



**2021**

# **Design Rules**

Rev. 2021.0

Changes from Rev. 2020.2 shown in Blue

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## Overview

This document outlines the requirements for any Team that intends to build a combat robot (“bot”) and compete in the 2021 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.

**Regardless of how you may interpret these rules, BattleBots officials have the final authority of whether your bot design will be allowed to be entered.**

**If you have any questions about the legality of any bot you are planning to build, contact BattleBots with detailed explanations and/or drawings prior to starting construction.**

**Likewise, if you plan to make any significant changes to your design during or after construction, check with BattleBots before making your changes.**

## Section 1. Bot Basics

### a. Mobility

Your bot can potentially 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.

### 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 bot. 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 “Multi-Bots”. Each Multi-Bot must meet all of the design requirements described in this document. And of course, the total weight of all the bots cannot exceed the limit set forth herein.

### e. Size Limits

The primary bot size limit is that a Team’s bot (or the combination of a Multi-Bot’s robots) has to start the match from completely within the space of an 8’ x 8’ square. Any bot must also be able to be moved through the 8’ x 8’ Arena entry doors without disassembly.

BattleBots officials may allow limited exceptions to the floor space limit if you can convincingly explain on your application why your bot needs a larger space.

#### f. MiniBots

A MiniBot is defined as a bot that weighs no more than **20.0 pounds** and does not have an Active Weapon (as defined in Section 8). A Team is only allowed to use a single MiniBot in any Match. However, a Team can use a different MiniBot in different Matches.

(BattleBots officials retain the right to exclude any MiniBot from competing in any Match).

#### g. 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.

#### h. 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. There may also be additional low barriers on the floor.

## Section 2. Weight Limits

### 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

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

- 1) The bot 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.

#### d. Non-Wheeled Bot Weight

Bots that do not use wheels for locomotion may be granted an additional weight allowance. Refer to the “Non-Wheeled Robots” section at the end of these Design Rules.

### 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 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. Jumper plugs should have a positive retention system and can’t project outside the exterior shell or cage of the bot.

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. Indicator Light(s)

All BattleBots are required to have a light, or combination of lights, that indicate if any electrical power is going to any of the bot's weapon, mobility, self-righting or flame systems. All lights must operate automatically when a Master Switch is turned on.

The lights can be any color, but must be sufficiently bright and located such that their illumination can be seen from normal viewing angles without the removal of any covers.

A light is not required to indicate if power is going to a remote-control receiver.

### c. 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 a Multi-Bot combination, 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.

### d. 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 used for the weapon and motion systems is **60 volts** with the batteries fully charged. The maximum voltage allowed for any low-power auxiliary systems anywhere else in the bot is **240 volts**. However, if your bot uses any voltages higher than 60 volts, 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. You may also be disqualified if you can't demonstrate that your RC system provides reliable, positive control in the arena.

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

Certain materials are not allowed to be used anywhere on the bot (including any covers or restraints).

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).
- Polyurethane foam

### 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, Styrofoam, etc.)
- Foam rubber used for armor or decoration
- Glass or brittle ceramics

Note that solid rubber or plastic is allowed on the bot's exterior.

### c. Inside the Bot

Foam plastic or rubber is allowed to be used in the interior of a bot, or inside tires.

### d. Magnets

If you plan on using magnets on your bot (except in motors, solenoids or relays), you have to provide us with the details of use and get preliminary approval.

## 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.
- Total gas storage per bot (or a Multi-Bot combination) is limited to **16.4 ounces**.
- All gas storage tanks must be protected with armor.
- The gas cannot be deliberately heated or cooled.
- The flame effect can be reliably started and stopped at will using the remote control.
- The maximum length of the flame is **4 feet**, regardless of the pointing direction.
- 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.

Note that the 4-foot flame length requirement will be strictly enforced, with potentially serious consequences for bots with flames exceeding this limit. BattleBots officials reserve the right to test a bot at any time [and to require changes to, or removal of, the flame system](#).

