2006 Aero Design® Rules

2006 AERO DESIGN® EAST AND WEST

SECTION 1
REQUIREMENTS FOR ALL CLASSES

11. INTRODUCTION

The Aero Design competition is intended to provide undergraduate and graduate engineering students with a real-life engineering exercise. The competition has been designed to provide exposure to the kinds of situations that engineers face in the real work environment. First and foremost a design competition, students will find themselves performing trade studies and making compromises to arrive at a design solution that will optimally meet the mission requirements while still conforming to the configuration limitations.

The importance of interpersonal communication skills is often overlooked by engineers, yet both written and oral communication skills are vital in the engineering workplace. To help teams develop these skills, a high percentage of a team's score is devoted to the Design Report and the oral presentation required in the competition.

Aero Design features three classes of competition—Regular, Open, and Micro. Regular Class is intended to be simpler than Open Class, and therefore more accessible to the fledgling team. Open Class is intended to be less restrictive than Regular Class, thereby opening a larger potential solution set. Its lack of restriction allows teams to pursue more complex vehicle configurations, thereby encouraging greater creativity in satisfying the mission requirements. Micro Class teams are required to make trades between two potentially conflicting requirements, carrying the highest payload fraction possible, while simultaneously pursuing the lowest empty weight possible.

Other SAE Aero Design Competitions: Aero Design Brazil; SAE BRASIL - http://www.saebrasil.org.br/

11. Official Announcements and Competition Information

Teams are required to read the newsletters published by SAE and the other organizing bodies and to be familiar all official announcements concerning the competitions and rules interpretations released by the SAE Aero Design Rules Committee

The monthly SAE Collegiate Design Newsletter is published on-line and can be found at: http://students.sae.org/competitions/newsletters

11.1 Team Member Eligibility

Individual team members must be enrolled as degree seeking undergraduate or graduate students. Team members who have graduated during the seven (7) month period prior to the competition remain eligible to participate.

11.2 SAE Membership

Individual team members must be members of the Society of Automotive Engineers. Proof of SAE membership is required at the event. Students must have their membership card, documentation of membership, or membership number present at the competition.

COMMENT: Students may join online SAE online at www.sae.org/students.

11.3 Pilots

Pilots are not required to be students or SAE members, but they must be current members of either the **Academy of Model Aeronautics** or the **national model aircraft club** in their country of origin (such as the MAAC for Canadian teams). Valid AMA membership cards must be presented at the flying field prior to flying any team's aircraft. Copies of AMA application forms will not suffice as proof of AMA membership; the actual AMA card must be presented at the event flying field.

11.3 Liability Waiver and Insurance Requirements

All on-site participants and faculty advisors are required to sign a liability waiver upon registration. Individual medical and accident insurance coverage is the sole responsibility of the participant.

11.4 Ringers Prohibited

In order to maintain the integrity of a fair competition, the faculty advisor must prohibit ringers. A ringer is someone that has exceptional skills related to the competition (e.g., a professional model builder) who cannot be a legal member of the team but helps the team win points.

11.5 Design and Fabrication

The airplane must be designed and built by the SAE student members without direct involvement from professional engineers, radio control model experts, pilots, machinists, or related professionals. The students may use any literature or knowledge related to R/C aircraft design and construction and information from professionals or from professors as long as the information is given as discussion of alternatives with their pros and cons and is acknowledged in the references in the design report. Professionals may not make design decisions, nor contribute to the drawings, the report, or the construction of the airplane. The faculty advisor must sign the Statement of Compliance given in Appendix.

11.6 Original Design

Any aircraft presented for competition must be an original design whose configuration is conceived by the student team members. Photographic scaling of an existing model aircraft design is not allowed. Use of major components such as wings, fuselage, or empennage of existing model aircraft kits is prohibited. Use of standard model aircraft hardware such as engine mounts, control horns, and landing gear is allowed.

11.7 Official Languages

The official language of the SAE Aero Design series is English. Document submissions, presentations and discussions in English are acceptable at all competitions in the series.

Team members, judges and officials at Non U.S. competition events may use their respective national languages for document submissions, presentations and discussions if all the parties involved agree to the use of that language.

Aero Design East	**English**
Aero Design West	**English**
Aero Design Brasil	**Portuguese and English**

12. MULTIPLE ENTRIES

12.1 Unique Designs

Universities may enter more than one team in each Aero Design competition, but each entry must be a unique design, significantly different from each other. If the aircraft are not significantly different in the opinion of the Organizer, then the university will be considered to have only a single entry and only one of the teams and its aircraft will be allowed to participate in the competition. For example, two aircraft with identical wings and fuselages but different empennage would likely not be considered significantly different. For guidance regarding this topic, please email CollegiateCompetitions@sae.org.

12.2 Student Participation

Students may be members of two Aero Design Teams during the same competition: either Regular and Micro, or Open and Micro. Simultaneous entry in both Regular and Open Classes is prohibited.

12.3 Aircraft Classification/Duplicate Aircraft

Aircraft may only compete in one class. Simultaneous entry in Open, Regular, and Micro Class, with the same aircraft, is not allowed. When a team has an identical aircraft as a back-up, the back-up aircraft must go through inspection with the primary aircraft. If the entire back-up aircraft is used in competition, previously earned flight points are forfeited and flight point scoring starts over.

12.4 Aircraft Eligibility

Aircraft will only be allowed to compete during a single academic year. Aircraft may be entered in both Aero Design East and Aero Design West during the same calendar year, but that same aircraft may not be used in either competition during the following year. Entering the same aircraft in Aero Design West one year and Aero Design East the next year is not allowed.

13. REGISTRATION INFORMATION AND DEADLINES

Teams intending to participate in the 2006 Aero Design competitions must submit completed registration forms, with their registration fees, online at: www.sae.org by the following deadlines:

Aero Design East – Lockheed Martin Aeronautics Company, Marietta, GA; December 29, 2005
Aero Design West – SAE Southern California Section, San Fernando Valley, CA; December 29, 2005

The entry fee is non-refundable and failure to meet these deadlines will be considered a failure to qualify for the competition. Separate entry fees are required for the East and West events.

13.1 On-Site Registration - Document Copies Required

All participating team members must - at the time of on-site registration - provide photo copies of the following documents to be filed with the registration officials:

Photographic Identification:

(1) Drivers must present a valid, government issued, highway driver's license containing a photograph**.**

Non-drivers may substitute alternate photographic identification such as a university ID card or a passport**.**

Proof of Insurance:

(2) Medical insurance card or other proof of medical insurance coverage

On-site registration must be completed before team members are permitted to unload equipment or work on their competition vehicles.

