



**AIAA Foundation
Undergraduate Team Aircraft Design
Competition**

RFP: Cruise Missile Carrier

1999/2000

AIAA FOUNDATION

Undergraduate Team Aircraft Design Competition

I. RULES

1. All groups of three to ten undergraduate AIAA branch or at-large Student Members are eligible and encouraged to participate.
2. Six copies of the design will be submitted; each must bear the signatures, names and student numbers of the project leader and the AIAA Student Members who are participating. Designs that are submitted must be the work of the students, but guidance may come from the Faculty Advisor and should be accurately referenced and acknowledged.
3. Design projects that are used as part of organized classroom requirement are eligible and encouraged for competition.
4. The prizes shall be: First place-\$2,500; Second place-\$1,500; Third place-\$1,000; with the awards for the students submitting the winning designs. Certificates will be presented to the winning design team for display at their university and a certificate will also be presented to each team member and the faculty project advisor. One representative from the first place design team will be expected to present a summary design paper at the AIAA World Aviation Conference in 2001. Reasonable airfare and lodging will be defrayed by the AIAA Foundation for the team representative.
5. More than one design may be submitted from students at any one school. Projects should be no more than 100 double-spaced typewritten pages and typeset should be no smaller than 10pt Times (including graphs, drawings, photographs, and appendix) on 8.5" x 11.0" paper. Up to five of the 100 pages may be foldouts (11" x 22" max).
6. If a design group withdraws their project from the competition, the team chairman must notify the AIAA National Office immediately!

II. SCHEDULE AND ACTIVITY SEQUENCES

Significant activities, dates and addresses for submission of proposal and related materials are as follows:

- A. Letter of Intent — 10 March 2000
- B. Receipt of Proposal — 4 June 2000
- C. Announcement of Winners — September 2000

Groups intending to submit a proposal must submit a letter of intent (Item A), with a maximum length of one page to be received with the attached form on or before the date specified above, at the following address:

Mr. Robert Paczula
AIAA Student Programs
1801 Alexander Bell Drive, Suite 500
Reston, VA 20191-4344

The finished proposal must be submitted (post-marked) to the same address, on or before the date specified for the Receipt of Proposal (Item B).

III. PROPOSAL REQUIREMENTS

The technical proposal is the most important factor in the award of a contract. It should be specific and complete. While it is realized that all of the technical factors cannot be included in advance, the following should be included and keyed accordingly:

1. Demonstrate a thorough understanding of the Request for Proposal (RFP) requirements.
2. Describe the proposed technical approaches to comply with each of the requirements specified in the RFP, including phasing of tasks. Legibility, clarity, and completeness of the technical approach are primary factors in evaluation of the proposals.

3. Particular emphasis should be directed at identification of critical, technical problem areas.

Descriptions, sketches, drawings, systems analysis, method of attack, and discussions of new techniques should be presented in sufficient detail to permit engineering evaluation of the proposal.

Exceptions to proposed technical requirements should be identified and explained.

4. Include tradeoff studies performed to arrive at the final design.

5. Provide a description of automated design tools used to develop the design.

IV. BASIS FOR JUDGING

1. Technical Content (35 points)

This concerns the correctness of theory, validity of reasoning used, apparent understanding and grasp of the subject, etc. Are all major factors considered and a reasonably accurate evaluation of these factors presented?

2. Organization and Presentation (20 points)

The description of the design as an instrument of communication is a strong factor on judging. Organization of written design, clarity, and inclusion of pertinent information are major factors.

3. Originality (20 points)

The design proposal should avoid standard textbook information, and should show the independence of thinking or a fresh approach to the project. Does the method and treatment of the problem show imagination? Does the method show an adaptation or creation of automated design tools?

4. Practical Application and Feasibility (25 points)

The proposal should present conclusions or recommendations that are feasible and practical, and not merely lead the evaluators into further difficult or insolvable problems. Is the project realistic from a cost standpoint? Does the presentation include environmental impact studies (where applicable), and analysis of the function of the design in or for society?

REQUEST FOR PROPOSAL

Design of a Cruise Missile Carrier for the 1999/2000 AIAA Undergraduate Team Aircraft Design

I. OPPORTUNITY DESCRIPTION

Recent events point to a need for a new Cruise Missile Carrier aircraft to respond to rapidly changing situations. To be viable, this aircraft must be capable of carrying at least ten AGM-86C Conventional Cruise Missiles for a total unrefueled range of 5,000 nautical miles. Due to the increasingly tight Defense budgets, these aircraft should be designed to keep both acquisition and life cycle costs as low as possible. With this in mind, civil cargo and passenger variants should be investigated, as well as the possible benefits of unmanned operation.

