FLIGHT ENDURANCE

OVERVIEW

Participants analyze flight principles with a rubber band powered model aircraft.

PURPOSE

Participants have the opportunity to build, fly, and adjust (trim) a model to make long endurance flights inside a contained airspace. Models must be of fixed-wing design and comply with all event specifications. Rotary-wing aircraft and aerostats (lighter than air) aircraft are NOT permitted. All models are to be built and test flown during the current school year.

ELIGIBILITY

Participants are limited to two (2) individuals per chapter, one (1) entry per individual.

TIME LIMITS

A. Entries must be started and completed during the current school year.
B. Participants are provided a minimum of thirty (30) minutes for trim flights at the event site.

ATTIRE

Competition attire, as described in National TSA Dress Code (www.tsaweb.org/Dress-Code), is required for this event.

PROCEDURE

A. Participants report to the event coordinator at the time and place stated in the conference program to sign up for flight heats.
B. Participants proceed to the flying site for trim flying during the time designated for their heat. Time allotted for the trim portion may be extended according to the number of participants and site scheduling.

Each year it is amazing when students demonstrate their mastery of this event by flying planes in graceful arcs around an indoor space. Flights do not always go that way, but when they do, they are beautiful.
C. Participants have two (2) opportunities to fly their models for official times.

D. Participants attend a pilot’s meeting to review the sequence for making the official flights.

E. In an orderly fashion, participants wind their models and proceed to a group timer for permission to fly.

F. Participants place their models on the floor and wait for the signal to release from the timer. Timing begins when the model rises off the ground. A poster board launching platform will be provided.

G. Flight time ends when models hit the floor/ground or when they come to rest on an obstruction.

H. Only minor repairs are allowed during trim and time trials.

I. Each participant has the times of two (2) official flights recorded by the timer.

J. Immediately following the second flight, the participant will hand his/her motor to the judge for weighing.

K. Portfolios and planes will be placed on flight boxes for judging. Judges will begin with the top flight times and will evaluate planes, portfolios, and flight boxes until the top ten finalists have been determined. Planes that violate any part of Regulation C will be disqualified.

L. Ties are broken by determining the longest single flight time.

It is essential that students and advisors routinely check the TSA website (www.tsaweb.org) for updated information about TSA general rules and competitive events. This information is found on the website under Competitions/Updates and Clarification. When students participate in any TSA competitive event, they are responsible for knowing of updates, changes, or clarification related to that event.

☑️ Read the General Rules and Regulations in the front of this guide for information that applies to all of TSA’s competitive events.
REGULATIONS

A. Documentation materials (comprising “a portfolio”) are required and must be secured in a clear front report cover. The portfolio must include a flight log (see official sample that follows), with the previous ten (10) flights signed off by the participant’s advisor. The report cover must include the following single-sided, 8½” x 11” pages, in this order:

1. The technical attributes of the design and a description and identification of parts
2. The modifications and an explanation of why each was developed
3. A technical review of the flight log that explains the trim adjustments and modifications required to improve endurance. Experts from the Academy of Model Aeronautics (AMA) and the National Free Flight Society (NFFS) may scrutinize this information for validity.

Flight Log

<table>
<thead>
<tr>
<th>Participant ID#:</th>
<th>Dates:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight #</td>
<td># of winds</td>
</tr>
<tr>
<td>#1</td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td></td>
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<td>#4</td>
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<td>#7</td>
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<tr>
<td>#8</td>
<td></td>
</tr>
<tr>
<td>#9</td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td></td>
</tr>
</tbody>
</table>

Flight Log
B. The aircraft and its parts must be contained in a flight box that does not exceed 25cm x 40cm x 60cm. Flight box hardware, such as hinges, handles, and wheels, are not to be measured.

C. Materials include the following:

1. Models are to be made of wood, tissue paper, condenser paper, and plastic film, such as Mylar, for fuselage and flying surfaces (wings, fin, and stabilizer). No plastic foams are allowed.

2. Models MUST use commercially available “fix-pitch” propeller or “fixed-pitch” propeller assembly: minimum of 140mm to a maximum of 170mm in diameter. Propellers may be trimmed, shaped, balanced, or re-pitched, but must remain fixed in pitch. Variable-pitch propellers and/or mechanisms are NOT permitted.

3. Fuselage dimension: minimum of 300mm in length measured with prop assembly attached.

4. Wingspan: maximum of 50cm horizontally projected, wing chord 12cm projected.

5. Rubber motor: maximum weight of motor is 1.50 grams, including the O-rings. No length measurement is made. Spare motors are allowed during the official flights. Two (2) rubber O-rings may be used on the rubber motor loop for easier handling of wound motors.

