HELICOPTER B



1. **DESCRIPTION:** Prior to the tournament, teams will construct, collect data on test flights, analyze and optimize free flight rubber-powered helicopters to achieve maximum time aloft.

   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 15 minutes

2. **EVENT PARAMETERS:**
   a. Teams may bring up to 2 helicopters, Flight Log, transportation boxes, tools, and equipment.
   b. Teams must bring one or more Measurement Boxes; transportation and measurement boxes may be the same box.
   c. The Event Supervisor will provide all other measurement tools and timing devices for scoring purposes.
3. **CONSTRUCTION PARAMETERS:**
   a. Helicopters may be constructed from published plans, commercial kits, competitor's designs, and/or other sources of design. Kits, if used, must not contain any pre-glued joints or pre-covered surfaces.
   b. The uppermost part of the helicopter (the part that would touch a flat ceiling first during flight) must be a flat balsa wood disc, large enough to cover a dime. **The face of the disc must be the part that contacts the ceiling if the helicopter goes that high.**
   c. Any materials except Boron filaments may be used in construction of the helicopter and boxes.
   d. The helicopter, in its flight configuration, must fit fully into a team-provided Measurement Box without a lid/cover.
      i. The external dimensions of the Measurement Box must fit within a right, rectangular prism of 32.0cm x 24.0cm x 47.0cm, including any external protuberances on the lidless box.
   e. "Flight Configuration" means the helicopter is fully assembled and ready to fly. For example, no change in chord, span, length, or total lifting area can occur after removing the helicopter from its box and throughout the flight itself. Components that rotate during flight, such as propellers or rotors, may be rotated to allow the helicopter to fit into the box. The rubber motor(s) does not have to be on the helicopter or wound.
   f. The helicopter may use up to three fixed rotors. There is no minimum limit on the number of blades or their chord. Rotors are defined as one or more separate lifting surfaces, referred to as blades, that contribute lift by rotating on a common path around a vertical axis. There must not be any other lifting surfaces.
   g. Total mass of the helicopter, excluding the rubber motor(s), must be 4.0 g or more.
   h. Participants must be able to answer questions on design, construction, and operation of the device per the Building Policy found on www.soinc.org.
4. **THE COMPETITION:**
   a. **Prior to day of Tournament**
      i. An indoor location will be selected by the Tournament officials. The following will be announced:
         (1) The room dimensions (approximate length, width, and ceiling height).
         (2) Competition factors such as air currents.
   b. **Day of Tournament** and prior to the first time slot:
      i. The Event Supervisor will determine if:
         (1) Multiple official flights may occur simultaneously.
         (2) Practice flights may occur throughout the Competition, at the Event Supervisor's discretion, but must yield to any official flights.
         (3) No practice flights will occur in the final half-hour of the event's last period. (Teams that declare a trim flight during their 10-minute Flight Period may still fly).
      ii. Once participants enter the cordoned off competition area to trim, practice, or compete, they must not receive outside materials (except as permitted by the Event Supervisor), assistance, or communication. Only participants may handle helicopters until the event ends. Teams violating this rule will be ranked below all other teams. Spectators will be in a separate area.
   c. **Self-Check Inspection Station (Optional)**
      i. Prior to check-in with the Event Supervisor, a self-check inspection station may be made available to participants for checking their Measurement Box(es), and helicopters. Modifications may be made prior to check-in.

d. **Check-In**
   i. At check-in, participants will present their helicopters in Measurement Box(es) and Flight Logs for inspection immediately prior to their Flight Period.
      (1) **Teams from the same school can share the same Measurement Box.**
   ii. The Event Supervisor will verify the external dimensions of the Measurement Box(es) and that the helicopter fits fully inside the Measurement Box while in its flight configuration. The helicopter's overall dimensions must not change after being removed from the box. This may be verified by showing that the helicopter slides into and out of the box without changing shape at the discretion of the Event Supervisor.
   iii. The participants will remove the helicopter from the box to allow for the mass to be measured.
   iv. All motor(s) will be collected and returned to the team at the start of their 10-minute Flight Period.
   v. Only participants should handle the helicopters or Measurement Box(es).

