

RFL Extensible Technical Regulations,

Robot Club & Grille version, 2003

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1. General

1.1. All participants build and operate robots at their own risk. Combat robotics is inherently dangerous. There are no amount of regulations that can encompass all the dangers involved. Please take care to not hurt yourself or others when building, testing and competing.

1.2. This rule set was designed to be adjusted by each event depending on its safety concerns. Any part of these rules [bracketed in red] are parts that may change from event to event. Any {parts bracketed in green} may be stricken or disallowed entirely from event to event. Text parts <bracketed in blue> are specific to the Robot Club & Grille in Pittsburgh (abbreviated "RCG").

1.3. 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.

1.4. Compliance with all event rules is mandatory. It is expected that competitors stay with in the rules and procedures of their own accord and do not require constant policing.

1.5. Each event has safety inspections. It is at their sole discretion that your robot be allowed to compete. As a builder you are obligated to disclose all operating principles and potential dangers to the inspection staff.

1.6. Cardinal Safety Rules: Failure to comply with any of the following rules could result in expulsion or worse, injury and death.

1.6.1. Radios may not be turned on at or near events for any purpose without obtaining the appropriate frequency clip or explicit permission from the event.

1.6.2. Proper activation and deactivation of robots is critical. Robots should only be activated in the arena, testing areas, or with expressed consent of the event and it's safety officials.

1.6.3. All robots should be able to be FULLY deactivated, which includes power to drive and weaponry, in under [45 seconds].

1.6.4. All robots not in an arena or official testing area should 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.

1.6.5. All robots not in an arena or official testing area should have secure safety covers over any sharp edges and restraints on any active weapons or pinch hazards.

1.6.6. 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.

1.7. <The RCG has no specific weapon requirement, low wedges are likely to get stuck under the side bumpers.>

2. Weight Classes. Some events may offer weight bonuses in each class for non-wheeled robots and for certain activities at events. Check each event for specifics and definitions. <Walker robots, defined as robots with non-rotating feet, get a 50% weight bonus.

Weight classes are:

Antweight	0.00 - 1.00 lb (1.50 lb walker)
Beetle	1.01 - 3.00 lb (4.50 lb walker)
Hobbyweight	3.01 - 12.00 lb (18.0 lb walker)
Featherweight	12.01 - 30.00 lb (45.0 lb walker)
Lightweight	30.01 - 60.0 lb (90.0 lb walker)
Middleweight	60.5 - 120.0 lb (180.0 lb walker)
Heavyweight	120.5 - 220.0 (330.0 lb walker)

For Ants to Featherweights, our scale reads in 100^{ths} of a pound. Larger robots are weighed on a scale with 0.5 pound resolution. If the scale dithers between two weights, the higher weight will be used.>

3. Mobility

3.1. All robots must have [easily visible mobility] in order to compete. [If you are designing a non-rolling robot, it is always best to contact the event organizer for pre approval, especially if you are planning on taking advantage of a weight bonus.] <We recommend contacting the RCG at botclub@lazytoad.com to preapprove any walker designs.>

Methods of mobility include:

3.1.1. Rolling (wheels or the whole robot)

3.1.2. Walking (linear actuated legs) <At the RCG, we simply require the feet to be non-rotating; we therefore allow many more designs. Note that “square wheels” are considered rotating feet. It is allowable for a rotating motor or cam to move the legs, as long as the legs themselves do not rotate.>

3.1.3. Shuffling (rotational cam operated legs)

3.1.4. Ground effect air cushions (hovercrafts)

3.1.5. Jumping and hopping [although the height may be limited by each event due to arena safety constraints]

3.1.6. Flying (airfoil based, helium balloons, ornithopters, etc.) [currently flying robots are not allowed unless prior approval by the event has been granted.]

