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AIRCRAFT AND ARMAMENT EXPERIMENTAL ESTABLISHMENT

BOSCOMBE DOWN

Spitfire PR. Mk.XI MB.789
(Merlin 63)

Level speed performance
and position error

This report deals with the aircraft (or equipment) as tested. Action to remedy defects or decisions to accept items not in strict compliance with the specification are matters for decision and action by the Ministry of Aircraft Prodn

A.& A.E.E. ref: 4493/44 - AS.56/Gen.
M.A.P. ref: Nil.
Period of tests: August, 1943.

1. Introduction.

Measurements of all-out and cruising speeds at altitude have been made on Spitfire PR. Mk.XI MB.789. The aircraft was on loan from the PR. Unit at Benson, and was delivered in the condition in which it is used operationally.

2. Condition of aircraft relevant to tests.

2.1 General. The principal features of the aircraft were:-

Merlin 63 engine.
Rotol four-bladed propeller.
Individual ejector exhausts.
Temperate air intake with no ice-guard.
One radiator and oil cooler in a duct under the port wing.
Other radiator and intercooler coolant radiator in a duct under the starboard wing.
Leading edge fuel tanks, and enlarged oil tank.
No armament.
No bullet-proof windscreen.
Balloon hood.
One internal rear view mirror on each side.
Wireless mast behind cockpit.
No aerial wires.
Retractable tail wheel.
Mark V type of fin and rudder.
The windscreen was not of the type fitted to other marks of Spitfire, as it was rounded and did not have any formers.
The position and setting of the Mk.VIII type of pressure head is shown in Fig.4.

2.2 Engine numbers and limitations. The aircraft was fitted with a Merlin 63 engine, Nos. 107983/352253.

The limitations of the Merlin 63 applicable at the time of test were:-

	R.P.M.	Boost lb/sqin.
Maximum for all-out level flight (5 min.limit)	3000	+18
" " cruising	2650	+ 7

2.3 Loading. The take-off weight was 8,040 lb. This was the weight of the aircraft as delivered with all tanks filled.

3. Scope of tests.

(i) The position error was measured in level flight by the aneroid method, with flaps and undercarriage up.

(ii) Level speeds were measured as follow:-

(a) At all-out level power conditions in F.S. supercharger at heights up to 40,000 ft.
(b) At maximum cruising conditions, i.e. 2650 rpm, +7 lb/sq.in. boost, in F.S. supercharger at similar heights.

/(c)

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(c) At 2350 rpm and full throttle in F.S. supercharger over the small height range giving boosts between +1 and +4 lb/sq.in.

This test was made because the speed under these conditions was specifically requested by the PR. Unit holding the aircraft.

Throughout these tests the radiator flaps were closed.

4. Results of tests.

The results have been corrected to standard atmospheric conditions by the methods of Report No. A.& A.E.E./Res/170.

The level speed results have been corrected to 95% of the take-off weight, by the methods of the same report. A 'strut' correction has been applied, the source of this correction being Report No. ARC.6420. The compressibility correction has been determined by the method given in the Addendum to Report No. A.& A.E.E./Res/147.

(i) The position error correction varies from +5.5 mph at 140 mph ASI to -5.3 mph at 340 mph ASI. Full details are given in Fig.2. The altimeter corrections when the altimeter is connected to the static of the airspeed system are given in Fig.3.

(ii) Full results of the level speed tests are given in Table I. The maximum true air speeds under each condition were:-

All-out level speed in F.S. gear 417 mph ASI at 24,200 ft.
Max. cruising speed in F.S. gear 397 mph ASI at 31,000 ft.

The maximum speeds at 38,000 ft. were:-

All-out level 387 mph ASI
Max. cruising 378 mph ASI

Using 2350 rpm and full throttle, a boost of +3½ lb/sq.in. will be obtained at 28,500 ft. in standard atmsopheric conditions, the corresponding true air speed in level flight being 351 mph ASI.

