

MISSION POSSIBLE B

1. **DESCRIPTION:** 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 tasks.
TEAM: 1-3 **IMPOUND:** Yes **EYE PROTECTION:** #2 **SET-UP:** 30 minutes **MAX. RUN-TIME:** 3 minutes
2. **SAFETY PARAMETERS:** 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 must receive only receive participation points.
3. **CONSTRUCTION PARAMETERS:**
 - a. All parts of the device must fit **and stay** within a 60.0 cm x 60.0 cm x 60.0 cm imaginary cube during its operation. **The only exception to this limit is the last movement of the final task.**
 - b. The device must be designed and constructed to consecutively execute a sequence of tasks selected by the team from the list in section 4.
 - i. The Starting Task must be designed as Task 4.a. and the Final Task must be designed as Task 4.m.
 - ii. No more than 8 additional Tasks (from 4.b. - 4.k.) plus the "special task" are counted for points between the Starting Task and the Final Task and these may occur in any order.
 - iii. After the Starting Task, the device must be designed to operate autonomously.
 - iv. Each task 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. Parallel and/or dead end tasks are not allowed.
 - v. **Each moveable/adjustable physical object in the device can only be utilized by one assigned task.**
 - vi. Other non-scoreable tasks may be incorporated into the device and must contribute to the completion of the Final Task. These tasks receive no points **but must be listed** on the Task Sequence List (TSL).
 - c. Electric components are limited to batteries, wires, mechanical switches, and/or up to three motors. No computers, integrated circuits, or any other unlisted electric components are permitted in the device.
 - d. Hazardous liquids, flames, and materials (e.g., rat traps, **lead objects, etc.**) are not permitted.
 - e. 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.
 - f. Energy devices (i.e., batteries/mousetraps), except motors, may be activated prior to starting the device.
 - g. A team must be disqualified if the device is remotely timed or controlled.
 - h. **The top and at least one vertical wall must be open or transparent for viewing all actions and tasks.**
4. **THE TASKS:** Tasks receive points only if successful, listed on the TSL, and contribute towards Final Task completion within the 3-min time limit. A single action must contribute to only one scoreable task.
 - a. (100 pts) **Starting Task-** Initiate **the first** action by dropping a **US quarter coin into the device from a position higher than the entire device. This first action must not be one of the scorable tasks listed.**
 - b. (20 pts) **Open a closed plastic egg so the contents fall out and cause the next action.**
 - c. (20 pts) **Use the force of moving air to push an object at least a linear distance of 10 cm. The new position of the object must cause the next action.**
 - d. (20 pts) Turn a screw such that it moves an object at least 2.0 cm in the direction parallel to the screw's axis of rotation before causing the next action.
 - e. (20 pts) Release the energy stored in a spring (**not** a mouse/rat trap) such that it causes the next action.
 - f. (30 pts) Use a pulley system with an IMA greater than 2 to lift an object at least 5.0 cm before the object causes the next action.
 - g. (30 pts) Combine two levers of different classes into a system with an IMA greater than 5 **to lift an object so that the object causes** the next action.
 - h. (30 pts) Use a rack & pinion gear to move an object at least 5.0cm before **the object** causes the next action.
 - i. (40 pts) **Lift** an object with a 3rd class lever at least 15.0cm **above** where it starts. The lever must not touch the object at the beginning or end of this task. The final placement of the object must cause the next action.
 - j. (50 pts) **Move and pour granular material from one container to another container that is higher in the device. The entire initial container must be below the receiving container at task start but may be above the receiving container at task completion. The granular material in the receiving container must cause the next action.**
 - k. (50 pts) Use a gear system of at least 3 homemade, non-electrical, non-commercially constructed gears, **so that the final gear turns at least 360° and the turning of the final axle causes the next action.**
 - l. (20 pts + bonus) Special Task: Pull a mass up a ramp at least 10 cm (vertical), causing the next action. The **maximum angle of the ramp is 45°** measured from horizontal. Bonus points will be awarded based on both the mass raised and the height traveled. **The mass must be a solid mass and be easily removed.**

