

V1.2

Using a 32-bit motor driver chip and
Field-Oriented Control (FOC), the
RoboMaster C60 Brushless DC Motor Speed
Controller enables precise control over motor
torque.



Exclusively designed for the RoboMaster
M600 7-in-1 Brushless DC Motor and
C60 Brushless DC Motor Speed Controller,
the M600 Accessories Kit includes several
pins and a terminal block.

RoboMaster Specification Manual,
RoboMaster User Manual, Introduction
of RoboMaster Module

The M600 Accessories Kit includes several
pins and a terminal block, enabling a
complete pin-to-pin connection for the
RoboMaster module.

ROBOMASTER 2023 UNIVERSITY CHAMPIONSHIP

RULES MANUAL

Prepared by the RoboMaster Organizing Committee

Updated on April 2023

Intellectual Property Statement

The RoboMaster Organizing Committee (RMOC) encourages and promotes technical innovation and open-source technology, and respects the intellectual property rights of participating teams. All rights related to the intellectual property developed during the competition are owned by individual teams. The RMOC will not participate in the handling of intellectual property disputes within the team. The participating teams must properly handle all aspects of intellectual property rights among internal school members, company members and other members of the team.





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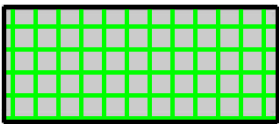

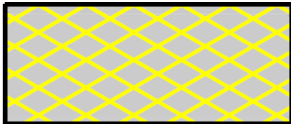


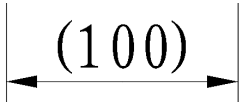
For suggestions on open-source materials, please refer to: <https://bbs.robomaster.com/thread-7026-1-1.html>.

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
April 20, 2023	V1.2	<ol style="list-style-type: none"> Added restrictions for inter-robot communication between the Radar and Sentry. Modified the weight of the 42mm Luminous Projectile. Modified the Power Rune-related mechanism. Removed the emergency stop button for the Engineer Robot Operator. Removed the location restriction on remote HP and projectile exchange. Modified the deduction mechanism for Aerial Robots for exceeding the Initial Launching Speed Limit. Modified the Radar-related mechanism. Added commissioning rules for Pit Crews outside the robot initialization areas. Modified the relevant descriptions of robot ejection. Modified the relevant penalty rules for Sentry Robots. Added penalties for 42mm projectiles hitting the Power Rune.
January 13, 2023	V1.1	<ol style="list-style-type: none"> Added descriptions of the dropping of minerals at the Resource Island. Added descriptions of how projectiles are to be used in each Division. Adjusted HP Deduction Mechanism for Critical Referee System Modules Going Offline. Added descriptions of how a team's Project Document and Technical Proposal in the Final Robot Assessment impact its initial Gold Coin quantity in a Regional Competition. Adjusted the process flow for the exchange of minerals and added descriptions of the functions of an Exchange Station. Increased the upper limit for extra chassis power in HP recovery and the respawn mechanism. Added descriptions of the Radar-related mechanism. Modified relevant descriptions of Yellow Card and Red Card warnings. Adjusted the identity requirements for a Tactical Coach and the relevant penalties. Adjusted relevant standards and penalties for the Operator Room. Modified relevant penalties for projectile usage. Adjusted relevant penalties for the exchange of minerals. Fixed known issues and improved some descriptions.
October 26, 2022	V1.0	First Release

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1. Foreword

1.1 About the Competition

The RoboMaster 2023 University Championship (“RMUC 2023”) will take place mainly in a shooting battle format between robots. Participating teams are required to design, develop and create multiple robots in compliance with specifications to form a robotic team. During a seven-minute round, each of both teams strives to destroy the other’s base through tactical combat to win the match.

1.2 About the Specifications Manuals

The Specifications Manuals include the Rules Manual, Participant Manual, Robot Building Specifications Manual, etc. The Specifications Manuals and their additions are applicable to all participating teams, referees, competition staff, and other partners.

The RMOC reserves the right to update the Specifications Manuals outside of the competition period as necessary.

During the competition, the RMOC may modify the competition specifications in the following phases, but such changes will not affect robot structures.

- Regional Competitions: modifications may be made after the competition for a single division has ended;
- Final Tournament: modifications may be made after the end of each competition phase (for example, Group Stage or top-16 matches).

The Chief Referee holds the final authority to interpret competition rules during the event. Any questions related to the specifications may only be directed to the Chief Referee for consultation.



- On how to use the operating interface, please refer to the “[RoboMaster University Championship Player’s Client Interface Instructions](#)”.
 - More reference materials can also be found in the appendices to this Manual.
-

1.3 Q&A

Any participating team or other relevant personnel who have questions about the Specifications Manuals may submit them through our official channel. The RMOC will reply to them periodically through the following Q&A process. The Q&A process is as follows:

1. To submit questions about the specifications manuals, the inquirer should complete a questionnaire available at this link:

<https://djistore.wjx.cn/vj/wPiwIJ0.aspx>

2. On each Monday (before 12:00 pm, Beijing Time), the RMOC will gather all qualifying questions from the previous Monday to Sunday and provide responses to them on the following Friday (before 8:00 pm, Beijing Time) in the RoboMaster 2023 University Series Rules and Technical Q&A Document:

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

The Rules Q&A is considered an authoritative source with the same effect as the Specifications Manuals. In the case of any discrepancy between the Q&A and Specifications Manuals, the one that most recently will take precedence.

2. Key Terms

In this chapter, we will provide an overview of commonly used terms in the competition rules. For details on each term, please refer to relevant chapter using associated keywords.

Table 2-1 Overview of Key Terms

Term	Definition
Robots	
Standard Robot	Includes Regular Standard and Balancing Standard Robots. For a detailed definition of the Balancing Standard Robot, please refer to the “Standard Robots” chapter of the “RoboMaster University Series 2023 Robot Building Specifications Manual” .
Ground Robot	Includes Heroes, Engineers, Standards, and Sentries.
Referee System	The Referee System is an electronic penalty system used for robotic competitions. It integrates computation, communication, and control features and includes the Robot Side, which is installed on the competing robot; the server, which manages the competition and collects data from the Robot Side; and the player’s client, which is installed on the PC, allows players to view robot information such as robot power, projectile launches and damage, and conducts automatic ruling based on competition rules.
Inter-Robot Communication	An interactive method for robots to communicate with one another through the Referee System serial port.
Robot Chassis	A mechanism that carries the robot’s powertrain system and its accessories; a mechanism that supports the body of a robot.
Chassis Power	The power that supports the powertrain system enabling a robot to move horizontally. For details, please refer to the definition of “Chassis Power” in the “Referee System Mounting Specifications” chapter of the “RoboMaster University Series 2023 Robot Building Specifications Manual” .
Built-in Launching Mechanism	A Launching Mechanism readily attached to a robot.
Optional Launching Mechanism	A Launching Mechanism that can be installed as an optional component on a robot.
Initial Launching Speed	The speed detected by the relevant modules of the Referee System after a projectile or Dart has completed its acceleration.

Term	Definition
Barrel Heat	The barrel heat generated by a robot after launching a projectile. A robot's ability to continuously launch projectiles is 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.
Maximum HP	The maximum value to which a robot's HP can be restored.
Experience Point	The accumulated points needed for a robot to level up, 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.
Attack	The launch of a projectile or Dart by a robot that hits an Armor Module or Dart Detection Module and causes damage.
Destruction	Where a robot attacks the Armor Module of an Enemy Base, Outpost or robot until the latter's HP drops to zero. If a robot is in a "non-surviving" state or the Referee System cannot detect a destroying robot for reasons other than suffering a hit on its Armor Module, it will assume 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	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. Note: After a robot is defeated or ejected, the Referee System will cut off power supply to the robot (except for the Mini PC).
Ejection	A robot's status when it is directly ejected due to a Red Card Warning. Note: After a robot is defeated or ejected, the Referee System will cut off power supply to the robot (except for the Mini PC).

Term	Definition
Offline	The Referee System Main Controller Module is unable to connect to the Referee System Server during the competition, due to a power outage on the robot or other reasons.
Temporary Activation	A status where a robot's chassis and gimbal is powered on temporarily after it has been defeated or ejected. The Launching Mechanism for the robot will be powered off.
Occupy	When a surviving robot has reached a Buff Point and its RFID Interaction Module has detected the RFID Interaction Module Card in the area.
Entanglement	A status where 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.
Collision	An active act of collision by a robot during the competition.
Battlefield	
Buff Point	A zone that, once occupied by a robot during the competition, will generate a special effect.
Penalty Zone	An area into which a robot's entry is forbidden.
Battlefield Components	Composite elements of the Battlefield, including but not limited to: the Base, Outpost, and Power Rune.
Staff	
Arbitration Commission	A body consisting of the Chief Referee and other members of the RMOC, responsible for handling appeals.
Referee	Personnel responsible for maintaining the order of the competition and enforcing its rules.
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.
Head Inspector	The referee responsible for leading and assigning pre-match inspection tasks, with the final right of interpretation over the inspection standards.
Participating Teams	The teams that have registered and been recorded in the registration system for the current competition season.
Participants	Individuals that have registered and been recorded in the registration system for the current competition season.
Tactical Coach	Participants responsible for instructing their teams on tactical deployment. Each team may have a Tactical Coach, who can be any Pit Crew member of the team.
Pit Crew Members	Regular Members and Supervisors who have registered for this Season and have been entered into the registration system, and can enter the Staging Area and Competition Area.

Term	Definition
Operator	The Pit Crew members responsible for controlling robots during the competition, including Ground Robot and Gimbal Operators, and pilots.
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.
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	
Total Damage	<p>The HP deducted from a robot or Battlefield Component caused by a projectile or Dart 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 Total Damage; ● 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 is not added to the other team's Total Damage.
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 Outpost HP	The remaining HP of a team's Outpost subtracted from the remaining HP of the enemy's Outpost at the end of a round.
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 surviving 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 lineup is as follows:

Table 3-1 Robot Lineup

Type	Numbering	Full Lineup (Units)	Competition Stage
Hero Robot	1	1	Regional Competition, Wild Card Competition and Final Tournament
Hero Robot	2	1	
Standard Robot	3/4	2	Mainland China Regional Competition
	3/4/5	3	International Regional Competition, Wild Card Competition and Final Tournament
Aerial Robot	6	1	Regional Competition, Wild Card Competition and Final Tournament
Sentry Robot	7	1	
Dart System	8	1	
Radar	9	1	

- The minimum lineup for the first round of each match is as follows: four robots, excluding Radars and Dart Systems.



- In the Mainland China Regional Competition, each team is only allowed to deploy one Balancing Standard Robot. In the International Regional Competition, Wild Card Competition, and Final Tournament, each team is allowed to deploy two Balancing Standard Robots.

The Operator line-ups shall be as shown below:

Table 3-2 Operator Lineup

Type	Robot Operated	Number of Operators in Full Lineup
Ground Robot Operator	Hero Robot	1
	Engineer Robot	1
	Standard Robot	Mainland China Regional Competition: 2 International Regional Competition, Wild Card Competition and Final Tournament: 3
	Sentry Robot	0
Aerial Gimbal Operator	Aerial Robot, Dart System	1
Pilot	Aerial Robot	1



- 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.
- A pilot can operate an Aerial Robot in the competition only after passing the Pilot Assessment by the RMOC. For details on the Pilot Assessment, please refer to the [“RoboMaster 2023 University Championship Participant Manual”](#).

3.1 Hero Robot

Hero Robots are the only robots that can launch 42mm projectiles on the Battlefield.

Table 3-3 Key Features of Hero Robots

Key Features	Descriptions
Initial Zone	Starting Zone
Operating Mode	There is no restrictions. One remote control and one Custom Controller can be configured at most
Inter-Robot Communication	Allowed

Key Features	Descriptions
Level-Up Mechanism	<p>Applicable</p> <p>Note: Chassis Power Consumption Limit, Initial HP, Maximum HP, Initial Launching Speed Limit, Barrel Heat Limit, Barrel Cooling Value per Second, and Experience Value are related to levels and chassis types. For their details, please refer to “5.6 Level-Up Mechanism”.</p>
Launching Mechanism	<ul style="list-style-type: none"> ● Fixed 42mm Launching Mechanism: 1 ● Optional 17mm Launching Mechanism: Allowed to be installed
Projectiles	<p>Built-in Launching Mechanism (42mm Projectiles):</p> <ul style="list-style-type: none"> ● 42mm projectile can be pre-loaded before a match. ● During a match, participants can obtain 42mm projectiles from Engineer Robots and redeem Projectile Allowance through the Economy System. <p>Optional Launching Mechanism (17mm Projectiles):</p> <ul style="list-style-type: none"> ● 17mm Projectiles can be pre-loaded before a match. ● During a match, participants can obtain 17mm projectiles from the Official Projectile Supplier and redeem Projectile Allowance through the Economy System.
Buff Point Occupation	<ul style="list-style-type: none"> ● Base Buff Points ● Elevated Ground Buff Point ● Launch Ramp Buff Point ● Outpost Buff Point ● Power Rune Activation Point ● Restoration Zone ● Hero Robot Sniper Point ● Controlled Zones
Respawn Methods	<ul style="list-style-type: none"> ● Progressive respawn ● Instant respawn through exchange

3.2 Engineer Robot

An Engineer Robot can move and exchange minerals for Gold Coins.

Table 3-4 Key Features of Engineer Robots

Key Features	Descriptions
Initial Zone	Starting Zone
Operating Mode	There is no restrictions. One remote control and one Custom Controller can be configured at most
Inter-Robot Communication	Allowed
Level-Up Mechanism	N/A
Initial HP / Maximum HP	500
Experience Value	50
Chassis Power Consumption Limit	N/A
Launching Mechanism	Not Available
Projectiles	42mm projectile can be pre-loaded before a match
Buff Point Occupation	<ul style="list-style-type: none"> ● Restoration Zone ● Resource Island Buff Point
Respawn Methods	<ul style="list-style-type: none"> ● Progressive respawn ● Instant respawn through exchange

3.3 Standard Robot

Standard Robots can launch 17mm projectiles. Participating teams can build Regular Standard or Balancing Standard Robots.

Table 3-5 Key Features of Standard Robots

Key Features	Description
Initial Zone	Starting Zone
Operating Mode	There is no restrictions. One remote control and one Custom Controller can be configured at most

Key Features	Description
Inter-Robot Communication	Allowed
Level-Up Mechanism	Applicable Note: Chassis Power Consumption Limit, Initial HP, Maximum HP, Initial Launching Speed Limit, Barrel Heat Limit, Barrel Cooling Value per Second, and Experience Value are related to levels and chassis types. For their details, please refer to “5.6 Level-Up Mechanism”.
Launching Mechanism	<ul style="list-style-type: none"> Built-in 17mm Launching Mechanism: 1 Optional 17mm Launching Mechanism: Allowed to be installed
Projectiles	<ul style="list-style-type: none"> 17mm Projectiles can be pre-loaded before a match. During a match, participants can obtain 17mm projectiles from the Official Projectile Supplier and redeem Projectile Allowance through the Economy System.
Buff Point Occupation	<ul style="list-style-type: none"> Base Buff Point Elevated Ground Buff Point Launch Ramp Buff Point Outpost Buff Point Power Rune Buff Point Restoration Zone Controlled Zone
Respawn Methods	<ul style="list-style-type: none"> Progressive respawn Instant respawn through exchange

3.4 Aerial Robot

An Aerial Robot can initiate air support, have a first-person view, and launch attacks from the air.

Table 3-6 Key Features of Aerial Robots

Key Features	Description
Initial Zone	Landing Pad
Operating Mode	There is no restrictions. Only a maximum of two remote controls and one Custom Controller can be configured.

Key Features	Description
Inter-Robot Communication	Allowed
Level-Up Mechanism	N/A
Initial Launching Speed Limit (m/s)	30
Barrel Heat Limit	N/A
Launching Mechanism	Optional 17mm Launching Mechanism: Allowed to be installed
Projectiles	<ul style="list-style-type: none"> 17mm Projectiles can be pre-loaded before a match. During a match, participants that call for air support will receive 17mm projectile allowance and supply for a limited time.

3.5 Sentry Robot

Sentry Robots must operate fully autonomously and guard their team's Base.

Table 3-7 Key Features of Sentry Robots

Key Features	Descriptions
Initial Zone	Sentry Starting Zone
Operating Mode	Automatic, with maximum one remote controller for debugging
Inter-Robot Communication	Allowed, but it cannot receive data from robots other than a Radar.
Level-Up Mechanism	N/A
Initial HP / Maximum HP	1000
Experience Value	75
Maximum Chassis Power Consumption (W)	150 Note: If a Sentry Robot exceeds its Chassis Power Consumption Limit, its HP will not be deducted but its chassis will power off.
Initial Launching Speed Limit (m/s)	30
Barrel Heat Limit	240

Key Features	Descriptions
Barrel Cooling Value per Second	80
Launching Mechanism	Built-in 17mm Launching Mechanism: 2
Projectiles	17mm Projectiles can be pre-loaded before a match.
Buff Point Occupation	<ul style="list-style-type: none"> ● Sentry Patrol Zones ● Elevated Ground Buff Point ● Power Rune Buff Point ● Outpost Buff Point ● Launch Ramp Buff Point
Respawn Methods	Not applicable

3.6 Dart System

A Dart System can attack the enemy's Outpost and Base by launching Darts.

Table 3-8 Key Features of Dart Systems

Key Features	Descriptions
Initial Zone	Dart Launching Station
Operating Mode	There is no restrictions. One remote control and one Custom Controller can be configured at most
Inter-Robot Communication	Allowed

3.7 Radar

The Radar can acquire Battlefield information autonomously and send it to its team's robots or player's client through inter-robot communication.

Table 3-9 Key Features of Radars

Key Features	Descriptions
Initial Zone	Radar Base
Operating Mode	Fully automatic, with maximum one remote controller for commissioning
Inter-Robot Communication	Allowed, but it cannot receive data from robots other than a Sentry Robot

4. Competition Area

4.1 Introduction



- The dimension error margin of all Battlefield components described here is within $\pm 5\%$. 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.
- The rendering is for illustrative purposes only. The specific dimensions of the site shall be based on the corresponding drawings.
- In the Mainland China Regional Competition, the guiding and decorative lines for the red/blue teams in the Battlefield shall be made of red/blue ground rubber.

The core competition area of the RMUC is called the “Battlefield”. The Battlefield is 28m long and 15m wide. Its inner structure is made of wood materials and the surface is laid with PVC flooring (3mm thick). It consists of the Base Zone, Elevated Zone, Open Zone and Flight Zone. On the perimeter of the Battlefield is a black steel perimeter wall with a height of 2.4m from its upper edge to the Battlefield ground surface.

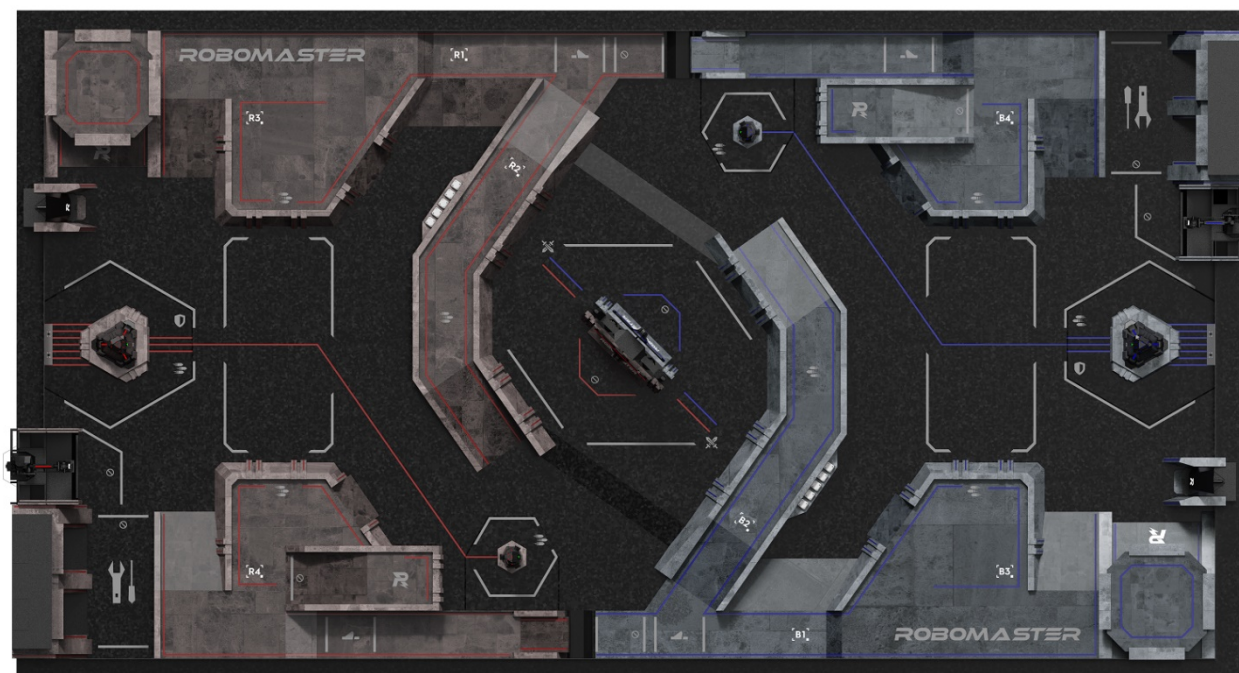


Figure 4-1 Battlefield Top View Rendering



Figure 4-2 Battlefield Side View Rendering

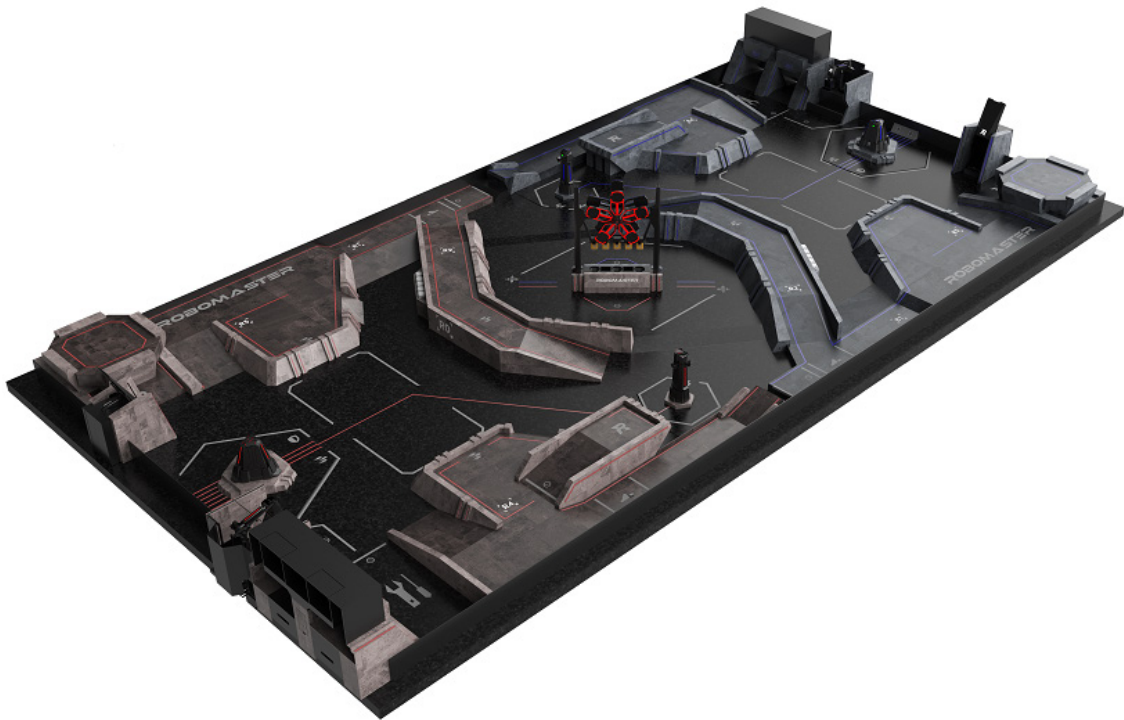
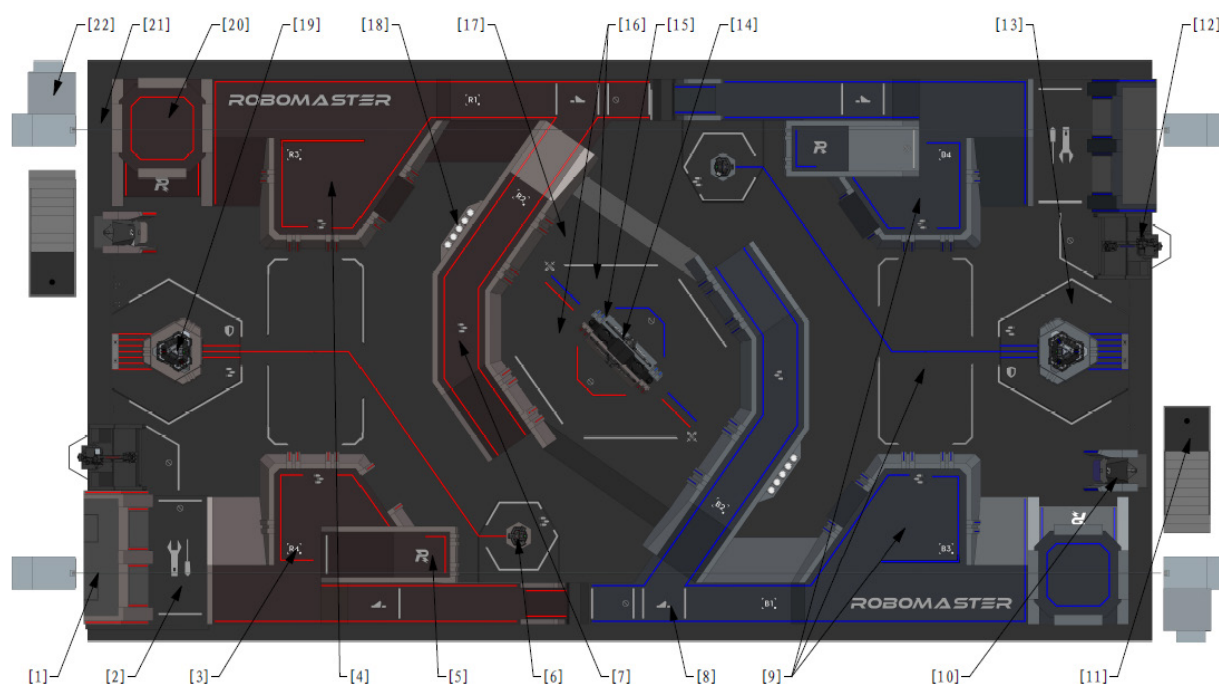
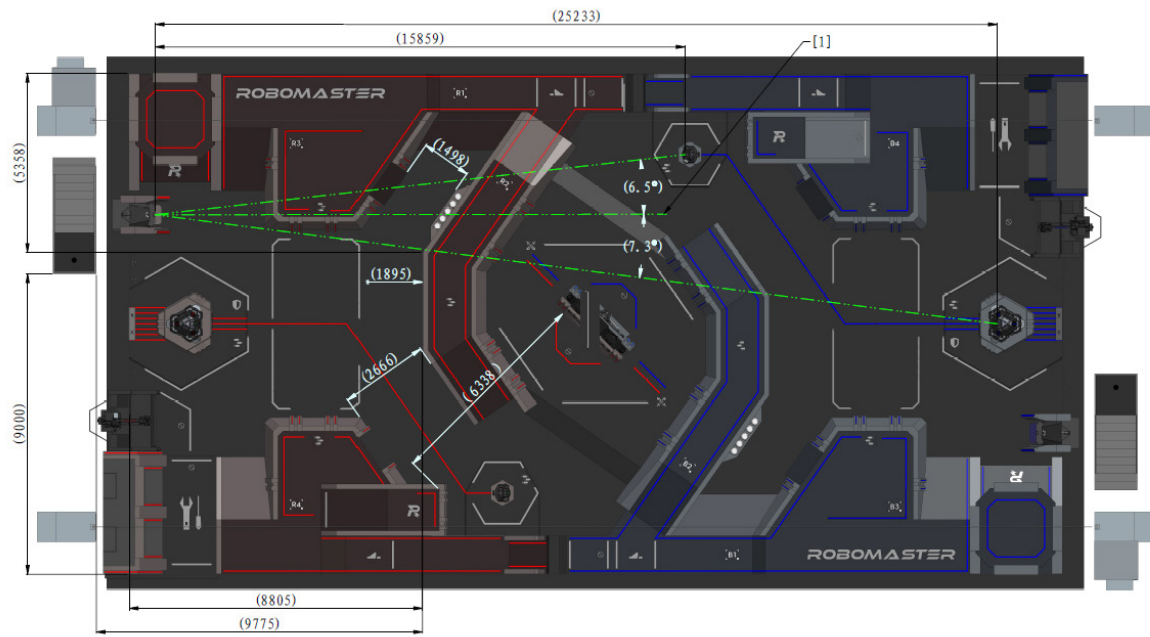


Figure 4-3 Battlefield Axonometric Rendering



[1]	Aerial Safety Rope	[2]	Supplier Zone	[3]	R4 Trapezoid-Shaped Elevated Ground	[4]	R3 Trapezoid-Shaped Elevated Ground
[5]	Power Rune Activation Point	[6]	Outpost	[7]	R2 Ring-Shaped Elevated Ground	[8]	Road Zone
[9]	Sentry Patrol Zones	[10]	Dart Launching Station	[11]	Radar Base	[12]	Exchange Zone
[13]	Starting Zone	[14]	Power Rune	[15]	Large Resource Island	[16]	Controlled Zones
[17]	Bumpy Roads	[18]	Small Resource Island	[19]	Base	[20]	Landing Pad
	Aerial Robot						
[21]	Projectile Reload window	[22]	Pilot Room				

Figure 4-4 Battlefield Modules

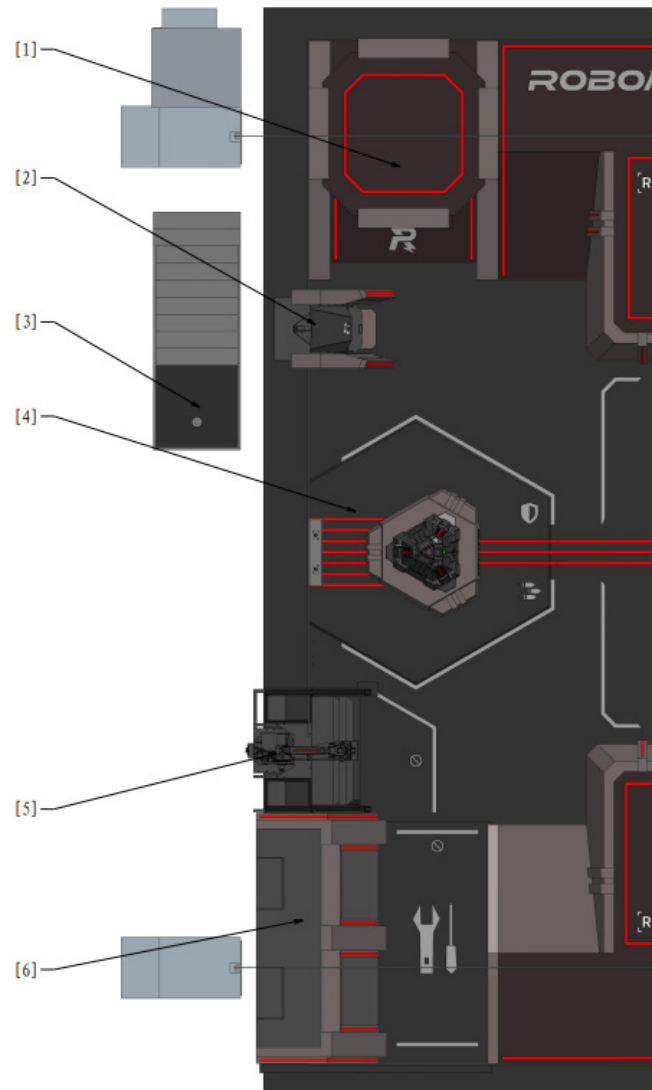


[1] Parallel with the Side of the Battlefield and Facing the Dart Launching Station

Figure 4-5 Battlefield Module Dimensions

4.2 Base Zone

The Base Zone consists of the Starting Zone, Base, Dart Launching Station, Landing Pad, Radar Base, Supplier Zone, and Exchange Zone. The Starting Zone is the hexagonal area around the Base.

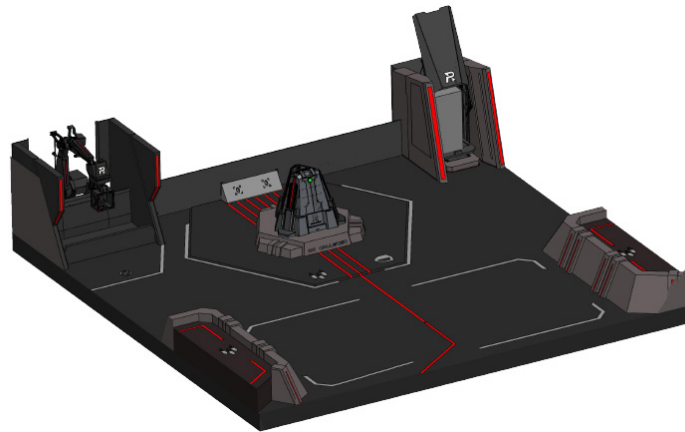
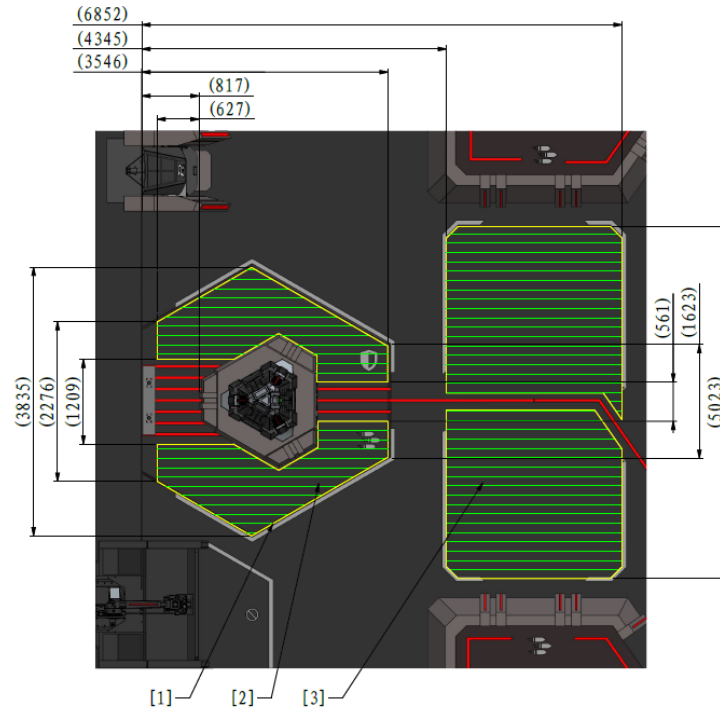


- | | | | | | | | | | | | |
|-----|-------------|-----|------------------------|-----|------------|-----|---------------|-----|---------------|-----|---------------|
| [1] | Landing Pad | [2] | Dart Launching Station | [3] | Radar Base | [4] | Starting Zone | [5] | Exchange Zone | [6] | Supplier Zone |
|-----|-------------|-----|------------------------|-----|------------|-----|---------------|-----|---------------|-----|---------------|

Figure 4-6 Base Zone

4.2.1 Robot Starting Zone

The Starting Zone is a hexagonal area around the Base, where Ground Robots (except Sentries) stand by before the competition starts. The Starting Zone includes a Base Buff Point, as shown below. The Sentry Starting Zone is located between two Trapezoid-shaped Elevated Grounds, where Sentry Robots stand by before the competition starts.



