P-40Q
M.R.

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232 sq ft Wing Area

ENGINEERING DIVISION MEMORANDUM
REPORT SERIAL NO. ENG-47-1728-A
5 April 1944

FLIGHT TESTS ON THE CURTISS XP-40Q-2, AAF No. 42-9987

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Flight Test Engineering Branch
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I Introduction

Flight tests were conducted on the XP-40Q-2 airplane at the contractor's plant, Buffalo, New York, by Lt. Robert M. Edholm from 8 March to 24 March 1944, during which time 20 flights were made for a total flying time of approximately 25 hours. These tests were made at the request of the Chief, Aircraft Projects, Engineering Division, in order to check the high speed and climb performance at military and war emergency power ratings.

The XP-40Q-2 is a modified version of the P-40 series fighter airplane. The wing tips are square or clipped, the coolant radiator system has been moved into the wing section and a "bubble" type canopy is installed. It is equipped with an Allison V-1710-121 engine with water injection and a four bladed Curtiss Electric controllable propeller, blade design 714-102-18.

The -2A model was flown at the time of the tests, several modifications in the cockpit and the installation of automatic coolant and oil shutters being noted. Comments on the -2A model are noted in other sections of this report.

II Summary

In general the airplane performance and handling characteristics were very good, and it is a decided improvement over previous models of the P-40 series. At war emergency power with water injection a high speed of 420 MPH at 15,000 ft. and a maximum rate of climb of 4410 ft. per minute at 5000 ft. were obtained. At military power a high speed of 407 MPH at 21,000 ft. and a maximum rate of climb of 3210 ft. per minute at sea level were obtained. At 3200 RPM with water injection, a maximum increase of speed of 4 MPH at 20,500 ft. and a maximum increase in the rate of climb of 530 ft. per minute at 16,700 ft. were obtained. Improved performance through use of 3200 RPM, war emergency power, may only be realized between 12,000 and 32,000 ft. in climb and between 20,000 ft. and 32,000 ft. in level flight.

III Condition of Aircraft Relative to the Tests

A. Flight tests were conducted at a take-off gross weight of 9000 lb. with the c.g. at 29.8% MAC, wheels up. This weight corresponds to full combat weight of the production airplane and includes full fuel and oil, 11 gallons of water and ballast for four caliber .50 guns and 235 rounds of ammunition per gun.

B. All tests were conducted with landing gear retracted and wing flaps neutral. In level flight oil cooler flaps were closed and coolant flaps neutral; in climb oil cooler flaps and coolant flaps were wide open.

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The coolant flap neutral position corresponds to a flush or streamlined position. Dummy gun blast tubes were installed and all radio antennae were in place.

C. The engine was not provided with an automatic boost control and performance could not be obtained at a single control setting.

D. The airplane had been sanded and buffed prior to flight tests by the Materiel Command; however, use had reduced the finish to one representative of a service finish.

IV Flight Characteristics

A. Taxiing and Ground Handling

The airplane responds readily to braking application, although slight "pumping" of brake pedals is necessary for heavy braking. Because of the long nose and its height in the taxi position, vision ahead is greatly restricted and weaving of a fairly wide magnitude is necessary. The tail wheel is steerable which makes response to directional control easy with rudder applications. Because of the narrow tread care must be exercised during strong cross winds.

B. Take-off

The take-off characteristics of the P-40N are normal for a single engine airplane. Slight right rudder trim and neutral elevator trim are required. The airplane takes off after a normal ground run and has a normal initial angle of climb. Vision ahead is satisfactory for take-off upon acceleration to nose down position but poor in climb over nose making constant turning necessary.

C. Stability

Longitudiral, directional, and lateral stability were checked at rated power level flight, cruising power level flight, and wheels and flaps down in power off glide. In all cases, the airplane was statically and dynamically stable longitudinally and directionally, and generally neutrally stable laterally.

D. Trim and Balance

The airplane is readily trimmed for all conditions of speed and power. In contrast to previous P-40 model airplanes, very slight aileron trim is required over the entire speed range. In addition, rudder trim correction has been so reduced that 4-1/2 points will cover the entire speed power range in contrast to a value of about twice that amount on previous P-40 model airplanes.

The airplane is noticeably nose heavy when flaps and landing gear are extended, but this change in trim can be easily corrected by use of the elevator trim tab. Opening of the prestone and oil cooler

flaps cause only very slight changes in nose heavy trim.

E. Controllability

Handling qualities have been greatly improved over previous P-40 model airplanes. Steep right turns (against engine torque) are easily executed. The control forces about the three axes are light and well balanced. At high speeds up to 425 IAS all controls were moderate in force and greatly effective.

F. Maneuverability

The maneuverability of this airplane over previous P-40 model airplanes has been greatly increased due to the squared or clipped wing tips. The rate of roll is very good and it has a normal radius of turn for a fighter. Response to controls in rolls, loops, and Immelman turns is good and these maneuvers are easily executed.

