CONFIDENTIAL TSCEP5E-1F/NAK/mm/36305

FLIGHT SECTION MEMORANDUM

REPORT SERIAL NO. TSCEP5E-1938

6 August 1945

War Emergency Performance on the Bell P-63A-9 Airplane, AAF No. 42-69417

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WAR EMERGENCY PERFORMANCE ON THE BELL P-63A-9 AIRPLANE, AAF NO. 42-69417

I. Introduction

Flight tests were conducted on the P-63A-9 airplane, AAF No. 42-69417, at Wright Field, Dayton, Ohio from 21 September 1944 to 31 March 1945. These tests were conducted at the request of the Project Engineer, Capt. E.E. Sands, Fighter Branch, Production Section, Procurement Division in order to obtain war emergency performance in level flight and climb. All tests were flown by Major R.B. Johnston with Capt. N.A. Krause and Lt. J.L. Corkill as Flight Test Engineers.

II. Summary

In general, handling characteristics, controllability, and stability of this airplane are satisfactory and comparable to other P-63 model airplanes. No comments or comparison can be made of performance obtained as no guarantees or estimated results have been submitted by the manufacturer at this power.

The principal results of performance obtained are as follows:

A.	High speed (58" and 3000 RPM) 16,000 Ft.	400.5 MPH
B.	Maximum speed at sea level (75" and 3000 RPM)	366 MPH
C.	Rate of Climb	
	1. Sea Level (75" and 3000 RPM)	3600 Ft./Min.
	2. Time to climb to service ceiling	31.2 Min.

All performance data is corrected to standard atmosphere and level flight data is corrected to weight at altitude.

III. Condition of Aircraft Relative to Tests

All tests were conducted at the fighter configuration at a take-off gross weight of 8,950 pounds with the C.G. at 25.1% MAC wheels down and 25.9% MAC wheels up. This weight includes full fuel and oil, four 50 caliber machine guns, and one 37 mm. cannon and ballast for ammunition for the above armament.

The airplane was equipped with an Allison 12 cylinder type V-1710-93 engine, and incorporates an auxiliary stage supercharger. The supercharger is automatically regulated. The P-63A-9 airplane is equipped with a water injection system which is automatic, coming in at 56" Hg. All power figures are based on Power curves, the Eng. Spec. No. and date not given. The airplane was equipped with an Aeroproducts propeller type A6425D3 being four bladed, hydraulically operated, and constant speed. It is 11 feet in diameter and has a pitch range of from 24 1/2 degrees low to 59 1/2 degrees high.

All flights were made with gear and flaps up, oil and coolant shutters automatic, and mixture automatic rich.

IV. Flight Characteristics

A. Taxiing and ground handling in general are very good. The tricycle gear and excellant vision over the nose makes ground handling easy. The brakes are not as strong as previous models by Bell Aircraft, and care must be taken not to overheat them while taxiing; especially the right brake, as the torque tends to turn the airplane to the left. Therefore the brakes must be used intermittently rather than steady to keep them from overheating.

B. Take-Off

The take-off roll is very short and easily controlled when the power is applied gradually. The rudder takes effect around 40 MPH and offers good directional control. Four to five degrees right rudder trim and neutral elevator trim are recommended for take-off. At military power the initial climb is steep; however good control can be maintained without excessive trim changes.

C. Stability

The airplane is statically and dynamically stable longitudinally. Laterally it is neutrally stable. The rudder forces are light and the directional stability is low which makes a poor gun platform.

D. Trim and Balance

Elevator and rudder trim tabs can be controlled from the cockpit, but the aileron tab is fixed and can be adjusted only on the ground. An aileron tab which can be controlled from the cockpit would be desirable since the fuel does not drain evenly from the two wing tanks. Therefore, the pilot must watch his fuel closely or he will be holding left or right pressure on the stick before he realizes it. The controls appear to be very well balanced.

E. Controllability

The airplane is easily controlled with sufficient control surfaces and control surface travel provided. All control forces are relatively light and do not build up excessively with speed.

F. Maneuverability

No extreme maneuvers were executed; however, in general the airplane is very maneuverable. The radius of turn seemed to be very small.

G. Stalling Characteristics

Stall characteristics are very good. Stall is straight forward and positive. Stall warning is given from three to five miles per hour above the stalling speed by a slight buffeting of the elevators.

H. Spinning Characteristics

No spins were attempted. Spin tests have been conducted on the P-63A airplane and have been reported in Memorandum Report No. TSCEP5ER-1859.

I. Diving Characteristics

Only shallow dives were made; however, the handling characteristics seemed to be good with no excessive forces building up on the rudder or elevator with changes in speed. Pull-outs are easily made with no tendency for elevator forces to reverse and the nose to " tuck under ".

J. Operation on Reduced Number of Engines

Not applicable

K. High Altitude Trials

During high altitude runs the engine has a tendency to cut out with changes in power setting. The pilot has no control over the propeller RPM, thus the RPM stays at 3,000 though the manifold pressure can drop from 56" to 45".

From the pilots standpoint, the basic feature of the uni-lever control is undesirable since there are two definite periods when the pilot desires high RPM and low manifold pressure which are impossible to obtain with the uni-lever control. These two times are in dog fights and while landing.

At altitudes of 15,000 feet to 25,000 feet the cockpit heater does not radiate sufficient heat to keep the pilot warm. Above 25,00 feet the heater gives no heat at all.

L. Approach and Landing Vision

Vision is good for both approach and landing since vision straight ahead is always good.

When the throttle is retarded, the propeller goes to full high pitch allowing the engine to slow down to approximately 1800 RPM. Then, when power is applied, time must be given for the propeller to change to a lower pitch before any power is obtained. This is usually accompanied with a "sputter" or cough throwing out black smoke. Since the RPM goes to full high pitch when

the throttle is retarded, the airplane has a tendency to "float" and not slow down as most airplanes when the power is cut. Because of these features, the throttle and propeller in one control is not desirable for approach and landing.

M. Night Flying

Lighting in the cockpit is very good. Vision at night is very good. Care must be excercised when lowering the landing light so that good directional control may be maintained.