- m. (200 pts) **Final Task - Raise a commercial 9V battery and up to an optional 10 dominoes** on a platform so that the surface of the platform is higher than any other part of the device. All 4 of the following conditions must be met: 1) The battery must be a 9 V battery and any dominoes are less than 4.5 cm x 2.5 cm x 0.8 cm; 2) The surface of the platform must be a flat, smooth, solid plane with no raised edges at all times. The item(s) must not be held or attached to any part of the platform. The use of materials or surfaces to increase friction is prohibited; 3) When the device is started the item(s) must be free-standing, the battery upright with the contacts up and any dominoes, if used, on their narrow long side. Items used must not be touching at the start. All items used must stay in contact with the top of the platform but after the start the item(s) may touch each other or fall over (not off the platform); 4) During the entire run nothing else must be on the platform.
5. **TASK SEQUENCE LIST (TSL):** The TSL details the sequence of tasks to occur during device operation.
- Tasks in section 4, intended to earn points, must be sequentially numbered and identified by letter in both the TSL and device. Non-scoreable actions or tasks must be listed in the TSL, but not be numbered.
 - The TSL must be submitted at impound and **must follow the specified format** posted on www.soinc.org.
6. **TIMING AND OPERATION OF DEVICE:**
- The ideal operation time for maximum points is 60.0 seconds at Regionals, between 60.0 and 90.0 seconds at States, and between 90.0 and 120.0 seconds at Nationals (time announced after impound).
 - Timing of the device begins when a team member **releases the quarter, dropping it into the device**.
 - Timing of the device stops when the final task is completed, which is when the platform comes to a complete stop or when 180.0 seconds elapses (whichever comes first).
 - 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.
 - If an action inadvertently starts a task out of sequence on the TSL then all tasks skipped in the listed sequence must not earn points even if they are completed.
 - If the team completes a task themselves or makes an adjustment that leads directly to completion of the task in the next action, that task must not receive points (even if it is the final task).
7. **SCORING POINTS:** High score wins.
- Teams that impound a device but fail to compete receive participation points.
 - Points can only be earned for tasks successfully completed before 180.0 seconds elapses.
 - 2 pts for each full second of operation up to the ideal time.
 - 10 pts for self-measurement along a permanently installed ruler **awarded only once per each task (except 4.m.)** requiring movement of a certain distance **or** requiring an IMA. **Max. 80 pts.**
 - 25 pts** if the TSL is submitted **at impound**.
 - 25 pts** if the TSL uses the format specified. **See www.soinc.org website for an example TSL.**
 - 25 pts** if the tasks **in the TSL and** within the device are correspondingly labeled.
 - 25 pts if the TSL is 100% accurate in documentation of intended scoreable and non-scoreable tasks.
 - 50 pts if the team uses no more than 30 minutes to set up their device.
 - Point value listed for the first time each lettered task is successfully completed as indicated in section 4.
 - 1 pt for every 50 grams of mass lifted up the ramp in Special Task 1. Max 100 pts. **(5kg)**
 - 1 pt for every whole vertical cm the mass is raised in Special Task 1.
 - 1 pt for every **whole cm the top of the platform is lifted from its original, horizontal position by the device during the run. Points awarded even if platform does not leave the device. Max 150 pts.**
 - 25 pts for the battery and 2 pts for each domino not touching each other and remaining in their free standing, upright position on the platform during the run and after the platform comes to a complete stop.
8. **PENALTIES:**
- 1 pt for each full second that the device operates beyond the ideal time until Final Task completion or the 180.0-second time limit is reached (whichever occurs first).
 - 15 pts each time the device is touched, adjusted, or restarted.
 - 50 pts, one time, for any part or substance that leaves the boundary of the device during the operation **with the exception of the last movement of the final task.**
9. **TIERS:** Unsafe devices must not be allowed to run, and **teams will** receive only participation points.
- Tier 1: Devices without any violations.
 - Tier 2: Devices with competition violations other than those listed under penalties.
 - Tier 3: Devices with construction violations, parallel or “dead end” paths.
 - Tier 4: Devices impounded after the deadline.
10. **TIES:** are broken by this sequence: 1. Fewest penalty points, 2. Greatest **distance the platform is** lifted in the final task (only if the final task is completed), 3. Closest to ideal time.

Recommended Resource: The **Mission Possible DVD** and training resources are available at www.soinc.org