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FLIGHT TEST
U. S. NAVAL AIR STATION
PATUXENT RIVER, MD.

FINAL FLIGHT REPORT

of

PRODUCTION INSPECTION TRIALS
(TED NO. BIS 2154)

on

MODEL F6F-3 AIRPLANE
(CONTRACT NOa(s)-846)

held

1 NOVEMBER 1944 to 8 JANUARY 1945

by

FLIGHT TEST

at

U. S. NAVAL AIR STATION
PATUXENT RIVER, MD.

for

BOARD OF INSPECTION AND SURVEY

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BIS 2154 - Model F6F-3 No. 42874 Photo PTR 16070
Left Side View 11-21-44

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OFFICIAL NAVY PHOTOGRAPH
NOT TO BE USED FOR PUBLICATION

REFERENCES

(a) BuAer conf. ltr. AER-E-211-JCM C10618 dated 24 April 1944.

(b) Contract NOa(s)-846 dated 29 Dec. 1943.

(c) SD-286-3 Detail Specification for Model F6F-3 Airplane, dated 30 Sept. 1942.

(d) Power Curves for model R-2800-8 and -10 engines AEL proj. 3911.

(e) NAS Patuxent River conf. ltr. NA83, VF6F-3, TED No. BIS 2116 (FT) 44239 dated 27 Nov. 1944.

(f) NAS Patuxent River ltr. NA83, VF6F-3 (FT) (88) dated 1 Feb. 1944.

INTRODUCTION - Model F6F-3 airplane No. 42874 was received from Armament Test on 28 October 1944 for the purpose of conducting the Production Inspection Trials directed by reference (a). This model F6F-3 airplane was procured under reference (b), designed and constructed by Grumman Aircraft Engineering Corporation, Bethpage, Long Island, New York, in general accordance with reference (c), and is a single-place, single-engine landplane fighter for use aboard aircraft carriers. A Pratt and Whitney model R-2800-10W two stage supercharged engine, and a Hamilton Standard, constant-speed, three-blade propeller of 13'1" diameter, blade design No. 6501A-0, were installed.

Model F6F-3 airplane No. 42874 differed from the production model described in reference (c) in that the armament consisted of two .50 caliber BAM guns and one T31(M3) 20mm automatic aircraft gun in each wing. Each inboard gun of the standard .50 caliber installation was removed and replaced by a 20mm cannon. Provision was made for 210 rounds of 20mm ammunition for each cannon. Gun blast openings were faired over with tape, MHF and VHF radio antennas were installed, and a standard F6F bomb rack was mounted under the starboard wing center section. Photographs showing the airplane and equipment are included, enclosure 1.

PURPOSE OF TEST - The purpose of the tests conducted by Flight Test on model F6F-3 airplane No. 42874 was to determine performance data, flight characteristics, and general suitability for service use as a fighter type airplane.

METHOD OF TEST - Engine power ratings were based on AEL power curves, reference (d); and actual power developed was indicated by a torquemeter installed on the engine.

The loading condition of the subject airplane as flown during these trials is summarized as follows:

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WEIGHT AND BALANCE SUMMARY

Loading	Overload Fighter
Par. from Detail Spec.....	104b (modified)
Gross weight - lbs.....	12,680
Useful load - lbs.....	3595
Useful load - % gross wt.....	28.3
Weight empty - lbs.....	9085
Wing loading - lbs/sq.ft.....	38.4
Take-off power loading - lbs. per BHP...	6.5
Center of gravity location % MAC:	
Wheels up.....	28.5
Wheels down.....	26.3
Detailed useful load:	
Pilot - lbs.....	200.0
Fuel:	
Main - (175 gals) - lbs.....	1050
Reserve - gals (75 gals) - lbs.	450
Oil - (16 gals) - lbs.....	120
Anti-detonant (16 gals) - lbs..	125
Trapped fuel & oil - lbs.....	92.5
50 cal. wing guns installation (4) - lbs.....	266.0
20mm cannon installation (2) - lbs.....	387.5
50 cal. ammunition - (1600 rds)	480.0
20mm ammunition - (420) rds....	260.0
Gun sight - lbs.....	5.6
Navigating equipment - lbs.....	3.3
Oxygen equipment - lbs.....	27.5
Pyrotechnics - lbs.....	4.9
Gun camera - lbs.....	4.2
Life raft (seat type) - lbs....	14.0
Radio - lbs.....	95.5
Emergency equipment - lbs.....	8.7

