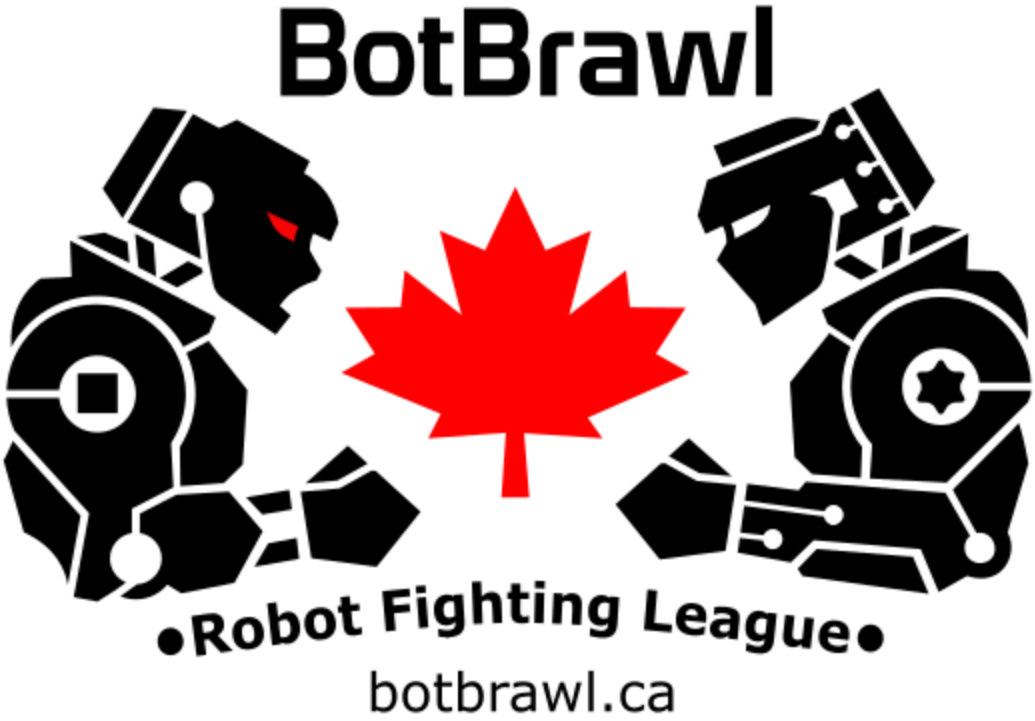
BotBrawl Events Inc.
Official Ruleset



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Introduction

a) About BotBrawl

BotBrawl's purpose is to provide a safe and regulated avenue for teams to fight home-made robots against one another. We offer standardized rules, venues, arenas, and most importantly we foster a community of like-minded teams who share this wild hobby.

Use your knowledge of wood working, welding, programming, and electronics to design and build your very own fighting robot. Building bots is a great way to learn and master a new skill or to rekindle your love of all things metal. It's time to put those shop skills to work and enter the world of combat robotics!

We host events throughout the year in southern Ontario, everyone is welcome to join our ranks! Check out our social media to join the community.

b) How to Use This Ruleset

BotBrawl Events Inc. uses a modified SPARC (Standardized Procedures for the Advancement of Robotic Combat) ruleset, which are available at http://sparc.tools/ for viewing. However, some rules have been modified/removed for BotBrawl's purposes, and it is up to the combatant to review this ruleset prior to competing. All applicable rules for the specified section will be in that section, and if it is not, the previous section should be referenced. If you have any questions/concerns about BotBrawl's events or robot designs, please send an email to info@botbrawl.ca.

Updates from the last version of this document will be shown with a red marker beside the line with the updated text. This is an example of what that may look like. Note that only a portion of the line beside the red marker may have been updated.

Section 1

Combat Classes

1. Match Overview

The Match Overview section will outline the various procedures that can take place before, during, or after a match. The event organizers hold the right to make changes to these procedures at any time, and without notice.

a) Robot Load In and Activation

In arenas where robot power-up is possible with the driver not standing on the combat area preference will be given to that method.

- The combat area is defined as the region of the arena where active combat occurs. This would exclude gutters between internal barricades in the arena and the arena walls.

Priority for load in is as follows:

- Least dangerous robot being activated by someone inside the combat area.
- Most dangerous robot being activated by someone inside the combat area.
- Least dangerous robot being activated by someone outside the combat area.
- Most dangerous robot being activated by someone outside the combat area.

The process for activating a robot is as follows:

- The robot is placed in a stable position on the combat area with the drive wheels oriented such that when they come in contact with the combat area the direction of travel will be away from other robots, persons, and entry doors. If the robot has a weapon that is aimable it will be aimed at the wall furthest from the arena entry door.
- Weapon covers are removed.
- The transmitter is turned on.
- The main power is turned on.
    - If separate, weapon power is turned on. This applies to both a separate power loop and non-electrical power systems. (i.e., pneumatics)
- Weapon locks are removed.
- If the robot is being activated by a person inside the combat area, they then exit the arena, otherwise the robot is driven to the starting square from their power on location.
- No movement or functional testing is permitted while anyone is in the combat area.

Once both robots are activated and in their starting areas, the arena access point will be closed, and a maximum of 20 seconds will be allowed for a brief weapon/drive system test if the drivers desire. No weapon testing of any sort will be allowed prior to the arena door being closed. In the event that

the arena is equipped with multiple access doors, and each robot is loaded through a separate door, the door will be opened to allow load in then shut once the operator is out of the arena.

After this, the arena manager will ask both drivers if they are ready and the fight will begin.

b) Post-Fight Activities

At the end of the fight, both robots cease movement and allow their weapon systems to de-energize. Once the weapon systems have been de-energized, the judges may request that one or both robots demonstrate that either their drive or weapon system is still functional.

- Demonstration of drive system functionality will be done by the robot returning to its starting location.
- Demonstration of weapon system functionality will be done by the robot returning to its starting location and briefly applying power to the weapon system to show that it is still operational. The robot will not spin to full speed during this demonstration.

Once this is completed, the robot deactivation and load out procedure can begin.

c) Robot Deactivation and Load Out

In arenas where robot power down is possible with the driver not standing on the combat area, preference will be given to that method. In the event of an unexpected situation, the order in which robots are powered down may be altered by the arena manager.

Priority for load out is as follows:

- Most dangerous robot being deactivated by someone outside the combat area.
- Least dangerous robot being deactivated by someone outside the combat area.
- Most dangerous robot being deactivated by someone inside the combat area.
- Least dangerous robot being deactivated by someone inside the combat area.

The process for deactivating a robot is as follows:

- The weapon system is disabled. This includes any applicable weapon locks, power cut-off and venting. The exact order of this procedure will be left to the discretion of the builder as differing designs may necessitate different safe shutdown procedures.
- The main power is turned off.
- The transmitter is turned off.
- Weapon covers are reinstalled.

- If the robot is able to be removed from the arena without a cart/assistance it may be removed at this time, otherwise robots will be removed from the arena once all robots have had their weapon locks installed and are powered down.

d) Emergency Deactivation Procedure

In the event of an emergency (for example: one or more robots on fire) the standard procedure does not apply. The following attempts to address the vast majority of possible situations that are likely to occur:

- One robot is burning and the other is mobile:
    - The mobile robot is to move to the wall furthest from the arena entry door and align its drive wheels parallel with the wall. If the robot has an active weapon, it is to immediately begin dissipating stored energy (spinning down, release for spring actuated weapons, etc.) and if possible, bring it next to or into contact with the wall it is aimed at.
    - Once the working robot is in position, the arena manager will enter the arena and extinguish the fire, then, if possible, remove the robot from the arena.
    - The operator of the non-burning robot may then proceed with normal load out procedures.
- One robot is burning and the other is immobile:
    - If the immobile robot has an active weapon, it is to immediately begin dissipating stored energy (spinning down, release for spring actuated weapons, etc.) If the robot retains some degree of mobility but cannot move in a reliable manner it will attempt to angle itself such that any weapons that are aimable are aimed at the wall furthest from the arena entry door.
    - Once the arena is able to be entered safely, the arena manager will enter the arena and extinguish the fire, then, if possible, remove the robot from the arena.
    - The operator of the non-burning robot may then proceed with normal load out procedures.
- Both robots are burning:
    - Both robots will, if applicable, immediately attempt to dissipate any stored energy systems and will attempt no other actions.
    - Once the arena is able to be entered safely, the arena manager will enter the arena and extinguish the fire, then, if possible, remove both robots from the arena.

