

V1.2

Using a 52-58 motor driver chip and
field-oriented control (FOC), the
RoboMaster C620 Brushless DC Motor Speed
Controller enables precise control over motor
torque.



Especially designed for the RoboMaster
M6000 P19 Brushless DC Motor and
C620 Brushless DC Motor Speed Controller,
this M6000 Assembly Kit includes several
modules and a torx tool.

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

The M6000 Assembly Kit includes several
modules and a torx tool, enabling a
complete assembly system for the
RoboMaster M6000.

The 23rd China University Robot Competition

ROBOMASTER 2024

University Championship

Rules Manual

Prepared by RoboMaster Organizing Committee

Released in April 2024

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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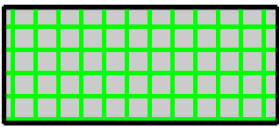

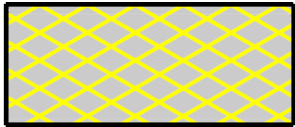
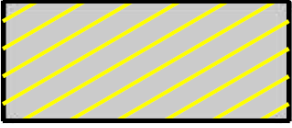

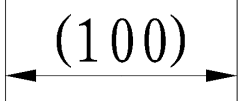
For suggestions on open-source materials, please refer to: <https://bbs.robomaster.com/thread-7026-1-1.html>.

Using this Manual

Legend

 Important notes and supplementary information	“√” Applicable	“-” Not applicable
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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

Release Notes

Date	Version	Release Notes
2024.04.18	V1.2	<ol style="list-style-type: none"> 1. Added instructions on how to judge whether a robot is in certain Buff Points. 2. Revised the method of allocating Experience Points for Darts hitting random targets of the Base. 3. Revised the mathematical description for the poses of the Exchange Station at low difficulty levels. 4. Revised the relevant descriptions for determining the competition outcome of Sentry Robots. 5. Revised some descriptions and drawings related to the Battlefield and mechanisms. 6. Revised certain descriptions of penalties and the competition process.
2023.12.28	V1.1	<ol style="list-style-type: none"> 1. Revised the conditions under which opponent robots and battlefield components shield against damage from 42 mm projectiles. 2. Added drawings of the Base and the Base Dart Detection Module. 3. Added instructions on transparent materials and Nugget surface roughness in Tunnels and resource islands. 4. Revised the location of the Localization Marker and the terrain of Trapezoid-Shaped Elevated Ground No. 4. 5. Revised the attack damage to different Armor Modules of the Base. 6. Revised the HP and Defense Buffs of the Sentry Robot. 7. Revised the Launch Ramp Buff and the buff mechanism of Power Rune Activation Point. 8. Added the impact of project documents and technical proposals on Gold Coins. 9. Removed the option to gain Experience Points with assists. 10. Revised the movement range of the Base Dart Detection Module. 11. Revised the number of Pit Crew and related competition processes. 12. Revised regulations on penalties related to the Balancing Standard Robot. 13. Revised processes related to appeals.
2023.10.18	V1.0	First release

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1. Foreword

1.1 About the Competition

The RoboMaster 2024 University Championship (“RMUC 2024”) under the China University Robot Competition is a shooting sport-style robotics competition. Participating teams are required to design, develop and create a fleet of robots in compliance with specifications. 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.

- During Regional Competitions: after the end of the competition for a single division.
- During the Final Tournament: after the end of each competition phase (for example: Group Stage or top-16 matches).

The RMOC reserves the right of final interpretation over the Specifications Manuals. During the event, only the Chief Referee can answer queries on the Specifications Manuals on behalf of the RMOC. Any questions related to the specifications may only be directed to the Chief Referee for consultation.



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.

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

<https://qingflow.com/f/8ac4033d>

2. The RMOC will respond within 5 working days at this link:

<https://qingflow.com/appView/8ac4033d/shareView/f5f09581>

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. The Q&A for each season applies only to the current season.

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 the relevant chapter using associated keywords.

Table 2-1 Overview of Key Terms

Term	Definition
Robots	
Standard Robots	Standard Robots include 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 2024 University Series Robot Building Specifications Manual .
Ground Robots	Including 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 consists of the robot-side modules, the server and player’s client installed on the PC. It can monitor robot power, projectile launches and damage, and execute 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 propulsion system and its accessories; a mechanism that supports the body of a robot.
Chassis Power	The power of the propulsion system that enables horizontal movement and rotation of the robot. For more details, please refer to the definition of chassis power in the “Referee System Mounting Specifications” chapter of the RoboMaster 2024 University Series Robot Building Specifications Manual .
Launching Mechanism	A mechanism capable of launching a projectile from a robot on a fixed trajectory and at a certain initial speed.
Locking of the Launching Mechanism	If the Launching Mechanism is locked, it will be powered off.
Unlocking of the Launching Mechanism	If the Launching Mechanism is unlocked, it will be powered on or off depending on its Projectile Allowance.

Term	Definition
Initial Projectile Speed	The speed detected by the relevant modules of the Referee System after a projectile or Dart has completed its acceleration.
Barrel Heat	The barrel heat generated by a robot after launching a projectile.
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 required for a robot to level up, which can be obtained in various ways.
Attack	A robot's behavior in launching projectiles or Darts.
Destruction	Where a robot attacks the Armor Module of an opponent Base, Outpost, or robot until the latter's HP drops to zero.
Assist	Where a robot (except the destroyer) inflicts damage on an opponent robot within 10 seconds before the latter's destruction.
Invincible	When a robot receives a 100% Defense Buff, the Defense Buff will not be affected by any other mechanisms.
Alive	The Referee System Main Controller Module normally connects to the Referee System Server and the robot's HP is not zero.
Defeated	<p>Where a robot's HP drops to zero after its Armor Module has been attacked or collided; it has exceeded its Chassis Power Consumption limit, Initial Projectile Speed limit, or Barrel Heat limit; it goes offline unusually; its Referee System module has gone offline.</p> <p>Note: After a robot is defeated or ejected, the Referee System will cut off the power supply to the robot (except for the Mini PC).</p>
Out of Combat	An alive robot has not fired a projectile and suffered any HP deduction for six seconds.
Ejected	<p>Where a robot is issued a Red Card Warning.</p> <p>Note: After a robot is defeated or ejected, the Referee System will cut off the power supply to the robot (except for the Mini PC).</p>
Irregular Offline	The Referee System Main Controller Module is disconnected from the Referee System Server during the competition, due to a power outage on the robot or other reasons.

Term	Definition
Temporary Activation	Where a robot’s chassis and gimbal are powered on temporarily after it has been defeated or ejected. The Launching Mechanism for the robot will be powered off.
Occupation	Where an alive robot has reached a Buff Point, its RFID Interaction Module has detected the RFID Interaction Module Card in the area or has met other conditions, and it has obtained certain special effects.
Entanglement	Mechanisms of robots are entangled with one another during the competition, i.e. one robot remains connected to the other robot and is pulled with said robot whichever direction it moves.
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 documents 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 who have registered and been recorded in the registration system for the current competition season.

Term	Definition
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	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.
Operator	The Pit Crew members responsible for controlling robots during the competition, including Ground Robot Operators, Aerial Gimbal Operators, and Pilots.
Offending Team	A participating team that violates the competition rules.
Offender	Participants that violate the competition rules.
Competition Process	
Round	A complete competition that includes the setup period, the referee system initialization period, a 5-second countdown 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 Participating Team during the Setup Period.
Factors Determining the Competition Outcome	
Attack Damage	The HP deducted from a robot or Battlefield Component when hit by projectiles or Darts. Note: HP deduction caused by the imposition of penalty for the violation of one side's robot, Base, or Outpost is included in the opponent's Attack Damage.
Non-attack Damage	HP deducted as a result of exceeding the Initial Projectile Speed limit, Barrel Heat limit and Chassis Power Consumption limit, a collision on an Armor Module, the Referee System going offline, or an irregular offline status.
Net Base HP	It is equal to the remaining HP of one's Base minus the remaining HP of the other Base at the end of a round.
Net Outpost HP	It is equal to the remaining HP of a team's Outpost minus the remaining HP of the other Outpost at the end of a round.
Net Sentry HP	It is equal to the remaining HP of a team's Sentry minus the remaining HP of the other Sentry at the end of a round.

Term	Definition
Total Remaining HP	The total value of remaining HP of one's alive 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 2024 University Series Robot Building Specifications Manual](#).

The required robot line-up is as follows:

Table 3-1 Robot Line-up

Type	No.	Full Lineup (Units)	Competition Stage
Hero Robot	1	1	Regional Competition, Wild Card Competition and Final Tournament
Engineer Robot	2	1	
Standard Robot	3/4	2	Mainland China Regional Competition
	3/5	2	Invitational 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 the Radar and Dart System.
- Each team is only allowed to deploy one Balancing Standard Robot.

The operator line-up shall be as shown below:

Table 3-2 Operator Line-up

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 (optional), Dart System (optional)	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 for the current match.
-  When the Aerial Robot and Dart System are not fielded, the Aerial Gimbal Operator may control the player’s client corresponding to the Aerial and Dart System and wear the corresponding headphone but must remain at the designated area after the Three-Minute Setup Period.
- A Pilot can operate an Aerial Robot in the competition only after obtaining the Pilot qualification. For details, please refer to the [RoboMaster 2024 University Championship Participant Manual](#).

3.1 Hero Robot

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

Table 3-3 Key Features of Hero Robots

Key Features	Descriptions
Initial Zone	Starting Zone

Key Features	Descriptions
Operating Mode	There are no restrictions. Up to one remote control and one custom controller.
Inter-Robot Communication	Allowed
Level-Up Mechanism	Applicable Note: Chassis Power Consumption Limit, Initial HP, Maximum HP, Barrel Heat Limit, and Barrel Cooling Value per Second are related to levels and chassis types. For their details, please refer to “5.7 Experience and Performance Systems”.
Initial Projectile Speed Limit (m/s)	16
Launching Mechanism	One 42 mm launching mechanism
Projectiles	<ul style="list-style-type: none"> ● 42 mm projectiles can be pre-loaded before the Seven-Minute Round. ● During the Seven-Minute Round, participants can exchange Projectile Allowance through the Economic 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 Activation Point ● Restoration Zone ● Hero Robot Sniper Point
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 Nuggets for Gold Coins.

Table 3-4 Key Features of Engineer Robots

Key Features	Descriptions
Initial Zone	Starting Zone
Operating Mode	There are no restrictions. Up to one remote control and one custom controller.
Inter-Robot Communication	Allowed
Level-Up Mechanism	Not applicable Note: For details, please refer to “5.7 Experience and Performance Systems”.
Initial HP / Maximum HP	250
Chassis Power Consumption Limit	Not applicable
Launching Mechanism	Not applicable
Projectiles	42 mm and 17 mm projectiles can be pre-loaded before the Seven-Minute Round.
Buff Point Occupation	<ul style="list-style-type: none"> ● Restoration Zone ● Resource Island Buff Point ● Exchange Zone
Respawn Methods	<ul style="list-style-type: none"> ● Progressive respawn ● Instant respawn through exchange

3.3 Standard Robot

Standard Robots can launch 17 mm 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 are no restrictions. Up to one remote control and one custom controller.

Key Features	Description
Inter-Robot Communication	Allowed
Level-Up Mechanism	Applicable Note: Chassis Power Consumption Limit, Initial HP, Maximum HP, Barrel Heat Limit, and Barrel Cooling Value per Second are related to levels, chassis, and Launching Mechanism types. For their details, please refer to “5.7 Experience and Performance Systems”.
Initial Projectile Speed Limit (m/s)	30
Launching Mechanism	One 17 mm Launching Mechanism
Projectiles	<ul style="list-style-type: none"> ● 17 mm projectiles can be pre-loaded before the Seven-Minute Round. ● During the Seven-Minute Round, participants can obtain 17 mm projectiles from the Official Projectile Supplier and exchange Projectile Allowance through the Economic 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 Activation Point ● Restoration 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 are no restrictions. Up to two remote controls and one custom controller.

Key Features	Description
Inter-Robot Communication	Allowed
Level-Up Mechanism	Not applicable
Initial Projectile Speed Limit (m/s)	30
Barrel Heat Limit	No restrictions
Launching Mechanism	One 17 mm Launching Mechanism
Projectiles	<ul style="list-style-type: none"> ● 17 mm projectiles can be pre-loaded before the Seven-Minute Round. ● During the Seven-Minute Round, participants that call for air support will receive 17 mm Projectile Allowance and reloading for a limited time.

3.5 Sentry Robot

Sentry Robots need to operate fully automatically and can launch 17 mm projectiles.

Table 3-7 Key Features of Standard Robots

Key Features	Descriptions
Initial Zone	Sentry Starting Zone
Operating Mode	Automatic, up to one remote controller for debugging
Inter-Robot Communication	It can send data to all robots of own team, but can only receive Radar data
Level-Up Mechanism	Not applicable Note: For details, please refer to “5.7 Experience and Performance Systems”.
Initial HP / Maximum HP	400
Chassis Power Consumption Limit (W)	100
Initial Projectile Speed Limit (m/s)	30
Barrel Heat Limit	400

Key Features	Descriptions
Barrel Cooling Value per Second	80
Launching Mechanism	Two 17 mm Launching Mechanisms
Projectiles	17 mm projectiles can be pre-loaded before the Seven-Minute Round.
Buff Point Occupation	<ul style="list-style-type: none"> ● Restoration Zone ● Sentry Patrol Zone ● Elevated Ground Buff Point ● Power Rune Activation Point ● Outpost Buff Point ● Launch Ramp Buff Point
Respawn Methods	<ul style="list-style-type: none"> ● Progressive respawn ● Instant respawn through exchange

3.6 Dart System

A Dart System can attack the opponent’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	No restrictions, up to one remote controller
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 Foundation

Key Features	Descriptions
Operating Mode	Automatic, up to one remote controller for debugging
Inter-Robot Communication	It can send data to all robots of own team, but can only receive data from the Sentry Robot.

4. Competition Area

4.1 Overview



- 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 a Regional Competition, the guiding and decorative lines for the red/blue teams in the Battlefield shall be made of red/blue PVC flooring.

The core competition area of the RMUC is called the “Battlefield”. The Battlefield is 28 m long and 15 m 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 2.4 m from its upper edge to the Battlefield ground surface.



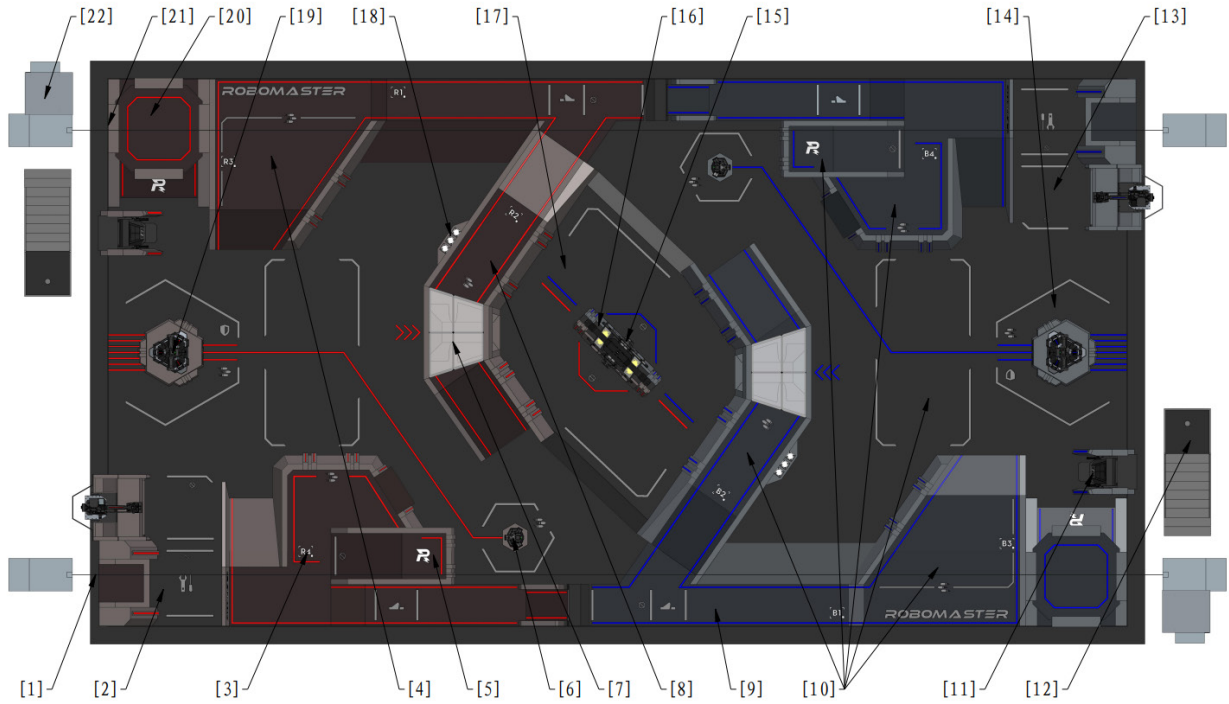
Figure 4-1 Battlefield Top View Rendering



Figure 4-2 Battlefield Side View Rendering

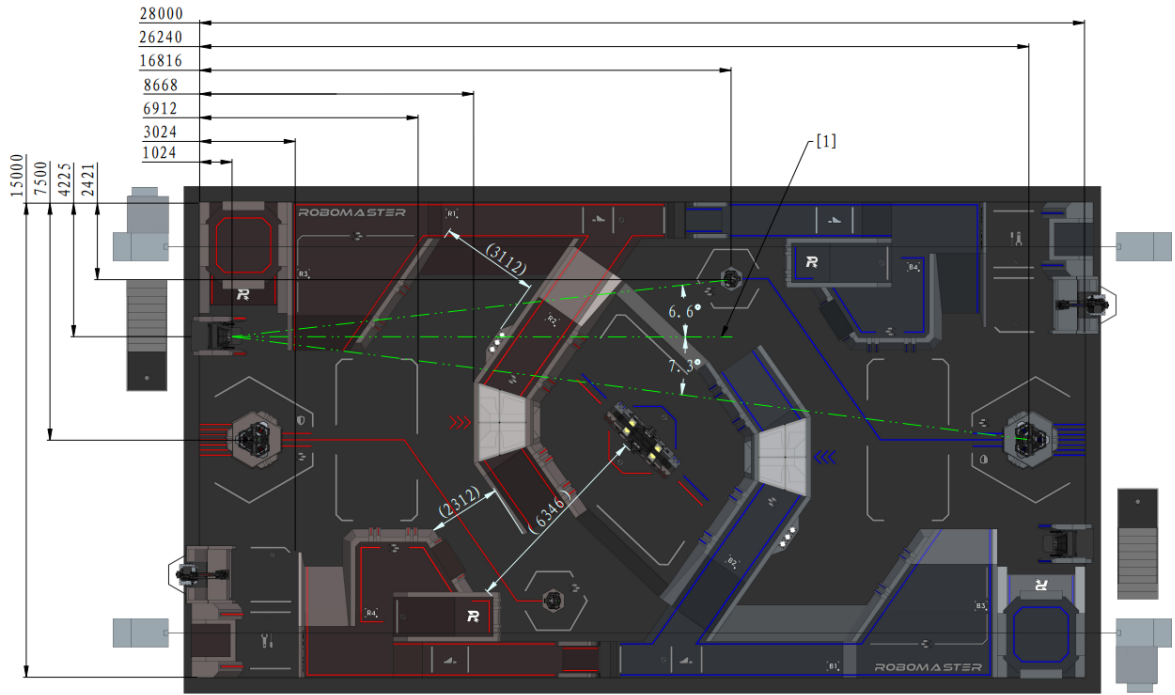


Figure 4-3 Battlefield Axonometric Rendering



- | | | | |
|--|--------------------------|---|---|
| [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] Tunnel | [8] R2 Ring-Shaped Elevated Ground |
| [9] Road Zone | [10] Sentry Patrol Zones | [11] Dart Launching Station | [12] Radar Foundation |
| [13] Exchange Zone | [14] Starting Zone | [15] Power Rune | [16] Large Resource Island |
| [17] Bumpy Roads | [18] Resource Island | [19] Base | [20] Landing Pad |
| [21] Aerial Robot projectile reload window | [22] Pilot Room | | |

Figure 4-4 Battlefield Modules

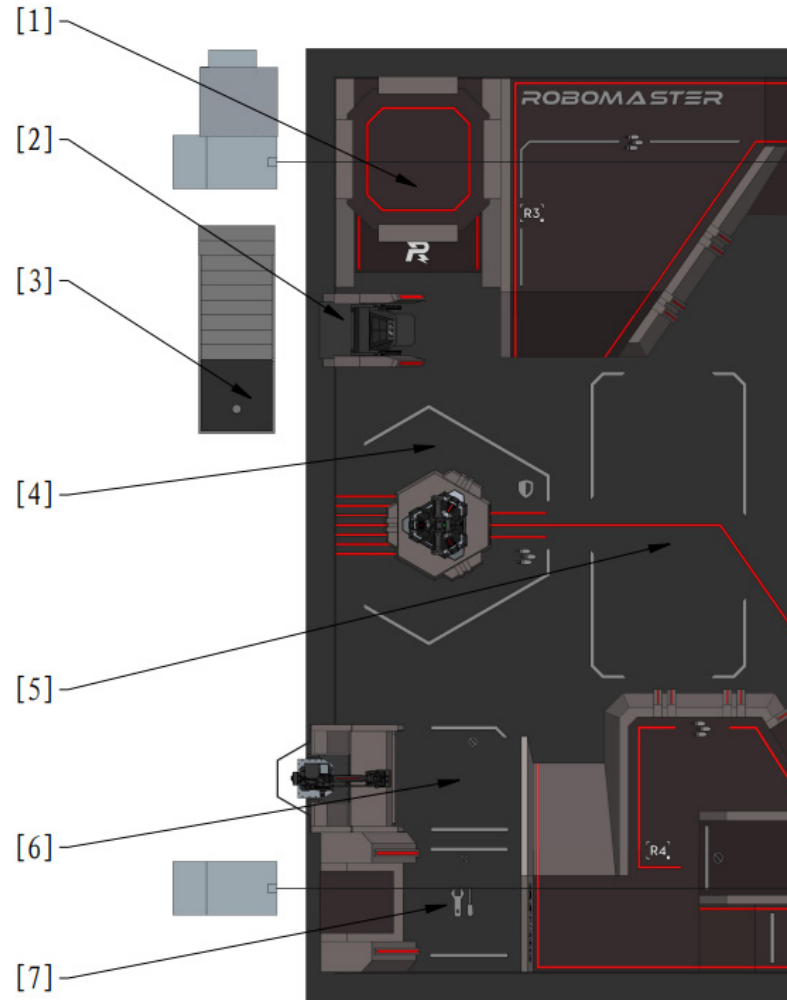


[1] Parallel with the long side of the Battlefield and the orientation of the Dart Launching Station

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 Foundation, Supplier Zone, and Exchange Zone.



- | | | | | | | | |
|-----|----------------------|-----|------------------------|-----|------------------|-----|---------------|
| [1] | Landing Pad | [2] | Dart Launching Station | [3] | Radar Foundation | [4] | Starting Zone |
| [5] | Sentry Starting Zone | [6] | Exchange Zone | [7] | 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.

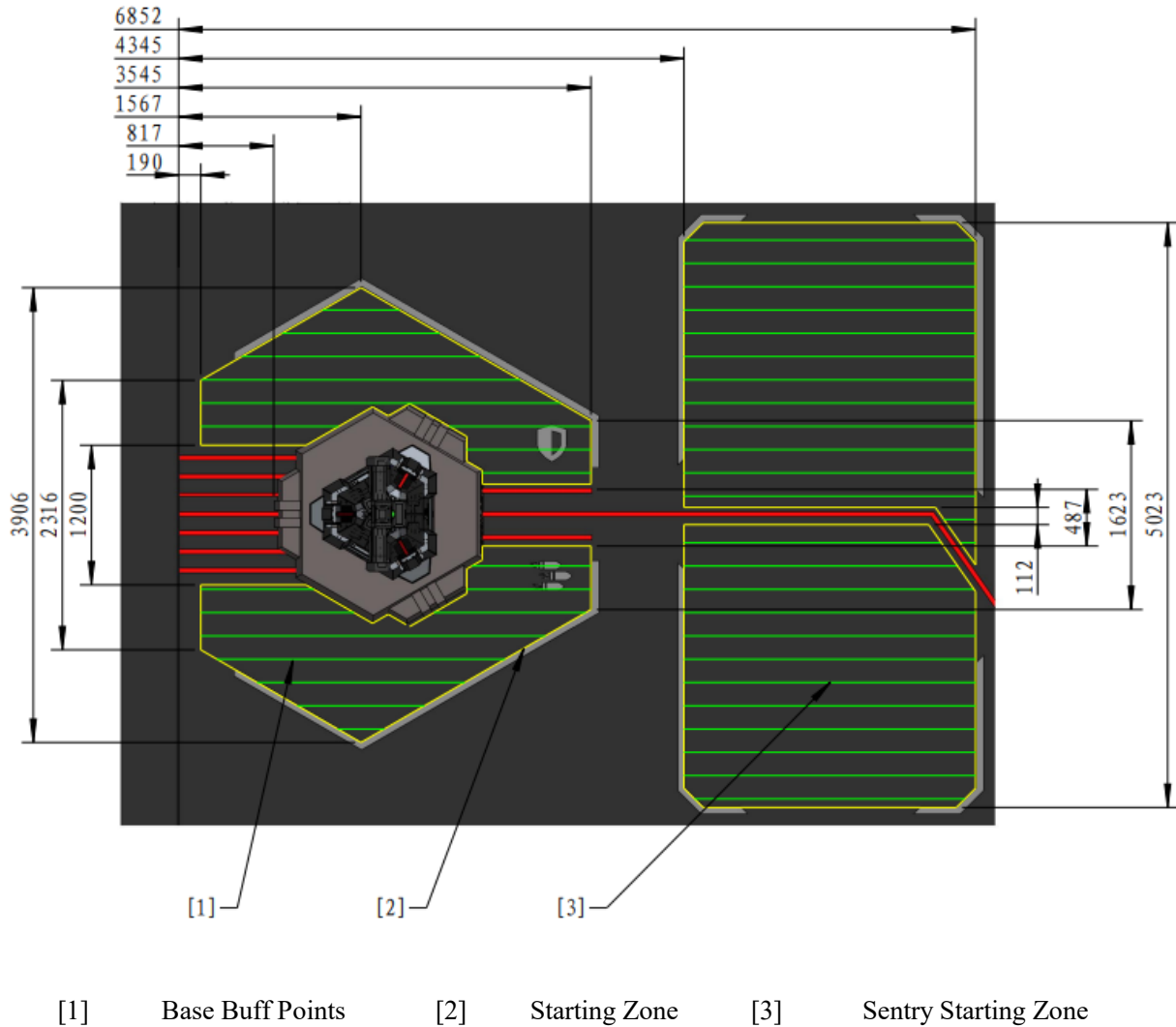
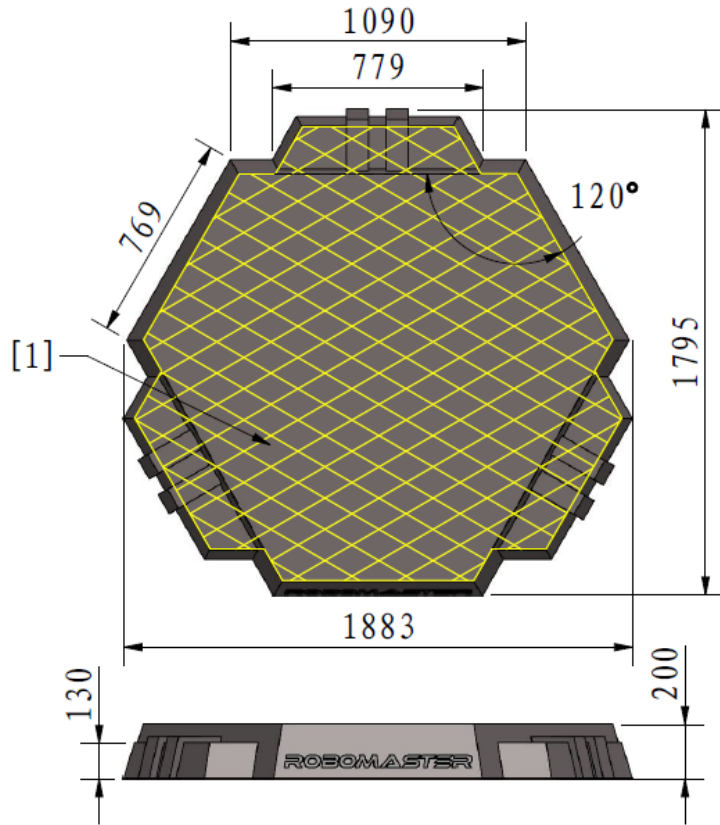


Figure 4-7 Robot Starting Zone

4.2.2 Base

The Base is at the heart of offense and defense on the battlefield. 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 Protective Armor has two states: closed or expanded.

