

**SECRET**

1st Part of Report No. A & A.E.E./767, E.

8 FEB 1943

**AIRCRAFT AND ARMAMENT EXPERIMENTAL ESTABLISHMENT**  
**BOSCOMBE DOWN**

Mosquito NF. Mk. XV. M.P. 469  
(2 Merlin 61's)

Short performance and handling trials

A. & A.E.E. ref:- 4487/44 - A.M. 61/15  
M.A.P. ref:- S.B. 39800/DD/RDA  
Date of tests:- January 1943.

DATE 19/12/52  
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This report deals with the aircraft as tested. Action to remedy defects or deficiencies to accept items not in strict compliance with the specification are matters for decision and action by the Ministry of Aircraft Production.

**UNCLASSIFIED**

SUMMARY

This aircraft has extended wings, a low pressure cabin, four blade metal propellers, four 0.303" Browning guns in an external fairing below the fuselage and is intended for high altitude night fighter work. Short tests to determine its climb and level speed performance were made at the normal load of 17,465 lb. with the centre of gravity at 7.0" aft of datum; an assessment of the principal handling qualities was obtained.

At normal maximum climbing conditions the time to reach the service ceiling of 43,000 ft. is 32½ minutes; it is possible to climb about 800 ft. above this by closing the radiator flaps if care is taken with regard to the engine temperatures. The top speeds are 397 m.p.h. at 16,500 ft. in M.S. gear and 408 m.p.h. at 27,800 ft. in F.S. gear. Owing to unreliable gauges no accurate assessment of the cooling can be obtained but the indications are that the maximum allowable coolant temperature may be exceeded under E.S.M. conditions whilst the oil cooling is satisfactory for T.S.M. conditions.

The handling is satisfactory, there being no tendency for any of the controls to freeze up at height, nor is the extent of icing inside the cabin at all serious; there is no marked difference in behaviour when compared with normal Mosquito aircraft.

1. Introduction.

1.1 This aircraft is a pressure cabin Mosquito modified to meet the operational requirement of a very high ceiling. Brief performance measurements were required by M.A.P. letter of 23.11.42 to check its climb and top speed. The opportunity was taken during the necessarily limited trials to obtain an assessment of the cooling, operation of the pressure cabin, and to do some brief handling tests.

2. Condition of aircraft relevant to tests.

The aircraft differs in several important respects from the normal Mosquito and a fairly full description will be given. Reference can be made to the photographs attached and to Fig. 1.

2.1 External details.

2.11 It is equipped with two Merlin 61 engines having the usual reversed flow coolant system and with the intercooler radiators mounted beneath each nacelle close behind the propeller; the air intake is also on the underside of each nacelle some way aft of the intercooler radiator. The main coolant and oil radiators are mounted in the centre section and the exit flaps for these are manually controlled. The radiators are made by Morris Motors Ltd., and details are given below.

Main coolant radiator	Port QDK Stbd. QDL	2.93 sq.ft.
Intercooler radiator	QDR	0.79 sq.ft.
Oil cooler	Port QDP Stbd. QDQ	3.23 sq.ft.
Cabin heater	Port QDM Stbd. QDN	0.318 sq.ft.

/2.12

Courtesy Neil Stirling



2.12 The wing span of 62.6 ft., 8.4 ft. more than normal, gives a wing of 479 sq. ft. representing an increase of 29 sq. ft.

2.13 Beneath the fuselage are mounted four 0.303" Browning guns enclosed in a fairly large fairing. The normal ammunition carried is 500 rounds per gun but accommodation is available for 750 r.p.g. Spent cases are ejected through unsealed chutes in the bottom of the casing whilst the gun muzzles are sealed by rubber caps.

2.14 Apart from twin aerials on top of the fuselage no external radio equipment is carried.

A fuel cooler of 23.9 sq. ins. matrix area (Drg. No. QDB) is fitted on the starboard side of the fuselage below the wing.

There is a pitot pressure tube near the top of the fin whilst a static vent is situated on the starboard side of the nose (Figs. 2 and 3). The nose differs from the normal Mosquito design being about 5 ins. longer and practically symmetrical about the centre line of the aircraft. An access door to certain radio equipment is provided in the upper part of this unpressurised portion of the fuselage.

The sides of the transparent cockpit canopy bulge outwards to afford a better rearward view.

## 2.2 Internal details.

2.21 A low pressure cabin (2 lb/sq.in. differential pressure) is formed in the fuselage by a straight and continuous vertical bulkhead about one foot forward of the instrument panel and an aft bulkhead built in three "steps" in such a way as to include all radio equipment behind the occupants. The cabin is pressurised by a single Marshall supercharger mounted on the port engine, the delivery from which passes through a heater before reaching the cabin. There are three controls, two manual and one automatic, governing the cabin pressure system. Behind the pilot there is a three-position cock which can either spill the air outside the cabin, or deliver it hot or cold to the cabin; an emergency release valve is situated on the starboard side of the cockpit. When the former is set either Hot or Cold and the latter is closed, the cabin pressure is automatically controlled by a Westland valve which is designed to allow gradual building up of pressure from 15,000 ft. until the full differential pressure of 2 lb/sq.in is reached at about 30,000 ft. Thereafter the pressure difference is maintained constant. An altimeter and pressure gauge indicate the cabin "height" and pressure whilst a red warning light comes on when the pressure falls  $\frac{1}{2}$  lb/sq.in. below normal. .

The front panels, pilot's direct vision panel, the upper front panels, and the bulged sides of the cockpit canopy are made up of double layers of transparent material; three reservoirs of silica gel are connected to the interspaces of these sandwiches in order to maintain the air in a dry state. The remainder of the canopy is made up of single layer transparent material.