- One or more robots are burning during a rumble:
    - All mobile, non-burning robots will move to the closest arena wall that is not used to access the arena and begin dissipating stored energy.
    - All immobile robots will immediately begin dissipating stored energy and will perform no other actions unless they are able to rotate such that they are able to angle any aimable weapon systems at the wall furthest from the arena entry door.
    - Once the arena is able to be entered safely the arena manager will enter the arena and extinguish the fire, then, if possible, remove the robot from the arena.
    - If there is time left, the match will be allowed to resume.
- One or more robots are acting erratically/stuck on
    - The operator(s) of the robot(s) will turn off their transmitters to attempt to activate the robot's failsafe.
        - If this works, then normal load out procedures will resume.
    - In the event that the robot(s) are still acting erratically the robots will be allowed to drain their batteries until they are safe to approach.
    - Should a robot in the arena still be fully functional, no weapon system be active on the malfunctioning robot and all involved operators agree to it the operator of the still working robot may attempt to pin and prop up the malfunctioning robot such that its wheels are no longer in contact with the ground. The operator of the malfunctioning robot will then be allowed to power off their robot. Once powered off they will exit the arena and the robot that was pinning the malfunctioning robot will be allowed to go through normal load out procedures. The malfunctioning robot will then complete its load out procedures.

e) Emergency Match Stoppage Procedure

In the event of an arena breach, damage to the arena that renders it unsafe, or any other event that is otherwise judged a safety risk by event staff, the match shall immediately be halted.

If a competitor continues to fight after the arena manager has called for the fight to be stopped, they will be disqualified. Repeated infractions will result in removal from the tournament. It is the responsibility of the driver to ensure that they respond promptly to the call to stop fighting.

Once fighting has ceased, the robots will be deactivated. The deactivated robots may be left in place or moved to a safe location in or around the arena until a determination about the status of the fight is made. No work may be done on the bots during this time. The source of the safety issue will then

be inspected to determine the appropriate action. Once the issue has been resolved, a determination will be made as to whether or not the fight will resume. If possible, the fight will resume from the point where it was paused. If resuming the fight is determined to not be possible due to a safety concern or other issue, the fight will be judged up until the point where it was stopped.

The safety of the crowd, competitors, and crew must always be considered when determining if any additional measures need to be taken beyond resolving the immediate safety issue.

f) Match Frequency

All competing robots will be given a minimum of 20 minutes between matches. The 20-minute timer will begin when a winner is decided from the previous match, and the competing robots are expected to be in the arena before the timer ends. Additional time may be granted if a competitor is competing with multiple robots if time allows. Should there be time conflicts (e.g., the venue is closing shortly), the time between matches may need to be shortened. Should this be the case, all competitors will be notified as soon as the event organizer is aware.

g) Postponements

Each robot will be awarded 1 postponement to use per day. A postponement will provide you an additional 20 minutes before your next fight, beginning at the moment the postponement is granted. To use a postponement, a team representative must notify the arena manager that they wish to use a postponement. The event organizers retain the right to modify any postponement rule before or during an event. All postponement rules will be covered during the drivers meeting for clarity.

h) Match Duration

The standard maximum match duration for a match in any weight class is 3 minutes. The standard maximum match duration for a rumble in any weight class is 5 minutes.

i) Un-Sticks

Matches will be paused to separate robots if they become stuck together in the arena. Robots that become stuck together will be allowed 10 seconds to attempt to separate. If they are not able to do so, an un-stick will be called for by the arena manager. An unstick can only be called for by the drivers or arena manager and the arena manager has the final say on whether or not the un-stick will be granted. No modifications or repairs are allowed during an unstick. The robots will be separated, making every possible attempt to cause no further damage.

If the robots are unable to be safely separated inside the box or in a timely manner, the winner of the fight will be determined by a judge's decision up until that point in the fight.

Each robot gets one un-stick per match, but only if the opposing robot was not the cause for their immobilization. For example, if a robot were to get itself stuck on the arena wall somehow, they would get an un-stick. If the robot was placed against the wall by their opponent in a manner that prevented operation, (i.e., rammed into a stuck position, weapon contact causes a stuck position, lifted into position, etc.) they would not get an un-stick. The arena manager will determine if this applies and may be determined by a video review if necessary. Only the driver of the stuck robot can call for an un-stick in this situation.

j) Knockouts

When a robot has ceased moving in a controlled manner, but has not tapped out, the arena manager will begin a 10 second countdown. If the robot is unable to demonstrate controlled translational movement before the countdown ends, it will be declared the loser by Knockout. If, during this time, the robot is able to show controlled translational movement, or if the opposing robot attacks it, the countdown will cease. This means that a "dead" robot will not be counted out if the opposing robot continues to attack, and the match will not end until the match timer expires, or one robot taps out.

A robot with one side of its drivetrain disabled will not be counted out if it can demonstrate controlled translational movement. Controlled translational movement is defined as being able to traverse in a manner such that the net movements of the robot are in a linear direction.

In the case of multi-bots, the countdown will begin when at least 51% of the mass of the multi-bot is unable to move. A visual identifier is required on a multibot segment if that segment alone meets the knock-out threshold. For multi-bots with an even number of robots (2, 4, etc.), and equal weights for each portion, the team will identify which are considered to be the heaviest.

In the event of a simultaneous knock-out, both robots will be placed in their standard orientation on the combat area by the arena manager and allowed an attempt to demonstrate controlled movement. If both robots are able to function, the match will resume. If one robot is able to function, that robot will be declared the winner by knockout. If neither robot is able to function, the match will go to the judges. Should the battery of a robot become exposed, the match will be halted and the robot with the exposed battery will lose by knockout.

k) Death Zones/Pushouts

If the arena is equipped with a Death Zone/Pit/Push-out or similar hazard, a robot entering this area in a one-on-one match will result in the robot being counted out. If the robot is able to escape before the end of the countdown, the match will continue as normal. Otherwise, that robot will lose the match.

In the event that both robots enter the death zone simultaneously, they will be returned to the combat area and the match will resume. A robot that places its opponent in the death zone must be able to do

so without also becoming stuck itself. If it is not able to separate from the other robot, this will be treated as simultaneous entry.

In a rumble, any robots entering the area will be eliminated from the rumble and are to cease the operation of weapon systems immediately.

l) Pinning/Lifting

Any robot pinning or lifting their opponent may only continue to pin or lift them for 10 seconds at a time. After 10 seconds has elapsed, the robot in control must release the opposing robot. If the robot in control is not able to release the opposing robot, then the match will be halted, and the robots will be separated.

- "Release" is defined as complete physical separation such that both robots are able to freely move away from their current location.
- Refusal to comply with the arena manager's request to release the opponent when the robots are not stuck together will result in forfeit of the match.

m) Tapping Out

At any time during a match the robot operator may choose to tap out. Once an operator has tapped out, combat will cease, and the opposing robot will be declared the winner.

- Tapping out is done either by informing the arena manager that you are tapping out verbally, banging on the arena walls, or by using a designated tap out button or similar object should one be available.

n) Entanglement

Entanglement is defined as a situation where a robot becomes physically intertwined with a piece of its opponent to the extent that their movement or weapon is significantly restricted or halted.

If, in the judgment of the event officials, an entanglement has resulted in a prolonged period of inactivity (approximately 15 seconds), the match may be paused.

The Arena Manager will attempt to separate the robots with minimal impact on either robot. If a part of the robot becomes damaged due to the Arena Manager's actions during separation, the match will resume, nonetheless.

Judges will consider entanglement when determining the outcome of a match. If a robot's design or actions consistently lead to entanglements that hinder the opponent's ability to compete, it may be disqualified, whether intentional or not. If the judges feel that the entanglement was unavoidable, then the judges may be more lenient about the entanglement.

After each entanglement, the robot that caused the entanglement and the cause itself will be added to an internal ledger. If the offending team gets its 3rd strike of entanglement with the same cause, it may be disqualified from future tournaments until a change is made and the event organizers are happy with the change. An entanglement infraction will be removed from the ledger after 2 years.

If a match ends with both robots entangled, the judges will determine the winner based on the overall performance and demonstrated control leading up to the entanglement.

2. Robot Construction

All participants build and operate robots at their own risk. Combat robotics is inherently dangerous. There is no amount of regulation that can encompass all the dangers involved. Please take care to not hurt yourself or others when building, testing or competing.

If you have a robot or weapon design that does not fit within the categories set forth in these rules, or is in some way ambiguous or borderline, please contact the event organizer. Safe innovation is always encouraged, but surprising the event staff with your brilliant exploitation of a loophole may cause your robot to be disqualified before it ever competes.

Each event has safety inspections. It is at the event organizer's sole discretion that your robot is allowed to compete. As a builder, you are obligated to disclose all operating principles and potential dangers to the inspection staff.

Failure to comply with any of the following rules could result in expulsion or serious injuries.

