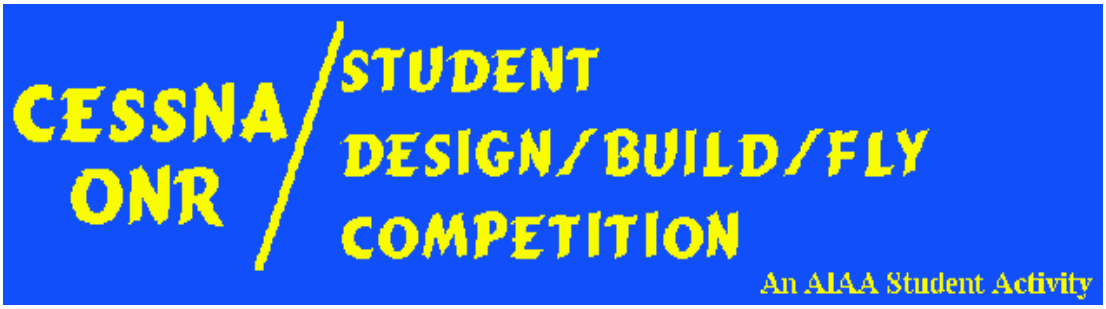


2005 Rules and Vehicle Design

Note: Rules are "Draft" until 31 October 2004

Summary:

The AIAA through the Applied Aerodynamics, Aircraft Design, Design Engineering and Flight Test Technical Committees and the AIAA Foundation invites all university students to participate in the **Cessna/ONR Student Design/Build/Fly Competition**. The contest will provide a real-world aircraft design experience for engineering students by giving them the opportunity to validate their analytic studies.

Student teams will design, fabricate, and demonstrate the flight capabilities of an unmanned, electric powered, radio controlled aircraft that can best meet the specified mission profile. The goal is a balanced design possessing good demonstrated flight handling qualities and practical and affordable manufacturing requirements while providing a high vehicle performance.

To encourage innovation and maintain a fresh design challenge for each new year, the design requirements and performance objectives will be updated for each new contest year. The changes will provide new design requirements and opportunities, while allowing for application of technology developed by the teams from prior years.

Cash prizes are $2500 for 1st, $1500 for 2nd and $1000 for 3rd place. Winners will be invited to present their designs at the 2005 Aircraft Technology, Integration and Operations Conference.

Judging:

Students must design, document, fabricate, and demonstrate the aircraft they determine as best capable of achieving the highest score on the specified mission profile(s). Flight scores will be based on the demonstrated mission performance obtained during the contest.

Each team must also submit a written Design Report. A maximum of 100 points will be awarded for the team design report. Scores for the written reports will be announced at the beginning of the fly-off.

Each aircraft will have computed a Rated Aircraft Cost, reflecting the complexity/technology of the design.

The overall team score is a combination of the Design Report, Rated Aircraft Cost and Flight scores. The team with the highest overall team score will be declared the winner.

Scores will be DECLAIRED FINAL 7 working days after the completion of the contest. This period will allow for review of the scores in a timely fashion following the contest.

All submitted reports are the property of AIAA, Cessna and ONR and may be published or reproduced at their discretion.

Contest Site:

Host for the competition will be the Office of Naval Research. The fly-off is planned to be held at Webster Field at St Inigos, MD.

You can check on weather historical conditions at www.weatherbase.com or www.weatherunderground.com.

Team Requirements:

All team members (except for a pre-approved designated pilot) must be full time students at an accredited University or College and student members of the AIAA. The team must be composed of both under classmen and upper classmen, with at least 1/3 of the members being under classmen (Freshman, Sophomores or Juniors). The pilot must be an AMA (Academy of Model Aeronautics) member. Teams may use a non-university member for the pilot if desired. We will also provide qualified pilots on the contest day for any teams who are unable to have their pilot attend.

Past Year Reports:

The top scoring report from the past years competition will be available for reference on the contest web site. The team with the top scoring report from this years contest will be required to submit an electronic copy of their report following the competition, which will be placed on the contest web site for the next years competition.

Sponsorship:

Teams may solicit and accept sponsorship in the form of funds or materials and components from commercial organizations. All **design, analysis and fabrication** of the contest entry is the sole responsibility of the student team members.

Schedule:

A completed electronic entry form is due to the contest administrator on or before **31 October 2004**.

The entry form for the DBF is different than that used for all other AIAA student competitions. The DBF entry form is a MS-Word file and can be found on the contest web site. It must be submitted by e-mail to the contest administrator at gregory.s.page@nrl.navy.mil . Be sure to include the Phone and FAX number for your

team advisor and at least one student contact so we may reach you in case of any last minute problems or changes. All teams are required to provide two point-of-contact e-mail addresses with their contest application, one of which must be the teams advisor. ***It is the teams responsibility to make sure the e-mail contact addresses they supply remain active during the entire period from entry to the close of the competition, as e-mail will be the primary means to provide information and updates.***

Please Note: *The Entry Name* may not be changed once the form is submitted, but must be retained and used in all reports and correspondence during the competition year.

Written reports (**5 hard copies, electronic reports will not be accepted**), are due to the Chief of Scoring by COB **8 March 2005**. Reports will be judged "as received", no "corrections/additions/page changes" will be made by the organizers so check your reports carefully before sending them. COB is taken as 5 pm local time at the address provided for delivery of the written reports. Scores for the written reports will be announced at the beginning of the fly-off.

(A note primarily for foreign entrants but also allowed for domestic teams. If sending the report by courier is prohibitive you may send it electronically to a commercial printer (KINKO's comes to mind) local to the report submission address and have them print/collate and DELIVER the reports to meet the deadline. No deadline exceptions will be made, but this may be easier than international courier service.)

The contest is scheduled for **22-24 April 2005**. The competition will run from noon to 5PM on Friday, and 8AM to 5PM on Saturday and Sunday. Final awards will be presented at the end of Sunday's competition. All teams are encouraged to stay and attend the awards presentations on Sunday.

Please note that tech inspections will be available on Friday **22 April**. Teams are encouraged to be prepared to have your plane inspected on Friday. Inspections will also be available on Saturday, but waiting until Saturday to go through tech may mean that your team will miss one or more rounds through the flight queue. If we have a full turnout you may not be able to get in a full set of scoring flights unless you are "ready to fly" at every opportunity.

