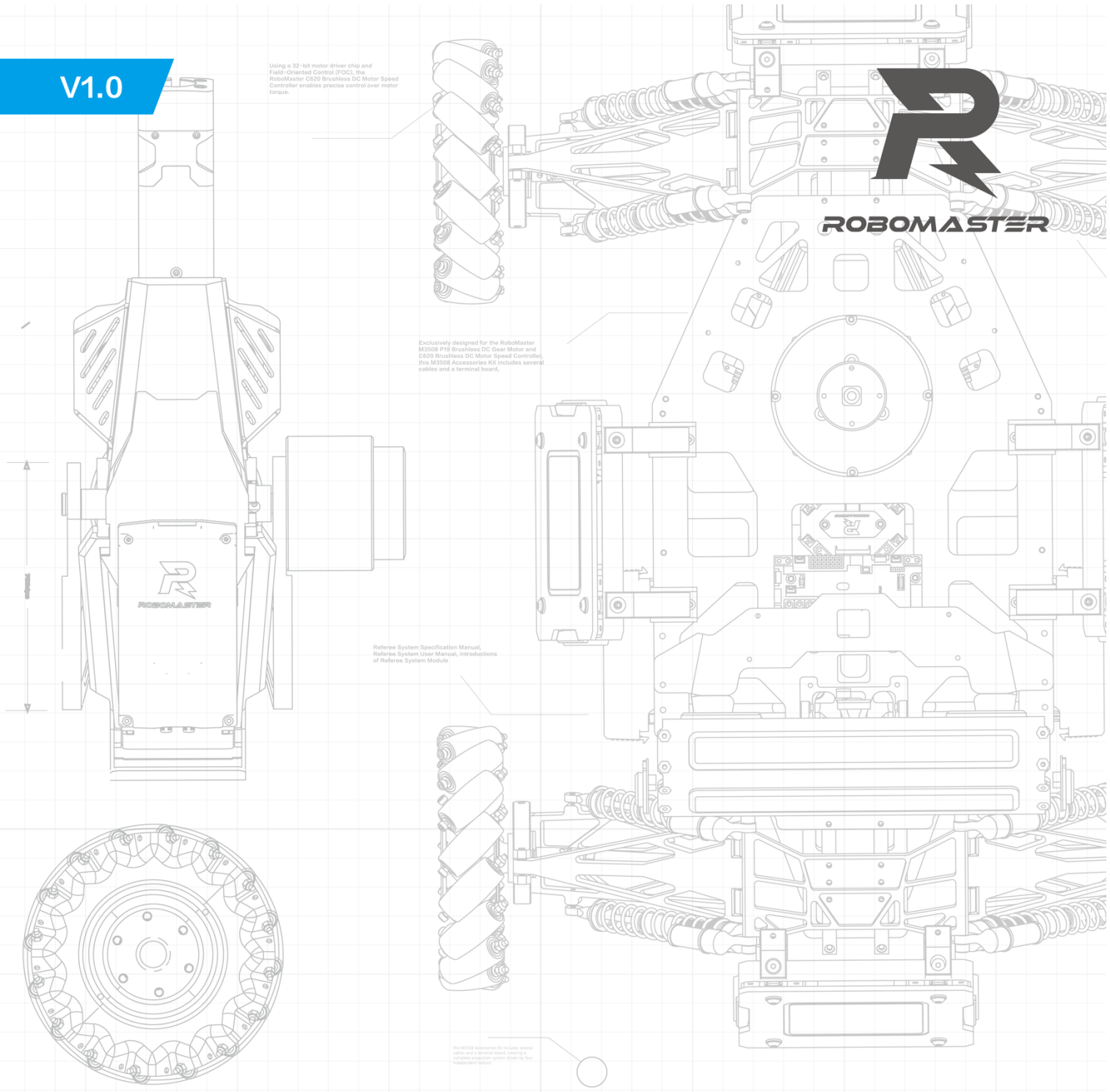
V1.0




# ROBOMASTER 2019
## ROBOTICS COMPETITION

# RULES MANUAL

The *RoboMaster* Organizing Committee

September 20th, 2018

# Change Log

| Date | Version | Change Record |
| --- | --- | --- |
| **9/20/2018** | 1.0 | Release |

**The RoboMaster Organizing Committee reserves the right to revise and finalize the rules manual**

# Contents

# Group Organization

## Sponsors:

DJI (Shenzhen) Technology Co., Ltd.

## Undertaking Organization:

RoboMaster Organizing Committee

# Competition Background

Robotics is currently one of the most cutting-edge technologies in the world. After developing for more than 50 years, the robot industry comes inte a new era. In the coming three to five years, there will be a massive upsurge in the global robotic industry, and China will become one of the major world markets. With this in mind, the RoboMaster Robotics Competition was created to keep up with the development and hone the skills required by today's modern robotics industry.

The RoboMaster Robotics Competition encourages innovation in robotics automation and intelligent technology while placing robot battles in its core. Also, RoboMaster Robotics Competition displays the beauty of engineering technology and populize robotic knowledge around society by balancing technical challenge and watching value.

Previousily, the participating robots were designed and operated by teams of young engineers, mostly university students. The competition not only puts heavy emphasis on engineering skills and teamwork, but also plays an important role in cultivating the innovativeness, technical capabilities, and communication skills of young engineers and scientists.

All RoboMaster 2019 Robotics Competition entrants 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 Manua Specification Manual l" (all documents are subject to the latest version officially released by the 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.

# Objectives

## Influence of the Robotics Industry Expansion

The competition draws attention to the robotics industry through its intense battles, strict scientific standards, and innovative event schedules.

## Promoting the Development of Practical Teaching

By participating in the competition, colleges and universities promote the development of practical teaching with cutting-edge technology, and cultivate relevant teachers. Their participation also helps establish a teaching practice center and an open smart technology laboratory. Through experiments and tests in robotics competitions, scientific theory and practice are more closely integrated. During the process, a group of outstanding scientific and technological engineers are trained to promote the transformation of scientific and technological achievements.

## Promoting Popular Participation

During the event's initial stages, various robotic activities will be held combined with local characters of the host venue. There will also be close cooperation with related enterprises to integrate resources and create an interactive experience for members of the public and highlight cutting-edge scientific and technological achievements.

## Summarizing Academic Achievements

In addition to the competing process itself, this event also focuses on bringing together academic and technological achievements within the robotics field through events. " The RoboMaster 2019 Young Engineer Summit " fully explains it. This conference serves as a platform for teams to share their new achievements in robotics research and development, and promote in-depth exchanges of research and ideas.

# Chapter 1: Introduction

The core of RoboMaster 2019 Robotics Competition is a shootout between robots using semi-automatic projectile launchers. To participate the competition, teams must design and develop multiple robots that meet the requirements of the rules. These robots can be either remotely operated or fully-automated. They must be able to independently collect projectiles placed in the competition area and use them to attack the opposing team's robots and base zone to win matches. Compared with the 2018 season, Official Projectile Suppliers are used instead of designed by teams; the capacity of projectiles, the Launch speed, and the Launch frequency of Aerials are no longer restricted, which increase their strategic advantage; Heroes have new roles. It can no longer climb to the resource islands and obtain the Projectile Containers; Engineers are responsible for rescuing and obtaining Projectile Containers; the mission of Standard Robots is also adjusted. In terms of the battlefield, the Official Projectile Supplier and base are the core props officially provided; the number of resource islands are reduced to 1; Power Runes are redesigned; the road conditions in the Open Zone are more complicated.

## 1.1 Season Schedule

Complete the registration information accurately on the RoboMaster official website registration system (https://www.robomaster.com/en-US/user/login) and complete the preparation requirements for each stage before the deadline. Teams will be admitted and allowed to start their research and development for the competition after passing the Rules Exam successfully. Teams that pass the series of technical Assessment and complete the Referee System Exam can qualify for the Regional Competitions. You will be eligible for the Final Tournament if you achieve outstanding results in the Chinese Regional Competition, International Regional Competition, or Wild Card Competition.

**Reminders**

It is recommended that each team drafts a 2019 Season Schedule to evaluate their personnel and funding requirements. Teams are also advised to stick to a budget when making their robots to avoid wasting funds 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 announcements by the organizing committee.

| Schedule | Item | Location | Eligible Competitions/ Location | Content |
|---|---|---|---|---|
| **September 20 - October 31, 2018 (UTC+8)** | Registration on Official Website | Online | Required for Teams from Mainland China | Log in the RoboMaster website and complete the registration as required. |
| **September 20th - November 16th, 2018 (UTC+8)** | Registration on Official Website | Online | Required for teams from Hong Kong, Macau, Taiwan and Overseas | |
| **October 22, 2018, 10:00-22:00 (UTC+8)** | The first batch of Rule Exam (Chinese) | Online | Required for Teams from Mainland China | Teams that pass the Rule Exam can get the Organizing Committee's Competition Education Product Discount Coupons and qualify to submit the Season Schedule. |
| **November 20, 2018, 10:00-22:00 (UTC+8)** | The second batch of Rule Exam (Chinese and English) | Online | Required for teams from Hong Kong, Macau, Taiwan and Overseas | |
| **October 22, 2018 - November 30, 2018 (UTC+8)** | Season Schedule | Online | Optional for all the teams | Approved teams can obtain the Organizing Committee's Competition Education Product Discount Coupons |
| **October 22 - December 25, 2018 (UTC+8)** | Technical Proposal | Online | Required for Teams from Mainland China | Approved teams can obtain the Organizing Committee's Competition Education Product Discount Coupons and qualify to submit a Mid-term Robot Assessment Video. |
| **October 22, 2018 - January 23, 2019 (UTC+8)** | | Online | Required for teams from Hong Kong, Macau, Taiwan and Overseas | |
| **December 25, 2018 - January 23, 2019 (UTC+8)** | Mid-term Robot Assessment Video | Online | Required for Teams from Mainland China | Approved teams can obtain the Organizing Committee's Competition Education Product Discount |
| **January 23, 2019 -** | | Online | Required for | |

| Schedule | Item | Location | Eligible Competitions/ Location | Content |
|---|---|---|---|---|
| **March 1, 2019 (UTC+8)** | | | teams from Hong Kong, Macau, Taiwan and Overseas | Coupons and qualify to submit a Final Robot Assessment Video. |
| **January 23, 2019 - April 1, 2019 (UTC+8)** | Final Robot Assessment Video | Online | Required for Teams from Mainland China | Qualify for the Referee System Exam |
| **March 1, 2019 - June 3, 2019 (UTC+8)** | | Online | Required for teams from Hong Kong, Macau, Taiwan and Overseas | |
| **January 23, 2019 - April 2, 2019 (UTC+8)** | Referee System Exam (Chinese) | Online | Required for Teams from Mainland China | Referee System issuance and Regional Competition qualification |
| **March 1, 2019 - June 4, 2019 (UTC+8)** | Referee System Exam (Chinese and English) | Online | Required for teams from Hong Kong, Macau, Taiwan and Overseas | |
| **May 14-19, 2019** | South China Regional Competition | To be determined | Teams from Mainland China | Teams from Mainland China choose their competition region or accepts the arrangements of the organizing committee based the score of their technical reviews. |
| **May 21-26, 2019 (UTC+8)** | Central China Regional Competition | To be determined | | |
| **May 28 - June 2, 2019 (UTC+8)** | North China Regional Competition | To be determined | | |
| **July 2019** | International Regional Competition | To be determined | Teams from Hong Kong, Macau, Taiwan and Overseas | Teams that pass the Referee System Exam qualify for International Regional Competition. |
| **July 2019** | Wild Card Competition | Shenzhen | Teams from Mainland China | Runners up of the Regional Competition |

| Schedule | Item | Location | Eligible Competitions/ Location | Content |
|---|---|---|---|---|
| | | | | qualify for Wild Card Competition |
| **Jul. 2019 – Aug. 2019** | Final Tournament | Shenzhen | Teams from Mainland China; Teams from Hong Kong, Macau, Taiwan and Overseas | Winners of the Regional Competition, International Competition, and Wild Card Competition qualify to compete in the Final Tournament |

# 1.2 Prizes

## 1.2.1 Final Tournament

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

| Award | Ranking | Qty. | Reward |
|---|---|---|---|
| **Regional Competition – First Prize** | Regional Champion | 1/region | Championship Trophy<br>Regional Grand Prize Certificate<br>Cash prize of USD $ 4,500 (before tax) |
| | Regional First Runner-up | 1/region | First Runner-up Trophy<br>Regional Grand Prize Certificate<br>Cash prize of USD $ 4,500 (before tax) |
| | Regional Second Runner-up | 1/region | Second Runner-up Trophy<br>Regional Grand Prize Certificate<br>Cash prize of USD $ 4,500 (before tax) |
| | The top ranked teams in each region can qualify to enter the Final Tournament based on the region's allocated quota. | 16 | Regional Grand Prize Certificate<br>Cash prize of USD $ 4,500 (before tax) |
| **Regional Competition – Second Prize** | In addition to the teams directly advancing to the Final Tournament, the teams with the top rankings of the rest in each region may advance based on each region's allocated quota. | Multiple | Regional Second Prize Certificate |
| **Regional Competition – Third Prize** | Teams that did not win first and second prizes in the Regional Competition | Multiple | Regional Third Prize Certificate |

**Note:** International Regional Competitions are classed as Regional Competitions.

## 1.2.4 Outstanding Contribution Awards

| Award | Remarks | Qty. | Reward |
|---|---|---|---|
| **Outstanding Supervisor** | Outstanding Supervisor of the year | 4 | Honor certificate<br>USD $ 3,000 (pre-tax) |
| | Outstanding Supervisor in the Regional Competitions | 4 | Honor certificate<br>USD $ 750 (pre-tax) |
| **Outstanding Captain** | Outstanding Captain of the year | 4 | Honor certificate<br>USD $ 750 (pre-tax) |
| | Outstanding Captain in the Regional Competitions | 4 | Honor certificate<br>USD $ 300 (pre-tax) |
| **Outstanding Advisor** | Outstanding Advisor of the year | 4 | Honor certificate<br>USD $ 750 (pre-tax) |
| | Outstanding Advisor in the Regional Competitions | 4 | Honor certificate<br>USD $ 300 (pre-tax) |
| **Outstanding Project Manager** | Outstanding Project Manager of the year | 4 | Honor certificate<br>USD $ 450 (pre-tax) |
| | Outstanding Project Manager in the Regional Competitions | 4 | Honor certificate<br>USD $ 150 (pre-tax) |
| **Outstanding PR Manager** | Outstanding PR Manager of the year | 4 | Honor certificate<br>USD $ 450 (pre-tax) |
| | Outstanding PR Manager in the Regional Competitions | 4 | Honor certificate<br>USD $ 150 (pre-tax) |
| **Outstanding Business Manager** | Outstanding Business Manager of the year | 4 | Honor certificate<br>USD $ 450 (pre-tax) |
| | Regional Competition Outstanding Business Manager | 4 | Honor certificate<br>USD $ 150 (pre-tax) |
| **Outstanding Volunteer** | Outstanding Volunteer of the year | 10 | Honor certificate |
| | Outstanding Volunteer in the Regional Competitions | 4 | Honor certificate |
| **Best Exterior Design Award** | Best Exterior Design Award of the year Standard Robot | Multiple | Honor certificate<br>USD $ 750 (pre-tax) |
| | Best Exterior Design Award of the year Engineer | Multiple | Honor certificate<br>USD $ 750 (pre-tax) |
| | Best Exterior Design Award of the year Hero | Multiple | Honor certificate<br>USD $ 750 (pre-tax) |
| | Best Exterior Design Award of the year Aerial | Multiple | Honor certificate<br>USD $ 750 (pre-tax) |
| | Best Exterior Design Award of the year | Multiple | Honor certificate |

| Award | Remarks | Qty. | Reward |
|---|---|---|---|
| | Sentry | | USD $ 750 (pre-tax) |
| | Regional Competition Best Exterior Design Award Standard Robot | Multiple | Honor certificate USD $ 450 (pre-tax) |
| | Regional Competition Best Exterior Design Award Engineer | Multiple | Honor certificate USD $450 (pre-tax) |
| | Regional Competition Best Exterior Design Award Hero | Multiple | Honor certificate USD $ 450 (pre-tax) |
| | Regional Competition Best Exterior Design Award Aerial | Multiple | Honor certificate USD $ 450 (pre-tax) |
| | Regional Competition Best Exterior Design Award Sentry | Multiple | Honor certificate USD $ 450 (pre-tax) |
| **Creativity Award** | | 4 | Honor certificate |

## 1.2.5 Open Source Prize

| Award | Remarks | Qty. | Reward |
|---|---|---|---|
| **Open Source Grand Prize** | In the 2019 season (September 20, 2018 to August 31, 2019), the core technologies were publicly shared in the RoboMaster Forum and the official website to promote the development of the RoboMaster Robotics Competition and the culture and spirit of engineers. | 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 handling of intellectual property disputes among the internal members of the team. The participating teams must properly handle all aspects of intellectual property rights among internal school members, company members and other members of the team.

References and related suggestions for open source materials: **https://bbs.robomaster.com/thread-7026-1-1.html**

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

**Violation penalty:** If there are any violations to the intellectual property rights of the competition & 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 Updates to the Rules and FAQs

Based on the overall 2019 season preparations and actual events during the competition, the following aspects of RoboMaster 2019 Robotics Competition rules may be adjusted:

1. Make small adjustments to balancing parameters of the rules (projectile capacity, power restriction, etc.).
2. Modify the rules that provide advantages through non-technical means.
3. Add penalties or amendments to actions that cause the competition to be unbalanced.

To ensure a fair and just competition and the timeliness of the updates and to promote the smooth operation of the competition, the organizing committee will issue the " Rules Hotfix Announcement" (hereinafter referred to as the "Amendment Notice") for explaining and updating rules, which is usually done in two ways:

1. Extracting the corresponding content from the latest version of the Rules Manual, and modifying the original content to clarify the rules.
2. Directly adding new rules, regulations, and penalties.

When interpreting the rules, Amendment Notices take precedence over the latest version of the Rules Manual. Rules and regulations that are not mentioned in the Amendment Notice should be interpreted based on the latest version of the Rules Manual. Changes to the rules involved in the Amendment Notice will be updated in the Rule Manual, after which the Amendment Notice will be void and the version number of the rule book will be increased after the update. All rule book updates will be posted in the RoboMaster official forum (bbs.robomaster.com) "Events section," with

the latest version number pinned to the top.

| Communication Q&A platform | |
|---|---|
| **Platform** | **Remarks** |
| **Official forum** | Questions about the competition rules can be found in the "FAQ" sub-section of the RoboMaster official forum (posts) the RoboMaster Organizing Committee will reply to each forum question within 1-2 business days.<br>Each week, posts relating to the rules and rules Q&A will be summarized in the same post, and the "FAQ" sub-section in the "Competition" section of the RoboMaster official forum (bbs.robomaster.com) will be updated in unison.<br>Post title format:<br>1. Technical Q & A: "[Technical Q&A] + Post Title"<br>2. Rules Q & A: "[Rules Q&A] + Post Title"<br>3. Other Q & A (such as materials, etc.): "[Other Q&A] + Post Title"<br>Note: The title of the post contains braces "[]" |
| **Telephone** | 0755-36383255 |
| **Official E-mail** | robomaster@dji.com |
| **Competition QQ Group** | RoboMaster 2019 Robotics Competition Official Entry QQ Group: 791094259 |
| **Technical Exchange QQ Group:** | RoboMaster technical exchange and sharing: 562566495<br>Note: To apply to join the technical exchange group, you must submit your resume to the official competition email address robomaster@dji.com. |
| **Entry consultation QQ number** | Event Staff No-1-QQ number: 2355418059<br>Note: Official notices and consultations related to the competition are subject to the information and answers published in the official competition QQ number. |
| **Entry consultation WeChat account** | Entry consultation WeChat account: rmsaiwu |
| **WeChat Group** | Add the official competition WeChat account (rmsaiwu) and apply to join the corresponding competition entry group (the official competition entry WeChat group, PR Manager WeChat group, and Supervisor exchange group) |

# Chapter 2: Team Requirements

## 2.1 Participants

The RoboMaster Robotics Competition advocates the spirit of teamwork. To encourage all of team members to play an equally important roles, the RoboMaster Organizing Committee will reward the team member who has the most contribution throughout the various stages of the competition, i.e. Outstanding Captain, Outstanding Supervisor, etc.

Every team must have a member serving in the following roles:

| Team Member | Role | Number | role |
|---|---|---|---|
| **Supervisor** | A professional representative from the university who mentors the team throughout the competition. | 1-5 | An instructor, professor, or any other member of faculty teaching staff from the university who is qualified to perform scientific research and teaching. |
| **Advisor** | Members of former teams and engineers who provide guidances and supports to the team in terms of strategy, technology, and management. | 0-5 | Full-time students, undergraduates, postgraduates, and doctoral students in institutions of higher learning, as well as engineers, scientists, researchers, and faculty members working in enterprises, research institutions, or freelancers |
| **Captain** | The student leader of the team to direct all technological and strategic aspects; also serves as the contact person for the RoboMaster Organizing Committee. | 5-35 | Full-time students, undergraduates, postgraduates, and doctoral students in institutions of higher learning before August 2019 |
| **PR Manager** | The PR Manager leads the promotion of the robotics team and other competition-related projects. | | |
| **Project Manager** | Oversees the entire project. | | |
| **Team** | Team Members are separated into | | |

| Team Member | Role | Number | role |
|---|---|---|---|
| **Member** | groups that serve in technical or operational roles. The technical group is further separated into mechanical, electric control, or vision sub-groups etc. | | |

The following is a description of the responsibilities of each role in a team:

**Supervisor:**

As the team's professional mentor, the Supervisor serves as a leader and guardian who is responsible for building and managing the team. The Supervisor's responsibilities include: ensure the safety of team members and their properties directing and managing team expenses during the contest; ensuring that the Team Leader and Project Managers report project progress and other issues to the RoboMaster Organizing Committee; instructing the team on how to draft plans, solve R&D issues, and complete Technical Reports on time and helping the team to complete the contest successfully. The Supervisor must actively cooperates with the RoboMaster Organizing Committee throughout the competition. The Supervisor cannot also serve as an operator, Project Manager, PR Manager, or Advisor at the same time.

**Advisor:**

Full-time students, undergraduates, postgraduates and doctoral students in institutions of higher learning, as well as engineers, scientists, researchers and faculty members working in enterprises, research institutions or freelancers, including sponsor-designated personnel, engineers, scientists, researchers who already worked in the enterprise or scientific research institutions, etc., who join the team as advisors. Advisors can be involved with tasks such as the manufacturing of robots and other matters related to the competition, but they cannot also serve as Supervisors, Captains, Operators, Project Managers, or PR Managers at the same time.

**Captain:**

The Captain is responsible for technologies and strategies. The Captain's responsibilities include: dividing works, planning, and the arranging game strategies, attending prematch meetings, representing the team during the confirmation of match results and representing the team during appeal processes and any subsequent hearings. At the end of the competition, the captain is responsible for the succession and development of the team. The Captain can also serve as an operator; however, they cannot also hold the post of Project Manager, PR Manager or Advisor at the same time.

**Project Manager:**

The Project Manager oversees the entire project. The Project Manager's responsibilities include: managing the project's overall progress, comprehensively considering R&D costs, work safety and

other issues and making overall management decisions (e.g. progress, outcomes, costs, etc.).

**PR Manager:**

The PR Manager leads all public relations efforts to support the team throughout the competition. The PR Manager's responsibilities are: Integrating the team's promotional materials, establishing a comprehensive promotional system, planning and organizing promotional activities via multiple platforms to increase the team's exposure.

**Business Manager:**

Responsible for integrating the internal and external resources of the team, writing and revising the investment plan, finding partners through various channels and providing technical support and funding for the team. The PR Manager and Project Manager can be concurrently appointed as the Business Manager.

**Team Members:**

Team members are usually divided into the three groups: the Technical Group, the Operations Group and the Operator Group, with each group having specific responsibilities: The technical team is responsible for robot design and production, and it is recommended that the group has an industrial designer with external robot design experience. The operation group is responsible for organizing and planning events, and it is recommended that the operation team has a team member responsible for acquiring funding. The operator team is responsible for controlling the robots during the competition.

## 2.2 Team Regulations

1.The team must cooperate with a secondary education institution. The Supervisor must be a lecturer, professor or other faculty member qualified to research and teach at the institution.

**Violations and Penalties:**

Registration is rejected.

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 work together, may be allowed to have more than one team. However, this must first be verified by the RoboMaster Organizing Committee. Teams must also receive authorization from their school to enter the competition and submit proof of authorization during the registration process. For the authorization letter template, check the registration system.

**Violations and Penalties:**

Registration is rejected.

3. The team name must be in the form of "XXX-Team" ("-" is only a separator, not in the actual team name), and the team comes up with their own name. Teams may abbreviate their university name if preferred. The total length of the team name should not exceed 16 English letters or 8 Chinese characters. The team name must be positive and inoffensive and comply with all related regulations

and laws (e.g. copyright laws).

**Violations and Penalties:**

Registration is rejected until the team name meets the aforementioned requirements.

4. Two or more schools that do not have their own separate, individual teams can form an intercollegiate team. Before the establishment of an intercollegiate Team, members must sufficiently communicate with each other about establishing the team. After the establishment of the intercollegiate team, it shall not be split and it may only participate in RoboMaster 2019 Robotics Competition as that team. The team itself must deal with any operating and R&D costs, personnel distribution or disputes that may arise within an intercollegiate team. The RoboMaster Organizing Committee assumes no responsibility for any of these issues. The school names of the team members in the intercollegiate team must also be abbreviated. The registered team name (as seen in Point 3) is "Intercollegiate Team" instead of "Team." The intercollegiate team must also submit a joint team statement during the registration process. For the intercollegiate team letter template, check the registration system.

**Violations and Penalties:**

Registration is rejected until the team name meets the aforementioned requirements. If a Consortium Team disbands after passing the Technical Report stage, they are viewed as having voluntarily dropped out of the competition.

5. In addition to the Supervisor and Advisor, each team must have at least 5 players and no more than 35 players.

**Violations and Penalties:**

Registration is rejected until the number of team members meets the aforementioned requirement.

6. Each team must have 1 Captain, 1 Project Manager, and 1 PR Manager.

**Violations and Penalties:**

Registration is rejected until the team member information meets the aforementioned requirement.

7. Each team must have at least 1 Supervisor and no more than 5 Supervisors.

**Violations and Penalties:**

Registration is rejected until the number of Supervisors meets the aforementioned requirement.

8. Each team may have 0-5 Advisors.

**Violations and Penalties:**

Registration is rejected until the number of Advisors meets the aforementioned requirement.

9. Any team member (including Supervisors, Captains, PR Managers, Project Managers, Team Members, and Advisors) may only participate in one team during the 2019 season.

**Violations and Penalties:**

Once the Chief Referee has confirmed the situation, the offending participant and every team he/she is part of is regarded as cheating.

## 2.3 Types of Teams

**Teams from Mainland China:** Domestic Teams that passed registration review and technical review within the specified time and meet the competition requirements.
**Rights:** Eligible to enter formal competitions to qualify for subsequent rounds; can receive awards as set out in the award rules.

**Teams from Hong Kong, Macau, Taiwan and Overseas:** Teams accepted by the organizing committee to participate in the competition have passed registration review and technical review within the specified time and are in line with the competition requirements.
**Eligibility:** Teams from Hong Kong, Macau, Taiwan and Overseas generally come from universities in Hong Kong, Macau, Taiwan, and overseas. Due to the different education systems, the qualifications of Hong Kong, Macau, Taiwan, and overseas teams will not be restricted.
**Rights:** Eligible to enter formal competitions to qualify for subsequent rounds; can receive awards as set out in the award rules.

## 2.4 Sponsorship Regulations

In order to find financial, material, and other assistance, teams are encouraged to seek sponsorships independently. In the process of conducting investment promotion work, in order to protect the interests of each team and maintain the overall brand identity of the competition, it is necessary to follow the investment guidelines provided by the organizing committee. The investment guideline is only for the supporting services and sponsorship support of the participating teams, and does not involve the return and benefits related to the RoboMaster competition. For details, please refer to the "RoboMaster 2019 Robotic Competition Team Investment Manual", which you can read by clicking the following link: **https://bbs.robomaster.com/thread-7028-1-1.html**
Participating teams must follow the investment promotion process when seeking investments, report the rights of both parties to the organizing committee and obtain approval from the organizing committee. Such "investments" include ads placed on the bodies of the robots, title sponsors' appearances on the competition spectator system, etc. If the aforementioned process is not followed, the organizing committee has the right not to cooperate in the implementation of the relevant rights and interests of the competition. The organizing committee only confirms whether the sponsors of the participating teams are cooperating enterprises and whether the organizing committee can give the participating teams assistance in implementing the rights and interests of the competition. It is not responsible for any of the sponsors.