N. Noise and Vibration

Both noise and vibration levels are relatively high. When the engine starts and before 1000 RPM is obtained, it vibrates excessively. In flight the noise and vibration levels are high. These seem to be caused by the relatively light construction of the fuselage with two doors to the cockpit between the engine and propeller.

O. Pilot's Report on Vision and Cockpit Lay Out

The cockpit and instrument arrangement was changed considerably for test purposes therefore no recommendations can be made.

P. Crew Report on Lay Out of Individual Stations

Not applicable.

V. Ship Board Tests

Not applicable.

VII. Performance Data

A. Airspeed, Altimeter, and Free Air Temperature Calibration

1. The airspeed, altimeter, and free air temperature position corrections are shown in Figure 1, Figure 2, and Figure 3 respectively.

B. High Speed

1. Curves of speed vs altitude are given in Figure 4 and Figure 5 at a take-off gross weight of 8,950 pounds.

2. High speeds in level flight at 3000 RPM, mixture auto-rich, oil and coolant shutters automatic at a gross weight at take-off of 8,950 pounds are presented in the following table.

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ALT. FT.	TRUE SPEED MPH	INTAKE MAN. PRESS. " HG.	BHP FROM CHART	THROTTLE
0	366.0	75.0	1820	W.O.
5000	381.5	73.0	1718	W.O.
10000	393.0	67.0	1530	W.O.
15000	400.0	59.0	1320	W.O.
16000	400.0	57.9	1285	W.O.
20000	394.5	52.5	1147	W.O.
25000	387.5	46.0	990	W.O.
30000	380.5	39.6	850	W.O.
35000	374.0	33.4	715	W.O.
37000	366.0	31.0	660	W.O.

C. Climb Data

1. Climb performance at 3000 RPM mixture auto-rich, oil and coolant shutters automatic and at a take-off gross weight of 8,950 pounds is presented in the following table. Climb performance curves are shown in Figures 6 and 7.

ALT. FT.	MAN. PRESS. " HG.	BHP FROM CHART	RATE OF CLIMB FT/MIN.	TIME TO CLIMB MIN.
0	75	1820	3600	
4000	71.5	1725	3690	1.00
5000	70.5	1700	3680	1.30
10000	65.5	1540	3520	2.80
15000	59.5	1360	3390	4.20
16000	58.0	1320	3100	4.50
20000	52.8	1175	2660	5.80
25000	46.0	985	2020	8.00
30000	39.0	810	1400	11.00
35000	31.2	665	780	15.60
38000	26.8	570	400	20.6

S/C = Service Ceiling 40,400 100 Ft/Min. Rate of climb
A/C = Absolute Ceiling 41,200 ft.

2. Time to climb to service ceiling at War Emergency Power was 31.2 minutes.

D. Cooling Shutter Tests

1. The effect of oil and coolant shutter position on indicated air-speed and coolant temperature in level flight is shown in Figure 8 and Figure 9.

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VII. Curves

Curves are located in Appendix I.

VIII. Conclusions

None

IX. Recommendations

It is recommended that the uni-lever control of RPM and manifold pressure be changed so the pilot may have separate control of each.

X. General Dimensions and Photographs

A. General Dimensions

Length	32 ft. 8 3/8 inches
Height	12 ft. 6 7/8 inches
Span	38 ft. 4 inches

B. Photographs

1. #142407 Front View
2. #142408 3/4 Front View
3. #142409 Side View
4. #142410 3/4 Rear View

Distribution

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11 Fighter Unit, Flight Section

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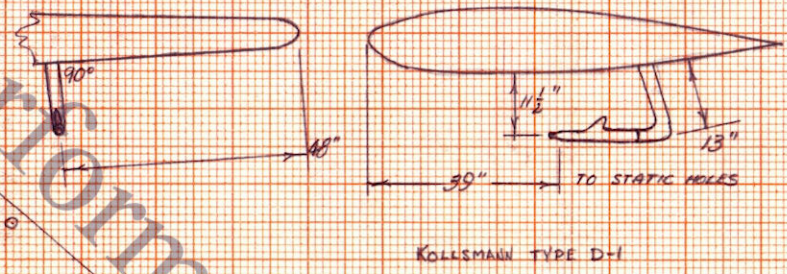
APPENDIX A

FIGURE I	Airspeed Calibration
FIGURE II	Altimeter Calibration
FIGURE III	Free Air Temp. Calibration
FIGURE IV	Speed vs Altitude
FIGURE V	Level Flight Data
FIGURE VI	Climb Data
FIGURE VII	Climb Data
FIGURE VIII	Level Flight Oil Shutter Calibration
FIGURE IX	Level Flight Coolant Shutter Calibration
FIGURE X	RPM vs P_2/P_1 (Fuel - Air)
FIGURE XI	Gross Weight at Altitude
FIGURE XII	Power Required at Sea Level

