

15 lb. Technical Regulations for XtremeBOTS Regional Competitions

Revision Date: February, 2020

1. General

- 1.1. All participants build and operate 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.
- 1.2. 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 info@xtremebots.org. 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.
- 1.3. Compliance with all event rules is mandatory. It is expected that competitors stay within the rules and procedures of their own accord and do not require constant policing.
- 1.4. 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.
- 1.5. Cardinal Safety Rules: Failure to comply with any of the following rules could result in expulsion or worse, injury and death.
 - 1.5.1. 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 personnel or its safety officials.
 - 1.5.2. All robots must be able to be FULLY deactivated, which includes power to the drive and the weaponry, **within 60 seconds by a manual disconnect.** (Removable link or Main Power Switch)
 - 1.5.3. 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. (We strongly suggest a custom designed block that ensures the robot will not be inadvertently dislodged from the block)
 - 1.5.4. 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 neon orange or another high-visibility color. Locking devices must be clearly capable of stopping, arresting or otherwise preventing harmful motion of the weapon. C- Clamps and locking pliers are not allowed.
 - 1.5.5. *Weapon locking pins must be in place when a robot is placed in the arena. However, the locking pin may be removed before weapon power is applied during a robot's power-on procedure. This includes all powered weapons regardless of the power source.*

- 1.5.6. 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. *A special area in or near the pits will be provided for repeated drilling and or grinding. These operations should not be performed at your pit table if a special area is designated.* Continued failure to follow safety directions could result in an individuals or the entire team disqualification for the event. (This includes and is not limited to wearing SAFETY GLASSES at ALL times while in the pit area.)
- 1.5.7. Any sharp-edged weapon must have the edge effectively covered until the bot is in the ring.

2. **Weight Classes.** These events offer the 15 pound weight class only.

3. **Mobility**

- 3.1. All robots must have easily visible and controlled mobility in order to compete. Methods of mobility include:
 - 3.1.1. Rolling (wheels, tracks or the whole robot)
 - 3.1.2. 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.
 - 3.1.3. Shuffling (rotational cam operated legs)
 - 3.1.4. Ground effect air cushions (hovercrafts)

4. **Robot control requirements:**

- 4.1. *Tele-operated robots must be radio controlled via 2.4GHz Spread Spectrum radio systems, or similar radio/receiver systems that require binding between a single specific radio and receiver.*
- 4.2. Tethered control is not allowed.
- 4.3. Radio system restrictions for this event with corresponding weight and or weapon restrictions:
 - 4.3.1. Radio systems that stop all motion in the robot (drive and weapons), when the transmitter loses power or signal, are required for all robots. This may be inherent in the robots electrical system or be part of programmed fail-safes in the radio.
 - 4.3.2. *All robot radio systems must be Spektrum (preferred) or Hobby King 2.4 ghz spread spectrum radio systems. Those with similar binding systems other than the preferred Spektrum or Hobby King systems must explain the binding properties of their specific system during inspections.*

5. **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 contact league personnel.

- 5.1. 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).

- 5.2. The autonomous functionality of a robot must have the capability of being remotely armed and disarmed. (This does not include internal sensors, drive gyros, or closed loop motor controls.)
 - 5.2.1. While disarmed, all autonomous functions must be disabled.
 - 5.2.2. When activated the robot must have no autonomous functions enabled, and all autonomous functions must failsafe to off if there is loss of power or radio signal.
 - 5.2.3. In case of damage to components that remotely disarm the robot, the robots autonomous functions are required to automatically disarm within one minute of the match length time 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, LIon, A123 LiFe Nano Phosphate. **Lithium Polymer batteries (LiPo) are prohibited (Fire and explosion hazard exists when incorrectly charged, shorted, or punctured)**. If your design uses a new type of battery, or you are not sure about it, contact info@xtremebots.org.
- 6.2. *The maximum on-board voltage, from a single battery or combination thereof is **28.8 volts** for 15# class robots for this league. (It is understood that a charged battery's initial voltage state may be 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 manual disconnect that can be activated within **15 seconds** without endangering the person turning it off. (E.g. No body parts in the way of weapons or pinch points.) Shut down must include a **manually** operated mechanical method of disconnecting the main battery power, such as a switch (Hella, 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 **within 60 seconds by a manual disconnect** , as specified in section 1.5.
- 6.4. All efforts must be made to protect battery terminals from a direct short and causing a battery fire.
- 6.5. *All robots must have a separate light per circuit that is **easily visible from the outside** of the robot and shows that its circuit's power is activated. LED's and fiber optics are good, low power options for this.*

