

V2.0

Using a 33-bit motor driver chip and Field-Oriented Control (FOC), the RoboMaster G200 Brushless DC Motor Speed Controller enables precise control over motor torque.



Customized designed for the RoboMaster G200 G200 P19 Brushless DC Motor and G200 Brushless DC Motor Speed Controller, this M3000 Assembly Kit includes an ABS sensor and a terminal board.

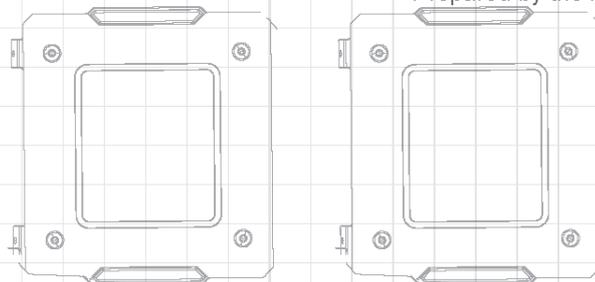
RoboMaster System Specification Manual, RoboMaster User Manual, Introduction of RoboMaster System Kit etc.

The M3000 Assembly Kit includes several cables and a terminal board, ensuring a complete production system when they are interconnected.

ROBOMASTER 2022 UNIVERSITY CHAMPIONSHIP

RULES MANUAL

Prepared by the RoboMaster Organizing Committee
Updated on August 2022



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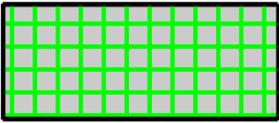
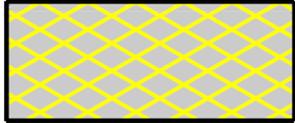
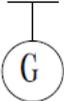
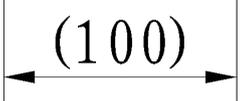
For suggestions on open source materials, please refer to: <https://bbs.robomaster.com/thread-7026-1-1.html>.

Using this Manual

Legend

 Prohibition	 Important notes	 Hints and tips	 Definitions and references
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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

Change Log

Date	Version	Release Notes
2022.08.16	V2.0	<ol style="list-style-type: none"> 1. Changed the Ground Rubber for the Red and Blue Battlefields to orange and green lighting effects respectively, and altered relevant drawings throughout the document 2. Adjusted the scope of Supplier Penalty Zone 3. Altered the Exchange Station and its exchange mechanism, and added an Exchange Penalty Zone 4. Adjusted the Initial Position of the Obstacle 5. Revised the size and quality parameters for projectiles 6. Added descriptions of the damage value inflicted on the Base, the Triangular Armor Module of the Outpost, and the Dart Detection Module by collision 7. Adjusted the Gold Coin exchange ratio for Air Support 8. Adjusted the conditions for the Rotating Armor of the Outpost to stop rotating, and added a relevant Gold Coin Reward Mechanism 9. Adjusted the value magnitude of the Experience System and the Experience Points required for a Hero's Level Up 10. Adjusted the light effects for some Battlefield Components 11. Added descriptions of the starting time of the Official Technical Timeout 12. Revised some penalty rules and details for violations 13. Revised the "Serious Violations" section 14. Revised the "Irregularities" section 15. Revised the Appeal Process 16. Added definitions of a successful appeal and failed appeal
2022.05.18	V1.3	<ol style="list-style-type: none"> 1. Adjusted the Standard Robot serial number 2. Added descriptions of the brightness of the Dart Guiding Light 3. Adjusted the usage arrangements for projectiles 4. Added descriptions of the Invincible status of robots 5. Removed the restriction that a robot cannot reconnect to the competition once it has been in the Irregular Offline Status for more than 30 seconds 6. Optimized the relevant descriptions of the 42mm Projectile Allowance Redemption Mechanism

		<ol style="list-style-type: none"> 7. Supplementary notes: The Elevated Ground Buff Point and the Hero's Sniper Point are not related to one another, and the Hero's Sniper Point can only be occupied by its own side. 8. Revised the conditions for HP recovery by Engineer Robots 9. Optimized the descriptions of the Winning Criteria 10. Supplementary notes: If multiple Yellow Cards are received successively, the blockage time for the operation interface will add up accordingly. 11. Added definitions of "carry" and "entanglement" 12. Supplementary notes: Only the Operators and Tactical Coach for the robots on the Battlefield are allowed in the Operator Room.
<p>2022.03.29</p>	<p>V1.2</p>	<ol style="list-style-type: none"> 1. Adjusted the footnotes for the Basic Robot Information 2. Updated the following drawings: Dimensions of the Base Protective Armor When Closed, The Radar Base, Relative Position of the Base Radar, The Exchange Station, and The Outpost. 3. Altered the dimensions of the Radar Base 4. Added descriptions of the Aerial Safety Rope indicator 5. Adjusted the HP Deduction Mechanism for collision damage 6. Added descriptions of the relationship between the Initial Gold Coin and Technical Proposal 7. Added descriptions of the reset of the Rotating Armor when it stops rotating 8. Added descriptions of the lighting effects when the Base and Outpost is in the Invincible status and the Base's Virtual Shield is activated 9. Added descriptions of the Mobile 17mm Launching Mechanism of Aerial Robots 10. Added descriptions of situations where an Engineer Rescue Card may not be able to be detected at a Buff Point 11. Adjusted the duration for the opening of the Dart Launching Station's gate 12. Added penalties for the placement of the Commissioning Remote Controller and carrying of the Engineer Rescue Card
<p>2022.01.11</p>	<p>V1.1</p>	<ol style="list-style-type: none"> 1. Adjusted competition criteria for RoboMaster Robot Self-Assembled Version Type A and RoboMaster AI Robot 2020 Standard Version 2. Removed rotating elevator 3. Adjusted positions of Obstacle Blocks 4. Updated drawings of Battlefield Components

		<ol style="list-style-type: none"> 5. Adjusted Outpost Mechanism 6. Adjusted the Rotation Strategy for the Power Rune 7. Adjusted the sources of impact on the initial economy 8. Removed gold coin compensation when Base Armor is open 9. Updated some penalty rules
2021.10.15	V1.0	First Release

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1. Introduction of Competition

The RoboMaster 2022 University Championship (RMUC 2022) takes the form of shooting battles between robots, in which two teams attack each other's base by launching projectiles in 7 minutes. Participating teams are required to design, develop and create multiple robots in compliance with specifications to form a battle team.

During the competition, the RMOC may modify the competition rules at the following stages, but will not cause any change in the structures of participating teams' robots.



- During Regional Competitions: after the end of the competition for a single division.
- During the Final Tournament: after the end of a competition phase (e.g., Group Stage, top-16 matches, etc.).

1.1 Overview of Competition Process

All robots entering the stage must first pass the Pre-match Inspection to ensure they meet the technical specifications set by the RMOC for the fairness of the competition. After completing the Inspection, team members need to go to the Staging Area with their robots and wait to enter the Competition Area for the match.

Before the start of each match, all teams must be guided by staff to enter the Competition Area from the Staging Area. Each round consists of a Three-Minute Setup Period and a Seven-Minute Round. Between the two periods, there is a 20-Second Referee System Initialization Period.

By the end of each match, teams must clean up projectiles left in the magazine and Launching Mechanism of each robot, return them to the designated area and leave the Competition Area. For details on the Competition Process, please refer to "4 Competition Process".

1.2 Robot and Operator

RoboMaster requires robots to fight together as a team with good coordination and teamwork. For details on the robot building specifications, please refer to the "[RoboMaster 2022 University Series Robot Building Specifications Manual](#)".

1.2.1 Robot Lineup

The robot lineup for the RMUC 2022 is as follows:

Table 1-1 Line-up of Robots

Type	No.	Full Lineup (Units)	Competition Stage
Hero Robot	1	1	

Type	No.	Full Lineup (Units)	Competition Stage
Engineer robot	2	1	Regional Competition, Wild Card Competition and Final Tournament
Standard robot	3/4	2	Mainland China Regional Competition
	3/4/5	3	International Regional Competition, Wild Card Competition and Final Tournament
Aerial Robot	6	1	Regional Competition, Wild Card Competition and Final Tournament
Sentry Robot	7	1	
Dart System	8	1	
Radar	9	1	

Minimum lineup for the first round of each match: Except for Radar and Dart System, four robots.



- When there are no special classification instructions, Standard robots include regular Standard robots, Auto Standard robots, and Balancing Standard robots, but other types can be included when there are such instructions.
- Only teams that did not qualify for the offline competitions of the RoboMaster 2021 University Series (except for the RoboMaster 2021 University AI Challenge) are allowed to deploy a maximum of one non-modified RoboMaster Robot Self-Assembled Version Type A or one RoboMaster AI Robot 2020 Standard Version whose modification meets the new design criteria. For the new design criteria, please refer to the [“RoboMaster 2022 University Series Robot Building Specifications Manual”](#).
- When building their robots, the remaining teams must not modify the abovementioned robots into a newly designed robot or directly use their frame, material or other important components during the production process, and are only allowed to use the motor coupling, Launching Mechanism, Loading Mechanism, or other such parts of the abovementioned robots.

1.2.2 Robot's Basic Information

The robot parameters for the RMUC 2022 are as follows:

Table 1-2 Robot parameters

Robots Specifications	Hero Robot	Engineer robot	Standard robot	Aerial Robot	Sentry Robot	Dart System	Radar
Chassis Power Consumption Limit (W)	Notes 1 & 2	No limit	Notes 1 & 2	-	30	-	-
Initial HP	Note 2	500	Note 2	-	600	-	-
Maximum HP	Note 2	500	Note 2	-	600	-	-
Initial Launching Speed Limit (m/s)	Notes 2 & 3	-	Notes 2 & 3	30	30	-	-
Barrel Heat Limit	Notes 2 & 4	-	Notes 2 & 4	-	320	-	-
Barrel Cooling Value per Second	Note 2	-	Note 2	-	100	-	-
Experience Value	Note 2	50	Note 2	-	75	-	-
Projectile Launch Speed (round/s)	Notes 2 & 4	-	Notes 2 & 4	No limit	Notes 2 & 4	-	-
Initial position	Starting Zone	Starting Zone	Starting Zone	Landing Pad	Sentry Rail	Dart Launching Station	Radar Base

Note 1: For the buffer energy correlated to the maximum chassis power limit, please refer to “3.2.3 Exceeding Chassis Power Consumption Limit

Note 2: For details, please refer to “3.8 Level-Up Mechanism”.

Note 3: For details, please refer to “3.2.1 Exceeding the Initial Launching Speed Limit”.

Note 4: For details please refer to “3.2.2 Barrel Overheating and Cooling”.



- Robot Chassis: A mechanism that carries a robot propulsion system and its accessories.
- Chassis Power Consumption: The power that supports the propulsion system enabling a robot to move horizontally, not including the power used for special tasks (e.g., power consumption for functional movements such as moving the upper mechanical structure).
- Initial Launching Speed: The speed detected by the relevant modules of the Referee System after a projectile or dart has completed its acceleration.
- Initial Projectile Quantity: The quantity of projectiles that a Pit Crew Member can load into the magazines of a robot before the start of a round.
- Barrel Heat: A mechanism for limiting the continuous firing of projectiles by robots. For more details, please refer to “3.2.2 Barrel Overheating and Cooling”.

The requirements on the projectile types, initial projectile quantity, projectile procurement method, and projectile unloading for robots are as follows:

Table 1-3 Requirements on the Projectile Types, Initial Projectile Quantity, Projectile Procurement Method, and Projectile Unloading for Robots

Robot Type	Projectile Type	Initial Projectile Quantity (rounds)	Procurement Method	Projectile Unloading Rules before Each Round
Hero Robot	42mm projectile	Total 100	To obtain from the side of the Battlefield before the competition	No need to unload 42mm projectiles
Engineer robot	42mm projectile		To obtain from the side of the Battlefield before the competition	
Hero Robot	17mm projectile	0	To obtain from the Official Projectile Supplier during the competition	To unload all 17mm projectiles
Engineer robot	17mm projectile	0	To obtain from the Official Projectile Supplier during the competition	To unload all 17mm projectiles
Automatic Standard Robot	17mm projectile	500	To obtain from the side of the Battlefield before the competition	No need to unload 17mm projectiles
Other Standard Robots	17mm projectile	0	To obtain from the Official Projectile Supplier during the competition	To unload all 17mm projectiles

Robot Type	Projectile Type	Initial Projectile Quantity (rounds)	Procurement Method	Projectile Unloading Rules before Each Round
Aerial Robot	17mm projectile	500	To obtain from the side of the Battlefield before the competition	No need to unload 17mm projectiles
Sentry Robot	17mm projectile	500	To obtain from the side of the Battlefield before the competition	No need to unload 17mm projectiles

The common mechanisms of the robots are as follows:



- “□” indicates: Available
- “-” indicates: Not Available

Table 1-4 Common Mechanisms for the Robots

Robots Mechanism	Standard robot	Engineer robot	Hero Robot	Sentry Robot	Aerial Robot	Dart System	Radar
Inter-Robot Communication	○	○	○	○	○	○	○
Mobile 17mm Launching Mechanism	○	-	○	-	○	-	-
Chassis Power Consumption Limit	○	-	○	○	-	-	-
Barrel Heat	○	-	○	○	-	-	-
Level-Up Mechanism	○	-	○	-	-	-	-
External Controller	○	○	○	-	To be used only by the aerial gimbal operator	○	-

Robots Mechanism	Standard robot	Engineer robot	Hero Robot	Sentry Robot	Aerial Robot	Dart System	Radar
Carrying Minerals	-	○	-	-	-	-	-
Carrying Obstacle Blocks	○	○	○	-	-	-	-

Table 1-5 Buff Point Mechanisms for the Robots

Robots Buff Point	Standard robot	Engineer robot	Hero Robot	Sentry Robot	Aerial Robot
Restoration Zone	○	○	○	-	-
Base Buff Points	○	-	○	-	-
Elevated Ground Buff Point	○	-	○	-	-
Power Rune Buff Point	○	-	○	-	-
Resource Island Buff Point	-	○	-	-	-
Hero Robot Sniper Point	-	-	○	-	-
Outpost Buff Point	○	-	○	-	-
Launch Ramp Buff Point	○	-	○	-	-

1.2.2.1 Hero Robot

Hero Robots are the only robots that can launch 42mm projectiles on the Battlefield. They are able to inflict additional damage when attacking from a designated location on the Battlefield. The 42mm projectiles to be launched by a Hero Robot can be mounted on an Engineer Robot or Hero Robot before the match. Hero Robots need to redeem their projectile allowance through the Economic System in the Supplier Zone. In a round of a match, the maximum projectile allowance for a Hero Robot is 100 rounds of 42mm projectiles. After its projectile allowance has been used up, the 42mm Launching Mechanism of a Hero Robot will be powered off.

Table 1-6 Key Information Sources for Hero Robot

Content	Source
Hero Robot Sniper Point Mechanism	“3.6.8 Hero Robot Sniper Point Mechanism”
Hero Robot Projectile Supply Mechanism	“3.3.2 42mm Projectile Allowance Redemption Mechanism”

1.2.2.2 Engineer robot

Engineer robots can transport minerals and obstacle blocks, and rescue and reload projectiles for other Ground Robots.

Table 1-7 Key Information Sources for Engineer Robots

Content	Source
Minerals	“2.6.1.2 Minerals” “3.4.3 Mineral-related Mechanism”
Engineer Robot rescue	“3.9 HP Recovery and Revival Mechanism”
Obstacle Block	“2.6.1.1 Obstacle Block”

1.2.2.3 Standard robot

Teams can build Regular Standard Robots or any of the following two types of Standard Robots:

- **Balancing Standard Robot:** A Standard Robot that meets the definition of a Balancing Standard Robot can be fit with a balancing chassis. Only Standard Robots with a balancing chassis are allowed additional Barrel Heat Buffs. For the latest definition of the Balancing Standard Robot, please refer to the relevant definition in “1.2.2.3 Standard robot” of the [RoboMaster University Series 2022 Robot Building Specifications Manual](#).
- **Automatic Standard Robot:** Automatic Standard Robots are not given any options on their chassis or Launching Mechanism types, but their performance parameters are superior than those of other robots. An Automatic Standard Robot cannot have an operator. The Aerial Gimbal Operator can issue commands to an Auto Standard Robot through the small map.

Table 1-8 Key Information Sources for Standard Robots

Content	Source
Attributes of Automatic Standard Robots	“Table 3-12 Attributes of Automatic Standard Robots”
Attributes of Balancing Standard Robots	“Table 3-13 Attributes of Standard Robot Chassis”



A robot can be fitted with a balancing chassis only when it meets the criteria for a Balancing Standard Robot.

1.2.2.4 Aerial Robot

Aerial Robots do not have Fixed Launching Mechanisms, and can be mounted with a Mobile 17mm Launching Mechanism. When the competition starts, an Aerial Robot can take off and may only launch projectiles after redeeming air support by using gold coins according to the economic system. Since Aerial Robots do not operate by the concepts of Barrel Heat and HP, the penalties for them exceeding their parameter limits will be explained in a separate section.

Table 1-9 Key Information Sources for Aerial Robots

Content	Source
Air support	“3.3 Economic System”
Aerial Robot-Related Mechanisms	“3.11 Aerial Robot-Related Mechanisms”

1.2.2.5 Sentry Robot

Sentry Robots are responsible for guarding their team’s Base, and are the key to winning the competition. A Sentry Robot remains in the Invincible status as long as its team’s Outpost is not destroyed. If a Sentry Robot exceeds its chassis power consumption limit, its HP will not be deducted but the chassis will be powered off.

For one round of a match, a Sentry Robot is given a maximum projectile allowance of 500 rounds of 17mm projectiles. The Launching Mechanism will be powered off once the quantity of launched projectiles has reached the maximum projectile allowance.

Table 1-10 Key Information Sources for Sentry Robots

Content	Source
Relationship between a Sentry Robot, Outpost and Base	“3.5 Relationship between a Sentry Robot, Outpost and Base”

1.2.2.6 Dart System

The Dart System is made up of the Dart Launcher and darts. The Aerial Gimbal Operator can launch darts through the client interface and the Referee System’s inter-robot communication function, or the remote controller. For each round of a match, the Dart Launcher may be loaded with 4 darts. The Dart System is allowed to launch twice, each with a window period of 15s.

The dart guiding light on the Base and Outpost will turn on once the target can be attacked.

Table 1-11 Key Information Sources for Dart Systems

Content	Source
Dart Launching Mechanism	“3.12 Dart Launching Mechanism”
Guiding Light	“3.5 Relationship between a Sentry Robot, Outpost and Base”

1.2.2.7 Radar

A Radar provides vision and warnings to all robots of the team. The Radar is situated outside the Battlefield. The Aerial Gimbal Operator is able to view the Radar images, while the Radar can also relay information to the team's robots through the inter-robot communication function.

The Radar's computing system shall be connected to a 220V utility power supply.

Table 1-12 Key Information Sources for Radars

Content	Source
Initial position of the Radar	"2.2.5 Radar Base"

1.2.3 Operator Lineup

- 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 Pit Crew Member.
- A pilot can operate an Aerial Robot in the competition only after passing the Pilot Assessment by the RMOC. For details on the Pilot Assessment, please refer to the [RoboMaster 2022 University Championship Participant Manual](#).



Operator lineup is as follows:

Table 1-13 Line-up of Operators

Type	Robot Operated	Number of operators in full lineup
Ground Robot Operator	Hero Robot	1
	Standard robot	Mainland China Regional Competition: 2 International Regional Competition, Wild Card Competition and Final Tournament: 3
	Engineer robot	1
Aerial Gimbal Operator	Aerial, Dart System, Radar	1
Pilot	Aerial Robot	1



Ground robot: Hero, Engineer and Standard, collectively.

1.3 Tactical Coach

Each team can have one Tactical Coach, who may enter the Operator Room during the Three-Minute Setup Period to make tactical arrangements with the Operators, but must leave the Operator Room before the end of the Three-Minute Setup Period.

The Tactical Coach can be any participating member in the team (apart from reserve members).

2. Competition Area

2.1 Introduction



- The dimension error margin of all battlefield components described here is within $\pm 5\%$. The unit for the size parameters on the site drawings is mm.
- The Battlefield has a symmetrical layout with a central line. All descriptions and illustrations of Battlefield modules in this text will be based on the Red Team as an example but will apply equally to the Blue Team.
- A buff point is an area where robots can receive buffs of a certain nature. Please refer to “3.6 Battlefield Buff Mechanism” for details on the buff point mechanism for the relevant areas mentioned in this chapter.
- A penalty zone is an area that designated robots are forbidden from entering. Please refer to “5.2.3.2 Interaction between Robots and Battlefield Components” for the penalty zone debuff rules for the relevant areas mentioned in this chapter.
- The orange and green lines below are light effects on the site, which along with the lighting changes as the competition progresses and according to the Competition Mechanism. Their specific operation shall be based on the actual situation.

The core competition area of the RMUC is called the “Battlefield”. The Battlefield is 28 meters long and 15 meters wide. Its inner structure is made of wood materials and the surface is laid with PVC flooring (3 mm thick). It consists of the Base Zone, Elevated Ground, Resource Island Zone, Supplier 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.

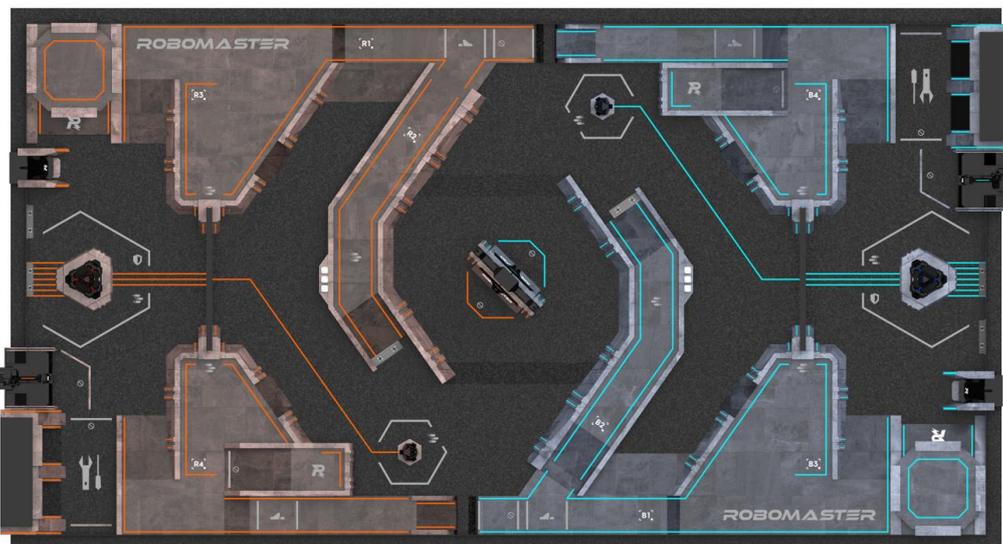


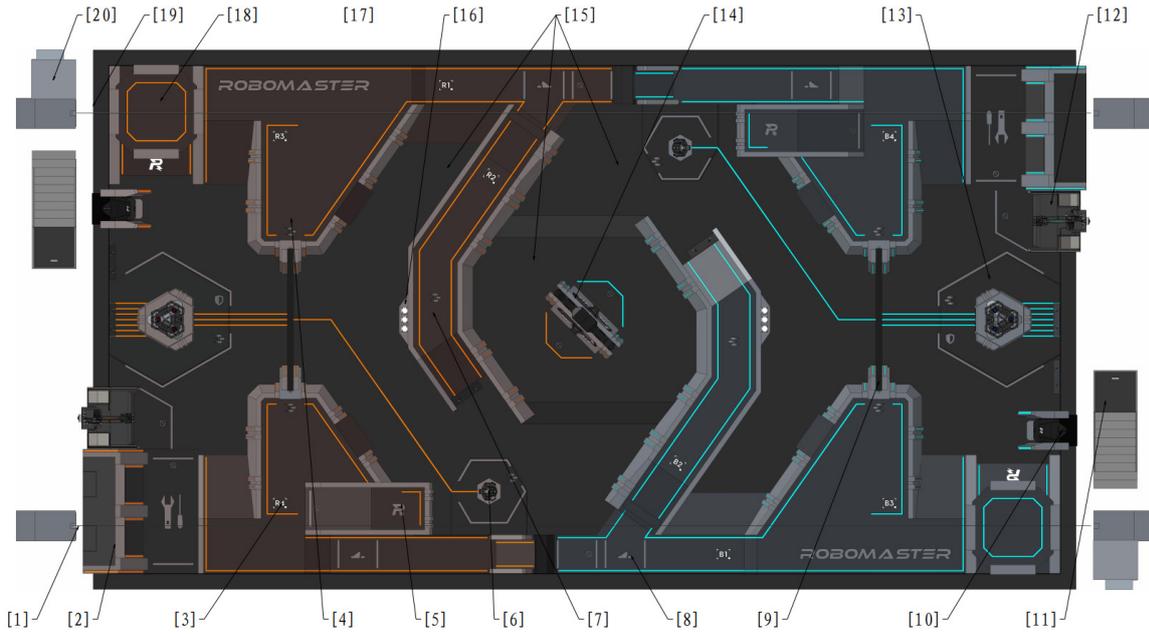
Figure 2-1 Top-view Rendering of the Battlefield



Figure 2-2 Side-view Rendering of the Battlefield

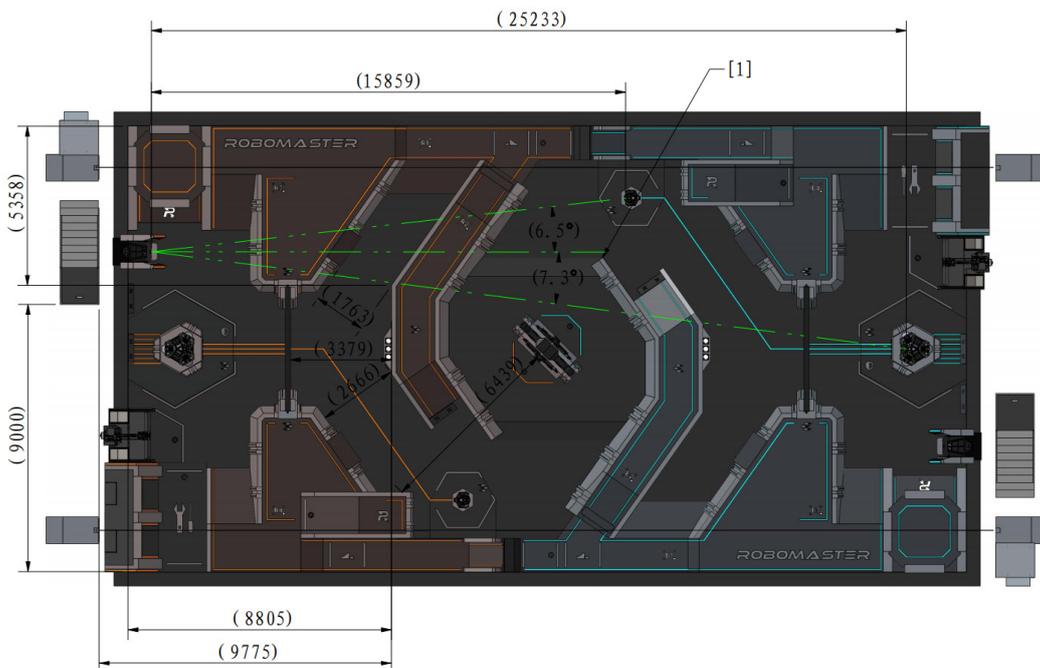


Figure 2-3 Axonometric Rendering of the Battlefield



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

Figure 2-4 Battlefield Modules

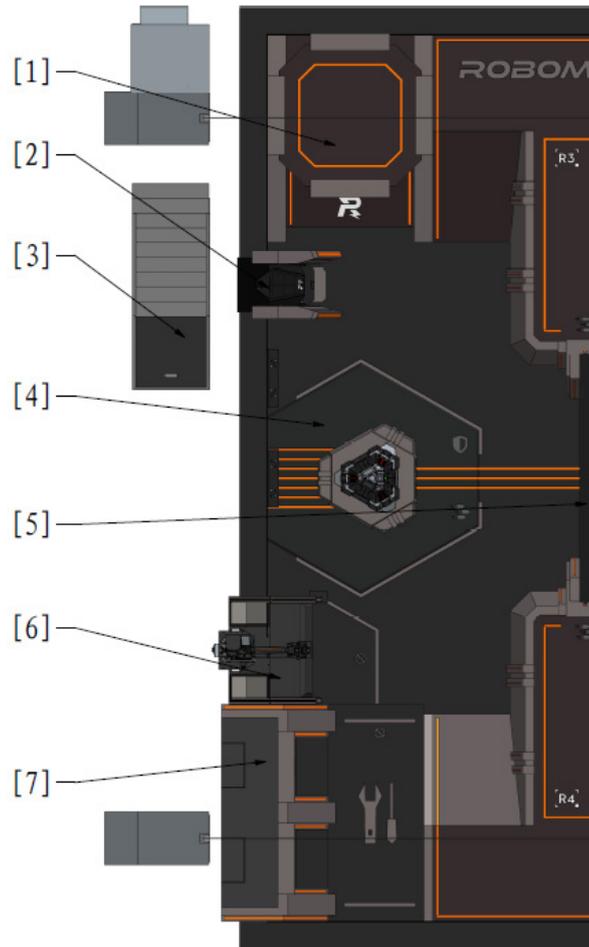


- [1] Parallel with the side of the Battlefield and facing the Dart Launching Station

Figure 2-5 Localization Dimensions for Battlefield Modules

2.2 Base Zone

The Base Zone consists of the Starting Zone, Base, Dart Launching Station, Landing Pad, Radar Base, Supplier Zone, Exchange Zone and Sentry Rail. The Starting Zone is the hexagonal area around the Base, while the Base, Dart Launching Station, Landing Pad, Radar Base, Supplier Zone, Exchange Zone and Sentry Rail are each located around the Starting Zone.

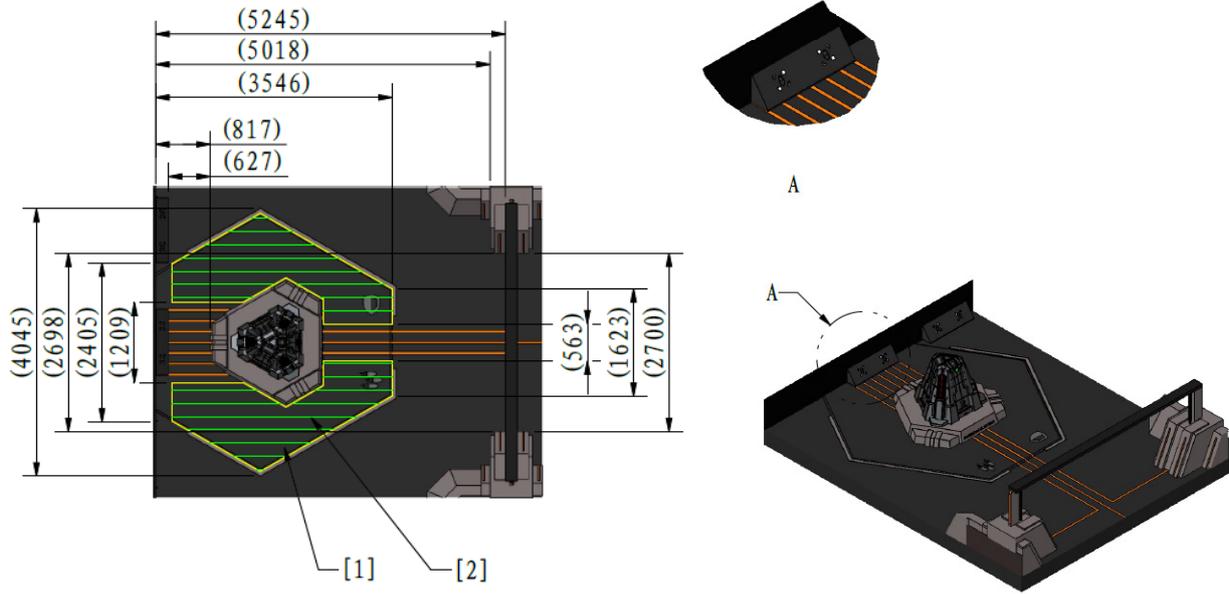


- [1] Landing Pad
- [2] Dart Launching Station
- [3] Radar Base
- [4] Starting Zone
- [5] Sentry Rail
- [6] Exchange Zone
- [7] Supplier Zone

Figure 2-6 Base Zone

2.2.1 Starting Zone

The Starting Zone is the hexagonal area near the Base, where robots are placed before the start of a match.