[1] Starting Zone

[2] Base Buff Points

[3] Sentry Starting Zone

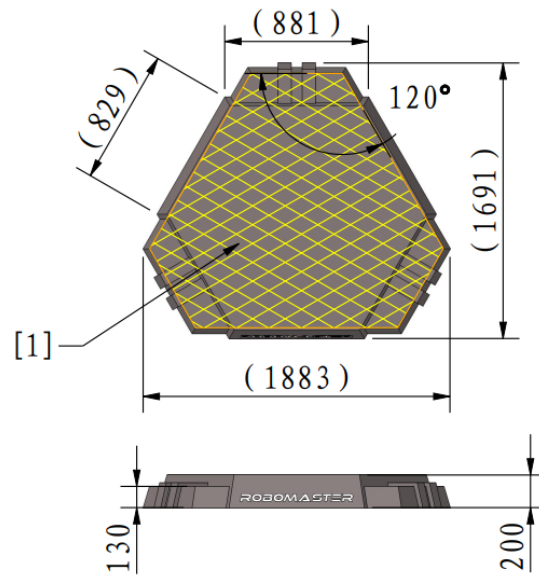
Figure 4-7 Robot Starting Zone

4.2.2 Base

The Base is the central component of both offensive and defensive strategies for each team. It is placed on the Base Foundation in the Starting Zones of each team. A Base consists of the body of the Base, Armor Modules, Dart

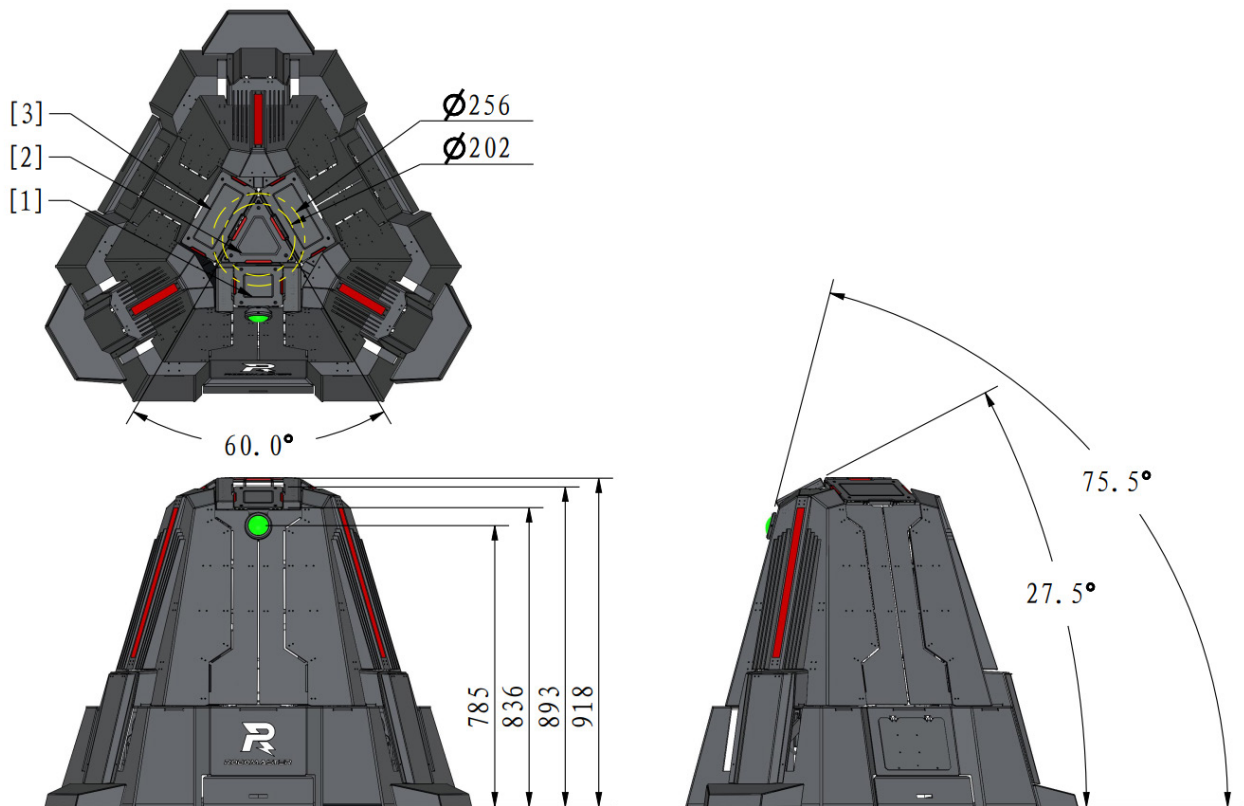
Detection Module, Base Protective Armor, etc. The Base Armor can either be in a closed or expanded state.

The Base Foundation is where the Base is placed, and is located in the Starting Zone. The space above the Base Foundation is the penalty zone of the Base.



[1] Base Penalty Zone

Figure 4-8 Base Foundation



[1] Dart Detection Module [2] Triangular Armor Module [3] Large Armor Module

Figure 4-9 Closed State of Base Protective Armor

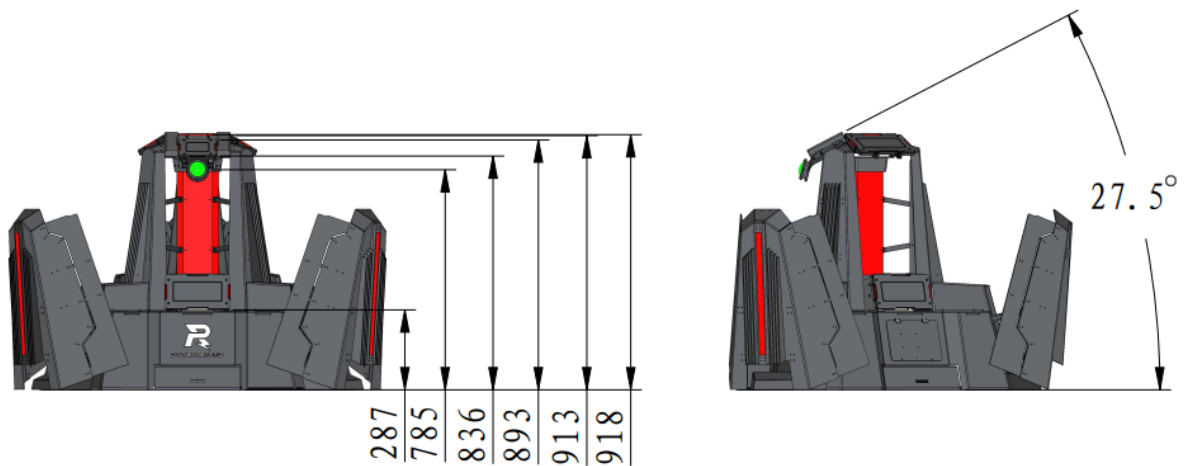
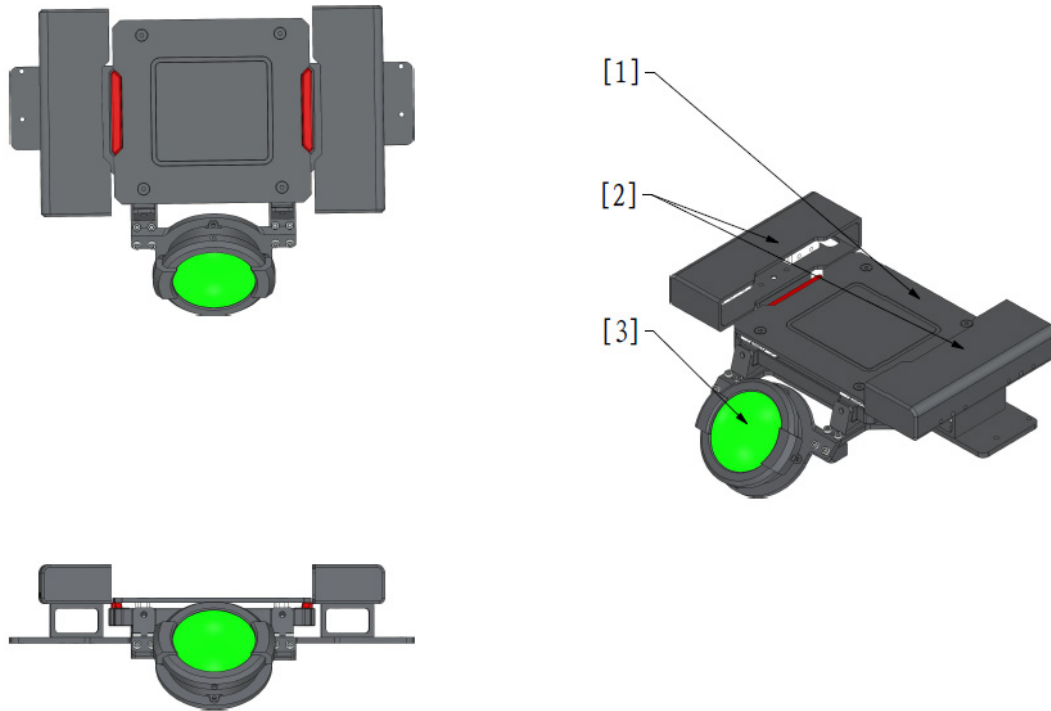


Figure 4-10 Expanded State of Base Protective Armor

The Dart Detection Module is located on the top of both the Base and Outpost, and it consists of a Small Armor Module, Dart detection sensor and Dart guiding light.

The Small Armor Module of the Dart Detection Module can detect attacks by Darts and 42mm projectiles. The Dart Detection Sensor can detect the infrared light emitted by a Dart trigger device. When a Dart Detection Module detects infrared light and an attack simultaneously, the system will deem the module as having been hit by a Dart. When only an attack is detected, the system will deem the module as having been hit by a projectile. The Dart Guiding Light emits green visible light with a wavelength of 520 nm. When approximating a point light source, its luminous intensity is around 10 cd; while the brightness measured on its outer surface is 5000 lx, and the diameter of its light-emitting part is 55mm. It is for guiding Darts toward their targets.



[1] Small Armor Module [2] Dart Detection Sensor [3] Dart Guiding Light

Figure 4-11 Dart Detection Module

4.2.3 Dart Launching Station

The Dart Launcher can only be placed in the Dart Launching Station, which consists of the main body, gliding platform and gate.

The gliding platform has an area of 600*1,000mm and is made of iron (which is magnetic). The gliding platform can glide forward and backward to assist with the placing of a Dart Launcher.

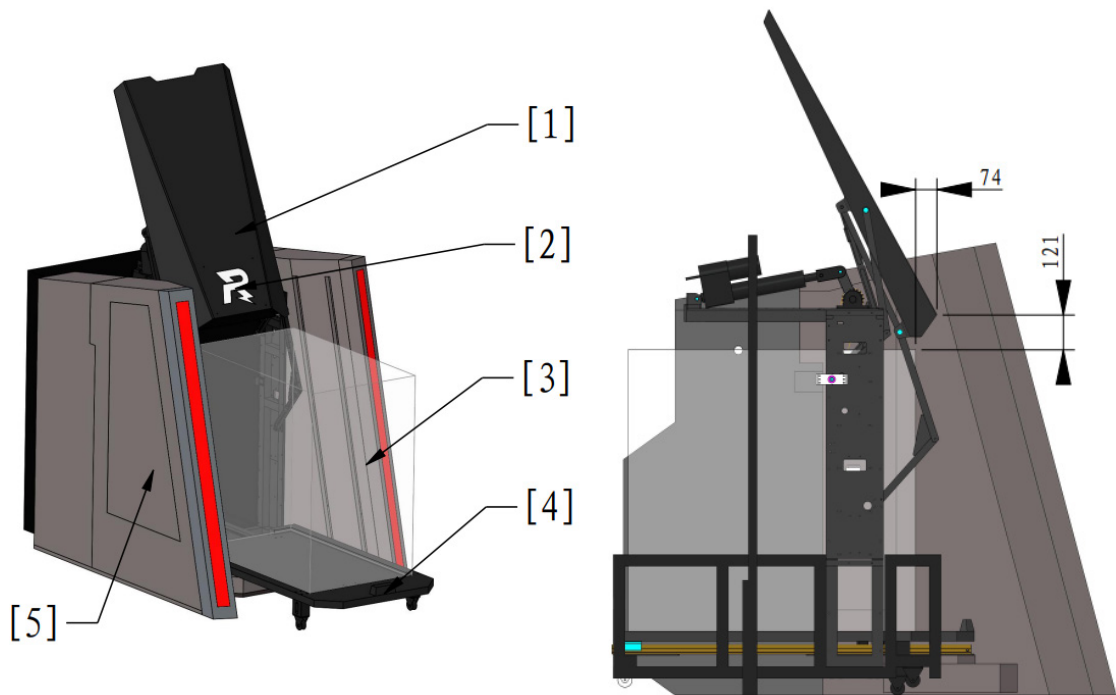
During the Three-Minute Setup Period, the Dart Launching Station will be in the open status. The Pit Crew Members will pull out the gliding platform then place the Dart Launcher in the square space on the platform. After ensuring the Dart Launching System is operating normally, the Pit Crew Members will push the gliding platform back into the main body of the Dart Launching Station, which automatically locks into place. Before the start of a match, the gate will close automatically.

The status indicator of the Dart Launching Station shows different light effects according to its status, as shown below.

Table 4-1 Light Effects of Status Indicators on Dart Launching Stations

Status of Dart Launching Station	Light Indicator of the Dart Launching Station
Robot is Connected and the Sliding Rail is in Place	Solid white

Status of Dart Launching Station	Light Indicator of the Dart Launching Station
Robot Disconnected	White flashes (1Hz)
Robot is Connected but the Sliding Rail is Not in Place	White flashes (3Hz)
Gate Opening	White flashes (3Hz)
Gate Opened	Solid white
Gate Closing	White flashes (3Hz)



- [1] Gate [2] Status Light Indicators [3] Placement Area for the Dart Launcher [4] Gliding Platform [5] Main Body of Dart Launching Station

Figure 4-12 Dart Launching Station

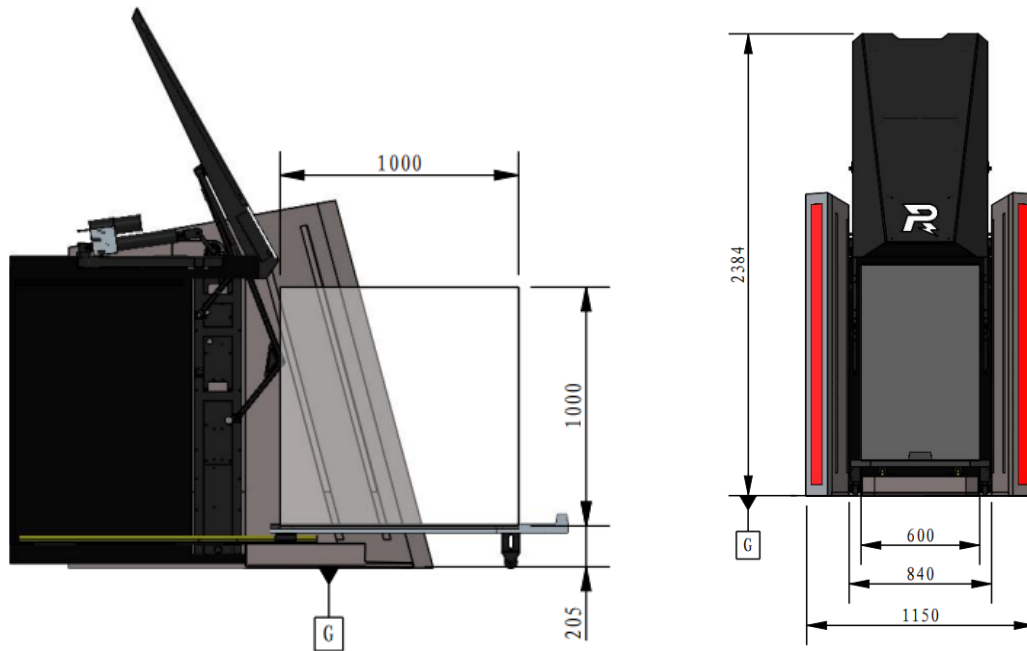
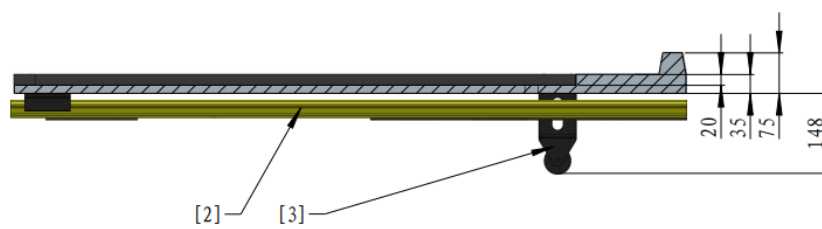
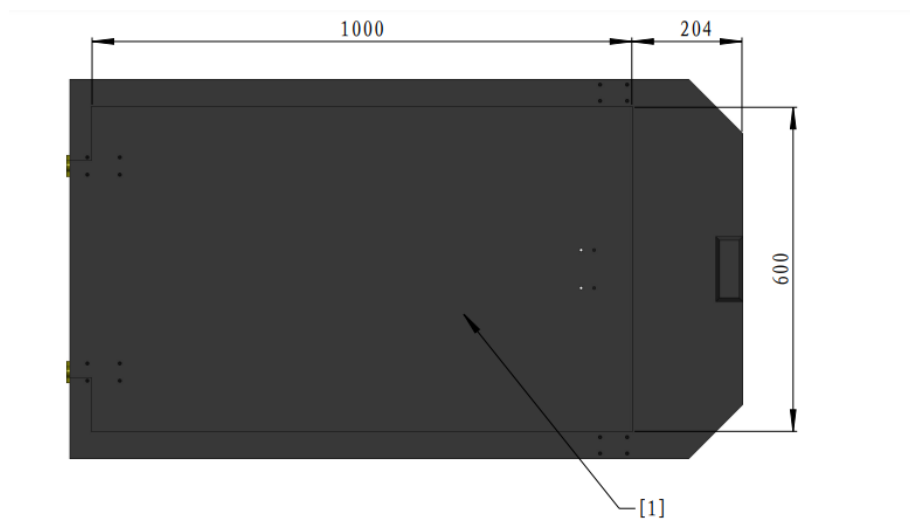


Figure 4-13 Gliding Platform Slides Out



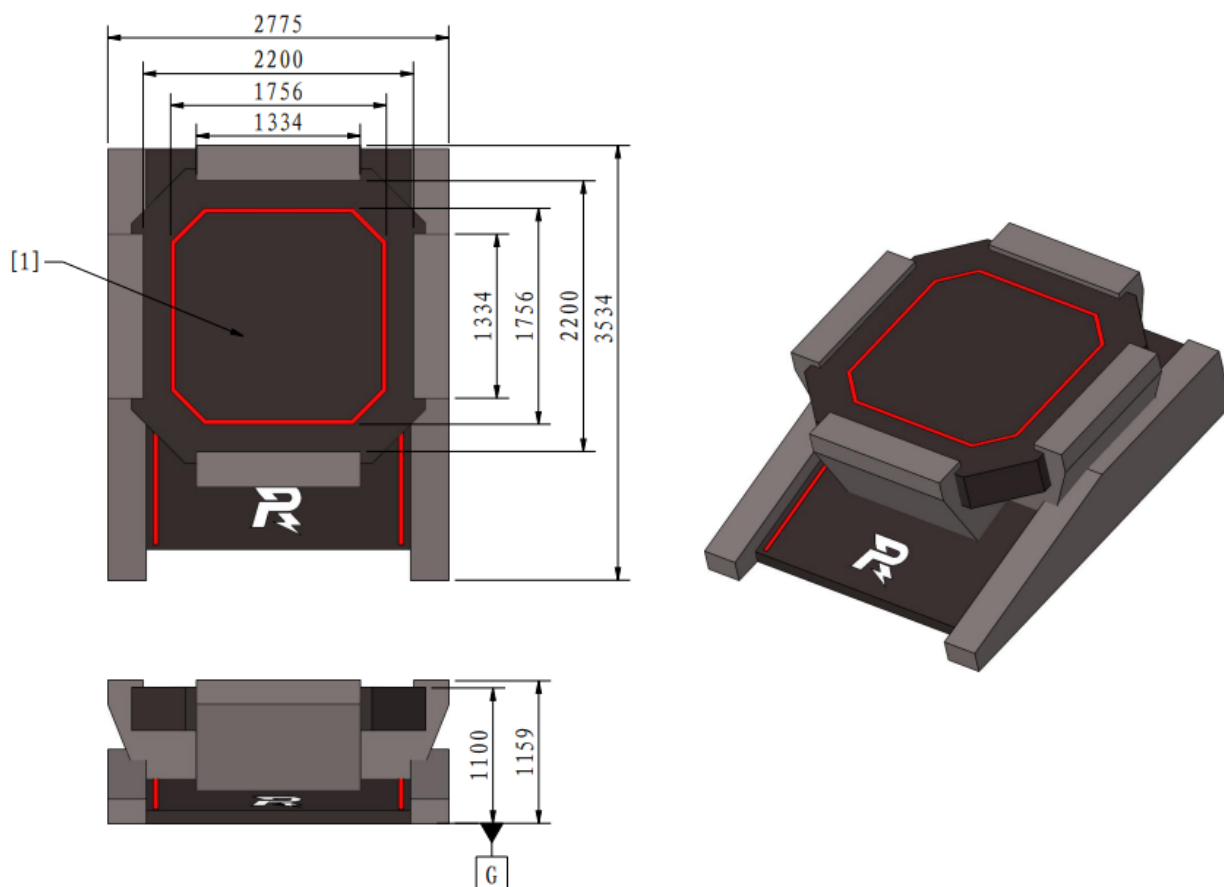
[1] Flat Surface for Placing Dart Launcher [2] Gliding Platform Rail [3] Supporting Wheel

Figure 4-14 Dimensions of Gliding Platform

4.2.4 Landing Pad

The Landing Pad is the initialization zone for Aerial Robots.

Prior to the start of the match, an Aerial Robot must be placed on a Launching Pad platform, its projection must within the boundaries of the Landing Pad, and it must be connected to an Aerial Safety Rope accordance with guidelines.



[1] Landing Pad Platform

Figure 4-15 Landing Pad

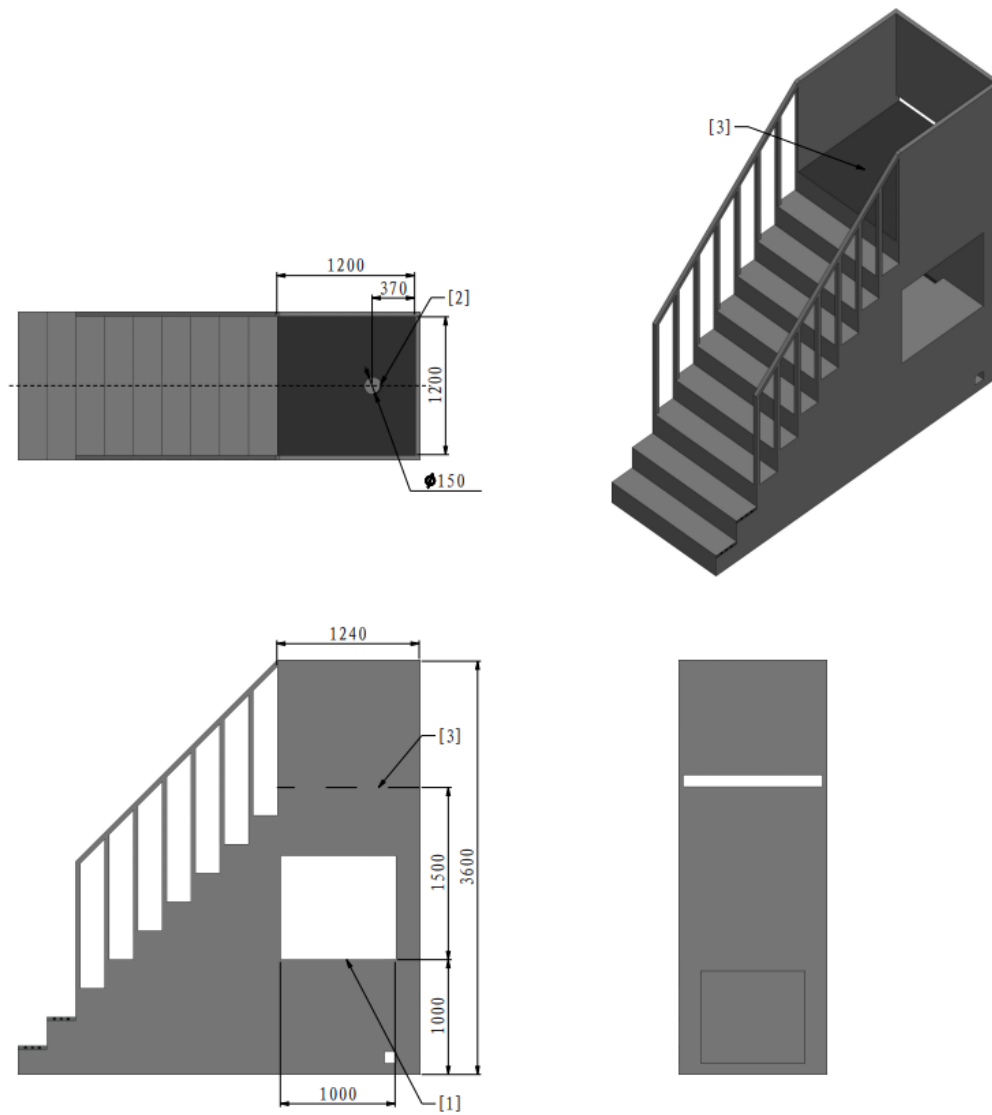
4.2.5 Radar Base

A Radar Base is for placing a Radar sensor. It features a top platform that measures 1200*1200mm, made of iron panel material (which is magnetic). The height of the platform to the Battlefield ground should be approximately 2500mm, and the non-transparent perimeter wall around it is 1100mm high. On the platform are two sensor data cable slots, which may be used as needed during the competition.

The Radar Computing End is powered by 220V mains supply. Its platform has the following:

- One official display device that supports HDMI signal input only, with a resolution of 1920*1080. Teams can use it to check the operation status of the Radar.

- One HDMI cable for connecting the Radar to the official display device.
- One immobile power outlet for supplying power to the Radar and other official equipment.

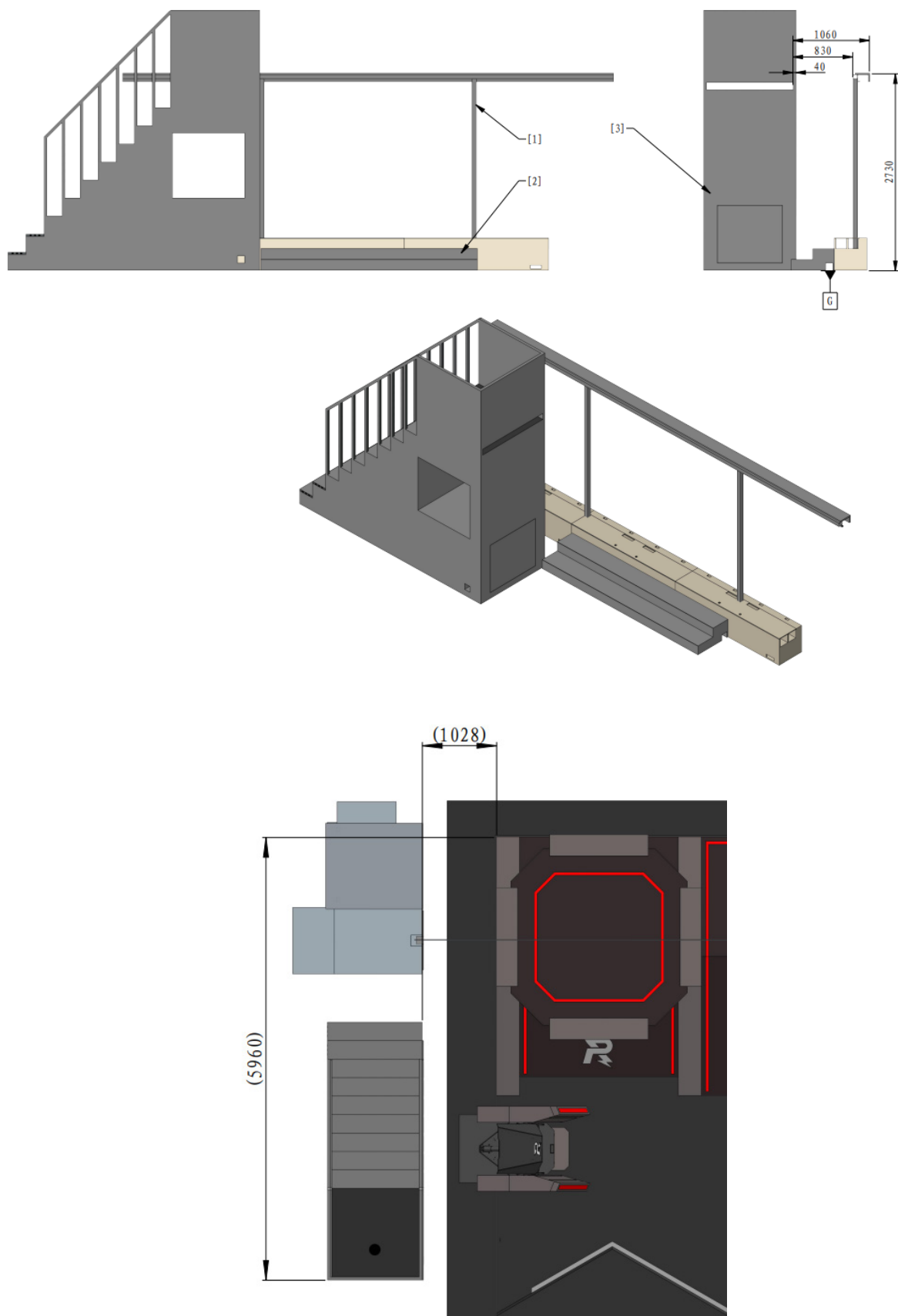


[1] Radar Computer Platform

[2] Sensor Data Cable Slot

[3] Radar Sensor Platform

Figure 4-16 Radar Base



[1] Electric Door

[2] Steps

[3] Radar Base

Figure 4-17 Relative Position of the Radar Base

4.2.6 Supplier Zone

A Supplier Zone is an important area for the reloading of projectiles and the recovery of robot HP. The Supplier Zone includes the Official Projectile Supplier, Restoration Zone, and Supplier Penalty Zone.

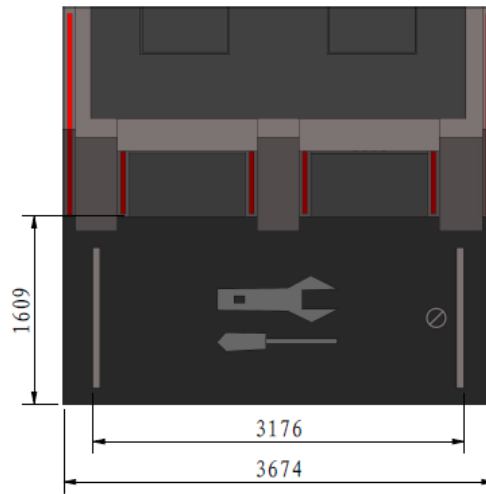


Figure 4-18 Supplier Zone



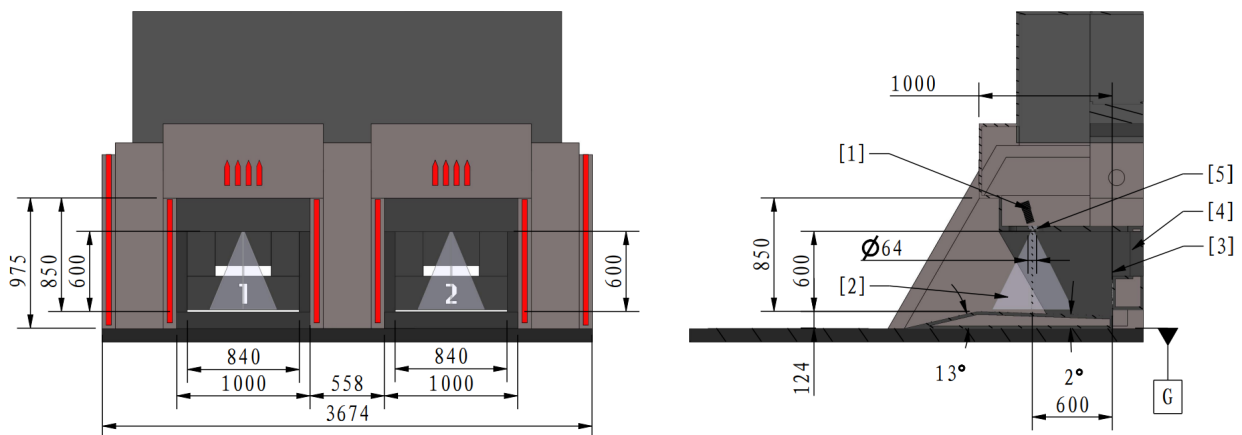
Due to the large size of the projectile outlet, teams are advised to enlarge the projectile loading port and pad the internal wall of the projectile storage area with buffer materials, to prevent projectiles from falling in the process of loading them into the projectile storage area.

4.2.6.1 Official Projectile Supplier

A Projectile Supplier provides 17mm projectiles during matches and consists of a Projectile Outlet, auxiliary alignment laser sight, camera and monitor. The camera in the projectile outlet captures real-time images of the robot's projectile storage area and displays them on the front monitor. Additionally, the Operator can use the laser light projected by the cross laser light to adjust the robot's position.



Cross laser light: formed by two perpendicular laser lights intersected at the center of the Projectile Outlet.

