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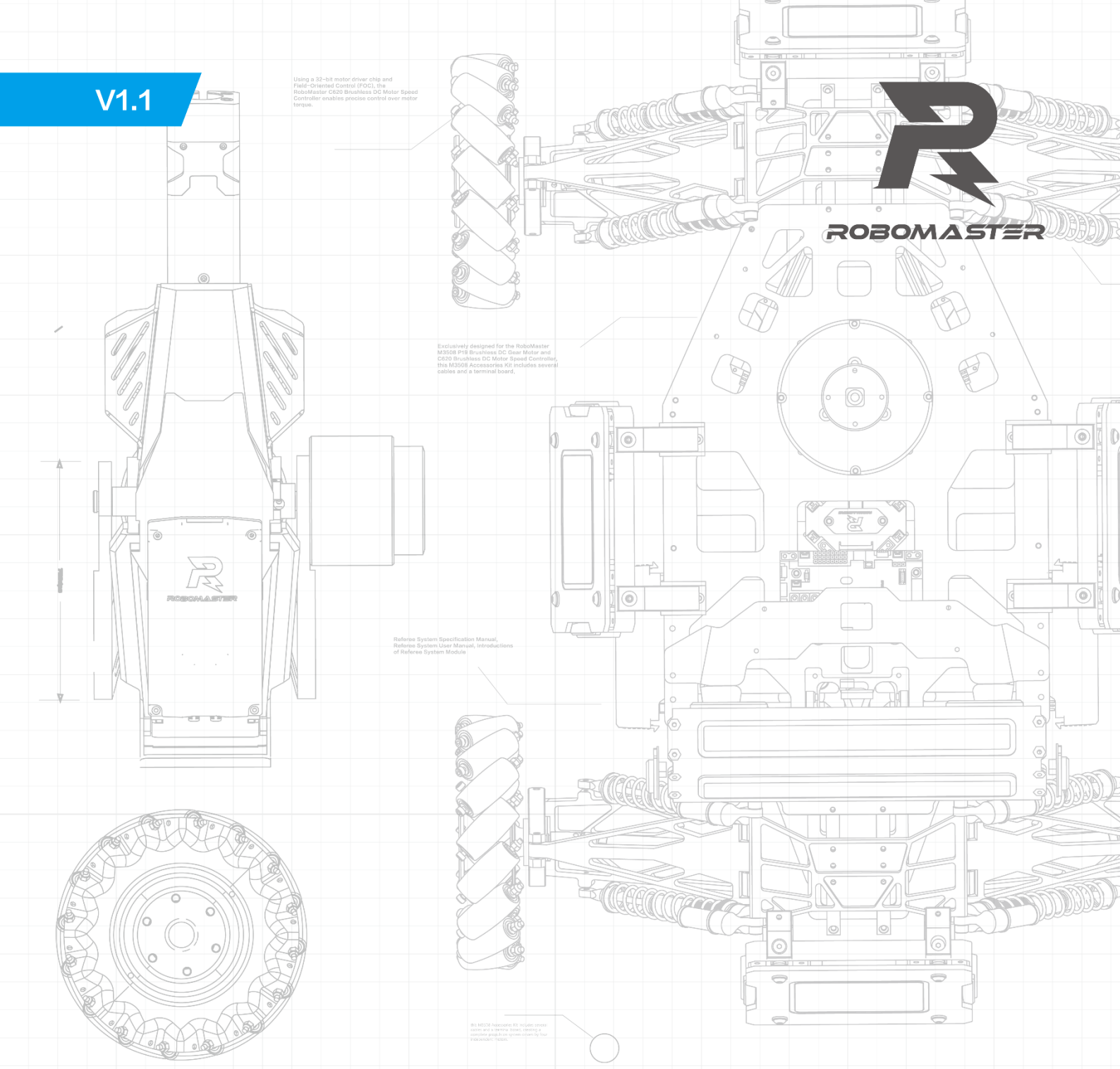


ROBOMASTER 2019
ROBOTICS COMPETITION

RULES MANUAL

The *RoboMaster* Organizing Committee

November 30th, 2018

Release Notes

Date	Version	Changes
9/20/2018	1.0	Release
11/30/2018	1.1	1. Update Competition Area drawings and parameter (including Battlefield, Bridge, Resource Island, Projectile Container, Assistive Column, Power Rune, Landing Pad and Official Projectile Supplier) 2. Update Hero Barrel Heat and HP Deduction caused by 42 mm Standard Projectile 3. Update HP Deduction inspected by Base Triangle Armor 4. Update Energy system of Aerial 5. Update aesthetic design of robot 6. Update Pre-match Inspection Form (glossiness limit, flight inspection, weight of the Referee System) 7. Update awards of the Regional Competition, Aesthetic Design Award, Outstanding Contribution Award and Open Source Prize 8. Update Types of Team, Requirement for Team, Technical Assessment Specification and Technical Exchange QQ Group.

Contents

Competition Background

Founded by SZ DJI Technology Co., Ltd. and designed for young engineers, RoboMaster is a global educational robotics program that includes events, campus clubs, and pop-culture spinoffs.

The RoboMaster Robotics Competition is China’ s first FPV-shooter-based robotics competition. It requires participants to go beyond their textbooks to develop a diverse fleet of robots. Through a process of independent research and development, students gain invaluable industrial practice and strategic planning skills. This helps to combine their book knowledge with practice in this field. The most advanced and intelligent robots are built through intense competition and relentless improvement.

RMRC is a global competition that technology enthusiasts from all over the world can enjoy and take part in. With this competition, we hope that robotics and engineering can reach a greater audience and inspire future generations.

RoboMaster attempts to reform the traditional methods of training talent. In the process of developing robotics, participants are provided with a platform where they can interact with like-minded peers, hone and further improve their skills, and advance tirelessly towards their dreams. All RoboMaster 2019 Robotics Competition participants should abide by the rules and the relevant documents of the competition. Three main entry specification documents are required for the RoboMaster 2019 Robotics Competition. They are *RoboMaster 2019 Robotics Competition Rules Manual*, *RoboMaster 2019 Robotics Competition Participants Manual*, and *RoboMaster 2019 Robotics Competition Referee System Specification Manual* (all documents are subject to the latest version officially released by the RoboMaster Organizing Committee).

The competition rules described in the *RoboMaster 2019 Robotics Competition Rules Manual* should be literally interpreted. Participants are not allowed to speculate and distort the meaning of the words in the manual. The interpretation of the RM2019 competition rules should not be combined with information from previous rules manuals, nor should you refer to any previous competition rules descriptions, core game venue sizes and projectile specifications in the process of designing robots.

Core Values

What is the purpose of this program?

- To bring passionate engineers together.
- To encourage people to thrive when faced with challenges.
- To empower visionaries to create.

The youth engineer culture that RoboMaster advocates:

- Elegance: Students are encouraged not just to solve a problem, but to iterate and perfect an elegant solution.
- Professionalism: Keep improving, always push oneself to the limit, and be eager to innovate.
- Team spirit: See the big picture, collaborate with others, and have a strong sense of responsibility towards the success of the team.
- Leadership: Be determined to lead the team to greater heights and have the vision and the foresight to improve oneself.

Chapter 1: Introduction

The core form of RoboMaster 2019 Robotics Competition is a shootout between robots using semi-automatic projectile launchers. To participate in the competition, teams must design and develop multiple robots that meet the requirements. These robots can be either remotely operated or fully-automated to independently collect projectiles placed in the Competition Area and use them to attack the opposing team's robots. To win the competition, one must destroy the opponent's Base. Compared with the 2018 Season, Official Projectile Supplier is provided by the RMOC instead of designed by teams; the capacity of projectiles, the speed of launch, and the frequency of launch of Aerial are no longer restricted, which increase the robot's strategic advantage; Hero can no longer climb the Resource Island to obtain Projectile Containers; Engineer is responsible for obtaining Projectile Containers and resucing robots; Standard also has new tasks. In terms of the Battlefield, the Official Projectile Supplier and the Base are core components provided by the RMOC; the number of Resource Island drops to one; the Power Rune is redesigned and the road condition of the Open Zone is more complicated.

1.1 Season Schedule

1. Teams must complete the Technical Assessment task of corresponding stage before qualifying for further Assessment, Warm-up Competition, Regional Competition, International Regional Competition, Wild Card Competition and Final Tournament. Only outstanding teams of Regional Competition, International Regional Competition or Wild Card Competition qualify for Final Tournament.
2. Teams passing the Technical Assessment can gain the corresponding number of RM Online Product Education Discount provided by the RMOC. For online product of each type of robot, please refer to Table 8-1 RM Online Product Education Discount. It is recommended that each team drafts out a 2019 Season Schedule to evaluate its personnel and funding needs. Teams are also advised to stick to a budget when making their robots at the beginning of the preparation stage. The following is the RoboMaster 2019 Robotics Season Schedule for reference only. The specific time is subject to the latest announcement by the RMOC.

Schedule	Item	Eligible Competitions	Rights & Duties
September 20 - October 31, 2018 (UTC+8)	Registration on Official Website	Required for teams from Mainland China	Log in the RoboMaster website and complete the registration as required.
September 20 - November 16, 2018 (UTC+8)		Required for teams from Hong Kong, Macau, Taiwan and Overseas	
October 22, 2018, 10:00-22:00 (UTC+8)	The first round of Rules Exam (Chinese)	1. Required for all teams 2. Teams that have passed the first round of Rules Exam cannot take the second round.	1. Receive one set of product discount coupon for Aerial and one set for Standard. 2. Teams that gain 100 points in the first round of Rules Exam will receive one GM6020 motor. 3. The first ten teams that gain 100 points in the second round of Rules Exam will receive one GM6020 motor each. 4. Qualify for submiting the Season Schedule.
November 20, 2018, 10:00-22:00 (UTC+8)	The second round of Rules Exam (Chinese and English)		
October 22, 2018 - November 30, 2018 (UTC+8)	Season Schedule	Required for teams from Mainland China	1. Receive one set of product discount coupon for Hero, one for Engineer and one for Sentry. 2. Qualify for submiting the Mid-term Robot Assessment Video. 3. Make the Season Schedule open source and the top five open source teams will receive a set of the Standard referee system of the RM2018 version (VTM not included).
October 22, 2018 - December 25, 2018 (UTC+8)		Required for teams from Hong Kong, Macau, Taiwan and Overseas	
December 25, 2018 - January 23, 2019 (UTC+8)	Mid-term Robot Assessment Video + BOM form	Required for teams from Mainland China	1. Receive two sets of product discount coupon for Standard and seven 20% off discount coupons for Manifold 2 (EMMC). 2. The top ten teams will receive one
January 23, 2019 - March 1, 2019		Required for teams from	

Schedule	Item	Eligible Competitions	Rights & Duties
(UTC+8)		Hong Kong, Macau, Taiwan and Overseas	set of the Standard referee system of the RM2018 version (VTM included). 3. The top 48 teams are allowed to borrow a set of the Standard referee system of the RM2019 version in advance. 4. The top 80% teams will qualify for submiting their technical proposal.
December 25, 2018 to February 22, 2019	Technical Proposal	Required for teams from Mainland China	1. Qualify for submiting the Final Robot Assessment Video 2. Make the technical proposal open source and the top five open source teams will receive a set of the Standard referee system of the RM2018 version (VTM not included).
January 23, 2019 - April 1, 2019 (UTC+8)		Required for teams from Hong Kong, Macau, Taiwan and Overseas	
January 23, 2019 - April 1, 2019 (UTC+8)	Final Robot Assessment Video	Required for teams from Mainland China	Qualify for the Referee System Exam
March 1, 2019 - June 3, 2019 (UTC+8)		Required for teams from Hong Kong, Macau, Taiwan and Overseas	
January 23, 2019 - April 2, 2019 (UTC+8)	Referee System Exam (Chinese)	Required for teams from Mainland China	Qualify for borrowing the full set of referee system and participating in the (Chinese) Regional Competition.
March 1, 2019 - June 4, 2019 (UTC+8)		Required for teams from Hong Kong, Macau, Taiwan and Overseas	
May 2019 - September 2019	Team's Season Summary	Optional	-

Schedule	Item	Eligible Competitions	Rights & Duties
The whole season	Open source report	Optional	Eligible to run for the selection of the Open Source Award.

Table 1-1 Onlie Match Schedule

Schedule	Item	Eligible Competitions	Rights & Duties
May 14-19, 2019	South China Regional Competition	Teams from Mainland China	Teams from Mainland China are free to choose the competition region or accept the arrangements made by the organizing committee. The priority in choosing the competition area is based on the score of technical assessment.
May 21-26, 2019 (UTC+8)	Central China Regional Competition		
May 28 - June 2, 2019 (UTC+8)	North China Regional Competition		
July 2019	International Regional Competition	Teams from Hong Kong, Macau, Taiwan and Overseas	Teams that pass the Referee System Exam qualify for the International Regional Competition.
July 2019	Wild Card Competition	Teams from Mainland China	Teams that rank the second place of the Regional Competition qualify for the Wild Card Competition
July 2019 – August 2019	Final Tournament	Teams from Mainland China; Teams from Hong Kong, Macau, Taiwan and Overseas	Winners of the Regional Competition, International Regional Competition and Wild Card Competition qualify for the Final Tournament

Table 1-2 Offline Match Schedule

Note: For details about technical assessment specifications, please refer to Appendix 3 Technical Assessment Specification.

1.2 Prize

1.2.1 Final Tournament

Award	Ranking	Qty.	Reward
Grand Prize	Champion	1	Champion Trophy Champion Medal Grand Prize Certificate Cash prize of USD $ 75,000 (before tax)
	2nd	1	First Runner-up Trophy First Runner-up Medal Grand Prize Certificate Cash prize of USD $ 45,000 (before tax)
	3rd	1	Second Runner-up Trophy Second runner-up medals Grand Prize Certificate Cash prize of USD $ 15,000 (before tax)
	4th	1	Grand Prize Certificate Cash prize of USD $ 15,000 (before tax)
First Prize	5th to 8th	4	First Prize Certificate Cash prize of USD $ 7,500 (before tax)
	9th to 16th	8	First Prize Certificate Cash prize of USD $ 4,500 (before tax)
Second Prize	17th to 32nd	16	Second Prize Certificate

Note: The name of the award will be changed later and is subject to the actual certificate issued.

1.2.2 Wild Card Competition

Award	Ranking	Qty.	Reward
Third Prize	Teams that did not advance to the Final Tournament	Multiple	Third Prize Certificate

1.2.3 Regional Competition

Award	Ranking	Qty.	Reward
Grand Prize	Regional Champion	1/region	Champion Trophy Regional Grand Prize Certificate Cash prize of USD $ 4,500 (before tax)
	Regional First Runner-up	1/region	First Runner-up Trophy Regional Grand Prize Certificate Cash prize of USD $ 4,500 (before tax)

	Regional Second Runner-up	1/region	Second Runner-up Trophy Regional Grand Prize Certificate Cash prize of USD $ 4,500 (before tax)
	Regional 4th	1/region	Regional Grand Prize Certificate Cash prize of USD $ 4,500 (before tax)
First Prize	Based on the region's allocated quota, top ranking teams in each region qualify for the Final Tournament.	12 in total from four regions	Regional Grand Prize Certificate Cash prize of USD $ 4,500 (before tax)
Second Prize	In addition to the teams that directly advance to the Final Tournament, other top-ranking teams in each region may advance to based on each region's allocated quota.	Multiple	Regional Second Prize Certificate
Third Prize	Teams that did not win first and second prizes in the Regional Competition	Multiple	Regional Third Prize Certificate

Note: The International Regional Competition is one kind of the Regional Competition.

1.2.4 Outstanding Contribution Award

Award	Description	Qty.	Reward
Outstanding Supervisor	Outstanding Supervisor of the Year	6	Honor certificate USD $ 1,500 (pre-tax)
	Outstanding Supervisor in the Regional Competition	6	Honor certificate USD $ 750 (pre-tax)
Outstanding Captain	Outstanding Captain of the Year	4	Honor certificate USD $ 750 (pre-tax)
	Outstanding Captain in the Regional Competition	4	Honor certificate USD $ 300 (pre-tax)
Outstanding Project Manager	Outstanding Project Manager of the Year	4	Honor certificate USD $ 750 (pre-tax)
	Outstanding Project Manager in the Regional Competition	4	Honor certificate USD $ 300 (pre-tax)
Outstanding PR Manager	Outstanding PR Manager of the Year	4	Honor certificate USD $ 450 (pre-tax)
	Outstanding PR Manager in the Regional Competition	4	Honor certificate USD $ 150 (pre-tax)
Outstanding Business Manager	Outstanding Business Manager of the Year	4	Honor certificate USD $ 450 (pre-tax)
	Outstanding Business Manager in the Regional Competition	4	Honor certificate USD $ 150 (pre-tax)
Outstanding Advisor	Outstanding Advisor of the Year	4	Honor certificate USD $ 450 (pre-tax)
	Outstanding Advisor in the Regional Competition	4	Honor certificate USD $ 150 (pre-tax)
Outstanding Volunteer	Outstanding Volunteer of the Year	10	Honor certificate
	Outstanding Volunteer in the Regional Competition	10	Honor certificate
Creativity Award	-	4	Honor certificate

1.2.5 Aesthetic Design Award

In order to improve the identity and aesthetics of the robot's appearance, the organizing committee encourages teams to add industrial design elements when designing the robot protective case. The organizing committee will award teams with aesthetically pleasing robots.

The Aesthetic Design Award includes the Best Aesthetic Design Award and the Outstanding Aesthetic Design Award. The Best Aesthetic Design Award will select the most aesthetically pleasing robots in

each unit and reward them. The Outstanding Aesthetic Design Award will select the top ten teams that make the most beautiful and exquisite robots. The ten winning teams for the Outstanding Aesthetic Design Award will be rewarded with Technical Timeout. See the chart below for more details.

1. **The Best Aesthetic Design of the Year will be determined by the organizing committee in the section of Mock Inspection of the Final Tournament.**

Robot	Qty.	Reward
Best Aesthetic Design of the Year		
Standard	1	Honor certificate USD $ 750 (before tax)
Engineer	1	Honor certificate USD $ 750 (before tax)
Hero	1	Honor certificate USD $ 750 (before tax)
Aerial	1	Honor certificate USD $ 750 (before tax)
Sentry	1	Honor certificate USD $ 750 (before tax)
Outstanding Aesthetic Design Award of the Year		
All	10	A 2-minute Team Technical Timeout (only valid in the Final Tournament)

2. **Aesthetic Design in the Regional Competition will be determined by the organizing committee in the section of Mock Inspection of the Regional Competition.**

Robot	Qty.	Reward
Best Aesthetic Design in the Regional Competition		
Standard	1	Honor certificate USD $ 750 (before tax)
Engineer	1	Honor certificate USD $ 750 (before tax)
Hero	1	Honor certificate USD $ 750 (before tax)
Aerial	1	Honor certificate USD $ 750 (before tax)
Sentry	1	Honor certificate USD $ 750 (before tax)
Outstanding Aesthetic Design Award in the Regional Competition		
All	10	A 2-minute Team Technical Timeout (only valid in the Final Tournament)

1.2.6 Open Source Prize

Award	Description	Qty.	Reward
Open Source Grand Prize	In the RM 2019 Season (September 20, 2018 to August 31, 2019), teams share their core technology or operation management methods in the RoboMaster Forum and the official website, promoting the development of the RoboMaster Robotics Competition and the engineering culture and spirit.	Multiple	Honor certificate USD $ 15,000 (pre-tax)
Open Source First Prize		Multiple	Honor certificate USD $ 7,500 (pre-tax)
Open Source Second Prize		Multiple	Honor certificate USD $ 4,500 (pre-tax)
Open Source Third Prize		Multiple	Honor certificate USD $ 1,500 (pre-tax)
Open Source Outstanding Prize		Multiple	Honor certificate Class A: USD $ 750 (before tax) Class B: USD $ 450 (before tax) Class C: USD $ 300 (before tax)

1.3 Intellectual Property Statement

The RoboMaster Organizing Committee encourages and advocates technological innovation and open source technology and respects the intellectual property of the teams. All rights related to the intellectual property developed during the competition will be owned by the team. The RoboMaster Organizing Committee will not participate in the process of handling intellectual property disputes among team members. The participating teams must properly handle all aspects of intellectual property rights among school members, company members and other members of the team.

While using the RoboMaster Referee System and other supporting materials provided by the RoboMaster Organizing Committee, teams should respect the ownership of intellectual property. Teams are also prohibited from engaging in any behavior that violates intellectual property rights, including but not limited to reverse engineering, replication or translation.

Violations & Penalties:

If there are any violations to the intellectual property rights of the competition and education products provided by the RoboMaster Organizing Committee and the organizer, the party which owns the rights will pursue compensation according to the law.

1.4 Rules Update and Q&A

Based on the actual situation of the preparation and competition stage in the RM 2019 Season, RoboMaster 2019 Robotics Competition rules of the following aspects may be updated:

1. Minor adjustments to balancing parameters (projectile capacity, power restriction, etc.).
2. Modifications to the rules that participants can gain advantages through non-technical means.
3. Additional penalties or amendments to actions that lead to an unbalanced competition.

To ensure a fair and just competition, the timeliness of rules update, and the healthy running of the competition, the organizing committee will issue the *Rules Hotfix Announcement* (hereinafter referred to as "the *Announcement*") to explain and update rules, which is usually presented in two ways:

1. Continue to use the latest version of the *Rules Manual* and replace the specific texts with modifications and updates.
2. Directly add new rules, regulations, and penalties.

The *Announcement* reserves a highter right of interpretation over the latest version of the *Rules Manual*. Rules and regulations that are not mentioned in the *Announcement* are subject to the latest version of the *Rules Manual*. Changes of the *Announcement* will be updated in the *Rules Manual* and later revoked. The *Rules Manual* will have a higher version number. All updates of the *Rules Manual* will be posted on the Events section of the RoboMaster official forum, with the latest version number pinned to the top.

Q&A Channel	
Channel	**Description**
Official forum	Questions about the competition rules can be found in the FAQ sub-section of the Events section of the RoboMaster official forum. Post question andthe RoboMaster Organizing Committee will reply to it within 1-2 working days. Each week, posts related to rules and rules Q&A will be summarized in the same post, which is synchronized in the FAQ sub-section of the Competition section of the RoboMaster official forum. Post title format: 1. Technical Q&A: "[Technical Q&A] + Post Title" 2. Rules Q&A: "[Rules Q&A] + Post Title" 3. Other Q&A (such as materials, etc.): "[Other Q&A] + Post Title" **Note:** The title of the post should contain square brackets "[]"
Telephone	0755-36383255
Official E-mail	robomaster@dji.com
Competition QQ Group	RoboMaster 2019 Robotics Competition Official Entry QQ Group: 791094259
Competition Enquiry Account	QQ: 2355418059 **Note:** Official notices and enquiry related to the competition are subject to the information and answers published via the official QQ number.
	WeChat: rmsaiwu
WeChat Group	Add the WeChat account (rmsaiwu) and apply to join the corresponding group (the official competition WeChat group, PR Manager WeChat group, and Supervisor exchange group)

Chapter 2: Team Requirement

2.1 Requirement for Participant

The RoboMaster Robotics Competition advocates teamwork spirit. To encourage team members to play important roles, the RMOC will reward those who contribute the most throughout the competition with rewards like Outstanding Captain, Outstanding Supervisor, etc. (please refer to 1.2.4 Outstanding Contribution Award)

Requirement for Participant			
Participant	**Role**	**Number**	**Qualificaition**
Supervisor	Head of the team, responsible for team building and management	1-5	Faculties of the team's college or university who are qualified for teaching and scientific research.
Advisor	Provide strategic, technical and management support and guidance to the team	0-5	Full-time junior college students, undergraduates, postgraduates, and doctoral students in colleges and universities, as well as engineers, researchers and faculties working in enterprises, research institutions, or freelancers
Captain	Key member of the team, responsible for technology and tactics, also serves as the major liaison for the RMOC	5-35	Full-time junior college students, undergraduates, postgraduates, and doctoral students in colleges and universitiesbefore August 2019
Public Relations (PR) Manager	Responsible for promotion		
Organizational Project Management (OPM)	Oversees the entire project		
Team Member	Divided into Technical Group, Operation Group and Operator Group		

Duty Specification

Supervisor:

1. Responsible for the safety of team members and their properties, guidance and management of the use of funds.
2. Instruct the team to develop project plan and solve R&D issues, helping the team to complete the competition successfully.
3. Actively cooperate with the RMOC and push Captain and OPM to regularly report project progress to the RMOC.
4. Cannot serve as Operator, OPM, PR Manager, or Advisor at the same time.

Advisor:

Advisor can undertake tasks of manufacturing robots and other competition affairs, but cannot serve as Supervisor, Captain, Operator, OPM, or PR Manager at the same time.

Captain:

1. Responsible for division of labour, overall planning and tatics arrangement and adjustment.
2. Attend Captains Meeting, represent the team to confirm match results and participate in appeal processes and any subsequent hearings.
3. Responsible for the heritage and development of the team after the competition.
4. Can serve as Operator but cannot serve as OPM, PR Manager or Advisor at the same time.

OPM:

1. Oversees the entire project.
2. Comprehensively considers R&D costs, work safety and other issues.
3. Plays a decisive role in the project's general obejective (e.g. progress, outcome, costs, etc.).

PR Manager:

1. Responsible for pooling promotion resources and establishing a comprehensive system.
2. Plan and organize activities via multiple platforms to increase the influence of the team and RM competition.

Business Manager:

1. Responsible for pooling internal and external resources.
2. Write and revise investment plans, and seek cooperation through various channels.
3. Provide technical support and funding for the team.
4. PR Manager and OPM can be concurrently appointed as Business Manager.

Team Member:

Team members are usually divided into three groups: Technical Group, Operation Group and

Operator Group.

1. Technical Group is responsible for R&D work such as robot design and manufacturing and has technical directions such as machine, electronic control and vision. It is recommended that the group has an industrial designer who is in charge of the aesthetic design of robots.
2. Operation Group is responsible for promoting, organizing and planning the competition. It is recommended that the group has a team member who is in charge of attracting investment.
3. Operator Group is responsible for controlling robots during the competition.

2.2 Requirement for Team

1. The team must cooperate with a college or university and meet the requirments of role, number and qualification stated in 2.1 Requirement for Participant.
2. In principle, only one team per school is eligible to participate in the competition. Institutions that have multiple campuses in different cities, which makes it difficult for students to compete as a team, are allowed to have more than one team once verified by the Committee. Teams must obtain the entry authorization from their school and submit the proof to the registration system. For the entry authorization template, please refer to the registration system. For a team, the precondition to register for the competition is to obtain the stamped authorization from the college (or campus) it represents. Applicants must ensure that their registration information is complete and accurate, and will undertake the corresponding responsibilities. They must bear all consequences caused by missing any information or providing incorrect registration information. For special circumstances, applicants can contact the Committee to deal with the issue. The Committee reserves the right of final interpretation.
3. The team comes up with their own name, whichmust be in the format of "XXX-Team" ("-" is only a separator, not in the actual team name) and the total length should not exceed 16 English characters or 8 Chinese characters. The team name cannot consist of the college name or its abbreviation in Chinese or English, or such Chinese characters as "队", "团队" and "战队" which mean "team" in English, or special symbols like "*/-+". The team name must reflect the positive and pioneering spirit of the team and comply with relevant state laws and regulations.
4. Two or more schools that do not have their own teams to register for the competition can form an intercollegiate team.
   A. Before the establishment of an intercollegiate team, members must fully communicate with each other based on the actual situation. The team itself must deal with issues of operating and R&D costs, staffing or disputes that may hence arise. RMOC assumes no responsibility for any of these issues.
   B. Once established, the intercollegiate team shall not dissolve and may only participate in the RoboMaster 2019 Robotics Competition as that team. If the intercollegiate team that has passed the review of technical report dissolves, it shall be deemed as r its qualification for the competiton.

C. The team name of an intercollegiate team should be "XXX Intercollegiate Team" instead of "XXX Team." It must also submit a statement provided by the team's school to the registration system. For the template of the intercollegiate team statement, please refer to the registration system.

5. Any team member (including Supervisor, Advisor, Captain, PR Manager, OPM and Team Members) may only participate in one team during the 2019 Season.

Violations and Penalties:

1. If Item 2.2.1-2.2.4 have not been met, the Committee will reject the application.
2. If Item 2.2.5 has not been met, the violator and each team that he/she is part of is regarded as cheating once confirmed by the Chief Referee.

2.3 Types of Team

Teams from Mainland China	
Definition	Come from colleges in mainland China, pass the registration review and technical review within the specified time and meet the competition requirements.
Rights	Eligible for the competition and subsequent rounds. Qualify for awards as set out in Award Rules.
Entry Procedures	Implement the competition process in accordance with standards for teams from mainland China.
	Participate in the (Chinese) Regional Competition and outstanding performers qualify for the Wild Card Competition and the Final Tournament.
Teams from Hong Kong, Macau, Taiwan and Overseas	
Definition	Come from Hong Kong, Macau, Taiwan and Overseas, invited by the Committee to participate in the competition, pass the registration review and technical review within the specified time and meet the competition requirements.
Rights	Eligible for the competition and subsequent rounds. Qualify for awards as set out in Award Rules.
	Due to different education systems, education backgraound of teams from Hong Kong, Macau, Taiwan and Overseas will not be restricted.
Entry Procedures	Implement the competition process in accordance with standards for teams from Hong Kong, Macau, Taiwan and Overseas.
	Participate in the International Regional Competition and outstanding performers qualify for the Wild Card Competition and the Final Tournament.

Chinese and Foreign Joint Teams	
Definition	Come from Chinese-foreign cooperatively-run colleges, pass the registration review and technical review within the specified time and meet the competition requirements.
Rights	Eligible for the competition and subsequent rounds. Qualify for awards as set out in Award Rules.
Entry Procedure	If the college is located in mainland China, its team is subject to standards for teams from mainland China.
	If the college is located in Hong Kong, Macau, Taiwan or overseas, its team is subject to standards for teams from Hong Kong, Macau, Taiwan and overseas.
	In the RoboMaster 2019 Season, teams are free to choose to follow the entry procedures for mainland China or the other. The entry procedure shall not be changed throughout the season once confirmed with the staff of the Committee in the registration period.

Note: Event procedure includes policies of material granting, purchasing, and supporting services.

2.4 Sponsor Specification

In order to obtain financial, material, and other assistance, teams are encouraged by the RMOC to seek sponsorships independently. In the process of looking for sponsors, teams need to follow the investment guideline provided by the RMOC in order to protect the interests of each team and maintain the overall brand image of the competition. The investment guideline is only subject to supporting services and sponsorship support of the teams, and does not involve the return and benefits related to the RoboMaster competition.

Teams must follow the investment process to declare the rights of both parties to the RMOC for approval. Such "sponsorship" include ads placed on the robot body, title sponsors' appearances on the competition spectator system, etc. If the aforementioned process is not followed, the RMOC has the right not to cooperate in the implementation of relevant rights and interests of the competition. The RMOC is only responsible to confirm whether the sponsors are acceptable partners and to decide whether to assist the team in implementing rights and interests of the competition. The RMOC is not responsible for any party of the sponsorship.

Violations and Penalties:

For actions that damage the brand of the RMOC and the Organizer, and the trademark and intellectual property rights of sponsors, certain penalties such as disqualification from the competition and being subject to legal liability will be imposed on by the RMOC.

Chapter 3: Robot Technical Specification

Teams are expected to make and develop robots independently and can purchase basic components and modules from SZ DJI Technology Co., Ltd. with student discounts or from other manufacturers. For details of RoboMaster education products and purchasing, please refer to RoboMaster 2019 Robotics Competition Instructions for Purchasing Materials posted on the official website.

Robots must follow the specifications defined in this chapter, otherwise they shall fail the pre-match inspection.

It is recommended that participating teams consider the following aspects when designing robots:

1. Plan and analyze the mechanical design before making robots, Use mature industrial products and modules to improve the reliability of mechanisms.
2. Read this chapter carefully, plan well in advance, improve mechanism functions according to the rules and ensure that robots meet technical specifications.
3. Read the *RoboMaster 2019 Robotics Competition Referee System Specification Manual* carefully, pay attention to the various installation specifications and usage methods of the referee system, in order to avoid failing the pre-match inspection due to improper installation.
4. Evaluate manpower and fund demands in advance and make budgets and plans for robot making so as to avoid unnecessary iterations of robots during the preparation phase.
5. Pay attention to the manufacturability of components to reduce costs and processing difficulty. Modularize components for easy replacement.
6. Since robots will endure massive shootouts during the competition, good durability and maintainability are required.
7. There will be certain manufacturing errors between the actual objects and the drawings. When designing the robot structure, consider the manufacturing errors of the Battlefield Components, and do not overly rely on the accuracy of the size measurements.
8. During the process of robot design and structure production, try to add industrial design elements to improve the aesthetic extent. The aesthetic design should not interfere with the enemy with non-technical means. Robots installed with protective cases must satisfy the constraints specified in the pre-match inspection form. Restrictions on robot coloring will be released later.

