DETAIL SPECIFICATION

FOR

MODEL F4F-3 AIRPLANE

(CLASS VF)

(SINGLE ENGINE)

(SINGLE-SEAT LANDPLANE)

****

INTRODUCTION

1a. This specification covers the requirements for the design of a single-engine single seat landplane fighter for use aboard aircraft carriers. This airplane shall be similar to Model F4F-3 Airplane on contract 68219 except as herein specified. The airplanes purchased under contract 75736 shall be known as Model F4F-3 Airplanes.

1b. As a landplane, it shall take off from the deck of an aircraft carrier with or without the aid of a catapult and land on the carrier deck in an arresting gear or on an ordinary landing field.

1c. The airplane shall not be designed for float type landing gear.

1d. The airplane shall be designed for catapulting as a landplane.

2a. General Specification for the Design of Airplanes for the United States Navy No. SD-24-D dated 1 September 1935 and changes to date of invitation to bid form a part of this specification and shall be followed except as modified herein. The numbers of the paragraphs of this specification correspond to the numbers of the paragraphs of the General Specification.

3a. Material, process, and design specifications in effect at date of invitation to bid shall be considered a part of this specification.

12a. All contract changes authorized for Model F4F-3 Airplane on contract 68219 to date of invitation to bid, that are applicable to this airplane, shall be considered a part of this specification.

12b. Trial Board and other recommendations resulting from trials of Model F4F-3 Airplane on contract 68219, that are applicable to this airplane, shall be considered a part of this specification.

12c. Model F4F-3 Airplane #1848 manufactured under contract 68219, shall be designated as the basic airplane.

17a. No deviation from this specification shall be permitted unless approved by the Bureau of Aeronautics.

PART I

CHARACTERISTICS

101a. The following characteristics are considered reasonable for this airplane and shall be equalled, or, if possible, bettered.

** 102a. The gross weights are estimated to be as follows:
(with armor plate and with fuel and oil protection)

Fighter (110 gals.)	6895
Bomber (2-100# class bombs, 110 gals.)	6891
Fighter (147 gals. maximum)	7432

** 104a. The useful load as a fighter shall be as follows:

USEFUL LOAD		1602
CREW		200
GASOLINE (110 gals.)		660
OIL (9 gals.)		68
ARMAMENT		546.1
Fixed gun installation (4 - .50 cal. guns)	524.5	
Provision for bombs	0	
Pyrotechnics	7.9	
Gun camera	13.7	
EQUIPMENT		127.9
Communicating	62.3	
Navigating	3.5	
Miscellaneous	62.1	

NOTE: For detail distribution of weights see Appendix II-A.

** 104b. The useful load as a bomber with 2-100# class bombs, 2-.50 cal. guns and 110 gals. of fuel shall be 1598 pounds.

** 104c. The useful load as a fighter with 147 gallons of fuel (maximum), 11 gallons oil (maximum), and four .50 cal. wing guns shall be 2139 pounds.

** 105a. The Weight Empty as a carrier landplane in the combat condition is estimated to be as follows:

WEIGHT EMPTY			5293
Wing Group			882
Wings		805	
Ailerons		38	
Flaps		39	
Tail Group			147
Stabilizer		64	
Elevator		42	
Fin		18	
Rudder		23	
Body Group			846
Fuselage, less engine section		495	
Alighting gear - land type		351	
Main landing gear	286		
Retracting mechanism	33		
Auxiliary landing gear	32		
Engine Section Group			298
Power Plant			2432
Engine (as installed)		1540	
Engine accessories		242	
Power plant controls		23	
Propeller		312	
Starting system		43	
Lubricating system		30	
Tanks (11 gals.)	10		
Piping, etc.	20		
Fuel system		242	
Tanks (160 gals.)(with tank protection)	164		
Piping, Purging system & fuel pressurizing system	78		
Fixed Equipment			688
Instruments		58	
Surface controls		113	
Furnishings		172	
Electrical equipment		140	
Hoisting gear (Provisions only)		1	
Arresting hook installation		27	
Emergency flotation gear (Provisions only)		22	
Armor plate		155	

