



THE CRC ROBOTICS
SENIOR COMPETITION

RULEBOOK

Outlining the full rules for

ARCANUM  **2022**

A program of

**AEST
EAST**

ALLIANCE POUR L'ENSEIGNEMENT DE LA SCIENCE ET DE LA TECHNOLOGIE
EDUCATIONAL ALLIANCE FOR SCIENCE AND TECHNOLOGY

Foreword

i. Welcome to the CRC Robotics Competition

On behalf of the Educational Alliance for Science and Technology (EAST) and CRC Robotics, welcome and congratulations to all the participants on joining your school's/organization's robotics team and embarking on the CRC Robotics Competition journey! Take it from the current leaders of CRC Robotics, who were all former student participants in the CRC Robotics Competition: you will remember this unparalleled experience for many years to come.

We wish to welcome and thank the many teachers, staff, parents, and mentors for embarking on this journey and for all the hard work you will put in to enrich your students' lives throughout this activity. A big thank-you to all the volunteers involved in CRC Robotics, whose dedication has allowed us to hold Arcanum 2022, our 21st annual competition.

In addition, we wish to acknowledge all our partners, without whom CRC Robotics could not exist.

The 2021-2022 CRC Robotics season will have a lot to offer: an enhanced Arduino-based robot control platform, more clear and finite evaluation rubrics and the integration of a junior category to the competition for younger students.

We wish to thank the Principal of Curé-Antoine-Labelle High School, Karine Legendre, and her team led by Christian Robert and Dominic Ouimet for their warm welcome as the host school and for the time and energy they've put towards the success of this event.

Good luck to all and we will see you at Arcanum 2022 from March 9th to 12th, 2022 at Curé-Antoine-Labelle High School in Laval.



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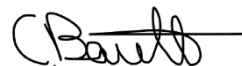
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ii. About CRC Robotics

CRC Robotics was founded in 2001 by a group of young professionals and teachers, fueled by their passion for robotics and education. Unsatisfied with the robotics competitions available for high schools and CEGEPs in Canada, they created an annual competition linking science, technology, engineering and mathematics (STEM) with computers, arts and languages.

We've since grown into an organization run by former participants willing to give other students the chance to participate in the CRC Robotics adventure that has been so much fun for them. The Competition now welcomes elementary, high school and CEGEP teams from coast to coast in a 4-day, action-packed event held annually.

We believe in providing exciting learning opportunities to students with various interests and goals. Under the umbrella of the Educational Alliance for Science and Technology (EAST), we hold events allowing tomorrow's leaders to find their passion and develop key skills that will serve as assets in an ever-changing, global world.

In essence, the CRC Robotics Competition is:

- A coherent body of several competitions, integrating different disciplines and unique challenges, including languages, computers, mathematics, science, art and much more;
- An experience that develops the qualities of a leader and teaches students about organization and teamwork, since everything is directed and performed by the students;
- An event that involves students from elementary schools, high schools, CEGEPs, professional vocational centres and community organizations from all over Canada;
- A challenge that allows students to apply the theoretical knowledge gained in the classroom to a practical application in order to familiarize the students with technology outside of the classroom;
- A chance to take part in an extra-curricular activity and work with students and mentors from different backgrounds and domains (engineers, technicians, university professors, etc.).

iii. Roles within the CRC Robotics Competition

In the CRC Robotics Competition, there are three different roles: students, teachers, and mentors. We have laid out the following responsibilities for each:

1. **Students are to do all the planning and building.** They should be creating the strategies, designing the critical paths, and controlling all aspects of the team. Any work done on any aspect of the Competition must be done entirely by the students.
2. **Teachers are available to provide the support that students may need, only if they need it.** They should not be directing the students, but instead, acting as an

advisor. If a student has a question, the teacher may point the student toward the answer or show the student how to find the solution. If a student is unsure of how to accomplish a specific task, the teacher may demonstrate, but any pieces attached to the robot are to be touched only by the students. However, we do realize that there may be times when an educator must step in for academic reasons. We believe that every teacher is a competent professional that can differentiate between teaching and doing.

3. **Mentors are external professionals who may be consulted throughout the course of this activity.** Their job is to help with questions which exceed both the students' and teachers' knowledge. An engineer would have more practical experience; however, the engineer may not direct the students as he/she is acting only as an advisor.

We value the participation of your team, but always keep in mind that this is the students' project. Let them show you what they are made of and let them develop their own skills! Their own work is what truly matters and that is what makes the CRC Robotics Competition so unique and relevant.

iv. Participating Schools

Once again, teams from coast to coast have decided to take on this year's CRC Robotics challenge:

| 2022 Team Number | School/Organization Name | Division | Rookie |
|------------------|---|----------|--------|
| 1 | West Island College | 2 | |
| 2 | Lake of Two Mountains High School | 2 | |
| 3 | Collège Sainte-Marcelline | 1 | |
| 4 | John Abbott College | 2 | |
| 5 | École secondaire Curé-Antoine-Labelle | 2 | |
| 6 | Macdonald High School | 1 | |
| 7 | Royal West Academy | 2 | |
| 8 | École secondaire Dalbé-Viau | 2 | ✓ |
| 9 | Champlain College Saint-Lambert | 2 | |
| 10 | Marianopolis College | 1 | |
| 11 | Cégep Vanier College | 1 | |
| 12 | École secondaire Monseigneur-Richard | 2 | |
| 13 | Collège André-Grasset | 2 | |
| 14 | St. George's School of Montreal | 2 | |
| 15 | Lower Canada College | 1 | |
| 16 | Cégep du Vieux-Montréal | 2 | |
| 17 | École secondaire Jules Verne | 1 | |
| 18 | West Island Black Community Association | 2 | ✓ |
| 19 | Collège de Bois-de-Boulogne | 2 | |
| 20 | Dawson College | 1 | |
| 21 | Cégep Marie-Victorin | 1 | ✓ |
| 22 | Collège Citoyen #1 | 1 | |
| 23 | Collège Citoyen #2 | 1 | |
| 24 | Collège Citoyen #3 | 1 | |
| 25 | Collège Citoyen #4 | 1 | |

v. Our Partners

One of the most important aspects of the CRC Robotics Competition is that it keeps registration fees for schools at a bare minimum to ensure an easy and equal access for schools from all socio-economic situations. This would not be possible without the help of our generous partners that, year after year, help us prepare this wonderful event for the students.



En collaboration avec



We are always seeking to establish new partnerships to achieve our goal of positively improving as many student lives as possible. If you or someone you know is willing to help us in any way, please contact our Partnerships Team at partnerships.crc@sciencetech.ca. On behalf of the students, a heartfelt thank-you!

vi. Season Calendar

| Item | Date & Location | Description |
|------------------------------|--------------------------------------|--|
| Information Sessions | Year-Round | <p>The CRC Robotics Organizing Committee is always available to meet you and present a what the Competition is all about and what it entails for students, teachers and their school or community organization.</p> <p>Interested parties may contact us via info.crc@sciencetech.ca.</p> |
| Registration Period | September 1, 2021 to October 1, 2021 | <p>Registration to the senior competition is opened to all high schools, CEGEPs and professional vocational centres in Canada. Late registration may be possible.</p> <p>Please contact info.crc@sciencetech.ca for more information.</p> |
| Training Day | November 2021 | <p>The Training Day is a hands-on tutorial and training day for teachers and mentors who wish to familiarize themselves with the technology involved in the CRC Robotics Competition as well as with the Competition structure and dynamics.</p> <p>The Training Day is organized according to the demand. Interested parties may contact us via info.crc@sciencetech.ca.</p> |
| Preliminary Rulebook Release | October 18, 2021 | <p>A partial version of the rulebook is made available to participants on www.robo-crc.ca/participant-portal/ one week prior to Kickoff. This way, participants can familiarize themselves with this year's game and prepare questions to be asked at Kickoff.</p> |

| | | |
|---|---|---|
| Kickoff | <p>October 25, 2021 at 7pm <i>Doors open at 6:30pm</i></p> <p>Curé-Antoine-Labelle H.S. 216 Blvd Marc-Aurèle-Fortin Laval, QC, H7L 1Z5</p> | <p>The Kickoff officially marks the beginning of the season for the participants. The complete rulebook and the playing field are revealed, and the participant kit is distributed to the teams.</p> <p>For logistical reasons, a maximum of 8 individuals per team may attend.</p> |
| CRC Workshops | <p>November 2021 to January 2022</p> | <p>Webinar-style workshops are held throughout the season and give participants more detailed information on certain components of the competition. Check out www.robo-crc.ca/participant-portal/ for dates and topics.</p> |
| Website, Video, and Tutorial Submission, and Programming Component Opt-In Deadline | <p>February 14, 2022 at 11:59:59pm EST Using the Participant Portal: www.robo-crc.ca/participant-portal</p> | <p>Having the website up and running and uploading the video to YouTube might take several hours. We therefore recommend you not to wait until the very last minute before starting the upload and going through the submission procedure. If you encounter any problems, send a detailed explanation to natasha.vitale@sciencetech.ca before the submission date and time.</p> <p>The Submission Form will be made available as of February 7, 2022.</p> |
| Deadline to make Website, Video, and Tutorial Public | <p>March 9, 2022 at 7:59:59am EST</p> | <p>Teams must make their website, video and tutorial available to the general public and the other teams prior to the start of the competition. For more information, refer to the specific sections outlining the details of these components.</p> |
| 21st Annual CRC Senior Robotics Competition Arcanum 2022 | <p>March 9-12, 2022</p> <p>Curé-Antoine-Labelle H.S. 216 Blvd Marc-Aurèle-Fortin Laval, QC, H7L 1Z5</p> | <p>Join us in the pinnacle of the 2021-2022 CRC Robotics season. After over four months of hard work, close to 25 teams will show off what their robot can do. An exciting, action-packed, 4-day event not to be missed!</p> |

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1. The Competition

The Competition is a four-day event that takes place annually at one of the participating schools. The final Competition rules are made public at Kickoff, approximately four months before the Competition.

The following presents the typical Competition schedule. The official and detailed schedule is made available a few weeks before the Competition at www.robo-crc.ca/participant-portal.

- Wednesday Afternoon: Team Arrival and Kiosk Setup
- Wednesday Evening: Kiosk Setup & Evaluations

- Thursday Morning: Preliminary Heat Block #1 and Evaluations
- Thursday Afternoon: Preliminary Heat Block #2 and Evaluations
- Thursday Evening: Preliminary Heat Block #3 and Evaluations

- Friday Morning: Preliminary Heat Block #4, Evaluations and Junior Games
- Friday Afternoon: Preliminary Heat Block #5 and Junior Awards Ceremony
- Friday Evening: Preliminary Heat Block #6 and Evaluations

- Saturday Morning: Knock-Out Rounds
- Saturday Afternoon: Quarterfinals, Semi-Finals and Kiosk Dismantling
- Saturday Evening: Finals and Awards Ceremony

1.1 Components

The Competition is divided into seven (7) distinct components, which allows students to demonstrate their strengths in different ways and across various disciplines. While not mandatory, teams may choose a theme that would be applicable to all components of the Competition.