3.1 General Technical Specification

All robots must meet the following general technical specifications for energy source, wireless, optical equipment, visual feature and robot numbering.

Type	Technical Specification
Energy Source	Robots may only use electrical or pneumatic power. Internal combustion engines, explosive substances and hazardous chemical materials are prohibited. **Power Supply:** Only use dry batteries such as No. 1, No. 5, and No. 7 produced by reputable manufacturers or lithium batteries with power management (such as TB47) produced by DJI. **Note:** An explosion-proof box will be placed at the entrance to each team in the Competition Area. During the competition, if a battery becomes a safety hazard, Technicians will put the hazardous battery into the explosion-proof box and will not return it to the participating team until the safety hazard is eliminated. **Violations and Penalties:** Robots equipped with batteries of violation would fail the pre-match inspection. Violators will be held legally liable for safety incidents caused by such batteries. **Gas Source:** The compressed gas pressure must not exceed 20 Mpa. The cylinder used should have a nominal pressure of no less than 30 MPa, and a double gauge constant pressure valve should be placed at the outlet of the cylinder. Robots using compressed gas for propulsion system must meet the following requirements: 1. Working gas: Working gas must be non-flammable and non-toxic, such as air, nitrogen or carbon dioxide. 2. Cylinder certification: Cylinder must be designed and manufactured for the pressure condition for usage, and certified by the officially recognized test organization of the country of origin with a valid conformity certificate. The certificate should be easily viewable. 3. Pressure regulator: The constant pressure valve must be directly installed on the gas cylinder/ tank. 4. Protection measure: Gas cylinder and gas pipe must be protected to prevent damage caused by rollover, collision and rotation from any direction, and moving parts failures. The container opening shall not be exposed in order to prevent damage caused by projectiles. 5. Loation of gas cylinder and pipe: The gas cylinder should be installed in a way that it and the gas pipe will not touch the ground no matter how the robot rolls.

Type	Technical Specification
	6. Cylinder installation: The cylinder must be safely mounted on the frame and ensure the container opening remains either level or upward. To fix to the frame, the container must have at least two fixed points, or one fixed surface that is more than 1/5 of its length. 7. Thermal insulation: The cylinder must be insulated from any possible heat sources by a barrier layer, such as a carbon fiber board or aluminum plate. 8. Gas Pipes and fittings: Gas pipes and fittings must be able to handle the system's maximum possible working pressure. **Note:** 1. It is forbidden to use air pumps that have to work with external power supplies in the Competition Area. Teams can bring low-pressure air pumps but they are not allowed to charge air pumps in the Competition Area. 2. During the competition, if the gas cylinders are found to have safety hazards (such as damage to the external protection device, hidden dangers arising from aging, etc.), participants must follow the instructions of the referee to deal with safety hazards. Otherwise, the robot will not be allowed to play and must be removed from the Competition Area. The actual situation is determined by the Chief Referee. **Violations and Penalties:** Robots that violate these gas-power specifications will fail the pre-match inspection. Furthermore, if a referee determines that an unauthorized gas-power source is being used, this shall be deemed as cheating. Teams will be held liable for any danger caused by using gas-power sources that do not meet these specifications.
Wireless	**Remote Controller** 1. Remote controller used with robots during the competition must be produced by DJI. 2. Each robot can only pair with one remote controller, each of which can only be targeted to one receiver. **Violations and Penalties:** 1. Robots not equipped with DJI-brand remote controllers cannot pass the pre-match inspection. 2. During the seven-minute match, if the remote controller used with robots is targeted to two or more receivers, the team will be considered cheating once confirmed by the Chief Referee or through investigation, and then it will be disqualified from the match.

Type	Technical Specification
	Wireless Communication: Unofficial wireless networks may interfere with the operation of the equipment related to the official referee system or participating robots. Participants are forbidden from setting up wireless networks in the relevant areas (including but not limited to the Preparation Area, Inspection Area, Staging Area, and Competition Area), and using radios to communicate with each other. **Violations and Penalties:** 1. If participants are found to set up wireless networks, they will be considered cheating once confirmed by the chief referee or through investigation, and then they will be disqualified from the match. 2. If participants are found to use radios to communicate and interfere with the normal process of the match, they will be considered cheating once confirmed by the chief referee or through investigation, and then they will be disqualified from the match.
Optical Equipment	1. The laser beam from the laser sight must be red and the optical power consumption is less than 35mW. 2. The projection angle of the laser sight must be less than or equal to 5° (i.e. the diameter of the laser spot perpendicularly projected by the laser sight on a vertical wall with a horizontal distance of 1m is less than 9cm). 3. During the competition, Aerial can be equipped with indicator lights on its body to better implement visual function and indicate its current flight status. Indicator lights on the body can only be placed at 6 locations at most, the number of lights on each of these 6 locations must not exceed 3 and the luminance of each bulb cannot exceed 5000Lux at 1 meter away.). Indicator lights should not interfere with the competition on the Battlefield (high-power LED that directly illuminates the Battlefield is prohibited.). 4. In addition to the laser sight, Engineers can be equipped with a visible light emitting device, and a fill light can be used to enhance the visual recognition feature when going to an island or acquiring a Projectile Container. 5. Optical elements used by robots must not cause harm to participants, referees, staff or audience members. **Violations and Penalties:** 1. Any robot that uses illegitimate optical equipment will not pass the pre-match inspection. 2. If any piece of optical equipment on the robot causes any physical injury to the participating team members, referees, staff or the audience, the offending party shall be investigated for legal liabilities.
Visual	The Referee System Armor Module is designed with clear lighting effects for the

Type	Technical Specification
Feature	development of automatic identification and sighting algorithms. The environment in and around the Competition Area is relatively complicated. The computer vision algorithm should adapt to the changes of the lighting of the venue and other possible interferences around the venue. RMOC cannot guarantee that the computer vision features of the Battlefield will not cause visual interference. 1. Robot sensors (such as lidar, camera, ultrasonic sensor, infrared sensor, etc.) must be installed without blocking the armor and must not project light on the armor. 2. Do not install any device (such as reflector, mirror, lens, etc.) that interferes with the computer vision feature identification of the Armor Module by reflecting or refracting the light on both sides of the armor on the robot. **Violations and Penalties:** Robots that violate the rules will fail the pre-match inspection.
Robot Numbering	1. During the pre-match inspection and the competition, the RMOC staff will paste number stickers on robots that enter the competition and also the armor plates at the Base according to the robot numbering rules. The robot number is shown in Table 3-1 Robot Entrance Lineup. For number stickers, please refer to Appendix 5 Reference Drawing.Stickers must be applied properly on the armor plates without bubbles, with one sticker on each side. 2. Except for the designated number stickers provided by RMOC, similar stickers may not be attached to the armor plates or other structures of the robot. Other decorative stickers on the robot shall not include distinct numbers. **Violations and Penalties:** 1. Robots that have unqualified stickers will fail the pre-match inspection. 2. During the competition, all robots are required to be pasted with their corresponding stickers; Otherwise they are not allowed to play. 3. In the competition, except for damages caused to stickers during a match, the robot will be deemed as cheating if any kind of unqualified sticker is found to be pasted on the robot. The offending team will receive a punitive forfeiture for any round of the challenge where it shows up with unqualified stickers.
Aesthetic Design	In order to prevent the robot's protective case from affecting the shootouts on the Battlefield or the audience's viewing experience, teams must comply with the following requirements of aesthetic design. **1. Glossiness:** The protective case can be made of any material. In order to prevent the protective case from reflecting the light emitted by the referee system which may affect the computer visual recognition, the surface glossiness of the case is required to be no

Type	Technical Specification
	more than 15 Gs. During the pre-match inspection, the inspector will measure the glossiness of the case with a glossmeter. The principle of glossmeter: A built-in light source emits a certain amount of light, which is projected onto the surface of the object to be detected. Then a built-in receiver receives the reflected light, and measures the glossiness of the surface according to the amount of reflected light. The glossmeter's measurement range is 0-101 Gs. It is known that the glossiness of a mirror surface is 101 Gs and that of a total diffuse reflection object is 0 Gs. **Note:** Matte paint and stickers are provided at the Inspection Area. If a team fails to meet the requirements, it can implement matte treatment to the surface. **2. Coating color:** To prevent the color of the protective case from causing any confusion with team color, teams should avoid using red and blue color schemes as much as possible. During the pre-match inspection, the inspector will measure and compare the case color with a colorimeter. Standards for red and blue color schemes will be issued later and evaluated by the Lab color system. **Note:** It is recommended that teams use a large area of dark and camouflage color as the bottom color and use acceptable colors to outline and embellish the case. **3. Installation:** The installation of the protective case needs to meet the normal inspection standards. For example, the armor panel cannot be blocked within 145 degrees in the positive direction. **Note:** It is recommended that teams use tough materials that are not easily damaged for the protective case, so as to avoid violations resulting from damage caused in the Competition Area. **Violations and Penalties:** Robots that do not meet the aesthetic design requirements will fail the pre-match inspection.
Launching Mechanism	Robots using compressed gas as the propellant for projectiles must not have an acceleration length (defined as the lineal length of the barrel that can provide acceleration to projectiles) exceeding 20 cm. **Note:** Launching Mechanism refers to a mechanism that allows projectiles to leave the robot on a fixed trajectory to cause damage to other robots. (This definition is applicable to all instances of "Launching Mechanism" mentioned in this manual.)

3.2 Robot Technical Specification

1. RoboMaster requires robots to fight together as a team. Good teamwork is therefore critical to victory. Robots are divided into two types: compulsory and optional. If an optional robot hasn't participated in a competition, its HP will be displayed as 0 in the referee system server of that round. Different types of robots must meet the corresponding technical specifications.
2. Before each match, different types of required robots must all pass the pre-match inspection to qualify for the match. After the first round of each match, subsequent rounds do not require the minimum lineup.
   If there are serious damages to a robot in the first round or there are serious safety hazards such as short circuit, the robot must be immediately powered off and taken away from the Competition Area to avoid safety risks in subsequent matches. The actual situation determined by the Chief Referee.
3. Each team is allowed to carry 2 standby robots at most during each match. Standby robots must also comply with all robot specifications and pass the pre-match inspection. Participants are required to declare the types of standby robots they are carrying during the pre-match inspection. Apart from Standard, other types of standby robots must be attached with armor stickers in the Inspection Area. When a standby Standard is required to enter the stage, team members must promptly get the corresponding sticker from the technicians and attach it in accordance with Robot Numbering stated in 3.1 General Technical Specification. Only then can the robot enter the stage. Standby robots are not allowed to replace after passing inspection.

<table>
<tr><th>Type</th><th>Numbering</th><th>Qty.</th><th>Property</th><th>Eligible Competition</th></tr>
<tr><td rowspan="2">Standard</td><td rowspan="2">3/4/5</td><td>3</td><td rowspan="3">Required</td><td>International Regional Competition, Wild Card Competition and the Final Tournament</td></tr>
<tr><td>2</td><td>Regional Competition</td></tr>
<tr><td>Hero</td><td>1</td><td>1</td><td rowspan="4">Regional competition, International Regional Competition, Wild Card Competition and the Final Tournament</td></tr>
<tr><td>Engineer</td><td>2</td><td rowspan="3">0-1</td><td rowspan="3">Optional</td></tr>
<tr><td>Aerial</td><td>6</td></tr>
<tr><td>Sentry</td><td>7</td></tr>
</table>

Table 3-1 Robot Entrance Lineup

Violations and Penalties:

1. Before each match, if any of the required robots does not pass the pre-match inspection, the team is deemed as give up its qualification for the round of the match and lose the match.
2. If a participating team replaces or adds a standby robot after passing the pre-match inspection or the standby robot does not pass the pre-match inspection, the team will be deemed as cheating and lose the match. The actual situation is determined by the Chief Referee.

3.2.1 Standard

Standard Specification			
Item	**Limit**	**Violations and Penalties**	**Note**
Initial HP	200	-	-
Object	except Aerial	-	-
Operating Mode	Manual, configured up to 1 remote controller	-	-
Total Power Supply Capacity (Wh)	200	Unable to pass the pre-match inspection	-
Power Supply Voltage (v)	30	Unable to pass the pre-match inspection	-
Robot Chassis Power Consumption (W)	80	HP deduction	Buffer energy 60 joules
Launching Mechanism Type	17 mm standard projectile	-	Can install only 1 Launching Mechanism and 1 laser sight
Projectile Supply Capability	Can only receive projectiles	-	-
Initial Projectile Quantity	0	-	All projectiles need to be removed before the start of each round.
Initial Firing Speed Limit for Projectiles (m/s)	30	HP deduction	-
Projectile Speed of Launch (shoot/s)	Negatively correlated with initial velocity	Refer to 3.3.3.1 Barrel Heat	-
Maximum Weight (kg)	20	Unable to pass the pre-match inspection	Include the battery weight, but not the weight of the referee system.
Maximum	600*600*500	Unable to pass the pre-	Height ≤500

Standard Specification			
Item	**Limit**	**Violations and Penalties**	**Note**
Initial Size (mm)		match inspection	Its orthographic projection on the ground should not exceed a 600*600 square.
Maximum Expansion Size (mm)	700*700*600	Unable to pass the pre-match inspection	Height ≤600 Its orthographic projection on the ground should not exceed a 700*700 square.
RoboMaster Referee System	Four small armor modules, one large armor module, Speed Monitor Module (17 mm standard projectile), Video Transmission Module (VTM), RFID Interaction Module, Positioning System Module, Main Controller Module, Power Management Module, Light Indicator Module	Unable to pass the pre-match inspection	-

Level	Maximum HP	Barrel Heat Limit	Barrel Cooling Value Per Second	Experience Points required for Level Up	Value of Experience Points
1	200	240	40	3	2.5
2	250	360	60	6	5
3	300	480	80	/	7.5

Note: For level up mechanism of Standard, please refer to 3.3.4 HP Recovery and Revival.

3.2.2 Sentry

Sentry and Base Shield:

1. If Sentry of both parties enter the stage,
   A. when a team loses its first robot (except Sentry and Aerial), the team's base defense will be

reduced from **100%** to **50%**.

B. when Sentry is destroyed, the base's entire defense will be automatically eliminated and the base shield opened.

2. If only one Sentry enters the stage,

A. when a team loses its first robot (except Aerial) within two minutes of the start of the match, the team's base defense will be reduced from **100%** to **50%**.

B. two minutes after the start of the match, the base's entire defenses will be automatically eliminated and the base shield opened.

Note: For the shape of expanded Base, please refer to 4.2.3 Base.

Sentry's HP Gain:

If Sentry destroys any enemy robot (except for Aerial, the results is calculated by the referee system server), it can obtain someHP Gain (**the Sentry's HP Gain = the corresponding Value of Experience Points of the killed robot * 20).**

For example, If Sentry destroys one Level 1 Standard of the enemy, the Sentry's HP Gain = 2.5 * 20 = 50.

Sentry Specification			
Item	**Limit**	**Violations and Penalties**	**Note**
Initial HP and Maximum HP	600	-	-
Object	except Aerial	-	-
Operating Mode	Fully Automatic	-	-
Total Power Supply Capacity (Wh)	200	Unable to pass the pre-match inspection	The total capacitance of the robot does not exceed 10 mF
Power Supply Voltage (v)	30	Unable to pass the pre-match inspection	-
Robot Chassis Power Consumption (W)	20	Unable to pass the pre-match inspection	Buffer energy 200 joules
Launching Mechanism Type	17 mm standard projectile	-	Can install only 1 Launching Mechanism and 1 laser sight
Projectile Supply Capability	Can only receive	-	Any form that delivers projectiles to other robots is prohibited.
Initial Projectile Quantity	500	-	• All projectiles need to be removed during the 3-minute setup period of the first round of each match. • After the first round, projectiles do not need to be removed before the start of each subsequent round. • Each team pre-loads the initial projectiles during the 3-minute setup period.
Initial Firing Speed Limit for Projectiles(m/s)	30	HP deduction	-

Sentry Specification			
Item	**Limit**	**Violations and Penalties**	**Note**
Projectile Speed of Launch (shoot/s)	Negatively correlated with initial velocity	Refer to 3.3.3.1 Barrel Heat	-
Maximum Weight (kg)	10	Unable to pass the pre-match inspection	Includes the battery weight, but not the weight of the referee system.
Maximum Size (mm)	500*500*600	Unable to pass the pre-match inspection	The maximum size of Sentry below the upper surface of the Sentry track is no more than 450 mm (include the maximum expansion size). The light indicator module is mounted on one side of the track and must be above the upper surface of the track. The light indicator module, positioning system module and its bracket are not included into the overall size constraints.
RoboMaster Referee System	Two large armor modules, Speed Monitor Module (17 mm standard projectile), Positioning System Module, Main Controller Module, Power Management Module, Light Indicator Module	Unable to pass the pre-match inspection	-

3.2.3 Hero

Hero Specification			
Item	**Limit**	**Violations and Penalties**	**Note**
Initial HP	300	-	-
Object	except Aerial	-	-
Operating Mode	Manual, configured up to 1 remote controller	-	-
Total Power Supply Capacity (Wh)	200	Unable to pass the pre-match inspection	-
Power Supply Voltage (v)	30	Unable to pass the pre-match inspection	-
Robot Chassis Power Consumption (W)	80	HP deduction	Buffer energy 60 joules
Launching Mechanism Type	17 mm and 42 mm standard projectiles	-	Each Launching Mechanism can only be equipped with one laser sight.
Projectile Supply Capability	Receive and supply	-	-
Initial Projectile Quantity	0	-	All projectiles need to be removed before the start of each round.
Initial Firing Speed Limit for Projectiles (m/s)	16.5	HP deduction	42 mm standard projectiles
	30	HP deduction	17 mm standard projectile
Projectile Speed of Launch (shoot/s)	Negatively correlated with initial velocity	Refer to 3.3.3.1 Barrel Heat	
Maximum Weight (kg)	35	Unable to pass the pre-match inspection	Includes the battery weight, but not the weight of the referee system.
Maximum Initial Size (mm)	800*800*800	Unable to pass the pre-match inspection	Height ≤800 Its orthographic projection on the ground should not exceed a 800*800 square.
Maximum Expansion Size (mm)	1200*1200*1200	Unable to pass the pre-match inspection	Height ≤1200 Its orthographic projection on the ground should not

Hero Specification			
Item	**Limit**	**Violations and Penalties**	**Note**
			exceed a 1200*1200 square.
RoboMaster Referee System	Five large armor modules, Speed Monitor Module (17 mm and 42 mm standard projectiles), Video Transmission Module (VTM), RFID Interaction Module, Positioning System Module, Main Controller Module, Power Management Module, Light Indicator Module	Unable to pass the pre-match inspection	-

Level	Maximum HP	17 mm Barrel Heat Limit	17 mm Barrel Cooling Value Per Second	42mm Barrel Heat Limit	42mm Barrel Cooling Value Per Second	Experience Points required for Level Up	Value of Experience Points
1	300	240	40	150	20	8	7.5
2	500	360	60	250	40	12	10
3	700	480	80	400	60	/	15

Note: For level up mechanism of Hero, please refer to 3.3.4 HP Recovery and Revival.

3.2.4 Aerial

Aerial's Energy System:

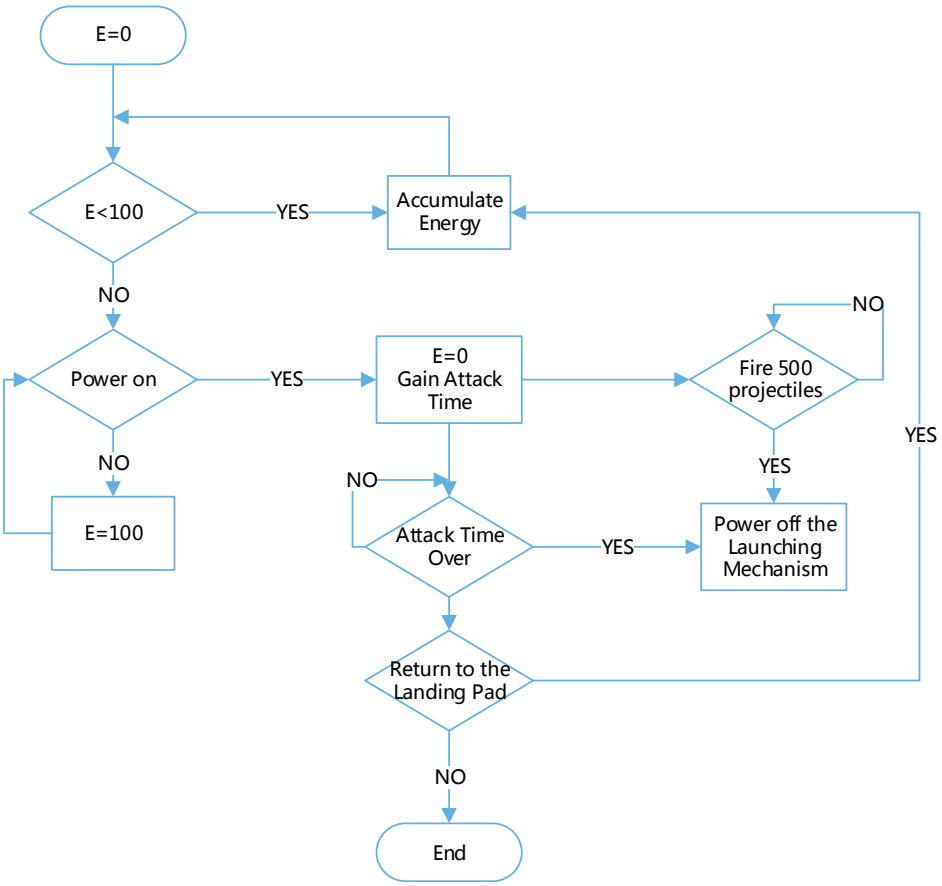
At the start of the competition, the energy of Aerial is E = 0.

When E < 100, the Launching Mechanism is powered off and cannot lauch projectiles.

When E = 100, the Aerial Gimbal Operator chooses whether to power up the Launching Mechanism.

The limit of E is 100 and the exceeding proportion will be eliminated automatically.

The logic diagram of energy is as follows:



Accumulatation of Energy:

1. After Aerial lands stably on the landing pad, it gains one Energy per second.
2. Once a robot is destroyed by the enemy, Aerial gains Energy immediately(**Aerial's Energy gain = Value of Experience Points of the destroyed robot*3**).

e.g. At the start of the competition, Aerial of the Red team took off from the landing pad after landing on it for 75s, E = 75 at that time. During the competition, the moment when a Level 2 Standard is destroyed by the Blue team, Energy of Aerial of the Red team is E = 75 + 5 * 3 = 90.

Consumption of Energy:

1. When the Launching Mechanism is powered on, Energy of Aerial falls to zero and it can launch projectiles at any speed within 50s. The Initial Firing Speed Limit is 30 m/s.
2. If Aerial returns to the landing pad before 50s has elapsed, the 50s attack time continues to count down and cannot accumulate Energy.
3. After 50s of attack time or after Aerial has launched 500 shoots of 17 mm standard projectiles, the Launching Mechanism will power off.
4. After 50s of attack time, Aerial must return to the landing pad to reaccumulate Energy. When E

= 100, the Operator can choose to power on the Launching Mechanism to reset Energy and get 50s attack time.

Penalties for exceeding Initial Firing Speed limit:

Deduct attack time. If Aerial's current Initial Firing Speed is V_1 and the Initial Firing Speed limit for projectiles is 30m/s, when the speed monitor module of the referee system detects one 17 mm standard projectile that exceeds the limit, the Aerial's attack time is reduced by $t = 0.5 (V_1 - 30)^2$ s.

Note: If the attack time is about to expire, the time deduction will be applied to the next attack time. Multiple exceedings will result in multiple attack time reductions.

Note about projectiles:

During the 3-minute setup period, the referee will provide 500 shoots of initial projectiles to the Pilot to preload. In the process of a round, in addition to the initial projectiles, the referee will provide extra projectiles as supplies. During a match, when Aerial is landed on the landing pad with the propellers off, projectile supplier can tell the referee in the operator room to reload Aerial. When the referee approves, the team members can load Aerial with projectiles. (please refer to 4.7 Operator Room)

Safety regulations during the competition:

1. No part of Aerial's barrel can exceed the top of the battlefield fence.
2. Aerial must be fitted with fully enclosed propeller guards.
3. If Aerial crashes into a tall cylindrical object, the propeller guards should protect the propellers from making direct contact with the object. The propeller guards should be strong enough to avoid serious damage and bear the weight of the aircraft.
4. Above the battlefield, there are cables, slip rings and retractable Aerial Safety Ropes to ensure Aerial's safety. Aerial must have a vertical safety rod with a height of 300 mm above the propellers installed on top of the body. The safety rod is rigidly connected to Aerial; a wire ring is fixed on the upper end of the safety rod as a pull ring for Aerial Safety Ropes. When Aerial is suspended by the pull ring, the safety rod and the pull ring can bear its static weight without any obvious deformation or damage.
5. Neither team can attack the other team's Aerial.
6. Aerial must not interfere with the normal operation of the ground robot during flight.
7. Teams should reasonably evaluate and fully test whether the propulsion system and power supply system of Aerial can meet the requirements of load and combat behaviors to prevent safety hazards or accidents during the competition.

Violations and Penalties:

1. Robots that actively fire at Aerial will be given a Level 4 Warning.
2. If Aerial collides with a ground robot during a match, the referee will consider it a malicious

collision and give the offending Aerial a Level 3 Warning.

3. If Aerial malfunctions or is repeatedly damaged due to the unreasonable design of the propulsion system or power supply system, it must be checked by the site technicians. Aerial has to be confirmed hazard-free by the Chief Referee before being allowed to return to the match. Otherwise, it will be prohibited from competing in other rounds of the match or being provided with any projectile. The actual situation is determined and executed by the Chief Referee.
4. If Aerial of a team is out of control (e.g. when Pilot can't properly control Aerial), crashes or falls inside the Battlefield, and Pilot can't restart the Aerial's propeller and control it to take off and function normally, Aerial will be ejected from the Battlefield by the referee system server. Aerial Safety Ropes will be used by Pilot and site technicians to lift Aerial to a certain height to avoid safety concerns caused by possible collision between the fallen Aerial and the ground robots.

Aerial Specification			
Item	**Limit**	**Violations and Penalties**	**Note**
Initial HP	None	-	-
Object	except Aerial	-	The referee system can only control the friction wheel motor.
Operating Mode	up to 2 remote controllers	-	-
Total Power Supply Capacity (Wh)	600	Unable to pass the pre-match inspection	-
Power Supply Voltage (v)	60	Unable to pass the pre-match inspection	-
Robot Chassis Power Consumption (W)	-	-	-
Launching Mechanism Type	17 mm standard projectile	-	Can install only 1 Launching Mechanism and 1 laser sight
Projectile Supply Capability	Can only receive		-
Initial Projectile Quantity	500	-	-
Initial Firing Speed Limit for Projectiles (m/s)	30 m/s	Attack time deduction	-
Projectile Speed of Launch (shoot/s)	No limits	-	-
Maximum Weight (kg)	10	Unable to pass the pre-match inspection.	Includes the battery weight but not the weight of projectiles or the referee system.
Maximum Size (mm)	1200*1200*800	Unable to pass the pre-match inspection.	Height ≤800 Its orthographic projection on the

Aerial Specification			
Item	**Limit**	**Violations and Penalties**	**Note**
			ground should not exceed a 1200*1200 square
RoboMaster Referee System	speed monitor module (17 mm standard projectile), Video Transmitter Module (VTM), positioning system module, main controller of referee system, power management system	Unable to pass the pre-match inspection	The weight of the entire referee system of Aerial is 0.6kg

3.2.5 Engineer

Restoration of HP:

Engineer restores 1% of its maximum HP per second if it avoids damage for at least 30 seconds during a single round (include damage caused by collisions, module goes offline, etc.).

Restrictions of Grabbing Mechanism:

1. During the competition, only Engineer can install one Grabbing Mechanism for Projectile Containers.
2. Engineer's Grabbing Mechanism is only allowed to grab one Projectile Container at a time.
3. When the body of the projecting Grabbing Mechanism is in close contact with a vertical plane, the maximum horizontal distance between the Grabbing Mechanism and the vertical plane is 400 mm. In other words, no part of the Grabbing Mechanism can cross the midline of the projectile depot in the central area of the Resource Island.
4. The Grabbing Mechanism cannot damage Battlefield Components. In particular, it cannot use serrated or sharp-edged structures to interact with projectile containers, which will cause irreversible damage.

Violations and Penalties:

1. If the Engineer's Grabbing Mechanism does not meet requirements, it will fail the pre-match inspection.

2. During a match, if the Engineer's Grabbing Mechanism is discovered to have serrated or sharp edges that cause irreversible deformation or severe damage to Projectile Containers, the violating robot will be ejected.

Engineer Specification			
Item	**Limit**	**Penalty for exceeding limit**	**Note**
Initial HP and Maximum HP	1,000	-	-
Object	Teammates	-	-
Operating Mode	configured up to 1 remote controller	-	-
Total Power Supply Capacity (Wh)	200	Unable to pass the pre-match inspection	-
Power Supply Voltage (v)	30	Unable to pass the pre-match inspection	-
Robot Chassis Power Consumption (W)	No limits	-	-
Launching Mechanism Type	Not available	-	-
Projectile Supply Capability	Can receive and supply	-	-
Initial Projectile Quantity	0	-	All projectiles need to be removed before the start of each round.
Maximum Weight (kg)	35	Unable to pass the pre-match inspection.	Includes the battery weight, but not the weight of the referee system.
Maximum Initial Size (mm)	800*800*800	Unable to pass the pre-match inspection	Height ≤800 Its orthographic projection on the ground should not exceed a 800*800 square
Maximum Expansion Size (mm)	1200*1200*1200	Unable to pass the pre-match inspection	Height ≤1200 Its orthographic projection on the ground should not exceed a 1200*1200 square
RoboMaster Referee	Four small armor modules, Video	Unable to pass the pre-match inspection	-

Engineer Specification			
Item	**Limit**	**Penalty for exceeding limit**	**Note**
System	Transmission Module (VTM), RFID interaction module, positioning system module, main controller module, power management module, light indicator module		

3.3 Referee System

3.3.1 Overview

1. During the competition, the referee system provided by the RMOC monitors a robot's behaviors, such as HP, projectile initial firing speed, and chassis power consumption and then sends real-time information to the computer of the corresponding operator and the referee system server. It also automatically determines the outcome of the competition. When designing robots, teams must reserve mechanical and electrical interfaces to the referee system and install the system as required in the latest version of the *RoboMaster 2019 Robotics Competition Referee System Specification Manual*. Otherwise, they will not pass the pre-match inspection.
2. The RoboMaster 2019 referee system consists of the following modules:

Module	Function
Camera Video Transmitter Module	Capture real-time video feed from the camera and transmit the data to the operator's monitor in the operator room.
Speed Monitor Module	Detect the projectile initial firing speed and if it overspeeds, the robot's HP will be deducted.
Armor Module	Use an armor plate and a sensor to detect when the robot is hit, and deduct corresponding HP values.
RFID Interaction Module	Interact with the Function Zone of the Battlefield and realize corresponding functions.
Positioning System Module	Detect a robot's position on the Battlefield and authorize the robot to connect to the main server.
Main Controller Module	Monitor all referee system modules, send real-time status of a robot to the server wirelessly, and authorize the robot to connect to the main server.
Power Management Module	Control power to the chassis, gimbal, and the launching mechanism, detect the chassis power consumption, and automatically cut off power supply for propulsion when a robot's HP drops to zero.
Light Indicator Module	Indicate the level of HP with the health bar, and its color is used to distinguish between the red/blue teams and the status of the robot.

For details of the size and mounting interface of the referee system, please refer to the *RoboMaster 2019 Robotics Competition Referee System Specification Manual*.

3. Robot status in the monitor process:

Status	Definition
Defense	The armor module reduces damage when it is hit or attacked by projectiles.
Defeat	HP drops to 0 when its armor module is attacked, it gets hit, the chassis

	power consumption exceeds the limit, the projectile initial firing speed exceeds the limit, the referee system goes offline (including ejected by the server).
Slay	A robot attacks the armor module of the enemy's robot till its HP drops to 0. A slain robot can be determined by the following two situations: 1. A robot defeats the enemy's robot with a critical hit. 2. If a defeated robot has been attacked by one or multiple robots 10s before its death, the last attacking robot is deemed as the killer.

3.3.2 Level Up

At the start of the competition, the initial Experience Point is 0. Hero and Standard start at Level 1 and gain Experience Points automatically per minute and by slaying enemy robots. After a level up, excessive Experience Points will be counted towards the next level.