2.22 The normal entrance hatch and ~~jet~~ <sup>jet</sup> ~~normal~~ overhead escape hatch and the direct vision panels on the side windscreens are still incorporated. In general, the installation of a pressure cabin has required very few modifications to the normal Mosquito cockpit.

2.23 The fuel available consists of 287 gallons in the inboard tanks and 48 gallons in the outboard, No.5., tanks; there is a pressure venting system operating upon the former but not upon the latter; as mentioned earlier, a fuel cooler is fitted, but this cools the fuel from the inboard tanks only.

## 3. Engine and Airframe Limitations, etc.

### 3.1 Engines.

Merlin 61.	Propeller reduction gear ratio 0.42.
Port	No.83107/A.333658
Starboard	No.82111/A.331548
Magnetos	Type BTH C6 SE 12S

/Max.



	R.P.M.	Maximum Limitations		Oil °C
		Boost (lb/in <sup>2</sup> )	Coolant °C	
Take-off	3000	+12	135	90
Climb Normal { 1 hour }	2850	+12	125	90
Combat { 5 mins. }	3000	+15	125	95
All-out level	3000	+15	125	95
Cruise - Rich	2650	+ 7	105	90
Cruise - Weak	2650	+ 4	105	90
Dive	3000	+15	-	-

### 3.2 Propellers.

Type DH. Hydromatic non-feathering 4 way single piece barrel. Experimental  
No. of Blades 4 (metal) (D1/445/1).

Dia. 12'-0"

Hub Mark SKP 64467A

Blade Mark SKP 64547-12A-10

Hub Serial No.

Port

Stbd.

Blade Serial Nos. 1

4A/40822

4A/40821

2

CN 47

CN 45

3

CN 48

CN 52

4

CN 49

CN 54

CN 51

CN 56

Fine Pitch Setting

24°

24°

Coarse Pitch Setting

65°

65°

### 3.3 Airframe Limitations (from Form 1187).

Dive	360 m.p.h.	A.S.I.*
Flaps down	150 "	"
Undercarriage down	180 "	"

\* The reduction from the standard figure is due to the extended wing tips fitted and the consequent reduction in reserve factor to 5.3.

Maximum permissible all-up weight = 17,395 lb.

Range of C.G. movement

Forward

Aft

U/c down

2.35' aft of datum 7.7" aft of datum  
(14,839 lb.)

3.4 Loading. The aircraft was flown at an all-up weight of 17,465 lb. with the centre of gravity at 7.0 ins. aft of datum, undercarriage down, this condition corresponding to the full operational load.

### 4. Tests made.

These were of a very brief nature and consisted of two full throttle climbs to ceiling at the estimated best climbing speeds, level speeds and position error measurements. Some cooling figures on the climb were obtained, but, as the thermostats were not removed and calibration of the electrical oil and coolant thermometers in the working range gave corrections up to as much as 15°C, the results quoted in the report should not be relied upon to give anything more than an approximate indication of the temperatures likely to be obtained.

Some brief handling tests were included in the programme.

### 5. Results of tests.

The quantitative results are given in Tables I - III and Figs. 4 - 9 and have been reduced by the methods given in Report No. A. & A.E.E./Res/170 incorporating A. & A.E.E. Memo. dated 27.8.42.

5.1 Performance. The speeds above 34,000 ft. are not considered to be as reliable as the others owing to the paucity of observations. On the ceiling climbs it was found that a certain increase in performance could be obtained by closing the flaps but at the expense of a fairly sharp rise in engine temperatures. It is expected, however, that if this expedient were adopted carefully approximately eight hundred feet could be gained.



5.2 Operation of the pressure cabin. The cabin height and differential pressure are plotted in Fig. 1 and it will be seen that the maximum difference of  $1\frac{1}{8}$  lb/sq. in. was reached at 34,000 ft., thereafter decreasing to about  $1\frac{1}{8}$  lb/sq. in. at the top of the climb. This deficiency may be due to excessive leakage from the cabin outstripping the supercharger capacity and in this connection the direct vision panels may have been a source of leakage as they did not fit absolutely tight.

One climb was made without the cabin pressure and it was noticed that the pressure warning light did not operate.

The degree of internal cabin icing which occurred with the air temperature experienced ( $-53^{\circ}\text{C}$  above 40,000 ft.) was comparatively slight, being chiefly confined to the single layer portions of the canopy though some 20% of the area of the double screens were affected, mostly along the edges. During descent the ice thickened but could be easily wiped off all surfaces by means of a glycol soaked rag.

The cabin was comfortably warm with the heating lever in the "Cold Air" position.

5.3 General handling. The following are the principal points noted :-

Stalling speeds: Flaps and undercarriage Up, radiator flaps closed,  
117 - 119 m.p.h. I.A.S.

Flaps and undercarriage Down, radiator flaps open,  
99 m.p.h. I.A.S.

5.31 Stalling characteristics, flaps and undercarriage UP. As the speed is reduced, the ailerons become almost ineffective at 142 m.p.h. I.A.S. and at about 126 m.p.h. some vibration begins, the aircraft becoming laterally unstable at 121 m.p.h. at this speed the rate of descent suddenly increases. The complete stall occurs at between 117 and 119 m.p.h. with a fairly heavy force exerted on the control column which is about  $\frac{1}{3}$  back from neutral. At the stall the nose drops gently but without any tendency to drop a wing, and in this condition the control column can be brought right back with the result that the aircraft goes into a stalled glide, the A.S.I. fluctuating quickly between 90 and 130 m.p.h.

There is much tail buffeting and considerable force is required to keep the control column right back, but there is no tendency to spin.

Recovery is immediate on allowing the control column to move forward to neutral.

