AIRCRAFT AND ARMAMENT EXPERIMENTAL ESTABLISHMENT
BOSCOMBE DOWN

Lancaster I PB.995
(4 Merlin 24)

Position error trials and determination of specific air range with a 22,000 lb. bomb fitted.

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72nd Part of	A.& A.E.E./766.	PD.435 - Oil cooling and [illegible] suitability tests at 70,000 lb. take-off weight.
73rd	do.	PD.435 - Brief handling trials at weights up to 72,000 lb.
74th	do.	PD.435 - Brief handling trials with front escape hatch open.
75th	do.	PB.592 - Performance trials with and without 22,000 lb. bomb after modification to aircraft.
76th	do.	W.4963 - The effect on level speed of the H2S Mk.III blister and the position error of a static vent with the blister fitted.

Summary

Brief tests to measure the position error correction and the specific air range at 15,000 ft. were made on Lancaster I PB.995, which was adapted to carry a 22,000 lb. . bomb externally. Fuel flows, taken from results on Lancaster I JB.127 (54th part of Report No. A.& A.E.E./766), were used in the determination of specific air range.

The A.P.I. requirement for the port static vent was satisfied only when the aircraft was fitted with the bomb.

At 64,000 lb. the optimum specific air range at 15,000 ft. in FS supercharger gear was 0.99 air miles per gallon, obtainable at an airspeed of 175 mph ASI. The corresponding engine conditions in the ICAN standard atmosphere are about +4.5 lbs sq.in. boost (full throttle) and 2350 rpm.

1. Introduction.

Position error trials on the aircraft with and without a 22,000 lb. bomb fitted have been made. One set of speed measurements at various power conditions have also been made at a height of 15,000 ft. to provide range data.

Speed measurements under similar conditions have also been made on Lancaster I PB.592 and are reported in 75th part of this Report. Lancaster I PB.592 differs from PB.995 in that the nose and dorsal turrets had been removed and the openings faired in.

2. Condition of aircraft relevant to tests.

2.1 General.

Fuselage. FN 5 nose turret with 2 x .303" guns.
FN 50 Dorsal turret with 2 x .303" guns with faired taboo rail.
FN 120 tail turret with four .303" guns.
No ventral turret (position blanked off).
Deepened bomb aimer's window (Mod.780).
Navigation blister on starboard side only.
Bomb doors removed and bomb bay fitted with a metal fairing.
22,000 lb. bomb fitted.
Cabin heating duct on starboard side of fuselage at wing root.

/Wings.

Wings. No barrage cutters
No de-icing equipment
Three pulsometer pump fairings under each wing.

2.2 Engines. Four Merlin 24's
Ice guards on air intakes
Multi-ejector exhausts without shrouds

Engine Nos.	Firm's No.	A.M. No.
P.O.	201169	508472
P.I.	204107	509941
S.I.	205781	510778
S.O.	203732	509754

2.3 Propellers. Hamilton constant speed, fully feathering propellers, type A5/159 (paddle blade) with a diameter of 13 ft., were fitted to all engines.

2.4 Pressure head and static vents. All speeds quoted refer to the pilot's ASI, the pitot side of which was connected to the Mk.VIII head on the port side of the fuselage (Mod.883) and the static side to the port static vent. The starboard static vent may be connected to the Mk.XIV bombsight. The static vents were fitted in the standard positions for aircraft on which no H2S blister is fitted. Figs.2 and 3 show the position of the pressure head and static vents respectively.

2.5 Loadings. The following weights and c.g. positions were used in the tests:-

Tests	Condition of aircraft	Take-off weight	C.G. position ins. aft of datum (u/c down)
Position error trials	Bomb not fitted	53,900 lbs.	45.3"
	Bomb fitted	66,530 lbs.	44.3"
Range measurements	Bomb fitted	72,000 lbs.	45.5"

3. Tests made.

3.1 Position error. The position error of the port and standard vents was measured, by means of the Aneroid method, with and without the 22,000 lb. D.P. bomb fitted.

With the bomb fitted the speed range tested was 130 - 250 mph ASI and without it the speed range was from 120 - 250 mph ASI.

The pitot position error for pressure heads in the present position has previously been measured on other aircraft and found to be negligible.

3.2 S.A. Range. Speed measurements at various powers were made at 15,000 ft., in FS supercharger gear with radiator flaps shut. These speeds have been used in conjunction with fuel flows measured on Lancaster I JB.127 (see 54th part of Report No. A.& A.E.E./766), to obtain an assessment of the specific air range.