[1] Starting Zone [2] Base Buff Points

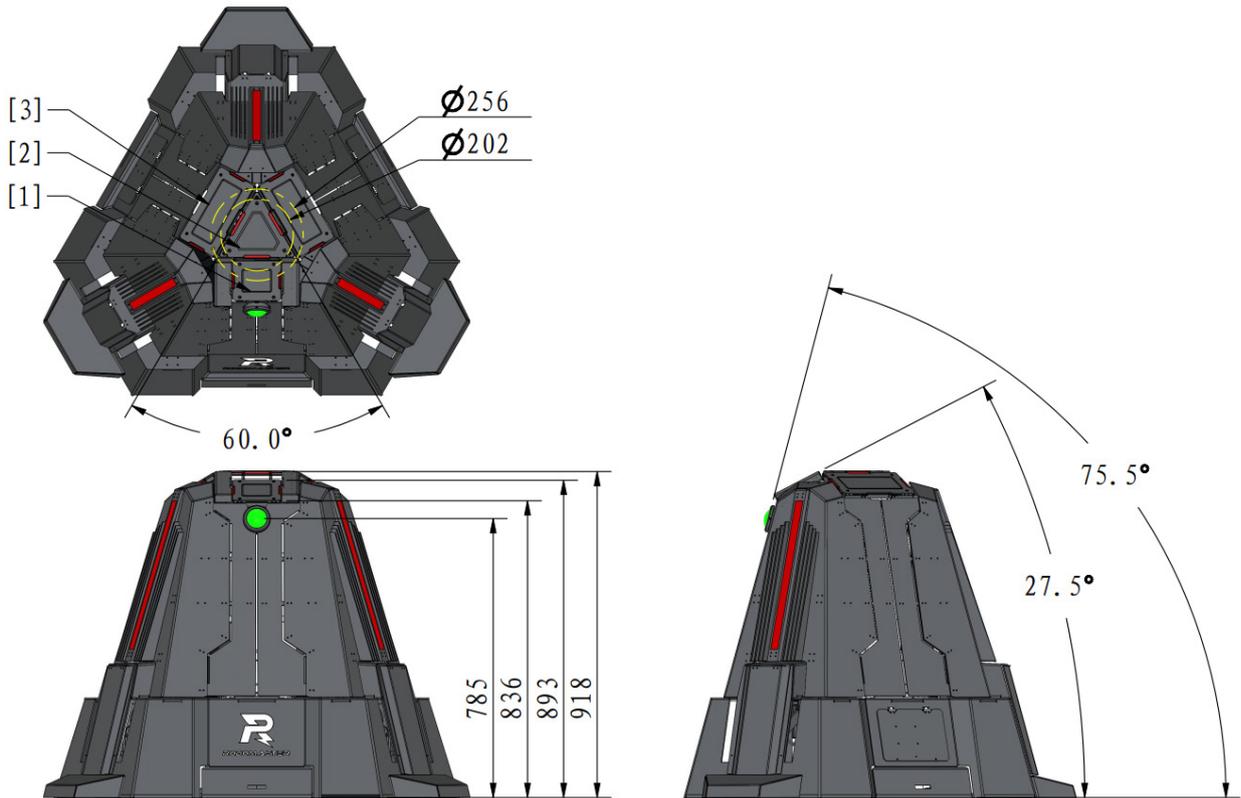
Figure 2-7 Robot Starting Zone

2.2.1.1 Base Buff Points

The Base Buff Point is located in the Starting Zone, as shown in “Figure 2-7 Robot Starting Zone”.

2.2.2 Base

A Base is the offensive and defensive core of each team. It is placed on the Base Foundation in the Starting Zones of each team. A Base consists of the body of the Base, Armor Modules, Dart Detection Module, Base Protective Armor, etc. The Base Armor can either be in a closed or expanded state.



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

Figure 2-8 Closed State of Base Protective Armor

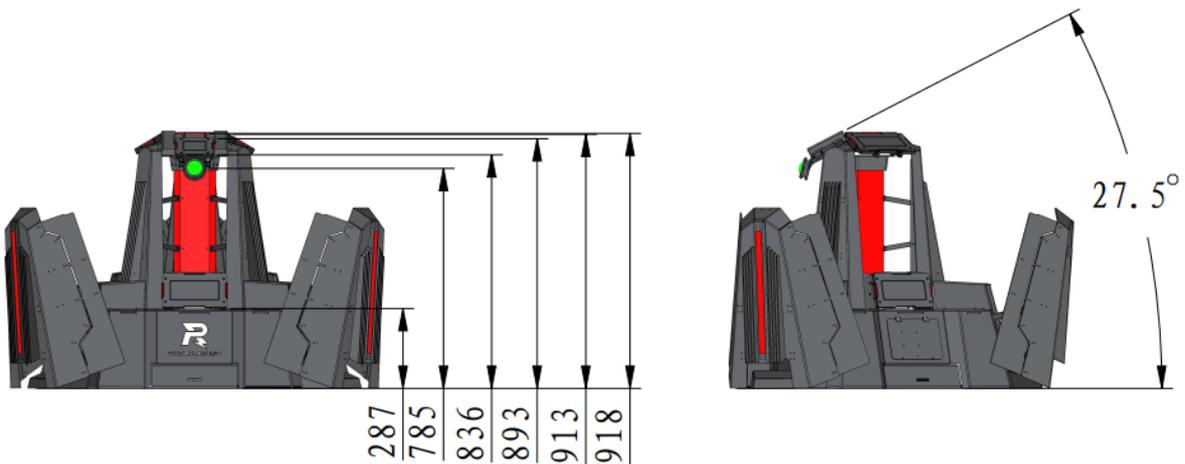
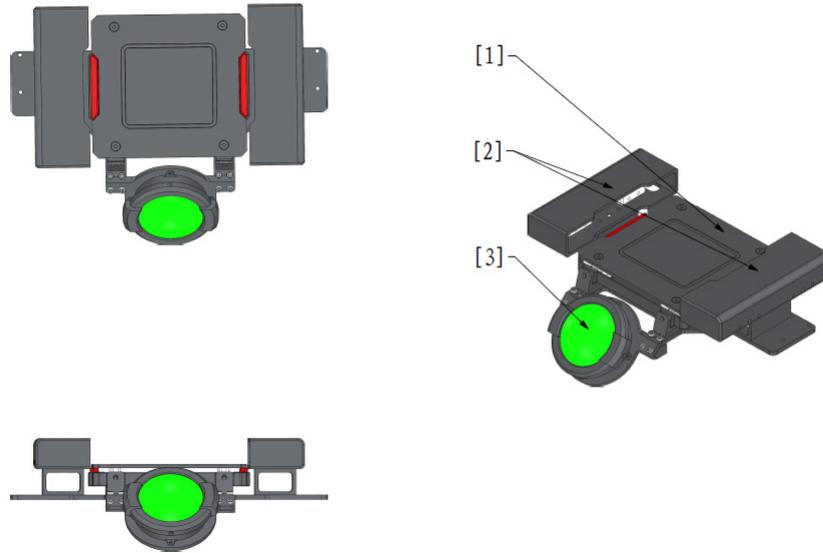


Figure 2-9 Expanded State of Base Protective Armor

The Dart Detection Module is located on the top of the Base and Outpost, consisting of a Small Armor Module, Dart Detection Sensor and dart guiding light.

The Small Armor Module of the Dart Detection Module can detect attacks by darts and 42mm projectiles. The Dart Detection Sensor can detect the infrared light emitted by a dart trigger device. When a Dart Detection Module detects infrared light and an attack simultaneously, the system will deem the module as having been hit by a dart. When only an attack is detected, the system will deem the module as having been hit by a projectile. The Dart Guiding Light has a brightness of 5000 lx and emits green visible light with a wavelength of 520 nm. The diameter of the light-emitting part is around 55 mm, which is for the purpose of guiding darts in their target attacks.

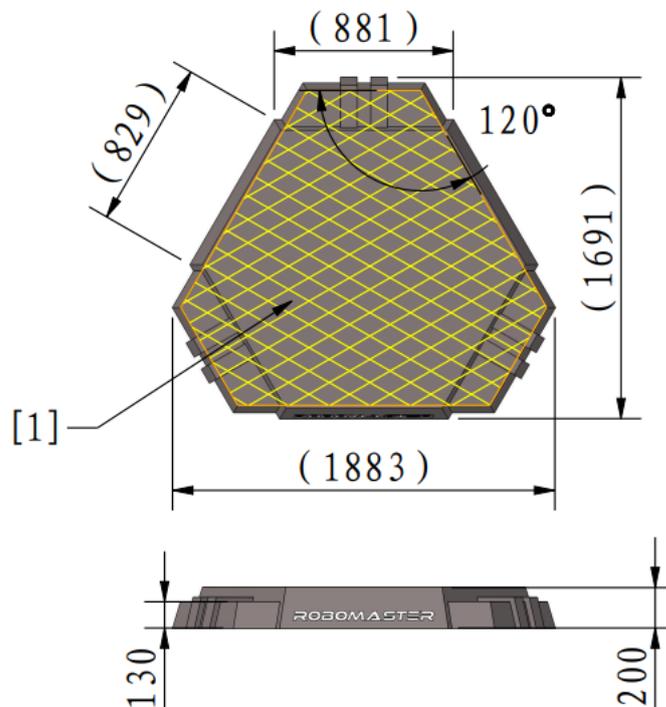


[1] Small Armor Module [2] Dart Detection Sensor [3] Dart guiding light

Figure 2-10 Dart Detection Module

2.2.2.1 Base Foundation

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

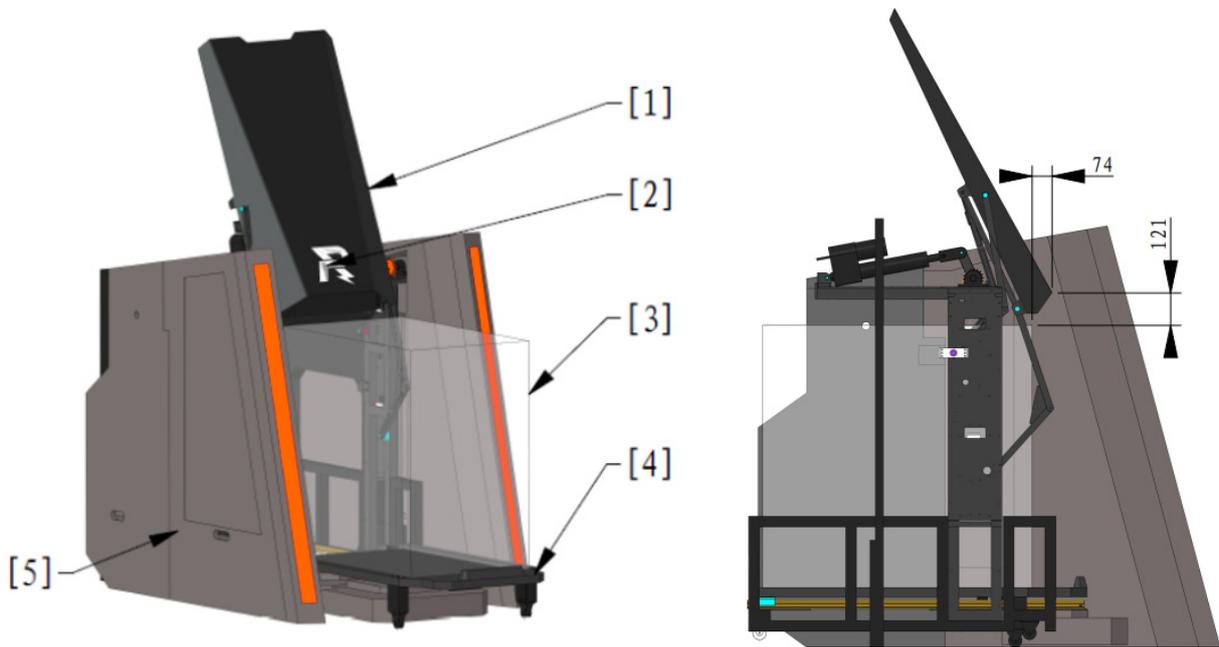
Figure 2-11 Base Foundation

2.2.3 Dart Launching Station

The Dart Launching Station is the only place for holding the Dart Launcher, and consists of the main body, gliding platform and gate.

The material of the gliding platform within an area of 600*1,000mm is iron (which is magnetic). The gliding platform can glide forward and backward for easy placing of a Dart Launcher.

During the Three-Minute Setup Period, the Dart Launching Station will be in the open status. The Pit Crew Members will pull out the gliding platform then place the Dart Launcher in the square space on the platform. After ensuring the Dart Launching System is operating normally, the Pit Crew Members will need to push the gliding platform back into the main body of the Dart Launching Station. When the “R” light is on, it means the gliding platform is in place and will lock itself automatically. Before the start of a match, the gate will close automatically.



- [1] Gate
- [2] Status Light Indicators
- [3] Setting Position of Dart Launcher
- [4] Gliding Platform
- [5] Main Body of Dart Launching Station

Figure 2-12 Dart Launching Station

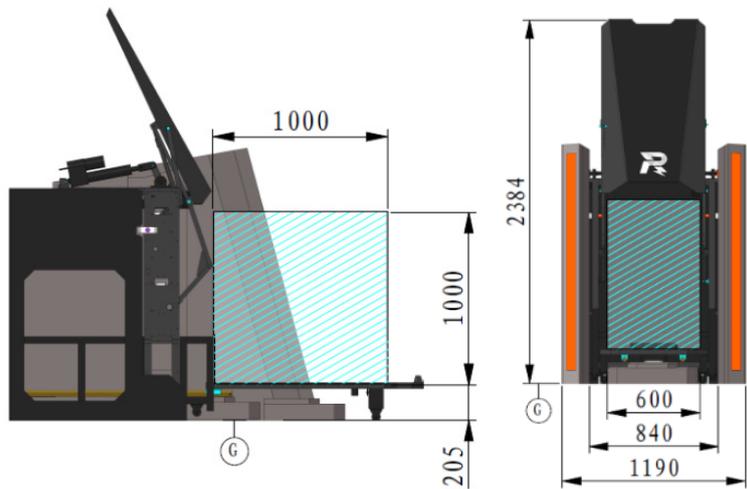
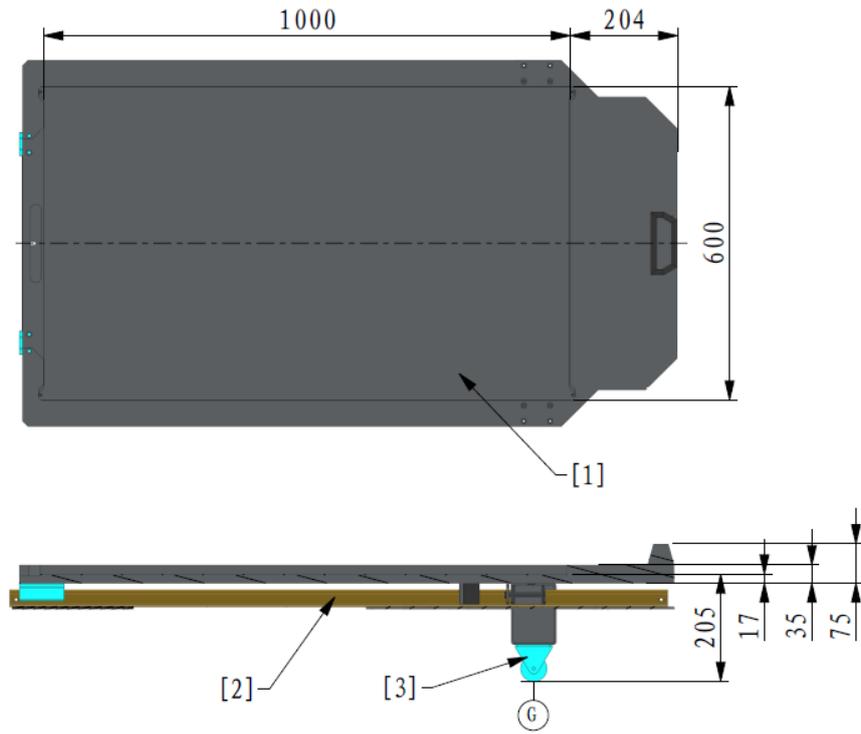


Figure 2-13 Gliding Platform Slides Out



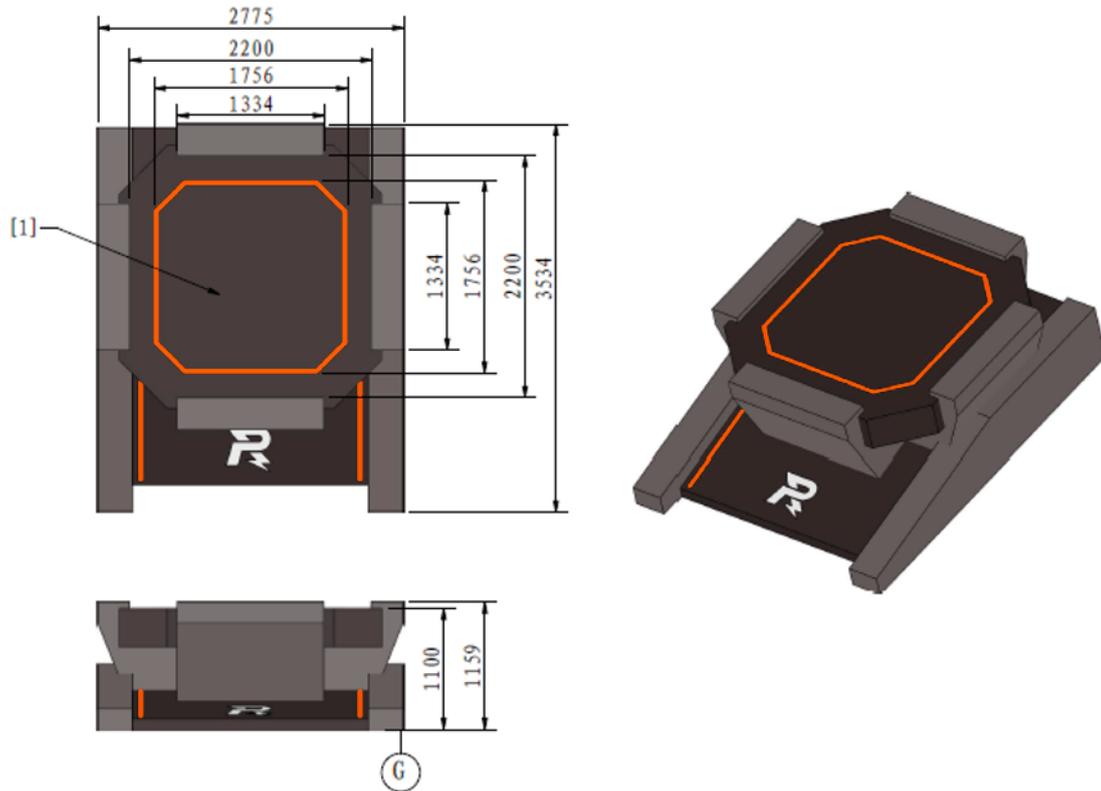
- [1] Flat surface for placing Dart Launcher [2] Gliding Platform Rail [3] Supporting wheel

Figure 2-14 Dimensions of the Gliding Platform

2.2.4 Landing Pad

The Landing Pad is the initialization zone for Aerial Robots.

Before a match begins, an Aerial Robot must be placed on a Launching Pad platform, its projection must be in the area of the Landing Pad, and it must be connected to an Aerial Safety Rope in accordance with the requirements.



[1] Landing pad platform

Figure 2-15 Landing Pad

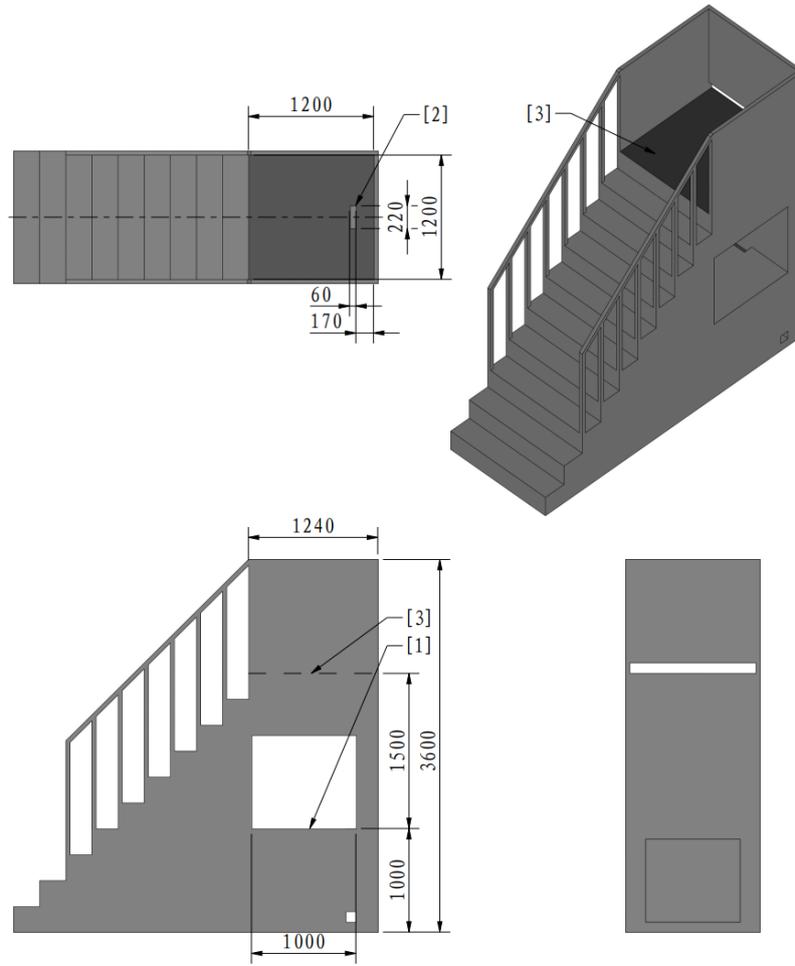
2.2.5 Radar Base

A Radar Base is the platform for placing a radar sensor. At its top is a platform with a surface area 1200*1200 mm, made of iron panel material (which is magnetic). The distance from the plane of the platform to the battlefield ground should be approximately 2500 mm, with a non-transparent perimeter wall around that is 1100 mm high. Two cable grooves are on the platform, to be used as required by the conditions of the actual site.

The Radar's data will be displayed on a monitor with an HDMI port in the Operator's Room. The following devices will be placed on the platform of the Radar's computer:

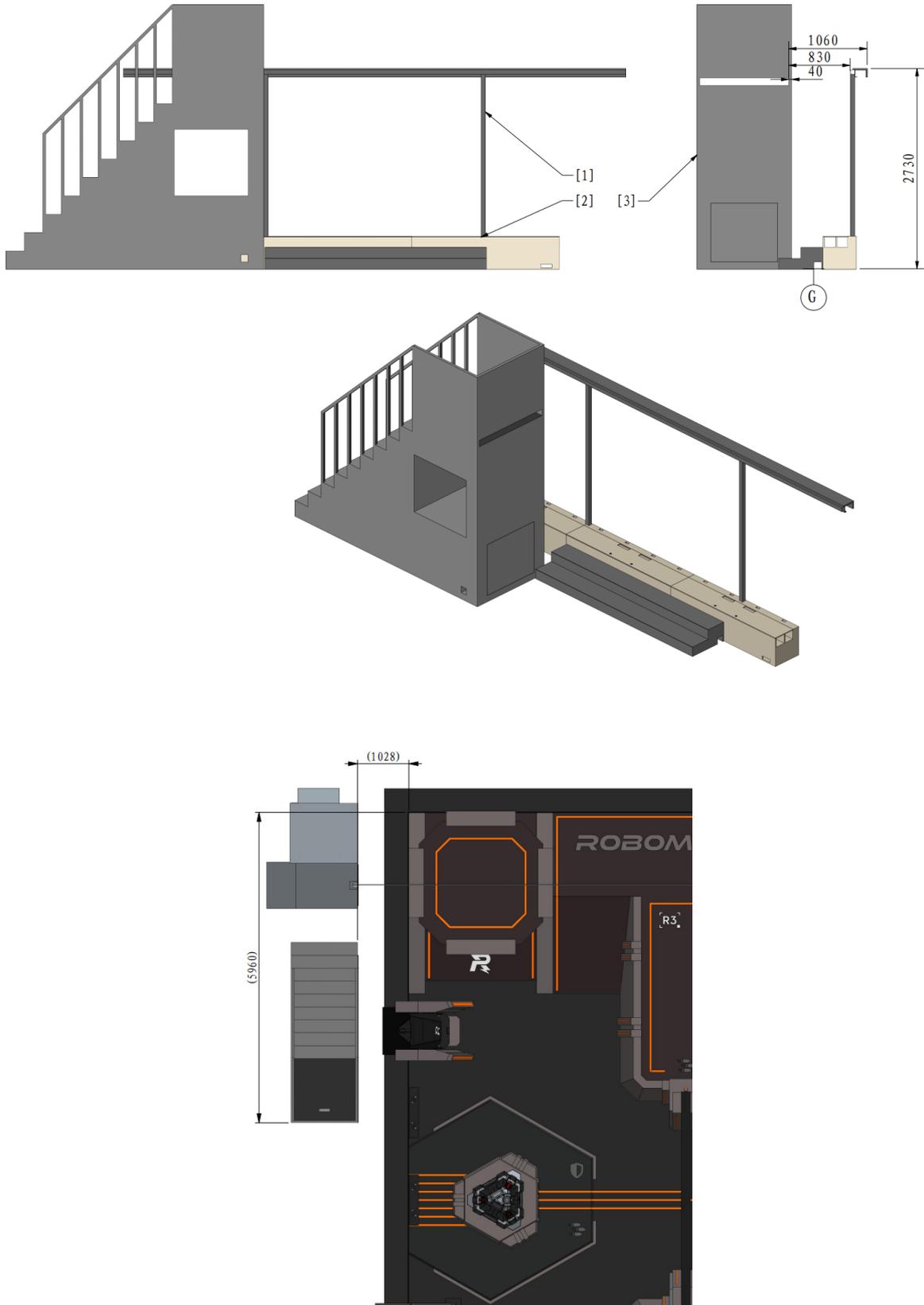
- One official monitor: For checking if the HDMI splitter is receiving any signal input, and if the image displayed is the same as on the Radar's monitor in the Operator's Room.
- One HDMI splitter: For transmitting the Radar's signal to the Operator's Room and the official monitor in the Radar Base.
- One power outlet: Supplying power to the Radar, official monitor and other official equipment.

The above devices must be left unmoved on the platform.



[1] Radar computer platform [2] Sensor data cable slot [3] Iron panel material

Figure 2-16 Radar Base



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

Figure 2-17 Relative Position of the Radar Base

2.2.6 Supplier Zone



Due to the large size of the Projectile Outlet, teams are advised to enlarge the Projectile Loading Port and pad the internal wall of the Projectile Magazine with buffer materials, to prevent projectiles from falling in the process of loading them into the magazine.

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

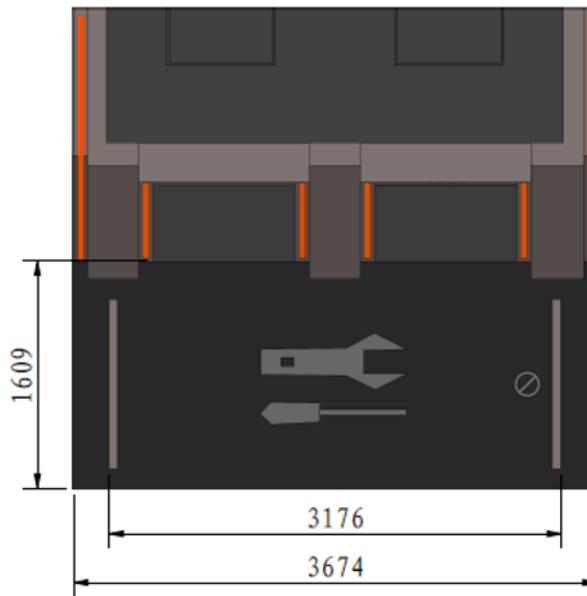


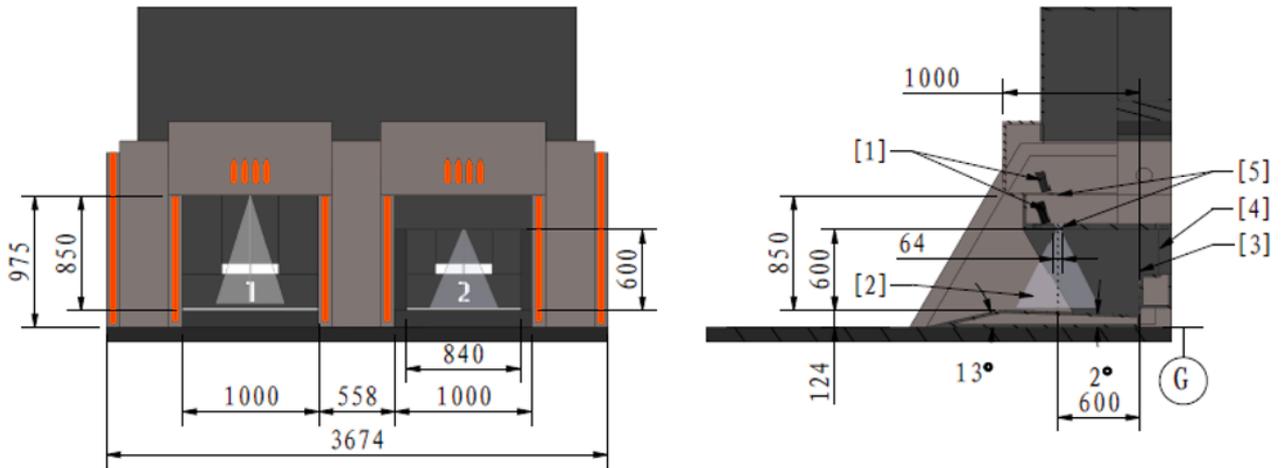
Figure 2-18 Supplier Zone

2.2.6.1 Official Projectile Supplier



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

A Projectile Supplier provides 17mm projectiles during matches and consists of a Projectile Outlet, an auxiliary alignment laser sight, a camera and a monitor. The camera of the projectile outlet will capture real-time images of the robot's magazine and display them on the front monitor. The operator can adjust the position of the robot through the laser projected by the cross laser light.

