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MISSION POSSIBLE

1. <u>DESCRIPTION</u>: Prior to the competition, teams must design, build, test, and document a "Rube Goldberg® like Device" that completes a required Final Task using a sequence of consecutive **Energy Transfers**.

TEAM: 1-2 students

IMPOUND: At state and national only

EYE PROTECTION: #2

SET-UP TIME: 30 minutes for points

MAX. RUN TIME: 3 minute limit

2. <u>SAFETY PARAMETERS</u>: All team members must properly wear safety spectacles with side shields at all times. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete. Each device must pass a safety inspection before operation. Devices with potential hazards or safety concerns must not be permitted to run unless safety concerns are resolved to the satisfaction of the event supervisor; otherwise they must receive only participation points.

3. CONSTRUCTION PARAMETERS:

- a. All parts of the device must fit and stay within a 60.0 x 60.0 x 60.0 cm imaginary cube during operation.
- b. The device must be designed and constructed to use forms of energy, listed in **3.e.**, to complete a sequence of **transfers** that all contribute to completion of the Final Task.
- c. The Device must begin with the Start Task and end with the Final Task as listed in Section 4.
- d. After the Starting Task, the device must be designed to operate autonomously. A team must be disqualified if the device is remotely timed or controlled.
- e. The **Five Basic Energy Forms used in transfers** that will count for points are electrical, mechanical, thermal, chemical, and electromagnetic spectrum (radio, infrared, and visible light only). Batteries, candles, small rocket igniters, etc., may receive points determined by the way they cause the next action.
- f. Each **transfer** in the device must be designed to contribute to the completion of the Final Task except the use of switches to turn off previously used motors and transfers for the Bonus Task. Parallel and/or dead end tasks are not allowed with the exception of switching off motors or for the Bonus Task.
- g. All scoreable actions and transfers must be visible with the exception of radio & infrared electromagnetic spectrum transfers.
- h. Other non-scoreable transfers may be incorporated into the device, but must contribute to the completion of the Final Task, receive no points, and be listed on the Energy Transfer List (ETL).
- i. Only wires, batteries, photo cells, homemade solenoids, switches, and up to three motors may be used in the device. No computers, integrated circuits or other electric components are allowed.
- j. All transfers take time, but any continuous action designed to take up time must not be electrical. In addition, at State & National adjusting a transfer that utilizes electricity in any way (either at the beginning, middle, or end of operation) intended to accomplish the ideal time is a violation.
- k. Matches, candles, or small rocket igniters may be used. However, hazardous liquids and materials (e.g., rat traps, **lead objects, etc.**) are not permitted.
- 1. All sources of energy and actions must be contained within the imaginary box before, during, and after the device's operation. The device must account for non-ideal ambient conditions. If the device is sensitive to light, air currents, radio waves, etc., the team must provide all necessary shielding.
- m. Power to any single electrical circuit must not exceed 10.0 volts. All batteries must be factory-sealed and voltage labeled by the manufacturer. Lead-acid batteries are not permitted.
- n. Energy devices (e.g., batteries, mousetraps, candles), except motors, may be activated prior to starting the device.
- o. The top and at least one vertical wall must be open or transparent for viewing all actions and tasks.
- 4. <u>THE COMPETITION</u>: Transfers receive points only if successful, are listed on the ETL, and contribute toward Final Task completion within the 3-minute time limit. A single action must contribute to only one scoreable **transfer**.
 - a. **Start Task** (100 points) (1) In a 1 pint container, randomized by shaking, is a mixture of up to 10 golf tees (4-10 cm long), 10 #1 metal paperclips, and 10 non-metallic 1-2 cm diameter marbles, (2) which are quickly poured into the device (3) from above the entire device, so that the mixture falls into the device and (4) triggers the first action, which (5) begins the chain of events. All materials in the mixture must be un-altered. If any part of 4.a. is violated, no points will be awarded for the Start Task or the Bonus Task.
 - b. An Energy Transfer can receive points when it directly transfers from one Basic Energy Form to a different Basic Energy Form, but only if it is successful and is listed in the ETL. Each of the five Basic Energy Forms may be used for scoreable transfers up to three times, but must transfer to a different Basic Energy Form than previously scored. All scoreable Energy Transfers must contribute toward the completion of the Final Task to earn points.