Late entries will **NOT** be accepted. Late or incomplete report submissions will **NOT** be judged. Teams who do not submit the required written reports will NOT be allowed to fly. It is the teams responsibility to assure that all deadlines are met, as they will be **strictly** enforced.

Communications:

The contest administration will maintain a World Wide Web site containing the latest information regarding the contest schedules, rules, and participating teams. The contest web site will also contain a list of potential suppliers for materials and equipment available to build an entry. The contest web site is located at:

http://www.ae.uiuc.edu/aiaadbf

Questions regarding the contest, schedules, or rules interpretation may be sent to the contest administrator by e-mail at:

gregory.s.page@nrl.navy.mil

The contest administrator will provide e-mail copies of questions received and their answers to all teams of record.

Written reports (only) should be sent to the Chief of Scoring at:

AIAA Design/Build/Fly Contest/Report Judging
Greg Page Bldg 210
ITT / AES
2560 Huntington Ave.
Alexandria, VA 22303
202-404-1251
202-767-6194 FAX

Aircraft Requirements - General

- The aircraft may be of any configuration except rotary wing or lighter-than-air.
- No structure/components may be dropped from the aircraft during flight.
- No form of externally assisted take-off is allowed. All energy for take-off must come from the on-board propulsion battery pack(s).
- Must be propeller driven and electric powered with an unmodified over-the-counter model electric motor. May use multiple motors and/or propellers. May be direct drive or with gear or belt reduction.
- ***NEW***: Motors may be any commercial brush or brushless electric motor.
- For safety, each aircraft will use a commercially produced propeller. Teams may modify the propeller diameter by clipping the tip, and may paint the blades to balance the propeller. No other modifications to the propeller are allowed. Commercial ducted fan units are allowed.
- Motors and batteries will be limited to a maximum of 40 Amp current draw by means of a 40 Amp fuse (per motor or pack) in the line from the positive battery terminal to the motor controller. Only ATO or blade style plastic fuses may be used. (e.g. "Maxi" size Slow Blow, 1.15"x0.85". Available online www.Mcmaster.com part #7460K51 $1.66 each)
- ***NEW***: Must use over the counter NiCad or NiMH batteries. For safety, battery packs must have shrink-wrap or other protection over all electrical contact points. The individual cells must be commercially available, and the manufacturers label must be readable (i.e. clear shrink wrap preferred). All battery disconnects must be "fully insulated" style connectors.
- ***NEW***: Maximum battery pack weight is **3** lb. Battery pack must power propulsion and payload systems only. Radio Rx and servos MUST be on a separate battery pack. Batteries may not be changed or charged between sorties during a flight period.
- Aircraft and pilot must be AMA legal. This means that the aircraft TOGW (take-off gross weight with payload) must be less than 55 lb, and the pilot must be a member of the AMA.
- Since this is an AMA sanctioned event, the team must submit proof that the aircraft has been flown prior to the contest date (in flight photo) to the technical inspection team. Contest supplied qualified pilots will be available to teams who require them.
- ***NEW***: Teams must use the contest supplied RAC calculation sheet. This Excel file will be available for download from the contest web site. Teams must use the file “as-is” for print inclusion in the Design Report, and must supply a separate signed (by the teams faculty advisor) copy of their Rated Aircraft Cost worksheet to the judges during technical inspection for verification.

  The RAC sheet presented at the tech inspection should match the final aircraft configuration

being flown at the contest, and may differ from the one submitted with the Design Report. During tech inspection the judges will determine an independent RAC value. The Rated Aircraft Cost obtained at the technical inspection will be used for the competition and may not be modified during the event.

Aircraft Requirements - Safety

All vehicles will undergo a safety inspection by a designated contest safety inspector prior to being allowed to make any competition or non-competition (i.e. practice) flight. All decisions of the safety inspector are final. Safety inspections will include the following as a minimum.

- Physical inspection of vehicle to insure structural integrity.

    1. Verify all components adequately secured to vehicle. Verify all fasteners tight and have either safety wire, locktite (fluid) or nylock nuts.
    2. Verify propeller structural and attachment integrity.
    3. Visual inspection of all electronic wiring to assure adequate wire gauges and connectors in use. Teams must notify inspector of expected maximum current draw for the propulsion system.
    4. Radio range check, motor off and motor on.
    5. Verify all controls move in the proper sense.
    6. Check general integrity of the payload system.

- Structural verification. All aircraft will be lifted with one lift point at each wing tip to verify adequate wing strength (this is "roughly" equivalent to a 2.5g load case) and to check for vehicle cg location. Both upright and inverted wing lift tests will be performed. Teams must mark the expected empty and loaded cg locations on the exterior of the aircraft fuselage. Special provisions will be made at the time of the contest for aircraft whose cg does not fall within the wing tip chord. This test will be made with the aircraft filled to its ***maximum payload capacity***.
- Radio fail-safe check. All aircraft radios must have a fail-safe mode that is automatically selected during loss of transmit signal. The fail-safe will be demonstrated on the ground by switching off the transmit radio. During fail safe the aircraft receiver must select:

    Throttle closed
    Full up elevator
    Full right rudder
    Full right (or left) aileron
    Full Flaps down (if so equipped)

    During Fail Safe the payload release system must NOT activate.

    The radio Fail Safe provisions will be strictly enforced.

- All aircraft must have a mechanical motor arming system separate from the onboard radio Rx switch. This MUST be the contest specified "blade" style fuse. This device must be located so it is accessible by a crewmember standing **ahead** of the propeller(s) for pusher aircraft, and standing **behind** the propeller(s) for tractor aircraft (i.e. the crew member must not reach across the propeller plane to access the fuse). The "Safety Arming Device" will be in "Safe" mode for all payload changes. The aircraft Rx should always be powered on and the throttle verified to be "closed" before activating the motor arming switch. Fuses MUST

be accessible from outside the aircraft and act as the "safeing" device.

Note: The aircraft must be “safed” (arming fuse removed) any time the aircraft is being manually moved, or while loading/unloading payload during the mission. The arming fuse must be removed anytime the aircraft is in the hanger area.