6. Model weight: minimum of 7.0 grams, maximum of 21.0 grams. Models are weighed without motors attached. Clay is permitted for trim ballast. Model is weighed with clay ballast.

7. Steel wire may be used only for the propeller shaft, motor hook, landing gear, and the connection between fuselage and tail. Small plastic tubes such as coffee stirrers may be used.

8. The two wheels must be a minimum of 15mm in diameter, made of plastic or wood, and they must roll freely by the weight of the plane on a smooth surface.
D. Acceptable flight support equipment includes the following:
   1. Mechanical rubber motor winders or battery-powered motor winders may be used. No AC-powered winders are allowed.
   2. A winding stooge may be used to anchor the model while its motor is being wound. A person may not serve as a winding stooge.
   3. Flight Endurance is an individual event. No one may assist the participant in any way during either trim or official flights. Violation of this regulation may result in disqualification.

E. When at rest, the landing gear must support the airplane without the fuselage and/or propeller touching the floor or launching pad.

**EVALUATION**

Evaluation is based on the duration of flight, written report, flight log, and flight box. A bonus of ten (10) seconds is added to the flight time per flight if the airplane successfully lands on its wheels and comes to a rest on its wheels.

**NOTES**

Two organizations—the Academy of Model Aeronautics (AMA) and the National Free Flight Society (NFFS)—welcome your inquiries and offer suggestions, help, and technical information concerning model aircraft and flight technology.

Contact the AMA: www.modelaircraft.org.
Contact NFFS: www.freeflight.org.
STEM INTEGRATION

This event aligns with the STEM educational standards noted below. Please refer to the STEM Integration section of this guide for more information.

Science, Technology, Engineering, Mathematics

COMMON CORE STATE STANDARDS (CCSS) INTEGRATION

Please refer to the Common Core State Standards (CCSS) Integration section of this guide for more information.

PRIMARY LEADERSHIP SKILLS

Leadership skills promoted in this event:

• CREATIVE THINKING — Students develop unique ideas for their entry to increase their competitive edge. Suggested leadership lessons: Creative Technologies and The Leadership Chronicles

• EVALUATION — Students improve their entry though testing and time trials. Suggested leadership lessons: Evaluation Imagination and Evaluation Methods

• PROBLEM SOLVING — Students make adjustments to their entry to fix any problems. Suggested leadership lessons: Finding the Right Way and Problem Solving Steps

Additional leadership skills promoted in this event: communication, critical thinking, organization

TSA AND CAREERS

This competition connects to one or more of the career areas featured in the TSA AND CAREERS section of this guide. Use The 16 Career Clusters chart and the TSA Competitions and The 16 Career Clusters grid as resources for information about careers.

CAREERS RELATED TO THIS EVENT

Aeronautical engineer
Aircraft systems engineer
Physics teacher
FLIGHT ENDURANCE
EVENT COORDINATOR INSTRUCTIONS

PERSONNEL
A. Event coordinator
B. Assistants, two (2) or more
C. Evaluators, two (2) or more
D. Timekeepers, two (2)

MATERIALS
Coordinator's notebook, containing:
A. Event guidelines, one (1) copy for the coordinator and for each evaluator
B. Official rating forms
C. List of entries with finalist report
D. List of evaluators/assistants
E. Flight score sheets
F. Marking pens (felt tip, fine point)
G. Two (2) metric tape measures
H. Two (2) rolls of caution tape
I. 125 zip lock bags
J. Three (3) launch pads (poster board, 30” x 40”)
K. Signs for door(s) reading Do Not Open, Flight in Progress, Knock for Entry
L. Three (3) helium balloons
M. One (1) fishing reel with line
N. Stop watches, three (3)
O. Electronic gram scale (to .01 gram)
P. Results envelope
RESPONSIBILITIES

A. Upon arrival at the conference, report to the CRC room and check the contents of the coordinator’s notebook. Review the event guidelines and check to see that enough evaluators/assistants have been scheduled.

B. Inspect the area(s) in which the event is being held for appropriate set-up, including room size, chairs, tables, outlets, etc. Notify the event manager of any potential problems.

C. One (1) hour before the event is scheduled to begin, meet with your evaluators/assistants to review time limits, procedures, and regulations. If questions arise that cannot be answered, speak to the event manager before the event begins.

D. For participants who violate the rules, the decision either to deduct 20% of the total points earned or to disqualify the entry must be discussed and verified with the evaluators, event coordinator, and a CRC manager; all must initial either of these actions on the rating form.