** 106a. Unit Weights:

Weight of wing group per sq.ft. net wing area (222 sq.ft.) - - - - - 3.97
Weight of tail group per sq.ft. net tail area (70.00 sq.ft.) - - - - 2.10
Weight of lubricating system per gallon capacity (11 gals. Oil capacity) - - - 2.73
Weight of fuel system per gallon capacity (147 gals.)(maximum) - - - 1.65

** 107a. The horsepower for the Pratt & Whitney R-1830-76 2-stage 2-speed engine is 1100 from sea level to 2500 feet altitude and 1050 HP from 4800 to 11000 feet altitude and 1000 HP from 12200 feet altitude to 19000 feet altitude at 2550 RPM with 3-blade constant speed propeller, geared 3 to 2. For take-off the engine is rated at 1200 HP at 2700 RPM.

108a. Areas: (in accordance with Appendix XXII)

Total wing area including 37.6 sq.ft. of fuselage and stub, and including ailerons	260
Control surface areas:	
Ailerons (2 at 5.74)	11.48
Total stabilizer area (including 1.8 sq.ft. of fuselage and 4.96 sq.ft. elevator balance)	30.43
Total elevator area aft of hinge (including 2.32 sq.ft. of tabs)	16.62
Total fin area (including 2.36 sq.ft. of rudder balance)	13.2
Total rudder area aft of hinge (including 0.56 sq.ft. of tab)	9.38
Total vertical tail area	22.58
Total horizontal tail area	49.05
Total flap area (2 at 14.85 sq.ft.)	29.70

** 111a. The unit loadings shall be as follows:

	Wing Load Lbs./sq.ft.(260)	Power Load Lbs./BHP(1000)
Fighter (110 gals.)	26.5	6.90
Bomber (110 gals. and 2-100# class bombs)	26.5	6.89
Fighter (147 gals. maximum)	28.6	7.43

112a. The airfoil section for the wings shall be NACA 23015 at fuselage tapered to NACA 23009 at tips.

** 113a. The performance is estimated to be as follows:

	(Normal) Fighter	(Bomber)	(Overload) Fighter
Fuel (gals.)	110	110	147
Gross weight (lbs.)	6895	6891	7432
High speed at sea level (MPH)	278	264	277
High speed at 5500 ft. (MPH)*	295	281	294
High speed at 6800 ft. (MPH)*	294	280	293
High speed at 13,000 ft. (MPH)*	313	297	312
High speed at 14,200 ft. (MPH)*	312	296	310
High speed at max. engine rated alt. 19,000 ft. (MPH)	330	314	328
High speed at airplane critical alt. 22,000 ft. (MPH)	326	320	336
Stalling speed at sea level with full load and without power (MPH)	74.4	74.4	77.4
Stalling speed at sea level with full load less fuel (MPH) without power	70.7	70.7	72.5
Stalling speed at sea level less 1/2 fuel without power	72.5	72.3	73.4
Initial rate of climb at sea level (ft./min.)	3300	3180	3070
Time of climb to 10000 ft. (min.)	3.5	4.1	4.2
Time of climb to 20000 ft. (min.)	7.6	8.1	8.4
Service ceiling (ft.)	31000	30000	30500
Endurance at high speed (hr.)(alt.)	.84	.84	1.2
Endurance at 90% high speed (hr.)(19000)	1.6	1.6	2.1
Endurance at 75% high speed (hr.)(feet)	3.2	3.2	4.3
Endurance at 60% high speed (hr.)(alt.)	4.4	4.4	6.4
Maximum endurance (hr.))	4.5	4.5	6.5
Maximum range (mi.)) at	880	860	1280
Average speed for maximum range (MPH)) 19000 feet	180	180	185
Average speed for maximum endurance (MPH)) altitude	160	160	165
Take-off distance in calm (feet)	631	640	738
Take-off distance in 15-knot wind (ft.)	384	389	449
Take-off distance in 25-knot wind (ft.)	252	256	295

* The high speed values necessary for a plot of high speed vs. altitude up to the maximum engine rated altitude shall be given. If less than four high speed values in addition to the speed at sea level and at maximum engine rated altitude are required for such a plot, high speed values at altitudes above the airplane critical altitude shall be given. The airplane critical altitude is defined as the altitude at which the engine in the airplane delivers rated horsepower at full throttle.

