

V1.0

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RoboMaster System Specification Manual, RoboMaster User Manual, Introduction of RoboMaster System Manual

The M600 Accessories Kit includes several cables and a terminal board, ensuring a complete preparation system others for your RoboMaster system.

ROBOMASTER 2023 UNIVERSITY LEAGUE

RULES MANUAL

Prepared by the RoboMaster Organizing Committee

Released on November 2022

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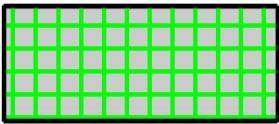

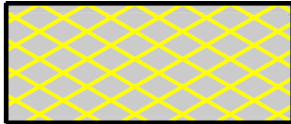
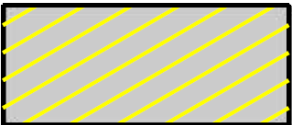

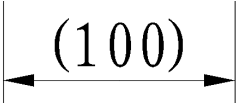
For suggestions on open source materials, please refer to: <https://bbs.robomaster.com/thread-7026-1-1.html>.

Using this Manual

Legend

 Prohibition	 Important notes	 Hints and tips	 Definitions and references
“√” Applicable	“-” Not applicable		

Legend for Battlefield Drawings

		
Buff point for both sides	Buff point for one side	Both sides penalty zone
		
One side penalty zone	The plane on which the battlefield is located is its lowest plane	Dimensions are for reference only

Change Log

Date	Version	Release Notes
November 18, 2022	V1.0	First Release

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1. Foreword

1.1 About the Competition

The RoboMaster University League (RMUL), organized by local academic institutions and universities, engaging in nearby universities, is dedicated to promote regional university robotic technology exchange, cultivate a strong academic atmosphere, and assist the development of regional technology innovation.

The RMUL 2023 comprises two battle formats: 3V3 Match and Standard Match

During 3V3 Matches, both teams need to independently develop their own Standard, Hero, and Sentry Robots, and conduct tactical Matches on the designated battlefield by commanding the robots to launch projectiles against enemy robots and bases. The winner at the end of the Match shall be the team with the higher remaining Base HP. The participating teams can advance to the RoboMaster University Championship (RMUC) through the [Scoring and Ranking System](#).

During Standard Matches, both teams need to independently develop their own Standard Robots, and engage in 1V1 battles on the designated site by commanding their robots to launch projectiles. The winner at the end of the Match shall be the team with the higher remaining Standard Robot HP.

1.2 About the Rules Manual

This Rules Manual and its additions are applicable to all participating teams, referees, competition staff, and other partners.

Outside the competition period, the RMOC may update this Rules Manual as required by circumstances.

During the competition, the Chief Referee has the final right of interpretation regarding competition rules. Only the Chief Referee can be consulted on any questions related to the competition rules.

1.3 Rules Inquiries

Any participating team or other relevant personnel who have questions about the specifications manuals (including the Rules Manual, Participant Manual, and Robot Building Specifications Manual) may direct them through our official channel, and the RMOC will reply to them periodically. The Q&A process is as follows:

1. The inquirer fills out a questionnaire and submits their queries at this link:
<https://djistore.wjx.cn/vj/wPiwIJ0.aspx>
2. On each Monday (before 12 pm), the RMOC will gather all qualifying questions from the last Monday to Sunday and provide its response to them on Friday (before 8 pm) in the RoboMaster 2023 University Series Rules and Technical Q&A Document:

<https://docs.qq.com/sheet/DUHdqbnhTSIlyY0dU?tab=BB08J2>

The Rules Q&A shall have the same effect as the specification manuals. In the case of any discrepancy between the Rules Q&A and specifications manuals, either one that was published the latest shall take precedence.

1.4 Main Changes to New Competition Season

Compared with RMUL 2022, the RMUL 2023 has been updated with the following changes:

Events:

- Removed the Automatic Standard Category of the Standard Match.

Competition Site:

- Added Visual Markers to the 3V3 Match site.

Robots:

- Adjusted the definition and relevant mechanisms of Sentry Robots.
- Removed Automatic Standard Robots and radars.

Mechanism:

- Adjusted Base HP and Virtual Shield value.

2. Key Terms

In this chapter, we will provide an overview of frequently encountered key terms related to the competition rules. For details on each term, please search for its relevant chapter based on its key words.

Table 2-1 Overview of Key Terms

Term	Definition
Robots	
Standard robot	Include Regular Standard and Balancing Standard Robots. For a detailed definition of the Balancing Standard Robot, please refer to the “2.2.3 Standard Robots” chapter of the RoboMaster University Series 2023 Robot Building Specifications Manual . All Standard Robots other than Balancing Standard are Regular Standard Robots.
Referee System	The Referee System is an electronic penalty system used for robotic competitions that integrates computation, communication, and control features. It includes the Robot Side installed on the robot, as well as the server and client software installed on the PC; and has functions such as monitoring robot power, projectile launches and damage, and automatic ruling based on competition rules.
Robot chassis	A mechanism that carries a robot propulsion system and its accessories.
Chassis Power	The power that supports the propulsion system enabling a robot to move horizontally, not including the power used for special tasks (e.g., power consumption for functional movements such as moving the upper mechanical structure).
Fixed Launching Mechanism	A Launching Mechanism readily attached to a robot.
Mobile Launching Mechanism	A Launching Mechanism that can be installed as an optional component on a robot.
Initial Launching Speed	The velocity detected by the relevant modules of the Referee System after a projectile or dart has completed its acceleration.
Barrel Heat	The barrel heat generated by a robot after launching a projectile. A robot’s continuous projectile launches are restricted by its Barrel Heat Limit.
Projectile allowance	The quantity of projectiles each robot is allowed to launch currently.
Initial HP	The HP value set by the Referee System for a robot at the start of the competition.
Current HP	A robot’s Real-time HP.

Term	Definition
Maximum HP	The maximum value to which a robot's HP can be restored.
Experience points	The accumulated points needed for a robot to upgrade itself, which can be obtained through natural growth, destroying or assisting in the attack of other robots, or other methods.
Experience Value	The experience points provided by a robot to an enemy robot when the former changes from Surviving to Non-Surviving Status.
Destruction	Where a robot attacks the Armor Module of an Enemy Base or robot until the latter's HP drops to zero. If a robot is in "non-surviving" status for reasons other than suffering a hit on its Armor Module, it will be deemed that no destroying robot has been found.
Assist	Where a robot (except the destroying robot) inflicts damage on an enemy robot within 10 seconds before the latter's destruction.
Invincible	When a robot receives a 100% Defense Buff
Survival	When the robot's HP is not zero
Defeat	<p>Where a robot's HP drops to zero after its Armor Module has been attacked or hit; it has exceeded its Chassis Power Consumption limit, Initial Launching Speed limit or Barrel Heat limit; its Referee System module has gone offline, etc.</p> <p>Note: After a robot is defeated or ejected, the Referee System will cut off power supply to the robot (except for the Mini PC).</p>
Ejection	<p>The robot is directly ejected by the Referee System due to a Red Card Warning.</p> <p>Note: After a robot is defeated or ejected, the Referee System will cut off power supply to the robot (except for the Mini PC).</p>
Offline	The Referee System Main Controller Module is unable to connect to the Referee System Server during the competition, due to power outage on the robot or other reasons.
Temporary Activation	After a robot is defeated or ejected, the referee may power on the robot's chassis and gimbal temporarily. The Launching Mechanism for the robot will be powered off.
Occupy	When a robot has reached a Buff Point and its RFID Interaction Module has detected the RFID Interaction Module Card in the area.
Entanglement	Mechanisms of robots are entangled with one another during the competition, i.e. one robot remains connected to the other robot and is pulled with said robot whichever direction it moves.

Term	Definition
Collision	An active act of collision by a robot during the competition.
Competition Site	
Buff Point	An area that provides special effects for the robot that occupies it during the competition.
Penalty Zone	An area into which a robot's entry is forbidden.
Battlefield Components	Composite elements of the Battlefield, including but not limited to: Base
Staff	
Arbitration Commission	A body consisting of the Chief Referee and other members of the RMOC, responsible for handling appeals.
Chief Referee	The person with the final right of interpretation over the competition rules during the competition.
Head Referee	The lead referee responsible for maintaining the order of the competition and enforcing its rules.
Referee	Personnel responsible for maintaining the order of the competition and enforcing its rules.
Head Inspector	The referee responsible for leading and assigning pre-match inspection tasks, with the final right of interpretation over the inspection standards.
Participants	Individuals that have registered and been recorded in the registration system for the current competition season.
Participating Teams	The teams that have registered and been recorded in the registration system for the current competition season.
Pit Crew Members	Regular Members, Supervisors and Advisors that have been registered on the registration system and can enter the Staging Area and Competition Area.
Operator	The Pit Crew members responsible for controlling robots during the competition.
Offending Team	A participating team that violates the competition rules.
Offending Personnel	Participants that violate the competition rules.
Offending Robot	A robot that violates the competition rules.

Term	Definition
Competition Process	
Round	A complete competition that includes the Setup Period, Referee System Initialization Period, and the competition round.
Match	Depending on the Competition System, a match may contain several rounds.
Official Technical Timeout	A Technical Timeout initiated by the Head Referee during the Setup Period or Referee System Initialization Period.
Team Technical Timeout	A Technical Timeout requested by a Captain during the Setup Period.
Factors Determining the Competition Outcome	
Damage HP	<p>The HP deducted from a robot or Battlefield Component caused by a projectile launch from an enemy robot.</p> <p>Exceptions are shown below:</p> <ul style="list-style-type: none"> ● HP deduction caused by one side's robot due to penalties will be included in the opponent's damage HP ● HP deducted as a result of exceeding the Initial Launching Speed limit, Barrel Heat limit and Maximum Chassis Power Consumption, a collision on an armor module, the Referee System going offline, or an offline status are not added to the other team's damage HP.
Net Base HP	At the end of each round, the remaining HP of one's Base is subtracted from the remaining HP of the other Base.
Net Sentry HP	The remaining HP of a team's Sentry subtracted from the remaining HP of the enemy's Sentry at the end of a round.
Total Remaining HP	The total value of remaining HP of one's survived robots at the end of each round.

3. Robot and Operator

RoboMaster requires robots to fight together as a team with good coordination and teamwork. For the robot building specifications, please refer to the “[RoboMaster 2023 University Series Robot Building Specifications Manual](#)”.

The required robot and operator lineup is as follows:

Table 3-1 Robot and Operator Lineup

Type	No.	Qty (set)	Operator lineup	Event
Hero Robot	1	0-1	1 Operator/Robot	3V3 Match
Standard robot	3/4	0-2	1 Operator/Robot	
Sentry Robot	7	0-1	0 Operator/Robot	
Standard robot	5	1	1 Operator/Robot	Standard Match



- In 3V3 Match and Standard Match, each team is only allowed to deploy one Balancing Standard Robot.
- In 3V3 Match, the total number of Hero and Standard Robots is less than 2. In the first round of each match, the number of line-up robots is greater than 2.
- In a Standard Match, the armor sticker of a Standard can be 3/4/5.
- An operator must be a Regular Member of a team in the current season.
- After the end of each round, the Operator can be replaced by a Regular Member among the Pit Crew Members for the current match.

The basic information of the robot is as follows:

Table 3-2 Robot's Basic Information

	3V3 Match			Standard Match	
Robot Type	Hero Robot	Standard robot	Sentry Robot	Regular Standard Robot	Balancing Standard Robot
Maximum Chassis Power Consumption (W)	For details on robot levels, please refer to “5.2.6 Level Up Mechanism”.		100	120	150
Initial HP			600	200	200
Maximum HP			600	200	200
Initial Launching Speed Limit (m/s)			30	18	18
Barrel Heat Limit			240	280	280
Barrel Cooling Value per Second			80	25	50
Experience Value			75	-	-
Initial position	Starting Zone	Starting Zone	Sentry Starting Zone	Starting Zone	Starting Zone

4. General Competition Mechanism

4.1 HP Deduction Mechanism

The HP of robots may be deducted in any of the following situations. The Referee System will round down the HP deduction and keep the integer when calculating the HP.

Table 4-1 Overview of the HP Deduction Mechanism

Reason \ Robots	Standard robot	Hero Robot	Sentry Robot
Exceeding the Barrel Heat Limit	✓	✓	✓
Exceeding the Initial Launching Speed Limit	✓	✓	✓
Exceeding Chassis Power Consumption Limit	✓	✓	-
Armor Module attacked by projectiles	✓	✓	✓
Armor module collided	✓	✓	✓
Important Referee System Modules gone offline	✓	✓	✓
Yellow or Red Card Warning	✓	✓	-

4.1.1 Exceeding the Initial Launching Speed Limit

Set the Initial Launching Speed limit as V_0 (m/s), the actual initial speed detected by the Referee System as V_1 (m/s).

When $V_1 > V_0$, if it's 17 mm projectile, the deducted HP = Maximum HP * L%. If it's 42mm projectile, the deducted HP = Maximum HP * M%. The values of L% and M% are correlated to the margin of excess. The larger the margin of excess, the greater the values of L% and M%.

Table 4-2 Penalty Mechanism for Exceeding Initial Launching Speed Limit

17 mm projectile	L%	42 mm projectile	M%
$0 < V_1 - V_0 < 5$	10%	$V_0 < V_1 \leq 1.1 * V_0$	10%
$5 \leq V_1 - V_0 < 10$	50%	$1.1 * V_0 < V_1 \leq 1.2 * V_0$	20%
$10 \leq V_1 - V_0$	100%	$1.2 * V_0 < V_1$	50%

4.1.2 Exceeding the Barrel Heat Limit and Cooling

Set the Barrel Heat limit as Q_0 , the current barrel heat as Q_1 . For each 17 mm projectile detected by the Referee System, the current barrel heat Q_1 is increased by 10 (regardless of its initial speed). For each 42 mm projectile detected, the current barrel heat Q_1 is increased by 100 (regardless of the 42 mm projectile's initial speed). The barrel cools at a frequency of 10 Hz. The cooling value per detection cycle = cooling value per second / 10.

- A. When $Q_1 > Q_0$, the first-person-view (FPV) visibility on the robot Operator's screen is reduced. The FPV will only return to normal when $Q_1 < Q_0$. The FPV for the client is as follows:

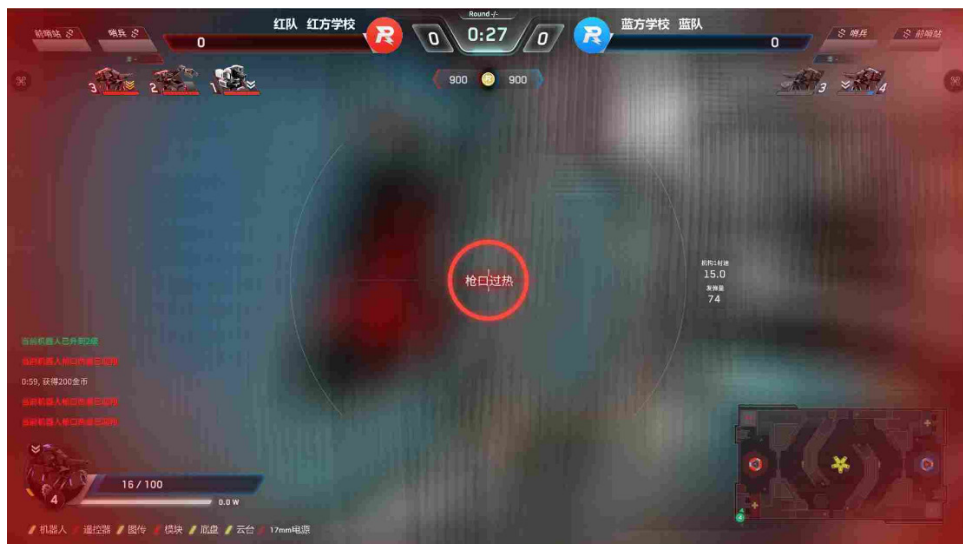


Figure 4-1 FPV of Client

- B. When $2Q_0 > Q_1 > Q_0$, the deducted HP for every 100 ms = $((Q_1 - Q_0) / 250) / 10 * \text{Maximum HP}$. After the HP deduction, the barrel cooling will be calculated.
- C. When $Q_1 \geq 2Q_0$, the immediate deducted HP = $(Q_1 - 2Q_0) / 250 * \text{Maximum HP}$. After deducting HP, set $Q_1 = 2Q_0$.

The below shows the HP deduction and cooling logic when the Barrel Heat limit is exceeded:

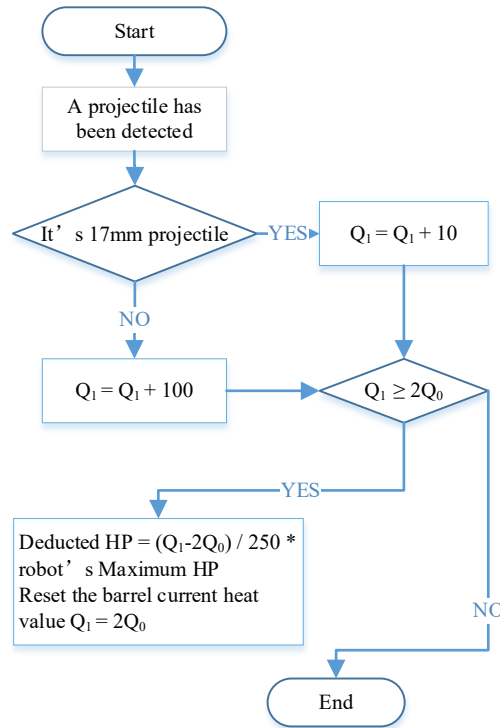


Figure 4-2 HP deduction logic for exceeding the Barrel Heat Limit

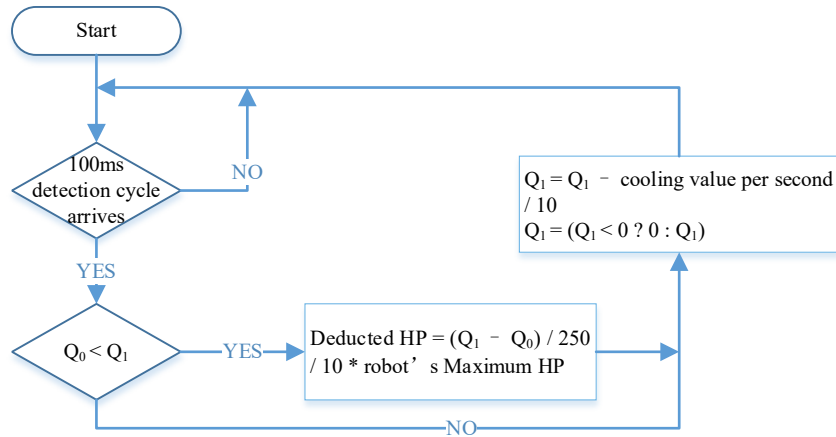


Figure 4-3 Cooling logic

4.1.3 Exceeding Chassis Power Consumption Limit

The chassis power consumption of robots will be continuously monitored by the Referee System, and the robot chassis needs to run within the chassis power consumption limit. Considering it is difficult for a robot to control instantaneous output power when in motion, a buffer energy (Z) has been defined to avoid the consequent penalty.

The buffer energy value of Hero, Standard and Sentry Robots is 60J.

The Referee System monitors chassis power consumption at a frequency of 10 Hz.