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

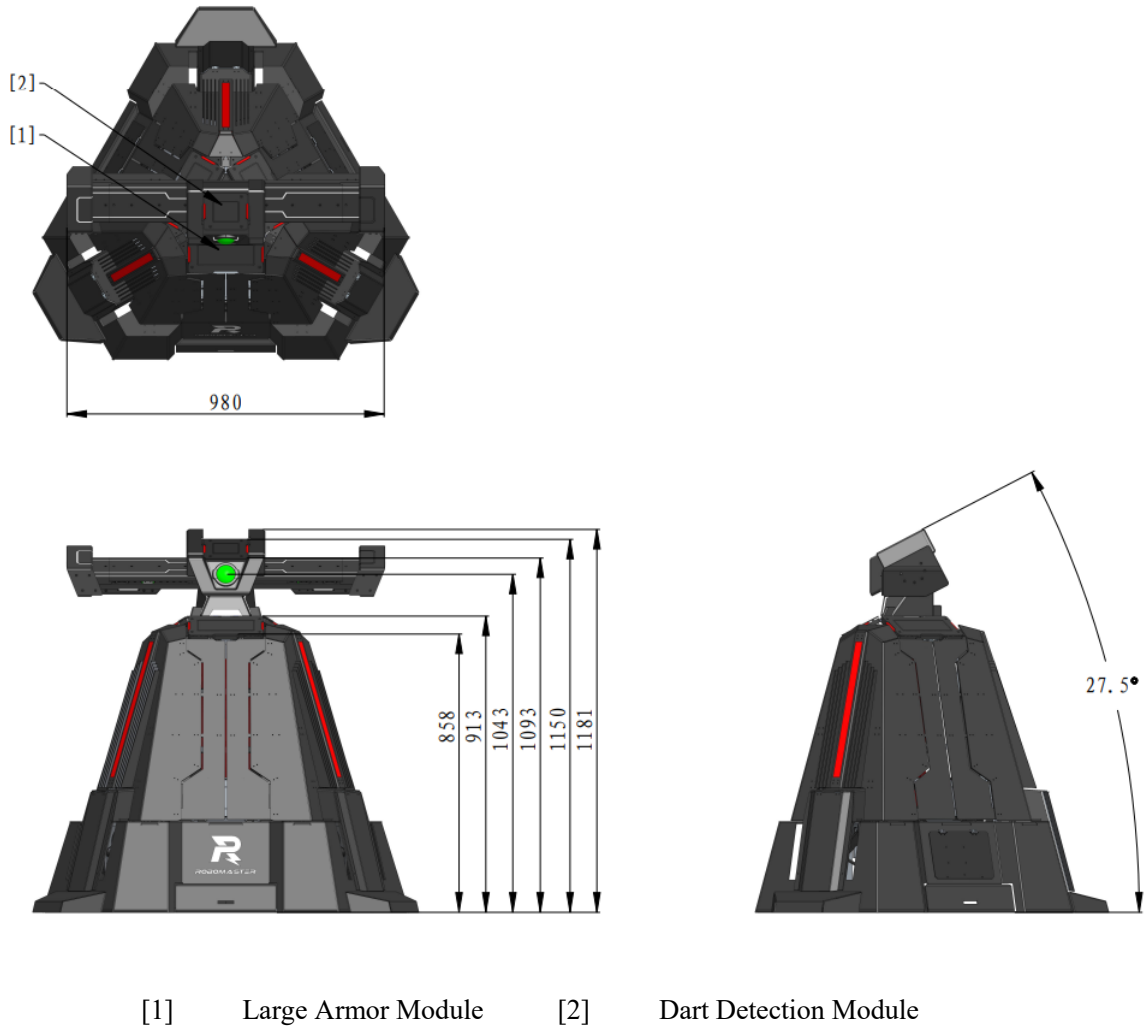


Figure 4-9 Closed State of Base Protective Armor

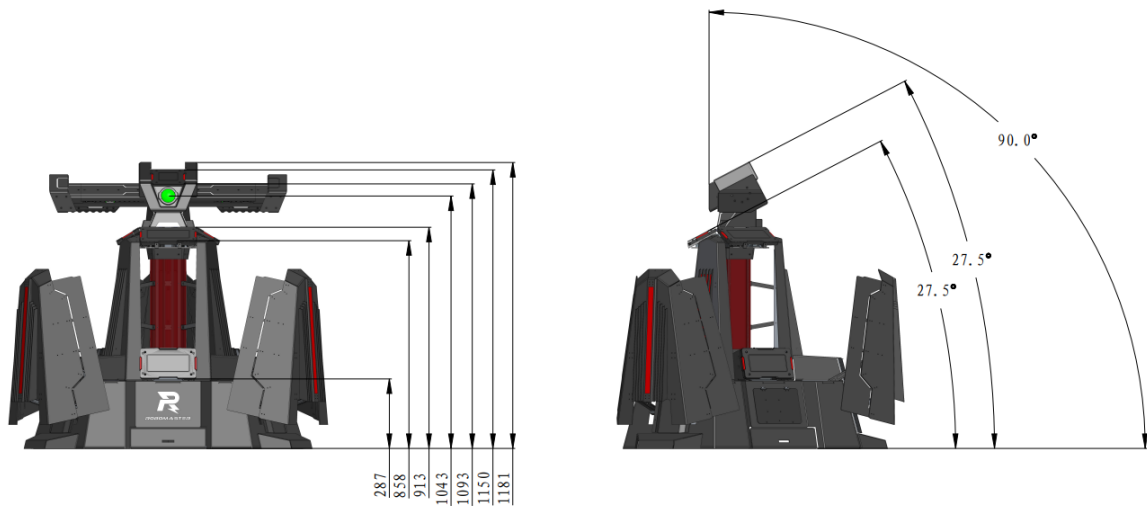
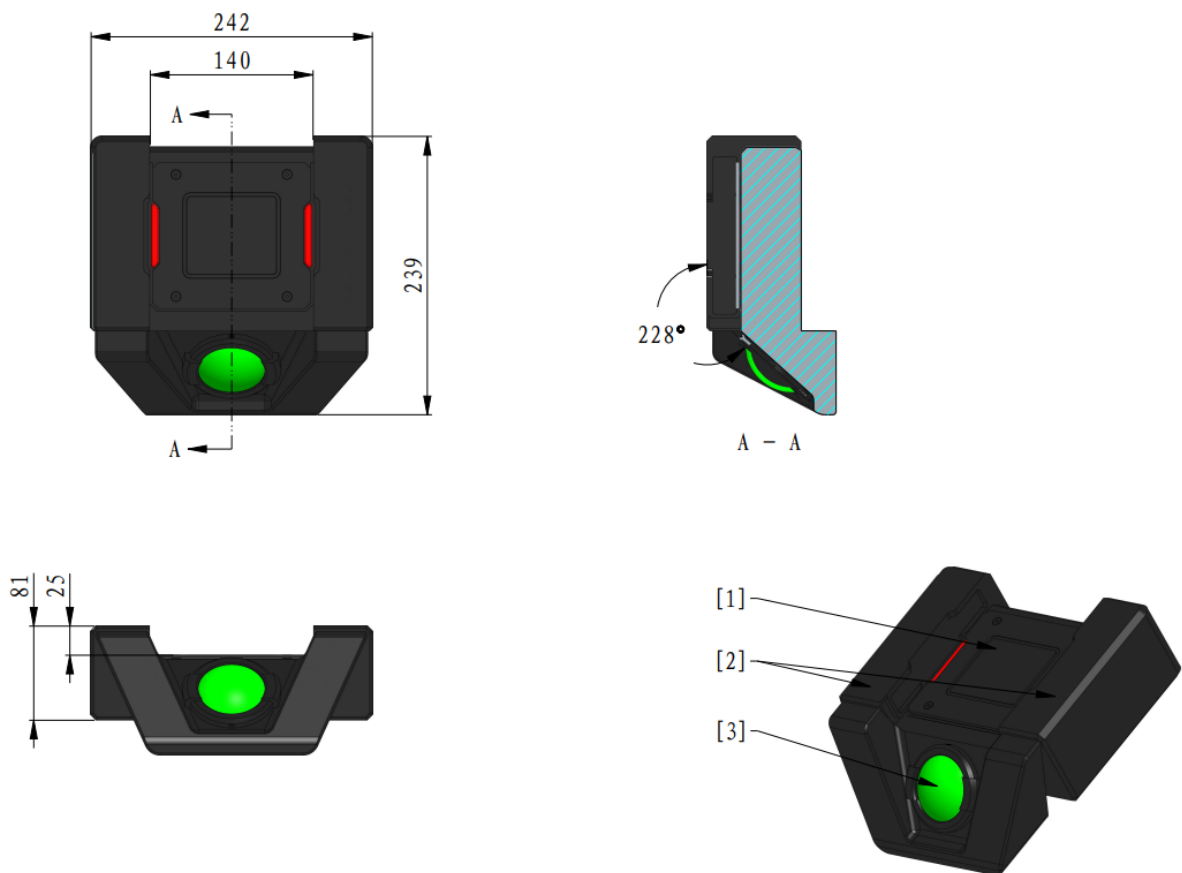


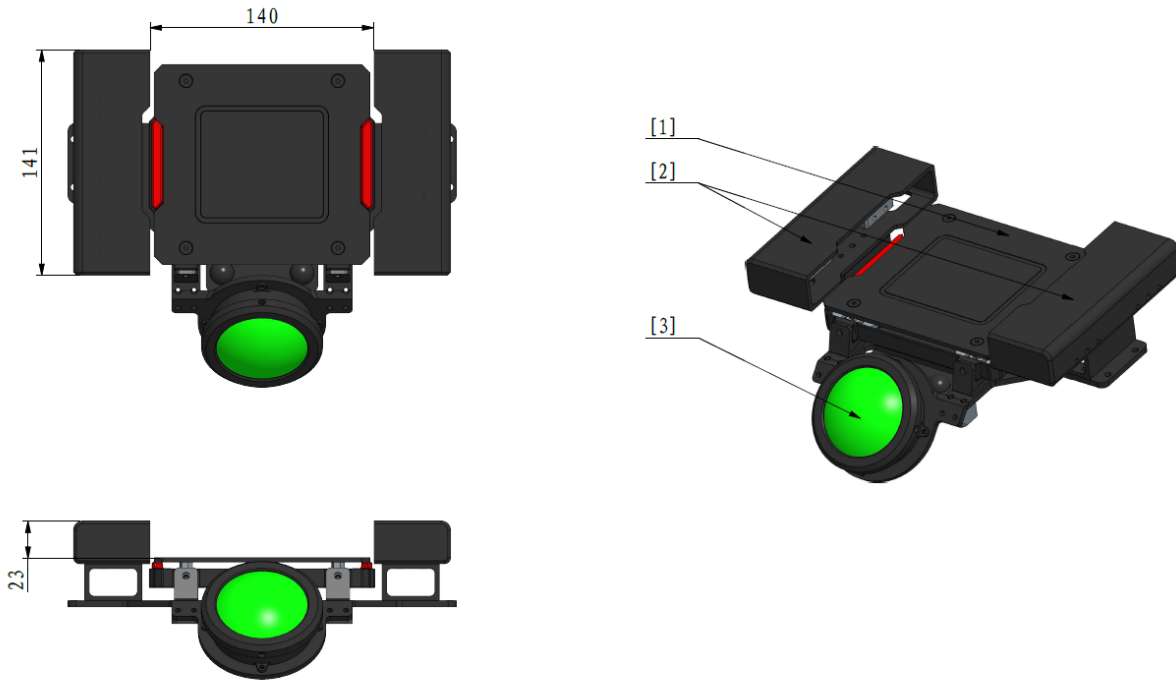
Figure 4-10 Expanded State of Base Protective Armor

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 42 mm projectiles. The Dart Detection Sensor can detect the infrared light emitted by a Dart Trigger. 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 55 mm. It is for guiding Darts toward their targets.



Base Dart Detection Module



Outpost Dart Detection Module

[1] Small Armor Module [2] Dart detection sensor [3] Dart guiding light

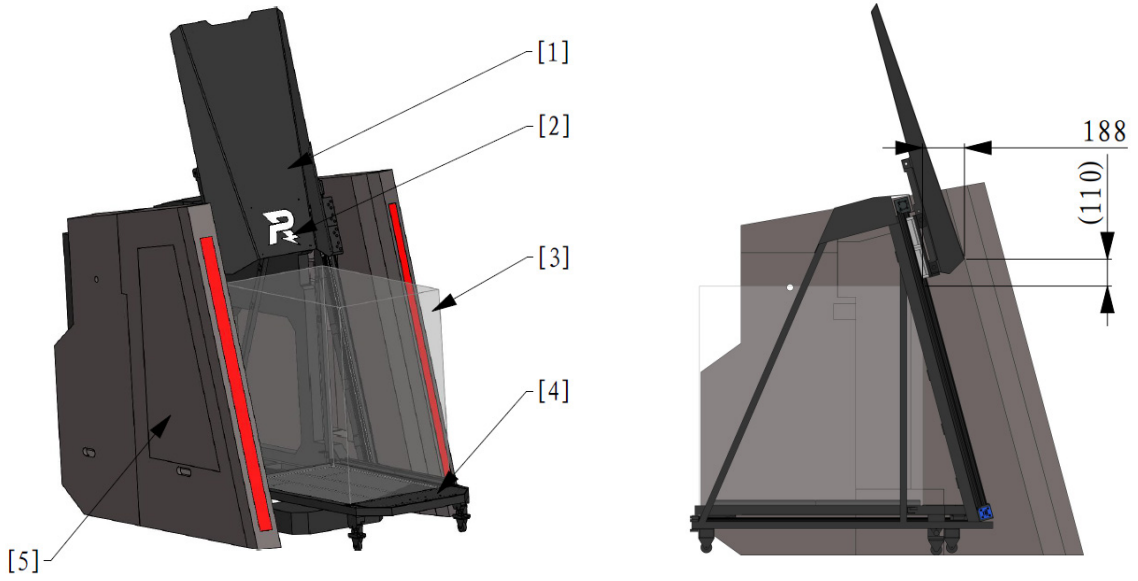
Figure 4-11 Dart Detection Module

4.2.3 Dart Launching Station

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

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

During the Three-Minute Setup Period, the Dart Launching Station will be in the open status. The Pit Crew will pull out the gliding platform and then place the Dart System in the square space on the platform. After ensuring the Dart System is operating normally, the Pit Crew 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.



- | | | | | | | | | | |
|-----|------|-----|------------------|-----|-----------------------------------|-----|------------------|-----|-------------------------------------|
| [1] | Gate | [2] | Status indicator | [3] | Space for placing the Dart System | [4] | Gliding platform | [5] | Main body of Dart Launching Station |
|-----|------|-----|------------------|-----|-----------------------------------|-----|------------------|-----|-------------------------------------|

Figure 4-12 Dart Launching Station

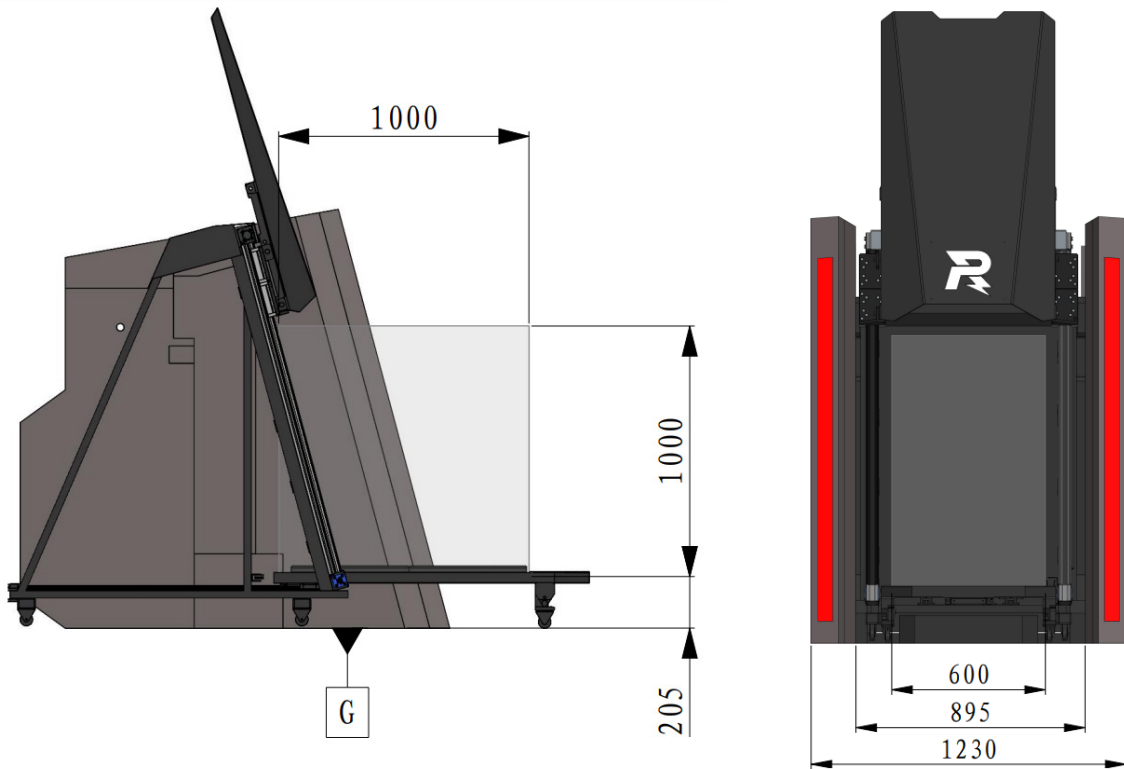
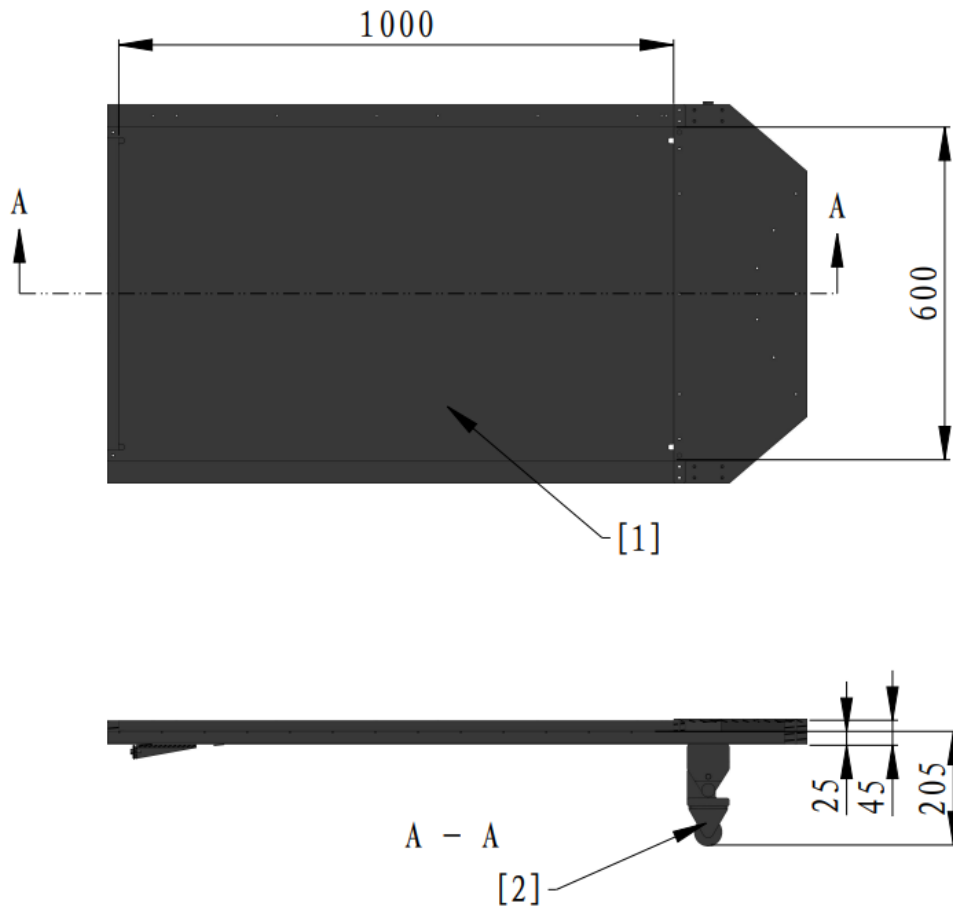


Figure 4-13 Gliding Platform Slides Out

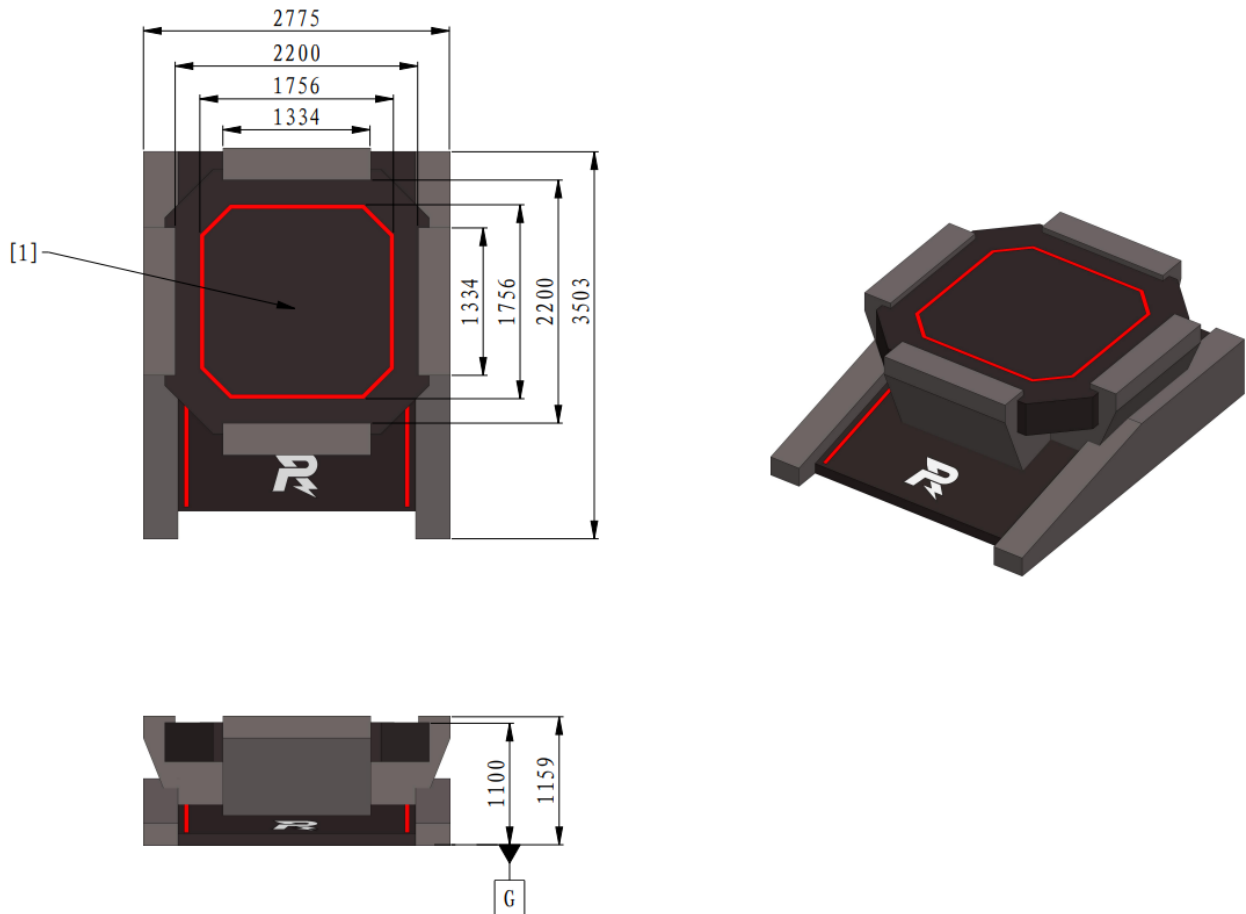


[1] Surface for placing the Dart System [2] Supporting wheel

Figure 4-14 Dimensions of Gliding Platform

4.2.4 Landing Pad

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



[1] Landing Pad platform

Figure 4-15 Landing Pad

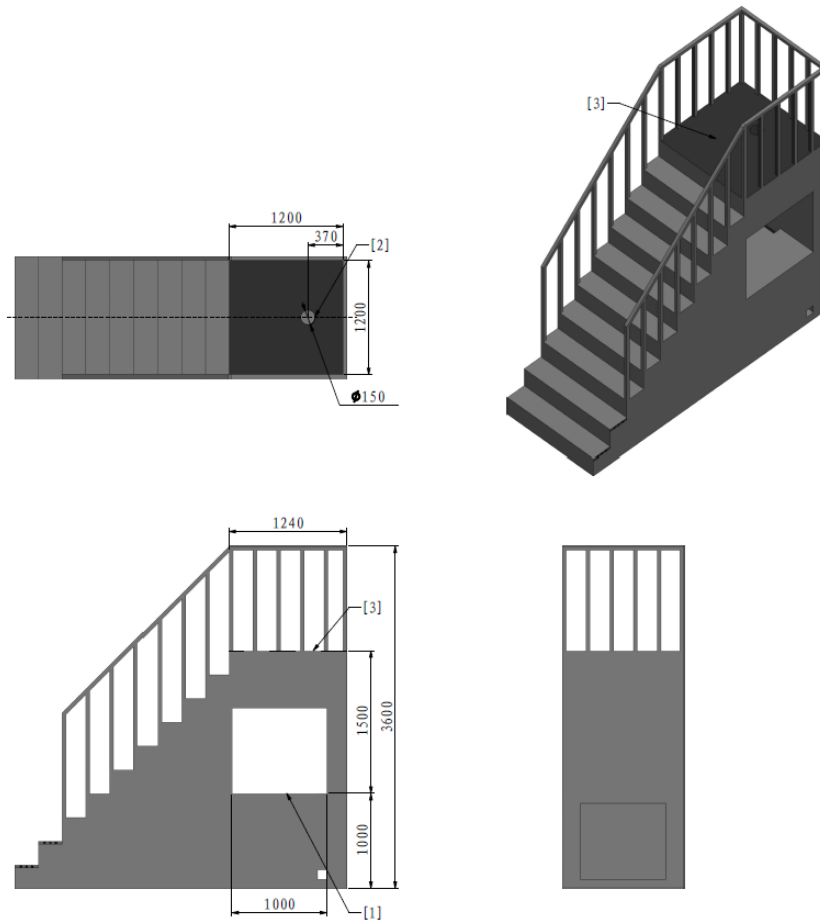
4.2.5 Radar Foundation

The Radar Foundation is for placing a Radar sensor. It features a top platform that measures 1.2*1.2 m, made of iron panel material (which is magnetic). The height of the platform to the battlefield ground should be approximately 2.5 m, and the non-transparent perimeter wall around it is 1.1 m high. On the platform are sensor data cable slots, which may be used as needed during the competition.

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

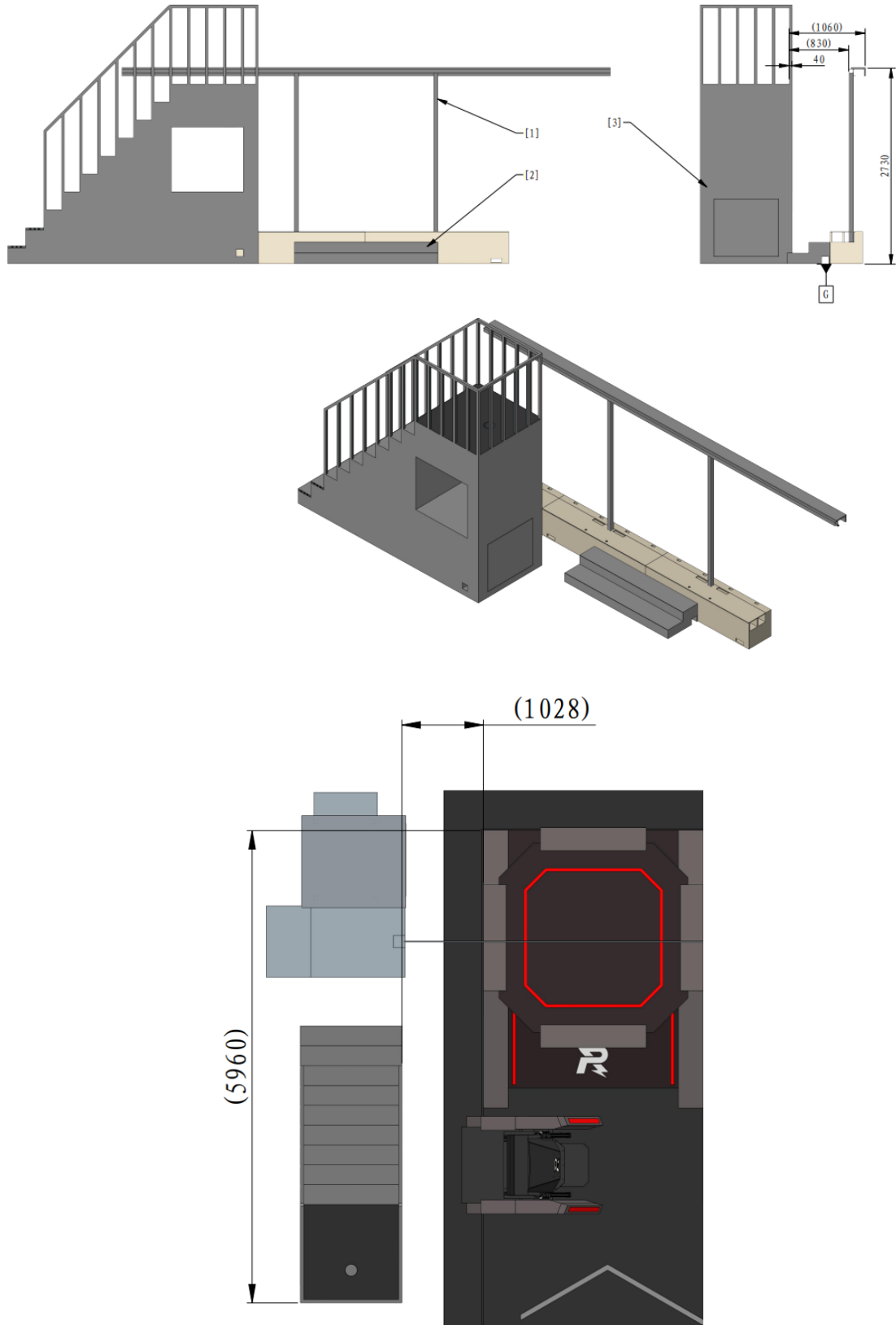
- One official display device that supports HDMI signal input only, with a resolution of 1920*1080. Participating teams can use it to check the operation status of the Radar.
- One HDMI cable for connecting the Radar to the official display device.

- One immobile power outlet for supplying power to the Radar and other official equipment.



- [1] Platform for placing the Radar Computing Platform [2] Sensor data cable slot [3] Radar sensor platform

Figure 4-16 Radar Foundation



[1] Electric door [2] Steps [3] Radar Foundation

Figure 4-17 Relative Location of the Radar Foundation

4.2.6 Supplier Zone

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

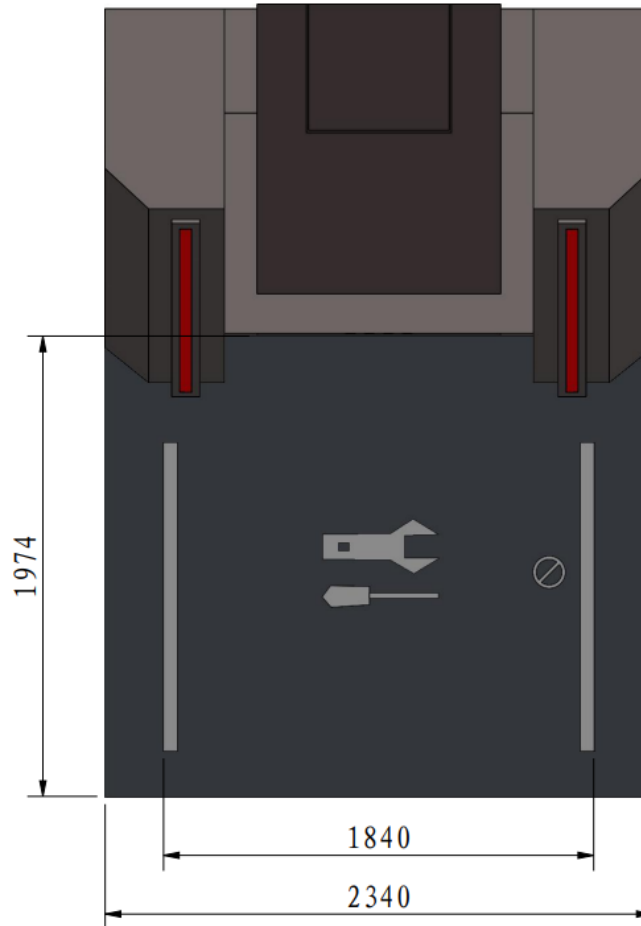


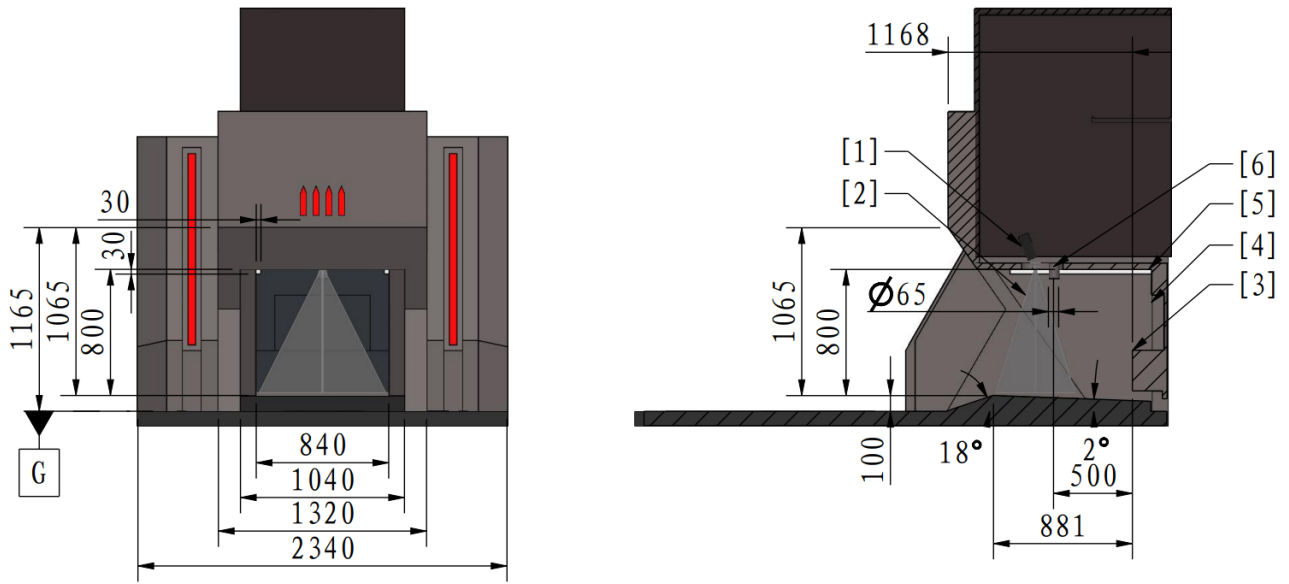
Figure 4-18 Supplier Zone

4.2.6.1 Official Projectile Supplier

The Official Projectile Supplier provides 17 mm projectiles during matches and consists of a projectile outlet, auxiliary alignment cross laser light, camera and display. The camera in the projectile outlet captures real-time images of the robot's magazine 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 location.



- Cross laser light: formed by two perpendicular laser lights intersected at the center of the projectile outlet.
- 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 magazine with buffer materials to prevent projectiles from falling in the process of loading them into the magazine.

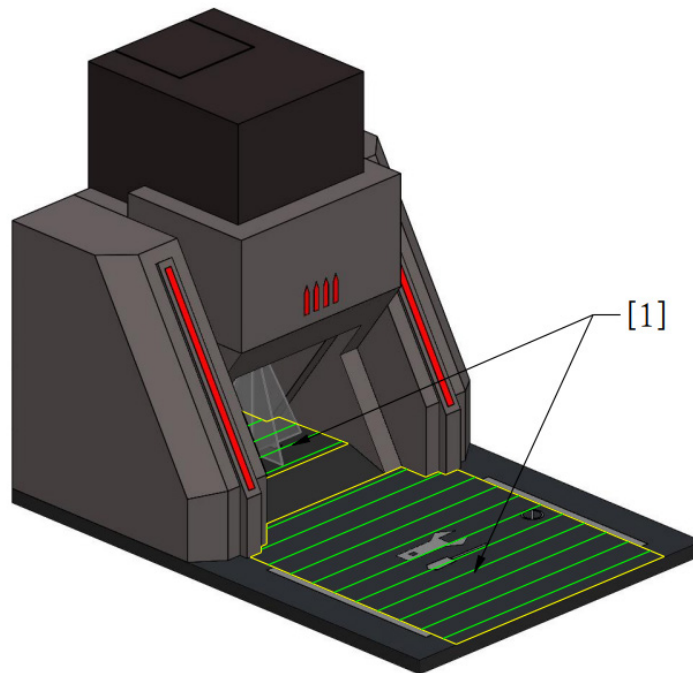


- [1] Camera
- [2] Lase light path
- [3] Steel wire mesh
- [4] Monitor
- [5] Auxiliary light indicator
- [6] Projectile outlet

Figure 4-19 Official Projectile Supplier

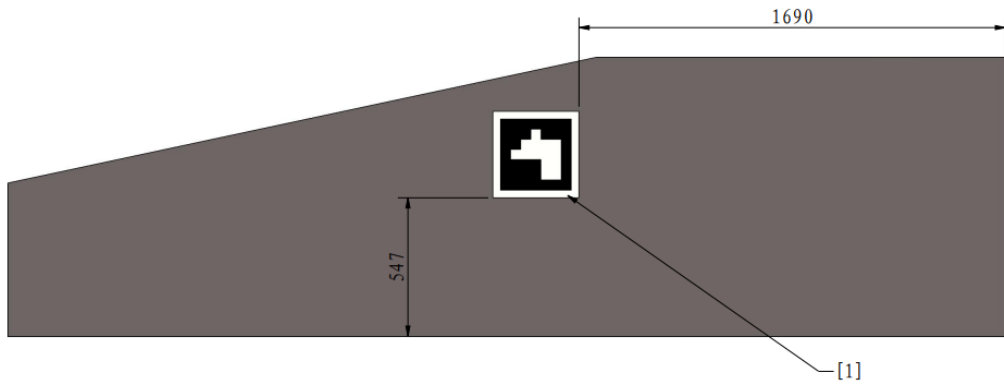
4.2.6.2 Restoration Zone

The Supplier Zone contains Restoration Zones, where RFID Interaction Module Cards are laid, as shown below.

