

Combat Robot Resource Guide

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Introduction

This document serves as a resource for Combat Robot builders and enthusiasts. It contains general information and links to resources that builders may find useful. The plan is to continually update the document as new information and resources become available. At the end of this document there will be a [changelog](#) where readers can check to see what new information has been added.

General Information

This section contains general information about Combat Robotics as a hobby including rules, weight classes, and where to find events.

Rules and Weight Classes

In general the rules and weight classes are fairly standardized. The information contained in this document is most relevant for the US competitions, however there is some crossover. Before you start building, it's best to find a local competition and see what rule set they use, every event has slight variations in the rules. This is usually related to the arena being used. For instance, some arenas have wood floors and do not allow fire, some arenas have push-outs and might have size limitations, etc. Check the rules for the event you're attending before you start building! When in doubt, contact the event organizer. Below is a list of standardized rule sets. Most events will rely on a standardized rule set rather than creating their own.

- [Sparc.Tools](#) - This site has a lot of great information and has probably the most referenced set of rules for most events. When in doubt, it's probably a good idea to look at the rules here first to get a good idea of what you can and cannot do.
- [RoboGames](#) - Even though RoboGames is no longer running, their website still has a lot of great information and a pretty thorough document on rules and weight classes.
- [NERC Rules](#) - NERC doesn't necessarily have it's own set of rules, but they run several events so it's good to know their ruleset.
- [WAR Plastic Ants](#) - The Plastic Ant class is a relatively new class and it has its own set of rules. WAR maintains this ruleset, so if you're looking for an ultra-beginner weight class, check out the rules for this new popular weight class.
- [BattleBots](#) - These rules only apply to the televised competition currently airing on Discovery. These rules are somewhat specific to the TV show and are not necessarily applicable to other competitions, but are included here for the sake of completeness.

Events

Unfortunately at this time there isn't a single repository for all the robot combat events, they are spread out a couple sites. Thankfully, most event organizers do use one of the following resources for posting their events.

- [BuildersDB](#) - The Builders Database is probably the first place you should look for an event. It has a lot of events and has a great registration feature, which makes it very useful for smaller events.
- [Robot Combat Events](#) - The name pretty much says it all! If you don't find anything on BuildersDB, check this site. If you can't find anything close to you on either one, it might be a good idea to check out some forums or ask around.

Links/Resources

For general information about building robots, I've compiled a list of resources like blogs, forums, and online calculators that should help you with the vast majority of common questions that come up. Generally speaking, the combat robot building community is VERY helpful and always willing to answer questions, but it's expected that you do some research beforehand. Questions like "what motor should I use" or "what design is best" or "what's the best weapon" are generally frowned upon because these are choices you need to make. Please do some research and use the many resources available before asking a lot of questions. Building a successful combat robot is quite difficult and takes a lot of research, for everyone.

Books/Magazines

Sometimes you just want to have a physical copy of something to read or reference when doing research. There aren't many physical resources out there, but they're worth checking out.

- [RioBotz Combat Robot Tutorial](#) - Buy this book if you're at all interested in building combat robots. Seriously, just buy it. It's \$10 and it will answer almost every question you have.
- [Servo Magazine](#) - If you're into robotics and electronics, Servo Magazine has a lot of articles that might interest you. It also has a recurring section called "Combat Zone" with articles written by builders. It's worth checking out. In addition to subscribing via print, you can also purchase a digital subscription which gives you access to previous issues via PDF.

Online Blogs/Guides

Following blogs from builders is a great way to get insight into how certain people or teams build, develop, and reiterate their designs. I'm limiting this section to only very active blogs that contain solid information. I'm trying to avoid blogs that may only have a handful of semi-relevant posts.

- [Ask Aaron](#) - This is less of a blog and more of a shotgun blast of information in the style of a late 90s site hosted on Geocities. There's a TON of information on this site and it's worth spending several dozen hours looking through all the information. If you can't find an answer to your question here, it's either not relevant, the wrong question to ask, or you aren't looking hard enough!
- [The Variable Constant](#) - This blog is run by Jamison Go, the builder of Silent Spring, MegatRON, and SawBlaze. There's a lot of general information on this blog, and a lot of background on most of his robots.

