

Using a 32-bit motor driver chip and Field-Oriented Control (FOC), the RoboMaster C620 Brushless DC Motor Speed Controller enables precise control over motor torque.

Exclusively designed for the RoboMaster M350B P19 Brushless DC Gear Motor and C620 Brushless DC Motor Speed Controller, the M350B Accessories Kit includes sensor cables and a terminal board.

Reference System Specification Manual, Reference System User Manual, Introduction of Reference System Manual.

Use M350B Accessories Kit to connect sensor cables and a terminal board to the reference system. For more information, please refer to the "Introduction of Reference System Manual".



ROBOMASTER 2020

TECHNICAL CHALLENGE

RULES FRAMEWORK

Prepared by the RoboMaster Organizing Committee
Released on October 2019

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Reading Tips

The content of these rules is not finalized. Kindly refer to the latest announcements of the organizing committee for further updates.

For details of the basic information and building specification, please refer to RoboMaster 2020 Technical Challenge Rules Manual and RoboMaster 2020 Robot Building Specification Manual to be released.

Symbol Descriptions

 Prohibition	 Important	 Hits and Tips	 Reference
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1. Robot

In each challenge, the robot lineup is as follows:

Table 1-1 Robot Lineup

Challenge	Qty. of Robot to Play	Qty. of Standby Robot (Optional)	Robot Numbering
Engineer Projectile Obtaining	1	Except Dart Targeting, each team can carry at most one standby robot in total of all challenges. In the Dart Targeting challenge, each team can carry at most four standby Darts.	2
Standard Racing and Smart Firing	1		3
2V2 Confrontation	1-2		<ul style="list-style-type: none">● Standard: 3● Sentry:7
Dart Targeting	4		8

2. Challenge



Note: The error margin of all battlefield components described here is within $\pm 5\%$ and the dimension unit is mm.

The Technical Challenge has four challenges: Engineer Projectile Obtaining, Standard Racing and Smart Firing, 2V2 Confrontation and Dart Targeting.

Pre-match preparation period, competition time of a single round and initial projectile quantity of each challenge are as follows:

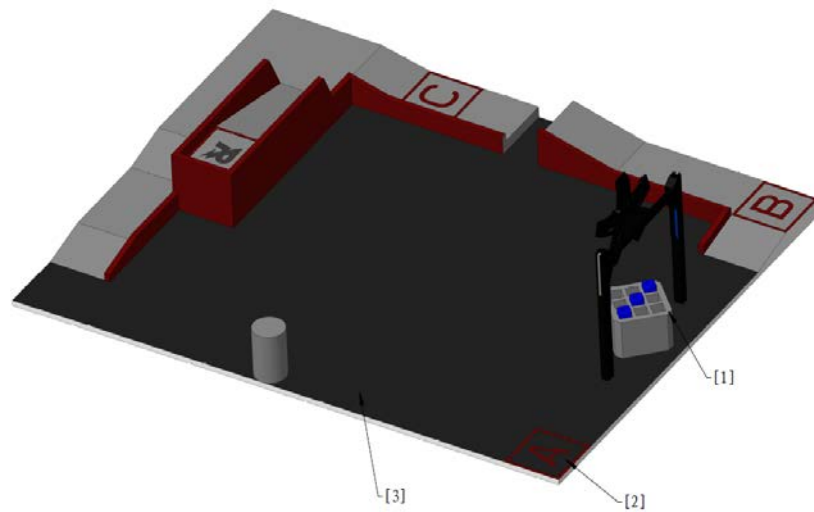
Table 2-1 Challenge Specification

Challenge	Pre-Match Preparation (min)	Time for a Round(min)	Initial Projectile Qty.	Participating Team Member Qty.
Engineer Projectile Obtaining	1	3	0	3-8
Standard Racing and Smart Firing	2	3	150	2-5
2V2 Confrontation	2	5	<ul style="list-style-type: none">● Standard: 100● Sentry: 500	3-10
Dart Targeting	2	1	-	2-5

2.1 Engineer Projectile Obtaining

The Engineer Projectile Obtaining challenge and the Standard Racing and Smart Firing challenge share one Battlefield which contains areas such as the Resource Island, Power Rune Activation Point and Road.

2.1.1 Battlefield



[1] Resource Island [2] Starting Zone [3] Litchi texture rubber

Figure 2-1 Battlefield of Engineer Projectile Obtaining

2.1.1.1 Resource Island

The Resource Island includes Projectile Depot, Power Rune. In the “Engineer Projectile Obtaining” challenge, Engineer needs to obtain projectile containers at the Resource Island.

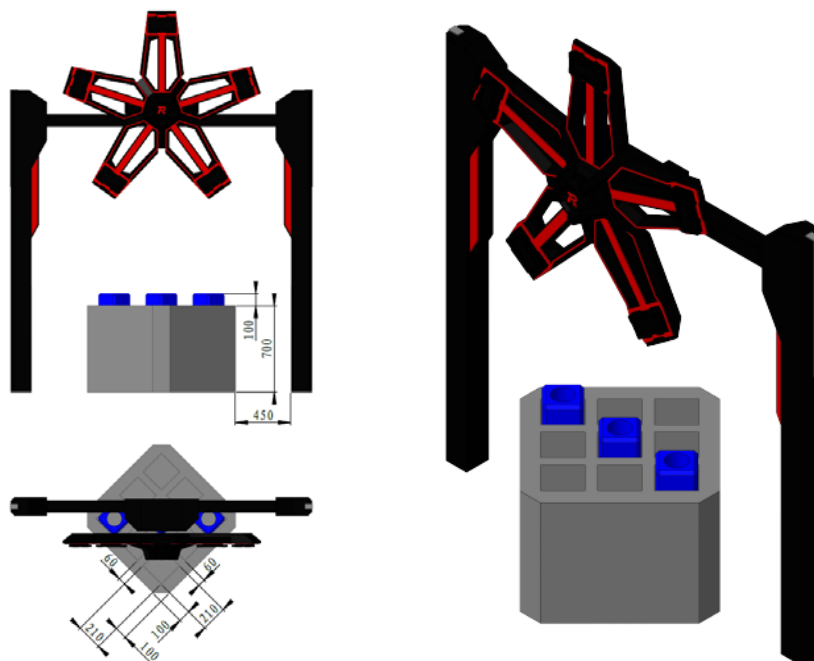


Figure 2-2 Resource Island

2.1.1.2 Projectile Depot

The Resource Island has 9 fixed Projectile Container grooves, on which are Projectile Containers.

In the “Engineer Projectile Obtaining” challenge, three projectile containers are placed on the Resource Island. In each of these projectile containers, there are twenty 42mm projectiles. Engineer can move or take away Projectile Containers to obtain projectiles.

Projectile Container

Projectile Container is 200 * 200 * 200 mm in size. Its six sides are chamfered and it is made out of EVA materials. The top side has a hole with a diameter of 115 mm. The depth of the Projectile Container on the Resource Island is 150 mm.