**Violations and Penalties:**

The RoboMaster Organizing Committee will impose certain penalties on actions that damage the brand of the RoboMaster Organizing Committee or sponsors, as well as the sponsor's trademark and intellectual property rights, such as disqualification from the competition and being subject to legal liability.

# Chapter 3: Robot Technical Specifications

All teams are expected to develop and build robots through independent research, learning, and effort. Teams can purchase the robotic components and modules necessary for building robots from SZ DJI Technology Co., Ltd. with student discounts or from other manufacturers. For RoboMaster education products and purchases, the details of the official website on the "RoboMaster 2019 Robotics Competition Instructions for Purchasing Materials" shall prevail.

All robots must follow the specifications defined in these instructions, otherwise they shall fail inspection and be disqualified from competition.

**The RM2019 Organizing Committee recommends that participating teams consider the following aspects of robot design:**

1. Analyze and plan the design of the mechanisms before production, try to select mature industrial products and modules to improve the reliability of the mechanisms;
2. Read the Robot Technical Specifications carefully, plan well in advance, improve functionality of the mechanism according to the rules and ensure that the robot fulfills the technical specification requirements;
3. Read the " RoboMaster 2019 Robotics Competition Referee System Specification Manual" closely, pay attention to the various installation specifications and usage methods of the referee system and avoid failing the prematch inspection due to improper installation;
4. Evaluate necessary manpower and capital in advance and make budgets and plans for robot production to avoid unnecessary iterations of robots during the preparation phase which waste funds and manpower;
5. Pay attention to the manufacturability of components, reduce the cost of components and make component processing easier. Modularize components for easy replacement;
6. During the competition, the robot will be in a large number of shootouts, which requires good durability and maintainability.
7. There will be certain manufacturing errors between the actual objects on the field and the drawings. When designing the structure of the robot, consider the manufacturing errors of the Battlefield Components, and do not overly rely on the accuracy of the size measurements.
8. In the robot design and structure production, try to add elements of industrial design to ensure the robot is aesthetically pleasing.

# 3.1 General Technical Specifications

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

| Type | Technical Specifications |
|---|---|
| **Energy Source** | Robots may only use electrical or pneumatic power. Internal combustion engines, explosive substances and hazardous chemical materials are prohibited.<br>**Power Supply**<br>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.<br>**Note:**<br>An explosion-proof box will be placed at the entrance of both the red and blue sides of the stadium. During the competition, if a battery becomes a safety hazard, the site technician 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.<br>**Violations and Penalties:**<br>Robots with batteries violating these specifications fail the prematch inspection. Violators will be held legally liable for safety incidents caused by non-compliant batteries.<br>**Air source:** The compressed air pressure must not exceed 20Mpa (international unit 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 has 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. Robots using compressed gas for a propulsion system must meet the following requirements:<br>1. Working gas: Working gas must be non-flammable and non-toxic, such as air, nitrogen or carbon dioxide.<br>2. Cylinder certification: Cylinders must be designed and manufactured for the pressure conditions used and certified by the officially recognized testing organization in its country of origin. You must display an actual, valid certificate at an easy to view location.<br>3. Pressure regulation: The constant pressure valve must be installed directly on the cylinder/gas cylinder.<br>4. Protection measures: The gas cylinder and the gas pipe must be protected to |

| Type | Technical Specifications |
| --- | --- |
| | prevent damage caused by rollovers, collisions from any direction or moving parts malfunction. The bottle opening shall not be exposed to prevent damage caused by projectiles.<br>5. Gas cylinder and pipe positioning: When installing the gas cylinder, please keep in mind that the robot may roll at any angle. Should a roll occur, the gas cylinder and pipe should not touch the ground.<br>6. Cylinder installation: The cylinder must be safely mounted on the frame. To ensure safety, the opening of the bottle must be level or pointed upward. There must be at least two fixed points, or at least 1/5 the container's length must be fixed to the frame;<br>7. Insulation: The cylinder must be insulated from any possible heat sources and a barrier layer, such as a carbon fiber board or aluminum plate, must be placed between the cylinder and the heat source.<br>8. Gas Pipes and Fittings: Gas pipes and fittings must be able to handle the system's maximum possible working pressure.<br>**Note:**<br>1. It is forbidden to use air pumps that must plug into external power supplies of the stadium to operate. The team can bring low-pressure air pumps but they are not allowed to be plugged into power sockets in the stadium area.<br>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.), the participating members must follow the instructions of the referee to deal with the safety hazards. Otherwise, the robot will not be allowed to enter the stage and must be removed from the competition, depending on the actual situation as determined by the Chief Referee.<br>**Violations and Penalties:**<br>Robots that violate these gas-power specifications will fail the prematch 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 Controls**<br>Remote control technology used by robots during the competition must be produced by SZ DJI Technology Co., Ltd.<br>During the competition, each remote controller configured for a robot can only correspond to one receiver. |

| Type | Technical Specifications |
| --- | --- |
| | **Violations and Penalties:**<br>1. Robots not equipped with DJI brand remote controls cannot pass prematch inspection.<br>2. During the seven-minute match, if the remote controller configured for a robot corresponds to two or more receivers, it will be considered cheating if confirmed by appeal or the Chief Referee, and the offending party will be disqualified.<br>**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 competition areas (including but not limited to the preparation area, inspection area, staging area, and competition area), and players are forbidden from using walkie-talkies to communicate with each other.<br>Wireless Networks<br>**Violations and Penalties:**<br>1. If a complaint about a wireless network is verified by the Chief Referee, it will be considered cheating, and the offending team will be disqualified.<br>2. If a complaint about team members using walkie-talkies to communicate with each other, and thus interfering with the normal conduct of the game, is verified by the Chief Referee, it will be considered cheating, and the offending team will be disqualified. |
| **Optical Equipment** | The power of the laser sight must be less than 35mW, the color of the emitted laser must be red, 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)<br>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.<br>During the competition, Aerials can be equipped with an indicator light on their fuselages to help better distinguish them and indicate their current flight status (indicator lights on the fuselage 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.). The indicator light should not interfere with the competition on the battlefield (no high-power LEDs that directly illuminates the battlefield, etc.).<br>Other light-emitting mechanisms are prohibited on all ground-based robots, as they can interfere with the Referee System. |

| Type | Technical Specifications |
| --- | --- |
| | Optical elements used by robots must not cause harm to participants, referees, staff or audience members.<br>**Violations and Penalties:**<br>1. If the laser power of the laser sight exceeds 35mW or the projection angle is greater than 5 degrees or the laser color is not red, it will not pass prematch inspection.<br>2. Robots that install obvious visible light devices in violation of regulations will not pass prematch inspection.<br>3. If any piece of optical equipment on the robot causes any physical injury to the participating team members, referees, staff or the audience, the legal responsibilities of the offending party will be investigated according to the law. |
| **Visual Characteristics** | As there are clear optical effects (lights) on both sides of the Referee System's armor modules, it is suggested that teams use this feature to develop a vision-based object detection algorithm for faster object recognition.<br>Robot sensors (such as radars, cameras, ultrasonic sensors, and infrared sensors) must be installed without obscuring the armor and must not project light onto the armor. Do not install devices (such as reflectors, mirrors, lenses, etc.) that interfere with the Computer Vision recognition of armor modules by reflecting or refracting the light on both sides of the armor. The Competition Area and its environment are complex, and teams should consider this when developing Computer Vision algorithms to better adapt to the changing illumination and other interference from around the Competition Area. The RoboMaster Organizing Committee cannot guarantee that visual features and effects in the field will not interfere with a robot's vision systems.<br>**Violations and Penalties:**<br>1. Robots that have sensors installed in violation of the regulations will not pass prematch inspection.<br>2. Robots that block or project light onto the armor module in violation of regulations will not pass prematch inspection.<br>3. Robots that have devices that reflect or refract light on either sides of the armor module are in violation of regulations will not pass prematch inspection. |
| **Robot Numbers** | During the prematch inspection and the competition, the organizing committee staff will stick the designated number stickers onto participating robots and the base armor plates. The participating robots are marked as red 1/blue 1 Hero, red 2/blue 2 Engineer, red 3/blue 3 Standard Robot, red 4/blue 4 Standard Robot, red 5/blue 5 Standard Robot, red 6/blue 6 Aerial (without sticker), and red 7/blue 7 Sentry.<br>The robot armor plate sticker must be flat and free of air bubbles. Only one |

| Type | Technical Specifications |
| --- | --- |
| | sticker can be attached to each piece of armor. Except for the designated number stickers provided by the Organizing Committee, similar stickers may not be attached to the armor or other structure of the robot, including other decorative stickers on the robot body. The stickers must not have any prominent numbers visible.<br>For a schematic of the robot number sticker, refer to **Appendix 5 Reference Pictures**<br>**Violations and Penalties:**<br>1. Robots that have unqualified stickers cannot pass prematch inspection.<br>2. During competition, all participating robots are required to paste the corresponding stickers, or else they will not be allowed to enter the stage.<br>3. During competition, unless a sticker was damaged during a match, unqualified stickers discovered on participating robots will be considered cheating and all matches where the robot had the unqualified sticker will be counted as losses. |
| **Robot Paint** | In order to enhance the robot's distinguishability and aesthetics, subsequent regulations on robots' appearances will be added. The specific requirements will be released in subsequent updates.<br>**Violations and Penalties:**<br>Robots that do not meet the appearance requirements will not be able to pass prematch inspection. |
| **Launching Mechanism** | Robots using gas as the propellant for projectiles must NOT have an acceleration length (defined as the straight length of the barrel that can provide acceleration to projectiles) exceeding 20cm.<br>Note: The Launching Mechanism refers to a mechanism that launches projectiles to cause damage to other robots. (This definition is applicable to all "launching mechanisms" mentioned in this manual.) |

# 3.2 RobotTypes

RoboMaster requires robots to fight together as a team. Good teamwork is therefore critical to winning matches. Robots are divided into two types: compulsory and optional robots; each type of robot has different technical specification requirements. Before each match, different types of required robots must all pass prematch inspection before they can qualify to enter the stage. After the first round of each match, subsequent rounds do not require the minimum lineup. If there is serious damage to a certain type of robot in the first match or there is a serious safety hazard such as a short circuit, the robot must be immediately powered off and leave the field to avoid safety risks in subsequent matches. During any such situation, you must follow the orders of the Chief Referee.
During each match, each team can carry up to 2 standby robots. The standby robots must also comply with all robot specifications and pass inspection. Participants are required to declare the types of standby robots they are carrying during prematch inspection. Apart from Standard Robots, other types of standby robots must be affixed with armor stickers in the Inspection Area. When a standby Standard Robot is required to enter the stage, the team members must promptly get the corresponding number stickers from the technicians and attach stickers which meet the "robot number" regulations. Only then can the robot enter the stage. Standby robots must not be replaced after passing inspection.
If a robot is not selected to participate in the competition, the robot's HP will be displayed as 0 in the referee system server. The following is the entrance lineup table for different kinds of robots:

| Category | Qty. | Type | Eligible Competitions |
|---|---|---|---|
| **Standard Robot** | 3 | Required | International Regional Competitions, Wild Card Competitions and the Final Tournament |
| | 2 | Required | Regional Competitions |
| **Sentry** | 0-1 | Optional | Regional competitions, International Regional Competitions, Wild Card Competitions and the Final Tournament |
| **Hero** | 1 | Required | Regional competitions, International Regional Competitions, Wild Card Competitions and the Final Tournament |
| **Aerial** | 0-1 | Optional | Regional competitions, International Regional Competitions, Wild Card Competitions and the Final Tournament |
| **Engineer** | 0-1 | Optional | Regional competitions, International Regional Competitions, Wild Card Competitions and the Final Tournament |

**Violations and Penalties:**

1. Before each match, if any of the required robots do not pass prematch inspection, the team is considered to have forfeited the match on the spot, and the match will be counted as a loss.
2. If a participating team replaces or adds a standby robot after passing prematch inspection or the standby robot does not pass prematch inspection, the team will be considered to be cheating and automatically lose the match. The Chief Referee will judge each situation on a case-by-case basis.

## 3.2.1 Standard Robot

The Standard Robot is a required robot. During Regional Competition, each team has two Standard Robots enter the stage. During International Regional Competition, Wild Card Competition and the Final Tournament, each team has three Standard Robots enter the stage. Standard Robots begin at Level 1 at the start of each round.

| Standard Robot Specifications | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| **Initial Blood** | 200 | - | - |
| **Allowed targets** | non-Aerial robots | - | - |
| **Operating Mode** | For manual control, configure up to 1 remote controller | - | - |
| **Total Power Supply Capacity (Wh)** | 200 | Unable to pass prematch inspection | - |
| **Power Supply Voltage (v)** | 30 | Unable to pass prematch inspection | - |
| **Robot Chassis Power Consumption (W)** | 80 | HP deduction | Buffer energy 60 joules |
| **Launching Mechanism type** | 17 mm projectile | - | Only 1 Launching Mechanism and 1 laser sight can be installed |
| **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 (m/s)** | 30 | HP deduction | - |
| **Projectile launch speed (projectiles/s)** | Negatively correlated with initial velocity | Refer to **3.3.1.1 Barrel Heat** | - |
| **Maximum** | 20 | Robots not meeting | Includes the battery |

| Standard Robot Specifications | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| **Weight (kg)** | | weight requirements will not pass prematch Inspection | weight, but not the weight of the Referee System. |
| **Maximum Initial Size (mm)** | 600 x 600 x 500 | Robots not meeting size requirements will not pass Prematch Inspection | 1. The height must not exceed 500, and the orthographic projection on the ground must not exceed 600 x 600.<br>2. Before the 3-minute match starts, the robot size must be within the maximum initial size range |
| **Maximum Expansion Size (mm)** | 700 x 700 x 600 | Robots not meeting size requirements will not pass Prematch Inspection | It may not exceed 600mm in height, and its orthographic projection on the ground may not exceed a 700 x 700 square. |
| **Activation Condition** | During the setup period, robots can be moved within the starting zone.<br>Projectiles can only be fired after the match has officially started. | For specific penalty regulations, refer to **5.5.2 Three-minute Setup** Period | - |
| **RoboMaster Referee System** | 4 Small Armor Modules, 1 Large Armor Module, Speed Monitor Module (17 mm projectile), Video Transmission Module (VTM), RFID Interaction Module, Positioning Module, Main Control Module, Power Supply Management Module, Light Strip Module | Robots not meeting the Referee System installation requirements will not pass prematch inspection | - |

| Robot Level | Maximum HP | Barrel | Barrel Cool- | Experience | Value of |
|---|---|---|---|---|---|

| (Standard Robot) | | Heat limit | Down Rate | Points required for Level Up | Experience Points |
|---|---|---|---|---|---|
| **Level 1 Standard Robot** | 200 | 240 | 40 | 3 | 2.5 |
| **Level 2 Standard Robot** | 250 | 360 | 60 | 6 | 5 |
| **Level 3 Standard Robot** | 300 | 480 | 80 | / | 7.5 |

Note: For the level up standards, refer to **3.3.2 Level Up**

## 3.2.2 Sentry Robot

Sentries are optional fully automated robots. Each team can have one Sentry enter the stage per match.

If a team has a Sentry on the stage, when a robot on the team loses HP due to an attack or collision on a robot's armor module or the robot's referee system module goes offline (including ejection by the server), causing the team to lose its first robot (except Sentries and Aerials), the team's base defenses are reduced to 50%. When the Sentry is destroyed, the base's entire defense is automatically eliminated, and the base shield will be opened.

If a team does not have a Sentry on the stage, when a robot of the team loses HP due to an attack or collision inflicted on the robot's armor module or the robot's referee system module goes offline (including ejection by the server) within two minutes of the start of the match, causing the team to lose its **first** robot (except Sentries and Aerials), the team's base defense will be reduced from **100%** to **50%**. Two minutes after the start of the match, the base's entire defenses are automatically eliminated, and the base shield is opened. If the team does not lose a robot within two minutes of the start of the match, all of the base's defenses of the base will be eliminated two minutes after the start of the match, and the base shield will be opened.

If a Sentry robot destroys any enemy robot (except for an Aerial, the results is calculated by the referee system server), an HP Gain can be obtained. One Experience Point corresponds to a gain of 20 HP, that is, **the Sentry's HP Gain = the corresponding Value of Experience Points of the killed robot x 20.** If the Sentry destroys one of the enemy's level one Standard Robots, the Sentry's HP Gain = 2.5 x 20 = 50, and the Sentry can obtain 50 points of HP Gain at this time.

| Sentry Specifications | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| **Initial Blood and Maximum HP** | 600 | - | - |
| **Allowed Targets** | non-Aerial robots | - | - |
| **Operating Mode** | Fully Automatic | - | - |
| **Total Power Supply Capacity (Wh)** | 200 | Unable to pass prematch inspection | The total capacitance of the robot does not exceed 10mF |
| **Power Supply Voltage (v)** | 30 | Unable to pass prematch inspection | - |
| **Robot Chassis Power Consumption (W)** | 20 | Unable to pass prematch inspection | Buffer energy 200 joules |
| **Launching Mechanism type** | 17 mm projectile | - | Only 1 Launching Mechanism and 1 laser sight can be installed |
| **Projectile Supply capability** | Can receive but cannot supply | - | Any operation that delivers projectiles to other robots is prohibited. |
| **Initial Projectile Quantity** | 500 | - | During the setup period of the first round of each match, projectiles must be emptied from all robots.<br>After the first round, you don't need to empty all the projectiles before the start of each subsequent round.<br>During the setup period of each round, the team will pre-load the initial projectiles. |
| **Initial Firing Speed Limit (m/s)** | 30 | HP deduction | - |
| **Projectile** | Negatively | Refer to | - |

| Sentry Specifications | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| **launch speed (projectiles/s)** | correlated with initial velocity | **3.3.1.1 Barrel Heat** | |
| **Maximum Weight (kg)** | 10 | Robots not meeting weight requirements will not pass prematch Inspection | Includes the battery weight, but not the weight of the Referee System. |
| **Maximum Initial Size (mm)** | 500 x 500 x 600 | Robots not meeting size requirements will not pass Prematch Inspection | The maximum size of the Sentry below the upper surface of the Sentry Rail is no more than 450mm (including the maximum extension). 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 module and positioning module Bracket do not count toward overall size constraints. |
| **Maximum Expansion Size (mm)** | 500 x 500 x 600 | Robots not meeting size requirements will not pass Prematch Inspection | - |
| **Activation Condition** | During the setup period, robots can be moved within the starting zone. Projectiles can only be fired after the match has officially started. | 1. Launching a projectile during the setup period will incur a verbal warning from the referee.<br>2. If a launched projectile or a fallen robot causes physical injury to on-site personnel, once verified, the offending party will be given a punitive forfeiture for the round. | During the setup period, robots can be moved within the starting zone. Projectiles can only be fired after the match has officially started. |
| **RoboMaster Referee System** | 2 Large Armor Modules, Speed Monitor Module (17 mm projectile), | Robots that do not meet the referee system's installation requirements will not pass inspection. | - |

| Sentry Specifications | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| | Positioning Module, Main Control Module, Power Supply Management Module, Light Strip Module | | |

### 3.2.3 Hero Robot

The Hero is a required robot. Each team can have one Hero enter the stage per match. At the start of each round, each Hero is level one.

| Hero Specifications | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| **Initial Blood** | 300 | - | - |
| **Allowed Targets** | non-Aerial robots | - | - |
| **Operating Mode** | For manual control, configure up to 1 remote controller | - | - |
| **Total Power Supply Capacity (Wh)** | 200 | Unable to pass prematch inspection | - |
| **Power Supply Voltage (v)** | 30 | Unable to pass prematch inspection | - |
| **Robot Chassis Power Consumption (W)** | 80 | HP deduction | Buffer energy 60 joules |
| **Launching Mechanism type** | 17 mm and 42 mm projectiles | - | Only one 17mm Launching Mechanism and one 42mm Launching Mechanism can be installed, and each Launching Mechanism can only be equipped with one laser sight. |
| **Projectile Supply capability** | Receive and supply | - | - |

| Hero Specifications | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| **Initial Projectile Quantity** | 0 | - | All projectiles need to be removed before the start of each round. |
| **Initial Firing Speed Limit (m/s)** | 16.5 | HP deduction | 42mm projectiles |
| | 30 | HP deduction | 17 mm projectile |
| **Projectile launch speed (projectiles/s)** | Negatively correlated with initial velocity | Refer to **3.3.1.1 Barrel Heat** | |
| **Maximum Weight (kg)** | 35 | Robots that do not meet the weight requirements will not pass inspection. | Includes the battery weight, but not the weight of the Referee System. |
| **Maximum Initial Size (mm)** | 800 x 800 x 800 | Robots that do not meet the size requirements will not pass inspection. | 1. The height shall not exceed 800, and the orthographic projection on the ground shall not exceed 800 x 800.<br>2. During the setup period, the robot size must be within the maximum initial size range. |
| **Maximum Expansion Size (mm)** | 1200 x 1200 x 1200 | Robots that do not meet the size requirements will not pass inspection. | The height shall not exceed 1200, and the orthographic projection on the ground shall not exceed 1200 x 1200. |
| **Activation Condition** | During the setup period, robots can be moved within the starting zone. Projectiles can only be fired after the match has officially started. | For specific penalty regulations, refer to **5.5.1 Setup Period.** | - |
| **RoboMaster Referee System** | 5 Large Armor Modules, Speed Monitor Module (17 mm and 42 mm projectiles), Video | Robots that do not meet the referee system's installation requirements will not pass inspection. | - |

| Hero Specifications | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| | Transmission Module (VTM), RFID Interaction Module, Positioning Module, Main Control Module, Power Supply Management Module, Light Strip Module | | |

| Robot type | Upper limit HP | 17 mm Barrel Heat Limit | 17 mm Barrel Cool-Down Value Per Second | 42mm Barrel Heat Limit | 42mm Barrel Cool-Down Value Per Second | Experience Points required for Level Up | Value of Experience Points |
|---|---|---|---|---|---|---|---|
| **Level 1 Hero** | 300 | 240 | 40 | 80 | 20 | 8 | 7.5 |
| **Level 2 Hero** | 500 | 360 | 60 | 120 | 40 | 12 | 10 |
| **Level 3 Hero** | 700 | 480 | 80 | 200 | 60 | / | 15 |

Note: For the Level Up mechanism of Heroes, refer to **3.3.2 Level Up**

## 3.2.4 Aerial Robot

Aerials are optional robots. Each team can have one Aerial enter the stage per match.

At the start of a match, an Aerial cannot launch projectiles until its Energy reaches 100. During the match, Aerials can accumulate energy each second it is on the landing pad and each time a robot on its team is destroyed.

After an Aerial lands stably on the landing pad, it gains 1 Energy per second, up to a maximum of 100 Energy. If the Aerial takes off from the landing pad before its energy reaches 100, it will stop gaining energy, but its Energy will not reset to 0. When the Aerial lands on the landing pad again, it will resume gaining Energy. Once its Energy reaches 100, even if the Aerial is on the landing pad, it will no longer gain Energy.

Once a robot on its team is destroyed, an Aerial gains Energy immediately. 1 Experience Point corresponds to a gain of 3 Energy, t**hat is, Aerial's Energy gain = Value of Experience Points of**

**the destroyed robot x 3.** Aerials can have a maximum of 100 Energy, at which point they will stop gaining Energy.

After an Aerial accumulates 100 Energy, the Aerial Gimbal Operator chooses whether to power up the launching mechanism. When the Aerial's launching mechanism is powered on, it can launch projectiles at any speed within 50s. The Initial Firing Speed Limit is 30m/s. After 50s or after it launches 500 17mm projectiles, the launching mechanism will power off, and the Aerial must return to the landing pad to recharge Energy. If the Aerial returns to the landing pad before 50s has elapsed, the 50s attack time continues to count down, but the Aerial will start gaining Energy.

Because Aerials do not have HP, exceeding the Aerial's Initial Firing Speed Limit will not cause an HP deduction, but will deduct attack time instead. If the Aerial's current initial launch speed for projectiles is $V_1$ and the projectile's maximum initial speed is 30m/s, when the speed monitor module of the Referee System detects one 17mm projectile that exceeds the speed 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 Energy recharge. Multiple "speeding" projectiles will result in multiple attack time reductions.

During the setup period, the referee will provide 500 rounds of initial projectiles to the pilot to preload the Aerial. During a round, in addition to the initial 500 rounds of 17mm projectiles, the referee will provide additional projectiles as re-supply projectiles for the match. During a match, when an Aerial is landed on the landing pad with the propellers off, team members other than the pilot can tell the operator room referee to reload the Aerial with projectiles. When the referee gives confirmation, the team members can load the Aerial with projectiles.

In order to ensure the safety of the competition site, no part of the Aerial's barrel can exceed the top of the battlefield fence during the competition. Neither team can attack the other team's Aerial. These robots must also be fitted with fully enclosed propeller guards. For example, if the Aerial robot 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.

Above the battlefield, there are cables, slip rings and retractable Aerial Safety Ropes to ensure the Aerials' safety. Every Aerial must have a vertical safety rod with a height of 300mm above the propellers installed on top of the fuselage. The safety rod is rigidly connected to the Aerial; a wire ring is fixed on the upper end of the safety rod as a pull ring for the Aerial Safety Rope. When the 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.

Note: The Aerial's propulsion system and power supply system should be reasonably evaluated and adequately tested for payload and combat maneuvering to prevent accidents during a match.

| Aerial robot parameters | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| **Initial Blood** | None | - | - |
| **Allowed Targets** | non-Aerial robots | - | The referee system can only control the friction wheel motor. |
| **Operating Mode** | No restriction, up to 2 remote controls | - | - |
| **Total Power Supply Capacity (Wh)** | 600 | Unable to pass prematch inspection | - |
| **Power Supply Voltage (v)** | 60 | Unable to pass prematch inspection | - |
| **Robot Chassis Power Consumption (W)** | - | - | - |
| **Launching Mechanism type** | 17 mm projectile | - | Only 1 Launching Mechanism and 1 laser sight can be installed |
| **Projectile Supply capability** | Can receive but cannot supply | | - |
| **Initial Projectile Quantity** | 500 | - | - |
| **Initial Firing Speed Limit (m/s)** | 30 m/s | Deduct a certain amount of attack time | - |
| **Projectile launch speed (projectiles/s)** | No limits | - | - |
| **Maximum Weight (kg)** | 10 | Robots that do not meet the weight requirements will not pass inspection. | Includes the battery but does not include projectiles or the referee system. |
| **Maximum Initial** | 1200 x 1200 x 800 | Robots that do not | - |

| Aerial robot parameters | | | |
|---|---|---|---|
| **Item** | **Limit** | **Violations and Penalties** | **Remarks** |
| **Size (mm)** | | meet the size requirements will not pass inspection. | |
| **Maximum Expansion Size (mm)** | 1200 x 1200 x 800 | - | The height must not exceed 800, and the orthographic projection on the ground must not exceed 1200 x 1200. |
| **Activation Condition** | During the setup period, Aerials can be adjusted on the landing pad, but the propellers cannot be spinning.<br>After the start of a match, when an Aerial accumulates 100 Energy points, it can launch projectiles, but only after the Aerial Gimbal Operator turns on the launching mechanism. | For specific penalty regulations, refer to **5.5.1 Setup Period**. | - |
| **RoboMaster Referee System** | Speed Monitor Module (17 mm projectile), Video Transmitter Module (VTM), Positioning Module, Referee System Main Controller, Power Supply Management System | Robots that do not meet the referee system's installation requirements will not pass inspection. | The weight of the entire Referee System of Aerials is 0.6kg |

## 3.2.5 Engineer Robot

Engineers are optional robots. Each team can have one Engineer enter the stage per match.

Engineer robots restore 1% of their maximum HP per second if they avoid damage for at least 30 seconds during a single round (including damage due to collisions, a module coming offline, etc.).

During the competition, Engineers can install one Grabbing Mechanism for Projectile Containers. Only Engineers can do this. Engineers' Grabbing Mechanisms are only allowed to grab one Projectile Container at a time. When the fuselage of the projecting Engineer's 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 projectiles depot in the central area of the resource island. The grabbing mechanism cannot damage Battlefield ComponentsBattlefield Components. In particular, it cannot use serrated or sharp-edged structures to interact with projectile containers, irreversibly damaging them.

**Violations and Penalties:**

1. If the Engineer's Grabbing Mechanism does not meet requirements, it will not be able to pass prematch 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 penalized.