1.1.01 Game

This year's game is named Arcanum 2022. The teams must participate in a tournament with their own radio-commanded robot and must ensure that they follow this game's specific rules and regulations. More information on the game can be found in Section 2 of this rulebook.

1.1.02 Robot

The design and construction of the robot primarily involve the application of engineering, science, technology and mathematics to ensure that the robot can participate in this year's game. Since the game changes from year to year, the students cannot reuse the exact same robot from previous years; however, certain parts and mechanisms may be reused. More information on the robot can be found in Section 3 of this rulebook.

1.1.03 Kiosk

The kiosk acts as an information booth, which presents the team's hard work to judges, fellow participants, and visitors to the Competition. It also acts as a workshop for the team's robot between the heats. The kiosk often represents the team's theme for this year's Competition and essentially involves the application of art and communication. More information on the kiosk can be found in Section 4 of this rulebook.

1.1.04 Programming

The programming component is designed to develop the skills and problem-solving process essential to state-of-the-art programming. In a unique way, a multitude of problems, ranging from the most basic to the most complex, will allow participants to become familiar with some of the modern applications of programming while offering a format created for the occasion, requiring strategy to choose one's battles well. More information on the programming competition can be found in Section 5 of this rulebook.

1.1.05 Video

A fully bilingual video must be submitted and be publicly available prior to the Competition and must present a description of the CRC Robotics Competition in a creative and innovative way. This aspect involves the application of technology, computers and languages. More information on the video can be found in Section 6 of this rulebook.

1.1.06 Website

A fully bilingual website must be created and publicly published prior to the Competition, with the goal of demonstrating the hard work of the team to the public. The website must include, but is not limited to, a list of participating students, a description of this year's game and the design and construction of the robot. This aspect involves the application of technology, computers and languages. More information on the website can be found in Section 7 of this rulebook.

1.1.07 Tutorial

The tutorial component allows teams to demonstrate their mechanical, electrical, programming, video and coding talents, among others, by providing a step-by-step explanation to achieve any particular task. The tutorial must be accessible on the team's

website and can hold various media formats. More information on the tutorial can be found in Section 8 of this rulebook.

1.2 Divisions

With a goal of making the Competition as fair as possible to teams with less experience, the CRC Robotics Organizing Committee has introduced a two-division system for certain elements of the Competition.

- 1.2.01 Teams are divided among Division 1 and Division 2 for the following components:
 - a. Robot Design;
 - b. Robot Construction;
 - c. Kiosk;
 - d. Video;
 - e. Website Content;
 - f. Website Design.
- 1.2.02 Teams are divided among High School and CEGEP for the Programming component.
- 1.2.03 This year's Division is based on the overall result obtained by the team in last year's Competition. The team's Division is the same for all previously mentioned components. ***Note:** Due to the effects of the COVID-19 pandemic on the Competition, the divisions for Arcanum 2022 were based on the overall result from Flip 2020 and not from Invicta 2021.
- 1.2.04 The top half of the overall ranking will be assigned to Division 1. If there is an odd number of teams, the median team will be in Division 2.
- 1.2.05 The divisions are re-assigned every year.
- 1.2.06 New high school teams are automatically placed in Division 2 while new CEGEP teams and vocational centres are automatically placed in Division 1.
- 1.2.07 A team in Division 2 can win the Overall Ranking award.
- 1.2.08 The best Division 1 and Division 2 teams will receive separate awards for the components based on the ranking for each component.
- 1.2.09 Teams will know their division on the night of the Competition Kickoff. However, if a team registers afterwards, these assignments can be modified. If it is the case, teams will be advised.
- 1.2.10 A Division 2 team can request to be upgraded into Division 1.
- 1.2.11 CRC Robotics has the final say in the division distribution.

1.3 Awards and Recognitions

Awards and recognitions are presented to the most performing team(s) in each component. If the division system is used for the ranking of a particular component, then awards are presented to the most performing team(s) in each division for the component. Refer to Section 1.2 for details on components for which teams will be ranked within their division only. In the event of a tie, both teams receive an award and/or recognition. In this section, an "award" is a prize that is presented for a component whose score counts towards the overall ranking and a "recognition" is a prize that is presented for a component whose score does not count towards the overall ranking.

1.3.01 Game

The Game award is presented to each team that was a finalist in this year's game. Finalists are the teams that participated in the final round of the game.

1.3.02 Robot Design

The Robot Design award is presented to the three teams that received the greatest scores from our engineering judges and that were deemed to have best designed their robot for the purpose of this year's game.

1.3.03 Robot Construction

The Robot Construction award is presented to the three teams that received the greatest scores from our engineering judges and that were deemed to have best constructed their robot for the purpose of this year's game.

1.3.04 Kiosk

The Kiosk award is presented to the three teams that received the greatest scores from our pedagogical judges and that were deemed to have the best designed, best constructed and best maintained kiosk.

1.3.05 Programming

The Programming award is presented to the three teams that achieved the highest scores in the programming component of the Competition and that were deemed to have the best executed the tasks at hand.

1.3.06 Video

The Video award is presented to the three teams that received the greatest scores from our professional/expert judges and that were deemed to have the best executed video.

1.3.07 Website Design

The Website Design award is presented to the three teams that received the greatest scores from our professional/expert judges and that were deemed to have the best website from a technical standpoint.

1.3.08 Website Content

The Website Content award is presented to the three teams that received the greatest scores from our professional/expert judges and that were deemed to have the best written content on their website.

1.3.09 Tutorial

The Tutorial recognition is presented to the team that was deemed to have the best explanation of the task selected. This winner is selected by the CRC Robotics Organizing Committee.

1.3.10 Never Say Die

The Never Say Die recognition is presented to the team that encountered many obstacles throughout the course of the Competition and that persevered to finally overcome those hurdles despite all hurdles. This winner is selected by the CRC Robotics Organizing Committee and receives a trophy that symbolizes all their hard work and perseverance.

1.3.11 Sportsmanship

The Sportsmanship recognition is presented to the three teams that are deemed the most respectful towards their peers and exhibit behavior based on values of respect and integrity that go beyond the Competition's rules and etiquette. The winning teams are selected by their peers and the team in first place also receives a trophy that symbolizes their sportsmanlike conduct: The Founders' Trophy.

1.4 Overall Ranking

1.4.01 Scoring Logic

1. For each component of the Competition, the number of points equal to the total number of teams is given to a first-place ranking. The score given to other ranks can be calculated using the following formula:

$$\text{Score} = \text{Total Number of Teams} - \text{Rank} + 1$$

2. Kiosk, Programming, Robot Design, Robot Construction, Website Design, Website Content, and Video components follow the formula mentioned above.
3. The game component counts for double the value of the formula mentioned above.
4. In the case of a tie, the teams receive the same score for that category.

5. The total number of points for all components determines the overall ranking.

1.4.02 Overall Ranking Award

The Overall Ranking award is presented to the three teams that receive the greatest score after combining the points in each component. They are deemed to be the best performing teams in the Competition as a whole. The team in first place also receives a trophy that symbolizes their success.

2. Game

The game component requires robots to score the greatest number of points while working in teams. It is the main component of the CRC Robotics Competition, giving each school an equal opportunity to demonstrate their robot design, robot construction and strategic playing skills. Refer to the Survival Guide for tips and suggestions.

CRC Robotics reserves the right to modify any and all values outlined in the following subsections at any time throughout the season. All teams will be promptly notified if a modification is made.

2.1 Teams

2.1.01 There is only one team, the red team, that participates in each game.

2.1.02 A team consists of five robots working cooperatively in each game.

2.1.03 The robots change partners in each game.

2.2 Playing Field

2.2.01 The playing field is composed of 3 platforms. Two platforms, on the upper level, are separated by a platform on the lower level. Two ramps allow you to move from the lower level to the upper level.

2.2.02 There are two starting zones on each of the three platforms.

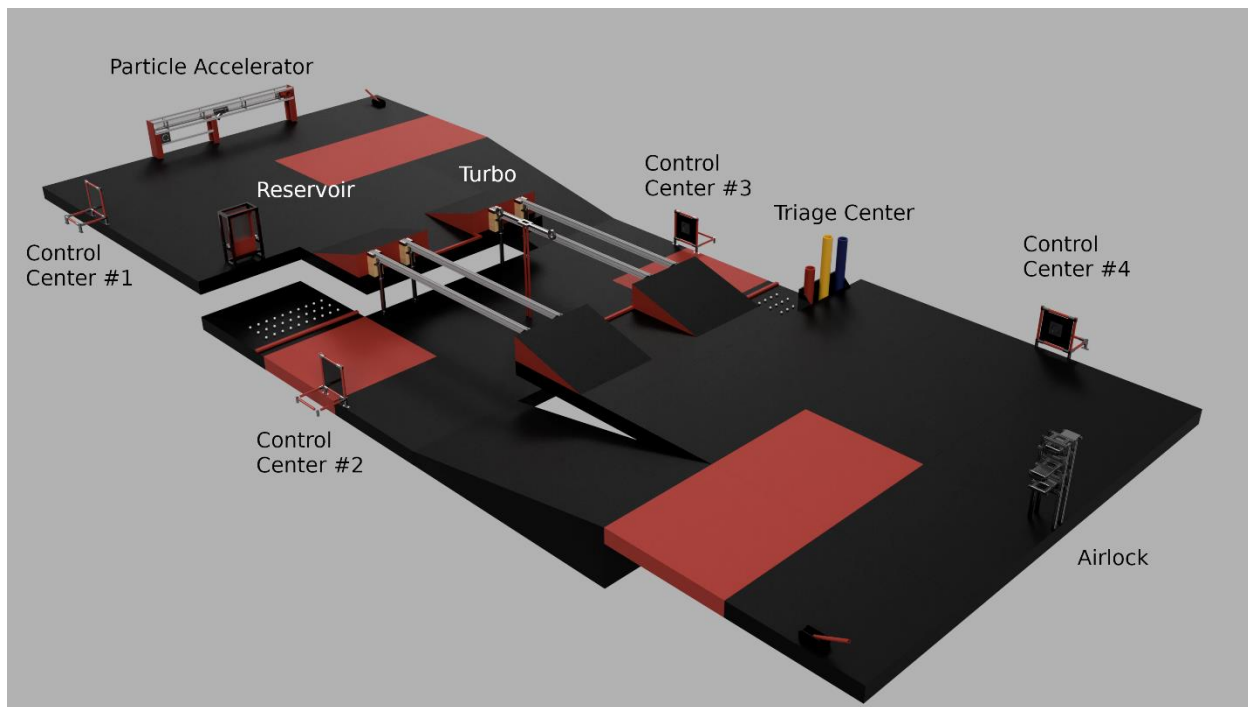
2.2.03 There are multiple stations on the field that need to be repaired.

