

· 2019 ·

MAKEX

MakeX Robotics Competition

# City Guardian

Technical Guide **V1.0**



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**MAKE X**

# CONTENTS

<b>1. Introduction.....</b>	<b>1</b>
1.1 <i>About MakeX.....</i>	<i>1</i>
1.2 <i>MakeX Spirit.....</i>	<i>1</i>
1.3 <i>About 2019 Season.....</i>	<i>2</i>
1.4 <i>Participation Requirements.....</i>	<i>2</i>
<b>2. Terms.....</b>	<b>3</b>
2.1 <i>Roles.....</i>	<i>3</i>
2.2 <i>Robot.....</i>	<i>3</i>
2.3 <i>Competition.....</i>	<i>4</i>
2.4 <i>Refereeing.....</i>	<i>5</i>
<b>3. The Competition .....</b>	<b>7</b>
3.1 <i>Arena .....</i>	<i>7</i>
3.2 <i>Missions.....</i>	<i>10</i>
3.3 <i>Mission Selection Method.....</i>	<i>27</i>
3.4 <i>Scoring Explanation .....</i>	<i>28</i>
3.5 <i>Single Match Flow Chart .....</i>	<i>29</i>
<b>4. Robot Technical Requirements .....</b>	<b>31</b>
4.1 <i>General Technical Requirements.....</i>	<i>31</i>
4.2 <i>Technical Requirements for Equipment .....</i>	<i>33</i>
4.3 <i>Other Technical Requirements.....</i>	<i>35</i>
<b>5. Competition Rules .....</b>	<b>37</b>
5.1 <i>Safety.....</i>	<i>37</i>
5.2 <i>Operation.....</i>	<i>38</i>
5.3 <i>Punishment.....</i>	<i>42</i>
5.4 <i>Abnormal Situation .....</i>	<i>43</i>

5.5	<i>Explanations .....</i>	43
6.	Technical Guide Statement .....	44
7.	Disclaimer .....	44
8.	Copyright Declaration .....	45
	Appendix 1: Competition Resources .....	47
	Appendix 2: MakeX Starter Robot Self-Check List (City Guardian) .....	48
	Appendix 3: List of Props .....	51

**MAKE X**

# 1. Introduction

## 1.1 About MakeX

MakeX is a platform of robotic competitions for guiding the growth of young people. It aims at inspiring people's enthusiasm for creativity, sharing, and collaboration through Robotics Competition, STEAM Carnival, etc.

MakeX Robotics Competition is hosted by the MakeX Robotics Competition Committee, organized by Shenzhen Hulu Maker Co., Ltd. and supported by Shenzhen Makeblock Co., Ltd. As the core activity of MakeX, it aims that through the competition, young people will discover the spirit of creativity, teamwork, fun and sharing. It is committed to promoting innovation in science, technology and education through high-level competition events, guiding young people to learn Science (S), Technology (T), Engineering (E), Art (A) and Mathematics (M) and applying such knowledge in solving practical problems through the exciting and challenging competitions.

## 1.2 MakeX Spirit

**Creativity:** we advocate curiousness and innovation, encourage all contestants to create unique high-tech works with their talent, and challenge themselves for continuous progress!

**Teamwork:** we advocate solidarity and friendship, encourage all contestants to develop a sense of responsibility and enterprising spirit, and sincerely work with their partners for win-win development!

**Fun:** we encourage contestants to build a positive, healthy mindset in the competition. Enjoy the journey and grow in the process.

**Sharing:** we encourage contestants to have an open mind as a maker and share their knowledge, responsibility and joy with everyone including their teammates and competitors.

MakeX spirit is the cultural cornerstone of the MakeX Robotics Competition. We hope to provide a platform for all contestants, mentors and industry experts to exchange ideas, study and grow up, and help young people acquire new skills

during creation, learn to respect others in teamwork, gain an enjoyable life experience in the competition, take delight in sharing with the society their knowledge and responsibility, and work hard to achieve their grand aspiration of changing the world and creating the future!

### **1.3 About 2019 Season**

In 2019 season, MakeX will hold regional robotics competition in more than 30 countries and regions around the world and will launch MakeX competition courses and organize various competition activities, worldwide spreading STEAM education among the teenagers.

Qualified teams can enter into 2019 MakeX World Championship and compete for the 2019 MakeX World Champion.

The theme of MakeX Starter for 2019 Season is “City Guardian” , which mainly tests contestants' logical thinking, strategic teamwork and problem-solving ability.

With the rapid development of the economy, some businesses, when they are chasing benefits have caused serious pollution such as air pollution, waste pollution, and soil pollution to the urban environment. The city is once again mired in environmental crisis. Let's break through the environmental crisis and protect our city!

### **1.4 Participation Requirements**

MakeX Robot Competition is dedicated to providing young people with a high-quality, high-impact and impressive viewing experience platform for robotic competitions. Young people aged 6 to 16 (including) can register through the official website. The requirements are as follows:

1 to 2 contestants and 1 to 2 mentors per team. Each team must have a competition number as the unique identification symbol of the team. The competition number will be automatically generated after registration.

## 2. Terms

### 2.1 Roles

**Contestant:** Participant who registered and participated in the 2019 MakeX Robotic Competition Starter City Guardian.

**Mentor:** Coach who registered and participated in the 2019 MakeX Robotics Competition Starter City Guardian.

**Alliance:** The resulting combination of two teams competing simultaneously in one arena.

**Team:** Team is composed of contestants and mentors, who are registered and will participating in the 2019 MakeX Robotics Competition Starter City Guardian.

**Captain of Alliance:** The two teams that form the Alliance should designate one of the contestants on the arena as the captain of the Alliance.

**Robot:** Robot that the team designed, constructed and participated in the Starter City Guardian for the MakeX 2019 Robots Competition.

**Referee:** A person who is responsible for managing the order of the competition, enforcing the competition rules and maintaining the spirit of the competition with a neutral manner.

**Operator:** During the manual stage, the driver who controls the robot by the Bluetooth Controller.

**Observer:** During the manual stage, the contestants who observe and provide feedback of the competition, and also responsible for stacking in the garbage station.

### 2.2 Robot

**Recognition:** Through sensors, robot obtains the color information of the props on the arena.

**Clamping:** The robot has direct contact with the competition props or controls competition props.

**Moving:** The robot transports the competition props by changing the position of the props.

**Report:** The robot provides clear and understandable information to others.

**Robot Chassis:** The basic element for robot construction.

**Parts:** In addition to the robot chassis, other elements used for the robot construction.

**Flexible Material:** During the competition, the material that can have an obvious deformation due to the action of the robots.

## 2.3 Competition

**Automatic:** The robots execute the program in an autonomous way.

**Manual:** The operator controls the robot through the Bluetooth Controller.

**Competition Start:** The referee gives the instruction, “Competition Start” , to the contestants.

**Automatic Stage End:** The referee gives the instruction, “Automatic Stage End” , to the contestants.

**Manual Stage Start:** The referee gives the instruction, “Manual stage Start” , to the contestants.

**Competition End:** The referee gives the instruction, “Competition End” , to the contestants.

**Starting Area:** The area where the robot can start. When the vertical projection of the chassis of the robot is Completely In this area, the robot can be started.

**Mission Area:** The area where the missions and corresponding props are located. It is divided into automatic missions area and manual missions area.

**Operator's Area:** During the manual stage, the area where the operator is allowed to stay.

**Observer's Area:** During the manual stage, the area where the observer is allowed to stay.

**Guideline:** The white line, width of 25 mm, on the competition mat that can guide the movement of robot.

**Competition Mat:** The field where all the competition elements are placed, including missions, track, props, etc.

**Table:** Constructed platform and frames which are supporting the competition mat.

**Automatic Independent Mission:** The mission which requires the robot execute



an automatic program in the automatic missions area. The team scores Independent Mission Points for the Red/Blue Team by completing this mission.

**Automatic Alliance Mission:** The mission which requires the robot executes an automatic program in the automatic area. The team scores Alliance Mission Points by completing this mission.

**Manual Alliance Mission:** The mission which requires contestants to complete it by controlling the robot through Bluetooth Controller in the manual mission area. The team scores Alliance Mission Points by completing this mission.

**Mission Background:** Introduction to mission's story.

**Mission Requirements:** A brief description of scoring and completion status for mission.

**Scoring Details:** Detailed explanation for the specific requirements of the mission scoring method.

**Single Match Points:** Used for ranking in the Qualification Round and the Championship Round.

**Robot Start:** The contestants switch on the power of the robot and let the robot start from the starting area.

**Robot Restart:** With the permission of the referee, the contestants take the robot from the arena and restart it.

**Robot Modification:** With the referee's permission, the contestants take the robot out of the arena and change the robot parts.

## 2.4 Refereeing

**Direct Contact:** During the competition, the contestant touches the props or robots, where contact ways include but are not limited to: skin, hair, clothing, accessories.

**Indirect Contact:** During the competition, when the contestants have direct contact with the robots and at the same time the robots also has contact with props.

**Completely In:** The vertical projection of the props or the robots are completely located in the designated area.

**Partially In:** The vertical projection of the props or the robots are partially located in the designated area or have contact with the designated area.

**Completely Out:** The vertical projection of the props or the robots are completely outside the designated area.

**Stationary State:** Props or robots are not moving respect to the competition mat.

**Real-time State:** The simultaneous condition of the props or the robots during the competition or stage.

**Final State:** The eventual condition of the props or the robots after the end of the competition or stage.



## 3. The Competition

### 3.1 Arena

The Arena MakeX Robotics Competition Starter City Guardian is divided into Automatic Mission Area and Manual Mission Area. The robots from an alliance complete the missions in designated area.



Fig 3.1 Competition Arena

#### Competition Mat Size

Competition mat size has two parts, 2370 mm \* 1150 mm for the Automatic Missions Area, and 2370 mm \* 1150 mm for the Manual Missions Area.