AIRSPEED CALIBRATION

P-63A-9 42-69417
VS
PACER AIRPLANE

FIGURE I



KOLLSMAN TYPE D-1

FIG. 1

FLIGHT TEST ENG BR WF 9-29-44

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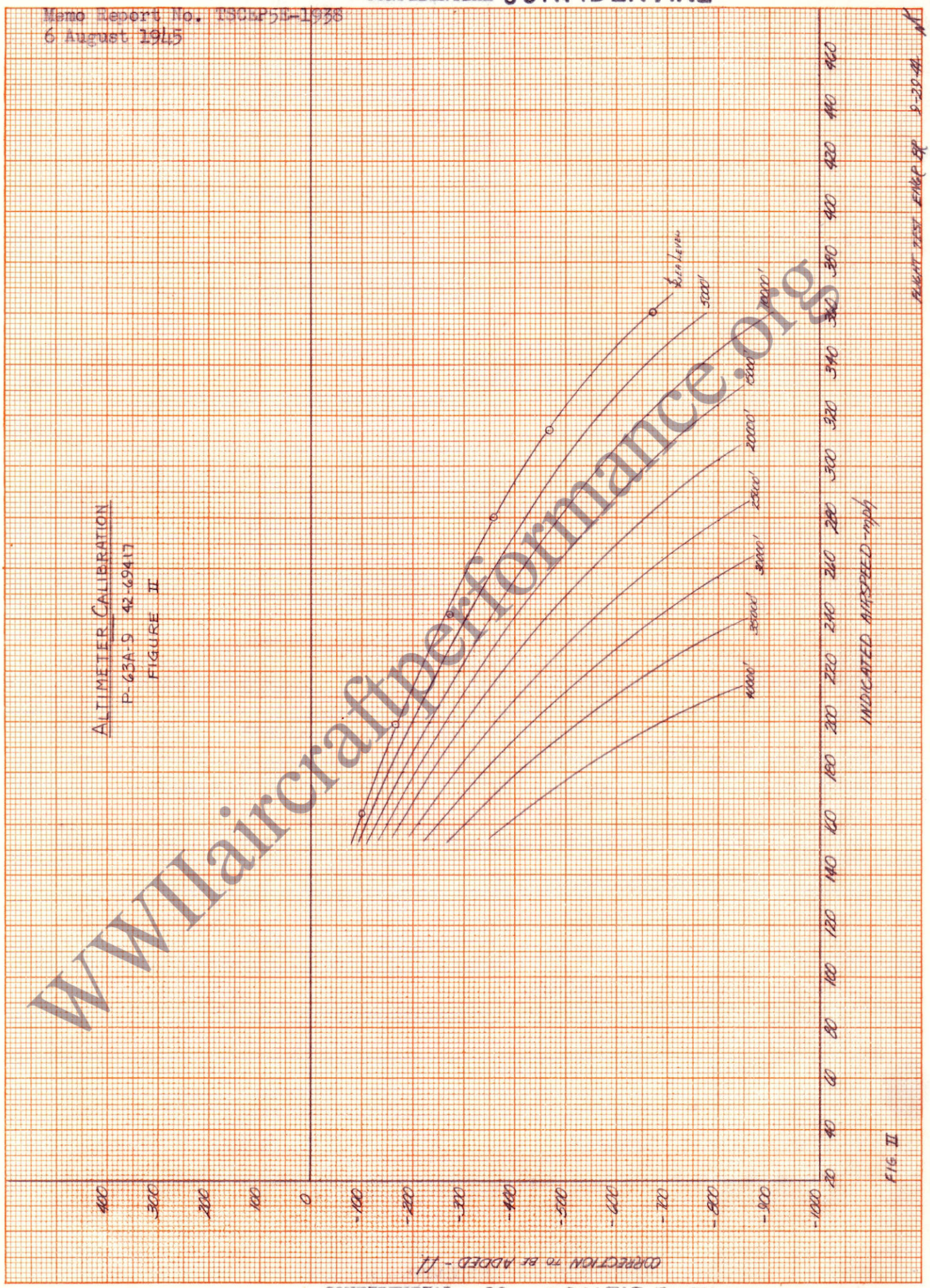

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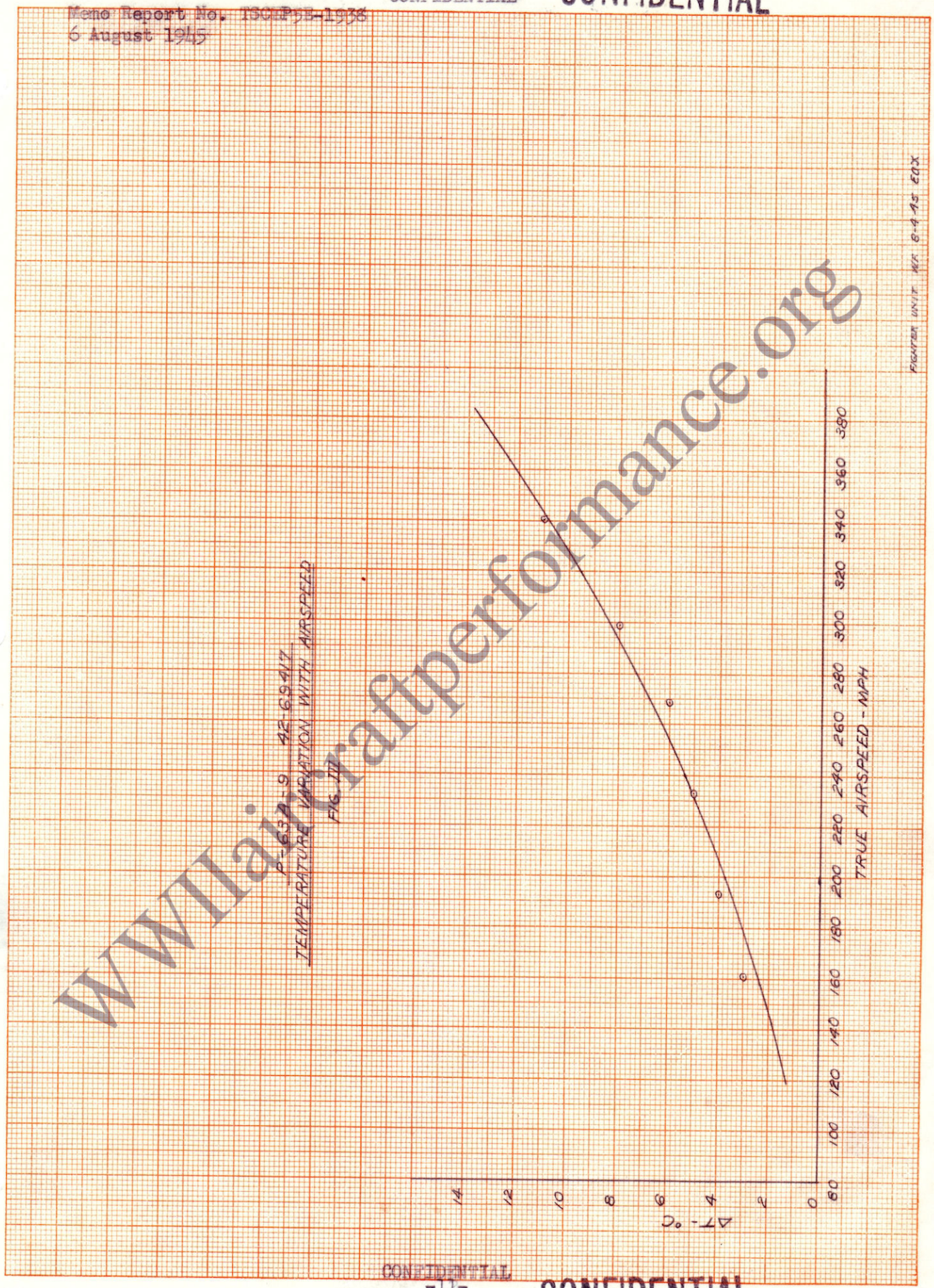

