



**2019**

# **Design Rules**

Rev. 2019.0

Changes from Rev. 2018.0 in Red text

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BattleBots® has no affiliation with any other robotic sports organization.

## Overview

This document outlines the requirements for any Team that intends to build a combat robot (“bot”) and compete in the 2019 BattleBots Tournament (the “Tournament”). The following rules have been constructed to be as unrestrictive to the design process as possible while balancing fairness to other competitors, arena damage, event-scheduling issues, and the safety of all competitors, crew, and audience members.

Nothing contained herein shall be construed as an official invitation to join and/or compete in the Tournament. BattleBots Inc. (“BattleBots”) must approve and accept your bot’s design for the Tournament. If your bot was accepted by BattleBots for use in any prior contest, that does not guarantee that the same bot will be accepted for use in this Tournament. If the design of your bot is accepted and you proceed for further consideration, you will receive additional instructions and/or documentation.

## Section 1. BattleBot Basics

### a. Mobility

Your bot can be a walker, roller, hopper, flier, slitherer, or whatever, as long as it moves around in a controlled manner without causing damage to the arena.

At a minimum, we would like your bot to be able to move around at a fast walking pace (~4 mph), but preferably MUCH faster. If your bot is slower, we expect it to have a really awesome weapon (or two).

### b. Bot Control

You must have reliable remote control over all of your bot’s functions and positions. Autonomous functions in the bot are acceptable, provided you are able to remotely disable or override those functions at any time.

### c. Weapons

Whether it’s a flipper, pounder, grabber or whatever, your bot must have at least one independently powered weapon that can seriously affect the operation of another BattleBot. Bring spares and/or alternate (modular) weapons. If your bot does not enter the arena with a functional, effective weapon, you will forfeit your match.

### d. Configuration

A bot can actually be comprised of two or more “MultiBots”. Each bot must meet the requirements described in this document, but only one of the bots is required to have a weapon. And of course, the total weight of all the bots cannot exceed the limit set forth herein.

There is no maximum size limit; however, your bot (or combination of bots) must be able to start the match from completely within the space of an 8’ x 8’ square.

### e. Mini-Bots

A Mini-Bot is defined as a small robot weighing no more than **20.0 pounds** that is a part of a Multi-Bot set.

### f. Component Protection

Batteries, high-pressure tanks, fuel tanks and fuel lines must be sufficiently protected. If you (or we) can jam the blade of a long screwdriver through the outer shell/frame of the bot and hit a battery, pressure tank, fuel tank or fuel line, it is not sufficiently protected.

### g. Floor Clearance

There is no specific requirement for the clearance underneath a bot; however, the arena floor may not be flat and the floor panels may not all be the same height. In addition, there may be “pop-up” obstacles.

## Section 2. Weight Limit

### a. Maximum Weight

The maximum allowed weight is **250.0 pounds** ready to fight. There is no minimum weight.

Flying bots (“Flybots”) are limited to a maximum of **10.0 pounds** each, ready to fight.

Exceptions to the Flybot weight limit may be made on a case-by-case basis, depending upon the construction and configuration of the Flybot. We are concerned about damage to the arena sides and ceiling.

Your bot’s final official weight will be measured on our certified scales at the Tournament. Any other weight measurements you have taken, at home or otherwise, will not be applicable. Note that scales can vary by 5% or more -- if your bot is overweight, you will have very little time at the Tournament to correct it. We recommend that you design your bot underweight and bring ballast.

### b. Weight Exclusions

- Safety covers and restraints do not count towards the weight of your bot.
- If you (or BattleBots) install one or two *small* cameras on your bot, the weight of such cameras will not count towards the weight limit of your bot.
- If BattleBots installs a telemetry package into your bot, the weight of the telemetry package will not count towards the weight limit of your bot.