2. PROJECT OBJECTIVE

2.1 Overall Objectives

The objective of this project is to design a new military aircraft that is capable of transporting and launching 10 AGM-86C missiles economically. Key elements of this project are to determine a means of establishing the cost effectiveness of the proposed aircraft and to investigate alternate payloads and mission ranges. The proposal will include a set of aircraft technologies incorporated into the design that are direct contributors in reducing costs.

3. DESIGN REQUIREMENTS AND CONSTRAINTS

3.1 General Design Requirements

1) The maximum landing weight equal to the 60% of maximum takeoff gross weight .

2) The aircraft shall be designed for a structural limit load factor of 2.5 g's.

- 3) Initial cruise ceiling of 30,000 feet at a cruise Mach Number no less than 0.85.
- 4) Maximum cruise altitude shall not be greater than 45,000 feet.
- 5) Design payload is ten AGM-86C missiles (~35,000 pounds).
- 6) Mission range is to be at least 5,000 nautical miles, unrefueled.
- 7) The aircraft will be compatible with current military and FAA airport operation requirements.
- 8) Military version of this aircraft will be capable of aerial refueling for extended range operations.
- 9) The general characteristics of the AGM-86C are listed below:

Primary Function: Air-to-ground strategic cruise missile

Length:	20 feet 9 inches
Weight:	3,250 pounds
Diameter:	24.5 inches
Wingspan:	12 feet

3.2 Requirements

3.2.1 Design Mission

Takeoff at maximum takeoff gross weight.

1. Warm-up and takeoff
 - The fuel allowance should be equal to:
 - a) fuel consumed during a 20 minute period of engine operation at idle power plus
 - b) 2 minutes of operation at maximum takeoff power.
2. Climb at maximum climb power and best climb speed from SL to best long-range cruise altitude (not a cruise climb).
3. Cruise at best long-range cruise altitude and Mach number to a launch point 4,000 nautical miles from takeoff.

4. Loiter at best loiter altitude Mach number for 30 minutes.
5. Launch payload.
6. Climb at maximum climb power and best climb speed to best cruise altitude.
7. Cruise at best cruise altitude and Mach number to a field 1,000 NM from launch point.
8. Landing. Descend to landing field with no fuel, time or distance credit.
9. Reserve fuel is to be 5 percent of total mission fuel.

3.2.2 Point Performance Requirements

The proposed aircraft shall satisfy the following Point Performance Requirements:

1. Cruise speed equal to or greater than Mach 0.85.
2. Minimum cruise ceiling equal to 30,000 feet at initial cruise speed.
3. Balanced field length at maximum TOGW shall be less than or equal to 8,000 feet, at sea level for an ICAO Std. Day.
4. Landing distance over 50 ft obstacle at maximum landing weight shall be less than or equal to 8,000 feet, at sea level, with one engine inoperative and an ICAO Std Day.
5. Landing distance over 50ft obstacle at end mission weight shall be less than or equal to 6000 feet, at sea level and an ICAO Std. Day. The aircraft shall also be capable of landing distance of 6800 feet at sea level on a USAF Tropical Day (89 degrees F and 14.7 psi).

4. Data Requirements

The technical proposal must convincingly demonstrate that the proposer can provide a superior solution to the need identified by this request for proposal. Therefore, it is the most important factor in the award of a contract. The proposal should satisfy the following tasks to show how the proposer would develop the design of a new aircraft.

1. Justify the final design and describe in detail the technologies and technical approach used to meet the mission requirements.
2. Provide carpet plots used to optimize the final selected design.
3. Include a dimensioned 3-view general arrangement drawing.
4. Include an inboard profile showing the general internal arrangement for both a cruise missile carrier and a commercial cargo configurations.
5. Include an illustrated description of the primary load bearing airframe structure and state rationale for material selection.
6. Include a V-n diagram.
7. Show an estimated drag build up for the cruise configuration.
8. Show a weight breakdown of major components and systems, and center of gravity travel.
9. Provide performance estimates and demonstrate aircraft stability for all flight and loading conditions.
10. Provide fly-away cost for a production run of 600 aircraft.

