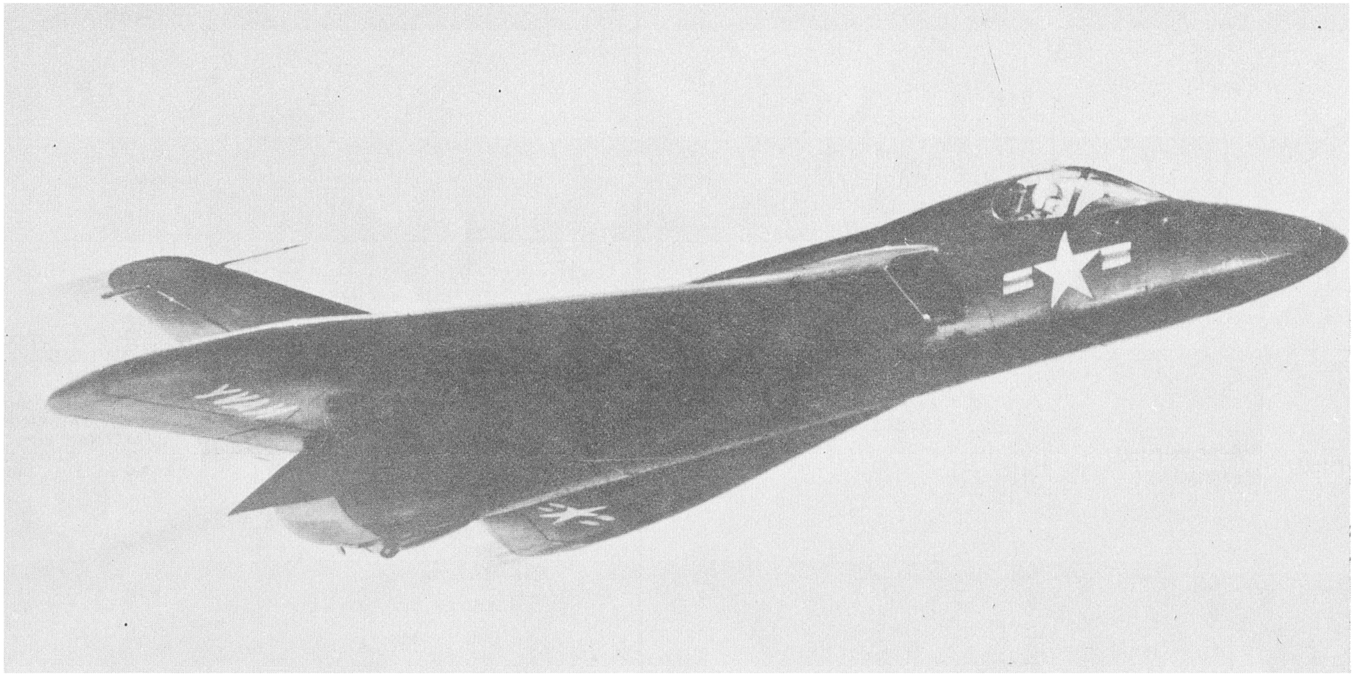
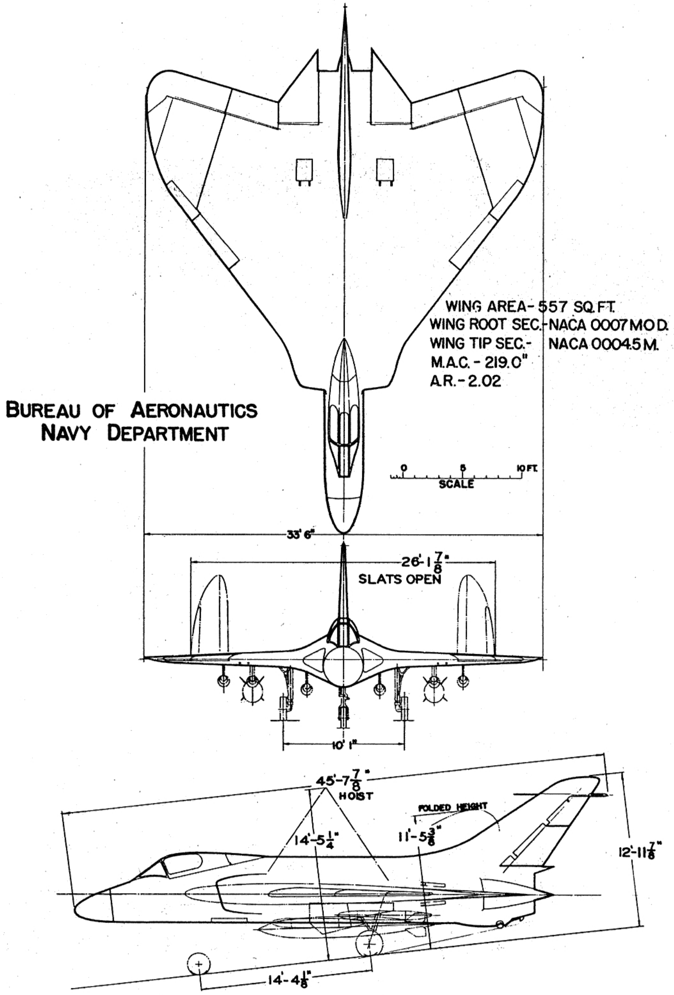


STANDARD AIRCRAFT CHARACTERISTICS

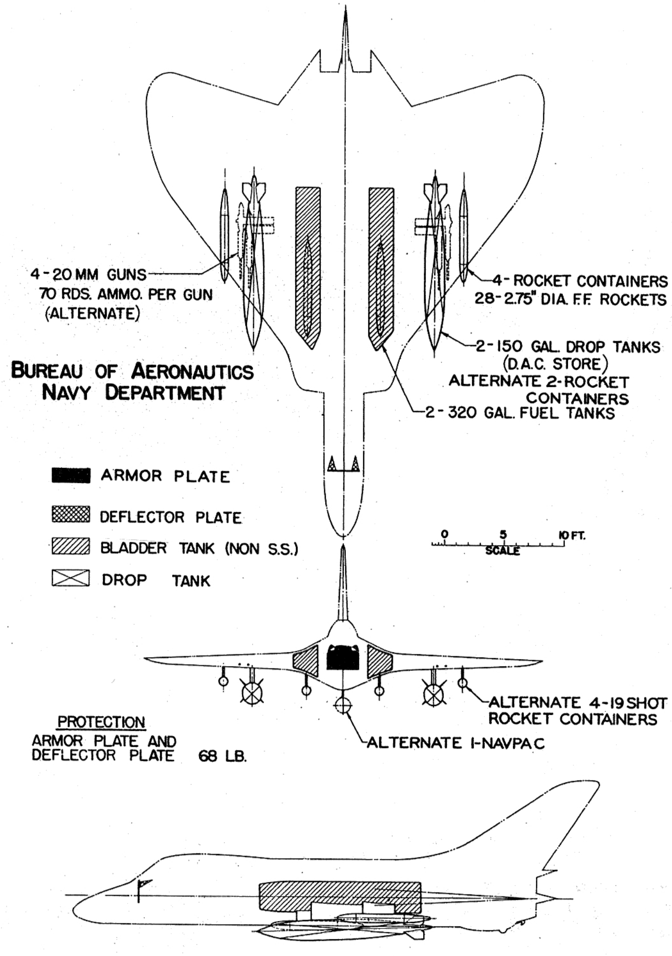
F4D-1 "SKY RAY"

DOUGLAS

Standard Aircraft Characteristics NAVAER 1335A (REV. 1-49)



DESCRIPTIVE ARRANGEMENT



ARMAMENT & TANKAGE

Standard Aircraft Characteristics NAVAER 1335B (REV. 1-49)

POWER PLANT

NO. & MODEL.......(1) J57-P-2
MFR..........Pratt & Whitney
TYPE...........2 Rotor Axial
LENGTH..................242"
DIAMETER.................41"
AUGUMENTATION.....Afterburner

RATINGS

	LBS. @	RPM N_1	RPM N_2	@ ALT.
MIL.+AB	14800	6150	9650	S.S.L.
MIL.	9220	6150	9650	S.S.L.
NORM.	8000	5800	9560	S.S.L.

SPEC. NO. N-1662-A

ORDNANCE

GUNS

NO.	SIZE	LOCATION	RDS.
4	20mm	Wings	280

FIRE CONTROL

Aero 10F - 1
(APG-30A Mk. 16 Mod. 5)

EXTERNAL LOAD

RACKS	NO.	LOCATION	MAX. CAP.
Aero 14B or C	4	Wing	4-19 shot 2.75 rockets
	2	Wing	Fuel or rockets
	1	Fuselage	Nav Pac

MISSION AND DESCRIPTION

The primary mission of the F4D-1 airplane is the interception and destruction of enemy aircraft. The airplane is designed to operate from aircraft carriers or land bases.

The airplane is a tailless, low aspect ratio single seat fighter. A single turbo-jet engine with afterburner is installed in the fuselage.

Automatic leading edge slats are provided as high lift devices for take-off and landing. Four hydraulically operated speed-retarding brakes are located inboard on the wing.

Flight control is provided by means of power operated elevons which perform the functions of conventional elevators and ailerons. Electrically actuated trimming surfaces are provided for lateral and longitudinal trim.

DEVELOPMENT

Mock up....................March 1949
First Flight.................May 1954
Service Use..............January 1955

DIMENSIONS

WING
AREA............557 Sq. Ft.
SPAN..............33' - 6"
M.A.C.............18' - 3"
SWEEPBACK(1/4 Chord)..46.5°
LENGTH.............45' - 8"
HEIGHT.............13' - 0"
TREAD..............10' - 1"

WEIGHTS

LOADINGS	LBS.	L.F.
EMPTY	15,225	....
BASIC	15,450	....
DESIGN	16,652	6.0
COMBAT	18,687	5.3
MAX.T.O. (Field)	23,050	4.8
(Cat.)	23,050	4.8
MAX.LAND. (Field)	19,050	....
(Arrest)	19,050	....

All weights are calculated.

FUEL AND OIL

GALS.	NO. TANKS	LOCATION
640	2	Wing
300	2	External

FUEL GRADE...........JP-4
FUEL SPEC.....MIL-F-5624A

OIL

CAPACITY (GALS.).........3.5
SPEC.............MIL-L-7808

ELECTRONICS

UHF COMM...........AN/ARC-27A
NAV. REC.............AN/ARN-21
RADIO ALTM..........AN/APN-22
IFF.................AN/APX-6B
FIRE CONTROL RDR......APG-30A
(P.S.A........E-10)
UHF D.F.................ARA-25
NAV. REC...............ARN-14E
MARKER BEACON REC......ARN-12

PERFORMANCE SUMMARY

TAKE-OFF LOADING CONDITION	(1) INTERCEPTOR 4 Rocket Packages		(4) INTERCEPTOR GUNS Full Internal Fuel		(7) FERRY Rocket Packages 2-150 Gal.Ext.Tanks
TAKE-OFF WEIGHT lb.	20,350		20,500		22,122
Fuel (JP-4) lb.	4,160		4.160		6,110
Payload lb.	504		190		None
Wing loading lb./sq.ft.	36.5		36.8		39.6
Stall speed - power-off kn.	112.3		113.1		117.4
Take-off run at S.L. - calm (B) ft.	1,180		1,205		1,430
Take-off run at S.L. 25 kn. wind(B) ft.	780		800		965
Take-off to clear 50 ft. - calm ft.	- -		- -		- -
Max. speed/altitude (A) kn./ft.	558/25,000		568/22,500		532/25,000
Rate of climb at S.L. (B)/(C) fpm	18,400/5,850		21,400/6,050		- /5,000
Time: S.L. to 40,000 ft. (B)/(C) min.	3.5/12.9		3.3/11.7		- /17.2
Time: S.L. to 50,000 ft. (B)/(C) min.	5.2/27.3(D)		5.0/24.0(D)		- /26.2(D)
Service ceiling (100 fpm) ft.	55400/44,600		55500/45,800		- /41,000
Combat range n.mi.	585		645		915
Average cruising speed kn.	518		518		510
Cruising altitude(s) ft.	43000/45,200		44400/46,700		39600/44500
Combat radius n.mi.	200		225		- -
Average cruising speed kn.	518		518		- -
Total endurance (Point intercept) min.	59		63		
COMBAT LOADING CONDITION	(2)	(3)	(5)	(6)	
COMBAT WEIGHT lb.	18,686	18,686	18,836	18,836	
Engine power	Mil + A/B	Military	Mil + A/B	Military	
Fuel lb.	2,496	2,496	2,496	2,496	
Combat speed/combat altitude kn./ft.	562/50,000	536/44,600	565/50,000	533/46,200	
Rate of climb/combat altitude fpm/ft.	3,350/50,000	500/44,600	3,510/50,000	500/46,200	
Combat ceiling (500 fpm) ft.	56,200	44,600	56,500	46,200	
Rate of climb at S.L. fpm	20,150(E)	6,460	23,640(E)	6,670	
Max. speed at S.L. kn.	640	523	645	550	
Max. speed/altitude kn./ft.	642/1,500	574/15,000	647/1,500	575/15,000	
LANDING WEIGHT lb.	16,613		17,068		
Fuel lb.	1,014		1,002		
Stall speed - power-off kn.	101.7		103.2		
Stall speed - with approach power kn.	97.4		98.9		

NOTES

Reason for reissue: Change to J57-P-2 engine.

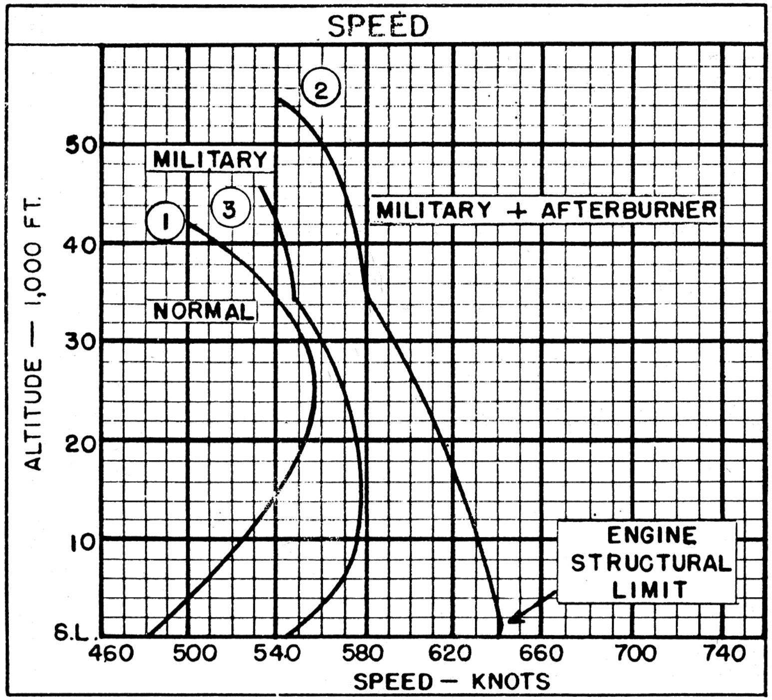
(A) Normal rated thrust.