G. Stalling Characteristics

In power off stalls with flaps and landing gear up or down, the airplane stalls straight forward in a well controlled stall if the maneuver is executed slowly. In power on stalls with flaps and landing gear up or down there is a tendency for the left wing to drop. If the maneuver is executed rather quickly the left wing will drop so fast that, for an inexperienced pilot, a spin may be inadvertently entered. Warning of the approaching stall is given by a noticeable buffeting of the controls and shaking of the airplane.

Stalls for complete configuration were conducted on the -2A airplane after completion of performance tests on the -2 airplane. Results of stall tests are given in Section VI.

H. Spinning Characteristics

No spin tests were performed.

I. Diving Characteristics

This airplane has very good diving characteristics as only slight aileron trim and moderate rudder trim are required. No buffeting of airplane or controls have been detected to speeds up to 425 IAS and the controls are moderate in force and very effective.

J. Single Engine Operation

Not applicable this airplane.

K. High Altitude Trials

The general operation of the airplane and the effectiveness of all controls at high altitudes and low temperatures are satisfactory.

However, trim tab forces greatly increased and it became more difficult to trim the airplane at extremely low temperatures. It was noted that operation of flaps and gear at about -57°C appeared to be 2 to 3 times slower than at normal temperatures.

L. Approach and Landing

The airplane has a fairly steep glide angle and it may be easily landed wheels first or 3 point. If a fairly high approach is made with power off vision is good over the nose. Because of the narrow landing gear tread the airplane has a tendency to ground loop easily and the pilot must necessarily be alert on rudder and brakes in a crosswind.

M. Night Flying

No night flights were made on this airplane. However, it is believed that direct or reflected glare from the instrument panel will be objectionable against the bubble type plexiglass canopy unless the panel is well hooded.

N. Noise and Vibration Level Tests at Crew Stations

The noise and vibration level in the cockpit is moderately low and is not objectionable at any time.

O. Pilot's Report on Vision and Cockpit Layout

All around vision from the cockpit is excellent for this type airplane with the bubble type plexiglass canopy installation. Vision is effected about 40° - 45° downward over the leading edge of the wing if the pilot seats himself high in the cockpit. Very little distortion was noted.

All controls in the cockpit are easily accessible to the pilot and in general the cockpit layout is satisfactory. However, it is believed that if a rudder trim tab wheel of larger diameter without a handle be substituted for the present one tab corrections could more easily and quickly be made.

Production P-40K, number 2A was flown upon termination of performance tests on #2 airplane and several cockpit alterations were noted. Oil cooler and prestone shutters are automatic which obviates the necessity of altering the exit positions of these shutters manually.

P. Crew Report on Layout of Individual Stations

Not applicable this airplane.

V Ship Board Tests

Ship board tests were not conducted.

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VI Performance Data

A. Airspeed Calibration

The location of the airspeed head and the airspeed position correction is given in Fig. 1.

B. Maximum Speed

1. Curves of Speed vs. Altitude are given in Fig. 2 for a take-off gross weight of 9000 lbs.

2. High speed at 3000 RPM, 75.0" Hg. (war emergency rating, water injection) was 420 MPH at 15,000 ft. Oil cooler flaps were closed and coolant flaps were neutral.

3. High speed at 3000 RPM, 59.5" Hg., (military power rating) was 407 MPH at 24,000 ft. Oil cooler flaps were closed and coolant flaps were neutral.

4. Maximum speed at 3200 RPM, 75.0" Hg. (water injection) was 422 MPH at 20,500 ft. Oil cooler flaps were closed and coolant flaps were neutral.

5. The effect of oil flaps and coolant flaps on speed and cooling was not obtained due to damage to the propeller before completion of flights. Adequate cooling was accomplished in level flight with the oil flaps closed and coolant flaps neutral.

C. Climbs

1. Results of climbs made at take-off gross weight of 9000 lbs. are given in Fig. 4 and Fig. 5, with corresponding power data given in Fig. 6. Climbs were made with oil and coolant flaps wide open.

2. Service ceiling for 3000 RPM was 39,000 ft. Maximum rate of climb for 3000 RPM, 59.5" Hg. (military power) was 3210 ft./min. at sea level. The maximum rate of climb for 3000 RPM, 75.0" Hg. (war emergency, water injection) was 4410 ft./min. at 5000 ft. with an initial rate of climb at sea level of 3960 ft./min. Water injection climbs were made until all the water was consumed. Since improved performance is realized with water injection up to 28,500 ft. in climb and up to 34,000 ft. in level flight it is evident that water injection provides more power up to these altitudes. 28,500 ft. in climb and 34,000 ft. in level flight correspond to an engine altitude of approximately 28,000 ft., the difference being due to ram. Chart powers given in Fig. 3 and Fig. 6 show less power with water on for these same altitudes; this condition is most likely due to the power curves being for different mixture strengths than those obtained in these tests.

