

The Tucson Pumpkin Toss

Official Competition Specification



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1.0 Competition Overview

Teams will each build one catapult capable of throwing 4lb pumpkins to compete for maximum distance up to 100m and destructive accuracies against moveable targets. The contest will be held on October 13, 2013, on the mall at the University of Arizona. No weight restrictions exist. In the case of a tie in score, the total catapult mass is the criteria used to determine a winner. Contestants must also be able to move their devices to and from firing positions due to the limited size of the UofA mall. Separate categories exist for gravity powered machines (Trebuchets) and torsion powered machines (Onagers). Qualification will occur in the morning, followed by official competition in the afternoon.

Distance: Each team will get two distance attempts, with points being awarded for the longest range, up to a maximum distance of 100m. Catapults exceeding 100m will only receive points for 100m.

Accuracy: Each team shall get two shots to hit a target constructed of one 4x8 foot piece of plywood placed at a distance of their choosing. Points are awarded by how close the team comes to hitting the target, with score doubled for a hit.

Combined: Distance and accuracy scores are combined to produce an overall winner. Maximum scores in these two categories will be equally weighted for this purpose.

Castle Bombardment: Following the competition, a castle-like target will be built 50m distance from the firing line, and any competitors may choose to participate in a free fire event to destroy it. This is not a part of the competition, but it will be fun.

1.1 Competition Categories:

Trebuchets: These are defined as machines which are powered strictly by the release of energy from a dropping counterweight mass (or masses)

Onagers: These are defined as machines which derive their power from the mechanical deformation of ropes, springs etc.

2.0 Rules

2.1 Materials

It is intended to allow contestants the widest possible choice with respect to building materials, however, lead is not allowed, and judges are empowered to disallow any other materials which they deem to be unsafe.

2.2 Building

1. Device extent shall be limited to fitting within a 10 foot wide by 12 foot long plot. There is no height or mass limit. Slings and throwing arms may exceed the front and rear bounds during firing.
2. Projectiles shall consist of common unmodified orange pumpkins, weighing no less than 4.0 lb, and supplied by the contestants.
3. In addition to a remote trigger or lanyard, machines must be equipped with a safety device sufficient to prevent accidental firing.
4. All machines will be fitted with an appropriate mechanical trigger that shall be used for every shot.

5. Machines may not use compressed or ignited gasses or liquids or combusting materials of any kind.
6. Turnbuckles and eye bolts. When used in or attached to the source of power for a machine, these items shall be rated to withstand 150% of the forces produced (e.g., if the cable attached to a turnbuckle will support 100 pounds of tension, the turnbuckle will be rated at 150 pounds of static load). Hardware store and home center hardware is often of low quality and rating, while aircraft or marine grade hardware is generally more appropriate. Judges shall have the authority to disqualify a participant if a load or rating level is not documented and is deemed hazardous.
7. All softwoods and non-laminated hardwoods, when used as a throwing arm or bow arm for a machine, shall be secured against breakage with a minimum of two layers of strapping tape with visible fibers (not duct tape) and opposing plies. It is recommended that all throwing arms not made of metal be wrapped in some form, using glue or polyurethane sealer soaked sisal or jute string, parachute cord, nylon cord, fiber glass, or other reasonable wrapping.
8. Machines may be mounted on sturdy wheels. This will become increasingly necessary as the number of contestants increases and there are only 5 slots available on the firing line.

2.3 Operations

1. The furthest extent of the forward part of the device prior to launch shall not extend over the reference (firing) line for measuring distance
2. Launch debris (other than the projectile) landing on the ground in front of the firing line after launch shall disqualify that particular throw. Exception: slings can hit the ground after launch.
3. Pumpkins are not to be altered in any way excepting official marker paints and/or removal of stems. Pumpkins shall be launched in their natural state.
4. All Machines must be able to fire within three (3) minutes of go-ahead signal if the number of competitors requires it. Firing order will be established ahead of time so that teams can be ready for their throw, and loading in parallel with other competitors is allowed given judge approval.
5. Stakes may be used to help anchor the device, but otherwise, no holes may be dug in the ground.
6. In the event of a pumpkin fragmenting in launch or flight, the minimum range fragment will count for range.
7. Loading operations shall not extend forwards of the firing line to ensure safety when other teams are loading and firing in parallel.