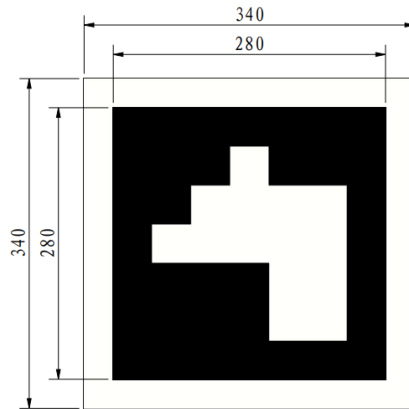


- [1] Restoration Zone

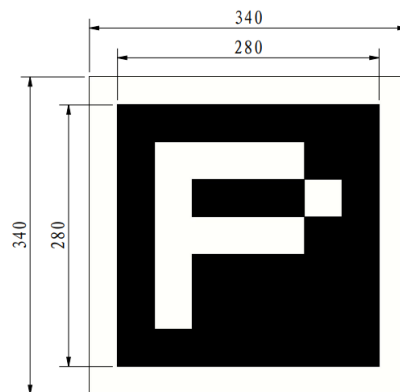
Figure 4-20 Restoration Zone



[1] Visual Marker



Red Team's Visual Marker

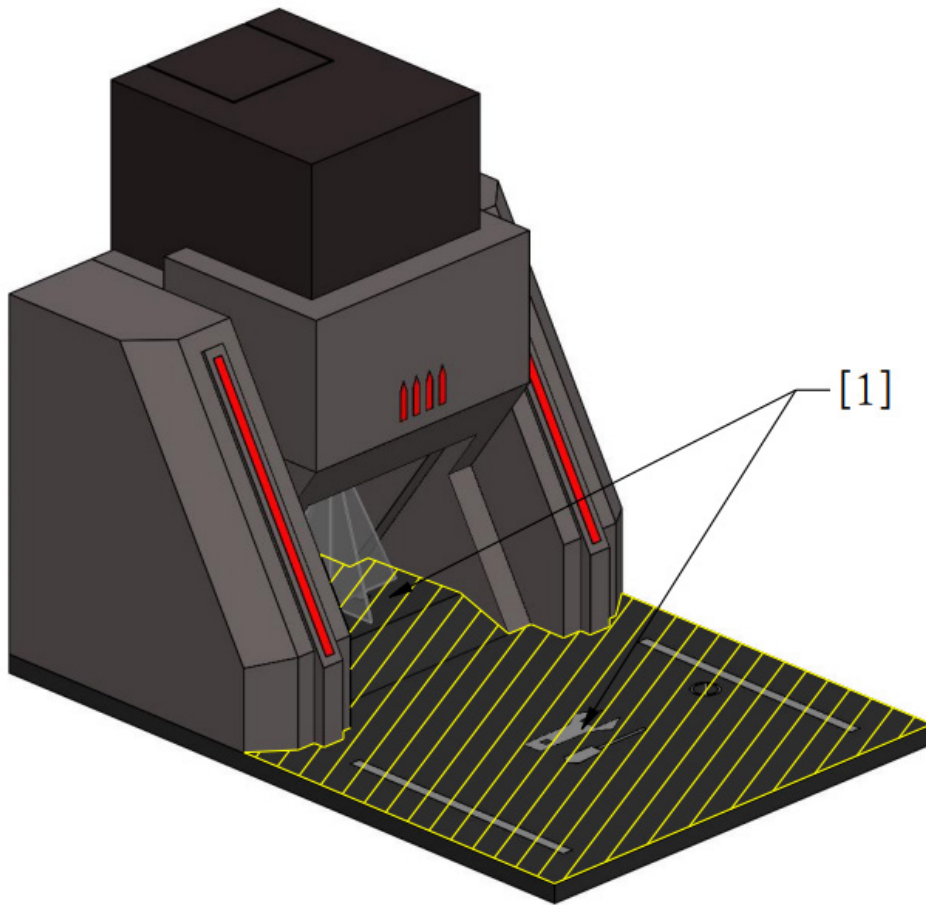


Blue Team's Visual Marker

Figure 4-21 Visual Markers

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:

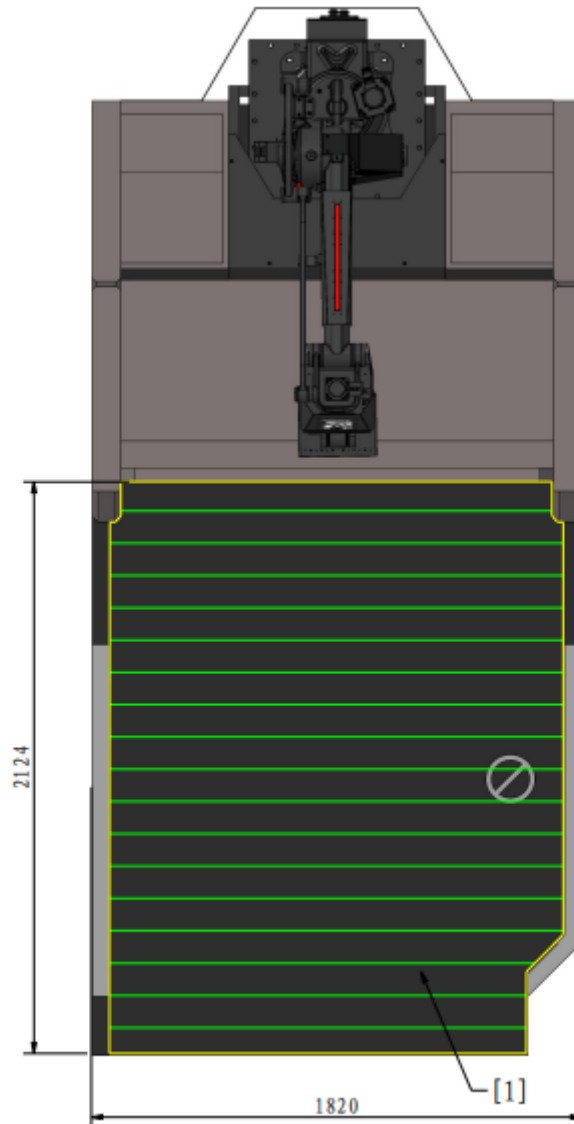


[1] Supplier Penalty Zone

Figure 4-22 Supplier Penalty Zone

4.2.7 Exchange Zone

The Exchange Zone is where an Engineer Robot exchanges for Nuggets, where RFID Interaction Module Cards are laid, as shown in the figure below:



[1] Exchange Zone Buff Point

Figure 4-23 Exchange Zone

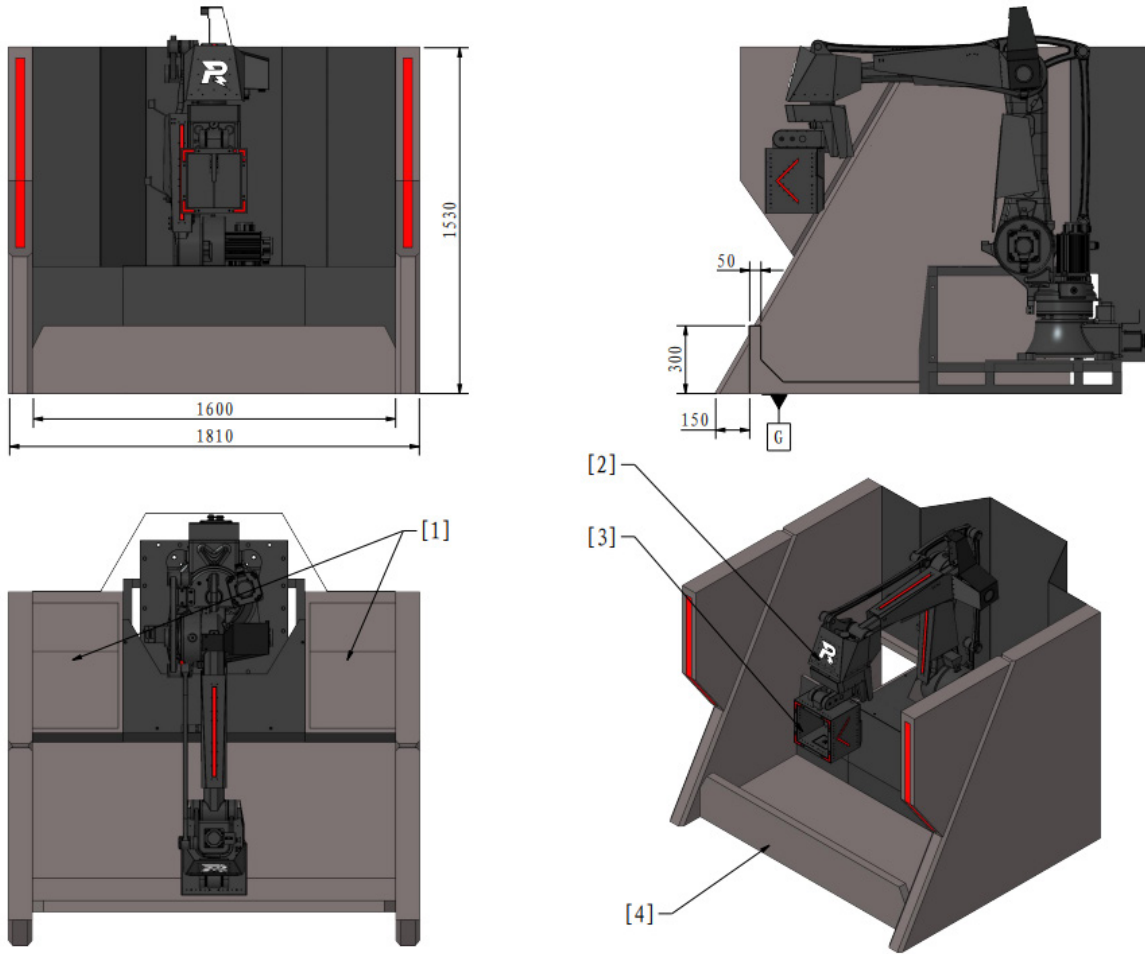
4.2.7.1 Exchange Station

The Exchange Station includes its main body and the Nugget collecting slot. Engineer Robots can exchange Nuggets 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 4-1 Light Effects of Status Indicators on Exchange Stations

Status of Exchange Station	Status Indicator of Exchange Station
Non-exchangeable	Off
Exchangeable (normal)	Solid white
When a Nugget is fully placed in the Nugget receptacle and the Nugget receptacle detects the RFID Interaction Module Card of the Nugget in the exchangeable status	White flashes (1 Hz)
After Nugget is exchanged within two seconds	White flashes (3 Hz)



- [1] Nugget collecting slot
- [2] R-figure status light indicator
- [3] Nugget receptacle
- [4] Front guard of Exchange Station

Figure 4-24 Exchange Station

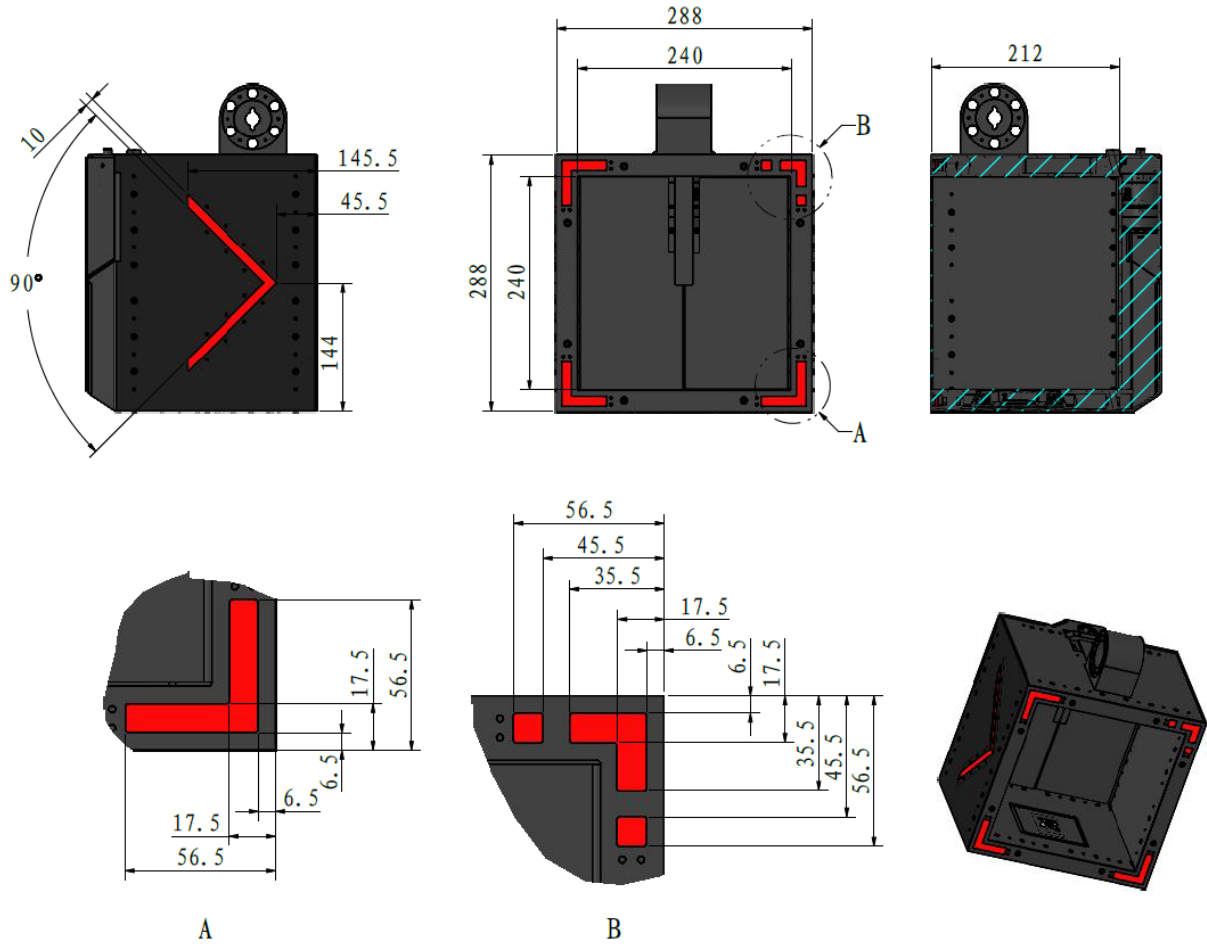
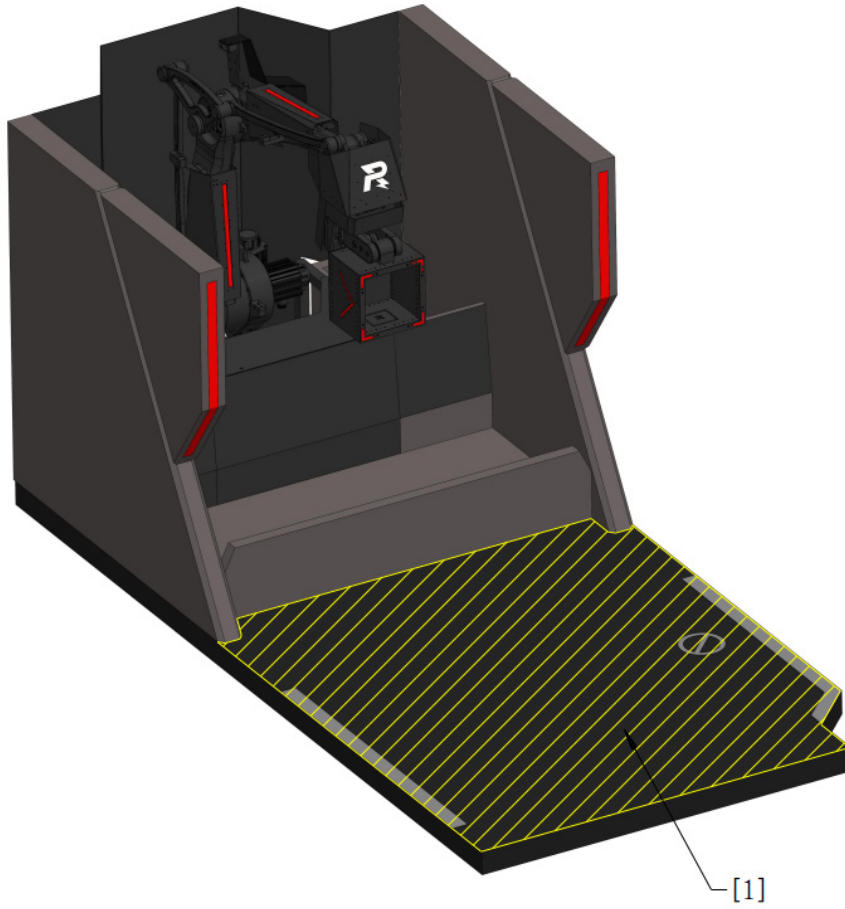


Figure 4-25 Nugget Receptacle

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

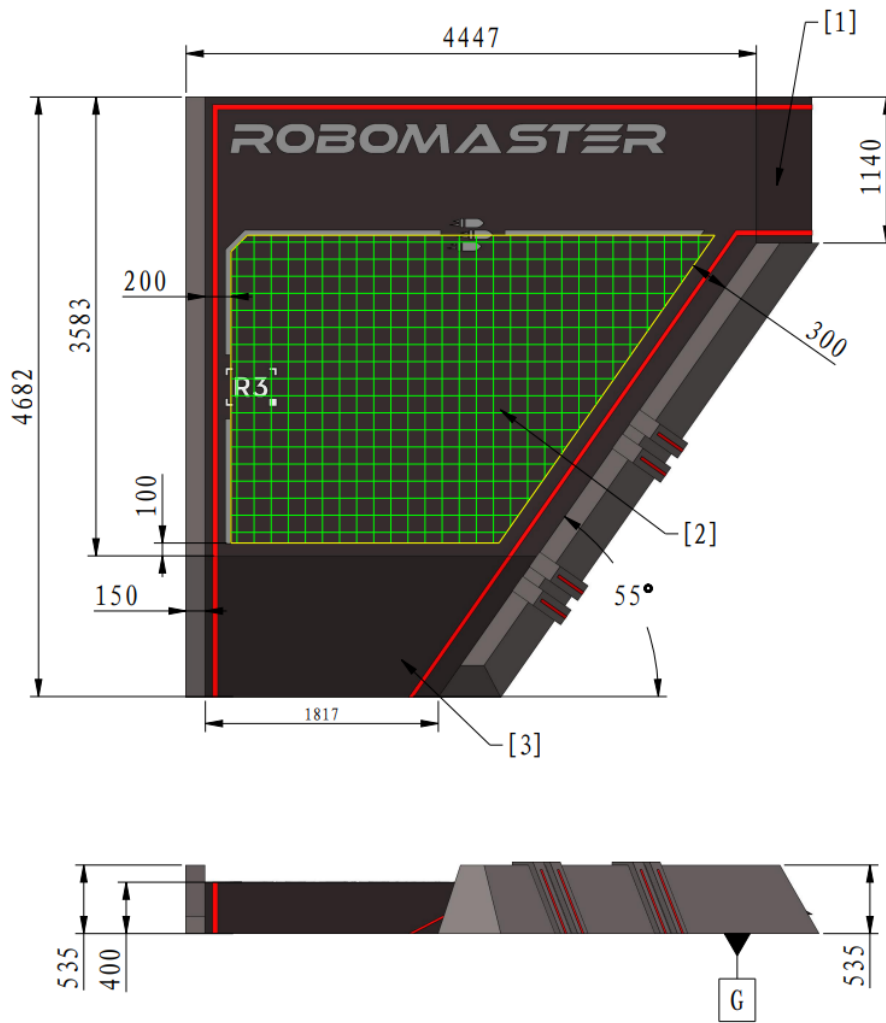
Figure 4-26 Exchange Penalty Zone

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 400 mm above the Battlefield and the height of its perimeter wall is 135 mm. 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.

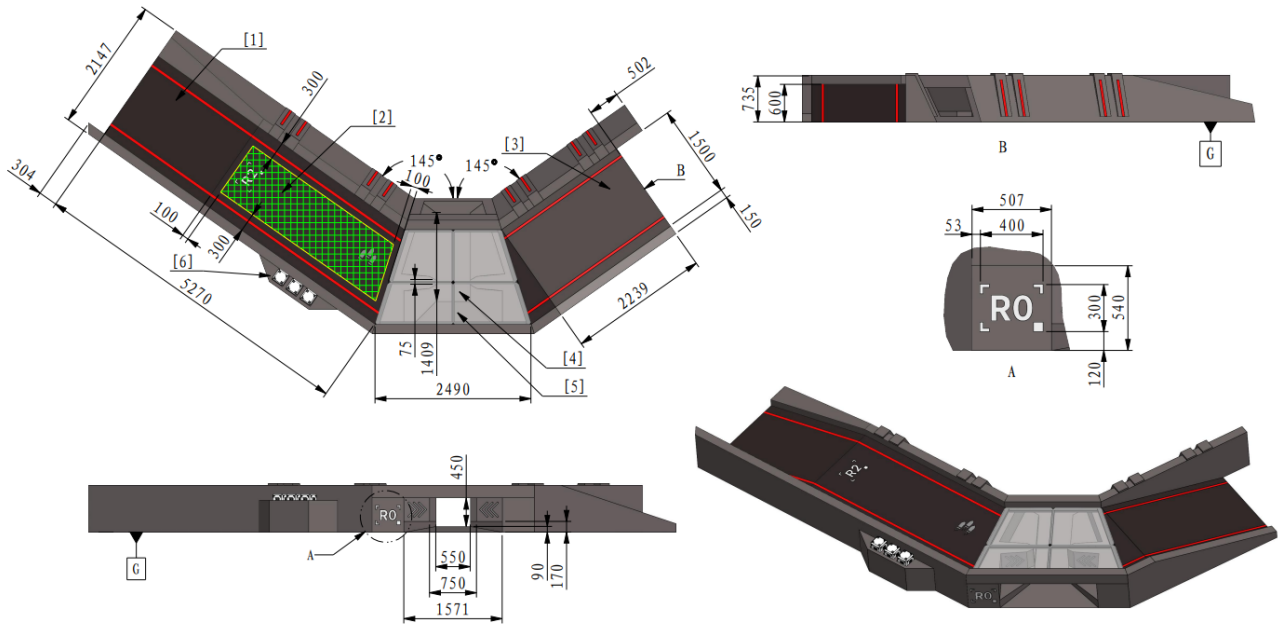


[1] 30° slope [2] Elevated Ground Buff Point [3] 20° Slope

Figure 4-27 R3 Trapezoid-Shaped 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 Tunnel, situated on the R2 Ring-Shaped Elevated Ground, connects the Base Zone and the Open Zone. The area above the Tunnel is made of transparent tempered glass. 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.

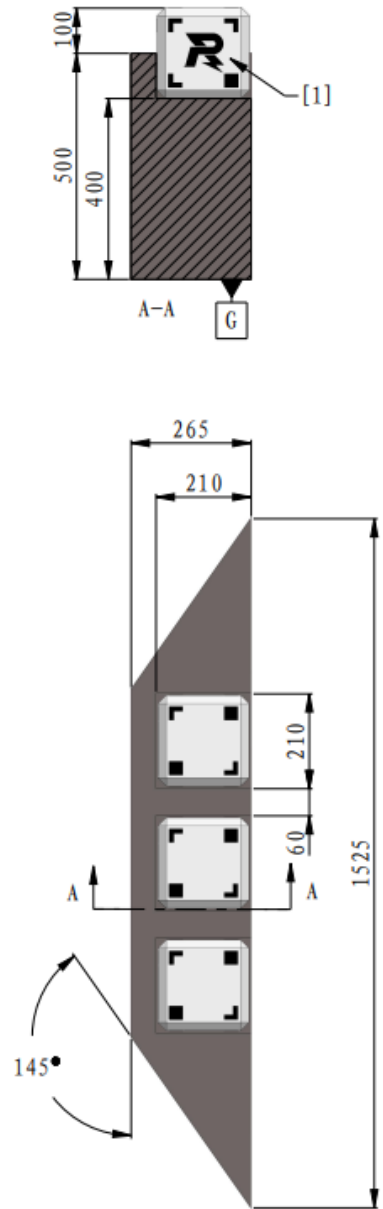


- | | | | |
|---------------|--------------------------------|---------------|------------|
| [1] 13° slope | [2] Elevated Ground Buff Point | [3] 15° slope | [4] Tunnel |
| [5] 10° slope | [6] Small Resource Island | | |

Figure 4-28 R2 Ring-Shaped 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 Silver Nuggets.



[1] Silver Mineral

Figure 4-29 Small Resource Island

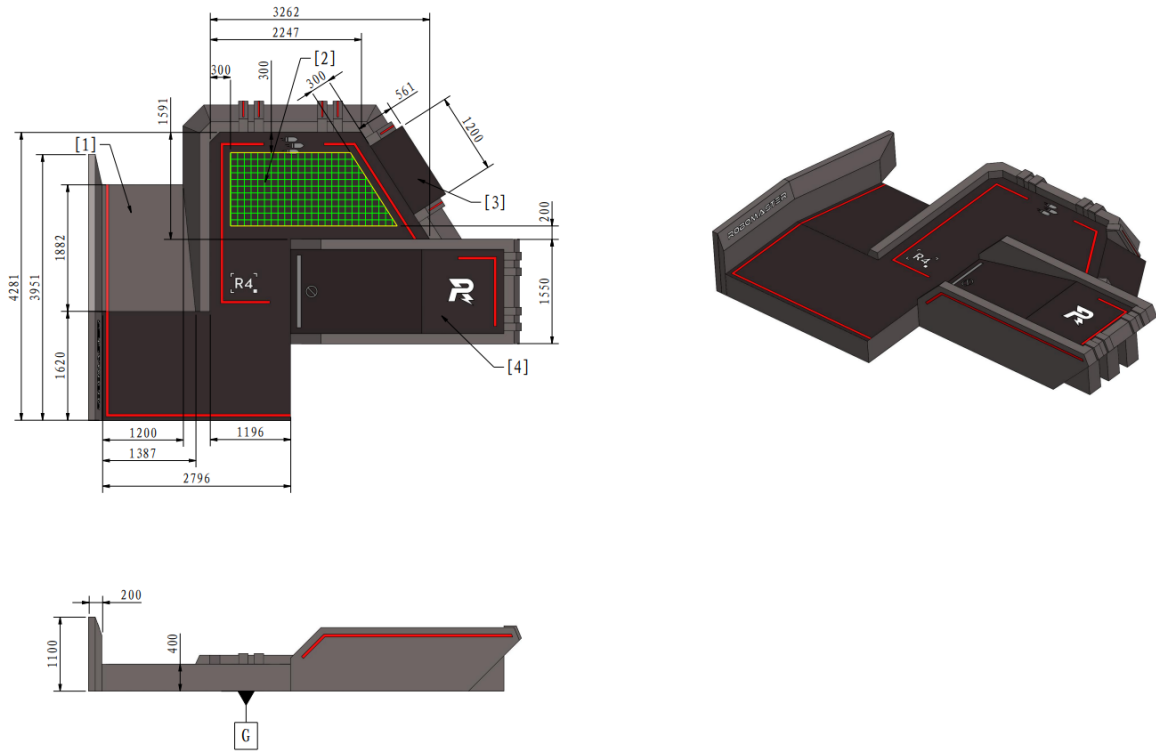


The Silver Nugget's side with the barcode will be facing down but may rotate the vertical axis, as shown in the figure, by 90°.

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 400 mm above the Battlefield.

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

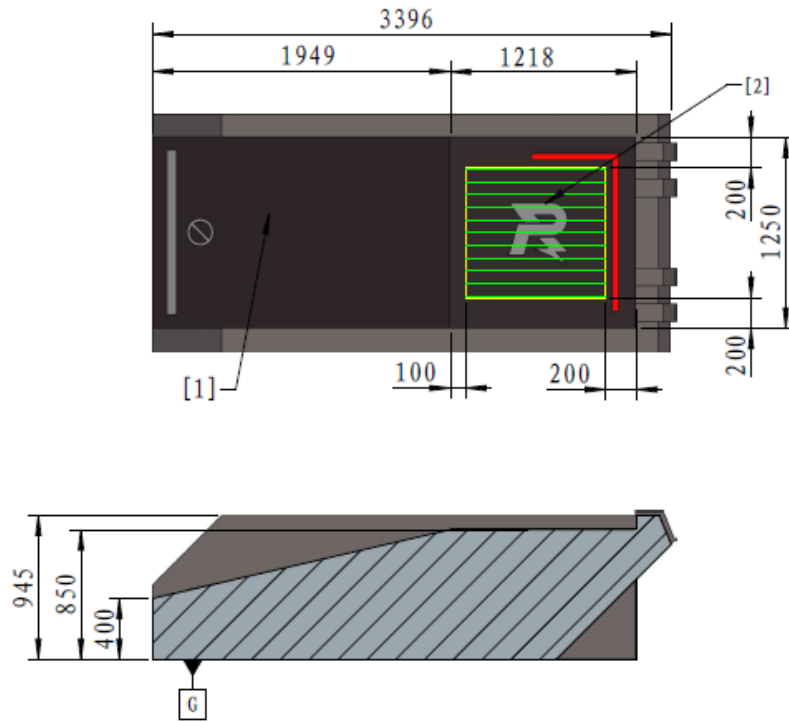


- | | | | |
|---------------|-----------------------------------|-----------------|---------------------------------|
| [1] 12° slope | [2] R4 Elevated Ground Buff Point | [3] 35.5° slope | [4] Power Rune Activation Point |
|---------------|-----------------------------------|-----------------|---------------------------------|

Figure 4-30 R4 Trapezoid-Shaped Elevated Ground

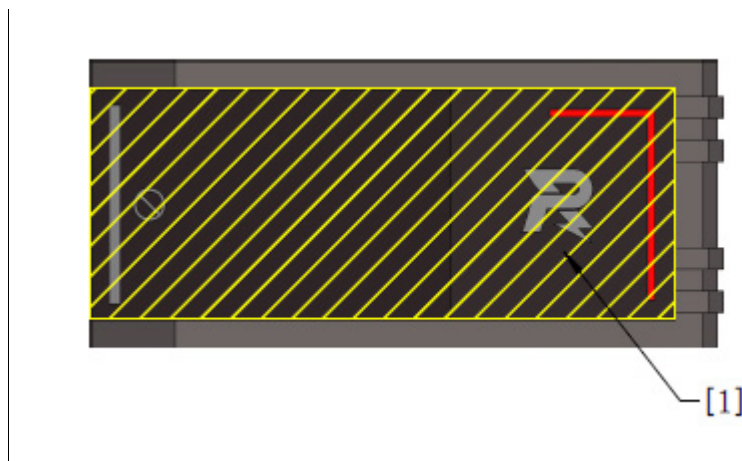
4.3.4 Power Rune Activation Point

The Power Rune Activation Point is located on the R4 Trapezoid-Shaped Elevated Ground, where a robot activates 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 4-31 Power Rune Activation Point

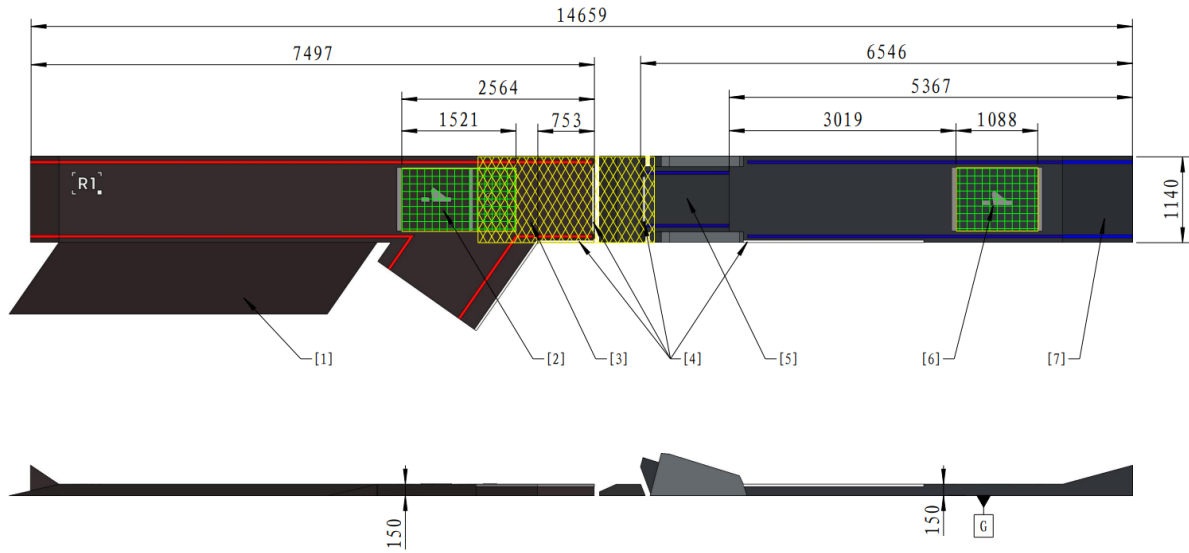


[1] Power Rune Activation Point Penalty Zone

Figure 4-32 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. Part of the road is the Road Penalty Zone. Except for using the Launch Ramp, the robots of both sides are forbidden from entering the Zone.