e. **Flight Period**
   i. The 10-minute Flight Period begins when the Event Supervisor returns the motors to the team.
   ii. Any flight beginning within the 10-minute Flight Period will be permitted to fly to completion.
   iii. Participants may make adjustments/repairs/trim flights during their official Flight Period.
   iv. Before each launch, participants must indicate to the Timers whether a flight is an official flight or a trim flight. A flight is considered official if a team fails to notify the Timer(s) of the flight's status.
   v. Teams must not be given extra time to recover or repair their helicopter.
   vi. Teams may make up to a total of 2 official flights using 1 or 2 helicopters.
   vii. Time aloft for each flight starts when the helicopter leaves the participant's hand and stops when any part of the helicopter touches the floor, the lifting surfaces no longer support the weight of the helicopter (such as the helicopter landing on a girder or basketball hoop) or the Event Supervisors otherwise determine the flight is over.
   viii. Event Supervisors are strongly encouraged to utilize three (3) timers on all flights. The median flight time in seconds to the precision of the device used is the official Time aloft.
   ix. Participants must not steer the helicopter during flights.
   x. Students must be on the floor to launch from their hands. Artificial aids cannot be used to increase launch height.
   xi. In the unlikely event of a collision with another helicopter, a team may elect a re-flight. The decision to re-fly may be made after the helicopter lands. Timers are allowed to delay a launch to avoid a possible collision. The 10-minute Flight Period does not apply to such a flight.

f. If requested by the Event Supervisor, the participants must demonstrate that each helicopter still fits fully inside the Measurement Box(es) in the flight configuration. Teams may not manipulate the configuration of the helicopter in order to fit into the box except to rotate components that rotated during flight such as rotors. The helicopter's overall dimensions must not change after being removed from the box. Motor(s) may be removed from the helicopter or left in place during the demonstration.

g. The Event Supervisor will review with teams their data recorded at the end of their Event Time.

h. Teams filing an appeal must leave their Helicopter(s), Measurement Box(es), and Flight Log in the event area.

5. **<u>FLIGHT LOGS</u>:**

a. Teams may present a Flight Log of recorded data for a BONUS. This data must include 6 or more parameters (3 required and at least 3 additional) with data for 10 or more test flights prior to the competition.
   i. The required parameters are:
      (1) Motor Size before wind-up
      (2) Number of Turns on Launch or Torque at Launch
      (3) Flight Time
   ii. The team must choose 3 additional data parameters beyond those required (e.g. turns remaining at landing, estimated/recorded peak flight altitude, the motor torque at landing, propeller pitch, etc.)

b. All numeric data must include units which may be listed with the column headers of the log. Torque units may be "arbitrary" if an uncalibrated torque meter with arbitrary numbers is utilized.

c. All logs will be returned to teams after inspection.



6. **SCORING:**
   a. Highest Final Score wins. A team's Final Score is the larger of the team's Flight Scores.
   b. Flight Score for each official flight=Flight Time x Bonuses (6.c).
   c. Bonuses:
      i. Teams with a complete Flight Log will receive a 20% bonus multiplier (x 1.2)
      ii. Teams with a partial Flight Log will receive a 10% bonus multiplier (x 1.1).
      iii. Teams without a Flight Log will receive no Flight Log bonus multiplier (x 1.0)
      iv. **Teams competing with only two-bladed rotors receive an additional 10% bonus multiplier (x1.1).**
      v. **Example Score: For a flight time of 68.00 seconds with a completed Flight Log and using two bladed rotors the score would be : 68.00 x 1.2 x 1.1 = 89.76 points.**
   d. Teams that violate rule(s) under "CONSTRUCTION PARAMETERS" or "COMPETITION" that do not have a specific penalty will be ranked after all teams that do not violate those rules.
   e. Ties will be broken by the longest non-scored official Flight Score.

7. **DEFINITIONS:**
   a. *Event Supervisor (ES)* is responsible for ensuring the event runs correctly. The ES can assign one or more event helpers to perform various competition tasks.
   b. *Flight Configuration* means the helicopter is fully assembled and ready to fly. For example, no change in chord, span, length, or total lifting area can occur after removing the helicopter from its box and throughout the flight itself. Components that rotate during flight, such as propellers or rotors, may be rotated to allow the helicopter to fit into the box. The rubber motor(s) does not have to be on the helicopter or wound.
   c. *Rotors* are defined as one or more separate lifting surfaces, referred to as blades, that contribute lift by rotating as a unit around a vertical axis.
   d. *Blade:* A blade is a single aerodynamic surface that extends no more than 90 degrees around the axis of rotation of the rotor.
   e. *Trim Flight:* A test or practice flight that is not used for official scoring.
   f. *Steering:* Participants using something to control the direction of motion once the device is released. (ex. Balloons, poles, rods, air, etc.)

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase; other resources are available on the Event Pages at soinc.org.

This event is sponsored by the National Free Flight Society (NFFS).