TABLE I
Level speed performance
Corrected to a wt. of 7,640 lb.(95% of T.O. wt.)
Radiator flaps closed

Ht. in std.atmos. (ft)	TAS mph	ASI mph	Corrections m.p.h. 'Strut'	P.E	C.E.	Boost lb/sq.in	RPM.	S/C gear
24,200*	417	295	+1.2	-3.3	-10.0	+18.0	2950	F.S.
26,000	414	284	+1.2	-2.9	-10.3	+15.5		
28,000	412	274	+1.2	-2.4	-10.7	+13.0		
30,000	408	260	+1.1	-1.7	-10.4	+10.8		
32,000	405	249	+1.2	-1.0	-10.3	+ 8.8		
34,000	401	237	+1.1	-0.5	-10.2	+ 6.8		
36,000	396	225	+0.9	+0.2	-10.0	+ 4.9		
38,000	387	209	+0.9	+1.0	- 9.5	+ 3.0		
24,000	369	259	+0.4	-1.6	- 5.9	+ 7.0	2650	
26,000	377	256	+0.5	-1.5	- 6.9	+ 7.0		
28,000	385	253	+0.7	-1.3	- 8.2	+ 7.0		
30,000	393	250	+0.8	-1.1	- 9.3	+ 7.0		
31,000*	397	248	+1.0	-1.0	-10.0	+ 7.0		
32,000	395	242	+1.0	-0.7	- 9.8	+ 6.2		
34,000	392	231	+0.9	-0.2	- 9.3	+ 4.3		
36,000	388	219	+0.8	+0.5	- 8.5	+ 2.7		
38,000	378	203	+0.7	+1.4	- 7.6	+ 1.1		
28,000	353	230	+0.4	-0.1	- 5.8	+ 3.8	2350	
30,000	352	220	+0.3	+0.5	- 5.7	+ 2.4		
32,000	349	210	+0.4	+1.0	- 5.8	+ 1.1		

* Full throttle heights.

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Fig 1

SPITFIRE PR Mk XI MB 789

(MERLIN 63)

LEVEL SPEED PERFORMANCE.

TAKE-OFF WEIGHT 8040 LBS

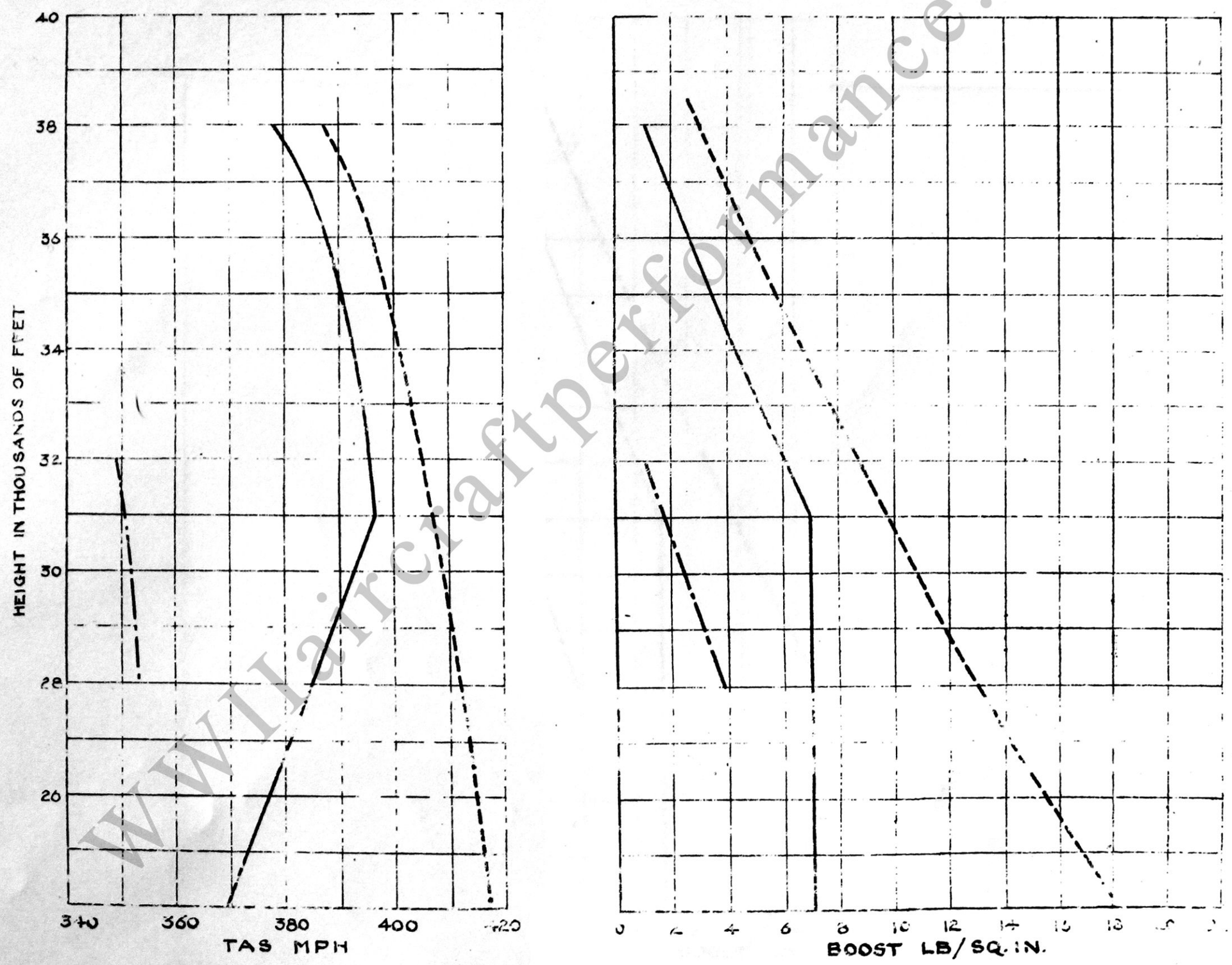
RESULTS CORRECTED TO A WEIGHT OF 7640 LBS (95% OF TAKE-OFF WEIGHT)