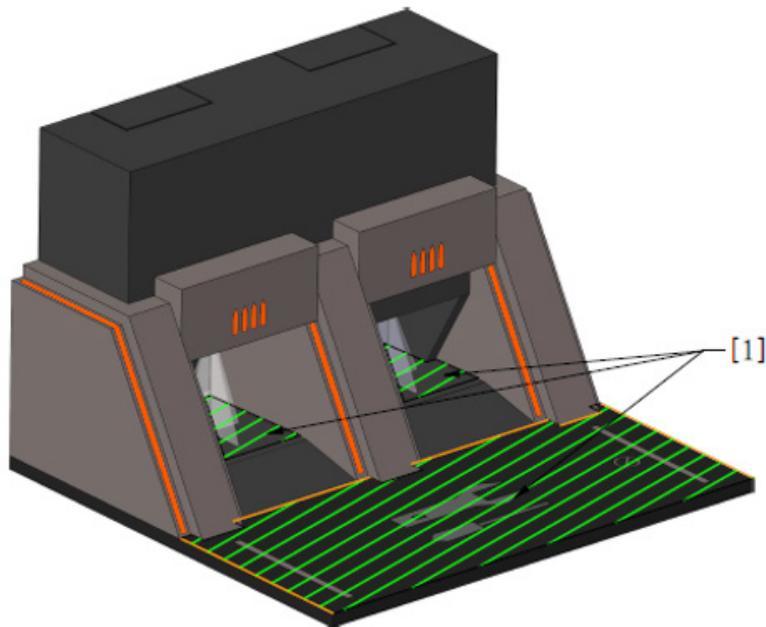


[1] Camera [2] Laser light path [3] Steel wire mesh [4] Monitor [5] Projectile Outlet

Figure 2-19 Official Projectile Supplier

2.2.6.2 Restoration Zone

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

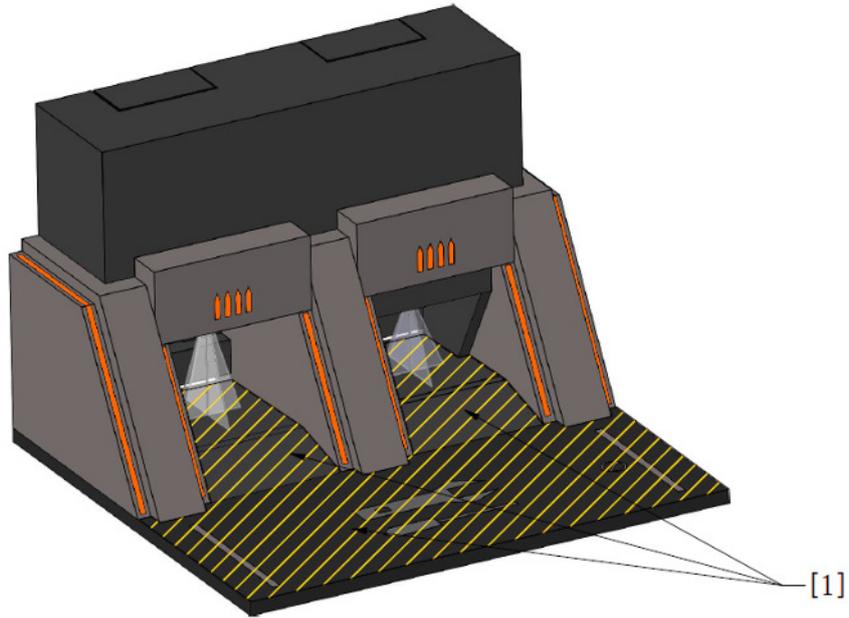


[1] Restoration Zone

Figure 2-20 Restoration Zones

2.2.6.3 Supplier Penalty Zone

The Supplier Penalty Zone refers to part of the Supplier Zone, as shown below:

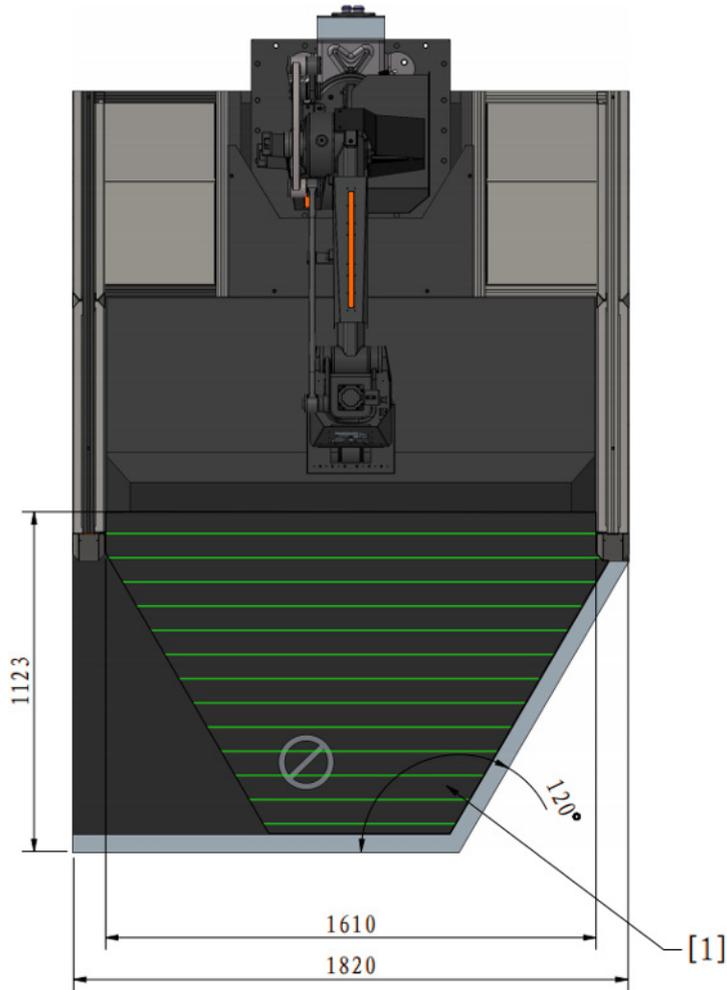


[1] Supplier Penalty Zone

Figure 2-21 Supplier Penalty Zone

2.2.7 Exchange Zone

The Exchange Zone is the area where robots exchange minerals, and includes the Exchange Station and Exchange Penalty Zone. Part of the Exchange Penalty Zone shall be placed with RFID Interaction Module Cards, as shown below:

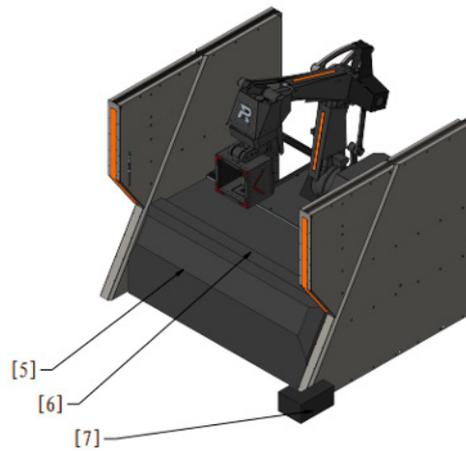
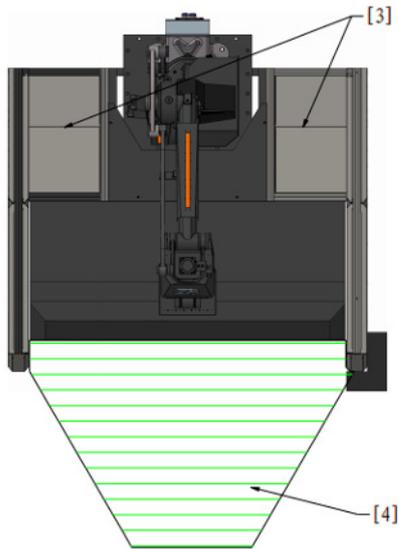
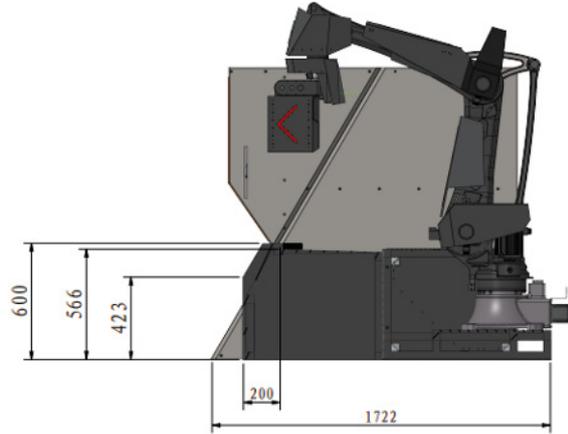
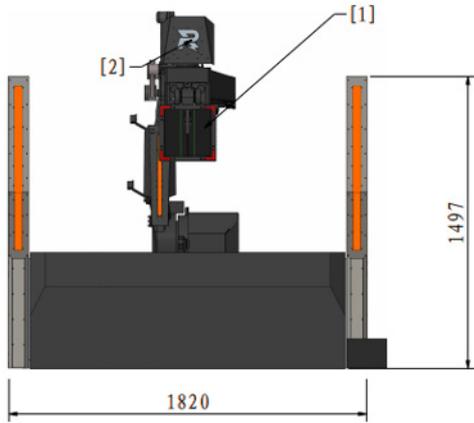


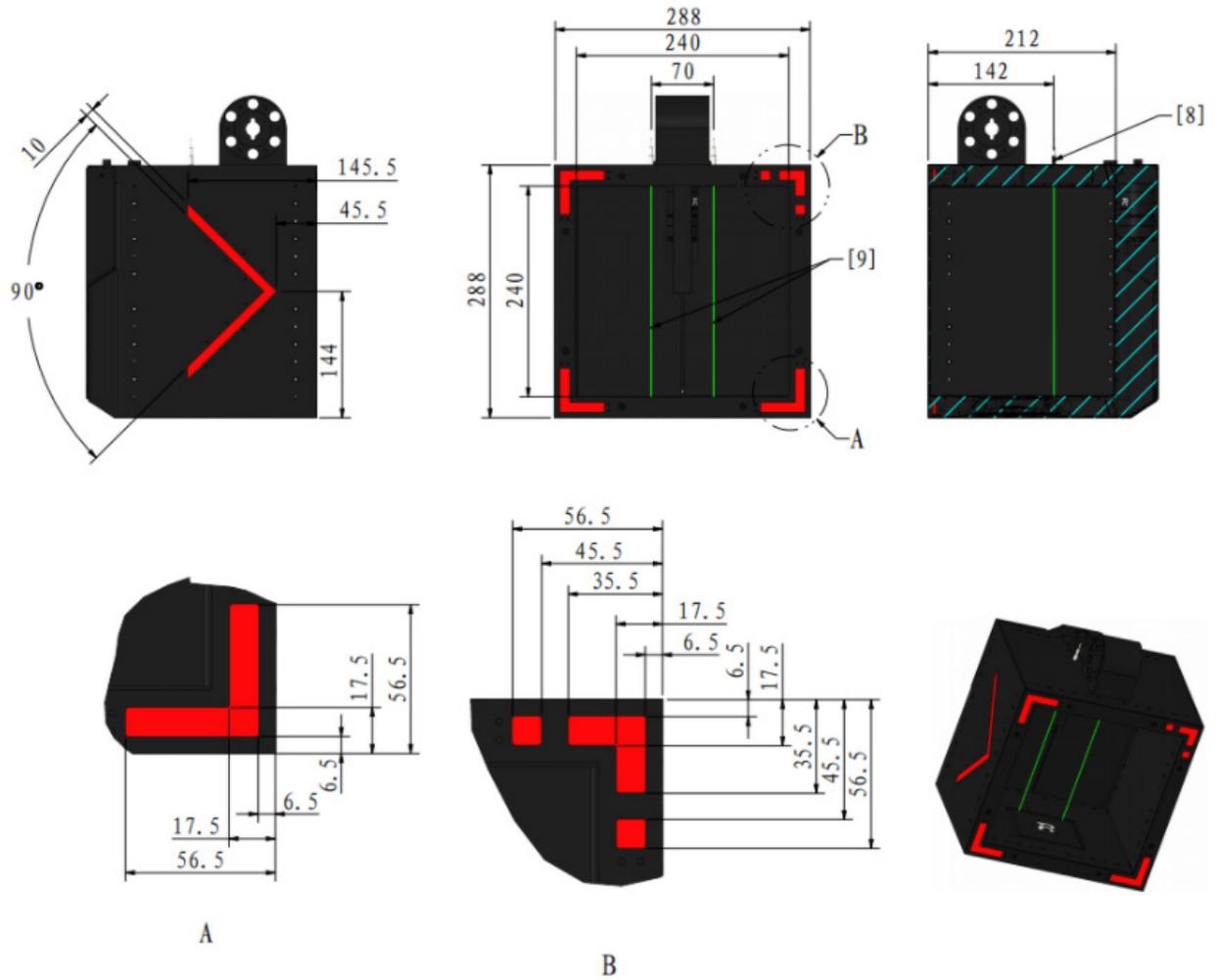
[1] RFID Interaction Module
Card placement zone

Figure 2-22 Exchange Zone

2.2.7.1 Exchange Station

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





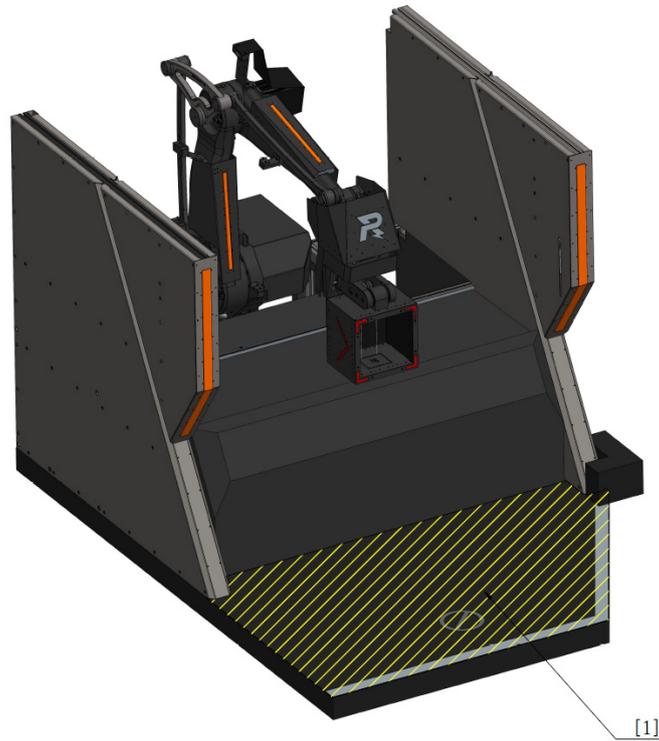
Scale: 3: 20

- | | | | |
|---|-------------------------|-----------------------------|---|
| [1] Mineral Receptacle | [2] "R" light indicator | [3] Mineral Collecting Slot | [4] RFID Interaction Module Card placement zone |
| [5] Exchange Station Base | [6] Horizontal panel | [7] Anti-collision bar | [8] Photoelectric sensor |
| [9] Photoelectric sensor beam (non-visible) | | | |

Figure 2-23 Exchange Station

2.2.7.2 Exchange Penalty Zone

The Exchange Penalty Zone refers to part of the Exchange Zone, as shown below:

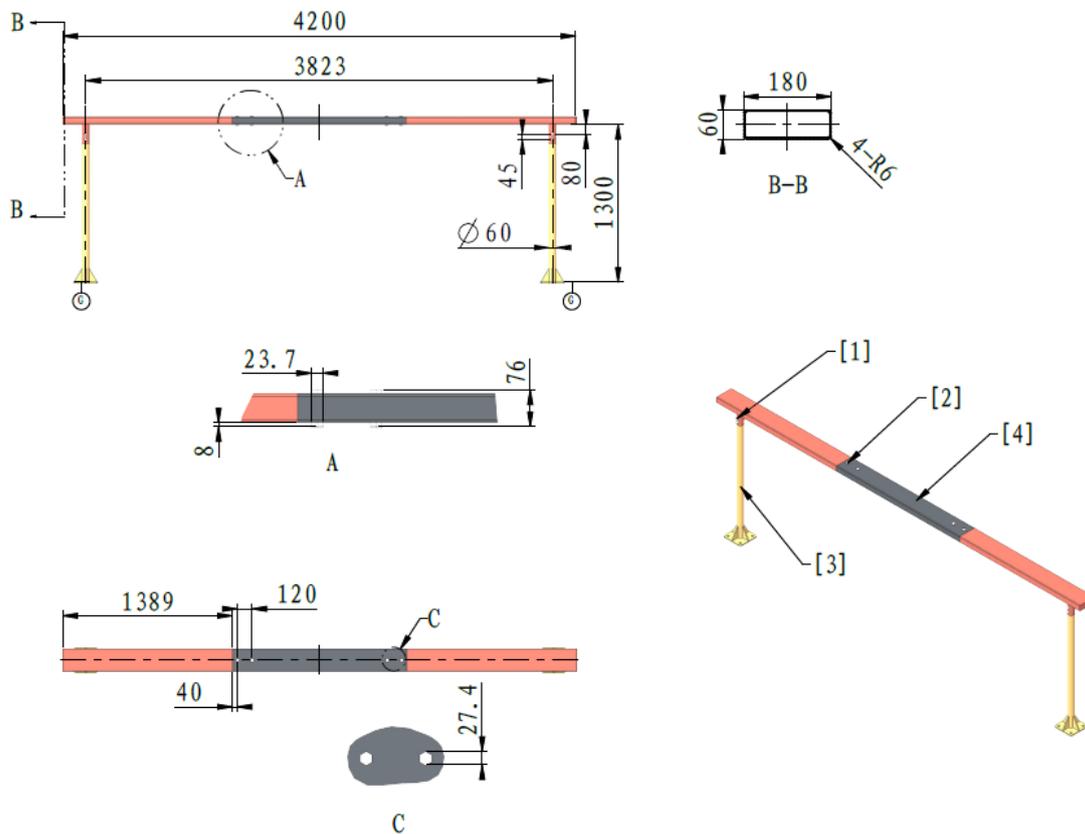


[1] Exchange Penalty Zone

Figure 2-24 Exchange Penalty Zone

2.2.8 Sentry Rail

The Sentry Rail is the only area where a Sentry Robot can be active. It is located near the Starting Zone, and consists of the body of the Rail and its supporting structure, in the material Q235 and with a painted surface. The distance between the lower surface of the Sentry Rail and the Battlefield ground should be 1300 mm.



[1] M8 Bolt [2] M16 Bolt [3] Rail Support [4] Main Body of the Rail

Figure 2-25 Sentry Rail



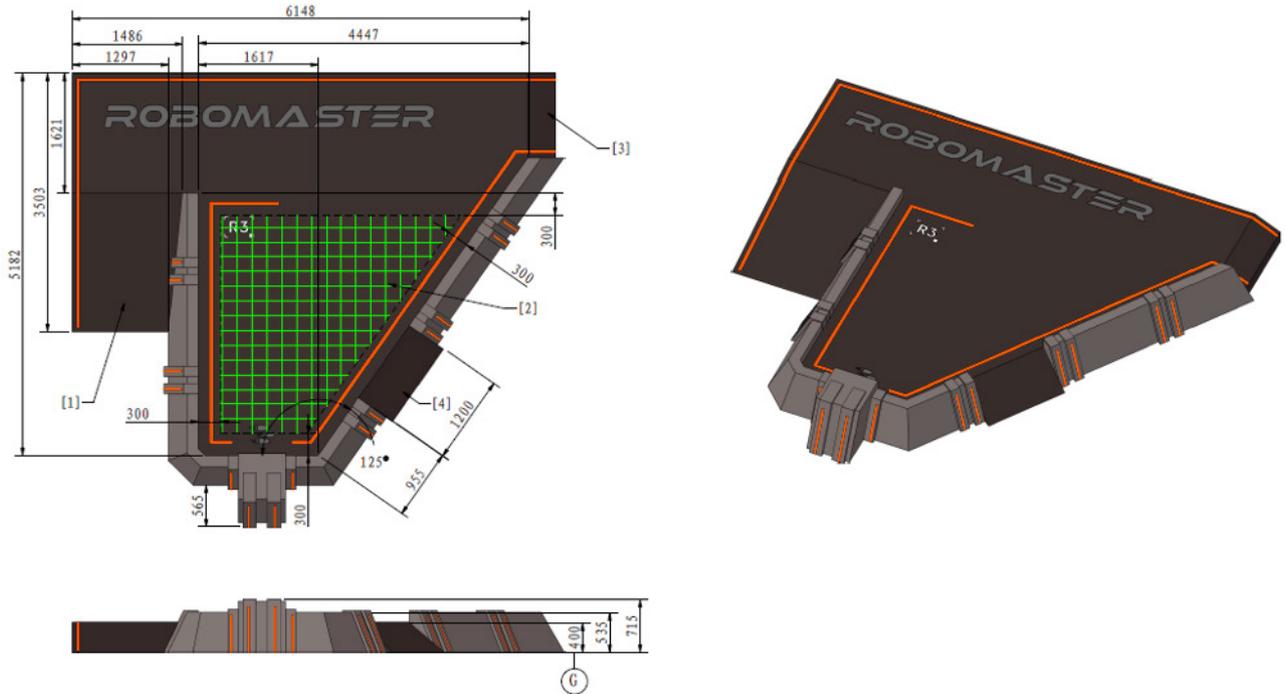
- The parts in the same color represent the same component. Connection and height gaps exist in the assemblage of different components.
- The hexagonal angles of the bolt head are not definite and are for reference only.
- TF-Luna and TOFSense-F radar distance sensors may be mounted on the bottom of both sides of the Sentry Rail, and may have a certain impact on the Sentry's own sensor.

2.3 Elevated Ground

An Elevated Ground is an area higher than the flat ground of the Battlefield. Each side has three Elevated Grounds that divide the Battlefield into different zones and create a three-dimensional space for the Battlefield. 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.

2.3.1 R3 Trapezoid-Shaped Elevated Ground

The R3 Trapezoid-Shaped Elevated Ground is located near the Landing Pad, at a height of 400mm above ground. The height of its perimeter wall is 135mm.



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

Figure 2-26 R3 Trapezoid-Shaped Elevated Ground

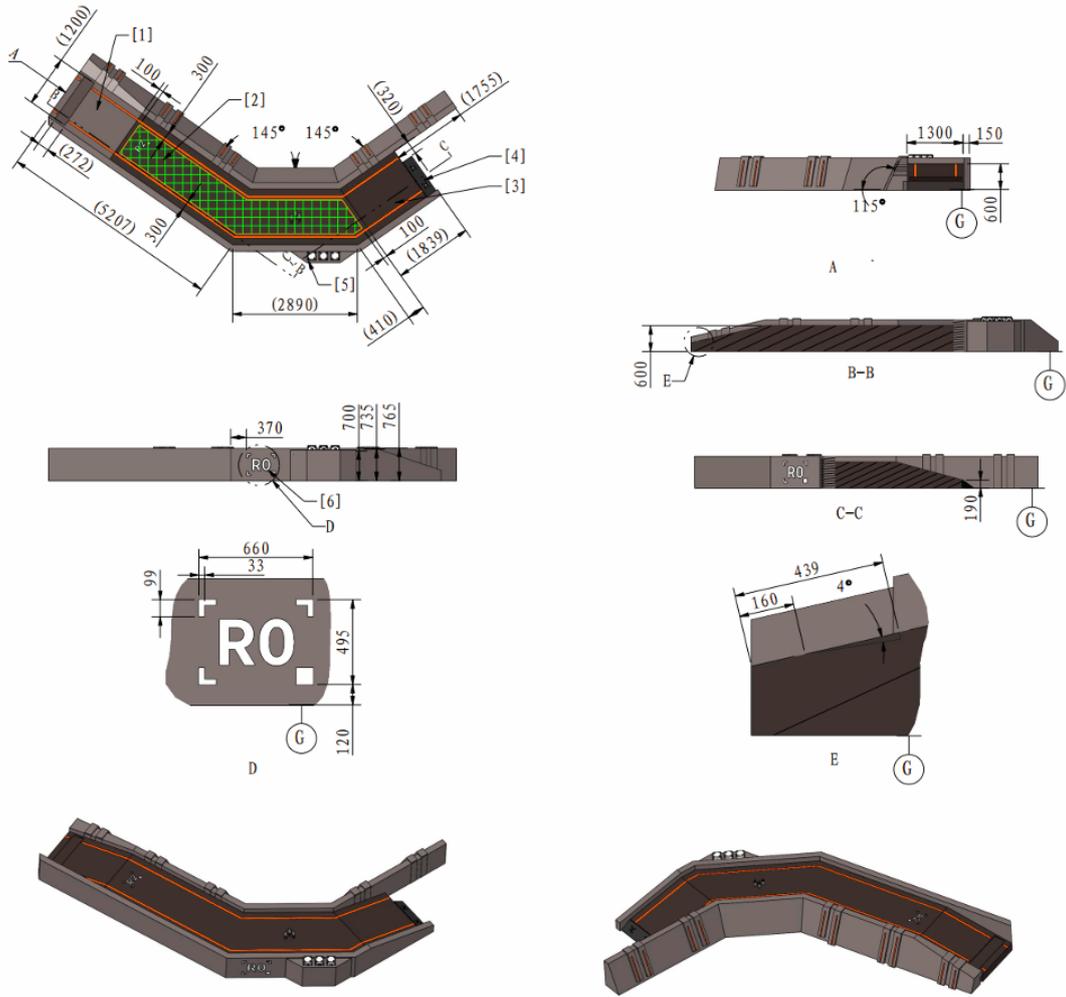
2.3.1.1 R3 Trapezoid-Shaped Elevated Ground Buff Point

The R3 Trapezoid-Shaped Elevated Ground has a Buff Point which is the Sniper Point of the Red Team’s Engineer Robot. Its location is shown in “Figure 2-26 R3 Trapezoid-Shaped Elevated Ground”.

2.3.2 R2 Ring-Shaped Elevated Ground

The R2 Ring-Shaped Elevated Ground is located near the Resource Island Zone, with one end connected to the road through the slope. The Small Resource Island is adjacent to the Ring-Shaped Elevated Ground, and is located outside the protective perimeter wall.

The site localization tag R0 is placed on the vertical surface near the Small Resource Island on the R2 Ring-Shaped Elevated Ground, as shown below. The team’s radar can obtain full-site location information through the Localization Marker.



- [1] 13° slope [2] Elevated Ground Buff Point [3] 15° slope [4] Obstacle Block [5] Small Resource Island

Figure 2-27 R2 Ring-Shaped Elevated Ground



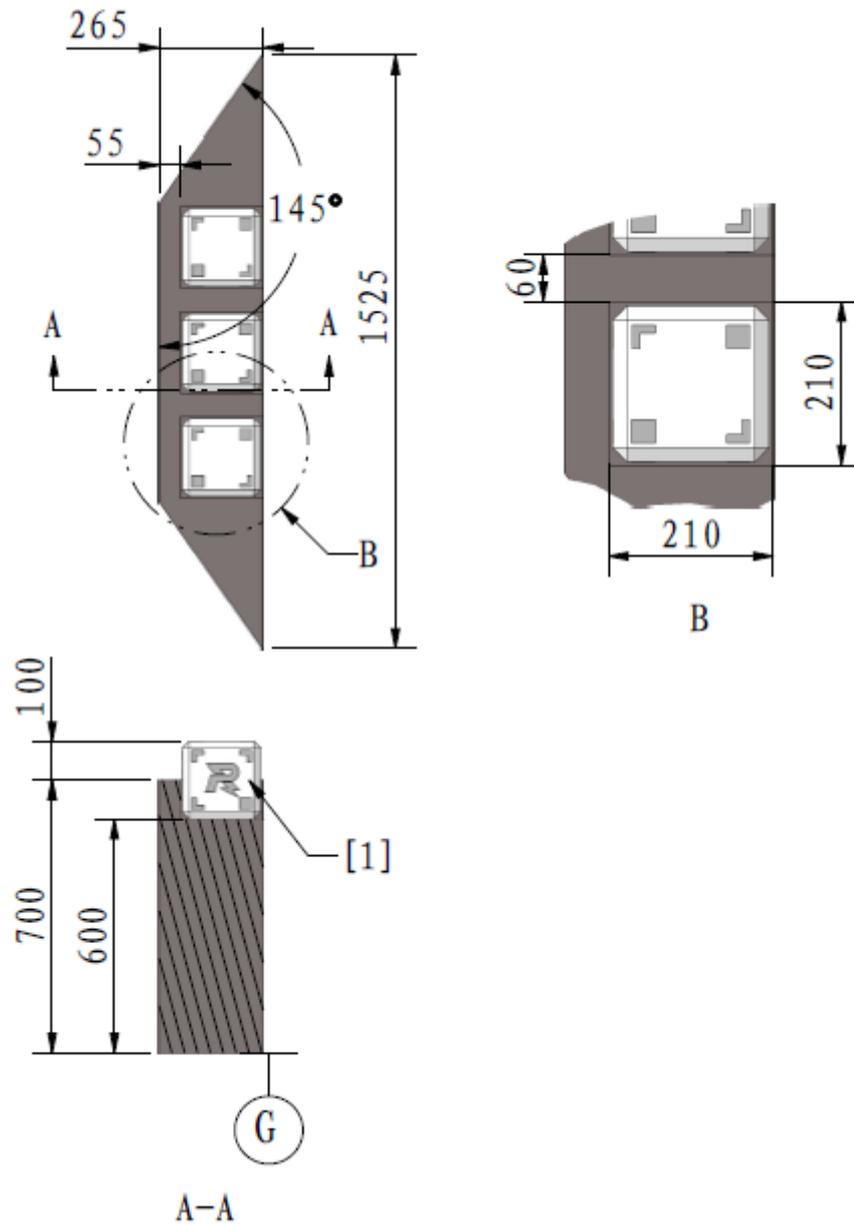
Figure 2-28 Dimensions of the R0 Localization Marker

2.3.2.1 R2 Elevated Ground Buff Point

The R2 Ring-Shaped Elevated Ground has a Buff Point. Its location is as shown in “Figure 2-27 R2 Ring-Shaped Elevated Ground”.

2.3.2.2 Small Resource Island

The Small Resource Island is adjacent to the Ring-Shaped Elevated Ground and located outside the protective perimeter wall. It has three grooves for minerals.