Refer to the Tournament Rules for more details.

## Section 8. Active Weapons

Every bot, except for a MiniBot, must have a real weapon (or multiple weapons). If the weapon does not look like it can damage or incapacitate another bot, that 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. Spinning Weapon Parts

Any spinning weapon bars, arms, drums, toothed-disks and the like cannot weigh more than **80 pounds**.

Whole-body spinning shells or surrounding cages cannot weigh more than **120 pounds**.

[Any spinning weapon that bolts together from multiple parts and/or has removable teeth must be pre-approved by BattleBots before the bot will be considered for entry into a BattleBots event. Detailed drawings, calculations, and other design information on the weapon and its attachments have to be submitted.](#)

### g. Maximum Robot Part Speed

No external moving part on a bot 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 bot.

#### **h. Lifter/Flipper Weapons**

Any lifting or grappling weapon will have to demonstrate that it can lift **250 lbs.** to a height of **12 inches**. Any flipper bot may have to show that it can throw a **250 lb.** weight more than **2 feet** into the air.

The lifting or flipping must be demonstrated without the bot moving along the floor.

BattleBots will supply a testing weight, but a Team can bring their own weight.

#### **i. Multi-Bot Weapons**

All of a Team's Multi-Bots, except for the one allowed MiniBot in a Match, must have an active weapon.

#### **j. Prohibited Weapons**

The following weapon types are not allowed under any circumstances:

- Fouling devices such as glue, nets, fishing line, ball bearings and such.
- Squirting 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. Non-Wheeled Robots

BattleBots wants to encourage interesting alternative forms of bot mobility. Therefore, bots that move around without the use of wheels may be allowed an additional weight advantage.

### a. "Walker" Bots

Bots that move around the Arena solely by walking ("Walkers") are allowed an upper weight limit of **500.0 pounds**. To be considered as a Walker, the bot has to move using only articulated legs. Specific requirements for a Walker are:

- It uses 2 or more legs that move forward and backward and lift off the floor.
- There are no additional wheels or skids that touch the floor, or that can support any part of the robot weight.
- The walking motion is independent of, and cannot depend upon, the weapon operation.
- The Walker meets all of the other bot design requirements (weapon, size, etc.).
- A Walker cannot be part of a Multi-Bot combination.

Regardless of the requirements specified above, it's entirely up to the discretion of BattleBots to determine if a bot qualifies as a Walker.

### b. Alternative Mobility

If your Team has a unique and interesting mobility design concept that is neither wheeled nor a Walker, BattleBots may -- on a case-by-case basis -- allow a maximum weight greater than 250 lbs., but less than 500 lbs.

Contact BattleBots with a basic design proposal, and be able to defend why any additional weight above 250 lb. is warranted and will allow fair competition against wheeled and Walker bots. Approval of a basic design proposal does not relieve a Team of the "Pre-Approval and Acceptance" requirements below.

### c. Pre-Approval and Acceptance

With the exception of weight, configuration and size, any non-wheeled bot must adhere to all other Design and Tournament Rules.

Any non-wheeled design must be pre-approved by BattleBots prior to starting any construction. For the pre-approval, a Team is required to provide a highly-detailed design proposal. See the entry document for complete proposal requirements.

Pre-approval of a design does not guarantee competition entry acceptance.

During bot construction, the Team must consistently advise BattleBots officials on their progress, and notify BattleBots immediately if there are any changes from the original design proposal. In addition, BattleBots officials can request information from the Team at any time.

As soon as the basic mobility mechanism is functional, the Team must submit a video of the partially-completed bot moving in a straight line and also turning while moving. Additional videos may be required.

Completion of a non-wheeled bot does not guarantee competition entry acceptance.

## Section 13. 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 14. 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 15. 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.

## Section 16. BattleBots Rights

BattleBots reserves the right to require you to modify or remove weights or magnets, or to make other modifications to your bot or its weapon system at any time during the contest.

[BattleBots also has the right to require disabling or removal of any flame system.](#)

**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.