Request for Proposal:

Next Generation Carrier-based Strike Fighter Aircraft

2025-2026 Undergraduate Team Aircraft Design Competition

AIAA Aircraft Design Technical Committee
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The system attributes and design constraints described in this document are derived from open-source reference material and tailored to be suitable for a student design activity. They are not official Navy requirements.

1. OPPORTUNITY DESCRIPTION

The objective of this study is to consider a candidate strike fighter aircraft replacement for the FA-18E/F aircraft with improved performance at a comparable unit acquisition cost. This is not a trivial challenge. As illustrated by "Augustine's Law", combat aircraft unit cost has been inexorably increasing with time (Fig 1). In order to maintain the number of aircraft in the Navy's inventory, this trend must be broken.

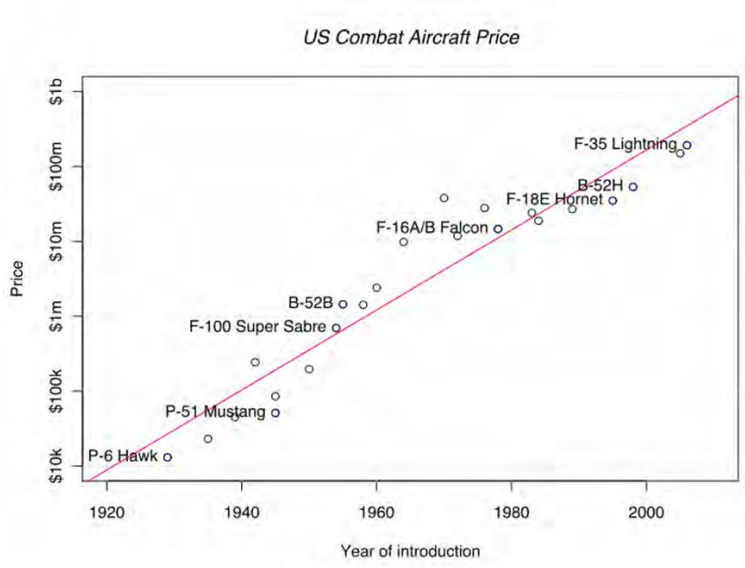

Figure 1 Combat Aircraft Acquisition Cost Increase

The candidate will be carrier-based and will perform missions currently conducted by the legacy aircraft, including air-to-air combat, strike, and electronic attack. The targeted initial operational capability (IOC) date is 2035.

2. PROJECT OBJECTIVE

The objective of this project is to design a new, affordable, carrier-based aircraft that will provide credible combat capability in an advanced air defense and counter air environment. Key elements of this project are to design conceptual aircraft which meet mandatory carrier suitability requirements, meet the unit recurring cost requirement and provide the maximum combat performance consistent with the carrier suitability and cost requirements.

3. DESIGN REQUIREMENTS, CONSTRAINTS, AND GUIDANCE

3.1. General Design

a) Configuration
    a. The aircraft may include any combination of survivability, vulnerability and effectiveness features to maximize its cost-effective capability.
b) Propulsion System
    a. The aircraft may be a single or multi-engine design.
    b. The engine(s) must be an existing production design to minimize development cost.
c) Materials
    a. Materials shall be suitable for a 25-year service life in a maritime environment (moisture intrusion, salt spray, etc.).
    b. Materials must be currently available in production quantities to minimize development risk.
d) Subsystems
    a. All subsystems technologies (including avionics and mission systems) shall currently be at technology readiness level (TRL) 6 or higher.
e) Ordnance (store) Carriage
    a. External carriage of ordnance is acceptable.
    b. Internal carriage of weapons is desirable for reduced radar cross section.

3.2. Carrier Suitability

a) The aircraft shall be operable from CVN-68 and CVN-78 class aircraft carriers.
b) The addition of the aircraft to the existing fleet should have minimal impact on operations for the carrier air wing.
    a. Considerations include, but are not limited to, compatibility with existing shipboard equipment, and time or crew support required for launch.

