CESSNA / ONR STUDENT DESIGN/BUILD/FLY COMPETITION

An AIAA Student Activity

2000/01 Rules and Vehicle Design

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. The winning teams will be invited to present their designs at the 2001 Applied Aerodynamics Conference.

Judging:

For the 2000/01 contest year aircraft will be designed to complete multiple mission sorties within a timed flight period.

Each team must also submit a written Design Report, which is divided into two phases as noted in the documentation requirements section. A maximum of 100 points will be awarded for the team design report. (One score will be given accounting for both sections.) Scores for the written reports will be announced at the beginning of the fly-off.

Additionally 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 paper, cost and flight scores. The team with the highest overall team score will be declared the winner.

Contest Site:

Host for the competition will be the Office of Naval Research. The fly-off will be held in St Inigos Maryland, at Webster Field, which is a part of the Patuxent River Naval Base. Due to the contest being held on an active military base it will be necessary to have the teams submit the name, SSN, place and date of birth and citizenship of each team member on the entry form.

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.

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 team members.

Schedule:

A completed entry form (electronic) is due to the contest administrator on or before **31 October 2000**. Written reports for the **PROPOSAL PHASE** (5 copies), are due to the contest administrator by COB **13 March 2001**. Written reports for the **ADDENDUM PHASE** (5 copies), are due to the contest administrator by COB **10 April 2001**. Scores for the written reports will be announced at the beginning of the fly-off. The contest is scheduled for **20-22 April 2001**.

Late submissions will not be judged. Teams who do not submit the required written reports will not be allowed to fly.

Please note that tech inspections will be available on Friday 20 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 your full 3 scoring flights unless you are "ready to fly" at every opportunity.

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.aae.uiuc.edu/aiaadbf

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.

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 copies of all 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
ITT SES
2560 Huntington Ave
Alexandria VA 22303
Phone: 202-404-1251

Aircraft Requirements - General

- The aircraft may be of any configuration except rotary wing or lighter-than-air.
- Maximum wing span is 10 feet.
- No payload may be carried internal to the wing.
- 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. For safety, each aircraft will use a commercially produced propeller. Teams may modify the propeller diameter by clipping the tip.
- All motors must be from the Graupner or Astro Flight families of brushed electric motors. Motors will be limited to a maximum of 40 Amp current draw by means of a single 40 Amp fuse in the line from the battery pack positive terminal to the motor controller. A lower current fuse may be used if desired.
- Must use over the counter NiCad 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.
- Maximum battery pack weight is 5.0 lb. Battery pack must power propulsion and payload systems. Radio Rx and servos (only) may 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 or video). The pilot need not be a student at the represented university.
- Teams will present a completed copy of their Rated Aircraft Cost worksheet to the judges during technical inspection for verification. The Rated Aircraft Cost assigned 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.

1. Physical inspection of vehicle to insure structural integrity.
   - Verify all components adequately secured to vehicle. Verify all fasteners tight and have either safety wire, lock-tite (fluid) or nylock nuts.
   - Verify propeller structural and attachment integrity.
   - 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.
   - Radio range check, motor off and motor on.
   - Verify all controls move in the proper sense.
   - Check general integrity of the payload system.
2. 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. 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 by weight* (Teams must inform the inspector and judges of their maximum design capacity and must make all flights within that capacity).
3. 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)
   - **The radio Fail Safe provisions will be strictly enforced.**

4. All aircraft must have a mechanical motor arming system separate from the onboard radio Rx switch. This may be a mechanical switch rated for the maximum current draw which is accessible from outside the aircraft, or can be a removable link such as an automotive "blade" style fuse. The aircraft Rx should always be powered on and the Tx throttle verified to be "closed" before activating the motor arming switch.

Mission Profile:

For the 2000/01 DBF contest, teams will fly a mix of two different mission tasks. Teams may fly as many sorties as desired within the flight period, but must switch to the other mission task with each new sortie. Either mission task may be selected for the first sortie. Each sortie will be assigned a score based on the matrix, below. The ***Single Flight Score*** is the sum of the score(s) for the individual sorties flown during a single flight period. The best three (3) ***Single Flight Scores*** for each team obtained during the weekends flying 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 unlimited flight attempts, the contest committee reserves the right to ration and/or schedule flights. The maximum number of scoring flights may also be reduced. 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:

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

Rated Aircraft Cost must be documented and included in the Addendum Report provided prior to the competition. (If not provided, a value of 100 will be used.)

