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U. S. NAVY
VFX
WEAPON SYSTEM

Model 225

PROPOSAL FOR ENGINEERING DEVELOPMENT & PRODUCTION

VOLUME 6 / Performance (U)

GROUP 4
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A

(U) SUMMARY

(C) The Model 225A Weapons System is a high performance carrier based fighter powered by (2) TF-30-P- turbofan engines and carries the AWG-9 AMCS missile fire control system, and (6) Phoenix missiles. It also operates in the air-to-air role with (6) Sparrow missiles and (4) Sidewinders. In the air-to-ground role, a variety of weapon loadings are possible including (10) MK-82 Snakeye bombs and a M61 gun or (14) MK-82 Snakeye bombs. For ferry or long range combat missions with reduced bomb loadings, 300 gallon external fuel tanks can be carried on the two wing stations and on the centerline station.

(C) Design features of the Model 225A include a low wing design for minimum airplane cross sectional area and semi-submerged weapons with sealed cavities and with adequate engine separation for reduced drag. A retractable high speed trimmer provides the neutral point control required to reduce trim drag to a minimum and significantly improve supersonic maneuverability. An important feature of the Model 225A is its light weight (52,900 pounds TOGW) and small size which is achieved by efficient structural and aerodynamic design.

(C) Figure 1, presented below, compares the Model 225A guaranteed performance with the VFX type specification TS-161 requirements.

(C) FIGURE 1

Weapon Loading		(4) Sparrow Missiles	(6) Phoenix Missiles	TS 161 Requirements
Carrier Suitability				
Carrier landing gross weight	lb	N.A.*	46,056	—
Minimum approach speed ($V_{PA\ min}$), 89.8°F, intermediate flaps	kt	↓	120	120
Single engine R/C, MRT, 89.8°F, intermediate flaps (ECS bleed off)	ft/min	N.A.	570	500
Combat Performance				
Combat gross weight	lb	46,788	N.A.	—
Maximum level flight speed, $\Lambda_{LE} = 70^0$	M	2.40	↓	2.2
Supersonic combat ceiling, $\Lambda_{LE} = 70^0$	ft	58,300	↓	58,000
Acceleration time (0.8M to 1.8M at 35,000 ft., CRT), $\Lambda_{LE} = 70^0$	min	2.08	↓	2.2
Combat maneuverability (0.9M at 35,000 ft.,) sustained buffet free load factor $\Lambda_{LE} = 45^0$	g	2.05	N.A.	2.0
Combat gross weight	lb	N.A.	52,636	—
Cruise ceiling (300 ft/min R/C, NRT)	ft	N.A.	39,250 (2)	38,000
Mission Performance				
Escort mission			N.A.	
Radius	nm	535	↓	500
Takeoff gross weight	lb	52,900	N.A.	—
Combat gross weight	lb	46,788	N.A.	—
Optimum cruise Mach at 35,000 ft	M	0.81	↓	—
Buffet onset load factor, $\Lambda_{LE} = 45^0$	g	1.7	N.A.	1.7
Fleet Air Defense mission (150 nm radius)				
Time on station	hr	N.A.	2.21	2.0
Takeoff gross weight	lb	↓	60,489 (1)	—
External fuel	gal.	N.A.	600	—

(1) 254 gallons of internal fuel off loaded
(2) Limited by buffet onset

N.A.* – Not applicable

1.0 (U) INTRODUCTION

(C) Model 225A Weapons System

(U) The McDonnell Model 225A meets or exceeds Navy VFX requirements for fleet air defense, escort and other fighter missions. A configuration consisting of fuselage mounted engines and a low wing and tail produces near optimum flying qualities, carrier suitability, performance, and weapons carriage versatility. This fuselage arrangement and the low wing provide a large, clean lower surface permitting low drag installation of a wide variety of external stores including six semi-submerged Phoenix missiles. A unique inflatable fairing insures low drag both with and without armament aboard.

(U) Installation of the TF30 engines directly behind forward located, horizontal ramp, variable geometry inlets provides a low distortion straight air flow path. This arrangement also minimizes propulsion installation and nozzle interference drag. Engine separation with fuel carried between the engines, rather than above, reduces fuselage height and cross section which, combined with large canopy glass areas, provides good rearward visibility. This fuel arrangement together with the shielding effect of the low wing, also provides significant vulnerability reduction.

(C) The achievement of a reasonably low gross weight has been a key objective of the design effort. A basic takeoff gross weight of 52,900 pounds has been realized through the selective use of titanium (40% DCPR weight), other advanced materials and unitized structural concepts.

(U) This design also provides the flexibility for growth with minimum change to the high performance VFX-2 and the RVFX-2 versions.

(C) Figure 1-1 presents a comparison of the Model 225A performance with the performance required in Type Specification 161. This performance has been achieved with satisfactory handling qualities and no compromise in safety of flight. Performance data are presented for the airplane in all roles of interest and for various wing sweep positions which are pertinent to the specific performance parameter being considered. The VFX-2 performance data with the General Electric and Pratt & Whitney advanced engines are presented in Volume 31.

(C) The excellent performance shown for the Model 225A results from a concerted effort to achieve low drag without incurring excessive weight penalties. The low wing configuration results from design iteration cycles in which a prime goal was to achieve the airframe, propulsion system, armament integration with both a minimum cross-sectional area and a smooth area distribution. The low wing design also substantially lowers the probability of post-eject store collision with the airplane. This problem tends to limit the effectiveness of high wing aircraft incorporating tails significantly below the wing chord. The airfoil section was developed to provide a large measure of the benefits of the Whitcomb supercritical airfoil for transonic maneuvering capabilities without incurring the problems associated with flow separation (drag and buffet) at low lift coefficients, and the difficulties of incorporating an efficient light weight high-lift system.

(C) An efficient full span double slotted trailing-edge flap and outer wing leading-edge slat comprise the major features of the high lift system. The system was optimized to provide the lift characteristics and lift-to-drag ratio required to establish a high level of carrier suitability. This level is consistent with the requirements for an advanced U.S. Navy airplane which will not only achieve the minimum requirements of TS-161 but also provide a measure of growth capability for a long and useful service life.

(C) Another reason for the excellent performance characteristics exhibited by Model 225A is the high speed trimmer which was incorporated as a result of a direct attack on the reduced supersonic maneuverability and the high subsonic trim drag exhibited by compact variable sweep aircraft at all but the lower sweeps. The trimmer provides the neutral point control required to offset the aft shift associated with aft wing sweep at subsonic speeds and reduces the usual detrimental aft shift with Mach number. In addition to accruing trim drag reductions, weight reductions result, not only from reduced fuel loads, but also due to the reduced loads carried by the wing at the structural design load factor at all sweeps and Mach numbers. Optimization of the high speed trimmer allowed a reduction in wing glove sweep for improved carrier suitability and improved static and dynamic stability at the forward sweep condition. This was achieved with the tail area required to satisfy control requirements, i.e. good nose wheel lift-off characteristics for both field takeoff and bolter conditions. Thus, the tail area reflects a near optimum tail size without a potential weight and drag penalty which could result from a "brute force" approach in providing the control loads required for satisfactory supersonic maneuverability.

(C) This report defines and substantiates the aerodynamic and performance characteristics of the Model 225A. A set of Standard Aircraft Characteristics Charts are included in Appendix A. All performance calculations dependent upon engine capabilities conform with the installed engine ratings of the TF30-P engines. The TF30-P- installed engine performance is derived from the basic Pratt and Whitney Model Specification N-1934-C dated 15 November 1967 as modified by Data Package No. PWA 3365 dated 26 April 1968. Pratt and Whitney Performance Deck dated January 1968 (non A/B) and Pratt and Whitney Performance Deck dated May 1968 (A/B) were also used. The Iris C/D nozzle performance used is as shown in Pratt and Whitney curve 251278. The thrust corrections and propulsion drags used for installation losses are discussed in Volume 11.