## Automatic Missions Area

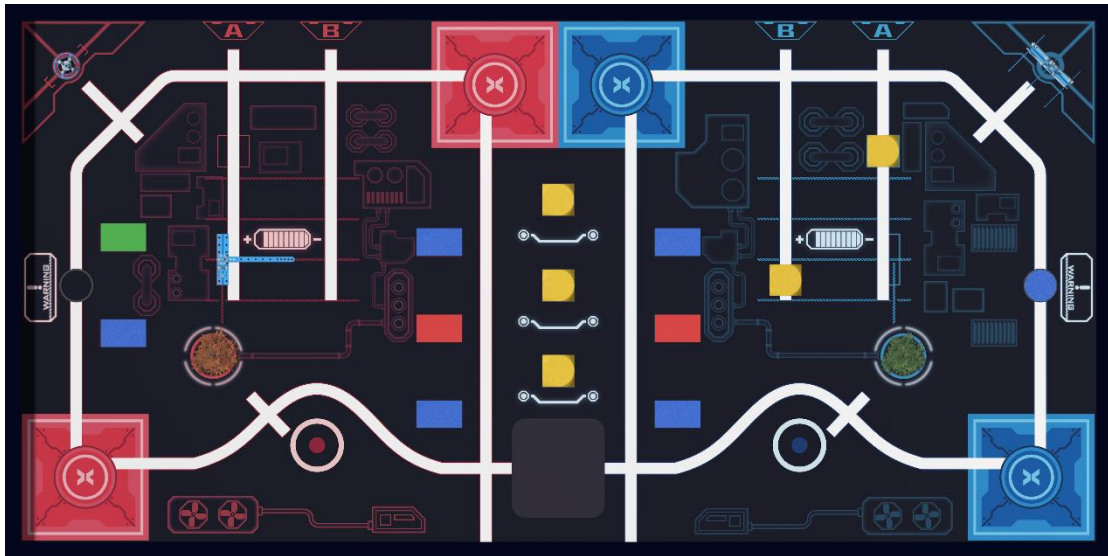


Fig 3.2 Automatic Missions Area

Robot needs to execute its automatic program to complete the missions in the Automatic Missions Area.

There are 9 mission areas in the Automatic Missions Area, including 6 independent mission areas (3 for each team in alliance) and 3 alliance mission areas. Each independent mission area has two alternative missions. Each independent mission area is intended for two alternative missions. For more details please refer to section 3.3 Mission Selection Method.

## Manual Missions Area

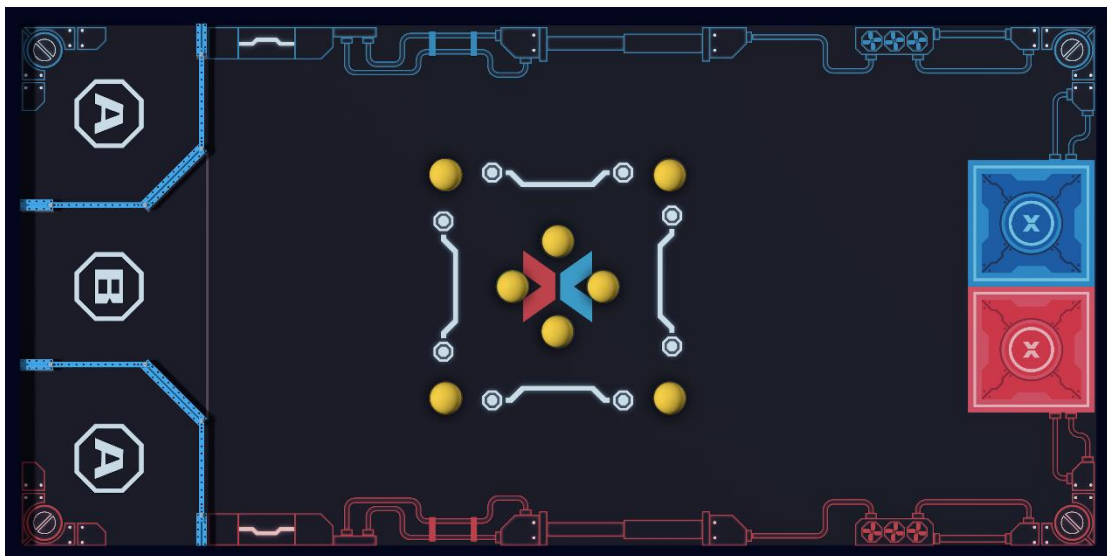


Fig 3.3 Manual Missions Area

In the Manual Missions Area, Contestants need to complete the mission by manually controlling the robots.

### Starting Area

The Starting Area is a square area of 280mm\*280mm (**within the black dash line shown in Fig 3.4**). Starting Area with blue color can be used by the blue team only and vice versa for the red team. There are 6 Starting Areas in the arena, 3 for the Blue team and 3 for the Red team. For each team, 2 Starting Areas are located in the Automatic Mission Area and 1 is located in Manual Mission Area.

Guideline may emerge inside the Starting Area to support the robot starting.

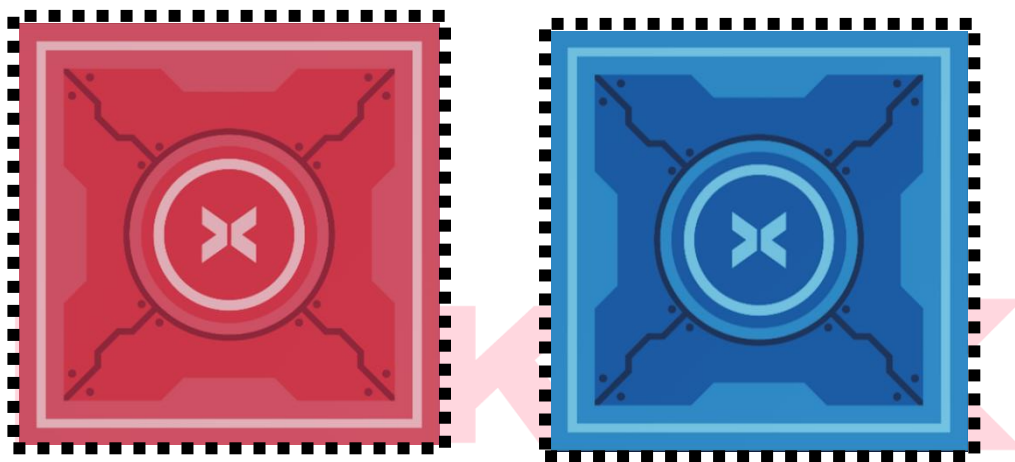


Fig 3.4 Starting Area

## 3.2 Missions

The Single Match lasts for 4 minutes, of which the first 2 minutes and 30 seconds is the time for Automatic Stage. Within the time, the contestants need to complete the Automatic Independent Missions and the Automatic Alliance Missions. The remaining 1 minute and 30 seconds is the time for the Manual Stage, where the contestants need to complete the Manual Alliance Mission. Maximum time for stages transition is 30 seconds and the Manual Stage will start directly after 30 seconds. Contestants should follow the instruction of referee.

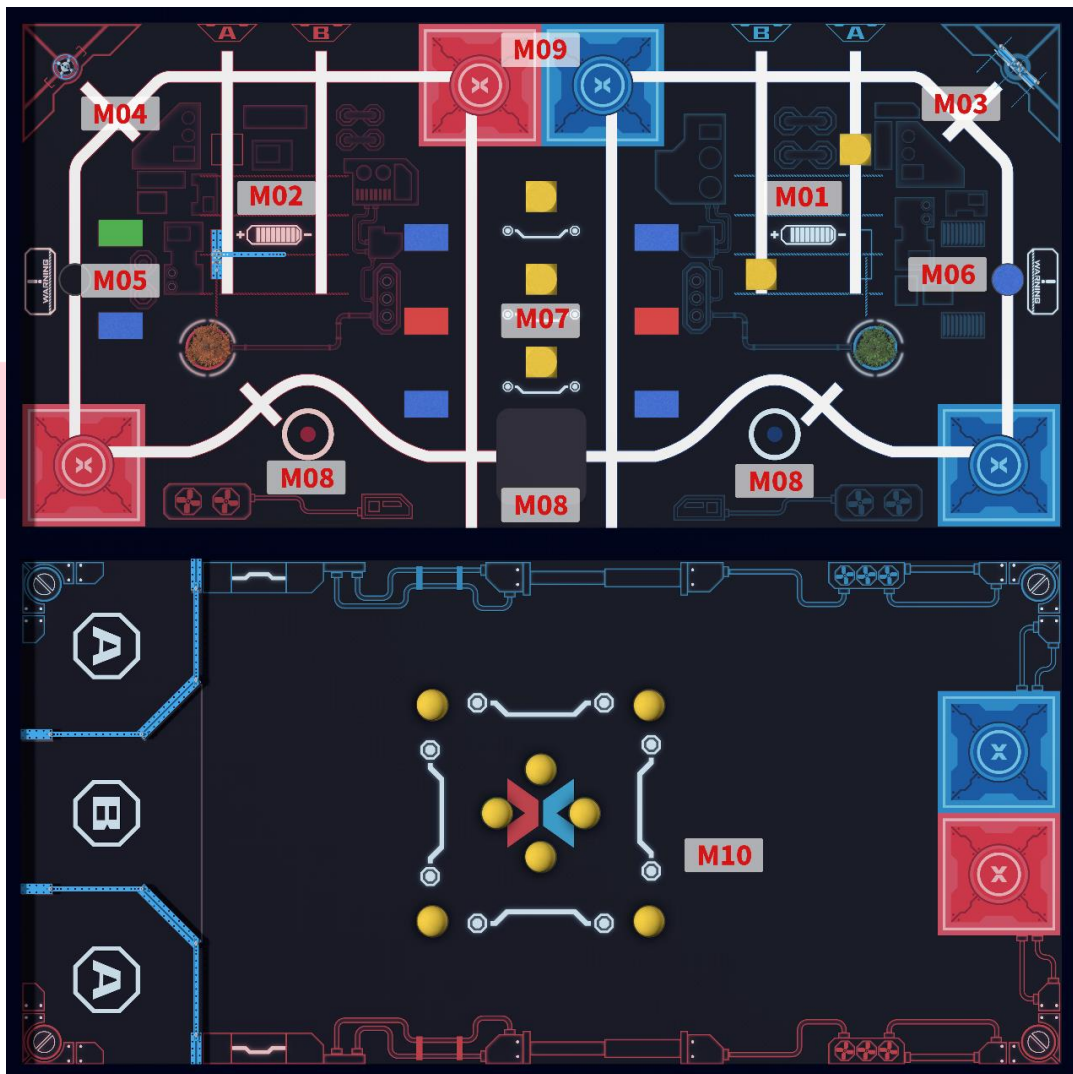


Fig 3.5 Mission Area Location

### Automatic Independent Missions

The robot needs to complete missions independently by executing automatic programs and score Independent Mission Points for the Red/Blue Team.