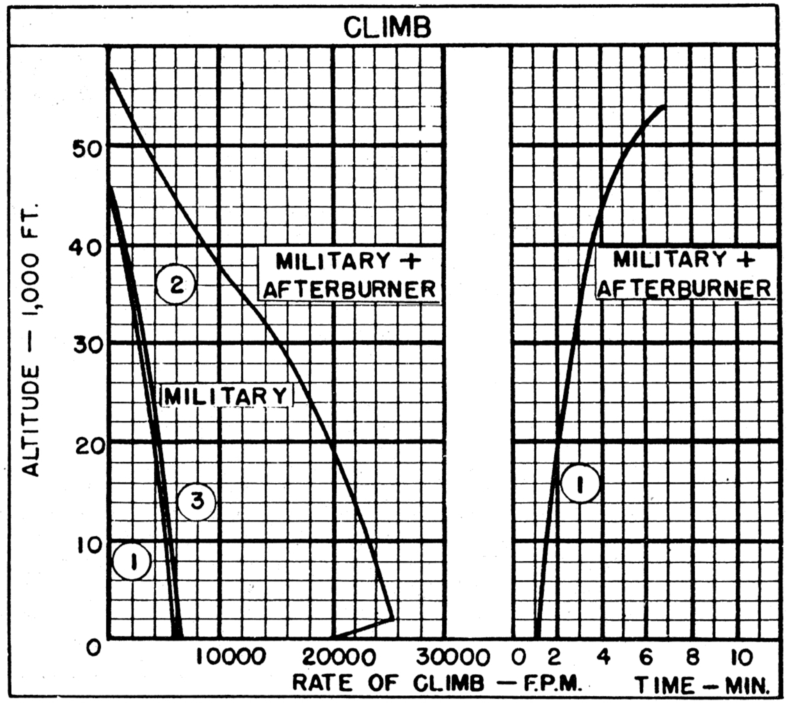
(B) Military rated thrust plus afterburning.

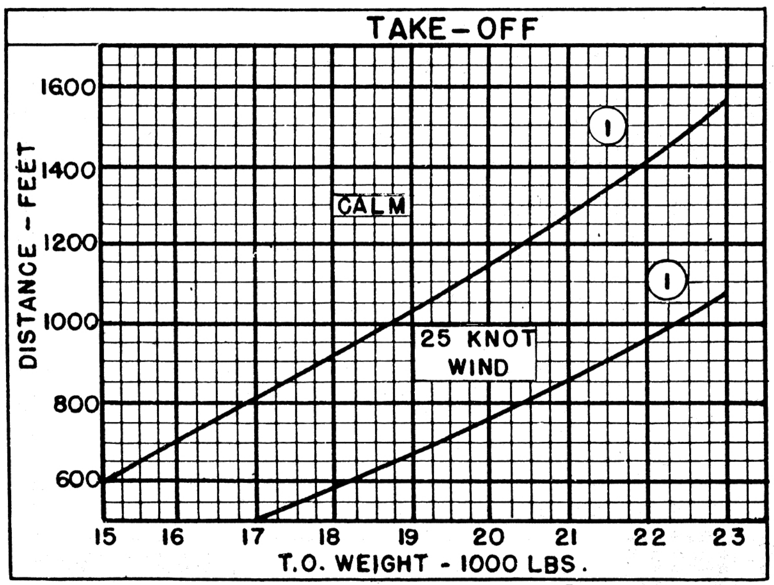
(C) Military rated thrust.

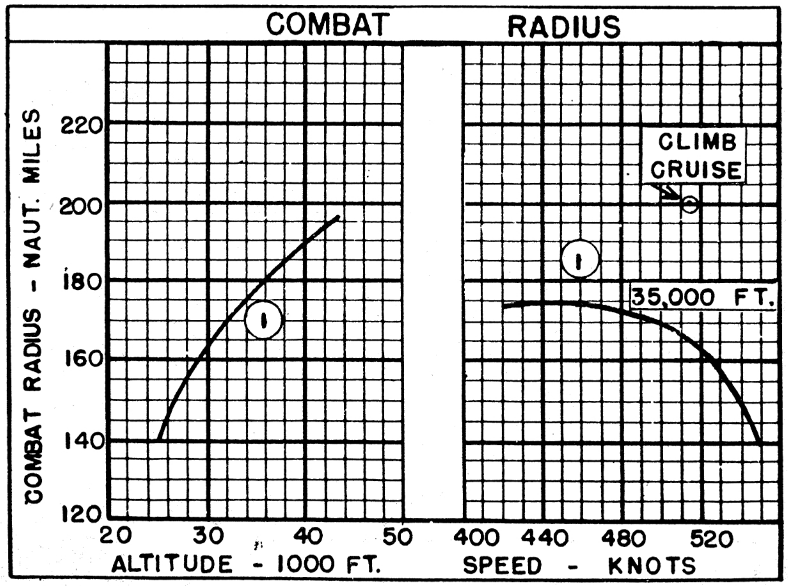
(D) Time to climb to service ceiling.

(E) Restricted by engine structural limit.









○ LOADING CONDITION COLUMN NUMBER

NOTES

Performance basis: Calculations

Range and radius are based on engine specification fuel consumption data increased by 5%.

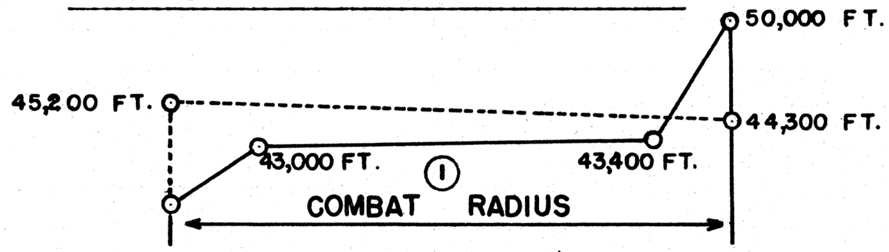
Spotting: A total of 84 airplanes (wings folded) can be accommodated in a landing spot on the flight and hangar decks of a CVA-19 class canted deck carrier.

Time to climb includes time for take-off and acceleration to climb speed.

INTERCEPTOR FIGHTER COMBAT RADIUS PROBLEM (AREA INTERCEPT)

WARM-UP, TAKE-OFF, ACCELERATE: 2 minutes at normal rated thrust.
CLIMB: To cruise ceiling at military rated thrust.
CRUISE-OUT: At speed for long range at cruise ceiling.
CLIMB: To 50,000 feet at military plus afterburner thrust.
COMBAT: At 50,000 feet for 5 minutes at military plus afterburner thrust.
CRUISE-BACK: At speed for long range at cruise ceiling.
RESERVE: 20 minutes at speed for maximum endurance at sea level plus 5% of initial fuel load.

COMBAT RADIUS = CLIMB + CRUISE-OUT = CRUISE BACK



INTERCEPTOR FIGHTER COMBAT ENDURANCE PROPLEM (POINT INTERCEPT)

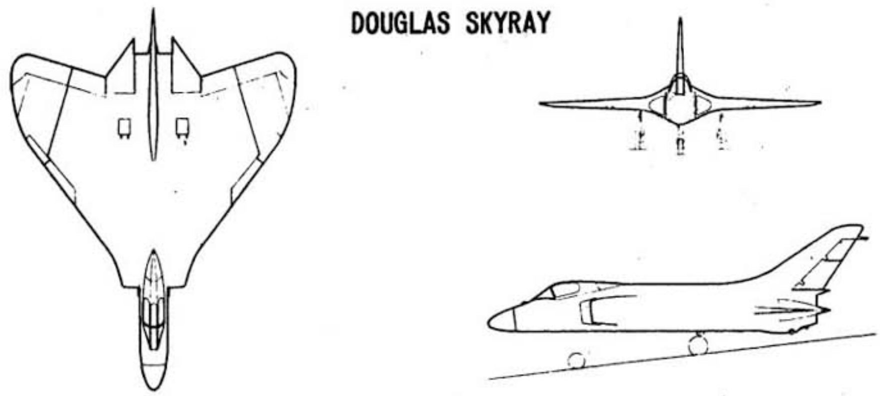
WARM-UP, TAKE-OFF, ACCELERATE: 2 minutes at normal rated thrust, 1 minute at military plus afterburner thrust.
CLIMB: To 50,000 feet at military plus afterburner thrust.
COMBAT: At 50,000 feet for 5 minutes at military power plus afterburner.
DESCEND: To 35,000 feet (no fuel used, no distance gained).
LOITER: At 35,000 feet for 29.8 minutes at speed for maximum endurance.
DESCEND: To sea level (no fuel used, no distance gained).
RESERVE: 20 minutes at speed for maximum endurance at sea level.

○ LOADING CONDITION COLUMN NUMBER

CHARACTERISTICS SUMMARY

FIGHTER F4D-1

DOUGLAS SKYRAY



WING AREA 557 Sq. Ft.
WING SPAN 33.5 Sq. Ft.
LENGTH 45.4 Ft.
HEIGHT 13 Ft.

AVAILABILITY			PROCUREMENT				
NUMBER AVAILABLE			NUMBER DELIVERED IN FISCAL YEARS				
ACTIVE	RESERVE	TOTAL					

STATUS

Contract approvals: N0a(s) 52-066, 1 July 1951, 2 airplanes; N0a(s) 51-637, 10 February 1951, 11 airplanes; N0a(s) 52-977, 24 April 1952, 230 airplanes; N0a(s) 54-320, 16 October 1953, 178 airplanes.

First Flight Dates: Prototype: January 1951; Production: June 1954

Production Status: All four hundred nineteen (419) aircraft of the production contracts have been delivered to the Navy.

ENGINES

(1) Pratt & Whitney J57-P-8B with afterburner.

	Thrust Lbs.
MIL + A/B	16,000
Military	10,200
Normal	8,700

FEATURES

Crew: 1
Carrier-based

Flight Control: Elevons
Fire Control: Aero 13F
Useable Fuel: 1240 Gal.

ARMAMENT

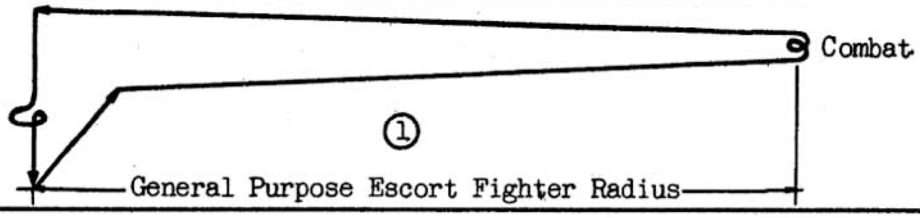
76 2.75 in. Rockets

4 AAM-N-7 Sidewinders.

4 20mm M-12 guns with a total of 280 rounds.

CHARACTERISTICS SUMMARY

BASIC MISSION F4D-1



PERFORMANCE

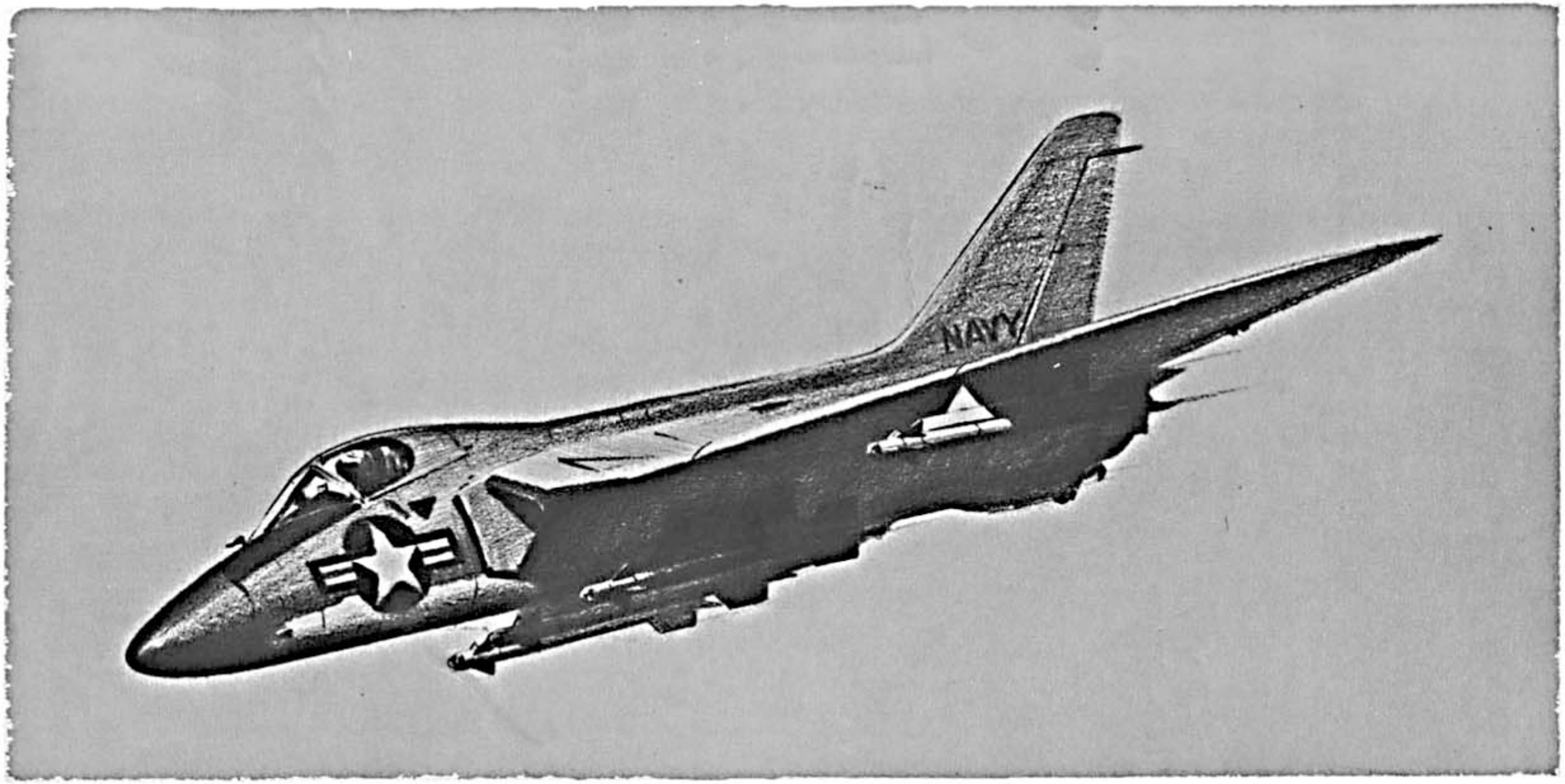
COMBAT RADIUS	COMBAT RANGE	SPEED
306 nautical miles at **452** knots average speed in **1.7** hours	**973** nautical miles at **447** knots average speed in **2.2** hours	**623** knots (M=.94) at sea level Combat Weight, Tanks off, Missiles on, A/B Thrust **565** knots (M=.98) at 35,000 ft. Combat Weight, Tanks off, Missiles on, A/B Thrust

CLIMB	CEILING	TAKE OFF
5400 Ft/Min at Sea Level, T.O. Weight, Military Thrust	**37,600** Ft. **100** Ft/Min, T.O. Weight Military Thrust	Take-off run **3295** Ft., No wind, sea level, T.O. Weight, Military Thrust
8400 Ft/Min at **35,000** Ft. Combat Weight, Tanks off, Missiles on, A/B Thrust	**51,000** Ft. **500** Ft/Min, Combat Weight Tanks off, Missiles on, A/B Thrust	Take-off over 50 Ft. Obstacle, **5055** Ft., No wind, sea level, T.O. weight, Military Thrust

LOAD	WEIGHTS	STALLING SPEED
Fuel **1240** gal. (JP-5) 4-20mm guns 4-Sidewinder Missiles 2-300 gal. Ext. Tanks	Empty .... **16,024** lb. Landing .... **18,982** lb. Combat .... **22,648** lb. (Full Int. Fuel) Take-off .... **27,116** lb.	**120.1** knots Take-off Weight Power-off **TIME TO CLIMB** **30,000** Ft. in **10.5** min. Take-off Weight Military Thrust

NOTES

Performance is based on contractor and NATESCEN flight test data. Combat range and radius are based directly on fuel consumption of the J57-P-8B engine derived from contractor and NATESCEN flight tests.