1.1 (C) REQUIREMENTS

(C) The major performance requirements of TS-161 are repeated in Figure 1-2 . For the sake of convenience, a complimentary table showing the performance of the Model 225A and the wing sweep position at which the performance is attained is shown in Section 5.0.

(C) FIGURE 1-1
MODEL 225A PERFORMANCE COMPARISON
(2) TF30-P- Engines
2247 Gallons of Internal JP-5 Fuel

Weapon Loading		(4) Sparrow Missiles	(6) Phoenix Missiles	TS 161 Requirements
Carrier Suitability				
Takeoff gross weight	lb	52,900	N.A.	——
Catapult endspeed, MRT, 89.8^{0}F	kt	119	↓	——
Wind over deck required, C-7 catapult, 89.8^{0}F	kt	-14	↓	-2
Catapult a/g, MRT, 89.8^{0}F		.135	N.A.	≥ 0.065
Takeoff gross weight	lb	N.A.	60,489 (1)	——
Catapult endspeed, MRT, 89.8^{0}F	kt	↓	129	——
Wind over deck required, C-7 catapult, 89.8^{0}F	kt	↓	+3	13
Catapult a/g, MRT, 89.8^{0}F		N.A.	.085	≥ 0.065
Carrier landing gross weight	lb	41,620	46,056	——
Minimum approach speed ($V_{PA\ min}$), 89.8^{0}F, intermediate flaps	kt	114	120	120*
Approach speed (1.1 $V_{PA\ min}$), 89.8^{0}F, intermediate flaps	kt	125	132	1.1 $V_{PA\ min}$
Arresting wind over deck required, MK-7 Mod. 2, 89.8^{0}F intermediate flaps	kt	-1	+8	10
Single engine R/C, MRT, 89.8^{0}F, intermediate flaps (ECS bleed off)	ft/min	850	570	500*
Combat Performance				
Combat gross weight	lb	46,788	52,636	——
Maximum level flight speed, $\Lambda_{LE} = 70^0$	M	2.40	2.31	2.2*
Supersonic combat ceiling, $\Lambda_{LE} = 70^0$	ft	58,300	54,700	58,000*
Acceleration time (0.8M to 1.8M at 35,000 ft., CRT), $\Lambda_{LE} = 70^0$	min	2.08	2.73	2.2*
Combat maneuverability (0.9M at 35,000 ft.,) sustained buffet free load factor, $\Lambda_{LE} = 45^0$	g	2.05	1.8	2.0*
Combat gross weight	lb	46,788	52,636	——
Cruise ceiling (300 ft/min R/C, NRT)	ft	41,450 (2)	39,250 (2)	38,000*
Mission Performance				
Escort mission		(3) (4)		
Radius	nm	502/535	429(3)	500*
Takeoff gross weight	lb	52,900	57,336	——
Radius	nm	816 (3)	N.A.	
Takeoff gross weight/external fuel	lb/gal	60,120(5)/900	N.A.	
Combat gross weight	lb	46,788	51,224	——
Optimum cruise Mach at 35,000 ft	M	0.81	.81	——
Buffet onset load factor, $\Lambda_{LE} = 45^0$	g	1.7	1.55	1.7*
Fleet Air Defense mission (150 nm radius)			(3) (4)	
Time on station	hr	3.03 (3)	2.0/2.21	2.0*
Takeoff gross weight	lb	57,780	60,489 (1)	——
External fuel	gal.	600	600	——

*Guaranteed performance
(1) Internal fuel off-loaded
(2) Limited by buffet onset
(3) 5% fuel flow safety factor included
(4) Without 5% fuel flow safety factor
(5) W.O.D. <20 kts, C7 catapult, 89.8^{0}F Day

(C) FIGURE 1–2

TYPE SPECIFICATION 161 PERFORMANCE REQUIREMENTS

Condition		Configuration		Requirement
		Armament	Fuel	
A. Flight envelope				
1. M_{max}	M	(4) Sparrows	60% internal	2.2*
2. NRT 300 ft/min ceiling	ft	(6) Phoenix	60% initial and external	38,000*
3. CRT combat ceiling	ft	(4) Sparrows	60% internal	58,000*
B. Maneuverability				
1. Buffet-free sustained normal load factor at .9m at 35,000 ft at CRT	g	(4) Sparrows	60% internal	2.0*
2. Buffet-free normal load factor at cruise M at 35,000 ft	g	(4) Sparrows	60% internal	1.7*
C. Acceleration				
1. a/g at CAT end speed at MRT on 89.8°F day		(6) Phoenix	Initial	.065
2. Time from .8m to 1.8m at 35,000 ft	min	(4) Sparrows	60% internal	2.2*
3. Decel from V_{MRT} to .8 V_{MRT} at 25,000 ft	sec			16
D. Rate-of-descent				
1. (R/D) AVG from 25,000 ft to 5,000 ft at 250 KCAS in CR and LO configuration	ft/min			4,500
E. Mission Performance				
1. CAP time at 35,000 ft	hr	(6) Phoenix	Required for 2.0 hr CAP time	2.0*
2. Design mission radius	nm	(4) Sparrows	Internal	500*
F. Approach and wave-off				
1. $V_{PA_{min}}$ on 89.8°F day ($\gamma = -4^0$)	kt	(6) Phoenix	4,000 lb	120*
2. Δh of 50 ft in __ sec without using more than 50% of $\Delta n_{z_{avail.}}$ ($\gamma = -4^0$)	sec	(6) Phoenix	4,000 lb	5*
3. a = 5 ft/sec^2 from $V_{PA_{min}}$ in __ sec at MRT on 89.8°F day	sec	(6) Phoenix	4,000 lb	2.5*
4. Single engine R/C at 1.1 $V_{PA_{min}}$ at MRT on 89.8°F day	ft/min	(6) Phoenix	4,000 lb	500*
G. Direct lift control				
1. Δn_z on 4^0 approach at $V_{PA_{min}}$	g	(6) Phoenix	4,000 lb	+.13, –.07
H. Carrier suitability				
1. W.O.D. for catapult (C–7; 89.8°F day)				
(a)	kt	(4) Sparrows	Internal	–2
(b)	kt	(6) Phoenix	Required for 2.0 hr CAP time	+13
2. W.O.D. for arrestment (MK–7, MOD.2;89.8°F day)	kt	Carrier landing design gross weight		+10
3. W.O.D. for barricade engagement (89.8°F day)	kt	Carrier landing design gross weight		+20

* Guaranteed performance.

2.0 (C) AIRPLANE DESCRIPTION

(C) The Model 225A is a two-place, low-wing, twin-engine, variable-sweep fighter capable of carrying a variety of armament loadings. Its loading in the Fleet Air Defense role is (6) Phoenix missiles semi-submerged in the lower surface of the fuselage. The loading in the Escort role is (4) Sparrow missiles which are semi-submerged in four of the Phoenix cavities with inflatable seals filling in the excess volume between the Sparrow outer moldlines and the inner moldlines of the Phoenix cavities. The same seals also close off the centerline Phoenix cavities such that an aerodynamically smooth surface exists across the bottom of the fuselage and up to the surface moldlines of the Sparrows. This seal smooths all six cavities when empty and is described in detail in Volume 21 Part 1.

(C) Air to the TF30-P- engines is inducted through (2) horizontal rocking ramp type inlets which are adjacent to the fuselage and whose lower moldlines fair into the lower surface of the wing glove section. Separation of the engines at the aft end produces not only a straight low flow distortion path to the engine but also reduces aft fuselage drag. An Iris C-D nozzle together with a nozzle fairing is used to get the best engine performance and the lowest drag. A three-view of the airplane is shown in Figure 2-1.

(C) In the air-to-ground role the Model 225A can carry (10) MK-82 Snakeye bombs and an M61 gun or (14) MK-82 Snakeye bombs. For long range missions with reduced bomb loadings, 300 gallon fuel tanks can be carried on the two wing stations and on the centerline station.