4. Radio control requirements:

4.1. Tele-operated robots must be radio controlled and use ground frequencies (27/49/50/75/900 for the United States) or an approved custom system as described in 4.8. <We only allow 27 and 49 Mhz for antweights and beetles, and only for robots with no active weapon.>

4.2. [Toy radio systems may be allowed in classes under 12lb. Check with your event if you plan to use one] <See above, ants and beetles with no active weapon.>

4.3. Tethered control is not allowed.

4.4. Pre 1991 non narrow band radio systems are not allowed.

4.5. Tele-operated robots 1 lb. or less must use an RC radio system and while fail safes are encouraged they are not required. [AM radios are allowed on all robots up to 12lbs that DO NOT have active weapons] . If the robot has active weapons or is heavier than 12lbs the robot must use an FM (PPM, PCM, or IPD) or digitally coded 900MHz radio (IFI). All robots above 1lb with active weapons or 12lbs and heavier must not show motion when radio contact is lost (failsafe).

4.6. Robots over [60lbs] must use PCM [, IPD, PPM,] with failsafes, or digitally coded 900 Mhz radios (IFI).

4.7. All robot radio systems should have a way to change frequencies (RC systems) or coded channels (900MHz systems). Having [two] or more frequencies available is <required>. Lack of extra frequencies may result in a forfeit.

4.8. [If you are using a home built control system you must first clear it with the event.]

4.9. [The event may require a separate power switch for the radio.] <The RCG requires a separate switch for radio power and main power, with separate indicator lights, for robots 12 pounds and above.>

4.10. [The event may have reserved frequencies for testing and safety which you may not use.] <The RCG will at some point reserve these frequencies for club equipment 68, 71, 79>.

4.11. [Events outside the United States may have additional restrictions on frequencies.]

5. Autonomous/Semi-Autonomous Robots: Robots which do not require human input for one or more of their functions. [If you are bringing an autonomous robot or a robot with significant autonomous functions please contact your event ahead of time.]

5.1. Any autonomous function of a robot, including drive and weapons, must have the capability of being remotely armed and disarmed.

5.2. While disarmed, the robot is not allowed to function in an autonomous fashion.

5.3. In addition to the required main power light, robots with autonomous functions must have an additional clearly visible light which indicates whether or not it is in autonomous mode.

5.4. When activated the robot should have no autonomous functions enabled, and all autonomous functions should fail-safe to off if there is loss of power or radio signal.

5.5. [In case of damage to components that remotely disarm the robot, the robot will automatically disarm 4 minutes after being armed.]

6. Batteries and Power

6.1. 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, etc. [If your design uses a new type of battery, or one you are not sure about please contact your event organizer] <Alkaline batteries are allowed in antweights and beetles only.>

6.2. All onboard voltages above [36 volts DC] require prior approval from the event. (It is understood that a charged battery's initial voltage state is above their nominal rated value)

6.3. All electrical power to weapons and drive systems (systems that could cause potential human bodily injury) must have a disconnect that can be activated within [10 seconds] without endangering the person turning it off. (eg. no body parts in the way of weapons or pinch points.) Please note that complete shut down time is specified in section 1.6.

6.4. All efforts should be made to protect battery terminals from a direct short and causing a battery fire. <RCG: required>

6.5. If your robot uses a grounded chassis you must have a switch capable of disconnecting this ground. ICE robots may be excepted from this rule if there is no way to isolate their grounding components. [contact your event organizer if you need this exception]

6.6. All Robots must have a light easily visible from the outside of the robot that shows its main power is activated. <RCG: requires a separate switch and indicator light for radio power as well.>