2.2.04 Two rails connecting both platforms can be lowered by activating both levers located on the opposite corners of the field.

2.2.05 Once lowered, the rails cannot be raised for the remainder of the heat.

2.2.06 It is strictly forbidden to cross the rails before they have been lowered completely.

2.2.07 The image below shows an isometric view (not to scale) of the playing field.



2.2.08 Unless otherwise communicated by the CRC Robotics Organizing Committee, in the event of a modification, measurements of the playing field recorded at Kickoff will be considered accurate. Teams are allowed a certain period of time at Kickoff to measure the different elements of the playing field. Should a team not be able to attend Kickoff due to extenuating circumstances, measurements will be provided to them from another participating team that volunteers to do so.

2.3 Game Pieces

2.3.01 The game pieces (GP) are golf balls.

2.3.02 A total of 100 GPs are available during each heat.

2.3.03 There is no limit to the number of GPs a robot can hold at any given moment during the game.

2.4 Putting Game Pieces into Play

2.4.01 Each robot can be preloaded with a maximum of 4 GPs. If a robot is preloaded with less than 4 GPs, the remaining GPs will be placed on the floor in the robot's starting zone.

2.4.02 70 GPs are found on the floor of the starting zones on the lower level. 10 GPs are preloaded in the reservoir.

- 2.4.03 The GPs on the floor can be picked up by any robot.
- 2.4.04 It is prohibited to launch, throw, or add mechanical acceleration to the GPs. They can only be dropped or put down on the floor in a controlled manner.
- 2.4.05 GPs that leave the field will be considered out of play and can no longer be used. It is not permitted to intentionally remove GPs from the playing field.

2.5 Stations

2.5.01 There are five stations that can 'break' during the heat.

2.5.02 Here are the five stations and their method of repair:

1. The Particle Accelerator is a long tube. There is an open trap door in the middle of the tube. To repair the Particle Accelerator, a GP must be inserted in the tube from the far right and travel the entirety of the tube. The trap door can be closed momentarily by pushing the button in front of the station, thus letting the GP pass through.
2. The Reservoir is a receptacle mounted on a pivot. Once the receptacle is filled to a certain level, it will tip over to empty, then return to its original position. The team must fill the bin to the point it tips over and empties to repair the Reservoir.
3. The Triage Centre is made up of three vertical tubes of different heights and colors (yellow, red and blue). To repair the Triage Centre, the team must insert 3 GPs into the tube, one after another, in the order identified by the indicator light. The order of the colors is random and changes after each GP.
4. The Airlock is divided into 4 levels, separated by handles. The handles must be pushed or pulled to allow the GP to drop from the upper level (L1) to the middle level (L2), then to the lower level (L3) and finally into the repair level (RL). Pulling on the handle between L1 and L2 will let the GP fall from L1 into L2. Then, pushing on the handle between L2 and L3 will let the GP fall from L2 to L3. Lastly, pulling on the handle between L3 and RL will let the GP fall into RL, repairing the station. A GP must be inserted into L1 from the opening located at the top of the Airlock. A robot can only interact with the handles located on the airlock.
5. The Control Centre is composed of 4 buttons spread out across all three platforms: 2 on the lower level, and 1 on each platform of the upper level. To repair the Control Centre, the team must push all four buttons. The buttons do not need to be pressed in a specific order. A button will remain pressed until the Control Centre has been repaired or until the end of the wave, whichever occurs first.

2.5.03 Each station has an indicator light that indicates which station must be repaired during the wave. If the indicator light is red, the station needs to be repaired. If the indicator light is green the station has either been repaired or is in no need of repair.

2.6 Turbo

- 2.6.01 The Turbo is a scale situated at the center of the playing field. To activate the Turbo, the scale must be tilted to one side for at least 1 second.
- 2.6.02 The Turbo supercharges the stations located on the upper platform on the side to which it leans.
- 2.6.03 The Turbo does not have an effect on the Control Centre station. It cannot be supercharged.
- 2.6.04 The supercharged platform will be identified by lights on the playing field.

2.7 Waves

- 2.7.01 A wave consists of a certain number of stations that need to be repaired within 1 minute. If all the actuators are repaired within this timeframe, the wave ends and is considered complete.
- 2.7.02 If the team is not able to repair all the stations before the 1-minute timeframe is over, the wave ends and is considered incomplete. In this case, all the stations needing repair will repair themselves automatically. A station that was automatically repaired can break again in a subsequent wave. No points will be awarded for stations that are repaired automatically.
- 2.7.03 The first wave begins at the start of the heat. Once a wave ends, a new one begins automatically.
- 2.7.04 Before each heat, all 5 pilots must agree upon a level of difficulty: 1, 2 or 3. This decision cannot be modified after the start of the heat. If the pilots cannot agree on a level of difficulty, they will be assigned Difficulty Level 1 by default.
- 2.7.05 The level of difficulty determines the number of stations to be repaired in each wave. The level of difficulty also determines the number of bonus points obtained if all the required stations are repaired before the end of a wave.

| Level of difficulty chosen before the heat | Number of stations to repair during each wave | Completed wave bonus |
|--|---|----------------------|
| 1 | 3 | 25 pts. |
| 2 | 4 | 50 pts. |
| 3 | 5 | 100 pts. |

2.8 Scoring Points

2.8.01 Repairing 1 station awards 50 points to the whole team.

2.8.02 Repairing 1 station supercharged by the Turbo awards 100 points to the whole team.

2.8.03 Repairing all broken stations before the end of the wave awards the Completed Wave bonus to the whole team. The value of the Completed Wave bonus is determined by the difficulty level.

2.8.04 If a team completes at least 1 wave during the heat, a game bonus is awarded to the entire team based on the duration of the last wave and the number of the last wave. The game bonus is calculated using the following formula: (using function FLOOR.MATH which rounds down the result from the calculation in brackets to the nearest whole unit):

Game bonus points = FLOOR.MATH[(Time elapsed during last wave in seconds / 10) * Number of the last wave]

2.8.05 The following are scoring examples. They constitute an integral part of the rules and a reference for scoring disputes.

| Difficulty chosen= 1 Number of stations to repair= 3 Wave bonus points= 25 | | | | | |
|--|--------------------------------------|----------------------------------|----------------|--|------------|
| Wave | Repaired stations (not supercharged) | Repaired stations (supercharged) | Wave complete? | Points | Duration |
| 1 | 2 | 1 | Yes | $2 \times 50 + 1 \times 100 + 25 = 225 \text{pts}$ | 58 seconds |
| 2 | 1 | 1 | No | $1 \times 50 + 1 \times 100 + 0 = 150 \text{pts}$ | 1 minute |
| 3 | 3 | 0 | Yes | $3 \times 50 + 0 \times 100 + 25 = 175 \text{pts}$ | 55 seconds |
| 4 | 0 | 3 | Yes | $0 \times 50 + 3 \times 100 + 25 = 325 \text{pts}$ | 57 seconds |
| 5 | 1 | 1 | No | $1 \times 50 + 1 \times 100 + 0 = 150 \text{pts}$ | 1 minute |
| 6 | 1 | 0 | No | $1 \times 50 + 0 \times 100 + 0 = 50 \text{pts}$ | 10 seconds |
| Wave points: | | | | 1075 pts | |
| Game bonus points: | | | | $\text{FLOOR.MATH}(10 \text{ sec} / 10 * 6) = 6 \text{ pts}$ | |
| Total = | | | | 1075 pts + 6 pts = 1081 pts | |

| Difficulty chosen= 2 Number of stations to repair= 4 Wave bonus points= 50 | | | | | |
|--|--------------------------------------|----------------------------------|----------------|---|----------|
| Wave | Repaired stations (not supercharged) | Repaired stations (supercharged) | Wave complete? | Points | Duration |
| 1 | 2 | 0 | No | $2 \times 50 + 0 \times 100 + 0 = 100 \text{pts}$ | 1 minute |
| 2 | 1 | 2 | No | $1 \times 50 + 2 \times 100 + 0 = 250 \text{pts}$ | 1 minute |
| 3 | 3 | 0 | No | $3 \times 50 + 0 \times 100 + 0 = 150 \text{pts}$ | 1 minute |
| 4 | 1 | 2 | No | $1 \times 50 + 2 \times 100 + 0 = 250 \text{pts}$ | 1 minute |
| 5 | 1 | 1 | No | $1 \times 50 + 1 \times 100 + 0 = 150 \text{pts}$ | 1 minute |
| Wave points: | | | | 900 pts | |
| Game bonus points: | | | | $\text{FLOOR.MATH}(60 \text{ sec} / 10 * 5) = 30 \text{ pts}$ | |
| Total = | | | | 900 pts + 30pts = 930 pts | |

| Difficulty chosen= 2 Number of stations to repair= 4 Wave bonus points= 50 | | | | | |
|--|--|-------------------------------------|----------------|---|------------|
| Wave | Repaired stations (not supercharged) | Repaired stations (supercharged) | Wave complete? | Points | Duration |
| 1 | 3 | 1 | Yes | $3 \times 50 + 1 \times 100 + 50 = 300\text{pts}$ | 42 seconds |
| 2 | 1 | 2 | Yes | $1 \times 50 + 2 \times 100 + 0 = 250\text{pts}$ | 45 seconds |
| 3 | 0 | 3 | No | $0 \times 50 + 3 \times 100 + 0 = 300\text{pts}$ | 1 minute |
| 4 | 0 | 4 | Yes | $0 \times 50 + 4 \times 100 + 50 = 450\text{pts}$ | 48 seconds |
| 5 | 2 | 2 | Yes | $2 \times 50 + 2 \times 100 + 50 = 350\text{pts}$ | 46 seconds |
| 6 | 0 | 1 | No | $0 \times 50 + 1 \times 100 + 0 = 100\text{pts}$ | 59 seconds |
| Wave points: | | | | 1750 pts | |
| Game bonus points: | | | | FLOOR.MATH(59 sec / 10 * 6)= 35 pts | |
| Total = | | | | 1750 pts + 35pts = 1785 pts | |

2.9 Judges and Penalties

2.9.01 Our referees are experts in calling and assessing penalties and always have the final word on the playing field. However, during the 15 minutes following the end of a heat, a team can challenge its final score if it has video evidence to support its claims. A team may be deprived by the referees of its right to challenge if they find it is unnecessarily abusing it.