Mission Profile:

Teams must complete the flight missions as outlined in the mission matrix below. Teams will have a maximum of **5** flight attempts. A flight attempt is defined as advancing the throttle “stick” for take-off, or going past the 2 minute preparation time. The best ***Single Flight Score*** from each of **2 different mission types** will be summed for the team's ***Total Flight Score***.

In the event that, due to time or facility limitations, it is not possible to allow all teams to have the maximum number of flight attempts, the contest committee reserves the right to ration and/or schedule flights. The exact determination of how to ration flights will be made on the contest day based on the number of entries, weather, and field conditions.

Each team's overall score will be computed from their ***Written Report Score, Total Flight Score***, and the ***Rated Aircraft Cost*** using the formula:

$$\text{SCORE} = \frac{\text{Written Report Score} * \text{Total Flight Score}}{\text{Rated Aircraft Cost}}$$

Mission Task Matrix

Mission	Description
	General Mission Information ... Aircraft must fit in a 2-ft wide by 1-ft high by 4-ft long (interior dimensions) box. The aircraft will be returned to the box at end of the flight as a part of each timed mission. ***The aircraft must not be damaged in any way during the “return to box” task.*** Note: There is no timed-repair of damage allowed in this years competition. ... The aircraft MUST be configured to support both wing tip EXTERNAL payload carriage and fuselage INTERNAL payload carriage, even if the sensor re-position mission is not flown. Wing tip lift tests will be performed with the INTERNAL payload only. ... Each payload is a 12” long 3” (metric 75mm) PVC tube (minimum length of the tube proper, with out any ends/caps/fairings). Ends must be closed. Ends may be faired in any manor desired. The identically same payload must be used for both the INTERNAL

and EXTERNAL payload missions (any fairings, fins or other structures used for the external mission must also be in place during the internal missions). Each payload must weigh at least 3 lbs.

- EXTERNAL payload must be carried on a hard-point located within 3 inches of the wing tip of the largest span wing. One payload hard-point will be located at each wing tip. The aircraft will NOT be required to fly with only one wing tip payload package loaded. External payload must be capable of remote (RC) release, but will use only manual reloading. ***Payload release must use a dedicated servo, it can not be integrated with any flight control servo.***
- INTERNAL payload must be carried fully inside the fuselage. Payload must be symmetric to the fuselage centerline. (ie. They can be side-by-side and symmetric to the fuselage centerline, or they may be one above the other and on the fuselage centerline). For dual-fuselage configurations one sensor package will be in each fuselage, on that fuselage's plane of symmetry.
- The Entry Name and University Name must be clearly visible on the upper surfaces of the upper-most wing. Font used should be large enough to allow easy identification in photographs of the aircraft (does not apply to in-flight photos).
- Teams must select one of the following missions for each flight. Teams may select a different mission for each of their scoring flight attempts.
- Take-off distance is 150 ft wheels off the runway. For each take-off of a multi-sortie mission the aircraft may be returned to the start line for each new take-off, or may start where it is. In either case the maximum take-off allowance is MEASURED from the start line.
- On landing the aircraft must land on the runway (but may roll off) to obtain a score for that flight.
- All payloads must be adequately secured using mechanical means. Tape and Velcro are not acceptable forms of restraint.
- Each team will be issued a Flight Scoring sheet when they complete the technical inspection (along with their DBF flight approval decal). The TEAM is responsible for maintaining the Flight Scoring sheet. They must present it to the flight line scoring judge before beginning each mission. They must present it to the main scoring judge for recording within 5 minutes of the completion of each flight. Scores reported later than 5 minutes from the recorded end-

	of-flight time will be scored as **0**. Duplicate scoring sheets will NOT be available. ... Maximum mission time is **10** minutes.
Sensor Reposition	**DF = 2.0** ... Mission Profile: 1. Aircraft will begin the mission with **2** EXTERNAL sensor payload packages. 2. Aircraft will take-off and fly **1** lap. After landing the aircraft will remotely deploy **1** sensor package at each of **2** separate release locations. 3. Aircraft will take-off and fly **1** lap. After landing the aircraft will taxi to a specified reload location near the first release location. The ground crew will, when instructed by the flight line judge, go out to the aircraft, safe the propulsion system, and manually re-load the payload. The ground crew will return to their "box" after reloading the first sensor package. The aircraft will taxi to the second reload location, and the ground crew will repeat the sensor reloading process. 4. Aircraft will take-off and fly **1** lap. On landing the aircraft must cross the take-off start line and come to a complete stop. 5. When instructed by the flight line judge the ground crew will retrieve the aircraft, return it to the "box" area, disassemble the aircraft and store it in the box. 6. Time stops when the box lid is closed and latched. ... One release location will be along the runway edge furthest from the pit crew "box", the other location will be along the runway centerline. Locations will be marked on the pavement by 10 ft x 10 ft rectangles. If the sensor package rolls out of the marked area it will be scored as an incomplete flight. ... On all laps flown the aircraft must complete a 360^{o} turn in the direction opposite of the base and final turns on the downwind leg of each lap. ... ***For this task there is no score for a partial mission*** ... For this task there is no score if the aircraft is not successfully returned to the box at the end of the mission. ... **Single Flight Score** is: SCORE = DF *(12-Mission_Time)
Maximum Utilization	**DF = 1.0**

	... Mission Profile: 1. Aircraft will begin the mission with **2** INTERNAL sensor payload packages. 2. Aircraft will take-off and fly **as many laps as the team deems possible.** 3. On landing the aircraft must cross the take-off start line and come to a complete stop. 4. When instructed by the flight line judge the ground crew will retrieve the aircraft, return it to the "box" area, disassemble the aircraft and store it in the box. 5. Time stops when the box lid is closed and latched. ... The total mission Time limit is 6 minutes. ... A Penalty of 1 lap will be assessed for each 15 seconds or portion thereof beyond the 6 minutes before the box is closed and latched. ... On all laps flown the aircraft must complete two (2) 360^{o} turns in the direction opposite of the base and final turns on the downwind leg of each lap. ... For this task there is no score if the aircraft is not successfully returned to the box at the end of the mission. ... **Single Flight Score** is: SCORE = DF * Number_of_Laps
Re-Supply	**DF=1.5** ... Mission Profile: 1. Aircraft will begin the mission with **2** INTERNAL sensor payload packages. 2. Aircraft will take-off and fly **1** lap. On landing it must cross the take-off start line and come to a complete stop. When instructed by the flight line judge the ground crew will go out to the aircraft and remove the payload. 3. Aircraft will take-off and fly **1** lap. On landing it must cross the take-off start line and come to a complete stop. When instructed by the flight line judge the ground crew will go out to the aircraft and re-install the payload. 4. Aircraft will take-off and fly **1** lap. On landing it must cross the take-off start line and come to a complete stop. When instructed by the flight line judge the ground crew will go out to the aircraft and remove the payload. 5. Aircraft will take-off and fly **1** lap. On landing it must cross the take-off start line and come to a complete stop. When instructed by the flight line