- Proper activation and deactivation of robots is critical. Robots must only be activated in the arena, testing areas, or with expressed consent of the event and its safety officials.
- All robots must be able to be fully deactivated, which includes power to drive and weaponry, in under 60 seconds by a manual disconnect.
- All robots not in an arena or official testing area must be raised or blocked up in a manner so that their wheels or legs cannot cause movement if the robot were turned on. Runaway robots are very dangerous.
- Locking devices: Moving weapons that can cause damage or injury must always have a clearly visible locking device in place when not in the arena. Locking devices must be clearly identified. Examples of acceptable options include neon paint, brightly colored tabs, and remove before flight tags. Locking devices must be clearly capable of stopping, arresting or otherwise preventing harmful motion of the weapon. Locking devices must securely affix in place on the robot such that they cannot easily come loose or fall off without intent.
- Weapon locking pins must be in place when weapon power is applied during a robot's power-on procedure. This includes all powered weapons regardless of the power source or weight class.
- It is expected that all builders will follow basic safety practices during work on the robot at your pit station. Please be alert and aware of your pit neighbours and people passing by.

a) BotBrawl Weight Classes

BotBrawl hosts three combat robot classes:

- 150g / 0.33lb Fairyweight
- 454g / 1lb Antweight
- 1361g / 3lb Beetleweight

b) Weight Bonuses

A robot may be subject to a weight bonus if it uses a shuffler, non-traditional, or walker drivetrain.

In the case of multibots, the smallest possible weight bonus will be applied to the group. For example, if one robot from a 1lb multibot pair uses a shuffler drivetrain, and the second robot uses a walker drivetrain, the multibot will be awarded the shuffler weight bonus for a total of 1.25lbs.

Weight bonuses are granted as follows.

i. Wheeled

A robot is considered to be wheeled if those parts of the robot which touch the ground and either cause it to move or support some or all of its weight undergo unrestrained rotation around an approximately horizontal axis during the normal operation of the robot's drivetrain. This includes all forms of wheels (including non circular, spoked, or offset-axis wheels) as well as continuous track or belt drive systems.

Robots that rely on a thrust method other than mechanical friction with the floor will not be considered walkers or shufflers. This is true even if the robot rests on an air cushion or skids rather than wheels.

Robots that float or fly are not allowed in an open-air competition. Hovercraft robots are allowed but are subject to wheeled weight limits. A jumping bot that has no wheel-driven locomotion and otherwise conforms to the walker definitions may receive the walker weight bonus. Keep in mind, the controlled movement and minimum speed requirements must be met.

A wheeled robot receives no weight bonus.

ii. Shufflers

If a robot is supported and/or propelled by parts that do not normally undergo continuous unrestrained rotation around a horizontal axis, but using a system of mechanical devices such as cams or crankshafts to generate reciprocating motion of those parts from one or more continuously rotating drive shafts, it will be considered a shuffler. The defining feature of a shuffler (versus a

walker) will be the ability to generate continual forward motion of the robot from continual rotation of its drive motors. Shufflers typically have electrical control systems indistinguishable from those on wheeled robots.

A shuffler robot will be granted a 25% weight bonus, provided it is not considered dangerous at heavier weight classes.

iii. Non-Traditional

Non-traditional robots are typically robots that do not fall into any of the other categories. The following robot types are considered non-traditional, though this list is not extensive:

- Robots propelled by bristles
- Robots propelled by gyroscopic effects
- Robots using ground effects or an air cushion to achieve movement
- Jumping/hopping robots
- Flying robots/drones

A robot considered non-traditional will be granted a 50% weight bonus, provided it is not considered dangerous at heavier weight classes.

iv. Walkers

Walkers are those robots in which multiple linear or limited-travel rotary actuators are intermittently driven to produce linear travel of the robot. Actuation may be through electric, pneumatic, or hydraulic means. Walkers must have no parts normally in contact with the ground undergoing continuous rotation and must require some change in timing or sequencing of the driving mechanisms to reverse direction. Walkers will typically have control systems significantly more complex than those found on shufflers or wheeled robots, involving multiple actuators, servos, or valves running through a specific sequence to produce motion.

A walker robot will be granted a 100% weight bonus, provided it is not considered dangerous at heavier weight classes.

c) Mobility

All robots must have easily visible and controlled mobility in order to compete. Methods of mobility include but are not limited to:

- Rolling (wheels, tracks or the whole robot)

- Walking: Walking robots have no rolling elements in contact with the floor and no continuous rolling or cam operated motion in contact with the floor, either directly or via a linkage. Motion is "continuous" if continuous operation of the drive motor(s) produces continuous motion of the robot. Linear-actuated legs and novel non-wheeled drive systems may qualify for this bonus. If you are intending to enter a non-wheeled robot in any event contact the event as soon as possible to determine what if any weight bonus you will qualify for.
- Bristle/Torque Drive: Vibration or torque reaction of a powered system to generate motion
- Gyro Walker: Gyroscopic forces used in conjunction with a rotating arm that tilts a portion of the robot to generate motion
- Shuffling (rotational cam operated legs)
- Ground effect air cushions (hovercrafts)
- Jumping and hopping may be allowed at some events, contact the event organizer if you're intending on using this as a method of locomotion.
- Flying (airfoil using, helium balloons, ornithopters, etc.) may be allowed at some events, contact the event organizer if you're intending on using this as a method of locomotion

d) Robot Control Requirements

Tele-operated robots must be radio controlled or use an approved custom system. Radio controlled robots must use approved ground frequencies. Tethered control is not allowed. Pre-1991 non-narrow band radio systems are not allowed.

Radio system restrictions for this event with corresponding weight and or weapon restrictions:

- Radio systems that stop all motion in the robot (drive and weapons), when the transmitter loses power or signal, are required for all robots with active weapons or any robot over 12lbs. This may be inherent in the robot's electrical system or be part of programmed fail-safes in the radio.
- If you are using a home-built control system, or a control system not covered here, you must first clear it with the event organizer.
- All robots that are either: a.) 30 lbs or above or b.) 12 lbs or above with an active weapon MUST use a radio system on the FM band with PCM, IPD coding, a digitally coded 900 MHz or 2.4GHz system (for example IFI, Spektrum, etc.), or an approved custom control system.
- This event does not require a separate power switch for the radio, but it is encouraged.

e) Autonomous/Semi-Autonomous Robots

Any robot that moves, seeks a target, or activates weapons without human control is considered autonomous. If your robot is autonomous, you are required to contact this event before registration.

- Autonomous robots must have a clearly visible light for each autonomous subsystem that indicates whether or not it is in autonomous mode, e.g., if your robot has two autonomous weapons it should have two "autonomous mode" lights (this is separate from any power or radio indicator lights used).
- Robots in the 12 pound or under classes are exempt from the remaining rules below, but safe operation, arming, and disarming must be demonstrated in safety inspections.
- The autonomous functionality of a robot must have the capability of being remotely armed and disarmed. (This does not include internal sensors, drive gyros, or closed loop motor controls.)
    - While disarmed, all autonomous functions must be disabled.
    - When activated, the robot must have no autonomous functions enabled, and all autonomous functions must failsafe to off if there is loss of power or radio signal.
    - In case of damage to components that remotely disarm the robot, the robot's autonomous functions are required to automatically disarm within one minute of the match length time after being armed.

f) Batteries and Power

The only permitted batteries are ones that cannot spill or spray any of their contents when damaged or inverted. This means that standard automotive and motorcycle wet cell batteries are prohibited. Examples of batteries that are permitted: gel cells, Hawkers, NiCads, NiMh, dry cells, AGM, LIon, LiFe, LiPo, etc. If your design uses a new type of battery, or one you are not sure about please contact the event organizers.

All onboard voltages above 48 Volts require prior approval. It is understood that a charged battery's initial voltage state is above their nominal rated value.

All electrical power to weapons and drive systems (systems that could cause potential human bodily injury) must have a manual disconnect that can be activated within 15 seconds without endangering the person turning it off (e.g., No body parts in the way of weapons or pinch points.) Shutdown must include a manually operated mechanical method of disconnecting the main battery power, such as a switch (Hella, Whyachi, etc.) or removable link. Relays may be used to control power, but there must also be a mechanical disconnect.

All efforts must be made to protect battery terminals from a direct short and causing a battery fire.

If your robot uses a grounded chassis, you must have a switch capable of disconnecting this ground. ICE robots are excepted from this rule if there is no practical way to isolate their grounding components. You must contact this event for this exception.

All robots must have a light easily visible from the outside of the robot that shows its main power is activated.

g) Pneumatics

Pneumatic systems on board the robot must only employ non-flammable, non-reactive gases (CO_2, Nitrogen and air are most common). It is not permissible to use fiber wound pressure vessels with liquefied gasses like CO_2 due to extreme temperature cycling.

You must have a safe and secure method of refilling your pneumatic system.