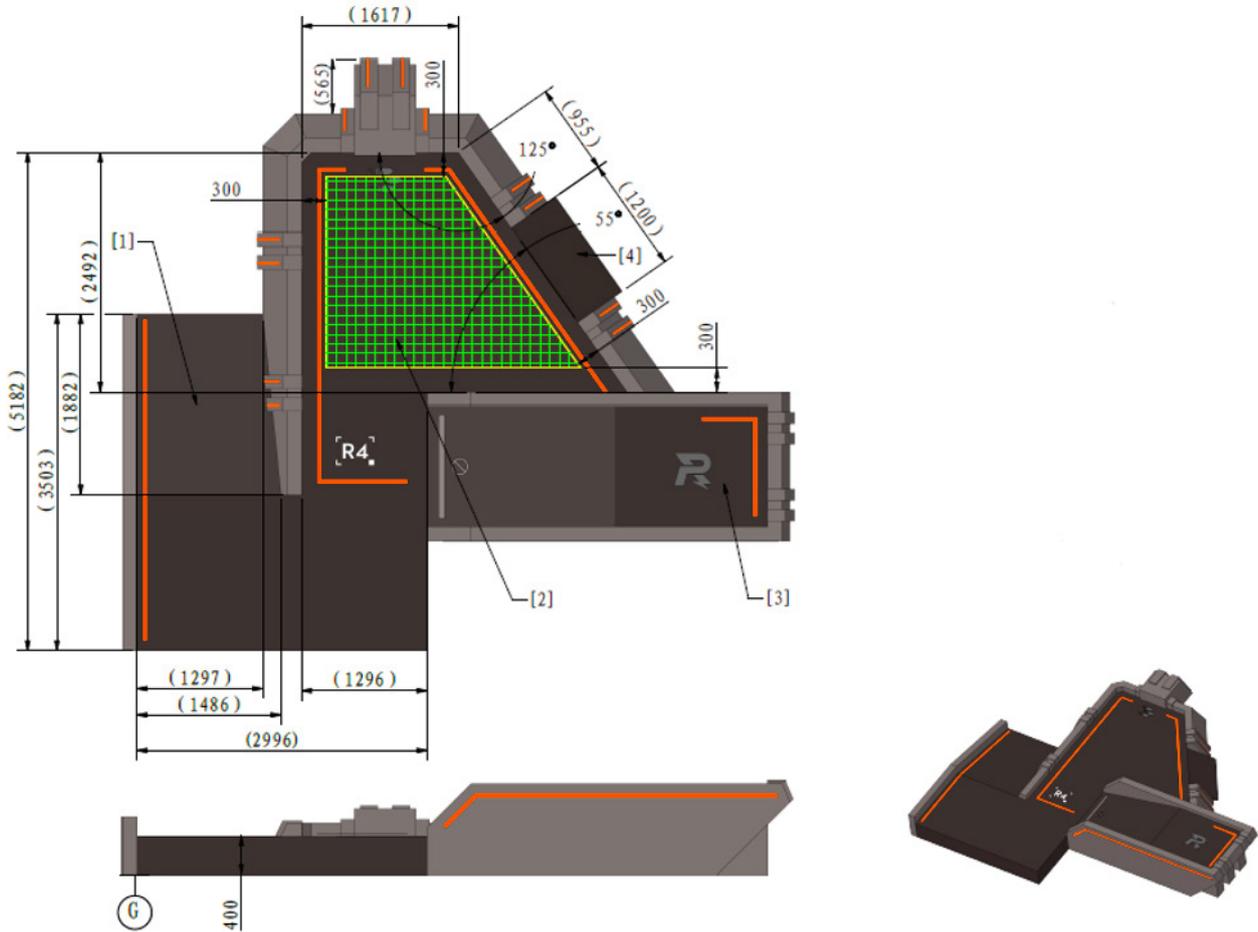


[1] Silver mineral

Figure 2-29 Small Resource Island

2.3.3 R4 Trapezoid-Shaped Elevated Ground

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



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

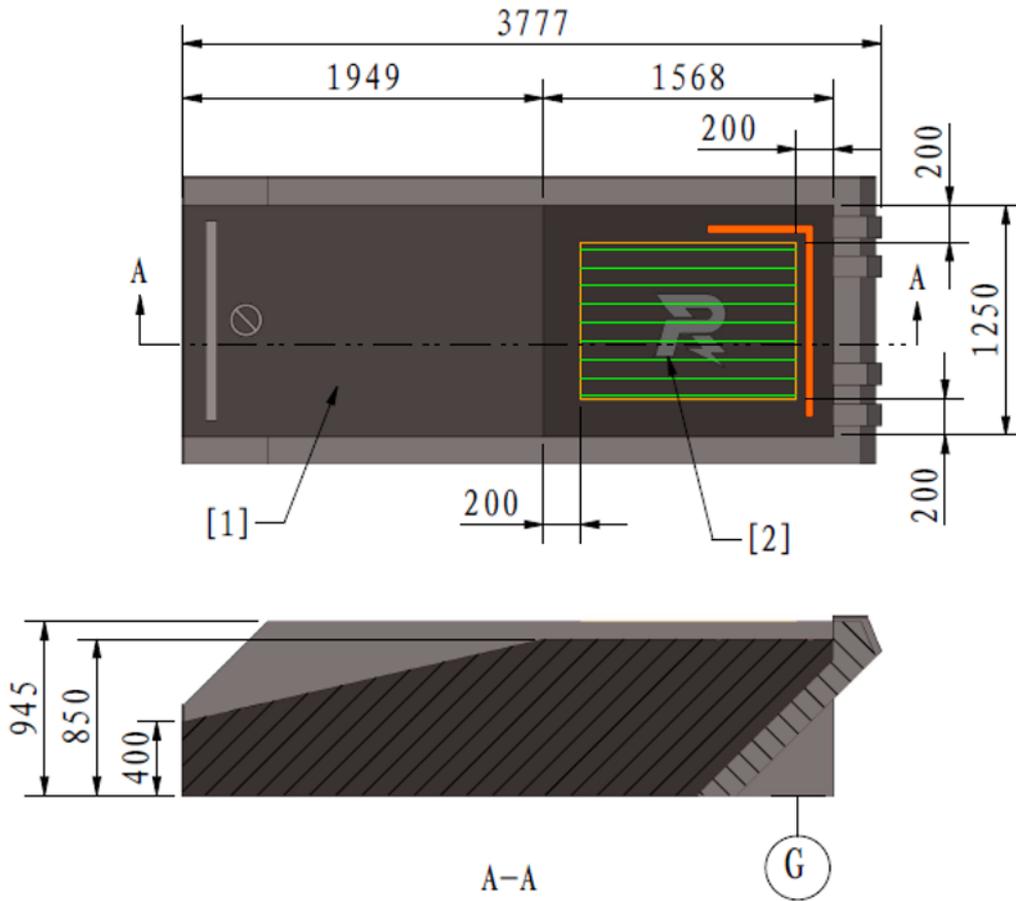
Figure 2-30 R4 Trapezoid-Shaped Elevated Ground

2.3.3.1 R4 Trapezoid-Shaped Elevated Ground Buff Point

The R4 Trapezoid-Shaped Elevated Ground has a Buff Point. Its location is as shown in “Figure 2-30 R4 Trapezoid-Shaped Elevated Ground”.

2.3.4 Power Rune Activation Point

The Power Rune Activation Point is where a robot hits to activate the Power Rune, and is located on the R4 Trapezoid-Shaped Elevated Ground. The activation point is connected to the R4 Trapezoid-Shaped Elevated Ground through the slope.

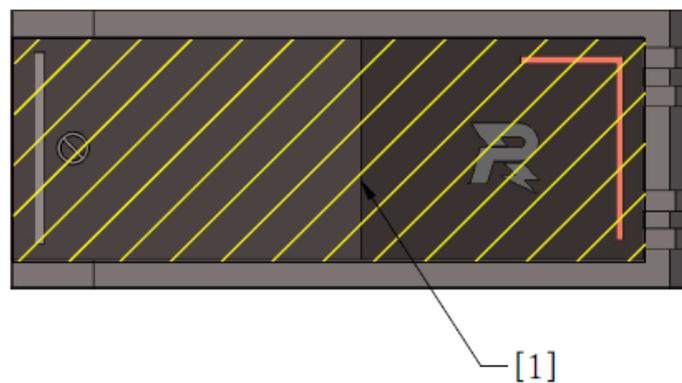


[1] 13° slope [2] Power Rune Activation Point

Figure 2-31 Power Rune Activation Point

2.3.4.1 Power Rune Activation Point Penalty Zone

The Power Rune Activation Point and the slope connecting the Power Rune Activation Point and R4 Trapezoid-Shaped Elevated Ground are the Power Rune Activation Point Penalty Zone.

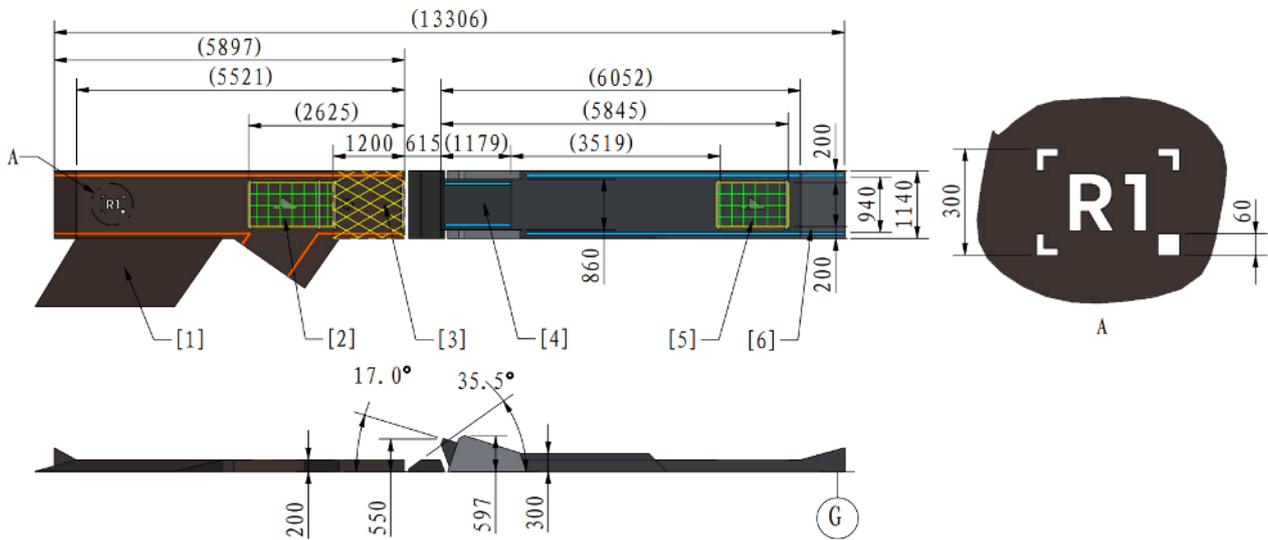


[1] Power Rune Activation Point Penalty Zone

Figure 2-32 Power Rune Activation Point Penalty Zone

2.3.5 Road Zone

The Road Zone connects the R3 Trapezoid-Shaped Elevated Ground of one side and the B4 Trapezoid-Shaped Elevated Ground of the other side. The Road Zone includes the road and the Launch Ramp.

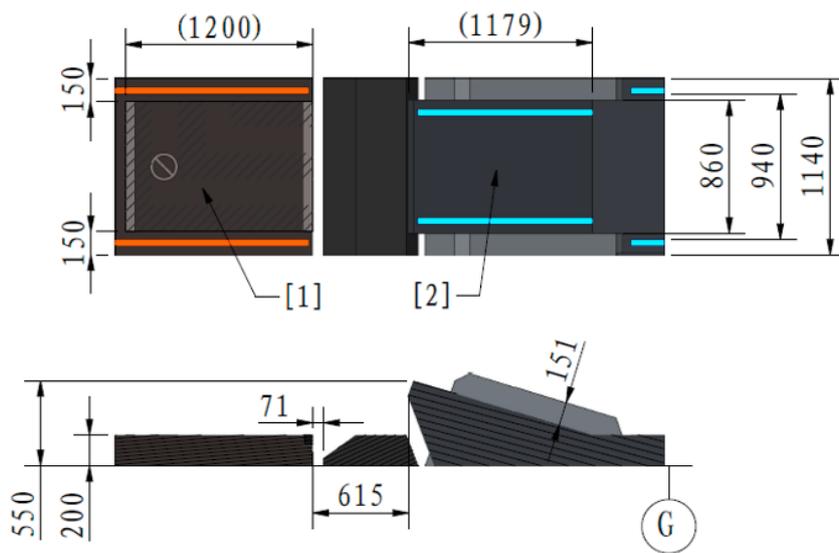


- [1] 9° slope [2] Launch Ramp Buff Point 1 [3] Road Penalty Zone
- [4] 17° slope [5] Launch Ramp Buff Point 2 [6] 15° slope

Figure 2-33 Road Zone

2.3.5.1 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 1200 mm from the edge of the ravine is the Buffer Zone. EVA foam rubber with a thickness of 100 mm and hardness of 25 HC should be placed under the road surface.



- [1] Buffer zone [2] 17° slope

Figure 2-34 Launch Ramp

2.3.5.2 Launch Ramp Buff Point

Each road has two Launch Ramp Buff Points. They are located respectively on the road surfaces in front of and behind the Launch Ramp, as shown in “Figure 2-33 Road Zone”.

2.3.5.3 Road Penalty Zone

The Buffer Zone on the road is a Road Penalty Zone. Apart from using the Launch Ramp, neither team’s robots are allowed to enter the zone. Its location is as shown in Figure 2-33 Road Zone.

2.4 Open Zone

The ground areas outside the Base Zones of both teams are the Open Zone, which consists of the Outpost and Resource Island. Part of the Open Zone are Bumpy Roads.

2.4.1 Resource Island

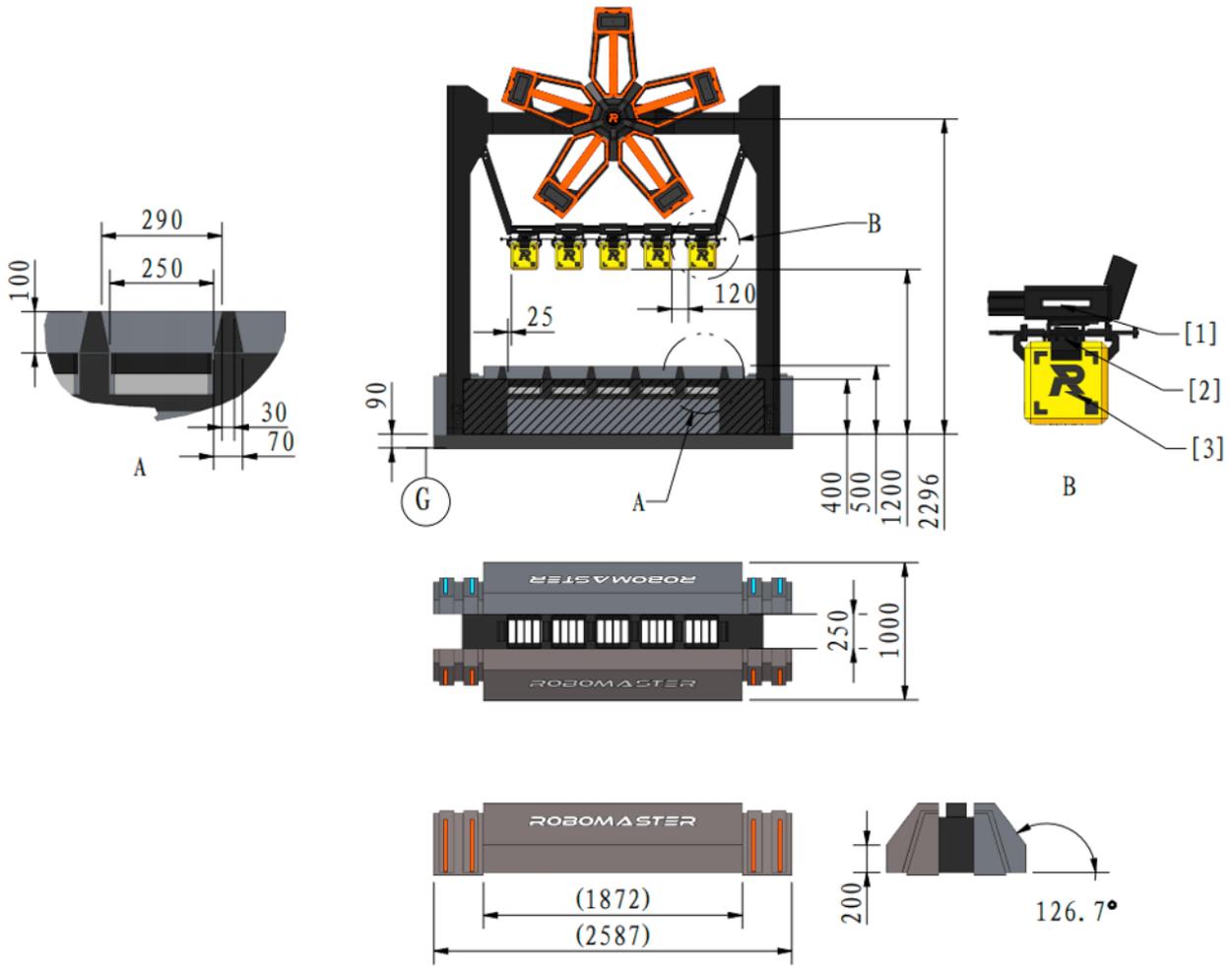
The Resource Island is located directly under the Power Rune at the center of the Battlefield. It consists of the mechanical claws and the Resource Island Base. There are five sets of mechanical claws, each holding a mineral after the competition starts. The claws will drop their minerals into the corresponding slot in the Resource Island Foundation during the competition. Each set of mechanical claws has two light indicators. For explanations of the light effects, refer to “Table 3-18 Descriptions of Light Effects on the Site”.

-
- When a mineral is dropped, the side with the barcode will be facing down.
- 💡 ● After a mineral is dropped, its position may differ from before, where the side with the barcode may not be facing down.
- The mineral may not necessarily fall squarely in the slot of the Resource Island Base.
-



[1] Power Rune [2] Resource Island mechanical claw [3] Resource Island Base

Figure 2-35 Axonometric View of Resource Island

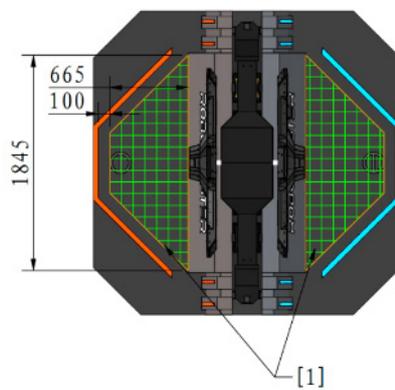


[1] Status Light Indicators [2] Mechanical Claw [3] Gold mineral

Figure 2-36 Dimensions of Resource Island

2.4.1.1 Resource Island Buff Point

The Resource Island Buff Points are located on both sides of the Resource Island. Engineer robots that occupy the buff points will earn a 50% defense buff. For details, please refer to “3.6.6 Resource Island Buff Mechanism”.

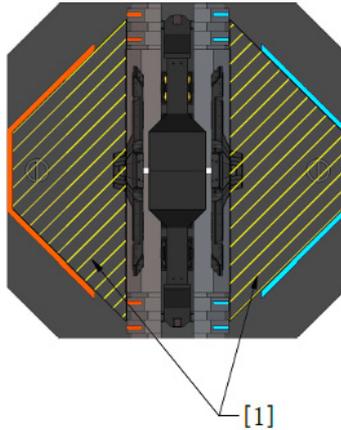


[1] Resource Island Buff Point

Figure 2-37 Resource Island Buff Point

2.4.1.2 Resource Island Penalty Zone

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



[1] Resource Island Penalty Zone

Figure 2-38 Resource Island Penalty Zone

2.4.1.3 Power Rune



- 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 Power Rune is located directly above the Resource Island. The Power Rune is powered by the motor and rotates 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 one side and that of the blue team are located on the other. The Power Runes of both teams rotate on the same axis.

A Power Rune has five light arms that are distributed evenly. The end of each light arm is installed with a Large Armor Module. The specific location and dimensions of the Large Armor Module are as follows:

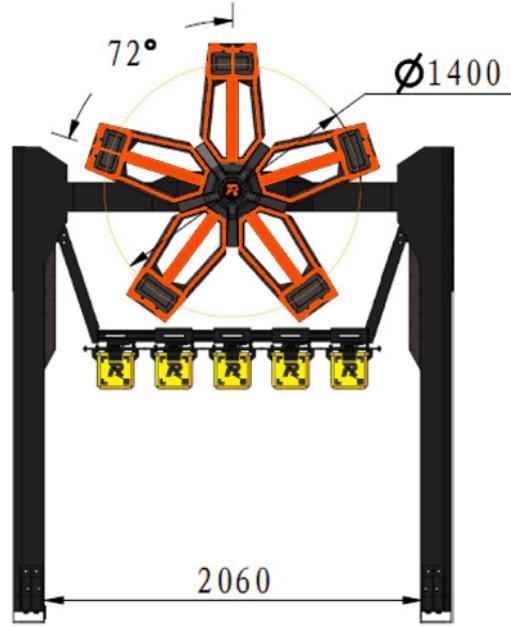


Figure 2-39 Power Rune

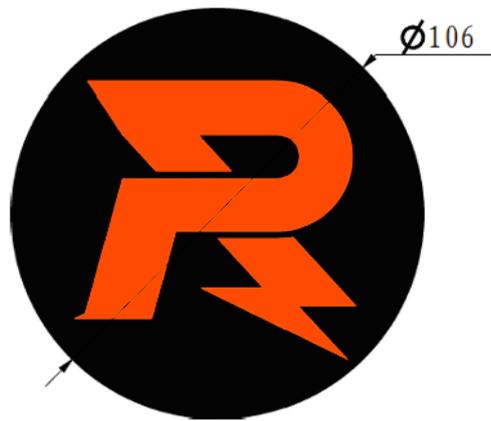
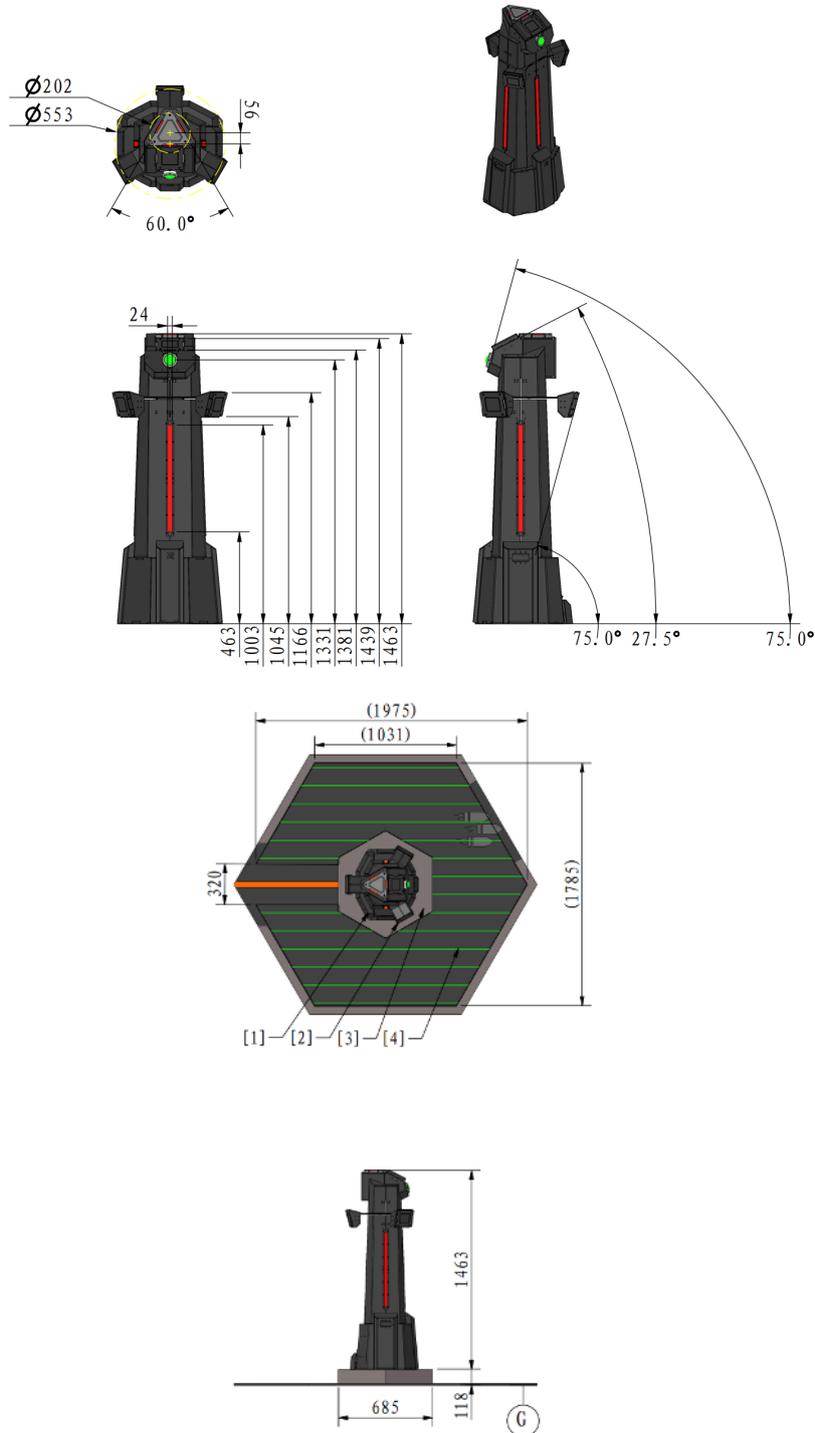


Figure 2-40 Central Logo of the Power Rune

2.4.2 Outpost

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

The Armor Module is divided into the Triangular Armor Module at the top and Rotating Armor Module in the middle. Refer to “Figure 2-10” for a drawing of the Dart Detection Module.



- [1] Outpost [2] Rotating Armor [3] Outpost Base [4] Outpost Buff Point

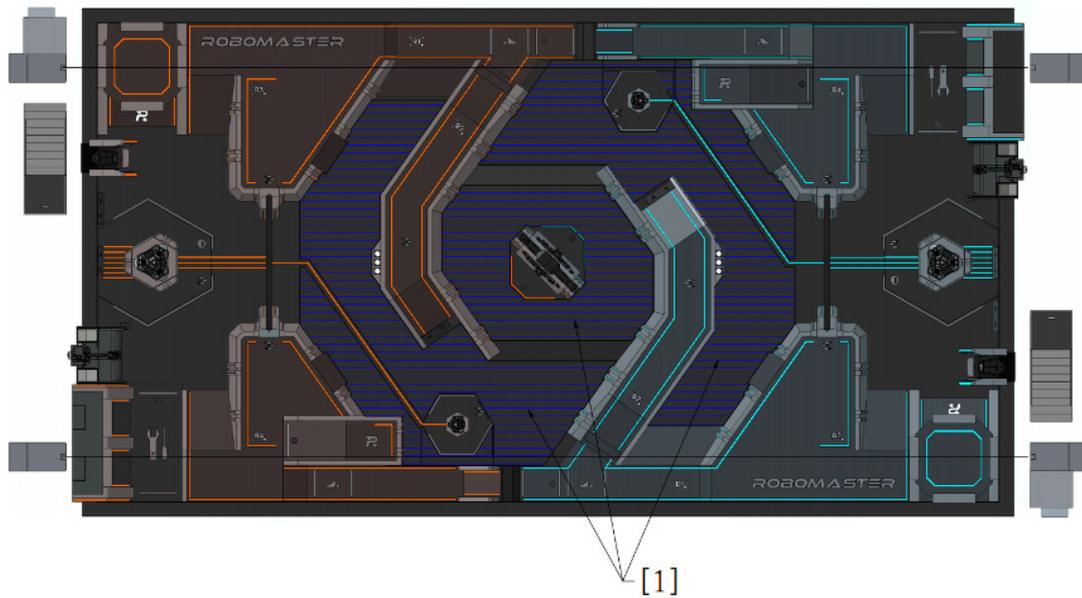
Figure 2-41 Outpost

2.4.2.1 Outpost Buff Point

The Outpost Buff Points are located around the Outpost. Their locations are as shown in “Figure 2-41 Outpost”.

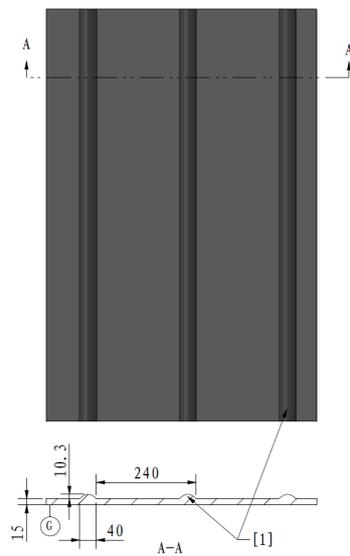
2.4.3 Bumpy Roads

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



[1] Bumpy Roads

Figure 2-42 Bumpy Roads



[1] Bump

Figure 2-43 Illustration of the Bumps

2.5 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.

2.5.1 Aerial Safety Rope

An Aerial Robot must be attached with an Aerial Safety Rope during a match to ensure the robot's safety. The robot's flight distance is restricted by the snap ring of the Aerial Safety Rope. The maximum total travel distance is 16 m. When an Aerial flies to the furthest location, the indicator on the retrieval device of the Aerial Safety Rope will flash at a frequency of 2 Hz. The Pilot will be able to see yellow flashes from the indicator through the goggles. To ensure flight safety, a Pilot is not allowed to fly an Aerial forward.

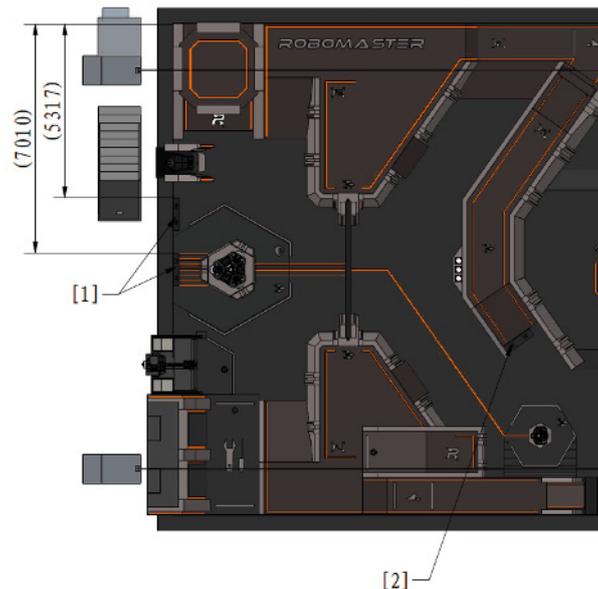
2.6 Miscellaneous

2.6.1 Mobile Battlefield Components

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

2.6.1.1 Obstacle Block

An obstacle block is an EVA right triangular prism, with a surface and internal hardness of $60\pm 5\text{HC}$ and $38\pm 5\text{HC}$ respectively, and a weight of about 2,250g. Each team has three obstacle blocks on the battlefield. Both teams' robots are allowed to use all of the six obstacle blocks. Four blocks are located near the Bases of both teams with their shorter sides in contact with the ground, and the other two blocks are located on the declining ramps of both teams' Ring-Shaped Elevated Grounds with their longer sides in contact with the ground.