	judge the ground crew will retrieve the aircraft, return it to the "box" area, disassemble the aircraft and store it in the box. 6. Time stops when the box lid is closed and latched. ... On all laps flown the aircraft must complete one (1) 360^{o} turn in the direction opposite of the base and final turns on the downwind leg of each lap. ... For this task there is no score if the aircraft is not successfully returned to the box at the end of the mission. **Single Flight Score** is: SCORE = DF * (12-Mission_Time). If only 3 of the 4 sorties are completed SCORE = DF * (6 - Mission_Time) If only 2 of the 4 sorties are completed SCORE = DF * (3 – Mission_Time) (Scores less than 0 will be counted as 0)

Aircraft that run off the runway before reaching the start line may be returned to the runway to taxi back to the line or may be carried to the line by the ground crew.

Aircraft Cost Model:

Rated Aircraft Cost, $ (Thousands) = (A*MEW + B*REP + C*MFHR)/1000

Coef.	Description	Value
A	Manufacturers Empty Weight Multiplier	$500 (NEW)
B	Rated Engine Power Multiplier	$1000 (NEW)
C	Manufacturing Cost Multiplier	$20 / hour
MEW	Manufacturers Empty Weight	Actual airframe weight [lb] with all flight and propulsion batteries but without any payload.
REP	Rated Engine Power	(1+.25*(# engines-1)) * ***Total Battery Weight [lbs]*** ***"Total Battery Weight"*** will be

		the weight of the propulsion battery pack(s) as determined by the judges scale during technical inspection. Total propulsion battery pack weight may not exceed **3** lb, but it may be lighter.
MFHR	Manufacturing Man Hours	Prescribed assembly hours by WBS (Work Breakdown Structure). MFHR = ∇ WBS hours **WBS 1.0 Wing(s): (NEW)** 10 hr/ft^2 Wing Span * Chord * # wings Note: All inputs on RAC worksheet in inches. Wing Span is longest distance perpendicular to fuselage axis on any wing. Chord is maximum exposed wing chord on any wing. For a blended wing-body, exposed wing starts 9 inch out from the body centerline. 5 hr * control_function_multiplier ailerons = 1 flaperons = 1.5 ailerons + flaps = 2 ailerons + spoilers = 2 ailerons + flaps + spoilers = 3 **WBS 2.0 Fuselage** 20 hr/ft^3 Body Length x Width x Height Note: All inputs on RAC worksheet in inches. Length is maximum body length. Width is maximum body width. Height is maximum body height (does not include landing gear height). Maximum body width and maximum body height may occur at different fuselage locations.

		For a blended wing-body, body width is fixed at 18 inch. Note: Maximum length of the body is defined to be the longest longitudinal length possible to measure on the aircraft, and may include spinner and part of vertical or horizontal surfaces. **WBS 3.0 Empennage** 5 hr/Vertical Surface (Any vertical surface, including winglets, struts, end plates, ventral etc) with no active control 10 hr/Vertical Surface (Any vertical surface) with an active control 10 hr/Horizontal Surface. A horizontal surface is a "wing" if it is more than 25% of the span of the greatest span horizontal surface.) A "V" tail is considered to be a Vertical surface without control (5 hr) plus a horizontal surface with controls (10 hr), for a total of 15 hr. **WBS 4.0 Flight Systems** 5 hr/servo or motor controller **WBS 5.0 (Deleted)**

Rated Aircraft Cost must be supplied when the aircraft enters the technical inspection. The RAC worksheet must be signed by the team advisor. RAC may not be changed during the competition unless it is determined by the contest officials to be inaccurate or inappropriate. The contest officials reserve the right to audit and revise the RAC for omissions or errors at any time.

General Mission Specification and Notes:

- Aircraft are to remain assembled while waiting in the queue. Teams will install the propulsion batteries once reaching the **3rd "On Deck"** position (i.e. when the aircraft is 3rd in the queue, the team must begin to install the batteries).
- Aircraft may not have any work performed in the starting line queue, other than as specified above at the 3rd On Deck position. Aircraft propulsion batteries may be left out of the aircraft when in line.
- Aircraft batteries may be charged while the aircraft is in the queue IF AND ONLY IF the batteries are removed from the aircraft.
- The aircraft propulsion system(s) must be disarmed or "safed" during any time when crew members are preparing the aircraft.
- Maximum flight support crew is: pilot, observer, and 3 ground crew. Only the designated ground crew may reload the aircraft payload . Pilot and observer may be members of the ground crew, provided total ground crew size remains 3 people.
- Observer and all ground crew must be students. Only the pilot may be a non-student.
- The upwind turn will be made after passing the upwind pylon. The downwind turn will be made after passing the downwind pylon. Upwind and downwind pylons will be 500 ft from the starting line. Aircraft must be "straight and level" when passing the pylon before initiating the turn.
- Aircraft must land on the paved portion of the runway. Aircraft may "run-off" the runway during roll-out.
- After landing, aircraft may taxi back to the starting line. Alternatively, aircraft may be carried back to the starting line; however, the team may not leave the pit area to retrieve the aircraft until the aircraft has come to a complete stop, and they are signaled it is "Ok" to retrieve the aircraft by the flight line judge. *Aircraft experiencing significant damage during landing will be considered to have completed their flight where they come to rest and may not be "carried" to the starting line to "complete" a lap. Determination of "significant –vs- non-critital" damage will be made by the flight line judges. Aircraft with "significant" damage will not receive a score for that flight. Aircraft with "non-critical" damage may continue to the disassembly task with no penalty.*
- Flight altitude must be sufficient for safe terrain clearance and low enough to maintain good visual contact with the aircraft. Decisions on safe flight altitude will be at the discretion of the flight line judges and all rulings will be final.

