Mech Warfare Rules
2018 Robogames Edition

Name of Event:	Mech-Warfare
Robots per Event:	Two
Length of Event:	8 minutes
Robot Weight Range:	Under 15 pounds
Robot Dimensions:	Less than 36 inches high
Arena Specifications:	15 ft x 15ft or 15ft x 22.5ft
Robot Control:	Teleoperated
Engineering Principles:	Mechanical engineering, electrical engineering, machining, vision systems, and computer science
Event Summary:	In the spirit of the giant walking combat machines popularized by Battletech and Japanese Anime. Mech Warfare is a contest of humanoid robots fighting in a scaled down cityscape. The contest envisions that an actual human would be piloting a robot in an urban combat setting. Robots are human controlled, but the operator must use a camera mounted on the robot for vision - no direct viewing of the field by operators is allowed. Robots have impact sensors to detect how often they've been shot.

All Mechs are subject to final approval by an official before competing, and may be rejected if considered unsafe for human bystanders or not keeping in the spirit of the event. To elaborate, these rules here are intended to keep things balanced and fair, while I'm sure there are little loopholes that can be found for most things, have a sense of honor and respect for your opponents, and don't try to 'gimmick' your way to a win.

Mech Warfare (MW) s a robotics competition. Our goal is to create a real-life robotic combat competition that mirror the scenarios found in sci-fi universes such as Battletech, Warhammer 40k and Armored Core. Competitors will build 1/18 scale armed robots which they will pilot through a wireless first-person POV system.

MW Official Event Organizers:
Don Croft – ghengisdhon@yahoo.com
John Harkey - harkeyjohn@gmail.com
David Fong - davidgfong@gmail.com

MW Event Organizers are the people in charge of the Mech Warfare event at Robogames. If you have questions about something Mech Warfare related (online or in person) these are the people who you need to talk to. Please do not email David Calkins, if it is Mech Warfare specific. While he is the Robogames event organizer, he defers anything related to MW to the MW Event Organizers.

All disagreements will be deferred to the MW Event Organizers for ruling. The MW Lead Judge will make the final decision for a final ruling. The MW Lead Judge for Robogames 2018 will be John Harkey.

Section I - Leagues of Play
For the 2018 Robogames, there will only be one (1) league of competition.(In future years, other leagues may return.) The 2018 Mech Warfare League is the Airsoft Classic League and is defined as:

1. The *Airsoft Classic* league is open to all walking robots with 4 or less legs. This is the main competition event.

Teams with multiple Mechs in their hangar have two options: Register and compete with the Mechs separately, or register as a single pilot/team with multiple mechs at their disposal. Mechs may not be switched out in the final matches.

Section II – Mech Construction
All competitors are subject to final approval by Mech Warfare event organizers or their appointed official. As part of the qualification process, each competitor must be presented to an official for a

Safety and Technical Inspection before competing, and must be re-inspected after any major alterations. A Mech may be rejected from competing if it is deemed to be unsafe for human bystanders or not in the spirit of the event. All Mechs should be designed within the spirit of the game. Do not try to 'gimmick' yourself to a win. If you have a question about a particular part of your robot, ask the event organizers beforehand.