Mission Task Matrix

No.	Score	Description
1	n	Heavy Payload Task • Carry 'n' pounds of steel 1 lap of the course. • Take-off within 200 ft (wheels off runway) • Minimum aircraft capacity is 5 lbs. Aircraft must fly at least the minimum capacity on each sortie of this type. Maximum aircraft capacity will be specified by the team at the initial technical inspection and may not be exceeded at any time during the competition. Maximum payload capacity may not be increased once the aircraft has received it's initial technical approval. The aircraft structural test will be conducted at each individual aircraft's maximum payload capacity. • All payload must be carried internally in a fully faired, fully closed structure. • Aircraft must complete a 360^{o} turn in the direction opposite of the base and final turns on each downwind leg.
2	n/5	Light Payload Task • Carry 'n' tennis balls for 2 full laps of the course. • Take-off within 200 ft (wheels off runway) • Minimum aircraft capacity is 10 tennis balls. Aircraft must fly at least the minimum capacity on each sortie of this type. Maximum aircraft capacity is 100 tennis balls. • All payload must be carried internally in a fully faired, fully closed structure. • 360 degree turn on downwind is not required for this task.

Payload Notes:

- Steel "Heavy" payload may be comprised of a maximum of 3 steel blocks on any sortie. Teams may have blocks of different weights, and may combine them in any fashion desired to comprise a payload.
- Steel blocks must be rectangular, at least 2 lbs. each, and be painted white. Each block will be weighed and it's weight marked on the block during the technical inspection. The weight assigned during the technical inspection will be used for the competition. Steel blocks may NOT have holes drilled in them for mounting, but must be restrained by some form of edge or cross retainer.
- Tennis balls may NOT be modified. They may not be taped, bolted, screwed or otherwise held together with the exception noted below.
- For both the heavy and light payload teams may employ a removable container or "speed loader". The container must be the same size and design for both payloads, but may employ different means to secure the payload internal to the container. Containers must be "reusable", meaning that they can be opened/closed multiple times (can not be glued shut) and employ reusable mechanical fasteners to secure the payload inside. Teams may be asked to demonstrate removal of the payload from the container by the judges.

Aircraft Cost Model

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

Coef.	Description	Value
A	Manufacturers Empty Weight Multiplier	$100 / lb.
B	Rated Engine Power Multiplier	$1 / watt

C	Manufacturing Cost Multiplier	$20 / hour
MEW	Manufacturers Empty Weight	Actual airframe weight, lb., without payload or batteries
REP	Rated Engine Power	# engines * ***Amp*** * 1.2 V/cell * # cells "***Amp***" will be the value of the inline fuse from the battery to the controller. Maximum value is 40A, but a lower current fuse may be used, and REP adjusted accordingly.
MFHR	Manufacturing Man Hours	Prescribed assembly hours by WBS (Work Breakdown Structure). MFHR = V WBS hours WBS 1.0 Wing(s): 15 hr/wing. + 4 hr/sq. ft. Projected Area + 2 hr/strut or brace + 3 hr/control surface Note: Winglets, end-plates, and biplane struts ARE included in the Projected Area calculation. WBS 2.0 Fuselage and/or pods 5 hr/body. 4 hr/ft of length WBS 3.0 Empenage 5 hr.(basic) + 5 hr./Vertical Surface + 10 hr./Horizontal Surface WBS 4.0 Flight Systems 5 hr.(basic) + 2 hr./servo or controller WBS 5.0 Propulsion Systems 5 hr./engine + 5 hr./propeller or fan

General Mission Specification and Notes:

- Since the contest requires multiple sorties during each flight period; ground handling, take-off and landing are paramount design considerations.
- Teams may fly multiple sorties within a *10 minute* flight period. For each new sortie the team must switch to the opposite mission task. The time to unload and reload the payload for the next sortie is part of the flight period.
- Aircraft will be brought to the flight line to begin the flight period with the payload for the first sortie (mission task) already loaded. Teams will be given a maximum of 2 minutes to place their aircraft on the starting line and prepare for competition before the judges start the timed flight period.
- Aircraft may not have any work performed in the starting line queue, including any charging or replacement of batteries. Aircraft must be "Read to Fly" with no further actions required when they enter the starting queue.
- The aircraft payload must be emptied and reloaded before each additional sortie. Aircraft propulsion system(s) must be disarmed or "safed" during all payload changes.
- Sorties may be repeated as many times as possible provided the aircraft has *passed the downwind turn pylon* before the time limit for the flight period ends.
- Maximum flight support crew is: pilot, observer, tally person and 3 ground crew. Only the designated ground crew may conduct the unloading/reloading. Pilot and observer may be members of the ground crew, provided total ground crew size remains 3 people. The tally person will be responsible for recording the payload carried on each sortie and verifying the amounts with the contest judge (while the aircraft is on it's next flight lap).
- 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 feet 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 to unload their payload, and reload for the next sortie. 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 minor landing damage may be repaired and fly additional sorties within the flight period. Repairs must be made on the starting line, and may not begin until the payload has been unloaded. Repairs must be completed before the payload is reloaded for the next sortie. All team members may assist in repairs, only ground crew members may reload the aircraft.
- Aircraft will be considered to have only *minor damage* if they can be repaired and presented as flight worthy within 30 minutes of the end of that flight period. Aircraft with only *minor damage* will be credited with their full ***Single Flight Score***.
- Aircraft which can be repaired during the competition, but not within 30 minutes of the flight period, will NOT be credited with a score for that flight period.
- 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).

NEW for This Year

- Wing span limit is changed to 10 feet.
- No payload may be carried internal to the wing.
- Only brush type electric motors from specified manufacturers are allowed. A physical current limit will be imposed.
- The cost formula is modified..
- Aircraft missions are revised. Aircraft must perform a different mission task on each sortie within the flight period.
- Take off field length is increased to 200 feet (wheels off).
- Report page limits and formats are modified. Sample report scoring worksheet is included.

Design Report:

Each team will submit a judged design report as outlined below. The design report will be submitted in two sections. Submission dates are 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). Both the Proposal and Addendum reports must contain the same cover, title page, and table of contents. All information used for scoring must be in the outlined sections. **Reports exceeding the total page limit will be scored as "1.0 of 100"**. Appendices may not be included.

All reports will be space and one half, 10 point Arial font. Tables will also be 10 point Arial font. Margins are 1 inch on all sides. All pages will be 8 1/2 x 11 inch, with the exception of the aircraft drawing package, which may be 11 x 17 inch.

Absolute maximum page count for the report is 50 pages for the Proposal phase report, and 10 pages for the Addendum phase report, including text, tables, figures, and table of contents (cover/title page is extra). Drawing package may not comprise more than 5 of the pages of the Proposal phase report page limit.

All figures must be either half (1/2) page or full (1) page format. No exceptions.

*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 well documented in the report for a maximum score.*

Design Report-PROPOSAL PHASE

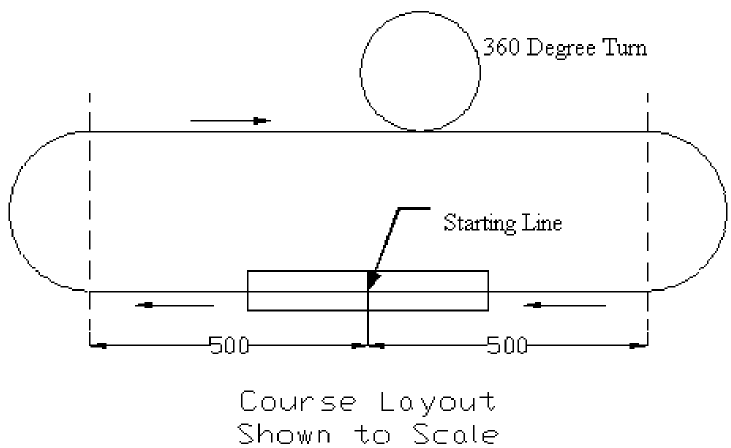
1. Executive Summary: (5 points): Provide a summary of the development of your design. This should be a narrative description highlighting the major areas in the development process for your final configuration and a broad description of the range of design alternatives investigated. Include an overview of the design tools used for each phase of the design development: conceptual design, preliminary design, and detailed design.
2. Management Summary (5 points): Describe the architecture of the design team. Provide a list of design personnel and assignment areas. Document the management structures used for personnel assignments, schedule control, and configuration control. 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, and report preparation periods.
3. Conceptual Design (20 points): Document the alternative concepts investigated during the conceptual design stage. Detail the design parameters investigated, and why each was felt to be important. 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. Include the values for

Rated Aircraft Cost assigned to each concept during the FOM 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, the FOM importance factors or ranking, and an explanation of the features that produced the final configuration selection.