(C) The basic wing airfoil (Figure 2-2) is a development specifically designed to provide the airfoil close to optimum for the VFX-1/VFX-2 requirements. A spoiler type Direct Lift Control (DLC) system (Figure 2-3) utilizes the inboard section of the spoilers. Speed brakes (Figure 2-4) are mounted on the fuselage lower surface and double as main landing gear doors. A unique two position door reduces the drag of the speed brake during normal gear cycle operations when it operates as a main landing gear door. This reduces gear drag during wave-off operations. Additional deceleration capability is afforded by symmetrical extension of the wing spoilers. A two position high speed trimmer (HST), located just aft of the inlets provides a minimum neutral point shift as the wing outer panel is swept back and reduces the neutral point shift with Mach number. This feature accrues improved performance and reduced weight and cost.

(C) The high lift system of the Model 225A consists of (1) full span leading edge slats on the outer wing, (2) aerodynamic wing intersection leading edge (AWILE) which effectively extends the outer panel slat inboard, and (3) full span, double slotted, trailing edge flaps (equivalent to a 30 percent increase in wing area due to aft translation of the flaps). A detailed planform view of the high lift devices is shown in Figure 2-5 with cross-sectional views shown in Figure 2-6.

(U) Catapult launches from aircraft carriers are made with fully deflected trailing edge flaps ($\delta_F = 45°$) with the Direct Lift Control (DLC) system inoperative. Field takeoff is made with the trailing edge flaps at

15° without DLC. Two engine approaches to carriers and airfields are made with the trailing edge flaps at 25° and DLC operative. Single engine approaches are made at the normal approach flap setting ($\delta_F = 25°$) with DLC. Bolters are accomplished with 15 degrees of flap. The flap retracts from 25 degrees to 15 degrees with compression of the main gear strut thereby providing improved nose wheel lift-off capabilities.

(U) Detailed description of the flight control systems are presented in Volumes 7 and 13. The horizontal tail and vertical tail configurations are defined in Figures 2-7 through 2-9.

A

2.1 (C) GENERAL DATA

Model Designation	MCAIR 225A
Type	All Weather Fighter
Engines	(2) TF30-P-
Manufacturer	Pratt & Whitney
Sea Level Static Uninstalled Thrust (C_{FG}= .985)	20450 lb
Fuel Capacity - Total Internal	15280 lb
External	6120 lb
Armament:	
(a) Air-to-Air	
Fleet Air Defense Loading	(6) Phoenix Missiles
Escort Loading	(4) Sparrow Missiles
(b) Air-to-Ground	(10) MK-82 Snakeye bombs + M61 gun.
Take-off Gross Weight with (4) Sparrows	52900 lb
Maximum Catapulting Design Gross Weight	66218 lb
Basic Flight Design Gross Weight	46788 lb
Design Limit Load Factor	+ 6.5 / - 3.0 g
Carrier Landing Design Gross Weight	46800 lb
Design Sinking Speed	24.8 fps
Center of Gravity Limits (Gear Up) $\Lambda_{L.E.}$ = 19°	14.5 - 24.5% MAC

A

2.2 (C) DIMENSIONAL DATA

Total Airplane	
Wetted Area:	
Λ LE = 19°	2894 ft^2
Λ LE = 70°	2854 ft^2
Overall Length	62.7 ft
Overall Height	15.65 ft
Wing	
Area, S_{REF} (Theoretical @ Λ_{LE} = 19°)	500 ft^2
Wetted Area	762 ft^2
Span, (Λ_{LE} = 19°)	57.8 ft
Aspect Ratio, AR	6.7
Chords (Theoretical @ Λ_{LE} = 19°):	
Root Chord	13.82 ft
Tip Chord	3.45 ft
M.A.C. $\bar{c}$	9.68 ft
Leading Edge Sweepback	19° to 70°
	80° Spotting
Taper Ratio (Theoretical @ Λ_{LE} = 19°)	0.25
Dihedral	4.0 deg
Geometric Twist	-2.5 deg
Incidence @ Root	2.25 deg
Airfoil Section (Streamwise, Λ_{LE} = 19°):	
Wing at Glove-Wing Intersection	MCAIR 35412-2.17 MOD
Tip	MCAIR 35412-2.17 MOD

Airfoil Thickness/Chord:	
Outer Panel at Glove-Wing Intersection	0.12
Tip	0.12
Wing Pivot Location:	
Spanwise	27.7 % Wing Semispan
Chordwise	34.5 % Wing Chord
Spoiler	
Span (Total One Side)	8.97 ft
Area (Total One Side)	14.2 ft^2
Average Chord	21.7 % Wing Chord
Position of Leading Edge (Average Percent of Wing Chord)	68.3 % Wing Chord
Maximum Deflection Up	52 deg
Spoiler, Direct Lift Control System	
Span (Inboard, One Side)	4.18 ft
Percent Wing Span Affected	15.26 %
Area (Inboard, One Side)	7.66 ft^2
Percent Wing Area Affected	14.28 %
Deflections (See Figure 2-3)	
Leading Edge Slats (Outer Wing)	
Area	36.6 ft^2
Percent Wing Area Affected	50.85 %
Span	37.3 ft
Percent Wing Span Affected	64.44 %
Chord (Average)	15 % Wing Chord
Deflection (Extended Down)	22 deg

Trailing Edge Flaps	
Type	Double-slotted
Span:	
Flap	46.32 ft
Percent Wing Span Affected	80.02 %
Chord:	
Flap	28.5 % Wing Chord
Vane	14.5 % Wing Chord
Flap Extension (Planview Projection)	20.7 % Wing Chord
Maximum Deflection:	
Flap	45 deg
Vane	22.5 deg
Area:	
Flap/Vane	97.30 ft^2/45.46 ft^2
Percent Wing Area Affected	70.43 %
AWILE	
Area, S	5.00 ft^2
Deflection	22 deg
Horizontal Tail (Stabilator)	
Area (Outboard of BL 73.20)	172 ft^2
Wetted Area	328 ft^2
Aspect Ratio (Exposed)	2.2
Taper Ratio (Exposed)	0.37
Sweepback:	
Leading Edge	45 deg
Quarter Chord	37.9 deg
Trailing Edge	9.1 deg
Span (Projected)	31.7 ft

Chords	
Root (At BL 73.20)	12.92 ft
Tip (At BL 190.2)	4.76 ft
M.A.C. (Based on Exposed Planform)	9.47 ft
Dihedral	-7.25 deg
Tail Length ($.25\bar{C}_W$ to $.25\bar{C}_S$)	18.93 ft
Airfoil:	
Root	NACA 0004.5-64 (Modified)
Tip	NACA 0002-64 (Modified)
Deflection, i_T(Total from W.C.P.)	+ 14 / -32 deg
Symmetrical Deflection (for Pitch Control)	+10/-28 deg
Differential Deflection (for Roll Control)	$\pm$ 4 deg
Hinge Line Location	F.S. 705 in.