5.32 Stalling characteristics, flaps and undercarriage DOWN. On reducing the speed the ailerons become rather ineffective below 111 m.p.h.; a slight tendency to drop the right wing occurs at 109 m.p.h. but this may be corrected by using about  $\frac{1}{3}$  aileron.

The beginning of the stalled state occurs at 109 m.p.h. with considerable tail buffeting and a slight lateral rocking motion. At 99 m.p.h. the aircraft is completely stalled and a fairly heavy load must be applied to the control column which is about  $\frac{1}{3}$  back from neutral.

On bringing the control column right back the aircraft falls into a stalled glide a state which is accompanied by much tail and fuselage buffeting and with the A.S.I. fluctuating rapidly between 60 and 110 m.p.h. The nose rises and falls fairly sharply and the force necessary on the control column varies appreciably but on the average is very heavy.

There is no tendency to spin and recovery is immediate on allowing the control column to move forward to neutral.

In general the stalling characteristics are similar to those of other Mosquito aircraft though exact comparison of the speeds is difficult owing to the rather doubtful value of the "position error" at low airspeeds.

5.33 Miscellaneous. On take-off there is a slight, easily corrected tendency to swing to port. The propellers tend to overspeed slightly (by an amount not exceeding 50 r.p.m.),

/During



During the climb the aircraft will not remain in the trimmed condition which becomes markedly worse at very high altitude.

In level, diving, or gliding flight the aircraft can be trimmed to the hands and feet off quite easily.

There is adequate range of all trimmer movements for all conditions of flight, including diving up to 340 m.p.h. A.S.I.

Except for a slight stiffening apparent in the ailerons at height, the controls and trimmers remain free at all times. The response of the propellers to change in constant speed control setting is completely satisfactory even after about  $\frac{1}{4}$  hour above 40,000 ft.

## 6. Conclusions.

6.1 The service ceiling of this aircraft at full load is approximately 43,000 ft; another 800 feet could probably be gained by careful manipulation of the radiator flaps.

6.2 The oil cooling appears adequate for tropical summer conditions but the radiators appear to be 5% outside limitations for temperate summer conditions. Should accurate cooling figures be required from this type of aircraft, more reliable thermometers must be installed.

6.3 The cabin pressuring system worked satisfactorily but the maximum differential pressure was  $1\frac{7}{8}$  lb/sq.in. at 34,000 ft., a fact which indicates excessive leakage from the cabin.

6.4 The handling qualities are satisfactory and the controls and trimmers are free at all heights; the extent of cabin misting experienced was small and not likely to cause trouble.

TABLE I

Full throttle climb  
Weight 17,465 lb.  
Radiator flaps fully open

Height ft.	Rate of Climb ft/min.	Time to height mins.	A. S. I. m.p.h.	Boost lb/in <sup>2</sup>		R. P. M.	S/C Gear
				Port	Stbd.		
0	2995	0	170	12.2	12.0	2850	M. S.
4,000	2980	1.3					
8,000	2965	2.7					
12,000	2950	4.0					
*14,000	2940	4.7		↓	↓		
16,000	2650	5.4		9.8	10.2		
18,000	2360	6.2		7.8	8.2		
20,000	2060	7.1		6.0	6.3		
20,500	2000, 2220	7.4	↓	5.6	5.9		F. S.
22,000	2230	8.1	167	12.2	12.0		
24,000	2245	9.0	165				
26,000	2255	9.8	162	↓	↓		
*26,500	2260	10.1	161	11.8	12.0		
28,000	1980	10.8	160	10.1	10.9		
30,000	1600, 1980	11.9	155	9.9	10.5	3000	
32,000	1670	13.0	152	8.0	8.6		
34,000	1360	14.3	150	6.1	6.7		
36,000	1050	16.0	147	4.1	4.9		
38,000	790	18.1	145	2.4	3.1		
40,000	500	21.2	142	0.9	1.6		
41,000	370	23.4	140	0.1	0.7		
42,000	230	26.8	138	-1.0	0.0		
43,000	100	32.7	136	-1.5	-0.8	↓	↓

\* Full throttle heights

Service ceiling 43,000 ft.

Absolute " 43,500 ft.

Greatest height reached 43,000 ft. (radiator flaps open)

/Table II



TABLE III (cont.)

Height ft.	Air Temp. °C	Oil Inlet Temp. °C		Coolant "In" to Rad.		Radiator Suitability	
		Port	Stbd.	Port °C	Stbd. °C	Port	Stbd.
22,000	-36	60 73 $\frac{1}{2}$ x 83 $\frac{1}{2}$ ø	Gauge failed	100	97	1.04x 0.93ø	1.07x 0.96ø
24,000	-39	60 73 x 83 ø		100	97	1.04x 0.94ø	1.07x 0.96ø
25,000	-42	60 72 $\frac{1}{2}$ x 82 $\frac{1}{2}$ ø		100	97	1.05x 0.95ø	1.07x 0.97ø
28,000	-45 $\frac{1}{2}$	60 72 x 82 ø		100	97	1.06x 0.96ø	1.07x 0.98ø
30,000	-49 $\frac{1}{2}$	60 72 x 82 ø		100	100	1.06x 0.96ø	1.06x 0.96ø
32,000	-51 $\frac{1}{2}$	60 70 $\frac{1}{2}$ x 80 $\frac{1}{2}$ ø		100	100	1.07x 0.97ø	1.07x 0.97ø
34,000	-54	64 74 x 84 ø		100	102	1.07x 0.99ø	1.07x 0.97ø
36,000	-55	66 76 $\frac{1}{2}$ x 83 ø		102	104	1.06x 1.00ø	1.04x 0.97ø
38,000	-54	-		-	-	-	-
40,000	-53	69 78 x 79 $\frac{1}{2}$ ø		107	112	1.03x 1.02ø	1.00x 0.99ø
42,000	-53	75 84 x 82 $\frac{1}{2}$ ø		107	112	1.03x 1.04ø	1.00x 1.02ø

x = Temperate summer conditions to AIM.491  
ø = Tropical summer conditions to AIM.491

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Air Commodore,  
Commanding A.&A.E.E.,  
Royal Air Force.



