

SD-261-1D-1B

REPORT No. 6756

Page: 1

Revised: 2-15-45

DETAIL SPECIFICATIONFORMODEL F4U-1D AIRPLANECLASS VF(SINGLE ENGINE)(SINGLE-SEAT LANDPLANE)

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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 known as model F4U-1D airplane and is a development of model XF4U-1 airplane.

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 28 November 1940 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 28 November 1940 shall be considered a part of this specification.

12a. Trial Board and other recommendations resulting from trials of model XF4U-1 airplane which are applicable to this airplane, shall be considered a part of this specification and shall be subject to weight, performance and cost adjustment.

\*\*12b. "The following changes authorized for model F4U-1 airplane contract NOa(s)-198, shall be considered a part of this specification: A, B, C, F, G, H, I, J, K, L, M, N, P, Q, R, S, W, X, Y, Z, AA, AC, AE, AG, AI, AJ, AK, AL, AM, AP, AQ, AR, AS, AT, AV, AW, AY, BB, BC, BD, BE, BF, BG, BH, BI, BJ, BK, BL, BM, BN, BO, BP, BQ, BR, BT, BU, BV, BZ, CC, CD, CE, CF, CK, CL, CM, CN, CO, CQ, CT, CU, CW, CX, CZ, DA, DB, DC, DE, DF, DH, DJ, DK, DM, DQ, DR, DV, DX, EB, EC, EF, EG, EI, EJ, EM, EN, EO, EP, EQ, ER, ET, EU, EY, EZ, FA, FD, FF, FG, FH, FI, FJ, FK, FM, FO, FP, FQ, FR, FU, FY, FZ, GC, GD, GE, GF, GH, GJ, GK, GL, GM, GN, GQ, GR, GT, GU, GZ, HC, HD." The substance of these changes has been incorporated in the body of this specification.

SD-261-1D-1B

REPORT No. 6756

Page: 2

Revised: 2-15-45

12c. In addition to the contract changes called out in the preceding paragraph, the following modifications shall also be considered a part of this specification:

- (a) Redesign ailerons and flaps (42.3#)
- (b) Provide greater rigidity for aileron controls (19.0#)
- (c) Provide greater stiffness in wing structure to avoid gun resonance (45.7#).
- (d) Redesign gun access doors (3.0#)
- (e) Provide self-sealing fuel cells that are resistant to aromatic fuel (52.8#)

\*\*12d. The following design changes which have not been made contract changes are incorporated in this specification:

<u>F4U-1</u> <u>PCN No.</u>	<u>F4U-1</u> <u>MCR No.</u>	
91	351	Installation of droppable tank and bomb on center section pylons.
93	321	Installation of redesigned tail wheel yoke to reduce ground angle.
94	336	Installation of H4E3 auxiliary fuel pump.
95	402	Elimination of three intermediate steps on sliding section track rack.
99	400	Relocation of control stick neutral position.
100	401	Inspection of main fuel cell hangar bolt attachment.
106	320	Instructions for engine installation and ground test.
110	396	Improvement of cockpit access.
117	233	Installation of ultra high frequency radio installation.
128	462	Installation of Jack and Heintz type starter in place of cartridge type.
132	169	Addition of rear securing chain to fixed gun compartment.
134	510	Increase strength of main wheel drag link brace tubes to use landing gear as a dive brake.
135	418	Redesign of cockpit cabin heater circuit to provide pressure drop across heater at low manifold pressure.
153	620	Modification of boresighting to use pattern #3.
154	478	Replacement of nose cowl attaching bolts.
155	505	Removal of provisions for outer panel tanks.
162	565	Provision for 150 gallon Navy standard tank.
167	582	Elimination of blast tube and addition of placard to fire overside only.
170	521	Installation of left hand center section pylon droppable fuel tank.
171	378	Installation of rocket projectiles.
176	327	Structural modification of outer panel due to removal of gasoline heater.
179	299	Installation of electrical release provisions on bomb rack.