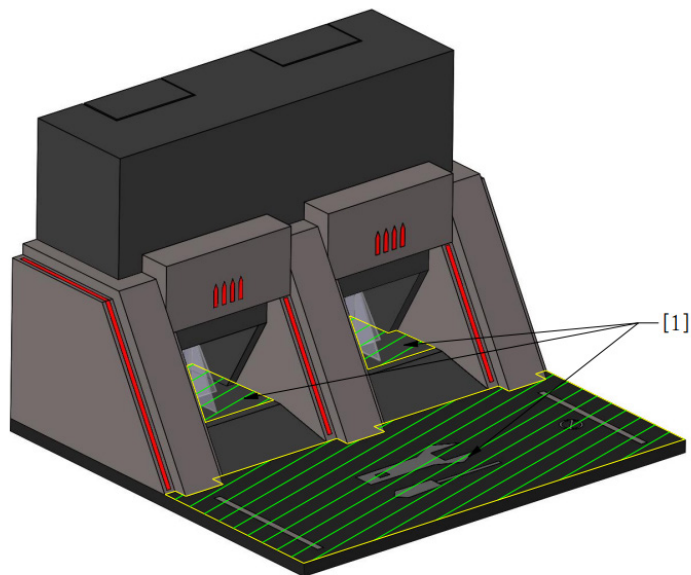


[1] Camera [2] Laser Light Path [3] Steel Wire Mesh [4] Monitor [5] Projectile Outlet

Figure 4-19 Official Projectile Supplier

4.2.6.2 Restoration Zone

The Supplier Zone has three Restoration Zones each containing RFID Interaction Module Cards. One zone is located in front of and the other two are in the Supplier Zone.

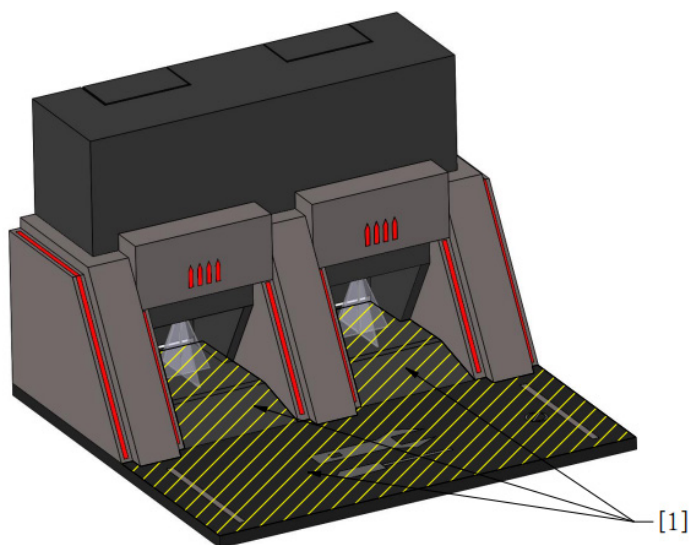


[1] Restoration Zone

Figure 4-20 Restoration Zone

4.2.6.3 Supplier Penalty Zone

One team's Supplier Zone is the Supplier Penalty Zone for the other team's robots, as shown below:



[1] Supplier Penalty Zone

Figure 4-21 Supplier Penalty Zone

4.2.7 Exchange Zone

An Exchange Zone is where a Hero Robot exchanges for minerals. as shown below:

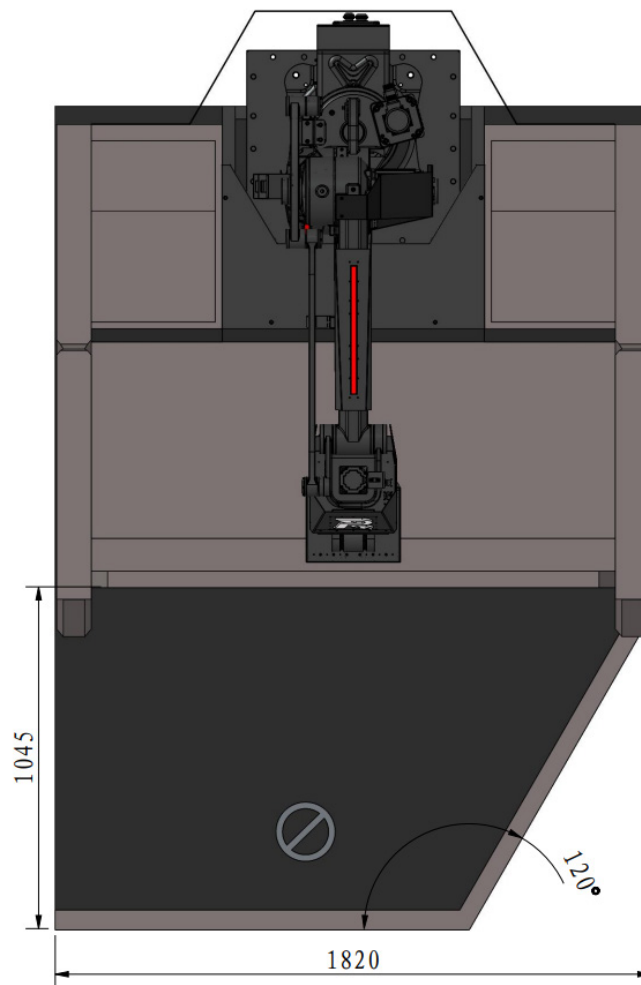


Figure 4-22 Exchange Zone

4.2.7.1 Exchange Station

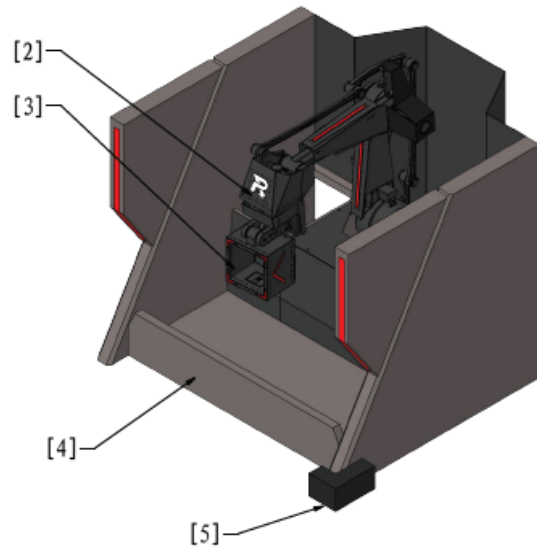
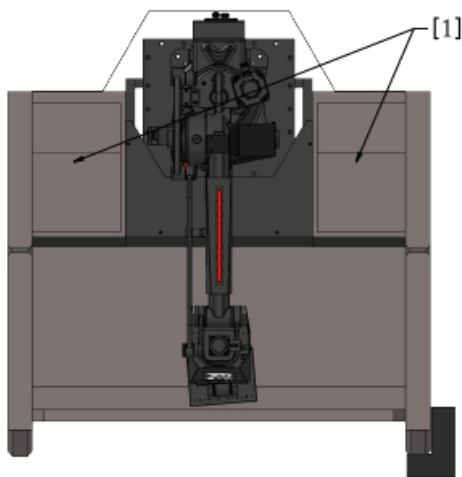
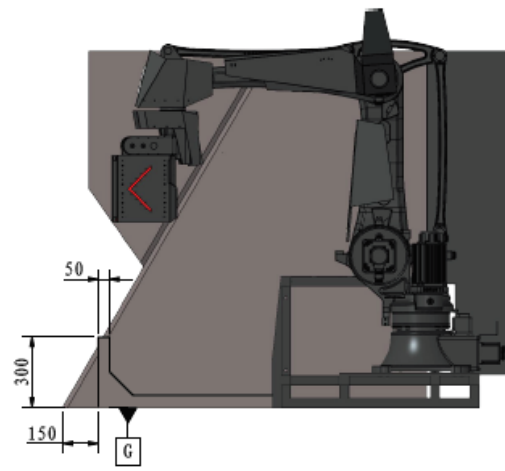
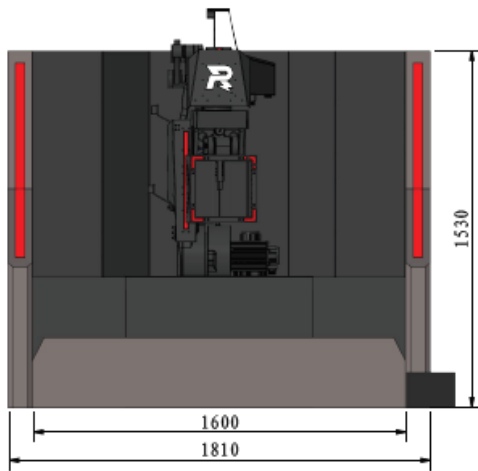
The Exchange Station consists of its Base, the Mineral Receptacle, and the Mineral Collecting Slot. Engineer Robots can redeem minerals at the Exchange Station for Gold Coins.

The status indicator of the Exchange Station shows different light effects according to its status, as shown in the table below:

Table 4-2 Light Effects of Status Indicators on Exchange Stations

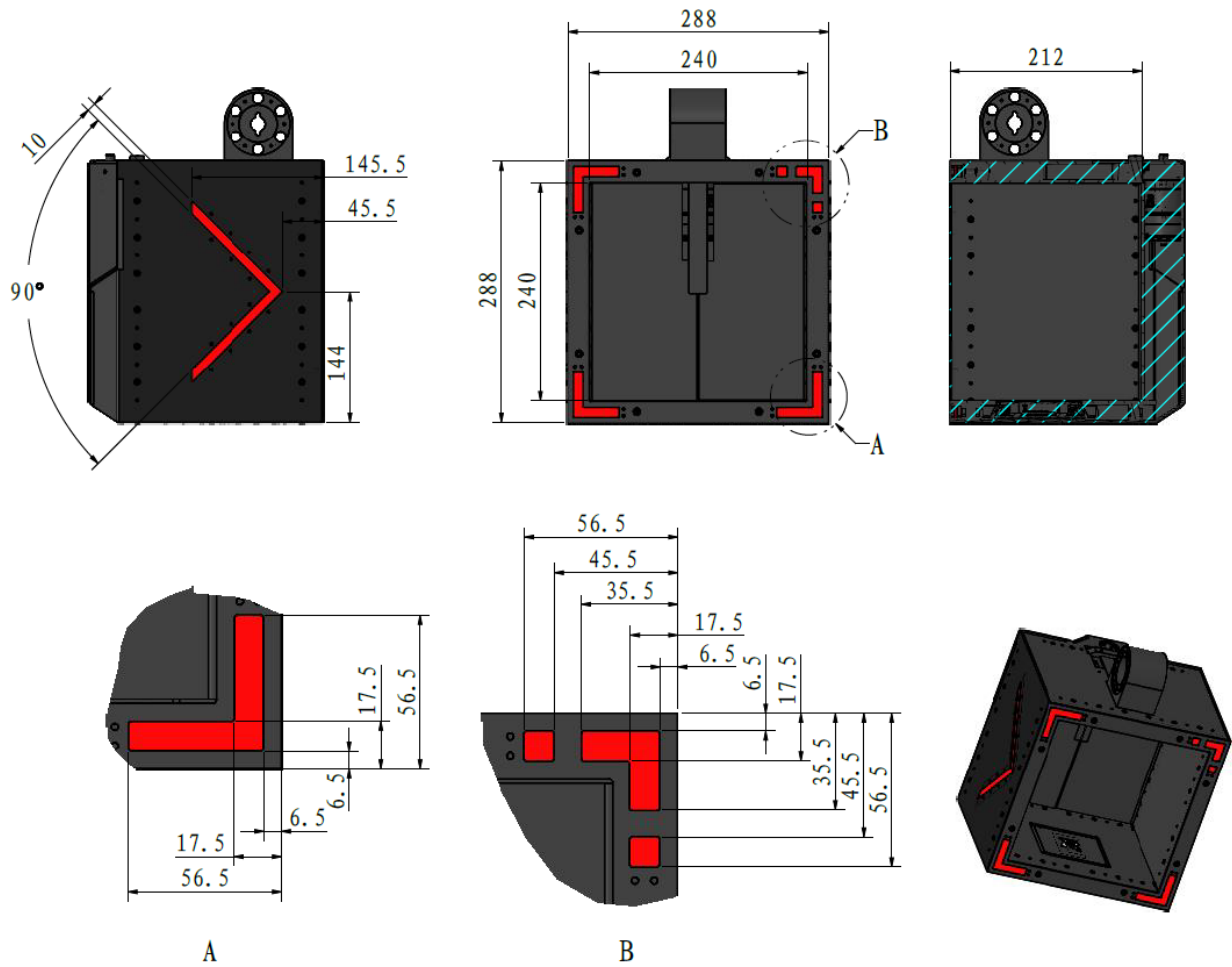
Status of Exchange Station	Status Indicator of Exchange Station
Non-exchangeable	Off
Exchangeable (normal)	Solid white

Status of Exchange Station	Status Indicator of Exchange Station
When the Photoelectric Sensor of the Mineral Receptacle is Triggered and the Mineral Receptacle Detects the RFID Interaction Module Card of a Mineral, in the Exchangeable Status	White flashes (1Hz)
After Mineral is Exchanged within 2 Seconds	White flashes (3Hz)



- | | | |
|-------------------------------------|-------------------------------------|------------------------|
| [1] Mineral Collecting Slot | [2] R-figure Status Light Indicator | [3] Mineral Receptacle |
| [4] Front Guard of Exchange Station | [5] Anti-collision Bar | |

Figure 4-23 Exchange Station



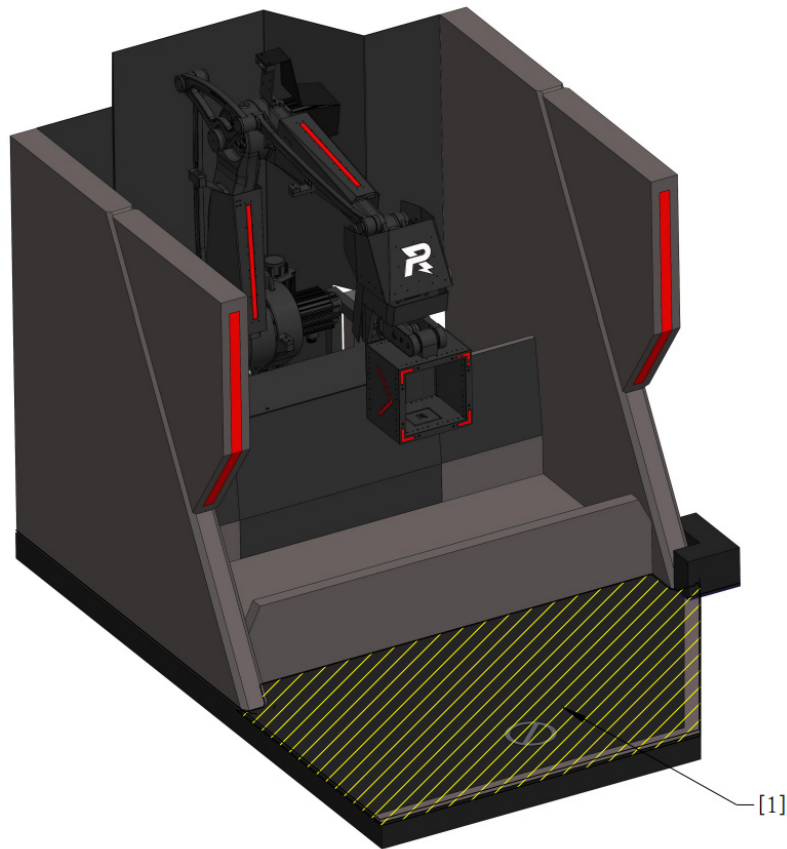
[1] Photoelectric Sensor Beam (non-visible)

[2] Photoelectric Sensor

Figure 4-24 Mineral Receptacle

4.2.7.2 Exchange Penalty Zone

One team's Exchange Zone is the Penalty Zone for the other team's robots, as shown below:



[1] Exchange Penalty Zone

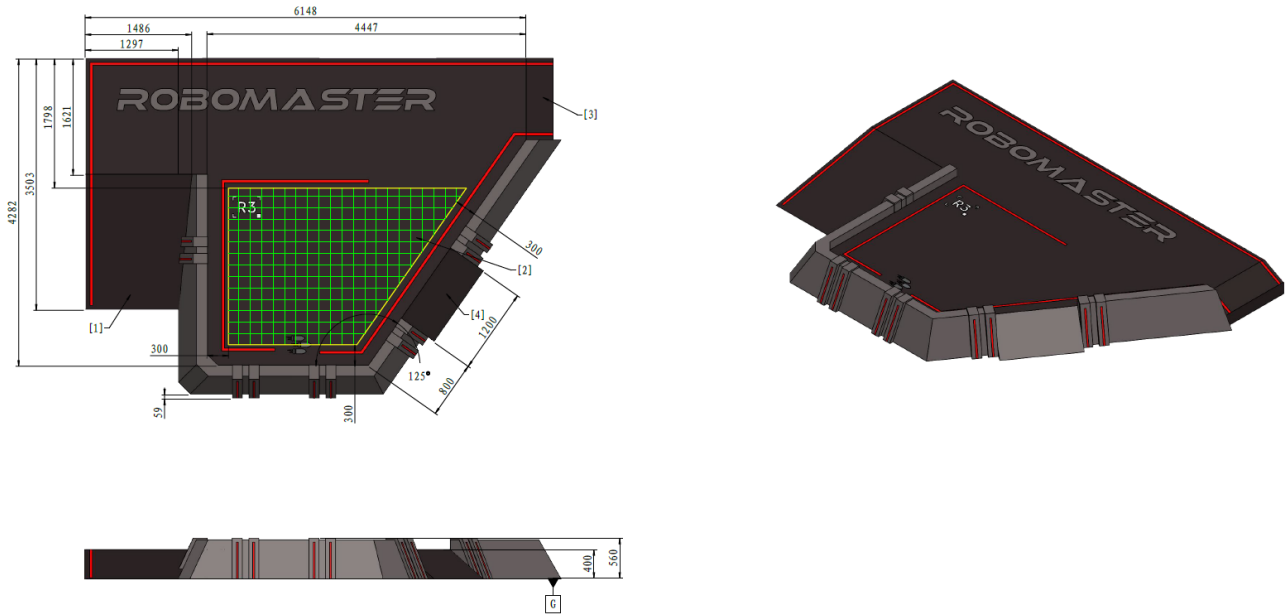
Figure 4-25 Exchange Penalty Zone

4.3 Elevated Zone

The Elevated Zone is an area higher than the flat ground of the Battlefield. On each half of the Battlefield, there are three Elevated Grounds designated for the red and blue teams respectively. These Elevated Grounds divide the Battlefield into different zones and create a three-dimensional space. The Red Team's Elevated Grounds include the R3 Trapezoid-Shaped Elevated Ground, R4 Trapezoid-Shaped Elevated Ground and R2 Ring-Shaped Elevated Ground. The Blue Team's Elevated Grounds include the B3 Trapezoid-Shaped Elevated Ground, B4 Trapezoid-Shaped Elevated Ground and B2 Ring-Shaped Elevated Ground.

4.3.1 R3 Trapezoid-Shaped Elevated Ground

The R3 Trapezoid-shaped Elevated Ground is located near the Red Team's Landing Pad, at a height of 400mm. The height of its perimeter wall is 135mm. The R3 Trapezoid-shaped Elevated Ground has a Buff Point which is also the Sniper Point of the Red Team's Hero Robot. Its location is shown below.

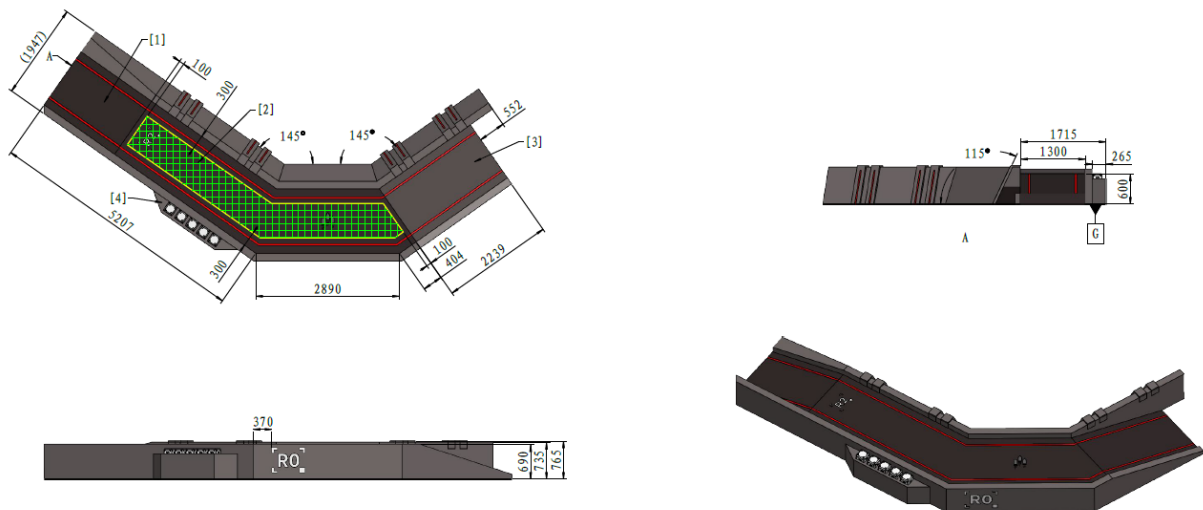


[1] 12° Slope [2] Elevated Ground Buff Point [3] 30° Slope [4] 35.5° Slope

Figure 4-26 R3 Trapezoidal Elevated Ground

4.3.2 R2 Ring-Shaped Elevated Ground

The R2 Ring-Shaped Elevated Ground is located near the Large Resource Island Zone and is connected to the road via the slope at one end. The Small Resource Island is positioned adjacent to the Ring-shaped Elevated Ground, and is located outside the Elevated Ground's protective perimeter wall. The R2 Ring-shaped Elevated Ground has a Buff Point, as shown below.

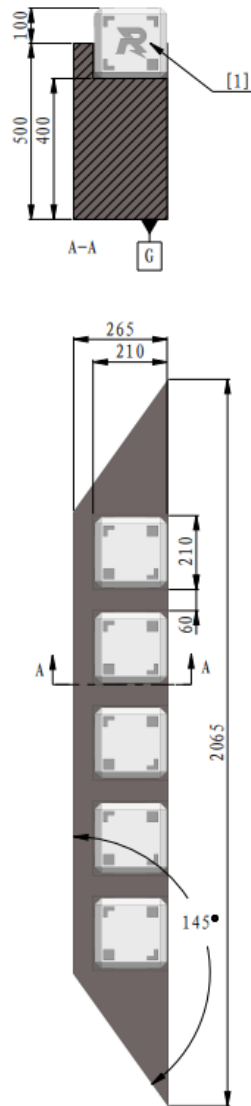


[1] 13° Slope [2] Elevated Ground Buff Point [3] 15° Slope [4] Small Resource Island

Figure 4-27 R2 Elevated Ground

4.3.2.1 Small Resource Island

The Small Resource Island is adjacent to the protective perimeter wall of the Ring-shaped Elevated Ground, and has five silver minerals.



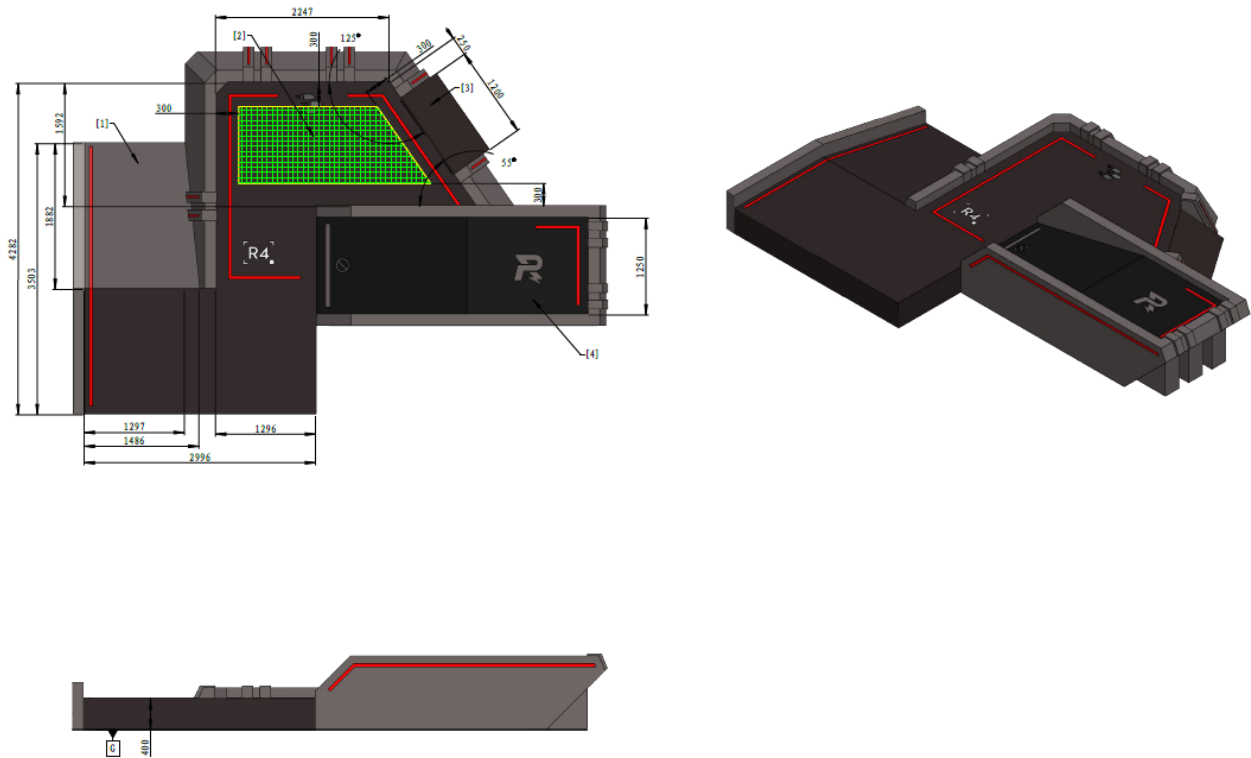
[1] Silver Mineral

Figure 4-28 Small Resource Island

4.3.3 R4 Trapezoid-Shaped Elevated Ground

The R4 Trapezoid-Shaped Elevated Ground is located near the Supplier Zone. Its surface has a height of 400mm, and the height of its perimeter walls is 135mm.

The R4 Trapezoid-shaped Elevated Ground has a Buff Point, as shown below.

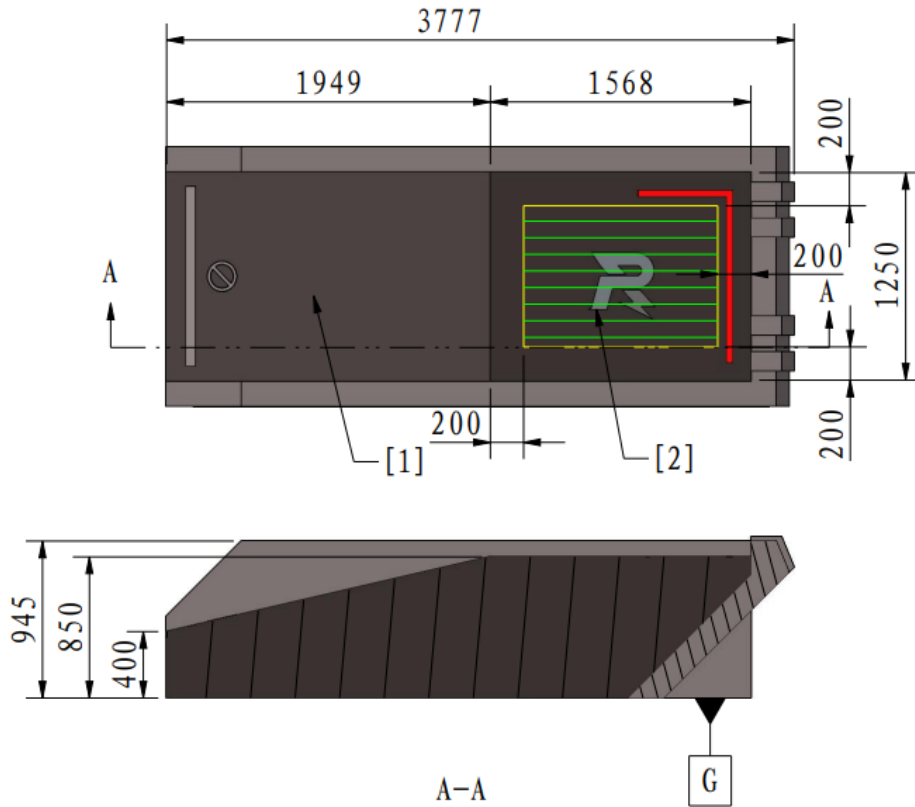


[1] 12° Slope [2] R4 Elevated Ground Buff Point [3] 35.5° Slope [4] Power Rune Activation Point

Figure 4-29 R4 Trapezoidal Elevated Ground

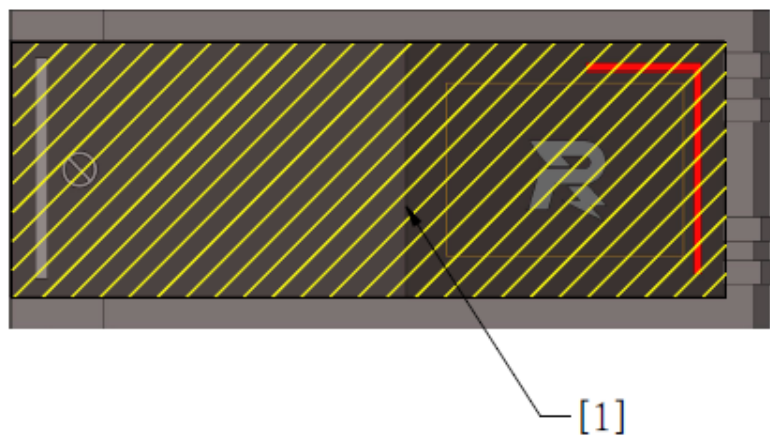
4.3.4 Power Rune Activation Point

The Power Rune Activation Point is located on the R4 Trapezoid-Shaped Elevated Ground, where a robot shoots and hits to activate the Power Rune. The activation point is connected to the R4 Trapezoid-Shaped Elevated Ground via the slope. One team's Power Rune Activation Point and the slope connecting the Power Rune Activation Point and R4 Trapezoid-shaped Elevated Ground are the other team's Power Rune Activation Point Penalty Zone.



[1] 13° Slope [2] Power Rune Activation Point

Figure 4-30 Power Rune Activation Point

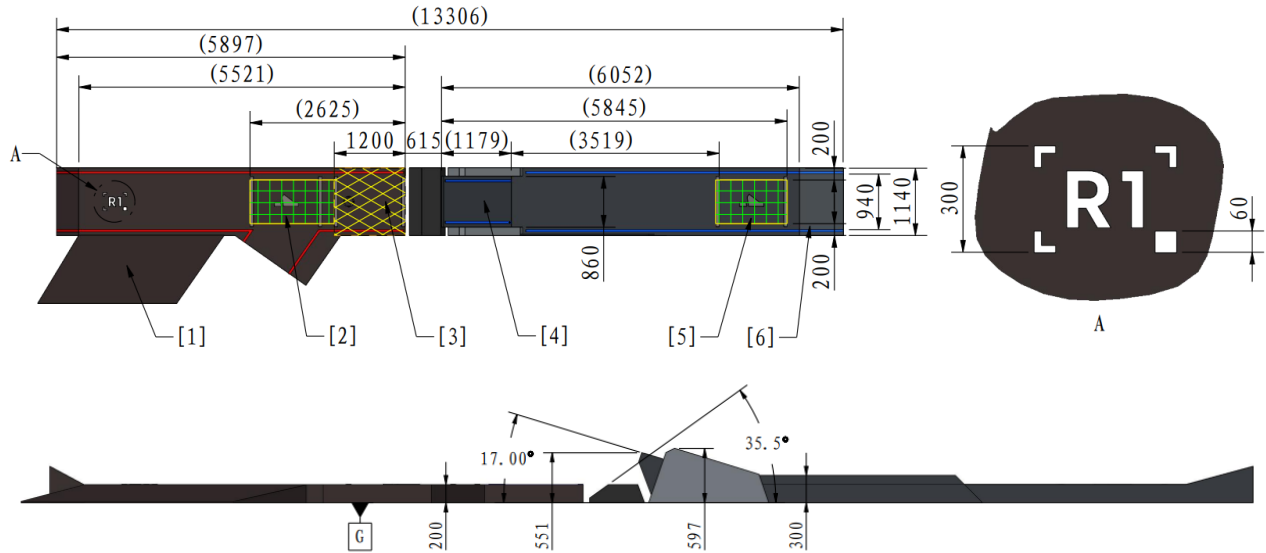


[1] Power Rune Activation Point Penalty Zone

Figure 4-31 Power Rune Activation Point Penalty Zone

4.3.5 Road Zone

The Road Zone connects the Trapezoid-shaped Elevated Grounds of both sides. The Road Zone includes the road and the Launch Ramp. Each road has two Launch Ramp Buff Points, which are located respectively on the roads in front of and behind the Launch Ramp. The Buffer Zone on the road is a Road Penalty Zone. Except for using the Launch Ramp, the robots of both sides are forbidden from entering the zone.



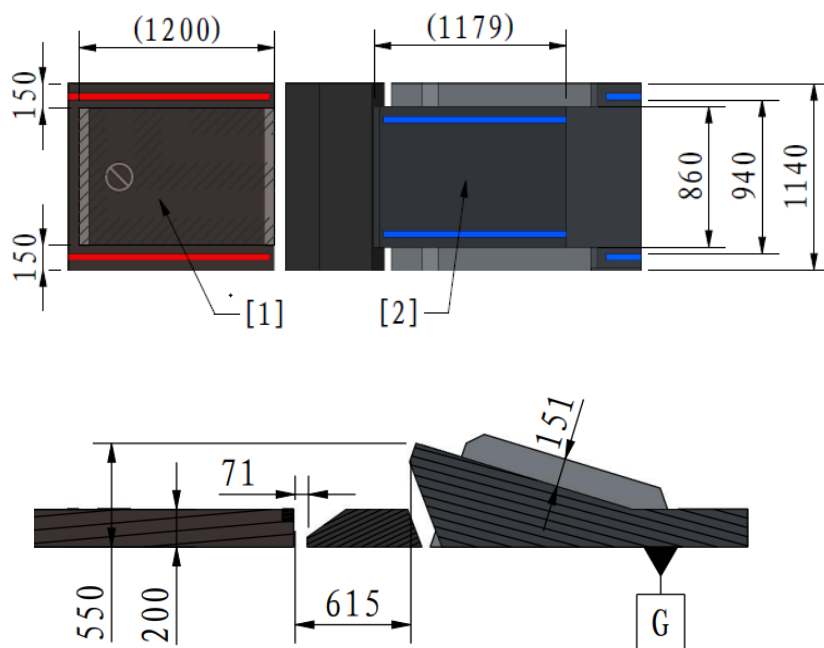
[1] 9° Slope [2] Launch Ramp Buff Point 1 [3] Road Penalty Zone

[4] 17° Slope [5] Launch Ramp Buff Point 2 [6] 15° Slope

Figure 4-32 Road Zone

4.3.5.1 Launch Ramp

The Launch Ramp is located on the Road Zone, with which robots can fly over the ravine and reach the territory of the other team quickly. The Road Zone situated 1200mm from the edge of the ravine is the Buffer Zone. EVA foam rubber with a thickness of 100mm and hardness of 25 HC should be placed under the road surface.