## **M01. Energy-saving Switch**

### **Mission background:**

The low-energy alarm is ringing in the city and robots need to switch on the energy-saving switch to reduce energy consumption.

### **Mission requirements:**

The robot needs to move the yellow block A to the same area as yellow block B which means switch on the energy-saving switch. The team scores 60 points for successful moving, the full point is 60.

### **Scoring details:**

The vertical projection of yellow block A in stationary state needs to be Completely In the same parallel area as yellow block B and stay for at least two seconds. If yellow block A is Partially In or Completely Out the area, this mission will not be scored.

The vertical projection of yellow block A in stationary state needs to contact the white guideline to score points.

The vertical projection of yellow block B in stationary state need to be Completely in the initial position, otherwise the mission will not be scored.

The initial position of yellow block B will be determined randomly before each Single Match starts.



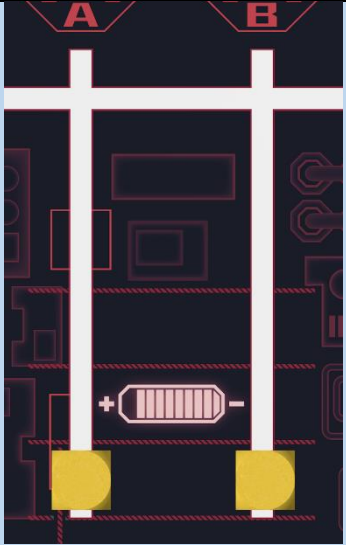
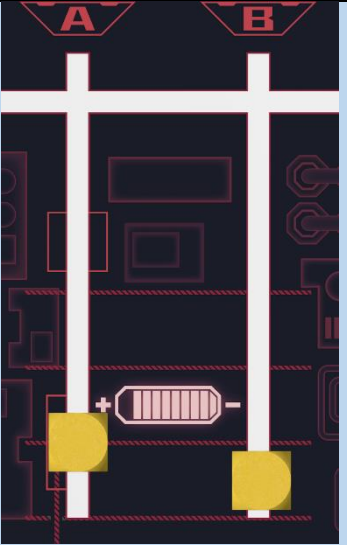
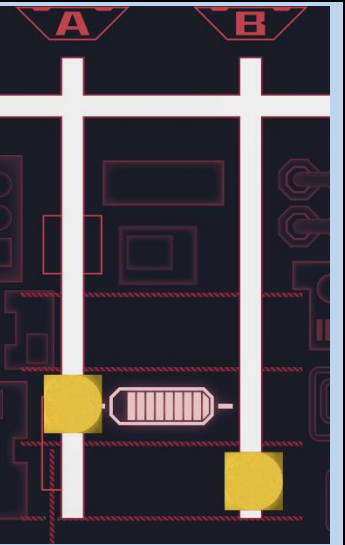
Status	Completely In	Partially In	Completely out
Figure			
Score or not	✓	✗	✗

Table 3.1 Scoring Details for Energy-saving Switch





## M02. Charging Station

### Mission background:

The city has started the energy-saving mode, and now it needs the robot to switch on the city's charging station.

### Mission requirements:

The robot needs to enter the charging station and rotate the switch in the specified direction for more than 90 degrees. The team scores 60 points for successful switching on, the full point is 60.

### Scoring details:

The final state of the switch does not affect the scoring, as long as the switch passes through two perpendicular lines (highlighted in Fig 3.7) in the specific direction (Arrow in Fig 3.6), the mission can be scored. No points will be scored if the switch rotates less than 90 degrees.

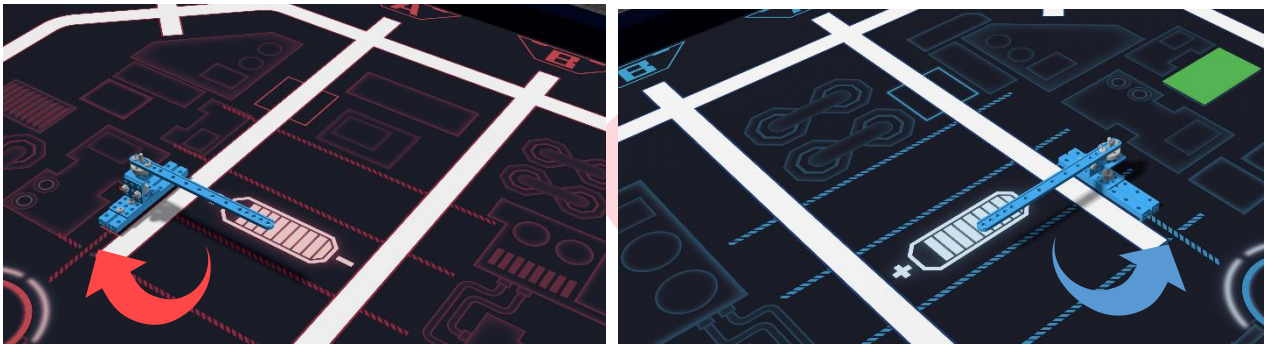


Fig 3.6 Rotating Direction of Switch (Initial State)



Fig 3.7 Switch-on State

### M03. Aging Power Plant

#### Mission background:

There is an aging power plant with 3 generators in the city. Robots need to dismantle all 3 generators.

#### Mission requirements:

The robot needs to move the 3 generators to another direction representing successfully dismantling of the power plant. The team scores 20 points for each successful generator dismantling, the full point is 60.

#### Scoring details:

As long as each of the 3 generator reaches the dismantled state, it can be scored.

Scoring for the same generator will not be repeated.

If any object (except the table) traps the movement of any generator to the dismantled state, the mission is not fully completed, and no point will be scored for the trapped generator.

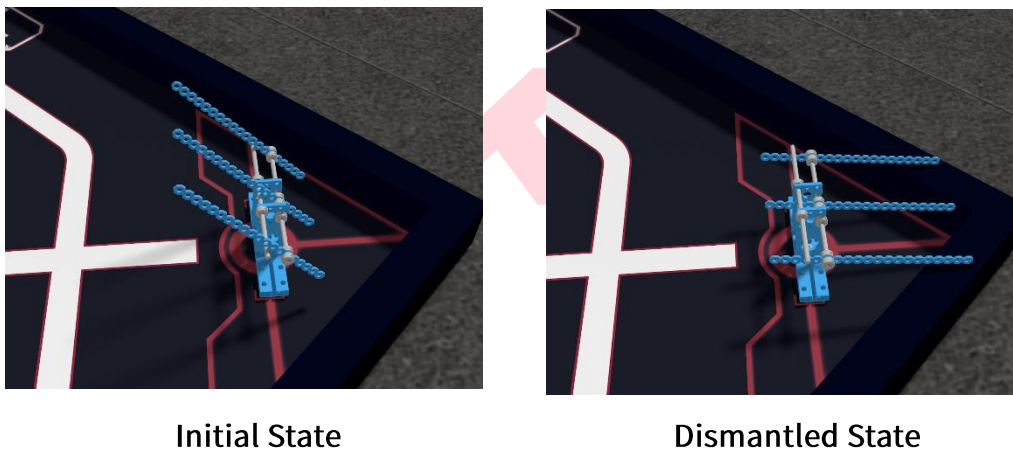


Fig 3.8 State of Aging Power Plant

## M04. Chimney Dismantling

### Mission background:

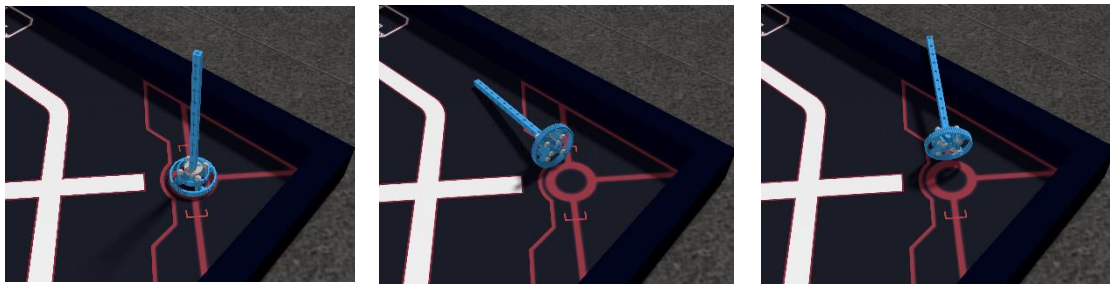
An old chimney is still standing in the city and robot should dismantle it.

### Mission requirements:

The robot needs to push down the chimney standing in the arena. The team scores 60 points for successful dismantling, the full point is 60.

### Scoring details:

As long as the top of the chimney touches any part of the Table, the mission can be scored. On the contrary, it will not be scored if the top does not touch the Table.



Initial State

Dismantled State 1

Dismantled State 2

Figure 3.9 State of Chimney

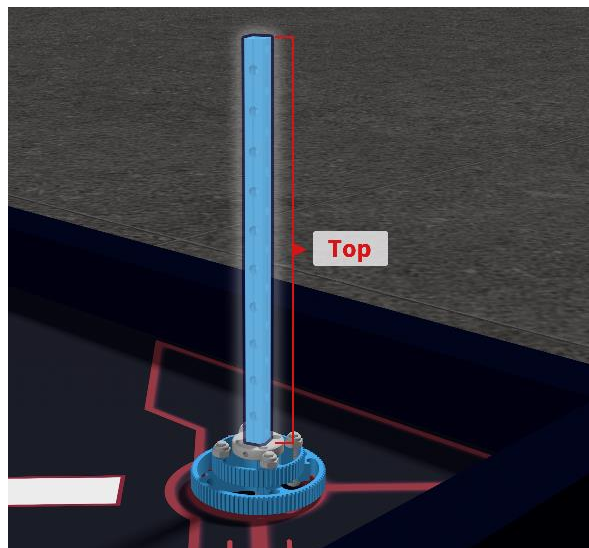


Figure 3.10 Top of Chimney

## **M05. Road Inspection**

### **Mission background:**

During daily work, the robot encounters road construction. Robots need to identify and avoid the danger to reach their destination.