7. Pneumatics

7.1. Example diagrams of typical pneumatic systems

7.1.1. CO2 based systems GeneralPneumaticsCO2.pdf

7.1.2. HPA based systems GeneralPneumaticsHPA.pdf

7.2. Pneumatic systems on board the robot should 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.

- 7.3. All pneumatic components on board a robot should be securely mounted. Particular attention should be made to pressure vessel mounting and armor to ensure that if ruptured it will not escape the robot. (the terms 'pressure vessel, bottle, and source tank' are used interchangeably)
- 7.4. All pneumatic components within the robot must be rated or certified for AT LEAST the maximum pressure in that part of the system. You may be required to show rating or certification documentation on ANY component in your system.
- 7.5. All pressure vessels must be rated for at least [120% OVER] the pressure they are used at and have a current hydro test date. (This is to give them a margin of safety if damaged during a fight) [If large expansion tanks, pressure lines, or actuators are used they also need to be over rated and the design should be submitted to the event organizer for pre approval]
- 7.6. All primary pressure vessels must have an over pressure device (burst/rupture disk or over pressure 'pop off') set to no more than 130% of that pressure vessels rating. (Most commercially available bottles come with the correct burst assemblies, use of these are encouraged)
- 7.7. If regulators or compressors are used anywhere in the pneumatic system there must be an (additional) over pressure device downstream of the regulator or compressor set for no more than 130% of the lowest rated component in that part of the pneumatic system.
- 7.8. All pneumatic systems must have a manual main shut off valve to isolate the rest of the system from the source tank. This valve should be easily accessed for robot de activation and refilling.
- 7.9. All pneumatic systems must have a manual bleed valve downstream of the main shut off valve to depressurize the system. This bleed valve should be easily accessed for deactivation. This valve must be left OPEN whenever the robot is not in the arena to ensure the system cannot operate accidentally.
- 7.9.1. It is <required> to bleed all pressure in the robot before exiting the arena. (You may be required to bleed the entire system if it is believed that you have any damaged components.)
- 7.10. You should have a safe and secure method of refilling your pneumatic system. [All pressure vessels should have the standard male quick disconnect for refilling or have an adapter to this fitting. (Standard paintball fill fitting available at many retail outlets and online. For specs see Part#12MPS from Foster, <http://www.couplers.com/straightthruFSTplugs.htm>)] <RCG: see our separate tournament and safety procedures for RCG rules on refilling and damage assessment.>
- 7.11. All pneumatic systems must have appropriate gauges scaled for maximum resolution of the pressures in that part of the system. (There should be gauges on both the high AND low pressure sides of regulators.)
- 7.12. If back check valves are used anywhere in the system you must ensure that any part of the system they isolate can be bled and has an over pressure device.

7.13. [Any pneumatic system which does not use a regulator, employs heaters, pressure boosters, or pressures above 2500psi should be pre qualified by the event organizer.] <RCG: no tank heaters allowed, maximum on-board pressure is 1000 psi for liquid CO2 and 2,500 psi for high pressure air or nitrogen. Working pressure allowed is up to the maximum on-board pressure. RCG provides liquid CO2 using standard paintball fittings. Other gasses are not provided. Contestants are not allowed to store pressurized filling cylinders in the pit area.>

7.14. Please note that some pneumatic systems with very low pressures (below 100 total psi on board), small volumes (12g CO2 powerlets), small robots (12 pounds or smaller), single use applications, or pneumatics used for internal actuation (as opposed to external weaponry) may not need to comply with all the rules above. [Consult your event organizer if you would like an exception.]

8. Hydraulics

8.1. All hydraulic components onboard a robot should be securely mounted. Particular attention should be made to pump and accumulator mounting and armor to ensure that if ruptured direct fluid streams will not escape the robot.

8.2. All hydraulic components within the robot must be rated or certified for AT LEAST the maximum pressure in that part of the system. You may be required to show rating or certification documentation on ANY component in your system.

8.3. Any accumulators or large reservoir must be rated for at least [120% OVER] the pressure they are used at. (This is to give them a margin of safety if damaged during a fight)

8.4. All hydraulic systems must have an over pressure by pass device set to no more than 130% of the lowest component rating. It must be rated to bypass the full volume of the hydraulic pump.

8.5. All hydraulic systems must have a(n) accessible manual by pass valve(s) to easily render the system harmless.

8.6. All hydraulic systems must have appropriate gauges scaled for maximum resolution of the pressures in that part of the system.

8.7. All hydraulic systems must use non flammable, non corrosive fluid and should be designed not to leak when inverted.

8.8. [Any hydraulic system using pressure boosters, or pressures above 5000psi (without accumulator) or pressures above 2000psi (with accumulator) should be pre qualified by the event organizer.]

8.9. Please note that some simple low pressure and volume hydraulic systems, like simple braking, or those used in small robots (12 pounds or smaller), may not need to adhere to all the rules above. [Consult your event organizer if you would like an exception.]

