

ROLLER COASTER
DIVISION B and DIVISION C
2012-2013

1. **DESCRIPTION:** Teams shall design and build a “roller coaster” meeting the requirements specified in these rules. The “roller coaster” shall mean the entire structure including the roller coaster track and the base, but not the actual vehicle. The “COASTER” shall mean the vehicle that travels on the roller coaster track. “Device” shall mean both the roller coaster and COASTER. This event requires teams to make some significant design trade-off decisions during both design and construction.
2. **A TEAM OF UP TO: 2 IMPOUND: YES EYE PROTECTION: #2 EVENT TIME: 10 min**
3. **IMPOUND:**
 - a. Teams **must** impound their device (both roller coaster and COASTER).
 - b. Teams **must** submit the following “Submittal Information” at Impound in writing:
 - i. **Start Height** (rounded up to nearest whole cm.)
 - ii. **Time Target** (either 30 or 60 seconds)
 - iii. **Vertical Jump Height 1** (rounded down to nearest whole cm.)
 - iv. **Vertical Jump Height 2** (rounded down to nearest whole cm.)
 - v. **School Name, Tournament Team Number, and Student Names**

Note 1: Teams shall be credited with a 50 point bonus for each of these five submittals. No bonus shall be awarded unless units are provided. Max Submittal Information Bonus (**SIB**) is 250 points. SIB score will be awarded regardless of whether the COASTER completes its run.

Note 2: Teams MUST also write School Name and Tournament Team Number on their roller coaster before entering the Impound area. Failure to do so will result in a ZERO SIB score.
 - c. Teams **are not** permitted to perform any adjustments or assembly to their device during impound. Adjustments and assembly shall only be permitted during their Event Time.
4. **EVENT PARAMETERS:**
 - a. Each team is allowed to enter only one device, built prior to the competition.
 - b. Teams will be given an opportunity for two runs within the Event Time.
5. **CONSTRUCTION PARAMETERS:**
 - a. The roller coaster track **must be built on a flat base**, which may be constructed of any sturdy material.
 - b. The base dimensions may not exceed:
 - i. For Division B: 1.0 m × 0.6 m.
 - ii. For Division C: 0.8 m × 0.6 m
 - c. No part of the roller coaster may extend outside the perimeter of the base.
 - d. The height of the roller coaster at every point, measured without the COASTER, may not exceed 1.0 m from the top of the base.
 - e. The entire roller coaster, including the actual track, may be constructed of any material, EXCEPT for any type of commercially available manufactured “track”. For example, BRIO and Hot Wheel tracks are not permitted.
 - f. The roller coaster track must be designed so that, at every point on the track, the COASTER can be removed by hand from the track in a direction perpendicular to the direction of the COASTER’s travel (“Removability Test”). High sidewalls are permitted as long as the COASTER complies with this removability test at every point of the track.

- g. The roller coaster track **may** be built with up to two vertical jumps (see 7d and 7e) over Jump Obstacles. COASTERS that successfully clear one or both Jump Obstacles shall receive bonus points. Teams are not obligated to include Jump Obstacles in their design; **the Jumps are optional**.
- h. Each Jump Obstacle, if employed, must be an individual entity, mounted to the roller coaster separately. The top of the Jump Obstacle must be level (flat and parallel to the base). The Jump Obstacle must have sufficient thickness that a COASTER collision with it will not deform the Jump Obstacle.
- i. Teams shall supply their own COASTER, which may be **any** object.
- j. The device shall be designed to run either 30 or 60 seconds as a Time Target. Teams will select their Time Target and indicate that choice in the paperwork submitted at Impound.
- k. The track must be designed with an initial release mechanism that will be used to start the COASTER.
- l. The use of electricity during the competition is prohibited.
- m. Magnets are permitted without restrictions. However, electromagnets (see 5l) are prohibited.
- n. Only gravity and magnetism may be used to propel the COASTER.
- o. Funnels shall not be permitted because the COASTER is entirely enclosed as it passes out of the funnel and therefore is in violation of the removability test (see 5f).
- p. The track must be designed with a clearly labeled “FINISH” line. Time shall stop once the COASTER **begins** to cross the finish line.
- q. The roller coaster must be safe to operate and not pose any danger to the participants, officials or spectators.

6. **COMPETITION:**

- a. Event Supervisor will confirm the team’s Time Target (30 or 60 seconds) prior to the team’s first run. The Time Target shall apply to both runs.
- b. Team will place the COASTER on the track.
- c. Team will provide sufficient notice to the Event Supervisor of when they intend to release the COASTER. This will allow the Event Supervisor to properly time the COASTER’s run.
- d. Teams will activate the release mechanism by hand, but may not touch the COASTER in doing so.
- e. Each run shall be timed by the Event Supervisor. Time shall begin once the release mechanism is activated and end when the first of the following happens:
 - i. The front of the COASTER touches the finish line
 - ii. The COASTER falls off the roller coaster (and travels outside the base perimeter)
 - iii. The COASTER stops its movement. (A COASTER may pause briefly, but if movement is not begun within 3 seconds, time will be stopped and 3 seconds will be subtracted from the run time.)
- f. Teams are not permitted to interfere with the COASTER after it has started its run.
- g. Teams may make adjustments to their device between the two runs.

