

EXPERIMENTAL DEPARTMENT REPORT

REFERENCE :— Dor/Chr/ELS.1/MNH. 8.10.43.

Subject of Report :—

SPITFIRE J.L.165 WITH MERLIN 66 AT 25 lbs.
BOOST PRESSURE.

PRELIMINARY REPORT.

General Conclusion :—

The increase of boost pressure to 25 lbs/sq.inch provides a considerable improvement in the low altitude performance of the Spitfire IX aircraft, the necessary modifications to achieve this being comparatively simple.

It appears that the propeller has insufficient blade area to absorb the increased power of the engine with a resultant loss of efficiency, especially noticeable on the climb performance. A propeller of greater diameter or increased blade area, such as a 5 blade type, should improve the rate of climb by some 300 feet per minute.

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Major Bulman. (M.A.)
Mr. Foord. (M.A.)

Test carried out on :—

Mr. Jones, C.T.O., A. & A.E.E., Boscombe
Mr. Jones, R.T.O. Hucknall. Down.

By :—

Test No.

Mr. Smith, Date :—
(Vickers-
Armstrongs Ltd).

SPITFIRE J.L.165.MERLIN 66 No.156359 AT 25 lbs. BOOST PRESSURE.PRELIMINARY REPORT.INTRODUCTION.

With the object of improving the performance of the Spitfire IX at low altitudes, the permissible boost pressure of a Merlin 66 has been increased for experimental purposes to 25 lbs. per square inch.

To achieve this the following modifications are necessary:-

- (a) Strengthening of engine mounting horseshoe internally and patch plate outside. Spitfire Modification No.971, Drawing 35137 - Sheet 15.
- (b) Modification of boost control by fitting stronger spring, new aneroid and adjusting stops to give + 18 lbs. at the gate and + 25 lbs. full open.
- (c) Use of special fuel, 160 Grade. (Both 11cc lead content and M.M.A. type has been used during tests).

Except for these modifications, the engine was a standard production Merlin 66, the aircraft being a normal Spitfire IX, with 10'-9" diameter Hydalignum propeller and standard tropical type of air intake, operating as temperate. The aircraft was flown at a weight of 7,234 lbs. (84 galls. total fuel capacity).

RESULTS OF TESTS.

Climbs and level speeds have been carried out at + 18 lbs. and + 25 lbs. boost. The results are shown on H.Ks.6244 and 6245 attached, which cover the climb and speed performances respectively, and in the tables below.

CLIMB PERFORMANCE.

Altitude feet.	Rate of Climb Ft./Min.	Improvement over climb at + 18 lbs. Boost. (See Note).
0	5740	780 feet/min.
5,000	5080	110 " "
10,000	5080	800 " "
15,000	4470	190 " "
20,000	3720	-
25,000	2950	-
30,000	2200	-

NOTE: Tests not yet completed at + 18 lbs. boost, figures quoted are based on a rate of climb drawn from points at which + 18 lbs. obtains on full throttle boost line.

It will be seen that the maximum improvement is gained on the throttled portions of the climb, the increase gradually diminishing after the full throttle heights have been reached. These climbs have been carried out with the radiator shutter closed, the radiator suitability allowing this to be done under English conditions.

The improvement in climb is not so great as would be expected from a comparison of the relative powers obtained at +18 lbs. and +25 lbs. boost, which indicate that the gain should be of the order of 1,100 feet/minute. This is probably due to a decrease of propeller efficiency at the higher powers. A propeller of greater solidity should show an improvement in this respect.

LEVEL SPEED PERFORMANCE.

Altitude.	+18 lbs. Boost.	+25 lbs. Boost.	Increase.
0 feet.	350 M.S.	354 M.S.	+ 24 M.P.H.
3,200 "	343 "	367 "(a)	+ 24 "
8,000 "	364 "	367 "	+ 3 "
10,000 "	367 "	377 F.S.	+ 10 "
14,400 "	373 F.S.	397 "(a)	+ 24 "
20,000 "	397 "(a)	397 "	- "
25,000 "	394 "	394 "	- "

(a) Full Throttle Heights.

It will be seen that the maximum increase in speed is 24 miles per hour obtained at ground level, and at 3,200 ft. and 14,400 ft. the full throttle heights in M.S. and F.S. gear respectively. These gains gradually diminish with increase of altitude, until, at the full throttle heights for +18 lbs. boost they entirely disappear.

It should be noted that there is no increase in the absolute speed obtained by the increase of boost, and it would appear that the efficiency of the propeller is somewhat reduced at the higher rating.

A further point of note is the full throttle height at +18 lbs. of boost which is somewhat lower than has previously been obtained with Merlin 60 engines. A check of the air intake efficiency was taken during tests, a minimum figure of 94% in level flight being shown at +25 lbs. sq. inch boost pressure. It would seem therefore that the full throttle height of this engine is low.

Charge temperatures have been recorded during climbs and level speed tests, the following minimum figures for intercooling being obtained:-

Combat Climb	-	39% M.S. Gear.
" "	-	37% F.S. Gear.
All-out Level Speed	-	40% M.S. Gear.
" " "	-	39% F.S. Gear.

Tests carried out to date show that the cooling at combat ratings is satisfactory for Tropical Summer Maximum conditions. A full report of the cooling characteristics will be issued later when further tests have been carried out. This feature is also noticeable on Spitfire J.L.106, operating at +25 lbs. boost.