Exemptions:

- Robots 12 lbs and under, and systems with gas storage of 2 fl oz or less are exempt from the remaining rules in this section provided that the maximum actuation pressure is 250psi or less and all components are used within the specifications provided by the manufacturer or supplier. If the specifications aren't available or reliable, then it will be up to the event organizer to decide if the component is being used in a sufficiently safe manner.
- Pneumatic systems with pressures below 100psi, small volumes (12-16g CO2 cartridges), single firing applications, or pneumatics used for internal actuation (as opposed to external weaponry) may also be exempted from the remaining pneumatic rules. You are required to contact this event if you would like an exception.

All pneumatic components on board a robot must be securely mounted. Particular attention must be made to pressure vessel mounting and armor to ensure that if ruptured it will not escape the robot.

All pneumatic components within the robot must be rated or certified for at least the maximum pressure in that part of the system. You may be required to show rating or certification documentation on any component in your system.

All pressure vessels must be rated for at least 120% of the pressure they are used at and have a current hydro test date. (This is to give them a margin of safety if damaged during a fight.) If large actuators, lines, or other components are used at pressures above 250psi, these will also need to be over-rated and are to be preapproved for this event.

All primary pressure vessels must have an over-pressure device (burst/rupture disk or over-pressure 'pop off') set to no more than 130% of that pressure vessel's rating. (Most commercially available bottles come with the correct burst assemblies, use of these is encouraged)

If regulators or compressors are used anywhere in the pneumatic system, there must be an (additional) over-pressure device downstream of the regulator or compressor set for no more than 130% of the lowest rated component in that part of the pneumatic system.

All pneumatic systems must have a manual main shut off valve to isolate the rest of the system from the source tank. This valve must be easily accessed for robot deactivation and refilling.

All pneumatic systems must have a manual bleed valve downstream of the main shut off valve to depressurize the system. This bleed valve must be easily accessed for deactivation. This valve must be left OPEN whenever the robot is not in the arena to ensure the system cannot operate accidentally.

- It is required to be able to easily bleed all pressure in the robot before exiting the arena. (You may be required to bleed the entire system if it is believed that you have any damaged components.)

All regulated pneumatic systems must have an appropriate gauge scaled for maximum resolution of the pressure on the low-pressure side of the system. HPA (air, nitrogen, or inert gas) systems must have gauges on both the high- and low-pressure sides of regulators. A gauge or other clear visual indication that the system is charged is strongly recommended for all pneumatic systems. Whether specifically required or not.

If back check valves are used anywhere in the system, you must ensure that any part of the system they isolate can be bled and has an over-pressure device.

Any pneumatic system that does not use a regulator, or employs heaters or pressure boosters, or pressures above 2500psi must be pre-qualified by the event you're planning to attend.

h) Hydraulics

Robots in the 12 lb class or lighter are exempt from the remaining rules in this section, but good engineering and best practices must be used in all hydraulic systems. However, the pressure for 12 pound or less robots is limited to 250psi and there must be an easy way to determine this pressure. Contact the event with any questions.

All hydraulic components onboard a robot must be securely mounted. Particular attention must be made to pump and accumulator mounting and armor to ensure that if ruptured direct fluid streams will not escape the robot.

All hydraulic components within the robot must be rated or certified for at least the maximum pressure in that part of the system. You may be required to show rating or certification documentation on any component in your system.

Any accumulators or large reservoirs must be rated for at least 120% of the pressure they are used at. (This is to give them a margin of safety if damaged during a fight)

All hydraulic systems must have an over pressure bypass device set to no more than 130% of the lowest component rating. It must be rated to bypass the full volume of the hydraulic pump.

All hydraulic systems must have an accessible manual bypass valve to easily render the system harmless. They must have appropriate gauges scaled for maximum resolution of the pressures in that part of the system. They must use non-flammable, non-corrosive fluid and must be designed not to leak when inverted.

Any hydraulic system using pressure boosters, or pressures above 5000psi (without accumulator) or pressures above 2000psi (with accumulator) must be prequalified by the event.

Please note that some simple low pressure and volume hydraulic systems, like simple braking, may not need to adhere to all the rules above. You are required to contact the event if you would like an exception.

i) Internal Combustion Engines

Internal Combustion Engines (ICE) and liquid fuels are not allowed at any indoors event. An exception may be made for an outdoors event. Please contact the event organizer before registration if you plan to bring an ICE-powered robot.

Fuel and Fuel Lines

- All commercially available grades of automobile or RC hobby fuel are allowed. Alcohol, Nitromethane, jet fuel and other specialty grades of fuel require prior approval.
- Fuel lines and tanks must be made of high-quality materials, and all ends must be clamped securely.
- All fuel tanks and lines must be well protected and armored from all sides including moving parts and heat sources inside the robot.

Fuel tank volume, on any robot, shall not be greater than the amount required to operate the engine for more than 1 minute longer than the match time at combat power plus a reasonable pre-match warm-up period. Total fuel volume, including fuel for both ICE and flame weapons (if allowed) may not exceed 20 oz unless prior approval is granted from this event.

The output of any engines connected to weapons or drive systems must be coupled through a clutch which will decouple the motor when it is at idle. (This does not include motors used for generators and hydraulic pumps.)

Any engine connected to a weapon must be capable of being started while the weapon locking pin is in place.

All engines must turn off or return to idle at loss of radio signal and turn off at loss of radio receiver power.

All engines must have a method of remotely shutting off.

Any robot with liquid fuel and oil must be designed not to leak when inverted. (Minor oil leakage may be tolerated, however if it affects the other robot or becomes a large cleanup issue you may be called, and the leaking robot will forfeit.)

Use of engines other than standard piston engines (i.e., turbines etc.) require prior approval for any event.

j) Rotational weapons

Rotational weapons or full body spinning robots are allowed at most events, however:

- Spinning weapons that can contact the outer arena walls during normal operation must be pre-approved by the event. (Contact with an inner arena curb, or containment wall is allowed and does not require prior permission.)
- Spinning weapons must come to a full stop within 60 seconds of the power being removed using a self-contained braking system.

k) Springs and Flywheels

Springs used in robots in the 12 lbs class or smaller and those loaded simply by the weight of the robot (e.g., suspension systems) are excepted from the rules in this section. However safe operation and good engineering are always required.

Any large springs used for drive or weapon power must have a way of loading and actuating the spring remotely under the robot's power.

- Under no circumstances must a large spring be loaded when the robot is out of the arena or testing area.
- Small springs like those used within switches or other small internal operations are excepted from this rule.

Any flywheel or similar kinetic energy storing device must not be spinning or storing energy in any way unless inside the arena or testing area.

- There must be a way of generating and dissipating the energy from the device remotely under the robot's power.

All springs, flywheels, and similar kinetic energy storing devices must fail to a safe position on loss of radio contact or power.

l) Forbidden Weapons and Materials

The following weapons and materials are absolutely forbidden from use:

- Weapons designed to cause invisible damage to the other robot. This includes but is not limited to:
    - Electrical weapons
    - RF jamming equipment, etc.
    - RF noise generated by an ICE. (Please use shielding around sparking components)
    - EMF fields from permanent or electro-magnets that affect another robot's electronics.
    - Entangling Weapons or defenses: weapons or defenses that can reasonably be expected to stop drive train and/or weapon motion by being wrapped around rotating parts. This includes nets, tapes, strings, and other entangling materials or devices.
    - Weapons or defenses that can reasonably be expected to stop combat completely of both (or more) robots.
- Weapons that require significant cleanup, or in some way damages the arena to require repair for further matches. This includes but is not limited to:
    - Liquid weapons. Additionally, a robot may not have liquid that can spill out when the robot is superficially damaged.
    - Foams and liquefied gasses
    - Powders, sand, ball bearings and other dry chaff weapons
- Un-tethered Projectiles
- Heat and fire are forbidden as weapons. This includes, but is not limited to the following:
    - Heat or fire weapons
    - Flammable liquids or gases
    - Explosives or flammable solids such as:
        - DOT Class C Devices
        - Gunpowder / Cartridge Primers
        - Military Explosives, etc.

- Light and smoke-based weapons that impair the viewing of robots by an entrant, judge, official or viewer. (You are allowed to physically engulf your opponent with your robot however.) This includes, but is not limited to the following:
    - Smoke weapons
    - Lights such as external lasers above 'class I' and bright strobe lights which may blind the opponent.
- Hazardous or dangerous materials are forbidden from use anywhere on a robot where they may contact humans, or by way of the robot being damaged (within reason) contact humans. Contact the event you plan to attend if you have a question.

m) Plastic Classes

The spirit of this class is to create an accessible and affordable class that encourages experimentation and rapid iteration by utilizing 3D printing. Robots may be disqualified at the Event Organizer's discretion if it is deemed to violate the spirit of the class. Contact the event organizer ahead of time if you are not sure your robot meets the following definition.

i. Allowed Materials

Frames and weapons may only be made from PLA, PLA+, PET, PETG, ABS, or ASA and must be FDM/FFF 3D printed. Materials that are functionally identical to PLA+ but have a different name for marketing purposes will be considered PLA+ when determining legality (ex. PLA Pro, Super PLA). No other types of plastics or materials are allowed (ie. metal, carbon fiber, UHMW, etc).

