

**ASME Student Design Competition – 2021 Rules
Harvesting the Sun and Wind**

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

ASME is excited to host an E-Fest Digital event in April 2021. E-Fest Digital will include career and professional development content, digital competitions (including the Human Powered Vehicle Challenge, the Student Design Competition, the Innovative Additive Manufacturing 3D Competition, the Oral Competition and the Elevator Pitch Competition) and much more! Additional details will be available soon. Questions may be directed to efests@asme.org.

We encourage students, competitors, and faculty members to take advantage of the learning experiences provided by both our competitions and other digital offerings throughout the year. Questions may be directed to efests@asme.org and a digital calendar will be posted on <http://efests.asme.org> with lots of information.

If local conditions permit, ASME may add an in-person E-Fest competitions-only experience in April 2021. An update on this will be provided on November 7, 2020 during our E-Fest Careers 2020 digital event.

Students are encouraged to download E-Fest competitions rules at <https://efests.asme.org/competitions> for LIVE and Digital events.

Additionally, ASME will be hosting a series of year-long digital events including a Student Town Hall (Sept. 17, 8:00 pm – 9:15 pm EDT), E-Fest Careers 2020 (November 7), webinars and other competitions. Please visit <http://efests.asme.org> for more details.

Announcements about ASME E-Fest Asia Pacific 2021 and E-Fest Latin America 2021 will be forthcoming and will be posted on <http://efests.asme.org>.

ASME Student Design Competition – 2021 Rules Harvesting the Sun and Wind

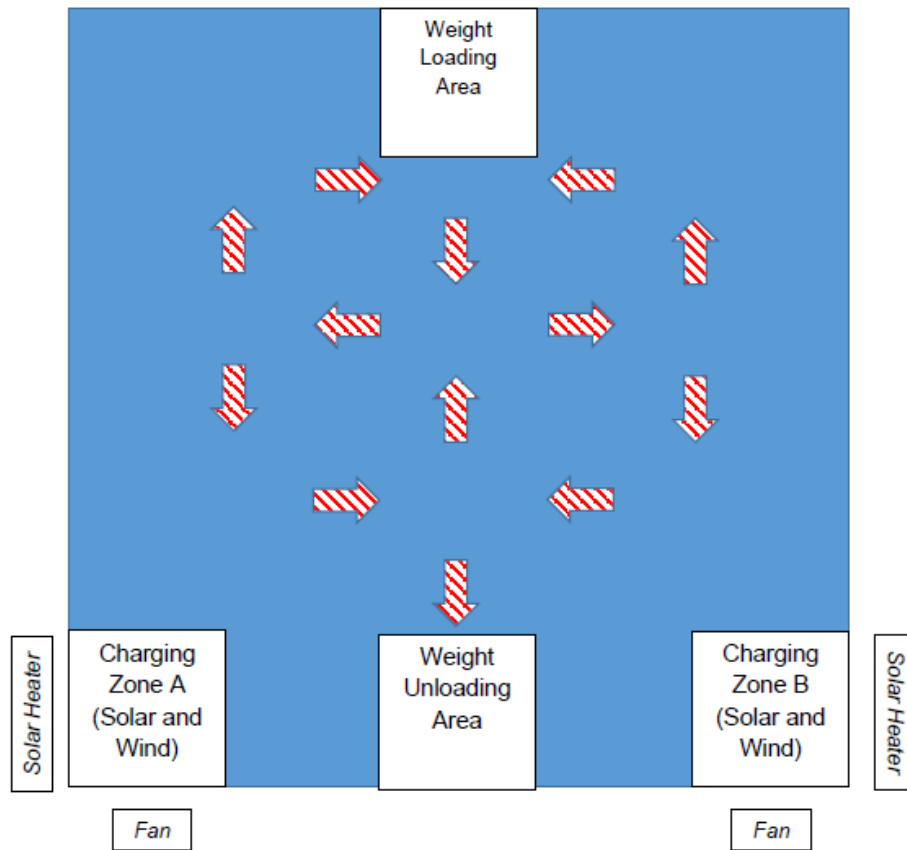
Nearly twenty percent of the energy consumed around the world to heat, power, or transport comes from renewable sources including biomass, geothermal, solar, hydropower, wind, and biofuels. Renewable sources now generate a quarter of global electricity, possibly rising to 45 percent by 2040. Much of the increase will likely come from solar, wind, and hydropower. The ability to generate these advances in technology will require the efforts of skilled engineers who need to appreciate the challenges involved in both collecting and using renewable energy. In addition, designing, building and operating “co-robots” -- robots that can assist other robots or people in accomplishing some goal – is an important skill to possess. This year’s competition requires teams to design and build a vehicle capable of collecting solar and wind energy to extend the duration of operation while of a remotely controlled vehicle that navigates a course and transports weights to earn points. The validation of your design is intended to take place at a face-to-face ASME E-Fest Student Design Competition and/or a virtual event to be held in spring 2021.

