SPARC Arena Construction Best Practices v1.1
(updated Feb 2024)

The content of this document is meant to cover best arena design and construction practices at the time of publication.

Cost Estimate:
While there are many variables that can influence the total cost of an arena these are the typical costs seen at the three most common scales of full combat capable arena:

150g arena: $200-500
1-3lb arena: $3,000-$8,000
30lb arena: $10,000-$25,000
220lb arena: $100,000+
(costs are USD)

Arena Frame:
Suitable materials for arena frame construction vary based upon which weight classes the arena will support.

For insect class events some common materials used are wood, aluminum extrusion, (80/20 and similar) and welded steel tubing. While building the structure of the arena out of wood may be an inexpensive option it will need careful design and regular maintenance to ensure that it can reliably contain weaponed insect class robots. Most arenas that are primarily constructed of wood use aluminum or steel in key areas for reinforcement and wall mounting.

For events with robots up to the 30lb weight class common arena materials are aluminum extrusion (80/20 and similar) and welded steel tubing. If aluminum extrusion framing is used it should be regularly inspected to ensure that the fasteners holding it together haven't loosened or that the frame components haven't been knocked out of alignment.

For events with robots larger than 30lbs welded steel is the only commonly used arena material. Welded steel frames should be periodically inspected to ensure that tubes are unbent and the welds are not cracked.

Arena Walls:
Polycarbonate (Lexan/Makrolon) is the material of choice for arena walls due to its impact resistance and clarity.

A "kickplate" should be used to minimize the chances of direct contact between robots and the arena walls. Kickplates often take the form of vertically mounted flat plate, I-beam, or C-channel segments that surround the perimeter of the combat surface and are designed to take direct weapon contact.

The preferred method for mounting polycarbonate wall panels is to fully constrain the perimeter of the sheet within a groove, allowing the sheet to float and flex within the groove during impacts. Partial grooves can be used, however the sheet will either need to be thicker to compensate or will need to be replaced more frequently. Polycarbonate panels should not be bolted directly to the arena frame as the bolt holes (and any other cutouts) create stress concentrations that can result in catastrophic failure due to a heavy impact.

When possible, multiple (commonly two) thinner layers of polycarbonate that result in the total desired thickness are preferable to a single thick sheet. The benefits of this arrangement are that the thinner sheets are more easily able to flex, reducing the shock of any one impact, and that the majority of the damage will be done to the inner layer which is more economical to replace than a single thicker sheet.

Polycarbonate is subject to UV degradation and should be stored indoors between events, or if that’s not possible, at a minimum under a covering that prevents the polycarbonate from being exposed to natural light. Care should also be taken to avoid scratching the surfaces of the sheets when cleaning and storing them. If possible, avoid sliding the faces of the sheets on any surface, including other polycarbonate sheets.

<u>Wall Thickness</u>
For 150gram events, 3/16” equivalent wall thickness is common and should be considered the minimum wall thickness for a full combat event.
For 1lb events, 1/4” equivalent.
For 3lb events, 3/8” equivalent.
For events up to 30lbs, 3/4” equivalent.
For events up to 220lbs, 1.5” equivalent wall thickness is common, or 1” equivalent with reduced tip speed limits and/or weapon weight limits.

Arena Floor:

Common floor materials are wood, (plywood, mdf, etc…) steel, and stainless steel. Textured fiberglass has been used in some insect class arenas as a sacrificial top layer over a wood base floor.

A steel floor allows robots to use magnets to augment their drive system. If you do not wish to allow this, you will want to highlight the no-magnets rule in your SPARC documents.

<u>Floor size</u>
For 150gram events, 3x3ft is the minimum recommended.
For 1lb events, 4x4ft is the minimum recommended.
For 3lb events, 8x6ft is the minimum recommended.
For 30lb events, 16x16ft is the minimum recommended.
For 220lb events, 40x40ft is the minimum recommended.
Modern robots can fight in a size-up arena (sometimes two sizes up) because they are usually fast enough to close wide gaps quickly.

Arena Access:

The two most common methods of accessing the interior of an arena are doors and sliding panels. In either case it is important to have a means of locking the access point in the closed position to eliminate the chances of an impact forcing the access point open.

With a hinged door a locking pin or bar that is secured to the frame is usually sufficient.

