Robot Project Competition Guidelines and Rules

UCSD MAE 3: Introduction to Mechanical Engineering Design
SP26

Last Revision Date: 04/20/2026

Project: Duel for the Fuel

Written by: MAE 3 Spring 2026 Instructional Team

Changelog

This section will be edited as rules are changed so all changes are easy to track:

Sections	Changes/Addition	Date
Contest Specific Rules	Clarification on “self destruct” components and removed 16” maximum limit.	4/20/2026
Contest Day Rules	Removed limitation on robots staying on their side of the playing field.	4/27/2026
Scoring	Added wording for clarification of power plant location.	4/27/2026
3D Print Volume	Clarified and max volumn, and increased max volume to 64 inch squared	4/27/2026
Contest Table CAD	Added ½” thick plate under MAEnium tower in contest table CAD	4/27/2026

Disclaimer

Features of the robot contest are subject to change throughout the quarter if necessary to balance the contest or to meet manufacturing constraints. In particular, the points may be subject to change. Points will be finalized by Lab 5.

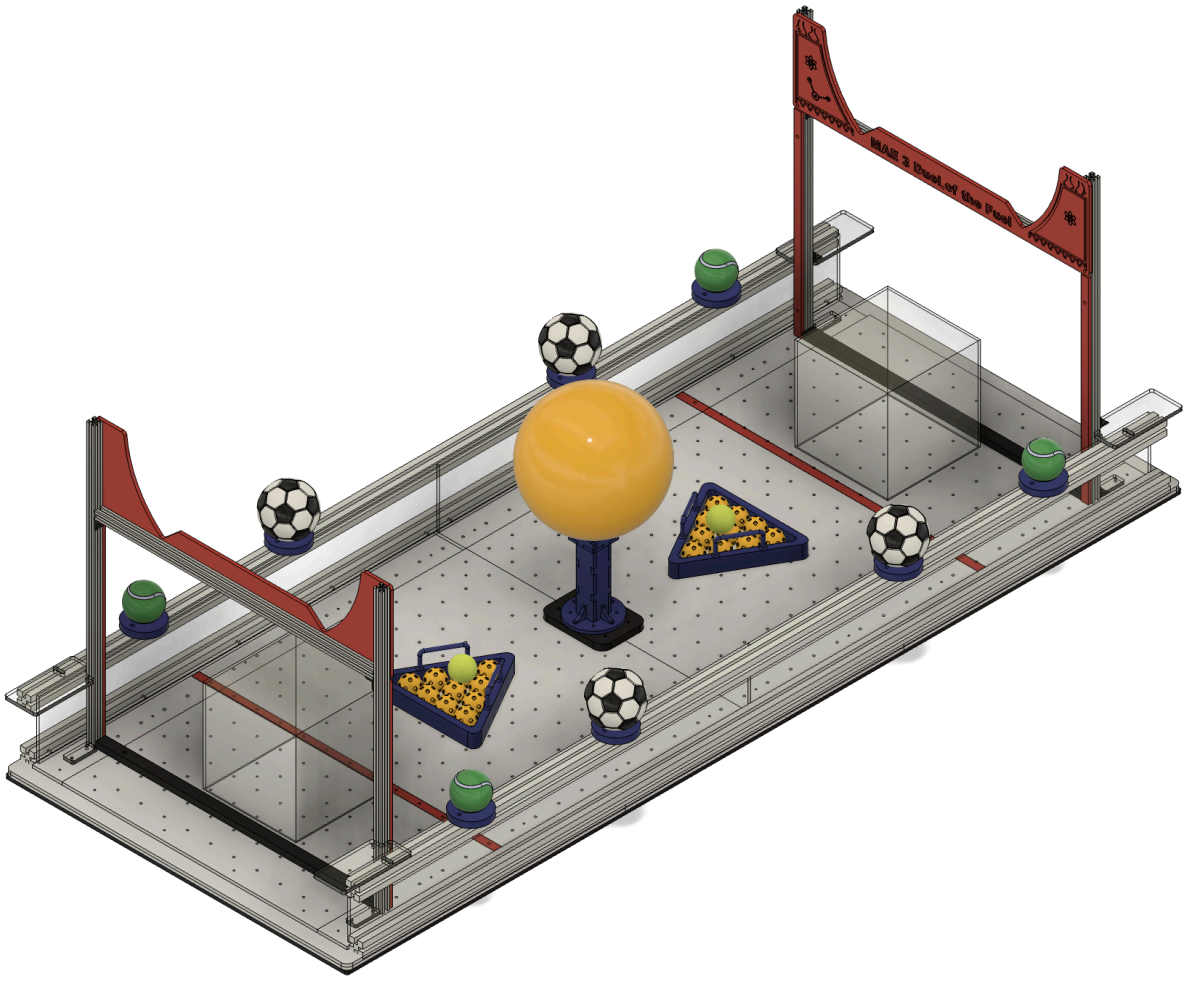
Overview

For the Spring 2026 MAE 3 Robot Contest, we introduce Duel for the Fuel!! Teams will harness newly discovered types of clean energy to compete and fuel the most efficient power plant. Each robot must collect fuel balls from around the contest field and deliver them to their respective plants. The objective is simple: gather as much fuel as possible to generate the highest energy score.