- c. An Energy Transfer List (ETL) must be submitted to the Event Supervisor by a specified time/date prior to or at the tournament. This list will detail each Energy Transfer in the sequence in which it will occur during operation of the device. See www.soinc.org for an example of the format required.
- d. Scoring will be based only on the Energy Transfers listed in the ETL. The ETL must be legible, neat and an accurate documentation of the device's operation. If the device includes extra Transfers that do not count for points, they must be documented in the list, but they must not be numbered.
- e. Each Energy Transfer intended to earn points must be labeled in the device with a number matching the ETL list for the Energy Transfer.
- f. **Bonus Task** Sort the mixture of golf tees, paperclips, and marbles into three different one-pint plastic containers similar to the original container. Each container must be labeled, by material, to score points. Sorting does not have to lead to the Final Task, but only items sorted before the time stops will receive points.
- g. **Final Task** (250 points) Switch on a light to signal the end of the action. It must be clearly visible to the judges, so they can accurately measure the operation time for the device.
- h. The ideal operation time for maximum points is 60.0 seconds at Regionals, between 60.1 and 90.0 seconds at States, and 90.1 to 120.0 seconds at Nationals (time announced after impound). At State and Nationals, event supervisors will observe the adjustment of the device for timing to ensure that electricity is not used per rule 3.j.
- i. Timing and scoring for the device begins when a team member pours the last of the objects from the pint container into the device. Timing of the device stops when the final light is first visible to the judges, or when 180.0 seconds elapse (whichever comes first).
- j. If the device **stops**, jams or fails, the team must be allowed to "adjust" it to continue operation. Any obvious stalling to gain a time advantage must result in disqualification.
- k. If an action inadvertently starts a **transfer** out of sequence on the ETL then all **transfers** skipped in the listed sequence must not earn points even if they are completed.
- 1. If a competitor completes a scoreable **transfer** or makes an adjustment that leads directly to completion of the **transfer** in the next action, that **transfer** must not receive points (even if it is the Final Task).

5. SCORING POINTS: High score wins.

- a. Teams that impound a device, but fail to compete, receive participation points.
- b. Points can only be earned for transfers successfully completed before 180.0 seconds elapse and no points will be awarded for anything that occurs after the final light shines.
- c. 0.1 pt for each .1 cm that the dimensions of the device are under 60.0 cm x 60.0 cm x 60.0 cm in each axis. Example: Device measures 40.0 cm x 38.9 cm x 52.4 cm. Pts. 20.0 + 21.1 + 7.6 = 48.7 pts.
- d. 2 pts for each full second of operation up to the ideal time.
- e. 5 pts awarded for each object successfully sorted in its correct final container (max=150 pts.).
- f. 25 pts if the ETL is submitted as designated by the tournament director.
- g. 25 pts if the ETL uses the format specified.
- h. 25 pts if the scoreable transfers in the ETL and within the device are correspondingly labeled.
- i. 25 pts if the ETL is 100% accurate in documentation of intended scoreable and non-scoreable transfers.
- j. 50 pts if the team uses no more than 30 minutes to set up their device.
- k. 30 pts for the first time an Energy Form is transferred per rule 4.b. (max=150 pts)
- 1. 20 pts for the second time an Energy Form is transferred per rule 4.b. (max=100 pts)
- m. 10 pts for the third time an Energy Form is transferred per rule 4.b. (max=50 pts)

Total Energy Form max points = 300 pts.

6. **PENALTIES**:

- a. Minus 1 pt for each full second that the device operates beyond the ideal time until the final light shines or the 180.0 second time limit is reached (whichever occurs first).
- b. Minus 5 pts for each original object sorted into a wrong final container.
- c. Minus 15 pts each time the device is touched, adjusted, or restarted.
- d. Minus 50 pts, one time, for any part or substance leaving the boundary of the device during the operation. Smoke, odors, light, radio waves, etc. may leave the device as long as none of these pose a hazard.
- 7. <u>TIERS</u>: Unsafe devices must not be allowed to run and **teams must** only receive participation points. Tier 1: Devices without any violations; Tier 2: Devices with construction violations; Tier 3: Devices with parallel path or "dead end" paths (other than in the Bonus Task); Tier 4: Devices impounded after the deadline.
- 8. <u>TIES</u>: are broken by this sequence: 1. Fewest penalty points; 2. Closest to perfect for objects in the three final containers; 3. Smallest overall dimension of device.
 - **Recommended Resources:** The **Mission Possible DVD** and training resources are available at www.soinc.org THIS EVENT IS SPONSORED BY: LOCKHEED MARTIN