1. Mechs are to be true walking robots. Legs must be servo/actuator driven. No cam-driven, wheeled, or treaded configurations.
2. Mechs may have up to 4 legs.
3. Average Mech size is expected to be between 4" and 18" tall. No robot may be taller than 36".
4. All robots initially default to a Medium Mech type. A competitor has the option at qualification time to declare if their robot is a Light Mech, Medium Mech or a Heavy Mech as long as the robot meets the criteria of that Mech type. All Mechwarfare robots will be called upon to fight any other type of robot during a match. Each Mech type has advantages and disadvantages. The robot will conform to the limitations of the chosen Mech type. After the Mech type is selected it cannot be changed for that particular Robogames weekend.
5. Medium Mechs have all the legacy initial hit points, quantity and size of target plates as called out in this document. Guns are required while additional melee weapons are optional. 1 or 2 can crew the robot.
6. Light Mechs weigh less than 3.5 pounds (weighed without a target system or ammunition). Possible advantages for the lightweight mech are faster walking speed and greater agility which affords movement in and through tighter places. A light Mech has less hit points and use smaller target plates that are harder to hit. The light Mech has one weapon which can be a gun or a Melee weapon. Only one pilot can operate a light Mech.
7. Heavy Mechs have at least 3 weapons, 2 of which must be independently aim-able which may require 2 turrets. Heavy Mechs have a minimum crew of 2 piloting the robot. More guns and melee weapons are optional. Advantages for this Mech are more starting hit points, more fire power. Disadvantages are the robot is heavier and may walk slower also may be larger so is less maneuverable. Another disadvantage is the target plates are a little bigger than the medium Mech.
8. Mechs may be remotely-operated or autonomous.
9. Pilots may only view the match through their first person POV (FPV) camera mounted on their Mech, further:
   1. Pilots are not allowed to view the arena or match directly. Up to two pilots are allowed per mech.
   2. Cameras should be mounted roughly in the horizontal center of the mass of the robot, where the 'cockpit' would be. The intention is to simulate piloting the Mech, not having cameras on your guns mounted to extensions so you can fire around corners without fear of being shot. This would fall under the 'Gimmick Clause'.
   3. Wireless 5.8GHz analog video is the preferred Mech Warfare video feed system. We have found this to be the most effective video system and recommend it for all competitors. It is preferred transmitters be 250 mW or less to avoid interfering with other competitors at the Robogames event. A multiband transmitter and receiver is also

recommended. Channels will be assigned to competitors to avoid interference and may be adjusted throughout the day as needed to minimize interference.

4. Wireless IP Cameras will not be supported by the event organizers at Mech Warfare for video feed but competitors are welcome to still use Wireless IP Cameras.
5. Two cameras are allowed per Mech.

10. All Mechs must use the approved target scoring system. The complete target system including target plates and transponder shall be loaned to the contestants for each match. Competitor supplied target scoring system shall not be used at Robogames. The mechanical and electrical interface shall be identical on each robot. The target plates will be certified prior to Robogames and verified before and after each match. The technical data package will be available for all to build their own target plates prior to Robogames so each contestant can have their own target plates if desired.
11. Mechs should not intentionally separate, or leave pieces of themselves behind, especially beacons or debris that would inhibit other competitors.
12. Mechs should not intentionally cause damage to the arena. Event Organizers will disqualify any Mech intentionally causing damage to the arena. Unintentional damage is fine but should be minimized. This is not a destruction derby.
13. No intentional entanglement type device is permitted by a Mech. (any device that restricts the movement of another Mech)

Section III – Weapons Systems
Only Airsoft class will be held at the Robogames 2018 Mech Warfare Event.

1. The *Airsoft* weapons class allows the use of electric Airsoft guns. Guns are to use standard Airsoft 6mm plastic BB ammo. Acceptable BB weights are 0.12 grams and 0.2 grams. Guns must not be so powerful as to cause damage to the Target Panels or Arena. AEG and "Defender" style weapons are allowed, anything more powerful will need to be tested beforehand. Maximum muzzle velocity allowed is 180 feet per second.
2. In all weapons classes, any Mech that is capable of shooting without explicit human input must have a verified remote kill switch and a visual indicator that they are "armed". We will not have Skynet go live on our watch.
3. Weapons designed to interfere in any way with an opponent's camera or wireless control are strictly forbidden.
4. Close-in melee weapons that poke or whack an opponent's target plates are allowed as long as intentional damage to the arena or opponent's Mech is avoided.

Section IV – Arena
1. The airsoft arena is approximately 15'x15' or 15'x22.5' depending on available floor space at Robogames 2018.
2. The walls of the arena will be non-transparent and of approximate 18" of height.
3. Buildings, averaging 1 to 2 feet tall, will be provided for cover. Building layout will be consistent throughout the event for ranked matches, however layout may not be finalized until the event. Exhibition matches may have varied building layouts at coordinator's discretion.