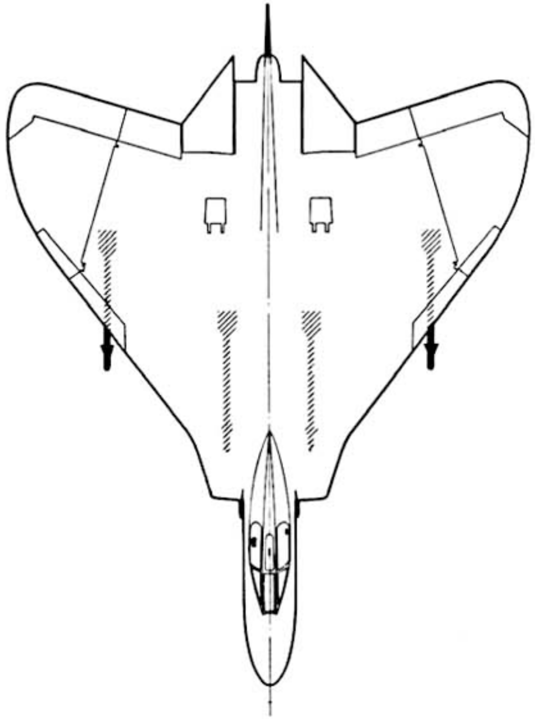


MISSILE SYSTEM CHARACTERISTICS

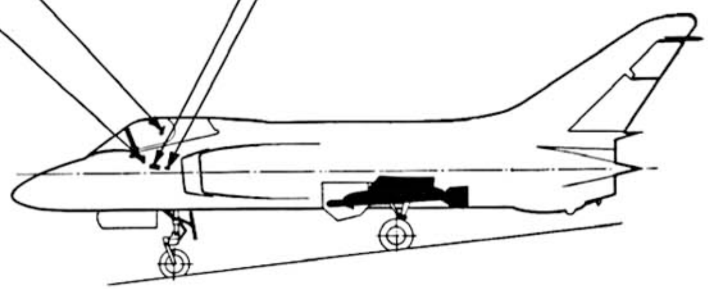
F4D-1 SKYRAY — AAM-N-7 SIDEWINDER

DOUGLAS AIRCRAFT COMPANY, INC.
EL SEGUNDO DIVISION

GENERAL ARRANGEMENT



DIMENSIONS	
Span	33.5 ft.
Length	45.4 ft.
Height	13.0 ft.



DESCRIPTION

The F4D-1 is a high performance, carrier-based, jet-powered airplane designed for the destruction of enemy aircraft.

The incorporation of a Sidewinder missile system in the F4D is intended to increase greatly the lethality of the aircraft in the accomplishment of its assigned mission.

Being an infrared homing device, the Sidewinder is less susceptible to jamming than other types of guidance which results in it having a kill probability substantially higher than conventional weapons.

The F4D-1, is capable of carrying four Sidewinders, and can conduct multiple firing passes on a single target.

STATUS: The seventy-fifth and subsequent F4D-1 airplanes have Sidewinder missile system capabilities.

ELECTRONICS

Equipment Carried In Basic F4D

UHF Comm. AN/ARC-27A
Nav. Rec. AN/ARN-21
Radio Altm. AN/APN-22
IFF AN/APX-6B
Idr. Finder AN/ARA-25
NAV PAC, consisting of:
VHF NAV AN/ARN-14
Marker Beacon AN/ARN-12
Fire Control.... Aero 13-F System
Consisting of:
Radar AN/APQ-50
Arm. Cont. Dir. .... Aero 5B
Opt. Sight Syst. Mk.16 Mod.11

Additional Equipment For Missile System None

FUEL

Gal.	No. Tanks	Location
640	2	Inner Wing
600	2	Ext. Droppable

Maximum Usable Fuel... 1240 Gal.
Fuel Grade JP-4
Fuel Spec. MIL-F-5624

LAUNCHING EQUIPMENT

Sidewinder Launcher ...... Aero X3A

WEIGHTS

LOADINGS		FOUR SIDEWINDER MISSILES
Empty		15827
Basic		15878
* Combat		21455
** Flight Design		18215
** Landing Design		16559
** Catapulting Design		23051

Useful Load		
Pilot		200
Fuel-Internal (640 Gal.-JP-4)		4160
Fuel-External (600 Gal.-JP-4)		3900
Oil		26
Trapped Fuel and Oil		33
Fairing-Gun Tunnel	(4)	4
Sidewinder Missile	(4)	640
Launchers	(4)	194
Pylon Instal.	(4)	147
Oxygen Equipment		14
Parakit, Seat and Back Pans		30
Aero 7A Racks	(2)	180
External Tank - 300 Gal.	(2)	388
Total Useful Load		9916
Gross Weight - Take-off		25743

* Less External Fuel and Drop Tanks
** See Spec. SD-458-1(1)

SIDEWINDER MISSILE SYSTEM

INSTALLATION

Four AAM-N-7 Sidewinder missiles can be carried on the F4D airplane, two on the outboard wing stations 124.625 and two on the inboard stations 32.000. Aero X3A guided missile launchers are installed at the same stations as the existing Aero 20A ejectors or Aero 14B launchers with which they are interchangeable.

The airplanes are presently configured with the required internal wiring. The only additional components that must be installed are the missile control console in the cockpit and the static pressure transducer in the equipment compartment.

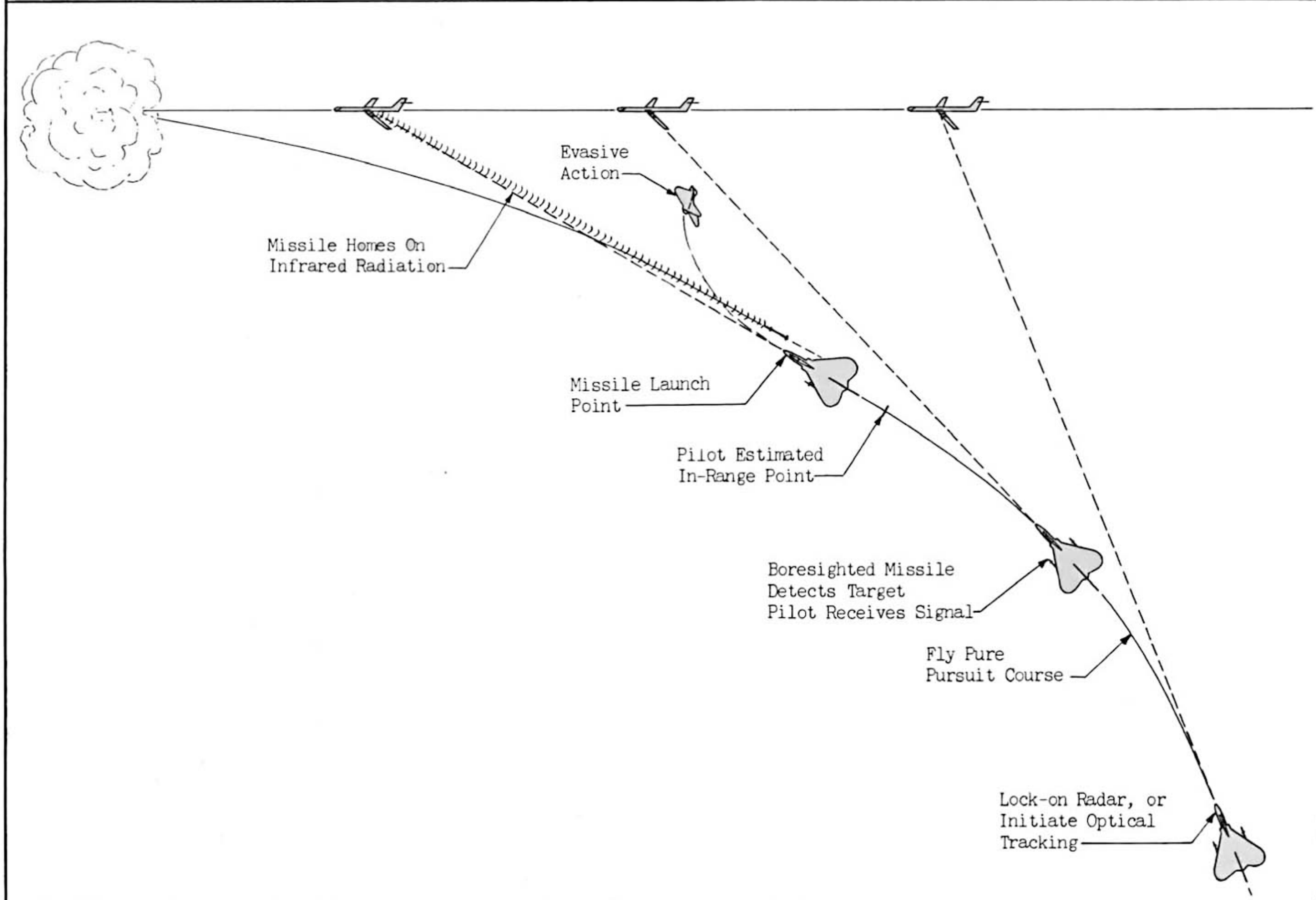
The airplane still retains the ability to carry two 300 gallon external fuel tanks along with the four missiles.

OPERATION

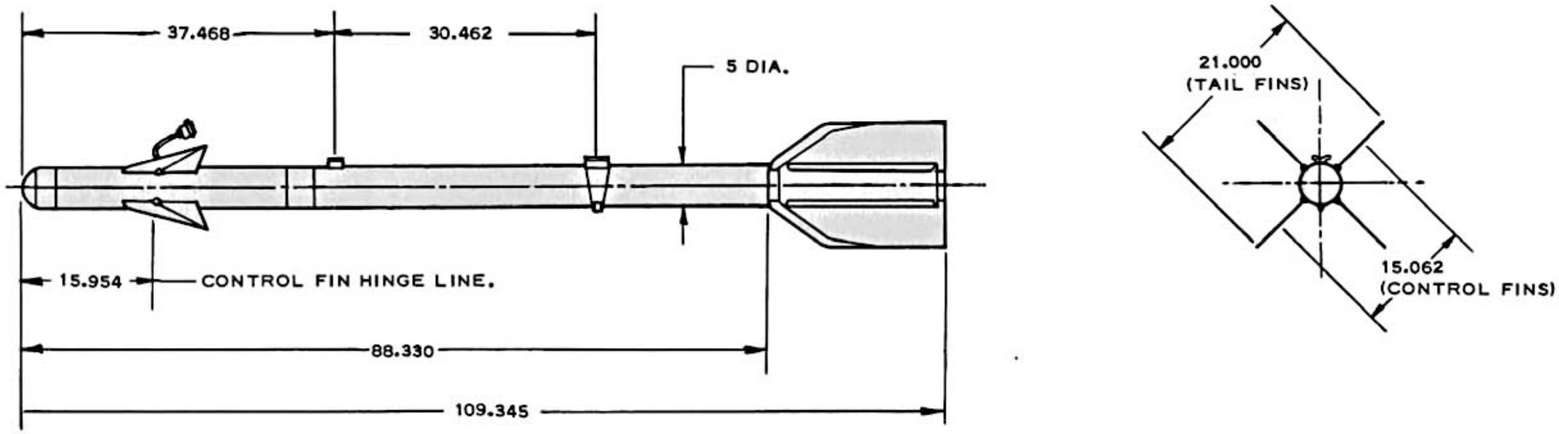
Sidewinder targets may be acquired either visually or by the the airplane's radar. The target may then be tracked by use of the optical sight or by flying the presentation on the radar indicator scope. When within firing range, the missile will send an aural signal to the pilot through his earphones The pilot is then free to launch a missile and initiate evasive action.

The Aero 13F fire control system in the F4D does not contain a Sidewinder missile computer so that a completely automatic firing capability is not available, but the radar can be used effectively for providing tracking and range information for the pilot. It is then left to the pilot's discretion as to when the missile is actually launched.

TYPICAL AIR-TO-AIR ATTACK



GENERAL ARRANGEMENT AAM-N-7 SIDEWINDER MISSILE



TYPE - Air-to-Air Missile

LENGTH - 109.345 inches

WEIGHT - 160 lbs.

BODY DIAMETER - 5.0 inches

WING SPAN - 21.0 inches

FIN SPAN - 15.062 inches

WARHEAD - 25 lbs.

HBX-1 - 10.5 lbs.

Frag Case - 14.5 lbs.

MOTOR - Solid propellant

Total Impulse - 8,400 lb-sec.

MANEUVER ACCELERATION -
10g - S.L. to 30,000 ft.

3g - 60,000 ft.

ALTITUDE RANGE - 0-60,000 ft.