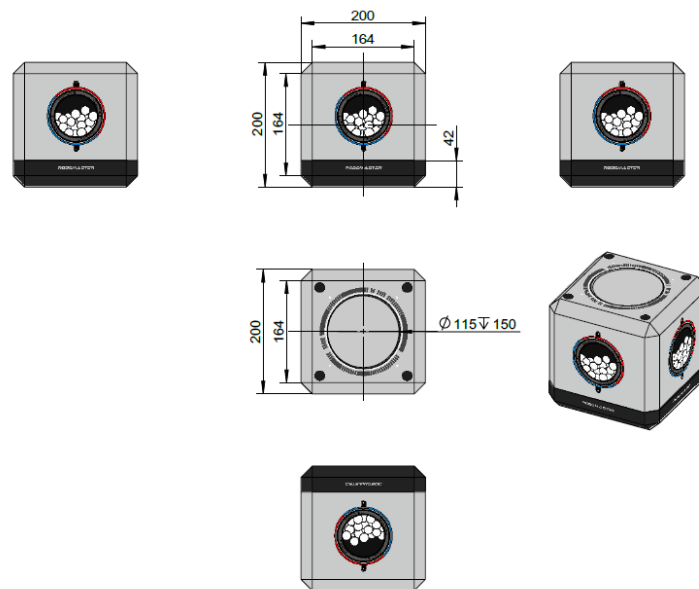


Figure 2-3 Projectile Container on the Resource Island

2.1.2 Rules

2.1.2.1 Challenge Rule

At the beginning of the competition, Engineer leaves the Zone A to retrieve three Projectile Containers on the Resource Island. After the Projectile Containers are retrieved, Engineer needs to move to the Zone C to complete the challenge.

2.1.2.2 Scoring Rule

Engineer moves to Zone C to count the quantity of projectiles. It needs to put the obtained projectiles into a storage box held by the staff. Projectile needs to be obtained naturally from the projectile interacting

mechanism of Engineer. One projectile gains five points.

The total time for each challenge is three minutes. If the projectile containers on the Resource Island are all taken, and the game time is not over when Engineer moves to Zone C, one point will be added for each remaining second. The final score will be zero if Engineer fails to move to Zone C.

2.1.2.3 Ranking Rule

Below is the team ranking rule in Engineer Projectile Obtaining:

1. Each team can initiate two challenges and take the highest total score of the two challenges as the final score. All teams will be ranked from high to low based on their total scores.
2. If the total scores of several teams are the same, the teams will be ranked based on the weight of their robots, with the lightest ranking higher.

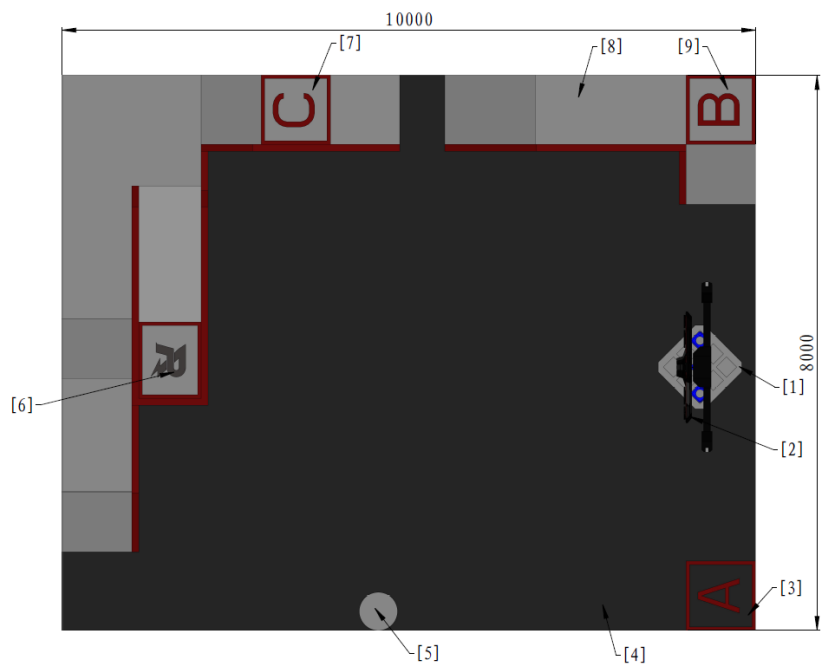
2.1.2.4 Eligibility

Engineer must successfully retrieve at least one round of projectile and move to Zone C in the schedule time.

2.2 Standard Racing and Smart Firing

The Standard Racing and Smart Firing challenge and the Engineer Projectile Obtaining challenge share one Battlefield.

2.2.1 Battlefield



- [1] Resource Island
- [2] Power Rune
- [3] Zone A
- [4] Litchi texture rubber
- [5] Spinning Platform
- [6] Power Rune Activation Point (Zone D)
- [7] Zone C
- [8] Road
- [9] Zone B

Figure 2-4 Standard Racing and Smart Firing Top View

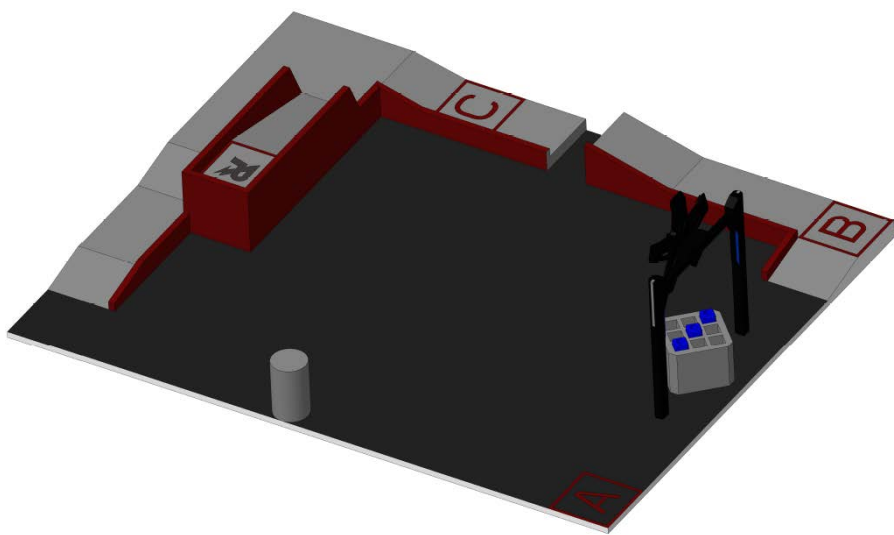
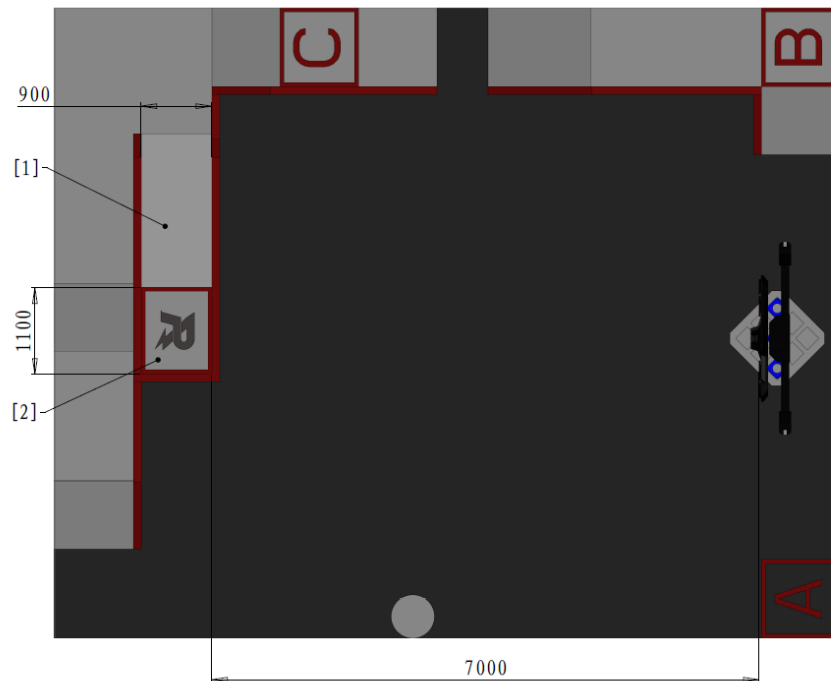