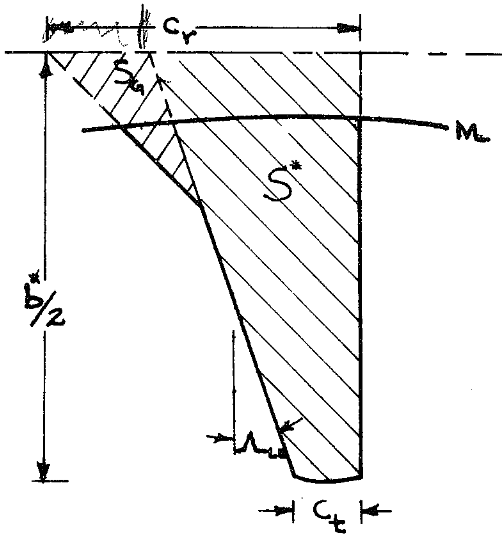
Vertical Tails

Area (Total Both Sides, Exposed)	114.1 ft^2
Wetted Area	238 ft^2
Span (Exposed)	6.5 ft
Aspect Ratio	0.76
Taper Ratio	0.28
Sweepback:	
Leading Edge	58.5 deg
Quarter Chord	52.5 deg
Trailing Edge	6.5 deg
Chords (Exposed):	
Root	13.63 ft
Tip	3.79 ft
M.A.C.	9.59 ft

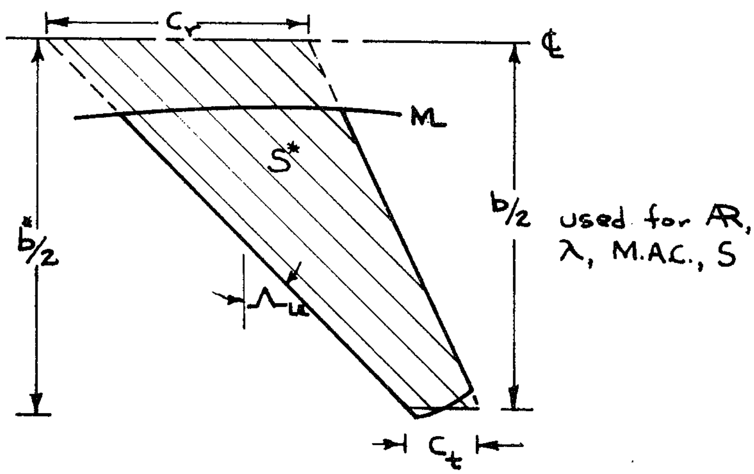
Cant Angle	10 deg
Tail Length (.25 $\overline{C}_W$ to .25 $\overline{C}_V$)	16.08 ft
Airfoil:	
Root	NACA 0004-64 (Modified)
Tip	NACA 0002.5-64 (Modified)
Rudders	
Area (Total)	31.8 ft^2
Moment Area (About Hinge Line) (per side)	24.40 ft^3
Sweepback of Hinge Line	30 deg
Span	83.2 % Fin Span
M.A.C.	3.16 ft
Maximum Deflection	$\pm$ 30 deg
High Speed Trimmer (HST)	
Area (Both Sides)	20 ft^2
Wetted Area	40 ft^2
Span (One Side)	3.26 ft
Aspect Ratio (Exposed)	1.07
Taper Ratio (Exposed)	.33
Leading Edge Sweepback	43°21' deg
Chords (Exposed):	
Root	4.61 ft
Tip	1.53 ft
M.A.C.	3.327 ft
Arm (.25 $\overline{C}_W$ to .25 $\overline{C}_{HST}$)	13.48 ft

Fuselage	
Length	59.66 ft
Maximum Height	7.13 ft
Maximum Width	13.09 ft
Wetted Area (Fuselage plus Nacelles and Nozzles)	1566 ft^2
Speedbrakes (Landing Gear Doors)	
Area (Total Maximum Projected)	20.5 ft^2
Hinge Line Location	F.S. 405.5 in.
Chord	3.25 ft
Maximum Deflection	75 deg

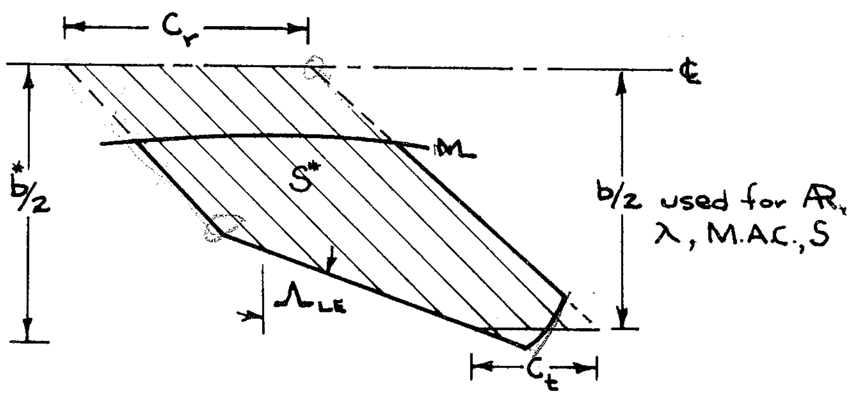
(C) ADDITIONAL DIMENSIONAL DATA



Leading Edge Sweep Angle, deg.	Λ_{LE}	= 19
Wing Area, ft^2	S*	= 500
Glove Area ft^2	S_G	= 72
Wing Wetted Area, ft^2	S_{wet}	= 762
Span, ft	b*	= 57.75
Aspect Ratio, b^2/S	AR	= 6.7
Root Chord, ft	C_r	= 13.82
Tip Chord, ft	C_t	= 3.45
Mean Aerodynamic Chord, ft M.A.C.	$\overline{c}$	= 9.68
Taper Ratio, C_t/C_r	λ	= .25



(deg.)	Λ_{LE}	= 45
(ft^2)	S*	= 528
(ft^2)	S_{wet}	= 723.2
(ft)	b*	= 49.3
	AR	= 4.59
(ft)	C_r	= 17.25
(ft)	C_t	= 4.16
(ft)	$\overline{c}$	= 12.06
	λ	= .24