[1] Buffer Zone [2] 17° Slope

Figure 4-33 Launch Ramp

4.4 Open Zone

The Open Zone consists mainly of an Outpost, Power Rune, Large Resource Island, and Controlled Zones. Part of the Open Zone are Bumpy Roads.

4.4.1 Large Resource Island

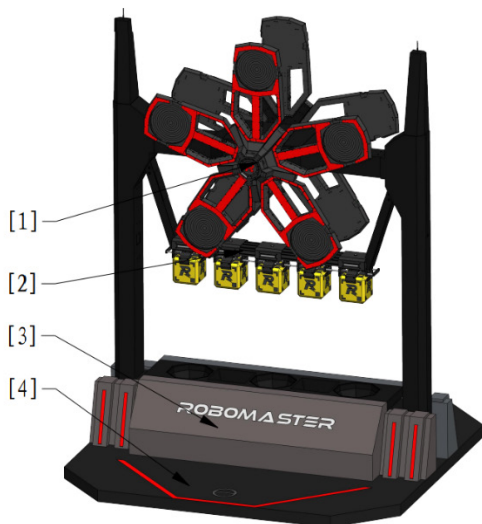
The Large Resource Island is located at the center of the Battlefield and directly below the Power Rune. It consists of five Large Resource Island Grippers and a Large Resource Island Base. At the start of the competition, each Gripper holds a mineral. During the match, the Grippers will release their minerals into their corresponding slots in the Large Resource Island Base. Each Gripper has two status indicators each facing the red and blue team respectively. The status indicator of the gripper shows different light effects according to its status, as shown below:

Table 4-3 Light Effects of Status Indicators on Grippers

Gripper Status	Status Indicators of Grippers
1.5 Seconds Before Releasing	White flashes (3Hz)

Gripper Status	Status Indicators of Grippers
Released	Off
Unreleased	Solid white

- When a mineral is dropped, the side with the barcode will be facing down.
- The mineral may not necessarily fall squarely in the slot of the Large Resource Island Base.
- The slots below Mineral No. 2 and 4 are flatter; while those under Mineral No. 1, 3, and 5 have uneven bases. After a mineral is dropped into the slot, the distance between its center of mass and the flat surface of the Large Resource Island shall be between 490mm and 550mm, and its position will be random. Moreover, the mineral's side with the barcode may not be facing down.



- [1] Power Rune [2] Large Resource Island Gripper [3] Large Resource Island Base [4] Large Resource Island Flat Surface

Figure 4-34 Axonometric View of the Large Resource Island Zone

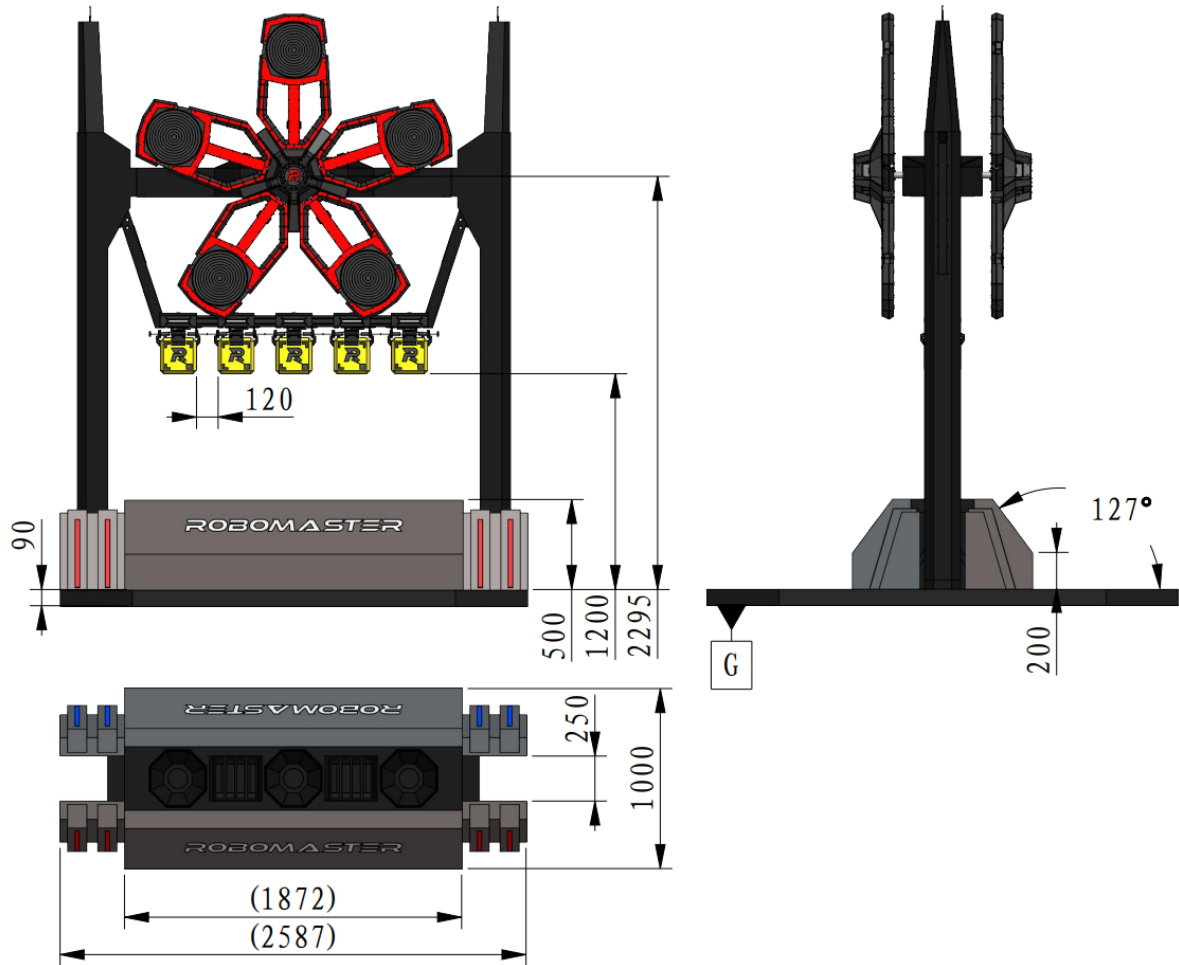
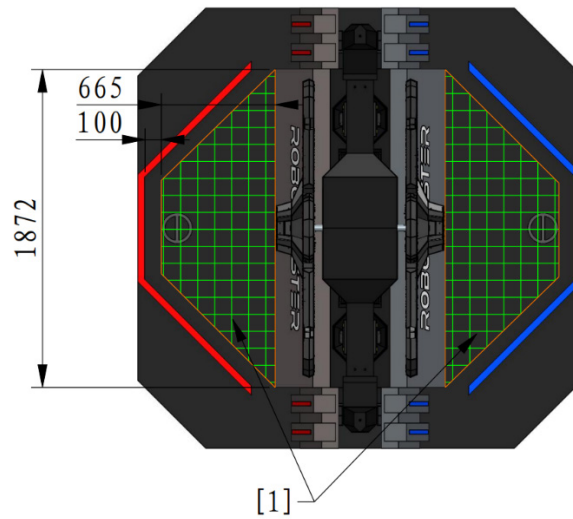


Figure 4-35 Dimensions of the Large Resource Island



Figure 4-36 Mineral Positions After being Dropped (for illustration only)

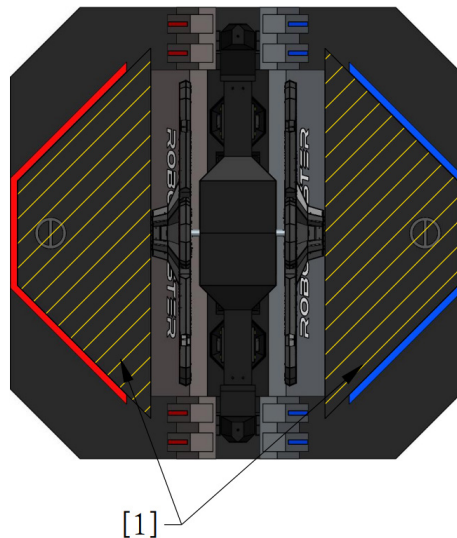
The Resource Island Buff Point is located on both sides of the Large Resource Island, as shown below:



[1] Resource Island Buff Point

Figure 4-37 Resource Island Buff Point

The Resource Island Penalty Zone is located on both sides of the Large Resource Island, as shown below:



[1] Resource Island Penalty Zone

Figure 4-38 Resource Island Penalty Zone

4.4.2 Power Rune

The Power Rune is located directly above the Large Resource Island. The Power Rune is powered by the motor and rotates synchronously at a regular rhythm. A robot needs to occupy the Power Rune Activation Point to activate the Power Rune. The Power Rune of the red team is located on one side and that of the blue team is located on the other.



- The Power Rune will have a slight dip in the middle due to its weight. The dip is around 0~50mm.
- Due to the viewing angle and transmission gap, a team may see parts of the Power Rune of the other side when observing its own Power Rune.

The Power Rune consists of five evenly distributed mounting brackets. Their positions and dimensions are as shown below.

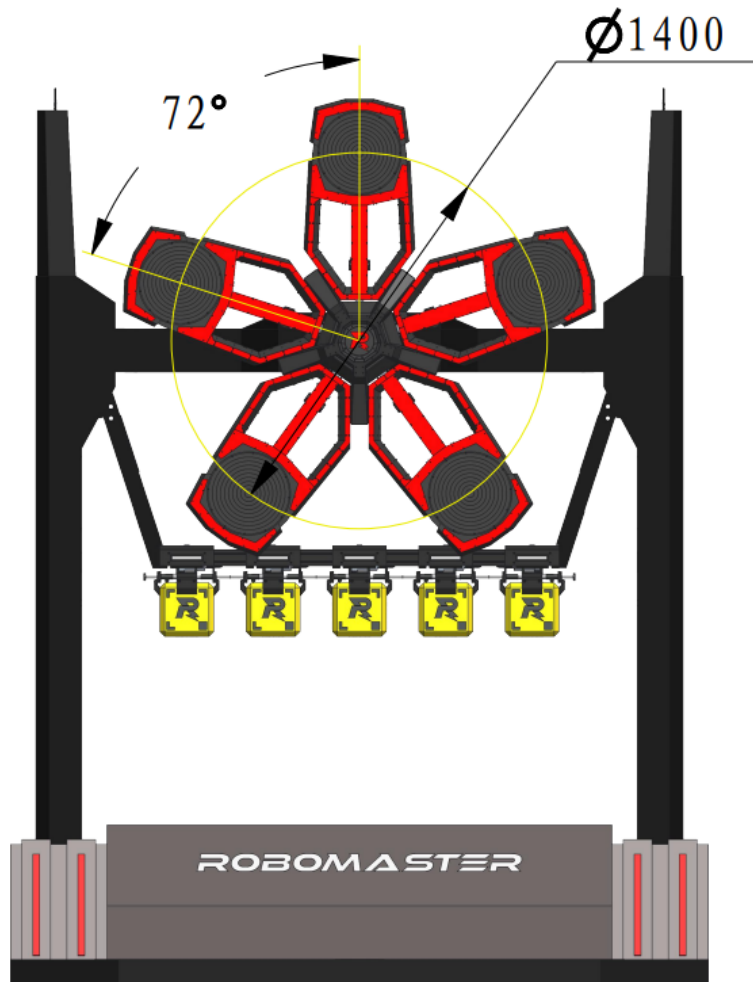


Figure 4-39 Power Rune

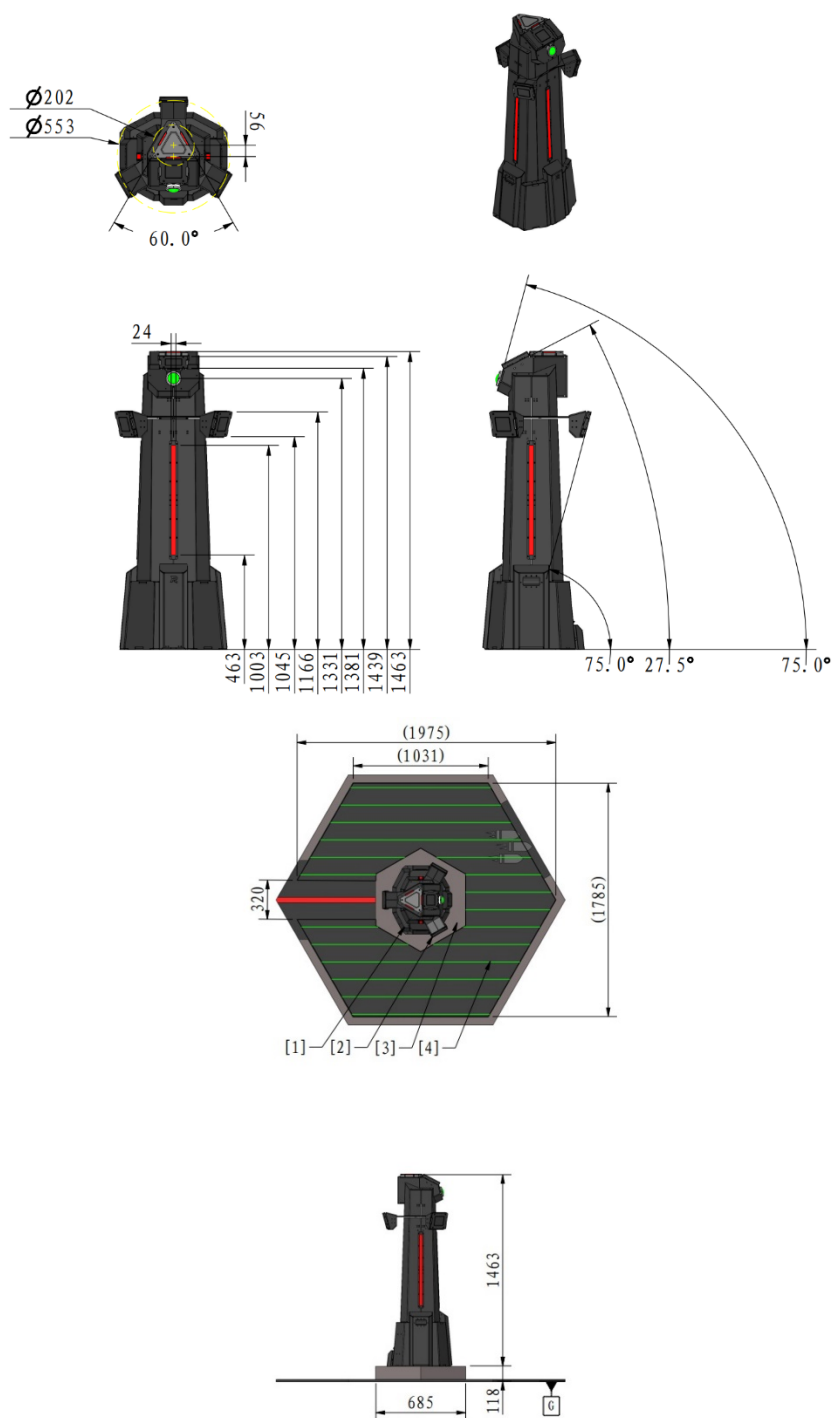
 The actual maximum diameter of a light arm's round target is 308mm, and its effective detection diameter is 300mm.



4.4.3 Outpost

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The Armor Module is divided into the Triangular Armor Module at the top and Rotating Armor Module in the middle. Refer to “Figure 4-11 Dart Detection Module” for a drawing of the Dart Detection Module. The Outpost Buff Point is located around the Outpost, its specific location is as shown below:



[1] Outpost

[2] Rotating Armor

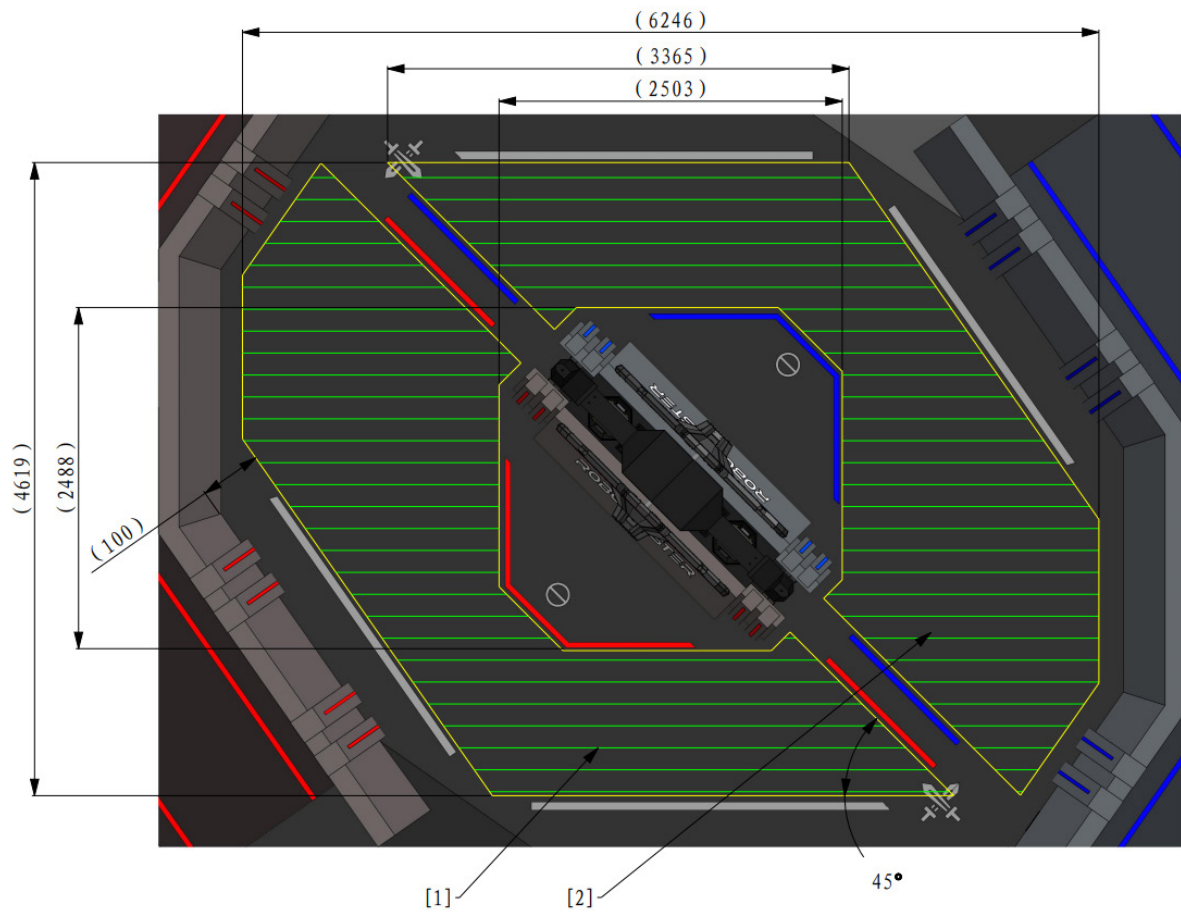
[3] Outpost Base

[4] Outpost Buff Point

Figure 4-42 Outpost

4.4.4 Controlled Zones

The Controlled Zones are located near the Large Resource Island, each belonging to the red and blue teams respectively.



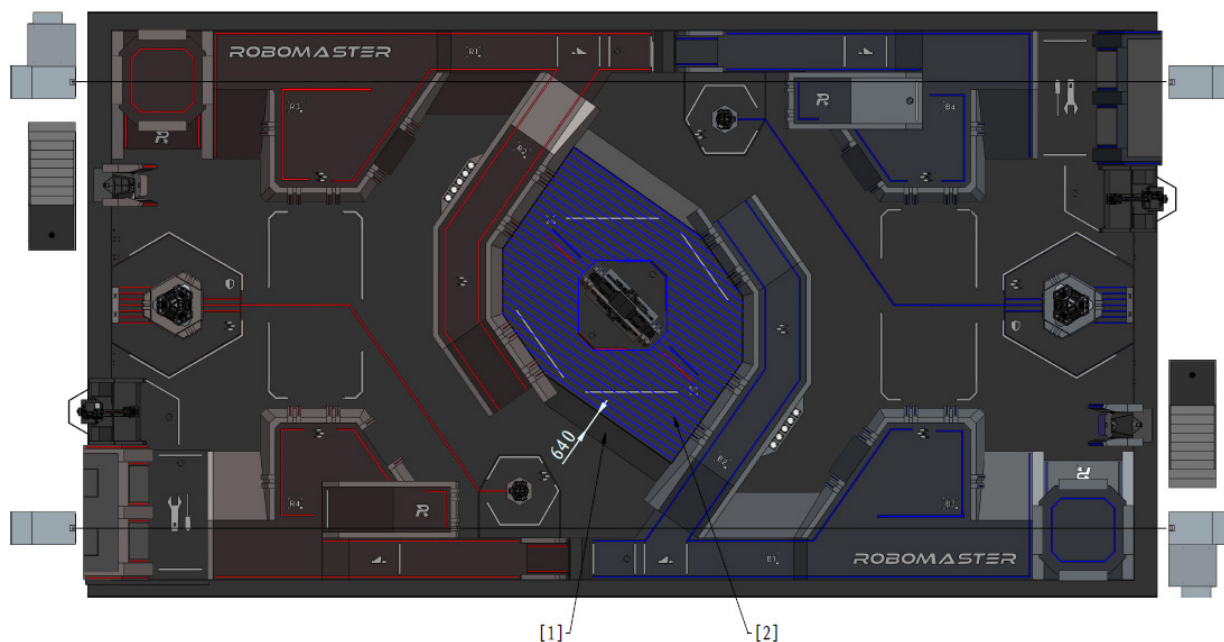
[1] Red Controlled Zone

[2] Blue Controlled Zone

Figure 4-43 Controlled Zones

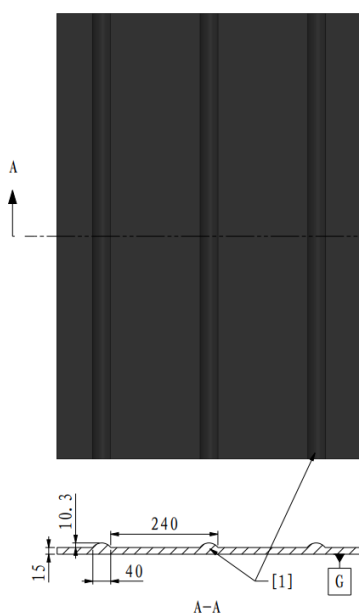
4.4.5 Bumpy Roads

The Bumpy Roads are located in some parts of the Open Zone. They have evenly spaced bumps on their surface with PVC flooring. The bumps of the Bumpy Roads are parallel with the long lower edge of the 8° slope of the Resource Island Zone.



[1] 8° Slope [2] Bumpy Roads

Figure 4-44 Bumpy Roads

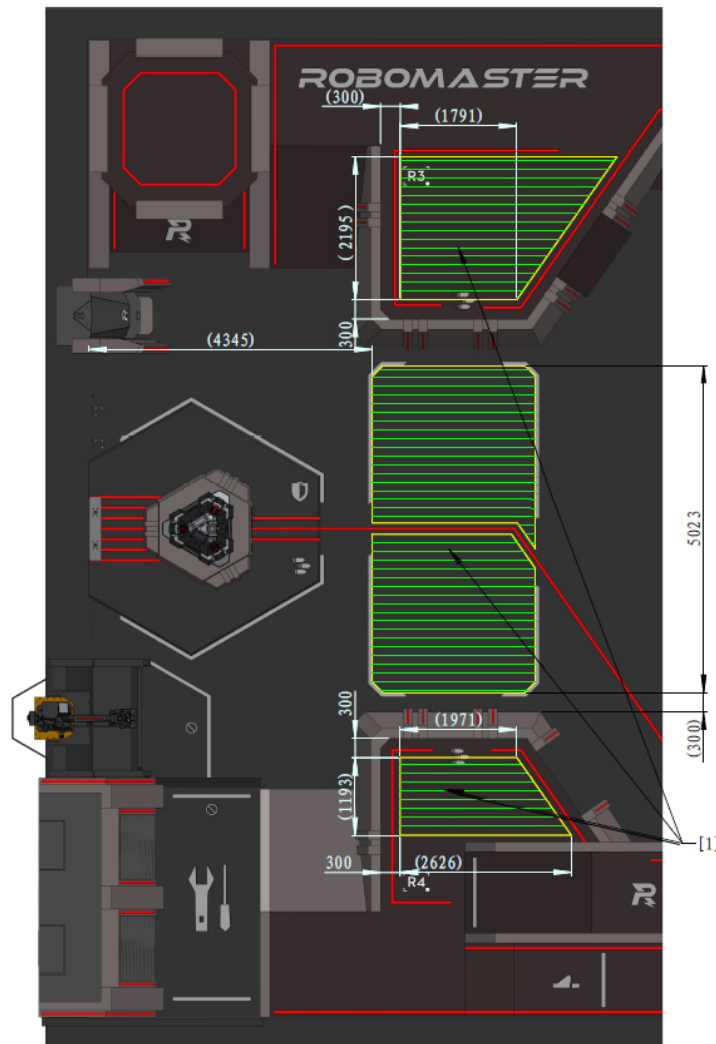


[1] Bump

Figure 4-45 Illustration of the Bumps

4.5 Sentry Patrol Zones

The Sentry Patrol Zones are the main activity area for Sentry Robots, as shown below:



[1] Sentry Patrol Zones

Figure 4-46 Sentry Patrol Zones

4.6 Flight Zone

The Flight Zone is the flight area for Aerial Robots. It includes the Landing Pad and the air space above it as well as the air space above the road connected to the R3 Trapezoid-Shaped Elevated Ground.

An Aerial Robot must be attached with an Aerial Safety Rope during a match to ensure the robot's safety. The Aerial Safety Rope is 2.4m long. The flight distance is restricted by the Snap Ring of the Aerial Safety Rope. The distance of the Snap Ring from the wide edge of one team's side of the Battlefield is 16 m. When an Aerial flies to the furthest location, the indicator on the retrieval device of the Aerial will flash at a frequency of 2Hz. The Pilot will be able to see yellow flashes from the indicator through the goggles. At this time, a Pilot is not allowed to fly an Aerial forward to ensure flight safety.

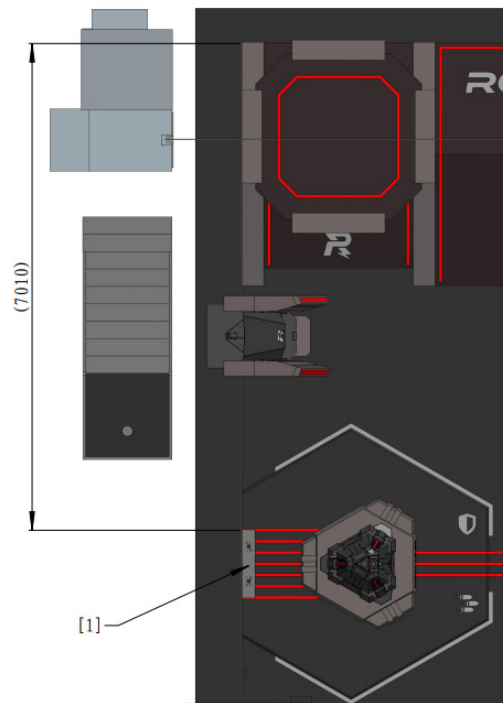
4.7 Other

4.7.1 Mobile Battlefield Components

Robots are allowed to grab and carry two types of Mobile Battlefield Components throughout the Battlefield, namely obstacle blocks and minerals.

4.7.1.1 Obstacle Block

An obstacle block is an EVA right triangular prism, with a surface and internal hardness of 60 ± 5 HC and 38 ± 5 HC respectively, and a weight of about 2,250 g. There is one obstacle block on each team's side of the Battlefield. Both teams' robots are allowed to use all the two obstacle blocks. The obstacle blocks are located behind the Bases of the two teams, with their shorter side in contact with the ground.



[1] Obstacle Blocks in Starting Zone

Figure 4-47 Obstacle Block Starting Zone

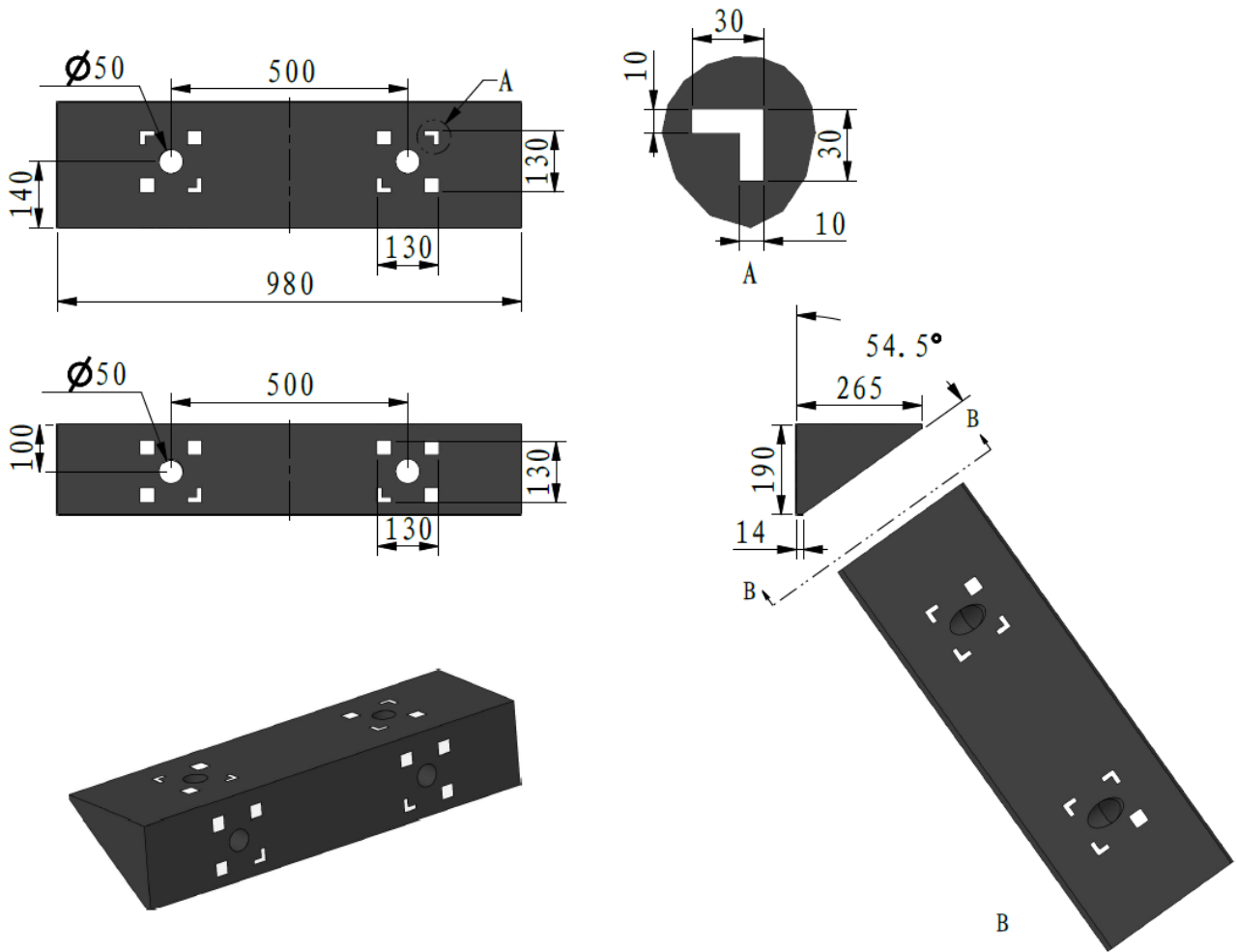


Figure 4-48 Obstacle Block

4.7.1.2 Minerals

A mineral is an EVA cube with beveled edges, dimensions of 200*200*200mm, a mass of 600g~700g, hardness of 38 ± 5 HC, and contains an RFID Interaction Module Card. The barcode images on all the minerals are the same, and the parallel distance between their RFID Interaction Module Cards and the surface of their barcode images is 50mm.

Large Resource Island Minerals (“Gold Minerals”):

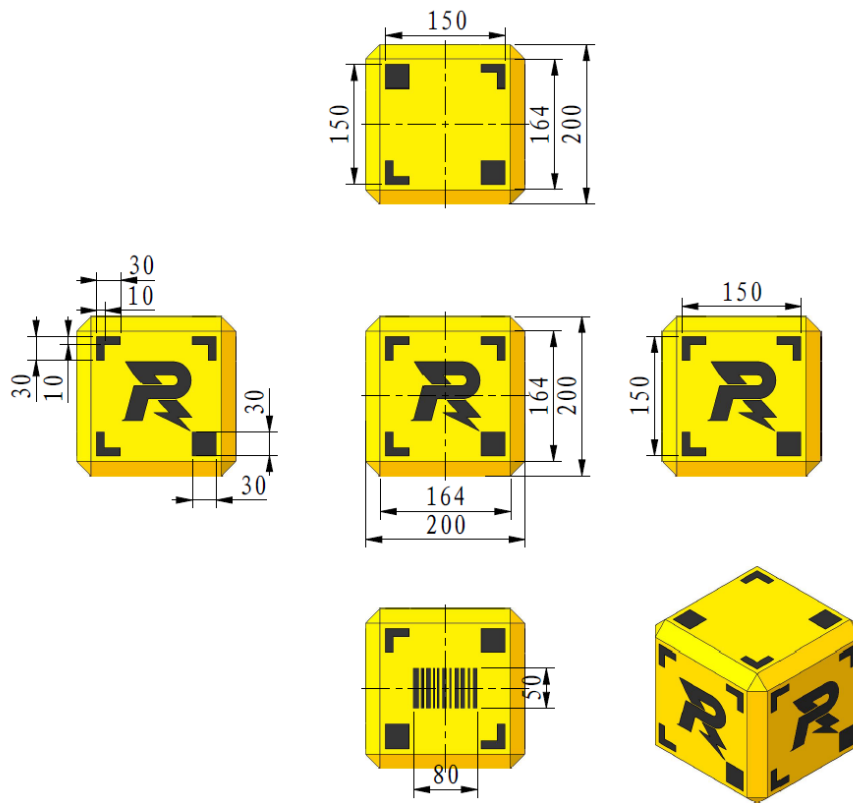


Figure 4-49 Gold Minerals

Small Resource Island Minerals (“Silver Minerals”):

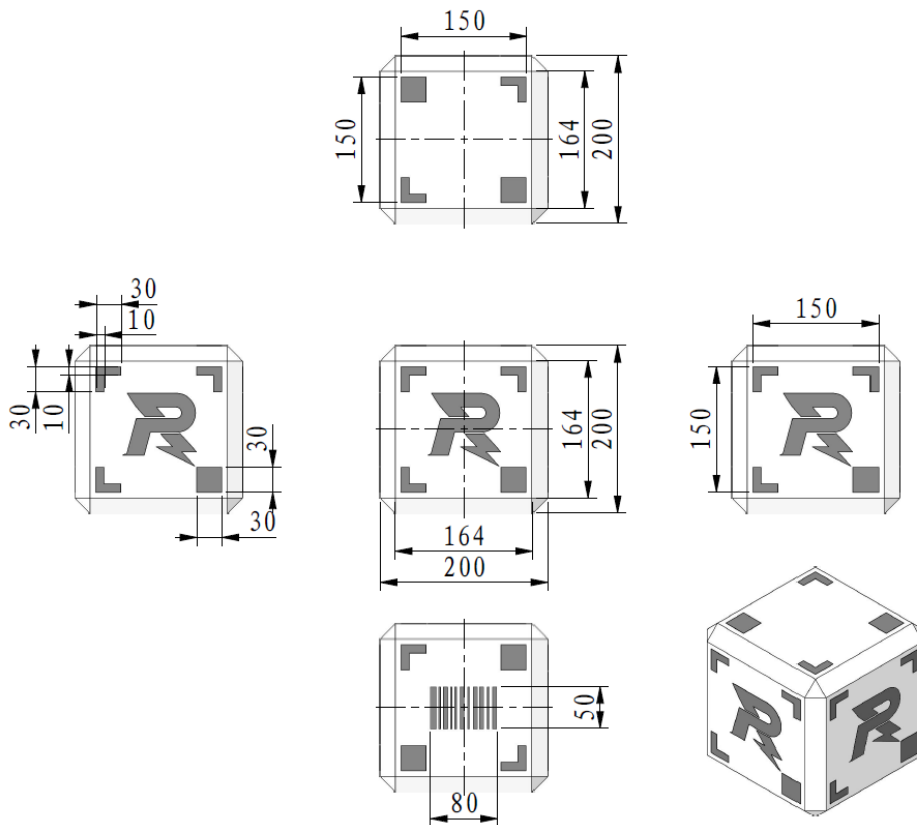


Figure 4-50 Silver Minerals

4.7.2 Projectiles

A robot can attack another robot's Armor Module by launching projectiles, thereby causing HP damage and ultimately destroying the robot. The parameters and scenarios of use for projectiles in the competition are as follows:

Table 4-4 Projectile Parameters and Scenarios of Use

Type	Appearance	Color	Size	Weight	Shore Hardness	Material	Scenarios of Use
42mm Projectile	Similar to a golf ball	White	42.5mm ± 0.5mm	41g ± 1g	90A	Plastic (TPE)	N/A
42mm Luminous Projectile	Similar to a golf ball	Semi-transparent	42.5mm ± 0.5mm	44.5g±0.5g	90A	Plastic (TPE)	The entire RMUC 2023
17mm Fluorescent Projectile	Spherical	Yellow-green	16.8mm ± 0.2mm	3.2g ± 0.1g	90A	Plastic (TPU)	The entire RMUC 2023

4.7.3 Localization Markers

There are several markers in the Battlefield that enable the localization of robots. The patterns will not be repeated and are asymmetrical in all directions. The site localization tag R0 is affixed on the vertical surface near the Small Resource Island on the R2 Ring-shaped Elevated Ground, as shown in “Figure 4-27 R2 Elevated Ground”. The positions of the other site localization tags are as shown below.

