

SPARC-based Insect Robot Construction Specifications v1.1

(With customizations for Vector Space Robot Combat)

- Overview and Purpose
 - The SPARC-based Insect Robot Construction Specifications were created to provide both builders and event organizers with an up-to-date and easy-to-implement rule set for use at insect-scale combat robot events.
 - The SPARC-based Insect Ruleset will call out areas where the rules are often altered by the events and will provide the most frequently used options for easy adaptation.
- General
 - All participants build and operate combat 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 and 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 their 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.
 - Cardinal Safety Rules: Failure to comply with any of the following rules could result in expulsion or worse, injury and death.
 - Radios that do not operate using spread spectrum technology may not be turned on at or near events for any purpose without obtaining explicit permission from the event and its safety officials.
 - 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 the 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 bots are VERY dangerous.
 - Locking devices: Moving weapons that can cause damage or injury must have a **clearly visible** locking device in place **at all times** when not in the arena. Locking devices must be painted in a high-visibility color(neon orange, neon green, etc). Locking devices must be clearly capable to stopping, arresting or otherwise preventing harmful motion of the weapon.
 - 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 neighbors and people passing by.
- Weight Classes.

This event offers the listed weight classes in section 4.1. There is a 100% weight bonus for non-wheeled robots(There may be a 50% weight bonus for shufflers or other forms of locomotion which do not fall within the definition of non-wheeled robot - see 5.1.2 for

a definition of a non-wheeled robot.)

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Rolling	Shufflers	Non-Wheeled
0.33lb / 150g	225 g	300 g
1lb / 454g	1.5 lb	2 lb
3lb / 1.36kg	4.5 lb	6 lb
6lb / 2.72kg	9 lb	12 lb

- Mobility

- All robots must have **easily visible and controlled mobility** in order to compete.

Methods of mobility include:

- Rolling (wheels, tracks or the whole robot)
- Non-wheeled: non-wheeled 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 organizers as soon as possible to determine what, if any, weight bonus you will qualify for.
- Shuffling(rotational cam operated legs)
- Ground effect air cushions(hovercrafts)
- Jumping and hopping
- Flying(airfoil using, helium balloons, ornithopters, etc.)

- Robot control requirements:

- Tele-operated robots must be radio controlled, or use an approved custom system as described in 6.4.3. Radio controlled robots must use approved ground frequencies, typically 27/49/50/53/75/900/2400 for the United States.
- 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. This may be inherent in the robots electrical system or be part of programmed failsafes in the radio. Robots 1 lb and less are required to have drive failsafes.
 - All robot radio systems must have a way to change frequencies or coded channels to prevent radio conflicts. Having at least **two** frequencies or coded channels available is **required**. Lack of extra frequencies may result in a forfeit. Digital spread-spectrum radios that use frequency hopping or automatic channel selection qualify under this rule.
 - If you are using a home-built control system, or a control system not covered here, you must first clear it with the event you plan to attend.
 - Toy radio systems are allowed for robots with no active weapons.
 - RC systems on the AM band are allowed at events for robots with no active weapons.
 - All robots with an active weapon MUST use a radio systems on the FM band with PCM, IPD coding, a digitally coded 900 MHz or 2.4GHz system(Spektrum, HobbyKing, etc), or an approved custom control system.
- This event does not require a separate power switch for the radio, but it is

encouraged.

- 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).
- 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, LiIon, LiFe, LiPoly, etc. If your design uses a new type of battery, or one you are not sure about please contact the event you're planning to attend.
 - All on-board voltages above **48 Volts** require prior approval from this event. (It is understood that the initial voltage state of a charged battery is above its 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** after the end of the match 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(Fingertech, Whyachi, etc) or removable link. Relays may be used to control power, but there must also be a mechanical disconnect. Please note that complete shut down time is specified in section 2.4.3.
 - 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.
- Pneumatics
 - Pneumatic systems on board the robot must only employ non-flammable, non-reactive gases(CO2, Nitrogen and air are most common). It is not permissible to use fiber wound pressure vessels with liquefied gasses like CO2 due to extreme temperature cycling.
 - You must have a safe and secure method of refilling your pneumatic system.
 - SPARC recommends the use of standard paintball fill fittings available at many retail outlets and online. For specs see Part#12MPS from Foster, <http://www.couplers.com>.
 - The maximum actuation pressure allowed for pneumatic systems in combat robots is **250 PSI**.
 - All components must be used within the specifications provided by the manufacturer or supplier.
 - Compressed air and/or CO2 refill stations will NOT be provided at the event; you must supply your own and be trained in their safe use. Event staff will help you place your refill station in a safe and secure location.

- Hydraulics
 - The pressure for 12 pound or less robots is limited to **250 PSI**, and there must be an easy way to determine this pressure. Contact the event with any questions.
- Internal Combustion Engines (ICE) and liquid fuels are **not** allowed at HCRC events.
- 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.
- Springs and flywheels
 - Any large springs used for drive or weapon power must have a way of loading and actuating the spring remotely under the robots 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 robots power.
 - All springs, flywheels, and similar kinetic energy storing devices must fail to a safe position on loss of radio contact or power.
- 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 IC engine. (Please use shielding around sparking components)
 - EMF fields from permanent or electromagnets that affect another robot's electronics.
 - Entangling Weapons or defenses: these are weapons or defenses that can reasonably be expected to stop drivetrain and/or weapon motion by being wrapped around rotating parts. This includes nets, tape, strings, and other entangling materials or devices.
 - Weapons or defenses that 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 bot 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
 - Untethered Projectiles (see tethered projectile description in Special Weapons section 14.1)
 - Heat and fire are forbidden as weapons. This includes, but is not limited to the

following:

- Heat or fire weapons not specifically allowed in the Special Weapons section(14.2)
- 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 not specifically allowed in the Special Weapons section (14.3)
 - 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.
- Special weapon descriptions allowed at this event:
 - Tethered Projectiles are allowed at this event.
 - If allowed, tethered projectiles must have a tether or restraining device that stops the projectile and is no longer than 2 feet.
 - Heat and Fire are **NOT** allowed at this event. Flame weapon rules are subject to change to comply with local fire regulations and fire officials.
 - Fuel must exit the robot and be ignited as a gas. It cannot leave the robot in a liquid or gelled form or use oxidizers.
 - Fuel types allowed are propane and butane, the maximum quantity allowed is 4 fl oz.
 - The fuel tank must be as far from the outer armor of the robot as practicable and be protected from heat sources within the robot.
 - The ignition system must have a remotely operated shutoff that allows the operator to disable it using the radio control system.
 - Smoke Effects are **NOT** allowed at this event.
 - Small smoke effects may be used. Please contact the event if you plan on using it.