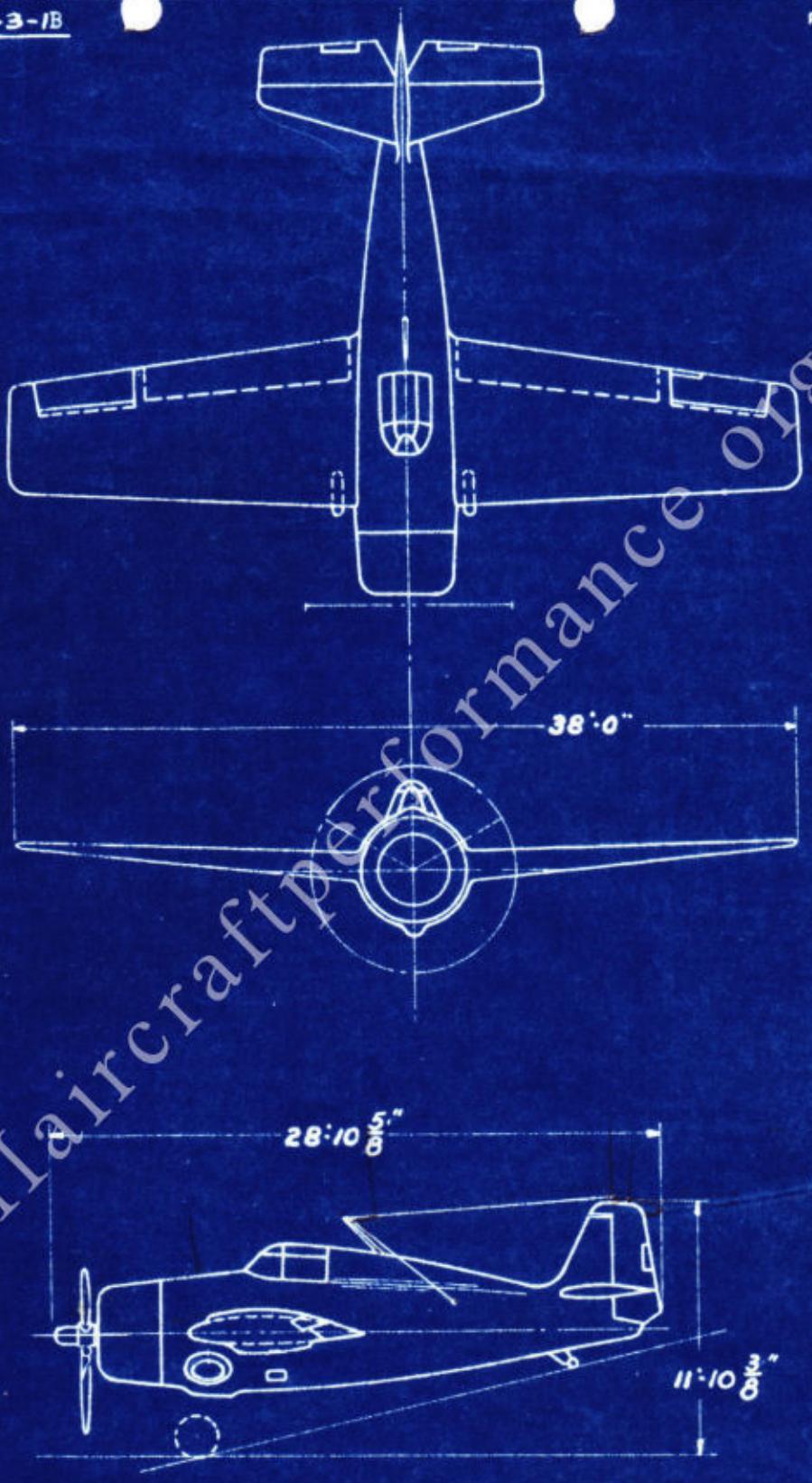
NOTE: The above performance is based on 1100 crank HP from sea level to 3500 and 1050 HP from 4800 to 11000 feet altitude and 1000 HP from 12200 to 19000 feet altitude, at 2550 RPM with the 3-blade constant speed propeller described in paragraph 551a, and geared 3 to 2. For take-off, the engine is rated at 1200 HP at 2700 RPM. The above performance is calculated with all external armament and radio equipment in place for each condition of loading.