TABLE II

Full throttle level speeds  
R.P.M. 3000 Radiator flaps closed

Height ft.	T. A. S. mph	A. S. I. mph	Corrections		Boost <sup>2</sup> lb/in <sup>2</sup>		S/C gear
			P. E. mph	C. E. mph	Port	Stbd.	
0	320	312	+8	0	15.0	15.0	M. S.
4,000	338	311	+8	-1			
8,000	357	310	+8	-2			
12,000	376	309	+8	-3½			
*16,500	397	305	+8	-5	14.6	↓	
18,000	395	296	+7½	-5½	13.1	13.7	
20,000	392	285	+7	-5½	11.0	11.5	
22,000	386	271	+6½	-5½	8.9	9.5	
24,000	378	257	+6	-5	6.9	7.5	↓
22,000	384	270	+6½	-5½	15.2	15.2	F. S.
24,000	393	268	+6½	-6	15.2	15.2	
26,000	401	265	+6	-6½	15.2	15.2	
*27,800	408	260	+6	-7	14.6	15.2	
30,000	401	247	+5½	-7	12.0	12.6	
36,000	374	206	+4	-5½	5.3	5.9	
40,000	347	174	+2½	-4½	1.6	2.1	↓

\* Full throttle heights.

TABLE III

Cooling climb

Radiator flaps fully open

- Note (i) For details of A. S. I. time, etc. on climb see Table I.  
(ii) For the reasons given in para. 4 the cooling results are to be regarded as approximate only.  
(iii) The temperatures given apply to only one of the two climbs made, but there was little difference between the observations.

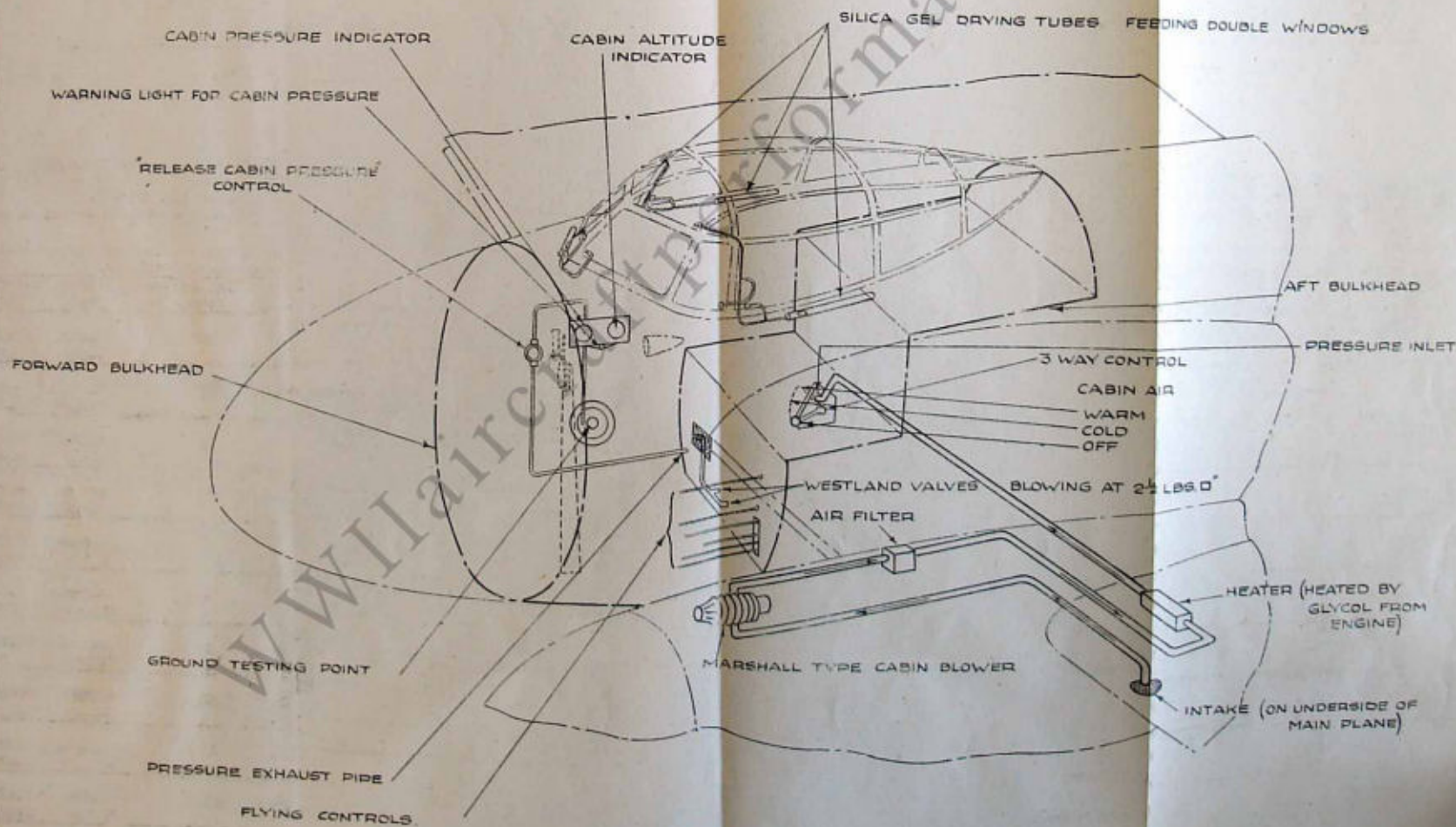
Height ft.	Air Temp. °C	Oil inlet temp. °C		Coolant "In" to Rad.		Radiator Suitability	
		Port	Stbd.	Port °C	Stbd. °C	Port	Stbd.
2,000	+ 5	60 72½x 82½p	Gauge failed	98	90	1.10x 0.96p	1.20x 1.03p
4,000	+ 1	60 72½x 82½p		100	92	1.10x 0.93p	1.16x 1.01p
6,000	- 3	60 72½x 82½p		100	92	1.07x 0.93p	1.15x 1.01p
8,000	- 8	60 73x 83p		100	97	1.05x 0.92p	1.09x 0.96p
10,000	-12½	60 73½x 83½p		100	98	1.05x 0.92p	1.07x 0.94p
12,000	-17	60 74 x 84 p		100	97	1.05x 0.93p	1.07x 0.94p
14,000	-22	60 75 x 85 p		100	99	1.04x 0.91p	1.05x 0.92p
16,000	-27	60 75½x 85½p		102	100	1.00x 0.91p	1.02x 0.93p
18,000	-32½	60 77 x 87 p		102	100	1.00x 0.89p	1.02x 0.89p
20,000	-35½	60 76 x 86 p	↓	102	100	1.01x 0.89p	1.02x 0.92p