1. During a seven-minute round, Standard gains one Experience Point per minute, and Hero gains two per minute. If a robot is defeated, its original Experience Points remains unchanged, but it can no longer obtain automatic gains.
2. During a match, one robot can obtain the corresponding Experience Points by slaying an enemy robot (the result is calculated by the referee system server).
   For example, a robot will directly gain 2.5 Experience Points when slaying a Level 1 Standard.

After a level up, the barrel heat limit, barrel cooling value, value of Experience Points, current HP, and maximum HP of the robot itself will be increased accordingly. Among these, the increase in current HP is the same as the increase in maximum HP.

Level	Maximum HP	Barrel Heat Limit	Barrel Cooling Value Per Second	Experience Points required for Level Up	Value of Experience Points
Level 1 Standard	200	240	40	3	2.5
Level 2 Standard	250	360	60	6	5
Level 3 Standard	300	480	80	/	7.5

Level	Maximum HP	17mm Barrel	17mm Barrel	42mm Barrel	42mm Barrel	Experience Points	Value of Experience

		Heat Limit	Cooling Value Per Second	Heat Limit	Cooling Value Per Second	Required for Level Up	Points
Level 1 Hero	300	240	40	150	20	8	7.5
Level 2 Hero	500	360	60	250	40	12	10
Level 3 Hero	700	480	80	400	60	/	15

3.3.3 HP Deduction

Causes for HP deduction: the barrel heat of the Launching Mechanism exceeds the limit; the initial speed exceeds the limit; the chassis power exceeds the limit; the armor module is hit; important modules go offline; and/or violation of rules.
When the referee system server calculates the HP, it rounds up the decimal point. For example, when an Engineer's Defense is at 80%, the HP deduction is 2 * (1-0.8) = 0.4, which rounds up to 0.

3.3.3.1 Barrel Heat

Different types of robots have different initial firing speed limits, heat limits, and cooling values per second according to their function and orientation.

Robot Type	Level	Initial Speed Limit (m/s)	17 mm Barrel Heat Limit	42 mm Barrel Heat Limit	17 mm Barrel Cooling Value Per Second	42mm Barrel Cooling Value Per Second
Standard	Level 1	30	240	/	40	/
	Level 2		360	/	60	/
	Level 3		480	/	80	/
Sentry	/	30	480	/	160	/
Hero	Level 1	17 mm Standard Projectiles: 30 42 mm Standard Projectiles: 16.5	240	150	40	20
	Level 2		360	250	60	40
	Level 3		480	400	80	60

Note:

1. Hero configured with two types of projectile Launching Mechanism will have barrel heat calculated separately for each type.
2. During a match, when Standard's HP is less than 20%, its 17 mm barrel cooling value per second will double.

Set the current barrel heat as Q_1, the heat limit as Q_0, the current initial speed as V_1 (m/s), and the initial firing speed limit as V_0 (m/s).

Penalties for exceeding the initial firing speed limit:

Take Standard as an example: the limit for the Standard's initial firing speed is 30m/s, which means when the projectile has accelerated, the detected speed must be less than or equal to 30m/s. The speed monitor module can only be installed at the end of the Launching Mechanism, and the speed cannot be measured until the projectile has fully accelerated.

When $V_1 > V_0$, each 17mm standard projectile with a speed of V_1 detected by the referee system will cause deduction, and the deducted HP=maximum HP*L%. For each 42mm standard projectile detected, the deducted HP=maximum HP*M%.

17mm Standard Projectile	L%	42mm Standard Projectile	M%
$\mathbf{0 < V_1 - V_0 < 5}$	10%	$\mathbf{V_0 < V_1 \le 1.1 * V_0}$	10%
$\mathbf{5 \le V_1 - V_0 < 10}$	50%	$\mathbf{1.1 * V_0 < V_1 \le 1.2 * V_0}$	20%
$\mathbf{10 \le V_1 - V_0}$	100%	$\mathbf{1.2 * V_0 < V_1}$	50%

Barrel heat:

1. For each 17mm standard projectile with a speed of V_1 detected by the referee system, the heat is

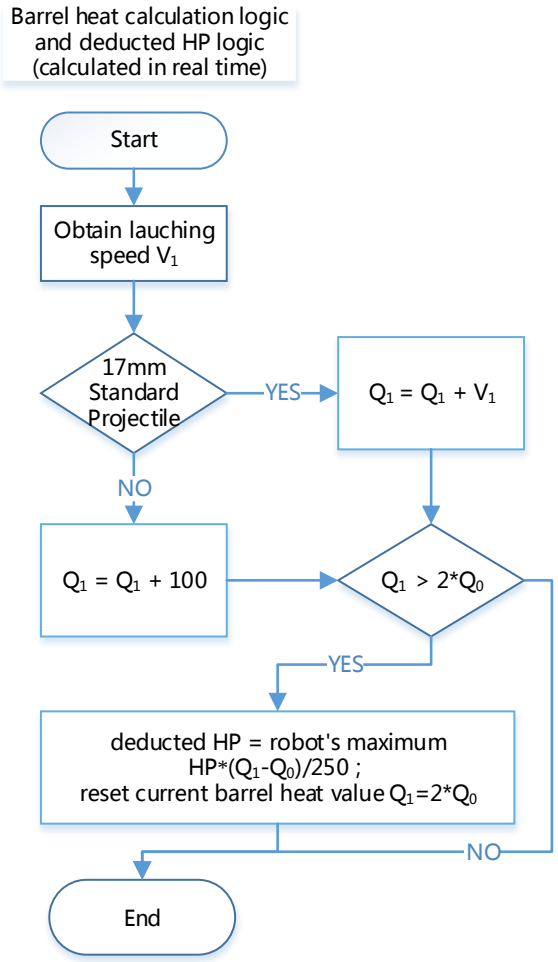
increased by V_1. For each 42mm standard projectile detected, the barrel heat is increased by 100 (regardless of its initial speed). The barrel heat is cooling at a frequency of 10Hz. The cooling value per period=cooling value per second/10.

A. When $Q_1 > Q_0$, the First Person View (FPV) visibility of the robot operator's computer will be reduced. When $Q_1 < Q_0$, the FPV will return to normal. The FPV for the client is as follows:

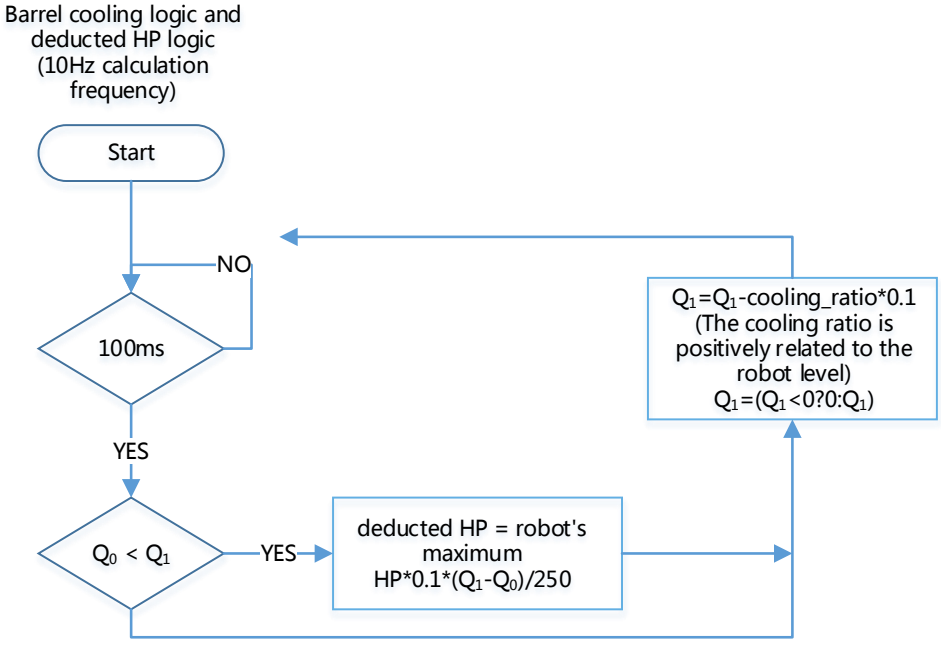
B. When $2*Q_0 > Q_1 > Q_0$, the deducted HP=$((Q_1–Q_0)/250)/10$*maximum HP for every 100ms. The HP will be calculated and cooled after deduction.

C. If $Q_1 \geq 2Q_0$, the deducted HP=$(Q_1-2*Q_0)/250$*maximum HP, and then set $Q_1=2Q_0$.

2. When the barrel heat exceeds the limit, the logic diagram of HP deduction is as follows:



3. Barrel heat cooling logic diagram



3.3.3.2 Chassis Power Consumption Limit

Robot's chassis: a mechanism that carries and installs the robot propulsion system and its accessories.

Chassis power consumption: the power that enables the robot to move horizontally, excluding power used for special tasks (such as the power consumption for functional movements like moving the upper mechanical structure).

The chassis power consumption of the robot will be continuously monitored by the referee system. The system monitors the chassis power consumption at a frequency of 10Hz and triggers penalties when the power consumption exceeds the limit.

Robot Type	Power Consumption Limit (watts)
Standard	80
Hero	80
Sentry	20
Aerial	No limit
Engineer	No limit

Ratio of exceeding the limit: K=(Pr-Pl)/Pl, where Pr is the instantaneous chassis output power consumption and Pl is the power consumption limit.

K	N%
K≤10%	10%
10% < K≤20%	20%
K > 20%	40%

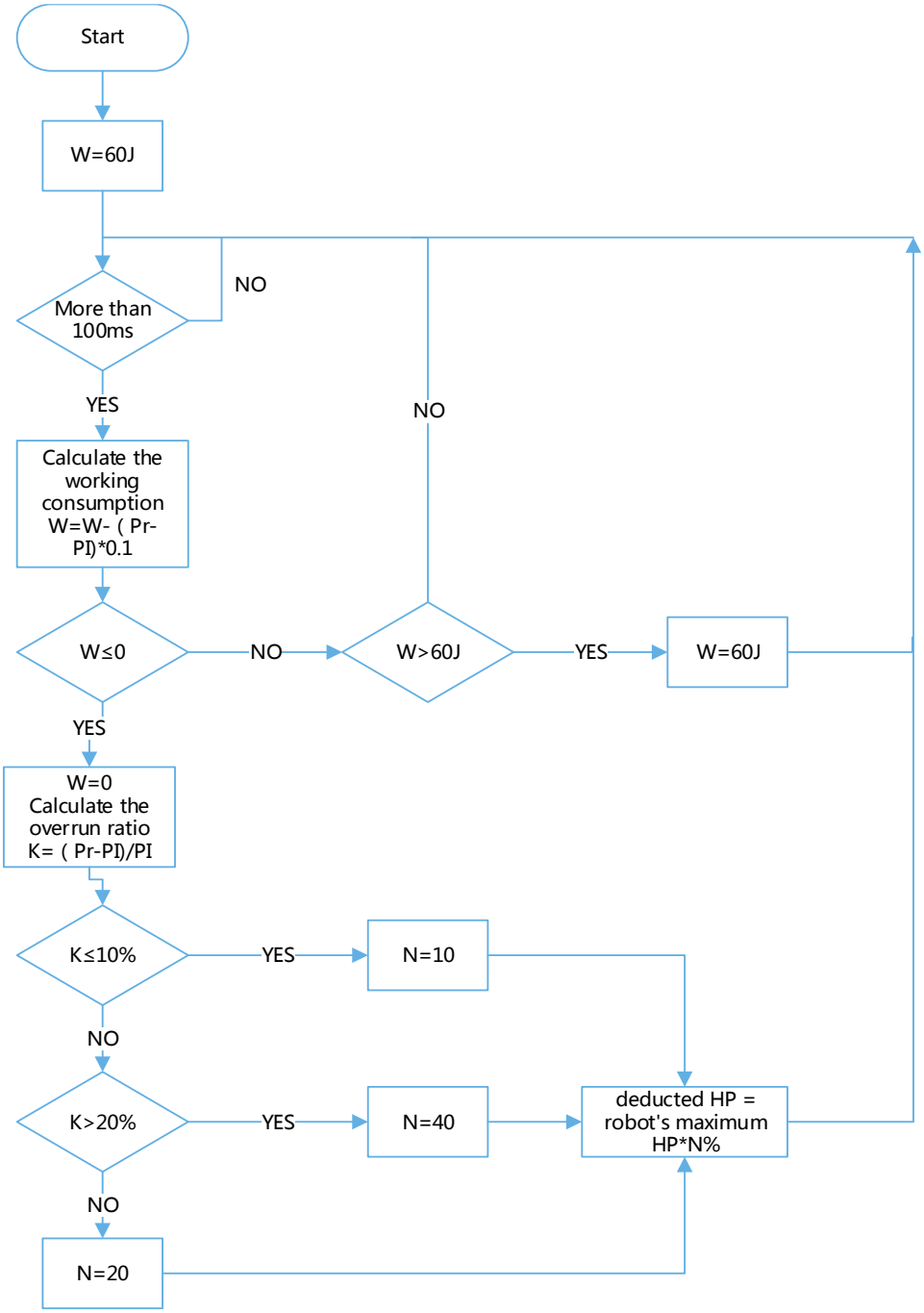
Considering that it is difficult to control instantaneous output power when the robot is in motion, the competition defines a buffer energy(W) of 6J on the referee system server.

Violations and Penalties:

1. When a Standard's or a Hero's chassis power consumption is more than 80 W, the deducted HP = maximum HP * N%.

   For example, if the robot has a continuous power output of 140 W, 60 J of energy will be consumed after 1 second. In the next 100 ms detection period, the calculated overrun ratio K = (140-80) / 80 = 75%. When K>20%, the deducted HP = 300 * 40% * 0.1 = 12.

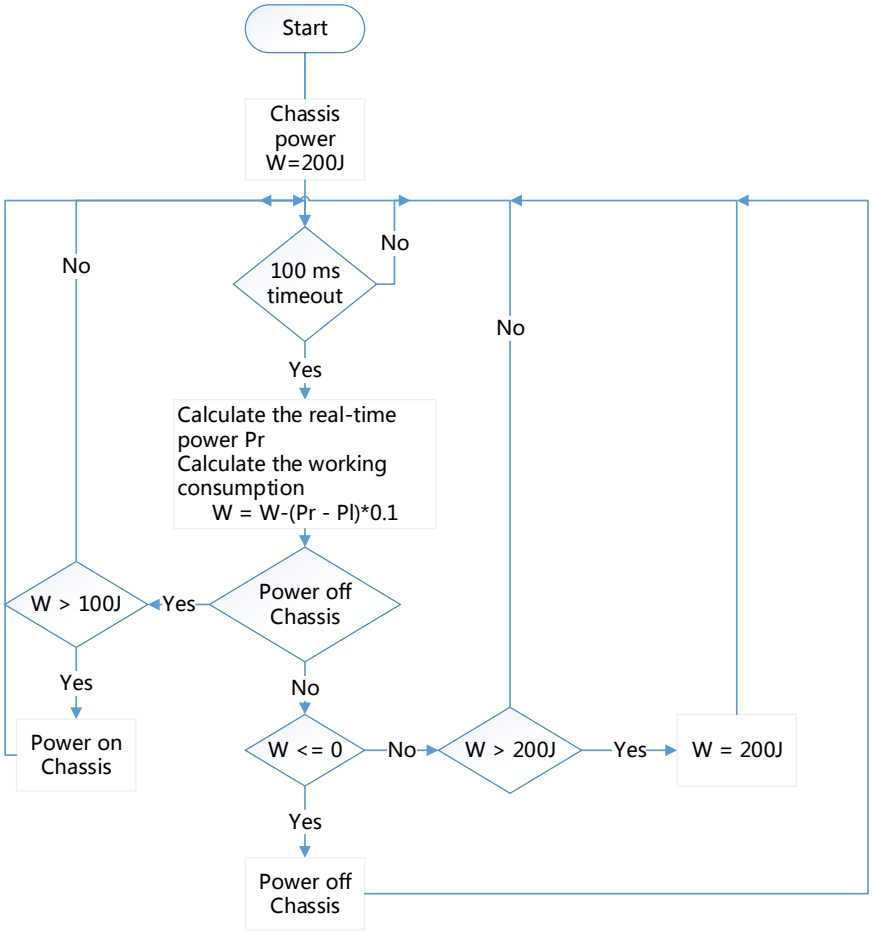
   The logic diagram of detection and HP deduction is shown below:



For example: Take a Level 3 Standard with the 80 W limit of chassis as an example. If it continues to output at 140 W, then 60 J of energy will be consumed after 1s. In the next 100 ms of detection period, the calculated ratio of exceeding the limit is K = (140-80) / 80 = 75%, which means K > 20% and the deducted HP = 300 * 40% * 0.1 = 12.

2. When a Sentry's chassis power consumption is more than 20 W, its chassis will be powered off.

Considering that a Sentry has difficulty controlling instantaneous power consumption while in motion, the Sentry's referee system server sets a buffer energy, W, equal to 200 joules. The frequency of chassis power consumption detection by the referee system is 10 Hz. The logic for the whole detection and chassis power off is shown below:



3.3.3.3 Armor Attack

The armor module detects damage sources base on its pressure sensor feedback and the vibration frequency of the armor plate. Damage sources are divided into projectile attack and collision. Projectile is the only legal damage source. Collisions including crashing into other robots, throwing objects or robot's components hitting against the Battlefield are prohibited. For penalties, please refer to 5.5.4.2 Collision and Getting Stuck.

The highest frequency which the armor module can detect is 20 Hz. When a 17mm projectile and 42mm projectile comes into contact with the armor module at speeds of 12m/s and 8m/s, respectively, they can be effectively detected. Below is the HP Deduction under the situation of no attack gain, which is for reference only. Please note that the actual HP Deduction may vary with the actual firing speed and firing distance, and the results are subject to the determination of the Referee System.

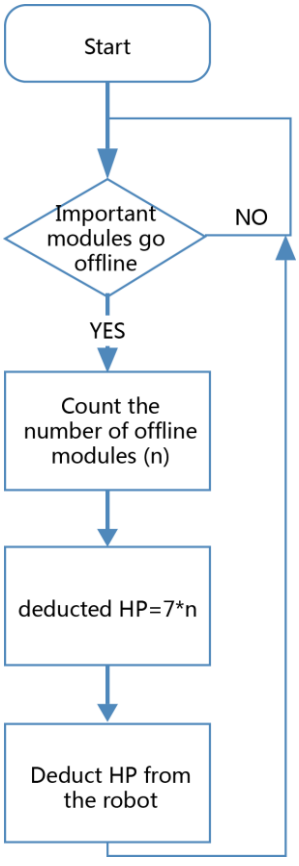
Attack Type	HP Deduction
42 mm Standard Projectile	100
17 mm Standard Projectile	10
Collision	2

The triangle armor at the top of the Base can only detect 42 mm standard projectiles, and the damage of such projectile is twice the large armor.

For example, under the situation of no attack gain, when Hero shoots 42mm standard projectiles to the top triangular armor of the Base, the Base HP is deducted by 200.

3.3.3.4 Status of Referee System

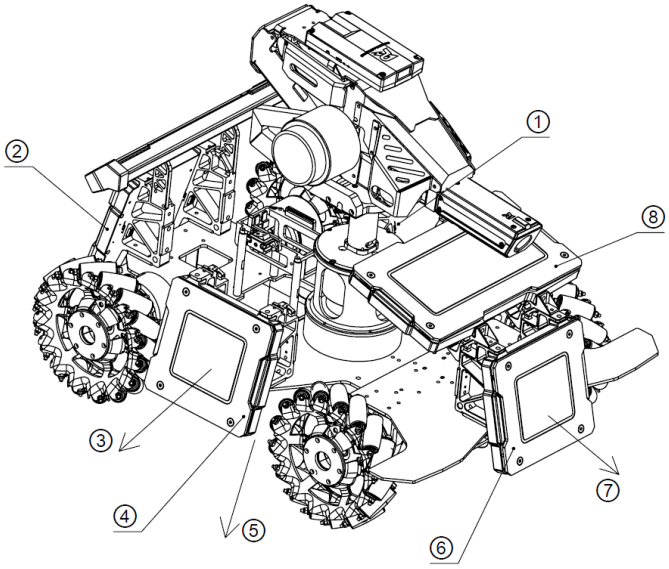
Install referee systems of the corresponding modules as required in the *RoboMaster 2019 Robotics Competition Referee System Specification Manual* During the competition, the connection between each module and the server must be stable. The referee system server detects the connectivity of each module at a frequeny of 2 Hz. If important modules, which are speed monitor module, positioning system module and armor module, go offline due to problems of design or structure, then a certain amount of HP will be deducted.



The armor module must be configured with the correct ID number before the pre-match inspection. The specific requirements are as follows:

Standard and Hero:

According to the Robot Coordinate System established by the armor module installation requirements, set the armor module ID of the Positive X axis as 0, the Negative Y axis as 1, the Negative X axis as 2, the Positive Y axis as 3 and the Negative Z axis as 4. Then, after entering the armor ID setting mode, tap the Positive X axis, the Negative Y axis, the Negative X axis, the Positive Y axis, and the Negative Z axis in turn to complete ID settings. (The side armor module ID specification mainly displays the attack direction on the operator's operation page, and the "real-time HP change information" produced by the referee system also refers to the spectification).



① Armor #1	② Armor #2	③ Positive Y axis	④ Armor #3
⑤ Positive Z axis	⑥ Armor #0	⑦ Positive X axis	⑧ Armor #4

Engineer:

Engineer has four pieces of armor. If a competition starts with an Engineer, the camera video transmitter module faces towards the Positive X axis of the Robot Coordinate System. The armor module ID of the Positive X axis is set as 0, the Positive Y axis as 1, the Negative X axis as 2, the Negative Y axis as 3.

Sentry:

Sentry has two pieces of armor, the ID of the one facing the Base Zone is 0, and the other is 1.

3.3.4 HP Recovery and Revival

Qualification:

Only Standard, Hero and Engineer are eligible for HP recovery and revival. A robot that is ejected due to a Level 4 Warning is not eligible for revival.

Revival procedure:

Robot(s) from one team can transport a defeated robot to the Restoration Zone of its own Supplier Zone. When the defeated robot detects the RFID interaction module of the Restoration Zone, it will

be revived after a certain period.

After revival, the Level and Experience Points of the robot before it was defeated are maintained, and the HP is restored to 20% of the maximum HP. The robot is on the 100% defensive within 10 seconds after revival.

Required detection time:

For robots defeated for the first time, they are revived in T seconds after their RFID interaction module detects that of the Restoration Zone. After that, the detection time is increased by 10 seconds following each revival.

Robot Type	T
Standard	5
Hero	10
Engineer	20

HP recovery procedure:

When a surviving robot is at its own Restoration Zone and detects the RFID interaction module of the Zone, it will recover HP at an amount equal to 5% of its maximum HP per second until its HP is fully restored.

Chapter 4: Competition Area

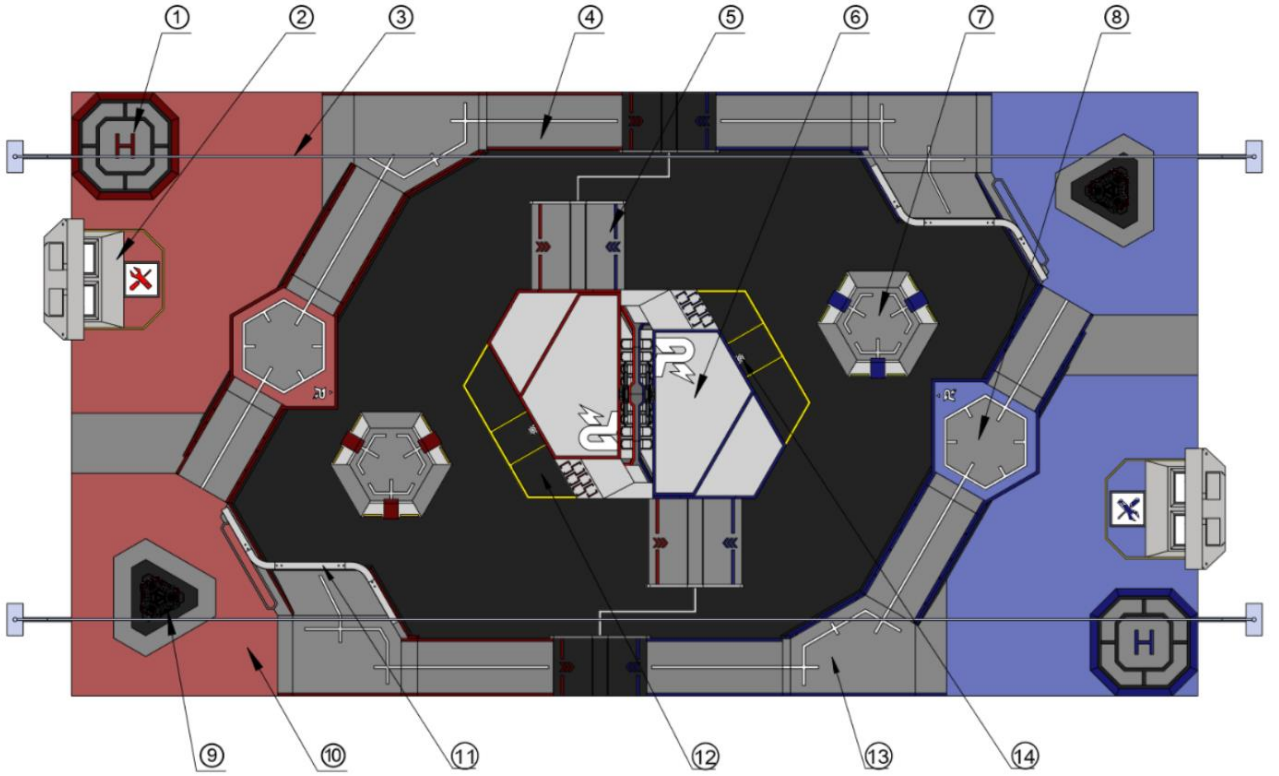
4.1 Overview

The core Competition Area of RoboMaster 2019 Robotics Competition is called the "Battlefield". It is 28 meters long and 15 meters wide, and consists of Starting Zone, Supplier Zone, Bridge, Open Zone, Resource Island, and Flight Zone.

Note: The error margin of all Battlefield Components described in the chapter is within ±5%.

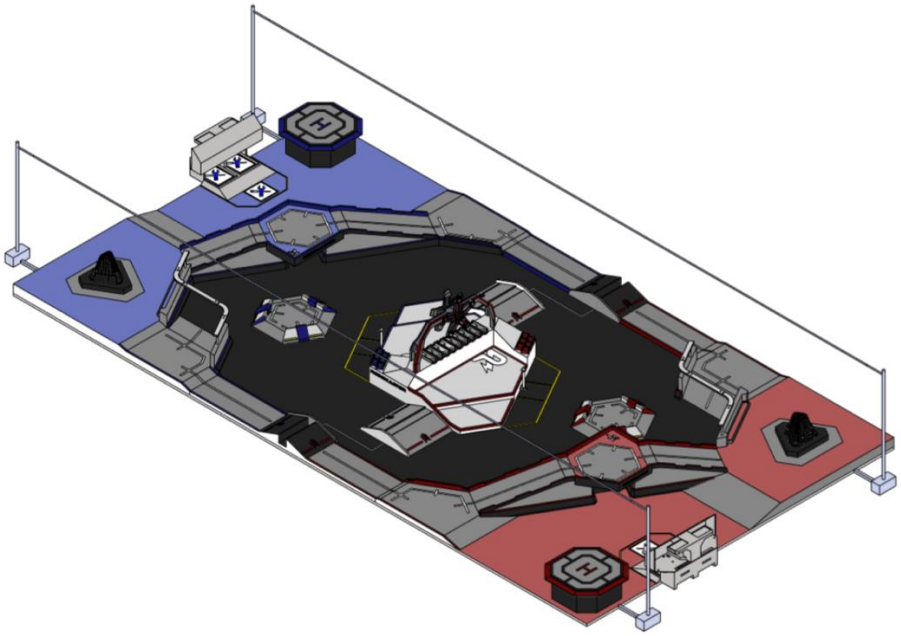
Below is the Battlefield:

1. **Top view:**



① Landing Pad	② Supplier Zone	③ Aerial Safety Rope	④ Road
⑤ Slope	⑥ Resource Island	⑦ Bunker	⑧ Bridge Top Platform
⑨ Base Zone	⑩ Starting Zone	⑪ Sentry Rail	⑫ Resource Island Penalty Zone
⑬ Bridge End Platform	⑭ Assistive Column	-	-

2. **Axonometric drawing:**



The Battlefield and the Bunker are laid with sand-grained rubber with a thickness of 3 mm. Part of the surface of the Bunker is covered with paint and the rubber substance is made of PVC. The reference picture is as follows:

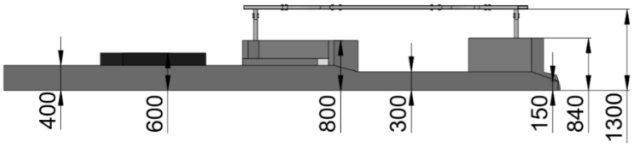
4.2 Starting Zone

Description:

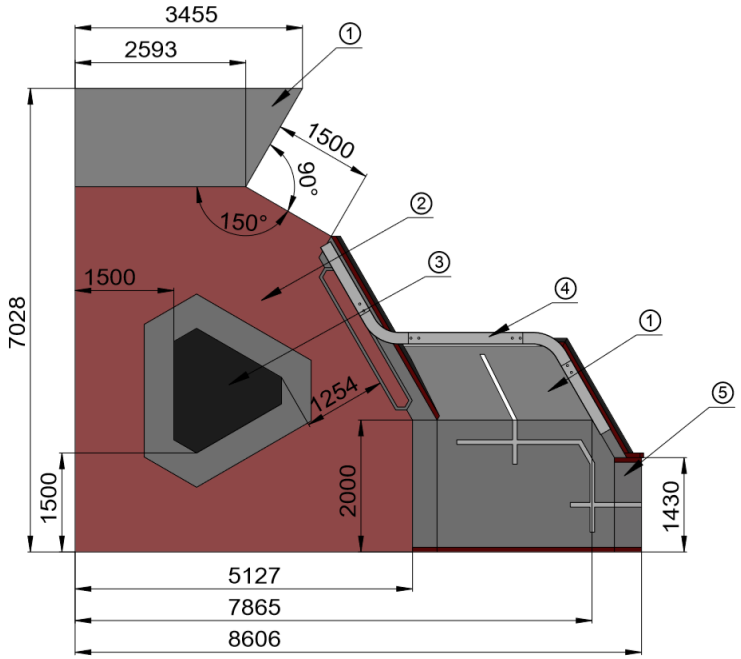
The Starting Zone is the area where the ground robots are placed before the official start of the match, including the Base Zone, Sentry Rail, and team's Base. The area where the red ground rubber is laid in the figure below is the Starting Zone of the red team (the blue team's Starting Zone is at the same position on the other side of the Battlefield).

The layout of the Starting Zone is as follows:

1. **Front view:**

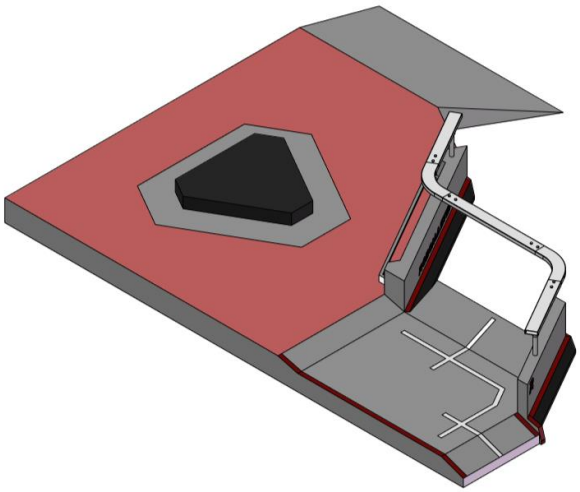


2. Top view:



① 15° Slope	② Starting Zone	③ Base Zone	④ Sentry Rail
⑤ 20° Slope	-	-	-

3. Axonometric drawing:



4.2.1 Base Zone

Description:

The Base Zone is a hexagonal platform located on top of the Starting Zone. Its top surface is 200 mm higher than that of the Starting Zone. One fixed Base is placed on top of the Base Zone. The Base Zone platform and the space above are Penalty Zones for robots of both teams. Robots of either side are not allowed to enter the Penalty Zone.