[1] Obstacle blocks in Starting Zone [2] Obstacle blocks in Ring-Shaped Elevated Grounds

Figure 2-44 Initial position of an obstacle block

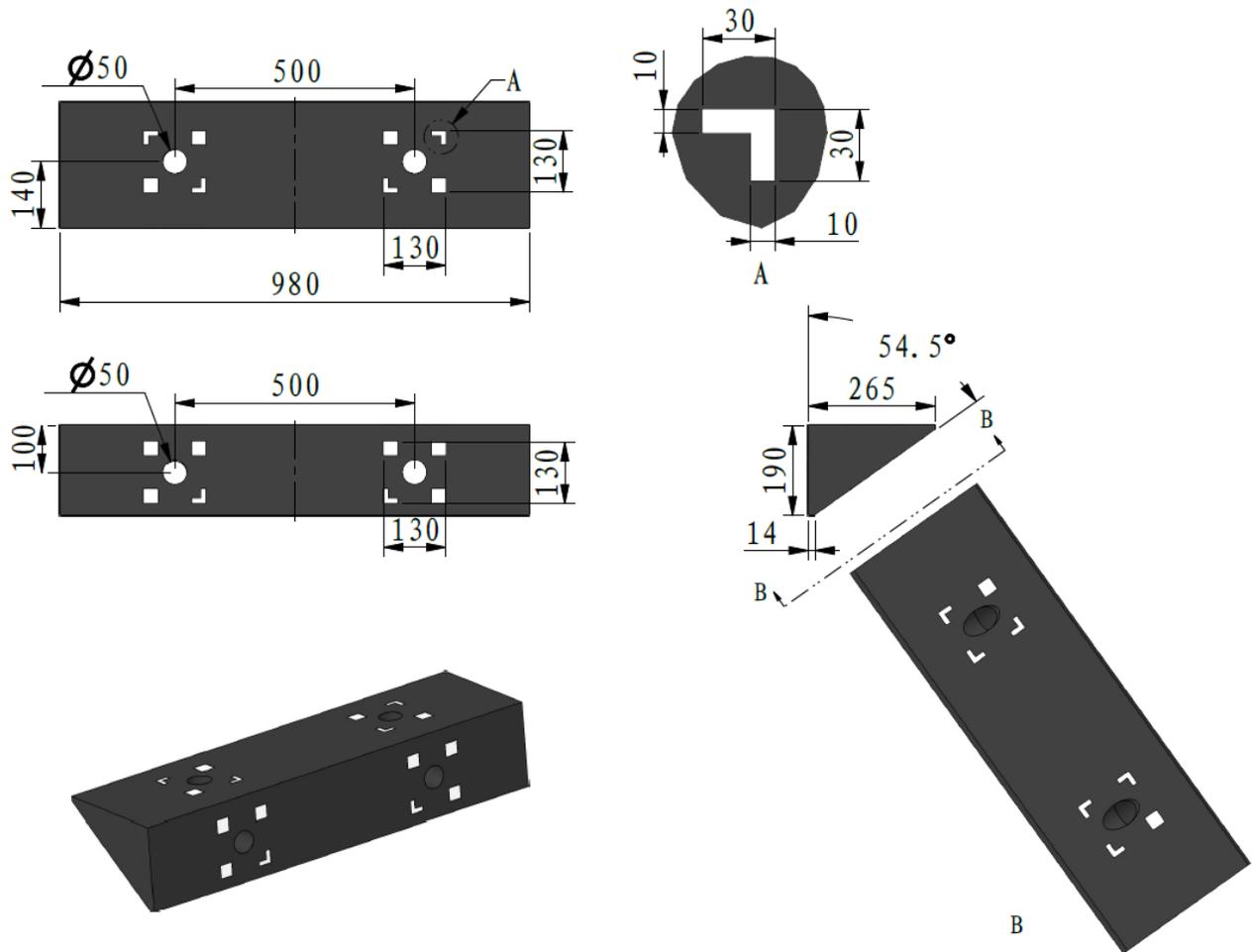


Figure 2-45 Obstacle blocks

2.6.1.2 Minerals

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

Resource Island Minerals (“Gold Minerals”):

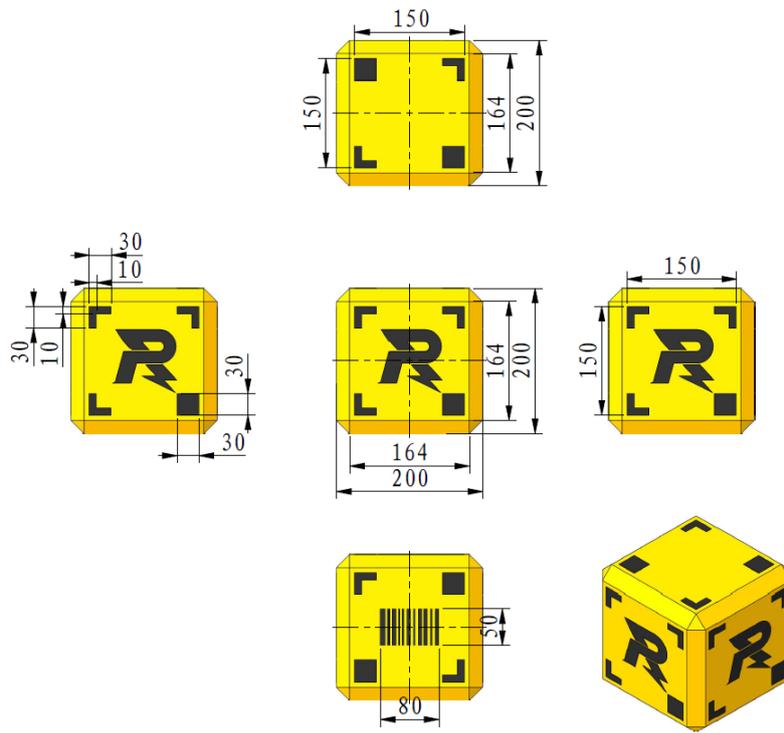


Figure 2-46 Gold minerals

Small Resource Island Minerals (“Silver Minerals”):

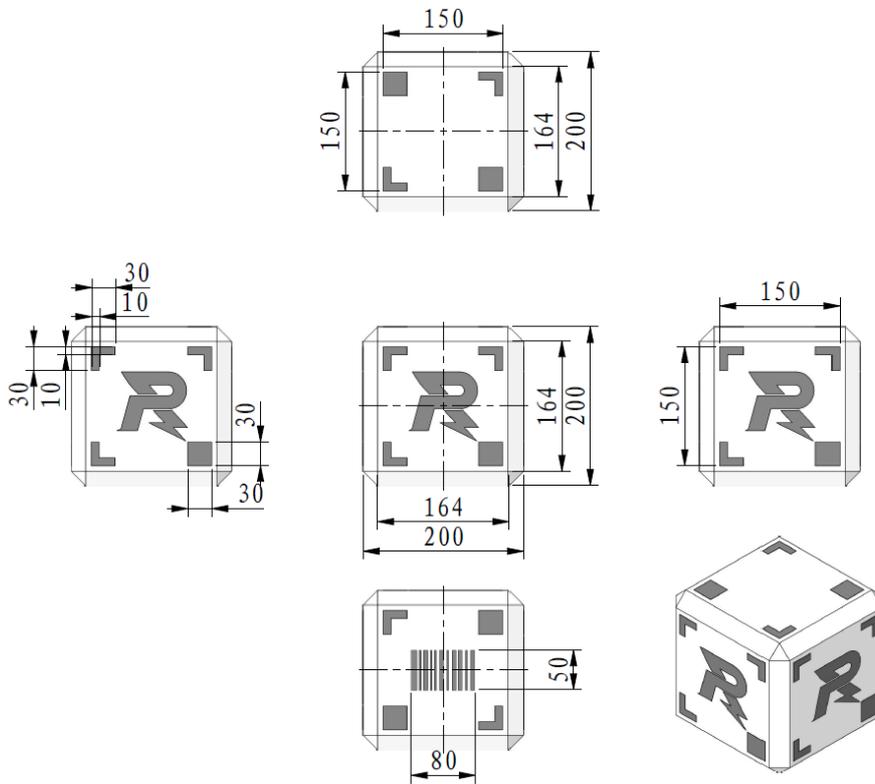


Figure 2-47 Silver minerals

2.6.2 Projectiles

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

Table 2-1 Projectile Parameters and Scenarios of Use

Type	Appearance	Color	Size	Weight	Shore Hardness	Material	Scenarios of Use
42mm projectile	Similar to a golf ball	White	42.5 mm ± 0.5 mm	41 g ± 1 g	90 A	Plastic (TPE)	Invitational Competition
42mm Luminous Projectile	Similar to a golf ball	Semi-transparent	42.5 mm ± 0.5 mm	43 g±0.5 g	90 A	Plastic (TPE)	Wild Card Competition, Final Tournament
17mm Fluorescent Projectile	Spherical	Yellow-green	16.8 mm ± 0.2 mm	3.2 g ± 0.1 g	90 A	Plastic (TPU)	The entire RMUC 2022

2.6.3 Engineer Rescue Card

The size of an Engineer Rescue Card is 110*90mm. It can be used for speeding up the revival process of one team’s robots.

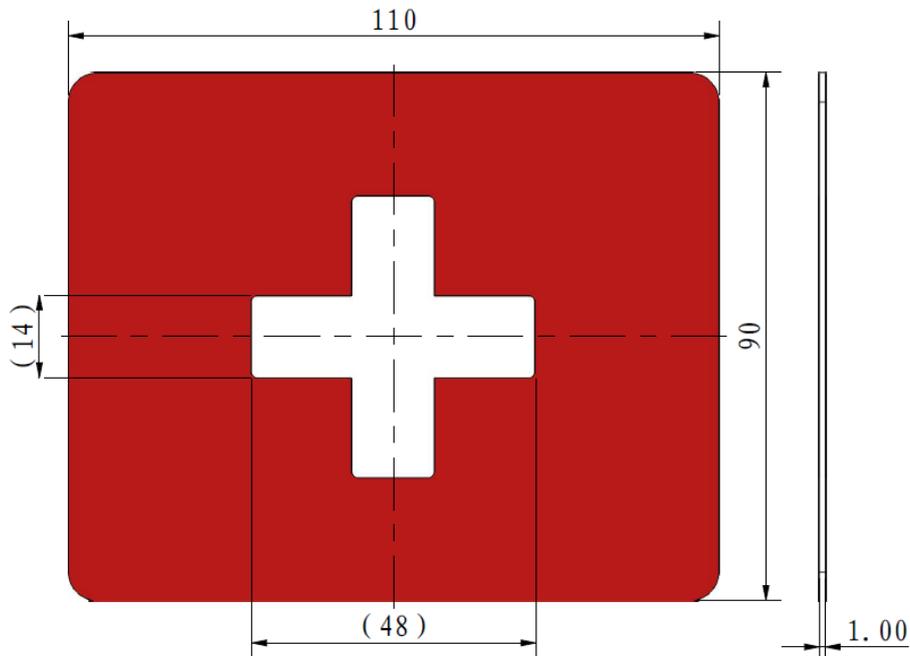


Figure 2-48 Engineer Rescue Card

2.6.4 Localization Markers

There are several markers in the battlefield that enable the localization of robots. The patterns will not be repeated and are asymmetrical in all directions.

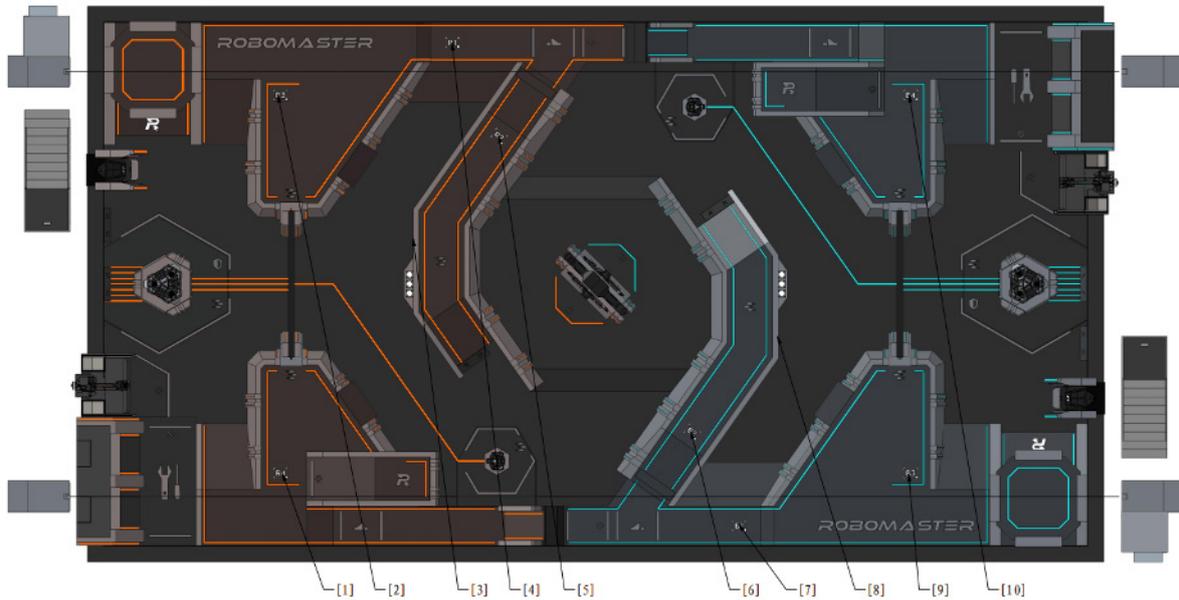


Figure 2-49 Localization Markers

Table 2-2 Coordinates of the Localization Markers

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



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

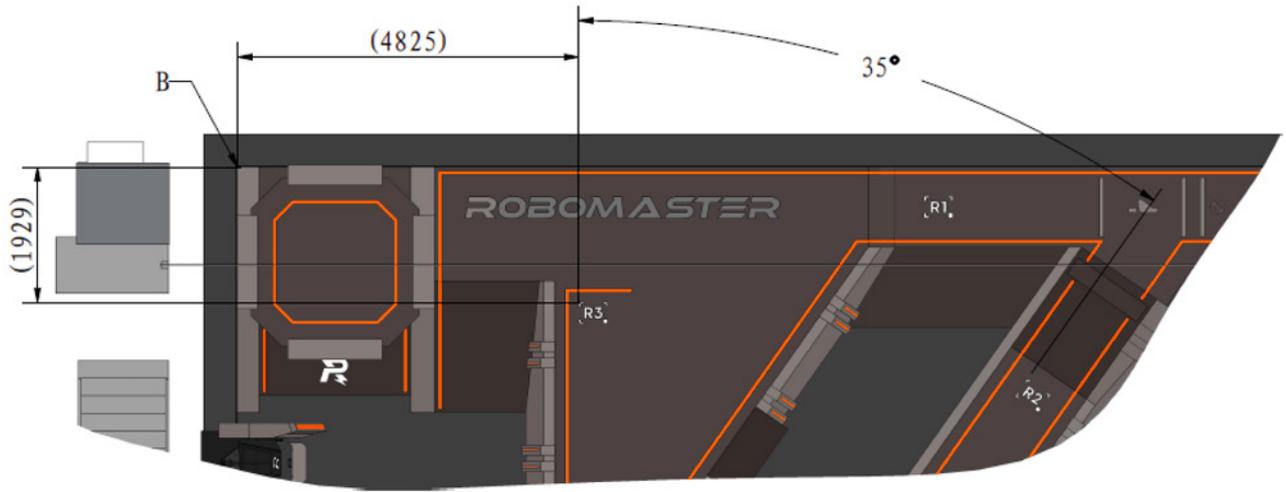


Figure 2-50 Illustrations of the Origin of the Coordinates and Included Angle

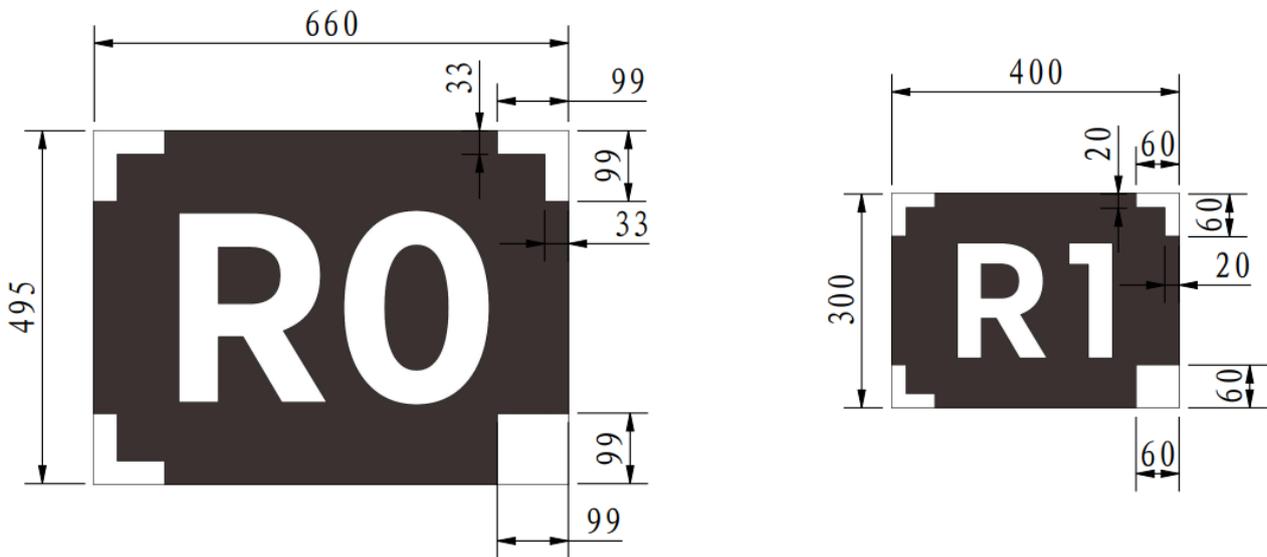


Figure 2-51 Dimensions of the Localization Markers



The dimensions are the same for tags R1 to R4.

2.6.5 Operator Room

Operator Room lies outside the Battlefield and is an area for Operators during the competition. Operator Room consists of Main Operator Room and Pilot Room. Each 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 Aerial Gimbal Operator is equipped with two displays, one showing the video-transmitted images from the Aerial Robot and the other showing the source images transmitted from the Radar. The Pilot Room is located in an area near the Landing Pad outside the Battlefield, as shown in “Figure 2-4 Battlefield Modules”.

3. Competition Mechanism

3.1 Robot Status and Gain Type

During the competition, the robot has different statuses, as follows:

Table 3-1 Robot Status

Status	Definition
Survival	When the robot's HP is not zero
Defeat	Where a robot's HP drops to zero after its Armor Module has been attacked or hit; it has exceeded its Chassis Power Consumption limit, Initial Launching Speed limit or Barrel Heat limit; its Referee System module has gone offline, etc.
Invincible	When a robot receives a 100% Defense Buff
	 The Invincible status also applies to the Base and Outpost.
Ejection	Where a robot is ejected directly by the Referee System as a penalty after being issued with a Red Card or having accumulated 8 violation scores.
Offline	The Referee System Main Controller Module is unable to connect to the Referee System Server due to power outage on the robot or other reasons.
Temporary Activation	After a robot is defeated or ejected, the referee may revive the robot temporarily and instruct the relevant operator to control the robot. The Launching Mechanism for the robot will be powered off. The referee can discontinue the temporarily activated status of the robot at any time. After termination, the robot will reset to its status before the temporary activation.



After a robot is defeated or ejected, the Referee System will cut off power supply to the robot (except for the Mini PC).

Robots can gain corresponding gain by completing certain mission. The gain types are as follows:

Table 3-2 Robot Buffs

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

3.2 HP Deduction Mechanism

The HP of ground robots and Sentry will be deducted in any of the following situations: the Barrel Heat limit, Initial Launching Speed limit or Maximum Chassis Power Consumption of a Launching Mechanism is exceeded; an Armor Module is attacked by a projectile or strike; an important module of the Referee System goes offline; penalty for violation of rules; etc.

The Referee System will round down the HP deduction and keep the integer when calculating the HP.

3.2.1 Exceeding the Initial Launching Speed Limit

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

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

Table 3-3 Penalty Mechanism for Exceeding Initial Launching Speed Limit

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

3.2.2 Barrel Overheating and Cooling

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

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



Figure 3-1 FPV of Client

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

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

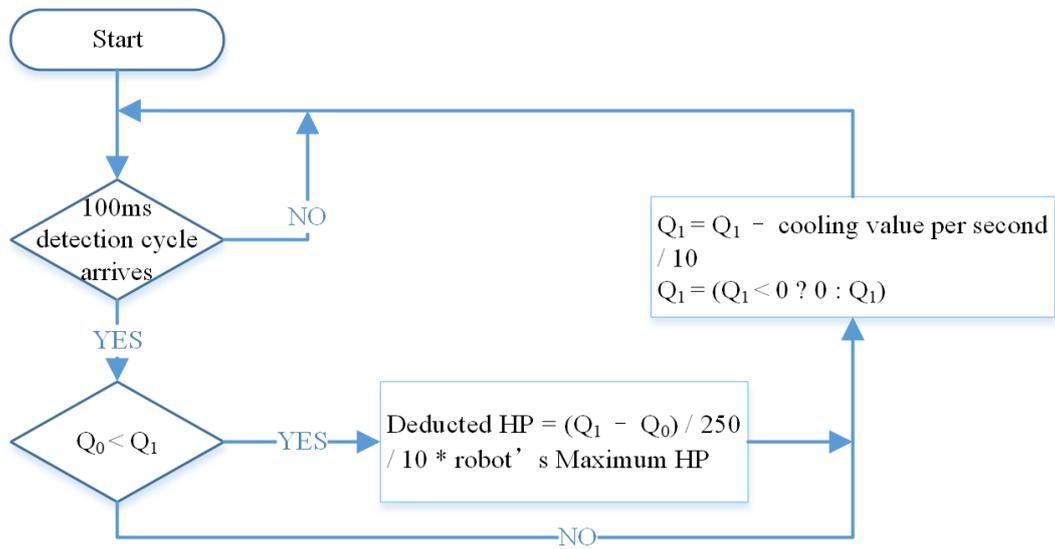
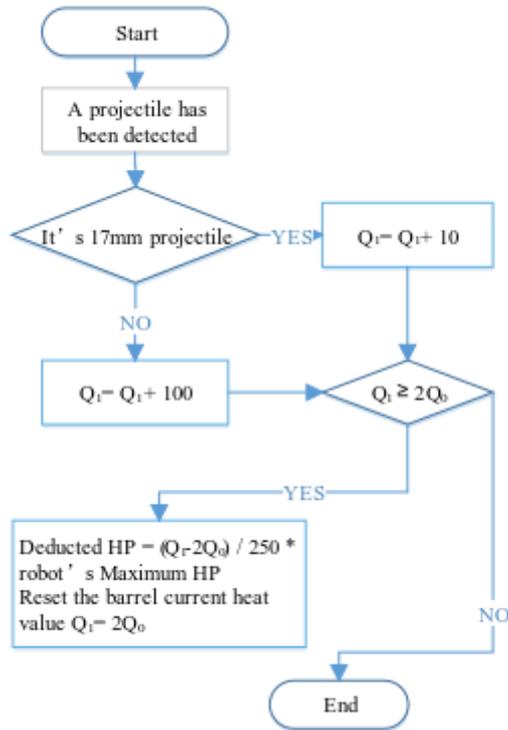


Figure 3-2 (Above) HP Deduction Logic and (Below) Cooling Logic when Barrel Heat Limit is Exceeded

3.2.3 Exceeding Chassis Power Consumption Limit

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

The buffer energy (Z) of Sentry is 200J; while the Z values of Standard or Hero may differ according to these two scenarios:

- If Standard or Hero has not triggered the Launch Ramp Buff, its buffer energy limit is 60J.
- If Standard or Hero has triggered the Launch Ramp Buff, its buffer energy limit increases to 250J. If the buffer energy reaches below 60J after subsequent consumption, it can be restored up to 60J. Refer to “3.6.3 Launch Ramp Buff Mechanism” for details on the Launch Ramp buff mechanism.

Standard and Hero:

After the buffer energy has been depleted, if the Chassis Power Consumption of a Standard or Hero Robot exceeds the limit, the deducted HP in each detection cycle = Maximum HP * N% * 0.1.

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

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

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

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

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

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

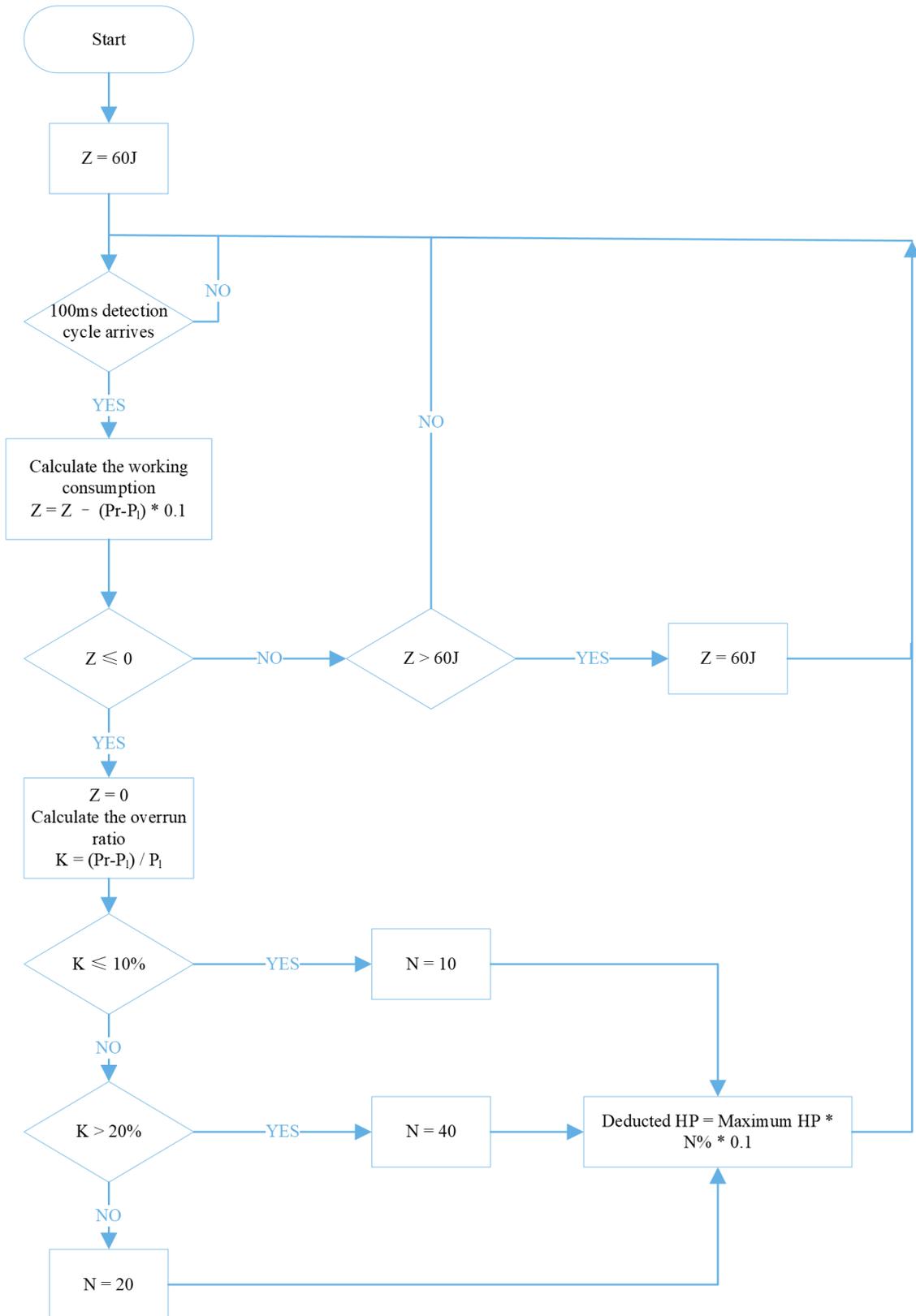


Figure 3-3 Chassis Power Consumption Detection and HP Deduction Logic of Standard and Hero Robots

Sentry:

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

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

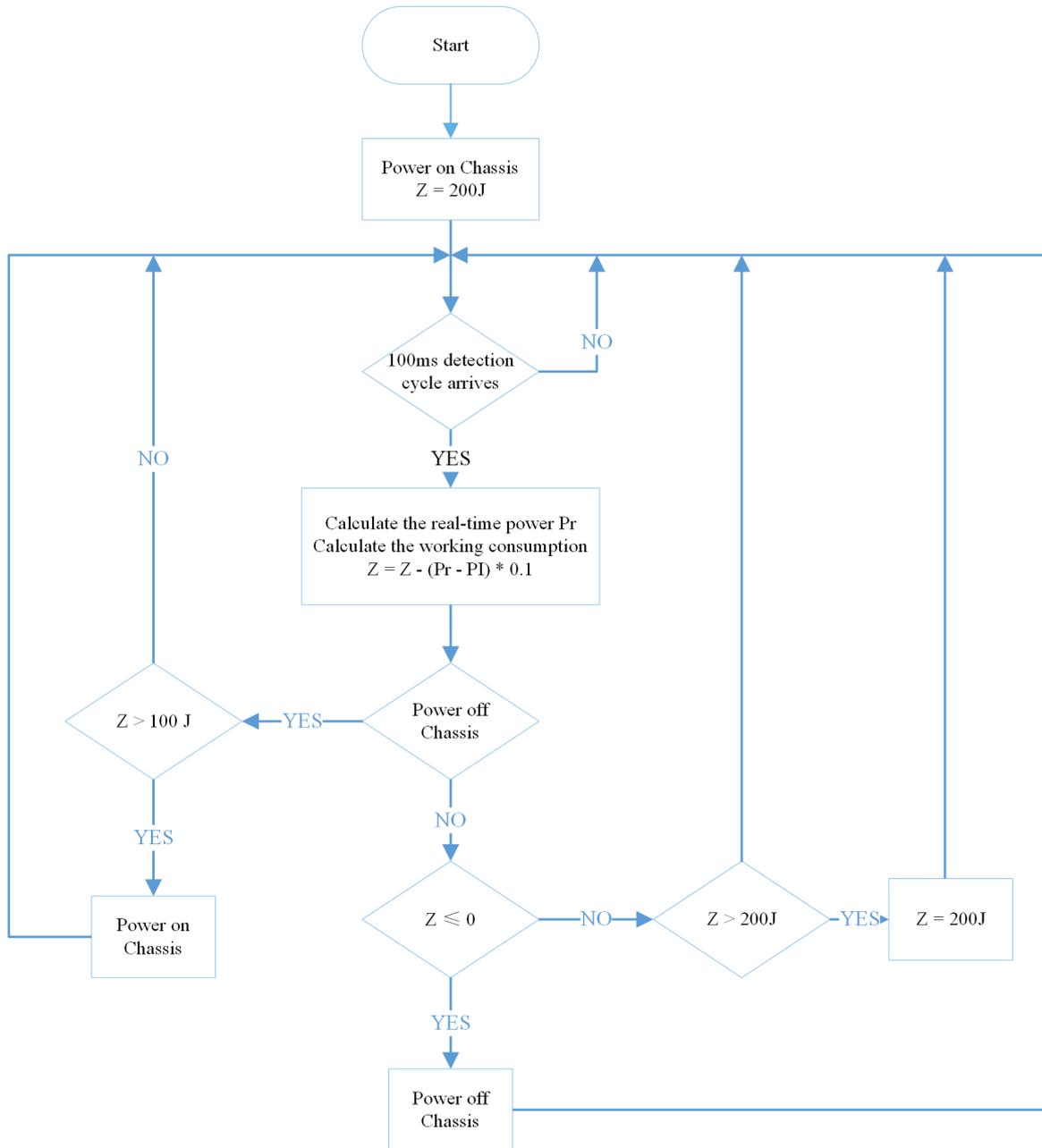


Figure 3-4 Chassis Power Consumption Detection and Chassis Power-off Logic of Sentry Robots

3.2.4 Attack Damage

The Dart Detection Module detects attacks from Darts and 42mm projectiles through the Armor Module and the phototube. The interval for dart detection is one second.