Excess Percentage: $K = (P_r - P_l) / P_l * 100\%$, where P_r is the instantaneous Chassis Power Consumption output and

P_1 is the power consumption limit.

Table 4-3 Penalty Mechanism for Exceeding Chassis Power Consumption Limit

K	N%
$K \leq 10\%$	10%
$10\% < K \leq 20\%$	20%
$K > 20\%$	40%

Standard and Hero:

After the exhaustion of buffer energy, when the Chassis Power Consumption of Standard or Hero exceeds the limit, in each detection cycle the deducted HP = Maximum HP * N% * 0.1.

The logic graph for chassis power consumption detection and HP deductions for a Standard or Hero Robot is shown below:

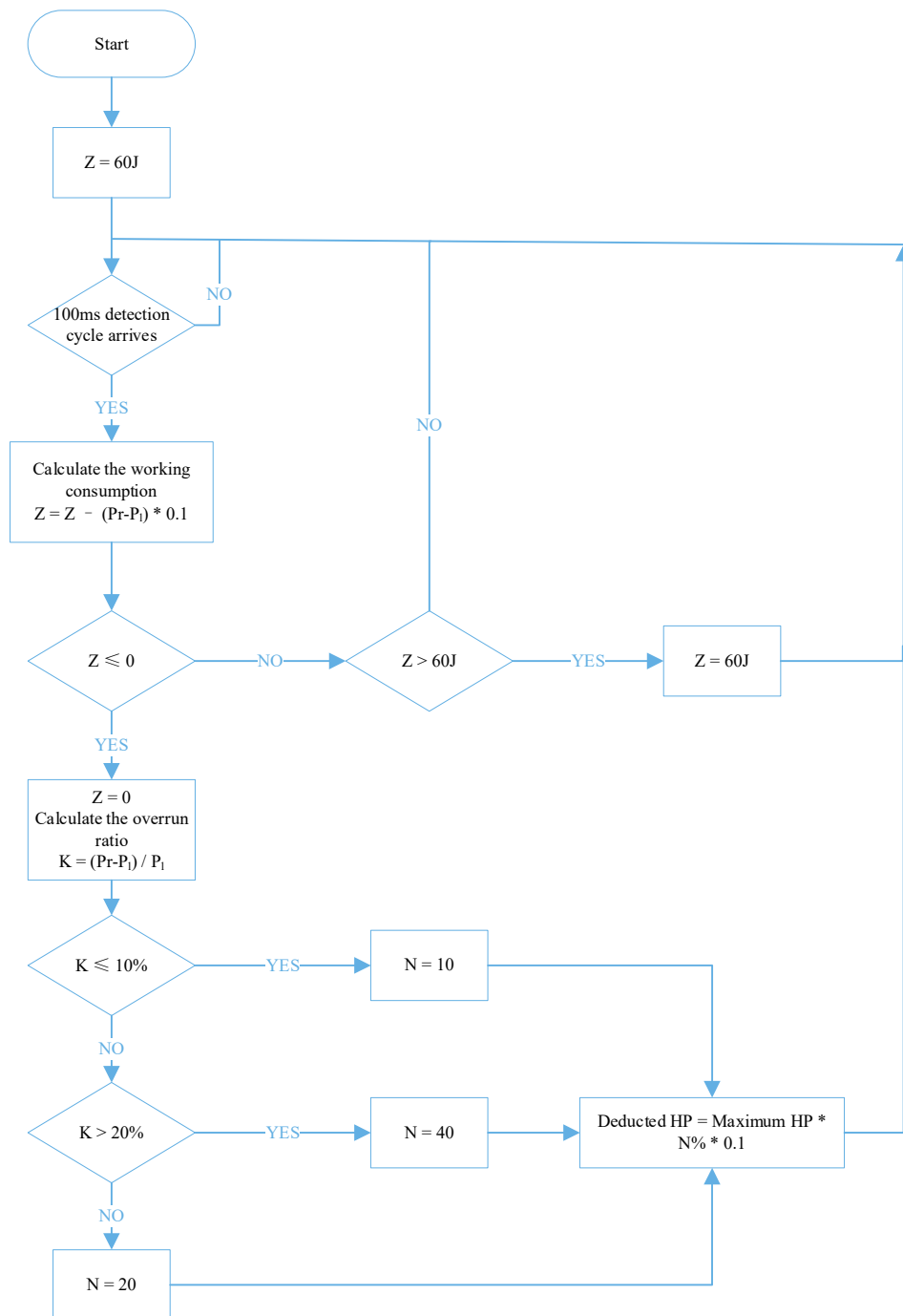


Figure 4-4 Chassis Power Consumption Detection and HP Deduction Logic of Standard and Hero

Sentry:

After the buffer energy is depleted, if the chassis power consumption of a Sentry Robot exceeds the limit, the Referee System will temporarily shut down the chassis' power output.

The logic graph for chassis power consumption detection of Sentry and chassis power-off is shown below:

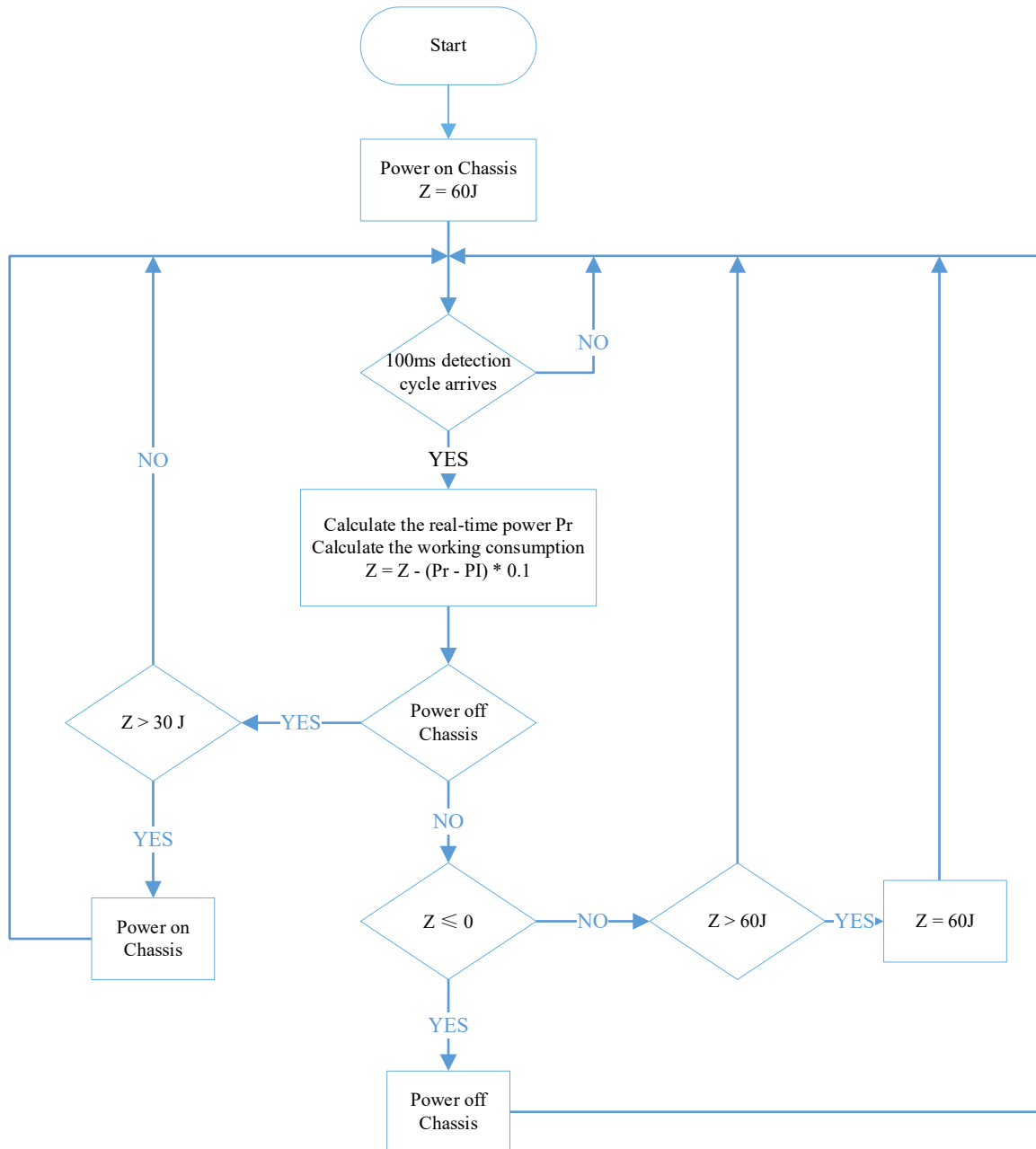


Figure 4-5 Chassis Power Consumption Detection and Chassis Power-off Logic of Sentry

4.1.4 Attack Damage

An Armor Module detects projectile attacks using the pressure sensor and the vibration frequency of the Armor.

The shortest detection interval for an Armor Module is 50 ms (when hitting an Armor Module using a 42 mm projectile, the detection interval can be extended to a maximum of 200 ms).

The projectile needs to come into contact with the impact surface of the armor module at a certain speed in order to be successfully detected. The velocity range for the detection of different projectile types by an armor module is as follows:

Table 4-4 An armor module's detection speed for different projectile types

Armor Module	17 mm projectile	42 mm projectile
Large Armor Module, Small Armor Module	Higher than 12 m/s	Higher than 8 m/s



In an actual match, the normal speed of a projectile that touches the Armor Module attack surface is different from its initial Launching speed due to the projectile's speed decay and its incident angle not being normal to the Armor Module attack surface. Damage detection is based on the normal component of the projectile's speed upon contact with the Armor Module attack surface.

A robot experiences damage when its Armor Module is struck. However, a robot is not allowed to cause HP damage to the other side's robots through striking (including collision with the robots or launching objects).

The table below sets out the HP deductions for different armors assuming no buff points are received:

Table 4-5 Attack damage HP deduction mechanism

Damage type	HP Damage Value
42 mm projectile	Robot Armor Module: 100 Base Armor Module: 200
17 mm projectile	Robot Armor Module: 10 Base Armor Module: 5
Collision	2

4.1.5 Referee System Going Offline

According to the latest version of the “[RoboMaster 2023 University Series Robot-Building Specifications Manual](#)”, robots must be mounted with their corresponding Referee System modules, and each Referee System module must have a stable connection to its server throughout the competition. The Referee System server detects the connectivity of each module at a frequency of 2 Hz. If important Referee System Modules go offline due to design or structural problems, then the HP of the corresponding robots will be deducted.



Important Referee System Modules: Speed Monitoring Module, Armor Module and Supercapacitor Management Module.

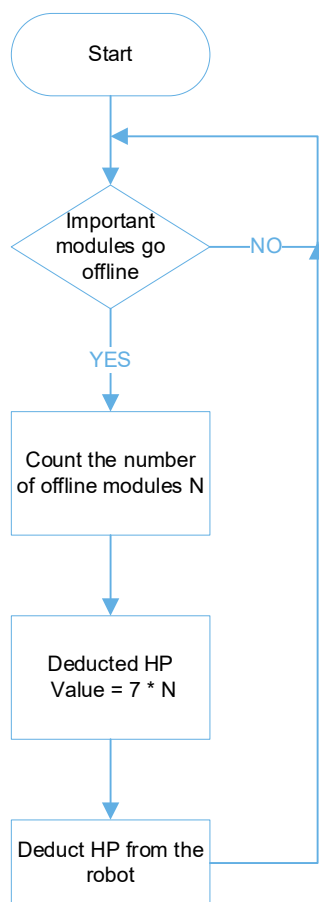


Figure 4-6 HP Deduction Mechanism for Important Referee System Modules Going Offline

4.1.6 Irregular Offline Status

During the competition, if a robot enters into the Offline status, it can reconnect to the competition while its experience and levels will continue to be calculated during the offline period.

Table 4-6 Consequences of irregular offline status

Robot Type	Consequences of irregular offline status
Hero, Standard	<ul style="list-style-type: none"> When the power supply to the Launching Mechanism, Gimbal and Chassis is cut off, 5% of the Maximum HP is deducted for each second elapsed until it drops to zero. The RFID Interaction Module is disabled. The robot no longer detects any damage caused by collision or projectile attacks. The revival progress drops to zero.

Robot Type	Consequences of irregular offline status
Sentry Robot	<ul style="list-style-type: none">● When the power supply to the Launching Mechanism, Gimbal and Chassis is cut off, 5% of the Maximum HP is deducted for each second elapsed until it drops to zero.● The RFID Interaction Module is disabled.● The robot no longer detects any damage caused by collision or projectile attacks.

5. 3V3 Match

During a five-minute round, both teams control their robots to engage in tactical combat on the Battlefield. The team that destroys the other's Base shall be the winner.

5.1 Competition Area

5.1.1 Introduction



- The error margin for the dimensions of all Battlefield Components described in the document is $\pm 10\%$. The unit for the size parameters on the site drawings is mm.
- The Battlefield has a symmetrical layout with a central line. All descriptions and illustrations of Battlefield modules in this text will be based on the Red Team as an example but will apply equally to the Blue Team.
- There are two types of Battlefields in the RMUL 2023: wooden or joint. The type of Battlefield used shall depend on the competition site.
- Static electricity may occur at the site, so participating teams are advised to take the relevant protective measures.

The core competition area of the 3V3 Match is called the "Battlefield". The Battlefield is 12 m x 8 m in size. Each team has a Starting Zone, Supplier Zone and Buff Zone on the Battlefield.

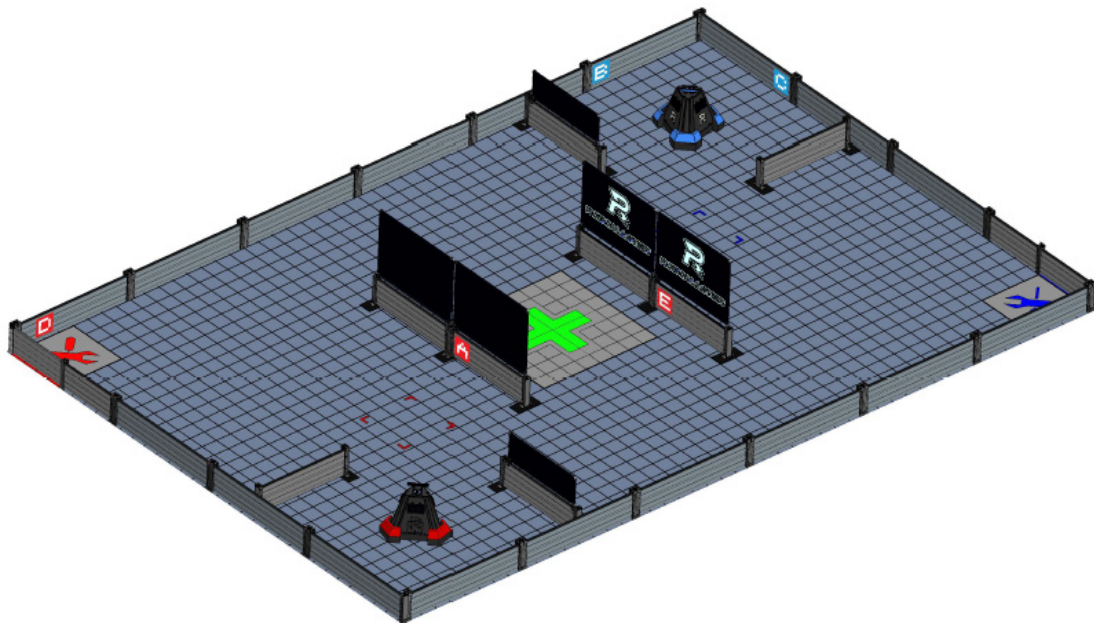
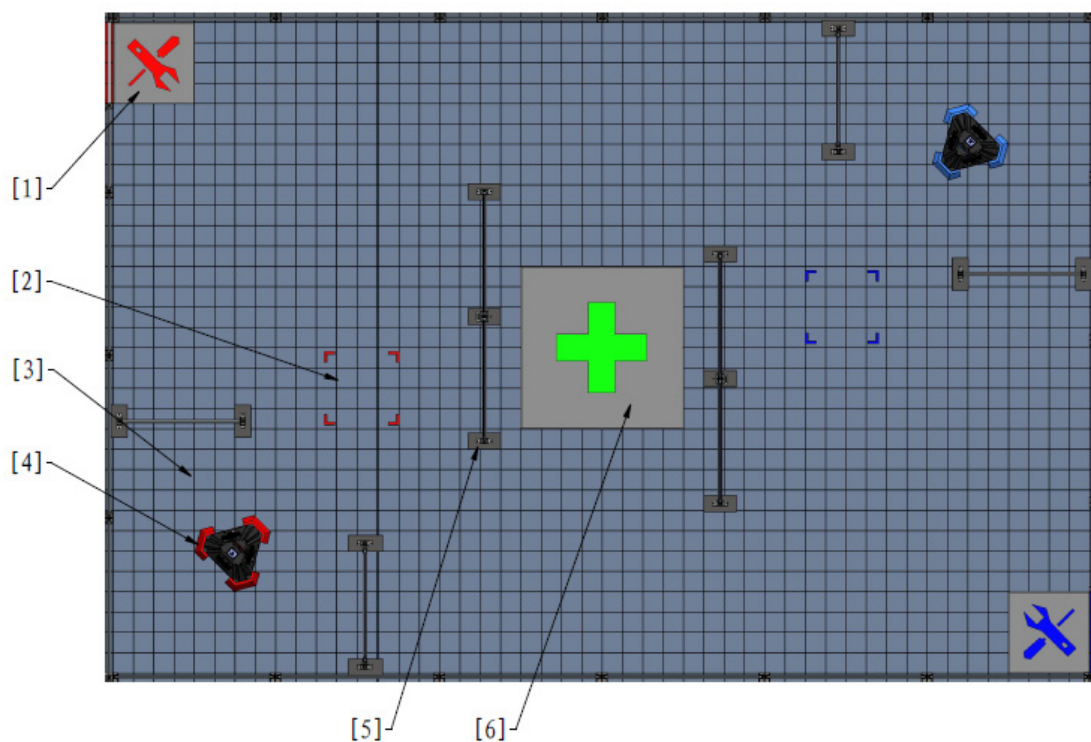


Figure 5-1 Axonometric view of 3V3 Match Joint Battlefield



- [1] Projectile Supplier Zone [2] Sentry Starting Zone [3] Starting Zone [4] Base [5] Bunker [6] Central Buff Point

