

- DESCRIPTION:** Competitors may construct a self-propelled air-levitated vehicle with up to two battery-powered motors that turn one propeller each to levitate and move the vehicle down a track. Competitors must also be tested on their knowledge of classic mechanics and related topics.

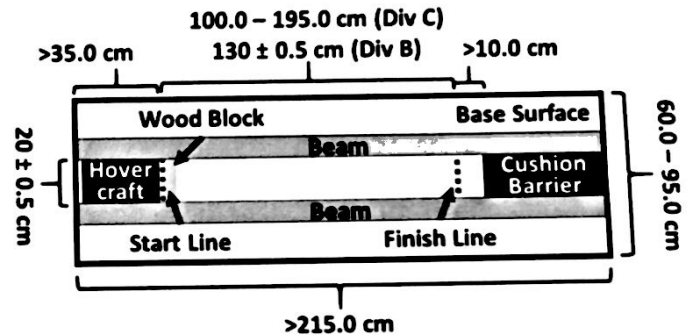
**A TEAM OF UP TO:** 2 **EYE PROTECTION:** B **IMPOUND:** Yes **APPROXIMATE TIME:** 50 minutes

## 2. EVENT PARAMETERS:

- All reference materials to be used during all parts of the competition must be initially secured in a 3-ring binder so that regardless of orientation, none can fall out.
- Competitors may bring writing utensils and any type of calculators for use during any part of the event.
- The vehicle must be placed in a box (vehicle and box must be labeled with the team name and tournament specific team number) and must be impounded. Tools and supplies do not need to be impounded.
- Competitors must wear eye protection during Part II. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows.

## 3. THE TRACK:

- The supervisor must supply two 8' long beams each with a width and height at least 30.0 mm (standard 2x4 metal framing studs recommended to ensure straightness), a cushioned barrier to stop vehicles, a small wood block to hold back the vehicle at the starting line, and a base surface at least 215.0 cm long and between 60.0 and 95.0 cm wide (standard 8' long table or countertop recommended).
- Each beam must be clamped or securely affixed to the base with the widest side in contact with the base to form the track side rails. There must be a gap of  $20 \pm 0.5$  cm between them to form the vehicle track.
- At one end of the track, a start line must be marked that is at least 35.0 cm from the edge of the track.
- At the other track end, the finish line must be marked (see 5.e for location) and a cushioned barrier at least 10.0 cm from the finish line must block the channel.
- Multiple tracks may be used to facilitate all teams competing in a timely manner, but the dimensions and specifications of all tracks must be the same.



## 4. CONSTRUCTION:

- The vehicle may be made of any material, but must not modify the track.
- The length of the vehicle must be between 15.0 and 30.0 cm and cannot exceed 30.0 cm during the run (including any inflated skirts). The vehicle, excluding dowel (see 4.g), must be less than 20.0 cm tall with the propellers in motion when non-levitated.
- The mass of the vehicle (including batteries and dowel) must be no more than 2000.0 grams.
- It is recommended that the vehicle be adjustable to accommodate variations in track rail width and height.
- The vehicle must have no more than two motors each rotating one propeller. Propellers must have shielding with holes less than 1/4" in diameter, which the event supervisor must test by trying to pass a 1/4" dowel through them.
- The entire vehicle, including the propeller(s) and required shielding, must not exceed 19.5 cm in width.
- The vehicle must have a 1/4" or larger dowel vertically attached within 5.0 cm of its front edge such that the top end is between 30.0 and 35.0 cm above the lowest vehicle surface.
- Commercial batteries, not exceeding 9.0 V as labeled, may be used to energize the motors on the vehicle. Multiple batteries may be connected together as long as the expected voltage across any points does not exceed 9.0 V as calculated by their labels. The vehicle must not have any other energy sources.
- Brushless motors and integrated circuits are not permitted.
- The vehicle must be levitated on a cushion of air as it moves down the track. Inflated skirts may remain in contact with the base surface, other vehicle components may occasionally contact the base surface, and continuous contact with the inside edge of the side rails is permitted. Competitors may be asked to demonstrate levitation by pushing the vehicle slightly down. If it then rises it is levitated.
- Vehicles must have an electric switch to permit safe starting. A stopping system to stop vehicle motion or shut off the motor is recommended.
- Competitors must be able to answer questions regarding the design, construction, and operation of the vehicle per the Building Policy found on [www.soinc.org](http://www.soinc.org).