Figure 2-5 Standard Racing and Smart Firing Axonometric Drawing

2.2.1.1 Power Rune Activation Point

Standard needs to shoot Power Rune at Power Rune Activation Point.



[1] 13° slope [2] Power Rune Activation Point (Zone D)

Figure 2-6 Power Rune Activation Point (Zone D)

2.2.1.2 Launch Ramp

When Standard reaches Zone B, it can choose to get access to Zone C quickly through the Road.

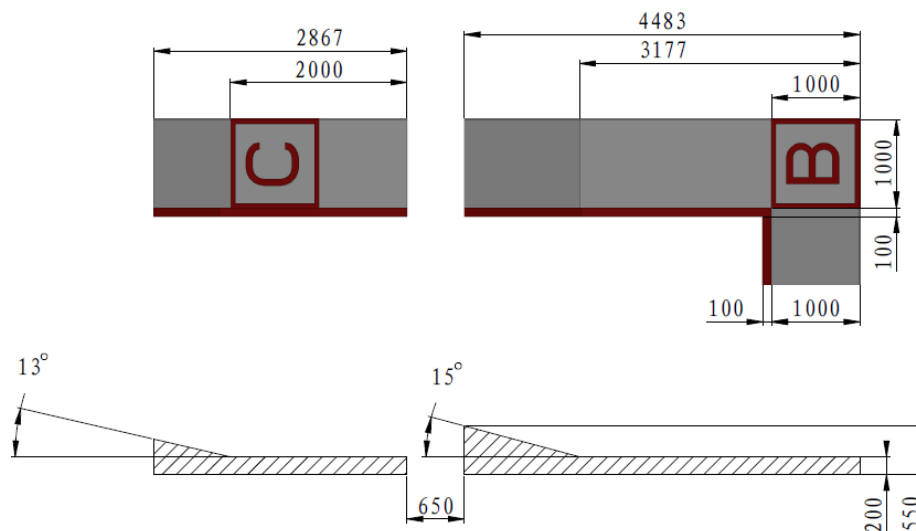
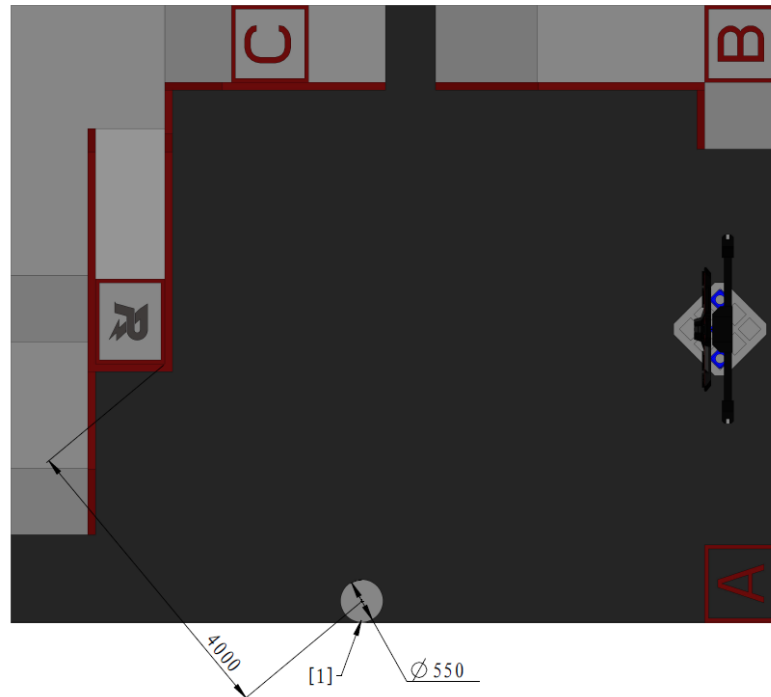


Figure 2-7 Road

2.2.1.3 Spinning Top

The Spinning Top is mounted on a platform at an altitude of 900 mm, at a distance of 4000 mm from Zone D. Four small Armor Modules and a Light Indicator Module are mounted on the Spinning Top. The lowest altitude of the Armor Modules from their bottom to the site is 930 mm, and the Light Indicator Module is fixed on one of the Armor Modules.

The Spinning Top has a HP of 300. Its specific diagram is subject to further updates.



[1] Spinning Top Platform

Figure 2-8 Relative Positional Relationship between Spinning Top Platform and Strike Point Zone D

States

The Spinning Top will be in one of two states: active and inactive.

1. Active

Competition begins. The Top spins with a regular variable velocity.

2. Inactive

HP of the Spinning Top becomes zero and the Top stops spinning.

2.2.1.4 Power Rune

The rotate speed of Power Rune will change with the strike process.

2.2.2 Rules

2.2.2.1 Competition Rule

The Standard is pre-loaded with 150 rounds of 17mm projectiles. During the 3-minute competition round, the Standard must complete the following missions:

1. Depart from Zone A, pass through Zone A, B and C on the site, eventually reaching Zone D and staying for 3 seconds. The barrel cooling value per second of the Standard is now five times its original value.
2. Standard strikes the Spinning Top at Zone D to make it inactive. Striking the Top in other places will be invalid.
3. After the Spinning Top is inactive, Standard needs to continue occupying Zone D for the Power Rune to be activated. If the robot leaves Zone D or has been defeated for longer than 2 seconds, any gains will be lost, and it will not be able to strike the Spinning Top or activate the Power Rune.
4. The Standard can try to activate the Power Rune at Zone D multiple times. The round ends once the Power Rune is activated completely.

The specific movement track of Standard is decided by the participant.

2.2.2.2 Scoring Rule

Record the time when each challenge is completed. If the Standard is still unable to make the Spinning Top inactive after the three-minute round's countdown has ended, the challenge will be deemed as failed.

2.2.2.3 Ranking Rule

Below is the team ranking rule in Standard Racing and Smart Firing:

1. Each team can initiate two challenges and take the shortest time used as the final score. The team that spends the least amount of time to finish the challenge ranks the highest
2. If the time to finish the challenge is the same, the teams will be ranked based on the remaining HP values of their robots.
3. If the time and the remaining HP values are the same, the teams will be ranked based on the weight of their robots, with the lighter ranking higher

2.2.2.4 Eligibility

The Standard must make the spinning top inactive for the team to be shortlisted.

