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Robot Construction Rules

Contents

NB: This table of contents is provided for readers' convenience only.

1. Overview and Purpose

1.1. This policy document "The BARL Robot Construction Rules" sets out the construction requirements participants must meet in order to qualify a robot and gain approved entry into BARL *Events*. In addition, this document;

- Ω Defines robot categories and weight classes.
- Ω Outlines the safety requirements with respect to presenting the robot for qualification, maintenance and assessment by event officials on site.
- Ω Defines the standards of measurement and assessment used to qualify a robot for *events.*
- Ω Outlines additional participant requirements with respect to safe robot handling, as it relates to the construction of the robot.
- Ω Outlines pre-entry requirements participants must follow in order to gain entry into BARL events.

1.2. These rules are subject to change and alteration, all new versions of this document, once approved, immediately invalidates and supersedes its previous versions.

2. Legal

2.1. BARL operates in the State of Victoria and is subject to its legislation, which may at any stage supersede or influence the rules of this document.

2.1.1. Where dispute, doubt, contradiction or conflict arises between the rules of this document and the State of Victoria and its representatives, all decisions will be made in favour of the State of Victoria, its legislation and representatives.

2.1.2. All participants build and operate robots at their own risk. Participants acknowledge and accept that combat robotics is inherently dangerous, and damage and injuries can occur; and upon submitting an application to participate in a BARL event, have thereby acknowledged their acceptance and indemnify BARL, its representatives, associated sponsors, facility owners and operators of any legal action in relation to any BARL event.

3. Definitions

3.1. Unless specifically defined in this document, the common meaning of a term is to be applied as found in the latest edition of the Oxford English Dictionary; Where upon such word does not exist in the Oxford English Dictionary, the meaning of a term shall be as per the latest edition of the Collins English Dictionary.

3.2. The following terms are defined as such;

3.2.1. Arena

3.2.1.1. The designated area, whether enclosed or not, where robot fighting and robot sports are conducted.

3.2.2. Circuit

3.2.2.1. An electronics circuit.

3.2.3. Effective pitch

3.2.3.1. The distance between the teeth of a saw blade.

3.2.4. Event

3.2.4.1. A single activity of competition, gaming or sport conducted in an Arena, (*See Arena*)

3.2.5. Event Official

3.2.5.1. Any person designated by BARL as having authority or specific powers to carry out tasks associated with an event

3.2.6. Measurement

3.2.6.1. The act of measuring, by event officials using a prescribed device

3.2.7. Non-wheeled

3.2.7.1. A Robot that does not contain wheels, or use wheels for locomotion

3.2.8. Power

3.2.8.1. Power, energy potential, kinetic energy

3.2.8.2. Of having power; having electricity or potential

3.2.9. Pressure vessel / Source tank

3.2.9.1. A tank for pressurized gasses, vapour, fuel, or liquid, whether under pressure or not, whether full or empty.

3.2.10. Robot

3.2.10.1. A Robot, a Drone, a Hovercraft, a Float-craft,

3.2.11. Rolling

3.2.11.1. A robot with one or more wheels, in contact with the ground, forming in part or whole, its primary drive system

3.2.12. Shufflers

3.2.12.1. A robot that is non-wheeled, that obtains locomotion by movement of articulated extrusions (i.e., legs)

3.2.13. Unacceptable Risk

3.2.13.1. Any Hazard, where the risk as deemed by event officials to be of or above a moderate likelihood of occurring, and whereby such occurrence is likely to cause injury or harm to persons, property or environment.

4. Standards and Measurements

4.1. Robots and robot weaponry will be measured by event officials, using prescribed devices only, and; such measurements as taken are used to determine eligibility and suitability for participation in events.

4.2. Prescribed devices are specified prior to the event and are used throughout the associated event, and; are not subject to change unless the prescribed device is faulty or unserviceable.

4.3. Prescribed devices include; Scales, Digital Callipers, Tape Measure, Metric Ruler, Laser Tachometer.

4.4. For the purposes of robot qualification; prescribed devices will be made available to all participants upon request at no less than **one hour prior to the first event**.

4.5. Measurements will be conducted in designated areas only.

4.6. Measurement of weight:

4.6.1. Weight is measured in grams (g) unless otherwise stated by policy or event requirements, and;

4.6.2. Weight will be measured to 2 decimal places only, and;

4.6.3. Where prescribed devices display greater than 2 decimal places, values equal and greater than 5 on the 3rd decimal place will be rounded up to the next value. Values less than 5 will be rounded to 0 and thus, ignored from measurement. No additional rounding of remaining decimal places shall be applied.

4.7. Measurement of Length:

4.7.1. Length is measured by event officials using millimetres (mm).

4.8. Measurement of RPM:

4.8.1. RPM will be measured by a non-contact laser tachometer and; the spinning device will be measured at the fastest speed possible for the device, in the open air, for a period of **3 seconds**, and; the **maximum value** displayed will be taken as the final

recorded value.

4.9. Measurement of Radius:

4.9.1. Radius of a spinning component is measured as Length *(Section 4.7)*, from the centre axis of rotation, to the outermost edge of the longest component affixed to the axis.