Two teams will compete head-to-head to collect, transport, and deposit fuel balls within the 60 second time limit. At the beginning of each match, fuel will be scattered around the playing field and begin leaking. You must collect the fuel quickly and bring it to your power plant's reactor to begin generating power!

Each fuel type carries a unique energy value or efficiency. As you collect each type of fuel, your plant will generate more power, increasing your plant's energy value. Some fuels have special behavior that causes your plant to increase efficiency or have a boost in energy production due to chemical reactions. Your team's responsibility is to construct a robot that collects as much fuel as possible and build the most efficient power plant you can! The victor is decided based on the total energy generation of your plant at the end of the 60 second time limit.

Playing Field



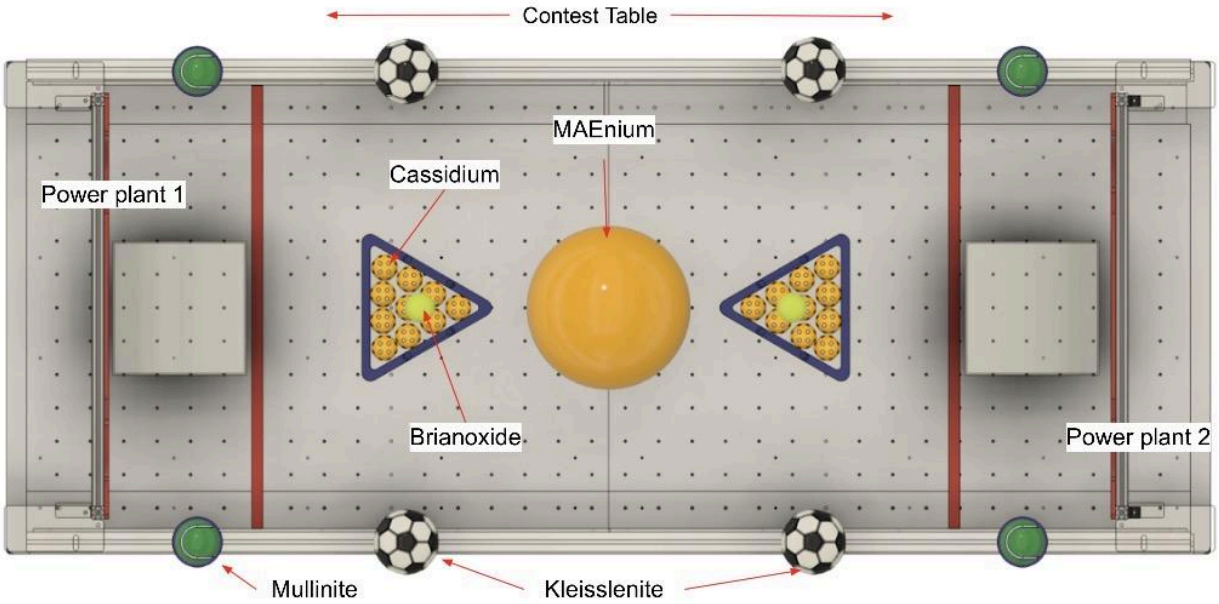
Scoring

Starting Parameters

Two robots will compete on either side of the contest table for **60 seconds**, with the goal of scoring the most points by retrieving various objects from all parts of the playing field and returning them to the Power Plant on your side of the field. The robots must fit in a 8x8x8in bounding box prior to the start of play and entirely behind the Power Plant HQ starting line 9in from the back of the field. This will be verified by test fitting a 8x8x8 in plastic box over the robots before the official play time starts.