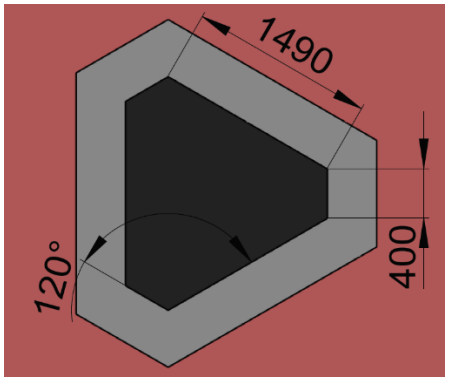
Violations and Penalties:

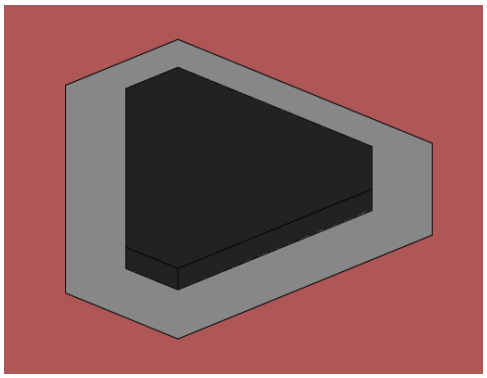
1. If any part of a robot enters the Base Zone for T second(s), the referee will issue a Level X Warning and the violator must leave the Base Zone.

T	X
T < 3	1
3 < T < 10	2
T > 10	3

2. If a robot causes damage to the Base structure and it no longer operates, or if an ejected robot remains at the Base Penalty Zone and causes some damages like the Base cannot open that affect the fairness of the competition, the referee will issue a **Level 5 Warning**. The actual situation shall be determined by the Head Referee and the Chief Referee.

The Base Zone is shown in the following figures:





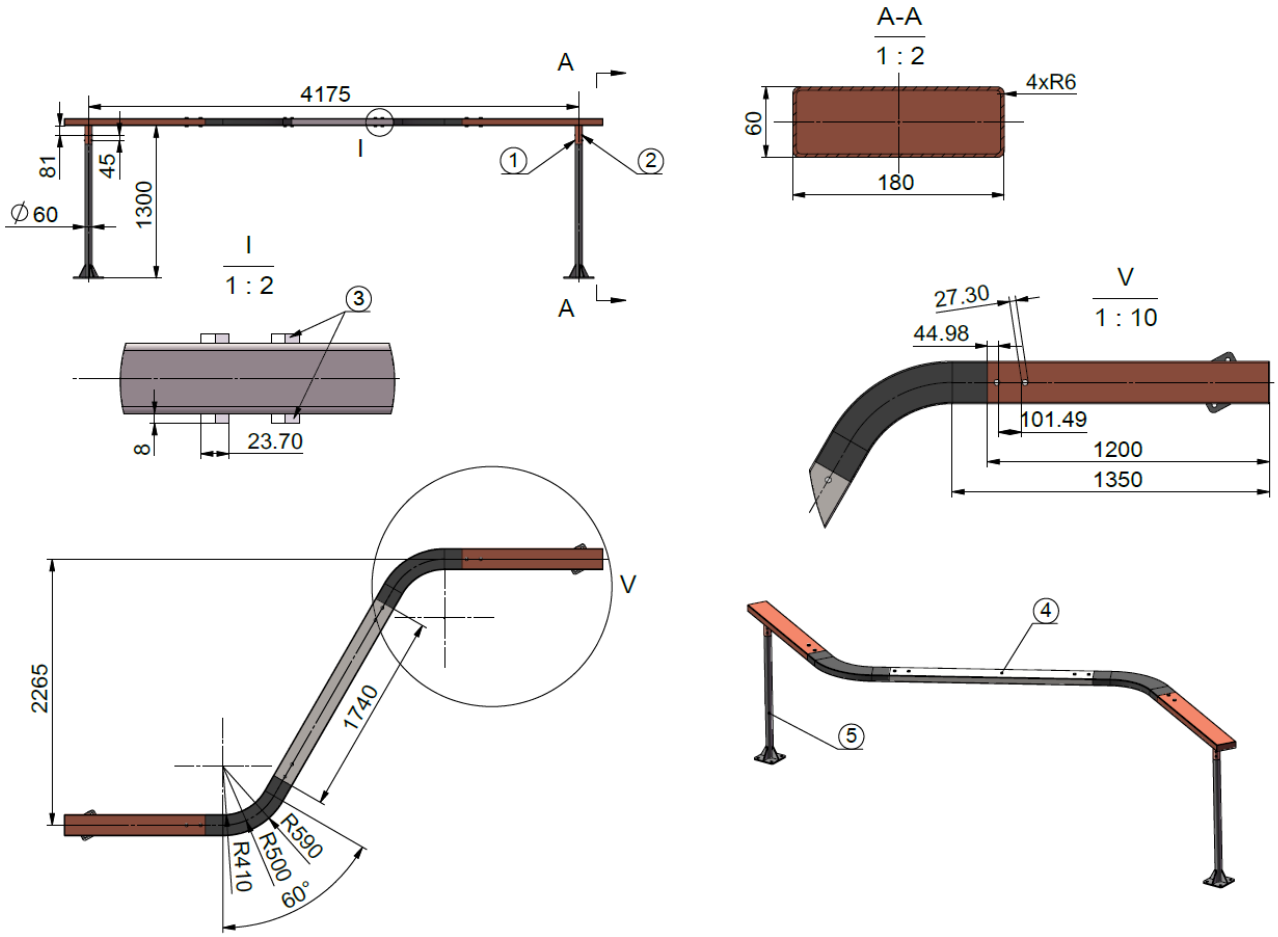
4.2.2 Sentry Rail

Description:

The Sentry Rail consists of the main rail and its supporting frame. The main rail is the only place on which a Sentry moves. The distance between the lower surface of the Sentry Rail and the Battlefield ground is 1300 mm in theory. However, due to the weight of the rail itself and other factors, there is a

certain height difference between the middle and the ends of the Sentry Rail. Therefore, the actual distance is 1250-1300 mm.

The surface of the Sentry Rail is matte paint. The dimensions of the Sentry Rail are as follows:



① M8x70 Bolt	② M8 Nut	③ M16 Bolt	④ Sentry Rail
⑤ Rail Support	-	-	-

Note:

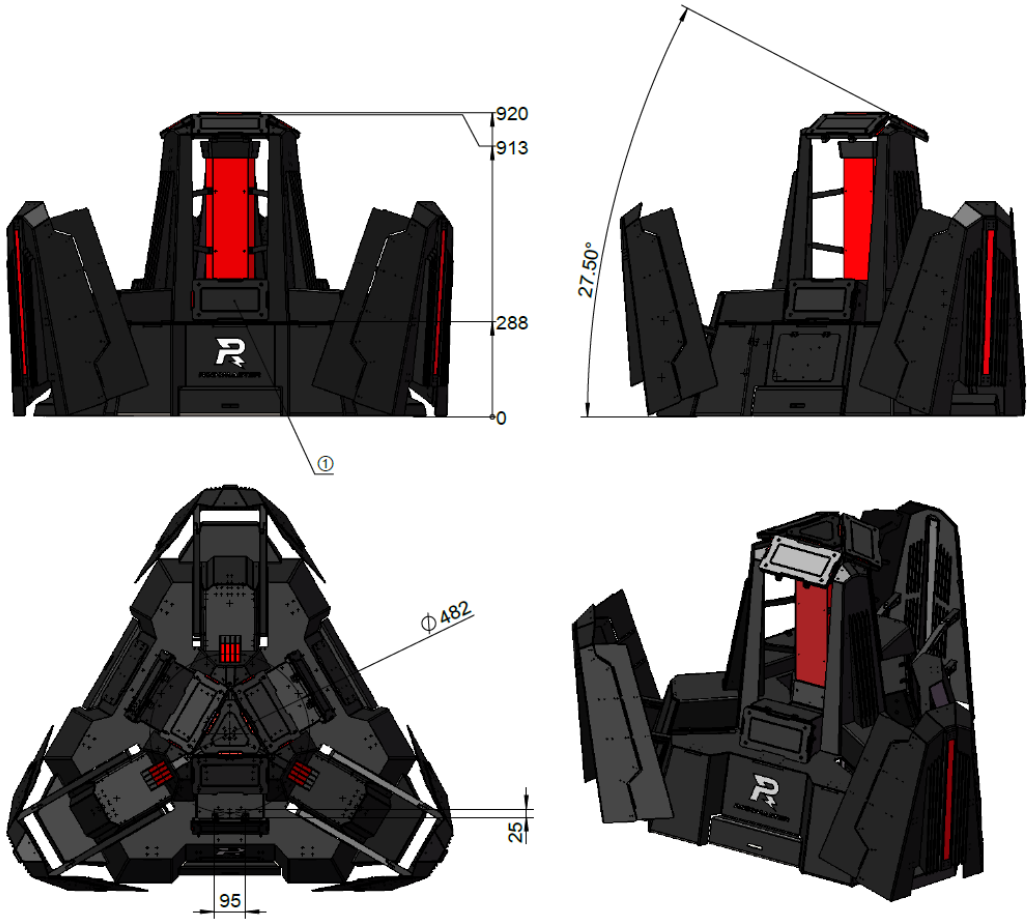
1. Each color in the diagram represents one component
2. Parts are connected by bolts
3. The flat tubes and round tubes of each part are welded together.
4. Flat tubes are formed by folding the three corners, and the final corner is welded shut.
5. The angle of the hexagonal bolt head after tightening is uncertain. The drawing is for illustration purposes only.

4.2.3 Base

Each team has a Baseof 2000 HP in total. On the top of the Base, there are 3 large armors and 1 triangular armor. In the middle of the interior, there are 3 large armors with the corresponding No.8 sticker attached. For details, please refer to Appendix 5 Reference Drawing. For information about HP deduction when the armor plate of the Base has been attacked, please refer to 3.3.3.3 Armor Attack.

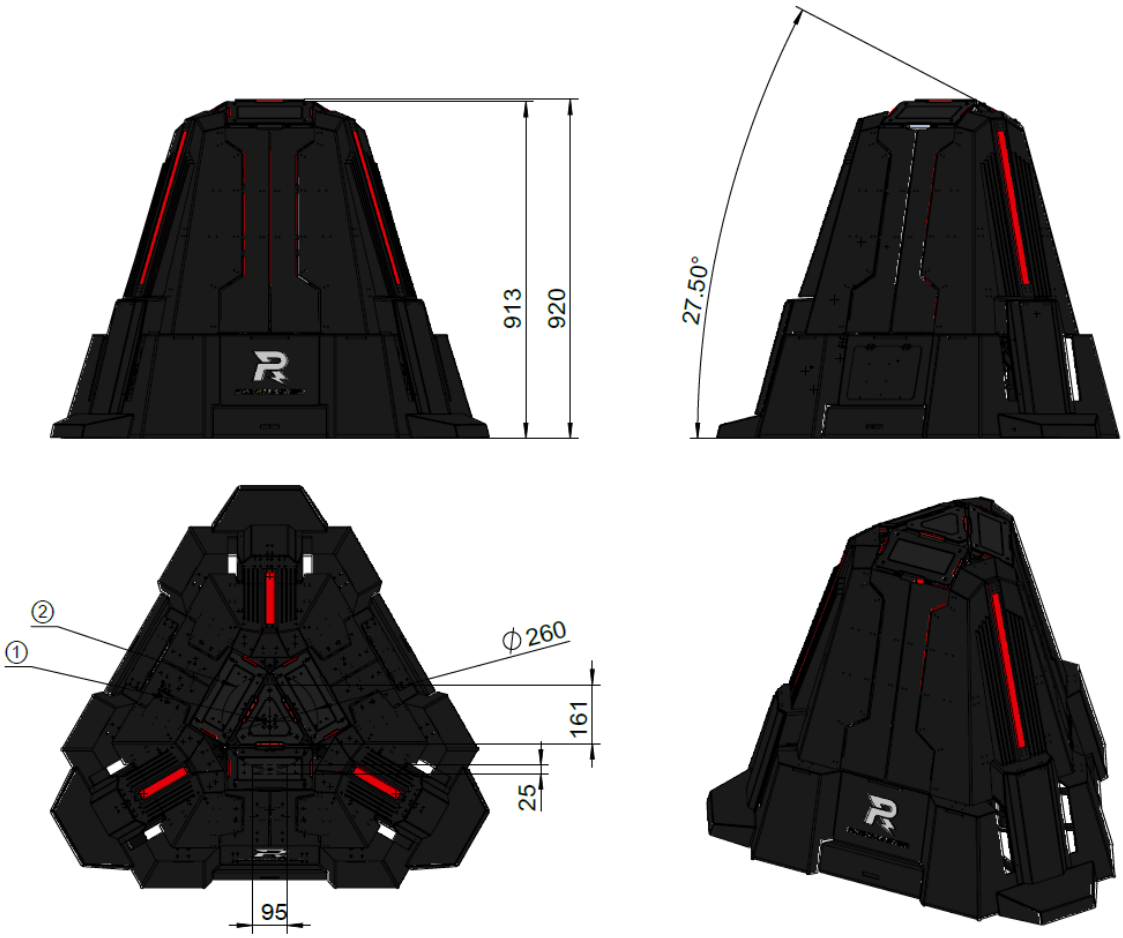
For the relationship between Sentry and the Base shield, please refer to 3.2.2 Sentry.

1. Base shield open:



① Intersection angle with the ground is 75°

② Base shield close:



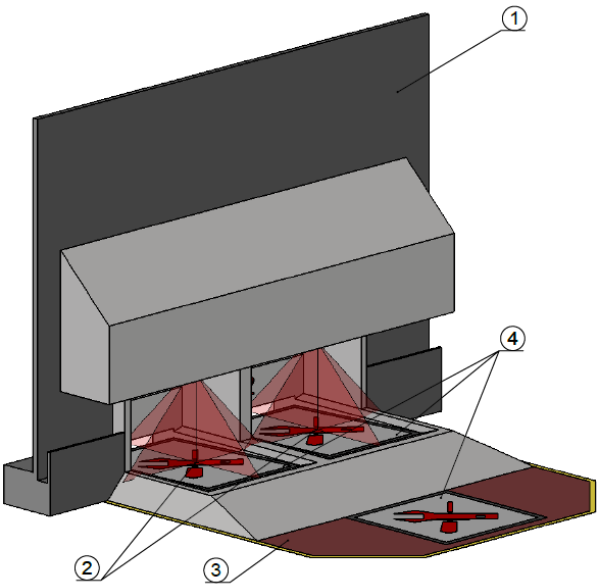
① Triangle Armor Module

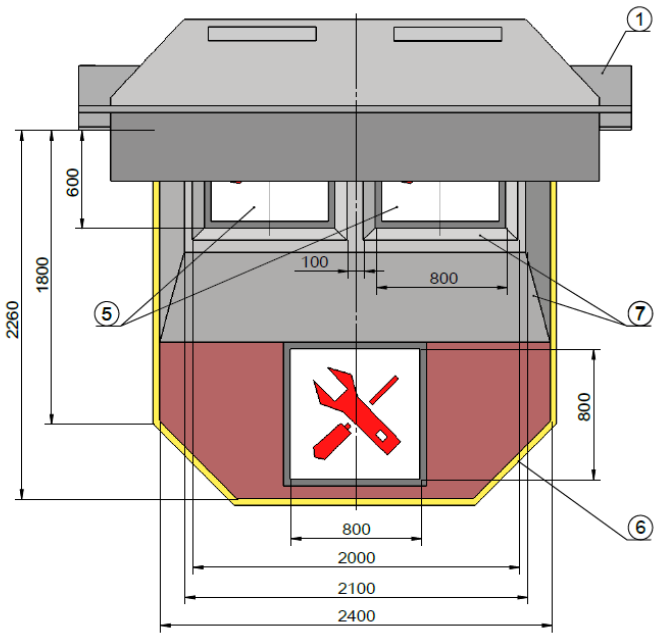
② Large Armor Module

4.3 Supplier Zone

Description:

Each team has one Supplier Zone which consists of three Restoration Zones and one Project Outlet. The Supplier Zone is an important area for robots to reload projectiles, revive defeated robots, and recover HP. Figures and dimensions are as follows:





① Perimeter Wall ② Laser Light Path ③ Ground ④ Restoration Zone

⑤ Restoration Zone of size 800*1100 ⑥ Supplier Penalty Zone ⑦ 15° Slope -

Note:

1. Since the Projectile Outlet is large, teams are recommended to enlarge the robot's Projectile Loading Port to prevent projectiles falling to the ground during reloading, and to use buffer materials as the internal wall of the Projectil Depot to avoid loss.
2. Engineer cannot go to the Supplier Zone for projectiles.

Supplier Penalty Zone:

The Supplier Zone of one team is the Penalty Zone to the other. As shown above, the internal and above space of the yellow frame with the largest outside dimensions of 2300 * 2400 is the Penalty Zone. Robot cannot enter into the opposing team's Supplier Zone and place Projectile Containers in the Penalty Zone.

Violations and Penalties:

Regulations	Penalties
1	If any part of a robot enters or flies above the opposing team's Supplier Zone for less than three seconds, the referee will issue a Level 1 Warning.
2	If any part of a robot enters or flies above the opposing team's Supplier Zone for 3-10s, or makes physical contact with Projectile Suppliers, the referee will issue a Level 2 Warning, and the robot must immediately leave the opposing team's Supplier Zone.
3	If any part of a robot enters or flies above the opposing team's Supplier Zone for 3-10 seconds and makes physical contact with Projectile Suppliers, or disturbs the normal projectile loading, recovery or revival of the enemy's robots, the referee will

	issue a Level 2 Warning, and the robot must immediately leave the opposing team's Supplier Zone.
4	If any part of a robot enters or flies above the opposing team's Supplier Zone for more than 10 seconds and makes physical contact with Projectile Suppliers, or causes the enemy's robots unable to supply projectiles or place Projectile Containers in the Penalty Zone, the referee will issue a Level 4 Warning. The actual situation shall be determined by the Head Referee and the Chief Referee.
5	If a robot causes structure damage to the opposing team's Projectile Supplier which can no longer provide projectiles, or if the ejected robot remains at the opposing team's Supplier Zone or the above space, causing robots of the team unable to obtain projectiles, the referee will issue a Level 5 Warning. The actual situation will be determined by the Head Referee and the Chief Referee.

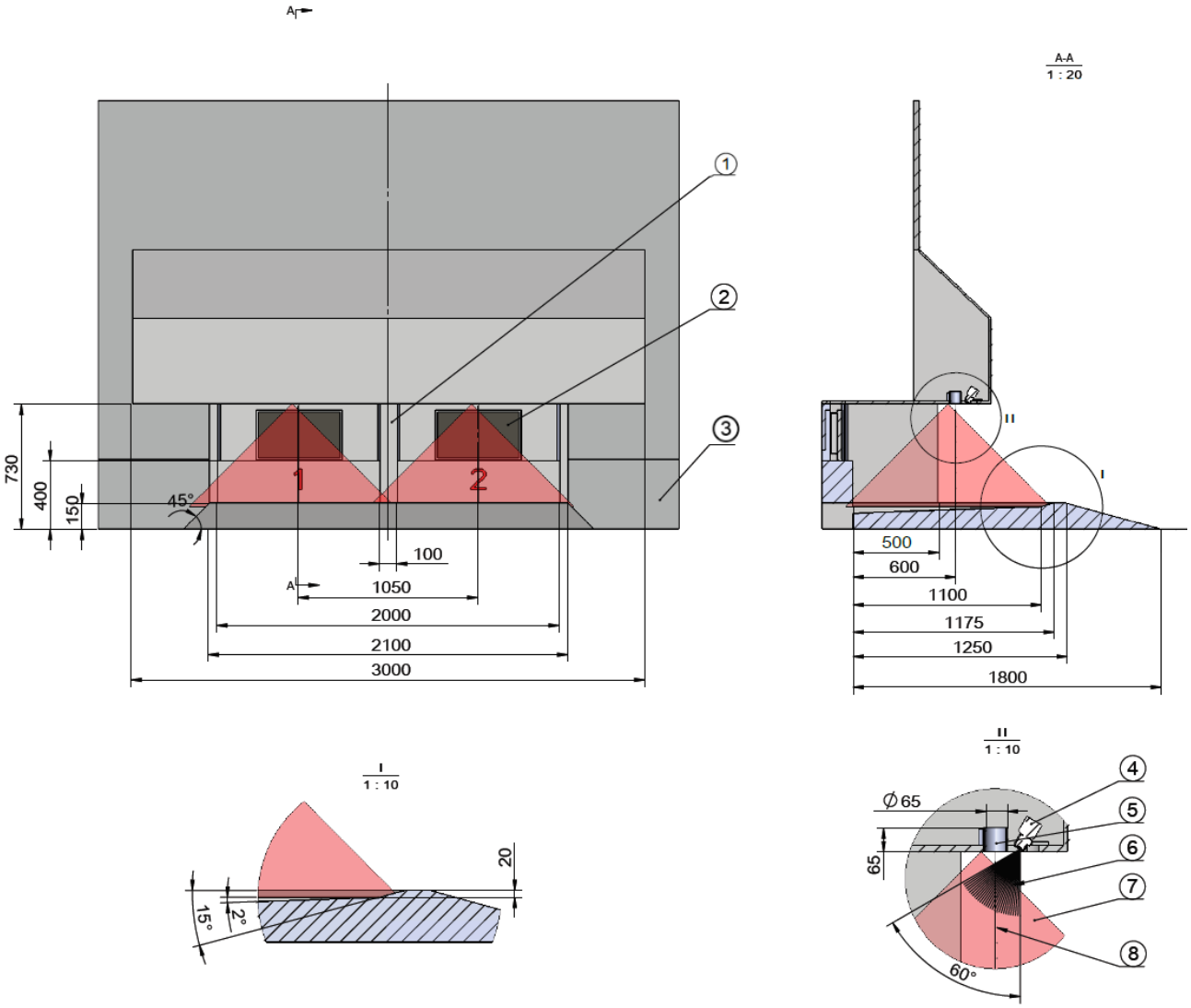
4.3.1 Restoration Zone

Description:

An area consists of a 800 * 800 mm and two 800 * 800 mm and laid with several RFID interaction modules. When ground robots detect the RFID interaction modules of the Restoration Zone, defeated robots can be revived and surviving robots recover HP. For specific implementations and values, please refer to 3.3.4 HP Recovery and Revival.

4.3.2 Projectile Supplier

Projectile Supplier provides 17 mm standard projectiles during a match, and each team has its own Projectile Supplier. At the beginning of each match, Projectile Supplier will issue 200 shoots of 17 mm projectiles, and then **150** shoots per minute. Projectile Supplier is directly controlled by the Operator from the Operator Room on the operation interface. Projectile Supplier consists of two Projectile Outlets, an auxiliary alignment laser sight, a camera, and a monitor. When a robot stays at the Outlet of the Projectile Supplier, the camera will capture the robot magazine in real time and display it on the front monitor. The operator can adjust the position of the robot through the laser projected by the cross laser light (formed by two horizontal laser light intersected at the circle center of the Outlet). This allows the operator to determine whether or not to supply projectiles.



① Intermediate Partition ② 21″ Monitor ③ Perimeter Wall ④ Camera
⑤ Projectile Outlet ⑥ Camera View-angle Range ⑦ Horizontal Laser Light Path A ⑧ Horizontal Laser Light Path B

4.4 Open Zone

Description:

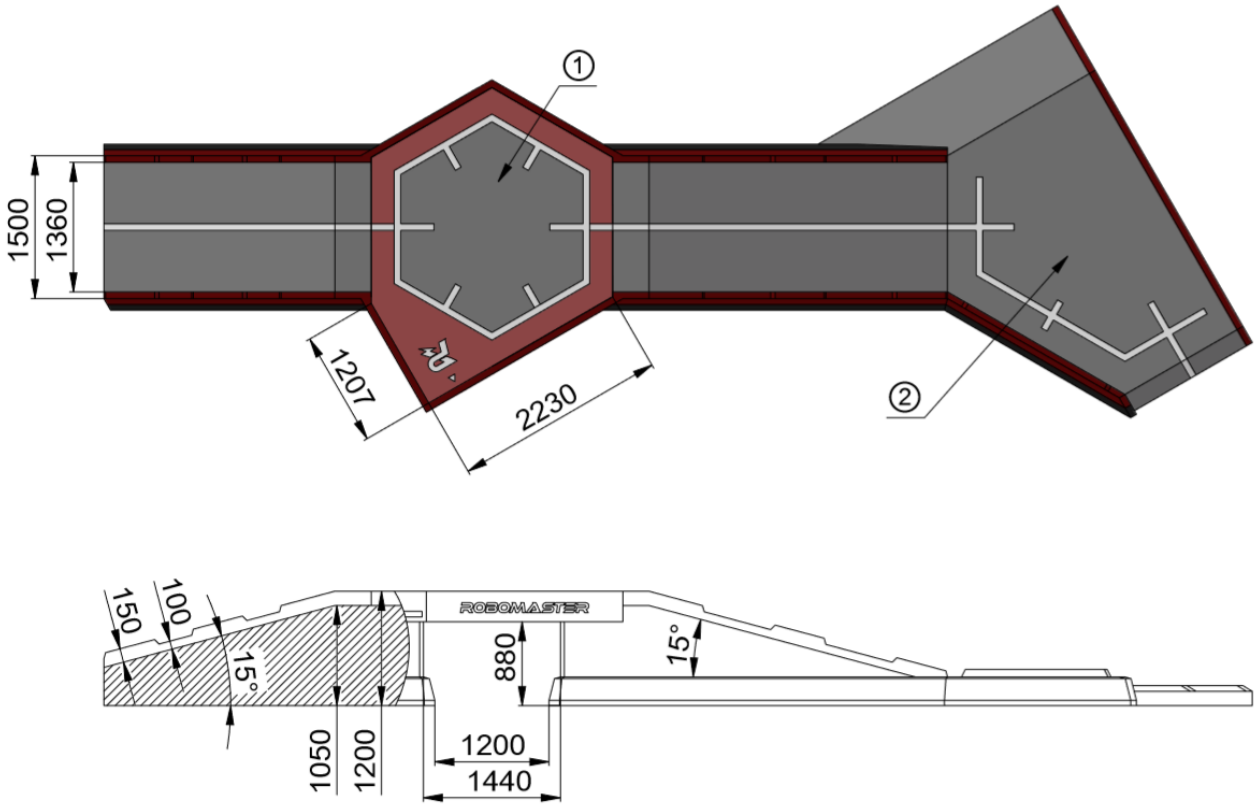
The center of the Battlefield is the Open Zone, which is an important and the most intense area for fighting. This area consists of Resource Island and Bunker Zone, as well as other core gear and components such as Power Rune, Assistive Column, Projectile Container, Projectile Depot and Bunker.

4.4.1 Bridge

Description:

Bridge is a core channel that connects the Open Zone and the Starting Zone, which is the shortcut for entering into the enemy's Starting Zone, including the Bridge Top Platform and Bridge End Platform.

Figure and dimensions are as follows:

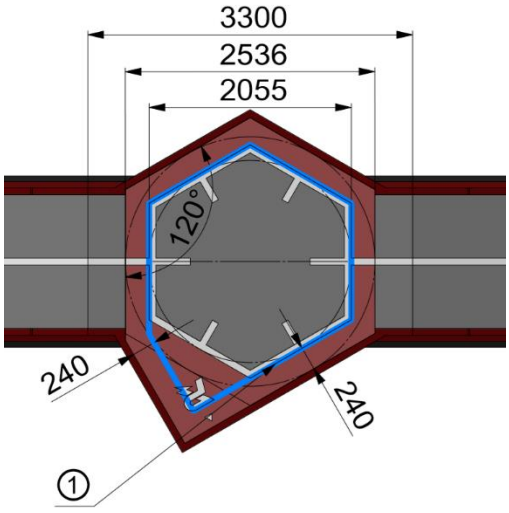


① Bridge Top Platform ② Bridge Top Platform

Bridge Top Platform Description:

The top surface of the Bridge is Bridge Top Platform, which is laid with several RFID interaction module cards. When a robot occupies the Bridge Top Platform, it can attack the Power Rune on the Reource Island. Then its barrel cooling value per second is five times faster than normal. Only robots of the first occupied team can gain this bonus.

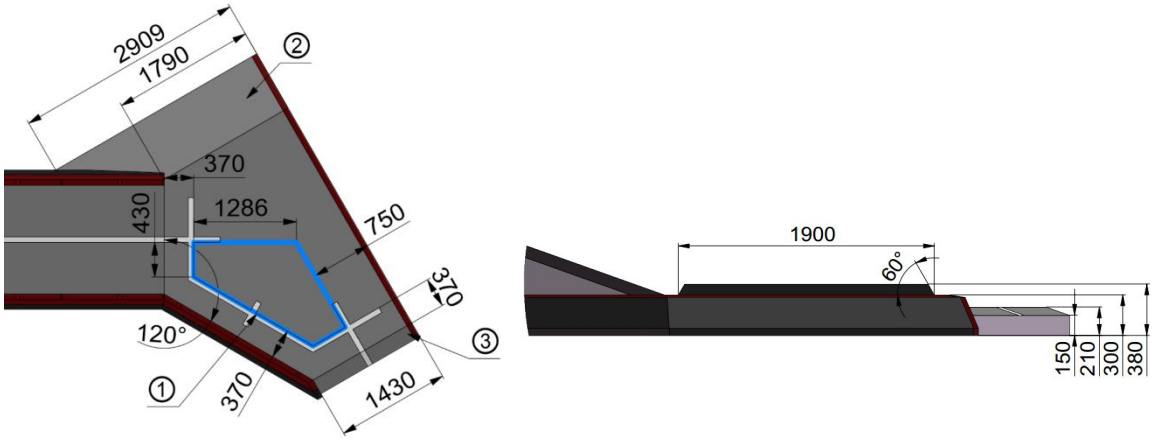
Dimensions are as follows:



① RFID interaction module cards laid inside the blue frame

Bridge End Platform Description:

Bridge End Platform is located at the end of the Bridge with strategic importance and laid with several RFID interaction module cards. When a robot occupies the Bridge End Platform, its barrel cooling value per second is five times faster than normal. Only robots of the first occupied team can gain this bonus.



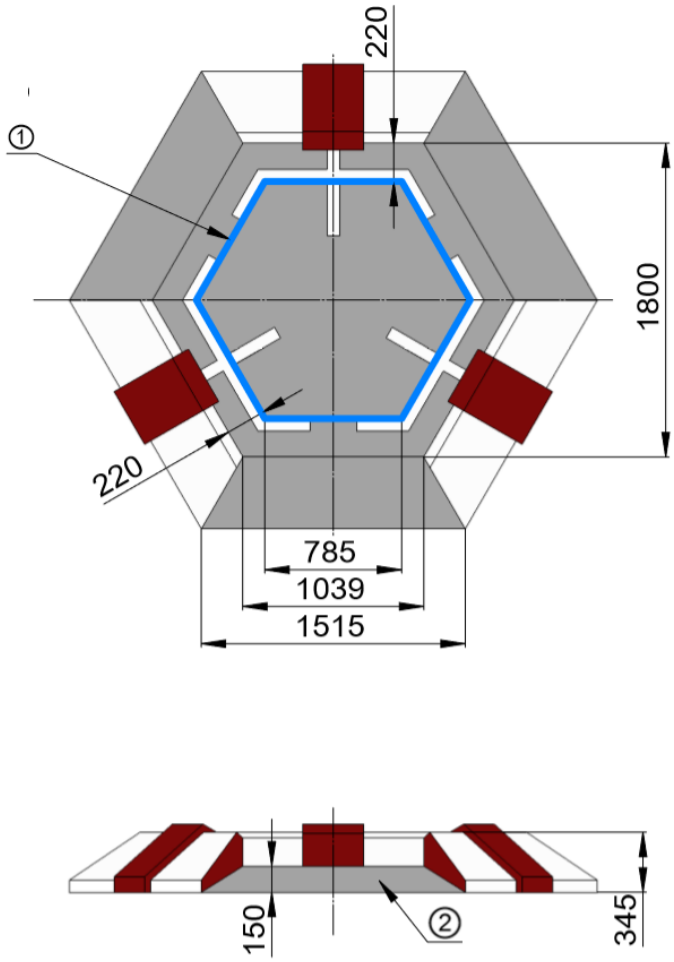
① RFID interaction module cards laid inside the blue frame ② 15° Slope ③ 17° Slope

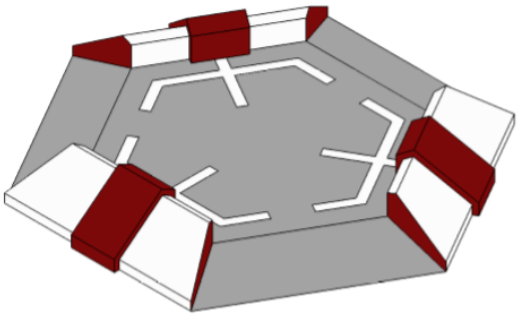
4.4.2 Bunker

Description:

The Open Zone contains two Bunkers: one sets barrel heat cooling value and the other sets defense bonus gain effect. When a robot occupies a Bunker, it receives a 50% defense bonus and the barrel heat cooling value is five times faster than normal. Only robots of the first occupied team can gain this bonus.