4.10. Measurement of Diameter:

4.10.1. Diameter of a spinning component is measured as 2 x Radius *(Section 4.9)*.

4.11. Measurement of Pi:

4.11.1. Pi is measured to 5 decimal places, as 3.14159.

4.12. Measurement of Moment of Inertia (MOI):

4.12.1. MOI when so calculated as it relates to the spinning tip speed in meters per second of an active weapon, will be determined by measuring the RPM *(Section 4.8)* and Diameter *(Section 4.10)* and applying this formula: (tip speed = (Pi x Diameter / 10,000) x RPM) / 60).

4.12.2. All other MOI calculations taking into account mass, rotational dynamics, shape and other geometry or variable conditions will not be made or taken into account to determine robot suitability or qualification of events.

4.13. Measurement of Effective pitch (Saw blades and Abrasives):

4.13.1. Effective pitch of Saw Blades is determined by the following formula: (Effective pitch = tooth count / diameter).

4.13.2. Effective pitch for abrasives; the grit size will be used in situ of tooth count using the formula (Tooth count = grit * circumference).

5. Qualification for Events

5.1. Time frames:

5.1.1. Unless otherwise specified by official BARL event notifications, participants must; submit event applications and registrations, including all applicable documentation and requirements specified in this policy and detailed in the BARL event notifications, **no less than 14 days** for destructive classes and **no less than 7 days** for non-destructive classes, prior to the event date.

5.2. Registration

5.2.1. Each robot must be pre-registered via the BARL web registration, or if permissible by event officials, by written format and submitted electronically. Each robot registration must include:

- Ω Intended Robot Classes
- Ω Robots method of locomotion

- Ω Operating frequencies
- Ω Weapon list and detailed descriptions
- Ω Completed hazard and risk assessment, completed by the builder

5.2.2. Builders and Designers of robots that contain any weapons, devices, extruding objects, capable of causing injury or damage, **OR** robots intended for classes of 13,610 g or above, must also submit the following specifications;

5.2.2.1. Total weight of robot,

5.2.2.2. Motor and drive system,

5.2.2.3. Voltage and power systems, including battery or fuel source,

5.2.2.4. Gearing ratios of main drive and weapon systems,

5.2.2.5. All weapon types, weights, dimensions and materials,

5.2.2.6. Detailed photographs of weapons

5.2.2.7. Any other relevant information or detail where applicable, so that the weapon systems attack, motion and potential damage impact can be easily assessed.

5.2.3. Each robot, robot controller and related devices, must undergo a physical safety inspection and evaluation prior to gaining acceptance into an event. This will be performed by designated event officials and includes, but is not limited to:

5.2.3.1. Physical inspection, including rigidity, structure, balance, movement testing

5.2.3.2. Measurement of weight and dimensions

5.2.3.3. Remote control feature testing, distance and limitation testing

5.2.3.4. RF Signalling, RF communication testing

5.2.3.5. Internal inspection(s)

5.2.3.6. Removal and testing of battery source(s) where applicable

5.2.3.7. Fuel and fluid inspection(s) and testing where applicable

5.2.3.8. Demonstration of functions

5.2.3.9. Demonstration of controls

5.2.3.10. Compliance checks in accordance with prescribed rules

5.2.3.11. Emergency stop mechanisms, where such are required

5.2.3.12. Review of builders risk assessment

5.2.3.13. Additional checks, as required, in accordance with special event rules or safety requirements

5.2.4. Builders and Designers are obligated to disclose all operating principles and potential dangers to the inspection staff during the safety evaluations.

5.2.5. Robots that are non-compliant will not be accepted for entry.

5.2.5.1. Participants may take corrective actions and request reassessment, up until 30 minutes prior to event start, subject to availability of event officials.

5.2.5.2. Reassessments are not limited, and are not guaranteed.

5.2.6. Where doubt exists as to the safety of the robot, or it is reasonably believed to pose an *unacceptable risk*, the robot will not be permitted.

5.3. Robot events are restricted by robot weight, defined by Weight classes, unless otherwise specified in this document, or expressly by event officials.

5.4. In all cases, sections 5.2.3, 5.2.4 and 5.2.4 notwithstanding, it is at the sole discretion of event officials that a robot be accepted to the event.

6. Robot Safety Requirements

6.1. All robots must be able to be **FULLY** deactivated by a **single operator**, which includes power to drive and weaponry, **in under 60 seconds by;**

6.1.1. Full disconnect of power source,

6.1.2. Full disconnect of weaponry,

6.1.3. Full disable of control inputs,

6.1.4. Full installation and activation of weaponry locking systems.

6.2. Locking devices **must be active** for all robots with moving weapons that can cause damage or injury, and:

6.2.1. Must have a **clearly visible** locking device in place **at all times** when not in the arena.

6.2.2. Locking devices must be entirely in a single neon orange, pink or yellow high-visibility colour.

6.2.3. Locking devices must be clearly capable of stopping, arresting or otherwise

preventing harmful motion of the weapon.

