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NA83  
VP4U-1  
PTR 2105  
(PT) (44078)

FEE/vba

TITLE: Model P4U-1 Airplane - Flight Test of Water Injection Equipment - TTD No. PTR 2105

REFERENCES:

- (a) BuAer conf. ltr. Aer-B-2112-M, C-Noa(s)-198, C-16067 of 28 July 1943.
- (b) Chance Vought Aircraft Report No. 6263, Water Injection System, dated 1 November 1943.
- (c) Recommended Changes, Model P4U-1 Airplane No. 17930, Items 1 to 6, dated through 31 December 1943.

INTRODUCTION

1. The subject test was conducted in accordance with reference (a) which requested that performance characteristics be obtained on the model P4U-1 airplane at both military and war emergency power.

PURPOSE

1. The purpose of these tests was to obtain the performance and operating characteristics of the model P4U-1 airplane using military and war emergency power.

METHOD OF TEST

1. The performance data were obtained and reduced to standard conditions in accordance with the established Flight Test methods.

DISCUSSION

1. The airplane was loaded as an overload fighter, less unprotected fuel, for all flights. A summary of the loading is as follows:

Gross Weight - pounds .....	12,162
Fuel - gallons .....	237
Oil - gallons .....	20
Injection fluid - gallons .....	10
Armament - .50 cal. machine guns ...	6
Ammunition - rounds .....	2,350

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2. Photographs forming enclosure 1 show model P4U-1 airplane No. 17930 as flown during the tests. A brief description of the configuration of the airplane is as follows:

- (a) The airplane was a late model production type incorporating all the latest changes, including the raised cabin installation.
- (b) A propeller of 13'1" diameter, blade design No. 6501A-0 was installed in lieu of the usual propeller of 13'4" diameter, blade design No. 6525A-21.
- (c) The top section of cowl flaps was replaced by a fixed plate completely covering the opening.
- (d) The arresting hook was removed and the opening for it faired over.
- (e) The new type high tail wheel was installed. This type projects out considerably farther than previously but is faired by a streamlined wooden block.
- (f) Several special instrument leads were carried externally from the firewall back to the cockpit. These were faired together to the fuselage by means of doped tape, making a half round projection of approximately 3/4" diameter.
- (g) The external finish was about the same as that on other production model P4U-1 airplanes at Flight Test. Wing walkways were installed. Gun blast and ejection openings were taped over.
- (h) The radio antenna was installed.



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3. The following tentative war emergency power ratings from reference (b) were used in the tests.

<u>Auxiliary Blower</u>	<u>RPM</u>	<u>Manifold Press. Inches Hg.</u>	<u>BP</u>	<u>Altitude Feet</u>
Neutral	2700	57.5	2250	S. L.
Low	2700	59.0	2135	12,400
High	2700	59.5	1975	16,900

4. During the early part of the tests it became apparent that the war emergency power ratings could not be obtained in any blower setting, and, as there was evidence that the mixture was running excessively rich, the carburetor was removed from the airplane and sent to the Naval Aircraft Factory for check. There it was found that the automatic mixture control was out of adjustment. Tests with the readjusted carburetor installed showed large increases in power and the engine was found to be delivering approximately rated power in all blower settings.

5. Due to instrumentation difficulties, reliable intercooler data and temperatures of the injection fluid in the tank and of the air surrounding the tank have not as yet been obtained. It is intended that these data be obtained in the near future on a similar model P4U-1 airplane using an improved instrument installation.

#### RESULTS

1. Charts contained in enclosure 2 are plots of the performance obtained during the tests. The power developed by the engine was measured by means of a torquemeter. It should be noted that there is only enough injection fluid capacity for approximately seven minutes operation at war emergency power, making it necessary that climbs at this power be made in separate stages of approximately seven minutes each. The performance at war emergency power is compared with that at military power as follows:

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<u>Power</u>	<u>War</u>	
	<u>Emergency</u>	<u>Military</u>
High blower airplane critical alt.-ft.....	20,300	22,800
Maximum speed at high blower airplane critical altitude - MPH.....	431	417
Low blower airplane critical altitude-ft..	14,600	17,600
Maximum speed at low blower airplane critical altitude - MPH.....	416	405
Maximum speed at S. L. - MPH.....	365	350
High blower climb crit. alt.-ft.....	16,500	20,000
Maximum rate of climb at high blower climb critical alt.-FPM.....	2540	1940
Low blower climb crit. alt. - ft.....	10,500	15,000
Maximum rate of climb at low blower climb crit. alt. - FPM.....	3010	2350
Maximum rate of climb at S. L.-FPM.....	3210	3040
Take-off speed - MPH.....	86.5	86.5
Take-off distance - no wind-ft.....	715	760
Take-off distance-25 knot wind-ft.....	335	360
Flap setting for take-off.....	Full	Full

2. A comparison of the military power performance of model F4U-1 No. 17930 with that obtained on model F4U-1 airplane No. 02155, an early production model, shows both the climb and speed performance of model F4U-1 airplane No. 17930 to be greatly superior. A comparison of critical values at military power is as follows:

	<u>Airplane Numbers</u>	
	<u>17930</u>	<u>02155</u>
Loading.....	Overload	Normal
Gross Wt.....	12,162	11,194
Airplane crit. alt.-high blower-ft.....	22,800	22,800
Maximum speed at ACA high blower-MPH....	417	395
Service ceiling-ft.....	41,000	39,000
Rate of climb at S. L.-FPM.....	3040	2900



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The above differences in performance may be attributed partly to the better efficiency of the new propeller and partly to the decreased drag of the faired arresting hook opening, modified cowl flap arrangement, and other minor changes in the configuration of the airplane. The relative benefit obtained from each of the above is not known.

3. The time required to realize war emergency power after the throttle control was moved full forward, turning on the water injection equipment, was found to be very short. There was a momentary drop of power for approximately  $\frac{1}{2}$  to 1 second followed by a surge as the engine built up to full war emergency powers.

#### CONCLUSIONS

1. Model F4U-1 airplane No. 17930 possesses substantially superior climb and maximum speed performance at military power in comparison with other model F4U-1 airplanes previously tested by Flight Test.
2. The performance increment gained by operating at war emergency power is large and should be of great military value.
3. The method for operating the water injection system is satisfactory.
4. Functioning of the manifold pressure regulator in connection with the water injection system is unsatisfactory in that it fails to maintain consistently the rated deck pressure settings and operates sluggishly and unreliably, particularly after prolonged flights in cold temperatures.

#### RECOMMENDATIONS

1. It is recommended that steps be taken to determine quantitatively the increment in maximum speed due to each of the important modifications of model F4U-1 airplane No. 17930 over previous productions model F4U-1 airplanes.
2. It is recommended that the anti-detonant capacity be increased to that necessary to allow operation at war emergency power for the full time now specified for military power and war emergency

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power in the fighter combat radius problem.

3. Recommendations concerning the difficulties encountered during the tests were made in reference (c).

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Encls: (HW)