4. Results of tests.

4.1 Position error correction. The position error correction curves for the port and starboard vents are given in Fig.1. The position error correction of the port vent, when the store is fitted, satisfies the A.P.I. requirements being about -0.7 mph at the normal cruising speed. The position error correction of the starboard static vent did not meet the requirements for the Mk.XIV bombsight when the bomb was fitted. We understand, however, that the SABS Mk.IIA will normally be fitted to these aircraft and this bombsight requires no correction to the static vent.

4.2 Specific air range. The results of the specific air range determination, corrected to ICAN standard conditions and to the mean weight on test of 64,000 lbs. by the methods of A.& A.E.E./Res/170 using a supercharger constant .002 are given in Table I and Fig.4.

/At this

At this weight the optimum specific air range under ICAN atmospheric conditions at 15,000 ft. in FS supercharger gear is 0.99 air miles per gallon. This is obtained by using full throttle and adjusting the rpm to give an airspeed of 175 mph ASI. The corresponding engine conditions in ICAN standard atmosphere are +4.5 lb/sq.in. boost and 2350 rpm.

A speed increase to 190 mph ASI causes a 3% loss of range.

The speed given for the optimum specific air range is greater than the minimum speed for comfortable continuous cruising.

5. Discussion of results.

For comparison with tests on Lancaster I PB.592 (see 75th part of this Report) which was a similar aircraft except for the removal of the nose and dorsal turrets (opening faired in), the value of the optimum specific air range has been corrected to a weight of 68,500 lbs.

The comparative values are:-

Aircraft	Weight lbs.	Optimum SA.R. a.m.p.g.	ASI mph
Lancaster I PB.592	68500	0.99	175
Lancaster I PB.995	68500	0.96	175

It can be seen that the installation of the turrets has reduced the A.M.P.G. by approximately 3%.

It should be noted, however, that this comparison is not strictly valid owing to possible differences in:-

(a) the horse-powers of the engine at given rpm, boost and mixture setting, and

(b) the drag of the two aircraft, with similar external configuration.

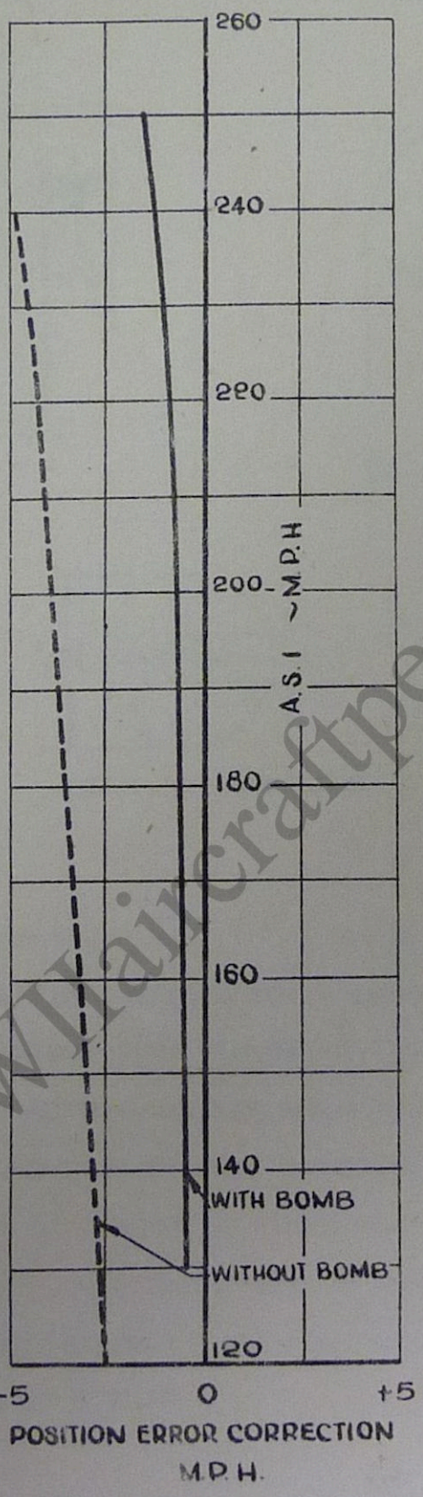
TABLE I

RPM	Boost lb/in^2		ASI mph	TAS mph	Total fuel flow galls/hr.	Specific air range
2650	+7.0		194	241	262	0.92
2550	+7.0		192	240	256	0.94
2450	+5.7	Full throttle	183	229	233	0.98
2350	+4.5		170	212	214	0.99
2250	+3.1		143	178	194	0.92