3. One climb was made at 3200 RPM with water injection from 13,000 ft. to 29,000 ft. The maximum increase in rate of climb was 530 ft/min. at 16,700 ft. Maximum rate of climb by extrapolation would be approximately 4080 ft/min. at 7000 ft. As shown in Fig. 4 there is no advantage in using 3200 RPM below 12,000 ft. or above 33,000 ft. Time to climb to altitude could be decreased by climbing at 3000 RPM to 12,000 ft. At 12,000 ft. shift to 3200 RPM and climb to 33,000 ft. At 33,000 ft. shift to 3000 RPM and continue to service ceiling.

4. Time to climb to 39,000 ft. at 3000 RPM, 59.5" Hg. was 28.9 min. Time to climb to 39,000 ft. at 3000 RPM, 75.0" Hg. was 26.9 min. Time to climb to 39,000 ft. at 3000 RPM, 75" Hg. to 12,000 ft., 3200 RPM from 12,000 to 33,000 ft. and 3000 RPM from 33,000 ft. 39,000 ft. was 26.1 min.

5. The maximum coolant temperature in climb was 108°C on a standard day (131°C on standard Army hot day) at 29,000 ft. outside air temperature of -43.0°C. The maximum oil temperature in climb was 78°C on a standard day (101°C on standard Army hot day) at 29,000 ft. outside air temperature of -43°C.

D. Stalling Speeds

Stalling speeds were not obtained on the -2 model due to damage to the propeller at the end of the test. Stalling speeds were obtained on the -2A model which weighed 21[illegible] lbs. at take-off with the c.g. at 30.0%.

Wing Flaps	Landing Gear	M.P.	RPM	Stall IAS
Up	Up		Power off	93
Up	Up	30	2150	71
Down	Up		Power off	77
Down	Down		Power off	80
Down	Down	30	2150	64

Incomplete stalls on the -2 airplane at 9000 lbs. indicate stalling speeds approximately 9 MPH faster than the -2A model.

VII Curves

All data given in the following curves has been reduced to NACA Standard Atmospheric Conditions.

Fig. 1 Airspeed Calibration
Fig. 2 Speed vs Altitude
Fig. 3 Level Flight Power Data
Fig. 4 Climb & Ceiling
Fig. 5 Time to Climb
Fig. 6 Climb Power Data
Fig. 7 Rate of Climb at Various Speeds

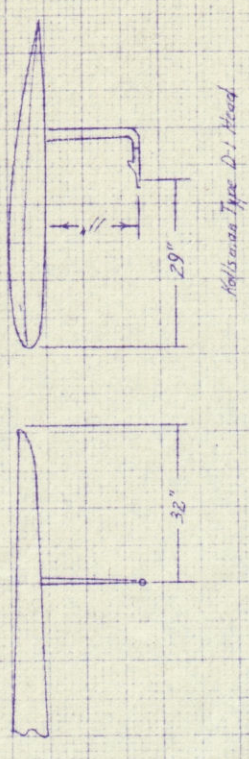

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FIG 1

AIRSPEED CALIBRATION
XP-40Q-2 42-9987
9000 LB @ T.O.