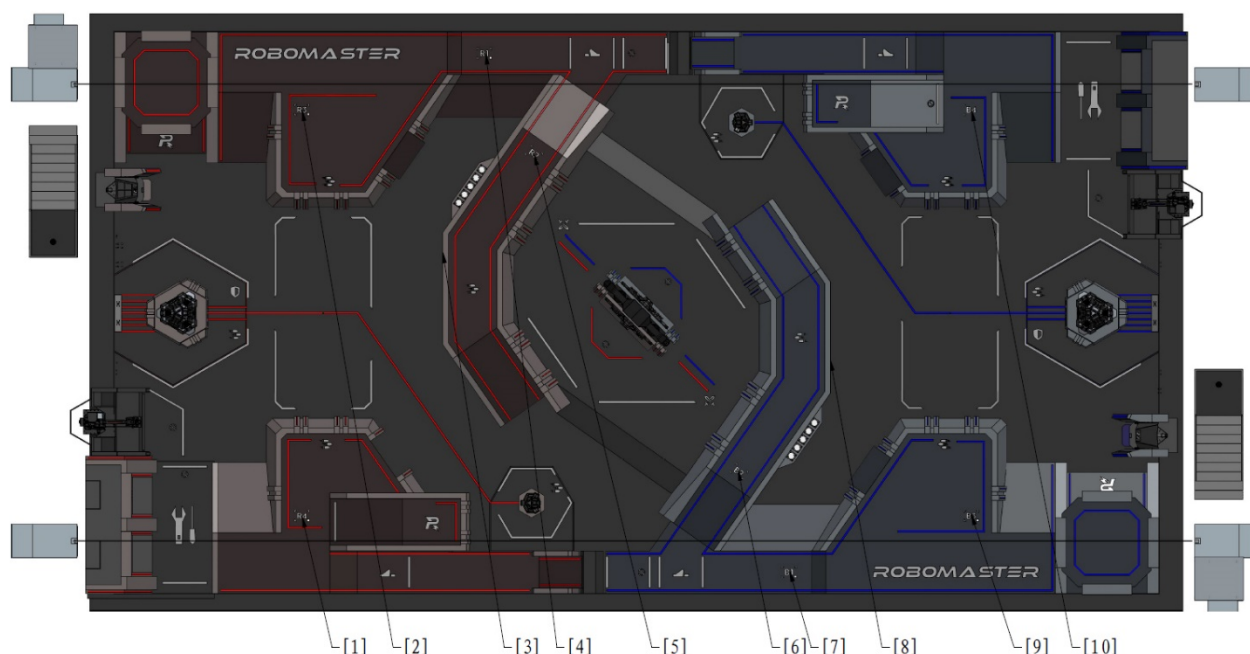


Figure 4-51 Localization Markers

Table 4-5 Coordinates of the Localization Markers

No.	1	2	3	4	5	6	7	8	9	10
Numbering	R4	R3	R0	R1	R2	B2	B1	B0	B3	B4
X	4825	4825	8805	9715	11175	16670	17885	19195	22775	22775
Y	-12770	-1930	-5730	-420	-3020	-11505	-14280	-9270	-12770	-1930
Z	400	400	-	200	600	600	200	-	400	400
Included angle	0°	0°	-	0°	35°	35°	0°	-	0°	0°



The corner of the Red Team's Landing Pad near the parameter wall near above the horizontal plane is the origin of the coordinates on the XY plane; the elevation point of the Battlefield ground is the origin of the Z-axis, i.e. point B in the figure below. The coordinates of each localization marker are the distance from the upper left of that marker to the origin of the coordinates. The included angle of a localization marker is the angle formed by that point and the R3 localization marker.

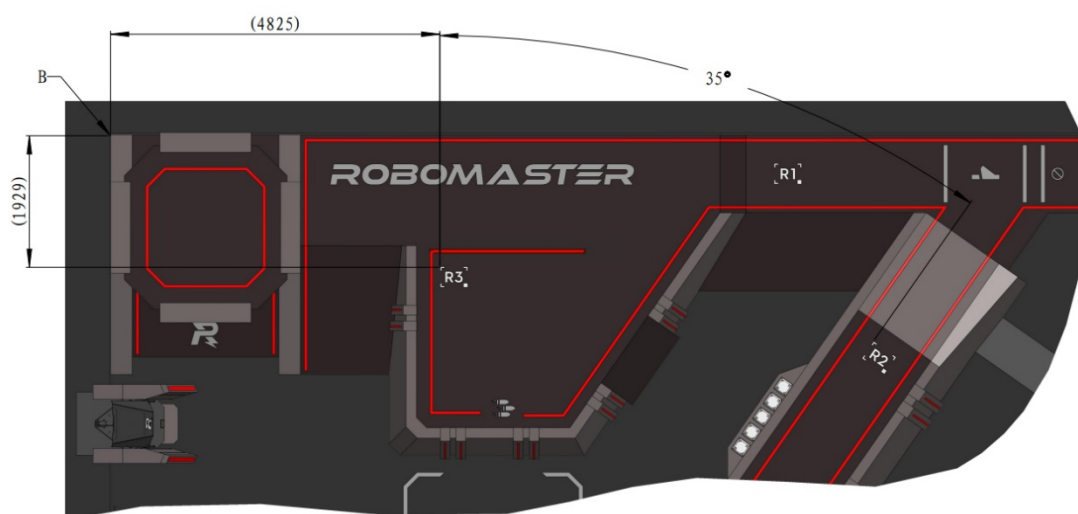


Figure 4-52 Illustrations of Origin of Coordinates and Included Angle

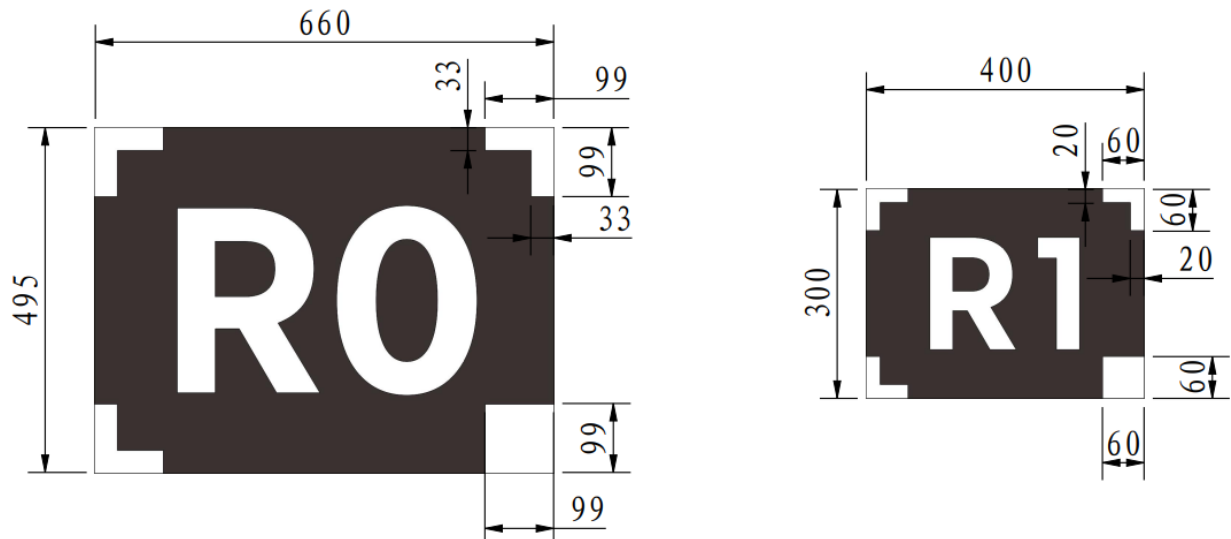


Figure 4-53 Dimensions of the Localization Markers



The dimensions are the same for tags R1 to R4.

4.7.4 Operator Room

Operator Room lies outside the Battlefield and is an area for Operators during the competition. The Operator Room consists of the Main Operator Room and the Pilot Room. The Main Operator Room shall be equipped with a corresponding number of computers, each connected to its corresponding official equipment such as a monitor, mouse, keyboard, USB hub and wired headset. The Pilot Room shall come with wired headphones, pilot goggles, and safety helmets.

5. Competition Mechanism

5.1 HP Deduction Mechanism

The HP of robots may be deducted in any of the following situations. The Referee System will round off the HP deduction to the nearest integer when calculating the HP.

Table 5-1 Overview of the HP Deduction Mechanism

Reason \ Robots	Hero Robot	Hero Robot	Standard Robot	Sentry Robot
Exceeding the Initial Launching Speed Limit	√	-	√	√
Exceeding the Barrel Heat Limit	√	-	√	√
Exceeding Chassis Power Consumption Limit	√	-	√	-
Armor Module Attacked by Projectiles	√	√	√	√
Armor Module Collided	√	√	√	√
Critical Referee System Modules Gone Offline	√	√	√	√
Yellow Card	√	√	√	-
Red Card	√	√	√	√

5.1.1 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 17mm 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 5-2 Penalty Mechanism for Exceeding Initial Launching Speed Limit

17mm projectile	L%	42mm 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%

5.1.2 Exceeding the Barrel Heat Limit and Cooling

Let the Barrel Heat Limit as Q_0 , the current barrel heat as Q_1 . For each 17mm projectile detected by the Referee System, the current barrel heat Q_1 is increased by 10 (regardless of its initial speed). For each 42mm projectile detected, the current barrel heat Q_1 is increased by 100 (regardless of the 42mm projectile's initial speed). The barrel cools at a frequency of 10Hz. 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 $Q_1 \leq Q_0$. The FPV of the player's client is as follows:

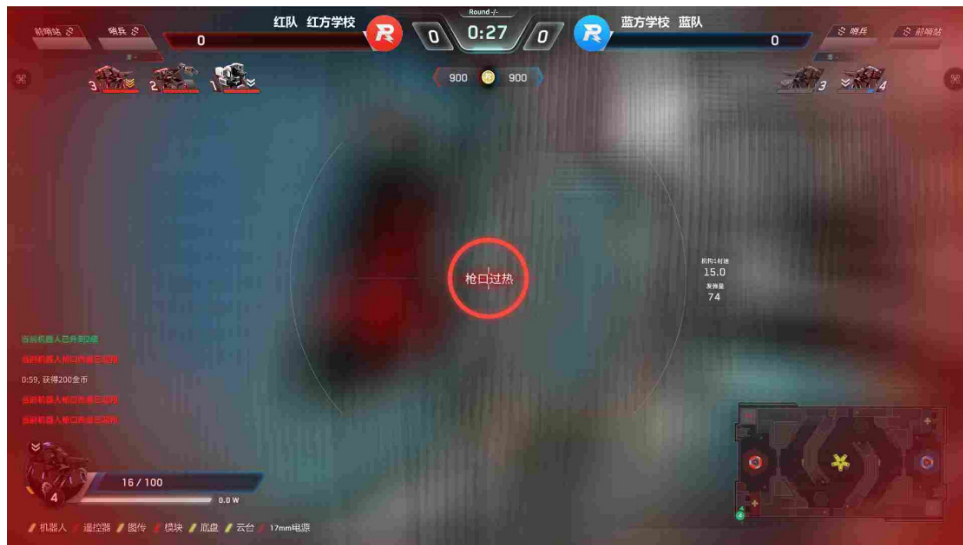


Figure 5-1 FPV of Participant

- 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 calculation and cooling logic when the Barrel Heat Limit is exceeded:

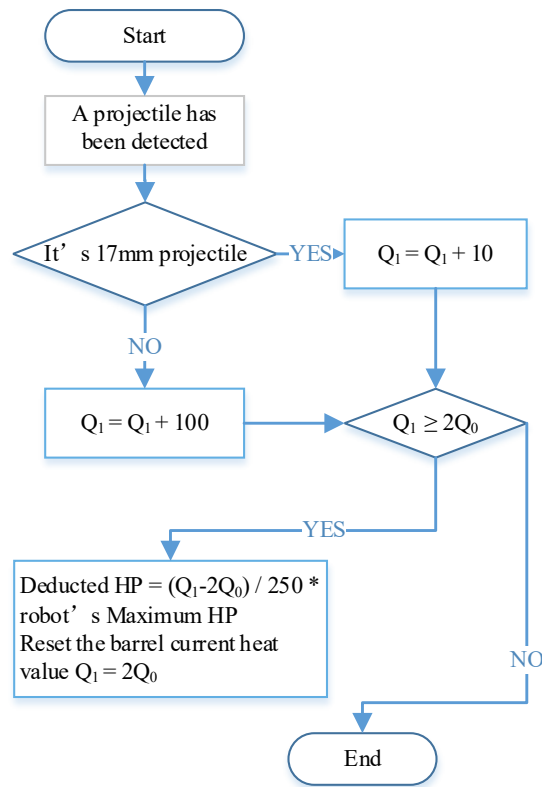


Figure 5-2 Barrel Heat Calculation Logic

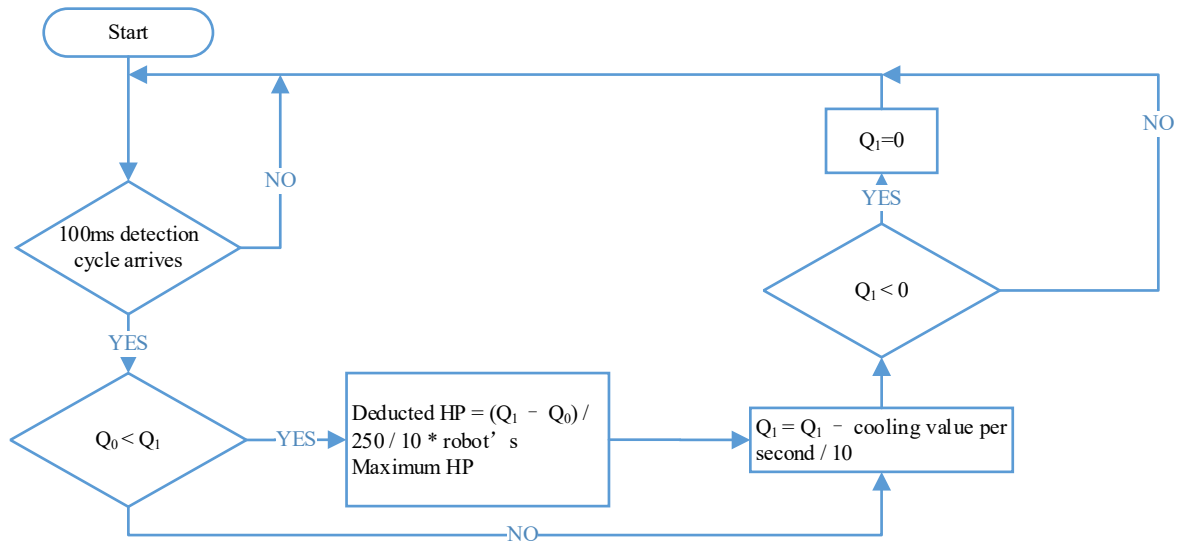


Figure 5-3 Barrel Heat Cooling Logic

5.1.3 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 of Hero, Standard or Sentry Robots may alter in the following two situations:

- If a Hero, Standard, or Sentry has not triggered the Launch Ramp Buff, its Buffer Energy Limit is 60J;
- If a Hero, Standard or Sentry has triggered the Launch Ramp Buff, its Buffer Energy Limit will increase to 250J. If the Buffer Energy reaches below 60J after subsequent consumption, it can be restored up to 60J. Refer to “5.5.3 Launch Ramp Buff Mechanism” for details on the Launch Ramp buff mechanism.

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 Referee System calculates Chassis Power Consumption at a frequency of 10Hz.

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

Table 5-3 Penalty Mechanism for Exceeding Chassis Power Consumption Limit

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

For example: If the Maximum Chassis Power Consumption of a Hero Robot has been upgraded to 60W and its Maximum HP to 350, while maintaining a continuous power output of 120W without triggering the Launch Ramp Buff, then the 60J of Buffer Energy will be fully consumed after one second. The excess percentage that can be calculated in the next 100 ms detection cycle, $K = (120 - 60) / 60 * 100\% = 100\%$. Since $K > 20\%$, the deducted HP = $350 * 40\% * 0.1 = 14$.

The logic graph for Chassis Power Consumption detection and HP deductions for a Standard or Hero Robot is shown below:

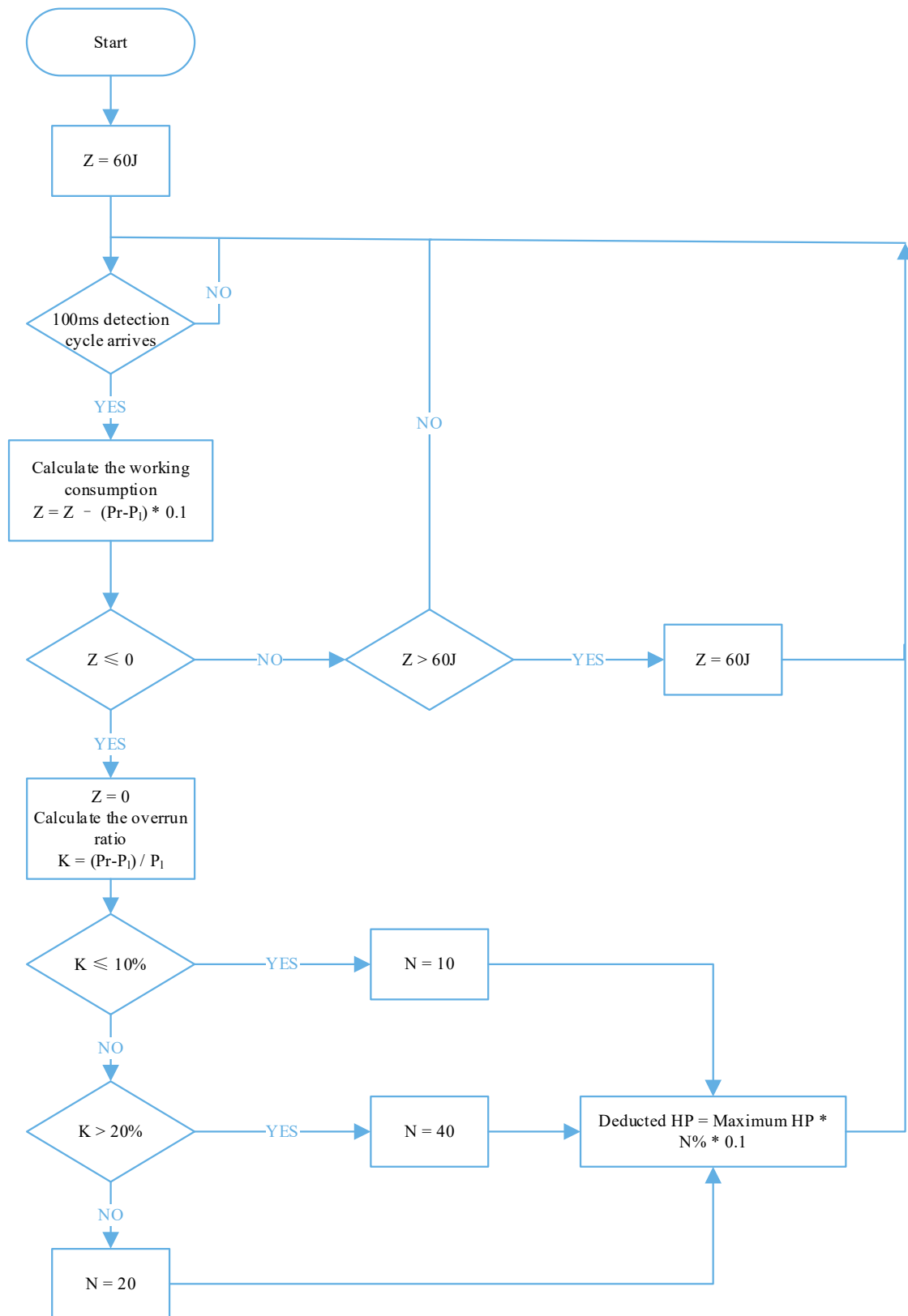


Figure 5-4 Chassis Power Consumption Detection and HP Deduction Logic of Standard and Hero

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:

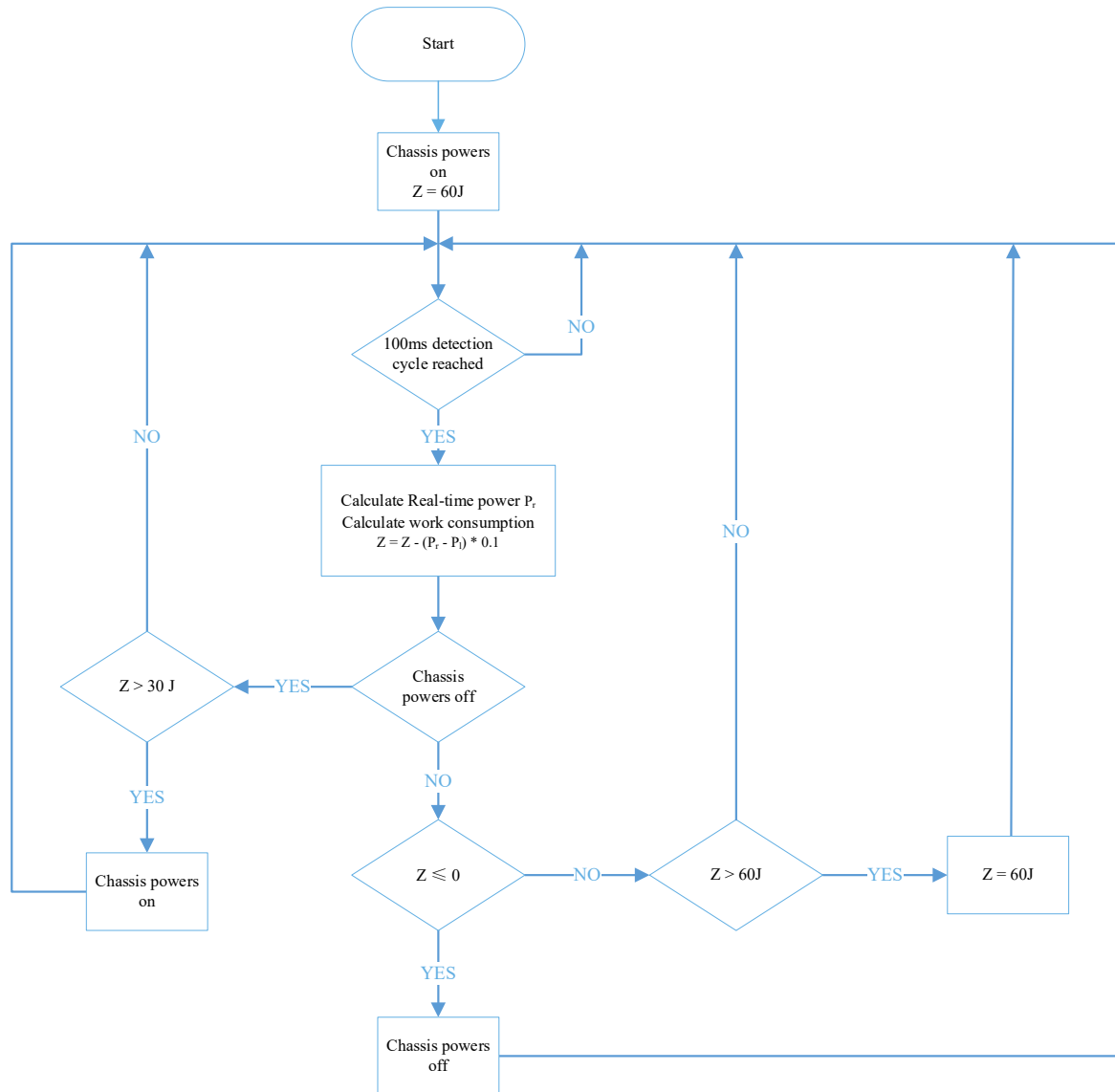


Figure 5-5 Chassis Power Consumption Detection and Chassis Power-off Logic of Sentry

5.1.4 Attack Damage

The Dart Detection Module detects attacks from Darts and 42mm projectiles through the Armor Module and the phototube. The minimum detection interval for Dart detection is 1,000ms.

An Armor Module detects projectile attacks through pressure sensors and the vibration frequency on the armor panel. The shortest detection interval for an Armor Module is 50ms (when an Armor Module is hit with a 42mm projectile, the detection interval can be extended to a maximum of 200ms).

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 5-4 An Armor Module's Detection Speed for Different Projectile Types

Armor Module	17mm Projectile	42mm Projectile
Large Armor Module, Small Armor Module	Higher than 12m/s	Higher than 8m/s
Triangular Armor Module	Non-applicable	Higher than 6m/s
Power Rune Armor Module	Higher than 12m/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.
- Teams are not allowed to hit a Power Rune with 42mm projectiles.

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).

Without buffs, the original HP damage shall be as follows:

Table 5-5 Attack Damage Deduction Mechanism

Target \ Damage Type	42mm Projectile	17mm Projectile	Collision	Dart
Robot Armor Module	100	10	2	0
Base Large Armor Module	200	5	2	0
Base Triangular Armor Module	300	0	0	0
Base Dart Detection Module	200	0	0	1000
Outpost Small Armor Module (static)	200	5	2	0

Target \ Damage Type	42mm Projectile	17mm Projectile	Collision	Dart
Outpost Small Armor Module (spinning)	200	10	2	0
Outpost Triangular Armor Module	300	0	0	0
Outpost Dart Detection Module	200	0	0	750

5.1.5 Referee System Going Offline

According to 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 2Hz. If Critical Referee System Modules go offline due to design or structural problems, it will result in the deduction of the HP of the corresponding Ground Robots.



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

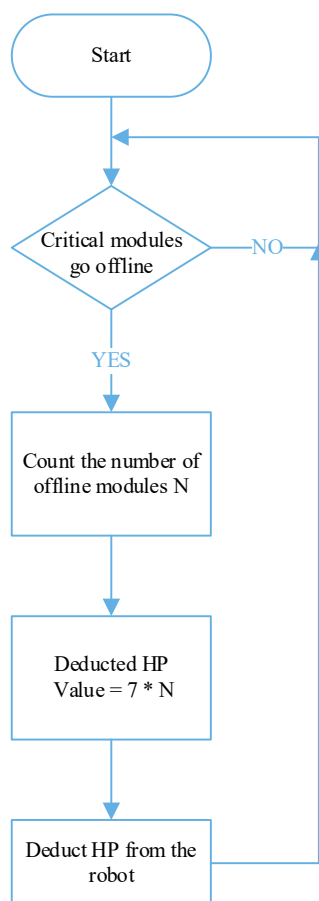


Figure 5-6 HP Deduction Mechanism for Critical Referee System Modules Going Offline

5.1.6 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 5-6 Consequences of Irregular Offline Status

Robot Type	Consequences of Irregular Offline Status
Hero, Engineer, and Standard	<ul style="list-style-type: none"> When the power supply to the Launching Mechanism (if any), 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 respawn process stops.
Aerial Robot	<ul style="list-style-type: none"> The Launching Mechanism is powered off and Air Support cannot be called.

Robot Type	Consequences of Irregular Offline Status
	<ul style="list-style-type: none"> ● Image transmission is disconnected.
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.

5.2 Economy System

During the competition, both teams will earn Gold Coins regularly. They can also exchange minerals for additional coins. Gold Coins can be exchanged for air support, 17mm and 42mm Projectile Allowance, HP recovery, and instant respawn.

At the start of the competition, both parties each have 400 initial Gold Coins. For every subsequent minute, 50 Gold Coins are added until five minutes after the competition starts (when the countdown is at 1:59). Both teams will receive 150 Gold Coins at the sixth minute (when the countdown is at 0:59).

The scores obtained by a team for its “Project Documents” and “Technical Proposal” during the Final Robot Assessment will impact the team’s initial Gold Coin quantity for each round during the Regional Competition. The corresponding relationship between the impact and each score is as follows:

Table 5-7 The Impact of the Total Score of Project Documents

Total Score of Project Documents	Degree of Impact
[0,60)	-25
[60,80)	0
[80,90)	+25
[90,100]	+50

Table 5-8 The Degree of Impact of the Score of Technical Proposal

Technical Proposal Score	Degree of Impact
[0,60)	-75
[60,80)	0
[80,90)	+75
[90,100]	+150

Table 5-9 Rules for Exchange

Item for Exchange	Redemption Ratio	Redemption Limit
17mm Projectile Allowance	<ul style="list-style-type: none"> Exchange at Restoration Zone: 50 coins/50 rounds Remote exchange: 200 coins/100 rounds 	1,500 rounds/team
42mm Projectile Allowance	<ul style="list-style-type: none"> Exchange at Restoration Zone: 75 coins/5 rounds Remote exchange: 300 coins/10 rounds 	100 rounds/team
Air Support	[25 x ROUNDUP (remaining cooling period/25)] Gold Coins/time	Three times
HP (Remote Exchange)	[100 + ROUNDUP ((420 - remaining competition time/60) x 20)] Gold Coins/time	Twice/team
Instant Respawn	[ROUNDUP ((420 - remaining competition time)/60) x 100 + robot level x 50] Gold Coins/robot	Twice/robot



- The time unit is “second”.
- “ROUNDUP” means to round up to the nearest integer.
- If the remaining cooling period for air support is zero, then no Gold Coins will be required to exchange for an air support.

5.2.1 Projectile Supply Mechanism

Before the competition starts, robots with Launching Mechanisms are allowed to pre-load projectiles. After the competition starts, Standard and Hero Robots can reload their 17mm projectiles at the Official Projectile Supplier.

When a robot is at its team's Official Projectile Supplier, the Operator can reload projectiles through the player's client. If the robot detected the RFID Interaction Module Card in the Supplier Zone, the Operator can directly select the projectile reload quantity on the Projectile Supply panel. If the robot fails to detect any RFID Interaction Module Card, the projectiles can be loaded through "Force Reload". After the projectile reload quantity is selected, the Official Projectile Supplier will automatically release such quantity of projectiles.

In each round, the Official Projectile Supplier provides a maximum 1,500 rounds of 17mm projectiles.

5.2.2 Projectile Allowance Mechanism

The Projectile Allowance for 17mm and 42mm projectiles is calculated separately. For every round of projectiles fired by a robot, the Projectile Allowance corresponding to the type of projectiles fired is reduced by 1 round. When the corresponding Projectile Allowance is not zero, the Launching Mechanism will remain powered on; otherwise, it will be powered off. If a Hero Robot launches more projectiles than its allowance (the Speed Monitor Module detects a 42mm projectile has been fired when the Projectile Allowance is 0), the Referee System will shield all the armors of the other team's robots, Outpost, and Base from 42mm projectile damage.

Each robot's Initial Projectile Allowance and its mechanism are provided below.

Table 5-10 Overview of Robot Projectile Allowance

Robots	Initial Projectile Allowance	Projectile Allowance Mechanism
Hero Robot	0	Exchanges for Projectile Allowance at the Restoration Zone or remotely
Standard Robot	0	
Aerial Robot	0	Receives Projectile Allowance when air support is requested.
Sentry Robot	750	Projectile Allowance cannot be exchanged

Exchange at Restoration Zone

When a robot detects an RFID Interaction Module Card in the Restoration Zone, the Operator can redeem Projectile Allowance through the player's client. The specific projectile types and quantities are shown below.

Table 5-11 Projectile Allowance Types and Quantities (When Exchanging at the Restoration Zone)

17mm Projectile Allowance	42mm Projectile Allowance
50 rounds	5 rounds

17mm Projectile Allowance	42mm Projectile Allowance
100 rounds	10 rounds
200 rounds	20 rounds

Remote exchange

In every round, each team has two opportunities for exchanging Projectile Allowance for 17mm and 42mm projectiles.

If an active robot has not fired projectiles and suffered any HP deduction for 6 seconds, it can remotely exchange for Projectile Allowance through the player's client, i.e. exchanging outside the Restoration Zone. The specific projectile types and quantities that can be exchanged are shown below.

Table 5-12 Projectile Allowance Types and Quantities (Remote Exchange)

17mm Projectile Allowance	42mm Projectile Allowance
100 rounds	10 rounds

When a remote exchange is successful, the Projectile Allowance will be effective after six seconds.