3. If a Standard Robot, Engineer, Hero, Sentry, or Aerial is equipped with mechanisms for grabbing Projectile Containers, it will not be able to pass prematch inspection.

| Engineer Robot Parameters | | | |
|---|---|---|---|
| **Item** | **Limit** | **Penalty for exceeding limit** | **Remarks** |
| **Initial Blood and Maximum HP** | 1,000 | - | - |
| **Partner Robots** | Friendly robots | - | - |
| **Operating Mode** | no restrictions, configure up to 1 remote controller | - | - |
| **Total Power Supply Capacity (Wh)** | 200 | Unable to pass prematch inspection | - |
| **Power Supply Voltage (v)** | 30 | Unable to pass prematch inspection | - |
| **Robot Chassis Power Consumption (W)** | No limits | - | - |
| **Launching Mechanism type** | Not available | - | - |
| **Projectile Supply capability** | Receive and supply | - | - |
| **Initial Projectile** | 0 | - | All projectiles need to be removed before the start of |

| Engineer Robot Parameters | | | |
|---|---|---|---|
| **Item** | **Limit** | **Penalty for exceeding limit** | **Remarks** |
| **Quantity** | | | each round. |
| **Maximum Weight (kg)** | 35 | Robots that do not meet the weight requirements will not pass inspection. | Includes the battery weight, but not the weight of the Referee System. |
| **Maximum Initial Size (mm)** | 800 x 800 x 800 | The robot fails the prematch inspection | 1. The height shall not exceed 800, and the orthographic projection on the ground shall not exceed 800 x 800.<br>2. During the setup period, the robot size must be within the initial size range. |
| **Maximum Expansion Size (mm)** | 1200 x 1200 x 1200 | The robot fails the prematch inspection | The height shall not exceed 1200, and the orthographic projection on the ground shall not exceed 1200 x 1200. |
| **Activation Condition** | During the setup period, robots can be moved within the starting zone. You cannot leave the starting zone before the round starts | For specific penalty regulations, refer to **5.5.2 Three-minute Setup** Period | - |
| **RoboMaster Referee System** | 4 Small Armor Modules, Video Transmission Module (VTM), RFID Interaction Module, Positioning Module, Main Control Module, Power Supply Management Module, Light Strip Module | Robots that do not meet the referee system's installation requirements will not pass inspection. | - |

# 3.3 Referee System Mechanisms

The participating robots shall install the corresponding referee system in accordance with the latest version of the RoboMaster 2019 Robotics Competition Referee System Specification Manual. All robot actions throughout a match are monitored by this Referee System.
During the Referee System's monitoring process, the following related states occur due to robot behavior:

| Status | Definition |
| --- | --- |
| **Defense** | Defense means that the armor module takes less damage when it is hit by projectiles and collisions. |
| **Destroy** | One robot attacks the armor module of an enemy robot until the enemy robot's HP falls to 0. |
| **Destroyed** | When a robot's HP is reduced to 0 due to attacks, exceeding the power consumption limit, exceeding the launch speed, etc. |

## 3.3.1 HP Deduction

During a match, a robot will lose HP when its Launching Mechanism Barrel overheats, its initial speed exceeds the upper limit, its armor module is attacked by the projectiles, important modules go offline, there are armor module collisions, the chassis power exceeds the upper limit, and/or from punishments for violations.
When the referee system server calculates the HP, it rounds off the deducted HP decimal point. For example, when an Engineer's defense is 80%, the HP deduction is 2 x (1-0.8) = 0.4, which is 0 after it is rounded off.

### 3.3.1.1 Barrel Heat

Different types of barrels have different heat limits and cooling rates which correspond to robots' features and positioning. When a match starts, the initial barrel heat value for every projectile launching mechanism is 0, and Standard Robots and Heroes are at Level 1. When a robot's experience level is upgraded, the barrel heat upper limits and cooling value per second are also increased. When a robot's barrel heat exceeds the preset limits, the computer screen of the corresponding operator displays a warning symbol, and FPV visibility is also reduced.

The following are the heat limits and cooling rate per second for the barrel for different robot types:

| Robot type | Level | Initial speed limit (m/s) | 17 mm Barrel Maximum Heat | 42mm Barrel Maximum Heat | 17 mm barrel heat Cooling Value Per Second | 42mm barrel heat Cooling Value Per Second |
|---|---|---|---|---|---|---|
| **Standard Robot** | Level 1 | 30 | 240 | / | 40 | / |
| | Level 2 | | 360 | / | 60 | / |
| | Level 3 | | 480 | / | 80 | / |
| **Sentry** | / | 30 | 480 | / | 160 | / |
| **Hero** | Level 1 | 17mm Projectiles: 30<br>42mm Projectiles: 16.5 | 240 | 80 | 40 | 20 |
| | Level 2 | | 360 | 120 | 60 | 40 |
| | Level 3 | | 480 | 200 | 80 | 60 |

**During a match, when the Standard Robot's HP is less than 20%, the Standard Robot's 17mm barrel has twice the original cooling rate.**

When a match starts, the initial barrel heat value for every projectile launching mechanism is 0. As projectiles are launched, the barrel heat increases. When the barrel heat is greater than 0, the muzzle heat is cooled at a frequency of 10 Hz. Each time a 17mm projectile with a velocity of V (m/s) is launched, the robot's barrel heat is increased by the value of V. Each time a 42mm projectile is launched, the robot's barrel heat is increased by 100.

**Note:**

1. Heroes configured with two types of projectile Launching Mechanisms will have barrel heat calculated separately for each type.

2. For the initial speed limit, take the Standard Robot as an example: the upper limit of the initial speed of the Standard Robot is 30m/s, which means that after the projectile is accelerated, the detected speed must be less than or equal to 30m/s. The speed measure module can only be installed at the end of the launching mechanism, and the measured value must be the value after the projectile has fully accelerated.

**These calculations are performed as follows:**

Take a current barrel heat of $Q_1$, the upper heat limit is $Q_0$, the current initial speed is $V_1$(m/s), and the initial speed upper limit is $V_0$(m/s).

1. When $Q_1 - Q_0 > 0$, the visibility of the first person viewing angle on the computer of the corresponding Operator is lowered. When $Q_1 < Q_0$, the first person view will return to normal. The first person view of the client is as follows:


2. The calculation of heat is divided into two threads

(1) The referee system detects a 17mm projectile with a speed of $V_1$.

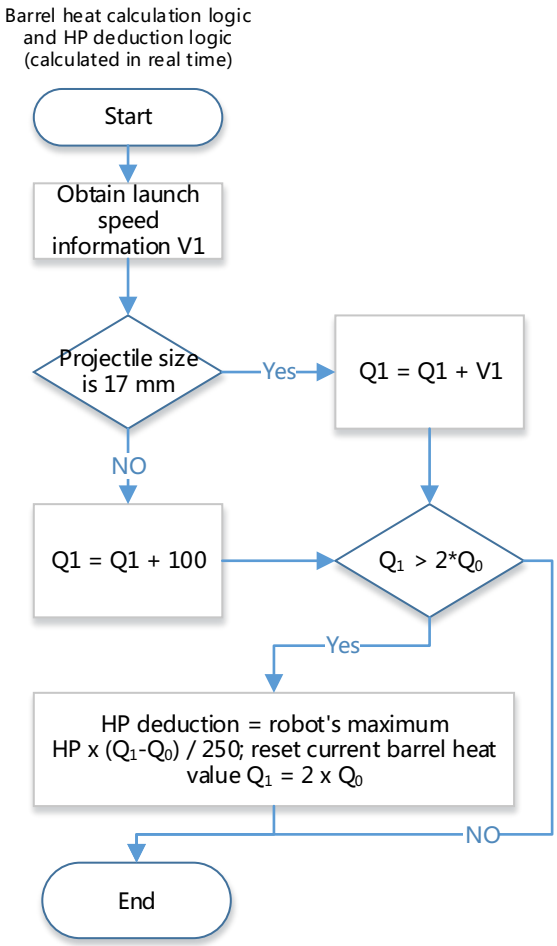
a) When $V_1$ <= $V_0$, the heat increases by $V_1$. Then, if $Q_1$ >= $2Q_0$, ($Q_1$-2 x $Q_0$)/250 x Maximum HP is immediately deducted, and $Q_1$ = $2Q_0$.

b) When 5 > $V_1$ - $V_0$ > 0, a penalty of 10% of the robot's maximum HP is deducted.

c) When 10 > $V_1$ - $V_0$ >= 5, a penalty of 50% of the robot's maximum HP is deducted.

d) When $V_1$ - $V_0$ >= 10, a penalty of 100% of the robot's maximum HP is deducted.

The logic for the deduction of barrel heat calculations exceeding the upper limit of HP is as follows:

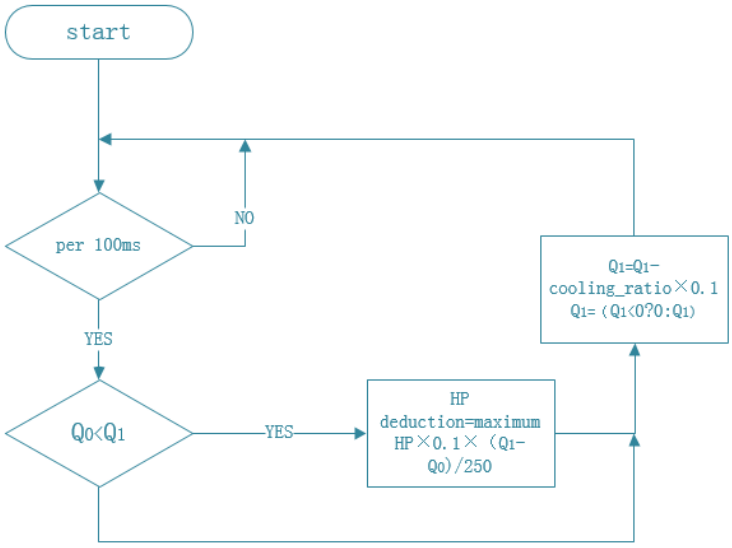



(2) 10 Hz periodic settlement thread.

a) When 2 x $Q_0$ > $Q_1$ > $Q_0$, a penalty ((Q1–Q0)/250)/10 x Maximum HP is deducted each period. The cooling value per second is then/10.

b) When $Q_1$ <= $Q_0$, the heat is directly cooled by the (per second cooling rate/10).

The logic for barrel heat cooling is as follows:




3. When launching a 42mm projectile, the overall mechanism is similar to that of a 17mm projectile. Each time the referee system detects a 42mm projectile being launched, the muzzle heat is increased by 100 (no correlation with the initial velocity of the 42mm projectile). The penalty for exceeding the speed limit is as follows:

(1) When $V_0$ < $V_1$ <= 1.1 x $V_0$, every time the referee system detects a 42mm projectile, it deducts 10% of the robot's maximum HP;

(2) When 1.1 x $V_0$ < $V_1$ <= 1.2 x $V_0$, every time the referee system detects a 42mm projectile, it deducts 20% of the robot's maximum HP;

(3) When 1.2 x $V_0$ < $V_1$, every time the referee system detects a 42mm projectile, it deducts 50% of the robot's maximum HP;

## 3.3.1.2 Robot Chassis Power Consumption Limits

A robot's chassis is the mechanism that carries the power system and accessories that allow it to move. Chassis power consumption refers to the power that enables the robot to move horizontally, excluding power used for special tasks, such as functional movements that include moving the upper mechanical structure.

The chassis power of the robot will be continuously monitored by the referee system. After the power is exceeded, the system will trigger the penalty mechanism. The Standard Robot and the Hero will lose HP.

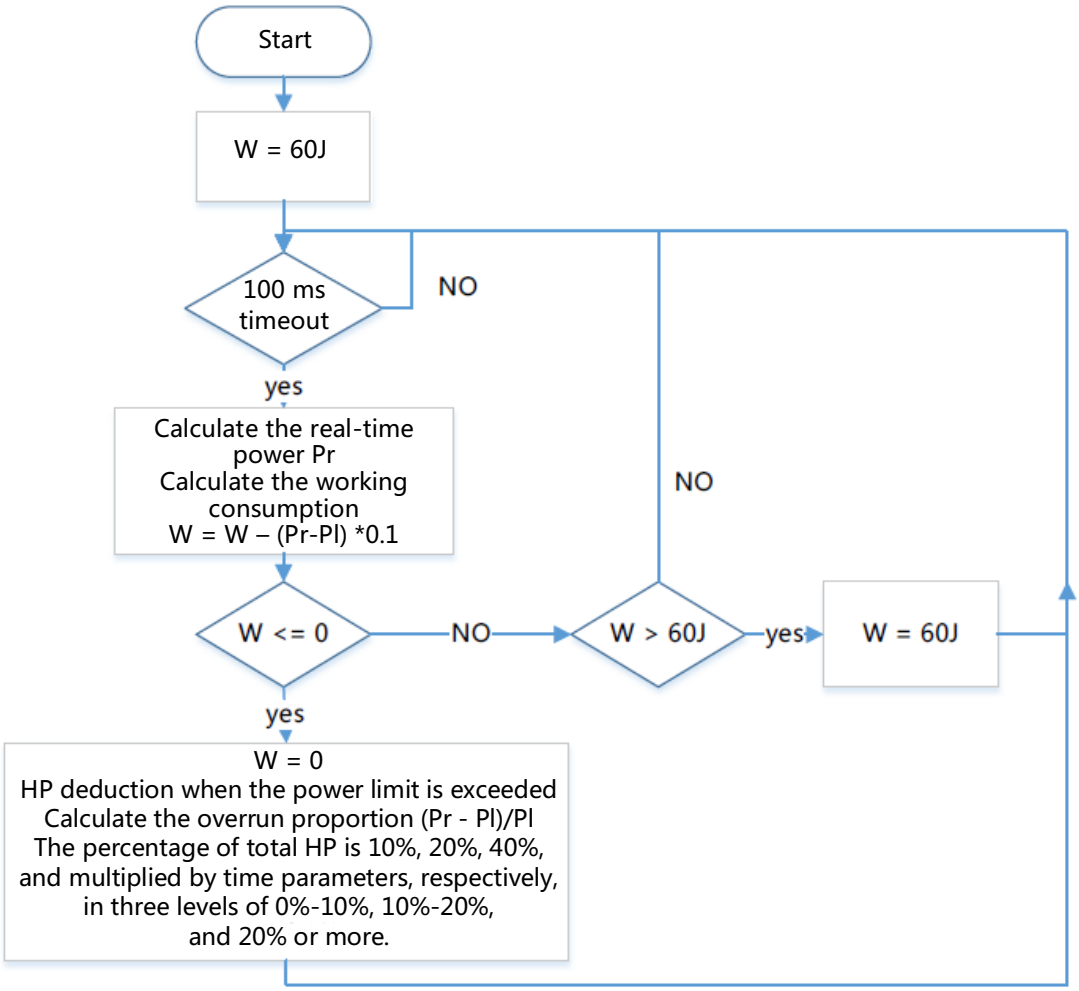
| Robot type | Power upper limit (Watts) |
| --- | --- |
| **Standard Robot** | 80 |
| **Sentry** | 20 |
| **Hero** | 80 |
| **Aerial** | No limit |
| **Engineer** | No limit |

**Violations and Penalties:**

**1. Standard Robots and Heroes:**

The amount of HP deducted due to exceeding chassis power consumption limits depends on the chassis power overrun ratio. The formula for the overrun ratio is: (Pr-Pl)/Pl, where Pr represents the instantaneous chassis output power, and Pl represents the defined power value specified by the competition. For the specific values, refer to the above table. If the chassis power consumption overrun is less than or equal to 10%, 10% of the robot's maximum HP is deducted. If the chassis power consumption overrun more than 10% and less than 20% (including 20%), 20% of the robot's maximum HP is deducted. If the chassis power consumption overrun exceeds 20%, 40% of the robot's maximum HP is deducted.

Considering the fact that it is difficult to control instantaneous output power when the robot is in motion, the competition defines a buffer energy, W, on the referee system server, which is equal to 60 joules. The frequency of chassis power consumption detection by the referee system is 10 Hz. The logic for the whole detection and HP deduction is shown below:

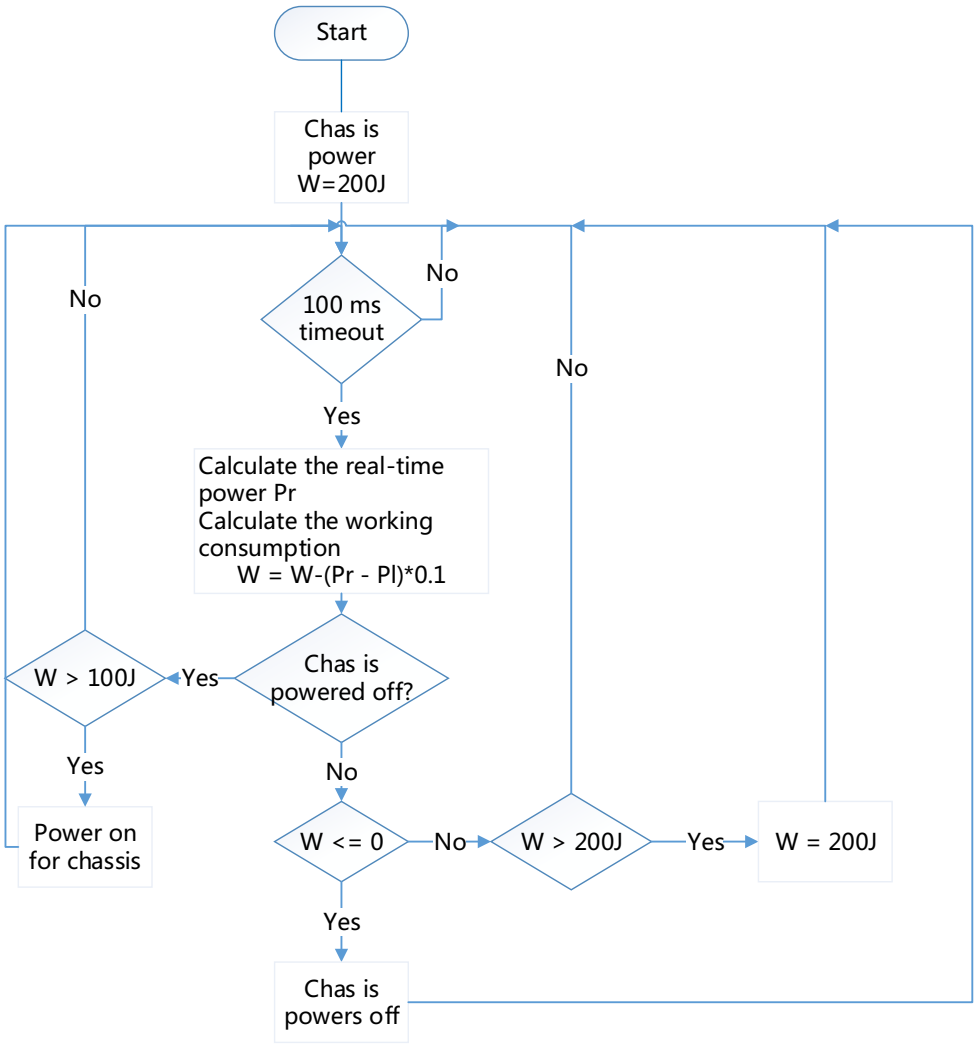



For example: Take the 80W limit of a level 3 Standard Robot chassis as an example. If the Standard Robot continues to output at 140W, then 60J of energy will be consumed after 1S. In the next 100ms detection period, the calculated overrun ratio is (140-80) / 80 = 75%. This exceeds the limited by 20% and the HP deduction is 300 x 40% x 0.1 = 12.

**2. Sentries**

Considering the serious impact of a Sentry being destroyed in a match, exceeding the power consumption limit of the Sentry chassis will not result in an HP deduction; the chassis will be powered off instead. 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:




### 3.3.1.3 Armor Attack

The armor module detects damage sources base on its pressure sensor feedback and the frequency of itself receiving hit. Damage sources are divided into projectile damage and collision damage. Different types of damage will cause a different amount of deduction on robot's HP. 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.

Launching projectiles at an enemy robot's armor modules is the only permitted attack method. Collisions and throwing objects or robot components from within the Battlefield are prohibited.

The HP damage caused by 17mm and 42mm projectiles is also different. The following is the data of the armor module projectile test for HP damage, for reference only. Please note that situation during the actual competition may vary, and the results are subject to the determination of the Referee System.

Whenever the armor module is hit by an impact (by any part of the other robot, its structure hits the

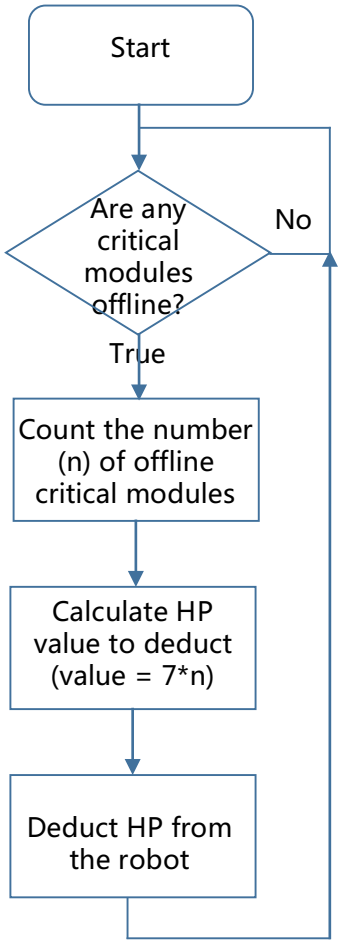
field props, etc.), the robot will lose 2 HP.

| Attack types | Damage Value |
| --- | --- |
| **42mm projectiles** | 50 |
| **17 mm projectile** | 10 |
| **Collisions** | 2 |

The triangle armor at the top of the base can only detect 42mm projectiles, and the damage of the 42mm projectile is 3 times that of ordinary armor. That is, when the Hero shoots the 42mm projectile to the top triangular armor of the base, the base HP is deducted by 150.

### 3.3.1.4 Offline Referee System

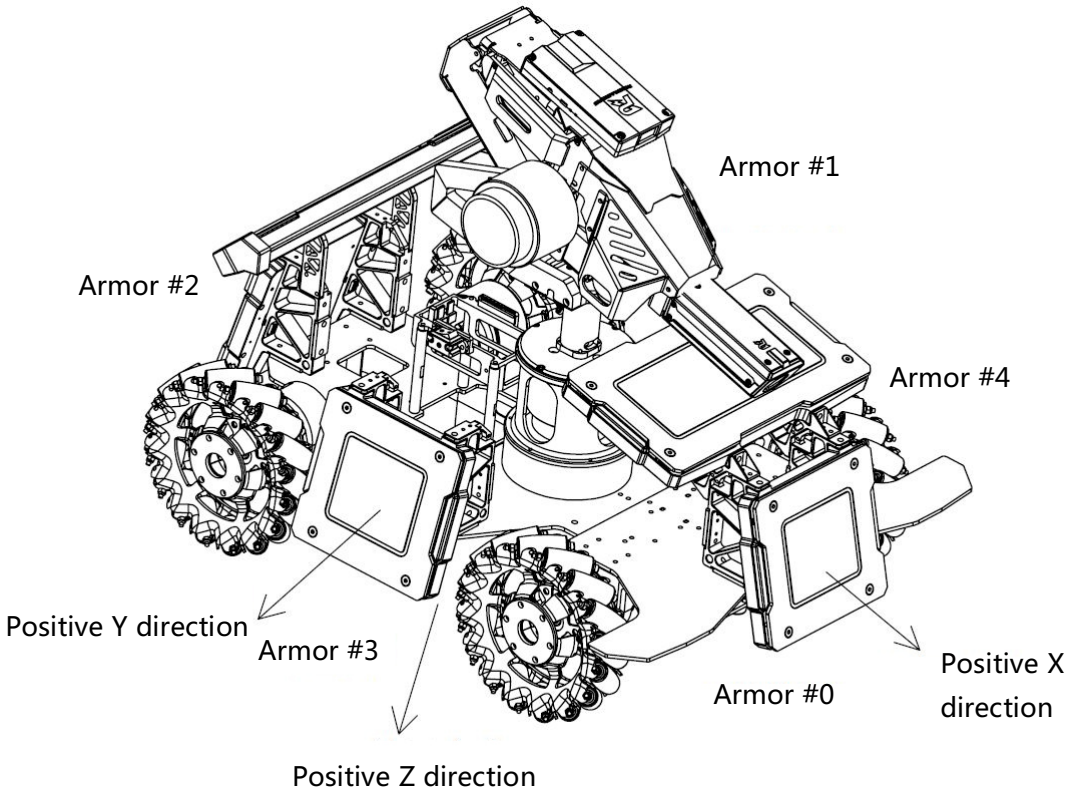
According to the "RoboMaster 2019 Robotics Competition Referee System Specification Manual", the referee system module of the corresponding robot is installed, and the stability of each module and server connection of the referee system must be maintained during the game. The referee system server detects the connectivity of each module at 2 Hz. Due to problems such as the design and structure of the robot, the important modules of the referee system are offline, that is, the speed measure module, the positioning module, and the armor module, and the corresponding amount of robot HP will be deducted.



The armor module must be configured with the correct ID number before the Prematch Inspection. The specific requirements are as follows:

**Standard Robots and Heroes:**

According to the robot coordinate system established by the armor module installation requirements, the armor module ID in the positive direction of the X axis is set to 0, the armor module ID in the negative direction of the Y axis is set to 1, and the armor module ID in the negative direction of the X axis is set to 2, and the armor module ID in the positive direction of the Y axis is set to 3. The negative direction of the Z axis is No. 4, that is, after entering the armor ID and setting mode, hit the armor module in the positive direction of the X axis, the negative direction of the Y axis, the negative direction of the X axis, the positive direction of the Y axis, and the negative direction of the Z axis in order to complete all the armor module ID settings for the robot. (The side armor module ID specification setting is there mainly to indicate the direction of the attacked robot in the operator's operation page, and the data output of the referee system "real-time HP change information" also references this)




**Engineer:**

The Engineer has four pieces of armor, and the positive direction of the Video Transmitter Module at the start of the match is the positive X-axis direction of the robot's coordinate system. The armor module ID in the positive direction of the X axis is set to 0, the armor module ID in the positive direction of the Y axis is set to 1, the armor module ID in the negative direction of the X axis is set to 2, and the armor module ID in the negative direction of the Y axis is set to 3.

**Sentry:**

The Sentry has 2 pieces of armor, the armor ID is 0 for the one facing the base zone, and 1 for the other piece.

## 3.3.2 Level Up

When a round begins, all the robots start with 0 experience points. Heroes and Standard Robots start at Level 1. During a match, Standard Robots and Heroes gain experience automatically each minute and by destroying enemy robots. After a level up, if there is excess experience, it is counted towards the next level.

During a 7-minute round, Standard Robots gain 1 Experience Point per minute, and Heroes gain 2 Experience Points per minute. If a robot is destroyed, its original Value of Experience Points remains unchanged, but the robot will no longer obtain automatic per minute Experience Point gains while it remains destroyed.

The Experience Point requirements for leveling-up Heroes and Standard Robots are as follows:

| Robot type | Level 1 – Level 2 | Level 2 – Level 3 | Experience Points Gained Per Minute |
|---|---|---|---|
| **Standard Robot** | 3 | 6 | 1 |
| **Hero** | 8 | 12 | 2 |

One robot attacks the armor module of an enemy robot until the enemy robot's HP falls to 0, destroying the robot.

During a match, one robot can obtain the corresponding Value of Experience Points by destroying an enemy robot (the result is calculated by the referee system server). There are two situations in which a robot can be destroyed:

1. When a robot gives a fatal blow to an enemy robot, the enemy robot is considered destroyed.
2. If a robot is attacked by one or more enemy robots within 10 seconds before it is destroyed by some other methods (by being attacked by a robot from its own team, exceeding the power consumption limit, exceeding the speed limit, etc.), this robot is considered to be have been destroyed by the last attacking enemy robot.

The Experience gained from destroying different types of robots is shown in the diagram below:

| Robot type | Level | Value of Experience Points |
|---|---|---|
| **Standard Robot** | Level 1 | 2.5 |
| | Level 2 | 5 |
| | Level 3 | 7.5 |
| **Hero** | Level 1 | 7.5 |
| | Level 2 | 10 |
| | Level 3 | 15 |
| **Engineer** | / | 5 |
| **Sentry** | / | 7.5 |

After a robot levels up, its barrel heat limit, heat cooling speed, experience, and maximum HP values all increase. Its maximum HP also increases.