E. Check in participants and evaluate models for special compliance during the scheduled trim session (completed flight log is inspected).

F. Secure models in the holding area so that models remain safe until the scheduled time for the official flights.

G. Distribute a list of entrants assigned to each designated evaluator/timer.

H. Each flight is recorded to the nearest one-tenth (.1) of a second. After the second flight, the times are added together. Up to three (3) groups may fly simultaneously in the assigned area for the event, with consideration for the safety of the models and participants.

I. Models and flight boxes of all contestants are checked again. Models showing deviations may be disqualified.

J. Secure the signatures of the evaluators on the official rating form after they have reviewed it.

K. Complete and submit the finalist report, which includes a ranking of the ten (10) finalists, and all related forms in the results envelope to the CRC room.

L. If necessary, manage security and the removal of materials from the event area.
# Flight Endurance

## 2015 & 2016 OFFICIAL RATING FORM

### Documentation (60 points)

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Minimal performance</th>
<th>Adequate performance</th>
<th>Exemplary performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-4 points</td>
<td>5-8 points</td>
<td>9-10 points</td>
</tr>
</tbody>
</table>

Evaluator: Using minimal (1-4 points), adequate (5-8 points) or exemplary (9-10 points) performance levels as a guideline, record the scores earned for the event criteria in the column spaces to the far right. The X1 or X2 notation in the criteria column is a multiplier factor for determining the points earned. (Example: an “adequate” score of 7 for an X1 criterion = 7 points; an “adequate” score of 7 for an X2 criterion = 14 points.)

<table>
<thead>
<tr>
<th>Portfolio components</th>
<th>Portfolio is unorganized and/or is missing three or more components.</th>
<th>Portfolio is organized adequately, with most, if not all, components present.</th>
<th>No components are missing in the portfolio, and content and organization are clearly evident.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical attributes</td>
<td>Attributes of the design are very sketchy in nature.</td>
<td>Attributes of the design are included and adequately reflect basic knowledge of flight design.</td>
<td>Clear and precise attributes of the design are given; an in-depth knowledge of flight design is exhibited.</td>
</tr>
<tr>
<td>Description and identification of parts</td>
<td>Two or more parts are not described or identified accurately.</td>
<td>Most parts are accurately described.</td>
<td>All parts are completely and accurately described and identified.</td>
</tr>
<tr>
<td>Modifications and technical review of flight log</td>
<td>Only one modification is noted, and/or an explanation of why the modification was made is missing.</td>
<td>Modifications are given with adequate explanations for how they improved flight endurance.</td>
<td>Modifications and an explanation of why they were made are provided; a clear and precise explanation for how they improved the flight endurance is provided.</td>
</tr>
<tr>
<td>Flight log</td>
<td>The flight log is incomplete; the advisor signature is not included.</td>
<td>The flight log is generally complete; the advisor’s signature may be missing.</td>
<td>The flight log is complete, with advisor’s signature; a thorough understanding of the flight log’s purpose is evident.</td>
</tr>
<tr>
<td>Flight box</td>
<td>The flight box exceeds dimensions by more than 1%.</td>
<td>The flight box exceeds dimensions by less than 1%.</td>
<td>The flight box adheres to the maximum size restrictions.</td>
</tr>
</tbody>
</table>

**SUBTOTAL (60 points)**

## Flight Times

Flight times recorded to the nearest tenth (.1) of a second.

<table>
<thead>
<tr>
<th>Duration of flight #1</th>
<th>Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of flight #2</td>
<td>Seconds</td>
</tr>
<tr>
<td>Landing bonus – add 10 seconds for each successful landing</td>
<td>Seconds</td>
</tr>
<tr>
<td>Total flight scores (combine flight #1, flight #2, and bonus for landing/s)</td>
<td>Seconds</td>
</tr>
</tbody>
</table>

**SUBTOTAL FLIGHT SCORE**
## FLIGHT ENDURANCE (continued)

Rules violations (a deduction of 20% of the total possible points) must be initialed by the evaluator, coordinator, and manager of the event. Record the deduction in the space to the far right.

Indicate the rule violated: __________

(To arrive at TOTAL score, add any subtotals and subtract rules violation points, as necessary. Check your math twice!)

<table>
<thead>
<tr>
<th>TOTAL (points to be determined)</th>
</tr>
</thead>
</table>

Comments:

I certify these results to be true and accurate to the best of my knowledge.

Evaluator

Printed name: ____________________________  Signature: ____________________________