6.3. Weapon locking devices **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.

6.4. All active weapons, articulated extrusions and associated components, **must NOT** be capable of activation without direct controller input from an operator. Specifically, weapons must not become rouge by being capable of operating independently of controlled input.

7. Operator Safety Requirements

7.1. All prescribed safety precautions in this policy must be adhered to at all times within, and in the vicinity of BARL operated premises.

7.1.1. A breach of the safety requirements is deemed as noncompliance and will result in a warning or expulsion from the premises and disqualification from an event, as per the following:

7.1.1.1. A single verbal or written warning for each breach, to a maximum of 3 warnings in a 24 hour period; and whereupon a 4th breach results in immediate expulsion from all registered events and the premises.

7.1.1.2. Immediate expulsion from all registered events and the premises; for such breaches where the actions were wilful or malicious, or pose an *unacceptable risk* or danger to others.

7.2. Robots must not be activated in undesignated areas.

7.3. Robots may only be activated under the following circumstances;

7.3.1. When active in the arena,

7.3.2. At designated testing areas,

7.3.3. At designated maintenance/build areas, when so permitted by event officials,

7.3.4. With expressed consent of the event officials.

7.4. All robots **not** in an arena or official testing area; whether acting as a display or undergoing maintenance, assembly or rework, or is otherwise stored, must be raised up in a manner so that;

7.4.1. The robots wheels, legs or propulsion devices cannot cause movement if the robot were turned on, and;

7.4.2. It is not within reach of children, and;

7.4.3. The robot, including any connected or associated components is not a trip hazard.

7.5. All builders and participants must follow safety practices when working on robots at the event, which include:

7.5.1. All building, maintenance, assembly, tooling, programming and re-work must be conducted in the designated areas only.

7.5.2. All robots and their controls must be **disabled** when not undergoing maintenance and assembly activities.

7.5.3. Robots containing weapons capable of causing damage or injury **must** be fully disabled; safety locking devices in place and weapon mechanisms must not be capable of harmful motion.

7.5.4. Maintain situational awareness of all people in the vicinity and people passing by.

7.5.5. Cease any and all action that is likely to pose a danger or risk to any person.

7.6. Follow all directions given, by event officials.

8. Competitions and Event Classifications

8.1. All Robot events are primarily designated and defined by **Weight Classes**;

8.2. Additional event classifications apply alternate, restrictive or additional robot build requirements for that designated event, and;

8.2.1. Multiple event classifications may apply to a single event, and;

8.2.2. Whereby any contradictions between permissible build options exist, the restrictions are to be applied and enforced over the permissible.

9. Weight Classes

9.1. Robots are defined by 3 categories based on their form of locomotion; Rolling, shufflers and non-wheeled. (*Refer to definitions, section 3*).

9.2. Robots are separated into competitive classes, by weight category.

9.3. Additional weight offset bonuses are allocated to shufflers and Non-Wheeled in each class as defined in *Table 1, Weight classes*;

Table 1, Weight classes:

Class Name	Rolling	Shufflers	Non-Wheeled
AntWeight	150 g	225 g	300 g
Half Kilobot	454 g	680 g	908 g

Kilobot	1000 g	1500 g	2000 g
BeetleWeight	1,360 g	2,040 g	2,720 g
MantisWeight	2,720 g	4,080 g	5,440 g
HobbyWeight	5,440 g	8,160 g	10,880 g
HobbyWeight Open Air	5,440 g Open Air	8,160 g Open Air	10,880 g Open Air
BantamWeight	6,800 g	10,200 g	13,600 g
FeatherWeight	13,610g	20,400 g	27,200 g
FeatherWeight Sportsman	13,610g Sportsman	20,400 g Sportsman	27,200 g Sportsman
FeatherWeight Open Air	13610 g Open Air	20,400 g Open Air	27,200 g Open Air
LightWeight	27,220 g	40,800 g	54,430 g
MiddleWeight	54,430 g	81,640 g	127,000 g
HeavyWeight	99,790 g	150,000 g	199,500 g
Robot Wars HeavyWeight	110,000 g	165,000 g	220,000 g
BattleBots HeavyWeight	113,400 g	170,000 g	227,000 g

9.4. With respect to weight; A robot is eligible, and may qualify for any class that the robot, when weighed by event officials, does not exceed the weight of that class, specifically;

9.4.1. A robot is permitted to be entered into a higher weight class in its category.

9.5. With respect to each class; a robot must not exceed the allocated class weight limit for its category.

10. Open Air Combat Classes

10.1. Any event where robots compete at any time in the open air, this event shall be deemed an Open Air event, and will be subject to these additional restrictions;

10.1.1. Participation of robots with weapon systems that are capable of tearing, snapping, severing, breaking, or cutting off portions of an opponent, is only with the express

consent of the lead event official prior to competing.