5.3 Battlefield-related Mechanism

Table 5-13 Overview of Interaction Between Robots and the Battlefield

Battlefield Components \ Robots	Hero Robot	Hero Robot	Standard Robot	Aerial Robot	Sentry Robot	Dart System
Base	√	-	√	√	√	√
Outpost	√	-	√	√	√	√
Controlled Zones	√	-	√	-	-	-
Minerals	-	√	-	-	-	-
Obstacle Block	√	√	√	-	√	-
Exchange Station	-	√	-	-	-	-
Power Rune	√	-	√	√	√	-

5.3.1 Base-related Mechanism

Base HP is 5000.

After the Invincible status of a Base has been removed and the Sentry of its team still survives, the Virtual Shield

of the Base will be enabled and have 250 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.

5.3.2 Outpost-related Mechanism

Outpost HP is 1500.

The middle armor of the Outpost is rotatable. For its initial position, refer to "Figure 4-42 Outpost". After the competition begins, the middle armor will start rotating and reach a speed of 0.4r/s in 5 seconds, then rotate at a uniform speed in a random direction. In each round, the Outposts of both the Red and Blue teams will rotate in the same, fixed direction.

When the middle armor of the Outpost is rotating, the original HP damage dealt to it by a 17mm projectile increases to 10 points.

- When the relevant criteria of the Controlled Zones are triggered, the rotating speed of the middle armor of one team's Outpost reduces by half. For details, please refer to "5.3.3 Controlled Zone Mechanism".
- One team's Outpost armor will stop rotating if the following conditions are met:
 - The team's Outpost is destroyed;
 - The other team's Base Armor is unfolded;
 - Three minutes into the round (when the countdown is at 3:59).

When the Outpost survives and its rotating armor stops rotating, the rotating armor returns to its initial position.

Within the first three minutes of the competition (when the countdown is at 6:59-4:00), for every 500 cumulative HP damage dealt by one team to the Outpost of the other team and if the robot causing the 500th HP damage is detected by the system as a Hero or Standard Robot, such robot will receive 25 Experience Points, otherwise the 25 Experience Points will be distributed evenly among the surviving Hero and Standard Robots of its team. The average is rounded up and shall be accurate to one decimal place.

5.3.3 Controlled Zone Mechanism

Both the red and blue teams each have a Controlled Zone, the details of which can be found in "Figure 4-43 Controlled Zones". When the Outpost of a team is active, its Controlled Zone remains active. A team's robots may only occupy their own Controlled Zone.

When a team's Standard or Hero Robot has occupied its Controlled Zone while the other team has not occupied its own Controlled Zone for more than six seconds, the rotating speed of the other team's Outpost armor will be reduced by half until the occupying team's Standard and Hero Robots have all left their Controlled Zone.



The change of the rotating speed of the Outpost's middle armor will complete within 2 seconds.

5.3.4 Mineral-related Mechanism

A Hero Robot can grab minerals from the Small Resource Island and Large Resource Island.

In each round, the Large Resource Island releases its minerals in three batches. The first batch is released at the 15th second of a round, the second at the first minute, and the third at the third minute. In the first batch, Mineral No. 3 is released; in the second batch, Mineral No. 1 and 5 are released simultaneously; and in the third batch, Mineral No. 2 and 4 are released simultaneously. The numbering for the minerals is as shown below:

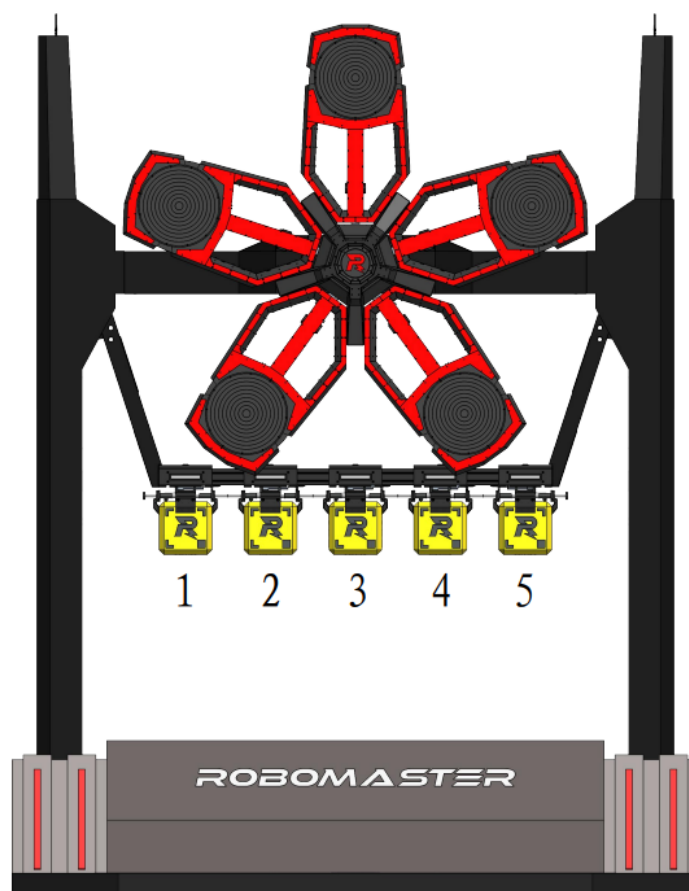


Figure 5-7 Numbering for Minerals

5.3.5 Exchange Station Mechanism

During the match, the Engineer carries minerals and places them in the Mineral Receptacle to exchange them.

The middle point of the intersecting edge between the front of the Exchange Station Base and the Battlefield ground shall be the origin "O". The direction towards the Mineral Collecting Slot from the normal line to the front plane of

the Base shall be the negative x-axis, while the upward vertical direction shall be the positive z-axis, thus forming a right-hand Cartesian coordinate system, named as the Exchange Station coordinate system OXYZ. The geometric center of the Mineral Receptacle's entry plane shall be the origin "E", the outward direction from the normal line to the Mineral Receptacle's entry plane shall be the positive x-axis, while the direction towards the "R" logo from the normal line to the Mineral Recognition Zone shall be the positive z-axis, thus forming a right-hand Cartesian coordinate system, named as the Mineral Receptacle coordinate system EX'Y'Z'. The outward-facing direction of the normal line to the entry plane of the Mineral Receptacle is e^{\rightarrow} . The symbol for the angle between the EX' axis of the Mineral Receptacle coordinate system and the XOY plane of the Exchange Station coordinate system shall be " θ "; that for the angle between the EY' axis of the former and the XOY plane of the latter shall be " Φ "; while the angle between the EX' axis of the former and the XOZ plane of the latter shall be known as " ψ ". The location and Euler angles of the Mineral Receptacle's point E in the Exchange Station coordinate system are to be collectively known as the pose of the Mineral Receptacle. The pose of the initial position (initial status) of the Mineral Receptacle coordinate system is: $x=-350$, $y=0$, $z=1150$, $\theta=0$, $\Phi=0$, $\psi=0$, unit of length is mm, and unit of angle is $^{\circ}$.

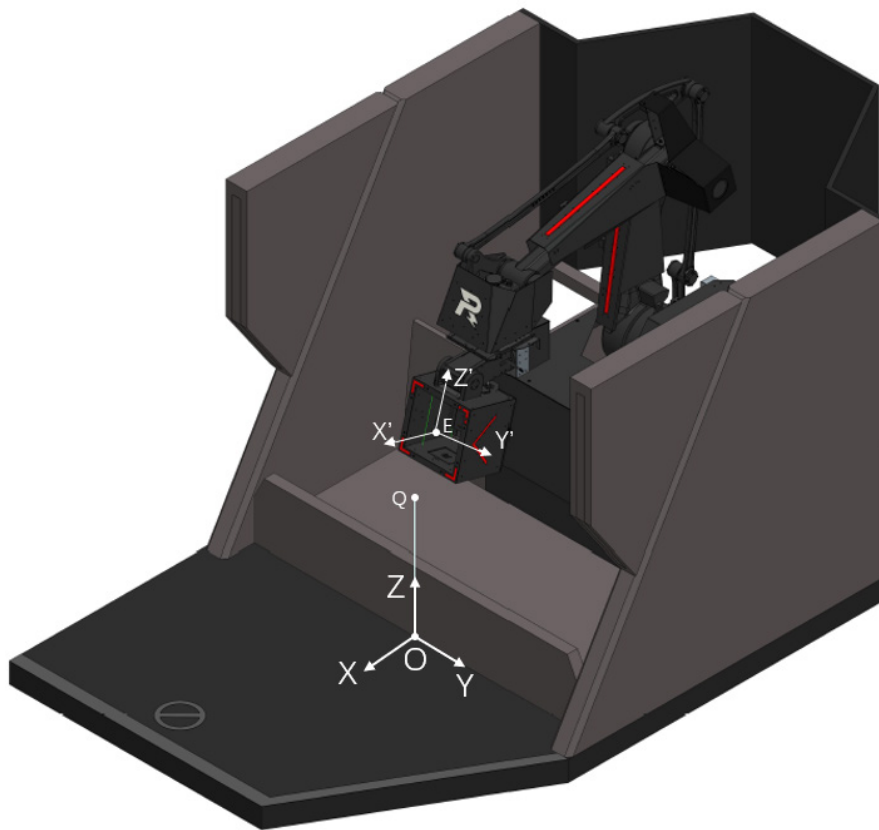
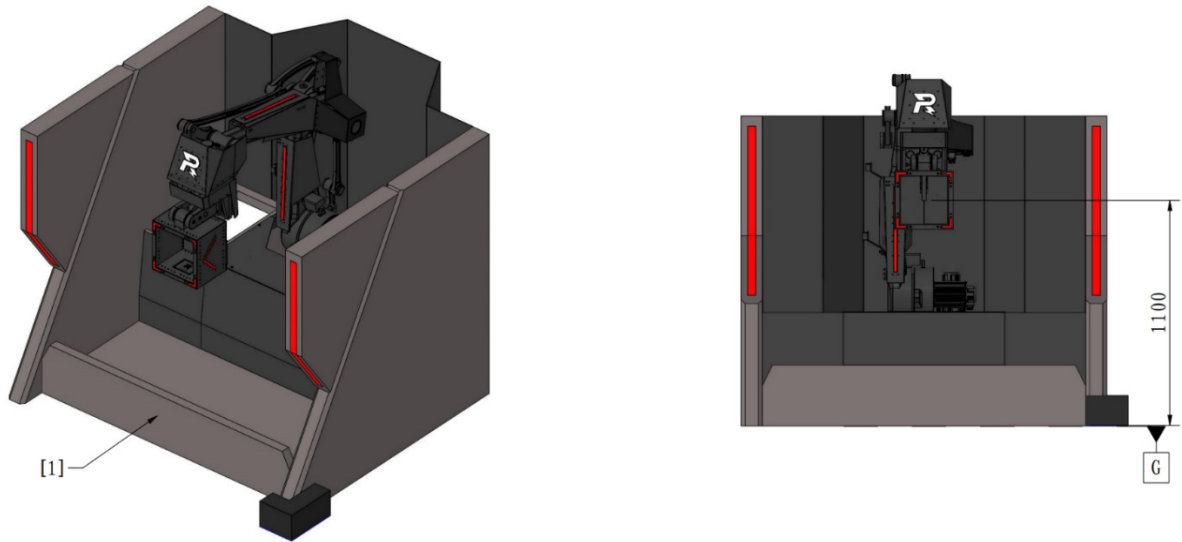


Figure 5-8 Coordinate System of the Exchange Station



[1] Front Guard of Exchange Station

Figure 5-9 The Mineral Receptacle in the Initial Position

The pose of the Mineral Receptacle shall satisfy the following:

- ① $x=-300, y=0, z=720$ or $x^2+y^2+(z-600)^2 \leq 300^2$ ($-270 \leq x \leq 0, -255 \leq y \leq 255, 720 \leq z \leq 900$);
- ② $\theta \in [0, 60], \Phi \in [-45, 45], \psi \in [-90, 90]$, when $\overrightarrow{EX'} \cdot \overrightarrow{OZ} > 0$, θ shall be positive; when $\overrightarrow{EY'} \cdot \overrightarrow{OZ} > 0$, Φ shall be positive; when $\overrightarrow{EX'} \cdot \overrightarrow{OY} > 0$, ψ shall be positive.
- ③ The coordinates of point Q is $(0, 0, 600)$, $|\vec{e}, \overrightarrow{EQ}| \in [0, 90]$;
- ④ Any structure of the Mineral Receptacle must not cross over the front plane of the Exchange Station Base.
- ⑤ The pose of the Mineral Receptacle is related to the difficulty level. Their relationship is as shown below:

Table 5-14 Value Range for the Mineral Receptacle's Pose at Different Levels of Difficulty

Level of Difficulty	x	y	z	θ	Φ	ψ
Level 0	-300	0	720	0	0	0
Level 1	-200	[-185,185]	720	0	0	0
Level 2	[-270, 0]	[-255, 255]	[720, 900]	0	0	0
Level 3	[-270, 0]	[-255, 255]	[720, 900]	[0, 60]	[-45, 45]	0
Level 4	[-270, 0]	[-255, 255]	[720, 900]	[0, 60]	[-45, 45]	[-90,90]

In each round and at the same level of difficulty, the change of position for the Mineral Receptacles of both the red and blue teams is the same.

When exchanging for minerals, an Operator can select their preferred level of difficulty. The quantity of Gold Coins available to acquire at each level of difficulty is different, as shown below.

Table 5-15 Gold Coin Quantities Available to Acquire for Each Difficulty Level

Level of Difficulty	Gold Coin Quantities Available for Exchange with Silver Minerals	Gold Coin Quantities Available for Exchange with Gold Minerals
Level 0	75	100
Level 1	100	125
Level 2	150	175
Level 3	225	250
Level 4	375	400

In each round, the first team to successfully exchange their Gold Minerals will receive additional 250 Gold Coins.

In addition, as the cumulative number of Gold Coins acquired by a team through mineral exchange increases, the team will be subject to a higher minimum level of difficulty, as shown below:


Table 5-16 Cumulative Gold Coins Received and Difficult Levels

Cumulative Gold Coin Quantity	Minimum Difficulty Level
575	Level 1
750	Level 2
1100	Level 3
1625	Level 4

Exchange process:

To exchange a mineral, the following four steps must be completed:

1. The Operator chooses the exchange difficulty on the player's client.
2. After the Mineral Receptacle moves into the corresponding position (exchangeable status), the Hero Robot drops the mineral in the correct direction (with the barcode facing down) into the Mineral Receptacle of the Exchange Station.
3. When the mineral is fully placed in and the Mineral Receptacle detects the RFID Interaction Module Card of the mineral, the Operator presses the corresponding button to confirm exchanging the mineral.
4. After the Exchange Station has retrieved a mineral, and if the system detects a successful exchange, the corresponding Gold Coins will be awarded to the exchanging party.

- When a mineral is fully placed in, the vertical projection of its bottom is completely within the inner Base of the Mineral Receptacle.
 -  ● The other non-barcode sides of the mineral in contact with the Mineral Recognition Zone may also be detected by the RFID Interaction Module.
 - A mineral that is not fully placed into a Mineral Receptacle may also be detected successfully.
-

In addition, the Operator should pay attention to the following during the exchange process:

- After choosing the exchange difficulty, the Operator must not change the difficulty when there is a mineral in the Mineral Receptacle. Before the mineral is successfully exchanged, the pose of the Exchange Station shall remain the same under the same difficulty.
- When exchanging minerals, the Hero Robot Operator may use the “Push Mineral” function which will move the Mineral Receptacle to its initial position and push out the mineral (if any) in the Mineral Receptacle. Thereafter, the Mineral Receptacle will return to its original position before the “Push Mineral” function was engaged.
- The Exchange Station will not detect obstacles in its path. If the Engineer Robot’s mechanisms come into contact or collide with the Mineral Receptacle during the movement of the Exchange Station, thus sustaining damage, it shall be borne solely by the participating team.

The specific exchange process is shown below:

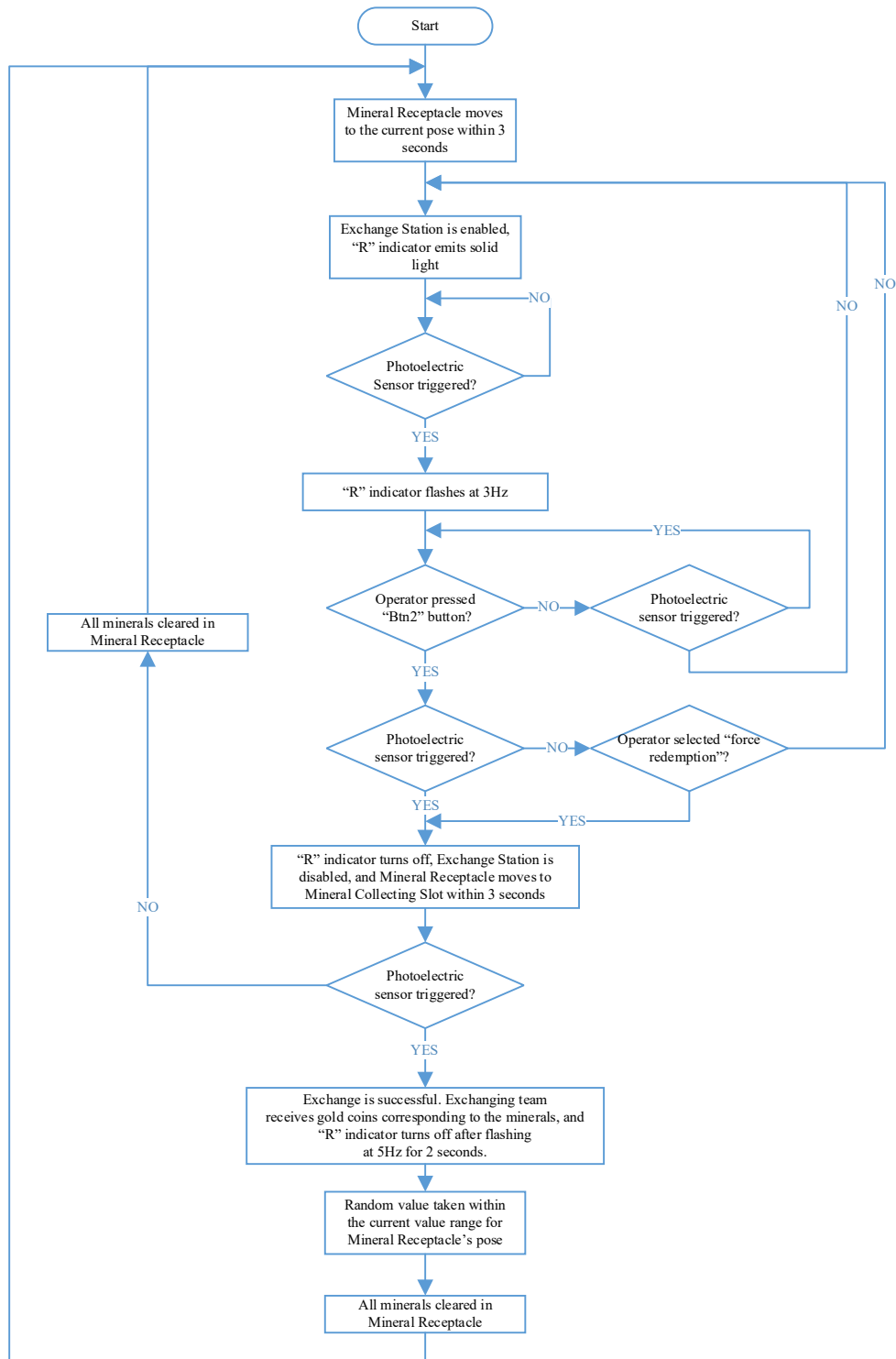


Figure 5-10 Mineral Exchange Logic

5.3.6 Power Rune Mechanism

Robots can activate the Power Rune by launching projectiles. The Red Team can only activate the Red Team's Power Rune while the Blue Team can only activate the Blue Team's Power Rune. Both sides can strike the Power Rune at the same time.

After a team activates its Power Rune, all surviving robots in the team will receive a certain amount of buff while the Power Rune is in the Active state. After the buff effect of the Power Rune has lapsed, the Power Rune will enter into the Unavailable state. Both teams can have Large Power Rune buffs at the same time. The buff effect of a team's Power Rune will run for 45 seconds starting from the time the Power Rune is activated by the team.



- After successfully activating the Power Rune, the HP damage value of Darts remains unchanged.
 - During the actual competition, the Power Rune will start spinning 10 seconds before it enters the Available status to ensure uniformity of speed.
-

The Power Rune is divided into two periods: the Small Power Rune and Large Power Rune.

- **Small Power Rune:** 1 minute and 2 minutes 30 seconds into the match (i.e., when the countdown is at 5:59 and 4:29), the Power Rune starts rotating and becomes available. If it is not activated within 30 seconds after it becomes available, it will revert to its Unavailable state. If one team's Small Power Rune has entered the Activated state, the other team's Small Power Rune immediately becomes unavailable. After a team's robot activates its Small Power Rune, all robots in the team will receive a 25% Defense Buff that lasts for 45 seconds. Once the current Small Power Rune buff lapses, the cumulative damage dealt by the team to its opponent's robots during the buff period will be converted into Experience Points to be distributed evenly among all active Hero and Standard Robots in the team. The ratio of conversion is: damage: experience = 10:1, with the maximum limit of conversion being 100 Experience Points.
- **Large Power Rune:** 4 minutes, 5 minutes 15 seconds, and 6 minutes 30 seconds into the match (i.e., when the countdown is at 2:59, 1:44, and 0:29), the Power Rune starts rotating and becomes available. If it is not activated within 30 seconds after it becomes available, it will revert to its Unavailable state. Each Armor Module of the Large Power Rune is divided into rings 1~10. After a team's robot activates its Large Power Rune, the system will provide the corresponding Attack and Defense Buffs to all the team's robots based on the total number of rings hit.

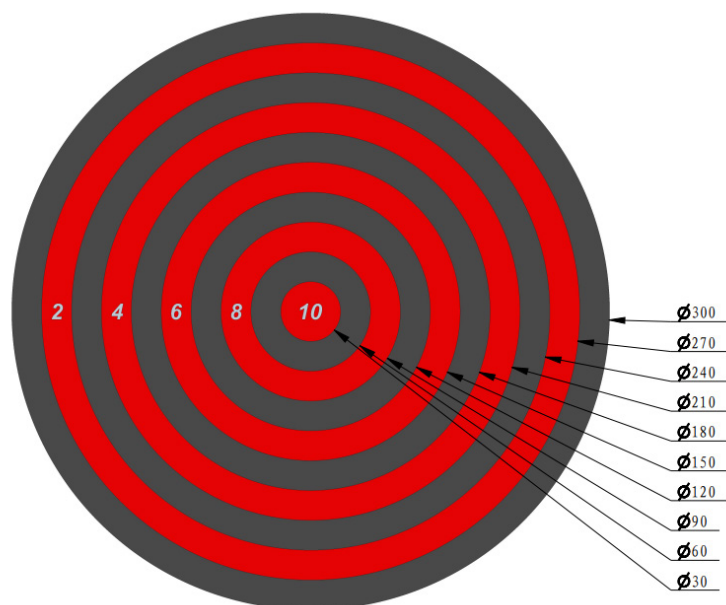


Table 5-11 Power Rune Hit Zones

The Armor Module can precisely detect the ring numbers hit by projectiles and activate the corresponding light effects, as shown below:

Table 5-17 Power Rune Armor Module Light Effects Corresponding to the Ring Numbers Hit

Ring Numbers Hit	Power Rune Armor Module Light Effects
Ring 1-9	Corresponding ring numbers are lit up
Ring 10	Rings 1, 3, 5, 7, 9, and 10 are lit up



The Armor Module detects projectile hit spots at an accuracy of 1mm in the radial direction.

After a team's robot activates its Large Power Rune, the system will provide the corresponding Attack and Defense Buffs based on the total number of hit rings, as shown below:

Table 5-18 Total Numbers of Rings Hit and Their Corresponding Buffs

Ring Number Range	Attack Buff	Defense Buff
[5, 15]	150%	25%
(15, 25]	155%	25%
(25, 35]	160%	25%
(35, 40]	175%	25%

Ring Number Range	Attack Buff	Defense Buff
(40, 45]	200%	25%
46	220%	30%
47	240%	35%
48	260%	40%
49	280%	45%
50	300%	50%

5.3.6.1 The Rotation Strategy for the Power Rune

The Power Rune of both teams rotate on the same axis, i.e. the red team's Power Rune rotates in the clockwise direction while the blue team's Power Rune rotates in the counterclockwise direction (as per the rotation direction when facing the respective team's Power Rune). Before the start of a round, the Power Rune rotate in a random direction. During the round, the Power Rune rotate in a consistent direction.

The rotating speed of a Small Power Rune is set at 10rpm.

The rotating speed of a Large Power Rune changes cyclically based on a trigonometric function. The target function for speed is: $\text{spd} = a * \sin(\omega * t) + b$, where the unit of "spd" is "rad/s", "t" is "s", and the value range of "a" is 0.780~1.045 and " ω " is 1.884~2.000, and "b" must always satisfy $b=2.090-a$. Each time when the Large Power Rune enters "available" status, all parameters will be reset, where "t" shall be 0, and "a" and " ω " shall be any value within the value range. The margin of error for the time between the actual spinning speed of the Large Power Rune and the objective speed function is within 500ms.

5.3.6.2 The Statuses of the Power Rune

The Power Rune has five statuses: Unavailable, Available, Activating, Activated and Activation Failed.

1. Unavailable

Within the 1st minute of the match (i.e. when the countdown is at 7:00-6:00) and the 4th minute of the match (i.e. when the countdown is at 3:59-3:00), the Power Rune is unavailable as shown below:

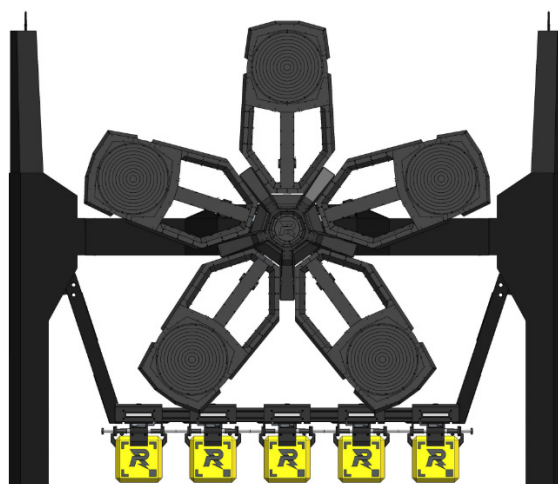


Figure 5-12 Power Rune When Unavailable

2. Available

After the first minute until the third minute of the match (i.e. countdown at 5:59-4:00) and four minutes into the match (i.e. countdown at 2:59), the Power Rune enters the available state as shown below:

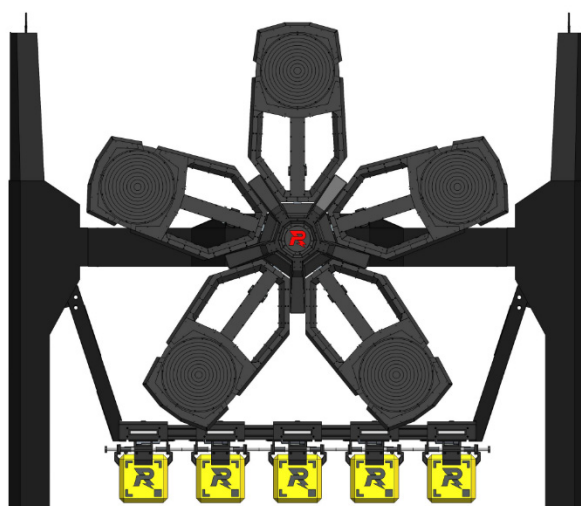


Figure 5-13 The Power Rune in Available Status

3. Activating

When the Small Power Rune is available, a Ground Robot (except for Engineers) that occupies its team's Power Rune Activation Point and stays there for 3 seconds or longer will launch the Power Rune into the Activating status. The Power Rune will turn on the arrow light effects on the light arms of any of the five Armor Modules at random, with Flowing Arrow Light activated on the middle axis of the Armor Module's corresponding light arm. If a projectile manages to hit the Armor Module within 2.5 seconds, its light arm will be completely lit up. At the same time, the Power Rune will randomly illuminate one of the remaining four armor modules, and so on and so forth.

When the Large Power Rune is available, a Ground Robot (except for Engineers) that occupies its team's Power Rune Activation Point and stays there for 3 seconds or longer will launch the Power Rune into the Activating status.

The Power Rune will turn on the arrow light effects on the light arms of any of the five Armor Modules at random. The special light effects on the Armor Module will light up, with Flowing Arrow Light activated on the middle axis of the Armor Module's corresponding light arm. If a projectile manages to hit the Armor Module within 2.5 seconds, its light arm will be completely lit up and the light effects corresponding to the ring numbers hit will be activated. At the same time, the Power Rune will randomly illuminate one of the remaining four armor modules, and so on and so forth.

The light effects are shown below:

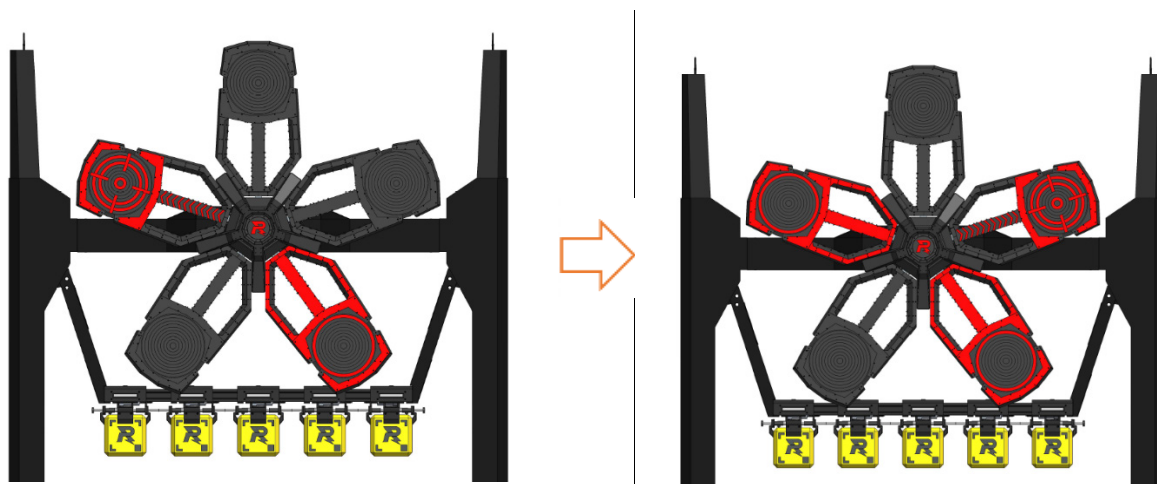


Figure 5-14 Small Power Rune When Activating

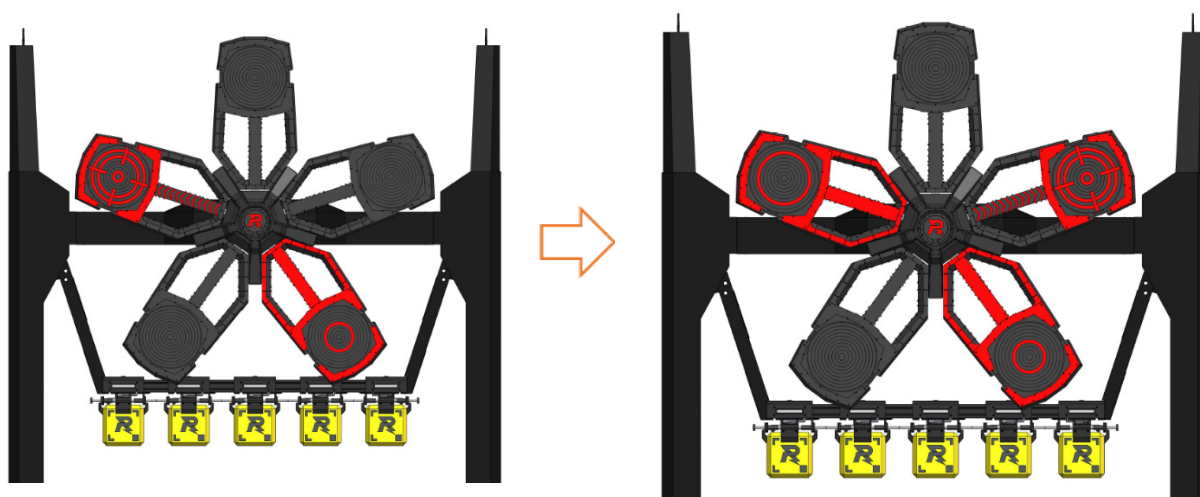


Figure 5-15 Large Power Rune When Activating

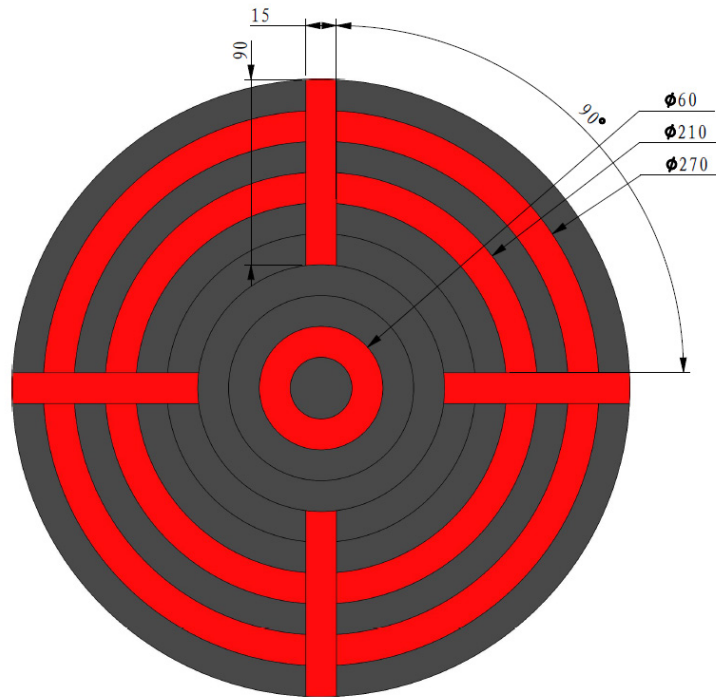


Figure 5-16 Large Power Rune Target When Available

4. Activated

If all five mounting brackets are illuminated, the Power Rune is then activated as shown below:

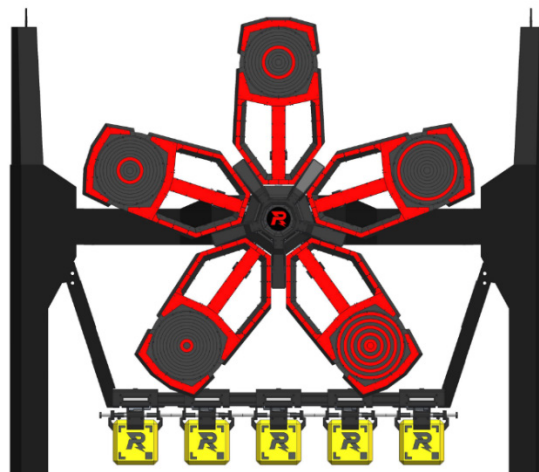


Figure 5-17 Power Rune When Activated

5. Activation Failed

If any of the following conditions occur during activation, the activation will fail and the Power Rune will be reset to the activating status again:

- Failure to hit a randomly lit Armor Module within 2.5 seconds;
- A non-randomly lit Armor Module is hit.