Composite and blended materials that use legal materials as a base are not permitted. Examples include but are not limited to:

- Carbon Fiber PLA
- Glass Filled ABS
- Flex PLA

TPU, silicone, or urethane may only be used in very specific scenarios. If there is any uncertainty, make sure to reach out to the event organizer for clarification. The event organizer has the final say on whether a TPU, silicone, or urethane part is legal and can ban your robot if it is believed that your robot does not adhere to the spirit of the class.

Examples of situations that allow TPU, silicone, or urethane include but are not limited to:

- Belts and pulleys (either drive or weapon)
- Wheels and wheel hubs

- Gears
- Motor cushions

Examples of situations where TPU, silicone, or urethane is NOT allowed include but are not limited to:

- Frame
- Armour
- Weapon

ii. COTS Parts

Commercial Off the Shelf (COTS) parts can be made from any material. This includes components such as motors, electronics, axles, bushings, bearings, fasteners, and adhesives. COTS parts may not be used outside of their typically accepted function.

Permitted examples include but are not limited to:

- Using shafts and bearings to allow wheels or a weapon to spin freely
- Using screws to attach two parts together.

Illegal examples include but are not limited to:

- Using COTS parts as counterbalances for weapons
- Using COTS parts as weapon impactors
- Using COTS parts as armor

COTS parts may be modified if necessary, so long as the function of the part is not significantly changed. Examples include but are not limited to:

- Shortening motor shafts
- Adding flats for set screw contact

COTS equivalent parts are allowed. Examples of COTS equivalent parts include but are not limited to

- Builder sourced/manufactured gearmotors
- Custom electronics
- Prototype components
- Axles that are not commercially available

Magnets to enhance traction or downforce are prohibited.

iii. Traction Elements

Non-allowed materials may be used if they meet the following requirements:

- Tires and other traction elements may be made from COTS rubber material, custom cast rubber, rubber coatings, or foam.
- Parts between motors/shafts and tires should either be COTS, foam, or 3D printed from allowed materials.
- Printed elements including COTS components must be from the allowed materials list.
- Tires, wheels, wheel components, and other traction elements made from materials not on the allowed materials list may not be designed such that they provide more armor or structure than a COTS equivalent part.

iv. Coatings and Post-Processing

Painting or otherwise marking robots is permitted if done solely for aesthetic purposes. Excessive coatings are subject to event organizer review and approval.

Post-processing of materials using techniques that enhance durability is not permitted. Disallowed processes include but are not limited to:

- Annealing
- Acetone soaking
- Boiling of parts

3. Tournament Procedures

a) Tournament Formats

Match formats for specific weight classes will be determined when the event is announced. The event organizer retains the ability to make a change to the match format for any weight class, at any given time, without notification. Any changes to the match formats will be discussed at the driver's meeting.

- Round Robin
    - Each robot faces each other robot in the weight class a single time. The robot with the greatest number of wins is declared the winner. In the event of a tie, the winner of the match between the two robots is declared the winner. Should more than two bots tie for the win, the winner will be determined with a judged rumble.
    - If desired, a double round robin format can be used where each robot will face each other twice. The same criteria are used for determining a winner. Should the results necessitate it, a tie-breaker match may be run to determine which robot places higher.
- Single Elimination
    - This format uses a standard single elimination bracket.
- Double Elimination (Standard format for classes with 6 or more robots entered)
    - In a double elimination bracket, all robots start in the winner's bracket. The losing robot in a winner's bracket match will move to the loser's bracket. The losing robot in a loser's bracket match is eliminated from the tournament.
    - In this format, the robot that "wins" the loser's bracket will need to defeat the robot that "wins" the winners bracket twice to win the overall event.
- Modified Double Elimination
    - The format is the same as a double elimination bracket however the overall final is treated as single elimination, meaning that if the robot that "wins" the loser's bracket will only have to defeat the robot that "wins" the winners bracket a single time to win the overall event.
- Other

Any match formats used not described above will be the responsibility of the host event to clearly describe.

b) Weight Verification

A robot may be re-weighed at any time during a tournament at the request of an event official or judge. The time required to verify that the robot is still within the legal weight limit will not be counted against the robots guaranteed time between matches. In the event that the robot in question is less than 5% over the weight limit they will need to be made underweight prior to their next match. If the robot is in excess of 5% above the weight limit, they will forfeit their prior match and will need to be made underweight prior to their next match. If repeated infractions occur during the same event, the robot will be disqualified from the event. If a robot has been modified since its last match, the team will be responsible for ensuring that any repairs or modifications done stay within the weight limit. In the event that an event official calls for a re-weigh immediately following a match (prior to either robot returning to the pit area or having any work done to them) both robots will be weighed to confirm that they are within the weight limit. If one of the two robots is overweight, it will immediately forfeit the match. If both robots are found to be overweight, the original match result will stand and both robots will be required to be brought below the weight limit prior to their next match.

If it is approved by the event officials, the addition of a small camera and protective shroud may be added to a robot even if such a system would exceed the normal weight limit. Any mount and shroud must be designed to provide protection and support to the camera only. This mount should be designed for easy removal for separate weighing of the robot if applicable.

c) Unsportsmanlike Conduct

Unsportsmanlike Conduct includes but is not limited to: Post fight contact, sabotage, distraction of opposing robot operators, blatant early movement, etc.

For the first incident of unintentional unsportsmanlike conduct, the person responsible will receive a warning. These warnings will carry over between events and will expire 25 months after the date of the incident.

For the second incident of unintentional unsportsmanlike conduct, the person responsible will automatically forfeit the match.

For any instance of clearly intentional (as ruled by the judges or event officials) unsportsmanlike conduct, the driver of the robot will be disqualified for the remainder of the event. This means that if they are driving robots in the tournament, they will need to find driver substitutes or those robots will be unable to continue to compete.

In the event that the unsportsmanlike conduct occurs during the finals of a double elimination tournament that is structured such that if the robot in the loser's bracket wins the two robots will fight again, the driver initiating the contact will forfeit not only the current match, but the match that potentially would follow.

4. Judging Guidelines

The judges will be located close enough to the arena manager that communication will not be hindered by the noise levels typical to a robot combat event. When a match does not end in the elimination of one of the combatants as defined by the match rules, the winner shall be determined by a judges' decision. In a judges' decision, the points awarded to the combatants by the panel of judges are totaled, and the robot with the majority of points is declared the winner.

Judges' decisions are final.

Two sets of judging criteria are provided to allow individual events to choose which format they would like to use based upon the desired complexity and emphasis of the scoring system. Most BotBrawl events use Damage, Control and Aggression Criteria.

a) Damage and Engagement Criteria

Points are awarded in 2 categories:

- Damage - 4 points
- Engagement - 5 points

All points must be awarded – each judge will determine how many points to award each combatant in each category, according to the judging guidelines below. The maximum possible score a combatant receives is 9 times the number of judges. Thus, a single judge will award a total of 9 points, and a 3-judge panel will award a total of 27 points.

i. Damage

Damage is about what is left at the end of the fight. Judges should note pre-existing damage and ignore it when it comes to rating the level of damage at the end of the match. The exception to this is damage that, if ignored, prevents an entry from reaching the maximum achievable damage grade. Typically, this will only apply to drive functionality.

- A Tier: No damage, cosmetic damage, or minor damage to purely ablative armor
- B Tier: Significant damage to purely ablative armor, minor damage to mobility systems that do not noticeably hinder movement, damage to structure or armor that does not significantly hinder function.
- C Tier: Damage to the mobility system or weapon system(s) that moderately hinders function, or damage that significantly impairs the function of a robot's structure or armor.
- D Tier: Significant impairment of drive or weapon systems.
- E Tier: Significant impairment of drive and weapon systems

To qualify as "purely ablative" armor an element must be clearly designed to serve the sole purpose of being damaged or destroyed to absorb damage to protect the main structure of the robot.

Significant impairment of the drive is classified as crab walking (appears to be translating via one drive side) or worse. Significant impairment of the weapon is all weapon system elements being rendered non-functional.

For robots that rely on their weapon systems for mobility damage to the weapon system such that it impacts their mobility will be considered damage to both systems.

For robots with independently powered weapons wedges, plows, forks, and other similar elements will be considered part of their structure or armor. For robots without independently powered weapons whichever feature they attack with will be treated as their weapon system.

For multibots the damage level should be averaged between all segments that participated in the match. If the average lands between grades the final grade should be rounded down. (Between C and D would become C)

1. Damage Scoring

- 2-2
    - 0-1 grades of separation.
- 3-1
    - 2 grades of separation.
- 4-0
    - 3+ grades of separation.