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 42mm 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 3-5 An Armor Module’s Detection Speed for Different Projectile Types

Armor Module	17mm projectile	42mm projectile
Large Armor Module, Small Armor Module	Higher than 12m/s	Higher than 8m/s
Triangular Armor Module	Not detected	Higher than 6m/s



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

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

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

Table 3-6 HP Deduction Mechanism for Attack Damage

Damage type	HP Damage Value
42mm projectile	<ul style="list-style-type: none"> ● Robot Armor Module: 100 ● Base and Outpost Armor Modules: 200 ● Triangle Armor Module of the Base and Outpost: 300
17mm projectile	<ul style="list-style-type: none"> ● Robot Armor Module: 10 ● Base and Outpost Armor Modules: 5
Collision	<ul style="list-style-type: none"> ● Robot Armor Module: 2 ● Base and Outpost Armor Modules: 2 ● Base, Triangular Armor Module of Outpost, Dart Detection Module: 0
Dart	<ul style="list-style-type: none"> ● Base: 1,000 ● Outpost: 750

3.2.5 Referee System Going Offline

According to the latest version of the “RoboMaster 2022 University Series Robot Building Specifications Manual”, robots must be mounted with their corresponding Referee System Modules, and each Referee System Module must have a stable connection to its server throughout the competition. The Referee System server detects the connectivity of each module at a frequency of 2 Hz. If important Referee System Modules go offline due to design or structural problems, it will result in the deduction of the HP of the corresponding Ground Robots and Sentry Robots



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

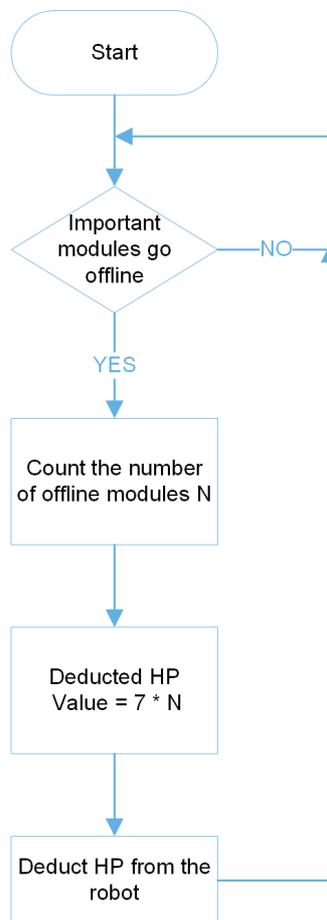


Figure 3-5 HP Deduction Mechanism for Important Referee System Modules When Offline

3.2.6 Irregular Offline Status

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

Table 3-7 Consequences of Offline Status

Robot Type	Consequences of irregular offline status
<p>Standard and Hero Robots</p>	<ul style="list-style-type: none"> ● When the power supply to the Launching Mechanism, Gimbal and Chassis is cut off, 5% of the Maximum HP is deducted for each second elapsed until it drops to zero. ● The RFID Interaction Module is disabled. ● The robot no longer detects any damage caused by collision or projectile attacks.
<p>Engineer robot</p>	<ul style="list-style-type: none"> ● When the power supply to the Gimbal and Chassis is cut off, 5% of the Maximum HP is deducted for each second passed by until it drops to zero. ● The RFID Interaction Module and RFID Interaction Module Card are disabled. ● The robot no longer detects any damage caused by collision or projectile attacks.
<p>Sentry Robot</p>	<ul style="list-style-type: none"> ● When the power supply to the Launching Mechanism, Gimbal and Chassis is cut off, 5% of the Maximum HP is deducted for each second elapsed until it drops to zero. ● The robot no longer detects any damage caused by collision or projectile attacks.
<p>Aerial Robot</p>	<p>The Launching Mechanism is powered off and Air Support cannot be called.</p>

3.3 Economic System

During the competition, both teams will earn gold coins regularly. They can also exchange minerals for additional coins. The gold coins can be used to redeem projectiles, call for air support, redeem 42mm projectile allowance for Hero Robots, etc.

After the competition starts, each team will have 200 initial coins. For every following minute, 100 gold coins will be given to each team until the fifth minute (when countdown is at 1:59). Both teams will receive 200 gold coins at the sixth minute (when countdown is at 0:59).

The score obtained by a team for its “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 the Technical Proposal score is as follows:



Degree of Impact	Technical Proposal Score
-25 gold coins	[0, 60)
0	[60, 80)

+25 gold coins	[80, 90)
+50 gold coins	[90, 100]

Each silver mineral can be exchanged for 100 gold coins. Each gold mineral can be exchanged for 300 gold coins.

Table 3-8 Rules of Redemption

Item for Exchange	Redemption ratio	Redemption limit
17mm projectile	50 coins/50 rounds	1500 rounds (including projectiles launched by the Automatic Standard Robots)
42mm projectile	75 coins/5 rounds	100 rounds
Air support	First Time: 0 coins; Second Time: 300 coins; Third Time: 300 coins After air support has been requested, the Aerial Robot will be able to launch 500 rounds of 17mm projectiles over 30 seconds (no coins need to be spent for the projectiles)	Three Times

3.3.1 17mm Projectile Redemption Mechanism

No projectiles need to be purchased for Automatic Standard Robots at the Official Projectile Supplier. They can be pre-loaded with a certain amount of 17mm projectiles before the competition. During the match, the Referee System will automatically deduct one gold coin from the relevant team for each launched 17mm projectile detected. The Launching Mechanism will be powered off once the total quantity of launched projectiles is 500 or the coin quantity is 0.

Ground Robots can exchange their gold coins at the Official Projectile Supplier for 17mm projectiles. The operator reloads projectiles through the client interface using a keyboard and mouse. Projectiles can be reloaded on robots after the match has started. If the operator decides to supply projectiles, he or she should press the “O” key on the keyboard. If a team has remaining gold coins and their robot has detected an RFID Interaction Module Card below the Supplier Zone, the projectile redemption quantity can be selected directly on the redemption panel to complete the exchange process. If a team has remaining gold coins but their robot’s RFID Interaction Module has not detected any RFID Interaction Module Card below, projectiles can be redeemed by initiating the “force projectile redemption” command. After the redemption is completed, the Official Projectile Supplier will automatically release the corresponding quantity of projectiles.

3.3.2 42mm Projectile Allowance Redemption Mechanism

The 42mm projectile allowance for a Hero Robot indicates the amount of 42mm projectiles the Hero Robot is currently allowed to launch. For each round of 42mm projectile launched, the projectile allowance reduces by 1 round. If the projectile allowance becomes zero, the power supply to the 42mm Launching Mechanism of the Hero Robot will be cut off. If a Hero Robot launches more projectiles than its allowance, the Referee System will shield all the armors of the other team's robots, Outpost, and Base from 42mm projectile damage.

During the competition, when a Hero Robot has reached the Supplier Zone, the Operator will press the "I" key to redeem projectile allowance.

If the Operator does not redeem projectile allowance during the competition, the Hero Robot's Launching Mechanism will not be powered on.

3.4 Battlefield-related Mechanism

3.4.1 Base-related Mechanism

Base HP is 5000.

3.4.1.1 Virtual Shield Mechanism

After the Invincible status of Base has been removed and Sentry of this side still survives, the Virtual Shield of the Base will be enabled and have 500 HP. When a robot attacks the enemy's Base, the HP of its Virtual Shield will first be deducted. If the Virtual Shield's HP has reduced to zero, the Base's HP will be deducted.

3.4.2 Outpost-related Mechanism

Outpost HP is 1500.

The Outpost is in the Invincible status 30 seconds after the start of the match. The middle armor of the Outpost is rotatable. For its initial position, refer to "Figure 2-41 Outpost". 30 seconds into the match, the middle armor will start rotating and reach a speed of 0.4 r/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.

The Outpost's armor will stop rotating once the following conditions are met:

- The Outpost is destroyed.
- The other team's Base Armor is unfolded.
- The competition has started for three minutes (countdown from 3:59).

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

During the period from the 30th second to third minute of the competition (countdown from 6:29 to 4:00), either party will receive 100 gold coins for every 500 cumulative points of damage inflicted on the other team's Outpost.

3.4.3 Mineral-related Mechanism

The Small Resource Island has three mineral slots located in fixed positions. Each slot has a mineral. For details, please refer to “Figure 2-29 Small Resource Island”.

Five minerals are hung from the top of the Resource Island. Their locations and numbering are as shown in “Figure 3-6 Numbering for Minerals”.

The Engineer may grab the minerals from the Small Resource Island and those released by the Resource Island.

In each round of the competition, the Resource Island will release its minerals in two batches. They are dropped 15 seconds and 3 minutes after the round starts respectively. The first batch to be released in turn are Mineral 2 and 4 at an interval of about 5 seconds; the second batch are the remaining three minerals, with Minerals 1 and 5 to be released first followed by Mineral 3 five seconds later. The numbering for the minerals is as shown below:

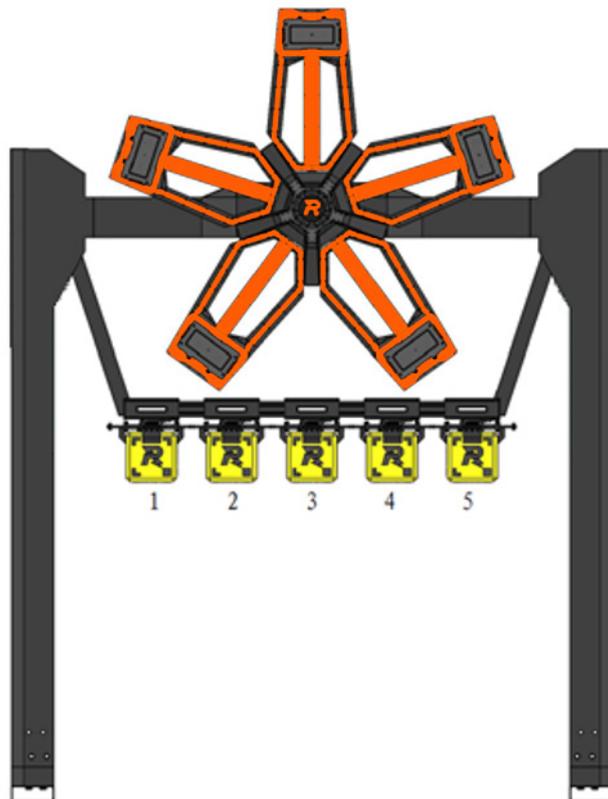


Figure 3-6 Numbering for Minerals

3.4.4 Exchange Station Mechanism

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

The middle point of the intersecting edge between the front of the Exchange Station Base and the Battlefield ground shall be the origin “O”. The direction towards the Mineral Collecting Slot from the normal line to the front plane of the Base shall be the negative x-axis, while the upward vertical direction shall be the positive z-axis, thus forming a right-hand Cartesian coordinate system. The positive directions of pitch, roll, and yaw shall be the clockwise directions on the positive x, y, and z-axes respectively. The outward-facing direction of the normal line to the entry plane of the Mineral Receptacle is \vec{e} . When \vec{e} is in the same direction as the positive x-axis and the plane on which the Mineral Recognition Zone is located is horizontal and below the normal line, the attitude angle of the Mineral Receptacle shall be 0. The pose of the Mineral Receptacle in the Initial Position (initial state) shall be: $x=-350$, $y=0$, $z=1100$, $\text{pitch}=0$, $\text{roll}=0$, $\text{yaw}=0$.



Mineral Recognition Zone: When the Mineral Receptacle is in the Initial Position, the frame on its inner bottom surface containing the “R” logo shall be the Mineral Recognition Zone.

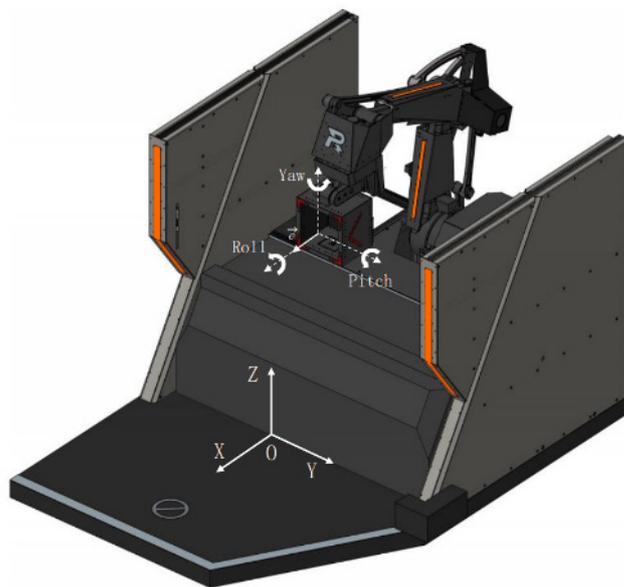
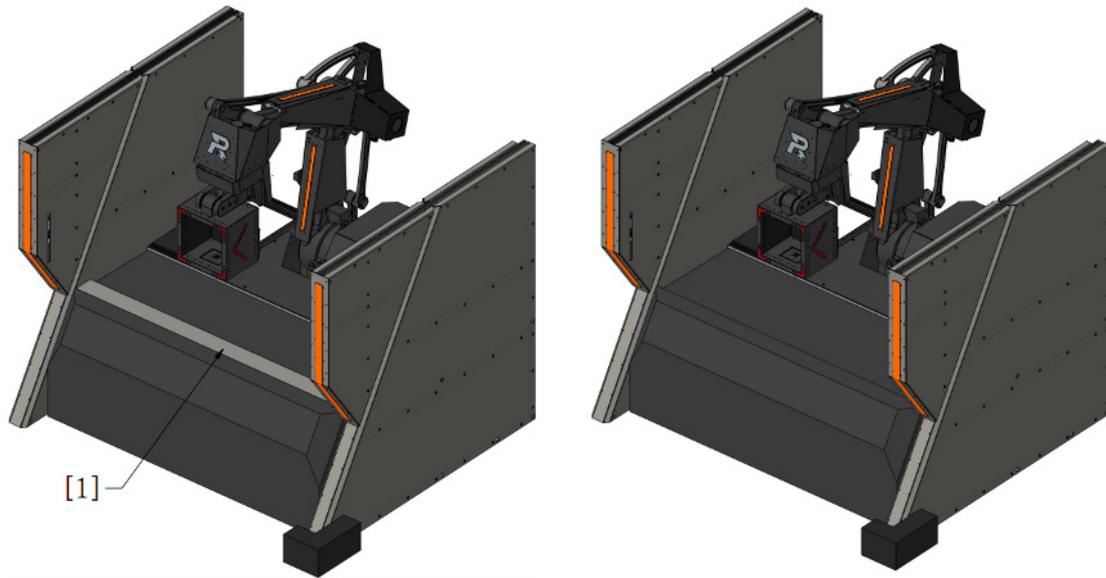


Figure 3-7 Coordinate system of the Exchange Station



With the horizontal panel

Without the horizontal panel

[1] Horizontal panel

Figure 3-8 The Mineral Receptacle in the Initial Position

In the RMUC 2022 Wild Card Competition and the Semi-finals of the Final Tournament, the coordinates of point E and the attitude angle of the Mineral Receptacle shall be fixed values: $x=-300$, $y=0$, $z=720$, $\text{pitch}=0$, $\text{roll}=0$, $\text{yaw}=0$. A 100mm-wide and 30mm-thick horizontal panel will be added to the Exchange Station Base to assist Engineer Robots in placing minerals, as shown below:

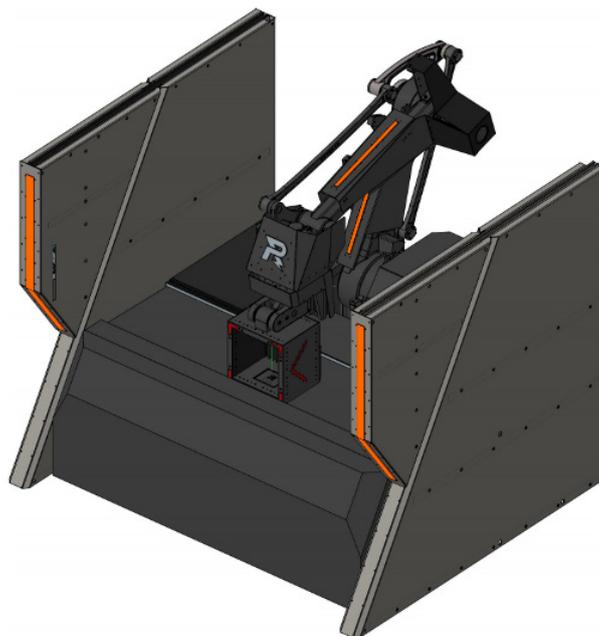


Figure 3-9 Pose of the Mineral Receptacle before the RMUC 2022 Wild Card Competition and Semi-finals of the Final Tournament

During the Semi-finals of the RMUC 2022 Final Tournament and the later stages, point E of the Mineral Receptacle shall satisfy the following conditions: The movement range of point E shall be a partial sphere with point Q (0, 0, 600) as the center and a radius of 300 mm. The formula for the range is: $x^2+y^2+(z-600)^2 \leq 300^2$ ($-270 \leq x \leq 0, -255 \leq y \leq 255, 720 \leq z \leq 900$, the unit being mm); the value range for the pose of the Mineral Receptacle shall be: $\text{pitch} \in [-60, 0], \text{roll} \in [-45, 45], \text{yaw} \in [-90, 90]$, the unit being “degree”; when the Mineral Receptacle is at any location and angle, $|\langle \vec{e}, \overrightarrow{EQ} \rangle| \in [0^\circ, 90^\circ]$, and any of its structure must not cross over the front plane of the Exchange Station Base. The pose of point E of the Mineral Receptacle is related to the cumulative score from the mineral exchange. For each successful exchange, the pose of point E of the Mineral Receptacle will update once within its value range, which shall be as follows:

Table 3-9 Pose value of point E corresponding to the cumulative score from a mineral exchange

Cumulative score from mineral exchange	x	y	z	pitch	roll	yaw
[0, 300)	-200	[-185,185]	720	0	0	0
[300, 400)	[-270, 0]	[-255, 255]	[720, 900]	0	0	0
[400, 900)	[-270, 0]	[-255, 255]	[720, 900]	[-60, 0]	[-45, 45]	0
[900, 2100]	[-270, 0]	[-255, 255]	[720, 900]	[-60, 0]	[-45, 45]	[-90,90]



In each round, if the cumulative exchanged gold coins of both teams are the same, the pose value of point E of their Mineral Receptacle shall be the same.

Starting and ending an exchange:

After confirming the exchange can commence, the Operator presses the “H” button on the keyboard.

- If the Engineer has successfully detected the RFID Interaction Module Card below the Exchange Zone at this time, the Engineer’s chassis power will be cut off and the Exchange Station will enter the exchange status;
- If the Engineer has not detected the RFID Interaction Module Card below the Exchange Zone at this time, the Operator may issue a “Force-start Exchange” command to activate the exchange status of the Exchange Station, at which point the Engineer’s chassis will be powered off.

After confirming the exchange can be discontinued, the Operator presses the “T” button on the keyboard, after which the Engineer’s chassis will power on and the Exchange Station will enter the initial status. If the Exchange Station is still in the middle of an exchange at this time, it will enter the initial status after completing the exchange.



With the front plane of the Exchange Station Base as the boundary, no object may cross over the plane when the Exchange Station’s Mineral Receptacle is in motion, otherwise the Mineral Receptacle will stop moving immediately and the Operator will not be able to end the exchange by pressing the “T” button on the keyboard, until the object moves out of the Exchange Station.

Exchange process:

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

1. The Operator presses the “H” button to activate the exchange status of the Exchange Station.
 2. The Engineer places its mineral in the Mineral Receptacle of the Exchange Station in the correct direction (with the barcode facing down).
 3. After the photoelectric sensor is triggered, the Operator presses the “Y” button in order to exchange minerals.
 4. After the Exchange Station has retrieved a mineral, and if the system detects a successful exchange, the corresponding score will be awarded to the exchanging party.
-



The other non-barcode sides of the mineral in contact with the Mineral Recognition Zone may also be detected by the RFID Interaction Module.

The specific exchange process is shown below:

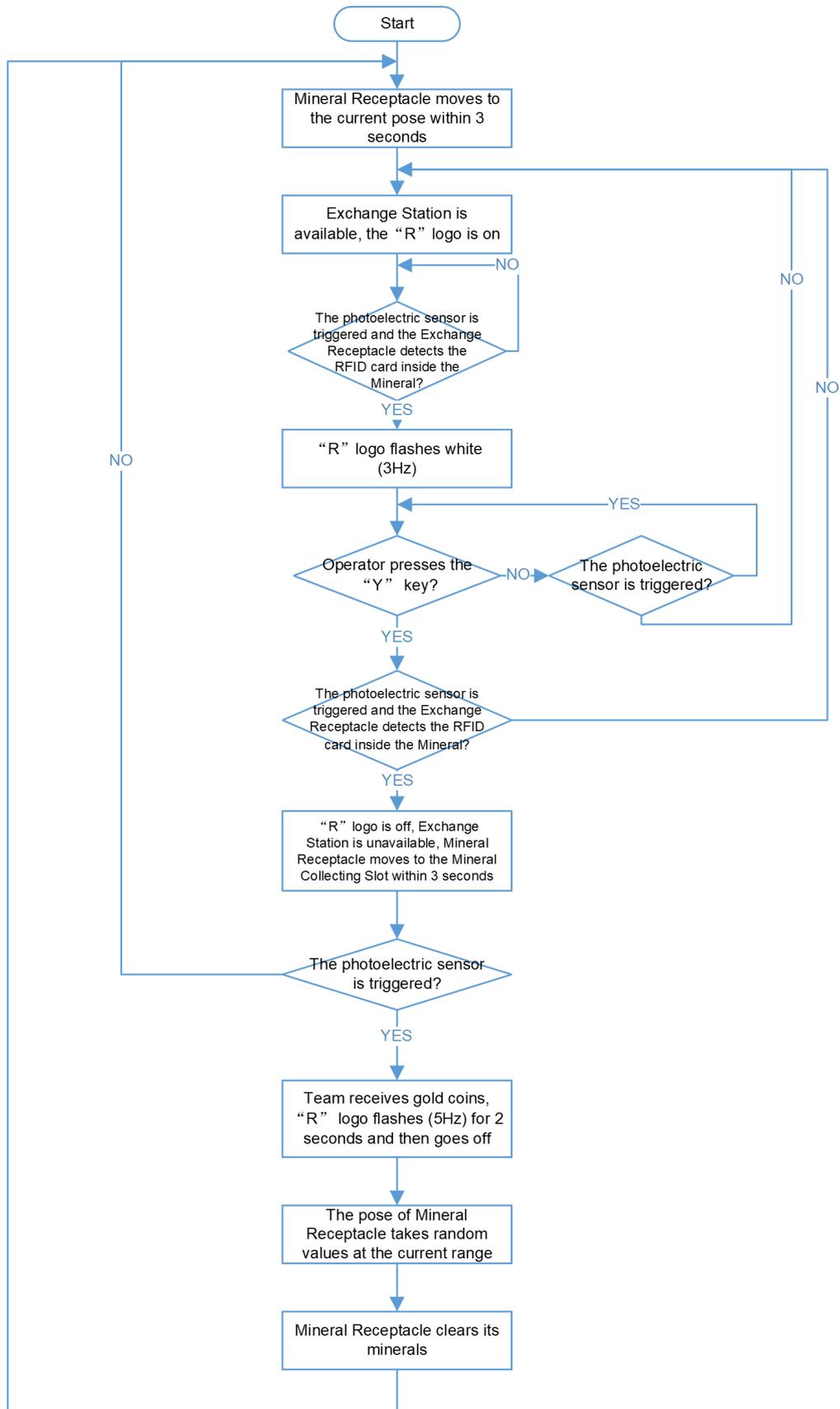


Figure 3-10 Mineral exchange logic

3.4.5 Power Rune Mechanism



After successfully activating the Power Rune, the HP damage value of darts remains unchanged. See Table 3-6 HP Deduction Mechanism for Attack Damage.

3.4.5.1 Mechanism Overview

The Power Rune is located at the center of the Battlefield. Robots can activate the Power Rune by striking it with projectiles. After it is activated, all surviving robots of the team will receive a buff.

The red team can only activate the red team's Power Rune and the blue team can only activate the blue team's Power Rune. Both sides can strike the Power Rune at the same time. If one side's Power Rune has entered the active state, the other side's Power Rune becomes unavailable.

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

- **Small Power Rune:** One minute into the match until the fourth minute (i.e., countdown at 5:59-4:00), the Power Rune starts rotating and becomes available. After the robot from one side successfully activates the Small Power Rune, all robots of the side gain a 1.5-time attack buff.
- **Large Power Rune:** Four minutes into the match (i.e. countdown at 2:59), the Power Rune starts rotating and becomes available. After the robot from one side activates the Large Power Rune, all robots of the side gain a double attack buff and 50% defense buff. If the other team has successfully activated the Large Power Rune, the attack buff of 17mm projectiles launched by its robots will be the number of the team's illuminated mounting brackets multiplied by 20%, while for 42mm projectiles it will be multiplied by 10%.

The duration of the Power Rune's buff effect is 45 seconds. After the buff effect of the Power Rune has lapsed, the Power Rune will enter into an unavailable state for 30 seconds. The unavailable state of a Small Power Rune after its buff effect has lapsed will not affect the Large Power Rune entering the available state.

3.4.5.2 Rotation Strategy

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 10 rpm.

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

3.4.5.3 Status

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

1. Unavailable

Within the first minute of the match (i.e. countdown at 7:00-6:00), the fourth minute of the match (i.e. countdown at 3:59-3:00) and the 30 seconds after each lapse of the Power Rune buff effect, the Power Rune is unavailable as shown below:

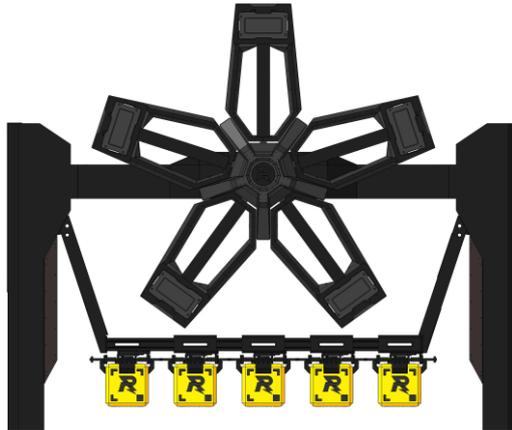


Figure 3-11 Power Rune when Unavailable

2. Available

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

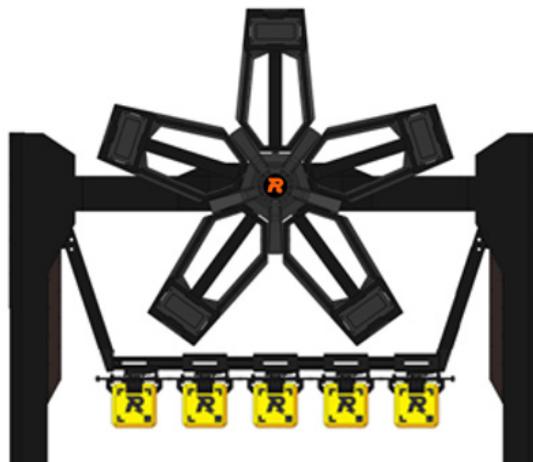


Figure 3-12 Power Rune when Available

3. Activating

When the Power Rune is available, a Standard or Hero Robot that occupies the Power Rune Activation Point and stays there for three seconds or longer will launch the Power Rune into the Activating status (see “Figure 3-13

Power Rune when Activating”). The Power Rune will turn on the arrow light effects on the light arms of any of the five Armor Modules at random. If a projectile manages to hit the Armor Module within 2.5 seconds, its light arm will be completely lit up. At the same time, the Power Rune will randomly illuminate one of the remaining four armor modules, so on and so forth, as shown below:

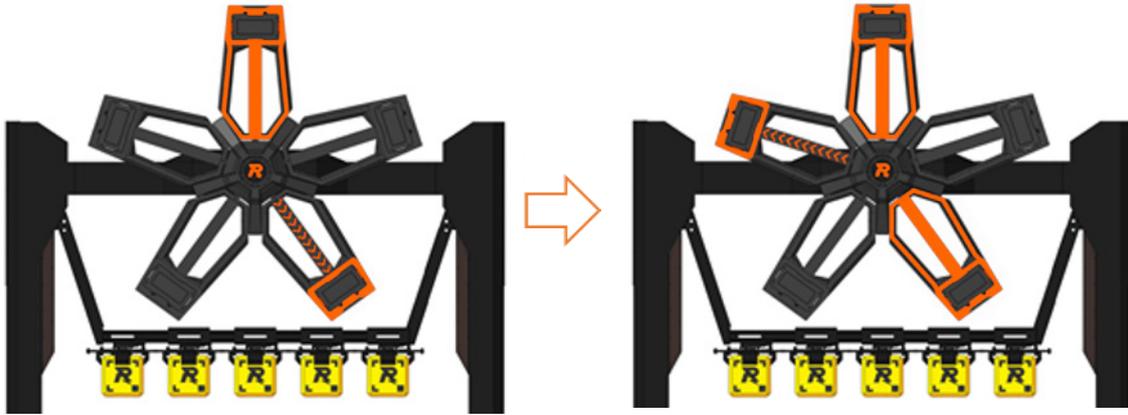


Figure 3-13 Power Rune when Activating

4. Activated

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



Figure 3-14 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

3.5 Relationship between a Sentry Robot, Outpost and Base

The Outpost is in the invincible status during the 30 seconds before the start of the competition.

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

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

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

After the competition has started for 30 seconds and if an Outpost is intact, the Dart Guiding Light on the Outpost will be on, and the Dart Guiding Light on the Base will be off; if the Outpost is destroyed, the Dart Guiding Light on the Outpost will be off, and the Dart Guiding Light on the Base will be on.