The amounts of HP Gain at each level are as follows:

| HP Gain by a Standard Robot when Leveling Up | | |
|---|---|---|
| **Level-Up Type** | **HP Gain** | **Maximum HP** |
| **Level 1 – Level 2** | 50 | 250 |
| **Level 2 – Level 3** | 50 | 300 |
| **HP Gain by a Hero when Leveling Up** | | |
| **Level-Up Type** | **HP Gain** | **Maximum HP** |
| **Level 1 – Level 2** | 200 | 500 |
| **Level 2 – Level 3** | 200 | 700 |

## 3.3.3 Revival

**Revival Procedures**

When a team's robot is in a destroyed state and has been in cooldown since it was destroyed, it can then be revived. **The robot that is ejected due to a Level Four Warning is not eligible for resurrection.**

One robot can transport a destroyed robot to the Regeneration Point of its own Restoration Zone. When the destroyed robot detects the RFID Interaction Module of the Regeneration Point, it will be revived after a certain period. A revived robot maintains the level and Experience it had before it was destroyed, its HP is restored to 20% of the maximum HP, and it has 100% defense within 10 seconds of being revived.

The cool-down times of different robot types are shown below:

| Robot type | Regeneration Point RFID Interaction Module |
|---|---|
| **Standard Robot** | After being destroyed for the first time, when the RFID Interaction Module of the destroyed robot detects the RFID Interaction Module of the Regeneration Point for 5s, it is revived. After each revival, the detection time of the site interaction module required for revival is increased by 10s. |
| **Hero** | After being destroyed for the first time, when the RFID Interaction Module of the destroyed robot detects the RFID Interaction Module of the Regeneration Point for 10s, it is revived. After each revival, the detection time of the site interaction module required for revival is increased by 10s. |
| **Engineer** | After being destroyed for the first time, when the RFID Interaction Module of the destroyed robot detects the RFID Interaction Module of the Regeneration Point for 20s, it is revived. After each revival, the detection time of the site interaction module required for revival is increased by 10s. |
| **Sentry** | Unrevivable |
| **Aerial** | Unrevivable |

**Recovery Procedure:**

When a robot is at the Regeneration Point area with its RFID interaction module, it will recover health at an amount equal to 5% of its maximum HP per second until its HP is fully restored.

## 3.3.5 Installation Specifications

The referee system is officially provided by the RM2019 Organizing Committee. It can record when the robot is attacked during a match, such as the HP, initial speed, and chassis power consumption and sends real-time information to the corresponding Operator Room computer and the referee system server to automatically determine the outcome of the match to ensure the fairness of the competition.

Teams must reserve the mechanical and electrical interfaces for installing the Referee System on their robots. Robots that do not meet the Referee System installation requirements fail the prematch inspection and cannot enter the stage

The RoboMaster 2019 Robotics Competition referee system consists of the following modules:

| Module | Purpose |
|---|---|
| **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** | Consists of an armor plate and a sensor to detect when the robot is hit by a projectile and collisions and deducts the corresponding HP. |
| **RFID Interaction Module** | Communicates with the functional areas of the battlefield to achieve the corresponding functions. |
| **Positioning Module** | The positioning module determines the robots' location on the battlefield and communicates with the main server. |
| **Main Control Module** | Monitors all referee system modules, sends the real-time status of the robot to the server, and provides authorization to connect to the competition server. |
| **Power Management Module** | Controls the chassis, gimbal, and power of the Launching Mechanism 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. |

Refer to the RoboMaster 2019 Robotics Competition Referee System Specification Manual for the installation interface and detailed dimensions of the referee system.

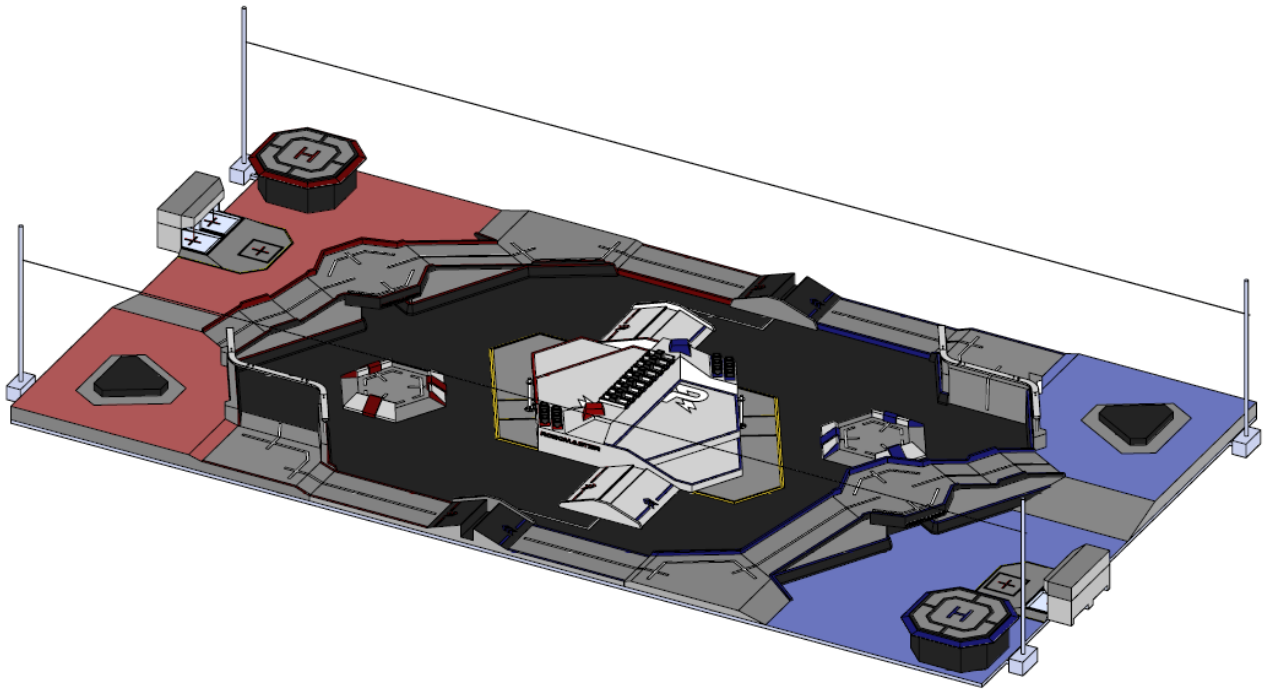
# Chapter 4: Competition Area

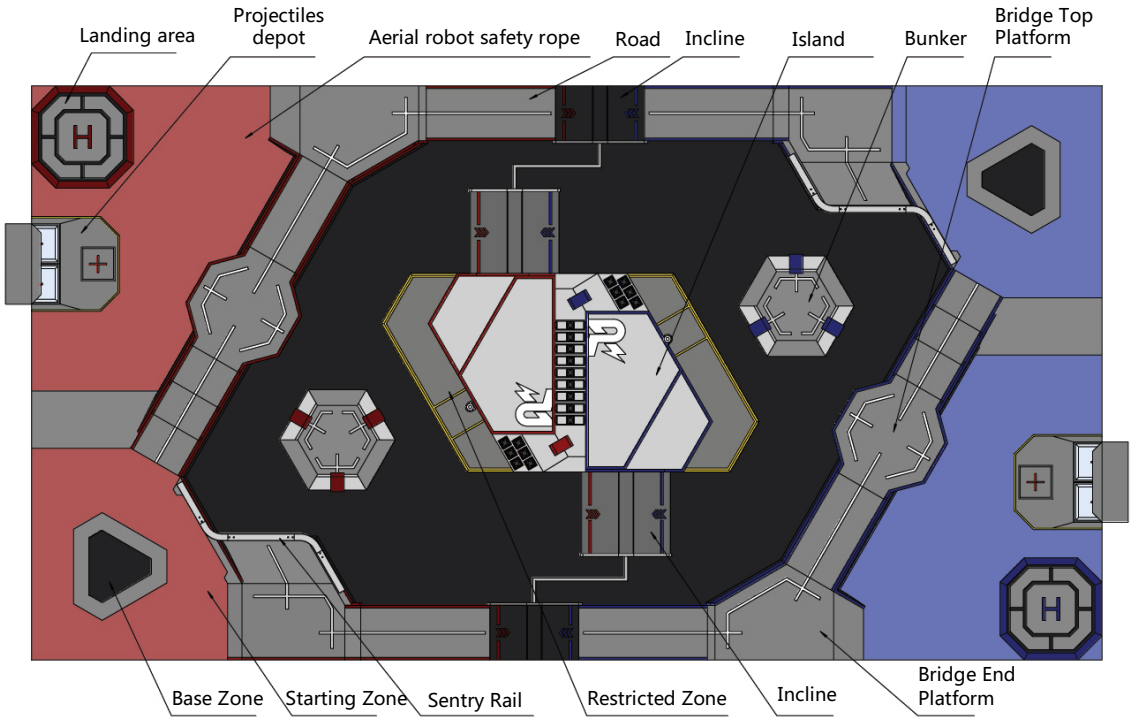
## 4.1 Competition Area Overview

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 Zones, Restoration Zones, Bridges, Open Zones, Resource Islands, and Flight Zones.

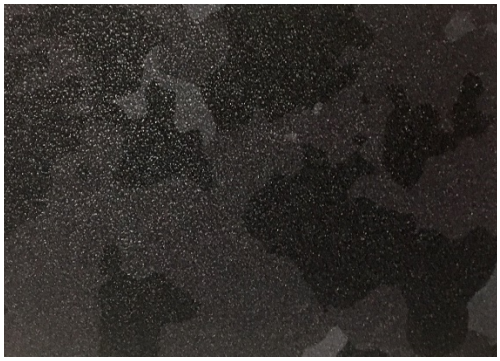
**Note:** The error margin of all Battlefield Components described in the chapter is within ±5%.

The battlefield is shown in the figure below:






The battlefield is laid with sand-grained rubber with a thickness of 3mm. The Resource Island is laid with sand-grained rubber with a thickness of 3mm; part of the surface of the Resource Island is covered with paint. The rubber substance is made of PVC. The reference picture is as follows:

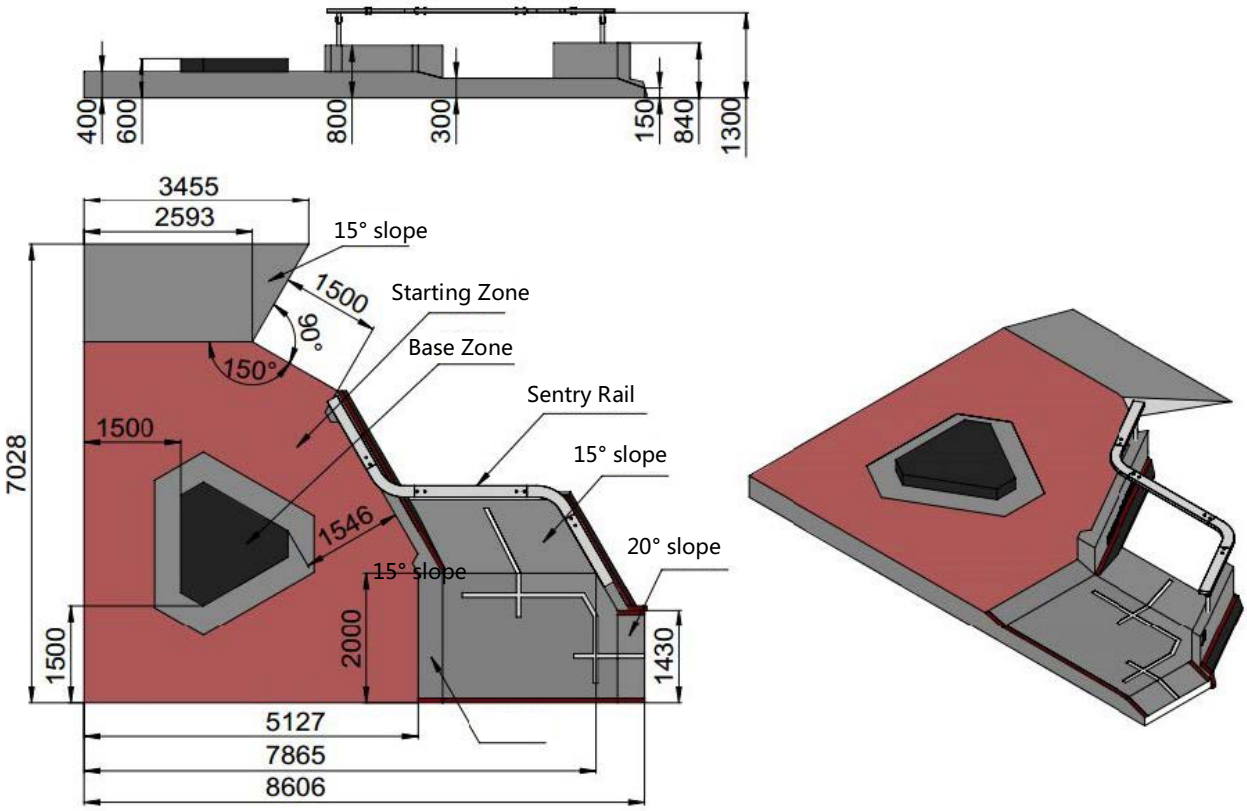


## 4.2 Starting Zone

**Area 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 area 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:**

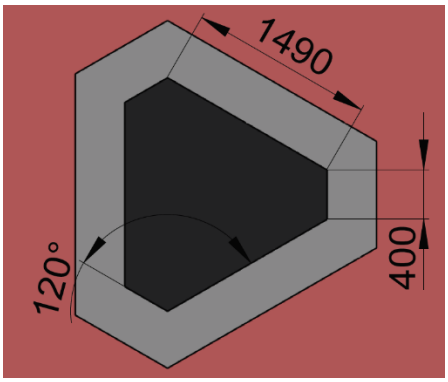


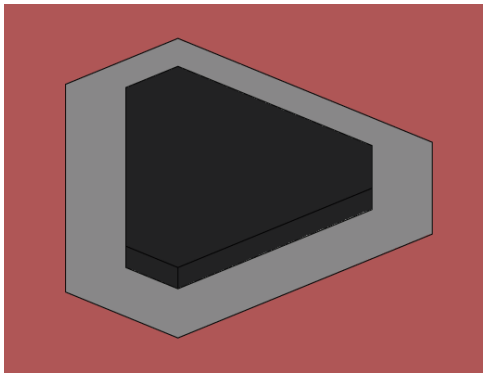

## 4.2.1 Base Zone

**Area Description:**

The Base Zone is a hexagonal platform located on top of the Starting Zone. Its top surface is 200mm 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 forbidden zones for robots of both teams. Robots of either side are not allowed to enter the base restricted zone. For specifics, see **Combat Rules**.

**The Base Zone is shown in the following figures:**



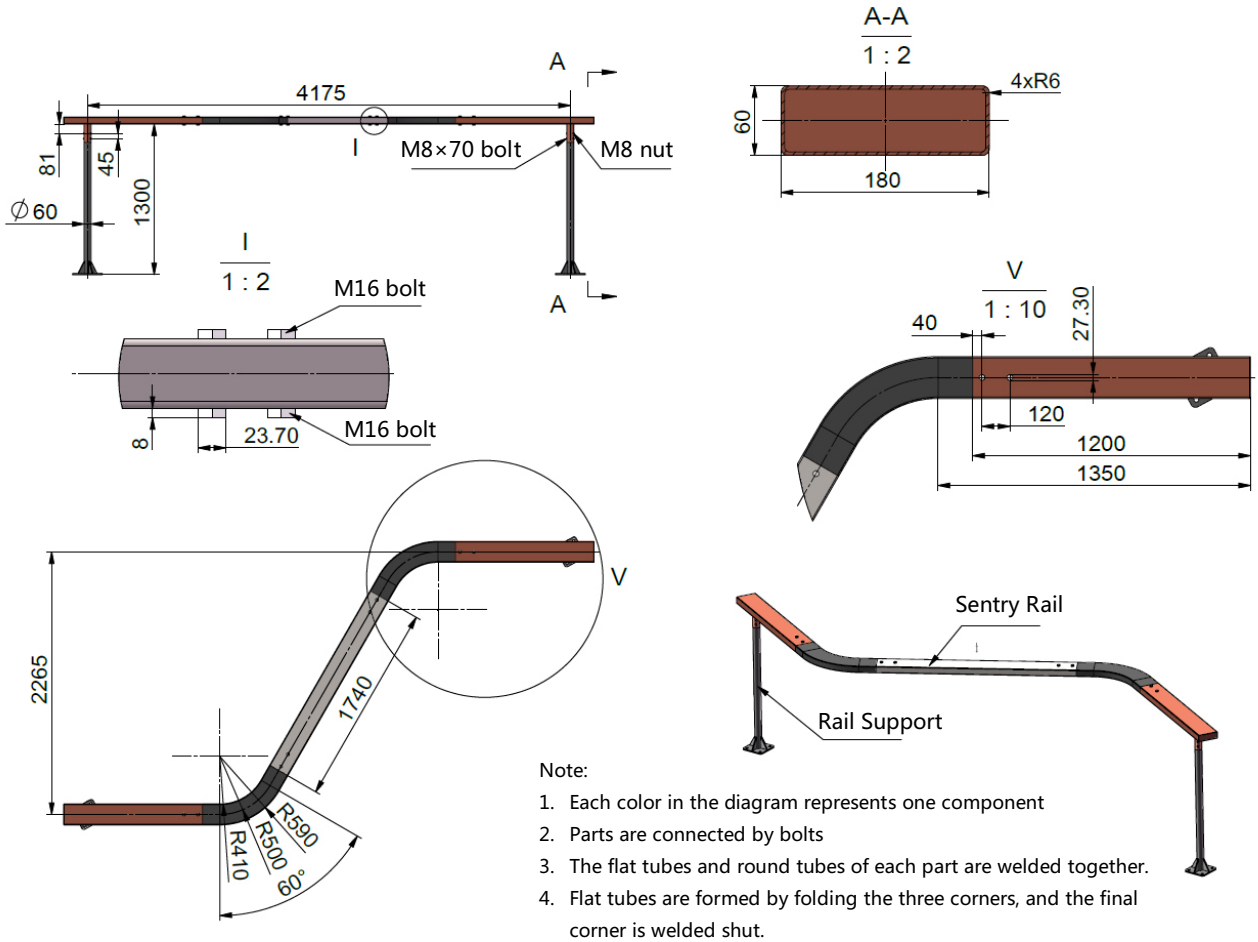
## 4.2.2 Sentry Rail

**Area Description:**

The Sentry Rail consists of two parts: the main rail and its supporting frame. The Sentry Rail is the only place on which a Sentry robot can move and operate. The distance between the lower surface of the Sentry Rail and the battlefield ground is 1300mm. Due to the weight of the rail and other factors, there is a certain height difference between the middle and the ends of the Sentry Rail. Therefore, the distance between the lower surface of the rail and the ground of the battlefield is 1250-1300mm.

During the 3-Minute setup period, the Sentry mounts its own mechanism on the main body of the rail, and must be steadily running or fixed on the Sentry Rail. If the Sentry seems unstable during the setup period which has a risk falling to the ground. Team members need to solve the problem at the request of the referee. Otherwise, the unstable Sentry will be ejected. The actual situation is judged by the chief referee.

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




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

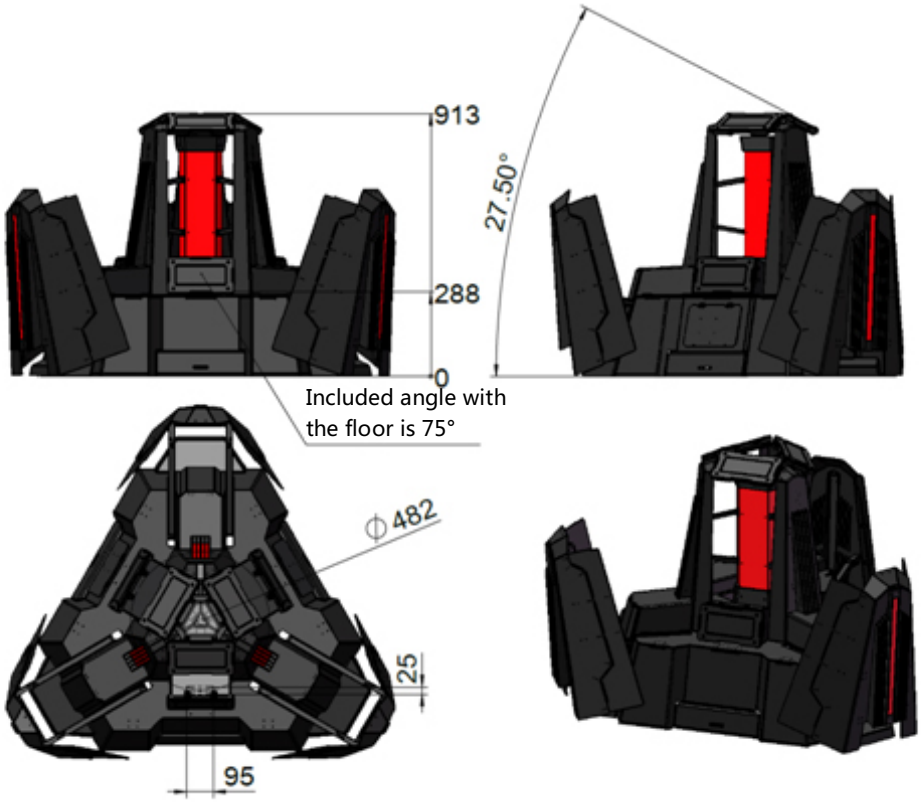
Both the red team and blue team has a base. Each base has 2000 health points in total. There are 3 large armors and 1 triangular armor installed on the top of the base. There are 3 large armors installed in the middle of the inner fuselage with the corresponding number 8 sticker attached to the them. See **Appendix 5 Reference Pictures** for details. The triangle armor at the top of the base can only detect 42mm projectiles. The damage register from ordinary armor. From example, when the Hero shoots the 42mm projectile to the top triangular armor of the base, the base HP is deducted by 150.

At the beginning of each match, bases are Invincible, and the base shield is closed.

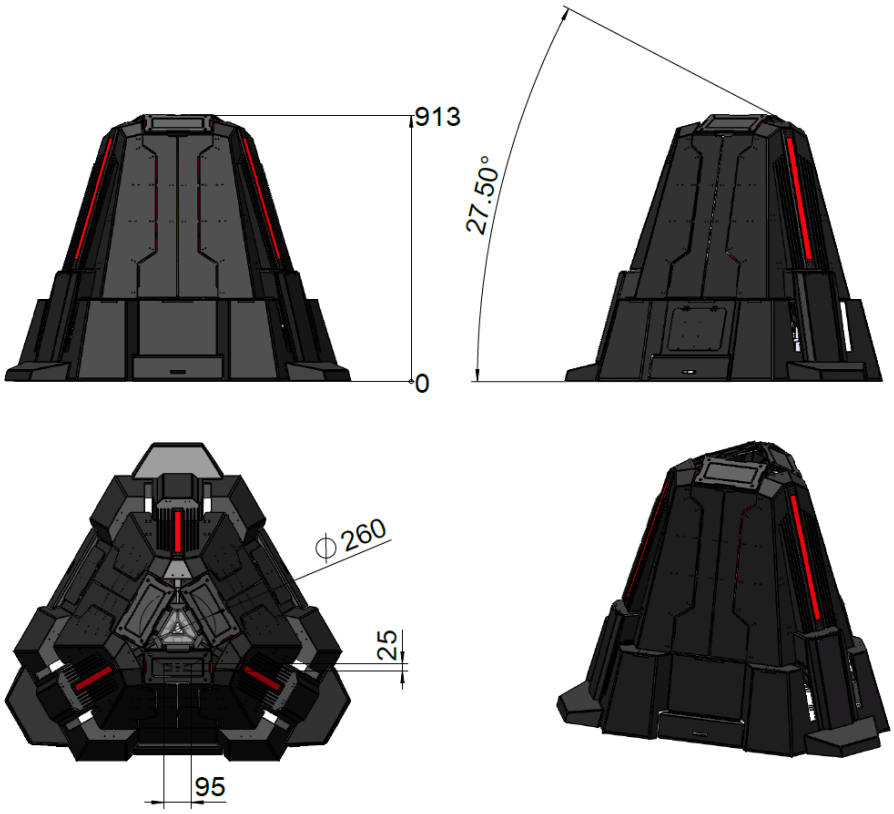
If a team has a Sentry on the stage, when there is a robot (except Sentries and Aerials) dies due to either enemy attacking, collision on the armors, orthe referee system modules offline (including ejection by the server), the base on that team will only have **50%** defense bonus. When the Sentry is destroyed, the base won't have any defense bonus, and the base shield will be opened.

If a team does not have a Sentry on the stage, when there is a robot (except Sentries and Aerials) dies

due to either enamy attacking, collision on the armor, or the referee system module offline (including ejection by the server) within two minutes period from the start of the match, the base defense bonus of that team will be reduced from **100%** to **50%**. The team won't have any base defense bonus after two minutes from the start of the match, and the base shield will be opened.
The following is a schematic diagram of the base, and the subsequent drawings with the top triangular large armor will be updated:




**Base with shields open**

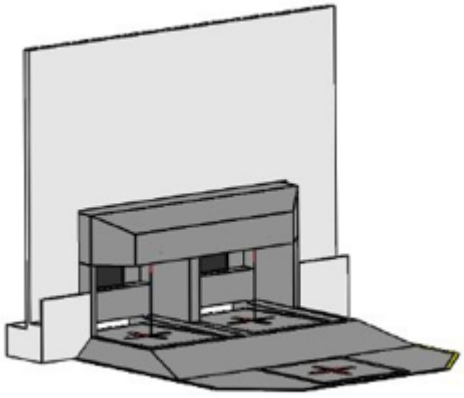


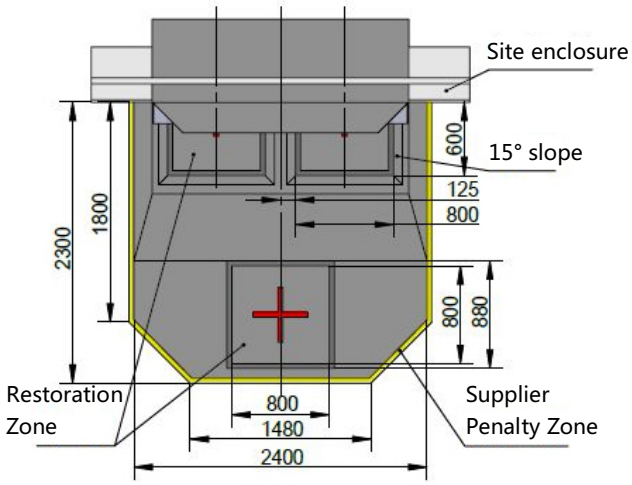

**Base with shields closed**

## 4.3 Restoration Zone

**Area description:**

Red and blue teams each have one Restoration Zone. The Restoration Zone of one team is the Supplier Penalty Zone for the opposite team. The Restoration Zone contains three Regeneration Points and a Supplier exit. It is an important area for robots to reload projectiles, revive destroyed robots, and regenerate HP. Images and dimensions of the bridges are as follows:






**Note:** The Supplier exit is large. To prevent projectiles falling to the ground during reloading, we recommend that the team increase the size of the robot's projection loading port.

