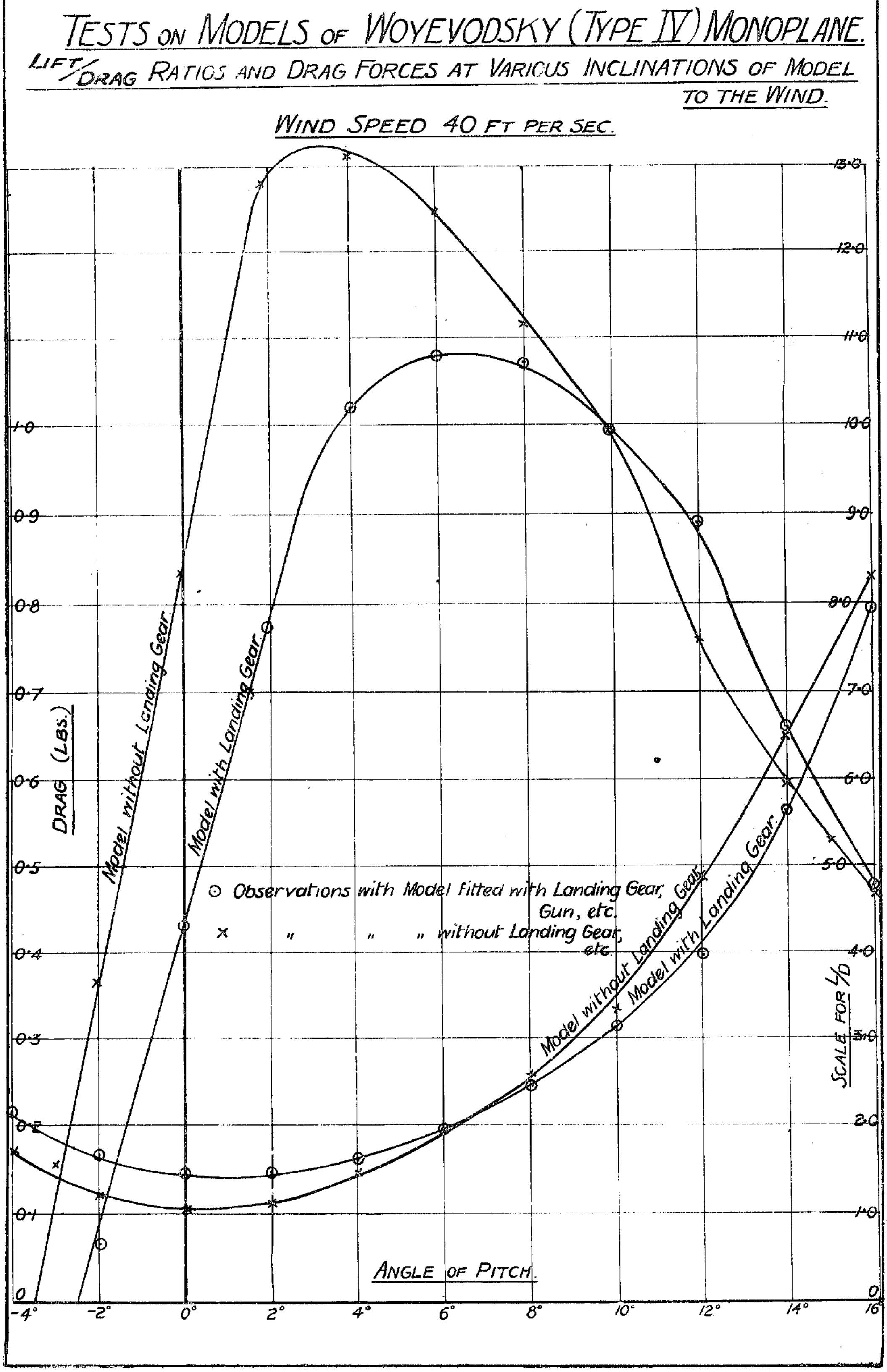
TESTS WITH MODELS OF WOYEVODSKY (TYPE IV) MONOPLANE.