7. Pneumatics

- 7.1. All 15# robots must use Low Pressure Air systems. (LPA)
- 7.2. Pneumatic systems on board the robot must only employ non-flammable, nonreactive gases (compressed air or disposable CO2 cartridges are permissible).
- 7.3. Example diagrams of typical pneumatic systems:
 - 7.3.1. 15# class robots - CO2 based systems, see attachment below
- 7.4. Pneumatic system refilling process:
 - 7.4.1. You must have a safe way of refilling the system and determining the on-board pressure.
 - 7.4.2. The maximum pressure that may be stored or used for the 15# class robot is 150 PSI or less. The maximum total volume of pressurized gas is 8 cubic feet at standard temperature and pressure.
 - 7.4.3. All components must be used within the specifications provided by the manufacturer or supplier. If the specifications aren't available or reliable, then it will be up to the Safety Official to decide if the component is being used in a sufficiently safe manner.
- 7.5. You must have a safe and secure method of refilling your pneumatic system. All LPA systems must have the standard Schrader valve for refilling; all CO2 systems must use single use tanks.
- 7.6. All pneumatic components on board a robot must be securely mounted. Particular attention must 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)
- 7.7. 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.
- 7.8. All pressure vessels must be rated for at least 120% of the pressure they are used at. (This is to give them a margin of safety if damaged during a fight.) It is not permissible to use fiber wound pressure vessels with liquefied gasses like CO2 due to extreme temperature cycling.
- 7.9. 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, and use of these is encouraged.)
- 7.10. 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.
- 7.11. All pneumatic systems must have a manual main shut off valve to isolate the rest of the system from the source tank. This valve must be easily accessed for robot deactivation and refilling. It must also be out of any danger areas.
- 7.12. All pneumatic systems must have a manual bleed valve downstream of the main shut off valve to depressurize the system. This bleed valve must 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.

- 7.12.1. It is required to be able to easily 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.)
- 7.13. All pneumatic systems must have appropriate gauges scaled for maximum resolution of the pressures in that part of the system.
- 7.14. 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.

8. **Hydraulics**

- 8.1. Robots in the 15# class are NOT allowed to use hydraulics.

9. **Internal Combustion Engines (ICE) and liquid fuels.**

- 9.1. Robots in the 15# class are NOT allowed to use ICE.

10. **Rotational weapons or full body spinning robots:**

- 10.1. 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.)
- 10.2. Spinning weapons must come to a full stop within 30 seconds of the power being removed.

11. **Springs and Flywheels**

- 11.1. Springs used in robots will use the remaining rules in this section. Safe operation, good engineering and best practices must be used in all systems.
- 11.2. Any large springs used for drive or weapon power must have a way of loading and actuating the spring remotely under the robots power.
 - 11.2.1. Under no circumstances must a large spring be loaded when the robot is out of the arena or testing area.
 - 11.2.2. Small springs like those used within switches or other small internal operations are exempt from this rule.
- 11.3. 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.
 - 11.3.1. There must be a way of generating and dissipating the energy from the device remotely under the robots power.
- 11.4. All springs, flywheels, and similar kinetic energy storing devices must fail to a safe position on loss of radio contact or power.