△ NIAGARA FALLS SPEED COURSE
○ ALTIMETER CHECK

CORRECTION TO BE ADDED - mph

INDICATED AIRSPEED-CORRECTED FOR INSTRUMENT ERROR-mph

ALL TEST DATA BY NACF 3-21-44

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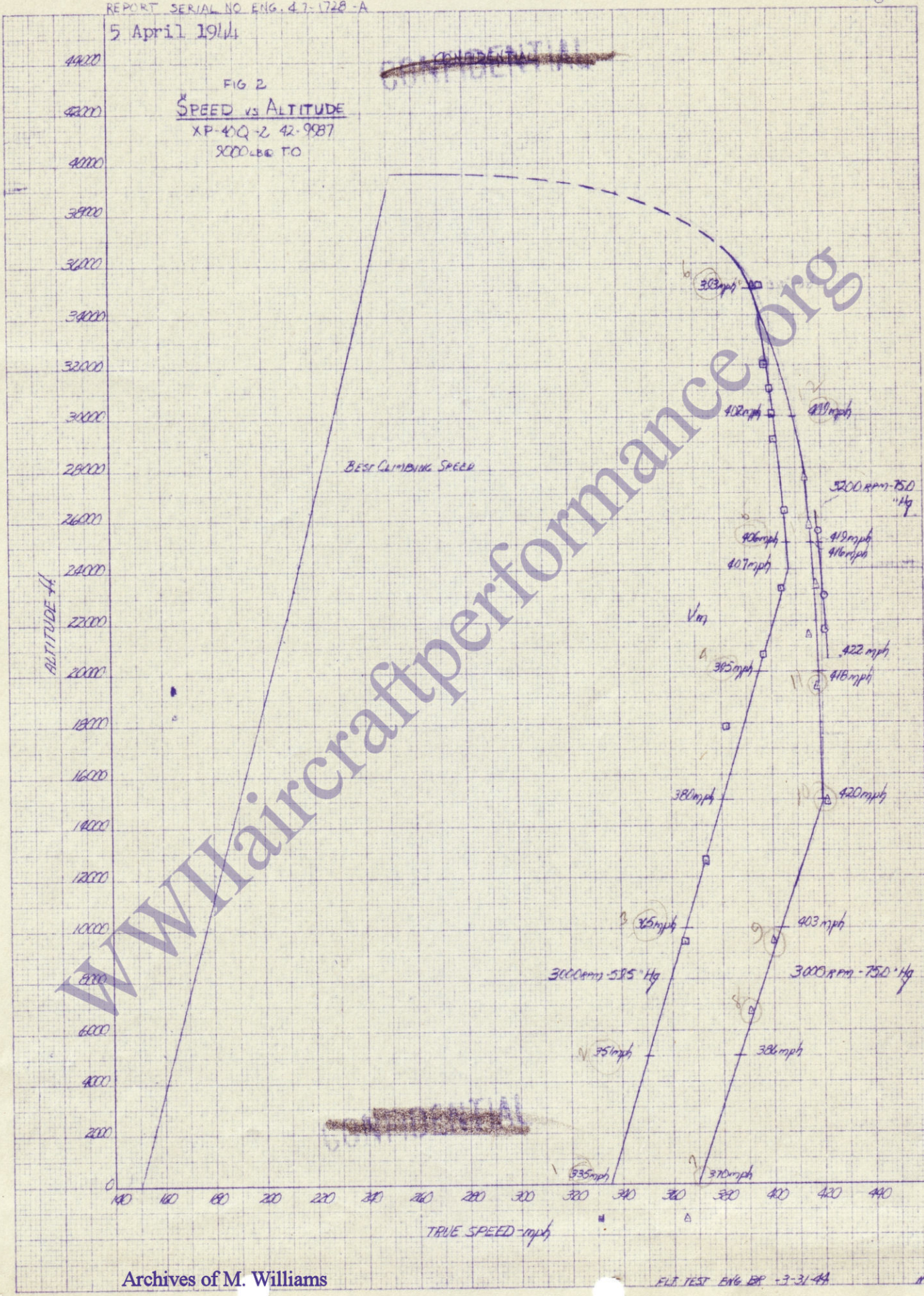
FIG 2
SPEED vs ALTITUDE
XP-40Q-2 42-9987
9000 LBS TO



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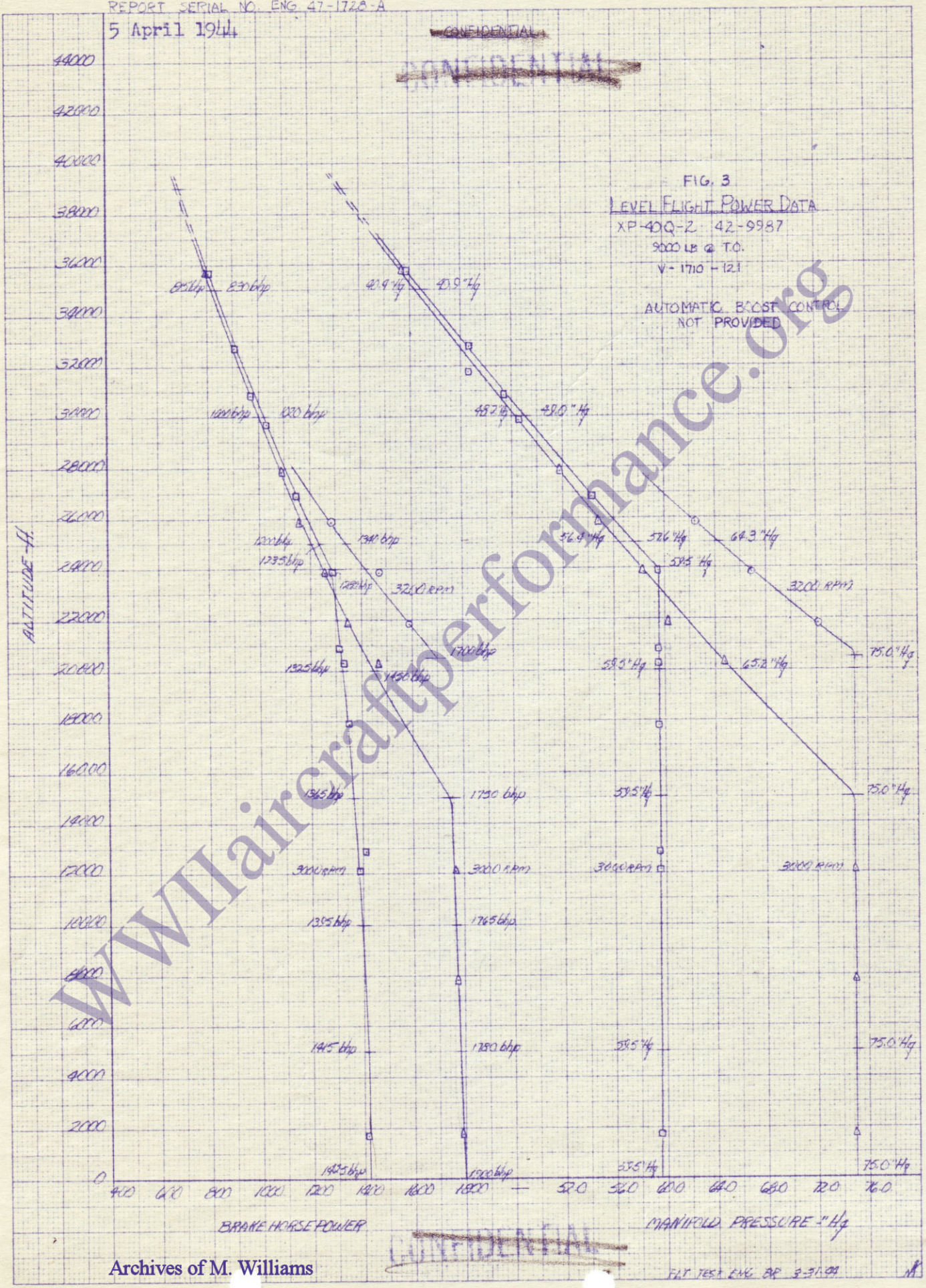