2.3 2V2 Confrontation

2.3.1 Participant

Participants qualify for 2V2 Confrontation are as follows:

- Teams that have obtained the entry qualification for the Regional Competition for the first time in the RoboMaster 2018 Robotics Competition or RoboMaster 2019 Robotics Competition
- Teams that have never obtained the entry qualification for the Regional Competition before the RoboMaster 2020 Robotics Competition

The RMOC will determine whether participants of this challenge meet relevant requirements for team and conduct an on-site verification of participants' identity.

2.3.2 Battlefield

The core Competition Area of 2V2 Confrontation is called the "Battlefield". The Battlefield is an area with the size of 8m x 6m. Within the area are the Base, Starting Zone, Sentry Rail, Supplier Zone, Restoration Zone and Buff Zone.

Ground of the Battlefield is non-smooth and its specific parameter is subject to the further updates.

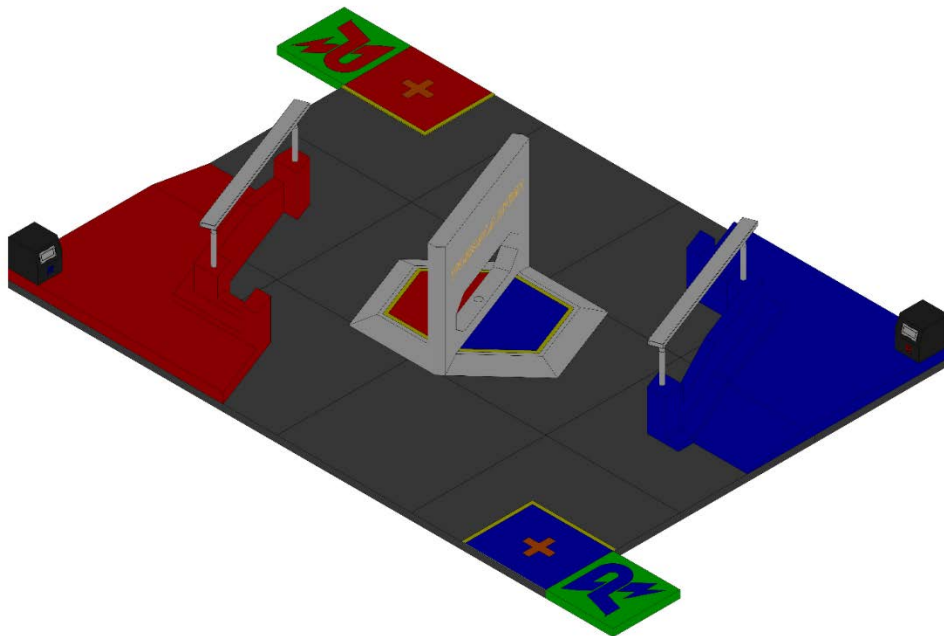


Figure 2-9 2V2 Confrontation Axonometric Drawing

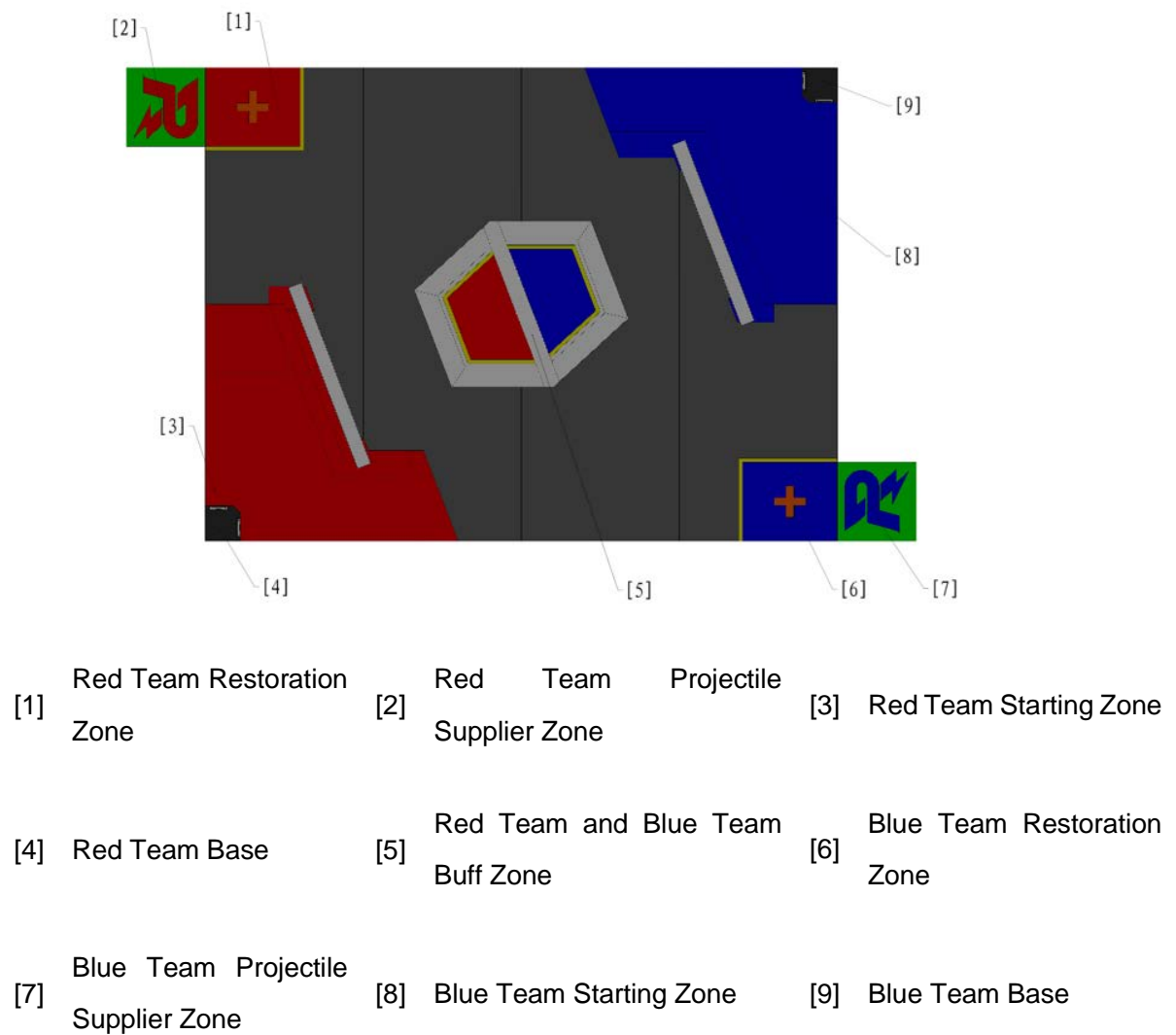


Figure 2-10 2V2 Confrontation Battlefield Top View

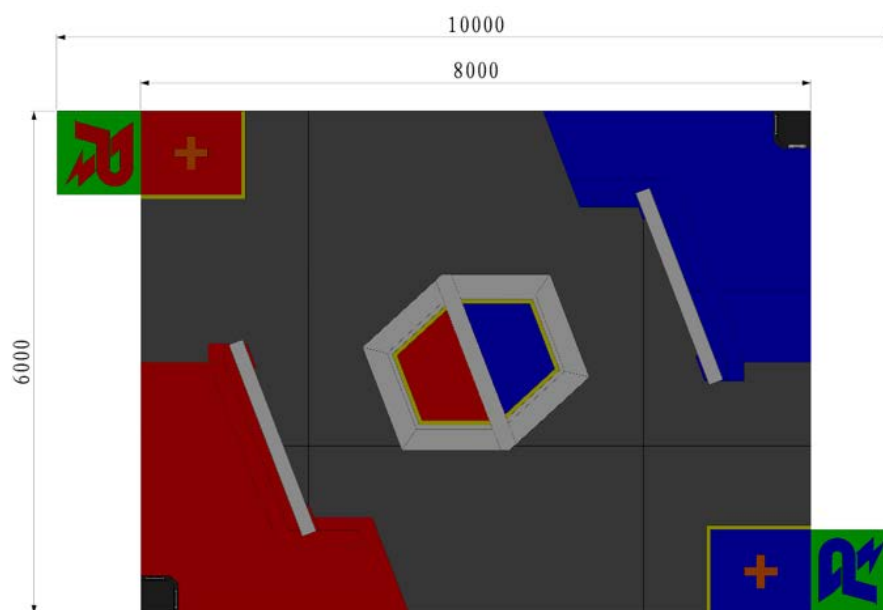


Figure 2-11 2V2 Confrontation Battlefield Size Dimensions

2.3.2.1 Starting Zone

The Starting Zone is the area where Standard is placed before a competition begins, which includes the Base, Base Zone and Sentry Rail.

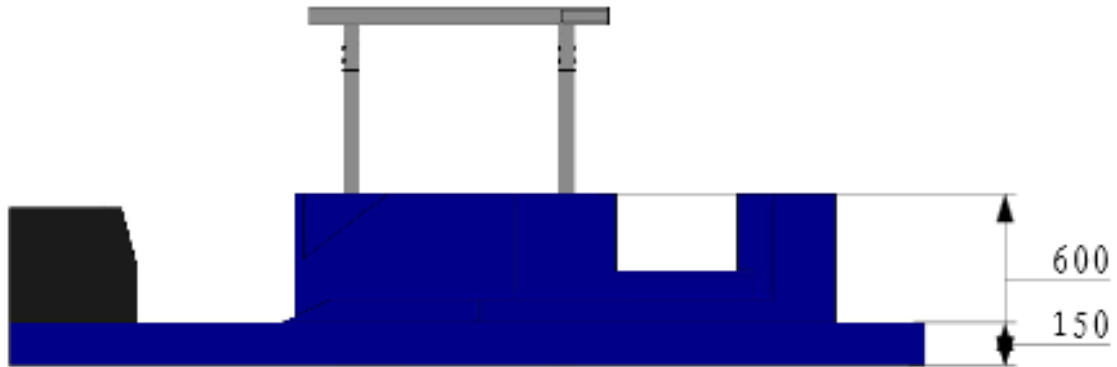
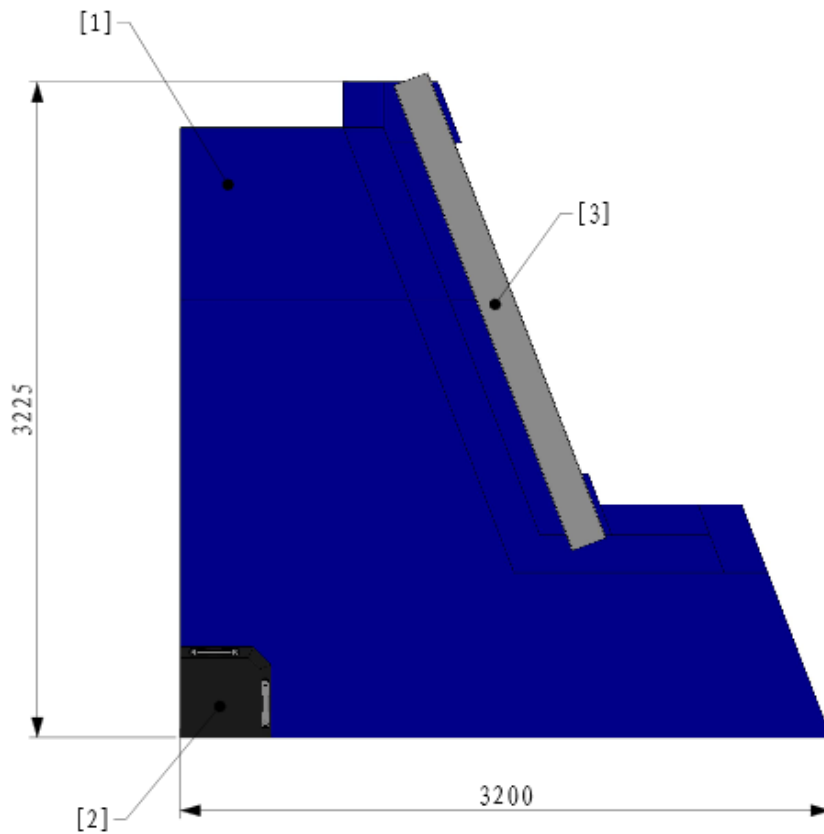