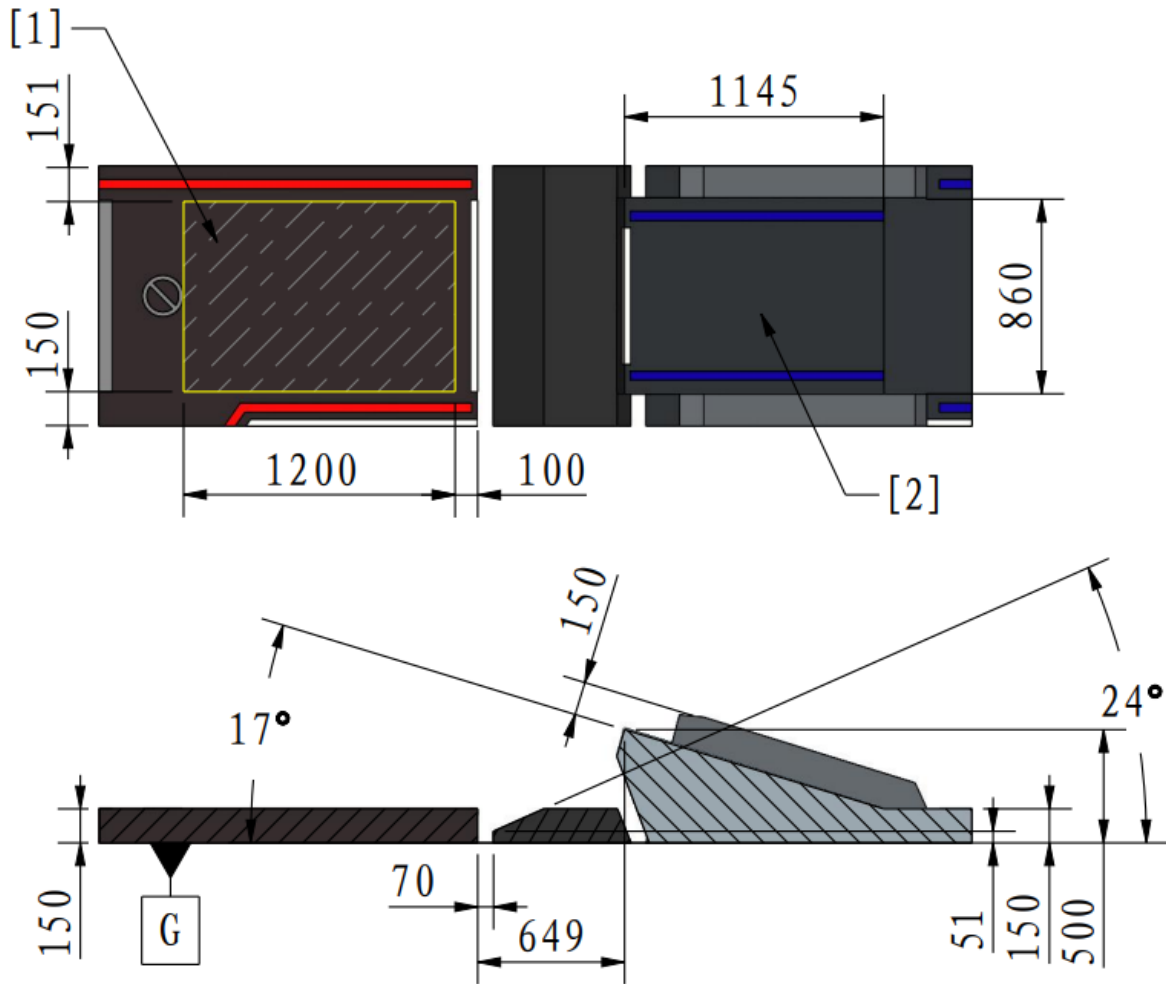


- | | | | | | | | |
|-----|------------|-----|--------------------------|-----|-------------------|-----|-----------------------|
| [1] | 7.5° slope | [2] | Launch Ramp Buff Point 1 | [3] | Road Penalty Zone | [4] | Aluminum corner guard |
| [5] | 17° slope | [6] | Launch Ramp Buff Point 2 | [7] | 15° slope | | |

Figure 4-33 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 1.2 m from the edge of the ravine is the Buffer Zone. EVA foam rubber with a thickness of 100 mm and hardness of 15-20 HC is placed under the road surface.



[1] Buffer Zone [2] 17° slope

Figure 4-34 Launch Ramp

4.4 Open Zone

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

4.4.1 Large Resource Island

The Large Resource Island is situated at the center of the Battlefield and directly below the Power Rune. It features three enclosed routes, containing a total of five Gold Nuggets. The transparent part of the routes is made of tempered glass. The Engineer Robot can grab Gold Nuggets from the Large Resource Island.

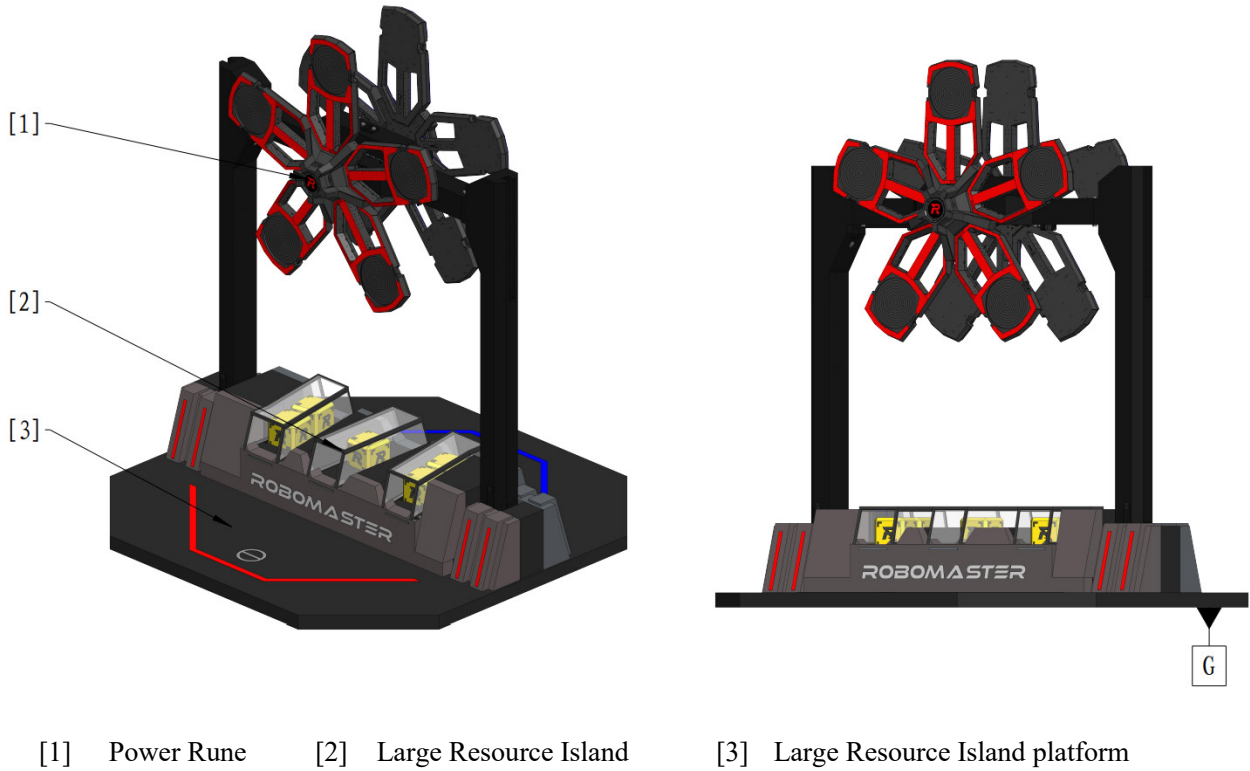


Figure 4-35 Axonometric View of the Large Resource Island

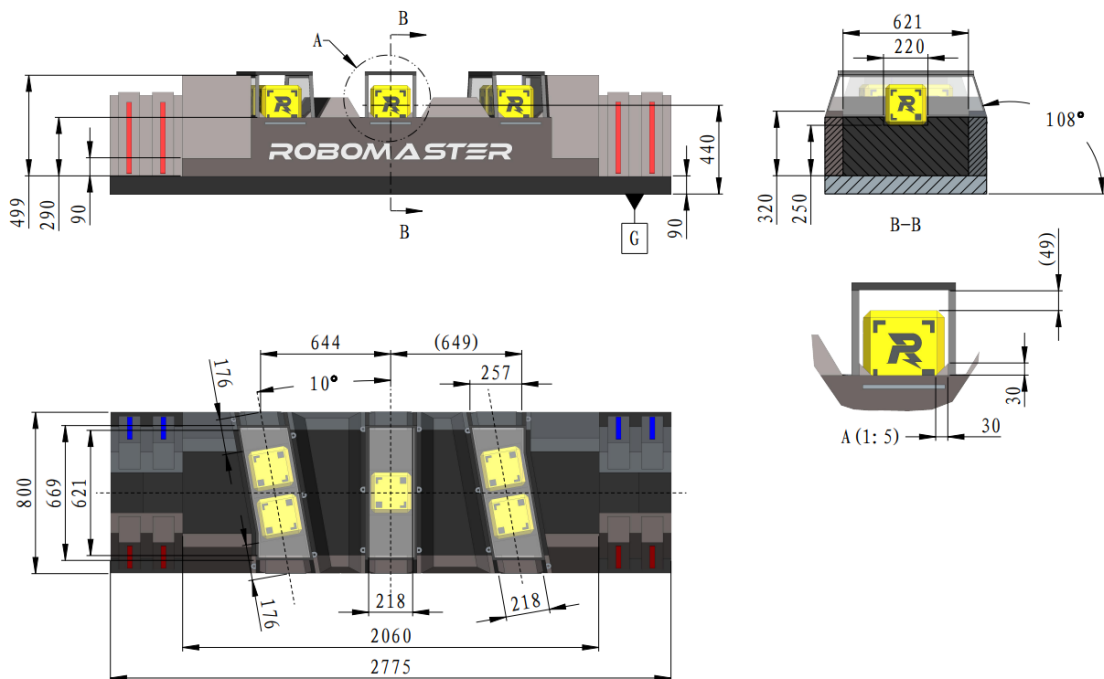
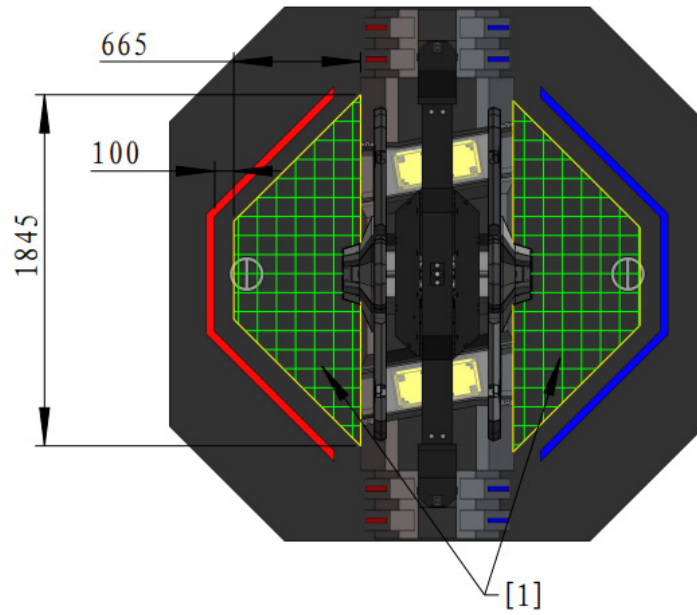


Figure 4-36 Dimensions of the Large Resource Island

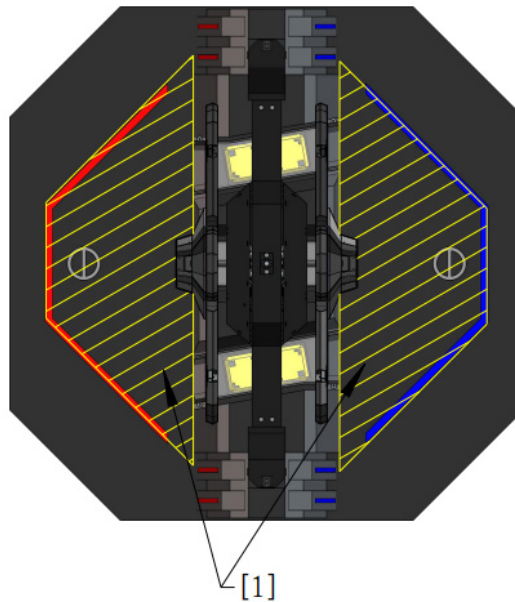
The Resource Island Buff Point is located on both sides of the Large Resource Island, as shown below:



[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 0-50 mm.
- 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 camera used for capturing images is set on the upper power rune, as shown in “Figure 4-40 Power Rune Camera”. The element will not be shown in subsequent drawings.

The Power Rune consists of five evenly distributed light arms. Their locations and dimensions are shown below:

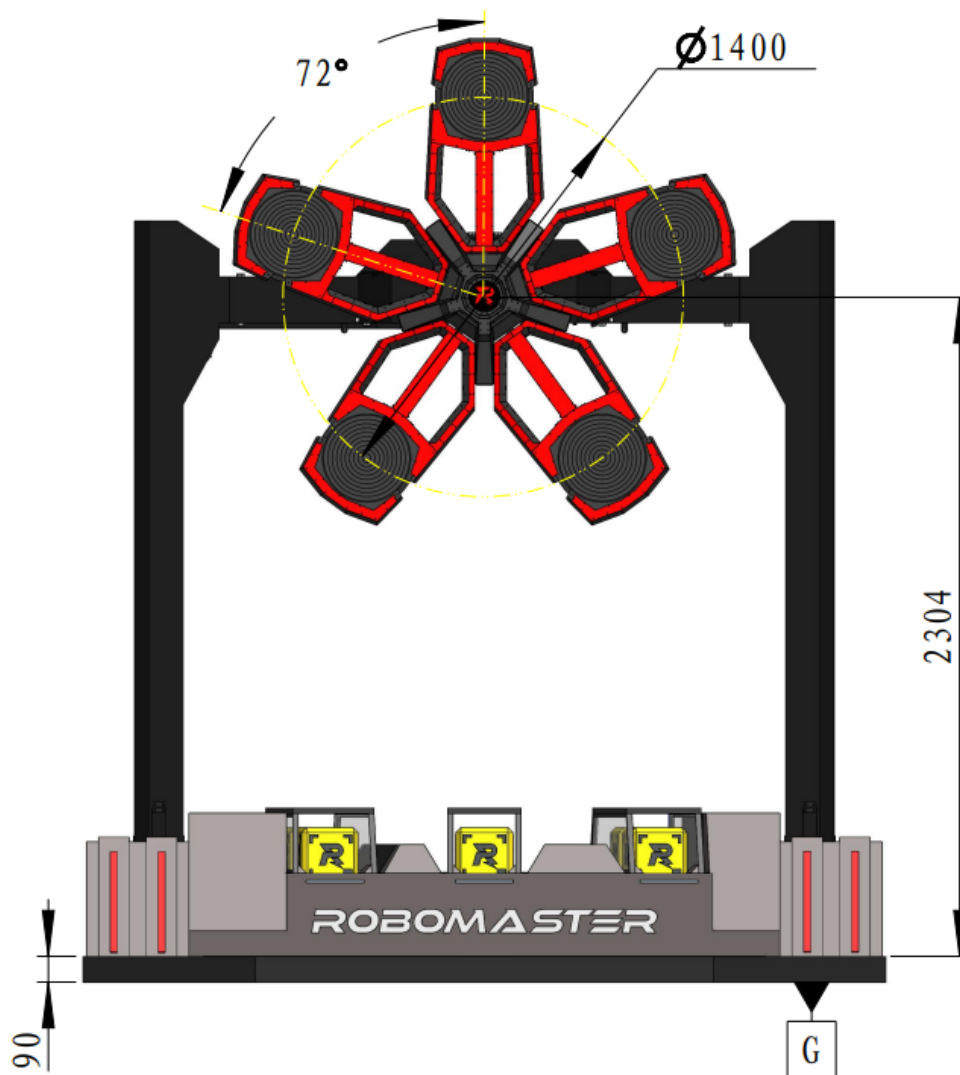
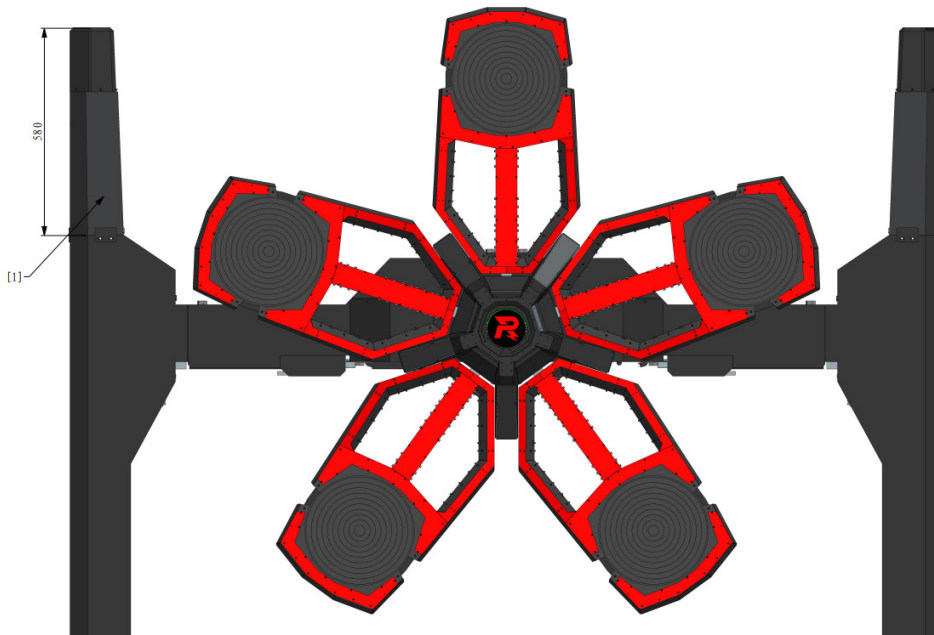


Figure 4-39 Power Rune



[1] Camera

Figure 4-40 Power Rune Camera

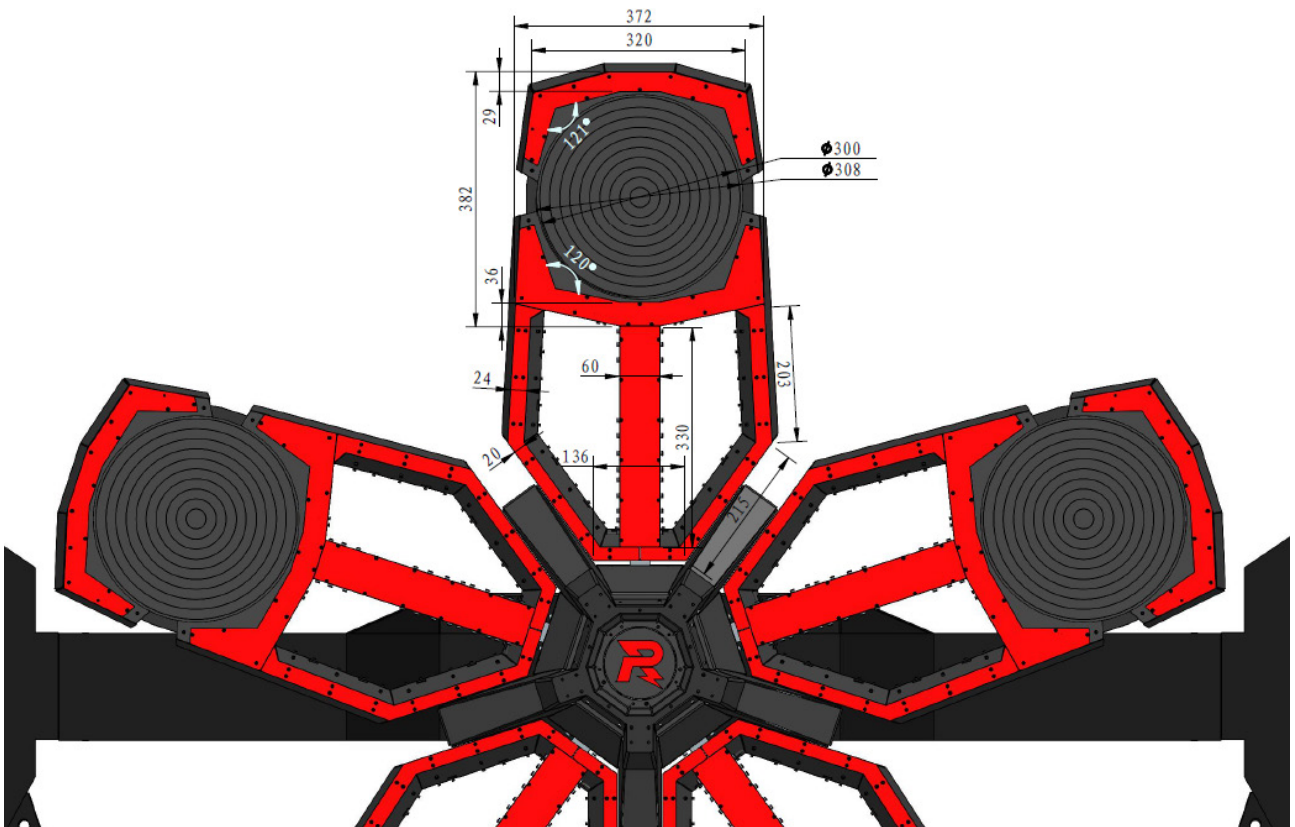


Figure 4-41 Power Rune Light Arms



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

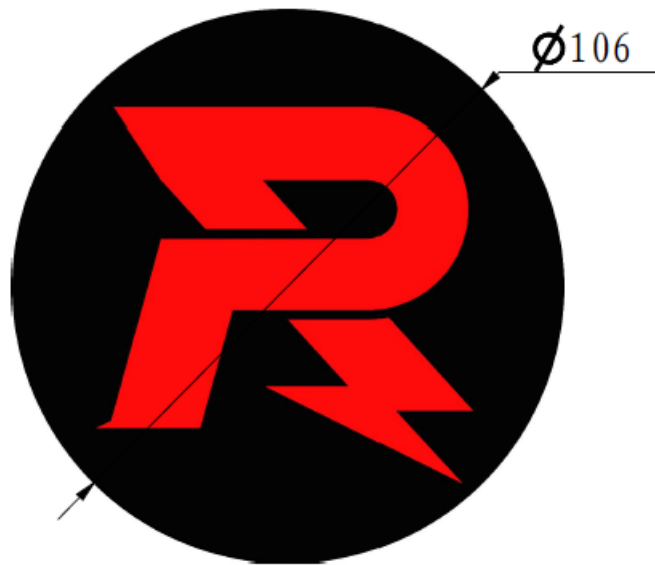


Figure 4-42 Central Logo of the Power Rune

4.4.3 Outpost

The Outpost is located on the Outpost Foundation near the road Launch Ramp. It consists of its main body, an Armor Module, and a Dart Detection Module.

The Outpost has a Triangular Armor Module at the top and a Rotating Armor Module in the middle (for details, refer to “Figure 4-11 Dart Detection Module”). The Outpost Buff Point is located around the Outpost. Its specific location is as shown below.

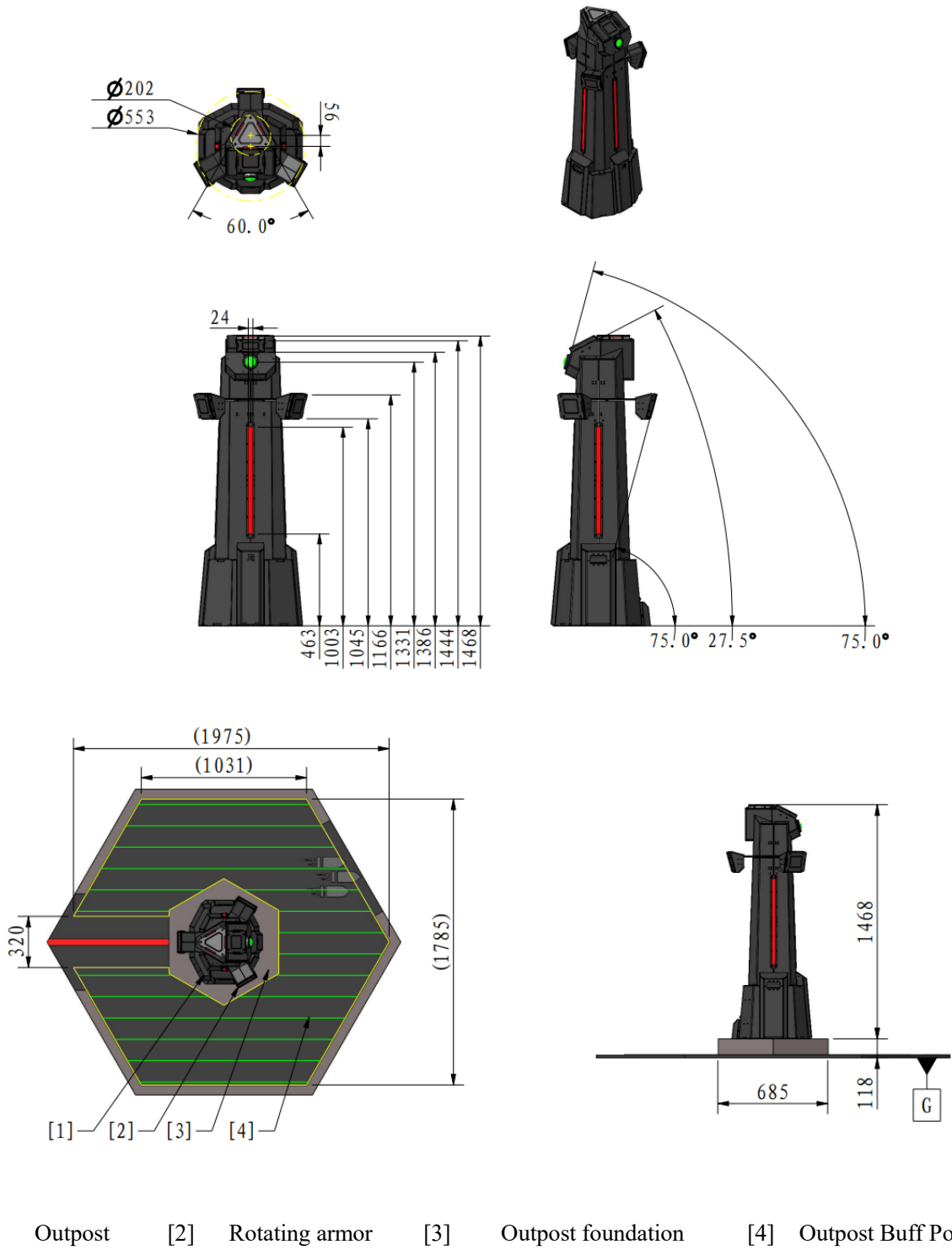
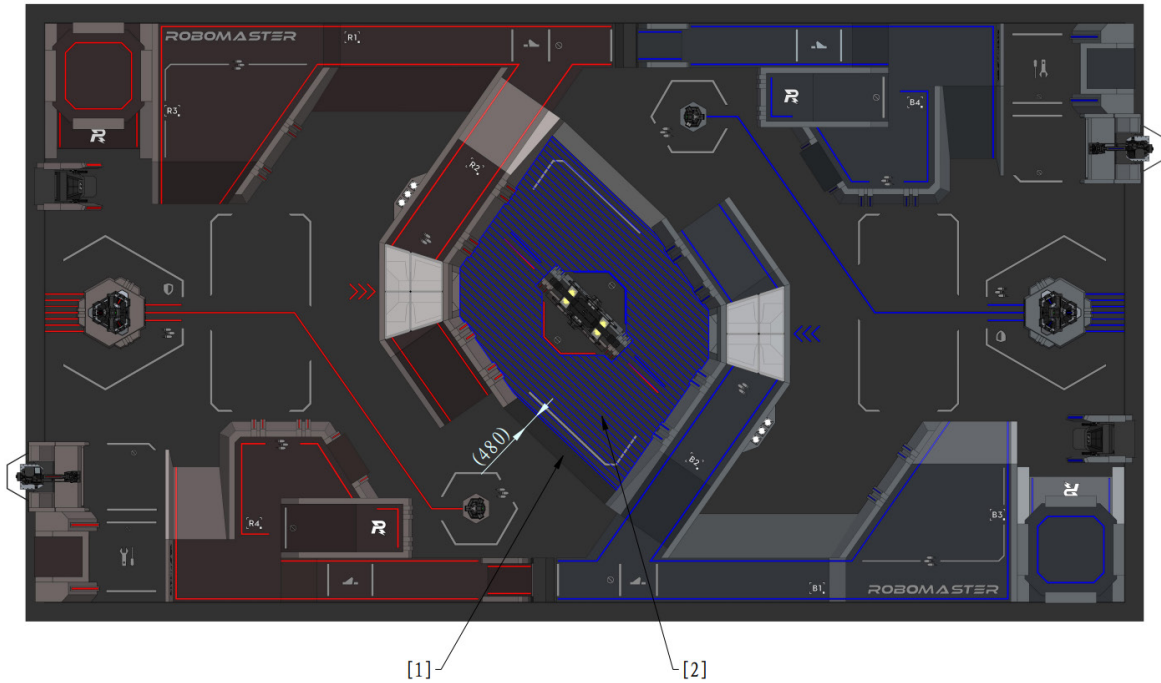


Figure 4-43 Outpost

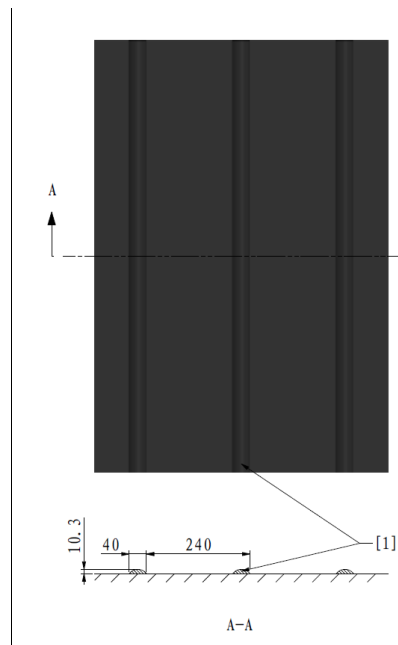
4.4.4 Bumpy Roads

The Bumpy Roads are located in some parts of the Open Zone. They have evenly spaced bumps on their surface with PVC flooring, as shown below.



[1] 10.5° 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 to an Aerial Safety Rope during a match to ensure the robot's safety. The Aerial Safety Rope is 2.4 m 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 approximately 16 m. When an Aerial Robot is at the farthest position, the Pilot should not fly it forward any further.

4.7 Others

4.7.1 Mobile Components

Nuggets are Mobile Components, which can be grabbed and carried by robots.



As the competition progresses, the surface of Mobile Components may suffer mild damage or gather dust.

Teams must adapt to such condition, but Mobile Components that are severely stained or damaged will not be used in the official competition.

4.7.1.1 Nuggets

Nugget is an EVA cube with beveled edges, dimensions of 200*200*200 mm, a mass of 600 g-700 g, hardness of 38±5 HC, and contains an RFID Interaction Module Card. The barcode images on all the Nuggets are the same, and the parallel distance between their RFID Interaction Module Cards and the surface of their barcode images is 50 mm. Due to variations in the manufacturing process, the surface roughness of Nuggets may fluctuate significantly. The reference value of the surface roughness (Sa) of a Nugget's screen print area is 30-40 μm. The reference value of the surface roughness (Sa) of the Gold Nugget's non-screen print area is 30-65 μm. The reference value of the surface roughness (Sa) of the Silver Nugget's non-screen print area is 12-16 μm.