13.2 Faculty Advisor

Each team is expected to have a Faculty Advisor appointed by the university. The Faculty Advisor is expected to accompany the team to the competition and will be considered by competition officials to be the official university representative.

Faculty Advisors may advise their teams on general engineering and engineering project management theory, but may not design any part of the vehicle nor directly participate in the development of any documentation or presentation. Additionally Faculty Advisors may neither fabricate nor assemble any components nor assist in the preparation, maintenance, or testing of the vehicle.

In Brief - Faculty Advisors may not design, build or repair any part of the plane.

13.3 SAE Aero Design Rules and Organizer Authority (New Section Title)

Rules Authority

The SAE Aero Design Rules are the responsibility of the SAE Aero Design Rules Committee and are issued under the authority of the SAE University Programs Committee. Official announcements from the SAE Aero Design Rules Committee, SAE or the other SAE Aero Design organizers shall be considered part of, and shall have the same validity as these rules.

Ambiguities or questions concerning the meaning or intent of these rules will be resolved by the SAE Aero Design Rules Committee, SAE or by the individual competition organizers as appropriate**.**

Rules Validity

The SAE Aero Design Rules posted on the SAE website and dated for the calendar year of the competition are the rules in effect for the competition. Rule sets dated for other years are invalid**.**

Rules Compliance

By entering a SAE Aero Design competition the team, members of the team as individuals, faculty advisors and other personnel of the entering university agree to comply with, and be bound by, these rules and all rule interpretations or procedures issued or announced by SAE, the SAE Aero Design Rules Committee and the other organizing bodies. All team members, faculty

advisors and other university representatives are required to cooperate with, and follow all instructions from, competition organizers, officials and judges**.**

Understanding the Rules

Teams are responsible for reading and understanding the rules in effect for the competition in which they are participating. The section and paragraph headings in these rules are provided only to facilitate reading; they do not affect the paragraph contents**.**

Participating in the Competition

Teams, team members as individuals, faculty advisors and other representatives of a registered university who are present on-site at a competition are considers to be "participating in the competition" from the time they arrive at the event site until they depart the site at the conclusion of the competition or earlier by withdrawing**.**

Violations of Intent

The violation of the intent of a rule will be considered a violation of the rule itself. Questions about the intent or meaning of a rule may be addressed to the SAE Aero Design Rules Committee or by the individual competition organizers as appropriate**.**

Right to Impound

SAE and the other competition organizing bodies reserve the right to impound any on-site registered aircraft at any time during a competition for inspection and examination by the organizers, officials and technical inspectors**.**

General Authority

SAE and the competition organizing bodies reserve the right to revise the schedule of any competition and/or interpret or modify the competition rules at any time and in any manner that is, in their sole judgment, required for the efficient operation of the event or the Aero Design series as a whole**.**

NOTICE: In the event that the number of teams registering for the competition exceeds the number of teams/participants the facilities can handle, then registration priority will be given to colleges and universities with SAE student chapters.

14. COMPLAINTS, PROTESTS, AND QUESTIONS

14.1 Complaints

Competition officials will be available to listen to complaints regarding errors in scoring, interpretation, or application of the rules during the competition. Competition officials will not be available to listen to complaints regarding the nature, validity, or efficacy of the rules themselves at the competition. In other words, the Organizer will not change the rulebook at the field.

14.2 Protests / Preliminary Review

If a team has a question about scoring, judging, policies, or any official action, they must bring the question to the Organizer's or SAE staff's attention for an informal preliminary review before a protest is filed.

14.2.1. Cause for Protest

A team may protest any rule interpretation, score or official action (unless specifically excluded from protest) which they feel has caused some actual, non-trivial, harm to their team, or has had a substantive effect on their score. Teams may not protest rule interpretations or actions that have not caused them any substantive damage**.**

14.2.2 Protest Format

If a faculty advisor or team captain feels that his complaint about an official action or rules interpretation was not properly addressed by the event officials, he or she may protest. All protests must be filed in writing to the Organizer by the faculty advisor or team captain only.

14.2.3 Protest Period

All protests must be submitted within thirty (30) minutes of the end of the flight round or other competition event to which the protest relates.

14.2.4 Protest Committee

Any protests must be reviewed by the Protest Committee. The Protest Committee must consist of a minimum of three members: the Organizer, an SAE Student Design Competitions representative, and either the Chief Steward, the Chief Judge, or the Air Boss. The decision of the Protest Committee must be final. If a member of the Aero Design Rules Committee is at the competition, he or she will be in the Protest Committee.

14.2.5 Protest Resolution

In order to have a protest considered, a team will be required to post twenty five (25) points as collateral. If the protest is sustained, the appropriate correction will be applied and the team will forfeit no points. If the protest is overruled, the team will forfeit the twenty five (25) collateral points.

14.3 Questions

Any questions or comments about the rules should be brought to the attention of the rules committee via the SAE Aero Design forum at **http://forums.sae.org/access/dispatch.cgi/aerodesign_pf**.

General information about hotels and other attractions in the area as well as a schedule of

events will be posted on the SAE website according to the competition in which you are competing: http://www.sae.org/students/aerodes.htm.

15. PROFESSIONAL CONDUCT

15.1 Unsportsmanlike Conduct

In the event of unsportsmanlike conduct by team members or that team's faculty advisor, the team will receive a warning from a Competition official. A second violation will result in expulsion of the team from the competition and loss of any points earned in all aspects of the competition.

15.2 Arguments with Officials

Arguments with or disobedience toward any competition official may result in the team being eliminated from the competition. All members of the team may be immediately escorted from the grounds.

15.3 Alcohol and Illegal Material

Alcoholic beverages, illegal drugs, firearms, weapons, or illegal material of any type are not permitted on the event sites at any time during the competition. Any violations of this rule will result in the immediate expulsion of all members of the offending school, not just the individual team member in violation. This rule applies to team members and faculty advisors. Any use of illegal drugs or any use of alcohol by an underage person must be reported to the local law enforcement authorities for prosecution.

15.4 Organizer's Authority

The Organizer reserves the exclusive right to revise the schedule of the competition and/or to interpret the competition rules at any time and in any manner which is required for efficient operation or safety of the competition.

SECTION 2
MISSION REQUIREMENTS

20. MISSION REQUIREMENTS

20.1 Takeoff

Takeoff is defined as the point at which the main wheels leave the ground.

20.1.1 Time Limit

Upon a signal given by the Air Boss, each team will have five (5) minutes to accomplish a successful takeoff. Multiple takeoff attempts are allowed within the five-minute window, whether or not the aircraft may have become airborne during an aborted attempt.