- [Equals Zero](#) - This blog is run by Charles Guan, the builder behind such classics as Overhaul, Überclocker, and Stance Stance Revolution. There's a lot of good technical information about building on his blog and if you're interested in brushless drive, there are a lot of great articles here to check out.

Calculators

- [Ask Aaron](#) - Once again, the Ask Aaron site has the best collection of calculators and tools for designing your robot. It has everything from battery calculators, weapon spinner calculators, drive-train gear ratio calculators, and more! If you want to ask how to calculate something, look here first. Actually, just look here first, you will most likely need something here regardless.
- [Team Cosmos](#) - Team Cosmos has a few calculators that might be a bit easier to digest than the more complex ones on Ask Aaron.
- [Dale's Homemade Robots](#) - Check the left-hand side of the screen. At the bottom there is a calculator section that has a lot of useful little calculators.
- [TechnoBots](#) - I just came across this site and it has several useful calculators. If anything, double-checking calculations is usually a good idea.

YouTube Channels

Reading is for nerds. Sometimes you just want to sit back on your couch and absorb information through your eyeballs. There are a lot of good YouTube channels focused on building combat robots. Consider subscribing to these channels and liking the videos, it takes a tremendous amount of work to put together videos and it's nice to see that people get something out of them.

- [Robert Cowan DIY](#) - This is my channel and of course it is the best one out there, please binge watch all the videos! But seriously, I have a wide range of information from general robot building to specific tool knowledge.
- [Team Panic](#) - Ben of Team Panic has a lot of good beginner information on his channel as well as build logs, fight footage, and event recaps.
- [Mechanical Ninjineer](#) - Good channel with lots of content, not all combat-related. Mostly focusing on smaller insect-class builds.
- [Team Cerberus](#) - Lots of fight videos, some build and event recap videos, mostly focusing on smaller insect-class robots.
- [Team Velocity](#) - If you just want to binge watch a ton of fights, this is the channel for you. There's not much tutorial information here, but there's a LOT of fight footage.
- [Alta's Projects](#) - This channel has a few good build logs and some good information on smaller scale building.
- [Chris Miksovsky](#) - Chris doesn't have a ton of content yet, but what it lacks in quantity, it makes up for in quality. There is some good information to be had from his channel.
- [Black Lightning Robotics](#) - I just found this channel and it has a few event reports, build logs and some good fight footage.

Online Forums

Sometimes you have a specific question or just need a second (or third or forth!) set of eyes to make sure you're headed in the right direction. Online forums are good for talking with actual builders after you've done your homework. There are a few active communities where you can post questions, talk with other builders, and see what others are up to.

- [Reddit](#) - The [/r/battlebots](#) subreddit is pretty active, although most of the posts are memes or related specifically to the TV show. But every so often there's a shiny needle in the meme haystack.
- [Sparc.Tools](#) - The SPARC Forum has a pretty active community as well. Although it's a smaller community, it's still worth looking through the posts for information.

Facebook Groups

Love it or hate it, Facebook has an established community for combat robot builders. I'm listing the public groups, but there are many other groups that are NOT public. These groups have various reasons for being closed and I will not list them here, nor will I privately recommend them to you outside of this document, or personally accept your requests. Do what everyone else does, build something, ask some questions and get to know the people in the community. The last thing these groups need is someone that's done absolutely no research to come in and ask "what about using an EMP?!".

General Groups

- [Antweight Combat Robots](#) - This is a great group for beginners since it caters to antweight (1lb) builders. It's a very active group and a great place to start.
- [Beetleweight Robot Combat](#) - Beetleweights are another excellent entry-level weight class. Note that a portion of the group's population is made up of builders from the United Kingdom, where the weight limit is 1.5kg as opposed to the 3lb weight limit in the United States.
- [Battlebots](#) - This group is more geared towards discussion about the TV show, but a lot of great discussions still come up from time to time and you can learn a lot. It's also a good place to chat directly with other builders.
- [Brushless Hipsters](#) - If you want to learn all the nuances of building a brushless drive or weapon system, this is the group for you. This is not a group for absolute beginners, but is a great place to read and gather information before you know what to ask.