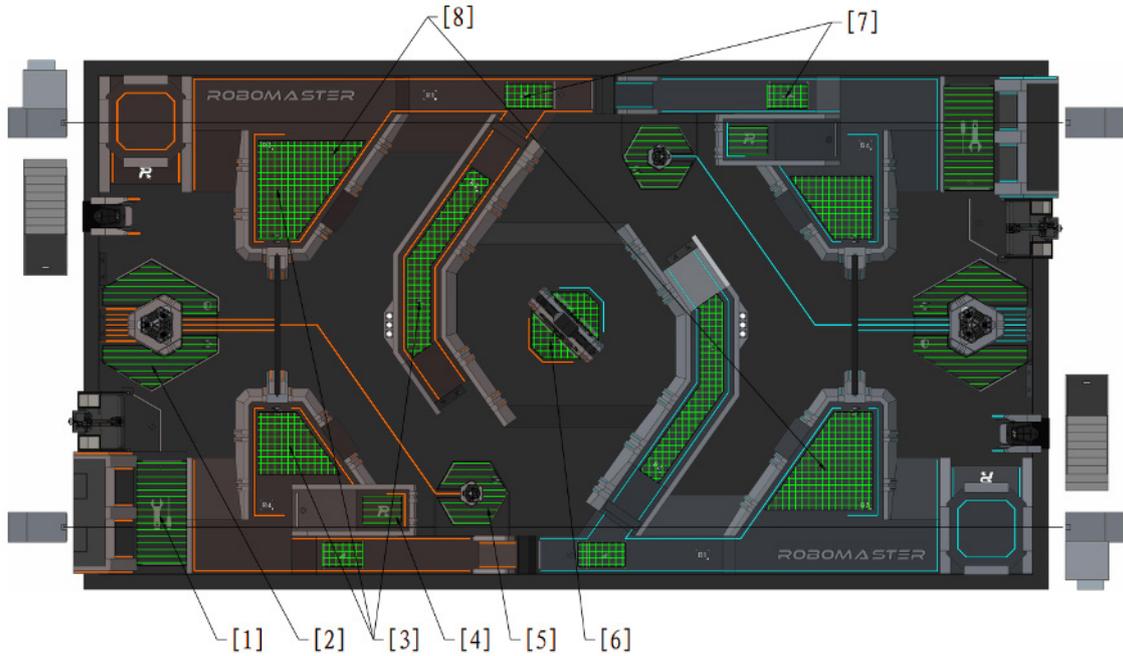
- When the Base and Outpost is in the Invincible status, their armor lights will become purple and not flash when under attack.
 - When the Virtual Shield of the Base is activated, its armor lights will become purple and flash when under attack.
-

3.6 Battlefield Buff Mechanism



Occupied: When a robot has reached a Buff Point area and its RFID Interaction Module has detected the RFID Interaction Module Card in the area.

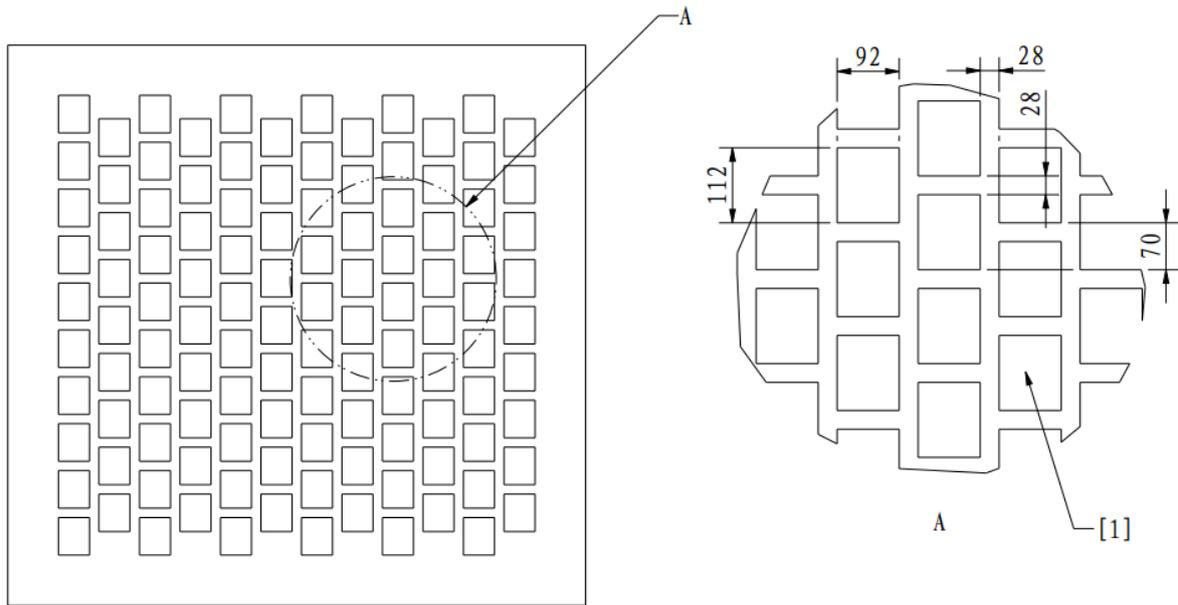
All Buff Point areas in the Battlefield are shown below:



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

Figure 3-15 Battlefield Buff Point Area

All Buff Point areas are laid with multiple RFID Interaction Module Cards. A Buff Point area can be occupied at the same time by multiple robots of one team. The disabling of the occupied status will be delayed by 2 seconds. If the occupying robot has been defeated, the buff gained will expire.



[1] Locations where RFID Interaction Module Cards are lodged

Figure 3-16 Placement of RFID Interaction Module Card



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

Engineer Robots are not allowed to procure any buff other than Supply Zone and Resource Island buffs.

3.6.1 Base Buff Points Mechanism

The Base’s buff points are located in the hexagonal zone around the Base, and can only be occupied by the robots of their own team. Robots that occupy the hexagonal area around their own team’s Base will gain a 50% defense buff and 3-time barrel heat cooling buff.

3.6.2 Elevated Ground Buff Mechanism



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

Elevated Ground Buff Points are present on the R3 Trapezoid-Shaped, R4 Trapezoid-Shaped and R2 Ring-Shaped Elevated Grounds. A robot that occupies an Elevated Ground Buff Point receives a 5-time barrel heat cooling buff. If a robot of one side occupies an Elevated Ground Buff Point of one zone, no robots of the other side are allowed to occupy it at the same time.

3.6.3 Launch Ramp Buff Mechanism

There are two Launch Ramp Buff Points on the respective roads for each team. A robot must detect the RFID Interaction Module Card of the two Launch Ramp Buff Points of its team within 10 seconds, in order to trigger the buff from the Launch Ramp. The two Launch Ramp Buff Detection Points can be occupied by both teams. A robot that triggers a buff from the Launch Ramp receives:

- 50% defense buff for 20 seconds
- An increase of buffer energy to 250J (see “3.2.3 Exceeding Chassis Power Consumption Limit”)
- 3-time buff for barrel heat cooling rate per second lasting 20 seconds

3.6.4 Outpost Buff Mechanism

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

3.6.5 Power Rune Buff Mechanism

When a team’s Power Rune is in the available state, and any of its robots occupies its own Power Rune Activation Zone for 3 seconds or longer, the Power Rune will enter the activating state (see “Figure 3-13 Power Rune when Activating”) and the robot occupying the zone will receive a 5-time barrel heat cooling buff.

3.6.6 Resource Island Buff Mechanism

An Engineer Robot that occupies the Resource Island Buff Point will receive a 50% defense buff. The buff points on both sides of the Resource Island are independent from one another. The Engineer Robots from either team may occupy the buff points on both sides of the Resource Island. If a robot of one team occupies a Resource Island Buff Point of one side, no robots of the other team are allowed to occupy it at the same time.

3.6.7 Restoration Zone Mechanism

A robot that occupies its team’s Restoration Zone can receive buffs for reviving defeated robots or recovering the HP of surviving robots. For the details of their implementation and values, please refer to “3.9 HP Recovery and Revival Mechanism.

3.6.8 Hero Robot Sniper Point Mechanism

The R3 and B3 Trapezoid-Shaped Elevated Grounds are the Hero's Sniper Points of each team respectively and can only be occupied by the robots of their own teams. When an Engineer Robot has occupied its team's Sniper Point, the attack inflicted by the robot's 42mm projectile on the enemy's Base will be buffed up by 2.5 times. The robot will also receive 10 gold coins for each round of launched 42mm projectile detected by the robot's Launching Mechanism.

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

3.7 Mobile 17mm Launching Mechanism

Either one of the Aerial, Standard and Hero Robots can be mounted with a Mobile 17mm Launching Mechanism, provided that it meets the technical specifications. All Launching Mechanisms must meet the relevant requirements for Initial Launching Speed Limit for Projectiles. Each Launching Mechanism can be mounted with a laser sight.

Example 1: Each Standard Robot has a Fixed 17mm Launching Mechanism. A team can mount a mobile 17mm Launching Mechanism on a Standard Robot as needed. The Robot will then have two 17mm Launching Mechanisms.

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

If a Standard or Hero is mounted with a Mobile 17mm Launching Mechanism, the Barrel Heat of the Mobile 17mm Launching Mechanism shall be calculated separately from the Fixed Launching Mechanisms. After the competition starts, the Operator needs to select the Launching Mechanism type for the Mobile 17mm Launching Mechanism. For details, please refer to "3.8.2 Performance System".

If an Aerial is mounted with a Mobile 17mm Launching Mechanism, its Barrel Heat shall not be restricted. For details, refer to "3.11 Aerial Robot-Related Mechanisms".

3.8 Level-Up Mechanism

3.8.1 Experience System



- Destruction: Where a robot attacks the Armor Module of an enemy robot until the latter's HP drops to zero. If a robot is in "non-surviving" status for reasons other than suffering a hit on its Armor Module, it will be deemed that no destroying robot has been found.
- Assist: Where a robot (not including the destroying robot) inflicts damage on the destroyed robot or Outpost within 10 seconds before its destruction.

- Experience value: The existing value of the robot or the Outpost; the robot’s experience value increases with the robot’s level.
- Experience points: The accumulated points needed for the robot to upgrade itself, which can be obtained through natural growth or destroying or assisting in the attack of other robots.

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

During the competition, a robot can earn experience points through natural growth or destroying or assisting in the attack of other robots. The upgrading mechanism is as follows:

- If the system detects that a Hero or Standard Robot is the destroying robot, it will receive the experience points corresponding to the experience value of the destroyed robot; otherwise, the latter’s experience points will be distributed evenly among the surviving Hero and Standard Robots of the opposing team. The average is rounded up and shall be accurate to one decimal place.
- The Hero or Standard Robot assisting in the attack will receive 25% of the experience points corresponding to the experience value of the destroyed robot.
- When the first robot in a match (except for an Aerial, Radar, and Dart System) is defeated or ejected and if the destroying robot is a Hero or Standard, it will receive 50 experience points; otherwise the 50 experience points will be evenly distributed among the surviving Hero and Standard Robots of the team gaining the First Blood. The average is rounded up and shall be accurate to one decimal place.

For example, when a Level 1 Standard has been destroyed, and if the destroying robot is Hero or Standard, it will gain 25 experience points directly. Each assisting Hero or Standard will gain $25 * 25\% = 6$ experience points.

- In addition, a Standard gains 2 experience points every 12 seconds, and a Hero gains 4 experience points every 12 seconds. If a Standard or Hero have been destroyed, their original experience value will remain the same, but they will no longer gain any experience points through natural growth during the time they are destroyed. Any excess experience points after leveling up will be counted towards the next level.

Table 3-10 Levels and Experience Points for Standard, Hero, Sentry and Engineer Robots and Outpost

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

Subject	Level	Experience Value	Experience Points Required for Leveling Up
	2	100	140
	3	150	-
Sentry Robot	-	75	-
Engineer Robot	-	50	-
Outpost	-	50	-

3.8.2 Performance System

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

No Launching Mechanism type needs to be selected for Automatic Standard Robots as they do not have Operators. If an Automatic Standard Robot is installed with a Mobile 17mm Launching Mechanism, the attributes of the Launching Mechanism will remain the same as those of the Fixed Launching Mechanism.

Table 3-11 Types of Chassis and Launching Mechanisms

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

Table 3-12 Attributes of Automatic Standard Robots

Level	Maximum HP	Maximum Chassis Power Consumption (W)	Barrel Heat Limit	Barrel Cooling Value per Second	Initial Launching Speed Limit (m/s)
1	300	120	120	40	30
2	400	120	180	60	30
3	500	120	240	80	30

Table 3-13 Attributes of Standard Robot Chassis

Chassis Type	Level	Maximum HP	Maximum Chassis Power Consumption (W)	Miscellaneous	Notes
Initial Status	1	100	40	-	-
Power-focused	1	150	60	-	-
	2	200	80	-	-
	3	250	100	-	-
HP-focused	1	200	45	-	-
	2	300	50	-	-
	3	400	55	-	-
Balancing chassis	1	300	60	Barrel cooling rate per second is increased by 50%.	This can only be selected if the robot meets the definition of a Balancing Standard Robot.
	2	400	80		
	3	500	100		

Table 3-14 Attributes of Hero Robot Chassis

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

Table 3-15 Attributes of the 17mm Launching Mechanism

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

Table 3-16 Attributes of the 42mm Launching Mechanism

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

3.9 HP Recovery and Revival Mechanism

- If an Engineer Robot is defeated or ejected, its Engineer Rescue Card will be deactivated.
 - If an Engineer Robot is separated from its Engineer Rescue Card, the Card will be deactivated for that round. The Engineer Robots of both red and blue teams are required to carry Engineer Rescue Cards of their team colors. A sample image of the Engineer Rescue Card can be found in “Figure 2-48 Engineer Rescue Card”.
-  When an Engineer rescues a defeated robot using an Engineer Rescue Card at any buff point, the defeated robot may not be able to detect the Engineer Rescue Card directly. To resolve the issue, you may adjust the location of the defeated robot.

Only the ground robot is qualified for HP recovery and revival, except for ejected robots.

3.9.1 HP Recovery Mechanism

Engineer robot: If an Engineer’s HP is not deducted for 30 seconds or after being revived from a defeat during a match, it will receive an HP recovery buff at 2% per second.

Ground robot: If an RFID Interaction Module Card of one’s own team is detected at the Restoration Zone, the robot will receive an HP recovery buff of 5% per second.

3.9.2 Revival Mechanism

Defeated ground robots must complete the revival process in order to be revived. Different robots execute their revival process in different ways:

If a Ground Robot detects an RFID Interaction Module Card at the Restoration Zone, the revival progress increases by 2 points per second.

If a Standard or Hero Robot detects an Engineer Rescue Card carried by its own team’s Engineer Robot, the revival progress increases by 1 point per second.

During the automatic revival of an Engineer Robot (without detecting any RFID Interaction Module Card), the revival progress increases automatically by 1 point per second.

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

Table 3-17 The Length of Revival Processes for Different Robots on Their First Defeat

Type	Revival process length
Standard robot	10
Hero Robot	20
Engineer robot	20

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

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

3.10 Mechanism Related to Sentry

The barrel heat of Sentry’s two Launching Mechanisms shall be calculated separately. When the total number of projectiles launched by two Launching Mechanisms has reached 500, the Launching Mechanism will be powered off.

3.11 Aerial Robot-Related Mechanisms

3.11.1 Air support

During the competition, an Aerial Robot gains one opportunity to reload 500 rounds of 17mm projectiles for each time it is called to provide air support. The Pilot can request for projectile reload from the Pilot Referee. After the Referee has approved the reload, the Pilot has 30 seconds to reload the Aerial with projectiles. The 30-second projectile reloading period is calculated from when the Pilot opens the projectile reload window.

3.11.2 Attack Deductions

3.11.2.1 Exceeding the Initial Launching Speed Limit

If the Referee System detects that the projectile of Aerial exceeds the Initial Launching Speed limit, the attack time of Aerial will be reduced. If the current attack time is about to expire, the time deduction will be applied to the next attack time. Attack time reductions will be accumulated in the case of multiple times of excess.

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

3.11.2.2 Modules Going Offline

Air support will become unavailable if an important module of an Aerial Robot goes offline when it is not in a state of providing air support. If an important module goes offline during the attack 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: $N = 25 * M$.

3.12 Dart Launching Mechanism

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 client. The Aerial Gimbal Operator is not allowed to launch Darts when the gate is opening or closing. The client will display the open or closed 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 Referee System's client interface. The Aerial Gimbal Operator can then launch darts by controlling the Dart Launcher for 15 seconds.

When the gate starts closing, an indication will be provided by the Referee System's client interface. The Aerial Gimbal Operator is forbidden from launching darts during this time. When a gate closes for the first time, the Dart Launching Station will enter a 15-second cooling period. The gate can only open for the second time after the end of the cooling period.

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

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

3.13 Light Effects on the Site

Some Battlefield Components will display different light effects at different stages of the competition, as shown below:

Table 3-18 Descriptions of Light Effects on the Site

Battlefield Components Competition Round	“R” Light Indicator of the Exchange Station	Light Indicator of Resource Island Mechanical Claws	Light Indicator of the Dart Launching Station
Three-Minute Setup Period (Battlefield Components are not connected to the server)	Off	Off	Off
Three-Minute Setup Period + Initialization Period (Battlefield Components are connected to the server)	Solid white	<ul style="list-style-type: none"> ● Without minerals: White flashes (1Hz) ● With minerals: Keep Open 	<ul style="list-style-type: none"> ● Robot not connected to the server: White flashes (1Hz) ● Robot is connected but the sliding rail is not in place: White flashes (3Hz) ● Robot is connected and the sliding rail is in place: Solid white
Seven-Minute Round (Normal status)	Off	<ul style="list-style-type: none"> ● Released: Off ● Unreleased: Solid white 	<ul style="list-style-type: none"> ● Robot is connected and the sliding rail is in place: Solid white ● Robot is not connected: Off

Battlefield Components Competition Round	“R” Light Indicator of the Exchange Station	Light Indicator of Resource Island Mechanical Claws	Light Indicator of the Dart Launching Station
			<ul style="list-style-type: none"> ● Robot is connected but the sliding rail is not in place: White flashes (1Hz)
<p>Seven-Minute Round (In Operation)</p>	<ul style="list-style-type: none"> ● The white light will emit a solid glow each time the Mineral Receptacle moves to the corresponding pose. ● If the photoelectric sensor of the Mineral Receptacle is triggered and the Mineral Receptacle detects the RFID Interaction Module Card of the mineral, the white light will flash (3Hz). ● Within 2 seconds after each mineral is exchanged: White flashes (5Hz) 	<p>3 seconds before release: White flashes (3Hz)</p>	<ul style="list-style-type: none"> ● When opening: White flashes (3Hz) ● After it is open: Solid white ● When closing: White flashes (3Hz)

3.14 Logic of Mechanism Overlap

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

Example 1: For example, if an Engineer Robot has not suffered any damage for 30 seconds, it will recover its HP at 2% of its Maximum HP per second. If the Engineer Robot is in its team’s HP Recovery and Revive Zone, its HP will recover at 5% of its Maximum HP per second.

Example 2: When a team has successfully activated the Power Rune, and the Hero Robot of the team fires a 42mm projectile from the Hero Robot Sniper Point and hits the triangular armor of the other team's Base, the damage inflicted is: $300 \times 2.5 = 750$

3.15 Winning Criteria

The official matches of RMUC 2022 consist of the Group Stage and the Knockout Stage. The competition system for the Group Stage is BO2. Except for the Semifinals and the Championship Match which are BO5, the competition system for all other Knockout Stages is BO3.

Winning criteria for a Single Round as shown below:

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

3.15.1 Group Stage

The following is a description of the points for the group stage:

Table 3-19 Points for Group Stage

Competition System	Competition result	Points	Notes
BO2	2:0	3:0	Winner of two rounds gains 3 points
	1:1	1:1	Each team obtains 1 point
	1:0	1:0	(One round draw) The winning team obtains 1 point
	0:0	0:0	(Two rounds draw): Each team obtains 0 point

Competition rankings for the Group Stage are determined by the sum of the points from each competition. The following order are used to determine competition results in descending order of priority:

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

- Damage HP: HP deduction (loss) generated by one side’s robot to the opponents robot or field items by attacking.

Exceptions are shown below:



- HP deduction caused by one sides robot due to penalties executed by the referee will be included in the opponents damage HP
- HP deducted as a result of exceeding the Initial Launching Speed limit, Barrel Heat limit and Maximum Chassis Power Consumption, a collision on an armor module, the Referee System going offline, or an offline status are not added to the other team’s damage HP.

- Net Base HP: At the end of each round, the remaining HP of one’s Base is subtracted from the remaining HP of the other Base.
- Net Outpost HP: The remaining HP of a team’s Outpost subtracted from the remaining HP of the enemy’s Outpost at the end of a round.

- Net Sentry HP: The remaining HP of a team's Sentry subtracted from the remaining HP of the enemy's Sentry at the end of a round.
 - Total Remaining HP: The total value of remaining HP of one's survived robots at the end of each round.
-

3.15.2 Knockout Stage

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

4. Competition Process

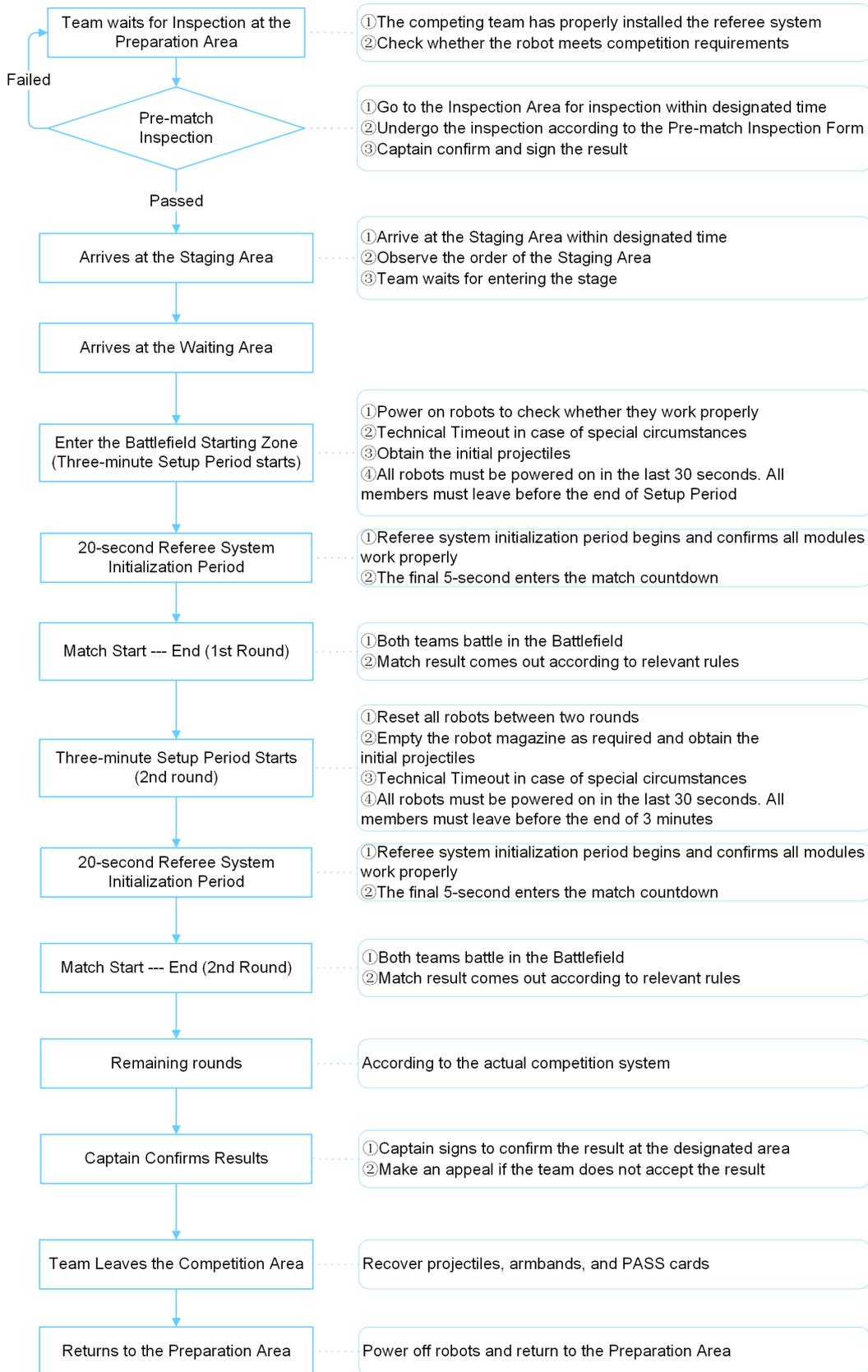


Figure 4-1 Process of A Single Match

4.1 Pre-Match Inspection



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

To ensure that robots meet the required standard specifications, each team must undergo Pre-match Inspection in the Inspection Area 90 minutes before the start of each match. For the requirements of the Pre-Match Inspection, please refer to the “[RoboMaster University Series 2022 Robot-Building Specifications Manual](#)”. The inspection process is as follows:

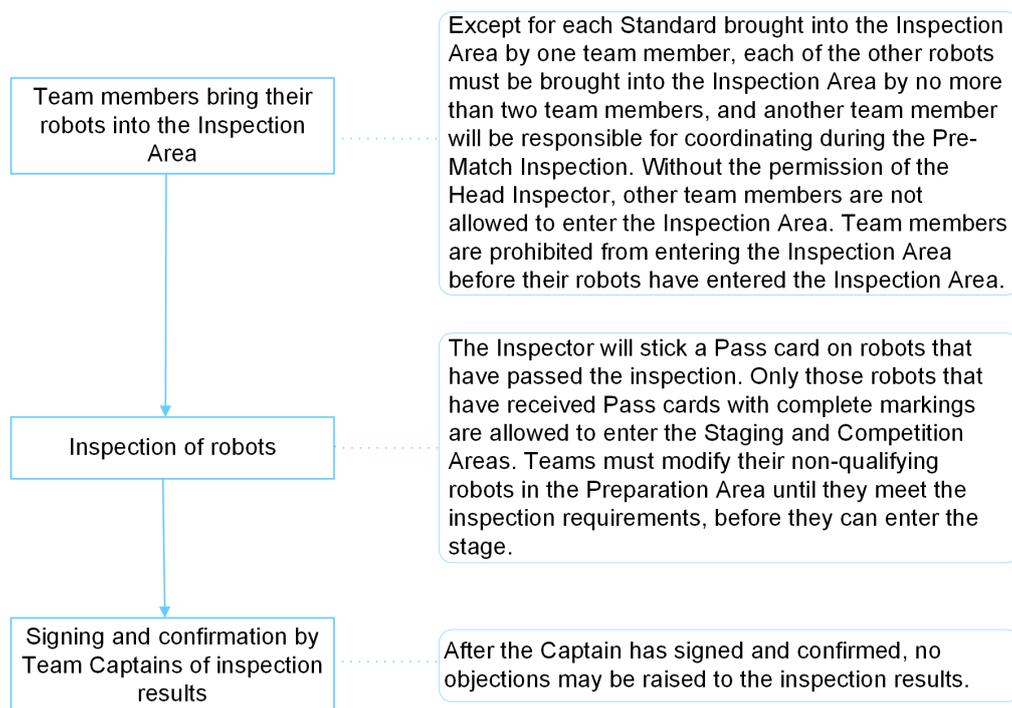


Figure 4-2 Pre-Match Inspection Process

The rules regarding backup robots are as follows:

- Each team can have a maximum of two backup robots (one backup Dart Launcher is seen as one backup robot) for each match. A maximum of 4 backup darts are allowed in the BO2 and BO3 Competition Systems, while a maximum of 8 backup darts are allowed for the BO5 Competition System.
- Team members are required to declare the types of backup robots they are carrying during Pre-match Inspection. Backup Hero, Engineer and Sentry must be attached with armor stickers in the Inspection Area. If a backup Standard Robot is needed on the field, a Pit Crew Member must obtain the corresponding armor sticker promptly from the referee. The attachment of armor stickers must follow the requirements stated in the “[RoboMaster University Series 2022 Robot-Building Specifications Manual](#)”.
- After passing the Pre-Match Inspection, backup robots cannot be replaced without permission. During Mock Inspection, the RMOC will issue Referee Systems to backup robots that have passed Mock Inspection. Teams can borrow the Referee Systems for no more than two backup robots.

4.2 Staging Area

Teams must arrive at the Staging Area 15 minutes before the match. The staff at the Staging Area will check the status of the participating robots and the Crew Members' information. If any team needs to repair its robots after entering the Staging Area, it must obtain the permission of the staff at the Staging Area. A robot may leave the Staging Area for repair only after the staff at the Staging Area have removed the Pass Card on the robot. When repair is finished, the robot needs to be brought back to the Inspection Area for another Pre-Match Inspection before re-entering the Staging Area, and the Team Captain must sign a new Staging Area Statement. If the team is unable to arrive at the Staging Area in time as a result of this delay, the robot will not be able to enter the match, and the team will bear the consequences.

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

4.3 Three-Minute Setup Period



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

During the Three-Minute Setup Period, the Pit Crew will place robots on their respective initialization locations, check whether the Referee System is operating normally, clear the projectiles of robots whose Initial Projectile Quantity is zero, load initial projectiles on robots whose Initial Projectile Quantity is not zero, load darts into the Dart Launcher, and mount the Radar on the Radar Base. The Pit Crew Members may repair robots or perform replacements using equivalent parts. The referee may initiate an Official Technical Timeout at any time and perform immediate inspections on robots.



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

90 seconds before the Three-Minute Setup Period ends, the Operator is advised to enter the Operator Room to complete commissioning for the keyboard and mouse (which can be brought on your own), and double-check whether the robot controls and official equipment are operating properly. If equipment in the Operator Room cannot operate normally, the Operator must raise the issue before the final 15 seconds of the Three-Minute Setup Period, otherwise the referee will not announce technical timeout. The Tactical Coach can make tactical deployments in the

Operator Room before a match, but is not allowed to enter the Battlefield, and must leave the Operator Room before the end of the Three-Minute Setup Period. Except for the Operators and Tactical Coach for the robots on the Battlefield, no Pit Crew members are allowed in the Operator Room.

When the Setup Period is left with 30 seconds, all robots in the Battlefield must be powered up, and the staff in the Battlefield should leave the Competition Area in an orderly manner. Before the five-second countdown begins, the Pit Crew Members must place the debugging remote controller for the Sentry Robots, Radar and Automatic Standard Robots in the designated area at the Battlefield entrance.

4.3.1 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 “Table 4-1 Descriptions of Technical Faults” for details), the Head Referee may announce an Official Technical Timeout and pause the setup countdown. The starting time of the Timeout shall be decided by the Head Referee based on the situation.

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

Table 4-1 Descriptions of Technical Faults

Rules	Description
1	A fault occurs with the official equipment in the operator room, and any key competition component in the Battlefield experiences structural damage or functional irregularity.
2	During the Three-Minute Setup Period of the first round, the Referee System module on a robot fails, for example where the robot is unable to transmit images back to the Operator’s Room normally or connect to the Referee System server.
3	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 7-Minute Round, it will be categorized as “regular battle damage”, as it cannot be determined whether the malfunction was caused by the Referee System Module, a flaw in a robot’s circuit or structural design, or robot combat from a previous match. Regular battle damage does not trigger an Official Technical Timeout, and the referee will provide a backup Referee System Module. Teams may request for a “Team Technical Timeout” to repair their robots.

4.3.2 Team Technical Timeout

If the mechanical structure of a robot, a software system, the keyboard or mouse in the Operator Room or other equipment experiences any faults, the team Captain may make a request to the referee in the Battlefield or Operator's Room for "Team Technical Timeout" before the 15-second countdown in the Three-Minute Setup Period, and indicate the requested timeout length and reasons for the request. Team Technical Timeout once requested and conveyed to the Head Referee, this Timeout cannot be cancelled or revised.

After the Team Technical Timeout is confirmed by the head referee, the head referee will notify both teams at the same time regardless of which team initiated the technical timeout. The Pit Crew of both teams may enter the Battlefield but can only inspect, repair, and commission their own team's robots in the Robot Initialization Area.