20.1.2 Takeoff Zone

Regular and Open Class aircraft must lift from the ground within a takeoff zone measuring 200 feet (61m) in length. Micro Class aircraft must lift from the ground within a takeoff zone measuring 100 feet (30m) in length. Takeoff direction will be determined by the Air Boss, and selected to face into the wind. Aircraft must remain on the runway during the takeoff roll.

20.1.3 Engine Run-up

Use of a helper to hold the model while the engine is revved prior to release for takeoff is allowed, but the helper may not push the model upon release. To stay within the takeoff zone, the main wheels of the aircraft are to be placed on the takeoff line.

20.1.4 Aircraft Configuration upon Liftoff

The aircraft must remain intact during takeoff, from release through liftoff. No parts may depart the aircraft during the takeoff process.

20.2 Competition Circuit Requirements

The aircraft must successfully complete one 360° circuit of the field. During departure and approach to landing, the pilot must not fly the aircraft in a pattern that will allow the aircraft to enter any of the no-fly zones (See Para. 20.3.4). More than one circuit of the field is allowed.

New for 2006: During a flight, each aircraft must fly past the departure end of the takeoff zone, turn the aircraft through approximately 180° of heading, and fly past the approach end of the takeoff zone prior to landing.

20.3 Landing

Landing is defined as occurring from initial touchdown to the point at which the aircraft stops moving. Initial touchdown is defined as the point at which any part of the aircraft touches the ground.

20.3.1 Landing Zone

Regular and Open Class aircraft must land in the same direction as takeoff within a designated landing zone measuring 400 feet (122m) in length. Micro Class aircraft must land in the same direction as takeoff within a designated landing

zone measuring 200 feet (61m) in length. Touch-and-goes are not allowed, and a crash-landing invalidates the landing attempt. A good landing is defined as touching down within the designated 400-foot zone, and remaining on the ground through rollout. Rolling-out beyond the landing zone is allowed, provided the aircraft touches-down within the landing zone. Bouncing across the boundary at the end of the landing zone is not allowed, and will be judged as a failed landing attempt. A failed landing attempt will result in no score for the round.

20.3.2 Post-landing Condition

The aircraft must takeoff and land intact to receive points for the flight attempt. All parts must remain attached to the aircraft during flight and landing maneuver, with the exception of the propeller. Broken propellers are allowed, and will not invalidate a flight attempt.

20.3.2 Flight Authority

The Organizer, Chief Judge, Air Boss, SAE Official, or other designated competition technical inspector may prohibit flight of any aircraft deemed non-flight-worthy until the non-flight-worthy condition has been repaired and the aircraft has been re-inspected by the judges.

20.3.3 Controllability

All aircraft must be controllable in flight.

20.3.4 No-Fly Zone

Each flying site will have site-specific no-fly zones. At no time is any aircraft to enter the no-fly zones, whether under controlled flight or uncontrolled. First infraction for crossing into the no-fly zone will result in an invalidated flight attempt and no points will be awarded for that flight. Second infraction will result in disqualification from the entire event and loss of all points. Flying over the pit area is not allowed at any time.

20.3.5 Flight Rules Announcement

Flight will be explained to all teams before the flight competition begins, either during the pilots' meeting or during activities surrounding the technical inspections and oral presentations.

20.3.6 Flight Rules Violations

Violation of any flight rule may result in the team being eliminated from the competition. All members of the team may be escorted from the grounds.

20.3.7 Local Field Rules

In addition to competition rules, the local flying club may have additional rules in place at the event flying field. Club rules will be obeyed during the flight competition; for example, the club may have specific frequency control procedures that must be used during the event.

20.5 Repairs and Alterations

The original design of the aircraft as presented in the written and oral reports must be maintained during the course of the competition.

20.5.1 Repairs

In the event of damage to the aircraft, the aircraft may be repaired provided such repairs do not change the original design.

20.3.7 Alterations

Alterations may only be made with the permission of the judges, and must be reported as described in section 60.3.3. Any changes in configuration after submission of the Design Report will result in penalty points to be assessed by the Competition Judges.

SECTION 3
REGULAR CLASS REQUIREMENTS

30. DESIGN OBJECTIVE

The objective of Regular Class is to design an aircraft that can lift as much weight as possible given the dual design constraints of power available and wing span limit. Accurately predicting the lifting capacity of the aircraft is an important part of the exercise, as prediction bonus points often determine the difference in placement between competing teams.

30.1 Aircraft Requirements and Restrictions

30.1.1 No lighter-than-air or rotary wing aircraft

Competing designs are limited to fixed wing aircraft only. No lighter-than-air or rotary wing aircraft such as helicopters or autogiros will be allowed to compete.

30.1.2 Wing Span Limit

Regular Class aircraft shall have a wing span of 94.488 inches, +/- .500 inches.

Wing span is defined as maximum overall width of the aircraft. Aircraft with an overall width that falls outside the stated tolerance will be disqualified from the competition.

30.1.3 Gross Weight Limit

Regular Class aircraft may not weigh more than fifty five (55) pounds with payload and fuel.

30.1.4 Payload Bay Limit(s)

Regular Class aircraft must be capable of carrying and fully enclosing a rectangular block measuring 3 inches by 5 inches by 16 inches. During technical inspection, compliance with this rule must be tested by inserting a block with these dimensions into the aircraft. This block must be easily inserted and removed without application of excess force during insertion or extraction, and the aircraft must be structurally airworthy with the block installed. Aircraft not capable of carrying and fully enclosing the defined cargo block will be disqualified from the competition.

30.1.5 Aircraft Identification

Team number as assigned by the SAE must be visible on both the top and bottom of the wing, and on both sides of the vertical stabilizer or other vertical surface in 4-inch numbers. The University name must be clearly displayed on the wings or fuselage. The University initials may be substituted in lieu of the University name provided the initials are unique and recognizable.

The assigned aircraft numbers appear next to the school name on the "Registered Teams" page of the SAE Aero Design section of the Collegiate Design Series website at http://www.sae.org/students/aeroeast.htm or http://www.sae.org/students/aerowest.htm.

30.1.6 Name and Address

Regular Class aircraft must be identified with the school name and address either on the outside or the inside of the aircraft.

30.2 Aircraft Systems Requirements

30.2.1 Engine Requirements

Regular Class aircraft must be powered by a single, unmodified O.S. .61FX with E-4010 Muffler. No muffler extensions or headers that fit between the engine cylinder and the muffler may be used. Muffler baffles must be installed, and must be unmodified from the factory installed configuration. No fuel pumps are allowed.

While the engine may not be modified from its stock configuration, two specific

components may be installed on the engine for convenience and/or safety purposes:

(a) Remote needle valves, including needle valves that may be adjusted in flight, are allowed.