RADIATOR FLAPS CLOSED

- - - - - - ALL OUT LEVEL SPEEDS

——— SPEEDS AT MAXIMUM CRUISING CONDITIONS

—·—·— SPEEDS AT 2350 R.P.M. AND FULL THROTTLE



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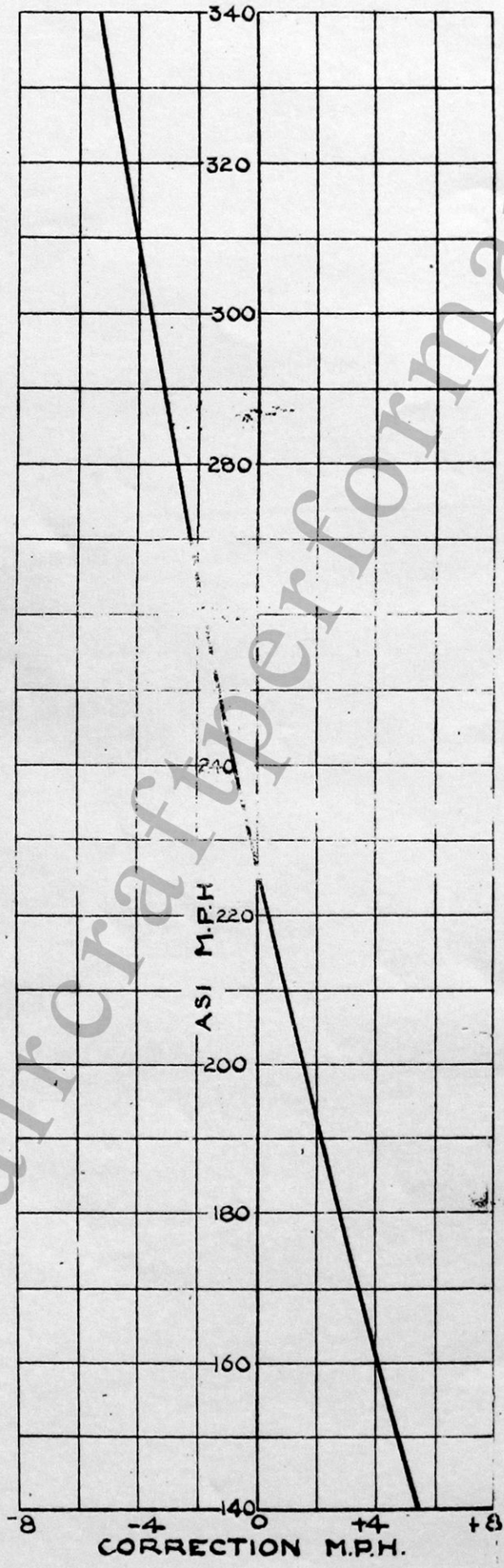
SPITFIRE PR Mk XI MB 789