7. **SCORE PARAMETERS:**

- a. Start Height (SH) shall mean the vertical distance between the COASTER at its lowest point and the top of the base at the time of launch. Teams shall receive a Start Height Bonus (**SHB**) for every centimeter that the Start Height is less than 100 cm.
 - i. Division B: 5 points per cm less than 100 cm; max is 250 point bonus.
 - ii. Division C: 25 points per cm less than 100 cm; max is 1250 point bonus.

b. Time Target (TT) shall mean the time that a device is designed to travel to the finish line. Teams may design for a TT of 30 or 60 seconds. Teams will receive a Time Target Bonus (TTB) for a Time Target of 60 seconds. No bonus shall be awarded for a TT of 30 seconds.

- i. Division B: If TT = 60 seconds, TTB = 200 points, otherwise 0 points.
- ii. Division C: If TT = 60 seconds, TTB = 500 points, otherwise 0 points.

c. Time Accuracy (TA) shall mean the absolute value of the difference between the TT and the Actual Time (AT) of the COASTER's run (see 6e). Time Accuracy Penalty (TAP) shall be more heavily penalized for designs with a TT of 60 seconds as follows:

- i. Division B:
 1. If TT = 30 seconds, TAP = 1 point per 0.01 seconds of TA
 2. If TT = 60 seconds, TAP = 1.5 points per 0.01 seconds of TA
- ii. Division C:
 1. If TT = 30 seconds, TAP = 1 point per 0.01 seconds of TA
 2. If TT = 60 seconds, TAP = 3 points per 0.01 seconds of TA

d. *Bonus 1.* Vertical Jump Height 1 (VJH1) shall be the vertical height of the first Jump Obstacle over which the COASTER jumps. Teams shall receive a Vertical Jump Height 1 Bonus (VJH1B) for every centimeter of the vertical jump. The VJH1 must be at least 10 cm to earn bonus points. The jump must be successfully completed, as defined by the COASTER landing on the other side of the Jump Obstacle and continuing on the track, to get points for the VJH1B.

- i. VJH1 = Height of top of Jump Obstacle 1 (measured from the top of the base) –
Height of highest point (excluding sidewalls) of track where the COASTER departs for Jump 1 (measured from top of the base)
Round down to nearest whole centimeter.
- ii. Division B: VJH1B = 10 points per cm, if the jump is successful, otherwise 0 points.
- iii. Division C: VJH1B = 25 points per cm, if the jump is successful, otherwise 0 points.

e. *Bonus 2.* Vertical Jump Height 2 (VJH2) shall be the vertical height of the second Jump Obstacle over which the COASTER jumps. Teams shall receive a Vertical Jump Height Bonus (VJH2B) for every centimeter of the second vertical jump. The VJH2 must be at least 5 cm to earn bonus points. The jump must be successfully completed, as defined by the COASTER landing on the other side of the Jump Obstacle and continuing on the track, to get points for the VJH2B.

- i. VJH2 = Height of top of Jump Obstacle 2 (measured from the top of the base) –
Height of highest point (excluding sidewalls) of track where the COASTER departs for Jump 2 (measured from top of the base)
Round down to nearest whole centimeter.
- ii. Division B: VJH2B = 15 points per cm, if the jump is successful, otherwise 0 points.
- iii. Division C: VJH2B = 50 points per cm, if the jump is successful, otherwise 0 points.

8. **SCORING:**

- a. **Run Score:** The lower Run Score of two runs shall be counted. The RUN SCORE is defined as:

$$\text{RUN SCORE}_x = 4000 - \text{SHB} - \text{TTB} + \text{TAP}_x - \text{VJH1B}_x - \text{VJH2B}_x - \text{SIB}$$
, where "x" is the run number.

- b. **Ties** broken as follows: First tiebreaker: Highest VJH1 (whether successfully jumped or not);
Second tiebreaker: longest Actual Time (AT);
Third tiebreaker: highest SHB

- c. **Tier** Rankings: Tier 1 (no violations), Tier 2 (competition violation only), Tier 3 (construction violation)

Example Scoring:

Assume Division C team. On the first run, the ball falls off the track before it gets to the jump. On the second try, the team has a complete run.

Starting Height is 55 cm,

Time Target is 60 seconds,

Actual Time of run 1 is 40.10 seconds.

Actual Time of run 2 is 60.31 seconds,

Only 1 vertical jump of 13.2 cm which is jumped successfully only on the second run,

All submittals except for Target Time written on paper.

Starting Height Bonus: $SHB = 25 \times (100 - 55) = 1125$;

Time Target Bonus: $TTB = 500$;

Time Accuracy Penalty₁: $TAP_1 = 3 \times 100 \times \text{abs}(TT - AT_1) = 3 \times 100 \times \text{abs}(60 - 40.1) = 5970$;

Time Accuracy Penalty₂: $TAP_2 = 3 \times 100 \times \text{abs}(TT - AT_2) = 3 \times 100 \times \text{abs}(60 - 60.31) = 93$;

$VJH1B_1 = 0$, since the jump was not completed successfully;

$VJH1B_2 = 25 \times 13 = 325$, since the jump height is rounded down to the nearest cm;

$VJH2B_1 = VJH2B_2 = 0$ since there is no 2nd jump;

$SIB = 200$, because one piece of information was missing from the paperwork.

$RUN\ SCORE_1 = 4000 - 1125 - 500 + 5970 - 0 - 0 - 200 = \underline{8145}$.

$RUN\ SCORE_2 = 4000 - 1125 - 500 + 93 - 325 - 0 - 200 = \underline{1943}$.

Better RUN SCORE is **1943**.