(b) Tubes that redirect the exhaust flow may be affixed to the exhaust pipe.

NOTE: Engine tear-down and inspection may be performed by the competition officials at any time during the competition.

30.2.2 Gear boxes, Drives, and Shafts

Gearboxes, belt drive systems, and propeller shaft extensions are allowed as long as a one-to-one propeller to engine RPM is maintained. The prop(s) must rotate at engine RPM.

30.2.3 Competition Supplied Fuel

The fuel for Regular Class entries will be a common grade, ten percent (10%) nitro methane fuel supplied by the Organizer.

30.2.4 Fuel Tanks

Fuel tanks must be accessible to determine contents during inspections. Tanks may be pressurized by a stock fitting on the engine muffler only.

30.2.5 Gyroscopic Assist Prohibited

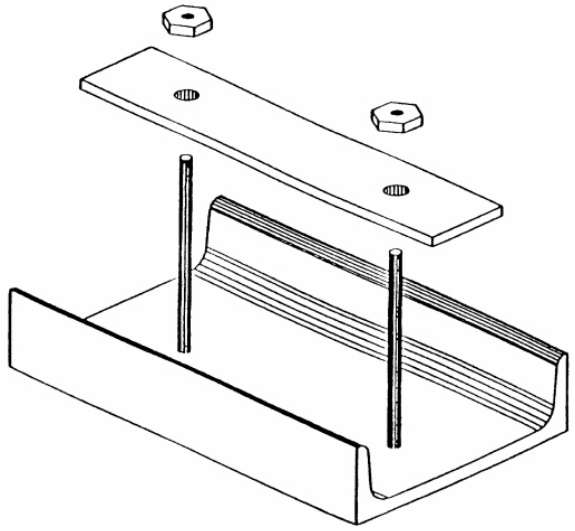
No gyroscopic assist of any kind is allowed in the Regular Class.

30.2.6 Payload Requirements

30.2.6.1 Payload and Payload Support

The payload must consist of a support assembly and payload plates. All payload carried for score must be carried within the cargo bay. The support assembly must be constructed so as to retain the weights as a homogeneous mass. There is no required configuration for the payload plates. An example of one possible payload support configuration is provided below, but this is only an example. The design of the support assembly will depend upon the configuration of the payload plates. The payload must be secured to the airframe to ensure the payload will not shift or come loose in flight. The total payload consists of the plates plus the support assembly. It is the responsibility of each team to provide its own payload plates.

Example Payload Assembly Section



30.2.6.2 Payload Distribution

The payload cannot contribute to the structural integrity of the airframe, and must be secured to the airframe within the cargo bay so as to avoid shifting while in flight.

30.3 General Requirements

30.3.1 Radios

All radio transmitters must meet the FCC and Academy of Model Aeronautics 1991 standard for frequencies assigned to model aircraft. This rule refers to the narrower frequency band system adopted in 1991 and is denoted with a gold sticker on the transmitter or the transmitter module.

Amateur radio frequencies legal for use in the United States (53 MHz) are permitted, provided the pilot presents proof of ownership of an FCC license for use of such frequencies.

30.3.2 In-Flight Battery Packs

Regular Class aircraft must use a battery pack with no less than five hundred (500) mAh capacity. Batteries may be charged at any time on the ground.

30.3.3 Spinners or Safety Nuts Required

All aircraft must utilize either a spinner or a rounded safety nut.

30.3.4 Metal Propellers Prohibited

Metal propellers are not allowed.

30.3.5 Control Surface Slop

Aircraft control surfaces must not feature excessive slop. Sloppy control surfaces lead to reduced controllability in mild cases, or control surface flutter in severe cases.

30.3.6 Servo Sizing

Analysis and /or testing must be described in the Design Report that demonstrates the servos are adequately sized to handle the expected aerodynamic loads during flight.

30.3.7 Qualification Flights

Qualification flights are not required.

30.4 Regular Class Scoring

Regular Class, Open Class, and Micro Class aircraft are subject to the same mission parameters as explained in Section 2.

In order to participate in the flight portion of the competition, each team is required to have submitted a Design Report and delivered an Oral Presentation, both for score, in the competition.

30.4.1 Regular Class Flight Score

Regular Class aircraft will receive a flight score based upon the raw weight lifted and the team's prediction of the aircraft's maximum lifting capacity.

Flight Score = Raw Weight Score + Prediction Bonus

30.4.2 Raw Weight Score

The raw weight score will be determined by multiplying the weight lifted in pounds by 4. Lifting 25 pounds will result in a raw weight score of 100 points.

Raw Weight Score = Weight Lifted in pounds × 4

30.4.3 Payload Prediction Bonus

The prediction bonus will be determined according to the following formula:

$$\text{Prediction Bonus} = 20 - (\text{predicted payload} - \text{actual payload})^2$$

If the above number is positive, the resulting number will be applied as the prediction bonus. If the above number is negative, no bonus will be applied.

SECTION 4
OPEN CLASS REQUIREMENTS

40. DESIGN OBJECTIVE

The objective of Open Class is to design an aircraft that can lift as much weight as possible given the gross weight design constraint. Accurately predicting the lifting capacity of the aircraft is an important part of the exercise, as prediction bonus points often determine the difference in placement between competing teams.

40.1 Aircraft Requirements and Restrictions

40.1.1 No lighter-than-air or rotary wing aircraft

Competing designs are limited to fixed wing aircraft only. No lighter-than-air or rotary wing aircraft such as helicopters or autogiros will be allowed to compete.

40.1.2 Gross Weight Limit

Open Class aircraft may not weigh more than fifty five (55) pounds with payload and fuel.

40.1.3 Wing Span Limit

Open Class aircraft are not limited by wing span.

40.1.4 Payload Bay Limit(s)

Open Class aircraft have no restrictions as to size, shape, or number of payload bays.

40.1.5 Aircraft Identification

Team number as assigned by the SAE must be visible on both the top and bottom of the wing, and on both sides of the vertical stabilizer or other vertical surface in 4-inch numbers. The University name must be clearly displayed on the wings or fuselage. The University initials may be substituted in lieu of the University name provided the initials are unique and recognizable.

The assigned aircraft numbers appear next to the school name on the "Registered Teams" page of the SAE Aero Design section of the Collegiate Design Series website at http://www.sae.org/students/aeroeast.htm or http://www.sae.org/students/aerowest.htm.

40.1.6 Name and Address

Open Class aircraft must be identified with the school name and address either on the outside or the inside of the aircraft.