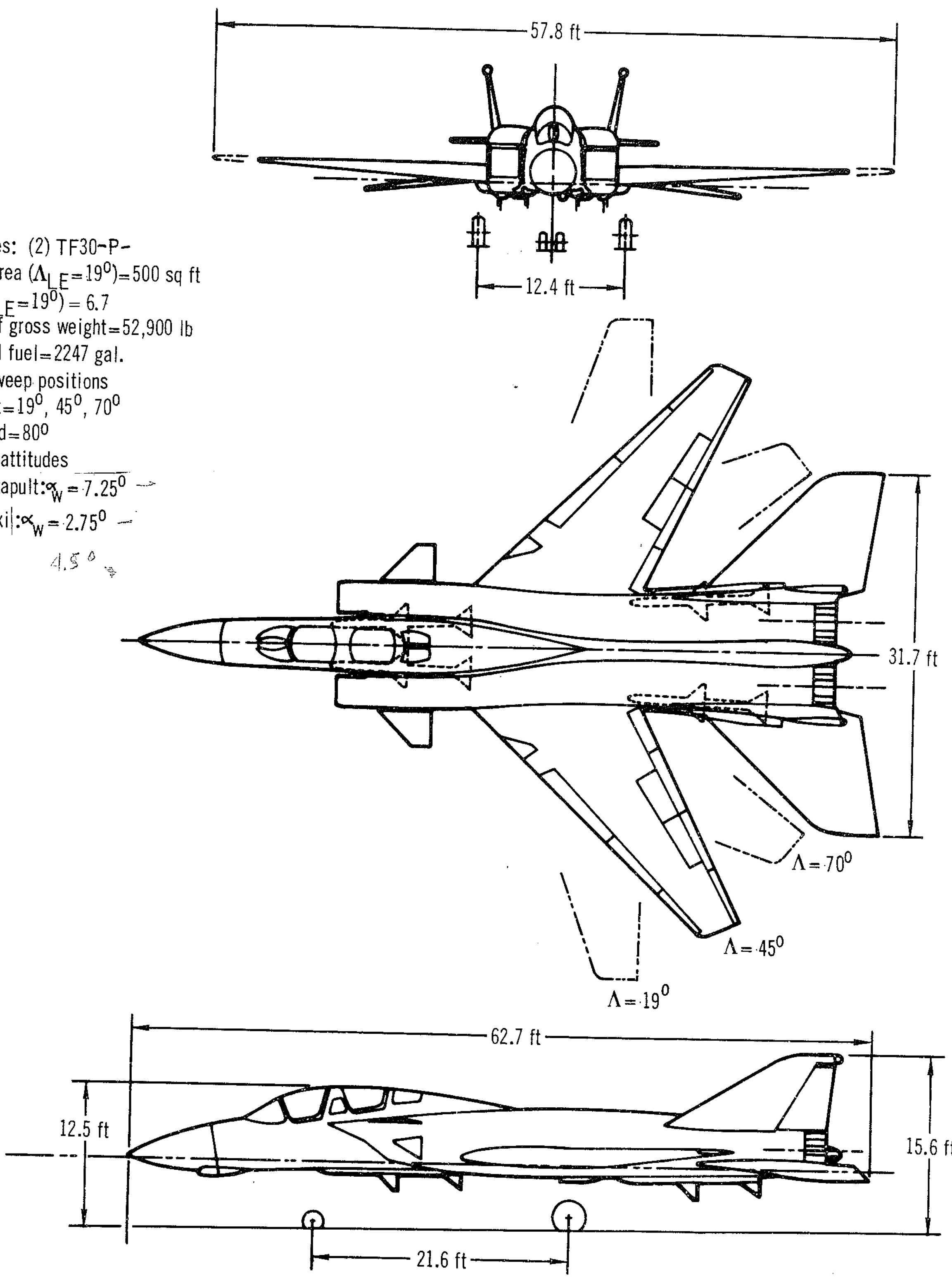


(deg.)	Λ_{LE}	= 70
(ft^2)	S*	= 502
(ft^2)	S_{wet}	= 678.2
(ft)	b*	= 36.8
	AR	= 2.42
(ft)	C_r	= 14.73
(ft)	C_t	= 7.08
(ft)	$\overline{c}$	= 14.87
	λ	= 0.48

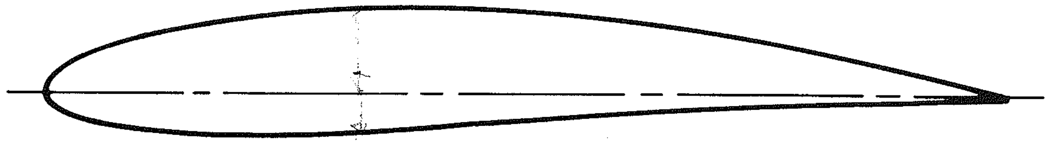
*asterisk indicates actual dimensions and areas

(C) FIGURE 2-1
MODEL 225A
GENERAL ARRANGEMENT

Engines: (2) TF30-P-
Wing area ($\Lambda_{LE}=19^0$)=500 sq ft
AR ($\Lambda_{LE}=19^0$) = 6.7
Takeoff gross weight=52,900 lb
Internal fuel=2247 gal.
Wing sweep positions
Flight=19^0, 45^0, 70^0
Stowed=80^0
Ground attitudes
Catapult: $\alpha_W = 7.25^0$
Taxi: $\alpha_W = 2.75^0$
4.5^0



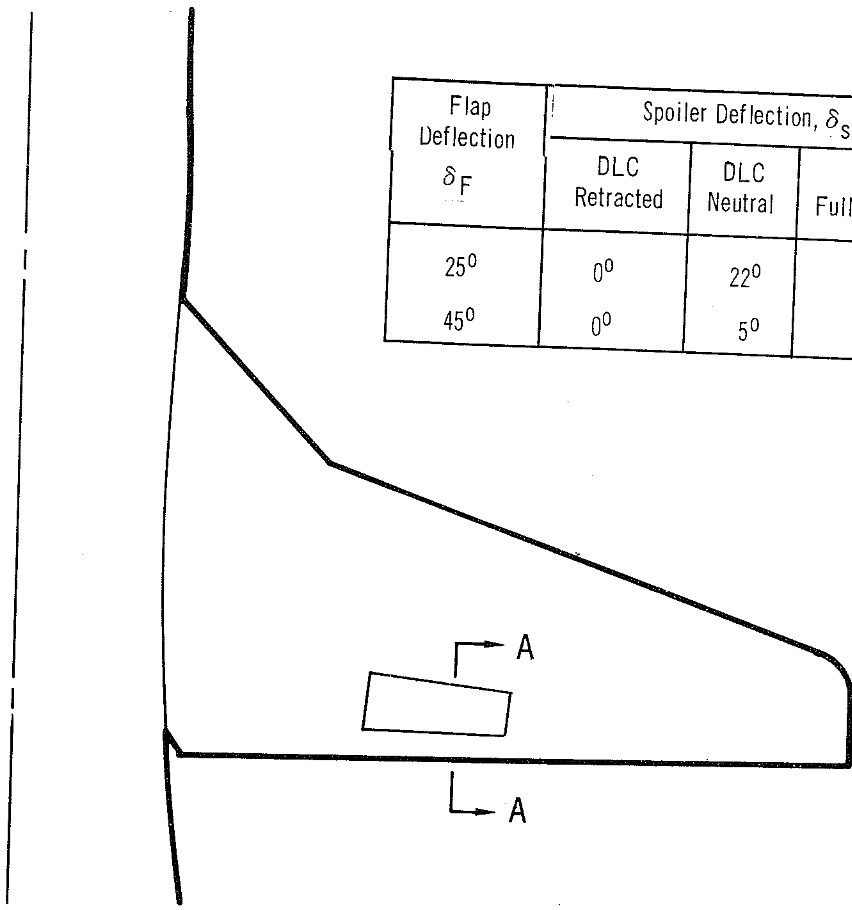
(C) FIGURE 2-2
TYPICAL WING AIRFOIL SECTION AT Λ_{LE} = 19° MCAIR 35412-2.17 MOD
Leading Edge Radius = 2.17%c $Max_{t/c}$ = 12%c at 35%c Design C_L = 0.4