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 type of Technical Timeout is determined by the Head Referee based on the request of the team. The team cannot dispute the type of Technical Timeout and the Technical Timeout process may not be used as a basis for appeals after the match.

A team cannot request for more Team Technical Timeout opportunities once they have been used up. The Team Technical Timeout arrangements for different competition stages are as follows:

Table 4-2 Team Technical Timeout Arrangement

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

4.4 Referee System Initialization Period

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

If in the first round of the match a robot experiences a technical fault with the Referee System, which causes the initialization countdown to stop, a maximum of two Pit Crew Members for the team are allowed to enter the Battlefield to inspect and solve the issue.

When the Referee System Initialization Period is left with 5 seconds, a clear countdown sound effect and live animation will be played. At this time, the keyboard connected to the computer in the Operator Room will be locked. When the countdown finishes and the keyboard unlocks, the match starts immediately.

4.5 Seven-Minute Round

During the 7-Minute Round, robots from both teams will engage in tactical combat on the core Competition Area (Battlefield).

4.6 End of Competition

A round ends either when time has elapsed or one team has fulfilled the conditions for winning. When a round ends, the match immediately enters the Three-Minute Setup Period for the next round. Please refer to “3.15 Winning Criteria” for details on the winning criteria. The match is over when a winner has emerged or all rounds have ended.

4.7 Results Confirmation

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

Within 5 minutes after the end of a match, the Captains of both teams must sign and confirm the match results. If a team Captain does not sign and confirm the results within 5 minutes or has not requested an appeal, it is deemed that the team agrees with the match results. Once the team Captain has signed the Form, all rights to an appeal are forfeited. Please refer to “7 Appeal” for details on the appeal process.

5. Violations and Penalties

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

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

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

5.1 Penalty System

5.1.1 Forms of Penalties

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

Table 5-1 Forms of Penalties

Forms of Penalties	Descriptions
Automatic penalties by the Referee System	HP deductions as a result of a robot exceeding its parameter limits or a Referee System Module going offline. The HP deductions mentioned in “3.2 HP Deduction Mechanism”, except those caused by attacks, are all automatic penalties by the Referee System.
Manual penalties through the Referee System	Penalties issued by the referee through the server against participants and robots for violation of rules.
Manual Penalties	Used in situations where penalties cannot be issued through the Referee System, for example giving a verbal warning or disqualifying a team

5.1.2 Violation Scores

Before the start of each round, each robot has a violation score of zero. A robot that is issued a Yellow Card during the round will receive 2 violation scores.

- When a robot has 4 violation scores, a yellow exclamation point will appear on the robot's avatar on the client interface.
- When a robot has 6 violation scores, a red exclamation point will appear on the robot's avatar on the client interface
- When a robot has 8 violation scores, the robot will be ejected automatically from the current round of the match.

5.1.3 Types of penalties

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

Table 5-2 Types of Penalties

Types of penalties	Descriptions
Verbal Warning	Verbal alert
Yellow Card	<ul style="list-style-type: none"> ● One team receives a Yellow Card: <ul style="list-style-type: none"> ➤ The operation interface of the offending Operator will be blocked for 5 seconds, while the operation interfaces of other Operators in the offending team will be blocked for 2 seconds. ➤ The Referee System automatically deducts 15% of the offending robot's Maximum HP (except for Sentry Robots), while the other surviving robots' Maximum HP (except for Sentry Robots) is deducted by 5%. For each Yellow Card that is issued against the robot in the next 30 seconds, the deducted percentage will be twice that of the previous deduction for that robot, and 5% for the other surviving robots (except for Sentry Robots). <p>Example 1: An offending robot has a Maximum HP of 200 while the other robots in the team have a Maximum HP of 100. The offending robot is issued a Yellow Card each at the 15th, 25th and 58th second of a round. The HP deductions for the three Yellow Cards issued are as follows: The deducted HP for the offending robot are 30, 60 and 30. The deducted HP for the other robots are 5, 5 and 5.</p> <p>Example 2: An offending robot has a Maximum HP of 200 while the other robots in the team have a Maximum HP of 100. The offending robot is issued a Yellow Card each at the 15th, 25th and 40th second of a round. The HP deductions for the three Yellow Cards issued are as follows: The deducted HP for the offending robot are 30, 60 and 120. The deducted HP for the other robots are 5, 5 and 5.</p> <ul style="list-style-type: none"> ➤ The offending robot will receive 2 violation scores.

Types of penalties	Descriptions
	<ul style="list-style-type: none"> ● Both teams receive a Yellow Card: The interface of all Operators is blocked for 2 seconds and the maximum HP of all robots (except Sentry) is deducted by 5%. No violation scores recorded. <hr/> <ul style="list-style-type: none"> ● If multiple Yellow Cards are received successively, the blockage time for the operation interface will add up accordingly.  <ul style="list-style-type: none"> ● If a robot's remaining HP is less than or equal to that needs to be deducted from penalty, this robot's HP reduces to 1.
Red Card (Ejection)	<ul style="list-style-type: none"> ● Ejecting a robot <ul style="list-style-type: none"> ➤ If it is before a match, the offending robot will be barred from the match and must leave the Battlefield. ➤ If an Aerial Robot is ejected during the competition, its Launching Mechanism will be powered off, the image transmission display will become monochrome, and the robot can no longer start its propeller. ➤ 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 display and Inter-Robot Communication in the Operator Room will be disconnected ➤ If a robot other than an Aerial, Dart and Radar is ejected during the competition, the robot's HP will be reduced to zero and the image transmission will become monochrome. ● Ejection of Pit Crew Members: Members ejected by the referee must immediately leave the Competition Area and no substitute Pit Crew Members are allowed in the remaining rounds of the match. The robot operated by the ejected Operator will be ejected for this round, and will not be allowed to enter or be substituted by other robots in all other rounds of the current match.
Forfeiture	<ul style="list-style-type: none"> ● If a Forfeiture is issued before the start of the match (not including the Three-Minute Setup Period), all the Pit Crew of the offending team must leave the Competition Area. The offending team's Base, Outpost and Sentry's HP will be deducted to zero, and the HP of the team's other robots will be full. The opposing team's Base and Outpost HP and their robots' HP remain full.

Types of penalties	Descriptions
	<ul style="list-style-type: none"> ● If a Forfeiture is issued during a match (including the Three-Minute Setup Period), the round will end immediately. The offending team’s Base, Outpost and Sentry’s HP are deducted to zero, and the team’s other robots maintain their HP level at the end of the round. The HP of the opposing team’s Base, Outpost and robots remain at the level when the round ended. ● If a Forfeiture is issued after a match, the offending team’s Base, Outpost and Sentry’s HP will be deducted to zero, and the team’s other robots maintain their HP level from the end of the round. The HP of the opposing team’s Base, Outpost and robots remain at the level when the round ended. ● If a Forfeiture is issued in a match (hereinafter referred to as “Match Forfeiture”), it applies to all rounds in the match, and the HP for each round shall be calculated according to the above descriptions.
Disqualification	<ul style="list-style-type: none"> ● The team member is disqualified from the current competition season. ● The team is disqualified from the current competition season, but its results so far in this season will be maintained as a reference for other teams.

5.1.4 Miscellaneous

Apart from forfeiture, no other penalties can form the basis for an appeal by a team. The Arbitration Commission may reject an appeal if it has been made on such a basis.

5.2 Penalty Details

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

5.2.1 Staff

5.2.1.1 Participating Teams/Personnel

R1 Teams are required to meet the requirements in the [RoboMaster 2022 University Championship Participant Manual](#).

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

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

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

R3 Except for emergency situations, teams must be present at the Inspection Area at least 90 minutes before the start of each match for Pre-match Inspection. The team must stand by at the Staging Area 15 minutes before each match.

Penalties: The maximum penalty is forfeiture of the match.

R4 Team members must wear protective goggles when entering official designated areas such as the Preparation Area, Staging Area, Competition Area, and Projectile Unloading Area.

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

R5 Team members must not turn on the power and commission or repair their robots in the Staging Area.

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

R6 Apart from Pit Crew Members who have entered the Staging Area and Competition Area beforehand due to match-related reasons, no participants are allowed inside either area without special reasons.

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender shall be disqualified.

R7 Any participant who has entered the Staging Area and Competition Area may not leave either area without the permission of the referee.

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

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

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

R9 Except projectiles preset in the Inspection Area, teams must not bring their own projectiles into the Staging Area or Competition Area, and also must not take official projectiles away from the Competition Area.

Penalties: The staff will confiscate the projectiles and issue a verbal warning. If the warning is ineffective, the most serious penalty that can be imposed on the offenders is disqualification from the competition.

R10 Teams must not damage any official equipment (including but not limited to equipment in the Competition Area, Staging Area, Preparation Area and Inspection Area).

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

5.2.1.2 Pit Crew Members



- Pit Crew Members: Regular Members, Supervisors and Advisors that have been registered on the registration system and can enter the Staging Area and Competition Area, where only the Advisor is allowed to be the tactical coach.
 - Captain Armband: Any Regular Member that wears the 'Captain' armband performs the Captain role during the match. The Captain is responsible for managing and controlling the team's participation in the competition process, confirming results, and requesting for Technical Timeouts, appeals, etc.
-

R11 Each team can have a maximum of 19 Pit Crew Members enter the Competition Area, of which 17 must be Regular Members (not including the Tactical Coach), along with a Supervisor and a Tactical Coach. One Pit Crew Member should wear the “Captain” armband and undertake the Captain’s role.

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

R12 Pit Crew Members must meet identity requirements.

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

R13 Pit Crews must wear armbands which must not be covered. The “Captain” label of the Captain's armband must face the front.

Penalties: Verbal Warning.

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

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offender shall be issued a Red Card. The highest penalty that can be imposed on the offending team is disqualification.

R15 Pit Crew Members entering the Competition Area must not communicate with anyone from the outside.

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

R16 Except for the Tactical Coach and Operators for the robots on the Battlefield, no Pit Crew members are allowed in the Operator Room.

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

R17 The tactical adviser is not allowed to enter the Battlefield at all times and must leave the Operator’s Room before the end of the Three-Minute Setup Period.

Penalties: Verbal Warning. If the Warning is ineffective, a Red Card Warning shall be issued against the offender and the Tactical Coach of the team shall be disqualified from entering the Battlefield for subsequent matches in the current season.

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

Penalties: The offending team must bear the relevant responsibility.

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

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

R20 During an Official Technical Timeout, Pit Crew Members are not allowed to fix faults other than those in modules related to the Referee System.

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

R21 After the end of the Three-Minute Setup Period, the Pit Crew must place the Sentry Robot, Radar, and the Commissioning Remote Controller of the Automatic Standard Robot at the entrance of the Battlefield. The Remote Controller, Sentry Robot, and Radar cannot be used once the five-second countdown has started.

Penalties: Verbal Warning. If the verbal warning is ineffective, the team shall be issued a forfeiture of the match.

R22 Pit Crew Members are not allowed to bring headsets into the Operator Room.

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

5.2.1.3 Operator

R23 A Pilot that operates an Aerial Root must pass the Pilot Assessment.

Penalties: The team is issued a Forfeiture for the round, and the offending team member is disqualified.

R24 The Pilot is required to wear a long-sleeved top and protective goggles. When reloading projectiles, the Pilot must wear a helmet and can only stand outside the Perimeter Wall.

Penalties: Forbidden from supplying projectiles for Aerial during the match.



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

R25 Pilot can connect his phone to the remote controller to check the status of the Aerial, but he is not allowed to use the video transmitter function of the remote controller.

Penalties: Verbal Warning. If the verbal warning is ineffective, the team shall be issued a forfeiture of the match.

R26 A single projectile supply time for Pilot during the match cannot exceed 30 seconds.

Penalties: Verbal Warning, and the Pilot is required to return to the Pilot Room. If the Verbal Warning is ineffective, the offender shall be issued a Red Card.

R27 The use of one's own computers is prohibited in the Operator's Room.

Penalties: Verbal Warning. If the verbal warning is ineffective, the team shall be issued a forfeiture of the match.

R28 Operators must remain in the relevant Operator's Room during the Referee System Initialization Period and the Match, to operate the relevant computers, and must remain in position after a match has started, unless otherwise permitted by the referee.

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

R29 During the competition, Operators are required to wear headphones. Each Operator can use a maximum of one Remote Controller, except for Gimbal Operators who are allowed to use Gimbal Remote Controllers and Custom Controllers for darts and Aerial Robots at the same time.

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

5.2.2 Robots

5.2.2.1 General Rules

R30 Robots entering a match must pass Pre-match Inspection.

Penalties: Forfeiture for the round.

R31 Robots must meet the requirements in the [“RoboMaster University Series 2022 Robot Building Specifications Manual”](#).

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the most serious penalty that can be imposed is disqualification from the competition.



- The RMOC will conduct random inspections on the robots from time to time.
-

- Any report made against a robot for not complying with the robot building specifications manual must be supported by the relevant evidence.
-

R32 In the event of a dispute, teams are obligated to show their robot's mechanisms, circuit design drawings and relevant code documents to the RMOC and answer relevant technical questions.

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

R33 In the first round of a match, the robots must meet the minimum battle team size.

Penalties: Forfeiture for the match.

R34 Robots must be attached with armor stickers that meet the inspection specifications.

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

R35 When waiting in the Staging Area, team members are not allowed to bring robots out of the Staging Area without permission.

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

R36 Robots must not carry or present safety issues including but not limited to short circuits, crashing, creating fumes or lighting flames, parts falling to the ground, and gas cylinder explosions. If a safety issue is present or has arisen, team members must perform relevant operations in accordance with the referee's instructions.

Penalties: If it happens before the start of a match, the Pit Crew need to resolve the safety issue as required by the referee, otherwise the offending robot will not be allowed to appear on the Battlefield. If it is during the competition, a Verbal Warning shall be issued. If the Verbal Warning is ineffective, a Red Card shall be issued against the offending team member or robot. Any incident involving serious safety hazards shall be handled by the Head Referee in accordance with "6 Irregularities".



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

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

Penalties: Verbal Warning. If the Verbal Warning is ineffective, the offending robot may be issued a Red Card as the maximum penalty.

R38 During the Three-Minute Setup Period, any projectile must be launched into the projectile clearance bag.

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

R39 During the Three-Minute Setup Period, the replacement modules or parts used on robots must meet the requirements for “equivalent parts” as stated in “4.3 Three-Minute Setup Period”.

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

R40 During the competition, the robot is not allowed to disintegrate into sub-robots or sub-systems connected by multiple flexible cables, and must not cast or launch their own parts.

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

R41 During the competition, the Engineer Robot is allowed to obstruct its armor in the following two situations which may occur at the same time.

1. When projectiles are loaded, or a Mobile Battlefield Component is grabbed or moved, any one of the Engineer Robot’s armors is allowed to be blocked by a carried Mobile Battlefield Component and the 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.



Carry: The movement of a Mobile Component caused by the continuous direct or indirect contact between a robot and the Mobile Component during the competition.

-
2. An Engineer Robot’s Armor Modules can be obstructed by a robot being rescued.

Apart from that, no robots are allowed to block any of its Armor Module using its own body structure.



A Hero or Standard Robot is not allowed to obstruct its armors when carrying obstacles blocks.

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

R42 Teams are prohibited from using the Radar to collect information from outside the Battlefield that may affect the competition.

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

R43 Robots are not allowed to continuously launch projectiles or darts out of the Battlefield.

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

R44 The Dart System must not remain in a Ready-to-Launch State other than during the Seven-Minute Round.



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

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

5.2.2.2 Ground Robots

R45 During the Three-Minute Setup Period of each round, the teams must empty the 17mm Launching Mechanism of robots with a zero Initial Projectile Quantity until no more projectiles can be fired, and empty the 17mm projectiles of Engineer Robots.

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

R46 During the competition, Engineer is not allowed to use supplement lights except for procuring Mobile Battlefield Components. Other robots are not allowed to use the supplement light at any time (including visible and non-visible light).

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

R47 During a match, each team can have no more than one robot installed with a motorized 17mm Launching Mechanism.

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

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

R48 Standard Robots to be fit with a balancing chassis must meet the definition of a Balancing Standard Robot while surviving. See "1.2.2.3 Standard robot". This does not apply to Standard Robot under Non-surviving Status.



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

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

R49 Except for the Engineer Robot, no robots are allowed to carry minerals or Engineer Rescue Cards.

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

5.2.2.3 Aerial Robot

R50 During the Three-Minute Setup Period, team members may debug the Aerial Robot near the Landing Pad, but must not start the propeller.

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



If the team's Dart Launching System or Radar enters the stage, the Aerial Gimbal Operator can stay in the Operator Room.

R51 The Safety Rope of Aerial must be hooked onto the rigid ring.

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

R52 During the competition, the distance between the lowest point of an Aerial Robot and the Battlefield ground must not be less than 1500 mm, and no part of the 17mm Speed Detection Module carried by the Aerial Robot's gimbal Launching Mechanism can exceed the highest point of the Perimeter Wall of the Flight Zone

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



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

R53 During the competition, Aerial Robots are forbidden from flying outside the Battlefield.

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

R54 If 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.

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

5.2.3 Interactions

5.2.3.1 Interaction between Robots

R55 A robot may not use any of its body structures to strike an enemy robot in collision. If a defeated robot is obstructing a key path, the robot can be slowly pushed away.

-
- This rule applies to collisions between Balancing Standard Robot and Auto Standard Robot.
 - In any collision between an Aerial Robot and Ground Robot, the Aerial Robot will be deemed the offending robot.
 -  ● In any collision between a Sentry Robot and Ground Robot, 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.
-

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

Table 5-3 Penalties for Collision

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

R56 A robot must not get stuck together with any other robot due to active interference, blocking or collision.

-
-  Entanglement between robots: any continuous linkage created between robots during the competition
-

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

R57 A team's robots must not prevent an enemy robot from engaging in rescue operations through acts such as blocking.

- Any action that meets the following criteria constitutes a rescue.
 - The robot being rescued has been defeated.
 - The mechanisms of the rescuing robot and the robot being rescued must be connected, i.e. the rescuing robot remains connected to the robot being rescued whichever direction the rescuing robot moves towards.
 - The rescuing robot and the robot being rescued are moving towards their team's Restoration Zone (through the shortest route on the Battlefield)



Any action other than the above is not considered a rescue. The act of pushing by any robot is not considered a rescue.

- A rescuing robot that is moving towards its team's Restoration Zone during a rescue has priority passage and cannot be blocked.
-

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

R58 No robot may attack the Aerial Robot, Dart Launcher and Radar of the opposing team.

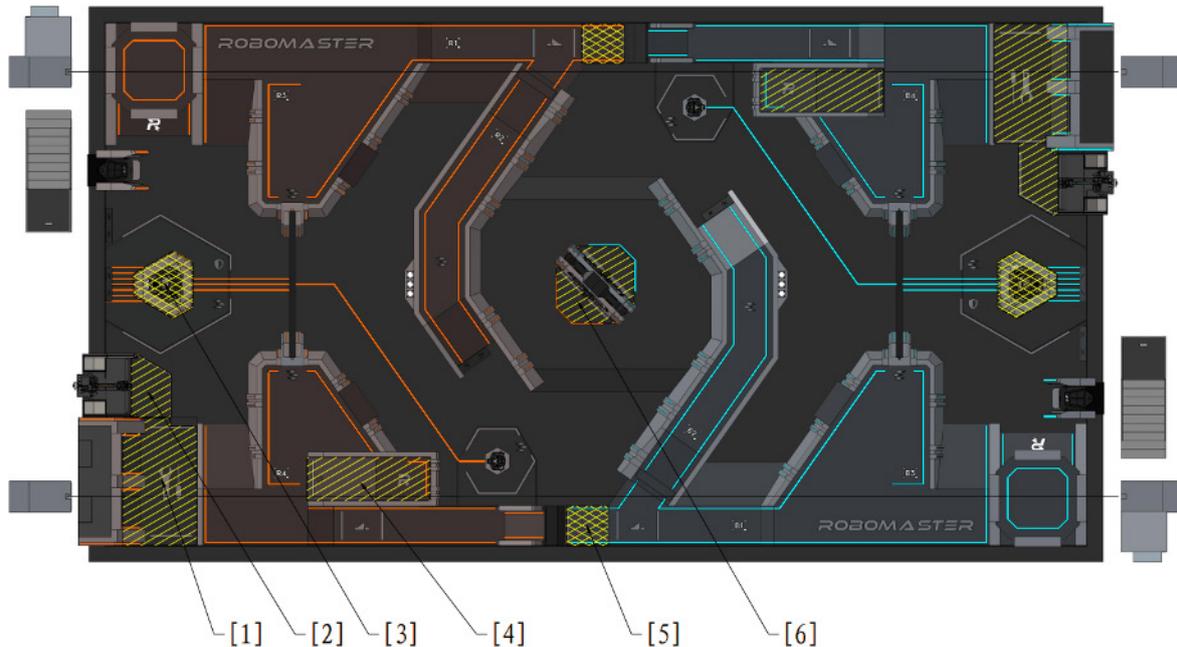
Penalties: The offending robot will be issued a Red Card.

R59 No robot may interfere with the regular projectile reload, HP recovery or revival of an enemy robot.

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

5.2.3.2 Interaction between Robots and Battlefield Components

In order to ensure the fairness of the competition and that robots in the Battlefield are able to receive buffs or reloads effectively, multiple penalty zones have been set up in the Battlefield. The entry of the team’s robot (including any Battlefield Component carried by the robot) into the Penalty Zone will be deemed as the robot’s entry into the Penalty Zone. The Penalty Zone is shown below.



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

Figure 5-1 Base Penalty Zone

R60 The Resource Island Penalty Zone is located on both sides of the Resource Island, and is not divided into the 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 and its Penalty Zone will be in the effective period if they contain a Gold Mineral that has not been grabbed by any robot, in which case the Engineer that arrives first shall occupy the Resource Island; otherwise they will be in the non-effective period.

- The Engineer Robots of both teams are not allowed to be in the same side of the Resource Island Penalty Zone. If the Engineer of one team has entered one side of the Resource Island Penalty Zone, the Engineer of the other team is forbidden from entering the side.

- If the Engineer of one team is in one side of the Resource Island Penalty Zone, the team's robots are allowed to enter the side. The other team's robots are forbidden from entering the side.
- If one team's robot other than an Engineer is in one side of the Resource Island Penalty Zone, they must exit once the Engineer of the other team later enters the same side.

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

R61 Robots are forbidden from entering the Base Penalty Zone or Road Penalty Zone.



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

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

R62 The robots of one team are forbidden from entering the Supplier Penalty Zone, Exchange Penalty Zone, and Power Rune Activation Point Penalty Zone, and must not cause any interference with or hindrance to the entry of the other team's robots into the Supplier Penalty Zone and Power Rune Activation Point Penalty Zone.



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 leaving the Penalty Zone.

Penalties: Warnings shall be issued against the offending robot based on how long the robot remained in the Penalty Zone and the impact of the violation. If it exceeds three seconds, a first Yellow Card shall be issued. Thereafter, each 10 seconds will incur a further Yellow Card. This shall carry on until the robot is ejected. A non-surviving robot that stays in a penalty zone for longer than 20 seconds may be imposed a maximum penalty of forfeiture of the round.

R63 Robots are not allowed to bring Mobile Battlefield Components into the penalty zones of both teams' Roads and Bases and their own team's Supplier Zone, Exchange Penalty Zone and Power Rune Activation Point, and the other team's Dart Launching Station. A robot that is in the Starting Zone Buff Point and Outpost Buff Point of its team must ensure the long edge of the obstacle block it carries is not at an angle larger than 30 degrees from the ground.



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

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

R64 During the competition, participating robots may only use projectiles supplied by the RMOC.

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

R65 During the 7-Minute Round, no robots other than Aerial Robots are allowed to obtain projectiles from places other than the Official Projectile Supplier and Engineer Robots.

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

R66 An Engineer Robot is not allowed to grab more than one ore at a time or grab an ore that has not been fully released.

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

R67 No robots other than Engineer Robots are allowed to have direct contact with the falling minerals or minerals in the Resource Island Base.

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

R68 During the competition, if the "R" light indicator of the Exchange Station is off, the Engineer Robot shall not place any mineral in the Mineral Receptacle.

Penalties: If the system detects that a mineral has been placed in the Mineral Receptacle, the offending robot shall be issued a Red Card.

R69 During the competition, no robot is allowed to move any Battlefield Components, damage any core component on the Battlefield using its body, or interfere with normal functions of the core components.



Hitting a mineral with a projectile is not a violation.



Core components: Including but not limited to the Dart Launching Station, Exchange Station, Official Projectile Supplier, Base and Outpost

Penalties: The highest penalty that can be imposed on an offending team is Forfeiture for that match.

5.3 Serious Violations

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

Table 5-4 Categories of Serious Violations

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

6. 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.

During the game, if the following abnormal situations occur, they will be handled in accordance with the corresponding methods. Both teams must not have any objections. The handling methods are as follows:

- When a robot safety hazard or irregularity in a robot has occurred on the Battlefield, such as a battery explosion, Aerial breaking an Aerial Safety Rope, stadium power outage, explosion of a compressed gas cylinder, or interpersonal conflict, the Head Referee will notify both teams' operators after discovering and confirming the emergency, and eject all robots through the Referee System. The result of the round will be invalidated. The round will restart after the safety hazard or exception has been eliminated.
- If non-key Battlefield Components are damaged during a match (damage to the ground rubber surface, ground lighting, or Base lighting), which do not affect the fairness of the match, the match will proceed as usual.
- The competition will carry on despite any anomaly with a robot's armor light effects or light bar effects or any damage to an Armor Module Sticker.
- If key Battlefield Components experience logical or structural faults, for example where the network connections are disrupted causing a robot to go offline, no buff is gained after a Power Rune is hit, or a Battlefield Component does not operate normally, the referee will solve the problem manually through the Referee System. If the failure cannot be dealt with manually, the referee will notify the operators of both sides and eject all robots at the same time, the competition will end immediately, and the result of the competition will be invalid. When problems are solved, there will be a replay.
- During a match, if there is structural damage or malfunction of key Battlefield Components that affects the fairness of the match and the Head Referee did not confirm and end the game in time, leading to a situation where a game that should have ended continues and has a winner, the results for the round shall be invalidated once the Chief Referee has made a determination to that effect within five minutes after the end of the round, and a rematch shall be held.
- In the case of a serious violation that would clearly have triggered a penalty of forfeiture, and the Head Referee did not confirm and execute it in time, the results for the round shall be invalidated once the Chief Referee has made a determination to that effect within five minutes after the end of the round, and the offending team will be issued a forfeiture.
- During the competition, if any situation has occurred that may affect the fairness of the competition, the Chief Referee shall notify the Captains of both teams of the situation and suspend the results confirmation process within five minutes after the end of the match, and shall make a determination within 60 minutes and notify both Captains of the final course of action.

7. Appeal

Every team has one appeal opportunity during each of the Regional, Revival 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 RMOC will no longer accept any appeal from the team. When processing an appeal, an Arbitration Commission, which is made up of the Chief Referee and the heads of the RMOC, will be formed. The Arbitration Commission makes the final decision on all appeals.

7.1 Appeal Process

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

*This process is for reference only. Please follow the updates from the Captains' meetings.

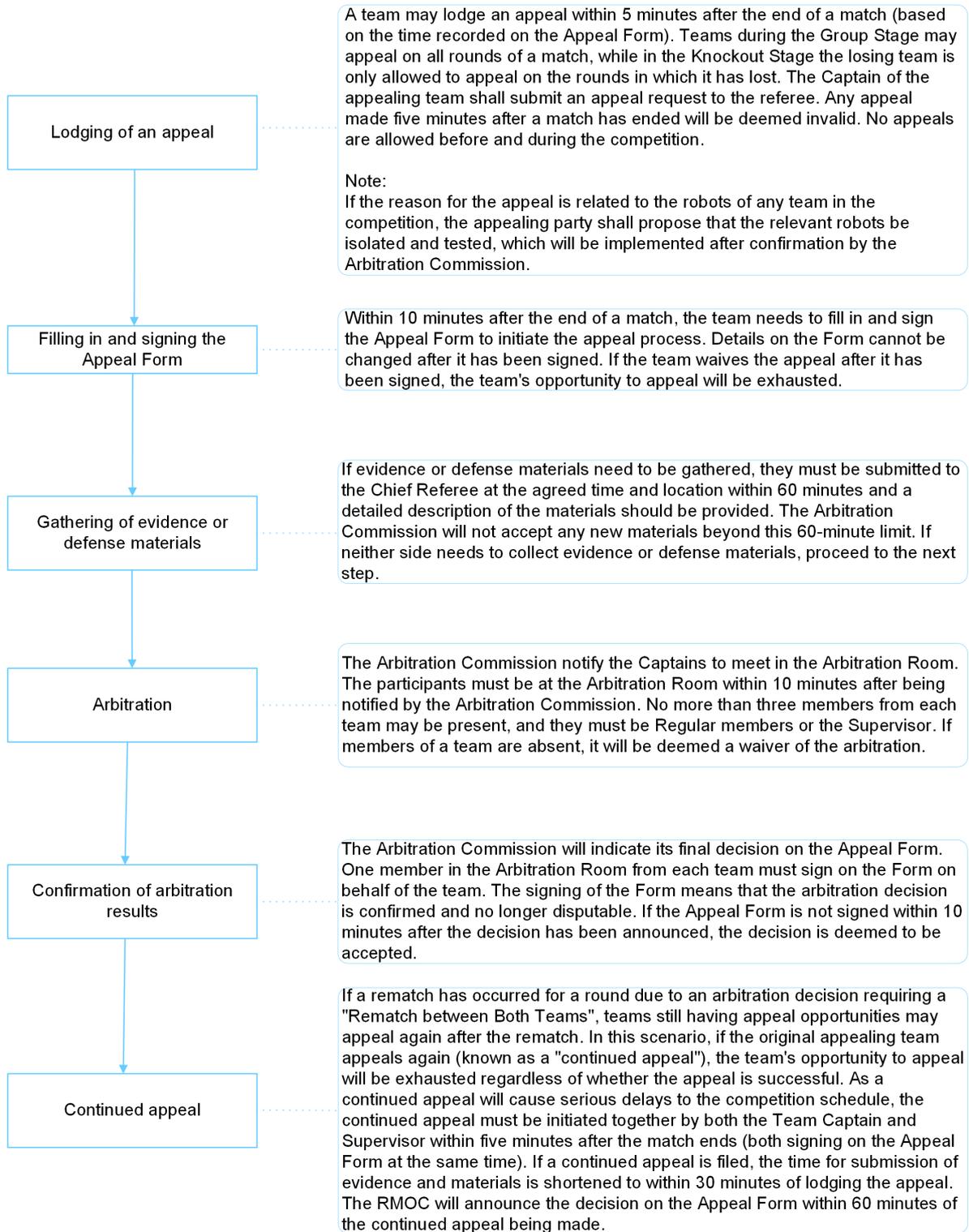


Figure 7-1 Appeal process

7.2 Appeal Materials

Appeal materials submitted by teams must follow the below specifications:

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

7.3 Appeal Decision

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

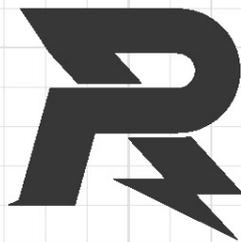


- Appeal successful: forfeiture issued against the respondent or rematch between both teams
 - Appeal failed: maintain the original match results
-

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



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



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