10.1.2. Robots with active weapons are subject to the respective requirements of those weapons.

11. Plastic Classes

11.1. Consist of an event in any weight class, where specific build requirements and restrictions are in place for all robots in that event, specifically; all robots must be built using approved plastic materials, in accordance with;

11.1.1. **Approved plastics** are: PET, PETG, ABS, PLA, or PLA+,

11.1.2. Any combination of these plastics may be used and are not limited or portioned in any way,

11.1.3. The chassis and weapons must consist solely of the approved plastic materials,

11.1.4. Non-plastic parts such as motors, electronics, axles, fasteners and adhesives can be any material, but cannot be used in such a way to enhance the structural integrity, armour the robot, or enhance any weapon. Magnets to enhance traction or downforce are **prohibited**. Foam is allowed for wheels and padding of electronics;

11.1.5. Steel cable, chains and pulleys must not be used,

11.1.6. Pursuant to 11.1.4, epoxy resin, hardeners, stiffeners or chemical agents that are designed to strengthen a surface, must **not** be used,

11.1.7. Robot chassis and weapons may be painted with water-based or acrylic-based paints for aesthetic purposes only, and must not contain metal or polyurethane.

11.1.8. Robots will be disqualified at the event officials' discretion if it is deemed to have been built in such a way that;

11.1.8.1. violate the build conditions in this section or,

11.1.8.2. Deliberate attempts to conceal, artificially strengthen, or gain unfair advantage that is not in the spirit of the class.

12. Destructive Class

12.1. A robot may enter a destructive class event if the robot has at least 1 weapon or design feature that is capable of causing damage to an opponent, **OR** if so permitted by the event, is by design capable of withstanding direct damage from an opponent.

13. Sportsman Class

13.1. A robot may be entered in the "Sportsman" class if it complies with the additional rules in this section;

13.1.1. **An active weapon is required**. The robot must include an active weapon or device.

These include but are not limited to lifters, hammers, clamps, and spinning weapons, and;

13.1.1.1. Is **NOT** a fixed spike, a ram, an extrusion or any other such weapon that require the movement of the robot to function, and;

13.1.1.2. The active weapon must be independent of the main drive power, and;

13.1.1.3. Must be able to be independently controlled by an operator.

13.1.2. **Wedge Limitations:** Active wedges are allowed with no restrictions. A robot may only have a single passive wedge.

13.1.2.1. An active wedge is defined as a wedge that is articulated and actuated independently of the drive system.

13.1.2.2. A passive wedge is any wedge that does not meet the requirements for classification as an active wedge; **and** is a wedge like object or; a fork and/or series of small, hinged, independent wedges or forks, along the same face of the robot.

13.1.2.3. At the event officials' discretion any weapons being primarily used as a passive wedge may be required to undergo modifications to reduce or remove this potential prior to continuing in a tournament should this use result in the robot being in violation of the restriction on the number of passive wedges permitted.

14. Mobility requirements

14.1. All robots must have **easily visible and controlled form of mobility** in order to compete. Methods of mobility include but are not limited to:

14.1.1. Rolling: by wheels, tracks or the entire robot.

14.1.2. 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.

14.1.3. Shuffling: rotational cam operated legs.

14.1.4. Ground effect air cushions or hovercrafts;

14.1.5. Jumping and hopping;

14.1.6. Flying: by means of rotational aerofoil (rotorcraft), helium balloons, ornithopters (flapping wings), and under specific conditions;

14.1.6.1. This method of locomotion must be part of an approved event and is

not permitted under general categories.

15. Robot Control Requirements:

15.1. Radio Controlled (RC) requirements:

15.2. Robots and operators will not be provided with reserved radio frequencies or exclusive use of radio frequencies, unless otherwise specified in advance; BARL will not guarantee any frequency will be free from interference or use during any event.

15.3. All robot radio control systems must be of a Digital spread-spectrum compliant, **OR** an automatic frequency hopping signal, **OR** have a **minimum of 2** available fixed control frequencies/coded channels that;

15.3.1. Are easily switchable within 60 seconds;

15.3.2. Are built into the robot and controls original design;

15.4. Pursuant to 12.1; Frequency availability is not guaranteed. Despite compliance, lack of available useable frequencies may result in a compelled forfeit due to inability to compete.

15.5. Radio controlled robots with an **active weapon**, **OR 13,600 g and above, MUST** use radio systems with PCM, IPD coding, and digitally coded to any of the following frequencies:

15.5.1. 900 MHz,

15.5.2. 2.4GHz, including Bluetooth and WiFi standards,

15.5.3. An approved custom control frequency.

15.6. All robots with **active weapon systems, MUST** include radio controls that;

15.6.1. When the transmitter loses power or signal, **stop all motion** in the robot; including drive and weapons,

15.6.2. Pursuant to 15.6.1, robots must have a circuit based, or a programmed power cut-off to drive and weapons power in the event of loss of control signal.

15.7. Custom radio control systems:

15.8. Custom built control systems may be used when compliant with section 15.5, subject to formal approval.

15.9. Builders must request approval for custom built radio control systems from event officials **no less than 7 days prior** to the event, and; must demonstrate compliance to the satisfaction of event officials, by one or more of the following;

15.9.1. Providing detailed circuit schematic, and build of materials,

15.9.2. Physical internal inspections,

15.9.3. Electronics inspection and testing,

15.9.4. RF scanning and testing,

15.9.5. By demonstrating relevance to, or being, a system that is of such close facsimile in electrical design, function and features, of a compliant commercial product **OR** of known compliant public open source product, that the system is reasonably considered, electronically identical.

