

Design Project No. 2
A Battery Powered Vehicle for
The 2004 Introduction to Engineering Tug-of-War

Specifications:

The purpose of this design project is to design a battery powered vehicle that is capable of competing in a tug-of-war contest with other vehicles in the introduction to engineering classes. The success of the vehicle will be determined by its ability to pull its opponent across a tug-of-war line.

1. The vehicle must have electricity as its sole source of power. This power must be contained solely in or on the car. No extension cords or tethers are permitted. The batteries may be of any size or voltage or kind. However, the vehicle may weigh no more than 16 ounces, or one pound. The vehicle must be autonomous, that is, it may not be remotely controlled by radio, infrared, or tether. The vehicle may be wheeled, tracked, legged or any other form of locomotion. The vehicle may not destroy the playing field but may attach itself to the playing field in a nondestructive manner in any way that it chooses. The vehicle must accomplish this by itself in an autonomous manner.

The vehicle may have any kind of wind up parts, compressed gasses or springs; however, any rocket motors, or any substance that burns or rapidly oxidizes in any manner is prohibited. (There must be no fire or smoke come from, or be contained in, the vehicle). The car may have any variety of mechanical, electrical or electronic equipment on board for the purpose of enhancing the performance of the vehicle, but this equipment must run off of the electrical energy on board. The vehicle may use any electrical storage device necessary but must derive its stored energy from the batteries on board.

2. The vehicle must be powered by an electric engine, or engines that are driven directly or indirectly by the batteries on board the vehicle.

3. The vehicle must be no greater in weight than 16 ounces and have a length no greater than 18 inches and a width of less than 12 inches. The height of the vehicle must not exceed 13 inches. The vehicle must be equipped with a hook on the rear of the vehicle that the tug-of-war line is hooked to. Failure of the hook causing the opposing vehicle to pull just the hook across the line will be considered a victory for the vehicle pulling the hook off the opposing vehicle.

4. The vehicle may be equipped with wheels, tracks, or other such similar devices for locomotion, or the vehicle may be equipped with such devices that would allow it to pull or push itself.

The Arena:

The arena or arenas, in the event that multiple contests are held, is four feet by eight feet. The arena is divided in half to produce two 4 feet by 4 feet areas. The arena is divided by

a black tug-of-war boundary line that the vehicles must drag at least 10 percent, or the opponents hook, across this line. The arena surface is made of a polycarbonate much like the surface of your desk. The arena has no sides or boundary; this means the team is responsible for catching its vehicle in the event that it goes off the playing surface.

In the event that a tug of war is in progress and winner for the match has not been determined, but one of the vehicles falls off the arena, the vehicle remaining on the arena surface will be declared the winner.

The form of the contest is a single elimination tournament. The winner of each round goes on to the next round. This means that when a bracket is called the eligible vehicle must be ready to participate. In the event that a vehicle can not be ready on the line within one minute of the time that his match is called, the vehicle will be considered in forfeit of the match and the opponent will move on to the next round.

In the event of an uneven number of teams one team will receive a bye in round one. The team receiving the bye will be randomly chosen.

Test Specifications:

1. Each of the vehicles will be weighed and measured to determine its conformity to the weight and dimensional requirements. Failure to conform will result in the vehicle being disqualified.
2. The battery configuration will be examined and the battery voltages will be measured to determine if the batteries are safe.
3. The designers will be responsible for placing his vehicle on the starting surface and starting or initiating the vehicle. The vehicle may be started with the assistance of the designer but after it is started the designer may no longer touch the vehicle.
4. Each vehicle must bear the team name. The name must be clearly visible while the vehicle sitting upright on its drive system.
5. The designers must clean up after their vehicle; i.e. if your vehicle trashes the arena it must be cleaned up by the designers of the vehicle so that the arena is in the same condition as before the designers used the arena.
6. The designer may not modify the arena. That is, he may not drill into the arena; nothing can be attached to the ramp or launching area except by the explicit action of the vehicle alone.
7. The vehicle may roll, fly, hop, or walk to perform its task...that is, no method of motion is ruled out, as long as the energy source is the battery.

8. In the event of a draw between two vehicles, the vehicle that is still running at the end of the contest will be declared the winner and will move to the next round. In the event that two vehicles break the tug-of-war rope the match will be restarted from the starting line.

9. Each of the vehicles must be supplied, at the time of the final test, with a document detailing the method by which the vehicle was conceived, the method of manufacture and the results of tests conducted on the vehicle prior to the actual test. The document must present the method and rationale for your design and any explanations that would inform the user as to the theory of operation of the vehicle. Any references used in the construction should be cited, any consultants used in the design procedure should also be named.

The report should contain a cost analysis of the design effort and give the cost of the individual test vehicle.

The report will consist of a title page, an executive summary or abstract, introduction, main body and conclusion. A list of references should be presented at the end of the report and the report should contain a table of contents and list of figures directly behind the title page.

The report must be supplied in a typed form on 8 1/2 x 11 plain white paper. The report must be in a folder that holds all of the pages of the report in a secure manner. The report must be turned in at the time of the time trial of the vehicle.

Grading Criteria:

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| 1. Success of the run | 50% |
| 2. Report of the design | 50% |

Success is defined as a best effort in the tug-of-war.

The final Test:

The final vehicle test will occur Monday December 6, 2004. The contest will be held in the atrium of the Sarkey's Energy Center. The contest will start at 3:00 pm and continue until a winner is determined.

The track will be available for test runs prior to the day of the contest. The track will be set up in the entry to room 213 of CEC for these test runs.

Good Luck.....