P-63A-9 42-69417
TEMPERATURE VARIATION WITH AIRSPEED
FIG. III

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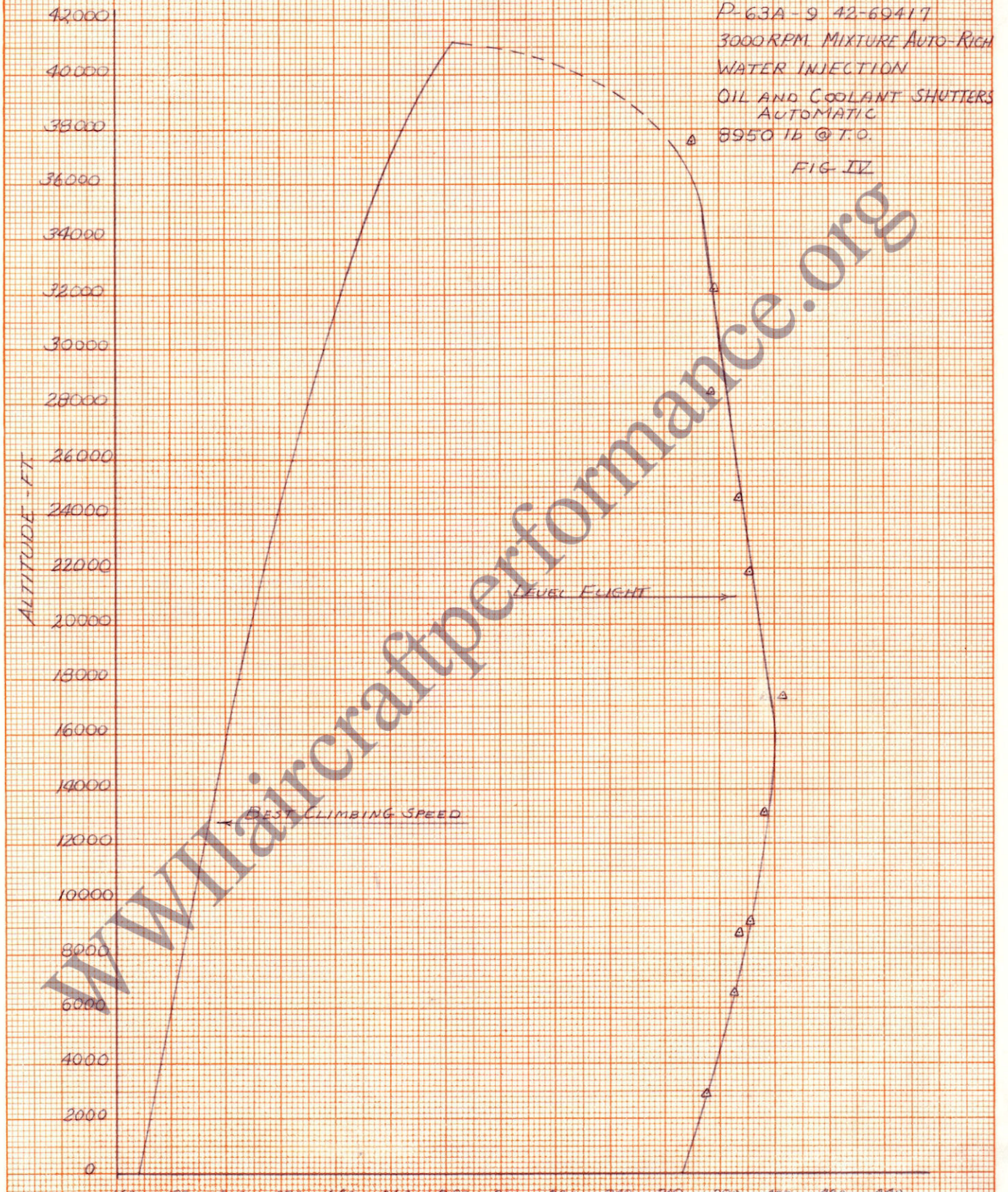
SPEED VS ALTITUDE
P-63A-9 42-69417
3000 RPM. MIXTURE AUTO-RICH
WATER INJECTION
OIL AND COOLANT SHUTTERS AUTOMATIC
8950 lb @ T.O.

FIG IV



Fighter Unit No. 7-10-45 MEC.

