

22 AUG 1944

AIRCRAFT AND ARMAMENT EXPERIMENTAL ESTABLISHMENT
BOSCOMBE DOWNHellcat FN.360
(Double Wasp R. 2800-10)Level speed performance in
auxiliary high supercharger gearA. & A. E. E. ref: CTO/AS.80.
M.A.P. ref: RA.5381/04/RDN.3a.
Period of tests: January - May 1944.TECHNICAL REFERENCE
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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 & action by the Ministry of Aircraft Production.

Progress of issue of report

Report No.	A. & A. E. E., R. A. File
15th Part of A. & A. E. E. /809	FN.344 - Handling trials with and without Mk. I. R.P. installation fitted.
16th do.	FN.344 - Effect on position error correction and speed of R.P. installation.
17th do.	FN.344 - Attitude measurements.
18th do.	FN.360 - Functioning tests of fuel system with 120 gallon drop tank.
19th do.	FN.360 - Brief handling trials with a long range drop tank beneath the fuselage.

1. Introduction.

Level speed performance has previously been measured in Main and Auxiliary low speed supercharger gears on Hellcat FN.322 (see 4th Part of this Report). At that time it was not possible to measure the high gear performance, as high altitude magnetoes were not fitted to that aircraft. High altitude magnetoes have now been obtained, but Hellcat FN.322 not now being available, the level speed performance in auxiliary high gear has been made on Hellcat FN.360.

The climb performance in high gear will form the subject of a further report.

2. Condition of aircraft relevant to tests.

2.1 General. This aircraft was identical in external configuration to that of FN.322 previously tested (see the 4th Part of this Report for full details).

2.2 Engine numbers and limitations. The aircraft was powered by a Double Wasp R.2800-10 engine, Maker's No. 8482, A.M. No. 48103.

The relevant engine limitations are given in the 4th Part of this Report.

2.3 Loading. The trials were made at a take-off weight of 12,150 lb., with the centre of gravity 28.4 inches aft of the leading edge at Station 75 (undercarriage down). This is the normal overload fighter loading without any external drop tank fitted. This weight was greater than that used for the tests on FN.322, which were made at the normal fighter loading of 11,400 lb. This higher weight of 12,150 lb. was necessitated by the need to carry sufficient fuel for the tests at high altitude.

3. Scope of tests.

Level speed measurements were made at 2700 rpm, 52 ins. Hg. manifold pressure (all-out level power) from 16,000 to 35,000 ft. altitude, with cooling gills closed and oil and intercooler flaps closed, at a take-off weight of 12,150 lb.

4. Results of tests.

The level speed performance has been corrected to standard ICAN atmospheric conditions by the methods of Report No. A. & A. E. E./Res/170, a supercharger constant $C = 0.002$ being used, and corrected to a mean weight of 11,500 lb. (i.e. 95% of take-off weight during the trials).

In order to relate these results to those obtained on FN.322 when using main and auxiliary low speed superchargers (reported in the 4th Part of this Report), they have also been corrected to 10,850 lb.

The position error correction used is given in the 4th Part of this Report. The compressibility error corrections given in Table III have been calculated by the methods given in Report No. A. & A. E. E./Res/208.

4.1 Level speed performance. The results are given in Table I and shown plotted in Fig.1. Also shown in Fig.1 is the performance corrected to a weight of 10,850 lb., the weight at which the previous level speed results were reported.

These results are summarised below:-

Auxiliary high speed supercharger gear		
	Weight 11500 lb.	Weight 10850 lb.
Max. true airspeed (mph) at full throttle height at max. permissible power.	373	375
Full throttle height at max. permissible power	23600	23600
True airspeed (mph) at max. permissible power at:		
30,000 ft.	352	357
35,000 ft.	307	320

The optimum change gear height from Auxiliary low to Auxiliary high speed supercharger for maximum level speed is when the manifold pressure in Auxiliary low gear has dropped to 45 $\frac{1}{2}$ ins. Hg. In standard ICAN atmospheric conditions this height is 22,200 ft.

5. Functioning of auxiliary high speed supercharger gear during trials.

During the high altitude performance trials in the auxiliary high gear considerable trouble was experienced with erratic operation of this gear (our letter dated 10th July 1944, ref: AEE/CTO/AS.80/83 refers). Some initial trouble was experienced with clutch slip, and when this was finally rectified the high gear performance was started. Wide variations in manifold pressure were obtained during the level speed performance measurements, both above and below full throttle height. These variations were much larger than could possibly be accounted for by variations in outside air temperature from day to day.

The air ducting through the auxiliary gears and the intercoolers etc. and all spring loaded doors in the system were visually examined, and appeared satisfactory. The auxiliary boost capsule which controls a butterfly in the air inlet to the auxiliary supercharger was then examined, and found to be defective. This was replaced, and the first set of levels after this replacement agreed substantially, as did the manifold pressure, with the best of the results so far obtained. However, on repeating tests, the manifold pressure again became erratic, although the auxiliary butterfly control capsule appeared to be still functioning.

Sufficient repeat tests were therefore necessary to define without doubt the level speed performance in auxiliary high speed supercharger gear. It is emphasised that the random variation observed would appear to be an inherent fault of the whole engine installation and its auxiliaries; and indeed this is confirmed by the fact that an even larger random variation of manifold pressure (and speed) has been observed on Corsair aircraft with a somewhat similar installation.

6. Discussion of results.

The speed-height curve at a weight of 10,850 lb. agrees with points obtained in auxiliary high speed supercharger on FN.322 (but which had been inadequate for reporting). Thus the level speed performance is applicable to both FN 360 and FN.322.

7. Further developments.

The climb performance in high gear is to be measured.