40.2 Aircraft Systems Requirements

40.2.1 Engine Requirements

Open Class aircraft must be powered by internal combustion, reciprocating engines. Any single Open Class engine may not have a displacement greater than .91 cubic inches. The common-use displacement will be used to determine displacement, i.e. the advertised displacement. For example, an O.S. .91FX is advertised as a .91, even though the actual displacement is .912 cubic inches. Open Class aircraft are not restricted as to total engine displacement, number of engines, make, or model.

40.2.2 Propeller and Gearbox Issues

Gearboxes are allowed in Open Class in which the propeller RPM differs from the engine RPM. Multiple engines, multiple propellers, propeller shrouds, and ducted fans are allowed in Open Class.

40.2.3 Competition Supplied Fuel

Open Class teams may provide their own fuel, but fuel for Open Class entries must be acceptable for use by the AMA and the competition organizer. No fuel systems with gaseous boosts in which gases other than air enter the internal combustion engine will be allowed; pressurized air is also not allowed. Engines utilizing extremely hazardous fuels such as those containing tetranitromethane or hydrazine are prohibited. Open Class teams are welcome to use the competition-supplied fuel used by the Regular Class.

40.2.4 Fuel Tanks

Open Class fuel tanks need not be accessible.

40.2.5 Gyroscopic Assist Allowed

Gyroscopic assist or other forms of stability augmentation are allowed in Open Class.

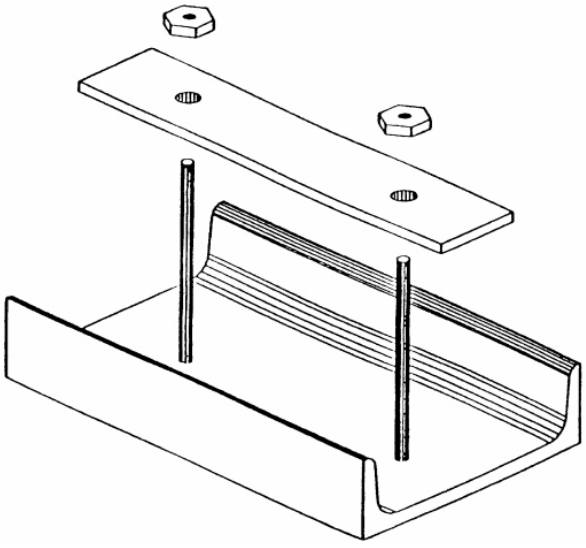
40.2.6 Payload Requirements

40.2.6.1 Payload and Payload Support

The payload must consist of a support assembly and payload plates. All payload carried for score must be carried within the cargo bay(s). The support assembly must be constructed so as to retain the weights as a homogeneous mass. There is no required configuration for the payload plates. An example of one possible payload support configuration is provided below, but this is only an example. The design of the support assembly will depend upon the configuration of the payload plates.

The total payload consists of the plates plus the support assembly. It is the responsibility of each team to provide its own payload plates.

Example Payload Assembly Section



40.2.6.2 Payload Distribution

The payload cannot contribute to the structural integrity of the airframe, and must be secured to the airframe within the cargo bay so as to avoid shifting while in flight.

40.3 General Requirements

40.3.1 Radios

All radio transmitters must meet the FCC and Academy of Model Aeronautics 1991 standard for frequencies assigned to model aircraft. This rule refers to the narrower frequency band system adopted in 1991 and is denoted with a gold sticker on the transmitter or the transmitter module.

Amateur radio frequencies legal for use in the United States (53 MHz) are permitted, provided the pilot presents proof of ownership of an FCC license for use of such frequencies.

40.3.2 In-Flight Battery Packs

Open Class aircraft must use a battery pack with capacity suitable to safely drive all the servos in the aircraft, taking into consideration the number of servos and potential current draw from those servos. Batteries may be charged at any time on the ground. Open Class aircraft must use a battery pack with no less than 700 mAh capacity.

40.3.3 Spinners and Safety Nuts Required

All aircraft must utilize either a spinner or a rounded safety nut.

40.3.4 Metal Propellers Prohibited

Metal propellers are not allowed.

40.3.5 Control Surface Slop

Aircraft control surfaces must not feature excessive slop. Sloppy control surfaces lead to reduced controllability in mild cases, or control surface flutter in severe cases.

40.3.6 Servo Sizing

Analysis and /or testing must be described in the Design Report that demonstrates the servos are adequately sized to handle the expected aerodynamic loads during flight.

40.3.7 Qualification Flights

Qualification flights are not required.

40.4 Open Class Scoring

Regular Class, Open Class, and Micro Class aircraft are subject to the same mission parameters as explained in Section 2.; however, two new flight bonuses are now available for Open Class teams.

In order to participate in the flight portion of the competition, each team is required to have submitted a Design Report and delivered an Oral Presentation, both for score, in the competition.

40.4.1 Open Class Flight Score

Open Class aircraft will receive a flight score based upon the raw weight lifted and the team's prediction of the aircraft's maximum lifting capacity, plus any bonuses earned.

Flight Score = Raw Weight Score + Prediction Bonus + Zero Payload Bonus + Stopping Bonus

40.4.2 Raw Weight Score

The raw weight score shall be determined by multiplying the weight lifted in pounds by 3. Lifting 33 1/3 pounds will result in a raw weight score of 100 points.

Raw Weight Score = Weight Lifted in pounds x 3

40.4.3 Payload Prediction Bonus

The prediction bonus will be determined according to the following formula:

$$\text{Prediction Bonus} = 20 - (\text{predicted payload} - \text{actual payload})^2$$

If the above number is positive, the resulting number will be applied as the prediction bonus. If the above number is negative, no bonus will be applied.

Zero Payload Bonus

Open Class aircraft may earn a flat 20-point bonus by performing a flight with zero payload.

Stopping Bonus

Open Class aircraft may earn a bonus by bringing their aircraft to a complete stop within the landing zone. In order to qualify for the Stopping Bonus, the aircraft may not leave the landing zone during the landing maneuver, and no part of the aircraft may touch the ground outside the landing zone.

The Stopping Bonus shall be 20% of the Raw Weight Score.

SECTION 5
MICRO CLASS REQUIREMENTS

50. DESIGN OBJECTIVE

The objective of Micro Class is to design an aircraft that can carry the highest payload fraction possible while simultaneously pursuing the lowest empty weight possible. Micro Class requires teams to make trades between two potentially conflicting requirements.

50.1 Aircraft Requirements and Restrictions

50.1.1 No lighter-than-air or rotary wing aircraft

Competing designs are limited to fixed wing aircraft only. No lighter-than-air or rotary wing aircraft such as helicopters or autogiros will be allowed to compete.

50.1.2 Wing Span Limit

Micro Class aircraft are not limited by wing span.