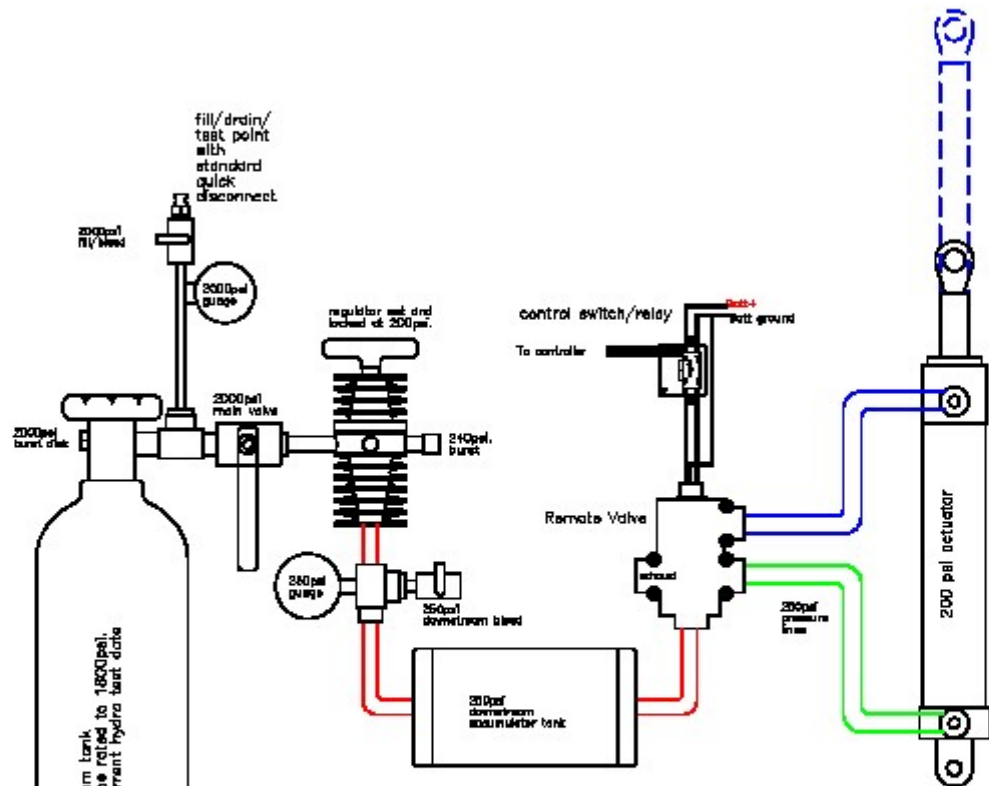
12. **Forbidden Weapons and Materials.**

The following weapons and materials are absolutely forbidden from use:

- 12.1. Weapons designed to cause invisible damage to the other robot. This includes but is not limited to:
 - 12.1.1. Electrical weapons
 - 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 electro-magnets that affect another robot's electronics.
 - 12.1.5. Weapons or defenses that stop combat completely of both (or more) robots. This includes nets, tapes, strings, and other entanglement devices.
- 12.2. 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:
 - 12.2.1. Liquid weapons. Additionally a bot may not have liquid that can spill out when the robot is superficially damaged.
 - 12.2.2. Foams and liquefied gasses
 - 12.2.3. Powders, sand, ball bearings and other dry chaff weapons
- 12.3. Un-tethered Projectiles (see tethered projectile description in Special Weapons section 13.1)
- 12.4. Heat and fire are forbidden as weapons. This includes, but is not limited to the following:
 - 12.4.1. Heat or fire weapons not specifically allowed in the Special Weapons section (13.1.1)
 - 12.4.2. Flammable liquids or gases
 - 12.4.3. Explosives or flammable solids such as: DOT Class C devices Gunpowder / Cartridge Primers Military Explosives, etc.
- 12.5. 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:
 - 12.5.1. Smoke weapons not specifically allowed in the Special Weapons section (13.1.1)
 - 12.5.2. Lights such as external lasers above 'class I' and bright strobe lights which may blind the opponent.
- 12.6. 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.

13. **Special Weapon Descriptions Allowed:**

- 13.1. Tethered Projectiles are allowed at these events, and must be no longer than 3 feet.
 - 13.1.1. Heat, Smoke and Fire are not allowed at these events.



Typical CO₂ based system for actuation of a piston type actuator.

- finned regulator designed for CO₂ to minimize freezing.
- appropriate burst assemblies on high and low pressure sides
- high and low pressure bleeds
- high pressure main valve downstream of fill/drain/test point and gauge