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3.2.1. Launch Performance

a) The aircraft shall be capable of launch on a tropical day, (89.8° F) with zero wind over the deck (WOD).
b) Catapult minimum end airspeed
    a. Defined as the airspeed required at the end of the catapult stroke to support the aircraft under the conditions of altitude loss, lift limit, pitch rate limit, and longitudinal acceleration specified for catapulting.
    b. Catapult minimum end airspeed shall be the highest of the following:
        i. An end speed which results in the CG position of the aircraft sinking no more than 10 feet from its position at the end of the power stroke, with a deck run not to exceed 32 feet (distance from the end of the power stroke to round-down), with cockpit control position held either fixed or free or controls active.
        ii. The speed represented by 90% of the maximum lift coefficient, power off, out of ground effect.
        iii. The minimum airspeed at which the aircraft has a longitudinal acceleration of 0.065 g (2.0913 ft/sec^2) at zero flight path angle.
        iv. If multi-engine, the minimum aircraft control speed with one engine inoperative
c) Catapult performance data can be found in Section 5.

3.2.2. Recovery Performance

a) Arrestment engaging speed (horizontal aircraft velocity relative to the ship at touchdown) shall be assumed to be 5% greater than approach speed.
b) Approach airspeed shall be greater than 10% above stall speed, but less than 145 knots.
c) Arrestment landing weight shall include sufficient fuel for 20 minutes loiter at 10,000 ft and two landing attempts, 25% maximum fuel weight, and 50% store weight.

3.3. Payload Requirements

3.3.1. Air to Air Combat

a) Avionics/sensors weight shall be 2,500 lb. (internal to airframe)
b) Ordnance load shall be:
    a. AIM-120C: QTY 6
    b. AIM-9X: QTY 2

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3.3.2. Strike

a) Avionics/sensors weight shall be 2,500 lb. (internal to airframe)
b) Ordnance load shall be:
    a. MK-83 JDAM: QTY 4
    b. AIM-9X: QTY 2

3.4. Mission Requirements

3.4.1. Air to Air Combat

a) A 700 nm. minimum combat radius is required.
    - A 1,000 nm. combat radius is desirable.
b) Combat shall consist of a minimum of 2 minutes at maximum thrust at best turning speed (speed for highest rate of turn) at 10,000 ft.
    - A combat time of 5 minutes at maximum thrust is desirable.
c) Ordinance shall be carried for the entire mission (including arrestment).
d) The aircraft shall have an 8.0 deg/sec minimum sustained turn rate at 20,000 ft at the mid mission fuel weight.
    - A 10.0 deg/sec turn rate is desirable.
e) A Mach 1.6 dash speed at 30,000 ft. is required.
    - Mach 2.0 dash speed is desired.

3.4.2. Strike

a) A 700 nm. minimum combat radius is required.
    - A 1,000 nm. combat radius is desirable.
b) Mid mission combat shall consist of 50 nm sea level dashes (ingress and egress) at intermediate thrust (maximum non-afterburning)
c) Sea level dash speed shall be Mach .85 or greater (intermediate thrust).
    - Mach .90 is desirable.
d) Ordinance shall be carried for the entire mission (including arrestment).

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3.5. Point Performance Requirements (based on CVN-68 class category aircraft carrier)

a) The design vertical load factor (N_z) shall be greater than 7g at mid mission weight.
    - 8.0g is desirable.
b) Aircraft external store carriage capability (ordnance, tanks, or pods) shall not be less than 10,000 lb in total or less than 3,000 lb for any single store.
c) Launch requirements must be achievable with a Wind Over Deck (WOD) no greater than zero (i.e., no headwind) and using the C-13-2 catapult (see performance chart provided in Section 5)
d) Recovery requirements must be achievable with a WOD not greater than 15 knots and using the Mark 7 Mod 3 arresting gear (see performance chart provided in Section 5).
e) If multi-engine, launch single-engine rate of climb (SEROC) not less than 200 ft/min.
f) If multi-engine, approach SEROC not less than 500 ft/min.
g) Unfolded wingspan shall not exceed 60 feet.
h) Folded wingspan shall not exceed 35 feet.
i) Overall aircraft length shall not exceed 50 feet (jet blast deflector clearance).
j) Overall aircraft height shall not exceed 18.5 feet (aft hangar bay height).
k) Spot factor should be minimized by minimizing total planform area for aircraft in stowed configuration (e.g., wings folded).
l) Maximum take-off gross weight shall not be greater than 90,000 lb (elevator deck strength limits and support equipment capability).