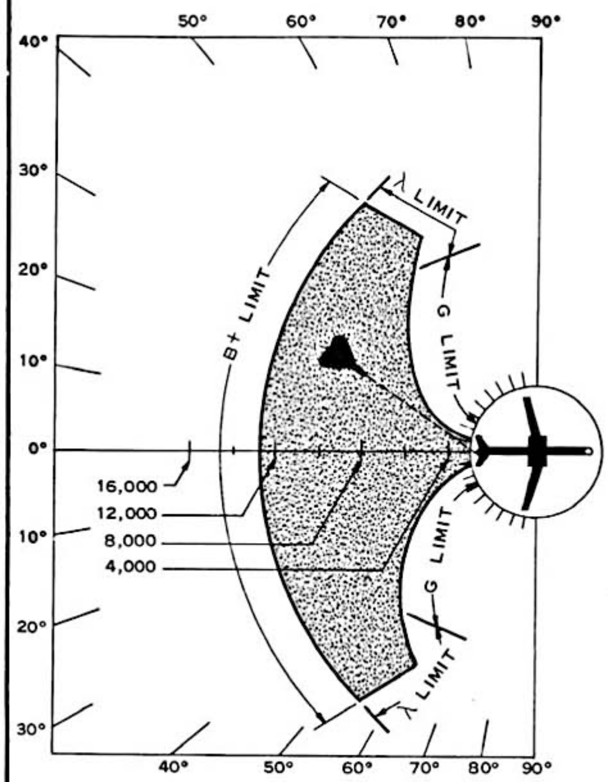
TARGET DETECTION - Infrared (passive)

GUIDANCE TYPE - Proportional navigation

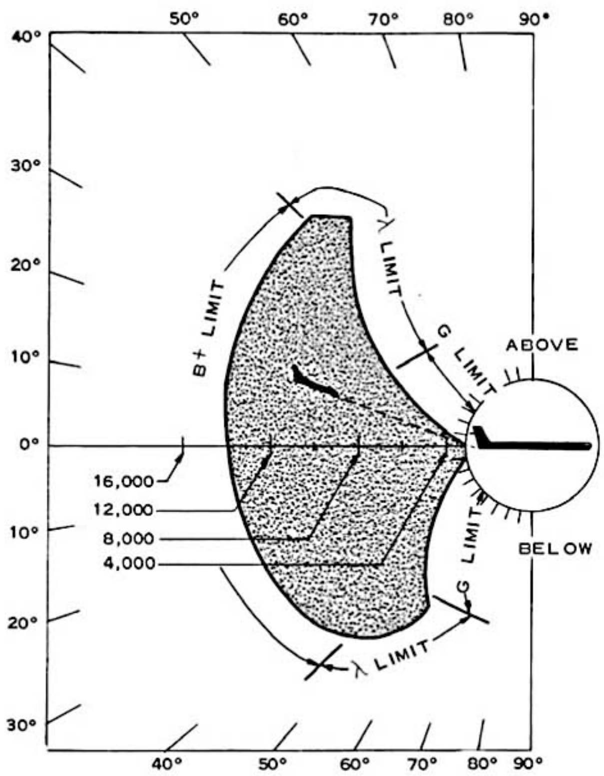
LAUNCHING MANEUVER - Pursuit tracking

SIDEWINDER MISSION OPERATIONAL ENVELOPES

HORIZONTAL PLANE



VERTICAL PLANE



CONDITIONS:

Target Altitude	40,000 ft.
Target Velocity	Mach. 0.8
Launch Velocity	Mach. 0.8
No Target Maneuver	

NOTES: The envelopes are not sufficiently accurate to serve as a set of firing tables but they can be used as a guide to the tactical use of the weapon.

It is to be noted also, that it was assumed the missile had zero angle of attack when launched. Variations in other missile parameters impose a "haziness" as to the exact edge of the envelope for any one particular article.

EXPLANATION OF LIMITS ON ATTACK ENVELOPES

1. The B+ limit indicates that internal power terminates far enough from the target to cause a miss in excess of 10 feet. This is essentially a range limitation.

2. The λ limit is a mechanical limit imposed on the seeker telescope to a maximum lead angle of 20 degrees.

3. The g limit occurs for missiles fired at relatively short ranges from large angles off the target's tail. The missile is unable to get into a collision course with the target because of excessive lateral accelerations required.

REFERENCE: NAVORD REPORT 4914

PERFORMANCE

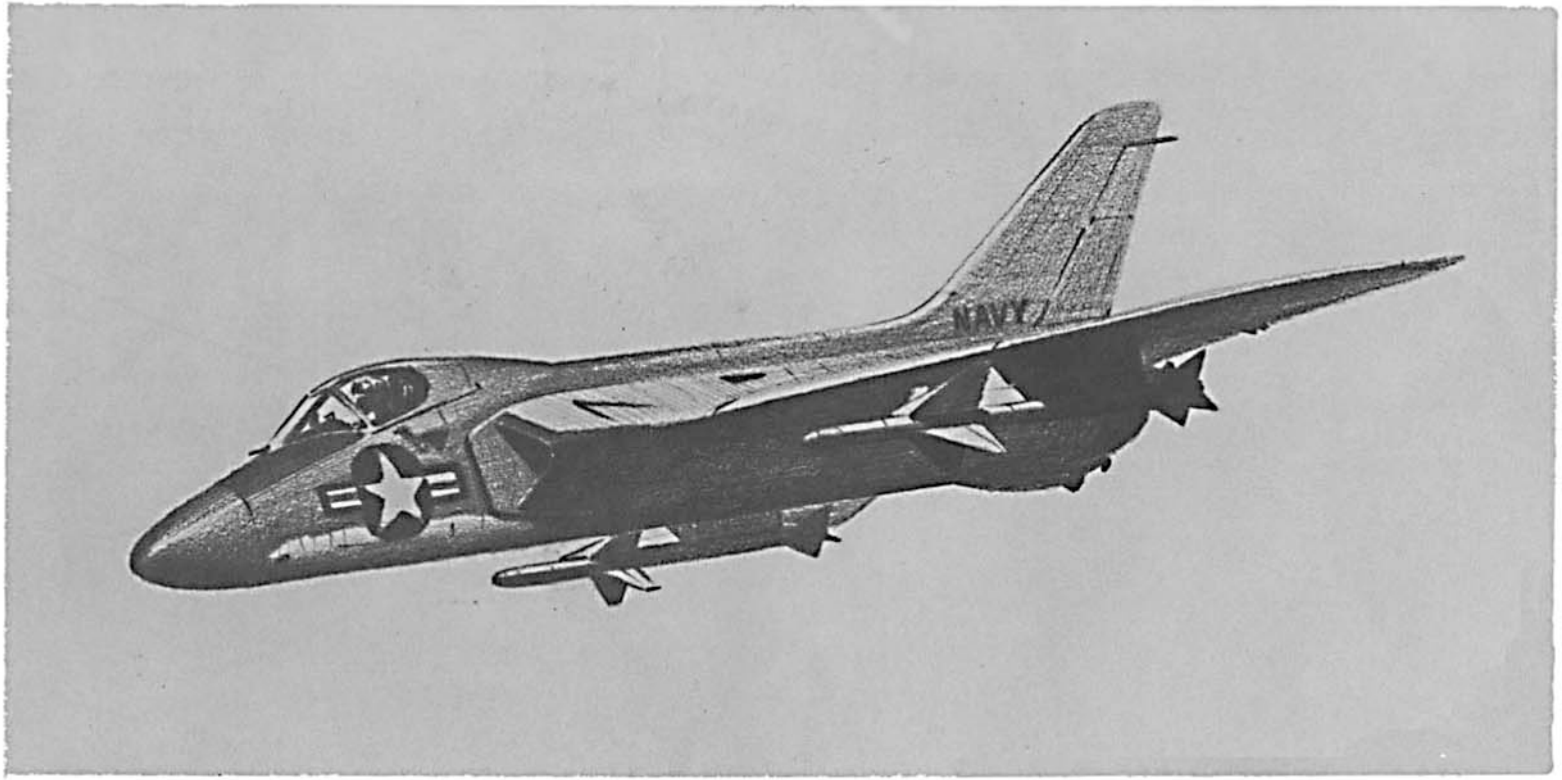
CONDITION \ CONFIGURATION		4-7-Shot Rocket Packages Two 300 Gallon Tanks	4 Sidewinder Missiles Two 300 Gallon Tanks
TAKE-OFF WEIGHT	lb.	25,582	25,743
Fuel (JP-4) Internal/External	lb.	4160/3900	4160/3900
Stall Speed - Power Off	kn.	123.1	123.5
Wind Req'd for Catapult Take-Off C11-1 Catapult (Military) (A)	kn.	16	17
Combat Radius (B)	n.mi.	279	288
Mission Time/Cycle Time	hr./hr.	1.5/1.8	1.5/1.9
COMBAT WEIGHT (External Tanks Dropped Full Internal Fuel Plus Armament)	lb.	21,294	21,455
Engine Thrust		MIL+AB	MIL+AB
Fuel (JP-4)	lb.	4160	4160
Maximum Speed At 35,000 ft.	kn./M	572/.994	572/.994
Maximum Speed At 45,000 ft.	kn./M	561/.976	561/.976
Combat Ceiling	ft.	52,300	51,900
LANDING WEIGHT (5% Total Fuel +20 Min. S.L. Loiter)	lb.	18,444	17,921
Fuel (5% Total Fuel + Loiter Fuel)	lb.	1310	1266
Stall Speed - Power Off	kn.	105.3	103.8
Wind Req'd For Arrested Landing With MK. 7 Mod. 1-3 (C)	kn.	23 [14]	22 [12]

NOTES

(A) Based on NATC recommended minimum catapult speed (approx. 73% $C_{L_{max}}$). C11-1 catapult characteristics based on 1.35 peak to mean acceleration ratio.

(B) General Purpose & Escort Fighter Mission

(C) Based on present MK. 7 arresting gear limits. Figures in brackets [] represent CVA-59 class carrier. Other numbers represent CVA-19 and CVA-41 class carriers.



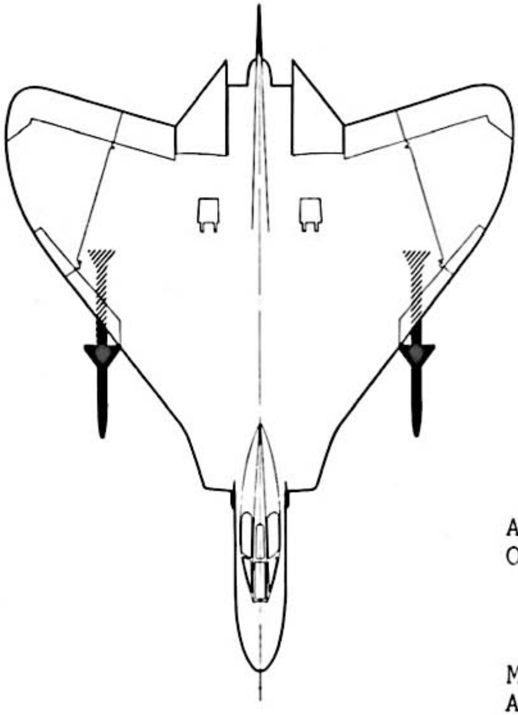
MISSILE SYSTEM CHARACTERISTICS
F4D-1 SKYRAY – XAAM-N-3 SPARROW II

DOUGLAS AIRCRAFT COMPANY, INC.

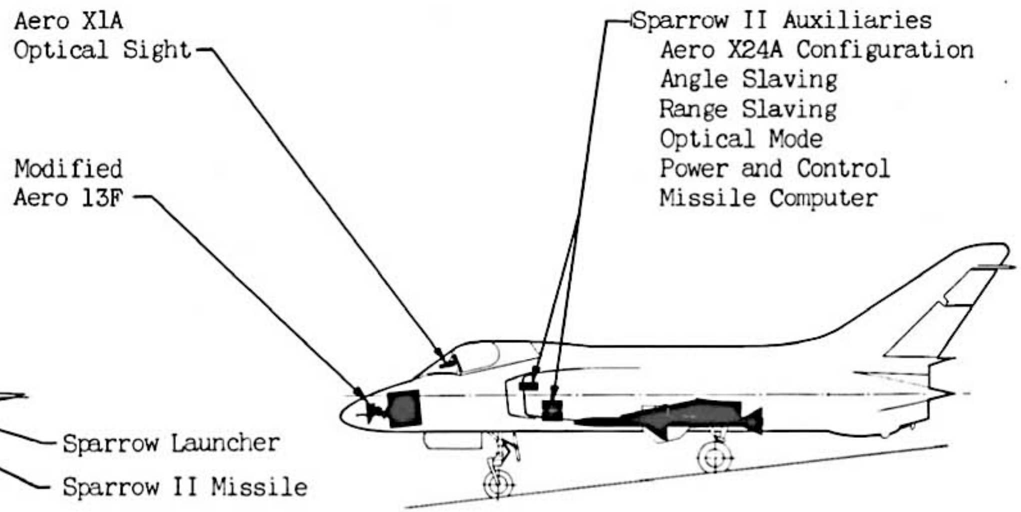
EL SEGUNDO DIVISION

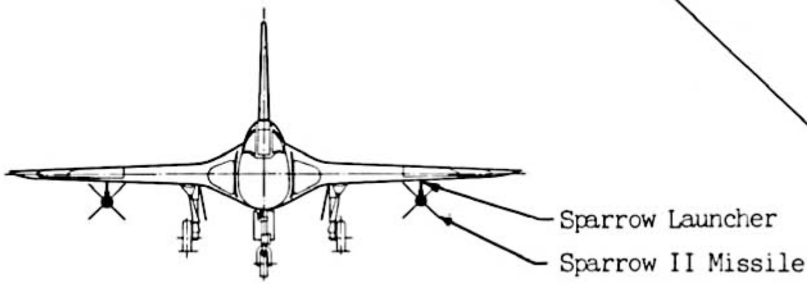
NOTE:
Although presented as incorporated in actual airplanes, this missile system is a study only.

GENERAL ARRANGEMENT



DIMENSIONS	
Span	33.5 ft.
Length	45.4 ft.
Height	13.0 ft.





DESCRIPTION

The F4D-1 is a high performance carrier based jet powered aircraft designed primarily for the interception and destruction of enemy aircraft with a secondary mission as a general purpose fighter.

The Sparrow II air-to-air missile system is intended to increase considerably the kill potential of the F4D in combat conditions. The Sparrow II, having an active radar system, is independent of the launch aircraft control and guidance thereby materially increasing the survival probability of the F4D against enemy defenses by reason that it can initiate evasive action once the missile is launched.

The F4D is configured to carry one Sparrow II on each wing and along with the Aero 13F fire control system, the airplane is capable of all-weather operation.

STATUS: The Sparrow II missile system has been installed and evaluated in an F4D-1 airplane in conjunction with the Aero X24A ACS. The system is not installed in any production aircraft.

ELECTRONICS

Equipment Carried In Basic F4D-1

- UHF Comm. AN/ARC-27A
- Nav. Rec. AN/ARN-21
- Radio Altm. AN/APN-22
- IFF AN/APX-6B
- Dir. Finder AN/ARA-25
- NAVPAC .... (AN/ARN-14, AN/ARN-12)
- Fire Control ...... Aero 13-F System
  - Radar AN/APQ-50
  - Arm. Cont. Dir. .... Aero 5B
  - Opt. Sight Syst. .... Aero X1A

Additional Equip. For Missile Syst.