2.4 Safety

1. In addition to a remote trigger, all machines must have a 2nd safety strap or mechanism to hold the throwing arm or boom in case of early fire when loading.
2. Machine crews are responsible for the safe operation of their machine during the contest. They are to make sure that their crew and all other machines' crews are clear of moving parts and that no one is directly in front of, or behind, the machine when it is discharged.
3. Hard Hats and Eye Protection are to be worn by all team members participating in the launch activity.
4. All teams shall include at least 1 actively engaged adult of age 21 or greater.
5. No person shall be less than 4 feet away from the plane of the throw at launch. Incursion into the neighboring team's plot is allowed if judges determine it does not effect their operation.
6. An air horn, or similar warning device shall be sounded just prior to launch for the purpose of alerting surrounding personnel of an imminent throw.
7. Alcoholic beverages are not allowed.

8. Judges have the authority to stop any activity deemed unsafe. Failure to comply with safety instructions from the judges shall result in disqualification.
9. All personnel in the backrange area shall be required to wear hardhats.

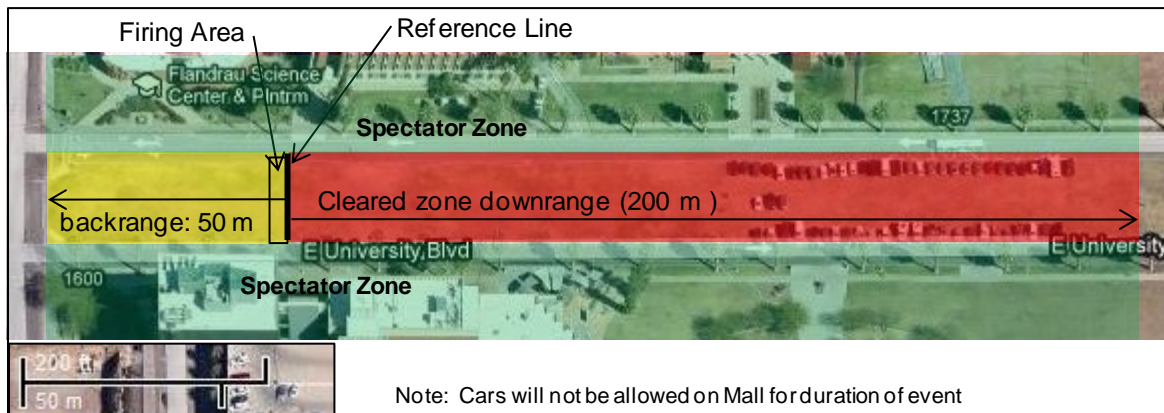


Figure 1: Competition Range Setup at UA Mall

2.5 Inspections

1. As a basis of reference, machines will be constructed so that the major frame works shall be durable enough to sustain being tipped over on its side and remain stable. While machines will not necessarily be tipped over for inspection, it will be the standard used by judges, and may be used as a determinant in allowing or disallowing any machine.
2. Preliminary inspections of the machine will be made before it is discharged. The judges will check for structural integrity of the components of the machine.
3. The operational demonstration phase of the inspection shall, at a minimum, consist of two shots from the machine configured for the maximum power it will use during the contest. These two shots shall consistently deliver a 4lb. pumpkin, or reasonable substitute, downrange without mechanical failure, in a reasonably straight trajectory. Variance for wind is allowed.
4. Static inspection for stability of the machine and mechanical observation of the framework and mechanism shall be made after the firing.
5. Machines will be weighed after the contest if there is a tie in score; either in range, accuracy, or for overall score. Machine weight includes all items attached to the device prior to execution of a maximum distance shot. This includes trebuchet counterweights.
6. There will be open, non official measured shooting from 8 a.m. until 11 a.m. (TBR). All inspections and qualification shots will be done at this time.

3.0 Range setup

The competition will be held at the University of Arizona on the center mall. Devices shall be set up along a distance reference line with 200m of cleared distance in front and 50m of cleared distance in back as shown in figure 1. Areas will be set up on the north and south sides of the firing line for spectator viewing.