# MOSQUITO N.F. Mk. XV MP-469

## G.A. OF PRESSURE CABIN.

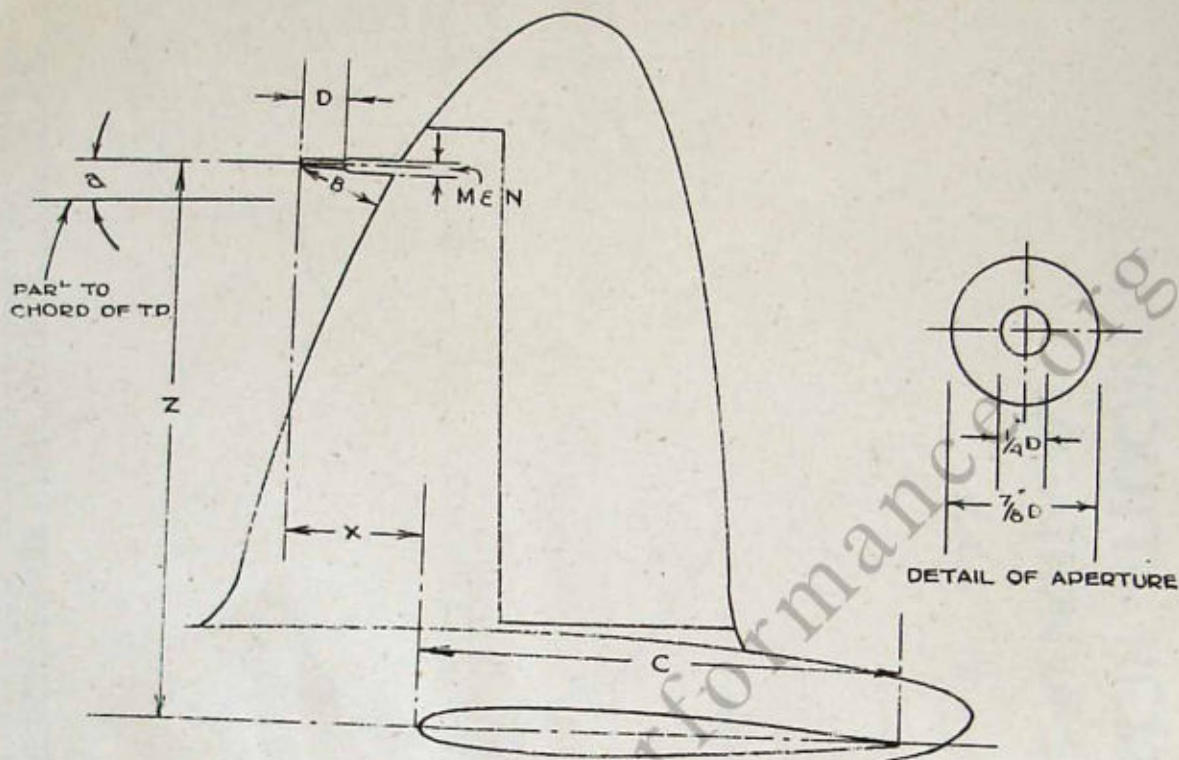
FIG. 1





# MOSQUITO N.F. Mk XV MD 469

## PRESSURE HEAD POSITION



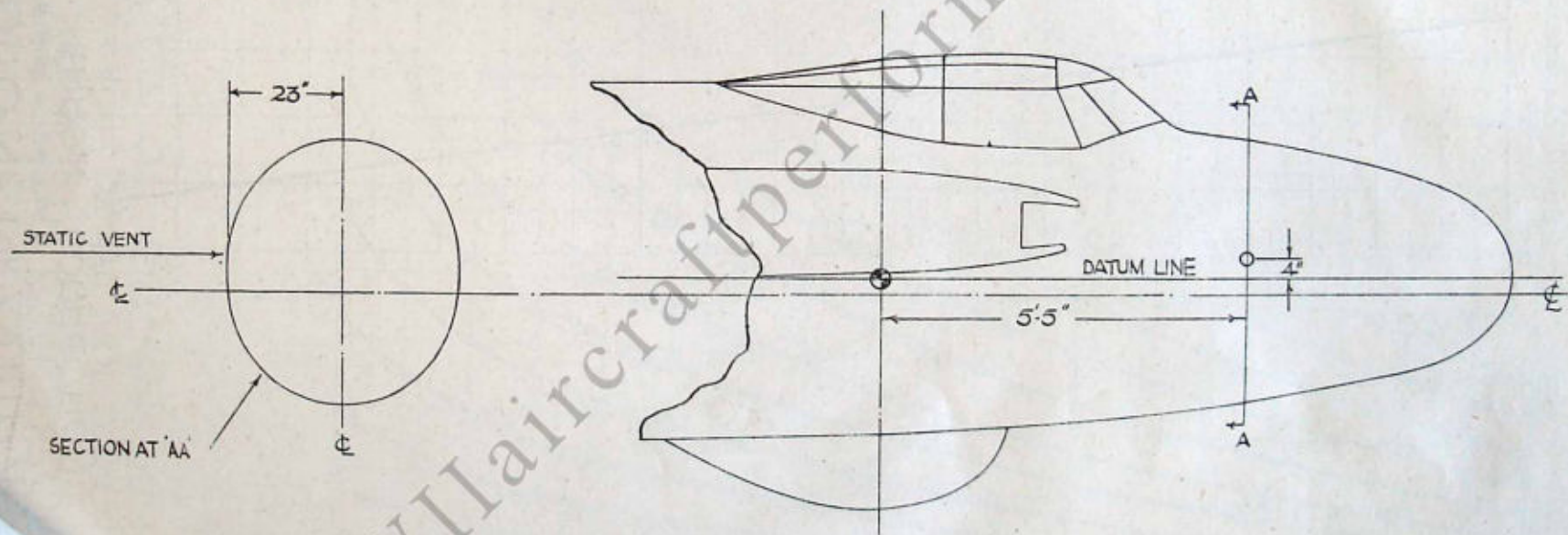
Type of Pressure Head	NOT MARKED ON HEAD
Ratio of Aperture of Tube to External Dia. of Static Tube	28.6%
Incidence of Tail Plane (at root)	-1°-20'
a Angle of Static Tube to Chord of Tail Plane	-0°-30'
D Nose of Static to Supporting Strut	6"
B " " " " Fin (Minimum distance)	10"
Z " " " " Chord Line of TP	6'-5"
X " " " " T.P. Leading Edge (parallel to chord)	1'-0 1/2"
C Length of Chord of T.P. (at root)	5'-7 1/2"