Figure 5-2 Modules of 3V3 Match Joint Battlefield

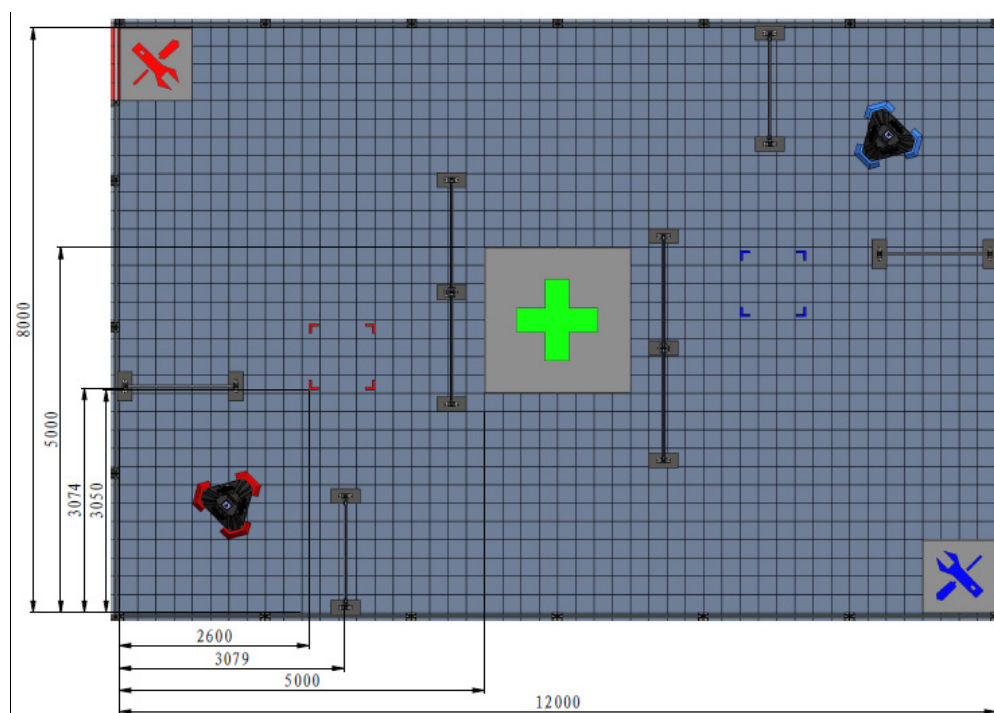


Figure 5-3 Dimensions of 3V3 Match Joint Battlefield

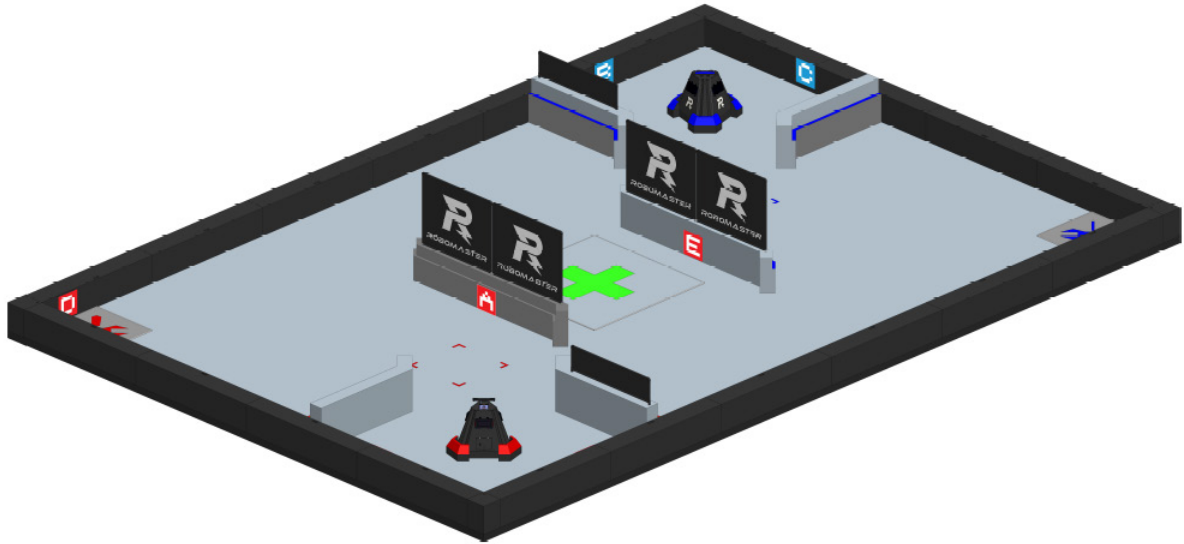
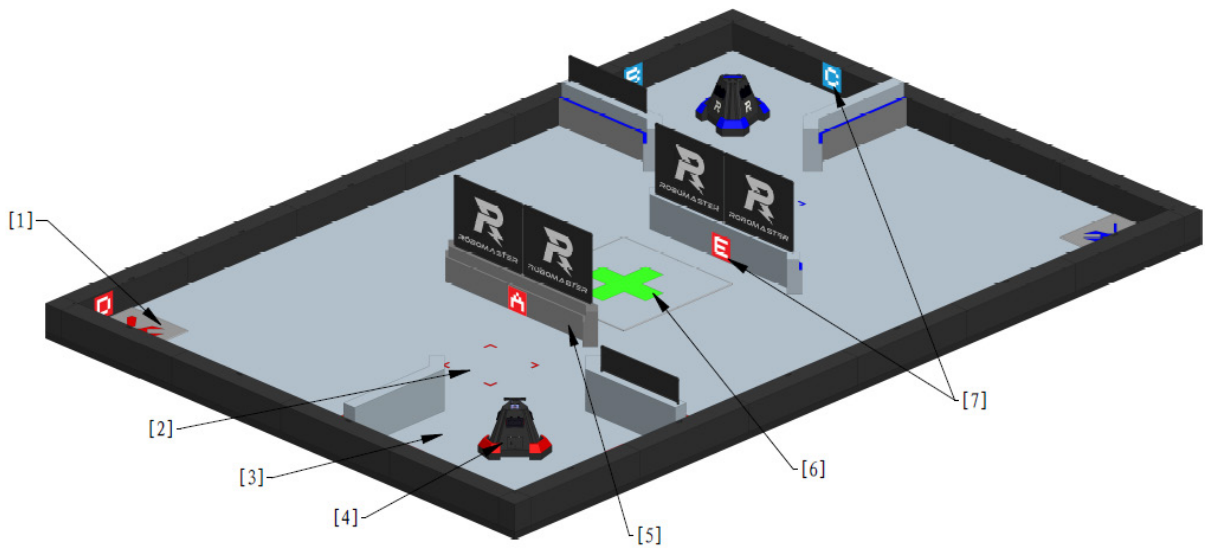


Figure 5-4 Axonometric view of 3V3 Match Wooden Battlefield



- | | | | | |
|------------------------------|--------------------------|-------------------|----------|------------|
| [1] Projectile Supplier Zone | [2] Sentry Starting Zone | [3] Starting Zone | [4] Base | [5] Bunker |
| [6] Central Buff Point | [7] Visual Marker | | | |

Figure 5-5 Modules of 3V3 Match Wooden Battlefield

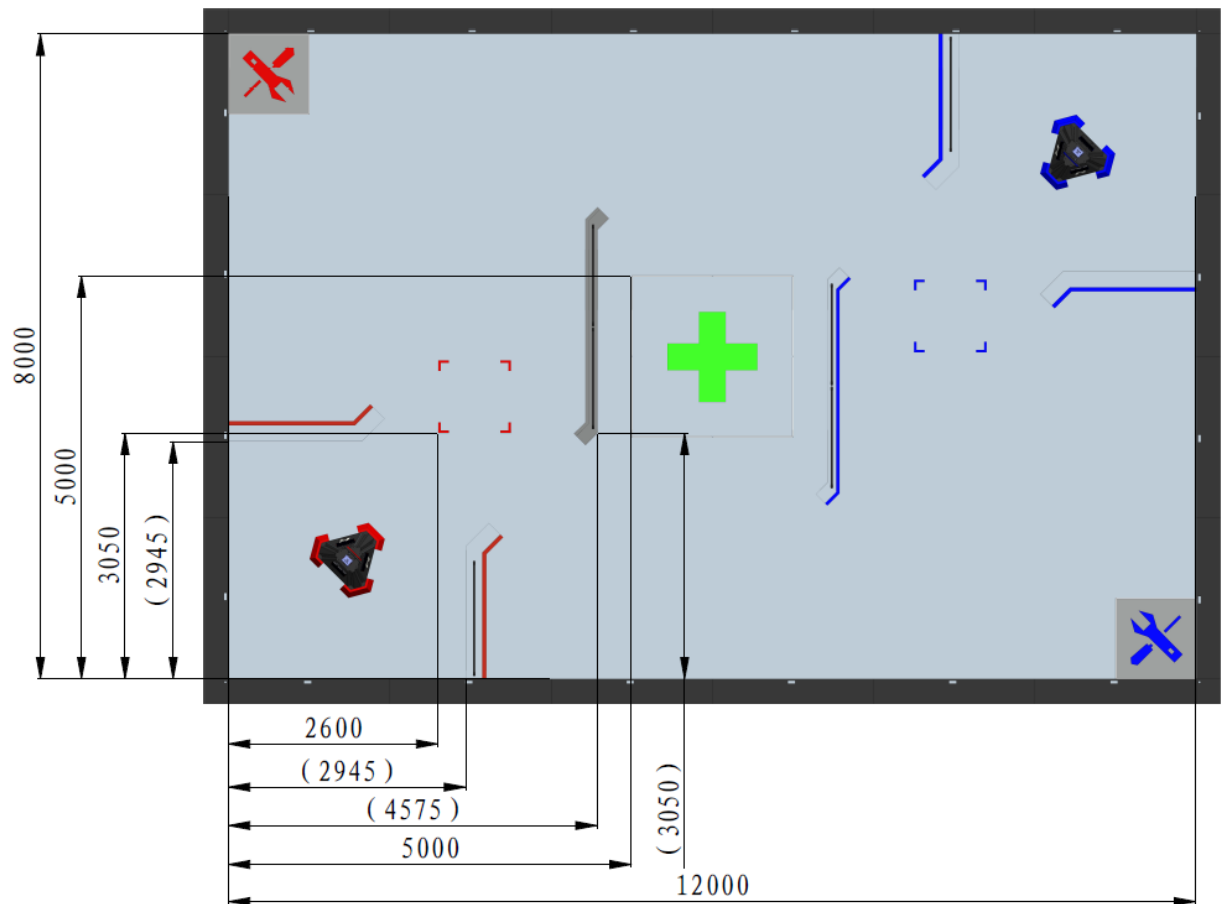
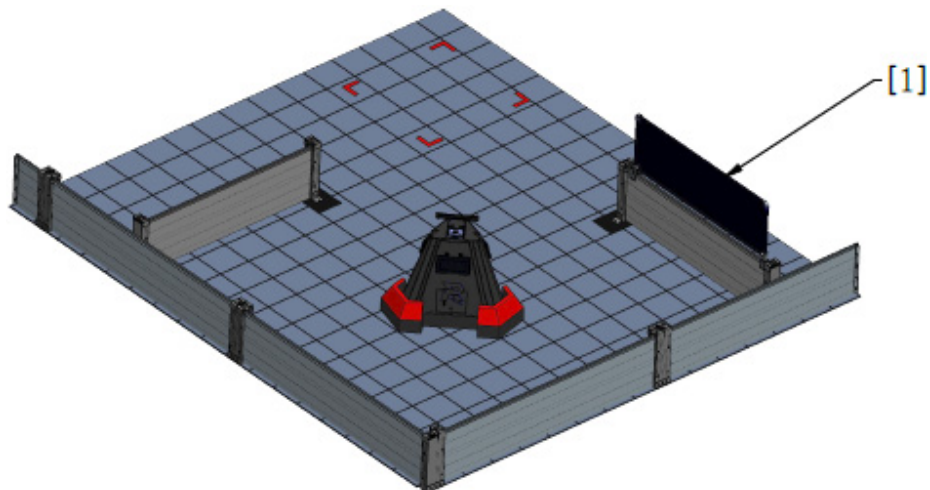


Figure 5-6 Dimensions of 3V3 Match Wooden Battlefield

5.1.2 Starting Zone

The Starting Zone is the robots' placement area before a match, mainly including the Base.



[1] Perimeter wall of the Starting Zone on the Joint Battlefield

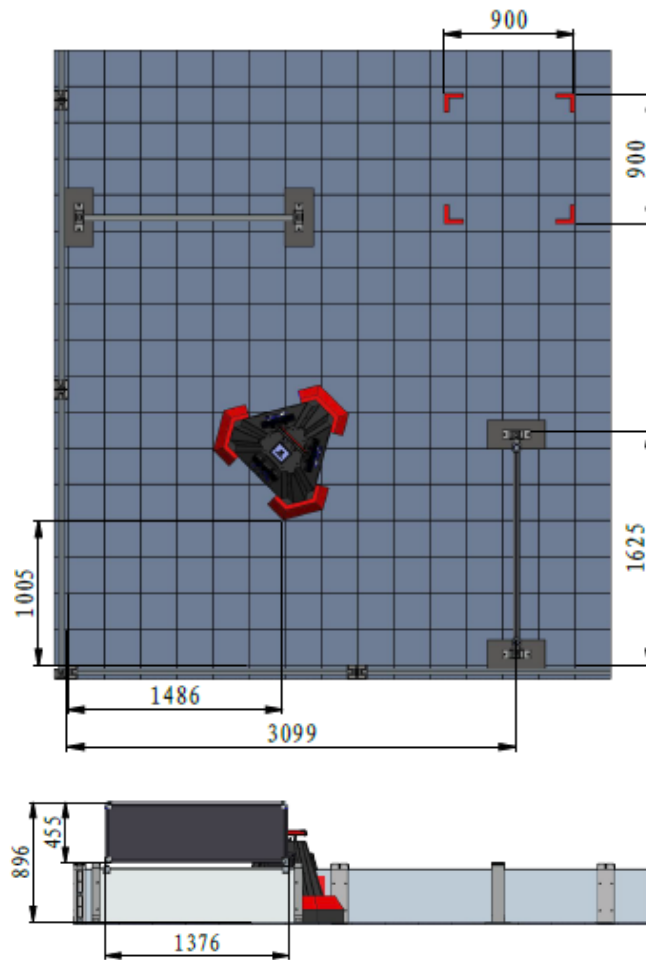
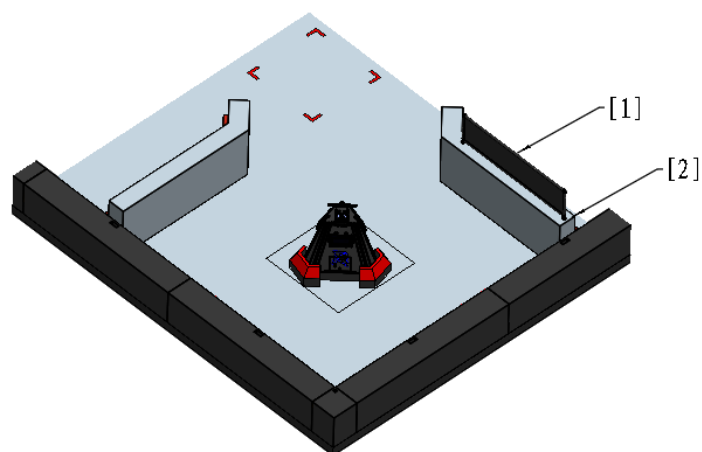


Figure 5-7 Starting Zone on the Joint Battlefield



[1] Gauze perimeter wall of the Starting Zone [2] Wooden perimeter wall of the Starting Zone

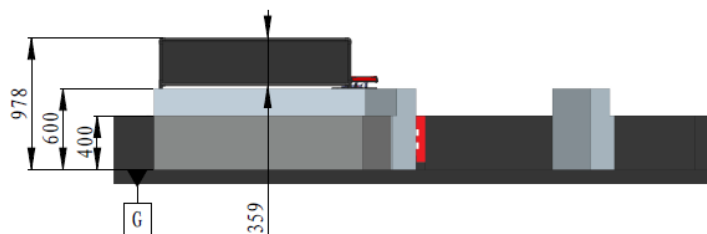
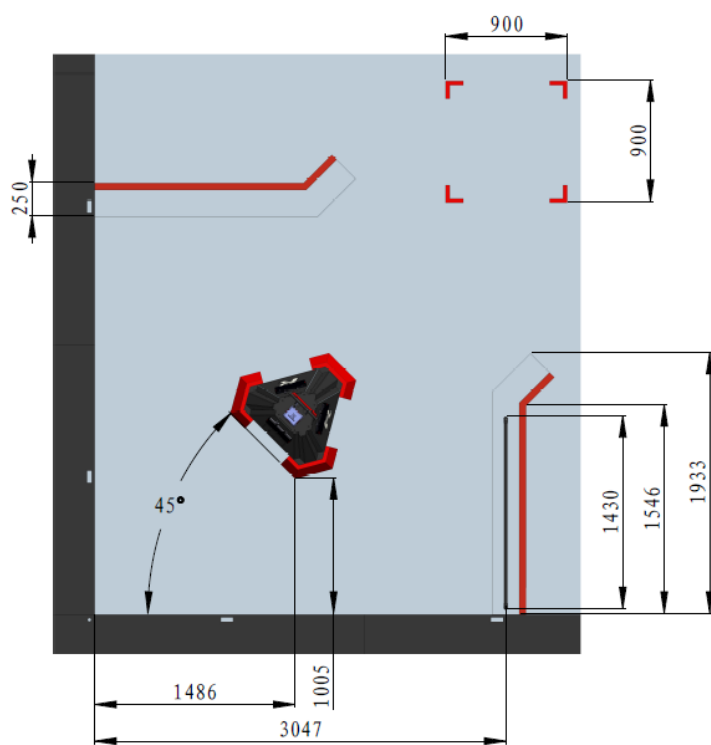


Figure 5-8 Starting Zone on the Wooden Battlefield

5.1.2.1 Base

The Red Team and Blue Team each have a Base. The Base is equipped with several Armor Modules with stickers attached.