### **Mission requirements:**

When the robot encounters a color card, it needs to complete color recognition and correctly report the color information in a visual form. After completing the report of the first color card, 20 points will be scored. The robot continues to complete the recognition and report for the second color card. After completing the report of the second color card, another 30 points will be scored. The full point is 50.

### **Scoring details:**

The robot reports color information in a visual form by displaying specified letters (R for red, G for green, B for blue) or displaying lights with the same color.

The order of color cards will be determined randomly before each Single Match started.

The time of report must be at least 2 seconds and the robot should keep the Stationary State to ensure that the referee receives the robot's information accurately.

After completing the first color card, if the contestants request robot restart and then complete the second color card, the team can score only 20 points for completing the first color card without extra 30 points for the second color card.

The contestants can attempt this mission multiple times, and the attempt with the highest points will be recorded.

For each color card, If the robot reports multiple different information for it, only the last reported information will be considered valid.

For each attempt, the first color card encountered by the robot is regarded as the first one. If the robot restarts, the inspection sequence of the color cards will be redefined. (Respect to Fig 3.11)

The mainboard power indication LED and the sensor power indication LED will not be considered as valid information.

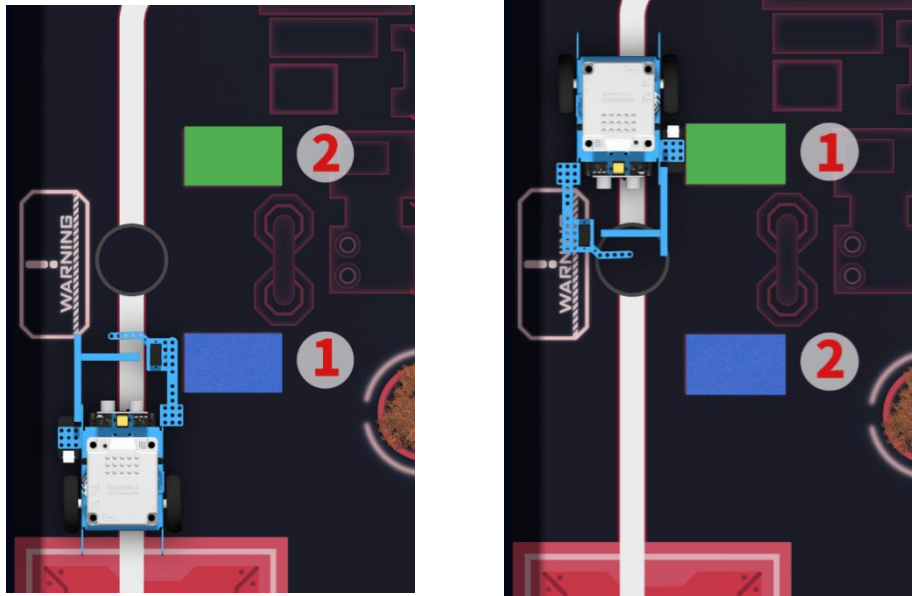


Fig 3.11 Inspection Sequence of Color Card

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## M06. Obstacle Removal

### Mission background:

After the rainstorm, an obstacle is on the road and affects urban traffic and normal life.

### Mission requirements:

The robots need to move the obstacle away from the road. The team scores 50 points for successful moving, the full point is 50.

### Scoring details:

If the vertical projection of the obstacle in Stationary State is Completely Out of the initial circle and stay for at least 2 seconds, the mission can be scored.

If the vertical projection of the obstacle in Stationary State is Partially In the initial circle, the mission cannot be scored.

Inclination or fall over of the obstacle does not affect the scoring.



Fig 3.12 Obstacle on Road

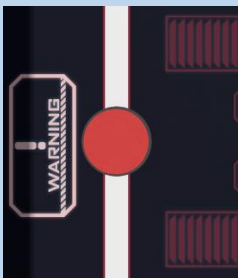

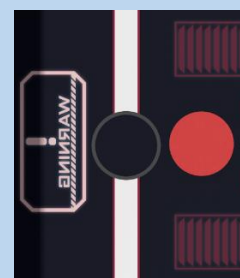
Status	Completely In	Partially In	Completely out
Figure			
Score or not	✗	✗	✓

Table 3.2 Scoring Details for Obstacle Removal (Direction of Removal is just for reference)



## Automatic Alliance Missions

The robot needs to execute automatic programs and cooperate with their alliance team to complete these missions. After completing the missions, the team will score the Alliance Mission Points.

### M07. Waste Sorting

#### Mission background:

There are 3 construction wastes in the city center. Robots need to classify and dispose these construction wastes.

#### Mission requirements:

The robot needs to distinguish the construction waste type by recognizing the correspondent color cards (red or blue). Then, robot needs to move the construction waste to the corresponding (red or blue) treatment areas according to the waste categories (red or blue) To identify the treatment areas, please refer to Fig 3.13. The alliance teams score 20 points for each successful sorting of construction waste, the full point is 60.

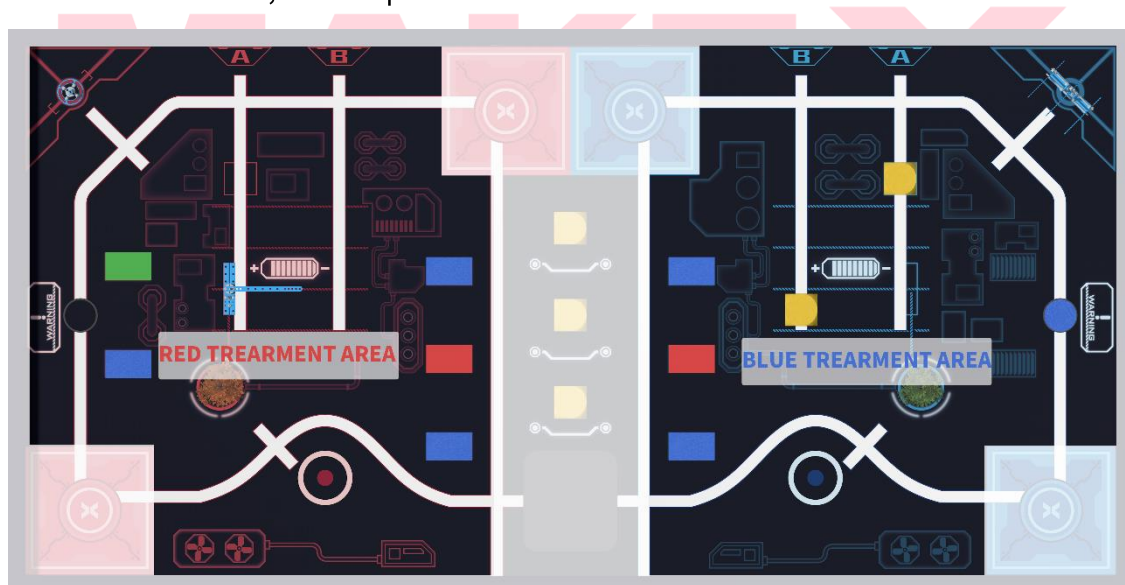


Fig 3.13 Details of Waste Treatment Area

#### Scoring details:

The red card represents that the corresponding construction waste needs to be processed at red treatment area. The blue card represents that the corresponding construction waste needs to be processed at blue treatment area.

The order of color cards will be determined randomly before a Single Match started.

If the vertical projection of the waste in stationary state is Completely In the correct

treatment area and stays at least 2 seconds, the waste can be scored.

If the vertical projection of the waste in stationary state is Partially In or Completely In the Starting Area, the waste cannot be scored.

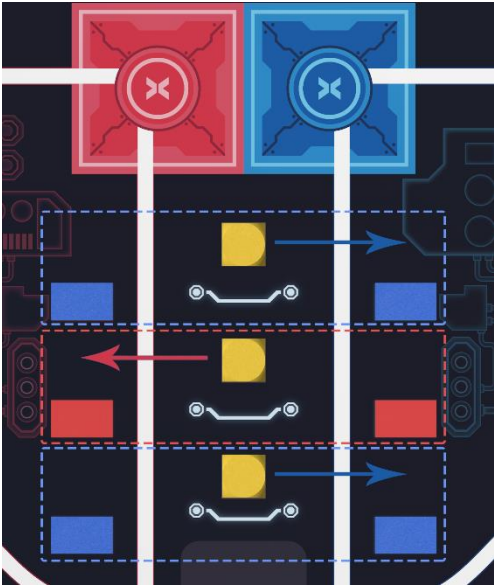


Fig 3.14 Correspondence between Color Card and Construction Waste

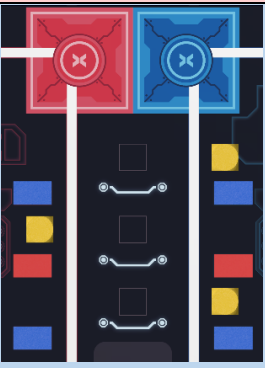
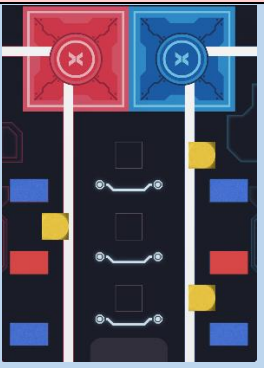
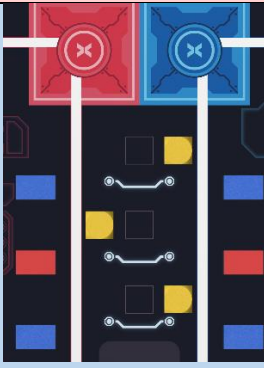
Status	Completely In	Partially In	Completely out
Figure			
Score or not	✓	✗	✗

Table 3.3 Scoring Details for Waste Sorting



## M08. Forest Planting

### Mission background:

To prevent desertification in suburban areas, the robots from the alliance team need to work in different roles, and plant saplings, to prevent the desertification.

