

ASM International is a professional organization dedicated to the dissemination of information about materials and education on the subject of materials. This includes their properties, uses, behavior, how they are manufactured, how new materials are created, and to a lesser extent how to design using specific materials. This competition is meant to bring the concepts of materials selection and the relative advantages of different materials to the forefront through the design of a CO₂ jet powered dragster vehicle.

The CO₂ vehicles for this competition are similar to those for the existing Technology Student Association competition that many students are familiar with except that we have fewer restrictions. Participants are encouraged to use whatever materials they judge best for their particular vehicles. Creativity is encouraged. Outside of safety during construction, testing, and on the race day, there are no restrictions whatsoever on materials used. The vehicle configurations need only conform to the regulations, specifications, and tolerances listed below.

The Eastern Virginia Chapter of ASM International would like to give special thanks to the Henrico County Public School System for kindly providing the use of their track and timing equipment and to William Batkins for donating his expertise and time in setting up and acting as event coordinator for this competition.

Safety is Paramount.

Care must be exercised in the fabrication and testing of your vehicle before the event. Appropriate safety precautions regarding the handling and use of your materials, and personal protective equipment (PPE) like safety glasses, dust masks, and gloves, must to be used if appropriate. Information about the use and precautions for handling of many materials is available, often on the internet, in documents called Material Safety Data Sheets. On race day, any mechanical failure or recognized potential for failure, especially separation of the vehicle from the guide line or separation of any component from the vehicle, may be grounds for disqualification at the sole discretion of the event coordinators.

General Requirements:

Each participant is limited to a **single entry** for the competition. Each entry must include the **two parts** listed immediately below.

Part 1: The participant will write and submit a one page document following the format outlined below describing what materials were selected and why they were selected for construction of the vehicle. This is the Material Description and Selection Document (**MDSD**).

Part 2: The participant will design and build a CO₂ jet powered vehicle according to the regulations, specifications, and tolerances listed below.

Race Day Procedure:

1. There are time limitations for the competition, so the number of participants is limited. Preregistration is encouraged as participants will qualify on a first come, first served basis until all spots are filled. Latecomers will be put on a waitlist and will be allowed to compete if time permits; however, registering

on race day is risky. It is possible latecomers will be allowed to compete only if others are eliminated due to safety concerns before time trials begin. Preregistration instructions can be found at easternva.asminternational.org. Look for **2017 CO2 Dragster Contest** on the main page under **Chapter Events**.

2. On the day of the competition, participants must check their entries in at the time and place stated in the program that may be downloaded from the web page listed directly above. **You must have both your vehicle and your MDSD in order to compete.**
3. Entries will be reviewed by contest officials to determine their safety on the track, among other things.
4. Safe vehicles will race for two (2) qualifying times, one on each lane of the raceway. The two times will be added together to produce the participants' **composite run times**.
5. Vehicles that do not meet both event and safety regulations will be disqualified.
6. The vehicles will be scored and the awards will be given based on the procedure described below.
7. Following the race, participants must pick up their entries from the display area at the time and place stated in the event program. Unclaimed vehicles will be discarded.

Scoring and Awards:

There will be two divisions for the competition, the Junior High Division (including younger participants) and the High School Division. There will be three cash prizes awarded in each division, \$50 for First Place, \$25 for Second Place, and \$15 for Third Place. Depending on participation on the day of the event, there may also be a Senior Division made up of college age and older participants, although there will be no cash prizes awarded in that division.

The six (6) participants within each division whose vehicles have **the lowest qualifying composite run times** will be designated as **finalists**. The prize committee will rank the finalists' MDSDs at the conclusion of the track runs. The **finalists** with the three highest ranked MDSD documents will be awarded First, Second, and Third Places in order of increasing composite run times. In other words, of the six best run times in a division, the participants with MDSDs ranked in the top half will win awards. **Note that this means participants with the best run times may not win prizes. A high quality MDSD (top 50%) and having one of the top six (6) composite run times are both requirements for winning.**

Example: The finalists (those with the lowest six composite times) for a division are shown below along with their MDSD rankings and prizes. The list is sorted from best (lowest) to worst (highest) composite run times. The best MDSD rank for the finalists is 1 and the worst is 6.