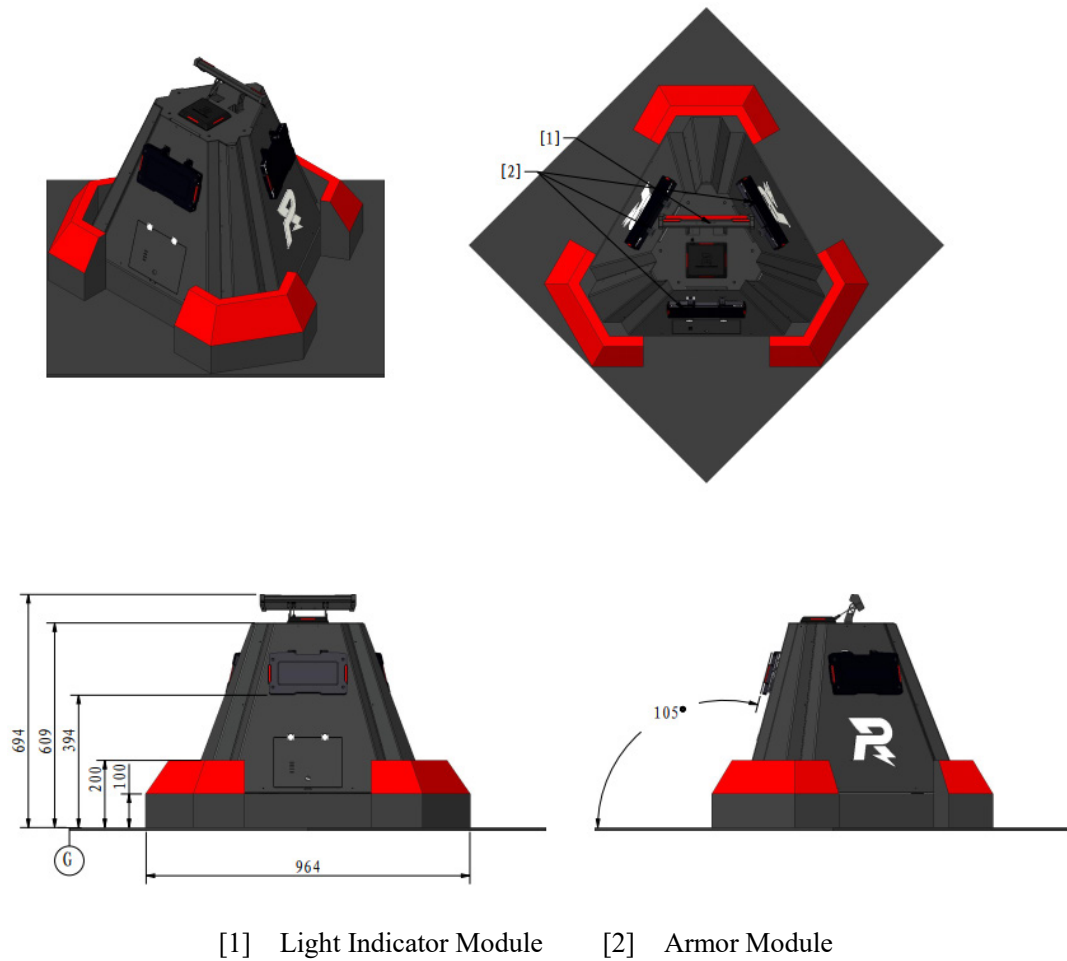


Figure 5-9 Base

5.1.3 Bunker

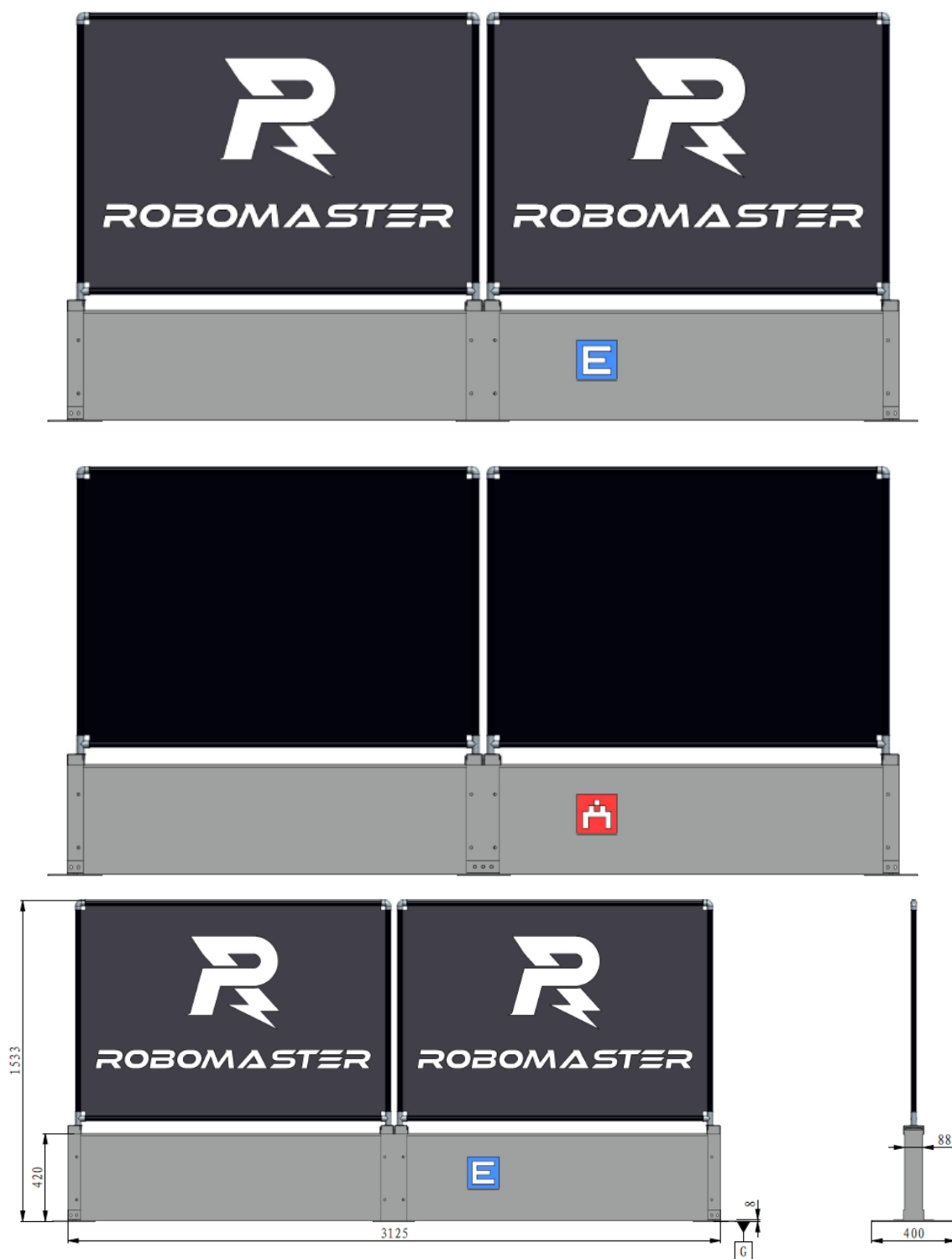


Figure 5-10 Bunker on the Joint Battlefield

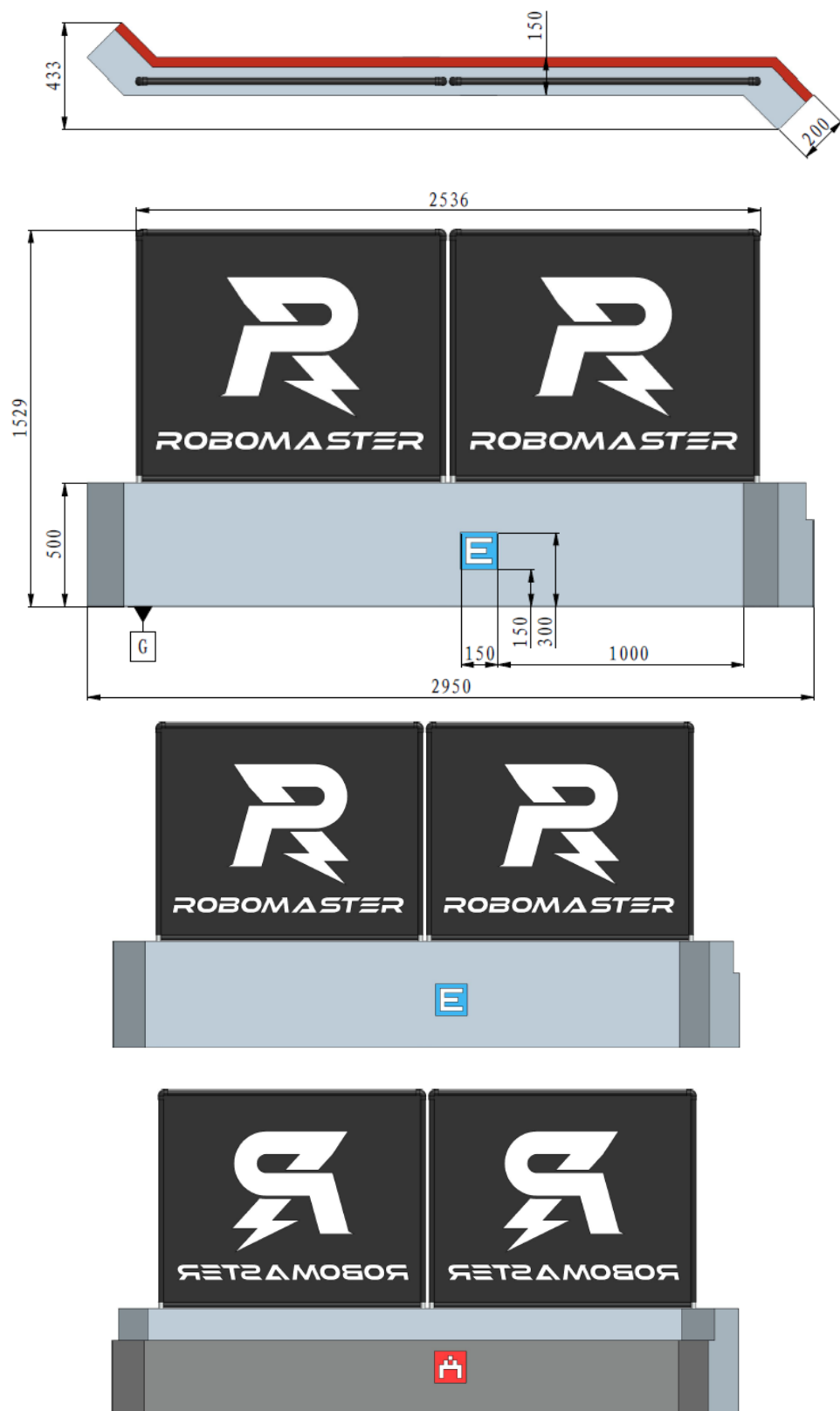


Figure 5-11 Bunker on the Wooden Battlefield

5.1.4 Projectile Supply Zone

Supply Zone is an important area for robots to replenish projectile and reset HP.

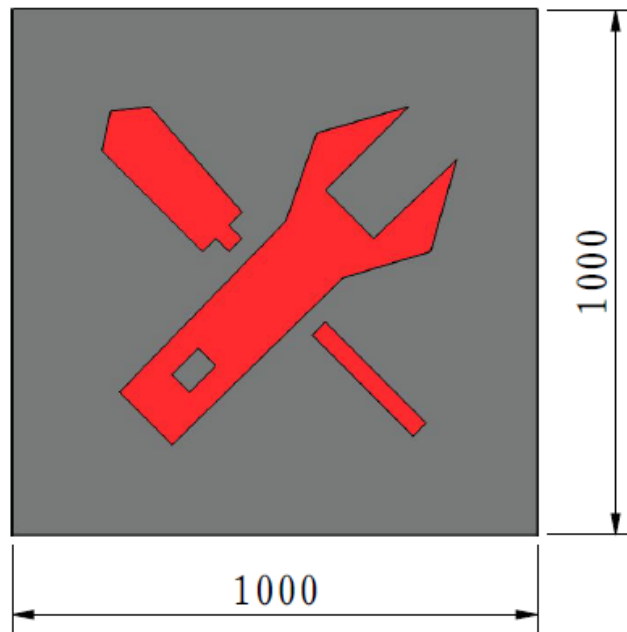


Figure 5-12 Restoration Zone

5.1.4.1 Supplier Penalty Zone

The Supplier Zone of one side is the Supplier Penalty Zone for the robots of the other side.

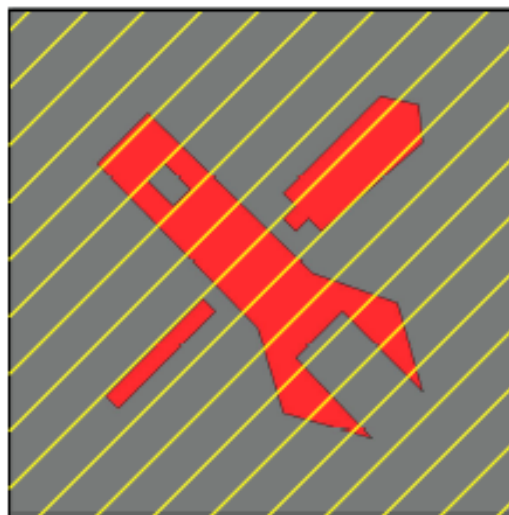


Figure 5-13 Supplier penalty zone

5.1.5 Central Buff Point

Central Buff Point is located at the center of the battlefield.

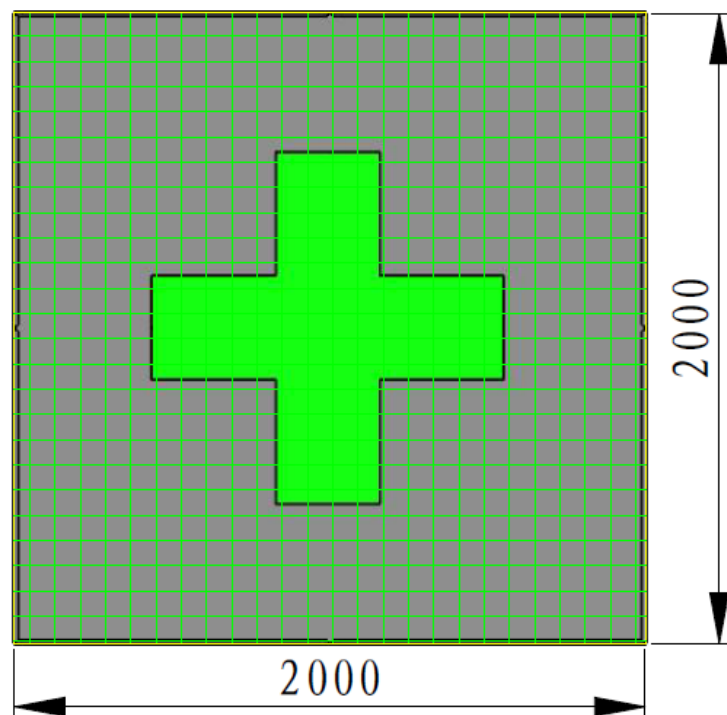
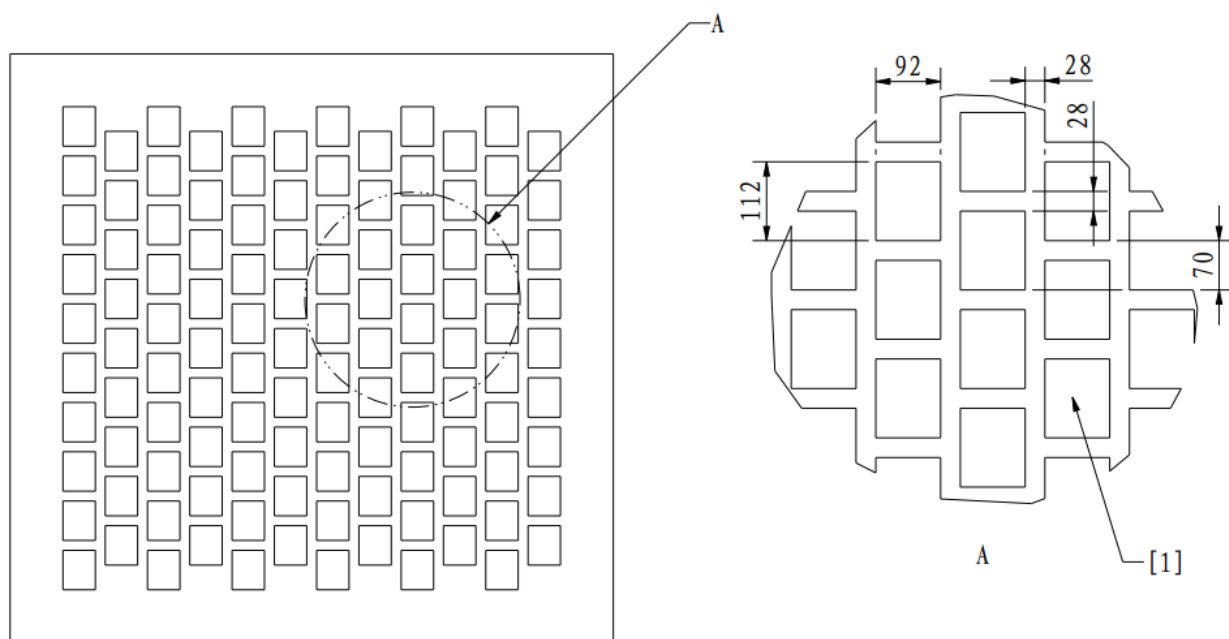


Figure 5-14 Central Buff Point



[1] Locations where RFID Interaction Module Cards are lodged

Figure 5-15 Layout of the RFID Interaction Module Cards



Deadbands may exist for the RFID Interaction Module Cards at the Buff Points in the Battlefield. The teams have to adjust on their own.

5.1.6 Miscellaneous

5.1.6.1 Projectiles

Robots attack the Armor Modules of enemy robots by launching projectiles, causing damage to their HP so as to ultimately defeat them. The parameters and scenarios of use for projectiles in the competition are as follows:

Table 5-1 Projectile Parameters and Scenarios of Use

Type	Appearance	Color	Size	Weight	Shore Hardness	Material	Scenarios of Use
42 mm projectile	Similar to a golf ball	White	42.5 mm \pm 0.5 mm	41 g \pm 1 g	90 A	Plastic (TPE)	3V3 Match
17 mm projectile	Spherical	Yellow-green	16.8 mm \pm 0.2 mm	3.2 g \pm 0.1 g	90 A	Plastic (TPU)	All RMUL Events

5.1.6.2 Projectile Reloader

An off-field reloading operator may refill projectiles for a robot using an official Projectile Reloader. The Projectile Reloader is shown below:

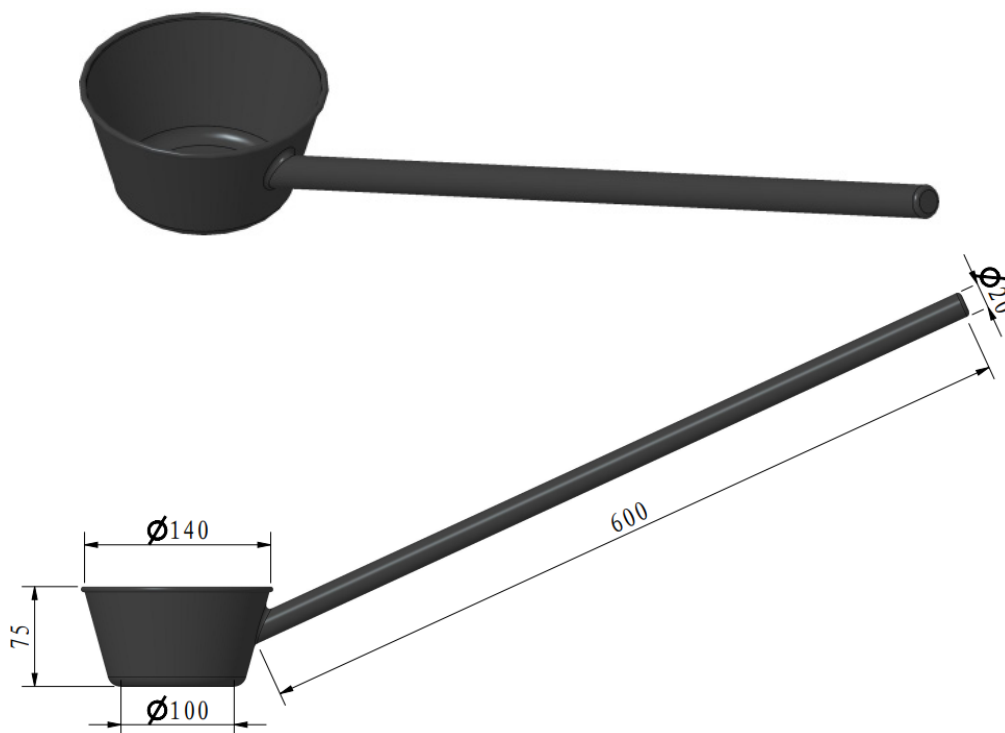


Figure 5-16 Projectile Reloader

5.1.6.3 Visual Marker

A Visual Marker is a square label with a side length of 150 mm and red or blue words on a white background. Each Marker is different. For their codes, please refer to [“RoboMaster 2022 University AI Challenge Visual Marker Library”](#).