2.9.02 The referees on the playing field have full authority to judge all aspects of the game. In particular, the referees will:

- Prevent robots, robot extensions and dropped robot parts from negatively blocking other robots;
- Prevent robots from damaging the playing field and GPs;
- Prevent robots from violating the air space on the edges of the playing field;
- Try their best to make sure the numbers displayed on the screens are accurate and updated as soon as possible; however, their ruling overrides whatever is displayed on the screens.

2.9.03 Any robot that is deemed dangerous (based on its design or behaviour) by any of the referees runs the risk of being disqualified from the heat, and even from the tournament.

2.9.04 Various robot parts may be placed, intentionally or not, on or around the playing field by a robot, on the condition that they are removed from the playing field or from its surroundings by the robot before the end of the heat. If items are no longer in contact with the robot by the end of the heat, the robot that released these items will be liable to an individual junk penalty of 4% of its total score for the heat for each item left on or around the playing field.

- 2.9.05 If a liquid leaks from a robot during the heat, the robot that is leaking will be given a score of 0.
- 2.9.06 While we trust that all participants will provide clear intentions, certain conducts may occur that require sanctions, especially during the heat of battle. To avoid such penalties, remain courteous at all times. These penalties are considered as Unsportsmanlike Conduct and have a series of escalating consequences, depending on the severity of the issue. The number of points deducted from the robot's total score for that heat will be at the discretion of the head referee and will be proportional to the severity of the action. Some examples of the types of behaviour that signal a lapse of sportsmanlike behavior are:
- A deliberate attempt to disable or damage another robot;
 - A deliberate attempt to hit another robot with a GP, robot part or playing field element;
 - Inappropriate behaviour directed at an official, another participant, or a spectator.
- 2.9.07 The minimum score that can be awarded for any given heat is 0 points; therefore, if a penalty brings a robot's total score to below 0, the final score awarded to the robot for the heat will be 0.
- 2.9.08 If a team judges that its robot needs assistance on the playing field during a heat, its pilot may ask the referee to assist their robot. The assisted robot will be liable to an assistance penalty of 20% of its total score for the heat. The referees reserve the right not to assist the robot even if asked to do so by the pilot.
- 2.9.09 Any deliberate attempt to throw a GP or put a GP out of play will result in a 20% penalty of the robot's total score for the heat for each GP affected.

2.10 Heat Progress

- 2.10.01 All 5 robots must start inside one of the 6 available starting zones located on the two upper platforms and on the lower level.
- 2.10.02 All heats are 5 minutes in duration. When the heat time is over, all parts of all robots must stop moving. All the points generated by the team due to the motion of their robots after the heat ends will be canceled. Although an estimate might appear on the screens near the playing field, the remaining time until the end of a heat is controlled by the head referee.
- 2.10.03 Team members may not interfere with or touch any element of the playing field, robots or GPs during the heat.

- 2.10.04 The robots cannot damage the playing field or the GPs.
- 2.10.05 All robots must be labelled with the school's name (either full or shortened) and number. These two elements must be clearly visible to the crowd and referees. If these elements are not all visible, the robot will not be allowed to participate in the heat. Adding the robot's name (if any) is optional.
- 2.10.06 If a robot is not able to fully exit its starting zone during the heat for whatever reason and is not actively trying to score points from its starting zone, or if it is simply absent, it will be considered as an inactive robot. Robots with one or more inactive robots on their team will receive a 20% bonus of their total score for the heat for each inactive robot to compensate for the disadvantage of playing with less teammates. Inactive robots will be removed from the playing field after 30 seconds of inactivity to prevent them from blocking play.
- 2.10.07 If a robot makes it out of its starting zone and stops moving for whatever reason, it will be considered a broken robot. If the robot breaks before it meets the sharing requirements, then it will not share the team's score, but the other robot's score (from the same team) will not be multiplied by 1.2, because, initially, the broken robot was an active robot. Broken robots will be removed from the playing field after 30 seconds of inactivity to prevent them from blocking play.
- 2.10.08 If a robot is not able to move out of its starting zone but is actively participating in the making of points, it will share the team's points.
- 2.10.09 Following the buzzer signaling the end of play, team members are not allowed to enter the playing field, to touch any robot, or to touch the GPs before they are cleared to do so by the head referee. It is essential that the configuration of the GPs, at the end of the heat, remain intact for scoring purposes. The head referee will indicate when the team members are allowed to enter the playing field.

2.11 Pilot and Co-pilot

- 2.11.01 Each team's pilot, co-pilot (spotter), and robot participating in the next heat must be in the "On Deck Area" when the buzzer sounds to end the previous heat. If not, a penalty is assessed to the offending robot. It is the team's responsibility to make sure the team is on time, even if the schedule is delayed.
- 2.11.02 If a robot, pilot, or co-pilot of a team is not ready to start, the heat will start without the team in question.
- 2.11.03 The pilot and co-pilot must remain seated during the entire game in their designated seats provided by CRC Robotics, which are placed within the designated areas surrounding the playing field.

- 2.11.04 Each person is responsible for taking all necessary precautions to ensure their own safety.
- 2.11.05 Before the start of the heat, the referees will ask the red team for their choice of one of the 3 difficulties. If the team cannot agree on a difficulty level, they will be assigned Difficulty Level 1.

2.12 Tournament Progress

2.12.01 The tournament consists of 5 stages:

- a. **Preliminary Round:** These heats are played on Thursday and Friday by all teams. After all the preliminary heats have been completed, each robot will cast out their two lowest scoring heats. Heats affected by an unsportsmanlike penalty cannot be cast out. The total of all other heats will be summed to determine each robot's final rank for the preliminary round. Depending on a team's rank, teams can advance directly to semi-finals or quarterfinals, or they will play in the knock-out round.
- b. **Knock-Out Round:** These heats are played on Saturday morning by teams that did not directly advance to quarterfinals or semi-finals. This round provides teams with an opportunity to advance further in the tournament. The final score of all the heats played by a robot in the knock-out round will be added to determine its ranking in this round.
- c. **Quarterfinals:** Top teams from the preliminary and knock-out rounds advance to this stage of the tournament. The final score of all the heats played by a robot in the quarterfinals will be added to determine its ranking in this round.
- d. **Semi-Finals:** Top teams from the preliminary rounds and quarterfinals advance to this stage of the tournament. The final score of all the heats played by a robot in the semi-finals will be added to determine its ranking in this round.
- e. **Finals:** Top teams from the semi-finals advance to this stage of the tournament. The final score of all the heats played by a robot in the finals will be added to determine its ranking in this round.

2.12.02 The schedule for the various rounds will be published at the beginning of the Competition.

3. Robot

This section outlines the robot design and construction constraints on which robots will be evaluated at the Competition. Non-compliance with the following rules will cause robots to fail certification. Uncertified robots are not allowed to compete. Refer to the Wiki for tips and suggestions. The evaluation rubrics used by the judges to evaluate the robot design and robot construction as well as the Robot Certification Form may be found at the end of this section.

3.1 Transmission and Controls

3.1.01 Authorized Controller and Functionality

The controller acts as the robot brain. All robot control signals must originate from a CRC 9880A or CRC 9880B controller, referred to as “the controller” in the rest of this document.

3.1.02 Remote Control

The robot may only be remotely controlled by any wired remote control connected to the XBee module pair provided by CRC Robotics, linking the remote control to the controller. The remote control must send all commands to the controller. However, the robot may perform autonomous actions.

3.1.03 Other Transmitters

It is forbidden to use any transmission methods or any method disrupting other robots in any way.

3.1.04 Other Control Systems

Other onboard control systems are allowed if and only if a motor, a servo, any actuator type or a 12V motor controller is not connected to them.

3.1.05 Onboard Cameras

Cameras may be attached to robots, but live transmission of the images is prohibited during the heats.

3.2 Low-Voltage Control Circuit and Motorization

The low-voltage circuitry refers to the controller power source and all sensors and servos powered through a 5V controller port and the controller power source.

3.2.01 Low-Voltage Sensors

Usage of any onboard sensors to give feedback to the controller is allowed. Encoders using I2C communication are allowed.

3.2.02 Low-Voltage Continuous Rotation Servos

All “Radio-Controlled Hobby”-type continuous rotation servos are allowed. Low-voltage continuous servos must be powered through a 5V controller port. Standard partial-rotation servos that have been internally modified to run continuously are allowed and count as “low-voltage continuous rotation servos”. For reference, the following are some examples of legal continuous rotation servos: VEX EDR 3-wire motors, VEX EDR 2-wire 393 motors, VEX EDR 2-wire 269 motors, POWER HD 1501MG, FEETECH FS0403 and HITEC HSR-1425CR. Thousands of different models are available on the market. When in doubt, contact CRC Robotics.

3.2.03 Low-Voltage Standard Servos

Standard servos are closed-loop systems that can only partially rotate. All “Radio-Controlled Hobby” type standard servos are allowed. Low-voltage standard servos must be powered through a 5V controller port. For reference, the following are some examples of legal partial-rotation servos: VEX EDR 3-wire servo, POWER HD DSP33, FEETECH FT5313M and HITEC HS-625MG. Thousands of different models are available on the market. When in doubt, contact CRC Robotics.

3.2.04 Low-Voltage Servo Controller

External motor controllers are permitted if and only if they are used to control a low-voltage servo (continuous or standard) that is not equipped with an internal motor controller. For reference, the following are some examples of legal servos: VEX EDR 2-wire 393 motors and VEX EDR 2-wire 269 motors. Low-voltage servo controllers must be powered through a 5V robot controller port.

3.2.05 Power Expander

The use of VEX Power Expander (VEX EDR Part Number: 276-2271) is forbidden.

3.2.06 Controller Power Source

The controller must be powered by the 12V power circuit.

3.3 Power Circuit and Motorization

The power circuitry refers to all motors powered by the 12V batteries.

3.3.01 Power Circuit Source

The power circuit must be fed by one 12V, maximum 8Ah lead-acid or Nickel-Cadmium sealed battery or two 12V, maximum 4Ah parallel-wired lead-acid or Nickel-Cadmium sealed batteries.