4. (Optional Rule - to be determined by the Event Organizers prior to the event start) One or two buildings will have openings for a Light Mech to enter and exit. The approximate opening will be 13 inches wide and 12 inches high. There will be additional smaller openings in other walls for shooting at other Mechs outside of the building. Those openings will start at approximately 4 inches from the floor and continue up another 4 inches in height. The outside Mech will be able to inflict BB hits on the inside Mech from the open window wall even though the inside Mechs plates may not be visible.
5. All 'streets' will be approximately 36" wide. Alleyways will be approximately 18" wide.
6. All sizes are approximate. Your Mech must be able to deal with any small changes in these dimensions.
7. The arena may have natural features that result in a disadvantage for the Mech that does not initially leave the starting corner.
8. The Arena buildings may vary in size. First person POV can be a bit disorienting navigating the arena. Distinguishing markings may be put on the arena wall or buildings by the MW event organizers.
9. The arena floor is covered with ⅜" thick EVA anti-fatigue foam. This provides a uniform controlled walking surface. For 15 pound and under robots this surface is stiff. People walking on it will find it slightly compliant. It is advised to test your robots walking gait on the EVA foam surface before Robogames. This will allow you to adjust the robot's walking gait and foot material to more efficiently walk in the arena. The EVA anti-fatigue foam can be found at Lowes, Home depot, Harbor Freight and Amazon. Google ⅜" EVA anti-fatigue foam.

Section V - Qualification

All competitors must complete a qualification trial prior to competing during Friday's regular hours (typically 10AM-8PM. This will be dependent on the event organizers travel plans and Robogames scheduling.). Prior to the event, your team will be given a timeslot for qualifications, you must be available during this time. Only competitors that have completed a qualification trial will be placed in the competition bracket. It is expected that your Video and Scoring System be 100% functional prior to attempting your qualification round. This will be tested prior to your qualification round. Certified Robogames target plate system shall be used to qualify.

1. You will first be required to demonstrate that your Mech has a working video link using your camera. You must also confirm and demonstrate that the loaner target plate system mounts onto your robot properly and functions correctly.
2. Muzzle velocity of guns will be measured to verify they are less than 180 feet per second. To qualify, 10 shots shall be fired and all 10 shall be less than 180 feet per second. At any time between matches at Robogames gun velocity may be retested. If the gun is found to exceed 180 feet per second the competitor will not be able to compete in follow on matches until the velocity is reduced.
3. You have a maximum of 8 minutes to complete this setup phase on your first qualification attempt. The qualification round runs for 5 minutes. Subsequent qualification attempts only allow for 5 minutes of staging time.
4. A qualification round consists of the following: The Mech will start in a corner of the arena. Each corner will contain a small Target Beacon (such as an aluminum can) mounted 8-12" from

the ground. The Mech must pilot and hit all 4 Target Beacons in under 5 minutes. Each Target Beacon must be hit using the Mech's primary weapon system. If there is time remaining after the 4 Target Beacons are hit, the Mech must continue the same pattern and demonstrate that it can function for a full 5 minutes continuously.

5. The qualification trial will run under the same technical requirements as regular matches: in particular, pilots cannot view the arena directly and may not be assisted by spectators. This trial is intended to show that your Mech can walk and that your camera and guns work. You must maintain control, wireless video feed, and mobility requirements during the entire qualification round.

6. The qualification process may be attempted as many times as time permits, however, competitors who have already attempted must wait on the end of the longest line. If you do not show up or are not ready by the time your time slot comes up, you will be moved to the back of the line.

7. There will be an option to submit a prequalification video in lieu of the "qualification round". A thread will be created in Trossen Mech Warfare forum that will allow for competitors to submit a video of their Mech performing the qualification round for 5 minutes. A standard household item such as a plastic cup can be used in place of the Scoring Beacons. The Mech Warfare arena does not have to be simulated in the pre-qualification video. The pre-qualification video must show that the Mech can move and shoot at Target Beacons for a minimum of 5 minutes. Submissions can be made from Feb 15th 2018 through April 15th 2018. The primary goal of this is to provide a bonus to competitors who are showing up prepared, but does not replace the on-site qualification requirement. Any competitor who submits an approved pre-qualification video will be awarded with a 1 HP (Hit Point) "battle-hardened" bonus to their Mech for that year. Timeslots will be handed out on a first-come-first-serve basis.