The color codes for Visual Markers are:

Red RGB: R255 G51 B51; CMYK: C0 M89 Y75 K0; HEX: ff3333

Blue RGB: R51 G153 B204; CMYK: C74 M30 Y13 K0; HEX: 3399cc

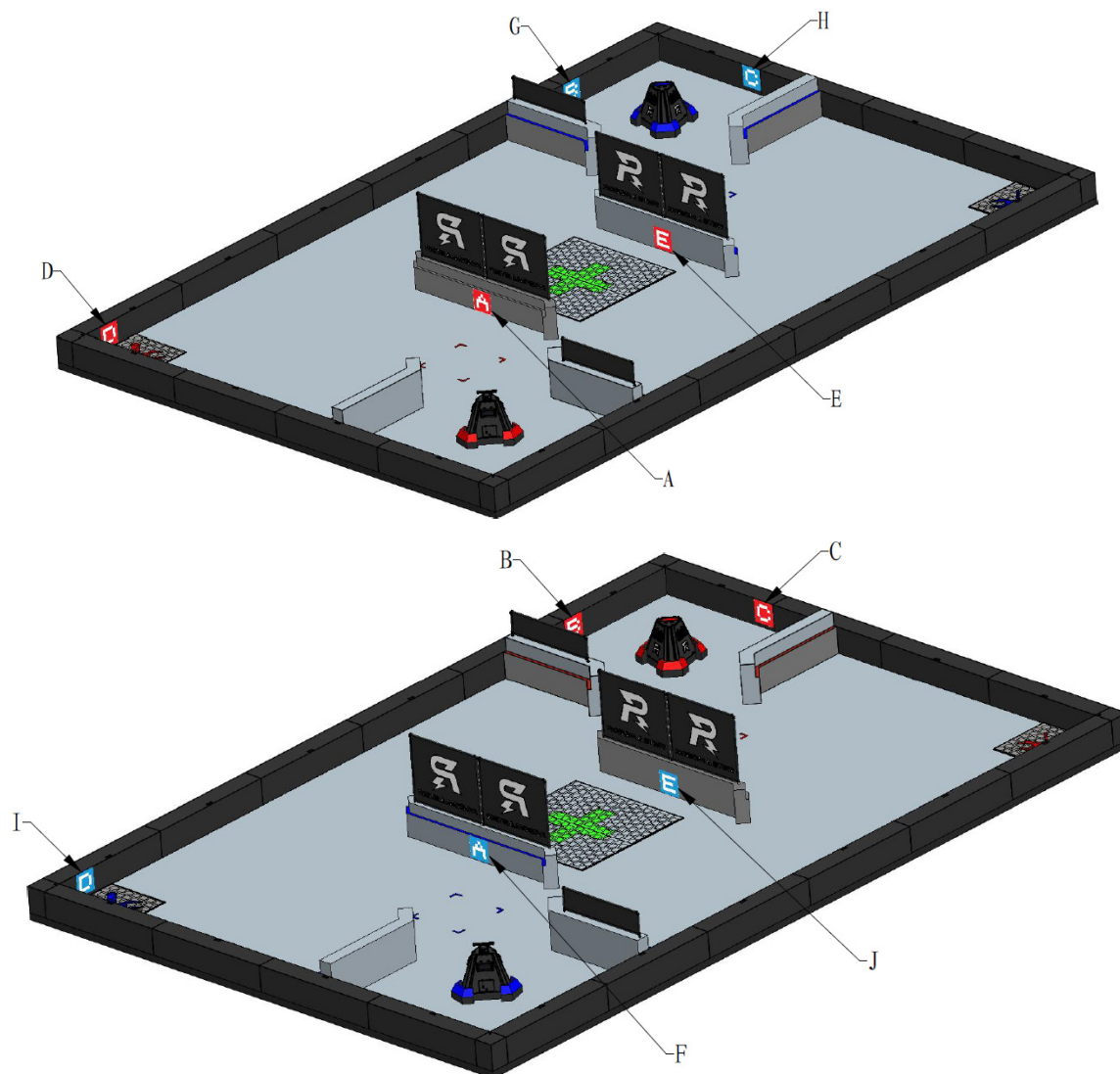


Figure 5-17 Diagram of Visual Markers

5.1.6.4 Operator Room

Operator Room lies outside the Battlefield and is an area for Operators during the competition. Each Operator Room must be equipped with a corresponding number of computers with official equipment such as monitor, mouse, keyboard and USB hub.

5.2 Competition Mechanism

5.2.1 Mobile 17 mm Launching Mechanism

A Mobile 17 mm Launching Mechanism can be mounted on either a Standard or a Hero Robots, provided that it meets the technical specifications of all robots. All Launching Mechanisms must meet the relevant requirements for Initial Launching Speed Limit for Projectiles. Each Launching Mechanism can be mounted with a laser sight.

Example: A Standard Robot can be equipped with one 17 mm launching mechanism. A team can mount a mobile 17 mm Launching Mechanism on a Standard Robot as needed. The Robot will then have two 17 mm Launching Mechanisms.

The Barrel Heat of a Mobile 17 mm Launching Mechanism is calculated separately from a Fixed Launching Mechanism. At the start of a match, the operator must select the type of Launching Mechanism for the Mobile 17 mm Launching Mechanism.

5.2.2 HP Recovery and Revival Mechanism

All robots may recover their HP (except for ejected robots); only Sentries cannot be revived.

5.2.2.1 HP Recovery Mechanism



HP Bag: Allow robot HP recovery at a maximum speed of 10% per second within 5 seconds.

Each team has 3 HP Bags when the match begins. If a team has one or more HP Bags, its operator can press the “K” key to consume an HP Bag when its robot has occupied the team’s Projectile Supplier Zone. For the same robot, the next HP Bag can only be used after the previous one is completed (namely, 5 seconds after it takes effect).

Both teams can acquire more HP Bags by occupying the Central Buff Point. For detailed acquisition methods, please refer to “5.2.4.2 Central Buff Point Mechanism.”

From the start to the 4th minute of the competition (countdown from 4:59-0:59), a living Sentry Robot that occupies its Supplier Zone will recover its HP at 100 points/second. The total maximum HP that can be recovered in this manner is 600.

5.2.2.2 Revival Mechanism

- A defeated Standard or Hero Robot can be revived automatically, by completing the revival process.
- During the auto revival of Standard and Hero Robots, their revival progress gains 2 points automatically per second.
- Once a Standard or Hero Robot is revived, its Launching Mechanism will be powered off. Once it occupies its team’s Restoration Zone, its Launching Mechanism will power on automatically.

The length of revival processes for different robots on their first defeat are shown as follows:

Table 5-2 The length of revival processes for different robots on their first defeat

Type	Revival process length
Standard robot	10
Hero Robot	20

The revival process length for the same robot increases by 10 after each defeat.

A revived robot will maintain its level, performance points and experience points from before its defeat, and its HP will be restored to 20% of the Maximum HP. The robot is invincible for 10 seconds after revival.

5.2.3 Projectile supplies

In each round, Standard and Hero Robots can enter their Supplier Zone at any time, where the off-field reloading operator can refill projectiles for them using the official Projectile Reloader. For details on the Projectile Reloader, please refer to “Figure 5-16 Projectile Reloader”.



Reloading operators can only refill projectiles using the official projectile reloader, and cannot touch the robots in any other manner.

5.2.4 Battlefield-related Mechanism

5.2.4.1 Base HP

Base HP is 1500.

When a team's robots are defeated or ejected, the “invincible” status of its Base will be lifted and its Virtual Shield will be enabled. A Virtual Shield has 1,500 HP. When a robot attacks the enemy's Base, the HP of its Virtual Shield will first be deducted. If the Virtual Shield's HP has reduced to zero, the Base's HP will be deducted.

A team's Invincible Status and Virtual Shield become ineffective when its Sentry is destroyed or ejected.

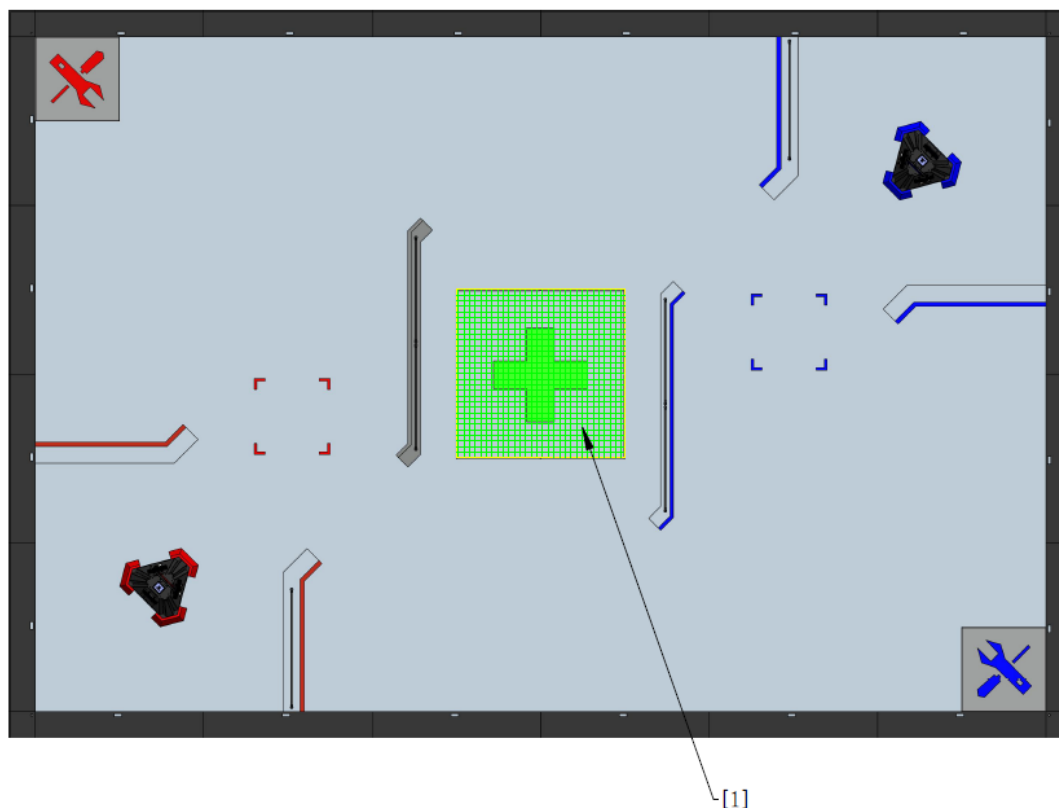
If a team's Sentry Robots have not showed up on the Battlefield after one minute's entry into the competition, the “invincible” status of the team's base and its Virtual Shield will be disabled.



The HP of Virtual Shields cannot be restored, and the HP deduction suffered by a Virtual Shield from being attacked will be included in the damage HP of the other team.

5.2.4.2 Central Buff Point Mechanism

The location of the Central Buff Point is shown below (with a wooden battlefield as an example):



[1] Central Buff Point

Figure 5-18 Central Buff Point

Within the first minute of the match, Central Buff Point is not activated, and no robot can occupy the Zone.

One minute into the competition (when the countdown is at 3:59), the Central Buff Point becomes active. Any Hero or Standard Robot that occupies a Central Buff Point will gain 10 energy points for its team per second. Any Sentry Robot that occupies a Central Buff Point will gain additional 10 energy points for its team per second. Both teams can occupy Central Buff Point simultaneously, and the deactivation of Occupied Status is delayed by 2 seconds.

If a robot is attacked while occupying a Central Buff Point, the energy received by its team will be deducted: For every 17 mm projectile detected, 2 energy points will be deducted, and for every 42 mm projectile detected, 20 energy points will be deducted, until the team's energy is reduced to zero.

When a team occupying Central Buff Point has gained 100 energy points, the Zone becomes deactivated immediately. The occupying team gains 2 HP Bags, and both teams' occupation energy becomes zero. The deactivated status of Central Buff Point will last for 90 seconds. Central Buff Point becomes activated again after 90 seconds.

5.2.5 Mechanism Related to Sentry

The barrel heat of Sentry's two Launching Mechanisms shall be calculated separately. When the total number of projectiles launched by two Launching Mechanisms has reached 750, the Launching Mechanism will be powered off.

5.2.6 Level-Up Mechanism

5.2.6.1 Experience System

After the match starts, Standard and Hero are both at Level 1. They can upgrade themselves by gaining experience points.

During the competition, a robot can earn experience points through natural growth or by destroying other robots.

The mechanism is as follows:

- If a robot has destroyed an enemy robot, the latter's experience points will be distributed evenly among the surviving Hero and Standard Robots of the destroying robot's team.
- Upon the first robot defeat in the competition, an additional 50 experience points will be evenly distributed among the surviving Hero and Standard Robots of the destroying robot's team.



The average is rounded up and shall be accurate to one decimal place.

- In addition, a Standard gains 1 experience points every 6 seconds, and a Hero gains 1 experience point every 3 seconds. If a Standard or Hero have been destroyed, their original experience value will remain the same, but they will no longer gain any experience points through natural growth during the time they are destroyed. Any excess experience points after leveling up will be counted towards the next level.

Table 5-3 Levels and Experience Points for Standard, Hero, and Sentry Robots

Robot Type	Level	Experience Value	Experience Points Required for Leveling Up
Standard robot	1	25	30
	2	50	60
	3	75	-
Hero Robot	1	75	80
	2	100	120
	3	150	-
Sentry Robot	-	75	-

5.2.6.2 Performance System

After the start of a match, the operators of the Standard and Hero Robots may select the types of chassis and Launching Mechanism for the robots. If a Standard or Hero Robot is to be installed with a Mobile 17 mm Launching Mechanism, the type of Launching Mechanism will also need to be selected. A robot's chassis and Launching Mechanism, once selected, cannot be changed during a competition round.

Table 5-4 Types of Chassis and Launching Mechanisms

Robot Type	Chassis Type	Launching Mechanism Type
Standard robot	HP-focused	Burst-focused
	Power-focused	Cooling-focused
	Balancing chassis	Projectile speed-focused
Hero Robot	HP-focused	Burst-focused
	Power-focused	Projectile speed-focused

Table 5-2 Attributes of Standard Robot Chassis

Chassis Type	Level	Maximum HP	Maximum Chassis Power Consumption (W)
Initial Status	1	100	40
Power-focused	1	150	60
	2	200	80
	3	250	100
HP-focused	1	200	45
	2	300	50
	3	400	55
Balancing chassis	1	300	60
	2	400	80
	3	500	100



- A Balancing Standard Robot can only have a balancing chassis.
- A Balancing Standard Robot's barrel cooling rate per second is increased by 50%.

Table 5-3 Attributes of Hero Robot Chassis

Chassis Type	Level	Maximum HP	Maximum Chassis Power Consumption (W)
Initial Status	1	150	50
Power-focused	1	200	70
	2	250	90
	3	300	120
HP-focused	1	250	55
	2	350	60
	3	450	65

Table 5-4 Attributes of 17 mm Launching Mechanism

Launching Mechanism Type	Level	Barrel Heat Limit	Barrel Cooling Value per Second	Initial Launching Speed Limit (m/s)
Initial Status	1	50	10	15
Burst-focused	1	150	15	15
	2	280	25	15
	3	400	35	15
Cooling-focused	1	50	40	15
	2	100	60	18
	3	150	80	18
Projectile speed-focused	1	75	15	30
	2	150	25	30
	3	200	35	30

Table 5-5 Attributes of 42 mm Launching Mechanisms

Launching Mechanism Type	Level	Barrel Heat Limit	Barrel Cooling Value per Second	Initial Launching Speed Limit (m/s)
Initial Status	1	100	20	10
Burst-focused	1	200	40	10
	2	350	80	10
	3	500	120	10
Projectile speed-focused	1	100	20	16
	2	200	60	16
	3	300	100	16

5.2.7 Economic System

Both teams will receive gold coins regularly during the competition. Gold coins can only be exchanged for Projectile Allowance.

Each team has 200 coins at the start of the match. For every minute afterwards, 200 gold coins will be given to each team until the second minute (when countdown is at 2:59). In the third minute (when countdown is at 1:59) and fourth minute (when countdown is at 0:59) of the game, both sides can get 300 gold coins again.

Table 5-6 Rules for Exchange

Redemption item	Redemption ratio
17 mm projectile	50 coins/50 rounds
42 mm projectile	75 coins/5 rounds

When the game starts, every time the referee system detects a 17 mm or 42 mm projectile, the robot that fires it will lose a corresponding projectile. When the projectile of the robot is exhausted, the launching mechanism will be powered off.

Standard and Hero Robots can exchange 17 mm or 42 mm projectiles with gold coins at any time in the Supplier Zone. The operator reloads projectiles through the client interface using a keyboard and mouse. Projectiles can be reloaded on robots after the match has started. If projectile reloading is confirmed to take place and there are gold coins remaining, a team can select the number of projectiles on the exchange panel and complete the exchange by having its Standard Robot operator press the “O” key and Hero operator press the “I” key.



- Hero Robots can be pre-loaded with 17 mm or 42 mm projectiles, while Standard Robots can only be pre-loaded with 17 mm projectiles. Both robot types can have their 17 mm projectiles reloaded by the off-field reloading operator of the Supplier Zone during the competition. Sentry Robots can only be pre-loaded with 17 mm projectiles, and cannot reload projectiles during the competition.
 - When the available projectiles are exhausted, the launching mechanism will be powered off.
 - During the period when power to the Hero Robot's Launching Mechanism is disconnected, all the armor of enemy robots and their Base will shield against attacks from 42 mm projectiles.
-

5.2.8 Winning Criteria

Winning criteria for a Single Round as shown below:

1. When the Base of one team is destroyed, the round ends immediately and the surviving team wins.
2. When the entire seven minutes of a round elapses, if the Bases of both teams have survived, the team with the higher remaining Base HP is the winner.
3. If a round has ended, and the remaining Base HP of both teams are the same, the team with the higher remaining Sentry HP is the winner.
4. If a round has ended, and the remaining Base HP and Sentry HP of both teams are the same, the team that inflicted more damage to other team is the winner.
5. If neither team fulfills these criteria, the round is considered a draw. A draw in the Knockout Stage leads to an immediate tie-breaker round until a team wins.

5.2.9 Competition System

The 3V3 Match consists of the Group Stage and the Knockout Stage. The competition system of Group Stage is BO2; the system of Knockout Stage is all BO3.

5.2.9.1 Group Stage

Table 5-7 Group stage points

Competition System	Competition result	Points
BO2	2:0	The team winning two rounds gains 3 points, while the team losing two rounds gains 0 point
	1:1	Each team obtains 1 point
	1:0	(draw for one round): The team winning one round gains 1 point, and the team losing one round gains 0 point
	0:0	(Two rounds draw): Each team obtains 0 point

The ranking for the Group Stage is determined by the total points for each match. The following order are used to determine competition results in descending order of priority:

1. The team with the higher number of total points ranks higher.
2. If the total points of teams are the same, the team with the higher total Net Base HP ranks higher.
3. If the total Net Base HP of teams are the same, the team with the higher total Net Sentry HP from all rounds ranks higher.
4. If the total Net Sentry HP are the same, the team with the higher total Damage HP ranks higher.
5. If two or more teams still tie for the same place according to these criteria, the RMOC will arrange a playoff match on a round-robin basis.