4. Preliminary Design (20 points): Document the design parameter and sizing trades investigated during the preliminary design stage. Detail the design parameters investigated, and why each was felt to be important. Describe the FOM's used and the mission or design feature each FOM supports. Describe the analytic methods used during the preliminary design stage, the expected accuracy and why each was selected for this design phase. Numerical data will be more extensive at this stage, and should include as a minimum configuration and sizing parameter values sufficient to justify the selection of the final value chosen for each of the major design and sizing parameters. Include a summary of the key features that distinguish the final configuration.
5. Detail Design (20 points): Final performance data should be provided for the design, including take off performance, handling qualities and g load capability, range and endurance, and payload fraction. Component selection and systems architecture should be included in this section. The Drawing Package 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, and location of propulsion and flight control system components.
6. Manufacturing Plan (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.

Design Report-ADDENDUM PHASE

7. Lessons Learned (10 points): Document any areas where the final contest aircraft differs from the PROPOSAL design. Also identify areas for improvement in the next design and manufacturing process implementation.
8. Aircraft Cost (10 points) Document your final competition aircraft's *Rated Aircraft Cost* using the contest supplied cost models. Provide a table indicating values for each airframe dependent parameter in the cost model. Provide a table listing manufacturing hours broken down by the supplied WBS structure.



Sample of Judges Scoring Worksheet

Executive Summary (5 points)

Summary of development of the design

Highlights major areas in the development process for final configuration

Describes range of design alternatives investigated

Overview of the design tools used in each phase

Format, completeness, readability

Management Summary (5 points)

Architecture of the design team

List of design personnel and assignments areas

Documents personnel assignments, schedule control, and configuration control

Milestone chart showing planned and actual timing of major elements
Format. Completeness, Readability

Conceptual Design(20 points)

Documents alternative concepts investigated

Design parameters investigated and why important

Figures of merit used, mission feature of each FOM

Discussion of Rated Aircraft Cost for each concept

Final ranking chart of each design for each FOM

Features that produced the final configuration selection

Format, completeness, readability

Preliminary Design (20 points)

Design parameters investigated and why important

Figures of merit used, mission feature of each FOM

Analytic methods used, expected accuracy, and why selected

Configuration/sizing data

Features that produced the final configuration selection

Format, completeness, readability

Detail Design (20 points)

Performance data (takeoff, handling qualities, range, endurance, payload)

Component selection and systems architecture

Drawing package (3-view, dimensions, structure, systems layout)

Innovative configuration solutions, manufacturing process, cost reduction

Format, completeness, readability

Manufacturing Plan (10 points)

Process selected for major component manufacture

Manufacturing process investigated and FOM's used

Analytic methods (cost, skill matrix, scheduling)

Innovative configuration solutions, manufacturing process, cost reduction

Format, completeness, readability

ADDENDUM

Lessons Learned (10 points)

Aircraft differences from the PROPOSAL design & Justification

Areas for improvement in the next design and manufacturing process

Time and cost required to implement change/improvement realized

Format, completeness, readability

Aircraft Cost (10 points)

Documentation of Rated Aircraft Cost

Format, completeness, readability

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CESSNA / ONR
STUDENT DESIGN/BUILD/FLY COMPETITION
An AIAA Student Activity

Frequently Asked Questions (FAQ)
2000/01 Competition Specific
(Updated 31 May 2000)

Payload Questions:

1. **Question:** What are the dimensions of tennis balls?
   Answer: Tennis balls are regulated by the appropriate play associations. From their specifications on the WWW, the diameter must be between 2.575" and 2.7", and the weight must be between 2 and 2-1/16 ounces. Any competition legal tennis ball is OK, we are not going to specify a particular brand or color.
2. **Question:** Are wing pods for carrying the cargo permitted? Is removal of the pods for a different mission flight a modification to the aircraft structure?
   Answer: Wing pods may be used for carrying the payload. The pods may be removed to change payload, but must be re-installed for each mission flight (they may be empty for one of the payloads, and used for the other payload if desired).
3. **Question:** Can we put payload in the wing, such as in a hollow spar?
   Answer: For this year payload MAY NOT be carried internal to the wing. That does not prohibit the payload bay extending between the wing panels in the "wing carry over" area, as long as it is entirely inside the fuselage structure.

Cost Formula Questions:

1. **Question**: How is the maximum current limit (40A) applied to multiple motors and battery packs? Is there supposed to be one 40amp fuse for each motor or one fuse for all motors?
   Answer: The 40A limit can be considered as a system wide current limit. No motor or battery may see more than a 40A current. Therefore, if you have two separate packs feeding two separate motors, each motor/pack would have a 40A (max) fuse. If there is one pack feeding two motors, there would be one 40A (max) fuse at the pack. Finally if there is one pack feeding one motor, there would be a single 40A (max) fuse at the pack.
2. **Question:** The battery voltage in mentioned in the published rules is 1.2V. Is it allowed to use batteries with a different voltage?
   Answer: The 1.2V used in the cost formulas is a "typical" value for a NiCad cell under load (it would be higher under no load, and lower under high loads). All aircraft **must** use NiCad batteries. The actual circuit voltage will vary depending on the actual load at any time. The "nominal" 1.2V value will be used for the cost formulas.
3. **Question:** In the cost formula the REP equation contains both the number of engines, and the number of cells. How are multiple engine REP's computed?
   Answer: The REP is computed for each engine multiplied by the number of cells powering that engine. The individual engine REP's are then summed for the total REP.
   For example:

(1) If there are 2 engines connected to a single 20 cell pack, the REP would be
2 engine*40A*1.2V*20 cells = 1920
(2) If there are two engines each connected to a separate 20 cell pack, the REP would be
1 engine*40A*1.2V*20 cells + 1 engine*40A*1.2V*20 cells = 1920
(3) If there are tow engine each connected to a separate 10 cell pack (20 cells total) the REP would be
1 engine*40A*1.2V*10 cells + 1 engine*40A*1.2V*10 cells = 960

4. **Question:** Are the initial cost for set-up per span or per semi-span?
Answer: Per span.
5. **Question:** Is a flying wing considered to have a fuselage?
Answer: It has a fuselage if any body portion extends beyond the "natural" planform of the wing. That includes a "squashed" cross-section nacelle or boom if the resulting section through it is not an "airfoil", and if there is a clear chord length "jump" to the body region.
6. **Question:** Does the length of the fuselage or pod extend through the wing chord?
Answer: If an individual body (be it fuselage or pod) extends both ahead of and behind the wing planform, the length across the wing chord is included, as the body length is from the leading to trailing end of the body. If a body exists only ahead of or behind the wing planform, but not both, the length of the body is that length beyond the wing planform (and the area over the wing planform is considered to be a fairing).
7. **Question:** Where is the line drawn between a bump on a wing and a pod? For instance, what are mostly embedded engines, unfaired motor mounts, and faired, externally mounted servos considered?
Answer: A wing mounted nacelle/engine (faired or not) or boom is a pod, as is any other wing mounted structure that extends outside of the basic wing planform (i.e. ahead of the leading edge, behind the trailing edge, or spanwise beyond the wing tip profile when the high lift devices are retracted). The length is that portion of the pod (including a spinner) that extends beyond the wing planform. Servo fairings are not considered a pod if their footprint lies entirely within the wing or fuselage surface.
8. **Question:** Where do V-tails fit into the cost/ complexity formula?
Answer: A "V" tail would be the same as one horizontal plus one vertical. It is still two separate surfaces that need to be manufactured. The area of a horizontal is usually greater than a vertical which is the reason for the greater "cost" in the formula. The additional rigging complexities of the "V" tail justify it having the same cost as a conventional horizontal plus vertical tail.
9. **Question:** How is a flying wing with a single vertical still considered in the empenage cost formula"
Answer: It would be "charged" with a basic empenage cost, and a vertical tail surface cost. There would be no cost for a horizontal, since it doesn't have one.
10. **Question:** Are winglets taxed under the cost/ complexity formula? What about aerodynamic biplane struts and wing braces or multi-surface wings?
Answer: A winglet (or tip sail) is included in the projected area of the wing as if it was folded down flat and added to the span of the wing, but is not treated as a separate surface (i.e. a wing plus winglet will be computed as only one "wing", but with a larger total span). Interplane struts are included in the same manor. Multi-surface wings are treated as multiple wings with the exception that slats/flaps are considered part of the main wing.