Large Resource Island Nuggets (“Gold Nuggets”):

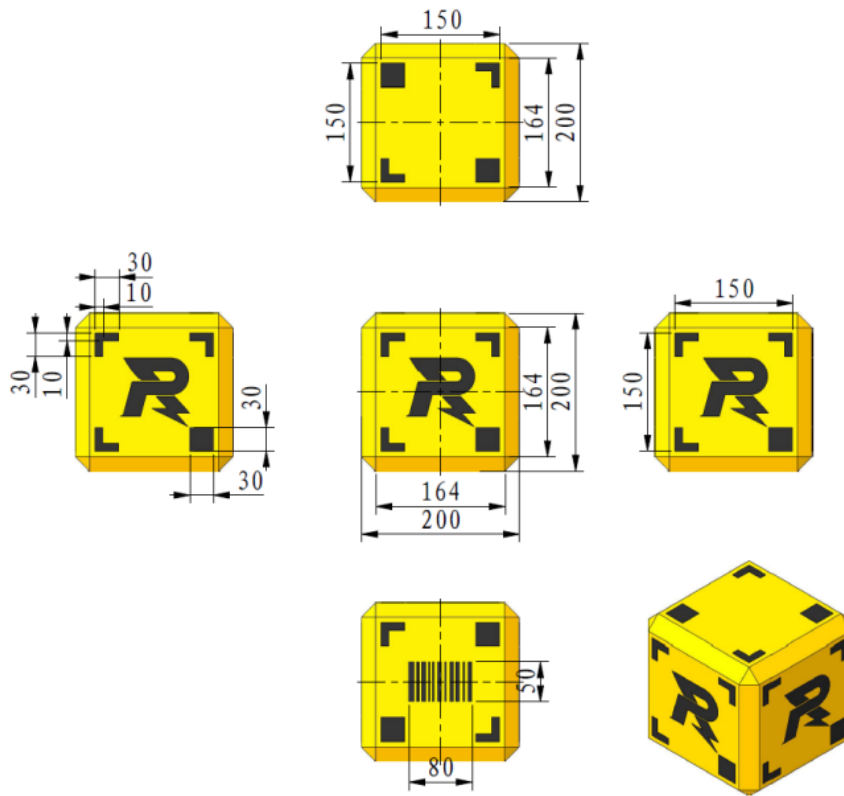


Figure 4-47 Gold Nuggets

Small Resource Island Nuggets (“Silver Nuggets”):

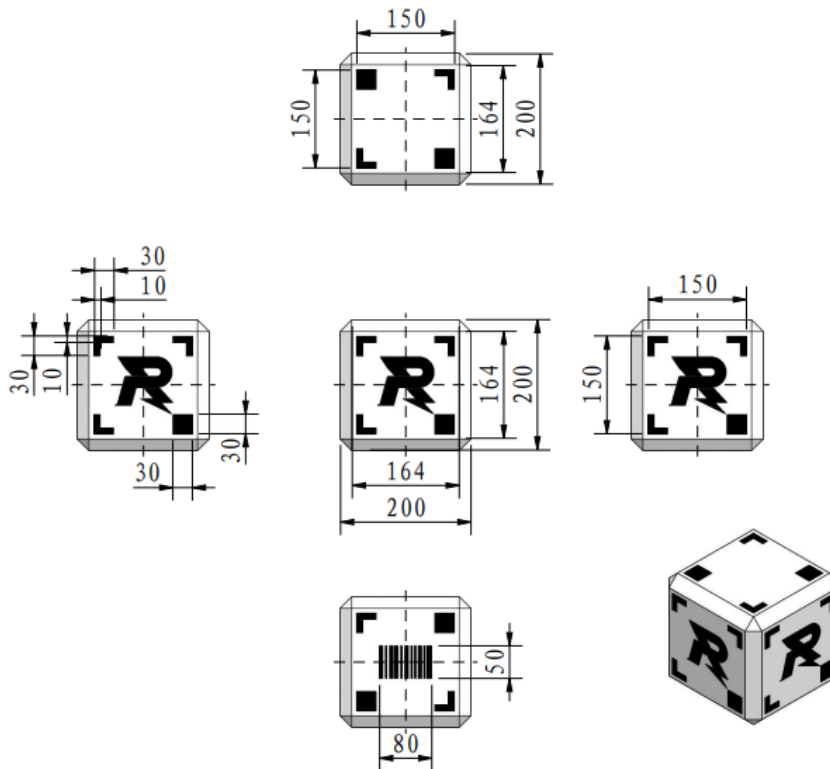


Figure 4-48 Silver Nuggets

4.7.2 Projectiles

Robots deal damage by firing projectiles to attack Armor Modules. The parameters and scenarios of use for projectiles in the competition are as follows:

Table 4-2 Projectile Parameters and Scenarios of Use

Type	Appearance	Color	Dimensions	Weight	Shore Hardness	Material	Scenarios of Use
42 mm Luminous Projectile	Similar to a golf ball	Semi-transparent	42.5 mm ± 0.5 mm	44.5 g±0.5 g	90±5 A	Plastic (TPE)	The entire RMUC 2024
17 mm Fluorescent Projectile	Sphere	Yellow-green	16.8 mm ± 0.2 mm	3.2 g ± 0.1 g	90±5 A	Plastic (TPU)	The entire RMUC 2024

4.7.3 Localization Markers

There are several markers on the battlefield that enable the localization of robots. The patterns will not be repeated and are asymmetrical in all directions. All Localization Markers have the same dimensions. Localization Marker R0 is affixed on the vertical surface near the Small Resource Island on the R2 Ring-shaped Elevated Ground, as shown in “Figure 4-28 R2 Ring-Shaped Elevated Ground”. The locations of the other Localization Markers are shown below.

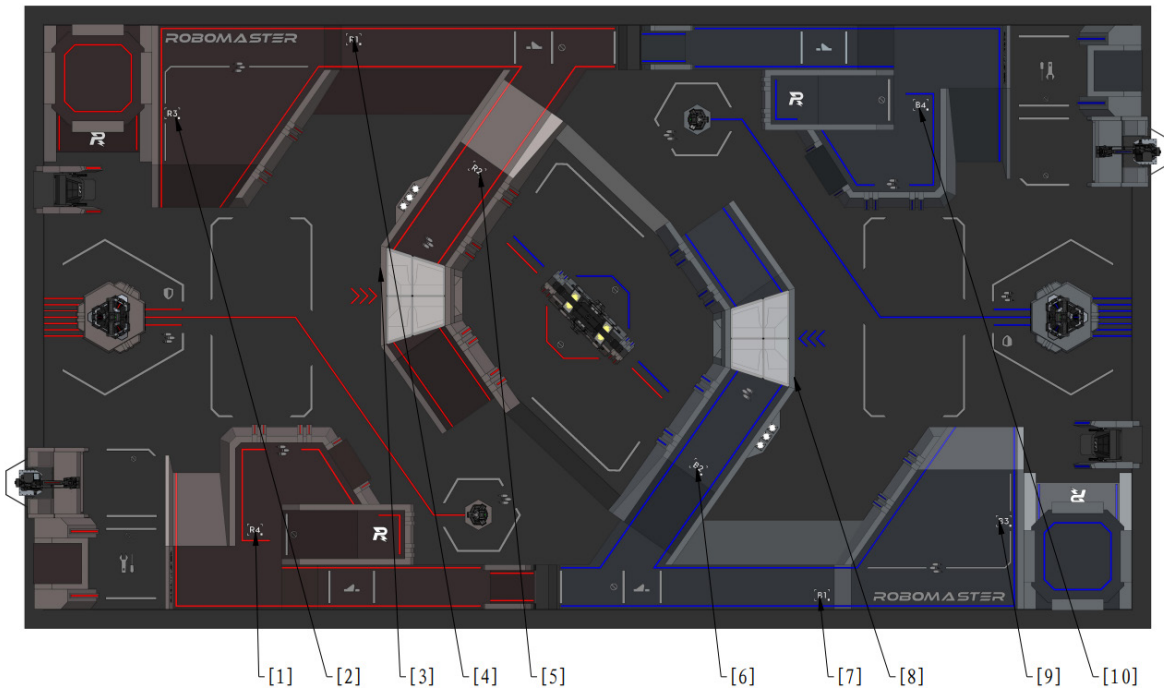


Figure 4-49 Localization Marker

Table 4-3 Coordinates of the Localization Marker

No.	1	2	3	4	5	6	7	8	9	10
No.	R4	R3	R0	R1	R2	B2	B1	B0	B3	B4
X	5230	3085	8670	7770	11070	16770	19830	19330	24505	22370
Y	-12810	-2110	-5715	-210	-3470	-11110	-14490	-9285	-12590	-1890
Z	400	400	420	150	600	600	150	420	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 Localization Marker to the origin of the coordinates. The included angle of a Localization Marker is the angle formed by that point and the Localization Marker R3.

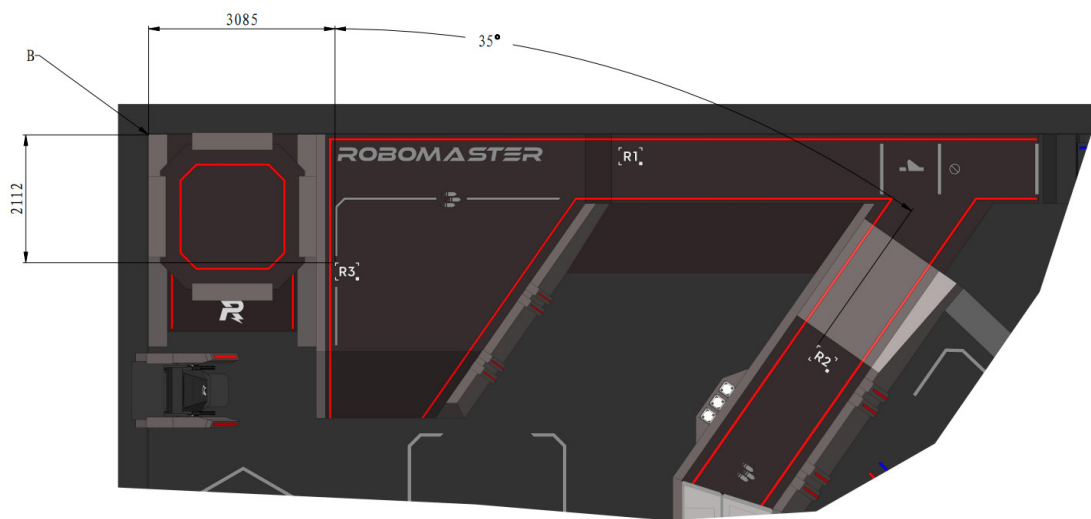


Figure 4-50 Illustrations of Origin of Coordinates and Included Angle

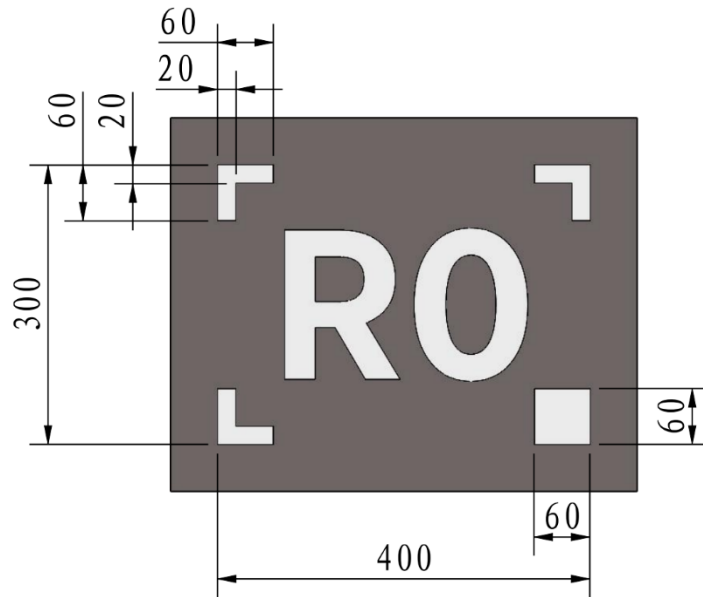


Figure 4-51 Dimensions of the Localization Marker

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, goggles, and safety helmets.

5. Competition Mechanism

5.1 HP Deduction Mechanism

The HP of Ground 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

Robots HP Deduction Reason	Hero Robot	Engineer Robot	Standard Robot	Sentry Robot
Exceeding the Initial Projectile Speed Limit	√	-	√	√
Exceeding the Barrel Heat Limit	√	-	√	√
Exceeding Chassis Power Consumption Limit	√	-	√	√
Attack Damage or Collision	√	√	√	√
Critical Referee System Modules gone offline	√	√	√	√
Irregular Offline Status	√	√	√	√
Yellow or Red Card Warning	√	√	√	√

5.1.1 Exceeding the Initial Projectile Speed Limit

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

When $V_1 > V_0$, if it's a 17 mm projectile, the deducted HP = Maximum HP * L%. If it's a 42 mm 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 the Initial Projectile Speed Limit

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

5.1.2 Barrel Overheating and Cooling

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

- A. When $Q_1 > Q_0$, the First Person View (FPV) visibility of the robot operator's computer will be reduced. When $Q_1 \leq Q_0$, the FPV will return to normal.
- 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 HP deduction, set $Q_1 = 2Q_0$.

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

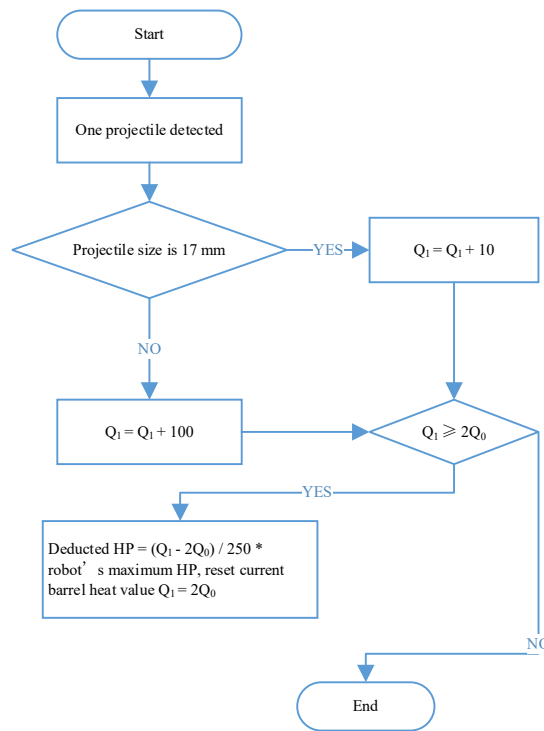


Figure 5-1 Barrel Heat Calculation Logic

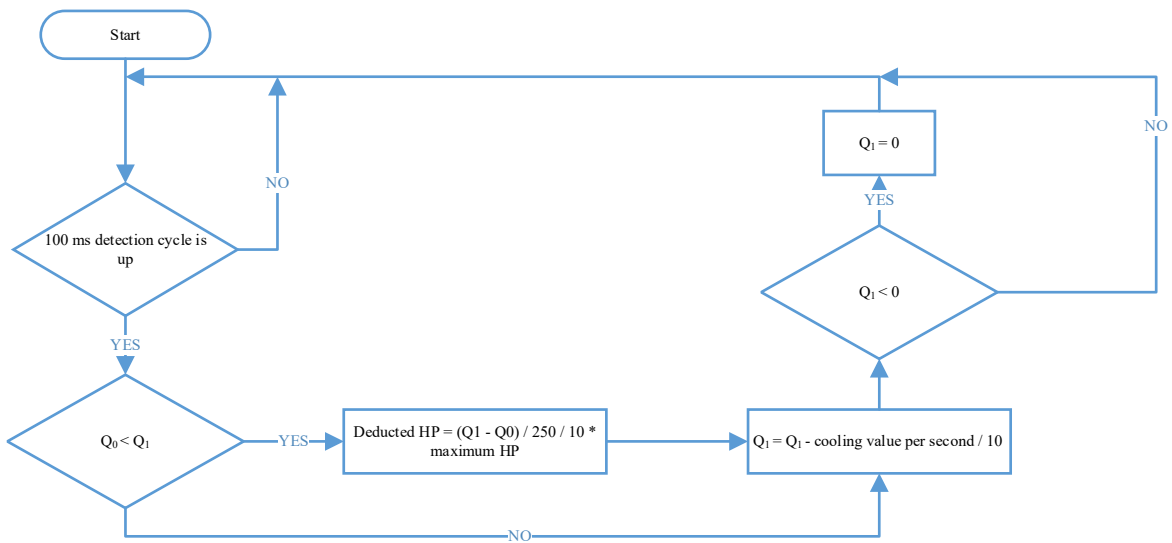


Figure 5-2 Barrel Heat Cooling Logic

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 power consumption output when in motion, buffer energy (Z) has been defined to avoid the consequent penalty.

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 Chassis Power Consumption Limit of a Hero Robot has been levelled up to 60 W and its Maximum HP to 350, while maintaining a continuous power output of 120 W without triggering the Launch Ramp Buff, then the 60 J 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 = $350 * 40\% * 0.1 = 14$.

After buffer energy has been exhausted, when the chassis power consumption of Hero, Standard, and Sentry exceeds the limit, the deducted HP for each detection cycle = Maximum HP * N% * 0.1.

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

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

The logic graph for Chassis Power Consumption detection and Deducted HP for Hero, Standard, and Sentry is shown below:

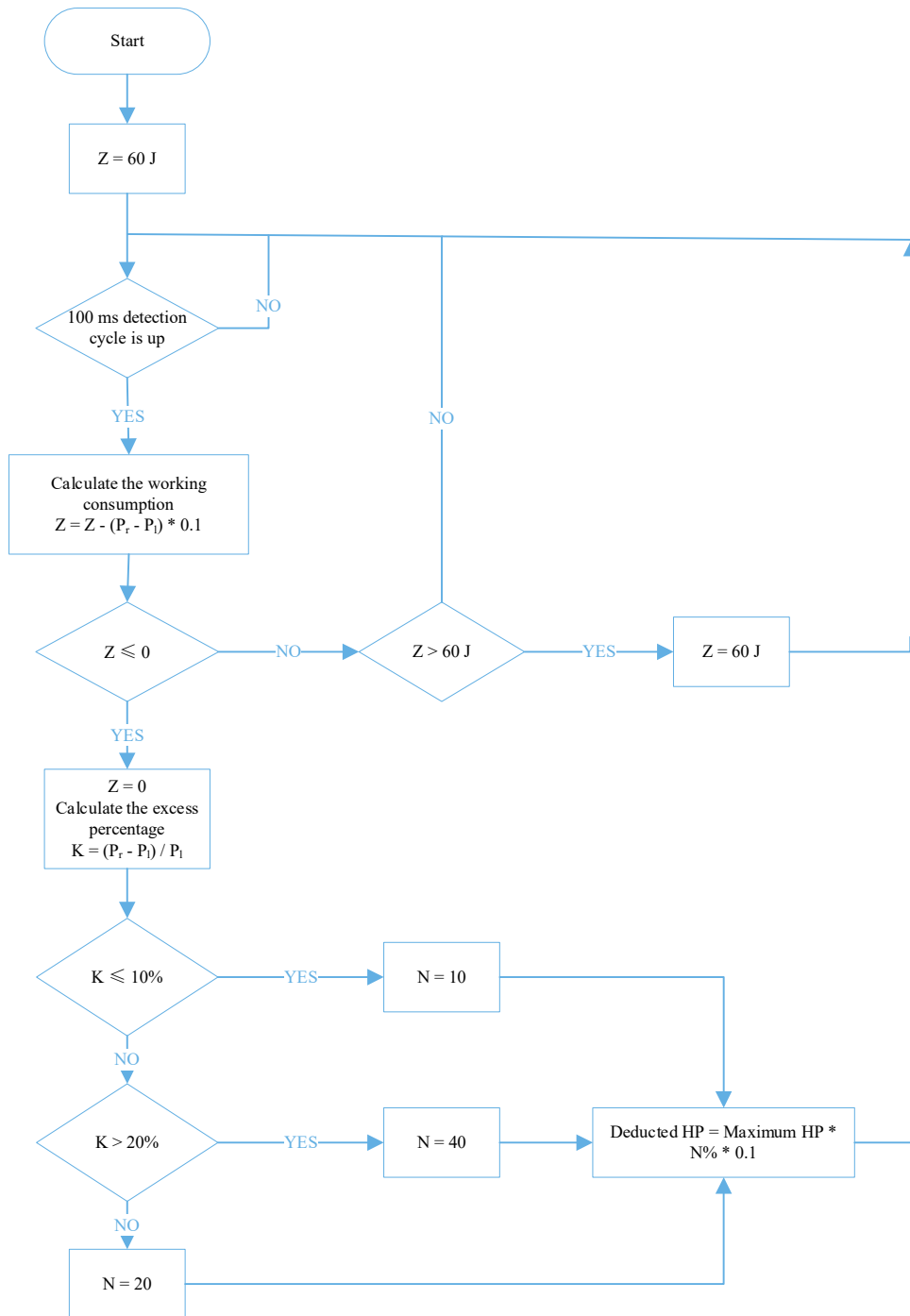


Figure 5-3 Chassis Power Consumption Detection and HP Deduction Logic of Hero, Standard, and Sentry

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 60 J.
- If a Hero, Standard or Sentry has triggered the Launch Ramp Buff, its Buffer Energy Limit will increase to 250 J. If the Buffer Energy reaches below 60 J after subsequent consumption, it can be restored up to 60 J. Refer to “5.3.2.3 Launch Ramp Buff Mechanism” for details on the Launch Ramp buff mechanism.

5.1.4 Attack Damage or Collision

The Dart Detection Module detects attacks from Darts and 42 mm projectiles through the Armor Module and the phototube.

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 50 ms (when an Armor Module is hit with a 42 mm projectile, the detection interval can be extended to a maximum of 200 ms).

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

Table 5-4 Effective Detection Speeds of Armor Modules for Different Types of Projectiles

Armor Module	17 mm projectile	42 mm projectile
Large Armor Module, Small Armor Module	Higher than 12 m/s	Higher than 8 m/s
Triangular Armor Module	Not applicable	Higher than 6 m/s
Power Rune Armor Module	Higher than 12 m/s	-



- In an actual match, the normal speed of a projectile that touches the Armor Module attack surface is different from its Initial Projectile 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 42 mm projectiles.

A robot or battlefield component experiences damage, which can probably be determined as projectile damage, when its Armor Module is collided. However, a robot is not allowed to cause damage to the other side's robots through collision (including collision with the robots or launching objects).

Without buffs, the original damage shall be as follows:

Table 5-5 HP Deduction Mechanism for Attack Damage or Striking

Target \ Damage type	42 mm projectile	17 mm projectile	Dart	Collision
Robot Armor Module	100	10	0	2
Base Large Armor Module (Top)	200	1	0	0
Base Large Armor Module (Bottom)	200	5	0	2
Base Dart Detection Module	200	0	Fixed Target: 1,000 Random Target: 1200	0
Outpost Small Armor Module (static)	200	5	0	2
Outpost Small Armor Module (spinning)	200	10	0	2
Outpost Triangular Armor Module	300	0	0	0
Outpost Dart Detection Module	200	0	750	0

5.1.5 Referee System Going Offline

Participating teams must mount the corresponding referee system modules on their robots in accordance with the requirements of the [RoboMaster 2024 University Series Robot Building Specifications Manual](#), and ensure the stability of the connection between each module of the referee system and the server throughout the competition. The Referee System server detects the connectivity of each module at a frequency of 2 Hz. 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. If a Speed Monitor Module (17mm Projectile) or (42mm Projectile) mounted on a robot goes offline, the robot’s 17mm or 42mm Launching Mechanism will be powered off immediately.



Critical Referee System Modules: Positioning System Module, Armor Module and Super-capacitor Management Module.

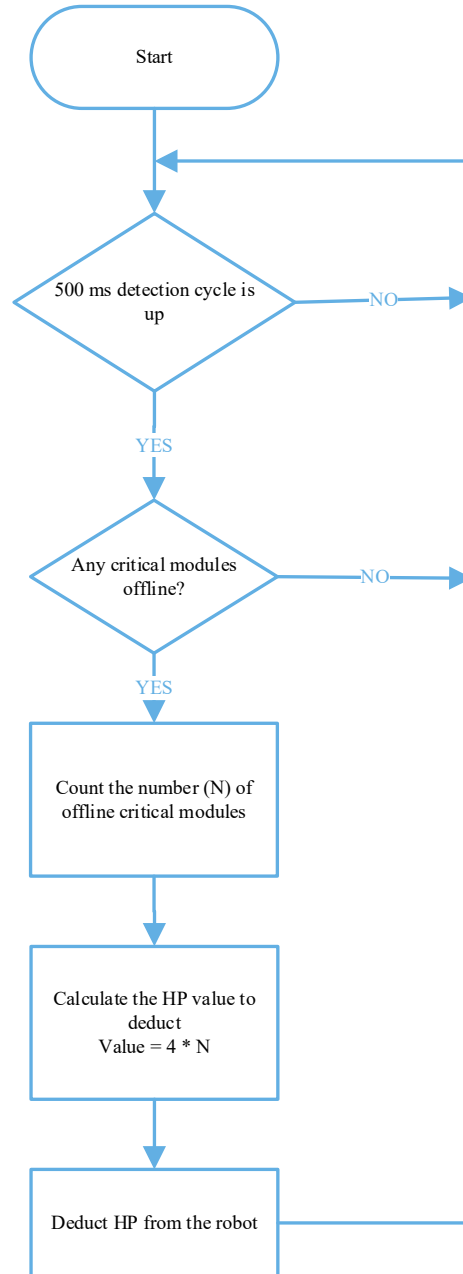


Figure 5-4 HP Deduction Mechanism for Critical Referee System Module Going Offline

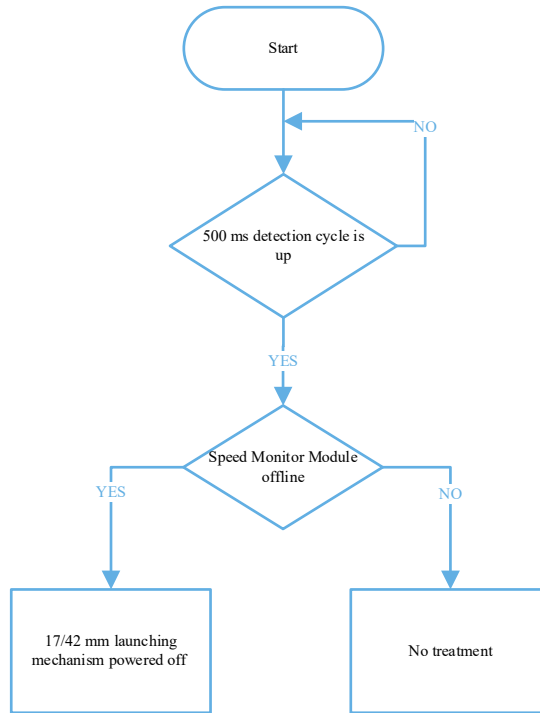


Figure 5-5 Offline and Power-off Mechanism for Speed Monitor Module

5.1.6 Irregular Offline Status

During the competition, if a robot enters the Irregular Offline state, 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
<p>Ground Robots</p>	<ul style="list-style-type: none"> ● When the Launching Mechanism (if any), Gimbal and Chassis are powered off, 5% of the Maximum HP is deducted for each second elapsed until it drops to zero. ● The RFID Interaction Module is expired. ● The robot no longer detects any damage caused by collision and projectile hits and any HP deduction for the module going offline. ● The respawn process stops. ● The inter-robot communication disconnects.
<p>Aerial Robot</p>	<ul style="list-style-type: none"> ● The Launching Mechanism is powered off and air support cannot be requested. ● Image transmission is disconnected.

Robot Type	Consequences of irregular offline status
Radar	<ul style="list-style-type: none"> The inter-robot communication disconnects.
Dart	<ul style="list-style-type: none"> The Dart Launching Station's gate cannot open.

5.1.7 Penalty Damage

When a robot receives penalties such as a Yellow Card or Red Card Warning, its HP may be deducted. For details, refer to “7.1 Penalty System”.

5.2 HP Recovery and Respawn Mechanism

Only Ground Robots can recover their HP and respawn. Ejected robots cannot recover their HP and respawn.

5.2.1 HP Recovery Mechanism

Ground Robots:

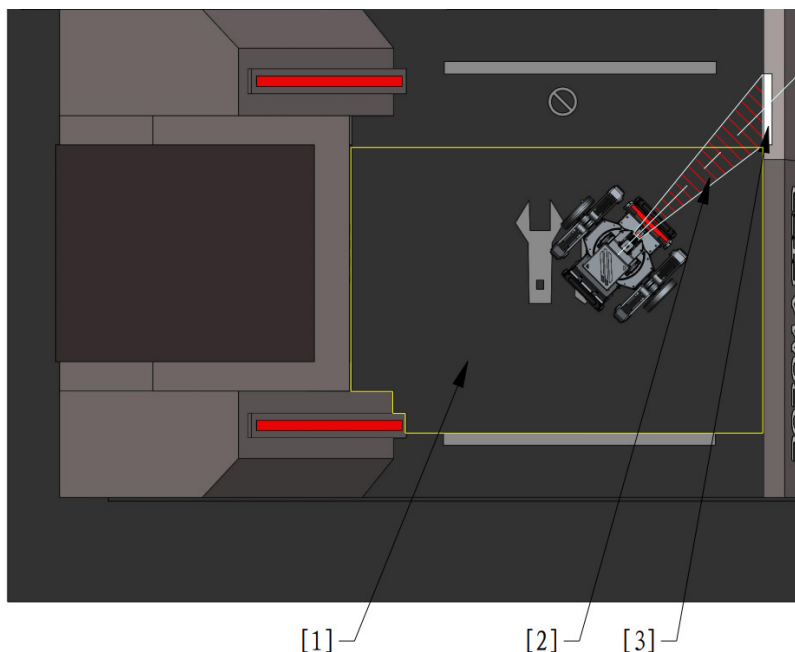
A robot that occupies the Restoration Zone of its team will receive an HP Recovery Buff of 10% of its Maximum HP per second. Four minutes after the start of the game (at 02:59 countdown): When the robot is out of combat and occupies the Restoration Zone of its team, it will receive an HP Recovery Buff of 25% of its Maximum HP per second and have its Chassis Power Consumption Limit doubled but without exceeding 200 W. When the robot is not out of combat, the aforementioned 25% HP Recovery Buff and Chassis Power Consumption Limit increase will expire immediately; when the situation where the robot cannot occupy the Restoration Zone of its team lasts four seconds, the Chassis Power Consumption Limit increase will expire.

Hero, Standard, Sentry:

In a round, when the robot is out of combat, it has the option to exchange 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 six seconds after a remote HP exchange is confirmed, the exchange will lapse and the Gold Coins will not be returned.

- How to judge whether a robot is in the Restoration Zone: When a robot’s RFID Interaction Module detects the RFID Interaction Module Card of the Restoration Zone, or its Video Transmitter Module (VTM) recognizes a Visual Marker for the Restoration Zone when the robot is located in a Restoration Zone outside the Official Projectile Supplier, the robot shall be deemed to be in the Restoration Zone. An alive robot in its team’s Restoration Zone is deemed to have occupied the Restoration Zone.
- The VTM is able to recognize a Visual Marker only when the Visual Marker is in the image center of the VTM and the VTM has no obvious roll angle.



[1] Recognizable zone [2] Image transmission range of robot [3] Visual Marker

Figure 5-6 Relative Location of the Robots VTM and Visual Marker

5.2.2 Respawn Mechanism

A defeated robot can respawn by waiting for the respawn process to complete or exchanging Gold Coins for instant respawn before the process is completed.

- When seeking to complete a respawn process, the respawn process required is related to the remaining time of the competition when the robot is defeated and the robot’s cumulative number of instant respawn exchanges. Its formula is as follows:

$$\text{Respawn process} = 10 + (420 - \text{remaining competition time})/10 + 20 * \text{cumulative number of instant respawn exchanges}$$

The unit of the remaining competition time is “second”. The number is rounded off to the nearest integer.

The respawn process of a robot starts immediately after it is defeated. From the moment the robot is defeated, the process increases by 1 per second; if the robot is in the Restoration Zone, its respawn progress is increased to 4 per second.

When seeking to complete the respawn process:

- The revived robot retains its level and Experience Points from before its defeat and remains in an Invincible status for 10 seconds.
- Its HP is restored to 10% of the Maximum HP.
- Its Launching Mechanism is locked and will be unlocked when the revived robot occupies the Restoration Zone.

In addition, the Sentry Robot’s HP will be immediately restored to its 100% maximum HP after it is revived, but the robot can be defeated up to five times in each round. After being defeated five times in a round, the Sentry Robot cannot be respawned.

- When exchanging Gold Coins for an instant respawn:
 - The respawned robot retains its level and Experience Points from before its defeat and remains in an Invincible status for three seconds.
 - Its HP is restored to 100% of the Maximum HP.
 - Its Launching Mechanism is immediately unlocked.
 - Its Chassis Power Consumption Limit is doubled (up to 200 W), for 4 seconds.

Example: A robot is defeated at the 300th second of the match and respawned twice through exchanges for instant respawn. In this case, its respawn process length this time is calculated as $10 + 300 / 10 + 20 + 20 = 80$.

5.3 Buff Mechanism

5.3.1 Power Rune Mechanism

Robots can activate Power Runes 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 alive robots in the team will receive a certain amount of buff while the Power Rune is in the Activated 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.



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 respectively), 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. During the buff period of the Small Power Rune, all Hero and Standard Robots experience a 100% boost in earned experience. The whole team can gain a maximum of 800 extra Experience Points in one buff period of the Small Power Rune.
- **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 respectively), 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. Meanwhile, when the Large Power Rune is activated, 500 Experience Points will be equally assigned to the Hero and Standard Robots that occupy the Power Rune Activation Point.

- If the Power Rune Activation Point is occupied by the Sentry only, the Experience Points will be divided equally among the Hero and Standard robots alive on the team that activates the Large Power Rune.



- How to judge whether the robot occupies the Power Rune Activation Point: When a robot's RFID Interaction Module detects the RFID Interaction Module Card of the Power Rune Activation Point, or when the coordinates of its Positioning System Module reach the Power Rune Activation Point through a Trapezoid-shaped Elevated Ground slope and stay, the robot shall be deemed to have occupied the Power Rune Activation Point.

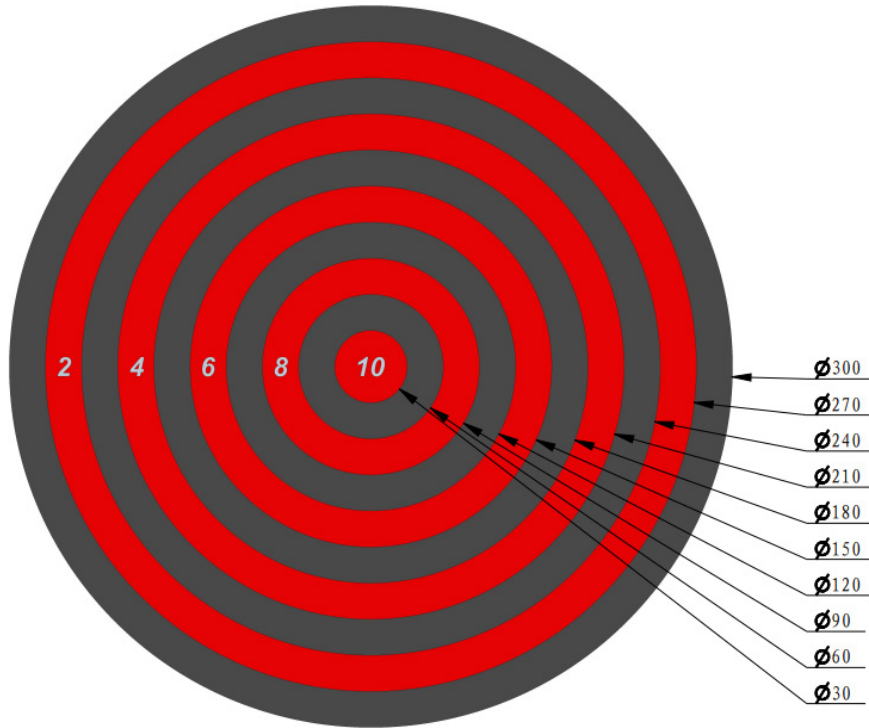


Figure 5-7 Power Rune Strike Zones

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

Table 5-7 Power Rune Armor Module Light Effects Corresponding to the Ring Numbers Hit

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



The Power Rune Armor Module detects projectile hit spots at an accuracy of 1 mm 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 5-8 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]	200%	25%
(40, 45]	300%	25%
46	340%	30%
47	380%	35%
48	420%	40%
49	460%	45%
50	500%	50%

5.3.1.1 The Rotation Strategy for the Power Rune

The Power Runes 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 Runes rotate in a random direction. During the round, the Power Runes rotate in a consistent direction.