### Mission requirements:

Each sapling corresponds to two stages of the missions. For example, in the first stage, the red team's sapling needs to be moved to transit area by red team's robot, so the alliance teams score 20 points. The blue team's robot continues the second stage by moving the red team's sapling from the transit area to blue team's desert area and, so the alliance teams score extra 10 points.

Similar for blue team's sapling, the blue team's robot needs to move their sapling to transit area and scores 20 points for alliance. The red team's robot continues to next stage by moving blue team's sapling from transit area to red team's desert area and scores extra 10 points for alliance. The full score is 60 points. The sequence of moving blue or red team's sapling does not affect the scoring.



Fig 3.15 Details of Area

### Scoring details:

The vertical projection of the saplings' bottom in stationary state must be Completely In or Partially In the transit area and stay for at least two seconds, so the alliance teams can score 20 points.

The vertical projection of the saplings' bottom in stationary state must be Completely In or Partially In the desert area and stay for at least two seconds, so the alliance teams can score 10 points.

If the sapling has become an Invalid Prop (Read Section 5 for the definition) before moved in the transit area, then, moving this sapling to transit area cannot score.

If the sapling has become an Invalid Prop in the transit area, then, moving the invalid sapling to the desert area cannot score.

For this mission, if one robot completes two stages for one sampling, only the first stage can be scored, and the other stage of the mission cannot be scored. Only when two robots cooperate to complete the two stages of missions separately, the alliance can score full points for each sapling.


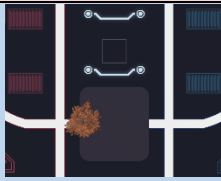

Status	Completely In	Partially In	Completely Out
Figure			
Score or not?	✓	✓	✗

Table 3.4 Scoring Details for Transit Area

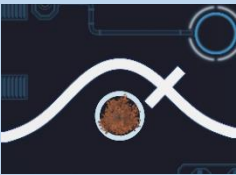


Status	Completely In	Partially In	Completely Out
Figure			
Score or not?	✓	✓	✗

Table 3.5 Scoring Details for Desert Areas

## M09. City Party

### Mission background:

After hard working, the robots return to their base and hold a big party.

### Mission requirements:

First, the robots from alliance team return to their own stage area. After that, one robot starts to play music, and the other robot starts to dance (repeated swing, rotation or forward-backward). The action of two robots must last for at least three seconds. The team scores 10 points for a successful party, the full point is 10.

### Scoring details:

Only by returning from the non-starting area to the stage area, the robots can perform the party action. Robots Starting and performing directly in the Stage Area will not score.

After the vertical projection of the robot chassis is Partially In the stage area, the robot can perform the party action.

When the above scoring details are met, the referee will start timing when the two robots start party action together.



Fig 3.16 Stage Area

## Manual Alliance Mission

The contestants need to manually control their robots in this stage and cooperate with the alliance team to complete this mission. After completing the mission, the team will score the Alliance Mission Points.

### M10. Garbage Recycling

#### Mission background:

Garbage recycling plants at the city center are in trouble. The piled garbage in the city center need to be sorted and moved to the correct garbage stations. Robots from the alliance team need to work together to recycle garbage.

#### Mission requirements:

Robots from the alliance team need to move the circular garbage on the arena to the designated garbage station A. The alliance teams score 5 points for each successful placing of the circular garbage.

Robots from the alliance team need to move the spherical garbage on the arena to the designated garbage station B. The alliance teams score 5 points for each successful placing of the spherical garbage.

During the competition, the alliance teams' observer can stack the garbage which has been moved into station by robots to score extra points. The observer needs to take the spherical garbage from station B to station A and stack the garbages (shown in Fig 3.18) to save the space of the garbage station. The alliance scores extra 5 points for each successful garbage stack in station A.

Full point for this mission is 100.

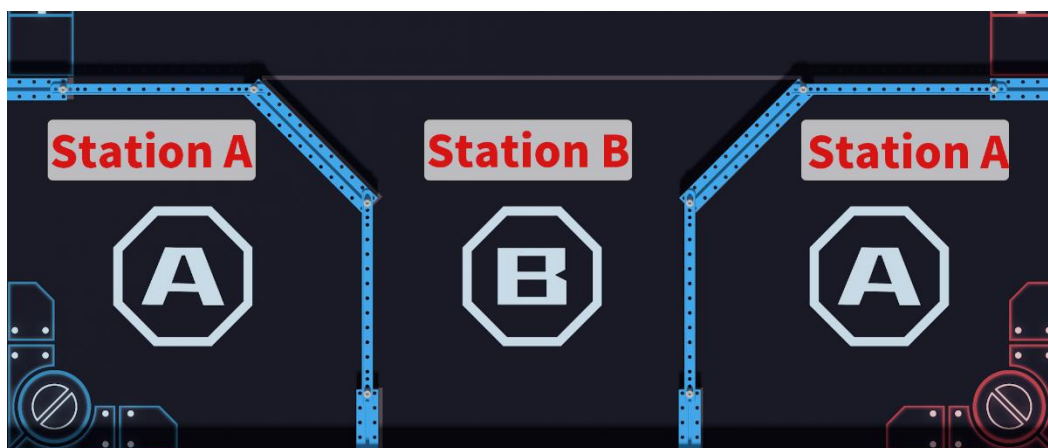


Fig 3.17 Garbage Stations (A&B)

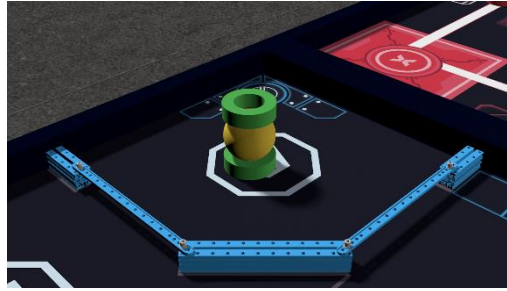


Fig 3.18 Garbage Stack (Color of garbage will not affect score)

### Scoring details:

After the end of Manual Stage, the alliance can score if the garbage or garbage stack is Completely In the correct garbage station.

During the Manual Stage, the observer must only stack garbage inside the garbage station area (shown in Fig 3.17). If the observer is against this detail, the team will receive a Violation with 20 points deduction.

During the stacking operation, the observer must not touch a prop that has contact with the robot. If the observer is against this detail the team will receive a Violation with 20 points deduction, but the prop can be scored for further operation.

During the stacking operation, the observer must not touch the garbage that is not Completely In garbage station. If the observer is against this detail, the team will receive a Violation with 20 points deduction, but the prop can be scored for further operation.

During the Manual Stage, if a garbage is moved Completely In a wrong garbage station by a robot, the robot operator will receive a Violation with 20 points deduction. The correspondent garbage can be scored if either Observer or robot moves it Completely In the correct garbage station, but the previous Violation will be kept.

During the manual stage, if the Observer takes the spherical garbage (moved Completely In station by robot) from Station B to Station A and makes a stack, the spherical garbage can be scored for either sorting process and stacking process. If the observer does not make a stack, the spherical garbage in Station A cannot be scored.

During the manual stage, if observer takes the circular garbage (moved Completely In station by robot) from Station A to Station B, the spherical garbage cannot be scored.

Score for this mission = Sorting points for spherical & circular garbage + Stacking points. Violation deduction will be calculated in Single Match Points (Section 3.4).

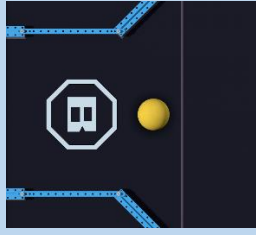
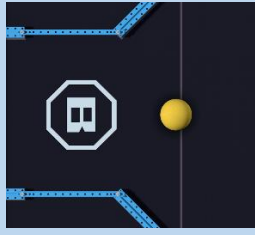
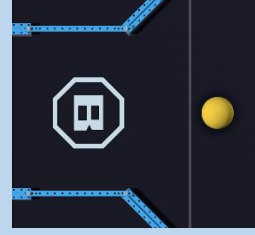
Status	Completely In	Partially In	Completely out
Figure			
score or not	✓	✗	✗

Table 3.6 Scoring Details for Spherical Garbage Recycling

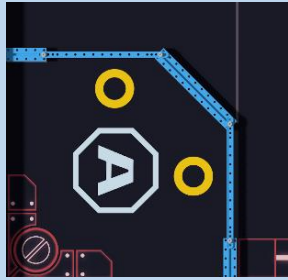
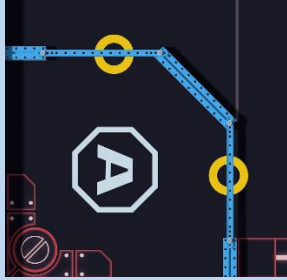
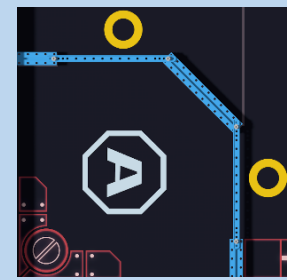
Status	Completely In	Partially In	Completely out
Figure			
Score or not	✓	✗	✗

Table 3.7 Scoring Details for Circular Garbage Recycling

### 3.3 Mission Selection Method

In each regional competition, points race or 2019 MakeX (World) Championship, the contestants from one team need to complete 3 Automatic Independent Missions(**AIM**), 2 Automatic Alliance Missions(**AAM**) and 1 Manual Alliance Mission(**MAM**).

In each regional competition, points race or 2019 MakeX World Championship, the Authorized Organizer or MakeX Robotics Competition Committee will select specific missions from the alternative missions, according the Mission Selection Method, and publish the selected missions before the competition take place. Alliance teams will encounter same Automatic Independent Missions.