Name	Composite Time (sec)	MDSD Rank	Prize
Able	1.51	4	
Betty	2.14	2	First
Cora	2.53	5	
Dave	2.67	6	
Edward	3.08	1	Second
Francine	3.45	3	Third

Betty, Edward, and Francine won prizes because they had the best three MDSD write-ups of the six finalists. Betty won First Place because she had the lowest time of the three, followed by Edward and Francine. Note that Able, who had the best (lowest) composite time, did not win because his MDSD was not scored in the top half of the finalists (1, 2, or 3) by the prize committee.

Material Description and Selection Document (MDS):

MS1. Each participant **MUST** submit a clear, logical, and convincing document that describes the materials selected for the vehicle and the reasons for their selection. What are the advantages of the materials you used? What were the disadvantages of other materials that you considered? What materials would you have preferred to use? What prevented you from using them? Reasonable arguments could be made for many different materials.

MS2. Examples of some the factors that might be considered when selecting a material for a structure are:

Cost	Availability	Ductility	Transparency	Density	Toxicity
Strength	Formability	Recyclability	Stiffness	Toughness	Friction
Ease of Machining	Ease of Joining/Assembly			Durability	Safety

MS3. The document must be a single, letter sized (8 ½" x 11") page. It must have one inch (1") margins at the top, bottom, left, and right. It must be no longer than 300 words. The text must be typed or computer printed, double spaced, and 10pt to 12pt in size.

MS4. The participant's name, age, and school must be included at the top of the page.

MS5. Plagiarism is grounds for disqualification of the participant.

General Competition and Vehicle Regulations:

- The distance between the race track start and finish lines is twenty (20) meters.
- All CO2 cartridges for the race will be provided by the race organizer.
- No repair, maintenance, or adjustments will be allowed after the entries have been checked in. Any damage that occurs during the race will be evaluated by the event coordinator to determine whether or not the vehicle will be allowed to race again.
- The participant must place his name, age, and school name on his vehicle for identification purposes.
- Participants must allow the organizers to place decals on their vehicles if sponsors are found to support the event. All vehicles will carry exactly the same decals, so the added weight of the decals will be the same for all vehicles. No contestant will gain an advantage based on the decals.

Vehicle Specifications and Tolerances:

Vehicle Body	<u>Minimum</u>	<u>Maximum</u>
DB1. Body length	200 mm	305 mm
DB2. Body height, with wheels	-	75 mm
DB3. Body width at axles, both front and back	35 mm	42 mm
DB4. Total vehicle width including wheels	-	90 mm
Axles & Wheelbase	<u>Minimum</u>	<u>Maximum</u>
A1. Vehicles must have two (2) axles per vehicle, no more		
A2. Bottom of axle hole or bearing above bottom of vehicle	5 mm	10 mm
A3. Axle hole from front and rear of vehicle	9 mm	100 mm
A4. Wheelbase (axle distance apart at farthest points)	105 mm	270 mm
A5. Bearings, bushings, and lubricants may be used		
Spacer Washers & Clips	<u>Minimum</u>	<u>Maximum</u>
S1. Spacer washers	-	10

Power Plant (CO₂ Cartridge Hole)

P1. The power plant hole must be at the rearmost point of the vehicle and must be drilled parallel to the racing surface to assure proper puncture of the CO₂ cartridge. **Sufficient structure must be retained around the entire power plant to maintain structural integrity.** Do not paint inside the CO₂ cartridge hole.

	<u>Minimum</u>	<u>Maximum</u>
P2. Cartridge hole depth	48 mm	54 mm
P3. Cartridge hole diameter	19 mm	20 mm
P4. Lowest point of cartridge hole diameter above track	26 mm	40 mm

Eye Screws

ES1. Vehicles must have exactly two (2) eye screws per vehicle that meet tolerances ES2 and ES3 below, mounted on the bottom of the vehicle along the vehicle's center line. The eye screws may not make contact with the track. The track guide line must pass through both eye screws. It is the responsibility of the car designer to ensure that the eye screw holes are tightly closed to prevent the line from slipping out.

	<u>Minimum</u>	<u>Maximum</u>
ES2. Eye screw inside diameter	3 mm	5 mm
ES3. Distance between eye screws at farthest points	150 mm	270 mm

Wheels

W1. Vehicles must have exactly four (4) wheels, each one subject to the tolerances W2 and W3 below. All wheels must touch the track at the same time. All wheels must roll. Diameter and width of each wheel must be consistent for its full circumference.

	<u>Minimum</u>	<u>Maximum</u>
W2. Wheel diameter	30 mm	40 mm
W3. Wheel width	2 mm	18 mm