15.10. Puppetry control systems;

15.11. Any control system that requires in any part, to be worn over the person, or controlled by direct touch, or indirect touch through manipulation of lever, rod, string, cables or other such means, so as to exert kinetic control over locomotion and/or weapons, regardless of power source, is considered to be a puppet; this form of control is expressly **forbidden**.

15.12. Tethered control systems:

15.13. A tethered control system, whereby any part of the robot control input for locomotion, weapons, or ancillary devices, is transmitted through one or more cable/wires between the robot and control device held by an operator, is only permissible when **all** of these conditions have been met:

15.13.1. The arena physically supports this type of event.

15.13.2. The event type is a tethered approved or designated event.

15.13.3. Tethered wires are isolated from the robot power source.

15.13.4. Tethered wires have a quick-release mechanism, whereby the tether is separated at the robot and any applied current can be physically disconnected from its source instantly.

15.13.5. The control system has been approved by event officials.

15.14. Other control systems:

15.15. Control systems that are **NOT** radio controlled, tethered controlled, or otherwise expressly described by this policy, may be accepted upon evaluation by event officials, if all of the following conditions are met;

15.15.1. A **single operator** is able to control **all functions** of the robot, in **real time**,

15.15.2. All operators **must** be able to disable, and completely **stop all power** to drive and weapons in a **single action**,

15.15.3. The control is operated remotely; specifically that the robot can be controlled from

behind a barrier with **no direct contact** by the operator,

15.15.4. The controls must **not** hinder or interfere with other robots or controls, or subsidiary electronic, mechanic or passive systems required for the operation of the event,

15.15.5. The control system does **not** require any arena modifications, or special accommodations, or impose an unreasonable adjustment to procedures, the event or other competitors,

15.15.6. **And**; upon review of the control system, event officials determine that all conditions have been met, and that no risk to safety exists.

16. Autonomous controlled Robots

16.1. **Autonomous/Semi-Autonomous Robots:** Any robot that moves, seeks a target, or activates weapons without human control is considered autonomous, and;

16.1.1. The autonomous functionality of a robot must have the capability of being remotely armed and disarmed by the operator, **using a latching-button, toggle-switch** or **latching lever-switch**, and;

16.1.1.1. While disarmed, all autonomous functions **MUST** be disabled,

16.1.1.2. upon activation the robot **must** have **no autonomous functions enabled**, and;

16.1.1.3. All autonomous functions **must** failsafe to **off** if there is loss of power or radio signal.

16.1.1.4. Upon damage or malfunction whereby there is a loss of constant signal, the robot **must** automatically disarm **within one minute of the match length time** after being armed.

16.2. Must have **clearly visible** illuminated lights, visible from the top surface of the robot, from a minimum of 120 degrees as per the following;

16.2.1. A red or magenta light, prominently placed at the highest position of the body of the robot, excluding weapons, where most practicable; illuminated solid when the robot power systems have been engaged,

16.2.2. A blue light, positioned adjacent to the red light, solidly illuminated when any autonomous mode is activated,

16.2.3. A single orange light, per each autonomous weapon activation, positioned either;

16.2.3.1. At the base of, or position of extrusion of the weapon; or

16.2.3.2. For side face mounted weapons, perpendicular to the base or position of extrusion, on the top of the robot base

16.2.4. A solid green light, positioned adjacent to the red light, that indicates that autonomous mode has been deactivated, and;

16.2.4.1. Cannot be illuminated when the blue light is illuminated

16.2.4.2. Cannot be illuminated when an orange light is illuminated

16.2.4.3. Cannot be illuminated when the robot drive systems are active

16.2.4.4. Must only be illuminated when the red light is active

16.2.5. For all robots **above 5,000 g** with a surface area of **equal or less than 600mm** square;

16.2.5.1. A minimum of 5mm domed lens/bulb must be used; or

16.2.5.2. A minimum of 5050 SMD LED or equivalent, with 120 degrees of visibility or greater

16.2.6. For all robots **above 5,000 g** with a surface area **greater than 600mm** square;

16.2.6.1. A minimum of 4x grouped 5mm domed lens/bulb per colour grouping must be used; or

16.2.6.2. A minimum of 4x grouped 5050 SMD LED or equivalent, with 120 degrees of visibility or greater, per colour grouping, Or;

16.2.6.3. Such combination of lighting of equivalent size

17. Power Source Requirements

17.1. Batteries and DC Power:

17.2. Batteries must be of a type that cannot spill, leak or spray any of their chemical contents when damaged or inverted.

17.2.1. Automotive and motorcycle wet cell batteries are prohibited.

17.2.2. Batteries that solely comprise of one of the following materials; gel cells, NiCad's, NiMh, dry cells, Absorbent Glass Mat (AGM), LIon, LiFe, and LiPoly are pre-approved for usage.