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FIG. 4

CLIMB & CEILING

XP-40Q-2 42-9987

9000 LB @ T.O.

OIL & COOLANT FLAPS - W.O.

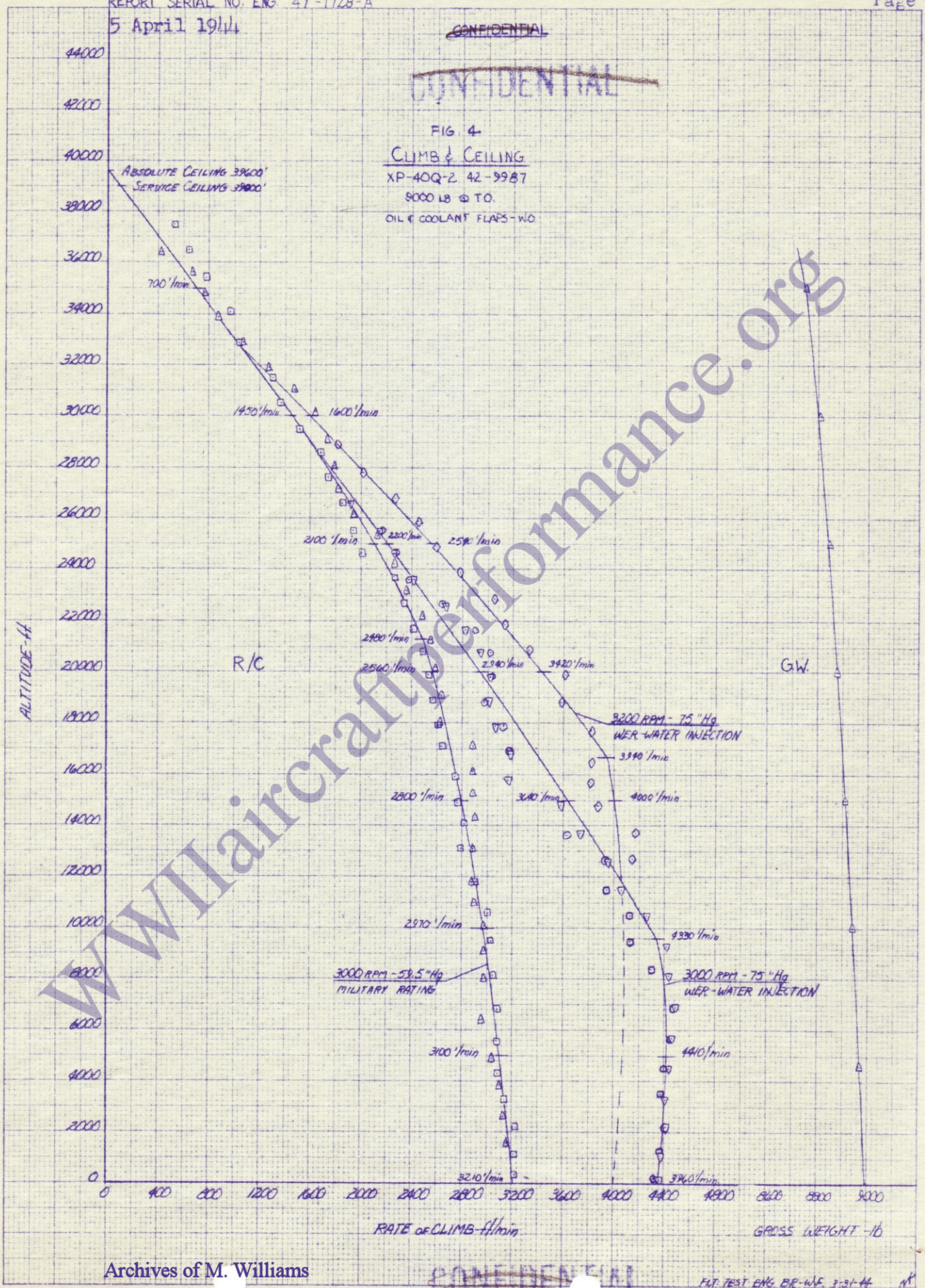

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FIG. 5
TIME TO CLIMB
XP-40Q-2 42-9987
9000 LBS T.O.