The Mission Selection Methods for Elementary Group (age 6 to 13) and Intermediate Group (age 12 to 16) are same, but the selected missions may vary according the difficulty level.

Mission Selection Method is as follows:

SELECTED MISSIONS	ALTERNATIVE MISSIONS		SELECTION METHOD
<b>AIM 1</b>	M01	M02	Pick 1 from 2 alternatives
<b>AIM 2</b>	M03	M04	Pick 1 from 2 alternatives
<b>AIM 3</b>	M05	M06	Pick 1 from 2 alternatives
<b>AAM 1</b>	M07	M08	Pick 1 from 2 alternatives
<b>AAM 2</b>	M09		Compulsory mission
<b>MAM</b>	M10		Compulsory mission

Table 3.8 Mission Selection Method

## 3.4 Scoring Explanation

### Score in Automatic Stage

During the automatic stage, the referee will give points according to the real-time state of each mission. Once a mission is completed, the team can score points immediately, and the subsequent operations by the contestants or robots will not affect the scoring of the completed mission.

### Score in Manual Stage

During the manual stage, the referee will monitor the progress of the competition in real time and give Warnings and Violations. After the manual stage, the referee will give points according to the final state of the mission.

### Single Match Points

After the end of each Single Match, the referee will confirm the team's Single Match points. Each team's Single Match Points consist of 3 parts: Alliance Mission Points, Independent Mission Points for the Red/Blue Team and the Violation Points. The method for calculating the Single Match Points is as follows:

**Single Match Points of Qualification Round** = Independent Mission Points for Red/Blue Team + Alliance Mission Points - Violation Points for Red/Blue Team.

**Single Match Points of Championship Round** = Independent Mission Points for Red Team + Independent Mission Points for Blue Team + Alliance Mission Points - Violation Points for Red Team - Violation Points for Blue Team.



## 3.5 Single Match Flow Chart

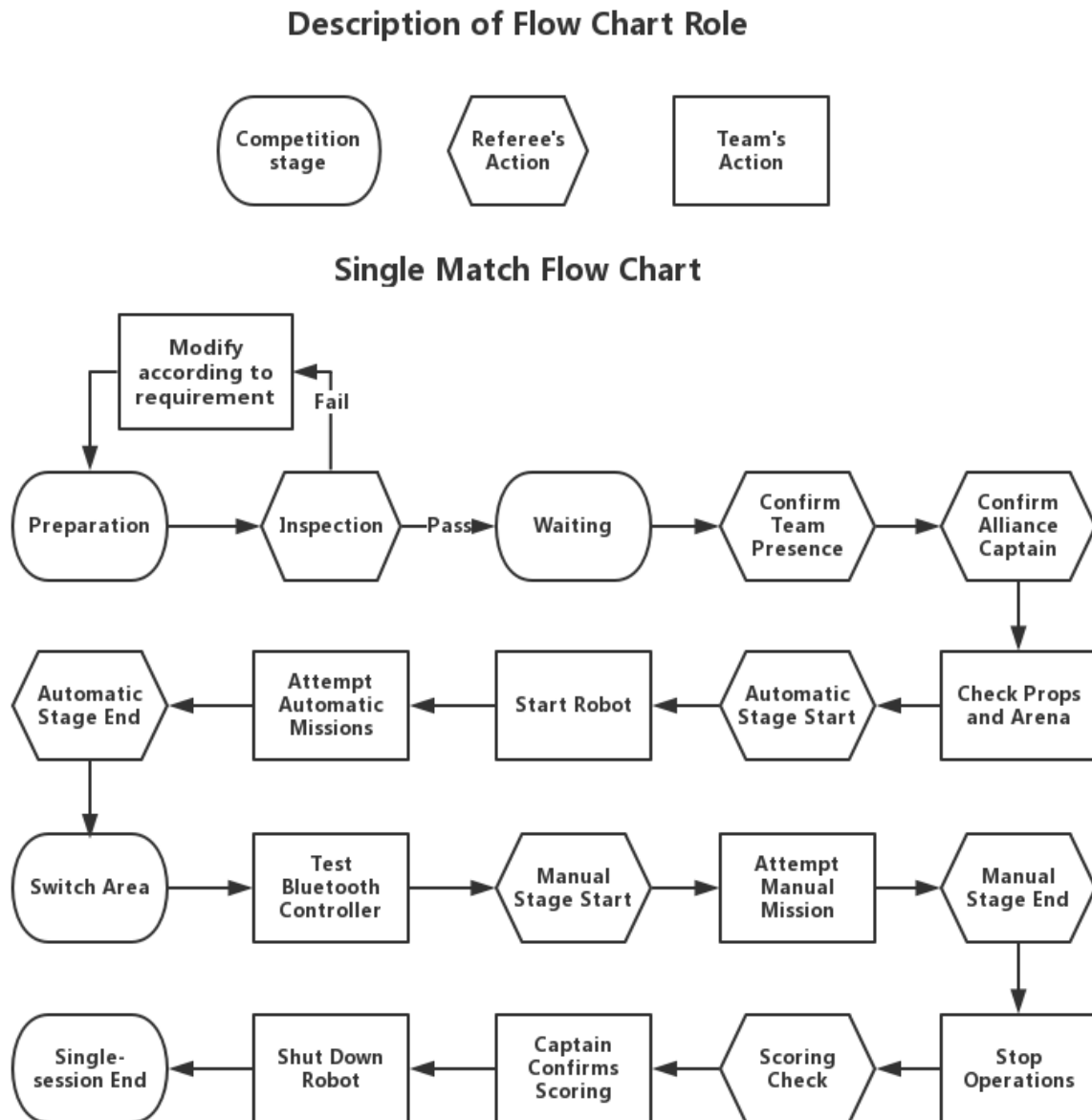


Fig 3.19 Single Match Flow Chart

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## 4. Robot Technical Requirements

When the teams are designing their robots to participate in the 2019 MakeX Robotics Competition Starter City Guardian should comply with the following technical requirements. It is suggested that the teams should read and get familiar with all the Technical Requirements before designing and constructing robots. The Technical requirements provide a fair and safe competition platform for all teams, and encourage teams to make innovative designs of their robots on the prerequisites of meeting technical requirements.

### 4.1 General Technical Requirements

#### Safety of the Robot

- T01. Dangerous high-power equipment is not allowed to be used by the teams during the competition and the preparation of the competition.
- T02. If the robot uses energy storage equipment (springs, etc.), it should ensure the safety in the process of using it.
- T03. The structures and parts of the robots that may cause potential injury to personnel in the process of clamping, handling, etc. should be provided with safety protection.
- T04. Robots should not pursue the destruction of the site in the process of clamping and handling.
- T05. Robots are not allowed to use flammable gases, parts with potential fire risk, hydraulic components, Mercury-containing components, exposed hazardous materials, unsafe counterweights, designs that may cause entanglement and competition delays, sharp edges, materials containing liquids or gelatinous substances, and any parts that may conduct electrical current from the robot to the arena.
- T06. The robot's safety will be thoroughly checked during the Inspection. Teams can be pre-checked through the Robot Self-Checklist.

#### Number of the Robot

- T07. Only one robot per team is allowed to compete in each regional competition, points race or 2019 MakeX World Championship. Any

kind of replacement of the robot is not allowed after Inspection.

**T08.** It is allowed to replace the defect parts of the robot (such as wheels, motors or sensors) but except the mBot chassis.

**T09.** Replacement of the mBot chassis will be considered as using a second robot, and the team will be disqualified for all Single Match.

### Size of the Robot

**T10.** The Size of Robot is defined by its length, width and height. The vertical projection of the robots on the horizontal plane must not exceed the specified dimension of the square area, and the height of the robots must not exceed the specified dimension. This is considered that the robot's size conforms to the Robot Size Requirements. Robot's height is measured from the horizontal plane of the arena (contact with robots) to the furthest structure of the robot respect to the arena plane.

**T11.** The maximum size means that the size of the robot must not exceed the limit at any time in any stage of the competition.

**T12.** If the robot uses flexible materials (including but not limited to cable ties and decorative stickers), the flexible materials must comply to the size requirements of the robot without being affected by external forces when measuring the size of the robot.

**T13.** The following table presents the Robot Size Requirements:

	Requirements	Remarks
<b>Maximum Size</b>	280mm (Length) 280mm (Width) 300mm (Height)	1. During the whole process of the competition, the vertical projection of the robot on the arena should not exceed 280 mm by 280 mm square area and the height should not exceed 300 mm. 2. During Inspection, the teams should show and check the maximum size of the robot.

**Table 4.1 Robot Size Requirements**

### Weight of the Robot

**T14.** Weight of the Robot refers to the net weight of the robot at any time during the competition (excluding the props from the arena).

**T15.** Weight of Robot must be less than 2 KG

## 4.2 Technical Requirements for Equipment

### Main Control Board

- T16.** Robots should use the specific mainboard (mCore, manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 1) to prevent the teams from using some of the high-efficiency mainboards to affect the fairness of the competition.

### Sensor

- T17.** Robots should use the specific electronic sensors (electronic sensors manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: not limited) to prevent the teams from using some high-precision sensors to affect the fairness of the competition.

### Motor and Servo

- T18.** The robot should use the specific DC motors (130 DC geared motor 6V/312RPM or 130 DC geared motors 6V/200RPM manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 2) to ensure the fairness of the competition.
- T19.** The robot should use the specific servo (9g micro servo manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 1) to ensure the fairness of the competition.

### Wireless-Control

- T20.** The robot should use the specific wireless-control equipment (Bluetooth Controller and mBot Bluetooth modules manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 1 of each).
- T21.** The robots are only allowed to use mBot Bluetooth modules and Bluetooth Controller for wireless controls. The 2.4G Wi-Fi Controller is not allowed to use.

### Mechanical Parts

- T22.** The robots should use the specific robot chassis (the mBot chassis manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Only 1) which must not present any cutting or twisting operations, etc. to change its physical form.