With a sliding panel the locking method is dependent on how the panel is designed. If you're sliding a solid sheet of polycarbonate for access and using a locking pin that pierces the sliding element, ensure that it does not create a stress concentration point that can lead to fracturing. Other options are a security bar or pin that inserts adjacent to the sliding panel and prevents motion. If the sliding panel is built into a frame then a pin through the non-polycarbonate portion of the sliding panel would not create stress risers.

Arena Roof:

Roofs are regularly impacted by high speed debris, but they can also be hit by entire robots striking with full weapon force. So roofs must be built to handle the same level of energy as the vertical walls. With most arenas visibility through the roof is not a concern, so more material options are available for roof construction.

Arena Lighting:

If you anticipate using your arena in locations that are not well lit or your roof design limits the light passing into the arena you will need to consider lighting solutions. Some major factors to consider when selecting a lighting solution are: Shatter resistance, voltage, color temperature, light output, and wattage. It is recommended that any arena lights be located inside the arena as that will not only minimize glare for the audience but will also keep any damage that occurs to the lighting system located in the arena.

Arena Hazards:

If you opt to include arena hazards (pits, saws, hammers, spinning bars, etc…) keep in mind that these hazards will be subject to full force impacts from the robots competing in the arena and they should be built to handle these impacts without needing frequent repair. If the pits drop below the arena, ensure that they are built as strongly as the arena walls on all sides and bottom.

Arena Safety:

Fires happen in robot combat; to deal with these you should have some equipment on hand at all times including: A large metal bucket partially filled with sand and a scoop, thick heat and cut resistant gloves, and a fire extinguisher*. The purpose of the bucket is to contain a damaged/burning battery. Often the battery cannot be removed from the robot safely so when possible size the bucket such that it is able to contain an entire bot. None of the previously mentioned equipment will put out a lipo fire, however the nature of lipo fires in robot combat tends to be such that the best route is to put out any immediately surrounding fires and get the burning robot outdoors immediately, transported either in the sand filled

bucket or on a fire resistant cart while using the extinguisher to keep the fire from spreading and keep things cool. Once outside and not emitting flames/hot gases, measures can be taken to separate the lipo from the rest of the robot.
*CO_2 extinguishers are top recommendation because they do not foul up the robot like chemical extinguishers.

It is recommended that some sort of ventilation system (exhausted outdoors or recycled through filtration) exist in your arena design to allow smoke to dissipate after a fire. Lipo smoke is harmful to breathe.

Arena Examples:

Group & Weight Class	**Robot Battles**, 3lb and under
Frame	80/20 style aluminum extrusion
Walls	Dual layered 1/8” polycarbonate with air gaps for non access walls
Floor	Layered plywood and MDF attached to frame
Access	Sliding 1/4" wall panels
Roof	1/4” polycarbonate slotted into frame
Special	Side wheels for tipping and rolling on edge

Group & Weight Class	**NERC**, 30lb and under
Frame	80/20 style extrusion
Walls	Double layered 1/4” polycarbonate (1/2” total)
Floor	Plywood
Access	Locking doors
Roof	Double layered polycarbonate using 1/16” and 1/4” sheets
EO Note	Modern 30lb robots have reached a power level where this arena is no longer adequate for full combat because the manner in which the panels are secured is not sufficient to prevent them from popping out after a heavy impact. In addition, the current kickplates (treadplate over 2x12 wood) regularly break after heavy impacts.

Group & Weight Class	**NERC**, 30lbs and under
Frame	Welded steel
Walls	Double layered 1/4” polycarbonate (1/2” total)
Floor	Layered plywood
Access	Door with locking bar
Roof	Plywood with tarp above

Group & Weight Class	**Kilobots (Saskatoon)**, 3lb and under
Frame	Welded steel, built as a trailer (no set-up)
Walls	3/8" polycarbonate with steel kickplate
Floor	Two layers of 1/8" steel
Access	Sliding half-walls with locking pins
Roof	1/2" plywood

Group & Weight Class	**Kilobots (Calgary)**, 3lb and under
Frame	80/20 style extruded aluminum
Walls	3/8" polycarbonate with steel kickplate
Floor	1/8" steel
Access	Sliding half-walls with locking pins
Roof	1/2" plywood