Additional information is included in the FAQ (Frequently Asked Questions).

Protest Procedures

Submitting a protest against a competing team is a serious matter and will be treated as such. Teams may submit a protest to the Contest Administrator at any time during the competition. Protests must be submitted in writing and signed by the team advisor (if present at the competition) or the team captain if a faculty advisor is not present. Protests will be posted for all teams to review.

If the protest is rejected, the submitting team(s) will forfeit one of their remaining flight attempts. If all flight attempts have been used, the team(s) will forfeit their lowest Single Flight score.

Protests and the appropriate penalty (ranging from a requirement to repeat a flight for

minor infractions to disqualification from the contest for deliberate attempts to misinform officials or violate the contest rules) will be decided by the Contest Administrator and the Contest Director, in consultation with other Contest Officials. The decision of the Contest Administrator and Contest Director is final.

Design Report:

Each team will submit a judged design report as outlined below. The submission date is contained in the schedule section of this document. Reports must be bound. (Simple spiral bindings are sufficient and preferred; 3-ring binders are not allowed.) All information used for scoring must be in the outlined sections.

Absolute maximum page count for the report is **60 pages**, including text, tables, and figures (cover/title page and table of contents is extra). Drawing package may not comprise more than 5 of the pages of the report page limit. All reports will be at least one and one half line spacing, 10-pt Arial font. Tables and figures will also be at least 10-pt Arial font. Margins are at least 1 inch on all sides. All figures must be either half (1/2) page or full (1) page format. No exceptions. Report pages will be 8 1/2 x 11 inch with the exception of the drawing package. The drawing package may be on 11 x 17 inch pages. The 3-view drawing **must** be on an 11 x 17 inch page. Appendices may not be included. **Reports not meeting these requirements will be scored as "1 of 100"**.

*Please note that the judges will be using this same report outline for evaluating reports. **ALL** items listed will be expected to be present, easy to locate and identify, and be well documented in the report for a maximum score.*

Design Report

1. Executive Summary: (5 points):
   Provide a summary of the development of your design. This should be a narrative description highlighting the major areas in the development process for your final configuration and a broad description of the range of design alternatives investigated.
2. Management Summary (5 points):
   Describe the organization of the design team. Provide a chart of design personnel and assignment areas. Include a (single) milestone chart showing planned and actual timing of major elements of the design process, including as a minimum the conceptual design stage, preliminary design stage, detailed design stage, flight testing and report preparation periods.
3. Conceptual Design (20 points):
   Describe the key elements of the mission requirements (problem statement). Document the alternative configuration concepts (e.g. biplane, canard, flying wing, pusher -Vs tractor, number of engines etc.) investigated during the conceptual design stage and the reason why each concept was considered. Describe and document the numerical figures of merit (FOM's) used to screen competing concepts, and the mission feature each FOM was selected to support. *Rated Aircraft Cost* should be one of the FOM's used during the screening process. Numerical data need not be extensive at this stage, but should include as a minimum: a final ranking chart giving the quantitative value of each design for each FOM.
4. Preliminary Design (30 points):

Document the design parameter and sizing trades investigated during the preliminary design stage, and why each was felt to be important to the mission. Describe the analysis methods used. Describe the mission model used and the predicted performance. Provide estimates of the aircraft lift, drag and stability characteristics. Document the design optimization and trade studies conducted and their results.

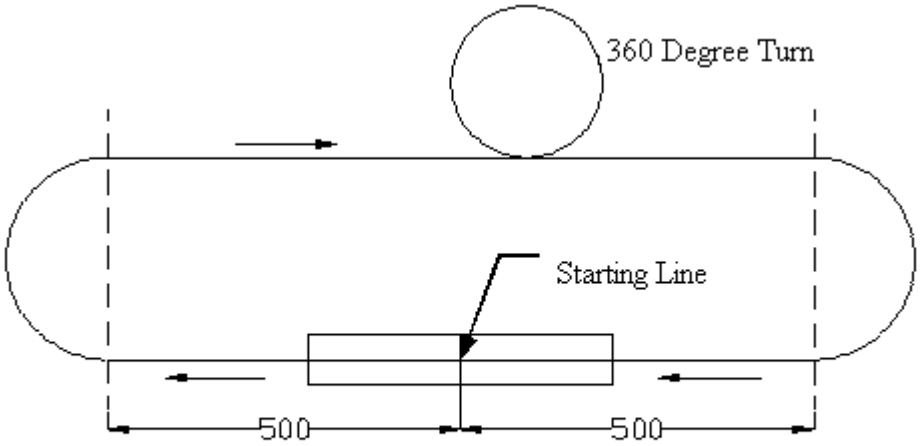
5. Detail Design (15 points for discussion items, 10 points for drawing package, 25 points total for the section):
   Document component selection and systems architecture selection. Include your final competition aircraft's ***Rated Aircraft Cost*** using the contest supplied cost model. RAC table should include all input parameter, intermediate and final computation.

   Include a table giving data for the sized aircraft. A copy of this table must be posted by the team at their "pit" area (poster board). The table should include;
   Geometry: length, span, height, wing area, Aspect Ratio, control volumes
   Performance: CL max, L/D max, maximum Rate of Climb, stall speed, maximum speed, take-off field length (two sets, empty and gross weight)
   Weight Statement (airframe, propulsion system, control system, payload system, payload, empty weight, gross weight)
   Systems (radio used, servos used, battery configuration used, motor used, propeller (nominal), gear ratio (if used))

   The Drawing Package will be included with this section and must contain **as a minimum** a 3-view drawing of the design in sufficient detail to indicate aircraft size and configuration; primary structure component size and location; payload size, location and restraint method; and location of propulsion and flight control system components.

6. Manufacturing Plan and processes (10 points):
   Document the process selected for manufacture of major components and assemblies of the final design. Detail the manufacturing processes investigated, and describe the FOM's used (including but not limited to: availability, required skill levels and cost) to screen competing concepts. Describe the analytic methods (cost, skill matrix, scheduling time lines) used to select the final set of manufacturing processes. Include a manufacturing milestone chart showing scheduled event timings.