The rotating speed of a Small Power Rune is set at $1/3 \pi$ rad/s.

The rotating speed of a Large Power Rune changes cyclically based on a trigonometric function. The target function for speed is $spd = a * \sin(\omega * t) + b$, 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 rotating speed of the Large Power Rune and the target function for speed is within 500 ms.

5.3.1.2 The Statuses of the Power Rune

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

1. Unavailable

The Power Rune enters the Unavailable status, as shown below:

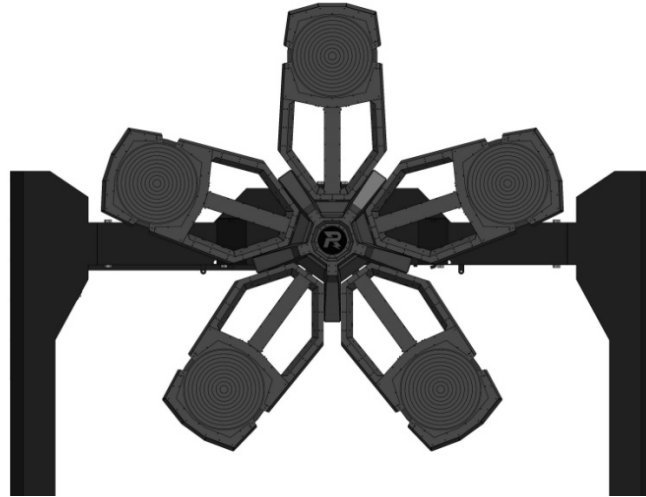


Figure 5-8 Power Rune When Unavailable

2. Available

The Power Rune enters the Available status, as shown below:

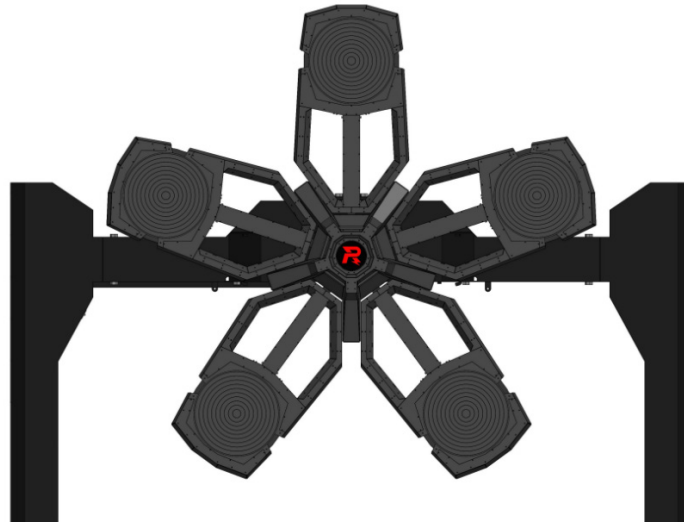


Figure 5-9 Power Rune When Available

3. Activating

When the Power Rune is available, a Ground Robot (except for Engineers) that occupies its team's Power Rune Activation Point and stays there for three 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 (for the Large Power Rune, the light arm will also activate the corresponding light effect based on the number of rings hit). 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 as shown below:

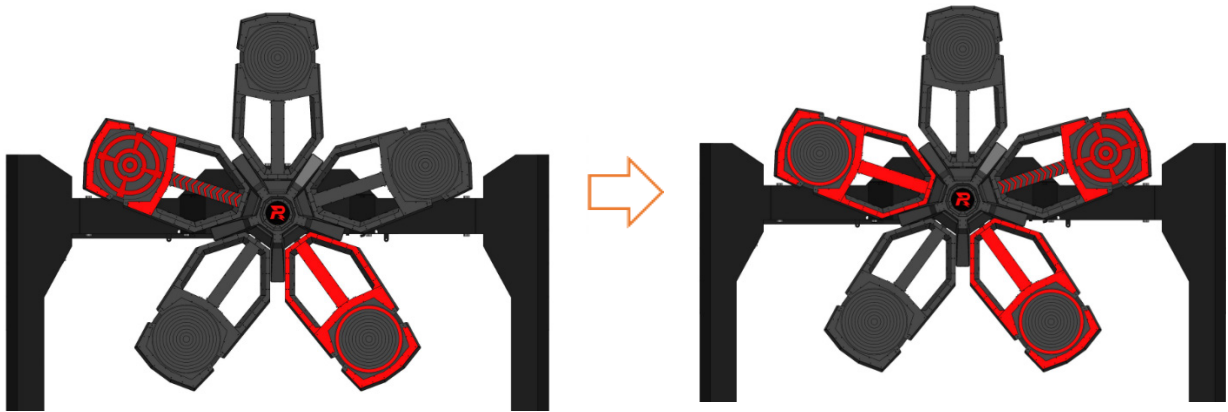


Figure 5-10 Small Power Rune When Activating

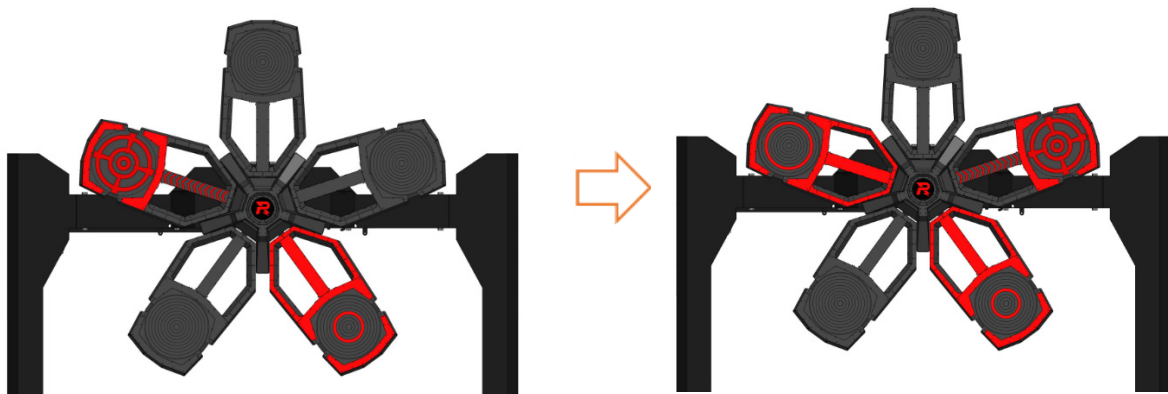


Figure 5-11 Large Power Rune When Activating

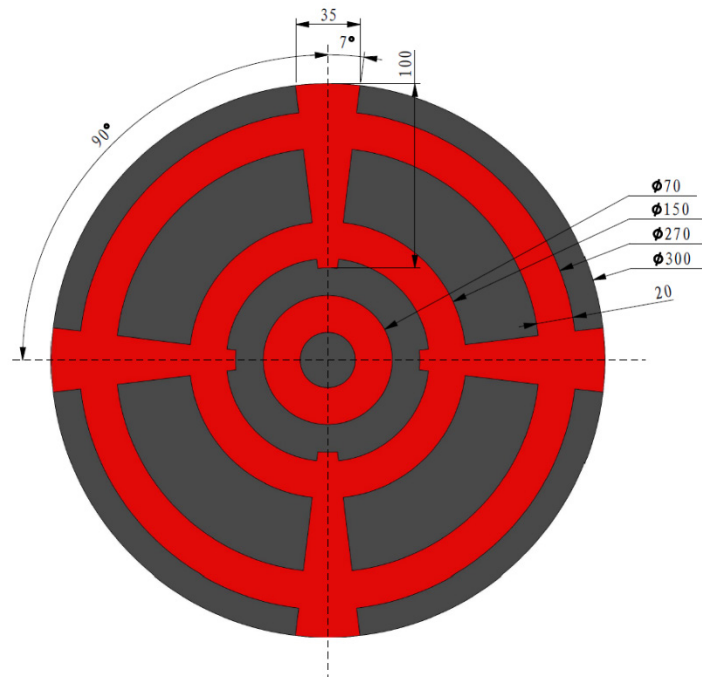


Figure 5-12 Power Rune Target When Available

4. Activated

If all five light arms are illuminated, the Power Rune is activated as shown below:

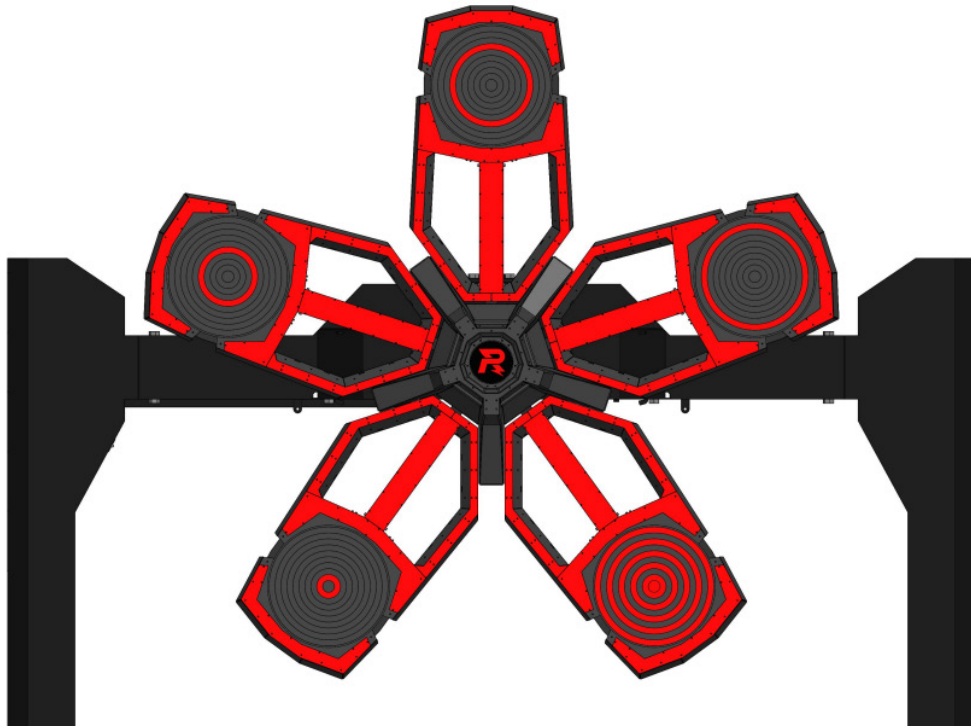


Figure 5-13 Power Rune When Activated

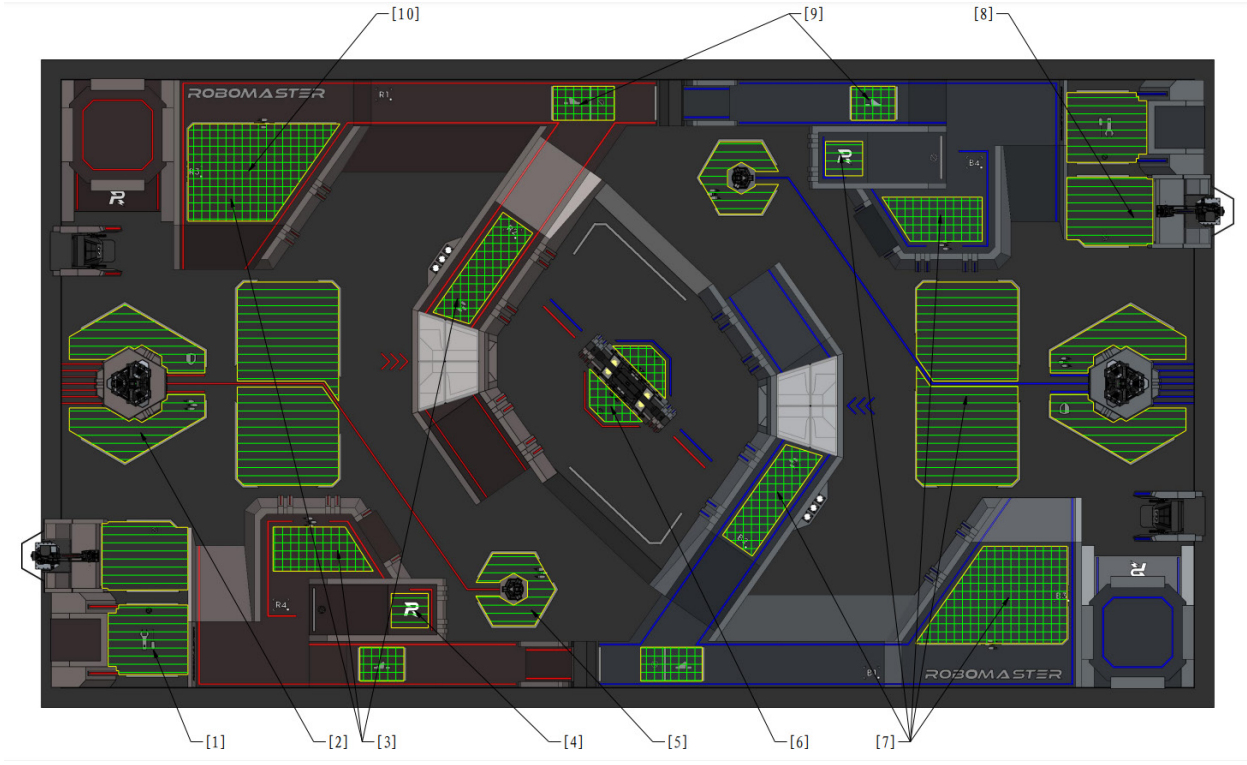
5. Activation Failed

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

5.3.2 Battlefield-related Buff Mechanisms

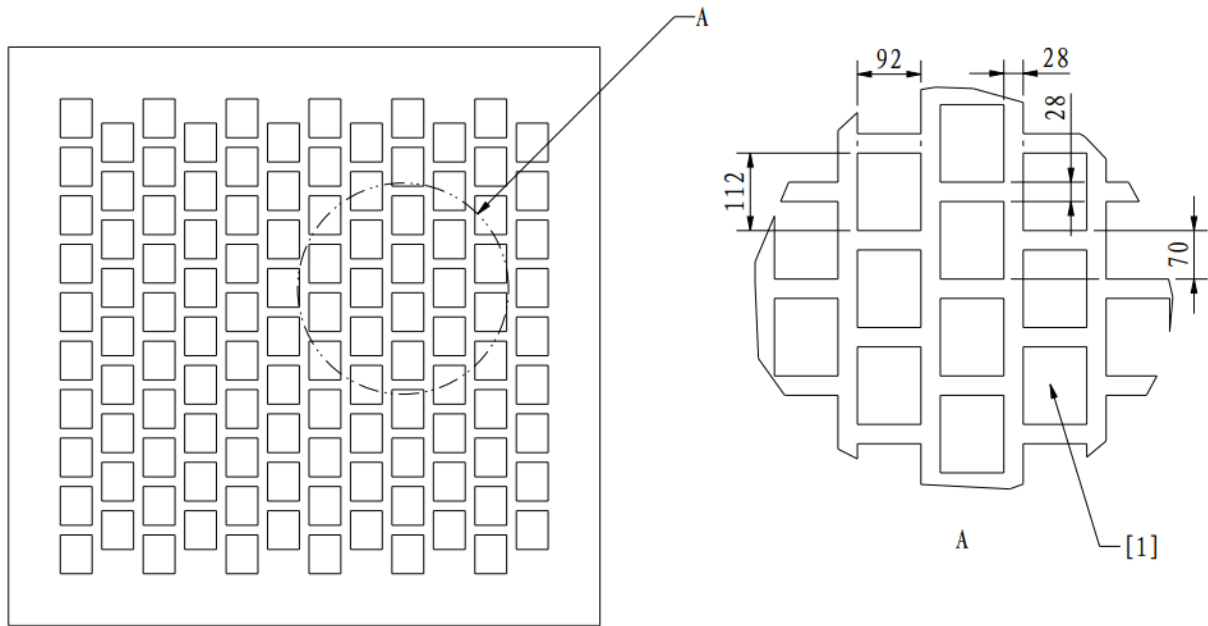
All Buff Points in the Battlefield are as shown below:



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

Figure 5-14 Battlefield Buff Point Area

The expiry of the occupation status will be delayed by 2 seconds. If the occupying robot has been defeated or ejected, the buff gained will expire.



[1] Locations where RFID Interaction Module Cards are lodged

Figure 5-15 Layout of the RFID Interaction Module Cards




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

Table 5-9 Overview of the Buff Mechanisms for Ground Robots

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

Robots Buff Point	Hero Robot	Engineer Robot	Standard Robot	Sentry Robot
Outpost Buff Point	√	-	√	√
Launch Ramp Buff Point	√	-	√	√
Sentry Patrol Zone	-	-	-	√
Exchange Zone Buff Point	-	√	-	-

Table 5-10 Overview of Buff Types

Type	Definition
Attack Buff	Increase damage caused by projectile attacks
Defense Buff	Change the damage suffered from a projectile attack or collision.  Defense Buffs are not applicable to HP deductions caused by violation penalties, the Referee System going offline, exceeding limits, etc.
Barrel Heat Cooling Buff	Increase the barrel cooling value per second.
Buffer Energy Buff	The robot 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.

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

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

Example 1: Say the red team’s robot has a 200% Attack Buff and the blue team’s robot has a 25% Defense Buff, and the progress marked by the radar of the opponent exceeds 100. If the red team’s robot launches a round of 42 mm projectiles and hits the blue team’s robot, the damage suffered by the latter should be: $100*200%*(1-25%+15%) = 180$

Example 2: Say the red team’s robot has a 200% Attack Buff and the progress marked by the radar of the opponent exceeds 100. If the red team’s robot launches a round of 42 mm projectiles and hits the blue team’s robot, the damage suffered by the latter should be: $100*200%*(1+15%) = 230$

When a robot receives more than one buff of the same type, the maximum buff effect should be applied, including Attack Buff, Defense Buff (excluding negative Defense Buff), HP recovery, and Barrel Heat Cooling Buff.

Example: The red team's Standard robot obtains a 25% Defense Buff by activating the Large Power Rune. If the robot then secures the Base Buff Point on its own side, the Defense Buff rises to 50%. However, if a subsequent -15% Defense Buff is applied, the net Defense Buff is 35%.

If the final damage or HP recovery after buff calculation is a decimal number, it shall be rounded off.

5.3.2.1 Base Buff Point Mechanism

The Base Buff Point can only be occupied by Hero and Standard Robots of the team to which it belongs. Multiple robots of one team can occupy the Base Buff Point simultaneously.

In the Seven-Minute Round, a robot that occupies the Base Buff Point on its own side will receive a 50% Defense Buff.

During the 2nd-to-3rd, 3rd-to-5th, and 5th-to-7th minutes of the competition (i.e., when the countdown is at 04:59-04:00, 03:59-02:00, and 01:59-00:00, respectively), robots that occupy the Base Buff Point on their own side will gain a 2-time, 3-time, and 5-time Barrel Heat Cooling Buff, respectively.

5.3.2.2 Elevated Ground Buff Point 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.

Hero, Standard, and Sentry Robots can all occupy the Elevated Ground Buff Point. Multiple robots of one team can occupy the Elevated Ground Buff Point simultaneously. If a robot of one side occupies an Elevated Ground Buff Point, no robots of the other side can occupy it at the same time.

During the 2nd-to-3rd, 3rd-to-5th, and 5th-to-7th minutes of the competition (i.e., when the countdown is at 04:59-04:00, 03:59-02:00, and 01:59-00:00, respectively), robots that occupy the Elevated Ground Buff Point will gain a 2-time, 3-time, and 5-time Barrel Heat Cooling Buff, respectively.

5.3.2.3 Launch Ramp Buff Mechanism

There are two Launch Ramp Buff Points on the respective roads for each team. Hero, Standard, and Sentry robots can all occupy the Launch Ramp Buff Points. Multiple robots of one team can occupy the Launch Ramp Buff Point simultaneously. 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 Launch Ramp Buff. The two Launch Ramp Buff Points can be occupied by both teams.

A robot that triggers the Launch Ramp Buff receives:

- 50% Defense Buff for 20 seconds
- An increase of buffer energy to 250 J (see “5.1.3 Exceeding Chassis Power Consumption Limit”)
- During the 2nd-to-3rd, 3rd-to-5th, and 5th-to-7th minutes of the competition (i.e., when the countdown is at 04:59-04:00, 03:59-02:00, and 01:59-00:00, respectively), robots that trigger the Launch Ramp Buff Point will gain a 2-time, 3-time, and 5-time Barrel Heat Cooling Buff, respectively, lasting 20 seconds.

5.3.2.4 Outpost Buff Point Mechanism

When a team’s Outpost is intact, any Hero, Standard, and Sentry Robot can occupy the Outpost Buff Point of the team. Multiple robots of one team can occupy the Outpost Buff Point simultaneously.

During the 2nd-to-3rd, 3rd-to-5th, and 5th-to-7th minutes of the competition (i.e., when the countdown is at 04:59-04:00, 03:59-02:00, and 01:59-00:00, respectively), robots that occupy the Outpost Buff Point will gain a 2-time, 3-time, and 5-time Barrel Heat Cooling Buff, respectively.

5.3.2.5 Power Rune Activation Point Mechanism

A Hero, Standard, or Sentry Robot can occupy its team’s Power Rune Activation Point. Multiple robots of one team can occupy the Power Rune Activation Point simultaneously.

When a team’s Power Rune is in the Available status, and any of its robots has occupied its own Power Rune Activation Point for at least three seconds, the Power Rune will enter the Activating status. During the 2nd-to-3rd, 3rd-to-5th, and 5th-to-7th minutes of the competition (i.e., when the countdown is at 04:59-04:00, 03:59-02:00, and 01:59-00:00, respectively), the robot occupying the zone will receive a 2, 3, or 5-time Barrel Heat Cooling Buff, respectively.

5.3.2.6 Resource Island Buff Point Mechanism

Only Engineer Robots can occupy the Resource Island Buff Point. 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 can occupy it at the same time.

During the first minute of the competition (i.e., when the countdown is at 06:59-05:59), an Engineer Robot that occupies the Resource Island Buff Point will receive a 75% Defense Buff.

5.3.2.7 Restoration Zone Mechanism

Ground robots can occupy their team's Restoration Zone. Multiple robots of one team can occupy the Restoration Zone simultaneously.

A robot 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 "5.2 HP Recovery and Respawn Mechanism".

5.3.2.8 Exchange Zone Buff Point Mechanism

Only Engineer Robots of a team can occupy the team's Exchange Zone Buff Point.

An Engineer Robot that occupies the Exchange Zone Buff Point is invincible.

5.3.2.9 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 Hero Robots of their respective teams. When a Hero Robot has occupied its team's Sniper Point, the attack inflicted by the robot's 42 mm projectile on the opponent's Base will receive a 250% Attack Buff. The robot will also receive 10 Gold Coins for each round of launched 42 mm projectile detected by the robot's Launching Mechanism.

When the Base of a team is attacked with a 42 mm 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 against 42 mm projectiles.

5.4 Outpost-Related Mechanism

The middle armor of the Outpost is rotatable. For its initial position, refer to "Figure 4-43 Outpost". Once the competition begins, the middle armor will start rotating and reach a speed of 0.8π rad/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 17 mm projectile increases to 10 points.

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 Protective Armor is expanded.
- Three minutes into the round (when the countdown is at 3:59).

While the Outpost is alive, its middle armor stops rotating in the following sequence: The rotating armor decelerates immediately and returns to its initial position within 10 seconds.



When the Outposts of both teams stop rotating simultaneously, the time when their rotating armor reaches the initial position may differ slightly.

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 Referee System as a Hero or Standard Robot, such robot will receive 100 Experience Points, otherwise the 100 Experience Points will be distributed evenly among the alive Hero and Standard Robots of its team. The average is rounded up and shall be accurate to one decimal place.

5.5 Relationship between the Sentry Robot, Outpost and Base

Base HP is 5000, and Outpost HP is 1500.

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.

Where an Outpost has been destroyed, and if the Sentry has been away from the Sentry Patrol Zone for more than 40 seconds, not entered the Battlefield, been ejected, or been defeated for the first time, the Base Protective Armor will be expanded.

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

- How to judge whether a Sentry is in the Sentry Patrol Zone: When a Sentry's RFID Interaction Module detects the RFID Interaction Module Card of the Sentry Patrol Zone, or when the coordinates of its Positioning System Module are located in the Sentry Patrol Zone, the Sentry shall be deemed as being in the Sentry Patrol Zone.



- When a Base is in the Invincible status, its armor lights will become purple and not flash when under attack.
 - When a Base is not in the Invincible status, its armor lights will be in the color of the corresponding team and flash when under attack.
-

5.6 Economic System

During the competition, both teams will earn Gold Coins regularly. They can also exchange Nuggets for additional coins. Gold Coins can be exchanged for air support, 17 mm and 42 mm Projectile Allowance, remote 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 5-11 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 5-12 The Degree of Impact of the Technical Proposal Score

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

Table 5-13 Rules for Exchange

Item for Exchange	Exchange Ratio	Exchange Limit
17 mm Projectile Allowance	<ul style="list-style-type: none"> ● On-site Exchange: 10 Gold Coins/10 rounds ● Remote exchange: 150 Gold Coins/100 rounds 	1,500 rounds/team

Item for Exchange	Exchange Ratio	Exchange Limit
42 mm Projectile Allowance	<ul style="list-style-type: none"> ● On-site Exchange: 15 Gold Coins/1 round ● Remote exchange: 200 Gold Coins/10 rounds 	100 rounds/team
Air support	[25 x ROUNDUP (remaining cooling period/25)] Gold Coins/time	Three times
HP (remote exchange)	[50 + ROUNDUP ((420 - remaining competition time)/60) x 20] Gold Coins/time	Unlimited
Instant respawn	[ROUNDUP((420 - remaining competition time)/60) x 80 + robot level x 20] Gold Coins/robot	Unlimited



- The time unit is “second”.
- “ROUNDUP” means to round up to the nearest integer.

5.6.1 Exchange Station Mechanism

During the match, the Engineer carries Nuggets and places them in the Nugget 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 Nugget 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. A right-hand orthogonal coordinate system EX'Y'Z' is established using the geometric center of the Nugget receptacle’s entry plane as the origin E. The X', Y', and Z' axes align parallel to and share consistent positive directions with the X, Y, and Z axes, respectively. The unit normal vector of the Nugget receptacle’s entry plane is \vec{e} . A spherical coordinate system (r, θ , φ) is set up based on the Nugget receptacle coordinate system. In this system, θ represents the angle between \vec{e} 's projection on the X'Y' plane and the positive X' axis, with θ in the range of [-180, 180). φ denotes the angle between \vec{e} and the positive Z' axis, falling within (0, 180). α represents the Nugget receptacle's rotation angle around the \vec{e} direction, where counterclockwise rotation assigns a positive value to α .

The pose of the Nugget receptacle is defined by the coordinates (x, y, z) of the central point E on the entry plane of the Nugget receptacle in the OXYZ system, combined with the azimuth coordinates (θ , φ) of the unit normal vector \vec{e} in the Nugget receptacle spherical coordinate system, and the rotation of the Nugget receptacle around the \vec{e} direction (α). This set of parameters is expressed as (x, y, z, θ , φ , α). The pose of the Nugget receptacle coordinate

system in the initial position (initial state) shall be:

$x = -350, y = 0, z = 1150, \theta = 0, \varphi = 90, \text{ and } \alpha = 0$ (length unit: mm; angle unit: $^{\circ}$)

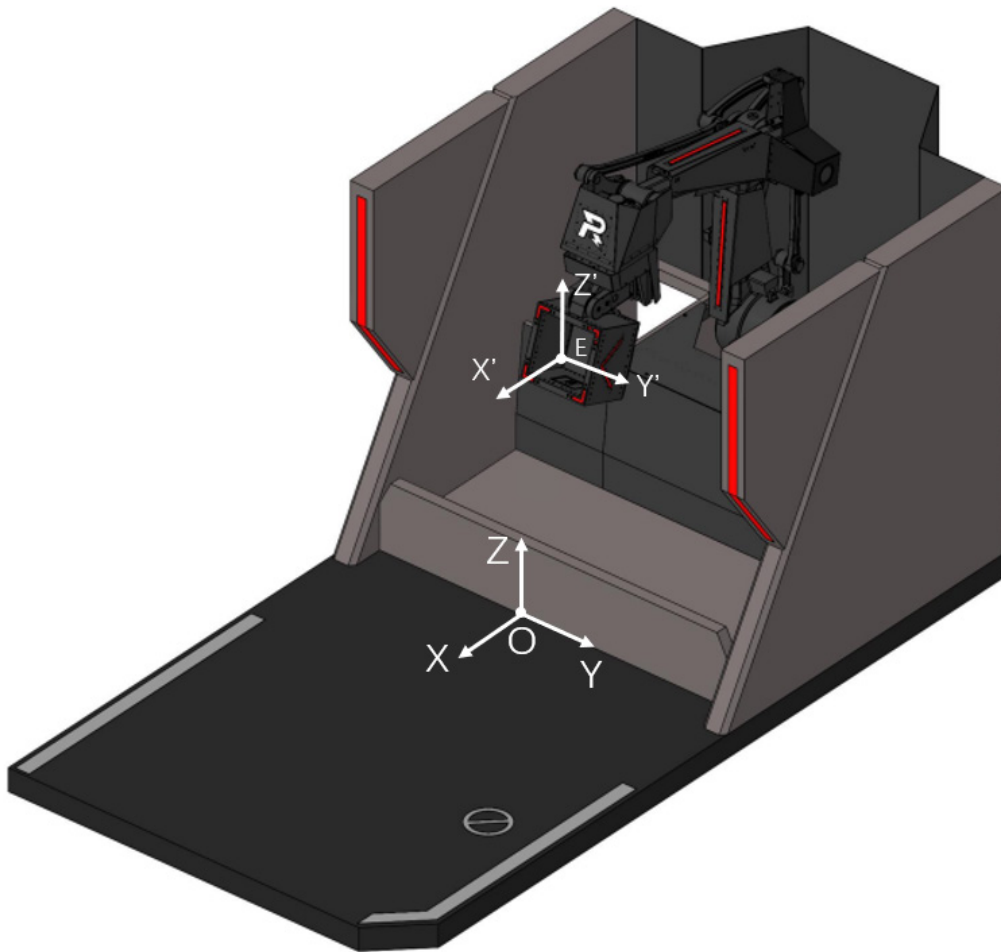


Figure 5-16 Coordinate System of the Exchange Station

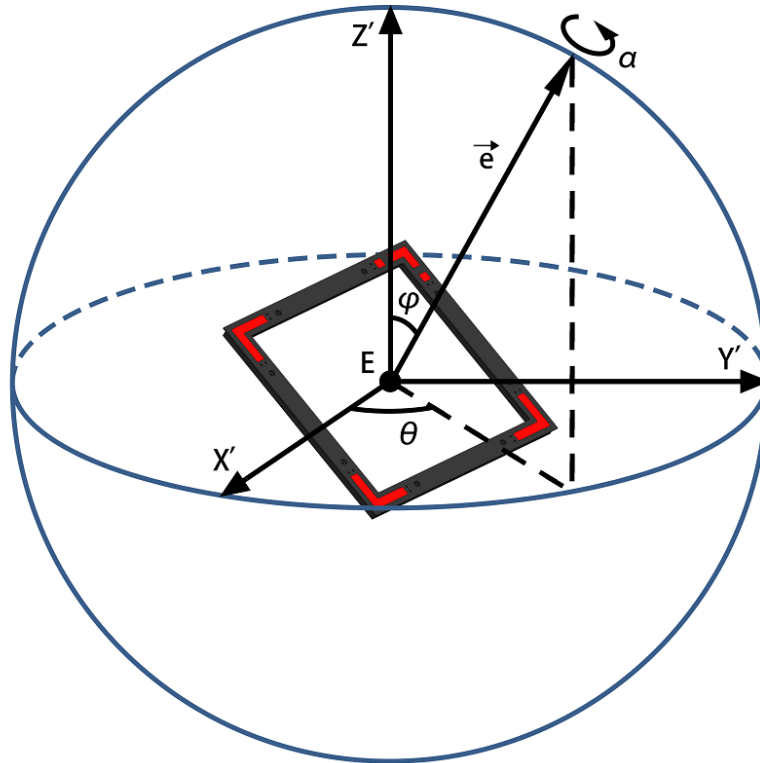
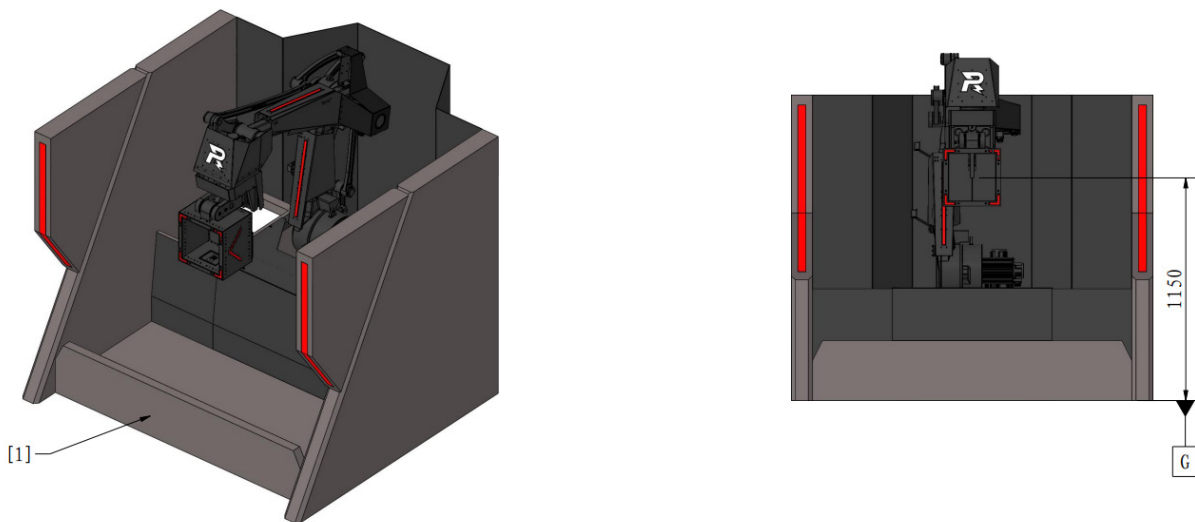


Figure 5-17 Nugget Receptacle's Direction



[1] Front guard of Exchange Station

Figure 5-18 The Nugget Receptacle in the Initial Position

The pose of the Nugget receptacle shall satisfy the following:

① $x^2 + y^2 + (z - 600)^2 \leq 300^2$ ($-270 \leq x \leq 0$, $-255 \leq y \leq 255$, $720 \leq z \leq 900$);

- ② Any structure of the Nugget receptacle must not cross over the front plane of the Exchange Station Base.
- ③ The pose of the Nugget receptacle is related to the difficulty level. Their relationship is as shown below:

Table 5-14 Value Range for the Nugget Receptacle’s Pose at Different Difficulty Levels

Difficulty Level	x	y	z	θ	φ	α
Level 1	-200	[-185,185]	720	0	90	0
Level 2	[-270,0]	[-255,255]	[720,900]	0	90	0
Level 3	[-270,0]	[-255,255]	[720,900]	0	[0,90]	[-45,45]
Level 4	[-270,0]	[-255,255]	[720,900]	[-90,90]	[0,90]	[-45,45]
Level 5	[-270,0]	[-255,255]	[720,900]	[-135,135]	[0,90]	[-45,45]

In each round and at the same difficulty level, the change of pose for the Nugget receptacles of both the red and blue teams is the same.