Missile Auxiliaries Consisting of
- Range Slaving Unit
- Angle Slaving Unit
- Power and Control Unit

Sparrow Computer Ballistics Deck

FUEL

Gal.	No. Tanks	Location
640	2	Inner Wing
600	2	Ext. Droppable

Maximum Usable Fuel...... 1240 Gal.
Fuel Grade JP-4
Fuel Spec. MIL-F-5624

LAUNCHING EQUIPMENT

DAC Integral Pylon Launcher

WEIGHTS

LOADINGS	TWO SPARROW II MISSILES
Empty	15886
Basic	15937
* Combat	21653
** Flight Design	18215
** Landing Design	16559
** Catapulting Design	23051
Useful Load	
Pilot	200
Fuel-Internal (640 Gal-JP-4)	4160
Fuel-External (600 Gal-JP-4)	3900
Oil	26
Trapped Fuel and Oil	33
Fairing-Gun Tunnel (4)	4
Sparrow II Missile (2)	840
Launcher and Adapter (2)	280
Oxygen Equipment	14
Parakit, Seat and Back Pans	30
Aero 7A Racks (2)	180
External Tanks-300 Gal. (2)	388
Total Useful Load	10055
Gross Weight - Take-off	25941

* Less External Fuel and Drop Tanks
** See Spec. SD-458-1(1)

SPARROW II MISSILE SYSTEM

INSTALLATION

The Sparrow II missiles can be carried on special launchers, on each wing of the F4D-1. Its installation is interchangeable with the Aero 20A rack or Sidewinder pylon installation on wing station 124.625

Range slaving, angle slaving and power and control units will be installed in the electronic equipment compartment in place of the MK 86 computer and are used to slave the Aero 13F radar to the missile radar.

In the cockpit an Aero X1A modified servoed optical sight will be substituted for the present MK11 sight. This will improve the cockpit arrangement and retain both optical and all-weather displays of the Aero 13F system.

The AN/APQ-50 radar of the Aero 13F system will have to be modified to accommodate Sparrow II missile capabilities by the addition of synchros and resolvers plus some circuitry modification.

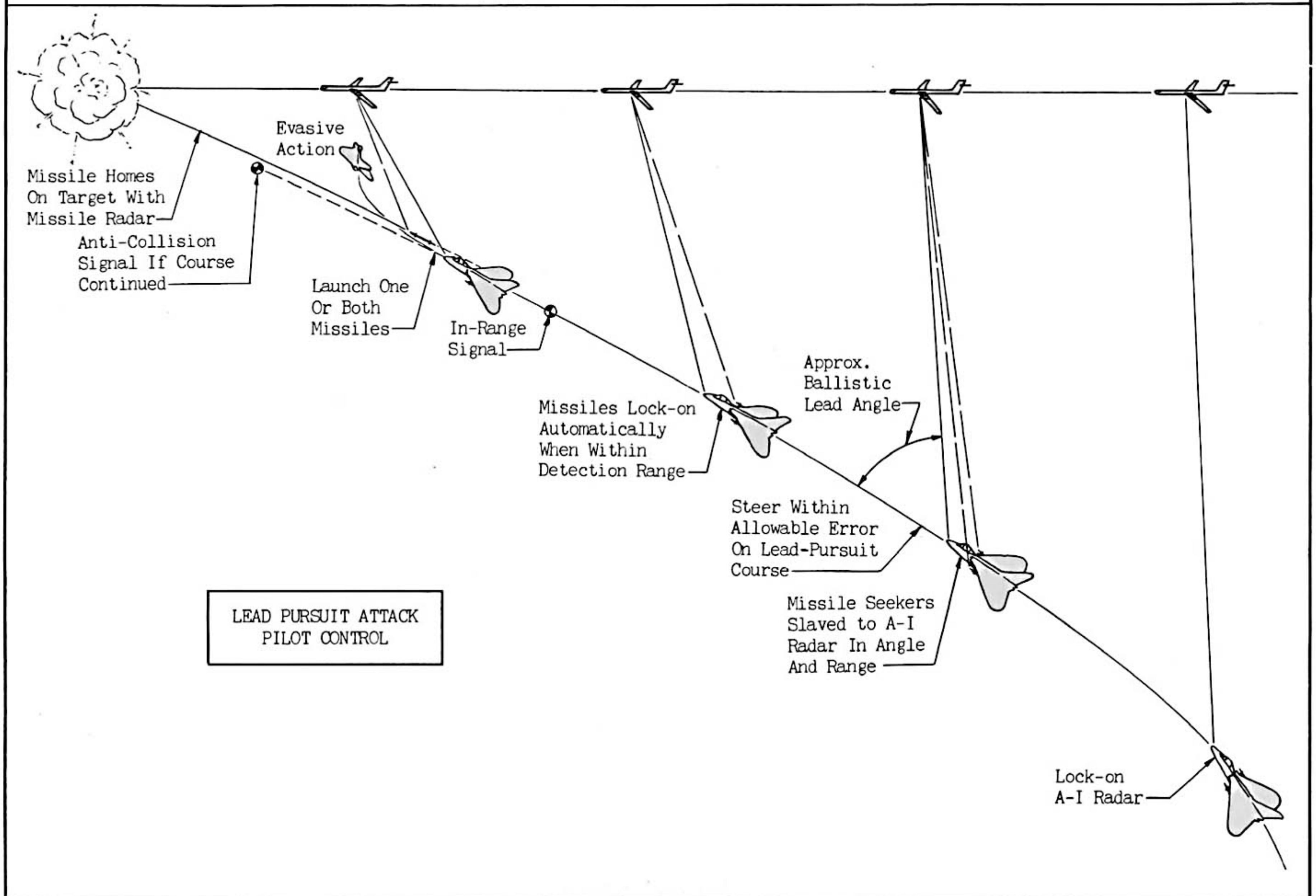
OPERATION

The Sparrow II missile in combination with the Aero 13F ACS is capable of all-weather or optical operation. The target is acquired either visually or by radar and tracked until the missile is fired. Firing indication is given to the pilot when the launch aircraft is within range by means of an in-range signal given by the missile computer.

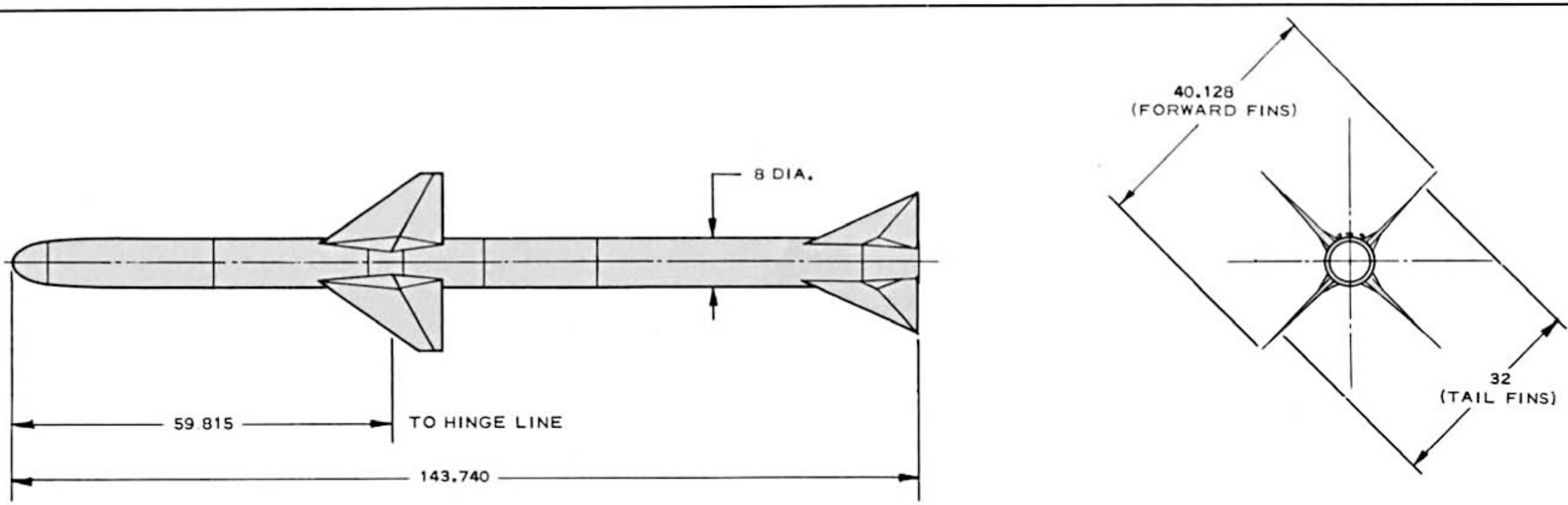
Studies of the Sparrow II missile indicate the feasibility of snap-up attacks. Use of this type of attack is particularly desirable against very high speed targets where there is insufficient time to climb to altitude. Similar to horizontal attacks, lead angle is required, however permissible launch errors can be quite large.

In general, the maximum absolute range for most attacks is between 20,000 feet and 40,000 feet with corresponding flight time ranging from 15 to 25 seconds.

TYPICAL AIR-TO-AIR ATTACK



GENERAL ARRANGEMENT XAAM-N-3 SPARROW II MISSILE



DIAMETER - 8 in.

LENGTH - 144 in.

GROSS WEIGHT - 420 lbs.

FUSE-WARHEAD WT. - 72 lbs.

PROPULSION - Solid-Propellant Rocket

Thrust - 8000 lbs.

Burning Time - 1.84 sec.

GUIDANCE - K-Band Active Pulse Radar

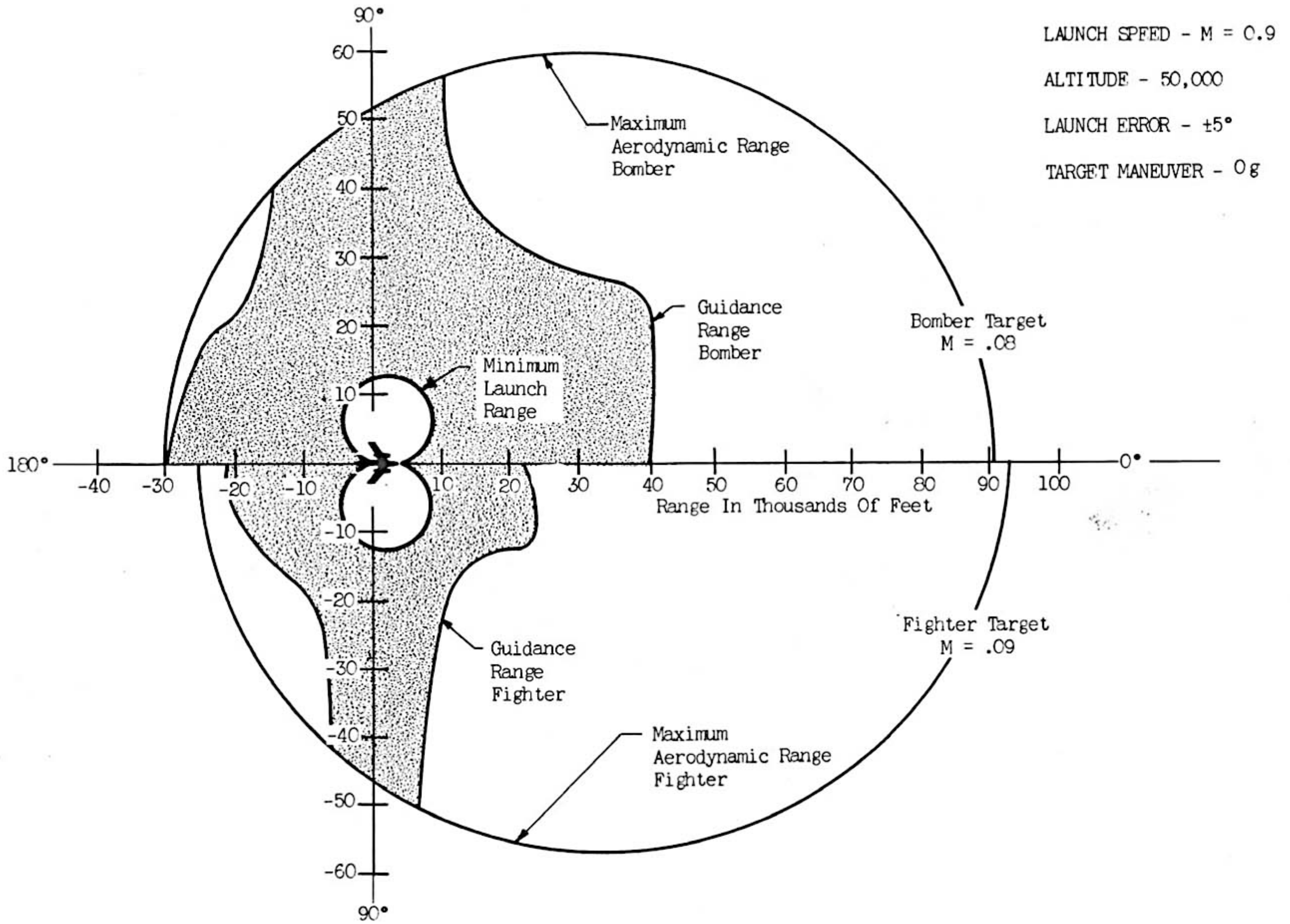
MAX. RANGE - 6 Nautical Mile

MAX. MANEUVERABILITY - 20 g

MAX. VELOCITY - 3000 ft./sec.

OPERATIONAL ALTITUDE - 100 to 60,000 ft.

SPARROW II MISSION OPERATIONAL ENVELOPE



CONDITION / CONFIGURATION		4 7-Shot Rocket Packages Two 300 Gallon Tanks	2 Sparrow II Missiles Two 300 Gallon Tanks
TAKE-OFF WEIGHT	lb.	25,582	25,941
Fuel (JP-4) Internal/External	lb.	4160/3900	4160/3900
Stall Speed - Power Off	kn.	123.1	123.9
Wind Req'd For Catapult Take-Off C11-1 Catapult (Military) (A)	kn.	16	19
Combat Radius (B)	n.mi.	279	294
Mission Time/Cycle Time	hr./hr.	1.5/1.8	1.5/1.9
COMBAT WEIGHT (External Tanks Dropped, Full Internal Fuel)	lb.	21,294	21,653
Engine Thrust		MIL+AB	MIL+AB
Fuel (JP-4)	lb.	4160	4160
Maximum Speed At 35,000 ft.	kn./M	572/.994	574/.997
Maximum Speed At 45,000 ft.	kn./M	561/.976	563/.979
Combat Ceiling	ft.	52,300	52,100
LANDING WEIGHT (5% Total Fuel +20 Min. S.L. Loiter)	lb.	18,444	17,926
Fuel (5% Total Fuel + Loiter Fuel)	lb.	1310	1273
Stall Speed - Power Off	kn.	105.3	103.9
Wind Req'd For Arrested Landing With MK. 7 Mod. 1-3 (C)	kn.	23 [14]	22 [12]

NOTES

(A) Based on NATC recommended minimum catapult speed (approx. 73% $C_{L_{max}}$). C11-1 catapult characteristics based on 1.35 peak to mean acceleration ratio.