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W-25339

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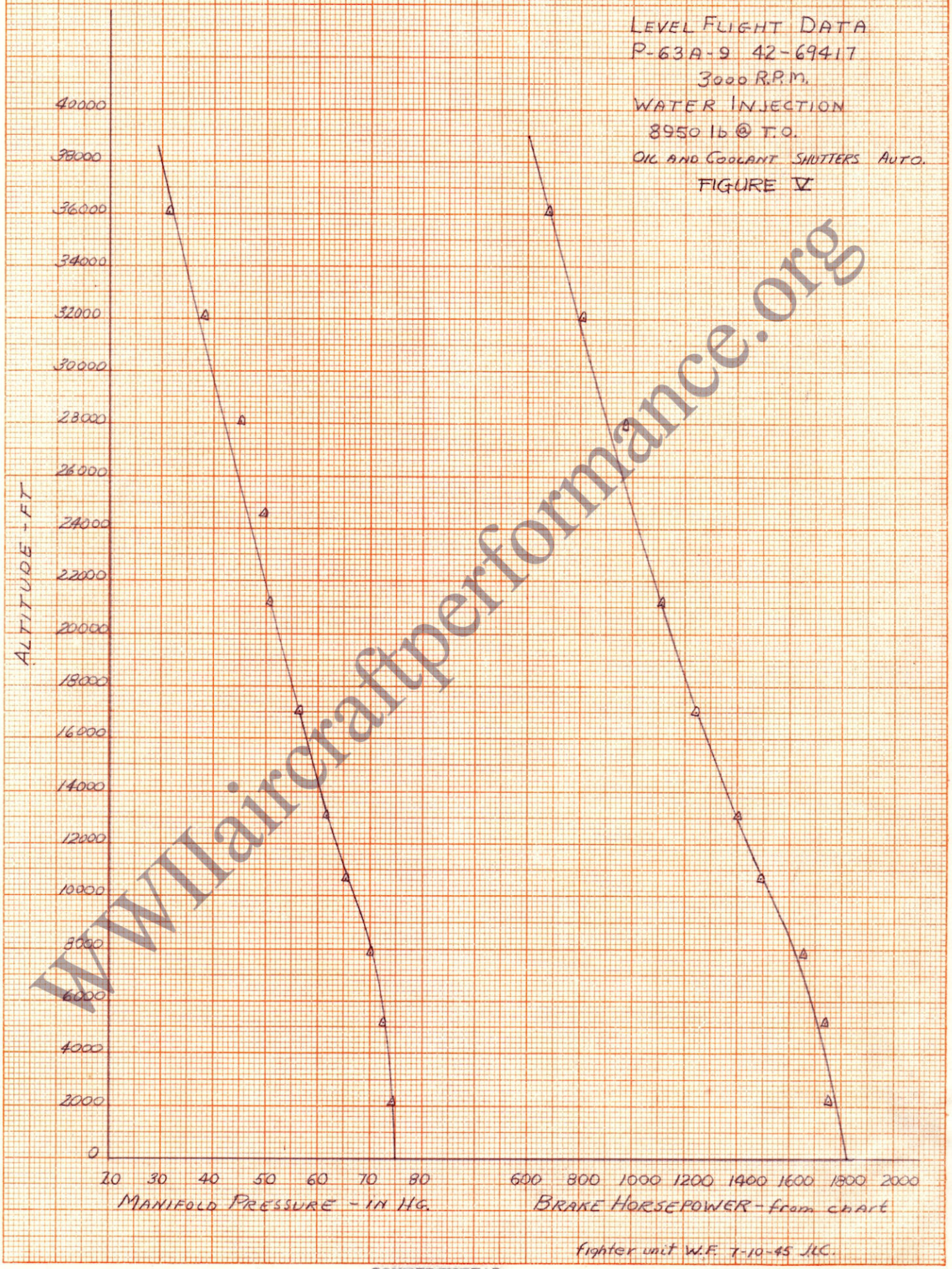
LEVEL FLIGHT DATA
P-63A-9 42-69417
3000 R.P.M.
WATER INJECTION
3950 lb @ T.O.
OIL AND COOLANT SHUTTERS AUTO.
FIGURE V



fighter unit W.F. 7-10-45 J.C.

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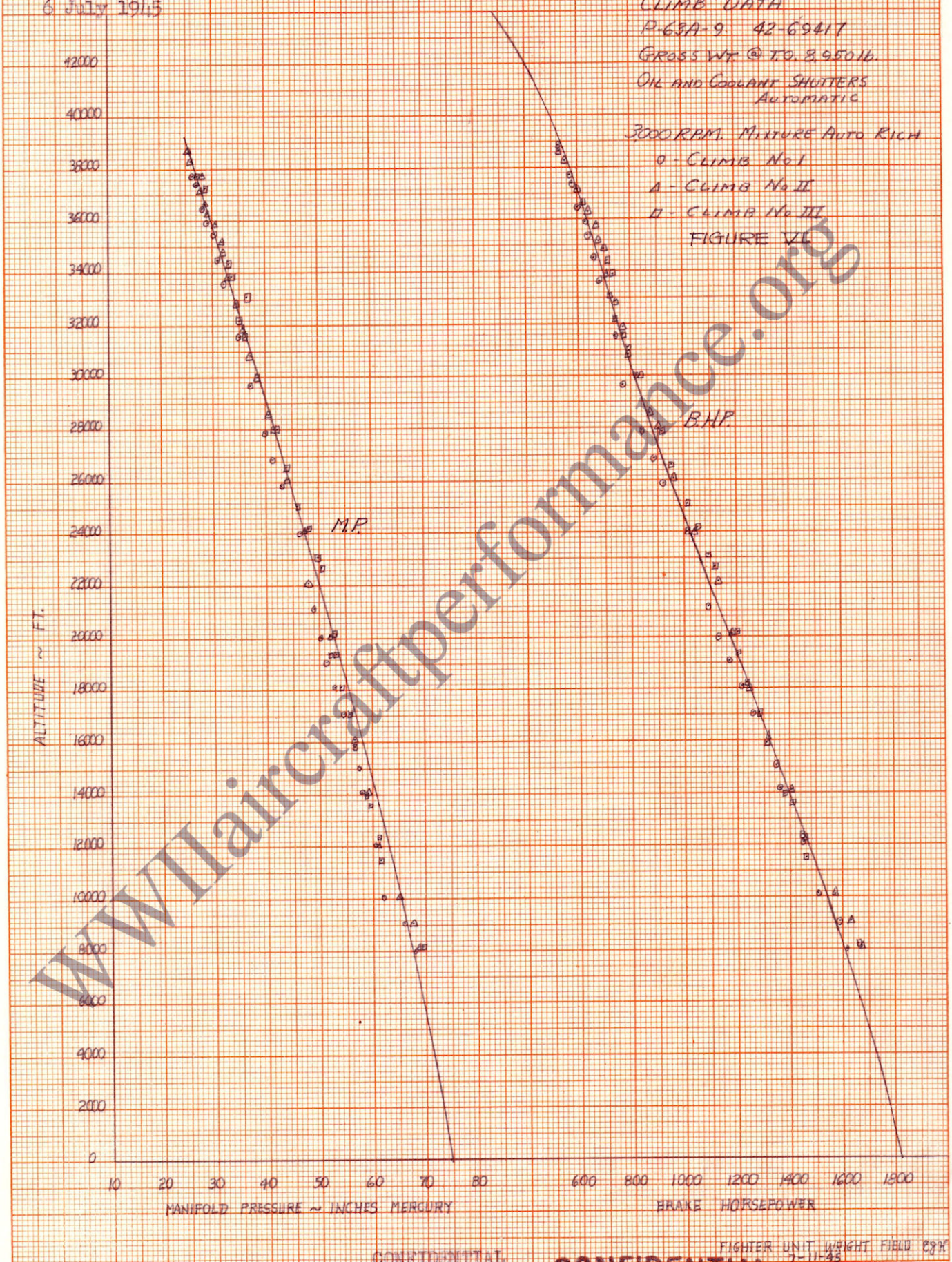
6 July 1945