5.4 Relationship between a Sentry Robot, Outpost and Base

At the start of the competition, the Base and Sentry are in the Invincible status.

If the Outpost of one side has been destroyed, the Invincible status of its Sentry and Base will be disabled, and the Base's Virtual Shield will be activated.

Where an Outpost has been destroyed, and if the Sentry has not entered the Battlefield, been destroyed or ejected, the Armor of their Base will be expanded and the Virtual Shield will be disabled.

If no Outpost has been destroyed and the Sentry is defeated or ejected, the team's Base will remain in the invincible status.

When an Outpost is intact, the Dart guiding light on the Outpost is on, the Dart guiding light on the Base is off.

When the Outpost is destroyed, the Dart guiding light on the Outpost is off, the Dart guiding light on the Base is on.

Once a team's Outpost is destroyed, if its Sentry cannot detect the RFID Interaction Module Card of the Sentry Patrol Zone for over 10 seconds, then the HP of its Base's Virtual Shield will be deducted by 25 points per second.

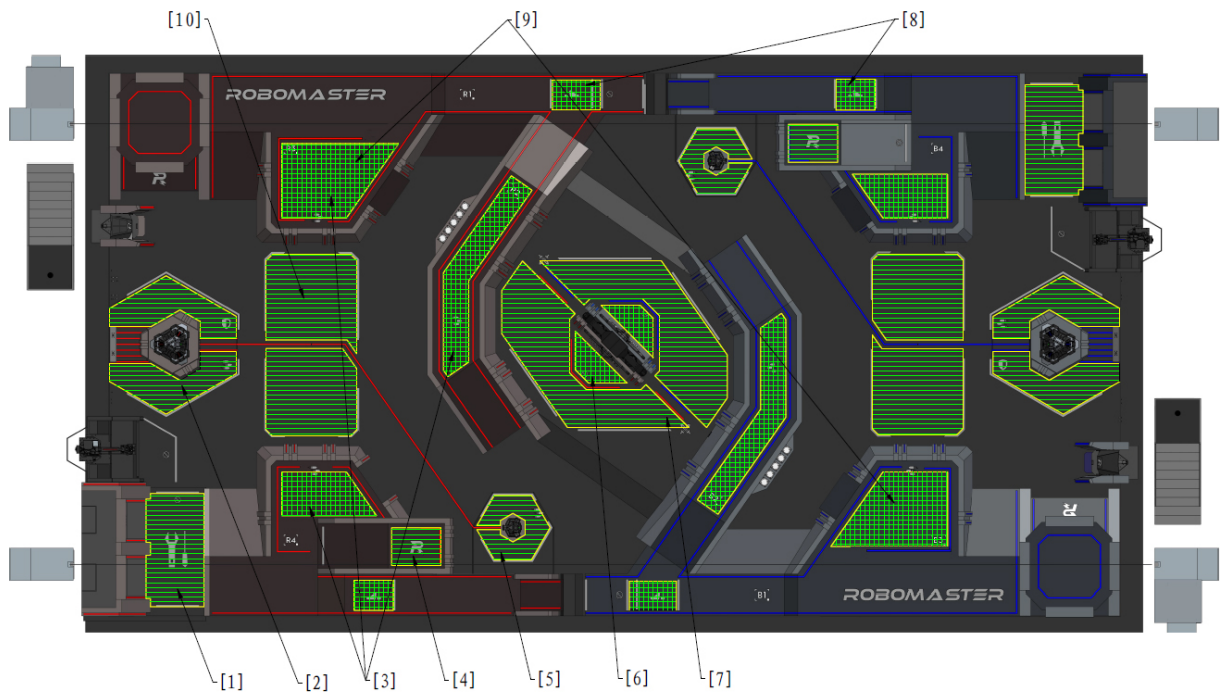
If a Base's Virtual Shield HP drops to zero due to this reason, or if it has dropped to zero and the team's Sentry cannot detect the RFID Interaction Module Card in the Sentry Patrol Zone for 10 seconds or longer, the team's Base Protective Armor will open.



- When a Base is in the Invincible status, its armor lights will become purple and not flash when under attack.
 - When the Virtual Shield of a Base is activated, its armor lights will become purple and flash when under attack.
-

5.5 Buff Mechanism

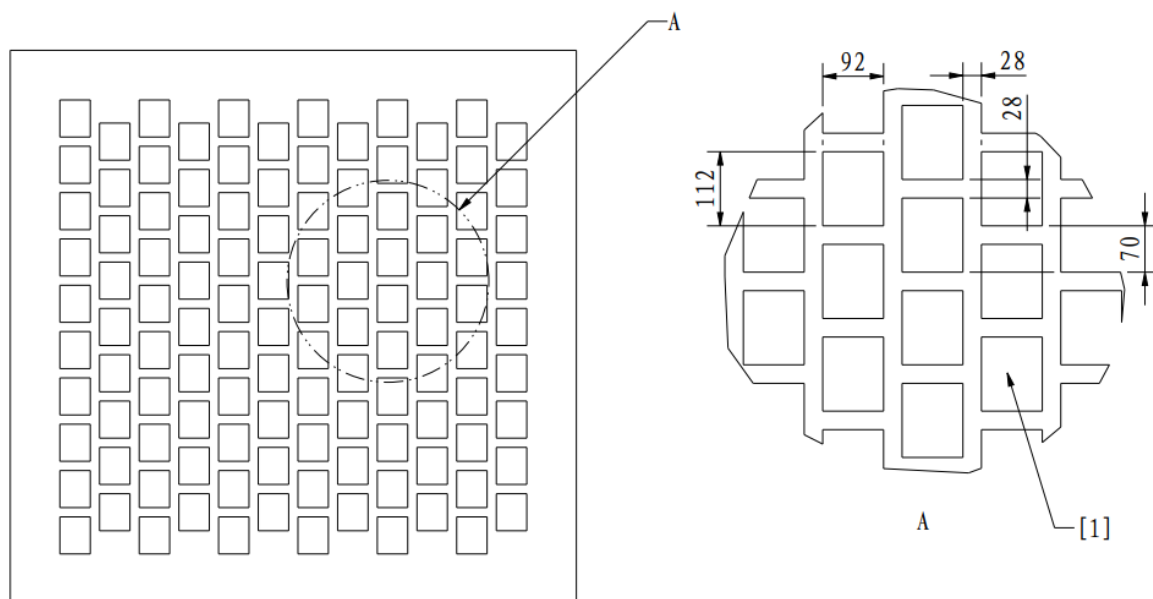
All Buff Points in the Battlefield are shown below:



- | | | | |
|-----------------------------|--------------------------------|--------------------------------|---------------------------------|
| [1] Restoration Zone | [2] Base Buff Points | [3] Elevated Ground Buff Point | [4] Power Rune Activation Point |
| [5] Outpost Buff Point | [6] Resource Island Buff Point | [7] Controlled Zones | [8] Launch Ramp Buff Point |
| [9] Hero Robot Sniper Point | [10] Sentry Patrol Zones | | |

Figure 5-18 Battlefield Buff Point Area

All Buff Points are laid with multiple RFID Interaction Module Cards. If the actual placement area of the Sentry Patrol Zone is larger than that shown in the image, you should lay additional RFID Interaction Module Cards that are around 300mm thick from the Battlefield ground surface of the Sentry Patrol Zone toward the Base and the Ring-shaped Elevated Ground. A Buff Point area can be occupied at the same time by multiple robots of one team. The disabling of the occupied status will be delayed by 2 seconds. If the occupying robot has been defeated, the buff gained will expire.



[1] Locations Where RFID Interaction Module Cards are Lodged

Figure 5-19 Placement of RFID Interaction Module Card




Deadbands may exist for the RFID Interaction Module Cards at the Buff Points on the Battlefield. The teams should make adjustments and adapt accordingly.

Table 5-19 Overview of the Buff Mechanism for Ground Robots

Robots Buff Point	Hero Robot	Hero Robot	Standard Robot	Sentry Robot
Restoration Zone	√	√	√	-
Base Buff Points	√	-	√	-
Elevated Ground Buff Point	√	-	√	√
Power Rune Buff Point	√	-	√	√
Resource Island Buff Point	-	√	-	-
Hero Robot Sniper Point	√	-	-	-
Outpost Buff Point	√	-	√	√

Robots Buff Point	Hero Robot	Hero Robot	Standard Robot	Sentry Robot
Launch Ramp Buff Point	√	-	√	√
Controlled Zones	√	-	√	-
Sentry Patrol Zones	-	-	-	√

Table 5-20 Overview of Buff Types

Type	Definition
Attack Buff	Damage caused by projectile attacks is increased.
Defense Buff	<p>Reduces the damage suffered from a projectile attack or impact.</p> <hr/> <p> Defense buffs are not applicable to HP deductions caused by penalties, the Referee System going offline, exceeding limits, etc.</p>
Barrel Heat Cooling Buff	Increases the barrel heat cooling rate per second.
Buffer Energy Buff	Receives extra buffer energy for chassis power.
HP Recovery Buff	The robot recovers a certain amount of HP every second until it reaches the Maximum HP.

An Attack Buff increases the projectile damage dealt by a robot to the original damage*Attack Buff.

A Defense Buff reduces the attack damage received by a robot to the original damage*(1-Defense Buff).

Example: If the red team's robot has a 200% Attack Buff and the blue team's robot has a 25% Defense Buff, and the red team's robot launches a round of 42mm projectiles and hits the blue team's robot, the damage suffered by the latter shall be: $100 \times 200\% \times (1 - 25\%) = 150$

When a robot receives more than one buff of the same type, the maximum buff effect shall be applied, including for attack, defense, HP recovery, and barrel heat cooling.

Example: For example, if a Hero Robot has not suffered any HP deduction for 20 seconds, it will recover its HP at 5% of its Maximum HP per second. If the Engineer is in its team's HP Recovery and Revive Zone, its HP will recover at 10% of its Maximum HP per second.

5.5.1 Base Buff Mechanism

A Base Buff Point can only be occupied by robots of the team to which it belongs. Robots that occupy the hexagonal area around their own team's Base will gain a 50% defense buff and a 3-time barrel heat cooling buff.

5.5.2 Elevated Ground Buff Mechanism



- The occupation statuses of the Elevated Ground Buff Points of different zones are completely independent of and unrelated to one another.
- The occupation statuses of the Elevated Ground Buff Point and the Hero's Sniper Point are completely independent of and unrelated to one another.

Robots that occupy an Elevated Ground Buff Point area will gain a 5-time barrel heat cooling buff. If a robot of one side occupies an Elevated Ground Buff Point of one zone, no robots of the other side are allowed to occupy it at the same time.

5.5.3 Launch Ramp Buff Mechanism

There are two Launch Ramp Buff Points on the respective roads for each team. A robot must detect the RFID Interaction Module Card of the two Launch Ramp Buff Points of its team within 10 seconds, in order to trigger the buff from the Launch Ramp. The Launch Ramp Buff Points on both sides can be occupied by both teams, except that while one team's robot is occupying one Launch Ramp Buff Point, the other team's robots cannot occupy the other Buff Point. A robot that triggers a buff from the Launch Ramp receives:

- 50% defense buff for 20 seconds
- An increase of buffer energy to 250J (see "5.1.3 Exceeding Chassis Power Consumption Limit")
- 3-time buff for barrel heat cooling rate per second lasting 20 seconds

5.5.4 Outpost Buff Mechanism

When a team's Outpost is intact, any robot occupying the Outpost Buff Zone of the team will receive a 5-time barrel heat cooling buff.

5.5.5 Power Rune Buff Mechanism

When a team's Power Rune is in the Available status, and any of its robots has occupied its own Power Rune Activation Zone for at least 3 seconds, the Power Rune will enter the Activating status and the robot occupying the zone will receive a 5-time barrel heat cooling buff.

5.5.6 Resource Island Buff Mechanism

An Engineer Robot that occupies the Resource Island Buff Point will receive a 50% defense buff. The buff points

on both sides of the Large Resource Island are independent of one another. The Engineer Robots from either team may occupy the buff points on both sides of the Large Resource Island. If a robot of one team occupies a Resource Island Buff Point of one side, no robots of the other team are allowed to occupy it at the same time.

5.5.7 Restoration Zone Mechanism

A Ground Robot (except for Sentry Robots) that occupies its team's Restoration Zone will boost the respawn process or receive a HP Recovery Buff. For the details of their implementation and values, please refer to "5.7 HP Recovery and Respawn Mechanism".

5.5.8 Hero Robot Sniper Point Mechanism

The R3 and B3 Trapezoid-Shaped Elevated Grounds are the Hero's Sniper Points of each team respectively and can only be occupied by the robots of their own teams. When a Hero Robot has occupied its team's Sniper Point, the attack inflicted by the robot's 42mm projectile on the enemy's Base will receive a 250% Attack Buff. The robot will also receive 10 Gold Coins for each round of launched 42mm projectile detected by the robot's Launching Mechanism.

When the Base of a team is attacked with a 42mm projectile by a Hero Robot occupying the sniper point, it will enter a 10-second defense period. During the defense period, the Base of the team will receive a 100% defense buff for 42mm projectiles.

5.6 Level-Up Mechanism

5.6.1 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, destroying or assisting in the attack of other robots, attacking an Outpost or Small Power Rune, or other methods. The mechanism is as follows:

- If the system detects that a Hero or Standard Robot is the destroying robot, it will receive the Experience Points corresponding to the Experience Value of the destroyed robot; otherwise, the latter's Experience Points will be distributed evenly among the surviving Hero and Standard Robots of the opposing team. The average is rounded up and shall be accurate to one decimal place.
- The Hero or Standard Robot assisting in the attack will receive 25% of the Experience Points corresponding to the Experience Value of the destroyed robot.

- When the first robot in a match (except for an Aerial, Radar, and Dart System) is defeated or ejected and if the destroying robot is a Hero or Standard, it will receive 50 Experience Points. Otherwise, the 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.

For example, when a Level 1 Standard has been destroyed, and if the destroying robot is a Hero or Standard, it will gain 25 Experience Points directly. Each assisting Hero or Standard will gain $25 * 25\% = 6.3$ Experience Points.

- 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 is defeated, its original Experience Points will remain unchanged. The robots cannot receive any Experience Points while in the non-surviving status. Any excess Experience Points after leveling up will be counted towards the next level.

Table 5-21 Levels and Experience of Ground Robots

Subject	Level	Experience Value	Experience Points Required for Leveling Up
Hero Robot	1	75	60
	2	100	140
	3	150	-
Hero robot	-	50	-
Standard robot	1	25	30
	2	50	90
	3	75	-
Sentry Robot	-	75	-

5.6.2 Performance System

After the start of the Three-Minute Setup Period, 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 an Optional 17mm Launching Mechanism, the type of Launching Mechanism will also need to be selected. After the competition starts, a robot's chassis and Launching Mechanism, once selected, cannot be changed during a competition round.

Table 5-22 Types of Chassis and Launching Mechanisms

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

Table 5-23 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 5-24 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

Chassis Type	Level	Maximum HP	Maximum Chassis Power Consumption (W)
Balancing Chassis	1	300	60
	2	400	80
	3	500	100

Table 5-25 Attributes of 17mm Launching Mechanisms

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	200	10	15
	2	400	15	15
	3	600	30	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 5-26 Attributes of 42mm 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.

- A Balancing Standard Robot can only have a balancing chassis.



- For Balancing Standard Robots of the same level and Launching Mechanism type, their barrel cooling rate per second is higher than that of Regular Standard Robots by 50%.

5.7 HP Recovery and Respawn Mechanism

Only Ground Robots can recover their HP and be respawned, except in the following situations:

- Ejected robots cannot recover their HP and be respawned;
- Sentry Robots cannot be respawned.

5.7.1 HP Recovery Mechanism

Ground Robots (except for Sentries): A robot that detects the RFID Interaction Module Card of its team's Restoration Zone will receive an HP Recovery Buff of 10% of its Maximum HP per second. After the fourth minute from the start of the competition (when the countdown is at 2: 59), if a surviving robot has not fired projectiles and suffered any HP deduction for 6 seconds and detects the RFID Interaction Module Card of its team's Restoration Zone, it will receive an HP Recovery Buff of 25% of its Maximum HP per second and have its Chassis Power Consumption Limit doubled but without exceeding 200W. If the robot fails to detect the RFID Interaction Module Card of its team's Restoration Zone, the above HP Recovery Buff will lapse immediately. If the robot fires a projectile, suffers HP deduction, or fails to detect the RFID Interaction Module Card, the above Chassis Power Consumption Limit buff will lapse after 4 seconds.

Hero, Standard: In a round, if an active robot has not fired a projectile and suffered any HP deduction for 6 seconds, it can utilize its remote HP exchange opportunities to redeem HP remotely. Six seconds after a remote HP exchange is confirmed, the robot will receive an additional 60% of its current Maximum HP, with its HP however not exceeding the Maximum HP.



If the robot is defeated or ejected within 6 seconds after a remote HP exchange is confirmed, the exchange will lapse and the exchange opportunity will be deemed as used.

Engineer: If an Engineer's HP is not deducted for 20 seconds or after being respawned from a defeat during a round, it will receive an HP Recovery Buff at 5% of its Maximum HP per second.

Sentry: If an Engineer does not suffer any HP deduction for 20 seconds, it will receive an HP Recovery Buff of 1% of its Maximum HP per second.

5.7.2 Respawn Mechanism

After being defeated, a robot will immediately commence its respawn process. After completing its respawn process, a defeated robot can confirm its respawn on the player's client or exchange Gold Coins for instant respawn before the respawn process is completed.

When seeking to complete a respawn process, the respawn process required is related to the remaining time of the competition. Its formula is as follows:

$$\text{Respawn process} = 10 + (420 - \text{remaining competition time})/10$$

To be rounded off to the nearest integer.

The robot's respawn process begins from the moment it is defeated. The respawn process advances 1 points per second. If the robot has detected the RFID Interaction Module Card of the Restoration Zone, its respawn progress is increased to 4 per second.

A respawned robot will maintain its level, performance points and Experience Points from before its defeat and remain in Invincible status for 10 seconds. Its HP will also be restored to 10% of the Maximum HP.

If the robot did not complete its respawn process at the Restoration Zone, then its Launching Mechanism will be powered off after it is respawned. Once it has detected the RFID Interaction Module Card of the Restoration Zone while its Projectile Allowance is more than zero, its Launching Mechanism will be automatically powered on.

When exchanging Gold Coins for instant respawn, a robot will also receive the following effects:

- Its HP is restored to 100% of its Maximum HP when respawned;
- Its Chassis Power Consumption Limit is doubled (up to 200W), for 4 seconds;
- The default process length required for its next respawn will be longer by 20.

5.8 Optional 17mm Launching Mechanism

Either one of the Aerial, Standard and Hero Robots can be mounted with an Optional 17mm Launching Mechanism, provided that it meets the technical specifications. 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 1: Each Standard Robot has a Built-in 17mm Launching Mechanism. A team can mount an Optional 17mm Launching Mechanism on a Standard Robot as needed. The Robot will then have two 17mm Launching Mechanisms.

Example 2: Aerial Robots do not have Built-in Launching Mechanisms. A team can mount an Optional 17mm Launching Mechanism on an Aerial Robot as needed. The Robot will then have a 17mm Launching Mechanism.

If a Standard or Hero is mounted with an Optional 17mm Launching Mechanism, the Barrel Heat of the Optional 17mm Launching Mechanism shall be calculated separately from the Built-in Launching Mechanism. After the start of the Three-Minute Setup Period, the Operator needs to select the Launching Mechanism type for the Optional 17mm Launching Mechanism. For details, please refer to “5.6.2 Performance System”.

If an Aerial is mounted with an Optional 17mm Launching Mechanism, its Barrel Heat will not be restricted.

5.9 Aerial Robot-Related Mechanisms

5.9.1 Air Support

At the start of the competition, air support is in a cooling state with a cooling period of 175 seconds. After the cooling state is removed, the teams can call for air support. When air support is in a cooling state, teams can exchange their Gold Coins for air support. Each air support lasts for 30 seconds. Once air support ends, it will return to its cooling period of 175 seconds.

Below is the formula for calculating the Gold Coin quantity required for air support, with the result to be rounded up to the nearest integer:

Required Gold Coins = 25 x ROUNDUP (Remaining cooling period/25)

During air support, the Aerial Robot will receive a first-person view of the Battlefield and 500 rounds of Projectile Allowance. Meanwhile, one projectile reload opportunity will be given for each call for air support. To reload, the Pilot needs to request a projectile reload from the Pilot Referee. After the Referee confirms the Pilot has Projectile Allowance, the Pilot must wear a long-sleeved top with goggles and a safety helmet before they can reload the Aerial's projectiles outside the Perimeter Wall within 30 seconds from the moment the Pilot opens the Reload Window.



- The safety helmet and pilot goggles are placed in the Pilot Room.
- Since the helmet and headset cannot be worn at the same time, Pilot needs to take off the headset before wearing the helmet.

5.9.2 Attack Deductions

5.9.2.1 Exceeding the Initial Launching Speed Limit

If the Referee System detects that the projectile of an Aerial exceeds the Initial Launching Speed limit, the air support time of the Aerial will be reduced. Air support time reductions will be accumulated if the limit is exceeded multiple times. If the time to be deducted equals or exceeds the remaining time in this air support, the air support will end immediately.

Assume the Aerial's current Initial Launching Speed is V_1 and the Initial Launching Speed limit is 30m/s, when the Referee System's Speed Monitoring Module detects one 17mm projectile that its Initial Launching Speed V_1 exceeds 30m/s, the Aerial's air support time will be reduced by: $t = 0.5 (V_1 - 30)^2$ s, to be rounded off to the closest integer.

5.9.2.2 Modules Going Offline

If an important Referee System Module goes offline during the air support time, the Projectile Allowance of the Aerial will be reduced. The correlation between the number of important modules gone offline (M) and the Projectile Allowance reduced per second (N) is: $N = 25 * M$.

5.10 Dart Launching Mechanism

In each round, a Dart Launcher can carry 4 Darts. 30 seconds into each round, the gate of a Dart Launching Station has two opening opportunities, which the Aerial Gimbal Operator can choose when to use.

During the competition, the Aerial Gimbal Operator may use the keyboard and mouse cursor to control the gate of the Dart Launching Station on the player's client. The Aerial Gimbal Operator is not allowed to launch Darts when the gate is opening or closing. The player's client will display the status of the gate.



It takes around 7 seconds for the gate to open completely.

When the gate is fully open, an indication will be provided by the player's client interface of the Referee System. The Aerial Gimbal Operator can then launch Darts by controlling the Dart Launcher for 15 seconds.

When the gate starts closing, an indication will be provided by the player's client interface of the Referee System. The Aerial Gimbal Operator is forbidden from launching Darts during this time. When a gate closes for the first

time, the Dart Launching Station will enter a 15-second cooling period. The gate can only open for the second time after the end of the cooling period.

After the Dart Launching Station is completely opened, the Dart Detection Module on the Outpost or Base of the other team will update the detection window period for 20 seconds. The launched Dart needs to hit the Dart Detection Module within the detection window period, or the attack will be void. When a Dart hits the Outpost or Base of the other team, the operating interface of all their Operators will be obstructed for 5 or 10 seconds. If the target is hit continuously, the obstructed duration for the interface will increase accordingly. Each time the target is hit, the detection window will be closed for 2 seconds.

When the Dart Guiding Light on the Base or Outpost is illuminated, its buff points will be disabled temporarily for 30 seconds if the Base or Outpost is hit by a Dart; if it is hit successively, the disabled period will be reset.

5.11 Radar-related Mechanism

One team's Radar can detect the location of the other team's Ground Robot and send the coordinates of the robot to the Referee System server. If the deviation of the linear distance from the coordinates to the actual plane coordinates detected by the corresponding robot's Positioning System Module is less than 0.6m, the mark shall be deemed "accurate"; otherwise it shall be deemed an "error".

Every Ground Robot has a "marked progress" with a value range of 0~120. The accuracy of a marking and the previous marking as well as the Radar's coordinates transmission interval will affect said progress. The specific rules are as shown below. Assuming the impact of the previous received coordinates data on a robot's marked progress is "x", and the initial value of x is "0".

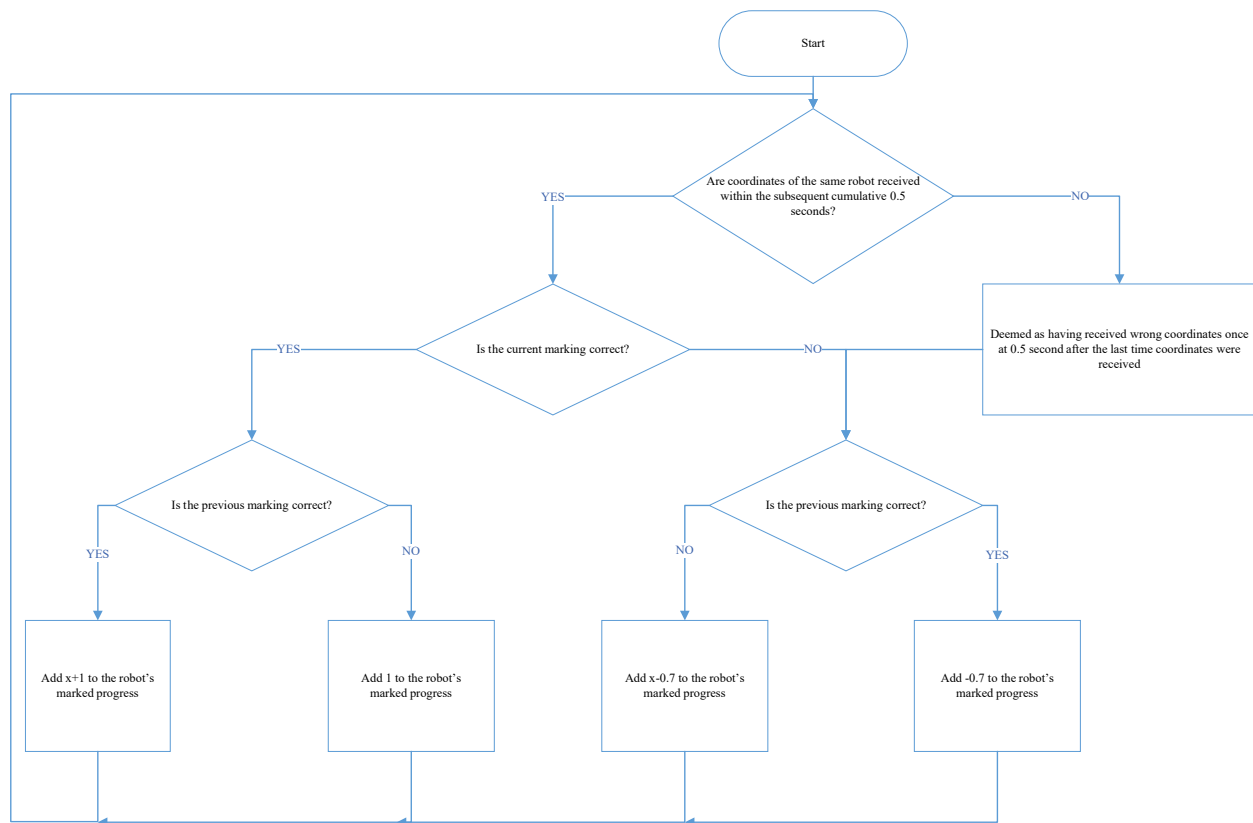


Figure 5-20 Radar Mechanism Logic

Example: If a team's Radar sends the coordinates of the other team's Engineer Robot at a frequency of 5Hz and an accuracy of 100% continuously to the Referee System server, then the marked progress of the Engineer Robot within 0 to 1 second at an interval of 0.2 second shall be 1, 3, 6, 10, and 15 respectively. At the 3rd second, the robot's marked progress will reach 120. Thereafter, if the Radar sends the robot's coordinates at a frequency of 5Hz and an accuracy of 0% to the Referee System server, then the marked progress of the robot within 3.0 to 4.0 seconds at an interval of 0.2 second shall be 119.3, 117.9, 115.8, 113, and 109.5 respectively. Thereafter, if the Radar does not send the Engineer Robot's coordinates for 1.0 second, then the marked progress of the robot within 4.0 to 5.0 seconds shall be 105.3 and 100.4 respectively (determined as two additional and consecutive errors based on the previous error). Thereafter, if the Radar sends the correct coordinates of the Engineer Robot twice consecutively, then the robot's marked progress shall be 101.4 and 103.4 respectively.

When the marked progress of a team's robot equals and exceeds 100, the small map of the other team will show the actual location detected by the robot's Positioning System Module and mark it with a special tag; otherwise it will only show the location corresponding to the robot's coordinates sent by the latter team's Radar and will not mark the location with a special tag.



Due to the wireless environment of the competition site, the coordinates detected by a robot's Positioning System Module may drift intermittently or continuously.

5.12 Competition System and Winning Criteria

The official matches of RMUC 2023 consist of the Group Stage and the Knockout Stage. The competition system for the Group Stage is BO2. Except for the Semifinals and the Championship Match which are BO5, the competition system for all other Knockout Stages is BO3.

Winning criteria for a Single Round as shown below:

1. When a round has ended and if the Base of either team has survived, the team with the higher remaining Base HP shall be the winner.
2. If a round has ended, and the Remaining Base HP of both teams is the same, the team with the higher Remaining Outpost HP shall be the winner.
3. If a round has ended and the remaining Base HP of both teams are the same and the Outposts have been destroyed, the team with the higher Remaining Sentry HP shall be the winner.
4. If a round has ended and the remaining Base HP of both teams are the same, the Outposts have been destroyed, and the Remaining Sentry HP are the same, the team that has inflicted the higher Total Damage shall be the winner.
5. If a round has ended and the remaining Base HP of both teams is the same, the Outposts have been destroyed, the Remaining Sentry HP are the same, and the Total Damage inflicted by each team is the same, the team with the higher Total Robot Remaining HP shall be the winner.
6. If a round has ended and the Remaining Base HP of both teams is the same, the Outposts have not been destroyed and the Remaining Outpost HP are the same, the team that has inflicted the higher Total Damage shall be the winner.
7. If a round has ended and the Remaining Base HP of both teams is the same, the Outposts have not been destroyed, the Remaining Outpost HP are the same, and the Total Damage inflicted by each team is the same, the team with the higher Total Robot Remaining HP shall be the winner.
8. If neither team fulfills these criteria, the round shall be considered a draw. A draw in the Knockout Stage shall lead to an immediate tie-breaker round until a team wins.

5.12.1 Group Stage

The following is a description of the points for the Group Stage:

Table 5-27 Group Stage Points

Competition System	Competition Result	Points	Notes
BO2	2:0	3:0	Winner of two rounds gains 3 points
	1:1	1:1	Each team obtains 1 point
	1:0	1:0	(One round draw) The winning team obtains 1 point
	0:0	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 is used to determine competition ranking in a 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 is the same, the team with the higher Total Net Outpost HP from all rounds ranks higher.
4. If the total Net Outpost HP of teams is the same, the team with the higher Total Net Sentry HP from all rounds ranks higher.
5. If the total Net Sentry HP is the same, the team with the higher Total Damage ranks higher.
6. 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.

5.12.2 Knockout Stage

A team wins the Knockout Stage if it has won the most number of rounds. BO3 requires the winning of two rounds while BO5 requires the winning of three rounds.

6. Competition Process

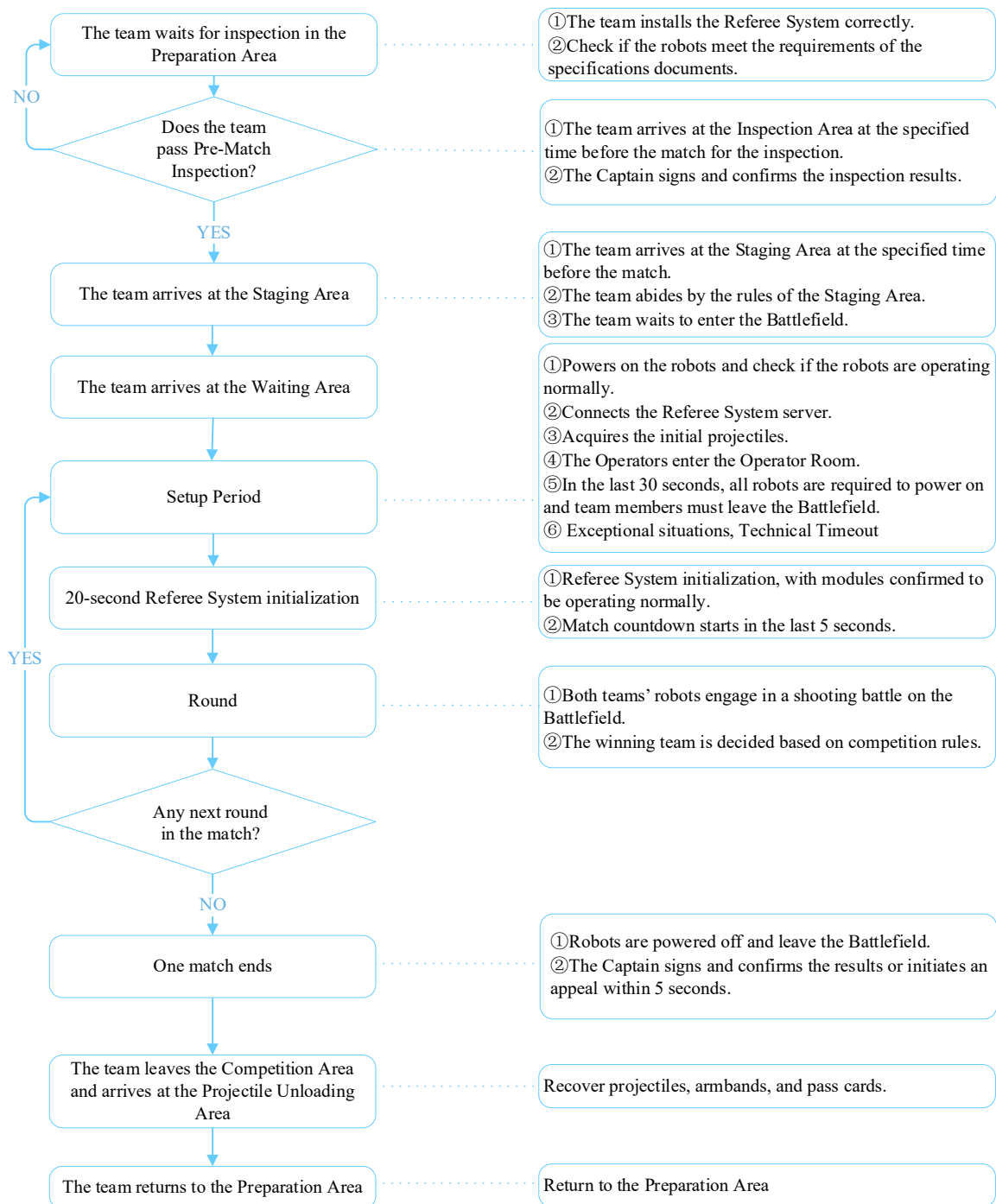


Figure 6-1 Process for a Single Match

6.1 Pre-Match Inspection



- The inspection results of the Mock 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.