5.2.9.2 Knockout Stage

A team wins the Knockout Stage if it has won the greatest number of rounds: The BO3 format requires two wins.

6. Standard Match

During a two-minute round, the robots from both teams engage in a shootout on the Battlefield. The team that destroys the other's robots shall be the winner.

During a Standard Match, a Standard Robot:



- Will maintain the same experience and robot level.
- Cannot be mounted with a Mobile 17 mm Launching Mechanism.
- May launch up to 200 rounds of 17 mm projectiles.

6.1 Competition Area

The core competition area of the 3V3 Match is called the “Battlefield”. The Battlefield is a 5 m x 5 m area that contains the Starting Zones of the blue and red teams.

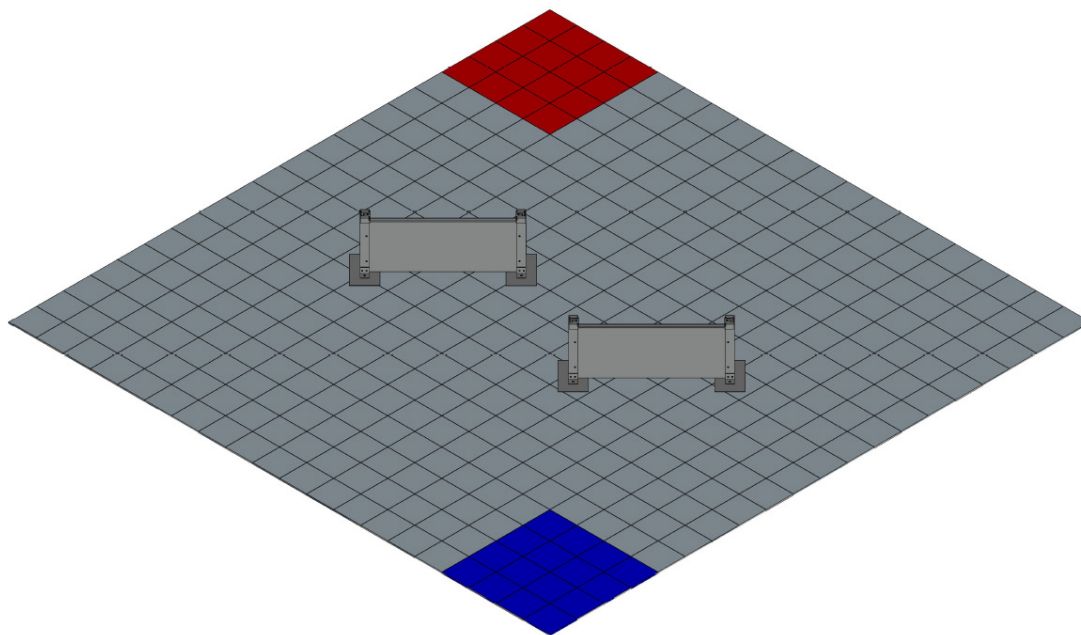
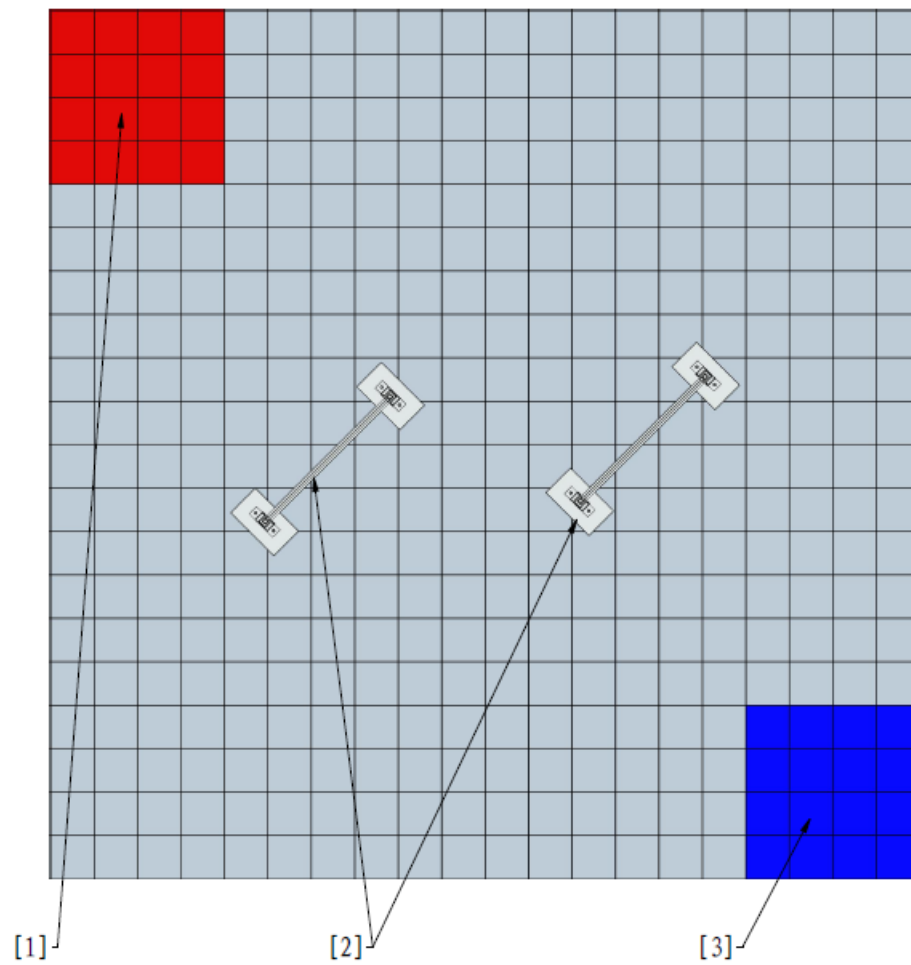


Figure 5-19 Axonometric View of the Standard Match Joint Battlefield



[1] Red Team's Starting Zone [2] Bunker [3] Blue Team's Starting Zone

Figure 5-20 Top View of the Standard Match Joint Battlefield

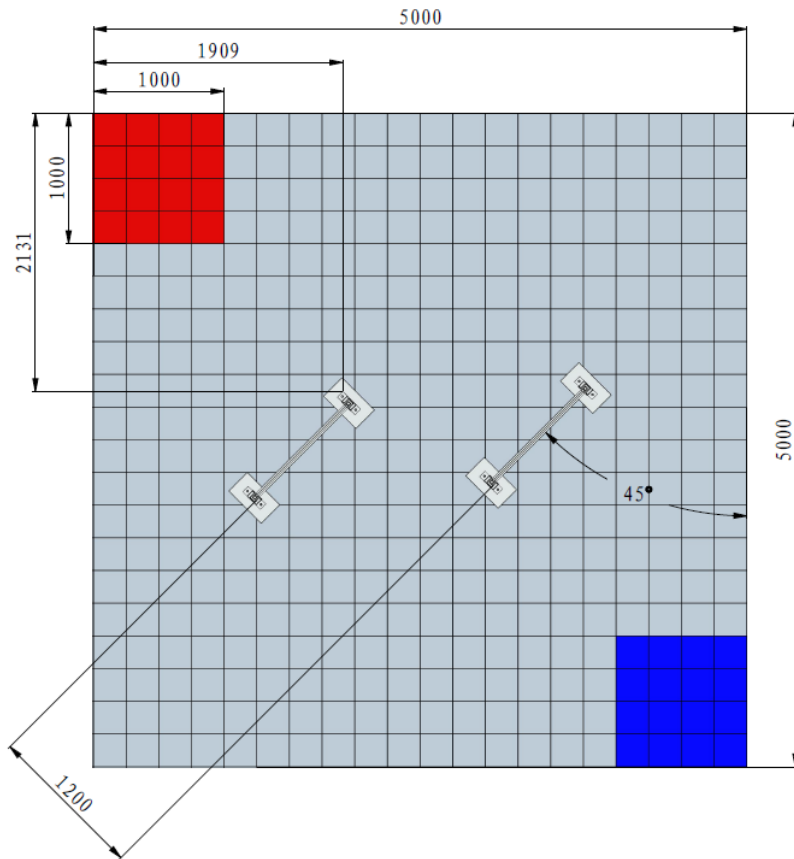


Figure 5-21 Dimensions of the Standard Match Joint Battlefield

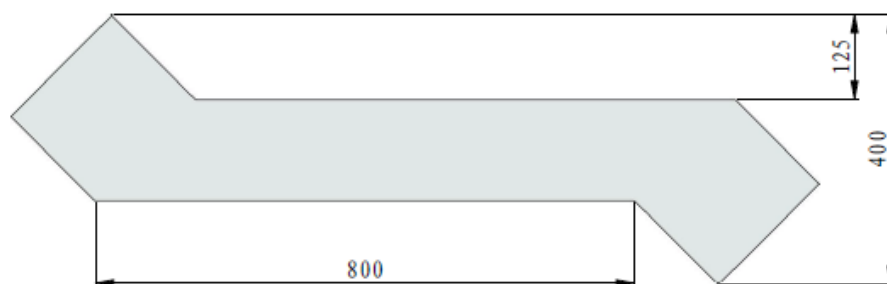


Figure 5-22 Bunker

6.2 Winning Criteria

1. Where a robot attacks the Armor Module of an enemy robot until the latter's HP drops to zero.
2. When the time of a round is exhausted, if neither team has a zero remaining HP, the team with higher remaining HP wins.
3. When the time of a round is exhausted, if neither team has a zero HP and their remaining HP are the same, the robot with less weight wins.
4. If neither team fulfills these criteria, the round is considered a draw. A draw in the Knockout Stage leads to an immediate tie-breaker round until a team wins.

6.3 Competition System

Standard Match consists of two parts: the Group Stage and the Knockout Stage. The competition system of Group Stage is BO2; the system of Knockout Stage is all BO3.

6.3.1 Group Stage

Table 5-8 Group stage points

Competition System	Competition result	Points
BO2	2:0	The team winning two rounds gains 3 points, while the team losing two rounds gains 0 point
	1:1	Each team obtains 1 point
	1:0	(draw for one round): The team winning one round gains 1 point, and the team losing one round gains 0 point
	0:0	(Two rounds draw): Each team obtains 0 point

Competition rankings for the Group Stage are determined by the sum of the points from each competition. Teams are ranked based on the following order from 1 to 3, in descending order of priority:

1. The team with the higher number of total points ranks higher.
2. If two teams have equal points, the winner of the two in the group match will be ranked higher.
3. If there are three teams with equal points or two teams with equal points are tied, the one with highest Net Sentry HP after all games will be ranked higher.

4. If two or more teams still tie for the same place according to these criteria, the RMOC will arrange a playoff match on a round-robin basis.

6.3.2 Knockout Stage

A team wins the Knockout Stage if it has won the greatest number of rounds: The BO3 format requires two wins.

7. Competition Process

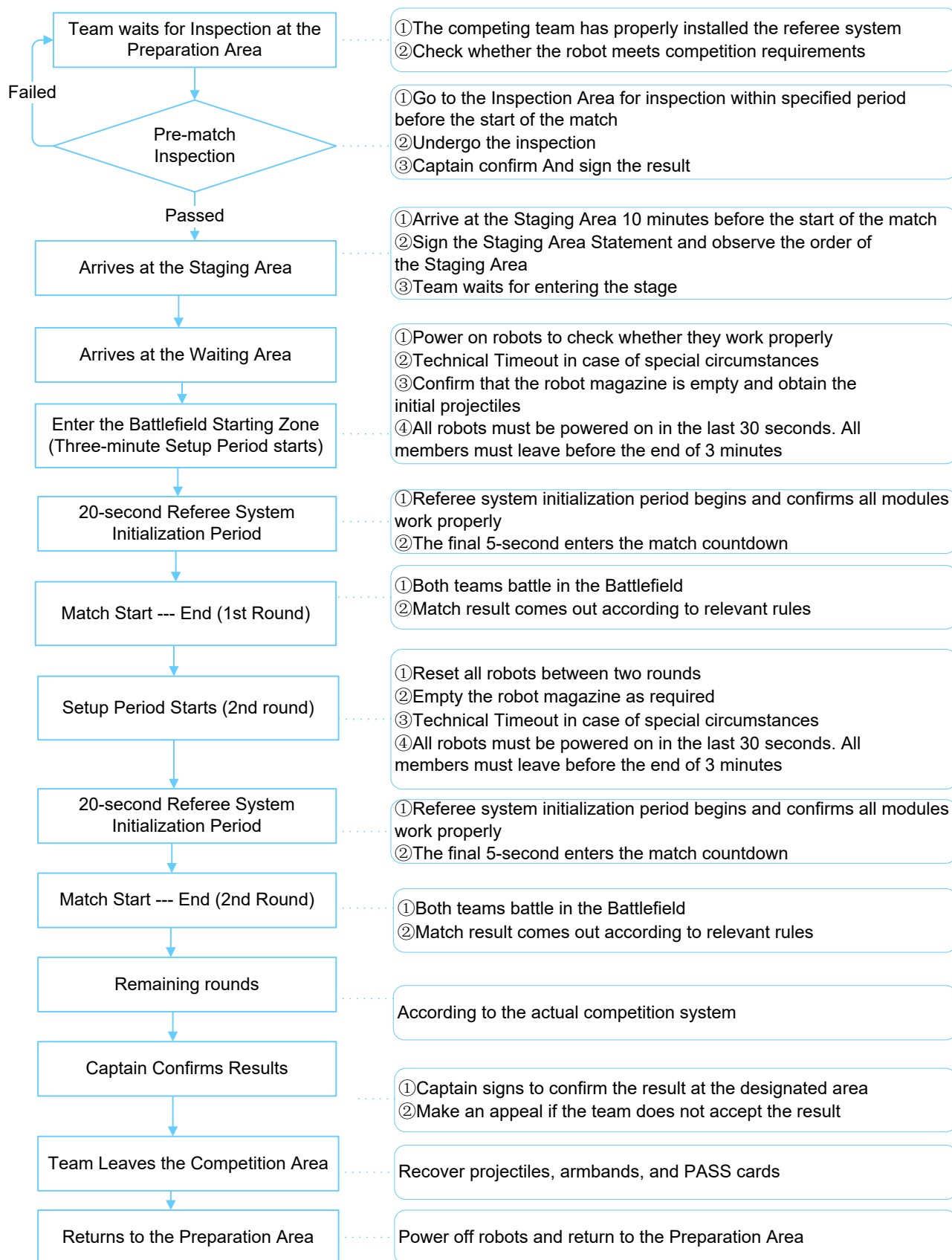


Figure 7-1 Process for a single match

7.1 Pre-Match Inspection



- The results of the Pre-match Inspection and Practice Match are for reference only and are not taken into account for the inspection in the actual competition.
- The inspection results during the competition are only valid for the current match.

In order to make sure that the robots manufactured by all teams conform to the manufacturing specifications, 3V3 and Standard Match teams must arrive at the Inspection Area 60 and 40 minutes in advance, respectively, for Pre-match Inspection. For the requirements of the Pre-Match Inspection, please refer to the “[RoboMaster 2023 University Series Robot-Building Specifications Manual](#)”. The inspection process is as follows:

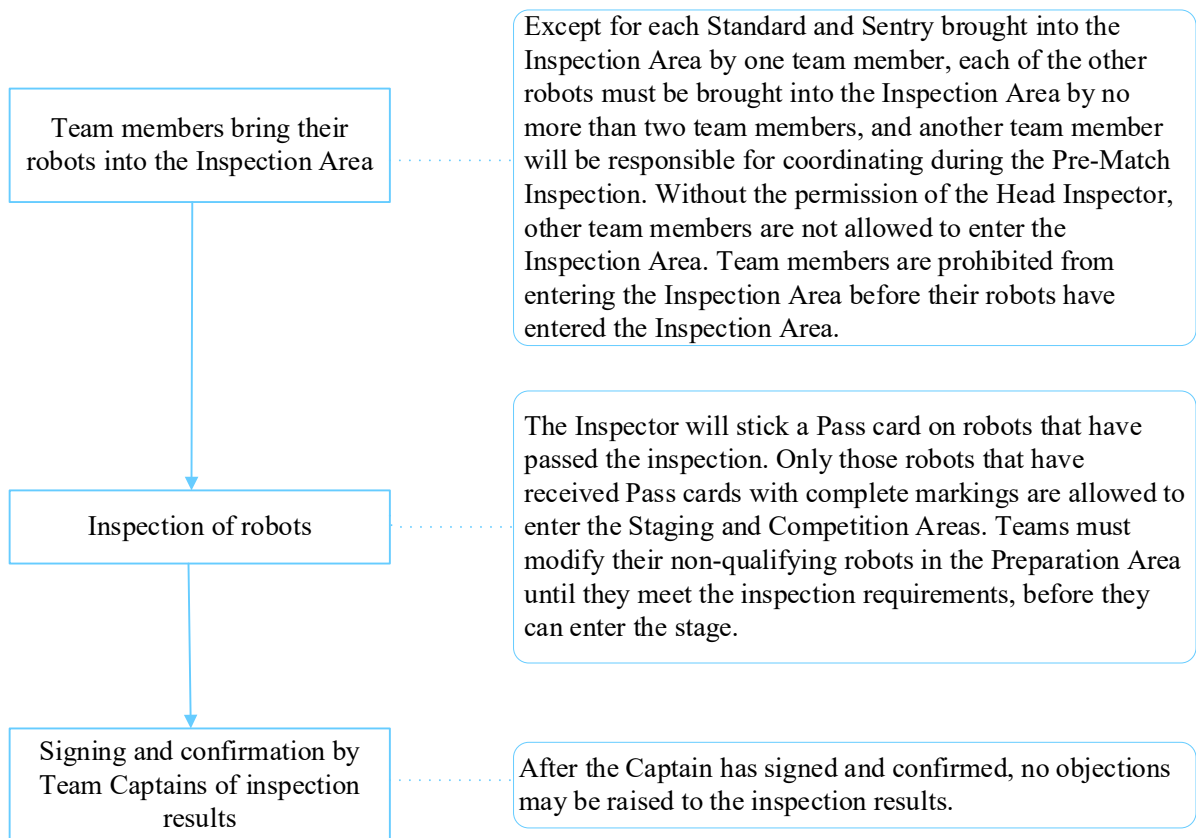


Figure 7-2 Pre-match Inspection Process

The rules regarding backup robots are as follows:

- During each round, each team can carry no more than one backup robot.
- Team members are required to declare the types of backup robots they are carrying during Pre-match Inspection. Backup Hero and Sentry must be attached with armor stickers in the Pre-match Inspection Area. If a backup Standard Robot is needed on the field, a Pit Crew Member must obtain the corresponding armor sticker

promptly from the referee. The attachment of armor stickers must follow the requirements stated in the [“RoboMaster 2023 University Series Robot-Building Specifications Manual”](#).

After passing the Pre-Match Inspection, backup robots cannot be replaced without permission. During Mock Inspection, the RMOC will issue Referee Systems to backup robots that have passed Mock Inspection. For all RMUL events, each team can borrow at most one backup robot’s Referee Systems.