SD-261-1D-1B

REPORT NO. 6756

Page: 3

Revised: 2-15-45

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:

Interceptor (178 gals.)	11343#
Fighter (237 gals.)	12086#
Long Range Fighter (407 gals.)	13286#
Long Range Bomber (407 gals., 1-1000# bomb)	14311#

\*\*104a. The useful load as an interceptor shall be as follows:

USEFUL LOAD		2520
CREW		200
FUEL (178 gals.)		1068
OIL (12 gals.)		90
TRAPPED FUEL AND OIL		111
WATER INJECTION MIXTURE (10 gals.)		75
ARMAMENT		769
Fixed gun and sight installation (6-.50 cal., 1200 rds. and sight)	761.1	
Pyrotechnics	3.7	
Gun Camera Installation	3.9	
EQUIPMENT		207
Communicating (radio)	146.7	
Navigating	4.3	
Miscellaneous	56.5	

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

USEFUL LOAD		3263
CREW		200
FUEL (237 gals.)		1422
OIL (16 gals.)		120
TRAPPED FUEL AND OIL		111
WATER INJECTION MIXTURE (10 gals.)		75
ARMAMENT		1128
Fixed gun and sight installation (6-.50 cal., 2400 rds., and sight)	1119.9	
Pyrotechnics	3.7	
Gun Camera Installation	3.9	
EQUIPMENT		207

\*\*104c. The useful load as a long range fighter shall be as follows:

USEFUL LOAD		4463
CREW		200
FUEL (237 gals.)(in main tank)		1422
FUEL (170 gals.)(in droppable tank)		1020
DROPPABLE FUEL TANK INSTALLATION		118
OIL (24-1/4 gals.)		182
TRAPPED FUEL & OIL		111
WATER INJECTION MIXTURE (10 gals.)		75
ARMAMENT (Same as paragraph 104b)		1128
EQUIPMENT (Same as paragraph 104a)		207

SD-261-1D-1B

REPORT No. 6756

Page: 4

Revised: 2-15-45

\*\*104d. The useful load as a long range bomber shall be as follows:

USEFUL LOAD		5488
CREW		200
FUEL (237 gals.)(in main tank)		1422
FUEL (170 gals.)(in droppable tank)		1020
DROPPABLE FUEL TANK INSTALLATION		118
OIL (24-1/4 gals.)		182
TRAPPED FUEL AND OIL		111
WATER INJECTION MIXTURE (10 gals.)		75
ARMAMENT		2153
Fixed gun and sight installation (6-.50 cal. 2400 rds. and sight)	1119.9	
1-1000# bomb installation	1025.3	
Pyrotechnics	3.7	
Gun Camera Installation	3.9	
EQUIPMENT (Same as paragraph 104a.)		207

\*\*105a. The weight empty as a carrier landplane is estimated to be as follows:

WEIGHT EMPTY		8823.0
<u>WING GROUP</u>		2144.9
Center Section	1094.8	
Outer Panel	871.0	
Tips	3.9	
Ailerons	72.1	
Flaps	103.1	
<u>TAIL GROUP</u>		172.6
Stabilizer	67.2	
Elevator	60.5	
Fin	13.9	
Rudder	31.0	
<u>BODY GROUP</u>		1476.2
Fuselage	772.1	
Alighting Gear	704.1	
Main Alighting Gear	598.9	
Auxiliary alighting gear	105.2	
<u>ENGINE SECTION GROUP</u>		308.2
<u>POWER PLANT GROUP</u>		3747.7
Engine(as installed)	2476.5	
Engine Accessories	259.0	
Power Plant Controls	49.2	
Propeller	490.9	
Starting System	39.6	
Lubricating System	128.6	
Tank	21.5	
Piping, etc.	107.1	
Fuel System	266.9	
Tank and Protection	179.3	
Piping, etc.	87.6	
Water Injection System	37.0	

SD-261-1D-1B

REPORT No. 6756

Page: 5  
Revised: 2-18-45

\*\*105a. (Continued)

FIXED EQUIPMENT GROUP

973.4

Instruments	48.3
Surface Controls	140.6
Hydraulic System	120.2
Electrical	199.8
Armament Provision	329.4
Furnishings	95.3
Auxiliary Gear	39.8
Hoisting Gear	0.0
Arresting Gear	39.8

\*\*106a. Unit Weights:

Weight of wing group per sq. ft. gross wing area (314 sq.ft.)	"6.83"
Weight of tail group per sq. ft. net tail area (79.9 sq. ft.)	"2.16"
Weight of lubricating system per gallon capacity (24.25 gals. oil)	"5.30"
Weight of fuel system per gallon capacity (237 gals. fuel)	"1.13"

107a. The normal power rating for the Pratt & Whitney Model R-2800-8W two-stage, two speed engine is estimated to be 1675 HP from sea level to 5500 ft. altitude at 2550 RPM, 1625 HP at 2550 RPM at 17000 ft. altitude and 1550 HP at 2550 RPM at 21,500 ft. altitude with three blade propeller. For take-off the engine is rated at 2000 HP at 2700 RPM. The gear ratio is 2 to 1.