## 4.3.1 Restoration Zone

**Area description:**

Three 800 x 800 mm area with several RFID Interaction Modules laid out under the floor. When the RFID interaction modules communicate with the RFID modules in a robot's Referee System, the destroyed robot begins regenerating. For specific implementations, see **3.3.3 Revival**

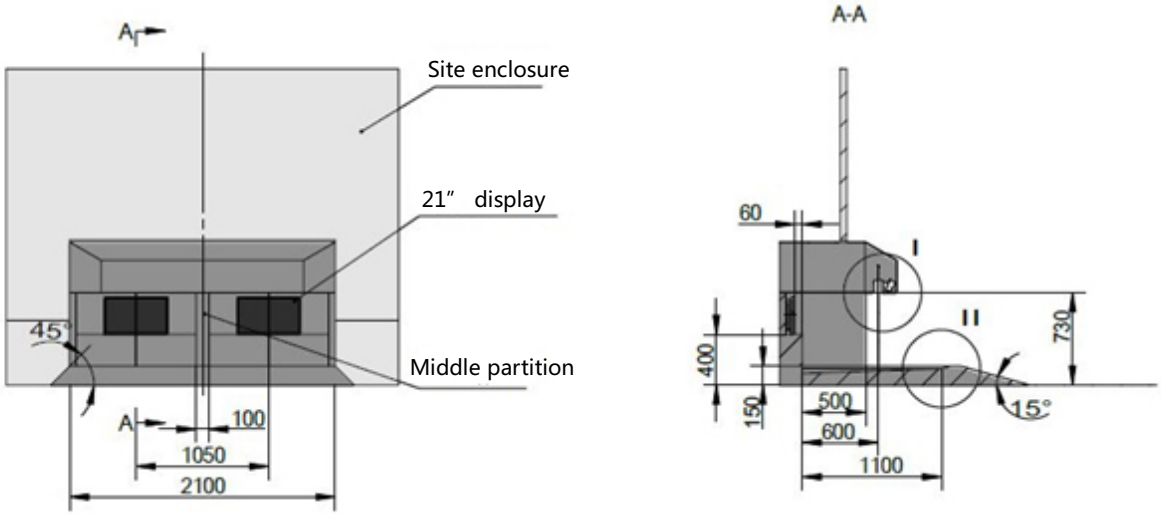
## 4.3.2 Supplier Penalty Zone

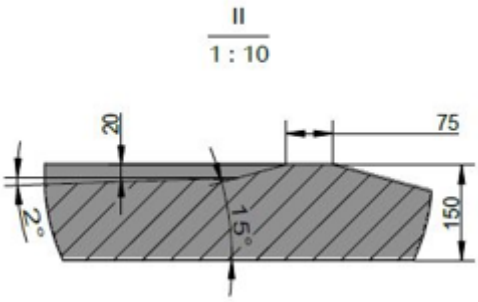
**Area description:**

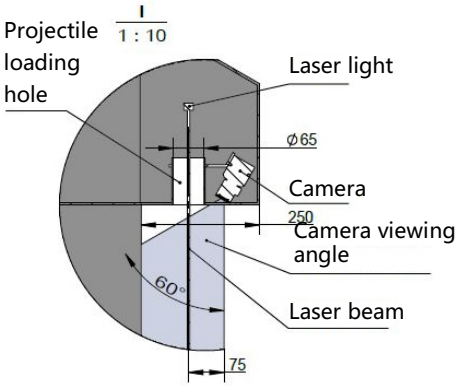
Restoration zones are Supplier Penalty Zones for enemy robots, and enemy robots are forbidden to enter the space within and above the 2300 x 2400mm yellow boundary area. Opposing robots are prohibited from entering the Supplier Penalty Zone. Please refer to **Combat Rules** for specific penalty details.

## 4.3.3 Official Projectile Supplier

Suppliers provides 17mm projectiles during a match, and each team has its own Supplier. At the beginning of each match, the Supplier will be issued 200 rounds of 17mm projectiles, and then **150** rounds of 17mm projectiles will be issued every minute thereafter. The Supplier is directly controlled by the operator from the Operator RoomOperator Room using an operation interface. Suppliers have two projectile exports, an auxiliary alignment laser sight, a camera, and a monitor. When the robot is in the position of the supply station, the exit port 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 by the laser of the auxiliary laser sight. This allows the operator to determine whether or not to supply the projectile.






# 4.4 Open Zone

**Area description:**

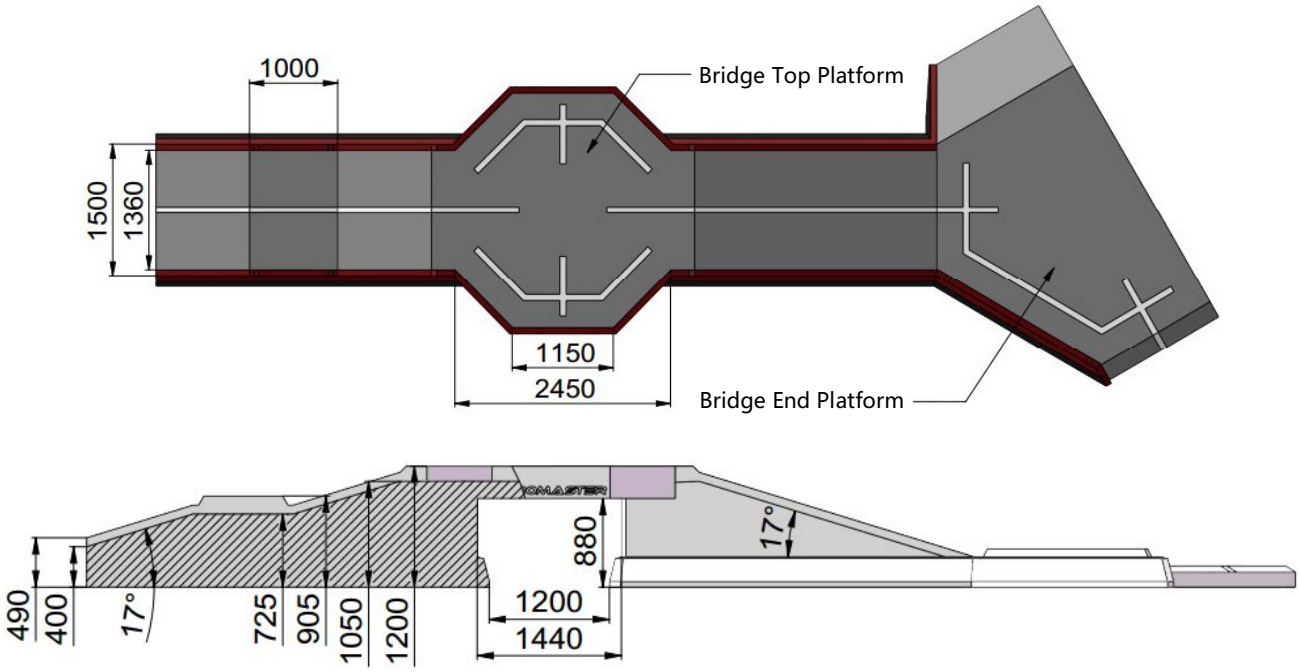
The center of the Battlefield is called the Open Zone. This is an important area during battles and where a majority of the projectile launching, maneuvering, and robot destruction occurs. This area contains Resource Islands and Bunkers, as well as other core elements, including Power Runes, Projectile Containers, and Assistive Column.

## 4.4.1 Bridge

**Area description:**

Bridges connect the Open Zone and Starting Zone and are the fastest path for entering an enemy team's Starting Zone. It includes the Bridge Top Platform and Bridge End Platform.

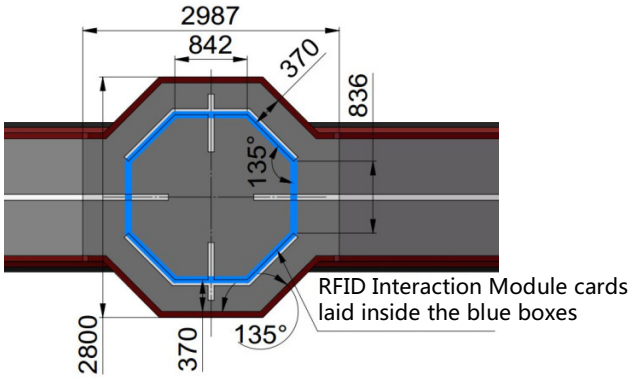
Images and dimensions of the bridges are as follows:



**Bridge Top Platform Description:**

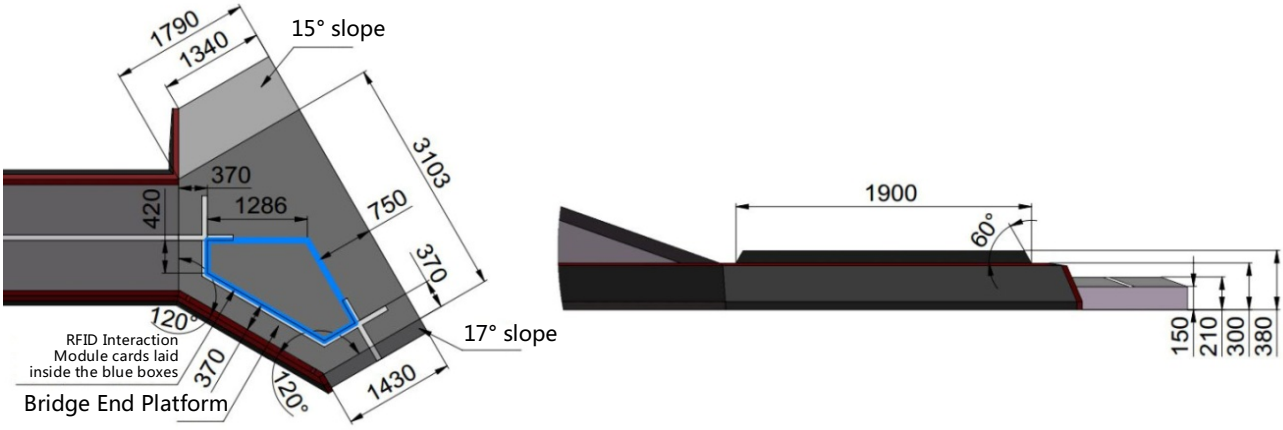
The top surface of bridges is called Bridge Top Platform. A number of RFID Interaction Module cards are laid under the bridge top platforms. When a robot occupies the bridge top platform, the per second cooling rate of its barrel heat is five times faster than normal, and only the robots of the team that first occupies the bridge top platform gain this bonus.

The dimensions of the bridge top platforms are as follows:




**Bridge End Platform description:**

Bridge End Platform are located at the ends of bridges and contain several RFID interaction modules, making them an important strategic location during a match. When a robot occupies a bridge end platform, the per second cooling rate of its barrel heat is five times faster than normal, and only the robots of the team that first occupies the bridge end platform gain this bonus.

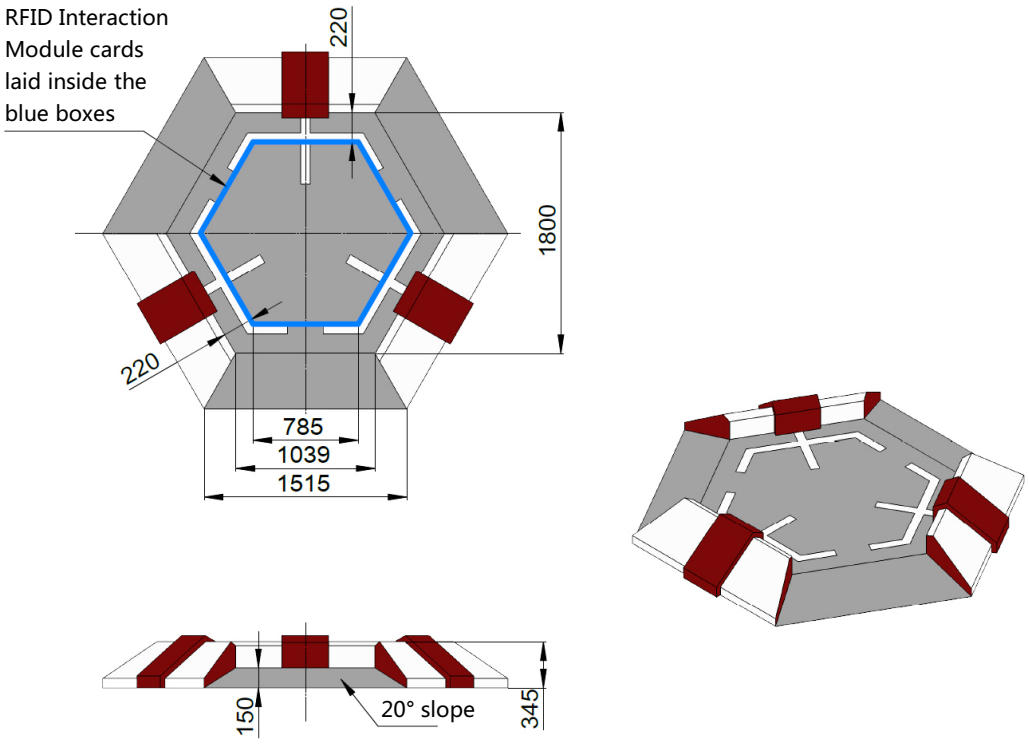



## 4.4.2 Bunkers

**Area description:**

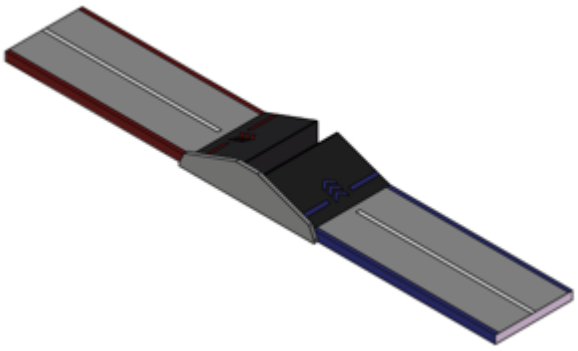
The Open Zone contains two bunkers:one that accelerates the cool-down value of barrel heat, and another that enhances defensive abilities. When a robot occupies a bunker, it receives a 50% defense bonus and the barrel cool-off rate is increased five times. Only the robots of the team that first occupies the bunker gain this bonus.

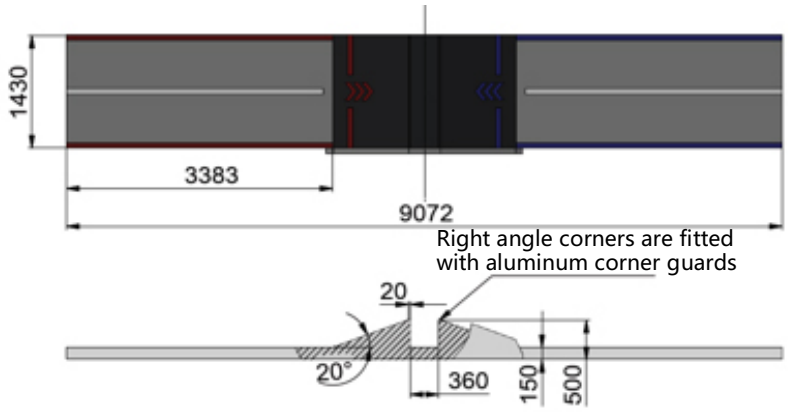
The bunker is shown in the following figure:




## 4.4.3 Roads

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. The specifics are shown in the figure below:

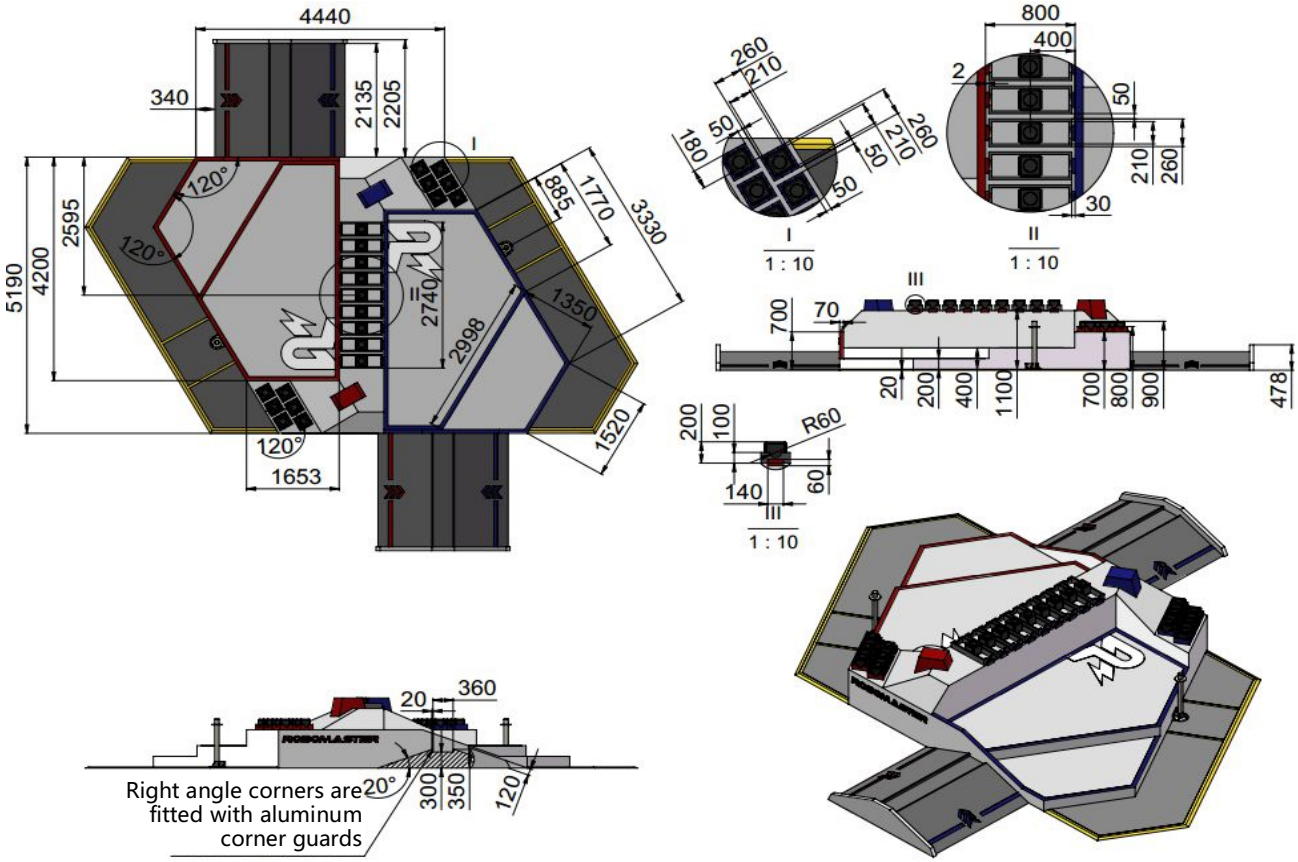





# 4.5 Resource Islands

**Area description:**

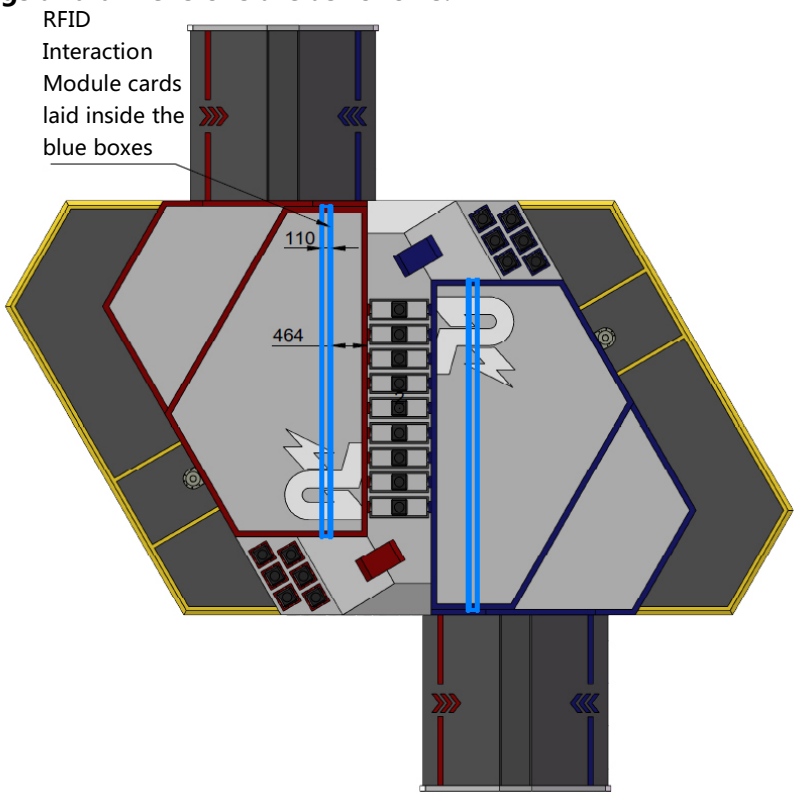
Resource Islands are elevated irregular hexagonal platforms located in the middle of the Battlefield. They include Projectile Containers, Power Rune, and Assistive Column. Engineers of either team are allowed to obtain Projectile Containers from Resource Islands.




There is a line of RFID interaction modules (defense cards) located along the edges of the Resource Islands. When a robot detects one of these defense cards, it receives a 80% defense bonus for 20 seconds. When a robot detects an RFID Interaction Module card again, it receives a 80% defense

bonus for 20 seconds. This bonus will not accumulateive with the previous bonus.

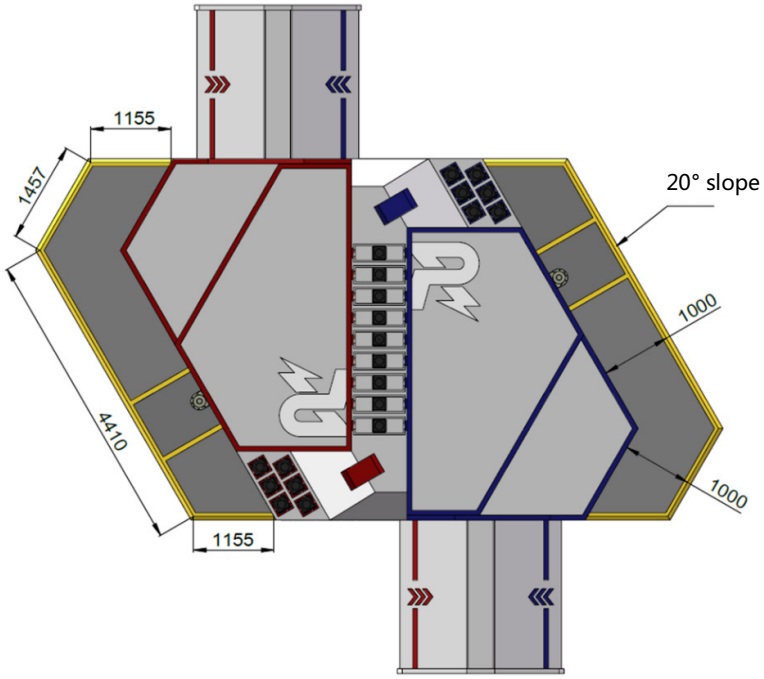
**The specific drawings and dimensions are as follows:**




## 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:




Engineers have priority in the penalty zones around Resource Islands. Standard Robots and Heroes are prohibited from blocking the landing area and the Projectile Container pickup area in the penalty zones around Resource Islands. If a Standard Robot from any team disrupts Engineers who are trying to land, to leave the island, or to pick up Projectile Containers, the violating robot will be penalized. The penalty shall be determined by the Head Referee and the Chief Referee based on the circumstances.

Engineers from any team shall not disrupt the Engineer of the other team who trying to land, to leave the island, or to pick up Projectile Containers. Violating robots will be penalized.

**Violations and Penalties:**

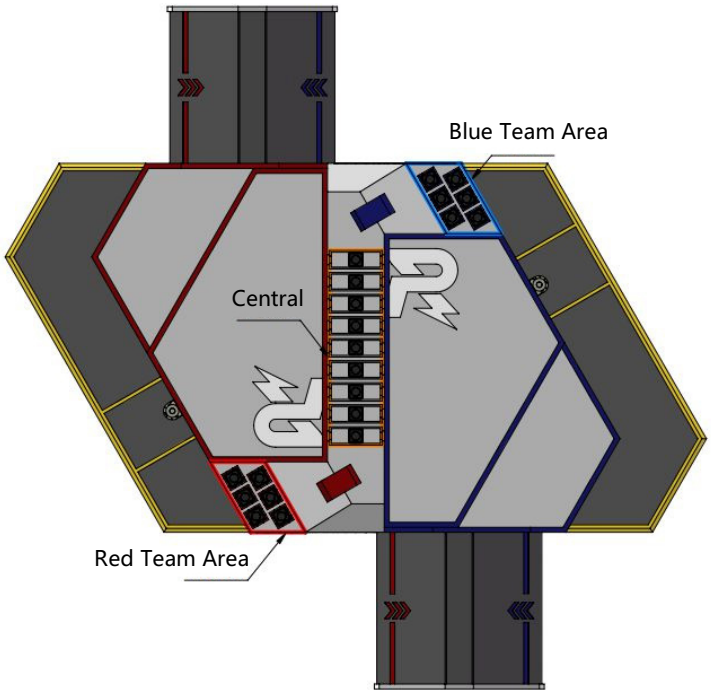
| Regulations | Penalty Standards |
|---|---|
| 1 | If a Standard Robot disrupts an Engineer from the other team that is landing or leaving a resource island or picking up Projectile Containers for a short period of time (less than 3 seconds), the referee will give a Level One Warning to the violator; |
| 2 | If a Standard or Hero disrupts an Engineer robot from the other team that is landing or leaving a resource island or picking up Projectile Containers, for a significant period of time (between 3-10 seconds), the referee will give a Level Two Warning to the violator, and the robot must leave the resource island; |
| 3 | If a Standard Robot or Hero disrupts an Engineer robot from the other team that is landing or leaving a resource island or obtaining Projectile Containers for a long period of time (10 seconds or above), the referee will give a Level Three Warning to the violator, and the robot must leave the penalty area; |
| 4 | If a Standard Robot or Hero is in the resource island penalty area for a long time and repeatedly interferes with or affects other Engineers entering and leaving the resource island or acquiring Projectile Containers, and the other robot gets in a serious collision, the referee will give the violating team a Level Four Warning. The |

| | |
|---|---|
| | actual situation is determined by the Main Referee and Chief Referee. |

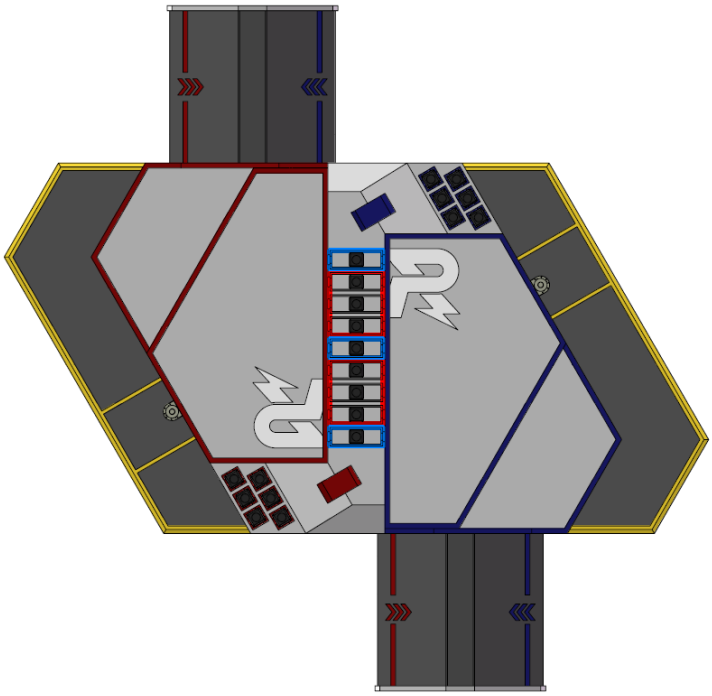
| Regulations | Penalty Standards |
|---|---|
| 1 | If an Engineer disrupts an Engineer robot that is landing or leaving a resource island or picking up Projectile Containers for a short period of time (less than 3 seconds), the referee will give a Level One Warning to the violator; |
| 2 | If an Engineer disrupts an Engineer from the other team that is landing or leaving a resource island or picking up Projectile Containers for a significant period of time (between 3-10 seconds), the referee will give a Level Two Warning to the violator. |
| 3 | If an Engineer robot disrupts an Engineer robot from the other team that is landing or leaving a resource island or picking up Projectile Containers for a long period of time (10 seconds or above), the referee will give a Level Three Warning to the violator; |
| 4 | If an Engineer disrupts an Engineer from the other team that is landing or leaving a resource island or picking up Projectile Containers repeatedly or for a significant period of time and clashes with a robot from the other team, the referee will give a Level Four Warning to the violator. The Head and Chief Referees will make the decision by the actual condition. |

## 4.5.2 Projectile Depot

The resource island is provided with 21 fixed-position Projectile Container grooves, which holds full Projectile Containers. There are 6 Projectile Containers with 6 42mm projectiles in each of projectile depot on both sides of the resource island. There are 9 Projectile Containers in the central area projectile depot, and each Projectile Container is equipped with 20 42mm projectiles.
Before each round begins, side referees will place projectiles in the containers and then place the containers in the appropriate positions on the Resource Islands. Engineers can move or take away them to obtain projectiles.
The location of the projectile container is shown in the following diagram:




At the start of the match, the central area Projectile Container is not raised inside the resource island and will rise twice at specific times of the match. If the Projectile Container is not fully raised and static, the Engineer cannot grab the Projectile Container or obtain the projectiles in the Projectile Container. The blue frame in the central area below identify the Projectile Containers that are raised for the first time, and the red frame identify the Projectile Containers that are raised for the second time. The positions of the Projectile Containers are as shown below:



**Projectile Container**

Projectile containers are 200 x 200 x 200 mm in size; their six faces are chamfered, and they are made

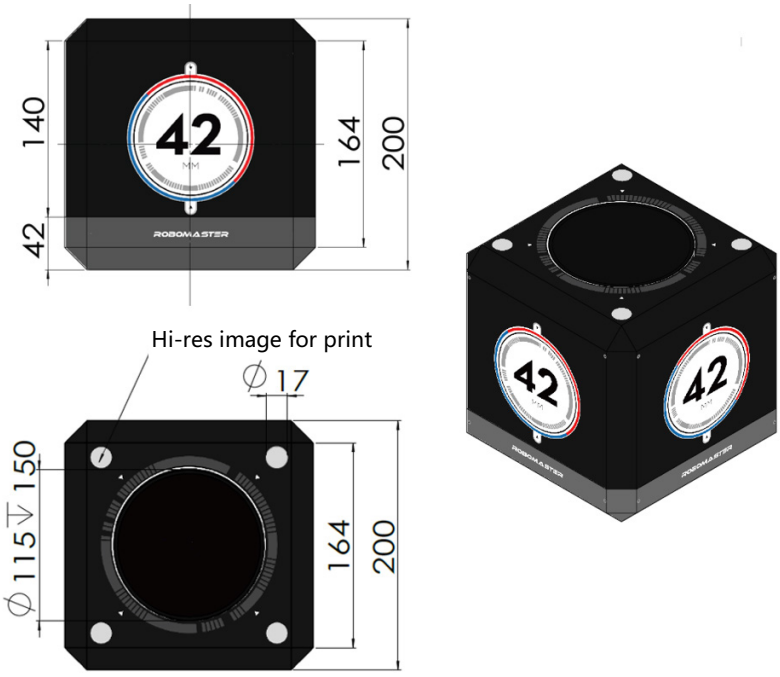
out of EVA. The top surface has a hole with a diameter of 115mm. The hole depths of different types of Projectile Containers are different. The depth of the Projectile Containers in the middle of the resource island is 150mm, and the depth of the Projectile Containers on both sides of the resource island is 75-80mm.