3.3.02 Kill Switch

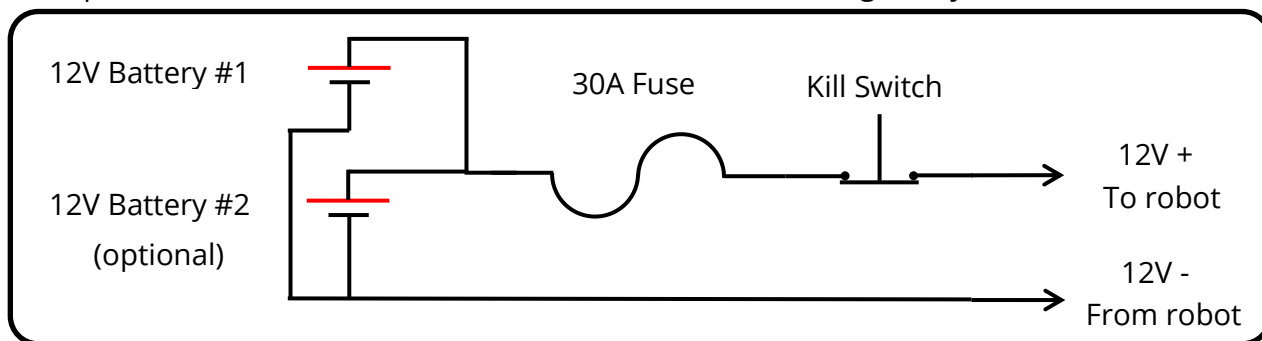
For safety reasons, the robot must have an easily identifiable and accessible ON/OFF kill switch. The kill switch must be connected to the circuit such that it kills the robot's 12V-circuit when the switch is pushed down, not pulled. The kill switch that must be used on all robots is the NPB22-J, or a switch deemed equivalent by CRC Robotics.

3.3.03 Fuse

All robots must have a fuse (single usage or reusable) between the 12V batteries and the power motors. The total 12V battery output must be limited to 30A.

3.3.04 Safety Specification Scheme

The power circuit must, at a minimum, adhere to the following safety schematic:



3.3.05 Power Motors

Only the following power motors can be used as part of the power circuit, with any or no gearbox attached:

| Motor Type | Part Number |
|----------------------|--|
| <i>Banebot Motor</i> | RS555 and/or RS550 |
| <i>goBilda Motor</i> | Modern Robotics/MATRIX 12VDC Motor Legal replacement: RobotZone 12VDC Motor for heavy duty planetary gearbox |

3.3.06 Power Motor Count

The maximum number of power motors allowed on the robot is 8, with a maximum of 4 power motors of the same type and gearbox combination. In all cases, the maximum number of motors of the same type, regardless of the coupled gearbox, is 6.

3.3.07 Power Motor Modifications

Any modification to the electrical components of the power motors is prohibited. Modifications may only be made to the mechanical components of the power motors, if desired. Therefore, the gearbox can be changed or removed completely.

3.3.08 Power Servos

Servos powered by the 12V power circuit are prohibited.

3.3.09 Power Motor Controller

Power motors may be controlled with relays, interrupts, switches and/or any motor controllers, such as the Victor SPX.

3.3.10 Capacitors

The addition of capacitors to the 12V power circuit of the robot is permitted. The role of these capacitors is to reduce the magnetic field emitted by the motors. However, no electrolytic capacitors are permitted for this task. The capacitor may not be used to accumulate charge. If the capacitor is polarized (if it contains only one direction for connection), it is considered illegal.

3.4 Pneumatics

There are many dangers to working with high pressure systems. Thus, the following regulations are put in place to emulate the same safety standards present with the power circuit.

3.4.01 Kill Switch

If the robot uses any pneumatics, it must have an easily identifiable and accessible ON/OFF manual pneumatic kill switch. All actuators/valves must be at the ambient pressure when turned to OFF.

3.4.02 Maximum Pressure

The pneumatic system of the robot must be divided into two parts. Their maximal pressures are the following:

- Tank section: 90 psi
- Low pressure section (actuators/valves): 55 psi

3.4.03 Pneumatic System Protection

In a similar fashion to the fuse in an electrical circuit, the pneumatic system must be equipped with an overflow valve that can be controlled to release any pressure greater than 90 psi.

3.4.04 Altered Pneumatic Parts

All pneumatic pieces (actuators, valves, cylinders, tanks, switches, etc.) must be unchanged from their original state, as purchased new. No altered parts will be accepted. All serial numbers must be visible for certification.

3.4.05 Actuator/Cylinder Control

Each actuator/cylinder must be controlled by no more than one valve.

3.4.06 Valve Control

All the valves must be controlled by the controller. It is permitted to add relays or power modules to the low-voltage or power-electrical circuit to control the valves if they are still controlled by the controller.

3.4.07 Maximum Input and Tube Diameters

The valves must have a maximal input hole of 1/8" (3mm). The tubes between valves and their actuators/cylinders must have a maximal diameter of 3/16" (5 mm).

3.4.08 Manometers

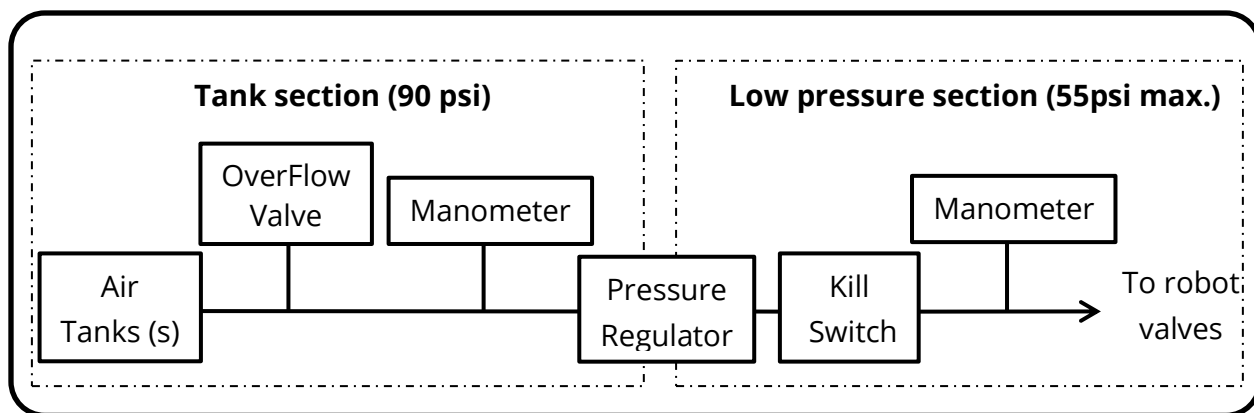
A manometer must be installed in both low- and high-pressure sections.

3.4.09 Series/Parallel Plugging

Plugging several tanks in series or in parallel is allowed if their pressure does not exceed 90 psi.

3.4.10 Safety Specification Scheme

The pneumatic system must, at a minimum, adhere to the following safety schematic:



3.5 Alternative Power and Energy Systems

3.5.01 Gravitational Energy

There is no restriction with regards to using gravity.

3.5.02 Single Decompression Springs

A spring that, after having started the heat in a compressed or stretched state, releases its energy during the heat, but cannot return to its original state without human intervention, will be deemed illegal.

3.5.03 Proper Spring Usage

If spring systems are used, they must be in relaxed states, or compressed or stretched by the same batteries and motors used during the heat, before the heat begins. Spring systems that function through oscillation are also allowed, given they conform to the above rules.

3.5.04 Fans

Fans can only be used to cool down motors or electrical components that can potentially overheat.

3.5.05 Lights

Lights can be used on robots, but they must draw their energy from the 12V power circuit. Blinding lights or other components deemed distracting or disruptive by the certification judge or the referees on the playing field must be disconnected.

3.5.06 Lasers

The use of lasers of any type is prohibited.

3.5.07 Other Electrical Sources

The only electrical power sources allowed are the ones stated in Sections 3.2 and 3.3.

3.6 Dimensions

3.6.01 Initial Size Limits

Robot dimensions are limited to an initial dimension limit of 76.2 cm x 76.2 cm (length x width) at the beginning of each heat. There is no initial height limit.

3.6.02 Extension Constraints

After a heat begins, robots can extend their dimensions up to 106.68 cm x 106.68 cm.

3.6.03 Moving Parts

Moving robot parts are allowed if they do not extend beyond the allowed dimensions and height limit at the beginning of and during a heat.

3.6.04 Robot Parts

A “robot part” is defined as the following: *All things that touch the robot at the beginning of the heat, except playing field elements and GPs.*

3.7 Certification

3.7.01 Safety Inspection

Robots will be required to pass a safety inspection (on site, at the Competition) in order to be judged and have access to the playing field. During the certification, the electrical power circuit will be inspected for its integrity. If parts are protected inside boxes, the boxes will need to be opened during certification. Should any part of the circuit be inaccessible, the robot will not be certified. Refer to the certification criteria at the end of this section.

3.7.02 Post-Certification Modifications

Teams may modify their robot between heats at their discretion. However, each electrical modification and each modification made to enlarge the robot’s dimensions must be subsequently certified. Failure to recertify the robot will result in all points gained in subsequent heats to be void.

3.7.03 Safety

Any robot deemed to be dangerous for any reason can be disqualified until the necessary safety measures are put into place.

3.8 Evaluation

3.8.01 The Evaluation Process

The evaluation of a team's work includes two stages: the Preliminaries and the Finals.

The Preliminaries:

- All registered teams are divided into pools. The number of teams per pool is dependent on the number of registered teams.
- The judges of each pool evaluate and rank teams' work. Judges are participating mentors or qualified CRC volunteers. Judges are never assigned to pools containing their current or past teams.
- Each pool is evaluated by different judges. Judges of all pools follow the same judging criteria for each category.
- The top teams in each pool will qualify for the Finals. The number of qualifiers per pool is dependent on the number of registered teams.

The Finals:

- Finalists are the top teams from each pool in the Preliminaries.
- There are no pools in the Finals. All finalists are evaluated by the same judges.
- Judges evaluate and rank the finalists' work. Judges are field experts and did not judge in the Preliminaries. Judges in the Finals follow the same judging criteria used in the Preliminaries.
- Based on the ranking provided by the judges, the top three teams in each division will receive awards.

3.8.02 Evaluation Criteria

The evaluation criteria are divided into three levels: Standard, Developed and Advanced.

- The Standard level provides minimal criteria that should be satisfied. These criteria may target specific rules in the rulebook or requirements which are considered essential for acceptable work.
- The Developed level includes criteria which, when satisfied, demonstrate a commendable work quality.
- The Advanced level groups criteria which, when satisfied, set a team apart from the rest.

3.8.03 Schedule

The timeframes for the preliminary evaluations will be provided to the teams on the first day of the Competition. The teams that advance to the final round will be provided with their timeframe after the preliminary round.

3.8.04 Presentations

The preliminary and final presentations will take place in a closed room at the host school.

3.8.05 Language

The presentation can be done in the language of preference of the team.

3.8.06 Visual Support

Visual support is permitted.