4. Report Requirements

The report should satisfy the following tasks to show how the proposer would develop the design of a new aircraft.

a. Justify the final design and describe in detail the technologies and technical approach used to meet the mission requirements.
b. Provide carpet plots used to optimize the final selected design.
c. Include a dimensioned 3-view general arrangement drawing.
d. Include an inboard profile showing the general internal arrangement.
e. Include an illustrated description of the primary load bearing airframe structure and state rationale for material selection.
f. Include performance flight envelope, payload-range, and V-n diagrams.
g. Quantify aerodynamic characteristics (drag in particular) for key mission segments.
h. Show a weight breakdown of major components and systems, and center of gravity travel.
i. Provide performance estimates and demonstrate aircraft stability for all flight and loading conditions.
j. Provide unit cost for a production run of 500 aircraft.
k. The discussion of additional roles, use-cases, or potential design variants is encouraged.

5. Reference Materials

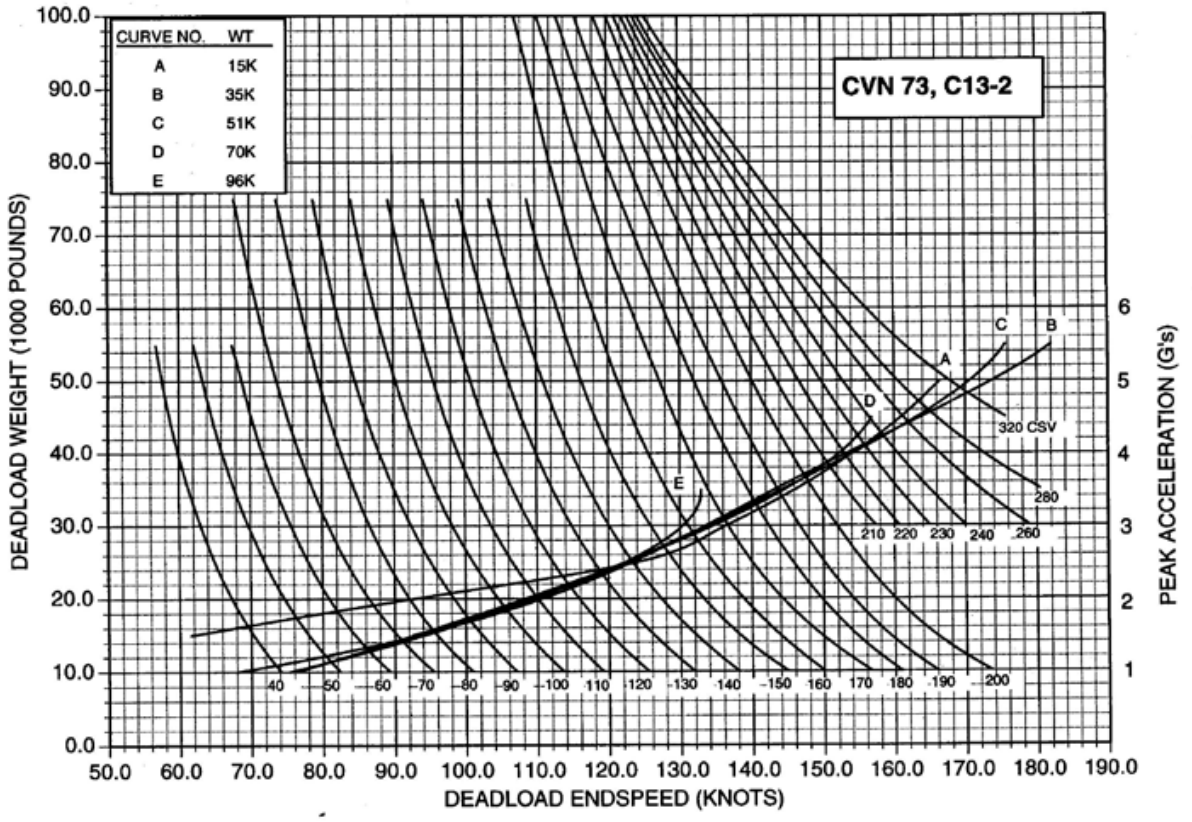

Figure 4-14
TYPICAL C13-2 MINIMUM PERFORMANCE AND LOAD FACTOR CURVES

Figure 2: C13-2 Catapult Performance Curves

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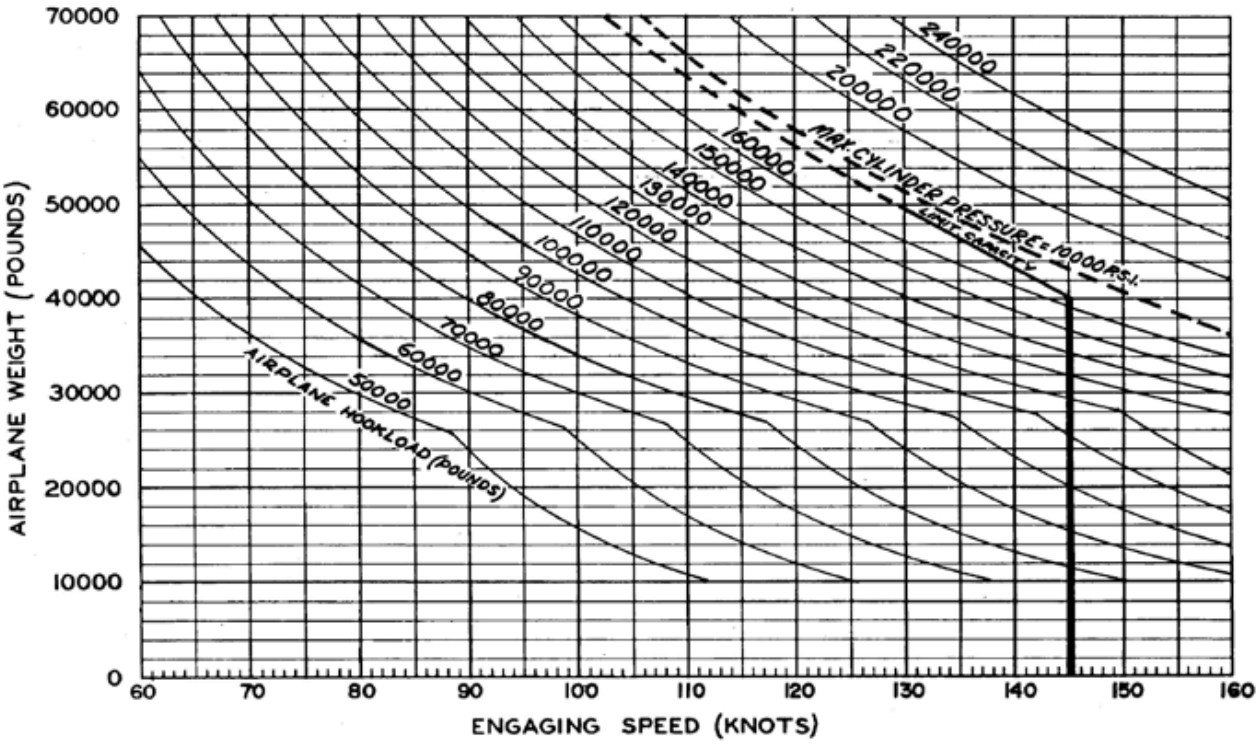

