



**ASME Student Design Competition – 2022 Rules
H₂Go Revisited**

**ATTENTION E-FESTERS! Please read this important announcement about
ASME E-Fests® in 2021 & 2022**

ASME E-Fest Digital (March 25-26, 2022) and affiliated competitions will NOT be held in-person. They will continue to be virtual for academic year '21-'22.

ASME will be hosting a series of year-long digital events including E-Fest Careers 2021 (November 13), competition “how to” webinars and much more. Please visit <http://efests.asme.org> for more details.

ASME Student Design Competition – 2022 Rules H₂Go – Revisited

We are modifying a competition from a decade ago (2011), the basis for which revolves around a water-propelled vehicle. The interest in renewable energy applications has risen to new heights since the competition was first run. In the 2011 rules, we stated that: “Devices to convert and store this energy could be created and an untapped and readily available energy source utilized. In addition, the water itself could be stored for a variety of everyday uses.”

Your challenge this year is to design a scaled, proof-of-concept prototype for water energy conversion. Your prototype will propel your vehicle by converting the potential energy of water that you will manually load into your device. Using that water as the power to propel your vehicle, your goal is to transport the water and unload as much water with your remotely controlled vehicle to a water delivery area in 15 minutes. *The validation of your design is scheduled to take place over several weeks in March, prior to the E-Fest Digital on March 25-26, 2022. See below for the details and event timing.*

General Rules: team eligibility, overall design setup and constraints:

1. Students participating in the competition must be undergraduate engineering students (any engineering discipline is allowed) and must be ASME student members. There is no limit on the number of students on a team or the number of teams from a school. Each student may only participate on one team (contribute to one device) – participants from schools fielding more than one team will be asked to affirm this at the competition.
2. Teams **must provide a rigid sizing box with a top** for the device. This box must be 50 cm x 50 cm x 50 cm (internal dimensions) or smaller. Teams will be required to verify box dimensions and that their device fits within the storage box in a submission video prior to the virtual competition.
3. The competition will take place in three stages, requiring teams to submit videos to ASME: 1) testing setup, 2) description and preliminary operation, and 3) the virtual competition for actual scoring. Design modifications are allowed until the final stage.
4. Teams must construct their own demonstration field which must be a 3-meter by 3-meter space marked on the floor by tape (see Figure 1). The devices must stay within the tape during demonstration. The field will have a ½ meter x ½ meter water filling area and a similar sized water delivery area.
5. Teams must build a device propelled by energy generated from the water manually poured into the device at the start of the round. The device must be completely powered by the potential energy of the water, and no other initially stored energy (such as electrical energy, pre-loaded springs or weights, or compressed gas).
6. Devices may use a battery powered system to run all device **control** functions: steering, braking, deploying water collection systems, opening or closing valves, etc. An RC remote controller should be operated by one team member to control the movement of the device. The remote controller may have its own battery. We encourage teams to use rechargeable batteries wherever possible, but they are not required.

7. Teams will provide water and all containers to fill, capture and measure the water that is transported from the Water Loading Area to the Water Unloading Area. Water must be transported across the playing field in a vehicle which must remain on the ground until the water has been unloaded. Teams may provide a water capture container to drain the water from the vehicle when it is within the Unloading Area. Opening and closing drain valves can be done either manually or remotely. The water capture container can then be lifted and manually poured into an unaltered commercial measuring container with clear volume markings in milliliters (mL).
8. Each demonstration will begin with the device in the rigid sizing box near the Water Loading Area. One team member may remove the device and place it within the Loading Area and fill the device with any amount of water desired. Once the device leaves the Loading Area it may not be touched until it reaches the Unloading Area.

Figure 1: Playing Field
(3 m x 3 m overall size)



(*Loading, Unloading and Bonus Target areas are $\frac{1}{2} m \times \frac{1}{2} m$)

March 4, 2022 Deliverables: testing setup compliance and design evaluation

9. By 11:59 pm US EST March 4, registered teams must submit a video that validates the requirements of the competition: clearly verify the Playing Field and Sizing Box with dimensions, and the water collection and measurement systems by the Unloading Area.
10. The description of the device and its operation are not required at this time, as it will be part of the March 11 video.
11. Teams are also requested to submit a 2nd design validation video on March 4. This is not required, but a bonus factor based on the judges score of the design validation video will be used in the competition scoring. This 10-minute video or PowerPoint presentation with voice over should describe the team design process and should cover:
 - the design process and decisions made during the project
 - the description of the final device and its unique qualities
 - the procedures taken by the team to test during the fabrication of the device and ongoing validation and refinements in preparation for the competition
12. Teams that submit a design video will be scored from 0 to 10. This score will be incorporated into a Design Scoring Factor used to calculate the final device score for the competition as follows:

$$\text{Design Scoring Factor} = 1 + (\text{Judges Score})/100$$

March 11, 2022 Deliverable: device operation and initial performance

13. By 11:59 pm US EST March 11, registered teams that submitted an approved Competition Compliance video on March 4 will create and submit a video of their device operating on their Playing Field.
14. At the start of the video, a team member will take the device from the sizing box, and briefly explain how the device will operate.
15. The device operator will then fill the device with water and remotely drive the device to the Water Unloading Area.
16. The device must fit inside the Sizing Box when it is set in the Water Loading Area, however, it is an allowable control function to remotely alter the device size as long as it does not touch the ground outside the Loading Area boundary.
17. For this Preliminary Device testing, each team will have no more than 5 minutes after describing the device to fill the water, remotely control the device to the Water Unloading Area, and deposit some water into the collection container.
18. Teams should clearly show a timer on their video when device filling begins, and end the video showing the final elapsed five-minute time, and also show the measured water captured. The video of the timed run and the measuring of the captured water should be recorded in one continuous take, without cut-a-ways or time skips.
19. In order to qualify for the final round of the competition, teams must successfully move their device to the Unloading Area powered by water and deposit some amount of water; the measurement of water volume will only count in the final round and March 18.