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 and tools the team would use to make minor repairs during the competition. This box must be less than 50 cm x 50 cm x 50 cm (internal dimensions). Throughout the competition, the device and any tools must fit completely and remain stored within the sizing box. *Do not show up at the competition without a legal sizing box and tools!*
3. The competition will take place over two days. Design modifications are allowed between the two rounds on Day 1 and before Day 2 rounds start. Devices must remain within the sizing box between all rounds on Day 2.
4. The demonstration field will be a 5-meter by 5-meter space marked on the floor by tape. (See Figure 1) Devices must stay within the tape during demonstration. The field will have four 1-meter x 1-meter areas: two Charging Zones that are specific to teams, a Weight Loading Area and a Weight Unloading Area that are used by all teams. There will be thirteen target arrows taped to the floor that will be used to earn points.
5. Teams must build a device propelled completely by **one rechargeable AAA battery** that is located on the device. **Competition batteries will be provided to each team by the judges** (AmazonBasics AAA Rechargeable Batteries rated at 800 mA-hrs) and teams will be given time to charge all batteries. The competition will start with the AAA battery fully charged; during the competition energy can be collected within the team’s Charging Zone to replenish the battery energy – teams will be assigned Zone A or B for each

- demonstration. The use of mechanical energy is allowed if it is generated by the energy collected, teams may not use pre-loaded springs or weights or initially compressed gas.
6. Devices must use the same AAA battery that propels the device to also power all device *control* functions: steering, braking, deploying energy collection systems, engaging the drive system, etc. An RC remote controller must be used by one team member to control the movement of the device. The remote controller may have its own battery, and this does not have to be rechargeable.
 7. If the competition takes place at a face-to-face E-Fest, the judges will provide the solar energy and wind sources for all playing surfaces:
 - The solar energy will be simulated by a *500W Utilitech Portable Halogen Work Light with Floor Stand* as the source of solar energy for each Charging Zone at the competition. (Teams may acquire this fan from a variety of online sources, such as Amazon, for design and testing, or may acquire any halogen light source for design and testing, it must be 500W or less.) At the competition, teams will be allowed to position the solar energy source near the edge of the Charging Zone at the start of their demonstrations.
 - The wind energy will be simulated by a Lasko model 3300 20" Wind Machine Fan with 3 speed settings as the source of wind energy for each Charging Zone at the competition. (Teams may acquire this fan from Amazon or other online sources for design and testing.) At the competition, teams will be allowed to position the wind energy source near the edge of the Charging Zone at the start of their demonstrations.
 - During the demonstrations, a team member will be permitted to turn on the two energy sources while the device is in the Charging Zone, and then turn off all energy sources when the device leaves the Charging Zone.
 8. All devices ***must be capable of recharging*** the AAA battery using either the solar or wind energy sources. Before the competition each team will be asked to demonstrate this capability to the judges – teams must prove that power is being provided to the AAA battery due to the solar or wind sources.
 9. Each demonstration will begin with the device in the Weight Loading Area. A team member may manually load weights in ½ kg increments onto the device for transport to the Weight Unloading Area. If the competition takes place at a face-to-face E-Fest the judges will provide all teams with uniform ½ kg steel plates that are roughly 8 cm x 8 cm x 1 cm in dimension. Teams will load between one and ten plates (from ½ to 5 kg) for each trip to the Unloading Area. Devices should be able to accommodate some variability in plate dimensions, and must also properly secure plates the device during the trip.

Figure 1: Playing Field (for face-to-face competition)
(5m x 5m overall size)



10. After a device is loaded as much as the team chooses, points are earned by traversing the Playing Field to the Unloading Area and driving over Arrows on the ground. Devices must be approximately centered over the Arrow when crossing it and must travel in the direction of the arrow. After a device has left the Loading Zone it may cross as many or few arrows as the team wishes before unloading the weights. Teams earn points for each arrow crossed as the device moves to the Unloading Zone; points are only awarded once per arrow during each round trip from Loading to the Unloading Zone. Points are awarded as follows:

$$\text{Arrow Scoring Factor} = (\text{Number of arrows properly crossed})/10$$

11. A team's points for each trip carrying weights from the Weight Loading Area to the Dropoff Area will be calculated:

$$\text{Trip Score} = \text{Arrow Scoring Factor} * \text{Total Weight Delivered to Dropoff Area}$$

12. A team's total points for each round will be the sum of all Trip Scores.

13. When the AAA battery on the device requires recharging, teams must drive their device to the team's assigned Charging Zone without any manual assistance, the Solar or Wind power source will be turned on, and the device recharged. If a device becomes stranded without power on the Playing Field, a team member will be allowed to manually place the device in the Charging Zone, however a time penalty will be assessed before the power sources can be activated – these time penalties are described below.
14. Teams may replace the AAA battery between any rounds, however replacement battery must be one of the batteries provided by the judges and should be stored in the sizing box throughout the competition.