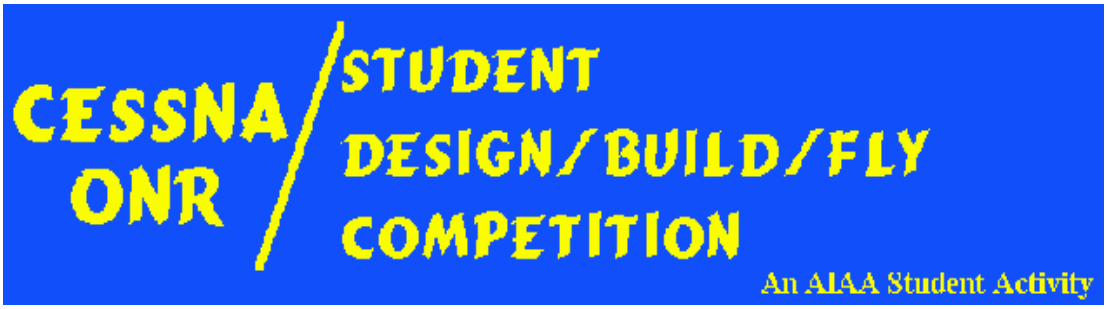
7. Testing Plan (5 points):
   Detail testing objectives, schedules, check-lists, results and any lessons learned for component and full aircraft testing, both static and dynamic (ie. in flight).



Course Layout
Shown to Scale

[AIAA Student Design/Build/Fly Competition homepage] [AIAA Homepage]

27 September 2004 Revision



Frequently Asked Questions (FAQ)
2005 Competition Specific

Please check the FAQ often during the competition. Please note that rules interpretation questions are not answered by e-mail until after the entry date (when all participant e-mail address are known), so that all teams will have equal access to all rules information.

General Notes:

1. Brushless motors are now legal.

2. Ni-mH batteries are now legal. Li-Poly batteries are NOT legal for use either as propulsion or RC batteries.
3. There has been some question of the interpretation of "spare" parts for repair. "Spare" parts may include:
   - Any purchased component, such as: wheels, propellers, motors, servos, control links, control horns
   - Team Fabricated spare parts are limited to: landing gear, control surfaces, hatches, linkages and mechanical actuator mechanisms

   All other aircraft components must be repaired, meaning they retain some reasonable portion of the original, or are completely re-fabricated by the on site team members using the same materials and techniques as the component they replace.

Payload Questions:

1. **Question:** If for the sensor reposition flight we are able to reload only one of the payloads can we continue the flight?
   Answer: No. Letting a plane fly with only one of the two external (or internal) payloads loaded would provide an advantage (and is not provided for in the scoring equations). Flying with only one EXTERNAL payload attached could also present a controllability problem and thus is considered a Safety of Flight issue as well. The aircraft MAY NOT be flown at any time with only one of the two external payloads attached.
2. **Question:** Is there any restriction on the wall thickness of the PVC tube (schedule 40 or schedule 80)?
   Answer: No. Since the total payload unit must weight is specified, it does not matter what portion of the payload weight comes from the PVC tube versus what is ballast added to meet the minimum weight.

3. **Question:** The contest rules state that the payload must be symmetric to the fuselage centerline. Does this rule-out putting payloads inline? ie; end to end internal to the fuselage?
   Answer: Yes. You may not have the internal payloads stored one in front of the other.
4. **Question:** Is the PVC we have to use for the payloads 3" ID or 3"OD?
   Answer: See #6
5. **Question:** The rules state that the payload need to be carried on hard points located within 3" of the wing tips. Does this mean that the centerline of the payload has to be within 3" of the wing tip, or the outermost edge of the payload has to be within 3" of the wing tip?
   Answer: The payload centerline must be within 3" of the wing tip.
6. **Question: PVC Pipe for Payload Questions**
   Answer: Several teams have contacted me about finding many more variations of "3 inch PVC" pipe than I knew existed. To simplify, any PVC pipe of greater than 3" inside diameter will be allowed for the payloads. Teams should have the payload ends removable so the judges can verify the inside diameter only if the outside diameter of their pipe is less than 3 ¼" (which will be assumed sufficient for a 3" inside diameter).
7. **Question:** Can we drill holes in the PVC pipe to allow installing the release mechanism latches?
   Answer: Yes, you may drill holes in the PVC to attach components as required. The Release mechanism must attach to a fitting "external" to the tube profile, it can not reach "inside" the tube to connect to it.
8. **Question:** Can the release mechanism be inside the PVC payload and be controlled by a separate RC system?
   Answer: No. The release system must be a part of the aircraft, not the payload. Also see QA #7 above.
9. **Question:** Is it legal to carry the payloads with their axis perpendicular to the fuselage axis?
   Answer: Yes, as long as the payload is carried in the "fuselage" and not in the wing, and they still retain the "side-by-side" symmetry, placing one ahead of the other is not allowed (see #3 above).
10. **Question:** For the Re-supply mission, can we unload/reload the payloads by means of a box-type case? Or must we unload/reload one payload at a time by hand?
    Answer: You may have a module that contains both payloads. The payload(s) weight will be measured when removed from the module.

Flight / Mission Questions

1. **Question:** Do we have to fly two different missions to get a score?
   Answer: No. If you choose or are unable to fly more than 1 mission you will still get a score for that mission.
2. **Question:** What would constitute "non-critical" versus "significant damage" on landing as described in the rules?
   Answer: The decision will be at the discretion of the flight line judges. In general, "non-critical" damage would allow the aircraft to be easily returned to safe flight status. A couple of examples of "non-critical" damage would be a broken propeller, bent landing gear, sheared nylon bolts or minor scratches to the finish. If any component is structurally damaged and would be considered a hazard to safe flight then it will be considered as "significant damage".
3. **Questions:** Does the ten minute mission window apply to one flight attempt (chosen from Mission A, B or C) or to two different Missions flown in one uninterrupted sequence?
   Answer: The 10 minute window is for a single mission event (A, B or C).
4. **Question:** In the rules examples, all the times are in round minutes. What accuracy will be used for determining flight times?
   Answer: It's just to make the rules document cases simple. We will record times to the accuracy possible, probably to nearest second.
5. **Question:** Is there a minimum altitude for flying the course?