Figure 3: Arresting Gear Performance Curves

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CATALOG OF CURRENT CARRIER AIRCRAFT SUITABILITY DATA

AIRCRAFT	GROSS TAKEOFF WEIGHT W (LBS)	LENGTH (TAIL NOT FOLDED) (FEET) L	WINGSPAN NO WINGTIP MISSILES (FEET) b	FOLDED SPAN (FEET) b_f	OVERALL HEIGHT (FEET) h	FOLDED HEIGHT (FEET) h_f	FOLDING HEIGHT (FEET)	FORWARD FUSELAGE HEIGHT (FEET) h_1	MAXIMUM HEIGHT ON JACKS (1) (FEET)	DISTANCE NOSE TO NOSE GEAR (FEET)	DISTANCE NOSE GEAR TO TAIL (FEET) A	DISTANCE NOSE TO MAIN GEAR (FEET) B_1	DISTANCE NOSE TO BUMPER (FEET) B_2	WHEEL BASE (FEET) C	WHEEL TREAD (FEET) T	TURNING RADIUS ABOUT MAIN GEAR (FEET) D	TIP OVER ANGLE (AFT C.G) γ (DEG)	TIP BACK ANGLE α (DEG)	SPOT FACTOR
E-2C	52000	57.6	80.6	29.3	18.3	16.5	22.9	9.7	18.7	4.6	53.0	27.9	47.0	23.3	19.5	50.0	17.3	9	2.01
C-2A	54830	56.6	80.6	29.3	16.9	15.9	22.4	11.1	19.1	1.4	55.2	24.6	45.6	23.2	19.5	50.0	14.2	8	1.97
S-3A	52539	53.3	68.7	29.5	22.8	15.3	31.1	11.6	17.0	7.0	45.3	25.8	NA	18.8	13.8	41.2	21.1	16	1.49
A-6E	58600	54.8	53.0	25.2	16.3	16.3	21.1	13.6	18.7	6.4	48.4	23.5	54.2	17.1	11.0	33.0	17.8	10	1.42
EA-6B	65000	59.4	53.0	25.2	16.7	16.7	21.1	14.1	20.3	11.0	48.4	28.2	59.4	17.2	10.8	33.0	19.9	10	1.46
F-14A	69800	61.9	64.1	33.3	16.0	NA	NA	12.4	18.9	16.7	45.2	39.7	NA	23.0	16.4	39.6	24.0	9	1.55
F/A-18	50060	56.0	37.5	27.5	15.1	15.1	15.1	10.4	17.6	17.9	38.1	35.8	NA	17.9	10.2	38	22.7	18	1.18
A-7E	42000	46.1	38.7	23.8	16.1	16.1	17.1	10.7	17.8	9.3	36.8	25.0	37.5	15.7	9.5	29	12.0	10	1.00
EA-3B (2)	73000	80.0	72.5	48.2	22.8	16.6	27.3	12.0	18.5	16.3	63.7	43.0	58.0	26.7	10.5	45	25.4	12	2.94

(1) GEAR EXTENDED AND TWO INCH TIRE CLEARANCE. TAIL & WINGS FOLDED.
(2) BRIDLE LAUNCHED

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TABLE 3.1.10-II CATALOG OF CURRENT CARRIER SUITABILITY DATA

Source: https://ntrs.nasa.gov/api/citations/19880019533/downloads/19880019533.pdf
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Additional Useful Links:

1. Sortie Generation Capacity of Embarked Airwings
    - https://apps.dtic.mil/sti/tr/pdf/ADA359178.pdf
2. F/A-18E/F Super Hornet Aircraft (F/A-18E/F)
    - https://www.globalsecurity.org/military/library/budget/fy2012/sar/f-a-18e-f_december_2012_sar.pdf
3. Lessons Learned from the F/F-22 and F/A-18E/F Development Programs
    - https://apps.dtic.mil/sti/tr/pdf/ADA440032.pdf
4. The Influence of Ship Configuration on the Design of the Joint Strike Fighter:
    - https://apps.dtic.mil/sti/tr/pdf/ADA399988.pdf