CLIMB DATA
P-63A-9 42-69417
GROSS WT @ T.O. 8,950 lb.
OIL AND COOLANT SHUTTERS AUTOMATIC

3000 R.P.M. MIXTURE AUTO RICH
0 - CLIMB No I
Δ - CLIMB No II
□ - CLIMB No III

FIGURE VI



FIGHTER UNIT WRIGHT FIELD 7-11-45

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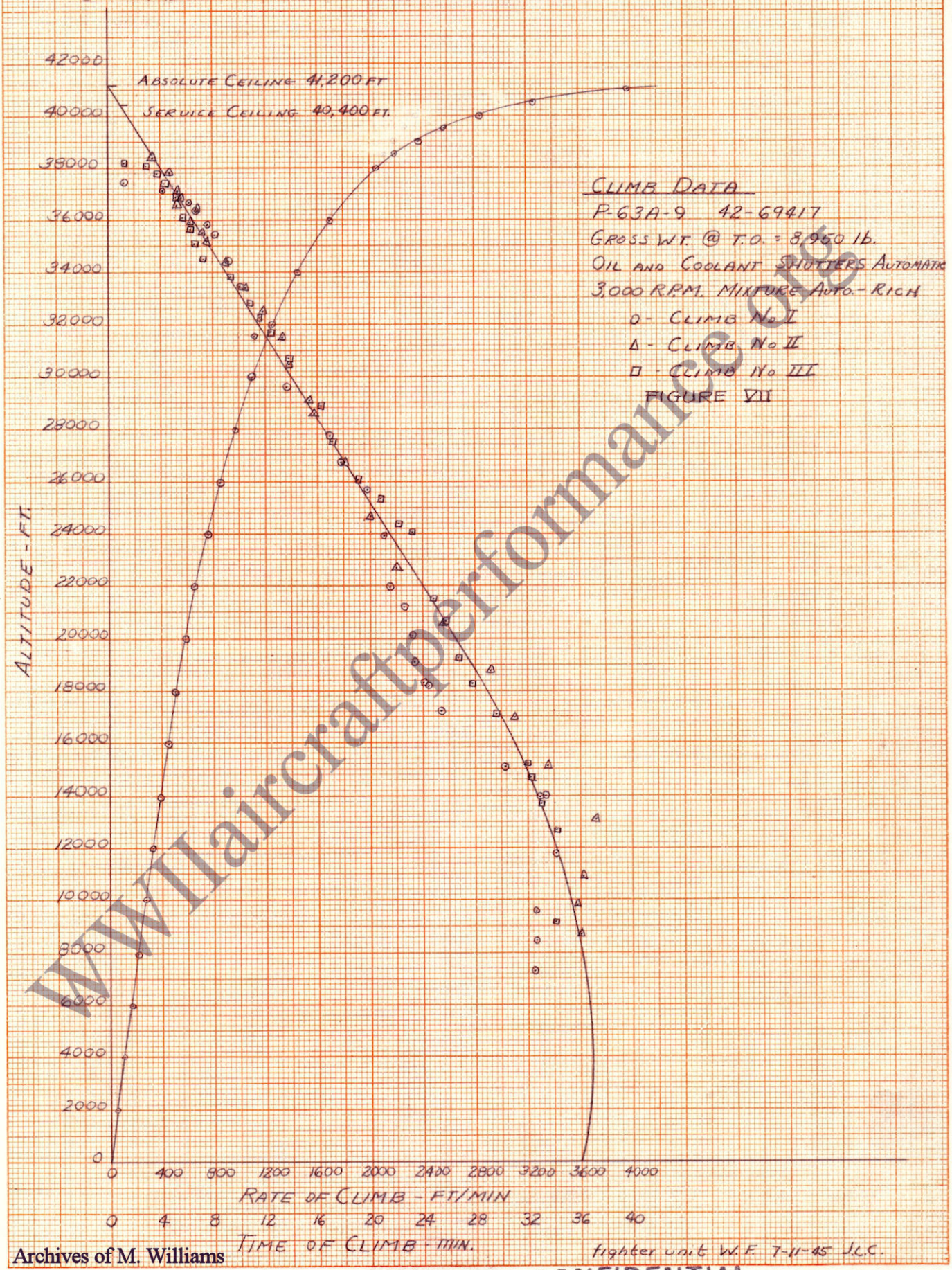