The projected wing area is the projected area of each "wing" taken individually. For example, a biplane will have 2 wings, each with it's own projected area. For wings or wing panels with any type of extensible high-lift device (Slat, FCK, VCK, Flap etc.) the wing projected area used will be at the high-lift device setting which causes the greatest projected area.
11. **Question:** Just how big can a canard or horizontal be before it is considered a wing?
Answer: If there are multiple flying surfaces, and there is **no** overlap between the surface, the

largest area one is considered a wing. If the "other" surfaces have a high-lift system, they will be considered to be a second (or third) wing.

Flight / Mission Questions

1. **Question:** The rules state the aircraft must have the wheels off the ground in 200 feet. Is there any height requirement?
   Answer: No, the rules are correct as stated. Aircraft must have **ALL** wheels off the ground by the 200 foot line, and they must remain off until the landing. Their is no "obstacle" height requirement for this year.
2. **Question:** Can the battery pack be **changed out** or "**topped off**" between sorties?
   Answer: No. Only payload may be unloaded and reloaded. Batteries may not be recharged. Batteries may not be charged or topped off while waiting in the starting queue either.
3. **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.
4. **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.
5. **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.
6. **Question:** If the aircraft runs off the runway but is not damaged, can the ground crew help retrieve it?
   Answer: If the aircraft runs off the runway, the ground crew can go to retrieve it once it has stopped.
7. **Question:** Where must the "minor repairs" be made?
   Answer: Repairs must be made on the starting line if the plane is to be eligible to make an additional sortie within the "10 minute" time period.

   Repairs for the "30 minute" rule may be made at the teams pit, but must be clearly "repairs" not getting out another airplane. You can't change out the fuselage, wing or empenage with new parts, you must repair the "flown" primary airframe structure. Systems (radio, servos, propulsion) and secondary airframe structure (landing gear legs, wheels) may be replaced and qualify for the repair rule.

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:** What is a sortie and what is meant by multiple sorties may be flown?
   Answer: For this years (00/01) competition there are two different sorties, a heavy payload sortie and a voluminous payload sortie. Teams may complete as many cycles of theses "sorties" as

possible within their given 10 minute competition time period. The paylaod "type" must switch for each new sortie.

3. **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.
4. **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.
5. **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.
6. **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.
7. **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.
8. **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.
9. **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.
10. **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).
11. **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.

12. **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.
13. **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.
14. **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.
15. **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.
16. **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).
17. **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.
18. **Question:** Could the electricians in the Electronics Shop at our university build the battery pack, since they are licensed electricians?
Answer: Yes, as long as they use commercially available cells.
19. **Question:** Do you have a vendor list for speed controller and/or gear reduction suppliers?
Answer: The "MOTORS" and "ACCESSORIES" sources listed on the web site vendor page can supply controller and gearbox sources that are suited to their motors. Other sources would include all of the major hobby part suppliers listed in RC magazines.
20. **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 <u>***required***</u> that your radio system be able to provide this function.
21. **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.
22. **Question:** Do the wires and connectors have to be commercially available?
Answer: Yes
23. **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.

24. **Question:** Will the payload be supplied by the team or the contest administration?
    Answer: By the team.
25. **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 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.
26. **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.
27. **Question:** Is information available about previous year designs and results?
    Answer: A summary of characteristics for all the entries that competed in the last years contest will be available on the contest web site. Remember that the objective of the prior years contest was slightly different, so you will have to adapt the design data accordingly. (Prior year rules will also be maintained on the web site for reference.)
28. **Question:** Would we ever have to make any vertical loops with the UAV?
    Answer: No

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