17.2.3. Any Batteries that have publicly been known to be either; faulty, dangerous, recalled by manufacturer, or unstable, must not be used, and;

17.2.3.1. If installed or present at an event, must be removed from the robot and not used; or the robot will be disqualified and withdrawn from all events.

17.3. All on-board voltages operating at **48 Volts and above** are **not permitted** without express

approval by event officials.

17.4. All Robots **must include** a mechanical method, capable of completely physically separating all electrical power, instantaneously from all power sources of the robot, and;

17.4.1. Does not endanger the person turning it off, of injury or shock; and

17.4.2. The method must be such, that power is disconnected from all sources in a **single action**, and;

17.4.3. Is either a **toggle-switch, latching lever-switch, latching-button switch, plug or terminal** that is manually disconnected, and;

17.4.4. Both **positive and negative** terminals are disconnected, and;

17.4.5. If this solution is located inside the robot, operators must be able to access this solution and manually disconnect all power sources simultaneously within **15 seconds,** and;

17.4.6. If used in conjunction with a remote power disconnection solution, such as with the use of a relay switch or other solution, the robot must also include a **manually** operated mechanical method of disconnecting the main battery power, and; the manual disconnection must be connected first in series with such device.

17.5. Battery terminals must be sufficiently protected and shielded to prevent, any possibility of a direct short.

17.6. Batteries **must be enclosed** inside the robot in such a way that; the batteries are **not visible** from any surface, and; the batteries are **protected** using the frame/chassis of the robot from direct puncture, cutting or crushing.

17.7. All Robots **must** display a solid red or magenta light, mounted to the top face, visible from the top of the robot at an angle of no less than 120 degrees, when the robots' main power is activated, except in such cases where;

17.7.1. The robot is of 150g or AntWeight equivalent weight class and contains no active weapons; **OR**

17.7.2. The robot by its design, cannot reasonably have attached a light; and the robot does not contain any weapons capable of causing injury.

17.8. Pursuant to 17.5, all electric power sources, including batteries, must have short circuit protection as such, that in the event of a short circuit, power to all circuitry will be removed **within 2 seconds**.

17.9. Pursuant to 17.5 and 17.8, All DC electric power sources, including batteries, must have **reverse voltage/current protection**, and prevent all power to circuitry **within 2 seconds**, and;

17.10. **All tethered power sources**; must employ a quick-release mechanism that meets all of the following:

17.10.1. Must separate the tethered power connection **at the robot** in a single action that can be completed **within 2 seconds,**

17.10.2. Pursuant to 17.10.1, Must be able to be removed by **biomechanical** (human) applied force.

17.10.3. May not be easily bent, tangled, fouled, or otherwise hindered from release; or whereby if such occurred, the tether would so be released.

17.10.4. Event officials or robot operator must be able to terminate the power source immediately by **latching-button press, toggle-switch**, or **latching lever-switch**; specifically, removal of manual screws, cabling or alligator clips is prohibited.

18. Springs and flywheels

18.1. Springs and flywheels may be used subject to;

18.1.1. Small springs that form a component of switches, electronics, or other small internal operations of devices may be used without restriction.

18.1.2. Springs used in robots in the **5,440 g class or less**, and those **loaded solely by the weight of the robot**; such as for wheel suspension systems, may be used without restriction.

18.1.3. Any springs used for drive or weapon power must be able load and actuate the spring remotely under the robot's power.

18.1.3.1. Large springs, or springs used in robots **above 5,440 g** weight class, must **NOT** be loaded when the robot is out of the arena or testing area.

18.1.4. 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.

18.1.4.1. Robots **must** be capable of generating and dissipating the energy from the device remotely under the robot's power.

18.1.5. All springs, flywheels, and similar kinetic energy storing devices must fail to a safe position on loss of radio contact or power **within 60 seconds**.

19. Pneumatics

19.1. Pneumatic systems installed in the robot must only employ non-flammable, nonreactive gases such as CO2, Nitrogen and Air, and;

19.1.1. Fiber wound pressure vessels with liquefied gasses are **prohibited**.

19.2. The robot team must have a safe and secure method of refilling the pneumatic system that;

19.2.1. Does not require unreasonable, disproportionate amount of space to house, setup, operate and otherwise facilitate, and;

19.2.2. If used with all reasonable precautions, does not pose a safety risk, risk of fire, injury, gas leak, chemical leak, toxic fumes or vapour, and;

19.2.3. The use of such fuels is contingent upon their use being lawful, permissible by event policy and officials; and the facility owners' discretion, to allow such devices on site.

19.3. All pneumatic components installed in a robot must be securely mounted in such a way as to;

19.3.1. Be secured to the most heaviest part of the robot main chassis, and;

19.3.2. Ensure that if ruptured, the pressure vessel cannot escape or be launched from the robot.

19.4. All pneumatic components within the robot must be rated or certified at **no less than** the maximum pressure in that part of the system, and;

19.4.1. The robot team will be required to show proof of rating or certification documentation on **ANY** component in the system.

19.5. All pressure vessels must be rated for at least **120% of the standard pressure** they are set to, and have a **current hydro test date**.