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RESULTS OF TEST

A. Performance (overload fighter - gross wt. = 12,680 lbs .)

POWER	NORMAL	MILITARY
1. Maximum speed (high blower):		
Brake horsepower.....	1580	1670
Airplane critical alt. - ft.....	24100	23400
Maximum speed at ACA - MPH.....	371.5	376.0
2. Service ceiling - ft.....	38100	38600
3. Maximum rate of climb at sea level - ft/min.....	2490	3080
4. Stalling speed at sea level:		
Clean condition - power on - MPH..	98.5	
Clean condition - power off - MPH.	100.5	
Landing condition - power on -MPH.	78.5	
Landing condition - power off -MPH	86.0	
5. Take-off data (full flap):		
Distance in no wind - ft.....	700	
Distance in 25 knot wind - ft.....	320	
Take-off speed - MPH.....	82.5	
BHP at take-off.....	2000	

Performance curves are included, enclosure 2 (Photo PTR Nos. 17917, 17892, and 21854)

B. Miscellaneous Tests

1. *Maximum Rate of Roll

Condition	IAS KTS	VT MPH	Degrees Timed	Rate of Roll Degrees/Sec. Left	Right	pb/2V Left	Right
Landing	90	130.4	90	35	38	.068	.074
Landing	110	157.2	90	41	48	.066	.078
Clean	140	198.0	90	48	55	.062	.071
Clean	170	239.8	90	60	70	.061	.074
Clean	200	281.0	90	81	84	.074	.076
Clean	240	336.0	270	80	89	.061	.068

* The rates of roll represent approximately the steady rate of roll at full aileron deflection and do not include the effect of starting and stopping the roll. The expression pb/2V is a measure of aileron effectiveness where p is the rate of roll - radians/sec., b the span - feet, and V the true airspeed - feet/sec.

C. Flight Characteristics

Longitudinal stability of the airplane loaded as an overload fighter at the normal center-of-gravity of 28.5% (wheels up) was positive under all conditions and powers. In the carrier approach condition at 75 knots V_i (IAS) the longitudinal stability was marginally positive. The elevator trim tabs were adequate, the minimum trim speed in a power off glide, landing condition, being 87 knots V_i. In a change from a power off to a power on glide (landing condition) a slight back pressure on the stick was required to maintain trim.

Lateral stability was positive in all conditions. Aileron control was found to be adequate and control forces low to moderate in the landing condition, carrier approach.

Directional stability was positive in all conditions and rudder control was considered adequate. Rudder trim effectiveness was not sufficient to trim to zero force in the high power climb or the carrier approach condition.

An investigation was conducted to determine the fore and aft center-of-gravity limits and the following results were obtained. At 30.1% MAC (wheels up) the longitudinal stability was statically and dynamically positive except in the high power climb condition where static stability was neutral to negative in a momentary nose-up flight disturbance. Nose-down displacements from trim resulted in positive static stability.

At 33.5%MAC (wheels up) in high speed level and cruising level flight the longitudinal stability was weak positive to neutral, statically and dynamically. In high power climbs, the airplane was statically unstable with nose-up changes from trim. Nose down displacements resulted in moderately positive static stability. In low power glides, static stability was weak and dynamic stability weak to neutral. In the landing condition, carrier approach, the airplane was statically unstable following nose-up displacement from trim, but statically stable after nose-down displacement.

At 34.4% MAC (wheels up) the most aft center-of-gravity attempted, the airplane was statically unstable in the carrier approach and high power climb condition. The stability increased with speed and in the high speed level flight condition was approximately neutral. In the cruising level flight condition the stability is marginally positive statically and dynamically, and in low power glides and power off glides, the airplane is (statically) unstable following nose-up displacements and stable after nose-down displacements (resulting generally in oscillations to the unstable nose-up attitude). Weak positive static and dynamic stability was attained in the landing condition, power off glide. Elevator force reversals occur in accelerated flight resulting from a two "g" turn starting from level trimmed flight (180 knots V_i) which required forward pressure on the stick to prevent the turn from tightening into a stall, particularly when the turn is to the left.