107b. For military rating see paragraph 503a.

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

Total wing area including 37.7 sq. ft. fuselage and including ailerons 314 sq.ft.

Control surface areas:

Ailerons (2 at 9.05)	18.1
Total stabilizer area (including 4.7 sq. ft. of fuselage area and 2.7 sq. ft. elevator balance).	36.0
Total elevator area aft of hinge including .74 sq. ft. balance tab area and 1.36 sq. ft. trim tab area	21.9
Total fin area (including 1.66 sq. ft. of rudder balance) and .86 sq. ft. below the rudder	9.0
Total rudder area aft of hinge (.85 sq. ft. tab area)	13.0
Total vertical tail area	22.0
Total horizontal tail area	57.9
Total flap area	36.4

SD-261-1D-1B

REPORT No. 6756

Page: 6

Revised: 2-15-45

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

	WING LOAD Lbs./ sq. ft. (314)	POWER LOAD Lbs/BHP(1550)
Interceptor (178 gallons)	36.12	7.32
Fighter (237 gallons)	38.49	7.80
Long Range Fighter (407 gallons)	42.31	8.57
Long Range Bomber (407 gals., 1-1000# bomb)	45.58	9.23

112a. The airfoil section shall be NACA-23018 for wing root and NACA-23009 for wing tip section.

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

	INTERCEPTOR	FIGHTER	LONG R. BOMBER
Fuel (gals.)	178	237	407
Gross Weight (lbs.)	11,343	12,086	14,311
High Speed at sea level (mph)*	318	317	287
High Speed at 7700 ft. (mph)*	345	344	310
High Speed at 9300 ft. (mph)*	344	343	309
High Speed at 20,100 ft. (mph)*	388	386	344
High Speed at 21,700 ft. (mph)*	386	384	342
High Speed at maximum engine rated altitude, 21,500 ft. (mph)*	386	384	342
High Speed at airplane critical altitude, 24,400 ft. (mph)*	401	398	353
High Speed at airplane critical altitude, 23,000 ft. (mph)**	401	398	353
High Speed at airplane critical altitude, 20,000 ft. (mph)***	419	416	373
Stalling Speed at sea level with full load without power (mph)	86.2	89.0	96.8
Stalling Speed at sea level with full load with power (mph)****	77.0	79.5	86.5
Stalling Speed at sea level with full load less fuel (mph)****	73.3	74.7	78.8
Stalling Speed at sea level with full load less 1/2 fuel (mph)****	75.2	77.2	82.7
Initial rate of climb at sea level (ft/min)**	3250	2990	2200
Initial rate of climb at sea level (ft/min)***	3390	3110	2300
Initial rate of climb at sea level (ft/min)*	2880	2650	1930
Time to climb to 10,000 ft. (min.)*	3.8	4.3	6.1
Time to climb to 20,000 ft. (min.)*	8.2	9.2	13.8
Service ceiling (ft.)*	38,700	37,100	31,400
Endurance at high speed at 21,500 ft.(hrs.)*	.86	1.15	1.97
Endurance at 90% high speed * at 21,500 ft.(hrs.)	1.39	1.83	2.94
Endurance at 75% high speed * at 21,500 ft.(hrs.)	2.64	3.42	5.20
Endurance at 60% high speed * at 21,500 ft. (hrs)	3.79	4.82	7.02
Maximum endurance at 5500 ft. (hrs.)	4.97	6.62	10.41
Maximum range at 5500 ft. (miles)	973	1264	1676

SD-261-1D-1B

REPORT No. 6756

Page: 7

Revised: 2-15-45

\*\*113a. (Continued)

	Interceptor	Fighter	Long Range Bomber
Average speed for maximum range at 5500 ft. (mph.)	196	191	173
Average speed for maximum endurance at 5500 ft. (mph.)	196	191	147
Take-off distance in calm (ft.)	562	652	977
Take-off distance in 15-knot wind (ft.)	357	421	654
Take-off distance in 25-knot wind (ft.)	243	289	465

- \* Normal rated power
- \*\* Military rated power
- \*\*\* War Emergency Power
- \*\*\*\* Approximately 400 bhp<sup>3</sup> (2200 rpm at  
17" hg manifold pressure)

Notes:

1. The airplane critical altitude is defined as the altitude at which the engine in the airplane delivers rated horsepower at full throttle and rated rpm.
2. The above performance is based on rated engine powers as given in paragraph 503a, with critical altitudes from flight test data, and with the propeller specified in paragraph 551b.
3. The above performance is calculated with all external armament and radio equipment specified in place for each condition of loading (\*AN/ARR-2 homing antenna in retracted position).