(Contd.).

CONCLUSIONS.

From the foregoing results it will be seen that increasing the boost of a Merlin 66 engine to + 25 lbs. per sq.inch provides a considerable improvement in the low altitude performance of the Spitfire Mk.IX aircraft, the modifications necessary to absorb the extra power being comparatively simple to execute.

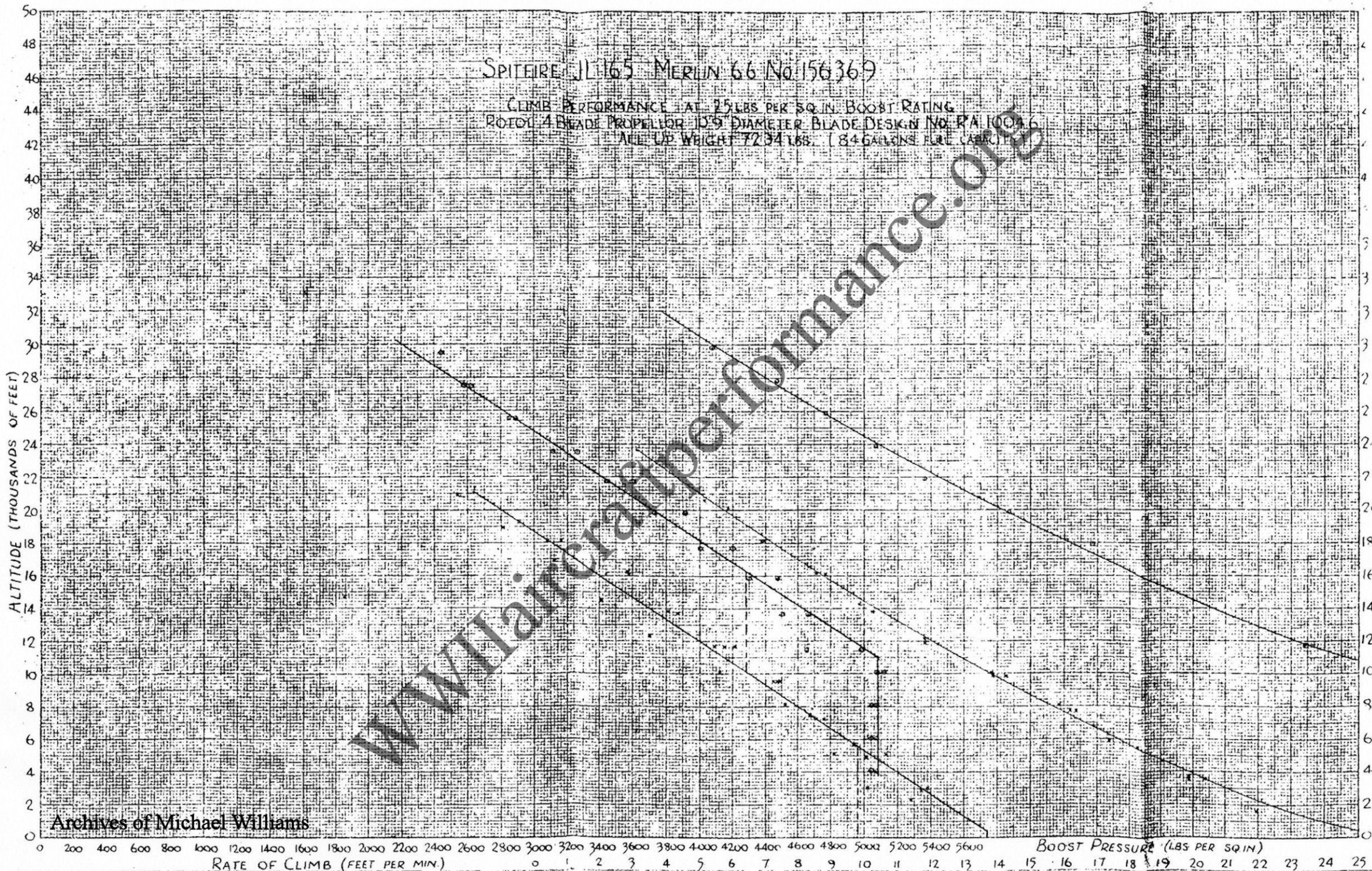
It appears that the propeller has insufficient blade area to absorb the increased power output of the engine with a resultant loss of efficiency, especially noticeable on climb performance.

A propeller of greater diameter or increased blade area such as a 5 blade type, should improve the rate of climb by some 300 feet per minute.

Dor/Chr/R.L.Strang.

SPITEIRE JL 165 MERLIN 66 No 156369

CLIMB PERFORMANCE AT 25 LBS PER SQ IN BOOST RATING
ROTOR 4 BLADE PROPELLOR 13'9" DIAMETER BLADE DESIGN NO RA 10046
ALL UP WEIGHT 7234 LBS. (84 GALLONS FUEL CAPACITY)



P. FIRE J165 MERLIN 66 No 156369

LEV. SPEED PERFORMANCE AT 25 LBS PER SQ IN. BOOST RATING
 NOT 4 BLADE PROPELLOR 10.9 DIAMETER BLADE DESIGN NO RA 10046
 NET UP WEIGHT 7234 LBS (84 GALLONS FUEL CAPACITY)