9. {Internal Combustion Engines (ICE) and liquid fuels.}

<RCG: due to inadequate ventilation, no ICE allowed.>

10. { Rotational weapons or full body spinning robots:}

<RCG: no Kinetic energy limits or RPM limits, but we must approve all spinners with blades higher than 7" that extend 7" or more beyond the robot body. Such robots could potentially reach over the steel bumpers to hit the Lexan walls directly.>

11. Springs and flywheels

11.1. Any large springs used for drive or weapon power must have a way of loading and actuating the spring remotely under the robots power.

11.1.1. Under no circumstances should a large spring be loaded when the robot is out of the arena or testing area.

11.1.2. Small springs like those used within switches or other small internal operations are excepted from this rule. [In addition springs used in robots under 12 pounds may be excepted from this rule. Please contact your event organizer.]

11.2. Any flywheel or similar kinetic energy storing device should not be spinning or storing energy in any way unless inside the arena or testing area.

11.2.1. There must be a way of generating and dissipating the energy from the device remotely under the robots power.

11.3. All springs, flywheels, and similar kinetic energy storing devices should fail to a safe position on loss of radio contact or power.

<11a. Hammer Bots. RCG: because our floor is only 1/8" steel, we cannot allow robots with overhead weapons that can pierce or dent the floor. All such robots must contain some kind of stopping mechanism to prevent the hammer or piercer from contacting the floor with force. Please contact us for pre-approval for such robots.>

12. Forbidden Weapons and Materials. The following weapons and materials shall be forbidden from use: [Note that some of the listed items may be allowed for effects but not as weapons. If you have an application of these items which you feel should be allowed, consult your event organizer ahead of time.]

12.1. Weapons designed to cause invisible damage to the other robot. This includes but is not limited to:

12.1.1. Electricity as a weapon such as Tesla coils, Van der Graaf generators, stun guns, or cattle prods

12.1.2. RF jamming equipment, etc.

12.1.3. RF noise generated by an IC engine. (please use shielding around sparking components)

12.1.4. EMF fields from permanent or electromagnets which affect another robots electronics.

12.2. Weapons or defenses which tend to stop combat completely of both (or more) robots. This includes, but is not limited to the following:

- 12.2.1. Entanglement devices. Such as nets, fishing line, cables, string, glues or tapes which require the match to be stopped, and the robots separated. (If this occurs the 'entangler' forfeits the match)
- 12.2.2. Entanglement devices where the 'entangler' continues to move freely are allowed. [If you have a question contact your event organizer.] <RCG: no entanglement devices allowed.>
- 12.3. 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:
 - 12.3.1. Liquids, foams, liquefied gasses
 - 12.3.2. Powders, sand, ball bearings and other dry chaff. [Some events may allow limited use of these materials if you can clean them up easily.] <RCG: not allowed.>
 - 12.3.3. Items which may shatter or explode. This includes, but is not limited to the following:(Note: The intent of this rule is too avoid people using carbide tipped wood cutting blades that could disintegrate on contact with ferrous metals, exceptions can be granted upon review.)
 - 12.3.3.1. Carbide tipped cutting blades.
 - 12.3.3.2. Abrasive cutoff blades, etc.
- 12.4. Untethered Projectiles. Projectiles must have a tether capable of stopping the projectile at full speed and be no longer than [8 feet]. [Some events may allow detachable/launchable entanglement devices]
- 12.5. Heat and fire are forbidden as weapons, [however some events may allow limited fire effects]. <RCG: no Fire of any kind.> This includes, but is not limited to the following:
 - 12.5.1. Heat specifically generated to damage an opponent
 - 12.5.2. flammable liquids or gases
 - 12.5.3. Explosives or flammable solids such as:
 - 12.5.3.1. DOT Class C devices
 - 12.5.3.2. Gunpowder / Cartridge Primers
 - 12.5.3.3. Military Explosives, etc.
- 12.6. Light and smoke based weapons which 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:
 - 12.6.1. Large quantities of smoke or dust. [Limited smoke effects may be allowed by some events.] <RCG: no smoke or dust>
 - 12.6.2. Lights such as external lasers above [5mw output] and bright strobe lights which may blind the opponent.
- 12.7. 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. [If you have a question please contact your event organizer.] <RCG: contact us at botclub@lazytoad.com>

* If you plan on using the RFL rule set for your event you are welcome to. Our only requirement is that it not be changed other than in the extensible areas, and that it be referred to as the RFL Tech Regs.