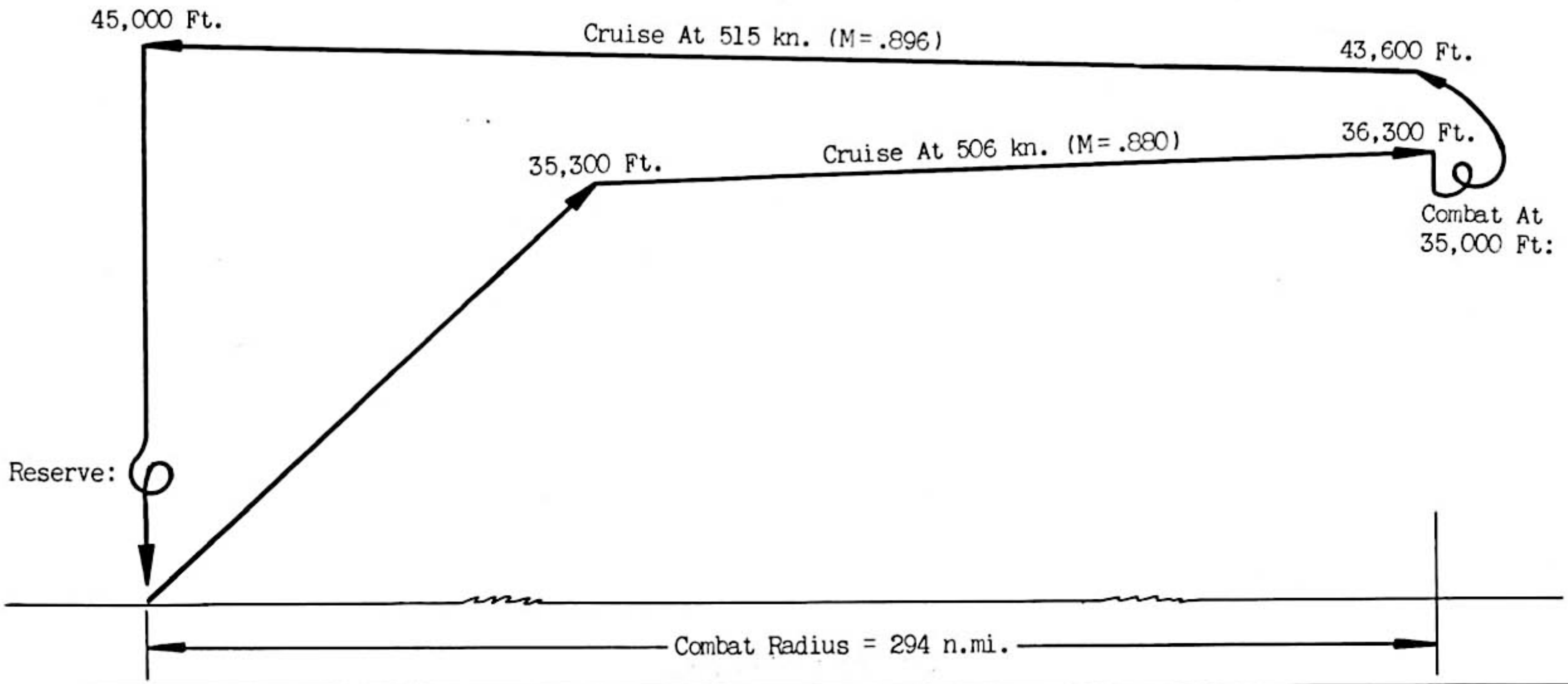
(B) General purpose & escort fighter mission.

(C) Based on present MK. 7 arresting gear limits. Figures in brackets [] represent CVA-59 class carrier. Other numbers represent CVA-19 and CVA-41 class carriers.

COMBAT RADIUS DESCRIPTION

GENERAL PURPOSE & ESCORT FIGHTER MISSION
Two Sparrow II Missiles
Two 300 - Gallon Tanks

Start Engine Take-off and Accelerate	Climb	Cruise-out	Descent	Combat	Cruise-back	Reserve
5 min. sea level normal static thrust.	Climb on course at max. rate of climb with military thrust to altitude for best range but not greater than ceiling for 300 f.p.m. rate of climb with normal thrust.	Cruise out at altitude for best range at speed for long range.	To 35,000 ft. No fuel used. No distance gained. Launch missiles.	5 min. at V_{max} with military thrust plus afterburning plus 15 min. at V_{max} with military thrust.	Cruise back at altitude for best range at speed for long range.	5% of total initial fuel plus fuel for 20 min. at speed for max. endurance at sea level.



MISSILE SYSTEM CHARACTERISTICS

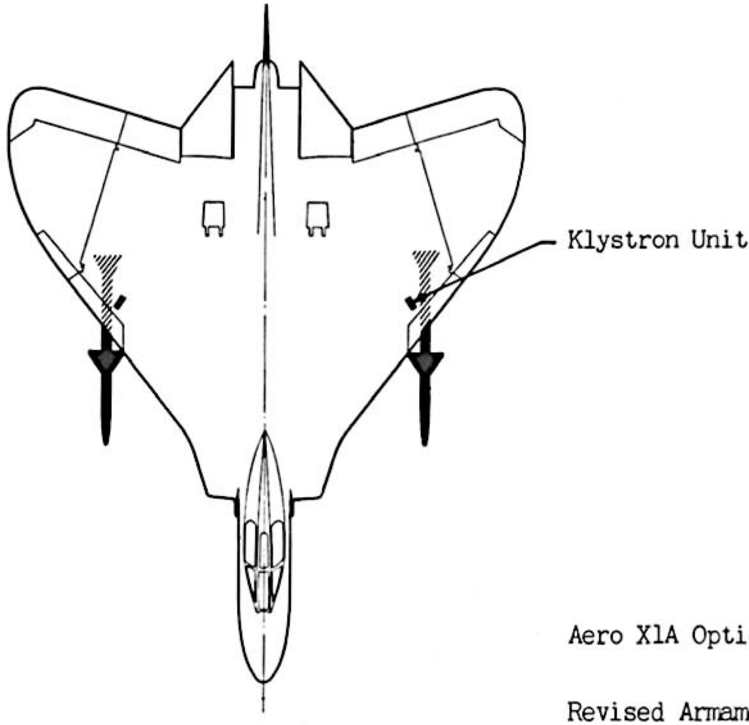
F4D-1 SKYRAY — YAAM-N-6 SPARROW III

DOUGLAS AIRCRAFT COMPANY, INC.

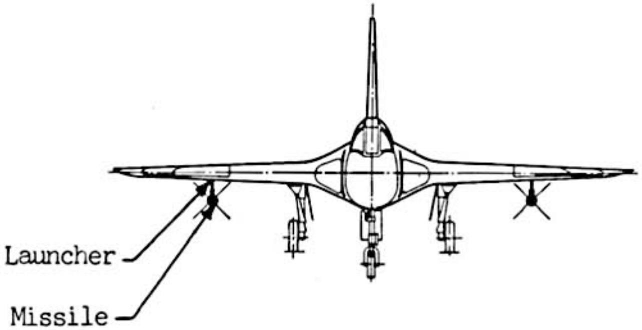
EL SEGUNDO DIVISION

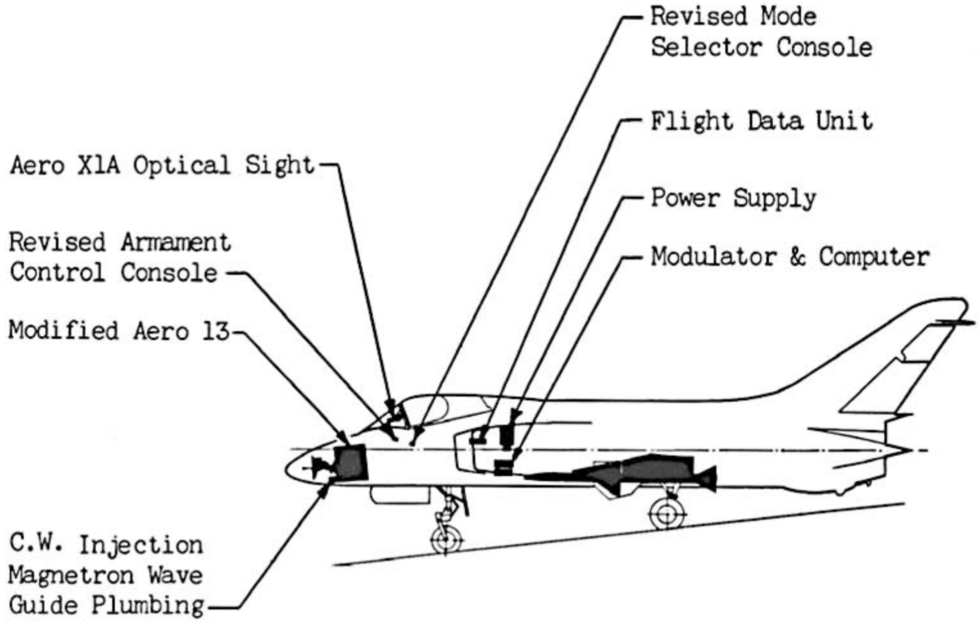
NOTE:
Although presented as incorporated in actual airplanes, this missile system is a study only.

GENERAL ARRANGEMENT



DIMENSIONS	
Span	33.5 ft.
Length	45.4 ft.
Height	13.0 ft.





DESCRIPTION

The F4D-1 is a high performance carrier based airplane whose primary mission is the destruction of enemy aircraft.

The incorporation of the Sparrow III missile system is intended to increase the destructive potential of the F4D-1 airplane by its ability to launch Sparrow III missiles at relatively long ranges with minimum restrictions on the interceptor's approach course. The high altitude performance of the Sparrow III utilizes the snap-up capabilities of the missile and insures maximum high altitude performance of the F4D-1 Sparrow III weapons system.

The installation of the Sparrow III system utilizing the Raytheon APA-127 Missile auxiliaries will not affect the present gun-rocket capability of the airplane therefore providing the Navy with a flexible all-weather weapons system capable of operating with Sparrow III missiles, Sidewinder missiles, 20mm guns and rockets.

STATUS: The Sparrow III missile system is being studied for all F4D-1 airplanes.

ELECTRONICS

Equipment Carried In Basic F4D-1

UHF Comm.	AN/ARC-27A
Nav. Rec.	AN/ARN-21
Radio Altm.	AN/APN-22
IFF	AN/APX-6B
Dir. Finder	AN/ARA-25
NAVPAC	(AN/ARN-14, AN/ARN-12)
Fire Control	Aero 13-F System
Radar	AN/APQ-50
Arm. Cont. Dir.	Aero 5B
Opt. Sight Syst.	Aero X1A

Additional Equip. For Missile Syst.

Sparrow III Missile Auxiliaries (APA-127 Radar Set Group)

FUEL

Gal.	No. Tanks	Location
640	2	Inner Wing
600	2	Ext. Droppable

Maximum Usable Fuel.... 1240 Gal.
Fuel Grade JP-4
Fuel Spec. MIL-F-5624

LAUNCHING EQUIPMENT

Douglas Integral Launcher

WEIGHTS

LOADINGS	TWO SPARROW III MISSILES
Empty	16034
Basic	16085
* Combat	21721
** Flight Design	18215
** Landing Design	16559
** Catapulting Design	23051
Useful Load	
Pilot	200
Fuel-Internal (640 Gal. JP-4)	4160
Fuel-External (600 Gal. JP-4)	3900
Oil	26
Trapped Fuel and Oil	33
Fairing Gun Tunnel (4)	4
Sparrow III Missile (2)	760
Sparrow Launcher and Adapter (2)	280
Oxygen Equipment	14
Parakit, Seat and Back Pans	30
Aero 7A Racks (2)	180
External Tanks-300 Gal. (2)	388
Total Useful Load	9975
Gross Weight - Take-off	26009

* Less External Fuel and Drop Tanks
** See Spec. SD-458-1(1)

SPARROW III MISSILE SYSTEM

INSTALLATION

The F4D-1 airplane is capable of carrying two Sparrow III air-to-air missiles, one on each wing at Station 124.625. Contractor designed integal pylon-launchers are installed in place of the present ejector rack or Sidewinder pylons which are interchangeable on the same wing station.

The airplane contains the necessary wiring to the wing pylons, the modified Aero 13F fire control system, the Aero X1A optical sight and the necessary pilot control consoles. The APA-127 missile auxiliaries are installed in the electronics compartment which along with the wing pylons may be removed if missile configuration is not desired.

The airplane can be configured to carry two Sparrow III missiles and two Sidewinder missiles simultaneously.

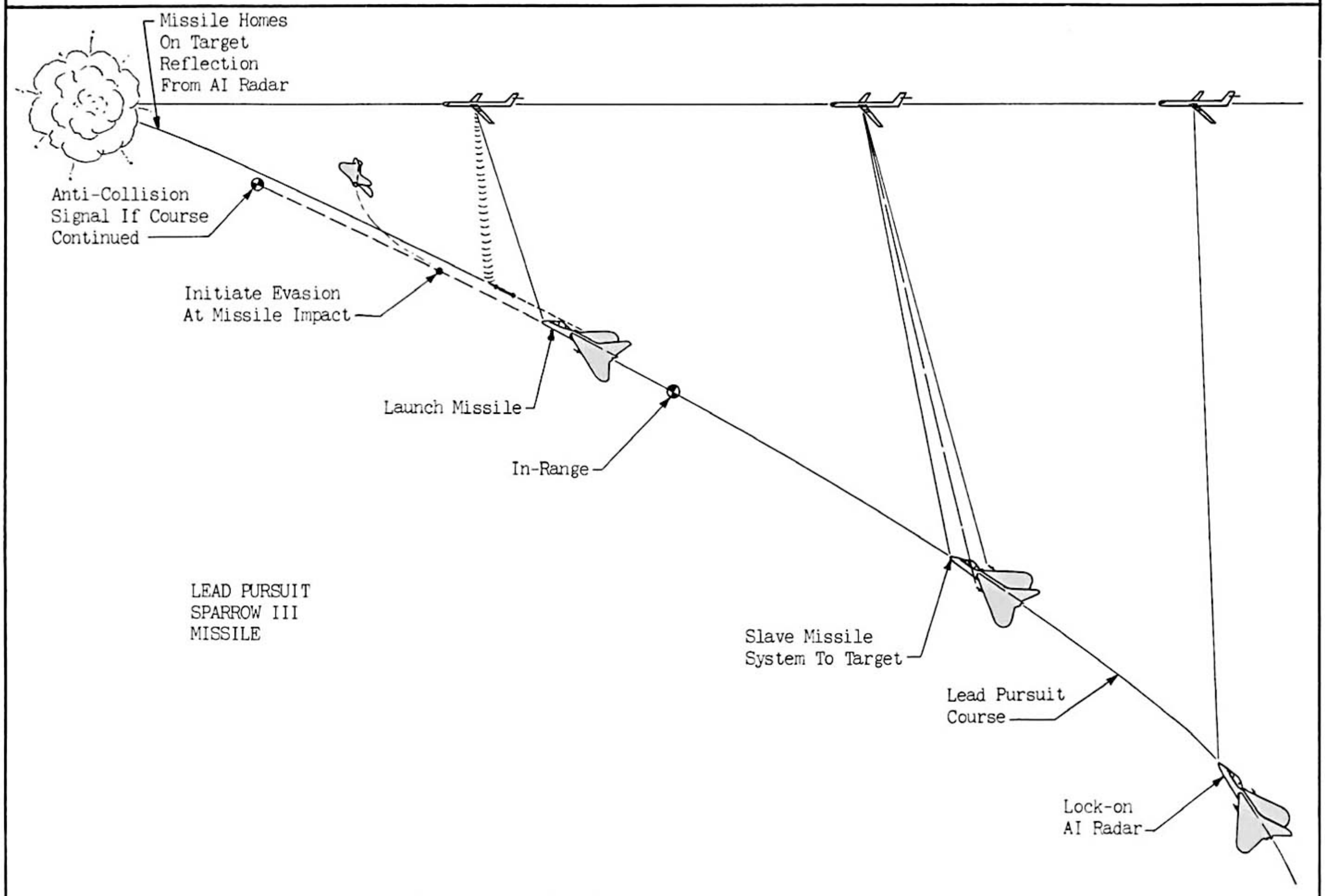
OPERATION

The pilot acquires the target by means of the AI pulse radar and after lock-on, he maneuvers the aircraft according to the information on the radar indicator scope to establish his attack course.