3.8.07 Structure

The presentations must abide by the following structure:

| Length | Action |
|--------|--|
| 5min | The team presents the robot (without the judges interrupting). |
| 5min | The judges ask their questions to the evaluated team. |
| 5min | The judges give feedback, rank teams, discuss and move toward the next team. |

3.9 Evaluation Form for Robot Design

| Topic | Level | Criterion |
|---------------------|-----------|---|
| Design & Creativity | Standard | Is the robot designed for the game? The robot is designed to play this year's game and can adopt efficient game strategies. |
| | Developed | Is the robot efficient? The robot's intended mechanisms, components and programming use minimal resources for maximum output. |
| | Advanced | Is the robot inventive? The robot is designed with creative concepts, ingenious details and "out-of-the-box" thinking. |
| Presentation | Standard | Did the team present and justify their approach to the design? The team can intelligibly explain how it approached this year's game, highlighting their technical expertise, team size, and challenges. |
| | Developed | Did the team explain their journey? The team can clearly present and justify the evolution of their designs, technical drawings or prototypes in a professional and concise presentation. |
| | Advanced | Did the team defend their decisions? When faced with questions, the team can confidently explain and justify their decisions. |

3.10 Evaluation Form for Robot Construction

| Topic | Level | Criterion |
|-------------------------|-----------|---|
| Structure & Maintenance | Standard | Is the robot efficiently built? Appropriate materials are used in their proper context and the robot is robustly assembled. The robot has low mechanical tolerance and is well-calibrated. The robot is reliable/resilient and can withstand multiple heats without repair. The electrical and control systems are to standard, namely the convenience of the wire gage used and the wire management. |
| | Developed | Does the robot move as intended? The robot's driving mechanism operates smoothly. The robot's ancillary systems are stable and make precise movements. Motors and mechanisms are appropriate for intended tasks. |
| | Advanced | Is robot maintenance accessible and optimized? All components can be easily accessed, maintained and replaced. The electrical system is protected and accessible. The robot parts can be swapped easily. Maintenance required on the robot is minimal. |
| Presentation | Standard | Did the team present and justify their build process? The team can describe and justify the build process and the choice and use of tools and machines required throughout the build. |
| | Developed | Did the team highlight the efficiency of their build? The team can justify the number and allocation of motors and choice of material and point out outstanding qualities and functions of their robot. The team can clearly present and justify the evolution of their build process, technical drawings or prototypes. |
| | Advanced | Did the team defend their decisions? When faced with questions, the team can confidently explain and justify their decisions. |

3.11 Robot Certification Form

Team: _____

| Component | Item | Certification | | |
|-------------|---|---------------|--------------|----------------|
| | | Acceptable | Unacceptable | Not Applicable |
| Electricity | Accessible Circuit | | | |
| | 12V Batteries (type and wiring) | | | |
| | Visible Master Kill Switch | | | |
| | 30A Fuse or Equivalent | | | |
| | Capacitors | | | |
| Motor count | Banebot Motor | | | |
| | Black Motor | | | |
| | GoBilda Motors | | | |
| | 5V Servos | | | |
| | Integrity of the Motors | | | |
| Electronics | Speed Controller | | | |
| | Other Electronic Devices | | | |
| | Robot Controller Type and Port Limitations (if any) | | | |
| Pneumatics | Presence of Pneumatics | | | |
| | Visible Master Kill Switch | | | |
| | Pressure Valve | | | |
| | Number of Cylinders | | | |
| Robot | Dimension of the Robot | | | |
| | Visibility of School Name and Team Number | | | |
| | Robot Safety (electric circuit, exposed screw, sharp edge, dangerous mechanism, etc.) | | | |

Notes: _____

CRC Robotics Signature

Team Signature

4. Kiosk

The kiosk component requires the organization of an information kiosk and presentation of accomplishments to visitors and judges. This component gives each school an equal opportunity to showcase their school, their team and their robot while also developing presentation and artistic skills. Refer to the Wiki for tips and suggestions. The evaluation rubric used by the judges to evaluate the kiosk as well as the Kiosk Certification form may be found at the end of this section.

4.1 Constraints

4.1.01 Space Provided

A 12' by 12' space is available to each team. The maximum height of the kiosk is 9'6".

4.1.02 Material Provided

Items provided by CRC Robotics: 1 folding table (if desired), 2 school chairs (if desired) and 1 electrical outlet with 2 plugs (120V, 15A total).

4.1.03 Layout

Each team's kiosk must have the following:

- a) A distinct and delineated pit area for robot maintenance, modifications and repairs;
- b) A school and robot demonstration and presentation area;
- c) A clear and obvious identification of the team number and full school name.

4.1.04 Levels

It is not permitted to have any livable space on a second level due to safety concerns, including during set-up and dismantling time.

4.1.05 Respect for Neighbors

The surrounding kiosk areas must be respected; otherwise, the team at fault will be penalized for any behavior that has a negative impact on other kiosks (e.g. loud music, extending beyond the kiosk footprint, etc.).

4.1.06 Visual Appeal

Since kiosk spots are randomly assigned to teams, the outside walls of a kiosk will not be judged for reasons of equality. However, teams are encouraged to put an effort to make both the interior and exterior side of the walls of their kiosk visually appealing for the benefit of visitors and other participants.

4.1.07 Electrical Work Conformity

All electrical work within the kiosk must adhere to Québec's building safety standards.

4.1.08 Safety

If any CRC Robotics official feels that there is a risk of accident either with the kiosk or with the construction methodology (e.g. unsafe ladder, tools, etc.), CRC Robotics will consult the team and stop the building process until a safe approach or correction can be agreed upon.

4.1.09 Identification

The name of the school/organization and the team number must be properly displayed at the entrance of the kiosk.

4.1.10 Bilingualism

The information displayed and available in the interior or on the exterior of the kiosk must be entirely bilingual.

4.1.11 Competition Readiness

In an effort to have the best experience possible for all teams, kiosk elements must be painted and cut before teams arrive at the Competition. Minor tweaks will be permitted, but if major parts of the kiosk are being built on site, a penalty will be sanctioned.

4.1.12 Safety Gear

Each kiosk must be equipped with at least one first aid kit, at least three pairs of safety glasses and at least 3 pairs of work gloves or mechanic's gloves. It is the responsibility of the participants and the adults in charge of each team to make sure proper safety gear is worn when necessary, both inside and outside the kiosk.

4.1.13 Access

There must be clear access for the robot and team members within the kiosk.

4.1.14 Assembly Time Limit

The kiosk must be fully mounted and ready for judging within 6 hours of a team's scheduled arrival time. The arrival schedule will be sent by email to all teams in the days prior to the Competition.

4.1.15 Dismantling Time

Kiosks may not be dismantled until instructed to do so by the CRC Robotics Organizing Committee.

4.1.16 Dismantling

A team's kiosk area must be cleared and cleaned by 6:00 p.m. on the Saturday night of the Competition. No damage can be done to the area. Any team leaving any debris will be subject to a \$200 fine as well as any cleaning costs incurred by the host school. Repeat offenders may be subject to further penalties.

4.2 Certification

4.2.01 Safety Inspection

Each kiosk will be required to pass a safety inspection on the Wednesday afternoon of the Competition in order to be judged. Refer to the certification form at the end of this section.

4.3 Evaluation

4.3.01 The Evaluation Process

The evaluation of a team's work includes two stages: the Preliminaries and the Finals.

The Preliminaries:

- All registered teams are divided into pools. The number of teams per pool is dependent on the number of registered teams.
- The judges of each pool evaluate and rank teams' work. Judges are participating mentors or qualified CRC volunteers. Judges are never assigned to pools containing their current or past teams.
- Each pool is evaluated by different judges. Judges of all pools follow the same judging criteria for each category.
- The top teams in each pool will qualify for the Finals. The number of qualifiers per pool is dependent on the number of registered teams.

The Finals:

- Finalists are the top teams from each pool in the Preliminaries.
- There are no pools in the Finals. All finalists are evaluated by the same judges.
- Judges evaluate and rank the finalists' work. Judges are field experts and did not judge in the Preliminaries. Judges in the Finals follow the same judging criteria used in the Preliminaries.
- Based on the ranking provided by the judges, the top three teams in each division will receive awards.

4.3.02 Evaluation Criteria

The evaluation criteria are divided into three levels: Standard, Developed and Advanced.

- The Standard level provides minimal criteria that should be satisfied. These criteria may target specific rules in the rulebook or requirements which are considered essential for acceptable work.
- The Developed level includes criteria which, when satisfied, demonstrate a commendable work quality.
- The Advanced level groups criteria which, when satisfied, set a team apart from the rest.

4.3.03 Multiple Teams per School

Kiosk spaces of teams from the same school will be placed beside each other. If the school decides to build one combined kiosk, judges will be informed to evaluate them separately, without considering the other space.

4.3.04 Language

Teams must ensure to always have at least 1 bilingual student speaker in the kiosk, giving presentations to and answering questions from the general public. However, the presentation for the evaluation can be conducted in the language of preference of the team.

4.3.05 Presentations

Preliminary and final presentations will take place in the kiosk of the evaluated team.

4.3.06 Schedule

There will not be a detailed schedule provided for the judging of the kiosks. Instead, time intervals will be provided during which the judges may visit the kiosks. This measure is necessary given the nature of this component of the Competition. However, a visual signal in the kiosk area will inform participants that the kiosk judging is in session.

4.3.07 Visual Support

Visual support is permitted.

4.3.08 Structure

The presentations must abide by the following structure:

| Length | Action |
|--------|--|
| 5min | The team presents the kiosk (without the judges interrupting). |
| 5min | The judges ask their questions to the evaluated team. |
| 5min | The judges give feedback, rank teams, discuss and move toward the next team. |

4.4 Kiosk Evaluation Form

| Topic | Level | Criterion |
|--------------|-----------|---|
| Construction | Standard | <p>Is the kiosk's layout optimal for a functional workspace?</p> <p>The kiosk demonstrates a good understanding in creating a functional workspace (i.e. tool placement and organization, functionality, etc.).</p> |
| | Developed | <p>Is the kiosk engaging and reflective of the team's theme?</p> <p>The kiosk is intriguing to the public. Students interact with the public in a respectful and friendly way.</p> |
| | Advanced | <p>Does the kiosk surprise and amaze?</p> <p>The kiosk has a "wow" factor. It creatively demonstrates excellence in detail and craftsmanship. The kiosk uses lights, screens, sounds, and props in such a way that it augments the visitor's experience.</p> |
| Presentation | Standard | <p>Did the team engage the audience with their journey?</p> <p>The team can clearly explain their inspiration and justify the process regarding the design and construction of the kiosk, considering their expertise, team size, challenges, and limitations.</p> |
| | Developed | <p>Does the presentation add to the value of the kiosk?</p> <p>The presentation of the kiosk is creative, engaging and related to the theme of the kiosk.</p> |
| | Advanced | <p>Is the presentation an immersive experience?</p> <p>The presentation generates connections facilitating the involvement of the audience as partners to the team.</p> |

4.5 Kiosk Certification Form

Team: _____

| Component | Item | Certification | | |
|---|---|---------------|--------------|----------------|
| | | Acceptable | Unacceptable | Not Applicable |
| Electrical: Wiring & Outlets | Wire Gauge | | | |
| | Layout | | | |
| | Protected | | | |
| | Grounded | | | |
| | Anchored | | | |
| Structural Integrity | Walls | | | |
| | Roof | | | |
| | Floor | | | |
| Safety | Tools properly stored | | | |
| | Proper fastening / anchoring (Accessories, equipment, shelves, objects, etc.) | | | |
| | Public access | | | |
| | Maneuverability inside kiosk (Ability to move around without hitting things) | | | |
| | Safety equipment (First Aid Kit, safety glasses, gloves, etc.) | | | |
| | No space on a second level | | | |
| Aesthetics | Respects neighboring kiosks (sound, paint, etc.) | | | |
| | Space does not exceed 12' x 12' | | | |

Notes: _____

CRC Robotics Signature

Team Signature

5. Programming

The Programming component allows teams to develop and demonstrate their programming skills. Teams are evaluated on their performance in solving programming-related problems. Refer to the Wiki for tips and suggestions.