In a 45°, 320 knot dive, starting from level flight at 150 knots V_i (with no change in trim) an approximate forward force of 15 lbs. was required to hold the airplane in the dive. Trimming out this force resulted in a force estimated at 3 lbs./G for pull-out. This is considered marginally light. The center-of-gravity position attained under the most forward practicable loading condition (gross wt. 10,760 lbs.) was 23.3% MAC (wheels down) 25.8% MAC (wheels up). The airplane in this condition was statically and dynamically stable under all conditions of power and speed; stick forces were similar to those of a normal loaded F6F-3. Landing characteristics were normal and elevator control was adequate.

DISCUSSION -

1. The stability characteristics of model F6F-3 airplane No. 42874 loaded as an overload fighter at the normal center-of-gravity position of 28.5% MAC (wheels up) did not differ appreciably from that of the standard model F6F-3 production airplane with the conventional installation of six .50 caliber machine guns.

2. Attention is invited to the increase in overall width of the airplane in the folded wings condition because of the extra length of the 20 mm cannon installation. This is shown, photographically in the front view (wings folded), enclosure 1. (Photo PTR No 18015).

3. Fuel pressure evaluation, carbon monoxide survey and aileron stick forces on representative model F6F-3 airplanes have been submitted, reference (e). A temperature survey was reported in reference (f).

CONCLUSIONS

1. Model F6F-3 airplane No. 42874, with the special ordnance installation of four (4) .50 caliber machine guns and two (2) 20 millimeter automatic aircraft guns, did not differ markedly, in any performance characteristic, from the standard model F6F-3 airplane reported on in reference (e).

2. At the normal center-of-gravity position of 28.5% (wheels up) there was no appreciable difference evidenced in the stability characteristics over that of the standard model F6F-3 airplane.

3. With the aircraft loaded as an overload fighter (gross weight - 12,680 lbs.), it is concluded that:

(a) The maximum rearward center-of-gravity position for satisfactory stability and controllability is 32.5% MAC.

(b) The maximum rearward center-of-gravity position for reasonably safe operation (with satisfactory control) for pilots experienced in the type is 33.5% MAC (wheels up).

(c) The maximum rearward center-of-gravity position beyond which flight operations are not safe is 34.5% MAC (wheels up).

4. With the aircraft loaded to obtain the most forward center-of-gravity practicable, 23.3% MAC (wheels down), the landing characteristics and control forces are satisfactory.

5. The model F6F-3 airplane with the 20 millimeter installation was found to be satisfactory for service use as a fighter aircraft except for the defects covered by Recommendations.

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RECOMMENDATIONS -

1. The recommendations listed in reference (e) are concurred in.

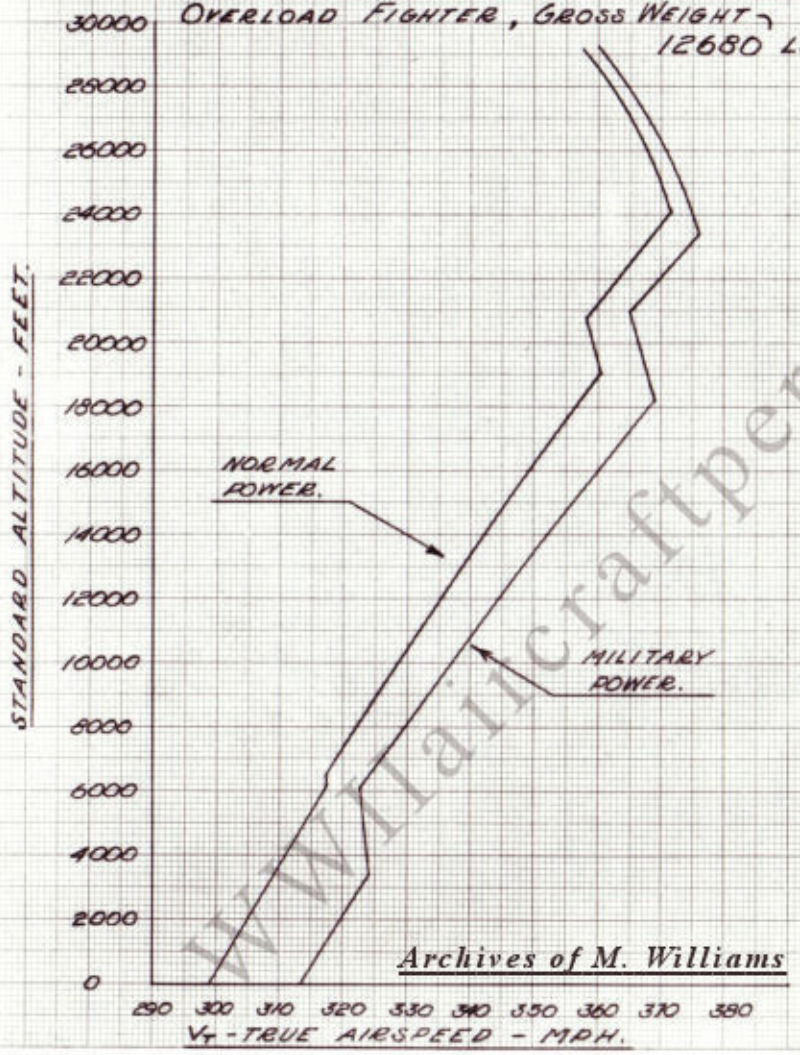
2. An after center-of-gravity limit of 33.5% MAC (wheels up) is recommended for this type aircraft at the gross weight of 12,680 lbs. (overload fighter condition).