March 18, 2022 Deliverable: *competition scoring round*

20. By 11:59 pm US EDT March 18, teams must operate, record and upload their video with their device performing to transport water for competition scoring. By March 17 all qualified teams will be given a unique identification sheet that they must show at the start of their performance video. This will ensure that all teams are running their final demonstration on the same day, and have the same amount of time to operate.
21. For the final demonstration, teams will have 15 minutes to transport as much water as possible from the Water Loading Area to the collection system at the Water Unloading Area. Teams can make as many trips as they wish within the 15 minutes time period.
22. The demonstration score for each trip is the amount of water (measured in mL) moved from the Water Loading Area to the Water Unloading Area and collected in the measuring container with the following score adjustments:

$$\text{Trip Score} = (\text{Design Scoring Factor}) * (\text{Return Bonus}) * (\text{Target Bonus}) * (\text{mL of Water})$$

23. Water can be manually or remotely removed from the device to a collection container. The collection container can be manually emptied into the measurement container. At all times, the device itself may not be lifted, shifted, or otherwise moved from the ground during this process.
24. The *Design Scoring Factor* was explained in #12
25. The *Return Bonus* = 2 if a team is able to remotely drive the vehicle from the Loading Area to the Unloading Area and also drive back to the Loading Area remotely using water power after removing water for scoring. Water can only be added in the Loading Area. Teams can decide to manually return their device to the Loading Area after all desired water has been moved to the collection container for measurement; the Return Bonus score = 1 when the vehicle is returned manually.
26. If the vehicle attempts to return but does not make it all the way to the Loading Area, the operator may manually place the vehicle in the Loading Area and start a new trip. The Return Bonus = 1 if this happens.
27. The *Target Bonus* = 1.25 if a team passes any part of their vehicle over either of the Bonus Target Areas (Figure 1) when going from the Loading Area to the Unloading Area. There is no extra bonus to go to both Target Areas, and there is no extra bonus to visit the Target Area again on a return trip if teams are attempting to earn the Return Bonus; the Target Bonus score = 1 if teams go straight from the Loading to the Unloading Area.
28. A team's total points for the competition will be the sum of all Trip Scores within the 15-minute time limit.
29. The top three places will be awarded prizes. Any ties will be broken based on the amount of water transported in 15 minutes – with no bonus adjustment factors.

Activity Timing for 2022 SDC E-Fest Digital Competition

The delivery dates for the activities associated with the 2022 virtual Student Design Competition are summarized below:

To be eligible to submit a Competition Compliance video, teams must have registered for the E-Fest Digital.

- (Required) Compliance with Competition requirements March 4, 2022 (11:59 p.m. US EST)
 - Teams must submit a video of their competition setup as detailed in above competition rule #9.
- (Optional) Preliminary Design Review March 4, 2022 (11:59 p.m. US EST)
 - Teams may submit a 10-minute video or PowerPoint presentation as explained in above competition rules #11 and 12.
 - While this is not required, it will earn teams a scoring bonus in the competition.

To be eligible to submit a 2nd initial performance video, teams must have received confirmation from ASME SDC that their Competition Compliance video was approved.

- (Required) Preliminary Device Performance March 11, 2022 (11:59 p.m. US EST)
 - Teams must submit a video as detailed in above competition rules #13 to 19.

To be eligible to submit the scoring performance video, teams must have received confirmation from ASME SDC that their initial performance video was approved.

- (Required) “Live” Scoring Competition March 18, 2022 (11:59 p.m. US EDT)
 - All teams will be given instructions for identifying their device and must operate their devices as detailed in above rules #20 to 29.
 - Teams will have 15 minutes to operate their device, recording and uploading their video with their final performance.

The videos submitted on March 18 will be scored by ASME SDC judges to determine the top 3 place teams. These results will be announced during the awards ceremony on March 26th (time TBA) during E-Fest Digital.

Video Submission, ASME Release Form(s) & E-Fest Digital Registration

E-Fest Digital (March 25-26, 2022) registration is required for team captains and team members. There is no fee to register for E-Fest Digital or SDC. Once your E-Fest Digital competition registration is complete, team captains and team members will be directed to a Google form to:

1. Required videos and videos based upon winning teams in subsequent elimination rounds
2. Sign an ASME Video Release Form (required by all team members and team captains)

Prizes & Winners

- 1st place - \$500
- 2nd place - \$300
- 3rd place - \$150
- SDC competition winners will be announced during E-Fest Digital on Saturday, March 26, 2022 during the awards ceremony.

Questions & SDC Q&A Forum

- Questions may be directed to sdc@asme.org
- The SDC Q&A Forum will open in mid-September on the E-Fest website ([https://efests.asme.org/competitions/student-design-competition-\(sdc\)](https://efests.asme.org/competitions/student-design-competition-(sdc))). The Q&A Forum will close by February 1, 2022.