Note that the robots must fit entirely in this box without pushing up against the box (i.e. the robot must remain under 8x8x8 in even after the box has been removed before the timer starts). Once the official play time begins, the robot will then be allowed to expand outside of this bounding volume under its own power. Once play time has commenced, no one is permitted to touch their robot or reach into the playing field.

Ball Placement



Various elements are placed around the contest table and must be collected to power your team's power plant. There are 10 Cassidium and one Brianoxide on the table surface on each team's side which begin leaking from their containment at the beginning of the match when the containment field is lifted. These balls are all worth 20 points alone if you collect them, but if you collect both of the Brianoxide on the table a chemical reaction occurs which makes them add 250 points together. There are also 2 Mullinite and 2 Kleisslenite in their fuel tanks at the perimeter of the table on each side. There is one MAEnium ball at the center of the table.

Ball Scoring

There are 5 types of ball each with a different point value, point values range as shown below.
Point multiplier for different types of ball:

BALL TYPE	POINT DIFFERENCE
MAEnium (Big center ball)	x1.5 (In the event of a tie, the team with the MAEnium ball will win)
Brianoxide (Yellow Rubber)	20 base (If you hold both at the end “Chemical Reaction” gives + 250)
Kleisslenite (Soccer)	100
Mullinite (Tennis)	80
Cassidium (Mini red wiffle)	20

Teams may score with any ball on the table, and must compete over who gets the only MAEnium ball. MAEnium acts as a catalyst for the fuels of this power plant and increases efficiency of power generation. Therefore, if the teams end with the same number of points overall, the team who has the MAEnium ball on their side or who has collected the MAEnium in their power plant will win. If a team collects both of the Brianoxide, they will get a 250 point bonus.

Scoring Summarized

Scoring Summary	
Cassidium	20
Mullinite	80
Kleisslenite	100
Brianoxide	20
MAEnium	x1.5
Chemical Reaction	250

sp26 robot contest scoring sheet

Template:

Team A			Team B		
	# of fuel	Points	Points	# of fuel	
Cassidium	0	0	0	0	Cassidium
Mullinite	0	0	0	0	Mullinite
Kleisslenite	0	0	0	0	Kleisslenite
Brianoxide	0	0	0	0	Brianoxide
MAEnium	0	0	0	0	MAEnium
Chemical Reaction	0	0	0	0	Chemical Reaction
	Total Points:	0	0	:Total Points	

Example 1:

Team A			Team B		
	# of fuel	Points	Points	# of fuel	
Cassidium	5	100	160	8	Cassidium
Mullinite	4	320	0	0	Mullinite
Kleisslenite	0	0	300	3	Kleisslenite
Brianoxide	1	20	20	1	Brianoxide
MAEnium	0	0	0	0	MAEnium
Chemical Reaction	0	0	0	0	Chemical Reaction
	Total Points:	440	480	:Total Points	
Team B					

Example 2 (Chemical Reaction):

Team A			Team B		
	# of fuel	Points	Points	# of fuel	
Cassidium	5	100	160	8	Cassidium
Mullinite	4	320	0	0	Mullinite
Kleisslenite	0	0	300	3	Kleisslenite
Brianoxide	2	40	0	0	Brianoxide
MAEnium	0	0	0	0	MAEnium
Chemical Reaction	1	250	0	0	Chemical Reaction
	Total Points:	710	460	:Total Points	
Team A					

Example 3 (MAEnium Tie Breaker):

Team A			Team B		
	# of fuel	Points	Points	# of fuel	
Cassidium	5	100	160	8	Cassidium
Mullinite	0	0	0	0	Mullinite
Kleisslenite	0	0	100	1	Kleisslenite
Brianoxide	2	40	0	0	Brianoxide
MAEnium	0	0	130	1	MAEnium
Chemical Reaction	1	250	0	0	Chemical Reaction
	Total Points:	390	390	:Total Points	

Team B

General MAE 3 Competition Rules

Competition Operation

- Robot setup time on the contest table cannot exceed 2 minutes per round.
- Manufacturing variations will exist between playing fields. It is the team's responsibility to design a robot that will work on all contest tables.
- Robots will compete in a head-to-head competition. However, operation of the robot without an opponent will be an important part of the robot grade.