To ensure that robots meet the requirements of the specifications documents, each team must undergo Pre-match Inspection in the Inspection Area 90 minutes before the start of each match. For the requirements of the Pre-Match Inspection, please refer to the [“RoboMaster University Series 2023 Robot-Building Specifications Manual”](#). The inspection process is as follows:

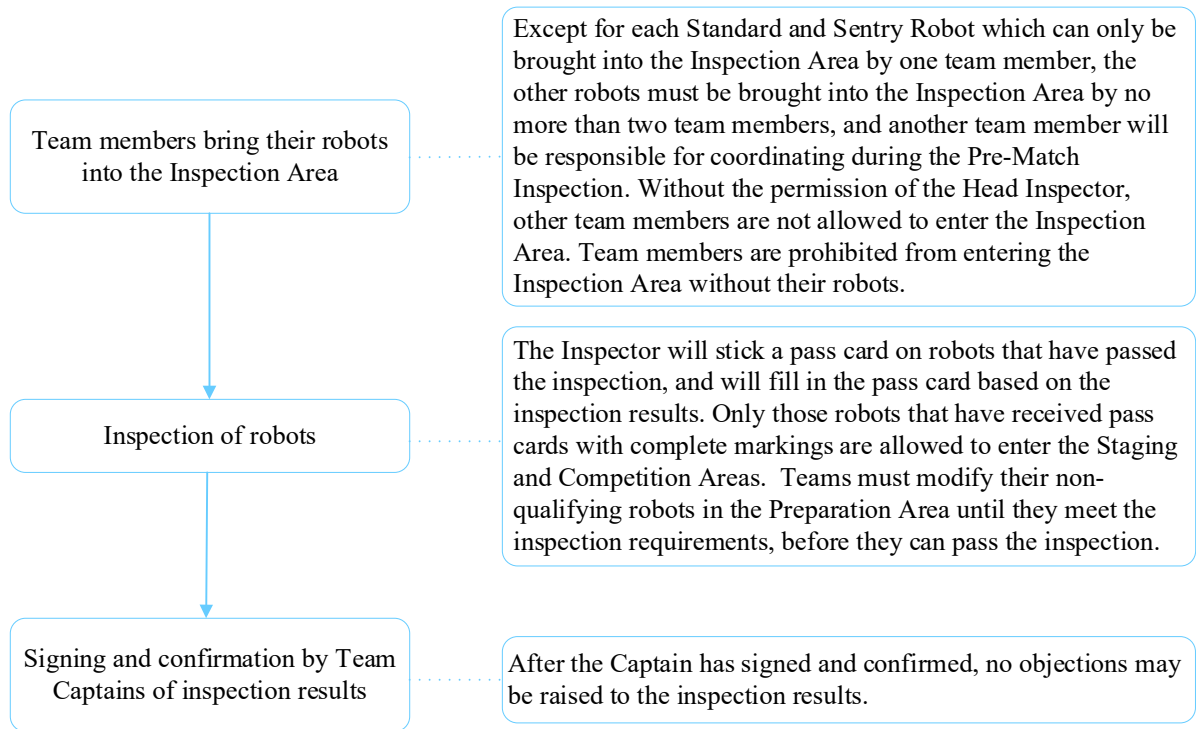


Figure 6-2 Pre-match Inspection Process

The rules regarding backup robots are as follows:

- Each team can have a maximum of two backup robots for each match. A maximum of four backup Darts are allowed in the BO2 and BO3 Competition Systems, while a maximum of eight backup Darts are allowed for the BO5 Competition System.
- Team members are required to declare the types of backup robots they are carrying during Pre-match Inspection. Backup Hero, Engineer and Sentry must be attached with armor stickers in the 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 University Series 2023 Robot-Building Specifications Manual”](#).
- Teams can borrow the Referee Systems for no more than two backup robots.

6.2 Staging Area

Teams must arrive at the Staging Area 15 minutes before the match. The staff at the Staging Area will verify the Pass Cards of participating robots and details of Pit Crews, and issue armbands. Each team is allowed to have a

maximum of 18 Pit Crew, which must include one Supervisor and up to 17 regular members. One Pit Crew Member should wear the “Captain” armband and undertake the Captain’s role. 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. 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. 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 Three-Minute Setup Period will begin when the door opens.

6.3 Three-Minute Setup Period



After the end of the second and fourth round of a BO5 match, both teams have ten minutes to work on their robots. When ten minutes run out, the Three-Minute Setup Period of the next round begins.

During the Three-Minute Setup Period, the Pit Crew will place robots on their respective initialization areas, check whether the Referee System is operating normally, pre-load their robots with initial projectiles, load Darts into the Dart Launcher, and mount the Radar on the Radar Base. Pit Crew Members may repair robots or replace equivalent parts, provided the requirements of the specifications documents are met. Pit Crew Members are required to commission their robots near their team’s Robot Initialization Area. Only one Pit Crew Member of each team is allowed to leave the Initialization Area to commission their robots, and they must not cross the other team’s Ring-shaped Elevated Ground.



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.

90 seconds before the Three-Minute Setup Period ends, the Operator is advised to enter the Operator Room to complete commissioning 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 equipment in the Operator Room cannot operate normally, the Operator must raise the issue before the final 15 seconds of the Three-Minute Setup Period,

otherwise the Referee will not announce technical timeout. During the Three-Minute Setup Period, only one person, in addition to the operators of the deployed robots, is allowed to enter the Operator Room. The Tactical Coach may enter the Operator room to make tactical deployments. Non-Operators must leave the Operator Room before the Three-Minute Setup Period ends.

When the Three-minute Setup Period is down to 30 seconds, all robots in the Battlefield must be powered up, robots that are not powered up must be removed from the Battlefield, and the staff in the Battlefield should leave the Competition Area in an orderly manner. After the end of the Three-minute Setup Period, the Pit Crew must place the Remote Controllers for the Sentry Robots and Radars in the designated area at the Battlefield entrance.

6.3.1 Official Technical Timeout

During the Three-Minute Setup Period, if the Referee System, official equipment or other modules related to the Referee System experience any faults, or a robot needs to be inspected urgently (see below for details), the Head Referee may 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 of the Referee System or official equipment has been eliminated and the Head Referee has resumed the countdown, Pit Crew Members are required to follow the set procedures for the Three-Minute Setup Period and leave the Battlefield within the specified time.

Table 6-1 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 Three-minute Setup Period of the first round, the modules of the robot client on the Referee System Robot Side experience faults, such as: damage of the Armor Module, Speed Monitor Module going offline, etc.
3	During the Three-Minute 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 the Three-Minute Setup Period between rounds or during the Seven-Minute 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 a robot’s circuit or structural design, or robot

combat from a previous match. Regular battle damage does not trigger an Official Technical Timeout, and the Referee will provide a backup Referee System Module. 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.

6.3.2 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’s Room for “Team Technical Timeout” only before the 15-second countdown in the Three-minute 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 Referee will notify both teams at the same time regardless of which team initiated the timeout.

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 Three-Minute Setup Period on a first-come-first-served basis. The Technical Timeout usage is recorded in the Match Results Confirmation Form.

The Team Technical Timeout arrangements for different phases in a competition stage are as follows:

Table 6-2 Team Technical Timeout Arrangement

Competition Phase	Arrangement
Group Stage	Two Technical Timeouts for 2 minutes each
Knockout Stage	One Technical Timeout for 3 minutes. Technical Timeout opportunities not used in the Group Stage can be carried over to the Knockout Stage

6.4 Referee System Initialization Period

After the Three-Minute Setup Period, the match enters a 20-Second Referee System Initialization Period. During the Initialization Period, the Referee System server will automatically detect the connection status of the player’s

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 player's client will not respond to control commands from robots (including Custom Controllers). Once the countdown finishes, the player's client resumes responding to control commands from robots, and the competition starts.

6.5 Seven-Minute Round

During the Seven-minute Round, robots from both teams will engage in a shooting battle on the core Competition Area (Battlefield).

6.6 End of Competition

When the time of one round of competition runs out or one team triggers the winning conditions in advance, this round of competition ends. Please refer to "5.12 Winning Criteria" for details on the winning criteria. The match is over when a winner has emerged or all rounds have ended.

6.7 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.

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 accepts the match results.

7. Violations and Penalties

In order to ensure the fairness of the competition and maintain competition discipline, the participating teams, participants, and participant robots must strictly follow the competition rules. If there is a violation, the Referee will issue a corresponding penalty. 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.

Penalty of violation stated in this chapter will be determined by the Head Referee according to the actual situation. 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.

7.1 Penalty System

7.1.1 Forms of Penalties

During the competition, the Referee System or Referees shall issue penalties against participating personnel and robots who violate competition rules. The forms of penalties are as follows.

Table 7-1 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 during the competition. The HP deductions mentioned in “5.1 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 robots for violation of rules
Manual Penalties Through Referees	Used in situations where penalties cannot be issued through the Referee System, for example giving a Verbal Warning or disqualifying a team

7.1.2 Types of Penalties

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

Table 7-2 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 operating interface for the offending robot is blocked for 5 seconds and those for other robots are 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. If the robot receives a Yellow Card again within 30 seconds after it receives a Yellow Card, the deducted percentage of their current Maximum HP 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: A Standard 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: A Standard 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 50th 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> <ul style="list-style-type: none"> ➤ 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-team Yellow Card:

Types of Penalties	Descriptions
	<p>The interface of all Operators is blocked for 2 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 by single robots.</p> <hr/> <ul style="list-style-type: none"> ● If multiple Yellow Cards are received successively, the blockage time for the operation interface will add up accordingly, and the 30-second countdown will be reset.  <ul style="list-style-type: none"> ● 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.
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, nor can they be replaced by other robots for all rounds in the current match; ➤ If a robot is ejected during the Referee System Initialization Period, the Red Card Warning shall be issued after the competition starts; ➤ If an Aerial is ejected during the competition, its Launching Mechanism will be powered off, image transmission will be disconnected, the Pilot cannot start the Aerial's propellers, and the Gimbal Operator cannot call for air support; if the Aerial is flying, the Operator must immediately land it onto the Landing Pad; ➤ If the Dart System is ejected during the competition, the Dart launching button will be hidden from view, the gate of the Dart Launching Station can no longer be opened; if the gate is already open, it will close immediately; ➤ If a Radar is ejected during the competition, the Radar's inter-robot communication will be disconnected; ➤ If a robot other than an Aerial, Dart, and robots other than a Radar is ejected during the competition, the robot's HP will become 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. If an Operator is ejected, all robots controlled by them shall also be ejected for the current round and will not be allowed to join the Battlefield

Types of Penalties	Descriptions
	<p>nor can they be replaced by other robots for all rounds in the current match. If an Aerial Gimbal Operator, Aerial Robot, and Dart System are all ejected, they will no longer be allowed to compete nor can they be replaced by other robots in all rounds of the current match.</p>
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 (including the Three-minute Setup Period and Referee System Initialization Period). The offending team’s Base, Outpost and Sentry’s HP will become zero, and the HP of the team’s other robots will be full. The opposing team’s Base and Outpost HP and their robots’ HP remain full; ➤ If a Forfeiture is issued during a round, the round will end immediately. The offending team’s Base, Outpost 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, Outpost and robots will remain at the level when the round ended; ➤ If a Forfeiture is issued after a match, the offending team’s Base, Outpost 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, Outpost 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, and 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.

7.2 Penalty Details

This chapter specifies the penalty rules for the competition. The R# rules clearly indicate the rules that participating teams, participants and robots must follow.

7.2.1 Staff

7.2.1.1 General Rules

- R1 Teams are required to meet the requirements in the [“RoboMaster 2023 University Championship Participant Manual”](#).

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: The team may be issued a maximum penalty of disqualification and the offending party may be required to compensate accordingly, as judged based on the team’s subjective intention and the impact of its violation on the competition process.

- R4 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 offender may be disqualified as the maximum penalty.

- R5 Any participant who has entered the Staging Area and Competition Area may not leave either area without the permission of the Referee.

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.

- R6 Except for the projectiles preloaded in the Inspection Area, participating teams are not allowed to bring the projectiles to be used in the competition into the Staging Area or Competition Area.

Penalties: Confiscation of projectiles and Verbal Warning. If the Verbal Warning is ineffective, the offender may be disqualified as the maximum penalty.

- R7 After a match is over, the Pit Crews must power off all their robots, remove them from the Competition Area and empty all projectiles inside 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 After a match ends, Pit Crew must return all projectiles used in the competition to the Projectile Unloading Area.

Penalties: Confiscation of projectiles and disqualification of the offending personnel from subsequent matches in the current division. The highest penalty that can be imposed on the offending personnel is disqualification.

R9 Except for emergency situations, teams must be present at the Inspection Area at least 90 minutes before the start of each match for Pre-match Inspection. The team must stand by at the Staging Area 15 minutes before each match.

Penalties: The maximum penalty is a Match Forfeiture.

R10 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.

R11 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 the Verbal Warning is ineffective, the offender may be imposed a maximum penalty of disqualification from the competition.

R12 Pit Crews must wear armbands which must not be covered. One member must wear the “Captain” armband.

Penalties: Verbal Warning.

R13 Without the permission of the Referee, Pit Crew Members entering the Battlefield must not communicate with anyone from the outside.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender may be disqualified as the maximum penalty.

R14 Except for the Radar, team members are not allowed to power their self-prepared equipment using the power supply for official equipment in the Competition Area. However, they may bring their own power supply.

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

7.2.1.2 Battlefield Specifications

R15 Pit Crews must wear protective goggles when inside the Battlefield.

Penalties: The offender is barred from the Battlefield.

R16 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.

R17 After the end of the Three-Minute 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.

R18 After the end of the Three-Minute Setup Period, the Pit Crew must place the Commissioning Remote Controller for the Sentry Robot and Radar at the entrance of the Battlefield. The Remote Controller cannot be used to commission the Sentry Robot and Radar once the five-second countdown has started.

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

R19 During the Three-Minute 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.

7.2.1.3 Operator Room Requirements

R20 During the Three-Minute Setup Period, only one person, in addition to the Operators of the deployed robots, is allowed to enter the Operator Room. Non-operators must leave the Operator Room before the Three-Minute Setup Period ends.

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 Room during the Referee System Initialization Period and the Match to operate the relevant control equipment, wear the corresponding headphones, and must remain in position after the end of the Three-minute Setup Period, 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 can use a maximum of one Remote Controller and Custom Controller, except for Gimbal Operators who are allowed to use Gimbal Remote Controllers and Custom Controllers for Darts and Aerial Robots at the same time.

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.

R24 A Pilot that operates an Aerial Robot must pass the Pilot Assessment.

Penalties: The team is issued a Round Forfeiture and the offending team member is disqualified.

R25 Pilots are not allowed to use the image transmission function.

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

R26 During the competition, a Pilot must meet the attire, location, and reloading time requirements when reloading projectiles for an Aerial Robot.

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

7.2.2 Robots

7.2.2.1 General Rules

R27 Robots and Custom Controllers to be deployed in a match must pass a Pre-Match Inspection.


Penalties: Round Forfeiture.

R28 In the first round of a match, the robots must meet the minimum battle team size.

Penalties: Match Forfeiture.

R29 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.
-

R30 In the event of a dispute, teams are obligated to show their robot’s mechanisms, circuit design drawings and relevant code documents to the RMOC and answer relevant technical questions.

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

R31 Before the Referee System Initialization Period, robots must be attached with armor stickers that meet the specifications documents.

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

R32 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.

R33 Robots must not carry or present safety issues including but not limited to short circuits, crashing, creating fumes or lighting flames, parts falling to the ground, and gas cylinder explosions. If a safety issue is present or has arisen, team members must perform 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 “8 Irregularities”.



For safety reasons, if an Aerial Robot appears to be flying erratically during the competition, the Head Referee will eject the robot and the Pilot must stop operating it.

R34 Robots are not allowed to fire projectiles out of the Battlefield.

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

R35 Dart Systems are not allowed to fire Darts out of the Battlefield.

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

R36 On the Battlefield, each team can have no more than one robot installed with an Optional 17mm Launching Mechanism.

Penalties: During the Three-Minute Setup Period, if any team in the Battlefield has multiple robots installed with Optional 17mm Launching Mechanisms, the Pit Crew Members must remove the excess robots from the Battlefield as required by the rules. If it has entered the Referee System Initialization Period, the Referee System will automatically retain the active robot allowed to be mounted with an Optional 17mm Launching Mechanism and having the smallest robot number, while issuing a Red Card to the remaining offending robots.

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

R37 During the Three-Minute Setup Period and the Referee System Initialization Period, robots in the Battlefield are not allowed to leave their corresponding initialization zones.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the highest penalty that can be imposed on an offending robot is a Red Card.

R38 If any projectile needs to be fired during the Three-minute Setup Period, it must be launched into the projectile clearance bag.

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

R39 During the Three-Minute Setup Period, robots intending to change their modules or parts must meet the requirements for “Equivalent Parts”.

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

R40 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.

R41 During the competition, Engineer is not allowed to use supplement lights except for procuring Mobile Battlefield Components. Other robots are not allowed to use the supplement light at any time (including visible and non-visible light).

Penalties: A Verbal Warning will be given if it is occurring for the first time in the match; if the Warning is ineffective, the offending robot will be issued a Yellow Card. If the violation is repeated in another round of the same match, a Verbal Warning will be given again; if the warning is ineffective, the offending robot will be issued a Red Card.

7.2.2.2 Ground Robots

R42 During the competition, no robots are allowed to block any of its Armor Module using its own body structure.

When a Hero Robot is grabbing or carrying a Mobile Battlefield Component, any one of its armors is allowed to be blocked by the carried Mobile Battlefield Component and its relevant body structure, and the Armor Module obstructed can be different each time, but multiple Armor Modules are not allowed to be obstructed at the same time.



Hero, Standard, and Sentry Robots are not allowed to obstruct their Armor Modules when carrying obstacles blocks.

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

R43 During the competition, Balancing Standard Robots must meet the definition of a Balancing Standard Robot while they are alive. 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.

7.2.2.3 Aerial Robot

R44 During the Three-Minute Setup Period, team members may debug the Aerial Robot near the Landing Pad, but must not start the propeller.

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



If a team has a Dart System in the Battlefield and it has not been ejected, the Aerial Gimbal Operator is allowed to remain in the Operator Room.

R45 The hook of the Aerial Safety Rope must be attached to the rigid ring of the Aerial Robot's vertical rigid safety rod.

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

R46 During the competition, the distance between the lowest point of an Aerial Robot and the Battlefield ground must not be less than 1500mm, and no part of the 17mm Speed Detection Module carried by the Aerial Robot's gimbal Launching Mechanism can exceed the highest point of the Perimeter Wall of the Flight Zone

Penalties: A Gesture or Verbal Warning is given to the pilot, to remind him or her to adjust the flight altitude. If a warning is ineffective, the offending robot shall be issued a Red Card and forbidden from entering any rounds in the same match.



- If an Aerial Robot has a 17mm Launching Mechanism, the robot's flight altitude will be determined based on its 17mm Speed Monitor Module;
 - If an Aerial Robot does not have a 17mm Launching Mechanism, the robot's flight altitude will be determined based on the plane of its rotors.
-

R47 During the competition, Aerial Robots are forbidden from flying outside the Battlefield.

Penalties: The offending robot will be issued a Red Card. Aerial Robots are not allowed to enter the other rounds in the same match and all matches after this competition stage.

R48 If Aerial experiences technical faults, or is damaged due to the unreasonable design of the powertrain system or power supply system during the competition, it must be checked by the Referee and must be cleared by the Head Referee as hazard-free before it can be allowed to return to the match.

Penalties: The offending robot will be issued a Red Card. The offending robot is not allowed to enter the other rounds in the same match.

7.2.2.4 Other robots

R49 Teams are prohibited from using the Radar to collect information from outside the Battlefield that may affect the competition.

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

R50 The Dart System must not remain in a Ready-to-Launch state other than during the Seven-minute Round.



Ready-to-Launch State: The energy storage element used for providing initial kinetic energy for Darts is in a tense, inflated, and rotating state. Energy storage element includes but not limited to rubber band, cylinder, friction wheel, etc.

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

7.2.3 Interactions

7.2.3.1 Interaction between Robots

R51 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 an Aerial Robot and Ground Robot, the Aerial Robot will be deemed the offending robot;
- In any collision between two Ground Robots, the offending robot will be the robot 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 7-3 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, or seriously impeding the normal movement of the other team's robot.

R52 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.

R53 No robot may attack the Aerial Robot, Dart Launcher and Radar of the opposing team.

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

R54 A robot must not use any means other than firing projectiles to interfere with an enemy robot's projectile reload, HP recovery, or respawn.

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

R55 No robot and its actions are allowed to obstruct an enemy robot's entry into its Supplier Zone or Power Rune Activation Point.

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

R56 No robot is allowed to use any means to remove an enemy Sentry Robot out of the Patrol Zone including, but not limited to, actions such as collision and entanglement.

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

R57 No robot is allowed to move its own team's surviving Sentry Robot through any physical means.

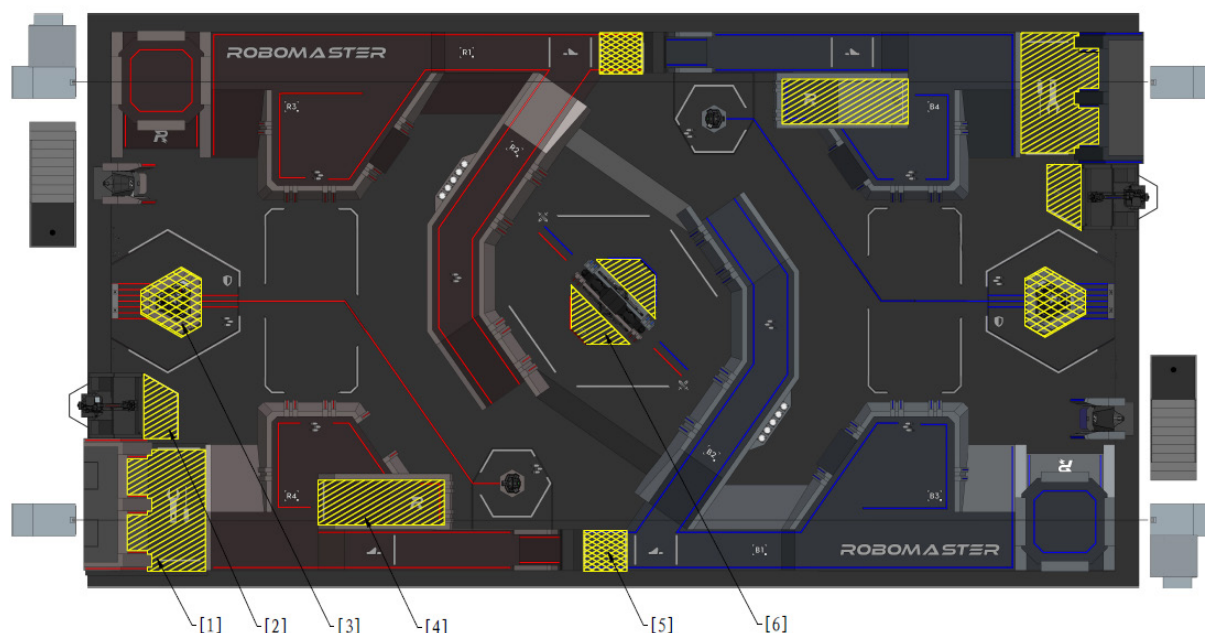
Penalties: Warnings shall be issued against the offending robot judged based on their subjective intention and the Sentry Robot's degree of movement.

Table 7-4 Penalties for Moving Sentry Robots

Violation Level	Descriptions
Yellow Card	Causing one team's Sentry Robot to move passively.
Red Card	Causing one team's Sentry Robot to move passively over a longer distance.

7.2.3.2 Interaction between Robots and Battlefield Components

Multiple Penalty Zones are set in the Battlefield. The entry of the team's robot (including any Battlefield Component carried by the robot) into the Penalty Zone will be deemed as the robot's entry into the Penalty Zone. The Penalty Zone is shown below.



- | | | |
|--|---------------------------|----------------------------------|
| [1] Supplier Penalty Zone | [2] Exchange Penalty Zone | [3] Base Penalty Zone |
| [4] Power Rune Activation Point Penalty Zone | [5] Road Penalty Zone | [6] Resource Island Penalty Zone |

Figure 7-1 Base Penalty Zone

R58 The Resource Island Penalty Zone is located on both sides of the Large Resource Island, and is not divided into red and blue sides. During its effective period, the Engineer Robots of both teams have priority access to the Resource Island Penalty Zone. The specific rules are as follows:



The effective/non-effective period of the Resource Island Penalty Zone: The Large Resource Island and its Penalty Zone will be in the effective period if they contain a Gold Mineral that has not been grabbed by any robot; otherwise they will be in the non-effective period.

- The Engineer Robots of both teams are not allowed to be in the same side of the Resource Island Penalty Zone. If the Engineer of one team has entered one side of the Resource Island Penalty Zone, the Engineer of the other team is forbidden from entering the side.
- If the Engineer of one team is in one side of the Resource Island Penalty Zone, the team's robots are allowed to enter the side. The other team's robots are forbidden from entering the side.
- If one team's robot other than an Engineer is in one side of the Resource Island Penalty Zone, they must exit once the Engineer of the other team later enters the same side.

Penalties: An offending robot that remains in the Penalty Zone for longer three seconds will be issued a Yellow Card, and a further Yellow Card for every five seconds thereafter until the offending robot is ejected. If an offending robot collides into an Engineer Robot, it will be issued two consecutive Yellow Cards.

R59 Robots are forbidden from entering the Base Penalty Zone or Road Penalty Zone.



A robot is not deemed in violation if it has entered and is unable to leave the Launch Ramp Penalty Zone due to a failed attempt at the Launch Ramp.

Penalties: Warnings shall be issued against the offending robot 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 ejected. An offending robot that causes serious damage to an enemy robot by remaining in a Penalty Zone will be issued a Red Card.

R60 No robot is allowed to enter the Supplier, Exchange and Power Rune Activation Point Penalty Zones



If a robot is defeated or ejected in any Penalty Zone, the Referee may activate the robot temporarily as required and guide the Robot's Operator in controlling the robot to leave the Penalty Zone.

Penalties: Warnings shall be issued against the offending robot 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 shall be issued. Thereafter, each 5 seconds will incur a further Yellow Card. This shall carry on until the robot is ejected. A non-surviving robot that stays in a penalty zone for longer than 20 seconds may be imposed a maximum penalty of a Round Forfeiture.

R61 Robots are not allowed to bring Mobile Battlefield Components into the penalty zones of both teams' Roads and Bases and their own team's Supplier Zone, Exchange Penalty Zone and Power Rune Activation Point, and

the other team's Dart Launching Station. A robot that is in the Base Buff Point and Outpost Buff Point of its team must ensure the long edge of the obstacle block it carries is not at an angle larger than 30 degrees from the ground.



Any angle judged by the naked eye may contain margins of error.

Penalties: A Yellow Card will be issued against the offending robot. If any subsequent Mobile Battlefield Component has a decisive impact on the other team's Launch Ramp, projectile supply, Power Rune, Dart launches and target hits, or affects the normal operation of any Battlefield Component, the offending robot will be issued a Red Card.

R62 During the competition, robots may only use projectiles supplied by the RMOC.

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

R63 Robots are not allowed to grab minerals that have not been fully released.

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

R64 No robots other than Engineer Robots are allowed to have direct contact with falling Minerals or Minerals in the Large Resource Island Base.

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

R65 During the competition, robots are not allowed to destroy nor affect the normal function of the Battlefield Components.

Penalties: The maximum penalty is a Match Forfeiture.

R66 A Power Rune cannot be hit using 42mm projectiles.

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

7.3 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 7-5 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

Rules	Type
3.	Violating rules mentioned in this chapter and refusing to accept penalties
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.	Where a situation that violates the specifications documents has occurred on the Battlefield and it has been determined by the Chief Referee as a serious violation
7.	Deliberate damage of the opponent's robots, Battlefield Components or related official 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 affects the progress of the matches, goes against the spirit of fair competition, or is deemed as serious in nature by the Chief Referee

8. 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, 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.
- The competition will carry on despite any anomaly with a robot's armor light effects or light bar effects or any damage to an Armor Module Sticker.
- If key Battlefield Components experience logical or structural faults, for example where the network connections are disrupted causing a robot to go offline, no buff is gained after a Power Rune is hit, 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 a situation where a game that should have ended continues and has a winner, the results for the round shall be invalidated once the Chief Referee has made a determination to that effect within five minutes after the end of the round, and a rematch shall be held.
- In the case of a serious violation that would clearly have triggered a penalty of Forfeiture, and the Head Referee did not confirm and execute it in time, the results for the round shall be invalidated once the Chief Referee has made a determination to that effect within five minutes after the end of the round, and the offending team will be issued a Forfeiture.
- During the competition, if any situation has occurred that may affect the fairness of the competition, the Chief Referee shall notify the Captains of both teams of the situation and suspend the results confirmation process within five minutes after the end of the match, and shall make a determination within 60 minutes and notify both Captains of the final course of action.

9. Appeal

Every team has one appeal opportunity during each of the Regional Competitions, Wild Card Competitions and Final Tournaments. Appeal opportunities cannot be used cumulatively across competitions. If an appeal is successful, the team involved retains its right to appeal again in future matches. If it is unsuccessful, the team will have exhausted its one opportunity to appeal. 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:



- Verbal Warnings and Yellow and Red Cards issued as penalties for violations
- The types and processes of Technical Timeouts initiated.

- No appeal is allowed 5 minutes after a Match Results Confirmation Form has been signed or a match has ended.
-

9.1 Appeal Process

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

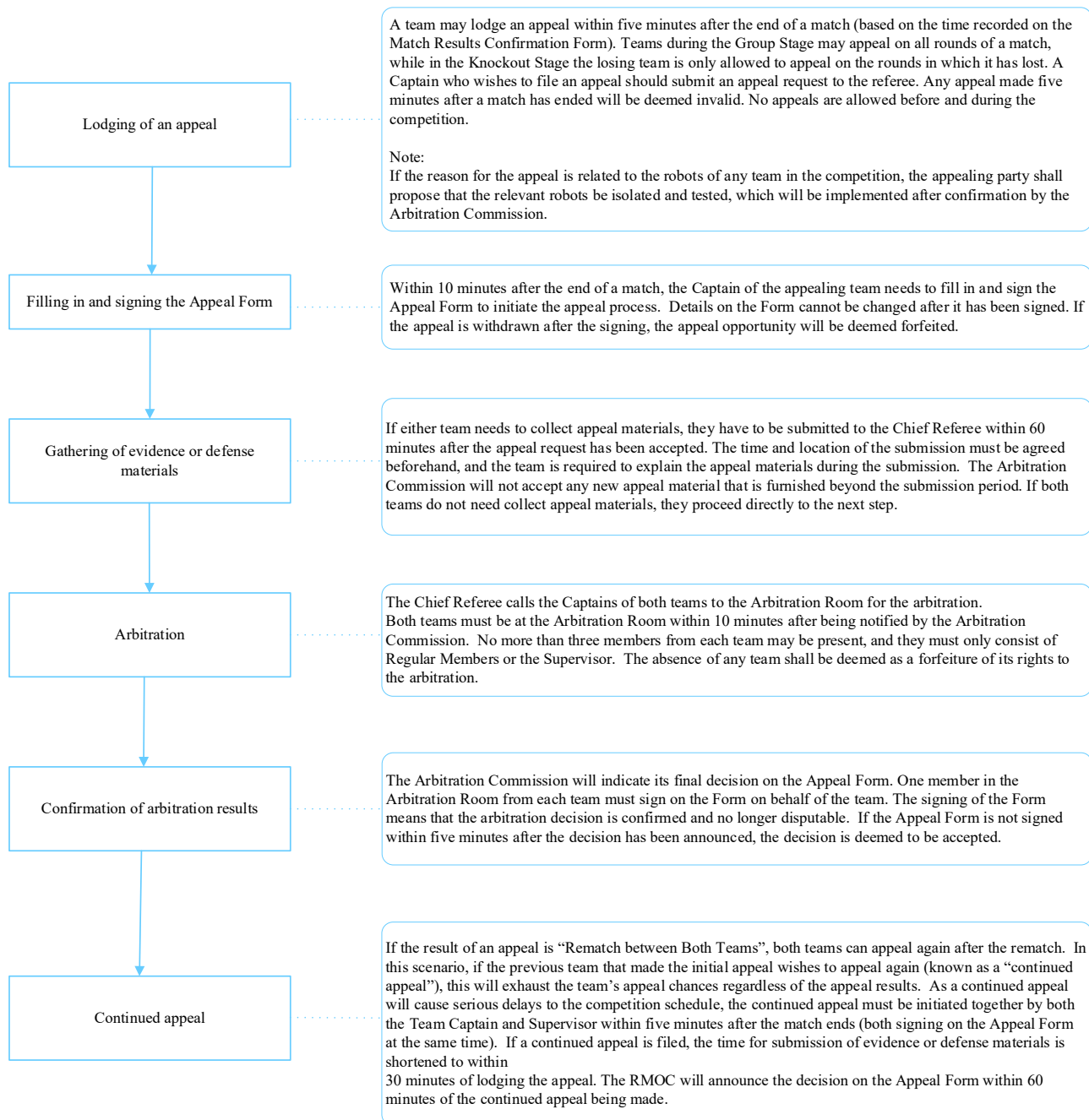


Figure 9-1 Appeal Process

9.2 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 1 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.

9.3 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.



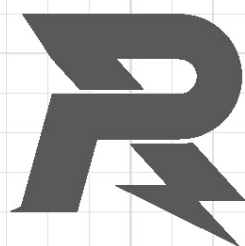
Provided it does not affect the schedule of the entire competition, the rematch will in principle be held on the same day after all the other matches.

Appendix References

This chapter contains relevant reference materials for RMUC.

Appendix Table 1 Overview of Reference Materials

Categories	Download Links and Documents List
Competition Specifications Documents	<p>To download the user manual, visit:</p> <p>https://www.robomaster.com/en-US/resource/pages/announcement/1504</p> <ul style="list-style-type: none"> ● Rules Manual ● Participant Manual ● RoRobot Building Specifications Manual
Referee System Related	<p>To download the user manual, visit:</p> <p>https://www.robomaster.com/en-US/products/components/Referee?djifrom=nav</p> <ul style="list-style-type: none"> ● RoboMaster Referee System User Manual ● Referee System Serial Port Protocol Appendix ● User Manuals of Referee System Modules ● FAQ
RoboMaster Champion Related	<p>To download the user manual, visit:</p> <p>https://www.robomaster.com/en-US/products/components/detail/3785</p> <ul style="list-style-type: none"> ● Player's Client Interface Instructions ● Referee's Client Interface Instructions



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