Answer: No. Altitude must be high enough for safe flight as set by the discretion of the Contest Director.

6. **Question:** How are the turns made, and is there a set turn radius?
   Answer: The turns may not be initiated until the turn judge raises his flag (for the two 180 degree turns), but may then proceed to be any turn radius and rate the aircraft is capable of. The 360 degree turn can be initiated anytime the aircraft is on the "downwind" leg and also may be any turn radius and rate the aircraft is capable of.
7. **Question:** Is it safe to assume that if the rules do not explicitly forbid something, it is allowed?
   Answer: The rules are intentionally designed to not impose too many limitations while allowing each team an equal chance. If something adheres to the "spirit" of the rules it is likely to be allowed. If you have any specific questions you would like clarified they may be addressed in a private e-mail to the contest administrator. Ideas will not be disclosed to other teams if they represent a legal and innovative approach. If it is deemed to be not legal, it may be added to this FAQ or posted to the other teams at the administrators discretion.
8. **Question:** Can we tailor the configuration of the aircraft differently for the different missions? For example, could we use different sized propulsion systems for each flight?
   Answer: You cannot change the hardware configuration of the aircraft for the different missions. You could however run only 1 motor of a two motor aircraft for a no payload lap/flight, and run both motors for a with payload lap/flight, provided both motors and propellers are installed for all flights. You can however change the propeller diameter/pitch for each flight attempt.
9. **Question:** Can you provide a sketch of the locations of the drop zones for the sensor reposition mission?
   Answer: The information provided in the rules section should be sufficient for design purposes, the exact locations will be a function of the runway in use and may differ somewhat if we change runways due to wind direction.
   The first release/pickup area will be after the take-off “start line” so the aircraft will have completed a full lap prior to the first release. The first release will be near the opposite side of the runway from the observers and aircraft staging. The second will be near the runway centerline to allow an easier transition for take-off. Both locations will be close enough to the start line and nominal pilot/crew locations to provide good pilot visibility and far enough apart to require good aircraft ground handling.
10. **Question:** Must the aircraft come to a complete stop before releasing the sensor-deployment payload(s)?
    Answer: Yes
11. **Question:** In the sensor reposition mission disassembly, can we release the tip payloads using the RC system, and the payloads be stored “off” the airframe?
    Answer: Yes, the payloads may be stored “in the box” either attached to the wing tips or removed. If removed, they may be released either using the RC system (it is on a separate battery from the motor, the motor battery must be disconnected by removing the arming fuse before ANY work on disassembly begins) or manually.

Report Questions

1. **Question:** For the “Testing Plan” section of the report in-flight tests are required. Is there a point penalty for not completing the in-flight tests?
   Answer: To obtain the maximum points **all** information asked for in a section must be present. Point deductions will be determined by the judges based on provided-vs-missing information.
2. **Question:** In the RAC is “motor controller” the same as “speed controller”.
   Answer: Yes, the two terms could be taken interchangeably.
3. **Question:** In the RAC do electric brakes count as a type of controller
   Answer: Yes. A single servo or solenoid controlling air or hydraulic brakes would count as one

controller. If a separate electric actuators are used for each wheel, that would count as two (or more) controllers

4. **Question:** The RAC states: "A "V" tail is considered to be a Vertical surface without control (5 hr) plus a horizontal surface with controls (10 hr), for a total of 15 hrs" .How is the horizontal span of the V-tail applied under the provision that: "A horizontal surface is a 'wing' if it is more than 25% of the span of the greatest span horizontal surface."?
   Answer: For the “25% span” rule the horizontal projection of a V-tail will be used as the effective horizontal span.
5. **Question:** Could you please define "control volumes" as stated in the Rules, Design Report section, paragraph 5
   Answer: These are the classic static control volumes, (Surface_area x Lever Arm)/Reference_length
6. **Question:** How will the maximum exposed wing chord would be measured for a flying wing. For payload considerations, it is stated that the "fuselage" is the inner most 9" of semi-span. Does this also apply for the maximum exposed chord measurement, or will the max chord be measured at the centerline (if this is the largest chord length).
   Answer: For “All Wing” configurations the maximum wing chord will be measured 9” out from the centerline or at the largest chord location that is MORE than 9” out from the centerline.
7. **Question:** How will the maximum chord length (root) for a delta wing with varying leading sweep be calculated to be used in RAC calculation?
   Answer: The same as outlined for a flying wing in the question above.
8. **Question:** How is the RAC computed for configurations with multiple fuselages?
   Answer: The “width” in the RAC formula would be the width of the multiple fuselages if placed side by side, ie it would not include the span of the wing between the fuselages.
9. **Question:** In the RAC, do we include the tail while writing the maximum length, height and width of the fuselage
   Answer: As stated in the rules, the length of the vertical tail would be included in the fuselage length if it extends aft of the fuselage. The height of the vertical tail is not included.

General Questions

1. **Question:** Can there be thrust vectoring via rotating the engine, nozzles, blown surfaces etc.?
   Answer: Yes. Any of the above options is allowed, and may be varied during flight. However, "rotary wing" vehicles are not allowed, so you may need to consult the judges with your specific design and it's thrust levels to be sure it doesn't cross over the line into vertical flight capability.
2. **Question:** Do all of the team members need to be student members of AIAA?
   Answer: Since the DBF is part of the AIAA competitions sanctioned by the Student Activities Committee and the AIAA Foundation, all team members should be student members of the AIAA.
3. **Question:** What was the maximum number of people that can make-up a team.
   Answer: There is no specific limit on team size. It is up to the team itself to determine a size sufficient to meet the required tasks and small enough to remain manageable. It is expected most teams would fall in the 5 to 10 member size range, but this is only an estimated guideline.

   There is a maximum size of the flight crew (pilot and assistant) and ground crew (3) for this years competition. Please see the RULES section for more details on the limitations on the flight and ground crews.
4. **Question:** Is it necessary to list all team members on the entry.
   Answer: Yes, we need to know all the team members to verify the under/upper classmen rule.
5. **Question:** What is meant by "Upper and Under Classmen"
   Answer: Upper Classmen are (for purposes of the contest) seniors and/or graduate students. Lower Classmen are Freshmen, Sophomores and Juniors.