The Bunker is shown in the following figure:



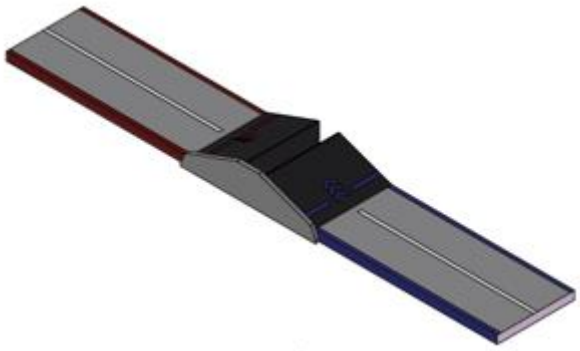


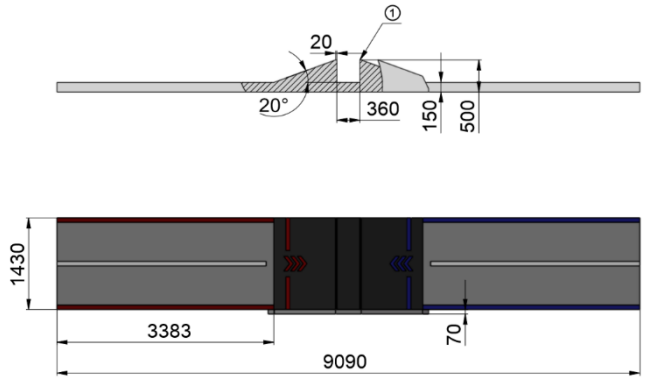
① RFID interaction module cards laid inside the blue frame

② 20° Slope

4.4.3 Road

The Road in the Open Zone connects one side of the Bridge End Platform with the other side of the Starting Zone, and a slope is placed in the middle of the Road. Figures are shownbelow:





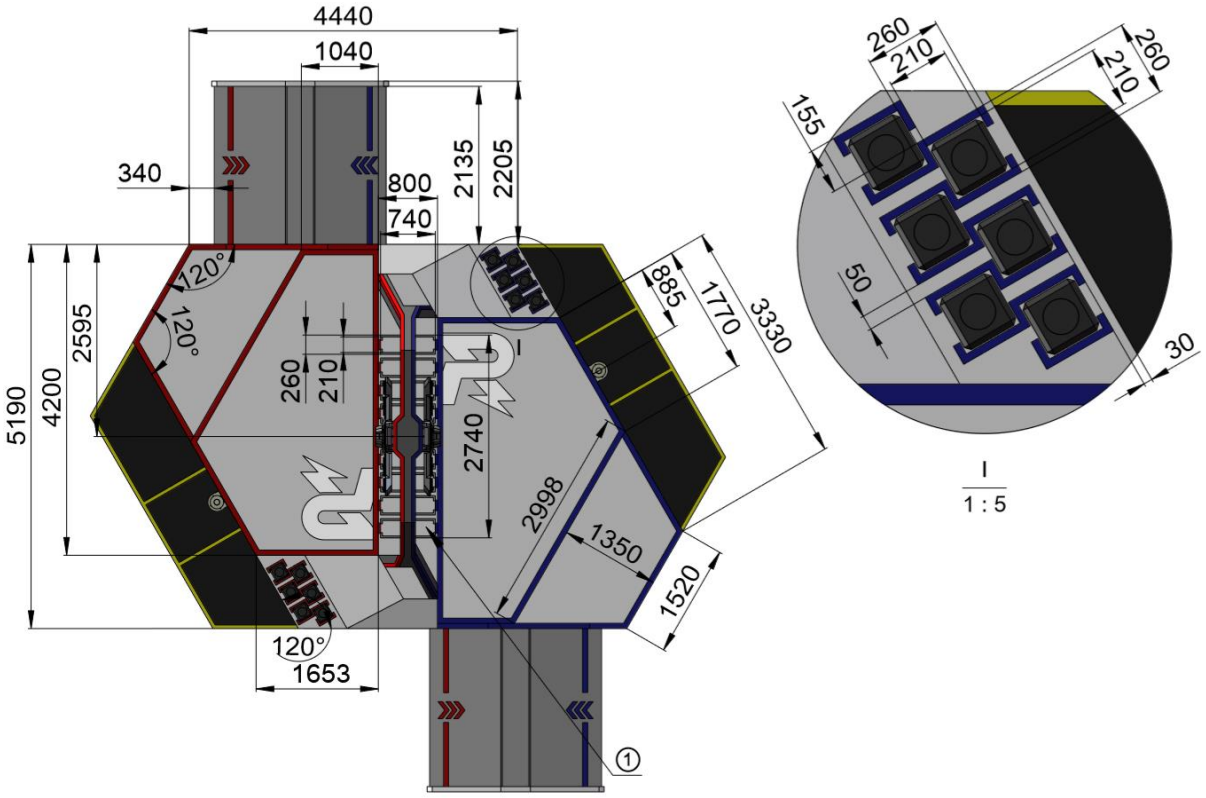
① Right angle corners are fitted with aluminum corner guards

4.5 Resource Island

Description:

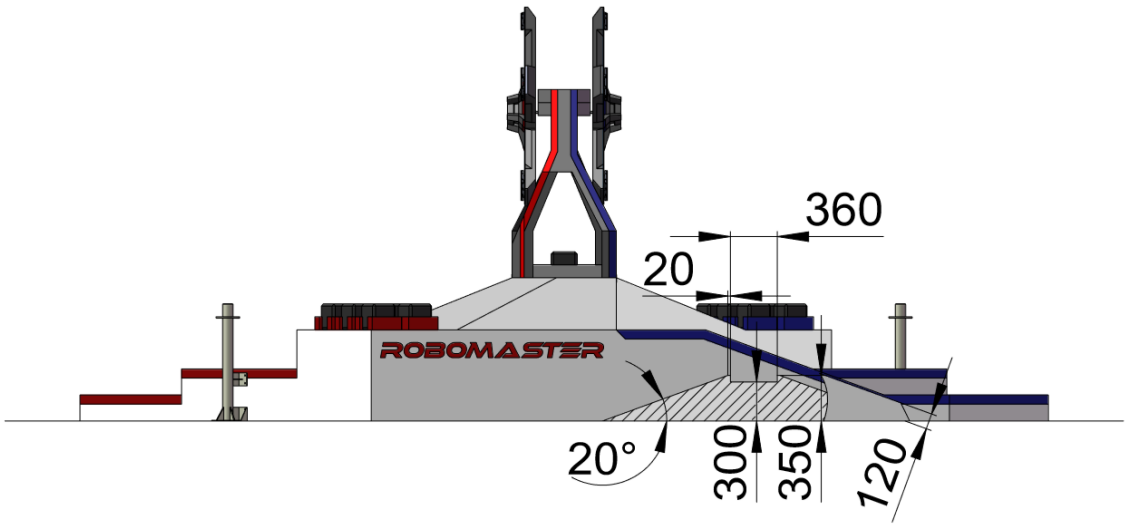
Located in the middle of the Battlefield, Resource Island is an irregular hexagonal platform and consists of Projectile Container, Power Rune, and Assistive Column. Engineer of both teams are allowed to obtain Projectile Containers from the Resource Island.

1. **Top view:**

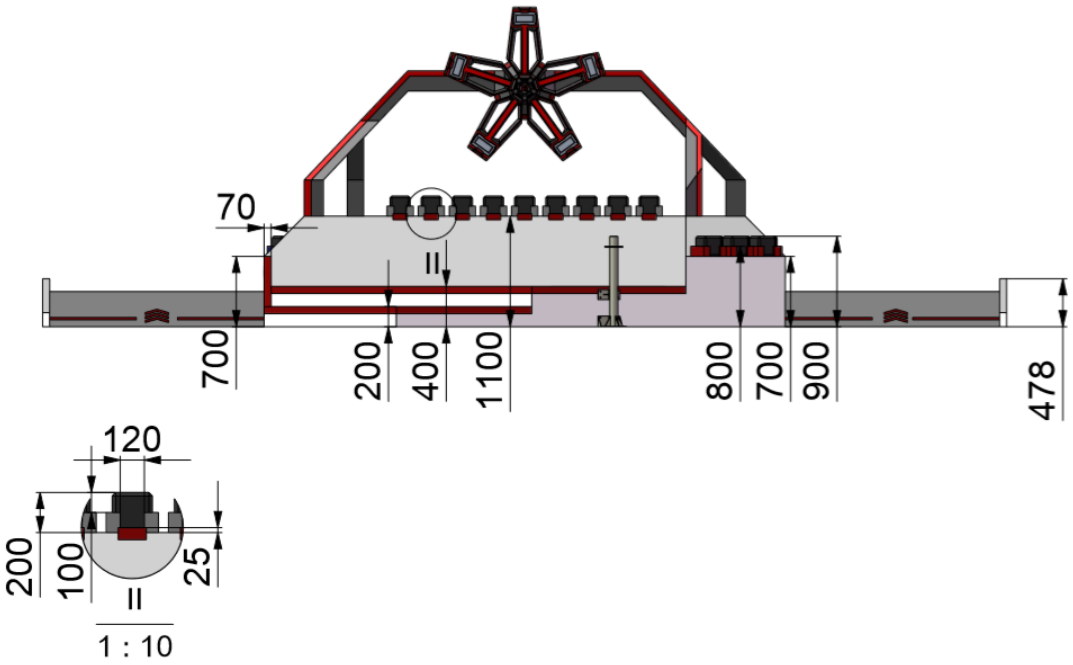


① Projectile Containers are placed at the center of each groove

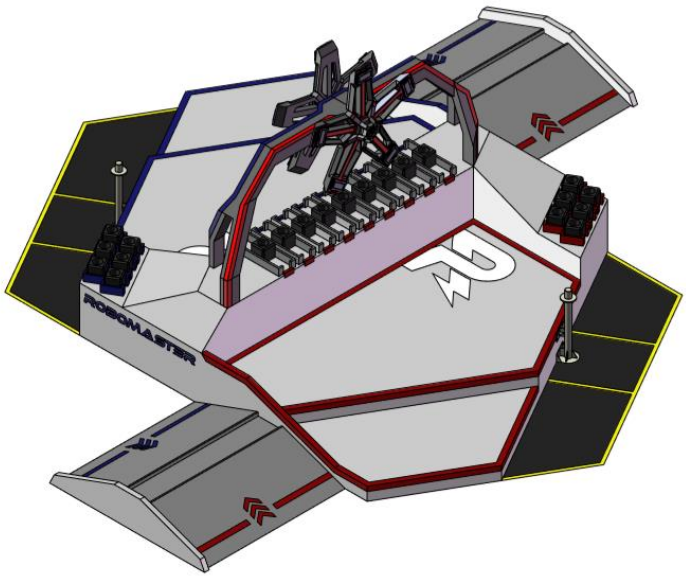
2. **Front view:**



3. **Side view:**

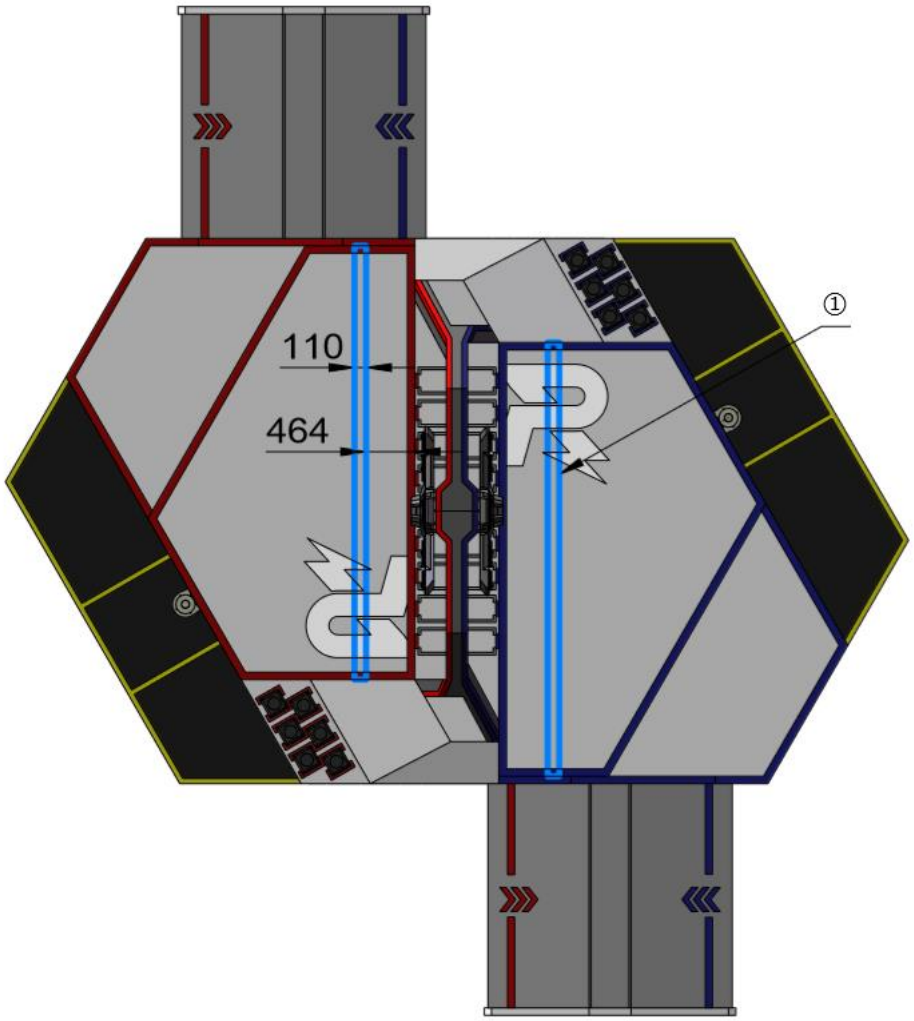


4. **Axonometric drawing:**



There is a row of RFID interaction modules (defense card) located along the edges of the Resource Island. When a robot detects this defense card, it receives a 80% defense for 20 seconds. When a robot detects the RFID interaction module card again, its original defense eliminates and refreshes to 80% defense for 20 seconds.

The specific drawings and dimensions are as follows:

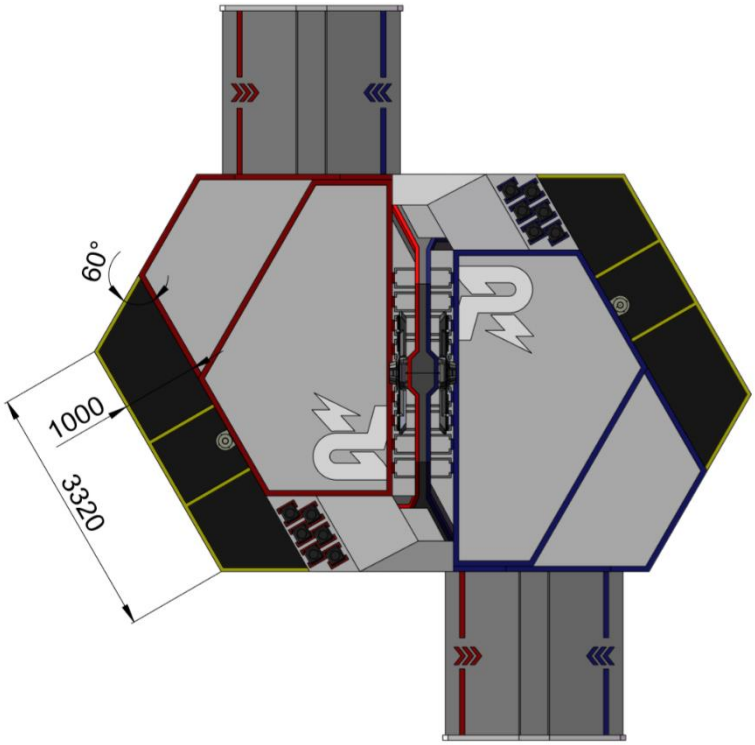


① RFID Interaction Module cards laid inside the blue boxes

4.5.1 Resource Island Penalty Zone

The shape of Resource Island Penalty Zone is an irregular polygon, indicated by a yellow border that outlines the Resource Island.

The Penalty Zone is shown in the following figure:



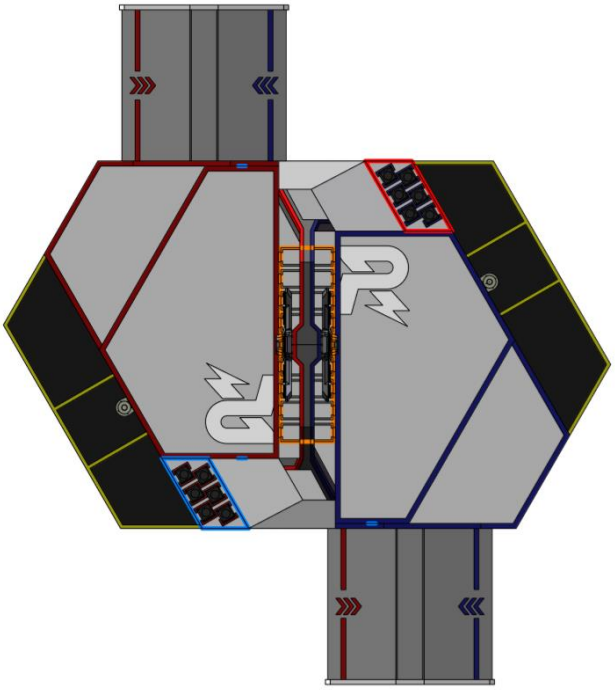
Violations and Penalties:

1. In the Penalty Zone around Resource Island, Engineers have priority While Standard and Hero are prohibited from blocking the landing area and the area to obtain Projectile Containers.
2. If any robot stays in the Penalty Zone for T second(s) and disrupts Engineer of the opposing team in landing, leaveing the Resource Island or obtaining Projectile Containers, the referee will issue a Level X Warning. The actual situation shall be determined by the Head Referee and the Chief Referee. The robot must immediately leave the Penalty Zone.
3. If Standard or Hero stays in the Penalty Zone and its space above for more than 10 seconds, constantly disturbs Engineer of the opposing team in landing, leaveing the Resource Island or obtaining Projectile Containers, and gets in serious collisions with the opposing team's robot, the referee will issue a Level 4 Warning. The actual situation shall be determined by the Head Referee and the Chief Referee.
4. Engineer can stay in the Penalty Zone for a long time, but it cannot repeatedly disturb Engineer of the opposing team in landing, leaveing the Resource Island or obtaining Projectile Containers, and gets in serious collisions with it; otherwise, the referee will issue a Level 4 Warning. The actual situation shall be determined by the Head Referee and the Chief Referee.

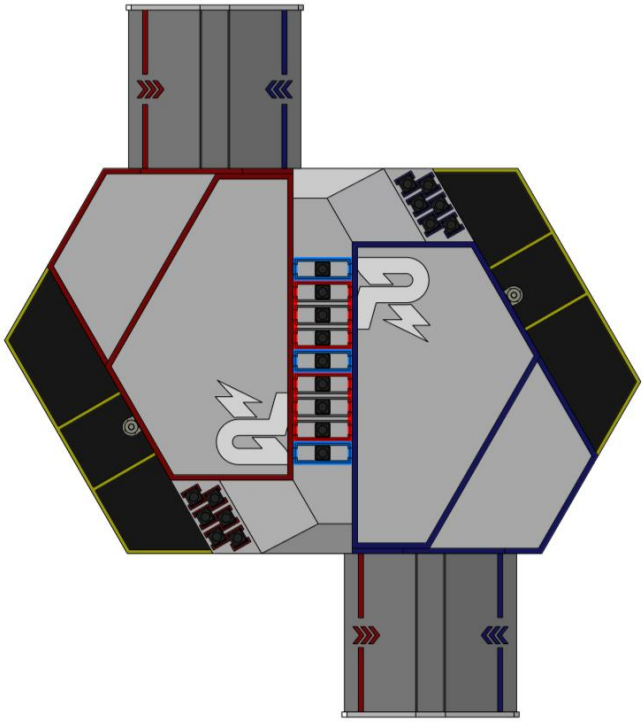
T	X
T < 3	1
3 < T < 10	2
T > 10	3

4.5.2 Projectile Depot

The Resource Island is provided with 21 fixed Projectile Container grooves, which holds full Projectile Containers. In each Projectile Depot on both sides of the Resource Island, there are six Projectile Containers with six 42 mm standard projectiles. In the Projectile Depot of the central area, there are nine Projectile Containerscontaining twenty 42 mm standard projectiles.
Before each round, Side Referees will place projectiles in Projectile Containers and then place the containers in the appropriate positions on the Resource Island. Engineer can move or take away containers to obtain projectiles.
The location of Projectile Containers is shown in the following diagram:



The central area Projectile Containers will rise twice. The first time is at the start of the match, the second is after 3 minutes of the start. If Projectile Containers are not fully raised and in still state, Engineer cannot grab the Projectile Container or obtain projectiles from the Projectile Container. The blue frame in the central area below identifies Projectile Containers that are raised for the first time, and the red frame identifies those for the second time. Positions of the Projectile Containers are as shown below:



Projectile Container:

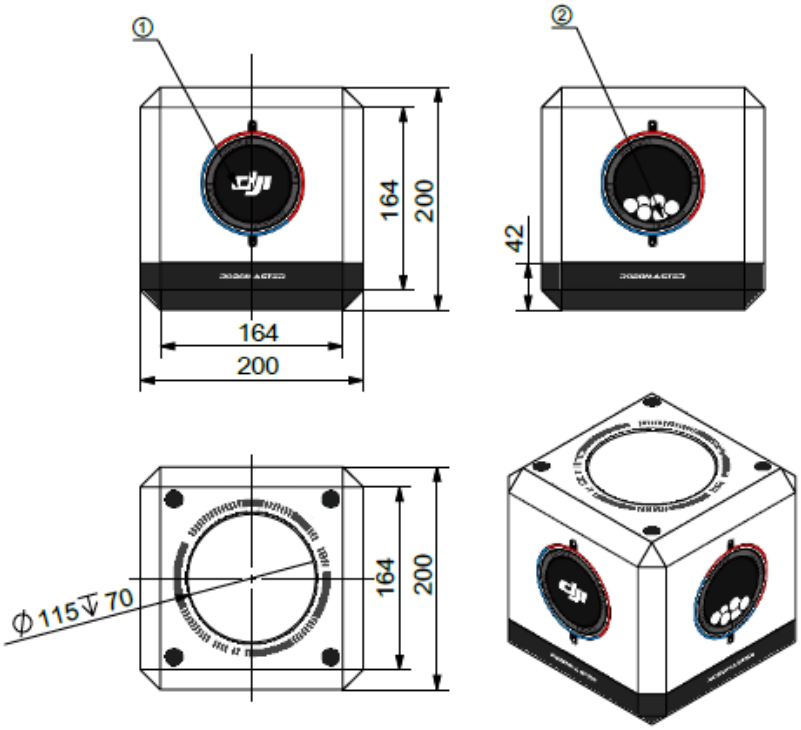
Projectile container is a 200*200*200 mm cube. Its six faces are chamfered and it is made out of EVA. The top side has a hole with a diameter of 115 mm. The hole depth of different types of Projectile Container is different. The depth of the Projectile Containers in the middle of the Resource Island is 150 mm, and the depth of the Projectile Containers on both sides is 75 mm.

During a match, robots can use Projectile Containers as obstacles, but robots under the Resource Island are prohibited from placing Projectile Containers on the Resource Island platform.

Violations and Penalties:

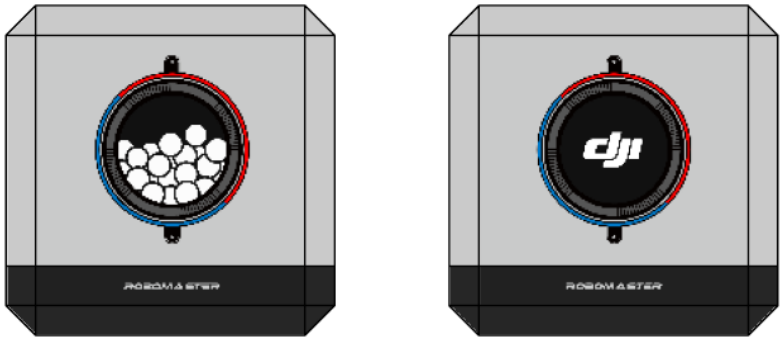
1. If any robot under the Resource Island places Projectile Containers on the Resource Island platform, the referee will issue a Level 2 Warning.
2. If any robot grabs Projectile Containers or obtains projectiles from the Containers before they has been raised, the referee will issue a Level 3 Warning.

Projectile Containers on both sides of the Resource Island:



① This icon is subject to future changes ② This icon means "This side out"

Projectile Containers in the central area of the Resource Island platform:



4.5.3 Assistive Column

On both sides of the Resource Island, there are two Assistive Columns which are made of Q235 carbon structural steel with a matt surface. Engineer can use the Assistive Column with its Landing Mechanism to ascend to the Island and obtain projectiles.

During the match, no robot shall set Projectile Containers on the Assistive Column, place or discard Containers in the Assistive Column Penalty Zone.

Violations and Penalties:

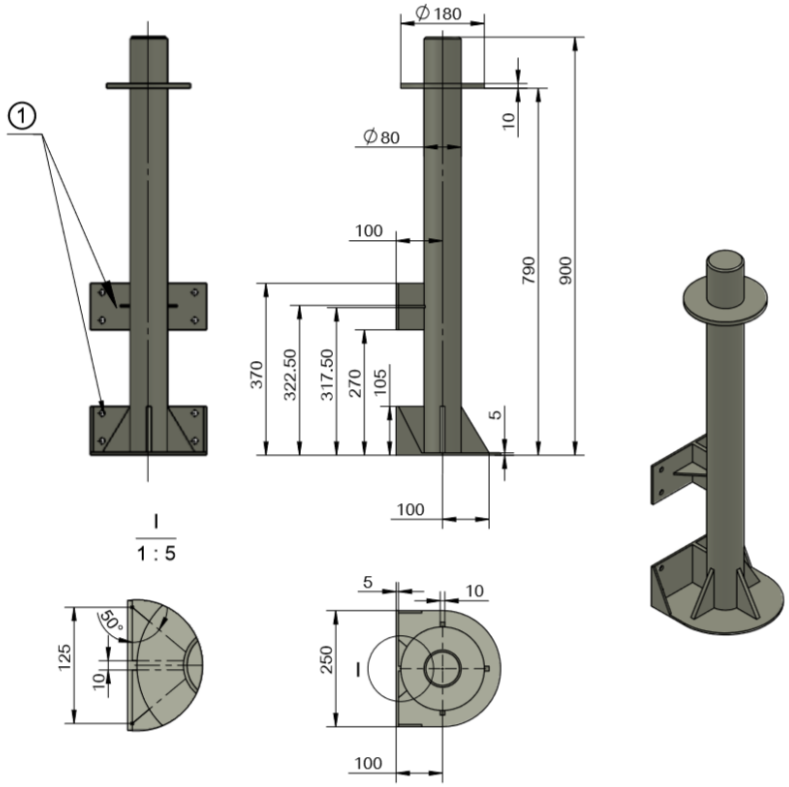
1. If any robot places Projectile Containers in the Assistive Column Penalty Zone with a mechanical arm or other methods (such as shooting), the referee will issue a Level 2 Warning. The actual situation shall be determined by the Head Referee.
2. During a match, if a robot sets Projectile Containers on the Assistive Column, the referee will

issue a Level 4 Warning.

Note:

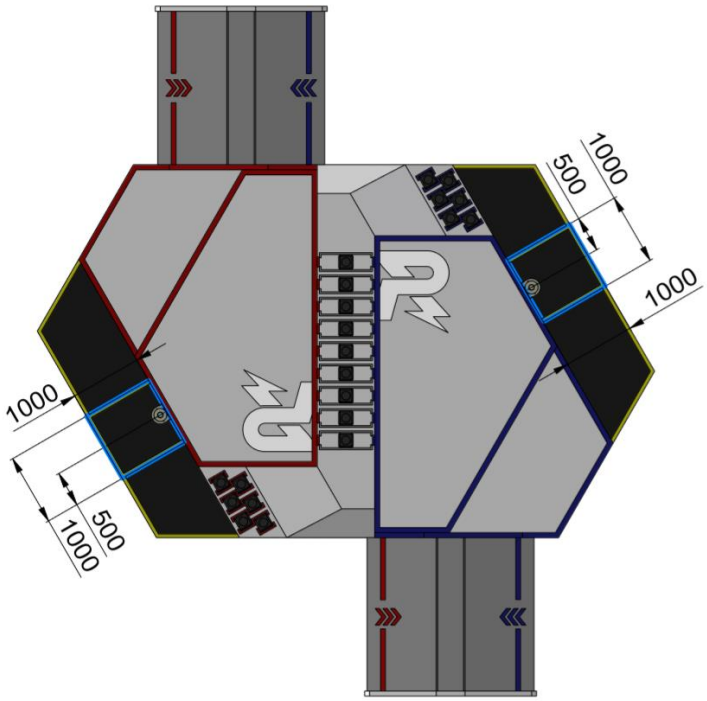
1. Since the surface of the Assistive Column is inevitably scratched from repeated use in the Battlefield, the mechanical structure of robots should be properly designed based on this assumption.
2. Teams need to consider the possible impact to their own robots with a Projectile Container placing on the plane or stair of the Resource Island and prepare an appropriate solution.
3. When Engineer uses the Assistive Column to ascend to the Resource Island, its mechanical structure will touch the Column. Teams should take this into consideration when designing robots and avoid structural damage to the mechanical structure.
4. The connection between the step surface with a diameter of 180 mm and the two sides of the round tube with a diameter of 80 mm on the Assistive Column may have an inevitable structure (solder joint and surface finish) by improper processing.

Below shows dimensions of the Assistive Column on the Resource Island:



① Holes of the Assistive Column are connected to the Resource Island by bolts, which are M8 hex cup head seld-tapping screw

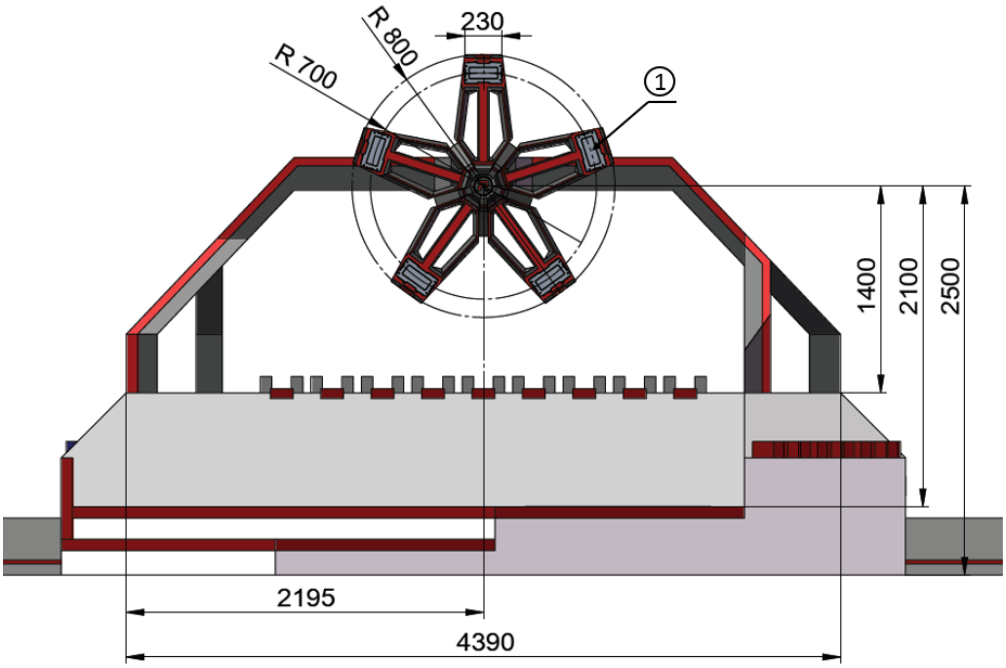
The area around the Assistive Column demarcated by a blue square 1000 mm in length is the Assistive Column Penalty Zone, as shown in the blue box in the following figure:



4.5.4 Power Rune

The Power Rune is located in the center of the Resource Island, with one is the blue team and the other the red team. If the Power Rune of one side is activated, the corresponding team will gain twice the attack bonus lasting for one minute. Each team can only activate its corresponding Power Rune and can activate at the same time. Take the red team's Power Rune as an example and this also applies to the blue team.

The Power Rune is distributed evenly with five Large Armor Modules. The specific location and dimensions are as follows:



① Large Armor Module

1. When a round is down to the last 4 minutes, the Power Rune starts to rotate at a constant speed of 10 RPM (Round-Per-Minute). At this moment, the Power Rune cannot be activated.