Figure 2-12 Starting Zone Front View



[1] 10° slope [2] Base [3] Sentry Rail

Figure 2-13 Starting Zone Top View

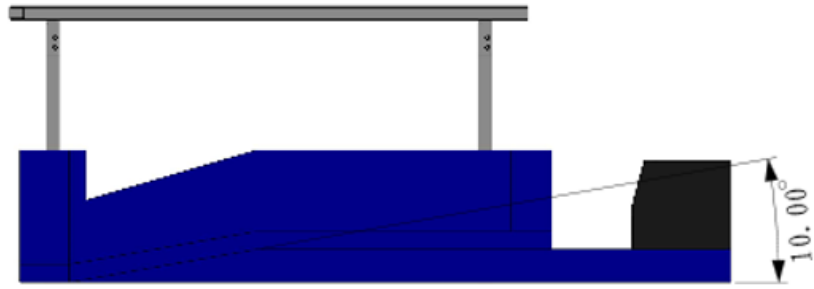


Figure 2-14 Starting Zone Side View

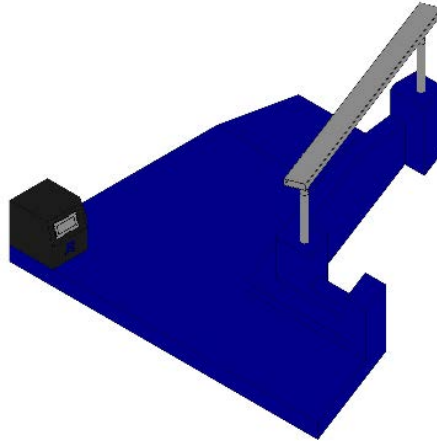
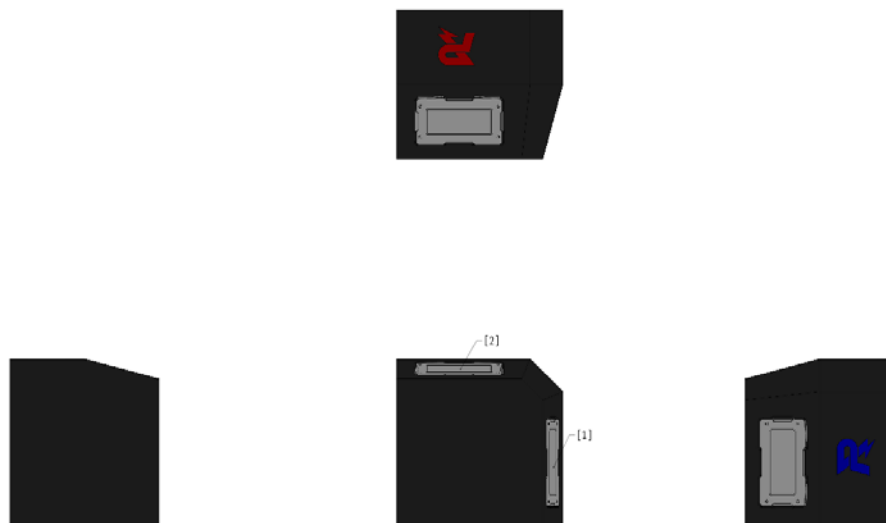


Figure 2-15 Starting Zone Axonometric Drawing

2.3.2.1.1 Base

The total HP of a Base is 1000. The Red Team and Blue Team each have a Base. Each Base is installed with two large armors. A corresponding sticker is attached on the armor plate.



[1] Large Armor Module [2] Large Armor Module

Figure 2-16 Base Three Views

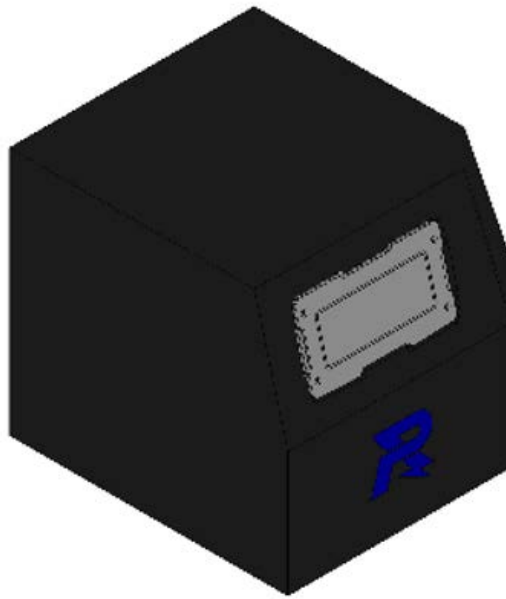


Figure 2-17 Base Axonometric Drawing

Relationship of Sentry and Base

- **If Sentry is playing:** When Sentry is destroyed, the original 60% defense of the Base will be eliminated
- **If Sentry is not playing:** Two minutes after the start of the match, the original 60% defense of the Base will be eliminated

2.3.2.1.2 Sentry Rail

The Sentry Rail consists of the main rail and its supporting frame. The main rail is the only place on which a Sentry moves. The surface of the Sentry Rail is matte paint. The distance between the underside of Sentry Rail and the ground is 1190 mm.

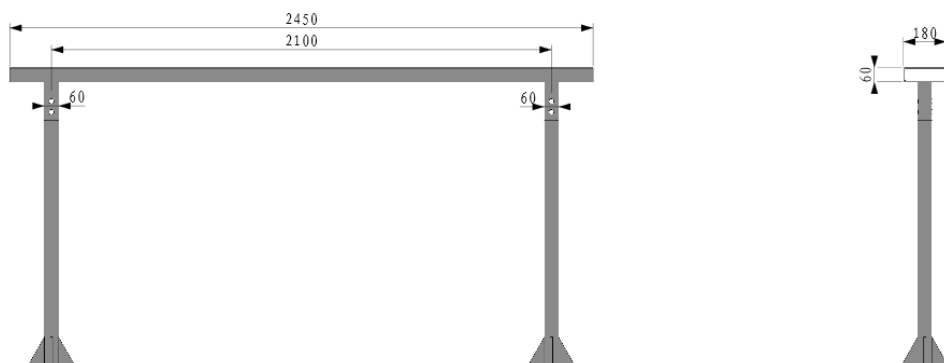


Figure 2-18 Sentry Rail Front View and Side View



Figure 2-19 Sentry Rail Axonometric Drawing

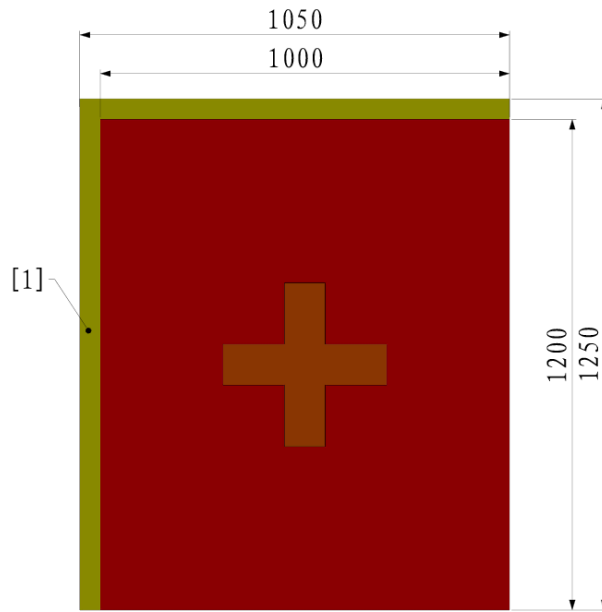
2.3.2.2 Supplier Zone

The Supplier Zone is an important area for reloading the projectiles and restoring the HP of a robot. Each Supplier Zone consists of a Restoration Zone and Projectile Supply Zone. The Red and Blue Teams each have a Supplier Zone.

2.3.2.2.1 Restoration Zone

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

The dimensions of the Restoration Zone are shown below:



[1] Supplier Penalty Zone

Figure 2-20 Restoration Zone Top View

2.3.2.2.2 Projectile Supplier Zone

One of the sides of the Perimeter Wall of the Supplier Zone is mirror stainless steel.

In each round, a Supplier outside the Battlefield will supply 150 rounds 17mm projectiles for robots for twice. Operator needs to control the robot to the Projectile Supplier Zone, where he can observe the whole process of projectile supplying from the mirror reflection.

The projectile supply time is at the start of the first minute (countdown at 4:00) and at the start of the third minute (countdown at 2:00).