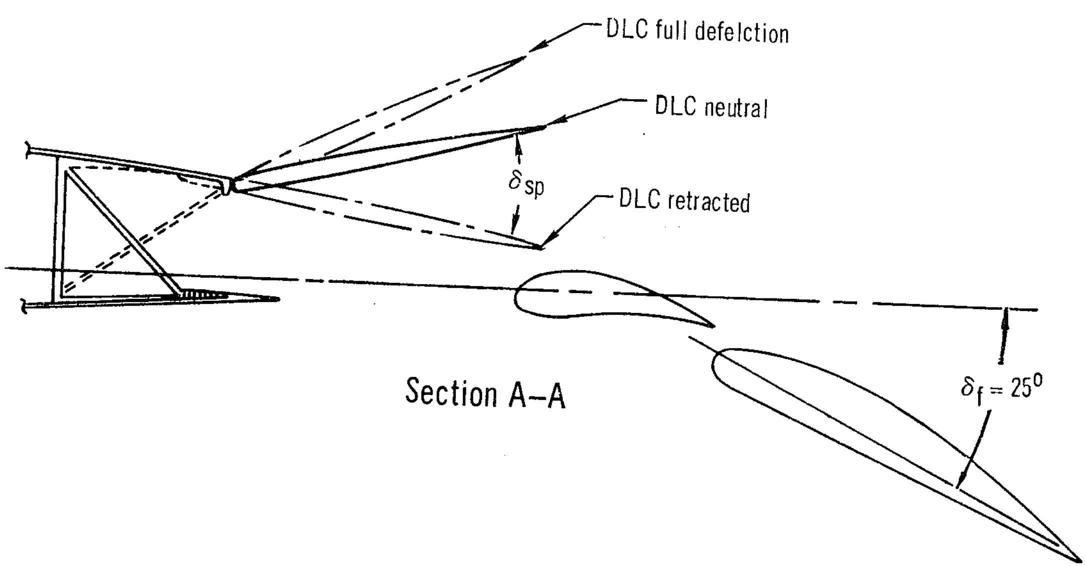


% Chord	Z_{Upper} % Chord	% Chord	Z_{Lower} % Chord
0.0	0.0	0.0	0.0
0.050	0.463	0.050	−0.463
0.100	0.651	0.100	−0.651
0.250	1.006	0.250	−1.006
0.473	1.394	0.526	−1.390
0.688	1.688	0.811	−1.669
0.901	1.922	1.098	−1.881
1.327	2.310	1.672	−2.204
1.761	2.634	2.238	−2.442
2.212	2.922	2.787	−2.632
2.685	3.179	3.314	−2.783
3.182	3.425	3.817	−2.926
3.711	3.619	4.288	−3.025
4.703	3.994	5.296	−3.231
5.714	4.308	6.285	−3.388
7.685	4.841	8.314	−3.624
9.661	5.309	10.338	−3.794
11.641	5.735	12.358	−3.923
13.623	6.124	14.376	−4.016
15.607	6.481	16.392	−4.075
19.584	7.095	20.415	−4.095
24.672	7.657	25.327	−4.033
29.701	8.044	30.298	−3.892
34.731	8.306	35.268	−3.681
39.775	8.452	40.224	−3.410
44.869	8.455	45.130	−3.116
49.938	8.315	50.061	−2.810
55.001	8.048	54.998	−2.488
60.073	7.645	59.926	−2.157
65.177	7.052	64.822	−1.844
70.230	6.260	69.769	−1.552
75.238	5.317	74.761	−1.271
80.216	4.285	79.783	−1.013
85.162	3.217	84.837	−0.763
90.108	2.147	89.891	−0.511
95.054	1.074	94.945	−0.256
100.000	0.0	100.000	0.0

(C) FIGURE 2–3
DIRECT LIFT CONTROL SYSTEM

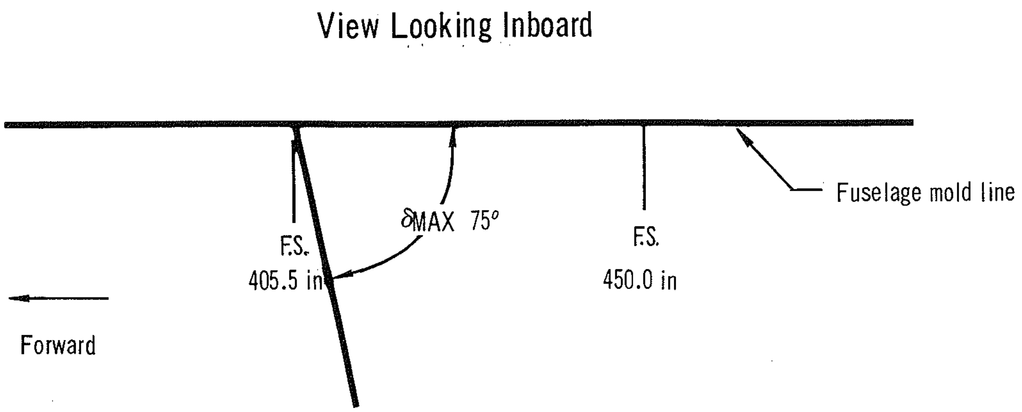
Flap Deflection δ_F	Spoiler Deflection, δ_{sp}		
	DLC Retracted	DLC Neutral	DLC Full Deflection
25^0	0^0	22^0	35^0
45^0	0^0	5^0	10^0