Regional Groups

A quick note about the regional groups. These are good places to find information about the local events hosted by the groups, or meet people near you or that will be attending these events. Please, do NOT just blast the same question to every single group you can find, regardless of your location. This is a great way to get banned and disliked in the community.

- [Northeast Robotics Club](#) (NERC) - This is the group behind Motorama and other events. If you're in the north eastern US, this is the group for you!
- [Arizona Robotic Combat](#) - This group is geared towards builders near or in the Arizona region. But that was probably assumed.
- [Colorado Combat Robotics Club](#) - This is a small group for the Colorado-based builders, like myself!
- [Western Allied Robotics](#) (WAR) - This group is for people in the pacific northwest region of the US.
- [Texas Robot Conflict](#) - I've heard that Texas is a pretty big place and you shouldn't mess with it. In any event, if you're from around these parts, this is a good group to check out!

Where to Purchase Parts

If you're building a combat robot, you're gonna need parts! The list below represents the most common places to purchase parts. Read the description of each to give you an idea of where to find what you're looking for. These links are in no particular order.

General Parts

- [Amazon](#) - Amazon is carrying more and more parts every day. In the past year or so, they've really started carrying more 'industrial' parts too, which includes bearings, shafts, fasteners, etc. It's a great place to get generic items. I use it for wiring harnesses, connectors, basic tools, etc. I put this at the top of the list because it's usually the first place I look. Note, the link included is an affiliate link which will help support this guide and my channel if you use it to purchase items.
- [eBay](#) - Combat robots can be very expensive, especially when prototyping a new design. eBay is great for cheap electronics (for proving a design) or purchasing scrap material. I use eBay for all my exotic metal needs; it's a great place to get cut-offs of titanium or other exotic materials for a fraction of the price of new.

Hardware/Materials

- [McMaster-Carr](#) - This is my favorite site. If you're looking for ANY piece of hardware, chances are they have it. If they don't, it probably doesn't exist. It's not always the cheapest place to

buy something, but if you need a special size screw for your design, this is the place to go. You can find bearings, specialty washers, spacers, shims, fasteners, inserts, etc. Their site is also wonderfully laid out and has one of the best searches around. Most items also have a 3D model, so I often use it just for their models.

- [Sackin Metals](#) - This is a great store on eBay for titanium. They don't have regular stock, but if you look through their listings you should be able to find what you need. Their prices are pretty good too.
- [Discount Steel](#) - If you're looking for metal stock, this is a good place to start looking. They have everything categorized so it's easy to find.
- [Online Metals](#) - This is a great site for buying metal stock. They have great categories which makes it easy to find what you need easily.
- [VXB](#) - This is THE place for bearings. Their prices can be pretty reasonable and if you can't find it here, it might be time to rethink your bearing choice. Note, they also sell on Amazon and eBay, so I usually use their bearing search tool to find the bearing I want and then look on Amazon to see if I can combine it with other orders. They're great for determining which bearing to use.
- Your Local Hardware Store - I usually start my projects at hardware stores. Sure, you can go online to McMaster-Carr and find that exotic screw that works, but it might be \$2 a piece. Why not start your research with what's commonly available at a hardware store? It's a great place to get ideas and see what's easy to get.

Electronics or Robot Specific Parts

- [Hobby King](#) - Hobby King is the go-to store for brushless motors, ESCs, batteries, radios, etc. Basically, if you're looking for any of the guts to go in your robot, I would look here first. Keep in mind, stock levels fluctuate and parts are often discontinued without notice. So if you're testing motors, make sure to grab extras as soon as you can because you never know when (or if) they'll be back in stock.
- [ServoCity](#) - If you're looking for mechanical components, structural components, bearings, shafts, tubes, etc, this is the place to look. They have a little bit of everything and also have a great selection of high quality motors and servos.
- [The Robot Marketplace](#) - This is one of the only stores on the entire Internet that caters specifically to combat robot builders. Their product selection has pretty much everything you need from smaller insect-class robots up to heavyweights. If you're looking for a specific motor, controller, or wheels, this is a good place to start. Generally speaking, most of the products here have been tested in combat, which is not the case at other stores.
- [Fingertech Robotics](#) - If you're looking to build an insect-class robot or are just getting start, you should check out Fingertech. They cater to beginner and insect-class builders and all their products are aimed towards combat robotics. Note, their store is located in Canada and shipping to the US can get pricey at times. However, their products are usually stocked elsewhere, so check the other stores on this list to save on shipping.