5.1 Scope

5.1.01 Goal

The Programming component is primarily a learning experience. Simply based on analysis and problem-solving through programming, it will allow participants to learn how to solve simple and complex situations using programming. The objective is not to test the participants' knowledge of a programming language, but rather to test their knowledge of the principles and techniques required to design and implement a program in the best possible way.

5.1.02 Challenge

Participants will face several individual programming problems that will be solved separately from one another. However, participants will have to score as many points as possible in the overall challenge according to a certain arrangement of the problems solved. See section 5.4 for more information.

5.2 Rules

5.2.01 Final Score

A team's score in the overall challenge determines the team's ranking in the Programming component of the Competition.

5.2.02 Tie-breaker Logic

The submission time of the last problem completed by the team will break ties between two identical scores. The advantage will go to the team that solved it the fastest.

5.2.03 Unsportsmanlike Conduct

Any team caught cheating or exhibiting unsportsmanlike conduct is subject to disqualification. Examples of cheating or unsportsmanlike conduct include, but are not limited to, any attempt to:

- Mislead another team;
- Copy the solutions of another team;
- Use the solution belonging to someone who is not an official participant of the Competition.

5.3 Evaluations

5.3.01 Languages

The programming languages permitted are java, javascript, python et C/C++.

5.3.02 Evaluation

The evaluation will be done by a judge from the CRC Robotics Organizing Committee. The judge will enter the "inputs" of the problem into the "Standard Input" in 1 block according to what is specified by the problem and correct what the code will output in 1 block in the "Standard Output". The judge's decisions are final.

5.3.03 Partial Points

A team may receive half of the points associated with a problem if the output format of their code does not perfectly match that mentioned in the problem description, but it is clear that the program has performed the correct calculations and still gives the correct answers. In addition, the answers must be clearly defined in the code output. However, any bonus that requires completion of the problem to be obtained will not be valid. The decision to award such a fraction of the points is entirely at the discretion of the judges.

5.4 Format

5.4.01 Schedule

The programming challenge will be divided into two 3-hour programming blocks where participants will solve different problems from one block to another. For the remainder of the programming rules, these blocks will be referred to as Block A and Block B. The detailed schedule of the programming challenge will be given at the beginning of the Competition.

5.4.02 Problems

The content of a problem is related to the category that encompasses it. Problems can be of varying difficulty, with a more difficult problem awarding more points than an easier one. However, problems given earlier in the Competition, in Block A, are likely to be easier than problems given in Block B.

5.4.03 Categories and Bonus

Problems will be separated into several categories, granting a bonus multiplier upon completion of the category. The categories group problems with a similar theme, requiring a similar solution, or using similar concepts. Completion of at least one problem in each

5.4.04 Blocks A and B

However, for Block A, the categories will all contain 3 to 4 problems and will be as follows:

- ### 5.4.05 Scoring Example

Example:

CRC Robotics Competition

Explanation:

The category bonus in (2D) is not obtained because the problem 2D.1 obeys the rule 5.3.03. Since one problem in each category has been completed, an overall bonus is applied to the problem worth the most points in each category. Finally, the multiplier of 2.25 is there when the overall bonus and the category bonus are applied on the same problem ($1.5 \times 1.5 = 2.25$). Evidently, it is 1 if no bonus is applied.

6. Video

The following section outlines the rules and regulations of the video component. Refer to the Wiki for tips and suggestions. The evaluation rubric used by the judges to evaluate the video may be found in at the end of this section.

6.1 Format

6.1.01 Run-time

The submitted video must be no more than 5 minutes long, not including end credits.

6.1.02 Stylization/Style

The video submitted must have a fictional narrative or journalistic/documentary style.

6.2 Required Content

6.2.01 CRC Robotics Competition Description

The video must briefly describe the CRC Robotics Competition in such a way that the components are presented, and the goal of the Competition is mentioned. The video must visually show the time, place and name of this year's Competition during its run time.

6.2.02 Bilingualism

Both the English and French languages must be equally represented in the video, either through dialogue and/or subtitles. YouTube's closed-captioning tool is not permitted.

6.2.03 Copyright Law Adhesion

There must not contain copyrighted material in the video, unless the team has expressed permission from the content creator to use it in such a fashion. If the video is themed around an existing work, it must be clearly mentioned and credited. It is the responsibility of each team to ensure that the video does not violate YouTube's Copyrighted Content policy.

6.2.04 Forbidden Content

No vulgar, offensive, violent or inappropriate content is tolerated. When in doubt, contact CRC Robotics.

6.2.05 Asset Reuse

The reuse of content or assets from a previous submission is prohibited. Any attempt to submit a video containing the same content or assets from a previous submission may be subject to a penalty determined by CRC Robotics.

6.3 Submission

6.3.01 Deadline and Submission Platform

The video must be uploaded to YouTube in order to be judged. Refer to the Season Calendar in the Foreword of this document for the date and platform on which to submit the video. The specific URL pointing to the video's YouTube page must be provided at the time of submission. Video upload must be done by the deadline. A team that does not submit a video will receive a score of zero in the video component. A team that submits a video within a day following the deadline will be evaluated; however, this team will not be able to rank within the "Top 3" for the video component. Submissions received more than 24 hours after the deadline will not be judged.

6.3.02 Privacy Settings

The video's privacy setting must be switched to "Public" no later than the first day of the Competition. Refer to the Season Calendar in the Foreword of this document for the exact time and date.

6.3.03 Video Description Content

The video description on YouTube must mention the date and location of this year's CRC Robotics Competition and show a hyperlink to the following URL: www.robo-crc.ca.

6.4 Evaluation

6.4.01 The Evaluation Process

The evaluation of a team's work includes two stages: the Preliminaries and the Finals.

The Preliminaries:

- All registered teams are divided into pools. The number of teams per pool is dependent on the number of registered teams.
- The judges of each pool evaluate and rank teams' work. Judges are participating mentors or qualified CRC volunteers. Judges are never assigned to pools containing their current or past teams.

- Each pool is evaluated by different judges. Judges of all pools follow the same judging criteria for each category.
- The top teams in each pool will qualify for the Finals. The number of qualifiers per pool is dependent on the number of registered teams.

The Finals:

- Finalists are the top teams from each pool in the Preliminaries.
- There are no pools in the Finals. All finalists are evaluated by the same judges.
- Judges evaluate and rank the finalists' work. Judges are field experts and did not judge in the Preliminaries. Judges in the Finals follow the same judging criteria used in the Preliminaries.
- Based on the ranking provided by the judges, the top three teams in each division will receive awards.

6.4.02 Evaluation Criteria

The evaluation criteria are divided into three levels: Standard, Developed and Advanced.

- The Standard level provides minimal criteria that should be satisfied. These criteria may target specific rules in the rulebook or requirements which are considered essential for acceptable work.
- The Developed level includes criteria which, when satisfied, demonstrate a commendable work quality.
- The Advanced level groups criteria which, when satisfied, set a team apart from the rest.

6.5 Video Evaluation Form

| Topic | Level | Criterion |
|-----------|-----------|---|
| Content | Standard | Does the video include the required elements in a creative way? The video includes the elements required in the rulebook. The acting and the script are up to quality standards. |
| | Developed | Is the story engaging and fluid in both content and delivery? Presence of a well-integrated central theme or storyline that presents the mandatory content. Entertainment value of the video based on the execution, creativity, and originality of the concept. The plot is accessible and engaging to the general public. |
| | Advanced | Does the video offer a quality entertainment experience? The video is appealing and enjoyable. It offers unpredictable, interesting, and engaging twists. |
| Technical | Standard | Does the video's technical quality engage the viewer? Quality of the base picture and audible voice. Presence of a basic editing and voice mixing process. |
| | Developed | Do the scenes reflect directorial intent in execution and sequence? Creativity of the camera usage (i.e. creative angle, multi-angle filming, etc.). Mastery in the film-making process (i.e. use of original artwork, visual effects, selection of music / sound effects, etc.). |
| | Advanced | Does the video enhance the cinematic experience? The editing process is seamless to the viewer and the flow of the video is remarkable. Creative usage of sound effects, music, and other auditory cues that enrich the viewer experience and support the plot. |

7. Website

The following section outlines the rules and regulations of the website content and design components. Refer to the Wiki for tips and suggestions. The evaluation rubrics used by the judges to evaluate the website design and the website content may be found at the end of this section.

7.1 Technical Requirements

7.1.01 Compatibility

The website must be functional in the mobile and desktop version of Google Chrome, Firefox and Safari.

7.1.02 Quality Assurance

The website should be tested prior to submission. Any bugs found during evaluation will negatively affect the team's score in the website design component. Bugs include, but are not limited to, malformed links, missing images or actions that cause a "500 error".

7.1.03 HTML Standards Adhesion

The website should validate against HTML5 Standards (<http://www.w3.org/TR/html5/>), with little to no errors.

7.1.04 CSS Standards Adhesion

The website should validate against CSS 3.0 (<https://www.w3.org/standards/techs/css#stds> & <https://jigsaw.w3.org/css-validator/>) or better with little to no errors.

7.2 Website Content

7.2.01 Bilingualism

The website content must be fully bilingual. When the locale is changed to French, no English content should be displayed. When the locale is changed to English, no French content should be displayed.