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

**Violations and Penalties:**

1. Any robot under the resource island placing a Projectile Container on the resource island platform will be given a Level Two Warning by the referee.
2. Any robot grabbing a Projectile Container or obtaining projectiles from a Projectile Container without raising the Projectile Container will be given a Level Three Warning by the referee.

The projectile container is shown in the following figure:




**Note:** The pattern on the outer surface of the Projectile Container will be modified and updated later.

## 4.5.3 Assistive Columns

There are two Assistive Columns on both sides of resource islands that are made out of Q235 with a matt surface. Teams can design their Engineer robots to utilize these Assistive Columns to access the Resource Islands and obtain projectiles.

During the match, no robot shall set the Projectile Container on the Assistive Columns of a resource island or place them in the Assistive Column penalty area.

**Violations and Penalties:**

1. Any robot placing a Projectile Container in the Assistive Column penalty area using a mechanical arm or other method (such as shooting) will receive a Level Two Warning. The actual situation is

determined by the head referee according to the situation of the match.

2. During a match, a team will be penalized with a Level Four Warning if any of its robots sets a Projectile Container on the Assistive Column of a resource island.

**Note:**

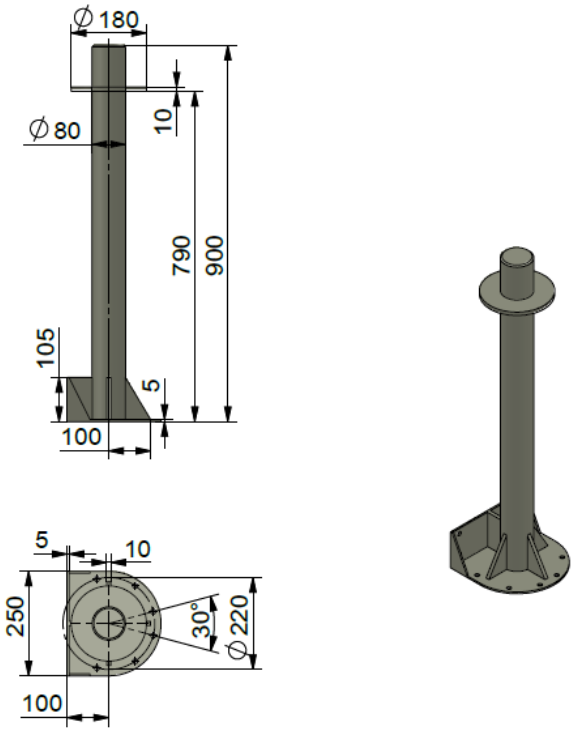
1. The surface of Assistive Columns will be scratched from repeated use so the mechanical structures of robots should be designed with this in mind.

2. Consider the possible impact to robots if there is a Projectile Container on the platform of a resource island and prepare the appropriate solution;

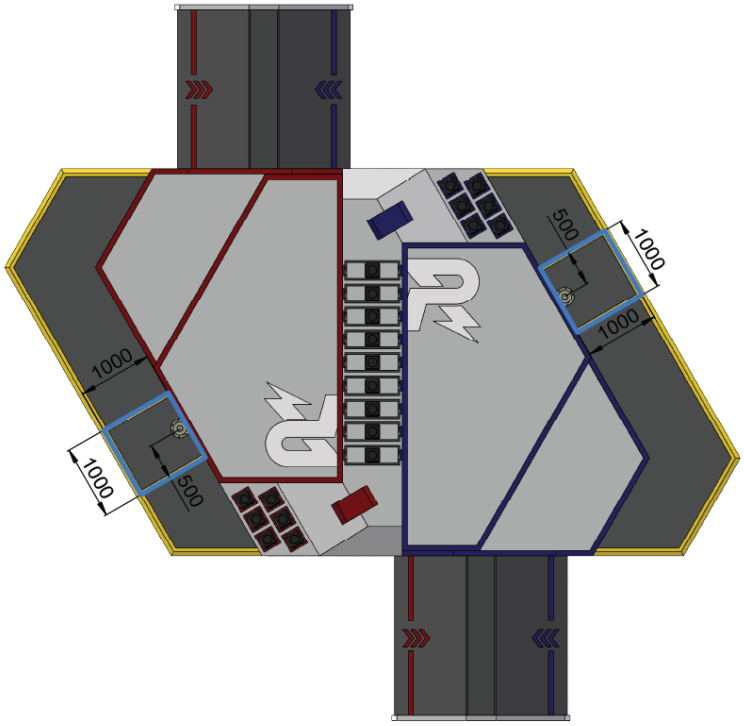
3. If Engineer robot will use the Assistive Columns to land on the island, and their mechanical structures will come into contact with the column. Participating teams should take this into consideration when designing the robots so as to avoid damaging the column.

4. There may be welding spots and painted surfaces where the upper platform of the Assistive Columns and their support tubing intersect. These are a result of unavoidable elements of the production process.

**The dimensions of the Resource Island Assistive Columns are shown in the following diagrams:**




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




### 4.5.4 Power Runes

**Power Runes:**

At the top of the resource island in the center of the battlefield, there is a Power Rune. The specific drawings and implementations will be updated.

## 4.6 Flight Zone

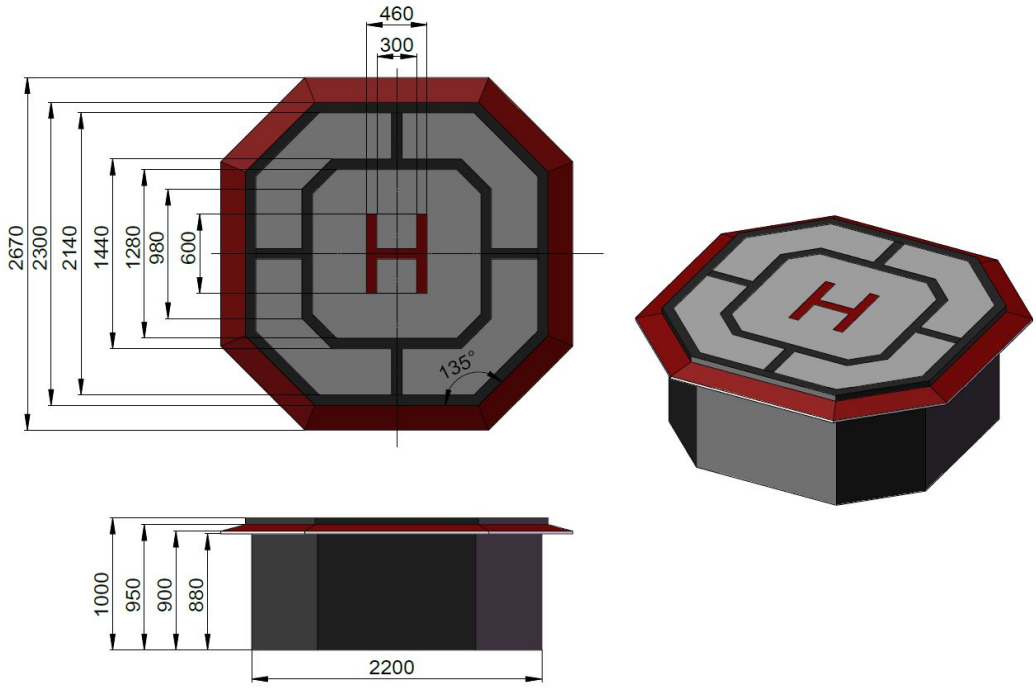
**Area description:**

This is the area where an Aerial robot is permitted to operate. This area includes a Landing Pad and Aerial Safety Rope.

### 4.6.1 Landing Pads

The Landing Pads are where Aerials take off and land. Each team must place their Aerial on their Landing Pad before the start of each round.

The dimensions of the Landing Pads are shown below:




## 4.6.2 Aerial Safety Rope

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 Safety Rope is 3m long.

To limit the flight range and protect the Battlefield, each team must connect their Aerial to the Safety Rope using the bead ring on top of the Aerial's vertical safety rod before each round. The maximum horizontal flight distance of an Aerial is 16 meters from the Landing Pad, with a catch-mechanism in place to prevent the robot from flying outside this distance.

During the competition, the distance between the lowest point of the Aerial during the flight and the floor shall not be less than 1300 mm. No part of the aerial robot's barrel may exceed the top of the battlefield fence. Aerials should pay attention to flight safety during the competition and actively avoid ground robots.

**Violations and Penalties:**

If any part of an Aerial's launching mechanism exceeds the maximum altitude, Pilot Room referees will warn the operator to decrease the altitude of the robot. If the operator ignores this warning, the Aerial will be ejected from the Battlefield with a Level 4 Warning (The video transmission module and launching mechanism are powered off and the robot must immediately land on the landing pad), and the team is not allowed to use it for the remainder of the match.

# 4.7 Operator Room

**Area description:**

Each room contains the computers and referee communication equipment needed for the competition. The Operator Room is the only place where operators can control their robots (except for Aerials) during the competition.

**Properties and Roles:**

During the Regional Competition, the Operator Room includes five computers for operating robots that come with mice, keyboards, USB hubs, headsets and other official equipment. As some equipment, such as mice and keyboards, may suffer from performance degradation over time, we recommend that operators bring their own equipment. However, all operators are responsible for setting up their own equipment during the setup period. There is no power supplied to the operator room. Operators must therefore bring their own power supplies to operate their equipment if necessary.

Aerials have two operators and one projectile loader. One operator,the pilot, controls the flight and the other, the Aerial gimbal operator, controls the gimbal. The projectile loader manually loads Aerials with projectiles.

Aerials can also send FPV video feeds to the Aerial gimbal operator in the operator room, offering an aerial perspective. However, the pilot must stay in a separate pilot room and control the flight path without access to FPV videos. The gimbal operator can send one-way voice commands to the pilot using communication devices provided by the RoboMaster Organizing Committee, but the pilot cannot reply. The projectile loader next to the Pilot Operator Room must wear the long-sleeved shirt, helmet, and goggles provided by the organizing committee. The Pilot can communicate with the Projectile Loader only when Projectiles need to be loaded. During any other times, the Projectile Loader and Pilot may not have any verbal or physical communication.

If one team does not have an Aerial, the Aerial gimbal operator and pilot are not allowed to enter the Operator Room and must watch the match from the Pit Area .

The Standard Robots, Heroes, and Engineers can only have one operator each. The Sentry is a fully automated robot that functions without an operator. One operator can only control one robot and its corresponding computer; these positions cannot be switched after a round has begun.

There are also referees present in the Operator and Pilot Rooms. The referees are responsible for maintaining order during matches, helping to solve any problems in order to ensure normal operation of official equipment during the setup period.

All operators in the Operator room must wear the headsets provided by the RoboMaster Organizing Committee in order to receive instructions from the Head Referee. Aerial gimbal operators are also equipped with a similar microphone to communicate with teammates. Operators, aerial gimbal operators, and pilots cannot leave their post without a referee's permission.

**Violations and Penalties:**

1. The use of an unauthorized power supply in the Operator Room is regarded as cheating.

2. Operators, Aerial gimbal operators, and pilots who leave their post without permission, as well as Projectile Loaders who leave their designated areas, will receive a verbal warning. Failing to comply with this warning will result in a punitive forfeit for the violating team.
3. Operators, Aerial gimbal operators, and pilots who do not wear their headsets will receive a verbal warning. Team Members who do not comply with this verbal warning will be removed from the stadium, and the robots they had been operating will be ejected with a Level Four Warning after the start of the match. The team will not be allowed to have a substitute operator enter the Operator Room.
4. Operators that leave their area after the start of a match will be verbally warned by the Operator Room Referee, and the operator must return to their specified position. Team Members who do not comply with the verbal warning will be sent off the premises and the robots they operate will be ejected with a Level 4 Warning after the start of the match, and the team is not allowed a substitute operator to enter the Operator Room to make up for the position. Moreover, the team may not have a substitute operator enter the Operator Room. If the ejected team member does not comply and leave the premises, the entire team will be penalized with a punitive forfeit for the round.

## 4.8 Projectiles

Launching projectiles is the only acceptable method for attacking other robots. Robots must use projectiles to hit the armor sensors of enemy robots, thereby causing damage to any enemy robots' HP in order to destroy them. Both 17 mm and 42 mm projectiles are used during a match. Their specifications are as follows:

| Type | Appearance | Color | Size | Weight | Shore Hardness | Material |
|---|---|---|---|---|---|---|
| **42mm Standard Projectiles** | Similar to the shape and size of a golf ball | White | 42 mm (±0.5 mm) | 42g (±0.2 g) | 90 A | Plastic (TPE) |
| **17mm Standard Projectiles** | Round | | 16.9 mm (±0.1 mm) | 2.9g (±0.1g) | 90 A | Plastic (TPU) |
| **42mm Light-emitting projectiles** | Similar to the shape and size of a golf ball | Transparent | 42 mm (±0.5 mm) | To be determined | 90 A | Plastic (TPE) |
| **17mm Light-emitting projectiles** | 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 matches.

2. Luminous Projectiles are used in the Final Tournament after the Konckout Stage (top 16).

# Chapter 5: Competition Rundown and Rules

This chapter consists of the core competition rundown, regulations, and the rules of the Chinese Regional Competition , International Regional Competition , Wild Card Competition, and Final Tournament. During the official matches of RoboMaster 2019 Robotics Competition, each team will prepare for the matches in the Preparation Area, arrive at the Inspection Area for prematch inspection of robots, wait for the match 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 those areas will be provided in the corresponding map in the RoboMaster 2019 Competition Manual.

## 5.1 General Competition Rundown

The RoboMaster 2019 Robotics Competition consists of the Group Stage and the Konckout Stage. Before each match begins, all robots need to pass a prematch inspection performed by the RoboMaster Organizing Committee. This is to ensure that all robots fulfill the technical specifications set by the committee for a fairness. All teams must follow referees and volunteers when entering the Competition Area. By the end of each match, teams must clean up the projectiles left in the firing mechanism of each robot and return them to the designated areas.

Matches can be two, three, or five rounds depending on the Competition System. Each round consists of a three-minute setup period and a seven-minute round period. There is also a twenty-second initialization period for the Referee System between the setup period and the round period.

During the setup period, team members can enter the Battlefield to test and set up their robots. When there is 1 minute and 30 seconds remaining of the setup period, the operator needs to go to the Operator Room (including the pilot room) to check whether the official equipment is functioning normally and prepare for the match. In the final 30s, remaining Pit Crew Members must return to the Pit Area. After the setup period, the match enters a twenty-second Referee System Initialization Period.

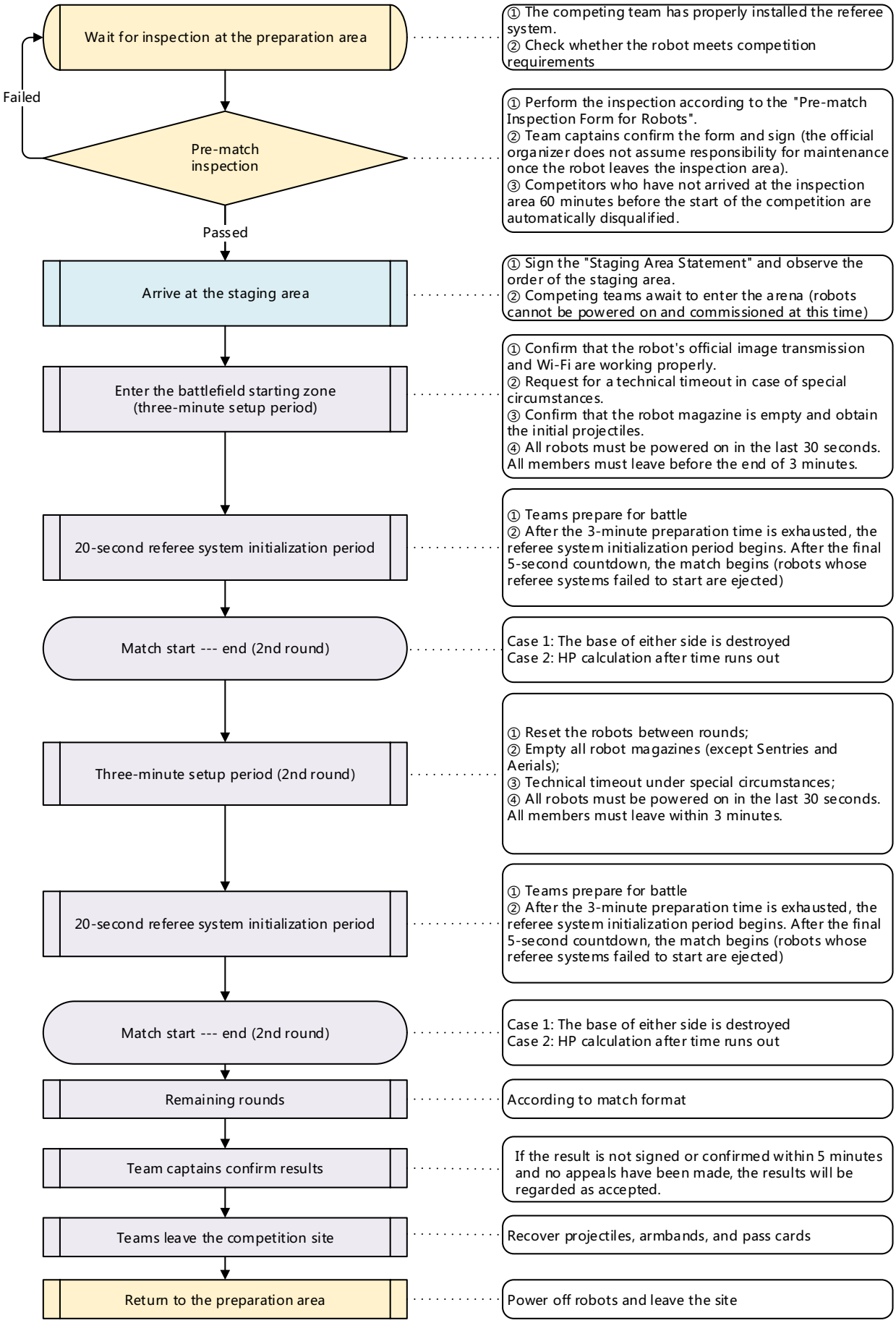
During the last five seconds of the initialization period, competitors will hear a countdown alert sound, and a countdown timer will be displayed, at the same time the keyboard connected to the computer in the Operator Room will be locked. The round starts immediately after the countdown finishes. A round ends either when the seven minutes round is over or one team fulfills the criteria to win the round. When one round ends, the match immediately enters the setup period for the next round. The winner is determined and the match is over.

During every seven-minute match, robots from both teams will compete on the Battlefield. All robots must have the RoboMaster Organizing Committee's Referee System installed for recording projectile hits, monitoring the projectile launching mechanism, and measuring chassis power consumption. The Referee System cuts off a robot's power supply when its Health Points reach zero. During any round, the real-time status of all robots is sent to both the operator's computers and the Referee System's server. The Referee System server determines the outcomes of all rounds automatically. During the rounds, referees will issue penalties for rules violations by robots, operators, Aerial gimbal operators and pilots.

**Note:**

After the end of second round of a BO5 match and of the fourth round, both teams have 10 minutes to work on their robots, and immediately after the end of the 10 minutes, the Setup Period of the next round begins.

**The process of a 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 (2nd 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 an Individual Round:**

Matches consist of two, three, or five rounds, which are traditionally called BO2, BO3, and BO5 respectively. A match can end in one of the following outcomes:

| Competition System | Group Stage | Konckout Stage |
|---|---|---|
| Two-round | 2:0: Winning team obtains 3 points,<br>1:1: Each team obtains 1 point,<br>0:2: Losing team obtains 0 point<br>1:0 (one round tie): The team winning one game gains one point, and the losing team gains 0 points.<br>0:0 (Tie in both rounds): Each team obtains 0 points. | N/A |
| Best of Three | N/A | The team that wins two rounds is crowned the winner |
| Best of Five | N/A | The team that wins three rounds is crowned the winner. |

**Criteria for Winning an Individual Round:**

1. The round ends immediately when the base of one team is destroyed, giving the opposing team a win.

2. When the entire seven minutes of a round is up, if the bases of both teams have survived, the team with the higher number of Base Health Points is the winner.

3. When the entire seven minutes of a round is up, if the bases of both teams have survived and both have the same remaining value of Base Health Points, the team with the higher Damage Output wins.

4. When the seven minutes of a round is up, if the bases of both teams have survived and both have the same remaining value of Base HP, the team with the higher combined HP wins.

If neither team fulfills these criteria, the round is considered a draw. A draw in the Konckout Stage leads to an immediate tie-breaker round until a team wins.

**Rankings for Group Stage:**

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

1. The team with the higher number of match points is ranked higher.

2. If the total match points are the same, the team with the higher number of remaining Base Health Points is ranked higher.

3. If the total remaining Base Health Points are the same, the team with the higher Damage Output is ranked higher.

If two or more teams share the same ranking, the RoboMaster Organizing Committee will arrange playoff matches on a round-robin basis.

**The definitions for the previously-described criteria are as follow:**

1. Damage Output: The total damage accrued by the end of each round from successfully hitting the armor modules of an opposing team's robots and base. The opposing team's HP loss as the result of penalties from the referee is also included in the Damage Output.

2. Remaining Base Health Points:The total number of Base Health Points remaining for one team's Base Zones at the end of each round after deducting the other opposing team's remaining Base Health Points.

3. Total Remaining HP: The total value of the remaining HP of all the surviving robots of a team at the end of each round.

# 5.3 Competition Area Staff

## 5.3.1 Team Member Standards for the Competition Area

1. The team members who enter the Staging Area and Competition Area are all called pit crew members. During each match, up to 14 pit crew members per team (including Supervisors) can enter the Staging Area and Battlefield area to prepare for a match (including the team's Captain, Operators, Supervisor, and Advisors). The captain and at least one Supervisor present at the scene must enter the Battlefield area as Pit Crew Members.

**Violations and Penalties:**

The referee will give a verbal warning to any team that sends more than fourteen pit crew members into the Staging Area or Competition Area. The extra pit crew members must leave these areas. If the team does not obey this rule after the referee has given several verbal warnings, the team receives a Level Four Warning.

2. During each round, operators must stay in their respective operator rooms. The other pit crew members must stay in the Pit Area outside of the Battlefield. Pit crew members are prohibited from leaving the area they are stationed in without receiving approval from a referee.

**Violations and Penalties:**

Pit crew members who leave the Competition Area without a referee's permission will be given a verbal warning by the referee. If the violating pit crew member does not comply with the warning, that member will be asked to leave the competition area for all of the remaining rounds of the current match, and the team is not allowed to have a substitute member to enter the Battlefield area. If pit crew members do not obey a referee's order to leave the Competition Area, their team loses that round.

## 5.3.2 Event Staff

Teams will be guided by volunteers and staff members from the RoboMaster Organizing Committee throughout the competition. During the competition, the Chief Referee has the final right of interpretation regarding competition rules. Teams can only approach the Chief Referee if they have queries regarding the competition rules.

| Role of Event Staff | Duties |
|---|---|
| Head Inspector | Oversees all prematch inspections. Has the final decision on whether a team passes their prematch inspection. |
| Inspector | Assists with prematch inspections. Cannot be involved with or assist in the maintenance of robots in any way. |
| Chief Referee | Has the final decision and right of interpretation regarding competition rules. Issues penalties for severe violations of the rules (disqualification from the competition), has the right to issue additional penalties following an appeal. |
| Head Referee | Responsible for controlling match progress, issues official Technical Timeouts, receives and confirms Team Technical Timeout and confirms the validity of match results.<br>During the match, the Head Referee receives information from Side Referees and Operator Room Referees, and confirms and issues Level One-Five Warnings for violations. |
| Side Referee | Executes competition procedures and leads the team members in and out of the battlefield. Reports a robot's violation to the head referee during matches. Reports any rule violations to the Head Referee, receives the application for a Team Technical Timeout and reports to the Head Referee for confirmation. |
| Operator Room Referee | Executes competition procedures. Guides the pit crew members to enter and exit the Operator Rooms. Reports any rule violations to the Head Referee, |

| Role of Event Staff | Duties |
| --- | --- |
| | receives the application for a Technical Timeout from teams, and reports to the Head Referee for confirmation. Assists operators in solving technical problems with the Operator Room's equipment. Can apply for official Technical Timeouts, but cannot assist pit crew members in repairing the mouse and keyboard. |
| Technician | Maintains the Battlefield, assists pit crew members in solving technical problems with the Referee System during the setup period, can apply for official Technical Timeouts, but cannot assist crew members in repairing and maintaining their robots. |

# 5.4 Prematch Procedures

## 5.4.1 Inspection Regulations

To ensure that robots meet the required specifications, each team must undergo a prematch inspection in the Inspection Area. Please refer to the **Appendix 4 Prematch Inspection Form** Prematch Inspection Form for a full list of these requirements.

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

**Violations and Penalties:**

Unless there is an emergency, teams will forfeit and be credited a loss if they do not arrive at the Inspection Area on time. 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 Robots must be brought into the Inspection Area by one team member. Sentries, Aerials, Heroes, and Engineers must be brought to the Inspection Area by two members. One team member must also oversee the prematch inspection work. Team members are prohibited from entering the Inspection Area without permission before their robots arrive.

**Violations and Penalties:**

Extra team members who are not participating in the prematch inspection must leave the Inspection Area.

3. During the prematch 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 can only modify their robots in Preparation Area before their robots receive a pass card.

**Violations and Penalties:**

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

4. Teams must have one Hero and one Standard Robot that pass the prematch inspection to enter the stage Regional Competition requires two standard robots, and International Regional Competition, Wild Card Competition, and Final Tournament require 3 standard robots. When the inspection is complete, Team Captains must sign the inspection form to confirm that they agree with the inspection results.

**Violations and Penalties:**

1. If a team's hero or two of the standard robots fail to pass the prematch inspection, the team forfeits and is credited a loss.

2. After the team captain signs and confirms, no objection may be raised to the results of the inspection. Teams will be deemed as cheating if any robots that failed the prematch inspection are found inside the Competition Area. Any rounds of the match these robots compete in are also forfeited. The final decision will be judged by the Head Referee and Chief Referee

## 5.4.2 Staging Area Regulations

When the prematch 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.

Team Captains must also sign a Staging Area Statement to confirm that the match can take place 10 minutes before every match begins.