Section VI – Match Rules
A match consists of two Mechs facing off in an arena, trying to reduce one another's Hit Points (HP). The winner is the Mech with the most HP left at the end of a match. The Scoring system consists of target plates and a transponder unit which wirelessly relays information back to a base station.

1. Structured match play will be scheduled throughout the day on Saturday and carry into Sunday. Structured match format will be determined by the number of Mechs registered and qualified and will be announced prior to the event. All qualified Mechs will be guaranteed at least two rounds of match play. The Championship round will be the best two out of three rounds and will be held on Sunday after match play finishes. Open/pickup play will be allowed after the Championship play finishes depending on time available.

2. At the start of each day the match play schedule (time slots) will be posted in two places on large paper taped to a wall. One location will be visible to the audience while the second location will be clearly viewable in the pit area behind the arena. We will follow this match play schedule as close as possible, environment permitting. The poster papers will be updated as necessary throughout the day. The initial match play schedule will be determined once the final tally of qualified Mechs is determined. All Mechs are expected to be present at the start of their scheduled match play. Match schedules may slip throughout the day but none will occur prior to the initial match play schedule. Any Mech not present at the start of their match play, will forfeit the round.

3. A match will consist of two phases, a staging phase and a combat phase. The match will actually start at the staging phase. Pilots are allowed to view and enter the arena as well as handle the robot during the staging phase. Pilots are not allowed to directly view the arena during the combat phase. The staging phase will start at the scheduled designated time regardless if there are competitors or not. The staging phase is a maximum of 8 minutes while the combat phase is a maximum of 8 minutes. The combat phase starts at + 8 minutes or when both competitors signal ready. For a competitor to signal combat ready the robot must be in its arena corner, powered up, pilot sitting at the pilot station and ready to fight. If one or both competitors have not signaled ready after + 8 minutes the combat phase begins and the non-ready robots will receive 1 HP penalty for every 10 seconds until they enter combat or reach 0 HP. The goal is to promote regular match times.
4. Medium Mechs start a match with 20 hit points (HP), bipeds will receive an extra +10 HP. Light Mechs will start with -5 HP from the medium type. Heavy Mechs will start with an extra +5 HP. Tripeds will add 0 HP. All classes can earn a pre-qualification of +1 HP. Any permutations of the classes will add or subtract from the medium Mech. For example a heavy biped would be 20 + 5 + 10 = 35 HP. A light biped would be 20 -5 +10 = 25 HP. Remaining HP will be reduced as the transponder unit registers hits, or when penalty hits are assessed.
5. The combat phase has a maximum length of 8 minutes. Combat phase ends when either one of the Mech's has it's HP reduced to 0, or when the combat phase runs past the 8 minute limit. The Mech with the higher HP at the match's end wins. For a Mech to win the other robot must lose at least 1 hit point in either the staging phase or combat phase. If neither Mech loses a hit point during both phases of the match, the winner will be determined by a coin toss or any other random method.
6. If at the end of the match both Mechs have equal HP remaining, the winner will be determined by a coin toss or other random method.
7. Mechs will start in opposite corners of the arena facing the center. The corners will be masked off with 3'x3' squares taped on the floor, a Mech will start in the center of the square.
8. Competitors reduce an opponent's HP by scoring hits on an opponent's target plates
9. The scoring system will not score more than 1 hit per second, regardless of how often it is hit. This is determined by the software running on the Transponder board.
10. (Optional Rule – to be determined by the Event Organizers prior to the event start) BB hits on a target plate are needed to score a HP. After a HP on a specific target plate is scored a cool down period of 1 second will be added before another HP can be scored on that specific target plate. Many bb hits could occur during the cool down time without registering a valid HP score. The first bb hit after the cool down time will register a HP score and begin the next cool down period. Successive scored HP will accumulate additional 1 second periods to the total cool down time. If no hits have registered on a target plate for 5 seconds after the current cool down period of that plate it will reset back to 1 second cool down time. For a Medium Mech starting out with 20 HP the first HP will decrement the score to 19. A cool down period of 1 second will occur before another HP can score. If the score decrements to 18 then the cool down time becomes 2 seconds until a 3rd possible HP can be scored. If successive HP are being scored then this cool down time can grow up to 19 seconds before the last HP can score. Once again if there is a gap in HP at any time exceeding 5 seconds plus the current cool down period the cool down time resets to 1

second. The intent of this rule is to promote Mech movement in the arena and extend the average match times.