7.2.02 Team Roster

The website must contain a browsable roster of every student, teacher and mentor on the team, which includes each member's:

- a. Name

- b. Photograph (optional)
- c. Sub-team / Contribution

7.2.03 CRC Robotics Competition Description

The website must contain a page that briefly describes the CRC Robotics Competition in such a way that the components are presented, and the goal of the Competition is mentioned. This page must also show the time, place and name of this year's Competition.

7.2.04 Game Description

The website must explain the game rules in an original fashion and in enough detail such that the game can be understood from an outsider's perspective.

7.2.05 Progress in Each Component

The website must detail:

- a. the steps in the design and construction of the robot;
- b. conception and prototype plans and drawings;
- c. most recent design plans and drawings available at time of submission;
- d. photos of the robot, at various stages of construction;
- e. the progress in each component of the CRC Robotics Competition;
- f. the hardships that were encountered along the way;
- g. the solutions to the aforementioned problems.

7.2.06 Student Experience Documentation

The experiences and lessons learned, as well as hardships encountered, must be documented on the website. The aforementioned documentation must contain:

- a. what the team learned;
- b. what the team enjoyed regarding the preparation for the Competition;
- c. the concepts or aspects with which the team struggled;
- d. the sacrifices made for the team.

7.2.07 Copyright Law Adhesion

There must not contain copyrighted material on the website, unless the team has expressed permission from the content creator to use it in such a fashion. If the website is themed around an existing work, it must be clearly mentioned and credited.

7.2.08 Asset Reuse

The reuse of content or assets from a previous submission is prohibited. Any attempt to submit a website containing the same content or assets from a previous submission may be subject to a penalty determined by CRC Robotics.

7.2.09 Forbidden Content

No vulgar, offensive, violent or inappropriate content is tolerated. When in doubt, contact the CRC Robotics Organizing Committee.

7.3 Submission

7.3.01 Online Accessibility

The website must be publicly accessible and hosted on the server provided by CRC Robotics.

7.3.02 Post-Submission Changes

Once submitted, changes must not be made to the website. Should changes be discovered past the submission date, the website will be considered as not submitted.

7.3.03 Deadline and Submission Platform

Refer to the Season Calendar in the Foreword of this document for the exact date and platform on which to submit the website. The specific URL pointing to the website must be provided at the time of submission. A team that does not submit a website will receive a score of zero in the website design and website content components. A team that submits a website within a day following the deadline will be evaluated; however, this team will not be able to rank within the "Top 3" for the website design or website content components. Submissions received more than 24 hours after the deadline will not be judged.

7.3.04 Website Visibility

The entirety of the website must be made visible to the general public and, preferably, discoverable by search engines no later than the first day of the Competition. Refer to the Season Calendar in the Foreword of this document for the exact time and date. No points will be deducted if the website is not discoverable by search engines.

7.4 Evaluation

7.4.01 The Evaluation Process

The evaluation of a team's work includes two stages: the Preliminaries and the Finals.

The Preliminaries:

- All registered teams are divided into pools. The number of teams per pool is dependent on the number of registered teams.

- The judges of each pool evaluate and rank teams' work. Judges are participating mentors or qualified CRC volunteers. Judges are never assigned to pools containing their current or past teams.
- Each pool is evaluated by different judges. Judges of all pools follow the same judging criteria for each category.
- The top teams in each pool will qualify for the Finals. The number of qualifiers per pool is dependent on the number of registered teams.

The Finals:

- Finalists are the top teams from each pool in the Preliminaries.
- There are no pools in the Finals. All finalists are evaluated by the same judges.
- Judges evaluate and rank the finalists' work. Judges are field experts and did not judge in the Preliminaries. Judges in the Finals follow the same judging criteria used in the Preliminaries.
- Based on the ranking provided by the judges, the top three teams in each division will receive awards.

7.4.02 Evaluation Criteria

The evaluation criteria are divided into three levels: Standard, Developed and Advanced.

- The Standard level provides minimal criteria that should be satisfied. These criteria may target specific rules in the rulebook or requirements which are considered essential for acceptable work.
- The Developed level includes criteria which, when satisfied, demonstrate a commendable work quality.
- The Advanced level groups criteria which, when satisfied, set a team apart from the rest.

7.5 Website Design Evaluation Form

| Topic | Level | Criterion |
|------------|-----------|--|
| Aesthetics | Standard | Is the website user-friendly? The site structure, page structure, and menu design allow for easy navigation to find information quickly and easily. The website clearly denotes interactive elements and uses of CSS animations correctly. The website uses accessibility features to make it available to people who are visually impaired (e.g. ARIA, alt attribute on img tags, etc.). Presence of user/social interaction. |
| | Developed | Does the creativity of design and layout captivate the user? The overall design, including choice and combination of colors, fonts, and layout are appealing and conducive of a pleasant user experience. |
| | Advanced | Does the content benefit from the appeal of the web design? The design is relevant to the inspiration of the content. The design contributes to a clear understanding of the website's intent. |
| Technical | Standard | Does the website operate smoothly? There are no bugs, including, but not limited to, malformed links, missing images, or actions that cause a "500" error that are detrimental to the overall user experience and content delivery. |
| | Developed | Does the code used reflect an understanding of efficient web coding by the creator? The site's code is well-formed and validated. The site demonstrates a grasp of underlying web technologies and indicates a proficient level of web programming (i.e. not solely relying on a website template or content management system). |
| | Advanced | Do the web technologies enhance the user's interactions and content? Demonstrates a mastery in creating elements that utilizes advanced web frameworks. |

7.6 Website Content Evaluation Form

| Topic | Level | Criterion |
|---------|-----------|--|
| Content | Standard | Is the content well-formed and does it contribute to a satisfying user experience? The overall content, including choice of words and phrases are engaging and attract the user. No grammar, syntax or spelling errors should be visible, including blatant translations performed using Google Translate or other similar services. |
| | Developed | Is the content creative and conducive to the website's intent? Experience-driven content should be present (e.g. student experience, challenges, tutorials, interviews, vlog of season highlights, etc.). Usage of pictures, schematics or any other graphic communication tools are used in a logical and sound manner. |
| | Advanced | Does the design benefit from the delivery of the web content? The content is creatively wrapped around a compelling theme that is carried throughout all sections in a linguistic and artistic fashion. The content conveys a story in which the reader gets invested while navigating from page to page. The content inspires people to know more about the team, the CRC Robotics Competition and robotics in general. |

8. Tutorial

To promote the sharing of knowledge and to encourage a spirit of cooperation between the CRC Robotics Competition teams, the CRC Robotics Organizing Committee awards the team with the best tutorial each year. All tutorials of adequate quality will be added to the CRC Robotics website permanently, each with credit to the team that submitting it. The following section outlines the tutorial constraints on which all submitted tutorials will be evaluated. Refer to the Wiki for tips and suggestions. Tutorials are judged on the relevance of the subject and the quality of the submission. The evaluation rubric used by the judges to evaluate the tutorial may be found at the end of this section.

8.1 Requirements

8.1.01 Topic

The tutorial should demonstrate knowledge directly related to any component of the Competition. Although it is strongly encouraged to cover new matter, it is tolerated to cover a subject already present in the tutorial section of CRC Robotics website.

8.1.02 Format

Tutorials must be in video format and cannot be longer than 3 minutes, excluding end credits. The tutorial must be prominently visible and accessible on the team's website.

8.1.03 Structure

The tutorial can be structured in one or more of the following ways:

- A theoretical and simplified explanation of a common system (e.g. internal functioning of DC motors);
- A step-by-step explanation to achieve a specific task;
- A practical demonstration of a complex system to perform a specific task.

8.1.04 Asset Reuse

The reuse of content or assets from a previous submission is prohibited. Any attempt to submit a tutorial containing the same content or assets from a previous submission may be subject to a penalty determined by CRC Robotics.

8.1.05 Bilingualism

Both the English and French languages must be equally represented in the tutorial, either through dialogue and/or subtitles. YouTube's closed-captioning tool is not permitted.

8.2 Submission

8.2.01 Deadline and Submission Platform

The tutorial must be uploaded to YouTube in order to be judged. Refer to the Season Calendar in the Foreword of this document for the date and platform on which to submit the video. The specific URL pointing to the tutorial's YouTube page must be provided at the time of submission. Upload must be done by the deadline. A team that submits a tutorial within a day following the deadline will be evaluated; however, this team will not be able to rank within the "Top 3" for the tutorial component. Submissions received more than 24 hours after the deadline will not be judged.

8.2.02 Privacy Settings

The tutorial video's privacy setting must be switched to "Public" no later than the first day of the Competition. Refer to the Season Calendar in the Foreword of this document for the exact time and date.

8.2.03 Multiple Submissions

A team can submit multiple tutorials. If a team submits multiple tutorials, one will be chosen at random to be evaluated, but all of them may be added to the CRC Robotics website.

8.3 Evaluation

8.3.01 The Evaluation Process

The evaluation of a team's work includes two stages: the Preliminaries and the Finals.

The Preliminaries:

- All registered teams are divided into pools. The number of teams per pool is dependent on the number of registered teams.
- The judges of each pool evaluate and rank teams' work. Judges are qualified CRC volunteers. Judges are never assigned to pools containing their past teams.
- Each pool is evaluated by different judges. Judges of all pools follow the same judging criteria for each category.
- The top teams in each pool will qualify for the Finals. The number of qualifiers per pool is dependent on the number of registered teams.

The Finals:

- Finalists are the top teams from each pool in the Preliminaries.
- There are no pools in the Finals. All finalists are evaluated by the same judges.

- Judges evaluate and rank the finalists' work. Judges are qualified CRC volunteers and did not judge in the Preliminaries. Judges in the Finals follow the same judging criteria used in the Preliminaries.
- Based on the ranking provided by the judges, the top three teams in each division will receive awards.

8.3.02 Evaluation Criteria

The evaluation criteria are divided into three levels: Standard, Developed and Advanced.

- The Standard level provides minimal criteria that should be satisfied. These criteria may target specific rules in the rulebook or requirements which are considered essential for acceptable work.
- The Developed level includes criteria which, when satisfied, demonstrate a commendable work quality.
- The Advanced level groups criteria which, when satisfied, set a team apart from the rest.

8.4 Tutorial Evaluation Form

| Topic | Level | Criterion |
|---------|-----------|--|
| Content | Standard | Is the content relevant, accurate and effectively presented? The tutorial is a simplified explanation and/or practical demonstration of a system or task relevant to one or more components of the CRC Robotics Competition. |
| | Developed | Is the tutorial appealing to the user? Usage of pictures, schematics or any other graphic communication tools are used in a logical and sound manner. |
| | Advanced | Does the tutorial entice the user to learn more about the subject? The content inspires people to know more about the topic and refers them to specific resources where they can learn more on the subject. |