**Violations and Penalties:**

Unless an emergency arises, any team whose captain does not sign the Staging Area Statement five minutes before the start of a match will lose their right to compete and be assessed a loss. The staff within the staging area and the Chief Referee have the final say.

2. All robots in the Staging Area must undergoes a prematch inspection and have a "Pass Card" placed on them.

**Violations and Penalties:**

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

3. The total number of pit crew members in the Staging Area cannot exceed 14 per team.

**Violations and Penalties:**

Any additional crew members will be asked to leave the Staging Area.

4. Robots cannot be powered on or undergo maintenance in the Staging Area, as their Wi-Fi and video transmission signals can interfere with ongoing matches in the Competition Area. If robots require maintenance after entering the staging area, the team must first inform the staging area staff. The "Pass Card" on the robot must then be removed, and the signed Staging Area Statement becomes invalid. The team can then take their robots back to the Maintenance Area to carry out the repairing. When the maintenance is finished, the team must bring their robots back to the Inspection Area for another prematch inspection before reentering the staging area, and their team captain must sign another Staging Area Statement. If a delay results in the failure to sign the Staging Area Statement/Declaration on time, the robot cannot enter the stage, and the team is held responsible.

**Violations and Penalties:**

The first time a team powers on one of their robots for whatever purpose, they will receive a verbal warning from Staging Area staff. If the three warnings are not heeded, the offending team will be given a Punitive Forfeiture. The staff within the Staging Area and the Chief Referee have the final say.

# 5.5 Match Procedures

The RM2019 competition has a tight schedule and features many teams. The event is also streamed online in real time. Any accidents or interruptions can cause delays that result in a negative impact on our competitors and over a million audience. To ensure our event is proceeding as well as it can possibly be, all participants must adhere to the pre-arranged schedules, instructions, and guidelines provided by the RoboMaster Organization Committee, its officials, and its volunteers. All participants are expected to abide by the rules and regulations as outlined in the RoboMaster 2019 Rules Manual.

Teams can only enter the Competition Area and set up their robots after leaving the Staging Area. When the previous match ends, the referee will allow the next pair of teams to take their 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 teams into the arena. All robots are continuously monitored by the Referee System. The Head Referee and Side Referees will announce rule violations and subsequent penalties, as well as address any emergencies that occur. Major penalties and appeals in the competition will be publicized.

## 5.5.1 Types of Fouls

| Type | Penalty |
| --- | --- |
| **Warning (Level One Warning)** | The screen of all operators of the violating team is blacked out for three seconds upon receiving a warning. |
| **HP Deduction (Level Two Warning)** | The screens of all operators of the violating team will be blacked out for five seconds and the violating robot will lose **2** points. The Referee System will also automatically deduct 5% Maximum HP from all remaining robots (except Aerials and bases) of the violating team. |
| **HP Deduction (Level Three Warning)** | The screen of the violating operator will be blacked out for ten seconds, the screens of all other operators on the violating team will be blacked out for five seconds, and 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. |
| **Ejection (Level Four Warning)** | Ejected Robots: Ground robots and Sentries are immediately disabled by the Referee System. Aerials will have their Launching Mechanisms (including the loading mechanism and friction wheels) powered off, video footage transmission disconnected and must immediately land on the Landing Pad.<br>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 to substitute in for the remaining rounds of the match. The robot operated by the ejected operator will be penalized at the start of all rounds of the current match. The amount of HP deducted from the robot will be counted towards the other team's Damage Output.<br>Robots that are ejected cannot be restored for the duration of the current round. |
| **Punitive Forfeiture (Level Five Warning)** | When a Punitive Forfeiture is issued before the match (not including the three-minute setup period) and the match has not yet started, the Pit Crew Members of the offending party must all leave the competition area. The Base HP of the losing team is also set to 0, while the opposing team's Base HP remains its maximum.<br>When a Punitive Forfeiture is issued during a match (including the three-minute setup period) the Head Referee directly destroys all robots of the offending team via the Referee System, and the round is over. The Base HP of the losing team is also set to 0, while the opposing team's Base HP remains at the amount that it was prior to the round ending. At this point, the members of both sides must listen to the referee's instructions to move the robot off the arena. If a team receives this |

| Type | Penalty |
| --- | --- |
| | penalty after the round due to an appeal, the Base HP value for the losing team is set at 0, and the opposing team's value is the value recorded at the end of the match.<br>The amount of HP deducted by the robot due to a Punitive Forfeiture will be counted towards the opponent team's Damage Output. |

**Note:**

1. Each robot starts with **9** points at the beginning of each match. If a robot gets a Level Two Warning, it will lose **2** points and for Level Three Warnings, **4** points will be deducted. When the points is less than or equal to **0**, the offending robot will be subject to a Level Four Warning and be ejected off by the referee system server.
2. When the robot has **5** points or less, the robot's avatar on the interface of the robot server client will display a yellow exclamation mark; when the robot has **2** points or less, the it will display a red exclamation mark instead.

The penalty system used throughout the competition consists of the five warnings described in the previous table. A team may receive a Level Four or Level Five Warning immediately after severely breaking the rules, whereas some penalties may gradually be upgraded from a Level One Warning. For example, if a team's robot crashes into their opponent's Sentry at high speed, it will immediately receive a Level Four Warning, whereas a lighter collision might only merit a Level One 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 One Warning multiple times in the same round, the Referee can assess a Level Two, Level Three, or Level Four Warning, even if the robot does not fulfill the requirements for a Level Two, Level Three, or Level Four Warning. **Level One Warnings, Level Two Warnings, Level Three Warnings and Level Four Warnings are not grounds for a team to file an appeal.**

During a match and before issuing Level Four or a Level Five Warnings, the head referee will announce the warning through the headset to the participating players. 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 into consideration the status and position of the robot. Team members must obey the Head Referee when given a Level Four or Level Five Warning.

## 5.5.2 Three-minute Setup Period

Before the setup period begins, both teams must be ready and waiting at the side of the Battlefield. The 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 and the side referees will open the gates to allow the teams to enter. When the gates open, the setup period begins for the teams to prepare their robots. All penalties for violations occurring during the setup period will be executed after the start of the match.

1. The number of pit crew members for each team cannot exceed 14.

**Violations and Penalties:**

The referee will give a verbal warning to any team that sends more than 14 pit crew members into the Competition Area. The extra pit crew members must leave these areas. If the team does not obey this rule after the referee has given several verbal warnings, the team will receive a Level Four Warning.

2. Pit Crew members from both teams place their robots in the Starting Zone and check that the Referee System on each robot is working correctly. 3. Both teams can only test ground robots in their own Starting Zone and must not test ground robots in other areas.

**Violations and Penalties:**

Teams will receive a verbal warning if they test their robots in areas other than the starting zone, and any offending robots must be returned to the Starting Zone. Any robots that fail to complete with repeated warnings are ejected from the round.

4. Aerial robots cannot be commissioned (propellers rotating) and projectiles can only be launched into the projectile bag.

**Violations and Penalties:**

(1) If an Aerial moves outside the landing pad area or its propellers are rotating while on the landing pad, it will be regarded as a violation and the referee will give a verbal warning to stop the propellers. Non-compliance will result in a Level Two Warning for the offending team;

(2) If an Aerial Robot flies away from the landing pad, the referee will disqualify the violating robot;

(3) If the launching of an aerial robot's projectile or early start-up result in any bodily harm to on-site personnel, once the violation is verified, the violation party will be assessed a loss for the current round.

5. All participating robot projectiles must be empty and the robot can no longer fire projectiles (except for Aerials and Sentries after the first round).

**Violations and Penalties:**

(1) Robots with projectiles not fully emptied will be ejected for the round;

(2) In first round of each match, Sentries and Aerials must be emptied of projectiles. In other rounds of the same match, projectiles do not need to be emptied.

6. Pit crew members cannot pick up projectiles found on the ground and insert them into their robots.

**Violations and Penalties:**

(1) If a pit crew member picks up a projectile on the battlefield, the referee will give a verbal warning. If the warning is not heeded, the referee will give a Level Two Warning.

(2) If a pit crew member personally picks up a projectile and loads a robot, the referee will disqualify the robot.

(3) Teams that use unofficial projectiles will be disqualified from the competition.

7. Aerials must be placed on the Landing Pad and attached to a Aerial Safety Rope. Each round of a match, a staff member will pass 500 17mm projectiles to the projectile loaders of both teams, with the team being responsible for loading these projectiles into their Aerial. During the competition, if the projectile loader needs to load the Aerial, he can indicate this to the pilot room referee, and the referee will supply the projectile loader with projectiles.

**Violations and Penalties:**

(1) An aerial that does not connect the Aerial Safety Rope as required will be ejected.

(2) If the Aerial is commissioned or repaired in an area other than the Landing Pad, the referee will give a verbal warning. If the verbal warning is not obeyed, the Aerial will be ejected.

8. Pit crew members must ensure that their robots work safely when testing in the Starting Zone. The team must also ensure that their fully-automated robots do not injure Battlefield personnel.

**Violations and Penalties:**

If the launching of an aerial robot's projectile or early start-up result in any bodily harm to on-site personnel, the violating party will be assessed a loss for the current round.

9. During the last 30 seconds of the setup period, all robots on the battlefield must be powered on. Referees will also instruct pit crew members to leave the field.

**Violations and Penalties:**

Pit crew members will receive verbal reminders if they do not power on their robots and leave the Battlefield.

10. At the end of the setup period, pit crew members from both teams must return to their appointed areas outside the Battlefield.

**Violations and Penalties:**

Pit crew members who fail to leave the Battlefield at the end of the setup period will be ejected and in all remaining rounds of the match, the team cannot have other substitute members enter the competition area. If these crew members continue to disobey orders to leave and remain on the Battlefield, their team will be assessed as a loss for that round. The actual situation is subject to the referee's on-site penalty.

11. Ground-based robots cannot leave their Starting Zone before the round begins or transform to exceed the maximum initial size. Robots cannot launch projectiles in advance. The referee system will lock the keyboard for 20 seconds and the last 5 seconds of the self-test. At this time, the operator cannot use the keyboard to control the robot. Before the keyboard is locked, the operator should not moves the robot away from the Starting Zone or transforms the robot beyond the maximum initial size. After the keyboard is locked, the operator should move the robot back to the Starting Zone and transform it to its initial size. The referee will execute the penalty according to the corresponding violation regulations after the game officially starts.

**Violations and Penalties:**

| Regulations | Violations and Penalties |
|---|---|
| 1 | If a ground robot moves to the non-starting zone before the round officially begins, transforms beyond the maximum initial size, or a projectile is fired, it will be considered a violation, and the referee will give a verbal warning; |
| 2 | Non-compliance with the warning will result in a Level Two Warning after the round begins; |
| 3 | If the robot moves to the non-starting zone area in advance and has sufficient time to return to the starting zone, or the robot false starts for a long distance, but the operator does not obey the referee warning and does not return to the starting zone before the official start of the round, the referee will issue a Level Four Warning to the violating robot. The actual situation will be determined by the head referee and chief referee; |
| 4 | If the launched projectile on a early moving robot causes physical injury to on-site |

| Regulations | Violations and Penalties |
| --- | --- |
| | personnel, once verified, the offending party will be given a punitive forfeiture for the round. The actual situation will be determined by the head referee and chief referee. |

12. Sentry robots must be fully automated during matches but can be controlled remotely during the setup period (the three minutes before the start of each round). During the setup period, the participating members must place the Sentry remote control in the designated area of the battlefield entrance after completing the preparatory work.

**Violations and Penalties:**

Using non-SZ DJI Technology Co., Ltd. remote controls will result in robots failing the prematch inspection. If it is discovered that a remote control has been used for the Sentry robot during a match at any point (7 min. total), or the Chief Referee confirms that cheating has taken place, this will result in an immediate loss for the offending team.

## 5.5.2.1 Technical Timeouts

**Official Technical Timeout**

The Head Referee can announce an Official Technical Timeout during the setup period if the Referee System, operator equipment, or other modules related to the Referee System malfunction. Examples of malfunctions include:

| Regulations | Description |
| --- | --- |
| 1 | The 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 cannot 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 suppliers cannot provide projectiles, etc.) |
| 4 | Any other situations determined to require a Official Technical Timeout by the Head Referee. |

An Official Technical Timeout may only be implemented after an Operator Room Technician or Field Technician reports to the Head Referee. Pit crew members cannot request an Official Technical Timeout.

If case 2 occurs during the setup period of the second round or later rounds, the damage will be is 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 Competing Team's Technical Timeout to repair their robots.

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. Pit crew members can also enter the Battlefield to repair other robots. However, they must leave the Battlefield when the Referee System has been repaired.

**Competing Team's Technical Timeouts**

Teams can also request a Competition Team's Technical Timeout from the Head Referee during the setup period for their current round, or the following round. This timeout can be requested if a robot's systems or control equipment (such as keyboards and mice) break down. Pit crew members can use the timeout to enter the staging area or landing pad to repair their robots.

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 a team technical timeout.

Note: Subsequently, there may be added a mechanism for obtaining additional technical timeouts for the participating teams through other means.

**Note:**

1. Any request for a Competing Team's Technical Timeout must be submitted by a 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 during this 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 Competing Team's Technical Timeout regardless of which team requested the timeout. All pit crew members from both teams can enter the Battlefield to repair their robots during this time. 3. Only the team that requested the timeout will expend one of its chances to request such a timeout. During the last 20 seconds of the timeout, referees will remind team members to leave the field. When the timeout expires, all pit crew members must leave the field.

**Violations and Penalties:**

Pit crew members 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 members fail to comply with this penalty and still remain on the Battlefield, their team will immediately assesse a loss for the round.

3. When team initiate a timeout and reaffirm by the main referee, each approved timeout uses up one of the timeouts allotted to each team, regardless of the time spent or the purpose of the timeout. For example, if a team initiate a two-minute Competing Team's Technical Timeout but only uses 40 seconds of this time, the full two-minute Competing Team's Technical Timeout is still deducted. At this point, the referee will continue the technical timeout or the referee will confirm that both teams are ready to end the technical timeout. Additionally, if a team is granted a Competing Team's Technical Timeout but does not enter the Battlefield, they will still use up one of their 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 Competing Team's 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 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-minutes setup period, the match enters a twenty-second Referee System Initialization Period. During the self-test, the competition server will automatically detect the client connection status, the robot referee system module status, the competition elements status, etc. If the status does not meet the requirements of the start of the round, such as an offline client, robot, or battlefield element, the countdown will be suspended. At this time, only the RoboMaster Organizing Committee staff and a team member of the team can enter the battlefield to view the cause of the malfunction. Teams cannot request a technical timeout during the Referee System Initialization Period. After the faulty elements are repaired, the referee resumes the self-test, and the self-test countdown continues. The game server will restore the HP of all the robots, ensuring that all robots have full HP when the round officially begins.

During the Referee System Initialization Period, Operators (except Aerial operators) can only be in the Operator Room and Pilots can only be in the Pilot Room. During the last five seconds of Twenty-Second Referee System Initialization Period, competitors will hear a countdown alert sound and a

countdown timer will be displayed, at which time the keyboard connected to the computer in the Operator Room is locked. The round starts immediately after the countdown finishes.

## 5.5.4 Seven-minute Match Rounds

After a round begins, all operators and pilots from both teams must stay in their Operator and Pilot Rooms, projectile loaders must stay at the designated area next to the Pilot Room, and all the other team members must watch the match at the audience area.

### 5.5.4.1 Projectile Collection

1. Robots may not obtain projectiles from Sentries or Aerials.

**Violations and Penalties:**

Robots that obtain projectiles from a Sentry or Aerial will be ejected from the round with a Level Four 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 Four Warning. The actual situation is determined by the head referee and chief referee.

3. All robots must use official RM2019 projectiles and cannot use any unofficial projectiles.

**Violations and Penalties:**

Any team being found to be using unofficial projectiles will be regarded as cheating and disqualify.

4. Infantry and hero cannot directly collect Projectile Containers from a Resource Island.

**Violations and Penalties:**

Infantry and Heroes illegally collecting Projectile Containers will be ejected from the round with a Level Four Warning. The actual situation is determined by the head referee and chief referee.

5. The Engineers can only grab one Projectile Container at a time or only one projectile in one Projectile Container at a time. When one Projectile Container completely leaves the groove of the resource island, the next Projectile Container can be taken.

**Violations and Penalties:**

When an Engineer grabs more than one Projectile Containers at a time or acquires more than one Projectile from a Projectile Container at a time, they will be issued a Level Two Warning (for the first offense). If the robot violates the rule again, the referee will give the operator a Level Four Warning. The actual situation will be determined by the head referee and chief referee.

## 5.5.4.2 Combat Rules

**1. Collision Penalties**

1. A robot may not use any of its structures to collide with enemy robots, regardless of whether the opposing robots are alive or have already been destroyed. When a Battlefield element leaves the field connecting with a robot, it is considered part of the robot.

Teams can fire projectiles at any place at opposing team's ground robots within the projectile speed limits previously stated in the rules. If the attack causes damage to any structures, the Camera Transmission Module, or circuits on a robot, this will be considered incidental damage and is not a basis for collisions or other types of penalties. However, if the Referee System module is damaged, a technician will provide backup modules during the setup period before the next round.

Please note that to ensure that Sentries are fully capable of moving along their tracks, any robots that attacks a Sentry (including those in a deceased state) either intentionally or unintentionally without authorization will be penalized.

**Violations and Penalties:**

| Regulations | Penalty Standards |
|---|---|
| 1 | If a robot intentionally crashes into an opposing robot in any way, the referee will issue a Level One Warning. |
| 2 | If a robot intentionally and repeatedly crashes into an opposing team's robot or disturbs the normal movement of their opponent, the referee will issue a Level Two Warning. |
| 3 | If a robot intentionally and repeatedly crashes into an opposing team's robot or disturbs the normal movement of their opponent for a long time or long distance, the referee will issue a Level Three Warning. |
| 4 | If a robot intentionally, directly, quickly, and repeatedly crashes into an opposing team's robot or a robot intentionally crashes into an enemy robot and knocks it a far distance, affecting the normal movement of the enemy robot, the referee will regard this as a serious, malicious collision and will issue a Level Four Warning to the violating robot. The actual situation shall be judged by the head referee and chief referee; |

**Note:** The penalty of colliding with a destroyed robot (not including slowly pushing away a destroyed robot because it is blocking a path), the referee will impose a Level 1-4 warning on the violating robot or the offending team according to the penalty criteria in the above table.

**2. Penalty of Restoration Zone**

Robots cannot enter the opposing team's restoration zone.

**Violations and Penalties:**

| Regulations | Penalty Standards |
|---|---|
| 1 | If a robot enters or flies above the opposing team's Restoration Zone for less than three seconds, the referee will issue a Level One Warning. |
| 2 | If a robot enters or flies above the opposing team's Restoration Zone for 3-10s, or makes physical contact with the opposing team's Projectile Supplier, the referee will issue a Level Two Warning and the robot must immediately leave the opposing team's Restoration Zone; |
| 3 | If a robot enters or flies above the opposing team's Supplier area for 3-10 seconds or makes physical contact with the opposing team's Supplier, or interferes with the robot's normal projectile loading, regeneration, or revival, the referee will give the violating team a Level Three Warning, and the robot must withdraw from the other team's Supplier area; |
| 4 | If a robot enters or flies above the opposing team's Supplier area for longer than 10 seconds or makes physical contact with the opposing team's Supplier, the referee will issue a Level Four Warning. The actual situation shall be determined by the main referee and chief referee; |
| 5 | If a robot makes physical contact with an opposing team's Projectile Supplier and causes damage that prevents the Supplier from providing or if the ejected robot remains at the other team's Supplier area or above it, causing the robots on the other team to be unable to obtain projectiles, the referee will issue a Level Five Warning. The actual situation will be determined by the main referee and chief referee. |

**3. Aerial Related Penalties**

(1) Neither team can attack the other team's Aerial.

**Violations and Penalties:**

A robot that deliberately shoots at an Aerial robot will be ejected from the round with a Level Four Warning.

(2) Aerials cannot interfere with the normal operation of the ground robot during flight.

**Violations and Penalties:**

If an Aerial collides with a ground robot in flight, the referee will regard this as a malicious collision and give the offending party a Level Three Warning;

(3)Aerial robots that fail to work properly or becomes damaged due to the poor design of its propulsion or power systems, it must land and undergo a safety inspection with a field technician. This robot can only return to the Battlefield after it has been confirmed by the Head Referee that no safety concerns are present. Otherwise, this robot may not take off again, and it will be ejected from the remainder of the match, or projectiles will no longer be supplied to it. The chief referee will take action according to the actual situation.

**Violations and Penalties:**

If Aerial is out of control (the Pilot can't properly control the Aerial, etc.) and crashes or falls inside the battlefield, and the Pilot can't start the propellers again or regain control Aerial to take off and operate normally, the Aerial will be ejected by the referee system server, and Aerial Safety Rope will be lifted to a certain height by the pilot referee and field Technician to prevent the fallen Aerial from colliding with the ground robot, causing a safety hazard.

(4) Pit Crew Members can supply projectiles for Aerials outside the battlefield, but must wear a long-sleeved shirt, helmet, and goggles, and each reload time must be within 30s.

**Violations and Penalties:**

1. Members who do not wear long-sleeved tops, helmets, and goggles may not load projectiles for Aerials.
2. If a Projectile Loader loads for more than 30s, the referee will give a verbal warning and ask the Projectile Loader return to the designated area. If the Projectile Loader does not return to the designated area, the team's Projectile Loader will be ejected and must return to the Pit Area. In the remaining rounds of the match, the team may not have a substitute Projectile Loader to load the Aerial. Pilots may not reload Aerials during the seven-minute round.

**4. Base Zone Penalties**

In order to prevent the robots of both sides from entering the base zone and colliding with the base, Pit Area affecting the normal operation of the base or causing structural damage to the base, no robot may not enter the base zone.

**Violations and Penalties:**

| Regulations | Penalty Standards |
|---|---|
| 1 | If any part of a Hero, Sentry, or Engineer robot enters a Base Zone for 3 seconds or less, the referee will issue a Level One Warning. |
| 2 | If any part of a Hero, Sentry, or Engineer robot enters a Base Zone for 3-10 seconds, the referee will issue a Level Two Warning, and the robot must leave the area immediately. |
| 3 | If any part of a Hero, Sentry, or Engineer robot enters a Base Zone for more than 10 seconds, the referee will issue the robot a Level Three Warning, and the violating robot must exit the Base Zone; |
| 4 | If a Hero, Sentry, or Engineer causes damage to the structure of the Base such that it no longer operates normally, or if an ejected robot remains at the Base penalty zone, preventing the base from opening and affecting the fairness of the competition, the referee will issue the violating team a Level Five Warning. The actual situation shall be determined by the head referee and chief referee. |

**5. Penalties for Getting Stuck Together**

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

**Violations and Penalties:**

| Regulations | Penalty Standards |
|---|---|
| 1 | If any part of a robot gets stuck together with any part of an opposing team's robot due to interference, blocking or collisions for a short period (less than 10s), preventing the normal movement of the opposing robot, the referee will issue that robot a Level One Warning. |
| 2 | If any part of a robot gets stuck together with any part of an opposing team's robot due to interference, blocking or collisions for a long period (between 10s and 30s), preventing the normal movement of the opposing robot, the referee will issue that robot a Level Two Warning. |
| 3 | If any part of a robot gets stuck together with any part of an opposing team's robot due to interference, blocking or collisions for a long period (between 30s and 60s), preventing the normal movement of the opposing robot, the referee will issue that robot a Level Three Warning. |
| 4 | If any part of a robot gets stuck together with any part of an opposing team's robot due to interference, blocking or collisions for a long period (longer than 60s), preventing the normal movement of the opposing robot, the referee will issue that robot a Level Four Warning. The actual situation is determined by the head referee and chief referee; |
| 5 | If any part of a robot gets stuck together with any part of an opposing team's robot due to interference, blocking or collisions for a long period (longer than 60s), preventing the normal movement of the opposing robot, and causing severe damage to the structure of the opposing team's robot, or if an ejected robot remains stuck together with any part of the opposing team's robot, preventing the normal movement of the opposing team's robot, the referee will issue the offending robot a Level Five Warning. The actual situation is determined by the head referee and chief referee. |

**Note:**

1. When the two robots are stuck together during a match, the referee will notify the two operators to take appropriate actions to detach the robots. The two operators must then cooperate with the referee's instructions and perform the requested operations;

2. The penalty for getting stuck to a destroyed robot: the referee will issue a Level One to Level Four Warning to the offending robot or the offending team according to the penalty criteria in the above table.

## 5.5.4.3 Transformation and Interaction

1. Robots are prohibited from intentionally separating into smaller robots or systems. Robots cannot intentionally cast off or launch their own parts.

**Violations and Penalties:**

A robot that separates into smaller robots or intentionally casts off its own parts will receive a Level Four Warning.

2. Robots cannot cover each other's Referee System armor modules by linking together or transforming to block each other against avoid incoming attacks for long periods. The only exception to this rule is when robots are collecting projectiles or rescuing a destroyed robot.

**Violations and Penalties:**

A robot that violates this rule will receive one of the following penalties: Level One Warning: blocking duration of 3 seconds or less Level Two Warning: blocking duration of 3-10 seconds Level Three Warning: blocking duration greater than 10 seconds The Head Referee has the final say on all decisions regarding these penalties.

3. A robot may block at most four armor modules of another robot when it is rescuing or that robot.

**Violations and Penalties:**

When rescuing other friendly robots, if the rescuing and rescued robot are connected, the time allowed for one robot to shield more than one armor side of the other robot is determined by the Head Referee and the Chief Referee, and they may give Level Three (less than 3 seconds), Level Two (between 3-10 seconds), or Level Three (10 seconds or above) warnings based on the circumstances.

4. Robots are prohibited from using adhesive materials and substances (e.g. duct tape) on its projectile grabbing mechanism.

**Violations and Penalties:**

(1) A robot equipped with a sticking mechanism, such as 3M adhesive, cannot pass the Prematch Inspection;

(2) Using of 3M adhesives and other sticky materials for picking up and dropping projectiles during a match will be considered cheating, and all rounds in which the violating robot participated will all be assessed as losses.

5. None of the robot's moving mechanisms may cause damage to the core Battlefield Components / Mechanisms (bases, power runes, assist columns, sentry rails, and projectile depots) on the Battlefield.

**Violations and Penalties:**

Once a robot causes damage to the Battlefield Components / Mechanisms, 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 destroyed (excluding robots ejected by the referee system server), another robot from its team can rescue it by bringing it to Teams can rescue a destroyed robot by bringing it to its team's Regeneration Point. A destroyed robot that has completed the revival process at its team's Regeneration Point will automatically be revived. During the rescue and regeneration process, opposing robots may launch projectiles at the robots performing the rescue, but they cannot block or crash into these robots.

**Violations and Penalties:**

| Regulations | Penalty Standards |
|---|---|
| 1 | If any part of a robot interrupts, blocks, or crashes into robots involved in a rescue or revival process and briefly interferes with the process, the referee will issue a Level Two Warning. |
| 2 | If any part of a robot crashes into robots involved in a rescue or revival process and repeatedly interrupts the process by direct and high speed collision, or interferes with the opposing team's robot for a long period (within 10s), the referee will issue a Level Three Warning. |
| 3 | If any part of a robot crashes into robots involved in a rescue or revival process and briefly interrupts the process by direct and repeated high speed collision, or interferes with the opposing team's robot for a long period (longer than 10s), the referee will issue a Level Four Warning. The actual situation will be determined by the head referee and chief referee; |
| 4 | If any part of a robot crashes into robots involved in a rescue or revival process and interrupts the process, blocks their path, or causes physical damage, the referee will issue a Level Five Warning and declare the offending team as the losers of that round. The actual situation will be judged by Head Referee and Chief Referee. |

2. When the robots from either team are rescuing other friendly robots, do not grab any Referee System module from the rescued robot.

Violations and Penalties:

Robots which do not meet the installation requirements of the Referee System will not be able to pass the pre-competition inspection.