The following table can be used as a quick reference.

		Robot 2				
		A	B	C	D	E
Robot 1	A	2-2	2-2	3-1	4-0	4-0
	B	2-2	2-2	2-2	3-1	4-0
	C	1-3	2-2	2-2	2-2	3-1
	D	0-4	1-3	2-2	2-2	2-2
	E	0-4	0-4	1-3	2-2	2-2

ii. Engagement

Engagement is about which robot takes charge of the flow of the match. Robots that score well in engagement will bring the fight to their opponent.

1. Engagement Examples

Actions that positively contribute to engagement

- Attacking the opponent
- Pinning the opponent
- Getting the opponent stuck/high centered
- Chasing the opponent
- Inverting the opponent if it significantly impacts their ability to engage with the opponent

Actions that negatively contribute to engagement

- Sitting in one area waiting for the opponent to attack
- Fleeing from the opponent
- Performing anything from the positive contribution section to your own entry instead of your opponent

Actions that are neutral with respect to engagement

- Brief disengagements to prepare/reset/spin up your weapon
- Self righting attempts
- Inversion that does not impact a robot's ability to fight
- Missed attacks

For scoring engagement in fights involving multibots you should look at how the entry as a whole influenced the flow of the match.

A robot being slower should not directly impact its engagement score. Focus on what the robot is doing, not how fast it is doing it.

2. Engagement Scoring

- 3-2
    - This robot spent a slightly larger portion of the match dictating the flow of the fight
    - Throughout the fight this robot consistently maintained a slight edge on directing the flow of the match
- 4-1

- This robot spent a large portion of the match dictating the flow of the fight
- This robot consistently maintained a significant edge on directing the flow of the match

- 5-0
  - This robot spent most or all of the match dictating the flow of the fight

b) Damage, Control and Aggression Criteria

Points are awarded in 3 categories:

- Aggression - 5 points
- Control - 6 points
- Damage - 8 points

All points must be awarded - each judge will determine how many points to award each combatant in each category, according to the judging guidelines below. The maximum possible score a combatant receives is 19 times the number of judges. Thus, a single judge will award a total of 19 points, and a 3-judge panel will award a total of 57 points.

i. Scoring Aggression

Aggression scoring will be based on the relative amount of time each robot spends attacking the other. Attacks do not have to cause damage to count for aggression points, but a distinction will be made between chasing a fleeing opponent and randomly crashing around the arena.

Points will not be awarded for aggression if a robot is completely uncontrollable or unable to do more than turn in place, even if it is trying to attack. Sitting still and waiting for your opponent to drive into your weapon does not count for aggression points, even if it is an amazingly destructive weapon. Robots must show translational movement toward their opponent for it to be counted as aggression.

1. Awarding Aggression Points

- 5-0: shall be awarded only when one of the robots never attempts to attack the other, and the other consistently attacks.
- 4-1: shall be awarded in the case of significant dominance of attacks by one robot, with the other only attempting to attack a few times during the match.
- 3-2: shall be awarded when:

- Both robots consistently attack the other.
- Both robots only attack the other for part of the match.
- Both robots spend most of the match avoiding each other. It will be up to the judge's discretion to decide which robot made more attempts to attack the other.
- A combatant who attacks a full-body spinner (e.g., intentionally drives within the perimeter of the spinning weapon) is automatically considered the aggressor and awarded a 3-2 score in the case where either robot consistently attacks, or both robots consistently avoid each other.

- There can be no ties in aggression. Judges must decide that one robot is more aggressive than the other.
- A combatant is considered a "full body spinner" if the robot cannot be attacked without moving within the perimeter of the spinning weapon.

ii. Scoring Control

Control scoring will be based on the relative amount of time each robot spends in control of the fight.

The primary means of scoring points in this category involves using elements of the robot or arena against the opponent in a manner that doesn't directly involve the weapon system of the robot causing damage. This would include utilizing any arena hazards to cause damage to the opposing robot.

Examples of control include:

- A grabbing/lifting/wedge robot making guiding contact with the opposing robot and delivering them to an arena hazard or hitting them against the combat surface and/or arena walls.
- Flipping over the opposing robot.
- Immobilizing or otherwise stalling the opponent's weapon.
- A spinning robot being able to get its weapon to full speed.

1. Awarding Control Points

- 6-0: shall be awarded only when one robot completely controls the momentum of the match. Examples of this would include:
  - A wedge or ramming robot prevents a spinning weapon from ever reaching full speed.
  - A grabber or crusher consistently grabbing and manipulating its opponent with little to no offense from the opponent.

  - A flipper reliably flips its opponent without frequent missed flips.
  - A spinner being able to consistently and repeatedly get its weapon back to speed after hitting the opponent.

- 5-1: shall be awarded in the case of significant dominance by one competitor. The competitor receiving 5 points should frequently exhibit the relevant behaviors noted in the control example section with only short periods of the opposing robot gaining the upper hand.
- 4-2: shall be awarded in the case of slight dominance by one competitor. The competitor receiving 4 points should exhibit the relevant behaviors noted in the control example section for a clear majority of the match.
- 3-3: shall be awarded when both robots are either able to demonstrate control for a significant portion of the match or neither robot is able to reasonably demonstrate control during a match.

iii. Scoring Damage

Judges should be knowledgeable about how different materials are damaged. Some materials such as Titanium will send off bright sparks when hit but are still very strong and may be largely undamaged. Other materials such as aluminum will not send off bright sparks when hit. Judges should not be influenced by things like sparks, but rather how deep or incapacitating a "wound" is.

Judges should be knowledgeable about the different materials used in robot construction and how damage to these materials can reduce a robot's functionality. Judges should not be unduly influenced by highly visual damage that doesn't affect a combatant's functionality effectiveness or defensibility. For example, a gash in a combatant's armor may be very visible but only minimally reduce the armor's functionality.

Judges should look for damage that may not be visually striking but affects the functionality of a combatant. For example:

- A small bend in a lifting arm or spinner weapon may dramatically affect its functionality by preventing it from having its full range of motion.
- Bent armor or skirts can prevent the Combatant from resting squarely on the floor, reducing the effectiveness of the drive train.
- A wobbly wheel indicates that it is bent and will not get as much traction.
- Cuts or holes through armor may mean there is more damage inside.

Trivial:

- Flip over (or being propelled onto bumper, ramp, or other obstacle) causing no loss of mobility or loss of weapon functionality, except where flipping causes full loss of mobility and the robot is unable to show translational movement.
- Direct impacts which do not leave a visible dent or scratch.
- Sparks resulting from a strike of an opponent's weapon.
- Being lifted in the air with no damage and no lasting loss of traction.

Cosmetic:

- Visible scratches to armor.
- Non-penetrating cut or dent or slight bending of armor or exposed frame.
- Removal of non-structural, non-functional cosmetic pieces (dolls, foliage, foam, or "ablative" armor).
- Damage to wheel, spinning blade, or other exposed moving part not resulting in loss of functionality or mobility.

Minor:

- Flip over (or being propelled onto a bump or other obstacle) causing some loss of mobility or control or making it impossible to use a weapon.
- Intermittent smoke not associated with noticeable power drop.
- Penetrating dent or small hole.
- Removal of most or all of a wheel, or saw blade, spike, tooth, or other weapon component, which does not result in a loss of functionality or mobility.
- Slightly warped frame not resulting in loss of mobility or weapon function.

Significant:

- Continuous smoke, or smoke associated with partial loss of power of drive or weapons.
- Torn, ripped, or badly warped armor or large hole punched in armor.
- Damage or removal of wheels resulting in impaired mobility.
- Damage to rotary weapons resulting in loss of weapon speed or severe vibration.
- Damage to arm, hammer, or other moving part resulting in partial loss of weapon functionality.

- Visibly bent or warped frame/weapon that results in partial impairment to the function of the damaged system.

Major:

- Smoke and visible fire.
- Armor section completely removed exposing interior components.
- Removal of wheels, spinning blade, saw, hammer, or lifting arm, or other major component (including wedges/plows) resulting in total loss of weapon functionality or mobility.
- Frame warping, causing partial loss of mobility or complete loss of functionality of the weapon system.
- Internal components (batteries, speed controller, radio, motor) broken free from mounts and resting or dragging on the arena floor.
- Significant leak of hydraulic fluid.
- Obvious leaks of pneumatic gases.
- Apparent complete loss of weapon system function.

Massive:

- Armor shell or major completely torn off frame.
- Major subassemblies torn free from frame.
- Loss of structural integrity - major frame or armor sections dragging or resting on floor.
- Total loss of power.

1. Awarding Damage Points

Scoring of damage points is based on relative grading of each robot's damage.