### c. Additional Decoration Weight

BattleBots can have additional decoration that increases the robot weight over the 250 pound limit, subject to the following:

- 1) The BattleBot without the decoration cannot weigh over the 250 pound limit.
- 2) The decoration itself cannot weigh more than 10 pounds.
- 3) The decoration cannot protect the robot or serve as a weapon.
- 4) The decoration cannot easily become a fouling hazard.
- 5) The decoration must be removable with simple tools in 5 minutes or less.
- 6) Prior to a match, any opposing Team has the right to require removal of the decoration.
- 7) BattleBots officials can require removal of the decoration at any time for any reason.

## Section 3. Activation/Deactivation

If your bot is not easy and safe to activate and deactivate, it will not be approved. We are VERY strict about this.

Activation and deactivation must be done by **one person** and within the maximum amount of time permitted herein.

Even if a bot’s activation and deactivation system meets the letter of the rules as defined below, BattleBots Inc. will make the final decision whether to accept or reject the system.

### a. Master Switches

The Master Switch locations and their access should be one of the first things you think about when designing your bot.

A minimum of two Master Switches are required:

- A “Mobility Master Switch” that mechanically and directly shuts off electric power to the drive system.
- A separate “Weapons Master Switch” that mechanically and directly shuts off all electric power to any weapon and/or Flame system.

More than two Master Switches are allowed as long as it is possible to independently shut off power to the drive and the weapons systems.

Requirements for all of the Master Switches are:

- 1) Switch operation must be simple enough to allow any event crewperson to use it.
- 2) Normal switch operation cannot require any lifting or tilting of the bot.
- 3) Switch operation cannot require that a person get in the path of any weapon.
- 4) A special tool may be used to operate a Master Switch. If your bot requires a special tool to operate a Master Switch, you must bring a spare tool.

All switches have to be operated within the Activation/Deactivation time limit.

An insertable/removable jumper plug is an approved (and preferred) alternative to either type of Master Switch.

If the robot has a powered rotating shell, you must have a method that locks the shell from moving.

If any Weapons Master Switch is located inside the robot underneath a rotating shell, then the robot must have a “Weapon Kill Switch” accessible from the outside of the robot that directly disconnects all electric power from any shell-spinning mechanism, and is located such that rotating the shell is not required to operate the switch (such as on top in the center of the shell, or on the bottom of the bot).

If access to the Weapon Kill Switch is on the bottom of the bot, you must provide a special tool or device that enables one person to flip over the bot without that person touching the bot.

### b. Activation

It cannot require more than **30 seconds** to activate the bot, including the removal of safety covers and restraints and the operation of the Master Switches. For MultiBots, all of the bots combined have to be activated within the time limit.

When any Master Switch (or combination of Master Switches) is turned on, there must be no motion at all by the bot or its weapons.

### c. Deactivation

When your bot is deactivated, it must be incapable of moving or of operating any of its weapons. Deactivation cannot require more than **30 seconds**.

If the bot has just been seriously damaged in combat, the deactivation time requirement may be waived for that match, but the bot must be otherwise rendered safe before removing it from the arena.

## Section 4. Electrical System

### a. Maximum Voltage

The maximum allowed voltage anywhere in the bot is **220 volts**. However, if your bot uses voltages higher than **48 volts** nominal, you will have to convince us that you know what you are doing, and we reserve the right to reject your bot's design for failure to meet our safety requirements.

### b. Batteries

Any type of commercially-available battery may be used. If your bot uses lead-acid batteries, they must be factory-marked as AGM-type.

Protect your batteries well. If your batteries catch fire during a match, the arena may (at the sole discretion of the BattleBots) be sealed off until the fire has burned itself out and the fumes have cleared.

**Batteries have to be removed from the bot after each match, and re-installed just prior to a new match, so they should be readily accessible.**

## Section 5. Remote Control

All communications to or from bots must use a commercially available remote control ("RC") system that uses a form of Digital Spread Spectrum ("DSS") communication with automatic pairing between the transmitter and receiver.

There are many systems and conversions available. A good commercial DSS system is virtually immune to interference. It is your responsibility to confirm that your RC equipment cannot interfere with any other RC system operating on the same frequency.

Your control systems have to be designed such that if your transmitter(s) lose power or are turned off, your bot and its weapon(s) will stop moving.