7.2 Staging Area

After the pre-match inspection, the teams should arrive at the Staging Area at least 10 minutes before the start of each round. In a 3V3 Match, each team is allowed to have a maximum of seven Pit Crew, which must include one Supervisor and up to six Regular Members (including reloading operators). In a Standard Match, each team is allowed to have a maximum of three Pit Crew, which must include one Supervisors and up to two Regular Members. Other team members are not allowed to be present at the competition site on behalf of the Supervisor. One Pit Crew Member should wear the “Captain” armband and undertake the Captain’s role. The staff at the Staging Area will verify the Pass Cards of participating robots and details of Pit Crews, and issue armbands. If any team needs to repair its robots after entering the Staging Area, they must obtain the permission of the staff at the Staging Area. A robot may leave the Staging Area for repair only after the staff at the Staging Area have removed the Pass Card on the robot. When repair is finished, the robot needs to be brought back to the Inspection Area for another Pre-Match Inspection before re-entering the Staging Area, and the Team Captain must sign a new Staging Area Statement. If the team is unable to arrive at the Staging Area in time as a result of this delay, the robot will not be able to enter the match, and the team will bear the consequences.



Captain Armband: Any Regular Member that wears the 'Captain' armband performs the Captain role during the match. The Captain is responsible for managing and controlling the team’s participation in the competition process, confirming results, and requesting for Technical Timeouts, appeals, etc.

After leaving the Staging Area, the participating teams will enter the waiting area of the Competition Area to place their robots. When the previous match has ended and with the permission of the referee, the next pair of participating teams will wait at the entrance of the Battlefield with their robots for further instructions. After the referee has confirmed that both teams are ready, he or she will open the door and lead the team members into the Competition Area. The countdown for the Setup Period will begin when the doors are opened.

7.3 Setup Period

The Setup Period for a 3V3 Match is three minutes, and two minutes for a Standard Match. During the Setup Period, Pit Crew Members shall place their robots on their respective Starting Zones, check whether their Referee Systems are operating normally, and load their Standard Robots with initial projectiles. Pit Crew may repair robots or replace

equivalent parts, while Referees may initiate temporary inspection on these robots anytime.



Equivalent parts: Standard modules or components having the same material, form and functions, for example motors of the same model and self-built friction wheel modules.

One minute before the Setup Period ends, the Operator is advised to enter the Operator Room to complete debugging for the keyboard and mouse (which can be brought on your own), and double-check whether the robot controls and official equipment are operating properly. If any official equipment does not operate normally, the Pit Crew Members must raise the issue before entering the final 15 seconds of the Setup Period. Otherwise, no technical timeout will be allowed by the referee. Except for the Operators of the robots on the Battlefield, the Pit Crew are not allowed in the Operator Room.

Thirty seconds before the Setup Period ends, all robots on the Battlefield must be powered up, and the staff on the Battlefield should leave the Competition Area in an orderly manner. Before the five-second countdown begins, the Pit Crew must place the Commissioning Remote Controller for the Sentry Robot in the designated area at the Battlefield entrance.

7.3.1 Official Technical Timeout

During the Setup Period, if the Referee System, equipment inside the Operator Room or other modules related to the Referee System malfunctions (for details see the table below), the Head Referee can announce an Official Technical Timeout and pause the setup countdown. The starting time of the Timeout shall be decided by the Head Referee based on the situation.

During an Official Technical Timeout, team members can only work with the staff in eliminating the relevant faults of the Referee System or other official equipment, and are not allowed to repair other faults. When the relevant fault of the Referee System or official equipment has been eliminated and the Chief Referee has resumed the countdown, Pit Crew Members are required to follow the set procedures for the Setup Period and leave the Battlefield within the specified time.

Table 7-1 Failures

Rules	Description
1	A fault occurs with the official equipment in the operator room, and any key competition component in the Battlefield experiences structural damage or functional irregularity.
2	During the Setup Period of the first round, the modules of the robot client on the Referee System experience faults, such as: damage of the Armor Module, Speed Monitor Module going offline, etc.

3	During the Setup Period, the main controller of the Referee System is unable to connect to the server or a robot cannot transmit images to the Operator Room.
4	Other situations where the head referee deems it necessary to call an Official Technical Timeout.

If the malfunction referred to in Rule 2 occurs during a Setup Period between rounds or during a Round, it will be categorized as “regular battle damage”, as it cannot be determined whether the malfunction was caused by the Referee System module, a flaw in the robot’s electrical or structural designs, or the robot combat from previous matches. Regular battle damage will not trigger an Official Technical Timeout. Referees will provide backup Referee System modules. Teams may request for a “Team Technical Timeout” to repair their robots.

If the referee determines that the malfunction referred to in Rule 2 and 3 above is caused by the team, the referee will explain the situation and end the Official Technical Timeout.

7.3.2 Team Technical Timeout

If the mechanical structure of a robot, a software system, the keyboard or mouse in the Operator Room or other equipment experiences any faults, the Team Captain may make a request to the referee in the Battlefield or Operator Room for “Team Technical Timeout” before entering the final 15 seconds of the Setup Period, and indicate the requested timeout length and reasons for the request. Team Technical Timeout once requested and conveyed to the Head Referee, this Timeout cannot be cancelled or revised.

After the Team Technical Timeout is confirmed by the head referee, the head referee will notify both teams at the same time regardless of which team initiated the technical timeout. Pit Crew Members may enter the Battlefield to repair robots, while the members of both teams can only inspect, repair and commission their own robots in the initialization zones for the robots.

The Head Referee may end the Technical Timeout once they determine that the teams are ready. Even if the participating team does not enter the battlefield or ends the Technical Timeout early, the opportunity consumed is still the opportunity corresponding to the time declared by the participating team when applying.

To ensure that subsequent matches begin on time, only one Team Technical Timeout is allowed in each Setup Period on a first-come-first-served basis. The Technical Timeout usage is recorded in the Match Results Confirmation Form.

A team cannot request for more Team Technical Timeout opportunities once they have been used up. During each event, each team has two technical timeout opportunities.

7.4 Referee System Initialization Period

After the Setup Period, the match enters a 20-second Referee System Initialization Period. During the Initialization Period, the competition server will automatically detect the connection status of the client, the Referee System module status of the robot, the status of Battlefield Components and restore the HP of all robots, ensuring their HP are full when the match officially begins.

If the Head Referee initiates an Official Technical Timeout during the Referee System Initialization Period and requires the team to troubleshoot and fix a problem, such team will be allowed to send a maximum of two Pit Crew Members into the Battlefield to do so.

When the Referee System Initialization Period is left with 5 seconds, a clear countdown sound effect and live animation will be played. At this time, the client will not respond to control commands from robots (including Custom Controllers). Once the countdown finishes, the keyboard is unlocked and the competition starts.

7.5 Competition Round

During the matches, the robots from both teams in 3V3 and Standard Matches compete tactically on the core competition area (the Battlefield).

7.6 End of Competition

A round ends either when the full time has elapsed or one team has fulfilled the conditions for winning. When a round ends, the match immediately enters the Setup Period for the next round. The match is over when a winner has emerged or all rounds have ended.

7.7 Results Confirmation

During a match, the referee will record on the Match Results Confirmation Form the penalties issued for each round, the key competition data at the end of the match, the winning teams, the use of Technical Timeout opportunities by the teams, and other relevant details. After each match, the Captains are required to confirm the results.

Within 5 minutes after the end of a match, the Captains of both teams must sign and confirm the match results. If a team Captain does not sign and confirm the results within 5 minutes or has not requested an appeal, it is deemed that the team agrees with the match results. Once the team Captain has signed the Form, all rights to an appeal are forfeited.

8. Violations and Penalties

In order to ensure the fairness of the competition and maintain serious competition discipline, the participating teams and robots must strictly follow the competition rules. If there is a violation, the referee will give a corresponding penalty for the violation. Some penalties issued before the official start of the competition will be enforced after the official start of the competition. Serious violations and all appeals in the competition will be publicized.

The corresponding penalties for all violations of this chapter shall be determined by the referee on duty based on the actual situation of the competition. If there is a situation during the competition that affects the fairness of the competition but is not involved in the penalty rules or serious violations, the head referee will make a judgment based on the actual situation.

8.1 Penalty System

8.1.1 Forms of Penalties

During a match, the referee may issue penalties against participants and robots that have failed to comply with competition rules. The forms of penalties are as follows.

Table 8-1 Forms of penalties


Forms of Penalties	Descriptions
Automatic penalties by the Referee System	HP deductions as a result of a robot exceeding its parameter limits or a Referee System Module going offline. The HP deductions mentioned in “4.1 HP Deduction Mechanism”, except those caused by attacks, are all automatic penalties by the Referee System.
Manual penalties through the Referee System	Penalties issued by the referee through the server against participants and robots for violation of rules.
Manual Penalties	Used in situations where penalties cannot be issued through the Referee System, for example issuing a verbal warning or disqualifying a team.

8.1.2 Types of penalties

There are five types of penalties that can be issued during the competition, as shown below.

Table 8-2 Types of penalties

Types of penalties	Descriptions
Verbal Warning	Verbal alert
Yellow Card	<ul style="list-style-type: none"> ● One team receives a Yellow Card: <ul style="list-style-type: none"> ➤ The operation interface of the offending Operator will be blocked for 5 seconds, while the operation interfaces of other Operators in the offending team will be blocked for 2 seconds. ➤ If the offending robot is a Sentry, its chassis will be powered off for five seconds while the other surviving robots will have their HP deducted by 5% of their current Maximum HP. ➤ If the offending robot is not a Sentry, the Referee System will automatically deduct the offending robot's HP by 15% of its Maximum HP, while the remaining surviving robots (except for Sentries) will have their HP deducted by 5% of their Maximum HP. For each Yellow Card that is issued against the robot in the next 30 seconds, the deducted percentage will be twice that of the previous deduction for that robot, and 5% for the other surviving robots (except for Sentry Robots). <p>Example 1: An offending robot has a Maximum HP of 200 while the other robots in the team have a Maximum HP of 100.</p> <p>If the offending robot receives a Yellow Card at the 15th, 25th, and 58th second of the competition respectively, the HP deduction caused by each of the Yellow Cards shall be as follows: The offending robot's HP is deducted by 30, 60 and 30 respectively. The deducted HP for the other robots are 5, 5 and 5.</p> <p>Example 2: An offending robot has a Maximum HP of 200 while the other robots in the team have a Maximum HP of 100.</p> <p>If the offending robot receives a Yellow Card at the 15th, 25th, and 40th second of the competition respectively, the HP deduction caused by each of the Yellow Cards shall be as follows: The offending robot's HP is deducted by 30, 60 and 120 respectively. The deducted HP for the other robots are 5, 5 and 5.</p> ➤ In each round, a robot that has been issued a cumulative four Yellow Card Warnings will receive a Red Card Warning. <ul style="list-style-type: none"> ● Both teams receive a Yellow Card:

Types of penalties	Descriptions
	<p>The interface of all Operators is blocked for two seconds and the HP of all robots (except Sentries) is deducted by 5% of their Maximum HP, without taking into account the cumulative number of Yellow Card Warnings received.</p> <hr/> <div>  <ul style="list-style-type: none"> ● If multiple Yellow Cards are received successively, the blockage time for the operation interface will add up accordingly. ● If a robot's remaining HP is less than or equal to that needs to be deducted from penalty, this robot's HP reduces to 1. </div>
Red Card (Ejection)	<ul style="list-style-type: none"> ● Ejecting a robot <ul style="list-style-type: none"> ➤ If a robot is ejected before entering the Referee System Initialization Period, the offending robot will not be allowed to enter and must be removed from the Battlefield. ➤ If a Sentry is ejected during the competition, its Launching Mechanism will be powered off and the Referee System will cut off power supply to its chassis. ➤ If a robot is ejected during the competition, the robot's HP will turn zero and the transmitted images will become monochrome. ● Ejection of Pit Crew Members: Pit Crew members ejected by a referee must leave the Competition Area immediately and cannot be replaced by other Pit Crew Members for all rounds in the current match. All robots controlled by an ejected Operator shall also be ejected for the current round, and will not be allowed to join the Battlefield nor can they be replaced by other robots for all rounds in the current match.
Forfeiture	<ul style="list-style-type: none"> ● If a Forfeiture is issued for a round (hereinafter referred to as "Round Forfeiture"), the following rules shall apply. <ul style="list-style-type: none"> ➤ If a Forfeiture is issued before the start of the match (not including the Three-Minute Setup Period). The offending team's Base and Sentry's HP will become zero, and the HP of the team's other robots will be full. The opposing team's Base HP and robots' HP remain their maximum ➤ If a Forfeiture is issued during a match (including the Three-Minute Setup Period), the round will end immediately. The offending team's Base and Sentry's HP will become zero, and the team's other robots maintain their HP level at the end of the round. The HP of the opposing team's Base and robots will remain at the level when the round ended.

Types of penalties	Descriptions
	<ul style="list-style-type: none"> ➤ If a Forfeiture is issued after a match, the offending team's Base and Sentry's HP will become zero, and the team's other robots will maintain their HP level from the end of the round. The HP of the opposing team's Base and robots will remain at the level from when the round ended. ● If a Forfeiture is issued in a match (hereinafter referred to as "Match Forfeiture"), it applies to all rounds in the match, where the Pit Crew of the offending team must leave the Competition Area. The HP for each round shall be calculated according to the above descriptions.
Disqualification	<ul style="list-style-type: none"> ● The team member is disqualified from the current competition season. ● The team is disqualified from the current competition season, but its results so far in this season will be maintained as a reference for other teams.

8.2 Penalty Details

This chapter sets out the penalty rules and defines the relevant measures to be taken by the referee after a violation has occurred. The R# rules clearly indicate the rules that participating teams, participants and robots must follow.

8.2.1 Staff

8.2.1.1 General Rules

R1 The requirements stated in [“RoboMaster 2023 University League Participant Manual”](#) must be met.

Penalties: The highest penalty that can be imposed on the offending team is disqualification.

R2 Teams must not set up their own wireless networks or communicate with team members using walkie-talkies in the relevant competition areas (including but not limited the Preparation Area, Inspection Area, Staging Area and Competition Area).

Penalties: The highest penalty that can be imposed on the offending team is disqualification.

R3 Teams must not damage any official equipment (including but not limited to equipment in the Competition Area, Staging Area, Preparation Area and Inspection Area).

Penalties: Verbal Warning, and the offending team is required to pay compensation as per the price. The team may be issued a maximum penalty of disqualification, as judged based on the team's subjective intention and the impact of its violation on the competition process.

- R4 Except projectiles preset in the Inspection Area, teams must not bring their own projectiles into the Inspection Area, Staging Area or Competition Area, and also must not take official projectiles away from the Competition Area.

Penalties: The staff will confiscate the projectiles and issue a verbal warning. If the warning does not work, the most serious penalty that can be imposed on the offender is disqualification from the competition.

- R5 Apart from Pit Crew Members who have entered the Staging Area and Competition Area due to match-related reasons, no participants are allowed inside either area without special reasons.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offending team member shall be disqualified.

- R6 Any participant who has entered the Staging Area and Competition Area may not leave either area without permission.

Penalties: Offender are not allowed to enter the Staging Area and Competition Area. The most serious penalty that can be imposed is disqualification from the competition.

- R7 After the end of a match, participants must clear the projectiles loaded in the robots at the Projectile Unloading Area.

Penalties: The offending robot will be detained in the Projectile Unloading Area, until its projectiles are cleared.

- R8 Except for emergency situations, teams must be present at the Inspection Area before the start of each match for Pre-match Inspection. The team must stand by at the Staging Area 10 minutes before each match.

Penalties: Match Forfeiture

- R9 Team members must not turn on the power and commission or repair their robots in the Staging Area.

Penalties: Verbal Warning. If violations persist despite the warning, the team will be issued a Forfeiture for the match.

- R10 The identities and number of personnel of each team entering designated areas such as the Preparation, Inspection, Staging, and Competition Areas must meet the relevant requirements.

Penalties: Verbal Warning. If violations persist despite the warning, the team will be issued a Forfeiture for the match.

- R11 Pit Crews must wear armbands which must not be covered. One member must wear the “Captain” armband.

Penalties: Verbal Warning.

- R12 Pit Crew Members entering the Competition Area must not communicate with anyone from the outside.

Penalties: Verbal Warning. If violations persist despite the warning, the team will be issued a Forfeiture for the match.

R13 Pit Crew Members are not allowed to power their equipment using the power supply for official equipment in the Competition Area. However, they may bring their own power supply.

Penalties: Verbal warning will be given; and if it does not work, the offender will be issued a Red Card. The highest penalty that can be imposed on the offending team is disqualification.

8.2.1.2 Battlefield Specifications

R14 Participants must wear protective goggles when inside the Battlefield.

Penalties: The offender will be prevented from accessing the area.

R15 During an Official Technical Timeout, Pit Crew Members are not allowed to fix faults other than those in modules related to the Referee System.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender shall be issued a Red Card.

R16 After the end of the Setup Period, Pit Crew Members must return to the designated area outside the Battlefield. During the competition, Pit Crew Members are not allowed to leave the area without the permission of the referee.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender shall be issued a Red Card.

R17 After the end of the Setup Period, the Pit Crew must place the Commissioning Remote Controller for the Sentry Robot at the entrance of the Battlefield. The Remote Controller cannot be used to commission the Sentry Robot once the five-second countdown has started.

Penalties: Verbal Warning. If the verbal warning is ineffective, the team shall be issued a Round Forfeiture.

R18 During the Setup Period, Pit Crew Members must ensure their robots are operating safely and will not cause harm to any person or equipment in the Competition Area.

Penalties: The offending team must bear the relevant responsibility.

R19 During the competition, a reloading operator is not allowed to touch a robot except when refilling projectiles using the official Projectile Reloader.

Penalties: Verbal Warning. If the warning is ineffective, the offender shall be issued a Red Card.

8.2.1.3 Operator Room Requirements

R20 Besides the operator, no other Pit Crew Members are allowed inside the Operator Room.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender shall be issued a Red Card.

R21 Operators must remain in the relevant Operator's Room during the Referee System Initialization Period and the Match, to operate the relevant computers, and must remain in position after a match has started, unless otherwise permitted by the referee.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender shall be issued a Red Card.

R22 During the competition, each operator is equipped with at most one remote controller.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender shall be issued a Red Card.

R23 Operators are not allowed to use their own headphones or computers in the Operator Room.

Penalties: Verbal Warning. If the verbal warning is ineffective, the team shall be issued a Round Forfeiture.

8.2.2 Robots

R24 Robots and Custom Controllers to be deployed in a match must pass a Pre-Match Inspection.


Penalties: Forfeiture of Round

R25 In the first round of a match, the robots must meet the minimum battle team size.

Penalties: Match Forfeiture

R26 Robots must meet the requirements in the [“RoboMaster University Series 2023 Robot Building Specifications Manual”](#).

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender may be imposed a maximum penalty of disqualification from the competition.

-
- The RMOC will conduct random checks on robots.
 -  ● Any report made against a robot for not complying with the robot building specifications manual must be supported by the relevant evidence.
-

R27 Robots must be attached with armor stickers that meet the inspection specifications.

Penalties: If the violation happens before the start of a match, the offending robot will be barred from the match. If the violation happens during a match, the highest penalty that can be imposed on the offending team is a Red Card, based on the seriousness of the situation.

R28 When waiting in the Staging Area, team members are not allowed to bring robots out of the Staging Area without permission.

Penalties: Verbal Warning. If the warning is ineffective, the offenders and robots will be issued a red card, with the most serious penalty being disqualification from the competition.