M Major axis of strut	1 1/4"
N Minor " " "	1 1/4"
y Distance from Plane of Symmetry	NIL
Position	CL OF AIRCRAFT LEADING EDGE OF FIN
Semi-span of T/P	10'-4 1/2"



# MOSQUITO N.E. MK XV - MP 469

## LOCATION OF STATIC VENT.

SCALE  $\frac{1}{2}$ " = 1 FOOT.

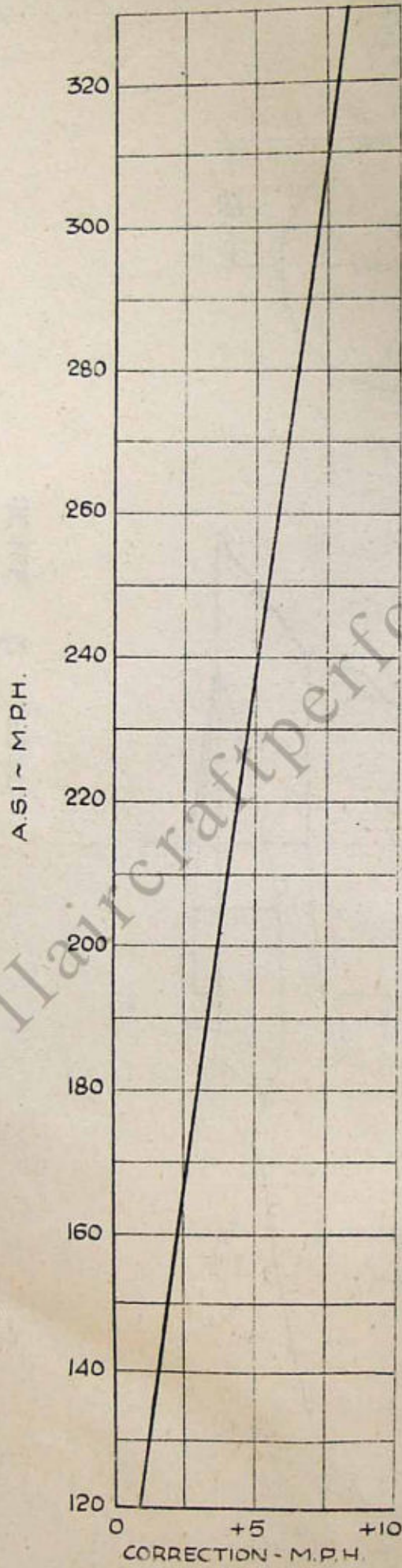




# FIG. 4 MOSQUITO NF. Mk. XV M.P. 40

WEIGHT ~ 17465 lb.

POSITION ERROR CORRECTION



OVER	Nº A&A E E / 7679	CURVE Nº 4712	TRACED E.A.A.	DATE OF TEST 15.1.45	CHECKED <i>ASK</i>	APPROVED	D.O
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### CORRECTION TO ALTIMETER DUE TO CONNECTION TO STATIC VENT