- 8-0 or 7-1: shall be awarded when:
    - One robot suffers nothing more than trivial damage, and the other is at least significantly damaged.
    - One robot has suffered major or massive damage and the other is no more than cosmetically damaged.
- 6-2: shall be awarded when:
    - One robot suffers at least minor damage and the other suffers major or worse damage.

  - One robot has suffered cosmetic damage and the other has suffered at least significant damage.

- 5-3: shall be awarded when:
  - Both robots have suffered nearly the same level of damage, but one is slightly more damaged than the other.
  - One robot has suffered trivial or cosmetic damage and the other has suffered minor damage.
- 4-4: shall be awarded when:
  - Both robots have suffered the same level of damage, or
  - Neither robot has even cosmetically damaged the other

Damage that is self-inflicted by a robot's own systems and not directly or indirectly caused by contact with the other robot or an active arena hazard will not be counted against that robot for scoring purposes.

c) Post-Match Inspection

Judges may request the combatants to demonstrate operability of their robot's drive train and/or weapon following the end of the match before the arena doors are opened.

Judges may inspect the combatant's robot after a match to determine how best to award damage points. If a judge needs to examine one or both combatant's robots before awarding damage points, he or she will notify the arena marshal or other designated official immediately after the end of the match. The inspection will be conducted by the entire panel. The judges will not handle the combatant's robot. The driver or a designated team member will handle the combatant's robot. A member of the opponent's team will be present during any such inspection.

Section 2

Sumo Classes

1. Match Overview

The Match Overview section will outline the various procedures that can take place before, during, or after a match. The event organizers hold the right to make changes to these procedures at any time, and without notice.

This section will override any rules set out in Section 1. Anything not mentioned in this section will resort back to Section 1 for clarification.

a) The Arena

Each round will take place on a playing field consisting of a circular platform, 10 feet in diameter, raised approximately 4" above the 'crash area' for robots to fall safely. There will be a steel pole mounted vertically in the center, less than 2" in diameter. The floor will be made of plywood.

Robots may grip the steel pole but must be able to release it under its own power. Robots cannot start a match attached to the pole. A robot may only clamp/attach to the pole for 15 seconds at a time but may do so repeatedly. Physical contact with the pole is not required for this rule. Entrapment of the pole can invoke the 15 second rule.

- Placing a ring around the pole which technically is not touching it but serves to attach a robot to it counts as attaching to the pole.

Robots may not intentionally cause damage to the steel pole.

Robots may, in some fashion, secure themselves to the floor. They must be free at the beginning of the match. Under their own power they may secure themselves to the floor but must also be able to disengage under their own power. This may only occur for 15 seconds max but may be repeated.

b) Match Formats

A match will consist of three rounds. Each round will start with an audible or verbal command from the referee, with both machines facing each other, in the center of the platform approximately 6 inches from the pole. The winner of three out of five rounds will be awarded the match. A round is considered won when a robot has been knocked out or tapped out. The event organizer reserves the right to revert to a best-two-out-of-three format if time is getting short.

c) Match Duration

The standard maximum match duration for a match in any weight class is 3 minutes. If neither robot has crossed the boundary line or been 'knocked out' of the ring at the end of round, the judge(s) will choose a winner by assigning points to each robot (aggressiveness 1p, strategy 1p, driving 1p). The robot with at least 2/3 points wins.

d) Inactivity

If at any time during a match there is a period of inactivity for one or both robots that exceeds 20 seconds, the referee will initiate a 10 second countdown, ending as soon as the robot(s) regains mobility. If only one robot is still mobile at the end of the countdown, the mobile robot will be deemed the winner of the round. If both robots are disabled at the end of the countdown, the judges will decide whether to call the round a draw and redo or declare a winner for that round.

e) Knockouts

The object for a competing machine during a round will be to remain within the boundary of the playing field longer than one's opponent. A robot will be "knocked out" if any part of it touches the ground outside of the playing field or the containment ring. Once a starting command is given, no one other than the referee may touch a competing machine until a win or time-out is declared.

If both machines leave the playing field, it will be up to the judge(s) to decide which robot left first, or if a reset and restart is necessary.

2. Robot Construction

a) BotBrawl Weight Classes

BotBrawl hosts two sumo robot classes:

- 30lb / 13.61kg – 30lb Sumo
- 150lb / 68.18kg – 150lb Sumo

b) Mobility

All robots must be capable of a linear speed of 5 feet per minute. This requirement must only be met during initial inspection. This rule is not a means to disqualify any competing bot or to determine the winner of a bout.

Robots may not use any kind of spikes, cleats or studs on their wheels or shuffling mechanisms to dig into the wooden platform.

c) Batteries and Power

Any individual robot that weighs more than 45lbs may NOT use LiPo batteries for safety reasons.

All sumo weight classes must refrain from having exposed wiring accessible from the outside of the robot. The event organizer has the right to enforce covers to be added to a robot to cover any

exposed wiring, and to prevent any electrical shorts or battery incidents. Failing to do so may cause you to forfeit your next match.

d) Carrying Handles

Any individual robot that weighs more than 45lbs MUST have a safety handle that is easily accessible for carrying, obviously visible, and permanently attached.

e) Engagement

Each robot has 10 seconds to either engage with the opponent, or fully cross the center line of the arena, or you will be disqualified from the match. If this behaviour continues, you may be disqualified from the tournament.

Section 3

Balloon Bots

1. Match Rules

Robots will have 3 small balloons attached to their backs, and a pointed screw attached to a mechanism. To win, competitors must puncture the balloons on the opposing robots while avoiding having their balloons popped. Once all 3 balloons are popped, that competitor is eliminated from the game. The last robot with at least one inflated balloon wins.

Robots with no inflated balloons are eliminated.

Balloons that are no longer attached to a robot are counted as deflated.

Balloons that become deflated due to the floor, walls, or arena debris are counted as deflated.

Balloons that are punctured are counted as deflated once they are smaller than 2" diameter.

Robots that are eliminated, are, with their spike down, to drive towards and park near the side of the arena, if possible, and remain immobile for the remainder of the match.

Matches will end when there is one robot remaining, or after 5 minutes. If there is no winner after 5 minutes, all robots may return to the battle to pop any remaining balloons. After all balloons have been popped, the winner will be declared.

Robots designed with the intent to flip, damage, or cause harm to other robots are not allowed.

Balloons will be inexpensive water balloons inflated with air. Inflated dimensions are approximately ~3" inches in diameter and ~5" long. Organizers will do their best to ensure consistency between balloons.

Robots are only allowed to pin for a maximum of 10 seconds. Pinning is when a robot pins or traps another robot against the wall or other obstacle.

2. Robot Build Rules

a) Drivetrain

Drive motors/gearbox combos (referred to as motors) will be functionally equivalent to the 16mm diameter gearmotors in Appendix B. Any off the shelf ratio is allowed, however custom gearbox setups are not allowed.

All robots are allowed a maximum of 2 drive Motors.

- We recommend using direct 2-wheel drive.

Drive wheels are unrestricted.

- We recommend hubs and foam wheels, off the shelf small robot wheels, toy wheels, or custom 3d printed wheels.

The drivetrains listed below are prohibited. If you have questions on drivetrain legality, contact the event organizer.

- Belt/chain driven 4+ wheel drive (4wd, 6wd etc.)
- Flight
- Sharp or damaging drive wheels/hubs
- Vibration drive

b) Weapon

Weapons shall have no more than 4" of reach. The weapon arm may be longer than 4", providing the tip of the screw may extend no further from the perimeter of your robot than 4".

Weapons will be powered by a single servo motor. When rated at 6V, the servo motor will not turn faster than a maximum speed of 0.10 sec/60°. When rated at 6V, the servo motor will not exceed a maximum torque of 45.0 Kg/cm.

Weapon arms may not rotate faster than a maximum speed of 0.10 sec/60°, although they do not have to be directly driven.

Weapon arms may not exceed a rotation angle of 100°.

The only allowed weapon tip will be a single, unmodified #6 1-¼ drywall screw. See links in Appendix B for examples. These screws will be provided at the event, and event provided screws will be required to be used while competing. We recommend competitors purchase their own screws to ensure they work with their robot.

The weapon screw can be mounted at any angle. Weapons require both a weapon lockout and sharp edge covers for safety. Weapons may only extend from the front of the robot.

c) Chassis

All chassis materials will be allowed.

- This allows builders to use whatever material is most easy for them to build the robot out of, whether it be cardboard, 3d printing, wood, or machined metal.

When measured with the robot sitting flat on its drivetrain, robots will not exceed 10" wide by 10" long x 10" tall at any time, in any configuration or possible position.

The outer faces of the robot will be within 15° of vertical for the first 1/2" up from the floor. No wedges!

Balloon bots will have attachment points for balloons mounted on the back or top, behind the weapon of their robot. The balloons do not have to fit inside the robot dimensions defined above.