Contest-Specific Rules

- All parts of your robot must be behind the starting goal line at the beginning of the match and be contained within an 8x8x8in volume until the match starts
- If a fuel ball enters either team's net at any point during the game, it counts towards their score, and cannot be removed at any time.
- Robots can interact with each other and are allowed to push each other. However, robots cannot be purposefully designed to damage another robot. Examples of designs that are not allowed include design features that are meant to penetrate, flip, or cut another robot, or that its primary intent is damaging another robot
    - Components designed to “self destruct”, or intentionally break themselves when coming in contact with the opponent’s robot are not considered intentionally damaging by the opponent’s robot and cannot be used to disqualify the opposing team
- Any components of your robot that detach from the robot at any point with any velocity must have a minimum frontal area of 3x3 inches
    - For the purpose of this competition, “detach” means that a component becomes no longer connected to another part of the robot by rigid material, even if it is still attached by a non-rigid material like string, it is still considered to be “detached”

CAD Rules

- All CAD used in the robot project must be your own original work, excluding CAD files and tools shared on the MAE 3 website.

Manufacturing

- Each robot must **only be built out of kit parts** provided.
- Robots must be built in the Design Studio **only using Design Studio tools**.
- The disassembled robot must fit in the team's locker, where it must be stored.
- Cable ties (zip ties) can only be used for strain relief.
- Purposefully using the electrical cables for any purpose other than transmitting electricity is not allowed.

- Kit materials may not be changed chemically. DC Motors may not be rewound.
- The insulation must remain on the electrical wire in the kit except where the wire end is attached to another component, and there may be up to 0.5” of insulating can be removed.2 m

Playing Field

- Damaging the playing field or the control boxes may result in disqualification.
- Gaining traction by use of adhesives, or by abrading or breaking the surface of the playing field is not allowed. However, it is permissible for a team to bolt a stationary robot to the table using the existing mounting points on the table.
- A machine may not contaminate with lubricant or other substances the playing field or an opponent's machine (internal lubrication of a machine is permissible).

Kit Parts and Use Guidelines

Each machine must be constructed solely from materials provided in the Kit Parts list (List attached below). Some key points on these guidelines are:

- No foam core allowed in the final robot (as stated in the kit parts list).
- The wire and string are “serve-yourself”, but are limited in length as noted.
- The paper cover on the acrylic parts is not to be used as a separate part. If it is detached from the acrylic, it must be discarded.

In addition to the kit parts listed in the table, the following items may be included in the machine:

- Nuts, bolts, and washers included in the Design Studio bin. These include bolts from size 2 to size 10, and metric screws for mounting the motors.
- Only take nuts and bolts from the bin as you need them, and **search through the spare bolt bin** before taking more (we went through $1,500 in fasteners last year!).
- Adhesives are allowed, including acrylic adhesive and hot glue, but should only be used when necessary. Hot glue is only allowed for non-structural components like strain relief, and excessive use of glue in the final robot will lead to reduced points on the final robot grade.
- Tape used ONLY for electrical insulation.
- Lubricants used only to reduce friction within one's machine (not on the contest table).
- Nonfunctional decorations. These are encouraged!

Replacement Material Policy: We have some extra material that can be used for experimentation. This material will be made available in the lab scrap bins. In addition, each section tutor has access to a limited amount of replacement material for their

section. If you need replacement parts, contact your tutor. Some replacement of "mistakes" made to kit parts will be available, but supplies are limited, and replacement is not guaranteed.

Electrical Power

The robots must be powered solely from electrical power transferred through the power cord, and from potential energy stored in the robot at the start of the contest. The kit includes 4 geared DC motors, and 2 non-geared DC motors. Electrical power will be provided from a power supply with a maximum of 5V DC output. The power will be controlled by the following switches:

- Two Fixed 5 Volt DC switches
- Two Variable Voltage switches (0 to 5VDC) with a user-controlled knob to adjust the voltage.