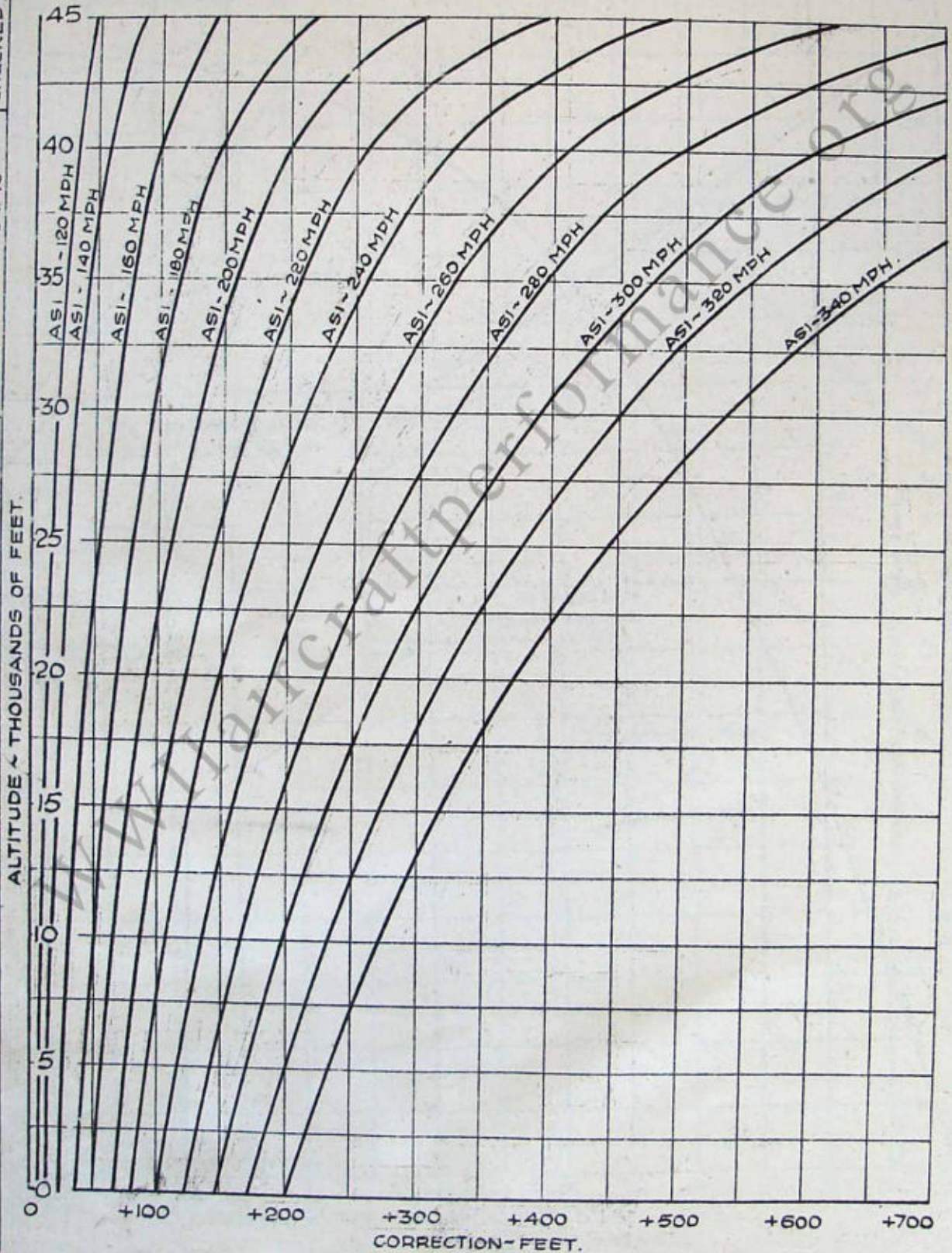




FIG 6

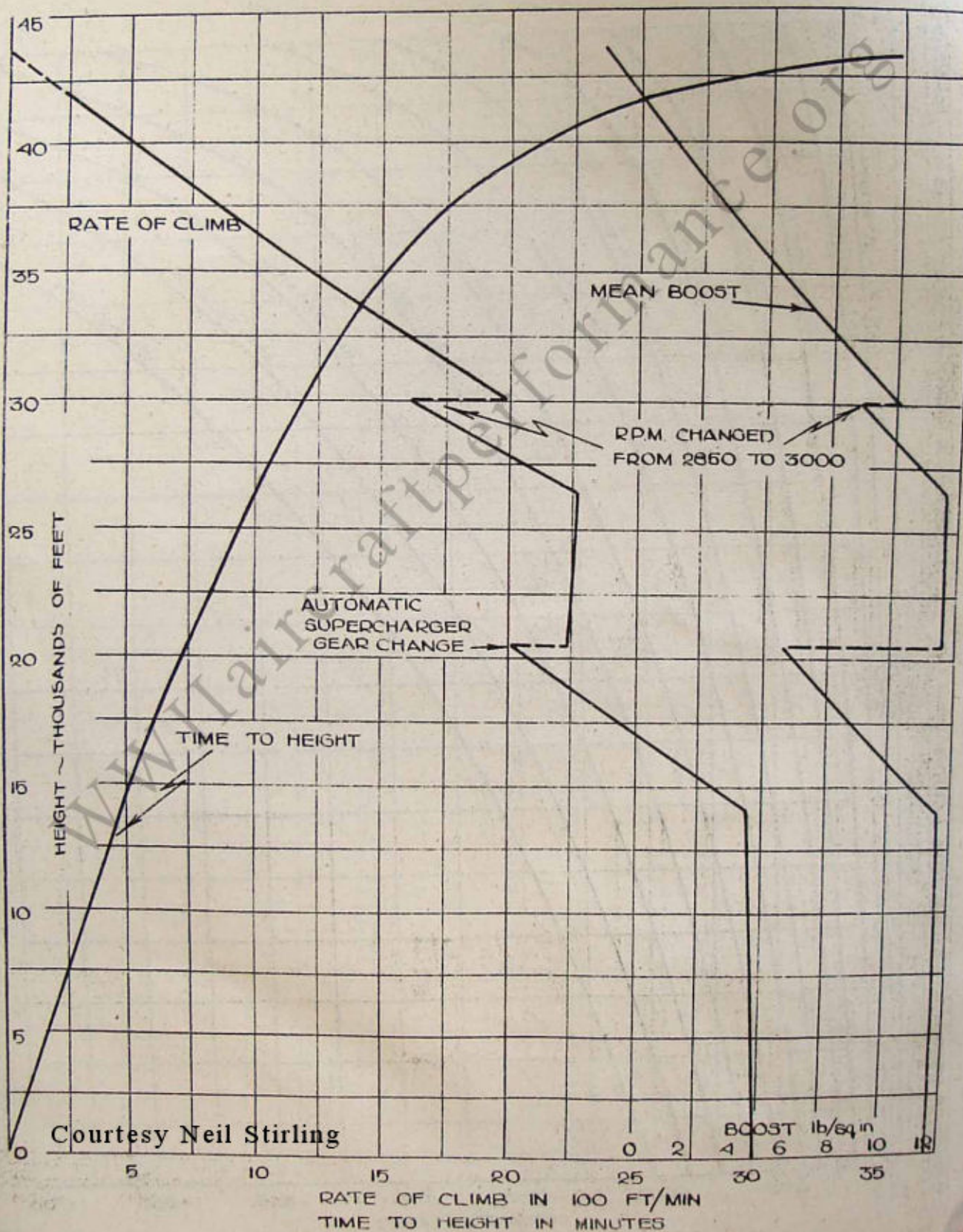
# MOSQUITO N.F. MK XV MD 40

TWO MERLIN 61

FULL THROTTLE CLIMB.

WEIGHT ~ 17465 lb.

RADIATOR FLAPS FULLY OPEN.