DETAILS OF MODELS SHEWING CONTOURS OF THE WINGS AND FUSELAGE.

MODEL INCLUDING DETAILS OF ENGINE COWLING, CHASSIS AND GUN SHEWN IN FULL LINES.
MODIFIED MODEL SHEWN BY BROKEN LINES.

FIG 2.


TESTS ON MODELS OF WOYEVODSKY (TYPE IV) MONOPLANE.
LIFT/DRAG RATIOS AND DRAG FORCES AT VARIOUS INCLINATIONS OF MODEL TO THE WIND.
WIND SPEED 40 FT PER SEC.
DRAG (LBS.)
SCALE FOR L/D
ANGLE OF PITCH.
⊙ Observations with Model fitted with Landing Gear, Gun, etc.
× " " " without Landing Gear, etc.
Model without Landing Gear.
Model with Landing Gear.
Model without Landing Gear.
Model with Landing Gear.
0
0·1
0·2
0·3
0·4
0·5
0·6
0·7
0·8
0·9
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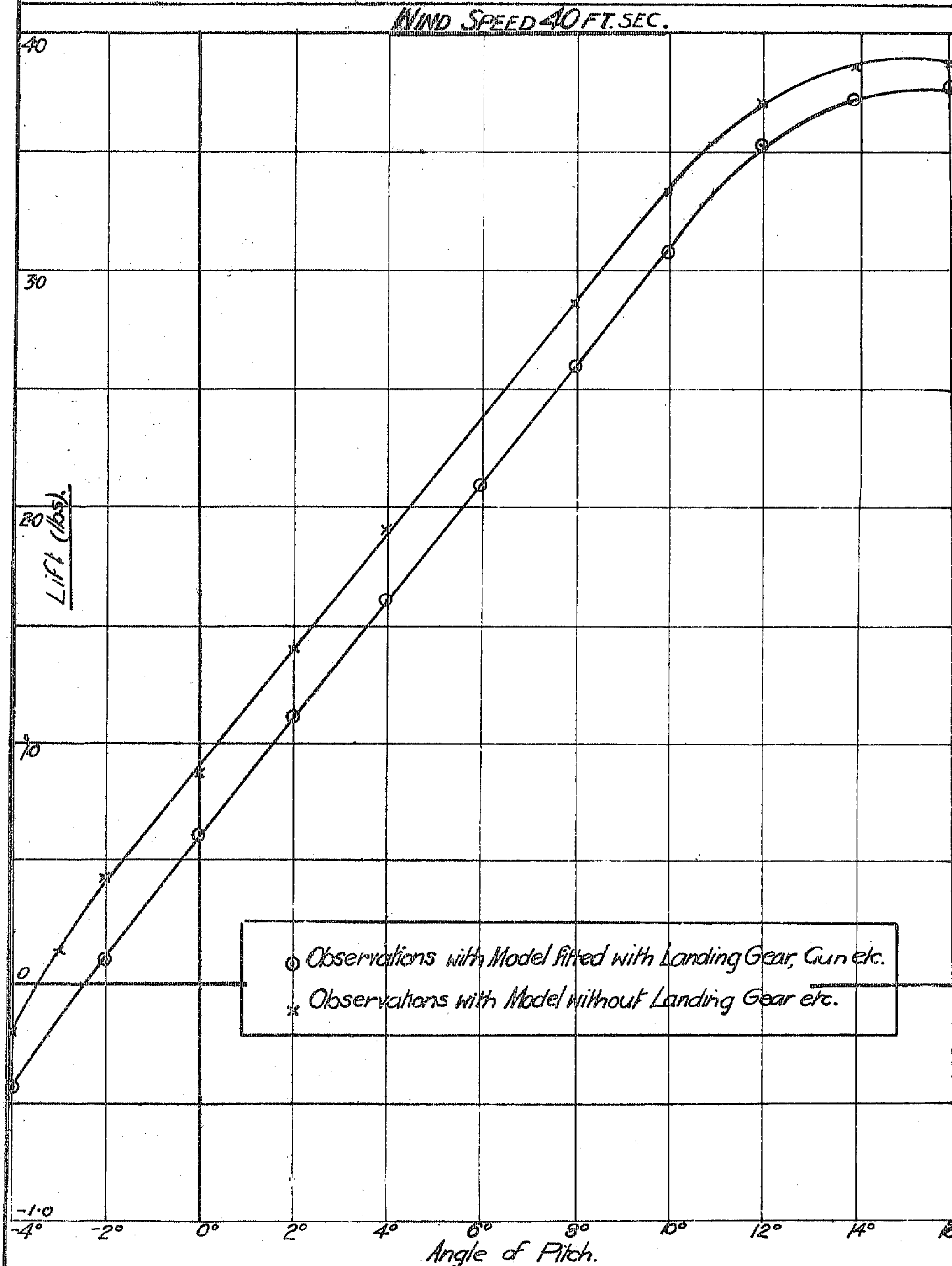
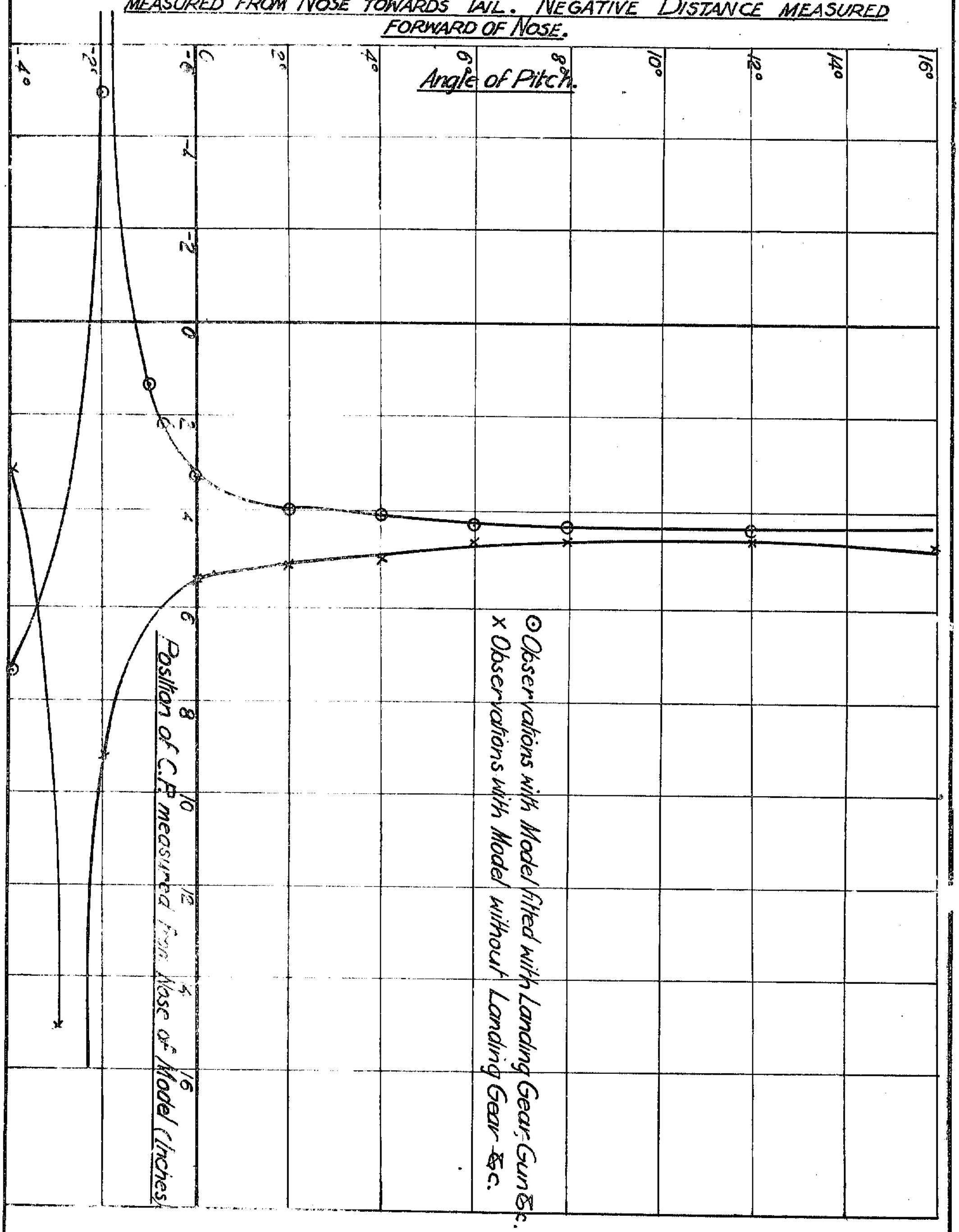
3·0
4·0
5·0
6·0
7·0
8·0
9·0
10·0
11·0
12·0
13·0
-4°
-2°
0°
2°
4°
6°
8°
10°
12°
14°
16