2. When the red team robot reaches the red team's Bridge Top Platform and stays for 3 seconds (which means the robot enters into the blue outlined box of the Bridge Top Platform. The robot's RFID interaction module detects the RFID interaction module card within the Bridge Top Platform and prompts on the client), the red team's Power Rune will illuminate one of the five armor

modules randomly, and the center axis of the bracket will have an arrow-shaped light flow effect.

3. If a projectile hits the illuminated armor module, the bracket will be fully illuminated. At the same time, the Power Rune will randomly illuminate one of the remaining four armor modules.

4. If the second illuminated armor module is hit by a projectile (i.e., the armor module with the arrow-shaped light flow effect on the central axis of the bracket), the bracket will also be fully illuminated. At the same time, the Power Rune will randomly illuminate one of the remaining three armor modules, so on and so forth.

5. If all five armor modules are hit consecutively by projectiles and the entire Power Rune is illuminated, then the Power Rune is fully activated.

6. In the firing process, if the randomly illuminated armor module is not hit within 2.5 seconds, the activation fails, and the Power Rune will return to the state of being "ready to be activated". When one of the five armor modules is randomly illuminated, the center axis of the bracket will have an arrow-shaped light flow effect.

(The next version of rules will fine-tune the parameters such as the rotation speed, structure, and dimensions of the Power Rune, but such adjustments will not affect the identification of it.)

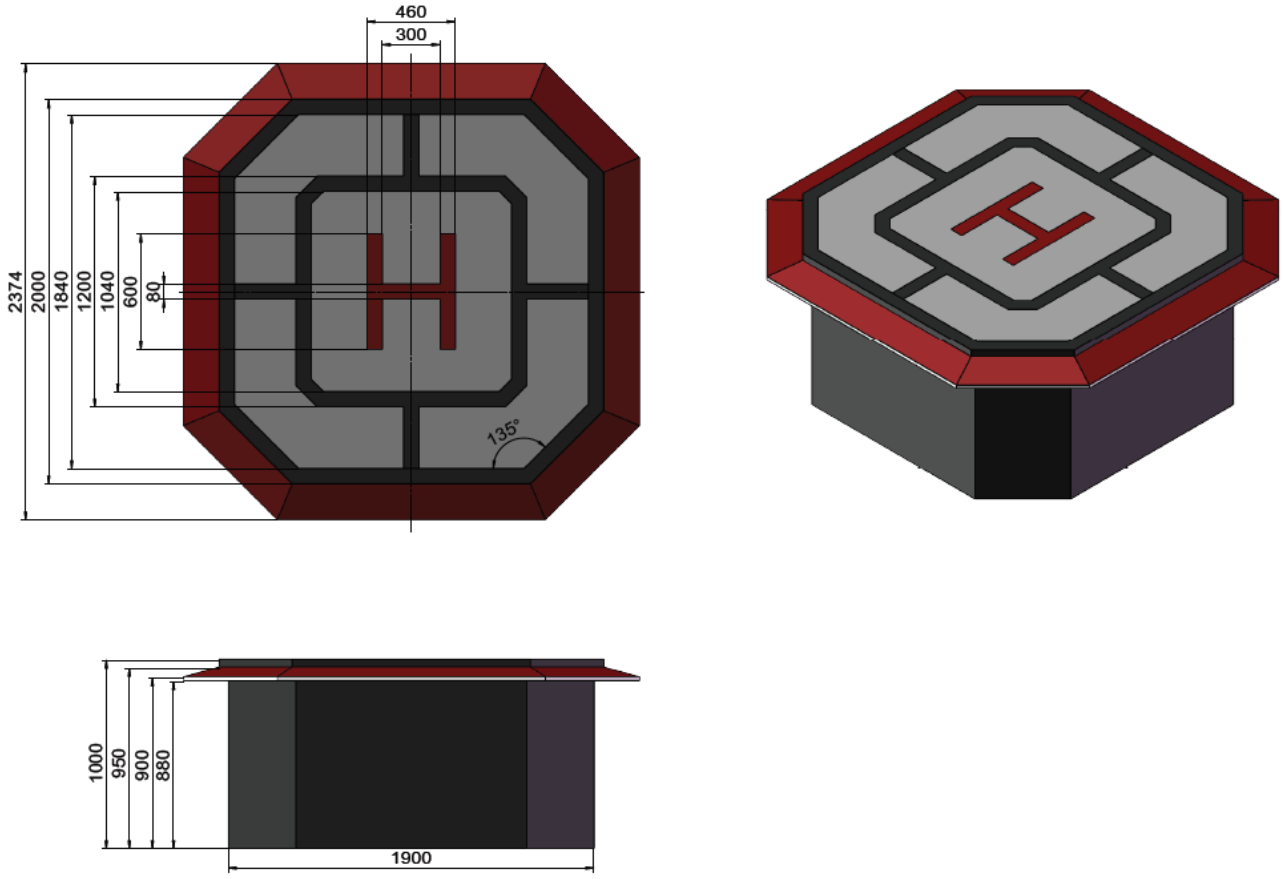
4.6 Flight Zone

Description:
An area where Aerial is permitted to operate, including a Landing Pad and Aerial Safety Rope.

4.6.1 Landing Pad

The Landing Pad is where Aerial takes off and lands. Before the start of each round, Aerial must be placed on the Landing Pad.

The dimensions of the Landing Pad are shown below:



4.6.2 Aerial Safety Rope

1. Aerial Safety Ropes are attached to a pulley, which slides on a fixed horizontal steel cable over the Battlefield. This steel cable is 4m above the ground, and the Aerial Safety Rope is 3m long.
2. Before each round, both teams must connect their Aerial to the Safety Rope using the bead ring in order to limit the flight range and protect the Battlefield. The flight distance of Aerial in the Battlefield is limited. There is a snap ring in the center of the cable that sets up Aerial (16 meters from the Battelefield fence to the Landing Pad of its own team). When the bead ring of the Safety Rope reaches to the snap ring of the cable, Aerial can no longer move forward.
3. During the competition, the distance between the lowest point of Aerial in flight and the floor shall not be less than 1300 mm (which is the same as the lower surface of Sentry Rail and the Open Zone). No part of Aerial's barrel may exceed the top of the Battlefield fence. Aerial should pay attention to flight safety during the competition and actively avoid ground robots.

Violations and Penalties:

If any part of Aerial's barrel exceeds the height of the fence, Pilot Room referees will warn the Pilot to reduce height. If the Pilot ignores the warning, Aerial will be ejected from the Battlefield with a

Level 4 Warning (The video transmission module and launching mechanism are powered off and Aerial must immediately land on the Landing Pad), and the team is not allowed to use Aerial for the remaining rounds of the match.

4.7 Operator Room

Description:

On both sides of the Battlefield, there are Operator Room of red/blue team and Pilot Room, which are equipped with computers of the corresponding robot and communication devices for referees. The Operator Room is the only place where operators can control their robots in real time during the competition.

Facility:

1. During the Regional Competition, the Operator Room includes five computers and each has mouse, keyboard, USB hub and headset. As some equipment such as mouse and keyboard may suffer from performance degradation over time, it is recommended that operators bring their own equipment and sett up during the 3-minute setup period.
2. There is no extra power supplied to the Operator Room. Operators must therefore bring their own power supply for their own equipment.

Operator description:

1. Aerial:

Operator Category	Duty	Position during the Match	Available Visual Information
1 Aerial Gimbal Operator	Control the Aerial Gimbal	Operator Room of red/blue team	Vision by Aerials
1 Pilot	Control Aerial	Pilot Room	Directly see the Aerial in the competition area and control its flying
1 Projectile Supplier	Manually load and supply projectiles to Aerial	Designated area next to the Pilot Room	-
	Must wear a long-sleeved top and the helmet and goggle provided by the RMOC. Each projectile supply time should not exceed 30s.		
Note: 1) **Aerial Gimbal Operator can send one-way voice commands to Pilot via the equipment provided by the RMOC, but Pilot cannot respond back.** 2) **Communication with the Projectile Supplier is only allowed when the Pilot needs projectile**			

supply. At some other time, any verbal or physical communication between the Supplier and the Pilot is prohibited.

3) **If a team does not have Aerial, the team's Aerial Gimbal Operator and Pilot are not allowed to enter the Operator Room and need to watch the game from the Pit Area.**
4) **Pilot can connect to the remote controller for the status of Aerial via his phone.**

2. Standard, Hero, and Engineer can only have one Operator each. Since Sentry is a fully automated robot, it has no operator.
3. Operator can only operate on his corresponding computer and cannot change after a round has begun.

Operator Room Referee:

1. In the Operator Room, there are referees who are responsible for maintaining order, helping technicians to solve problems and ensuring the normal operation of official equipment during the setup period.
2. Operators in the Operator Room must wear the headsets provided by the RMOC in order to receive instructions from the Head Referee. Operators cannot leave their post without referee's permission.

Violations and Penalties:

1. The use of an unauthorized power supply in the Operator Room is regarded as damaging components.
2. Pit Crew who does not wear a long-sleeved top, helmet or goggle may not supply projectiles for Aerial.
3. If a Projectile Supplier spends more than 30s supplying projectiles, the Referee will issue a verbal warning and ask the Supplier to return to the designated area. If the Supplier does not comply, he will be ejected to the Pit Area. In the remaining rounds of the match, the team may not have a substitute Supplier to supply Aerial, nor may the Pilot of the team supply Aerial during the seven-minute round.
4. Operator, Aerial Gimbal Operator or Pilot who leaves his post, or Projectile Supplier who leaves his designated area will receive a verbal warning. The team with a member fails to comply with the warning will be punished as lose for the round.
5. Operator, Aerial Gimbal Operator or Pilot who does not wear headsets will receive a verbal warning. Team Member who does not comply with this verbal warning will be ejected, and the robot he operates will be ejected with a Level 4 Warning after the start of the match. The team will not be allowed to have a substitute Operator enter the Operator Room in that round.
6. Operator that changes his position after the start of a match will receive a verbal warning from the Operator Room Referee, and the Operator must return to his specified position. Team Member who does not comply with this warning will be sent off with a Level 4 Warning, and the robot he operates will be ejected with a Level 4 Warning after the start of the match. The team is not allowed to have a substitute Operator enter the Operator Room. If the ejected team member does not comply, the entire team will be punished as lose for the round.

4.8 Projectile

Projectile is the only acceptable component to attack robots. Robots must use projectiles to hit the armor modules of the enemy robots, causing damage to their HPand defeat them. Both 17 mm and 42 mm standard projectiles are used during a match. Their specifications are as follows:

Type	Appearance	Color	Size	Weight	Shore Hardness	Material
42 mm Standard Projectile	Similar to the shape and size of a golf ball	White	42.5 mm (±0.5 mm)	42g (±0.2 g)	90 A	Plastic (TPE)
17 mm Standard Projectile	Round		16.9 mm (±0.1 mm)	2.9g (±0.1g)	90 A	Plastic (TPU)
42 mm Luminous Projectile	Similar to the shape and size of a golf ball	Transparent	42.5 mm (±0.5 mm)	To be determined	90 A	Plastic (TPE)
17 mm Luminous Projectile	Round		16.9 mm (±0.1 mm)	To be determined	90 A	Plastic (TPE)

Note:

1. Official RM2019 projectiles must be used in all RM2019 Season matches.
2. Luminous Projectiles are used in the Final Tournament after the Knock-out Stage (final 16).

Chapter 5: Competition Procedure and Rules

This chapter mainly covers the core competition procedures and penalty explanations for the Chinese Regional Competition, International Regional Competition, Wild Card Competition, and Final Tournament of the RobotMaster 2019 Robotics Competition (RM2019). During the official matches of RM2019, each team will prepare for the matches in the Preparation Area, arrive at the Inspection Area for the pre-match inspection, wait in the Staging Area, and finally enter the Competition Area to compete. Each team is required to leave the Competition Area and return to the Preparation Area after each match.

Specific locations of these areas and arrival pattern will be introduced in the Participant's Manual published later in the Season.

5.1 General Competition Rundown

The official matches of RM2019 consists of the Group Stage and the Knock-out Stage. Before each match begins, all robots need to pass the pre-match inspection performed by the RMOC, which is to ensure that all robots fulfill the technical specifications set by the RMOC for fairness. All teams must be guided by referees and volunteers to enter the Competition Area. By the end of each match, teams must clean up projectiles left in the Launching Mechanism of each robot and return them to the designated areas.

There are two, three, or five rounds of competition depending on the Competition System. Each round consists of a three-minute setup period and a seven-minute round period. Between the two periods, there is a twenty-second referee system initialization period.

Team members can enter the Battlefield to test and set up their robots as required during the setup period. During the remaining 1 minute and 30 seconds, Operator needs to go to the Operator Room (including the Pilot Room) to check the status of the official equipment and prepare for the match. During the final 30s, the remaining Pit Crew must return to the Pit Area. After the setup period, the match enters a twenty-second referee system initialization period.

During the final five seconds of the initialization period, participants will hear a countdown alert sound, and see a countdown timer and a live animation. At the same time, the keyboard connected to the computer in the Operator Room will be locked. The round of match starts immediately after

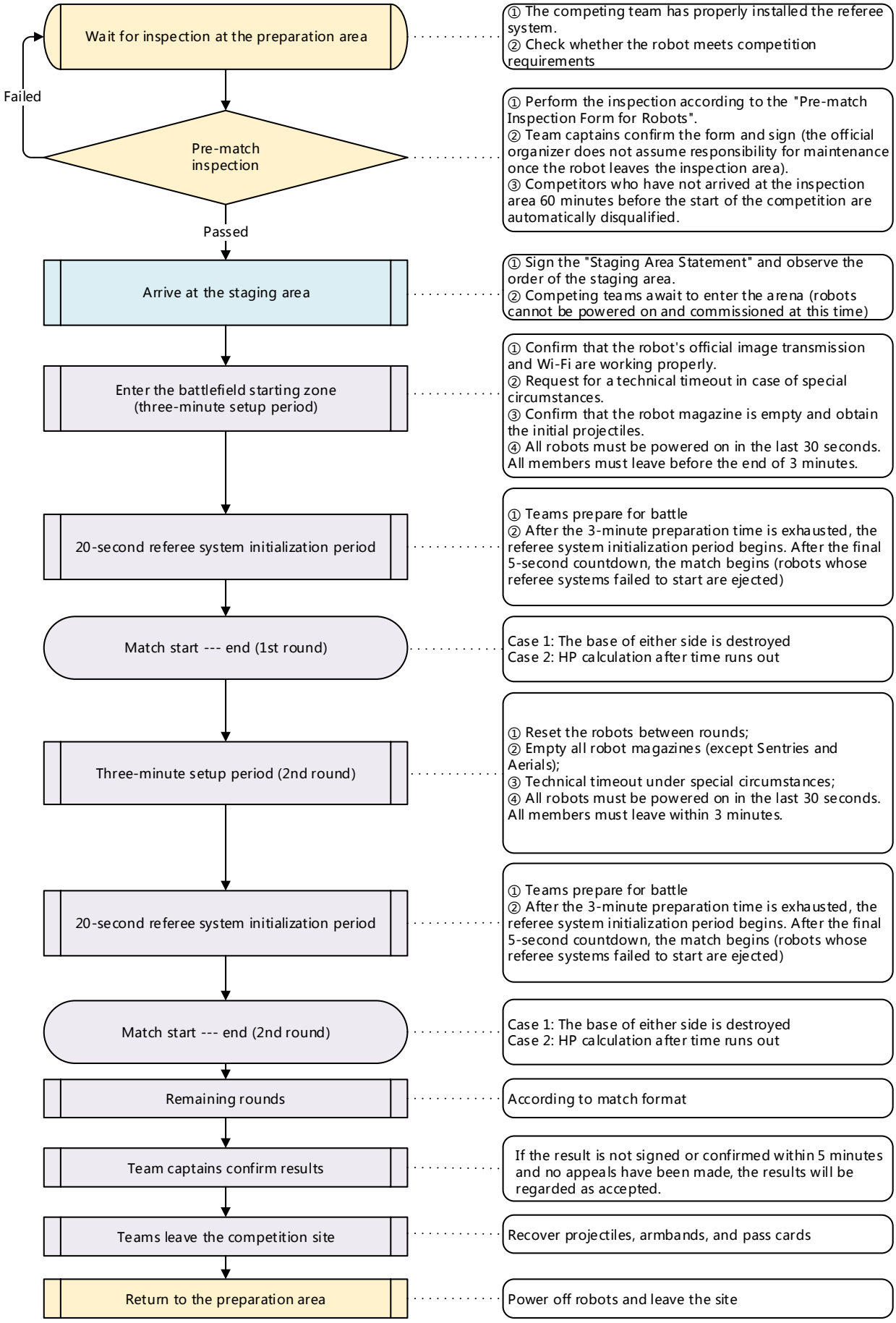
the countdown finishes. When the time runs out or one team fulfills the criteria to win the round, a round comes to an end. Subsequently, the match immediately enters the setup period for the next round. When the winner is determined, the match is over.

During the seven-minute round period, robots from both teams will compete on the Battlefield of the stadium. All robots must install the Referee System provided by the RMOC to record HP value and projectile hits and monitor the Launching Mechanism and Chassis Power Consumption. Besides, it cuts off a robot's power supply when its HP drops to zero. During the match, the real-time status of all robots is sent to both the Operator's computer and the Referee System's server. The Referee System server determines the outcomes of all rounds automatically. Referees will penalize foul plays of robots, Operator, Aerial Gimbal Operator or Pilot.

Note:

After the end of the second fourth round of a BO5 match, both teams have 10 minutes to work on their robots. When 10 minutes run out, the setupperiod of the next round begins.

The procedure of a single match is shown below:


Wait for inspection at the preparation area
① The competing team has properly installed the referee system.
② Check whether the robot meets competition requirements
Failed
Pre-match inspection
① Perform the inspection according to the "Pre-match Inspection Form for Robots".
② Team captains confirm the form and sign (the official organizer does not assume responsibility for maintenance once the robot leaves the inspection area).
③ Competitors who have not arrived at the inspection area 60 minutes before the start of the competition are automatically disqualified.
Passed
Arrive at the staging area
① Sign the "Staging Area Statement" and observe the order of the staging area.
② Competing teams await to enter the arena (robots cannot be powered on and commissioned at this time)
Enter the battlefield starting zone (three-minute setup period)
① Confirm that the robot's official image transmission and Wi-Fi are working properly.
② Request for a technical timeout in case of special circumstances.
③ Confirm that the robot magazine is empty and obtain the initial projectiles.
④ All robots must be powered on in the last 30 seconds. All members must leave before the end of 3 minutes.
20-second referee system initialization period
① Teams prepare for battle
② After the 3-minute preparation time is exhausted, the referee system initialization period begins. After the final 5-second countdown, the match begins (robots whose referee systems failed to start are ejected)
Match start --- end (1st round)
Case 1: The base of either side is destroyed
Case 2: HP calculation after time runs out
Three-minute setup period (2nd round)
① Reset the robots between rounds;
② Empty all robot magazines (except Sentries and Aerials);
③ Technical timeout under special circumstances;
④ All robots must be powered on in the last 30 seconds. All members must leave within 3 minutes.
20-second referee system initialization period
① Teams prepare for battle
② After the 3-minute preparation time is exhausted, the referee system initialization period begins. After the final 5-second countdown, the match begins (robots whose referee systems failed to start are ejected)
Match start --- end (2nd round)
Case 1: The base of either side is destroyed
Case 2: HP calculation after time runs out
Remaining rounds
According to match format
Team captains confirm results
If the result is not signed or confirmed within 5 minutes and no appeals have been made, the results will be regarded as accepted.
Teams leave the competition site
Recover projectiles, armbands, and pass cards
Return to the preparation area
Power off robots and leave the site

5.2 Criteria Required to Win

Criteria for Winning a Match:

There are two, three or five rounds in a match, which are called BO2, BO3 and BO5 Competition System respectively according to the general competition system of competitive games. Based on the difference of Group Stage and Knock-out Stage, a match may have the following outcomes:

Competition System	Group Stage	Knock-out Stage
BO2	2:0: Winning team obtains 3 points 1:1: Each team obtains 1 point 0:2: Losing team obtains 0 point 1:0 (one round draw): The team winning one game gains one point, and the team losing one game gains 0 point. 0:0 (two rounds draw): Each team obtains 0 point	N/A
BO3	N/A	The team that wins two rounds is crowned the winner
BO5	N/A	The team that wins three rounds is crowned the winner.

Criteria for Winning a Single Round:

1. When the Base of one team is destroyed, the round ends immediately and the surviving team wins.
2. When the entire seven-minute round periodruns up, if the Bases of both teams have not been destroyed, the team with the higher Base HP is the winner.
3. When the entire seven-minute round peiod runs up, if the Bases of both teams have not been destroyed and both have the same remaining Base HP, the team with the higher HP Deduction wins.
4. When the seven-minute round period runs up, if the Bases of both teams have not been destroyed, both have the same remaining Base HP and HP Deduction, the team with the higher total remaining HP of all robots wins.

If these criteria still cannot determine the winner, the round is considered a draw. A draw in the Knock-out Stage leads to an extra round until a team wins.

Rankings for Group Round Robin:

The following criteria are used to determine rankings in descending order of priority:

1. The team with the higher match points ranks higher.
2. If the total match points are the same, the team with the higher total Net Base HP ranks higher.
3. If the total Net Base HP are the same, the team with the higher total HP Deduction ranks higher.

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

Definitions related to HP:

HP Deduction:

1. At the end of each round, the total damage accrued from successfully hitting the armor modules of the opposing team's robot and leading to its deduction of HP.
2. HP deducted from violations and penalties determined by the referee will be counted as the enemy's HP Deduction. (deducted HP of different levels of warning varies)
3. HP deducted from the Initial Firing Speed exceeds the limit, Barrel Heat exceeds the limit, Chassis Power Consumption exceeds the limit and the Referee System goes offline are not counted as HP Deduction.

Net Base HP: At the end of each round, the remaining Base HP of one team minus that of the opposing team.

Total Remaining HP: At the end of each round, the total value of the remaining HP of all surviving robots of a team.

5.3 Competition Area Personnel

5.3.1 Specification for Participant

1. Participants who enter the Staging Area and Competition Area are called Pit Crew. During each match, 14 Pit Crew per team (including Supervisor) atmost can enter to prepare for the match (including the team's Captain, Operator, Supervisor, and Advisor). The Captain and at least one Supervisor present at the scene must enter the Competition Area as Pit Crew.

Violations and Penalties:

If any team has more than 14 Pit Crew , the Referee will issue a verbal warning. The extra member must leave the Staging Area and Competition Area. If the Referee's several verbal warnings are ignored, the team will be punished as lose for the round.

2. During the seven-minute round period, Operators must stay in their respective Operator Rooms.

Other Pit Crew must stay in the Pit Area outside of the Battlefield. Pit Crew are prohibited from leaving the Area without the Referee's permission.

Violations and Penalties:

Pit Crew who leave the Pit Area without the Referee's permission will be given a verbal warning. If he fails to comply with the warning, he will be ejected and for all of the remaining rounds of the match, the team is not allowed to have a substitute member to enter the Competition Area. If the team member continues to stay in the Competition Area, the team will be punished as loses for the round.

5.3.2 Specification for Event Staff

Teams will be guided by volunteers and staff members throughout the competition. Apart from volunteers and general staff members, teams will also come into contact with the following event staff from RMOC. During the competition, the Chief Referee has the final right of interpretation regarding competition rules. Any questions related to competition rules can only be consulted with the Chief Referee.

Role	Duty
Head Inspector	Oversees all pre-match inspections and has the final decision on whether a team passes the pre-match inspection.
Inspector	Assists with pre-match inspections but does not get involved in or assist any team with the maintenance of robots in any way.
Chief Referee	Has the final decision and right of interpretation regarding competition rules. During the competition, Chief Referee issues severe violations and penalties (disqualification), accepts appeals after the match, and has the right to impose additional penalties before and after the competition.
Head Referee	In charge of the execution of Referees' decisions, controls the competition process, executes Official Technical Timeouts, receives and confirms Team Technical Timeout and ensures the validity of match results. During the match, the Head Referee receives information from Side Referees and Operator Room Referees, and confirms and executes Level 1-5 Warnings for violations.
Side Referee	Executes competition procedures, guides team members to enter and exit the Battlefield, reports a robot's violation to the Head Referee during matches. Receives applications of Team Technical Timeout and reports to the Head Referee for confirmation.
Operator Room	Executes competition procedures, guides participants to enter and exit the

Role	Duty
Referee	Operator Room, reports Operator's violations and Technical Timeout to the Head Referee, assists operators in solving technical problems of the Operator Room's equipment, can apply for Official Technical Timeout, but does not assist participants in repairing the mouse and keyboard.
Technician	Maintains components of the Battlefield, assists participants in solving technical problems with the Referee System during the setup period, can apply for Official Technical Timeout, but does not assist participants in repairing and maintaining their robots.

5.4 Pre-match Procedure

5.4.1 Inspection Specification

To ensure that robots meet the required specifications, each team must undergo the pre-match inspection in the Inspection Area. For requirements of pre-match inspection, please refer to Table 8-1 RM Online Product Education Discount

Appendix 4 Pre-match Inspection Form.

1. Each team must reach the Inspection Area to start the pre-match inspection at least 60 minutes before the match begins.

Violations and Penalties:

Except for emergencies, teams that fail to reach the Inspection Area within the specified time will lose the match. The actual situation is determined by the Head Inspector and Chief Referee.

2. A maximum of 14 team members can enter the Inspection Area. Standard must be brought into the Inspection Area by one team member while Sentry, Aerial, Hero, and Engineer be brought by two members. One team member must also oversee the pre-match inspection work. Team members are prohibited from entering the Inspection Area without permission before their robots enter the Inspection Area.

Violations and Penalties:

Extra team members or those who do not participate in the pre-match inspection must leave the Inspection Area.

3. During the pre-match inspection, inspectors will place a "Pass Card" on robots that pass the inspection. Only robots with a "Pass Card" can enter the Staging Area and Competition Area. Teams need to modify their robots that fail the inspection in a designated area or the Preparation Area until the inspection requirements are met.

Violations and Penalties:

Robots without a "Pass Card" cannot enter the Staging Area and Competition Area.

4. Required robots must pass the inspection to be qualified for the round. When the inspection is complete, the team Captain must sign the Inspection Form to confirm that they agree with the inspection results. (refer to Table 3-1 Robot Entrance Lineup)

Violations and Penalties:

1. If any required robot faisl the pre-match inspection, the team is deemed as give up its qualification for the round of the match and lose the match..
2. After the team Captain signs for confirmation, no objection may be raised to the results of the inspection. Teams will be deemed as cheating if any robot that fails the pre-match inspection is found inside the Competition Area. Any round attended by the above-mentioned robot will be directly recorded as failed. The actual situation is determined by the Head Referee and Chief

Referee

5.4.2 Staging Area Specification

When the pre-match inspection is complete, the teams must arrive at the Staging Area at least 15 minutes before their match begins. All robots and team members must be re-checked at the Staging Area.

1. Team Captain must sign a Staging Area Statement 10 minutes before every match begins to confirm that the team is able to compete.

Violations and Penalties:

Except for emergencies, if the team Captain fails to sign the Staging Area Statement five minutes before the match, then the team will be disqualified and automatically lose the match. The actual situation is determined by staff of the Staging Area and the Chief Referee.

2. All robots in the Staging Area must pass the pre-match inspection and have a "Pass Card" placed on them.

Violations and Penalties:

Robots without a "Pass Card" will be denied entry to the Competition Area.

3. The total number of Pit Crew per team in the Staging Area cannot exceed 14.

Violations and Penalties:

Extra Pit Crew will be asked to leave the Staging Area.

Robots cannot be powered on to be adjusted or maintained in the Staging Area. If robots require maintenance after entering the Staging Area, the team must first inform staff of the Staging Area. Only when the "Pass Card" on the robot be removed and the signed Staging Area Statement become invalid can the robot that needs maintenance return to the Maintenance Area. When the maintenance is finished, the team must bring their robots back to the Inspection Area for reinspection. After passing the reinspection, the team returns to the Staging Area and the Captain resigns the Statement. If a delay results in the failure to sign the Statement on time, the robot cannot play, and the team is held responsible.

Violations and Penalties:

The first time a team powers on his robots will receive a verbal warning from Staging Area staff. If three warnings are not heeded, the team will lose the round. The actual situation is determined by the Staging Area staff and the Chief Referee.

5.5 Match Procedure

Since the RM2019 Competition has a tight schedule, many teams and is streamed online in real time, any delay or accident will have a negative impact on our teams and a million audience. To ensure the normal proceeding, all participants must adhere to the pre-arranged schedules, instructions, and guidelines provided by the RMOC event staff, referees and volunteers, and abide by the rules and regulations as outlined in the Rules Manual.

Teams can only enter and set up their robots in the designated area of the Competition Areaafter leaving the Staging Area. When the previous match ends, the Referee will allow the next team to take its robots to the entrance of the Battlefield and wait for further instructions. After the Battlefield is ready, the setup period countdown begins, and the Referee will guide the participating team into the Comperition Area. All robots are continuously monitored by the Referee System. The Head Referee and Side Referees will announce rule violations and penalties, as well as address any emergencies that occur. Severe violations and appeals in the competition will be publicized.

5.5.1 Penalty Type

Below is warnings and penalties that a Referee executes:

Type	Penalty
Warning (Level 1 Warning)	The operation interface of all Operators from the violating team will be blocked for three seconds upon receiving a warning.
HP Deduction (Level 2 Warning)	● The operation interface of all Operators from the violating team will be blocked for five seconds. ● The Referee System will automatically deduct 5% of the current Maximum HP from all surviving robots (except Aerial and Base) of the violating team. ● The violating robot will lose **2** points.
HP Deduction (Level 3 Warning)	● The operation interface of the violating Operator will be blocked for ten seconds and other operators on the violating team for five seconds. ● The violating robot will be deducted 50% of its current Maximum HP and other surviving robots (except Aerial and Base) 5% of their current Maximum HP. ● The violating robot will lose **4** points.
Ejection (Level 4 Warning)	● Ejected Robots: In the round of the match, ground robots and Sentry are immediately slain by the Referee System (deduct all HP). Aerial will have its Launching Mechanism (including the loading mechanism and friction wheel) powered off and its VTM disconnected and must immediately land on the

Type	Penalty
	Landing Pad. Robots that are ejected cannot be revived. ● Ejected Operators or other members: Members ejected by the Referee must immediately leave the Competition Area and no substitute Operator or Pit Crew Member is allowed for the remaining rounds of the match. The robot operated by the ejected Operator will be ejected at the start of all rounds of the current match. The amount of HP deducted from the ejection will be counted towards the other team's HP Deduction.
Lose (Level 5 Warning)	● When a Lose is issued before the match (not including the three-minute setup period) and the match has not yet started, the Pit Crew of the offending party must all leave the Competition Area. The Base HP and all robots' HP of the losing team are set to 0, while the opposing team's Base HP and robots' HP remain their maximum. ● When a Lose is issued during a match (including the three-minute setup period), the Head Referee directly slays all robots of the offending team via the Referee System, and the round is over. The Base HP and all robots' HP of the losing team is set to 0, while the opposing team's Base HP and robots' HP remain at the amount when the round ends. At this point, pit crew of both sides must listen to the Referee's instruction to power off and move robots off the Battlefield. ● When a Lose is issued after the round due to an appeal, the Base HP value and all robots' HP of the losing team is set to 0, and the opposing team's Base HP and robots' HP remain at the amount when the round ends.

Note:

1. Each robot starts with **9** points at the beginning of each match. If a robot gets a Level 2 Warning, it will lose **2** points and for Level 3 Warnings, **4** points. When the points is less than or equal to **5**, the robot's avatar on the interface of the robot server client will display a yellow exclamation mark.. When the points is less than or equal to **2**, the avatar will display a red exclamation mark instead. When the points is less than or equal to **0**, the violating robot will be ejected.
2. The HP deducted by the Referee's warning and penalty will be counted towards the opposing team's HP Deduction.
3. The penalty system used throughout the competition consists of the five warnings described above. Some violaitons may immediately bring on a Level 4 or Level 5 Warning, whereas some may gradually upgrade from a Level 1 Warning. For example, if a team's robot crashes into the

opposing team's Sentry at high speed, it will immediately receive a Level 4 Warning and be ejected, whereas a lighter collision might only bring on a Level 1 Warning. Repeating the same fault within a round can also result in the severity of a warning gradually. For example, if a team earns a Level 1 Warning multiple times in the same round, the Referee can issue a Level 2, Level 3, or Level 4 Warning, even if the robot does not fulfill the requirements for those levels. **Level 1 Warning, Level 2 Warning, Level 3 Warning and Level 4 Warning are not grounds for a team to file an appeal.**

4. During a match and before issuing a Level 4 or Level 5 Warning, the Head Referee will announce the warning to the participants via headsets. After the announcement (about 10 seconds), the Head Referee sends the ejection order of the robot through the Referee System. The ejection order does not take the status and position of the robot into consideration. Team members must obey the Level 4 or Level 5 Warning issued by the Head Referee.