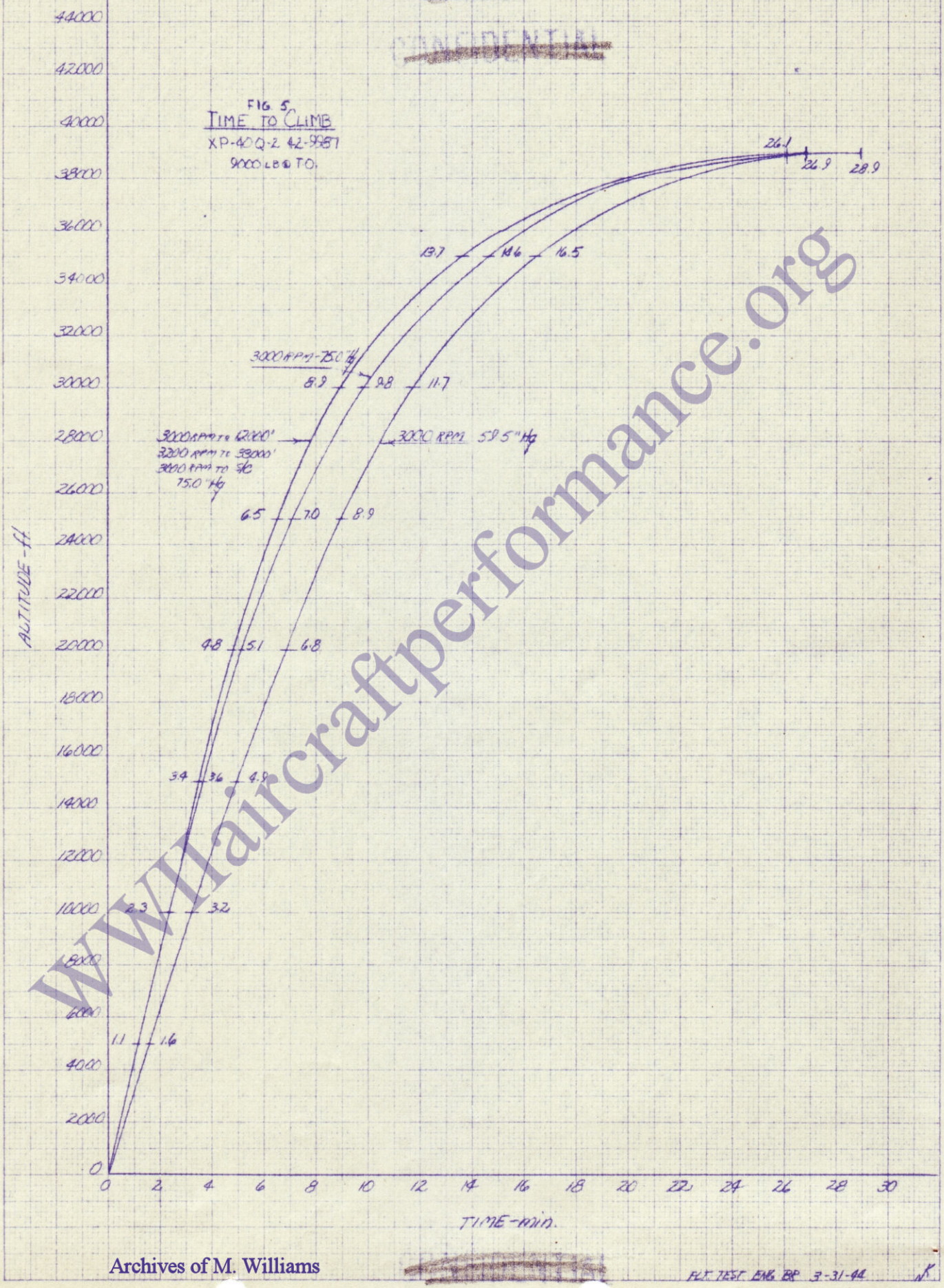

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FIG. 6

CLIMB POWER DATA

XP-40Q-2 42-9967
9000 LB @ T.O.
V-1710-121

AUTOMATIC BOOST CONTROL NOT PROVIDED.