19.6. Large actuators, lines, or other components are used at pressures **above 250psi,** will also need to be over-rated; subject to approval and advise on a case by case basis, as so determined by event officials, and approval is not guaranteed.

19.7. All primary pressure vessels must have an over pressure device such as a burst/rupture disk or over pressure 'pop off', set to **no more than 130%** of that pressure vessels rating.

19.8. If regulators or compressors are used at any stage 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.

19.9. 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 accessible for robot de-activation and refilling.

19.10. All pneumatic systems must have a manual bleed valve **downstream** of the main shut off valve to depressurize the system, in such a way that;

19.10.1. This bleed valve must be **easily accessible** for deactivation, and;

19.10.2. This valve can **remain open** without human action, and must be left **OPEN** whenever the robot is not in the arena to ensure the system cannot operate accidentally, and;

19.10.3. The robot can be quickly bled of all pressure in the system before exiting the arena.

19.11. All regulated pneumatic systems must have an appropriate gauge for their system, scaled to the following:

19.11.1. Maximum resolution of the pressure on the **low-pressure** side of the system.

19.11.2. HPA (air, nitrogen, or inert gas) systems must have gauges on both the **high AND low-pressure sides** of regulators.

19.12. Robots *should* have a clear visual indication such as a gauge or visible light, showing that the system is charged.

19.13. If back check valves are used anywhere in the system, the isolated portions of the system must have;

19.13.1. An bleed valve that can fully bleed the isolated section of pressure and has an over pressure device, and;

19.13.2. The bleed valve(s) are capable of being held in open state without human interaction.

19.14. Any pneumatic system that **does not use a regulator**, or employs **heaters** or **pressure boosters**, or **pressures above 2500psi** must be pre-qualified by event officials, or are otherwise **prohibited**.

20. Hydraulics

20.1. Simple low pressure, low volume hydraulic systems, are exempt from all requirements in this section, and may be used without restriction; if they meet **all** of these criteria;

20.1.1. Are used **only** as part of the **drive system** for **breaking**, **steering**, or **counter-steering**, and;

20.1.2. Are of a **closed-system**, allowing **multiple uses** and as such, does not require re-gassing, re-fueling, re-pressurising or resetting, and;

20.1.3. Are of a volume of **100g or less** per closed system.

20.2. Robots **5,440 g or lighter** are exempt from the remaining rules in this section, provided that;

20.2.1. Best engineering practices are used in the construction of all hydraulic systems, and;

20.2.2. Pressure is limited to **250psi**, and;

20.2.3. Must use **non-flammable**, **non-corrosive** fluid and must be designed not to leak when inverted, and;

20.2.4. Robots must have a **gauged and visible means** to determine this pressure.

20.3. All hydraulic components installed in a robot must be securely mounted in such a way as to;

20.3.1. Ensure that in the event of the pump and/or accumulator were ruptured direct fluid streams will **not escape** the robot.

20.4. All hydraulic components within the robot must be rated or certified at **no less** than the maximum pressure in that part of the system, and; the robot team will be required to show proof of rating or certification documentation on **ANY** component in the hydraulic system.

20.5. Any accumulators or large reservoir must be rated for at **least 120%** of the pressure they are used.

20.6. All hydraulic systems must have an over pressure bypass device set to **no more than 130%** of the lowest component rating, **and**; must be rated to bypass the full volume of the hydraulic pump.

20.7. All hydraulic systems must have an **accessible manual bypass valve(s)** to easily render the system innocuous.

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

20.9. All hydraulic systems must use **non-flammable, non-corrosive** fluid and must be designed not to leak when inverted.

20.10. Any hydraulic system using **pressure boosters**, or **pressures above 5000psi** without accumulator, or pressures **above 2000psi** with accumulator must be pre-qualified by event officials, or are otherwise **prohibited**.

21. Internal Combustion Engines and liquid fuels

21.1. Internal Combustion Engines (ICE) and liquid fuels are **not permitted** at any BARL event and must not be used.

22. Weapons

22.1. Excessively Destructive Weapons:

22.1.1. Weapons deemed too destructive by virtue of their mass, MOI or other characteristics may be further limited or disallowed at the discretion of the event officials.

22.2. Rotational and spinning weapons

22.2.1. Rotational weapons are such devices that, when under active power, spin in a 360 degree rotational axis, regardless of direction or alternating direction and speed, and include;

22.2.2. A spinning weapon as an fixed extrusion, mounted on an articulated arm, or;

22.2.3. A robot chassis designed as a weapon, capable of itself, spinning as a whole, or;

22.2.4. A spinning mechanism, mounted around the perimeter of a robot chassis, capable of freely spinning independently of the robot chassis, and;

22.2.5. **Must include** at least one of the following;

22.2.5.1. Edges comprising of cable, wire, plastic-line, blades, blunt objects/surfaces, abrasive objects, studs or spikes.

22.2.6. Spinning weapons capable of contacting the outer arena walls, or viewing surfaces of an arena during normal operation must not be used.

22.2.7. Spinning weapons must come to a full stop within **60 seconds** of the power being removed, and must use a self-contained braking system.