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

Span: Wings (monoplane)	40' 11.73"
Span: Wings folded	17' 0.50"
Height, over cabin thrust line level (approx.)	11' 4.09"
Height, over tail thrust line level (approx.)	15' 1.28"
Height over propeller, three-point position	14' 8.48"
Height to top of hoisting sling (approx.)	11' 11.19"
Length (maximum)	33' 4.13"
Length from hoisting sling to the most aft part of tail thrust line level, rudder neutral, elevator down	24' 11.44"
L.E.W. to c.g. (empty) 24.5% M.A.C. (Wheels Down)	26.67"
L.E.W. to c.g. (Interceptor) (Wheels Down)	32.90"
L.E.W. to c.g. (Fighter) (Wheels Down)	33.73"
Center of gravity, normal loading condition: (Wheels Down) Horizontal location, %M.A.C.	31.17%
Vertical location, below thrust line	8.9"
L.E. Wing to rudder hinge line	20' 7.5"
L.E. Wing to elevator hinge line	23' 7.09"

SD-261-1D-1B

REPORT No. 6756

Page: 8

Revised: 2-15-45

\*\*116a. (Continued)

Angle of line through c.g. and point of contact of wheels with normal to thrust line (approx.)	20° 14'
Angle between lines joining c.g. and points of contact of wheels (front elevation)	36° 4'
Ground Angle	10° 59'
Dihedral (outer panel)	8.5°
Sweepback (leading edge outer panels)	4° 10'
Chord at root section	105"
Chord at construction tip section	71.38"
Mean aerodynamic chord, inches	94.0"
Wing section and thickness; at root section (% chord)	18%
at construction tip section (% chord)	9%
Average - frontal area divided by wing area	16%
Geometric aspect ratio of the following:	
Wing cellule	5.35
Horizontal tail surfaces	4.70
Vertical tail surfaces	1.24
Aileron span	7' 6"
Aileron Chord, mean (aft of hinge)	14.3"
Wing incidence, at root section	2°
Clearance of wing at lowest point above ground, thrust line level	49.26"
Tail span	16' 6"
Stabilizer, incidence	1.25°
Wheel tread	12' 1"
Wheel size	32" x 8"
Tire and tube size (main wheels)	32" x 8"
Tail wheel tire	12.5" x 4.5"
Diameter of propeller (3 blades)(nominal dia. 13' 0")	13' 1"
High lift device:	
Type of wing flap	NACA Slotted
Span of wing flaps (% of wing span)	46%
Flap Chord aft of hinge, average (% wing chord)	21%
Flap angle, maximum (degrees)	50°
Aileron droop, degrees	None
Propeller clearance, normal loading condition:	
Thrust line level	8.03"
Three-point attitude	22.35"
117a. Angular movements for full movement of controls on each side of neutral: (as limited by the stops in the pilot's cockpit).	
Rudder	25° right 25° left
Rudder pedal	4.4" aft., 4.4" fwd.
Elevator	20° above, 16° below
Elevator control	7" forward, 9-1/2" aft.
Aileron (normal)	19° up, 14° down
Aileron Control	10-1/4" right, 10-1/4" left
Rudder tab control	7-1/2 turns for 40° of tab



SD-261-1B-1B

REPORT NO. 6756

Page: 9

117a. (Continued)

Elevator tab control  
Aileron tab control  
Rudder tab  
Elevator tab  
Aileron tab  
Flaps  
Flap control

4.66 turns for 30° tab  
5½ turns for 30° of tab  
20° right, 20° left  
10° up, 20° down  
15° up, 15° down  
50°  
power operated