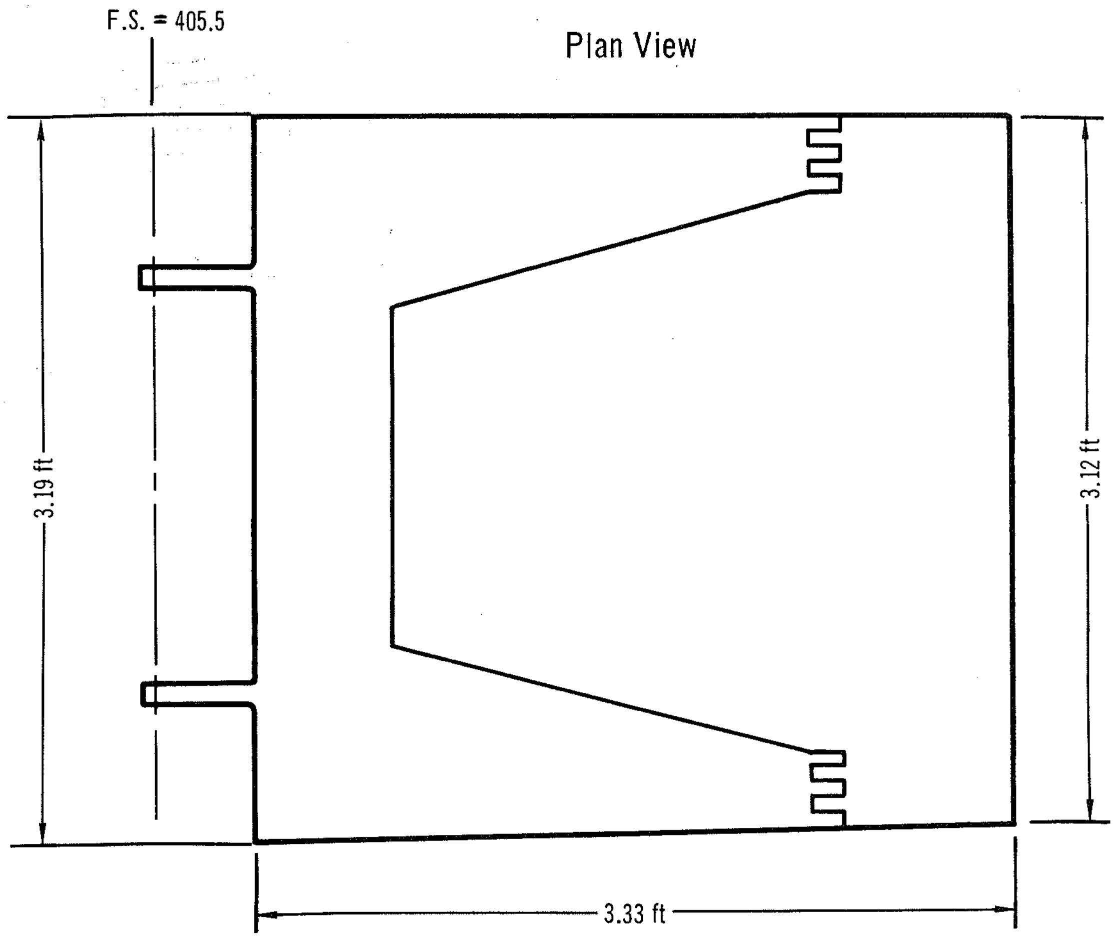




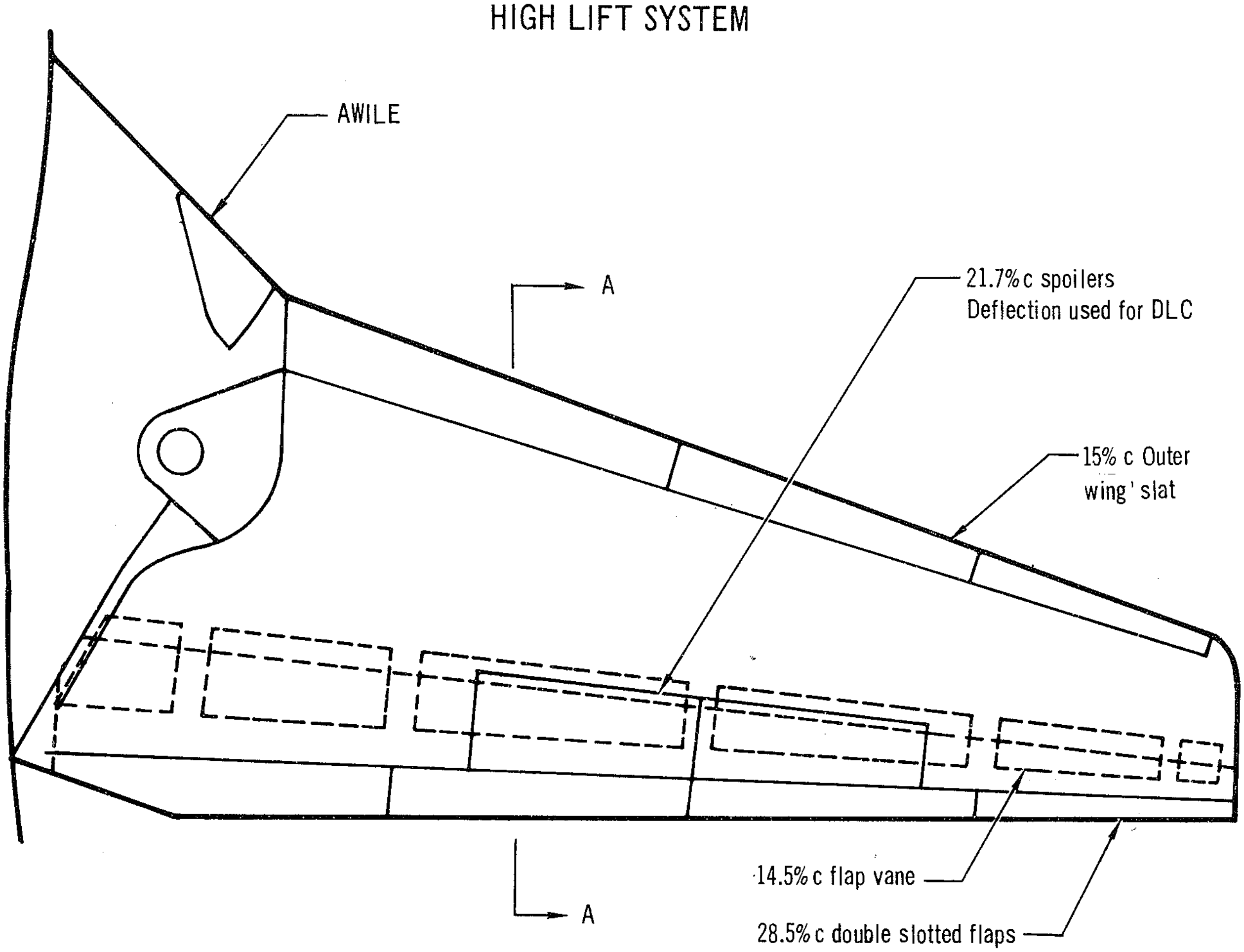
Section A–A

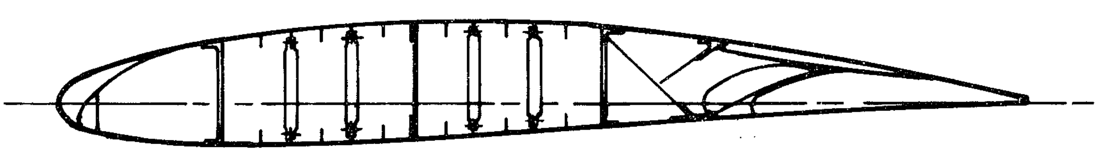
(C) FIGURE 2-4
SPEEDBRAKE GEOMETRY





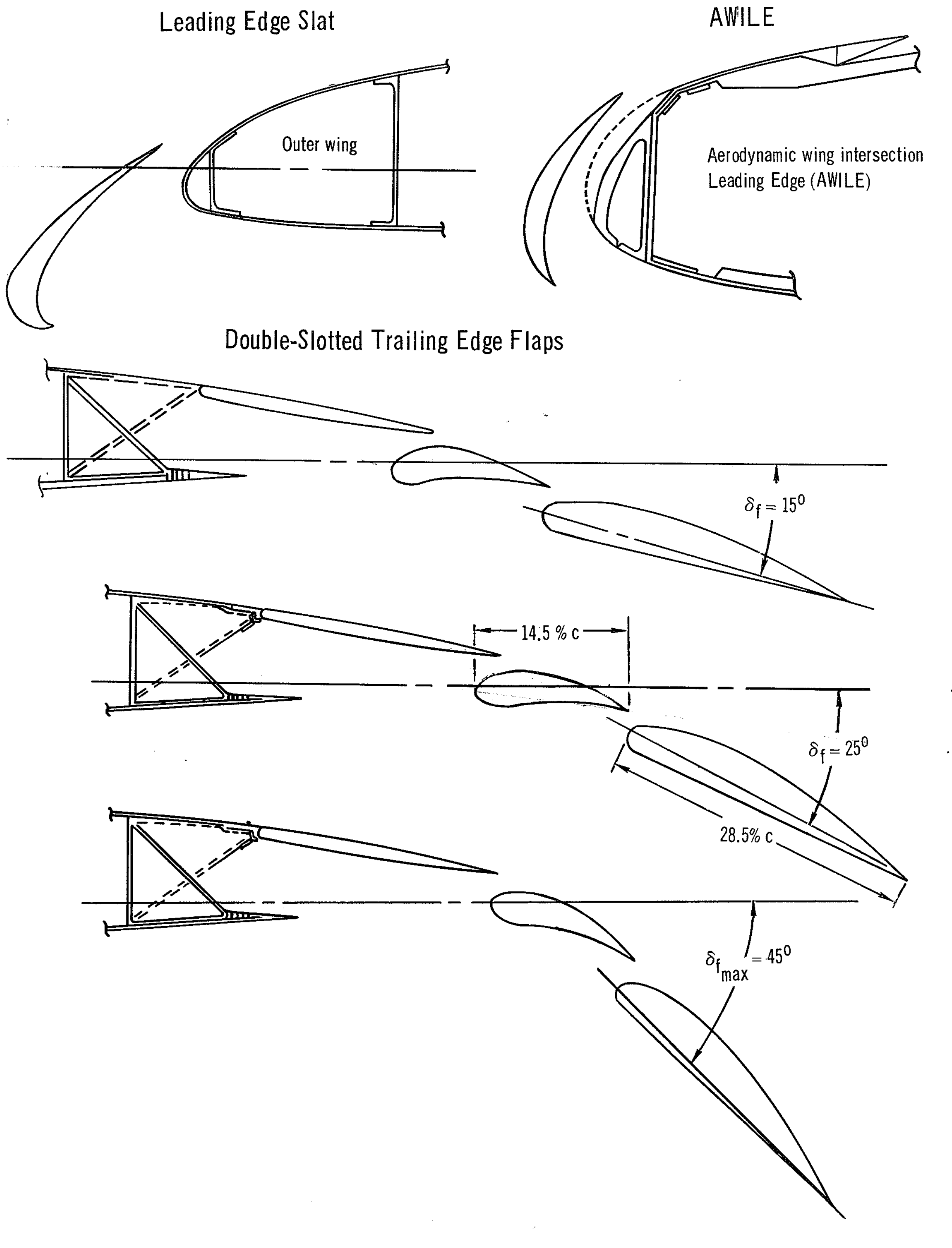
(C) FIGURE 2–5
HIGH LIFT SYSTEM





Section A–A

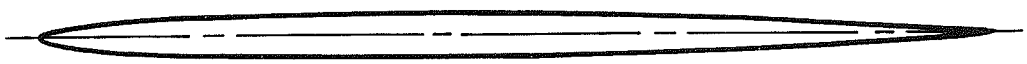
(C) FIGURE 2-6
SECTIONAL VIEW OF HIGH LIFT DEVICES



(C) FIGURE 2-7
HORIZONTAL TAIL AIRFOIL SECTIONS

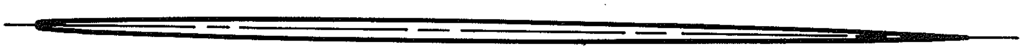
Root Airfoil: NACA-0004.5-64(Mod)