22.3. Limitations on Spinning Weapons:

22.4. All spinning weapons or extruding implements whether affixed to the robot body/frame or by articulated arm, capable of rotating 360 degrees in any direction, must;

22.5. Operate with a tip speed at or below **6.096 m/s**.

22.6. Where a spinning weapon tip speed exceeds 6.096 m/s; or by virtue of the weapons mass, or destructive capability, is likely to pose an *unacceptable risk* of injury or damage potential, as so deemed by event officials, the weapon will either be;

22.6.1. limited to lower speeds by modification,

22.6.2. Replaced with another weapon,

22.6.3. Disallowed, and removed from the robot.

22.7. **Sawing and drilling weapons** may exceed 6.096 m/s limit if they meet all of the following requirements:

22.7.1. **For saws;** the effective tooth pitch for the saw or saw like weapon must be **≥5**.
For example, a 10" saw blade with 60 teeth would meet this requirement. A 10" saw blade with 40 teeth would not.

22.7.2. **For abrasives**; the grit size will be used in situ of tooth count and must be **≥5**.

22.7.3. **Saws and saw like weapons are limited to**; the manufacturer's rated RPM for

commercial blades; or in the case of a custom saw blade, limited to the rated RPM of the direct equivalent commercial saw blade, subject to ± 5% variation on tooth count, diameter, thickness.

22.8. Forbidden weapons;

22.9. Forbidden Weapons and Materials; are expressly **forbidden**; and must **NOT** form any part of the robot;

22.9.1. Any weapon, as so used, applied to the robot or otherwise fitting the description of a Prohibited Weapon, as so described by Schedule 3 of the CONTROL OF WEAPONS REGULATIONS 2011(VIC), is **expressly forbidden**.

22.9.2. Any device, or combination of devices or objects, where so carried together, would be considered a firearm or ammunition as per the definitions of a firearm in the FIREARMS ACT 1996 (VIC), is **expressly forbidden**.

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

22.9.3.1. Electrical weapons

22.9.3.2. RF jamming equipment, etc.

22.9.3.3. RF noise generated by an IC engine.

22.9.3.4. EMF fields from permanent or electro-magnets that affect another robot's electronics.

22.9.3.5. Entangling Weapons or defenses; that can reasonably be expected to stop drive train and/or weapon motion by being wrapped around rotating parts. This includes nets, tapes, strings, and other entangling materials or devices.

22.9.3.6. Weapons or defenses that that can reasonably be expected to stop combat completely of opponent robots.

22.9.4. Weapons that require significant clean-up, or is expected or likely to cause damages to the arena, that would require repair or render the arena unserviceable, or would cause a hindrance or safety issue for further matches, This includes but is not limited to:

22.9.4.1. Liquid weapons,

22.9.4.2. Foams and liquefied gasses,

22.9.4.3. Powders, sand, ball bearings and other dry chaff weapons.

22.9.4.4. Un-tethered Projectiles.

22.10. **Heat and fire are forbidden as weapons.** This includes, but is not limited to the following:

22.10.1. Heat or fire weapons not specifically allowed in other sections of this policy,

22.10.2. Flammable liquids or gases,

22.10.3. Explosives or flammable solids such as:

22.10.3.1. DOT Class C Devices

22.10.3.2. Gunpowder / Cartridge Primers

22.10.3.3. Military Explosives, improvised explosives, or chemicals or compounds so mixed together would become unstable, reactive or explosive.

22.11. **Light and smoke** based weapons that impair the viewing of robots by an Entrant, Judge, Official or Viewer. This includes, but is not limited to the following:

22.11.1. Smoke weapons not specifically permitted by any other section of this policy,

22.11.2. Lights such as external lasers above 'class I' and bright strobe lights which may blind the opponent and observers.

22.12. **Hazardous or dangerous materials**, such as, but not limited to; acids, corrosive chemicals, controlled substances, licensed chemicals, reactive chemicals, and flammable liquids are **forbidden from use** anywhere on a robot, or where they may contact humans, or by way of the robot being damaged would likely contact humans.

23. Special weapons

23.1. These special weapons defined are only permissible under strict conditions, and only when expressly authorised in writing by event officials, under these circumstances;

23.2. Tethered Projectiles:

23.2.1. If allowed, tethered projectiles must have a tether or restraining device that stops the projectile and is no longer than **2 meters**.

23.3. Smoke Effects:

23.3.1. Smoke effects and smoke systems, specifically selected and approved by BARL, and authorized for use only under strict rules or procedures, and;

23.3.1.1. When arena contains sufficient ventilation to extract fumes and maintain visibility of robots sufficient for scoring, judging and so that operators may safely maintain control of their robot, and;

23.3.1.2. In open air categories, where upon such smoke effects are permissible by local laws and regulations, and upon such, that the

venue owner or officials permit such use.

23.4. RF Weapons:

23.4.1. If authorised, and strictly as part of a specific class, RF Weapons may be used, if as such, it forms part of the authorised method of attack as event rules and; is strictly permitted if all participating robots contain **no active weaponry or weapons** that have the capability to cause damage or injury.

----------End of document----------

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