We will verify your system at the Tournament. If your RC system interferes with other systems at the Tournament, you may be disqualified.

If you have elaborate RC communication station equipment, you will have **60 seconds** to set it up and **60 seconds** to remove it.

## Section 6. Construction Materials

Basically, we do not want to have to clean up a big (or toxic) mess after a match.

### a. Prohibited Materials

This is not a comprehensive list. Be sensible. Check with BattleBots if you are unsure whether or not materials used on your bot may be prohibited.

- Radioactive materials.
- Hazardous loose fibers (asbestos, etc.). Carbon or fiberglass composites are OK.
- Toxic or reactive metals (e.g., Cadmium, Mercury, Lithium), except in batteries.
- Organic substances (except wood, wood products and battery electrolytes).

### b. On the Bot Exterior

Stuff on the outside of your bot should not foul up the arena when it's fighting another bot. This list is also not comprehensive, so be sensible here too. Not allowed are:

- Lead metal (Pb).
- Rigid plastic foams (PVC, Polystyrene, Polyurethane, etc.)
- Glass or brittle ceramics

## Section 7. Flames

Flame outputs are intended for showmanship only and are not considered to be an Active Weapon, as defined below.

### a. Flame Output Requirements

Flame outputs are subject to the following:

- Only pure propane, pure butane, or a combination of the two can be used.
- Gas storage per bot is limited to **16.4 ounces** in a single protected tank.
- The gas cannot be deliberately heated or cooled.
- The flame effect can be started and stopped at will using the remote control.
- The maximum length of the flame is **4 feet**.
- The length and angle limits of the flame must be adjustable.
- Flames from Flybots must be aimed vertically downward.
- **At maximum gas flow, the flame can't operate for more than 1 minute total time.**

## Section 8. Active Weapons

Every bot (or at least one bot that is part of a MultiBot) must have a real weapon (or multiple weapons). If the weapon does not look like it can damage or incapacitate another bot, your bot will not be accepted.

### a. Weapon Definition

A weapon is a powered part of your bot that is remotely operated, independent of its mobility method (wheels or otherwise). The weapon can be used in conjunction with moving the bot, but the basic effectiveness of the weapon cannot depend on bot movement. The weapon's effectiveness also cannot depend on the use of Flames.

Wedges, Thwackbots and such are allowed, but must have additional powered weapons.

### b. Projectile Weapons

Projectile weapons are allowed, as long as they do not create an arena-fouling problem. Projectile weapons must not use explosives. Springs, catapults and gas-pressure powered guns may be acceptable. You may be required to show that your projectile weapon will not damage the Lexan exterior of the arena.

### c. Multiple Weapons

A bot can have more than one weapon, but at least one of the installed weapons must display the ability to damage or incapacitate.

The use of interchangeable (modular) weapons is encouraged. However, the bot cannot weigh more than the specified limit regardless of weapon configuration.

### e. Spinning Weapons

Spinning weapons must have a fail-safe that causes power to be removed from the spinning part(s) if the RC signal is lost.

Spinning weapons must spin down from full speed to a full stop within **60 seconds** on command from the remote controller, or if the RC signal is lost.

### f. Maximum Robot Part Speed

No external moving part on a BattleBot can have a speed at its fastest point that exceeds **370 ft./sec.** Likewise, any projectile emitted from a robot cannot exceed this same limit speed. BattleBots officials reserve the right to test any robot at any time to verify that the limit is not exceeded. The testing may require some slight alteration to the appearance of the BattleBot.

### g. Prohibited Weapons

The following weapon types are not allowed under any circumstances:

- Fouling devices such as glue, nets, fishing line, ball bearings and such.
- Squirted liquids or liquefied gasses such as liquid Nitrogen.
- EMP generators or other means intended to damage or jam the opponent bot's electronics.
- Deliberate smoke generators.
- Bright lights, lasers, etc., that are distracting or dangerous to vision.
- Weapons that damage the other bot by destroying themselves.