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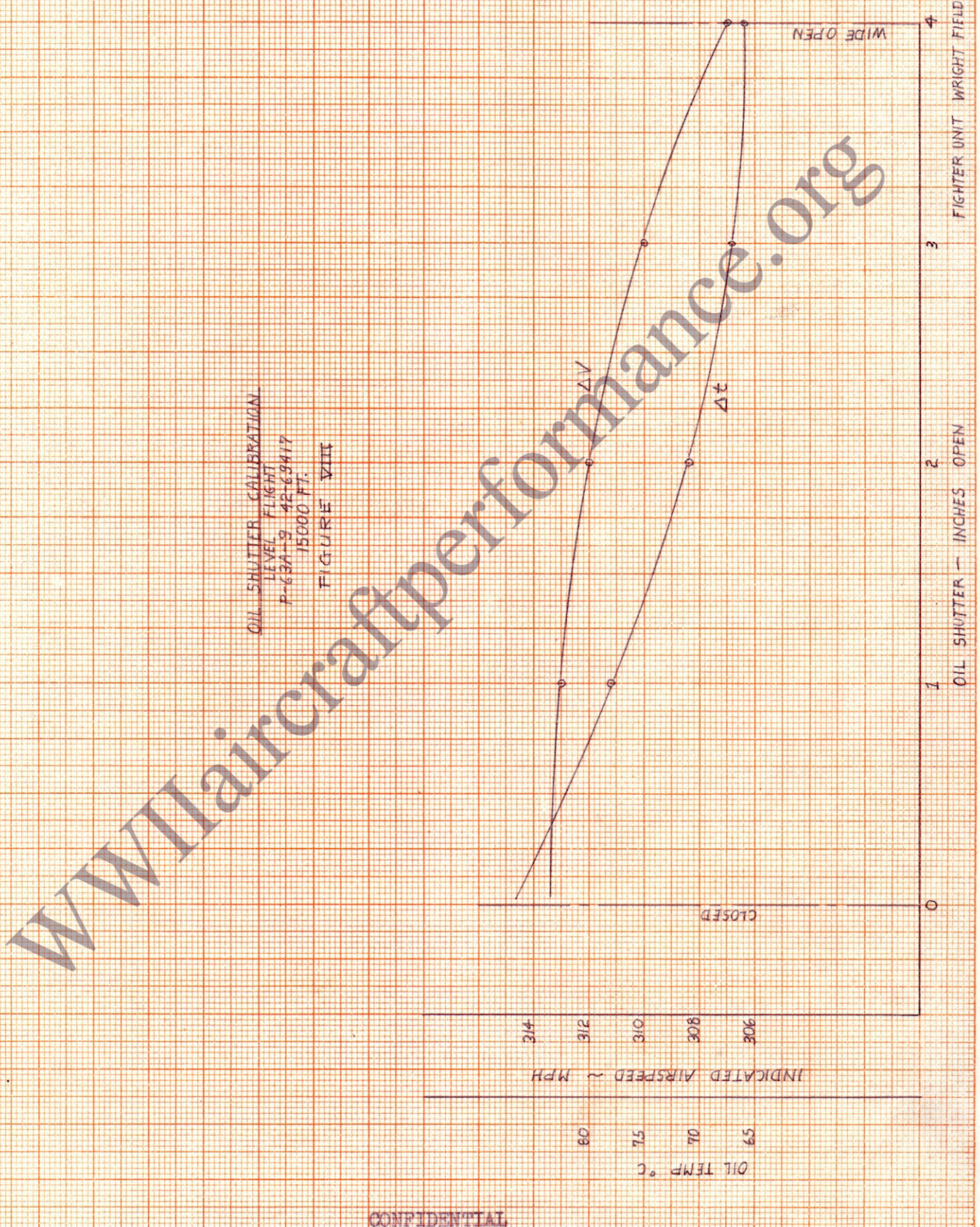

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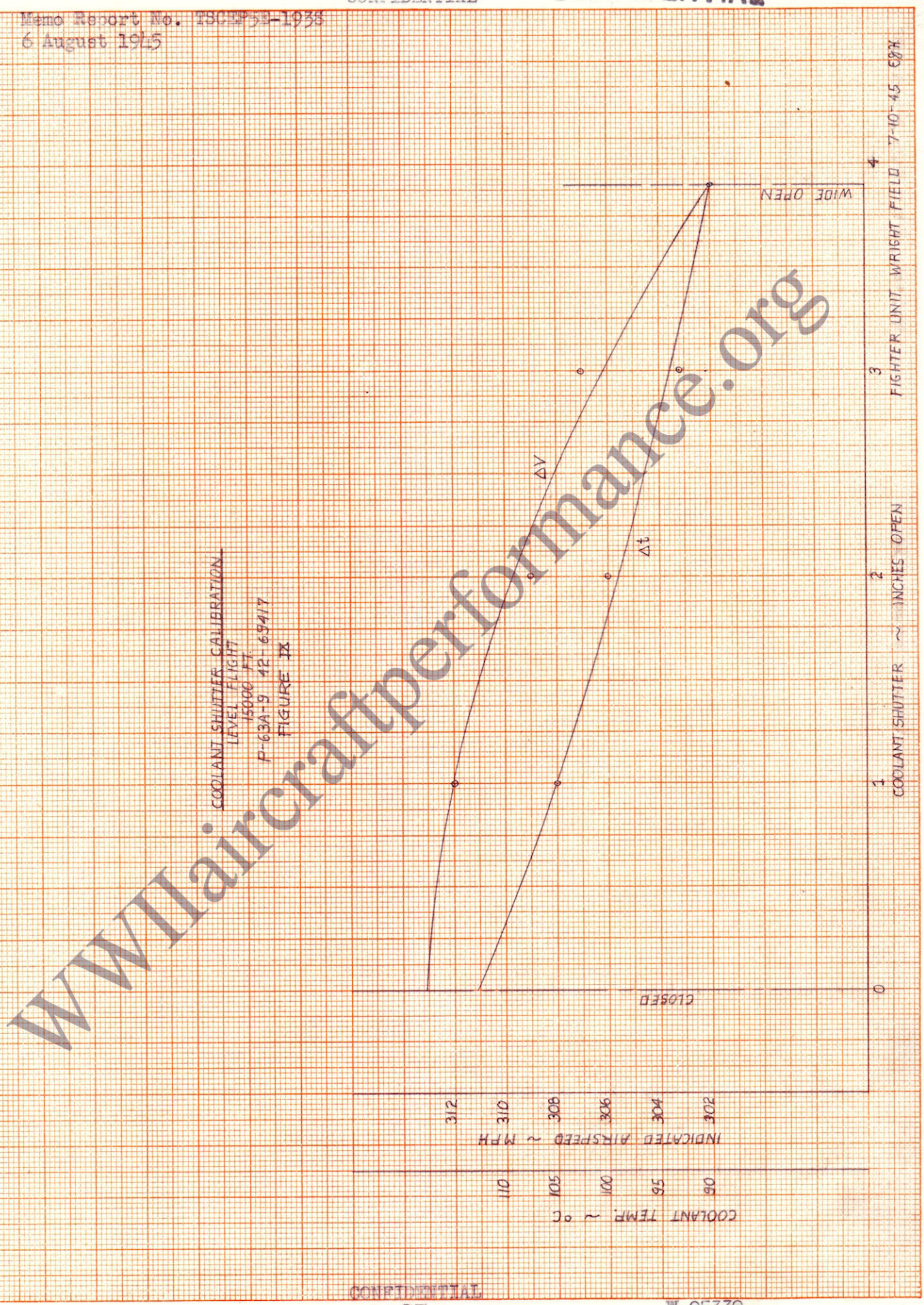