Demonstration Setup Rules: preparing for testing, operator/device operation

15. Team devices will be brought to the testing area in the team sizing box.
16. One person from the team will remove the device from the sizing box and prepare the device to operate. Other than connecting power to the device and setting up to operate, no modifications are permitted during this setup time. There is no specific time limit on this setup, but **it must be done by only one person.**
17. The testing area surface will be reasonably level and may be either smooth or non-smooth (e.g. hard surfaces, carpet, or other flooring typically found in public areas).
18. Only one team member will be allowed to control the device when time is started. This person would also retrieve and place the device in the Charging Zone if it becomes stranded.
19. Teams are allowed to control their device with one remote control, operated by one team member. A second team member may load and unload weights, and control the energy sources in the Charging Area. All other team members must remain away from the playing surface area.
20. The duration of each device test is given in the following sections; if the device or devices are not able to continue, the testing round will be stopped.

Day 1 Testing Rules: initial rounds of performance measurement

21. During the first day of the competition, devices will be tested once without another competitor and a second time with another competitor on the Playing Field.
22. Multiple teams may operate their devices at the same time on several Playing Fields to expedite the competition. The number of simultaneously operating devices will be determined by the lead judge(s) at each EFest.
23. For the **Individual** testing round, each team will have 5 minutes to earn points after setup. If a device becomes stranded and must be manually placed in the Charging Zone, this will incur a 15 second time penalty each time.
24. For the **Competitive** testing round, two teams will compete on the Playing Field and will have 10 minutes to earn points after setup. The A and B teams will be randomly drawn. A team device may not enter the Charging Zone of the other team. If a device becomes stranded and must be manually placed on the starting ramp, this will incur a 15 second

time penalty for the first manual intervention, with the penalty increasing by 15 seconds each subsequent time (15, 30, 45, etc. seconds).

25. The final team score for the Day 1 Qualifying will be the sum of the points scored during the two test rounds. The top 16 scoring teams will advance to the Elimination Round Testing on Day 2 of the competition. The bracket is shown below. Ties will be broken using the performance score from the **Competitive** test round.



Day 2 Competition Bracket (with seeding based on Day 1 results)

Day 2 Elimination Testing Rules: head-to-head, knockout rounds

26. For the Elimination testing rounds, two teams will compete on a Playing Field based on the Competition Bracket set by Day 1 results. Rounds will last 15 minutes and the time will start when the first team declares that it is ready to start. The higher seeded team can select either the A or B position.
27. A team device may not enter the Charging Zone of the other team. If a device becomes stranded and must be manually placed in the Charging Zone, this will incur a 30 second time penalty for the first manual intervention, with the penalty increasing by 30 seconds each subsequent time (30, 60, etc. seconds).
28. If two teams are tied in any of the head-to-head competitions, there will be a tie breaker where both teams will place their devices in their Charging Zone and the first device to move to the Weight Loading Area, pick up a ½ kg load and move to the Unloading Zone is the winner.
29. Winning teams from each elimination game will advance and continue competing against each other until an overall winner is determined. A competition to determine 3rd place will be held between the semi-final losers.

Teams will have the option of participating in (1) only the face-to-face event at the in-person E-Fest, (2) only the virtual event at the Digital E-Fest, or (3) in both competitions. As we have previously stated, ASME cannot guarantee that all of these events will happen, but is working to provide both types of event. Information will be provided when final decisions are made.

The SDC rules provided above, as well as SDC Q&A responses that will be posted from September 2020 through February 2021 should provide all teams with the required information to design, build and test devices.

These comments apply to the Digital Competition:

- Teams will be required to build a competition playing surface that matches Figure 1, teams will have to provide AAA batteries specified in rule #5, solar/wind energy sources specified in rule #7, and weights specified in rule #9.
- Teams will be required to provide a Judging video in advance of the virtual competition. This would include confirmation of the playing surface, AAA battery, energy sources and weights. Details on this confirmation video will be provided as the ASME E-Fest Digital is finalized.
- Teams will be required to record and provide a video of their device in operation following the competition rules #15 - #29. The precise implementation of this will again be determined as the ASME E-Fest Digital is finalized. The desired format will be live demonstrations taking place simultaneously at each school, however it might be necessary to judge performances by recorded video submissions.