R29 Robots must not carry or present safety issues including but not limited to short circuits, crashing, creating fumes or lighting flames, and falling to the ground. If a safety issue is present or has arisen, team members must execute the relevant operations in accordance with the referee's instructions.

Penalties: If it happens before the start of a match, the Pit Crew need to resolve the safety issue as required by the referee, otherwise the offending robot will not be allowed to appear on the Battlefield. If it is during the competition, a Verbal Warning shall be issued. If the Verbal Warning is ineffective, a Red Card shall be issued against the offending team member or robot. Any incident involving serious safety hazards shall be handled by the Head Referee in accordance with "9 Irregularities".

R30 Robots are not allowed to fire projectiles out of the Battlefield.

Penalties: Verbal Warning. If the Warning is ineffective, the offending robot shall be issued a Red Card.

R31 During the Setup Period and the Referee System Initialization Period, robots in the Battlefield are not allowed to leave their corresponding initialization zones.

Penalties: If it is during the Setup Period, a Verbal Warning shall be given. If the Verbal Warning is ineffective, the highest penalty that can be imposed on the offending team is a Red Card. If it is during the Referee System Initialization Period, the Chief Referee shall issue a Yellow Card or Red Card against the offending team, judged based on the offending team's subjective intention and the impact of its violation on the competition.

R32 During the Setup Period, all projectile must be launched into the projectile clearance bag.

Penalties: Verbal Warning. If the Verbal Warning does not work, the offending team member and robot shall be issued a Red Card.

R33 During the competition, the robot is not allowed to disintegrate into sub-robots or sub-systems connected by multiple flexible cables, and must not cast or launch their own parts.

Penalties: The offending robot will be issued a Red Card.

R34 During the competition, robots are not allowed to block any Armor Module with its body or transform beyond its maximum expansion size.

Penalties: Warnings shall be issued against the offending team as judged based on their subjective intention. If the blocking was intentional, a Yellow Card will be issued along with a Verbal Warning. If the Verbal Warning is ineffective, a Red Card shall be issued. If the blocking was passive in nature, the offender will be issued a Yellow Card.

R35 During the Setup Period, the replacement modules and parts used on robots must meet the requirements for "equivalent parts" as stated in "7.3 Setup Period".

Penalties: Verbal Warning. If Verbal Warning is ineffective, the offending robot shall be issued a Red Card.

R36 During 3V3 Match, each team can have no more than one robot mounted with a motorized 17 mm Launching Mechanism.

Penalties: During the Setup Period, if any team in the Battlefield has multiple robots mounted with mobile 17 mm Launching Mechanisms, the Pit Crew Members must remove the excess robots from the Battlefield as required by the rules. If the Initialization Period has commenced, the Referee System shall automatically retain the robot with the smallest serial number while issuing a Red Card against all the remaining offending robots.

For example: if a team's Hero and Standard Robots are found to be installed with a Mobile 17 mm Launching Mechanism during the Initialization Period, the Referee System's server will automatically eject the Standard Robot.

R37 Standard Robots to be fitted with a balancing chassis must meet the definition of a Balancing Standard Robot when it is living. This does not apply to Standard Robot under Non-surviving Status.



In the Supplier Zone, a Balancing Standard Robot is not required to meet the definition of a Balancing Standard Robot.

Penalties: Warnings shall be issued against the offending robot based on the length of the violation. If it exceeds 3 seconds, a first Yellow Card is issued. Thereafter, each 10 seconds will incur a further Yellow Card. This carries on until the robot is depleted.

R38 During the competition, the vertical projection of the vertical axis of a Balancing Standard Robot's Launching Mechanism must intersect with the vertical projection of its Armor Module, except only when the robot is in a rotating or reciprocating rotating motion at a uniform speed. However, when in reciprocating rotation, the vertical projection of the central axis of the robot's reciprocating motion must overlap with that of its X-axis. The robot will still be considered as moving at uniform speed despite any temporary speed variation caused by acceleration or deceleration of the motor when the robot changes the direction during its reciprocating motion.

Penalties: For a violation, the offending robot will be issued a Yellow Card and a Verbal Warning; if the Verbal Warning is ineffective, a Yellow Card will be issued every three seconds until the robot is in "non-surviving" status.

8.2.3 Interactions

8.2.3.1 Interaction between Robots

R39 A robot may not use any of its body structures to strike an enemy robot in collision. If a defeated robot is obstructing a key path, the robot can be slowly pushed away.



In any collision between robots, the offending robot will be deemed by the referee as the initiator.

Penalties: Warnings shall be issued against the offending robot judged based on their subjective intention and the degree of collision.

Table 8-3 Collision violation penalty standard

Violation level	Descriptions
Yellow Card	Actively causing high-speed front collision, active pushing causing the other team's robot to move, or impeding the normal movement of the other team's robot.
Red Card	Actively, maliciously and repeatedly causing high-speed front collision, active and prolonged pushing causing the other team's robot to move over a fairly long distance, seriously impeding the normal movement of the other team's robot, or securing a major advantage unfairly by means of aggressive collision.

R40 A robot must not get stuck together with any other robot due to active interference, blocking or collision.

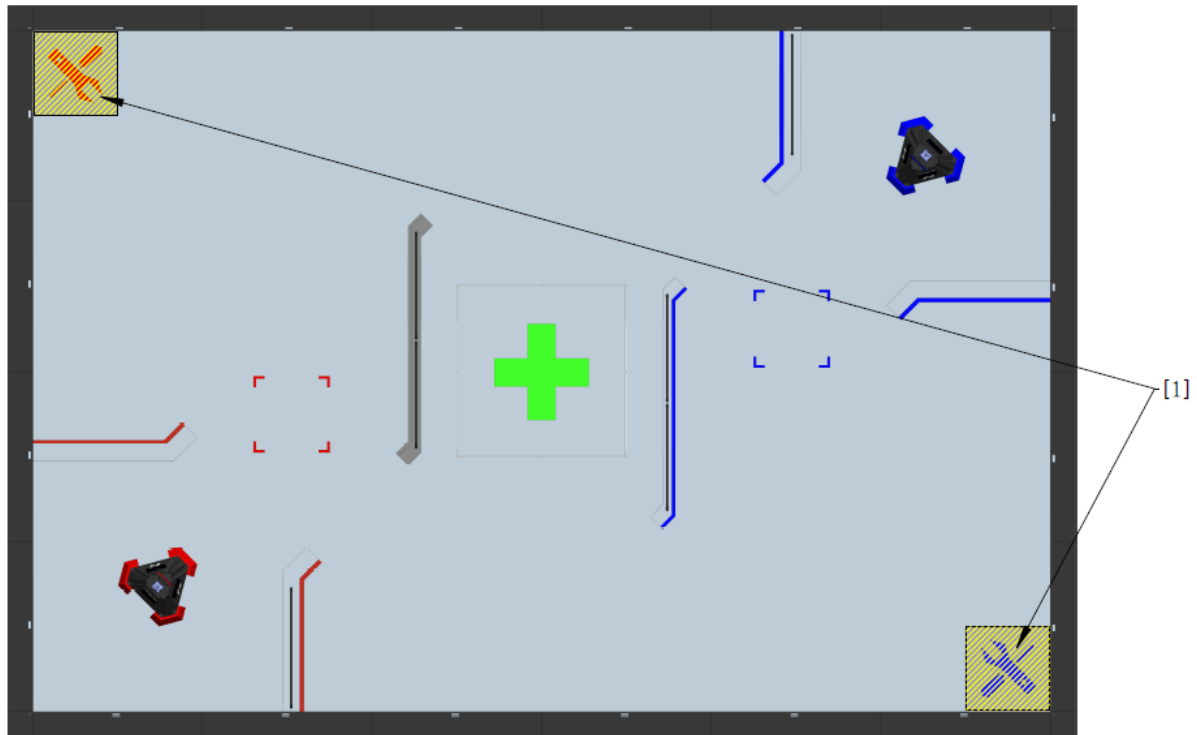
Penalties: Counting from when an entanglement is determined, warnings shall be issued against the offending robot based on the length of the violation. If it exceeds 10 seconds, a first Yellow Card will be issued. Thereafter, each 20 seconds will incur a further Yellow Card. This shall carry on until the robot is ejected. Regardless of whether the offending robot is alive, if the violation goes on for longer than 90 seconds, the offending team will be issued a Round Forfeiture.

R41 A robot uses any means other than firing projectiles to interfere with an enemy robot's projectile reload, HP recovery, or revival in any area.

Penalties: The offending robot will be issued a Yellow Card.

8.2.3.2 Interaction between Robots and Battlefield Components

To ensure the fairness of the competition and that robots in the Battlefield are able to receive buffs and reloads effectively, Supplier Penalty Zones have been set up in the Battlefield which the robots of one or both teams are forbidden from entering, as shown below (with a wooden battlefield as an example). The Supplier Zone of one team is the Supplier Penalty Zone for the other.



[1] Supplier Penalty Zone

Figure 8-1 Base Penalty Zone

R42 The robots of one team are forbidden from entering the Supplier Penalty Zone, and must not cause any interference with or hindrance to the entry of the other team's robots into the Supplier Penalty Zone.

Penalties: Warnings shall be issued against the offending team based on how long the robot remained in the Penalty Zone and the impact of the violation. If it exceeds 3 seconds, a first Yellow Card is issued. Thereafter, each 10 seconds will incur a further Yellow Card. This carries on until the robot is depleted. An offending robot that causes serious damage to an enemy robot by remaining in a Penalty Zone will be issued a Red Card.

R43 Participating robots are only allowed to use projectiles provided officially by the RMOC.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the highest penalty that can be imposed on the offending team is disqualification, based on the seriousness of the situation.

8.3 Serious Violations

The following actions are considered serious violations of rules. The highest penalty a referee may impose on an offending team for serious violations is disqualification.

Table 8-4 Categories of Serious Violations

Rules	Type
1	The participants are not members of the team, or the participating robots do not belong to the team.
2	Replacing backup robots without permission, or exceeding the maximum quantity limit for backup robots
3	Violating rules mentioned in this chapter and refusing to accept penalties, for example a Pit Crew Member interfering with the regular work process of a referee.
4	Tampering with or damaging the Referee System, or interfering with any detecting function of the Referee System through technical means.
5	Installing explosives or other prohibited materials on robots
6	A situation has occurred in the Competition Area that violates Pre-Match Inspection requirements
7	Deliberate damage of the opponent's robots, Battlefield Components and related equipment
8	Causing delays deliberately or refusing to immediately leave the Competition Area after a match has ended, thereby disrupting the schedule of the competition
9	A team member using robots to collide into or attack other people deliberately, putting themselves and other people at risk of injury
10	Serious verbal or physical conflicts between team members and the staff of the RMOC, other participating teams, audience, etc.
11	A team member's refusal to cooperate, deliberate delay or provision of false materials and information during the Arbitration Commission's handling of an appeal request.
12	In respect of any violation of local laws and regulations occurring inside the Competition Area, Audience Area, dormitories or other relevant competition zones during the competition, the RMOC, apart from issuing the most severe penalty of "disqualification", will fully cooperate with the relevant authorities to pursue appropriate legal actions against the offenders.
13	Any other violation that seriously affects the progress of the matches, goes against the spirit of fair competition, or is deemed as serious in nature by the Chief Referee.

9. Irregularities



There will be a certain delay in the referee's manual penalties and handling of abnormal situations. If it has a major impact on the result of the competition, the Chief Referee will determine the final processing result according to the actual situation.

If any of the following anomalies occur during the competition, it shall be handled according to the corresponding process, to which both teams cannot object. The handling process is as follows:

- When a serious safety hazard or irregularity has occurred on the Battlefield, such as a battery explosion, Aerial breaking an Aerial Safety Rope, stadium power outage, explosion of a compressed gas cylinder, or interpersonal conflict, the Head Referee will notify both teams' operators after discovering and confirming the emergency, and eject all robots through the Referee System. The result of the round will be invalidated. The round will restart after the safety hazard or exception has been eliminated.
- If non-key Battlefield Components are damaged during a match (damage to the ground rubber surface, ground lighting, or Base lighting), which do not affect the fairness of the match, the match will proceed as usual.
- If key Battlefield Components experience logical or structural faults, for example where the network connections are disrupted causing a robot to go offline or a Battlefield Component does not operate normally, the referee will solve the problem manually through the Referee System. If the failure cannot be dealt with manually, the referee will notify the operators of both sides and eject all robots at the same time, the competition will end immediately, and the result of the competition will be invalid. When problems are solved, there will be a replay.
- During a match, if there is structural damage or malfunction of key battlefield components that affects the fairness of the match and the Head Referee did not confirm and end the game in time, leading to the situation that a game that should have ended continues to proceed and has victory, After the competition, after appeal or upon verification by the Chief Referee, the result of the competition is invalid and a rematch will be required.
- In the case of a serious violation that would clearly have triggered a penalty of forfeiture, and the Chief Referee did not confirm and execute it in time, the results of the round will be invalidated after an appeal has been made or the Chief Referee has made a determination to that effect after the end of the round, and the offending team will be issued a forfeiture.

10. Appeal

Each team has one opportunity to appeal in each event of each division during the RMUL 2023. Such opportunities cannot be accumulated. If an appeal is successful, a team can appeal again in future matches; otherwise the team will no longer be allowed to appeal during the competition. When a team has exhausted its opportunity to appeal, the Arbitration Commission will no longer accept any appeal from the team. The Arbitration Commission reserves the final right of interpretation with regard to its appeal decisions.

- Any grounds for appeal cited by a team involving the following situations may be rejected outright by the Arbitration Commission:
 - A robot's collision with the battlefield during the competition has caused the battlefield or components to shift, thus increasing the margin of error.
 - Verbal Warnings and Yellow and Red Cards issued as penalties for violations.
 - The types and processes of Technical Timeouts initiated.
 - No appeal is allowed five minutes after a Match Results Confirmation Form has been signed or a match has ended.
-



10.1 Appeal Process

Teams that filing an appeal need to follow procedures as shown below:

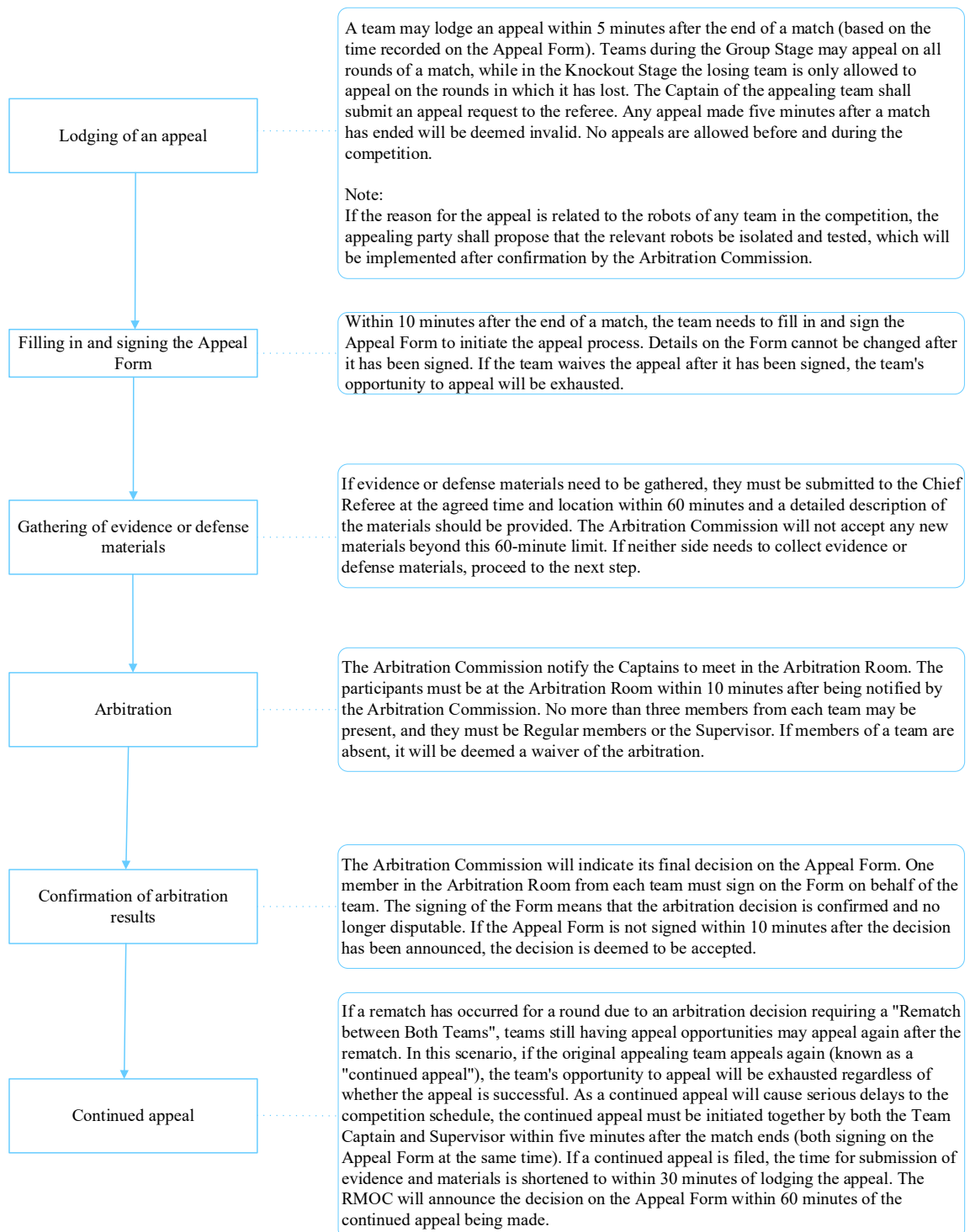


Figure 10-1 Appeal Process

10.2 Appeal Materials

Appeal materials submitted by teams must follow the below specifications:

- Material type: Only materials stored on a USB flash drive and the robots themselves will be accepted as appeal materials. Materials submitted in other forms will not be accepted by the Arbitration Commission.
- USB flash drives: The edited video (the video materials should be prepared by the team itself) and the text files for the appeal should be placed according to the directory.
- Material format: No video may exceed one minute in length or 100MB in size. The name of the video must indicate the specific match, the round of the match and the time it was taken (rounded to minutes). The videos should be compatible with the latest version of Windows Media Player; the photos must be in JPG format; and the text documents must be in PDF format and not exceed 1,000 words in length.
- Material naming: The file name of each video and photo must be within 30 Chinese characters.
- Text requirements: One text file can only correspond to one video or a photo, which must be indicated in the text. Text files only need to explain the violations reflected in the corresponding materials.
- Robot evidence: The Arbitration Commission has the authority to isolate any relevant robot from both teams after an appeal has been made. These robots will be returned to the teams at the latest when the arbitration decision is announced.

10.3 Appeal Decision

Arbitration results include: maintaining the original match results, a forfeiture issued against the respondent, and rematch between both teams. Teams may not appeal against the decision made by the Arbitration Commission.



- Appeal successful: forfeiture issued against the respondent or rematch between both teams
 - Appeal failed: maintain the original match results
-

If the Arbitration Commission requests both teams to have a rematch, they will inform both teams of the time of this rematch. If both teams refuse to hold a rematch, the appeal is deemed failed and the original match results are maintained. A team that refuses a rematch is considered to have forfeited the match and will be issued a Match Forfeiture.



Provided it does not affect the schedule of the entire competition, the rematch will in principle be held on the same day after all the other matches.



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