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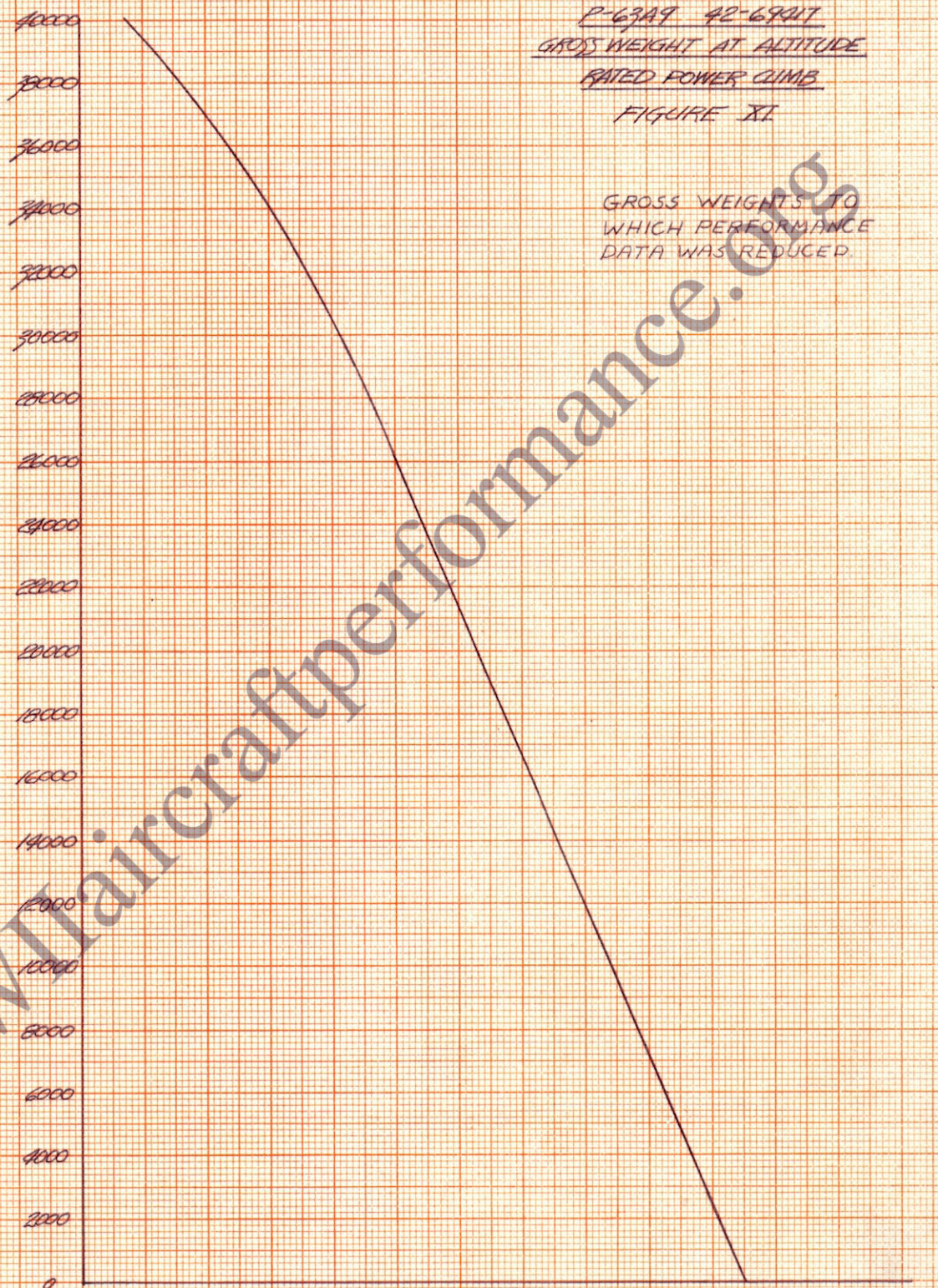
RPN vs $\frac{P_2}{P_1}$ (FUEL AIR)
P-63A-9 42-69417
FIGURE X

FIGHTER UNIT WRIGHT FIELD 7-10-45 EHM

P-63A9 42-69817
GROSS WEIGHT AT ALTITUDE
RATED POWER CLIMB
FIGURE XI

GROSS WEIGHTS TO
WHICH PERFORMANCE
DATA WAS REDUCED



FIGHTER UNIT W.F 7-10-45 JLC.

POWER REQUIRED
AT
SEA LEVEL
F-63A-3 42-6917
FIGURE XII

△ - 2965 D.A.
○ - 6650 D.A.
□ - 8900 D.A.
▽ - 9330 D.A.
◇ - 13,200 D.A.
◇ - 17,400 D.A.
◇ 21,900 D.A.
▷ 24,650 D.A.
○ 24,880 D.A.
□ 25,310 D.A.
◇ 28,570 D.A.
✕ 32,330 D.A.
△ 37,950 D.A.

1700 1600 1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200

60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500

V/W

FIGHTER UNIT W.E. 7-10-45 EJH

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