11. (Optional Rule - to be determined by the Event Organizers prior to the event start) Each target plate will score up to 10 hit points. This is determined by target system software. Additional hit points can be scored on other target plates. This is meant to promote Mech movement in the arena and avoid a standing shootout between two Mechs.

12. (Optional Rule - to be determined by the Event Organizers prior to the event start) If a Mech hit points are below 10 hit points the Mech will regain a hit point for every 20 seconds no hits are registered. If a Mech hit points are below 5 hit points the Mech will regain a hit point for every 15 seconds no hits are registered.

13. (Optional Rule - to be determined by the Event Organizers prior to the event start) In tandem with rule 11 above, as each hit point is earned any panels that were previously hit gain the ability to register another hit point. In other words, the 10 point hit limit on damaged plates would increment to 11 when the first hit point is earned. More hit points earned would result in damaged plates increasing the hit point limit. The intent of this rule is to promote more robot mobility.

14. (Optional Rule - to be determined by the Event Organizers prior to the event start) One or two arena guns will be used to guard portions of the arena. The guns will be autonomous. Each gun will have target plates. Arena guns have 5 HP and will be disabled for the rest of the match if hit 5 times.

15. (Optional Rule - to be determined by the Event Organizers prior to the event start) One or two booby traps will be positioned in the arena. Each booby trap can only be set off once and has the potential to hit a Mech target plate.

16. A knock over will score as a hit if the scoring transponder detects it. During the event that your Mech falls over and is unable to right itself, the match will be paused while the Mech is assisted. Bipeds are penalized 1 HP of damage, quads are penalized 5 HP. The clock will not stop during any assistance.

17. If a target plate, properly mounted according to Section VII, should fall off of a robot, the combat phase clock will be paused, the plate will be re-attached, and the Mech will be assessed one hit point.

18. Forfeit: If you feel you cannot continue the match for whatever reason, you have the option of forfeiting the match.

19. Spectators/team members will be able to view the full arena and match, however they cannot provide hints, tips or assistance to pilots. Any team member viewing the match directly and giving information to their pilot will cause an immediate forfeit of the match. The only people allowed to communicate with the pilots are refs and MW event organizers.

20. In all matches, at least 1 event organizer and at least 1 referee (who will be or be appointed by the event organizers) will oversee the match.

21. MW event organizers have the authority to request any MW competitor not currently competing in the ongoing match to turn off any wireless transmitting device (WiFi Routers, Wireless IP Cameras, Scoring Transponders, and/or Wireless 5.8 GHz video transmitters) during a match to reduce wireless interference.

22. If a robot loses power during the match it will not be helped. The competitor can shoot at the unpowered Mech to score hit points or let the match clock run out. The target system is self-

powered and should still operate independent of a host robot failure. If an unpowered robot also has an inoperative target plate system then two judges will visually count hits to the target plates by the shooter.

Section VII – MWScore Transponders
A Certified target plate systems will be loaned to each competitor prior to the match.