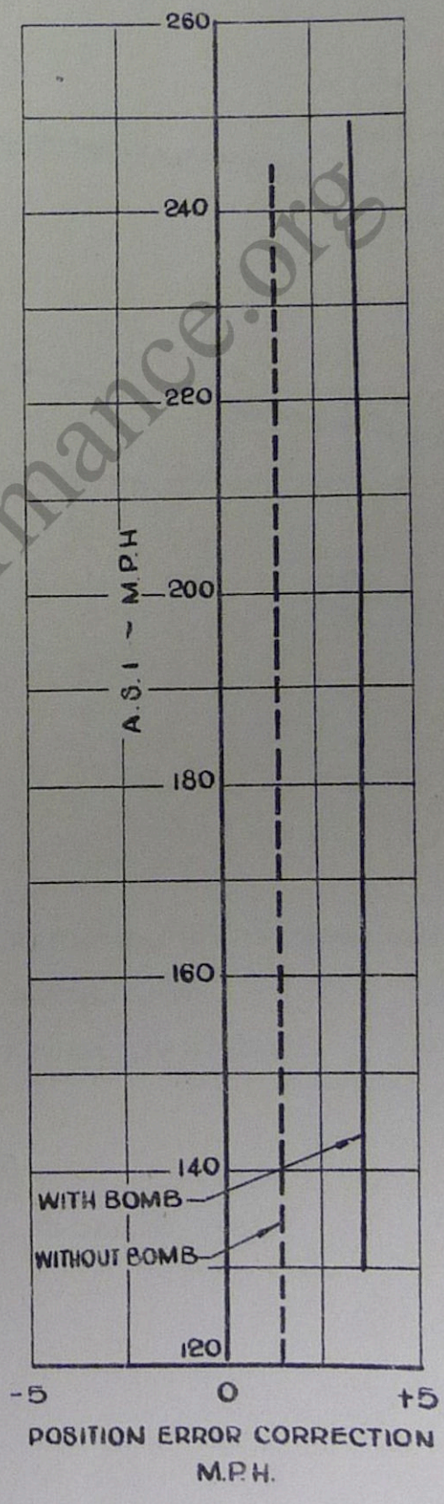
FIG 1

WEIGHT ~ WITH BOMB 66500 IBS
WITHOUT BOMB 54,000 IBS

PORT VENT



STARBOARD VENT.



POSITION ERROR OF STATIC VENTS

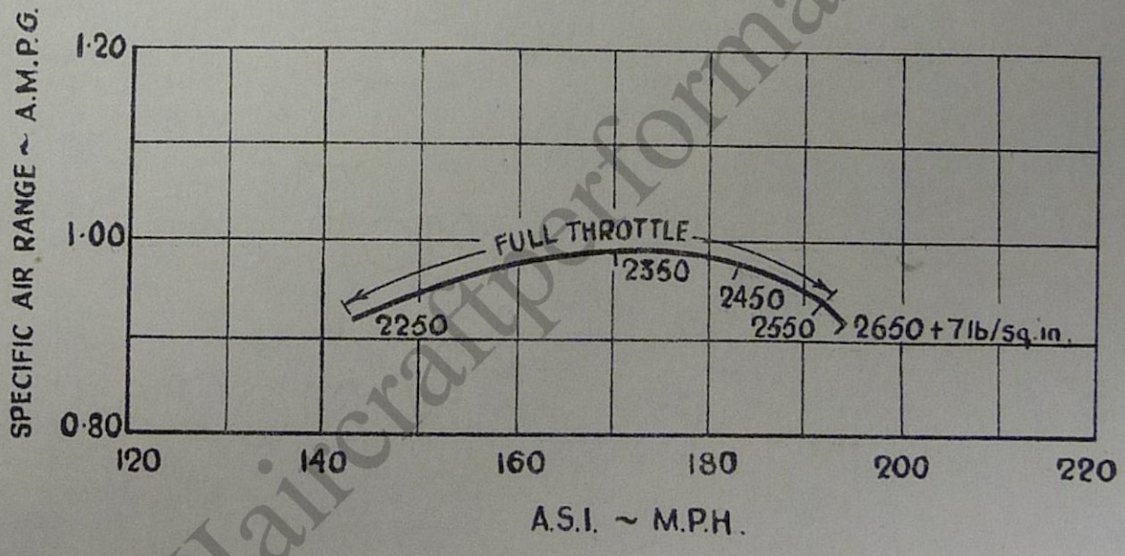
FIG. 4

CORRECTED TO A WEIGHT OF 64,000 LB.

15,000 FT.

F.S GEAR COLD AIR.

RADIATOR FLAPS CLOSED



SPECIFIC AIR RANGE WITH BOMB FITTED