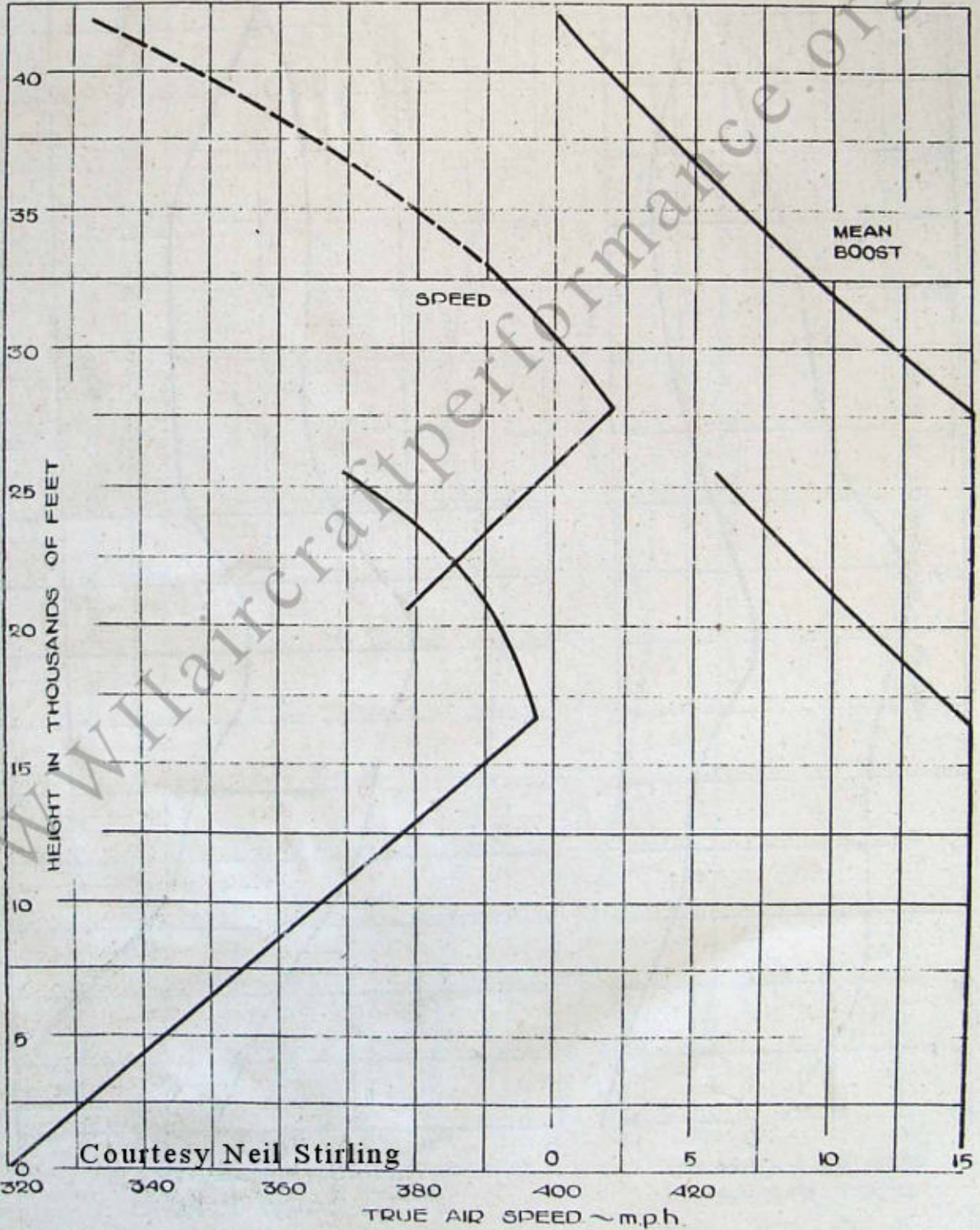
# MOSQUITO N.F. Mk XV MP 469

TWO MERLIN 61

## FULL THROTTLE LEVEL SPEEDS

WEIGHT ~ 17465 lb

RADIATOR FLAPS CLOSED



Courtesy Neil Stirling

TRUE AIR SPEED ~ m.p.h.