The dimensions of the Projectile Supplier Zone are shown below:

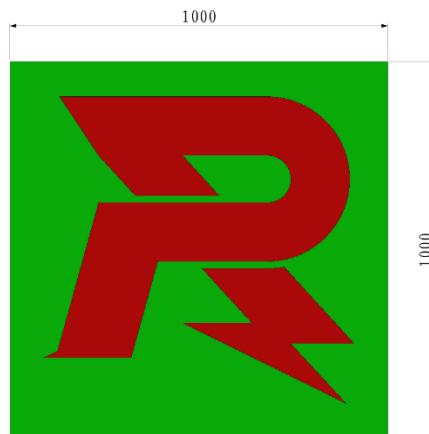


Figure 2-21 Projectile Supplier Zone Top View

2.3.2.2.3 Supplier Penalty Zone

The Supplier Zone of one team is the Penalty Zone to the other.

2.3.2.3 Buff Zone

The Buff Zone is a hexagonal island zone located at the center of the Battlefield. The Buff Zone is divided into two sides by a Perimeter Wall, in the middle of which there is a feature area for observation (the actual effects will be based on conditions at the competition site). Both Red Team and Blue Team has its own Buff Zone.

The robots situated on the Buff Zone will receive a 50% defense and its barrel cooling value per second is increased to 5 times of its origin. Only robots of the first occupied team can gain this bonus. If the robot leaves this area for more than two seconds, the gain will be invalid.

After the first minute of the match (countdown at 4:00), the attack gain of the Buff Zone enters into an available state. If a robot stays on the Buff Zone for continuously in a single duration of more than 15 seconds, all the robots of its team will receive a 1.5 times attack level boost. After the robot has left the Buff Zone, the attack level boost remains effective for 30 seconds. If one side has won an attack level boost, the other side will not be able to receive any attack level boost and the occupying time for both sides will revert to zero, until the effective duration of the attack level boost has elapsed. Occupying time cannot be accumulated, and will revert to zero after the robot has left the Buff Zone for longer than 2 seconds.

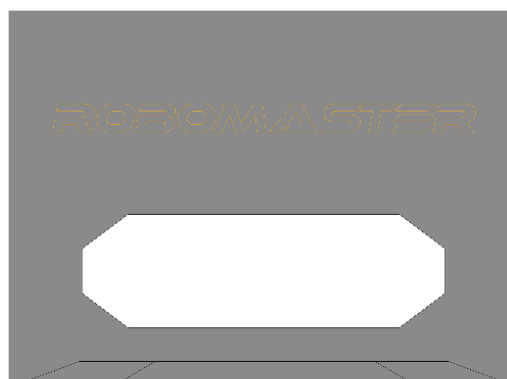


Figure 2-22 Buff Zone Front View

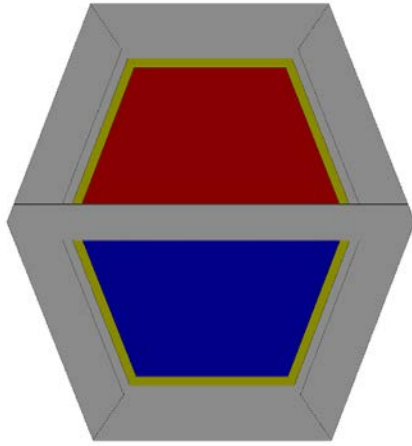


Figure 2-23 Buff Zone Top View

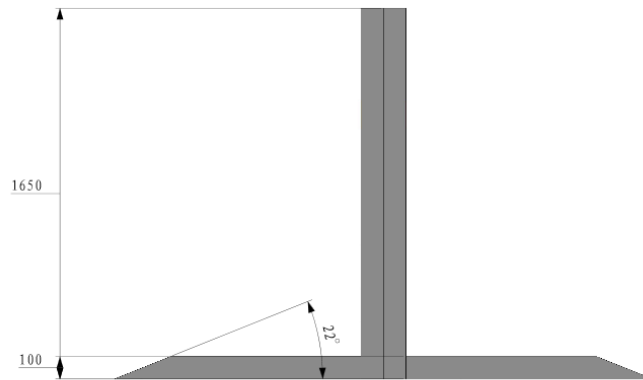


Figure 2-24 Buff Zone Side View

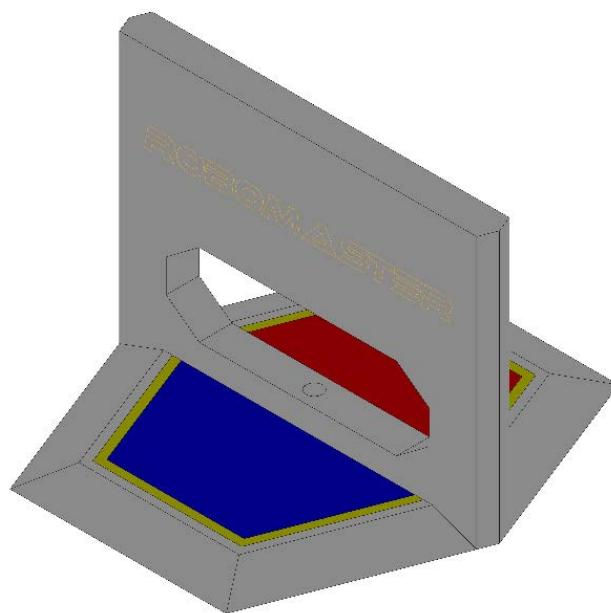


Figure 2-25 Buff Zone Axonometric Drawing

2.3.3 Rules

2.3.3.1 Challenge Rule

Standard is pre-loaded with 100 rounds of 17mm projectiles and Sentry with 500 rounds of 17mm projectiles. During the 5-minute competition round, Standard and Sentry of both sides engage in a 2V2 Confrontation in the Battlefield and attempt to shoot the Armor Modules in the opponent's Base.

2.3.3.2 Criteria Required to Win

Criteria for Winning a Single Round as shown below:

1. When the Base of one team is destroyed, the round ends immediately and the surviving team wins.
2. When the duration of a round has elapsed and if the Bases of both teams have survived, the team with the higher Remaining HP is the winner.
3. When the duration of a round has elapsed and if the Bases of both teams have survived with both having the same Remaining HP, the team with the higher HP Deduction wins.
4. When the duration of a round has elapsed and if the Bases of both teams have survived with both having the same Remaining HP and HP Deduction, the team with the higher total remaining Robot HP wins.

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

2.3.3.3 Group Stage

Depending on the Competition System, there are two or three rounds in a match, which are called BO2 and BO3 Competition System respectively according to the general competition system of competitive games. 2V2 Confrontation consists of the Group Stage and the Knockout Stage. The competition system of Group Stage is BO2; the system of Knockout Stage is all BO3.

Table 2-2 Scores of Group Stage

Competition System	Competition result	Score
BO2	2:0	Winning team obtains 3 points
	1:1	Each team obtains 1 point

Competition System	Competition result	Score
	0:2	Losing team obtains 0 points
	1:0	(one round draw): The team winning one game gains one point, and the team losing one game gains 0 point
	0:0	(two rounds draw): Each team obtains 0 point

The ranking of the Group Stage is determined by the total score of each game; the Knockout Stage is determined by the number of wins. The following criteria are used to determine rankings in descending order of priority:

1. The team with the higher match points ranks higher.
2. If the total match points of teams are the same, the team with the higher total Net Base HP ranks higher.
3. If the total Net Base HP are the same, the team with the higher total HP Deduction ranks higher.
4. If the total HP Deduction are the same, the team with the higher total remaining HP of all robots ranks higher.

