12th Part of Report No. A. & A.E.E./767,a

AIRCRAFT AND ARMAMENT EXPERIMENTAL ESTABLISHMENT
BOSCOMBE DOWN

Mosquito F Mk.II W.4096
(2 Merlin 21's)

Comparative level speed performance with standard and tropical engine cowlings

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M.A.P. ref: RA.4111/RDL1(c)
Period of tests: April to October 1943

Progress of issue of report

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12th Part of A. & A.E.E./767,a.	W.4052 - Tests with an air brake fitted round the fuselage.
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15th do.	DD.736 - Flame damping trials with four fishtail exhausts and ducts.
16th do.	W.4096 - Effect of air cleaner elements on range.

1. Introduction.

A tropical air cleaner installation has been designed for Mosquito aircraft, it being possible to switch the air cleaner in or out of use. This installation necessitated a redesign of the air intake and the surrounding engine cowling.

Previous fuel consumption tests were made with the tropical cowling fitted and the air cleaner elements both in and out of use (see the 16th Part of this Report). This, of course, did not give the effect of the new cowling on overall drag of the aircraft, nor the effect of the change of design of the carburettor air intake in the tropical cowlings (with air cleaner elements inoperative). The present series of speed tests were therefore made, first with the tropical engine cowlings fitted, but cleaner elements by-passed, and then with the standard cowlings fitted, to obtain a true comparison.

2. Condition of aircraft relevant to tests.

2.1 General. The aircraft was a standard fighter Mosquito Mk.II finished in night black camouflage, and with the following external equipment:

4 - 0.303" machine guns and 4 - 20 mm. Hispano guns in the nose.
Ejector chutes unsealed.
A.I. aerials on the nose, and on the top and bottom surfaces of the wings near the tips.
An aerial mast, but no aerials
Two twin saxaphone ejector exhaust systems covered by unslotted ducts on each engine.

2.2 Cowling installation. A photograph of the lower part of the tropical cowling, including the carburettor air intake, is given in the 16th Part of this Report. It will be seen that gap type iceguards formed an integral part of this installation.

The standard cowlings had no unusual features. Stone guards were fitted internally just before the carburettor. Iceguards were not fitted in front of the air intakes, these not being usually fitted to standard cowlings at the time of commencement of tests.

2.3 Engine numbers. All tests with the tropical cowlings on were completed with the following Merlin 21 engines fitted:

Port engine: A.262292/49143
Stbd. engine: [illegible]1408/61795

Mid way through the tests with standard cowlings fitted the port engine failed, and was replaced by engine A.313214/60017. The bench test horse power figures for this engine were in good agreement with those for the replaced engine. A check of the performance already measured was made, and no discrepancy was found, and it was concluded that the engine change had had no deleterious effect on performance.

2.4 Engine limitations. The relevant engine limitations in vogue at commencement of the tests and adhered to throughout this series of tests were:-

	RPM	Boost (lb/sq.in.)
All-out level	3000	+12
Max. weak mixture cruising	2650	+ 4

2.5 Loading. The aircraft was loaded to a take-off weight of 19,855 lb. with the centre of gravity 15.4" aft of the datum point (undercarriage down).

3. Scope of tests.

Level speed measurements both with standard and tropical cowlings were made between 6000 and 20,000 feet in M.S. supercharger and between 12,000 and 24,000 feet in F.S. supercharger at all-out level and maximum weak mixture cruising powers.

4. Results.

The results were corrected to ICAN standard atmospheric conditions and to 18,850 lb. (i.e. 95% of take-off weight) by the methods of A. & A.E.E./Res/170, a supercharger constant C = 0.002 being employed. The position error correction used was measured on this aircraft and is given in the 13th Part of this Report.

The results are given in Tables I and II and shown plotted in Fig.1., and are summarised below:-

(i) Standard cowling:

Max. true airspeed at all-out level power (a) M.S. S/c = 348 mph at 10,800 ft.
" " " " " " " (b) F.S. " = 358 mph at 17,700 ft.

Max. true airspeed at weak mixture cruising power:
(a) M.S. S/c = 318 mph at 16,000 ft.
(b) F.S. " = 324 mph at 21,700 ft.

(ii) Tropical cowling:

Max. true airspeed at all-out level power (a) M.S. S/c = 336 mph at 9,400 ft.
(b) F.S. " = 346 mph at 16,000 ft.

Max. true airspeed at weak mixture cruising power:
(a) M.S. S/c = 310 mph at 15,200 ft.
(b) F.S. " = 314 mph at 20,900 ft.

5. Discussion of results.

5.1 Change of external form. The effect on level speed performance due to the change in drag alone (assuming no effect on carburation) is obtained by comparing the performance below the full throttle heights. From Tables I and II and Fig.1 it will be seen that the tropical cowlings reduce the true airspeed by some 5 - 7 mph at constant boost, the greatest reduction measured being at the full throttle height at weak mixture cruising power in F.S. supercharger (i.e. 7 mph).

5.2 Change of intake design. The re-designed carburettor air intake has reduced the "ram" considerably, a drop in full throttle height of 1,400 feet in M.S. and 1,700 feet in F.S. supercharger being obtained under all-out level power conditions. At maximum weak mixture cruising power, in either supercharger gear, the reduction in full throttle height was 800 feet.