### 5.5.4.5 Emergency Cases

1. When safety risks arise on the Battlefield (such as an exploded battery, the Aerial Safety Rope breaking and causing it to fly towards the audience area, a power outage, the explosion of a compressed gas canister, or an injury to a staff member), the head referee will notify both teams through the two Operator Room Referees after discovering and confirming the emergency, and destroys all robots through the referee system. The result of the round is invalidated. When the repair work is complete, the round will restart.
2. If a robot breaks down after undergoing an inspection, this is deemed as incidental damage and the competition will continue. If there is a robot damaged in the first round of the match, the damaged robot will be banned from entering the stage. In order to avoid impacting the normal progression of the competition, rounds after the first round do not require the minimum lineup.
3. If the general elements in the battlefield are damaged during a match (such as damage to the ground rubber, the lighting, or the base armor), the match will proceed normally. If there are structural damages or malfunctions of key Battlefield Components (base cannot normally open shield, the base armor module shifts, drops or cannot detect hit damage, the power rune cannot be triggered by normal hit, the Aerial safety rope breaks or is worn out, suppliers cannot provide projectiles, etc.) the head referee will notify both teams through the two Operator Room Referees after discovering and confirming the emergency. They shall then destroy all robots through the referee system. The result of the match will be invalided. The field technicians will enter the battlefield to repair the elements, and once the props are functioning normally, there will be a rematch.
4. If the Official Projectile Supplier becomes damaged, 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 members of both teams that the Referee System will destroy all robots. The current round ends immediately, and the results are discarded. When repair work is complete, there will be a rematch.
5. If a key area of the Battlefield is not working properly and the problem was not caused by a registered team (for example, a robot is not revived after reaching the Regeneration Point), the Head Referee will manually trigger these items for the team. This process may cause delays, and the Head Referee will not be held responsible for the impact of these delays. If the error cannot be resolved manually, the Head Referee will announce to the pit crew members on both teams that the Referee System will destroy all robots. The round ends immediately and the results are discarded. When repair work is complete, there will be a rematch.
6. During a match, if there are abnormal functioning of or structural damage to key Battlefield Components / Mechanisms that affect the fairness of the match and the head referee did not confirm and end the game in time, resulting in the game that should have ended resulting in a win and loss

for the teams, After verification by the Chief Referee, the result of the round is deemed invalid, and there will be a rematch.

7. If there is a serious violation that obviously deserves a Level Five Warning but the head referee did not confirm and execute the warning in a timely manner. After the match, once the chief referee or appeal is confirmed, the original results of the game are invalidated, and a Level Five Warning will be issued to the offending team.

## 5.5.5 Severe Violations of the Rules and Cheating

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

The following actions are considered cheating:

| Regulations | Cheating |
|---|---|
| **1** | Changing or damaging the Referee System, concealing power consumption measurements through technical tricks, and/or damaging measuring systems. |
| **2** | A robot's behavior is different from that exhibited during the prematch inspection (such as changes in size and Referee System installation positions.) |
| **3** | Operators are not team members; robots are not made by the team. |
| **4** | Manually operating a fully-automated robot. |
| **5** | Use of unofficial projectiles. |
| **6** | Other behavior that the Chief Referee determines to be serious misconduct. |

The following actions are considered a severe violation of the rules:

| Regulations | Types of severe rule violations |
|---|---|
| **1** | Conform to the results for any violation of the rules mentioned in this document but refusal to accept penalties; |
| **2** | Refusing to leave the Competition Area after the match ends. |
| **3** | Installing explosives or other prohibited items on robots. |
| **4** | Team members using robots to crash into or attack people. |
| **5** | Team members purposely damaging an opponent's robots, battlefield items, or the Competition Area. |
| **6** | Team members engaging in a physical confrontation with a referee, their opponents, or the audience. |

| | |
|---|---|
| **7** | Team members not cooperating when the RoboMaster Organizing Committee is hearing an appeal. |
| **8** | Other severe actions that go against the guidelines and spirits of the competition, and the penalties8 will be determined by the 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 RoboMaster Organizing Committee will fully cooperate with the relevant authorities to pursue appropriate legal action against the offender. |

# 5.6 Post-Match Procedures

Members from both teams must turn off the power supply for all their robots and remove them from the Competition Area when the match is finished. Teams are required to remove all the projectiles from the robots and then return to the Preparation Area.

**Violations and Penalties:**

Once the match is over, if a robot has not fired all its projectiles, the robot will be detained in the unloading area.

## 5.6.1 Results Confirmation

During each match, the head referee assistant records the results, penalties, and the remaining HP for each round (at both the team's Base and the total value) for both teams on a Match Results Confirmation Form. The technical timeout usage will be recorded in the technical timeout schedule. The Team Captains must then 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 Record Form in the Referee Area within **five minutes of the match ending**. If a Team Captain does not turn up at the referee area to sign the Match Record Form or request an appeal, it is deemed that their team agrees with the match results written on the Match Record Form.

Once the Team Captain has signed the Match Record Form, all rights to an appeal are forfeited.

## 5.6.2 Appeals

Every team has the right to one during each Regional Competition, Wild Card Competition, International Regional Competition, and in the Final Tournament. However, appeals cannot be accumulated across competitions. If an appeal is successful, a team can appeal again in future matches. After three unsuccessful appeals, the Organizing Committee will not accept further appeals from the team. When processing an appeal, an Appeals Panel will be formed that is made up of Chief Referees. **The appeal panel 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 count against the team's appeal chances regardless of the appeal results. Due to potential delays to the competition schedule, this "continued appeal" must be initiated by both the Team Captain and Team Supervisor within five minutes of the match ending. The appeal process for a "continued appeal" is also simplified, with the time for the submission of evidence and materials being shortened. The time for the submission of evidence and materials being shortened to within 30 minutes of the match ending. The RoboMaster Organizing Committee will announce the result of the appeal in the appeal form within one hour of the match ending.

### 5.6.2.1 Appeals Process

1. Within five minutes of the match ending, the Team Captain submits an appeal to the Chief Referee on duty in the Referee Area and signs an Appeal Form. The RoboMaster Organizing Committee will not accept any appeals five minutes after a match ends. They will also not accept any appeals received either 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, RoboMaster Event Staff will invite Team Captains from both teams to meet in the Arbitration Room. If the team that made the appeal requests a robot inspection, the Appeals Panel will transfer all robots from both teams to the Arbitration Room for immediate inspection. Each team can only send three members into the Arbitration Room, and one must be either the Team Captain, Project Manager, important member or Supervisor.

4. Members of both teams can collect evidence and materials to submit to the Appeals Panel;

5. The Appeals Panel will conduct further communication with both teams inside the Arbitration Room after evidence and materials have been submitted.

6. The Arbitration Panel makes a final decision. Both Team Captains sign the Appeal Form to confirm

the result. Once signed, both teams cannot question the appeal results any further.

### 5.6.2.2 Appeal Validity

1. Appeal Request Validity Period: Appeals must be made within five minutes of the end of each match and recorded on the Appeal Form. The Appeals Panel will not accept any appeal requests five minutes after the stated Appeal Request Validity Period.

2. Arrival at the Arbitration Room: Both teams must arrive at the Arbitration Room within 30 minutes of receiving a notification from the Appeals Panel. An absent team is deemed to have forfeited their right to an appeal and must accept any decision made by the Appeals Panel. If more than three members of a team enter the Arbitration Room or the attendees do not belong to the related team, the team is also considered to have forfeited their right to an appeal.

3. Submission of Evidence and Materials: A team must submit evidence and materials within 60 minutes of requesting an appeal, and the Appeals Panel will not accept any new materials beyond this 60-minute limit.

### 5.6.2.3 Appeal Materials

1. Types: The Appeals Panel only accepts materials stored on a USB drive or on a competing robot.

2. USB Drive Requirements: The team must prepare videos extracts and other document files as materials for their appeal. The RoboMaster Organizing Committee will not assist in the collection of videos to maintain neutrality throughout the process.

3. Materials Requirements: Each video cannot exceed 1 minute in length or 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. Materials Name: The name of each video and photo must 30 characters or less.

5. Text Requirements: 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. Robot Evidence: The Appeals Panel has the authority to isolate any relevant robots 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 no later than when the appeal is adjudicated.

### 5.6.2.4 Appealing Decisions

The Appeals Panel 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 Appeals Panel 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 during the remainder of the competition. A team that refuses a rematch is considered to have forfeited the match and lost.

# Appendix 1 Safety Instructions

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 his or her teammates, members of the opposing teams, referees, competition personnel, 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-competition safety inspections 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 stage as well as the competition stages of the event, all team members must pay full attention to potential safety issues, and the team's Advisors must be responsible for instructing and supervising the team on safety issues.
6. The team must guarantee the safety of all the robots it enters into the competition. This includes ensuring the projectile launchers installed on the robots are safe, and that the projectiles will not cause any harm (either directly or indirectly) to any operator, referee, competition personnel, or audience member.
7. The team will take sufficient and necessary safety measures during R&D, training, and competition stages of the event regarding any hazardous situations that may occur. This includes but is not limited to: preventing the control systems 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; making sure that one or more persons have been appointed as an emergency responder; wearing goggles and helmets; properly applying the lock function in the robots control system before engaging in debugging or adjustments; and including 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 robots breaking down, autonomous airborne robots 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 Definitions of RoboMaster Terminology

| Terms | Definition |
|---|---|
| **Competition Names** | |
| **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 Robot** | Required robots with multiple uses throughout the competition. |
| **Aerial Robot** | A robot that provides an aerial view of the Battlefield and can fire 17mm projectiles. |
| **Engineer Robot** | A robot built to provide assistance throughout the competition. One is required for each team. |
| **Staff Responsibilities** | |
| **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 |
|---|---|
| **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 prematch inspections and makes the final decision on whether the team passes the prematch inspection or not. |
| **Inspector** | Assists with prematch inspections |
| **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** | A comprehensive look at whether the team's required robots meet all the |

| Terms | Definition |
| --- | --- |
| **Robot 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 Teams** | |
| **Teams from Mainland China** | A team that is qualified to participate in the competition after passing the registration technical evaluation stages. These teams are typically from Mainland China. |
| **Teams 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. These teams are typically from universities outside of Mainland China. |
| **Technical Specifications** | |
| **Operating Air 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 characteristics** | Images used to assist robots. |
| **HP (HP)** | |
| **Initial Blood** | 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** | Damage caused by enemy projectiles that hit a robot's armor modules and base. HP deduction as the result of a penalty given by a referee is also included. |
| **Net Base HP Difference** | 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** | Captures live video from the camera and displays it on the operator's monitor in the Operator Room. |

| Terms | Definition |
| --- | --- |
| **Module** | |
| **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. |
| **Locating Module** | Obtains the location of each robot on the Battlefield. |
| **Main Control 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 Areas** | |
| **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. |
| **Maintenance Area** | The only area where the robots can be repaired. |
| **Crew 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** | A room for robot and Aerial Gimbal Operators to control their robots during the |

| Terms | Definition |
| --- | --- |
| **Operator Room** | competition. |
| **Pilot Room** | An area for pilots to see and control the Aerial robot during the competition. |
| **Red/Blue Crew 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 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. |

| Terms | Definition |
| --- | --- |
| **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 prematch 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 Hazards** | On-site safety inspectors will handle possible safety hazards and problems that may occur during the competition. |

| Terms | Definition |
| --- | --- |
| **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. |
| **Fouls** | If a team member violates any rule stated in the rulebook, he/she will receive different level penalties from referees. |
| **Level One Warning** | A light obstruction of the rules occurs. The screen of the operator will be blacked out for three seconds. |
| **Level Two 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 Three 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 Four 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 Five 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. |
| **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. |
| **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. |
| **Punitive** | A competing team will lose the round if they engage in an extremely serious |

| Terms | Definition |
| --- | --- |
| **Forfeiture** | violation of the rules or other forms of cheating. The referee determines this penalty in accordance with the rules that state it is applicable. |
| **Cheat** | 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 Specifications

## Technical Assessment Introduction

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 them in their future development. During the Technical Assessment, the RoboMaster Organizing Committee 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 RoboMaster Organizing Committee does not accept Technical Assessments that are overly rigid and or those that contain inaccuracies.

Only after completing the Technical Assessment within the specified deadline may teams move on to the next step of the assessment and become eligible for Warm-up Competition, Chinese Regional Competition, International Regional Competition, and Wild Card Competition, followed by the Final Tournament.

**The schedule for the RoboMaster 2019 Robotics Competition Technical Assessment is as follows:**

| Schedule | Item | Location | Eligible Competitions/ Location | Benefits |
|---|---|---|---|---|
| **October 22, 2018, 10:00-22:00 (UTC+8)** | Rules Exam | Online | Required | By passing, you can get a 40% education discount coupon for RM online products for 1 Aerial and 1 Standard Robot. A team with 100 points in the Rules Exam can get one GM6020 motor.<br>Obtains authorization to submit the Season Schedule. |
| **November 20, 2018, 10:00-22:00 (UTC+8)** | | | | |
| **October 22, 2018 - November 30, 2018** | Season Schedule | Online | Optional | Teams with excellent season schedule can get 1 set of |

| Schedule | Item | Location | Eligible Competitions/ Location | Benefits |
|---|---|---|---|---|
| **(UTC+8)** | | | | Standard referee system (2018 version)<br>Obtains authorization to submit mid-term robot assessment video. |
| **October 22 - December 25, 2018 (UTC+8)** | Technical Proposal | Online | Required for Teams from Mainland China | By passing, teams get a 40% education discount coupon for RM online products for 1 Hero, 1 Engineer, and 1 Sentry.<br>Obtain Final Robot Assessment Video submission permission. |
| **October 22, 2018 - January 23, 2019 (UTC+8)** | | Online | Required for teams from Hong Kong, Macau, Taiwan and Overseas | |
| **December 25, 2018 - January 23, 2019 (UTC+8)** | Mid-term Robot Assessment Video | Online | Required for Teams from Mainland China | By passing, teams get two 40% education discount coupons for RM online products for Standard Robots and five 20% education discount coupons for a Manifold 2 (EMMC).<br>Obtains authorization to submit Mid-term Robot Assessment Video. |
| **January 23, 2019 - March 1, 2019 (UTC+8)** | | Online | Required for teams from Hong Kong, Macau, Taiwan and Overseas | |
| **January 23, 2019 - April 1, 2019 (UTC+8)** | Final Robot Assessment Video | Online | Required for Teams from Mainland China | Allowed to enter 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 | Online | Required for Teams from Mainland China | Authority to access the Referee System and attend Regional Competitions. |

| Schedule | Item | Location | Eligible Competitions/ Location | Benefits |
|---|---|---|---|---|
| **March 1, 2019 - June 4, 2019 (UTC+8)** | | | Required for teams from Hong Kong, Macau, Taiwan and Overseas | |
| **May 2019 - Sep. 2019 (UTC+8)** | Season Summary | Document | Optional | - |
| **Throughout the competition** | Open Source Report | Document | Optional | - |
| **Throughout the competition** | Sharing experience and open source content | Optional | Optional | Any Season Schedule, Project Proposal, or Mid-term Robot Assessment Video that is deemed outstanding, along with experience sharing and open-source content on the official RoboMaster online discussion forum can win 1 set of Standard Referee System (RM2018 version). |

| Competition education products | Standard Robot | Hero Robot | Engineer Robot | Sentry Robot | Aerial Robot | Education discount coupon |
|---|---|---|---|---|---|---|
| **Dev Board Type A** | 1 | 1 | 1 | 1 | 1 | **40% off** |
| **Dev Board Cables Package** | 1 | 1 | 1 | 1 | 1 | |
| **N3 Standard** | / | / | / | / | 1 | |
| **Guidance Kit** | / | / | / | / | 1 | |
| **DJI E2000 PRO Tuned Propulsion System CCW-R** | / | / | / | / | 1 | |
| **DJI E2000 PRO Tuned Propulsion System CW-R** | / | / | / | / | 1 | |

| Competition education products | Standard Robot | Hero Robot | Engineer Robot | Sentry Robot | Aerial Robot | Education discount coupon |
|---|---|---|---|---|---|---|
| **M3508 P19 Brushless DC Gear Motor** | 4 | 4 | 4 | 2 | 0 | |
| **C620 Brushless Motor ESC** | 4 | 4 | 4 | 2 | 0 | |
| **M3508 Accessories Package** | 1 | 1 | 1 | 1 | 0 | |
| **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 | |
| **E2000 - R2170 Carbon Fiber Foldable Propellers (CW)** | / | / | / | / | 4 | |
| **E2000 - R2170 Carbon Fiber Foldable Propellers (CCW)** | / | / | / | / | 4 | |

The details of the Technical Assessments are as follows:

**1. Rules Exam**

Format: Multiple-choice questions randomly selected from the RoboMaster database. The quiz can be taken, submitted, and retaken an unlimited number of times within 24 hours of the start of the evaluation period.

Score Ranking: Based on the score and time of the most recent submission. Totals are first ranked by score, and if the scores are the same, they are then ranked by submission time. The maximum score for a Rules Exam is 100 points, with 90 points as passing.

**2. Season Schedule**

Format: Word document

Font: Microsoft YaHei (Chinese) or Arial (English) in size 11

File Size: Max. 5,000 words including diagrams (flowcharts, forms, etc.)

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

Submission Opportunities: 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 give a

final score of 85 points.)

Evaluation Requirements: The Season Schedule includes seven modules. Each of these modules has its own requirements, scoring criteria, and score. The RoboMaster Organizing Committee will assess all modules.

The details and requirements for the four modules of the Season Summary are as follows:

| Module | Content | Scoring Criteria | Score |
|---|---|---|---|
| **Competition Culture** | RM competition details and culture<br>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<br>Logical clarity and accuracy<br>Data clarity and accuracy | 25 |
| **Team Structure** | Team's management structure<br>Recruitment direction<br>Responsibilities of each role | Reasonable structure<br>Cooperativeness<br>Clarity of duties | 10 |
| **Knowledge Sharing** | Open source forum materials, material manuals, knowledge sharing platforms, procedures, document management software applications, training and self-learning processes. | Quality and quantity of information<br>Reasonable usage of open software<br>Reasonable study plan | 20 |
| **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)<br>Work arrangements that take both schoolwork and competition tasks into consideration | Thoroughness of investigation<br>Reasonable Planning<br>Reasonable resource allocation | 10 |
| **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. Technical Proposal**

Format: Word document

Font: Microsoft YaHei (Chinese) or Arial (English) in size 11

File Size: Max. 8,000 words including diagrams (flowcharts, forms, etc.)

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

File Name: College Name + Team Name + Registration Number + "First/Second/Third Project Proposal"

Submission Opportunities: 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 give a final score of 80 points.)
Evaluation Requirements: The Technical Proposal includes eight modules. Each of these modules has its own requirements, scoring criteria, and score. The RoboMaster Organizing Committee will assess all modules.
The details and requirements for the four modules of the Season Summary are as follows:

| Module | Content | Scoring Criteria | Score |
|---|---|---|---|
| **Requirements 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 | 15 |
| **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 and maintainability of robot layout and wiring | 10 |
| **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 improvements** | 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 |
| **Innovation** | Use case description of innovative methods applied to robots | Whether innovations lead to better results | 10 |
| **Aesthetic Design** | Demonstration of a robot's aesthetic design | Consistency, attractiveness, and artistic expression of style | 5 |
| **Total:** | | | 100 |

Based on a certain functional component, report on design requirement analysis, schematics, material selection, manufacturing methods and finite-element analysis

| Item | Content | Scoring Criteria | Score |
|---|---|---|---|
| **Requirements 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 Drawings** | 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 |
| **Materials and Manufacturing Processes** | 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:<br>1. Loading Condition<br>2. Meshing<br>3. Results Analysis<br>4. Optimization | Meshing and optimization method<br>Topological optimization registration | 30 |
| **Total:** | | | 100 |

**4. Mid-term Robot Assessment Video**

Format: Video

Basic Requirements of the Mid-term Robot Assessment:

(1) Complete at least the basic requirements for Heroes or Engineers.(Choose one between Hero and Engineer.)

(2) Complete the basic requirements for Standard Robots.

(3) Submission Opportunities: 3 (All items must reach the required standards.)

(4) Submission method: upload the video to Youku, set a viewing password, and submit the video URL and password through the registration system.

Video Standards:

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

(2) Sufficient lighting is recommended to best display every operation and movement.

(3) For clarity, every process must include captions along with clear and accurate explanations.

(4) The video must be concise and cannot exceed three minutes. Ensure the video is compact and well put together to save on assessment time.
(5) Editing is allowed; however, it must not be used to demonstrate fraudulent operations.
(6) Videos must have a resolution of 720p or higher.

Evaluation Requirements: Different parts correspond to different requirements and scores and will be scored according to different sections of the Mid-term Robot Assessment Video.

| Item | Basic Requirements |
|---|---|
| **Engineer** | Demonstrates complete movement capabilities, demonstrates the ability to acquire projectiles and the ability to climb projectile depots (the ability to land on resource islands is not mandatory). |
| **Hero** | Demonstrate full movement capabilities, continuous launching of projectiles (no manual assistance allowed) to hit targets 1, 3, and 5 m away and be able to calculate the hit ratio |
| **Standard Robot** | Continuously fire 50 rounds of projectiles from the magazine to hit targets that are 1 and 3 m away and be able to calculate the hit ratio<br>While not exceeding power consumption limit, Standard Robots must be able to climb a 20-degree slope and display real-time power data. |

**5. Final Robot Assessment**

Format: Video + BOM

Video Standards:

(1) A title must be displayed at the beginning of the video that includes the college name and date/place of the recording.
(2) Sufficient lighting is recommended to best display every operation and movement.
(3) For clarity, every process must include captions along with clear and accurate explanations.
(4) The video must be concise and cannot exceed three minutes. Ensure the video is compact and well put together to save on assessment time.
(5) Editing is allowed, however it must not be used to demonstrate fraudulent operations.
(6) Videos must have a resolution of 720p or higher.

**BOM:**

In order to encourage the team to manage the project well, control costs, and clarify the structure and material of each robot, research and development of the robot as well as subsequent iterations well, and add a BOM.

**Standards:** The BOM is chosen for the project and is filled in according to the template.

Submission Opportunities: 3 (All items must reach the required standards.)

Submission Method: Upload the video to youku.com as a private video with an access password, and then submit the video URL and password to the RoboMaster registration system. Assessment Requirements: The Final Robot Assessment includes four modules. Each of these modules has its own requirements, scoring criteria, and score. The RoboMaster Organizing Committee will assess all modules.

The details and requirements for the four modules of the Season Summary are as follows:

| Item | Content |
| --- | --- |
| **Engineer** | Demonstrate full movement capabilities, demonstrate the installation position reserved for the Referee System and demonstrate that the installation holes conform to the requirements stipulated in the rules |
| **Hero** | Demonstrate full movement capabilities, launch projectiles to hit targets 3 and 5 m away and be able to calculate the hit ratio<br>Demonstrate the installation position reserved for the referee system and that the installation holes conform to the requirements stipulated in the rules |
| **Standard Robot** | Continuously fire 50 rounds of projectiles from the magazine to hit targets that are 3 and 5 m away, and be able to calculate the hit ratio<br>While not exceeding power consumption limit, Standard Robots must be able to climb a 20 degree slope and display real-time power data.<br>Demonstrate the installation position reserved for the referee system and that the installation holes conform to the requirements stipulated in the rules |
| **Full lineup display** | Show a photo of all final robots and all participating players from the team and individual hi-res photos of each robot. |

**6. Referee System Examination**

Format: Multiple-choice questions randomly selected from the RoboMaster database. The quiz can be taken, submitted, and retaken an unlimited number of times within 24 hours of the start of the evaluation period.

Score Ranking: Based on the score and time of the most recent submission. Full marks for the Referee System Exam is 100 points; 90 points is the minimum passing score.

**7. Season Summary**

Format: Word document

Font: Microsoft YaHei (Chinese) or Arial (English) in size 11

File Size: Max. 8,000 words

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

Evaluation Requirements: The Season Summary includes four modules. Each of these modules has its own requirements, scoring criteria, and score. The RoboMaster Organizing Committee will assess all modules.

The details and requirements for the four modules of the Season Summary 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 |

# Appendix 4 Prematch Inspection Form

| Category | Inspection Items | Description |
|---|---|---|
| Robot Size & Mass | Robot's initial size(length x width x height) | Standard Robot: 600 x 600 x 500 mm<br>Sentry: 500 x 500 x 600 mm (excluding the light indicator module, positioning module, and positioning module (support/scaffold/frame/cradle/stand/mount?))<br>Hero: 800 x 800 x 800 mm<br>Aerial: 1200 x 1200 x 800 mm<br>Engineer: 800 x 800 x 800 mm |
| | Robot's Expansion size (length x width x height) | Standard Robot: 700 x 700 x 600 mm<br>Sentry: 500 x 500 x 500 mm (Distance from the lowest point of the robot to the upper surface of Sentry Rail MUST not exceed 450mm)<br>Hero: 1200 x 1200 x 1200mm<br>Aerial: 1200 x 1200 x 800mm (height)<br>Engineer: 1200 x 1200 x 1200mm |
| | Robot Mass | Standard Robot: 20kg (excluding) 3.4kg of the Referee System)<br>Sentry: 10kg (subtract the 2.5kg of the Referee System)<br>Hero: 35kg (subtract the 4.6 kg of the Referee System)<br>Aerial: 10kg (subtract the 0.6kg of the Referee System)<br>Engineer: 35kg (subtract the 3.7kg of the Referee System)<br>Note: The weight of the referee system will be updated later. (The mass of referee system is subject to change.) |
| Robot modules | Referee System Completeness | The Referee System modules should be complete (intact) and unmodified. |
| | Aerial safety module | 1. The Vertical Safety Rod of the Aerial should be 300mm 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;<br>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;<br>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 Items | Description |
| --- | --- | --- |
| | | 4. The propeller blades should not collide with the surface of a cylinder of any diameter when flying horizontally at a cylinder;<br>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;<br>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;<br>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;<br>4. The area within 145° of the of the armor plate must not be covered and HP can be deducted normally;<br>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;<br>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;<br>7. For Hero and Engineer, the height difference between the lower edge of any two armor modules MUST not exceed 100mm;<br>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;<br>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 Items | 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 Updates | Robot modules should be updated to their latest versions. |
| | Power Tests | 1. The power curve should be normal;<br>2. A chassis should stop moving after its power is cut off; |
| | Main Control Module | 1. For the main control module screen, there can be no obstruction within 50mm above the button, making it convenient for operation;<br>2. There should be no electromagnetic device that may interfere with the main control module within 100mm of the "Robomaster" logo located on the module.<br>3. The infrared receiver should not be blocked for the sake of convenience during manual connection to the server before each match.<br>4. Ensure that the upgrade interface is accessible for wire plug-ins; |
| | Power management unit | 1. the indicators MUST not blocked;<br>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;<br>2. Connection wires of the left and right auxiliary light bars are parallel to the ground;<br>3. The main light bar of Standard Robots must be above the upper edge of the armor module; |
| | RFID Interaction Module | 1. 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);<br>2. Only the Hero can be equipped with one 17mm launching mechanism and one 42mm shooting mechanism;<br>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. |

| Category | Inspection Items | Description |
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| | | 4. There MUST any large magnetic material or inducible magnetic material (e.g. iron barrel, motors, magnets) within 70mm of the "RoboMaster" logo on the speed measurement module.<br>5. Re-calibration should be completed every time it leaves the Inspection Area; |
| | Locating Module | 1. The Locating Module should be installed horizontally with its top surface facing up, the front surface should be parallel with the frontal plane of the robot;<br>2. The imaginary line connecting the Locating Module and a base station should not be blocked during movement;<br>3. Except for the bottom face, there should be at least 10cm of clearance on each of the other five surfaces;<br>4. The LINK indicator should flash green, and the SYS indicator should flash red; |
| | Camera Transmission Module | A robot should transmit pictures back normally; |
| Pneumatics | | 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.<br>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.<br>3. Working gas: Working gas must be non-flammable and non-toxic: such as air, nitrogen, or carbon dioxide.<br>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.<br>5. The pressure regulator must be directly installed on the container's main outlet valve.<br>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 |

| Category | Inspection Items | Description |
| --- | --- | --- |
| | | caused by projectiles.<br>7. All pneumatic tubes, valves, and compressed gas containers must be concealed and installed in the interior of the robot. No part of the pneumatic system should come into<br>contact with the ground at any time;<br>8. Cylinder installation: The cylinder must be safely mounted on the vehicle frame. To ensure safety, the container must be either horizontal or vertical.<br>There must be at least two fixed points, and at least 1/5 the container's length must be fixed to the frame;<br>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<br>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;<br>2. The supply voltage should not be higher than 30V and there should be no risk of short circuiting;<br>3. Each operator should have no more than 1 remote control, and must be supplied by DJI;<br>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)<br>5. A ground unit should not be retrofitted with unofficial lighting effects;<br>6. A robot should not possess any devices that may damage the battlefield;<br>7. A robot should not possess any mechanisms that allow it to couple with other robots;<br>8. The robot should not be decorated in red or blue or large areas of reflective materials.<br>9. The Engineer is beautifully painted in vibrant colors; |

| Category | Inspection Items | Description |
| --- | --- | --- |
| | | 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. |
| Remarks | | |

# Appendix 5 Reference Pictures


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