1. **Target plate system specifications:**
    1. Full sized target plates are 3.5"x3.5", with an active area of 3.5"x 3.5". Half-size plates are 1.75"x3.5". Large-size plates are 4.5"x 4.5".
    2. The target plate system is contained within the 4 target plate set. The rear plate contains the radio transponder and battery. The rear plate is deeper than the other 3 plates. Since target system is self-powered the only host electrical connection is an open collector discrete on two pins that generates a low pulse of different widths to indicate which plate was hit. The pulse widths are the same as the legacy transponder board.
    3. The legacy small LED board on top of the robot will no longer be used.
    4. Medium Mech Quadrupeds must carry 4 full-sized plates, one on each side of the body. Medium Mech Bipeds or Tripeds must carry a full front and rear plate, as well as half size plates on each side of their body or arms (depending upon which provides an unobstructed view).   Light Mechs will carry one half size plate on each side of the robot mounted in a vertical or horizontal orientation. Heavy Mechs will carry 4 large-size plates that are 4.5" by 4.5" in size with one plate mounted on each side of the robot.
    5. Target plates must be reasonably and FIRMLY mounted on a Mech, with their entire face located less than 22" off the ground, and not obscured by any limbs. Plates should be mounted on a flat, vertical surface, using two strips of 3.5" length velcro, so that the target plate is perpendicular to the ground. (An in depth description of Target Plate mounting will be posted on the Trossen Robotics Mech Warfare forum prior to the event. In any case, if you have any questions on Target Plate mounting, contact the event organizers.) Target panels cannot be mounted to legs. Use common sense when choosing a mounting location, and keep in mind the spirit of the game. If you are firing on an opponent, they should be capable of hitting your scoring plates. Every effort should be made to have all target plates on a Mech in the same vertical plane. If a mechanical design exists that does not allow for this, full plates can have no more than 1" of vertical separation. This cannot be used to specifically give a Mech a defensive advantage.
    6. In order to allow autonomous bots, and those using visual tracking, competitors may bring a visual fiducial of any color which may be applied to an opponent's target plates using tape of any color. Fiducials should be no bigger than 3"x3". As these fiducials may become damaged during use, it is suggested to bring a decent quantity of them with you.
    7. Target plates will have 2 white LEDs that light up when hit to give visual feedback to the audience and shooter.
    8. A single colored LED on all target plates will light up when a HP is decremented.
    9. When the score reaches zero all the colored LEDs will latch on indicating all the HPs are gone.

10. Target plates will have an IR LED emitting at approximately 10 KHz. The emitter can be used as a tracking source.
11. Scoring displays will be set up in locations visible to both competitors and spectators.

Section VII – Safety

1. When outside the competition arena, all guns must have a physical barrel lock in place which prevents BBs from being fired. Failure to follow this rule, as observed by the MW event organizers or appointed officials, will result in a warning to the violating Mech Warfare team. A second violation will result in disqualification from the MW event.
2. If at any time outside of the competition arena and observed by the MW event organizers or appointed officials, a gun is fired and a BB exits the gun (not stopped by the barrel lock) the violating Mech Warfare team will be disqualified for the remainder of the event.
3. Ultra-bright lasers (greater than a class 2 laser) are prohibited. All lasers must have an off switch or cover when they are outside of the arena.
4. When inside the competition arena, safety glasses must be worn. Safety glasses will be provided for use by the MW event organizers.
5. Anyone entering the competition arena must receive approval from the MW event organizers or appointed officials prior to entering the arena.
6. A small tent will be provided at Robogames to test fire your gun for debugging and calibration purposes. The Mech with the gun can be placed inside the tent and the tent zipped up to prevent projectiles from escaping. The tent walls are netted so the results can be observed.

Section VIII – Record of Changes

1. June 22, 2009 - Document created from 2009 rule set
2. June 23, 2009 - Slight changes, notes added. Removed weight limit (we will have weight classes some day).
3. July 29, 2009 - Final highlighting changes before release to general public.
4. December 7, 2009 - Revision for final release.
5. April 6, 2010 - Actually posted (yay!)
6. April 27, 2010 - Began revisions for 2011
7. May 24, 2010 - Posted draft for 2011
8. September 22, 2010 - Revision for final release.
9. April 9th, 2012 - Revision for final release.
10. April 26th - Revision for 2013 Ruleset.
11. January 20, 2016 – Revision for the 2016 Robogames Mech Warfare Event
12. January 30, 2017 - Revision for the 2017 Robogames Mech Warfare Event
13. January 30, 2018 - Revision for the 2018 Robogames Mech Warfare Event