(MERLIN 63)

POSITION ERROR CORRECTION

TAKE-OFF WT 8040 LBS.
FLAPS AND UNDERCARRIAGE UP
RADIATOR FLAPS CLOSED



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SPITFIRE PR Mk XI MB 789 Fig 3

(MERLIN 63)

CORRECTION TO ALTIMETER WHEN CONNECTED TO STATIC OF AIRSPEED INDICATOR SYSTEM.

TAKE-OFF WT 8040 LBS.
FLAPS AND UNDERCARRIAGE UP.
RADIATOR FLAPS CLOSED.

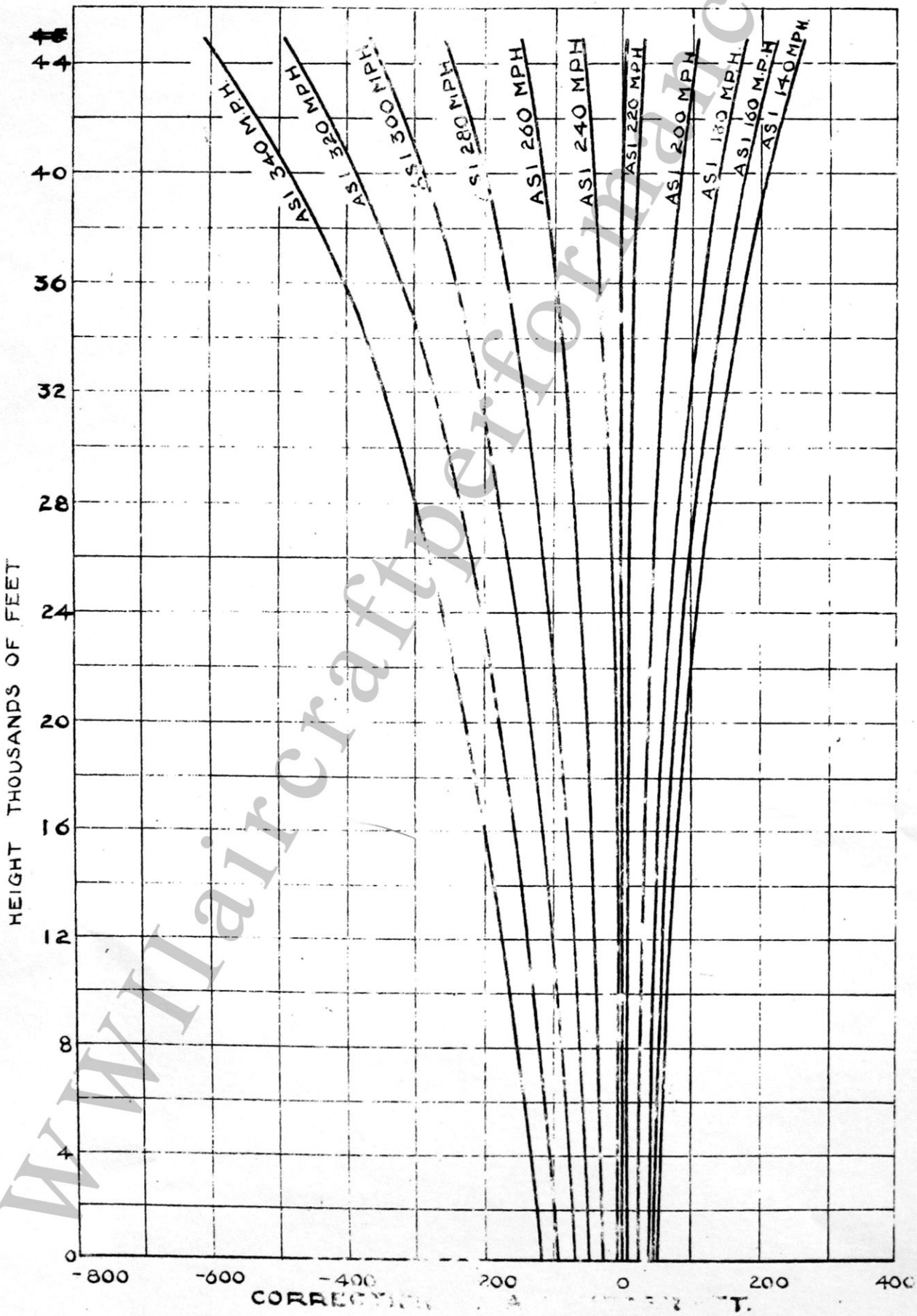

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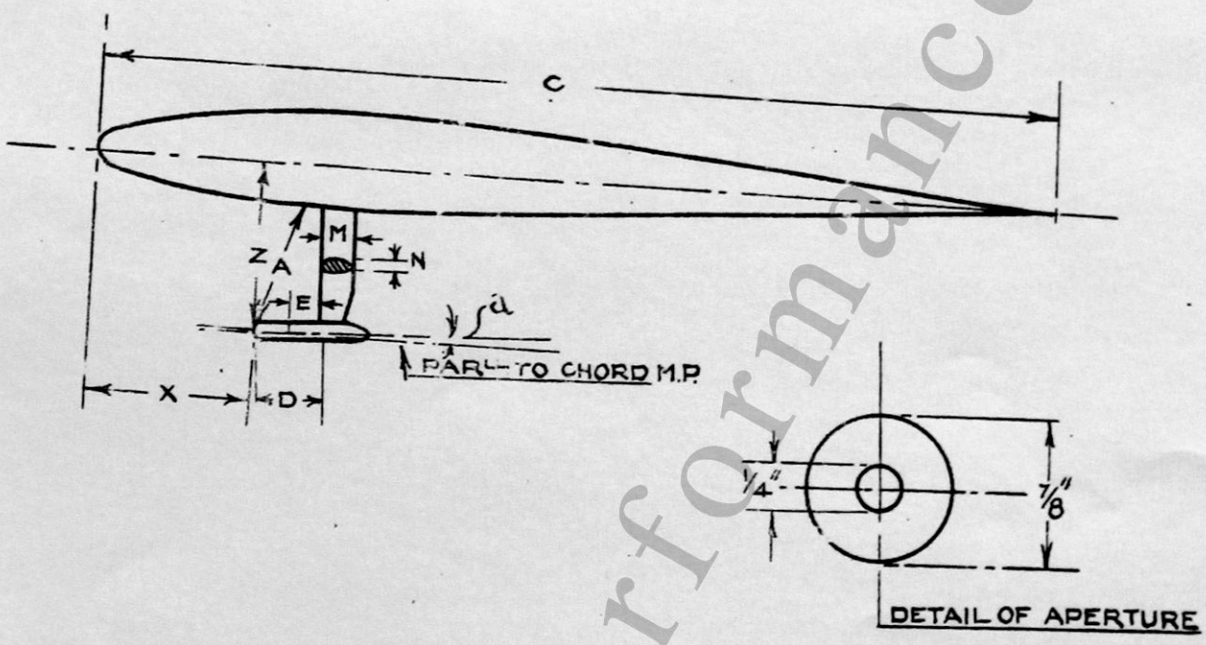
Fig 4.

SPITFIRE PR MK XI MB 7

PRESSURE HEAD POSITION.



Type of Pressure Head	REF Nº 6A/730 SERIAL Nº 1732
Ratio of Aperture of Tube to External Dia. of Static Tube	28·6%
Incidence of Main Plane (adjacent to Pressure Head)	0°-40′
a Angle of Head to Chord of Main Plane	-0°-10′
A Nose of Head to Main Plane (Minimum distance)	11¼″
D " " " " Supporting Strut	5¾″
Z " " " " " Chord line	12⅝″
X " " " " N.P. Leading Edge (parallel to chord)	22½″
C Length of Chord at Section	5′-0″
M Major axis of Strut	2¾ TAPERING TO 2″
N Minor " " "	¾″
Y Distance from Plane of Symmetry	14′-8″
P Position	UNDERSIDE PORT MP
Semi span	18′-6″.
Wing Section	——
Ratio of Thickness to Chord of Aerofoil Section adjacent to Pressure Head	8·7%

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