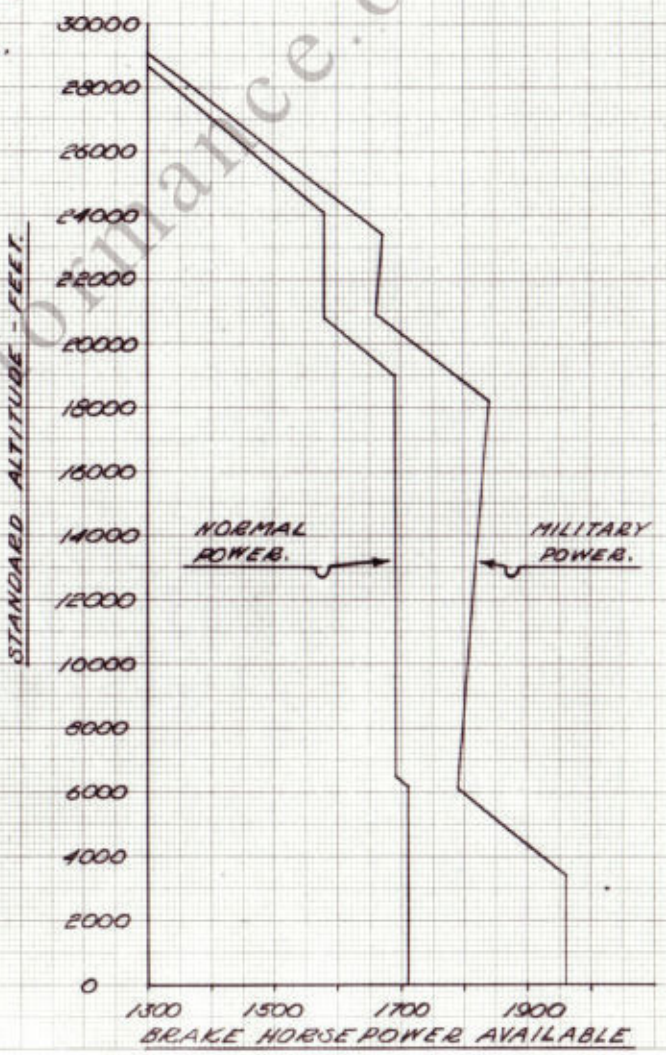
Encl.

1. HW - Twenty-one (21) photographs, PTR Nos. 16072, 16068, 16069 16067, 16071, 18015, 18017, 18012, 18018, 18013, 18014, 15796, 15797, 18009, 18008, 18006, 18007, 18016, 15798, 18011, 18010.
2. HW - Three (3) performance curves, PTR Nos. 17917, 17892, 21854.

PHOTO PTR. 17892
J.W.G. 1-5-45

MODEL F6F-3, AIRPLANE No. 42874
PERFORMANCE CHARACTERISTICS
OVERLOAD FIGHTER, GROSS WEIGHT - 12680 Lbs.