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

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

Difficulty Level	Gold Coin Quantities Available for Exchange with Silver Nuggets	Gold Coin Quantities Available for Exchange with Gold Nuggets
Level 1	75	200
Level 2	100	225
Level 3	150	275
Level 4	225	350
Level 5	375	500

In addition, as the cumulative number of Gold Coins acquired by a team through Nugget exchange increases, the team will be subject to a higher minimum difficulty level. However, the Gold Coins exchanged with each Nugget thereafter will be multiplied by a certain factor. The mechanism is shown below.

Table 5-16 Cumulative Gold Coins Received and Difficulty Levels

Cumulative Gold Coin Quantity	Minimum Difficulty Level	Gold Coins Multiplication Factor
625	Level 2	1 time
750	Level 3	1 time

Cumulative Gold Coin Quantity	Minimum Difficulty Level	Gold Coins Multiplication Factor
1,000	Level 4	1.4 times
1,600	Level 5	2 times

Example: The Red Team’s Engineer Robot exchanges 3 Silver Nuggets for 1,125 Gold Coins consecutively at Level 5 Difficulty after the start of a round. It then exchanges 1 Gold Nugget at Level 5 Difficulty, then the quantity of Gold Coins acquired this time is $500 \times 1.4 = 700$, and the cumulative Gold Coin quantity received from Nugget exchange so far is 1,825. If the robot subsequently exchanges another Gold Nugget at Level 5 Difficulty, the Gold Coin quantity obtained then will be $500 \times 2 = 1,000$.

Once the operator sets the exchange difficulty and the Nugget receptacle adjusts to the corresponding pose, the potential Gold Coin value from this exchange decreases over time (t) until the exchange is completed. The time for each successful exchange for its corresponding difficulty is calculated independently. The rate of decrease (x) is:

Range of t	Decrease Rate (x)
$t \leq 15s$	0%
$15s < t \leq 65s$	$2\% * (t-15)$
$t > 65s$	100%

The reduction is capped at the Gold Coin quantity difference between the chosen difficulty and the next lower difficulty. If the Level 1 difficulty is initially selected, there is no decrease.

The number of Gold Coins that a robot gains through an exchange is calculated as follows: $(A - 0.02 * (t - 15) * (A - B)) * m * n, (t > 15)$

Where A indicates the threshold Gold Coin quantity for this Nugget exchange, B indicates the threshold Gold Coin quantity at the next lower difficulty level of the exchange of this type of Nuggets, t indicates the exchange duration, m indicates the multiplication factor of the cumulative Gold Coins that Engineer Robots gain through the Nugget exchange, and n indicates the multiplication factor of Gold Coins that Engineer Robots in semi-automatic control gain by exchanging Nuggets.


Example 1: The red team's Engineer Robot selects the Level 3 difficulty. 10 seconds after the Nugget receptacle arrives at the corresponding pose, the red team's operator of the Engineer Robot cancels the exchange, re-enters the exchange process, and selects the Level 4 difficulty. 5 seconds after the Nugget receptacle arrives at the corresponding pose, the operator cancels the exchange once again, re-enters the process, and selects the Level 3 difficulty. In this case, the time will be counted from 10 seconds once the Nugget receptacle arrives at the corresponding pose.

Example 2: Suppose the red team's Engineer Robot completes a Gold Nugget exchange of Level 5 difficulty in 20 seconds after the Nugget receptacle reaches the designated pose (when the R light activates). The cumulative Gold Coins that have been received through Nugget exchange prior to this exchange is 1800. In that case, the actual number of Gold Coins earned is: $(500 - 0.02 * (20 - 15) * (500 - 350)) * 2 = 970$.

Exchange process:

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

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

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

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 Nugget in the Nugget receptacle. Before the Nugget is successfully exchanged, the pose of the Exchange Station shall remain the same under the same difficulty.
- When exchanging Nuggets, the Engineer Robot's operator may use the "Push Nugget" function which will move the Nugget receptacle to its initial position and push out the Nugget (if any) in the Nugget receptacle.
- The Exchange Station will not detect obstacles in its path. If the Engineer Robot's mechanisms come into contact or collide with the Nugget 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:

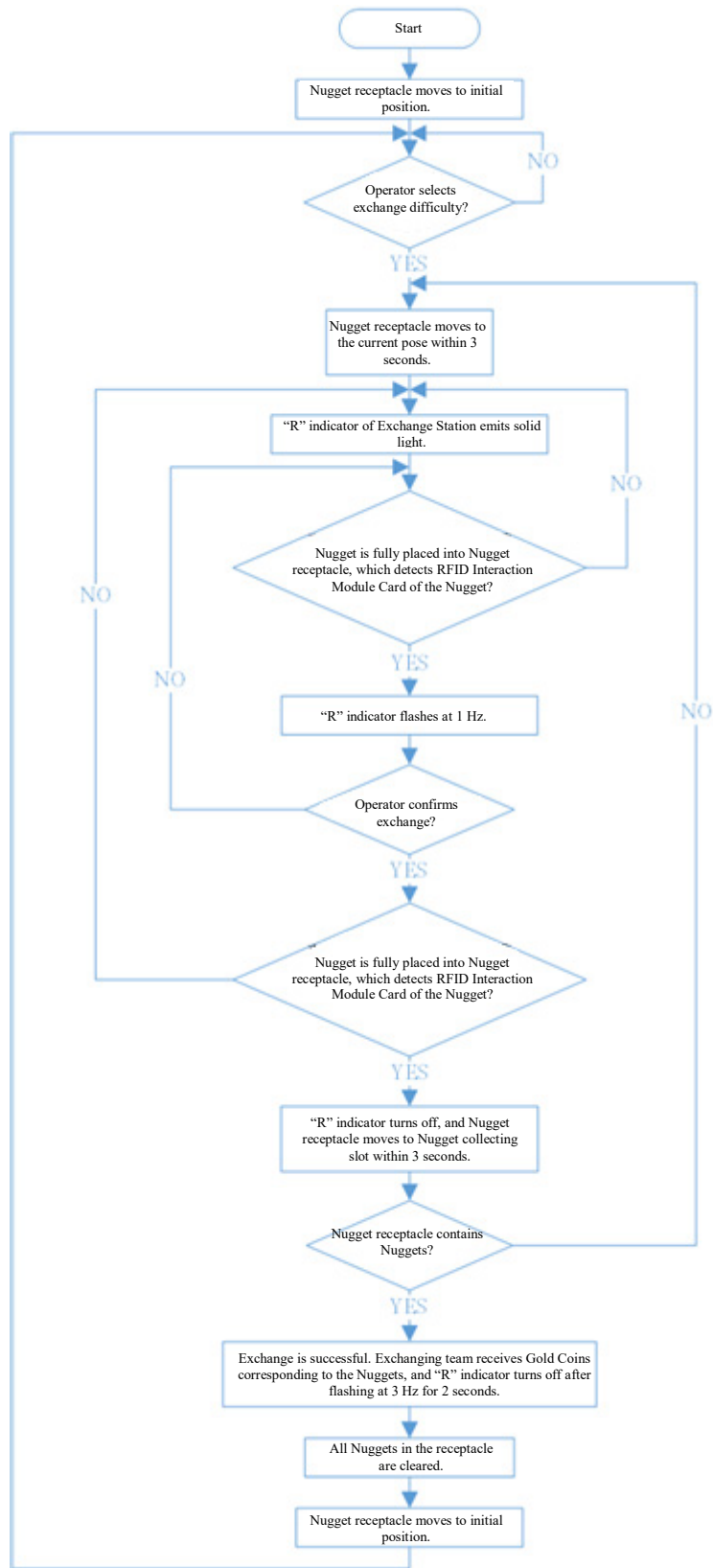


Figure 5-19 Nugget Exchange Logic

5.6.2 Official Projectile Supplier-Related Mechanism

Before the Seven-Minute Round starts, Ground and Aerial Robots can pre-load projectiles. During the Seven-Minute Round, Ground Robots can reload their 17 mm projectiles at the Official Projectile Supplier.

When a robot is at its own team's Official Projectile Supplier, the operator can reload projectiles through the player's client. If the robot detects the RFID Interaction Module Card in the Supplier Zone, the operator can directly select the projectile reload quantity on the Reload 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 400 rounds of 17 mm projectiles.

5.6.3 Projectile Allowance Mechanism

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 Launching Mechanism is locked, its power stays off; when it is unlocked and the Projectile Allowance for the corresponding projectile type is greater than zero, its power remains on, otherwise it is powered off. Three seconds after a Hero Robot changes from alive to non-alive state, or a Hero Robot has launched more projectiles than its allowance (the Speed Monitor Module detects a 42 mm projectile being fired when the Projectile Allowance is 0), or the Speed Monitor Module can still detect 42 mm projectile being launched after the Hero Robot's defeat, when detecting the launch of the third 42 mm projectile, all the Armor Modules of the other team's robots, Outpost, and Base will be shielded from 42 mm projectile damage, until the Hero Robot changes to alive state and the Projectile Allowance is larger than 0.

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

Table 5-17 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	
Sentry Robot	400	
Aerial Robot	0	Receives Projectile Allowance when air support is requested.

On-site Exchange

When a robot occupies the Restoration Zone, the operator can exchange for Projectile Allowance through the player’s client. A Sentry Robot can exchange for Projectile Allowance through the Referee System Serial Port on its own. The specific projectile types and quantities that can be exchanged are shown below.

Table 5-18 Projectile Allowance Types and Quantities (When performing the On-site Exchange)

17 mm Projectile Allowance	42 mm Projectile Allowance
10 rounds	1 round

Remote exchange

In every round, all teams have opportunities for remotely exchanging Projectile Allowance for 17 mm and 42 mm projectiles.

When a robot is out of combat, the operator can remotely exchange for Projectile Allowance through the player's client. A Sentry Robot can remotely exchange for Projectile Allowance through the Referee System Serial Port on its own. The specific projectile types and quantities that can be exchanged are shown below.

Table 5-19 Projectile Allowance Types and Quantities (Remote Exchange)

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

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

5.7 Experience and Performance Systems

5.7.1 Experience System

After the match starts, Standard and Hero Robots are both at Level 1. They can go up to Level 10 (the highest level possible) by gaining Experience Points. Engineer and Sentry Robots cannot gain Experience Points or level up. Engineer Robots will always be considered Level 1, and Sentry Robots will always be considered Level 10. Aerial Robots cannot gain Experience Points or level up.

During the competition, a robot earns Experience Points in various ways, as shown below:

Behavior Type	Experience Points Gained
Launching projectiles	<ul style="list-style-type: none"> ● Standard robot: For every 1 projectile launched, the robot gains 1 Experience Point. ● Hero robot: For every 1 projectile launched, the robot gains 10 Experience Points.

Behavior Type	Experience Points Gained
<p>Dealing Attack Damage</p>	<ul style="list-style-type: none"> ● Dealing attack damage to a robot: For every 1 point of damage dealt, the attacking team gains 4 Experience Points ● Dealing damage from 17 mm projectiles to the Large Armor Module on top of the Base: For every 1 point of damage dealt, the attacking team gains 2 Experience Points ● Dealing attack damage to the Outpost or the Large Armor Module at the bottom of the Base, or dealing damage from 42 mm projectiles to the Large Armor Module on top of the Base: For every 1 point of damage dealt, the attacking team gains 1 Experience Point <p>When the robots of one team, the Base or the Outpost receives attack damage, but the Referee System does not detect the source of the damage, the source of the damage cannot gain Experience Points or it is penalty/the robot of the same team: if the damage is from projectiles, the Experience Points will be equally divided among all of the other team's robots that can deal the projectile damage of that type and gain experience; if the damage is not from projectiles, the Experience Points will be equally assigned to all alive Hero and Standard Robots of the other team at the moment. The average is rounded up and shall be accurate to one decimal place.</p> <p>Example: A Standard Robot of the blue team received 10 points of damage from a 17 mm projectile, but the system is unable to identify the damage's origin. At this moment, the red team has 2 alive Standard Robots and 1 alive Hero Robot. As a result, the Experience Points gained by an alive Standard Robot is $4 \times 10 / 2 = 20$. The alive Hero Robot gains no Experience Point.</p>
<p>Defeated robots</p>	<ul style="list-style-type: none"> ● If a robot is destroyed and the destroyer is eligible to gain experience, the number of Experience Points gained is as follows: <ul style="list-style-type: none"> ➢ When the destroyed robot's level is not lower than that of the destroyer, the Experience Points are calculated as follows: <p>The Experience Points gained by destroyer = $50 \times \text{the level of the destroyed robot} \times (1 + 0.2 \times \text{the difference between the level of the destroyed robot and that of the destroyer})$</p> ➢ When the destroyed robot's level is lower than that of the destroyer, the level difference is considered to be 0. The Experience Points are calculated as follows: <p>The Experience Points gained by destroyer = $50 \times \text{the level of the destroyed robot}$</p>

Behavior Type	Experience Points Gained
	<ul style="list-style-type: none"> If the Referee System does not identify a destroyer or if the destroyer is ineligible for experience: The level of the destroyer is considered to be the level corresponding to the average Experience Points of the opponent's alive Hero and Standard Robots. After calculating according to the formula above, the Experience Points are divided equally among the alive Hero and Standard Robots of the other team. The average value of Experience Points is rounded off. If a robot is not alive or the Referee System is unable to detect a destroyer for reasons other than suffering a hit on its Armor Module, it will be deemed that no destroyer has been found. <p>Example 1: When a Level 2 Standard Robot destroys a Level 6 Standard Robot of the opponent, the number of Experience Points gained by the destroyer is $50 * 6 * (1 + (6 - 2) * 0.2) = 540$</p> <p>Example 2: A Level 9 Standard Robot on the red team was defeated without identifying the destroyer. Meanwhile, the blue team has 2 alive Standard Robots with total Experience Points of 1,100 and 4,400 respectively, leading to an average experience of 2,750, which corresponds to Level 6. As a result, the Experience Points acquired by each Standard Robot on the blue team are: $50 * 9 * (1 + (9 - 6) * 0.2) / 2 = 360$.</p>
<p>Activating the Small Power Rune</p>	<p>For details, refer to “5.3.1 Power Rune Mechanism”.</p>
<p>Activating the Large Power Rune</p>	<p>For details, refer to “5.3.1 Power Rune Mechanism”.</p>
<p>Striking the Outpost</p>	<p>For details, refer to “5.4 Outpost-Related Mechanism”.</p>
<p>Dealing sniper damage</p>	<p>For every 1 point of sniper damage dealt, the robot gains 100 Experience Points.</p>
<p>Gaining Launch Ramp buff</p>	<p>The robot gains 300 Experience Points when it gains Launch Ramp buff for the first time.</p>
<p>Hitting the Outpost/Base using a Dart</p>	<p>For details, refer to “5.8.4 Dart-Related Mechanism”.</p>

Table 5-20 Levels and Experience Points of Hero and Standard Robots

Level	Experience Points Required for Leveling Up
1	0
2	550
3	1100
4	1650
5	2200
6	2750
7	3300
8	3850
9	4400
10	5000

When a Balancing Standard Robot gains experience, it receives an additional 50% of the original Experience Points. Robots operating in semi-automatic mode get an additional 100% of the original Experience Points. If a Balancing Standard Robot chooses to operate in semi-automatic mode, it gains an additional 150% of the original Experience Points.



Example: A Balancing Standard Robot, after gaining the Small Power Rune Buff, deals 10 points of damage using 17 mm projectiles on an opposing robot. Consequently, it gains experience calculated as follows: $4 * 10 * (1 + 100\% + 50\%) = 100$.

5.7.2 Performance System

During 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. Once the Seven-Minute Round has begun, the robots' chassis and launching mechanism types, once selected, cannot be changed during the entire round.



- If the chassis or launching mechanism types are not selected, after the start of the Seven-Minute Round, the unselected chassis performance type will be automatically set to “HP-Focused”, and the unselected barrel type will be automatically set to “Cooling-Focused”.

- After a robot is levelled up, its current HP and Barrel Heat Limit will be immediately increased correspondingly.

Table 5-21 Attributes of Hero Robot Chassis

Chassis Type	Level	Maximum HP	Chassis Power Consumption Limit (W)
Power-focused	1	200	70
	2	225	75
	3	250	80
	4	275	85
	5	300	90
	6	325	95
	7	350	100
	8	375	105
	9	400	110
	10	500	120
HP-focused	1	250	55
	2	275	60
	3	300	65
	4	325	70
	5	350	75
	6	375	80
	7	400	85
	8	425	90
	9	450	100

Chassis Type	Level	Maximum HP	Chassis Power Consumption Limit (W)
	10	500	120

Table 5-22 Attributes of Standard Robot Chassis

Chassis Type	Level	Maximum HP	Chassis Power Consumption Limit (W)
Power-focused	1	150	60
	2	175	65
	3	200	70
	4	225	75
	5	250	80
	6	275	85
	7	300	90
	8	325	95
	9	350	100
	10	400	100
HP-focused	1	200	45
	2	225	50
	3	250	55
	4	275	60
	5	300	65
	6	325	70
	7	350	75
	8	375	80

Chassis Type	Level	Maximum HP	Chassis Power Consumption Limit (W)
	9	400	90
	10	400	100

Table 5-23 Attributes of 17 mm Launching Mechanisms

Launching Mechanism Type	Level	Barrel Heat Limit	Barrel Cooling Value per Second
Burst-focused	1	200	10
	2	250	15
	3	300	20
	4	350	25
	5	400	30
	6	450	35
	7	500	40
	8	550	45
	9	600	50
	10	650	60
Cooling-focused	1	50	40
	2	85	45
	3	120	50
	4	155	55
	5	190	60
	6	225	65
	7	260	70
	8	295	75
	9	330	80
	10	400	80

Table 5-24 Attributes of 42 mm Launching Mechanisms

Launching Mechanism Type	Level	Barrel Heat Limit	Barrel Cooling Value per Second
Default	1	200	40
	2	230	48
	3	260	56
	4	290	64
	5	320	72
	6	350	80
	7	380	88
	8	410	96
	9	440	104
	10	500	120

5.8 Robot-Related Mechanism

5.8.1 Engineer Robot-Related Mechanism

An Engineer Robot possesses 50% Defense Buff during the first three minutes of the competition (when the countdown is at 6:59-4:00).

5.8.2 Aerial Robot-Related Mechanism

5.8.2.1 Air support

At the start of the competition, air support is in a cooling state with a cooling period of 170 seconds. After the cooling state expires, 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 35 seconds. Once air support ends, it will return to its cooling period of 170 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. An Aerial can launch projectiles once it is no longer in contact with the Landing Pad. 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 goggles are placed in the Pilot Room.
- Since the safety helmet and headset cannot be worn at the same time, the Pilot needs to take off the headset before wearing the safety helmet before reloading.

5.8.2.2 Attack Deductions

Exceeding the Initial Projectile Speed Limit

If the Referee System detects that the projectile of an Aerial exceeds the Initial Projectile 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 Projectile Speed is V_1 and the Initial Projectile Speed limit is 30 m/s, when the Referee System's Speed Monitor Module detects one 17 mm projectile that its Initial Projectile Speed V_1 exceeds 30 m/s, the Aerial's air support time will be reduced by: $t = 0.5(V_1 - 30)^2$ s. The result is rounded to the nearest whole number.

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: $N = 25 * M$.

5.8.3 Sentry-Related Mechanism

Sentry Robots can exchange for Projectile Allowance, remotely exchange for projectiles and HP, confirm respawn, and exchange instant respawn through coin exchange, all through communicating directly with the Referee System's

server. Concurrently, the Aerial Gimbal Operator can influence the Sentry's actions using specific commands via the player's client of the Referee System. The Aerial Gimbal Operator can execute the following commands:

- Forward the Small Map marker
- Buy Projectile Allowance in the Restoration Zone
- Reload projectiles at the Official Projectile Supplier
- Confirm respawn
- Remotely exchange projectiles
- Remotely exchange for HP
- Instant respawn through remote exchange

For each action performed, the Aerial Gimbal Operator must spend 50 Gold Coins.

At the beginning of the competition, the Sentry Robot has a 60% Defense Buff. It loses the buff when it is defeated for the first time or receives HP recovery of any kind.

5.8.4 Dart-Related Mechanism

In each round, a Dart System 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 System 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 an Outpost is destroyed, the Aerial Gimbal Operator can choose the Dart's target as either the "Fixed Target" or the "Random Target" via the player's client of the Referee System before the Dart Launching Station's gate opens. If "Random Target" is selected, the Dart Detection Module and Dart guiding light will shift together to a random target within set parameters before the gate is fully open, and move back to the initial location when the gate starts closing.

The Dart Detection Module and Dart guiding light maintain their relative locations while moving, staying within the same plane relative to their original location. Their movement extends parallel to the field's width, ranging from -280 mm to 280 mm from their starting point.

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 other team's Outpost, the Fixed Target of the Dart Detection Module, or the Random Target of the Dart Detection Module, the operating interface of all their operators will be obstructed for 5, 10, or 15 seconds. The alive Standard and Hero Robots of the attacking side share 200, 600, or 2,500 Experience Points. Besides, if the Dart hits the Dart Detection Module after selecting "Random Target", the attacked Base will receive an HP damage of 1,200, and 25% of the current maximum HP of all alive Ground Robots will be deducted. The HP deduction will be included in the team's Total Damage, but the attacking robot will not gain Experience Points for the HP deduction and the defeat caused thereby. If the target is hit continuously, the blockage duration for the interface will increase accordingly. Each time the target is hit, the detection window will be closed for 2 seconds.



To ensure detection accuracy, there is a delay in the determination of damage caused by 42 mm projectiles hitting the Dart Detection Module in the detection window.

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

5.8.5 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 0.8 m, the mark shall be deemed "accurate"; if the deviation is equal to or greater than 0.8 m but less than 1.6 m, the mark shall be deemed "half accurate"; if the deviation is equal to or greater than 1.6 m, the mark 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 the marked progress. The specific rules are shown below. Assuming the impact of the previously received coordinates data on a robot's marked progress is "x", and the initial value of x is "0".

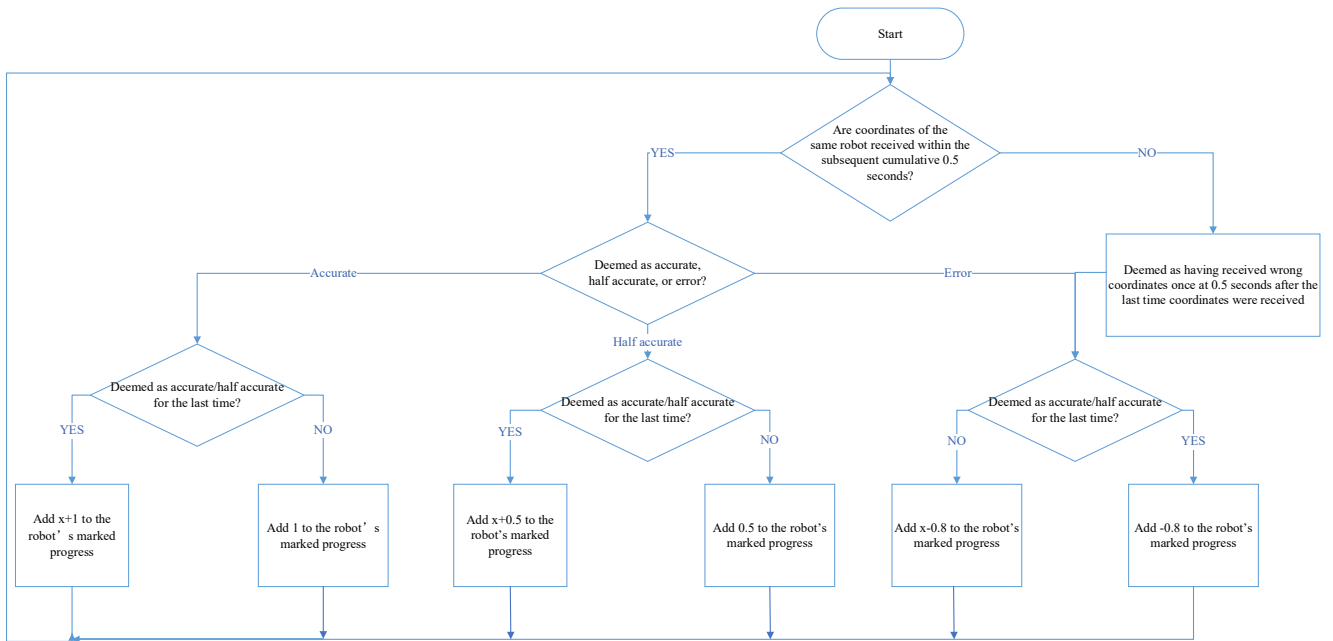


Figure 5-20 Radar Mechanism Logic

Example: If a team’s Radar sends the coordinates of the other team’s Engineer Robot at a frequency of 5 Hz and an accuracy of 100% continuously to the Referee System server, the marked progress of the Engineer Robot within 0 to 1 second at an interval of 0.2 seconds 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 5 Hz and an accuracy of 0% to the Referee System server, the marked progress of the robot within 3.0 to 4.0 seconds at an interval of 0.2 seconds shall be 119.2, 117.6, 115.2, 112, and 108 respectively. Thereafter, if the Radar does not send the Engineer Robot’s coordinates for 1.0 seconds, the marked progress of the robot within 4.0 to 5.0 seconds shall be 103.2 and 97.6 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, the robot’s marked progress shall be 98.6 and 100.6 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. The market robot will receive a -15% Defense Buff. (Hereinafter, the negative Defense Buff is referred to as “vulnerability”.) 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 or have other effects.

If the Radar causes a team’s robot vulnerable for 1 minute (In case of several robots vulnerable at the same time, the duration of the buff will be calculated separately), the Radar will receive a cumulative chance. The Radar can send a command to the Referee System, consume the chance, and turn the -15% Defense Buff of all vulnerable robots into a -30% Defense Buff, which will last for 10 seconds. This effect can be triggered twice at most for each round.



If the wireless environment of the competition site is poor, or a large part of the Positioning System Module is blocked, the coordinates detected by a robot's Positioning System Module may drift intermittently or continuously.

5.9 Operation Method of Robots

Between the Three-Minute Setup Period and the 15-Second Referee System Initialization Period, the operators of the Hero, Engineer, and Standard Robots can select one of the following operation methods of the robots: manual control and semi-automatic control

- A robot in manual control mode is granted the permissions of image transmission and common control. The operator can control the robot in FPV.
- A robot in semi-automatic control mode is not granted the permissions of transmission and common control. During the Seven-Minute Round, the operator cannot control the robot using a remote controller. The operator can see the big map that is similar to the interface of the Aerial Gimbal Operator. The operator can click the big map to send requests to the controlled robot. The interval between two requests cannot be shorter than 3 seconds. Besides, when an Engineer Robot exchanges Nuggets (the system detects the Engineer Robot in the Exchange Station Buff Point and the operator selects the difficulty level and confirms or cancels the exchange), the operator is granted the permissions of image transmission and common control temporarily.



For more information about the operation methods, see [RoboMaster Referee System Serial Port Protocol Appendix](#).

In both control modes, the robot can use the inter-robot communication and receive image information about custom UI. The Experience Points that Hero and Standard Robots in semi-automatic control mode gain are increased by 100%. The Gold Coins that Engineer Robots in semi-automatic control gain by exchanging Nuggets at the Exchange Station are increased by 50%. This increase and the multiplication factor of the Exchange Station are calculated separately.

Example: An Engineer Robot has exchanged Nuggets for over 1,625 Gold Coins. It then exchanges 1 Gold Nugget at Level 5 Difficulty; the quantity of Gold Coins acquired this time is $500 * 2 * 1.5 = 1500$.

5.10 Competition System and Winning Criteria

The official competition of RMUC 2024 consist of two stages: the Group Stage and the Knockout Stage. The Group Stage follows the BO2 or BO3 competition system, while for Knockout Stage it is BO3 or BO5.

Winning criteria for a single round as shown below:

1. When a round has ended and if the Base of either team is destroyed, 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 is the same and the Outposts have been destroyed, the team with the higher Remaining Sentry Defeat Count 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 Defeat Count is the same, the team with the higher Remaining Sentry HP 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, and the Remaining Sentry Defeat Count and Remaining Sentry HP of both teams are the same, the team that has inflicted the greater total attack damage will be the winner.
6. If a round has ended and the Remaining Base HP of both teams is the same, the Outposts have been destroyed, the Remaining Sentry Defeat Count and Remaining Sentry HP of both teams are the same, and the Total Attack Damage dealt by the two teams are the same, the team with the higher Total Robot Remaining HP will 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 and the Remaining Outpost HP are the same, the team that has inflicted the higher Total Attack Damage shall be the winner.
8. 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 Attack Damage inflicted by each team is the same, the team with the higher Total Robot Remaining HP shall be the winner.
9. If neither team fulfills these criteria, the round shall be considered a draw. In BO3 and BO5 rounds, any draw will result in an immediate tie-breaker round, until a winner emerges.

6. Competition Process

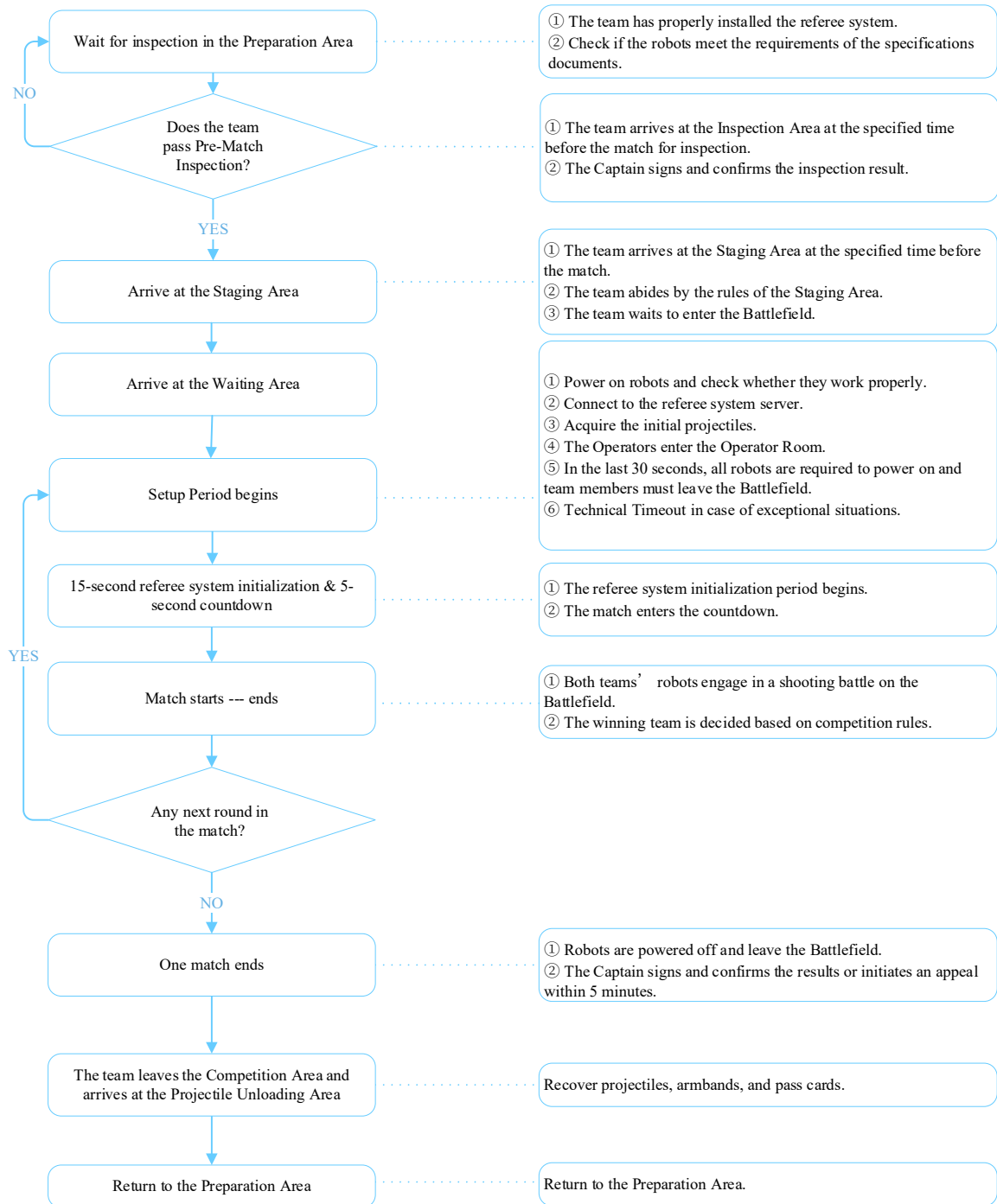


Figure 6-1 Process for A Single Match

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 applicable to the current match.
- Passing of inspection only means that the robot meets the specifications at the time of inspection. Teams are required to ensure that their robots fulfill the requirements of the Building Specifications Manual at all times.