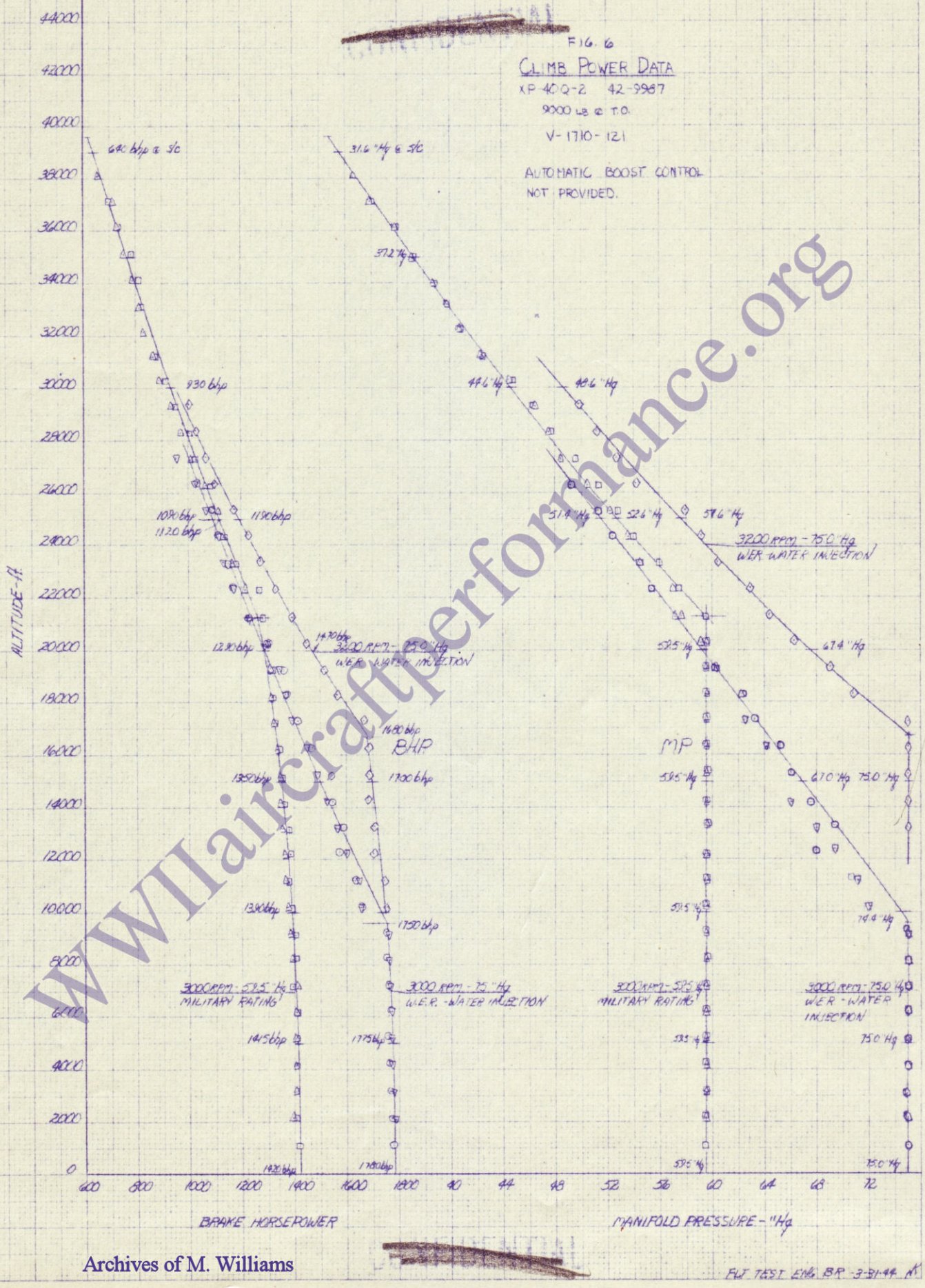

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FIG. 7

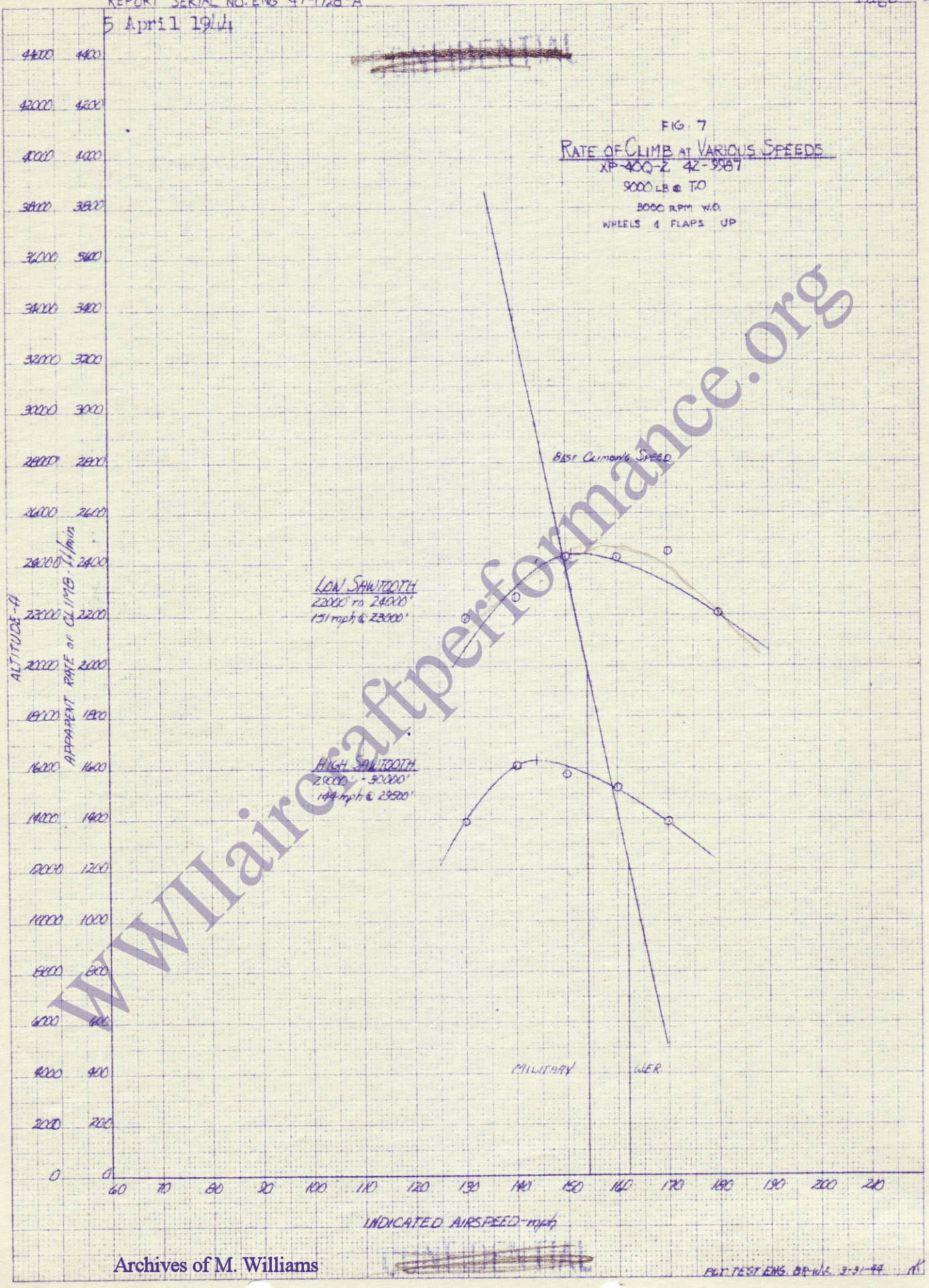
RATE OF CLIMB AT VARIOUS SPEEDS

XP-400-2 42-9587

9000 LB @ T.O.

3000 RPM W.O.

WHEELS & FLAPS UP



VIII Conclusions

A. The airplane is a decided improvement over previous models of the P-40 series. In theaters where P-40's are being used the airplane could be a very good replacement since P-40 parts and trained mechanics would be available immediately. Major assemblies and small parts are interchangeable with other models.

B. The performance of the airplane was good, particularly at low altitudes. It compares favorably with other fighter airplanes in the low altitude class.

C. There is no decided advantage in using water injection at wide open throttle in climb after the military power critical is reached. There is a decrease in the rate of climb above 28,500 ft. There is a slight increase in high speed up to 33,000 ft. Since there is an automatic shut-off on the water injection system which turns off the water below 60" Hg. (military power) it would be advisable for combat flying to be done with the water system in the automatic position. A slight improvement would be gained in performance if this was reset to operate at approximately 48 inches.

D. Increasing the RPM to 3200 for war emergency rating should be limited to altitudes between 12,000 ft. and 33,000 ft. since the performance drops off above and below these altitudes.

E. Flight characteristics of the airplane are very good, all requirements for a fighter being filled adequately. Trim, balance, and effectiveness of control have been definitely improved over previous P-40 models.

F. Maintenance problems appeared to be normal.

IX Recommendations