- [Pololu](#) - They have a great selection of smaller-scale robot parts. However, be careful because not all of their parts are suitable for combat. But it's a good resource for gearmotors, wheels, and some electronics.
- [EndBots](#) - EndBots has a small selection of parts for smaller-scale robots. If you're looking to build a small budget-minded robot, this is a great place to look.
- [BotKits](#) - This is the home of the infamous D2 beetleweight kit. They also have motors, controllers, and various hardware.
- [RobotShop](#) - This site has just about everything you would need to build a robot. It's not focused on combat specifically, but there's still some good stuff there.
- [SparkFun Electronics](#) - SparkFun has a few combat-specific parts here and there, and a wide selection of other components you might find useful. If you're looking to do an autonomous bot, or one with sensors, this would be a great place to look.
- [KitBots](#) - Not to be confused with BotKits, this site sells a lot of useful components for smaller combat robots.
- [Robot Power](#) - This site sells a lot of speed controllers for bots of various sizes, including the popular "Scorpion" line of speed controllers.
- [BaneBots](#) - BaneBots makes some great wheels and gearboxes, mostly for larger size robots. You can buy their gearboxes and wheels elsewhere, but they have custom sizes and more options directly on their site.
- [BotsDepot](#) - BotsDepot is home to Kinetic, a nice 3lb drum-based kit.
- [Battle Robot Kit](#) - These guys have a couple insect-class kits, including Lobotomy and Taserface, as well as some other insect-class parts.

Getting Parts Made

It's rare that you can build an entire combat robot without making any custom parts. Below is a list of vendors that others have used successfully for their own builds. So if you're in search of a machine shop, waterjet cutter, etc that will do one-off parts, check the links below.

- [Rocky Mountain Waterjet](#) - This is my go-to for all waterjet cut parts. Their prices are reasonable and they have a very quick turnaround time. They are based out of Colorado. Ask for Brad and tell them Robert referred you to them, he has experience quoting parts for combat robots and he can help you understand what you need to know. They do ship parts and carry basic material like aluminum and some steel. info@rockymountainwaterjet.com
- [Big Blue Saw](#) - BBS is an online waterjet company that has been used for many years by many different teams. They are quick and have good quality. If you just want to submit files online and get them in the mail without any hassle, this is a good option. They tend to be more expensive than local options, but if you don't have a local option, they may be a good alternative.
- [Team Whyachi](#) - Not only is Whyachi a successful Battlebots competitor, but they're also a full-service machine shop offering machining as well as waterjet cutting. They aren't cheap, but they know what they're doing.

- [Metalex Thermal Specialties](#) - This is where I go for all my heat-treating. I have had very good luck with them and never had a cracked weapon (fingers crossed)! They are a bit difficult to deal with, only take cash, and you will need to call them. But they do good work and are reasonable. They are located in Colorado and will ship. Tell them Robert Cowan referred you.

Contribute to the Guide

I want to keep this guide as tidy and relevant as possible. I'm not interested in having 2 pages worth of links to people's personal blogs where they have one or two small tutorials about their first antweight build. This guide is meant to be a curated list of the best resources available at the time, not ALL resources available. I will be reaching out to a small group of builders that I know and trust to help me keep this guide up to date. If you want to help contribute, reach out to me. I am not including any contact information because you should already know me, and I should already know you. This list is NOT the right way to promote your new YouTube channel, blog, website, or store. If your information is not included in this list it could mean that I'm not aware of it, but it could also mean that I don't feel it's relevant for some reason. My ultimate goal for this document is for it to be accessible, not intimidating, and relevant to the current state of combat robot building.