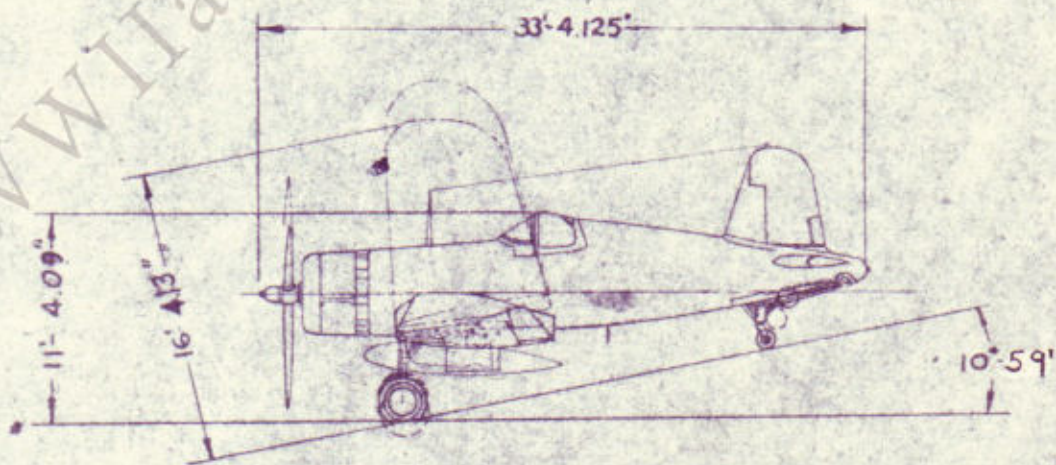
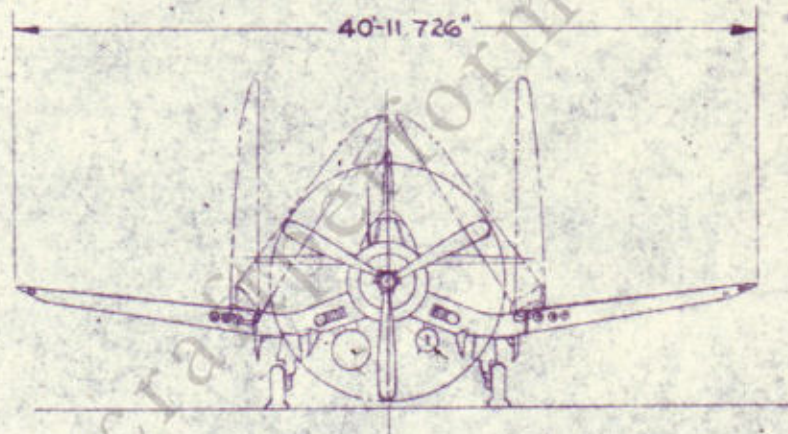
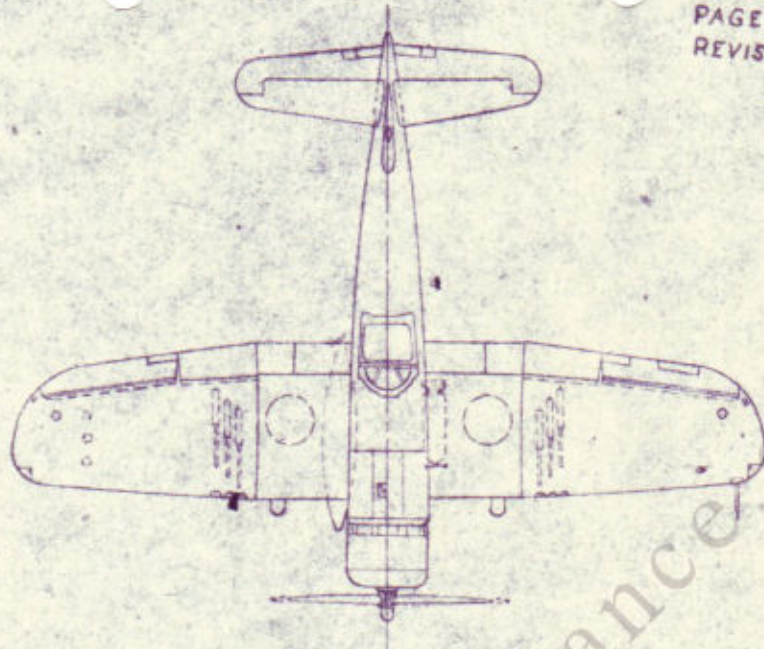
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SD-261-ID-1B

REPORT NO. 6756

PAGE: 10

REVISED: 2-16-45



MODEL F4U-ID