5.5.2 Three-minute Setup Period

Before the three-minute setup period of each round begins, both teams must wait at the area where robots are placed. Side Referees will check that both teams are prepared and then inform the Head Referee. The Head Referee will announce that both teams can enter the Battlefield. Participants need to move robots to the gate of the Battlefield. Side Referees will open the gate and guide participants to enter. When the gate open, the setup period countdown begins. All penalties for violations occurring during the setup period will be executed after the start of the match.

1. The number of pit crew per team cannot exceed 14.

Violations and Penalties:

The referee will issue a verbal warning to any team that has more than 14 pit crew. Extra member must leave the the Competition Area. If several verbal warnings are ignored, the team will lose the round.

2. Pit crew from both teams place their ground robots in their own Starting Zone to inspect whether the referee system equipment that directly connects to the robots operates normally. Moving within their own Starting Zone is allowed. Before the round begins, ground robots cannot leave their own Starting Zone, transform beyond their maximum initial size and fire projectiles in advance. The Referee System will lock the keyboard for the last five seconds of the twenty-second referee system initialization period. Therefore, at this time, Operators cannot use their keyboards. If the Operator controls the robot to leave the Starting Zone or transform beyond its maximum initial size before the keyboard is locked and fails to make it return to the Starting Zone or restore to its initial size due to keyboard lock, the Referee will issue and enforce penalties according to the corresponding violation regulations after the start of the match.

Violations and Penalties:

1) If a ground robot leaves its own Starting Zone, transforms beyond its maximum initial size or fires projectiles before the match starts, it will be deemed as cheating and the Referee will issue a verbal warning.

2) If the violator does not obey the verbal warning, the Referee will issue a Level 2 Warning after the start of the match.

3) If a robot leaves its own Starting Zone and has plenty of time to return to the Starting Zone, or a robot has jumped the gun for a long distance, but the Operator refuses to obey the Referee's warning and does not control the robot to return to the Starting Zone before the start of the match, the Referee will issue a Level 4 Warning to the violating robot. The actual situation is be

determined by the Head Referee and Chief Referee.

3. Aerial can be adjusted within the Landing Pad, and the Aerial Safety Rope should be connected as required. Propellers cannot be turned on and projectiles can only be fired into the Projectile Storage Bag. After the match begins and 100 points of Energy accumulated, the Aerial Gimbal Operator may choose to start the Launching Mechanism to fire projectiles.

Violations and Penalties:

1) If Aerial leaves the Landing Pad, launches projectiles or rotates its propellers in the Landing Pad within the three-minute set-up period, itlers in the e fired into the herReferee will issue a verbal warning. If the team does not obey, it will be given a Level 2 Warning.

2) If Aerial starts its propellers and flies off the Landing Pad, it will be banned from this round.

3) If Aerial is adjusted or repaired outside the Landing Pad, the Referee will issue a verbal warning. If the team does not obey, Aerial will be banned from this round.

4) Aerial that does not have an Aerial Safety Rope attached as required is not allowed to play in this round.

4. In the three-minute setup period, pit crew will mount a Sentry on the main structure of the Sentry Rail, and Sentry must be steadily fixed or operated on the Rail.

Violations and Penalties:

If the fixation becomes unstable and Sentry may fall to the ground in the three-minute setup period, the team members need to solve the installation problem at the request of the Referee. Otherwise, the faulted Sentry will not be allowed to play. The actual situation is determined by the Chief Referee.

5. Sentry and Aerial must empty their projectiles in the first round of the match until they can no longer fire projectiles. In other rounds of the same match, they can keep projectiles. Other robots must empty their projectiles until they can no longer fire projectiles.

Note: In each round of a match, staff will distribute 500 shoots of 17 mm standard projectiles to the Projectile Supplier of both teams, who can choose to supply their Aerial.

Violations and Penalties:

Robots that do not empty projectiles as required are allowed to play in this round.

6. Pit crew cannot pick up projectiles found on the Battlefield and supply to their own robots.

Violations and Penalties:

1) If a pit crew member picks up a projectile on the Battlefield, the Referee will issue a verbal warning. If the warning is not heeded, the Referee will issue a Level 2 Warning.

2) If a pit crew member personally picks up a projectile and supplies a robot, the Referee will

disqualify the robot.

3) If a pit crew member supplies projectiles that are not provided by the RMOC, the violating party will be disqualified.

7. Pit crew members must ensure that their robots work safely and will not injure any person in the Battlefield.

Violations and Penalties:

If a robot injures on-site personnel due to firing projectiles, losing control or malfunction, the violating party will be punished as lose for the round.

8. During the last 30 seconds of the setup period, all robots on the Battlefield must be powered on. At the same time, Referees will instruct pit crew to leave the field.

Violations and Penalties:

Pit crew that does not leave the Battlefield will receive verbal warning and be reminded to power on their robots as soon as possible.

9. At the end of the setup period, pit crew from both teams must return to their designated area outside the Battlefield.

Violations and Penalties:

At the end of the setup period, Pit crew who fail to leave the Battlefield will be ejected and the team is not allowed to have other substitute members to enter the Competition Area in the remaining rounds of the match. If the ejected crew member does not obey and remain on the Battlefield, the team will be punished as lose for that round. The actual situation is determined by the Head Referee's on-site penalty.

10. Fully automated Sentry can only be adjusted via remote controller before the match and during the setup period. When the match starts, participants can use remote controller. During the setup period, participants must place the Sentry remote controller in the designated area of the Battlefield entrance after completing the preparatory work.

Violations and Penalties:

If a remote controller is used for Sentry during a match, it will be deemed as cheating once confirmed by the Head Referee or through investigation. All matches that Sentry uses a remote controller will be punished as lose.

5.5.2.1 Technical Timeout

Official Technical Timeout:

During the setup period, if the Referee System, Operator equipment or other modules related to the Referee System fails to work properly, the Head Referee can announce an Official Technical Timeout and suspend the setup countdown. Examples of malfunctions include:

Rule	Description
1	Official equipment inside the Operator Room malfunctions.
2	During the setup period of the first round, the Referee System module on the robot fails. For example, the robot cannot normally transfer the image back to the Operator Room, or connect to the referee system server;
3	Structural damage or malfunction of key Battlefield Components (Base cannot normally open shield, Base armor module shifts, drops or cannot detect hit damage, Power Rune cannot be triggered by normal hit, Aerial Safety Rope breaks or is worn out, and Projectile Supplier cannot provide projectiles, etc.)
4	Any other situations requiring an Official Technical Timeout determined by the Head Referee.

1. An Official Technical Timeout may only be implemented after an Operator Room Technician or Field Technician reports to the Head Referee. Pit crew cannot request an Official Technical Timeout.
2. If Item 2 occurs during the setup period of the second round or later rounds, the damage will be considered incidental and an Official Technical Timeout will not be permitted. In these situations, it is too hard to determine whether the malfunctions were caused by the Referee System modules, a failure in the robot's mechanical or electrical system design, or operational mistakes made in previous matches. However, a Field Technician will provide backup Referee System modules, and the team can request a Team Technical Timeout to repair their robots.
3. During an Official Technical Timeout, the team members can only cooperate with the technicians to eliminate the faults of the relevant referee system modules and cannot repair other faults. They must leave the Battlefield when the Referee System has been repaired.

Team Technical Timeout:

If the mechanical structure of all robots, software system or equipment like keyboard and mouse that is brought to the Operator Room fails to work properly, teams can request a Team Technical Timeout from the Head Referee during the setup period. Pit crew can use the Timeout to enter the Battlefield to repair their robots. Team members can only adjust their own robots in the Starting Zone or Landing Pad.

During RM2019 Regional Competition and International Regional Competition, each team has one 1-minute Technical Timeout, one 2-minute Technical Timeout, and one 3-minute Technical Timeout. Once all Team Technical Timeout requests are used, the team can no longer request.

Note: Subsequently, there may be a mechanism for obtaining additional Team Technical Timeouts through other means.

Note:

1. Any request for a Team Technical Timeout must be submitted by the team Captain to a Side Referee or Operator Room Referee, with the length of the Timeout requested and the reason being clearly stated. The Head Referee announces the Timeout after confirming with other referees. The setup period countdown is paused at that time.

Violations and Penalties:

The Head Referee will only accept requests for Technical Timeouts raised by the team Captain.

2. The Head Referee will inform both teams of the Team Technical Timeout regardless of which team requests. Pit crew from both teams can enter the Battlefield to repair their robots during this time. Only the team that requests the Timeout will expend one of its chances to timeout. During the last 20 seconds of the Timeout, referees will remind team members to leave the Battlefield. When the Timeout expires, pit crew must leave the Battlefield.

Violations and Penalties:

Pit crew who do not leave the Battlefield will be ejected, and in all remaining rounds of the match, the team cannot have other substitute members enter the Competition Area. If the ejected crew member fails to comply and still remains on the Battlefield, the team will immediately be punished as lose for the round.

3. When a Team Technical Timeout is initiated and confirmed by the Head Referee, the team uses up one of its allotted Timeouts regardless of the premature end of the Timeout. For example, if a team initiates a two-minute Team Technical Timeout but only uses dozens of seconds to maintain their robots, the full two-minute Team Technical Timeout is still deducted. At this point, the Referee will continue the Technical Timeout countdown or end prematurely when heconfirms that both teams are ready. Additionally, if a team is granted a Team Technical Timeout but does not enter the Battlefield, it still uses up one of its Timeouts.
4. The team that calls for a Technical Timeout must do so before the last 15 seconds of the setup period. Between the last 15 seconds of the setup period until the end of the official round, a Technical Timeout cannot be called.
5. To ensure that subsequent matches begin on time, only one Team Technical Timeout is allowed per setup period. This Timeout is granted to the team that successfully places a request first. 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 captain cannot dispute the type of Technical Timeout when signing the form and the Technical Timeout process may not be used as a basis for appeals after the match.

5.5.3 Referee System Initialization Period

After the 3-minute setup period, the match enters a twenty-second Referee System Initialization Period. During the initialization, the competition server will automatically detect the status of client connection, the robot referee system module the competition elements, etc. If the status does not meet the requirements of the start of the round, such as an offline client, robot, or Battlefield Component, the countdown will be suspended. At this time, only theRMOC staff and a pit crew member of the team can enter the Battlefield to check the cause of the malfunction. Teams cannot request a Team Technical Timeout during the Referee System Initialization Period. After repairing malfunctions, the Referee resumes the initialization, and the countdown continues. The competition server will restore the HP of all robots, ensuring that all robots have full HP when the round officially begins.

During the Referee System Initialization Period, Operators (except Aerial Operator) can only stay in the Operator Room and Pilots can only in the Pilot Room. During the last five seconds of the Twenty-Second Referee System Initialization Period, participants will hear a countdown alert sound and see a countdown timer and a live animation. At the same time, the keyboard connected to the computer in the Operator Room will be locked. The round of match starts immediately after the 5-second countdown finishes.

5.5.4 Seven-minute Match Round

After a round begins, all Operators from both teams must stay in their Operator Room, Projectile Supplier must stay at the designated area next to the Pilot Room, and other Pit Crew must watch the match at the Pit Area next to the Battlefield.

For violations and penalties of Supplier Penalty Zone, please refer to 4.3 Supplier Zone.

For violations and penalties of Resource Island Penalty Zone, please refer to 4.5.1 Resource Island Penalty Zone.

5.5.4.1 Projectile Obtaining

1. Robots may not obtain projectiles from Sentry or Aerial.

Violations and Penalties:

Robots that obtain projectiles from Sentry or Aerial will be ejected from the round with a Level 4 Warning. The actual situation is determined by the Head Referee and Chief Referee.

2. During a match, robots may not directly collect projectiles from the ground.

Violations and Penalties:

Robots that collect projectiles from the ground will be ejected from the round with a Level 4 Warning. The actual situation is determined by the Head Referee and Chief Referee.

3. Robots must use official RM2019 projectiles and cannot use any unofficial projectiles.

Violations and Penalties:

Any team being found to use unofficial projectiles will be regarded as cheating and disqualify once confirmed through investigation.

4. Sentry and Hero cannot directly collect Projectile Containers from the Resource Island.

Violations and Penalties:

Sentry or Hero illegally collecting Projectile Containers will be ejected from the round with a Level 4 Warning. The actual situation is determined by the Head Referee and Chief Referee.

5. Engineer can only grab one Projectile Container at a time atmost or only projectiles from one Projectile Container at a time. Only when one Projectile Container completely leaves the groove of the Resource Island, can the next Projectile Container be taken.

Violations and Penalties:

When Engineer grabs more than one Projectile Containers at a time or obtain projectiles from more than one Projectile Container at a time, it will be issued a Level 2 Warning for the first offense. If it violates again, the Referee will issue a Level 4 Warning. The actual situation is determined by the Head Referee and Chief Referee.

5.5.4.2 Collision and Getting Stuck

Collision:

A robot may not use any of its structures to collide with the enemy's robots, regardless of whether the opposing robots have already been defeated. When a Battlefield component leaves the gound of the Battlefield and connects with a robot, it is considered part of the robot.

Teams can fire projectiles that meet the firing speed requirements at any part of the opposing team's ground robots. If the attack causes bending to any mechanical structure, damage of the VTM or circuit of the robot, this will be considered incidental damage and is not seen as basis for collisions or other types of penalties. However, if the Referee System module is damaged by prjectile, technicians will provide backup modules.

Note: To ensure that Sentry is fully capable of moving along its Rail, any part of a robot that attacks the opposing team's Sentry (including a defeated one) either intentionally or unintentionally will be deemed as violation and penalized.

Violations and Penalties:

Rule	Penalty Criterion
1	If a robot intentionally touches and crashes into the opposing team's robot, the Referee will consider it plain collision and issue a Level 1 Warning.
2	If a robot intentionally and rapidly crashes into the opposing team's robot or pushes the opposing team's robot to move, affecting its normal movement, the referee will consider it violent collision and issue a Level 2 Warning.
3	If a robot intentionally and rapidly crashes into the opposing team's robot, pushes the opposing team's robot to move for a long distance or affects its normal movement for a long time, the referee will consider it violent collision and issue a Level 3 Warning.
4	If a robot intentionally, directly, rapidly, and repeatedly crashes into the opposing team's robot or a robot intentionally crashes into the opposing team's robot and knocks it a far distance, affecting its normal movement, the referee will consider it severe and violent collision and issue a Level 4 Warning. The actual situation is determined by the Head Referee and Chief Referee.

Note: As for the penalty of colliding with a defeated robot (not including slowly pushing away a defeated robot because it blocks the road), the Referee will issue a Level 1-4 Warning on the violating robot or the team according to the above penalty criteria.

Getting Stuck:

A robot must not get stuck together with any other robot due to active interference, blocking or collision. If any part of a robot gets stuck together with any part of the opposing team's robot due to

interference, blocking or collisions for T second(s), affecting the normal movement of the opposing robot, the Referee will issue a Level X Warning.

T	X
T < 10	1
10 < T < 30	2
30 < T < 60	3
T > 60	4

If any part of a robot gets stuck together with any part of the opposing team's robot due to interference, blocking or collisions for a long period (longer than 60s), affecting the normal movement of the robot, and causing severe damage to the structure of the robot, or if an ejected robot remains stucking together with any part of the opposing team's robot, affecting the normal movement of the robot, the Referee will issue a Level 5 Warning. The actual situation is determined by the Head Referee and Chief Referee.

Note:

1. When two robots get stuck together during a match, the Referee will notify the two Operators to take appropriate actions to detach the robots. The two operators must cooperate with the Referee's instructions and perform the requested operations.
2. If a robot gets stuck to a defeated robot, the Referee will issue a Level 1 to Level 4 Warning according to the above penalty criteria.

5.5.4.3 Transformation and Interaction

1. Robots are prohibited from intentionally separating into sub-robots or sub-systems that are connected with flexible cable. Robots cannot intentionally cast off or launch their own parts.

Violations and Penalties:

A robot that separates into sub-robots or sub-systems or intentionally casts off its own parts will receive a Level 4 Warning.

2. A robot cannot cover its armor module by transforming or getting stuck together to its own side's robot for long periods in order to avoid attacks from the opposing team's robots. The only exception to this rule is when robots are collecting projectiles or rescuing a defeated robot.

Violations and Penalties:

According to the blocking duration and the purpose of getting stuck together, a robot that violates this rule will receive one of the following penalties: Level 1 Warning for 3 seconds or less; Level 2 Warning for 3-10 seconds; Level 3 Warning for more than 10 seconds. The actual situation is determined by the Head Referee and Chief Referee.

3. A robot may block at most four armor modules with each other when it is rescuing its own side's robot.

Violations and Penalties:

During the process of rescuing, if the rescuing and rescued robot are stuck together, if they block more than four armor modules, they will receive one of the following penalties according to the duration: Level 1 Warning for 3 seconds or less; Level 2 Warning for 3-10 seconds; Level 3 Warning for more than 10 seconds. The actual situation is determined by the Head Referee and Chief Referee.

4. Robots are prohibited from using sticky materials like 3M tape on its Projectile Grabbing Mechanism for projectiles.

Violations and Penalties:

1) A robot equipped with sticky materials 3M tape cannot pass the pre-match inspection.

2) A robot that has passed the pre-match inspectin but uses sticky materials to pick up and drop projectiles during the match will be considered cheating. All rounds in which the violating robot participated will be punished as lose.

5. None of the robot's moving mechanisms may cause damage to the core Battlefield Components (Base, Power Runes, Assistive Column, Sentry Rail, and Projectile Depot) on the Battlefield.

Violations and Penalties:

Once a robot causes damage to the Battlefield Components, the Referee shall confirm the damage and end the match, assessing a loss for the violating team.

5.5.4.4 Rescue and Revival

1. After a robot is defeated (excluding robots ejected by the referee system server), its own side's robot can rescue it to the team's Restoration Zone. It will automatically revive after completing the revival process. (please refer to 3.3.4 HP Recovery and Revival)
   During the rescue and revival process, the opposing team's robots may launch projectiles at the rescuing robots, but they cannot block or crash into these robots.

Violations and Penalties:

Rule	Penalty Criterion
1	If any part of a robot interrupts, blocks or crashes into robots involved in a rescue or revival process, briefly affecting the process, the Referee will issue a Level 2 Warning.
2	If any part of a robot intentionally and rapidly crashes into robots involved in a rescue or revival process, affecting the process, or interferes with the opposing team's robot for a long period (within 10s), the Referee will issue a Level 3 Warning.

3	If any part of a robot intentionally and rapidly crashes into robots involved in a rescue or revival process, briefly affecting the process, or interferes with the opposing team's robot for a long period (more than 10s), the Referee will issue a Level 4 Warning. The actual situation is determined by the Head Referee and Chief Referee.
4	If any part of a robot intentionally blocks the way or repeatedly and severely crashes into robots involved in a rescue or revival process, affecting the process and causing physical damage that the resucing robots cannot operate, the Referee will issue a Level 5 Warning and the violating team will be punished as lose for the round. The actual situation is determined by the Head Referee and Chief Referee.

2. The rescuing robot cannot grab any Referee System module of the rescued robot.

Violations and Penalties:

Robots which do not meet the installation requirements of the Referee System will fail the pre-match inspection.

5.5.4.5 Exception Handling

1. If a robot breaks down after the pre-match inspection, it will be deemed as incidental damage and the competition continues. If a robot has been damaged in the first round of the match and there are safety risks like short circuit, it needs to be powered off immediately and leaves the Competition Area to avoid affecting the normal progress of the competition. The actual situation is determined by the Head Referee.
2. When severe safety risks and exception of robots arise on the Battlefield (battery explosion, Aerial flying towards the Audience Area due to broken Aerial Safety Rope, stadium power outage, explosion of a compressed gas cylinder, or interpersonnel conflict), the Head Referee will notify both teams through the Operator Room Referees after discovering and confirming the emergency, and slay all robots through the Referee System. The result of the round will be invalid. When safety risks or exception is eliminated, the round will restart.
3. If the general Battlefield Components are damaged during a match (damage to the ground rubber, gound lighting, or Base armor lighting), the match will proceed normally. If there is structural damage or malfunction of key Battlefield Components (Base cannot normally open shield, Base armor module shifts, drops or cannot detect hit damage, Power Rune cannot be triggered by normal hit, Aerial safety rope breaks or is worn out), the Head Referee will notify both teams through the Operator Room Referees after discovering and confirming the emergency, and slay all robots through the Referee System. The result of the round will be invalid. The field technicians will enter the Battlefield to repair, and once the Components

function normally, there will be a rematch.

4. If the Official Projectile Supplier goes wrong, the Head Referee will evaluate whether this affects the fairness of the match. If it does, the Head Referee will announce to the Pit Crew of both teams that the Referee System will slay all robots. The current round ends immediately, the result of the round will be invalid and there will be a rematch.
5. If some Battlefield Components have logistic problem that is not caused by participants in the process of the match (hit Power Rune but HP gain is not triggered), the Head Referee will manually solve the problem through the Referee System. This process may cause delays, and the RMOC will not be held responsible for the impact of these delays. If the problem cannot be solved manually is confirmed cannot be eliminated, the Head Referee will announce to the Pit Crew on both teams that the Referee System will slay all robots. The round ends immediately, the result will be invaild and there will be a rematch.
6. During a match, if there is structural damage or malfunction of key Battlefield Components that affects the fairness of the match and the Head Referee did not confirm and end the game in time, leading to the situation that a game that should have ended continues to proceed and has victory, the result of the round is deemed invalid once confirmed by the Chief Referee, and there will be a rematch.
7. If there is a serious violation that obviously deserves a Level 5 Warning but the Head Referee did not confirm and execute in time, the result of the game will be invalid and a Level 5 Warning will be appended to the violating team once confirmed by the Chief Referee or through investigation after the match,.

5.5.5 Severe Violation and Cheating

To ensure fairness and proper regulation of the competition, any cheating or severe violation by an individual or a team will lead to the disqualification from the competition. The team will be prohibited from participating in the RM2019 Season and receiving any awards. The results of any match participated in by this team are documented for their opponents' reference.

The following actions are considered cheating:

Rule	Cheating
1	Change or damage the Referee System, conceal power consumption measurements through technical tricks, and/or damage measuring system
2	A robot's behavior is different from that exhibited during the pre-match inspection, such as change in size and the installation of the Referee System
3	Operator is not team member and robot is not made by the team

4	Manually operate a robot that is required to be fully automated
5	Use unofficial projectiles
6	Other behavior that violates the game spirit or is determined to be cheating by the Chief Referee

The following actions are considered a severe violation of rules:

Rule	Severe Violation
1	Violate rules mentioned in this document but refuse to accept penalties (ejected Pit Crew do not leave the Competition Area, intervene with the Referee, etc.)
2	Refuse to leave the Competition Area immediately after the match ends, affecting the match process.
3	Install explosives or other prohibited materials on robots
4	Team members use robots to crash into or attack people, creating safety risks.
5	Team members purposely damage the opponent's robots, Battlefield Components and other related equipment.
6	Team members engage in a physical confrontation with the Referee, their opponents, or the audience.
7	Team members do not cooperate when the RMOC is hearing an appeal.
8	Other severe actions that go against the guidelines and spirits of the competition, and the penalties will be determined by the Head Referee and Chief Referee.
9	Violation of local laws and regulations inside the Competition Area, Audience Area, or accommodation. In addition to being disqualified from the competition, the RMOC will fully cooperate with the relevant authorities to pursue appropriate legal action against the offender.

5.6 Post-Match Procedure

Members from both teams must power off all their robots and remove them from the Competition Area when the match is over. Teams are required to empty all projectiles from the robots in the designated area and then return to the Preparation Area.

Violations and Penalties:

Once the match is over, if a robot has not emptied its projectiles, the robot will be detained in the Projectile Unloading Area.

5.6.1 Results Confirmation

During each match, the Head Referee assistant records the results, penalties, and the remaining HP of the team's robots and Base for each round on a Match Results Confirmation Form. The Technical Timeout usage will be recorded in the Technical Timeout Form. Team Captain must go to the Referee Area to confirm the results at the end of a match and Technical Timeout usage. The Referee will not accept appeal requests between the rounds of an individual match.

Both teams must confirm the match results by signing the Match Results Confirmation Form in the Referee Area within **five minutes after the match ends**. If a team Captain does not turn up at the Referee Area to sign the Form or request an appeal, it is deemed that their team agrees with the match results written on the Form.

Once the team Captain has signed the Form, all rights to an appeal are forfeited.

5.6.2 Appeal

Every team has the right to appeal during each Regional Competition, Wild Card Competition, International Regional Competition, and the Final Tournament. However, appeals cannot be accumulated across competitions. If an appeal is successful, the appeal right reserves; otherwise, one appeal right is consumed. When all rights are exhausted, the RMOC will not accept any appeal from the team. When processing an appeal, an Arbitration Commission, which is made up of Chief Referee and heads of the RMOC, will be formed. **The Arbitration Commission makes the final decision on all appeals**.

If the result of an appeal is "Result Determined by a Rematch", both teams can appeal again after the rematch. In this scenario, if the previous team that made the initial appeal wants to appeal again (known as a "continued appeal"), this will consume the team's appeal right regardless of the appeal results. Due to potential delays to the competition schedule, this "continued appeal" must be initiated by both the Captain and Supervisor within five minutes after the match ends (both sign on the Appeal Form at the same time). The appeal process for a "continued appeal" is also simplified. The time for the submission of evidence and materials being shortened to within 30 minutes of the appeal. The RMOC will announce the result of the appeal in the Appeal Form within one hour of the continued appeal.

5.6.2.1 Appeal Process

1. Within five minutes after the match ends, the Captain submits an appeal to the Chief Referee in the Referee Area and signs an Appeal Form. After five minutes of the end, any appeal will be deemed invalid. No appeal can be initiated before or during the match.
2. The Chief Referee checks whether the appeal can be processed.
3. After the Chief Referee has accepted the appeal, Event Staff will invite Captain from both teams to meet in the Arbitration Room. If the team that made the appeal requests a robot inspection, the Arbitration Commission will transfer all robots from both teams to the Arbitration Room for immediate inspection. Each team can only send three members to the Arbitration Room, and one must be either the Captain, OPM, key member or Supervisor.
4. Members of both teams can collect evidence and materials to submit to the Arbitration Commission.
5. The Arbitration Commission will conduct further communication with both teams inside the Arbitration Room after evidence and materials have been submitted.

6. The Arbitration Commission makes a final decision. Both Captains sign the Appeal Form to confirm the decision. Once signed, both teams can no longer question the appeal result.

5.6.2.2 Appeal Validity

1. Appeal Request: Appeals must be made within five minutes after the end of each match and recorded on the Appeal Form. The Arbitration Commission will not accept any appeal requests that exceeds the validity period.
2. Attendance to the Arbitration Room: Both teams must arrive at the Arbitration Room within 30 minutes after receiving a notification from the Arbitration Commission. An absent team is deemed to give up their right to an appeal and must accept any decision made by the Arbitration Commission. If more than three members of a team enter the Arbitration Room or the identity of attendees do not meet the requirements, the team is also considered to give up their right to an appeal.
3. Submission of Evidence and Materials: A team must submit evidence and materials within 60 minutes after requesting an appeal, and the Arbitration Commission will not accept any new materials beyond this 60-minute limit.

5.6.2.3 Appeal Material

1. Types: The Arbitration Commission only accepts materials stored on a USB drive or on a competing robot.
2. USB Drive: The team must prepare video extracts and other document files as materials for their appeal. The RMOC will not assist in the collection of videos to maintain neutrality throughout the process.
3. Format: Each video cannot exceed 1 minute in length be over 500 MB in size. The name of the video must indicate the specific round of the match and the time it was taken. Videos should be compatible with the latest version of Windows Media Player, photos must be in JPG format, and text documents must be in Word format and not exceed 1,000 words in length.
4. Name: The name of each video and photo must not exceed 30 characters.
5. Text: Each text document can only refer to one video or photo and must clearly state the name of the video or photo being referred to. The text document only needs to reflect the specific rules violation in support of the photo/video/robot(s).
6. Evidence of Robot: The Arbitration Commission has the authority to isolate any relevant robot

from both teams after an appeal has been made. These robots will not be isolated for more than three hours and will be returned to teams when the appeal is adjudicated.

5.6.2.4 Appealing Decision

The Arbitration Commission will release their final decision in the Appeal Form within three hours of the appeal being made. This decision has one of three possible outcomes: Original Result Upheld, Original Result Reversed, or Result Determined by a Rematch.
Neither team may argue against the outcome of an appeal. 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 have a rematch, this appeal is discarded and both teams retain their right to appeal. A team that refuses a rematch is considered to have forfeited the match and lost.

Appendix 1 Safety Instruction

Every team and all its members must fully understand and accept that safety is of paramount importance when competing at the RoboMaster 2019 Robotics Competition. To protect the rights and interests of all those who participate in the competition, as well as the rights and interests of the event organizers, everyone who enters the RoboMaster 2019 Robotics Competition must make the following commitments, uphold and abide by the following safety clauses in accordance with applicable laws and regulations:

1. All team members who register to take part in the RoboMaster 2019 Robotics Competition state that they are fully capable of civil conduct and can independently manufacture and operate robots. Prior to manufacturing robots, all team members will use materials provided by SZ DJI Technology Co., Ltd., carefully read registration rules, competition regulations, and other important documents containing rules and regulations related to the competition.
2. During the competition, all team members will ensure that their actions, including the manufacturing, testing, and use of robots will not cause any injury or damage to their teammates, members of the opposing team, referees, event staff, audience members, equipment or the Competition Area.
3. The team must ensure that the structural design of its robots will not hinder the safety inspections that take place prior to the commencement of the competition and agree to cooperate fully with the pre-inspection carried out by the RoboMaster Organizing Committee.
4. The team guarantees that it will not use any internal combustion engines, explosives, high-pressure air products, or energetic materials.
5. Throughout the R&D, training as well as competition stage of the event, all team members must pay full attention to potential safety issues, and the team's Advisor must be responsible for instructing and supervising the team on safety issues.
6. The team must guarantee the safety of all robots. This includes ensuring the projectile launcher installed on the robots is safe, and that the projectiles will not cause any harm either directly or indirectly to any operator, referee, evebt staff or audience.
7. The team will take sufficient and necessary safety measures during R&D, training, and competition stage of the event regarding any hazardous situations that may occur. This includes but is not limited to: preventing the control system from becoming unstable; anticipating every potential operation prior to carrying out the operation to avoid wrongful operation or a collision between team members or between robots and team members; prohibiting team members from engaging in solo training and making sure that one or more people have been appointed as an emergency responder; wearing goggles and helmets; properly applying the lock function in the robot control system before engaging in debugging or adjustments; and equipping an emergency stop function on all robots.
8. The team will be held responsible for all accidents and losses that occur as a result from robot breaking down, drone losing control and any other unexpected circumstances.

9. The materials bought from or provided by the organizer of this competition (SZ DJI Technology Co., Ltd.) such as batteries and the Referee System must be used in accordance with the information contained in their user manuals. SZ DJI Technology Co., Ltd. will not be held responsible for any injuries that arise from the improper use of these materials. The team will be held responsible for any injuries caused to its own members or any other persons, as well as for damage caused to property arising from the production and operation of its robots.
10. All team members must remain in strict compliance with the laws and regulations of the country or region. All team members must also pledge that their robots will only be used for the RoboMaster competitions and that their robots will not be illegally modified or used for any illicit purpose(s).

Appendix 2 Definition of RoboMaster Terminology

Terms	Definition
Competition Name	
Warm-up Competition	A voluntary competition held in Shenzhen for teams to practice on the actual RoboMaster 2018 Battlefield.
Chinese Regional Competition	The actual number of participants in the Mainland China teams and the regional distribution will determine the city the qualifiers will be held in. The results of the competition will determine the teams that advance to the RoboMaster 2019 Wild Card Competition and Final Tournament.
International Regional Competition	The actual number of participating teams and the regional distribution of the teams from Hong Kong, Macau, Taiwan and Overseas will determine the city the qualifiers will be held in. The results of the competition will determine the teams that advance to the RoboMaster 2019 Final Tournament.
Wild Card Competition	Competition for the last spots in the Final Tournament among teams that performed strongly, but did not qualify during Regional Competitions.
Final Tournament	A week-long tournament for teams that qualified in the Chinese Regional Competitions or Wild Card Competitions or International Regional Competition to determine the final champion of RoboMaster 2019.
Robot Type	
Sentry	Autonomous robots that protect a team's Base.
Hero	The main robot of the competition.
Standard	Required robots with multiple uses throughout the competition.
Aerial	A robot that provides an aerial view of the Battlefield and can fire 17mm projectiles.
Engineer	A robot built to provide assistance throughout the competition. One is required for each team.
Staff Duty	
Supervisor	A professional representative of the university who mentors the team throughout the season.
Advisor	Senior team members or professional engineers who guide the team in strategy, technology, and/or management.
Registered Captain	A student leader of the team to direct all technological and strategic aspects. Also serves as the team's contact person for the RoboMaster Organizing Committee.