1. Six (6) photographs
2. Three (3) charts of performance characteristics





REP No. PTR 2105  
Model P4U-1 - #17930  
3/4 Left Rear View

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OFFICIAL NAVY PHOTOGRAPH  
NOT TO BE USED FOR PUBLICATION

Photo PTR 2919c  
1-27-44

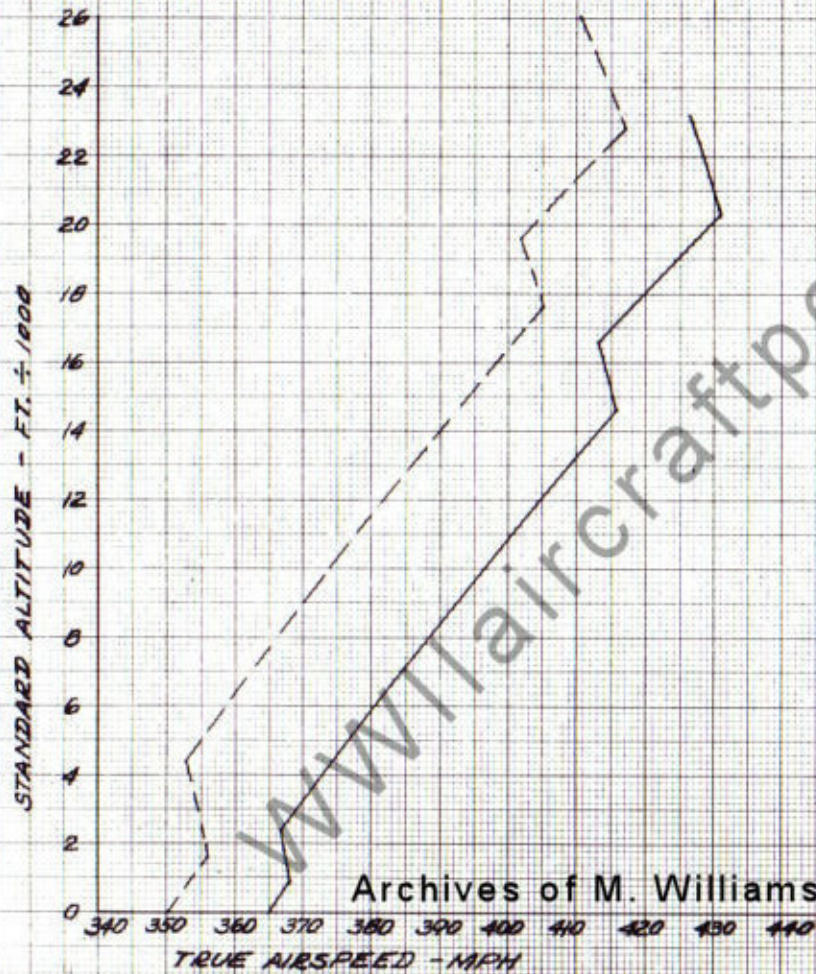


MODEL F4U-1 AIRPLANE No. 17930  
 PERFORMANCE CHARACTERISTICS  
 OVERLOAD FIGHTER LESS UNPROTECTED FUEL, GROSS WT. = 12,162 LBS.

PHOTO PTR 5169  
 4-3-44

----- MILITARY POWER  
 \_\_\_\_\_ WAR EMERGENCY POWER

MAXIMUM SPEED



AIRPLANE CRITICAL ALTITUDES  
 MODEL R-2800-B ENGINE



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FIG. 1  
 F.E.E.



MODEL F4U-1 AIRPLANE No. 17930  
 PERFORMANCE CHARACTERISTICS  
 OVERLOAD FIGHTER LESS UNPROTECTED FUEL, GROSS WT. = 12,162 LBS.