Each switch is Double Pole Double Throw (DPDT) switches, which can operate a DC motor in either direction. Note the kit contains six DC motors, but only four user-controlled switches. More than one electrical device can be connected to a single switch, but the voltage may drop if a large current draw is placed on the power supply. Use of motors, solenoids, and switches will be covered in lecture and is described in the course pack.

Review the Power Supply and Multimeter Use carefully. Issues with the electrical power often occur with the Variable Voltage switches, since the maximum current output is less in these switches. The non-geared motors draw high current and startup problems may occur if multiple non-geared motors with high loads are tied to the variable voltage source!

3D Printed Parts

Each team may have parts made in the Design Studio's 3D printers under the following guidelines.

- The combined volume of all 3D printed parts may not exceed 64 cubic inches per team. (***Note: All print must fit in the 4x4x4 inch cube AT THE SAME TIME***)
- Individual printed parts must fit within a 4x4x4in cube.
- Team members must create the CAD files for all 3D printed parts, except for gears, timing belt pulleys, and selected parts that will be posted on the MAE3 webpage.
- Teams can experiment with 3D printing and parts that are not used on the robot will not count towards the team's total. However, priority to the 3D printer will go to students working during their section time and to teams which have not yet

used 3D printers as much. Use of the 3D printer may be heavy during the final weeks of the class, so do not count on readily available access at that point.

Furthermore, students are allowed to use/access other 3D printers, on or off campus, provided that the material used to print the final robot part is PLA.

Energy Sources

The energy used by the devices in the competition must come solely from:

1. Potential energy derived through a change in altitude of the center of gravity of the machine
2. Potential energy achieved by the deformation of the springs provided by the kit
3. Electrical energy derived through the umbilical during the 60 seconds when the power supply is energized.

Contest Day Details

The contest will be held during the MAE finals period and will be open to the public. The contest will be held in a single elimination fashion (like a tennis tournament). During the lab period of the last week of classes, each section will hold a section-wide contest. The results of this contest will be used to seed the placement of the final contest. Thus, teams that perform better during their section contest will have statistically easier contests in the early rounds. Since the number of teams in the class will not be exactly a power of 2, the higher seeded teams may get a "bye" during the first round. If necessary, "wild card" teams will be selected to have a second chance in the contest, to ensure that all pyramid spots are filled.

For each round of the competition:

1. Contestants will randomly be assigned to start on either side of the playing field.
    a. Variations exist between contest tables, robots are expected to be able to perform regardless of what table they are assigned to.
    b. Judges and/or instructors will disqualify any robot that appears to be a safety hazard.
2. A maximum set-up time of 2 minutes will be allowed at the contest table.
    a. Configuration of the machine is permitted between rounds; for example, adjusting the configuration to the side of the playing field the machine starts on.
3. During each round, operators may interact with their machine during a contest only through normal operation of the switch boxes (for example, you cannot touch the machine with one's hands during operation).
    a. Furthermore, each machine can only interact with the surface of the playing field and objects on the playing field.

4. After sixty seconds have elapsed, each team will stop providing input to their robot through their controllers
    a. Failure to stop at sixty seconds will result in disqualification
5. The judges will wait until all the playing pieces have stopped moving before determining the winner.
    a. Points will be awarded based upon the final location of the playing pieces, regardless of which machine moved them
6. A maximum of 1 minute will be allowed for removal of all parts of each machine after each contest.

Performance in the contest depends on numerous factors that do not relate to engineering quality of the robot, including driving skill and luck!
The grade for the project will not be adversely affected by poor performance in the contest, *but will be based upon*:

1. Performance of the machine without an opponent. A video record of the robot performance at its best should be included in the team's oral presentation and on the team's website.
2. Effective communication of the design (orally and in final reports).
3. Documentation of the design process and justification of decisions made.
4. Analysis of machine performance in the robot reports.
5. Following good design practices.

A trophy will be presented to each member of the winning teams, and a number of machines will be selected for display in the Design Studio. Team members must work out among themselves who will keep the final machine (after their display period). Teams will post presentations and a video of their robot on the class web page, which they can cherish forever.