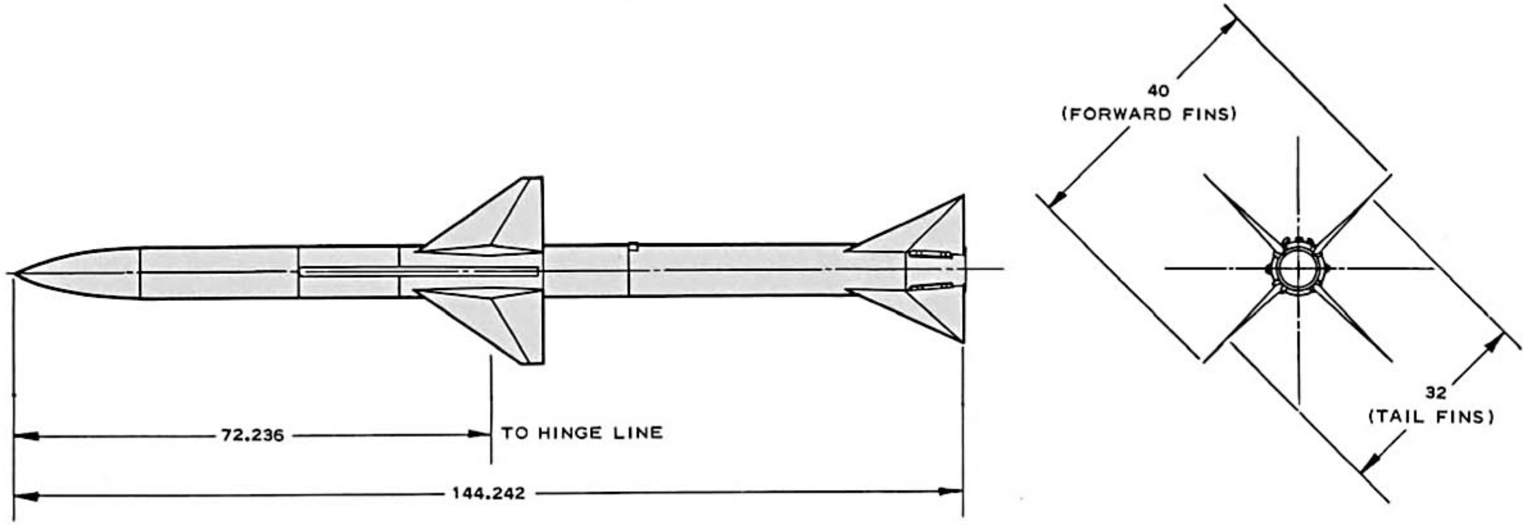
During the track portion of the flight, the AI radar illuminates the target with CW radiation and when within range, the missile seeker locks on the target. The computer will provide in-range indication to the pilot when within firing range and likewise provide a breakaway signal.

After launch, the pilot may start an evasive maneuver which is limited by the fact that the AI radar must illuminate the target until missile intercept.

TYPICAL AIR-TO-AIR ATTACK



GENERAL ARRANGEMENT YAAM-N-6 SPARROW III MISSILE



TYPE - Air-to-Air

LENGTH - 12 ft.

DIAMETER - 8 in.

WEIGHT - 380 lb.

PROPULSION:

MOTOR - Solid Propellant Rocket

TOTAL IMPULSE - 16,000 lbs.-sec.

GUIDANCE:

Proportional Navigation With a

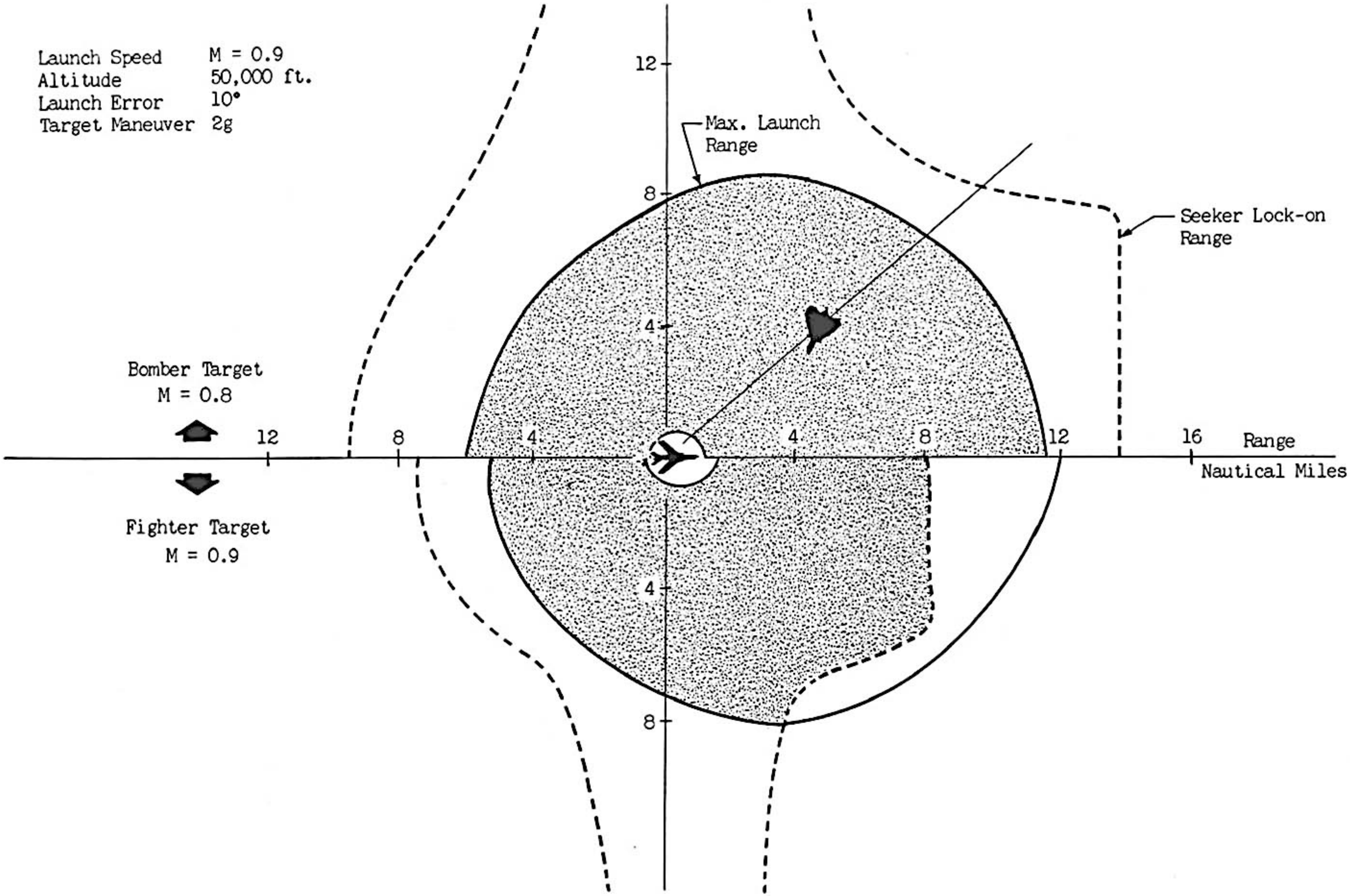
Semi-Active, "X" Band CW Homing Radar

WARHEAD - 65 lbs.

ALTITUDE CAPABILITY - Sea Level to 60,000 ft.

LAUNCH SPEED - Up to Mach 1.3

SPARROW III MISSION OPERATIONAL ENVELOPE



PERFORMANCE

CONDITION / CONFIGURATION		4-7 Shot Rocket Packages Two 300 Gallon Tanks	2 Sparrow III Missiles Two 300 Gallon Tanks
TAKE-OFF WEIGHT	lb.	25,582	26,009
Fuel (JP-4) Internal/External	lb.	4160/3900	4160/3900
Stall Speed - Power Off	kn.	123.1	124.1
Wind Req'd For Catapult Take-Off			
C11-1 Catapult (Military) (A)	kn.	16	19
Combat Radius (B)	n.mi.	279	293
Mission Time/Cycle Time	hr./hr.	1.5/1.8	1.5/1.9
COMBAT WEIGHT (External Tanks Dropped Full Internal Fuel Plus Armament)	lb.	21,294	21,721
Engine Thrust		MIL+AB	MIL+AB
Fuel (JP-4)	lb.	4160	4160
Maximum Speed At 35,000 ft.	kn./M	572/.994	574/.997
Maximum Speed At 45,000 ft.	kn./M	561/.976	563/.979
Combat Ceiling	ft.	52,300	52,000
LANDING WEIGHT (5% Total Fuel + 20 Min. S.L. Loiter)	lb.	18,444	18,078
Fuel (5% Total Fuel + Loiter Fuel)	lb.	1310	1277
Stall Speed - Power Off	kn.	105.3	104.3
Wind Req'd For Arrested Landing			
With MK. 7 Mod. 1-3 (C)	kn.	23 [14]	22 [12]

NOTES

(A) Based on NATC recommended minimum catapult speed (approx. 73% $C_{L_{max}}$). C11-1 catapult characteristics based on 1.35 peak to mean acceleration ratio.

(B) General purpose & escort fighter mission.

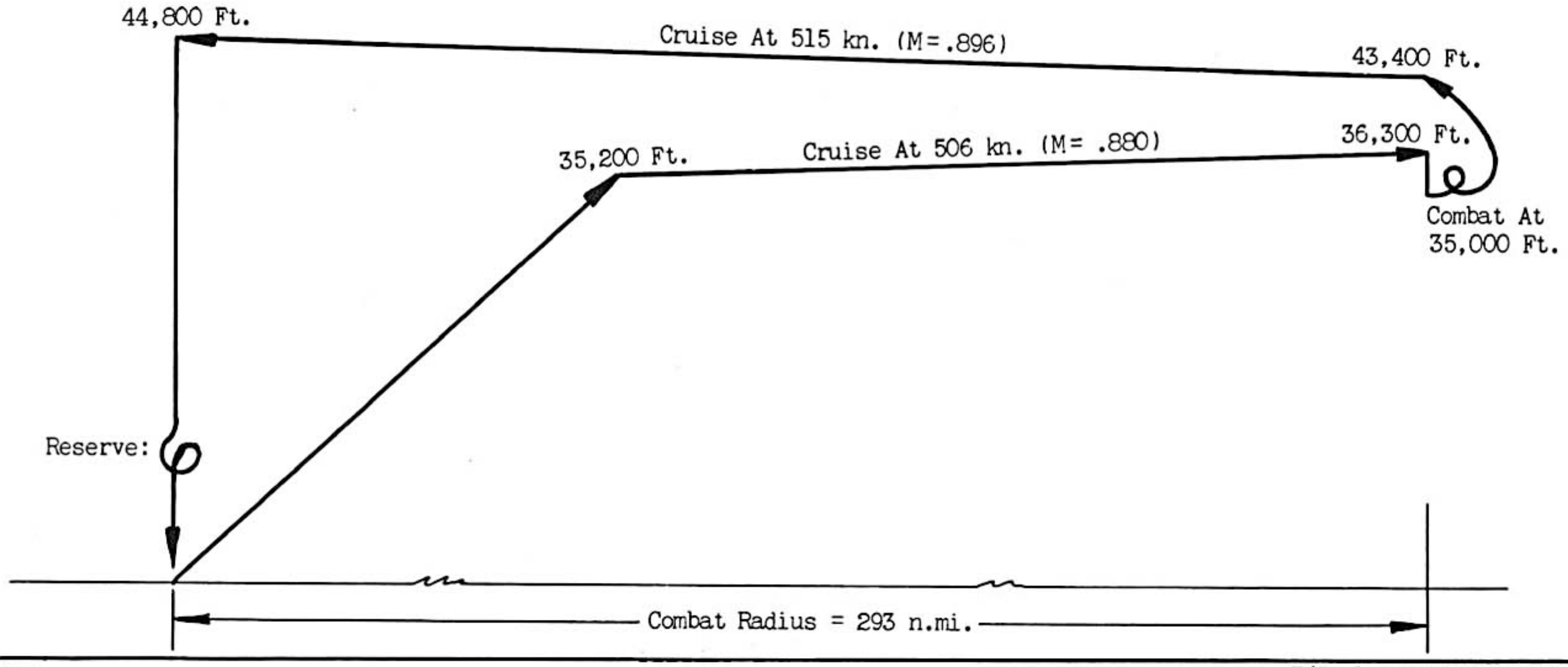
(C) Based on present MK. 7 arresting gear limits. Figures in brackets [] represent CVA-59 class carrier. Other numbers represent CVA-19 and CVA-41 class carriers.

COMBAT RADIUS DESCRIPTION

GENERAL PURPOSE & ESCORT FIGHTER MISSION

Two Sparrow III Missiles
Two 300 Gallon Tanks

Start Engine Take-off and Accelerate	Climb	Cruise-out	Descend	Combat	Cruise-Back	Reserve
5 min. sea level normal static thrust.	Climb on course at max. rate of climb with military thrust to altitude for best range but not greater than ceiling for 300 f.p.m. rate of climb with normal thrust.	Cruise out at altitude for best range at speed for long range.	To 35,000 ft. No fuel used. No distance gained. Launch missiles.	5 min. at V_{max} with military thrust plus afterburning plus 15 min. at V_{max} with military thrust.	Cruise back at altitude for best range at speed for long range.	5% of total initial fuel plus fuel for 20 min. at speed for max. endurance at sea level.