PHOTO PTR 5170  
 4-3-44

INDICATED BRAKE HORSEPOWER  
 REQUIRED VS. MAXIMUM TRUE  
 INDICATED AIRSPEED

AIRSPEED INDICATOR CALIBRATION

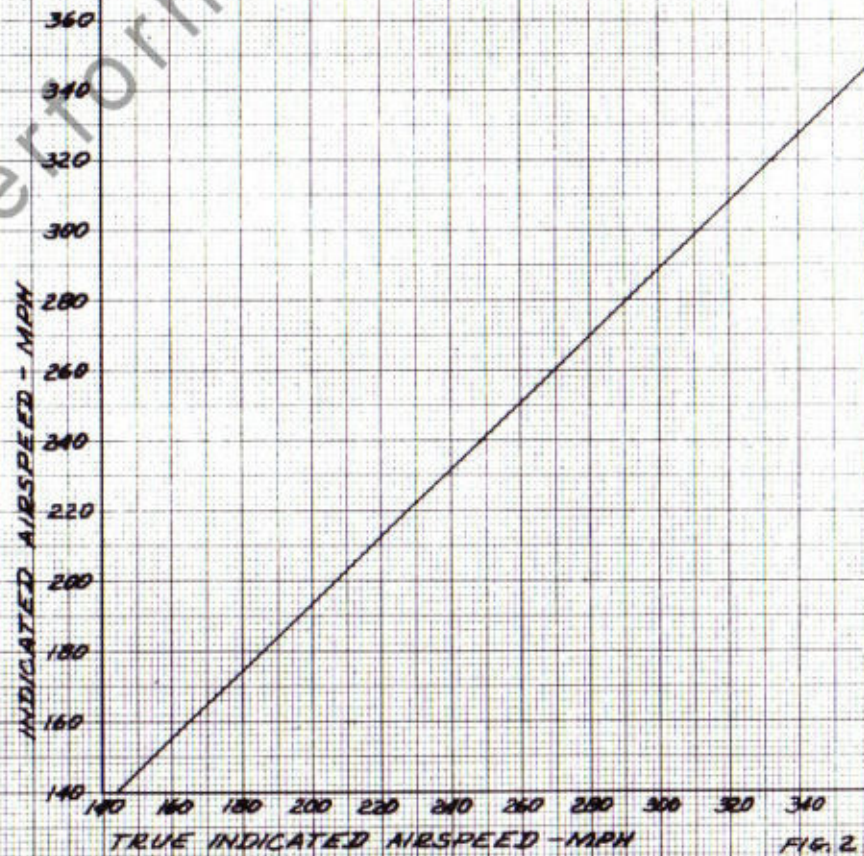
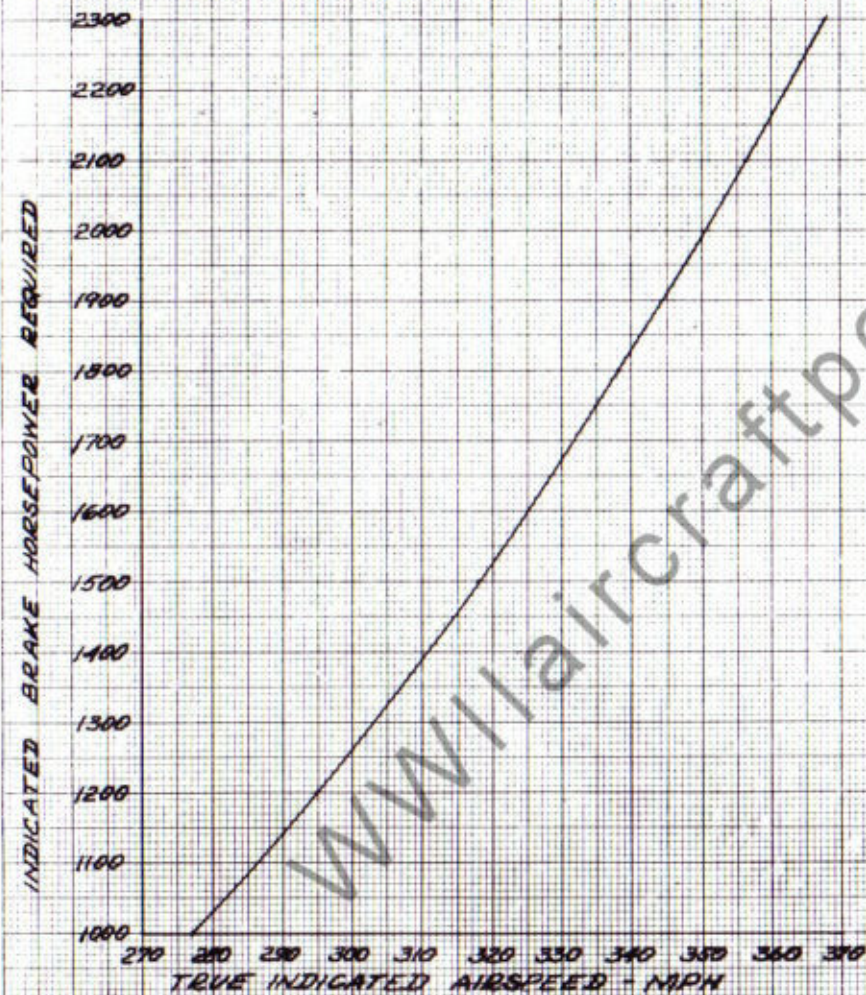