To ensure that robots meet the requirements of the [RoboMaster 2024 University Series Robot Building Specifications Manual](#), each team must undergo Pre-match Inspection in the Inspection Area 90 minutes before the start of each match. The inspection process is as follows:

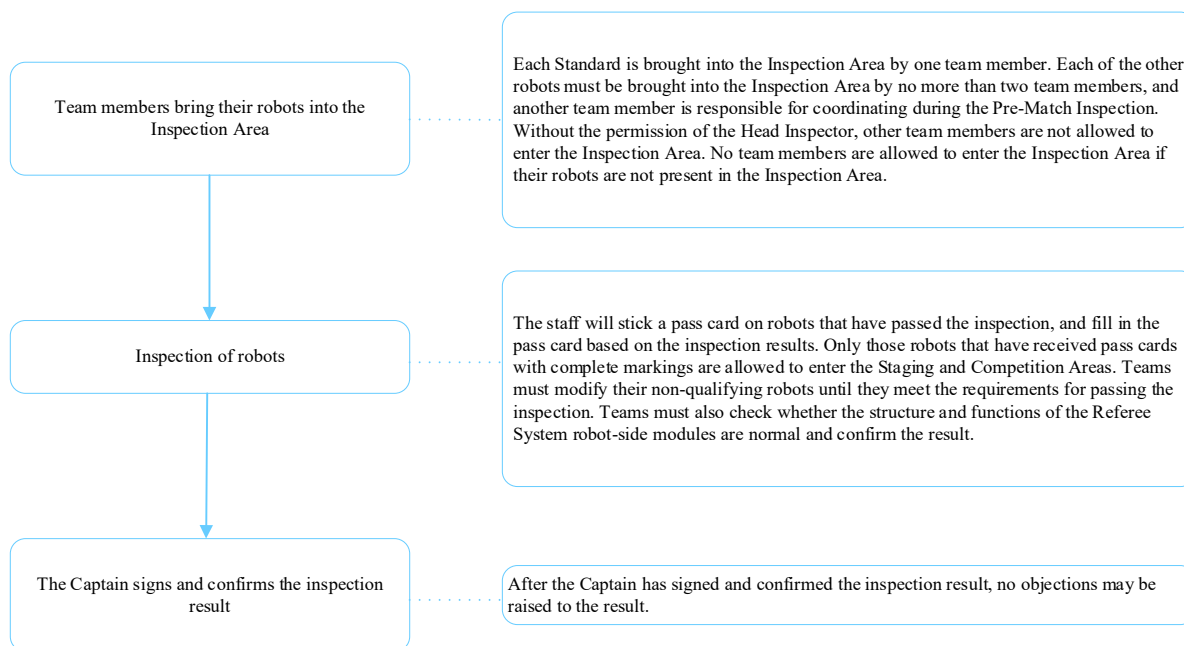


Figure 6-2 Pre-match Inspection Process

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 each BO2 and BO3 match, while a maximum of eight backup Darts are allowed in each BO5 match.
- 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 2024 University Series Robot Building Specifications Manual](#).

- Teams can borrow the Referee Systems for no more than two backup robots.

6.2 Staging

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 Crew, and issue armbands. Each team is allowed to have a maximum of 20 Pit Crew, which must include one Supervisor and up to 19 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 referee. 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’s duties include managing the team’s competition process, confirming results, and raising appeals.


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. The referee will follow the competition process, 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 10 minutes to debug their robots. When 10 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 in their respective initialization areas, check whether the Referee System is operating normally, pre-load their robots with initial projectiles, load Darts into the Dart System, and mount the Radar on the Radar Foundation. Pit Crew may repair robots or replace equivalent parts, provided the requirements of the specifications documents are met. Pit Crew are required to commission their robots near their team’s Starting Zone. Only one Pit Crew Member of each team is allowed to leave the Starting Zone 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.
-  If the equivalent part includes the Referee System Module, the participating team must ensure that the Referee System's robot-side modules work properly, including version number, sensor calibration, and mounting specifications. When the Referee System robot-side modules in the equivalent part experience an abnormality, all consequences arising therefrom will be borne by the participating team and it will not trigger an Official Technical Timeout.

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 (both can be brought on your own), and double-check whether the robot controls and official equipment are operating properly. If any official equipment in the Operator Room cannot operate normally, the Pit Crew members 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 and Aerial Gimbal Operators for the deployed robots, is allowed to enter the Operator Room. The Tactical Coach may enter the Operator Room to make tactical deployments. Personnel other than operators mentioned above 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, radars, and semi-autonomous robots 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, Pit Crew can only eliminate the relevant faults of the Referee System or other official equipment according to the requirements of the referee, and are not allowed to repair other faults. When the relevant fault of the Referee System or official equipment has been eliminated and the Head Referee has resumed the countdown, Pit Crew 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

Rule	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 Referee System’s robot-side modules experience faults, such as damage to 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’s modules, 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. Participating teams may request 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 Pit Crew may make a request to the referee in the Battlefield or Operator Room for “Team Technical Timeout” only before the 15-second countdown in the Three-minute Setup Period, where they should also provide the 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	2 Technical Timeouts for 2 minutes each
Knockout Stage	1 Technical Timeout for 3 minutes; Technical Timeout opportunities not used in the Group Stage can be carried over to the Knockout Stage

6.4 15-Second Referee System Initialization Period

After the Three-Minute Setup Period, the match enters a 15-Second Referee System Initialization Period, during which the competition server will automatically detect the connection status of the player's client, the Referee System robot-side modules' statuses, the status of Battlefield Components and reset the HP of all robots, ensuring their HP are full when the match officially begins.

6.5 5-Second Countdown

After the 15-Second Referee System Initialization Period, the match enters a 5-Second Countdown. At this time, the player's client will not respond to control commands from robots (including custom controllers). Once the countdown finishes, the keyboard is unlocked and the competition starts.

6.6 Seven-Minute Round

During the Seven-Minute Round, robots from both teams will engage in a shooting battle on the Battlefield.

6.7 End of Round

When the time of one round of competition runs out or one team triggers the winning criteria in advance, this round of competition ends. For more information about the winning criteria, see "5.10 Competition System and Winning Criteria". The match is over when a winner has emerged or all rounds have ended.

6.8 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 agrees with the match results.

6.9 Projectile Unloading

After a match is over, members from both teams must power off all their robots, remove them from the Battlefield, and proceed to the Projectile Unloading Area to unload their projectiles. At the Projectile Unloading Area, teams must follow the instructions of the staff and return all armbands and pass cards, empty the projectiles in their robots, and return all projectiles used in the competition.

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 violation 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.



If a team’s actions have directly caused the other team to commit a violation, the other team shall not be deemed in violation but it must cease its violating behavior immediately.

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 limits or a Referee System going offline. 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 referee penalties	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

The types of penalties are 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"> ➤ If the offending robot is a Sentry, its chassis will be powered off for 2 seconds while the operating interface of other alive robots will be obstructed for 2 seconds. ➤ If the offending robot is not a Sentry, the operating interface for the offending robot is blocked for 5 seconds and those for other robots are blocked for 2 seconds. ➤ The Referee System will automatically deduct the offending robot’s HP by 15% of its current Maximum HP, while the remaining alive robots will have their HP deducted by 5% of their current Maximum HP. If the robot receives a Yellow Card again within 30 seconds after it receives a Yellow Card, the percentage of their current Maximum HP deducted will be twice that of the previous deduction for that robot, and 5% for the other alive robots on the team. <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. If the offending robot receives one Yellow Card at the 15th, 25th, and 58th second of the competition respectively, the HP deduction caused by each of the Yellow Cards should 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. If the offending robot receives one Yellow Card at the 15th, 25th, and 50th second of the competition respectively, the HP deduction caused by each of the Yellow Cards should be as follows: the offending robot’s HP is deducted by 30, 60, and 120 respectively; the deducted HP for the other robots are 5, 5 and 5.</p> ➤ In each round, a robot that has been issued a cumulative four Yellow Card Warnings will receive a Red Card Warning. <ul style="list-style-type: none"> ● Both teams receive a Yellow Card: <p>The interface of all operators is blocked for two seconds and the HP of all robots is deducted by 5% of their Maximum HP, without taking into account the cumulative number of Yellow Card Warnings received.</p>

Types of penalties	Descriptions
	<ul style="list-style-type: none"> ● If a robot receives successive Yellow Card Warnings, the time that the operation interface is blocked will add up accordingly. The 30-second period 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.
<p>Red Card (Ejection)</p>	<ul style="list-style-type: none"> ● Ejection of robots <ul style="list-style-type: none"> ➤ If a robot is ejected before entering the 15-Second Referee System Initialization Period, the offending robot will not be allowed to enter and must be removed from the Battlefield, nor can it be replaced by other robots in any round of the current match. ➤ If a robot is ejected during the 15-Second Referee System Initialization Period, the Red Card Warning should 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 Aerial 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 Radar is ejected during the competition, the robot's HP will become zero and the transmitted images will become monochrome. ➤ If a Sentry Robot is ejected during the competition, its remaining defeat count will become zero. ● Ejection of Pit Crew: Pit Crew members ejected by a referee must leave the Competition Area immediately and cannot be replaced by other Pit Crew 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, nor can they be replaced by other robots for all rounds in the current match. If an Aerial Gimbal

Types of penalties	Descriptions
	<p>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>
<p>Forfeiture</p>	<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 Seven-Minute Round, including the Three-Minute Setup Period and 15-Second Referee System Initialization Period, the HP of the offending team’s Base, Outpost, and Sentry will become zero, the Remaining Sentry Defeat Count will become zero, and the HP of the team's other robots will remain full. The HP of the opposing team’s Base, Outpost, and robots remain full. ➤ If a Forfeiture is issued during the Seven-Minute Round, the round will end immediately. The HP of the offending team’s Base, Outpost, and Sentry will become zero, the Remaining Sentry Defeat Count will become zero, and the team's other robots will 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 ends. ➤ If a Forfeiture is issued after the Seven-Minute Round, the HP of the offending team’s Base, Outpost and Sentry will become zero, the team’s Sentry will maintain its HP level and remaining defeat count at the end of the round, and the team's other robots will 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 ends. ● If a Forfeiture is issued for a match (hereinafter referred to as “Match Forfeiture”), it applies to all rounds in the match, and the HP for each round should be calculated according to the above descriptions.
<p>Exclusion from Awards</p>	<ul style="list-style-type: none"> ● Participants are excluded from awards. ● Participating teams are excluded from awards.
<p>Disqualification</p>	<ul style="list-style-type: none"> ● Participants are disqualified from the competition and excluded from awards. ● The team is disqualified from the competition and excluded from the awards, but its results so far in this season will be maintained as a basis for other teams’ advancement.

7.2 Penalty Rules

This chapter specifies the violation 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 Participating teams are required to meet the requirements in the [RoboMaster 2024 University Championship Participant Manual](#).

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

R2 Participants and their actions must not interfere with the normal operation of the Official Equipment, competition processes, and the normal work of the RMOC personnel.

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

R3 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 to the Preparation Area, Inspection Area, Staging Area and Competition Area).

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

R4 Teams must not damage any official equipment (including but not limited to equipment in the Competition Area, Staging Area, Preparation Area and Inspection Area).

Penalty: The highest penalty that can be imposed on the offending team is disqualification and compensation as per the price.

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

Penalty: The highest penalty that can be imposed on the offender is disqualification.

R6 Any Pit Crew member who has entered the Staging Area and Competition Area for competition needs may not leave either area or be replaced by another Pit Crew member without the permission of the referee.

Penalty: Offenders are not allowed to enter the Staging Area and Competition Area. The highest penalty that can be imposed is disqualification.

R7 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.

Penalty: Projectiles are confiscated, with the highest penalty being the disqualification of the offender from the competition.

R8 After a match is over, the Pit Crew must power off all their robots, remove them from the competition area and empty all projectiles inside the robots at the Projectile Unloading Area.

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

R9 After a match is over, Pit Crew must return all projectiles used in the competition to the Projectile Unloading Area.

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

R10 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.

Penalty: The highest penalty is a Match Forfeiture.

R11 Without the permission of the referee, a team may not power on and commission or repair a robot in areas outside the Battlefield from the time the robot passes an Inspection to the end of a match.

Penalty: The highest penalty is a Match Forfeiture.

R12 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.

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

R13 Pit Crew must wear armbands which must not be covered. One member must wear the “Captain” armband.

Penalty: The highest penalty that can be imposed on the offender is disqualification.

R14 Without the permission of the referee, Pit Crew entering the Competition Area must not communicate with anyone from the outside.

Penalty: The highest penalty that can be imposed on the offender is disqualification.

R15 Except for the Radar, the Pit Crew 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.

Penalty: The highest penalty that can be imposed on the offender is disqualification.

R16 Except for special circumstances, Pit Crew are prohibited from wearing slippers into the Competition Area.

Penalty: The highest penalty that can be imposed on the offender is a Red Card.

7.2.1.2 Battlefield Specifications

R17 Pit Crew must wear protective goggles when inside the Battlefield.

Penalty: The offender is barred from the battlefield.

R18 During an Official Technical Timeout, Pit Crew are not allowed to fix faults other than those in modules related to the Referee System.

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

R19 After the end of the Three-Minute Setup Period, Pit Crew must return to the designated area outside the Battlefield. During the competition, Pit Crew are not allowed to leave the area without the permission of the referee.

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

R20 After the Three-Minute Setup Period, the Commissioning Remote Controllers for the Sentry Robots, radars, and semi-autonomous robots must be placed in the designated location at the Battlefield entrance, while the Remote Controllers for other robots must be placed in the designated location in the Operator Room or at the Battlefield entrance.

Penalty: If it is before the Seven-Minute Round, a Verbal Warning shall be issued. If the Verbal Warning is ineffective, a Red Card shall be issued against the offending robot; if it is during the Seven-Minute Round, a Red Card shall be issued against the offending robot.

R21 After the Five-Second Countdown, the Pit Crew must not operate remote controllers located outside the Operator Room that correspond to deployed robots.

Penalty: A Red Card shall be issued against the offending robot, with the highest penalty being a Round Forfeiture.

R22 Pit Crew must ensure their robots are operating safely and will not cause harm to any person or equipment in the Competition Area.

Penalty: The offending team must bear the relevant responsibility.

7.2.1.3 Operator Room Requirements

R23 During the Three-Minute Setup Period, only one person, in addition to the operators and Aerial Gimbal Operators for the deployed robots, is allowed to enter the Operator Room. Personnel other than the operators mentioned above must leave the Operator Room before the Three-Minute Setup Period ends.

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

R24 Operators must remain in the relevant Operator Room during the 15-Second Referee System Initialization Period and the Seven-Minute Round to operate the relevant control equipment, wear the corresponding headphones, and must remain in its location after the Three-Minute Setup Period, unless otherwise permitted by the referee.

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

R25 During the Seven-Minute Round, Aerial Gimbal Operators may use Gimbal Remote Controllers, custom controllers for Aerial Robots, and remote controllers for Darts at the same time, while a Pilot may use only one remote controller. Besides, each operator must configure a control device according to the requirements for the robot's control method.

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

R26 Operators are not allowed to use their own headphones or computers in the Operator Room.

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

R27 During the competition, communication with those outside the Operator Room is forbidden.

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

R28 A Pilot can operate an Aerial Robot only after obtaining the Pilot qualification.

Penalty: The team is issued a Round Forfeiture and the offender is disqualified.

R29 During the competition, a Pilot must not repair an Aerial Robot while reloading its projectiles.

Penalty: The highest penalty is a Red Card warning against the Aerial Robot.

R30 During the competition, a Pilot must meet the attire, location, and reloading time requirements when reloading projectiles for an Aerial Robot.

Penalty: 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

R31 Robots and custom controllers to be deployed in a match must pass a Pre-Match Inspection.

Penalty: Round Forfeiture.

R32 In the first round of a match, the robots must meet the minimum battle team lineup.

Penalty: Match Forfeiture.

R33 Robots must meet the requirements in the [RoboMaster 2024 University Series Robot Building Specifications Manual](#).

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



- 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.
-

R34 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.

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

R35 Before the 15-Second Referee System Initialization Period, armor stickers that meet the requirements in the specifications documents must be attached to robots.

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

R36 When waiting in the Staging Area, team members are not allowed to bring robots out of the Staging Area without permission.

Penalty: Verbal warning. If the warning is ineffective, the offenders and robots will be issued a Red Card, with the highest penalty being disqualification from the competition.

R37 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.

Penalty: 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 offender or the offending 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 land the robot and stop its propeller, and is no longer allowed to operate the robot.

R38 Robots are not allowed to fire projectiles out of the Battlefield.

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

R39 Dart Systems are not allowed to fire Darts out of the Battlefield.

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

R40 During the Three-Minute Setup Period and the 15-Second Referee System Initialization Period, robots in the Battlefield are not allowed to leave their corresponding initialization zones.

Penalty: The offending robot can be issued a Red Card as the highest penalty.

R41 If any projectile needs to be fired during the Three-minute Setup Period, it must be launched into the projectile clearance bag.

Penalty: The offending robot can be issued a Red Card as the highest penalty.

R42 During the Three-Minute Setup Period, the replacement modules or parts used on robots must meet the requirements for equivalent parts.

Penalty: The offending robot can be issued a Red Card as the highest penalty.

7.2.2.2 Ground Robot

R43 During the competition, no alive robot is allowed to block any of its Armor Modules with its body. No robot is allowed to block more than one Armor Module on any other alive robot in its team. When an Engineer Robot is grabbing or carrying a Mobile Component, any one of its armors is allowed to be blocked by the carried Mobile 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 a Mobile Component.
- If the obstructed Armor Modules are offline, the robot shall not be deemed in violation.

Penalty: Verbal Warning. If the Verbal Warning is ineffective, the duration of the violation is timed. If the duration of the violation 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 not alive.

R44 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 when not alive.

- In the Supplier Zone and the Tunnel, a Balancing Standard Robot is not required to meet the definition of a Balancing Standard Robot.
- If the Balancing Standard Robot has an abnormal posture and obviously does not have the ability to move autonomously, it will not be considered a violation. The matter of fact will be determined by the Head Referee.

Penalty: Warnings should 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 not alive.

7.2.2.3 Aerial Robot

R45 During the Three-Minute Setup Period, the Pit Crew may debug the Aerial Robot near the Landing Pad, but must not start the propeller.

Penalty: The offender and the offending robot can be issued a Red Card as the highest penalty.

R46 The hook of the Aerial Safety Rope must be attached to the rigid ring of the Aerial Robot’s vertical rigid safety rod.

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

R47 During the competition, the distance between the lowest point of an Aerial Robot and the Battlefield ground must not be less than 1.5 m, and no part of the Speed Monitor Module (17mm Projectile) carried by the Aerial Robot’s gimbal Launching Mechanism can exceed the highest point of the perimeter wall of the Flight Zone.

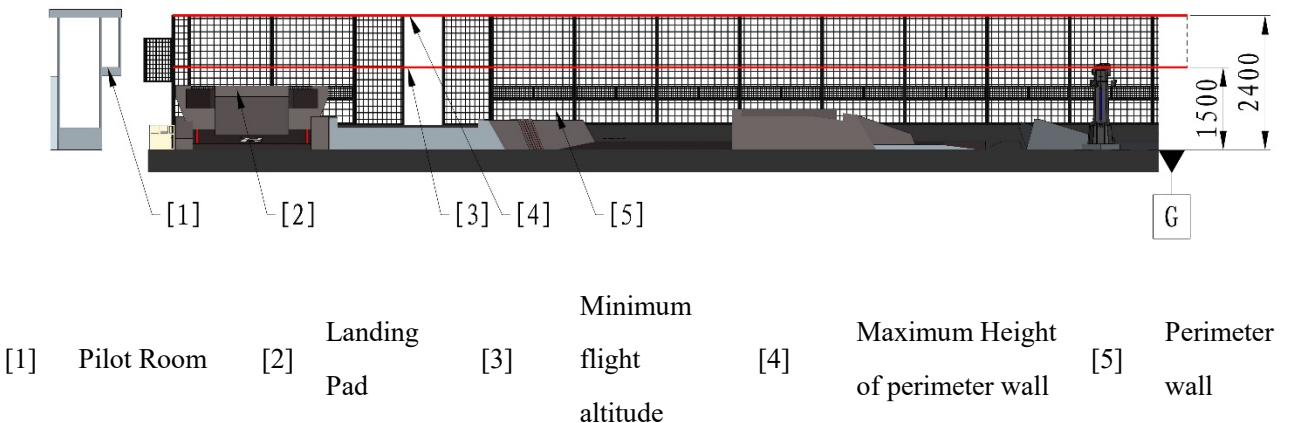


Figure 7-1 Schematic of Flight Altitude Limit

Penalty: 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.

R48 During the competition, Aerial Robots are forbidden from flying outside the Battlefield.

Penalty: 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.

R49 During the competition, Aerial Robots are prohibited from launching projectiles while in contact with the Landing Pad.

Penalty: The offending robot can be issued a Red Card as the highest penalty.

R50 If an Aerial experiences technical faults, or is damaged due to the unreasonable design of the propulsion 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.

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



If an Aerial Robot crashes in the Battlefield, the referee may, depending on the situation, retrieve the robot to the Landing Pad and any consequences arising from the retrieval process shall be borne by the participating team. If the robot has suffered severe structural damage, the Aerial Safety Rope hook has fallen off, or the competition is about to end, the referee may not retrieve the robot.

7.2.2.4 Other robots

R51 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 component used for providing initial kinetic energy for Darts is in a tense, inflated, and rotating state. Energy storage component includes but is not limited to rubber band, cylinder, friction wheel, etc.

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

7.2.3 Interactions

7.2.3.1 Interaction between Robots

R52 A robot may not use any of its body structures to strike an opponent robot in collision. If a defeated robot is blocking a key path, the robot can be slowly pushed away.

-
- In any collision between an Aerial and a Ground Robot while the Aerial Robot is flying, the Aerial Robot will be deemed the offending robot.
 - In any collision between an Aerial and a Ground Robot after the Aerial Robot has landed on the Battlefield or while it is being retrieved, the Ground 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.
-

Penalty: 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	<ul style="list-style-type: none"> ● Actively causing frontal and high-speed collision ● Active pushing that causes the other team’s robot to move noticeably ● Active pushing that impedes the normal movement of the other team’s robot
Red Card	<ul style="list-style-type: none"> ● Actively causing high-speed, repeated and intense frontal collision ● Active pushing that causes the other team’s robot to move for a longer distance ● Active pushing that seriously impedes the normal movement of the other team’s robot

If any collision has caused serious consequences to the other team’s robot or rendered the competition unfair, in the next round of the same competition stage, the offending robot (based on the robot numbering) will be barred from the Battlefield and cannot be substituted by another robot.

R53 A robot must not get entangled with any other robot (except for robots that cannot be respawned) due to active interference, blocking, or collision.

Penalty: Counting from when an entanglement is determined, warnings should 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 should carry on until the offending robot is ejected.

Regardless of whether the offending robot is alive, if the violation goes on for longer than 90 seconds, the offending team may be issued a Round Forfeiture, as judged based on their subjective intention.

R54 No robot may attack the Aerial Robot, Dart Launcher and Radar of the opposing team.

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

R55 A robot must not use any means other than firing projectiles to interfere with an opponent robot's projectile reload, HP recovery, or respawn in any area.

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

R56 No robot and its actions are allowed to block an opponent robot's entry into its Supplier Zone, Exchange Zone, or Power Rune Activation Point.

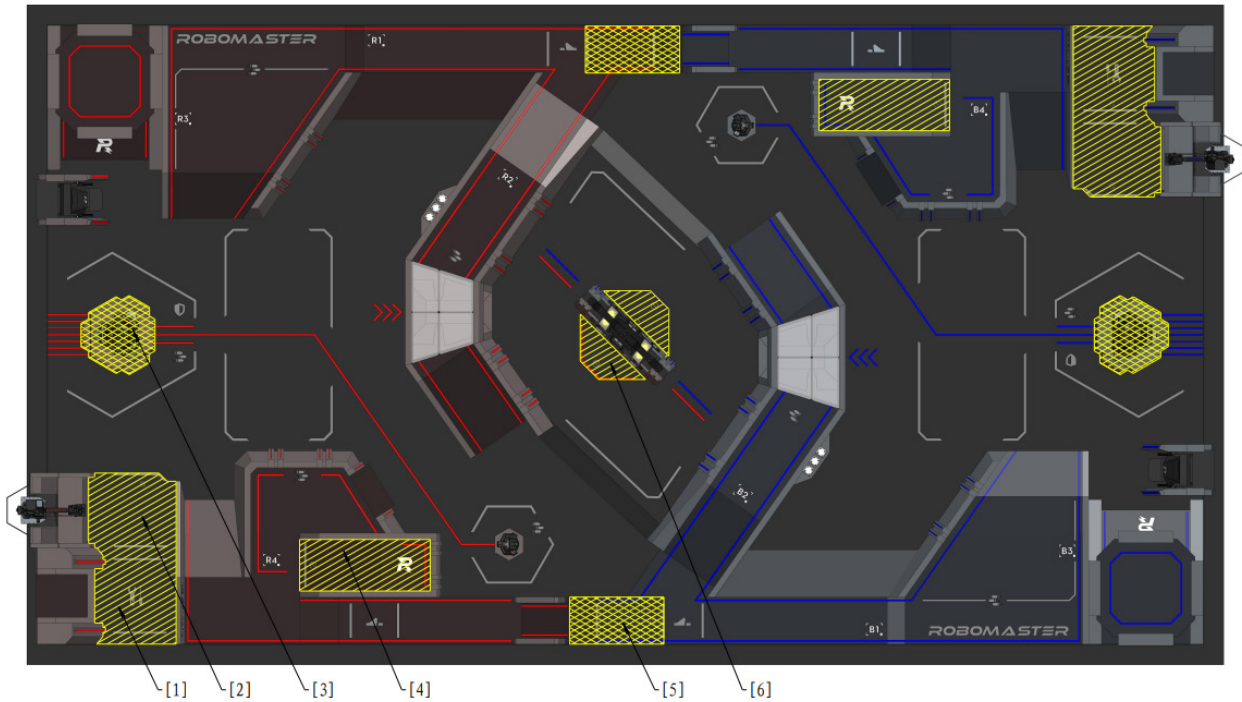
Penalty: The offending robot will be issued a Yellow Card. If the Verbal Warning is ineffective, the offending robot will be issued a Red Card.

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

Penalty: According to the subjective intention and the degree of movement, a maximum of four Yellow Cards shall be issued to the offending robot.

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 range of 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 7-2 Battlefield 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 Resource Island Penalty Zone is active in the first minute of each round; at other times, it is expired.

- The Engineer Robots of both teams are not allowed to be on 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 on 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 on one side of the Resource Island Penalty Zone, they must exit once the Engineer of the other team later enters the same side.

Penalty: An offending robot that remains in the Penalty Zone for longer than 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.

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- A robot is not deemed in violation if it has entered and is unable to leave the Road Penalty Zone due to a failed attempt at the Launch Ramp.
 -  ● A robot is not deemed in violation if it is unable to leave the Road Penalty Zone from a Launch Ramp Buff Point after a failed attempt at the Launch Ramp, because the other team's robot is also on the Buff Point.
-

Penalty: 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 offending robot is ejected. An offending robot that causes serious damage to an opponent 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.

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

R61 Robots are not allowed to bring Mobile 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.

Penalty: A Yellow Card will be issued against the offending robot. If any subsequent Mobile 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 Core Component, the offending robot will be issued a Red Card.

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

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

R63 During the competition, robots are not allowed to destroy nor affect the normal function of the Battlefield Components.

Penalty: The highest penalty is a Match Forfeiture.

R64 Any robot is not allowed to hit the Power Rune using 42 mm projectiles.

Penalty: The offending robot can be issued a Red Card as the highest penalty.

7.3 Serious Violations

The following actions are considered serious violations of rules. The highest penalty the RMOC may impose on an offending team for serious violations is disqualification. In the event of any violation of local laws and regulations, the RMOC will fully cooperate with the relevant authorities in pursuing appropriate legal action against the offender.

Table 7-4 Categories of Serious Violations

Rule	Type
1.	Malicious destruction of the Battlefield, Battlefield Components, other official equipment, or the drones or equipment of other teams.
2.	Falsification, assumption of a false identity, or any other behavior determined as cheating.
3.	Tampering with or damaging the referee system, or interfering with any detecting function of the referee system through technical means.
4.	Circumstances that violate the specifications documents and determined by the Chief Referee as serious violations.
5.	Disobedience over penalties, refusal to cooperate, deliberate delay, disrupting the competition, forfeiting without valid reasons, boycotting, or other behavior that hinders the competition.
6.	Match throwing or manipulation.
7.	Providing property to others or illegally soliciting or accepting property from others for the purpose of obtaining an unjust competition outcome or improper benefits.
8.	Uncivilized and immoral conduct involving defamation, verbal abuse, rude gestures, malicious heckling, or malicious throwing of objects.
9.	Publishing, spreading or disseminating to the media false or irresponsible remarks.
10.	Deliberately attacking or colliding with others in a manner that endangers themselves or others.

Rule	Type
11.	Carrying hazardous items or contraband.
12.	Other behavior that violates the spirit of the competition and is deemed a serious violation.
13.	Other conduct that violates core socialist values, sports ethics, public order and norms, the culture and discipline of the competition, laws and regulations, or that causes an adverse impact on society.

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 irregularities occur, 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, such as a battery explosion, Aerial breaking an Aerial Safety Rope, stadium power outage, explosion of a compressed gas cylinder, or interpersonal conflict, the Head Referee will notify both teams' operators after discovering and confirming the emergency, and eject all robots through the Referee System. The result of the round will be invalidated. The round will restart after the safety hazard or exception has been eliminated. While handling an irregular situation, the RMOC will prioritize safety issues and any consequences arising from the handling process shall be borne by the participating teams.
- If non-key Battlefield Components are damaged during a match (damage to the PVC flooring, the light indicators on the competition area, or the light effects on the Base), 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 indicator effects or any damage to an Armor Module Sticker.
- If functional irregularities or structural damage occur to key official equipment and Battlefield Components during the competition, thus rendering it unfair, for example, where the network connections are disrupted, causing a robot to go offline, no buff effect is triggered 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 key official equipment and Battlefield Components experience functional irregularities or structural damage that affects the fairness of the competition, 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 Head Referee has made a determination to that effect within 5 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 Head 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. The handling outcome is final and cannot be challenged by both teams.

9. Appeal

Every team has one appeal opportunity during each of the Regional Competition, Wild Card Competition, 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. After the appeal is accepted, the Arbitration Commission will deliberate on the appeal materials and relevant evidence. On behalf of the Arbitration Commission, the Chief Referee will then communicate and confirm the appeal decision. The Arbitration Commission reserves the final right of interpretation with regard to its appeal decisions.

The following situations do not constitute a basis for appeal:

- Verbal Warnings and Yellow and Red Cards issued as penalties for violations.
- The types and processes of Technical Timeouts initiated.
- “Regular battle damage” occurred at the Referee System’ robot-side modules.

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

9.1 Appeal Process

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



Figure 9-1 Appeal Process

9.2 Appeal Materials

The appeal materials submitted by the participating teams cannot exceed 500 MB in size for each file. The number of files cannot exceed 10.

9.3 Appeal Decision

Appeal decisions include: maintaining the original match results, a forfeiture against the respondent, and rematch between both teams. After the Arbitration Commission confirms the appeal decision, neither team is allowed to challenge it.



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

If the communicated appeal decision is a rematch between both teams, but neither team is willing to accept a rematch, the appeal shall be deemed as failed and the original match results will be maintained.



- 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, depending on the actual situation.
 - The flow of the rematch shall be the same as the regular matches. Both teams are required to compete according to the time stipulated by the RMOC and the relevant rules.
-

Appendix 1 References

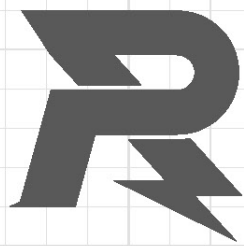
This chapter provides relevant reference materials for RMUC.

Appendix Table 1 Overview of Reference Materials

Category	Download Links and Documents List
<p>Specifications Manuals</p>	<p>Download address : https://www.robomaster.com/en-US/resource/pages/announcement/1658</p> <ul style="list-style-type: none"> ● Rules Manual ● Participant Manual ● Robot Building Specifications Manual
<p>Referee System related</p>	<p>Download address: (click “Download related documents” on the webpage) https://www.robomaster.com/en-US/products/components/referee</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
<p>RoboMaster Champion related</p>	<p>Download address : https://www.robomaster.com/en-US/products/components/referee</p> <ul style="list-style-type: none"> ● Player’s Client Interface Instructions ● Referee’s Client Interface Instructions

Appendix 2 Plans for Future Rules

Rules for the 2025 RoboMaster season and plans for future rules will be updated in version 2.0 of this document.



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