50.1.3 Payload Bay Limit(s)

Micro Class aircraft have no restrictions as to size, shape, or number of payload bays.

50.1.4 Aircraft Identification

Team number as assigned by the SAE must be visible on the wings. The University name must be clearly displayed on the wings or fuselage. The University initials may be substituted in lieu of the University name provided the initials are unique and recognizable.

The assigned aircraft numbers appear next to the school name on the "Registered Teams" page of the SAE Aero Design section of the Collegiate Design Series website at http://www.sae.org/students/aeroeast.htm or http://www.sae.org/students/aerowest.htm.

50.1.6 Name and Address

Micro Class aircraft must be identified with the school name and address either on the outside or the inside of the aircraft.

50.2 Aircraft Systems Requirements

50.2.1 Engine Requirements

Micro Class aircraft are restricted to internal combustion, reciprocating engines or electric motor propulsion.

50.2.2 Propeller and Gearbox Issues

Gearboxes in Micro Class in which the propeller RPM differs from the engine or motor RPM are allowed. Multiple engines or motors, multiple propellers, propeller shrouds, and ducted fans are allowed in Micro Class.

50.2.3 Competition Supplied Fuel

Micro Class teams may provide their own fuel, but fuel for Micro Class entries must be acceptable for use by the AMA and the competition organizer. No fuel systems with gaseous boosts in which gases other than air enter the internal combustion engine will be allowed; pressurized air is also not allowed. Engines utilizing extremely hazardous fuels such as those containing tetranitromethane or hydrazine are prohibited. Micro Class teams are welcome to use the competition-supplied fuel used by the Regular Class.

50.2.4 Fuel Tanks

Micro Class fuel tanks need not be accessible.

50.2.5 Gyroscopic Assist Allowed

Gyroscopic assist or other forms of stability augmentation are allowed in Micro Class.

50.2.6 Payload Requirements

50.2.6.1 Payload and Payload Support

Micro Class aircraft are not limited as to payload type, i.e. payload plates vs.lead shot vs. water ballast.

50.2.6.2 Payload Distribution

The payload cannot contribute to the structural integrity of the airframe, and must be secured to the airframe within the cargo bay so as to avoid shifting while in flight.

50.3 General Requirements

50.3.1 Radios

All radio transmitters must meet the FCC and Academy of Model Aeronautics 1991 standard for frequencies assigned to model aircraft. This rule refers to the narrower frequency band system adopted in 1991 and is denoted with a gold sticker on the transmitter or the transmitter module.

Amateur radio frequencies legal for use in the United States (53 MHz) are permitted, provided the pilot presents proof of ownership of an FCC license for use of such frequencies.

50.3.2 In-Flight Battery Packs

Micro Class aircraft must use a battery pack with capacity suitable to safely drive all the servos in the aircraft, taking into consideration the number of servos and potential current draw from those servos. Batteries may be charged at any time on the ground.

Micro Class aircraft utilizing electric motor propulsion are allowed to use systems with Battery Eliminator Circuitry that allows a single battery pack to power both the motor and the radio equipment.

50.3.3 Spinners and Safety Nuts Required

All aircraft must utilize either a spinner or a rounded safety nut.

50.3.4 Metal Propellers Prohibited

Metal propellers are not allowed.

50.3.5 Control Surface Slop

Aircraft control surfaces must not feature excessive slop. Sloppy control surfaces

lead to reduced controllability in mild cases, or control surface flutter in severe cases.

50.3.6 Servo Sizing

Servos must be adequately sized to handle the expected air loads during flight.

50.3.7 Qualification Flights

Qualification flights are not required.

50.4 Micro Class Scoring

Regular Class, Open Class and Micro Class aircraft are subject to the same mission parameters as explained in Section 2.

In order to participate in the flight portion of the competition, each team is required to have submitted a Design Report and delivered an Oral Presentation, both for score, in the competition.

50.4.1 Micro Class Flight Score

The Micro Class flight score shall be determined according to the following formula:

$$\textbf{Flight Score} = (10 - EW) \times PF \times 13$$

Where EW = Empty Weight in pounds, and

$$PF = \text{Payload Fraction} = \frac{PayloadWeight}{EmptyWeight + PayloadWeight}$$

50.4.2 Payload Prediction Bonus

No prediction points are available for Micro Class.

SECTION 6
DESIGN REPORT AND ORAL PRESENTATION

60. DESIGN AND ORAL REPORTS

60.1 Design Reports

The Design Report is the primary means in which a team is to convey to the judges how they arrived at their conclusion, that the aircraft they are entering in the competition is the aircraft most suited to perform the intended mission. The Design Report should explain the team's thought processes and engineering philosophy that drove them to their conclusions. Further, it should detail the methods, procedures, and where applicable, the calculations used to arrive at the presented solution.

The SAE Technical Paper standard is a good guideline for the Design Report, http://www.sae.org/products/papers/paprinfo/present.htm.

Some topics that are important to cover are: selection of the overall vehicle configuration, wing plan form design including airfoil selection, drag analysis including three-dimensional drag effects, aircraft stability and control, power plant performance including both static and dynamic thrust, and performance prediction. Other topics as appropriate may be included. For more information regarding performance prediction, a white paper by Leland Nicolai is available on the Aero Design website.

The Design Report consists of the report itself, the plans, and a payload prediction graph. The Statement of Compliance needs to be included as page 2 of the Design Report. The Design Report must be scored with the following maximum number of points available for each section:

Report	40 Points
Plans	5 Points
Prediction Graph	5 Points
Total Design Score	**50 Points**

60.1.1 Design Report Requirements

60.1.1.1 Page Limit

The report must not exceed thirty (30) double-spaced, single-sided typewritten pages, including appendices, Cover Page, Statement of Compliance, Table of Contents, Plans, and Prediction Graph.

If the design report exceeds thirty (30) pages, the judges will only read and judge the first thirty pages.

60.1.1.2 Paper Size

Report pages must be printed on ANSI A sized paper (8 ½ x 11 inches). For teams outside North America, page size must be the closest size available to ANSI A.

60.1.1.3 Font

The minimum size type is 12 point proportional or a 10 character per inch non-proportional font.

60.1.1.4 Margins

1" Left, ½" right, top, and bottom.

60.1.1.5 Binding

The report must be bound with no loose pages.

60.1.1.6 Cover Page

All Design Reports must feature a cover page that states the team's name, school, and team number. The cover page will count against the 30-page limit.

60.1.1.7 Number of Copies

Three (3) printed and bound copies of the report must be provided prior to the deadline as stated in the appendix.