This loss in full throttle height gave a total reduction in speed of 14 mph (True) above full throttle height in both gears, either at all-out level

/or

or maximum weak mixture cruising powers. The corresponding drop in boost was about 1.5 lb/sq.in. at all-out level power. By the methods of A. & A.E.E./Res/170, this change in power represents a reduction in speed of some 10 mph (True). Thus, as about 5 mph of the total of 14 mph reduction in speed was due to the external drag (see 5.1, above), the reduction in performance is fully accounted for.

TABLE I

Level speed performance with standard cowlings.
Mean weight: 18,850 lb. Radiator flaps closed

Standard Height feet	True Air Speed mph	ASI mph	Corrections mph P.E.	Corrections mph C.E.	RPM	Mean Boost lb/in²	Mixture	Carb. Air	S/c gear
6,000	328	303	-1.3	-1.4	3000	+12	Rich	Cold	M.S.
8,000	336	301	-1.2	-2.0					
10,800	348	299	-1.0	-2.8					
12,000	348	293	-0.7	-3.0		+11.0			
14,000	347	283	0	-3.4		+ 9.2			
16,000	345	272	+0.5	-3.6		+ 7.7			
18,000	341	260	+0.8	-3.7		+ 6.0			
20,000	334	246	+1.1	-3.6		+ 4.5			
6,000	280	256	+0.9	-0.9	2650	+ 4	Weak		
8,000	288	255	+0.9	-1.2					
10,000	295	254	+0.9	-1.6					
12,000	303	253	+1.0	-2.0					
14,000	311	252	+1.0	-2.4					
*16,000	318	250	+1.0	-2.8					
18,000	315	240	+1.1	-2.9		+ 2.6			
20,000	306	225	+1.0	-2.7		+ 1.2			
12,000	335	282	+0.1	-2.7	3000	+12	Rich		F.S.
14,000	343	280	+0.2	-3.2					
16,000	351	277	+0.3	-3.7					
*17,700	358	276	+0.3	-4.2					
20,000	354	262	+0.8	-4.4		+ 9.7			
22,000	349	249	+1.0	-4.3		+ 7.9			
24,000	342	236	+1.1	-4.0		+ 6.2			
12,000	287	240	+1.1	-1.7	2650	+ 4	Weak		
14,000	295	238	+1.1	-2.0					
16,000	303	238	+1.1	-2.4					
18,000	310	236	+1.1	-2.7					
20,000	318	234	+1.1	-3.1					
*21,700	324	232	+1.0	-3.3					
24,000	311	215	+0.9	-3.1		+ 2.3			

* Full throttle heights

/TABLE II

TABLE II

Level speed performance with tropical cowlings
Mean weight: 18,850 lb. Radiator flaps closed

Standard Height feet	True Air Speed mph	ASI mph	Corrections mph P.E.	Corrections mph C.E.	RPM	Mean Boost lb/in^2	Mixture	Carb. Air	S/c gear
6,000	323	297	-0.9	-1.3	3000	+12	Rich	Cold	M.S.
8,000	331	295	-0.7	-1.8					
* 9,400	336	293	-0.6	-2.2					
12,000	336	282	+0.1	-2.7		+ 9.5			
14,000	335	272	+0.5	-3.0		+ 7.8			
16,000	332	261	+0.8	-3.2		+ 6.2			
18,000	327	249	+1.1	-3.3		+ 4.6			
20,000	318	235	+1.1	-3.1		+ 3.1			
6,000	275	251	+1.0	-0.9	2650	+ 4	Weak		
8,000	283	250	+1.0	-1.2					
10,000	290	249	+1.1	-1.5					
12,000	298	249	+1.1	-1.9					
14,000	305	247	+1.1	-2.3					
*15,200	310	246	+1.1	-2.5					
16,000	309	243	+1.1	-2.6		+ 3.4			
18,000	303	231	+1.0	-2.6		+ 1.9			
20,000	292	215	+0.8	-2.3		+ 0.4			
12,000	330	277	+0.3	-2.6	3000	+12	Rich		F.S.
14,000	338	275	+0.3	-3.1					
*16,000	346	273	+0.4	-3.6					
18,000	344	263	+0.7	-3.8		+10.0			
20,000	341	252	+1.0	-3.9		+ 8.1			
22,000	336	240	+1.1	-3.8		+ 6.3			
24,000	328	227	+1.0	-3.6		+ 4.6			
12,000	282	235	+1.1	-1.6	2650	+4	Weak		
14,000	289	233	+1.1	-1.9					
16,000	296	232	+1.0	-2.2					
18,000	303	230	+1.0	-2.5					
20,000	311	229	+1.0	-2.9					
*20,900	314	228	+1.0	-3.0					
22,000	310	221	+1.0	-2.9		+ 3.0			
24,000	298	205	+0.7	-2.7		+ 1.4			

* Full throttle heights.

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FIG. 1.

LEVEL SPEED PERFORMANCE

WEIGHT - 18850 LBS.

FLAPS AND UNDERCARRIAGE UP RADIATOR FLAPS CLOSED

---------- STANDARD COWLINGS

———— TROPICAL COWLINGS