Hosting/Organizing an Event

So, you want to host your own event? Obviously if you're starting out, it's best to start small and build an arena for ants and possibly beetles. There are a few resources online that go into details about how to construct an arena. It would be a good idea to look at the [rules section](#) above and also talk to a few other event organizers to get an idea of what you need in terms of liability forms, safety, etc. There are few resources you can use for arena building, judging criteria, etc. I will add to this list as more become available.

[Sparc.Tools](#) - This site has a good arena construction guide as well as other general resources for hosting your own event. The information on this page is a slight bit outdated, but it's a good starting point.

Glossary of Terms

- **Antweight** - This refers to the 1lb (US) weight class of combat robots.
- **Beetleweight** - This refers to the 3lb (US) weight class of combat robots.
- **ESC** - This acronym stands for 'electronic speed controller. This typically refers to the electronics that control the speed for a brushless motor. Generally speaking, this is a motor

driver that has an RC input, power input, and outputs to control a brushless motor. You send it a signal from your radio (or any device that outputs an RC pulse signal) and it will vary the speed of the connected motor.

- **Fairyweight** - This refers to the 150g (US) weight class of combat robots.
- **Featherweight** - This refers to the 30lb (US) weight class of combat robots.
- **Heavyweight** - This refers to either the 220lb (US) or 250lb (Battlebots) weight class of combat robots. In most cases, 220lb is the heavyweight class, but for Battlebots (the TV show), 250 is the weight limit.
- **Hobbyweight** - This refers to the 12lb (US) weight class of combat robots.
- **KE** - This stands for 'Kinetic Energy' and refers to the amount of energy stored in a spinning mass. This unit of measurement is typically J or Joules. A very general rule of thumb is around 150 J per pound. Therefore a 3lb Beetleweight robot would have around 450 J worth of energy at full weapon speed, whereas a 220 pound heavyweight would have 33 KJ. This is a rough estimate, many robots can vary from this number quite a bit, but it's good to know a range. Somewhere between 100 and 200 J per pound should be competitive.
- **Lightweight** - This refers to the 60lb (US) weight class of combat robots.
- **Melty Brain** - This is a type of robot where the entire robot spins, and is moved by tracking the position it's facing and increasing or decreasing the speed of the drive, which translates into motion in a given direction. Think of a spinning disc spinning very slowly (for this example). If you want to drive the robot away from you, it would wait until the 'front' of the robot is facing away from you and it would (while spinning) slightly increase the speed of the motors to drive slightly away from you. The heading is usually indicated by a light that blinks once per revolution. In much the same way as a shell spinner, it uses a light to indicate the 'direction' of motion. This is a tricky design to pull off, but since the entire robot spins, the entire robot becomes the weapon. This gives it the ability to have very high KE (kinetic energy) numbers. This is also referred to as 'translational drift'.
- **Middleweight** - This refers to the 120lb (US) weight class of combat robots.
- **Sportsman** - This is a special class of combat robot that either does not use a kinetic energy weapon (spinning mass) or has severe restrictions to spinning weapons. This is usually due to arena considerations. Sportsman robots are typically flippers, wedges, hammer-bot, flippers, or any type of combat robot that doesn't rely directly on a spinning kinetic energy weapon.
- **SRiMec** - This stands for 'self-righting mechanism'. It's a term used to describe a (usually) mechanical mechanism used for self-righting a combat robot during a match. It can also be called a shrimech.
- **Translational Drift** - see 'Melty Brain'

Revision History

- 01/07/2019 - Added glossary section, still filling this out.
- 01/06/2019 - Added Black Lightning Robotics. Added a couple of vendors to the "getting parts made" section. Document goes live, added a couple new vendors based on suggestions.
- 01/02/2019 - Added 'getting parts made' section. Still a work in progress, but I will add more to this soon.

- 12/5/2019 - Added books/magazines section. Completed the online forums section. Added stuff to 'where to buy'. Added hosting an event section.
- 11/29/2018 - Added "Contribute to the Guide" section. Added links to 'regional' facebook groups. Added WAR plastic ants rules and NERC rules.
- 11/28/2018 - Added links, added headings, started to build out the content
- 11/19/2018 - Created document