** 116a. The principal dimensions of the airplane are as follows:

Span: Wings (monoplane)	38' 0"
Span: Wings folded	--
Height, over cabin thrust line level (approx.)	9' 10"
Height, over tail thrust line level (approx.)	11' 11"
Height over propeller, three-point position	11' 9"
Height to top of hoisting sling (approx.)	9' 11"
Length (maximum) (approx.)	28' 10-1/2"
Length from hoisting sling to furtherest aft part of tail, thrust line level, rudder neutral, elevator down:	20' 7"
L.E.W. to c.g. (empty)	19.53
L.E.W. to c.g. (Bomber)	26.46
L.E.W. to c.g. (Fighter - Overload)	26.93
Center of gravity, normal loading condition:	
Horizontal location, % M.A.C.	27.23
Vertical location, below thrust line	0.5
Horizontal distance from rudder hinge line	18' 4"
Horizontal distance from elevator hinge line	18' 0"
Angle of line through c.g. and point of contact of wheels with normal to thrust line (approx.)	17°
Angle between lines joining c.g. and points of contact of wheels (front elevation)	58° 30'
Ground angle	12° 20'
Dihedral (outer panel)	5°
Sweepback (leading edge)	none
Chord at root section	98"
Chord at construction tip section	61.44"
Mean aerodynamic chord, inches	84.14
Wing section and thickness; at root section (% chord)	NACA 23015 (15%)
at construction tip section (% chord)	NACA 23009 (9%)
average - frontal area divided by wing area	0.1073
Effective aspect ratio of the following:	
Wing cellule	5.56
Horizontal tail surfaces	3.8
Vertical tail surfaces	1.21
Aileron span (approx.)	5' 0"
Aileron chord, mean	1' 3-29/32"
Wing incidence, at root section	0°
Clearance of wing at root above ground thrust line level (approx.)	3' 10-1/2"
Tail span	13' 8"
Stabilizer, incidence	1-1/2°
Wheel tread	6' 4-31/32"
Wheel size	26" x 6"
Tire and tube size (main wheels)	26" x 6"
Tail wheel tire	6" x 2-1/2"
Diameter of propeller (3 blades)	9' 9"
High lift device:	
Type of wing flap	split
Span of wing flaps (% of wing span):	10' 7/16"
Flap chord aft of hinge, average (% wing chord)	1' 9-3/8"
Flap angle, maximum (degrees)	43
Aileron droop, degrees	0
Propeller clearance, normal loading condition:	
Thrust line level	8-3/4"

** 117a. Angular movement for full movement of control each side of neutral: (as limited by the stops in the pilot's cockpit)

Rudder	29 degrees right, 29 degrees left
Rudder pedal	3 inches forward, 3-1/8 inches aft
Elevators	26 degrees above, 20 degrees below
Elevator control	7-7/16 inches forward, 12-3/32 inches aft
Ailerons	19 degrees above, 15 degrees below
Aileron control	8-15/16 inches right, 8-15/16 inches left
Elevator tab control	6-3/4 turns of handle for 16-3/4 degree of tab movement
Elevator tabs	5° 54' up, 10° 51' down
Rudder tab control	8-1/2 turns of handle for 38-3/4° of tab movement
Rudder tabs	22° 19' left, 16° 26' right
Aileron tab control	8/9 turns of handle for 40° of tab movement
Aileron tab (left hand only)	20 degrees up, 20 degrees down.



MODEL F4F-3 AIRPLANE

REPORT NO. 1469A