L.E. Radius = .224%c   Max t/c = 4.5%c at 40% c



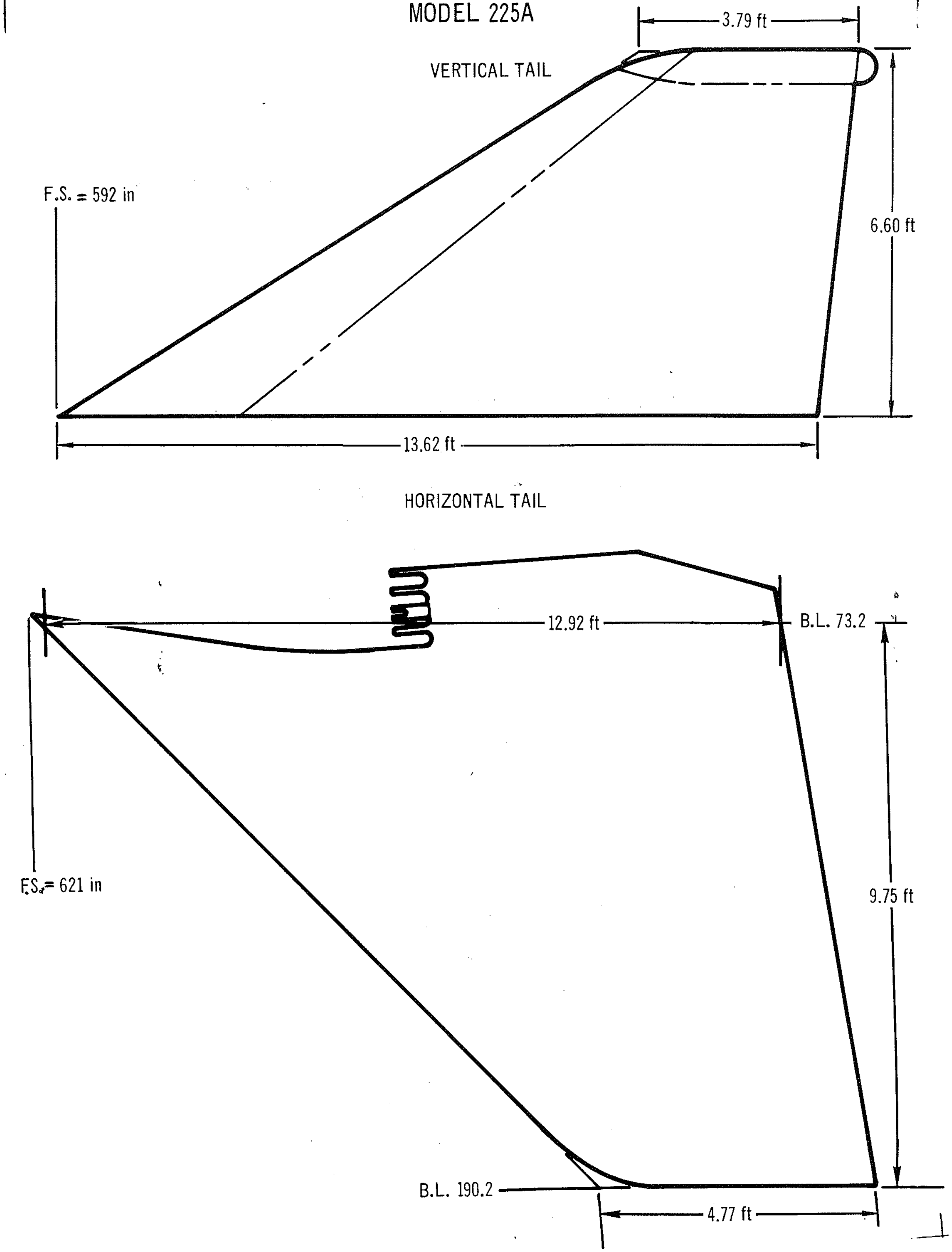
Tip Airfoil: NACA- 0002.0-64(Mod)

L.E. Radius = .044%c   Max t/c = 2.0%c at 40% c



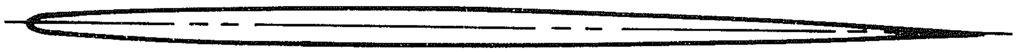
	Root	Tip
% Chord	Z-% Chord	Z-% Chord
0.0	0.000	0.000
0.025	±0.104	±0.046
0.05	±0.146	±0.065
0.075	±0.179	±0.079
0.10	±0.205	±0.091
0.15	±0.250	±0.111
0.20	±0.287	±0.127
0.30	±0.349	±0.155
0.40	±0.400	±0.178
0.60	±0.484	±0.215
0.80	±0.553	±0.246
1.00	±0.613	±0.272
2.00	±0.835	±0.371
3.00	±0.993	±0.441
4.00	±1.119	±0.497
5.00	±1.225	±0.544
10.00	±1.590	±0.706
20.00	±1.986	±0.882
30.00	±2.185	±0.971
40.00	±2.250	±1.001
50.00	±2.174	±0.966
60.00	±1.959	±0.870
70.00	±1.627	±0.723
80.00	±1.220	±0.542
100.00	±0.396	±0.176

(C) FIGURE 2-8
MODEL 225A



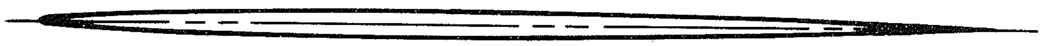
(C) FIGURE 2–9
VERTICAL TAIL AIRFOIL SECTIONS
Root Airfoil: NACA–0004–64 (Mod)

Leading edge radius = .176%c Max t/c = 4% c at 40% c



Tip Airfoil: NACA–0002.5–64 (Mod)

Leading edge radius = .069% c Max t/c = 2.5% c at 40% c



% Chord	Root	Tip
	Z % Chord	Z % Chord
0.0	0.000	0.000
0.025	±0.092	±0.057
0.050	±0.130	±0.081
0.075	±0.159	±0.098
0.10	±0.183	±0.113
0.15	±0.223	±0.138
0.20	±0.256	±0.158
0.30	±0.312	±0.191
0.40	±0.358	±0.219
0.60	±0.433	±0.264
0.80	±0.496	±0.301
1.00	±0.550	±0.333
2.00	±0.752	±0.450
3.00	±0.897	±0.533
4.00	±1.013	±0.598
5.00	±1.110	±0.652
10.00	±1.444	±0.842
20.00	±1.793	±1.066
30.00	±1.952	±1.200
40.00	±2.000	±1.249
50.00	±1.967	±1.217
60.00	±1.831	±1.116
70.00	±1.535	±0.939
75.00	±1.310	±0.820
100.00	±0.040	±0.174

(C) FIGURE 2–10
MODEL 225A
CATAPULT GEOMETRY

CONDITION	A	B	C	D	E	F	G	H	J	K
TRACKING (STATIC)	–	–	33.7°	–	5.4°	9.07	14.70	52.25	–	–
BUFFING	–	–	–	–	4.2°	6.92	15.50	54.60	–	–
HOOK-UP	51.64	83.08	27.7°	14.8°	5.4°	9.03	14.70	52.25	–	–
INITIAL TENSION	–	84.08	23.6°	13.1°	4.7°	7.68	15.15	53.60	–	–
FINAL TENSION	–	84.70	20.8°	11.6°	4.8°	6.67	14.85	52.60	7.24	0.92
RELEASE	–	84.19	23.0°	12.9°	4.7°	7.47	15.12	53.40	–	–
START OF RUN	–	–	23.0°	–	4.7°	7.47	15.12	53.40	7.58	1.72
END OF TOW RUN	–	–	21.2°	–	4.7°	6.82	14.95	52.80	–	–
ALL TIRES FLAT	–	85.04	19.5°	10.4°	5.6°	6.00	10.90	52.25	6.90	0.25

ALL DIMENSIONS ARE IN INCHES OR DEGREES

Note: Tracking (static) condition E = 5.0° for data in report.