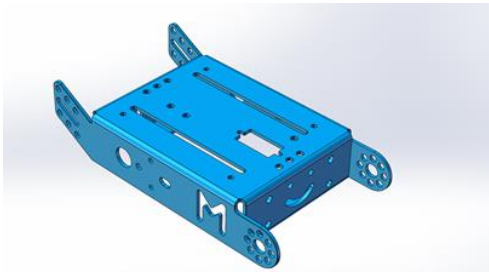


Fig 4.1 Robot Chassis

- T23. 3D printing parts are allowed to use for following purpose: counterweight, decorative or structural.
- T24. In addition to 3D printing parts, other mechanical parts must be manufactured or sold by Shenzhen Makeblock Co., Ltd.
- T25. The robot is allowed to use purchased or self-made non-electronic parts as counterweight. Those parts should not have magnetic or any impact on the electronic sensors or mainboard.

Battery

- T26. The robots should use the specific model of 3.75V mBot battery (mBot battery manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 1), and the battery must be securely fixed on the robot.

 Allowed	 Prohibited

Table 4.2 Allowed and Prohibited Model of mBot Battery

- T27. To ensure the fairness of the competition, robot is prohibited to use 6V Power Connector (for AA battery holder).
- T28. To ensure the fairness and safety of the competition, the teams should read the Instructions of Batteries (see Appendix 1).

## 4.3 Other Technical Requirements

### Use of Programming Software

- T29. The robot programming software can be Arduino IDE, mBlock5 or mBlock3 for PC (v3.4.11).

### Team Number

- T30. Each team should have a team number as the unique identification symbol of their team. Team number should be obtained after the team has registered on MakeX official website.



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## 5. Competition Rules

### 5.1 Safety

#### Robot's Safety

- R01. The design and construction of the robots by the teams should meet the Technical Requirements.
- R02. Each part of the robot should be used safely under the guide of the mentor.
- R03. The referee has the right to reject dangerous robots to enter the arena for competition. The referee has the right to judge whether to disqualify the team for all Single Match according to the danger level of the robot.

#### Team's Safety

- R04. Under the guide of the mentor and after reading this Technical Guide, contestants can proceed to prepare for the competition and to design and construct their robot.
- R05. In the preparation process, the team must follow the instructions of the mentor and should not perform any dangerous action without mentor's authorization.
- R06. The team should pay attention to safety when using dangerous tools (screwdrivers, sharp knives) and must use under the guide of their mentors.
- R07. The referee has the right to reject the teams that do not conform the safety rules to entry the competition arena. The referee has the right to disqualify a team for all Single Match according to the level of danger.
- R08. During the competition, teams should wear goggles; long hair should be tied up; teams are prohibited from wearing slippers into the competition arena.

## 5.2 Operation

### Late Arrival

- R09. Teams should arrive on time, and the referee has the right to disqualify teams for one Single Match who are not present on time.

### Role and Position during Competition

- R10. During the automatic stage, the contestants can compete in the following area (shown by figure 5.1). The dimension of area may vary according to the actual size of the competition venue.
- R11. In the manual stage, an operator and an observer for each team are required to compete in the following area (shown by figure 5.1). The contestants are not allowed to compete outside the specific operating area. If there is only one contestant in the team, one specific competition role should be selected to participate in the competition. The dimension of area may vary according to the actual size of the competition venue.

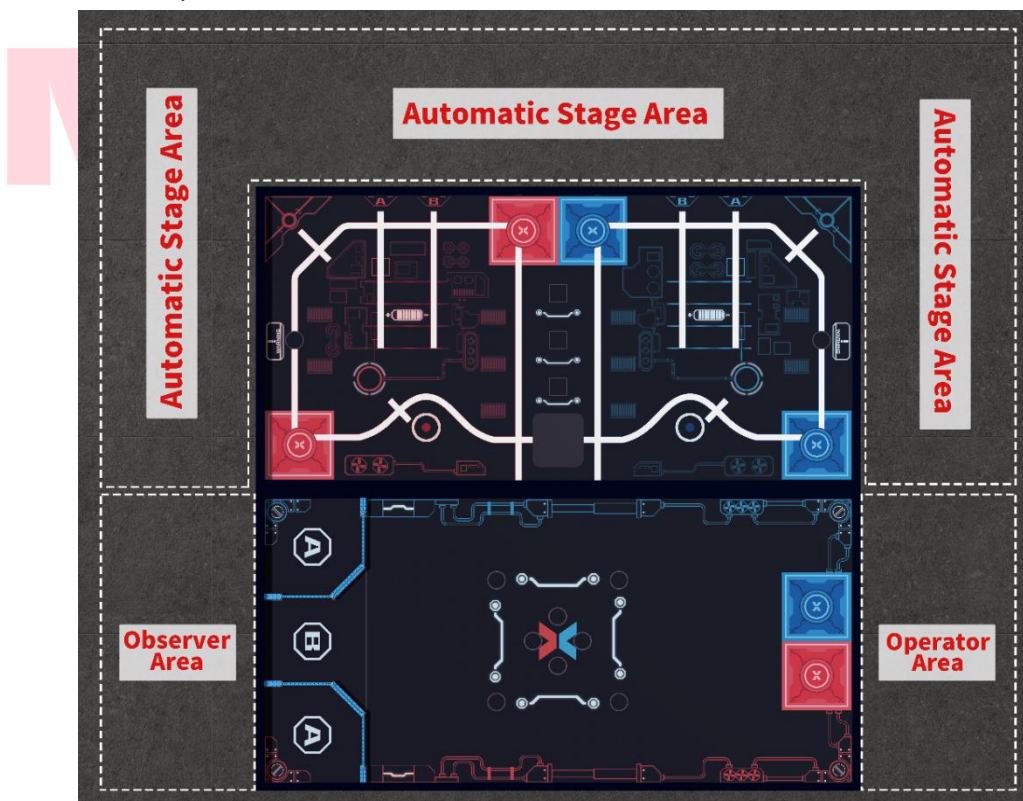


Fig 5.1 Operation Area

- R12. In the manual stage, if the operator and the observer need to exchange their roles, they should apply to the referee and announce, “Red team exchange role” or “Blue team exchange role”. After the

referee responds, “Agree Red team Exchange” or “Agree Blue team Exchange” , the current operation should be stopped, and the contestants go to correspondent operation area to continue the competition. During the change of roles, the competition will be timed normally.

### **Robot Start in Advance**

**R13.** Contestants must start the robot after the referee announces the start of the competition. If the robot is started in advance, the team will get Warning for the first time and the competition will restart. If the robot is started in advance for the second time, the referee has the right to disqualify the team for one Single Match.

### **Robot Restart**

**R14.** The contestants must start the robot in their starting area after the referee announces the start of the competition. Only when the robot is placed inside the starting area (the vertical projection of the chassis is within the starting area), the team can start or switch the robot's program.

**R15.** If the robot is started outside the starting area, the team will get a Warning for the first time. For the second time, the team will get a Violation and 20 points will be deducted. If the robot is started outside the starting area and it brings scoring advantage, the scoring related prop will become Invalid Prop, and the prop cannot be scored.

### **Restart and Modification of the Robot**

**R16.** During the competition, the contestants can restart and modify the robot at any time.

**R17.** If the contestants choose to restart or modified their robot, the contestant of the Red team should raise his hand to the referee and announce, “Red team requests Restart” . The contestant of the Blue Team should raise his hand to the referee and announce, “Blue team requests Restart” . After the referee responds, “Agree Red team Restart” or “Agree Blue team Restart” , the robot can be taken out by contestants for restart or modification.

**R18.** The robot can be modified after been taking out from the arena. The modified robot must conform to the technical requirements. Referees have the right to spot check the robots after the end of each Single Match. If the robot has non-conformity with technical requirements or violations, the referee has the right to disqualify the

team for one Single Match.

- R19.** If contestants restart the robot when it touches the props, the contestant's action will be regarded as Indirect Contact. The correspondent prop becomes invalid (no scoring for following operations), but it does not affect the points that the props have scored before. If other props are also touching with the prop which in contacts with robot, the other props become invalid as well.
- R20.** The restart and/or modification of the robots will not suspend the competition, and the competition will be timed normally.
- R21.** If the robot cannot be reached by the contestants, they can ask the referee for help. The contestant can raise his hand to the referee and announce, “Blue team requests take out” or “Red team requests take out” . The responsibility for any kinds of impact due to the referee's touch should be undertaken by the team itself.

### Special Case

- R22.** After agreed by contestant from both alliance teams, the Captain of Alliance can apply to the referee announce “Automatic Stage Completed (or Manual Stage Complete) and record the used time.
- R23.** If the robot completes alliance team's Automatic Independent Mission, both alliance teams cannot score for that mission.
- R24.** If the robot moves any prop Completely In or Partially in the Starting Area and affecting the starting of robot, the prop will become an Invalid Prop and the referee has the right to take out the corresponding prop.
- R25.** If the robot moves any prop Completely Out the Table, the corresponding prop will become an Invalid Prop and cannot put back on Table.
- R26.** During Automatic Stage, if the contestant indirect controls the robot, the referee has the right to disqualify teams for one Single Match.

### Violation Due to Contact with the Robot

- R27.** During the competition, with the exception of obtaining restart permission from the referee, contestants are strictly prohibited from directly contacting robots which are not located inside one of the Starting Area. Each violated contact with robot will be considered as a Violation, and 20 points will be deducted for the team. If the violated contact with Robot completes the mission, the scoring prop(s) in that mission will become invalid, and the prop(s) cannot be scored.

### **Violation Due to Contact with the Props**

**R28.** During the competition, except for the designated area in the manual stage, the contestants are strictly prohibited from direct contacting the props. Each violated contact with props will be considered as a Violation, 20 points will be deducted for the team. If the violated contact with props completes the mission, the scoring prop(s) in that mission will become invalid, and the prop(s) cannot be scored.

### **Violation Due to Mentoring**

**R29.** During the whole process of the competition, including but not limited to the parents or mentors of the contestants must not go into the competition area by any means and give any form of mentoring to the contestants. In case of violated mentoring happens, the referee has the right to disqualify the team for one Single Match.