Teams are also required to submit a PDF file emailed by the deadline date as stated in the appendix to: Aerodesign@sae.org. Subject line must read Design Report, Aero Design East (or West) 2006.

60.1.2 Plan Requirements

60.1.2.1 Paper Size

Plan sheet must be ANSI B sized paper (11 x 17 inches). For teams outside North America, page size must be the closest size available to ANSI B. Plans must only consist of one (1) sheet, single-sided, and must have the US-standard third-order projection.

60.1.2.2 Required Views

The plans shall consist of a standard aeronautical three-view, using a US-standard third-order projection; i.e., right side view in the lower left with the nose pointing right, top view above the right side view also with the nose pointing right, and front view in the lower right.

60.1.2.3 Dimensions

Dimensions must be in inches and decimal inches, to an appropriate level of precision. **(Hint: four decimal places are too many!)**

60.1.2.4 Summary Data

The plans must also contain a table with a summary of pertinent aircraft data such as wingspan, empty weight, engine make and model for Open Class or Micro Class, etc.

60.1.2.5 Other Required Markings

The plans must be marked with the team name, school name, and team number.

60.1.3 Payload Prediction Curve Requirements

60.1.3.1 Number of Copies

One copy of the payload prediction curve will be bound with each Design Report and will count against the 30-page limit. One copy of the payload prediction curve will be provided loose-leaf, not bound to the reports. One copy per report plus one loose-leaf copy equals four payload prediction curves submitted.

60.1.3.2 Paper Size

Prediction curves must be printed on ANSI A sized paper (8 ½ x 11 inches) in landscape format. For teams outside North America, paper size must be the closest size available to ANSI A.

60.1.3.3 Graph Markings

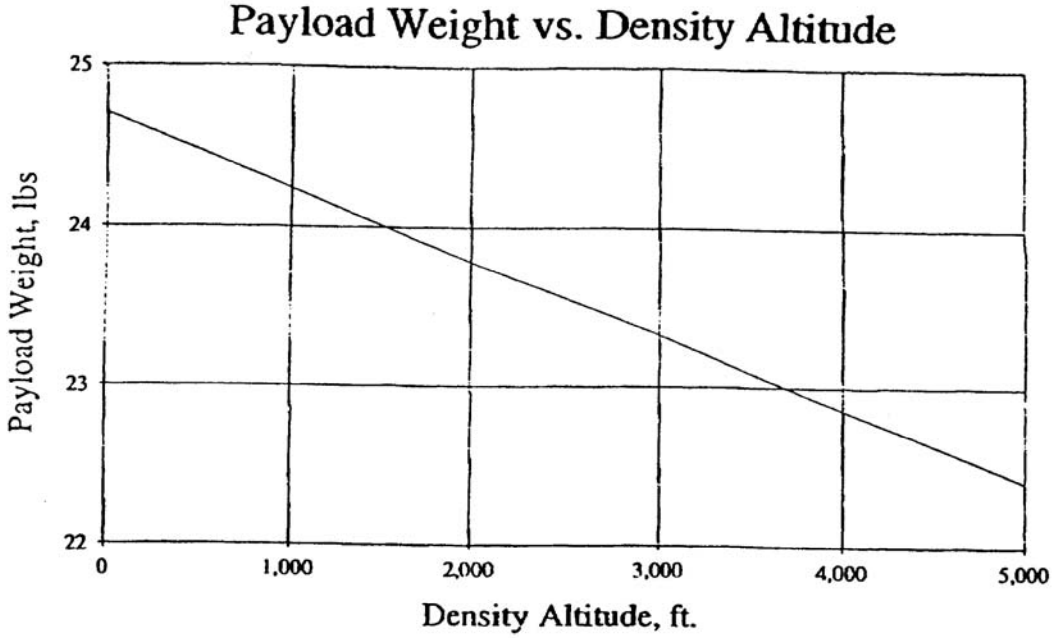
The payload prediction curve (graph) must be marked with the team name and school name across the top of the graph, and with the team number marked in the bottom-right corner. The graph must include the formula used to calculate the curve.

60.1.3.4 Nature of the Curve

For Regular and Open Classes, the curve must present the payload capacity of the aircraft in pounds as a function of density altitude in feet. For Micro Class, the curve must present the payload *fraction* of the aircraft as a function of density altitude in feet. The graph must be linearized over the relevant range, and the linear equation used to predict the payload capacity or payload fraction must be clearly shown on the graph.

Only one curve, and hence one equation, may be presented on the graph. This curve may take into account predicted headwind for local conditions, rolling drag, inertia, engine and propeller performance, or any other factors that may affect takeoff performance. All these factors are allowed components of the prediction curve, but only one curve will be allowed; multiple curves to account for varying headwind conditions will not be allowed. Teams presenting multiple curves will receive no bonus points for payload prediction.

Payload Prediction Chart – Example



$W_{max} = 24.7 - (4.6 \times 10^{-4})^{h}$ density

60.1.3.5 Scoring Precedence

In scoring the payload prediction, the equation as printed on the prediction graph will be used to calculate the prediction bonus. In the event the line as printed on the graph contradicts the equation, the equation must be used to determine the prediction bonus. Teams omitting the prediction curve equation from the prediction graph will receive no bonus points for payload prediction.

60.1.3.6 Micro Class Not Exempt

Although no payload prediction bonus is available for Micro Class, Micro Class teams are still required to provide a payload prediction curve according to the guidelines described above.

60.1.4 Submission Deadlines

The Design Report, plans, and payload prediction graph must be postmarked no later than the date indicated on the Action Deadlines given in the Appendix. Neither the Organizer nor the SAE is responsible for any lost or misdirected reports or plans. The SAE suggests that all reports and plans be sent certified mail with a return receipt requested.

60.2 Oral Presentation

Each team is to give a fifteen-minute technical presentation of their design. Judging criteria for the presentation include both the quality of the technical content AND the manner in which that content is presented. During this presentation, the team should present in oral form the same information they should have provided in their Design Report (section 60.1).

As a guideline, teams should prepare for the Oral Presentation as if they were trying to convince a government customer to purchase their aircraft design instead of any competitor's design. That means a team should give a detailed explanation of how they arrived at the conclusion that their design is the best. Teams should explain why they chose their design configuration, and then present the results of any analysis or testing that was done to justify their design choices. Any aspects of the design relevant to aircraft performance should be explained.

Regular and Micro Class aircraft must be present at the Oral Presentation. Open Class participants should make every effort to bring all or a portion of their aircraft to the presentation; however, if the size of the aircraft prevents its display, adequate photographs are acceptable substitutes.

The Oral Presentation must be given in English, and it is worth a maximum of 50 points. Teams that exceed the 15 minute presentation time will be penalized five points against

their Oral Presentation score.