- This can be anything from a binder clip, a zip tie, some tape, a clothes pin, or a slot that the knot sealing the balloon goes through.

No part of the balloon may exceed a maximum height of 7" measured from the floor with the robot not moving.

The balloons must be exposed from the top, back, and sides. Don't wall in your balloons!

The completed robot must weigh no more than 3 lbs, not including balloons.

- We recommend designing with the intent to weigh less than 1lb, as a heavier robot will have reduced performance.

The chassis is not a weapon. Decorations or other structures must not have sharp edges/points. Designs seeking to exploit the popping of other balloons with sharps not on the weapon are not allowed.

d) Electronics

The only battery chemistry permitted are standard hobby grade Lithium Polymer batteries. These are commonly used on drones/quadcopters and hobby RC planes/vehicles.

Combined Batteries should not be rated less than 350 mAh, or any more than 2s (7.4V nominal) voltage. High voltage LiPo batteries that supply above standard 2s (7.4V nominal) voltages are not allowed. Multiple batteries are allowed.

- We recommend a 2s 350-500mAh Battery.

Batteries must be protected from puncture by other robots from all sides.

- We recommend having the batteries under some sort of cover. Can be as simple as a sturdy 3d print or a small piece of durable plastic that can withstand the attack of another robot.

Any radio/RX/custom control system may be used. Please use your best judgement to understand if it is safe. The event organizer has the final say about any potentially unsafe control systems.

- We recommend something similar to the links in Appendix B.

Any ESC (DC motor controller) can be used.

- We recommend something similar to the list in Appendix B.

All robots must have some sort of battery monitor or battery voltage indicator built in.

- We recommend something similar to the list in Appendix B.

All robots must have an easily accessible power switch.

- We recommend a switch that requires no tools, like a toggle switch, or a turn switch.

A proper failsafe is not required, though highly recommended. Use this as a learning experience for larger combat robots.

No additional motors or servos may be used on the robot aside from purely decorative purposes.

3. Inspections/Penalties

Inspections will not be performed on all robots. The honour system will be used, however, should a robot appear to or be found to be breaking a rule, that robot may be inspected to the full extent of the rules.

Should a robot be found to be breaking any rules, that robot may be substituted for a stock balloon robot provided by the event organizers.

Robots who break game rules may be subject to having one or more balloons removed before the start of the next match.

Should a robot be found to be against the spirit of the division, that robot may be substituted for a stock balloon robot provided by the event organizers.

Section 4

Appendices

1. Appendix A – Judge's Scorecard

The following pages contain the "cheat sheet" that may be provided to each judge during each fight. This sheet summarizes the criteria outlined in this ruleset and is meant to be a quick reference for the judges. The judge's scorecard is not meant to overrule this ruleset.

BotBrawl Judges' Scorecard

White Robot: _____ (White Robot Name) _____ (Score)

Red Robot: _____ (Red Robot Name) _____ (Score)

Aggression (5pts)

Aggression is to be awarded completely independently from which robot does the damage.

5-0: One robot never attempts to attack the other.

4-1: One robot mostly dominates, the other attacks a few times.

3-2: Both robots consistently attack each other, or both robots only attack for part of the match, or both robots spend most of the time avoiding each other.

Aggression may not tie. The judge must decide which robot was more aggressive.

Control (6pts)

Control is awarded based on the relative time that each robot spends in control of the fight.

6-0: One robot completely controls the momentum of the match.

5-1: One robot shows significant dominance during the match.

4-2: One robot shows slight dominance during the match.

3-3: Both robots demonstrate control for a significant portion of the match, or neither robot demonstrates control during the match.

Examples: flipping, grappling, delivering into arena walls/hazards, pinning, etc.

Damage (8pts)

Damage is awarded based on the relative grading of each robot's damage.

8-0, 7-1: One robot suffers trivial or cosmetic damage, the other is at least significantly damaged.

6-2: One robot suffers minor damage, the other suffers major damage.

5-3: Both robots are similarly damaged, but one robot is damaged more.

4-4: Both robots have suffered the same level of damage.

Damage that is self-inflicted by a robot's own systems will not be counted against that robot for scoring purposes.

See reverse for damage examples.

White Robot **Red Robot**

White Robot **Red Robot**

White Robot **Red Robot**

Post-Match Inspection

Judges may request the drivers to demonstrate operability of their robot's drive train and/or weapon following the end of the match, before the arena doors are opened.

Trivial:

- A flip over, causing no loss of mobility or loss of weapon functionality, except where flipping causes full loss of mobility and the robot is unable to show translational movement.
- Sparks resulting from strike of opponent's weapon (but no visible scratch of dent)
- Being lifted in the air with no damage and no lasting loss of traction.

Cosmetic:

- Visible scratches to armor.
- Non-penetrating cut or dent or slight bending of armor or exposed frame.
- Removal of non-structural, non-functional cosmetic pieces (dolls, foliage, foam, or “ablative" armor).
- Damage to wheel, spinning blade, or other exposed moving part not resulting in loss of functionality or mobility.

Minor:

- A flip over, causing some loss of mobility or control or making it impossible to use a weapon.
- Intermittent smoke not associated with noticeable power drop.
- Penetrating dent or small hole.
- Removal of most or all of a wheel or weapon component, which does not result in a loss of functionality or mobility.
- Slightly warped frame not resulting in loss of mobility or weapon function.

Significant:

- Continuous smoke, or smoke associated with partial loss of power of drive or weapons.
- Torn, ripped, or badly warped armor or large hole punched in armor.
- Damage or removal of wheels resulting in impaired mobility.
- Damage to a weapon resulting in partial loss of weapon functionality or severe vibration.
- Visibly bent or warped frame that results in partial impairment to the function of the damaged system.

Major:

- The armor section was completely removed exposing interior components.
- Removal of major component(s) resulting in total loss of functionality or mobility.
- Internal components broken free from mounts and resting or dragging on the arena floor.
- Apparent complete loss of weapon system function.
- Loss of structural integrity - major frame of armor section dragging or resting on floor.
- Total loss of power.

2. Appendix B – Balloon Bots Parts List

16mm Gearmotor Links

- https://www.fingertechrobotics.com/proddetail.php?prod=ft-Sspark16
- https://www.botkits.com/collections/all-products/products/four-battle-hardened-motors?variant=31142859341926

Screw Links

- https://www.homedepot.ca/product/paulin—6-x-1-1-4-inch-flat-head-phillips-drive-coarse-thread-drywall-screws-100pcs/1000140794
- https://www.rona.ca/en/1-1-4-screws-with-bugle-head-and-coarse-thread-box-of-100-1399145

Radio/Receiver Links

- https://hobbyking.com/en_us/hobbykingr-tmhk-gt2b-3ch-2-4ghz-transmitter-and-receiver-w-rechargable-li-ion-battery-1.html
- https://hobbyking.com/en_us/turnigy-tgy-i6-mode-2-afhds-transmitter-and-6ch-receiver.html?queryID=97a54aa6b684a0c57ab8b9b14a1af182&objectID=45922&indexName=hbk_live_magento_en_us_products

ESC Links

- https://www.fingertechrobotics.com/proddetail.php?prod=ft-tinyESCv2
- https://www.vexrobotics.com/276-2193.html

Battery Monitor Links

- https://www.amazon.ca/KeeYees-Digital-Voltmeter-2-5V-30V-Voltage/dp/B07YTYVP79/ref=sr_1_9?dchild=1&keywords=voltmeter&qid=1591553144&sr=8-9
- https://hobbyking.com/en_us/battery-monitor-2-6s.html?queryID=d0a25430e92a66c60310ef785ff0baa8&objectID=37197&indexName=hbk_live_magento_en_us_products

3. Appendix C – Updates and Revisions

Revision	Date	Modified By	Description of Changes
0	May 1, 2023	Tyler Beadle	Initial Release – Modified existing SPARC rules, added Balloon Bots, Judges' Scorecard.
1	January 1, 2024	Tyler Beadle	Added sections, reformatted rules slightly. Removed unused weight classes for brevity. Added Sumo ruleset. Added weight classes. Removed Balloon Bots scoring.
2	April 7, 2025	Tyler Beadle	Updated the ruleset to align with the new 2024 SPARC rules for the 2025 season. Small, inconsequential verbiage adjustments have not been marked.
3	January 6, 2026	Tyler Beadle	Clarified weight bonuses for multibots. Changed sumo from 2/3 to 3/5. Added ability to review un-sticks if needed. Added ledger in the entanglement section. Added verbiage about covering wiring in sumo bots.
4	May 5, 2026	Tyler Beadle	Added Plastic Classes section. Added 150g Fairyweights. Clarified LiPo batteries in robots weighing more than 45lbs. Clarified no cleats on shuffling robots either. Converted document over to docs.