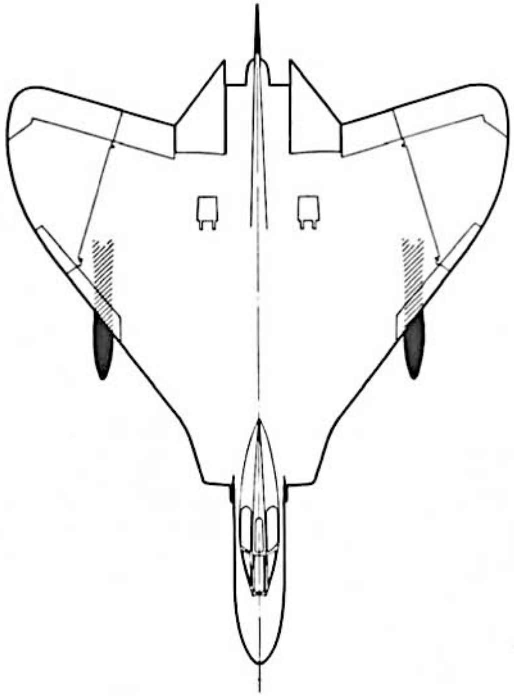
MISSILE SYSTEM CHARACTERISTICS
F4D-1 SKYRAY — MB-1 GENIE

DOUGLAS AIRCRAFT COMPANY, INC.

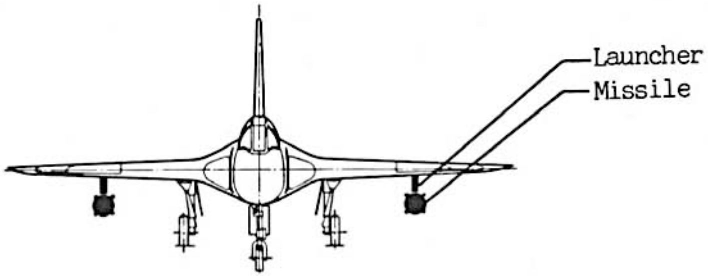
EL SEGUNDO DIVISION

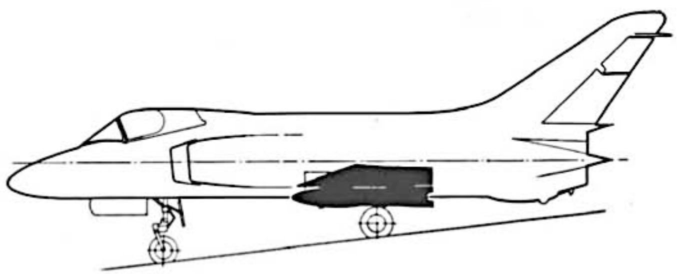
NOTE:
Although presented as incorporated in actual airplanes, this missile system is a study only.

GENERAL ARRANGEMENT



DIMENSIONS	
Span	33.5 ft.
Length	45.4 ft.
Height	13.0 ft.





DESCRIPTION

The F4D, a high performance carrier-based airplane, is designed primarily for the destruction of enemy aircraft. With the ever increasing destructive power of nuclear weapons now being carried by bombers, it has become necessary to increase vastly the effectiveness of all fighter aircraft.

The incorporation of the MB-1 Genie missile into the F4D-1 weapons system is intended to increase materially the F4D's interception potential because of the missile's high flight velocity and considerably higher allowable miss distance.

Additional information such as missile details and operational capabilities may be found in Douglas Secret Report 27064 dated 30 May 1956 and Douglas Secret Report SM27125 dated 1 August 1956.

ELECTRONICS

Equipment Carried In Basic F4D-1

UHF Comm. AN/ARC-27A
Nav. Rec. AN/ARN-21
Radio Altm. AN/APN-22
IFF AN/APX-6B
Dir. Finder AN/ARA-25
NAV PAC, consisting of:
VHF NAV AN/ARN-14
Marker Beacon AN/ARN-12
Fire Control.... Aero 13-F System
Consisting of:
Radar AN/APQ-50
Arm. Cont. Dir. .... Aero 5B
Opt.Sight Syst. Mk.16 Mod.11

Additional Equipment For Missile System

Genie Computer Ballistics Deck

FUEL

Gal.	No. Tanks	Location
640	2	Inner Wing
600	2	Ext.Droppabble

Maximum Usable Fuel....1240 Gal.
Fuel Grade JP-4
Fuel Spec. MIL-F-5624

LAUNCHING EQUIPMENT

Genie Launcher On Special Pylon

WEIGHTS

LOADINGS	TWO MB-1 MISSILES
Empty	15853
Basic	15904
* Combat	22260
** Flight Design	18215
** Landing Design	16559
** Catapulting Design	23051
Useful Load	
Pilot	200
Fuel-Internal (640 Gal.-JP-4)	4160
Fuel-External (600 Gal.-JP-4)	3900
Oil	26
Trapped Fuel and Oil	33
Fairing-Gun Tunnel (4)	4
Genie Missile (2)	1624
Genie Pylon Incl. Adapter (2)	52
Launcher (2)	84
Oxygen Equipment	14
Parakit, Seat and Back Pans	30
Aero 7A Racks (2)	180
External Tanks-300 Gal. (2)	388
Total Useful Load	10695
Gross Weight - Take-off	26548

* Less External Fuel & Drop Tanks
** See Spec. SD-458-1(1)

GENIE MISSILLESYSTEM

INSTALLATION

The F4D-1 airplane can carry two MB-1 Genie air-to-air missiles, one on each wing at Station 124.625. The special pylon launcher is interchangeable with the present ejector rack, Sparrow pylon or the Sidewinder pylon all of which may be carried on this wing station. The necessary wiring is provided within the airplane to accept the MB-1 Genie missile.

The Aero 13F fire control system has the MB-1 Genie missile ballistics deck installed and is configured to provide the necessary signals to the missile fuzing system.

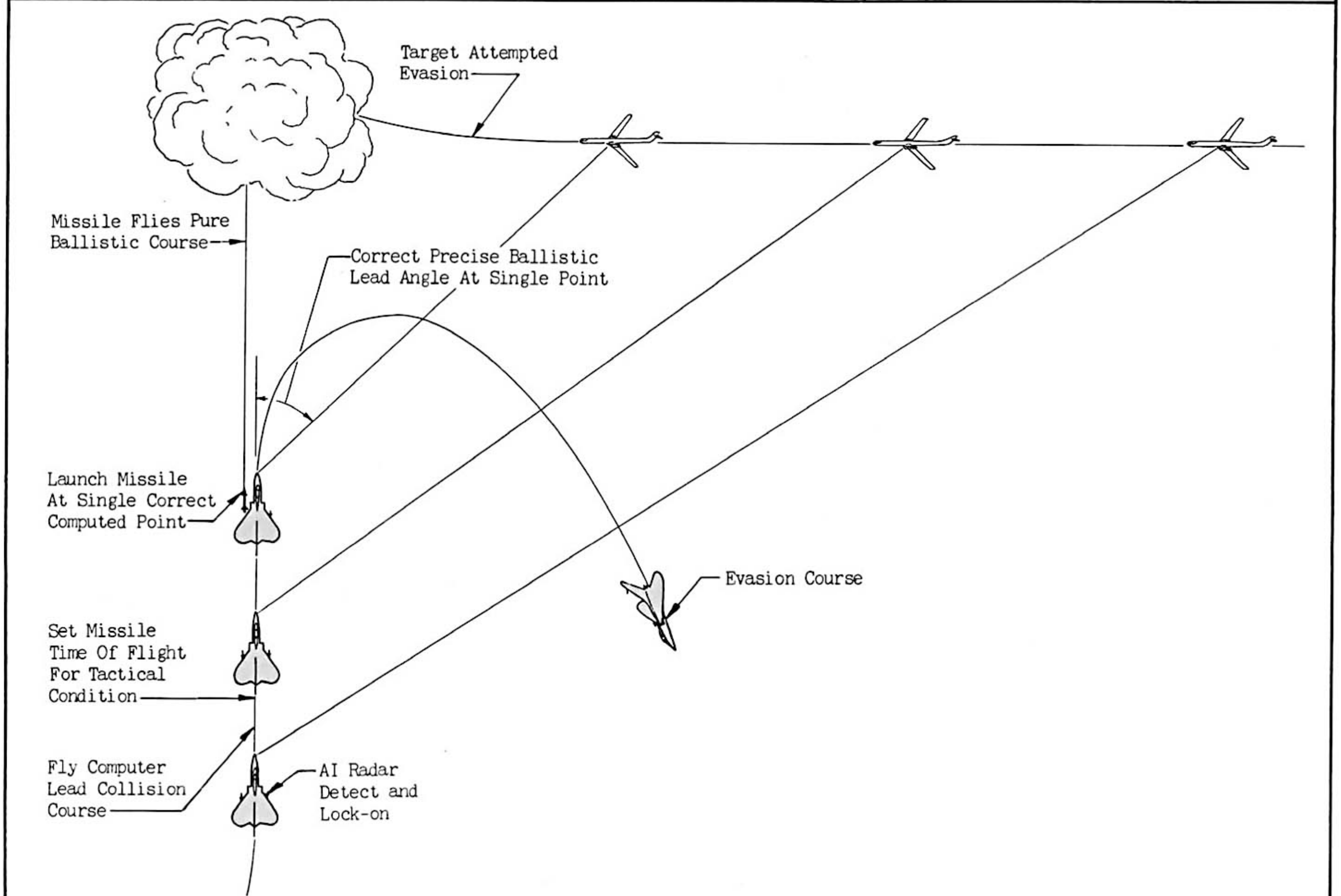
OPERATION

The pilot acquires the target with the AI radar and follows the attack presentation shown by the indicator scope. The computer will determine when the aircraft is within firing range. When the pilot launches the missile, the computer will have calculated the time of flight of the missile and this signal will have been sent to the missile to set the time fuze. Immediately after firing, the pilot initiates his escape maneuver.

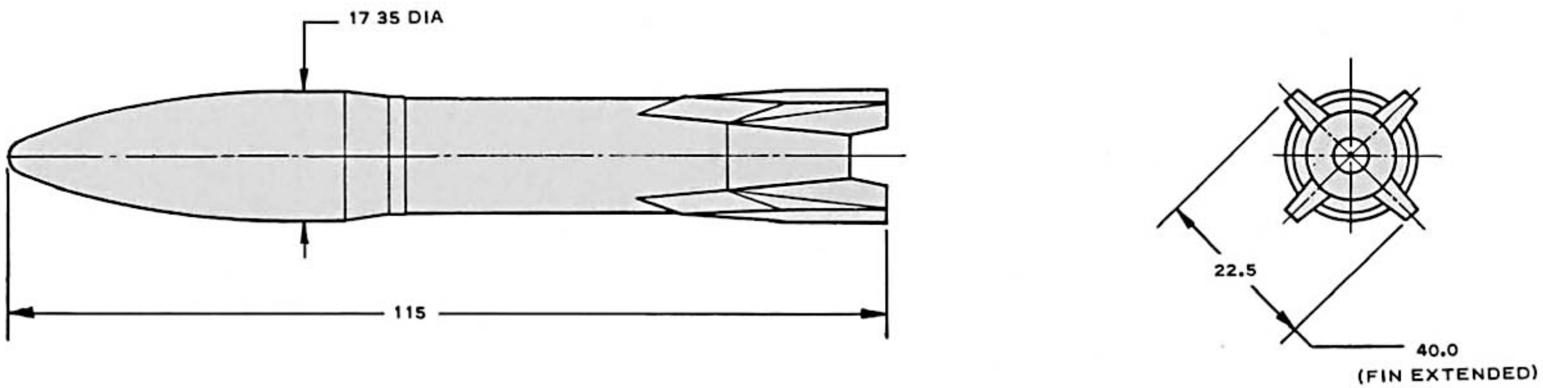
The Aero 13F fire control system will provide the firing signal instead of the pilot in a lead-collision mode of attack.

The minimum relative range, the distance between airplane and burst point is approximately 15,000 feet at low altitude.

TYPICAL AIR-TO-AIR ATTACK



GENERAL ARRANGEMENT MB-1 GENIE MISSILE



LENGTH - 115 in.

MAX. BODY DIA. - 17.35 in.

GROSS WEIGHT - 812 lbs.

BURNOUT WEIGHT - 480 lbs.

WARHEAD WEIGHT - 220 lbs.

RANGE

MINIMUM (Low Altitude Attack) - Approx 15,000 ft.

MAXIMUM (High Altitude Attack) - Approx 50,000 ft.

AVERAGE INCREMENTAL VELOCITY

(Added to That of Launch Aircraft) - 3,000 ft./sec.

MOTOR THRUST - 36,000 lbs.

BURNING TIME - 2 sec.

OPERATIONAL ALTITUDE - Sea Level To 80,000 ft.

PERFORMANCE

CONDITION \ CONFIGURATION		4-7 Shot Rocket Packages Two 300 Gallon Tanks	2 Genie Missiles Two 300 Gallon Tanks
TAKE-OFF WEIGHT	lb.	25,582	26,548
Fuel (JP-4) Internal/External	lb.	4160/3900	4160/3900
Stall Speed - Power Off	kn.	123.1	125.3
Wind Req'd For Catapult Take-Off C11-1 Catapult (Military) (A)	kn.	16	23
Combat Radius (B)	n.mi.	279	259
Mission Time/Cycle Time	hr./hr.	1.5/1.8	1.5/1.8
COMBAT WEIGHT (External Tanks Dropped Full Internal Fuel Plus Armament)	lb.	21,294	22,260
Engine Thrust		MIL+AB	MIL+AB
Fuel (JP-4)	lb.	4160	4160
Maximum Speed At 35,000 ft.	kn./M	572/.994	570/.990
Maximum Speed At 45,000 ft.	kn./M	561/.976	559/.973
Combat Ceiling	ft.	52,300	50,700
LANDING WEIGHT (5% Total Fuel + 20 Min. S.L. Loiter)	lb.	18,444	17,739
Fuel (5% Total Fuel + Loiter Fuel)	lb.	1310	1263
Stall Speed - Power Off	kn.	105.3	103.3
Wind Req'd For Arrested Landing With MK. 7 Mod. 1-3 (C)	kn.	23 [14]	21 [11]

NOTES

(A) Based on NATC recommended minimum catapult speed (approx. 73% $C_{L_{max}}$). C11-1 catapult characteristics based on 1.35 peak to mean acceleration ratio.

(B) General purpose & escort fighter mission.

(C) Based on present MK. 7 arresting gear limits. Figures in brackets [] represent CVA-59 class carrier. Other numbers represent CVA-19 and CVA-41 class carriers.

COMBAT RADIUS DESCRIPTION

GENERAL PURPOSE & ESCORT FIGHTER
Two Genie Missiles
Two 300 Gallon Tanks

Start Engine Take-off and Accelerate	Climb	Cruise-Out	Descend	Combat	Cruise-Back	Reserve
5 min. sea level normal static thrust.	Climb on course at max. rate of climb with military thrust to altitude for best range but not greater than ceiling for 300 f.p.m. rate of climb with normal thrust.	Cruise out at altitude for best range at speed for long range.	To 35,000 ft. No fuel used. No distance gained. Launch missiles.	5 min. at V_{max} with military thrust plus afterburning plus 15 min. at V_{max} with military thrust	Cruise back at altitude for best range at speed for long range.	5% of total initial fuel plus fuel for 20 min. at speed for max. endurance at sea level.