TABLE I
Level speed performance
Normal fighter overload; mean weight = 11,500 lb.
No external drop tank or bombs carried

Standard height feet	TAS mph	ASI mph	Corrections mph		RPM	Manifold pressure (Ins.Hg)	Mixture	Supercharger gear
			P.E.	C.E.				
16000	342	258	+12.9	-3.9	2700	52.0	Auto rich	Auxiliary High gear
18000	350	256	+12.8	-4.2	↓	↓	↓	
20000	358	253	+12.8	-4.6	↓	↓	↓	
22000	366	251	+12.7	-5.0	↓	↓	↓	
*23600	373	249	+12.7	-5.2	↓	↓	↓	
26000	368	235	+12.3	-5.1	↓	46.1	↓	
28000	361	222	+11.9	-4.8	↓	42.1	↓	
30000	352	209	+11.5	-4.5	↓	38.7	↓	
32000	339	193	+11.0	-4.1	↓	35.6	↓	
34000	321	173	+10.5	-3.4	↓	32.7	↓	
35000	307	164	+10.2	-3.2	↓	31.3	↓	

* Full throttle height.

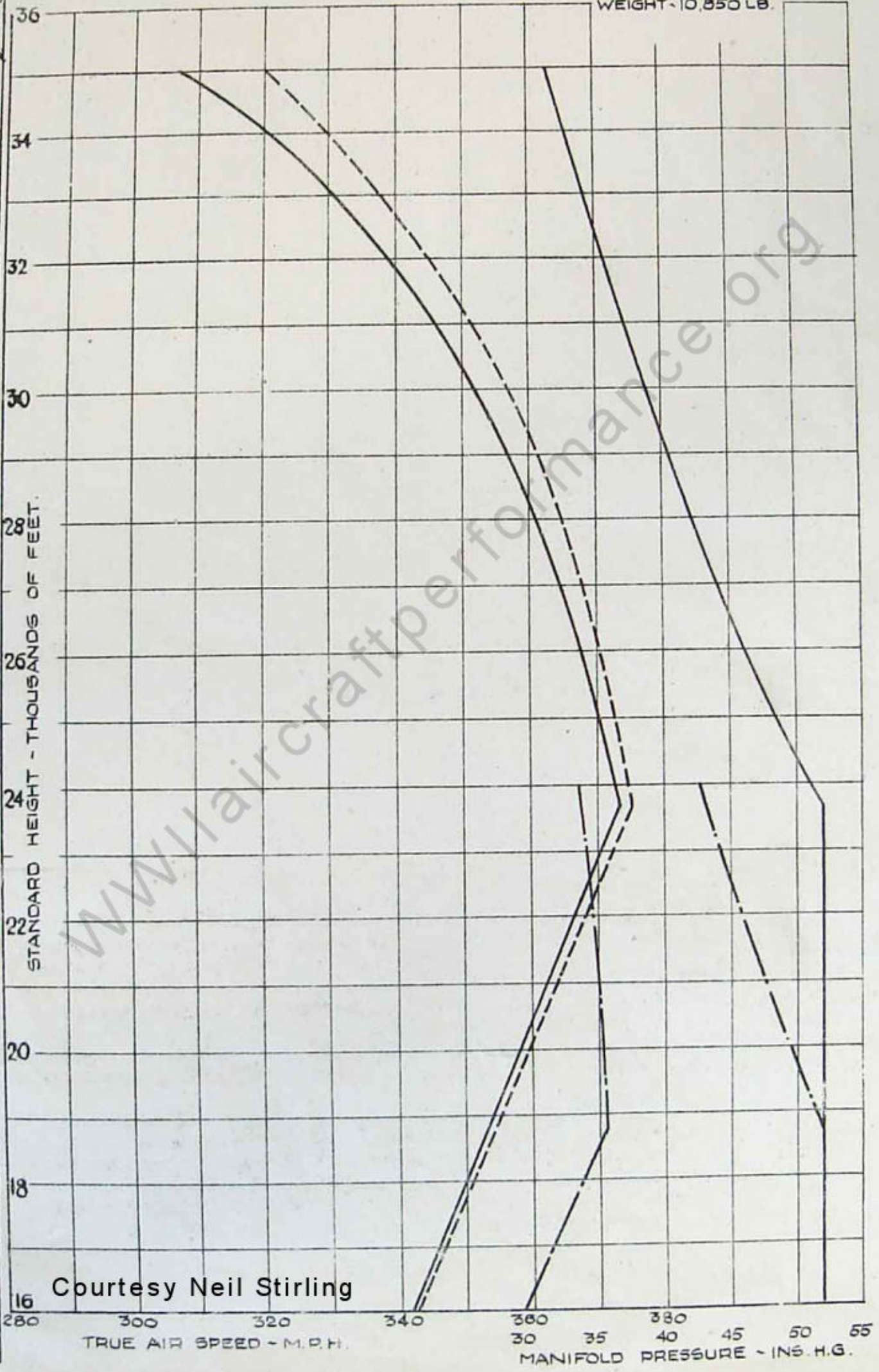
LEVEL SPEED PERFORMANCE IN AUXILIARY HIGH GEAR. Fig 1

COOLING GILLS DIL COOLER AND INTERCOOLER FLAPS CLOSED.

——— AUXILIARY HIGH SPEED GEAR - WEIGHT - 11,500 LB.

- - - - - " " " " " - WEIGHT - 10,850 LB.

- · - · - " LOW " " (REPRODUCED FROM 4th PART OF THIS REPORT)



D.O. 7-266
 20th PART OF REPORT N° A.E.A.E.E. 809 HELLCAT FN 360 CURVE N° 6567 TRACED A.A. DATE 25.7.44. CHECKED J.A.L. APPROVED

Courtesy Neil Stirling