A. It is recommended that the possibility of dropping the engine nose 3° for forward visibility be investigated.

B. It is recommended that the water supply be increased to approximately 15 minutes.

C. It is recommended that further investigation be made for the use of 3200 RPM. The engine manufacturer's representative could furnish no information as to time limits and power available. The data obtained indicates an increase in performance between 12,000 ft. and 33,000 ft. in climb and between 20,000 and 33,000 ft. in level flight.

D. It is recommended that investigation be made of the lack of automatic propeller control at high RPM. In both the -2 and -2A there was a definite lack of propeller control. A constant speed of 3000 RPM could not be maintained in climb or level flight.

E. It is recommended that the loss of oil through the auxiliary

blower clutch at high power be investigated.

F. It is recommended that a rudder trim tab wheel of larger diameter without a handle be substituted for the present installation.

G. It is recommended that automatic coolant and oil flaps be installed on the production model.

X General Dimensions and Photographs

A. General Dimensions

1.	Span	35' 2-1/2"
2.	Length	33' 4-5/32"
3.	Wing Root Length	9'
4.	Wing Tip	49-7/16"
5.	Tread	8' 2-1/2"

B. Photographs (the photographs show the airplane equipped with rounded wing tips and leading edge airspeed installation).

1.	Front view	#3417
2.	3/4 front view	#3418
3.	Side view	#3419
4.	3/4 rear view	#3420

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1. FRONT VIEW

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2. 3/4 FRONT VIEW

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3. SIDE VIEW

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4. 3/4 REAR VIEW

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