TESTS ON MODELS OF WOYEVODSKY TYPE IV MONOPLANE. LIFT FORCES AT VARIOUS INCLINATIONS OF MODEL TO THE WIND.



TESTS ON MODELS OF WOYEVODSKY TYPE IV MONOPLANE.

POSITION OF C.P. MEASURED ALONG BASE OF FUSELAGE. POSITIVE DISTANCES MEASURED FROM NOSE TOWARDS TAIL. NEGATIVE DISTANCE MEASURED FORWARD OF NOSE.



DETAILS OF WIND FORCES WITH MODELS OF THE WOYEVODSKY TYPE IV. MONOPLANES.

TABLE 1.

Wind Speed 40 ft./sec.

Angle of Pitch.	Model with undercarriage, cowling, &c.			
	Lift (lbs.).	Drag (lbs.).	L/D.	Position of Centre of Pressure (inches).
− 4°	− 0·430	0·2148	− 2·00	+ 7·4
− 2°	+ 0·105	0·1641	+ 0·64	− 4·9
0	0·617	0·1430	4·30	+ 3·31
+ 2°	1·112	0·1440	7·72	3·97
4°	1·602	0·1577	10·17	4·10
6°	2·092	0·1940	10·78	4·23
8°	2·594	0·2422	10·70	4·31
10°	3·075	0·3094	9·94	4·33
12°	3·522	0·3965	8·84	4·35
14°	3·711	0·5635	6·59	4·46
16°	3·767	0·7950	4·74	4·77
17°	3·730	0·9340	3·99	4·70

TABLE 2.

Wind Speed 40 ft./sec.

Angle of Pitch.	Model without undercarriage, cowling, &c.			
	Lift (lbs.).	Drag (lbs.).	L/D.	Position of Centre of Pressure (inches).
− 4°	− 0·200	0·1719	− 1·16	3·17
− 3°	—	—	—	15·08
− 2°	+ 0·443	+0·1212	+ 3·65	+ 9·20
0°	0·872	0·1044	8·35	5·37
+ 2°	1·395	0·1180	11·82	5·33
4°	1·011	0·1453	13·16	5·12
6°	2·378	0·1920	12·38	4·86
8°	2·862	0·2562	11·17	4·60
10°	3·335	0·3342	9·97	4·57
12°	3·710	0·4888	7·59	4·53
14°	3·855	0·6494	5·94	4·61
16°	3·871	0·8300	4·66	4·73
17°	3·800	0·9350	4·06	4·80

The position of the centre of pressure is given as the distance measured from the nose along the bottom edge of the fuselage. Positive distances are measured from the nose towards the tail; negative signs denote distances forward of the nose of the model.