Terms	Definition
Organizational Project Manager	Oversees the RoboMaster project by managing project schedules, budgets, and personal safety.
PR Manager	Leads promotion of the robotics team and other competition-related projects.
Team Member	Includes technical group, operations group, and operator group. The technical group is split into electronic (embedded system), algorithm (visual), mechanical, and hardware.
Operator	A team member who controls a robot. Operators are categorized into those that operate ground robots, and those that fly airborne robots. Two operators are required to control airborne robots, an Aerial Gimbal Operator who controls the gimbal-mounted firing mechanism and a Pilot who manages the flight path.
Pit Crew Member	Team members who enter the Staging and Competition Areas
Head Inspector	An inspector who oversees all the pre-match inspections and makes the final decision on whether the team passes the pre-match inspection or not.
Inspector	Assists with the pre-match inspection
Chief Referee	Has the final decision and right of interpretation regarding competition rules. Issues penalties for severe violations of the rules. Has the right to issue additional penalties following an appeal.
Head Referee	The main person responsible for controlling competition procedures and penalties.
Side Referee	Executes competition procedures and penalties from their position around the perimeter of the Battlefield.
Operator Room Referee	Executes competition procedures and penalties from their position in the Operator Room.
Field Technician	Maintains the Battlefield by repairing it and other related elements. In addition, solves technical issues related to the Referee System.
Technical Assessment	
Rules Exam	An exam that tests the understanding of and ability to interpret the content of the RoboMaster 2019 Robotics Competition Rules Manual.
Season Schedule	A Season Schedule that checks the team's realistic scientific abilities to prepare for the competition including its culture, project analysis, team structure, knowledge sharing ability, auditing systems, resource management, and business plan.
Technical Proposal	A Technical Proposal that looks at how the team will design and develop their robots while conforming to the requirements, structural design, programming logic, ergonomics, scientific design, scientific practice improvement, innovation and aesthetic design.
Mid-term Robot	A comprehensive look at whether the team's required robots meet all the

Terms	Definition
Assessment Video	minimum specifications required to show readiness for the competition.
Final Robot Assessment Video	A comprehensive look at whether the team's robots meet all the minimum specifications required to show readiness for the competition.
Referee System Exam	A test based on the RoboMaster 2019 Robotics Competition Referee System Specification Manual to check understanding of the ability to install and use the Referee System.
Participating Team	
Team from Mainland China	A team that is qualified to participate in the competition after passing the registration and technical evaluations within the specified time. The team is typically from Mainland China.
Team from Hong Kong, Macau, Taiwan and Overseas	A team that received an invitation from the RoboMaster Organizing Committee (RMOC) and qualified for the competition by successfully passing the registration and technical evaluations. The team is typically from universities outside of Mainland China.
Chinese and Foreign Joint Team	A team that is qualified to participate in the competition after passing the registration and technical evaluations within the specified time. The team is typically from universities cooperatively-runned by Mainland China and outside of Mainland China.
Technical Specification	
Working Gas Pressure	The air pressure required for the main parts and gas pipes on a robot to work.
Energy Source	Robots can be powered by electricity and air pressure.
Optical Equipment	Robots taking action to reach goals by using different power and different colors at different visible wavelengths during a match.
Visual Feature	Images used to assist robots.
HP	
Initial HP	The HP of each robot set by the Referee System at the beginning of every round.
Current HP	A real-time HP measurement of robots during a match.
Maximum HP	The maximum HP available for each robot.
HP Deduction	1. At the end of each round, the total damage accrued from successfully hitting the armor modules of the opposing team's robot and leading to its deduction of HP. 2. HP deducted from violations and penalties determined by the referee will be counted as the enemy's HP Deduction. (deducted HP of different levels

Terms	Definition
	of warning varies) 3. HP deducted from the Initial Firing Speed exceeds the limit, Barrel Heat exceeds the limit, Chassis Power Consumption exceeds the limit and the Referee System goes offline are not counted as HP Deduction.
Net Base HP	The difference between the remaining HP of the Base of both teams.
HP Gain	Robots that are rewarded with additional HP by triggering core gears on the Battlefield or leveling up.
Referee System	
Video Transmission Module	Captures live video from the camera and displays it on the operator's monitor in the Operator Room.
Speed Monitor Module	Detects the initial speed of the projectile when it is launched by the robot's launching mechanism, and the Referee System deducts the robot's HP when the speed exceeds the limit.
Armor Module	Comprised of armor plates and sensors this module Protects the internal workings of robots and detects projectile impacts to deduct HP accordingly.
RFID Interaction Module	Communicates with RFID-enabled Battlefield Components (such as the Revival/Recovery Zone) to activate predetermined functions.
Positioning System Module	Obtains the location of each robot on the Battlefield.
Main Controller Module	Monitors all referee system modules and sends the real-time status of the robot to the server.
Power Management Module	Controls the propulsion power, detects the power consumption of the chassis, and when the HP is 0, it automatically cuts off power supply for propulsion.
Light Indicator Module	The length of the light bar indicates the level of HP, and the color of the light bar can be used to distinguish between the red/blue sides and the status of the robot.
Functional Area	
Preparation Area	Includes the Inspection Area, Maintenance Area, and a rest area.
Staging Area	Where qualified robots and participants prepare for a match.
Competition Area	The formal tournament area that includes different functional areas, such as the competition field (also known as the Battlefield), referee area, stage, projectile management area, operator room, audience area, unloading area, and arbitration room.
Competition Field (Battlefield)	The main competition site for participating robots. Includes a Starting Zone, Base Zone, Resource Islands, Landing Pads and Restoration Zone.
Inspection Area	Where the participating robots undergo an inspection before competing.

Terms	Definition
Maintenance Area	The only area where the robots can be repaired.
Pit Area	The only area for players and robots to rest outside matches.
Referee Area	Where the Head and Chief Referees implement competition procedures, confirm participants performance, process appeal requests, and carry out other official duties.
Red/Blue Operator Room	A room for robot and Aerial Gimbal Operators to control their robots during the competition.
Pilot Room	An area for pilots to see and control the Aerial robot during the competition.
Red/Blue Pit Area	The only area where non-operating pit crew members may sit and observe matches.
Unloading Area	An area to unload projectiles from all robots after a match finishes.
Arbitration Room	A room for representatives of the RoboMaster Organizing Committee and Chief Referee to deal with appeal requests.
Red/Blue Entrance (Exit)	The pathway for participants to enter and exit the Competition Area.
Battlefield Component	
Starting Zone	The only area where all ground robots have a three-minute setup period. This area includes the Base Zone and Sentry Rail.
Base Zone	Where each team's Base is located.
Base	The area that has core tools with 2000 HP, and is the main factor that determines which team wins.
Sentry Rail	The only area the Sentry robot can access, includes a sliding rail and support frame.
Bridge Top Platform	Located at the top plane of the bridge with Perimeter Wall on both sides to prevent robots from falling off the Bridge Top Platform. Robots occupying the Bridge Top Platform can receive accelerated barrel heat cool-downs and additional defensive capabilities.
Bridge End Platform	Located at one of the exits of the bridges. These are areas where occupying robots can get a double barrel heat cooldown rate.
Bridge	Robots can occupy higher spots on the bridges for attack advantages, including the Bridge Top Platform that has the highest point and the Bridge End Platform. The bridge connects the Base Zone on one side and the Bridge End Platform on the other.
Bunker	The key location in the main Battlefield where the barrel heat cool-down rate and the defensive capabilities of occupying robots will be improved.
Resource Island	The most essential part of the Battlefield that consists of the projectile bank, Power Rune, and Assistive Column. The robot can get different quantities and

Terms	Definition
	different types of projectiles from the different projectile containers by ascending the Resource Island platform.
Assistive Column	Fixed columns located on both sides of the Resource Islands. Robots can use the Assistive Columns to ascend to Resource Island and get projectiles from the a projectile container.
Supplier Penalty Zone	A Supplier zone is the Supplier Penalty Zone for the opposing team. A team entering the opposing team's Supplier Penalty Zone will receive penalties.
Restoration Zone	Each team can use the Regeneration Points to initiate the recovery and revival of any of their robots that have exhausted their HP. Destroyed robots can also be brought here to be revived.
Landing Pad	This is where the aerial robots of each team take off and land.
Open Zone	Located at various points around the Battlefield, these are designed to test the power capabilities of a robot's chassis.
Aerial Safety Rope	The Aerial Safety Rope is fixed to a steel cable and connected through pulleys that limit the Aerial robots flight range. All Aerials must be attached to a Safety rope via a slip ring before each match begins.
Aerial Safety Rope Bracket	The compartment that ensures the correct height and tension of the steel cable.
Judging	
3-Minute Setup Period	This period provides three minutes before a match for teams to enter the Competition Area and test their robots and equipment.
7-Minute Round	A seven-minute period for teams to compete on the Battlefield.
20-Second Referee System Initialization Period	A twenty-second period provided between the setup period and a round for connecting and checking the Referee System.
Pass Card	Indicates that a robot has passed the pre-match inspection. Only robots with a Pass Card can enter the Staging and Competition Areas.
Official Technical Timeout	During the setup period of the first round, technicians can request that the Chief Referee provide a Official Technical Timeout when the Referee System or other equipment in the Operator Rooms malfunction, or functional problems occur with critical equipment in the Battlefield.
Team Technical Timeout	A pause in the competition that teams may request during the setup period to address specific needs. Teams are required to confirm the timeout with signatures before a Technical Timeout is accepted.
Safety Hazard	On-site safety inspectors will handle possible safety hazards and problems

Terms	Definition
	that may occur during the competition.
Robot Projectile Unloading	Robots are required to unload all projectiles during the setup period to ensure that both teams have the same number of projectiles and the competition remains fair.
Rescue	After a robot dies on one team, a teammate can carry the dead robot to the Regeneration Point to resurrect the robot. After a certain amount of time, the dead robot will come back to life with full HP. This is called robot rescue.
Foul	If a team member violates any rule stated in the rulebook, he/she will receive different level penalties from referees.
Level 1 Warning	A light obstruction of the rules occurs. The screen of the operator will be blacked out for three seconds.
Level 2 Warning	During the competition, when a warning is issued for an obvious and direct violation of the rules/regulations, the violating operator's screen will be blacked out for 5 seconds and the screens of all other operators on the violator's team will be blacked out for 5 seconds. The violating robot will lose 2 points and 50% of its Max HP. The Referee System will also automatically deduct 5% Max HP from all of the violating team's remaining robots (except Aerials and Bases), which will count towards the opposing team's damage output.
Level 3 Warning	During the competition, for the team's obvious and more serious violations of the rules and regulations, when the penalty is issued, the screen of the violating operator will be blacked out for 10s and the screens of all other operators of the violating team will be blacked out for 5s. The violating robot will lose 4 points and 50% of its Maximum HP. The Referee System will also automatically deduct 5% Maximum HP from all remaining robots (except Aerials and bases) of the violating team, which will count towards the damage output of the opposing team.
Level 4 Warning	A competing team exhibits serious misconduct, and is applied directly to the offending robot. This penalty sends an eject command to a robot and reduces its HP to 0.
Level 5 Warning	A competing team exhibits very serious misconduct. This penalty results in a team being automatically declared the loser of the current match.
Collision	An occasion during a match when two team's robots collide with each other because of poor control by their operators. Referees will decide the penalty for the culprit of such an occasion based on the actual contact that takes place and the impact the crash has on the match.
Get Stuck Together	An occasion in a match when one team's robot cannot avoid the other team's robot. Referees will decide the penalty for the culprit based on the actual contact that takes place and the impact the crash has on the match.

Terms	Definition
Operator Desertion	If an Aerial operator or a ground robot operator leaves their Operator Room without permission, he or she will be penalized by the referee accordingly.
Lose	A competing team will lose the round if they engage in an extremely serious violation of the rules or other forms of cheating. The referee determines this penalty in accordance with the rules that state it is applicable.
Cheating	Forms of cheating are clearly set out in the rules. Referees will usually punish cheating by declaring the current round to have been lost by the offending team, with more serious forms of cheating leading to disqualification from the competition and its awards.
Appeal	If any of the teams hold different opinions regarding the results of a game, they can request for an appeal from the competition's RoboMaster Organizing Committee within a designated period. The number of appeals available to each team is subject to the stipulations set out in the rules. The team making the appeal must hand in supportive materials to the Appeals Panel, and members from the Appeals Panel as well as the Team Captains from both teams need to gather in the Arbitration Room to discuss the issue and come to a conclusion.
Result Confirmation	Team Captains from both teams must go to the Referee Area to confirm they have no objections to the result of a match by signing off on the results within a designated period after each match.

Appendix 3 Technical Assessment Specification

For the schedule of the RoboMaster 2019 Robotics Competition Technical Assessment, please refer to 1.1 Season Schedule. All teams that compete in the RoboMaster 2019 Robotics Competition must complete a Technical Assessment in accordance with the requirements of the RoboMaster Organizing Committee and within the time specified.

The purpose of the Technical Assessment is to demonstrate the technical skills of a team, better prepare the team for the competition, and help in the future development. During the Technical Assessment, the RMOC encourages teams to be innovative and not stick to a rigid structure. Teams should also ensure that their report is clear and contains sufficient data. The RMOC does not accept Technical Assessment that is overly rigid or contains inaccuracies.

Technical Assessment will be graded according to certain requirements and the grade will be displayed in the registration system. The following shows the relation between scores and grades.

Rating System	
Score	Grade
90 ≤ X ≤ 100	A
75 ≤ X < 90	B
60 ≤ X < 75	C
45 ≤ X < 60	D
30 ≤ X < 45	E
0 ≤ X < 30	F

The details of Technical Assessment are as follows:

1. **Rules Exam**

Exam content: *RoboMaster 2019 Robotics Competition Rules Manual V1.0* and relevant competition rules

Exam Form:

A. 50 multiple-choice questions (generated randomly). Full mark is 100, with 2 marks for each question. The cut-off score is 90.

B. The exam can be done more than one time within the effective time, and the minimum interval between the start time of the first and the second attempt is 40 minutes.

C. The result of the exam is based on the last submission within the effective exam period.

2. Season Schedule

Format: PDF document

Font: Microsoft YaHei (Chinese) or Times New Roman (English) in size 10

File Size: no limit on the length, including diagrams (flowchart, table, etc.)

Filename: College Name + Team Name + "First/Second Season Schedule "

Submission Opportunity: 2 (The score of a second submission will receive a five-point deduction. For example, a second submission that receives a score of 90 will have five points deducted to a final score of 85 points.)

Evaluation Requirement: The Season Schedule includes seven modules. Each of these modules has its own requirements.

The details and requirements for the modules are as follows:

Module	Content	Scoring Criteria	Score
Competition Culture	RM competition details and culture Core team culture	Clarity and accuracy	5
Project Analysis	The structure of each robot, all the other components that need to be finished (deadlines for actions), the capital and human resource requirements for each part.	Content breadth and depth Logical clarity and accuracy Data clarity and accuracy	25
Team Structure	Team's management structure	Reasonable structure	10
	Recruitment direction	Cooperativeness	
	Responsibilities of each role	Clarity of duties	
Knowledge Sharing	Open source forum materials, material manuals, knowledge sharing platform	Quality and quantity of information	20
	procedures, document management software applications	Reasonable usage of open software	
	training and self-learning processes	Reasonable study plan	
Auditing System	Task proposal, allocation, verification, evaluation, progress tracking and results acceptance system	Reasonable processes that are easily executable	15
Resource Management	Evaluation of resources available (budgeting, materials, and manufacturing resources)	Thoroughness of investigation	10
	Arrangement of manpower and schedule	Reasonable Planning	
	Work arrangements that take both schoolwork and competition tasks into consideration	Reasonable resource allocation	
Business Plan	Acquisition of resources and materials needed throughout the season Team sponsorship and promotional plan	Clarity and quality of plan	15

Total:	100

3. Mid-term Robot Assessment Video

Submission Format: Video + BOM Form

Basic Requirement:

A. Complete at least the requirements for Hero or Engineer and submit the BOM Form of the corresponding robot.

B. Complete the requirements for Standard and submit the BOM Form.

Submission Opportunity: 3 (The score of a second submission will receive a five-point deduction; the third a 10-point deduction. For example, the third submission that receives a score of 90 will have ten points deducted to a final score of 80 points.)

Submission method:

A. Upload the video to Youku and set an access password.

B. Fill the BOM Form according to the template.

C. Submit the video URL, access password and BOM Form through the registration system.

Video Standard:

A. A title that includes the college name and date/place of the recording must be displayed at the beginning of the video.

B. It is recommended to record the video in a place with sufficient lighting so as to best display every operation and movement.

C. For clarity, every process must include captions along with clear and accurate explanations.

D. The video must be concise and cannot exceed three minutes. Ensure the video is compact and well put together to save on assessment time.

E. Editing is allowed, but fraudulent operations are forbidden.

F. Videos must have a resolution of 720p or higher.

Evaluation Requirement: Different items have different requirements and scores. Below is the specific requirements of each item.

Item	Display Content	Criteria for Pass
Engineer	a) Complete movement b) Obtain projectiles c) Climb up projectile depot	a) Can move normally b) Can obtain projectils
Hero	a) Complete movement b) Launch projectiles successively (no human assistance) to targets one, three, and five meters away and calculate the hit rates. c) Climb a 15-degree slope and display the power	a) Can move normally b) Can attack c) Not exceed the power limit in the process of display

	consumption data in real time.	
Standard	a) Complete movement b) Launch 50 shoots of projectiles successively (no human assistance) to targets one, three, and five meters away and calculate the hit rates. c) Climb a 15-degree slope and display the power consumption data in real time.	

4. Technical Proposal

Format: PDF document

Font: Microsoft YaHei (Chinese) or Times New Roman (English) in size 10

File Size: Max. 8,000 words including diagram (flowchart, table, etc.)

Content Requirement: Graphs and flowcharts that include adequate data, focus on key points, and demonstrate sound logic.

File Name: College Name + Team Name + "First/Second/Third Technical Proposal"

Submission Opportunity: 3 (The score of a second submission will receive a five-point deduction, and the third submission will receive a ten-point deduction. For example, a third submission that receives a score of 90 will have ten points deducted to a final score of 80 points.)

Evaluation Requirement: The Technical Proposal includes eight modules. Each of these modules has its own requirements, scoring criteria, and score.

The details and requirements for the modules are as follows:

Module	Content	Scoring Criteria	Score
Requirement Confirmation	From the rules and team's ability, determine task priorities and key technologies for winning matches.	Clarity and quality of technical requirements and specifications	10
Structural Design	Assemblies or component Project Proposal attached in the document appendix	Analysis of the quality, requirements, performance, material usage, component selection, and manufacturing method	20
Programming Logic	Show the program logic diagram for one of the robots	Logic accuracy, modularity, requirement fulfillment	10
User-robot interaction	Use case description for one user-robot interaction design solution	Intuitiveness of design Optimization of user-robot interaction Quality	10

Module	Content	Scoring Criteria	Score
		and maintainability of robot layout and wiring	
Scientific Design Method	Use case description of simulations combined with real-world implementations	Demonstration of theory-based design, comparison between simulation and real-world results	15
Theory-based Improvement	Use case description of practical improvement methods being applied to robots	Whether the experimental method is scientific, whether the data analysis is reasonable, whether the cause analysis is correct, whether the improvement method is effective, whether there are homemade debugging software and tools	15
Sensor Selection	Analyze the sensor selection of a car, the purpose of using visual and general sensors	Whether the selected sensor is rational and gereatly improves the operating performance	10
Innovation	Use case description of innovative methods applied to robots	Whether innovations lead to better results	10
Total:			100

Based on a certain functional component, the analysis report can focus on the following aspects:

Item	Content	Scoring Criteria	Score
Requirement Analysis	Mechanism function, performance indexes and analysis under different working conditions. Sensor and actuator selection parameters	Quality of analysis, usage of dynamic simulation	30
Design Drawing	Taking one component as an example and show the engineering diagram (with STEP file)	Complete diagrams that show: 2D and 3D drawings, dimensions, tolerance, fonts, label positions, materials, surface treatment, etc.	20
Material and Manufacturing Process	Lists the materials selection, manufacturing techniques/cost, and plan to reduce costs for different batches	Selection of materials and accessories, labor cost calculations, rationale of manufacturing processes and costs, costs reduction plan	20
Finite Element Analysis	An FEM report for a certain component that includes: loading	Meshing and optimization method Topological optimization	30

	condition, meshing, Results Analysis, Optimization	registration	
Total:			100

5. Final Robot Assessment Video

Submission Format: Video

Basic Requirement: Hero and Standard are required and other robots are optional.

Submission Method: Upload the video to Youku, set an access password, and submit the video URL and password to the registration system.

The video standard and submission opportunity are the same with the Mid-term Robot Assessment Video.

Assessment Requirement: Different items hace different requirements and scores. The following are the specific requirements for each item:

Item	Display Content	Criteria for pass
Hero	a) Launch projectiles successively (no human assistance) to targets one, three, and five meters away and calculate the hit rates. b) Climb a 15-degree slope and display the power consumption data in real time. c) A place reserved to install the Referee System.	a) Can attack b) The power consumption should not exceed the limit during display c) Equipped with a protective case, presentable appearance and no bare wires d) The referee system installation positions meet the requirements
Standard	a) Complete movement b) Launch 50 shoots of projectiles successively to targets one, three, and five meters away and calculate the hit rates c) Climb a 15-degree slope and display the power consumption data in real time d) A place reserved to install the Referee System	
Engineer	a) Complete movement b) Obtain projectiles c) A place reserved to install the Referee System	a) Can obtain projectile b) The referee system installation positions meet the requirements
Sentry	a) Move along the Rail b) The Launching Mechanism continuously fire 50 shoots of projectiles at the target and calculate the hit rate.	a) Can move along the rail freely b) Can attack
Aerial	a) Display the flying ability of the Aerial	a) Can fly

	b) Successively fire 50 shoots of projectiles after taking off and calculate the hit rate.	b) Can attack
Full lineup display	Clearly display the complete form of all robots and group photos of all team members	All robots of the team should be consistent in style, presentable in appearance and with no bare wires

6. Referee System Examination

Exam content: Multiple-choice questions randomly selected from the RoboMaster database.

Exam form:

A. Full mark is 100. The cut-off score is 90.

B. The exam can be done more than one time within the effective time, and the minimum interval between the start time of the first and the second attempt is 20 minutes.

C. The result of the exam is based on the last submission within the effective exam period.

7. Season Summary

Format: PDF document

Font: Microsoft YaHei (Chinese) or Times New Roman (English) in size 10

File Size: Max. 8,000 words

Content Requirement: Graphs and flowcharts that include adequate data, focus on key points, and demonstrate sound logic.

Evaluation Requirement: The Season Summary includes four modules. Each of these modules has its own requirements, scoring criteria, and score.

The details and requirements for the modules are as follows:

Module	Content	Scoring Criteria	Score
Academic Innovation	All competition-related patents, academic articles, and open-source documents	The quality and quantity of patents, articles and open-source documents	30
Competition Analysis	Analyzes problems that arise in each match and then finds a cause and solution	Comprehensiveness of analysis Adequacy of data Helpfulness of the summary	10
Team Development	Summary of the problems and challenges encountered throughout the season, plans to improve and develop the team		25
Project Manager	Causes, data, and results of each improvement and iteration		35
Total:			100

Product	Standard	Hero	Engineer	Sentry	Aerial	Discount
Dev Board Type A	1	1	1	1	1	40% off
Dev Board Cables Package	1	1	1	1	1	

M3508 P19 Brushless DC Gear Motor	4	4	4	2	-	
C620 Brushless Motor ESC	4	4	4	2	-	
M3508 Accessories Package	1	1	1	1	-	
M2006 P36 Brushless DC Gear Motor	1	1	1	1	1	
C610 Brushless Motor ESC	1	1	1	1	1	
TB47D Battery	1	2	2	1	8	
6020 Gimbal Motor	2	2	-	2	2	
N3 Flight Control	-	-	-	-	1	
Guidance Package	-	-	-	-	1	

Table 8-1 RM Online Product Education Discount

Appendix 4 Pre-match Inspection Form

Category	Inspection Item	Description
Robot Size & Mass	Initial Size(length * width * height)	Standard: 600 * 600 * 500 mm Sentry: 500 * 500 * 600 mm (excluding the Light Indicator Module, Positioning System Module, and Positioning System Module Bracket) Hero: 800 * 800 * 800 mm Aerial: 1200 * 1200 * 800 mm Engineer: 800 * 800 * 800 mm
	Expansion Size (length * width * height)	Standard: 700 * 700 * 600 mm Sentry: 500 * 500 * 500 mm (Distance from the lowest point of the robot to the upper surface of Sentry Rail MUST not exceed 450mm) Hero: 1200 * 1200 * 1200 mm Aerial: 1200 * 1200 * 800 mm (height) Engineer: 1200 * 1200 * 1200 mm
	Mass	Standard: 20 kg (excluding) 3.4kg of the Referee System) Sentry: 10 kg (subtract the 2.5 kg of the Referee System) Hero: 35 kg (subtract the 4.6 kg of the Referee System) Aerial: 10 kg (subtract the 0.6 kg of the Referee System) Engineer: 35 kg (subtract the 3.7 kg of the Referee System) Note: The weight of the referee system will be updated later. (The mass of referee system is subject to change.)
Robot Module	Referee System Completeness	The Referee System modules should be complete (intact) and unmodified.
	Aerial Safety Module	1. The Vertical Safety Rod of Aerial should be 300 mm higher than the top of the propeller and rigidly coupled to the robot body. The wire loop attached to the rod is used as a pull ring; 2. The Vertical Safety Rod and the pull ring should be capable of withstanding the robot's static (weight/inertia) without significant deformation or damage; 3. Full propeller guard that does not leave the propellers exposed and has a certain level of durability (durability measurement method to be determined);

Category	Inspection Item	Description
		4. The propeller blades should not collide with the surface of a cylinder of any diameter when flying horizontally at a cylinder; 5. The lighting effects (e.g. brightness, flashing frequency) of the signal indicators must not interfere with the competition process. There should be no more than 6 indicator lights on the entire Aerial Robot.
	Armor Module	1. Only official mounts are allowed. They MUST not be modified or damaged; 2. The imaginary connection lines between the X-axis armor plates and Y-axis armor plates respectively should be perpendicular to each other and intersect the geometric center of a robot. X-axis and Y-axis armor modules allow a ±50mm deviation from the geometric center; 3. The weight-bearing surface and the armor plate mount must be firmly and rigidly connected, and the two screws of each mount must be installed; 4. The area within 145° of the of the armor plate must not be covered and HP can be deducted normally; 5. The top armor mount coupled with the front armor mount, and the impact surface top armor is angled at 15° to the horizontal plane. Any obstruction to the orthographic projection area of the top armor impact surface MUST not exceed 110mm x 63mm for Standard Robots and 120mm x 74mm for Heroes; The height of the lower edge of the armor before and after transformation must fall within 60-150 mm for Standard Robots, 50-400mm for Engineers, and 60-200mm; 7. For Hero and Engineer, the height difference between the lower edge of any two armor modules MUST not exceed 100mm; 8. The projected vectors of the normal vectors of the armor module's stress-bearing surface on the XY plane must be equal to the positive/negative X axis and Y axis in the body coordinate system, respectively; 9. For Sentry, the maximum height below the upper surface of the rail shall not exceed 450mm (including the entire light indicator module and the maximum extension size); the upper edge of the armor shall be within ±100mm from the upper surface of the track, and the impact surface and the the horizontal plane shall be at a 75° angle;

Category	Inspection Item	Description
		10. The robot armor sticker must be consistent with the robot number with no obvious bubbles. Only one sticker can be attached to one piece of armor;
	Robot Firmware Update	Robot modules should be updated to their latest versions.
	Power Inspection	1. The power curve should be normal; 2. A chassis should stop moving after its power is cut off;
	Main Controller Module	1. For the main control module screen, there can be no obstruction within 50mm above the button, making it convenient for operation; 2. There should be no electromagnetic device that may interfere with the main control module within 100 mm of the "Robomaster" logo located on the module. 3. The infrared receiver should not be blocked for the sake of convenience during manual connection to the server before each match. 4. Ensure that the upgrade interface is accessible for wire plug-ins;
	Power Management Module	1. the indicators MUST not blocked; 2. The power module should have good heat dissipation;
	Light Indicator Module	1. the front main light bar and the top auxiliary light bar should be fully visible from at least one viewing angle; 2. Connection wires of the left and right auxiliary light bars are parallel to the ground; 3. The main light bar of Standard Robots must be above the upper edge of the armor module;
	RFID Interaction Module	When the card is swiped, the RF card on the ground can be detected normally;
	Speed Monitor Module	1. The projectile speed and rate of fire should be displayed (each robot must be capable of shooting using a remote control for the convenience of inspection); 2. Only Hero can be equipped with one 17 mm Launching Mechanism and one 42 mm Launching Mechanism; 3. The area covered by any obstruction on the lightbar on each side of the speed measurement module must not exceed 1/5 of the original area of the light bar. 4. There MUST any large magnetic material or inducible magnetic material (e.g. iron barrel, motors, magnets) within 70 mm of the "RoboMaster" logo on the speed measurement module.

Category	Inspection Item	Description
		5. Re-calibration should be completed every time it leaves the Inspection Area;
	Positioning System Module	1. The Positioning System Module should be installed horizontally with its top surface facing up, the front surface should be parallel with the frontal plane of the robot; 2. The imaginary line connecting the Positioning System Module and a base station should not be blocked during movement; 3. Except for the bottom face, there should be at least 10 cm of clearance on each of the other five surfaces; 4. The LINK indicator should flash green, and the SYS indicator should flash red;
	Video Transmission Module	A robot should transmit pictures back normally.
Energy Source		1. The gas cylinder must have a certificate of competency and a certificate of conformity which is consistent with the nameplate of the cylinder itself. The nameplate of the cylinder should be visible at the time of inspection, and the certificate should be easily viewable. 2. The air pressure must not exceed Mps20Mpa (SI Unit, which is commonly used for the air pressure units mentioned below. Other air pressure units must be converted to ensure that the air pressure value meets the requirements.) The cylinder used should have a nominal pressure greater than or equal to 30 MPa, and a double gauge constant pressure valve is placed at the outlet of the cylinder. 3. Working gas: Working gas must be non-flammable and non-toxic: such as air, nitrogen, or carbon dioxide. 4. Cylinder certification: Cylinders must be designed and manufactured for the pressure conditions used, and certified by the officially recognized testing organization of its country of origin, and the certificate shall be displayed and easily visible. 5. The pressure regulator must be directly installed on the container’ s main outlet valve. 6. The compressed gas container must be adequately protected from rollovers, impacts, and stress resulting from mechanical faults. The container opening shall not be exposed to prevent damage caused by projectiles. 7. All pneumatic tubes, valves, and compressed gas containers

Category	Inspection Item	Description
		must be concealed and installed in the interior of the robot. No part of the pneumatic system should come into contact with the ground at any time; 8. Cylinder installation: The cylinder must be safely mounted on the vehicle frame. To ensure safety, the container must be either horizontal or vertical. There must be at least two fixed points, and at least 1/5 the container's length must be fixed to the frame; 9. Thermal Insulation: The cylinder must be insulated from any possible heat sources by a barrier layer, such as a carbon fiber board or aluminum plate 10. Gas Pipes and Fittings: Gas pipes and fittings must be capable of handling the maximum possible working pressure of the system.
Others		1. A DJI-supplied battery cell or a No. 1, No. 5 and No. 7 dry battery produced by a reputable manufacturer should be used; the total battery capacity of each robot should not exceed 600Wh; 2. The supply voltage should not be higher than 30V and there should be no risk of short circuiting; 3. Each operator should have no more than 1 remote control, and must be supplied by DJI; 4. Every barrel can have at most one red laser sight, the power of the laser sight must be less than 35mW, and the projection angle of the laser sight must be no more than 5 degrees (i.e., a laser sight emitting a laser beam at a perpendicular angle onto a vertical wall 1 m away will cast a laser spot less than 9 cm in diameter on the wall) 5. A ground unit should not be retrofitted with unofficial lighting effects; 6. A robot should not possess any devices that may damage the battlefield; 7. A robot should not possess any mechanisms that allow it to couple with other robots; 8. The robot should not be decorated in red or blue or large areas of reflective materials. 9. The Engineer is beautifully painted in vibrant colors; 10. Do not project light onto the armor; do not install devices that interfere with the visual feature recognition of armor modules by reflecting or refracting the light on both sides of the armor.

Appendix 5 Reference Drawing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