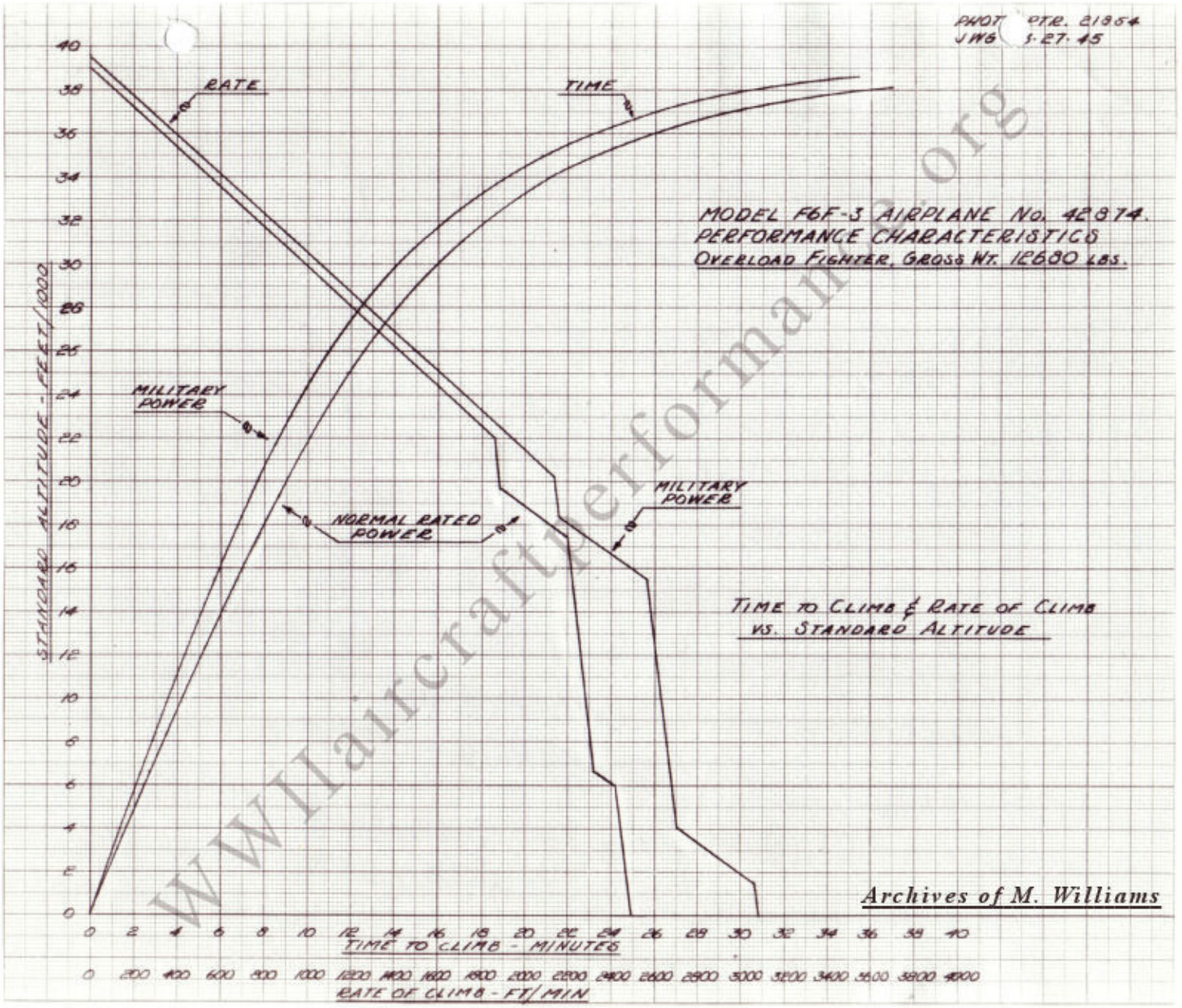


PHOTO PTR. 17917
J.W.G. 1-6-46

MODEL F6F-3, AIRPLANE NO. 42874
PERFORMANCE CHARACTERISTICS
OVERLOAD FIGHTER, GROSS WT. 12680 LBS.