## Section 9. Internal Combustion Engines

Internal combustion engines are allowed, but with the following requirements:

- The engine must use a self-starter that is activated by remote control.
- Any electric fuel pumps must be able to be shut off by remote control.
- If the engine uses a separate fuel tank, the tank and fuel line must be well protected.
- The fuel tank must be vented (no pressurized tanks) with a vent system that will not continuously leak fuel if the bot is upside-down.

## Section 10. Pneumatics

**Pneumatics can be dangerous. If you are not familiar with pneumatic systems, use another energy source for your weapons.**

Requirements for any pneumatic system are:

- Systems can use Nitrogen (N<sub>2</sub>) gas or compressed air. CO<sub>2</sub> cannot be used.
- The gasses cannot be deliberately heated or cooled.
- The maximum allowed stored pressure is **3000 psi**.
- The maximum allowed regulated system pressure is **400 psi**.
- There are no specific restrictions on the system design; however, the pneumatic system must use best practices and commercially available components that are rated for the operating pressures used.
- On-board air compressors that fill a buffer tank are allowed and preferred over stored N<sub>2</sub>. In a match, you may start pressurizing after the arena has been closed, but prior to the start of combat.
- You must have a way to shut off or purge the pneumatic system as part of the deactivation procedure.
- Nitrogen pneumatic systems should be designed to be filled using a Parker SST-N2M straight-through stainless steel quick-disconnect male plug fitting, or an exact equivalent fitting from other manufacturers (ref. <https://www.mcmaster.com/#6543k43/=1budh1k>). BattleBots will provide a nitrogen filling station equipped with the Parker ST type Sleeve Lock Socket.
- If you insist on using a different fitting than described above, you're required to bring your own adapter hose and data sheets describing all your filling system components. Like the rest of your robot, they will have to be approved by BattleBots inspectors or you cannot compete.

Pressures above the stated limits may be approved if you can convince us that you have the necessary knowledge and experience to safely engineer such a system.

## Section 11. Hydraulics

Requirements for any hydraulic system are:

- The maximum allowed system pressure is **3000 psi**. A higher limit may be approved if you can convince us that you've the necessary expertise to engineer a reliable and safe system.
- The hydraulic fluid must be non-flammable, non-corrosive, have moderate-to-low toxicity, and be rated for the maximum pressure used in the hydraulic system.
- There are no specific restrictions on the system design; however, the hydraulic system must use best practices and commercially available components that are rated for the operating pressures used.
- Hydraulic reservoir tanks must be protected within the bot.
- You must have a way to depressurize the system as part of the deactivation procedure.

## Section 12. Handling Safety

Any sharp edges or corners on the bot that could injure someone must have a removable protective cover that cannot be accidentally knocked off. That is: they must be mechanically fastened, and not held on by friction or gravity.

If a weapon or other part of a deactivated bot can move such that it could injure a person, it must have some built-in or external method of preventing such movement.

If BattleBots decides that your covers or restraints are not adequate, you will not be allowed to move your bot from your pit area to the arena.

Also, you will not be allowed to hand-carry your bot anywhere during the Tournament. You are required to bring your own hand-truck or dolly for moving your bot.

## Section 13. Telemetry Package

BattleBots Inc. may choose to install a self-powered telemetry package into your bot. As such, you need to leave room in the bot for a module approximately the size of an iPhone.

## Section 14. Appearance

Your bot may be seen on national TV and the television network has broadcast standards, so please make sure that your submission is compliant and suitable for television. BattleBots and its affiliates reserve the right, in their sole and absolute discretion, to require changes to, or elimination of, any design elements, graphics, or wording on your bot.

### Notice:

**These Design Rules may change at any time with or without specific notice to you. Any changes made to these rules will be noted in a revised Design Rules document with a higher Rev number. You acknowledge and agree that it is your responsibility to read, understand, and comply with any and all rules provided herein or otherwise by BattleBots. It is strongly encouraged that you check these Design Rules often for any changes that may affect your design, build, and/or ability to compete in the Tournament. BattleBots reserves the right to remove any Team from the Tournament at any time for any reason (including, without limitation, failure to meet safety and/or technical requirements) in its sole and absolute discretion.**