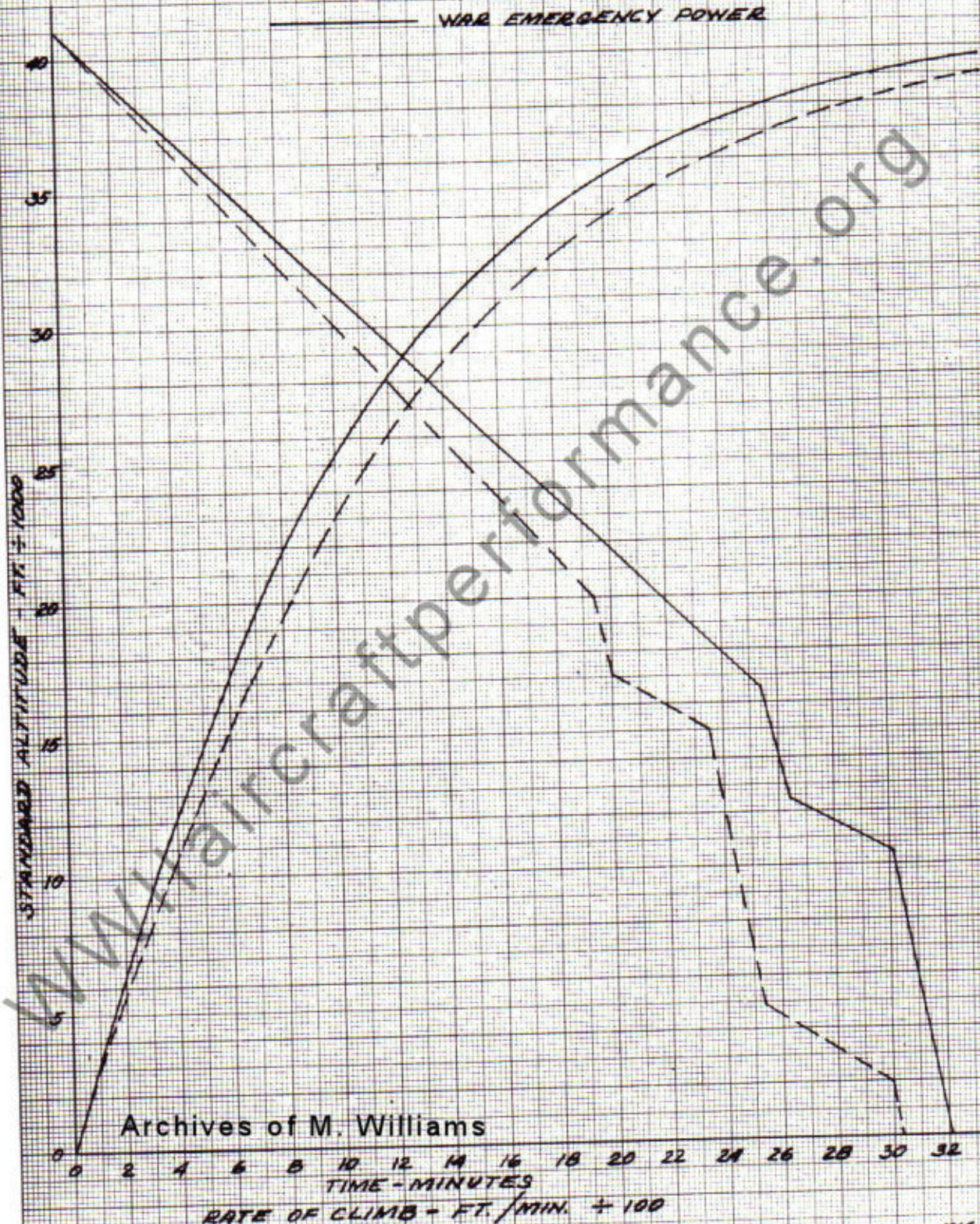
FIG. 2  
 F.E.E.



MODEL FAU-1 AIRPLANE No. 17930  
 PERFORMANCE CHARACTERISTICS  
 OVERLOAD FIGHTER LESS UNPROTECTED FUEL, GROSS WT. = 12,162 LBS.

PHOTO PTR 5171  
 4-3-44

--- MILITARY POWER  
 — WAR EMERGENCY POWER



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