60.3 Technical Inspection

60.3.1 Conformance to Configuration Requirements

Technical Inspection is the event during which the aircraft are checked for compliance to the aircraft configuration requirements. Regular Class aircraft will be measured for wingspan, fit of the cargo block into the payload bay, and compliance of the engine to configuration requirements. Open Class aircraft will be checked for engine displacement and gross weight requirements. Any spare aircraft or spare components (major assemblies such as wings, fuselages, empennage) must be inspected with the primary competition aircraft.

60.3.2 Technical Inspection

Technical Inspection will be used to assess airworthiness of entered aircraft. Items mentioned in sections 30.3, 40.3, and 50.3 will be verified, as well as any other items that could cause an aircraft to depart controlled flight. Wing warp, control surface alignment, center of gravity, and many other items will be inspected during this event.

60.3.3 Aircraft Conformance to Plans

During Technical Inspection the aircraft will be inspected for conformance to the plans presented in the Design Report. Any deviation in construction of the aircraft since submission of the Design Report must be reported in writing at the time of the Technical Inspection. The judges may assess penalty points based upon the magnitude of the change as determined by the judges.

60.3.4 Scoring the Technical Inspection

No points are available to be scored as a result of the Technical Inspection: teams may only lose points as a result of errors and problems encountered during the inspection process. Any penalties assessed during Technical Inspection will be applied to the overall Design Report score.

60.4 Total Competition Scoring

The overall competition score will be the sum of the individual components:

Overall Score = Design Report Score + Oral Presentation Score + Flight Score

60.5 Projection Equipment

Teams planning to use data projection are responsible for bringing, or other wise arranging for, their own data projectors. Some data projectors may be provided by the organizers; however teams should not rely on either the availability or functionality of such equipment.

SECTION 7
NOTICE OF PROPOSED FUTURE RULE CHANGES

This section is intended to give teams advance notice of proposed changes to the Aero Design rules for 2007. These changes might have a significant effect on the design of the aircraft. This is an informational notice only and does not imply that the proposed change will in fact be adopted.

Regular Class wingspan limitations and payload bay will change annually. SAE will make every attempt announce the wingspan for the following year at the events.

Micro Class rules will remain unchanged for 2007.

Various Open Class changes are being considered for 2007:

Reconfigurable Aircraft. Under this proposal, aircraft would be required to reconfigure upon command from the transmitter. Conceptually, the aircraft would have a small wingspan maximum during engine start and taxi. Then, prior to takeoff, with nobody touching the aircraft, the pilot would command the aircraft to reconfigure into a new configuration with a much larger wingspan minimum. The aircraft would then perform the standard mission. Hands-off reconfiguring back to the smaller wingspan maximum would not be required. This option is being considered as either a hard requirement for the class or as a bonus.

Payload Drop. Under this proposal, in lieu of performing a flight with zero payload, Open Class aircraft would be required to carry aloft a payload of pre-defined configuration. Upon pilot command, the aircraft would be required to drop or jettison the payload for a parachute recovery. Contest Organizers would provide the payload(s), parachute(s), and an interface design for deploying the parachute.

APPENDIX
2006 SAE AERO DESIGN

STATEMENT OF COMPLIANCE
Certification of Qualification

Team Name: _____ Team Number: _____

School: _____

Faculty Advisor: _____

Faculty Advisor E-Mail: _____

Statement of Compliance

As Faculty Advisor, I certify that the registered team members are enrolled in collegiate courses. This team has designed, constructed and/or modified the radio controlled airplane they will use for the SAE Aero Design 2006 competition, without direct assistance from professional engineers, R/C model experts or pilots, or related professionals.

_____

Signature of Faculty Advisor

Team Captain Information:

Team Captain:
Captain's E-mail:
Captain's Phone:

Note: A copy of this statement needs to be included in your Design Report as page 2 (see 60.1).

2006 AERO DESIGN EAST - ACTION DEADLINES
LOCKHEED MARTIN AERONAUTICS COMPANY
MARIETTA, GEORGIA
APRIL 21 - 23, 2006

1 Registration

Register on-line at: www.sae.org (October 3, 2005)

Early registration fee	**$350.00**
Early registration deadline	**December 29, 2005**

2 Design Reports, Plans, and

Payload Prediction Graph (postmarked)	**March 10, 2006**

DESIGN REPORTS:

HARDCOPIES: Three (3) Hardcopies of the Design Report must be postmarked by midnight on March 10, 2006.

Mail to: Attn: Lonnie Dong

C/o Community Relations/SAE Aero Design East

Lockheed Martin Aeronautics Company

86 South Cobb Drive

Mail Zone 0261

Marietta, GA 30063

ELECTRONIC COPIES: Electronic copy of Design Report must be submitted by midnight March 10, 2006 to: AeroDesign@sae.org

Subject line must read: Aero Design East Design Report, school name and number

3 Rules Inquiries concerning Aero Design East Only

Any inquiries regarding rules or for Aero Design East 2006 will be answered by SAE Rules Committee via the SAE Aero Design forum http://forums.sae.org/access/dispatch.cgi/aerodesign_pf.

4 Official 2006 Aero Design East Website

HTTP://WWW.SAE.ORG/STUDENTS/AEROEAST.HTM

THE COBB COUNTY SPORTS AVIATION COMPLEX

HTTP://CCRC.INFO

2006 AERO DESIGN WEST - ACTION DEADLINES
SAE SOUTHERN CALIFORNIA SECTION
ENCINO, CALIFORNIA
JUNE 2-4, 2006

1 Registration

Register on-line at: www.sae.org (October 3, 2005)

Early registration fee	**$350.00**
Early registration deadline	**December 29, 2006**

2 Design Reports, Plans, and Payload Prediction Graph (postmarked) by

April 29, 2006

DESIGN REPORTS:

HARDCOPIES: Hardcopies of the Design Report must be postmarked by midnight on

April 29, 2006

Mail to: David Eichstedt

Lockheed Martin Aeronautics Company

1011 Lockheed Way, Mail Zone 0201

Palmdale, CA 93559

ELECTRONIC COPIES: Electronic copy of Design Report must be submitted by midnight April 29, 2006 to: AeroDesign@sae.org

Subject line must read: Aero Design West Design Report, school name and number

Rules Inquiries concerning Aero Design West Only

Any inquiries regarding rules or for Aero Design West 2006 will be answered by SAE Rules Committee via the Aero Design forum, http://forums.sae.org/access/dispatch.cgi/aerodesign_pf

4 Official 2006 Aero Design West Website

HTTP://WWW.SAE.ORG/STUDENTS/AEROWEST.HTM