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



- HP Deduction: At the end of each round, the total damage accrued from successfully hitting the armor modules of the opposing team's robot and leading to its deduction of HP.
 - HP deducted from the Initial Firing Speed exceeds the limit, Barrel Heat exceeds the limit, Chassis Power Consumption exceeds the limit and the Referee System goes offline are not counted as HP Deduction.
 - HP deducted from violations and penalties (Level 2 to 5 Warnings) determined by the referee will be counted as the enemy's HP Deduction.
 - Net Base HP: At the end of each round, the remaining Base HP of one team minus that of the opposing team.
 - Total Remaining HP: At the end of each round, the total value of the remaining HP of all surviving robots of a team.
-

2.3.3.4 Knockout Stage

Knockout Stage is determined by the number of wins: BO3 Competition System needs to win two rounds.

2.3.3.5 Eligibility

Awards are in a certain proportion based on the scores.

2.3.3.6 Collision and Getting Stuck Together

2.3.3.6.1 Collision

Collision refers to an occasion during a match when two team's robots collide with each other because of poor control by their operators. A robot may not use any of its structures to collide with the enemy's robots, regardless of whether the opposing robots have already been defeated, not including slowly pushing away a defeated robot because it blocks the road. When a Battlefield element leaves the field connecting with a robot, it is considered part of the robot.

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

Referees will decide the penalty as shown below for the culprit of such an occasion based on the actual contact that takes place.

Violations and Penalties:

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

2.3.3.6.2 Getting Stuck Together

Getting stuck together refers to an occasion in a match when robots are difficult to separate. When two robots get stuck together during a match, the referee will notify Operators from both sides to take appropriate actions to detach the robots. Operators must cooperate with the referee's instructions and perform the requested operations. A robot must not get stuck together with any other robot due to active interference, blocking or collision.

Referees will decide the penalty as shown below for the culprit based on the actual contact that takes place and the impact the getting stuck has on the match.

Violations and Penalties:

If any part of a robot gets stuck together with any part of the opposing team's robot due to active interference, blocking or collisions for T second(s), the referee will issue a Level X Warning.

T Second(s)	Level X Warning
$T \leq 10$	1
$10 < T \leq 30$	2
$30 < T \leq 60$	3
$T > 60$	4
$T > 90$	5

2.4 Dart Targeting

2.4.1 Battlefield

2.4.1.1 Dart Launcher

The Dart Launcher is an official Battlefield Component. Its opening is heading at the middle point between the opponent's Base and Outpost. The Dart Launch Opening has two positions: open and closed. The team must place the Dart Launcher in the Launch Opening within the setup period. The team must launch the Darts when the Launch Opening is open.

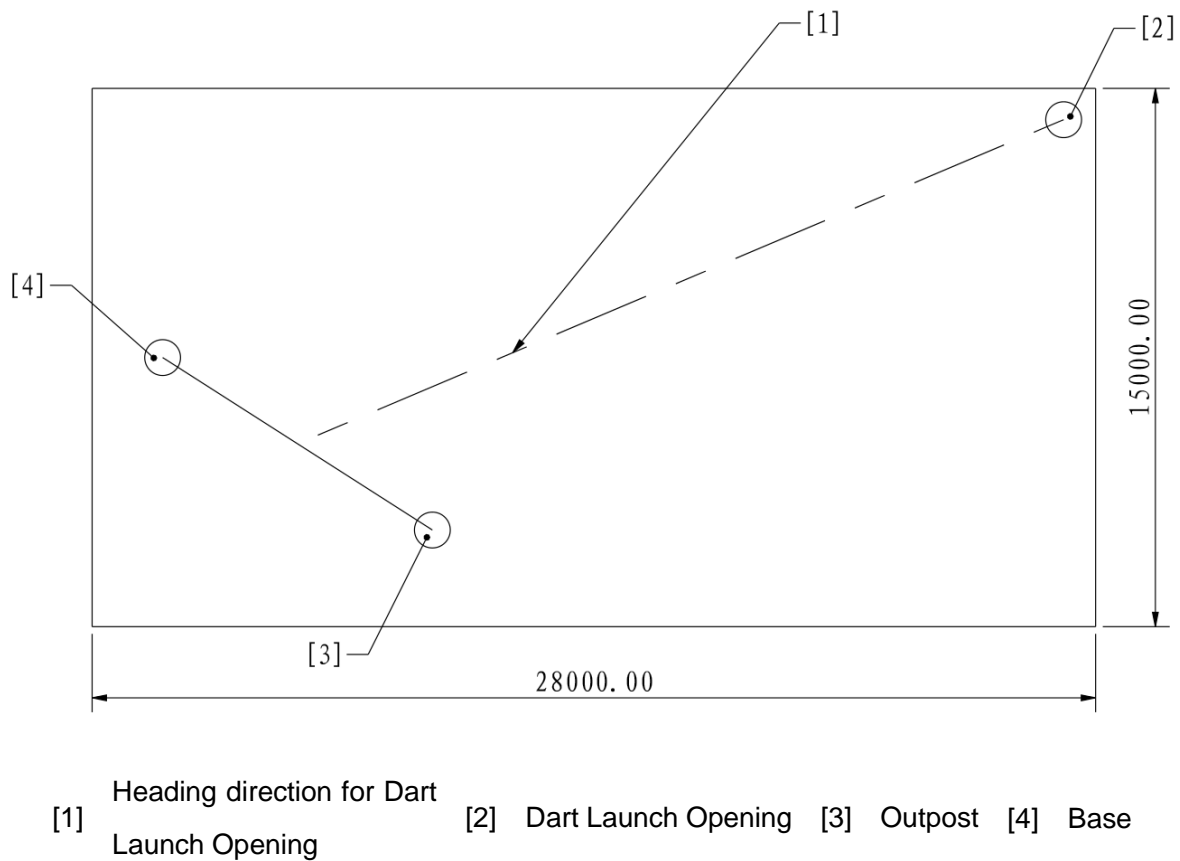


Figure 2-26 Heading direction for Dart Launch Opening

2.4.2 Rules

2.4.2.1 Qualifications

Each team must produce at least four Darts in order to participate.

2.4.2.2 Challenge Rule

After the competition has begun, the team has a setup period of two minutes to adjust the Darts. Thereafter, the team must launch all the Darts within one minute. The total time for each challenge is three minutes.

2.4.2.3 Scoring Rule

Each successful hit at a subject by a Dart is counted as one valid hit.

2.4.2.4 Ranking Rule

Below is the team ranking rule in Dart Targeting:

1. Each team can initiate two challenges and take the highest total score of the two challenges as the final score. All teams will be ranked from high to low based on their total scores.
2. In the case of two or more teams having the same number of subject hits, the team whose last subject hit was achieved in the shortest time will be given the higher ranking (time is accurate to milliseconds and subject to server record time).

2.4.2.5 Eligibility

A team must have at least one valid subject hit to be shortlisted.



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