## 5. THE COMPETITION:

### Part I: Written Test

- Unless otherwise requested, answers must be in metric units with appropriate significant figures.
- Teams must be given a minimum of 20 minutes to complete a written test.
- Questions may be multiple choice, true-false, completion, or calculation problems.
- The competition must consist of at least five questions from each of the following areas:
  - Newton's Laws of Motion: inertia, force, impulse, action-reaction
  - Kinematics: projectile velocity, speed, acceleration, position
  - Kinetic energy: calculation, momentum, non-relativistic
  - Air cushioned vehicles and applications: history, design, capabilities
  - Fluid mechanics (Division C only): density, buoyancy, viscosity, Bernoulli's principle, Pascal's law

### Part II: Vehicle Testing

- The length of the timed portion of the track is between 100.0 and 195.0 cm (Division C) / fixed at 130 ± 0.5 cm (Division B). Supervisors must mark the distance on the track.
  - The target time is between 5.0 and 25.0 s. The event supervisor must announce the exact length (Division C only) and time after impound, which must be the same for all teams.
  - Event supervisors must check vehicle specifications during impound or right before a team's testing period begins. Teams must be notified as soon as possible if a vehicle does not meet specifications. Event supervisors may also recheck specifications after a successful run (e.g., to remeasure the mass).
  - Teams must have a total of 8 minutes to adjust and repair their vehicle, and make 5 failed or 2 successful runs (whichever comes first). Event supervisors must give teams a warning at 7 minutes.
  - Teams may modify the vehicle during the impound period or their 8 minutes vehicle testing period, if time is available. This may be to bring the vehicle into compliance with the event specifications.
  - Prior to starting the first run, and without actually turning on the motor, teams must demonstrate a safe starting and stopping process. Vehicle testing period timing must not stop for this demonstration.
  - To begin a run, competitors must place their vehicle on the track directly before the start line. Event supervisors must place a small wood block in front of the vehicle to keep it from moving.
  - When ready, competitors may turn on their motors and indicate that their vehicle is ready.
  - Teams must not touch the vehicle after motors are turned on until the vehicle passes the finish line or the event supervisor declares the run as a failed run.
  - The students must give a countdown of "3, 2, 1, launch". The event supervisor must then release the vehicle by removing the small wood block. Timing must start when the dowel crosses the start line and stop when it crosses the finish line.
  - Supervisors are encouraged to use photogates for more precise timing and use at least one back-up manual timer. If only manual timers are utilized, 3 timers are recommended. The middle value of the 3 timers must be the officially recorded time. Time is recorded in seconds to the device precision.
  - A run must count as long as it is started before the 8-minute period has elapsed.
  - A failed run occurs if a vehicle does not meet construction specifications when timing for that run starts, fails to move for 3 seconds at any time, fails to cross the finish line within triple the target time, or any part of the vehicle falls off. After a failed run, the team must be allowed to repair and restart their vehicle if time remains in the 8-minute period, for a maximum of 5 failed runs.
  - Teams filing an appeal regarding Part II must leave their vehicle in the competition area.
  - The supervisor must verify with the team the correct recording of Part II data on the team scoresheet.
6. **SCORING:** A scoring rubric is available on the event page on [www.soinc.org](http://www.soinc.org)
- Mass Score (MS) = (mass of vehicle / mass of heaviest successful vehicle of all teams) x 25 points.
  - Time Score (TS) = (1 - (abs (run time - target time) / run time)) x 25 points. The smallest possible TS is 0.
  - Teams with no successful runs or that are disqualified for unsafe operation receive a TS and MS of 0. Teams must still be allowed to compete in Part I.
  - The mass of the vehicle must be multiplied by 0.7 when calculating the MS if any construction violation(s) are corrected during the Part II testing period or if the team misses impound.
  - The TS for a successful run must be multiplied by 0.9 when calculating the Final Score if the team violates any of the rules in THE COMPETITION during that run. Rule violations during failed runs do not result in this penalty.
  - Exam Score (ES): (Part I score / Highest Part I score for all teams) x 50 points
  - Final Score (FS) = MS + best run TS + ES. The maximum possible FS is 100 points. High score wins.
  - Tie Breakers: 1<sup>st</sup> - Best ES; 2<sup>nd</sup> - Best MS; 3<sup>rd</sup> - Best other successful run TS; 4<sup>th</sup> - specific test questions

**Recommended Resources:** All reference and training resources including the **Hovercraft DVD** and the **Chem/Phy Science CD** are available on the Official Science Olympiad Store or Website at [www.soinc.org](http://www.soinc.org)