### **Egregious Behaviors**

**R30.** It will be regarded as Egregious Behaviors if a team or a person related with the team incurs into, but not limited to, any of the following circumstances. In case of Egregious Behaviours happens, the referee has the right to disqualify a team for one or all Single Match.

- Impolite behaviors (abuse, bad words, unnecessary physical contact).
- Seriously affecting the competition and the safety of the audiences. Interfering the process of competition.
- Seriously violating the spirit of competition (e.g. cheating).
- Repeated violations or ignoring the referee's warning.

### **Using Programming Tools**

**R31.** During the competition, the teams should not bring computers, tablets, etc. into the arena for programming. In case of Using Programming Tools inside the arena, the referee has the right to disqualify the teams for one Single Match.

### **Wireless Remote-Control Operation**

**R32.** Except for the manual stage, the teams should not use Bluetooth communication, 2.4 G Wi-Fi communication or infrared communication, etc. to control the robots in the competition area. Otherwise, they will be deemed as manual control of the robots. Except during the manual stage, the team who manually controls a robot in the competition will be disqualified for one Single Match.

- R33.** The connection between the robots and the wireless controller can only be initialized after the end of the Automatic Stage. Robots are not allowed to wirelessly connect any device during the Automatic Stage of the competition; otherwise, the referee has the right to disqualify the teams for one Single Match.

### Uncertainty of Props and Arena

- R34.** Due to the uncertainty of production and processing, there will be unavoidable minor difference (Dimensions, weight, color or flatness) for all props and Arena. The design of the robot should consider and adapt those factors. If there are other free props and arena, contestants are allowed to request for exchange.
- R35.** Robots should be able to adapt to the uncontrollable factors such as folds of mat, changes in lighting, etc. The teams should perform their own targeted testing for those uncontrollable factors' impact on robot.

### Unexpected Quit

- R36.** After onsite registration, if the team cannot continue the competition due to unexpected reasons, the team should report the reason to the MakeX Robotics Competition Committee and the sessions involved by the team must be held as usual.

## 5.3 Punishment

### Warning

- R37.** The referee gives the team an oral notice, Warning, and requires the team to stop violating the rules and obey the referee's instructions. During the Warning, the competition will be timed normally.

### Violation

- R38.** The referee gives the team a noted punishment, Violation with 20 points deducted for the team. When referee discovers that the team has corresponding violated performance, the Violation will be given immediately. During the Violation, the competition will be timed normally.

### Invalid Prop

- R39.** From the moment the conditions for Invalid Prop are reached, it will trigger the Invalid Prop and the referee will announce the specific prop is invalid. The referee should have the right to determine whether

the props are invalid or not according to the contents of this Guide and the behaviour of the teams.

- R40.** The referee has the right to determine whether the final state of the prop before invalid can be scored or not according to the contents of this Guide.

## 5.4 Abnormal Situation

When something unexpected happens, the referee has the right to pause the competition and take action. Including but not limited to following situation:

### Potential Safety Risk

- R41.** The competition venue emerges problems that might affect the safety of teams or robot.

### Damage of Arena or Prop

- R42.** The props or arena are damaged accidentally, and the competition cannot continue.

### Re-competition

- R43.** Referees have the right to discuss and determine if a Re-competition is necessary according to the actual situation.
- R44.** The abnormal situation caused by the team themselves such as low battery life, failure of robot's parts etc. will not lead to Re-competition.

## 5.5 Explanations

- R45.** To ensure fair and high-quality competition experience, MakeX Robotics Competition Committee has the right to update this Guide regularly, and to publish and implement necessary changes before the competition.
- R46.** During the competition, all matters not specified in the Technical Guide can be decided by the referee team.
- R47.** This Technical Guide is the reference for the referee. During the competition, the referee has the right to give final decision.



## 6. Technical Guide Statement

The official language for MakeX is Chinese. English or other language translations are prepared to facilitate the team's preparation process. All documents translated to English are for reference only.

The MakeX Robots Competition Committee reserves the final interpretation of MakeX Robots Competition - Technical Guide for City Guardian.

## 7. Disclaimer

All contestants in 2019 MakeX Robotics Competition should fully understand that safety is the most important issue for the sustainable development of MakeX Robotics Competition. To protect the rights and interests of all contestants and organizers, according to relevant laws and regulations, all contestants registered for the MakeX 2019 Robots Competition Starter City Guardian, should acknowledge and abide by the following safety provisions:

Contestants should take adequate safety precautions when constructing the robots, and all parts used for constructing the robots should be purchased from legal manufacturers.

Contestants should ensure that the structural design of the robots takes into account the convenience of the inspection and actively cooperate with the host of the competition.

When modifying and using the parts with potential safety hazards for the robots, it must conform to the national laws, regulations and quality & safety standards. Those operations should be manufactured and operated by persons with relevant professional qualifications.

During the competition, the teams should ensure that all the actions such as construction, testing and preparation will not do harm to their own team and other teams, referees, staff, audiences, equipment and arenas.

In the process of construction and competition, if any action that may violate the national laws, regulations or standards occur, all consequences will be borne by the contestants themselves.

The competition kits and parts sold and provided by the supporter, Shenzhen



Makeblock Co., Ltd., should be used in accordance with the instructions. Shenzhen Makeblock Co., Ltd. and MakeX Committee will not be responsible for any injury or loss of property caused by improper use.

## 8. Copyright Declaration

Shenzhen Hulu Maker Co., Ltd. reserves the copyright of this Technical Guide. Without the written consent or authorization from Shenzhen Hulu Maker Co., Ltd, any entity or individual may not reproduce, including but not limited to any network media, electronic media or written media.



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## Appendix 1: Competition Resources

MakeX Official website: <http://www.makex.cc>

Any Feedback & Question Please Sent to: [info@makex.cc](mailto:info@makex.cc)

Additional Information: <http://www.makex.cc/information/download/>

### Instruction of mBot batteries:

1. The output voltage of battery will decrease because of lower power or aging.
2. If the output voltage lower than a certain level, it may have an impact on the stability of the system.

### Recommendation:

1. Use a newer battery when participating in the competition.
2. Fully charge the battery before each game.



Fig. A Battery Safety Instruction



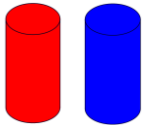




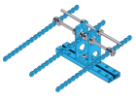
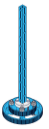

## Appendix 2: MakeX Starter Robot Self-Check List (City Guardian)

MakeX Starter Robot Self-Check List (City Guardian)			
Safety of Robot			
No.	Items	Specific Requirements	Status
1	High-power Equipment	Dangerous high-power equipment is not allowed to be used by the teams during the competition and the preparation of the competition.	
2	Energy storage equipment	If the robot uses energy storage equipment (springs, etc.), it should ensure the safety in the process of using.	
3	Safety protection	The structures and parts of robots that may cause potential injury to person in the process of clamping and handling etc. should be provided with safety protection.	
4	Damaged arena	Robots should not take the initiative to destroy the site in the process of clamping and handling.	
5	Banned substance	Robots are not allowed to use the flammable gases, parts with potential fire risk, hydraulic components, Mercury-containing components, exposed hazardous materials, unsafe counterweights, designs that may cause entanglement and competition delays, sharp edges, materials containing liquids or gelatinous substances, and any parts that may	

		conduct electrical current from the robot to the arena.	
<b>Number, Size and Weight of Robots</b>			
<b>No.</b>	<b>Items</b>	<b>Specific requirements</b>	<b>Status</b>
6	Number of robots	Only one robot is allowed to compete in each point race or 2019 MakeX World Championship. Any kinds of replacement of the robot is not allowed after Inspection.	
7	Robot's size	Robots should conform to the requirements by T11, T12, T13, T14.	
8	Robot's weight	Weight of Robot should be less than 2 KG during the competition.	
<b>Parts of Robot</b>			
<b>No.</b>	<b>Items</b>	<b>Specific Requirements</b>	<b>Status</b>
9	Mainboard	Robots should use the specific mainboard (mCore, manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 1).	
10	Sensor	Robots should use the specific electronic sensors (electronic sensors manufactured and sold by Shenzhen Makeblock Co., Ltd, Quantity: not limited)	
11	Motor	The robot should use the specific DC motors (130 DC geared motor 6V/312RPM or 130 DC geared motors 6V/200RPM manufactured and sold by Shenzhen Makeblock Co., Ltd, Quantity: Maximum 2)	
12	Servo	The robot should use the specific servo (9g micro servo manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 1).	

13	Wireless control	The robot should to use the specific wireless-control equipment (Bluetooth Controller and mBot Bluetooth modules manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 1 of each).	
14	Chassis	The robots should use the specific robot chassis (the mBot chassis manufactured and sold by Shenzhen Makeblock Co., Ltd, Quantity: Only 1) and should not sustain any cutting or twisting operations, etc. to change its physical form.	
15	3D printing parts	In addition to 3D printing parts, other mechanical parts must be manufactured or sold by Shenzhen Makeblock Co., Ltd.	
16	Counterweight parts	The robot is allowed to use purchased or self-made non-electronic parts as counterweight. Those parts should not have magnetic or any impact on the electronic sensors or mainboard.	
17	Battery	The robots should use the specific model of 3.75V mBot battery (mBot battery manufactured and sold by Shenzhen Makeblock Co., Ltd., Quantity: Maximum 1), and the battery must securely fixed on the robot. Robot is prohibited to use 6V Power Connector (for AA battery holder).	

## Appendix 3: List of Props

Name	Figure for Reference	Key size <sup>1</sup>	Mission Used
Yellow block		Maximum Length 70mm	M01, M07
Color card		Length 100mm Width 60mm Thickness 1mm	M05, M07
Obstacle		Height 140mm Diameter 70mm	M06
Spherical garbage		Diameter 70mm	M10
Circular garbage		Height 20mm Inner diameter 40mm External diameter 70mm	M10
Garbage station frame		*	M10
Switch		*	M02
Power Plant		*	M03
Chimney		*	M04
Sapling		*	M08

<sup>1</sup> Prop's size has unavoidable error, please read Competition Rules R34 & R35 for details.

\* Please refer to the real prop for the size.

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