6. **Question:** Is it allowed to have/declare more then 1 pilot in a team (in case one of them can not go to the contest, or simply have a back-up pilot)?
   Answer: Yes, teams may register multiple pilots as long as each meets the requirements listed in the rules.
7. **Question:** Can we have corporate sponsors? If so, can we put their logo on the UAV at any place that pleases them?
   Answer: Teams may solicit and accept sponsorship in the form of funds or materials and components from commercial organizations. All design, analysis and fabrication of the contest entry is the sole responsibility of the team members.

   Sponsor and university decals or logos may be placed as desired. Teams should make sure that the final color scheme of the aircraft provides good visibility of the aircraft location and orientation for the pilot.
8. **Question:** What is COB in the submission dates mean?
   Answer: COB - Close of Business: data must ARRIVE by 5 PM local time at the specified location.
9. **Question:** The contest day is graduation. Is there any possibility of moving the contest.
   Answer: In selecting the contest date we have tried to minimize the conflicts with graduation, finals, mothers day,... We can't miss all possible conflicts as each university is on a slightly different schedule. Moving the date earlier would greatly increase the risk of unacceptable weather, and further shorten the time available to design and build the entries (which will seem VERY short by then).
10. **Question:** We were wondering if it wouldn't be easier to just send an official representative from the competition to our school, fly our plane, and take down the score. Then compare with all the other schools competing(they'd probably be on home turf as well), and make the final decision that way?
    Answer: The single site -vs- fly-at-home issue was discussed much by the contest organizers prior to selecting the current contest structure for many of the same reasons you raised. We realize that it is difficult for students to obtain funds for fabricating an entry, even without the added costs of travel. In the end we selected the single-site format for mainly two reasons: (1) the single-site format will allow the teams to see each others entries and learn from each other and will add to the competitive fever always present when pitting your best efforts against others; and (2) the single site is the only way to assure a level playing field for all entries, as weather variations at multiple sites and days would inevitably help some entries and hinder others.
11. **Question:** At what wind speed will the contest be called.
    Answer: It will be up to each team to determine whether they want to fly or not. The contest will be called (and the rain date used) if the wind speed exceeds 30 mph for a period of time sufficient to prevent all teams who are ready to fly from being assigned a flight time slot. The 30 mph limit is consistent with normal AMA competitions and is required to retain our contest insurance coverage.
12. **Question:** Will a hard runway be used?
    Answer: We will select a site that provides a paved runway. Note that a "smooth" paved runway for manned aircraft may still seem "rough" for contest aircraft.
13. **Question:** Our team has completed our design calculations and we have found a manufacturer that carries wing components that will meet our design criteria. Can we purchase components (i.e. foam cores and skins) to construct the wing for our UAV, or are we required to build it from scratch?
    Answer: You may use unassembled components such as wing cores providing they are integrated in a way that results in the final configuration being an original design.
14. **Question:** Does the plane have to be an external propeller plane, or can it be a duct fan UAV?
    Answer: Ducted fans are also legal if they use a commercial fan assembly.

15. **Question:** In terms of propellers. Can they be any kind of Gas engine propeller if we wish? Or do they have to be Electric motor propellers? And if we can only use electric motor propellers, can we cut them? Basically, if we wish to, can we use any kind of non-electric motor propellers if they are commercially available?
    Answer: Any commercial propeller for either gas or electric models may be used. Props may be cut to reduce their diameter but the blades may not be reduced in thickness (such as by sanding the airfoils to a new profile) or in chord (such as by trimming the trailing edges).
16. **Question:** What constitutes "over the counter" batteries, and does this apply to the battery pack or to the individual cells?
    Answer: The "Over the Counter" refers to the individual cells. This is a change from the rule for the 1996/97 contest year.
17. **Question:** How is the radio fail-safe described in the safety supplement to be implemented.
    Answer: This is a feature available in many production RC radio systems. It is ***required*** that your radio system be able to provide this function.
18. **Question:** Can we construct a composite can for an otherwise stock over the counter model motor?
    Does the motor controller have to be an over-the-counter controller?
    Answer: The motor and/or controller must be an unmodified commercial product. The intent of this rule is to prevent excessive cost, and to provide all teams access to equal propulsion technology so they can concentrate on the aircraft aerodynamics and structural aspects.
19. **Question:** Do the wires and connectors have to be commercially available?
    Answer: Yes
20. **Question:** When you check the CG, what kind of a point will you use? For example will it be checked with fingers or dowels or something even sharper?
    Answer: The CG check will be coincident with the structural verification test described in the Safety Requirements supplement to the basic rules. Specifically, two team members will be asked to pick the aircraft up by the wing tips using their hands (usually a clenched fist placed under the wing at the desired location works well). They will (gently) lift the aircraft at it's full contest weight by the wing tips at the marked axial CG location.
21. **Question:** Will the payload be supplied by the team or the contest administration?
    Answer: By the team.
22. **Question:** If battery power fails can an immediate landing be made without making a complete lap (question paraphrased by editor)
    Answer: First priority is safety of personnel, followed by minimizing damage to facilities and equipment. If power fails unexpectedly the pilot will setup for as safe an emergency landing as possible. If the plane does not pass the downwind pylon that sortie's payload will not count, but any prior sorties will still be credited toward the overall score.
23. **Question:** Will there be a maximum altitude, other than the visibility requirement?
    Answer: There is no specific numerical altitude limit. It would be very difficult to enforce a rigorous altitude limit without altitude telemetry equipment on each aircraft which would be a significant expense burden. The contest flight judge will enforce maintaining a "safe" altitude for both personnel/ground and flight visibility reasons, and may order the pilot to descend if he feels the altitude is too high. In general, altitudes of 300 to 500 feet are probably nominal, and altitudes near 1000 feet are likely to have the judge order a decent.
24. **Question:** Would we ever have to make any vertical loops with the UAV?
    Answer: No
25. **Question:** Does the 1/3 under classmen rule apply to the people present at the fly-off site?
    Answer: No. The 1/3 , 2/3 distribution applies to the team as a whole, from the entry date through the end of the contest. Not all team members must be present at the fly-off.

[Top] [AIAA Student Design/Build/Fly Competition homepage][AIAA Homepage]