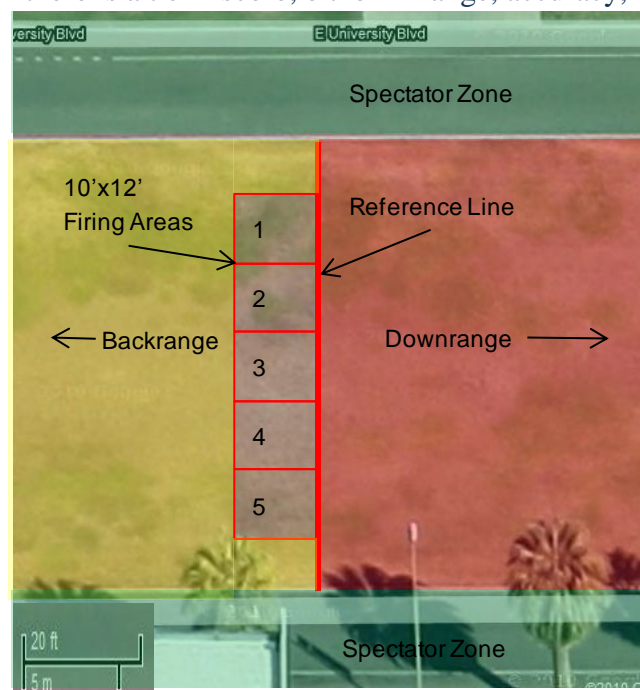


Figure 2: Firing Area Setup

Devices will be checked-in by the judges upon arrival prior to the competition to determine their compliance with the rules. This activity shall include two test firings of the device to demonstrate safe operation to the judges.

Each of the firing plots shall be 10 feet wide and 12 feet long. With the exception of the trigger lanyard and the person pulling it (see safety rule 4 above), no part of the device may contact the ground outside this area before launch. Figure 2 shows a closer image of the firing area with rough layouts for each of the 10x12 foot plots on the firing line.

4.0 Competition Scoring

4.1 Range

Each device is allowed two shots, with the maximum of the two being used as the official range score. Scoring distance is defined as the downrange component of the pumpkin's impact point (not slant range). Shots fired into the spectator or backrange zones score zero (0) meters. Shots exceeding 100m will be scored as 100m.

Should multiple teams achieve the maximum 100m range, the catapult with the lowest total mass (including counterweights) wins.

Example 1: Device#4 shoots 73m on the first attempt, but misfires on the 2nd shot, receiving a 0m score. The resulting distance score for Device#4 is 73m.

Example 2: Device #2 and #3 both exceed the 100 m maximum distance. Device 2 weighs 125 lb while device 3 weighs 210 lb. Device 2 wins the distance competition on the strength of its lower weight.

4.2 Accuracy

An 8 foot wide by 4 foot high wall made of plywood shall be placed by the judges roughly in front of the device at a downrange distance chosen by the contestants, but less than 100m. Two shots are allowed at this target, and a raw score is downrange distance minus miss distance; where miss distance is measured as the shortest distance from the impact point to a point on the wall. Scores are doubled if the wall is hit. The best of the two tries is taken for score. Ties are resolved in favor of the lighter device.

*Example 3: The Trebuchet #4 team has the target setup at 35m downrange. They hit 5 m away on their first shot and hit the wall on the 2nd shot. The first shot scores $35-5 = 30$ points. The 2nd scores $2*35 = 70$ points, which is used as their overall accuracy score.*

4.3 Combined Competition

The range and accuracy scores are scaled to each be worth a maximum of 100 points each and then summed to provide an overall score. These adjusted scores are established by giving the winner of each category 100 points, and scaling the others down proportionally to zero depending upon their raw score.

Adjusted scores derived from the distance contest are complicated by the total mass contribution to those shots exceeding 100m. The catapult with the lowest total mass exceeding 100m receives 100 points. Any other catapults exceeding 100m receive an adjusted score pro-rated down by the ratio of their mass compared to that of the winning catapult. The adjusted score of those remaining catapults (which did not reach 100m) is further pro-rated down by range, starting from the lowest score achieved by catapults exceeding 100m.

Example 4: Onager #2 and #5 exceed 100m distances with ranges of 104 and 113 m respectively. Onager #2 weighs 210 lb while Onager #5 weighs 277 lb. Onager #2 wins the distance competition receiving 100 points due to its lower total weight, and Onager #5 finishes 2nd, receiving an adjusted score of $100 \cdot (210\text{lb}/277\text{lb}) = 75.8$ points. Onagers #1, #3 and #4 received distances of 23, 32 and 98m respectively, so their adjusted scores (which do not depend on weight) are $75.8 \cdot (23/100) = 11.6$ points, $75.8 \cdot (32/100) = 24.3$ points, and $75.8 \cdot (98/100) = 74.3$ points respectively for the distance contest.

Accuracy scores are also pro-rated down from the maximum raw score value. The winner receives 100 points, and with others receiving scores adjusted by the ratio of their performance divided by that of the winning catapult in their category.

Example 5: Trebuchet #4 wins the accuracy contest with a raw score of 70 points (see Example 3 above). They therefore receive 100 points towards the combined competition. Trebuchet #1 has a raw accuracy score of 44, which pro-rates down to $100 \cdot (44/70) = 62.8$ points.

Total combined scores are established by summing the resulting adjusted scores for distance and accuracy. The total possible score for a given catapult is therefore 200 points. Ties are decided in favor of the catapult with the lower weight.